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HOLT

Earth Science

Directed Reading

HOLT, RINEHART AND WINSTON
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Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: What Is Earth Science?

1. For thousands of years, people have looked at the world and wondered

what ____________________ shaped it.

2. How did cultures throughout history attempt to explain events such as volcano eruptions, earthquakes, and eclipses?

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3. How does modern science attempt to understand Earth and its changing landscape?

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THE SCIENTIFIC STUDY OF EARTH

______ **4.** Scientists in China began keeping records of earthquakes as early as
- **a.** 200 BCE.
- **b.** 480 BCE.
- **c.** 780 BCE.
- **d.** 1780 BCE.

______ **5.** What kind of catalog did the ancient Greeks compile?
- **a.** a catalog of rocks and minerals
- **b.** a catalog of stars in the universe
- **c.** a catalog of gods and goddesses
- **d.** a catalog of fashion

______ **6.** What did the Maya track in ancient times?
- **a.** the tides
- **b.** the movement of people and animals
- **c.** changes in rocks and minerals
- **d.** the movements of the sun, moon, and planets

______ **7.** Based on their observations, the Maya created
- **a.** jewelry.
- **b.** calendars.
- **c.** books.
- **d.** pyramids.

______ **8.** For a long time, scientific discoveries were limited to
- **a.** observations of phenomena that could be made with the help of scientific instruments.
- **b.** observations of phenomena that could not be seen, only imagined.
- **c.** myths and legends surrounding phenomena.
- **d.** observations of phenomena that could be seen with the unaided eye.

______ **9.** What inventions in the 17th century made seeing previously hidden worlds possible?
- **a.** the astrolabe and the compass
- **b.** the microscope and the telescope
- **c.** the microscope and the corrective lens
- **d.** binoculars and magnifiers

______ **10.** Earth science is the scientific study of
- **a.** astrology.
- **b.** supernatural phenomena.
- **c.** cosmetology.
- **d.** Earth and the universe around it.

______ **11.** It is assumed in Earth science that causes of natural events, or phenomena,
- **a.** can be understood through careful observation and experimentation.
- **b.** can be understood through methods other than careful observation and experimentation.
- **c.** will not be understood until the next century.
- **d.** can never be fully understood.

BRANCHES OF EARTH SCIENCE

______ **12.** What improves when technology, such as new processes or equipment, is developed?
- **a.** the ability to change human nature
- **b.** the ability to make observations
- **c.** the ability to prevent wars
- **d.** the ability to prevent natural disasters

______ **13.** The four major areas of study in Earth science are
- **a.** volcanology, astronomy, geology, and meteorology.
- **b.** the solid Earth, the oceans, the atmosphere, and the universe beyond Earth.
- **c.** the Earth around us, the Earth we can see, the Earth we cannot see, and the universe.
- **d.** geography, agriculture, astronomy, and astrology.

Name ____________________ Class ____________ Date ____________

______ **14.** Geology is the scientific study of
- **a.** rocks, maps, processes, and technology of Earth.
- **b.** legends, observations, technology, and structure of the solid Earth.
- **c.** the origin and history of Mayan culture.
- **d.** the origin, history, structure of Earth, and the processes that shape Earth.

______ **15.** Areas of study for geologists might include
- **a.** the atmosphere, climate, and weather patterns.
- **b.** Earth's crust, forces within Earth, and fossils.
- **c.** chemistry, physics, and math.
- **d.** diet, nutrition, and exercise.

16. What is the scientific study of the oceans called?

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17. Name four features of the ocean that oceanographers study.

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18. A branch of science called ____________ is the scientific study of Earth's atmosphere, especially in relation to weather and climate.

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19. Name two technologies that meteorologists use to study the atmospheric conditions that produce weather.

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20. Name three weather factors that meteorologists measure.

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21. Define *climate.*

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22. The scientific study of the universe, called ______________________, is one of the oldest branches of Earth science.

23. How long ago were the ancient Babylonians charting positions of the planets and stars?

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24. Modern astronomers use Earth- and space-based ______________________ to study the sun, the moon, the planets, and the universe.

25. What two technologies have provided astronomers with new information about the universe?

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26. A new field of Earth science called ______________________ studies the ways in which humans interact with their environment.

27. Name four issues that environmental scientists study.

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THE IMPORTANCE OF EARTH SCIENCE

______ **28.** Natural forces that shape Earth
- **a.** have little or no effect on life on Earth.
- **b.** affect life on Earth.
- **c.** have not been studied.
- **d.** are hard to quantify so they cannot be measured.

______ **29.** What natural event could bury a town under ash?
- **a.** lunar eclipse
- **b.** earthquake
- **c.** volcano
- **d.** flood

______ **30.** What natural event could produce waves that destroy shorelines?
- **a.** earthquake
- **b.** forest fire
- **c.** volcano
- **d.** lunar eclipse

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Directed Reading *continued*

______ **31.** By understanding how natural forces shape our environment, Earth scientists can
- **a.** design devices to prevent natural disasters.
- **b.** figure out how to increase workforce productivity.
- **c.** teach people how to lead healthier lives.
- **d.** predict potential disasters more accurately and help save lives and property.

______ **32.** The work of Earth scientists can help us understand our place in
- **a.** the universe.
- **b.** the atmosphere.
- **c.** the food chain.
- **d.** our society.

______ **33.** Which category of Earth scientists has come up with new ideas about the origins of our universe?
- **a.** meteorologists
- **b.** cosmetologists
- **c.** astronomers
- **d.** astrologists

______ **34.** The resources that make life as we know it possible come from
- **a.** Earth.
- **b.** other galaxies.
- **c.** hard work.
- **d.** the government.

______ **35.** Earth scientists strive to help people learn how to
- **a.** improve their diets.
- **b.** invest their money.
- **c.** read and write.
- **d.** use Earth's resources wisely.

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Skills Worksheet

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Section: Science as a Process

1. How does science differ from other kinds of human endeavors such as art, architecture, and philosophy?

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2. What is the goal of science?

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3. What do scientists do?

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BEHAVIOR OF NATURAL SYSTEMS

______ **4.** Scientists begin with the assumption that nature
a. is undeniable.
b. is understandable.
c. is nearly impossible to understand.
d. cannot be understood.

______ **5.** What do scientists expect?
a. Different forces in different situations will cause similar results.
b. Different forces in similar situations will cause similar results.
c. Similar forces in different situations will cause similar results.
d. Similar forces in similar situations will cause similar results.

______ **6.** Scientists also expect that nature is
a. predictable.
b. practical.
c. impractical.
d. unpredictable.

7. What does studying ice cores in Antarctica help scientists understand?

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8. How do scientists increase their understanding of complex natural systems?

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SCIENTIFIC METHODS

______ **9.** What are the organized and logical approaches to scientific research called?
- **a.** scientific community
- **b.** scientific development
- **c.** scientific understanding
- **d.** scientific methods

______ **10.** Which of the following is true of scientific methods?
- **a.** They are guidelines to scientific problem solving.
- **b.** They are a set of sequential steps that must always be followed.
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- **a.** theories.
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- **a.** answers.
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- **a.** an idea or explanation that can never be proven
- **b.** an idea or explanation that cannot be tested
- **c.** an idea or explanation that is based on observations and can be tested
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15. How can hypotheses be developed, and on what are most hypotheses based?

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16. After a hypothesis is proposed, how is it tested?

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17. What is an experiment?

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18. A factor in an experiment that can be changed is called

a(n) ______________________.

19. The factor in an experiment that is deliberately manipulated is called

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20. The factor in an experiment that changes as a result of manipulation of the

independent variable(s) is called a(n) ______________________.

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22. Most scientific experiments are ______________________ experiments.

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27. What else might the results of scientific inquiry lead to?

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- **b.** books and periodicals
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______ **31.** The SI includes standard measurements for
- **a.** cups, pints, quarts, and gallons.
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a. distance in centimeters rather than millimeters
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- **a.** must undergo review and testing by other scientists.
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b. the public for peer review.
c. other scientists for peer review.
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Skills Worksheet

Directed Reading

Section: Earth: A Unique Planet

1. List three reasons that Earth is unique.

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2. Why do scientists study the characteristics that make life on Earth possible?

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EARTH BASICS

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

rock	ellipse	oblate spheroid
global ocean	Earth	radius
points	diameter	mountains

3. The third planet from the sun in our solar system is ________________________.

4. Formed about 4.6 billion years ago, Earth is made mostly of ________________________.

5. About 70 percent of Earth's surface is covered with water, called the ________________________.

6. Earth appears to be a perfect circle, but it is actually a slightly flattened sphere called a(n) ________________________.

7. Earth's surface is relatively smooth; that is, the distance between Earth's high and low ________________________ are small relative to its size.

8. Earth's average ________________________ is 12,756 km.

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EARTH'S INTERIOR

9. Define seismic waves.

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10. What have scientists learned about Earth by studying seismic waves?

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In the space provided, write the letter of the definition that best matches the term or phrase.

______ **11.** crust

______ **12.** oceanic crust

______ **13.** continental crust

______ **14.** Moho

______ **15.** mantle

______ **16.** core

______ **17.** lithosphere

______ **18.** asthenosphere

______ **19.** plasticity

______ **20.** mesosphere

______ **21.** outer core

a. the solid, outer layer of Earth that consists of the crust and the rigid upper part of the mantle

b. the central part of Earth below the mantle

c. the strong, lower part of the mantle between the asthenosphere and the outer core

d. the thin, solid, outermost layer of Earth above the mantle

e. the crust beneath the oceans

f. the lower boundary of the crust

g. the layer of rock between Earth's crust and core

h. the crust that makes up the continents

i. the solid, plastic layer of the mantle beneath the lithosphere; made of mantle rock that flows very slowly, which allows tectonic plates to move on top of it

j. a dense liquid below the mantle

k. the ability of a solid to flow

EARTH AS A MAGNET

______ **22.** The lines of force of Earth's magnetic field extend between
- **a.** the North Pole and the South Pole.
- **b.** the poles and the equator.
- **c.** the North geomagnetic pole and the South geomagnetic pole.
- **d.** the core and the crust.

______ **23.** Earth's magnetic field extends beyond the atmosphere and affects a region of space called the
- **a.** mesosphere.
- **b.** atmosphere.
- **c.** electrosphere.
- **d.** magnetosphere.

______ **24.** The source of Earth's magnetic field may be
- **a.** the liquid iron in Earth's outer core.
- **b.** the solid rock in the asthenosphere.
- **c.** Earth's dense, rigid inner core.
- **d.** The rocky mantle.

______ **25.** Scientists have learned that, in addition to Earth, the sun and moon also have
- **a.** magnetic fields.
- **b.** liquid outer cores.
- **c.** large amounts of iron.
- **d.** a magnetosphere.

EARTH'S GRAVITY

26. Define gravity.

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27. Explain Isaac Newton's law of gravitation.

28. What is weight, and what unit is used to measure it?

29. On Earth, how much does a kilogram of mass weigh?

30. Explain how the location of an object affects its mass and weight.

31. According to the law of gravitation, how does the force of gravity relate to an object's distance from Earth's center?

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____

32. Explain why a single object would weigh more at the either the North or South Pole than it would at the equator.

____

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Energy in the Earth System

1. Traditionally, how have different fields of earth science been studied?

____

____

2. How are scientists approaching the study of Earth today?

____

____

____

EARTH-SYSTEM SCIENCE

In the space provided, write the letter of the description that best matches the term or phrase.

______ **3.** system

______ **4.** matter

______ **5.** energy

______ **6.** closed system

______ **7.** open system

a. the ability to do work

b. a set of particles or interacting components considered to be a distinct physical entity for the purpose of study

c. a system in which energy, but not matter, is exchanged with the surroundings

d. a system in which both energy and matter are exchanged with the surroundings

e. anything that has mass and takes up space

8. What is true of systems in terms of their size and boundaries?

____

____

____

____

9. How does a large, complex system like the Earth system operate?

____

____

____

Name ______________________ Class ______________ Date ____________

10. In what four ways can energy be transferred?

11. How might a system be described in terms of matter and energy?

12. Give one example of a closed system and explain what makes it a closed system.

13. Give one example of an open system and explain what makes it an open system.

14. Why does the Earth system resemble a closed system, even though it is technically an open system?

Name ____________________ Class ____________ Date ____________

EARTH'S FOUR SPHERES

15. Matter on Earth occurs in what three states?

____

____

____

16. The Earth system is composed of four ______________ that are storehouses of all of the planet's matter.

17. A mixture of gases that surrounds a planet or moon is called its ______________.

18. The portion of Earth that is water is called the ______________.

19. The mostly solid, rocky part of Earth that extends from the center of the core to the surface of the crust is called the ______________.

20. The part of Earth where life exists and that includes all of the living organisms on Earth is called the ______________.

21. What purpose does the atmosphere serve?

____

____

____

22. Where can Earth's fresh water supply be found?

____

____

____

23. What parts of Earth are included in the geosphere?

____

____

____

24. What is the biosphere composed of?

____

____

____

EARTH'S ENERGY BUDGET

In the space provided, write the letter of the description that best matches the term or phrase.

______ **25.** first law of thermodynamics

______ **26.** energy budget

______ **27.** second law of thermodynamics

______ **28.** convection

a. additions in energy as well as subtractions are balanced in the transfer of all energy among Earth's spheres

b. energy is transferred between systems, but it cannot be created or destroyed

c. material is heated, the material's density decreases, and the hot material rises and releases heat; cooler, denser material sinks and displaces the hot material

d. energy transfer takes place, and matter becomes less organized with time

29. Like energy, ______________________ can be transferred, but cannot be created or destroyed.

30. The overall effect of the second law of thermodynamics is that the universe's ______________________ is spread out more and more uniformly over time.

31. Earth's four main spheres are ______________________ that can be thought of as huge storehouses of matter and energy.

32. How are matter and energy exchanged between the spheres?

____

____

33. When Earth formed, its interior was heated by what two processes?

____

____

34. Because Earth's interior is warmer than its surface layers, hot materials move toward the surface in a process called ______________________.

35. Earth's most important external energy source is the ______________________.

36. The heat generated by solar radiation causes the movement of air masses, which in turn creates ______________________ and ocean currents.

37. What is another important source of external energy from the sun and moon?

____

38. The pull of the sun and the moon, combined with Earth's rotation, generates ______________________ that cause currents and drive the mixing of ocean water.

CYCLES IN THE EARTH SYSTEM

39. Define reservoir.

____

____

____

40. Define cycle.

____

____

____

41. What happens to nitrogen as it passes through the nitrogen cycle?

____

____

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

42. What happens to carbon in the short-term carbon cycle?

43. What happens to carbon in the long-term carbon cycle?

44. Through which spheres does phosphorus move during the phosphorus cycle?

45. Describe the sequence of the phosphorus cycle.

46. Describe the water cycle.

47. What is transpiration?

HUMANS AND THE EARTH SYSTEM

48. The carbon cycle is affected when humans use ______________________.

49. When humans burn fuels, ______________________ is rapidly returned to the atmospheric reservoir.

50. Both the nitrogen and phosphorus cycles are affected by ______________________.

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Ecology

1. Define ecology.

____

____

____

2. What word also means "non-living?"

____

____

____

ECOSYSTEMS

In the space provided, write the letter of the description that best matches the term or phrase.

______ **3.** ecosystem

______ **4.** producers

______ **5.** consumers

______ **6.** decomposers

a. organisms that get their energy from eating other organisms

b. a community of organisms and their abiotic environment

c. organisms that make their own food; a source of food for other organisms

d. organisms that get energy by breaking down dead organisms

BALANCING FORCES IN ECOSYSTEMS

7. What else becomes limited because amounts of matter and energy in an ecosystem are limited?

____

8. The largest population that an environment can support at any given time is called the ______________________.

9. In general, ecosystems react to changes in ways that maintain or restore ______________________ in the ecosystem.

Name ______________________ Class ____________ Date ____________

Directed Reading *continued*

10. When might an ecosystem be unable to restore a community of organisms to its original state?

____

____

11. The ultimate source of energy for almost every ecosystem is the ______________________.

12. Plants capture solar energy by a chemical process called ______________________.

13. Chemical changes that take place as energy and matter are cycled through an ecosystem result in what?

____

____

14. On the energy pyramid, where is the least amount of energy available to organisms found?

____

____

15. The sequence in which organisms consume other organisms can be represented by a(n) ______________________.

16. A diagram that shows the complex feeding relationships among organisms in an ecosystem is a(n) ______________________.

HUMAN STEWARDSHIP OF THE ENVIRONMENT

17. What effect might changes in an ecosystem have on a human population?

____

____

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

18. Identify three ways in which human activity can disrupt ecological balances.

____

____

____

19. Define pollution.

____

____

____

20. How can people help keep Earth's ecosystems in balance?

____

____

____

____

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Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Finding Locations on Earth

1. What shape is Earth?

____

____

2. What can be used on Earth to establish reference points?

____

____

____

3. For what purpose are the points where Earth's axis of rotation intersects Earth's surface used?

____

____

4. What are the reference points where Earth's axis intersects Earth's surface?

____

5. What is the equator?

____

____

____

6. What is used to locate places on Earth's surface?

____

____

____

LATITUDE

______ **7.** Parallels are a set of circles on the reference grid
- **a.** that describe positions north and south of the equator.
- **b.** that describe positions north and south of the Greenwich Meridian.
- **c.** that crisscross the Earth parallel to the poles and the equator.
- **d.** that describe positions east and west of the equator.

______ **8.** How did parallels get their name?
a. They run around the world east and west of the equator.
b. They run around the world perpendicular to the equator.
c. They run around the world parallel to the equator.
d. They run around the world horizontal to the poles.

______ **9.** What is latitude?
a. the distance around Earth at the equator
b. the distance between meridians
c. the actual distance north and south of the equator
d. the angular distance north and south of the equator

______ **10.** How is latitude measured?
a. in hours
b. in degrees
c. in kilometers
d. in miles

______ **11.** What is the latitude of the equator?
a. 10° latitude
b. 0° longitude
c. 90° latitude
d. 0° latitude

______ **12.** What part of a circle is the distance from the equator to either pole?
a. one-half
b. one-eighth
c. one-fourth
d. a whole circle

______ **13.** What is the latitude of both the North Pole and the South Pole?
a. 25°
b. 180°
c. 360°
d. 90°

______ **14.** What is the actual distance in kilometers of 1° of latitude?
a. 1 kilometer
b. 11 kilometers
c. 111 kilometers
d. 1,111 kilometers

______ **15.** How are parallels north and south of the equator labeled?
a. E and W
b. N and S
c. degrees and minutes
d. latitude and longitude

Name ______________________ Class ______________ Date ____________

______ **16.** What does each degree of latitude consist of?
a. 90 equal parts, called minutes
b. 30 equal parts, called minutes
c. 60 equal parts, called seconds
d. 60 equal parts, called minutes

17. Into how many portions is each minute of latitude divided?

____

____

18. What is the latitude of Washington, D.C., including minutes and seconds?

____

LONGITUDE

______ **19.** To determine the specific location of a place, you need to know
a. the latitude, and how far north or south that place is along its circle of latitude.
b. the latitude, and how far east or west that place is along its circle of latitude.
c. the longitude, and how far east or west that place is along its circle of longitude.
d. only the longitude.

______ **20.** How are east-west locations established?
a. by using meridians
b. by using north-south locations
c. by counting degrees
d. by using a map

______ **21.** What is a meridian?
a. a circle that runs around the globe through the poles
b. half of a semicircle that runs from the equator to a pole
c. a semicircle that runs from pole to pole
d. the same thing as latitude

______ **22.** By international agreement, one meridian was selected to be
a. 360°.
b. the number one meridian.
c. 180°.
d. 0°.

______ **23.** What is the 0° meridian, which passes through Greenwich, England, called?
a. the number one meridian
b. the prime meridian
c. the 180° meridian
d. the English meridian

______ **24.** What is longitude?
a. the angular distance, measured in degrees, east or west of the prime meridian
b. the angular distance, measured in degrees, north or south of the prime meridian
c. the angular distance, measured in minutes, east or west of the prime meridian
d. the angular distance, measured in degrees, east or west of the equator

______ **25.** Where is the meridian that is opposite the prime meridian located?
a. all the way around the world
b. 90°, or a quarter of the way, around the world
c. 180°, or halfway, around the world
d. at the equator

______ **26.** All locations east of the prime meridian have
a. longitudes between 0° and 180°W.
b. longitudes between 0° and 180°E.
c. latitudes between 0° and 180°E.
d. latitudes between 0° and 180°W.

______ **27.** All locations west of the prime meridian have
a. latitudes between 0° and 180°W.
b. longitudes between 0° and 180°E.
c. latitudes between 0° and 180°E.
d. longitudes between 0° and 180°W.

28. Like latitude, how can longitude be expressed more precisely?

____

29. What is the precise location of Washington, D.C. in degrees, minutes, and seconds?

____

30. What does the distance covered by a degree of longitude depend on?

____

____

31. What does a degree of longitude equal in kilometers at the equator?

____

32. Where do all meridians meet?

____

____

33. What happens to a degree of longitude as you move from the equator toward the poles?

____

____

GREAT CIRCLES

______ **34.** What is a great circle often used for?
- **a.** navigation, especially by ships at sea
- **b.** navigation, especially by long-distance aircraft
- **c.** navigation, especially by short-distance aircraft
- **d.** navigation, especially by ships on inland lakes

______ **35.** What is a great circle?
- **a.** any circle that divides the globe into halves, or marks the diameter of the globe
- **b.** any circle that divides the globe into degrees, or marks the circumference of the globe
- **c.** any circle that divides the globe into halves, or marks the circumference of the globe
- **d.** any circle around the globe

______ **36.** Any circle formed by two meridians of longitude directly across the globe from each other is
- **a.** a great circle.
- **b.** a minor circle.
- **c.** longitude.
- **d.** latitude.

______ **37.** What is the only line of latitude that is a great circle?
- **a.** the prime meridian
- **b.** the North Pole
- **c.** the South Pole
- **d.** the equator

Name ______________________ Class ______________ Date ______________

______ **38.** Great circles can run
a. only in a north-south direction around the globe.
b. in any direction around the globe.
c. only in a east-west direction around the globe.
d. only around the equator.

______ **39.** Why do air and sea routes often travel along great circles?
a. because they are the longest distance between two points on Earth
b. because they are the only safe routes between two points on Earth
c. because they are the only routes that connect two points on Earth
d. because they are the shortest distance between two points on Earth

FINDING DIRECTION

______ **40.** A magnetic compass can indicate direction because Earth has magnetic properties
a. as if a powerful bar-shaped magnet were buried at Earth's center.
b. as if a powerful horseshoe magnet were buried at Earth's center.
c. that apparently originate in outer space.
d. as if it were a giant sphere-shaped magnet.

______ **41.** Earth's magnetic poles are
a. at an angle to the sun and the other planets.
b. constantly reversing polarity.
c. at an angle to the sun's axis of rotation.
d. at an angle to Earth's axis of rotation.

______ **42.** What are the geomagnetic poles?
a. the areas on Earth's surface just above where the poles of the imaginary magnet would be
b. the areas opposite where the poles of the imaginary magnet would be on the other side of Earth
c. the areas on Earth's surface just below where the poles of the imaginary magnet would be
d. the areas around the poles where large magnets are buried in Earth

______ **43.** What is true of the geomagnetic poles and the geographic poles?
a. They are both at areas where magnets are found in Earth.
b. They are located in different places.
c. They are the same thing but have different names.
d. They are located in the same places.

______ **44.** Where does the needle of a compass point to?
a. the geographic North Pole
b. the geomagnetic south pole
c. the geomagnetic north pole
d. the geographic South Pole

Name ______________________ Class ____________ Date __________

Directed Reading *continued*

45. What is magnetic declination?

____

____

46. How is magnetic declination measured in the Northern Hemisphere?

____

____

47. What will a compass needle align with at all locations along the line of 0° magnetic declination?

____

____

____

48. By using magnetic declination, what can a person use a compass to determine?

____

____

49. What is the global positioning system used for?

____

____

50. What is the global positioning system?

____

____

____

51. How does a GPS receiver work?

____

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Mapping Earth's Surface

1. What is a globe?

____

2. What are the advantages of globes?

____

____

____

____

3. Why did people develop a variety of maps for studying and displaying information about Earth?

____

____

HOW SCIENTISTS MAKE MAPS

4. What is the science of making maps called?

____

5. What do cartographers use to make maps?

____

____

6. How do cartographers conduct field surveys?

____

____

____

7. What do cartographers do with the information they collect during a field survey?

____

____

____

8. What is remote sensing, and how do cartographers use it?

____

____

____

____

____

9. How are maps often made?

____

____

____

MAP PROJECTIONS

In the space provided, write the letter of the description that best matches the term or phrase.

______ **10.** map projection

______ **11.** cylindrical projection

______ **12.** azimuthal projection

______ **13.** conic projection

a. a projection made by placing a paper cone over a lighted globe so that the axis of the cone aligns with the axis of the globe.

b. a projection made by placing a sheet of paper over a globe such that the paper touches it at only one point

c. a flat map that represents the three-dimensional curved surface of a globe

d. a projection made by wrapping a paper cylinder around a lighted globe

14. What happens when a curved surface is transferred to a flat map?

____

15. In what ways may an area shown on a map be distorted?

____

____

16. How is the size of the area shown on a map related to the distortion? Give examples.

____

____

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17. How do meridians that appear on a cylindrical projection differ from meridians on a globe?

____

____

____

18. Describe the accuracy and distortion of a cylindrical projection.

____

____

19. What are two advantages of cylindrical projections?

____

____

____

20. Describe the accuracy and distortion of an azimuthal projection.

____

____

____

____

21. Why are azimuthal projections a great help to navigators plotting routes used in air travel?

____

____

____

22. Where does the cone touch the globe in a conic projection?

____

____

23. Where is there the least distortion in a conic projection?

____

____

Name ______________________ Class ______________ Date ____________

24. What is a polyconic projection and why is it useful?

____

____

____

READING A MAP

______ **25.** What must you be able to do to read a map?
a. understand the symbols, be able to find directions, and calculate distances
b. know where to research the history of map making
c. memorize the distances between key points and find directions
d. know the compass points and understand the symbols

______ **26.** What is the first step in correctly interpreting a map?
a. align the map by wrapping it around a globe
b. look up the symbols in a dictionary
c. determine how the compass directions are displayed
d. find your current location on the map

______ **27.** How are maps commonly drawn?
a. north at top, east at the right, west at the left, south at the bottom
b. east at top, north at the right, west at the left, south at the bottom
c. north at top, east at the left, west at the right, south at the bottom
d. south at top, east at the right, west at the left, north at the bottom

______ **28.** Where do parallels and meridians run on most maps?
a. Meridians run from side to side, parallels from top to bottom.
b. Parallels run from side to side, meridians from top to bottom.
c. Parallels run from top to side, meridians from top to bottom.
d. Parallels run from top to bottom, meridians from side to side.

______ **29.** On maps drawn by the USGS, what features are marked by parallels?
a. the eastern and the western boundary
b. the western and the eastern boundary
c. the southern and the western boundary
d. the northern and the southern boundary

______ **30.** How are eastern and western boundaries of USGS maps indicated?
a. by parallels
b. by meridians of longitude
c. by framed edges
d. by curved lines

Name ______________________ Class ______________ Date ____________

______ **31.** What is a compass rose?
a. a symbol that indicates the latitude and longitude
b. a symbol that indicates the directions for finding distance
c. a symbol that indicates the cardinal directions
d. a symbol that indicates the blue jay directions

______ **32.** What are the cardinal directions?
a. northeast and southwest
b. all the points on the compass
c. north and south
d. north, east, south, and west

______ **33.** The arrow that points north on some maps is
a. generally labeled and may not point to the top of the map.
b. generally unlabeled and may not point to the top of the map.
c. generally labeled and always points to the top of the map.
d. generally unlabeled and always points to the top of the map.

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

parallel	fractional scale	legend
graphic scale	symbol	verbal scale
longitude	scale	

34. A list of map symbols and their meaning is called a ______________________.

35. On a map, a ______________________ may resemble the feature it represents or it may be more abstract.

36. The relationship between the distance shown on a map and the actual distance is the ______________________.

37. A printed line with ruler-like markings that represents a unit of measurement, such as the kilometer or mile, is called a ______________________.

38. The ratio 1:25,000 printed on a map is an example of a ______________________.

39. The sentence "One centimeter is equal to one kilometer." is an example of a ______________________.

40. How do you find the actual distance between two points on Earth using a graphic scale?

____

____

Name ______________ Class ______________ Date ______________

Directed Reading *continued*

41. What does the fractional scale 1:10,000 on a map indicate?

____

42. What happens to a fractional scale when different systems of measurement are used? Give an example.

____

____

43. What is an isogram?

____

____

____

44. What are the meanings of *iso-* and *-gram*?

____

____

45. What are isobars?

____

____

46. What is true of isobars on a weather map?

____

____

47. Why will isobars never cross one another?

____

____

48. What do scientists commonly use isograms to show?

____

____

____

Name ________________ Class ________ Date ________

Skills Worksheet

Directed Reading

Section: Types of Maps

______ **1.** What are some of the characteristics of an area shown on maps used by Earth scientists?
a. types of animals, types of plants, types of minerals
b. types of rocks, differences in air pressure, varying depths of groundwater
c. types of governments, differences in tire pressure, varying depths of focus
d. types of countries, types of states, types of counties

TOPOGRAPHIC MAPS

______ **2.** What do topographic maps show?
a. surface features of Earth
b. surfaces of highways
c. cities and counties
d. the tops of mountains

______ **3.** What is topography?
a. the study of mountains
b. the study of weather and climates of Earth
c. the size and shape of the land surface features of a region
d. the features of Earth beneath the surface crust

______ **4.** What do most topographic maps show besides natural features?
a. types and properties of soils
b. constructed features, such as buildings and roads
c. weather features, such as temperature and precipitation
d. types of rocks found in a given area

______ **5.** How are topographic maps made?
a. by putting available photographs together with old maps to make a new map
b. by using land-level photographs and estimates of distance collected in the field
c. by using subterranean photographs and survey points collected in the field
d. by using aerial photographs and survey points collected in the field

______ **6.** Topographic maps show the height of land above sea level, which is called
a. irrigation.
b. revelation.
c. elevation.
d. elevator.

______ **7.** What is mean sea level, or the place from which elevation is measured?
a. the point midway between the highest and next to highest tide levels of the ocean
b. the point midway between the highest and lowest tide levels of the ocean
c. the point midway between the lowest and next to lowest tide levels of the ocean
d. the point closest to the lowest and next to highest tide levels of the ocean

______ **8.** What is the elevation at mean sea level?
a. -20
b. 100
c. 500
d. 0

______ **9.** What would be the advantage of a topographic map of an island over a typical map projection?
a. It would show the island's plants, water, and resources.
b. It would show the island's villages, roads, and ports.
c. It would show the island's location, buildings, and farms.
d. It would show the island's size, shape, and elevation.

______ **10.** What are contour lines used to show on topographic maps?
a. irrigation
b. elevation
c. escalation
d. aeration

______ **11.** What is a contour line?
a. an isogram that connects points of equal elevation
b. an anagram that connects points of equal elevation
c. an isogram that connects points that have different elevations
d. an epigram that connects points of equal elevation

______ **12.** Because points at a given elevation are connected, the shape of
a. the common lines reflects the shape of the land.
b. the contour lines reflects the shape of the map.
c. the contour lines reflects the shape of the land.
d. the epigrams reflects the shape of the land.

Name ______________________ Class ______________ Date ______________

______ **13.** What is the contour interval?

a. the difference in contour between one elevation line and the next
b. the difference in elevation between one elevation line and the next
c. the difference in elevation between one contour line and the next
d. the difference in contour between one contour line and the next

14. What is relief on a map?

____

____

____

15. What is the contour interval like on a map where the relief is high? Give an example.

____

____

____

16. What is the contour interval like on a map where the relief is low? Give an example

____

____

____

17. What is an index contour?

____

____

____

18. How are exact elevations marked?

____

____

19. What indicates the shapes of landforms on a topographic map?

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

20. What do contour lines spaced widely apart indicate?

____

____

21. What do contour lines spaced closely together indicate?

____

____

22. Describe the contour line that indicates a valley.

____

____

23. Where will the V in the contour line point if a stream or river flows through the valley? Explain why.

____

____

____

24. How is the width of a valley represented on a contour map?

____

____

25. How are hilltops indicated on a topographical map?

____

____

26. What are depression contours?

____

____

____

27. What does the color of a symbol indicate on a topographic map?

____

____

____

Name ______________________ Class ______________ Date ____________

In the space provided, write the letter of the color that is used to represent each feature on contour maps.

______ **28.** major highways

______ **29.** bodies of water

______ **30.** buildings, boundaries, roads, railroads

______ **31.** contour lines

______ **32.** areas not verified by field exploration

______ **33.** forested areas

a. black
b. red
c. blue
d. green
e. brown or black
f. purple

GEOLOGIC MAPS

______ **34.** What are geologic maps designed to show?
a. the distribution of topographic features
b. the distribution of geologic features
c. realistic geologic features
d. the distribution of political boundaries

______ **35.** What in particular do geologic maps show about a given area?
a. types of rocks and locations of faults, folds, and other structures
b. types of organisms and locations of habitats and ecosystems
c. types of roads and locations of highways and rest stops
d. types of contours and locations of roads, lakes, and buildings

______ **36.** What type of maps are geologic maps created on top of?
a. case maps
b. topographic maps
c. reference maps
d. base maps

______ **37.** What does the base map provide?
a. underground features, such as faults or folds, to help identify the location of geographic units
b. surface features, such as rocks, faults, or folds, to help identify the location of geologic units
c. map features, such as bodies of water or roads, to help identify the location of geographic units
d. surface features, such as topography or roads, to help identify the location of geologic units

Name ______________________ Class ______________ Date ______________

______ **38.** What is a geologic unit?
- **a.** a volume of rock of different age ranges and rock types
- **b.** a single rock of a given age range and rock type
- **c.** a volume of rock of a given age range and rock type
- **d.** a single rock of different age ranges and rock types

______ **39.** What types of units are usually assigned colors in the same color family, such as different shades of blue?
- **a.** geologic units of similar ages
- **b.** geologic units of similar colors
- **c.** geologic units of similar types of rock
- **d.** geologic units of different ages

40. Describe the set of letters that geologists assign to each rock unit and what the letters symbolize.

____

____

____

____

41. What do contact lines indicate on geologic maps?

____

____

42. Describe the two main types of contacts.

____

____

43. What are strike and dip symbols?

____

____

____

SOIL MAPS

______ **44.** Why do Earth scientists construct soil maps?
- **a.** to classify, map, and describe sediment
- **b.** to classify, map, and describe soils
- **c.** to survey, record, and spread soils
- **d.** to decide where to use more soil as land fill

______ **45.** What are soil maps based on?
a. surveys that reveal information about locations of soil
b. surveys that record information about properties of soil
c. surveys that record information about properties of vegetation
d. surveys that record information about properties of minerals

______ **46.** What is the government agency in charge of soil data?
a. Natural Resources Conservation Service
b. Natural Resources Conversation Service
c. American Resources Conservation Service
d. National Resources Conservation Service

______ **47.** What department is the NRCS part of in the U.S. federal government?
a. the Department of Forestry
b. the Department of Horticulture
c. the Department of Minerals
d. the Department of Agriculture

48. What are the three main parts of a soil survey?

____

____

49. Describe the three parts of a soil survey.

____

____

____

____

____

50. How does knowing soil properties help farmers, agricultural engineers, and government agencies?

____

____

OTHER TYPES OF MAPS

______ **51.** Earth scientists use maps to show the location and flow of water and air by plotting data from various points around a region and
a. using isotopes to connect the points with different data.
b. using isograms to connect the points with identical data.
c. using isograms to connect the points with different data.
d. using epigrams to connect the points with identical data.

Name ______________________ Class ______________ Date ____________

______ **52.** What do meteorologists use maps for?
- **a.** to record and predict meteorites
- **b.** to record and predict volcanic eruptions
- **c.** to record and predict the weather
- **d.** to record and predict earthquakes

______ **53.** What types of things may be plotted on weather maps?
- **a.** precipitation, air pressure, weather fronts
- **b.** condensation, ice formation, climate
- **c.** volcanoes, earthquakes, tidal waves
- **d.** mountains, valleys, waterways

______ **54.** What can be recorded about groundwater by using maps?
- **a.** mineral content and saline content
- **b.** location and direction of flow
- **c.** purity and taste
- **d.** amount and best way to drill wells

______ **55.** What other things do Earth scientists use maps to study?
- **a.** changes in geography, state lines, and economic factors
- **b.** changes in the life cycles of organisms
- **c.** changes in topography, available resources, and factors that affect climate
- **d.** changes in global geopolitical boundaries

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Matter

1. What is matter?

____

____

2. What does mass mean?

____

____

PROPERTIES OF MATTER

______ 3. What are two types of properties of matter?
   a. physical and atomic
   b. chemical and magnetic
   c. physical and chemical
   d. chemical and mental

______ 4. What kind of properties can be observed without changing the composition of the substance?
   a. chemical
   b. physical
   c. magnetic
   d. atomic

______ 5. Which of the following are all physical properties of matter?
   a. density, color, hardness
   b. density, reactions, hardness
   c. chemistry, freezing point, color
   d. lightness, electrons, boiling point

______ 6. The properties that describe how a substance reacts with other substances to produce different substances are
   a. chemical properties.
   b. physical properties.
   c. magnetic properties.
   d. atomic properties.

Name ______________________ Class ______________ Date ____________

______ **7.** When iron reacts with oxygen to form rust, the reaction is an example of a
a. physical property of oxygen.
b. magnetic property of oxygen.
c. chemical property of iron.
d. physical property of iron.

______ **8.** Which of the following is a chemical property of helium?
a. Helium does not react with other substances but does form new substances.
b. Helium reacts with other substances but does not form new substances.
c. Helium reacts with other substances to form new substances.
d. Helium does not react with other substances to form new substances.

______ **9.** A substance that cannot be broken down into simpler, stable substances by chemical means is
a. an element.
b. an atom.
c. matter.
d. mass.

______ **10.** What does each element have that can be used to identify it?
a. a group of chemicals and atoms
b. a group of compounds
c. a characteristic set of physical and chemical properties
d. a characteristic set of magnetic properties

______ **11.** About how many elements occur naturally on Earth?
a. more than 1,000
b. more than 90
c. more than 900
d. more than 9,000

______ **12.** About how many elements have been created in laboratories?
a. about 36
b. about 12
c. about 60
d. about 24

______ **13.** How many elements make up 98% of Earth's crust?
a. two
b. four
c. eight
d. six

______ **14.** What is an *atom*?
a. the smallest unit of an element
b. the smallest unit of oxygen
c. the smallest unit of matter
d. the smallest unit in the universe

______ **15.** How many atoms lined up side by side would equal the thickness of a book page?
a. about a hundred
b. more than a million
c. less than a hundred thousand
d. less than a thousand

ATOMIC STRUCTURE

______ **16.** Atoms are made up of smaller parts called
a. elemental particles.
b. subatomic particles.
c. material particles.
d. energy particles.

______ **17.** What are the three major kinds of subatomic particles?
a. matter, energy, elements
b. atoms, elements, subtrons
c. nucleus, positrons, magnitrons
d. protons, electrons, neutrons

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **18.** protons

______ **19.** electrons

______ **20.** neutrons

a. particles that have a negative charge
b. particles that have no charge
c. particles that have a positive charge

21. What is the nucleus of an atom?

____

____

22. Why does the nucleus of an atom have a positive charge?

____

____

____

Name ________________ Class ________ Date ________

23. How much of an atom's mass does the nucleus make up?

____

____

24. How much of an atom's volume does the nucleus make up?

____

25. What makes up most of the volume of an atom?

____

____

26. What is an electron cloud?

____

____

27. Why are electrons attracted to the nucleus of an atom?

____

____

28. What holds the electrons in an atom?

____

____

ATOMIC NUMBER

______ **29.** What is the atomic number of an element?
- **a.** the number of neutrons in the nucleus of the atom
- **b.** the number of protons and neutrons in the nucleus of the atom
- **c.** the number of protons in the nucleus of the atom
- **d.** the number of electrons in the nucleus of an atom

______ **30.** An uncharged atom has an equal number of
- **a.** neutrons and electrons.
- **b.** protons and electrons.
- **c.** protons and neutrons.
- **d.** protons, electrons, and neutrons.

______ **31.** The atomic number of an uncharged atom is also equal to
- **a.** the number of its neutrons.
- **b.** the number of its subatomic particles.
- **c.** the number of its elements.
- **d.** the number of its electrons.

_____ **32.** Elements on the periodic table are ordered according to
a. their weight.
b. their atomic numbers.
c. their mass.
d. their number of neutrons.

_____ **33.** The periodic table is a system for
a. classifying neutrons.
b. classifying chemicals.
c. classifying elements.
d. classifying matter.

_____ **34.** Elements in the same column on the periodic table have similar arrangements of what?
a. electrons in their atoms
b. protons in their atoms
c. neutrons in their atoms
d. positrons in their atoms

_____ **35.** Elements that have similar arrangements of electrons also have
a. similar numbers of neutrons.
b. similar chemical properties.
c. similar elemental properties.
d. similar physical properties.

ATOMIC MASS

_____ **36.** What is the *mass number* of an atom?
a. the sum of its protons and electrons
b. the sum of its protons, electrons, and neutrons
c. the sum of its neutrons and electrons
d. the sum of its protons and neutrons

_____ **37.** Since the mass of a subatomic particle is too small to be expressed easily in grams, what special unit is used?
a. atomic matter unit (amu)
b. elemental mass unit (emu)
c. atomic mass unit (amu)
d. subatomic mass unit (smu)

_____ **38.** Which subatomic particles each have an atomic mass unit close to 1?
a. electrons and neutrons
b. protons and neutrons
c. protons and electrons
d. electrons and positrons

Name ______________________ Class ____________ Date ____________

______ **39.** The mass of one proton is equal to the combined mass of how many electrons?
a. less than 1
b. about 184
c. about 1,840
d. much more than 1,840

______ **40.** When calculating an atom's approximate mass, how is the mass of electrons figured?
a. It is ignored.
b. It is figured at 1 over 1,840.
c. It is figured at 1 for every proton.
d. It is figured at 1,840 for every proton.

______ **41.** Although all atoms of the same element contain the same number of protons, the number of its
a. neutrons may differ.
b. neutrons is always smaller.
c. positrons may differ.
d. electrons may differ.

______ **42.** Which of the following is true of atoms of helium?
a. All have two neutrons, but some have only one electron.
b. Most have two neutrons, but some have only one neutron.
c. Most have one proton, but some have only one neutron.
d. All have one neutron, but some have only one proton.

______ **43.** An atom with the same number of protons as other atoms
a. has a different atomic number.
b. has no mass.
c. has no atomic number.
d. has the same atomic number.

44. What is an isotope?

____

____

____

45. How does a helium atom that has two neutrons compare with a helium atom that has only one neutron?

____

____

____

46. Why do different isotopes of the same element have slightly different properties?

____

____

____

____

____

THE PERIODIC TABLE OF ELEMENTS

______ **47.** What is the atomic number of hydrogen?
a. 2
b. 3
c. 1
d. 6

______ **48.** What is the symbol of hydrogen?
a. C
b. H
c. He
d. 1

______ **49.** What is the atomic number of sodium?
a. 1
b. 6
c. 11
d. 0

______ **50.** What is the name of the element that has the symbol Ca?
a. Cesium
b. Californium
c. Cobalt
d. Calcium

______ **51.** What is the symbol of iron?
a. I
b. Ir
c. Fe
d. F

Name ______________________ Class ______________ Date ______________

______ **52.** What is the atomic number of iron?
- **a.** 26
- **b.** 8
- **c.** 55
- **d.** 4

______ **53.** What is the symbol of uranium?
- **a.** Ur
- **b.** U
- **c.** Fe
- **d.** Um

______ **54.** What is the atomic number of uranium?
- **a.** 92
- **b.** 28
- **c.** 238
- **d.** 7

In the space provided, write the letter of the atomic number that matches the element on the periodic table.

______ **55.** helium	**a.** 8
______ **56.** carbon	**b.** 10
______ **57.** nitrogen	**c.** 6
______ **58.** oxygen	**d.** 16
______ **59.** neon	**e.** 13
______ **60.** aluminum	**f.** 2
______ **61.** sulfur	**g.** 17
______ **62.** chlorine	**h.** 7

63. Why does the periodic table use an average atomic mass for each element?

____

____

64. What does average atomic mass mean?

____

____

____

Name ______________________ Class ____________ Date __________

65. How many naturally occurring isotopes of hydrogen are there?

____

66. Why does each isotope of hydrogen have a mass number different from the others?

____

____

67. How can you determine the average atomic mass of hydrogen?

____

____

____

68. What is the average atomic mass of hydrogen, as noted in the periodic table?

____

VALENCE ELECTRONS AND PERIODIC PROPERTIES

______ **69.** Elements are arranged in columns on the period table based on what?
- **a.** similarities in their physical properties
- **b.** similarities in their chemical properties
- **c.** differences in their physical properties
- **d.** differences in their chemical properties

______ **70.** What are columns called on the periodic table?
- **a.** properties
- **b.** rows
- **c.** valences
- **d.** groups

______ **71.** The number of outermost electrons in an atom's electron cloud largely determine an atom's
- **a.** chemical properties.
- **b.** physical properties.
- **c.** magnetic properties.
- **d.** atomic properties.

______ **72.** What are the outermost electrons in an atom's electron cloud called?
- **a.** atomic electrons
- **b.** nuclear electrons
- **c.** valence electrons
- **d.** periodic electrons

______ **73.** Within each group on the periodic table, the atoms of each element generally have
- **a.** the same physical properties.
- **b.** different chemical properties.
- **c.** the same number of valence atoms.
- **d.** the same atomic numbers.

______ **74.** How many valence electrons do atoms of elements in Groups 3–12 have?
- **a.** 3 or more
- **b.** 2 or more
- **c.** only 1
- **d.** 1 or 2

75. In groups 13-18 on the periodic table, what is the number of valence electrons in each atom?

____

____

76. What is true of an atom that has 8 valence electrons?

____

77. What is true of elements whose atoms have 1, 2, or 3 valence electrons?

____

78. What is the main difference between *metals* and *nonmetals*?

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Combinations of Atoms

______ **1.** What is true of the elements found in Earth's crust?
- **a.** They usually occur in pure form.
- **b.** They generally occur in combination with other elements.
- **c.** They usually do not occur in combination with other elements.
- **d.** They generally occur in pure form, but in combination with other elements.

______ **2.** What is a *compound*?
- **a.** a substance made of two or more elements joined by chemical bonds between the atoms of those elements
- **b.** a substance made of a single element joined by chemical bonds between the atoms of that element
- **c.** a substance made of thousands of elements joined by chemical bonds between the atoms of those elements
- **d.** a substance made of two or more subatomic particles joined by physical bonds

______ **3.** The properties of a compound are
- **a.** the same as those of the elements that make up the compound.
- **b.** physically similar to the elements of the compound.
- **c.** chemically similar to the elements of the compound.
- **d.** different from those of the elements that make up the compound.

MOLECULES

______ **4.** The smallest unit of matter that can exist by itself and retain all of a substance's chemical properties is a(n)
- **a.** mixture.
- **b.** atom.
- **c.** molecule.
- **d.** element.

______ **5.** In a molecule of two or more atoms, how are the atoms connected?
- **a.** The atoms are chemically bonded together.
- **b.** Magnetism connects the atoms.
- **c.** The atoms are physically mixed.
- **d.** Electrostatic energy bonds the atoms together.

______ **6.** Molecules that are made up of only two atoms are called
a. subatomic particles.
b. diatomic molecules.
c. isotopes.
d. chemical formulas.

______ **7.** What does O_2 mean?
a. It means a diatomic molecule with 2 parts.
b. It means an oxygen compound with 2 parts.
c. It means a mixture of 2 parts oxygen.
d. O is the symbol for oxygen; the subscript 2 is the number of oxygen atoms bonded together.

CHEMICAL FORMULAS

______ **8.** In any compound, the elements that make up the compound
a. occur in different relative proportions.
b. occur in the same relative proportions.
c. do not occur in measurable proportions.
d. do not occur in the same relative proportions.

______ **9.** What is a *chemical formula*?
a. a combination of letters and numbers that shows which elements make up a compound
b. the numbers used to show how many chemical and physical bonds a molecule has
c. a combination of subscripts and letters that shows which electrons make up a mixture
d. the letters used to show how many chemical and physical bonds a molecule has

______ **10.** What does the chemical formula H_2O mean?
a. Each water molecule has one atom of hydrogen and one atom of oxygen.
b. Each water molecule has one atom of hydrogen and two atoms of oxygen.
c. Each water molecule has two atoms of hydrogen and two atoms of oxygen.
d. Each water molecule has two atoms of hydrogen and one atom of oxygen.

______ **11.** In a chemical formula, what does a subscript that follows the symbol for a element indicate?
a. half the number of atoms of that element in the molecule
b. the number of atoms of that element in the molecule
c. double the number of atoms of that element in the molecule
d. the number of molecules of that element in an atom

Name ______________ Class ______________ Date ______________

CHEMICAL EQUATIONS

______ **12.** How do elements and compounds form new compounds?
- **a.** by being heated and melting together
- **b.** by combining through physical reactions
- **c.** by combining through chemical reactions
- **d.** by dividing through chemical reactions

______ **13.** What is a *chemical equation*?
- **a.** a formula that describes the physical reaction of elements and compounds combining to form new compounds
- **b.** a formula that describes the chemical reaction of elements that do not combine to form new compounds
- **c.** a formula that describes the chemical reaction of elements and compounds combining to form new compounds
- **d.** a formula that describes the physical reaction of compounds that do not combine to form new compounds

______ **14.** In a chemical equation, what is shown on the left-hand side of the arrow?
- **a.** the reactions
- **b.** the products
- **c.** the molecules
- **d.** the reactants

______ **15.** In a chemical equation, what is shown on the right-hand side of the arrow?
- **a.** the reactions
- **b.** the products
- **c.** the molecules
- **d.** the reactants

______ **16.** What does the arrow in a chemical reaction mean?
- **a.** “gives” or “yields”
- **b.** “gives” and “takes”
- **c.** “takes” or “yields”
- **d.** “takes” or “makes”

17. Explain the equation $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.

____

____

18. When is a chemical equation balanced?

____

____

19. Why can you not change chemical formulas to balance an equation?

____

____

____

20. What are coefficients?

____

____

21. In the equation $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$, what is the coefficient in $2H_2O$? How is the coefficient used?

____

____

____

____

22. In the equation $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$, how is the coefficient in $2O_2$ used?

____

____

____

____

CHEMICAL BONDS

______ **23.** What are *chemical bonds*?

- **a.** the forces that hold the molecules in atoms together
- **b.** the forces that hold the subatomic particles within molecules together with other molecules
- **c.** the forces that hold the subatomic particles in atoms within molecules together
- **d.** the forces that hold the atoms within molecules together

______ **24.** Chemical bonds form because of

- **a.** the transmutation of energy.
- **b.** the attraction between positive and negative charges.
- **c.** the change of matter into energy.
- **d.** positive and negative charges repelling each other.

______ **25.** How do atoms form chemical bonds?
a. by combining protons
b. by either transferring or sharing neutrons
c. by either transferring or sharing valence electrons
d. by either combining or rearranging valence electrons

______ **26.** What is the result of variations in the forces that hold molecules together?
a. a wide range of physical and chemical properties
b. a wide range of behavioral difficulties
c. a narrow range of physical and chemical properties
d. virtually nothing

______ **27.** When scientists study the interactions of atoms, what can they predict?
a. how long it takes for chemical bonds to form
b. how subatomic particles will split apart to form other atoms
c. which kinds of atoms will form chemical bonds together
d. the weather

______ **28.** How many valence electrons can a hydrogen atom have?
a. 1
b. 2
c. 3
d. 4

______ **29.** How can hydrogen reach a more chemically unreactive state?
a. by splitting
b. by fusing
c. by giving up or accepting another proton
d. by giving up or accepting another electron

______ **30.** What happens when an electron is transferred from one atom to another?
a. Only the atom that accepts the electron becomes charged; the other becomes neutral.
b. Only the atom that gave up the electron becomes charged; the other becomes neutral.
c. Both atoms lose their charge.
d. Both atoms become charged.

______ **31.** What is an *ion*?
a. an atom or molecule that has a neutral charge
b. an atom or molecule that carries a negative or positive charge
c. an atom that has at least one extra neutron
d. an atom that has at least one extra proton

Name ______________________ Class ______________ Date ____________

______ **32.** How many electrons do neutral sodium atoms have?
a. 1
b. 11
c. 8
d. 2

______ **33.** How many valance electrons does a sodium atom have?
a. 8
b. 11
c. 1
d. 2

______ **34.** If a neutral sodium atom loses its outermost electron, how many electrons are now in its outermost electron cloud?
a. 8
b. 2
c. 11
d. 1

______ **35.** When an atom gives up an electron and no longer has a balance between positive and negative charges, what does it become?
a. a molecule
b. an isotope
c. neutral
d. an ion

______ **36.** When a sodium atom releases its valence electron, what does it become?
a. a proton
b. a sodium isotope
c. a positive sodium ion
d. a negative sodium ion

______ **37.** If a neutral chlorine atom accepts an electron, what happens?
a. It now has 8 valence electrons, and it becomes a chemically unstable, positively charged chloride ion.
b. It now has 7 valence electrons, and it becomes a chemically unstable, negatively charged chloride ion.
c. It now has 8 valence electrons, and it becomes a chemically stable, negatively charged chloride ion.
d. It now has 7 valence electrons, and it becomes a chemically stable, positively charged chloride ion.

Name ______________________ Class ______________ Date ____________

______ **38.** What is an *ionic bond*?
a. the force between charged ions that results from neutron transfer between atoms
b. the opposing force between uncharged ions
c. the attractive force between ions with the same charge
d. the attractive force between oppositely charged ions

______ **39.** An *ionic compound is* formed through the transfer of
a. electrons.
b. protons.
c. neutrons.
d. energy.

______ **40.** When are most ionic compounds formed?
a. when electrons are transferred between atoms of metallic elements
b. when neutrons are transferred between atoms of metallic and nonmetallic elements
c. when electrons are transferred between atoms of metallic and nonmetallic elements
d. when electrons are transferred between atoms of nonmetallic elements

______ **41.** Sodium chloride is composed of
a. negatively charged sodium ions and positively charged chloride ions.
b. positively charged sodium ions and negatively charged chloride ions.
c. positively charged sodium ions and chloride ions.
d. negatively charged sodium ions and chloride ions.

42. What is a covalent bond?

____

____

____

43. If atoms are sharing electrons, what happens to the positive nucleus of each atom?

____

____

____

Name ______________________ Class ______________ Date ____________

44. What force keeps atoms that share electrons joined?

45. What is a covalent compound?

46. How do two atoms of hydrogen combine with one atom of oxygen to form a water molecule?

47. Why would atoms that are covalently bonded not share electrons equally?

48. What is a polar covalent bond?

49. Explain how water is an example of a molecule that forms because of polar covalent bonds.

50. What is caused by a water molecule's slightly negative charge at its oxygen end and the slightly positive charge at its hydrogen end?

____

____

____

MIXTURES

______ **51.** What is a mixture?

a. a combination of five or more substances that are not chemically combined
b. a combination of two or more substances that are chemically combined
c. a combination of two or more substances that are not chemically combined
d. a combination of 10 or more substances that are chemically combined

______ **52.** The substances that make up a mixture

a. keep their individual properties.
b. lose their individual properties.
c. combine chemically.
d. lose their individual chemical properties.

______ **53.** Unlike a compound, a mixture

a. can be separated into its parts by chemical means.
b. cannot be separated into its parts by physical means.
c. cannot be separated into its parts by chemical means.
d. can be separated into its parts by physical means.

______ **54.** To separate a mixture of powdered sulfur, S, and iron, Fe, filings, you can

a. use chemical means.
b. use a magnet to attract the iron.
c. add more chemicals.
d. pick out the sulfur by hand.

______ **55.** What are heterogeneous mixtures?

a. three or more substances that are uniformly distributed
b. two or more substances that are not uniformly distributed
c. three or more substances that cannot be separated by physical means
d. two or more substances that can be separated by physical means

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

______ **56.** What rock is an example of a heterogeneous mixture of minerals?
a. limestone
b. feldspar
c. quartz
d. granite

57. What is a homogeneous mixture?

____

____

58. What is a homogeneous mixture of two or more substances uniformly dispersed throughout the mixture?

____

____

59. What is dissolved in the solution known as sea water?

____

____

____

60. What is happening in sea water on a molecular level, in terms of positive and negative charges?

____

____

____

____

____

____

61. What is an alloy?

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: What Is a Mineral?

1. What do a ruby, a gold nugget, and a grain of salt have in common?

____

____

____

2. What substances are the basic materials of Earth's crust?

____

____

3. What is a *mineral*?

____

____

CHARACTERISTICS OF MINERALS

______ **4.** To determine if a substance is a mineral or a nonmineral, scientists
- **a.** run a lot of tests.
- **b.** ask three basic questions.
- **c.** ask five basic questions.
- **d.** ask four basic questions.

______ **5.** Scientists determine that a substance is a mineral when the answer to
- **a.** half the questions is yes.
- **b.** half the questions is no.
- **c.** all four questions is yes.
- **d.** all four questions is no.

______ **6.** What is an inorganic substance?
- **a.** one that is hard, dense, and lifeless
- **b.** one that is made up of living things or the remains of living things
- **c.** one that is not made up of living things or the remains of living things
- **d.** something made up of the remains of ancient plants

______ **7.** Which of the following is a question scientists ask to determine if a substance is a mineral?
- **a.** Does the substance occur naturally?
- **b.** Will the substance sink to the bottom of a tank?
- **c.** Is the substance shiny and heavy?
- **d.** Is the substance manufactured?

______ **8.** Why is obsidian not a mineral?
- **a.** It does not sink to the bottom of a water tank.
- **b.** The atoms are not arranged in a regularly repeating crystalline structure.
- **c.** The atoms are arranged in a regularly repeating crystalline structure.
- **d.** It does not conduct electricity.

______ **9.** What is the fourth question scientists ask to determine if a substance is a mineral?
- **a.** Does it weigh more than most other substances of its density?
- **b.** Does it float or sink?
- **c.** Does it have a consistent chemical composition?
- **d.** Does it have an inconsistent chemical composition?

KINDS OF MINERALS

______ **10.** How many different kinds of minerals have scientists identified?
- **a.** fewer than 3,000
- **b.** more than 3,000
- **c.** fewer than 200
- **d.** more than 30,000

______ **11.** How many minerals are common?
- **a.** fewer than 20
- **b.** about a dozen
- **c.** more than 20
- **d.** more than 3,000

______ **12.** The common minerals are called
- **a.** sand.
- **b.** dirt-forming minerals.
- **c.** rock-forming minerals.
- **d.** common form minerals.

______ **13.** Which of the following are among the 10 most common minerals?
- **a.** quartz, sand, uranium, rock salt
- **b.** diamonds, rock candy, salt
- **c.** ice, sediment, sugar
- **d.** quartz, gypsum, halite

______ **14.** What are the two main groups of minerals?
- **a.** reflective and nonreflective
- **b.** silicate and nonsilicate
- **c.** nutritional and non-nutritional
- **d.** animal and vegetable

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

15. What is the basis for classifying minerals into two main groups?

____

____

16. Describe a *silicate* mineral.

____

____

17. What two atoms are found in the mineral quartz?

____

____

18. What are the most common silicate minerals?

____

____

19. What determines what type of feldspar will form?

____

20. In addition to quartz and feldspars, what is another type of silicate mineral?

____

21. Ferromagnesian minerals are rich in what metals?

____

____

____

22. 96% of Earth's crust is made up of what?

____

Name ______________________ Class ______________ Date ______________

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **23.** carbonates

______ **24.** halides

______ **25.** native elements

______ **26.** oxides

______ **27.** sulfates

______ **28.** sulfides

a. elements uncombined with other elements

b. compounds that contain a sulfate group (SO_4)

c. compounds that contain a carbonate group (CO_3)

d. compounds that consist of one or more elements combined with sulfur

e. compounds that contain oxygen and an element other than silicon

f. compounds that consist of chlorine or fluorine combined with sodium, potassium, or calcium

29. What are *nonsilicate* minerals?

____

____

30. What are the six major groups of nonsilicate minerals?

____

____

____

____

____

____

CRYSTALLINE STRUCTURE

______ **31.** What do all minerals in Earth's crust have?

a. a silicon atom and an oxygen atom
b. a crystalline structure
c. the same number of elements and compounds
d. the same number of protons and electrons

______ **32.** What characterizes each type of mineral crystal?

a. a silicon atom and an oxygen atom
b. the unique number of elements and compounds
c. shared geometric shapes
d. a specific geometric arrangement of atoms

33. What is a *crystal*?

____

____

____

34. Each type of mineral crystal is characterized by what?

____

35. What hinders the growth of single, large crystals?

____

36. As a result of the conditions under which minerals form, minerals are commonly made up of what?

____

____

37. If a crystal forms where the surrounding material is not restrictive, how will the mineral develop?

____

____

____

38. Why is knowing crystal shapes helpful?

____

____

39. How do scientists use X rays to study the structure of crystals?

____

____

____

____

____

CRYSTALLINE STRUCTURE OF SILICATE MINERALS

______ **40.** The crystalline structure of silicate minerals is
- **a.** made up of different basic building blocks.
- **b.** made up of the same basic building blocks.
- **c.** inconsistent from mineral to mineral.
- **d.** unique, unlike any other crystal.

______ **41.** What does each building block of the crystalline structure of silicate minerals have?
- **a.** four oxygen atoms arranged in a pyramid with one silicon atom in the center
- **b.** one oxygen atom with four silicon atoms in the center
- **c.** three oxygen atoms arranged in a pyramid with two silicon atoms in the center
- **d.** four oxygen atoms arranged in a pyramid with four silicon atoms in the center

______ **42.** How many sides does the basic building block of the crystalline structure of silicate minerals have?
- **a.** 1
- **b.** 2
- **c.** 3
- **d.** 4

______ **43.** What is the basic building block of the crystalline structure of silicate minerals called?
- **a.** silicon tetrahedron
- **b.** silicon-oxygen octagon
- **c.** oxygen tetrahedron
- **d.** silicon-oxygen tetrahedron

______ **44.** What is true of silicon-oxygen tetrahedra?
- **a.** They combine in the same arrangements to form different silicates.
- **b.** They combine in different arrangements to form different silicates.
- **c.** They combine in the same arrangements to form the same silicates.
- **d.** They combine in different arrangements to form nonsilicates.

______ **45.** The various arrangements of the silicon-oxygen tetrahedra are a result of
- **a.** the kinds of bonds that form between the silicon atoms of the tetrahedra and other tetrahedra.
- **b.** the kinds of bonds that form between the oxygen atoms of the tetrahedra and the silicon atoms of the tetrahedra.
- **c.** the kinds of bonds that form between the oxygen atoms of the tetrahedra and other atoms.
- **d.** the kinds of bonds that form between the silicon atoms of the tetrahedra and other atoms.

______ **46.** The oxygen and silicon atoms of the tetrahedra may bond with
a. silicon atoms of other tetrahedra only.
b. atoms of neighboring tetrahedra, and bonds may form between the silicon atoms and other elements outside the tetrahedra.
c. atoms of other elements only.
d. atoms of neighboring tetrahedra, and bonds may form between the oxygen atoms and other elements outside the tetrahedra.

THE CRYSTALLINE STRUCTURE OF NONSILICATE MINERALS

______ **47.** Why do nonsilicate minerals show a variety of crystalline structures?
a. because nonsilicate minerals are similar to silicate minerals
b. because nonsilicate minerals have similar chemical compositions
c. because nonsilicate minerals have diverse chemical compositions
d. because silicate minerals have diverse chemical compositions

______ **48.** What are common crystal structures for nonsilicate minerals?
a. cubes, spheres, triangles
b. cubes, hexagonal prisms, irregular messes
c. prisms, polyspheres, tetragons
d. cubes, hexagonal prisms, irregular masses

______ **49.** Nonsilicates may form
a. tetrahedra that are similar to those in silicates.
b. tetrahedra that are similar to those in nonsilicates.
c. tetrahedra that are exactly the same as those in silicates.
d. other crystalline structures that are exactly like silicates.

______ **50.** What is true of the ions in the center of nonsilicate tetrahedra?
a. They are oxygen.
b. They are not silicon.
c. They are silicon.
d. They are not ions.

51. How can classes of nonsilicate minerals be divided into smaller groups?

____

____

____

52. What determines a nonsilicate's characteristics?

____

____

____

53. Why do the native elements have very high densities?

____

____

____

____

54. What is *closest packing*?

____

____

____

____

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Identifying Minerals

______ **1.** Mineralogists are scientists who
- **a.** study the weather.
- **b.** examine, analyze, and classify the weather.
- **c.** examine, analyze, and classify minerals.
- **d.** examine, analyze, and classify animals.

______ **2.** Mineralogists identify minerals by
- **a.** using special equipment.
- **b.** finding similar minerals in books.
- **c.** studying properties of the weather.
- **d.** studying the properties of minerals.

PHYSICAL PROPERTIES OF MINERALS

______ **3.** Each mineral has specific properties that are a result of
- **a.** scientific theory.
- **b.** crystals in its chemicals.
- **c.** chemical composition and crystalline structure.
- **d.** specialized equipment.

______ **4.** What is one property of a mineral that is easy to observe?
- **a.** magnetism
- **b.** size
- **c.** weight
- **d.** color

______ **5.** Color alone is generally
- **a.** a reliable clue for identifying a mineral sample.
- **b.** not a reliable clue for identifying a mineral sample.
- **c.** the best way of identifying a mineral sample.
- **d.** not a clue for identifying a mineral sample.

______ **6.** What is true of mineral color?
- **a.** It takes large amounts of certain elements to affect color.
- **b.** Very small amounts of certain elements may greatly affect color.
- **c.** Many minerals are dissimilar in color.
- **d.** All minerals are similar in color.

______ **7.** What is corundum?
- **a.** yellow pyrite with traces of fool's gold
- **b.** a bluish mineral composed of aluminum and carbon atoms
- **c.** a colorless mineral composed of aluminum and oxygen atoms
- **d.** amethyst with traces of chromium

Name ________________________ Class ______________ Date ____________

______ **8.** What is corundum with traces of chromium, Cr?
a. a red gem called diamond
b. a red gem called sapphire
c. a red gem called ruby
d. a red gem called garnet

______ **9.** What causes the purple color of amethyst?
a. carbon, C; and iron, Fe
b. manganese, Mn; and corundum
c. quartz and crystal
d. manganese, Mn; and iron, Fe

______ **10.** What is another reason that color is unreliable in identifying minerals?
a. Color is not a significant property of minerals.
b. Most minerals are basically the same color.
c. Weathered surfaces may hide the color of minerals.
d. Minerals and elements are basically the same color.

______ **11.** What is streak?
a. the shape of the mineral crystal when frozen
b. the color of the mineral in powdered form
c. the surface color observed when the mineral is cleaved
d. the color of the mineral in large crystals

______ **12.** The easiest way to observe the streak of a mineral is to
a. rub some of the mineral against a streak plate.
b. rub two pieces of the mineral together.
c. rub the mineral on paper.
d. use rubbing compound to make it shine.

______ **13.** What is true of the streak's color?
a. It is almost always the same as the mineral in solid form.
b. It may differ from the color of the mineral in solid form.
c. It may differ from the color of the mineral in liquid form.
d. It is never accurate, but scientists still use it.

______ **14.** What kind of streak do metallic minerals generally have?
a. silver
b. neutral or no streak
c. dark
d. very light

15. Describe the streak of most nonmetallic minerals.

____

____

____

Name ____________________ Class ______________ Date ______________

16. What is *luster*?

____

____

17. What is *metallic luster*?

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **18.** glassy luster

______ **19.** waxy luster

______ **20.** pearly luster

______ **21.** brilliant luster

______ **22.** dull or earthy luster

a. diamond, for example

b. mineral that lacks any shiny appearance

c. transparent quartz and other minerals that look like glass

d. minerals such as mica

e. minerals that have the appearance of candle wax

23. What is *cleavage* in geology?

____

____

24. Where does a mineral break when it has cleavage?

____

____

____

25. What is *fracture* in minerals?

____

____

____

26. How do mineralogists describe a fracture?

____

____

Name ______________________ Class ______________ Date ____________

27. What is *hardness* in mineralogy?

____

____

____

28. Describe an example of how hardness does NOT mean "resistance to cleavage or fracture."

____

____

____

29. What is the *Mohs hardness scale*?

____

____

____

30. How do mineralogists test the hardness of an unknown mineral?

____

____

31. What are the softest and hardest minerals on the Mohs hardness scale?

____

32. How would you use the Mohs hardness scale to test an unknown mineral?

____

____

33. What does a diamond's hardness result from?

____

____

____

34. Why does a mineral always have the same general shape?

____

____

____

35. What is the basic crystal system where three axes of equal length intersect at 90° angles?

____

36. What is a tetragonal crystal system?

____

____

____

37. What is the basic crystal system where two of the three axes of unequal length intersect at 90° angles, and the third axis is oblique to the others?

____

38. What is an orthorhombic crystal system?

____

____

39. What is the basic crystal system where three horizontal axes of the same length intersect at 120° angles, and the vertical axis is longer or shorter than the horizontal axes?

____

____

40. What is a triclinic crystal system?

____

____

41. What can cause the six basic crystal shapes to become more complex?

____

____

42. How would a piece of galena feel compared with a piece of quartz of the same size?

____

____

43. What is *density*?

____

____

Name ______________________ Class ______________ Date ____________

44. On what does the density of a mineral depend?

____

____

45. What are the densities of most of the common minerals in Earth's crust?

____

____

SPECIAL PROPERTIES OF MINERALS

______ **46.** What color is calcite in ordinary light?
- **a.** white
- **b.** red
- **c.** blue
- **d.** violet

______ **47.** What color does calcite appear to be in ultraviolet light?
- **a.** white
- **b.** red
- **c.** blue
- **d.** violet

______ **48.** Minerals with the property of fluorescence
- **a.** absorb ultraviolet light and then produce invisible light of a single color.
- **b.** reflect ultraviolet light and then produce visible light of various colors.
- **c.** reflect ultraviolet light and then produce invisible light of various colors.
- **d.** absorb ultraviolet light and then produce visible light of various colors.

______ **49.** Phosphorescence is the property that causes a mineral to
- **a.** turn colors after ultraviolet light is turned on.
- **b.** bubble when it is converted to liquid form.
- **c.** grow after ultraviolet light is turned on.
- **d.** glow after ultraviolet light is turned off.

______ **50.** Phosphorescence is useful in mining
- **a.** lithium, an ore of eucryptite.
- **b.** eucryptite, an ore of lithium.
- **c.** eucharite, an ore of mythium.
- **d.** kryptonite, an ore of lithium.

Name ________________________ Class ______________ Date ____________

Directed Reading *continued*

______ **51.** What is a chatoyancy?
a. a silky appearance some minerals display in ultraviolet light
b. a silky appearance some minerals display in reflected light
c. a soft appearance some minerals display in phosphorescent light
d. a foggy appearance some minerals display in deflected light

______ **52.** What it chatoyancy also called?
a. cat-and-mouse effect
b. catnip effect
c. cat's-cradle effect
d. cat's-eye effect

______ **53.** What causes chatoyancy?
a. loosely packed perpendicular fibers within a mineral
b. closely packed perpendicular fibers within a mineral
c. loosely packed parallel fibers within a mineral
d. closely packed parallel fibers within a mineral

______ **54.** What is asterism?
a. a phenomenon in which a six-sided star shape appears when a mineral reflects light
b. a phenomenon in which a five-sided star shape appears when a mineral absorbs light
c. a phenomenon in which a four-sided shape appears when a mineral reflects light
d. a phenomenon in which a square appears in a mineral

______ **55.** What happens to light rays as they pass through transparent minerals?
a. They straighten out.
b. They bend.
c. They are absorbed.
d. They are reflected.

______ **56.** What is refraction?
a. the absorption of light rays as they pass from a substance, such as air, to another substance, such as a mineral
b. the disappearance of light rays as they pass from a substance, such as air, to another substance, such as a mineral
c. the bending of light rays as they pass from a substance, such as air, to another substance, such as a mineral
d. the ending of light rays as they pass from a substance, such as rock, to another substance, such as a soil

57. Describe the property called *double refraction.*

____

____

Directed Reading *continued*

58. What causes double refraction to occur?

59. Magnets may attract small particles of some minerals that contain what element?

60. What do bar magnets and some pieces of lodestone both have?

61. From what conditions does *radioactivity* result?

62. What are two examples of radioactive elements?

63. What is the most common mineral that contains uranium?

Name ______________________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Rocks and the Rock Cycle

_____ **1.** The solid part of Earth is made up of material called
- **a.** glacial ice.
- **b.** lava.
- **c.** rock.
- **d.** wood.

_____ **2.** Rock can be a collection of one or more minerals, or it might be made of
- **a.** inorganic matter.
- **b.** solid organic matter.
- **c.** liquid organic matter.
- **d.** chemicals.

_____ **3.** Which of the following can rock sometimes be made of?
- **a.** brick
- **b.** mineral matter that is not crystalline
- **c.** inorganic matter
- **d.** plastic

_____ **4.** Scientists who study the processes that form and change rock are called
- **a.** geologists.
- **b.** paleontologists.
- **c.** botanists.
- **d.** zoologists.

THREE MAJOR TYPES OF ROCKS

_____ **5.** The word igneous comes from a Latin term that means
- **a.** "from fire."
- **b.** "from wind."
- **c.** "from rock."
- **d.** "from fossils."

_____ **6.** How do rocks get broken down into small fragments?
- **a.** by freezing
- **b.** by erosion
- **c.** by deposition
- **d.** by crystallization

Name ______________________ Class ____________ Date ____________

______ **7.** Which of the following does NOT change the form of existing rock?
a. extreme pressure
b. extreme heat
c. a chemical process
d. light

______ **8.** The word metamorphic means
a. "changed from."
b. "to become."
c. "changed form."
d. "to form."

In the space provided, write the letter of the description that best matches the term or phrase.

______ **9.** igneous rock
______ **10.** sedimentary rock
______ **11.** lava
______ **12.** metamorphic rock
______ **13.** magma
______ **14.** sediment

a. rock that forms when existing rock is altered
b. molten rock
c. rock that forms when molten rock cools and hardens
d. rock that forms when rock fragments are compressed or cemented together
e. molten rock that is exposed at Earth's surface
f. rocks, mineral crystals, and organic matter that have been broken into fragments

THE ROCK CYCLE

15. Define *rock cycle.*

____

____

____

16. When a body of ______________ rock is exposed at Earth's surface, a number of processes break the rock down into sediment.

17. When bits and pieces of rock are compacted or cemented, the bits and pieces become ______________ rocks.

18. If sedimentary rocks are subjected to changes in temperature and pressure, the rocks may become ______________ rocks.

19. Under certain temperature and pressure conditions, metamorphic rock will melt and form ______________.

20. If magma cools, it turns into new ______________ rock.

21. A particular body of rock does not always pass through each stage of the ______________.

PROPERTIES OF ROCKS

22. How are the physical and chemical properties of rock determined?

____

____

____

23. What do the physical characteristics of a rock reflect?

____

____

24. What does the chemical stability of the minerals in the rock determine?

____

____

25. The way that minerals and rocks form is related to the ______________ of the rock.

26. What did N.L. Bowen learn when he first began studying how minerals crystallize from magma?

____

____

____

____

____

27. Define *Bowen's reaction series.*

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

28. According to Bowen's hypothesis, what are the two ways that minerals form?

____

____

____

29. The rate at which a mineral chemically breaks down is dependent on the

______________________ of the mineral.

30. The chemical stability of minerals is dependent on the strength of the

______________________ between atoms in the mineral.

31. What two factors determine rocks' natural zones of weakness?

____

____

32. Both sedimentary and metamorphic rocks tend to break in

______________________.

33. When rock formed under intense ______________________ is uplifted to Earth's surface, decreased pressure allows the joints and fractures to open.

34. Once weaknesses are exposed to air, the processes of physical and chemical

______________________ begin.

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Igneous Rock

Use the terms from the list below to complete the sentences that follow. Each term may be used only once.

crystalline igneous rock chemical composition

1. When magma cools and hardens, it forms ______________________.

2. Most igneous rock can be identified as ______________________ because the minerals in the rock crystallize as igneous rock forms from magma.

3. The ______________________ of minerals in the rock and its texture determine the identity of the igneous rock.

THE FORMATION OF MAGMA

In the space provided, write the letter of the answer choice that best completes each statement or best answers each question.

______ **4.** Magma forms when rock
a. cools.
b. solidifies.
c. weathers.
d. melts.

______ **5.** Three factors that affect whether rock melts include temperature, pressure, and
a. the presence of fluids in the rock.
b. the chemical composition of the rock.
c. the composition of the fluid in the rock.
d. the chemical/fluid ratio of the rock.

______ **6.** Rock melts when
a. its temperature drops below the melting point of minerals in the rock.
b. its temperature rises above the melting point of minerals in the rock.
c. the air temperature reaches 38°C.
d. it breaks into fragments.

______ **7.** Adding fluids to hot rock generally
a. increases the melting point of certain minerals in the rock.
b. has no effect on the melting point of certain minerals in the rock.
c. decreases the melting point of certain minerals in the rock.
d. causes the rock to crystallize.

______ **8.** The first minerals to melt have the
a. highest melting point.
b. lowest melting point.
c. darkest color.
d. lightest color.

______ **9.** The process by which different minerals in rock melt at different temperatures is called
a. meltdown.
b. partial melting.
c. total melting.
d. decomposition.

______ **10.** How does the cooling process of magma compare with the melting process?
a. The cooling process is the same as the process of partial melting.
b. The cooling process is the reverse of the process of partial melting.
c. The cooling process is faster than the process of partial melting.
d. The cooling process is slower than the process of partial melting.

______ **11.** As temperature drops, the first minerals to crystallize from magma have
a. the lowest freezing point.
b. the highest freezing point.
c. no freezing point.
d. the same freezing points.

______ **12.** The crystallization and removal of different minerals from the cooling magma is called
a. partial cooling.
b. total freezing.
c. crystallization.
d. fractional crystallization.

______ **13.** Crystals that form during fractional crystallization
a. settle in the middle of the magma chamber.
b. settle at the bottom or stick to the walls and ceiling of the magma chamber.
c. leave the magma chamber.
d. dissolve in the magma chamber.

______ **14.** In some crystals, why is the chemical composition of the inner part different from that of the outer part?
- **a.** The crystallization took place very quickly.
- **b.** The crystallization happened over a long period.
- **c.** The temperature of the magma changed during crystallization.
- **d.** The composition of the magma changed while the crystal was growing.

TEXTURES OF IGNEOUS ROCKS

In the space provided, write the letter of the description that best matches the term or phrase.

______ **15.** intrusive igneous rock

______ **16.** extrusive igneous rock

______ **17.** coarse-grained texture

______ **18.** fine-grained texture

______ **19.** porphyritic texture

______ **20.** glassy texture

______ **21.** vesicular texture

a. the texture of quickly cooled magma that has a mixture of large and small crystals

b. the texture of quickly cooled magma that contains dissolved gasses that become trapped as bubbles

c. the texture of igneous rock that is composed of small crystals

d. rock formed from the cooling and solidification of lava at Earth's surface

e. the texture of quickly cooled magma that contains a small percentage of dissolved gasses

f. rock formed from the cooling and solidification of magma beneath Earth's surface

g. the texture of igneous rock that is composed of large mineral grains

22. How do intrusive and extrusive igneous rocks differ from each other?

____

____

____

23. What determines the texture of igneous rock?

____

24. What determines the size of crystals in igneous rock?

____

25. Large mineral crystals are commonly found in ______________________.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

26. An example of igneous rock with a coarse-grained texture is

________________________.

27. Two examples of igneous rock with a fine-grained texture are

________________________ and ________________________.

28. A rock that has a glassy texture is called ________________________.

________________________.

29. Holes in a rock that result from rapid cooling are called

________________________.

30. An example of igneous rock that has a vesicular texture is

________________________.

COMPOSITION OF IGNEOUS ROCKS

31. What determines the mineral composition of an igneous rock?

____

____

32. Define *felsic*.

____

____

33. List five mineral components of felsic rock.

____

____

____

____

____

34. Name four examples of felsic rock.

____

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

35. Define *mafic.*

____

____

____

36. List the main mineral components of mafic rock.

____

____

____

37. What two components are responsible for the dark color of mafic rock?

____

____

38. Name two examples of mafic rock.

____

____

39. What four minerals make up rocks in the intermediate family?

____

____

____

____

40. How does the silica content of an intermediate rock compare with that of a felsic or mafic rock?

____

____

____

41. Name two rocks from the intermediate family.

____

____

____

Name ______________________ Class ______________ Date ____________

INTRUSIVE IGNEOUS ROCK STRUCTURES

In the space provided, write the letter of the description that best matches the term or phrase.

______ **42.** intrusion

______ **43.** batholith

______ **44.** stock

______ **45.** laccolith

______ **46.** sill

______ **47.** dike

a. the largest of all intrusions; spreads at least 100 km^2 when exposed on Earth's surface

b. a dome that forms when magma flows between rock layers and spreads

c. an igneous rock mass that forms underground

d. a mass that forms when magma flows between rock layers and hardens; lies parallel to the rock layers that surround it

e. an intrusion similar to a batholith; covers less than 100 km^2 of Earth's surface

f. a mass that forms when magma flows and hardens across layers of rock rather than parallel to them

EXTRUSIVE IGNEOUS ROCK STRUCTURES

In the space provided, write the letter of the description that best matches the term or phrase.

______ **50.** extrusion

______ **51.** volcano

______ **52.** volcanic neck

______ **53.** lava flow

______ **54.** lava plateau

______ **55.** tuff

a. an extrusion that takes the form of a flat mass of rock

b. volcanic ash deposits that form during an eruption

c. an igneous rock mass that forms on Earth's surface

d. a series of lava flows that cover a vast area with thick rock

e. the solidified central vent that remains after the soft parts of a volcano are eroded by wind and water

f. a vent through which magma, gases, or volcanic ash is expelled

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Sedimentary Rock

1. Define *sediment.*

____

____

____

2. What three factors determine the characteristics of sedimentary rock?

____

____

____

FORMATION OF SEDIMENTARY ROCKS

3. How are newly formed sediments transported to new locations?

____

____

____

4. What determines the composition of sediment?

____

____

____

5. What happens to sediment as it is moved from one place to another?

____

____

____

6. What are the two main processes that convert loose sediment to sedimentary rock?

____

____

____

7. The process in which the volume and porosity of a sediment is reduced by the weight and pressure of overlying sediments is called

______________________.

8. The process in which minerals precipitate into pore spaces between sediment grains and bind sediments together to form rock is called

______________________.

CHEMICAL SEDIMENTARY ROCK

______ **9.** Sedimentary rock that forms when minerals precipitate from a solution or settle from a suspension is called

a. organic sedimentary rock.
b. chemical sedimentary rock.
c. clastic sedimentary rock.
d. elastic sedimentary rock.

______ **10.** One reason that minerals precipitate is because of

a. evaporation.
b. compaction.
c. cementation.
d. condensation.

______ **11.** When water evaporates, it leaves behind minerals called

a. metamorphites.
b. magma.
c. crystals.
d. evaporites.

______ **12.** Two examples of evaporites are

a. coal and granite.
b. gypsum and halite.
c. chalk and limestone.
d. sandstone and shale.

______ **13.** The Bonneville Salt Flats near the Great Salt Lake in Utah are a good example of

a. evaporite deposits.
b. coal deposits.
c. limestone deposits.
d. shale deposits.

Name ______________________ Class ______________ Date ______________

ORGANIC SEDIMENTARY ROCKS

Use the terms from the following list to complete the sentences below. Each term may be used only once. Some terms will not be used.

chalk	coral	carbon
calcite	coal	limestone
organic sedimentary rock		

14. Sedimentary rock that forms from the remains of plants or animals is called

______________________.

15. Some limestones and ______________________ are examples of organic sedimentary rocks.

16. Coal forms from plant remains that are buried before they decay and are then compacted into matter that is composed mainly of ______________________.

17. Organic limestone forms when marine organisms such as coral, clams, oysters, and plankton remove chemical components of the minerals ______________________ and aragonite from sea water.

18. When marine organisms die, their shells eventually become

______________________.

19. An example of limestone made up of the shells of tiny, one-celled marine organisms that settle to the ocean floor is ______________________.

CLASTIC SEDIMENTARY ROCK

In the space provided, write the letter of the description that best matches the term or phrase.

______ **20.** clastic sedimentary rock

______ **21.** conglomerate

______ **22.** breccia

______ **23.** sandstone

______ **24.** shale

______ **25.** quartz

a. mineral that is a major component of most sandstones

b. rock composed of angular fragments with sharp corners that range in size from fine mud to boulders

c. sedimentary rock that forms when fragments of preexisting rocks are compacted or cemented together

d. rock made up of sand-sized grains cemented together

e. rock that consists of clay-sized particles that are cemented and compacted

f. rock composed of rounded fragments sized from fine mud to boulders

CHARACTERISTICS OF CLASTIC SEDIMENTS

26. What two factors determine the physical characteristics of sediments?

____

____

27. Name the four agents that transport sediments.

____

____

____

____

28. How does the speed with which the agent of erosion moves the sediment affect that sediment?

____

____

29. Define *sorting*.

____

____

30. How do poorly sorted and well-sorted sediments differ?

____

____

31. What causes sediment to change in size and shape as it is transported from its source to where it is deposited?

____

____

32. In general, how do sediment particles that travel long distances differ from those that have traveled short distances?

____

____

____

Name ______________________ Class ______________ Date ______________

SEDIMENTARY ROCK FEATURES

In the space provided, write the letter of the description that best matches the term or phrase.

______ **33.** depositional environment

______ **34.** stratification

______ **35.** bed

______ **36.** massive bed

______ **37.** cross-bed

______ **38.** graded bedding

______ **39.** reverse grading

a. a stratified layer

b. a bed characterized by slanting layers

c. a type of stratification in which various sizes and kinds of materials are deposited in one layer

d. a bed with no internal structure

e. a type of stratification in which the smallest grains are on the bottom and larger grains are on top

f. the layering of sedimentary rock, which occurs when the conditions of deposition change

g. the setting in which sediment is deposited

40. A sedimentary rock feature caused by the action of wind or water on sand is called a(n) ______________________.

41. A sedimentary rock feature that forms when a muddy deposit dries and shrinks is called a(n) ______________________.

42. How are fossils formed?

____

____

43. How are concretions formed?

____

____

44. How are geodes formed?

____

____

Name ______________________ Class ____________ Date ____________

Skills Worksheet

Directed Reading

Section: Metamorphic Rock

1. Define *metamorphism.*

____

____

2. Where does most metamorphic rock form?

____

____

3. Metamorphic rock forms from which three types of rock?

____

____

____

FORMATION OF METAMORPHIC ROCKS

Use the terms from the following list to complete the sentences below. Each term may be used only once.

parallel bands	composition	magma
pressure	tectonic plates	metamorphism

4. Hot fluids, heat, and ____________________ cause some minerals to change into other minerals.

5. Minerals might change in size or shape, or they sometimes separate into ____________________ that give rocks a layered appearance.

6. Hot fluids from magma can circulate through the rock and change the mineral ____________________ by dissolving some minerals and adding others.

7. The type of rock that forms because of ____________________ can indicate the conditions that were in place when the original rock changed.

8. One type of metamorphism occurs when small volumes of rock come in contact with ____________________.

9. The second type of metamorphism occurs when large areas of Earth's crust are affected by the heat and pressure caused by the movement and collisions of ____________________.

Name ______________________ Class ______________ Date ____________

10. Define *contact metamorphism.*

____

____

____

11. Describe the area of rock that is affected by contact metamorphism.

____

____

12. In addition to changes caused by heat from magma, what other occurrence can cause changes in the surrounding rock during contact metamorphism?

____

____

____

13. Define *regional metamorphism.*

____

____

____

14. Explain how metamorphic rock forms during regional metamorphism.

____

____

____

15. Which type of metamorphism causes most metamorphic rock to form?

____

____

____

16. Explain why rocks that are formed as a result of contact metamorphism are often found near those formed by regional metamorphism.

____

____

____

Name ______________________ Class ______________ Date ____________

CLASSIFICATION OF METAMORPHIC ROCKS

17. In what two ways are metamorphic rocks classified?

____

____

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **18.** foliation

______ **19.** slate

______ **20.** schist

______ **21.** gneiss

______ **22.** nonfoliated

______ **23.** quartzite

______ **24.** marble

a. a coarse-grained rock that forms when large amounts of heat and pressure are exerted on slate

b. the metamorphic rock texture in which mineral grains are arranged in planes or bands

c. a nonfoliated rock that forms when quartz sandstone is metamorphosed

d. the metamorphic rock texture in which mineral grains are not arranged in planes or bands

e. a foliated rock that forms when pressure is exerted on the sedimentary rock shale

f. a metamorphic rock that forms from the compression of limestone

g. a metamorphic rock that forms when intense heat and pressure underground cause the minerals in schist to separate into bands as the minerals recrystallize

25. Explain the two ways in which foliated metamorphic rock might form.

____

____

____

____

26. Describe two characteristics of nonfoliated metamorphic rock.

____

____

____

____

Name ______________________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Mineral Resources

1. How many different minerals have been identified in Earth's crust?

____

2. What are three examples of metals?

____

____

____

3. What are two examples of nonmetals?

____

____

4. List three characteristics of metals.

____

____

____

5. List two characteristics of nonmetals.

____

____

ORES

In the space provided, write the letter of the description that best matches the term or phrase.

______ **6.** cinnabar

______ **7.** native element

______ **8.** bauxite

______ **9.** ore

______ **10.** magnatite

______ **11.** compound

a. metallic mineral that can exist in Earth's crust as a nugget of pure metal

b. mineral consisting of two or more elements

c. mineral deposit from which mineral resources can be removed profitably

d. ore from which mercury can be removed

e. ore from which aluminum can be removed

f. ore from which iron can be removed

Name ______________________ Class ______________ Date ______________

12. Name three ores that form within cooling magma.

____

____

____

13. What happens to dense metallic minerals as magma cools?

____

14. The process that occurs when magma comes into contact with existing rock is ______________________.

15. Heat and chemical reactions with hot fluids from magma sometimes change the surrounding rock and form ______________________.

16. Hot fluids that can move through small cracks in rock are ______________________.

17. Narrow zones of rock formed when minerals precipitate from the hydrothermal solution are called ______________________.

18. An ore deposit that forms from many thick mineral veins in a small region is called a(n) ______________________.

19. List four valuable heavy minerals that commonly make up veins.

____

____

____

____

20. What happens first when movement of water helps form ore deposits?

____

____

21. What happens when currents become too weak to carry the dense metals?

____

____

Name ______________________ Class ______________ Date ____________

22. Because of the mechanical action of the stream, fragments become concentrated at the bottom of stream beds in ________________.

USES OF MINERAL RESOURCES

______ **23.** An example of a metal valued for its beauty is
a. gypsum.
b. calcite.
c. platinum.
d. sulfur.

______ **24.** Sources of valuable minerals and elements such as gold are
a. nonmetallic minerals.
b. gemstones.
c. metallic ores.
d. calcite and gypsum.

______ **25.** Gemstones are
a. valuable metallic ores.
b. rare nonmetallic minerals.
c. metals such as gold and platinum.
d. common nonmetallic ores.

______ **26.** A mineral often used as a building material is
a. quartz.
b. graphite.
c. platinum.
d. gypsum.

MINERAL EXPLORATION AND MINING

______ **27.** In order to be considered for mining, the area must have
a. a much higher concentration of minerals than is found elsewhere.
b. large gold and silver deposits.
c. gemstones.
d. radioactivity.

______ **28.** During mineral exploration, people search for mineral deposits by
a. tracking weather patterns.
b. studying local geology.
c. avoiding earthquake zones.
d. searching only for metallic ores.

______ **29.** Special equipment is used to measure and identify patterns in
a. organic materials, rock samples, and economic recovery.
b. placer deposits, streambeds, and veins.
c. native elements, compounds, and ore deposits.
d. magnetism, gravity, radioactivity, and rock color.

______ **30.** Subsurface mining techniques are used for mineral deposits
a. close to Earth's surface.
b. in the oceans.
c. in stream beds.
d. below Earth's surface.

______ **31.** When overlying rock material is stripped away to reveal mineral deposits, the process is called
a. subsurface mining.
b. nodule mining.
c. surface mining.
d. placer mining.

______ **32.** Minerals in placer deposits are mined
a. in open pits.
b. by dredging.
c. on the deep-ocean floor.
d. deep underground.

______ **33.** A nodule would be found
a. in a subsurface mine.
b. on the ocean floor.
c. in a river or stream.
d. in an open-pit mine.

______ **34.** Undersea mining is not practical because
a. there are no valuable minerals in the ocean.
b. nodules cannot be recovered.
c. minerals cannot be removed from nodules.
d. it is difficult and expensive.

Back Print

Name ________________ Class ________ Date ________

Skills Worksheet

Directed Reading

Section: Nonrenewable Energy

1. Name two things energy is used for.

____

____

2. Energy resources that exist in limited amounts and cannot be replaced quickly are called ________________.

FOSSIL FUELS

______ **3.** Nonrenewable natural resources formed from the remains of living things are called
a. fossil fuels.
b. prehistoric rock.
c. magma.
d. plants and animals.

______ **4.** Examples of fossil fuels are
a. gold, peat moss, and minerals.
b. solar energy and light.
c. coal, petroleum, and natural gas.
d. wind energy and heat.

______ **5.** Fossil fuels that consist of compounds containing stored energy used by plants and animals millions of years ago are called
a. renewable resources.
b. nuclear fuels.
c. undersea nodules.
d. hydrocarbons.

______ **6.** What happens when hydrocarbons are burned?
a. The forming of chemical bonds produces radioactive energy.
b. The breaking of chemical bonds reduces heat and light energy.
c. The forming of chemical bonds releases energy as heat and light.
d. The breaking of chemical bonds releases energy as heat and light.

______ **7.** Coal deposits are the remains of plants that have undergone a complex chemical process called
a. energization.
b. carbonization.
c. burning.
d. fossilization.

______ **8.** Carbonization occurs when partially decomposed plant material
a. is buried in swamp mud and becomes peat.
b. becomes river sediment.
c. develops into a renewable resource.
d. releases propane and carbon dioxide.

______ **9.** The complex chemical and physical processes would produce coal only if what is NOT present in a swamp?
a. carbon dioxide
b. methane
c. oxygen
d. bacteria

______ **10.** As peat is covered by layers of sediments, the weight squeezes out water and gases, forming a denser material called
a. anthracite.
b. lignite.
c. oxygen.
d. bituminous coal.

______ **11.** Bituminous coal is formed when
a. increased temperature and pressure of more sediments compacts lignite.
b. decreased temperature and pressure of more sediments compacts lignite.
c. Earth's crust folds, producing higher temperatures and pressure.
d. Earth's crust folds, producing lower temperatures and pressure.

______ **12.** Where Earth's crust folds, producing high temperatures and pressure, bituminous coal changes into
a. lignite.
b. bacteria.
c. anthracite.
d. peat.

13. Carbon is what percent of bituminous coal?

____

14. What happened when prehistoric plants and microorganisms died in shallow prehistoric oceans and lakes?

____

15. As buried sediment accumulated on ocean floors and lake bottoms, what happened to the sediment?

____

____

Name ________________________ Class ______________ Date ____________

Directed Reading *continued*

16. What is another name for petroleum?

____

17. In what form is petroleum?

____

18. In what form is natural gas?

____

19. Why are petroleum and natural gas deposits highly sought after?

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **20.** cap rock

______ **21.** permeable rock

______ **22.** impermeable rock

a. rock through which liquids cannot flow

b. the impermeable layer of rock above an oil reservoir

c. rock with spaces through which liquids can flow

23. Why does petroleum rise above trapped water beneath the cap rock?

____

24. Why does natural gas rise above petroleum beneath the cap rock?

____

25. What often happens when a well is drilled into an oil reservoir?

____

FOSSIL-FUEL SUPPLIES

26. One of the main sources of energy around the world is ______________________.

27. Unrefined petroleum is called ______________________.

28. The most abundant fossil fuel in the world is ______________________.

29. A material that contains hard-to-mine petroleum is ______________________.

30. One fossil fuel with undiscovered reserves is ______________________.

31. Name five items for which crude oil is used besides fuel.

____

____

____

____

____

32. In what three countries is almost two-thirds of the world's coal found?

____

____

____

NUCLEAR ENERGY

______ **33.** The basis of nuclear technology is
a. making weapons.
b. striking atomic nuclei with high-energy particles.
c. creating atoms in a laboratory.
d. joining the neutrons of several atoms.

______ **34.** Energy produced by nuclear technologies is called
a. nuclear fission.
b. a nuclear reaction.
c. nuclear energy.
d. nuclear waste.

______ **35.** Splitting the nucleus of a large atom into two or more smaller nuclei is called
a. nuclear energy.
b. nuclear splitting.
c. nuclear fusion.
d. nuclear fission.

______ **36.** Splitting an atom creates a powerful reaction because
a. atoms contain no smaller parts.
b. the forces holding the nucleus together are extremely strong.
c. the chemical bonds between atoms are unbreakable.
d. the nucleus of an atom is weak.

______ **37.** What happens when the nucleus of an atom splits?
a. It releases additional neutrons as well as energy.
b. It releases additional electrons as well as energy.
c. It combines with nearby atoms.
d. Nothing happens.

______ **38.** What occurs as newly released neutrons from an atomic reaction strike other nearby nuclei?
a. splitting of a neutron
b. a chain reaction
c. joining of two nuclei
d. nuclear fusion

______ **39.** An uncontrolled fission reaction may result in
a. the splitting of a neutron.
b. an electrical storm.
c. the joining of two nuclei.
d. an explosion.

______ **40.** What kind of nuclear reaction must occur in order to produce heat that can be used to generate electricity?
a. controlled fission
b. controlled fusion
c. uncontrolled fission
d. uncontrolled fusion

41. The equipment in which controlled nuclear fission is carried out is a(n) ______________________.

42. The process of nuclear fission releases a tremendous amount of ______________________.

43. The element currently used for nuclear fission is ______________________.

44. After uranium-235 is processed into fuel pellets, the fuel pellets are said to be what?

____

45. Enriched fuel pellets are used to make ______________________.

46. What happens when bundles of fuel rods are bombarded by neutrons?

____

____

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

47. What happens to fuel rods that are used to create nuclear fission?

____

____

48. Describe how heat from fuel rods provides power for electric generators.

____

____

____

49. What happens to excess heat?

____

____

____

50. What are two advantages of nuclear power plants?

____

____

51. What is a disadvantage of nuclear fission?

____

____

52. Why must wastes from nuclear fission be stored safely?

____

____

53. Where are nuclear wastes from nuclear power plants currently stored?

____

____

____

54. Where are other wastes from nuclear power plants currently stored?

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

55. The process in which nuclei of hydrogen atoms combine to form larger nuclei of helium is called ______________________.

56. The process of nuclear fusion releases ______________________.

57. What temperatures are needed for fusion reactions to occur?

____

____

____

58. If a commercial fusion reactor could be built, what might be used as fuel?

____

____

____

59. What is an advantage of using ocean water as fuel for nuclear fusion?

____

____

____

60. What other advantages would energy from nuclear fusion have?

____

____

____

Name ______________________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Renewable Energy

1. If worldwide energy consumption increases as predicted, in how many years will the world's supply of fossil fuels be used up?

____

2. Why is nuclear energy not considered the best replacement for fossil fuels?

____

____

____

3. What is the name of resources that can be replaced as they are used or within a human life span?

____

GEOTHERMAL ENERGY

______ **4.** What flows far beneath Earth's surface?
- **a.** nuclear energy
- **b.** fossil fuels
- **c.** water
- **d.** natural gas

______ **5.** How does water beneath the surface become heated?
- **a.** by the atmosphere
- **b.** by heat absorbed by Earth's surface
- **c.** by steam produced by the sun
- **d.** by rocks heated by magma

______ **6.** Geothermal energy comes from
- **a.** deep within the Earth.
- **b.** Earth's surface.
- **c.** right below Earth's surface.
- **d.** the atmosphere.

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

______ **7.** Which is NOT a way that geothermal energy has been harnessed?
- **a.** using geothermal steam to drive turbines
- **b.** mining ores
- **c.** pumping water into hot rocks
- **d.** drilling wells to reach hot water

______ **8.** Which place obtains 85% of its home heating from geothermal power?
- **a.** San Francisco
- **b.** Japan
- **c.** France
- **d.** Iceland

SOLAR ENERGY

9. How long does it take the sun to provide enough energy to meet Earth's energy needs for one year?

____

10. What is solar energy?

____

____

____

11. What is the chief challenge scientists face with regard to solar energy?

____

____

____

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **12.** solar collector

______ **13.** active system

______ **14.** photovoltaic cell

______ **15.** passive system

a. a system that converts solar energy directly into electricity for small objects

b. a system that converts sunshine into heat energy without moving parts

c. a device such as a box with a glass top that converts sunshine into energy

d. a system for using solar energy that uses solar collectors

Name ______________________ Class ____________ Date ____________

16. Describe how a solar collector might work.

17. What is a disadvantage of solar collectors?

ENERGY FROM MOVING WATER

18. What are two sources of energy from moving water?

19. What is energy produced by running water called?

20. How much of the United States' electricity comes from hydroelectric power plants?

21. Why is a dam necessary for a hydroelectric plant?

22. What happens inside a hydroelectric plant?

23. How have people made use of tides as a source of energy?

ENERGY FROM BIOMASS

______ **24.** Which is NOT an example of biomass?
- **a.** paper waste
- **b.** manure
- **c.** coal
- **d.** wood

______ **25.** Where is biomass a major source of energy?
- **a.** in many developing countries
- **b.** in the United States
- **c.** in Europe
- **d.** in many industrial countries

______ **26.** What percentage of trees that are cut down are used as an energy source?
- **a.** 100%
- **b.** 25%
- **c.** less than 50%
- **d.** more than 50%

______ **27.** The action of bacteria on biomass can produce
- **a.** natural gas and petroleum.
- **b.** gases and liquids that can be burned as fuel.
- **c.** fire and water.
- **d.** electricity and nuclear fission.

ENERGY FROM WIND

28. What causes wind?

____

29. What devices convert wind energy into mechanical energy?

____

30. In what kinds of places is wind energy currently producing electricity?

____

31. What is the name for a group of hundreds of giant wind turbines?

____

32. How much energy might such large groups of wind turbines produce?

____

33. What is the main disadvantage of wind energy?

____

Back Print

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Resources and Conservation

______ **1.** According to predictions, worldwide coal reserves will last
a. about 20 years.
b. about 100 years.
c. about 200 years.
d. indefinitely.

______ **2.** According to predictions, humans will have used half of Earth's oil supply within
a. 20 years.
b. 100 years.
c. 200 years.
d. 1,000 years.

______ **3.** What are people doing about the limited supply of traditional energy resources?
a. stopping the use of fossil fuels
b. researching new energy sources
c. giving up coal mining
d. using only renewable resources

4. In general, how can mining damage the environment?

____

____

5. How can fossil fuels and nuclear power generation damage the environment?

____

____

6. How have governments helped reduce the impact of energy use on the environment?

____

____

ENVIRONMENTAL IMPACTS OF MINING

7. Name two kinds of pollution caused by mining.

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

8. How does mining affect water resources?

____

____

9. Describe a mining practice that harms wildlife habitats.

____

____

10. What may happen to land above a mine as a result of removing materials below the surface?

____

11. Why are fires in coal mines a problem?

____

____

12. What is the purpose of laws in the United States that regulate mines?

____

____

13. Name three laws that regulate mining operations.

____

____

____

14. What law protects threatened or endangered species from mining?

____

15. What is reclamation?

____

____

16. What is the effect of reclamation?

____

17. How do some mining operations work to reduce environmental damage?

____

____

FOSSIL FUELS AND THE ENVIRONMENT

______ **18.** What is a likely feature of land where strip mining has been performed?
- **a.** green forests
- **b.** deep holes
- **c.** rolling hills
- **d.** clear water

______ **19.** What can happen to land whose plants and topsoil are removed by strip mining?
- **a.** It can provide new habitats for wildlife.
- **b.** It can be turned into fertile farm land.
- **c.** It often erodes quickly.
- **d.** Nothing happens to it.

______ **20.** When rocks exposed by mining weather to form acids, what may be a harmful effect?
- **a.** Runoff can carry the acids into rivers and harm aquatic life.
- **b.** The rocks can wear away and form poisoned soil.
- **c.** Acid runoff can form gullies and ravines.
- **d.** The mines can no longer produce high-quality coal.

______ **21.** When coal with a high sulfur content is burned, what is released into the atmosphere in large amounts?
- **a.** carbon dioxide
- **b.** carbon monoxide
- **c.** hydrogen
- **d.** sulfur dioxide

______ **22.** Under what conditions does acid precipitation form?
- **a.** when SO_2 combines with water in the air
- **b.** when CO_2 combines with water in the air
- **c.** when water breaks up into hydrogen and oxygen
- **d.** when hydrogen combines with CO

______ **23.** A major cause of acid rain is
- **a.** burning coal.
- **b.** burning gasoline.
- **c.** catalytic converters.
- **d.** combining petroleum and natural gas.

______ **24.** Which is NOT an effective way to reduce pollutants emitted by cars?
- **a.** careful maintenance
- **b.** catalytic converters
- **c.** coal use regulations
- **d.** emissions testing

Name ______________________ Class ______________ Date ____________

CONSERVATION

______ **25.** The preservation and wise use of natural resources is called
- **a.** environmental science.
- **b.** recycling.
- **c.** conservation.
- **d.** reclamation.

26. Name three ways conservation can help the environment.

____

____

____

27. Why are people in developing countries using more mineral resources?

____

____

28. Name two ways minerals can be conserved.

____

____

29. Define *recycling*.

____

____

____

30. Name three metals that are often recycled.

____

____

____

31. Compared with the energy used by mining and manufacturing, how much energy does recycling require?

____

32. How does insulation in a home help conserve energy?

____

____

Name ________________ Class ________ Date ________

Directed Reading *continued*

33. How do energy-efficient appliances help conserve energy?

____

____

34. Describe two additional ways to conserve energy in your home.

____

____

35. How much carbon dioxide does an average car produce for each 3.8 L of gasoline burned?

____

36. Describe three ways to conserve gasoline.

____

____

____

37. What do scientists predict about freshwater resources by the year 2050?

____

____

38. Describe four ways to help conserve water.

____

____

____

____

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Determining Relative Age

1. How old is Earth estimated to be?

____

2. Who originated the idea that Earth is billions of years old?

____

3. On what did the 18th-century Scottish physician and farmer base his conclusions?

____

UNIFORMITARIANISM

4. What did James Hutton theorize?

____

____

5. What is the principle of uniformitarianism?

____

____

6. In what way is the principle of uniformitarianism important to the science of geology?

____

7. How did later geologists refine Hutton's ideas?

____

____

8. Before Hutton, what two things did people believe about the age and geology of Earth?

____

____

9. What question did Hutton's principle of uniformitarianism raise?

____

Name ______________________ Class ____________ Date __________

10. What did Hutton observe about the forces that shaped the land on his farm?

____

____

____

11. How did Hutton's observations and conclusions influence other scientists?

____

____

____

12. What is one way to learn about Earth's past?

____

____

RELATIVE AGE

______ **13.** Layers of rock are called
- **a.** strata.
- **b.** data.
- **c.** errata.
- **d.** pages.

______ **14.** The order of rock layers reveals
- **a.** the type of rock in the layers.
- **b.** the relative age of the layers.
- **c.** the exact years in which each layer formed.
- **d.** periods of volcanic activity.

______ **15.** Relative age indicates
- **a.** the true age of the rock layers.
- **b.** that all rock was formed at the same time.
- **c.** the amount of erosion in a rock layer.
- **d.** that one rock layer is older than another layer.

______ **16.** Although various types of rock form layers, what type of rock is commonly used by scientists to determine the relative age of rocks?
- **a.** igneous rock
- **b.** metamorphic rock
- **c.** sedimentary rock
- **d.** superheated rock

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LAW OF SUPERPOSITION

______ **17.** Sedimentary rocks form when
- **a.** lava flows from volcanoes at different periods of volcanic activity.
- **b.** new layers of sediment are deposited on top of old layers of sediment.
- **c.** magma is injected into older rock from Earth's core and then cools.
- **d.** rivers erode igneous rocks and wind forms the edges into layered shapes.

______ **18.** Layers of compressed and hardened sediments are called
- **a.** beds.
- **b.** leaves.
- **c.** shelves.
- **d.** sheets.

______ **19.** What is a bedding plane?
- **a.** a single sediment bed
- **b.** a dark-colored layer of sediment
- **c.** a light-colored layer of sediment
- **d.** a boundary between rock beds

______ **20.** The law of superposition helps scientists determine the
- **a.** relative age of a layer of sedimentary rock.
- **b.** true age of a layer of sedimentary rock.
- **c.** composition of a layer of sedimentary rock.
- **d.** rate at which a layer of sedimentary rock will erode.

PRINCIPLE OF ORIGINAL HORIZONTALITY

______ **21.** In what kinds of layers does sedimentary rock generally form?
- **a.** vertical
- **b.** horizontal
- **c.** circular pools
- **d.** rippled curves

______ **22.** What can scientists assume when sedimentary rock layers are not horizontal?
- **a.** The rock has been tilted or deformed.
- **b.** The rock is not actually sedimentary.
- **c.** The rock has been eroded.
- **d.** The law of superposition is wrong.

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______ **23.** What causes sedimentary rock layers to be tilted or deformed?
- **a.** erosion by water
- **b.** lava flows from volcanoes
- **c.** movements of Earth's crust
- **d.** the weight of new layers of sediment

______ **24.** When sedimentary rock is tilted or deformed, scientists know that crustal movements occurred
- **a.** while lava was flowing.
- **b.** before the rock was formed.
- **c.** while the rock was forming.
- **d.** after the rock was formed.

25. In what cases is it difficult to apply the law of superposition?

____

____

26. When sedimentary rock layers have been tilted or deformed, what must scientists do before they can apply the law of superposition?

____

____

27. What is graded bedding?

____

____

28. What can scientists assume if large particles are in the top of a layer of sedimentary rock?

____

____

29. When sandy sediments form curved beds at an angle to the bedding plane, what are the sedimentary layers called?

____

30. Why do the layers in cross-beds appear to be curved at the bottom and cut off at the top?

____

____

____

____

31. Why do scientists study the shapes of cross-beds?

____

____

32. What are ripple marks, and how are they formed?

____

____

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33. What can scientists assume if ripple marks in sedimentary rock point up?

____

____

34. How do scientists use ripple marks to determine the relative ages of rocks?

____

____

____

UNCONFORMITIES

______ **35.** How are buried rock layers exposed to erosion?

- **a.** They are lifted up by changes in weather.
- **b.** They expand when Earth's climate warms.
- **c.** They are lifted up by movements of Earth's crust.
- **d.** Buried layers are never exposed to erosion.

______ **36.** An unconformity shows that

- **a.** erosion occurs all the time.
- **b.** deposition stopped for a period of time.
- **c.** an area was underwater.
- **d.** volcanic action increased at one time.

______ **37.** According to the law of superposition, what is the age relationship of rocks on either side of an unconformity?

- **a.** All the rocks beneath an unconformity are younger than the rocks above it.
- **b.** All the rocks at the boundary of an unconformity are the same age.
- **c.** All the rocks beneath an unconformity are older than the rocks above it.
- **d.** The age relationship between rocks at an unconformity cannot be determined.

______ **38.** Which of the following is NOT a type of unconformity?
a. two
b. three
c. four
d. five

______ **39.** Which of the following is NOT a type of unconformity?
a. discontinuity
b. disconformity
c. nonconformity
d. angular unconformity

______ **40.** How does a nonconformity form?
a. Unstratified igneous or metamorphic rock is folded and tilted and then eroded.
b. Unstratified igneous or metamorphic rock is uplifted, erodes, and then covered by new igneous or metamorphic rock.
c. Stratified rock is buried beneath unstratified igneous or metamorphic rock when a volcano erupts.
d. Unstratified igneous or metamorphic rock us uplifted, erodes, and then sediments are deposited on the eroded surface.

In the space provided, write the letter of the description that best matches the term or phrase.

______ **41.** unconformity
______ **42.** deposition
______ **43.** angular unconformity
______ **44.** erosion
______ **45.** nonconformity
______ **46.** disconformity

a. accumulation of sediments
b. the boundary between older layers of sedimentary rock and overlying younger layers
c. break in the geologic record showing that deposition stopped for a period of time
d. natural force that can cause breaks in the geologic record
e. boundary between stratified rock on top of unstratified rock
f. the boundary between a set of tilted layers and a set of horizontal layers

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

47. What can happen when rock layers have been disturbed by faults or intrusions?

____

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____

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48. What is a fault?

____

____

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49. Explain how an intrusion forms.

____

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____

50. What law do scientists apply to determine relative ages of rock when they find faults or intrusions?

____

____

51. Explain the law of crosscutting relationships.

____

____

____

____

52. What is the relative age of a fault or igneous intrusion that cuts through an unconformity?

____

____

____

Name ______________________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Determining Absolute Age

1. What does *relative age* indicate?

____

____

2. Besides relative age, what else do scientists need to know in order to learn more about Earth's history?

____

3. What is absolute age?

____

____

ABSOLUTE DATING METHODS

______ **4.** A method scientists use to determine absolute age is
- **a.** observing and calculating climate changes that may or may not have occurred over time.
- **b.** using geologic processes that can be observed and measured over time.
- **c.** using geologic processes that have been observed during earthquakes and volcanic eruptions.
- **d.** studying the interaction of plants and animals and making guesses about the past.

______ **5.** Another method of determining absolute age is
- **a.** measuring the chemical composition of certain materials in rock.
- **b.** measuring the sediment contained in several layers of rock.
- **c.** recording which layer of rock is on top of other layers.
- **d.** analyzing the chemical composition of soils on top of rock.

______ **6.** The age of a stream can be measured using rates of erosion
- **a.** by measuring the amount of sediment in the stream.
- **b.** by measuring the rate at which the stream erodes its bed.
- **c.** by measuring the rate at which water flows through the stream during a flood.
- **d.** by measuring the number of streams that join the stream along its full length.

______ **7.** Over what time period can rates of erosion help scientists determine absolute age?
a. more than 2,000,000 years
b. from 1,000,000 to 2,000,000 years
c. from 100,000 to 200,000 years
d. from 10,000 to 20,000 years

______ **8.** Which geologic feature can be given an absolute age using rates of erosion?
a. Mt. Saint Helens
b. the Grand Canyon
c. Niagara Falls
d. Lake Superior

______ **9.** Rate of erosion is not a dependable way of determining the absolute age of the Grand Canyon because
a. the Grand Canyon formed during a huge flood, and little evidence remains.
b. the Grand Canyon formed over millions of years, and rates of erosion may have varied greatly.
c. the Grand Canyon has been surrounded by deserts, where rates of erosion are very slow.
d. the Grand Canyon is too large for rates of erosion to be measured.

10. In what way can the rate of deposition be used to estimate absolute age?

____

____

____

11. In general, at about what rate is sedimentary rock such as limestone, shale, or sandstone deposited?

____

____

12. What are two reasons a sedimentary layer might not be deposited at the average rate?

____

____

13. How are varves similar to the rings of a tree?

____

____

Name ______________________ Class ______________ Date ____________

14. What do varves look like?

____

____

15. Where and how do varves generally form?

____

____

____

16. How many layers make up a single varve?

____

____

17. How are varves useful to geologists?

____

____

RADIOMETRIC DATING

______ **18.** Small amounts of what type of materials in rocks can act as natural clocks?

a. sedimentary materials
b. intrusive materials
c. radioactive materials
d. igneous materials

______ **19.** Atoms of the same element that have different numbers of neutrons are called

a. varves.
b. isotopes.
c. radioactive particles.
d. alpha particles.

______ **20.** Radioactive isotopes emit particles and energy

a. at a constant rate regardless of surrounding conditions.
b. at differing rates regardless of surrounding conditions.
c. at differing rates depending on surrounding conditions.
d. at a constant rate if conditions remain the same.

Name ______________________ Class ______________ Date ____________

______ **21.** When radioactive isotopes decay,
a. particles are emitted, but no energy is released.
b. particles are emitted, and rocks become smaller.
c. particles are emitted, and small amounts of energy are released.
d. particles are emitted, and large amounts of energy are released.

______ **22.** In what way is the natural breakdown of radioactive elements most useful to scientists?
a. It can provide an estimate of the absolute age of rocks.
b. It can accurately measure the absolute age of rocks.
c. It can provide an estimate of the relative age of rocks.
d. It can accurately measure the relative age of rocks.

______ **23.** The method of using radioactive decay to measure the absolute age of rocks is called
a. blind dating.
b. radioactive dating.
c. radiometric dating.
d. decay dating.

______ **24.** What happens when an atom emits particles and energy?
a. The atom always remains unchanged.
b. The atom always changes into a different isotope of the same element.
c. The atom always changes into a different isotope of the same element.
d. The atom changes into a different isotope of the same element or into an isotope of a different element.

______ **25.** The original radioactive isotope in a rock is called
a. the parent isotope.
b. the daughter isotope.
c. the breakdown isotope.
d. the clock isotope.

26. What do scientists measure when using radiometric dating?

____

____

____

27. What are daughter isotopes?

____

____

____

Name ______________________ Class ____________ Date __________

28. How do scientists determine the absolute age of a rock using radiometric dating?

____

____

____

____

29. What changes the rate of radioactive decay?

____

30. What have scientists determined about the time that is required for half of any amount of a radioactive isotope to decay?

____

____

31. What is a half-life?

____

____

____

32. If you began with 10 g of a parent isotope, how much of that isotope would be left after one half-life?

____

33. How much of an original isotope remains at the end of a second half-life?

____

34. How can scientists determine the age of a rock sample using the half-life of a parent isotope?

____

____

____

35. What does a higher percentage of daughter isotopes in a rock mean?

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

36. How could a parent or daughter isotope be gained or lost?

____

____

____

37. What determines which radioactive element will give a more accurate measurement of a rock's age?

____

____

38. How long is the half-life of uranium-238?

____

39. For dating what kinds of geologic samples containing uranium is ^{238}U most useful? Why?

____

____

____

40. What is the half-life of potassium-40?

____

41. In what kinds of rock does potassium-40 occur?

____

____

42. What ages of rock are dated by potassium-40?

____

____

43. What is the half-life of rubidium-87, and how is it related to and used in conjunction with ^{40}K?

____

____

____

____

CARBON DATING

_____ **44.** The method used to determine the age of organic remains included in rock layers is called
- **a.** argon-argon dating, or argon-2 dating.
- **b.** carboniferous dating, or wet-carbon dating.
- **c.** carbon-carbon dating, or carbon-2 dating.
- **d.** carbon-14 dating, or radiocarbon dating.

_____ **45.** What carbon isotope combines with oxygen to form radioactive carbon dioxide, CO_2?
- **a.** carbon-12
- **b.** carbon-13
- **c.** carbon-14
- **d.** carbon-15

_____ **46.** What does most CO_2 in the atmosphere contain?
- **a.** about equal amounts of nonradioactive carbon-12 and the radioactive isotope carbon-14
- **b.** small amounts of nonradioactive carbon-12 and large amounts of the radioactive isotope carbon-14
- **c.** nonradioactive carbon-12 and no radioactive isotope carbon-14
- **d.** large amounts of nonradioactive carbon-12 and small amounts of the radioactive isotope carbon-14

47. Describe how all living organisms end up containing both ^{12}C and ^{14}C.

____

____

____

____

48. What is the first step in finding the age of a small amount of organic material?

____

____

____

____

____

49. What is the second step in finding the age of a small amount of organic material?

____

____

____

____

50. What is the half life of carbon-14?

____

51. Why does radioactive carbon-14 begin to decay after a plant or animal dies?

____

____

52. What happens to the carbon-14 in the tissues of a plant or animal that has died?

____

____

____

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Skills Worksheet

Directed Reading

Section: The Fossil Record

______ **1.** For what geological information are fossils an important source?
- **a.** learning whether rock is sedimentary, igneous, or metamorphic
- **b.** finding the absolute and relative ages of rocks
- **c.** seeing the erosion patterns on ancient rocks
- **d.** learning whether rocks have intrusions or faults

______ **2.** Fossils provide clues to
- **a.** past geologic events, climates, and evolution of living things.
- **b.** past weather, cloud cover, and changes in seasons.
- **c.** recent events in human history.
- **d.** the earliest development of the Solar System.

In the space provided, write the letter of the description that best matches the term or phrase.

______ **3.** fossil

______ **4.** paleontology

______ **5.** sedimentary rock

______ **6.** igneous or metamorphic rock

a. the type of rock in which almost all fossils are discovered

b. the study of fossils

c. the remains of an animal or plant that lived in a previous geologic time

d. rock in which fossils are rarely discovered

7. Why are most fossils found in sedimentary rock?

____

____

____

8. Why are fossils so rarely found in igneous or metamorphic rock?

____

____

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____

Name ______________________ Class ______________ Date ____________

INTERPRETING THE FOSSIL RECORD

9. What type of information does the fossil record provide?

____

____

10. How do fossils provide important clues to environmental changes that occurred in Earth's past?

____

____

____

11. What is one way scientists can tell if an area of land was once covered by an ocean?

____

____

12. What is one way scientists can use information from fossils?

____

____

FOSSILIZATION

______ **13.** What usually happens to dead plants or animals?
- **a.** They become fossils.
- **b.** They just stay where they are.
- **c.** They are eaten or decomposed by bacteria.
- **d.** Nothing happens to them.

______ **14.** Which type of organisms usually become fossils?
- **a.** organisms that were buried quickly or protected from decay
- **b.** organisms that were ignored by passing animals.
- **c.** organisms that lived in water.
- **d.** organisms that had hard outer shells.

______ **15.** In general, what parts of organisms become fossils?
- **a.** all parts are equally likely to be fossilized
- **b.** hard parts, such as wood, bones, shells, or teeth
- **c.** soft parts, such as skin and organs
- **d.** only very hard woods

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______ **16.** Why are mummified remains found in very dry places?
a. Most bacteria thrive in dry environments.
b. Bacteria do not cause decay in dry environments.
c. Fewer animals live in dry environments.
d. Most bacteria cannot survive in dry environments.

______ **17.** Which method of fossilization was also used by ancient civilizations?
a. petrification
b. excretion
c. mummification
d. deposition

______ **18.** How are insects preserved in amber?
a. They eat tree sap, which preserves their bodies.
b. They become trapped in tree sap, which hardens.
c. They lay eggs in sap, which hatch before the sap hardens.
d. Tree sap is very dry, and few bacteria live in it.

______ **19.** What material has been recovered from amber in rare cases?
a. DNA
b. RNA
c. living insects
d. antennae

______ **20.** Tar seeps are formed by thick deposits of
a. clay.
b. amber.
c. petroleum.
d. silica

______ **21.** What about tar seeps led fossilized animals to become trapped in the sticky tar?
a. Tar smells good to animals.
b. Tar seeps are commonly covered by water.
c. Tar seeps are often found in steep holes.
d. Tar seeps are surrounded by food.

______ **22.** Which is a common petrifying mineral?
a. talc
b. molybdenum
c. silica
d. gypsum

TYPES OF FOSSILS

______ **23.** An imprint displays
a. an exact, complete form of an organism.
b. internal details of an organism.
c. the hard portions of an organism.
d. the surface features of an organism.

______ **24.** Which type of fossil is formed when mud fills a mold and hardens?
a. an imprint
b. a mold
c. a cast
d. a coprolite

______ **25.** What does a cast show about an animal?
a. It shows how an animal reproduced.
b. It provides an exact replica of the animal.
c. It shows what the animal's natural enemies were.
d. It provides a general idea of the animal's size.

______ **26.** What type of fossil gives scientists clues about what ancient animals ate?
a. an imprint
b. a cast
c. a coprolite
d. a mold

______ **27.** Gastroliths are commonly found
a. in layers of clay.
b. close to dinosaur remains.
c. at the bottoms of tar seeps.
d. in empty pockets within shale.

______ **28.** A trace fossil is
a. fossilized dung or waste materials from ancient animals, such as dinosaurs.
b. fossilized evidence of past animal movement such as a track, footprint, boring, or burrow.
c. the carbonized outline of a leaf, stem, flower, or fish that was made in soft mud or clay.
d. the complete fossilized body of an ancient animal.

______ **29.** Scientists study trace fossils to find
a. exactly what an animal looked like.
b. precisely what an animal weighed.
c. clues to an animal's appearance and activities.
d. clues to what an animal ate.

______ **30.** Which of the following is an example of a trace fossil?
a. an intact dinosaur tooth
b. a bird's footprint
c. an imprint of a leaf
d. a spider in amber

31. From what kinds of animals have scientists found trace fossils of footprints?

____

____

____

____

INDEX FOSSILS

______ **32.** Fossils that are found only in the rock layers of a particular geologic period are called
a. trace fossils.
b. imprints.
c. index fossils.
d. complete fossils.

______ **33.** Index fossils are found
a. in a very small geographic area.
b. in igneous rocks.
c. widely scattered in rocks over a large region.
d. widely scattered through many layers of rocks.

______ **34.** What is most important about the features of an index fossil?
a. Its features must be recognized as coming from other organisms that became fossils.
b. Its features must be equally clear in each of the different fossils found.
c. Its features must differ according to the location on Earth in which it is found.
d. Its features must clearly distinguish it from other fossils.

______ **35.** The organisms that form index fossils lived
a. during a short span of geologic time.
b. during a long span of geologic time.
c. for about 2 million years
d. over any span of geologic time, long or short.

______ **36.** How commonly distributed must the fossil of an organism be in order to be considered an index fossil?
a. The fossil must be rare and unique.
b. The fossil must occur in fairly large numbers within the rock layers.
c. The fossil may exist in any numbers, but it must be found within many different layers of rock.
d. The fossil must occur in small numbers in a very specific location.

INDEX FOSSILS AND ABSOLUTE AGE

______ **37.** Scientists use index fossils to
a. determine the relative ages of different rock layers.
b. find dividing points in the fossil record.
c. determine branches in the development of species.
d. determine the absolute ages of specific rock layers.

______ **38.** Rock layers in which index fossils have been found can be dated accurately because the organisms that formed the index fossils lived
a. for a long span of geologic time.
b. for a short span of geologic time.
c. all over Earth.
d. in a small part of Earth.

______ **39.** How old are the rock layers in which ammonite fossils are found?
a. 100 and 200 million years
b. 180 to 206 million years
c. 206 to 220 million years
d. 220 to 300 million years

40. How can scientists use index fossils to determine the absolute age of rock layers in different parts of the world?

____

____

____

____

41. What else do geologists use index fossils to find?

____

____

____

____

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Skills Worksheet

Directed Reading

Section: Geologic Time

1. Where can we find evidence of changes in conditions on Earth's surface?

____

2. What do scientists use to describe the sequence and length of changes in Earth's crust?

____

3. What is the purpose of the geologic time scale?

____

THE GEOLOGIC COLUMN

4. What two things did 19th century scientists do to determine the relative ages of sedimentary rock all over the world?

____

____

5. Why did scientists combine their observations of rocks all over the world?

____

____

6. The ordered arrangement of rock layers is called

a(n) ______________________.

7. In a geologic column, the oldest rocks are located at the

______________________ of the column.

8. What two things distinguish a rock layer in a geologic column?

____

____

9. How do the fossils in the upper layers of a geologic column differ from those in the lower, older layers?

____

____

____

10. Many of the fossils that have been discovered in the oldest layers of rock have been ______________________ for millions of years.

11. When the first geologic columns were developed, what factors did scientists use to estimate the ages of rock layers?

____

____

12. What method has enabled scientists to determine the ages of rock layers more accurately?

____

13. Suppose a scientist wants to determine the age of a rock layer with a geologic column. With what does the scientist compare the rock layer?

____

____

14. Suppose a layer of rock matches a layer on the geologic column. What does this tell a scientist?

____

DIVISIONS OF GEOLOGIC TIME

15. What three indicators do geologists use to divide the geologic time scale into smaller units?

____

16. How are rocks grouped within each unit of geologic time similar?

____

17. A unit of geologic time is usually characterized by ______________________ of a dominant life-form.

18. What does the abbreviation *Ma* stand for?

____

19. When did Precambrian time begin?

____

20. What species were common during the Cambrian Period?

____

____

Name ______________________ Class ______________ Date ______________

21. What happened to the atmosphere during the Ordovician Period?

____

22. When did the Silurian Period begin?

____

23. During which period did the age of fishes begin?

____

24. In what era was the Carboniferous Period?

____

25. In North America, into what two periods is the Carboniferous Period divided?

____

26. What was the dominant life-form of the Jurassic Period?

____

27. What marked the end of the Mesozoic Era?

____

28. In which epoch did the age of mammals begin?

____

29. When did the Eocene Epoch begin?

____

30. In what epoch did large carnivores appear?

____

31. In what period was the Pleistocene Epoch?

____

32. In what epoch did complex human societies develop?

____

33. The largest unit of geologic time is called a(n) ______________________.

34. Name the four eons into which geologic time is divided.

____

____

35. The Hadean eon, the Archean eon, and the Proterozoic eon make up an interval called ______________________.

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Directed Reading *continued*

36. Why is it difficult to divide Precambrian time into smaller time units?

____

37. An eon is divided into smaller units of geologic time called ____________________.

38. The first era of the Phanerozoic eon was the ____________________.

39. The Paleozoic Era lasted about ____________________.

40. What kinds of fossils are found in rocks from the Paleozoic Era?

____

41. The era after the Paleozoic Era was the ____________________.

42. What kinds of fossils are found in rocks from the Mesozoic Era?

____

43. The present geologic era is called the ____________________.

44. When did the present geologic era begin?

____

45. What kinds of fossils are common in Cenozoic rocks?

____

46. An era is divided into shorter time units called ____________________.

47. How do geologic periods get their names?

____

48. A period may be divided into smaller units called ____________________.

49. Why can scientists not always divide a period into epochs?

____

____

50. An epoch may be divided into shorter units called ____________________.

51. How is an age defined?

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Precambrian Time and the Paleozoic Era

1. Where is the geologic history of Earth recorded?

____

2. What kind of information can scientists get from the types of rock and the fossils in a rock layer?

____

EVOLUTION

3. The gradual development of new organisms from other organisms since the beginning of life is called ______________________.

4. In what year was the theory of evolution by natural selection proposed, and by whom?

____

5. Climatic and geologic changes could affect an organism's ability to ______________________.

6. What do scientists study to learn why some organisms survived over long periods and others became extinct?

____

____

PRECAMBRIAN TIME

______ **7.** What is a nebula?
- **a.** the newly formed sun
- **b.** a large cloud
- **c.** a star
- **d.** a planet

______ **8.** When did the Earth form?
- **a.** about 540 million years ago
- **b.** about 4.6 billion years ago
- **c.** after Precambrian time
- **d.** before Precambrian time

Name ______________________ Class ______________ Date ____________

______ **9.** The time interval that began with the formation of Earth is called
a. the Cenozoic Era.
b. the Mesozoic Era.
c. the Paleozoic Era.
d. Precambrian time.

______ **10.** When did Precambrian time begin?
a. about 4.6 billion years ago
b. about 540 million years ago
c. about 10 billion years ago
d. about 88 million years ago

______ **11.** Approximately when did Precambrian time end?
a. 3 million years ago
b. 540 million years ago
c. 1 million years ago
d. 10,000 years ago

______ **12.** About how much of Earth's history occurred during Precambrian time?
a. 20%
b. 40%
c. 50%
d. 88%

______ **13.** We know little about Precambrian time because
a. no rocks exist from that time.
b. Earth did not exist.
c. no organisms existed so there are no fossils.
d. Precambrian rocks were damaged and therefore could not be identified.

14. A large area of exposed Precambrian rocks is called a

______________________.

15. Name four things that cause the formation of shields.

____

____

____

____

16. How much of the world's minerals occur in the rocks of Precambrian shields?

____

____

Name ______________________ Class ______________ Date ____________

17. What valuable minerals are found in the rocks of Precambrian shields?

____

18. Name three possible reasons why fossils are rare in Precambrian rocks.

____

____

____

19. Precambrian fossils consisting of reeflike deposits formed by blue-green algae are called ______________________.

20. Where do stromatolites form today?

____

21. What does the presence of stromatolite fossils in Precambrian rocks indicate?

____

THE PALEOZOIC ERA

______ **22.** When did the Paleozoic Era occur?
- **a.** before Precambrian time
- **b.** after Precambrian time
- **c.** before Earth was formed
- **d.** after the Mesozoic Era

______ **23.** Approximately when did the Paleozoic Era begin?
- **a.** 540 thousand years ago
- **b.** 248 million years ago
- **c.** 540 million years ago
- **d.** 3.9 billion years ago

______ **24.** Approximately when did the Paleozoic Era end?
- **a.** 540 thousand years ago
- **b.** 5,000 years ago
- **c.** 5 million years ago
- **d.** 248 million years ago

______ **25.** When the Paleozoic Era began, Earth's landmasses were
- **a.** arranged much as they are today.
- **b.** located in a single region of the world.
- **c.** unstable due to tectonic activity.
- **d.** scattered around the world.

______ **26.** By the end of the Paleozoic Era, Earth's landmasses had
a. collapsed and dropped below sea level.
b. collided to form a supercontinent called Pangaea.
c. disappeared as a result of tectonic activity.
d. lost all of their mineral deposits.

______ **27.** How do Paleozoic rocks differ from Precambrian rocks?
a. Paleozoic rocks contain many fossils.
b. Paleozoic rocks are much older.
c. Paleozoic rocks were formed by tectonic activity.
d. Paleozoic rocks are found only in North America.

______ **28.** How many periods is the Paleozoic Era divided into?
a. four
b. six
c. seven
d. three

______ **29.** What is the first period of the Paleozoic Era called?
a. Permian Period
b. Cambrian Period
c. Silurian Period
d. Carboniferous Period

______ **30.** Which of the following organisms appeared during the Cambrian Period?
a. primitive organisms
b. mammals
c. marine life-forms
d. marine vertebrates

In the space provided, write the letter of the description that best matches the term or phrase.

______ **31.** brachiopod

______ **32.** invertebrate

______ **33.** index fossil

______ **34.** trilobite

a. a fossil that scientists use to date rocks
b. the most common Cambrian invertebrate
c. a shelled animal common during the Cambrian Period
d. an animal that does not have a backbone

35. Evidence of what type of organism has NOT been found in Cambrian rocks?

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **36.** vertebrate

______ **37.** cephalopod mollusk

______ **38.** graptolite

a. one of the dominant invertebrate life-forms during the Ordovician Period

b. an animal that has a backbone

c. a tiny invertebrate that lived in the ocean during the Ordovician Period

39. How did Ordovician fish differ from modern fish?

____

40. A scorpion-like sea creature that lived during the Silurian Period was the ______________________.

41. In what period did the first land plants and land animals evolve?

____

42. Another name for the Devonian Period is the ______________________.

In the space provided, write the letter of the description that best matches the term or phrase.

______ **43.** rhipidistian

______ **44.** Ichthyostega

______ **45.** lungfish

a. the first amphibians

b. an air-breathing fish with strong fins that could crawl to land

c. a fish with the ability to breathe air

46. Name three types of plants that began to develop during the Devonian Period.

____

____

____

47. Briefly describe the climate during the Carboniferous Period.

____

____

Name ______________ Class ______________ Date ______________

Directed Reading *continued*

48. Briefly describe the landscape during the Carboniferous Period.

____

____

49. What does the word *carboniferous* mean?

____

50. Into what periods is the Carboniferous Period divided in North America?

____

51. What organism from the Carboniferous Period is thought to be the modern ancestor of the sea star?

____

52. What did the vertebrates that appeared at the end of the Pennsylvanian Period look like?

____

____

53. Which period marks the end of the Paleozoic Era?

____

54. What event occurred at the end of the Permian Period that affected a large number of Paleozoic life-forms?

____

55. What had happened to the continents by the end of the Permian Period?

____

56. What environmental changes had occurred by the end of the Permian Period?

____

____

57. Name two marine invertebrates that became extinct as a result of the environmental changes at the end of the Permian Period.

____

____

58. What animals survived the environmental changes at the end of the Permian Period?

____

Back Print

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: The Mesozoic and Cenozoic Eras

______ **1.** How many marine organisms died at the end of the Permian Period?
a. 50%
b. 78%
c. 90%
d. 100%

______ **2.** How many land organisms died at the end of the Permian Period?
a. 50%
b. 78%
c. 90%
d. 100%

______ **3.** What occurs during a mass extinction?
a. All species die off.
b. Large numbers of species die off.
c. Organisms adapt to environmental change.
d. Most life-forms survive.

4. Why did an abundance of new life-forms appear after the mass extinction of the Permian Period?

____

____

THE MESOZOIC ERA

5. When did the Mesozoic Era begin?

____

6. When did the Mesozoic Era end?

____

7. What happened to Pangaea during the Mesozoic Era?

____

8. What caused mountain ranges to form during the Mesozoic Era?

____

9. Describe the landscape and climate during the Mesozoic Era.

____

____

10. Name five kinds of animals that flourished during the Mesozoic Era.

____

____

____

____

11. What is another name for the Mesozoic Era?

____

12. How many periods is the Mesozoic Era divided into?

____

13. Triassic Period plants that resembled today's palm trees are called

______________________.

14. Reptiles that lived in the oceans during the Triassic Period were called

______________________.

15. A type of shellfish that serves as a Mesozoic index fossil is called a(n)

______________________.

16. What was the dominant life-form during the Jurassic Period?

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **17.** ornithischian

______ **18.** Apatosaurus

______ **19.** saurischian

______ **20.** pterosaur

______ **21.** Stegosaurus

a. a "bird-hipped" dinosaur

b. a flying reptile with skin-covered wings

c. a saurischian weighing up to 50 tons

d. a "lizard-hipped" dinosaur

e. one of the best-known ornithischians

22. A dinosaur that was nearly 6 m tall and had teeth up to 15 cm long was called the ______________________.

23. A dinosaur with armor was called the ______________________.

Name ______________________ Class ______________ Date ____________

24. A dinosaur with a horn was called the ______________________.

25. A dinosaur with a bill like a duck was called the ______________________.

26. The earliest flowering plant, which appeared during the Cretaceous Period, was called a(n) ______________________.

27. Why have no dinosaur fossils been found in rocks formed after the Cretaceous Period?

____

____

28. What are two theories about the cause of the mass extinction at the end of the Cretaceous Period?

____

____

29. The theory that a giant meteorite crash caused the extinction of dinosaurs is called the ______________________.

____

30. A substance from meteorites that would have spread over Earth after a large meteorite crash is called ______________________.

THE CENOZOIC ERA

31. The geologic era that includes the present period is called the ______________________.

32. When did the Cenozoic Era begin?

____

33. What happened to Earth's continents during the Cenozoic Era?

____

34. What changes have occurred in Earth's climate during the Cenozoic Era?

____

35. Why is the Cenozoic Era called the Age of Mammals?

____

36. The period of the Cenozoic Era that includes the time before the last ice age is called the ______________________.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

37. The period of the Cenozoic Era that began with the last ice age and includes the present is called the ______________________.

38. Name the epochs of the Tertiary Period.

____

____

39. Name the epochs of the Quaternary Period.

____

40. When did the first primates evolve?

____

41. What happened to world temperatures at the end of the Eocene Epoch?

____

42. What caused the uplifting of the Himalayas?

____

____

43. Why did many grasses, cone-bearing trees, and hardwood trees grow during the Oligocene Epoch?

____

____

____

44. What climatic changes affected Antarctica during the Miocene Epoch?

____

____

45. When did the largest known land mammals live?

____

46. Name three examples of predators that evolved during the Pliocene Epoch.

____

____

____

____

47. Why did the sea level fall toward the end of the Pliocene Epoch?

____

____

48. When did the Pleistocene Epoch begin?

____

49. Where were fossils of the earliest ancestors of modern humans discovered?

____

____

50. When did the Holocene Epoch begin?

____

____

51. If the entire history of Earth is pictured as occurring in one year, on what date would dinosaurs have disappeared?

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Continental Drift

1. Who obtained new information about the continents and their coastlines 400 years ago?

____

2. What did people notice when they studied new world maps 400 years ago?

____

____

WEGENER'S HYPOTHESIS

______ **3.** The German scientist Alfred Wegener proposed a hypothesis now called
- **a.** paleomagnetism.
- **b.** continental drift.
- **c.** floating continents.
- **d.** sea-floor spreading.

______ **4.** Wegener hypothesized that the continents formed part of a single land mass, or
- **a.** mid-ocean ridge.
- **b.** monocontinent.
- **c.** supercontinent.
- **d.** world land.

______ **5.** When did Wegener think that small continents began forming?
- **a.** 25 million years ago.
- **b.** 2.5 billion years ago.
- **c.** 250 million years ago.
- **d.** 2.5 million years ago.

______ **6.** Wegener speculated that over millions of years these small continents
- **a.** moved closer together.
- **b.** did not move.
- **c.** drifted to the southern hemisphere.
- **d.** drifted to their present locations.

Name ______________________ Class ______________ Date ______________

______ **7.** What did Wegener hypothesize about mountain ranges such as the Andes?
- **a.** that the crumpling of the crust in places produced them
- **b.** that volcanic eruptions created them
- **c.** that they always existed
- **d.** that the pressure of the oceans produced them

8. Why was Wegener interested in finding fossils of the same plants and animals on two different continents?

____

____

9. Where were the fossils from the extinct land reptile called *Mesosaurus* found?

____

10. Why did Wegener believe that the fossils found in South America and western Africa proved that South America and Africa had once been joined?

____

____

____

____

11. How did the ages and types of rocks found in some coastal areas of Africa and South America support Wegener's hypothesis?

____

____

12. How did the locations of mountain chains support Wegener's hypothesis?

____

____

13. Give an example of a mountain chain that seems to continue from one continent to other continents across the ocean.

____

____

____

____

____

14. What do layers of debris from ancient glaciers in southern Africa and South America indicate to geologists?

____

____

15. What evidence shows that tropical or subtropical swamps used to cover areas that now have colder climates?

____

16. How did Wegener account for differences in climate between the past and today?

____

____

17. According to Wegener, how did the continents move?

____

18. Why did scientists disagree with Wegener's theory of how the continents moved?

____

19. Why was Wegener's theory not proven in his lifetime?

____

MID-OCEAN RIDGES

______ **20.** Undersea mountain ranges with steep, narrow valleys in the center are called

a. black smokers.
b. the Mid-Atlantic Ridge.
c. mid-ocean ridges.
d. sea floor ridges.

______ **21.** Compared to sediment found farther from a ridge, sea-floor sediment closer to a ridge is

a. thicker.
b. thinner.
c. older.
d. larger.

______ **22.** Compared to rocks farther from a ridge, rocks closer to a ridge are
- **a.** larger.
- **b.** smaller.
- **c.** older.
- **d.** younger.

______ **23.** The oldest ocean rocks are
- **a.** 3.8 billion years old.
- **b.** 175 million years old.
- **c.** more than 175 million years old.
- **d.** older than rocks on land.

SEA-FLOOR SPREADING

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **24.** magma

______ **25.** paleomagnetism

______ **26.** rift

______ **27.** sea-floor spreading

a. the mechanism that causes the continents to move

b. molten rock

c. a crack in Earth's crust

d. the study of the magnetic properties of rocks

28. Describe the process of sea-floor spreading.

____

____

____

____

PALEOMAGNETISM

29. In what way is Earth like a giant magnet?

____

30. How does a compass determine direction?

____

____

____

Name ______________________ Class ______________ Date ____________

31. Explain how solidified magma comes to be magnetic.

____

____

____

32. Why do scientists think that Earth's magnetic field has not always pointed north?

____

____

33. Rocks with magnetic fields that point north have ______________________.

34. Rocks with magnetic fields that point south have ______________________.

35. What pattern did scientists discover when they placed rocks into chronological periods of normal and reverse polarity?

____

36. The pattern of normal and reverse polarity in rocks enabled scientists to create the ______________________.

37. Describe the puzzling magnetic patterns scientists found on the ocean floor.

____

____

____

38. On a map of the ocean floor, what do the magnetic patterns show?

____

____

39. What did scientists think happened to cause the magnetic patterns they found?

____

____

____

40. What did scientists do in order to assign ages to sea-floor rocks?

____

____

Name ________________ Class ________ Date ________

Directed Reading *continued*

41. Where were the youngest rocks on the sea floor?

____

42. Where were the older rocks on the sea floor?

____

43. Where does new rock form on the sea floor?

____

44. What do sea-floor rock patterns indicate about how rock forms?

____

____

45. What supports Hess's theory of sea-floor spreading?

____

____

WEGENER REDEEMED

______ **46.** Scientists have found evidence of reversal patterns in
a. rocks only on the ocean floor.
b. rocks only on land.
c. rocks on the ocean floor and on land.
d. rocks from the moon.

______ **47.** Continents move over Earth's surface
a. by plowing through the sea floor.
b. on ice sheets on the sea floor.
c. by rolling on Earth's molten core.
d. by the widening sea floor, which acts as a conveyor belt.

______ **48.** The mechanism that verifies Wegener's hypothesis of continental drift is
a. geomagnetic reversal.
b. magnetic symmetry.
c. sea-floor contracting.
d. sea-floor spreading.

Back Print

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: The Theory of Plate Tectonics

1. The theory that explains why and how continents move is called

____.

2. By what time period was evidence supporting continental drift, which led to the development of plate tectonics, developed?

____

HOW CONTINENTS MOVE

In the space provided, write the letter of the definition that best matches the term or phrase.

______ 3. oceanic crust

______ 4. continental crust

______ 5. tectonic plates

______ 6. lithosphere

______ 7. asthenosphere

a. the solid outer layer of Earth, that consists of the crust and the rigid upper part of the mantle

b. dense crust made of rock that is rich in iron and magnesium

c. blocks of Earth's shell that ride on a deformable layer of the mantle

d. solid, plastic layer of the mantle beneath the lithosphere

e. low-density crust made of rock that is rich in silica

8. What is "plastic" rock and how does it move?

____

____

9. Describe how continents and oceans are carried on tectonic plates.

____

TECTONIC PLATES

10. How many major tectonic plates have scientists identified?

____

11. Why are the boundaries of the tectonic plates not always easy to identify?

____

____

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

12. How do scientists identify plate boundaries?

____

13. A sudden movement along the boundary of a tectonic plate is a(n)

____.

14. Frequent earthquakes in a given zone are evidence that

____

15. How do volcanoes help identify the locations of plates boundaries?

____

____

16. A zone of active volcanoes that encircles the Pacific Ocean is known as the

____.

17. In addition to volcanoes, what also occurs frequently in the Pacific Ring of Fire?

____

18. What do the characteristics of the Pacific Ring of Fire indicate?

____

TYPES OF PLATE BOUNDARIES

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **19.** divergent

______ **20.** convergent

______ **21.** transform

______ **22.** mid-ocean ridge

______ **23.** subduction zone

______ **24.** fracture zone

a. boundary between tectonic plates that are sliding past each other horizontally

b. region where one plate moves under another

c. boundary between tectonic plates that are moving away from each other

d. undersea mountain range

e. short segments of a mid-ocean ridge that are connected by transform boundaries

f. the boundary between tectonic plates that are colliding

Name ______________________ Class ______________ Date ____________

25. Name three areas where plate boundaries may be located.

____

____

____

26. What happens to magma at divergent boundaries?

____

____

____

27. Describe the rock that forms when magma cools to form new oceanic lithosphere.

____

____

28. A narrow area that forms where the plates at a divergent boundary separate is called a ________________________.

29. Where are most divergent boundaries located?

____

____

30. Describe an example of a rift valley.

____

____

31. When oceanic lithosphere collides with continental lithosphere, the oceanic lithosphere is less dense than the continental lithosphere, so it sinks, or ________________________.

32. What deep-ocean feature forms at subduction zones?

____

____

33. As the oceanic plate subducts, it releases fluids into the mantle, causing magma to form and rise to the surface, forming ________________________.

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

34. What happens when two plates made of continental lithosphere collide?

____

____

35. What is an example of a large mountain range formed when two plates made of continental lithosphere collided?

____

36. What happens when two plates made of oceanic lithosphere collide?

____

____

37. What is produced from magma formed from melted mantle rock?

____

38. An example of a feature that formed when two plates made of oceanic lithosphere collided is ______________________.

39. What causes earthquakes at transform boundaries?

____

40. How are transform boundaries different from other types of boundaries?

____

41. An example of a transform boundary is the ______________________.

42. The San Andreas Fault is located between what two plates?

____

____

43. Transform boundaries that connect short segments of a mid-ocean ridge are called ______________________.

44. What is an example of a convergent boundary?

____

____

45. What is an example of a divergent boundary in the mid-Atlantic?

____

____

CAUSES OF PLATE MOTION

______ **46.** The movement of heated material due to differences in density is called
a. convection.
b. a convection cell.
c. radioactivity.
d. plate motion.

______ **47.** The cycle in which the cooler, denser water sinks and the warmer water rises to the surface to create a cycle is called
a. convection.
b. plate tectonics.
c. a convection cell.
d. boiling water.

______ **48.** Earth's mantle is heated by
a. tectonic plates.
b. core energy and radioactivity.
c. boiling water.
d. cool, dense mantle material.

______ **49.** What causes tectonic plate movement?
a. Hot material in the mantle sinks.
b. Lack of a convection cell causes plates to rise.
c. The mantle drags overlying tectonic plates along.
d. Divergent boundaries come together.

______ **50.** What happens to newer, warmer rock at a mid-ocean ridge as it cools?
a. It is elevated above nearby rock.
b. It slopes downward away from the ridge.
c. It sinks into the mantle and pulls away from the ridge.
d. It exerts force on the plate.

51. The force on the rest of the plate from the asthenosphere below cooling, sinking rock is called ______________________.

52. What happens as a result of ridge push?

____

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

53. Is ridge push the main driving force of plate motion? Along with ridge push, what did scientists study for clues to forces that drive plate motion?

____

____

____

54. What happens to magma in places where plates pull away from each other at mid-ocean ridges?

____

____

55. The force exerted by a sinking plate caused by the subduction of lithosphere into the asthenosphere is called ______________________.

56. Compared to speed of plates that are not subducting, plates that are subducting move ______________________.

57. What three forces work together to cause plate motions?

____

____

____

Back Print

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: The Changing Continents

1. What is the result of slow movements of tectonic plates?

____

____

RESHAPING EARTH'S CRUST

In the space provided, write the letter of the definition that best matches the term or phrase.

______ 2. shield

______ 3. rifting

______ 4. cratons

a. rocks that have been exposed at Earth's surface

b. large areas of stable rock older than 540 million years

c. the process by which a continent breaks apart

5. Describe continental crust.

____

6. What probably causes continental lithosphere to become thinner and weaken?

____

7. What happens when the lithosphere weakens?

____

____

8. What are two ways by which continents can change?

____

In the space provided, write the letter of the definition that best matches the term or phrase.

______ 9. terrane

______ 10. accretion

______ 11. seamount

______ 12. atoll

a. a small volcanic island or underwater mountain

b. the process by which a terrane becomes part of a continent

c. a piece of lithosphere that has a unique geologic history

d. a small coral island

Name ______________________ Class ______________ Date ____________

13. Describe the rocks and fossils of a terrane.

____

14. What is found at the boundaries of a terrane?

____

15. Describe the magnetic properties of a terrane.

____

16. What happens when a tectonic plate carrying a terrane subducts under a plate made of continental crust?

____

17. What two forms might terranes take when they become part of a continent?

____

18. Name three kinds of materials that can form terranes.

____

____

19. What often happens when large terranes and continents collide?

____

20. What is an example of a mountain chain that formed when a large terrane and a continent collided?

____

EFFECTS OF CONTINENTAL CHANGE

21. Name three factors that affect a continent's climate.

____

____

____

22. How have movements of tectonic plates affected modern climates?

____

____

23. Most of Earth's continental surfaces were once covered

by ______________________.

24. Ice covered most of Earth when all the continents were located near ______________________.

25. What caused Earth's temperatures to change and its ice sheet to melt?

____

26. What happens to populations of organisms as continents rift or as mountains form?

____

27. What is an example of a unique species that evolved on Madagascar?

____

28. Why did unique species of plants and animals evolve on Madagascar?

____

____

THE SUPERCONTINENT CYCLE

______ **29.** A picture of continental change throughout time has been constructed by
- **a.** paleontologists.
- **b.** geologists.
- **c.** geographers.
- **d.** scientists from many fields.

______ **30.** Supercontinents are
- **a.** large landmasses formed in the past from smaller continents.
- **b.** the large continents that exist today.
- **c.** pieces of large landmasses that broke apart.
- **d.** large oceans that covered Earth in the past.

______ **31.** According to the theory of the supercontinent cycle, what will probably occur in the future?
- **a.** No new supercontinents will form.
- **b.** Old supercontinents will reappear.
- **c.** Continents will stay as they are.
- **d.** A new supercontinent will form.

______ **32.** Supercontinents form when
- **a.** rifts form in the lithosphere.
- **b.** new convergent boundaries form after continents collide.
- **c.** heat builds up in Earth's interior.
- **d.** continental lithosphere subducts.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

______ **33.** What causes a supercontinent to break apart?
- **a.** Heat inside Earth causes rifts to form in the supercontinent.
- **b.** The convergent boundary between two continents becomes inactive.
- **c.** A new convergent boundary forms.
- **d.** The supercontinent cycle stops.

______ **34.** The supercontinent that formed about 300 million years ago is called
- **a.** Laurasia.
- **b.** Gondwanaland.
- **c.** Africa.
- **d.** Pangaea.

______ **35.** The body of water on the eastern edge of Pangaea was
- **a.** the Ural Sea.
- **b.** the Tethys Sea.
- **c.** the Panthalassa Ocean.
- **d.** the Russian Sea.

______ **36.** Pangaea was surrounded by
- **a.** mountains.
- **b.** seas.
- **c.** an ocean.
- **d.** other supercontinents.

______ **37.** One mountain range that formed when Pangaea was created was
- **a.** the Rocky Mountains.
- **b.** the Alps.
- **c.** the Himalayas.
- **d.** the Appalachians.

______ **38.** How were Laurasia and Gondwanaland created?
- **a.** Pangaea collided with another supercontinent.
- **b.** North America collided with Eurasia.
- **c.** Pangaea split from north to south.
- **d.** A rift split Pangaea from east to west.

______ **39.** The Tethys Sea eventually became
- **a.** the North Atlantic Ocean.
- **b.** Gondwanaland.
- **c.** the Mediterranean Sea.
- **d.** Laurasia.

40. How were South America and Africa formed?

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

41. How was the South Atlantic Ocean formed?

____

____

42. How were India, Australia, and Antarctica formed?

____

____

43. How were the Himalaya Mountains formed?

____

____

44. When did the Himalaya Mountains begin to form?

____

____

45. How did the Rocky Mountains, the Andes, and the Alps form?

____

____

46. How did tectonic plate motion affect the oceans?

____

____

47. What will happen to Africa and the Mediterranean Sea in 150 million years if plate movements continue at current rates?

____

____

48. Describe how east Africa will change if plate movements continue at current rates.

____

____

49. What will cause the Atlantic Ocean to widen over the next 150 million years?

____

____

____

50. What will happen to Australia if plate movements continue?

____

____

51. What will happen to the region west of the San Andreas Fault in 150 million years?

____

____

52. According to scientists' predictions, what will happen to the continents in 250 million years?

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: How Rock Deforms

1. What is *deformation*?

____

____

ISOSTASY

______ **2.** When the weight of part of the Earth's crust changes, what sometimes occurs?
a. isostasy
b. isolation
c. deformation
d. lithoformation

______ **3.** What is the asthenosphere?
a. Earth's crust
b. the plastic part of the mantle
c. the lithospheric plates
d. the atmosphere

______ **4.** When parts of the lithosphere thicken and become heavier, they
a. push up the atmosphere.
b. sink deeper into the asthenosphere.
c. push up the asthenosphere.
d. are thrust into the atmosphere.

______ **5.** If parts of the lithosphere thin and become lighter,
a. they push down the mantle.
b. they push up the asthenosphere.
c. they push up the atmosphere.
d. the lithosphere rises higher in the asthenosphere.

______ **6.** A condition of gravitational and buoyant equilibrium between Earth's lithosphere and asthenosphere is called
a. isostasy.
b. deformation.
c. slippage.
d. downward pressure.

Name ________________ Class ________ Date ________

7. How often do isostatic adjustments occur in mountainous regions?

____

8. What is the effect of erosion on mountains?

____

____

____

9. Describe the process called *uplift*.

____

____

____

10. Describe the process known as *subsidence*.

____

____

____

11. When glaciers and ice sheets melt, what happens to the land they covered and to the ocean floor?

____

____

STRESS

______ 12. What changes occur in rock in the Earth's crust as the lithosphere moves?
- **a.** It is liquified, solidified, and cemented.
- **b.** It is squeezed, stretched, and twisted.
- **c.** Since it is extremely hard, it keeps its shape.
- **d.** It is stressed until it breaks like glass.

______ 13. What is stress?
- **a.** the cracks caused by squeezing, stretching, and twisting
- **b.** the type of isostatic adjustment the crust makes
- **c.** the type of force exerted on each unit of area
- **d.** the amount of force exerted on each unit of area

Back Print

______ **14.** The type of stress that squeezes and shortens a body is called
a. collision.
b. tension.
c. compression.
d. convergence.

______ **15.** In addition to reducing the amount of space that rock occupies, compression
a. pushes rocks higher up or deeper down into the crust.
b. pulls rocks higher up into the crust.
c. pushes rocks deeper down into the crust.
d. transforms tectonic plates.

______ **16.** Where is one place that compression occurs?
a. where tectonic plates pull apart
b. where tectonic plates are stable
c. where tectonic plates collide
d. where tectonic plates neither pull apart or collide

______ **17.** The type of stress known as *tension*
a. squeezes a body and reduces its volume.
b. stretches and pulls a body apart.
c. forces rock together.
d. causes explosions.

______ **18.** When tension pulls rocks apart, the rocks
a. become distorted.
b. thicken.
c. take up more volume.
d. become thinner.

19. Where is one place that tension occurs?

____

____

20. What effect does *shear stress* have?

____

____

____

____

21. What happens to sheared rocks as they slide past each other?

____

____

22. Where is shear stress common?

____

____

____

STRAIN

______ **23.** What is strain?
- **a.** the result of tension on rock
- **b.** any change in shape or volume of rock caused by stress
- **c.** when rock withstands any pressure put on it without changing
- **d.** when rock breaks because of compression

______ **24.** The amount of stress rock can withstand without changing shape permanently is
- **a.** unlimited.
- **b.** nearly unlimited.
- **c.** limited.
- **d.** limited, but rarely tested.

______ **25.** Materials that break as a result of stress are said to be
- **a.** brittle.
- **b.** fragile.
- **c.** delicate.
- **d.** ductile.

______ **26.** Materials that bend or deform without breaking as a result of stress are referred to as
- **a.** brittle.
- **b.** fragile.
- **c.** delicate.
- **d.** ductile.

27. What affects whether rock is brittle or ductile?

____

28. What other two factors also affect how rock will deform?

____

____

29. In what way will rock deform at lower temperature and pressure and at higher temperature and pressure?

____

____

30. What three factors determine the type of strain that stress will cause to rocks?

____

____

____

FOLDS

______ **31.** What is a fold?
- **a.** stress that causes deformed rock
- **b.** rock that causes deformation
- **c.** a bend in rock layers that results from stress
- **d.** a ductile strain of rock

______ **32.** Rock folds are most easily observed where
- **a.** magma from volcanoes spreads downward.
- **b.** flat layers of rock were compressed inward.
- **c.** jagged layers of rock were squeezed outward.
- **d.** earthquakes flattened layers of rock.

______ **33.** Which of the following is true of folds?
- **a.** Cracks never appear and the rock layers always remain intact.
- **b.** Sometimes cracks appear, but the rock layers never remain intact.
- **c.** Cracks never appear, but usually the rock layers remain intact.
- **d.** Sometimes cracks appear, but most commonly the rock layers remain intact.

Name ________________________ Class ______________ Date ____________

34. What are two types of stress that can cause a fold?

____

____

35. What are the sloping sides of folds called, and what is the area in a fold called where limbs meet at the bend in the rock layer?

____

36. What is the term for a plane that could slice a symmetrical fold?

____

37. If a fold appears to be lying on its side, the fold is said to be ________________________.

38. Why is each fold unique?

____

____

39. To categorize a fold, what do scientists study?

____

____

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **40.** anticline

______ **41.** syncline

______ **42.** monocline

______ **43.** ridge

a. a fold in which both limbs are horizontal or almost horizontal

b. a large, narrow strip of elevated land, can occur near mountains

c. a fold in which the youngest layer is in the center, bowl shaped

d. a fold in which the oldest layer is in the center, arch shaped

44. How do monoclines form?

____

____

____

45. Sometimes, a large anticline forms a(n) ________________________.

Name ______________________ Class ____________ Date ____________

46. What type of fold may cause a valley?

____

47. What two types of folds formed the ridges and valleys of the Appalachian Mountains?

____

____

FAULTS

______ **48.** Stresses on rock close to Earth's surface, where temperatures and pressures are low, may cause the rock to

a. collapse.
b. become ductile.
c. bend.
d. break.

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **49.** fracture
______ **50.** fault
______ **51.** fault plane
______ **52.** hanging wall
______ **53.** footwall

a. the surface along which the motion occurs in a fault
b. the rock below the fault plane
c. a break along which one block slides relative to another
d. a break around which there is no movement of the surrounding rock
e. the rock above the rock plane in a nonvertical fault

54. What is a normal fault, and where does it usually form?

____

____

____

55. What kind of landforms can normal faults form?

____

____

____

Name ______________ Class ______________ Date ______________

Directed Reading *continued*

56. How does a reverse fault form?

____

____

57. What is a thrust fault?

____

____

58. Where are reverse faults and thrust faults common?

____

____

59. What does the strike of a fault describe?

____

____

____

60. What is a strike-slip fault?

____

61. What is one example of a large fault system?

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: How Mountains Form

______ **1.** How high is Mount Everest?
- **a.** about 1980 km above sea level
- **b.** more than 8 km below sea level
- **c.** more than 8 km above sea level
- **d.** more than 80 km above sea level

______ **2.** What causes Mount Everest to grow taller every year?
- **a.** forces inside the Earth
- **b.** volcanoes
- **c.** the Earth's magnetic field
- **d.** gravity

MOUNTAIN RANGES AND SYSTEMS

3. Define mountain range, and provide two examples of mountain ranges.

____

____

4. What is the term for a group of adjacent mountain ranges?

____

____

5. Which four mountain ranges make up the Appalachian mountain system?

____

____

____

____

6. What are Earth's two major mountain belts?

____

____

7. Which mountain belt forms a ring around the Pacific Ocean?

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

8. Where does the Eurasian-Melanesian mountain belt run?

____

____

PLATE TECTONICS AND MOUNTAINS

______ **9.** The major mountain belts are located along
a. divergent plate boundaries.
b. convergent plate boundaries.
c. international boundaries.
d. deep-ocean ridges.

______ **10.** What does the location of the two major mountain belts tell scientists?
a. Oceans form as a result of collision and divergence between tectonic plates.
b. Mountains do not form as a result of collisions between tectonic plates.
c. Most mountains form as a result of the divergence of tectonic plates.
d. Most mountains form as a result of collisions between tectonic plates.

______ **11.** The Appalachians are located along
a. active and previously active convergent plate boundaries.
b. active divergent plate boundaries.
c. previously active convergent plate boundaries.
d. previously active divergent plate boundaries.

______ **12.** When oceanic lithosphere and continental lithosphere collide at convergent plate boundaries, what may be formed?
a. mountains
b. huge depressions
c. oceanic trenches
d. volcanoes

______ **13.** What happens when moving plates collide at convergent plate boundaries?
a. The continental lithosphere subducts beneath the oceanic lithosphere.
b. The oceanic atmosphere subducts beneath the continental atmosphere.
c. The oceanic lithosphere subducts beneath the continental lithosphere.
d. The oceanic lithosphere subducts beneath the continental stratosphere.

______ **14.** What happens when plate collision produces large-scale deformation?
a. Oceans are created.
b. High mountains are uplifted.
c. Deep ocean trenches are created.
d. Deep valleys are created.

______ **15.** What is produced by the partial melting of the mantle and crust?
a. mountains that may subduct to form volcanic mountains on Earth's surface
b. magma that may erupt to form volcanic mountains on Earth's surface
c. ocean currents that may warm the continental lithosphere so much that volcanoes result
d. atmospheric changes that can eventually cause mountains to form

______ **16.** Which is an example of volcanic mountains formed by colliding plates that eventually produced magma and eruptions?
a. the Cascade Range
b. the Appalachians
c. Mount Sinai
d. Mount Everest

17. What are terranes?

____

____

____

18. Where do volcanic mountains commonly form?

____

____

19. What happens during the collision of two plates whose edges consist of oceanic lithosphere?

____

____

20. When the denser oceanic plate subducts, what happens?

____

____

____

Name ______________________ Class ____________ Date __________

Directed Reading *continued*

21. What islands are an example of the peaks of volcanic mountains that rose above sea level?

____

____

22. When two continents collide, what can happen?

____

____

____

23. What happened about 100 million years ago to what is now India ?

____

____

24. What happened to the oceanic lithosphere of the Indian plate when it collided with the Eurasian plate?

____

____

25. Why did the subduction of the oceanic lithosphere of the Indian plate stop when the continental lithosphere of India collided with the continental lithosphere of Eurasia, and what happened to the Himalayas?

____

____

26. Why are the Himalayas still growing taller?

____

____

____

____

TYPES OF MOUNTAINS

______ **27.** The rock formations of mountains
- **a.** are relatively uncomplicated structures.
- **b.** are just elevated parts of Earth's crust.
- **c.** provide evidence of the stresses that created the mountains.
- **d.** provide no evidence of the stresses that created the mountains.

______ **28.** Scientists classify mountains according to
- **a.** the way the crust was deformed and shaped by mountain-building stresses.
- **b.** how the crust was preserved by subduction and collision.
- **c.** the amount of loose rock that results from continental collisions.
- **d.** the location either in the oceanic lithosphere or on a continental plate.

______ **29.** What do the highest mountain ranges in the world consist of?
- **a.** ancient rock formations
- **b.** folded mountains that form when continents collide
- **c.** tectonic plates subducting under the continental lithosphere
- **d.** old mountains that form when continents diverge

______ **30.** How do folded mountains form?
- **a.** Tectonic plate movements squeeze rock layers together into accordian-like folds.
- **b.** Tectonic plate movements melt rock layers together into magma.
- **c.** The continental lithosphere squeezes rock layers together and deposits them into the oceanic lithosphere.
- **d.** Tectonic plate movements squeeze rock layers together into tight places.

______ **31.** What do the same stresses that form folded mountains also do?
- **a.** form folded valleys
- **b.** uplift rivers
- **c.** uplift plateaus
- **d.** fold rock formations

______ **32.** What are plateaus?
- **a.** small, arched areas of rock high above sea level
- **b.** large, flat areas of rock high above sea level
- **c.** large, flat areas of rock below sea level
- **d.** small, flat areas of rock below sea level

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

33. Where are most plateaus located?

____

____

34. Where is the Colorado plateau located?

____

____

35. What are fault-block mountains?

____

____

36. What mountain range consists of many fault-block mountains, and where is it located?

____

37. When do grabens form?

____

____

____

38. What is true of grabens and fault-block mountain ranges?

.____

39. What is an example in the United States of grabens separated by fault-block mountain ranges?

____

____

40. Describe a dome mountain.

____

____

____

41. What are two ways dome mountains can form?

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

42. Where in the United States are two examples of dome mountains?

____

____

43. How do volcanic mountains form?

____

____

____

44. Where do volcanic mountains usually form?

____

____

____

45. Where in the United States can an example of volcanic mountains be found?

____

____

____

46. Where are some of the world's largest volcanic mountains?

____

____

____

47. What makes mid-ocean ridges volcanically active areas?

____

____

____

48. How are volcanic islands formed? Give an example of Volcanic mountains.

____

____

____

____

49. Besides mid-ocean ridges, where else do large volcanic mountains form?

____

____

50. What are hot spots, and what happens at hot spots?

____

____

____

51. What is an example of a volcanic mountain that resulted from hot spots?

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: How and Where Earthquakes Happen

1. Define *earthquake*.

____

____

____

2. When do earthquakes usually occur?

____

____

____

3. What is a fault?

____

____

____

WHY EARTHQUAKES HAPPEN

______ **4.** Rocks along both sides of a fault are usually
- **a.** not pressed together.
- **b.** tightly pressed together.
- **c.** loosely pressed together.
- **d.** not touching.

______ **5.** What prevents rocks from moving past each other in a fault?
- **a.** stress
- **b.** energy
- **c.** friction
- **d.** weight

______ **6.** What is a fault that is in an immobilized state called?
- **a.** rocked
- **b.** locked
- **c.** faulted
- **d.** frozen

Name ______________________ Class ______________ Date ____________

______ **7.** The trembling and vibrations of an earthquake are caused when
a. the rocks become so pressed together that they shatter and release energy.
b. the friction is reduced so much that the rocks cannot move past each other.
c. the stress is reduced so much that the rocks of a fault suddenly break apart.
d. the stress becomes so great that the rocks of a fault suddenly grind past each other.

______ **8.** Geologists think that earthquakes are caused by
a. elastic deformation.
b. elastic rebound.
c. elastic compression.
d. elastic waves.

______ **9.** The sudden return of elastically deformed rock to its undeformed shape is called
a. elastic rebound.
b. elastic decompression.
c. elastic compression.
d. elastic deformation.

______ **10.** In the process of elastic rebound, rocks on each side of a fault
a. are ground down into gravel.
b. move quickly.
c. move slowly.
d. grind to a halt.

______ **11.** What happens if a fault is locked?
a. Stress in the rock decreases.
b. Rocks pull apart.
c. Rocks release energy.
d. Stress in the rock increases.

______ **12.** When rocks are stressed past the point at which they can maintain their integrity, they
a. fracture.
b. deform.
c. compress.
d. decompress.

______ **13.** After the rocks fracture, what happens?
a. They collapse and fall back to their original shape.
b. They rebound and spring back to their original shape.
c. They are ground down into gravel.
d. They release their energy and disintegrate.

Name ______________________ Class ______________ Date ______________

______ **14.** The location within Earth along a fault where the first motion of an earthquake occurs is called the
a. epicenter.
b. fault.
c. focus.
d. shadow.

15. Define *epicenter*.

____

____

____

16. About 90% of continental earthquakes have a

shallow ______________________.

17. Earthquakes that take place within 70 km of Earth's surface have

______________________ foci.

18. Earthquakes with intermediate foci occur at what depths?

____

____

19. Earthquakes with deep foci occur at what depths?

____

20. Where do earthquakes that have deep foci usually occur?

____

____

21. Why do earthquakes that usually cause the most damage have shallow foci?

____

____

SEISMIC WAVES

______ **22.** When rocks along a fault slip into new positions, they release energy in the form of vibrations called
a. tidal waves.
b. elastic waves.
c. seismic waves.
d. focus waves.

Name ______________________ Class ______________ Date ______________

______ **23.** Where do seismic waves travel?
- **a.** outward in all directions from the focus through the surrounding rock
- **b.** inward in all directions from the epicenter through the surrounding rock
- **c.** outward in all directions from Earth's core through its surface
- **d.** inward in all directions from the focus through the epicenter

______ **24.** How many types of waves do earthquakes produce?
- **a.** three
- **b.** six
- **c.** two
- **d.** 10

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **25.** body wave

______ **26.** surface wave

______ **27.** p wave

______ **28.** s wave

- **a.** a seismic wave that travels along the surface of a medium
- **b.** the fastest seismic wave; causes particles of rock to move in a back-and forth direction parallel to the direction in which the wave is traveling; can travel through solids, liquids, and gases
- **c.** the second-fastest seismic wave; causes particles of rock to move in a side-to-side direction perpendicular to the direction in which the wave is traveling; can only travel through solids
- **d.** a seismic wave that travels through the body of a medium

29. What are two other names for P waves?

____

____

30. What are two other names for S waves?

____

____

31. How do surface waves form?

____

32. What are the two types of surface waves called?

____

____

Name ______________________ Class ______________ Date ____________

33. Rock moves in what way as a result of a Love wave?

____

____

____

34. The ground moves in what way as a result of a Rayleigh wave?

____

____

____

SEISMIC WAVES AND EARTH'S INTERIOR

______ **35.** The composition of the material through which P waves and S waves travel affects
- **a.** the power and duration of the waves.
- **b.** the angle that the waves travel.
- **c.** the speed and direction of the waves.
- **d.** the intensity and composition of the waves.

______ **36.** What type of materials do P waves travel through fastest?
- **a.** materials that are not rigid and not easily compressed
- **b.** materials that are very rigid and not easily compressed
- **c.** materials that are not rigid and are easily compressed
- **d.** materials that are very rigid and are easily compressed

______ **37.** What did Croation scientist Andrija Monorovicic discover in 1909?
- **a.** The speed of seismic waves increases abruptly at about 30 km beneath the surface of continents.
- **b.** The speed of seismic waves decreases abruptly at about 30 km beneath the surface of continents.
- **c.** The speed of seismic waves increases abruptly at about 30 km above the surface of continents.
- **d.** The speed of seismic waves decreases abruptly at about 30 km beneath the surface of oceans.

38. Name the three main compositional layers of Earth.

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

39. Name the five mechanical layers of Earth.

40. Define *shadow zone.*

41. Why do shadow zones exist?

42. What happens to seismic waves as they travel through materials of differing rigidities?

43. Why don't S waves reach the S-wave shadow zone?

44. How does a P-wave shadow zone form?

Name ______________________ Class ______________ Date ____________

EARTHQUAKES AND PLATE TECTONICS

In the space provided, write the letter of the description that best matches the term or phrase.

______ **45.** tectonic plate boundaries

______ **46.** convergent plate boundaries

______ **47.** divergent plate boundaries

______ **48.** continental plate boundaries

a. a point at which two continental plates converge, diverge, or move horizontally in opposite directions

b. a point at which plates move away from each other

c. a point at which stress on rock is the greatest

d. a point at which plates move toward each other and collide

49. Why do earthquakes occur along the mid-ocean ridges?

____

____

____

FAULT ZONES

______ **50.** A fault zone is a region of

a. numerous, closely spaced faults.
b. a few, closely spaced faults.
c. Earth's core where the rocks form faults.
d. Earth's mantle where faults form.

51. Why do fault zones occur at plate boundaries?

____

____

____

52. What is the name of the fault zone that extends almost the entire length of Turkey?

____

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

53. How did the New Madrid, Missouri, earthquake differ from many other major earthquakes in terms of its location?

____

____

____

54. What was discovered in the Mississippi River region in the late 1970s?

____

____

____

55. When did a major fault zone in the North American plate form?

____

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Studying Earthquakes

______ **1.** What is the study of earthquakes and seismic waves called?
a. meteorology
b. seismology
c. zoology
d. cartography

RECORDING EARTHQUAKES

______ **2.** A seismograph is an instrument that records vibrations
a. in the ground.
b. in the atmosphere.
c. above the ground.
d. in Earth's core.

3. Name the types of motion that a modern three-component seismograph records.

____

____

____

4. How do seismographs record motion?

____

____

5. A tracing of earthquake motion that is recorded by a seismograph is called

a(n) ______________________.

6. Why are P waves the first waves to be recorded by a seismograph?

____

7. Which type of wave is the second wave to be recorded by a seismograph?

____

8. What types of waves are the slowest, and therefore the last to be recorded by a seismograph?

____

____

____

Name ______________________ Class ____________ Date ____________

LOCATING AN EARTHQUAKE

______ **9.** Scientists determine the distance to an epicenter by analyzing
a. the length of the P waves and the S waves.
b. the frequency of the P waves and the S waves.
c. the power of the P waves and the S waves.
d. the arrival times of the P waves and the S waves.

______ **10.** The longer the lag time between the arrival of the P waves and the S waves,
a. the closer the earthquake occurred.
b. the weaker the earthquake's vibrations.
c. the farther away the earthquake occurred.
d. the stronger the earthquake's vibrations.

______ **11.** Scientists consult a lag-time graph to determine how far an earthquake occurred from
a. a given seismograph station.
b. the earthquake's focus.
c. the earthquake's epicenter.
d. the equator.

______ **12.** A lag-time graph translates the difference in arrival times of the P waves and S waves into distance from the epicenter to
a. the earthquake.
b. each station.
c. each pole.
d. the equator.

______ **13.** What does a lag-time graph determine about an earthquake?
a. its focus
b. its strength
c. its start time
d. its end time

14. Before computers were widely available, how did scientists locate the epicenter of an earthquake?

____

____

____

15. On the early maps, the radius of each circle was equal to what?

____

____

Name ______________________ Class ______________ Date ____________

16. Where would the epicenter of the earthquake be found on the map?

____

____

____

EARTHQUAKE MEASUREMENT

______ **17.** Scientists who study earthquakes are interested in the amount of
- **a.** P waves and S waves in an earthquake.
- **b.** energy absorbed by an earthquake.
- **c.** energy released by an earthquake.
- **d.** electricity released by an earthquake.

In the space provided, write the letter of the description that best matches the term or phrase.

______ **18.** magnitude

______ **19.** Richter scale

______ **20.** moment magnitude

______ **21.** intensity

______ **22.** Mercalli scale

a. the amount of damage caused by an earthquake

b. the measure of earthquake strength based on the size of the area of the fault that moves, the average distance that the fault block moves, and the rigidity of the rocks in the fault zone

c. the measure of the strength of an earthquake

d. a measurement system that expresses earthquake intensity in Roman numerals and describes the effects of each intensity

e. a measurement system that bases earthquake strength on ground motion

23. Which magnitude scale was widely used for most of the 20th century?

____

24. Which magnitude scale do scientists generally prefer now?

____

25. The Richter scale and the moment magnitude scale provide similar values for what?

____

26. The moment magnitude scale is more accurate for measuring what?

____

27. What is the highest moment magnitude recorded for an earthquake so far?

____

28. What was the moment magnitude of the earthquake in Kobe, Japan, in 1995?

____

29. What is the moment magnitude of earthquakes that generally are not felt by people?

____

30. How is Intensity I described on the modified Mercalli intensity scale?

____

____

____

31. How is Intensity XII described on the modified Mercalli intensity scale?

____

____

____

32. Upon what does the intensity of an earthquake depend?

____

____

Back Print

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Earthquakes and Society

1. What causes most injuries during an earthquake?

____

____

____

____

2. Name four other dangers that result from earthquakes.

____

____

____

____

TSUNAMIS

______ **3.** A giant ocean wave that forms after a volcanic eruption, submarine earthquake, or landslide is called a
a. tsunami.
b. hurricane.
c. tornado.
d. riptide.

______ **4.** A tsumani may begin to form as a result of a sudden drop or rise in the ocean floor associated with
a. seismic gaps.
b. riptides.
c. undersea earthquakes.
d. mudslides.

______ **5.** Which of the following drops and rises with the ocean floor as it moves?
a. a tall building
b. the earthquake's epicenter
c. a large mass of sea water
d. floodwater

______ **6.** What occurs when water moves up and down as it adjusts to a change in sea level?
a. a series of long, low waves that increase in height as they near the shore
b. a series of short, high waves that increase in height as they near the shore
c. a series of long, low waves that decrease in height as they near the shore
d. a series of short, low waves that decrease in height as they near the shore

DESTRUCTION TO BUILDINGS AND PROPERTY

______ **7.** Most buildings are not designed to withstand the
a. swaying motion caused by earthquakes.
b. extreme vibrations caused by earthquakes.
c. swaying motion caused by tsunamis.
d. extreme vibrations caused by tsunamis.

______ **8.** During an earthquake, buildings with weak walls
a. will not sway.
b. may collapse completely.
c. will probably remain standing.
d. will suffer no damage.

______ **9.** What can affect the way that a building responds to seismic waves?
a. the type of heating and cooling system in the building
b. the type of ground beneath the building
c. the type of windows in the building
d. the type of plumbing in the building

10. What would a building likely to be damaged during an earthquake be built upon?

____

____

EARTHQUAKE SAFETY

______ **11.** Where could a destructive earthquake take place?
a. only in regions where tornadoes occur
b. in any region of the United States
c. only on the coastlines of large continents
d. only in regions where tsunamis occur

Name ________________________ Class ______________ Date ____________

_______ **12.** In what geographic areas in the United States are destructive earthquakes more likely to occur?
a. the Midwest
b. the East Coast
c. the South
d. California or Alaska

_______ **13.** Earthquake safety rules may help
a. prevent buildings from collapsing.
b. scientists predict earthquakes.
c. prevent death, injury, and property damage.
d. shorten the earthquake's duration.

_______ **14.** Before an earthquake occurs, people should
a. be unprepared.
b. be prepared.
c. run away as fast as they can.
d. board up their houses.

_______ **15.** Which of the following supplies are NOT necessary when preparing for an earthquake?
a. canned food and bottled water
b. flashlights and batteries
c. portable radios
d. piles of firewood

_______ **16.** Which of the following should you NOT do if an earthquake strikes?
a. stay calm
b. panic
c. protect yourself from falling debris
d. move to a safer position between tremors

17. What should you stay away from if you are indoors during an earthquake?

____

____

____

18. What should you do if you are in a car during an earthquake?

____

____

____

19. What should you check for after an earthquake?

____

____

20. What should you always avoid after an earthquake?

____

____

EARTHQUAKE WARNINGS AND FORECASTS

______ **21.** Being able to predict earthquakes accurately could
- **a.** negatively affect people's lives.
- **b.** make it impossible for people to prepare.
- **c.** increase the number of injuries and deaths.
- **d.** help prevent injuries and deaths.

______ **22.** Why do scientists study past earthquakes?
- **a.** to prevent future earthquakes
- **b.** to better understand why tsunamis occur
- **c.** to predict where future earthquakes are most likely to occur
- **d.** to change the history of earthquakes

______ **23.** The best earthquake forecasts
- **a.** are totally accurate to the day.
- **b.** may be off by several years.
- **c.** will only be off by a day or two.
- **d.** are of no real use to scientists.

______ **24.** By detecting changes in Earth's crust, scientists may be able to
- **a.** make forecasts more accurate.
- **b.** make forecasts less accurate.
- **c.** prevent future earthquakes.
- **d.** prevent future tsunamis.

______ **25.** Faults near many population centers have been
- **a.** located and mapped.
- **b.** located and destroyed.
- **c.** relocated and mapped.
- **d.** relocated and destroyed.

______ **26.** What can be measured by instruments placed along faults?
- **a.** large changes in rock movement around the faults
- **b.** small changes in epicenter movement around the faults
- **c.** small changes in rock movement around the faults
- **d.** large changes in crust movement around the faults

Name ______________________ Class ______________ Date ______________

______ **27.** What else can be detected when instruments are placed along faults?
a. a decrease in stress
b. an increase in stress
c. an increase in fault size
d. a decrease in fault size

______ **28.** Using instruments placed along faults to predict earthquakes
a. is both reliable and accurate.
b. is a useless exercise.
c. is not a method currently used.
d. can detect an increase in stress.

29. Define *seismic gap*.

____

____

____

30. What do some scientists think will occur near seismic gaps?

____

____

31. Scientists believe that future earthquakes may occur at gaps along which fault zone?

____

____

32. Some earthquakes are preceded by ______________________.

33. What is a foreshock?

____

____

34. How long before an earthquake might foreshocks occur?

____

____

35. Where and when did the only earthquake that has ever been predicted by foreshocks occur?

____

____

36. For what do scientists use a variety of sensors?

____

____

37. What happens when the cracks in rocks, caused by stress in fault zones, are filled with water?

____

____

38. What do scientists monitor in fault zones?

____

____

____

39. What do scientists hope to do with information gathered at fault zones?

____

____

40. Earthquake prediction is mostly unreliable because not all earthquakes have

______________________ or other precursors.

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Volcanoes and Plate Tectonics

______ **1.** Some volcanic eruptions can be more powerful than a(n)
- **a.** hand grenade.
- **b.** earthquake.
- **c.** geyser.
- **d.** atomic bomb.

______ **2.** The cause of many volcanic eruptions is the movement of
- **a.** Earth's mesosphere.
- **b.** Earth's inner core.
- **c.** Earth's tectonic plates.
- **d.** Earth's oceans.

______ **3.** The movement of tectonic plates is driven by Earth's
- **a.** mantle.
- **b.** internal heat.
- **c.** internal forces.
- **d.** internal pressure.

______ **4.** Scientists can learn more about volcanic eruptions by studying
- **a.** temperatures within Earth.
- **b.** temperatures in Earth's atmosphere.
- **c.** external Earth temperatures.
- **d.** the movements of migrating animals.

______ **5.** Combined temperature and pressure in the lower part of Earth's mantle keeps rocks
- **a.** at their melting point.
- **b.** below their melting point.
- **c.** from reaching their melting point.
- **d.** above their melting point.

FORMATION OF MAGMA

______ **6.** Despite high temperature, most of the mantle remains solid because of the
- **a.** large amount of ice above the mantle.
- **b.** space between the rock.
- **c.** large amount of pressure from the surrounding rock.
- **d.** lack of pressure from the surrounding rock.

______ **7.** Sometimes Earth's solid mantle and crust melt to form
a. magma.
b. mesosphere.
c. petroleum.
d. mineral elements.

______ **8.** Which of the following is NOT a way magma can form?
a. The temperature of rock rises above the melting point of the minerals the rock is composed of.
b. Excess pressure is removed from rock that is above its melting point.
c. Addition of fluids, such as water, increase the melting point of some minerals in the rock.
d. Addition of fluids, such as water, may decrease the melting point of some minerals in the rock.

VOLCANISM

______ **9.** Magma rises upward through the crust because
a. the magma is less dense than surrounding rock.
b. magma is more dense than surrounding rock.
c. magma is the same density as the surrounding rock.
d. the surrounding rock is porous.

______ **10.** As hot bodies of magma rise toward the surface and melt surrounding rock,
a. they become smaller.
b. they become larger.
c. their size remains the same.
d. they disperse.

______ **11.** As magma rises, and is forced into cracks in the surrounding rock,
a. large blocks of rock break off and melt.
b. large blocks of rock hold magma inside.
c. large rocks are broken down.
d. magma disperses.

______ **12.** Lava flows from an opening in Earth's surface called a
a. depression.
b. geyser.
c. vent.
d. blowhole.

Name ______________________ Class ______________ Date ____________

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **13.** volcanism

______ **14.** lava

______ **15.** volcano

a. a vent or fissure in Earth's surface through which magma and gases are expelled

b. any activity that includes the movement of magma toward or onto Earth's surface

c. magma that flows onto Earth's surface; the rock that forms when lava cools and solidifies

MAJOR VOLCANIC ZONES

______ **16.** Volcanoes erupt on Earth's surface
- **a.** mostly in random locations.
- **b.** in all mountainous areas.
- **c.** only along the Pacific coast.
- **d.** mostly near tectonic plate boundaries.

______ **17.** A major zone of active volcanoes encircling the Pacific Ocean is called
- **a.** the Major Pacific Earthquake Zone.
- **b.** the Pacific Ring of Volcanoes.
- **c.** the Pacific Ring of Fire.
- **d.** the Pacific tectonic plate.

______ **18.** The Pacific Ring of Fire is also one of Earth's major
- **a.** flood zones.
- **b.** hurricane zones.
- **c.** drought zones.
- **d.** earthquake zones.

______ **19.** Many volcanoes are located along
- **a.** reduction zones.
- **b.** subduction zones.
- **c.** earthquake zones.
- **d.** continental zones.

______ **20.** One tectonic plate moves under another along a(n)
- **a.** reduction zone.
- **b.** subduction zone.
- **c.** earthquake zone.
- **d.** continental zone.

Name ______________________________ Class ______________ Date ____________

______ **21.** When a plate of oceanic lithosphere meets one that consists of continental lithosphere, the oceanic lithosphere
a. moves over the continental lithosphere.
b. becomes continental lithosphere.
c. moves beneath the continental lithosphere.
d. moves through the continental lithosphere.

______ **22.** On the ocean floor, along the edge of the continent where the plate is subducted,
a. a deep trench forms.
b. a shallow trench forms.
c. a narrow trench forms.
d. a wide trench forms.

______ **23.** At subduction zones, the plate of continental lithosphere
a. buckles and folds to form a mountain on the edge of the continent.
b. buckles and folds to form a line of mountains along the edge of the continent.
c. creates a line of earthquakes along the edge of the continent.
d. creates a line of denser oceanic lithosphere.

______ **24.** As the oceanic plate sinks into the asthenosphere, water can combine with crust and mantle material
a. and increase the melting point of the rock.
b. and decrease the melting point of the rock.
c. leaving the melting point of the rock unchanged.
d. and cause rock to solidify.

______ **25.** When magma rises through the lithosphere to Earth's surface,
a. volcanic mountains form along the tectonic plate.
b. volcanic ash builds up along the tectonic plate.
c. lava creates mountains along the tectonic plate.
d. lava levels mountains along the tectonic plate.

______ **26.** When two plates with oceanic lithosphere at their boundaries collide,
a. both plates subduct, forming a trench.
b. one plate subducts, forming a trench.
c. magma never reaches the surface.
d. magma is trapped in the resulting trench.

______ **27.** If two plates with oceanic lithosphere collide,
a. magma cannot form since no additional fluids are introduced into the mantle.
b. magma forms as fluids are introduced into the mantle.
c. magma cannot reach the surface.
d. magma sinks deep into ocean trenches.

______ **28.** When oceanic lithosphere subducts beneath oceanic lithosphere, magma rises to the surface to form an
a. island chain.
b. island cone.
c. island arc.
d. island trench.

______ **29.** An example of the early stages of an island arc are the
a. Aleutian Islands.
b. Faroe Islands.
c. Channel Islands.
d. islands of Japan.

______ **30.** As island arcs become larger, they join to form one landmass, such as the islands that make up the
a. Solomon Islands.
b. Aleutian Islands.
c. Channel Islands.
d. islands of Japan.

31. Explain what happens as magma comes to the surface where plates move apart at mid-ocean ridges.

____

____

____

____

32. Why don't humans notice most volcanic eruptions that take place along mid-ocean ridges?

____

____

____

33. What is happening in Iceland, where volcanic eruptions happen along mid-ocean ridges?

____

____

____

____

Use the numbers 1 through 4 to show the sequence of volcano development in a hot spot.

______ **34.** Volcanoes form in the interior of a tectonic plate.

______ **35.** Columns of solid, hot material called mantle plumes rise and reach the lithosphere.

______ **36.** Magma rises to the surface and breaks through the overlying crust.

______ **37.** A mantle plume reaches the lithosphere, and spreads out.

38. Describe what happens to volcanic activity when the lithospheric plate above a mantle plume continues to drift.

____

____

____

____

39. Besides developing within the interior of a lithospheric plate, what is another way a hot spot may form?

____

____

____

INTRUSIVE ACTIVITY

In the space provided, write the letter of the description that best matches the term or phrase.

______ **40.** igneous rocks

______ **41.** plutons

______ **42.** dikes

______ **43.** batholiths

a. rocks that form when magma cools

b. small tubular plutons; may be only a few centimeters wide

c. large formations of igneous rock, created by magma that does not reach Earth's surface, but cools and solidifies inside the crust

d. large plutons that cover an area of at least 100 km^2 when exposed on Earth's surface

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Volcanic Eruptions

______ **1.** Lava provides an opportunity for scientists to study
- **a.** the nature of Earth's inner core.
- **b.** the nature of Earth's tectonic plates.
- **c.** temperatures within Earth.
- **d.** the nature of Earth's crust and mantle.

______ **2.** By analyzing the composition of volcanic rocks, geologists have concluded that there
- **a.** is only one general type of magma.
- **b.** are two general types of magma.
- **c.** are three general types of magma.
- **d.** are two minerals in magma.

______ **3.** Magma or igneous rock that is rich in feldspar and silica and is generally light in color is called
- **a.** felsic.
- **b.** oceanic.
- **c.** mantle.
- **d.** mafic.

______ **4.** Magma or igneous rock that is rich in magnesium and iron and is generally dark in color is called
- **a.** felsic.
- **b.** oceanic.
- **c.** mantle.
- **d.** mafic.

______ **5.** Mafic rock commonly makes up
- **a.** oceanic crust.
- **b.** continental crust.
- **c.** Earth's inner core.
- **d.** tectonic plates.

______ **6.** Felsic rock commonly makes up
- **a.** oceanic crust.
- **b.** continental crust.
- **c.** Earth's inner core.
- **d.** tectonic plates.

Name ________________________ Class ______________ Date ______________

TYPES OF ERUPTIONS

______ **7.** The force of a volcanic eruption is affected by
- **a.** magma temperature.
- **b.** the distance from the top of the volcano to its base.
- **c.** the viscosity of magma.
- **d.** the geologic age of the volcano.

______ **8.** Mafic magmas, with low viscosity and runny lava, cause
- **a.** quiet eruptions.
- **b.** explosive eruptions.
- **c.** continuous eruptions.
- **d.** most volcanic eruptions.

______ **9.** Felsic magmas, with high viscosity and sticky lava, cause
- **a.** quiet eruptions.
- **b.** explosive eruptions.
- **c.** continuous eruptions.
- **d.** most volcanic eruptions.

______ **10.** Explosive eruptions are most likely to be caused by magma with
- **a.** small amounts of dissolved gases.
- **b.** large amounts of trapped, dissolved gases.
- **c.** any amount of dissolved gases.
- **d.** small amounts of dissolved rock.

______ **11.** Oceanic volcanoes commonly form from
- **a.** mafic magma.
- **b.** felsic magma.
- **c.** mafic or felsic magma.
- **d.** solid magma.

______ **12.** Eruptions from oceanic volcanoes are usually
- **a.** quiet eruptions.
- **b.** explosive eruptions.
- **c.** continuous eruptions.
- **d.** small eruptions.

______ **13.** When mafic lava cools rapidly it
- **a.** becomes less viscous.
- **b.** becomes explosive.
- **c.** forms a crust.
- **d.** shoots pyroclastic material.

Name ______________________ Class ______________ Date ______________

14. How does pahoehoe form? Why is the word *pahoehoe* used to describe this kind of volcanic rock?

____

____

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **15.** pahoehoe

______ **16.** aa lava

______ **17.** blocky lava

a. forms jagged, sharp chunks when it cools

b. forms a smooth, ropy texture as it cools

c. breaks into large chunks at the surface while hot lava continues to flow underneath

18. What is pyroclastic material?

____

____

____

____

Use the terms from the following list to complete the sentences below. Each term may be used only once.

volcanic bombs	lapilli	volcanic ash
volcanic blocks	volcanic dust	

19. Pyroclastic particles less than 2 mm in diameter that mostly fall on the land that immediately surrounds the volcano are called ______________________.

20. Pyroclastic particles less than 0.25 mm in diameter that are so small they might travel around Earth in the upper atmosphere are called ______________________.

21. Large pyroclastic particles less than 64 mm in diameter that generally fall near the vent are called ______________________, a name taken from a Latin word meaning “little stones.”

Name ______________________ Class ______________ Date ______________

22. Large clots of lava thrown out of an erupting volcano while red-hot, that spin through the air, cool, and develop a round or spindle shape are called ______________________.

23. The largest pyroclastic particles, which form from solid rock blasted from the volcano's vent, are called ______________________.

TYPES OF VOLCANOES

In the space provided, write the letter of the description that best matches the term or phrase.

______ **24.** volcanic cone

______ **25.** crater

______ **26.** shield volcano

______ **27.** cinder cone

______ **28.** composite volcano

a. a volcanic cone that is broad at the base and has gently sloping sides

b. structure formed by lava and pyroclastic material ejected during volcanic eruptions

c. volcano with very steep slopes that are rarely more than a few hundred meters high and have angles close to 40°

d. volcano made of alternating layers of hardened lava flows and pyroclastic material

e. the funnel-shaped pit at the top of a volcanic vent

CALDERAS

29. What is a *caldera*?

____

____

____

30. What are the three steps that most often occur in the formation of a caldera?

____

____

____

31. How did the caldera on the volcanic island of Krakatau form?

____

____

____

Name ______________________ Class ____________ Date __________

32. How was Crater Lake in Oregon formed?

____

____

____

____

PREDICTING VOLCANIC ERUPTIONS

______ **33.** One of the most important warning signals of volcanic eruptions is
- **a.** a change in earthquake activity around the volcano.
- **b.** a change in air pressure around the volcano.
- **c.** a change in animal behavior around the volcano.
- **d.** increased steepness of the volcanic cone.

34. What are three causes of small earthquakes that could signal a volcanic eruption?

____

____

____

35. What happens before an eruption that may cause the surface of the volcano to bulge outward?

____

____

____

36. What are three comparisons scientists make between a volcano's past behavior and its current behavior in order to help predict an eruption?

____

____

____

37. What are two problems scientists face in using a volcano's past behavior to predict a future eruption?

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Weathering Processes

______ **1.** Most rocks deep within Earth's crust formed under extreme conditions of
- **a.** gas and water.
- **b.** change and uplift.
- **c.** temperature and pressure.
- **d.** weathering and erosion.

______ **2.** Rocks that are uplifted to the surface are exposed to what in Earth's atmosphere?
- **a.** gases and water
- **b.** radiation and pressure.
- **c.** temperature and pressure
- **d.** weathering and erosion

______ **3.** What is the change in the physical form and chemical composition of rock called?
- **a.** radiation
- **b.** erosion
- **c.** uplift
- **d.** weathering

MECHANICAL WEATHERING

______ **4.** In addition to ice and running water, common agents of mechanical weathering are
- **a.** radioactivity, animals, and humans.
- **b.** gravity, wind, and plants and animals.
- **c.** sunlight, gravity, and wind.
- **d.** erosion, gravity, and farming.

______ **5.** What can happen to rocks as plants grow?
- **a.** They attract animals that crack the rock.
- **b.** Their roots grow and expand to create pressure that wedges rocks apart.
- **c.** They pull weaker rock up to the surface.
- **d.** They attract water that freezes in cracks.

______ **6.** Over time, the digging activities of what kinds of animals can weather rock?
- **a.** birds and fishes
- **b.** climbing animals
- **c.** burrowing animals
- **d.** domesticated animals

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In the space provided, write the letter of the definition or description that best matches the term or phrase.

______ **7.** mechanical weathering

______ **8.** joints

______ **9.** exfoliation

______ **10.** ice wedging

______ **11.** abrasion

a. a process in which rock breaks into curved sheets and then peels away from the underlying rock

b. the grinding and wearing away of rock surfaces through the physical action of other rock or sand particles

c. long, curved cracks in rocks that run parallel to the surface, resulting from decreasing pressure when rock is uplifted

d. the process by which rocks break down into smaller pieces by physical means

e. weathering in which water seeps into rocks, freezes, expands, and widens existing cracks, eventually splitting rocks apart

CHEMICAL WEATHERING

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **12.** chemical weathering

______ **13.** acids

______ **14.** bases

______ **15.** oxidation

______ **16.** hydrolysis

______ **17.** leaching

______ **18.** carbonation

______ **19.** organic acids

______ **20.** acid precipitation

a. rain, sleet, or snow that contains a high concentration of acids, often due to air pollution

b. a process in which water carries dissolved minerals to lower layers of rock

c. the conversion of a compound into a carbonate, thus speeding weathering

d. the process by which rock is broken down as a result of chemical reactions with the environment

e. the process by which an element combines with oxygen

f. a chemical reaction between water and another substance to form two or more new substances

g. acids produced by lichens and mosses

h. substances that form hydroxide ions in water;

i. substances that form hydronium ions in rock;

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

21. When chemical reactions act on the mineral in rock, what substances besides water and rock are commonly involved?

____

____

22. What are hydronium ions and how do they affect minerals?

____

____

23. What are hydroxide ions and how do they affect minerals?

____

____

24. What are two things that chemical weathering changes in rock?

____

____

25. What causes the red color of much of the soil in the southeastern United States and the red color of many rocks?

____

26. Describe the process by which the common clay called kaolin is produced.

____

____

____

27. When is carbonic acid formed?

____

____

28. What happens when carbonic acid reacts with the calcite in limestone?

____

____

29. What substances do fossil fuels produce when they are burned?

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

30. How does acid precipitation form?

____

____

____

____

____

31. What kind of damage does acid precipitation do and why?

____

____

____

32. What has the U. S. government done to regulate power plant emissions?

____

____

____

33. How have power plants reduced the occurrence of acid precipitation?

____

____

____

Back Print

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Rates of Weathering

1. Describe the general time frame for mechanical and chemical weathering.

____

____

2. What is the average rate at which carbonation dissolves limestone?

____

3. At the average rate, how long would it take to dissolve a layer of limestone 150 m thick?

____

4. List three important factors that determine the rate at which rock weathers.

____

____

DIFFERENTIAL WEATHERING

5. Define differential weathering.

____

____

____

6. Explain how mechanical and chemical weathering affect igneous rock that contains quartz.

____

____

____

____

____

Name ______________________ Class ______________ Date ____________

ROCK COMPOSITION

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

silicates	weathering	sand
calcite	clay	grains
rocks	carbonation	

7. Limestone and other sedimentary rocks that contain ______________________ weather most rapidly.

8. Limestone weathers rapidly because it undergoes ______________________.

9. Other sedimentary rocks are affected mainly by mechanical ______________________.

10. The rates at which these sedimentary rocks weather depends mostly on the material that holds the sediment ______________________ together.

11. Shales that are not firmly cemented together may break up to form ______________________.

12. Conglomerates and sandstones that are strongly cemented by ______________________ resist weathering.

AMOUNT OF EXPOSURE

13. List two important factors related to exposure that determine the rate of weathering of a rock.

____

____

14. What is a rock's surface area?

____

____

15. What effect does breaking a rock into smaller pieces have on its surface area and how does this effect weathering?

____

____

____

____

Name ______________________ Class ______________ Date ____________

16. Describe the natural zones of weakness within a rock.

____

____

17. How does the water that enters cracks in rock mechanically weather those rocks?

____

____

18. How does chemical weathering affect cracked rocks?

____

____

CLIMATE

19. In general, what type of climate allows the fastest type of weathering? Explain your answer.

____

____

____

20. In what other type of climate is weathering fairly quick? Explain your answer.

____

____

____

21. Why is the rate of weathering slowest in hot, dry climates?

____

____

____

22. Explain how weathering has affected Cleopatra's Needle, both in Egypt and in New York City.

____

____

____

TOPOGRAPHY

_______ **23.** Topography, which influences the rate of weathering, is
- **a.** the fertility and flatness of the land.
- **b.** the moisture and temperature of the land.
- **c.** the elevation and slope of the land.
- **d.** the hotness and dryness of the land.

_______ **24.** Because temperatures are generally cold at high elevations, what is more common at high elevations than at low?
- **a.** ice wedging
- **b.** carbonation
- **c.** oxidation
- **d.** silicates

_______ **25.** What happens to weathered rock fragments on steep slopes?
- **a.** They are more exposed to chemical weathering.
- **b.** They become more firmly attached to the slopes.
- **c.** They are carried away by animals and humans.
- **d.** They are pulled downhill by gravity and washed out by rain.

_______ **26.** New surfaces of mountains are continually exposed to weathering as a result of
- **a.** the constant rain and winds.
- **b.** the dryness of the mountain climate.
- **c.** the removal of surface rocks.
- **d.** the actions of animals and humans.

HUMAN ACTIVITIES

27. In general, how do the human activities of mining and construction affect rocks?

____

____

28. How does mining contribute to the weathering of rock?

____

____

29. How does construction contribute to the weathering of rock?

____

____

____

Name ______________________ Class ______________ Date ____________

30. What are two recreational activities that can speed up weathering by exposing new rock surfaces?

____

____

PLANT AND ANIMAL ACTIVITIES

31. How do the roots of plants promote the weathering of rocks?

____

____

____

____

32. Describe two ways in which animals can contribute to the weathering of rocks.

____

____

____

____

Name ________________ Class ________________ Date ________________

Skills Worksheet

Directed Reading

Section: Soil

1. The layer of weathered rock fragments that covers much of Earth's surface is called ________________.

2. The solid, unweathered rock that lies beneath the top layer is called ________________.

3. A loose mixture of rock fragments and organic material that can support the growth of vegetation is called ________________.

CHARACTERISTICS OF SOIL

4. What is a soil's parent rock?

____

5. What is soil that forms and stays directly over its parent rock called?

____

6. Describe transported soil.

____

____

7. What does parent rock that is rich in feldspar or other minerals that contain aluminum weather to form?

____

8. What kinds of rocks weather to form sandy soils?

____

9. What is the color of soil generally related to?

____

10. Give two examples of soil colors and tell what each means.

____

____

Name ______________________ Class ______________ Date ______________

11. Describe the three main types of rock particles in soil.

____

____

____

SOIL PROFILE

In the space provided, writer the letter of the description that best matches the terms or phrase.

______ **12.** soil profile

______ **13.** horizon

______ **14.** the A horizon

______ **15.** humus

______ **16.** the B horizon

______ **17.** the C horizon

a. a mixture of organic materials and rock particles where most organisms that inhabit soil live

b. a vertical section of soil that shows the layers of horizons

c. a layer that consists of partially-weathered bed-rock, where the first mechanical and chemical changes happen

d. a horizontal layer of soil that can be distinguished from the layers above and below it

e. a layer that contains the minerals leached from the topsoil, clay, and, sometimes, humus

f. a dark organic material made from the decayed remains of organisms

SOIL AND CLIMATE

______ **18.** What is one of the most important factors that influences soil formation?

a. plants
b. climate
c. erosion
d. leaching

______ **19.** Heavy rainfalls and high temperatures in tropical climates support chemical weathering that creates thick soils called

a. clay.
b. laterites.
c. silt.
d. sand.

Name ______________________ Class ______________ Date ____________

______ **20** What happens to tropical topsoil as a result of heavy rains?
a. The soil in the A horizon grows thick.
b. Minerals are quickly broken down to enrich the soil.
c. The topsoil washes into the ocean.
d. Leaching of the topsoil keeps the A horizon thin.

______ **21.** In tropical climates, a thin layer of humus usually covers the B horizon because
a. organic material is continuously added to the soil.
b. thin soils develop rapidly.
c. mineral are broken down by weathering.
d. farming continuously takes place in the tropics.

______ **22.** In temperate zones, where temperatures range between cool and warm, which soil horizons reach a thickness of several meters?
a. horizons A and C
b. horizons A and B
c. horizons B and C
d. all horizons

______ **23.** What soil type forms in temperate climates that receive more than 65 cm of rain per year and contains clay, quartz, and iron compounds.
a. pedalfer
b. laterites
c. regolith
d. pedocal

______ **24.** What fertile soil type containing large amounts of calcium carbonate forms in temperate climates that receive less than 65 cm of rain per year?
a. pedalfer soil
b. laterite soil
c. regolith
d. pedocal soil

______ **25.** The soil that forms in desert and arctic climates, where mechanical and chemical weathering occur slowly,
a. is thick and fertile.
b. contains large amounts of clay and calcium carbonate.
c. is thin and has little humus.
d. contains large amounts of quartz and iron.

Name ______________________ Class ______________ Date ____________

SOIL AND TOPOGRAPHY

26. Explain how the topography of a slope affects its soil.

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27. Why is soil on the sides of mountains generally of poor quality?

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28. Describe the soil composition of lowlands that retain water.

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29. What area provides the best surface for formation of thick, fertile layers of residual soil?

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Name ______________________ Class ____________ Date ________

Skills Worksheet

Directed Reading

Section: Erosion

1. Define erosion.

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2. List the four most common agents of erosion.

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3. List three important ways by which water moves weathered rock.

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____

____

SOIL EROSION

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

wind	humus	climate
water	solution	gullying
subsoil	fertility	topsoil
air	erosion	

4. As rock weathers, it eventually becomes very fine particles that mix with humus, water, and ______________________ to form soil.

5. The natural balance of erosion and new soil formation can be upset by land use and ______________________.

6. Some farming and ranching practices increase soil ______________________.

7. An accelerated soil erosion caused by the plowing of furrows up and down slopes that allows water to run swiftly over soil, carrying away the topsoil, is called ______________________.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

8. Sheet erosion strips away parallel layers of ______________________, eventually exposing the surface of the soil beneath.

9. During dry seasons, ______________________ can remove the topsoil in clouds of dust and drifting sand, creating large storms.

10. Constant erosion reduces the ______________________ of the soil by removing the A horizon, which contains humus.

11. How do some farming and ranching practices increase soil erosion?

____

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12. Why is erosion so dangerous in some countries?

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SOIL CONSERVATION

13. How can construction projects increase the rate of erosion?

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____

14. Why is soil erosion a special concern for deserts and mountain regions?

____

____

____

15. How are land developers working to prevent erosion?

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____

16. In addition to land developers, what other group is working to preserve topsoil?

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **17.** contour plowing

______ **18.** strip-cropping

______ **19.** terracing

______ **20.** crop rotation

a. planting a field with one type of crop one year and a different type of crop the next year

b. plowing soil in curved bands that follow the shape of the land, thus preventing soil from flowing directly down slopes

c. building steplike ridges that follow the contours of a sloped field, thus slowing the downslope movement of water

d. planting crops in alternating bands, one of which is a cover crop that slows rain runoff

GRAVITY AND EROSION

______ **21.** The movement of a large mass of sediment or a section of land down a slope is called

a. gullying.
b. mass movement.
c. erosion.
d. a rockslide.

______ **22.** What is the rapid fall of rocks, ranging in size from tiny fragments to large boulders, from a steep cliff?

a. a rockfall.
b. a mudflow.
c. a landslide.
d. a slump.

______ **23.** Occurring as a result of heavy rainfall, spring thaws, volcanic eruptions, or earthquakes, the sudden fall down a steep slope of masses of loose rock combined with soil is called a

a. rockfall.
b. mudflow.
c. landslide.
d. slump.

______ **24.** What may occur in dry regions during a sudden, heavy rainfall or as a result of volcanic eruptions, with mud churning and tumbling down slopes and through valleys?

a. a rockfall.
b. a mudflow.
c. a landslide.
d. a slump.

______ **25.** What occurs along very steep slopes when saturation by water and loss of friction with underlying rock cause loose soil to slip downhill in one huge piece?
a. a rockfall.
b. a mudflow.
c. a landslide.
d. a slump.

______ **26.** The slow, downslope flow of soil saturated with water over hard or frozen layers in areas surrounding glaciers at high elevations is called
a. creep.
b. solifluction.
c. talus.
d. landslide.

______ **27.** The extremely slow downhill movement of weathered rock material, occurring when water separates rock particles and allows them to move freely, is called
a. creep.
b. solifluction.
c. talus.
d. landslide.

______ **28.** What are piles of rock fragments that accumulate at the base of a slope called?
a. creep.
b. solifluction.
c. talus.
d. landslide.

EROSION AND LANDFORMS

29. Define landform.

____

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30. What are the three major landforms shaped by weathering and erosion?

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Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

31. List three minor landforms.

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32. Describe the two opposing forces that affect all landforms.

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33. Explain what happens in the early stages in the history of a mountain.

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34. Describe what happens to a mountain later in its history.

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35. How is a peneplain formed?

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36. What is a plain?

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37. Define plateau.

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Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

38. How does a young plateau differ in shape from an older plateau?

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39. Describe the effects of weathering and erosion on plateaus in dry climates.

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40. What are *mesas?*

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41. Define butte.

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42. How does weathering and erosion affect landforms in wet climates?

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Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: The Water Cycle

1. What question has puzzled people for centuries?

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2. Once people were able to measure the amount of water that falls to Earth, what did they discover?

____

____

3. Once people had learned how much water falls to Earth, what more puzzling question remained?

____

____

MOVEMENT OF WATER ON EARTH

______ **4.** What is essential for humans and all other organisms?
- **a.** water vapor
- **b.** rivers
- **c.** water
- **d.** icecaps

______ **5.** How much of Earth's surface is covered with water?
- **a.** about a third
- **b.** about half
- **c.** more than two-thirds
- **d.** more than three-quarters

______ **6.** Where is Earth's surface water NOT found?
- **a.** in the lakes and oceans
- **b.** in groundwater
- **c.** in rivers and streams
- **d.** in the atmosphere

______ **7.** Groundwater is water that
- **a.** flows through the rock below Earth's surface.
- **b.** flows in streams and rivers on Earth's surface.
- **c.** falls to Earth as rain.
- **d.** has melted from snow and the polar icecaps.

______ **8.** In addition to streams and rivers, lakes, oceans, polar icecaps, and groundwater, where else is water found on Earth?
a. trapped in volcanoes
b. sealed inside fossils
c. in the tissues of living organisms
d. in mineral crystals

______ **9.** Water occurring as an invisible gas is called
a. water vapor.
b. water particulate.
c. water distillate.
d. water transpiration.

______ **10.** Where is water vapor found?
a. in underground streams
b. deep in the oceans
c. in the polar icecaps
d. in the atmosphere

______ **11.** Where can you find small particles of liquid water in the atmosphere?
a. in clouds and fog
b. in rivers and streams
c. in groundwater
d. in water vapor

______ **12.** What is always happening to Earth's water?
a. It is all rapidly changing from a liquid to a gas.
b. It is all slowly changing from a gas to a solid.
c. It is all rapidly changing from a liquid to a solid.
d. It is constantly changing from one form to another.

______ **13.** An example of water changing from a solid to a liquid is
a. water vapor escaping from oceans into the atmosphere.
b. water vapor falling from the sky as rain.
c. glaciers melting to form streams.
d. puddles freezing into ice.

______ **14.** What is the continuous movement of water from the atmosphere to the land and oceans and back to the atmosphere?
a. the hydrogen cycle
b. the water cycle
c. evaporation
d. condensation

______ **15.** By what process does liquid water change into water vapor?
a. evaporation
b. condensation
c. precipitation
d. respiration

______ **16.** About how much water evaporates into the atmosphere each year?
a. 5,000 km^3
b. 50,000 km^3
c. 500,000 km^3
d. 5,000,000 km^3

______ **17.** About 86% of the atmosphere's water vapor comes from
a. living organisms.
b. rivers, lakes, and streams.
c. clouds and fog.
d. the oceans.

______ **18.** What is the process by which plants release water into the atmosphere?
a. precipitation
b. transpiration
c. evaporation
d. condensation

______ **19.** Total loss of water from an area is equal to all of the water
a. that runs off in rivers and streams and is absorbed by the ground.
b. lost by precipitation and transpiration.
c. lost by evaporation and transpiration.
d. that evaporates from the soil and from streams and lakes.

______ **20.** In what part of the water cycle does water change from a gas to a liquid?
a. evaporation
b. transpiration
c. precipitation
d. condensation

______ **21.** When water vapor rises in the atmosphere, it
a. expands, cools, and condenses.
b. freezes into ice.
c. expands, warms up, and condenses.
d. compresses and heats up.

______ **22.** When water vapor cools and condenses into tiny droplets in the atmosphere, what do they form?
a. snow
b. ice
c. clouds
d. sleet

______ **23.** What is any form of water that falls to Earth's surface from the clouds?
a. condensation
b. transpiration
c. evaporation
d. precipitation

______ **24.** Which is not a form of precipitation?
a. rain
b. fog
c. sleet
d. snow

25. What percentage of all precipitation falls on Earth's oceans?

____

26. What happens to rain, snow, sleet, or hail that falls on land?

____

27. Describe what happens to all water that falls as precipitation.

____

____

____

WATER BUDGET

______ **28.** What is the continuous cycle of evapotranspiration, condensation, and precipitation?
a. runoff
b. Earth's water budget
c. the water cycle
d. the hydrogen cycle

______ **29.** Using the language of a financial statement, the "income" of Earth's water budget is
a. precipitation.
b. evaporation.
c. condensation.
d. runoff.

______ **30.** Using the language of a financial statement, the "expenses" of Earth's water budget are
a. precipitation and condensation.
b. clouds and fog.
c. condensation and freezing.
d. evapotranspiration and runoff.

______ **31.** In what way is the water budget of the whole Earth balanced?
a. The amount of evapotranspiration and runoff is less than the amount of precipitation.
b. The amount of precipitation is greater than the amount of condensation and freezing.
c. The amount of precipitation is equal to the amount of runoff and condensation.
d. The amount of precipitation is equal to the amount of evapotranspiration and runoff.

______ **32.** Which of the following factors affect the local water budget?
a. just the temperature and the amount of rainfall
b. temperature, vegetation, wind, and rainfall
c. temperature, human habitation, season of the year, and sunlight
d. vegetation, season of the year, sunlight, and day of the week

______ **33.** What occurs when precipitation exceeds evapotranspiration and runoff in an area?
a. dry soil
b. irrigation
c. moist soil and possible flooding
d. vegetation

______ **34.** What is a possible local result when evapotranspiration and runoff are greater than precipitation in an area?
a. Soil will become moist, and flooding is possible.
b. Soil will stabilize, making irrigation unnecessary.
c. Soil can become moist and wash away.
d. Soil can become dry, and irrigation may be necessary.

______ **35.** How does vegetation affect the water budget in an area?
a. Vegetation reduces runoff but increases evapotranspiration.
b. Vegetation reduces runoff and evapotranspiration.
c. Vegetation increases runoff and decreases evapotranspiration.
d. Vegetation increases runoff and evapotranspiration.

Name ______________________ Class ______________ Date ____________

______ **36.** Which of the following factors increases the rate of evapotranspiration?
a. precipitation
b. steep slopes
c. wind
d. clouds

______ **37.** The factors that affect the local water budgets worldwide vary
a. randomly.
b. geographically.
c. artificially.
d. geologically.

______ **38.** How does precipitation in a desert compare with precipitation in a tropical rain forest?
a. It is much greater.
b. It is much less.
c. It is about the same.
d. It is slightly less.

______ **39.** In most places on Earth, the local water budget also changes with
a. the phase of the moon.
b. the time of the day.
c. the days of the week.
d. the seasons.

______ **40.** How do cooler temperatures affect the rate of evapotranspiration?
a. They speed it up.
b. They slow it down.
c. They have no effect.
d. They first slow it down and then later speed it up.

______ **41.** What happens to the rate of evapotranspiration in warmer months?
a. It increases.
b. It decreases.
c. It does not change.
d. It first decreases and then increases.

______ **42.** When do streams transport more water?
a. in cooler months
b. in warmer months
c. in months with long days
d. in months with little rain

Name ______________________ Class ______________ Date ____________

______ **43.** On average, how much water does each person in the United States use each year?
a. 25,000 gal
b. 25,000 L
c. 95,000 gal
d. 95,000 L

______ **44.** Which of the following is NOT a common use of water by people in the United States?
a. bathing
b. cooling food
c. watering lawns
d. drinking

______ **45.** In addition to personal use by people, large amounts of water are also used by
a. agriculture and industry.
b. colleges and universities.
c. mining and manufacturing.
d. agriculture and water parks.

______ **46.** As the population of the United States increases, the demand for water
a. is unaffected.
b. also increases.
c. remains the same.
d. decreases.

______ **47.** What happens to about 90% of the water used by cities and industry in the United States?
a. It evaporates into the atmosphere.
b. It is completely consumed by human uses.
c. It is treated in water treatment plants and reused.
d. It is returned to rivers or to the oceans as wastewater.

______ **48.** What is a problem with some of the wastewater that people dispose of?
a. Some of it has been changed into ice.
b. Too much of it evaporates.
c. Some of it contains harmful materials.
d. Too much of it is allowed to flow away.

______ **49.** What can pollute rivers and harm plants and animals in the water?
a. toxic materials
b. ice
c. discolored materials
d. materials downstream

Name ______________________ Class ______________ Date ____________

50. Why is water conservation important to people?

____

____

51. What is water conservation?

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52. How can individuals help save water resources?

____

____

53. What can governments do to help conserve water?

____

____

54. What are antipollution laws designed to prevent?

____

____

55. In addition to conservation, what is another way of protecting the water supply?

____

56. What is desalination?

____

____

57. What are the drawbacks of desalination?

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____

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58. Explain today's best way of ensuring our supplies of fresh water.

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Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Stream Erosion

1. When does a river system begin to form?

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2. What happens when the soil in an area soaks up as much water as it can hold?

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____

3. What is a narrow ditch formed when runoff erodes rock and soil?

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4. What landscape feature can develop from a gully?

____

____

5. What processes are responsible for the formation of a valley?

____

____

PARTS OF A RIVER SYSTEM

6. What are the two parts of a river system?

____

____

____

7. What happens to a stream channel over time?

____

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

_____ **8.** tributary
_____ **9.** watershed
_____ **10.** divide
_____ **11.** channel
_____ **12.** bank
_____ **13.** bed

a. ridge or elevated area that separates watersheds
b. part of a stream channel that is below water level
c. the narrow depression that a stream follows as it flows downhill
d. a stream that flows into a lake or larger stream
e. edge of a stream channel above water level
f. the land that is drained by a river system

CHANNEL EROSION

_____ **14.** What causes river systems to change continuously?
a. precipitation
b. evapotranspiration
c. condensation
d. erosion

_____ **15.** What is the process by which channels lengthen and branch out at their upper ends, where runoff enters the streams?
a. forward erosion
b. runoff erosion
c. headward erosion
d. branch erosion

_____ **16.** What effect can erosion of the slopes in a watershed have on the river system?
a. It can make it narrower and faster.
b. It can extend a river system and add to the area of the watershed.
c. It can shrink a river system and remove area from the watershed.
d. It can make the river system wider and deeper.

_____ **17.** When a stream from one watershed is “captured” by a stream from another watershed, the process is known as
a. stream theft.
b. stream growth.
c. stream expansion.
d. stream piracy.

Name ______________________ Class ______________ Date ____________

______ **18.** What characteristic of a stream makes it able to “capture” another stream?
a. The “capturing” stream is older.
b. The “capturing” stream is longer.
c. The “capturing” stream has a higher rate of erosion.
d. The “capturing” stream begins at a higher elevation.

______ **19.** What does a stream do once it has been “captured”?
a. It develops a lower rate of erosion.
b. It soon escapes from the “capturing” river system.
c. It adds its silt to the “capturing” stream’s bed.
d. It drains into the “capturing” river system.

______ **20.** What does a stream transport as it flows downhill?
a. boulders, trees, and coal
b. soil, sand, and vegetation
c. soil, rock fragments, and minerals
d. mostly large pieces of rock

______ **21.** The materials carried by a stream are called the
a. stream baggage.
b. stream load.
c. stream channel.
d. stream bank.

______ **22.** The three forms of stream load are
a. stream load, stream bed, and stream channel.
b. suspended load, sustained load, and retained load.
c. sustained load, bed load, and dissolved load.
d. suspended load, bed load, and dissolved load.

______ **23.** Which stream load consists of particles of fine sand and silt?
a. suspended load
b. sustained load
c. bed load
d. dissolved load

______ **24.** What is meant by a stream’s rate of downstream travel?
a. load of the water
b. flow rate of the water
c. velocity of the water
d. outflow of the water

______ **25.** How does a stream’s velocity create its suspended load?
a. It prevents the particles from sinking to the stream bed.
b. It raises the temperature and makes the particles rise.
c. It pushes rocks to the side.
d. It changes water’s chemistry so that it suspends some particles.

_______ **26.** The bed load is made up of
- **a.** dissolved materials such as salt.
- **b.** larger, coarser materials such as gravel and pebbles.
- **c.** plant materials such as leaves.
- **d.** fine materials such as sand and silt.

_______ **27.** How does a stream's bed load move?
- **a.** It is carried in suspension in the water.
- **b.** It jumps and rolls along the bed of the stream.
- **c.** It is dissolved in the stream's water.
- **d.** It is pushed along the tops of the banks.

_______ **28.** Mineral matter that is transported in liquid solution is the stream's
- **a.** suspended load.
- **b.** bed load.
- **c.** dissolved load.
- **d.** mineral load.

_______ **29.** A stream's discharge is
- **a.** the total volume of water moved by a stream over a given time period.
- **b.** the total volume of water moved by a stream in its lifetime.
- **c.** the total volume of a stream's load.
- **d.** the direction in which a stream flows.

30. What is the relationship between a stream's speed, the stream's discharge, and the load the stream can carry?

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31. How does the load of a swift stream compare with the load of a slow stream?

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32. How does a stream's velocity affect its channel?

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33. What factor plays the biggest role in a stream's velocity?

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34. Describe the gradient of a stream.

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____

35. At what point is a stream's gradient generally steep?

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36. How does the gradient at a stream's headwaters affect its velocity and channel?

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37. What is the mouth of a stream?

____

38. At a stream's mouth, how does its gradient often change?

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____

39. Why does a stream's velocity and erosive power often decrease at its mouth?

____

____

40. In what way does a stream's channel change by the time it reaches the sea?

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Name ______________________ Class ______________ Date ______________

EVOLUTION OF RIVER CHANNELS

______ **41.** The erosive power of a stream decreases
- **a.** as its load, discharge, and gradient increase.
- **b.** as its load, channel, and velocity increase.
- **c.** as its load, discharge, and gradient stay the same.
- **d.** as its load, discharge, and gradient decrease.

______ **42.** What happens to a stream's channel over time?
- **a.** It becomes deeper and rockier.
- **b.** It becomes wider and deeper.
- **c.** It becomes narrower and deeper.
- **d.** It becomes wider and more shallow.

______ **43.** A stream is called a river when
- **a.** the stream becomes longer and wider.
- **b.** the stream is added to a map.
- **c.** the stream becomes faster and deeper.
- **d.** the stream joins another body of water.

______ **44.** What may develop as a river evolves?
- **a.** a deeper and faster flow
- **b.** a straighter channel
- **c.** sharp turns
- **d.** curves and bends

______ **45.** A river with many bends probably has
- **a.** a steeper gradient than a river with fewer bends.
- **b.** a heavier discharge than a river with more bends.
- **c.** a lower gradient than a river with fewer bends.
- **d.** a lower discharge than a river with fewer bends.

______ **46.** What are meanders?
- **a.** a winding pattern of wide curves in a river
- **b.** a series of waterfalls in a river
- **c.** single curves in a river
- **d.** deep cuts in a river channel

______ **47.** Meanders develop when
- **a.** a river's channel gets deeper, and its velocity decreases.
- **b.** the gradient of a river decreases, and the velocity of water decreases.
- **c.** the gradient of a river increases, and the velocity of water increases.
- **d.** a river ages and slows down.

Name ______________________ Class ______________ Date ______________

______ **48.** When the velocity of water decreases,
a. a river cuts a deeper channel.
b. a river is more likely to erode down into its bed.
c. a river is less able to erode down into its bed.
d. a river is less able to erode its banks.

______ **49.** As a river's water velocity slows and it flows through its channel, what happens?
a. More energy is directed against the river's banks, causing greater erosion of the banks.
b. More energy is directed against the river's banks, causing less erosion of the banks.
c. Less energy is directed against the river's banks, causing greater erosion of the banks.
d. Less energy is directed against the river's banks, causing less erosion of the banks.

______ **50.** What happens on the outside of a curve as a river rounds a bend?
a. The velocity of water decreases, and the outside of the curve erodes less.
b. The velocity of water increases, and the outside of the curve erodes more.
c. The velocity of water decreases, and the outside of the curve erodes more.
d. The velocity of water decreases, and the outside of the curve erodes more.

______ **51.** What happens to the velocity of water on the inside of a curve as a river rounds a bend?
a. It increases.
b. It stays the same as on the outside of the curve.
c. It decreases.
d. It is unchanged.

______ **52.** What effect does the change in water velocity on the inside of a river's bend have?
a. The channel erodes more rapidly.
b. A bar of deposited sediment forms.
c. The inside bank becomes wider and lower.
d. The bend begins to straighten out.

Name ______________________ Class ______________ Date ______________

______ **53.** Why does sediment build up where it does in the bend of a river?

a. Because water is moving more slowly inside the bend, more sediment settles out of the stream.
b. Because water is blocked by the inside of the bend, sediment cannot continue to flow downstream.
c. Because water is moving more slowly outside the bend, sediment deposits on the inside of the curve.
d. Because the inside of the bend erodes more rapidly, it makes room for more sediment.

______ **54.** In what way does a curve in a stream become larger?

a. Erosion shrinks the inside of a curve while further sediment is deposited on the opposite bank, where the water is moving more slowly.
b. Erosion enlarges the outside of the curve, and further sediment is deposited where the curve has become wider.
c. Erosion shrinks the outside of the curve where water is moving more quickly, while further sediment is washed away.
d. Erosion enlarges the outside of the curve while further sediment is deposited on the opposite bank, where the water is moving more slowly.

55. How can an oxbow lake form?

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____

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56. How many channels do most rivers have?

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57. How do some rivers end up with multiple channels?

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____

____

58. What is a braided stream?

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____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

59. What is it about a stream's sediment load that causes it to be a braided stream?

____

____

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60. Compare a braided stream with a meandering stream.

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61. How does the channel of a braided stream change?

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62. What could cause a single river to change from a braided stream to a meandering stream?

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Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Stream Deposition

1. When is the total load that a stream can carry greatest?

____

____

2. What decreases a stream's ability to carry its load?

____

____

____

3. What happens when the velocity of water in a stream decreases?

____

____

DELTAS AND ALLUVIAL FANS

______ **4.** Where can a stream deposit sediment?
- **a.** only in water
- **b.** only on land
- **c.** on land or in water
- **d.** only in the ocean

______ **5.** The load carried by a stream may be deposited when
- **a.** the stream reaches an ocean or lake.
- **b.** the stream's banks erode.
- **c.** the stream is "captured."
- **d.** the stream dries up.

______ **6.** What happens when a stream empties into a large body of water?
- **a.** The stream comes to a sudden stop.
- **b.** The stream's velocity can increase or decrease.
- **c.** The stream's velocity increases sharply.
- **d.** The stream's velocity decreases sharply.

______ **7.** In what shape is a stream's load usually deposited at its mouth?
- **a.** rectangle
- **b.** square
- **c.** triangle
- **d.** circle

Name ______________________ Class ______________ Date ____________

______ **8.** What is a delta?
- **a.** a triangular-shaped deposit of sediment formed at the bends of rivers
- **b.** a triangular-shaped deposit of sediment where the mouth of a stream enters a larger body of water
- **c.** a deposit of sediment with multiple channels in a braided stream
- **d.** a pyramid-shaped deposit of sediment that may form at any point in a stream

______ **9.** How is the exact shape of a delta determined?
- **a.** by waves, tides, offshore depths, and a stream's sediment load
- **b.** by the amount of sediment carried by a stream
- **c.** by winds, rainfall, climate zone, and a stream's sediment load
- **d.** by construction of human structures on a stream's banks

______ **10.** Which of the following results in a decrease in a stream's speed?
- **a.** when a stream leaves a plateau and descends a steep slope
- **b.** when a stream descends a steep slope and reaches a flat plain
- **c.** when a stream moves from a slope into rocky terrain
- **d.** when a stream ascends a steep slope and reaches a plateau

______ **11.** What happens when a stream descends a slope and enters a flat plain?
- **a.** The stream cuts a new channel higher on the slope.
- **b.** The stream deposits its load on the side of the slope.
- **c.** The stream forms a meander at the base of the slope.
- **d.** The stream deposits some of its load at the base of the slope.

12. Describe an alluvial fan.

____

____

____

13. In which direction does an alluvial fan's tip point?

____

____

14. Where do alluvial fans commonly form?

____

____

15. What kinds of streams commonly form alluvial fans?

____

____

Name ______________________ Class ______________ Date ______________

16. How do alluvial fans differ from deltas?

____

____

____

FLOODPLAINS

Use terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

floodplain	banks	delta
flood	channel	natural levee
velocity	rainfall	

17. The volume of water in nearly all streams varies depending on the amount of ______________________ and snowmelt in the watershed.

18. When the volume of water in a stream increases dramatically, it can overflow its ______________________ and wash over the valley floor.

19. The area along a river that forms from sediments deposited when a river floods is called a ______________________.

20. A stream loses ______________________ when it overflows its banks and spreads out over its floodplain.

21. When a stream overflows, it deposits its coarser sediments along the banks of the channel, which eventually produces a ______________________.

22. Why does all of the load deposited by a stream in a flood not form levees?

____

____

____

____

23. What is the effect of a series of floods on a stream's floodplain?

____

____

____

Name ______________________ Class ______________ Date ____________

24. Why are swampy areas common on floodplains?

____

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____

25. Why do people choose to live in floodplains, despite the risk of flooding and the sometimes swampy soil?

____

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____

HUMAN IMPACTS ON FLOODING

_______ **26.** Which of the following contributes to the size and number of floods in many areas?
- **a.** sunspot activity
- **b.** human activity
- **c.** cloud cover
- **d.** animal activity

_______ **27.** How does vegetation protect the ground surface from erosion?
- **a.** It takes up water that would otherwise run off.
- **b.** It changes the direction water flows.
- **c.** It prevents water from reaching the ground.
- **d.** It dries the soil quickly so it can hold more water.

_______ **28.** What happens when people remove much of the ground cover in an area?
- **a.** Water evaporates more slowly, and the likelihood of flooding increases.
- **b.** Water is absorbed more quickly, and the likelihood of flooding decreases.
- **c.** Water flows more slowly across the surface, and the likelihood of flooding decreases.
- **d.** Water flows more freely across the surface, and the likelihood of flooding increases.

Name ______________________ Class ______________ Date ______________

______ **29.** What are two examples of human activities that can increase the volume and speed of runoff?
a. logging and building dams
b. clearing land and planting trees
c. logging and clearing land
d. digging shipping channels and harbors

______ **30.** What kind of natural event can increase the likelihood of flooding?
a. a forest fire that removes vegetation
b. a population explosion among one kind of animal
c. an increased growth of plants
d. a tornado that blows down trees

FLOOD CONTROL

In the space provided, write the letter of the description that best matches the term or phrase.

______ **31.** forest and soil conservation

______ **32.** dams

______ **33.** artificial levees

______ **34.** floodways

a. flood-control method that requires protection against erosion

b. indirect methods of flood control that prevent excess runoff during heavy rainfall

c. structures behind which artificial lakes act as reservoirs for excess runoff

d. permanent overflow channels that carry away excess water

35. What can the stored water behind a dam be used for?

____

____

36. What is one concern with artificial levees?

____

____

37. What can happen if a river erodes an artificial levee?

____

____

38. How do floodways help prevent flooding?

____

____

THE LIFE CYCLE OF LAKES

______ **39.** When a stream flows into a depression in the land instead of flowing to the ocean,
- **a.** a delta forms.
- **b.** a lake forms.
- **c.** a new stream forms.
- **d.** a braided stream forms.

______ **40.** Where are most lakes found?
- **a.** at high latitudes and in mountainous areas
- **b.** at sea level throughout the world
- **c.** below sea level throughout the world
- **d.** in river valleys

______ **41.** Most of the water in lakes comes from
- **a.** dams built by humans.
- **b.** canals built by humans.
- **c.** precipitation and melting ice and snow.
- **d.** precipitation and fog.

______ **42.** Other sources of water in lakes are
- **a.** springs, rivers, and runoff coming from the land.
- **b.** icebergs and glaciers.
- **c.** pumping stations along rivers.
- **d.** seasonal monsoons.

______ **43.** In geologic terms, for how long do most lakes exist?
- **a.** a long time
- **b.** a short time
- **c.** an unknown amount of time
- **d.** a human lifetime

______ **44.** Many lakes eventually disappear because
- **a.** people drain away their water for agriculture.
- **b.** amounts of precipitation suddenly fall.
- **c.** the rivers or streams that feed into them dry up.
- **d.** too much of their water drains away or evaporates.

______ **45.** What commonly causes a lake's water to drain away?
- **a.** Animals drink too much of it.
- **b.** People dig a canal below the level of the lake basin.
- **c.** An outflowing stream forms above the level of the lake basin.
- **d.** An outflowing stream erodes its bed below the level of the lake basin.

______ **46.** What is another way a lake can lose water?
a. If the climate becomes drier, evaporation may exceed precipitation.
b. If people use the lake's water, water use may exceed precipitation.
c. If vegetation grows around the lake, not enough runoff enters the lake.
d. If the climate becomes wetter, too much precipitation may cause the lake to overflow.

______ **47.** How else might a lake basin disappear?
a. It can turn into a river.
b. Rainfall can suddenly stop altogether.
c. It can freeze solid.
d. It can fill with sediment.

______ **48.** Where do sediments that build up in a lake come from?
a. from streams that feed the lake and sediments that are dumped into the lake by people
b. from people who dump them and from plants
c. from streams that feed the lake and from water that runs off the land directly into the lake
d. from streams that feed the lake and are trapped by dams

______ **49.** What happens as sediments build up in a lake over time?
a. Large banks develop on the sides of the lake, new water cannot enter the lake, and the lake dries up.
b. New shorelines are created by the sediments, and the sediments gradually fill the lake.
c. New shorelines are created by the sediments, blocking streams from entering the lake.
d. New shorelines develop, the lake becomes narrower, and it eventually turns into a river.

______ **50.** What effect can vegetation have in a shallow lake?
a. Organic deposits can pollute the lake's water.
b. Vegetation can use up all the water.
c. Organic deposits may accumulate in the bottom.
d. Vegetation can block the streams feeding the lake.

______ **51.** As organic deposits from vegetation grow denser on the bottom of a shallow lake, what can happen?
a. More vegetation grows.
b. Water can no longer enter the lake.
c. Coal forms.
d. A bog or swamp may form.

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Water Beneath the Surface

1. When water seeps underground, it fills ______________________ between rock particles.

2. The water below Earth's surface is called ______________________.

3. Groundwater is an important source of ______________________ in the United States.

PROPERTIES OF AQUIFERS

4. What is an aquifer?

____

____

____

5. The percentage of the total volume of rock or sediment that consists of open spaces is called ______________________.

6. The amount of uniformity in the size of rock or sediment particles is called ______________________.

7. How do well-sorted and poorly sorted sediment differ in terms of their particle size?

____

____

____

8. Loosely packed particles of rock have many open spaces, which results in ______________________ porosity.

9. Rock with tightly packed particles contains few open spaces, so it has ______________________ porosity.

10. In addition to sorting and particle packing, ______________________ also affects porosity.

11. Generally, the more irregular the grain shape, the more ______________________ the rock or sediment.

12. The ability of a rock or sediment to let fluids pass through its open pores, or spaces, is called ______________________.

13. For a rock to be permeable, the open spaces must be ______________________.

14. Sandstone is one of the most ______________________ rocks.

15. Because clay is composed of flat, fine-grained particles, it is ______________________.

ZONES OF AQUIFERS

16. What pulls water down through rock and soil layers until it reaches a layer of impermeable rock?

____

____

17. Define *zone of saturation.*

____

18. What does the term *saturation* mean?

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **19.** water table

______ **20.** capillary action

______ **21.** capillary fringe

______ **22.** zone of aeration

a. the attraction of water molecules to other materials

b. the upper surface of the zone of saturation

c. the area in which water is drawn from the zone of saturation

d. area between the water table and Earth's surface

23. How many regions does the zone of aeration have?

____

____

____

Name ______________________ Class ______________ Date ____________

MOVEMENT OF GROUNDWATER

24. Upon what does the rate at which groundwater moves horizontally depend?

____

____

25. Define *gradient*.

____

____

26. The velocity of groundwater increases as the water table's gradient ______________________.

TOPOGRAPHY AND THE WATER TABLE

27. The water table generally mirrors the surface ______________________.

28. List four factors that affect the depth of a water table.

____

____

____

____

29. What happens to water tables during times of prolonged rainfall?

____

____

30. What happens to water tables during times of drought?

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____

31. How many water tables do most areas of Earth have?

____

____

32. What is a perched water table?

____

____

Name ______________________ Class ______________ Date ____________

CONSERVING GROUNDWATER

33. In many communities, the only source of fresh water

is ________________________.

34. How long might it take for the water level in an aquifer to renew itself?

____

35. List three ways that a community might regulate the use of groundwater.

____

____

____

36. What is a recharge zone?

____

____

37. Why are recharge zones environmentally sensitive areas?

____

38. Name four ways that pollution can reach an aquifer.

____

____

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WELLS AND SPRINGS

______ **39.** A hole that is drilled to below the level of the water table and through which groundwater is brought to Earth's surface is called a(n)

a. well.
b. spring.
c. ditch.
d. artesian.

______ **40.** A natural flow of groundwater to the surface where the water table meets Earth's surface is called a(n)

a. well.
b. spring.
c. hole.
d. artesian.

Name ______________________ Class ______________ Date ______________

______ **41.** Ordinary wells work only if they penetrate
a. highly permeable sediment or rock.
b. the water table.
c. impermeable rock.
d. groundwater.

______ **42.** Pumping water from a well lowers the water table around the well and forms a(n)
a. ordinary well.
b. cone of depression.
c. ordinary spring.
d. drought.

______ **43.** If too much water is pumped from a well, what might happen as a result?
a. Nothing will happen.
b. The well and surrounding wells might go dry.
c. The well will refill.
d. A spring will form.

______ **44.** Which of the following formations are usually found in rugged terrain where the ground surface drops below the water table?
a. cones of depression
b. ordinary springs
c. ordinary wells
d. perched water tables

______ **45.** When might an ordinary spring go dry?
a. when a nearby well goes dry
b. during the rainy season
c. during dry seasons or severe droughts
d. during periods of high winds

______ **46.** An extensive aquifer through which water travels to a distant location may become part of a(n)
a. ordinary well.
b. ordinary spring.
c. water table.
d. artesian formation.

______ **47.** An artesian formation is a(n)
a. sloping layer of permeable rock between two layers of impermeable rock.
b. aquifer at a recharge zone.
c. artesian well.
d. artesian spring.

______ **48.** In an artesian formation, the top layer of impermeable rock is called the
a. artesian well.
b. aquifer.
c. recharge zone.
d. caprock.

49. When water enters the aquifer through the recharge zone of an artesian formation, the weight of the overlaying water causes the pressure in the aquifer to ______________.

50. Water can flow freely through a(n) ______________ without being pumped.

51. When cracks occur naturally in the caprock, water from an aquifer flows through the cracks, forming a(n) ______________.

HOT SPRINGS

52. Groundwater is heated when it passes through rock that has been heated by ______________.

53. Groundwater that has been heated to at least 37°C and then rises to the surface of Earth before cooling produces a(n) ______________.

54. Mineral deposits around a hot spring create step-like terraces of calcite called______________.

55. When chemically weathered rock mixes with hot water from the spring, it forms a sticky, liquid clay called a(n) ______________.

56. Mud pots that are brightly colored by minerals or organic materials are called ______________.

GEYSERS

57. What is a geyser?

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Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

58. What happens when the water in a geyser vent begins to boil?

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59. How long will a geyser eruption continue?

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60. What happens after a geyser erupts?

____

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Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Groundwater and Chemical Weathering

1. Water that is high in dissolved minerals such as calcium, magnesium, and iron is called ______________________.

2. Water that is relatively low in concentrations of dissolved minerals is called ______________________.

3. Water that is high in dissolved minerals tends to have a ______________________ taste, so many people do not like to drink it.

4. Some people think that using ______________________ is unappealing because household appliances or fixtures might be damaged by the buildup of mineral deposits.

RESULTS OF WEATHERING BY GROUNDWATER

5. How does chemical weathering work to dissolve minerals in rock?

____

____

____

6. Define the word *cavern*.

____

____

____

7. How does a cavern form?

____

____

____

8. What is one example of a large limestone cavern in the United States?

____

____

____

Back Print

In the space provided, write the letter of the description that best matches the term or phrase.

______ **9.** stalactite

______ **10.** stalagmite

______ **11.** column

a. created when upward- and downward-forming calcite deposits meet

b. created when calcite builds to form an upward-pointing cone

c. created when calcite drips form a cone- shaped deposit on a cavern ceiling

12. Define the word *sinkhole*.

____

____

13. A depression that forms when rock dissolves and overlying sediments settle into cracks in the rock is called a(n) ______________________ sinkhole.

14. Why do collapse sinkholes sometimes develop during dry periods?

____

____

15. Explain how natural bridges are formed.

____

____

____

KARST TOPOGRAPHY

16. Define *karst topography*.

____

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17. What are the common features of karst topography?

____

____

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18. In which five regions of the United States can karst topography be found?

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____

____

19. Karst topography usually forms in regions with ____________________ weather.

20. Formations made of ____________________ are usually found in karst topography.

21. In karst regions, as the plentiful groundwater dissolves the limestone, cracks in the rocks enlarge to form ____________________.

22. In dry regions, karst topography is the result of many ____________________ forming close to each other.

23. Karst topography in dry regions is characterized by ____________________ and ____________________.

24. Karst topography in dry regions might point to a climate that is becoming ____________________.

Back Print

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Glaciers: Moving Ice

1. What is a glacier?

____

____

____

FORMATION OF GLACIERS

______ **2.** An almost motionless mass of permanent snow and ice is called a
- **a.** glacier.
- **b.** snowfield.
- **c.** snowline.
- **d.** snowball.

______ **3.** How do snowfields form?
- **a.** Wind blows snow into drifts.
- **b.** Snow melts into ice in sunlight.
- **c.** Overlying layers flatten ice grains.
- **d.** Ice and snow accumulate above the snowline.

______ **4.** The elevation above which snow and ice remain throughout the year is called the
- **a.** glacier.
- **b.** snowfield.
- **c.** snowline.
- **d.** air.

______ **5.** How can snow accumulate year after year at high elevations and in polar regions?
- **a.** It is very dry at high elevations and in polar regions.
- **b.** There is little wind to blow the fallen snow away.
- **c.** Very little rain falls, so the snow does not melt and run off.
- **d.** The average temperature is near or below the freezing point of water.

______ **6.** Cycles of partial melting and refreezing cause snow to change into grainy ice called
- **a.** firn.
- **b.** drizzle.
- **c.** hail.
- **d.** rain.

______ **7.** What forces air out from between the ice grains in deep layers of snow and firn?
a. more snowfall
b. melting ice
c. constant wind
d. pressure from overlying snow layers

______ **8.** Which of the following causes a glacier to move downslope or outward?
a. its own weight
b. underlying ice
c. a stream of melted ice
d. heat from the sun

______ **9.** The size of a glacier depends on
a. the amount of ice added and the amount of snow blown away.
b. the amount of snow received and the amount of ice lost.
c. the amount of ice received and the amount of snow lost.
d. the amount of snow received and the amount of ice added.

10. Under what conditions does a glacier get smaller?

____

____

____

11. Explain how changes in the size of a glacier may indicate climatic change.

____

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____

TYPES OF GLACIERS

12. A glacier that forms in a mountainous region is called

a(n) ______________________ glacier.

13. Why are alpine glaciers confined to small areas?

____

____

____

Name ______________________ Class ______________ Date ______________

14. Name five regions in the world where alpine glaciers are found.

____

____

____

____

____

15. Massive sheets of ice that may cover millions of square kilometers are called

______________________ glaciers.

16. Another name for a continental glacier is a(n) ______________________.

17. In which two regions of the world do continental glaciers exist?

____

____

18. The maximum thickness of the Antarctic ice sheet is more than

______________________ in some places.

19. If the Antarctic and Greenland ice sheets melted, the water they contain would raise the sea level worldwide by more than ______________________.

MOVEMENT OF GLACIERS

______ **20.** What causes glaciers to flow downward?
- **a.** melting
- **b.** gravity
- **c.** wind
- **d.** snowfall

______ **21.** By how many processes do glaciers move?
- **a.** one
- **b.** two
- **c.** three
- **d.** four

______ **22.** The process that causes a glacier's base to melt and the glacier to slide is called
- **a.** glacial flow.
- **b.** ice sheeting.
- **c.** basal slip.
- **d.** glacial impact.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

______ **23.** In the process of basal slip, the glacier moves
a. after ice particles change shape and slide past one another.
b. after temperatures drop below freezing.
c. by sliding over a thin layer of water and sediment.
d. when wind pushes the ice downhill.

______ **24.** A glacier that moves by basal slip can work its way over small barriers by
a. melting and refreezing.
b. moving more slowly.
c. moving more quickly.
d. touching the ground.

25. Explain the process of *internal plastic flow.*

____

____

____

____

26. Name three factors that determine the rate at which ice flows at a given point.

____

____

____

27. Why do the edges of a glacier move more slowly than its center?

____

____

____

____

FEATURES OF GLACIERS

In the space provided, write the letter of the description that best matches the term or phrase.

______ **28.** crevasse
______ **29.** ice shelf
______ **30.** iceberg

a. large block of ice that breaks from an ice shelf
b. part of an ice sheet that moves out over the ocean
c. large crack on the surface of a glacier

Name ______________________ Class ____________ Date ____________

Directed Reading *continued*

31. Why does the ice on the surface of a glacier remain brittle?

____

32. How does a crevasse form on the surface of a glacier?

____

33. A crevasse on the surface of a glacier can be as deep

as ______________________.

34. In which direction do continental glaciers move?

____

35. Rising and falling tides can cause a(n) ______________________ to break off of an ice shelf.

36. Why do icebergs pose a hazard for ships?

____

____

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Glacial Erosion and Deposition

1. Name three examples of landforms created by glaciers.

____

____

____

2. Glaciers create landforms through which two processes?

____

GLACIAL EROSION

______ **3.** In what way are glaciers similar to rivers?
- **a.** Both are a result of rain.
- **b.** Both are agents of erosion.
- **c.** Both move only downhill.
- **d.** Both begin only high in mountains.

______ **4.** Why would landforms that result from glacial action differ from those formed by rivers?
- **a.** There is no real difference because both rivers and glaciers contain water.
- **b.** Glaciers move very slowly and do not affect landforms as much as rivers.
- **c.** Rivers flow so quickly that they have little effect on rock but a major effect on soil.
- **d.** Because of the size and density of glaciers, the landforms that result are different than those formed by rivers.

______ **5.** When rocks dragged by a glacier cause parallel grooves in bedrock, the grooves show
- **a.** that the rocks were harder than the bedrock.
- **b.** that the rocks were carried in a stream inside the glacier.
- **c.** the direction of the glacier's movement.
- **d.** how far the glacier moved in a day.

______ **6.** Glacial processes that shape mountains begin
- **a.** at the top of the valley where an alpine glacier forms.
- **b.** at the base of the valley where an alpine glacier moves.
- **c.** on the sides of the valley where an alpine glacier moves.
- **d.** at the leading edge of an alpine glacier in a valley.

Name ______________________ Class ______________ Date ______________

______ **7.** Rock fragments that become embedded in a glacier's ice as it moves down a river valley range in size from
a. microscopic particles to pebbles.
b. pebbles to large rocks.
c. large rocks to large boulders.
d. microscopic particles to large boulders.

______ **8.** Which of the following do NOT form when rock particles become embedded in a moving glacier?
a. deep grooves in bedrock
b. hanging valleys
c. polished rock surfaces
d. round, large rock projections

9. What happens to the walls of a V-shaped river valley as a glacier moves through it?

____

____

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **10.** cirque

______ **11.** arête

______ **12.** horn

______ **13.** roches moutonées

a. sharp, jagged ridge
b. rounded knobs of rock
c. bowl-shaped depression
d. sharp, pyramid-like peak

14. Explain how a cirque, an arête, and a horn are formed.

____

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Name ______________________ Class ______________ Date ______________

15. When a rock projection has been rounded by a glacier, which side is smooth and gently sloping?

____

____

____

____

____

16. Why is one side of a rock projection that has been rounded by a glacier steep and jagged?

____

____

17. What does *roches moutonées* mean in French?

____

____

18. Explain the process by which a V-shaped valley becomes a U-shaped valley.

____

____

19. The only way a U-shaped valley can form is through the process of glacial ______________________.

20. How does a hanging valley form?

____

____

____

____

____

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Name ______________________ Class ______________ Date ____________

21. How do landforms created by alpine glaciers differ from landforms created by continental glaciers?

____

____

____

____

____

GLACIAL DEPOSITION

22. When does glacial deposition occur?

____

23. Under what conditions will a glacier melt?

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **24.** stratified drift

______ **25.** erratic

______ **26.** glacial drift

______ **27.** till

a. large rock carried by a glacier from a distant source

b. unsorted glacial sediments that have been deposited

c. term used to describe all glacial sediments

d. glacial sediments that have been sorted and deposited

28. Why is the composition of an erratic usually different from that of the bed-rock over which it lies?

____

29. Stratified drift is sorted and deposited in layers by streams flowing from the ______________________.

30. Landforms that result when a glacier deposits till are called ______________________.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

31. What is the typical shape of a lateral moraine?

____

____

32. How does a medial moraine form?

____

____

____

33. Unsorted material left beneath a glacier when the ice melts is called ______________________.

34. What is the soil of a ground moraine usually like?

____

____

____

35. What are drumlins?

____

____

____

36. What do clusters of drumlins reveal about a glacier?

____

____

37. Where are terminal moraines located?

____

____

38. In the Midwest, where are many large terminal moraines found?

____

____

39. Where does meltwater come from, and what does it carry?

____

____

40. Why does glacial meltwater sometimes have beautiful colors?

____

____

41. A deposit of stratified drift that lies in front of a terminal moraine and is crossed by many meltwater streams is called a(n) ______________________.

42. How does a kettle form?

____

____

____

____

43. A long, winding ridge of gravel and coarse sand deposited by glacial meltwater streams is called a(n) ______________________.

GLACIAL LAKES

______ **44.** When glaciers erode surfaces and leave depressions in bedrock,
- **a.** mountains rise up.
- **b.** new rivers flow.
- **c.** lake basins usually form.
- **d.** moraines are left.

______ **45.** Lake basins form as a result of
- **a.** both glacial erosion or glacial deposition.
- **b.** only glacial deposition.
- **c.** only glacial erosion.
- **d.** neither glacial erosion nor glacial deposition.

______ **46.** Long, narrow lakes that form where terminal and lateral moraines block streams are called
- **a.** deep lakes.
- **b.** cold lakes.
- **c.** northern lakes.
- **d.** finger lakes.

______ **47.** Evidence of all kinds of glacial lakes can be seen in
- **a.** Illinois.
- **b.** Iowa.
- **c.** Minnesota.
- **d.** Ohio.

Name ______________________ Class ______________ Date ____________

______ **48.** Many large lakes that formed during the last glacial advance lost their outlet streams because
- **a.** glaciers no longer provided meltwater.
- **b.** climate changes occurred.
- **c.** snow no longer fell much.
- **d.** moraines blocked rivers.

______ **49.** In a lake without outlet streams, water leaves only by
- **a.** deposition.
- **b.** sedimentation.
- **c.** evaporation.
- **d.** precipitation.

______ **50.** In a salt lake, the lake becomes increasingly salty when water evaporates and
- **a.** dissolved salt is left behind.
- **b.** the lake becomes more polluted.
- **c.** there is additional rainfall.
- **d.** the lake level gets higher.

______ **51.** Salt lakes commonly form in
- **a.** wet climates where evaporation is slow and precipitation is high.
- **b.** cold climates where the lakes often freeze.
- **c.** cool, moist climates where precipitation is high.
- **d.** dry climates where evaporation is rapid and precipitation is low.

52. Explain how the Great Lakes of North America formed.

____

____

____

53. During their early stages, the Great Lakes emptied into which rivers?

____

____

____

54. When the Great Lakes became larger, where did they also begin to drain?

____

____

____

Name ______________________ Class ______________ Date ____________

55. What caused the Great Lakes to drain to the northeast after the glacial period?

____

____

____

____

____

56. The northeasterly flow of the Great Lakes resulted in the formation of ______________________.

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Ice Ages

1. Where are continental glaciers mainly located today?

____

____

2. A long period of climatic cooling during which continents are glaciated repeatedly is called a(n) ______________________.

3. When did the earliest known ice age begin?

____

____

4. When did the most recent ice age begin?

____

____

5. When did the last advance of the most recent ice age's ice sheets begin to retreat?

____

____

6. What conditions probably exist at the beginning of an ice age?

____

____

GLACIAL AND INTERGLACIAL PERIODS

______ **7.** What happens to continental glaciers during an ice age?
- **a.** They stay where they are.
- **b.** They advance once and retreat once.
- **c.** They advance and retreat several times.
- **d.** No one knows.

______ **8.** During an ice age, ice sheets advance
- **a.** during colder periods.
- **b.** during warmer periods.
- **c.** all the time.
- **d.** when the ice sheets begin to melt.

______ **9.** During an ice age, ice sheets retreat
a. all the time.
b. during warmer periods.
c. in a northerly direction.
d. during colder periods.

______ **10.** What is a period of cooler climate that is characterized by the advancement of glaciers called?
a. an ice age
b. an interglacial period
c. a glacial period
d. global warming

______ **11.** What is a period of warmer climate that is characterized by the retreat of glaciers called?
a. an ice age
b. an interglacial period
c. a glacial period
d. global warming

12. At this time, is Earth experiencing a glacial period or an interglacial period?

____

13. How much of Earth's surface was covered by glaciers during the last glacial period?

____

14. During the last glacial period, in what regions of the world did most glaciation take place?

____

____

15. Why did the coastlines of the continents extend farther during the last glacial period than they do today? Explain your answer.

____

____

16. What parts of North America were buried beneath ice during the last glacial period?

____

____

____

____

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

17. What type of glaciers covered parts of the western United States during the last glacial period?

____

____

18. How and from where did glaciers advance in the western United States?

____

____

____

19. Where was the great continental ice sheet in North America centered?

____

____

20. During the last glacial period, a continental ice sheet was centered on what is now the Baltic Sea. What parts of Europe did it cover?

____

____

____

____

21. In which mountain ranges of Europe and Asia did long alpine glaciers form?

____

____

22. What parts of the Southern Hemisphere were buried beneath ice during the last glacial period?

____

____

____

23. How do we know where glaciers existed during the last glacial period?

____

____

____

CAUSES OF ICE AGES

______ **24.** Which of the following theories provides an explanation for the cause of ice ages?
- **a.** Earth's atmosphere warms and cools periodically over time.
- **b.** Earth experienced periods of gradual warming that caused precipitation and led to the formation of glaciers.
- **c.** Temperature was not a factor in causing ice ages.
- **d.** Earth experienced periods of gradual cooling that brought on the advancement and eventual retreat of glaciers.

______ **25.** Which of the following observations led Serbian scientist Milutin Milankovitch to propose his theory about ice ages?
- **a.** Glaciers form in warm regions of the world.
- **b.** There has only been one ice age.
- **c.** Ice ages occur in cycles.
- **d.** Earth is presently in a glacial period.

______ **26.** What did Milankovitch think the cycles of ice ages could be linked to?
- **a.** the buildup of greenhouse gases in Earth's atmosphere
- **b.** cycles in Earth's movement relative to the sun
- **c.** cycles of lunar energy released by the moon
- **d.** periods of volcanic activity on Earth

______ **27.** The Milankovitch theory states that
- **a.** cyclical changes in Earth's orbit and in the tilt of Earth's axis over long periods cause climatic changes.
- **b.** random changes in Earth's orbit and in the tilt of Earth's axis may cause ice ages.
- **c.** cyclical changes in Earth's orbit indicate that the next glacial period will begin in about 3,000 years.
- **d.** cyclical changes in sunspot activity increase and decrease the amount of solar energy that reaches Earth.

______ **28.** According to the Milankovitch theory, over what time period do the cycles that cause ice ages occur?
- **a.** days and months
- **b.** decades
- **c.** thousands of years
- **d.** millions of years

______ **29.** How many periodic changes occur that affect the way Earth moves around the sun?
- **a.** two
- **b.** three
- **c.** four
- **d.** five

Name ________________ Class ________ Date ________

______ **30.** What is the shape of Earth's orbit around the sun called?
a. tilt
b. precession
c. eccentricity
d. circular

______ **31.** Every 100,000 years, the shape of Earth's orbit changes from
a. entirely circular to slightly elongated.
b. perfectly elongated to slightly circular.
c. perfectly circular to a little less than circular and back again.
d. nearly circular to elongated and back to nearly circular.

______ **32.** How long is the cycle during which the tilt of Earth's axis varies?
a. 15,000 years
b. 31,000 years
c. 37,000 years
d. 41,000 years

______ **33.** How much does the tilt of Earth's axis vary during this period?
a. between about 22.2° and 24.5°
b. between about 24.5° and 27.5°
c. between about 25.1° and 25.9°
d. between about 26° and 30°

______ **34.** The circular motion that causes Earth's axis to change its position, or wobble, is called
a. eccentricity.
b. precession.
c. tilt.
d. elongation.

______ **35.** As Earth wobbles on its axis, how long does it take for the axis to trace a complete circle?
a. 22,500 years
b. 25,700 years
c. 27,500 years
d. 41,000 years

______ **36.** Milankovitch calculated how changes in eccentricity, tilt, and precession might affect
a. the distribution of solar energy that reaches Earth's surface.
b. the distribution of lunar energy between Earth and the moon.
c. the amount of precipitation on Earth.
d. the orbit of the moon over the next century.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

_____ **37.** Changes in the distribution of solar energy on Earth
- **a.** cause crevasses to form in glaciers.
- **b.** result in the formation of moraines.
- **c.** affect global temperatures, which may cause an ice age.
- **d.** probably have no impact on global temperatures.

38. Evidence of past ice ages is found in the ______________________ of marine organisms from the order Foraminifera.

39. Formation of the shells of Foraminifera is affected by the ______________________ of ocean water.

40. Temperature of ocean water affects how much ______________________ the ocean water dissolves.

41. The amount of oxygen in ocean water affects how ______________________ organisms form their shells.

42. Under what conditions did Foraminifera organisms coil their shells to the right or left?

____

____

____

43. Where are Foraminifera shells found?

____

____

44. How does the study of Foraminifera shells relate to the Milankovitch theory?

____

____

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____

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Name ____________________ Class ____________ Date ____________

45. Explain how other scientific theories about the causes of ice ages differ from the Milankovitch theory.

____

____

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____

46. Describe two theories that suggest ice ages are related to changes in the amount of solar energy reaching Earth's surface.

____

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47. According to one theory, how could shifts in the positions of Earth's continents cause ice ages?

____

____

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Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Wind Erosion

______ **1.** Most sand grains are made up of
- **a.** quartz.
- **b.** salt.
- **c.** gold.
- **d.** iron ore.

______ **2.** Which of the following minerals is NOT commonly found in sand grains?
- **a.** mica
- **b.** salt
- **c.** magnetite
- **d.** feldspar

______ **3.** Which of the following is true of dust particles?
- **a.** They are the same size as sand grains.
- **b.** They are heavier than sand grains.
- **c.** They are smaller than sand grains.
- **d.** They are larger than sand grains.

______ **4.** Which of the following are NOT sources of dust?
- **a.** rocks and minerals
- **b.** plants and animals
- **c.** bacteria and pollution
- **d.** wind and water

HOW WIND MOVES SAND AND DUST

______ **5.** The movement of sand by short jumps and bounces is called
- **a.** weathering.
- **b.** saltation.
- **c.** pollution.
- **d.** deflation.

______ **6.** During saltation, sand grains move
- **a.** north.
- **b.** south.
- **c.** in the same direction as the wind.
- **d.** in the opposite direction of the wind.

Back Print

Name ______________________ Class ______________ Date ____________

______ **7.** Dust from volcanic eruptions may stay in the atmosphere
a. for about a month.
b. for several years.
c. until it rains.
d. until saltation is complete.

EFFECTS OF WIND EROSION

8. Why are the effects of wind erosion more obvious in deserts and along coastlines?

____

____

____

____

9. The type of erosion that removes fine, dry soil particles and leaves behind large rock particles is called ______________________.

10. The rock particles that often remain after deflation are closely packed and form a surface called ______________________.

11. Why is deflation a problem for farmers?

____

12. A shallow depression that forms when wind removes natural plant cover is called a(n) ______________________.

13. Rocks that have been pitted or smoothed by wind abrasion and that can be used to tell the direction of the prevailing wind are called ______________________.

14. What do scientists now think is responsible for producing large rock structures such as desert basins, natural bridges, and rock pinnacles?

____

____

____

____

Name ______________________ Class ______________ Date ____________

WIND DEPOSITION

15. What is one way sedimentary rocks form?

____

____

____

____

16. Mounds of wind-deposited sand are called ______________________.

17. A dune begins to form when wind speed is slowed by

a(n) ______________________.

18. The gentlest slope of a dune is the side that faces

the ______________________.

19. The steeper side of a dune upon which blown sand settles is called

a(n) ______________________.

20. A crescent-shaped dune whose face opens away from the wind is called

a(n) ______________________.

21. A crescent-shaped dune whose open side faces into the wind is called

a(n) ______________________.

22. Dunes that form at right angles to the wind direction and create sand ridges

in long, wavelike patterns are called ______________________.

23. Ridge-shaped dunes that form parallel to the direction that the wind blows

are called ______________________.

24. The movement that occurs as sand is blown over the crest of a dune is

called ______________________.

25. In mostly level areas, dunes migrate until they reach

a(n) ______________________.

Name ______________________ Class ______________ Date ____________

LOESS

______ **26.** Wind carries dust higher and farther than it carries
- **a.** rocks.
- **b.** loess.
- **c.** sand.
- **d.** sediment.

______ **27.** Thick deposits of yellowish, fine-grained sediment are called
- **a.** rocks.
- **b.** loess.
- **c.** sand.
- **d.** bluffs.

______ **28.** Loess is composed of
- **a.** compost.
- **b.** quartz, feldspar, hornblende, mica, and clay.
- **c.** desert pavement.
- **d.** salt.

______ **29.** In which of the following regions is loess NOT found?
- **a.** New Zealand
- **b.** central Europe
- **c.** North America
- **d.** China

______ **30.** Loess deposits are good for farming because they are very
- **a.** moist.
- **b.** dry.
- **c.** dusty.
- **d.** fertile.

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Wave Erosion

1. As wind moves over ocean water, it produces both currents and ______________________ that erode the coastline.

2. The place where the ocean and land meet is called ______________________.

SHORELINE EROSION

______ **3.** The abrasive action that breaks rocks into small pebbles and sand grains is called
- **a.** chemical weathering.
- **b.** saltation.
- **c.** mechanical weathering.
- **d.** deflation.

______ **4.** Shoreline erosion often occurs during storms, when waves crash and release large amounts of
- **a.** wind.
- **b.** rock.
- **c.** sand.
- **d.** energy.

______ **5.** Cracks in shoreline rock can become larger as a result of
- **a.** deflation.
- **b.** pollution.
- **c.** chemical weathering.
- **d.** tornadoes.

______ **6.** If waves erode the base of an overhanging rock and the rock collapses, the resulting feature is a
- **a.** sea cliff.
- **b.** headland.
- **c.** sea cave.
- **d.** sea arch.

______ **7.** A resistant rock formation that reaches out from the shore into the water is called a
- **a.** sea cliff.
- **b.** headland.
- **c.** sea cave.
- **d.** sea arch.

Name ______________________ Class ______________ Date ____________

______ **8.** In areas with less-resistant rock, wave erosion can produce
a. ventifacts.
b. headlands.
c. bays.
d. deflation hollows.

______ **9.** A large hole that forms when waves cut deep into weak shoreline rock is called a
a. terrace.
b. headland.
c. sea cave.
d. sea arch.

______ **10.** A formation that is created when waves cut completely through a headland is called a
a. sea cliff.
b. sea stack.
c. sea cave.
d. sea arch.

______ **11.** Offshore columns of rock that were once connected to a sea cliff or headland are called
a. sea stacks.
b. sea urchins.
c. sea caves.
d. sea arches.

______ **12.** A sea cliff that erodes until it is a nearly level platform is called a
a. wave-cut terrace.
b. headland.
c. sea cave.
d. wave-built terrace.

______ **13.** An offshore extension to a wave-cut terrace is called a
a. sea arch.
b. headland.
c. sea cave.
d. wave-built terrace.

Name ________________________________ Class ________________ Date ______________

BEACHES

______ **14.** An area of shoreline that is made up of deposited sediment is called a
- **a.** berm.
- **b.** sand bar.
- **c.** beach.
- **d.** bay.

______ **15.** Beaches form where
- **a.** more sediment is removed than is deposited.
- **b.** more sediment is deposited than is removed.
- **c.** sediment is equally deposited and removed.
- **d.** sediment is neither deposited nor removed.

______ **16.** The size and kind of material that makes up a beach is determined by
- **a.** the size of the beach.
- **b.** the composition of the source rock.
- **c.** the distance the waves carried the material.
- **d.** the season of the year.

______ **17.** The berm is a section of the beach that is
- **a.** raised.
- **b.** lower.
- **c.** flat.
- **d.** eroded.

______ **18.** A berm is likely to be high and steep during winter because large storms
- **a.** remove beach sand from the seaward side of the berm.
- **b.** deposit sand on the beach.
- **c.** move sand to a headland.
- **d.** deposit sand in an inlet.

______ **19.** Sand that is deposited offshore and forms a long underwater ridge is called a
- **a.** berm.
- **b.** sand bar.
- **c.** beach.
- **d.** inlet.

LONGSHORE-CURRENT DEPOSITS

______ **20.** The direction in which a wave approaches the shore determines
a. how the wave moves sediment.
b. how much erosion will occur.
c. how much rock will be washed ashore.
d. whether the beach will become polluted.

______ **21.** In a longshore current, water moves near the shoreline and
a. perpendicular to it.
b. at right angles to it.
c. parallel to it.
d. behind it.

______ **22.** Along a relatively straight coastline, sand will keep moving until
a. the shoreline changes direction.
b. a sea arch forms.
c. a headland erodes.
d. a sea cliff forms.

______ **23.** Shoreline deposits may build a long, narrow ridge of sand connected at one end to the shore called a
a. tombolo.
b. spit.
c. terrace.
d. bay.

______ **24.** A beach deposit that connects an offshore island to the mainland is called a
a. bay.
b. terrace.
c. spit.
d. tombolo.

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Coastal Erosion and Deposition

1. Coastlines are affected by the long-term rise and fall of ______________________ and the long-term uplifting and sinking of land that borders the water.

2. Coastlines are also affected by the rapid processes of wave erosion and ______________________.

ABSOLUTE SEA-LEVEL CHANGES

______ **3.** Sea level rises or falls when
- **a.** deposition occurs.
- **b.** erosion occurs.
- **c.** the amount of ocean water changes.
- **d.** pollution occurs.

______ **4.** Scientists estimate that during the last glacial period, some water that is now ocean existed as
- **a.** continental ice sheets.
- **b.** icebergs.
- **c.** ice drifts.
- **d.** alpine glaciers.

______ **5.** During the last glacial period, it is estimated that ice sheets held
- **a.** about 40 million cubic kilometers of ice.
- **b.** about 70 million cubic kilometers of ice.
- **c.** about 1 million cubic kilometers of ice.
- **d.** about 125 million cubic kilometers of ice.

______ **6.** Ice sheets in Antarctica and Greenland currently hold
- **a.** about 13 million cubic kilometers of ice.
- **b.** about 25 million cubic kilometers of ice.
- **c.** about 46 million cubic kilometers of ice.
- **d.** about 300 million cubic kilometers of ice.

______ **7.** During the last glacial period, sea level was
- **a.** higher than it is today.
- **b.** first lower and then higher than it is today.
- **c.** the same as it is today.
- **d.** lower than it is today.

Name ______________________ Class ______________ Date ______________

______ **8.** If today's polar ice caps were to melt completely,
a. the oceans would fall about 60 m.
b. the oceans would rise about 60 m.
c. the oceans would stay about the same.
d. Antarctica and Greenland would be submerged.

RELATIVE SEA-LEVEL CHANGES

9. When land or features near the coast change, ______________________ sea level changes.

10. A coastline can rise or sink because movements in Earth's ______________________.

11. In addition, coastlines near a(n) ______________________ may change as ______________________ move.

Identify the type of coastline described by each of the following features by writing *submergent* or *emergent* in the space provided.

______________________ **12.** when sea level rises or land level falls

______________________ **13.** when land rises or sea level falls

______________________ **14.** when erosion forms sea cliffs, narrow inlets, and bays

______________________ **15.** when divides between neighboring valleys become headlands separated by bays and inlets

______________________ **16.** when a gentle slope forms a smooth coastal plain with many long, wide beaches

______________________ **17.** when beaches generally are short, narrow and rocky

Name ______________________ Class ____________ Date ____________

In the space provided, write the letter of the description that best matches the term or phrase.

______ **18.** barrier island

______ **19.** fiord

______ **20.** estuary

______ **21.** lagoon

a. long narrow ridge of sand parallel to the shoreline

b. narrow region of shallow water that separates the shoreline and a barrier island

c. narrow, deep bay with steep walls

d. wide, shallow bay

PRESERVING THE COASTLINE

______ **22.** Which of the following activities are coastal lands NOT used for?
a. development and recreation
b. shipping
c. creating pollution
d. fishing

______ **23.** Which of the following is NOT considered a threat to coastal areas?
a. an oil spill
b. industrial pollution
c. residential sewage
d. a wildlife habitat

______ **24.** Coastal zones can be preserved by
a. developing environmentally sensitive areas.
b. increasing human activity along shorelines.
c. following guidelines for use.
d. introducing submerged coastlines.

______ **25.** Coastal protection has included
a. removing barrier islands.
b. removing marine birds and other animals.
c. drilling offshore.
d. rebuilding beaches damaged by storms.

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: The Water Planet

______ **1.** The body of salt water covering nearly three-quarters of the Earth's surface is called the
a. Earth's ocean.
b. Pacific Ocean.
c. salt-water ocean.
d. global ocean.

______ **2.** How many of the known planets have a covering of liquid water similar to that of Earth?
a. one
b. three
c. all
d. none

______ **3.** Why is Earth called the water planet?
a. Earth is three-quarters water.
b. Earth is the largest planet that has water.
c. No other known planet has water.
d. The global ocean is 1/4,000 of Earth's mass.

______ **4.** What percentage of water on Earth does the global ocean contain?
a. 50%
b. 85%
c. 97%
d. 100%

______ **5.** The most prominent feature on Earth is
a. the Pacific Ocean.
b. the continent of Asia.
c. the continental land mass.
d. the global ocean.

______ **6.** The global ocean is about 1/800 of Earth's total
a. mass.
b. volume.
c. surface area.
d. water area.

Name ______________________ Class ______________ Date ____________

DIVISIONS OF THE GLOBAL OCEAN

______ **7.** How many major oceans form the global ocean?
a. seven
b. five
c. three
d. one

______ **8.** The major oceans include the Atlantic, Pacific, Indian, Arctic and
a. Eastern oceans.
b. Western oceans.
c. Northern oceans.
d. Southern oceans.

______ **9.** The largest ocean on Earth's surface is the
a. Atlantic Ocean.
b. Pacific Ocean.
c. Indian Ocean.
d. Southern Ocean.

______ **10.** Earth's deepest ocean is the
a. Atlantic Ocean.
b. Pacific Ocean.
c. Indian Ocean.
d. Southern Ocean.

______ **11.** The ocean that contains more than one-half the ocean water on Earth is the
a. Atlantic Ocean.
b. Pacific Ocean.
c. Indian Ocean.
d. Southern Ocean.

______ **12.** The second-largest ocean on Earth's surface is the
a. Atlantic Ocean.
b. Pacific Ocean.
c. Indian Ocean.
d. Southern Ocean.

______ **13.** The average depth of the Atlantic Ocean is
a. 4.3 km.
b. 3.9 km.
c. 2.7 km.
d. 1.9 km.

Name ______________________ Class ______________ Date ____________

______ **14.** The third-largest ocean on Earth's surface is the
a. Atlantic Ocean.
b. Pacific Ocean.
c. Indian Ocean.
d. Southern Ocean.

______ **15.** The ocean extending from the coast of Antarctica to 60ºS latitude is the
a. Atlantic Ocean.
b. Pacific Ocean.
c. Indian Ocean.
d. Southern Ocean.

______ **16.** The Arctic Ocean is Earth's
a. oldest ocean.
b. deepest ocean.
c. widest ocean.
d. smallest ocean.

______ **17** A body of salt water that is smaller than an ocean is a(n)
a. sea.
b. lake.
c. river.
d. inlet.

18. Name three major seas.

____

____

____

EXPLORATION OF THE OCEAN

______ **19.** The study of the physical and chemical make-up of the ocean as well a its life-forms is called
a. oceanography.
b. oceanology.
c. sedimentology.
d. oceano-biology.

______ **20.** Modern oceanography began in
a. the 1750s.
b. the 1850s.
c. the 1950s.
d. ancient times.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

______ **21.** Matthew F. Maury was (a)n
- **a.** American army officer.
- **b.** American scientist.
- **c.** American naval officer.
- **d.** British naval officer.

______ **22.** What did Matthew F. Maury use to learn about ocean currents, winds, depths, and weather conditions?
- **a.** records from weather stations
- **b.** records from merchant ships
- **c.** records from navy ships
- **d.** diaries and journals

23. What measurements were made by HMS *Challenger* between 1872 and 1876?

____

____

____

24. What three types of samples were collected by HMS *Challenger* between 1872 and 1876?

____

____

____

25. The voyages of the HMS *Challenger* laid the foundation for the modern science of ______________________.

26. Why do drilling ships use reentry cones?

____

____

____

27. What valuable information do scientists gather from samples drilled by *JOIDES Resolution*?

____

____

____

____

____

Name ______________________ Class ______________ Date ______________

28. What organization operates the Japanese ship *CHIKYU*?

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **29.** the British navy ship HMS *Challenger*

______ **30.** the Japanese ship *CHIKYU*

______ **31.** the research ship *JOIDES Resolution*

a. the world's largest scientific drilling ship in the 1990s

b. the ship that laid the foundation for modern oceanography

c. the most advanced drilling ship now in use

32. Oceanographic research ships are often equipped

with ______________________.

33. What is *sonar*?

____

____

____

____

34. What do the letters in *sonar* stand for?

____

____

____

____

35. About how fast do the sound waves from a sonar transmitter travel through sea water?

____

____

____

____

36. What happens to the continuous series of sound waves sent from a sonar transmitter?

37. What measurements do scientists make when using sonar?

38. What do scientists calculate with the information they collect from sonar?

39. How do scientists use the information they collect using sonar?

40. What are underwater research vessels called *submersibles* used for?

41. What are two types of piloted submersibles?

42. What is the difference between a *bathyscaph* and a *bathysphere*?

43. What are two kinds of underwater tasks performed by submarine robots?

44. What is one major advantage a remotely piloted robot submersible has over a piloted submersible?

____

____

____

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

_____ **45.** bathysphere

_____ **46.** bathyscaph

_____ **47.** submarine robot

a. a spherical diving vessel that remains connected to the research ship for communication and life support

b. a piloted, self-propelled, free-moving submarine

c. remotely piloted submersible that allows oceanographers to study the ocean depths for long periods of time

48. Submersibles have helped scientists make exciting discoveries about the ______________________.

49. What types of marine life did scientists in one submersible find living at depths and temperatures where they thought no life would exist?

____

____

____

50. What are two characteristics of the deep ocean made it unlikely that oceanographers would discover life forms?

____

____

51. Why do life-forms in the deep ocean have unusual adaptations?

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Features of the Ocean Floor

_____ **1.** How many major areas does the ocean floor have?
a. one
b. two
c. three
d. four

_____ **2.** The shallow sea floor between the shoreline and the deep-ocean bottom is called the
a. continental margin.
b. deep-ocean basin.
c. continental crust.
d. oceanic crust.

_____ **3.** Continental margins are made up of continental crust
a. and a thin sediment layer.
b. and a thick wedge of sediment.
c. without a sedimentary layer.
d. or a sedimentary layer.

_____ **4.** The part of the ocean floor under deep water beyond the continental margin is called the
a. continental margin.
b. deep-ocean basin.
c. continental crust.
d. oceanic crust.

_____ **5.** The deep-ocean basin is made up of oceanic crust
a. and a thin sediment layer.
b. and a thick wedge of sediment.
c. without a sedimentary layer.
d. or a sedimentary layer.

CONTINENTAL MARGINS

_____ **6.** The line that divides the continental crust from the oceanic crust is
a. distinct.
b. on the surface.
c. under thick sediments.
d. at the shoreline.

______ **7.** The part of the continent covered by water is called the
a. shoreline.
b. continental margin.
c. continental shelf.
d. deep-ocean basin.

______ **8.** The continental shelf slopes gently from the shoreline, and drops about 0.12 m every
a. 10 m.
b. 100 m.
c. 1,000 m.
d. 10,000 m.

______ **9.** the average depth of the water covering a continental shelf is about
a. 6 m.
b. 60 m.
c. 160 m.
d. 600 m.

______ **10.** The continental shelf is part of the
a. continental margin.
b. deep-ocean basin.
c. ocean surface.
d. oceanic crust.

______ **11.** During glacial periods
a. sea level rises.
b. sea level falls.
c. sea level is unchanged.
d. continental shelves rise.

______ **12.** More continental shelf is exposed to weathering and erosion
a. when ice sheets melt and sea level rises.
b. during glacial periods when ice sheets hold water.
c. at the beginning of glacial periods when ice begins to freeze.
d. at the end of glacial periods when ice begins to melt.

______ **13.** The steep slope at the seaward edge of a continental shelf is called the
a. continental rise.
b. continental slope.
c. oceanic slope.
d. oceanic rise.

Name ______________________ Class ______________ Date ____________

14. Where is the boundary between the continental crust and the oceanic crust?

____

____

____

15. About how steeply does the ocean depth increase along the continental slope?

____

____

____

16. V-shaped valleys in the continental shelf and continental slope are called ______________________.

17. What is one place submarine canyons are often found?

____

____

18. How can turbidity currents help form submarine canyons?

____

____

____

19. How do turbidity currents form?

____

____

____

____

20. A raised wedge of sediment at the base of the continental slope is called a(n) ______________________.

Name ______________________ Class ______________ Date ____________

DEEP-OCEAN BASINS

21. What are four features of deep-ocean basins?

22. How do the mountains and the plains in deep-ocean basins compare to those on the surface of the continents?

23. What is the name of the deepest place in Earth's crust?

24. Where is the deepest place in Earth's crust located?

25. About how deep is the deepest place in Earth's crust?

26. In the deep-ocean basins, what is a *trench*?

27. How do trenches form in the deep-ocean basins?

28. Name three things that occur or form near trenches.

____

____

____

29. In the deep-ocean basins, what are *abyssal plains*?

____

____

____

30. About half of the deep-ocean basins are covered by ______________________.

31. The flattest regions on Earth are ______________________.

32. Layers of fine ______________________ cover the abyssal plains.

33. What are the two sources of sediments covering the abyssal plains?

____

____

34. How does the age of the oceanic crust affect the thickness of sediments on the abyssal plains?

____

____

35. How would distance from the continental margin to the abyssal plains affect the thickness of sediments?

____

____

36. Compare the sediment cover on abyssal plains that are bordered by trenches with the sediment cover on abyssal plains not bordered by trenches.

____

37. The most prominent features of ocean basins are ______________________.

38. Mid-ocean ridges form underwater ______________________.

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

39. What is one place where a mid-ocean ridge rises above sea level?

____

40. Where do mid-ocean ridges form?

____

41. What runs along the center of a mid-ocean ridge?

____

42. How does magma reach the sea floor?

____

43. What is formed when magma reaches the sea floor?

____

44. What happens to new lithosphere as it cools?

____

45. Blocks of crust bounded by faults, called ____________________ , form parallel to ridges as lithosphere cools and contracts.

46. What happens as ridges adjust to changes in the direction of plate motions?

____

____

47. Faults create rough areas called ____________________, which run perpendicular across mid-ocean ridges.

48. Where do *seamounts* form?

____

____

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **49.** guyot

______ **50.** hot spot

______ **51.** seamount

______ **52.** atoll

______ **53.** oceanic island

a. an area of increased volcanic activity where seamounts form

b. submerged seamount with a flat top

c. a seamount that rises above the ocean

d. an oceanic island that is in the process of being eroded into a guyot

e. submerged volcanic mountain taller than 1 km

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Ocean-Floor Sediments

______ **1.** Continental shelves and slopes are covered with
- **a.** sediments.
- **b.** turbidity currents.
- **c.** silica.
- **d.** petroleum.

______ **2.** Ocean sediments are composed of
- **a.** the same materials no matter which part of the ocean the sediments form in.
- **b.** only coarse gravel and sand carried into the water by wind and currents.
- **c.** only light particles that have been suspended in ocean water.
- **d.** various materials depending on which part of the ocean the sediments form in.

______ **3.** Sediments in the ocean are well sorted by
- **a.** shape.
- **b.** texture.
- **c.** age.
- **d.** size.

4. Name three ways sediments get into the ocean.

____

____

____

5. The types of sediments found close to shore are

usually ______________________.

6. The types of sediments usually deposited far from shore

are ______________________.

SOURCES OF DEEP OCEAN-BASIN SEDIMENTS

______ **7.** Compared to sediments found in shallow water, those found in the deep-ocean basin are usually
- **a.** coarser.
- **b.** sandier.
- **c.** heavier.
- **d.** finer.

______ **8.** Cylinders of sediment that are taken from sediment layers on the ocean floor are called
a. gravel.
b. *JOIDES*.
c. core samples.
d. organic sediments.

______ **9.** Most of the sediment in deep-ocean basins comes from
a. the shoreline.
b. rivers.
c. ocean water above.
d. core samples.

10. What are two ways to take sediment samples in deep ocean basins?

____

____

11. What is the name of one research vessel used to study ocean floor sediment core samples?

____

12. What is one type of sediment carried into the ocean basin by land from rivers?

____

13. In what two places does a river usually deposit a sediment load with rock particles?

____

____

14. Besides the shore and the continental shelf, where do large quantities of sediments occasionally end up?

____

____

15. Large quantities of sediments sliding from continental slopes to the ocean floor below create ______________________ currents.

Name ______________________ Class ______________ Date ______________

16. How does volcanic dust become sediment in the deep-ocean basins?

____

____

____

____

17. How do icebergs provide sediments that end up on the ocean basins?

____

____

____

____

18. What happens to a meteorite as it enters Earth's atmosphere?

____

____

19. What happens to most meteorite fragments after the meteorite vaporizes?

____

____

20. How are underwater landslides caused?

____

____

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **21.** biogenic sediments

______ **22.** calcium carbonate

______ **23.** silica

______ **24.** nodules

a. formed by shells of radiolarians and diatoms

b. remains of marine plants and animals

c. lumps of minerals found on the ocean floor

d. formed by skeletons of foraminiferans

PHYSICAL CLASSIFICATION OF SEDIMENTS

______ **25.** How many basic types of deep ocean-floor sediments are there?
a. one
b. two
c. three
d. four

______ **26.** Fine silt- and clay-sized particles of rock, found on the deep ocean floor, are called
a. muds.
b. ooze.
c. diatoms.
d. nodules.

______ **27.** Clay particles mixed with silt, sand, and biogenic material are called
a. red ooze.
b. red mud.
c. red clay.
d. red silt.

______ **28.** About how much of the ocean floor is covered with ooze?
a. 10%
b. 20%
c. 30%
d. 40%

______ **29.** About how much of the ooze on the ocean floor is made up of biogenic materials?
a. 10%
b. 20%
c. 30%
d. 40%

______ **30.** Calcareous ooze is made up mostly of
a. calcium carbide.
b. calcium carbonate.
c. calcium hydroxide.
d. calcium silicate.

______ **31.** Calcareous ooze is never found deeper than
a. 1 km.
b. 5 km.
c. .5 km
d. 10 km.

Directed Reading *continued*

______ **32.** In cold ocean water, between depths of 3 km and 5 km, calcium carbonate
- **a.** precipitates.
- **b.** expands.
- **c.** crystallizes.
- **d.** dissolves.

______ **33.** Siliceous ooze can be found
- **a.** only at depths over 5 km on the ocean floor.
- **b.** only at depths less than 5 km on the ocean floor.
- **c.** only at depths between 3 km and 5 km on the ocean floor.
- **d.** at any depth on the ocean floor.

______ **34.** Siliceous ooze is made up mostly of
- **a.** silicon carbide.
- **b.** silicon dioxide.
- **c.** calcium silicate.
- **d.** silica gel.

35. Why is most siliceous ooze found in the waters around Antarctica?

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **36.** mud

______ **37.** siliceous ooze

______ **38.** calcareous ooze

a. deep ocean-floor sediments found above a depth of 5 km

b. deep ocean-floor sediment usually found in the ocean around Antarctica

c. deep ocean-floor sediments consisting of very fine silt- and clay-sized rock particles

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Properties of Ocean Water

______ **1.** Water in the ocean
- **a.** is tasteless, odorless, and colorless.
- **b.** is muddy and brown.
- **c.** contains many dissolved solids and gases.
- **d.** is completely pure.

______ **2.** Scientists do NOT describe ocean water by using properties such as
- **a.** presence of dissolved gases and the presence of dissolved solids.
- **b.** salinity and temperature.
- **c.** presence of dissolved vitamins and dissolved minerals.
- **d.** density and color.

3. Why do scientists study the properties of ocean water?

____

____

____

____

DISSOLVED GASES

______ **4.** The two principal gases in the atmosphere are
- **a.** nitrogen and oxygen.
- **b.** oxygen and carbon dioxide.
- **c.** nitrogen and carbon dioxide.
- **d.** oxygen and carbon monoxide.

______ **5.** Ocean water contains a large amount of dissolved
- **a.** carbon monoxide.
- **b.** helium.
- **c.** carbon dioxide.
- **d.** nitrous oxide.

______ **6.** Most oxygen in the ocean
- **a.** enters at the surface of the ocean from the atmosphere.
- **b.** enters as dissolved gas from streams and rivers.
- **c.** is released as carbon dioxide dissolves.
- **d.** is made by plants in the ocean through photosynthesis.

Name ______________________ Class ______________ Date ____________

______ **7.** Gases dissolve most readily in what kind of water?
a. ocean water
b. fresh water
c. warm water
d. cold water

______ **8.** When ocean temperature rises,
a. excess gas is released into the atmosphere.
b. the ocean absorbs and holds carbon dioxide.
c. carbon dioxide is equalized between the ocean and atmosphere.
d. no change takes place.

______ **9.** How many times more carbon is in the oceans than in the atmosphere?
a. 20 times
b. 40 times
c. 60 times
d. 80 times

______ **10.** For how long might dissolved carbon dioxide be trapped in the ocean?
a. ten years
b. hundreds of years
c. from hundreds to thousands of years
d. millions of years

______ **11.** Because of their ability to dissolve and contain a large amount of carbon dioxide, oceans are often referred to as a(n)
a. carbon trap.
b. carbon sink.
c. infinite water supply.
d. Earth thermostat.

______ **12.** Because gaseous carbon dioxide affects the atmosphere's ability to trap thermal energy from the sun,
a. oceans warm easily in the tropics.
b. the temperature of the ocean fluctuates with the daily temperature.
c. oceans are important in the regulation of climate.
d. land temperature is directly related to the carbon dioxide content of the closest ocean.

DISSOLVED SOLIDS

______ **13.** Ocean water is made up of what percentage of dissolved solids?
a. 3.5%
b. 35.5%
c. 50.5%
d. 96.5%

______ **14.** The dissolved solids that give the ocean its salty taste are commonly called
a. sea solids.
b. brine.
c. sodium chloride.
d. sea salts.

______ **15.** Solids dissolved in ocean water are composed of about how many chemical elements?
a. 25
b. 50
c. 75
d. 100

______ **16.** The most common salt, halite, which makes up more than 85% of the oceans solids, is made of
a. sodium and chloride ions.
b. zinc and sodium.
c. sodium and phosphorus.
d. sodium only.

17. Elements that exist in very small amounts are

called ________________________.

18. What are three examples of trace elements found in the ocean?

____

____

____

19. What are the three main sources of the elements that form sea salts?

____

____

____

20. How do dissolved salts and other dissolved solids enter the ocean?

____

____

Name ______________________________ Class ______________ Date ____________

Directed Reading *continued*

SALINITY OF OCEAN WATER

21. A measure of the amount of dissolved salts and other solids in a given amount of liquid is ________________________.

22. How is salinity measured?

____

23. What is the average salinity of fresh water?

____

FACTORS THAT CHANGE SALINITY

24. What happens when evaporation and freezing remove water particles from the ocean?

____

____

25. Will tropical waters or polar waters have a higher salinity at the surface? Explain your answer.

____

____

____

26. Why does surface water generally have higher salinity than deep water?

____

27. Is the salinity of the global ocean the same in all locations?

____

28. Why is the salinity of the Red Sea more than 40%?

____

____

TEMPERATURE OF OCEAN WATER

______ **29.** Ocean temperature varies depending on

a. depth of water and percentage of salinity on the surface of the oceans.

b. depth of water and location on the surface of the oceans.

c. the number of plants and animals living in the surface water.

d. the amount of dissolved minerals on the surface of the oceans.

Name ______________________ Class ______________ Date ____________

30. Why does the temperature of the zone of surface water decrease only slightly as the depth increases?

____

____

____

31. What happens to the temperature of surface water as latitude increases?

____

32. Where does the greatest amount of solar energy reach the surface of the ocean?

____

33. What is the common temperature at the surface in tropical areas?

____

34. Why do vast amounts of sea ice exist in polar oceans? Explain your answer.

____

____

35. A floating layer of sea ice that completely covers an area of the ocean surface is called ______________________.

36. Why is pack ice rarely more than 5 m thick?

____

____

37. What determines changes in ocean surface temperature in the middle latitudes?

____

38. Why does the temperature of the water decrease sharply below the surface layer of the ocean?

____

____

39. The layer in a body of water in which water temperature drops with increased depth faster than it does in other layers is called

a(n) ______________________.

40. Why does the thermocline exist in the ocean?

____

____

____

41. What happens to the temperature of the water in the zone beneath the thermocline?

____

____

42. How does the 2ºC temperature of the deep zone affect the density of the ocean water?

____

____

43. How does the amount of dissolved gases in cold, deep ocean water compare to the amount of dissolved gases in warm shallow, ocean water?

____

____

____

____

DENSITY OF OCEAN WATER

44. The ratio of the mass of a substance to the volume of the substance; commonly expressed as grams per cubic centimeter for solids and liquids and as grams per liter for gases is called ______________________.

45. What two factors affect the density of ocean water?

____

____

46. What do dissolved solids, mostly salts, add to ocean water?

47. Which is more dense, ocean water or fresh water? Why?

____

____

Name ______________________ Class ______________ Date ____________

48. In what region is the densest ocean water found? Explain why this is true.

____

COLOR OF OCEAN WATER

49. How is the color of ocean water determined?

____

____

____

50. Why does ocean water appear blue?

____

____

____

51. What are *phytoplankton*?

____

____

____

52. How do the presence and amount of phytoplankton affect the shade of blue of the ocean?

____

____

____

53. How do scientists determine the presence of phytoplankton in the ocean?

____

____

54. How does the presence or absence of phytoplankton in the ocean indicate the health of the ocean?

____

____

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Life in the Oceans

______ **1.** What two major factors do marine organisms depend on for their survival?
a. essential nutrients in ocean water and sunlight
b. density of ocean water and sunlight
c. essential nutrients in ocean water and density of ocean water
d. salinity of ocean water and density of ocean water

OCEAN CHEMISTRY AND MARINE LIFE

2. Describe the chemistry of the ocean.

____

____

____

3. How do marine organisms help maintain the chemical balance of ocean water?

____

____

____

4. What are three elements absorbed by marine plants?

____

____

____

5. What is one way photosynthetic marine plants return oxygen to the ocean?

____

____

____

6. One way that nutrients return to the surface is through a process called ______________________.

Name ______________________ Class ______________ Date ______________

7. How do bacteria help release essential nutrients into the ocean?

____

____

____

8. Where do organisms in the ocean consume all the elements necessary for life?

____

9. What happens to elements necessary for life when ocean organisms die?

____

____

____

10. Where are nutrients stored in the ocean?

____

____

11. What must happen to nutrients stored in deep water before they can be used by most organisms in the ocean?

____

____

____

12. What is one way nutrients stored in deep water return to the surface?

____

____

____

13. What happens when wind blows steadily parallel to a coastline?

____

____

____

Name ______________________ Class ______________ Date ____________

14. In what part of the ocean do most marine organisms live?

____

____

____

15. The mass of mostly microscopic organisms that float or drift freely in the waters of aquatic environments are called ______________________.

16. How do plankton form the base of food webs in the ocean?

____

____

____

____

17. Organisms such as dolphins and squid, that swim actively in open water, are called ______________________.

18. Organisms that live at the bottom of oceans or bodies of fresh water are called ______________________.

OCEAN ENVIRONMENTS

Use the terms from the list below to complete the sentences that follow. Each term may be used only once.

pelagic zone	oceanic zone	hadal zone
bathyal zone	benthic zone	sublittoral zone
intertidal zone	abyssal zone	neritic zone
epipelagic zone		

19. The general term for the bottom region of oceans and bodies of fresh water is ______________________.

20. The general term for the region of an ocean or body of fresh water above the benthic zone is ______________________.

21. This is the shallowest benthic zone, located between the low-tide and high-tide zones. Shifting tides make it a continually changing environment for marine organisms. It is called the ______________________.

Name ______________________ Class ______________ Date ____________

22. Most organisms that live in the benthic zone live in this shallow zone. This constantly submerged area is located on the continental shelf and is home to sea stars, brittle stars, and sea lilies. It is called

the ______________________.

23. This zone begins at the continental slope and extends to a depth of 4,000 m. Little or no sunlight reaches this area so plant life is scarce. Animals living in this zone include octopuses, sea stars, and brachiopods. This zone is

called the ______________________.

24. This zone has no sunlight because it begins at 4,000 m and goes to a depth of 6,000 m. Organisms that call this zone home are sponges and worms. It is

called the ______________________.

25. This zone is confined to the ocean trenches—areas deeper than 6,000 m. This area is virtually unexplored, but scientists think that life here is sparse.

It is called the ______________________.

26. The region of the pelagic zone above the continental shelves has abundant sunlight, moderate temperatures, and relatively low water pressure, which are ideal conditions for marine life. Nekton fill the area's waters and are the source of much of the fish and seafood that humans eat. It is called

the ______________________.

27. The zone that extends into the deep waters beyond the continental shelf is divided into four zones based on depth. It is called the

______________________.

28. The uppermost area of the oceanic zone is sunlit and populated by sea life

such as dolphins. It is called the ______________________.

29. What are the deepest three areas of the oceanic zone?

____

____

____

30. What happens to the amount of marine life in the pelagic zone as depth increases?

____

Back Print

Name ________________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Ocean Resources

1. What are three important resources supplied by the ocean?

____

____

____

FRESH WATER FROM THE OCEAN

In the space provided, write the letter of the description that best matches the term or phrase.

______ 2. freezing

______ 3. distillation

______ 4. desalination

______ 5. reverse osmosis desalination

a. a process of removing salt from ocean water

b. a process using special membranes that allow water under high pressure to pass through, while blocking dissolved salts

c. a process in which water is frozen, and ice crystals are removed and then melted to obtain fresh water

d. a process in which liquid water is heated, then evaporates leaving dissolved salts behind, and condenses, resulting in pure, fresh water

6. Although desalination may provide needed fresh water, there is one significant drawback. What is it?

____

____

7. What is one disadvantage of using distillation as a means of desalination?

____

____

8. What is one advantage freezing as a means of desalination has over other processes?

____

____

MINERAL AND ENERGY RESOURCES

______ **9.** The most valuable resource found in the ocean is
- **a.** salt.
- **b.** minerals.
- **c.** petroleum.
- **d.** gold.

______ **10.** Offshore oil and natural gas deposits exist
- **a.** along the shorelines of the northern hemisphere.
- **b.** under sandy-bottom beaches.
- **c.** along continental margins.
- **d.** under the deepest ocean floors.

______ **11.** About how much of the world's oil supply is currently mined from offshore wells?
- **a.** one-third
- **b.** one-fourth
- **c.** one-half
- **d.** all

______ **12.** Potato-shaped lumps of minerals, called *nodules*, are found
- **a.** on the abyssal floor of the ocean.
- **b.** washed up along the shorelines in remote areas.
- **c.** in underwater oil wells.
- **d.** in ocean waters heavy with organic materials.

______ **13.** Recovery of nodules is difficult and expensive because
- **a.** they are so small.
- **b.** they contain manganese, iron, copper, nickel, cobalt, and phosphates.
- **c.** they are located in very deep water.
- **d.** the minerals they contain cost too much to recover.

______ **14.** The ocean is an important source of
- **a.** copper and silver.
- **b.** magnesium and bromine.
- **c.** trace minerals and iron.
- **d.** salt and diamonds.

Name ______________________ Class ____________ Date ____________

FOOD FROM THE OCEAN

Use the terms from the list below to complete the sentences that follow. Each term may be used only once.

overharvest	aquatic farms	food
protein	aquaculture	ecosystem

15. Of all the resources the ocean supplies, the one in greatest demand is ________________________.

16. Seafood is an important source of ________________________, which can be harvested by fishing or through aquaculture.

17. When people ________________________ the ocean over a long period of time, the fish populations can collapse.

18. A collapse of a fish population can damage the ________________________ and threaten the fishing industry.

19. The raising of aquatic plants and animals for human use or consumption is called ________________________.

20. Catfish, salmon, oysters, and shrimp are already being grown on ________________________.

21. Under the best conditions, which type of farm could produce more food, aquatic farms or agricultural farms? Why?

____

____

____

22. How might aquatic farms be fertilized in the future?

____

____

____

____

Name ______________________ Class ____________ Date ____________

OCEAN-WATER POLLUTION

______ **23.** Which of the following items is NOT a source of ocean-water pollution?
a. garbage
b. nuclear waste
c. decaying ocean organisms
d. sewage

______ **24.** What factors have reduced the ocean's ability to absorb wastes and renew itself?
a. growth of world population and use of more-toxic substances
b. shifting ocean floors and toxic ocean plant life
c. underground volcanoes and offshore drilling
d. oil spills and global warming

______ **25.** In addition to beaches, what other area is in the greatest danger from increasing ocean-water pollution?
a. warm tropical areas
b. polar regions
c. inland lakes
d. coastal areas

______ **26.** Which of the following items is NOT a dangerous pollutant in the ocean?
a. mercury
b. phosphates
c. DDT from insecticides
d. lead from gasoline

______ **27.** What are two ways scientists and governments have worked to reduce pollution?
a. DDT is banned worldwide, and use of leaded gasoline has been eliminated.
b. Use of DDT and leaded gasoline have both been reduced in the United States.
c. Insecticide use has been banned in the United States, and use of leaded gasoline has been reduced.
d. Use of DDT has been banned in the United States, and use of leaded gasoline has been reduced.

Name ________________ Class ________ Date ________

Skills Worksheet

Directed Reading

Section: Ocean Currents

1. A horizontal movement of water in a well-defined pattern is called

   a(n) ________________.

2. What are two ways that oceanographers identify ocean currents?

   ____

   ____

   ____

3. What are the two major categories of ocean currents?

   ____

FACTORS THAT AFFECT SURFACE CURRENTS

______ **4.** Currents that are driven by winds and move horizontally on or near the ocean's surface are called
- **a.** air currents.
- **b.** high-pressure areas.
- **c.** surface currents.
- **d.** low-pressure areas.

______ **5.** Which of the following factors do NOT control surface currents?
- **a.** floating debris
- **b.** air currents
- **c.** location of the continents
- **d.** Earth's rotation

______ **6.** All surface currents are affected by
- **a.** glaciers.
- **b.** ocean pollution.
- **c.** winds.
- **d.** the equator.

7. Explain what causes winds to form.

   ____

   ____

8. How does wind make water on the ocean's surface move?

   ____

   ____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

9. Two types of global wind belts that affect the flow of ocean surface water are called ____________________ and ____________________.

10. Wind belts located just north and south of the equator are called ____________________.

11. In the Northern Hemisphere, trade winds blow from the ____________________.

12. In the Southern Hemisphere, trade winds blow from the ____________________.

13. In both hemispheres, trade winds push currents ____________________ across the tropical latitudes of all three major oceans.

14. In the Northern Hemisphere, westerlies blow from the ____________________.

15. In the Southern Hemisphere, westerlies blow from the ____________________.

16. In the higher latitudes of both hemispheres, westerlies push ocean currents in which direction?

____

17. Why does a surface current get deflected and divided when it flows against a continent?

____

____

18. The curving of the path of oceans and winds due to Earth's rotation is called the ____________________.

19. Huge circles of moving water caused by wind belts and the Coriolis effect are called ____________________.

20. In which direction does the water flow in gyres of the Northern Hemisphere?

____

____

21. In which direction does the water flow in gyres of the Southern Hemisphere?

____

____

Name ______________________ Class ______________ Date ______________

MAJOR SURFACE CURRENTS

In the space provided, write the letter of the description that best matches the term or phrase.

______ **22.** North Atlantic Current

______ **23.** Canary Current

______ **24.** Antarctic Circumpolar Current

______ **25.** California Current

______ **26.** Gulf Stream

______ **27.** North Pacific Drift

______ **28.** Equatorial Countercurrent

______ **29.** Kuroshio Current

______ **30.** Norway Current

______ **31.** equatorial currents

______ **32.** Labrador Current

a. the world's largest current

b. the Pacific equivalent of the Gulf Stream

c. a current that keeps the coast of Norway ice-free

d. a cool, southward current that flows along the California coast

e. a cool, southward current split off from the North Atlantic Current

f. an eastward-flowing current lying between equatorial currents

g. a swift, warm current in the North Atlantic

h. a vast, slow-moving warm current

i. a cold current that flows south in the North Atlantic and joins the Gulf Stream

j. warm currents in the Atlantic, Pacific, and Indian Oceans that move westward

k. a current also known as the Antarctic Circumpolar Current

33. A current that is uninterrupted by any continents and crosses all three major oceans is the ______________________.

34. Currents in the northern Indian Ocean are governed by ______________________, which are winds whose directions change seasonally.

35. The Gulf Stream, the North Atlantic Current, the Canary Current, and the North Equatorial Current form the ______________________.

36. A vast area of calm, warm water at the center of the North Atlantic Gyre is called the ______________________.

37. Name two things you would find floating on the surface of the Sargasso Sea.

____

____

38. The pattern of currents in the North Pacific is similar to that in the

______________________.

39. The Kuroshio Current flows toward North America as the

______________________, and then southward as the

______________________.

DEEP CURRENTS

40. A streamlike movement of ocean water far below the surface is called

a(n) ______________________.

41. Deep currents move much more ______________________ than ocean currents.

42. What causes deep currents to form?

____

____

43. What causes the movement of polar waters?

____

____

44. Two factors that determine the density of water are temperature

and ______________________.

45. Explain why water in polar regions has high salinity.

____

____

____

46. Where is the world's densest and coldest ocean water?

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

47. A deep current of dense, cold water that moves northward to a latitude of about 40°N is called the ______________________

48. Where does the deep current that moves southward under the northward-flowing Gulf Stream form?

____

____

49. What causes the salinity of water in the Mediterranean Sea to increase?

____

____

____

50. To where does the denser, highly saline water of the Mediterranean Sea flow?

____

____

51. A strong current caused by an underwater landslide is called a(n) ______________________.

52. Explain how a turbidity current forms.

____

53. How does the water in a turbidity current appear compared with the surrounding water?

____

54. Why does a turbidity current move beneath the clear water that surrounds it?

____

____

Back Print

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Ocean Waves

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **1.** wave period

______ **2.** crest

______ **3.** wave height

______ **4.** wave

______ **5.** wavelength

______ **6.** trough

a. the lowest point between two crests of a wave

b. the vertical distance between the crest and the trough of a wave

c. a periodic disturbance in a solid, liquid, or gas as energy is transmitted through it

d. the highest point of a wave

e. the time required for two consecutive wave crests to pass a given point

f. the horizontal distance between two consecutive crests or two consecutive troughs

7. The formula for calculating the speed at which a wave moves is ______________________.

WAVE ENERGY

8. Moving air caused by the uneven heating of Earth's atmosphere is called ______________________.

9. What causes small waves or ripples to form on the ocean?

____

____

10. What causes a wave to become larger?

____

____

11. Explain why larger waves tend to grow larger and smaller waves die out.

____

____

____

Name ______________________ Class ______________ Date ______________

12. Why does a bottle floating on water move in a circular path, even though it appears to be moving up and down?

____

____

13. Where does a water particle in a wave end up at the end of the wave period?

____

____

14. What is the diameter of the circle traced by a water particle on the ocean surface as a wave passes a given point?

____

____

15. What happens to the energy received by a wave as the depth of the water increases?

____

____

16. What happens to the diameter of a water molecule's circular path as water depth increases?

____

____

17. How much circular motion of water molecules occurs at a depth of one-half the wavelength?

____

____

18. What three factors determine the size of a wave?

____

____

____

19. The distance that the wind blows across open water to generate waves is called ______________________.

Name ______________________ Class ____________ Date ____________

Directed Reading *continued*

20. What kind of wind produces very large waves?

____

____

21. What kind of wind produces choppy water with waves of various heights and lengths?

____

____

22. One of a group of long, rolling waves of similar size is called

a(n) ______________________.

23. What causes a whitecap to form?

____

____

24. Why could whitecaps possibly have an effect on climate?

____

____

WAVES AND THE COASTLINE

25. At what point does a wave touch the ocean bottom in shallow water near the coastline?

____

____

26. What causes a wave near the coastline to break?

____

____

27. A foamy mass of water that washes onto the coastline is called

a(n) ______________________.

28. What is the height of a wave when it breaks?

____

____

____

Name ______________________ Class ______________ Date ______________

29. What effect do breakers have on ocean sediments?

____

____

30. What three factors determine the size and force of breakers?

____

____

31. What happens to a breaker if the slope of the ocean floor is steep?

____

____

32. What happens to a breaker if the slope of the ocean floor is gentle?

____

____

33. The process by which ocean waves bend toward the coastline as they come near shallow water is called ______________________.

34. What causes wave refraction?

____

____

35. An irregular current caused when the water of breaking waves is pulled back into deeper water by gravity is called a(n) ______________________.

36. Where can a normally weak undertow create problems for swimmers?

____

____

37. What causes rip currents to form?

____

____

38. How can a rip current be detected?

____

____

39. A current that forms when waves approach the beach at an angle is called a(n) ______________________.

40. Longshore currents flow ______________________ to the shore.

41. Explain how a sandbar forms.

____

____

____

TSUNAMIS

______ **42.** Which of the following is the most common cause of tsunamis?
- **a.** the wind
- **b.** volcanic eruptions
- **c.** underwater landslides
- **d.** earthquakes on the ocean floor

______ **43.** Why is it incorrect to call a tsunami a tidal wave?
- **a.** because a tsunami is caused by earthquakes on land
- **b.** because a tsunami is not caused by tides
- **c.** because a tsunami is not a wave
- **d.** because a tsunami is not destructive

______ **44.** The wave height of a tsunami in deep water is usually
- **a.** 100 m.
- **b.** 890 km.
- **c.** less than 1 m.
- **d.** 500 km.

______ **45.** The wavelength of a tsunami in deep water may be as long as
- **a.** 91 m.
- **b.** 9 m.
- **c.** 2 km.
- **d.** 500 km.

______ **46.** A tsunami has a huge amount of energy because of
- **a.** its great depth.
- **b.** its long wavelength.
- **c.** its trough.
- **d.** its low speed.

______ **47.** Which of the following may signal the approach of a tsunami when its trough arrives before the crest?
a. The water level on shore rises quickly.
b. The water on the shore pulls back suddenly.
c. Waves of 9 to 12 m hit shore.
d. Low waves break on shore.

______ **48.** Which of the following was NOT affected by the tsunami triggered by an earthquake in Chile in 1960?
a. the coast of South America
b. Hawaii
c. New York
d. Japan

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Tides

1. The periodic rise and fall of the water level in the oceans is called ______________________.
2. The period when the water level is highest is called ______________________.
3. The period when the water level is lowest is called ______________________.

THE CAUSES OF TIDES

4. According to Newton's law of gravitation, what causes tides?

____

____

5. Why does the ocean on the side of Earth facing the moon bulge slightly?

____

____

6. When tidal bulge occurs, what is caused in the area of the bulge?

____

____

7. Why does a tidal bulge form on the opposite side of Earth?

____

____

8. What causes low tides?

____

____

BEHAVIOR OF TIDES

______ **9.** How long does it take for all areas of the ocean to pass under the moon?
- **a.** 24 h
- **b.** 29 h
- **c.** 24 h 50 min
- **d.** 29 days

Name ______________________ Class ______________ Date ______________

_____ **10.** Most places in the ocean have two high tides and two low tides daily because
- **a.** there is a tidal range.
- **b.** there are two tidal bulges.
- **c.** the moon rises about 50 min later each day.
- **d.** the tidal range varies from place to place.

_____ **11.** What is the difference in levels of ocean water at high tide and low tide called?
- **a.** low tide
- **b.** tidal bulge
- **c.** tidal range
- **d.** high tide

_____ **12.** A tide that results when the gravitational pull of the sun and moon combine to create higher high tides and lower low tides is called a
- **a.** neap tide.
- **b.** tidal range.
- **c.** spring tide.
- **d.** new moon.

_____ **13.** When do spring tides occur?
- **a.** in March and April
- **b.** every two months
- **c.** between the full moon and new moon
- **d.** twice each month

_____ **14.** A tide that occurs when the gravity of the sun and the moon work against each other and create a small daily tidal range is called a
- **a.** tidal range.
- **b.** spring tide.
- **c.** neap tide.
- **d.** full moon.

TIDAL VARIATIONS

15. Name four features of the ocean basin that influence tidal patterns in the basin.

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

In the space provided, write the letter of the description that best matches the term or phrase.

_______ **16.** Gulf of Mexico coast

_______ **17.** Pacific Coast

_______ **18.** Atlantic Coast of the United States

a. experiences a mixed tidal pattern featuring a very high tide followed by a very low tide

b. experiences two high tides and two low tides each day

c. experiences one high tide and one low tide each day

19. The slow, rocking motion of ocean water caused by tidal bulges moving around the ocean basins is called ______________________.

20. Where is it difficult to see the effects of tidal oscillations?

____

____

____

____

21. Explain why the Baltic and Mediterranean Seas have a very small tidal range.

____

____

____

____

____

22. Where might tidal oscillations amplify the effects of tidal bulges?

____

____

____

____

____

Name ______________________ Class ______________ Date ____________

TIDAL CURRENTS

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **23.** slack water

______ **24.** ebb tide

______ **25.** tidal current

______ **26.** tidal bore

______ **27.** flood tide

a. the movement of water toward and away from the coast

b. time period between flood tide and ebb tide

c. flow of tidal current toward the coast

d. surge of tidal water upstream in a river that enters the ocean through a long bay

e. flow of tidal current toward the ocean

28. Where are tidal currents strongest?

____

____

____

29. Tidal currents in bays and other narrow coastlines may reach speeds of ______________________.

30. The tidal bores in the River Severn in England reach as far as ______________________ inland.

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Characteristics of the Atmosphere

1. Define *atmosphere*.

____

____

2. Describe two important functions served by Earth's atmosphere.

____

____

____

COMPOSITION OF THE ATMOSPHERE

______ **3.** The most abundant elements in air include all of the following gases EXCEPT
a. oxygen.
b. hydrogen.
c. nitrogen.
d. argon.

______ **4.** The composition of air is approximately the same all over Earth up to an altitude of about
a. 40 km.
b. 60 km.
c. 80 km
d. 100 km.

______ **5.** The two most abundant compounds in air are the gases carbon dioxide and
a. carbon monoxide.
b. smog.
c. water vapor.
d. hydrocarbons.

______ **6.** In addition to containing gaseous elements and compounds, the atmosphere carries various kinds of tiny solid particles such as dust and
a. pollution.
b. pollen.
c. insects.
d. rocks.

Name ______________________ Class ______________ Date ______________

______ **7.** How much of Earth's atmosphere is composed of nitrogen?
a. 26%
b. 78%
c. 52%
d. 87%

______ **8.** The process by which nitrogen moves from air to the soil and then to plants and animals and eventually returns to the air is called the
a. life cycle.
b. atmospheric cycle.
c. earth cycle.
d. nitrogen cycle.

______ **9.** Nitrogen is removed from the air primarily by
a. salt water.
b. airborne bacteria.
c. nitrogen-fixing bacteria.
d. evaporation.

10. Describe the four steps of the nitrogen cycle.

____

____

____

____

11. What percentage of Earth's atmosphere is made up of oxygen?

____

____

12. Identify six ways oxygen is removed from the atmosphere.

____

____

____

____

____

____

____

Name ________________ Class ________________ Date ________________

13. Explain how oxygen is returned to the atmosphere.

____

____

____

14. Is the current oxygen content of the atmosphere lower, higher, or about the same as it was millions of years ago? Explain your answer.

____

____

____

15. As water evaporates from oceans, lakes, streams, and soil, it enters air as

________________________.

16. What is the life process by which plants and animals give off water vapor?

____

17. How is water vapor removed as it enters the atmosphere?

____

18. What are three factors that affect the percentage of water vapor in the air?

____

____

____

19. What percentage of water is in dry air?

____

20. What percentage of water is in moist air?

____

21. What is ozone? How does it differ from oxygen?

____

____

____

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

22. What purpose does the ozone layer serve?

____

____

____

23. Describe the effect of chlorofluorocarbons (CFCs) on the ozone layer.

____

____

____

____

24. What are particulates?

____

____

25. List seven different particulates.

____

____

____

____

____

____

____

26. Describe four common sources of particulates.

____

____

____

____

____

27. How do large particles in the atmosphere differ from small particles?

____

____

____

ATMOSPHERIC PRESSURE

______ **28.** What holds the gases of the atmosphere near Earth's surface?
- **a.** molecules
- **b.** air
- **c.** gravity
- **d.** pressure

______ **29.** The pressure exerted on a surface by the atmosphere is called
- **a.** water pressure.
- **b.** gravitational pressure.
- **c.** surface pressure.
- **d.** atmospheric pressure.

______ **30.** The pressure of the atmosphere is exerted
- **a.** unequally in all directions.
- **b.** equally in all directions.
- **c.** unequally sideways.
- **d.** unequally up and down.

______ **31.** How much of the total mass of the atmosphere does gravity keep within 32 km of Earth's surface?
- **a.** 1%
- **b.** 32%
- **c.** 99%
- **d.** 78%

______ **32.** Because the pull of gravity is not as strong at higher altitudes, the air molecules there are farther apart and exert
- **a.** less pressure.
- **b.** more pressure.
- **c.** the same pressure.
- **d.** no pressure.

______ **33.** It can be said that atmospheric pressure decreases as altitude
- **a.** decreases.
- **b.** disappears.
- **c.** increases.
- **d.** remains the same.

34. Besides altitude, what are two other factors that cause atmospheric pressure to change?

____

____

35. In general, what happens to atmospheric pressure at sea level when the temperature increases?

____

____

36. Why is air that contains a lot of water vapor less dense than drier air?

____

____

____

37. What three units do meteorologists use to measure atmospheric pressure?

____

____

____

MEASURING ATMOSPHERIC PRESSURE

In the space provided, write the letter of the description that best matches the term or phrase.

______ **38.** standard atmospheric pressure

______ **39.** barometer

______ **40.** mercurial barometer

______ **41.** aneroid barometer

______ **42.** altimeter

a. instrument that measures atmospheric pressure using a column of liquid mercury

b. instrument that measures atmospheric pressure; changes in atmospheric pressure cause the sides of a sealed metal container to bend inward or bulge out

c. an instrument used to measure atmospheric pressure

d. an aneroid barometer that registers altitude above sea level rather than air pressure

e. 1 atmosphere; the average atmospheric pressure at sea level, equalling 760 mm of mercury or 1,000 millibars

Name ______________________ Class ______________ Date ______________

43. In Earth's atmosphere, what causes the distinctive pattern of temperature changes with increasing altitude?

____

____

____

LAYERS OF THE ATMOSPHERE

In the space provided, write the letter of the description that best matches the term or phrase.

______ **44.** troposphere

______ **45.** tropopause

______ **46.** stratosphere

______ **47.** stratopause

______ **48.** mesophere

______ **49.** mesopause

______ **50.** thermosphere

______ **51.** ionosphere

______ **52.** auroras

______ **53.** exosphere

a. the layer of atmosphere between the troposphere and the mesosphere, in which temperature increases as altitude increases

b. the uppermost layer of atmosphere, in which temperature increases as altitude increases

c. upper boundary of the stratosphere

d. the upper boundary of the troposphere

e. upper boundary of the mesosphere

f. the coldest layer of the atmosphere, between the stratosphere and the thermosphere, in which temperature decreases as altitude increases

g. the lowest layer of the atmosphere, in which temperature drops at a constant rate as altitude increases

h. the region above the ionosphere, where Earth's atmosphere blends into the almost complete vacuum of space

i. phenomena caused by interactions between solar radiation and the ionosphere

j. the lower region of the thermosphere

54. Explain why the temperature in the troposphere decreases as altitude increases.

____

____

55. Why does temperature begin to increase in the upper stratosphere?

____

____

56. Explain why the temperature in the thermosphere steadily rises.

TEMPERATURE INVERSIONS

57. What is an air pollutant?

58. How do fossil fuels cause air pollution?

59. What is a temperature inversion?

60. What is smog?

Back Print

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Solar Energy and the Atmosphere

1. How is Earth's atmosphere heated?

____

____

2. Name the two primary sources of heat in the atmosphere.

____

____

____

RADIATION

In the space provided, write the letter of the description that best matches the term or phrase.

______ **3.** radiation

______ **4.** wavelength

______ **5.** electromagnetic waves

______ **6.** electromagnetic spectrum

a. the waves that make up all forms of radiation

b. the distance from any point on a wave to the identical point on the next wave

c. all of the frequencies or wavelengths of electromagnetic radiation

d. all forms of energy that travel through space as waves, including the energy that Earth receives from the sun

7. What form of radiation can humans see?

____

8. What are three forms of radiation that humans cannot see?

____

____

____

9. How fast do waves of radiation travel through space?

____

10. How are the wavelengths of visible light seen?

____

Name ______________________ Class ______________ Date ____________

11. Which wavelengths are shorter than visible light? Which are longer?

____

____

____

____

____

____

THE ATMOSPHERE AND SOLAR RADIATION

______ **12.** Almost all radiation that has a wavelength shorter than the wavelengths of visible light is absorbed by the
a. lower atmosphere.
b. thermosphere.
c. upper atmosphere.
d. stratosphere.

______ **13.** X rays, gamma rays, and ultraviolet rays are absorbed by molecules of nitrogen and oxygen in the mesosphere and
a. lower atmosphere.
b. thermosphere.
c. upper atmosphere.
d. stratosphere.

______ **14.** Ultraviolet rays are absorbed and act upon oxygen molecules to form ozone in the
a. lower atmosphere.
b. thermosphere.
c. upper atmosphere.
d. stratosphere.

______ **15.** Solar rays with longer wavelengths, such as visible and infrared waves, reach the
a. lower atmosphere.
b. thermosphere.
c. upper atmosphere.
d. stratosphere.

16. Most incoming infrared radiation is absorbed by carbon dioxide, water vapor, and other complex molecules in the ____________________.

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

17. How much of the radiation from visible light waves is absorbed as they pass through the atmosphere?

____

____

18. What causes scattering?

____

____

____

19. What happens when particles and gas molecules in the atmosphere reflect and bend solar rays?

____

____

____

____

20. What does scattering do to solar rays that are traveling to Earth?

____

____

____

____

21. What effect does scattering have on the sky's appearance?

____

____

____

____

22. What happens to solar energy that reaches Earth's surface?

____

____

____

____

Name ______________________ Class ______________ Date ____________

23. What are eight characteristics on which the amount of energy that is absorbed or reflected by Earth's surface depends?

____

____

____

____

____

____

____

____

24. What is the fraction of solar radiation that is reflected off a particular surface called?

____

____

____

25. What is Earth's albedo? Explain your answer.

____

____

____

ABSORPTION AND INFRARED ENERGY

______ **26.** Solar radiation that is not reflected is
- **a.** absorbed.
- **b.** scattered.
- **c.** radiated.
- **d.** dissipated.

______ **27.** When Earth's surface absorbs solar radiation, the surface materials are heated by
- **a.** longer-wavelength infrared rays and ultraviolet light.
- **b.** short-wavelength infrared rays and visible light.
- **c.** short-wavelength microwaves and infrared light.
- **d.** longer-wavelength microwaves and ultraviolet light.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

______ **28.** Heated materials on Earth's surface convert energy into infrared rays of longer wavelengths and
a. reabsorb energy as infrared waves.
b. reabsorb energy as radio waves.
c. reemit energy as infrared rays.
d. reemit energy as radio waves.

29. What happens to the infrared rays that are reemitted into the atmosphere?

____

____

____

30. What does the absorption of thermal energy from the ground do to Earth's surface?

____

____

____

31. Warm air near Earth's surface sometimes bends light rays to cause an effect called a ______________________.

32. One process that helps heat Earth's atmosphere that is similar to the process that heats a greenhouse is called the ______________________.

33. The warming of the surface and lower atmosphere of Earth that occurs when carbon dioxide, water vapor, and other gases in the air absorb and reradiate infrared radiation is called the ______________________.

34. How does the amount of solar energy that enters Earth's atmosphere generally compare to the amount that escapes into space?

____

____

____

35. What is one human activity that may have caused the average temperature of the atmosphere to increase in recent years?

____

____

____

Name ______________________ Class ______________ Date ____________

VARIATIONS IN TEMPERATURE

______ **36.** What is the primary factor that affects how much solar energy reaches any point on Earth's surface?
- **a.** surface features
- **b.** time of year
- **c.** latitude
- **d.** time of day

______ **37.** Near the equator, the rays of the sun strike the ground at an angle of about
- **a.** 90%.
- **b.** 45%.
- **c.** 60%.
- **d.** 10%.

______ **38.** Temperatures are higher at the equator because
- **a.** solar energy is spread out over a larger area.
- **b.** solar energy is concentrated in a small area.
- **c.** clouds hold in the solar energy.
- **d.** more solar energy is reflected into space.

______ **39.** Seasonal variations in temperature occur because of
- **a.** the changing distance between Earth and the sun.
- **b.** the speed of Earth's rotation.
- **c.** the tilt of Earth's axis.
- **d.** the variations in the sun's energy.

______ **40.** Why does the amount of water in the air affect the temperature of a region?
- **a.** Water vapor reflects sunlight.
- **b.** Water vapor cools the air.
- **c.** Water vapor creates clouds.
- **d.** Water vapor stores heat.

______ **41.** Which regions will generally have more moderate temperatures?
- **a.** regions in which winds blow from the land
- **b.** regions receiving ocean winds
- **c.** regions receiving high winds
- **d.** regions receiving little rain

42. Why are the warmest hours of the day usually mid- to late afternoon?

____

____

____

43. What happens to the energy when sunlight hits Earth at an angle smaller than 90°?

____

____

____

44. Why are average temperatures higher at the equator than near the poles?

____

____

____

45. Why does the Northern Hemisphere have higher temperatures for one part of the year and lower temperatures the rest?

____

____

____

46. Why does the amount of water in the air affect the temperature of a region?

____

____

47. Why do areas of high elevation become warm during the day and cool quickly at night?

____

____

48. Why do desert temperatures vary widely between day and night?

____

____

49. Why are land areas close to large bodies of water generally cooler during the day and warmer at night than similar inland areas?

____

____

____

____

Name ______________________ Class ______________ Date ______________

CONDUCTION

______ **50.** As they become heated, molecules in a substance
- **a.** move at the same rate as when they are cooled.
- **b.** move faster.
- **c.** move more slowly.
- **d.** do not move at all.

______ **51.** What effect do collisions between molecules have on the molecules?
- **a.** It changes their structure.
- **b.** It breaks them apart.
- **c.** It cools them.
- **d.** It warms them.

______ **52.** The transfer of energy as heat from one substance to another by direct contact is called
- **a.** conduction.
- **b.** collision.
- **c.** firing.
- **d.** baking.

______ **53.** Solid substances are good conductors because
- **a.** molecules are close together.
- **b.** molecules are far apart.
- **c.** molecules cannot collide.
- **d.** molecules move slowly.

______ **54.** Air is a poor conductor because
- **a.** molecules are close together.
- **b.** molecules are far apart.
- **c.** molecules cannot collide.
- **d.** molecules move slowly.

______ **55.** Conduction heats only the lowest few centimeters of the atmosphere because
- **a.** air does not come into direct contact with Earth.
- **b.** air comes into direct contact with Earth.
- **c.** molecules of air in the lower atmosphere are closer together.
- **d.** molecules in the upper atmosphere do not collide.

CONVECTION

56. What is the primary cause of the heating of the lower atmosphere?

____

____

____

Name ______________________ Class ____________ Date ____________

Directed Reading *continued*

57. The movement of matter due to differences in density caused by temperature variations resulting in the transfer of heat is called ____________________.

58. When does convection occur?

____

____

____

59. What happens to air heated by radiation or conduction?

____

____

____

60. How is Earth's atmosphere warmed evenly?

____

____

____

61. Why is the atmospheric pressure lower beneath a mass of warm air?

____

____

____

____

____

____

62. Explain how atmospheric pressure differences create winds.

____

____

____

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Atmospheric Circulation

1. What causes the movement of air worldwide?

____

____

2. In what pattern does air near Earth's surface generally flow?

____

____

3. Why does air near Earth's surface flow from the poles to the equator?

____

____

4. Where do high pressure regions form?

____

____

5. Where do low-pressure regions form?

____

____

THE CORIOLIS EFFECT

______ 6. The circulation of the atmosphere and of the oceans is affected by
- **a.** the rotation of Earth at the equator.
- **b.** the rotation of Earth on its axis.
- **c.** the rotation of the moon on its axis.
- **d.** seasonal storms.

______ 7. Earth's rotation causes its diameter to be
- **a.** greatest through the equator.
- **b.** greatest through the poles.
- **c.** equal through the equator and the poles.
- **d.** greater at the North Pole than at the South Pole.

Name ______________________ Class ____________ Date ____________

Directed Reading *continued*

8. Do points near the equator or points near the poles travel farther and faster in a day?

____

____

____

9. Why does air follow a curved path?

____

____

____

10. The curving of the path of a moving object from an otherwise straight path due to earth's rotation is called the ________________.

11. What impact does the Coriolis effect have on the winds?

____

____

____

12. What determines the path along which the Coriolis effect deflects moving objects?

____

____

____

13. In which direction does the Coriolis effect deflect moving objects in the Northern Hemisphere? In the Southern Hemisphere?

____

____

____

14. How does the speed of an object relate to the Coriolis effect?

____

____

____

Name ______________________ Class ______________ Date ____________

15. How do the mass and travel distances of air or ocean currents relate to the Coriolis effect?

____

____

16. In general, on what type of objects is the Coriolis effect detectable?

____

____

GLOBAL WINDS

______ **17.** What are the three looping patterns of air flow in each hemisphere called?
a. wind belts
b. convection cells
c. prevailing winds
d. global air flow

______ **18.** A wind belt is characterized by prevailing winds that
a. flow in one main direction.
b. flow from the southwest.
c. flow from the northeast.
d. flow in all directions.

______ **19.** The prevailing winds that blow from east to west from 30° latitude to the equator in both hemispheres are called the
a. trade winds.
b. polar easterlies.
c. wind belts.
d. westerlies.

______ **20.** In the Northern Hemisphere, trade winds flow from the
a. southeast.
b. south.
c. northeast.
d. northwest.

______ **21.** From what direction do trade winds flow in the Southern Hemisphere?
a. the northeast
b. the southeast
c. the north
d. the southwest

______ **22.** The prevailing winds that blow from west to east through the contiguous United States are the
a. trade winds.
b. doldrums.
c. polar easterlies.
d. westerlies.

______ **23.** What are the prevailing winds that blow from east to west between 60° and 90° in both hemispheres?
a. the westerlies
b. the polar easterlies
c. wind belts
d. the trade winds

______ **24.** A stormy region created where the polar easterlies meet warm air from the westerlies is called a
a. trade wind.
b. doldrum.
c. front.
d. wind belt.

______ **25.** The sun's rays shift northward and southward during the changing seasons of the year causing a shift in the position of
a. convection zones and horse latitudes.
b. fronts and trade winds.
c. pressure belts and wind belts.
d. convection zones and pressure belts.

In the space provided, write the letter of the description that best matches the term or phrase.

______ **26.** doldrums

______ **27.** horse latitudes

______ **28.** jet streams

______ **29.** subtropical jet streams

______ **30.** polar jet streams

a. narrow bands of winds formed when warm equatorial air meets the cooler air of the middle latitudes

b. narrow bands of strong winds that blow in the upper troposphere

c. bands of winds formed as a result of density differences between cold polar air and warmer air of the middle latitudes

d. subtropical high-pressure zones with weak and variable winds

e. a zone of low pressure at the equator where the trade wind systems meet

LOCAL WINDS

Use the terms from the list below to complete the sentences that follow. Each term may be used only once.

valley breeze	breezes	sea breeze
land breeze	mountain breeze	local winds

31. Air movement influenced by local conditions and local temperature variations often cause ______________________, which are not part of the global wind belts.

32. Gentle winds that extend over distances of less than 100 km are called ______________________.

33. As warm air above land rises and cool air from above water moves in to replace it, a cool wind moving from water to land, called a ______________________, forms in the afternoon.

34. Overnight, the land offshore cools more rapidly than the water does, and a sea breeze is replaced by a ______________________, which flows from the cool land toward the warmer water.

35. During the day in mountainous regions, a gentle breeze called a ______________________ forms when warm air from the valleys moves upslope.

36. At night in the mountains, cool air descends from the peaks to the valleys, creating a ______________________.

Back Print

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Atmospheric Moisture

1. The states in which water exists in the atmosphere are

called ______________________.

2. The gas phase of water is called ______________________.

3. The solid phase of water is called ______________________.

4. The liquid phase of water is called ______________________.

CHANGING FORMS OF WATER

______ **5.** When does water change from one phase to another?
- **a.** when water molecules are held stationary
- **b.** when evaporation occurs
- **c.** when heat energy is absorbed or released
- **d.** when molecules are in a crystalline arrangement

______ **6.** When ice absorbs energy, the molecules of ice
- **a.** move more quickly.
- **b.** become stationary.
- **c.** become crystals.
- **d.** slow down.

______ **7.** What phase does ice change into when it absorbs energy?
- **a.** gas
- **b.** liquid
- **c.** crystals
- **d.** solid

______ **8.** When liquid water absorbs energy, it changes to
- **a.** a gas.
- **b.** a liquid.
- **c.** crystals.
- **d.** a solid.

______ **9.** What happens to the water molecules when the water absorbs energy?
- **a.** They move closer together.
- **b.** They collide more frequently.
- **c.** They become stationary.
- **d.** They move more slowly.

Name ______________________ Class ______________ Date ____________

______ **10.** The process in which the fastest-moving molecules escape from liquid and form invisible water is called
a. condensation.
b. latent heat.
c. evaporation.
d. collision.

______ **11.** The name for heat energy that is absorbed or released during a phase change is
a. latent heat.
b. evaporation.
c. water vapor.
d. potential energy.

______ **12.** When liquid water evaporates, the water
a. releases energy into the atmosphere.
b. condenses into water vapor.
c. starts to flow more rapidly.
d. absorbs energy from the environment.

______ **13.** What happens to energy absorbed by water during evaporation?
a. It condenses to form a liquid.
b. It melts ice.
c. It is reflected into the atmosphere.
d. It becomes potential energy between water molecules.

______ **14.** The name for the process in which water vapor changes back into a liquid is
a. condensation.
b. latent heat.
c. collision.
d. evaporation.

______ **15.** During the condensation of water, latent heat
a. is released into the water.
b. disappears.
c. is released into the surrounding air.
d. is absorbed by the water.

______ **16.** What happens to latent heat when ice thaws?
a. It is released.
b. It is absorbed.
c. It is recycled.
d. It is lost.

Name ________________________ Class ______________ Date ____________

______ **17.** When water freezes, latent heat
a. condenses.
b. is released into the air.
c. evaporates.
d. is absorbed.

______ **18.** Through what process does most water enter the atmosphere?
a. evaporation
b. absorption
c. condensation
d. release

19. Where on Earth does most evaporation take place?

____

____

20. Name four other important sources of water vapor in the atmosphere.

____

____

____

____

21. How are plants, volcanoes, and burning fuels related to water vapor in the atmosphere?

____

____

22. What usually happens to ice before it changes into a gas?

____

23. What is the name of the process in which a solid changes directly into a gas?

____

24. Under what conditions might sublimation of snow and ice occur?

____

____

25. Water vapor can turn directly into ice without becoming a(n)

________________________.

HUMIDITY

In the space provided, write the letter of the definition that best matches the term or phrase.

_____ **26.** humidity

_____ **27.** dew point

_____ **28.** absolute humidity

_____ **29.** mixing ratio

a. the temperature at which condensation equals evaporation

b. water vapor in the atmosphere

c. the mass of water vapor contained in a given volume of air

d. the mass of water vapor in a unit of air relative to the mass of the dry air

30. What controls humidity?

____

31. What determines the rate of evaporation?

____

32. What happens to the rate of evaporation as the temperature gets higher?

____

33. What determines the rate of condensation?

____

34. The part of the total atmospheric pressure that is caused by water vapor is

______________________.

35. When there is equilibrium between the rate of evaporation and the rate of condensation, the air is ______________________.

36. The measure of the actual amount of water vapor in the air is called the

______________________.

37. What equation is used to calculate the absolute humidity?

____

38. Why do meteorologists prefer to describe humidity by using the mixing ratio of air?

____

____

39. What is the mixing ratio of air that has 18 g of water vapor in 1 kg of air?

____

Name ______________________ Class ______________ Date ______________

40. What is a common mixing ratio for air in polar regions?

____

41. Why is the mixing ratio not affected by changes in temperature or pressure?

____

____

42. The ratio of the actual water vapor content of the air to the amount of water vapor needed to reach saturation is called

______________________.

43. If a person wanted to know how close the air is to reaching the dew point,

he or she would calculate the ______________________.

44. At what point does air become saturated at 25°C?

____

45. How would you express the relative humidity of air that is 25°C and contains 5 g of water?

____

46. What can make the relative humidity change even if the temperature does not change?

____

47. What can make the relative humidity increase if the moisture in the air remains the same?

____

48. What happens to the relative humidity if the temperature increases as the moisture in the air remains constant?

____

49. What can cause air to cool to its dew point?

____

____

50. What is the name of the condensation that forms during the night?

____

51. What causes dew to form?

____

____

Name ______________________ Class ______________ Date ____________

52. Under what conditions is dew most likely to form?

____

53. What is the form of condensation that forms if the dew point falls below the freezing temperature of water?

____

54. What is the difference between frost and frozen dew?

____

____

MEASURING HUMIDITY

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **55.** dew cell

______ **56.** electrical conductance

______ **57.** psychrometer

a. an instrument used to measure relative humidity consisting of two identical thermometers

b. the ability to conduct electricity

c. an instrument used to measure humidity consisting of a heater and two electrodes

58. Why do meteorologists measure humidity?

____

59. What happens when the lithium chloride in a dew cell absorbs water from the air?

____

____

60. What happens as the water evaporates from the LiCl?

____

____

61. The temperature at which the LiCl in a dew cell loses its ability to conduct electricity is the ______________________.

62. What is the difference between the two thermometers of a psychrometer?

____

____

Name ______________________ Class ______________ Date ____________

63. What happens to the wet bulb-thermometer when the psychrometer is whirled through the air?

____

____

64. How does the temperature of the wet-bulb thermometer differ from that of the dry-bulb thermometer after the psychrometer is whirled through the air?

____

65. What would you use to calculate the relative humidity from a psychrometer?

____

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **66.** hair hygrometer

______ **67.** radiosonde

______ **68.** electric hygrometer

a. an instrument that measures humidity at high altitudes

b. an instrument that measures relative humidity by using a bundle of hairs

c. a package that carries instruments into the atmosphere

69. As relative humidity increases, what happens to hair?

____

____

70. What is a disadvantage of using a hair hygrometer?

____

____

71. How does an electric hygrometer work?

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Clouds and Fog

1. A collection of small water droplets or ice crystals falling slowly through the air is a(n) ______________________.

2. The crystals or droplets that make up clouds form when condensation or sublimation occurs more quickly than the process of ______________________.

3. A cloud that forms near or on Earth's surface is ______________________.

CLOUD FORMATION

______ **4.** What must be available for water vapor to condense and form a cloud?
- **a.** a solid surface
- **b.** empty space
- **c.** high winds
- **d.** a body of water

______ **5.** The lowest layer of the atmosphere is the
- **a.** stratosphere.
- **b.** ionosphere.
- **c.** troposphere.
- **d.** thermosphere.

______ **6.** What is present in the troposphere that is essential for cloud formation?
- **a.** a large solid surface
- **b.** large particles
- **c.** stationary dust surfaces
- **d.** tiny suspended particles

______ **7.** Suspended particles that provide a surface for water vapor to condense are called
- **a.** water molecules.
- **b.** salt molecules.
- **c.** condensation nuclei.
- **d.** saturated air.

______ **8.** What happens when water molecules collect on condensation nuclei?
- **a.** The rate of condensation decreases.
- **b.** Water droplets form.
- **c.** The air temperature reaches the dew point.
- **d.** The rate of evaporation decreases.

______ **9.** What condition must the air be in for clouds to form?
a. It must not be saturated with water vapor.
b. It must have a low relative humidity.
c. The rate of evaporation must be higher than the rate of condensation.
d. The rate of condensation must be higher than the rate of evaporation.

______ **10.** The net condensation that forms clouds may be caused by
a. the warming of air.
b. the cooling of air.
c. rapid evaporation of air.
d. constant air temperature.

ADIABATIC COOLING

______ **11.** What happens to molecules in rising air?
a. They move closer together.
b. They move farther apart.
c. They do not move.
d. They have more collisions.

______ **12.** What occurs in adiabatic cooling?
a. Two bodies of moist air mix and change the air temperature.
b. The temperature of an air mass decreases as the air rises.
c. Air rises on a mountain and cools.
d. Air moves over a warm surface and cools.

______ **13.** What does the adiabatic lapse rate describe?
a. the temperature of a rising or sinking parcel of air
b. the amount the temperature of rising or sinking air changes
c. the amount of clouds in rising or sinking air
d. the rate at which the temperature of rising or sinking air changes

______ **14.** What is the adiabatic lapse rate of clear air?
a. 1°C for every 100 m that air rises
b. 1°C for every 1000 m that air rises
c. -1°C for every 100 m that air rises
d. -0.5°C for every 100 m that air rises

______ **15.** What is the average adiabatic lapse rate of cloudy air?
a. more than 1°C per 100 m that air rises
b. -1°C per 100 m that air rises
c. between 0.5°C and 0.9°C per 100 m that air rises
d. between -0.5°C and -0.9°C per 100 m that air rises

Name ______________________ Class ____________ Date ____________

Directed Reading *continued*

16. Why does cloudy air have a slower rate of cooling than clear air?

____

____

17. What two things happen to the energy from the sun when it reaches Earth's surface?

____

____

____

18. Describe what happens to air near Earth's surface.

____

____

____

19. What is the name of the altitude where net condensation begins to form clouds.

____

MIXING

20. How does the mixing of two bodies of moist air with different temperatures cause clouds to form?

____

____

____

LIFTING

21. What are the results of air being forced upward?

____

22. What kind of terrain may force air upward?

____

23. How do large clouds associated with storm systems form?

____

____

Name ______________________ Class ______________ Date ______________

ADVECTIVE COOLING

24. What is the name of the process in which the temperature of an air mass decreases as it moves over a cold surface, such as cold ocean or land?

____

25. What happens when an air mass moves over a surface colder than the air is?

____

26. What must happen in order for air cooled by adiabatic cooling, mixing, lifting, or advective cooling to form clouds?

____

CLASSIFICATION OF CLOUDS

27. What two features are used to classify clouds?

____

____

28. Name the three basic forms of clouds.

____

____

____

29. What are the three altitude groups of clouds and their heights?

____

____

____

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **30.** stratus clouds

______ **31.** altostratus clouds

______ **32.** cumulus clouds

______ **33.** cumulonimbus clouds

______ **34.** cirrus clouds

______ **35.** cirrostratus clouds

a. feathery clouds composed of ice crystals

b. middle-altitude clouds that usually produce little precipitation

c. high, dark storm clouds

d. clouds that form a high, transparent veil

e. billowy, low-altitude clouds

f. clouds with a flat base forming at very low altitudes

36. Clouds that form where a layer of warm, moist air lies above a layer of cool air are called ______________________.

37. What do the prefix *nimbo-* and the suffix *-nimbus* mean?

____

38. How do nimbostratus clouds differ from other stratus clouds?

____

39. What does *cumulus* mean?

____

40. What does the characteristic flat base of cumulus clouds represent?

____

41. On what two factors does the height of a cumulus cloud depend?

____

____

42. In what kind of weather do cumulus clouds grow highest?

____

43. What are cumulus clouds at middle altitudes called?

____

44. Name the low clouds that are a combination of two kinds of clouds.

____

45. What do *cirrus* and *cirro-* mean?

____

46. At what altitude do cirrus clouds form?

____

47. Why does light easily pass through cirrus clouds?

____

48. What kind of clouds often appear before a snowfall or rainfall?

____

____

Name ______________________ Class ______________ Date ____________

FOG

49. Compare and contrast fog and clouds.

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **50.** radiation fog

______ **51.** advection fog

______ **52.** upslope fog

______ **53.** steam fog

a. forms when cool air moves over an inland warm body of water

b. forms due to the loss of heat by radiation when Earth cools at night

c. forms when warm, moist air from above water moves over a cold surface

d. forms when air rises along land slopes

54. Why is radiation fog thickest in valleys and other low places?

____

____

55. Why is radiation fog often thick around cities?

____

____

56. Where is advection fog common?

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Precipitation

1. Any form of water that falls to Earth's surface from the clouds is called ________________________.

2. Name four major types of moisture that fall from the air to Earth.

____

____

____

____

FORMS OF PRECIPITATION

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **3.** rain

______ **4.** drizzle

______ **5.** snow

______ **6.** sleet

______ **7.** glaze ice

______ **8.** ice storm

______ **9.** hail

a. precipitation consisting of ice particles

b. solid precipitation in the form of lumps of ice

c. a thick layer of ice on a surface

d. clear ice pellets formed when rain falls through a layer of freezing air

e. liquid precipitation

f. rain consisting of drops smaller than 0.5 mm in diameter

g. the condition which produces glaze ice

10. What is the size of normal raindrops?

____

11. What is the most common form of solid precipitation?

____

12. What are three forms in which snow may fall?

____

____

____

Name ________________________ Class ______________ Date ____________

13. How do snowflakes change in size as the temperature goes below 0°C?

____

14. In what kind of clouds does hail usually form?

____

15. What process causes hail to form and fall to the ground?

____

____

____

16. Why is hail potentially harmful?

____

CAUSES OF PRECIPITATION

______ **17.** The diameter of most cloud droplets is about
- **a.** 5 millimeters.
- **b.** 20 micrometers.
- **c.** 100 micrometers.
- **d.** 20 millimeters.

______ **18.** What must happen in order for a cloud droplet to fall as precipitation?
- **a.** It must freeze.
- **b.** It must decrease in size.
- **c.** It must increase in size.
- **d.** It must warm up.

______ **19.** What two processes cause cloud droplets to fall to Earth?
- **a.** coalescence and ultracooling
- **b.** coagulation and supercooling
- **c.** coalescence and supercooling
- **d.** coagulation and superwarming

______ **20.** What happens in the process of coalescence?
- **a.** Small droplets slow down as they fall.
- **b.** Small droplets combine to form larger droplets.
- **c.** Small droplets break up into smaller droplets.
- **d.** Large droplets divide into smaller droplets.

______ **21.** During supercooling, a substance becomes extremely cold and
- **a.** changes to a solid.
- **b.** changes to a gas.
- **c.** changes to a liquid.
- **d.** does not change its state.

Name ______________________________ Class ______________ Date ____________

______ **22.** What is NOT true of freezing nuclei?
- **a.** They are a form of precipitation.
- **b.** They are suspended in the air.
- **c.** They are solid particles.
- **d.** They are similar to ice in structure.

______ **23.** Why don't supercooled water droplets freeze?
- **a.** They are too cold.
- **b.** They are too large.
- **c.** There are not enough freezing nuclei available.
- **d.** There are too many solid particles in the air.

______ **24.** What does water vapor from supercooled water droplets do?
- **a.** It condenses on ice crystals that have formed on freezing nuclei.
- **b.** It evaporates from the freezing nuclei.
- **c.** Water vapor from the droplets evaporates.
- **d.** Water vapor makes ice crystals increase in size.

______ **25.** Which of the following are created by the process of supercooling?
- **a.** drizzle and rain
- **b.** sleet and hail
- **c.** glaze ice and snow
- **d.** snow and rain

MEASURING PRECIPITATION

26. What is the name of an instrument used to measure rainfall?

____

27. In one type of ______________________, a funnel fills one side of a divided bucket with 0.25 mm of rainwater, and then tips and sets off an electrical device that records the amount.

28. What instrument measures snow depth?

____

29. About how much snow does it take to produce 1 cm of water?

____

30. What does Doppler radar measure?

____

31. How does Doppler radar work?

____

____

Name ________________ Class ________ Date ________

32. Name three things meteorologists can determine with Doppler radar.

____

____

____

33. How does Doppler radar save lives?

____

WEATHER MODIFICATION

______ **34.** The process in which freezing or condensation nuclei are introduced into a cloud to cause rain is called
a. rain seeding.
b. cloud seeding.
c. precipitation growing.
d. nuclei dropping.

______ **35.** Which of the following are introduced into a cloud to cause rain because they resemble ice crystals?
a. snow flakes
b. hail stones
c. carbon monoxide pellets
d. silver iodide crystals

______ **36.** The substance used in cloud seeding to cool cloud droplets and cause ice crystals to form is
a. powdered dry ice.
b. sleet.
c. water vapor.
d. snow.

37. What are three ways in which cloud seeding materials are released?

____

____

____

38. Does cloud seeding cause a significant increase in precipitation?

____

39. What are two ways in which cloud seeding could help people?

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Air Masses

Use the terms from the following list to complete the sentences below. Each term may be used only once.

high pressure	poles	low pressure
equator	wind patterns	air pressure

1. Differences in ______________________ are caused by unequal heating of Earth's surface.

2. The region along the ______________________ receives more solar energy than the polar regions do.

3. Heated equatorial air rises and creates a belt of ______________________.

4. Cold air near the poles sinks and creates a belt of ______________________.

5. Differences in air pressure at various locations on Earth create ______________________.

HOW AIR MOVES

______ **6.** Air moves from
- **a.** east to west.
- **b.** west to east.
- **c.** areas of high pressure to areas of low pressure.
- **d.** areas of low pressure to areas of high pressure.

______ **7.** There is a general world-wide movement of air from the
- **a.** poles toward the equator.
- **b.** equator toward the poles.
- **c.** Northern Hemisphere to the Southern Hemisphere.
- **d.** Southern Hemisphere to the Northern Hemisphere.

FORMATION OF AIR MASSES

8. What happens to air when the air pressure differences are small?

____

____

____

Name ______________________ Class ______________ Date ____________

9. What is an air mass?

____

____

____

10. What are the characteristics of air masses that form over polar areas?

____

11. What are the characteristics of air masses that form over tropical oceans?

____

TYPES OF AIR MASSES

______ **12.** Air masses are categorized according to their
- **a.** destination region.
- **b.** source region.
- **c.** polar region.
- **d.** tropical region.

______ **13.** Cold air masses come from
- **a.** polar areas.
- **b.** tropical areas.
- **c.** equatorial areas.
- **d.** temperate areas.

______ **14.** Warm air masses come from
- **a.** arctic areas.
- **b.** temperate areas.
- **c.** tropical areas.
- **d.** polar areas.

______ **15.** What are air masses that form over the ocean called?
- **a.** oceanic
- **b.** maritime
- **c.** continental
- **d.** dry

______ **16.** Air masses that form over land are called
- **a.** wet.
- **b.** maritime.
- **c.** grounded.
- **d.** continental.

Name ____________________ Class ____________ Date ____________

Directed Reading *continued*

17. Name three large land masses over which continental air masses form.

____

____

____

18. What weather conditions do continental land masses generally bring when they move into a region?

____

____

19. Name and describe the two types of continental air masses.

____

____

____

20. How do air masses that form over the ocean differ from continental air masses?

____

____

21. What weather conditions do maritime air masses generally bring when they travel to a new location?

____

____

22. Name and describe the two types of maritime air masses.

____

____

____

____

NORTH AMERICAN AIR MASSES

23. List the four types of air masses that affect the weather of North America with their six source regions.

____

____

____

____

____

24. What type of weather does an air mass usually bring?

____

____

25. What may happen to an air mass as it moves away from its source region? Give an example.

____

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____

26. What develops when cold, dry air turns warm and moist?

____

____

27. Describe the weather created by maritime tropical air masses that form over the tropical Atlantic Ocean.

____

____

____

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Name ______________________ Class ______________ Date ____________

28. How does the weather created by maritime tropical air masses that form over the tropical Pacific Ocean differ from that created by air masses that form over the tropical Atlantic?

____

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29. Explain where continental polar air masses generally originate and move and the type of weather they bring.

____

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____

30. Describe maritime polar air masses that form over the North Pacific Ocean and the type of weather they create.

____

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____

31. How do continental polar Canadian air masses differ from the polar air masses that form over the North Pacific Ocean?

____

____

32. How do maritime polar Atlantic air masses differ in movement and weather creation from the maritime Pacific air masses?

____

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Back Print

Name ________________________________ Class ________________ Date ______________

Skills Worksheet

Directed Reading

Section: Fronts

______ **1.** When two unlike air masses meet, what usually keeps them separate?
a. temperature differences
b. moisture differences
c. differences in density
d. differences in pressure

______ **2.** The boundary that forms between two air masses when they meet is called a
a. front.
b. storm line.
c. squall line.
d. midlatitude.

TYPES OF FRONTS

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **3.** cold front

______ **4.** warm front

______ **5.** stationary front

______ **6.** occluded front

a. a front of air masses that moves either very slowly or not at all

b. the front edge of a moving mass of cold air that pushes beneath a warmer air mass like a wedge

c. the front edge of an advancing warm air mass that replaces colder air with warmer air

d. a front that forms when a cold air mass overtakes a warm air mass and lifts the warm air mass off the ground and over another air mass

7. Describe the storms that form along a cold front.

____

____

____

____

8. How does a slow-moving cold front differ from a fast-moving cold front?

____

____

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Name ______________________ Class ______________ Date ____________

9. How does a warm front form?

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10. What kind of weather does a warm front generally produce?

____

____

11. Describe how a stationary front forms.

____

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12. Compare the weather produced by a stationary front to the weather produced by a warm front.

____

____

____

POLAR FRONTS AND MIDLATITUDE CYCLONES

Use the terms from the following list to complete the sentences below. Each term may be used only once. Some terms may not be used.

midlatitude cyclone	warm front	anticyclone
waves	polar front	wave cyclones

13. The boundary where cold polar air meets the tropical air mass of the middle latitudes, especially over the ocean, is called the ______________________.

14. Bends that form in a stationary or cold fronts that are the beginnings of low-pressure storm centers are called ______________________.

15. Also known as midlatitude cyclones, ______________________ are low-pressure storm centers.

Name ______________________ Class ______________ Date ______________

16. An area of low pressure that is characterized by rotating wind that moves toward the rising air of the central low-pressure region is called

a ______________________.

17. Unlike the air in a midlatitude cyclone, the air of a(n)

______________________ sinks and flows outward from a center of high pressure.

18. Summarize the four stages of a midlatitude cyclone.

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19. Describe how midlatitude cyclones travel and move in North America.

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20. Describe an anticyclone.

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21. What kind of weather does an anticyclone bring?

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Name ______________________ Class ______________ Date ______________

SEVERE WEATHER

22. List five weather events that are considered severe weather.

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In the space provided, write the letter of the description that best matches the term or phrase.

______ **23.** thunderstorm

______ **24.** lightning

______ **25.** mature stage

______ **26.** dissipating stage

______ **27.** cumulus stage

______ **28.** thunder

a. the first stage of a thunderstorm, in which warm, moist air rises and water vapor in the air condenses to form a cumulus cloud

b. electricity that is discharged during a thunderstorm

c. an effect created when electricity heats the air, and the air expands rapidly

d. a usually brief, heavy storm that consists of rain, strong winds, lightning, and thunder

e. the third stage of a thunderstorm, in which strong downdrafts stop air currents from rising and the storm dies out as water vapor decreases

f. the second stage of a thunderstorm, in which condensation continues as the cloud rises and becomes a dark cumulonimbus cloud, perhaps producing torrential rain and hail

29. Describe how lightning forms and explain what it is.

____

____

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

Safir-Simpson scale	tornado	storm surge
cumulonimbus cloud bands	eyewall	eye
water vapor	hurricane	latent heat

30. A severe storm that develops over tropical oceans and whose winds of more than 120 km/h spiral in toward the intensely low-pressure storm center is called a(n) ______________________.

31. During a hurricane, large amounts of ______________________ are released, increasing the force of the rising air.

32. A fully developed hurricane consists of a series of thick ______________________ that spiral upward around the center of the storm.

33. Winds increase toward the calm, clear ______________________ of the storm and may reach speeds of 275 km/h.

34. The most dangerous aspect of a hurricane is a rising sea level and large waves, called a ______________________ .

35. Every hurricane is categorized on the ______________________ by using several factors, including central pressure, wind speed, and storm surge.

36. Define tornado.

____

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37. Explain how a tornado forms.

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Name ______________________ Class ______________ Date ____________

38. What happens when a tornado funnel touches ground?

____

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39. When and where do most tornadoes occur?

____

____

____

40. What makes a tornado so destructive?

____

____

____

Back Print

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Weather Instruments

1. Name five measurements on which weather observations are based.

____

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____

____

2. How do meteorologists use these measurements?

____

____

MEASURING LOWER ATMOSPHERIC CONDITIONS

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **3.** thermometer

______ **4.** electrical thermometer

______ **5.** thermistor

______ **6.** barometer

______ **7.** anemometer

______ **8.** wind vane

a. an instrument that measures atmospheric pressure

b. a thermal resistor that measures temperature and responds quickly to temperature changes

c. an instrument that measures wind speed

d. an instrument that measures and indicates temperature, often in the form of a sealed glass tube filled with mercury or alcohol

e. an instrument that determines the direction of wind with an arrow shaped device that turns freely as the tail catches the wind

f. an instrument that measures and indicates temperature using an electric current

9. Describe how an electrical thermometer works.

____

____

____

Name ______________________ Class ______________ Date ____________

10. Why do scientists use barometers to help them predict the weather?

____

____

11. Explain how an anemometer works.

____

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____

MEASURING UPPER-ATMOSPHERIC CONDITIONS

12. Why do meteorologists study upper-atmospheric conditions?

____

____

13. What is a radiosonde?

____

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14. Explain how a radiosonde works.

____

____

____

15. What is radar?

____

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16. How does radar track a storm?

____

____

____

Name ______________________ Class ______________ Date ____________

17. Explain what Doppler radar can tell meteorologists.

18. What important purpose do weather satellites serve?

19. How do weather satellites measure the direction and speed of the wind at the level of the clouds?

20. How do weather satellites monitor weather at night?

21. What types of marine conditions do weather satellites monitor?

22. Explain how meteorologists use supercomputers to forecast weather.

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Forecasting the Weather

1. How did people of early civilizations meet the challenges of weather prediction?

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2. Describe the origins of scientific weather forecasting.

____

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____

GLOBAL WEATHER MONITORING

3. List seven types of weather observations reported from weather stations around the world.

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4. What are three services provided by the World Meteorological Organization?

____

____

____

Name ______________________________ Class ______________ Date ____________

WEATHER MAPS

______ **5.** The data that weather stations collect are transferred
a. onto weather satellites.
b. to weather stations.
c. onto weather maps.
d. to weather instruments.

______ **6.** What do meterologists use to communicate data on a weather map that can be understood around the world?
a. words and colors
b. words and numbers
c. symbols and letters
d. symbols and colors

______ **7.** A pattern of meteorological symbols that represents the weather at a particular observing station and that is recorded on a weather map is
a. a station model.
b. a station report.
c. the station forecast.
d. the station weather.

______ **8.** Lines that connect points of equal temperature on a weather map are called
a. isolines.
b. isotherms.
c. thermal lines.
d. isobars.

______ **9.** Lines on a weather map that connect points of equal atmospheric pressure are
a. isopressures.
b. isotherms.
c. pressure lines.
d. isobars.

______ **10.** Closely spaced lines of atmospheric pressure indicate high wind speeds and
a. no change in pressure.
b. wet weather.
c. a gradual change in pressure.
d. a rapid change in pressure.

Name ________________________ Class ______________ Date ____________

______ **11.** Isobars that form circles on a weather map are marked with an H or an L and indicate centers of
a. heat and light.
b. high pressure and low pressure.
c. high temperature and low temperature.
d. high clouds and low clouds.

12. What do common weather symbols describe?

____

____

____

13. Besides cloud cover, wind speed and direction, and weather conditions, what else do stations models indicate?

____

____

14. What is the dew point and what does it indicate about the air?

____

____

15. Describe the number and the line in the upper right hand corner of the station model and explain what they show.

____

____

____

____

16. On a weather map, what identifies a front?

____

____

17. How are areas of precipitation commonly marked on weather maps?

____

____

____

Name ______________________ Class ______________ Date ______________

WEATHER FORECASTS

18. How do meteorologists forecast the weather?

____

____

____

____

____

19. How do computers use information supplied by Doppler radar and satellite images?

____

____

____

____

20. Explain why meteorologists use more than one computer model to forecast weather.

____

____

____

____

21. What types of weather information can be predicted most accurately?

____

____

____

22. What types of weather information are more difficult to predict accurately?

____

____

____

Name ______________________ Class ______________ Date ____________

23. Explain how meteorologists use computers to make more accurate forecasts.

____

____

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **24.** nowcasts

______ **25.** daily forecasts

______ **26.** extended forecasts

______ **27.** medium-range forecasts

______ **28.** long-range forecasts

______ **29.** watch

______ **30.** warning

a. predict weather accurately 3 to 7 days ahead

b. predict weather over monthly and seasonal periods

c. predict weather for a 48-hour period

d. predict weather 8 to 14 days ahead using computer analysis of slowly changing large-scale movements of air

e. issued when severe weather has been spotted or is expected within 24 hours

f. use radar and enable forecasters to focus on timing precipitation and tracking severe weather

g. issued when the conditions are ideal for severe weather

CONTROLLING THE WEATHER

31. What is cloud seeding?

____

____

____

32. How has cloud seeding been used in Russia?

____

____

____

Name ______________ Class ______________ Date ______________

Directed Reading *continued*

33. How have scientists attempted to control hurricanes?

____

____

____

34. Why have scientists abandoned storm and hurricane control?

____

____

____

35. How have scientists attempted to control lightning?

____

____

____

36. What have been the results of attempts at lightning control?

____

____

____

Back Print

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Factors That Affect Climate

1. The average weather conditions for an area over a long period of time are referred to as ________________.

2. The condition of the atmosphere at a particular time, such as temperature, humidity, wind, and precipitation is called ________________.

TEMPERATURE AND PRECIPITATION

______ **3.** Climates are chiefly determined by using
a. average wind velocity.
b. average temperature.
c. average temperature and precipitation.
d. average wind velocity and precipitation.

______ **4.** Adding the high and low temperatures of the day and dividing by two determines the average
a. monthly temperature range.
b. weekly temperature range.
c. yearly temperature range.
d. daily temperature range.

______ **5.** Precipitation is described by using
a. monthly averages.
b. monthly and yearly averages.
c. yearly averages and ranges.
d. monthly and yearly averages and ranges.

______ **6.** In describing climate, what is important to consider in addition to averages in precipitation and temperature?
a. extremes in temperature and precipitation
b. local weather conditions
c. seasonal averages
d. yearly fluctuations in temperature and precipitation

______ **7.** The factors that have the greatest influence on both temperature and precipitation are heat absorption and release,
a. location, and latitude.
b. season, and location.
c. latitude, and topography.
d. season, and topography.

Name ______________________ Class ______________ Date ______________

LATITUDE

8. One of the most important factors that determines a region's climate is ______________________.

9. Temperature and wind patterns are determined by ______________________.

10. The higher the ______________________ of an area is, the smaller the amount of solar energy received by the area is.

11. The sun's rays hit Earth at a 90° angle at the ______________________, so temperatures are high.

12. The sun's rays hit Earth at a smaller angle at the ______________________, so temperatures are low.

13. In the Northern Hemisphere, the northern half of Earth is tilted away from the ______________________ during winter.

14. In the Northern Hemisphere, how does the tilt of Earth's axis and the way the sun's rays hit an area while Earth orbits the sun affect climate?

____

____

15. Because Earth receives different amounts of solar energy at different latitudes, belts of cool, dense air form near the ______________________, while belts of warm, less dense air form at the equator.

16. Because cool air is dense, it forms regions of ______________________ pressure.

17. Warm air forms regions of ______________________ pressure.

18. Differences is air pressure create ______________________.

19. In the equatorial belt of low pressure called the ______________________, air rises and cools, and water vapor condenses, creating precipitation.

20. In regions between 20° and 30° latitude, known as the ______________________, air sinks, warms, and dries, so little precipitation occurs.

21. In the middle latitudes, between 45° to 60°, warm tropical air meets cold polar air, which leads to belts of ______________________ precipitation.

22. In high-pressure areas, above 60° latitude, air masses are dry and cold, and average precipitation is ______________.

HEAT ABSORPTION AND RELEASE

23. What two factors affect the amount of solar energy that an area receives?

24. Why does land heat faster than water?

25. What does the temperature of the land or water influence?

26. What does the temperature of the air affect?

27. Define the term *specific heat*.

28. In addition to specific heat, what causes the average temperatures of land and water at the same latitude to vary?

Name ______________ Class ______________ Date ______________

29. What influences the amount of heat absorbed or released by the air?

____

____

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **30.** El Niño-Southern Oscillation (ENSO)

______ **31.** El Niño

______ **32.** La Niña

______ **33.** monsoon

a. a seasonal wind that blows toward the land in the summer, bringing heavy rains, and that blows away from the land in the winter, bringing dry weather

b. a cool-water phase of ENSO that affects weather patterns

c. the warm-water phase of ENSO; a periodic occurrence in the eastern Pacific Ocean in which the surface-water temperature becomes unusually warm

d. a cycle of changing wind and water-current patterns in the Pacific Ocean

34. What may occur in the Pacific Ocean region and southeastern United States during El Niño?

____

____

35. What may occur in Indonesia and Australia during El Niño?

____

____

36. What causes monsoon climates such as that in southern Asia?

____

____

____

____

37. In what other areas do monsoon conditions occur?

____

____

TOPOGRAPHY

In the space provided, write the letter of the description that best matches the term or phrase.

______ **38.** topography

______ **39.** rain shadow

______ **40.** foehn

______ **41.** chinook

a. a process that affects climate on both sides of a mountain

b. the surface features of the land

c. the warm, dry wind that forms as part of a rain shadow on the eastern slopes of the Rocky Mountains

d. a dry wind that flows down the slopes of the Alps

42. How does elevation affect temperature?

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Climate Zones

1. Name Earth's three major types of climate zones.

____

____

____

2. Why does each of these zones have several types of climates?

____

____

TROPICAL CLIMATES

In the space provided, write the letter of the description that best matches the term or phrase.

______ **3.** tropical climate

______ **4.** tropical rain-forest climate

______ **5.** tropical desert climate

______ **6.** savanna climate

a. characterized by warm and dry temperatures; annual rainfall of less than 25 cm

b. characterized by wet summers and dry winters; annual rainfall of 50 cm

c. characterized by high temperatures and heavy precipitation during at least part of the year; typical of equatorial regions

d. characterized by warm and humid temperatures; annual rainfall of 200 cm

7. What regions are characterized by tropical rain-forest climates?

____

____

8. What regions are characterized by savanna climates?

____

____

9. What regions are characterized by tropical desert climates?

____

____

Name ______________________________ Class ______________ Date ____________

MIDDLE-LATITUDE CLIMATES

______ **10.** What climate does the Pacific Northwest of the United States have?
- **a.** marine west coast
- **b.** humid continental
- **c.** steppe
- **d.** Mediterranean

______ **11.** What climate is found in the Great Plains of the United States?
- **a.** humid continental
- **b.** humid subtropical
- **c.** steppe
- **d.** mediterranean

______ **12.** What climate is found in the southeastern United States?
- **a.** humid subtropical
- **b.** steppe
- **c.** humid continental
- **d.** mediterranean

______ **13.** What climate is found in the northeastern United States?
- **a.** humid subtropical
- **b.** humid continental
- **c.** steppe
- **d.** marine west coast

______ **14.** What climate is located along the coast of central and southern California?
- **a.** humid continental
- **b.** steppe
- **c.** mediterranean
- **d.** humid subtropical

Name ______________________ Class ____________ Date ____________

In the space provided, write the letter of the description that best matches the term or phrase.

______ **15.** middle-latitude climate

______ **16.** marine west coast climate

______ **17.** steppe climate

______ **18.** humid continental climate

______ **19.** humid subtropical climate

______ **20.** mediterranean climate

a. a dry climate with a large annual temperature range; annual precipitation of less than 40 cm

b. a mild climate with a low annual temperature range between summer and winter; annual precipitation of about 40 cm

c. a climate with a low annual temperature range; annual precipitation of 60 to 150 cm

d. a climate with a large annual temperature range; annual precipitation of 75 to 165 cm

e. a climate with a maximum average temperature of 8°C in the coldest month and a minimum average temperature of 10°C in the warmest month

f. a climate with a large annual temperature range; annual precipitation of greater than 75 cm

POLAR CLIMATES

In the space provided, write the letter of the description that best matches the term or phrase.

______ **21.** polar climate

______ **22.** subarctic climate

______ **23.** tundra climate

______ **24.** polar icecap climate

a. has average temperatures below 4°C; annual precipitation of 25 cm

b. has average temperatures that are near or below freezing; typical of polar regions

c. has average temperatures below 0°C; low annual precipitation

d. has the largest annual temperature range (63°C); annual precipitation of 25 to 50 cm

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

25. Treeless plains and nine months of temperatures below freezing characterize the ______________________ climate.

26. Little or no life, temperatures below freezing year-round, and high winds characterize the ______________________ climate.

27. Evergreen trees and brief, cool summers with long, cold winters characterize the ______________________ climate.

LOCAL CLIMATES

28. Define *microclimate.*

____

____

29. What influences microclimates?

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30. Why might the average temperature of a city be a few degrees higher than that of the surrounding rural area?

____

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31. How does elevation affect local climate?

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32. Describe the *highland climate.*

____

____

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

33. Explain how large bodies of water, such as lakes, influence local temperatures.

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34. What effect do large bodies of water have on precipitation?

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Name ________________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Climate Change

1. What two questions do scientists work to answer?

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____

____

2. Define *climatologist*.

____

____

____

STUDYING CLIMATE CHANGE

3. What practice helps climatologists make predictions about future climates?

____

____

Use the terms from the list below to complete the sentences that follow. Each term may be used only once.

sea-floor sediment	ice cores	general circulation models (GCMs)
fossils	tree rings	

4. When scientists find high ^{18}O levels in ____________________, they know that the water was cool in the past.

5. Thin ____________________ indicate cool weather and low precipitation in the past.

6. High levels of CO_2 found in ____________________ indicate warmer climate in the past, whereas ice ages follow decreases in CO_2.

7. By studying ____________________, scientists can learn how animals adapted to changing climates.

8. Computer-generated climate models that simulate changes in one variable when other variables remain unchanged are called ____________________.

Name ______________________ Class ____________ Date ____________

9. What four climate conditions can computer models be used to predict?

____

____

____

____

10. Complex computer models can model interactions between what five elements?

____

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____

POTENTIAL CAUSES OF CLIMATE CHANGE

11. What four factors might cause climate changes?

____

____

____

____

12. The movement of continents over millions of years caused by

______________________ may affect climate changes.

13. According to the Milankovitch theory, what three factors can lead to climate changes?

____

____

____

14. The shape of Earth's orbit changes from ______________________ to circular, affecting Earth's distance from the sun and therefore Earth's temperature and climate.

15. Decreasing ______________________ decreases temperature differences between seasons.

Name ______________________ Class ______________ Date ______________

16. The wobble of Earth on its axis changes the direction of Earth's tilt and can reverse the ______________________.

17. What human activities are responsible for releasing carbon dioxide, CO_2, into the atmosphere?

____

____

18. What can increases in CO_2 levels lead to?

____

____

19. Sulfur and ash from ______________________ can decrease temperatures by reflecting sunlight back into space.

POTENTIAL IMPACTS OF CLIMATE CHANGE

20. Climate change can affect what three life-forms?

____

____

____

21. What are three potential climate changes that could make survival of life on Earth more difficult for both humans and other species?

____

____

____

22. Define *global warming*.

____

____

____

____

____

Name ______________________ Class ______________ Date ____________

23. How could global warming affect plants and animals?

24. How could the melting of polar icecaps affect the shoreline and its inhabitants?

WHAT HUMANS CAN DO

25. What actions have countries taken to reduce the potential effects of global warming?

26. List four actions individuals can take to reduce CO_2 concentrations in the atmosphere that are caused by pollution.

27. Name two ways that people can change their transportation habits to reduce the release of CO_2 into the atmosphere.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

28. When driving, what are three things that can be done to make sure the car is burning fuel more efficiently?

____

____

____

29. How can hybrid cars reduce the amount of carbon dioxide in the atmosphere?

____

____

Back Print

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Viewing the Universe

1. How did observations of the sky help farmers in the past?

____

2. How did observations of the sky help sailors in the past?

____

3. What is the main reason people study the sky today?

____

4. What is astronomy?

____

THE VALUE OF ASTRONOMY

5. Name four exciting space discoveries astronomers have made.

____

____

____

____

6. What have astronomers learned from these discoveries?

____

____

7. What are the potential benefits to humans of studying the universe?

____

____

____

8. Name two federal agencies that support astronomical research.

____

____

____

CHARACTERISTICS OF THE UNIVERSE

______ **9.** The study of the origin, properties, processes, and evolution of the universe is called
a. astronomy.
b. the big bang.
c. gravity.
d. cosmology.

______ **10.** Most astronomers agree that the universe began with the big bang, which was
a. a gradual blooming of stars and planets.
b. a great dust swirl that appeared about 4 billion years ago.
c. a giant explosion that occurred about 14 billion years ago.
d. a black hole that turned inside out.

______ **11.** In addition to telescopes, what do astronomers commonly use to study the universe?
a. computer models.
b. experiments.
c. microscopes.
d. computer games.

______ **12.** What is the nearest part of the universe to Earth?
a. the Milky Way.
b. the solar system.
c. Mars.
d. a galaxy.

______ **13.** A large collection of stars, dust, and gas bound together by gravity is called a
a. solar system.
b. Milky Way.
c. comet.
d. galaxy.

______ **14.** The Milky Way is
a. Earth's solar system.
b. Earth's galaxy.
c. a star.
d. an asteroid.

______ **15.** How many galaxies exist in the universe?
a. one
b. hundreds
c. millions
d. billions

16. What is the average distance between Earth and the sun? What is this distance called?

____

17. How far does light travel in one year? What is this distance called?

____

18. How far from Earth is the nearest star besides the sun?

____

OBSERVING SPACE

_______ **19** Astronomers can see planets because planets
a. reflect light.
b. emit light.
c. emit radio waves.
d. emit X rays.

_______ **20.** What are all the frequencies or wavelengths of electromagnetic radiation called?
a. visible light.
b. the electric spectrum.
c. the radiation frequencies.
d. the electromagnetic spectrum

_______ **21.** Which is NOT an example of electromagnetic radiation?
a. radio waves
b. X rays
c. gravity
d. visible light

22. What is electromagnetic radiation composed of?

____

____

23. What happens when white light passes through a prism?

____

24. What causes the different colors in the color spectrum?

____

____

25. Which colors of light have the shortest wavelengths? Which have the longest?

____

Name ______________________ Class ______________ Date ______________

26. Describe the wavelengths of electromagnetic radiation that cannot be seen by humans.

____

____

____

27. Name six specific kinds of invisible wavelengths, which can only be detected by special instruments.

____

____

28. What happens if you place a thermometer in any wavelength of the visible spectrum?

____

29. How did Sir Frederick William Herschel discover infrared?

____

____

30. What does the word *infrared* mean?

____

31. How long are infrared waves compared with waves of visible light?

____

32. How long are radio waves compared with infrared waves?

____

33. What are the shortest wavelengths of visible light?

____

34. What does the word *ultraviolet* mean?

____

35. How long are X-ray wavelengths compared with ultraviolet wavelengths?

____

36. What are the shortest wavelengths?

____

____

Name ______________________ Class ______________ Date ______________

TELESCOPES

______ **37.** Galileo is known for
- **a.** discovering the moon.
- **b.** naming the Milky Way.
- **c.** using a telescope to study the sky.
- **d.** inventing the telescope.

______ **38.** A telescope is an instrument that
- **a.** collects electromagnetic radiation from the sky and concentrates it.
- **b.** changes X rays from the sky to visible light.
- **c.** makes infrared waves visible to humans.
- **d.** reflects light from the craters on the moon.

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **39.** optical telescope

______ **40.** lens

______ **41.** refracting telescope

______ **42.** reflecting telescope

______ **43.** radio telescope

- **a.** an instrument that uses a set of lenses to gather and focus light from distant objects
- **b.** an instrument that uses a curved mirror to gather and focus light from distant objects
- **c.** an instrument that detects radio waves from space
- **d.** a telescope that collects only visible light
- **e.** a clear object shaped to bend light in special ways

44. What are two problems with refracting telescopes?

____

____

____

____

____

45. What problem does a reflecting telescope solve?

____

46. Describe what happens to light that enters a reflecting telescope.

____

____

Name ______________________ Class ____________ Date __________

47. In what way are the mirrors in reflecting telescopes better than the objective lenses in refracting telescopes?

____

48. What are the largest reflecting telescopes and how large are they?

____

49. Name four kinds of invisible radiation that telescopes have been developed to detect.

____

____

____

____

50. What effect does Earth's atmosphere have on many forms of electromagnetic radiation?

____

____

____

51. Why do ground-based telescopes that detect invisible radiation work best at high elevations?

____

____

____

SPACE-BASED ASTRONOMY

52. Why have spacecraft with instruments proved valuable in investigating planets, stars, and other distant objects?

____

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **53.** *Hubble Space Telescope*

______ **54.** *Chandra X-ray Observatory*

______ **55.** *Compton Gamma Ray Observatory*

______ **56.** *Spitzer Space Telescope*

______ **57.** *James Webb Space Telescope*

a. was launched in 2003 to detect infrared radiation

b. orbits Earth to collect electromagnetic radiation from space objects

c. will be launched in 2011 to detect infrared radiation from objects in space

d. was used to detect gamma rays from objects such as black holes

e. makes clear images using X rays from objects in space

58. What planets were investigated by *Voyager 1* and *Voyager 2* spacecraft?

____

____

59. What information did the *Galileo* spacecraft gather about Jupiter?

____

____

____

60. What spacecraft began orbiting Saturn in 2004?

____

____

61. What will the *Huygens* probe do in December 2004?

____

____

62. Why are scientists interested in studying Titan?

____

____

____

Back Print

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

Earth's moon	robotic spacecraft	space shuttle
crewed spacecraft	the solar system	space port

63. Spacecraft that carry only instruments and computers are called ______________.

64. Spacecraft that do not carry humans can explore space and travel beyond the ______________.

65. Spacecraft that carry humans are ______________.

66. The humans have never traveled in space beyond ______________.

67. An example of a crewed spacecraft that orbits Earth to repair satellites and perform experiments is the ______________.

68. Why is it taking NASA a long time to launch a voyage to Mars?

____

____

69. What events focused public attention on the risks of human space exploration?

____

____

____

70. How has space study helped make weather predictions more accurate?

____

____

71. What kind of help do satellites give car drivers and airplane pilots?

____

____

72. How has space exploration led to improved electronics?

____

73. How has space exploration helped improve medical equipment?

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Movements of Earth

THE ROTATING EARTH

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

daylight	rotation	revolution
east	nighttime	year
day	west	night

1. The spinning of Earth on its axis is called ______________________.

2. A complete rotation of Earth takes about one ______________________.

3. As Earth rotates from west to east, the sun seems to rise in the ______________________.

4. The sun appears to set in the ______________________.

5. The side of Earth facing the sun at any given moment experiences ______________________.

6. The side of Earth facing away from the sun at any given moment experiences ______________________.

7. What did Foucault's pendulum provide in the 19th century?

____

8. What happens to the path of a pendulum over the course of a day?

____

9. What causes the apparent change in the path of a pendulum?

____

10. What causes deflection of ocean currents and wind belts?

____

11. In which direction are ocean currents and wind belts deflected in the Northern Hemisphere? In the Southern Hemisphere?

____

12. What is the curving of the path of wind belts and ocean currents called?

____

Name ______________________ Class ____________ Date ____________

THE REVOLVING EARTH

13. What is the average speed of Earth as it travels around the sun?

____

14. How long does each complete revolution of Earth around the sun take?

____

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **15.** revolution

______ **16.** orbit

______ **17.** ellipse

______ **18.** perihelion

______ **19.** aphelion

a. a closed curve whose shape is determined by two points within the curve

b. the point in a planet's orbit at which the planet is closest to the sun

c. the motion of a body that travels around another body in space

d. the point in a planet's orbit at which the planet is farthest from the sun

e. the path that a body follows as it travels around another body in space

20. What is the shape of Earth's orbit around the sun?

____

21. What is Earth's aphelion distance? Earth's perihelion distance?

____

CONSTELLATIONS AND EARTH'S MOTION

22. What is a constellation?

____

23. What did the International Astronomical Union do in 1930?

____

24. Where did many of the names for the constellations come from?

____

Name ______________________ Class ____________ Date ____________

25. What causes the position of a constellation to appear to change over a period of several hours?

____

26. What causes the position of a constellation to appear to change, at the same time of the evening, over a period of several weeks?

____

MEASURING TIME

______ **27.** The basis for the measurement of time is
- **a.** the sun's motion.
- **b.** the moon's motion.
- **c.** Earth's motion.
- **d.** the galaxy's motion.

______ **28.** The measurement of a day is determined by
- **a.** the rotation of Earth on its axis.
- **b.** Earth's revolution around the sun.
- **c.** the moon's motion around Earth.
- **d.** the period between successive full moons.

______ **29.** The measurement of a year is determined by
- **a.** the rotation of Earth on its axis.
- **b.** Earth's revolution around the sun.
- **c.** the moon's motion around Earth.
- **d.** the period between successive full moons.

______ **30.** The measurement of a month is based on
- **a.** the rotation of Earth on its axis.
- **b.** Earth's revolution around the sun.
- **c.** the moon's motion around Earth.
- **d.** Earth's motion around the moon.

______ **31.** Each rotation of Earth on its axis takes
- **a.** 24 hours.
- **b.** 29.5 days.
- **c.** 365 days.
- **d.** 365 1/4 days.

______ **32.** Each complete revolution of Earth around the sun takes
- **a.** 24 hours.
- **b.** 29.5 days.
- **c.** 365 days.
- **d.** 365 1/4 days.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

______ **33.** Today, a month is determined as roughly
a. 29.5 days.
b. one-twelfth of a year.
c. 28 days.
d. 365 days.

______ **34.** Who were the first people to use a calendar based on a solar year?
a. the Aztecs
b. the Romans
c. the Babylonians
d. the Egyptians

______ **35.** What civilization created a calendar based on a 12-month lunar year?
a. the Roman
b. the Babylonian
c. the Egyptian
d. the Aztec

36. What is a calendar?

____

____

37. Why is the extra 1/4 day of the year usually ignored?

____

38. What is a leap year? Explain why it is necessary.

____

____

____

39. What two Roman rulers were responsible for creating the yearly calendar as we know it?

____

40. What calendar problem did Pope Gregory XIII address and how did his committee solve it?

____

____

____

____

Name ______________________ Class ______________ Date ____________

41. What is the definition of noon?

____

____

42. Is it noon at the same time all over the world? Explain your answer.

____

____

43. How many degrees does each of Earth's 24 standard time zones cover? Explain your answer.

____

____

____

44. How is the time in one zone different from the time in the zone east of it?

____

45. What is the International Date Line ? What does it mark?

____

____

____

46. Why is daylight time shorter in the winter months than in the summer months?

____

47. Why does the United States use daylight savings time from April to October?

____

48. According to daylight savings time, what do we do to clocks in April and October?

____

____

49. Why do equatorial countries not observe daylight savings time?

____

____

THE SEASONS

______ **50.** Earth's axis is
- **a.** vertical.
- **b.** tilted at 12°.
- **c.** tilted at 23.5°.
- **d.** 90°.

______ **51.** During each revolution of Earth, the North Pole
- **a.** sometimes tilts toward the sun and sometimes tilts away.
- **b.** is always vertical.
- **c.** always tilts toward the sun.
- **d.** always tilts away from the sun.

______ **52.** When the North Pole tilts toward the sun, the Northern Hemisphere has
- **a.** the same amount of daylight as the Southern Hemisphere.
- **b.** longer periods of daylight than the Southern Hemisphere.
- **c.** shorter periods of daylight than the Southern Hemisphere.
- **d.** varying periods of daylight compared to the Southern Hemisphere.

______ **53.** When the North Pole tilts away from the sun, the sun's rays strike the Northern Hemisphere
- **a.** vertically.
- **b.** at a high angle.
- **c.** at a low angle.
- **d.** horizontally.

______ **54.** Seasons are caused by
- **a.** Earth's rotation on its axis.
- **b.** changes in the angle at which the sun's rays strike Earth.
- **c.** the distance of a place from the equator.
- **d.** differences in Earth's time zones.

______ **55.** Winter occurs in the Northern Hemisphere when
- **a.** the North Pole tilts away from the sun.
- **b.** the North Pole tilts toward the sun.
- **c.** the sun's rays strike the Northern Hemisphere at a high angle.
- **d.** the sun's rays creates more daylight hours.

______ **56.** A result of fewer daylight hours is
- **a.** less solar energy.
- **b.** more solar energy.
- **c.** higher temperatures.
- **d.** a longer season.

______ **57.** When it is winter in the Northern Hemisphere, the Southern Hemisphere experiences
a. winter.
b. summer.
c. spring.
d. fall.

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

autumnal equinox	hemisphere	equator
equinox	vernal equinox	celestial equator

58. A line drawn on the sky directly overhead from the equator on Earth is called the ______________________.

59. The moment when the sun appears to cross the celestial equator is a(an) ______________________.

60. At an equinox, the angle of the sun's rays along the ______________________ is 90°.

61. The beginning of fall in the Northern Hemisphere is marked by the ______________________, occurring on September 22 or 23.

62. The beginning of spring in the Northern Hemisphere is marked by the ______________________, falling on March 21 or 22.

63. What is true of the hours of daylight and darkness everywhere on Earth at an equinox?

____

64. What is a solstice?

____

____

65. What begins on the soltices each year?

____

66. Along what line do the sun's rays strike Earth at a 90° angle at the summer solstice? Where is this line located?

____

67. What happens to the sun in the Northern Hemisphere at the summer solstice?

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

68. How does the period of daylight change depending on your location on Earth at the summer solstice?

____

____

69. Along what line do the sun's rays strike Earth at a 90° angle at the winter solstice? Where is this line located?

____

70. Describe the hours of daylight in the Northern Hemisphere at the winter solstice.

____

Name ______________________ Class ____________ Date ____________

Skills Worksheet

Directed Reading

Section: Formation of the Solar System

1. The sun and all of the planets and other bodies that revolve around it make up the ______________________.
2. Any primary body that orbits the sun, or a similar body that orbits another star, is called a(n) ______________________.
3. In 1796, the French mathematician Pierre-Simon, marquis de Laplace, advanced the ______________________ to explain the origins of the solar system.

THE NEBULAR HYPOTHESIS

______ 4. Laplace's hypothesis states that the sun and the planets condensed at about the same time out of a rotating cloud of dust and gas called a
- a. planet.
- b. nebula.
- c. supernova.
- d. solar system.

______ 5. The rotating cloud of dust and gas from which our solar system is thought to have formed is called the
- a. solar nebula.
- b. gas giant.
- c. sun.
- d. nova

______ 6. Energy from collisions and pressure from gravity caused the center of the solar nebula to become
- a. hotter and less dense.
- b. cooler and denser.
- c. cooler and less dense.
- d. hotter and denser.

______ 7. Which of the following formed when the temperature at the center of the nebula reached about 10,000,000°C and hydrogen fusion began?
- a. Mars
- b. Earth
- c. the sun
- d. the moon

______ **8.** How much of the matter that was contained in the solar nebula makes up the sun?
a. 5%
b. about 99%
c. 25%
d. about 75%

FORMATION OF THE PLANETS

______ **9.** Small bodies from which a planet originated in the early development of the solar system are called
a. atmospheres.
b. planetesimals.
c. suns.
d. moons.

______ **10.** Some planetesimals joined together through collision and through the force of gravity to form larger bodies called
a. protoplanets.
b. sunspots.
c. protons.
d. nebulas.

______ **11.** The smaller bodies that orbit the planets are called
a. solar nebulas.
b. moons.
c. planetesimals.
d. suns.

12. Why are Mercury, Venus, Earth, and Mars called the *inner* planets?

____

____

13. Why did the inner planets, which contained large percentages of heavy elements such as iron and nickel, lose their less dense gases?

____

____

14. How do the surfaces of the inner planets compare with that of Earth today?

____

____

15. How do the inner planets differ from the outer planets?

____

Name ______________________ Class ______________ Date ______________

16. Jupiter, Saturn, Uranus, and Neptune are referred to as

______________________ planets.

17. How did distance from the sun affect the formation of the outer planets?

____

____

____

18. Name the three reasons why the outer planets are referred to as *gas giants*.

____

____

____

19. Which outer planet is farthest from the sun?

____

____

20. In what way does Pluto differ from the other outer planets?

____

____

21. In what way is Pluto similar to the other outer planets?

____

____

22. Why do many scientists believe that Pluto should not be classified as a major planet?

____

____

FORMATION OF SOLID EARTH

______ **23.** When Earth formed, its high temperature was NOT due to

a. heat produced when planetesimals collided with one another.

b. heat generated when the increasing weight of its outer layers compressed its inner layers.

c. the conversion of moving radioactive particles into heat energy.

d. an irregular orbit that brought it closer to the sun.

______ **24.** Dense materials such as molten iron sank to Earth's center and less dense materials were forced to the outer layers in a process called
a. distinction.
b. differentiation.
c. distribution.
d. delineation.

______ **25.** Which of the following did NOT form as one of Earth's layers when differentiation occurred?
a. core
b. mantle
c. atmosphere
d. crust

______ **26.** Which of the following elements is NOT present in large amounts in Earth's three layers ?
a. gold
b. iron
c. silica
d. magnesium

______ **27.** Earth's surface continued to change as a result of
a. increasing radiation.
b. colliding planetesimals.
c. the heat in Earth's interior.
d. hydrogen fusion.

FORMATION OF EARTH'S ATMOSPHERE

______ **28.** The original atmosphere of Earth consisted of
a. oxygen and nitrogen.
b. hydrogen and helium.
c. nitrogen and helium.
d. hydrogen and oxygen.

______ **29.** Today, hydrogen and helium occur mainly in the
a. oceans.
b. middle atmosphere.
c. lower atmosphere.
d. upper atmosphere.

______ **30.** Earth's early atmosphere formed when volcanic eruptions released gases in a process called
a. outgassing.
b. atmospheric composition.
c. air generation.
d. layering.

______ **31.** What is the molecule that contains three oxygen atoms and collects in Earth's upper atmosphere called?

a. oxygen
b. argon
c. ozone
d. carbon dioxide

32. Some of Earth's early organisms, such as cyanobacteria and early green plants, used ______________________ during photosynthesis.

33. Which byproduct of photosynthesis was released into the atmosphere?

____

____

34. When did the chemical composition of Earth's atmosphere reach that of today?

____

____

35. What is the present chemical composition of Earth's atmosphere?

____

____

36. How did Earth's first oceans form?

____

____

37. Comet collisions may have contributed a significant amount of ______________________ to Earth's surface.

38. The first ocean was probably made of ______________________ water.

39. The concentration of certain ______________________ in the oceans increased as rainwater dissolved rocks on land and carried these dissolved solids into the oceans.

40. When ocean water evaporated, chemicals in the ocean combined to form ______________________.

41. Earth's atmosphere and surface cooled because ocean water also dissolved much of the ______________________ in the atmosphere.

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Models of the Solar System

______ **1.** The first astronomers thought that the stars, planets, and sun revolved around
a. the sun.
b. the Milky Way.
c. Earth.
d. the moon.

EARLY MODELS OF THE SOLAR SYSTEM

______ **2.** More than 2,000 years ago, the Greek philosopher Aristotle suggested a model of the solar system that was Earth-centered, or
a. geocentric.
b. geometric.
c. geologic.
d. geothermal.

______ **3.** The pattern by which planets appear to move backward in the sky relative to the stars is called
a. reverse motion.
b. restrained motion.
c. retrograde motion.
d. revolving motion.

______ **4.** The Greek astronomer Claudius Ptolemy proposed that planets moved in small circles, or epicycles, as they
a. revolved in larger circles around the moon.
b. revolved in larger circles around the sun.
c. revolved in even smaller circles around Earth.
d. revolved in larger circles around Earth.

______ **5.** The Polish astronomer Nicolaus Copernicus proposed a model of the solar system that was sun-centered, or
a. lunacentric.
b. astrocentric.
c. heliocentric.
d. celestracentric.

______ **6.** According to Copernicus, all the planets revolved around
a. the sun in the same direction but at different speeds and distances.
b. the moon in the same direction but at different speeds and distances.
c. the sun in different directions but at the same speeds and distances.
d. the sun in different directions and different speeds and distances.

Name ______________________ Class ______________ Date ____________

KEPLER'S LAWS

7. Upon whose observations did Johannes Kepler base his three laws of planetary motion?

____

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **8.** eccentricity

______ **9.** ellipse

______ **10.** orbital period

a. a closed curve whose shape is determined by two points, or foci

b. the time required for a body to complete a single orbit

c. the degree of elongation of an elliptical orbit

11. What does the *law of ellipses* state?

____

____

____

12. In planetary orbits, one focus is located within the ______________________, and no object is located at the other focus.

13. How is eccentricity determined?

____

____

____

14. What did Kepler discover about the orbit of Mars?

____

____

____

15. The law of equal areas states that equal areas are covered in equal amounts of time as an object orbits the ______________________.

16. Kepler's third law, the law of periods, describes the relationship between the average distance of a planet from the sun and the ______________________ of the planet.

17. According to the law of periods, the cube of the average ____________________ of a planet from the sun is always proportional to the square of the period.

18. What mathematical formula is used to explain the law of periods?

____

____

____

NEWTON'S EXPLANATION OF KEPLER'S LAWS

Use the terms from the list below to complete the sentences that follow. Each term may be used only once.

revolution gravity inertia

19. The tendency of a stationary body to remain at rest or of a moving body to remain in motion until an outside force acts upon it is called ____________________.

20. Newton discovered that an outside force called ____________________ causes the orbit of a planet to curve.

21. The outer planets have longer periods of ____________________ than the inner planets because the outer planets are less affected by the sun's gravitational pull.

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: The Inner Planets

1. The planets closest to the sun are called the ______________________

2. Name the four inner planets.

____

____

____

____

3. The inner planets are also called______________________ because they are like Earth.

4. Describe the composition of the inner planets.

____

____

____

5. Bowl-shaped depressions called ______________________ formed on the surfaces of inner planets when the planets collided with other objects in space.

MERCURY

______ **6.** Mercury, the closest planet to the sun, circles the sun every
- **a.** 44 days.
- **b.** 88 days.
- **c.** four years.
- **d.** 80 hours.

______ **7.** Mercury rotates on its axis once every
- **a.** 95 days.
- **b.** 45 days.
- **c.** 59 days.
- **d.** five years.

______ **8.** Mercury's surface features a long line of cliffs and
- **a.** dry ocean beds.
- **b.** a large number of craters.
- **c.** shallow fresh-water springs.
- **d.** lava plains.

______ **9.** The absence of a dense atmosphere and Mercury's slow rotation contribute to
a. long days and short nights.
b. short days and long nights.
c. steady temperatures.
d. a large daily temperature range.

VENUS

10. How long is the orbital period of Venus, the second planet from the sun?

____

11. How often does Venus rotate?

____

12. The planet that Venus most resembles in mass, size, and density is

______________________.

13. Venus's atmospheric pressure is about ______________________ times the pressure on Earth.

14. What two factors cause the high temperatures on Venus?

____

____

15. What percentage of the atmosphere on Venus is composed of carbon dioxide?

____

16. What phenomenon occurs when solar energy heats Venus's surface and the high concentration of carbon dioxide in the atmosphere blocks most of the infrared radiation from escaping?

____

____

17. Venus appears to be very bright in the night sky because drops of

______________________ form a cloud layer that reflects sunlight.

18. Why is Venus commonly referred to as the *evening star* or *morning star?*

____

____

____

19. The surface of Venus is composed of which two types of rock?

____

____

In the space provided, write the letter of the description that best matches the term or phrase.

______ **20.** *Magellan*

______ **21.** volcano

______ **22.** Maat Mons

a. the highest volcano on Venus

b. a U.S. satellite that collected data about Venus

c. a landform commonly found on Venus

23. How could the craters on Venus be described?

____

24. What evidence indicates that Venus undergoes a periodic resurfacing?

____

____

EARTH

25. Earth is the ______________________ planet from the sun.

26. The orbital period of Earth is ______________________ days.

27. Earth completes one ______________________ on its axis every day.

28. How many moons does Earth have?

____

29. Over the last ______________________ years, Earth's continents separated from a single landmass and drifted to their present positions.

30. What two factors have caused the surface of Earth to keep changing?

____

____

31. Why is Earth the only outer planet on which water exists in a liquid state?

____

____

32. How was Earth able to maintain the moderate temperatures that were necessary to support life?

____

____

33. What three elements does Earth have in the proper combination necessary to support life?

____

____

____

MARS

34. Mars is the ______________________ planet from the sun.

35. How long is Mars's orbital period?

____

36. How often does Mars rotate on its axis?

____

37. Why are Mars's seasons similar to Earth's?

____

____

38. Mars is believed to have been geologically active because of its massive volcanoes and a system of deep ______________________ on its surface.

39. One of the many major volcanic regions on Mars is called ______________________.

40. The largest volcano on Mars is ______________________, which is three times the height of Mount Everest and has a base about the size of Nebraska.

41. Why do scientists think that Martian volcanoes have grown so large?

____

____

42. Two seismic wave-producing geological events called ______________________ indicate that volcanoes on Mars may still be active.

43. Why can water not exist as a liquid on Mars?

____

____

____

44. Which two spacecraft found evidence that liquid water once did exist on Mars's surface?

____

____

45. Mars has many surface features that are characteristic of

______________________ by water.

46. Where might water exist as permanent frost or as a liquid on Mars?

____

____

____

Back Print

Name ______________________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: The Outer Planets

In the space provided, write the letter of the description that best matches the term or phrase.

______ **1.** outer planets

______ **2.** asteroid belt

______ **3.** gas giant

______ **4.** Pluto

a. a planet with a deep and massive gaseous atmosphere

b. the planets farthest from the sun; include Jupiter, Saturn, Uranus, Neptune, and Pluto

c. the smallest and usually most distant planet; differs from other outer planets

d. a ring of debris that separates the inner planets from the outer planets

GAS GIANTS

______ **5.** How do the gas giants compare with the terrestrial planets?
- **a.** Gas giants are larger and more dense.
- **b.** Gas giants are larger and less dense.
- **c.** Gas giants are smaller and more dense.
- **d.** Gas giants are smaller and less dense.

______ **6.** Compared with the terrestrial planets, the gas giants
- **a.** have more gravity, which helps them retain gases.
- **b.** have less gravity, which helps them retain gases.
- **c.** have the same amount of gravity, which helps them retain gases.
- **d.** have no gravity, which helps them retain gases.

______ **7.** The thick atmosphere of the gas giants is made up of
- **a.** oxygen and hydrogen.
- **b.** helium and carbon dioxide.
- **c.** hydrogen and helium.
- **d.** carbon dioxide and oxygen.

______ **8.** The gas giants have ring systems that are made up of
- **a.** orbiting moons.
- **b.** dust and icy debris.
- **c.** comets.
- **d.** asteroids and gases.

Name ______________________ Class ______________ Date ______________

JUPITER

9. Jupiter is the ______________________ planet from the sun.

10. Jupiter's mass is more than ______________________ times that of Earth.

11. How long is Jupiter's orbital period?

____

12. How often does Jupiter rotates on its axis?

____

13. Jupiter has at least 60 ______________________, four of which are the size of small planets.

14. How much of Jupiter's atmosphere is composed of hydrogen and helium?

____

15. Jupiter's atmosphere is much like the atmosphere of the

______________________.

16. Why didn't Jupiter become a star?

____

____

____

17. What do Jupiter's unique bands of orange, gray, blue, and white indicate?

____

____

____

18. How do the bands form?

____

____

____

19. Describe Jupiter's Great Red Spot.

____

____

____

Name ______________________ Class ______________ Date ______________

20. What do Jupiter's high wind speeds tell scientists about the planet's weather?

____

____

21. How does Jupiter's large mass affect its interior temperature and pressure?

____

____

____

SATURN

______ **22.** How far is Saturn from the sun?
- **a.** It is the fourth planet from the sun.
- **b.** It is the sixth planet from the sun.
- **c.** It is the closest planet to the sun.
- **d.** It is the farthest planet from the sun.

______ **23.** How long is Saturn's orbital period?
- **a.** 100 years
- **b.** 2,950 years
- **c.** three years
- **d.** 29.5 years

______ **24.** How many moons does Saturn have?
- **a.** at least 30
- **b.** at least 60
- **c.** at least 75
- **d.** at least 125

______ **25.** How large is Titan, Saturn's largest moon?
- **a.** half the size of Earth
- **b.** twice the size of Earth
- **c.** half the size of the sun
- **d.** twice the size of Venus

26. Saturn, like the planet ______________________, is made up almost entirely of hydrogen and helium and has a rocky, iron core.

27. Saturn is the least ______________________ planet in the solar system.

28. Saturn is known for its ______________________, which are two times the planet's diameter.

29. Like Jupiter, Saturn has ______________________ of colored clouds.

Name ______________________ Class ____________ Date ____________

30. How often does Saturn rotate on its axis?

____

31. NASA's ______________ spacecraft will orbit Saturn for many years to gather information about the planet and its moon Titan.

URANUS

32. Uranus is the ______________ planet from the sun and the third largest planet in the solar system.

33. Why is Uranus a difficult planet to study?

____

____

34. Uranus has at least ______________ moons and at least 11 small rings.

35. The orbital period for Uranus is almost ______________ years.

36. Although most planets rotate with their axis perpendicular to their orbital planes, Uranus's axis is almost ______________ to the plane of its orbit.

37. How often does Uranus rotate?

____

38. The planet's blue-green color indicates that the atmosphere may contain significant amounts of ______________, in addition to hydrogen and helium.

NEPTUNE

39. Neptune is the ______________ planet from the sun and is similar to Uranus in size and mass.

40. Neptune's orbital period is nearly 164 years, and the planet rotates about every ______________ h.

41. Neptune has at least ______________ moons and possibly four rings.

42. How was Neptune's existence predicted before the planet was actually discovered?

____

____

____

43. Neptune's atmosphere is made up of which gases?

____

44. What have images taken by *Voyager 2* and the *Hubble Space Telescope* told us about Neptune's weather?

____

____

PLUTO

45. Pluto is the ______________ planet from the sun.

46. Pluto's orbit is an unusually elongated and tilted ______________.

47. How does Pluto compare with the other planets in terms of its size and distance from the sun?

____

____

48. What is Pluto made of?

____

____

OBJECTS BEYOND PLUTO

49. Describe the Kuiper belt.

____

____

____

50. Name two objects that have been found beyond Pluto.

____

____

EXOPLANETS

51. Define *exoplanet.*

____

____

52. Because exoplanets cannot be directly observed through telescopes or satellites, how do scientists know they exist?

____

____

____

____

53. How do scientists know that all of the exoplanets they have identified are larger than Saturn?

____

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Earth's Moon

In the space provided, write the letter of the description that best matches the term or phrase.

______ **1.** satellite

______ **2.** moon

______ **3.** *Sputnik I*

______ **4.** *Explorer I*

______ **5.** *Hubble Space Telescope*

a. a natural body that revolves around a planet and has a smaller mass than the planet

b. the first artificial satellite launched by the United States, in 1958

c. a natural or artificial body that orbits around a planet

d. an important information-gathering satellite now in orbit around Earth

e. the first artificial satellite, launched by the Soviet Union in exploring the moon

______ **6.** Between 1969 and 1972, the United States sent six spacecraft to the moon as part of what space program?
- **a.** Gemini
- **b.** Apollo
- **c.** Hubble
- **d.** Explorer

______ **7.** Why is the gravity experienced on the moon's surface so much less than the gravity experienced on Earth?
- **a.** because Earth has much less mass than the moon
- **b.** because the moon has much more weight than Earth
- **c.** because Earth has much more weight than the moon
- **d.** because the moon has much less mass than Earth

______ **8.** A person who exerts 600 newtons of force on Earth exerts how many newtons on the moon?
- **a.** 100
- **b.** 600
- **c.** 800
- **d.** 1,200

______ **9.** Why doesn't the moon have an atmosphere?
- **a.** because the air is too thin for gases
- **b.** because the cold temperature freezes gases
- **c.** because the gravity is too weak to hold gases.
- **d.** because the ground is too dry to hold gases.

______ **10.** How does the absence of an atmosphere affect the moon's surface temperature?
a. It is always cold.
b. It is always hot.
c. It varies greatly with the time of year.
d. It varies widely with the time of day.

THE LUNAR SURFACE

______ **11.** What word comes from the Latin word luna and refers to any feature of the moon?
a. lunar.
b. moony.
c. marine.
d. loony.

______ **12.** A dark, smooth area of the moon that reflects less light than other areas is called a(n)
a. luna.
b. anothosite.
c. mare.
d. crater.

______ **13.** Most of the moon's craters formed about 4 billion years ago when the moon was struck by
a. pieces left over from Earth.
b. rocks from volcanic eruptions.
c. another moon.
d. debris from the formation of the solar system.

______ **14.** Rilles, or long, deep channels running through the maria, are thought to be left over from
a. heavy rainstorms.
b. the formation of lava plains.
c. the Apollo space spacecraft.
d. asteroids striking the moon's surface.

______ **15.** How are lunar rocks similar to rocks on Earth?
a. They are metamorphic.
b. They contain many of the same elements.
c. They are sedimentary.
d. They contain fossils.

Name ______________________ Class ______________ Date ____________

_____ **16.** Where on the moon do light-colored, coarse-grained anorthosites rich in calcium and aluminum come from?
a. rilles
b. maria
c. lunar highlands
d. lava plains

_____ **17.** Fine-grained rocks from the maria that contain titanium, magnesium, and iron are
a. rilles.
b. basalts.
c. anorthosites.
d. regolith.

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

craters	water	anorthosites
rilles	asteroids	breccia
regolith	ridges	

18. Rough highlands composed of rocks called ______________________ form light patches on the moon.

19. Maria are plains of dark, solidified lava that formed when the lava filled basins created by impacts of massive ______________________.

20. Many bowl-shaped depressions called ______________________ cover the surface of the moon.

21. Long, narrow elevations of rock called ______________________ rise out of the surface of the moon and criss-cross the maria.

22. Over billions of years, meteorites have crushed the surface of the moon into ______________________, or dust and small fragments of rock.

23. The substance ______________________ is missing from the minerals in lunar rocks.

24. One type of rock found both in the highlands and maria is ______________________, which formed when meteorites struck the moon.

THE INTERIOR OF THE MOON

______ **25.** How do the rocks on the lunar surface compare with those on Earth?
a. They are lighter in color.
b. They are less dense.
c. They are darker.
d. They are equal in density.

______ **26.** How does the overall density of the moon compare with the density of Earth?
a. The moon's density is three times that of Earth.
b. The moon's density is three-fifths that of Earth.
c. The moon's density is five times that of Earth.
d. The moon's density is one fifth that of Earth.

______ **27.** Compared with Earth's interior, the interior of the moon is
a. more dense.
b. equal in density.
c. less dense.
d. without density.

______ **28.** Where do most moonquakes occur?
a. on the crust
b. in the mantle
c. under the crust
d. in the core

______ **29.** From moonquakes, scientists learned that the moon's interior
a. is made up of water.
b. has only one compositional layer.
c. has three compositional layers.
d. is frozen.

______ **30.** The side of the moon that always faces Earth and the side that always faces away from Earth are called the
a. close side and distant side.
b. light side and dark side.
c. near side and far side.
d. hot side and cold side.

______ **31.** What caused the crust on the side of the moon facing away from Earth to be thicker than that of the crust facing Earth?
a. the pull of Earth's gravity
b. the rotation of the moon on its axis
c. heat from the sun
d. the moon's unbalanced core

Name ______________________ Class ____________ Date ___________

______ **32.** The surface of the far side of the moon is mountainous and has
a. many large maria.
b. only a few small maria.
c. only a few ridges.
d. no ridges.

______ **33.** The thickest layer of the moon is the
a. maria.
b. crust.
c. mantle.
d. core.

______ **34.** The moon's non-uniform rotation indicates that the core is
a. neither completely solid nor completely liquid.
b. completely liquid.
c. completely solid.
d. completely magnetic.

THE FORMATION OF THE MOON

______ **35.** The theory that a Mars-sized body struck Earth and began the development of the moon is called the
a. giant impact hypothesis.
b. big bang theory.
c. theory of relativity.
d. huge explosion hypothesis.

______ **36.** The collision with a Mars-sized body ejected chunks of Earth's
a. liquid crust into orbit.
b. molten mantle out of orbit.
c. frozen core into orbit.
d. molten mantle into orbit.

______ **37.** The material ejected from Earth by its collision with a huge body eventually
a. flew out of the solar system.
b. clumped together to form the moon.
c. formed asteroids.
d. was absorbed by the sun.

______ **38.** Why did the material from the collision that clumped together continue to revolve around Earth?
a. because of the moon's density
b. because of Earth's density
c. because of the moon's gravitational pull
d. because of Earth's gravitational pull

39. How did the lunar interior change over time?

40. What happened when the outer surface of the moon cooled to form a crust over the molten interior?

41. What developments took place on the moon about 3 billion years ago?

42. Why is the moon a valuable source of information about the conditions that existed in the solar system long ago?

43. After impacts on the moon's surface formed deep basins, what do scientists think happened?

____

____

____

____

44. Why did more lava flow into the craters on the near side of the moon than into those on the far side?

____

____

____

____

45. Because there is no evidence of plate tectonics or convection currents in the moon's mantle to supply energy, how do scientists think that magma might have reached the moon's surface?

____

____

____

____

46. When and why did lava flows end?

____

____

____

____

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Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Movements of the Moon

1. Why is there a discrepancy between the lunar day as measured by the rotation of the moon on its axis and the time between lunar sunrises?

____

____

____

THE EARTH-MOON SYSTEM

2. If you could observe Earth and the moon from space, what would you see?

____

____

3. What do Earth and the moon form together?

____

4. Where is the balance point of the Earth-moon system located?

____

5. Why is the balance point of the Earth-moon system located where it is?

____

6. What is the balance point called?

____

7. Describe how the barycenter orbits the sun.

____

____

8. Why does Earth's distance from the moon vary over the course of a month?

____

____

____

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

moon	apogee	revolution
axis	rotation	perigee

9. The moon is at______________________ when it is farthest from Earth,.

10. The moon is at______________________ when it is closest to Earth,

11. The moon appears to rise and set at Earth's horizon because of Earth's rotation on its ______________________.

12. Because of Earth's rotation and the moon's ______________________, the moon actually rises or sets about 50 minutes later each night

13. The moon completes a ______________________on its axis only once during each orbit around Earth.

14. How often does the moon revolve around Earth relative to the stars?

____

15. Why do observers on Earth always see the same side of the moon?

____

____

16. As the moon orbits Earth, what part of the moon's surface changes?

____

____

17. What happens when the near side of the moon is NOT fully illuminated by the sun?

____

____

____

Name ______________________ Class ______________ Date ____________

ECLIPSES

In the space provided, write the letter of the description that best matches the term or phrase.

_____ **18.** eclipse

_____ **19.** umbra

_____ **20.** penumbra

_____ **21.** solar eclipse

_____ **22.** diamond-ring effect

_____ **23.** annular eclipse

a. the outer part of the shadow in an eclipse, where sunlight is partially blocked

b. an event in which the moon passes between Earth and the sun and the moon's shadow falls on Earth

c. the inner, cone-shaped part of the shadow in an eclipse, where sunlight is completely blocked

d. an event in which the shadow of one celestial body falls on another

e. the last bits of the sun's light visible before a total eclipse

f. an eclipse in which a thin ring of sunlight is visible around the outer edge of the moon

24. What occurs during a total solar eclipse?

____

____

____

25. What do observers who are located outside the umbra, but inside the penumbra see during a solar eclipse?

____

____

26. Describe the area of Earth covered by a total solar eclipse.

____

____

27. What are some effects of a total solar eclipse visible on Earth?

____

____

____

____

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Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

28. What causes an annular eclipse?

____

____

29. When does a lunar eclipse occur?

____

____

30. What must happen for a total lunar eclipse to occur?

____

____

31. Why is a totally eclipsed moon reddish in color?

____

____

32. About how many of each kind of eclipse occur during the calendar year?

____

33. Why don’t solar and lunar eclipses occur during every lunar orbit?

____

____

34. Under what two conditions do solar eclipses occur?

____

____

35. Under what two conditions do lunar eclipses occur?

____

____

36. Where are lunar eclipses visible?

____

____

____

Name ______________________ Class ____________ Date ____________

PHASES OF THE MOON

______ **37.** Why does the moon shine?
- **a.** because it reflects light from Earth
- **b.** because its surface is molten
- **c.** because it reflects light from the sun
- **d.** because it reflects light from all the planets

______ **38.** In astronomy, a phase is the change in the illuminated area
- **a.** of the sun as seen from Earth.
- **b.** of the solar system as seen from outside it.
- **c.** of Earth as it rotates on its axis.
- **d.** of one celestial body as seen from another body.

______ **39.** Phases of the moon are caused by the
- **a.** change in seasons.
- **b.** revolution of Earth on its axis.
- **c.** revolution of the moon on its axis.
- **d.** changing positions of the sun, moon, and Earth.

______ **40.** During this phase of the moon, the near side is dark, and no lighted area of the moon is visible on Earth.
- **a.** dark moon
- **b.** new moon
- **c.** near moon
- **d.** full moon

______ **41.** As the moon continues in its orbit around Earth, part of the near side becomes illuminated. The moon is said to be
- **a.** waxing.
- **b.** revolving.
- **c.** waning.
- **d.** spinning.

______ **42.** The waxing phases of the moon are
- **a.** waxing, growing, completing.
- **b.** crescent, half, whole.
- **c.** first quarter, second quarter, third quarter.
- **d.** waxing crescent, first quarter, waxing gibbous.

______ **43.** At what stage is the entire near side of the moon illuminated by the sun, because Earth is between the sun and moon?
- **a.** whole moon
- **b.** luminous moon
- **c.** new moon
- **d.** full moon

Name ______________________ Class ______________ Date ______________

______ **44.** When the lighted part of the near side of the moon appears to decrease in size, the moon is
- **a.** waxing.
- **b.** shrinking.
- **c.** waning.
- **d.** decreasing.

______ **45.** The waning phases of the moon are
- **a.** waning gibbous, last quarter, waning crescent.
- **b.** waning crescent, last quarter, waning gibbous.
- **c.** second quarter, third quarter, fourth quarter.
- **d.** waning, last quarter, invisible.

______ **46.** What is sunlight that is reflected off Earth and then off the moon called?
- **a.** moonshine
- **b.** sunshine
- **c.** earthshine
- **d.** moonlight

______ **47.** The period from one new moon to the next is
- **a.** 27.3 days.
- **b.** 30 days.
- **c.** 29.5 days.
- **d.** 31 days.

______ **48.** The position of the moon in each new moon phase is
- **a.** behind the sun.
- **b.** directly between Earth and the sun.
- **c.** in line with, and behind Earth.
- **d.** directly in front of the sun.

TIDES ON EARTH

Use terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

tides	gravity	rotation
bulge	phases	inertia

49. The forces of gravity and ______________________ together cause tides on Earth.

50. The ______________________ of Earth causes inertia, which in turn causes water on Earth's surface to move away from Earth's center.

51. At the same time, the ______________________ of the moon pulls all of the water on Earth toward the moon.

Back Print

52. On the side of Earth closest to the moon, the combination of the gravitational pull of the moon and inertial force causes a(n)

______________ in the water toward the moon.

53. Why does water on the side of Earth farthest from the moon bulge away from Earth in the opposite direction?

____

____

____

____

54. What is the result of these forces on Earth's oceans?

____

____

____

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Satellites of Other Planets

1. What did Galileo discover in 1610?

____

2. Which two planets do not have moons?

____

3. What do Saturn, Jupiter, Uranus, and Neptune have in addition to moons?

____

MOONS OF MARS

4. Name the moons of Mars and describe their orbits.

____

____

____

____

5. Describe the physical appearance of Mars's moons.

____

____

____

____

6. Explain why astronomers think that the moons of Mars are fairly old.

____

____

____

____

Name ______________________ Class ______________ Date ____________

MOONS OF JUPITER

______ **7.** What are the four largest moons of Jupiter known as?
- **a.** Galilean moons
- **b.** Jovian satellites
- **c.** gas-giant moons
- **d.** king's satellites

______ **8.** How do Jupiter's four largest moons compare to Earth's moon?
- **a.** Two are larger.
- **b.** One is smaller.
- **c.** They all are larger.
- **d.** They all are smaller.

______ **9.** The innermost of Jupiter's four large moons is
- **a.** Ganymede.
- **b.** Io.
- **c.** Callisto.
- **d.** Europa.

______ **10.** An engineer examining images from the Voyager spacecraft discovered
- **a.** another large moon.
- **b.** a crust of ice on Io.
- **c.** volcanoes on our moon.
- **d.** volcanoes on Io.

______ **11.** The lava on Io is much hotter than that on Earth because the lava there has more
- **a.** hydrogen and iron.
- **b.** magnesium and magma.
- **c.** nickel and sulfur.
- **d.** magnesium and iron.

______ **12.** Why do scientists think Io's volcanic material is mostly sulfur and sulfur dioxide?
- **a.** because parts of its surface are dark and smooth
- **b.** because most of its surface is covered by craters
- **c.** because parts of its surface are yellow-red
- **d.** because most of its surface is covered by ice

______ **13.** Io moves inward and outward in its orbit around Jupiter because of
- **a.** the gravitational pull of Jupiter's other moons.
- **b.** the force of its own inertia.
- **c.** Jupiter's gravitational pull.
- **d.** Jupiter's magnetic field.

Name ______________________ Class ______________ Date ____________

______ **14.** The in and out movements, caused by the difference between the force on one side of Io and that on the other side, are called
a. ionic forces.
b. gravitational forces.
c. tidal forces.
d. magnetic forces.

______ **15.** The forces that pull Io back and forth cause its surface to also
a. develop craters.
b. move in and out.
c. revolve more slowly.
d. attract other moons.

______ **16.** The flexing of Io's surface causes friction that heats and melts Io's interior, leading to
a. inertia.
b. volcanism.
c. tidal forces.
d. magnetism.

______ **17.** Data from the *Galileo* spacecraft show that Io has a(n)
a. iron core and a polar ice cap.
b. magnetic field and an icy crust.
c. iron core and perhaps a magnetic field.
d. magnetic field and perhaps a rock core.

______ **18.** What is Europa?
a. the moon closest to Jupiter
b. the second closest Galilean moon to Jupiter
c. the third closest Galilean moon to Jupiter
d. the fourth closest Galilean moon to Jupiter

______ **19.** How does this moon compare with Earth's moon?
a. It is about the same size but much more dense.
b. It is smaller and much less dense.
c. It is bigger and much more dense.
d. It is about the same size, but much less dense.

______ **20.** Scientists think Europa has a rock core that is covered with
a. a thick layer of ice.
b. oceans and seas.
c. a thick crust of rock.
d. rivers of lava.

______ **21.** What do scientists think might exist under Europa's surface layer?
- **a.** petroleum and perhaps coal
- **b.** liquid water and perhaps petroleum
- **c.** coal and perhaps simple forms of life
- **d.** liquid water and perhaps simple forms of life

22. The third Galilean moon from Jupiter is ______________________.

23. Why does the third Galilean moon have a relatively small mass although it is the largest moon in the solar system?

____

24. What are three features that appear on images of Ganymede's surface?

____

____

____

25. What do Io and Ganymede possess, that the other two Galilean moons do not?

____

26. The farthest Galilean moon from Jupiter is ______________________.

27. In what ways is the farthest Galilean moon similar to Ganymede?

____

____

28. Callisto has a surface covered with ______________________ that are the result of collisions that occurred early in the history of the solar system.

MOONS OF SATURN

______ **29.** How many moons does Saturn have?
- **a.** 15
- **b.** more than 50
- **c.** at least 30
- **d.** less than 100

______ **30.** Only Jupiter's moon Ganymede is larger than Saturn's largest moon, which is
- **a.** Olympus.
- **b.** Janus.
- **c.** Titan.
- **d.** Io.

______ **31.** Unlike any other moon in our solar system, Titan has
a. an atmosphere made of nitrogen.
b. an atmosphere made of oxygen.
c. oceans filled with water.
d. a core made of water.

______ **32.** Titan's surface may contain lakes or oceans of
a. liquid water.
b. solid lava.
c. liquid methane.
d. frozen gases.

______ **33.** In 2005, what space probe gathered information about Titan's atmosphere?
a. *Galileo*
b. *Apollo*
c. *Cassini*
d. *Huygens*

______ **34.** What shape characterizes Saturn's smaller moons?
a. round
b. elliptical
c. irregular
d. elongated

MOONS OF URANUS AND NEPTUNE

In the space provided, write the letter of the description that best matches the term or phrase.

______ **35.** Triton

______ **36.** Miranda

______ **37.** Uranus

______ **38.** Oberon

______ **39.** Neptune

a. the fifth of Uranus's moons to be discovered

b. one of Uranus's largest moons

c. planet with at least eight moons

d. Neptune's icy moon, which travels in a retrograde orbit

e. planet with at least 24 moons

PLUTO'S MOON

40. How does Pluto differ from other planets?

____

____

____

41. How is Pluto's relationship with its moon Charon unlike the relationships between other planets and their moons?

____

____

____

42. Why does one side of Pluto always face Charon?

____

____

____

RINGS OF THE GAS GIANTS

43. When was Saturn's set of rings discovered?

____

44. Describe Saturn's rings. What are they composed of?

____

____

____

____

45. What was the early theory about the origin of Saturn's rings?

____

____

____

____

46. What is the current theory about the origin of Saturn's rings?

____

____

____

____

____

Name ______________________ Class ____________ Date __________

Directed Reading *continued*

47. Describe Jupiter’s single ring.

____

____

____

____

48. How many rings does Uranus have?

____

49. Describe Neptune’s rings.

____

____

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Asteroids, Comets, and Meteoroids

1. In addition to the sun, planets, and their moons, what occupies the space in our solar system?

____

____

____

____

ASTEROIDS

______ **2.** What are asteroids?
- **a.** small stars outside the solar system
- **b.** rocky bodies that orbit the planets
- **c.** fragments of rock that orbit the sun
- **d.** small bodies of rock and ice with tails

______ **3.** Most asteroids are found in the asteroid belt located
- **a.** between the orbits of Mars and Jupiter.
- **b.** beyond the orbit of Neptune.
- **c.** in orbit around Earth.
- **d.** between the orbits of Mercury and Venus.

______ **4.** Concentrated in groups just ahead of and just behind Jupiter as it orbits the sun are the
- **a.** Martian asteroids.
- **b.** Roman asteroids.
- **c.** Turkish asteroids.
- **d.** Trojan asteroids.

______ **5.** The composition of asteroids is similar to that of the
- **a.** inner planets.
- **b.** gas giants.
- **c.** comets.
- **d.** outer planets.

______ **6.** For what reason do many astronomers think that asteroids in the asteroid belt were not able to form a planet?
- **a.** because of the strong gravitational force of Mars
- **b.** because of the strong gravitational force of Jupiter
- **c.** because of the tidal forces of the outer planets
- **d.** because of the inertia of the inner planets

______ **7.** The total mass of all asteroids, including that of the largest, is less than the mass of
a. both of Mars's moons.
b. Earth's moon.
c. the head of a comet.
d. the *Voyager* spacecraft.

Use the terms from the list below to complete the sentences that follow. Each term may be used only once. Some terms may not be used.

Mars	ellipses	carbon
iron	planets	asteroids
silicates	Ceres	Earth

8. The largest of the smaller bodies in the solar system

are ______________________.

9. The orbits of asteroids, like those of the planets,

are ______________________.

10. The largest known asteroid, ______________________, is about 1,000 km.

11. The closest asteroids to the sun are inside the orbit

of ______________________.

12. The most common type of asteroid is made mostly

of ______________________.

13. The second type of asteroid is composed of nickel and

______________________, making them appear shiny and metallic.

14. The third and rarest group of asteroids is made mostly of

______________________, which gives them a dark color.

15. What are near-Earth asteroids?

____

____

____

16. Why has interest in near-Earth asteroids increased in recent years?

____

____

____

Name ______________________ Class ______________ Date ______________

17. What do scientists hope to accomplish by identifying and monitoring near-Earth asteroids?

____

____

____

COMETS

______ **18.** What is a comet?
- **a.** a natural body that revolves around a planet
- **b.** a ring of pieces of rock and ice around a planet
- **c.** the largest of the smaller bodies in the solar system
- **d.** a small body of ice, rock, and cosmic dust that orbits the sun

______ **19.** What kind of orbit do comets follow?.
- **a.** fast
- **b.** slow
- **c.** circular
- **d.** elliptical

______ **20.** Halley's comet passes by Earth in its orbit every
- **a.** month.
- **b.** year.
- **c.** 76 years.
- **d.** 67 years.

______ **21.** A comet's spectacular tails form when
- **a.** sunlight changes the comet's ice to gas.
- **b.** sunlight is reflected from the coma.
- **c.** moonlight is reflected from the comet.
- **d.** gravity pulls gas from the comet.

In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.

______ **22.** nucleus	**a.** streams from the comet's head and always points away from the sun
______ **23.** coma	**b.** is composed of rock, ice, and metals
______ **24.** head	**c.** is made up of the nucleus and coma
______ **25.** ion tail	**d.** curves backward along the comet's orbit
______ **26.** dust tail	**e.** surrounds the nucleus in a spherical cloud of gas dust and reflects sunlight

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

27. Describe the Oort cloud.

____

____

____

28. Where is the Oort cloud located?

____

____

____

29. The gravity of a star that passes near the solar system may cause a comet to fall into a more elliptical ____________________ around the sun.

30. Name the flat region beyond Neptune's orbit that contains leftover planetesimals.

____

31. What are the many thousands of bodies located within this belt, including Pluto and its moon, called?

____

32. What is the difference between long-period and short-period comets?

____

____

____

____

33. What has forced some comets that originated in the Kuiper belt outward into the Oort cloud?

____

____

34. Give an example of a short-period comet.

____

____

METEOROIDS

35. What are meteoroids?

____

____

____

____

36. How do scientists think that most meteoroids originate?

____

____

____

____

37. What happens when a meteoroid enters Earth's atmosphere?

____

____

____

____

38. Why do meteor showers occur at about the same time each year?

____

____

____

____

Name ______________________ Class ______________ Date ____________

In the space provided, write the letter of the description that best matches the term or phrase.

______ **39.** meteor

______ **40.** shooting star

______ **41.** fireball

______ **42.** meteor shower

______ **43.** meteorite

______ **44.** stony meteorite

______ **45.** iron meteorite

______ **46.** stony-iron meteorite

a. a meteoroid that vaporizes very quickly in a brilliant flash of light

b. a bright streak of light that results when a meteoroid burns up in Earth's atmosphere

c. a meteorite similar in composition to rocks on Earth that may contain carbon compounds

d. the rarest type of meteorite

e. a meteoroid or any part of a meteoroid that is left when it hits Earth

f. a meteorite with a distinctive metallic appearance

g. a common name for a meteor

h. a large number of meteoroids entering Earth's atmosphere in a short period of time

47. Where do astronomers think that most meteorites come from?

____

48. Why are the oldest meteorites important?

____

____

____

49. Where do some rare meteorites originate?

____

50. According to computer simulations, how do these rare meteorites reach Earth?

____

____

____

Name ______________________________ Class _______________ Date _____________

Skills Worksheet

Directed Reading

Section: Structure of the Sun

1. From what did people once believe the sun's energy comes?

____

____

2. About how long ago did scientists discover that the sun's energy is quite different from fire?

____

____

THE SUN'S ENERGY

______ **3.** What does the sun look like to the unaided eye?
- **a.** a dazzling, brilliant ball that has no distinct features
- **b.** a bright disc with ridges and valleys
- **c.** a dazzling ball with seas and dark areas
- **d.** a softly glowing sphere with flaming edges

______ **4.** Why do astronomers use special filters to look at the sun?
- **a.** The sun seems only one color otherwise.
- **b.** No telescope can view the sun otherwise.
- **c.** The sun's brightness can damage your eyes.
- **d.** They view the sun only at night.

______ **5.** What do scientists use to break up the sun's light into a spectrum?
- **a.** a spectrometer
- **b.** a spectrograph
- **c.** a spectra-reader
- **d.** a light graphometer

______ **6.** What causes dark lines to form in the spectra of stars?
- **a.** Gases in the stars' interiors emit specific wavelengths of light.
- **b.** Gases in the stars' outer layers absorb specific wavelengths of light.
- **c.** Magnetic currents in the stars' outer layers distort wavelengths of light.
- **d.** Gases in the stars' outer layers emit specific wavelengths of light.

______ **7.** What factors determine which gases produce visible spectral lines?
- **a.** the size of the star
- **b.** the elements in a star
- **c.** the type of spectrograph that is used
- **d.** the temperature of a star's outer layers

______ **8.** What important factor can be determined by studying the spectrum a star?
a. the amounts of elements that are not contained in the star
b. the rate at which gases are released into a star's atmosphere
c. the numbers of gases that are present in a star's atmosphere
d. the amounts of elements that are present in a star's atmosphere

______ **9.** How can scientists deduce the temperature, density, and pressure of a gas in a star's surface?
a. by studying the spectrum of the star
b. by studying the spectrum of nearby stars
c. by studying the brightness of the star
d. by calculating the size of the star

______ **10.** To identify the elements in a star's atmosphere, scientists
a. match the spectral lines of starlight against the spectra from known stars.
b. match the spectral lines of starlight to those of Earth's elements.
c. match the spectral lines of starlight against the spectra of gases in Earth's atmosphere.
d. match the spectral lines of starlight to one another.

______ **11.** Why does matching the spectral lines of starlight to those of Earth's elements enable scientists to identify the elements in a star's atmosphere?
a. Groups of elements have the same spectral lines.
b. Individual elements may have the same spectral lines.
c. Each element has a unique pattern of spectral lines.
d. Each group of elements has unique spectral lines.

______ **12.** What element makes up about 75% of the sun's mass?
a. helium
b. iron
c. hydrogen
d. radium

______ **13.** How much of the sun's total mass is composed of hydrogen and helium?
a. about 75%
b. about 85%
c. about 90%
d. about 99%

______ **14.** The sun's spectrum reveals that it contains
a. almost nothing besides hydrogen.
b. almost all chemical elements.
c. only hydrogen and helium.
d. hydrogen, helium, oxygen, and carbon.

______ **15.** What atomic process combines nuclei of small atoms to form more-massive nuclei?
a. nuclear fission
b. nuclear fusion
c. nuclear half-life
d. nuclear decay

______ **16.** Nuclei of which atoms are the primary fuel for the sun?
a. hydrogen
b. helium
c. protons
d. electrons

17. What is the common makeup of a hydrogen atom?

____

18. What happens inside the sun to the electrons in hydrogen atoms?

____

19. How many steps occur in nuclear fusion inside the sun?

____

20. Describe the first step of nuclear fusion.

____

21. What happens to the charge of one hydrogen proton?

____

22. What is a particle that is emitted by one proton?

____

23. What is the result of the first step of fusion?

____

____

24. Describe the second step of nuclear fusion.

____

____

Name ______________________ Class ______________ Date ______________

25. Describe the third step of nuclear fusion.

____

____

26. What is released in the fusion of two two-proton-one-neutron nuclei?

____

27. What particles are fused together to form a helium nucleus?

____

28. How often is energy released during nuclear fusion?

____

29. When hydrogen fusion occurs in the sun, what is always one of the final products?

____

30. How does the mass of a helium nucleus compare with the mass of the hydrogen nuclei that fused to form it?

____

____

31. What is converted into energy during the series of fusion reactions that form helium nuclei inside the sun?

____

____

32. What causes the sun to shine and gives the sun its high temperature?

____

____

MASS CHANGING INTO ENERGY

______ **33.** In 1905, Albert Einstein proposed that a
- **a.** small amount of matter yields a large amount of energy.
- **b.** large amount of matter was equal to a large amount of energy.
- **c.** large amount of matter yields a small amount of energy.
- **d.** small amount of matter was equal to a small amount of energy.

Name ______________________ Class ______________ Date ____________

Directed Reading *continued*

______ **34.** At the time of Einstein's 1905 proposal, what two factors were unknown?
a. nuclear fission and electrons
b. energy and an atom's nucleus
c. energy and matter
d. nuclear fusion and the nucleus of the atom

______ **35.** Einstein's proposal was
a. part of his special theory of relativity.
b. part of his general theory of physics.
c. his basic theory about the makeup of atoms.
d. part of his special theory of energy.

______ **36.** What equation is part of Einstein's theory?
a. $E=mc$
b. $E^2=mc$
c. $E=mc^2$
d. $E=m^2c$

______ **37.** In the equation $E = mc^2$, "E" represents
a. mass, or the amount of matter.
b. a constant.
c. matter.
d. energy produced.

______ **38.** In the equation $E=mc^2$, "m" represents
a. the total mass in the universe.
b. the mass of one ounce of lead.
c. mass, or the amount of matter that is changed.
d. the amount of matter that remains.

______ **39.** In the equation $E=mc^2$, "c" represents
a. energy.
b. matter.
c. the diameter of the sun.
d. the speed of light.

______ **40.** What is the speed of light?
a. 300,000 km/hr
b. 300,000 km/s
c. 300,000 m/hr
d. 300,000 m/s

41. What can Einstein's equation be used to calculate?

____

____

42. How much hydrogen is changed into helium in the sun every second?

____

43. What subatomic particle is given off during fusion?

____

44. How long does it take neutrinos that escape from the sun to reach Earth?

____

45. What does the study of neutrinos indicate?

____

____

THE SUN'S INTERIOR

In the space provided, write the letter of the temperature that matches the part of the sun.

______ **46.** core

______ **47.** chromosphere

______ **48.** sunspot

______ **49.** radiative zone

______ **50.** corona

______ **51.** photosphere

______ **52.** convective zone

a. 3,800°C
b. 6,000°C
c. 4,000°C to 50,000°C
d. 1,000,000°C
e. 2,000,000° C
f. 2,000,000° C to 7,000,000°C
g. 15,000,000°C

______ **53.** What has revealed what the invisible layers of the sun may be like?
a. the solar wind
b. neutrinos
c. computer models
d. the sun's corona

______ **54.** In recent years, more detail has been learned about what is happening inside the sun by careful studies of
a. motions in the sun's corona.
b. motions on the sun's surface.
c. movement of sunspots.
d. changes in energy from the sun.

______ **55.** What is the size of the sun's core?

a. 25% of 1,390 km
b. 25% of 13,900 km
c. 25% of 139,000 km
d. 25% of 1,390,000 km

56. What is the sun's core made up of?

____

57. How does the mass of the sun compare with the mass of Earth?

____

58. What effect does the sun's large mass have on the density of the sun's core?

____

____

59. Compare the nuclei of atoms on Earth and in the sun's core.

____

____

____

60. What factors in the sun's core force nuclei close enough to fuse?

____

61. What is the most common nuclear reaction inside the sun?

____

62. What zone in the sun's interior surrounds the core, and what is its temperature?

____

63. In the radiative zone, in what form does energy move outward?

____

64. What zone surrounds the radiative zone, and what is its temperature?

____

65. Describe how energy produced in the sun's core moves through the convective zone. Compare the movement to an example on Earth.

____

____

____

Name ________________________ Class ______________ Date ____________

66. What causes the movement of gases in the convective zone?

____

____

____

THE SUN'S ATMOSPHERE

______ **67.** To what does the word atmosphere refer, when applied to the sun?
- **a.** the sheath of air surrounding the sun
- **b.** all of the gases that make up the sun
- **c.** the uppermost region of solar gases
- **d.** the regions of gases above the sun's core

______ **68.** What are the three layers of the sun's atmosphere?
- **a.** ionosphere, troposphere, stratosphere
- **b.** photosphere, chromosphere, convection zone
- **c.** photosphere, chromosphere, corona
- **d.** core, corona, photosphere

______ **69.** What is the innermost layer of the solar atmosphere called?
- **a.** photosphere
- **b.** chromosphere
- **c.** corona
- **d.** solar wind

70. What is the sun's photosphere?

____

71. Why are we able to see the photosphere from Earth?

____

____

72. What are sunspots?

____

____

73. What layer lies above the photosphere? How did this layer get its name?

____

____

Back Print

74. How do gases move in the chromosphere?

____

75. Describe the upward movement of gas in the chromosphere.

____

____

76. How do spacecraft study the sun?

____

____

77. What is the outermost layer of the sun's atmosphere called?

____

____

78. Describe the size and temperature of the corona.

____

____

____

79. How can the corona stop most subatomic particles from escaping into space, even though it is not very dense?

____

____

80. Under what condition may the corona be visible during the day?

____

____

Name ______________________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: Solar Activity

1. How do the gases that make up the sun's interior and atmosphere behave?

____

2. What causes the continuous rising and sinking of the sun's gases?

____

____

____

3. What else keeps the sun's gases in motion?

____

____

4. Why don't all locations on the sun rotate at the same speed?

____

____

5. On average, how long does it take the sun to rotate once?

____

____

SUNSPOTS

______ **6.** What do the movements of gases in the sun's convective zone and the movements caused by the sun's rotation produce?
a. solar wind
b. convection currents
c. charged ions
d. magnetic fields

______ **7.** Why are some regions of the photosphere so much cooler than others?
a. The sun's surface temperatures vary wildly.
b. Less energy is being transferred to the regions.
c. Changes in the magnetic fields reduce heat.
d. More energy is being transferred to the regions.

Name ______________________ Class ______________ Date ____________

______ **8.** How much cooler are the cool regions than the surrounding photosphere?
a. up to 3,000,000°C
b. up to 300,000°C
c. up to 30,000°C
d. up to 3,000°C

9. What is a sunspot?

____

____

10. What is granulation?

____

____

11. How might the diameter of a large sunspot compare to the size of Earth?

____

____

THE SUNSPOT CYCLE

______ **12.** What did sunspots first reveal about the sun?
a. The sun rotates.
b. The sun is not made of fire.
c. The sun is fueled by nuclear fusion.
d. The sun has a core.

______ **13.** Later, astronomers learned that the numbers and positions of sunspots vary in a cycle that lasts about
a. 75 years.
b. 50 years.
c. 27 years.
d. 11 years.

______ **14.** A sunspot cycle begins when
a. there is a sudden increase in the number of sunspots all across the sun.
b. the number of sunspots is very high but begins to decrease.
c. the number of sunspots is very low but begins to increase.
d. the location of sunspots on the sun suddenly changes.

Name ________________________ Class ______________ Date ____________

______ **15.** Where do groups of sunspots initially appear?
- **a.** at the sun's poles
- **b.** at the sun's equator
- **c.** all across the sun's surface
- **d.** about midway between the sun's equator and poles

______ **16.** Over the next few years after they appear, the number of sunspots
- **a.** increases until they reach a peak of 10 to 20 sunspots.
- **b.** increases until they reach a peak of more than 100 sunspots.
- **c.** decreases steadily until there are no sunspots at all.
- **d.** stabilizes between 40 and 50 sunspots.

17. What happens after the number of sunspots reaches its peak?

____

____

____

____

18. At what point does the sunspot cycle end and begin again?

____

____

____

SOLAR EJECTIONS

______ **19.** The solar-activity cycle is caused by
- **a.** the alignment of solar system planets.
- **b.** the changing solar magnetic field.
- **c.** the rate at which fusion occurs in the solar core.
- **d.** the changing pattern of currents in the convective layer.

______ **20.** The solar-activity cycle is characterized by
- **a.** decreases in solar surface events.
- **b.** increases in solar surface events.
- **c.** increases and decreases in sunspot activity.
- **d.** increases and decreases in various types of solar activities.

______ **21.** What are events in which the sun emits atomic particles called?
- **a.** solar cycles
- **b.** solar eruptions
- **c.** solar ejections
- **d.** solar events

Name ______________________ Class ______________ Date ______________

Directed Reading *continued*

______22. One form of atmospheric disturbance on the sun is called a prominence, which can be described as
- **a.** whirlpools in the photosphere.
- **b.** huge clouds of glowing gases.
- **c.** rivers of gas that look like streams.
- **d.** dark regions in the photosphere.

______23. What shape do prominences take?
- **a.** huge arches that reach high above the sun's surface
- **b.** huge circular storms on the sun's surface
- **c.** massive waves that cross the sun's surface
- **d.** giant masses of gas that resemble mountains

______24. How does each solar prominence get its shape?
- **a.** It follows curved lines of magnetic force from a region of one magnetic polarity to a field of the same polarity.
- **b.** It erupts from the sun's surface but is pulled back down by the sun's gravity, forming a curve.
- **c.** It follows the curved shape of the sun's surface.
- **d.** It follows curved lines of magnetic force from a region of one magnetic polarity to a field of the opposite polarity.

______25. What are the most violent of all solar disturbances?
- **a.** prominences
- **b.** sunspots
- **c.** solar flares
- **d.** coronal mass ejections

______26. A solar flare is a
- **a.** sudden outward eruption of electrically charged particles, such as electrons and protons.
- **b.** brief outward eruption of atomic particles, such as protons and neutrinos.
- **c.** gradual increase in the stream of charged particles that make up the solar wind.
- **d.** huge, arched prominence that breaks its magnetic field and streams outward.

______27. Although the trigger for a solar flare is unknown, scientists know that
- **a.** solar flares occur on a regular cycle that lasts about two years.
- **b.** solar flares release the energy stored in the strong magnetic fields of sunspots.
- **c.** solar flares are closely associated with the alignment of the planets in the solar system.
- **d.** solar flares are so powerful that they can be seen clearly in daytime.

______**28.** What can be formed by the release of energy in a solar flare?
a. prominences
b. coronal streams
c. coronal loops
d. waves in the solar wind

______**29.** How long do most solar flares last?
a. Few eruptions last more than an hour.
b. Most eruptions last for two or three hours.
c. Few eruptions last more than a minute.
d. Most eruptions last for a week.

______**30.** A coronal mass ejection is
a. a part of the corona that is thrown off from the sun.
b. a part of a coronal loop that does not curve back to the sun.
c. a prominence that breaks away from its magnetic field.
d. another name for a certain type of solar flare.

______**31.** What is the space around Earth that contains a magnetic field?
a. the magnetometer
b. the magnetic corona
c. the magnetosphere
d. the magnet band

32. What are geomagnetic storms? What are they caused by?

____

____

33. With what frequency do geomagnetic storms occur?

____

____

____

AURORAS

______**34.** What are auroras?
a. halos of light around stars and the moon
b. long arches of gas on the sun's surface
c. electromagnetic sparks in the sun's atmosphere
d. bands of light in the sky

______**35.** How are auroras caused?
a. They are caused by the interaction of solar wind and Earth's magnetosphere.
b. They are caused by the interaction of solar wind and Earth's atmosphere.
c. The solar wind bends around Earth.
d. The solar wind changes as it gets farther from the sun.

______**36.** Where on Earth are auroras usually seen?
a. near Earth's equator
b. everywhere in Earth's atmosphere
c. close to Earth's magnetic poles
d. only in Earth's northern hemisphere

______**37.** Why are auroras usually seen close to Earth's magnetic poles?
a. Electrically charged particles reach only Earth's magnetic poles.
b. Electrically charged particles are guided toward the poles by the planet's rotation.
c. Electrically charged particles are guided toward Earth's magnetic poles by Earth's magnetosphere.
d. Electrically charged particles are more easily seen through the thin air near the poles.

______**38.** How does the solar wind produce the colorful sheets of light?
a. Electrically charged particles heat up in Earth's atmosphere and begin to glow.
b. Electrically charged particles strike the atoms and gas molecules in the upper atmosphere.
c. Electrically charged particles enter the magnetosphere and begin to glow.
d. Electrically charged particles explode once they are in contact with the atoms and gases of the atmosphere.

______**39.** What are auroras near the north pole called?
a. aurora borealis (eastern lights)
b. aurora australis (aurora occidentalis)
c. aurora borealis (northern lights)
d. aurora australis (southern lights)

______**40.** What are auroras near the south pole called?
a. aurora borealis (eastern lights)
b. aurora australis (aurora occidentalis)
c. aurora borealis (northern lights)
d. aurora australis (southern lights)

Directed Reading *continued*

41. How far above Earth's surface do auroras normally occur?

____

____

42. When are auroras most frequent?

____

____

43. How often are auroras visible across the northern contiguous United States?

____

44. Where in the United States are auroras visible almost every clear, dark night?

____

45. In addition to Earth, where else have auroras been recorded?

____

____

Back Print

Name ________________ Class ________ Date ________

Skills Worksheet

Directed Reading

Section: Characteristics of Stars

1. What is a star?

____

____

2. How does the color of stars seen from Earth differ from their actual color?

____

____

ANALYZING STARLIGHT

______ **3.** How do astronomers learn about stars?
a. by analyzing the sounds that stars absorb
b. by analyzing the light that stars emit
c. by analyzing the sounds that stars emit
d. by analyzing the light that stars absorb

______ **4.** What are spectrographs?
a. devices that separate light into different colors
b. devices that separate light into different gases
c. graphs that separate light into different spectra
d. devices that gather light into different spectra

______ **5.** What are the three types of spectra?
a. remission, bright-line, and contiguous
b. emission, absorption, and composite
c. emission, absorption, and continuous
d. transmission, abduction, and continuous

______ **6.** What does a star's dark-line spectrum reveal?
a. the star's distance and size
b. the star's composition and magnitude
c. the star's texture and temperature
d. the star's composition and temperature

______ **7.** What is true of the layers of a star?
a. the inner layers are very cool, the outer layers are somewhat cool
b. the outer layers are very hot, the inner layers are somewhat cooler
c. the inner layers are very hot, the outer layers are somewhat cooler
d. the outer layers are very hot, the inner layers are somewhat hot

______ **8.** Elements in the outer layers of a star absorb
- **a.** some of the light radiating from within the star.
- **b.** some of the light radiating from outside the star.
- **c.** none of the light radiating from outside the star.
- **d.** none of the light radiating from inside the star.

THE COMPOSITIONS OF STARS

9. What do the colors and lines in the spectrum of a star indicate?

____

____

10. What is the most common element in stars? What is the second most common element?

____

THE TEMPERATURES OF STARS

In the space provided, write the letter of the color that best matches the surface temperature of a star.

______ **11.** less than 3,500°C

______ **12.** 10,000–30,000°C

______ **13.** 3,500–5,000°C

______ **14.** 5,000–6,000°C

______ **15.** 7,500–10,000°C

a. orange

b. red

c. yellow

d. blue-white

e. white

16. What is indicated by a star's color?

____

17. What color are the coolest stars?

____

THE SIZES AND MASSES OF STARS

______ **18.** What is the diameter of the sun?
- **a.** 1,390,000 km
- **b.** 11,390,000 km
- **c.** 1,390,000 miles
- **d.** 390,000 km

Name ______________________ Class ______________ Date ____________

_____ **19.** Stars that are very dense may have
a. greater temperature than the sun and still be much larger.
b. less mass than the sun and still be much smaller than the sun.
c. more mass than the sun and still be much smaller than the sun.
d. lower temperature than the sun and still be much larger.

STELLAR MOTION

_____ **20.** What two kinds of motion are associated with stars?
a. inferred motion and actual motion
b. actual motion and apparent motion
c. actual motion and imagined motion
d. inferred motion and apparent motion

_____ **21.** What causes the apparent motion of the stars, which we can see with the unaided eye?
a. the actual movement of the stars
b. the movement of the skies
c. the movement of the sun
d. the movement of the Earth

_____ **22.** What causes the circular trails of light seen in long-exposure photographs of the stars?
a. the revolution of the stars around the North Pole
b. the rotation of Earth on its axis
c. the revolution of Earth around the sun
d. the rotation of the stars on their axes

_____ **23.** In the Northern Hemisphere, the movement of stars called circumpolar stars makes them appear
a. to be extremely distant.
b. to circle the sun.
c. to circle Polaris, the North Star.
d. to circle Mars and Venus.

_____ **24.** What is true of all visible stars at the North Pole?
a. They are visible at the South Pole.
b. They are circumpolar.
c. They are perpendicular.
d. They are brighter than the sun.

25. What are three types of actual motion that stars may have?

____

____

____

Name ______________________ Class ____________ Date __________

26. What is the Doppler effect?

____

____

____

27. What does the fact that most distant galaxies have red-shifted spectra indicate?

____

DISTANCES TO STARS

______ **28.** What is a light-year?

a. the distance that light travels in one year
b. the same as the speed of light
c. the amount of time it takes light to travel one mile
d. the distance that light travels in one second

______ **29.** How many kilometers does light travel in one year?

a. 300,000 km
b. 9.46 billion km
c. 700 trillion km
d. 9.46 trillion km

______ **30.** When we witness an event on the sun, when did it actually take place?

a. about 8 minutes before we saw it
b. about 80 years ago
c. about 8 light-years before we saw it
d. about 8 years before we saw it

______ **31.** Except for the sun, what star is nearest to Earth?

a. Polaris
b. Proxima Centauri
c. Alpha Centauri
d. Jupiter

32. What is parallax and how do scientists use it?

____

____

____

____

33. How close must a star be in order for scientists to calculate its distance by measuring parallax?

____

____

STELLAR BRIGHTNESS

______ **34.** How many stars can be seen without a telescope on Earth?
- **a.** about 6,000
- **b.** more than 3 billion
- **c.** less than 1,000
- **d.** more than 3 trillion

______ **35.** What is the Hubble Space Telescope?
- **a.** a sun-orbiting telescope
- **b.** an Earth-orbiting telescope
- **c.** a land-based telescope
- **d.** a telescope on a rocket

36. What is a star's apparent magnitude?

____

____

37. What is a star's absolute magnitude?

____

____

Name ______________________ Class ____________ Date __________

Skills Worksheet

Directed Reading

Section: Stellar Evolution

______ **1.** Why are astronomers not able to observe the entire life of any star?
a. because of the movement of stars
b. because a star typically exists for billions of years
c. because the light of stars reaches Earth millions of years later
d. because a star typically does not exist long enough to be observed

CLASSIFYING STARS

2. What is luminosity?

____

____

3. What is the Hertzsprung-Russell diagram?

____

____

____

4. What is plotted on the horizontal axis and the vertical axis of the H-R diagram?

____

____

5. What is the main sequence?

____

____

____

____

STAR FORMATION

______ **6.** What is a nebula?
a. a cloud of gas and dust where a star begins
b. an explosion where dust collects
c. a false image of a star
d. a group of planets where a star begins

Name ______________________ Class ____________ Date ____________

______ **7.** What is Newton's law of universal gravitation?
- **a.** None of the objects in the universe attract each other through gravitational force.
- **b.** All objects in the universe attract each other through magnetic force.
- **c.** None of the objects in the universe attract each other through magnetic force.
- **d.** All objects in the universe attract each other through gravitational force.

______ **8.** Gravitational force increases as the mass of an object
- **a.** decreases or as the distance between two objects decreases.
- **b.** increases or as the distance between two objects increases.
- **c.** increases or as the distance between two objects decreases.
- **d.** decreases or as the distance between two objects increases.

9. What is a protostar?

____

____

____

10. What happens as more matter is pulled into a protostar?

____

____

11. What is important about the onset of fusion?

____

____

12. What happens as gravity increases the pressure on the matter within a star?

____

____

13. What does the equilibrium between the outward pressures of radiation and the force of gravity do?

____

14. How long does a main sequence star maintain a stable size?

____

____

Name ______________________________ Class ______________ Date ____________

THE MAIN-SEQUENCE STAGE

______ **15.** What is the second and longest stage in the life of a star?
- **a.** the fusion stage
- **b.** the stellar equilibrium stage
- **c.** the main-sequence stage
- **d.** the nebula stage

______ **16.** A star that has the same mass as the sun's mass
- **a.** stays on the main sequence for about 10 million years.
- **b.** stays on the main sequence for about 10 billion years.
- **c.** stays on the main sequence for about 14 billion years.
- **d.** stays on the main sequence for about 100 billion years.

LEAVING THE MAIN SEQUENCE

17. When does a star enter its third stage?

____

____

18. What does increased temperature from contraction in the core cause the helium core to do?

____

____

19. Describe the stars known as giants and their place on the H-R diagram.

____

____

20. What are supergiants?

____

____

THE FINAL STAGES OF A SUNLIKE STAR

______ **21.** What is a planetary nebula?
- **a.** a cloud of gas that forms around a sunlike star that is dying
- **b.** a cloud of gas that forms as a star is born
- **c.** a cloud of energy that is hard to identify
- **d.** a cloud of helium that forms around a star that is starting to fuse

Name ______________________ Class ______________ Date ____________

______ **22.** What is a white dwarf?
- **a.** a cool, extremely scattered core of matter leftover from an old star
- **b.** a hot, extremely scattered core of matter leftover from a red giant
- **c.** a hot, extremely dense core of matter leftover from an old star
- **d.** a cool, extremely dense core of matter leftover from a red giant

______ **23.** What is a black dwarf?
- **a.** a white dwarf that no longer gives off light
- **b.** a white dwarf that starts to give off more light
- **c.** a black star that becomes a white dwarf
- **d.** a star that is dying

______ **24.** An explosion on a white dwarf caused by a pressure build-up is a
- **a.** red giant.
- **b.** black dwarf.
- **c.** supergiant.
- **d.** nova.

______ **25.** What effect may a nova have on a star?
- **a.** It may cause it to become many thousands of times brighter.
- **b.** It may destroy the star.
- **c.** It may cause it to turn into a giant.
- **d.** It may cause it to become many thousands of times dimmer.

26. Describe a supernova and how it differs from a nova.

____

____

____

____

____

THE FINAL STAGES OF MASSIVE STARS

______ **27.** Stars that have masses of more than 8 times the sun's mass produce supernovas
- **a.** with the help of a secondary star.
- **b.** rarely.
- **c.** without needing a secondary star to fuel them.
- **d.** on a regular basis.

Name ________________________________ Class ________________ Date ______________

Directed Reading *continued*

______ **28.** After the supergiant stage, massive stars contract with a gravitational force that is
- **a.** a much less than that of small-mass stars.
- **b.** much greater than that of large-mass stars.
- **c.** much less than that of white dwarf stars.
- **d.** much greater than that of small mass stars.

29. What happens when the core uses up its fuel?

____

____

30. What is a neutron star?

____

____

31. What is a pulsar?

____

____

32. Describe how a black hole forms.

____

____

____

____

33. Why is locating black holes difficult?

____

____

Name ______________________ Class ______________ Date ______________

Skills Worksheet

Directed Reading

Section: Star Groups

_______ **1.** How many stars make up the universe?
a. hundreds
b. thousands
c. millions
d. trillions

CONSTELLATIONS

_______ **2.** Although the stars that make up a pattern appear to be close together,
a. they are not all the same distance from Earth.
b. they are not all stars.
c. they are all the same distance from Earth.
d. they are not all visible from Earth.

_______ **3.** If you look at the same region of the sky for several nights, the positions of the stars
a. appear to change in relation to one another.
b. appear to change some in relation to the sun.
c. do not appear to change in relation to one another.
d. appear to change in relation to the universe.

_______ **4.** Why do the stars appear to be fixed in their patterns?
a. because Earth revolves around the stars
b. because they are actually not moving
c. because of the small distance from which the stars are viewed
d. because of the tremendous distance from which the stars are viewed

_______ **5.** What are the patterns of stars and the region of space around them?
a. consternations
b. consultations
c. constellations
d. galaxies

6. Why are constellations useful?

____

____

____

____

Name ______________________ Class ______________ Date ____________

MULTIPLE-STAR SYSTEMS

______ **7.** What are binary stars?
- **a.** pairs of stars that revolve around each other and are held together by gravity
- **b.** multiple-star systems that revolve around each other and are held together by gravity
- **c.** pairs of stars that do not revolve around each other but are held together by gravity
- **d.** pairs of stars that revolve around each other and are held together by magnetism

______ **8.** What is a barycenter?
- **a.** the center of pressure in a star
- **b.** the center of mass in systems of stars
- **c.** the place where a star is hottest
- **d.** the place toward which stars travel

______ **9.** Where is the barycenter located when binary stars have similar masses?
- **a.** in one of the stars
- **b.** outside both stars
- **c.** in the center of each star
- **d.** somewhere between the stars

10. How many observed stars do astronomers estimate are part of multiple star systems?

____

STAR CLUSTERS

11. What are clusters?

____

____

12. Name and describe two kinds of clusters.

____

____

____

____

GALAXIES

______ **13.** What is a galaxy?
- **a.** a large-scale group of planets, stars, and moons bound together by gravity
- **b.** a large-scale group of stars, gas, and dust bound together by gravity
- **c.** a large-scale group of stars, rocks, and dirt bound together by gravity
- **d.** a large-scale group of gas, elements, and atoms bound together by gravity

______ **14.** What is the diameter of the Milky Way?
- **a.** about 100,000 years
- **b.** about 200 billion miles
- **c.** about 200 billion light-years
- **d.** about 100,000 light-years

______ **15.** What are Cepheid variables?
- **a.** small stars that fade in a regular pattern
- **b.** giant stars that brighten and fade in an irregular pattern
- **c.** giant stars that brighten and fade in a regular pattern
- **d.** dwarf stars that brighten and fade in a regular pattern

______ **16.** The longer a Cepheid's cycle,
- **a.** the dimmer the star's visual absolute magnitude.
- **b.** the brighter the star's visual absolute magnitude.
- **c.** the dimmer the star's telescopic magnitude.
- **d.** the brighter the star's apparent non-visual magnitude.

In the space provided, write the letter of the definition that best matches the term or phrase.

______ **17.** elliptical galaxy

______ **18.** barred spiral galaxy

______ **19.** irregular galaxy

______ **20.** spiral galaxy

a. varies from almost spherical to a stretched out football in shape and has a bright center

b. has a nucleus of bright stars and flattened arms that circle around the nucleus

c. has no particular shape and may have a low total mass

d. has a straight bar of stars that runs through the center

THE MILKY WAY

______ **21.** What does the Milky Way look like in the night sky?
- **a.** a cloudlike band that stretches across the sky
- **b.** a cloudy mass in the center of the sky
- **c.** a cloudlike elliptical mass
- **d.** a cloudy mass with spiral arms

22. How is the sun related to the Milky Way?

____

____

23. How long does it take the sun to orbit around the Milky Way?

____

24. What are the closest neighbors to the Milky Way?

____

25. How far from Earth are the Milky Way's closest neighbors?

____

QUASARS

______ **26.** When were quasars first discovered?
- **a.** 1663
- **b.** 1963
- **c.** 1863
- **d.** 1763

______ **27.** What does a quasar look like when viewed through an optical telescope?
- **a.** It appears as a point of light, almost like a small, faint star.
- **b.** It appears as a mass of light, almost like a large, faint star
- **c.** It appears as a point of light, almost like a small, bright star
- **d.** It appears as a mass of light, almost like a large, bright star

______ **28.** The word quasar is a shortened term for
- **a.** quasi-singular radioactive source.
- **b.** quasi-stellar radio star.
- **c.** quarter-stellar radio star.
- **d.** quasi-stellar radio source.

29. What do some quasars project?

____

____

30. Where are quasars located?

____

____

____

____

31. What could explain the large amount of energy emitted from a quasar?

____

____

____

____

Name ______________________ Class ______________ Date ____________

Skills Worksheet

Directed Reading

Section: The Big Bang Theory

______ **1.** What is cosmology?
- **a.** the study of the distance, mass, and time of the universe
- **b.** the study of the origin, structure, and future of the universe
- **c.** the study of the stars, planets, and people of the universe
- **d.** the study of how the stars affect Earth and the universe

______ **2.** Like all scientific theories, the theories about the origin and evolution of the universe
- **a.** are well-established.
- **b.** must constantly be tested against new observations and experiments.
- **c.** are occasionally tested against old observations and experiments.
- **d.** are considered to be true.

______ **3.** Many current theories of the universe began with observations made
- **a.** more than 300 years ago.
- **b.** more than 100 years ago.
- **c.** less than 100 years ago.
- **d.** less than 10 years ago.

HUBBLE'S OBSERVATIONS

4. What did Hubble discover near the end of the 1920s?

____

____

5. What did Hubble find out about the most distant galaxies?

____

____

6. What do the spectra of distant galaxies collected today say about Hubble's original findings?

____

THE BIG BANG THEORY EMERGES

7. Define the big bang theory.

____

____

Name ______________________ Class ____________ Date __________

Directed Reading *continued*

8. If you trace the expanding universe back in time, what would you find?

____

____

9. In terms of expansion, what is true of the universe today?

____

____

10. What is cosmic background radiation?

____

____

11. When do astronomers think cosmic background radiation formed?

____

____

12. What would the universe have been like soon after the big bang compared with now?

____

____

____

13. What is the temperature of the energy of the background radiation from the big bang?

____

____

14. What are the ripples in the cosmic background radiation, and what caused them?

____

____

____

Name ______________________ Class ______________ Date ____________

15. What may the ripples in the cosmic background radiation indicate about the early universe?

____

____

____

A UNIVERSE OF SURPRISES

______ **16.** Analyzing the ripples in cosmic background radiation tells us that the kinds of matter that humans, the planets, the stars, and matter between stars are made of

a. makes up only 73% of the universe.
b. makes up only 23% of the universe.
c. makes up only 4% of the universe.
d. makes up only 32% of the universe.

______ **17.** What is the type of matter called that does not give off light?

a. dark energy
b. darkness
c. dark matter
d. dark elements

______ **18.** What is dark energy?

a. Scientists think that it acts as a force that opposes gravity.
b. Scientists think that it is matter that does not give off any light.
c. Scientists think that it acts as a dark force that opposes reality.
d. Scientists think that it acts as a force that opposes magnetism.

______ **19.** Recent evidence suggests that distant galaxies are

a. closer to Earth than current theory would indicate.
b. moving faster than current theory would indicate.
c. farther from Earth any theory is able to describe.
d. farther from Earth than current theory would indicate.

______ **20.** Because of dark energy, the universe's rate of expansion

a. seems to be slowing.
b. seems to be undetectable.
c. seems to have stopped.
d. seems to be accelerating.

ena and making predictions can save people's lives. Scientific understanding of natural resources and environmental pollution has a significant impact on the lives of people.

16. Answers may vary. Sample answer: Agree. A hypothesis is a possible explanation of a problem or natural phenomenon. It should be considered to be flexible and never rigid, otherwise it will not lead to further understanding of problems or phenomena. If experimentation fails to support a hypothesis, the hypothesis should be modified or replaced, and experiments should be run again.

17. Answers may vary. Sample answer: Disagree. The process of peer review is an important part of the scientific process. The work of any scientist must be able to stand up to the legitimate criticism of other scientists who understand the problems being studied. Otherwise, the work can never be considered tested by the most rigorous standards and cannot be considered a real contribution to science.

18. Answers may vary. Sample answer: The communication of ideas between scientists within a field of study helps the best thinking to emerge in that field. Bringing those ideas to scientists in other fields of study helps to broaden and refine the thinking of all involved. New approaches and new ways of looking at ideas usually result.

19. Answers may vary. Sample answer: A key to the scientific study of natural phenomena is observation. Both the microscope and the telescope allowed observations to be made in new and more far-reaching ways. Before the lens was invented, the only observations scientific thinkers could make were with the unaided eye. The microscope and telescope opened up a whole new world of observation of small phenomena and of planets and stars, respectively. A new series of observations led to new hypotheses and a whole chain of new scientific inquiry.

20. Answers may vary. Sample answer: The idea that nature is predictable is a basic premise of science that has stood the test of time. Science currently employs some techniques to predict when and where some natural disasters might occur. However, scientists continue to use scientific methods to find ways to make these predictions with more accuracy and precision.

Directed Reading

SECTION: WHAT IS EARTH SCIENCE?

1. forces
2. by developing myths or stories
3. Modern science searches for natural causes and uses careful observations.
4. C
5. A
6. D
7. B
8. D
9. B
10. D
11. A
12. B
13. B
14. D
15. B
16. oceanography
17. waves, tides, ocean currents, ocean floor
18. meteorology
19. Answers may vary. Sample answer should include two of the following: satellites, weather maps, computer models
20. wind speed, temperature, and rainfall
21. the patterns of weather over long periods of time
22. astronomy
23. nearly 4,000 years ago
24. telescopes
25. rovers and space probes
26. environmental science
27. the use of natural resources, pollution, the health of plant and animal species on Earth, the effects of industries and technologies on the environment
28. B
29. C
30. A
31. D
32. A
33. C

34. A
35. D

SECTION: SCIENCE AS A PROCESS

1. Science does not have the same goals as other human endeavors.
2. to explain natural phenomena
3. They ask questions about natural events and then try to answer them through experiments and examination.
4. B
5. D
6. A
7. Earth's past climate changes
8. by following the same basic processes of studying and describing natural events
9. D
10. A
11. C
12. B
13. D
14. C
15. Hypotheses are usually developed through close and careful observation, and most are based on known facts about similar events.
16. with experiments
17. An experiment is a procedure carried out according to certain guidelines.
18. variable
19. independent variable
20. dependent variable
21. to serve as a standard of comparison with another group to which the control group is identical except for one factor
22. controlled
23. after many experiments and observations
24. if the hypothesis fits the known facts
25. if the experimental results differ from what was expected
26. new questions and further study
27. new knowledge and methods of inquiry that further science
28. B
29. C
30. C
31. B
32. C
33. A
34. C
35. B
36. D
37. A
38. the percentage of deviation of an experimental value from an accepted value
39. the range of values for a set percentage of measurements
40. They make additional observations to gather more evidence.
41. to simulate conditions in the natural world
42. a description, representation, or imitation of an object, system, process or concept
43. Physical models are three-dimensional models that can be touched.
44. maps and charts
45. a verbal or graphical model that represents how a system works or is organized
46. a mathematical equation that represents the way a system or process works
47. computer model
48. They can perform experiments by manipulating variables much as they would when performing a physical experiment.
49. C
50. A
51. B
52. C
53. A
54. B
55. D
56. More experiments are often designed to test and expand the original idea.
57. A theory is an explanation for some phenomenon that is based on observation, experimentation, and reasoning, which is supported by a large amount of evidence and does not conflict with existing experimental results or observations.
58. a general statement that explains how the natural world behaves under certain conditions for which no exceptions have been found
59. It allows scientists to identify explanations that fit a wide range of scientific evidence.
60. new disciplines of science
61. C

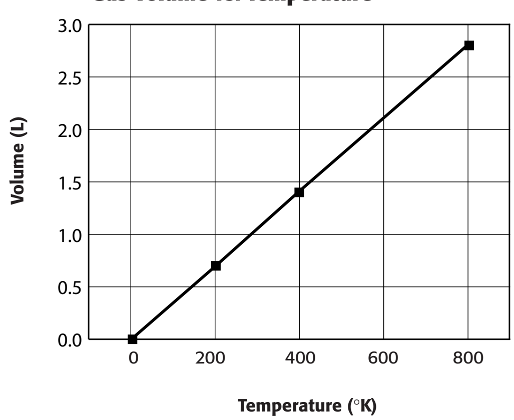
62. to improve computers, cars, medical equipment, and airplanes
63. to consider the possible negative effects of their work
64. alternatives, risks, and costs and benefits to humans and to Earth

Math Skills

1. 3
2. 3
3. 8
4. 560.589 − 23.47 = 537.12. There are five significant digits in the answer.
5. 462.0323 × 1.283 = 592.8. There are four significant digits in the answer.

Graphing Skills

1. 220.1°F
2. 2
3. 222.8°F
4. 225.5°F
5. Gas Volume vs. Temperature



Section Quizzes:

SECTION: WHAT IS EARTH SCIENCE?

1. D
2. E
3. B
4. C
5. A
6. A
7. B
8. D
9. B
10. B

SECTION: SCIENCE AS A PROCESS

1. C
2. A
3. E
4. D
5. B
6. C
7. A
8. D
9. B
10. D

Chapter Test A

1. H
2. I
3. F
4. J
5. D
6. B
7. A
8. E
9. C
10. G
11. A
12. B
13. D
14. C
15. B
16. A
17. A
18. C
19. D
20. C

Chapter Test B

1. E
2. D
3. A
4. C
5. B
6. C
7. B
8. A
9. D
10. C
11. D
12. B
13. A
14. C
15. C
16. B

Directed Reading

SECTION: EARTH: A UNIQUE PLANET

1. Earth is the only known planet in the solar system with liquid water; it is the only planet whose atmosphere contains a large proportion of oxygen; it is the only known planet to support life.
2. in order to know what life-supporting conditions to look for on other planets
3. Earth
4. rock
5. global ocean
6. oblate spheroid
7. points
8. diameter
9. Seismic waves are vibrations that travel through Earth.
10. that Earth is made up of three major compositional zones and five major structural zones.
11. D
12. E
13. H
14. F
15. G
16. B
17. A
18. I
19. K
20. C
21. J
22. C
23. D
24. A
25. A
26. Gravity is the force of attraction that exists between all matter in the universe.
27. The force of attraction between any two objects depends on the masses of the objects and the distance between the objects. The larger the masses of two objects, and the the closer together the objects are, the greater the force of gravity between the objects will be.
28. Weight is a measure of the strength of the pull of gravity on an object. The newton (N) is the unit used to measure weight.
29. 10 N
30. An object's weight depends on its mass and its distance from Earth's center.
31. According to the law of gravitation, the force of gravity decreases as the distance from Earth's center increases.
32. Earth bulges at the equator and is flattened at the poles. Therefore, an object at either pole would be closer to the center of Earth and so would be heavier than it would be at the equator, which is farther from Earth's center.

SECTION: ENERGY IN THE EARTH SYSTEM

1. Different fields of Earth science, such as geology, oceanography, and meteorology, have been studied separately.
2. Scientists are combining knowledge of several sciences to study Earth as a system.
3. B
4. E
5. A
6. C
7. D
8. Systems vary in size from subatomic to the universe; all systems have boundaries.
9. The Earth system operates as a result of the combination of smaller, interrelated systems.
10. Energy can be transferred as heat, light, vibrations, or electromagnetic waves.
11. A system can be described by the way that matter and energy are transferred within the system or to and from other systems.
12. Answers may vary. Sample answer: A closed-system aquarium contains everything it needs for life — plants produce oxygen, aquatic animals feed on plants or each other, and animal wastes and organic matter nourish the plants. Only sunlight enters from the surroundings.
13. Answers may vary. Sample answer: A lake is an open system. Water molecules enter through rainfall and streams; and water exits through streams, evaporation, and absorption by the ground. Sunlight and air exchange heat with the lake. Wind's energy is transferred as waves.
14. Matter exchange is limited. Energy enters the system as sunlight and exits

as heat. Only a small amount of dust and rock from space enters the system, and only a fraction of the hydrogen atoms in the atmosphere escape into space.

15. solid, liquid, gaseous
16. spheres
17. atmosphere
18. hydrosphere
19. geosphere
20. biosphere
21. The atmosphere provides air to breathe and it protects Earth from harmful radiation.
22. Fresh water can be found in lakes, rivers, streams, glaciers and polar ice sheets; and underground in soil and bedrock.
23. The geosphere includes all of the rock and soil on the surface of the continents and on the ocean floor, and the solid and molten interior of Earth.
24. The biosphere is composed of all forms of life in the geosphere, hydrosphere, and atmosphere. The biosphere also contains any organic matter that has not decomposed.
25. B
26. A
27. D
28. C
29. matter
30. energy
31. open systems
32. through chemical reactions, radioactive decay, the radiation of energy, and the growth and decay of organisms
33. radioactive decay and gravitational contraction
34. convection
35. sun
36. winds
37. gravitational energy
38. tides
39. A reservoir is a place where matter or energy is stored.
40. A cycle is a group of processes in which matter and energy repeatedly move through a series of reservoirs.
41. Nitrogen moves from air to soil, from soil to plants and animals, and back to air again. It is removed from the air by nitrogen-fixing bacteria, which are vital to the growth of all plants. When animals eat plants, the nitrogen becomes part of their bodies. The compounds are returned to the soil by the decay of dead animals and in animals' excretions. After nitrogen enters the soil, chemical processes release it back into the atmosphere.
42. In the short-term cycle, plants convert carbon dioxide into carbohydrates. Organisms heat the plants and obtain carbon, and then release it back into the air as carbon dioxide. Carbon is also released through wastes and decay of their remains.
43. In the long-term carbon cycle, carbon passes through all four spheres over a very long time period. Carbon is stored in the geosphere in buried plant or animal remains and in a type of rock called carbonate, which forms from shells and bones.
44. Phosphorus moves through all spheres except the atmosphere.
45. Phosphorus enters soil and water when rock breaks down and when phosphorus dissolves in water. Some organisms excrete phosphorus in their waste. Plants absorb the phosphorus from the soil, and animals absorb phosphorus from the plants. Phosphorus returns to the environment through decomposition.
46. Water changes from liquid to vapor through the energy transfers involved in evaporation and transpiration. During these processes, water absorbs heat and changes state. When the water loses energy, it condenses to form water droplets.
47. Transpiration is the release of water from plant leaves.
48. fossil fuels
49. carbon dioxide
50. agriculture

SECTION: ECOLOGY

1. Ecology is the study of the complex relationships between living things and their nonliving environment.
2. abiotic
3. B
4. C

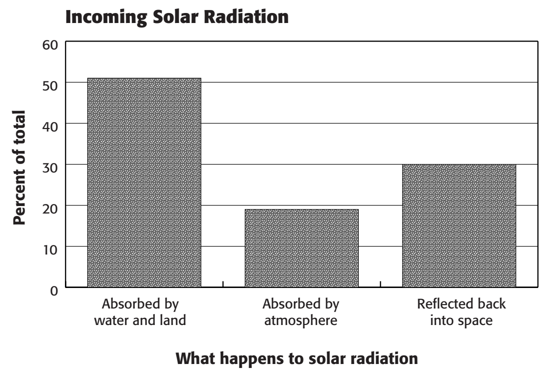
5. A
6. D
7. population growth
8. carrying capacity
9. balance
10. when the physical environment is permanently altered
11. sun
12. photosynthesis
13. temporary storage of energy or the loss of energy
14. at the top of the energy pyramid
15. food chain
16. food web
17. Changes in ecosystems can affect the ability of an area to sustain a human population.
18. Plant and animal populations can be destroyed by overconsumption of resources. Natural ecosystems can be destroyed when large natural areas are converted to agricultural or urban areas. Pollution can pose a serious threat to ecosystems.
19. Pollution is the contamination of the environment with harmful waste products or impurities.
20. by using fossil fuels, land and water resources, and other natural resources wisely

Math Skills

1. x = weight of the equipment in space
   $10x = 4{,}800$ N
   Divide each side by 10:
   $10x \div 10 = 4{,}800 \div 10$
   $x = 480$ N
2. Subtract 43 from each side:
   $12x = 204$
   Divide each side by 12:
   $x = 17$
3. multiply each side by 2:
   $4x + 10 - 8 = 44$
   $4x + 2 = 44$
   Subtract 2 from each side:
   $4x = 42$
   Divide each side by 4:
   $x = 10.5$
4. Multiply each side by 3:
   $6x - 48 = 18$
   Add 48 to each side:
   $6x = 66$
   Divide each side by 6:
   $x = 11$

Graphing Skills

1. nitrogen; 78%
2. other; 1%
3. oxygen; 21%
4.



Section Quizzes

EARTH: A UNIQUE PLANET

1. C
2. A
3. B
4. E
5. D
6. B
7. C
8. A
9. C
10. D

ENERGY IN THE EARTH SYSTEM

1. B
2. C
3. F
4. E
5. D
6. A
7. B
8. C
9. A
10. B

ECOLOGY

1. F
2. B
3. A
4. C
5. D
6. E
7. D
8. B
9. D
10. A

Chapter Test A

1. J
2. D
3. G
4. C
5. I
6. A
7. F
8. E
9. B
10. H
11. B
12. A
13. D
14. B
15. C
16. D

images to cartographers as they make maps. These images would show the shape and positions of geographic features more accurately than ground-level observations. Before remote sensing, cartographers had to rely on only on information gathered on the ground, including measurements and less accurate estimates.

20. Answers may vary. Sample answer: Twenty-five meters, or the difference between the highest and lowest elevations in the area shown on the topographical map, is relatively low relief. So the contour interval will probably be low, perhaps 1 to 3 meters. The cartographer selects an appropriate contour interval based on the relief of the area on the topographical map. A gradual change in elevation in an area of low relief is expressed with a low contour interval.

Directed Reading

SECTION: FINDING LOCATIONS ON EARTH

1. The Earth is a nearly perfect sphere.
2. Earth's axis of rotation can be used to establish reference points.
3. They are used as reference points for defining direction.
4. the geographic North and South poles
5. a circle halfway between the poles that divides Earth into the Northern and Southern Hemispheres
6. A reference grid made up of the equator and additional circles is used to locate places on Earth's surface.
7. A
8. C
9. D
10. B
11. B
12. C
13. D
14. C
15. B
16. D
17. 60 equal parts called seconds
18. 38°53'23"
19. B
20. A
21. C
22. D
23. B
24. A
25. C
26. B
27. D
28. in degrees, minutes, and seconds
29. 38°53'23"N, 77°00'33"W
30. The distance covered by a degree of longitude depends on where the degree is measured.
31. A degree of longitude at the equator equals about 111 kilometers.
32. All meridians meet at the poles.
33. The actual distance measured by a degree of longitude decreases.
34. B
35. C
36. A
37. D
38. B
39. D
40. A
41. D
42. A
43. B
44. C
45. the angle between the direction of the geographic pole and the direction in which the the compass needle points
46. degrees east or west of the geographic North Pole
47. with the geographic North Pole and the geomagnetic north pole for all locations along the of 0° magnetic declination.
48. geographic north for any place on Earth
49. It is another way people can find their locations on Earth.
50. The global positioning system is a satellite navigation system based on a global network of 24 satellites that transmit radio signals to Earth's surface.
51. A GPS receiver held by a person on the ground receives signals from three satellites to calculate the longitude, latitude, and altitude of the receiver on Earth.

SECTION: MAPPING EARTH'S SURFACE

1. a familiar model of Earth in the shape of a sphere

2. Globes can accurately represent the locations, relative areas, and relative shapes of Earth's surface features. They are especially useful in studying large surface features, such as continents and oceans.
3. because most globes are too small to show details of Earth's surface, such as streams and highways
4. cartography
5. They use data from a variety of sources to make maps.
6. by walking or driving through an area to be mapped and making measurements of that area.
7. They plot the information on a map.
8. Remote sensing is the process of gathering and analyzing information about an object without physically being in touch with it. Cartographers can collect information about a site without being there. They use equipment on satellites or airplanes to obtain images of Earth's surface.
9. by combining information from images gathered through remote sensing and information from field surveys
10. C
11. D
12. B
13. A
14. The image of the curved surface is distorted.
15. It may be distorted in size, shape, distance, or direction.
16. The larger the area being shown, the greater the distortion tends to be. A map of the entire Earth would show the greatest distortion. A map of a city would be only slightly distorted.
17. They appear as straight, parallel lines that have an equal amount of space between them, while meridians on a globe come together at the poles.
18. It is accurate near the equator but distorts distances and sizes near the poles.
19. Parallels and meridians form a grid, which makes locating positions easier. Also, the shapes of small areas are usually well preserved with minimal distortion.
20. Little distortion occurs at the point of contact, but the projection shows unequal spacing between parallels that cause distortion in both direction and distance. This distortion increases as distance from the point of contact increases.
21. because a great circle appears as a straight line on an azimuthal projection. Thus, by drawing a straight line between any two points on this projection, navigators can find a great-circle route.
22. along one parallel of latitude
23. in areas near the parallel where the cone and globe are in contact
24. It is a series of conic projections in which each cone touches the globe at a slightly different latitude. These projections are fitted together to form a continuous map. It is more accurate than a single conic projection.
25. A
26. C
27. A
28. B
29. D
30. B
31. C
32. D
33. A
34. legend
35. symbol
36. scale
37. graphic scale
38. fractional scale
39. verbal scale
40. You first measure the distance between the points as shown on the map. Then, you compare that measurement with the map scale.
41. that one unit of distance on the map represents 10,000 of the same unit on Earth
42. A fractional scale stays the same with any system of measurement, regardless of units. For example, the scale 1:100 could be read as 1 in. equals 100 in. or as 1 cm equals 100 cm.
43. a line on a map that represents a constant or equal value of a given quantity
44. *Iso-* is Greek for "equal;" *-gram* means "drawing."

45. isograms used by meteorologists to show changes in atmospheric pressure on weather maps
46. All points along an isobar share the same pressure value.
47. because one location cannot have two air pressures
48. to show areas that have similar measurements of precipitation, temperature, gravity, magnetism, density, elevation, or chemical composition

SECTION: TYPES OF MAPS

1. B
2. A
3. C
4. B
5. D
6. C
7. B
8. D
9. D
10. B
11. A
12. C
13. C
14. Relief is the difference between the highest and lowest elevations in a given area.
15. It is high. It may be 50 or 100 meters.
16. It is low. The contour interval may be 1 or 2 meters.
17. every fifth contour line on a map, which is bolder than the other lines and labeled with its elevation
18. by an x and a label
19. the spacing and direction of the contour lines
20. that the elevation is gradual and that the land is relatively level
21. that the change in elevation is rapid and that the slope of the land is steep
22. A contour line indicating a valley bends to form a V shape. The bend points toward the higher end of the valley.
23. It will point upstream, the direction from which the water flows, because rivers always flow from higher to lower elevations.
24. The width of the V shows the width of the valley.
25. by contour lines that form closed loops
26. closed-loop contour lines with short, straight lines perpendicular to the inside of the loop that point toward the center of the depression
27. The color of a symbol indicates the type of feature on a topographic map.
28. B
29. C
30. A
31. E
32. F
33. D
34. B
35. A
36. D
37. D
38. C
39. A
40. The set of letters usually consists of one capital letter symbolizing the age of the rock, generally by geologic period, followed by one or more lowercase letters that represent the name of the unit or type of rock.
41. They indicate contacts, or places at which two geologic units meet.
42. Depositional contacts show where one rock layer formed above another. Faults are cracks where rocks can move past each other.
43. Strike symbols indicate the direction in which rock beds run. Dip symbols indicate the angle at which the beds tilt.
44. B
45. B
46. A
47. D
48. text, maps, and tables
49. The text includes general information about the geology, topography, and climate of the area being mapped. The tables describe the types and volumes of soil in the area. There are usually two types of soil maps: a general map showing the approximate location of different types of soil in the area and one that shows detailed information.
50. It helps them identify ways to conserve and use soil and to plan sites for future development.

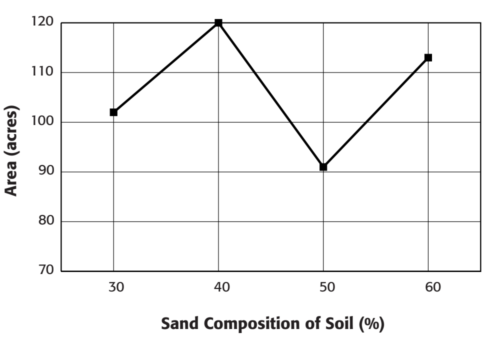
51. B
52. C
53. A
54. B
55. C

Math Skills

1. $10{,}000{,}000 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^7$
2. $10{,}000 = 10 \times 10 \times 10 \times 10 = 10^4$
3. $250{,}000 = 500 \times 500 = 500^2$
4. $10 = 10 \times 1 = 10^1$
5. $5 \times 5 \times 5 \times 5 = 625$; $2\times 2 \times 2 = 8$
   $625 \times 8 = 5000$
6. 1
7. $20^6 = 20 \times 20 \times 20 \times 20 \times 20 \times 20 = 64{,}000{,}000$
8. $13 \times 13 \times 13 \times 13 = 28{,}561$

Graphing Skills

1. 40%
2. 30%
3. 145 km^2
4. 174 km^2
5.



Section Quizzes

SECTION: FINDING LOCATIONS ON EARTH

1. E
2. D
3. A
4. B
5. C
6. B
7. C
8. A
9. C
10. D

SECTION: MAPPING EARTH'S SURFACE

1. C
2. D
3. E
4. B
5. A
6. D
7. A
8. B
9. C
10. C

SECTION: TYPES OF MAPS

1. D
2. C
3. E
4. A
5. B
6. D
7. A
8. C
9. B
10. D

Chapter Test A

1. E
2. I
3. F
4. J
5. H
6. D
7. G
8. A
9. B
10. C
11. B
12. A
13. B
14. A
15. D
16. B
17. C
18. B
19. D
20. A

Chapter Test B

1. C
2. A
3. E
4. B
5. D
6. D
7. B
8. A
9. B
10. C
11. D
12. D
13. B
14. A
15. C
16. contour lines
17. fractional scale
18. magnetic declination
19. geologic unit
20. cartography
21. Answers may vary. Sample answer: place's latitude indicates how many degrees north or south of the equator it is. Combining a place's latitude with its longitude (the number of degrees east or west of the prime meridian) determines its location on Earth.

19. To balance the equation, you would use a coefficient. Because combining the reactants will result in an extra oxygen atom, the coefficient 2 can be used in front of the H_2 so that the product will use all the oxygen atoms and now will be 2 molecules of water. The balanced equation is $2H_2 + O_2$ $2H_2O$.

20. Because sodium normally has 11 electrons and is neutral, it must also have 11 protons. If an electron is lost, the atom of sodium will now have 11 positively charged protons and 10 negatively charged electrons, a net positive charge. It is now a stable sodium ion.

Directed Reading

SECTION: MATTER

1. anything that takes up space and has mass
2. the amount of matter in any object
3. C
4. B
5. A
6. A
7. C
8. D
9. A
10. C
11. B
12. D
13. C
14. A
15. B
16. B
17. D
18. C
19. A
20. B
21. protons and neutrons packed close together in the center of an atom
22. because protons have a positive charge and neutrons have no charge
23. most of an atom's mass
24. very little of an atom's volume
25. empty space
26. a region of space that surrounds the nucleus, where electrons move
27. Opposite charges attract each other, and the negatively charged electrons are attracted to the positively charged nucleus.
28. the attraction of the negatively charged electrons to the positively charged nucleus
29. C
30. B
31. D
32. B
33. C
34. A
35. B
36. D
37. C
38. B
39. C
40. A
41. A
42. B
43. D
44. an atom that has the same number of protons as other atoms of the same element, but has a different number of neutrons
45. It is more massive than a helium atom that has one neutron.
46. because of their different number of neutrons and their different masses
47. C
48. B
49. C
50. D
51. C
52. A
53. B
54. A
55. F
56. C
57. H
58. A
59. B
60. E
61. D
62. G
63. because isotopes of an element have different masses
64. the weighted average of the atomic masses of the naturally occurring isotopes of an element
65. three
66. because each isotope has a different number of neutrons
67. by calculating the weighted average of the atomic masses of the three isotopes of hydrogen

68. 1.00794 amu
69. B
70. D
71. A
72. C
73. C
74. B
75. The number is the same as the atom's group number minus 10, except for helium, which has only two valence electrons.
76. It is considered stable or chemically unreactive.
77. They tend to lose electrons easily.
78. Metals tend to lose electrons easily; nonmetals are more likely to gain electrons.

SECTION: COMBINATIONS OF ATOMS

1. B
2. A
3. D
4. C
5. A
6. B
7. D
8. B
9. A
10. D
11. B
12. C
13. C
14. D
15. B
16. A
17. One molecule of methane, CH_4, reacts with two molecules of oxygen, O_2, to yield one molecule of carbon dioxide, CO_2, and two molecules of water, H_2O.
18. when the number of atoms of each element on the right side of the equation is equal to the number of atoms of the same element on the left side
19. Changing chemical formulas would mean that there are different substances in the reaction.
20. numbers put in front of chemical formulas to balance an equation
21. The methane molecule on the left side of the equation has four hydrogen atoms, and on the right side each water molecule has two hydrogen atoms. The coefficient 2 is placed in front of the formula for water to balance the number of hydrogen atoms.
22. The coefficient 2 is placed in from of the oxygen molecule on the left side of the equation to give both sides four oxygen atoms.
23. D
24. B
25. C
26. A
27. C
28. B
29. D
30. D
31. B
32. B
33. C
34. A
35. D
36. C
37. C
38. D
39. A
40. C
41. B
42. a bond that is formed by the attraction between atoms that share electrons
43. the positive nucleus of each atom is attracted to the shared negative electrons
44. the pull between the positive and negative charges
45. a compound formed by the sharing of electrons
46. Two hydrogen atoms share their single valence electrons with an oxygen atom that has six valence electrons. This creates a bond and gives oxygen a stable number of 8 outermost valence electrons. The oxygen atom shares two of its electrons with the hydrogen atoms, which gives each hydrogen atom two electrons.
47. because the ability of atoms of some elements to attract electrons from atoms of other elements differs
48. a covalent bond where the bonded atoms have an unequal attraction for the shared electrons
49. Two hydrogen atoms share electrons with an oxygen atom to form a water molecule. The oxygen atom has more ability to attract electrons than the

hydrogen atoms, so the atoms are not equally shared between the oxygen and hydrogen atoms. The electrons stay closer to the oxygen nucleus, which has more pull. As a result, the water molecule has a slightly negative charge at its oxygen end and slightly positive charges at its hydrogen ends.

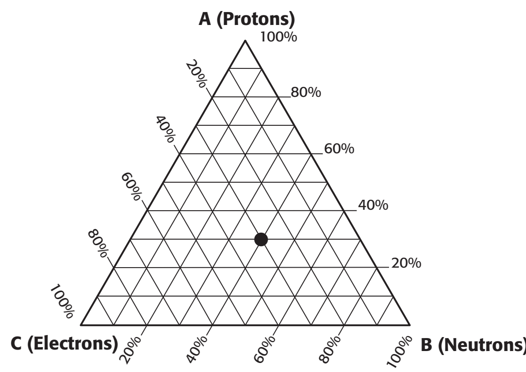
50. The slightly positive ends attract slightly negative ends of other water molecules.
51. C
52. A
53. D
54. B
55. B
56. D
57. a mixture having the same composition and properties throughout
58. a solution
59. Sodium chloride and other ionic compounds are dissolved in sea water.
60. The positive ends of water molecules attract negative chloride ions, and the negative end of water molecules attracts positive sodium ions. Eventually, all the sodium and chloride ions become uniformly distributed among the water molecules.
61. a solution composed of two or more metals

Math Skills

1. 1.6735×10^{-24} g
2. 2.6561×10^{-23} g
3. 1.66054×10^{-24} g
4. 0.000 000 000 000 000 000 006 23 kg
5. 0.000 000 000 000 000 008 5632 kg

Graphing Skills

1. 50%
2. 30%
3. 20%
4. Oxygen is the most common because it has the largest section of the lower part of its triangle relative to the other two plots.
5. Answers may vary. Sample answer: Each particle should be plotted on one of the three axes. Diagrams should accurately reflect the percentages shown in the table.



Section Quizzes

SECTION: MATTER

1. B
2. D
3. E
4. C
5. A
6. B
7. C
8. B
9. D
10. B

SECTION: COMBINATIONS OF ATOMS

1. D
2. C
3. E
4. B
5. A
6. D
7. B
8. C
9. C
10. A

Chapter Test A

1. E
2. I
3. J
4. A
5. H
6. F
7. G
8. D

20. Answers may vary. Sample answer: Quartz is a silicate mineral composed only of silicon and oxygen. The crystalline structure of quartz starts with the basic building block of silicate minerals, the silicon-oxygen tetrahedron. The silicon-oxygen tetrahedron is composed of four oxygen atoms surrounding a silicon atom. In quartz, each of these tetrahedra is bonded to four other tetrahedra in a framework that gives quartz its characteristic crystalline structure.

Directed Reading

SECTION: WHAT IS A MINERAL?

1. They are all minerals.
2. minerals
3. a natural, usually inorganic solid with a characteristic chemical composition, an orderly internal structure, and a characteristic set of physical properties
4. D
5. C
6. C
7. A
8. B
9. C
10. B
11. A
12. C
13. D
14. B
15. chemical compositions of the minerals
16. a mineral that contains a combination of silicon and oxygen
17. only silicon and oxygen
18. feldspars
19. It depends on which metal combines with silicon and oxygen atoms.
20. ferromagnesian minerals
21. iron and magnesium
22. silicate minerals
23. C
24. F
25. A
26. E
27. B
28. D
29. minerals that do not contain compounds of silicon and oxygen
30. carbonates, halides, native elements, oxides, sulfates, and sulfides
31. B
32. D
33. a solid with atoms, ions, or molecules arranged in a regular, repeating pattern
34. the characteristic geometry of that crystal's internal structure
35. the conditions under which minerals form
36. masses of crystals so small that they can only be seen with a microscope
37. as a single, large crystal that has one of six basic crystal shapes
38. It is helpful in identifying minerals.
39. X rays pass through a crystal, strike a photographic plate, and produce an image that shows the geometric arrangement of the atoms that make up the crystal.
40. B
41. A
42. D
43. D
44. B
45. C
46. D
47. C
48. D
49. A
50. B
51. based on structural similarities of the minerals' crystals
52. the structure of a nonsilicate crystal
53. because their crystal structures are based on packing atoms together as close as possible
54. Each metal atom is surrounded by 8 to 12 other metal atoms that are as close to each other as the charges of the atomic nuclei will allow.

SECTION: IDENTIFYING MINERALS

1. C
2. D
3. C
4. D
5. B
6. B
7. C
8. C
9. A
10. C
11. B
12. A
13. B
14. C

15. either colorless or a very light shade of the mineral's standard color
16. light that is reflected from a mineral's surface
17. If a mineral reflects light like a polished metal, then it has metallic luster.
18. C
19. E
20. D
21. A
22. B
23. the tendency of minerals to split along specific planes of weakness to form smooth, flat surfaces
24. along flat surfaces that generally run parallel to planes of weakness in the crystal structure
25. a mineral breaking unevenly into pieces that have curved or irregular surfaces
26. according to the appearance of the broken surface
27. the measure of a mineral to resist scratching
28. A diamond is very hard but can be split along cleavage planes more easily than softer minerals.
29. a scale that lists 10 minerals in order of increasing hardness
30. They scratch the mineral against those on the Mohs hardness scale.
31. Talc is the softest and diamond is the hardest.
32. Determine the hardest mineral on the scale that the unknown mineral will scratch.
33. a strong crystalline structure in which each carbon atom is firmly bonded to four other carbon atoms
34. The atoms that form the mineral's crystals always combine in the same geometric pattern.
35. isometric or cubic system
36. three axes intersect at 90° angles, the two horizontal axes are of equal length, the vertical axis is a different length than the horizontal axes
37. monoclinic system
38. three axes of unequal length intersect at 90° angles
39. hexagonal system
40. three axes of unequal length are oblique to each other
41. temperature, pressure, and other environmental conditions during crystal growth
42. It would feel heavier.
43. the ratio of the mass of a substance to the volume of a substance
44. on the kinds of atoms the mineral has and how closely they are packed
45. between 2 and 3 g/cm^3
46. A
47. B
48. D
49. D
50. B
51. B
52. D
53. D
54. A
55. B
56. C
57. a property of crystals of some transparent minerals to bend light, producing a double image of an object viewed through the crystal
58. because light rays are split into two parts as they enter the crystal
59. iron
60. a north pole at one end and a south pole at the other
61. unstable nuclei decay over time into stable nuclei by releasing particles and energy
62. uranium and radium
63. pitchblende

Math Skills

1. The formula is *area* = *lw*.
   $3.4 \times 4.2 = 14.3$ cm^2.
2. The formula is *volume* = *lwh*. Because one face is 9 cm^2, that means that the length, width, and height of the cube are each 3 cm.
   $3 \times 3 \times 3 = 27$ cm^3.
3. The formula is *volume* = *lwh*.
   $2.2 \times 2 \times 1.8 = 7.9$ cm^3.
4. The formula is *volume* = *1/3b²h*.
   $16 \times 5 = 80$; $80 \div 3 = 26.67$ cm^3
5. The formula for the volume of one pyramid is *volume* = *1/3b²h*.
   $4 \times 4.3 = 17.2$; $17.2 \div 3 = 5.7$ cm^3.
   To find the volume for the whole crystal, the volume of one pyramid must be multiplied by 2: 7 cm^3 $\times$ 2 = 11.4 cm^3.

Answer Key

Concept Review

1. E
2. C
3. G
4. D
5. B
6. H
7. J
8. F
9. A
10. I
11. C
12. C
13. D
14. C
15. A
16. A
17. B
18. C
19. B
20. D

Critical Thinking

1. B
2. A
3. D
4. A
5. C
6. A
7. A
8. C
9. B
10. C
11. Answers may vary. Sample answer: The rock structures in Joshua Tree National Park are piles of rocks that give the formation a rectangular shape. Other desert formations, like mesas and buttes, are mountain- or hill-like structures that are broader, steeper, and flat on top.
12. Answers may vary. Sample answer: Magma cooled near the surface; over time horizontal and vertical joints developed, creating hard rectangular rocks surrounded by soft clay and loose minerals; when the soft materials eroded, the inselbergs were left standing.
13. Answers may vary. Sample answer: No. Because of the manner in which they were formed, Inselbergs are likely to be found on flat deserts or plains.
14. Answers may vary. Sample answer: Agree: All solid, non-living materials, such as silt, dirt, dust, and rock, are at their own particular stage of the rock cycle.
15. Answers may vary. Sample answer: Disagree: At the same time erosion is taking place, other changes are occurring, such as the shifting of tectonic plates and erupting volcanoes, that add rock materials to the surface of Earth.
16. Answers may vary. Sample answer: Disagree: Although all rocks pass through the rock cycle, not all rocks complete the same steps in the same order.
17. Answers may vary. Sample answer: Agree: It is sometimes possible to identify a rock by its texture (crystal or grain size) or mineral composition (which affects a rock's color).
18. Answers may vary. Sample answer: Mountains on either coast point to major tectonic plate and possibly volcanic activity as playing a part in the development of the landscape.
19. Answers may vary. Sample answer: Even today we must know the qualities of rocks because we build on them and with them. They are used in many aspects of everyday life and technology.
20. Answers may vary. Sample answer: Studying rocks tells us how the physical planet Earth evolved. The past also holds clues to how it might continue to develop in the future.

Directed Reading

SECTION: ROCKS AND THE ROCK CYCLE

1. C
2. B
3. B
4. A
5. A
6. B
7. D
8. C
9. C
10. D
11. E
12. A
13. B
14. F

15. A rock cycle is the series of processes in which rock forms, changes from one type to another, is destroyed, and forms again by geological processes.
16. igneous
17. sedimentary
18. metamorphic
19. magma
20. igneous
21. rock cycle
22. Physical and chemical properties of rock are determined by how and where the rock is formed.
23. The physical characteristics of rock reflect the chemical composition of the rock as a whole and of the individual minerals that make up the rock.
24. Chemical stability determines the rate at which rock weathers and the way it breaks apart.
25. stability
26. Answers may vary. Sample answer: Bowen learned that as magma cools, certain minerals tend to crystallize first. As these minerals form, they remove specific elements from the magma, changing the magma's composition.
27. Bowen's reaction series is the simplified pattern that illustrates the order in which minerals crystallize from cooling magma according to their chemical composition and melting point.
28. The first way is characterized by a gradual, continuous formation of minerals that have similar chemical compositions. The second way is characterized by sudden changes in mineral types. The pattern of mineral formation depends on the chemical composition of the magma.
29. chemical stability
30. chemical bonds
31. Rocks' natural zones of weakness are determined by how and where the rocks form.
32. layers
33. pressure
34. weathering

SECTION: IGNEOUS ROCK

1. igneous rock
2. crystalline
3. chemical composition
4. D
5. A
6. B
7. C
8. B
9. B
10. B
11. B
12. D
13. B
14. D
15. F
16. D
17. G
18. C
19. A
20. E
21. B
22. Intrusive igneous rocks and extrusive igneous rocks form in different ways and have different-sized crystals.
23. The texture of igneous rock is determined by the size of its crystals.
24. The size of crystals in igneous rock is determined by the cooling rate of the magma.
25. intrusive igneous rock
26. granite
27. rhyolite, basalt
28. obsidian
29. vesicles
30. pumice
31. the chemical composition of the magma from which the rock formed
32. Felsic is used to describe magma or igneous rock that is rich in feldspars and silica and is generally light in color.
33. potassium feldspar, quartz, plagioclase feldspar, biotite mica, and muscovite mica
34. granite, rhyolite, obsidian, and pumice
35. Mafic describes magma or igneous rock that is rich in magnesium and iron and is generally dark in color.
36. plagioclase feldspar and pyroxene minerals
37. Ferromagnesian minerals and the mineral olivine are responsible for the dark color of mafic rock.
38. basalt and gabbro
39. plagioclase feldspar, hornblende, pyroxene, and biotite mica

40. An intermediate rock contains lower proportions of silica than rocks in the felsic family but higher proportions of silica than rocks in the mafic family.
41. diorite and andesite
42. C
43. A
44. E
45. B
46. D
47. F
48. C
49. F
50. E
51. A
52. D
53. B

SECTION: SEDIMENTARY ROCK

1. loose fragments of rock, minerals, and organic material that result from natural processes, including the physical breakdown of rocks
2. the source of the sediment, the way the sediment was moved, and the conditions under which the sediment was deposited
3. They are transported by wind, water, or ice.
4. The source of the sediment determines the sediment's composition.
5. Its characteristics change as it is physically broken down or chemically altered.
6. compaction and cementation
7. compaction
8. cementation
9. B
10. A
11. D
12. B
13. A
14. organic sedimentary rock
15. coal
16. carbon
17. calcite
18. limestone
19. chalk
20. C
21. F
22. B
23. D
24. E
25. A
26. the distance sediment is moved, and the agent that moves the sediment
27. water, ice, wind, and the effects of gravity
28. Speed affects the size of sediment particles that can be carried and the distance that the particles will move.
29. Sorting is the tendency for currents of air or water to separate sediments according to size.
30. Poorly sorted sediments have grains of different sizes and shapes; well-sorted sediments are all roughly the same size and shape.
31. Collisions between particles of sediment during transportation from one place to another can cause particles to change size and shape.
32. Generally, the farther sediment travels from its source, the finer and smoother the particles of sediment become.
33. G
34. F
35. A
36. D
37. B
38. C
39. E
40. ripple mark
41. mud crack
42. As sediments pile up, plant and animal remains are buried. Either hard parts remain or the hard parts dissolve and an impression is left in the sedimentary rock.
43. Concretions form when minerals precipitate from fluids and build up around a nucleus.
44. Groundwater sometimes deposits dissolved minerals inside cavities in sedimentary rock. The minerals may crystallize inside the cavities to form a geode.

SECTION: METAMORPHIC ROCK

1. Metamorphism is the process in which one type of rock changes into metamorphic rock because of chemical processes or changes in temperature and pressure.
2. deep in Earth's crust
3. from existing igneous, sedimentary, or metamorphic rock
4. pressure
5. parallel bands
6. composition
7. metamorphism

8. magma
9. tectonic plates
10. Contact metamorphism is a change in the texture, structure, or chemical composition of a rock due to contact with magma.
11. Only a small area of rock that surrounds the hot magma is changed by the magma's heat.
12. The movement of hot chemical fluids through fractures may also cause changes in the surrounding rock during contact metamorphism.
13. Regional metamorphism is a change in the texture, structure, or chemical composition of a rock due to changes in temperature and pressure over a large area, generally as a result of tectonic forces.
14. When one tectonic plate moves against another, it generates tremendous heat in the rocks at the edges of the tectonic plates. This heat and pressure causes chemical changes in the minerals of the rock.
15. Regional metamorphism causes most metamorphic rock to form.
16. Volcanism and movement of magma often accompany tectonic activity, so rocks formed by contact metamorphism can be found near those created by regional metamorphism.
17. Metamorphic rocks are first classified by texture and then by composition.
18. B
19. E
20. A
21. G
22. D
23. C
24. F
25. Extreme pressure may cause the mineral crystals in the rock to realign or regrow to form parallel bands, or foliation might occur as minerals that have different compostions separate to produce a series of alternating dark and light bands.
26. The original rock may contain grains of only one mineral or very small amounts of other minerals. In this case it does not form compositional bands when it is metamorphosed. Or, the original rock may contain grains that are round or square. Because the grains do not have some long and some short sides, these grains do not change position when exposed to pressure in one direction.

Math Skills

1. 2,900 k; 2; Rule 3; because zeros at the end of the number are not significant unless they have been measured or are the first estimated digit
2. 5 k; 1; Rule 1; because all nonzero digits are significant
3. 35 k; 2; Rule 1; because all nonzero digits are significant
4. 2,900 + 5 = 2,905 k; 4; Rule 2; because any zeros between significant digits are also significant

Graphing Skills

1. 10% quartz; 60% feldspar; 30% lithic grains
2. 30% quartz; 50% feldspar; 20% lithic grains
3. 50% quartz; 40% feldspar; 10% lithic grains
4. 90% quartz; 10% feldspar; 0% lithic grains

Section Quizzes

SECTION: ROCKS AND THE ROCK CYCLE

1. B
2. E
3. A
4. D
5. C
6. A
7. D
8. D
9. A
10. C

SECTION: IGNEOUS ROCK

1. D
2. A
3. E
4. B
5. C
6. C
7. B
8. A
9. B
10. B

SECTION: SEDIMENTARY ROCK

1. B
2. D
3. C
4. A
5. E
6. D
7. A
8. C
9. D
10. C

Answer Key

Concept Review

1. C
2. D
3. E
4. B
5. J
6. I
7. H
8. A
9. F
10. G
11. C
12. D
13. A
14. B
15. C
16. B
17. D
18. C
19. A
20. D

Critical Thinking

1. B
2. C
3. A
4. B
5. D
6. D
7. B
8. B
9. A
10. Answers may vary. Sample answer: The spinning rotors might harm birds that accidentally fly into them. To lessen the threat, screens could be put around the turbines or they could be equipped to repel birds.
11. Europeans use about half as much electricity as Californians.
12. Answers may vary. Students should support their arguments that wind energy's benefits do or do not outweigh their disadvantages.
13. Answers may vary. Sample answer: Disagree. Explosions are not the only risk of nuclear power. Nuclear plants create radioactive wastes that can harm life if not stored properly.
14. Answers may vary. Some students may say that because power from nuclear fusion would not harm the environment and would be unlimited, fusion is perfect. Others might say that there is no such thing as a perfect fuel or that the risks or problems of nuclear fusion are as yet unknown.
15. Answers may vary. Sample answer: Disagree. Scientists still need to better harness solar power, especially in areas where the sun does not shine often.
16. Answers may vary. Sample answer: Disagree. Hybrid cars still have some dangerous emissions.
17. Answers may vary. Sample answer: If people cut down live trees for fuel, this could add to the pollution of the air. It also harms the environment since trees are necessary to prevent erosion of soil and to keep ecological balance on Earth.
18. Answers may vary. Sample answer: Hydroelectric power based on tides would probably work well because the island nation is surrounded by oceans with tides. The tides could be harnessed to provide hydroelectric power.
19. Answers may vary. Sample answer: Because wind results from the uneven heating of Earth's surface by the sun, it could be considered a form of solar energy.
20. Answers may vary. Sample answer: Theoretically, a person who dug deeply enough in the backyard might break through the cap rock in an oil trap. The oil would then gush to the surface.

Directed Reading

SECTION: MINERAL RESOURCES

1. more than 3,000
2. gold, silver, aluminum
3. sulfur, quartz
4. They are shiny, good conductors of heat and electricity, and bend easily when in thin sheets.
5. They have a dull surface and are poor conductors of heat and electricity.
6. D
7. A
8. E
9. C
10. F
11. B
12. chromium, nickel, lead
13. They sink.
14. contact metamorphism

15. ores
16. hydrothermal solutions
17. veins
18. lode
19. gold, tin, lead, copper
20. Tiny fragments of native elements are released as rock weathers.
21. Fragments become concentrated at the bottom of stream beds.
22. placer deposits
23. C
24. C
25. B
26. D
27. A
28. B
29. D
30. D
31. C
32. B
33. B
34. D

SECTION: NONRENEWABLE ENERGY

1. transportation and manufacturing
2. nonrenewable resources
3. A
4. C
5. D
6. D
7. B
8. A
9. C
10. B
11. A
12. C
13. 80%
14. Their remains accumulated on the ocean floor and were buried by sediments.
15. Heat and pressure caused chemical changes that converted the remains to petroleum and natural gas.
16. oil
17. liquid
18. gas
19. They are important sources of energy for transportation, farming, and other industries.
20. B
21. C
22. A
23. because it is less dense than water
24. because it is less dense than both oil and water
25. The petroleum and natural gas often flow to the surface.
26. fossil fuels
27. crude oil
28. coal
29. oil shale
30. natural gas
31. Answers may vary. Sample answers: plastics, synthetic fabrics, medicines, waxes, synthetic rubber, insecticides, fertilizers, detergents, shampoos
32. United States, Russia, China
33. B
34. C
35. D
36. B
37. A
38. B
39. D
40. A
41. nuclear reactor
42. heat energy
43. uranium-235
44. uranium-enriched pellets
45. fuel rods
46. The uranium-235 nuclei in the fuel rods split and release neutrons and energy.
47. They become very hot.
48. Enriched fuel pellets are made into bundles of fuel rods, which are bombarded by neutrons. When struck by neutrons, the nuclei in the fuel rods split and release neutrons and energy.
49. The resulting chain reaction causes the fuel rods to become very hot.
50. They burn no fossil fuels and produce no air pollution.
51. Nuclear fission produces radioactive materials that have very long half-lives, so wastes must be safely stored for thousands of years.
52. The wastes give off high doses of radiation that can destroy plant and animal cells and can cause harmful changes in genetic material.
53. in dry casks or onsite water pools
54. onsite or in one of three U. S. disposal facilities
55. nuclear fusion
56. energy

57. temperatures of more than 15,000,000°C
58. hydrogen atoms from ocean water
59. It could create a nearly limitless supply of energy.
60. Wastes from fusion would be much less dangerous than wastes from fission.

SECTION: RENEWABLE ENERGY

1. 200 years
2. It has numerous safety concerns.
3. renewable resources
4. C
5. D
6. A
7. B
8. D
9. 15 minutes
10. the energy received by Earth from the sun in the form of radiation
11. how to capture even a small part of the energy that travels to Earth from the sun
12. C
13. D
14. A
15. B
16. A box with a glass top is placed on the roof of a building. Water circulates through tubes, which is heated by the sun, providing heat and hot water.
17. On cloudy days there may not be enough sunlight to heat the water.
18. running water of rivers and streams and ocean tides
19. hydroelectric energy
20. 11%
21. It holds back running water and channels the water through the plant.
22. Water channeled through the plant spins turbines, which turn generators that make electricity.
23. They have built dams to trap the water at high tide and release it at low tide, at which time it turns turbines.
24. C
25. A
26. D
27. B
28. air pressure differences caused by the sun's uneven heating of Earth's surface
29. wind turbines
30. locations with constant winds
31. wind farm
32. enough to meet the electricity needs of entire communities
33. The wind does not always blow, even in windy locations.

SECTION: RESOURCES AND CONSERVATION

1. C
2. A
3. B
4. It can damage or destroy fragile ecosystems.
5. They may add pollution to soil, water, and air.
6. They have created and enforced policies to govern these resources.
7. air and noise
8. Water can carry toxic substances from mining processes.
9. surface mining, which often uses explosions to remove layers of rock and soil
10. It may sink.
11. They are hard to put out and may be left to burn for centuries.
12. to prevent mining operations from contaminating local air, water, and soil resources
13. Clean Water Act, Safe Drinking Water Act, Comprehensive Response Compensation and Liability Act
14. Endangered Species Act
15. the process in which mining companies must return mined land to its original condition after mining is completed
16. It helps reduce the long-lasting environmental impact of mining.
17. through frequent inspections and by using processes that reduce impacts on the environment
18. B
19. C
20. A
21. D
22. A
23. B
24. C
25. C
26. ensure that resources last longer; reduce environmental damage; reduce pollution
27. They need them as their countries become more industrialized.

28. use abundant or renewable materials in their place; recycle
29. the process of recovering valuable or useful materials from waste or scrap; using materials more than once
30. iron, copper, aluminum
31. Recycling requires less energy.
32. It reduces the amount of energy needed for heating and cooling.
33. They reduce the amount of electricity used each day.
34. Turn off lights when leaving a room. Wash only full loads of dishes and laundry.
35. more than 8 kg
36. Walk, ride a bicycle, combine errands.
37. There will be a critical shortage.
38. Use water-saving shower heads, faucets, and toilets; turn off the faucet while you brush your teeth; water plants in the morning or at night; plant native plants in your yard.

Math Skills

1. *area* = *lw*
   $11.5 \times 4.7 = 54.05$ k²
2. *volume* = $\frac{4}{3}\pi r^3$
   $r = .375$ km
   $\frac{4}{3} \times 3.14 \times .05273 = volume$
   $\frac{4}{3} \times .16557 = .22076$
   $.22076 \times \frac{1}{2} = volume$ (of ½ sphere)
   volume = .11 km³
3. *area* = ½*bh*
   area = $\frac{1}{2} \times .32 \times .86$
   area = 0.138k²
4. *volume* = *lwh*
   volume = $4.1 \times 3.5 \times 2.7$
   volume = 38.74 m³
5. *area* = *lw*
   area = 6.5×5.2
   area = 33.8 m²

Graphing Skills

1. coal; 51.0%
2. 2,566 billion kilowatt hours; 69.5%
3. 396 billion kilowatt hours; 10.8%
4. Answers may vary. Graphs should be similar to the one on the first page but should reflect electricity generation in your state.

Section Quiz

SECTION: MINERAL RESOURCES

1. B
2. D
3. E
4. A
5. C
6. B
7. C
8. C
9. D
10. A

SECTION: NONRENEWABLE ENERGY

1. B
2. C
3. A
4. E
5. D
6. C
7. A
8. A
9. C
10. B

SECTION: RENEWABLE ENERGY

1. C
2. A
3. D
4. E
5. B
6. B
7. C
8. C
9. D
10. B

SECTION: RESOURCES AND CONSERVATION

1. B
2. A
3. C
4. D
5. B
6. C
7. C
8. D
9. B
10. A

Chapter Test A

1. E
2. G
3. A
4. H
5. I
6. B
7. D
8. J
9. F
10. C
11. B
12. C
13. D
14. D
15. C
16. C

record. One type of unconformity is a nonconformity, where igneous or metamorphic rock comes through layers of sedimentary rock to the surface, either through earthquake or volcanic activity. The exposed rock is affected by erosion and new layers of sediment are deposited on top of it.

20. Answers may vary. Sample answer: Radioactive isotopes emit alpha particles (or other particles) at a constant rate, in a process called alpha decay. Scientists are able to measure the mass of radioactive isotopes. Knowing the rate of radioactive decay, they deduce how the mass has reduced over time, and then they are able to deduce the age of the sample. Once they know the age of a sample, often they can deduce the age of other layers of rock near where the sample was found.

Directed Reading

SECTION: DETERMINING RELATIVE AGE

1. 4.6 billion years
2. James Hutton
3. on observation of geologic changes taking place on his farm
4. He theorized that the same forces that changed the landscape of his farm had changed the surface of Earth in the past.
5. Current geologic processes are the same processes that were at work in the past.
6. Uniformitarianism is one of the basic foundations of the science of geology.
7. Later geologists pointed out that although the processes of the past and present are the same, the rates at which the processes work may vary over time.
8. People believed that Earth was only about 6,000 years old and that all of its geologic features had formed at the same time.
9. Uniformitarianism raised serious questions about Earth's age.
10. He noted that the forces that changed the land on his farm operated very slowly.
11. Hutton's conclusions encouraged other scientists to learn more about Earth's history.
12. Determining the order in which rock layers and other rock structures formed
13. A
14. B
15. D
16. C
17. B
18. A
19. D
20. A
21. B
22. A
23. C
24. D
25. when tectonic forces push older layers of rock on top of younger ones or overturn a group of rock layers
26. They must look for clues to the original position of the rock layers.
27. the arrangement of layers in which coarse and heavy particles are located in the bottom layers of rock
28. The rock has been overturned by tectonic forces.
29. cross-beds
30. The tops of the sandy layers commonly erode before new layers are deposited.
31. to determine the original positions of the rock layers
32. Ripple marks are small waves that form on the surface of sand because of the action of water or wind.
33. that the layer of rock is undeformed
34. By examining the orientation of ripple marks, scientists can establish the original arrangement of rock layers, and then they can use the law of superposition.
35. C
36. B
37. C
38. B
39. A
40. D
41. C

42. A
43. F
44. D
45. E
46. B
47. The layers on either side of the boundary are nearly horizontal, and the rock layers may look as though they were deposited continuously. But a large time gap exists where the upper and lower layers meet.
48. A fault is a break or crack in Earth's crust along which rocks shift their position.
49. When magma is injected into rock and then cools and solidifies, an intrusion forms.
50. They apply the law of crosscutting relationships.
51. A fault or igneous intrusion is always younger than the rock layers it cuts through.
52. The fault or igneous intrusion is always younger than all the rocks it cuts through above and below the unconformity.

SECTION: DETERMINING ABSOLUTE AGE

1. only that one rock formation is younger or older than another rock formation
2. Scientists need to determine the numeric age, or absolute age, of a rock formation.
3. Absolute age is numeric age—actual age in years.
4. B
5. A
6. B
7. D
8. C
9. B
10. By using data collected over a long period of time, geologists can estimate the average rates of deposition for common sedimentary rocks.
11. In general, about 30 cm of sedimintary rock are deposited over a period of 1,000 years.
12. Answers may vary. Sample answer: a flood can deposit many meters of sediment in a single day, additionally, rates of deposition may change over time.
13. Like tree rings, varves form in distinct annual layers.
14. Varves consist of a light-colored band of coarse particles and a dark-colored band of finer particles.
15. Answers may vary. Sample answer: Varves generally form in glacial lakes. A rush of melted water during the summer carries large amounts of sediment into a lake, where coarse particles quickly settle to the bottom. When winter comes and ice forms, fine particles settle in a thin layer on top of the coarse particles.
16. Two: a coarse layer with a fine layer on top.
17. By counting the varves in a deposit, scientists can estimate the age of the deposit.
18. C
19. B
20. A
21. D
22. B
23. C
24. D
25. A
26. Scientists measure concentrations of the original radioactive isotope, or parent isotope, and of the newly formed isotopes, or daughter isotopes.
27. Daughter isotopes are a different isotope of the same element or an isotope of a different element into which a radioactive atom has changed as it emits particles and energy.
28. Scientists use the known decay rate to compare concentrations of the parent and daughter isotopes to determine the absolute age of a rock.
29. nothing
30. The amount of time is always the same and can be determined for any radioactive isotope.
31. A half-life is the amount of time it takes for half the mass of a given amount of a radioactive isotope to decay into its daughter isotopes.
32. 5 g
33. One-fourth

34. Answers may vary. Sample answer: Scientists compare the amounts of parent and daughter isotopes in the sample.
35. The higher the percentage of daughter isotopes, the older the rock is.
36. through leaking or contamination
37. the amount of time that has passed since a rock formed
38. 4.5 billion years
39. ^{238}U is most useful for dating rocks that are more than 10 million years old because its half-life is so long.
40. 1.25 billion years
41. Potassium-40 is found in mica, clay, and feldspar.
42. Potassium-40 is used to date rocks that are between 50,000 and 4.6 billion years old.
43. ^{87}Rb has a half-life of about 49 billion years. It commonly occurs in minerals that contain ^{40}K, so it can be used to verify the age of rocks that were previously dated using ^{40}K.
44. D
45. C
46. C
47. A
48. Scientists first determine the ratio of ^{14}C to ^{12}C in the sample.
49. The ratio of carbon-14 to carbon-12 in the sample is compared to the ratio that is known to exist in a living organism.
50. about 5,730 years
51. Because the organism is dead, it no longer absorbs ^{12}C or ^{14}C.
52. It decreases steadily as the radioactive carbon-14 decays to nonradioactive nitrogen-14.

SECTION: THE FOSSIL RECORD

1. B
2. B
3. C
4. B
5. A
6. D
7. The sediments that cover the fossils slow or stop the process of decay and protect the bodies of dead organisms from damage.
8. The intense heat, pressure, and chemical reactions that occur during the formation of igneous and metamorphic rocks destroy all organic structures.
9. The fossil record provides information about the geologic history of Earth.
10. by revealing the ways that organisms have changed throughout the geologic past
11. when fossils of marine plants and animals are discovered in areas far from any ocean
12. They can learn how environmental changes have affected living organisms.
13. C
14. A
15. B
16. D
17. C
18. B
19. A
20. C
21. B
22. C
23. D
24. C
25. B
26. C
27. B
28. B
29. C
30. B
31. Answers may vary. Sample answer: reptiles, amphibians, birds, and mammals
32. C
33. C
34. D
35. A
36. B
37. D
38. B
39. B
40. Answers may vary. Sample answer: Because the index fossils are known to come from a particular period of geologic time, if an index fossil is found in rock layers anywhere in the world, scientists know that the rock layers in which it was found formed during the same time period.

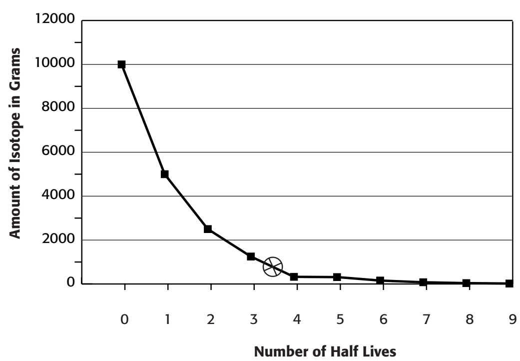
41. Answers may vary. Sample answer: Index fossils help geologists locate rock layers that are likely to contain deposits of oil and natural gas.

Math Skills

1. $\frac{1}{2}a = 120$; $2 \times \frac{1}{2}a = 2 \times 120$; $a = 240$
2. $\frac{1}{2}a = 60$; $2 \times \frac{1}{2}a = 2 \times 60$; $a = 120$
3. $\frac{1}{2}a = 105$; $4 \times \frac{1}{2}a = 4 \times 105$; $a = 420$
4. $\frac{1}{2}a = 25$; $4 \times \frac{1}{2}a = 4 \times 25$; $a = 100$
5. $\frac{1}{8}a = 40$; $8 \times \frac{1}{8}a = 8 \times 40$; $a = 320$

Graphing Skills

1. two
2. 12,500
3. because it shows the ratio between the two amounts, which changes drastically with each half-life
4. between the fourth and fifth half-lives
5. The sample must be between 17,100 and 22,800 years old, and about three and on-half half-lives have passed. The line should be marked within this range.



6. Students should mark a position between 3 and 4 on the x-axis and just under 1000 on the y-axis. Three and a half half-lives have passed.

Section Quizzes

SECTION: DETERMINING RELATIVE AGE

1. D
2. C
3. A
4. E
5. B
6. B
7. C
8. D
9. C
10. A

SECTION: DETERMINING ABSOLUTE AGE

1. C
2. B
3. D
4. E
5. A
6. D
7. D
8. B
9. C
10. C

SECTION: THE FOSSIL RECORD

1. B
2. E
3. A
4. D
5. C
6. A
7. D
8. B
9. A
10. B

Chapter Test A

1. E
2. I
3. B
4. A
5. G
6. J
7. C
8. F
9. D
10. H
11. C
12. A
13. D
14. B
15. C
16. C
17. D
18. A
19. B
20. C

Chapter Test B

1. H
2. E
3. C

Pangaea broke apart, and tectonic collisions once again created mountain ranges. However, the climate remained warm and humid and many reptiles evolved. In the Holocene Epoch, coastlines took their present shapes when sea level rose. These conditions were favorable to the evolution of Homo sapiens.

Directed Reading

SECTION: GEOLOGIC TIME

1. Evidence of change is recorded in the rock layers of Earth's crust.
2. geologic time scale
3. to outline the development of Earth and of life on Earth
4. They studied fossils and applied the principle that old layers of rock are below young layers.
5. Scientists combined their observations because no single area of Earth contained a record of all geologic time.
6. geologic column
7. bottom
8. They are distinguished by the types of rock the layers are made of and the kinds of fossils the layers contain.
9. Those in the upper layers resemble modern plants and animals, while those in the lower layers are of plants and animals different from those living today.
10. extinct
11. the average rates of sediment deposition
12. radiometric dating
13. a similar layer in a geologic column that contains the same fossils or has the same relative position
14. The rock layers likely formed at about the same time.
15. changes in Earth's surface, climate, and types of organisms
16. They contain similar fossils.
17. fossils
18. millions of years ago
19. 4,600 Ma
20. trilobites and brachiopods
21. It reached a modern oxygen-rich state.
22. 444 Ma
23. Devonian Period
24. Paleozoic Era
25. Pennsylvanian and Mississippian Periods
26. dinosaurs
27. mass extinctions
28. Paleocene Epoch
29. 55.8 Ma
30. Pliocene Epoch
31. Quaternary Period
32. Holocene Epoch
33. eon
34. Hadean, Archean, Proterozoic, and Phanerozoic
35. Precambrian time
36. Dividing Precambrian time into smaller units would be difficult because very few fossils exist in early Precambrian rocks.
37. eras
38. Paleozoic Era
39. 291 million years
40. a wide variety of marine and terrestrial life forms
41. Mesozoic Era
42. early forms of birds and reptiles
43. Cenozoic Era
44. 65.5 million years ago
45. mammals
46. periods
47. from the location in which fossils from the period were first discovered
48. epochs
49. Scientists may not be able to divide a period into epochs if the rock record is incomplete or deformed.
50. ages
51. An age is defined by the occurrence of distinct fossils in the fossil record.

SECTION: PRECAMBRIAN TIME AND THE PALEOZOIC ERA

1. in rock layers
2. information about the environment when the layer formed
3. evolution
4. 1859, Charles Darwin
5. survive
6. fossils
7. B
8. B
9. D
10. A
11. B
12. D
13. D

14. shield
15. volcanic activity, mountain building, sedimentation, and metamorphism
16. nearly half
17. nickel, iron, gold, and copper
18. Precambrian life-forms lacked bones and other hard parts; the rocks are extremely old; and many fossils were probably destroyed as a result of volcanic activity, erosion, folding and faulting
19. stromatolites
20. in warm, shallow waters
21. that shallow seas covered much of Earth during periods of Precambrian time
22. B
23. C
24. D
25. D
26. B
27. A
28. C
29. B
30. C
31. C
32. D
33. A
34. B
35. land-dwelling plants or mammals
36. B
37. A
38. C
39. They did not have jaws or teeth and their bodies were covered with thick, bony plates.
40. eurypterid
41. Silurian Period
42. Age of Fishes
43. B
44. A
45. C
46. giant horsetails, ferns, and cone-bearing plants
47. It was generally warm with high humidity.
48. Forests and swamps covered much of the land.
49. carbon bearing
50. Mississippian and Pennsylvanian Periods
51. crinoid
52. large lizards
53. Permian Period
54. mass extinction
55. They had joined to form the supercontinent Pangaea.
56. Areas of desert and dry savanna climates developed on the northwest side of mountains, and shallow inland seas disappeared.
57. trilobites and eurypterids
58. reptiles and amphibians

SECTION: THE MESOZOIC AND CENOZOIC ERAS

1. C
2. B
3. B
4. Resources and space were readily available.
5. 251 million years ago
6. 65.5 million years ago
7. It broke into smaller continents.
8. Collisions of tectonic plates
9. Shallow seas and marshes covered much of the land; the climate was warm and humid.
10. Lizards, turtles, crocodiles, snakes, and dinosaurs
11. Age of Reptiles
12. three
13. cycads
14. ichthyosaurs
15. ammonite
16. dinosaurs
17. A
18. C
19. D
20. B
21. E
22. Tyrannosaurus rex
23. ankylosaur
24. ceratopsian
25. hadrosaur
26. angiosperm
27. Dinosaurs died in a mass extinction that occurred during the Cretaceous Period.
28. Environmental changes resulted from the movement of continents and increased volcanic activity; and a giant meteorite crash raised dust that blocked the sun, which cooled Earth's climate and killed off plant and animal life
29. impact hypothesis

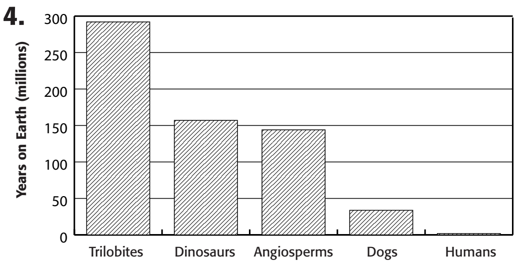
30. iridium
31. Cenozoic Era
32. 65.5 million years ago
33. They moved to their present-day positions.
34. Continental ice sheets have covered one-third of Earth's land at times.
35. Due to cooler climates, mammals became the dominant life-form and underwent many changes.
36. Tertiary Period
37. Quaternary Period
38. Paleocene, Eocene, Oligocene, Miocene, and Pliocene Epochs
39. Pleistocene and Holocene Epochs
40. during the Paleocene Epoch
41. They dropped by about 4°C.
42. the collision of the Indian subcontinent with the Eurasian continent
43. The worldwide climate became significantly cooler and drier, and these plants favored the cooler climate.
44. Circumpolar currents formed around Antarctica and the modern Antarctic icecap began to form.
45. during the Miocene Epoch
46. members of the bear, dog, and cat families
47. Dramatic climatic changes caused continental ice sheets to spread. As a result, much of Earth's water became locked in ice.
48. 1.8 million years ago
49. in Pleistocene sediments
50. 11,500 years ago
51. December 26

Math Skills

1. volume = $4/3\pi r^3$
   r: $1/2 \times d = 8.5$
   $4/3 \times \pi \times 8.5 \times 8.5 \times 8.5 = 2{,}570$ cm^3
2. area = πr^2
   r: $1/2 \times d = 21$
   $\pi \times 21 \times 21 = 1{,}385$ cm^2
3. area = $1/2\ bh$
   $1/2 \times 1.5 \times 2.2 = 1.65$ cm^2
4. area = lw
   Toe A = 9 cm × 6.5 cm = 58.5 cm^2
   Toe B = 8.7 cm × 6 cm = 52.2 cm^2
   Toe C = 9.4 cm × 7.2 cm = 67.68 cm^2
5. surface area = $2\pi r^2 + 2\pi rh$
   Tooth A = $2 \times \pi \times 3 \times 3 + 2 \times \pi \times 3 \times 6 = 169$ cm^2
   Tooth B = $2 \times \pi\ 3.5 \times 3.5 + 2 \times \pi \times 3.5 \times 5.5) = 198$ cm^2
   Tooth B has a larger surface area.

Graphing Skills

1. The longest period was the Cretaceous Period. The shortest period was the Triassic Period.
2. about 80.5 million years
3. about 185.5 million years
4.



Section Quizzes

SECTION: GEOLOGIC TIME

1. B
2. A
3. C
4. E
5. D
6. D
7. B
8. C
9. C
10. C

Answer Key

Concept Review

1. D	**11.** C
2. G	**12.** B
3. C	**13.** D
4. F	**14.** B
5. E	**15.** C
6. B	**16.** B
7. I	**17.** A
8. A	**18.** D
9. J	**19.** D
10. H	**20.** C

Critical Thinking

1. B
2. D
3. C
4. A
5. B
6. C
7. A
8. D
9. It is probably a convergent boundary because this is the kind of boundary where a deep-ocean trench typically forms.
10. Subduction is occurring because this is the process that creates deep-ocean trenches. Also, a subducting plate typically goes much faster than the plate it is moving beneath, so the Pacific Plate is subducting under the Philippine plate.
11. Slab pull is probably a major force behind the process because it occurs when a fast-moving plate subducts beneath a slower-moving plate.
12. Answers may vary. Sample answer: The Mariana Islands are probably an island arc because island arcs are formed when two plates of oceanic lithosphere collide and subduction occurs. Magma rises to the surface and forms a chain of volcanic islands.
13. Answers may vary. Sample answer: Disagree. A mechanism for Wegener's continental drift was crucial to his theory. Because continental drift could not be explained by the mechanism he suggested, his hypothesis did not hold up.
14. Answers may vary. Sample answer: Disagree. Plate boundaries often occur away from continent and ocean boundaries.
15. Answers may vary. Sample answer: Disagree. The west coast of North America is located within the Pacific Ring of Fire, a hotbed of earthquakes and volcanoes. Also, the San Andreas Fault, a transform boundary, is located on the west coast.
16. Answers may vary. Sample answer: Agree. Continental drift, which brings many climate changes, will continue.
17. The cause of the quake was two plates sliding past each other along a transform boundary. The ground moved north, because the area west of the San Andreas Fault, the Pacific Plate, is pushing north against the North American plate on the other side.
18. Japan is an island arc formed at a plate boundary where one plate subducts beneath another. Earthquakes are frequent occurrences at plate boundaries.
19. No. The San Andreas Fault is a transform boundary, where plates slide past each other horizontally. Transform boundaries do not produce magma, which can form volcanoes.
20. Answers may vary. Sample answer: You would look for evidence of rocks or fossils on the terrane. This material would differ from the material in the surrounding continental crust.

Directed Reading

SECTION: CONTINENTAL DRIFT

1. early explorers
2. The continents looked as though they could fit together like parts of a giant jigsaw puzzle.
3. B
4. C
5. C
6. D

7. A
8. If the continents had once been joined, fossils of the same plants and animals should be found in areas that were once connected.
9. in South America and western Africa
10. because it was unlikely that the reptiles had swum across the Atlantic and there was no evidence that land bridges had once connected the continents
11. Although the areas where the rocks came from were widely separated, the ages and types of rocks matched closely.
12. Mountain chains that ended at the coastline of one continent seemed to continue on other continents across the ocean.
13. The Appalachians extend northward along the east coast of North America; mountains of similar age and structure are found in Greenland, Scotland, and northern Europe.
14. that the continents have not always been located where they are now
15. fossil evidence, such as plant fossils
16. If the continents were once joined and positioned differently, there would have been climate differences.
17. He thought the continents plowed through the rock of the ocean floor.
18. Wegener's theory was easily disproved by geologic evidence.
19. He died before he identified a plausible mechanism for the movement of continents.
20. C
21. B
22. D
23. B
24. B
25. D
26. C
27. A
28. Magma rises from a rift in the ocean floor and fills it. As the ocean floor moves away, the magma cools and solidifies to form new rock that replaces the ocean floor.
29. Earth has north and south geomagnetic poles.
30. The compass needle aligns with the field of magnetic force that extends from one of Earth's poles to the other.
31. As magma turns to rock, iron-rich minerals align with Earth's magnetic field. The magnetic orientation becomes permanent when the rock hardens.
32. Scientists have discovered rocks whose magnetic orientations point opposite to Earth's current magnetic field.
33. normal polarity
34. reversed polarity
35. alternating normal and reversed polarity
36. geomagnetic reversal time scale
37. The striped magnetic pattern on one side of a mid-ocean ridge is a mirror image of the striped pattern on the other side of the ridge.
38. alternating bands of normal and reversed polarity matching the geomagnetic reversal time scale
39. As new sea floor forms, it records reversals in Earth's magnetic field.
40. They matched the magnetic patterns on each side of a mid-ocean ridge to the geomagnetic reversal time scale.
41. at the center of the ridge
42. farther away on either side of the ridge
43. at the rift in a mid-ocean ridge
44. New rock forms at the center of a ridge and then moves away from the center in opposite directions.
45. The symmetry of magnetic patterns and the symmetry of ages of sea-floor rocks
46. C
47. D
48. D

SECTION: THE THEORY OF PLATE TECTONICS

1. plate tectonics
2. by the 1960s
3. B
4. E
5. C
6. A
7. D
8. solid rock under great pressure that flows slowly, like putty

9. in the same way that passengers are carried by a bus
10. 15
11. They don't always match the familiar outlines of continents and oceans.
12. by studying data from earthquakes
13. earthquake
14. that two or more plates may meet in the area
15. Some volcanoes form when plate motions generate magma that erupts on Earth's surface.
16. Pacific Ring of Fire
17. earthquakes
18. that the Pacific Ocean is surrounded by plate boundaries
19. C
20. F
21. A
22. D
23. B
24. E
25. in the middle of the ocean floor, around the edges of continents, and within continents
26. Magma rises to the surface as plates move apart.
27. warm and light
28. rift valley
29. on the ocean floor
30. the Red Sea, between the African and Arabian plates
31. subducts
32. deep-ocean trench
33. volcanic mountains
34. The colliding edges crumple and thicken, forming large mountain ranges.
35. the Himalalya Mountains
36. One plate subducts under the other, forming a deep-ocean trench. Fluids from the subducted plate cause mantle rock to melt and form magma.
37. a chain of volcanic islands called an island arc
38. Japan
39. As plates slide past each other horizontally, they scrape against each other.
40. They do not produce magma.
41. San Andreas Fault
42. North American and Pacific plates
43. fracture zones
44. the Chilean trench along the west coast of South America
45. the boundary of the North American and Eurasian plates
46. A
47. C
48. B
49. C
50. C
51. ridge push
52. It pushes the rest of the plate away from the mid-ocean ridge.
53. convergent boundaries
54. It rises to the surface.
55. slab pull
56. faster
57. drag on the bottoms of tectonic plates, ridge push, and slab pull

SECTION: THE CHANGING CONTINENTS

1. They change the size and shape of the continents over millions of years.
2. A
3. C
4. B
5. It is thick with a high silica content.
6. heat from the mantle building up beneath the continent
7. A rift forms in the zone of weakness and the continent begins to break apart.
8. by breaking apart and by gaining material
9. C
10. B
11. A
12. D
13. They are different from those of neighboring terranes.
14. major faults
15. They generally do not match those of neighboring terranes.
16. The terrane is scraped off the subducting plate.
17. They might become mountains or simply add to the surface area of the continent.
18. seamounts, atolls, or large chunks of continental crust
19. Major mountain chains often form.
20. Himalaya Mountains
21. its location in relation to the equator and the poles, its location in relation

to oceans and other continents, and its mountain ranges

22. When continents move, air flow and moisture change, causing climates to change.

23. ice

24. South Pole

25. Continents began to drift around the globe.

26. They may be separated and unique species may evolve from existing species.

27. the fossa

28. Madagascar separated from Africa about 165 million years ago and separated from India about 88 million years ago. This isolated the plants and animals on the island of Madagascar, leading to unique species evolving.

29. D

30. A

31. D

32. B

33. A

34. D

35. B

36. C

37. D

38. D

39. C

40. Gondwanaland broke into the two continents, one of which became South America and Africa.

41. A rift between South America and Africa opened about 150 million years ago.

42. The other continent of Gondwanaland separated to form them.

43. As India broke away from Australia and Antarctica, it moved north and collided with Eurasia.

44. about 60 million years ago

45. Collisions of the drifting continents welded new crust onto the continents and uplifted the land.

46. New oceans opened up and others closed.

47. Africa will collide with Eurasia. The Mediterranean Sea will close.

48. It will separate from the rest of Africa and move eastward, resulting in the formation of a new ocean.

49. The North American and South American plates will move westward and the Eurasian and African plates will move eastward.

50. It will move north and collide with Eurasia.

51. It will move to where Alaska is today.

52. They will come together to form a new supercontinent.

Math Skills

1. 300,000,000: 3, 8, 3×10^8
160,000,000: 1.6, 8, 1.6×10^8
60,000,000: 6, 7, 6×10^7

2. 800,000,000 cm = 8×10 to the 8th power = 8×10^8

3. $0.00005 = 611 \text{ km} \div \text{time in years}$
$0.00005 \times \text{time} = 611 \text{ km}$
$\text{time} = 611 \text{ km} \div 0.0005 \text{ km/yr} =$
$12{,}220{,}000 \text{ yrs.} =$
1.222×10^7

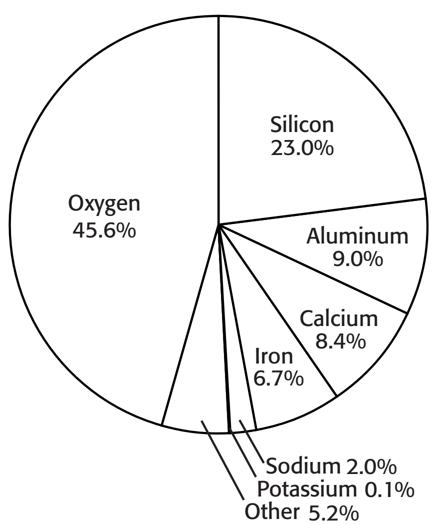
Graphing Skills

1. oxygen and silicon; 74.3%

2. magnesium; 2.1%

3. Only small amounts of these elements are necessary to enrich a substance, because even the small amounts present in the continental crust are considered enriching.

4. **Average Chemical Composition of Basaltic Layer of Oceanic Crust**



18. Answers may vary. Sample answer: The location of major mountain belts along convergent plate boundaries may be evidence that mountains are formed when tectonic plates collide. The uplift of major mountain ranges such as the Himalayas occurred as the result of the Indian continental plate colliding with the Eurasian continental plate. The Appalachians are not located along an active convergent plate boundary, but there is evidence that it was active at one time in geologic history.

19. Answers may vary. Sample answer: When wind, water, and ice erode the rock that forms mountains, it can reduce the weight of a mountain range. As mountain ranges become lighter over long periods of time, the crust will have less force of gravity and may uplift as a result of isostatic adjustment, the pressure of buoyancy from the asthenosphere.

20. Answers may vary. Sample answer: When the amount of stress exceeds the limit rock can withstand without permanently changing, the rock will deform. Permanent strain can result, either brittle strain (fractures) or ductile strain (bending).

Directed Reading

SECTION: HOW ROCK DEFORMS

1. the bending, tilting, and breaking of Earth's crust
2. C
3. B
4. B
5. D
6. A
7. constantly
8. It can significantly reduce the height and weight of mountains.
9. As a mountain becomes smaller, the surrounding crust becomes lighter and may rise by isostatic adjustment.
10. In areas where rivers deposit mud, sand, and gravel, the added weight causes the ocean floor to sink.
11. The land slowly rises and the ocean floor sinks.
12. B
13. D
14. C
15. A
16. C
17. B
18. D
19. at or near divergent boundaries, where tectonic plates pull apart
20. It distorts a body by pushing parts of the body in opposite directions.
21. They bend, twist, or break apart.
22. at transform boundaries where tectonic plates slide past each other horizontally
23. B
24. C
25. A
26. D
27. the composition of rock
28. temperature and pressure
29. in a brittle way; in a ductile way
30. the amount and type of stress, and the rate at which stress is applied
31. C
32. B
33. D
34. most commonly caused by compression, but also caused by shear stress
35. limbs; hinge
36. axial fold
37. overturned
38. The combination of stresses and conditions that cause a fold are unique.
39. the relative ages of rocks in the fold
40. D
41. C
42. A
43. B
44. when one area of a rock layer undergoes vertical stress but other areas of the rock layer do not
45. ridge
46. a large syncline
47. anticlines and synclines
48. D
49. D
50. C
51. A
52. E
53. B
54. A normal fault is a a fault where the hanging wall moved downward relative to the footwall. It usually forms at

divergent boundaries where tension is pulling the crust apart.

55. Normal faults may occur as a series of parallel fault lines that form steep, steplike landforms.

56. Compression causes the hanging wall to move upward relative to the footwall.

57. A thrust fault is a type of reverse fault where the fault plane is at a low angle or is nearly horizontal, and the rock of the hanging wall is pushed up and over the rock of the footwall.

58. in steep mountain ranges such as the Rockies and the Alps

59. The strike is the direction of the length of a fault.

60. In a strike-slip fault, the rock on either side of the fault plane slides horizontally because of shear stress.

61. the San Andreas fault in California

SECTION: HOW MOUNTAINS FORM

1. C

2. A

3. a group of adjacent mountains that are related to each other in shape and structure; Great Himalaya Range; Cascade Range

4. a mountain system

5. the Great Smoky, Blue Ridge, Cumberland, and Green mountain ranges

6. the circum-Pacific belt and the Eurasian-Melanesian belt

7. the circum-Pacific belt

8. from the Pacific islands through Asia, southern Europe, and into northwestern Africa

9. B

10. D

11. C

12. A

13. C

14. B

15. B

16. A

17. pieces of crust that are scraped off during subduction at the boundary where the oceanic and continental lithospheres collide; may later form mountains

18. where two plates whose edges consist of oceanic lithosphere collide

19. the denser plate subducts beneath the other oceanic plate

20. Fluids from the subducting lithosphere cause partial melting of the overlying mantle and crust, resulting in magma breaking through the oceanic lithosphere. An arc of volcanic mountains is formed on the ocean floor.

21. the Mariana Islands

22. Mountains can form.

23. India broke apart from Africa and Antarctica and became a separate continent that moved toward Eurasia.

24. The oceanic lithosphere subducted beneath the Eurasian plate until the continental lithosphere of India collided with the continental lithosphere of Eurasia.

25. The subduction stopped because the two continents had equally dense continental lithosphere. The deformation from the collision uplifted the Himalayas.

26. because the plates are still colliding

27. C

28. A

29. B

30. A

31. C

32. B

33. near mountain ranges

34. next to the Rockies

35. relatively higher blocks caused by faulting

36. the Sierra Nevada range of California

37. when steep faults break the crust into blocks, and one slips downward relative to surrounding blocks

38. They commonly occur together.

39. the Basin and Range Province of the western United States

40. a circular structure made of rock layers that slope away gradually from a central point

41. Magma can rise through the crust and push up rock layers. Tectonic forces can gently uplift rock layers.

42. the Black Hills of South Dakota; the Adirondack Mountains of New York

43. when magma erupts onto Earth's surface

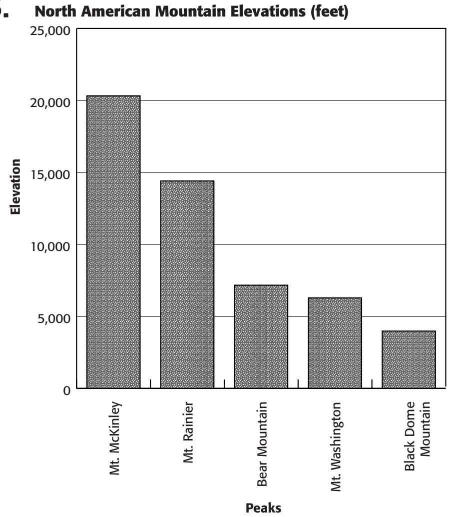
44. along convergent plate boundaries
45. the Cascade Range of Washington, Oregon, and northern California
46. They are part of mid-ocean ridges along divergent plate boundaries.
47. Magma rising to Earth's surface at divergent boundaries makes mid-ocean ridges volcanically active.
48. when the peaks of volcanic mountains rise above sea level; the Azores in the North Atlantic
49. on the ocean floor at hot spots
50. Hot spots are volcanically active areas that lie far from tectonic plate boundaries. Hot material rises through Earth's interior and reaches the lithosphere.
51. the Hawaiian Islands

Math Skills

1. $2x = 4{,}200$; $2x \div 2 = 4{,}200 \div 2$; $x = 2{,}100$
2. $1/2x = 11$; $2 \times 1/2x = 2 \times 11$; $x = 22$. OR $x = 2(11)$; $x = 22$
3. $145x = 725$; $145x \div 145 = 725 \div 145$; $x = 5$
4. $1/3x = 9$; $3 \times 1/3x = 3 \times 9$; $x = 27$. OR $x = 3(9)$; $x = 27$
5. $145x = 580$; $145x \div 145 = 580 \div 145$; $x = 4$

Graphing Skills

1. Mt. Elbrus
2. Antarctica
3. approximately 6,900 or 7,000 m
4. approximately 5,900 or 6,000 m
5. North American Mountain Elevations (feet)



Section Quizzes

SECTION: HOW ROCK DEFORMS

1. C
2. B
3. D
4. E
5. A
6. C
7. C
8. C
9. B
10. D

SECTION: HOW MOUNTAINS FORM

1. E
2. B
3. C
4. A
5. D
6. B
7. A
8. D
9. C
10. A

Chapter Test A

1. D
2. H
3. G
4. A
5. I
6. B
7. C
8. J
9. F
10. E
11. A
12. C
13. B
14. D
15. B
16. C
17. A
18. D
19. A
20. C

Chapter Test B

1. C
2. E
3. D
4. A
5. B
6. C
7. A
8. D
9. A
10. C
11. A
12. B
13. D
14. A
15. B
16. C
17. plateaus
18. convergent
19. rises
20. monocline
21. syncline
22. Answers may vary. Sample answer: One way that a dome mountain forms

waves are known, the scientist can use a lag-time graph to determine how far the epicenter is from the station. To find the exact location of the epicenter, the same data must be gathered from several other seismograph stations. Computers can then perform triangulations with the collected data to determine the earthquake's epicenter.

20. Answers may vary. Sample answer: A person would have to know the location of the earthquake's epicenter and the area it covered. Earthquake intensity is measured by the modified Mercalli scale, which describes damage in terms of human structures. If this earthquake took place in a wilderness area, relatively light damage in human terms could be predicted, despite its large magnitude. But if the earthquake occurred in a more populated area, it would be far more likely to be devastating.

Directed Reading

SECTION: HOW AND WHERE EARTHQUAKES HAPPEN

1. a movement or trembling of the ground caused by a sudden release of energy when rocks along a fault move
2. when rocks under stress suddenly shift along a fault
3. a break in a body of rock where one block slides relative to another
4. B
5. C
6. B
7. D
8. B
9. A
10. C
11. D
12. A
13. B
14. C
15. the point on Earth's surface directly above an earthquake's focus
16. focus
17. shallow
18. between 70 km and 300 km
19. between 300 km and 650 km
20. in subduction zones and farther from the plate boundary than shallower earthquakes
21. because by the time vibrations from an earthquake that has an intermediate or deep focus reach the surface, much of their energy has dissipated
22. C
23. A
24. C
25. D
26. A
27. B
28. C
29. primary waves or compression waves
30. secondary waves or shear waves
31. from motion along a shallow fault or from the conversion of energy when P waves and S waves reach Earth's surface
32. Love waves and Rayleigh waves
33. side-to-side and perpendicular to the direction in which the waves are traveling
34. with an elliptical, rolling motion
35. C
36. B
37. A
38. crust, mantle, core
39. lithosphere, asthenosphere, mesosphere, outer core, inner core
40. an area on Earth's surface where no direct seismic waves from a particular earthquake can be detected
41. because the materials that make up Earth's interior are not uniform in rigidity
42. The speed of the waves changes and the waves will bend and change direction as they pass through different materials.
43. because S waves cannot pass through the liquid outer core
44. The speed and direction of the waves change as they pass through each layer, and the waves bend in such a way that a P-wave shadow zone forms.
45. C
46. D
47. B
48. A
49. because oceanic lithosphere is pulling away from both sides of each ridge

50. A
51. because of the intense stress that results when plates separate, collide, subduct, or slide past each other
52. the North Anatolian fault zone
53. It did not occur near an active plate boundary.
54. an ancient fault zone deep within Earth's crust
55. at least 600 million years ago

SECTION: STUDYING EARTHQUAKES

1. B
2. A
3. vertical and horizontal (east-west and north-south)
4. by tracing wave-shaped lines on paper or by translating the motion into electronic signals
5. seismogram
6. because they are the fastest-moving seismic waves
7. S waves
8. surface waves, or Rayleigh and Love waves
9. D
10. C
11. A
12. B
13. C
14. by drawing circles on a map around at least three seismograph stations that recorded vibrations from an earthquake
15. the distance from that seismograph station to the earthquake's epicenter
16. the point at which all of the circles intersected
17. C
18. C
19. E
20. B
21. A
22. D
23. the Richter scale
24. the moment magnitude scale
25. small earthquakes
26. large earthquakes
27. 9.5
28. 6.9
29. 2.5
30. is not felt except by very few under especially favorable conditions
31. causes total destruction; distorts lines of sight and level; objects are thrown into the air
32. magnitude, the distance between the epicenter and the affected area, the local geology, and the earthquake's duration

SECTION: EARTHQUAKES AND SOCIETY

1. the collapse of buildings and other structures or falling objects and flying glass
2. landslides, fires, explosions caused by broken electric and gas lines, and floodwaters released from collapsing dams
3. A
4. C
5. C
6. A
7. A
8. B
9. B
10. loose soil and rock
11. B
12. D
13. C
14. B
15. D
16. B
17. windows, heavy furniture, and other objects that might topple over
18. stop in a place away from tall buildings, bridges, tunnels, and power lines; stay in the car until the tremors stop
19. fire and other hazards
20. downed power lines and objects that are touching them
21. D
22. C
23. B
24. A
25. A
26. C
27. B
28. D
29. an area along a fault where relatively few earthquakes have occurred recently but where earthquakes have occurred in the past
30. future earthquakes
31. the San Andreas Fault zone

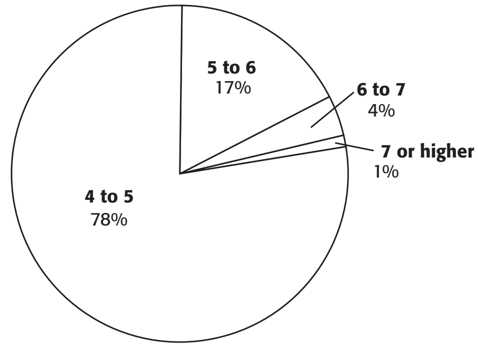
32. foreshocks
33. a small earthquake
34. a few seconds or a few weeks
35. Haicheng, China, in 1975
36. to detect slight tilting of the ground and to identify the strain and cracks in rocks caused by stress that builds up in fault zones
37. The magnetic and electrical properties of the rocks may change.
38. natural gas seepage from rocks that are strained or fractured from seismic activity
39. predict earthquakes
40. foreshocks

Math Skills

1. $5 - 2 = 3$; $30^3 = 30 \times 30 \times 30 = 27{,}000$. The magnitude 5 earthquake releases 27,000 times more energy than the magnitude 2 earthquake.
2. $8 - 4 = 4$; $30^4 = 30 \times 30 \times 30 \times 30 = 810{,}000$. The magnitude 8 earthquake releases 810,000 times more energy than the magnitude 4 earthquake.
3. $7 - 6 = 1$; or 30^1; any number raised to the power of 1 is equal to itself; therefore, $30^1 = 30$. The magnitude 7 earthquake releases 30 times more energy than the magnitude 6 earthquake.
4. $8 - 3 = 5$; $30^5 = 30 \times 30 \times 30 \times 30 \times 30 = 24{,}300{,}000$. The magnitude 8 earthquake releases 24,300,000 times more energy than the magnitude 3 earthquake.
5. $9 - 7 = 2$; $30^2 = 30 \times 30 = 900$. The magnitude 9 earthquake releases 900 times more energy than the magnitude 7 earthquake. $9 - 4 = 5$; $30^5 = 30 \times 30 \times 30 \times 30 \times 30 = 24{,}300{,}000$. The magnitude 9 earthquake releases 24,300,000 times more energy than the magnitude 4 earthquake.

Graphing Skills

1. 10%
2. $10\% \times 14{,}500 = 1{,}450$
3. $90\% \times 14{,}500 = 13{,}050$
4. earthquakes with a magnitude of 5–5.9
5. magnitude 4 to 5 = 78%; 5 to 6 = 17%; 6 to 7 = 4%; 7 or higher = 1 %



Section Quiz

HOW AND WHERE EARTHQUAKES HAPPEN

1. B
2. E
3. D
4. A
5. C
6. C
7. B
8. A
9. D
10. A

STUDYING EARTHQUAKES

1. E
2. D
3. C
4. B
5. A
6. D
7. B
8. A
9. C
10. B

EARTHQUAKES AND SOCIETY

1. C
2. A
3. B
4. B
5. B
6. D
7. A

Directed Reading

SECTION: VOLCANOES AND PLATE TECTONICS

1. D
2. C
3. B
4. A
5. B
6. C
7. A
8. C
9. A
10. B
11. C
12. C
13. B
14. C
15. A
16. D
17. C
18. D
19. B
20. B
21. C
22. A
23. B
24. B
25. A
26. B
27. B
28. C
29. A
30. D
31. Answers may vary. Sample answer: As plates pull apart, magma flows upward, adding material to the mid-ocean ridge and creating new lithosphere. The magma erupts to form underwater volcanoes.
32. Answers may vary. Sample answer: Most volcanic eruptions along mid-ocean ridges occur deep in the ocean, and cannot be seen by humans.
33. Iceland is divided by the North American plate and the Eurasian plate. One half of Iceland is moving east, and the other half is moving west. Magma flows to Earth's surface through large fissures in the middle of Iceland.
34. 4
35. 1
36. 3
37. 2
38. Answers may vary. Sample answer: When the lithospheric plate above the mantle plume begins to drift, the volcano on the surface drifts too, and the volcano is carried away from the mantle plume. The activity of the old volcano stops, and a new volcano forms over the mantle plume.
39. Hot spots may form along chains of cracks in Earth's crust.
40. A
41. C
42. B
43. D

SECTION: VOLCANIC ERUPTIONS

1. D
2. B
3. A
4. D
5. A
6. B
7. C
8. A
9. B
10. B
11. A
12. A
13. C
14. When lava continues to flow after a crust forms, the crust wrinkles to form pahoehoe. Pahoehoe forms a smooth, ropy texture as it cools. The Hawaiian word *pahoehoe* means ropy.
15. B
16. A
17. C
18. Pyroclastic material consists of fragments of rock that form during a volcanic eruption.
19. volcanic ash
20. volcanic dust
21. lapilli
22. volcanic bombs
23. volcanic blocks
24. B
25. E
26. A
27. C
28. D
29. A caldera is a large, circular depression that forms when the magma chamber below a volcano partially

empties and causes the ground above to sink.

30. a cone forms from volcanic eruptions; volcanic eruptions partially empty the magma chamber; the top of the cone collapses inward to form a caldera

31. The 6 km diameter caldera on the island of Krakatau formed when a large amount of magma discharged and exploded the volcanic cone.

32. Thousands of years ago, the cone of Mount Mazama in Oregon collapsed and formed a caldera that eventually filled with water.

33. A

34. growing pressure on surrounding rocks from magma moving upward; temperature changes within the rock; fracturing of the rock around a volcano

35. Magma moving upward beneath the surface may cause the surface of the volcano to bulge outward.

36. Answers may vary. Sample answer: Scientists compare previous earthquake activity, surface bulges, and composition of emitted gases with current behavior.

37. Answers may vary. Sample answer: Scientists have studied only a few active volcanoes long enough to establish activity patterns. Volcanoes that have been dormant for a long time may suddenly become active.

Math Skills

USING EXPONENTS TO EXPRESS SCIENTIFIC MEASUREMENTS

1. Answer: 4^6

2. Answer: 5^5

3. Answer: 2,401 m

Graphing Skills

1. Prior to the eruption, the average global temperature varied less than 0.3° C above or below average.

2. The lowest temperatures were recorded just before mid-1992.

3. The lowest global temperatures were 0.5°C below the normal global average. This was in mid-1992, about one year after the eruptions.

4. The global temperatures slowly equalized close to their norm. One might conclude that the atmosphere has the ability to recover from a disaster of limited scope.

5. Students must label their graphs and identify both the x and y axes. Individual graphs will depend on the recorded temperatures for the week.

6. Answers may vary.

7. Answers may vary. Students should be able to draw a conclusion about the general rise or fall in temperature over the course of the week.

Section Quizzes

SECTION: VOLCANOES AND PLATE TECTONICS

1. D	**6.** D
2. E	**7.** C
3. C	**8.** B
4. B	**9.** A
5. A	**10.** D

SECTION: VOLCANIC ERUPTIONS

1. E	**6.** A
2. C	**7.** B
3. A	**8.** D
4. D	**9.** D
5. B	**10.** A

Chapter Test A

1. E
2. F
3. C
4. G
5. J
6. D
7. B
8. I
9. A

Answer Key

Concept Review

1. J	**11.** B
2. B	**12.** C
3. D	**13.** B
4. H	**14.** C
5. G	**15.** C
6. C	**16.** D
7. A	**17.** A
8. E	**18.** D
9. F	**19.** D
10. I	**20.** D

Critical Thinking

1. B
2. A
3. A
4. D
5. C
6. C
7. A
8. B
9. D
10. A
11. Answers may vary. Sample answer: Beach erosion is much faster and much more easily observable than land erosion.
12. Answers may vary. Sample answer: Wind, waves, storms, and a rising sea level are physical forces that move beach sand.
13. Answers may vary. Sample answer: Causes of beach erosion include human use of shorelines and coastal waters, a 25–30 cm per century rise in sea level coupled with a sinking of coastal land, and global warming.
14. Answers may vary. Sample answer: Without erosion, beaches, dunes, barrier beaches, and bays and estuaries would never have formed.
15. Answers may vary. Sample answer: Disagree. Although erosion occurs naturally, it is also affected by human activities that greatly accelerate the process. Conservation measures must be taken to prevent rapid, destructive soil erosion.
16. Answers may vary. Sample answer: Agree. Even if one discounts the importance of preserving our wildlife and natural land formations, erosion control is important to the support of natural resources and human life.
17. Answers may vary. Sample answer: Disagree. Although erosion and weathering continue to flatten mountains and other high elevations, pressure from the inner portions of Earth continue to uplift new landforms.
18. Answers may vary. Sample answer: The modern sculpture with the lines and angles will weather faster because it has many more exposed surfaces than the smooth column does.
19. Answers may vary. Sample answer: The Minneapolis highway will weather faster. The city has more traffic, which causes abrasion, than the desert highway does. The summer heat and winter freezing and thawing will break apart concrete in Minnesota, whereas the dry desert heat will preserve the Arizona highway.
20. Answers may vary. Sample answer: The farmer could use a combination of strip-cropping and contour plowing. The contour plowing will prevent water from flowing directly down slopes in the hilly areas. Strip-cropping requires the planting of a cover crop, which slows the runoff of rainwater.

Directed Reading

SECTION: WEATHERING PROCESSES

1. C
2. A
3. D
4. B
5. B
6. C
7. D
8. C
9. A
10. E
11. B
12. D

13. I
14. H
15. E
16. F
17. B
18. C
19. G
20. A
21. carbon dioxide, oxygen, and acids
22. electrically charged particles formed from acids in water that can pull apart the chemical bonds of minerals
23. particles formed from bases in water that can change the structure of minerals
24. chemical composition and physical appearance
25. the presence of iron oxide caused by oxidation
26. It is produced by hydrolysis, when feldspar combines with water. Hydronium ions displace the potassium and calcium atoms in the feldspar crystals, which changes it to clay.
27. when carbon dioxide from the air dissolves in water.
28. The carbonic acid changes the calcite into calcium bicarbonate, which dissolves easily in water, so the limestone eventually weathers away.
29. nitrogen oxides and sulfur dioxides
30. The nitrogen oxides and sulfur dioxides produced when fossil fuels burn are released into the air. They combine with water in the atmosphere to produce nitric acid, nitrous acid, or sulfuric acid. When these fall to Earth, they are called acid precipitation.
30. nitric acid; nitrous acid; sulfuric acid
31. Acid precipitation wears away sculptures and historical monuments because it weathers rock faster than ordinary precipitation does.
32. In 1990, the Acid Rain Control Program was added to the Clean Air Act of 1970. The laws gave power plants ten years to clean up emissions.
33. by installing scrubbers that remove much of the sulfur dioxide before it can be released into the air

SECTION: RATES OF WEATHERING

1. Mechanical and chemical weathering are very slow processes.
2. one-twentieth of a centimeter (0.2 cm) every 100 years
3. 30 million years
4. rock composition, climate. and topography
5. Differential weathering is the process by which softer, less weather-resistant rocks wear away at a faster rate than harder, more weather-resistant rocks do.
6. Rocks containing quartz are essentially unchanged by chemical and mechanical weathering, because the composition and crystal structure of quartz make it resistant to chemical weathering. It is also hard, which helps it resist mechanical weathering.
7. calcite
8. carbonation
9. weathering
10. grains
11. clay
12. silicates
13. The amount of time that a surface is exposed and the amount of surface area that is exposed affect the rate of weathering.
14. the part of a rock that is exposed to air, water, and other agents of weathering
15. the exposed surface area is increased, which increases the total area available for weathering
16. The natural zones of weakness are fractures and joints, which increase the surface area and allow exposure to mechanical and chemical weathering.
17. Water moves through fractures or channels in rock, freezes, and creates pressure that eventually causes rocks to split by ice wedging.
18. As water moves through the cracks, chemical weathering removes rock material and makes the jointed or fractured area weaker.
19. Climates that have alternating hot and cold periods allow the fastest rate of weathering because freezing and thawing can cause the breakdown of rock by ice wedging.
20. Weathering is fairly rapid in warm, humid climates because constant moisture is destructive to exposed rock.
21. The lack of water in hot dry climates limits carbonation and ice wedging.

22. Cleopatra's Needle weathered more in 100 years of moisture, pollution, ice wedging, and acid rain in New York City than it did in the hot and dry Egyptian desert over the previous 3,000 years.
23. C
24. A
25. D
26. C
27. They often expose rock surfaces to weathering.
28. Mining often exposes rock to strong acids and other chemicals used in mining processes.
29. Construction removes soil and uncovers previously unexposed rock surfaces.
30. hiking and riding all-terrain vehicles
31. The roots of plants and trees often break apart rock as they grow, exposing more rock to weathering.
32. The burrowing habits of some animals result in mechanical weathering. Biological wastes of some animals can promote chemical weathering.

SECTION: SOIL

1. regolith
2. bedrock
3. soil
4. the rock from which a soil was weathered
5. residual soil
6. It is soil that was carried away from the location of its parent rock by water, wind, or glaciers and deposited elsewhere.
7. soils that contain large amounts of clay
8. rocks that contain large amounts of quartz, such as granite
9. the composition of the soil
10. black and red; black soil is commonly rich in organic material; red soil may form from iron-rich parent rocks.
11. Clay particles have diameters of less than 0.004 mm; silt particles, with diameters of 0.004 to 0.06 mm, are not easy to see, but can make soil feel gritty; sand particles have diameters from 0.06 to 2 mm.
12. B
13. D
14. A
15. F
16. E
17. C
18. B
19. B
20. D
21. A
22. D
23. A
24. D
25. C
26. Because rainwater runs downhill, much of the topsoil of slopes washes away. The soil at the top and bottom of the slope tends to be thicker than soil on the slop.
27. because the topsoil there is too thin to support much vegetation, which limits the amount of humus that is added to the soil. Therefore, it tends to be rocky with few nutrients.
28. They tend to have thick, wet soil and a high concentration of organic matter, which forms humus.
29. a fairly flat area with good drainage

SECTION: EROSION

1. Erosion is a process in which the materials of Earth's surface are loosened, dissolved, or worn away and transported from one place to another by a natural agent.
2. gravity; wind; glaciers; water
3. by ocean waves and currents; by streams and runoff; by movement of groundwater
4. air
5. climate
6. erosion
7. gullying
8. topsoil
9. wind
10. fertility
11. by removing plants that anchor soil with their roots and prevent wind and water from eroding the soil
12. because it removes fertile topsoil and prevents the countries from growing the crops needed to prevent widespread famine
13. by removing protective vegetation to build house and roads

14. because it may take hundreds or thousands of years to naturally replace eroded topsoil in these areas

15. Some are leaving trees and vegetation in place whenever possible. Others are planting cover crops to hold the soil in place.

16. Farmers are looking for new ways to preserve fertile topsoil.

17. B

18. D

19. C

20. A

21. B

22. A

23. C

24. B

25. D

26. B

27. A

28. C

29. A landform is a physical feature of Earth's surface.

30. mountains; plains; plateaus

31. hills; valleys; dunes

32. One process bends, breaks, and lifts Earth's crust and creates elevated landforms. The other process is weathering and erosion, which wears down the landforms.

33. In the early stages of the history of a mountain, while tectonic forces are uplifting the mountain, it rises faster than it is eroded. Such mountains tend to be steep and rugged and have sharp peaks and deep valleys.

34. When forces stop uplifting the mountain, weathering and erosion wear down the rugged peaks to rounded peaks and gentle slopes.

35. Over millions of years, mountains erode to low, featureless surfaces. A peneplain commonly has low, rolling hills.

36. A plain is a relatively flat landform near sea level.

37. A plateau is a broad, flat landform that has a high elevation.

38. Young plateaus commonly have deep stream valleys that separate broad, flat regions. Older plateaus have been eroded into rugged hills and valleys.

39. In dry climates, resistant rock produces plateaus that have flat tops.

40. Mesas are small table-like structures eroded from a plateau.

41. A butte is a mesa that has eroded even further to become a small, narrow-topped formation.

42. In wet climates, humidity and precipitation weather them into round shapes.

Math Skills

1. x = meters moved $4x = 1{,}000$ m
Divide each side of the equation by 4:
$x = 250$ m
The lighthouse was moved 250m

2. x = meters of erosion per year
$100x = 250$m
Divide each side by 100: $x = 2.5$
The ocean eroded about 2.5 m of beach per year.

3. Multiply each side by 3: $2x + 4 = 36$
Subtract 4 from each side: $2x = 32$
Divide each side by 2: $x = 16$

4. Subtract 6 from each side: $3\,(x - 14) = 15$
Divide each side by 3: $x - 14 = 5$
Add 14 to each side: $x = 19$

5. Add 11 to each side: $9x = 99$
Divide each side by 9: $x = 11$

6. Multiply each side by 2: $7x = 56$
Divide each side by 7: $x = 8$

Graphing Skills

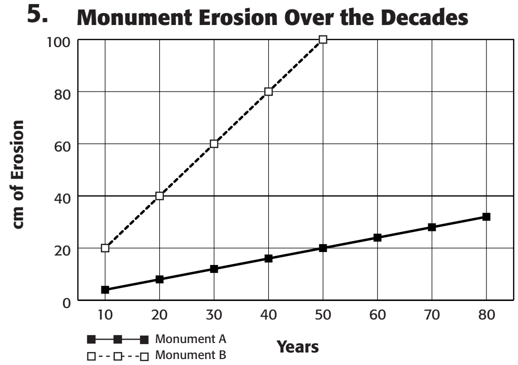
1. no erosion is shown—0 cm

2. 75°

3. at about 50°

4. Answers may vary. Sample answer: As the degree of slope begins to increase, the amount of soil that erodes increases rapidly. After the slope reaches about 50°, the rate of erosion tapers off.

5. **Monument Erosion Over the Decades**



20. Tree roots and other vegetation protect the soil from being washed away. In a floodplain, the soil absorbs much of the water that comes from flooding. Without soil, the flood would much more easily wash over the area. A forest fire would destroy vegetation and cause roots that hold soil to die, eventually eroding soil. This would extend the area of a flood even farther, causing more damage.

Directed Reading

SECTION: THE WATER CYCLE

1. the origin of Earth's water supply
2. Up to five times as much water falls to Earth as the rivers carry off.
3. Instead of wondering where all the water comes from, the more puzzling question became, where does all the water go?
4. C
5. C
6. D
7. A
8. C
9. A
10. D
11. D
12. D
13. C
14. B
15. A
16. D
17. B
18. B
19. D
20. A
21. C
22. C
23. D
24. B
25. 75%
26. It becomes runoff or groundwater.
27. Eventually, all of the water returns to the atmosphere through evapotranspiration, condenses, falls to Earth, and begins the water cycle again.
28. C
29. A
30. D
31. D
32. B
33. C
34. D
35. A
36. C
37. B
38. B
39. D
40. B
41. A
42. A
43. D
44. B
45. A
46. B
47. D
48. C
49. A
50. Only a small percentage of the water on Earth is fresh water that can be used by humans.
51. Water conservation is the wise use of water resources.
52. by limiting their use of water as much as possible
53. Governments can enforce conservation laws and antipollution laws.
54. Antipollution laws prohibit the dumping of waste into bodies of water. They are designed to keep toxic chemicals, metals, and other pollutants out of the water supply.
55. A second way to protect water supplies is to find alternative ways of obtaining fresh water.
56. Desalination is the process of removing salt from ocean water.
57. Desalination is expensive and is impractical for supplying water to large populations.
58. Currently, the best way to maintain supplies of fresh water is through wise use and conservation.

SECTION: STREAM EROSION

1. when precipitation exceeds evapotranspiration in a given area
2. The excess water moves downslope as runoff.
3. As runoff moves, it erodes rock and soil. It may eventually form a narrow ditch called a gully.
4. Eventually, a fully developed valley with a permanent stream can form.
5. precipitation and erosion

6. a mainstream and tributaries
7. It becomes wider and deeper as it erodes its banks and bed.
8. D
9. F
10. A
11. C
12. E
13. B
14. D
15. C
16. B
17. D
18. C
19. D
20. C
21. B
22. D
23. A
24. C
25. A
26. B
27. B
28. C
29. A
30. The faster a stream flows, the greater its discharge and the greater the load it can carry.
31. A swift stream carries more sediment and larger particles than a slow stream.
32. A stream's velocity determines how quickly it will cut down and widen its channel. The greater the stream's velocity, the more quickly it will erode its channel.
33. stream gradient
34. the change in a stream's elevation over a given horizontal distance—the steepness of the stream's descent
35. The gradient is generally steep near the headwater, or beginning of a stream.
36. Near the headwaters, a stream's velocity is high, which causes rapid channel erosion.
37. the point at which it enters a larger body of water
38. The gradient is often flatter at the mouth of a stream.
39. The stream's velocity and erosive power decrease at its mouth because the gradient is flatter.
40. By the time a stream channel reaches the sea, it has eroded to a nearly flat gradient.
41. D
42. B
43. A
44. D
45. C
46. A
47. B
48. C
49. A
50. B
51. C
52. B
53. A
54. D
55. Meanders become so curved that they almost form a loop that is separated only by a narrow strip of land. When the river cuts through this narrow neck, the meander can be isolated from the river, and an oxbow lake forms.
56. Most rivers have single channels.
57. Under certain conditions, sediment bars between a river's banks can divide the flow of the river into multiple channels.
58. A braided stream is a river that is composed of multiple channels that divide and rejoin around sediment bars on the channel floor.
59. When a stream has a large sediment load, particularly composed of coarse sand and gravel, the river is unable to move all of the load, and bars form on the channel floor.
60. Braided streams and meandering channels look very different, but they can cause just as much erosion.
61. The channel locations shift constantly as bars between channels erode and new bars form.
62. As the river's gradient and discharge change, it can change from a braided stream to a meandering stream.

SECTION: STREAM DEPOSITION

1. when a large volume of water is flowing swiftly
2. a decrease in the velocity of the water

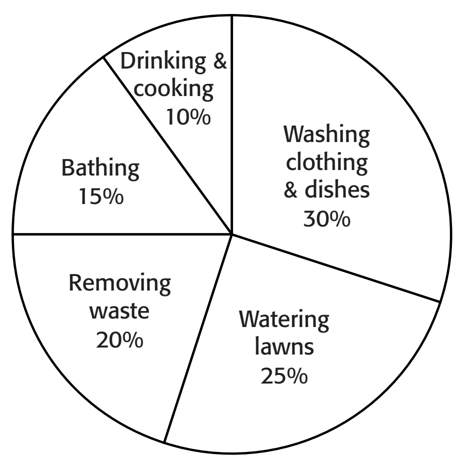
3. Part of the stream load is deposited as sediment.
4. C
5. A
6. D
7. C
8. B
9. A
10. B
11. D
12. An alluvial fan is a fan-shaped mass of sediment deposited at the base of a slope.
13. The tip of an alluvial fan points upstream.
14. in arid and semi-arid regions
15. temporary streams
16. Alluvial fans form on land, and deltas are deposited in water.
17. rainfall
18. banks
19. floodplain
20. velocity
21. natural levee
22. because finer sediments are carried out into the floodplain and deposited there
23. a thick layer of fine sediment, which becomes a source of rich floodplain soils
24. because drainage is usually poor in the area between the natural levees and the outer walls of the valley
25. Floodplains offer access to the river, and the soils are good for farming.
26. B
27. A
28. D
29. C
30. A
31. B
32. C
33. A
34. D
35. The stored water can be used to generate electricity, supply fresh water, and irrigate farmland.
36. They must be protected against erosion by the river.
37. If an artificial levee breaks, flooding and property damage can result.
38. When the volume of water in a river increases, floodways carry away the excess water and prevent the river from overflowing its banks.
39. B
40. A
41. C
42. A
43. B
44. D
45. D
46. A
47. D
48. C
49. B
50. C
51. D

Math Skills

1. 3.5×10^6
2. 9.5×10^4
3. 4×10^8
4. 2.64×10^6

Graphing Skills

1. 25%
2. 38%
3. manufacturing
4. drinking water
5.



Section Quizzes

SECTION: THE WATER CYCLE

1. D
2. E
3. A
4. C
5. B
6. C
7. A
8. B
9. D
10. C

Directed Reading

SECTION: WATER BENEATH THE SURFACE

1. pores
2. groundwater
3. fresh water
4. An aquifer is a body of rock or sediment in which large amounts of water can flow or be stored.
5. porosity
6. sorting
7. Most particles in well-sorted sediment are about the same size. Poorly sorted sediment contains particles of many sizes.
8. high
9. low
10. grain size
11. porous
12. permeability
13. connected
14. permeable
15. impermeable
16. gravity
17. The zone of saturation is the layer of an aquifer in which the pores are completely filled with water.
18. filled to capacity
19. B
20. A
21. C
22. D
23. three
24. The rate at which groundwater moves depends on the permeability of the aquifer and the gradient of the water table.
25. Gradient is the steepness of a slope.
26. increases
27. topography
28. surface topography, permeability of the aquifer, amount of rain, and rate of water usage
29. The water table rises during times of prolonged rainfall.
30. The water table falls and flattens during times of drought.
31. one
32. When a layer of impermeable rock sits on the main water table, a second table called a perched water table forms on top of the first.
33. groundwater
34. hundreds or thousands of years
35. monitor the groundwater level, discourage excess pumping, and recycle used water
36. A recharge zone is anywhere surface water can travel through permeable rock to reach the water table.
37. Recharge zones are environmentally sensitive because pollution in the zone can enter the aquifer.
38. Answers may vary. Sample answer can include four of the following: waste dumps, underground toxic-waste storage systems, fertilizers, pesticides, leaking sewage systems, salt water from the ocean
39. A
40. B
41. A
42. B
43. B
44. B
45. C
46. D
47. A
48. D
49. increase
50. artesian well
51. artesian spring
52. magma
53. hot spring
54. travertine
55. mud pot
56. paint pots
57. A geyser is a hot spring that periodically breaks through a surface pool or small vent with enough power to shoot into the air.
58. The boiling water produces steam that pushes the water above it to the surface.
59. An eruption will continue until most of the water and steam are emptied from the vent and chambers.
60. After a geyser erupts, groundwater continues to collect again and the process is repeated, often at regular intervals.

SECTION: GROUNDWATER AND CHEMICAL WEATHERING

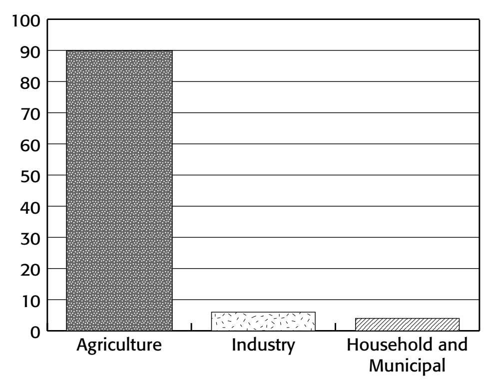
1. hard water
2. soft water
3. metallic
4. hard water
5. As water moves through soil, it combines with carbon dioxide to form carbonic acid. Chemical weathering occurs when this acid passes through rock, and the minerals break down and dissolve.
6. A cavern is a natural cavity that forms in rock as a result of the dissolution of minerals; also a large cave that commonly contains many smaller, connecting chambers.
7. As groundwater flows through cracks in nonporous limestone, carbonic acid widens the cracks by dissolving the limestone. Eventually a cavern forms.
8. Answers may vary. Sample answer: Carlsbad Caverns in New Mexico
9. C
10. B
11. A
12. A sinkhole is a circular depression that forms at the surface when rock dissolves, sediment is removed, or caves or mines collapse.
13. subsidence
14. During dry periods, the water table is low and caverns are not completely filled with water. As a result, the cavern roof is unsupported and may collapse.
15. A natural bridge is formed when the roof of a cavern collapses in several places, creating a line of sinkholes. The remaining rock between sinkholes creates the natural bridges.
16. Karst topography is the irregular topography caused by chemical weathering of limestone or other soluble rock by groundwater.
17. many closely spaced sinkholes and caverns
18. Kentucky; Tennessee, southern Indiana, northern Florida, and Puerto Rico
19. humid
20. limestone
21. cave systems
22. sinkholes
23. arches, spires
24. drier

Math Skills

1. $3 \times 3 = 9$
   $3.14 \times 9 \times 4 = 113.09$
   The volume of the sinkhole is approximately 113 m^3.
2. $1 \times 1 = 1$
   $3.14 \times 1 = 3.14$
   $3.8 \div 3.14 = 1.20$
   The depth of the hot tub is approximately 1.2 m.
3. $4 \times 4 = 16$
   $16 \times 3.14 \times 15 = 753.98$
   The volume of the glass is approximately 754 cm^3.

Graphing Skills

1. Agriculture; 70%
2. Household and Municipal; 10%
3. Answers may vary. Sample answer: Agriculture is the biggest consumer, so it would be the most logical target for conservation measures.
4. **Percent of Water That Is Consumed**



Section Quizzes

SECTION: WATER BENEATH THE SURFACE

1. B
2. D
3. A
4. C
5. E
6. B
7. D
8. B
9. C
10. A

deposits that create moraines and uneven land surfaces. Lakes form in these uneven landscape features. Kettles, which are large depressions created by glacial deposition, can fill with water to create lakes.

Directed Reading

SECTION: GLACIERS: MOVING ICE

1. A glacier is a large mass of moving ice.
2. B
3. D
4. C
5. D
6. A
7. D
8. A
9. B
10. A glacier gets smaller when the ice melts faster than snow is added.
11. Answers may vary. Sample answer: A glacier's size depends on snowfall gains and ice loss. Changes in average yearly temperatures and snowfall accumulation could upset the normal balance between snowfall and ice loss and cause glaciers to become larger or smaller. Thus, this could be a reflection of changes in climatic conditions.
12. alpine
13. Alpine glaciers are confined to small areas because of surrounding topography.
14. Alaska, the Himalaya Mountains, the Andes, the Alps, and New Zealand
15. continental
16. ice sheet
17. Greenland and Antarctica
18. 4,000 m
19. 80 m
20. B
21. B
22. C
23. C
24. A
25. Pressure deforms grains of ice under a glacier. As the grains deform, they slide over one another and cause the glacier to flow slowly.
26. the slope of the ground, the thickness of the ice, and the temperature of the ice
27. The edges of a glacier move more slowly than the center because of friction with underlying rock.
28. C
29. B
30. A
31. Low pressure on the surface ice causes the surface ice to remain brittle.
32. The glacier flows unevenly beneath the surface, and areas of tension and compression build up under the brittle surface. As a result, large cracks form on the surface.
33. 50 m
34. Continental glaciers move outward in all directions from their centers toward the edges of their landmasses.
35. iceberg
36. Icebergs are hazardous to ships because most of the iceberg is below the surface of the water and cannot be seen.

SECTION: GLACIAL EROSION AND DEPOSITION

1. large lakes, solitary boulders on flat plains, and jagged ridges
2. deposition and erosion
3. B
4. D
5. C
6. A
7. D
8. B
9. Rock breaks from the walls, and the walls become steeper. Rock is also broken from the floor of the valley.
10. C
11. A
12. D
13. B
14. When a moving glacier pulls blocks of rock from the floor of a valley, this action results in a bowl-shaped depression called a cirque. An arête forms between cirques. When several arêtes join, they form a horn.
15. the side facing the direction from which the glacier came
16. because rock is pulled away as the glacier passes
17. sheep rocks

18. As a glacier scrapes away from a V-shaped valley's walls and floor, the V-shape becomes a U-shape.
19. erosion
20. A small tributary glacier flows in a valley adjacent to the main alpine glacier. Because the smaller tributary glacier does not have as much cutting power as the main glacier, its U-shaped valley is not cut as deeply into the rock as the main glacier's valley. When the ice melts, the valley of the tributary glacier called a hanging valley is suspended high above the main valley floor.
21. Erosion by alpine glaciers leave sharp, rugged features, but continental glaciers erode by smoothing and leveling landforms, leaving behind a smooth, rounded landscape.
22. Glacial deposition occurs when a glacier melts.
23. A glacier will melt if it reaches low, warm elevations or if the climate becomes warmer.
24. D
25. A
26. C
27. B
28. There are differences in composition because a glacier carries an erratic a long distance.
29. meltwater
30. moraines
31. a long ridge
32. When two or more alpine glaciers join, their adjacent lateral moraines combine to form a medial moraine.
33. ground moraine
34. It is usually very rocky.
35. Drumlins are long, low, tear-shaped mounds of till that may have been molded from ground moraine by an ice sheet.
36. The long axes of drumlins are parallel to the direction of glacial movement, so drumlins reveal which direction the glacier was moving.
37. Terminal moraines are found at the leading edge of a glacier.
38. south of the Great Lakes
39. Meltwater flows from the surface and edges of the glacier, and beneath the glacier. It carries fine sediment, drift and rock particles.
40. because it carries very fine sediment
41. outwash plain
42. When a chunk of glacial ice is buried in drift, a cavity forms in the drift as the ice melts. The drift collapses into the cavity and forms a depression called a kettle.
43. esker
44. C
45. A
46. D
47. C
48. B
49. C
50. A
51. D
52. The Great Lakes formed as a result of both erosion and deposition by a continental glacier. River valleys became wider and deeper and were blocked off by moraines. Lakes formed when the ice sheet melted and meltwater became trapped in the valleys.
53. The lakes initially emptied into the Illinois and Wabash Rivers, which flowed into the Mississippi River.
54. When the lakes became larger, they also started to drain into the Atlantic Ocean through the Susquehanna, Mohawk, and Hudson River valleys.
55. Earth's crust rose after the weight of the glaciers was removed. This uplifted and shrank the lake beds and caused the lakes to drain to the northeast through the St. Lawrence River.
56. Niagara Falls

SECTION: ICE AGES

1. Continental glaciers are found mainly in latitudes near the North and South Poles.
2. ice age
3. about 800 million years ago
4. about 4 million years ago
5. about 15,000 years ago
6. Ice ages probably begin with a long, slow decrease in Earth's average temperatures.
7. C
8. A
9. B

10. C
11. B
12. Earth today is in an interglacial period.
13. about one-third
14. North America and Eurasia
15. So much water was locked in the ice of glaciers that sea level was as much as 140 m lower than it is today. As a result, continental coastlines extended much farther.
16. Canada and mountainous regions of Alaska, parts of the western United States, and the north central part of the United States as far south as the Missouri and Ohio Rivers were buried in ice.
17. Alpine glaciers covered parts of the western United States.
18. Small alpine glaciers joined to form large glaciers that flowed outward from the Rocky Mountains and the Cascade and Sierra Nevada Ranges.
19. It was centered in what is now the Hudson Bay region of Canada.
20. The ice sheet spread south over Germany, Belgium, and the Netherlands. It also spread west over Great Britain and Ireland, and east over Poland and Russia.
21. the Alps and the Himalayas
22. The Andes Mountains in South America and much of New Zealand were covered by mountainous ice fields and glaciers.
23. Many land features that were formed by glaciers are still recognizable today.
24. D
25. C
26. B
27. A
28. C
29. B
30. C
31. D
32. D
33. A
34. B
35. B
36. A
37. C
38. shells
39. temperature
40. oxygen
41. Foraminifera
42. Foraminifera organisms that lived in ocean waters that were warmer than 8°C coiled their shells to the right. Organisms that lived in much cooler waters coiled their shells to the left.
43. They are found in layers of sediment on the ocean floor.
44. The record of ice ages shown in marine sediments closely follows the cycle of cooling and warming predicted by the Milankovitch theory.
45. Answers may vary. Sample answer: The Milankovitch theory focuses on the distribution of solar energy that reaches Earth's surface. However, other theories suggest that ice ages were caused by changes in the amount of solar energy that reached Earth's surface.
46. Answers may vary. Sample answer: One theory proposes that changes in solar energy are caused by varying amounts of energy released by the sun. Another theory suggests that volcanic dust blocks the sun's rays, reducing the amount of solar energy reaching Earth's surface.
47. Changes in the positions of the continents could cause changes in global patterns of warm and cold air and ocean circulation.

Math Skills

1. 4,128 km^2: area of a rectangle = *lw;* 43 km × 96 km = 4,128 km^2
2. 10,395,000 m^2: area of a triangle = ½bh; 3,300 × 6,300 ÷ 2 = 10,395,000 m^2
3. 82,448 m^2: area of a circle = πr^2; 3.1416 × 162 × 162 = 82,448 m^2
4. 89,426 m^2: area of a rectangle = *lw;* 733 m × 122 m = 89,426 m^2

20. Answers may vary. Sample answer: When the sea rises over flat coastal plain, the shoreline moves inland, and dunes become isolated from the original shoreline. This creates barrier islands, which always form parallel to the shoreline. Barrier islands also can form when storms or wave activity cause sand spits to break away from landmasses. Waves, currents, and winds cause these sand deposits to move toward shore, and a line of dunes forms on the side that faces the shore.

Directed Reading

WIND EROSION

1. A
2. B
3. C
4. D
5. B
6. C
7. B
8. In these areas, fewer plant roots anchor soil and sand in place. Also, because these areas are dry, soil layers are thin and can easily be blown away.
9. deflation
10. desert pavement
11. Deflation is a problem for farmers because it blows away the best soil for growing crops.
12. deflation hollow
13. ventifacts
14. erosion due to surface water and weathering
15. Wind drops particles when it slows down and can no longer carry them. These particles are constantly covered by additional deposits. Cementation and pressure from overlying layers bind the particles together.
16. dunes
17. barrier
18. wind
19. slipface
20. barchan dune
21. parabolic dune
22. transverse dunes
23. longitudinal dunes
24. dune migration
25. barrier
26. C
27. B
28. B
29. A
30. D

WAVE EROSION

1. waves
2. shoreline
3. C
4. D
5. C
6. A
7. B
8. C
9. C
10. D
11. A
12. A
13. D
14. C
15. B
16. B
17. A
18. A
19. B
20. A
21. C
22. A
23. B
24. D

COASTAL EROSION AND DEPOSITION

1. sea level
2. deposition
3. C
4. A
5. B
6. B
7. D
8. B
9. relative
10. crust
11. tectonic plate boundary, tectonic plates
12. submergent
13. emergent
11. emergent
14. emergent
15. submergent
16. emergent
17. submergent
18. A
19. C
20. D
21. B
22. C
23. D
24. C
25. D

Answer Key

Concept Review

1. E
2. D
3. B
4. G
5. A
6. I
7. F
8. H
9. J
10. C
11. C
12. B
13. C
14. C
15. D
16. D
17. B
18. A
19. D
20. B

Critical Thinking

1. B
2. D
3. D
4. B
5. A
6. C
7. B
8. A
9. C
10. D
11. You would expect to find trenches because trenches form in the deep-ocean basin where one tectonic plate subducts below another plate.
12. earthquakes
13. By volcanoes. Volcanic mountain ranges form near trenches.
14. volcanic island arcs
15. Disagree. Each kind of submersible s effective for different needs and purposes.
16. Disagree. Deep-ocean sediment contains remains of sea animals which would be rare on land as well as nodules and more meteorite fragments. The compositions of mud and ooze on the ocean floor also differ from similar substances on land because they contain remains of ocean organisms.
17. Disagree. Sediments that have originated in rivers and settled in the ocean are just one way scientists can find out about land by studying the ocean.
18. Disagree. Technology is making more extensive study possible every day. For example, scientists using new submersible technology found life at depths they thought incompatible with life.
19. Yes. Erosion by turbidity currents is partially responsible for creating submarine canyons and trenches. Wave erosion is responsible for forming guyots.
20. People are probably most familiar with the continental shelf because it is most accessible. People use it for beach recreation, fishing, and oil drilling. All these are susceptible to misuse by people and therefore damage to the continental shelf.
21. You would expect the Mediterranean Sea to have many of the same features of an ocean because it is a large body of salt water and is connected to the global ocean. Differences might occur due to its being nearly surrounded by land and its being smaller than the oceans.

Directed Reading

SECTION: THE WATER PLANET

1. D
2. D
3. A
4. C
5. D
6. B
7. B
8. D
9. B
10. B
11. B
12. A
13. B
14. C
15. D.
16. D
17. A
18. Mediterranean, Caribbean, South China
19. A
20. B
21. C

22. C
23. Scientists aboard *Challenger* measured water temperature at great depths.
24. Scientists aboard *Challenger* collected samples of ocean water, sediments, and thousands of marine organisms.
25. oceanography
26. Reentry cones are used so that core samples can later be taken from the same place o the ocean floor.
27. Samples drilled by *JOIDES Resolution* provided valuable information about plate tectonics and the ocean floor.
28. the Integrated Ocean Drilling Program
29. B
30. C
31. A
32. sonar
33. Sonar is a system that uses acoustic signals to determine the location of objects or to communicate.
34. **so**und **n**avigation **a**nd **r**anging
35. 1,500 m/s
36. Answers may vary. Sample answer: Sound waves travel through sea water at about 1,5000 m/s, bounce off the solid ocean floor, and reflect back to a receiver.
37. Scientists measure the time sound waves take to travel from the transmitter to the ocean floor and to the receiver.
38. depth of the ocean floor
39. Scientists make maps and profiles of the ocean floor.
40. Answers may vary. Sample answer: Submersibles enable oceanographers to study the ocean depths.
41. a bathysphere and a bathyscaph
42. Answers may vary. Sample answer: A bathyscaph is a self-propelled, free-moving submarine. A bathysphere does not move freely, but remains tethered to the research ship for communications and life support.
43. Answers may vary. Sample answer: submarine robots take photographs and collect mineral samples from the ocean floor.
44. Answers may vary. Sample answer: Remotely piloted robot submersibles allow oceanographers to study ocean depths for long periods of time. Piloted submersibles can stay under water for five hours or less.
45. A
46. B
47. C
48. deep ocean
49. giant clams, blind white crabs, giant tube worms
50. Answers may vary. Sample answer: depth and temperature
51. because of the hostile environment

SECTION: FEATURES OF THE OCEAN FLOOR

1. B
2. A
3. B
4. B
5. A
6. C
7. C
8. B
9. B
10. A
11. B
12. B
13. B
14. at the base of the continental slope
15. several thousand meters within a fe kilometers
16. submarine canyons
17. Answers may vary. Sample answer: near the mouths of major rivers
18. Turbidity currents carry sediment down the continental slopes.
19. Turbidity currents form when earthquakes cause underwater landslides or when large sediment loads run down a slope.
20. continental rise
21. broad, flat plains; submerged volcanoes; gigantic mountain ranges; deep trenches
22. the mountains are higher and the plains are flatter in deep-ocean basins than on the surface of the continents.
23. the Mariana Trench
24. the western Pacific Ocean
25. more than 11,000 m deep
26. A trench is a long, narrow and steep depression that forms on the ocean floor.

27. Trenches form in deep-ocean basins as a result of subduction of a tectonic plate.
28. earthquakes, volcanic mountain ranges, volcanic island arcs
29. vast, flat areas of the deep-ocean basins where the ocean is more than 4 km deep
30. abyssal plains
31. abyssal plains
32. sediment
33. Sediments are carried by ocean currents and wind from the continental margins, and sediment is made by organisms that live in the ocean and settle to the ocean floor when they die.
34. Older crust is generally covered with thicker sediments than younger crust is.
35. More sediment would settle closer to the continental margin; less sediment would settle farther away.
36. Sediment cover on abyssal plains that are bordered by trenches is generally thinner than sediment cover on abyssal plains not bordered by trenches.
37. mid-ocean ridges
38. mountain ranges
39. Answers may vary. Sample answer: Iceland
40. Mid-ocean ridges form where plates pull away from each other.
41. A narrow depression, or rift, runs along the center of a mid-ocean ridge.
42. Magma reaches the sea floor through the rift.
43. Magma reaching the sea floor forms new lithosphere.
44. As lithosphere cools, it becomes denser and moves away from the rift.
45. abyssal hills
46. As ridges adjust to changes in the direction of plate motions, they break into segments bounded by faults.
47. fracture zones
48. Seamounts form near hot spots, areas of increased volcanic activity.
49. B
50. A
51. E
52. D
53. C

SECTION: OCEAN-FLOOR SEDIMENTS

1. A
2. D
3. D
4. Sediments are carried into the ocean by rivers, are washed away from the shoreline by wave erosion, or settle to the ocean bottom when the organisms that created them die.
5. heavier
6. lighter
7. D
8. C
9. C
10. Samples of the sediments in deep-ocean basins can be gathered by scooping, or by taking core samples.
11. *JOIDES Resolution*
12. Answers may vary. Sample answer: Rock particles are carried by land from rivers.
13. Sediment loads from rivers are deposited along the shore and on the continental shelf.
14. Occasionally, large quantities of sediments slide down continental slopes to the ocean floor.
15. turbidity
16. Volcanic dust is blown great distances out to sea by the wind. These particles land on the water's surface, and gradually settle to the bottom of the ocean.
17. Glaciers move across the land and pick up rocks, which become embedded in the ice. When an iceberg breaks from the glacier, it drifts out to sea, melts, and the rock material sinks to the ocean floor.
18. Much of a meteorite vaporizes as it enters Earth's atmosphere, and cosmic dust falls to Earth's surface.
19. Because most of Earth's surface is ocean, most meteorite fragments fall into the ocean and become part of the sediments on the ocean floor.
20. Underwater landslides can be caused by earthquakes, or happen wen the sediment-water mixture becomes denser than surrounding water.
21. B
22. D
23. A
24. C

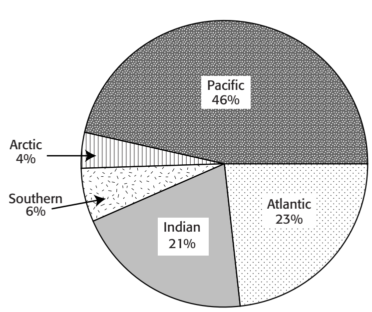
25. B
26. A
27. C
28. D
29. C
30. B
31. B
32. D
33. D
34. B
35. Because the waters around Antarctica are nutrient-rich, they are filled with diatoms and radiolarians. The skeletons of diatoms and radiolarians is the main source of silica in siliceous ooze.
36. C
37. B
38. A

Math Skills

1. .12/100 = x/22.5
.12 = 100x/22.5
.12 = 4.44x
x = .027
2. 1 km = 1,000 m
Grand Canyon = 1600 m
1600 = 11034x/100
160000 = 11034x
x = 14.5%
3. 1500/1 = x/6
x = 9000 m
4. (Divide by 2 to account for time to the ocean floor and back)
x = 1500 m/sec × 8 sec/2
2x = 12000
x = 6000 m

Graphing Skills

1. Biogenic; 54%
2. 99%
3. < 10 kg
4.



Section Quizzes

SECTION: THE WATER PLANET

1. D
2. E
3. C
4. A
5. B
6. D
7. C
8. C
9. B
10. B

SECTION: FEATURES OF THE OCEAN FLOOR

1. C
2. B
3. E
4. D
5. A
6. D
7. B
8. A
9. C
10. B

SECTION: OCEAN-FLOOR SEDIMENTS

1. C
2. B
3. E
4. D
5. A
6. C
7. B
8. D
9. A
10. B

Chapter Test A

1. G
2. C
3. B
4. A
5. F
6. I
7. D
8. J
9. H
10. E
11. B
12. C
13. D

Answer Key

Concept Review

1. E
2. I
3. J
4. C
5. F
6. A
7. D
8. B
9. G
10. H
11. A
12. C
13. A
14. C
15. D
16. B
17. A
18. B
19. D
20. B

Critical Thinking

1. B
2. D
3. A
4. C
5. A
6. B
7. D
8. C
9. D
10. B
11. Answers may vary. Answer should include: oil, toxic chemicals, waste products, garbage, human waste, metals, marine debris
12. Answers may vary. Answer should include: freshwater rivers and streams, ships, air, intentional dumping
13. Answers may vary. Sample answer: Government regulation, self-regulation by industries, individual responsibility, community support groups, and awareness programs can all help to control pollution.
14. Answers may vary. Sample answer: Agree. Many countries without adequate fresh water supplies are already using desalination processes. It will be more urgent to find fresh water as the world population grows.
15. Answers may vary. Sample answer: Agree. Temperature is a major factor in maintaining the balance in the ocean habitat. If the temperature changes, so will the sea life that cannot adapt.
16. Answers may vary. Sample answer: Agree. Pollutants absorbed into the ocean food chain may eventually be consumed by those who eat sea plants or animals. Pollutants can also affect aquaculture.
17. Answers may vary. Sample answer: Disagree. Ocean pollutants might prevent aquaculture from being as rich a food source as it otherwise would become.
18. Answers may vary. Sample answer: Eliminating oil pollutants from the water is most important because the chemical and life balance in the ocean is interrupted by pollution. The consequences of polluted waters are more far-reaching than those of reduced oil production.
19. Answers may vary. Sample answer: International organizations should monitor the mining of resources from the ocean. This would prevent depletion of resources and avoid boundary disputes among individual countries.
20. Answers may vary. Sample answer: Since sunlight affects the color of ocean water, the weather might determine color. On cloudy or stormy days, the water might appear to be a different shade than it is on calm, sunny days.

Directed Reading

SECTION: PROPERTIES OF OCEAN WATER

1. C
2. C
3. Answers may vary. Scientists study the properties of ocean water to understand the interactions between the ocean, the atmosphere, and the land.
4. A
5. C
6. A
7. D
8. A
9. C
10. C
11. B

12. C
13. A
14. D
15. C
16. A
17. trace elements
18. Answers may vary. Sample answer: gold, zinc, and phosphorous
19. volcanic eruptions, chemical weathering of rock on land, chemical reactions between sea water and newly formed sea-floor rocks
20. Rivers carry about 400 billion kilograms of dissolved solids into the ocean. As water evaporates from the ocean, salts and other minerals remain.
21. salinity
22. Salinity is measured as the number of grams of dissolved solids in 1000 g of ocean water.
23. 1%.
24. Dissolved salts and other solids remain.
25. Tropical waters have higher salinity at the surface than polar waters, because of the salinity of surface water increases as evaporation increases. Water evaporates more quickly in the tropics than at the poles.
26. Because surface water evaporates and freezes, surface water generally has higher salinity than deep water.
27. Salinity can vary greatly due to climate and other factors.
28. High salinity of the Red Sea is due to the hot, dry climate, which causes high levels of evaporation.
29. B
30. The mixing of the ocean's surface water distributes heat downwards, keeping the temperature of surface water relatively constant.
31. As latitude increases, the temperature of surface water decreases.
32. the equator
33. about 30°C
34. Because surface water temperatures are about -2°C, and ocean water freezes at about -2°C, vast areas of sea ice exist in polar areas.
35. pack ice
36. Ice insulates water below the pack ice and keeps it from freezing.
37. In the middle latitudes, the ocean surface temperatures vary by season. Ocean surface temperatures can vary by as much as 10°C to 20°C between summer and winter.
38. The sun cannot directly heat ocean water below the surface layer.
39. thermocline
40. Ocean water near the surface becomes less dense as energy from the sun warms the water, and cannot mix with the cold, dense water below.
41. Water temperature below the thermocline continues to decrease, but very slowly.
42. The colder water is, the denser it is.
43. Cold, deep ocean water contains more dissolved gases than warm, shallow water.
44. density
45. salinity and water temperature
46. dissolved solids add mass to the water
47. Ocean water is more dense than pure water because it contains more dissolved solids.
48. The densest ocean water is found in the polar regions, because water becomes denser as it becomes colder. The coldest water at the ocean surface is in the polar regions. The surface water sinks and moves through the ocean basins near the ocean floor.
49. Ocean water color is determined by the way it absorbs or reflects sunlight.
50. Ocean water absorbs most wavelengths of visible light and reflects the blue wavelength. The reflection of blue light makes ocean water appear blue.
51. *Phytoplankton* are microscopic plants in the ocean that provide food to many of the ocean's organisms.
52. Phytoplankton absorb red and blue light but reflect green light, so the presence and amount of phytoplankton affects the shade of blue in the ocean.
53. Scientists determine whether phytoplankton is present by studying variations in ocean color.

54. If there is no evidence of phytoplankton it may mean pollution has prevented phytoplankton growth.

SECTION: LIFE IN THE OCEANS

1. A
2. The chemistry of the ocean is a balance of dissolved gases and solids essential to marine life.
3. Marine organisms remove nutrients and gases from the ocean and return other nutrients and gases to the ocean.
4. Answers may vary. Marine organisms absorb large amounts of carbon, hydrogen, oxygen and sulfur, as well as nitrogen, phosphorus, and silicon.
5. Photosynthetic marine plants remove carbon dioxide from ocean water to produce oxygen.
6. recycling
7. Bacteria digest the remains of dead organisms and release essential nutrients into the ocean.
8. near the surface of the ocean
9. When organisms die they sink to lower depths, and decay. Elements necessary for life are released back into the ocean water.
10. Nutrients needed for life are stored in deep water.
11. Stored nutrients must return to the surface before most ocean organisms can use them.
12. Nutrients return to the surface through a process called upwelling.
13. When wind blows steadily parallel to a coastline, surface water moves farther offshore, and is replaced by deep, cold water.
14. Most marine organisms live in the upper 100 m of water.
15. plankton
16. Plankton are consumed by small organisms, which in turn become food for larger marine mammals.
17. nekton
18. benthos
19. benthic zone
20. pelagic zone
21. intertidal zone
22. sublittoral zone
23. bathyal zone
24. abyssal zone
25. hadal zone
26. neritic zone
27. oceanic zone
28. epiplagic zone
29. mesopelagic zone; bathypelagic zone; abyssopelagic zone
30. Marine life decreases as depth increases.

SECTION: OCEAN RESOURCES

1. food; minerals; fresh water
2. C
3. D
4. A
5. B
6. Most methods of desalination are costly.
7. Distillation uses a large amount of heat energy.
8. Freezing uses only about one-sixth the energy need by distillation.
9. C
10. C
11. B
12. A
13. C
14. B
15. food
16. protein
17. overharvest
18. ecosystem
19. aquaculture
20. aquatic farms
21. An aquatic farm could produce more food. Whereas agricultural farms use only the top layer of soil, an aquatic farm can use a wide range of depths to produce food.
22. Nutrient-rich bottom water may be pumped to the surface to fertilize aquatic farms.
23. C
24. A
25. D
26. B
27. D

Math Skills

1. 4.25; 4.25×10^5
2. 3.25; 3.25×10^5
3. 9; 9×10^3
4. 6.3; 6.3×10^4

Directed Reading

SECTION: OCEAN CURRENTS

1. current
2. by studying the physical and chemical characteristics of the ocean water, and by mapping the paths of debris that is dumped or washed overboard from ships
3. ocean currents and deep currents
4. C
5. A
6. C
7. Winds are caused by the uneven heating of the atmosphere. Variations in air temperature lead to variations in air density and pressure. Colder, denser air sinks and forms high-pressure areas. The movement of air from high-pressure to lower-pressure areas causes wind.
8. Kinetic energy is transferred from the air to the ocean.
9. trade winds, westerlies
10. trade winds
11. northeast
12. southeast
13. westward
14. southwest
15. northwest
16. eastward
17. because continents act as barriers to surface currents
18. Coriolis effect
19. gyres
20. to the right, or clockwise
21. to the left, or counterclockwise
22. H
23. E
24. A
25. D
26. G
27. K
28. F
29. B
30. C
31. J
32. I
33. Antarctic Circumpolar Current
34. monsoons
35. North Atlantic Gyre
36. Sargasso Sea
37. brown seaweed and debris
38. North Atlantic
39. North Atlantic, California Current
40. deep current
41. slowly
42. Cold, dense water of the polar regions sinks and flows beneath warmer ocean water.
43. When water cools, it contracts and become denser. Warm water expands, and because it is less dense it rises above the cold water.
44. salinity
45. There is a large amount of water frozen in icebergs and sea ice in these regions. When water freezes, the salt in the water does not freeze. The high salt content in this unfrozen water makes the water denser.
46. off the coast of Antarctica
47. Antarctic Bottom Water
48. in the North Atlantic, south of Greenland
49. An increase in evaporation and a decrease in rainfall each summer cause the Mediterranean Sea's salinity to increase.
50. It sinks and flows through the strait of Gibraltar into the Atlantic.
51. turbidity current
52. A turbidity current forms when large masses of sediment that have accumulated along a continent shelf or continental slope suddenly break loose and slide downhill. The landslide mixes the nearby water with sediment.
53. The water in a turbidity current appears denser and cloudier.
54. A turbidity current moves beneath the clear water because the turbidity current contains sediment and is therefore denser.

SECTION: OCEAN WAVES

1. E
2. D
3. B
4. C
5. F
6. A
7. wave speed = wavelength ÷ wave period
8. wind
9. friction between the moving air and water

10. The longer the wind blows from a given direction, the more energy is transferred from wind to water and the larger the wave becomes.
11. Larger waves have a larger surface area and therefore receive more energy from the wind than smaller waves do.
12. The bottle moves in a circular motion because even though wave energy moves from one water molecule to another, the water itself moves very little.
13. almost exactly where it started
14. Its diameter is equal to the height of the wave.
15. The energy received decreases.
16. The diameter of a water molecule's circular path decreases.
17. There is almost no circular motion.
18. the speed of the wind, the length of time the wind blows, and fetch
19. fetch
20. steady high winds that blow across a long fetch
21. strong, gusty winds
22. swell
23. A whitecap forms when winds blow the crest of a wave off.
24. because whitecaps reflect solar radiation and allow less radiation to reach the ocean
25. where the depth of the water is about half the wavelength
26. The bottom of the wave is slowed by friction, but the top of the wave continues moving at its original speed. The top of the wave gets farther and farther ahead of the bottom and topples over.
27. breaker
28. one to two times the height of the original wave
29. They scrape sediments off the ocean floor and move them along the coastline.
30. the original wave height, wavelength, and the steepness of the ocean floor close to the coastline
31. The height of the wave increases rapidly and the wave breaks with great force.
32. The wave rises slowly and spills forward with a rolling motion.
33. refraction
34. As a wave approaches the coastline, the part of the wave that is in deeper water maintains its speed while the part in shallower water slows. The wave gradually bends toward the beach.
35. undertow
36. along shorelines that have steep drop-offs
37. Water from large breakers returns to the ocean through channels that cut through underwater sandbars parallel to the beach.
38. They can be detected by a gap in a line of breakers, or by turbid water.
39. longshore current
40. parallel
41. If there is a bay or an inlet along the shoreline where waves refract, sand carried by longshore currents is deposited as wave energy lessens and forms low ridges called sandbars.
42. D
43. B
44. C
45. D
46. B
47. B
48. C

SECTION: TIDES

1. tide
2. high tide
3. low tide
4. the gravitational pull of the moon on Earth and Earth's waters
5. The gravitational pull of the moon causes the ocean on the side of Earth facing the moon to bulge slightly.
6. high tide
7. The Earth and moon revolve around a common center of gravity; the outward force causes the ocean on the side of Earth opposite the moon to bulge.
8. As ocean water flows toward the areas of high tide, the water level in other areas of the ocean drops.
9. C
10. B

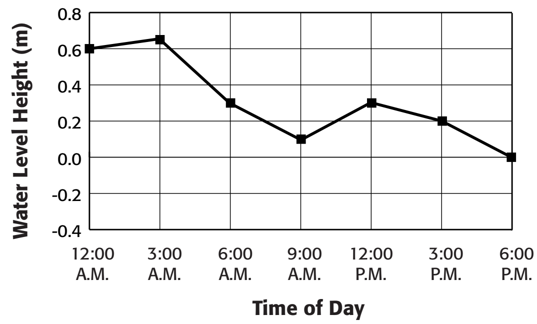
11. C
12. C
13. D
14. C
15. size, shape, depth, and location of the ocean basin in which the tides occur
16. C
17. A
18. B
19. tidal oscillation
20. along straight coastlines and in the open ocean
21. In enclosed seas such as the Baltic and Mediterranean, tidal oscillations reduce the effects of the tidal bulges. As a result, these seas have a small tidal range.
22. in small basins and narrow bays located off major ocean basins
23. B
24. E
25. A
26. D
27. C
28. between two adjacent coastal regions that have large differences in the height of the tides
29. 20 km/h
30. 33 km

Math Skills

1. $96.50 \div 9.0 = 10.7222$
   96.50 has four significant digits
   9.0 has two significant digits
   wave speed = 11 m/s
2. $250 \div 0.75 = 333.33$
   250 and 0.75 each have two significant digits
   wave speed = 330 km/h
3. $720 = x \div 0.8$
   $x = 720 \times 0.8$
   0.8 has one significant digit
   x (wavelength) = 600 km

Graphing Skills

1. 2 m
2. 24 m
3. During a storm, wave height decreases as wavelength increases.
4. Note: Axes indicating time of day and water level height may show some variation; however, datapoints must be graphed as shown below.



Section Quiz

SECTION: OCEAN CURRENTS

1. C
2. A
3. D
4. E
5. B
6. B
7. C
8. A
9. B
10. D

SECTION: OCEAN WAVES

1. D
2. C
3. E
4. A
5. B
6. C
7. D
8. A
9. C
10. B

Directed Reading

CHARACTERISTICS OF THE ATMOSPHERE

1. Atmosphere is a mixture of gases that surrounds a planet, such as Earth.
2. The atmosphere protects Earth's surface from the sun's radiation and helps regulate the temperature.
3. B
4. C
5. C
6. B
7. B
8. D
9. C
10. Nitrogen-fixing bacteria in soil change N_2 into nitrogen compounds; nitrogen compounds in plants are consumed by animals; nitrogen compounds return to the soil in wastes; decay and processes in the soil return N_2 to the atmosphere.
11. 21%
12. animals; bacteria; plants; forest fires; the burning of fuels; weathering of some rocks
13. Land and ocean plants produce large quantities of oxygen during photosynthesis.
14. The oxygen content is about the same because the amount of oxygen produced by plants each year equals the amount consumed by all animal life processes.
15. water vapor
16. transpiration
17. Water vapor is removed by the processes of condensation and precipitation.
18. Answer may vary. Sample answer: location; time of day; season
19. dry air
20. moist air
21. Ozone is a form of oxygen present in the atmosphere in small amounts. Ozone (O_3) is made up of three oxygen atoms, rather than two atoms.
22. The ozone layer absorbs harmful ultraviolet radiation from the sun. Without it, living organisms would be severely damaged by the sun.
23. CFCs break down ozone and have caused parts of the ozone layer to weaken.
24. Particulates are various tiny solid particles in the atmosphere.
25. volcanic dust; ash from fires; microscopic organisms; mineral particles from soil; pollen; particles from meteors; salt crystals
26. volcanic ash and dust; pollen; tornadoes and windstorms; sea spray
27. Large particles remain in the atmosphere briefly; tiny particles can remain suspended in the atmosphere for months or years.
28. C
29. D
30. B
31. C
32. A
33. C
34. temperature and the amount of water vapor in the air
35. As temperature increases, atmospheric pressure decreases.
36. Water vapor molecules have less mass than nitrogen or oxygen molecules. The lighter water vapor molecules replace an equal number of heavier oxygen and nitrogen molecules, making the volume of air less dense.
37. atmospheres (atm); millimeters or inches of mercury; millibars (mb)
38. E
39. C
40. A
41. B
42. D
43. The temperature differences mainly result from how solar energy is absorbed as it moves through the atmosphere.
44. G
45. D
46. A
47. C
48. F
49. E
50. B
51. J
52. I
53. H

54. Air in the troposphere is heated from below by thermal energy that radiates from Earth's surface.
55. Air in the upper stratosphere is heated from above by absorption of solar radiation by ozone.
56. In the thermosphere, nitrogen and oxygen atoms absorb solar radiation.
57. Air pollution is any substance in the atmosphere that is harmful to people, animals, plants, or property.
58. As fossil fuels burn, they may release substances such as sulfur dioxide gas, hydrocarbons, nitrogen oxide, carbon monoxide, and lead into the air.
59. A temperature inversion is the layering of warm air on top of cool air.
60. Smog is a general term for air pollution that indicates a combination of smoke and fog.

SOLAR ENERGY AND THE ATMOSPHERE

1. Earth's atmosphere is heated by the transfer of energy from the sun.
2. the absorption of the sun's rays by gases in the atmosphere; ocean and land surfaces absorb energy and then give off that energy as heat
3. D
4. B
5. A
6. C
7. visible light
8. ultraviolet light, X rays, radio waves
9. 300,000 km/s
10. Waves of visible light are seen as a spectrum of colors.
11. Ultraviolet rays, x rays, and gamma rays are shorter than visible light. Infrared rays and radio rays are longer.
12. C
13. B
14. D
15. A
16. troposphere
17. a small amount
18. Clouds, dust, water droplets, and gas molecules in the atmosphere disrupt the paths of radiation from the sun and cause scattering.
19. The deflection causes rays to travel in all directions without changing their wavelengths.
20. Scattering sends some of the radiation back into space. The remaining rays continue toward Earth's surface.
21. Scattering makes the sky appear blue and the sun appear red at sunrise and sunset.
22. The surface either absorbs or reflects the energy.
23. The amount absorbed and reflected depend on color, texture, composition, volume, mass, transparency, state of matter, and specific heat of the material on which the solar radiation falls.
24. albedo
25. 0.3; 30% of the solar energy reaching Earth's atmosphere is either reflected or scattered
26. A
27. B
28. C
29. Gas molecules in the atmosphere, such as water vapor and carbon dioxide, absorb the infrared rays.
30. Absorption of thermal energy heats the lower atmosphere and keeps Earth's surface warmer than it would be if there were no atmosphere.
30\. water vapor; carbon dioxide
31. mirage
32. greenhouse effect
33. greenhouse effect
34. The amount of solar energy that enters Earth's atmosphere is about equal to the amount that escapes into space.
35. The burning of fossil fuels has increased the amount of carbon dioxide in the atmosphere, which may intensify the greenhouse affect and cause Earth to become warmer in some areas and cooler in others.
36. C
37. A
38. B
39. C
40. D
41. B
42. Earth's surface must absorb energy for a while before enough heat has been absorbed and reradiated to raise the temperature of the atmosphere.

43. Solar energy is spread out over a larger area and so is less intense.
44. Energy at the equator reaches Earth's surface at an angle near 90° and is more intense. Energy reaches the poles at an angle smaller than 90° and is less intense.
45. When the Northern Hemisphere is tilted toward the sun it receives more direct sunlight and temperatures are at their highest. When the Northern Hemisphere is tilted away from the sun it receives less direct sunlight and temperatures are at their lowest.
46. water vapor stores heat
47. Thinner air at high elevations contains less water vapor and carbon dioxide to absorb heat.
48. In the desert there is little water vapor to hold the heat of the day.
49. Water heats up and cools down faster than air does, so the temperature of water changes less than the temperature of land.
50. B
51. D
52. A
53. A
54. B
55. B
56. The heating of the lower atmosphere is primarily the result of the distribution of heat through the troposphere by convection.
57. convection
58. Convection occurs when gases or liquids are heated unevenly.
59. the air becomes less dense and is pushed by nearby cooler air; the cooler air becomes warmer, and the cycle repeats.
60. The continuous cycle in which cold air sinks and warm air rises (convection) warms Earth's atmosphere evenly.
61. Warm air is less dense than cool air. It exerts less pressure than the same volume of cooler air does. So the atmospheric pressure is lower beneath a mass of warm air.
62. As dense, cool air moves into a low-pressure region, the less dense, warmer air is pushed upward. These pressure differences, which are the result of the unequal heating that causes convection, create winds.

ATMOSPHERIC CIRCULATION

1. pressure differences in the atmosphere
2. from the poles toward the equator
3. air moves from high-pressure regions to low-pressure regions
4. where cold air sinks toward Earth's surface
5. where warm air rises away from Earth's surface
6. B
7. A
8. Points near the equator. Because each point on Earth makes one complete rotation every day, points near the equator travel farther and faster in a day than points closer to the poles.
9. When air moves toward the poles, it travels east faster than the land beneath it. As a result, the air follows a curved path.
10. Coriolis effect
11. Winds that blow from high-pressure areas to lower-pressure areas curve as a result of the Coriolis effect.
12. The Coriolis effect deflects moving objects along a path that depends on the speed, latitude, and direction of the object.
13. Objects are deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.
14. The faster an object travels, the greater the Coriolis effect.
15. The Coriolis effect noticeably changes the paths of large masses that travel long distances.
16. In general, the Coriolis effect is detectable only on objects that move very fast or that travel long distances.
17. B
18. A
19. A
20. C
21. B
22. D
23. B

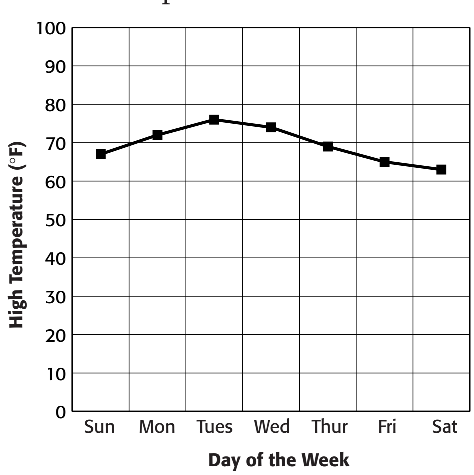
24. C
25. C
26. E
27. D
28. B
29. A
30. C
31. local winds
32. breezes
33. sea breeze
34. land breeze
35. valley breeze
36. mountain breeze

Math Skills

1. above 27°C ; 2 ; 1; all non-zero numbers are significant
2. 60 m; 3; 1; zeros at the end of a number are not significant
3. over 800 km; 1; 3 ; zeros at the end of a number are not significant (all non-zero numbers are significant)
4. 150 − 119 = 31 kph; 2; 1; all non-zero numbers are significant

Graphing Skills

1. The graph show the change in temperature in relation to the change in height of the foehn on the mountain slope.
2. 12°C / 1,500 m; 18°C / 900 m; 24°C / 300 m
3. Answers may vary. Sample answer: The increase in temperature is directly proportional to the decrease in altitude. The temperature rises 1° C for every 100 m the winds descend the mountain slope.
4.



5. The temperature goes in a relatively smooth curve upward from Sunday's temperature to a high on Tuesday, dipping back down by Saturday. No, the variables are not dependent on one another. Day of the week does not affect temperature. Temperature is affected by Earth's rotational cycle and by local weather factors, such as wind, precipitation, barometric pressure, and proximity to water.

Section Quizzes

SECTION: CHARACTERISTICS OF THE ATMOSPHERE

1. E
2. C
3. A
4. B
5. D
6. B
7. D
8. D
9. C
10. C

SECTION: SOLAR ENERGY AND THE ATMOSPHERE

1. B
2. E
3. A
4. D
5. C
6. D
7. A
8. B
9. C
10. B

SECTION: ATMOSPHERIC CIRCULATION

1. B
2. A
3. D
4. E
5. C
6. D
7. C
8. D
9. A
10. C

Chapter Test A

1. E
2. A
3. J
4. F
5. I
6. D
7. B
8. C
9. G
10. H
11. D
12. C
13. B
14. C
15. D
16. A
17. B
18. C
19. D
20. A

Answer Key

Concept Review

1. G
2. I
3. D
4. C
5. H
6. A
7. E
8. F
9. J
10. B
11. B
12. C
13. D
14. A
15. C
16. B
17. D
18. B
19. C
20. B

Critical Thinking

1. C
2. D
3. A
4. D
5. A
6. B
7. C
8. A
9. Advection fog; warm moist air from the Pacific cools as it moves across the California Current. Advection fog is common along coasts.
10. Answers may vary. Sample answer: It probably lessens because the California Current and the land on the coast have warmed up somewhat by September.
11. Radiation fog, which results from the loss of heat by radiation and is thickest in valleys.
12. Answers may vary. Sample answer: At the beach the temperature is at the dew point, so condensation can occur with just a little cooling. In downtown San Francisco more cooling must take place to reach the dew point. Further inland, the temperature is well above the dew point and so is less likely to reach the dew point.
13. Answers may vary. Sample answer: Disagree. Cloud seeding results are inconclusive and further experimentation is needed.
14. Answers may vary. Sample answer: Disagree. Hail is much more damaging than sleet.
15. Answers may vary. Sample answer: Disagree. The process of lifting, which results when air meets the sloping terrain of mountains, causes air to cool, expand, and form clouds that can cover mountaintops.
16. Answers may vary. Sample answer: Disagree. Only small amounts of moisture are added to the atmosphere from fuels.
17. Answers may vary. Sample answer: the relative humidity because it tells how nearly saturated the air is at a given temperature. The absolute humidity would only tell the amount of vapor, not how saturated the air is. The dew point by itself wouldn't tell you the humidity.
18. Answers may vary. Sample answer: A psychrometer, because it can measure temperature and humidity, and Doppler radar, because it predicts storms in detail.
19. Answers may vary. Sample answer: Clouds are formed by condensation of water vapor. Condensation rates would tend to be lower in warm, dry areas. Clean air would have fewer of the particles needed for water vapor to condense and form clouds.
20. You could expect snow because the cloud is a cirrocumulus, which commonly appear before snow or rain.

Directed Reading

SECTION: ATMOSPHERIC MOISTURE

1. phases
2. water vapor
3. ice
4. water
5. C
6. A
7. B
8. A
9. B
10. C

11. A
12. D
13. D
14. A
15. C.
16. B.
17. B
18. A
19. in oceans of the equatorial regions
20. evaporation from lakes, ponds, streams, and soil
21. They release small amounts of water vapor into the atmosphere.
22. It changes into a liquid.
23. sublimation
24. when the air is dry and the temperature is below freezing
25. liquid
26. B
27. A
28. C
29. D
30. rates of condensation and evaporation
31. air temperature
32. It gets higher.
33. vapor pressure
34. vapor pressure
35. saturated
36. absolute humidity
37. absolute humidity = mass of water vapor (grams) / volume of air (cubic meters)
38. because, as air moves, its volume changes as a result of temperature and pressure changes.
39. 18 g/kg
40. less than 1 g/kg
41. because the measurement uses only units of mass, not units of volume
42. relative humidity
43. relative humidity
44. when it contains 20 g of water vapor per 1 kg of air
45. 25%
46. moisture entering the air
47. a decrease in the temperature
48. The relative humidity will decrease.
49. conduction when the air is in contact with a cold surface
50. dew
51. Objects near the ground lose heat during the night, often dropping to the dew point of the surrounding air. Air comes into contact with the surfaces and water vapor condenses out of it.
52. Cool clear nights with little wind
53. frost
54. Frost forms when water vapor turns directly to ice; frozen dew forms when dew freezes as clear beads of ice.
55. C
56. B
57. A
58. It helps them predict weather conditions.
59. Its electrical conductance increases.
60. The LiCl loses its ability to conduct electricity.
61. dew point
62. The bulb of one is covered with a damp wick and the bulb of the other remains dry.
63. The water in the wick evaporates, and so heat is withdrawn from that thermometer.
64. That of the wet-bulb thermometer is lower.
65. the difference between the readings of the two thermometers
66. B
67. C
68. A
69. It gets longer.
70. It is less accurate than psychrometers and dew cells.
71. An electric current is passed through a moisture-attracting substance. The amount of moisture changes the electrical conductivity of the substance and can be measured and expressed as relative humidity of the surrounding air.

SECTION: CLOUDS AND FOG

1. cloud
2. evaporation
3. fog
4. A
5. C
6. D
7. C
8. B
9. D
10. B
11. B
12. B

13. D
14. C
15. D
16. because of the release of latent heat as the water condenses
17. Earth's surface absorbs it and then reradiates it as heat.
18. It absorbs heat. It rises, expands, and then cools.
19. condensation level
20. The combination causes the temperature of the air to change. The combined air may be cooled to below its dew point, which results in clouds.
21. the cooling of the air and cloud formation
22. sloping terrain, such as a mountain range
23. A mass of cold, dense air enters an area and pushes a less dense mass of warmer air upward.
24. advective cooling
25. The cold surface absorbs heat from the air and the air cools.
26. The air must be cooled to below its dew point.
27. shape and altitude
28. stratus, cumulus, cirrus
29. low clouds (0 to 2,000 m); middle clouds (2,000 to 6,000 m); high clouds (above 6,000 m)
30. F
31. B
32. E
33. C
34. A
35. D
36. stratus
37. "rain"
38. They can cause heavy precipitation.
39. "piled" or "heaped"
40. the condensation level
41. on the stability of the troposphere and on the amount of moisture in the air
42. hot, humid days
43. altocumulus clouds
44. stratocumulus clouds
45. "curly"
46. at altitudes above 6,000 m
47. because they are thin
48. cirrocumulus
49. Fog and clouds are both the result of the condensation of water vapor in the air, but fog is much nearer Earth's surface than clouds and forms differently.
50. B
51. C
52. D
53. A
54. because dense, cold air sinks to low elevations
55. Smoke and dust particles act as condensation nuclei.
56. along coasts

SECTION: PRECIPITATION

1. precipitation
2. rain, snow, sleet, and hail
3. E
4. F
5. A
6. D
7. C
8. G
9. B
10. 0.5 to 5 mm in diameter
11. snow
12. as small pellets, as individual crystals, or as crystals combining to form snowflakes
13. They get smaller.
14. cumulonimbus
15. Convection currents within clouds carry raindrops to high levels, where they freeze. They are carried upward again, accumulating additional layers of ice. They fall when they are too heavy for the convection currents to carry.
16. It can damage crops and property.
17. B
18. C
19. C
20. B
21. D
22. A
23. C
24. A
25. D
26. rain gauge
27. rain gauge.
28. measuring stick
29. 10 cm
30. the intensity of precipitation

31. It bounces radio waves off rain or snow and times how long the wave takes to return.
32. location, direction of movement, and intensity of precipitation
33. by warning people of approaching storms
34. B
35. D
36. A
37. burners on the ground, flares dropped from aircraft, or dropping from aircraft
38. Sometimes cloud seeding produces more rain and at other times it does not increase precipitation.
39. It could ease drought and it could help control severe storms.

Math Skills

1. x = the amount of snow
   1/10 = 4.3/x (Multiply both sides by x.)
   1/10x = 4.3 (Divide both sides by 1/10.)
   x = 43 cm
2. x = the height at the dew point of 20°
   34° − 20° = 14°
   -0.6°/100 = -14°/x (Multiply both sides by x.)
   -0.6x/100 = -14 (Multiply both sides by 100.)
   -0.6x = -1400 (Divide both sides by -0.6.)
   x = 2,333 m
3. x = relative humidity
   18x = 7 (Divide both sides by 18.)
   x = 38.9%
4. x = total amount of water vapor air can hold
   6 = 75/100x (Multiply both sides by 100.)
   600 = 75x (Divide both sides by 75.)
   x = 8g

Graphing Skills

1. 227 days; 62%
2. 71 days; 19%
3. 67 days; 18%
4. Answers may vary. Tables and pie graphs should look similar to the example.

Section Quizzes

SECTION: ATMOSPHERIC MOISTURE

1. B
2. D
3. E
4. A
5. C
6. B
7. D
8. C
9. A
10. B

SECTION: CLOUDS AND FOG

1. D
2. C
3. E
4. B
5. A
6. B
7. C
8. D
9. C
10. B

SECTION: PRECIPITATION

1. D
2. B
3. C
4. E
5. A
6. D
7. C
8. B
9. C
10. A

Chapter Test A

1. G
2. C
3. I
4. B
5. J
6. A
7. D
8. H
9. E
10. F
11. B
12. C
13. A
14. B

Answer Key

Concept Review

1. E	**11.** B
2. A	**12.** B
3. I	**13.** C
4. G	**14.** A
5. H	**15.** D
6. F	**16.** A
7. B	**17.** B
8. D	**18.** C
9. C	**19.** A
10. J	**20.** D

Critical Thinking

1. D
2. A
3. B
4. C
5. B
6. B
7. C
8. A
9. B
10. D
11. The heat and speed of lightning and its ability to start fires and kill make it dangerous.
12. Humid air and warm ground support a high level of lightning activity.
13. Answers may vary.Sample answer: Tornadoes are formed by thunderstorms, which also produce lightning. Thus it seems logical for them to be connected.
14. Answers may vary. Sample answer: Disagree. Although we are unable to control many weather events, cloud seeding to promote rain and to change hail to rain have been successful.
15. Answers may vary. Sample answer: Disagree. Although severe weather is common is warm weather, it also appears in cold climates in the form of snowstorms and blizzards.
16. Answers may vary. Sample answer: Agree. Weather monitoring offers a neutral base for discussion and an opportunity for countries to offer information and assistance to each other.
17. Answers may vary. Sample answer: Disagree. The data is only part of weather forecasting. A meteorologist must be able to interpret and compare data in order to prepare an accurate forecast.
18. Answers may vary. Sample answer: The air mass is likely a Continental tropical air mass originating from the southern continental United States or Mexico.
19. Answers may vary. Sample answer: In the short term, the anticyclone would not be a cause for concern, because it brings dry weather, rather than storms. This is because its sinking air does not cause clouds to form. In the longer term, if it stagnates over the region, the anticyclone might have bad effects such as air pollution or even droughts.
20. Answers may vary. Sample answer: No. When the atmosphere suddenly turns calm during a violent hurricane, it is likely the eye of the hurricane is passing over. As the hurricane continues on its course, the eye will move away with it, and there may be a second wave of violent weather.

Directed Reading

SECTION: AIR MASSES

1. air pressure
2. equator
3. low pressure
4. high pressure
5. wind patterns
6. C
7. A
8. When air pressure differences are small, air remains relatively stationary. It then takes on the characteristic temperature and humidity of the region.
9. An air mass is a large body of air throughout which temperature and moisture content are similar.
10. They are very cold and dry.
11. They are moist and warm.
12. B
13. A

14. C
15. B
16. D
17. northern Canada, northern Asia, and the southwestern United States
18. They generally bring dry weather.
19. Continental polar (cP) air masses are cold and dry. Continental tropical (cT) air masses are warm and dry.
20. The humidity in these air masses tends to be higher than that of continental air masses.
21. They bring precipitation and fog.
22. Maritime polar (mP) air masses are moist and cold. Maritime tropical (mT) air masses are moist and warm.
23. continental polar from Canada; maritime polar from the Pacific Ocean; maritime polar from the Atlantic; continental tropical from the U.S. southwest; maritime tropical from the Pacific; and maritime tropical from the Atlantic.
24. An air mass usually brings the weather of its source region.
25. Air masses sometimes change as they move; cold, dry air might warm and become moist as it moves from land to ocean.
26. Clouds and precipitation develop.
27. They bring mild, cloudy weather to the East coast in winter and hot, humid weather with thunderstorms in summer.
28. Maritime tropical air masses that form over the warm tropical Pacific usually do not reach the coast. In winter, they bring moderate precipitation to the coast and southwestern deserts.
29. Continental polar air masses form over ice- and snow-covered land. They move down over the northern United States, sometimes all the way to the Gulf of Mexico. They bring cool, dry air in summer and very cold weather in winter.
30. These air masses are cold and very moist. In winter they bring rain and snow to the Pacific coast. In summer, they bring cool, often foggy weather. As they move inland, they warm slightly and lose moisture over the mountains. Thus, they may bring cool, dry weather when they reach the central U.S.
31. The polar Pacific air masses are not as cold as the continental polar Canadian air masses.
32. Maritime polar air masses move generally eastward toward Europe, but sometimes they swing over Canada and New England. In winter, they bring cold, cloudy weather and snow. In summer, they can produce cool weather, low clouds, and fog.

SECTION: FRONTS

1. C
2. A
3. B
4. C
5. A
6. D
7. Storms that form along a cold front are usually short-lived and sometimes violent. A long line of heavy thunderstorms, called a squall line, may occur in the warm, moist air just ahead of a fast-moving cold front.
8. A slow-moving cold front lifts the warm air more slowly and produces weaker storms and lighter precipitation than a fast-moving cold front does.
9. A warm front forms when a cold air mass retreats from an area. The less dense warm air rises over the cool air. A gentle slope of clouds is formed that reaches out ahead of the base of the storm.
10. It produces precipitation over a large area and may cause violent weather.
11. When two air masses meet, the cold air moves parallel to the front, and neither air mass is displaced. The stationary front is then at a stand-still or it moves very slowly.
12. The weather created by a stationary front is similar to the weather created by a warm front.
13. polar front
14. waves
15. wave cyclones
16. midlatitude cyclones
17. anticyclone
18. stage 1: Winds move parallel to the front but in opposite directions on

both sides of a stationary or cold front; stage 2: A wave develops when a bulge of cold air advances ahead of the rest of the front; stage 3: The fast-moving part of the cold front overtakes the warm front, while an occluded front forms and the storm reaches high intensity; stage 4: The system loses all its energy and dissipates.

19. They generally travel about 45 km/h in an easterly direction and spin counter-clockwise. They move from the Pacific coast to the Atlantic coast following several storm tracks.

20. The air of an anticyclone sinks and flows outward from a center of high pressure. Because of the Coriolis effect, the circulation of air is clock-wise in the Northern Hemisphere.

21. An anticyclone brings dry weather; if it stagnates for a few days, it causes air pollution problems; if it lingers for a few weeks, it may cause droughts.

22. Severe weather may include large amounts of rain, lightning, hail, strong winds, and tornadoes.

23. D

24. B

25. F

26. E

27. A

28. C

29. Lightning forms when clouds have areas that carry distinct electrical charges. The upper part of the cloud usually carries a positive charge; the lower part carries a negative charge. Lightning is a huge spark that travels inside the cloud or between the cloud and the ground to equalize the electrical charges.

30. hurricane

31. latent heat

32. cumulonimbus cloud bands

33. eye

34. storm surge

35. Safir-Simpson scale

36. A tornado is a destructive, rotating column of air that has very high wind speeds and that may be visible as a funnel-shaped cloud.

37. A tornado forms when a thunderstorm meets high-altitude, horizontal winds. The winds cause the rising air in the storm to rotate. A storm cloud may develop a narrow, funnel-shaped extension that sometimes touches ground.

38. If a tornado funnel touches ground, it moves in a wandering, unpredictable path not more than 100 m wide. It usually destroys everything in its path.

39. Most tornadoes form in the spring and early summer in Tornado Alley, which extends from Texas up through the midwestern United States.

40. The speed of its winds—up to 400 km/h—make it destructive.

SECTION: WEATHER INSTRUMENTS

1. atmospheric pressure, humidity, temperature, wind speed, and precipitation

2. They use them to forecast weather patterns.

3. D

4. F

5. B

6. A

7. C

8. E

9. As the temperature rises, the electrical current flowing through the instrument increases and is translated into temperature readings.

10. because a drop in air pressure usually means that a front is approaching

11. Small cups are attached by spokes to the the shaft of an anemometer. The wind pushes against the cups and they rotate, triggering an electrical signal that registers the speed of the wind.

12. Meteorologists study upper-atmospheric conditions to get a better understanding of local and global weather patterns.

13. a package of instruments that is carried aloft by balloons to measure upper atmospheric conditions, including temperature, dew point, and wind velocity

14. The radiosonde sends measurements as radio waves to a receiver that records the information. The path of the balloon is tracked to determine the direction and speed of high-altitude winds. Eventually, the balloon bursts and the radiosonde falls back to Earth.

15. Radar, or radio detection and ranging, is a system that uses reflected radio waves to determine the velocity and location of objects.
16. Large particles of water in the atmosphere reflect radar pulses. So, precipitation and storms are visible on a radar screen.
17. It can indicate the precise location, movement, and extent of a storm. It can also report the intensity of precipitation and the wind patterns within a storm.
18. They provide weather information for regions where observations cannot be made from the ground.
19. by examining a continuous sequence of cloud images
20. At night, satellites use infrared energy to reveal temperatures at the tops of clouds, at the surface of the land, and at the ocean surface.
21. They can measure the temperature and flow of ocean currents and the height of ocean waves.
22. Supercomputers can solve the complex mathematical equations that describe the behavior of the atmosphere, store weather data from around the world, and store weather records for quick retrieval.

SECTION: FORECASTING THE WEATHER

1. Many early civilizations attributed weather conditions to gods, and some tried to forecast the weather using the positions of the moon and stars.
2. Scientific weather forecasting began with the invention of basic weather instruments such as the thermometer and the barometer. The invention of the telegraph in 1844 allowed meteorologists to share information quickly.
3. Reported weather observations include barometric pressure, surface wind, precipitation, temperature, humidity, cloud cover, and general weather conditions.
4. The WMO promotes the rapid exchange of weather information through the World Weather Watch. It helps developing countries establish or improve their meteorological services. It offers advice on the effect of weather on natural resources and human activities such as farming and transportation.
5. C
6. D
7. A
8. B
9. D
10. D
11. B
12. cloud cover, wind speed, wind direction, and weather conditions such as type of precipitation and storm activity
13. temperature, dew point, atmospheric pressure, and barometric tendency,
14. It is the temperature to which the air must cool in order for more water vapor to condense than to evaporate in a given amount of time. It indicates how high the humidity, or amount of water in the air, is.
15. The number, which shows the atmospheric pressure, has three digits; if it begins with a 0, then the the pressure is higher than 1,000 millibars. The line is drawn under the number; its position—horizontal or angled up or down—shows whether the atmospheric pressure is steady or is rising or falling.
16. sharp changes in wind speed and direction, temperature, or humidity
17. with different symbols or colors for different kinds and amounts
18. To forecast the weather, meteorologists regularly plot the intensity and path of weather systems on maps. They make comparisons with recent maps to follow the progress of weather systems, and then make predictions based on their observations.
19. Doppler radar and satellite images supply important information, such as the intensity of precipitation, for creating weather models.
20. Because computer models differ in the data they best handle, meteorologists consult more than one model to make the best possible predictions.
21. Temperature, wind direction, wind speed, cloudiness, and precipitation can usually be forecasted accurately.

22. It is often difficult to predict exactly when precipitation will occur or the exact amount.
23. They can manipulate data on temperature and pressure to simulate errors in measuring these data. Then they compare forecasts to see if slight data changes can cause substantial differences in forecasts.
24. F
25. C
26. A
27. D
28. B
29. G
30. E
31. Particles are added to clouds to cause the clouds to precipitate.
32. In Russia, cloud seeding has been used with some success on potential hail clouds to produce rain rather than hail.
33. Hurricanes have been seeded with freezing nuclei in an attempt to reduce the intensity of the storm.
34. because it is not an attainable goal with current technology.
35. by seeding potential lightning storms with silver-iodide nuclei
36. Seeding potential lightning storms has seemed to modify the occurrence of lightning, but results have been inconclusive.

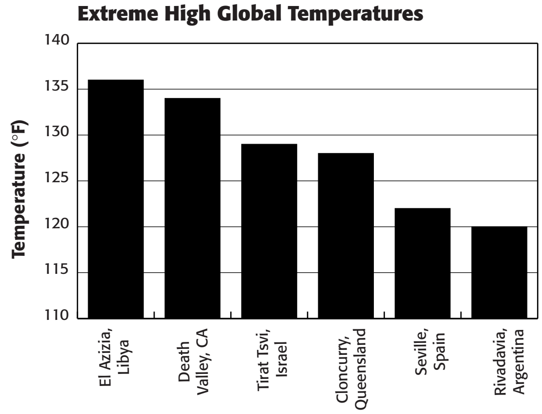
Math Skills

1. $5 + 5x - 5 = 10 + 4x - 5$
   $5x = 5 + 4x$
   $5x - 4x = 5 + 4x - 4x$
   $(5 - 4)x = 5 + (4 - 4)x$
   $x = 5$
2. $8y \div 8 = 4{,}600 \div 8$
   $y = 575$
3. $6x - 18 + x = -x + x + 10$
   $7x - 18 = 10$
   $7x - 18 + 18 = 10 + 18$
   $7x \div 7 = 28 \div 7$
   $(7 \div 7)x = 28 \div 7$
   $x = 4$

Graphing Skills

1. approximately 100 mph
2. F-5
3. Answers may vary. Sample answer: No winds have ever been recorded as high as those proposed by an F-6 rating.
4. Answers may vary. Students should label the x axis with the names of the regions. The y axis should show an adequate range of temperatures labeled in equal increments. Bars that represent the temperatures shown in the data table should be graphed.

Extreme High Global Temperatures



Section Quizzes

SECTION: AIR MASSES

1. C
2. A
3. B
4. D
5. A
6. D
7. B
8. B
9. C
10. A

SECTION: FRONTS

1. C
2. B
3. E
4. F
5. A
6. D
7. D
8. A
9. C
10. B

SECTION: WEATHER INSTRUMENTS

1. C
2. D
3. B
4. A
5. D
6. A
7. B
8. C
9. B
10. D

Directed Reading

SECTION: FACTORS THAT AFFECT CLIMATE

1. climate
2. weather
3. C
4. D
5. D
6. A
7. C
8. latitude
9. solar energy
10. latitude
11. equator
12. poles
13. sun
14. The days are shorter and the temperatures are lower during the winter months than in the summer months.
15. poles
16. high
17. low
18. wind
19. doldrums
20. subtropical highs
21. greater
22. low
23. latitude and cloud cover
24. Land surface is solid and unmoving. Surface ocean water is liquid and moves constantly. Waves, currents, and other movements replace warm surface water with colder water from below.
25. The temperature of the land or water influences the amount of heat that the air above the land or water absorbs or releases.
26. The temperature of the air affects the climate of the area.
27. Specific heat is the quantity of heat required to raise a unit mass of homogeneous material 1 K or 1°C in a specified way given constant pressure and volume.
28. differences in the loss of heat through evaporation, which affects water surfaces more than land
29. the temperature of ocean currents
30. D
31. C
32. B
33. A
34. typhoons, cyclones, and floods
35. droughts
36. the heating and cooling of the northern Indian peninsula
37. eastern Asia and the tropical regions of Australia and East Africa
38. B
39. A
40. D
41. C
42. As elevation increases, temperature generally decreases.

SECTION: CLIMATE ZONES

1. tropical, middle-latitude, and polar
2. because the amount of precipitation in each zone varies
3. C
4. D
5. A
6. B
7. Central Africa, the Amazon River basin, Central America, and Southeast Asia
8. South America, Africa, Southeast Asia, and northern Australia
9. Northern Africa and southwestern Asia
10. A
11. C
12. A
13. B
14. C
15. E
16. C
17. A
18. F
19. D
20. B
21. B
22. D
23. A
24. C
25. tundra
26. polar icecap
27. subarctic
28. A microclimate is the climate of a small area.
29. Microclimates are influenced by density of vegetation, by elevation, and by proximity to large bodies of water.
30. because pavement and buildings absorb and reradiate a lot of solar energy, creating a "heat island"

31. As elevation increases, temperature decreases and climate changes.
32. The highland climate is characterized by large variations in temperature and precipitation over short distances because of changes in elevation.
33. Water absorbs and releases heat more slowly than does land, so water tends to moderate land temperatures.
34. Large bodies of water can increase precipitation.

SECTION: CLIMATE CHANGE

1. Scientists try to find out whether the climate is really changing or whether changes are merely normal variations; and if the climate is truly changing, what is the cause?
2. A climatologist is a scientist who gathers data to study and compare past and present climates and to predict future climate change.
3. looking at past climates to find patterns in changes that occur
4. sea-floor sediment
5. tree rings
6. ice cores
7. fossils
8. general circulation models (GCMs)
9. Computer models can be used to predict temperature, precipitation, wind patterns, and sea-level changes.
10. oceans, wind, land, clouds, and vegetation
11. movement of tectonic plates, changes in Earth's orbit, human activity, and atmospheric changes
12. tectonic plate motion
13. changes in the shape of Earth's orbit and tilt, and the wobble of Earth on its axis
14. elliptical
15. tilt
16. seasons
17. Answers may vary. Sample answer: pollution from transportation and industry; the burning of trees to provide land for agriculture and urban development, deforestation
18. global warming
19. volcanic activity
20. humans, plants, animals
21. global warming, sea-level changes, precipitation changes
22. Global warming is a gradual increase in the average global temperature that is due to a higher concentration of gases such as carbon dioxide in the atmosphere.
23. Answers may vary. Sample answer: An increase in temperature could lead to increased evaporation, causing drier conditions. Plants and animals might not be able to live in these drier conditions.
24. Melting polar icecaps could raise the level of the oceans. On a shoreline with a gentle slope, the shoreline could shift inland many miles. Many coastal inhabitants would be displaced and freshwater and agricultural land would be decreased.
25. Treaties and laws have been passed to reduce pollution, industrial practices are monitored and changed, and community projects to reforest are in place.
26. Answers may vary. Sample answer can include four of the following: reducing automobile use, turning off lights when not in use, turning down heat in winter, reducing air conditioner use in summer, recycling
27. by using public transportation and driving fuel-efficient cars
28. make sure the car is properly tuned, make sure tires are properly inflated, and drive at a consistent speed
29. Hybrid cars use gasoline and electricity, so they release less carbon dioxide than other cars.

Math Skills

1. $4\pi r^2$: $4 \times 3.14 \times 9$ cm $\times 9$ cm $=$ 1017.4 cm^2
2. $4/3\pi r^3$: $4/3 \times 3.14 \times 9$ cm $\times 9$ cm $\times$ 9 cm $=$ 3052 cm^3
3. $4\pi r^2$: $4 \times 3.14 \times 18$ cm $\times 18$ cm $=$ 4069.5 cm^2; $4069.5 \div 1017.4 = 4$. The surface area of the new model is four times the surface area of the original.

Answer Key

Concept Review

1. H
2. C
3. J
4. I
5. B
6. D
7. G
8. E
9. A
10. F
11. C
12. D
13. B
14. B
15. A
16. D
17. A
18. C
19. C
20. D

Critical Thinking

1. B
2. D
3. B
4. D
5. C
6. A
7. C
8. B
9. Mars, because the tilt of its axis is the most similar to that of Earth.
10. They would have very large seasonal variations because one hemisphere would point almost directly at the sun during solstice while the other side would be in darkness.
11. The tilt of its axis means that it rotates in the opposite direction from Earth.
12. The sun would appear to rise in the west and set in the east.
13. Answers may vary. Sample answer: Disagree. The calendar was set up long ago to accurately reflect Earth's relationships to the sun and moon. Although it might be changed somewhat, it is hard to imagine it being any more useful.
14. Answers may vary. Sample answer: Disagree. Radio waves are long and X rays are short, but both can be seen as part of a continuum of electromagnetic radiation waves.
15. Answers may vary. Sample answer: Disagree. The invention of and adjustments to the calendar show that people since ancient times have been aware of astronomy's effects on life.
16. Answers may vary. Sample answer: Agree. Because most people do not work outdoors or depend on natural light for most activities, the system is outdated.
17. Answers may vary. Sample answer: Disagree. The constellations have helped scientists make important discoveries such as the rotation and revolution of Earth, and they continue to aid astronomers in the orientation of objects in the sky.
18. Answers may vary. Sample answer: The landings furthered our knowledge of the universe and of rocket science. They have stopped because cheaper, easier, and safer ways have been developed to explore space.
19. Ultraviolet radiation is potentially more harmful because its wavelength is shorter than that of visible light. Because infrared waves are longer than those of visible light and visible light waves are not harmful, infrared waves are not harmful. X rays are more harmful than ultraviolet waves because they are even shorter and therefore have more energy.
20. The telescope should be put on the top of a mountain where the air is dry and so is less likely to prevent radiation from reaching Earth. It would perhaps also be helpful to locate far from a large city.

Directed Reading

SECTION: VIEWING THE UNIVERSE

1. They helped farmers track seasons and predict floods and droughts.
2. They helped them navigate through unknown territory.
3. curiosity about what lies within the universe
4. the scientific study of the universe
5. new planets, stars, black holes, nebulas
6. more about the origin of Earth and the processes involved in the formation of our solar system

7. It could lead to new or improved energy sources on Earth. It could also help protect us from potential catastrophes such as collisions between asteroids and Earth.
8. the National Science Foundation and NASA
9. D
10. C
11. A
12. B
13. D
14. B
15. C
16. 150 million km; an astronomical unit
17. 9.4607×10^{12} km; a light-year
18. 4.2 light-years
19. A
20. D
21. C
22. traveling waves of electric and magnetic fields that oscillate at fixed frequencies and wavelengths
23. It is broken into a continuous set of colors.
24. Each color of light has a characteristic wavelength.
25. Blue and violet have the shortest. Orange and red have the longest.
26. Humans cannot see the wavelengths that are shorter than the wave lengths of violet light or longer than the wavelengths of red light.
27. infrared waves, microwaves, radio waves, ultraviolet rays, X rays, and gamma rays
28. The temperature reading will increase.
29. He moved the thermometer beyond the red end of the visible spectrum and noticed that the temperature increased.
30. ”below the red”
31. longer
32. longer
33. ultraviolet wavelengths
34. “beyond the violet”
35. shorter
36. gamma ray wavelengths
37. C
38. A
39. D
40. E
41. A
42. B
43. C
44. Their lenses focuses different colors of light at different distances, so objects in focus in red light will appear out of focus in blue light. Also, the ability to focus on distant objects is limited by the size of the lens. Lenses that are too large can sag and cause distorted images.
45. color separation resulting from the use of lenses
46. Light is reflected from a large curved mirror to a second mirror, which reflects it to the eyepiece, where it is magnified and focused.
47. They can be made very large without affecting the quality of the image.
48. The Keck Telescopes in Hawaii, which are each 10 m in diameter.
49. radio waves, gamma rays, X rays, infrared rays
50. It acts as a shield against them.
51. Water vapor can prevent invisible radiation from reaching Earth’s surface. At high elevations, the air is dry, so it does not block the radiation.
52. because in space Earth’s atmosphere cannot interfere with the detection of electromagnetic radiation.
53. B
54. E
55. D
56. A
57. C
58. Jupiter, Saturn, Uranus, and Neptune
59. the composition of Jupiter’s atmosphere and storm systems
60. *Cassini-Huygens*
61. detach from the *Cassini* orbiter to study the atmosphere of Titan, Saturn’s largest moon
62. to learn more about the origins of Earth, which has a nitrogen-rich atmosphere like that of Titan
63. robotic spacecraft
64. solar system
65. crewed spacecraft
66. Earth’s moon
67. space shuttle
68. because a voyage to Mars would be expensive, difficult, and dangerous.

69. the loss of the *Challenger* in 1986 and the *Columbia* in 2003 with their crews
70. Satellites in orbit provide information about weather all over Earth.
71. Satellites help them navigate.
72. It has led to inventing ways to make objects smaller and lighter.
73. It has led to improvements in heart pumps, based on research of fluid flow through rockets.

SECTION: MOVEMENTS OF EARTH

1. rotation
2. day
3. east
4. west
5. daylight
6. nighttime
7. evidence of Earth's rotation
8. It stays the same, but it appears to change.
9. Earth's rotation
10. Earth's rotation
11. to the right; to the left
12. Coriolis effect
13. 29.8 km/s
14. 365 1/4 days
15. C
16. E
17. A
18. B
19. D
20. an ellipse
21. 152 million km; 147 million km
22. a group of stars that are organized in a recognizable pattern
23. It divided the sky into 88 constellations.
24. from the ancient Greeks more than 2,000 years ago
25. Earth's rotation
26. Earth's revolution around the sun
27. C
28. A
29. B
30. C
31. A
32. D
33. B
34. D
35. B
36. a system created for measuring long intervals of time by dividing time into days, weeks, months, and years
37. to make the number of days on a calendar a whole number
38. every fourth year, which has an extra day; to account for the extra 1/4 day that occurs every year, so that calendars will be on the same schedule as Earth's movements
39. Julius Caesar and Augustus Caesar
40. The calendar had become misaligned with the seasons because the year is not exactly 365 1/4 days long. His committee decided that century years, such as 1800, would not be leap years, unless they are divisible by 400, as is the year 2000.
41. the time when the sun is highest in the sky
42. no. Because of Earth's rotation, the sun is highest above different locations at different times of day.
43. 15°. Because Earth is a sphere, its circumference equals 360°. Since it takes 24 hours to complete one rotation, it moves 1/24th of 360° in one hour, or 15°.
44. It is one hour earlier.
45. The International Date Line is a line that runs from north to south through the Pacific Ocean. It marks the point on Earth's surface where the date changes. When it is Friday west of the line, it is Thursday east of the line.
46. because of the tilt of Earth's axis
47. to take advantage of longer daylight time in those months when the sun rises earlier
48. In April we set them one hour ahead; in October we turn them one hour back.
49. There are not significant changes in the amount of daylight time throughout the year.
50. C
51. A
52. B
53. C
54. B
55. A
56. A
57. B
58. celestial equator
59. equinox
60. equator
61. autumnal equinox
62. vernal equinox

63. The hours of daylight and darkness are equal.
64. A solstice is the point at which the sun is as far north or as far south of the equator as possible.
65. the seasons of winter and summer
66. the Tropic of Cancer, located at 23.5° north latitude
67. It follows its highest path across the sky on that day.
68. The farther north of the equator you are, the longer the period of daylight.
69. the Tropic of Capricorn, located at 23.5° south latitude
70. The daylight hours are the fewest there.

Math Skills

1. $x = (1{,}277{,}400{,}000 \text{ km} - 628{,}760{,}000 \text{ km}) \div 150{,}000{,}000 \text{ km}$
   $x = 648{,}640{,}000 \div 150{,}000{,}000$
   $x = 4.32$ AU
2. $x = (.37 - .28) \times 150{,}000{,}000$ km
   $x = .09 \times 150{,}000{,}000$
   $x = 13{,}500{,}000$ km
3. $x = (49 \times 150{,}000{,}000 \text{ km}) - (29.5 \times 150{,}000{,}000 \text{ km})$
   $x = 7{,}350{,}000{,}000 - 4{,}425{,}000{,}000$
   $x = 2{,}925{,}000{,}000$ km
4. $x = [(5.4 \times 150{,}000{,}000 \text{ km}) - (3.1 \times 150{,}000{,}000 \text{ km})] - [(1.7 \times 150{,}000{,}000 \text{ km}) - (1.4 \times 150{,}000{,}000 \text{ km})]$
   $x = (810{,}000{,}000 - 465{,}000{,}000) - (255{,}000{,}000 - 210{,}000{,}000)$
   $x = 345{,}000{,}000 - 45{,}000{,}000$
   $x = 300{,}000{,}000$ km

Graphing Skills

1. June 15; 17.5
2. December 15; 7
3. June 15 is near the summer solstice; places in the Northern Hemisphere have the most hours of daylight on that day. December 15 is near the winter solstice; places in the Northern Hemisphere have the least hours of daylight on that day.
4. Answers may vary. Student graphs should resemble the one for Glasgow. Data plotted will vary by locale. Daylight savings time should not be a factor in plotting data.

Section Quizzes

SECTION: VIEWING THE UNIVERSE

1. C
2. B
3. E
4. D
5. A
6. B
7. C
8. D
9. C
10. B

SECTION: MOVEMENTS OF EARTH

1. B
2. C
3. A
4. E
5. D
6. C
7. B
8. D
9. A
10. A

Chapter Test A

1. G
2. I
3. H
4. E
5. J
6. A
7. B
8. D
9. F
10. C
11. B
12. C
13. D
14. D
15. A
16. A
17. B
18. C
19. B
20. A

Chapter Test B

1. B
2. C
3. E

Answer Key

Concept Review

1. E
2. I
3. A
4. C
5. H
6. B
7. F
8. J
9. D
10. G
11. B
12. D
13. B
14. C
15. D
16. D
17. A
18. D
19. B
20. A

Critical Thinking

1. C
2. C
3. B
4. D
5. C
6. B
7. A
8. C
9. B
10. A
11. Answers may vary. Sample answer: Scientists hope to learn about the formation of Earth and to gain some insight into other stars with closely orbiting planets.
12. Answers may vary. Sample answer: Mercury has many similarities to Earth, such as the magnetic field, but also some differences because it is so close to the sun.
13. Answers may vary. Sample answer: because magnetic fields can affect everything from the path of light to telephone reception to a planet's orbit
14. Answers may vary. Sample answer: Learning about the formation and development of other stars and their planets might give us clues about our solar system.
15. Answers may vary. Sample answer: Disagree. The fact that Pluto has a regular orbit around the sun and the fact that it has a moon are better criteria for whether it is a planet than size alone.
16. Answers may vary. Sample answer: Agree. The inner planets are more like Earth in their composition than are the outer planets.
17. Answers may vary. Sample answer: Agree. Earth has the ideal components of sunlight, atmosphere, temperature, and water to support life. If a planet similar to Earth with the same qualities exists in another solar system, it too could support life.
18. Answers may vary. Sample answer: We might learn more about our own solar system by studying this system, including how planets formed and even how life began.
19. Answers may vary. Sample answer: Since the asteroid belt clearly separates two types of planets, terrestrial and gas giants, it might indicate that this was the point beyond which matter was too far from the sun to form dense planets.
20. Answers may vary. Sample answer: Venus's atmosphere is 96% carbon dioxide, making it unbreathable for humans. It also has a pressure 90 times greater than Earth's and produces a runaway greenhouse effect that raises temperatures higher than 400°C. Colonists would have to create friendly minienvironments on Venus in order to survive. Perhaps the atmosphere could be altered over time by green plants and cyanobacteria, which use CO_2 and produce oxygen.

Directed Reading

FORMATION OF THE SOLAR SYSTEM

1. solar system
2. planet
3. nebular hypothesis
4. B
5. A
6. D
7. C
8. B
9. B
10. A
11. B
12. because they are closest to the sun
13. The planets' gravity was not strong enough to hold the gases, which may

have been boiled or blown away by radiation from the sun.
14. The solid surfaces of the inner planets are similar to that of Earth today.
15. The inner planets are smaller, rockier, and denser than the outer planets.
16. outer
17. The outer planets formed in colder regions, so they did not lose their lighter elements, such as hydrogen and helium; or their ices, such as water ice, methane ice, and ammonia ice.
18. They are composed mostly of gases, have low density, and are very large.
19. Pluto
20. Pluto is very small, and is even smaller than Earth's moon.
21. Pluto is very cold.
22. Astronomers have discovered hundreds of objects similar to Pluto that exist beyond Neptune's orbit. None are larger than Pluto, but Pluto is likely one of those objects.
23. D
24. B
25. C
26. A
27. C
28. B
29. D
30. A
31. C
32. carbon dioxide
33. oxygen
34. about 2 billion years ago
35. 78% nitrogen, 21% oxygen, 1% other
36. As the atmosphere formed, Earth cooled enough for water vapor in the atmosphere to cool and condense. Rain formed, and this liquid water collected on Earth's surface.
37. water
38. fresh
39. chemicals
40. salts
41. carbon dioxide

MODELS OF THE SOLAR SYSTEM

1. C
2. A
3. C
4. D
5. C
6. A
7. Tycho Brahe
8. C
9. A
10. B
11. Answers may vary. Sample answer: The law of ellipses states that each planet orbits the sun in a path called an ellipse, not in a circle.
12. sun
13. Eccentricity is determined by dividing the distance between the foci of the ellipse by the length of the major axis.
14. Kepler discovered that the orbit of Mars is an ellipse and that Mars moves fastest when it is closest to the sun.
15. sun
16. orbital period
17. distance
18. $K \times a^3 = p^2$, where K is a constant.
19. inertia
20. gravity
21. revolution

THE INNER PLANETS

1. inner planets
2. Mercury, Venus, Mars, Earth
3. terrestrial planets
4. They consist mostly of solid rock and have metallic cores.
5. impact craters
6. B
7. C
8. B
9. D
10. 225 days
11. once every 243 days
12. Earth
13. 90
14. a high concentration of carbon dioxide and its relative closeness to the sun
15. 96%
16. greenhouse effect
17. sulfur dioxide
18. because it is usually visible from Earth only in the morning or early evening
19. basalt and granite
20. B
21. C
22. A
23. They are about the same age and are surprisingly young.
24. the age of the craters and an abundance of volcanic features

25. third
26. 365 1/4 days
27. rotation
28. one
29. 250 million
30. weathering and erosion
31. Earth's unique atmosphere and distance from the sun allow water to exist in a liquid state.
32. Answers may vary. Sample answer: As oceans formed on Earth, they dissolved carbon dioxide from the atmosphere. As a result, the gas did not build up in the atmosphere and solar heat was able to escape. Moderate temperatures enabled living things to survive, and plants and cyanobacteria contributed oxygen.
33. water, temperature, and oxygen
34. fourth
35. 687 days
36. every 24 h and 37 min
37. because its axis tilts at nearly the same angle as Earth's
38. canyons
39. Tharsis Montes
40. Olympus Mons
41. because Mars has no tectonic plates
42. marsquakes
43. because the pressure and temperature of its atmosphere are too low
44. Spirit and Opportunity
45. erosion
46. just below Mars's surface

THE OUTER PLANETS

1. B
2. D
3. A
4. C
5. B
6. A
7. C
8. B
9. fifth
10. 300
11. almost 12 years
12. 9 h and 50 min
13. moons
14. 92%
15. sun
16. When Jupiter formed about 4.6 million years ago, it did not have enough mass to allow nuclear fusion to begin.
17. The colors suggest the presence of organic molecules mixed with ammonia, methane, and water vapor.
18. Jupiter's rapid rotation causes the atmospheric gases to swirl around the planet and form bands.
19. The Great Red Spot is an ongoing, massive hurricane-like storm that is about twice the diameter of Earth.
20. Answers may vary. Sample answer: that Jupiter's internal heat affects the planet's weather more than heat from the sun does
21. Jupiter's large mass causes the temperature and pressure in its interior to be much greater than on Earth.
22. B
23. D
24. A
25. A
26. Jupiter
27. dense
28. rings
29. bands
30. every 10 h and 30 min
31. Cassini
32. seventh
33. because it is nearly 3 billion kilometers from the sun
34. 24
35. 84
36. parallel
37. once every 17 h
38. methane
39. eighth
40. 16
41. eight
42. Answers may vary. Sample answer: After the discovery of Uranus, astronomers noticed irregularities in its orbit. They suspected an undiscovered planet was responsible for the variation. The position of the unknown planet eventually was calculated independently by John Couch Adams and Urbain Leverrier.
43. hydrogen, helium, and methane
44. Answers may vary. Sample answer: Neptune has an active weather system, with winds exceeding 1,000 km/h. A storm that is the size of Earth and is known as the Great Dark Spot appears and disappears intermittently.

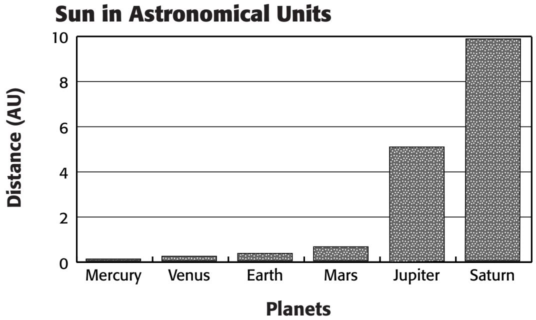
45. ninth
46. ellipse
47. Pluto is the smallest planet and is the farthest from the sun.
48. frozen methane, rock, and ice
49. The Kuiper belt is a region of the solar system that is just beyond the orbit of Neptune and contains small bodies made mostly of ice.
50. Quasar and Sedna
51. An exoplanet is a planet that circles a star other than our sun.
52. Answers may vary. Sample answer: They are detected because gravity tugs on the stars they orbit. The apparent shifting of stars in the sky may be the effect of orbiting planets that causes shifts in light wavelengths coming from the stars.
53. They know the planets are larger than Saturn because current technology can only detect large planets.

Math Skills

1. $K \times a^3 = p^2$
2. $p = 29.5$
$1 \times a^3 = 29.5 \times 29.5$
$a^3 = 870$
$a = 9.54 \times 9.54 \times 9.54 = 870$
3. The cubed number that is about equal to 870 is 9.54, so Saturn is 9.54 AU from the sun.
4. 1
5. $(12^3)(12^3) = 12^{3+3} = 12^6 = 2{,}985{,}984$
6. 23
7. $(2^2)^7 = 2^{2\times7} = 2^{14} = 16{,}384$

Graphing Skills

1. Mercury; 0.24 Earth years
2. Saturn; 29.5 Earth years
3. .88 Earth years; Mars
4. **Planets' Distance from the Sun in Astronomical Units**



Section Quizzes

FORMATION OF THE SOLAR SYSTEM

1. E
2. C
3. B
4. A
5. D
6. A
7. D
8. C
9. B
10. D

MODELS OF THE SOLAR SYSTEM

1. D
2. B
3. A
4. E
5. C
6. B
7. D
8. C
9. A
10. C

THE INNER PLANETS

1. C
2. D
3. B
4. E
5. A
6. B
7. D
8. D
9. A
10. B

THE OUTER PLANETS

1. E
2. B
3. A
4. C
5. D
6. D
7. A
8. B
9. B
10. C

Chapter Test A

1. B
2. D
3. F
4. G
5. A
6. J
7. C
8. I
9. H
10. E
11. C
12. A
13. D
14. A
15. C
16. A
17. D
18. C
19. D
20. B

Chapter Test B

1. E
2. B
3. D
4. F
5. C
6. A
7. D
8. A
9. A
10. B
11. B
12. D
13. C
14. B
15. A
16. D
17. C
18. B

Answer Key

Concept Review

1. H
2. I
3. D
4. A
5. G
6. E
7. F
8. B
9. C
10. J
11. B
12. B
13. C
14. A
15. B
16. B
17. B
18. C
19. D
20. D

Critical Thinking

1. B
2. A
3. A
4. B
5. D
6. C
7. B
8. C
9. B
10. A
11. Answers may vary. Sample answer: because Titan's impenetrable atmosphere made it impossible to get information about it
12. Answers may vary. Sample answer: The apparent presence of rain from the organic-rich atmosphere, as well as craters, which exist on other moons of Saturn, led him to predict lakes and oceans.
13. Answers may vary. Sample answer: the existence of radioactive material in Titan's core and the fact that such material causes tectonic activity on Earth
14. Answers may vary. Accept all reasonable answers based on the predictions and words of Lorenz.
15. Answers may vary. Sample answer: Disagree. Studying astronomy can give insight into the past, and may even allow us to prevent some disasters, but it cannot promise a totally "safe" future.
16. Answers may vary. Sample answer: Agree. There may come a point in history that Earth is either uninhabitable or not large enough—physically or politically. It may then be necessary to have located another inhabitable place in the solar system.
17. Answers may vary. Sample answer: Agree. The main components for life as it has evolved on Earth are water, atmosphere and temperature. If water exists elsewhere, it is possible that the other components are, or could be made, favorable for habitation.
18. Answers may vary. Sample answer: We should spend time studying those that might have the greatest effect, either negatively (a catastrophic collision with an asteroid) or positively (a new planet to inhabit).
19. Answers may vary. Sample answer: Because they are rare in general (and even more rare in populated areas), it would be good to track asteroid activity, but little beyond warning could be done in case of an impending collision.
20. Answers may vary. Sample answer: I accept this theory because the blocking of the sun for years would have had a great impact on the temperature of Earth, affecting all plants and animals in the food chain. Because dinosaurs were so huge, they required great amounts of food and would have suffered greatly with a severe reduction in the available food supply.

Directed Reading

EARTH'S MOON

1. C
2. A
3. E
4. B
5. D
6. B
7. D
8. A
9. C

10. D
11. A
12. C
13. D
14. B
15. B
16. C
17. B
18. anorthosites
19. asteroids
20. craters
21. ridges
22. regolith
23. water
24. breccia
25. D
26. B
27. C
28. B
29. C
30. C
31. A
32. B
33. C
34. A
35. A
36. D
37. B
38. D
39. Early in its history the moon was covered with molten rock. Over time, the densest materials moved to the center to form a core. The least dense formed an outer crust. The other materials formed the mantle between the core and the crust.
40. Debris left over from the formation of the solar system struck the solid surface and produced craters and regolith.
41. The number of small objects in the solar system decreased. Less material struck the lunar surface, and fewer craters were created. Virtually all geologic activity stopped, and the moon cooled.
42. because it cooled 3 billion years ago and looks today almost exactly as it did at that time
43. Lava flowed out of cracks, or fissures, in the crust. The lava flooded the crater basins to form maria.
44. The moon's crust is thinner on the near side, so much more lava flowed and settled there.
45. Some scientists think that the energy to produce the magma came from a long period of intense meteorite bombardment. Others think that radioactive decay of materials may have heated the moon's interior enough for magma to form.
46. Lava flows ended 3.1 billion years ago when the interior of the moon cooled completely.

MOVEMENTS OF THE MOON

1. While the moon is revolving around Earth, Earth and the moon are revolving around the sun.
2. that Earth and the moon revolve around each other
3. a single system that orbits the sun
4. The balance point is located within Earth's center.
5. because Earth's mass is greater than that of the moon
6. the barycenter
7. It orbits the sun in a smooth ellipse.
8. The orbit forms an ellipse that is elongated about 5% more than a circle.
9. apogee
10. perigee
11. axis
12. revolution
13. rotation
14. about once every 27.3 days
15. because the rotation and the revolution of the moon take the same amount of time.
16. the part of the moon's surface that is illuminated by sunlight
17. the near side is partly or fully darkened
18. D
19. C
20. A
21. B
22. E
23. F
24. The sun's light is completely blocked by the moon. The umbra falls on the area of Earth directly in line with the moon and the sun.
25. a partial solar eclipse

26. The area is only a small part of Earth, a few hundred kilometers across, and is seen only by those in the parts of Earth along its narrow path.
27. The eclipse causes the sky to become as dark as it does at twilight. During this period, the sunlight not eclipsed by the moon shows the normally invisible outer layers of the sun's atmosphere. The last sunlight may glisten like a diamond ring.
28. If the moon is at or near apogee when it comes between Earth and the sun, the moon's umbra does not reach Earth.
29. when Earth is positioned between the moon and the sun and when Earth's shadow crosses the lighted half of the moon
30. the entire moon must pass into Earth's umbra
31. because even during a total lunar eclipse sunlight is bent around Earth through its atmosphere and mainly red light reaches the moon
32. three or four solar eclipses and three or four lunar eclipses
33. because the orbit of the moon is not in the same plane as the orbit of Earth around the sun
34. when the moon crosses the plane of Earth's orbit and when, during this crossing, the moon is between Earth and the sun
35. when the moon crosses the plane of Earth's orbit and when, during this crossing, Earth is between the moon and the sun
36. everywhere on the dark side of Earth
37. C
38. D
39. D
40. B
41. A
42. D
43. D
44. C
45. A
46. C
47. C
48. B
49. inertia
50. rotation
51. gravity
52. bulge
53. It bulges away from Earth in the opposite direction because the moon's gravity there is weak and is exceeded by the inertial force on the water.
54. Water levels rise and fall along ocean shores on both sides of Earth.

SATELLITES OF OTHER PLANETS

1. four moons orbiting Jupiter
2. Mercury and Venus
3. rings
4. Phobos and Deimos are moons of Mars. They revolve quickly in opposite directions.
5. The moons are small, irregularly shaped chunks of rock that may be captured asteroids.
6. The moons contain a large number of craters, which indicates that the moons have been hit by many meteorites and asteroids, and so they may be very old.
7. A
8. C
9. B
10. D
11. D
12. C
13. A
14. C
15. B
16. B
17. C
18. B
19. D
20. A
21. D
22. Ganymede
23. because it is probably composed mostly of ice mixed with rock
24. craters, ridges, and valleys
25. strong magnetic fields
26. Callisto
27. in size, density, and composition
28. craters
29. C
30. C
31. A
32. C
33. D
34. C
35. D

36. A
37. E
38. B
39. C
40. Pluto's orbit is more elliptical and at a different angle than the other planets' orbits.
41. Pluto's moon, Charon, is almost half the size of Pluto. Some scientists consider them to be a double planet system.
42. because Charon completes one orbit of Pluto in 6.4 days, the same length of time as a day on Pluto
43. more than 300 years ago
44. Each of the rings is divided into hundreds of small ringlets. The ringlets are composed of billions of pieces of rock and ice ranging in size from dust particles to rocks the size of a house. Each piece follows its own orbit. The rings are very thin.
45. Astronomers once thought that the rings formed from material that was not able to clump together to form moons when Saturn was forming.
46. The rings are much younger than originally thought and are the remains of a large cometlike body that entered Saturn's system and was ripped apart by tidal forces.
47. Jupiter has a single, thin ring made of microscopic particles that may have been given off by Io or another of Jupiter's moons.
48. Uranus has a dozen thin rings.
49. Neptune's rings are clumply rather than thin and uniform.

ASTEROIDS, COMETS, AND METEORITES

1. The solar system includes millions of smaller bodies; some are tiny bits of dust or ice; others are as large as small moons.
2. C
3. A
4. D
5. A
6. B
7. B
8. asteroids
9. ellipses
10. Ceres
11. Mars
12. silicates
13. iron
14. carbon
15. more than a thousand asteroids whose wide, elliptical orbits bring them close to Earth
16. because these asteroids could inflict great damage if they were to hit Earth
17. They hope to predict and possibly avoid collisions.
18. D
19. D
20. C
21. A
22. B
23. E
24. C
25. A
26. D
27. It is a spherical cloud of dust and ice that contains billions of comets.
28. It lies far beyond Pluto's orbit. It surrounds the solar system and may reach as far as halfway to the nearest star.
29. orbit
30. the Kuiper belt
31. Kuiper belt objects
32. Long-period comets take more than 200 years to complete one orbit of the sun and may originate in the Oort cloud. Short-period comets take less than 200 years to complete one orbit around the sun, and most come from the Kuiper belt.
33. Jupiter's gravity
34. Halley's comet
35. Meteoroids are relatively small, rocky bodies that travel through space.
36. They think that most meteoroids are pieces of matter that became detached from passing comets. Those more than 1 cm in diameter are probably the result of collisions between asteroids.
37. Friction between the meteoroid and the atmosphere's molecules heat the meteoroid's surface. Most then burn up.
38. Earth intersects the orbits of comets that have left behind a trail of dust. As these particles burn up, they appear as meteors streaking across the sky.
39. B
40. G
41. A

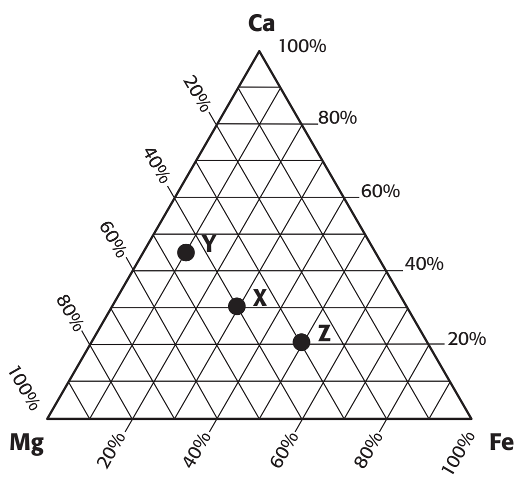
42. H
43. E
44. C
45. F
46. D
47. collisions between asteroids
48. because they may be 100 million years older than Earth and its moon, and thus may provide information about how the early solar system formed
49. on the moon and Mars
50. Meteorites that hit the moon or Mars can eject rocks that then fall to Earth.

Math Skills

1. 20^2
2. 38×10^3
3. 60×10^3
4. 1
5. $7^{12} \div 7^7 = 7^{(12-7)} = 7^5 = 16{,}807$
6. 14,641
7. $(6^4)^2 = 6^8 = 1{,}679{,}616$

Graphing Skills

1. 30% Ca; 30% Fe; 40% Mg
2. and **3.**



Section Quizzes

EARTH'S MOON

1. E	6. D
2. C	7. B
3. D	8. A
4. A	9. B
5. B	10. C

MOVEMENTS OF THE MOON

1. D	6. C
2. C	7. B
3. B	8. A
4. A	9. A
5. E	10. C

SATELLITES OF OTHER PLANETS

1. C	6. C
2. B	7. B
3. E	8. C
4. A	9. A
5. D	10. D

ASTEROIDS, COMETS, AND METEOROIDS

1. D	6. A
2. E	7. G
3. F	8. C
4. C	9. C
5. B	10. B

Chapter Test A

1. I	11. B
2. C	12. C
3. F	13. C
4. A	14. A
5. B	15. B
6. D	16. B
7. E	17. D
8. G	18. A
9. J	19. B
10. H	20. B

Chapter Test B

1. B
2. E
3. F
4. G
5. A
6. C
7. H
8. D
9. C
10. D
11. B
12. A
13. C
14. B
15. C
16. A

large amount of energy, and his equation $E = mc^2$ can be used to calculate how much. The sun's energy comes from fusion; specifically, energy is released when hydrogen nuclei collide and fuse, and the fact that the mass of the end products of fusion is less than the original mass bears out Einstein's theory that some mass is converted to energy.

Directed Reading

SECTION: STRUCTURE OF THE SUN

1. from fire
2. less than 100 years ago
3. A
4. C
5. B
6. B
7. D
8. D
9. A
10. B
11. C
12. C
13. D
14. B
15. B
16. A
17. one proton and one electron
18. The sun's intense heat strips the electrons from the protons.
19. three
20. Two hydrogen nuclei, or protons, collide and fuse.
21. Its positive charge is neutralized.
22. a positron
23. One proton becomes a neutron and changes the original two protons into a proton-neutron pair.
24. Another proton combines with the proton-neutron pair to produce a nucleus made up of two protons and one neutron.
25. two nuclei consisting of two protons and one neutron collide and fuse
26. two protons
27. two protons and two neutrons
28. at each step
29. a helium nucleus
30. The helium nucleus has slightly less mass—0.7%—than than the two hydrogen nuclei that combined to form it.
31. the lost mass from the hydrogen nuclei
32. the energy released during the three steps of nuclear fusion
33. A
34. D
35. A
36. C
37. D
38. C
39. D
40. B
41. the amount of energy produced from a given amount of matter
42. 600 million tons
43. neutrino
44. about 8 minutes
45. that the sun is fueled by the fusion of hydrogen into helium
46. G
47. C
48. A
49. F
50. D
51. B
52. E
53. C
54. B
55. D
56. entirely of ionized gas
57. The sun's mass is 300,000 times the mass of Earth.
58. The pressure from the sun's material is so great that the sun's core is 10 times as dense as iron.
59. On Earth, atoms generally consist of a nucleus surrounded by one or more electrons, but within the core of the sun, the energy and pressure strip electrons away from atomic nuclei.
60. high temperature and pressure
61. the fusion of hydrogen into helium
62. the radiative zone, from 2,000,000–7,000,000°C.
63. in the form of electromagnetic waves, or radiation
64. the convective zone; about 2,000,000°C
65. Energy moves through the convective zone by convection, which is the transfer of energy by moving matter. On Earth, boiling water carries energy upward by convection. In the sun's convective zone, hot gases carry energy to the surface.

66. As hot gases move outward and expand, they radiate and lose energy. As the gases cool, they become denser and sink back toward the core, where they are heated again and rise outward. Energy is transferred to the sun's surface as the gases rise and sink.
67. C
68. C
69. A
70. The photosphere is the visible surface of the sun.
71. because the layers above the photosphere are transparent
72. dark, cool areas in the photosphere.
73. Above the photosphere is the chromosphere, which means "color sphere." It is so-named because it has a reddish light that is typical of the color given off by hydrogen.
74. Gases in the chromosphere move away from the underlying photosphere.
75. narrow jets of hot gas that shoot outward and fall away; some reach heights of 16,000 km
76. Spacecraft can detect small details on the sun because they measure wavelengths of light that are blocked by Earth's atmosphere.
77. the corona
78. The corona is a huge region of very hot gas; its temperature is above 1,000,000°C.
79. The corona's magnetic field stops atomic particles from escaping into space.
80. When the moon moves between the sun and Earth, the photosphere's light is blocked, and the corona becomes visible.

SECTION: SOLAR ACTIVITY

1. The gases are in constant motion.
2. The energy produced in the sun's core and the force of gravity combine to keep the sun's gases in constant motion.
3. The gases also move because the sun rotates on its axis.
4. because the sun is a ball of hot gases rather than a solid sphere
5. 27 days
6. D
7. B
8. D
9. A sunspot is a dark area of the photosphere of the sun that is cooler than the surrounding areas and that has a strong magnetic field.
10. the grainy appearance of the photosphere
11. A large sunspot can have a diameter of more than 100,000 km, which is several times the diameter of Earth.
12. A
13. D
14. C
15. D
16. B
17. Sunspots at higher latitudes slowly disappear, and new ones appear closer to the sun's equator. Then the number of sunspots begins to decrease until it reaches a minimum.
18. Another 11-year cycle begins when the number of sunspots begins to increase again.
19. B
20. D
21. C
22. B
23. A
24. D
25. C
26. A
27. B
28. C
29. A
30. A
31. C
32. disturbances in Earth's magnetic field; caused by gusts of particles from coronal mass ejections
33. Although several small geomagnetic storms may occur each month, the average number of severe storms is less than once per year.
34. D
35. A
36. C
37. C
38. B
39. C
40. D

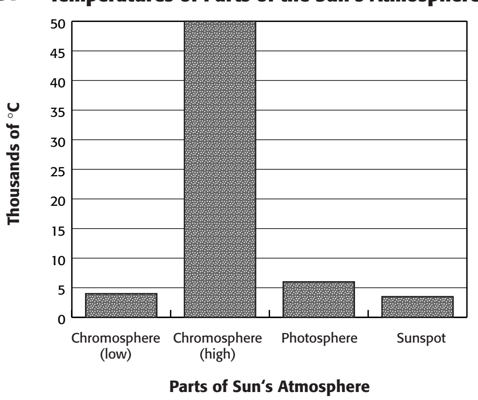
41. between 100 and 1,000 km
42. just after a peak in the sunspot cycle, especially after solar flares occur
43. about five times a year
44. in Alaska
45. on Jupiter and Saturn

Math Skills

1. 1.5×10^7°C
   $1.5 \times 10^7 = 1.5 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 15{,}000{,}000$
2. 3×10^5 km
   $3 \times 10^5 = 3 \times 10 \times 10 \times 10 \times 10 \times 10 = 300{,}000$
3. 1.39×10^6 km
   $1.39 \times 10^6 = 39 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 1{,}390{,}000$
4. 6×10^8 tons
   600 million = 600,000,000
   $6 \text{ x } 10^8 = 6 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 600{,}000{,}000$
5. 1.6×10^4 km
   $1.6 \times 10^4 = 1.6 \times 10 \times 10 \times 10 \times 10 = 16{,}000$

Graphing Skills

1. 7,000,000°C
2. core
3. convective zone
4. 1,500,000°C
5. Temperatures of Parts of the Sun's Atmosphere



Section Quizzes

SECTION: STRUCTURE OF THE SUN

1. B
2. E
3. D
4. A
5. C
6. D
7. A
8. B
9. C
10. A

SECTION: SOLAR ACTIVITY

1. E
2. C
3. D
4. A
5. B
6. B
7. C
8. D
9. D
10. A

Chapter Test A

1. G
2. H
3. J
4. B
5. I
6. F
7. C
8. A
9. D
10. E
11. C
12. B
13. C
14. A
15. B
16. D
17. C
18. B
19. C
20. B

Chapter Test B

1. D
2. C
3. B
4. A
5. E
6. J
7. H
8. F
9. I
10. G
11. B
12. D
13. B
14. A
15. C
16. B
17. A
18. B
19. D
20. A

of the universe were contained in a small volume at one time and then the big bang occurred, matter would have been sent out in all directions. Some of that matter would be very distant from Earth, but it—and the matter of Earth—would all be part of the original matter of the universe.

20. Answers may vary. Sample answer: The universe is still expanding, so in 14 billion years it should be more spread out, with relative distances between galaxies much greater than they are now. There are other possibilities. For example, if the supply of hydrogen for fusion in stars becomes exhausted and if stars all over the universe become black holes, the universe might collapse back into itself.

Directed Reading

SECTION: CHARACTERISTICS OF STARS

1. a ball of gases that gives off a tremendous amount of electromagnetic energy
2. From Earth, stars appear as tiny specs of white light, but they actually vary in color.
3. B
4. A
5. C
6. D
7. C
8. A
9. the elements that make up the star
10. hydrogen; helium
11. B
12. D
13. A
14. C
15. E
16. the surface temperature of the star
17. red
18. A
19. C
20. B
21. D
22. B
23. C
24. B
25. They rotate on an axis; they may revolve around another star; they either move away from or toward our solar system.
26. the apparent shift in wavelength of light emitted by a light source moving toward or away from an observer
27. that those galaxies are moving away from Earth
28. A
29. D
30. A
31. B
32. the apparent shift in a star's position when viewed from different locations. Scientists measure it to determine a relatively close star's distance from Earth.
33. within 1,000 light-years of Earth
34. A
35. B
36. the brightness of the star as it appears to us on Earth
37. the brightness that a star would have if all the stars were at a standard, uniform distance from Earth

SECTION: STELLAR EVOLUTION

1. B
2. the total amount of energy a star gives off each second
3. the graph that illustrates the pattern revealed when the surface temperatures of stars are plotted against their luminosity
4. The temperature of a star's surface is plotted on the horizontal axis; the luminosity is plotted on the vertical axis.
5. the band that runs diagonally through the H-R diagram and extends from cool, dim, red stars at the lower right to hot, bright, blue stars at the upper left
6. A
7. D
8. C
9. a shrinking, spinning region that begins to flatten into a disk with a central concentration of matter
10. Gravitational energy is converted into heat energy, and the temperature of the protostar increases.

11. It marks the birth of a star.
12. The rate of fusion increases.
13. It makes the star stable in size.
14. as long as it has an ample supply of hydrogen to fuse into helium
15. C
16. B
17. when almost all of the hydrogen atoms in its core have fused into helium atoms.
18. As the helium core becomes hotter, it transfers energy into a thin shell of hydrogen surrounding the core.
19. They are large, red stars whose hot core has used most of its hydrogen. They are above the main sequence
20. main-sequence stars that are more massive than the sun and become larger than regular giant stars
21. A
22. C
23. A
24. D
25. A
26. A supernova is a star that has such a tremendous explosion that it blows itself apart. Unlike a nova, a white dwarf can sometimes accumulate so much mass on its surface that gravity overwhelms the outward pressure. The star collapses and is so dense that the outer layers rebound and explode.
27. C
28. D
29. it begins to collapse under its own gravity, and it explodes
30. a small but extremely dense ball of neutrons left after a supernova
31. a neutron star that emits a beam of radio waves that sweep across space,
32. If the leftover core of a star contains more than 3 times the mass of the sun, the star may contract more under its greater gravity until the force crushes the dense core and leaves a black hole.
33. because they do not give off light

SECTION: STAR GROUPS

1. D
2. A
3. C
4. D
5. C
6. because they divide the sky into sectors that can help people locate a particular star
7. A
8. B
9. D
10. more than half
11. groups of hundreds or thousands of stars formed when nebulas collapse
12. Globular clusters have a spherical shape and contain up to 100,000 stars. Open clusters are loosely shaped and rarely contain more than a few hundred stars.
13. B
14. D
15. C
16. B
17. A
18. D
19. C
20. B
21. A
22. It is one of hundreds of billions of stars in the Milky Way.
23. about 225 million years
24. two irregular galaxies called the Large Magellanic Cloud and the Small Magellanic Cloud
25. more than 170,000 light-years away from Earth
26. B
27. A
28. D
29. a jet of gas
30. in the centers of galaxies that are distant from Earth.
31. the presence of a giant black hole

SECTION: THE BIG BANG THEORY

1. B
2. B
3. C
4. He found that the spectra of galaxies, except for the few closest to Earth, were shifted toward the red end of the spectrum.
5. that they showed the greatest red shift and thus were moving away from Earth the fastest
6. They confirm Hubble's original findings.

7. It is the theory that all matter and energy in the universe was compressed into an extremely small volume that about 14 billion years ago exploded and began expanding in all directions.
8. that all matter was close together at one time
9. It is still expanding and the galaxies continue to move away from one another.
10. low levels of energy evenly distributed throughout the universe
11. They think it formed shortly after the big bang.
12. The universe after the big bang would have been extremely hot and would have cooled to a great extent by now.
13. only about 3°C above absolute zero, the coldest temperature possible
14. They are irregularities in the cosmic background radiation, which were caused by small fluctuations in the distribution of matter in the early universe.
15. the first stages in the formation of the universe's first galaxies
16. C
17. C
18. A
19. D
20. D

Math Skills

1. $[(21 + 33) \div 3] \times [(3 \times 10^5) \times 60] = ?$
   $10^5 = 100{,}000$
   $21 + 33 = 54$
   $3 \times 100{,}000 = 300{,}000$
   $54 \div 3 = 18$
   $300{,}000 \times 60 = 18{,}000{,}000$
   $18 \times 18{,}000{,}000 = \div\ 324{,}000{,}000$
   Planet Z is 324,000,000 km from the star.
2. $[(95 + 15) \times 2] \times [(3 \text{ x } 10^5) \times 60 \times 60] = ?$
   $10^5 = 100{,}000$
   $95 + 15 = 110$
   $3 \times 100{,}000 = 300{,}000$
   $110 \times 2 = 220$
   $300{,}000 \times 60 \times 60 = 1{,}080{,}000{,}000$
   $220 \times 1{,}080{,}000{,}000 = 237{,}600{,}000{,}000$
   Planet F is 237,600,000,000 km from the star.
3. $10^5 = 100{,}000$
   $63 - 30 = 33$
   $3 \times 100{,}000 = 300{,}000$
   $33 \div 3 = 11$
   $300{,}000 \times 60 \times 60 = 1{,}080{,}000{,}000$
   $11 \times 1{,}080{,}000{,}000 = 11{,}880{,}000{,}000$
   Planet L is 11,880,000,000 km from the star.
4. $10^5 = 100{,}000$
   $22 + 11 = 33$
   $3 \times 100{,}000 = 300{,}000$
   $33 \times 4 = 132$
   $300{,}000 \times 60 = 18{,}000{,}000$
   $132 \times 18{,}000{,}000 = 2{,}376{,}000{,}000$
   Planet M is 2,376,000,000 km from the star.
5. $10^5 = 100{,}000$
   $19 \times 4 = 76$
   $3 \times 100{,}000 = 300{,}000$
   $76 \div 2 = 38$
   $300{,}000 \times 60 = 18{,}000{,}000$
   $38 \times 18{,}000{,}000 = 684{,}000{,}000$
   Planet N is 684,000,000 km from the star.