Geology of Virginia
Introduction and Geologic Background
CD-ROM 1

Teacher's Guide
Second Edition

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Foreword

The accompanying Teacher's Guide of lesson plans and copy masters for *Geology of Virginia - CD-ROM 1: Introduction and Geologic Background* is designed to complement any text or course of study in Geology. The CD-ROM and worksheets for studying geology may be used as the backbone for units in the absence of a text or curriculum guide. These instructional materials along with supporting explanations provided by the teacher will supply the information needed to cover the State Standards of Learning (SOLs) for the Earth Science curriculum.

The Geology of Virginia CD-ROM project is a series of four CD-ROMs. This CD-ROM, *Introduction and Geologic Background*, introduces major concepts of geology with a focus on Virginia examples. *Coastal Plain, Piedmont and Blue Ridge*, and *Valley and Ridge and Appalachian Plateaus* address the local geology of those physiographic provinces in Virginia.

The Geology of Virginia CD-ROM project was inspired by the lack of adequate educational material on the geology of Virginia for high school earth science students. In 1995, Stan Johnson, Virginia's State Geologist, and Tom Carroll, Executive Director of the Virginia Aggregates Association (now with Vulcan Materials Company), were concerned that adequate educational material on the geology of Virginia did not exist. In late 1998, Robert Whisonant, Parvinder Sethi, and Karen Cecil were independently discussing the concept of a Virginia geology CD-ROM that would address the subject matter and be tied to the new standards of learning. These individuals are in education at the university, college, and high school levels. All saw a need for new and different teaching materials that would capture the student's interest, mainly at the high school level.

In 1999, needs and resources came together to begin the creation of the CD-ROM series. Stan Johnson's Division of Mineral Resources provided technical and financial support, and campaigned for additional financial support from other governmental offices and private industry. Parvinder Sethi, Robert Whisonant, and Karen Cecil provided the expertise, time, and dedication needed to create a CD-ROM. Graduate assistants for the project, Phyllis Leary Newbill and Lori Combs, joined the team in fall 1999 and fall

2000, respectively. After the series was completed, the project team saw a need to revise CD-ROM 1, *Introduction and Geologic Background*. This work was done in summer 2001.

Letter to Teachers:

I have taught High School Earth Science for over eighteen years and General Geology at the college level for eleven years. The Geology of Virginia CD-ROM 1, *Introduction and Geologic Background*, has increased student enthusiasm and enhanced student learning. Also, student test scores have improved both on the chapter tests and the state Standards of Learning test after using this interactive CD-ROM.

The CD-ROM can be used in several different ways to enhance student learning. Students have worked independently on the CD-ROM in a computer laboratory setting and on their computers at home. With a computer, the CD-ROM can be displayed on a television monitor for lectures or projected on a large screen for presentations. At the college level, I used the CD-ROM in an electronic classroom to enhance my lectures. The digital chalk feature on the CD-ROM helps me to teach more effectively.

I hope you will be able to use our CD-ROM in your Earth Science class. It will give your students opportunity to have an interactive multimedia experience with geology. Also, they will be able to "travel" to different locations in Virginia without leaving the classroom.

Sincerely,
Karen Cecil

GEOLOGY OF VIRGINIA
CD-ROM 1: INTRODUCTION AND GEOLOGIC BACKGROUND

TEACHERS GUIDE

Table of Contents

CD-ROM Table of Contents

Geology of Virginia CD-ROM 1: Introduction and Geologic Background

Standards of Learning

This CD-ROM has been created for teachers and students and contains interactive and educational media to help teachers instruct Standards of Learning (SOLs) required by the State of Virginia. In the list of Virginia's Earth Science Standards of Learning below, "☑" indicates a topic covered by this CD-ROM. A "☐" indicates a topic not covered by this CD-ROM.

EARTH SCIENCE

ES.1 The student will conduct investigations in which:
- ☐ volume, area, mass, elapsed time, direction, temperature, pressure, distance, density, and changes in elevation/depth are calculated utilizing the most appropriate tools;
- ☑ technologies, including computers, are used to collect, analyze, and report data and to demonstrate concepts and simulate experimental conditions;
- ☑ scales, diagrams, maps, charts, graphs, tables, and profiles are constructed and interpreted;
- ☐ variables are manipulated with repeated trials; and
- ☑ a scientific viewpoint is constructed and defended.

ES.2 The student will demonstrate scientific reasoning and logic by
- ☐ analyzing how science explains and predicts the interaction and dynamics of complex Earth systems;
- ☑ recognizing that evidence is required to evaluate hypotheses and explanations;
- ☑ comparing different scientific explanations for the same observations about Earth;
- ☐ explaining that observation and logic are essential for reaching a conclusion;
- ☑ evaluating evidence for scientific theories related to plate tectonics, the structure of the Earth, and its ancient age and origin; and
- ☐ making informed judgments related to resource use and its effect of Earth systems.

ES.3 The student will investigate and understand how to read and interpret maps, models, charts and imagery. Key concepts include:
- ☑ maps (bathymetric, geologic, topographic, and weather);
- ☑ imagery (aerial photography and satellite images);
- ☐ direction and distance measurements on any map or globe; and
- ☐ location by latitude and longitude and topographic profiles.

ES.4 The student will investigate and understand the characteristics of the Earth including
- ☑ plate tectonics;
- ☐ water in all three states;
- ☐ position of the Earth in the solar system; and
- ☑ effects of density differences and energy transfer on the activities of the atmosphere, oceans, and Earth's interior.

ES.5 The student will investigate and understand how to identify major rock-forming and ore minerals based on physical and chemical properties. Key concepts include:

- ☑ properties including hardness, color and streak, luster, cleavage, fracture, and unique properties; and
- ☑ uses of minerals.

ES.6 The student will investigate and understand how to identify common rock types based on mineral composition and textures and the rock cycle as it relates to the transformation of rock types. Key concepts include

- ☑ igneous (intrusive and extrusive);
- ☑ sedimentary (clastic and chemical); and
- ☑ metamorphic (foliated and unfoliated) rocks.

ES.7 The student will investigate and understand the differences between renewable and nonrenewable resources. Key concepts include:

- ☑ fossil fuels, minerals, rocks, water, and vegetation;
- ☐ advantages and disadvantages of various energy sources;
- ☑ resources found in Virginia;
- ☑ use of resources and their effects on standards of living; and
- ☑ environmental costs and benefits.

ES.8 The student will investigate and understand geologic processes including plate tectonics. Key concepts include

- ☑ how geologic processes are evidenced in the physiographic provinces of Virginia including the Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateaus;
- ☑ processes (faulting, folding, volcanism, metamorphism, weathering, erosion, deposition, and sedimentation) and their resulting features; and
- ☑ tectonic processes (subduction, rifting and sea floor spreading, and continental collision).

ES.9 The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include

- ☑ process of soil development;
- ☑ development of karst topography;
- ☑ identification of groundwater zones including water table, zone of saturation, and zone of aeration;
- ☑ identification of other sources of fresh water including aquifers with reference to the hydrologic cycle; and
- ☑ dependence on freshwater resources and the effects of human usage on water quality.

ES.10 The student will investigate and understand that many aspects of the history and evolution of the Earth and life can be inferred by studying rocks and fossils. Key concepts include

- ☑ traces or remains of ancient, often extinct, life are preserved by various means in many sedimentary rocks;
- ☑ superposition, cross-cutting relationships, and radioactive decay are methods of dating bodies of rock; and
- ☑ rocks and fossils from many different geologic periods and epochs are found in Virginia.

ES.11 The student will investigate and understand that shorelines are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include

- ☑ physical and chemical changes (tides, waves, currents, sea level and ice cap variations, upwelling, and salinity concentrations);
- ☑ importance of environmental, geologic, and economic implications;
- ☑ system interactions (energy transfer, weather, and climate);
- ☑ features of the sea floor (continental margins, trenches, mid-ocean ridges, and abyssal plains) reflect tectonic processes; and
- ☐ public policy issues concerning the oceans.

ES.12 The student will investigate and understand the origin and evolution of the atmosphere and the interrelationship of geologic processes, biologic processes, and human activities on its composition and dynamics. Key concepts include

- ☑ scientific evidence for atmospheric changes over geologic time;
- ☐ current theories related to the effects of early life on the chemical makeup of the atmosphere;
- ☐ comparison of the Earth's atmosphere to that of other planets;
- ☐ atmospheric regulation mechanisms; and
- ☐ potential atmospheric compositional changes due to human, biologic, and geologic activity.

ES.13 The student will investigate and understand that energy transfer between the sun, Earth, and the Earth's atmosphere drivers weather and climate on Earth. Key concepts include

- ☐ observation and collection of weather data;
- ☐ prediction of weather patterns; and
- ☐ weather phenomena and the factors that affect climate.

ES.14 The student will investigate and understand that energy transfer between the sun, Earth, and the Earth's atmosphere drives weather and climate on Earth. Key concepts include

- ☐ characteristics of the sun, planets, their moons, comets, meteors, and asteroids; and cosmology and the origin of stars and stellar systems (the Big Bang, the solar nebular theory, stellar evolution, star systems, nebulae, constellations, and galaxies).

Instructions for Installation and Operation

COMPUTER AND SYSTEM REQUIREMENTS

- Pentium PC with at least 133 MHz speed, 32 MB RAM, 2 MB Video RAM, and 50 MB free hard disk space
- Monitor with a resolution of at least 640 x 480 and support for 16-bit high color or true color
- Multimedia speakers connected to a sound card in the computer
- Windows 3.x, Windows 95, or Windows 98 operating system

INSTALLATION INSTRUCTIONS

1. With your computer and speakers on, load the CD-ROM in the CD-ROM drive.
2. If the installation window does not automatically pop up, open INSTALL from the CD-ROM files. Follow on-screen instructions.
3. When installation is complete, a "Podium" window will appear with the GEOLOGY CDROM01 icon. Double click on the icon to begin.
4. To reopen the CD-ROM, click the Start button. Under Programs, select Podium. Click on GEOLOGY CDROM01.

USING THE CD-ROM

- One CD-ROM is designed to run on one computer.
- Click on buttons to navigate through the CD-ROM. Click anywhere on a screen to move back one screen. (See explanations of buttons below.)
- Click only once on a button. Then wait for the next display. Different computers may take longer to read large video and audio files. Wait to click another button until the computer has finished displaying.
- Text enclosed in boxes is linked to pop-up explanations or definitions. To see the pop-up information, move the mouse over the text in the box. The explanation will pop up on the screen. Move the mouse to another part of the screen to make the pop-up text disappear.
- Once you have clicked on a button for a slide show or video clip, wait until the display is finished before you click again.

NAVIGATION BUTTONS

- QUIT – takes you out of the CD-ROM after asking you to confirm your intention to exit
- MAIN TOPICS OF CHAPTER – takes you to the current chapter's table of contents screen
- HOME – takes you to the CD-ROM table of contents
- BACK – takes you back to the main text screen linked to the present screen
- NEXT – takes you forward to the next screen in the chapter

MINERALS: *Lesson Plan*

Subject/Grade
Earth Science 6-14

Goals of Lesson
Students will use the Minerals chapter of *Geology of Virginia CD-ROM 1: Introduction and Geologic Background* to comprehend and apply concepts of Earth Science Standards of Learning (SOLs) numbers 5 and 7 required by the State of Virginia.

Lesson Objectives
The student will investigate and understand how to identify major rock-forming and ore minerals based on physical and chemical properties. Students will discover types of mineral resources found in Virginia.

Materials/Resources Needed/Class Time:
- *Geology of Virginia CD-ROM 1: Introduction and Geologic Background*
- PC Computer with Windows 3.1 or Windows 95
- Computer with CD-ROM Drive 4.0 X or higher; 133 MHz processor with 32 MB RAM or higher
- Minerals Worksheets
- Worksheets will take 2-3 (50 min) class periods.

Activities/Tasks/Procedures:
- Students using the interactive, educational, multimedia CD-ROM will actively learn about minerals
- Students will answer questions on worksheets as they proceed through the CD-ROM

Provisions for Individual Differences:
- Students will advance through the CD-ROM at their own pace
- Students needing more time may install the CD-ROM on a single computer in the classroom.

Evaluation:
- Students will complete worksheets and finish the chapter on minerals.
- Students may use the CD-ROM as a review for a chapter test or for the State Standards of Learning (SOL) test in Earth Science.
- CD-ROM 1 may be used as a substitute for notes or lecture.

MINERALS: *Teacher Answer Sheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Minerals** from the Table of Contents.
- For an introduction click SLIDES and then VIDEO.
- Click CHAPTER TOPICS to begin the chapter.

1.1 Mineral Basics MORE INFO

1. List the five characteristics of minerals. (1.1a)

   naturally-occurring inorganic

   solid crystalline structure

   fixed or variable chemical composition

SLIDE 1 BACK SLIDE 2

2. Are fossils minerals? yes / no (circle one) (1.1.2)

BACK NEXT SLIDES

3. Why is obsidian not a mineral? (1.1.3a) It has no internal crystal structure.

NEXT

4. What are two types of crystal systems? (1.1.3b)

   hexagonal cubic

BACK BACK SLIDE

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

1. Crystal form MORE INFO

5. What is *crystal form*? (1.2.1) the geometric shape of mineral crystals

SLIDES

6. Quartz forms hexagonal crystals, and pyrite forms cubic crystals. (1.2.1.1a)

NEXT BACK BACK SLIDE

7. Chert is made up of microscopic crystals. (1.2.1.2)

BACK VIDEO

8. Give two reasons why the quartz in the video formed excellent crystals. (1.2.1.3)

   It cooled slowly.

   It had enough space.

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

2. Luster MORE INFO

9. What are the two basic types of luster? (1.2.2)

   metallic non-metallic

VIDEO BACK SLIDE 1

10. Give three examples of minerals with metallic luster. (1.2.2.1)

    gold silver or galena

    copper

BACK

11. Give three examples of non-metallic luster. (1.2.2)

    Student answers will vary, but may include earthy, waxy, vitreous adamantine, resinous, silky, or dull

SLIDE 2

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

3. Color and streak MORE INFO

12. The color of a mineral is always the same. True / False (circle one) (1.2.3)

SLIDE 1 BACK

VIDEO 1

13. What causes color variations in quartz? (1.2.3.2) chemical impurities

BACK

14. The color of a mineral's streak is a reliable way to identify a mineral. True / False (circle one) (1.2.3)

SLIDE 2

15. What color is the streak of hematite? (1.2.3.3) reddish-brown

BACK VIDEO 2

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

4. Hardness MORE INFO

16. What does hardness measure? (1.2.4) a mineral's resistance to scratching

VIDEO 1

17. Why can a piece of quartz scratch a glass plate? (1.2.4.1) The hardness of quartz is 7, and the hardness of a glass plate is 5.5.

BACK

18. List the Moh's Scale of Hardness (1-10). (1.2.4)

1. talc	6. orthoclase
2. gypsum	7. quartz
3. calcite	8. topaz
4. fluorite	9. corundum
5. apatite	10. diamond

SLIDES NEXT BACK BACK SLIDE

19. Give the hardness of these common objects. (1.2.4.3)

fingernail 2.5 penny 3.5 glass 5.5

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

5. Fracture and cleavage MORE INFO

20. What kind of surface is formed by fracture? (1.2.5) rough or irregular

21. What kind of surface is formed by cleavage? (1.2.5) flat planes

SLIDE 1

22. Give the type of fracture for each material. (1.2.5.1)

obsidian conchoidal asbestos fibrous

BACK SLIDE 2

23. List three minerals with cleavage. (1.2.5.2) biotite mica, orthoclase feldspar, and halite

BACK VIDEO

24. How many planes of cleavage does biotite have? (1.2.5.3) one

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

6. Specific Gravity MORE INFO

25. Define *specific gravity*. (1.2.6) the ratio of the weight of a mineral to the weight of an equal volume of water

26. Which feels heavier? gold / pyrite (circle one) (1.2.6)

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

7. Others MORE INFO

SLIDE 1 BACK

VIDEO 1

27. How would you identify magnetite? (1.2.7.2) Check to see whether a magnet would be attracted to it.

BACK VIDEO 2

28. What is one method for identifying calcite? (1.2.7.3) Apply dilute hydrochloric acid to determine whether the mineral fizzes

BACK

29. What are striations? (1.2.7) tiny, straight parallel grooves on cleavage faces of some minerals

SLIDE 2 BACK VIDEO 3

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

1. Silicates MORE INFO

30. Name the two elements that all silicates contain. (1.3.1)

silicon oxygen

Explore each MORE INFO, SLIDE, and VIDEO. Use the information to fill in the chart below.

	Luster	Fracture or cleavage	Color	Hardness	Uses
31. Olivine	glassy	fracture	olive-green	6.5	
32. Pyroxenes	glassy	cleavage	dark	5 to 7	
33. Amphiboles	glassy	cleavage	dark	5 to 6.5	
34. Biotite	shiny	cleavage	brown or black	2.5 to 3	fire-resistant tiles, rubber
35. Muscovite	shiny	cleavage	clear	2.7 to 3	computer chips
36. Plagioclase feldspar	pearly	cleavage	white to dark	6	ceramics, false teeth
37. Orthoclase feldspar	vitreous	cleavage	white or pink	6	ceramics, glass
38. Quartz	glassy	fracture	pink, gray, black, clear	7	abrasives, glass

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

2. Oxides MORE INFO

39. Oxide minerals are made up of oxygen and one or more metals. (1.3.2)

Hematite MORE INFO

40. What is hematite used for? (1.3.2.1) pigments and iron ore

SLIDE BACK BACK

Limonite MORE INFO

41. List two ways limonite can be identified. (1.3.2.2)
non-metallic luster, dull earthy yellow to dark brown color, and/or yellow to brown streak

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

3. Sulfates MORE INFO

42. Sulfate minerals contain sulfur and oxygen combined with other elements. (1.3.3)

Gypsum MORE INFO

43. What is gypsum used for? (1.3.3.1) wallboard and plaster of paris

SLIDE BACK BACK

Barite MORE INFO

44. What is barite used for? (1.3.3.2) paint, drilling muds, paper, and textiles

SLIDE

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

4. Sulfides MORE INFO

45. Sulfides contain sulfur and a metal (1.3.4)

Galena MORE INFO

46. Galena is a lead ore. (1.3.4.1)

SLIDE

47. What is one way geologists identify galena easily? (1.3.4.1.1) it feels especially heavy

BACK BACK

Pyrite MORE INFO

48. What is pyrite used for? (1.3.4.2) sulfur ore – sulfuric acid, explosives, fertilizer, pulp processing, and insecticides

SLIDE

49. Pyrite is also known as fool's gold. (1.3.4.2.1)

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

5. Carbonates MORE INFO

50. Carbonates contain the elements carbon and oxygen combined with other elements.

Calcite MORE INFO

51. List two uses for calcite. (1.3.5.1) fertilizer, cement, paper, and/or building stone

SLIDE 1 BACK SLIDE 2

52. Calcite is abundant in the sedimentary rock limestone. (1.3.5.1.2)

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

6. Others MORE INFO

53. Give two examples of native elements. (1.3.6)

gold copper

SLIDE 1

54. List two uses for gold. (1.3.6.1) monetary standard, jewelry, and/or scientific and medical instruments

BACK SLIDE 2

55. Diamonds are made up of pure carbon. (1.3.6.2)

BACK

56. Common halide minerals are halite and fluorite. (1.3.6)

SLIDE 3

57. What is the common name for the mineral halite? salt (1.3.6.3)

CHAPTER TOPICS

1.4 Selected Virginia Minerals MORE INFO

1. Quartz MORE INFO

58. Circle the Virginia province(s) in which quartz is common. (1.4.01)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

59. Purple quartz is called amethyst. (1.4.01.1)

BACK BACK

2. Feldspar MORE INFO

60. Circle the Virginia province(s) in which feldspar is common. (1.4.02)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

61. What are pegmatites? (1.4.02) very coarse-grained igneous rocks with large crystals

SLIDE

62. Amazonite can be found in Amelia County. (1.4.02.1)

BACK BACK

3. Mica MORE INFO

63. Circle the Virginia province(s) in which mica is common. (1.4.03)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

64. What is mica used for? (1.4.03.1) electric insulators and paint

BACK BACK

4. Hematite MORE INFO

65. Circle the Virginia province(s) in which hematite can be found. (1.4.04)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE 1

66. What color is the sandstone that contains hematite? (1.4.04.1) red

BACK SLIDE 2 BACK BACK

5. Limonite MORE INFO

67. Circle the Virginia province(s) in which limonite is common. (1.4.05)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

68. What is limonite mined for in Pulaski County? (1.4.05.1) pigments

BACK BACK

6. Galena MORE INFO

69. Circle the Virginia province(s) in which galena is found. (1.4.06)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

70. What was Wythe County's galena used for? (1.4.06.1) bullets in the Civil War

BACK BACK

7. Pyrite MORE INFO

71. Circle the Virginia province(s) in which pyrite was mined or is common. (1.4.07)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE BACK BACK

8. Calcite MORE INFO

72. Circle the Virginia province(s) in which calcite is common. (1.4.08)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE BACK BACK

9. Halite MORE INFO

73. Circle the Virginia province(s) in which halite is found. (1.4.09)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

74. Halite can be found in rocks beneath the town of Saltville. (1.4.09.1)

BACK BACK

10. Gypsum MORE INFO

75. Circle the Virginia province(s) in which gypsum is found. (1.4.10)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

76. Gypsum was mined in Washington County. (1.4.10.1)

BACK BACK

11. Gold MORE INFO

77. Circle the Virginia province(s) in which gold is found. (1.4.11)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

78. Virginia gold is on display at the Smithsonian in Washington D.C. (1.4.11.1)

BACK BACK

12. Diamond MORE INFO

79. How many diamonds have been found in or very near Virginia? (1.4.12) five

CHAPTER TOPICS

1.5 Tips for Mineral Collecting MORE INFO

1. Rules for mineral collecting MORE INFO

80. What are the first two rules for mineral collecting? (1.5.1)

Obtain permission to enter private property.

Do not collect in state and national parks.

BACK

2. Where to collect MORE INFO

1. Gem and mineral societies MORE INFO

81. What is the name of the mineral club closest to your home? (1.5.2.1a-1.5.2.1c)

student answers will vary

CHAPTER TOPICS

1.5 Tips for Mineral Collecting MORE INFO

2. Where to collect MORE INFO

2. Virginia Division of Mineral Resources MORE INFO

82. In what city is the Division of Mineral Resources office located? (1.5.2.2)

Charlottesville

CHAPTER TOPICS

1.5 Tips for Mineral Collecting MORE INFO

3. Equipment needed MORE INFO

83. List three types of equipment needed for mineral collecting. (1.5.3)

Student answers will vary, but will include three of the following: eye protection, gloves, sturdy shoes, prospector's pick, magnifying glass, bags or boxes for samples, pens, pocketknife, and hammer and chisel

You have reached the end of the Minerals chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

MINERALS: *Student Worksheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Minerals** from the Table of Contents.
- For an introduction click SLIDES and then VIDEO.
- Click CHAPTER TOPICS to begin the chapter.

1.1 Mineral Basics MORE INFO

1. List the five characteristics of minerals. (1.1a)

_____ _____

_____ _____

_____

SLIDE 1 BACK SLIDE 2

2. Are fossils minerals? yes / no (circle one) (1.1.2)

BACK NEXT SLIDES

3. Why is obsidian not a mineral? (1.1.3a) _____

_____

NEXT

4. What are two types of crystal systems? (1.1.3b)

_____ _____

BACK BACK SLIDE

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

1. Crystal form MORE INFO

5. What is *crystal form*? (1.2.1) _____

_____

SLIDES

6. Quartz forms _____ crystals, and pyrite forms _____ crystals. (1.2.1.1a)

NEXT BACK BACK SLIDE

7. _____ is made up of microscopic crystals. (1.2.1.2)

BACK VIDEO

8. Give two reasons why the quartz in the video formed excellent crystals. (1.2.1.3)

_____

_____

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

2. Luster MORE INFO

9. What are the two basic types of luster? (1.2.2)

_____ _____

VIDEO BACK SLIDE 1

10. Give three examples of minerals with metallic luster. (1.2.2.1)

_____ _____

_____

BACK

11. Give three examples of non-metallic luster. (1.2.2)

_____ _____

_____

SLIDE 2

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

3. Color and streak MORE INFO

12. The color of a mineral is always the same. True / False (circle one) (1.2.3)

SLIDE 1 BACK

VIDEO 1

13. What causes color variations in quartz? (1.2.3.2) _____

_____

BACK

14. The color of a mineral's streak is a reliable way to identify a mineral. True / False (circle one) (1.2.3)

SLIDE 2

15. What color is the streak of hematite? (1.2.3.3) _____

BACK VIDEO 2

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

4. Hardness MORE INFO

16. What does hardness measure? (1.2.4) _____

_____

VIDEO 1

17. Why can a piece of quartz scratch a glass plate? (1.2.4.1) _____

_____

BACK

18. List the Moh's Scale of Hardness (1-10). (1.2.4)

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

SLIDES NEXT BACK BACK SLIDE

19. Give the hardness of these common objects. (1.2.4.3)

fingernail _____ penny _____ glass _____

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

5. Fracture and cleavage MORE INFO

20. What kind of surface is formed by fracture? (1.2.5) _____

21. What kind of surface is formed by cleavage? (1.2.5) _____

SLIDE 1

22. Give the type of fracture for each material. (1.2.5.1)

obsidian _____ asbestos _____

BACK SLIDE 2

23. List three minerals with cleavage. (1.2.5.2) _____

_____

BACK VIDEO

24. How many planes of cleavage does biotite have? (1.2.5.3) _____

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

6. Specific Gravity MORE INFO

25. Define *specific gravity*. (1.2.6) _____

_____

_____

26. Which feels heavier? gold / pyrite (circle one) (1.2.6)

CHAPTER TOPICS

1.2 Mineral Identification MORE INFO

7. Others MORE INFO

SLIDE 1 BACK

VIDEO 1

27. How would you identify magnetite? (1.2.7.2) _____

_____

_____

BACK VIDEO 2

28. What is one method for identifying calcite? (1.2.7.3) _____

_____

_____

BACK

29. What are striations? (1.2.7) _____

_____

_____

SLIDE 2 BACK VIDEO 3

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

1. Silicates MORE INFO

30. Name the two elements that all silicates contain. (1.3.1)

_____ _____

Explore each MORE INFO, SLIDE, and VIDEO. Use the information to fill in the chart below.

	Luster	Fracture or cleavage	Color	Hardness	Uses
31. Olivine					
32. Pyroxenes					
33. Amphiboles					
34. Biotite					
35. Muscovite					
36. Plagioclase feldspar					
37. Orthoclase feldspar					
38. Quartz					

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

2. Oxides MORE INFO

31. Oxide minerals are made up of _____ and one or more _____. (1.3.2)

Hematite MORE INFO

32. What is hematite used for? (1.3.2.1) _____

_____

SLIDE BACK BACK

Limonite MORE INFO

33. List two ways limonite can be identified. (1.3.2.2)

_____

_____

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

3. Sulfates MORE INFO

34. Sulfate minerals contain _____ and _____ combined with other elements. (1.3.3)

Gypsum MORE INFO

35. What is gypsum used for? (1.3.3.1) _____

_____

SLIDE BACK BACK

Barite MORE INFO

36. What is barite used for? (1.3.3.2) _____

_____

SLIDE

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

4. Sulfides MORE INFO

37. Sulfides contain _____ and a _____ (1.3.4)

Galena MORE INFO

38. Galena is a _____ ore. (1.3.4.1)

SLIDE

39. What is one way geologists identify galena easily? (1.3.4.1.1) _____

_____

BACK BACK

Pyrite MORE INFO

40. What is pyrite used for? (1.3.4.2) _____

_____

_____

SLIDE

41. Pyrite is also known as _____ _____. (1.3.4.2.1)

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

5. Carbonates MORE INFO

42. Carbonates contain the elements _____ and _____ combined with other elements.

Calcite MORE INFO

43. List two uses for calcite. (1.3.5.1) _____

SLIDE 1 BACK SLIDE 2

44. Calcite is abundant in the sedimentary rock _____. (1.3.5.1.2)

CHAPTER TOPICS

1.3 Major Mineral Groups MORE INFO

6. Others MORE INFO

45. Give two examples of native elements. (1.3.6)

_____ _____

SLIDE 1

46. List two uses for gold. (1.3.6.1) _____

_____

BACK SLIDE 2

47. Diamonds are made up of pure _____. (1.3.6.2)

BACK

48. Common halide minerals are _____ and _____. (1.3.6)

SLIDE 3

49. What is the common name for the mineral halite? _____ (1.3.6.3)

CHAPTER TOPICS

1.4 Selected Virginia Minerals MORE INFO

1. Quartz MORE INFO

50. Circle the Virginia province(s) in which quartz is common. (1.4.01)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

51. Purple quartz is called _____. (1.4.01.1)

BACK BACK

2. Feldspar MORE INFO

52. Circle the Virginia province(s) in which feldspar is common. (1.4.02)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

53. What are pegmatites? (1.4.02) _____

_____

SLIDE

54. Amazonite can be found in _____ County. (1.4.02.1)

BACK BACK

3. Mica MORE INFO

55. Circle the Virginia province(s) in which mica is common. (1.4.03)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

56. What is mica used for? (1.4.03.1) _____

_____

BACK BACK

4. Hematite MORE INFO

57. Circle the Virginia province(s) in which hematite can be found. (1.4.04)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE 1

58. What color is the sandstone that contains hematite? (1.4.04.1) _____

BACK SLIDE 2 BACK BACK

5. Limonite MORE INFO

59. Circle the Virginia province(s) in which limonite is common. (1.4.05)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

60. What is limonite mined for in Pulaski County? (1.4.05.1) _____

BACK BACK

6. Galena MORE INFO

61. Circle the Virginia province(s) in which galena is found. (1.4.06)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

62. What was Wythe County's galena used for? (1.4.06.1) _____

_____

BACK BACK

7. Pyrite MORE INFO

63. Circle the Virginia province(s) in which pyrite was mined or is common. (1.4.07)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE BACK BACK

8. Calcite MORE INFO

64. Circle the Virginia province(s) in which calcite is common. (1.4.08)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE BACK BACK

9. Halite MORE INFO

65. Circle the Virginia province(s) in which halite is found. (1.4.09)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

66. Halite can be found in rocks beneath the town of _____.
(1.4.09.1)

BACK BACK

10. Gypsum MORE INFO

67. Circle the Virginia province(s) in which gypsum is found. (1.4.10)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

68. Gypsum was mined in _____ County. (1.4.10.1)

BACK BACK

11. Gold MORE INFO

69. Circle the Virginia province(s) in which gold is found. (1.4.11)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

SLIDE

70. Virginia gold is on display at the _____ in Washington D.C. (1.4.11.1)

BACK BACK

12. Diamond MORE INFO

71. How many diamonds have been found in or very near Virginia? (1.4.12) _____

CHAPTER TOPICS

1.5 Tips for Mineral Collecting MORE INFO

1. Rules for mineral collecting MORE INFO

72. What are the first two rules for mineral collecting? (1.5.1)

_____

_____

BACK

2. Where to collect MORE INFO

1. Gem and mineral societies MORE INFO

73. What is the name of the mineral club closest to your home? (1.5.2.1a-1.5.2.1c)

_____

CHAPTER TOPICS

1.5 Tips for Mineral Collecting MORE INFO

2. Where to collect MORE INFO

2. Virginia Division of Mineral Resources MORE INFO

74. In what city is the Division of Mineral Resources office located? (1.5.2.2)

_____

CHAPTER TOPICS

1.5 Tips for Mineral Collecting MORE INFO

3. Equipment needed MORE INFO

75. List three types of equipment needed for mineral collecting. (1.5.3)

_____

_____

_____

You have reached the end of the Minerals chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

ROCKS: *Lesson Plan*

Subject/Grade
Earth Science 6-12

Goals of Lesson
Students will use the Rocks chapter of *Geology of Virginia CD-ROM 1: Introduction and Geologic Background* to comprehend and apply concepts of Earth Science Standards of Learning (SOLs) numbers 6 and 7 required by the State of Virginia.

Lesson Objectives
The student will investigate and understand how to identify common rock types based on mineral composition and textures and the rock cycle as it relates to the transformation of rock types including igneous (intrusive and extrusive); sedimentary (detrital, chemical and organic); and metamorphic (foliated and nonfoliated) rocks.

Materials/Resources Needed/Class Time:
- Geology of Virginia CD-ROM 1
- PC Computer with Windows 3.1 or Windows 95
- Computer with CD-ROM Drive 4.0 X or higher; 133 MHz processor with 32 MB RAM or higher
- Rocks Worksheets
- Worksheets will take 2-3 (50 min) class periods.

Activities/Tasks/Procedures:
- Students using the interactive, educational, multimedia CD-ROM will actively learn about rocks.
- Students will answer questions on worksheets as they proceed through the CD-ROM.

Provisions for Individual Differences:
- Students will advance through the CD-ROM at their own pace.
- Students needing more time may install the CD-ROM on a single computer in the classroom.

Evaluation:
- Students will complete worksheets and finish the chapter on rocks.
- Students may use the CD-ROM as a review for a chapter test or for the State Standards of Learning (SOL) test in Earth Science.
- CD-ROM 1 may be used as a substitute for notes or lecture.

ROCKS: *Teacher Answer Sheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Rocks** from the Table of Contents.
- For an introduction click SLIDES.
- Click CHAPTER TOPICS to begin the chapter.

2.1 Rock Basics MORE INFO

1. Define *rock*. (2.1) natural solid composed of mineral grains, glass, or a combination of these

SLIDE

2. What minerals make up this sample of granite? (2.1.1) feldspar, biotite, and quartz

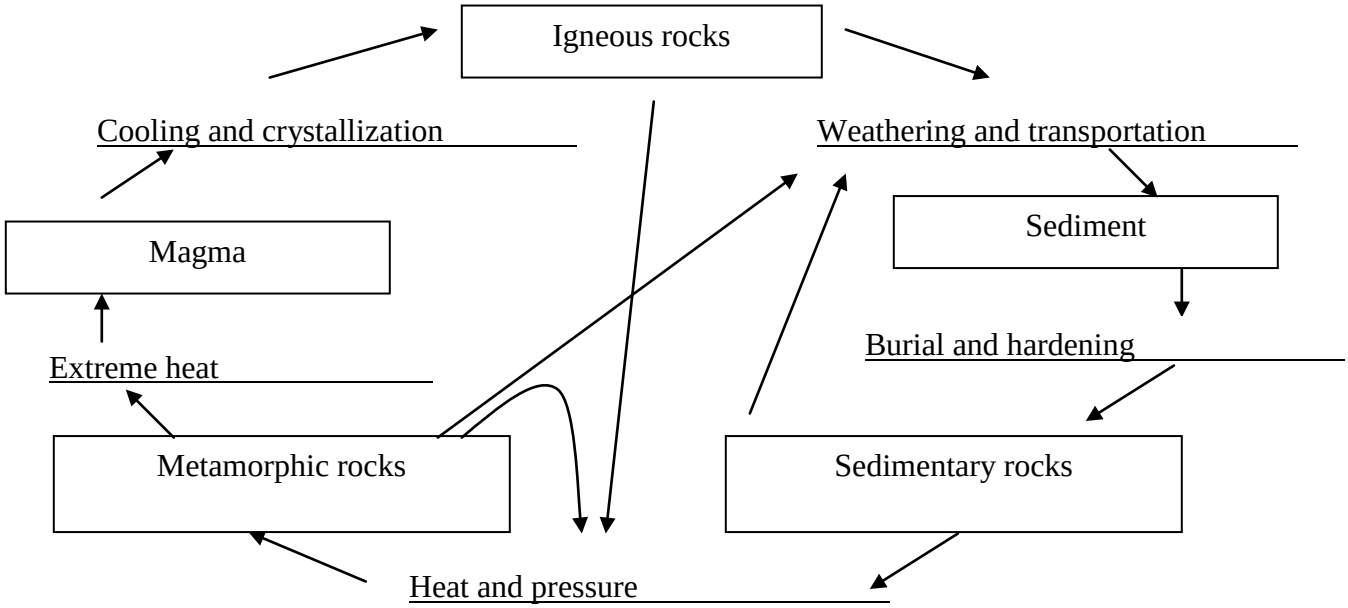
CHAPTER TOPICS

2.2 Rock Cycle MORE INFO

3. The rock cycle shows the relationships among the three major rock types. (2.2)

SLIDE

4. Fill in the blanks and boxes to represent the rock cycle. (2.2.1)



CHAPTER TOPICS

2.3 Igneous Rocks MORE INFO

5. Igneous rocks formed from molten material. (2.3)

1. Extrusive and intrusive MORE INFO

6. Where do extrusive igneous rocks form? (2.3.1a) on the earth's surface

SLIDE 1

7. A smooth, shiny, ropy lava flow is called pahoehoe. (2.3.1.1)

BACK SLIDE 2

8. A volcanic breccia is made up of broken pieces of volcanic material. (2.3.1.2)

BACK SLIDE 3

9. This ancient flood basalt flowed over large parts of Virginia about 570 million years ago. (2.3.1.3)

BACK

10. List three types of extrusive igneous rocks. (2.3.1a)

lava flows pyroclastic rocks

flood basalts

NEXT

11. Where do intrusive igneous rocks form? (2.3.1b) below the earth's surface

SLIDE BACK

12. List four types of intrusive igneous rocks. (2.3.1b)

dike sill

batholith stock

SLIDE

CHAPTER TOPICS

2.3 Igneous Rocks MORE INFO

2. Classification MORE INFO

13. The classification of igneous rocks is based on texture and composition. (2.3.2)

1. Texture MORE INFO

14. What mainly determines the texture of an igneous rock? (2.3.2.1a) the cooling rate of the magma

SLIDE 1

15. Phaneritic igneous rocks have crystals large enough to be seen with the naked eye. (2.3.2.1.1)

BACK SLIDE 2

16. Aphanitic igneous rocks have crystals too small to be seen with the naked eye. (2.3.2.1.2)

BACK NEXT SLIDE 1

17. Porphyritic igneous rocks have crystals of very different sizes. (2.3.2.1.3)

BACK SLIDE 2

18. Igneous rocks with vesicular texture contain holes made by gas bubbles in lava. (2.3.2.1.4)

BACK SLIDE 3

19. Igneous rocks made up of broken fragments have pyroclastic texture. (2.3.2.1.5)

BACK SLIDE 4

20. Pegmatites are igneous rocks with very large crystals. (2.3.2.1.6)

CHAPTER TOPICS

2.3 Igneous Rocks MORE INFO

2. Classification MORE INFO

2. Composition MORE INFO

21. Dark-colored minerals form mafic igneous rocks. (2.3.2.2)

SLIDES 1

22. List two mafic minerals. (2.3.2.2.1a) olivine, pyroxene, amphibole, and/or biotite

NEXT

23. Gabbro is an example of mafic igneous rock. (2.3.2.2.1b)

BACK BACK

24. Light-colored minerals form felsic igneous rocks. (2.3.2.2)

SLIDES 2

25. List two felsic minerals. (2.3.2.2.2a) muscovite, sodium-rich plagioclase feldspar, orthoclase feldspar, and/or quartz

NEXT

26. Granite is an example of a felsic igneous rock.

CHAPTER TOPICS

2.3 Igneous Rocks MORE INFO

3. Common igneous rocks MORE INFO

Granite SLIDE

27. Granite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.01)

BACK **Gabbro** SLIDE

28. Gabbro is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.02)

BACK **Diorite** SLIDE

29. Diorite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.03)

BACK **Peridotite** SLIDE

30. Peridotite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.04)

BACK **Rhyolite** SLIDE

31. Rhyolite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.05)

BACK **Basalt** SLIDE

32. Basalt is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.06)

BACK **Andesite** SLIDE

33. Andesite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.07)

BACK **Obsidian** SLIDE

34. Obsidian has glassy texture. (2.3.3.08)

BACK **Scoria** SLIDE

35. Scoria has vesicular texture. (2.3.3.09)

BACK **Pumice** SLIDE

36. How is pumice different from scoria? (2.3.3.10) It is less dense and lighter colored than scoria.

BACK **Tuff** SLIDE

37. Tuff has pyroclastic texture. (2.3.3.11)

BACK **Breccia** SLIDE

38. What is volcanic breccia? (2.3.3.12) igneous rock with large, angular fragments of volcanic material

CHAPTER TOPICS

2.4 Sedimentary Rocks MORE INFO

39. Sedimentary rocks form from the accumulation of sediment at the earth's surface. (2.4)

1. Origins of sedimentary rocks MORE INFO

40. List the three ways sedimentary rocks can form. (2.4.1)

grains of pre-existing rocks

chemical processes

organic processes

SLIDES

41. How is detritus classified? (2.4.1.1a) by grain size

NEXT

42. Conglomerate is an example of a detrital sedimentary rock. (2.4.1.1b)

BACK BACK SLIDE 1

43. Microcrystalline limestone is an example of a chemically formed sedimentary rock. (2.4.1.2)

BACK SLIDE 2

44. List two examples of organically formed sedimentary rocks. (2.4.1.3)
fossiliferous limestone coal

CHAPTER TOPICS

2.4 Sedimentary Rocks MORE INFO

2. Classification MORE INFO

45. Detrital sediment has clastic texture, whereas chemical and organic sediments have a non-clastic texture. (2.4.2)

1. Clastic texture MORE INFO

46. Clastic rocks are named according to their grain size and shape. (2.4.2.1)

SLIDE 1

47. Conglomerates are coarse-grained clastic rocks with rounded grains. Breccias are coarse-grained clastic rocks with angular grains. (2.4.2.1.1)

BACK SLIDE 2

48. What rock is formed by medium-sized grains in clastic sedimentary rock? (2.4.2.1.2) sandstone

BACK

49. What rocks are formed by fine grains in clastic sedimentary rock? (2.4.2.1)
mudrocks, including siltstone, and shale

SLIDE 3 BACK BACK

2. Non-clastic texture MORE INFO

50. List three non-clastic sedimentary rocks. (2.4.2.2)
fossiliferous limestone chert
coal

SLIDE BACK BACK

3. Composition MORE INFO

51. List eight minerals commonly found in sedimentary rocks. (2.4.2.3)

quartz	calcite
clay minerals	dolomite
gypsum	halite
feldspar	mica

quartz SLIDE

52. List two sedimentary rocks that commonly contain quartz. (2.4.2.3.1)

sandstone	chert

BACK calcite SLIDE

53. Limestone is a common sedimentary rock that contains calcite. (2.4.2.3.2)

BACK clay minerals SLIDE

54. Clay minerals usually form fine-grained rocks like shale. (2.4.2.3.3)

BACK dolomite SLIDE

55. Dolomite forms the rock dolostone. (2.4.2.3.4)

BACK gypsum and halite SLIDE

56. Gypsum and halite are common examples of evaporitic sedimentary rocks. (2.4.2.3.5)

BACK feldspar and mica SLIDE

57. Feldspar and mica are common minerals found in detrital sedimentary rocks. (2.4.2.3.6)

CHAPTER TOPICS

2.4 Sedimentary Rocks MORE INFO

2. Common sedimentary rocks MORE INFO

Conglomerate SLIDE

58. How would you identify conglomerate? (2.4.3.1) gravel-sized, rounded grains

BACK Sandstone SLIDE

59. How would you identify sandstone? (2.4.3.2) sandy feel and grain size

BACK Shale SLIDE

60. How would you identify shale? (2.4.3.3) fine grains and the way it splits apart along thin layers

BACK Limestone SLIDE

61. How would you identify limestone? (2.4.3.4) it fizzes with dilute hydrochloric acid; it commonly contains fossils

BACK Dolostone SLIDE

62. How would you identify dolostone? (2.4.3.5) scratches on the surface will react to dilute hydrochloric acid

BACK Chert SLIDE

63. How would you identify chert? (2.4.3.6) it makes sparks when struck against steel

CHAPTER TOPICS

2.4 Sedimentary Rocks MORE INFO

3. Special sedimentary rocks MORE INFO

64. Travertine is a calcite-rich rock found in cave formations. (2.4.4)

SLIDE 1 BACK

65. Chalk is a kind of limestone. (2.4.4)

SLIDE 2 BACK

66. Coquina is made of weakly cemented, broken animal shells. (2.4.4)

SLIDE 3 BACK

67. Coal is made up of compacted ancient vegetation formed in swamps. (2.4.4)

CHAPTER TOPICS

2.5 Metamorphic Rocks MORE INFO

68. What does *metamorphic* mean? (2.5) changed form

1. Agents of metamorphic change MORE INFO

69. List the three agents of metamorphic change. (2.5.1)

    heat pressure chemical activity

70. What is the range of temperatures at which metamorphism occurs? (2.5.1) 300 and 1470 degrees Fahrenheit

71. List three sources of heat for metamorphism. (2.5.1)

    magma friction along faults geothermal heat

72. List two sources of pressure. (2.5.1)

    Weight of overlying rocks shearing pressure from faults

73. List three functions of water in metamorphism. (2.5.1)

dissolves existing rocks transports dissolves materials

catalyze chemical changes

BACK

2. Classification MORE INFO

1. Foliated texture MORE INFO

74. In foliated texture, mineral grains from pre-existing rock are oriented parallel to each other. (2.5.2.1)

SLIDE 1 BACK

75. Slaty texture is characterized by fine grains and rocks that split apart easily. (2.5.2.1)

SLIDE 2 BACK

76. Phyllitic texture is characterized by fine grains and shiny, crinkled surfaces. (2.5.2.1)

SLIDE 3 BACK

77. Schistose rocks have visible grains and commonly contain mica. (2.5.2.1)

SLIDE 4 BACK

78. Gneissic rocks have minerals separated into light and dark bands. (2.5.2.1)

BACK

2. Non-foliated texture MORE INFO

79. Give three examples of metamorphic rocks with non-foliated texture. (2.5.2.2)

marble quartzite

soapstone

SLIDE BACK BACK

3. Composition MORE INFO

80. List five common minerals found in metamorphic rocks. (2.5.2.3)

quartz _____ feldspar _____

mica _____ calcite _____

hornblende _____

SLIDE 1

81. Put the four rocks below in order of increasing intensity of metamorphism. Use 1 for low-grade metamorphism and 4 for high-grade. (2.5.2.3.1)

3 schist 2 phyllite 4 gneiss 1 slate

BACK

82. Explore slides 2 – 6. Then match each index mineral with its description.

E chlorite	A. Blue crystals, high grade
D epidote	B. Dark and red-brown crystals, medium grade
B garnet	C. Brown crystals, medium to high grade
C staurolite	D. Green crystals, low to medium grade
A kyanite	E. Green color, low grade

CHAPTER TOPICS

2.5 Metamorphic Rocks MORE INFO

3. Common metamorphic rocks MORE INFO

Slate SLIDE

83. Slate forms from the metamorphism of the rock shale. (2.5.3.1)

BACK **Phyllite** SLIDE

84. Phyllite is more / less (circle one) metamorphosed than shale. (2.5.3.2)

BACK **Schist** SLIDE

85. How does schist usually look? (2.5.3.3) shiny and crinkled

BACK **Gneiss** SLIDE

86. How would you identify gneiss? (2.5.3.4) alternating bands of light and dark minerals

BACK **Amphibolite** SLIDE

87. Amphibolite is a hornblende-rich foliated metamorphic rock. (2.5.3.5)

BACK **Marble** SLIDE

88. Marble is metamorphosed limestone or dolomite. (2.5.3.6)

BACK **Quartzite** SLIDE

89. Quartzite is metamorphosed sandstone. (2.5.3.7)

BACK **Soapstone** SLIDE

90. Soapstone is composed of the mineral talc. (2.5.3.8)

CHAPTER TOPICS

2.6 Rocks in Virginia MORE INFO

1. Igneous rocks MORE INFO

91. In which two provinces are most of Virginia's igneous rocks found? (2.6.1a) Piedmont Blue Ridge

SLIDE 1

92. Where in Virginia could you find granite batholiths? List two cities. (2.6.1.1) Richmond and Martinsville

BACK SLIDE 2

93. In which two Virginia counties can you find the large crystals of pegmatites? (2.6.1.2) Amelia County Bedford County

BACK SLIDE 3

94. Where in Virginia can you find rhyolite lava and tuff? (2.6.1.3) Mount Rogers or Grayson County or Grayson Highlands State Park

BACK SLIDE 4

95. Where in Virginia can you find basalt and diabase? (2.6.1.4) Mesozoic Basins, Piedmont, and/or Culpeper County

BACK NEXT SLIDE

96. What Valley and Ridge county has unusual occurrences of igneous rocks? (2.6.1.5) Highland County

CHAPTER TOPICS

2.6 Rocks in Virginia MORE INFO

2. Sedimentary rocks MORE INFO

97. List the four areas where you can find sedimentary rocks in Virginia? (2.6.2a)

Coastal Plain Mesozoic Basins

Valley and Ridge Appalachian Plateaus

98. The Coastal Plain is underlain mainly by mud, sand, and gravel. (2.6.2a)

SLIDES NEXT

99. Who reportedly used a cave in the Yorktown Coquina for storing weapons? (2.6.2.1b) General Cornwallis

BACK BACK

100. List three sedimentary rocks found in the Mesozoic Basins. (2.6.2a)

conglomerate sandstone

shale

SLIDE BACK NEXT

101. List three sedimentary rocks that are common in Valley and Ridge valleys. (2.6.2b) Limestone dolomite

Shale

102. List two sedimentary rocks that are common on Valley and Ridge ridges. (2.6.2b)

sandstone conglomerate

SLIDE 1 BACK

103. List two sedimentary rocks found in the Appalachian Plateaus. (2.6.2b)

Any two of conglomerate, sandstone, shale, limestone, or coal

104. Coal is a major economic product in the Appalachian Plateaus. (2.6.2b)

SLIDE 2

CHAPTER TOPICS

2.6 Rocks in Virginia MORE INFO

3. Metamorphic rocks MORE INFO

105. In which two Virginia provinces can you find the most metamorphic rocks? (2.6.3a) Blue Ridge Piedmont

SLIDE 1

106. What is the Buckingham County slate used for? (2.6.3.1) roofing shingles

BACK SLIDE 2

107. What are augens? (2.6.3.2) eye-shaped mineral grains in metamorphic rocks

BACK SLIDE 3

108. What soft metamorphic rock is quarried in Albemarle County? (2.6.3.3) soapstone

BACK NEXT SLIDE 1

109. Where can you go to see an excellent exposure of greenstone of the Catoctin Formation? (2.6.3.4) Afton Mountain along Interstate 64

BACK SLIDE 2

110. What is unakite? (2.6.3.5) metamorphosed granite

111. List three minerals that make up unakite. (2.6.3.5) pink orthoclase feldspar, gray smoky quartz, and green epidote

You have reached the end of the Rocks chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

ROCKS: *Student Worksheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Rocks** from the Table of Contents.
- For an introduction click SLIDES.
- Click CHAPTER TOPICS to begin the chapter.

2.1 Rock Basics MORE INFO

1. Define *rock*. (2.1) _____

_____

_____

SLIDE

What minerals make up this sample of granite? (2.1.1) _____

_____

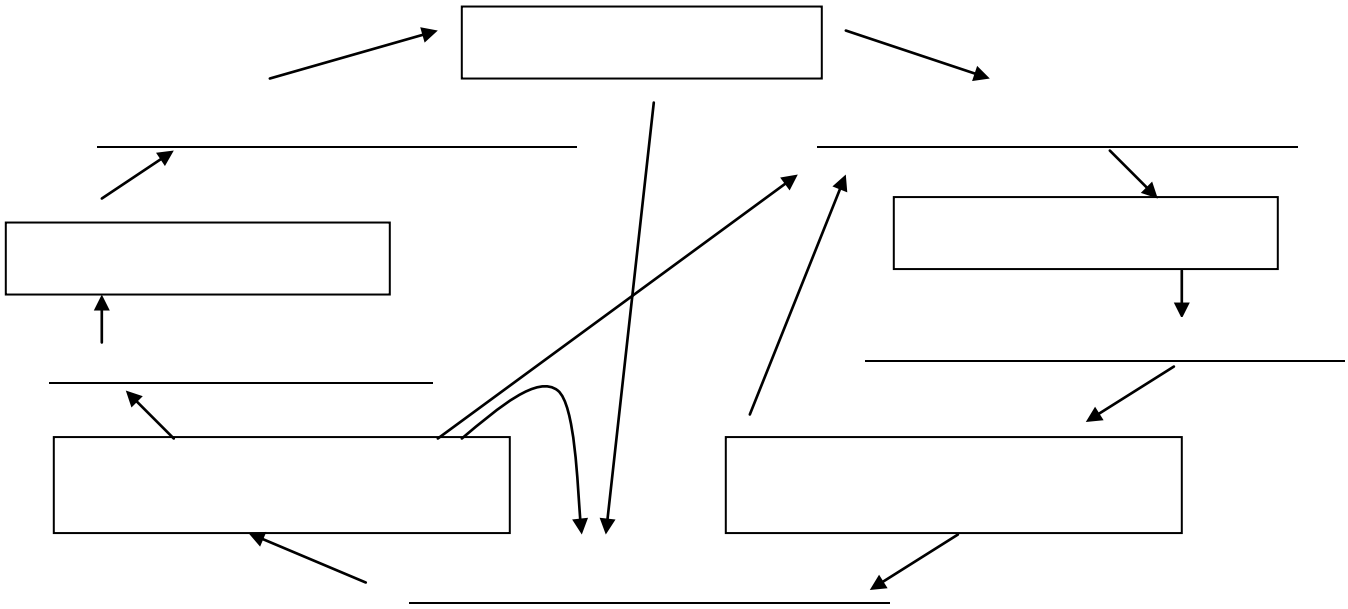
CHAPTER TOPICS

2.2 Rock Cycle MORE INFO

3. The rock cycle shows the _____ among the three major rock types. (2.2)

SLIDE

4. Fill in the blanks and boxes to represent the rock cycle. (2.2.1)



CHAPTER TOPICS

2.3 Igneous Rocks MORE INFO

5. Igneous rocks formed from _____ material. (2.3)

1. Extrusive and intrusive MORE INFO

6. Where do extrusive igneous rocks form? (2.3.1a) _____

_____

SLIDE 1

7. A smooth, shiny, ropy lava flow is called _____. (2.3.1.1)

BACK SLIDE 2

8. A _____ _____ is made up of broken pieces of volcanic material. (2.3.1.2)

BACK SLIDE 3

9. This ancient _____ _____ flowed over large parts of Virginia about 570 million years ago. (2.3.1.3)

BACK

10. List three types of extrusive igneous rocks. (2.3.1a)

_____ _____

_____

NEXT

11. Where do intrusive igneous rocks form? (2.3.1b) _____

_____

SLIDE BACK

12. List four types of intrusive igneous rocks. (2.3.1b)

_____ _____

_____ _____

SLIDE

CHAPTER TOPICS

2.3 Igneous Rocks MORE INFO

2. Classification MORE INFO

13. The classification of igneous rocks is based on _____ and _____. (2.3.2)

1. Texture MORE INFO

14. What mainly determines the texture of an igneous rock? (2.3.2.1a) _____

_____

SLIDE 1

15. _____ igneous rocks have crystals large enough to be seen with the naked eye. (2.3.2.1.1)

BACK SLIDE 2

16. _____ igneous rocks have crystals too small to be seen with the naked eye. (2.3.2.1.2)

BACK NEXT SLIDE 1

17. _____ igneous rocks have crystals of very different sizes. (2.3.2.1.3)

BACK SLIDE 2

18. Igneous rocks with _____ texture contain holes made by gas bubbles in lava. (2.3.2.1.4)

BACK SLIDE 3

19. Igneous rocks made up of broken fragments have _____ texture. (2.3.2.1.5)

BACK SLIDE 4

20. _____ are igneous rocks with very large crystals. (2.3.2.1.6)

CHAPTER TOPICS

2.3 Igneous Rocks MORE INFO

2. Classification MORE INFO

2. Composition MORE INFO

21. Dark-colored minerals form _____ igneous rocks. (2.3.2.2)

SLIDES 1

22. List two mafic minerals. (2.3.2.2.1a) _____

_____

NEXT

23. _____ is an example of mafic igneous rock. (2.3.2.2.1b)

BACK BACK

24. Light-colored minerals form _____ igneous rocks. (2.3.2.2)

SLIDES 2

25. List two felsic minerals. (2.3.2.2.2a) _____

_____

NEXT

26. _____ is an example of a felsic igneous rock.

CHAPTER TOPICS

2.3 Igneous Rocks MORE INFO

3. Common igneous rocks MORE INFO

Granite SLIDE

27. Granite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.01)

BACK Gabbro SLIDE

28. Gabbro is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.02)

BACK Diorite SLIDE

29. Diorite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.03)

BACK Peridotite SLIDE

30. Peridotite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.04)

BACK Rhyolite SLIDE

31. Rhyolite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.05)

BACK Basalt SLIDE

32. Basalt is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.06)

BACK Andesite SLIDE

33. Andesite is aphanitic / phaneritic (circle one) and mafic / intermediate / felsic (circle one). (2.3.3.07)

BACK Obsidian SLIDE

34. Obsidian has glassy texture. (2.3.3.08)

BACK Scoria SLIDE

35. Scoria has vesicular texture. (2.3.3.09)

BACK **Pumice** SLIDE

36. How is pumice different from scoria? (2.3.3.10) _____

_____

_____

BACK **Tuff** SLIDE

37. Tuff has _____ texture. (2.3.3.11)

BACK **Breccia** SLIDE

38. What is volcanic breccia? (2.3.3.12) _____

_____

_____

CHAPTER TOPICS

2.4 Sedimentary Rocks MORE INFO

39. Sedimentary rocks form from the accumulation of _____ at the earth's surface. (2.4)

1. Origins of sedimentary rocks MORE INFO

40. List the three ways sedimentary rocks can form. (2.4.1)

_____

_____

_____

SLIDES

41. How is detritus classified? (2.4.1.1a) _____

NEXT

42. _____ is an example of a detrital sedimentary rock. (2.4.1.1b)

BACK BACK SLIDE 1

43. _____ _____ is an example of a chemically formed sedimentary rock. (2.4.1.2)

BACK SLIDE 2

44. List two examples of organically formed sedimentary rocks. (2.4.1.3)

_____ _____

CHAPTER TOPICS

2.4 Sedimentary Rocks MORE INFO

2. Classification MORE INFO

45. Detrital sediment has _____ texture, whereas chemical and organic sediments have a _____ texture. (2.4.2)

1. Clastic texture MORE INFO

46. Clastic rocks are named according to their _____ _____ and _____. (2.4.2.1)

SLIDE 1

47. _____ are coarse-grained clastic rocks with rounded grains. _____ are coarse-grained clastic rocks with angular grains. (2.4.2.1.1)

BACK SLIDE 2

48. What rock is formed by medium-sized grains in clastic sedimentary rock? (2.4.2.1.2) _____

BACK

49. What rocks are formed by fine grains in clastic sedimentary rock? (2.4.2.1)

_____

SLIDE 3 BACK BACK

2. Non-clastic texture MORE INFO

50. List three non-clastic sedimentary rocks. (2.4.2.2)

_____ _____

_____

SLIDE BACK BACK

3. Composition MORE INFO

51. List eight minerals commonly found in sedimentary rocks. (2.4.2.3)

_____ _____

_____ _____

_____ _____

_____ _____

quartz SLIDE

52. List two sedimentary rocks that commonly contain quartz. (2.4.2.3.1)

_____ _____

BACK calcite SLIDE

53. _____ is a common sedimentary rock that contains calcite. (2.4.2.3.2)

BACK clay minerals SLIDE

54. Clay minerals usually form fine-grained rocks like _____. (2.4.2.3.3)

BACK dolomite SLIDE

55. Dolomite forms the rock _____. (2.4.2.3.4)

BACK gypsum and halite SLIDE

56. Gypsum and halite are common examples of _____ sedimentary rocks. (2.4.2.3.5)

BACK feldspar and mica SLIDE

57. Feldspar and mica are common minerals found in _____ sedimentary rocks. (2.4.2.3.6)

CHAPTER TOPICS

2.4 Sedimentary Rocks MORE INFO

2. Common sedimentary rocks MORE INFO

Conglomerate SLIDE

58. How would you identify conglomerate? (2.4.3.1) _____

_____

BACK Sandstone SLIDE

59. How would you identify sandstone? (2.4.3.2) _____

_____

BACK Shale SLIDE

60. How would you identify shale? (2.4.3.3) _____

_____

_____

BACK Limestone SLIDE

61. How would you identify limestone? (2.4.3.4) _____

_____

_____

BACK Dolostone SLIDE

62. How would you identify dolostone? (2.4.3.5) _____

_____

_____

BACK Chert SLIDE

63. How would you identify chert? (2.4.3.6) _____

_____

_____

CHAPTER TOPICS

2.4 Sedimentary Rocks MORE INFO

3. Special sedimentary rocks MORE INFO

64. Travertine is a calcite-rich rock found in _____ formations. (2.4.4)

SLIDE 1 BACK

65. Chalk is a kind of _____. (2.4.4)

SLIDE 2 BACK

66. Coquina is made of weakly cemented, broken _____ _____. (2.4.4)

SLIDE 3 BACK

67. Coal is made up of compacted ancient _____ formed in swamps. (2.4.4)

CHAPTER TOPICS

2.5 Metamorphic Rocks MORE INFO

68. What does *metamorphic* mean? (2.5) _____

1. Agents of metamorphic change MORE INFO

69. List the three agents of metamorphic change. (2.5.1)

_____ _____

_____

70. What is the range of temperatures at which metamorphism occurs? (2.5.1) _____

_____

71. List three sources of heat for metamorphism. (2.5.1)

_____ _____

_____

72. List two sources of pressure. (2.5.1)

_____ _____

73. List three functions of water in metamorphism. (2.5.1)

_____ _____

_____

BACK

2. Classification MORE INFO

1. Foliated texture MORE INFO

74. In foliated texture, mineral grains from pre-existing rock are oriented _____ to each other. (2.5.2.1)

SLIDE 1 BACK

75. _____ texture is characterized by fine grains and rocks that split apart easily. (2.5.2.1)

SLIDE 2 BACK

76. _____ texture is characterized by fine grains and shiny, crinkled surfaces. (2.5.2.1)

SLIDE 3 BACK

77. _____ rocks have visible grains and commonly contain mica. (2.5.2.1)

SLIDE 4 BACK

78. _____ rocks have minerals separated into light and dark bands. (2.5.2.1)

BACK

2. Non-foliated texture MORE INFO

79. Give three examples of metamorphic rocks with non-foliated texture. (2.5.2.2)

_____ _____

_____

SLIDE BACK BACK

3. Composition MORE INFO

80. List five common minerals found in metamorphic rocks. (2.5.2.3)

_____ _____

_____ _____

_____

SLIDE 1

81. Put the four rocks below in order of increasing intensity of metamorphism. Use 1 for low-grade metamorphism and 4 for high-grade. (2.5.2.3.1)

_____ schist _____ phyllite _____ gneiss _____ slate

BACK

82. Explore slides 2 – 6. Then match each index mineral with its description.

_____ chlorite	A. Blue crystals, high grade
_____ epidote	B. Dark and red-brown crystals, medium grade
_____ garnet	C. Brown crystals, medium to high grade
_____ staurolite	D. Green crystals, low to medium grade
_____ kyanite	E. Green color, low grade

CHAPTER TOPICS

2.5 Metamorphic Rocks MORE INFO

3. Common metamorphic rocks MORE INFO

Slate SLIDE

83. Slate forms from the metamorphism of the rock _____. (2.5.3.1)

BACK **Phyllite** SLIDE

84. Phyllite is more / less (circle one) metamorphosed than shale. (2.5.3.2)

BACK **Schist** SLIDE

85. How does schist usually look? (2.5.3.3) _____

BACK **Gneiss** SLIDE

How would you identify gneiss? (2.5.3.4) _____

_____

_____

BACK **Amphibolite** SLIDE

87. Amphibolite is a _____-rich foliated metamorphic rock. (2.5.3.5)

BACK **Marble** SLIDE

88. Marble is metamorphosed _____. (2.5.3.6)

BACK **Quartzite** SLIDE

89. Quartzite is metamorphosed _____. (2.5.3.7)

BACK **Soapstone** SLIDE

90. Soapstone is composed of the mineral _____. (2.5.3.8)

CHAPTER TOPICS

2.6 Rocks in Virginia MORE INFO

1. Igneous rocks MORE INFO

91. In which two provinces are most of Virginia's igneous rocks found? (2.6.1a)

_____ _____

SLIDE 1

92. Where in Virginia could you find granite batholiths? List two cities. (2.6.1.1)

_____

BACK SLIDE 2

93. In which two Virginia counties can you find the large crystals of pegmatites? (2.6.1.2) _____ _____

BACK SLIDE 3

94. Where in Virginia can you find rhyolite lava and tuff? (2.6.1.3) _____

_____

BACK SLIDE 4

95. Where in Virginia can you find basalt and diabase? (2.6.1.4) _____

_____

BACK NEXT SLIDE

96. What Valley and Ridge county has unusual occurrences of igneous rocks? (2.6.1.5) _____

CHAPTER TOPICS

2.6 Rocks in Virginia MORE INFO

2. Sedimentary rocks MORE INFO

97. List the four areas where you can find sedimentary rocks in Virginia? (2.6.2a)

_____ _____

_____ _____

98. The Coastal Plain is underlain mainly by _____, _____, and _____. (2.6.2a)

SLIDES NEXT

99. Who reportedly used a cave in the Yorktown Coquina for storing weapons? (2.6.2.1b) _____

BACK BACK

100. List three sedimentary rocks found in the Mesozoic Basins. (2.6.2a)

_____ _____

_____

SLIDE BACK NEXT

List three sedimentary rocks that are common in Valley and Ridge valleys. (2.6.2b) _____ _____

_____

List two sedimentary rocks that are common on Valley and Ridge ridges. (2.6.2b)

_____ _____

SLIDE 1 BACK

103. List two sedimentary rocks found in the Appalachian Plateaus. (2.6.2b)

_____ _____

104. _____ is a major economic product in the Appalachian Plateaus. (2.6.2b)

SLIDE 2

CHAPTER TOPICS

2.6 Rocks in Virginia MORE INFO

3. Metamorphic rocks MORE INFO

105. In which two Virginia provinces can you find the most metamorphic rocks? (2.6.3a) _____ _____

SLIDE 1

106. What is the Buckingham County slate used for? (2.6.3.1) _____

_____

BACK SLIDE 2

107. What are augens? (2.6.3.2) _____

_____

BACK SLIDE 3

108. What soft metamorphic rock is quarried in Albemarle County? (2.6.3.3)

_____

BACK NEXT SLIDE 1

109. Where can you go to see an excellent exposure of greenstone of the Catoctin Formation? (2.6.3.4) _____

_____

BACK SLIDE 2

110. What is unakite? (2.6.3.5) _____

111. List three minerals that make up unakite. (2.6.3.5) _____

_____

You have reached the end of the Rocks chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

FOSSILS AND GEOLOGIC TIME: *Lesson Plan*

Subject/Grade
Earth Science 6-12

Goals of Lesson
Students will use the Fossils and Geologic Time chapter of *Geology of Virginia CD-ROM 1: Introduction and Geologic Background* to comprehend and apply concepts of Earth Science Standards of Learning (SOLs) number 10 required by the State of Virginia.

Lesson Objectives
The student will investigate and understand that many aspects of the history and evolution of the Earth and life can be inferred by studying rocks and fossils including traces or remains of ancient, often extinct, life are preserved by various means in many sedimentary rocks; superposition, cross-cutting relationships; absolute and relative dating have different applications but can be used together to determine the age of rocks and structures; and rocks and fossils from many different geologic periods and epochs are found in Virginia.

Materials/Resources Needed/Class Time:
- *Geology of Virginia CD-ROM 1: Introduction and Geologic Background*
- PC Computer with Windows 3.1 or Windows 95
- Computer with CD-ROM Drive 4.0 X or higher; 133 MHz processor with 32 MB RAM or higher
- Fossils and Geologic Time Worksheets
- Worksheets will take 2-3 (50 min) class periods.

Activities/Tasks/Procedures:
- Students using the interactive, educational, multimedia CD-ROM will actively learn about fossils.
- Students will answer questions on worksheets as they proceed through the CD-ROM.

Provisions for Individual Differences:
- Students will advance through the CD-ROM at their own pace
- Students needing more time may install the CD-ROM on a single computer in the classroom.

Evaluation:
- Students will complete worksheets and finish the chapter on fossils
- Students may use the CD-ROM as a review for a chapter test or for the State Standards of Learning (SOL) test in Earth Science
- CD-ROM 1 may be used as a substitute for notes or lecture.

FOSSILS AND GEOLOGIC TIME: *Teacher Answer Sheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Fossils and Geologic Time** from the Table of Contents.
- For an introduction click SLIDES.
- Click CHAPTER TOPICS to begin the chapter.

3.1 Fossil Basics MORE INFO

1. What is a fossil? (3.1a) a life form or evidence of a life form preserved in an ancient rock

SLIDE 1 BACK

2. Traces of life such as tracks, trails, burrows, and coprolites are called ichnofossils. (3.1a)

SLIDE 2 BACK

3. How old must a fossil be? (3.1a) at least 10,000 years old

NEXT

4. Why are soft-bodied animals difficult to find fossilized? (3.1b) Their bodies decay quickly.

SLIDE 1 BACK

5. Many fossils in rocks are destroyed by weathering and erosion. (3.1b)

SLIDE 2

6. What kind of rocks are fossils generally found in? (3.1b) sedimentary

CHAPTER TOPICS

3.2 Methods of Preservation MORE INFO

7. What is petrifaction? (3.2) when the organism's original material is replaced with minerals

SLIDE 1

8. Name two minerals that are common in petrifaction. (3.2.1)
   silica calcite

BACK

9. Permineralization is the type of fossilization that occurs when holes in the original material are filled with minerals. (3.2)

SLIDE 2 BACK

10. How can soft tissues be preserved? (3.2) as carbon films or by carbonization

SLIDE 3 BACK

11. Cavities in rock that are the same shape as organisms are called molds. When these are filled with new material, the forms are called casts. (3.2)

SLIDE 4

12. In this photograph, the square contains a mold and the oval contains a cast. (3.2.4)

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

1. Fossil names MORE INFO

13. How many names do organisms have in the binomial system of scientific nomenclature? (3.3.1) two

14. How are organisms organized in scientific nomenclature? (3.3.1) groups related by certain basic features

SLIDE 1

15. What class do humans belong to? (3.3.1.1) Mammalia

BACK

16. The genus and species name for humans is *Homo sapiens*. (3.3.1)

SLIDE 2

17. What is Virginia's state fossil? (3.3.1.2) *Chesapecten jeffersonius*

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

2. Invertebrate animals MORE INFO

18. Invertebrate animals do not have backbones. (3.3.2)

Protozoans SLIDE

19. Protozoans are single-celled aquatic organisms. (3.3.2.1)

BACK **Porifera** SLIDE

20. Porifera are commonly known as sponges, and are multicellular aquatic organisms. (3.3.2.2)

BACK **Corals** SLIDE

21. Corals can be solitary or colonial organisms. (3.3.2.3)

BACK **Bryozoans** SLIDE

22. Bryozoans are also called "moss animals." (3.3.2.4)

23. What is this specimen of bryozoan called? (3.3.2.4) *Archimedes*

BACK **Brachiopods** SLIDE

24. Brachiopods resemble clams, but are in a completely different phylum. (3.3.2.5)

BACK **Mollusks** SLIDE

25. Mollusks include such groups as cephalopods, pelecypods, and gastropods. (3.3.2.6)

BACK **Echinoderms** SLIDE

26. List three important fossil groups of echinoderms. (3.3.2.7)

crinoids blastoids echinoids

BACK **Arthropods** SLIDE

27. What two familiar groups of animals are arthropods? (3.3.2.8)

insects spiders

28. List three important fossil groups of arthropods. (3.3.2.8)

trilobites eurypterids ostracods

BACK **Graptolites** SLIDE

29. Graptolites may have been transitional between the invertebrates and vertebrates. (3.3.2.9)

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

3. Vertebrate animals MORE INFO

30. Vertebrate animals all have backbones. (3.3.3a)

31. What parts of fishes are often fossilized? (3.3.3a) skeletons, scales, and teeth

SLIDE 1 BACK

32. What parts of amphibians are often fossilized? (3.3.3a) footprints and skeletons

33. What class do dinosaurs belong to? (3.3.3a) reptiles

SLIDE 2

34. Dinosaurs lived only during the Mesozoic. How long ago was the Mesozoic? (3.3.3.2) 245 to 66.4 million years ago

BACK NEXT

35. Birds are common / rare (circle one) as fossils. (3.3.3b)

36. What parts of mammals are commonly fossilized? (3.3.3b) bones and teeth

SLIDE

37. What kind of mammal fossil was found in Westmoreland County? (3.3.3.3) whale

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

4. Plants MORE INFO

38. Plants can live underwater as well as on dry land. (3.3.4a)

39. Stromatolites are laminated structures formed by colonies of bacteria called cyanobacteria. (3.3.4a)

SLIDE 1

40. Stromatolites are the oldest fossil forms on earth. How long have stromatolites lived on earth? (3.3.4.1) 3.5 billion years (That's a long time!)

BACK

41. Coccoliths and diatoms are plant fossils from plankton, microscopic floating marine organisms. (3.3.4a)

42. Lycopsids, or scale trees are common in coal beds. (3.3.4a)

SLIDE 2

43. Where in Virginia would you look for scale tree fossils? (3.3.4.2) southwestern Virginia in the coal fields

BACK NEXT

44. Horsetails and scouring rushes belong to a group called sphenopsids. (3.3.4b)

SLIDE

45. Sphenopsids have existed since the Devonian. How long ago was the Devonian? (3.3.4.3) 408 to 360 million years ago

BACK

46. Where would you look for fern fossils? (3.3.4b) late Paleozoic coal beds

SLIDES NEXT

47. The fossil *Glossopteris*, a seed fern, has been used as evidence to support the theory of continental drift. (3.3.4.4b)

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

5. Ichnofossils MORE INFO

48. What are tracks? (3.3.5) fossilized footprints

SLIDE 1 BACK

49. Trails are fossilized structures created by ancient worms and worm-like animals moving around on soft material. (3.3.5)

SLIDE 2 BACK SLIDE 3

50. Burrows are common in Paleozoic sandstones in Virginia. How long ago was the Paleozoic? (3.3.5.3) 570 to 245 million years ago

CHAPTER TOPICS

3.4 Selected Virginia Fossils MORE INFO

51. The oldest Coastal Plain fossils date from the Cretaceous. How long ago was the Cretaceous? (3.4a) 144 to 66.4 million years ago

SLIDE 1

52. List the three kinds of Coastal Plain fossils shown here. (3.4.1) tree, mollusks, and whale vertebra

BACK

53. How long ago was the Jurassic, when some Mesozoic Basins fossils were formed? (3.4a) 208 to 144 million years ago

54. Compare your answers from question 46 and 48. Which fossils are older? Coastal Plain or Mesozoic Basin (circle one) (3.4a)

SLIDE 2

55. List two types of fossils that have been found in the Mesozoic Basins. (3.4.2) dinosaur fish

BACK

56. The Valley and Ridge contain fossils from the Cambrian to the Mississippian. (3.4a)

SLIDE 3

57. List two types of fossils that have been found in the Valley and Ridge. (3.4.3) brachiopods plants

BACK

58. The Appalachian Plateaus area is famous for its plant fossils in coal beds. (3.4.1)

SLIDE 4

59. List two types of fossils found in the Appalachian Plateaus. (3.4.4) scale trees ferns

BACK NEXT

60. Why are fossils in metamorphic rocks rare? (3.4b) most fossils are destroyed when rocks are metamorphosed

SLIDE

61. What kind of fossil is shown in the specimen from the metamorphic rocks in Buckingham County? (3.4b) crinoid

BACK

62. Saltville fossils date from the late Pleistocene. How long ago was the Pleistocene? (3.4b) 1.6 million years ago to 10,000 years ago

SLIDES

63. Name two large mammals that have been found at Saltville. (3.4.6a)

musk ox mastadon

NEXT

64. What rocks did early humans in the Saltville area use for knives and scrapers? (3.4.6b) rhyolite and flint

CHAPTER TOPICS

3.5 Tips for Fossil Collecting MORE INFO

65. Write three rules or suggestion for fossil collecting. (3.5) student answers will vary

BACK

3.6 Geologic Time MORE INFO

66. List the two methods geologists use to determine how old a fossil or rock is. (3.6)

Relative age-dating Absolute age-dating

67. A method used to determine when an event happened compared to another event is called relative age-dating. (3.6)
68. A method used to determine how long ago an event occurred is called absolute age-dating. (3.6)

1. Relative age-dating MORE INFO

69. The principle of superposition states that the oldest layers of rock are found at the bottom of a sequence and the youngest are at the top. (3.6.1a)

SLIDE 1

70. The youngest layers of rock in the photograph are at the top / bottom (circle one). (3.6.1.1)

BACK

71. If a fault or intrusion cuts layers of rock, which is older? (3.6.1a)
fault or intrusion / layers of rock (circle one)

SLIDE 2

72. Where in Virginia can you see cross-cutting relationships where igneous intrusions cut sedimentary rocks? (3.6.1.2) Highland County

BACK **NEXT**

73. What are unconformities? (3.6.1b) surfaces in rocks caused by erosion or non-deposition that represent missing time

SLIDE 1

74. How big is the time gap in the unconformity in this photograph? (3.6.1.3)
500 million years

BACK

75. List three methods geologists use to determine the relative ages of rocks. (3.6.1b)
superposition
unconformities
cross-cutting relationships

SLIDE 2

76. The rocks in layer 6 are older / younger (circle one) than the rocks in layer 7. (3.6.1.4)

77. Which is older? Dike A / Dike B (circle one) (3.6.1.4)

78. Which of the three relative age-dating methods (see question 67) did you use to determine your answer to question 69? (3.6.1.4) cross-cutting relationships

79. If geologists can determine that the age of the fault is about 155 million years old, how old must layer 12 be? (3.6.1.4) younger than 155 million years old

CHAPTER TOPICS

3.6 Geologic Time MORE INFO

2. Absolute age-dating MORE INFO

80. Geologists use radioactivity to determine absolute ages of rocks. (3.6.2)
81. Uranium is the parent to the daughter lead. (3.6.2)

SLIDE

82. Geologists compare the amount of the parent material to the amount of the daughter material to determine the absolute age. (3.6.2.1)

CHAPTER TOPICS

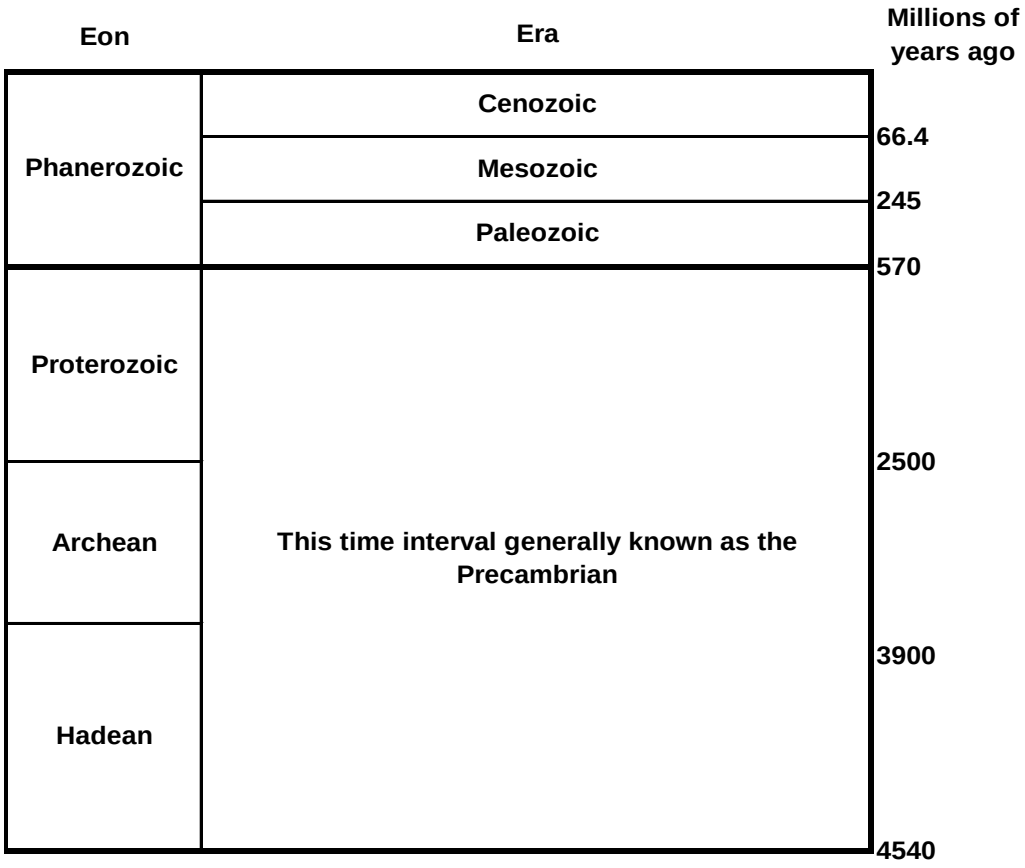
3.6 Geologic Time MORE INFO

3. Geologic time scale MORE INFO

83. Cambrian and Devonian rocks are named for places in Great Britain. (3.6.3)
84. The present geologic time scale divides the history of the earth into eons, eras, periods, and epochs. (3.6.3)

SLIDE

85. Click the left section of the chart. Then fill in the blanks on the chart below.



BACK

86. Click the middle section of the chart. Then fill in the blanks on the chart below.

Era	Period		Millions of years ago
Cenozoic	Quaternary		1.6
	Tertiary		66.4
Mesozoic	Cretaceous		144
	Jurassic		208
	Triassic		245
Paleozoic	Permian		286
	Carboniferous	Pennsylvanian	320
		Mississippian	360
	Devonian		408
	Silurian		438
	Ordovician		505
	Cambrian		570

BACK

87. Click the right section of the chart. Then fill in the blanks on the chart below.

Period	Epoch	Millions of years ago
Quaternary	Holocene	
	Pleistocene	0.01
Tertiary	Pliocene	1.6
	Miocene	5.3
	Oligocene	23.7
	Eocene	36.6
	Paleocene	57.8
		66.4

You have reached the end of the Fossils and Geologic Time chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

FOSSILS AND GEOLOGIC TIME: *Student Worksheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Fossils and Geologic Time** from the Table of Contents.
- For an introduction click SLIDES.
- Click CHAPTER TOPICS to begin the chapter.

3.1 Fossil Basics MORE INFO

1. What is a fossil? (3.1a) _____

_____

_____

SLIDE 1 BACK

2. Traces of life such as tracks, trails, burrows, and coprolites are called _____. (3.1a)

SLIDE 2 BACK

3. How old must a fossil be? (3.1a) _____

NEXT

4. Why are soft-bodied animals difficult to find fossilized? (3.1b) _____

_____

_____

SLIDE 1 BACK

5. Many fossils in rocks are destroyed by _____ and _____. (3.1b)

SLIDE 2

6. What kind of rocks are fossils generally found in? (3.1b) _____

CHAPTER TOPICS

3.2 Methods of Preservation MORE INFO

7. What is petrifaction? (3.2) _____

_____

_____

SLIDE 1

8. Name two minerals that are common in petrifaction. (3.2.1)

_____ _____

BACK

9. _____ is the type of fossilization that occurs when holes in the original material are filled with minerals. (3.2)

SLIDE 2 BACK

10. How can soft tissues be preserved? (3.2) _____

_____

SLIDE 3 BACK

11. Cavities in rock that are the same shape as organisms are called _____. When these are filled with new material, the forms are called _____. (3.2)

SLIDE 4

12. In this photograph, the square contains a _____ and the oval contains a _____. (3.2.4)

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

1. Fossil names MORE INFO

13. How many names do organisms have in the binomial system of scientific nomenclature? (3.3.1) _____

14. How are organisms organized in scientific nomenclature? (3.3.1) _____

_____

_____

SLIDE 1

15. What class do humans belong to? (3.3.1.1) _____

BACK

16. The genus and species name for humans is _____ _____. (3.3.1)

SLIDE 2

17. What is Virginia's state fossil? (3.3.1.2) _____

_____

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

2. Invertebrate animals MORE INFO

18. Invertebrate animals do not have _____. (3.3.2)

Protozoans SLIDE

19. Protozoans are _____-celled aquatic organisms. (3.3.2.1)

BACK **Porifera** SLIDE

20. Porifera are commonly known as _____, and are _____ aquatic organisms. (3.3.2.2)

BACK **Corals** SLIDE

21. Corals can be _____ or _____ organisms. (3.3.2.3)

BACK **Bryozoans** SLIDE

22. Bryozoans are also called "_____ _____." (3.3.2.4)

23. What is this specimen of bryozoan called? (3.3.2.4) _____

BACK **Brachiopods** SLIDE

24. Brachiopods resemble _____, but are in a completely different phylum. (3.3.2.5)

BACK **Mollusks** SLIDE

25. Mollusks include such groups as _____,
_____, and _____. (3.3.2.6)

BACK **Echinoderms** SLIDE

26. List three important fossil groups of echinoderms. (3.3.2.7)

_____ _____ _____

BACK **Arthropods** SLIDE

27. What two familiar groups of animals are arthropods? (3.3.2.8)

_____ _____

28. List three important fossil groups of arthropods. (3.3.2.8)

_____ _____ _____

BACK **Graptolites** SLIDE

29. Graptolites may have been transitional between the _____
and _____. (3.3.2.9)

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

3. Vertebrate animals MORE INFO

30. Vertebrate animals all have _____. (3.3.3a)
31. What parts of fishes are often fossilized? (3.3.3a) _____
_____

SLIDE 1 BACK

32. What parts of amphibians are often fossilized? (3.3.3a) _____
_____
33. What class do dinosaurs belong to? (3.3.3a) _____

SLIDE 2

34. Dinosaurs lived only during the Mesozoic. How long ago was the Mesozoic?
(3.3.3.2) _____

BACK NEXT

35. Birds are common / rare (circle one) as fossils. (3.3.3b)
36. What parts of mammals are commonly fossilized? (3.3.3b) _____

_____

SLIDE

37. What kind of mammal fossil was found in Westmoreland County? (3.3.3.3)

_____

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

4. Plants MORE INFO

38. Plants can live _____ as well as on dry land. (3.3.4a)
39. _____ are laminated structures formed by colonies of bacteria called cyanobacteria. (3.3.4a)

SLIDE 1

40. Stromatolites are the oldest fossil forms on earth. How long have stromatolites lived on earth? (3.3.4.1) _____ (That's a long time!)

BACK

41. Coccoliths and diatoms are plant fossils from _____, microscopic floating marine organisms. (3.3.4a)
42. Lycopsids, or _____ _____ are common in coal beds. (3.3.4a)

SLIDE 2

43. Where in Virginia would you look for scale tree fossils? (3.3.4.2) _____

_____

BACK NEXT

44. Horsetails and scouring rushes belong to a group called _____. (3.3.4b)

SLIDE

45. Sphenopsids have existed since the Devonian. How long ago was the Devonian? (3.3.4.3) _____

BACK

46. Where would you look for fern fossils? (3.3.4b) _____

_____

SLIDES NEXT

47. The fossil *Glossopteris*, a seed fern, has been used as evidence to support the theory of _____ _____. (3.3.4.4b)

CHAPTER TOPICS

3.3 Important Plant and Animal Fossils MORE INFO

5. Ichnofossils MORE INFO

48. What are tracks? (3.3.5) _____

SLIDE 1 BACK

49. _____ are fossilized structures created by ancient worms and worm-like animals moving around on soft material. (3.3.5)

SLIDE 2 BACK SLIDE 3

50. Burrows are common in Paleozoic sandstones in Virginia. How long ago was the Paleozoic? (3.3.5.3) _____

CHAPTER TOPICS

3.4 Selected Virginia Fossils MORE INFO

51. The oldest Coastal Plain fossils date from the Cretaceous. How long ago was the Cretaceous? (3.4a) _____

SLIDE 1

52. List the three kinds of Coastal Plain fossils shown here. (3.4.1) _____

_____

BACK

53. How long ago was the Jurassic, when some Mesozoic Basins fossils were formed? (3.4a) _____

54. Compare your answers from question 46 and 48. Which fossils are older? Coastal Plain or Mesozoic Basin (circle one) (3.4a)

SLIDE 2

55. List two types of fossils that have been found in the Mesozoic Basins. (3.4.2)

_____ _____

BACK

56. The Valley and Ridge contain fossils from the _____ to the _____. (3.4a)

SLIDE 3

57. List two types of fossils that have been found in the Valley and Ridge. (3.4.3)

_____ _____

BACK

58. The Appalachian Plateaus area is famous for its _____ fossils in coal beds. (3.4.1)

SLIDE 4

59. List two types of fossils found in the Appalachian Plateaus. (3.4.4)

_____ _____

BACK **NEXT**

60. Why are fossils in metamorphic rocks rare? (3.4b) _____

_____

SLIDE

61. What kind of fossil is shown in the specimen from the metamorphic rocks in Buckingham County? (3.4b) _____

BACK

62. Saltville fossils date from the late Pleistocene. How long ago was the Pleistocene? (3.4b) _____

SLIDES

63. Name two large mammals that have been found at Saltville. (3.4.6a)

_____ _____

NEXT

64. What rocks did early humans in the Saltville area use for knives and scrapers? (3.4.6b) _____

CHAPTER TOPICS

3.5 Tips for Fossil Collecting MORE INFO

65. Write three rules or suggestion for fossil collecting. (3.5) _____

_____

_____

_____

_____

_____

_____

_____

BACK

3.6 Geologic Time MORE INFO

66. List the two methods geologists use to determine how old a fossil or rock is. (3.6)

_____ _____

67. A method used to determine when an event happened compared to another event is called _____ age-dating. (3.6)
68. A method used to determine how long ago an event occurred is called _____ age-dating. (3.6)

1. Relative age-dating MORE INFO

69. The principle of _____ states that the oldest layers of rock are found at the bottom of a sequence and the youngest are at the top. (3.6.1a)

SLIDE 1

70. The youngest layers of rock in the photograph are at the top / bottom (circle one). (3.6.1.1)

BACK

71. If a fault or intrusion cuts layers of rock, which is older? (3.6.1a)
    fault or intrusion / layers of rock (circle one)

SLIDE 2

72. Where in Virginia can you see cross-cutting relationships where igneous intrusions cut sedimentary rocks? (3.6.1.2) _____

BACK NEXT

73. What are unconformities? (3.6.1b) _____

_____

_____

SLIDE 1

74. How big is the time gap in the unconformity in this photograph? (3.6.1.3)

_____

BACK

75. List three methods geologists use to determine the relative ages of rocks. (3.6.1b)

_____

_____

_____

SLIDE 2

76. The rocks in layer 6 are older / younger (circle one) than the rocks in layer 7. (3.6.1.4)
77. Which is older? Dike A / Dike B (circle one) (3.6.1.4)
78. Which of the three relative age-dating methods (see question 67) did you use to determine your answer to question 69? (3.6.1.4) _____

_____

79. If geologists can determine that the age of the fault is about 155 million years old, how old must layer 12 be? (3.6.1.4) _____

_____

CHAPTER TOPICS

3.6 Geologic Time MORE INFO

2. Absolute age-dating MORE INFO

80. Geologists use _____ to determine absolute ages of rocks. (3.6.2)
81. Uranium is the parent to the daughter _____. (3.6.2)

SLIDE

82. Geologists compare the amount of the _____ material to the amount of the _____ material to determine the absolute age. (3.6.2.1)

CHAPTER TOPICS

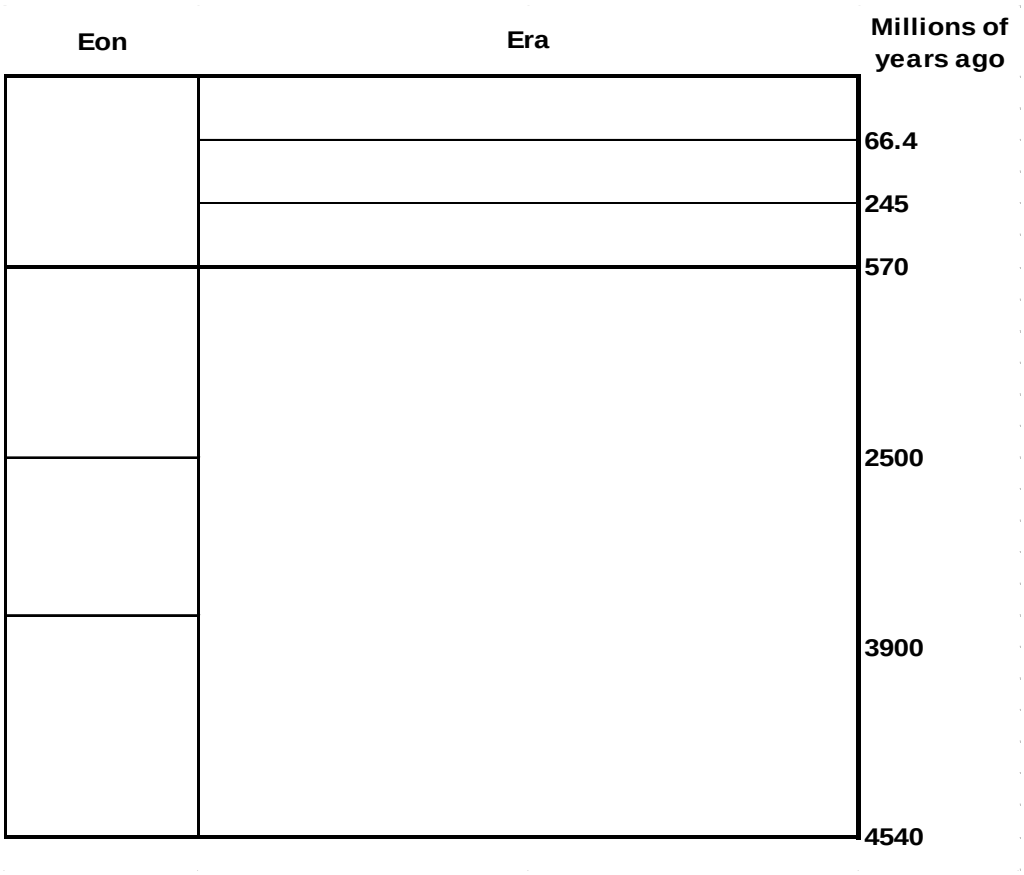
3.6 Geologic Time MORE INFO

3. Geologic time scale MORE INFO

83. Cambrian and Devonian rocks are named for places in _____ _____. (3.6.3)
84. The present geologic time scale divides the history of the earth into _____, _____, _____, and _____. (3.6.3)

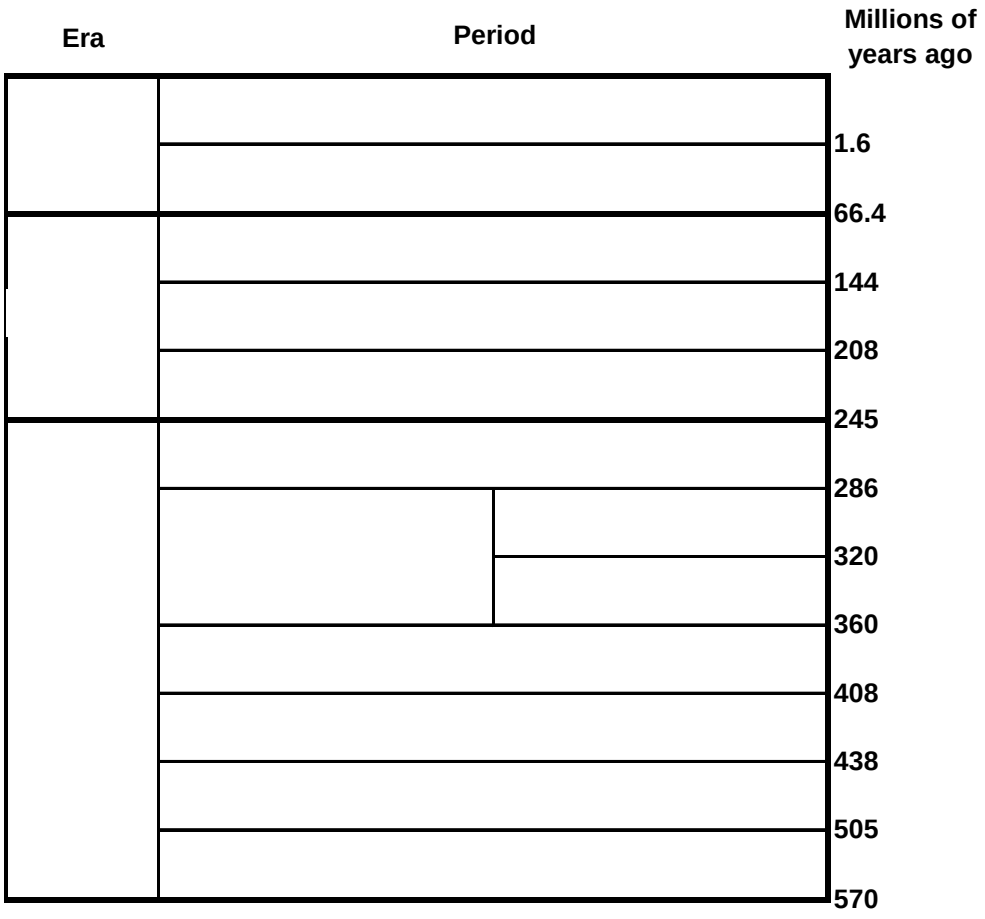
SLIDE

85. Click the left section of the chart. Then fill in the blanks on the chart below.



BACK

86. Click the middle section of the chart. Then fill in the blanks on the chart below.



BACK

87. Click the right section of the chart. Then fill in the blanks on the chart below.

You have reached the end of the Fossils and Geologic Time chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

STRUCTURES IN ROCKS: *Lesson Plan*

Subject/Grade
Earth Science 6-12

Goals of Lesson
Students will use the Structures in Rocks chapter of *Geology of Virginia CD-ROM 1: Introduction and Geologic Background* to comprehend and apply concepts of Earth Science Standards of Learning (SOLs) numbers 3 and 8 required by the State of Virginia.

Lesson Objectives
The student will investigate and understand geologic process including how geologic processes are evidenced in the physiographic provinces of Virginia; faulting, folding, metamorphism, deposition and sedimentation and their resulting features. The student will read and interpret geologic and topographic maps.

Materials/Resources Needed/Class Time:
- *Geology of Virginia CD-ROM 1: Introduction and Geologic Background*
- PC Computer with Windows 3.1 or Windows 95
- Computer with CD-ROM Drive 4.0 X or higher; 133 MHz processor with 32 MB RAM or higher
- Structures in Rocks Worksheets
- Worksheets will take 2-3 (50 min) class periods.

Activities/Tasks/Procedures:
- Students using the interactive, educational, multimedia CD-ROM will actively learn about geologic processes
- Students will answer questions on worksheets as they proceed through the CD-ROM

Provisions for Individual Differences:
- Students will advance through the CD-ROM at their own pace
- Students needing more time may install the CD-ROM on a single computer in the classroom.

Evaluation:
- Students will complete worksheets and finish the chapter on minerals
- Students may use the CD-ROM as a review for a chapter test or for the State Standards of Learning (SOL) test in Earth Science
- CD-ROM 1 may be used as a substitute for notes or lecture.

STRUCTURES IN ROCKS: *Teacher Answer Sheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Structures in Rocks** from the Table of Contents.
- For an introduction click SLIDES.
- Click CHAPTER TOPICS to begin the chapter.

4.1 Forces MORE INFO

1. What are stresses? (4.1a) forces that deform rocks

2. What are strains? (4.1a) changes in the volumes or shapes of rocks resulting from stress

NEXT

3. List three types of stress. (4.1b) tension
   compression shear stress

SLIDE 1

4. Normal faults are caused by tension. (4.1.1)

BACK

5. Compression pushes rocks together. (4.1a)

SLIDE 2 BACK

6. Shear stress pushes rocks horizontally past each other. (4.1b)

CHAPTER TOPICS

4.2 Geologic Structures MORE INFO

7. What are the two basic groups of geologic structures? (4.2)
   brittle ductile
8. Brittle structures are formed by fracturing or breaking rocks. Two examples of this kind of structure are joints and faults. (4.2)

9. Ductile structures are formed by bending, compressing, or stretching rocks. Four examples of this kind of structure are anticlines, synclines, domes, and basins. (4.2)

1. Joints MORE INFO

10. Define joints. (4.2.1) fractures or cracks in rock along which *no movement* has occurred

11. List three resources that can be stored in joints. (4.2.1) water oil natural gas

SLIDE 1

12. Which resource moved through the joint in the photograph? (4.2.1.1) water

BACK

13. Rocks can slide along joints. (4.2.1.2)

SLIDE 2

CHAPTER TOPICS

4.2 Geologic Structures MORE INFO

2. Faults MORE INFO

14. What are faults? (4.2.2a) fractures or cracks in rock along which movement *has* occurred

SLIDE

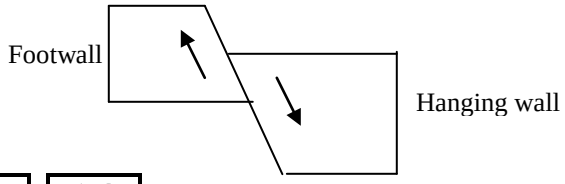
15. If you could stand on a fault plane in the middle of a faulted rock, the footwall would be below you and the hanging wall would be above you. (4.2.2.1)

BACK

16. A normal fault is a fault in which the hanging wall has moved up / down (circle one) relative to the footwall. (4.2.2a)

SLIDES 1

17. Normal faults are the result of tensional stress. (4.2.2.2a)
18. Draw a normal fault and label the hanging wall and footwall. Include arrows that indicate the movement of the fault. (4.2.2.2a)

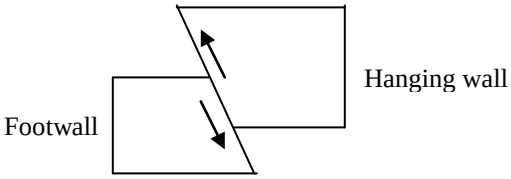


NEXT BACK BACK

19. A reverse fault is a fault in which the hanging wall has moved up / down (circle one) relative to the footwall. (4.2.2a)

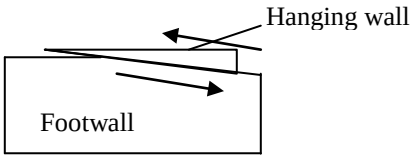
SLIDES 2

20. Reverse faults are the result of compressional stress. (4.2.2.3a)
21. Draw a reverse fault and label the hanging wall and footwall. Include arrows that indicate the movement of the fault. (4.2.2.3a)



NEXT BACK BACK

22. Reverse faults with low angles are called thrust faults. (4.2.2a)
23. Draw a thrust fault and label the hanging wall and footwall. Include arrows that indicate the movement of the fault. (4.2.2.4a)



SLIDES 3

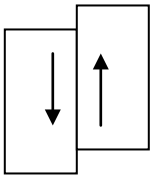
24. When might a thrust fault form? (4.2.2.4a) when tectonic plates come together to form mountains

NEXT BACK BACK NEXT

25. Strike-slip faults form where rocks slide past each other in a horizontal plane. (4.2.2b)

SLIDES

26. Draw a strike-slip fault. Include arrows that indicate the movement of the fault. (4.2.2.5a)



Map view

27. These faults are caused by shear stress. (4.2.2.5a)

NEXT BACK BACK

28. What important resources can travel along faults? (4.2.2b) oil or water

SLIDE 1

29. How can you tell that water has flowed out of the fault exposure in this photograph? (4.2.2.6) iron stains on the rock

BACK

30. Rocks can slide along faults. (4.2.2b)

SLIDE 2

31. Faults can create planes of weakness along which rocks can slide. (4.2.2.7)

BACK

32. Faults cause earthquakes when the rocks suddenly move. (4.2.2b)
33. Virginia has many faults and some of those faults are active. Can Virginia have earthquakes? (4.2.2b) Yes / No (Circle one.)

CHAPTER TOPICS

4.2 Geologic Structures MORE INFO

3. Anticlines and synclines MORE INFO

34. Anticlines and synclines are the up and down folds caused by compressional stress. (4.2.3)

SLIDES

35. Anticlines form the shape of the letter A; synclines form the shape of the bottom of the letter S. (4.2.3.1a)

NEXT

36. After erosion has occurred, the oldest rocks are in the center of anticlines / synclines (circle one), and the youngest rocks are in the center of anticlines / synclines (circle one). (4.2.3.1b)

NEXT

37. Sharp anticlines and synclines are called chevron folds. (4.2.3.1c)

BACK BACK BACK

38. Anticlines curve upward / downward (circle one). (4.2.3)

SLIDE 1

39. The steep cliffs that are part of the Iron Gate anticline in Alleghany County are made up of sandstone. (4.2.3.2)

BACK

40. Synclines curve upward / downward (circle one). (4.2.3)

SLIDE 2

41. Where is the syncline in this photograph? (4.2.3.3) Pulaski County

CHAPTER TOPICS

4.2 Geologic Structures MORE INFO

4. Domes and basins MORE INFO

42. Domes are caused by compression and uplift and resemble anticlines. (4.2.4)

SLIDES

43. Domes arch upward / downward (circle one). (4.2.4.1a)
44. When domes erode, the oldest / youngest (circle one) rocks are in the center of the structure. (4.2.4.1a)

NEXT

45. Where in Virginia is there an excellent example of a geologic dome? (4.2.4.1b) Burkes Garden, in Tazewell County

BACK BACK

46. Basins are caused by compression and downwarping and resemble synclines. (4.2.4)

SLIDE

47. Basins arch upward / downward (circle one). (4.2.4.2)
48. When basins erode, the oldest / youngest (circle one) rocks are in the center of the structure. (4.2.4.2)

CHAPTER TOPICS

4.3 Mapping Geologic Structures MORE INFO

1. Strike and dip MORE INFO

49. Strike and dip measure the orientation and slope of a rock. (4.3.1)
50. Geologists use these measurements to map geologic structures. (4.3.1)

SLIDES

51. What is the strike of these rock layers? (4.3.1.1a) due North

52. What is the dip of these rock layers? (4.3.1.1a) 75 degrees East

NEXT

53. Strike and dip symbols on a geologic map represent strikes and dips measured in the field. (4.3.1.1b)

BACK BACK

54. Define dip. (4.3.1) the angle between horizontal and the slope of the rock

55. Define strike. (4.3.1) the orientation of a horizontal line drawn perpendicular to the dip

CHAPTER TOPICS

4.3 Mapping Geologic Structures MORE INFO

2. Geologic maps and cross sections MORE INFO

56. Why are geologic maps important? Tell one reason. (4.3.2) answers will vary, but should include one of the following reasons: understanding geologic structures, finding economic minerals, and avoiding hazards

57. What do geologic maps show? (4.3.2) types and ages of rock exposed at the earth's surface, and also structures

SLIDE 1

58. Each color on a geologic map represents a different type or age of rock. (4.3.2.1)

59. Abbreviations for formations on geologic maps stand for the ages of the rocks and the formation name. (4.3.2.1)

BACK

60. What do cross sections show? (4.3.2) the geology of a vertical plane below the earth's surface

SLIDE 2

61. Geologic cross sections are representations of geologic structures found underground. (4.3.2.2)

CHAPTER TOPICS

4.4 Structures in Virginia Rocks MORE INFO

62. List five structures that can be found in Virginia. (4.4a)

anticlines
synclines
faults
domes
basins

SLIDE 1

63. Match the Virginia province with its geologic structures. (4.4.1)

D	Valley and Ridge	A. faults and gently dipping layers
E	Blue Ridge & Piedmont	B. nearly flat-lying layers
B	Appalachian Plateaus	C. layers dip toward ocean
C	Coastal Plain	D. folded and faulted sedimentary layers
A	Mesozoic Basins	E. folded and faulted metamorphic and igneous rocks

BACK

64. The Coastal Plain is underlain by beds dipping gently toward the ocean. (4.4a)

SLIDE 2

65. What may have caused some of the faulting in the Coastal Plain? (4.4.2) a meteorite that fell to the earth about 35 million years ago

BACK

66. In the Piedmont, folding and faulting have occurred, creating structures in the rocks there. (4.4a)

SLIDE 3

67. What two types of rocks are most commonly found in the Piedmont? (4.4.3)

igneous metamorphic

BACK

68. Structures in the Mesozoic Basins include tilted sedimentary rocks and large normal faults. (4.4a)

SLIDE 4

69. What is the approximate dip of these Mesozoic Basin rocks? (4.4.4) about 30º

BACK **NEXT**

70. Folds and faults are present in Blue Ridge rocks. (4.4b)

SLIDE 1

71. The Blue Ridge is underlain by intensely deformed igneous and metamorphic rocks. (4.4.5)

BACK

72. List three structures found in the Valley and Ridge of Virginia. (4.4b)

anticlines synclines thrust faults

SLIDE 2

73. In which Virginia county were these structures photographed? (4.4.6) Botetourt County

BACK

74. The Appalachian Plateaus are underlain by nearly flat-lying sedimentary rocks. (4.4b)

SLIDE 3

75. Flat-lying sedimentary rocks of the Appalachian Plateaus can be seen at Breaks Interstate Park in Dickenson County. (4.4.7)

You have reached the end of the Structures in Rocks chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

STRUCTURES IN ROCKS: *Student Worksheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Structures in Rocks** from the Table of Contents.
- For an introduction click SLIDES.
- Click CHAPTER TOPICS to begin the chapter.

4.1 Forces MORE INFO

1. What are stresses? (4.1a) _____

   _____

2. What are strains? (4.1a) _____

   _____

   _____

NEXT

List three types of stress. (4.1b) _____

_____ _____

SLIDE 1

4. _____ faults are caused by tension. (4.1.1)

BACK

5. _____ pushes rocks together. (4.1a)

SLIDE 2 BACK

6. _____ _____ pushes rocks horizontally past each other. (4.1b)

CHAPTER TOPICS

4.2 Geologic Structures MORE INFO

7. What are the two basic groups of geologic structures? (4.2)

   _____ _____

8. _____ structures are formed by fracturing or breaking rocks. Two examples of this kind of structure are _____ and _____. (4.2)

9. _____ structures are formed by bending, compressing, or stretching rocks. Four examples of this kind of structure are _____, _____, _____, and _____. (4.2)

1. Joints MORE INFO

10. Define joints. (4.2.1) _____

_____

_____

11. List three resources that can be stored in joints. (4.2.1) _____

_____ _____

SLIDE 1

12. Which resource moved through the joint in the photograph? (4.2.1.1) _____

_____

BACK

13. Rocks can _____ along joints. (4.2.1.2)

SLIDE 2

CHAPTER TOPICS

4.2 Geologic Structures MORE INFO

2. Faults MORE INFO

14. What are faults? (4.2.2a) _____

_____

_____

SLIDE

15. If you could stand on a fault plane in the middle of a faulted rock, the _____ would be below you and the _____ would be above you. (4.2.2.1)

BACK

16. A normal fault is a fault in which the hanging wall has moved up / down (circle one) relative to the footwall. (4.2.2a)

SLIDES 1

17. Normal faults are the result of _____ stress. (4.2.2.2a)
18. Draw a normal fault and label the hanging wall and footwall. Include arrows that indicate the movement of the fault. (4.2.2.2a)

NEXT BACK BACK

19. A reverse fault is a fault in which the hanging wall has moved up / down (circle one) relative to the footwall. (4.2.2a)

SLIDES 2

20. Reverse faults are the result of _____ stress. (4.2.2.3a)
21. Draw a reverse fault and label the hanging wall and footwall. Include arrows that indicate the movement of the fault. (4.2.2.3a)

NEXT BACK BACK

22. Reverse faults with low angles are called _____ faults. (4.2.2a)
23. Draw a thrust fault and label the hanging wall and footwall. Include arrows that indicate the movement of the fault. (4.2.2.4a)

SLIDES 3

24. When might a thrust fault form? (4.2.2.4a) _____

_____

_____

NEXT BACK BACK NEXT

25. _____ faults form where rocks slide past each other in a horizontal plane. (4.2.2b)

SLIDES

26. Draw a strike-slip fault. Include arrows that indicate the movement of the fault. (4.2.2.5a)

27. These faults are caused by _____ stress. (4.2.2.5a)

NEXT BACK BACK

28. What important resources can travel along faults? (4.2.2b) _____

_____

SLIDE 1

29. How can you tell that water has flowed out of the fault exposure in this photograph? (4.2.2.6) _____

BACK

30. Rocks can _____ along faults. (4.2.2b)

SLIDE 2

31. Faults can create _____ of _____ along which rocks can slide. (4.2.2.7)

BACK

32. Faults cause _____ when the rocks suddenly move. (4.2.2b)
33. Virginia has many faults and some of those faults are active. Can Virginia have earthquakes? (4.2.2b) Yes / No (Circle one.)

CHAPTER TOPICS

4.2 Geologic Structures MORE INFO

3. Anticlines and synclines MORE INFO

34. Anticlines and synclines are the up and down folds caused by _____ stress. (4.2.3)

SLIDES

35. Anticlines form the shape of the letter _____; synclines form the shape of the bottom of the letter _____. (4.2.3.1a)

NEXT

36. After erosion has occurred, the oldest rocks are in the center of anticlines / synclines (circle one), and the youngest rocks are in the center of anticlines / synclines (circle one). (4.2.3.1b)

NEXT

37. Sharp anticlines and synclines are called chevron _____ folds. (4.2.3.1c)

BACK BACK BACK

38. Anticlines curve upward / downward (circle one). (4.2.3)

SLIDE 1

39. The steep cliffs that are part of the Iron Gate anticline in Alleghany County are made up of _____. (4.2.3.2)

BACK

40. Synclines curve upward / downward (circle one). (4.2.3)

SLIDE 2

41. Where is the syncline in this photograph? (4.2.3.3) _____

_____

CHAPTER TOPICS

4.2 Geologic Structures MORE INFO

4. Domes and basins MORE INFO

42. Domes are caused by _____ and _____ and resemble anticlines. (4.2.4)

SLIDES

43. Domes arch upward / downward (circle one). (4.2.4.1a)
44. When domes erode, the oldest / youngest (circle one) rocks are in the center of the structure. (4.2.4.1a)

NEXT

45. Where in Virginia is there an excellent example of a geologic dome? (4.2.4.1b)

_____

BACK BACK

46. Basins are caused by _____ and _____ and resemble synclines. (4.2.4)

SLIDE

47. Basins arch upward / downward (circle one). (4.2.4.2)
48. When basins erode, the oldest / youngest (circle one) rocks are in the center of the structure. (4.2.4.2)

CHAPTER TOPICS

4.3 Mapping Geologic Structures MORE INFO

1. Strike and dip MORE INFO

49. Strike and dip measure the _____ and _____ of a rock. (4.3.1)
50. Geologists use these measurements to map _____ _____. (4.3.1)

SLIDES

51. What is the strike of these rock layers? (4.3.1.1a) _____

52. What is the dip of these rock layers? (4.3.1.1a) _____

NEXT

53. Strike and dip symbols on a geologic map represent strikes and dips _____ in the _____. (4.3.1.1b)

BACK BACK

54. Define dip. (4.3.1) _____

_____

_____

55. Define strike. (4.3.1) _____

_____

_____

CHAPTER TOPICS

4.3 Mapping Geologic Structures MORE INFO

2. Geologic maps and cross sections MORE INFO

56. Why are geologic maps important? Tell one reason. (4.3.2) _____

_____

_____

_____

57. What do geologic maps show? (4.3.2) _____

_____

_____

SLIDE 1

58. Each _____ on a geologic map represents a different type or age of rock. (4.3.2.1)

59. Abbreviations for formations on geologic maps stand for the _____ of the rocks and the _____ _____. (4.3.2.1)

BACK

60. What do cross sections show? (4.3.2) _____

_____

_____

SLIDE 2

61. Geologic _____ _____ are representations of geologic structures found underground. (4.3.2.2)

CHAPTER TOPICS

4.4 Structures in Virginia Rocks MORE INFO

62. List five structures that can be found in Virginia. (4.4a)

_____ _____

_____ _____

_____

SLIDE 1

63. Match the Virginia province with its geologic structures. (4.4.1)

_____ Valley and Ridge	A. faults and gently dipping layers
_____ Blue Ridge & Piedmont	B. nearly flat-lying layers
_____ Appalachian Plateaus	C. layers dip toward ocean
_____ Coastal Plain	D. folded and faulted sedimentary layers
_____ Mesozoic Basins	E. folded and faulted metamorphic and igneous rocks

BACK

64. The Coastal Plain is underlain by _____

_____

_____. (4.4a)

SLIDE 2

65. What may have caused some of the faulting in the Coastal Plain? (4.4.2) a_____

_____

_____

BACK

66. In the Piedmont, _____ and _____ have occurred, creating structures in the rocks there. (4.4a)

SLIDE 3

67. What two types of rocks are most commonly found in the Piedmont? (4.4.3)

_____ _____

BACK

68. Structures in the Mesozoic Basins include tilted sedimentary rocks and large _____ _____. (4.4a)

SLIDE 4

69. What is the approximate dip of these Mesozoic Basin rocks? (4.4.4) _____

BACK NEXT

70. _____ and _____ are present in Blue Ridge rocks. (4.4b)

SLIDE 1

71. The Blue Ridge is underlain by intensely deformed _____ and _____ rocks. (4.4.5)

BACK

72. List three structures found in the Valley and Ridge of Virginia. (4.4b)

_____ _____ _____

SLIDE 2

73. In which Virginia county were these structures photographed? (4.4.6) _____

_____

BACK

74. The Appalachian Plateaus are underlain by nearly flat-lying _____ rocks. (4.4b)

SLIDE 3

75. Flat-lying sedimentary rocks of the Appalachian Plateaus can be seen at _____ _____ Park in Dickenson County. (4.4.7)

You have reached the end of the Structures in Rocks chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

WEATHERING AND LANDFORMS: *Lesson Plan*

Subject/Grade
Earth Science 6-12

Goals of Lesson
Students will use the Weathering and Landforms chapter of *Geology of Virginia CD-ROM 1: Introduction and Geologic Background* to comprehend and apply concepts of Earth Science Standards of Learning (SOLs) number 9 and parts of 1, 2, 3, and 8 required by the State of Virginia.

Lesson Objectives
The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include soil development; development of karst topography; identification of groundwater zones; sources of freshwater; affect of human usage on water quality; processes of weathering, erosion, deposition, and sedimentation; uses of diagrams, maps and charts; interactions and dynamics of complex earth systems; and using geologic and topographic maps.

Materials/Resources Needed/Class Time:
- *Geology of Virginia CD-ROM 1: Introduction and Geologic Background*
- PC Computer with Windows 3.1 or Windows 95
- Computer with CD-ROM Drive 4.0 X or higher; 133 MHz processor with 32 MB RAM or higher
- Weathering and Landforms Worksheets
- Worksheets will take 3-4 (50 min) class periods.

Activities/Tasks/Procedures:
- Students using the interactive, educational, multimedia CD-ROM will actively learn about weathering and landforms
- Students will answer questions on worksheets as they proceed through the CD-ROM

Provisions for Individual Differences:
- Students will advance through the CD-ROM at their own pace
- Students needing more time may install the CD-ROM on a single computer in the classroom.

Evaluation:
- Students will complete worksheets and finish the chapter on weathering and landforms
- Students may use CD-ROM 1 as a review for a chapter test or for the State Standards of Learning (SOL) test in Earth Science.
- CD-ROM 1 may be used as a substitute for notes or lecture.

WEATHERING AND LANDFORMS: *Teacher Answer Sheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Weathering and Landforms** from the Table of Contents.
- For an introduction click SLIDES.
- Click CHAPTER TOPICS to begin the chapter.

5.1 Weathering MORE INFO

1. Physical weathering MORE INFO

1. What is physical weathering? (5.1.1a) rocks are broken into smaller pieces with no chemical changes

NEXT BACK

2. Using both screens, list four processes that cause physical weathering. (5.1.1a and 5.1.1b)

   frost action — heating and cooling

   exfoliation — organic activity

SLIDE

3. As water freezes, it pushes rocks apart, causing physical weathering. (5.1.1.1)

BACK NEXT

4. What kind of surface shape is caused by exfoliation? (5.1.1b) curved

SLIDE 1 BACK

5. List two ways organic activity can physically weather rocks. (5.1.1b)

   tree roots — burrowing animals

SLIDE 2

CHAPTER TOPICS

5.1 Weathering MORE INFO

2. Chemical weathering MORE INFO

6. Match each chemical weathering process with its definition. (5.1.2)

   B ____ dissolution

   C ____ hydrolysis

   A ____ oxidation

A. oxygen reacts with the original material to create new material
B. water breaks down mineral grains into the elements that make them up
C. elements in water replace elements in the original material, creating a new material

SLIDE 1

7. Natural Bridge is a spectacular example of dissolution in Virginia. (5.1.2.1)
8. Carbonate rocks in the bridge have been dissolved away by groundwater and surface water. (5.1.2.1)

BACK SLIDE 2

9. In this example of hydrolysis, feldspar-rich minerals are becoming soft clays. (5.1.2.2)

BACK SLIDE 3

10. Oxidation is characterized by red, orange, and yellow stains that look like rust. (5.1.2.3)

CHAPTER TOPICS

5.1 Weathering MORE INFO

3. Climate and weathering MORE INFO

11. Climate has an important effect on weathering. (5.1.3)
12. Which type of weathering is dominant in humid and warm climates? (5.1.3)
    chemical weathering

SLIDES

13. Slopes in humid areas tend to be rounded and gentle. (5.1.3.1a)

NEXT

14. In Virginia's humid climate, limestones and shales form valleys, and sandstones and conglomerates form ridges. (5.1.3.1b)

BACK BACK

15. Which type of weathering is dominant in dry and cold regions? (5.1.3)
    physical weathering

SLIDE

16. Landforms in dry areas tend to be sharp and angular. (5.1.3.2)

CHAPTER TOPICS

5.1 Weathering MORE INFO

4. Soil development MORE INFO

17. Match each soil type with its definition. (5.1.4)

A residual soil	A. weathering of bedrock below
C colluvial soil	B. formed on stream deposits
B alluvial soil	C. material that has moved downslope by gravity

SLIDE 1

18. How does "badlands" topography form? (5.1.4.1) from erosion by running water

BACK SLIDE 2

19. Colluvial soil tends to form on steep / gentle slopes (circle one). (5.1.4.2)

BACK SLIDE 3

20. Where in Virginia are alluvial soils very common? (5.1.4.3) Coastal Plain

CHAPTER TOPICS

5.2 Gravity Movements MORE INFO

21. When do gravity movements occur? (5.2a) when soil or rock moves downslope as a result of gravity

22. Gravity movements are also called mass movements or mass wasting. (5.2a)

NEXT BACK

23. Using both screens, match each gravity movement with speed and material. (5.2a and 5.2b)

B landslides	A. rapid; fragments fall through the air
D mudflows and debris flows	B. rapid or slow; soil and/or rock
A rockfalls	C. very slow; soil and rock fragments
C creep	D. rapid; soil, rocks, and water

24. When landslides are made up of mostly soil, they are called slumps. (5.2a)

SLIDE 1

25. Pressure from a slow-moving landslide has pushed this retaining wall downhill. (5.2.1)

BACK SLIDE 2

26. Debris flows occurred in 1995 in Madison County. (5.2.2)

BACK NEXT

27. The rubble that piles up as a result of rock falls is called talus. (5.2b)

SLIDE 1

28. Rocks detach and fall along bedding planes and joint surfaces. (5.2.3)

BACK SLIDE 2

29. Creep causes trees to become curved at their bases. (5.2.4)

CHAPTER TOPICS

5.3 Streams MORE INFO

30. Running water is a major agent in the shaping of continental landscapes. (5.3)

1. Erosion and sedimentation MORE INFO

31. When does erosion occur? (5.3.1) when streams lift fragments from the bottom and sides of the stream beds

SLIDE 1 BACK

32. What does solution mean? (5.3.1) Dissolved minerals are transported in the water

33. What does suspension mean? (5.3.1) Small particles, such as silt, are carried in the water

34. What does traction mean? (5.3.1) Larger particles are rolled, dragged, or pushed along the bottom

SLIDES

35. The plume of brown, muddy water in the photograph has abundant suspended sediment. (5.3.1.2a)

NEXT

36. Boulders in a river are part of the traction load. (5.3.1.2b)

BACK BACK

37. When does deposition occur? (5.3.1) when transported sediment settles to the bottom as stream velocity decreases

SLIDE 2

38. Floodplains are one of the results of deposition of river sediment. (5.3.1.3)

BACK

39. A drop in base level causes a stream to erode lower to a new level. (5.3.1)

SLIDE 3

40. Terraces show former levels of river erosion. (5.3.1.4)

CHAPTER TOPICS

5.3 Streams MORE INFO

2. Drainage MORE INFO

41. What is a drainage basin? (5.3.2) the area that a stream drains

SLIDE 1

42. Name three Virginia drainage basins. (5.3.2.1) answers will vary, but should include three of Potomac-Shenandoah, Rappahannock, York, James, Chowan, Roanoke, New, and/or Tennessee

BACK

43. Two common drainage system shapes are trellis and dendritic. (5.3.2)

SLIDE 2

44. Which type of drainage system shape is found in the Valley and Ridge? (5.3.2.2) trellis
45. Which type of drainage system shape is found in the Appalachian Plateaus? (5.3.2.2) dendritic

BACK

46. Water gaps are steep-walled, narrow valleys cut through ridges by streams. (5.3.2)

SLIDE 3

47. Which streams cut the water gaps shown in these photographs? (5.3.2.3) New River and Little Walker Creek

CHAPTER TOPICS

5.3 Streams MORE INFO

3. Lakes and floods MORE INFO

SLIDE 1

48. List the only two natural lakes in Virginia. (5.3.3.1) Mountain Lake and Lake Drummond

BACK

49. Floods occur when streams rise over the tops of their channels. (5.3.3)

SLIDE 2

CHAPTER TOPICS

5.4 Groundwater MORE INFO

50. Define groundwater. (5.4) fresh water stored beneath the earth's surface in openings in soil and rock

1. Groundwater basics MORE INFO

51. List three types of geologic materials that make good aquifers. (5.4.1) cavernous limestone gravel and sand fractured rocks

SLIDE 1 BACK

52. Water moves through the zone of aeration to the zone of saturation as it becomes groundwater. (5.4.1)
53. The top of the zone of saturation is called the water table. (5.4.1)

SLIDE 2

54. What is the zone of saturation? (5.4.1.2) where openings in soil and rock are completely filled with water

BACK

55. Where the water table intersects the ground surface, springs form. (5.4.1)

SLIDE 3

56. Falling Springs is a spring-fed creek that forms a waterfall. (5.4.1.3)

BACK

57. Hot springs form where heated groundwater flows to the surface. (5.4.1)

SLIDE 4

58. Where can you find hot springs in Virginia? (5.4.1.4) Bath County

CHAPTER TOPICS

5.4 Groundwater MORE INFO

2. Karst topography MORE INFO

59. List four common features of karst topography. (5.4.2)

caves sinkholes

disappearing or sinking streams natural bridges and tunnels

60. Match each karst feature with its description. (5.4.2)

D caves	A. surface depressions
A sinkholes	B. surface streams that flow underground
B disappearing streams	C. parts of a cave roof that remain
C natural bridges and tunnels	D. underground cavities large enough for human exploration

SLIDE 1 BACK SLIDE 2

61. Sinkholes are caused by the collapse of the underlying caverns. (5.4.2.2)

BACK SLIDE 3

62. Sinking Creek, in Giles County, is an example of a disappearing or sinking stream. (5.4.2.3)

BACK SLIDE 4

63. What state park should you visit if you want to see a karst tunnel? (5.4.2.4)

Natural Tunnel State Park

CHAPTER TOPICS

5.4 Groundwater MORE INFO

3. Human activities and groundwater MORE INFO

64. List three ways human activities can harm groundwater. (5.4.3)

polluting it / seepage from toxic materials or hazardous waste

over-pumping

saltwater encroachment

SLIDE 1

65. Why do you think that dumping trash in sinkholes is illegal now? (5.4.3.1)

answers will vary, but should mention groundwater protection from pollution and/or that pollutants can leach out of trash and pollute groundwater

BACK SLIDE 2

66. If pumping occurs faster than groundwater can move into the aquifer, a cone of depression forms. (5.4.3.2)

CHAPTER TOPICS

5.5 Shoreline Waves and Currents MORE INFO

67. Beaches and shorelines are shaped by the erosion, transportation, and deposition activities of waves, tides, and currents. (5.5a)

68. Storm waves can erode beaches and dunes. (5.5a)

SLIDE 1

69. What feature protects shorelines from erosion? (5.5.1) dunes

BACK

70. How can sediment move along a coast? (5.5a) in currents or longshore currents

SLIDE 2

71. Groins are structures built into the water to trap sediment carried by the longshore current. (5.5.2)

BACK

72. List three coastline features formed by the deposition of sediment. (5.5a)
    beaches barrier islands
    spits

SLIDES

73. What kind of sediment usually makes up beaches? (5.5.3a) sand

NEXT

74. What is a barrier island? (5.5.3b) long, narrow bars of sand detached from the mainland
75. How is a spit different from a barrier island? (5.5.3b) they are attached to land

BACK BACK NEXT

76. Tides are the rise and fall of sea level that occur mainly because of the moon's gravity. (5.5b)
77. What are estuaries? (5.5b) bodies of mixed salty and fresh water along coastlines

SLIDES

78. List four major estuaries in Virginia. (5.5.4a)
    Potomac River Rappahannock River
    York River James River

NEXT

79. Drowned river valleys create many estuaries along Virginia's coast. (5.5.4b)

BACK BACK

80. Give two ways that sea level can change over long periods of time. (5.5b)
    More or less water is present in oceans
    Land can uplift or subside (sink)

81. How are glaciers causing sea level to rise? (5.5b) melting glaciers release water, causing sea level to rise

CHAPTER TOPICS

5.6 Wind and Ice MORE INFO

82. Where in Virginia does wind shape the land the most? (5.6) along the shorelines

SLIDE 1

83. Sand fences are built to stabilize dunes on beaches. (5.6.1)

BACK

84. Virginia does not have any glaciers. True / False (circle one) (5.6)

SLIDE 2

85. Boulder fields probably formed when the climate was colder, but were not formed directly by glaciers. (5.6.2)

CHAPTER TOPICS

5.7 Landforms in Virginia MORE INFO

NEXT BACK

86. Using both screens, match each Virginia physiographic province with its landforms. (5.7a and 5.7b)

D Coastal Plain
A Piedmont
E Mesozoic Basins
B Blue Ridge
F Valley and Ridge
C Appalachian Plateaus

A. Low hills and shallow valleys.
B. Long, narrow mountain chain
C. Deep, narrow valleys and steep, rugged mountain sides
D. Low-relief (flat) surface
E. Shallow basins within the Piedmont
F. Long, linear valleys and intervening sharp ridges

SLIDE 1

87. How would you describe the Coastal Plain surface, as shown in the photograph on the left? (5.7.1) answers will vary, but should mention flat and/or featureless

BACK SLIDE 2

88. What does the word *Piedmont* mean literally? (5.7.2) foothills (*pied* means foot; *mont* means mountain)

BACK SLIDE 3

89. The Culpeper Basin at Manassas National Battlefield Park has high / low relief (circle one). (5.7.3)

BACK NEXT SLIDE 1

90. What is the highest point in Virginia? (5.7.4) Mount Rogers

BACK SLIDE 2

91. What landforms make up the Valley and Ridge? (5.7.5) parallel ridges and valleys

BACK SLIDE 3

92. Appalachian Plateaus landforms include rugged mountains and deep valleys. (5.7.6)

You have reached the end of the Weathering and Landforms chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

WEATHERING AND LANDFORMS: *Student Worksheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click NEXT to get to the Table of Contents
- Click on **Weathering and Landforms** from the Table of Contents.
- For an introduction click SLIDES.
- Click CHAPTER TOPICS to begin the chapter.

5.1 Weathering MORE INFO

1. Physical weathering MORE INFO

1. What is physical weathering? (5.1.1a) _____

_____

_____

NEXT BACK

2. Using both screens, list four processes that cause physical weathering. (5.1.1a and 5.1.1b)

_____ _____

_____ _____

SLIDE

3. As water _____, it pushes rocks apart, causing physical weathering. (5.1.1.1)

BACK NEXT

4. What kind of surface shape is caused by exfoliation? (5.1.1b) _____

SLIDE 1 BACK

5. List two ways organic activity can physically weather rocks. (5.1.1b)

_____ _____

SLIDE 2

CHAPTER TOPICS

5.1 Weathering MORE INFO

2. Chemical weathering MORE INFO

6. Match each chemical weathering process with its definition. (5.1.2)

_____ dissolution

_____ hydrolysis

_____ oxidation

D. oxygen reacts with the original material to create new material
E. water breaks down mineral grains into the elements that make them up
F. elements in water replace elements in the original material, creating a new material

SLIDE 1

7. _____ _____ is a spectacular example of dissolution in Virginia. (5.1.2.1)
8. Carbonate rocks in the bridge have been dissolved away by _____ and _____ _____. (5.1.2.1)

BACK SLIDE 2

9. In this example of hydrolysis, feldspar-rich minerals are becoming soft _____. (5.1.2.2)

BACK SLIDE 3

10. Oxidation is characterized by red, orange, and yellow stains that look like _____. (5.1.2.3)

CHAPTER TOPICS

5.1 Weathering MORE INFO

3. Climate and weathering MORE INFO

11. _____ has an important effect on weathering. (5.1.3)
12. Which type of weathering is dominant in humid and warm climates? (5.1.3)

_____

SLIDES

13. Slopes in humid areas tend to be _____ and gentle. (5.1.3.1a)

NEXT

14. In Virginia's humid climate, limestones and shales form _____, and sandstones and conglomerates form _____. (5.1.3.1b)

BACK BACK

15. Which type of weathering is dominant in dry and cold regions? (5.1.3)

_____

SLIDE

16. Landforms in dry areas tend to be _____ and angular. (5.1.3.2)

CHAPTER TOPICS

5.1 Weathering MORE INFO

4. Soil development MORE INFO

17. Match each soil type with its definition. (5.1.4)

_____ residual soil	A. weathering of bedrock below
_____ colluvial soil	B. formed on stream deposits
_____ alluvial soil	C. material that has moved downslope by gravity

SLIDE 1

18. How does "badlands" topography form? (5.1.4.1) _____

_____

BACK SLIDE 2

19. Colluvial soil tends to form on steep / gentle slopes (circle one). (5.1.4.2)

BACK SLIDE 3

20. Where in Virginia are alluvial soils very common? (5.1.4.3) _____

_____

CHAPTER TOPICS

5.2 Gravity Movements MORE INFO

21. When do gravity movements occur? (5.2a) _____

_____

_____

22. Gravity movements are also called _____ _____ or _____ _____. (5.2a)

NEXT BACK

23. Using both screens, match each gravity movement with speed and material. (5.2a and 5.2b)

_____ landslides	A. rapid; fragments fall through the air
_____ mudflows and debris flows	B. rapid or slow; soil and/or rock
_____ rockfalls	C. very slow; soil and rock fragments
_____ creep	D. rapid; soil, rocks, and water

24. When landslides are made up of mostly soil, they are called _____. (5.2a)

SLIDE 1

25. Pressure from a slow-moving landslide has pushed this _____ _____ downhill. (5.2.1)

BACK SLIDE 2

26. Debris flows occurred in 1995 in _____ County. (5.2.2)

BACK NEXT

27. The rubble that piles up as a result of rock falls is called _____. (5.2b)

SLIDE 1

28. Rocks detach and fall along _____ _____ and _____ surfaces. (5.2.3)

BACK SLIDE 2

29. Creep causes trees to become _____ at their bases. (5.2.4)

CHAPTER TOPICS

5.3 Streams MORE INFO

30. _____ _____ is a major agent in the shaping of continental landscapes. (5.3)

1. Erosion and sedimentation MORE INFO

31. When does erosion occur? (5.3.1) _____

_____

_____

SLIDE 1 BACK

32. What does solution mean? (5.3.1) _____

_____

33. What does suspension mean? (5.3.1) _____

_____

34. What does traction mean? (5.3.1) _____

_____

SLIDES

35. The plume of brown, muddy water in the photograph has abundant _____ sediment. (5.3.1.2a)

NEXT

36. Boulders in a river are part of the _____ load. (5.3.1.2b)

BACK BACK

37. When does deposition occur? (5.3.1) _____

_____

_____

SLIDE 2

38. _____ are one of the results of deposition of river sediment. (5.3.1.3)

BACK

39. A drop in _____ _____ causes a stream to erode lower to a new level. (5.3.1)

SLIDE 3

40. _____ show former levels of river erosion. (5.3.1.4)

CHAPTER TOPICS

5.3 Streams MORE INFO

2. Drainage MORE INFO

41. What is a drainage basin? (5.3.2) _____

_____

SLIDE 1

42. Name three Virginia drainage basins. (5.3.2.1) _____

_____

_____

BACK

43. Two common drainage system shapes are _____ and _____. (5.3.2)

SLIDE 2

44. Which type of drainage system shape is found in the Valley and Ridge? (5.3.2.2)

_____

45. Which type of drainage system shape is found in the Appalachian Plateaus? (5.3.2.2) _____

BACK

46. _____ _____ are steep-walled, narrow valleys cut through ridges by streams. (5.3.2)

SLIDE 3

47. Which streams cut the water gaps shown in these photographs? (5.3.2.3) _____

_____

CHAPTER TOPICS

5.3 Streams MORE INFO

3. Lakes and floods MORE INFO

SLIDE 1

48. List the only two natural lakes in Virginia. (5.3.3.1) _____

_____

BACK

49. _____ occur when streams rise over the tops of their channels. (5.3.3)

SLIDE 2

CHAPTER TOPICS

5.4 Groundwater MORE INFO

50. Define groundwater. (5.4) _____

_____

_____

1. Groundwater basics MORE INFO

51. List three types of geologic materials that make good aquifers. (5.4.1)

_____ _____

_____

SLIDE 1 BACK

52. Water moves through the zone of _____ to the zone of _____ as it becomes groundwater. (5.4.1)
53. The top of the zone of saturation is called the _____ _____. (5.4.1)

SLIDE 2

54. What is the zone of saturation? (5.4.1.2) _____

_____

_____

BACK

55. Where the water table intersects the ground surface, _____ form. (5.4.1)

SLIDE 3

56. _____ _____ is a spring-fed creek that forms a waterfall. (5.4.1.3)

BACK

57. _____ _____ form where heated groundwater flows to the surface. (5.4.1)

SLIDE 4

58. Where can you find hot springs in Virginia? (5.4.1.4) _____

_____

CHAPTER TOPICS

5.4 Groundwater MORE INFO

2. Karst topography MORE INFO

59. List four common features of karst topography. (5.4.2)

_____ _____

_____ _____

60. Match each karst feature with its description. (5.4.2)

_____ caves	A. surface depressions
_____ sinkholes	B. surface streams that flow underground
_____ disappearing streams	C. parts of a cave roof that remain
_____ natural bridges and tunnels	D. underground cavities large enough for human exploration

SLIDE 1 BACK SLIDE 2

61. Sinkholes are caused by the collapse of the underlying _____. (5.4.2.2)

BACK SLIDE 3

62. _____ Creek, in Giles County, is an example of a disappearing or sinking stream. (5.4.2.3)

BACK SLIDE 4

63. What state park should you visit if you want to see a karst tunnel? (5.4.2.4)

_____

CHAPTER TOPICS

5.4 Groundwater MORE INFO

3. Human activities and groundwater MORE INFO

64. List three ways human activities can harm groundwater. (5.4.3)

_____

_____

_____

SLIDE 1

65. Why do you think that dumping trash in sinkholes is illegal now? (5.4.3.1)

_____

_____

_____

BACK SLIDE 2

66. If pumping occurs faster than groundwater can move into the aquifer, a _____ of _____ forms. (5.4.3.2)

CHAPTER TOPICS

5.5 Shoreline Waves and Currents MORE INFO

67. Beaches and shorelines are shaped by the _____, _____, and _____ activities of waves, tides, and currents. (5.5a)

68. _____ _____ can erode beaches and dunes. (5.5a)

SLIDE 1

69. What feature protects shorelines from erosion? (5.5.1) _____

BACK

70. How can sediment move along a coast? (5.5a) _____

SLIDE 2

71. Groins are structures built into the water to trap sediment carried by the _____ current. (5.5.2)

BACK

72. List three coastline features formed by the deposition of sediment. (5.5a)

_____ _____

_____

SLIDES

73. What kind of sediment usually makes up beaches? (5.5.3a) _____

NEXT

74. What is a barrier island? (5.5.3b) _____

_____

75. How is a spit different from a barrier island? (5.5.3b) _____

_____

BACK BACK NEXT

76. _____ are the rise and fall of sea level that occur mainly because of the moon's gravity. (5.5b)

77. What are estuaries? (5.5b) _____

_____

SLIDES

78. List four major estuaries in Virginia. (5.5.4a)

_____ _____

_____ _____

NEXT

79. Drowned river valleys create many _____ along Virginia's coast. (5.5.4b)

BACK BACK

80. Give two ways that sea level can change over long periods of time. (5.5b)

_____

_____

81. How are glaciers causing sea level to rise? (5.5b) _____

_____

_____

CHAPTER TOPICS

5.6 Wind and Ice MORE INFO

82. Where in Virginia does wind shape the land the most? (5.6) _____

_____

SLIDE 1

83. Sand fences are built to stabilize _____ on beaches. (5.6.1)

BACK

84. Virginia does not have any glaciers. True / False (circle one) (5.6)

SLIDE 2

85. _____ _____ probably formed when the climate was colder, but were not formed directly by glaciers. (5.6.2)

CHAPTER TOPICS

5.7 Landforms in Virginia MORE INFO

NEXT BACK

86. Using both screens, match each Virginia physiographic province with its landforms. (5.7a and 5.7b)

_____ Coastal Plain
_____ Piedmont
_____ Mesozoic Basins
_____ Blue Ridge
_____ Valley and Ridge
_____ Appalachian Plateaus

A. Low hills and shallow valleys.
B. Long, narrow mountain chain
C. Deep, narrow valleys and steep, rugged mountain sides
D. Low-relief (flat) surface
E. Shallow basins within the Piedmont
F. Long, linear valleys and intervening sharp ridges

SLIDE 1

87. How would you describe the Coastal Plain surface, as shown in the photograph on the left? (5.7.1) _____

_____

BACK SLIDE 2

88. What does the word *Piedmont* mean literally? (5.7.2) _____

_____

BACK SLIDE 3

89. The Culpeper Basin at Manassas National Battlefield Park has high / low relief (circle one). (5.7.3)

BACK NEXT SLIDE 1

90. What is the highest point in Virginia? (5.7.4) _____

BACK SLIDE 2

91. What landforms make up the Valley and Ridge? (5.7.5) _____

_____

BACK SLIDE 3

92. Appalachian Plateaus landforms include _____ _____ and _____ _____. (5.7.6)

You have reached the end of the Weathering and Landforms chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

PLATE TECTONICS: *Lesson Plan*

Subject/Grade
Earth Science 6-12

Goals of Lesson
Students will use the Plate Tectonics chapter of *Geology of Virginia CD-ROM 1: Introduction and Geologic Background* to comprehend and apply concepts of Earth Science Standards of Learning (SOLs) number 8 and parts of 2, 4, and 11 required by the State of Virginia.

Lesson Objectives
The student will investigate and understand geologic processes including plate tectonics. Key concepts include how geologic processes are evidenced in the physiographic provinces of Virginia; tectonic processes (subduction, rifting and seafloor spreading, and continental collision); features of the seafloor (continental margins, trenches, mid-ocean ridges) reflect tectonic processes and evaluating evidence for scientific theories related to plate tectonics.

Materials/Resources Needed/Class Time:
- *Geology of Virginia CD-ROM 1: Introduction and Geologic Background*
- PC Computer with Windows 3.1 or Windows 95
- Computer with CD-ROM Drive 4.0 X or higher; 133 MHz processor with 32 MB RAM or higher
- Plate Tectonics Worksheets
- Worksheets will take 2-3 (50 min) class periods.

Activities/Tasks/Procedures:
- Students using the interactive, educational, multimedia CD-ROM will actively learn about plate tectonics
- Students will answer questions on worksheets as they proceed through the CD-ROM

Provisions for Individual Differences:
- Students will advance through the CD-ROM at their own pace
- Students needing more time may install the CD-ROM on a single computer in the classroom.

Evaluation:
- Students will complete worksheets and finish the chapter on plate tectonics
- Students may use CD-ROM 1 as a review for a chapter test or for the State Standards of Learning (SOL) test in Earth Science
- CD-ROM 1 may be used as a substitute for notes or lecture.

PLATE TECTONICS: *Teacher Answer Sheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click **NEXT** to get to the Table of Contents
- Click on **Plate Tectonics** from the Table of Contents.
- For an introduction click **SLIDES**.

1. The theory of plate tectonics explains the processes and structures in geology. (6)
2. The theory includes ideas about geoclines, mountain building, continental drift, and seafloor spreading. (6)

CHAPTER TOPICS

6.1 Theory Development MORE INFO

1. Geoclines MORE INFO

3. What American geologist proposed that the Appalachian Mountains began as a long, narrow, thick pile of sediment deposited along the edge of the continent? (6.1.1) James Hall

SLIDE

4. What types of rocks are found in the miogeocline? (6.1.1.1) limestone and sandstone
5. What types of rocks are found in the eugeocline? (6.1.1.1) shale and volcanic rocks

BACK

6. Why was the geocline theory incomplete? (6.1.1) No one knew how geoclines could be deformed and uplifted to become mountains.

BACK

2. Continental drift MORE INFO

7. What did Wegener propose? (6.1.2) that continents could move around on the earth's surface

SLIDE 1

8. What was the name of the supercontinent Wegener's idea suggested? (6.1.2.1) Pangaea
9. Evidence suggests that this supercontinent began to break up about 200 million years ago. (6.1.2.1)

BACK

10. What evidence did Wegener use to support his hypothesis? (6.1.2) similar fossils and matching glacial features

SLIDE 2

11. What seed fern was found on both sides of the Atlantic, and was used as evidence for continental drift? (6.1.2.2) *Glossopteris*

BACK

12. Why was the theory of continental drift initially rejected? (6.1.2) No known force could move continents through the seafloors between them.

BACK

3. Seafloor spreading MORE INFO

13. According to the hypothesis of seafloor spreading, where is new seafloor created? (6.1.3) at mid-ocean ridges
14. As seafloor rocks become cooler and more dense, they sink or subduct into the earth's interior. (6.1.3)

SLIDE 1

15. Where are the oldest known seafloor rocks found? (6.1.3.1) farthest from the mid-ocean ridge

BACK

16. Magnetic stripes in seafloor rocks were used as evidence to support seafloor spreading. (6.1.3)

SLIDE 2

17. Reversals of the earth's magnetic poles are recorded in magnetic minerals that are common on the seafloor. (6.1.3.2)
18. These signatures on the seafloor were mirror images of the same signatures on the other side of the mid-ocean ridge. (6.1.3.2)

BACK BACK

4. Plate tectonics MORE INFO

19. Name the three ideas that are combined in the theory of plate tectonics. (6.1.4a)
    geoclines and mountain building
    continental drift
    seafloor spreading
20. Where do the sediments from mountain chains along continent edges come from? (6.1.4a) geoclinal sediments

NEXT

21. If continents collide and rift apart, why do you think the coastlines of South America and Africa seem to match across the Atlantic Ocean? (6.1.4b) they were once together and then rifted apart
22. How do continents move around the earth's surface? (6.1.4b) they are pushed and pulled along with spreading seafloors

CHAPTER TOPICS

6.2 Principles of Plate Tectonics MORE INFO

23. The earth's outer shell is called the lithosphere. (6.2a)

SLIDE 1

24. The plastic layer below is called the asthenosphere. (6.2.1)
25. What does plastic mean? (Hint: Move your mouse over the box.) (6.2.1) capable of being deformed without breaking; silly putty is an example

BACK

26. Lithospheric plates include both continents and ocean basins. (6.2a)

SLIDE 2

27. What lithospheric plate is your school on? (6.2.2) North American plate

BACK

28. What does convection mean? (6.2a) fluid flow in which warm material rises and cool material sinks

SLIDE 3

29. The heat deep within the earth causes convection currents in the asthenosphere. (6.2.3)
30. Less dense material rises at mid-ocean ridges. (6.2.3)

BACK

31. Match each type of plate boundary with its definition. (6.2a)

A divergent boundary	A. plates move away from each other
C convergent boundary	B. plates slide past each other
B transform boundary	C. plates move toward each other

SLIDES

32. Divergent boundaries can be mid-ocean ridges or continental rift valleys. (6.2.4a)
33. Normal faulting and basalt-rich volcanoes are formed at continental rift valleys. (6.2.4a)

NEXT

34. Convergent boundaries form where two plates collide / come apart (circle one). (6.2.4b)

35. How are convergent boundaries identified? (6.2.4b) high mountains, volcanic island arc chains, and deep earthquakes

NEXT

36. Transform boundaries form where two plates slide past each other. (6.2.4c)
37. Name a famous fault along a transform boundary in California. (6.2.4c) San Andreas Fault

BACK BACK BACK NEXT

38. The Wilson Cycle is the cycle of rifting, drifting, and colliding plates. (6.2.b)
39. Rifting begins when magma rises toward the earth's surface. (6.2b)

SLIDE 1

40. Where on earth is there rifting occurring today? (6.2.5) East African rift system

BACK

41. The continental fragments separate, and new seafloor crust forms a mid-ocean ridge in the rift. (6.2b)

SLIDE 2

42. How long ago did the Red Sea form? (6.2.6) about five million years ago

BACK

43. When a passive margin forms, thick geoclinal sediments pile up along the edge of the continent. (6.2b)

SLIDE 3

44. Give an example of a present-day passive margin where sediments are accumulating and there is little tectonic activity. (6.2.7) eastern seaboard of the United States

BACK NEXT

45. Subduction causes island arcs and deep ocean trenches to form. (6.2c)

SLIDE 1

46. Island arcs are created from the subduction of colliding tectonic plates. (6.2.8)
47. What is the white shape in the corner of this photograph of an island arc? (6.2.8) space shuttle

BACK

48. When a continent collides with another continent, sediments along the margin are deformed and uplifted. (6.2c)

SLIDE 2

49. The Himalayan Mountains are forming where the Indian and Eurasian plates are colliding. (6.2.9)
50. Fossil shells of animals that once lived in the ocean can be found on Mount Everest, the highest peak in the world. (6.2.9)

CHAPTER TOPICS

6.3 Plate Tectonics History of Virginia MORE INFO

1. 1100 million years ago MORE INFO

51. The oldest rocks in Virginia formed during the Grenville orogeny in a continent-continent collision. (6.3.1)

SLIDE

52. The Old Rag Granite is one of the oldest rocks in Virginia. It is 1.1 billion years old. (6.3.1.1)

BACK BACK

2. 750 to 560 million years ago MORE INFO

53. The supercontinent that had formed began to rift apart. (6.3.2)

SLIDE 1

54. How long ago did this event occur? (6.3.2.1) 750 million years ago

55. Virginia was located below / above the equator at this time (circle one). (6.3.2.1)

BACK

56. In Virginia, rift basins formed and filled with volcanic rocks and continental sediments. (6.3.2)

57. Where in Virginia can you find evidence of this event? (6.3.2) Mount Rogers area in Grayson County

SLIDE 2

58. How did the rhyolite in the left photograph form? (6.3.2.2) lava flowed into the rift valley

59. How did the tuff in the right photograph form? (6.3.2.2) explosive volcanic event

BACK BACK

3. 560 million years ago MORE INFO

60. As the continental fragments separated, basalt poured out to form new seafloor crust. (6.3.3)

SLIDE 1

61. What was the name of the ocean that formed with this rifting? (6.3.3.1) Iapetus Ocean

BACK

62. Where can you find the basalt from the Iapetus Ocean today? (6.3.3) in the Catoctin rocks in the Blue Ridge of central and northern Virginia

SLIDE 2

63. Pillow lavas formed when molten lava erupted into seawater. (6.3.3.2)

BACK BACK

4. 560 to 480 million years ago MORE INFO

64. The continent that would one day become North America is called Laurentia. (6.3.4)

SLIDE 1

65. Between 560 and 480 million years ago, Iapetus continued to grow, and a passive margin developed along ancient North America's coast. (6.3.4.1)

BACK

66. Where in Virginia can you find the sandstone, shale, and limestone that formed during this time? (6.3.4) Valley and Ridge

SLIDE 2

67. What prominent Virginia feature is made up of these passive margin sediments and is pictured here? (6.3.4.2) Natural Bridge

BACK BACK

5. 480 to 250 million years ago MORE INFO

68. Subduction occurred along Virginia's coastline as the Iapetus Ocean began to close. (6.3.5)
69. New landmasses called terranes collided with and attached to the continent. (6.3.5)

SLIDE 1

70. Island arcs began to form off the coast, indicating that subduction was occurring. (6.3.5.1)
71. Virginia was located below / above the equator at this time (circle one). (6.3.5.1)

BACK

72. Where can you find these terranes today? (6.3.5) in the central and eastern Piedmont

SLIDE 2

73. As terranes attached to Virginia, granites intruded the existing rock. (6.3.5.2)

BACK

74. Thick piles of conglomerate, sandstone, and shale eroded from the mountains. (6.3.5)

SLIDE 3

75. Where was the sediment deposited? (6.3.5.3) in the Valley and Ridge and Appalachian Plateaus

76. Each terrane collision pushed up mountains to the east. (6.3.5.3)

BACK BACK

6. 250 million years ago MORE INFO

77. 250 million years ago, the supercontinent Pangaea formed when North America and Africa collided. (6.3.6)

78. Match the areas of Virginia with the tectonic activity that occurred there about 250 million years ago.

B	major mountain building	A. Western Virginia (Valley and Ridge and Appalachian Plateaus)
B	intrusions	
A	deposition of conglomerate	B. Blue Ridge and Piedmont
A	coal beds form in swamps	
A	deposition of sandstone and shale	
B	metamorphism	

79. What valuable mineral resource formed in the swamps along the edges of the mountains? (6.3.6) coal

SLIDE 1

80. Circle the Virginia provinces affected by the mountain-building event that occurred in Virginia 250 million years ago. (6.3.6.1)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge

Appalachian Plateaus

BACK BACK

7. 225 to 200 million years ago MORE INFO

81. Pangaea began to rift apart, starting a new Wilson Cycle about 225 million years ago. (6.3.7)

SLIDE 1

82. What features in eastern Virginia formed during this time? (6.3.7.1) rift basins

83. Virginia was located below / above the equator at this time (circle one). (6.3.7.1)

BACK

84. As the continent stretched and broke, the rift basins in the eastern Virginia filled with volcanic and continental sedimentary rocks. (6.3.7)
85. Where in Virginia would you look to find rocks from this time? (6.3.7) the Mesozoic Basins

SLIDE 2

86. List three rocks found in Virginia's Mesozoic Basins. (6.3.7.2)
conglomerate diabase
sandstone
87. What type of environment do the mud cracks indicate? (6.3.7.2) a drying lake bed

BACK BACK

8. 200 million years ago to present MORE INFO

88. The Atlantic Ocean opened and widened. (6.3.8)

SLIDE 1

89. How long has it taken for the ocean to widen to its present width? (6.3.8.1) about 200 million years

BACK

90. A passive margin formed along eastern North America, and a thick pile of sedimentary rocks was deposited, forming the Coastal Plain. (6.3.8)

SLIDE 2

91. Deposition continues today on the eastern edge of Virginia in the Coastal Plain. (6.3.8.2)

BACK

92. The Atlantic Ocean is growing smaller / larger (circle one). (6.3.8)

You have reached the end of the Plate Tectonics chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.

PLATE TECTONICS: *Student Worksheet*

CD-ROM 1: Introduction and Geologic Background

- From the title screen, click **NEXT** to get to the Table of Contents
- Click on **Plate Tectonics** from the Table of Contents.
- For an introduction click **SLIDES**.

1. The theory of _____ _____ explains the processes and structures in geology. (6)
2. The theory includes ideas about geoclines, _____ _____, _____ _____, and _____ _____. (6)

CHAPTER TOPICS

6.1 Theory Development MORE INFO

1. Geoclines MORE INFO

3. What American geologist proposed that the Appalachian Mountains began as a long, narrow, thick pile of sediment deposited along the edge of the continent? (6.1.1) _____

SLIDE

4. What types of rocks are found in the miogeocline? (6.1.1.1) _____

_____

5. What types of rocks are found in the eugeocline? (6.1.1.1) _____

_____

BACK

6. Why was the geocline theory incomplete? (6.1.1) _____

_____

BACK

2. Continental drift MORE INFO

7. What did Wegener propose? (6.1.2) _____

_____

SLIDE 1

8. What was the name of the supercontinent Wegener's idea suggested? (6.1.2.1)

_____

9. Evidence suggests that this supercontinent began to break up about _____ million years ago. (6.1.2.1)

BACK

10. What evidence did Wegener use to support his hypothesis? (6.1.2) _____

_____

_____

SLIDE 2

11. What seed fern was found on both sides of the Atlantic, and was used as evidence for continental drift? (6.1.2.2) _____

BACK

12. Why was the theory of continental drift initially rejected? (6.1.2) _____

_____

_____

BACK

3. Seafloor spreading MORE INFO

13. According to the hypothesis of seafloor spreading, where is new seafloor created? (6.1.3) _____

14. As seafloor rocks become cooler and more dense, they sink or _____ into the earth's interior. (6.1.3)

SLIDE 1

15. Where are the oldest known seafloor rocks found? (6.1.3.1) _____

_____

BACK

16. _____ stripes in seafloor rocks were used as evidence to support seafloor spreading. (6.1.3)

SLIDE 2

17. Reversals of the earth's magnetic poles are recorded in _____ _____ that are common on the seafloor. (6.1.3.2)
18. These signatures on the seafloor were _____ images of the same signatures on the other side of the mid-ocean ridge. (6.1.3.2)

BACK BACK

4. Plate tectonics MORE INFO

19. Name the three ideas that are combined in the theory of plate tectonics. (6.1.4a)

_____

_____

_____

20. Where do the sediments from mountain chains along continent edges come from? (6.1.4a) _____

NEXT

21. If continents collide and rift apart, why do you think the coastlines of South America and Africa seem to match across the Atlantic Ocean? (6.1.4b) _____

_____

_____

22. How do continents move around the earth's surface? (6.1.4b) _____

_____

_____

CHAPTER TOPICS

6.2 Principles of Plate Tectonics MORE INFO

23. The earth's outer shell is called the _____. (6.2a)

SLIDE 1

24. The plastic layer below is called the _____. (6.2.1)
25. What does plastic mean? (Hint: Move your mouse over the box.) (6.2.1) _____

_____

_____

BACK

26. Lithospheric plates include both _____ and _____ _____. (6.2a)

SLIDE 2

27. What lithospheric plate is your school on? (6.2.2) _____

_____

BACK

28. What does convection mean? (6.2a) _____

_____

_____

SLIDE 3

29. The heat deep within the earth causes _____ _____ in the asthenosphere. (6.2.3)
30. Less dense material rises at _____ _____. (6.2.3)

BACK

31. Match each type of plate boundary with its definition. (6.2a)

_____ divergent boundary	A. plates move away from each other
_____ convergent boundary	B. plates slide past each other
_____ transform boundary	C. plates move toward each other

SLIDES

32. Divergent boundaries can be _____ _____ or continental _____ _____. (6.2.4a)
33. Normal faulting and _____-rich volcanoes are formed at continental rift valleys. (6.2.4a)

NEXT

34. Convergent boundaries form where two plates collide / come apart (circle one). (6.2.4b)

35. How are convergent boundaries identified? (6.2.4b) _____

_____

_____

NEXT

36. _____ _____ form where two plates slide past each other. (6.2.4c)
37. Name a famous fault along a transform boundary in California. (6.2.4c) _____

_____

BACK BACK BACK NEXT

38. The _____ _____ is the cycle of rifting, drifting, and colliding plates. (6.2.b)
39. Rifting begins when _____ rises toward the earth's surface. (6.2b)

SLIDE 1

40. Where on earth is there rifting occurring today? (6.2.5) _____

_____

BACK

41. The continental fragments separate, and new _____ crust forms a _____ _____ in the rift. (6.2b)

SLIDE 2

42. How long ago did the Red Sea form? (6.2.6) _____

_____

BACK

43. When a passive margin forms, thick _____ sediments pile up along the edge of the continent. (6.2b)

SLIDE 3

44. Give an example of a present-day passive margin where sediments are accumulating and there is little tectonic activity. (6.2.7) _____

_____

_____

BACK NEXT

45. Subduction causes _____ _____ and deep ocean trenches to form. (6.2c)

SLIDE 1

46. Island arcs are created from the _____ of colliding tectonic plates. (6.2.8)
47. What is the white shape in the corner of this photograph of an island arc? (6.2.8)

_____

BACK

48. When a continent collides with another continent, sediments along the margin are _____ and _____. (6.2c)

SLIDE 2

49. The _____ Mountains are forming where the Indian and Eurasian plates are colliding. (6.2.9)
50. Fossil shells of animals that once lived in the ocean can be found on _____ _____, the highest peak in the world. (6.2.9)

CHAPTER TOPICS

6.3 Plate Tectonics History of Virginia MORE INFO

1. 1100 million years ago MORE INFO

51. The oldest rocks in Virginia formed during the _____ orogeny in a continent-continent collision. (6.3.1)

SLIDE

52. The _____ _____ Granite is one of the oldest rocks in Virginia. It is _____ billion years old. (6.3.1.1)

BACK BACK

2. 750 to 560 million years ago MORE INFO

53. The supercontinent that had formed began to _____ apart. (6.3.2)

SLIDE 1

54. How long ago did this event occur? (6.3.2.1) _____

55. Virginia was located below / above the equator at this time (circle one). (6.3.2.1)

BACK

56. In Virginia, rift basins formed and filled with _____ rocks and _____ _____. (6.3.2)

57. Where in Virginia can you find evidence of this event? (6.3.2) _____

_____

SLIDE 2

58. How did the rhyolite in the left photograph form? (6.3.2.2) _____

_____

59. How did the tuff in the right photograph form? (6.3.2.2) _____

_____

BACK BACK

3. 560 million years ago MORE INFO

60. As the continental fragments separated, _____ poured out to form new seafloor crust. (6.3.3)

SLIDE 1

61. What was the name of the ocean that formed with this rifting? (6.3.3.1) _____

_____

BACK

62. Where can you find the basalt from the Iapetus Ocean today? (6.3.3) _____

_____

_____

SLIDE 2

63. Pillow lavas formed when molten lava erupted into _____. (6.3.3.2)

BACK BACK

4. 560 to 480 million years ago MORE INFO

64. The continent that would one day become North America is called _____. (6.3.4)

SLIDE 1

65. Between 560 and 480 million years ago, _____ continued to grow, and a _____ _____ developed along ancient North America's coast. (6.3.4.1)

BACK

66. Where in Virginia can you find the sandstone, shale, and limestone that formed during this time? (6.3.4) _____

SLIDE 2

67. What prominent Virginia feature is made up of these passive margin sediments and is pictured here? (6.3.4.2) _____

BACK BACK

5. 480 to 250 million years ago MORE INFO

68. _____ occurred along Virginia's coastline as the Iapetus Ocean began to close. (6.3.5)
69. New landmasses called _____ collided with and attached to the continent. (6.3.5)

SLIDE 1

70. _____ _____ began to form off the coast, indicating that subduction was occurring. (6.3.5.1)
71. Virginia was located below / above the equator at this time (circle one). (6.3.5.1)

BACK

72. Where can you find these terranes today? (6.3.5) _____

_____

SLIDE 2

73. As terranes attached to Virginia, _____ intruded the existing rock. (6.3.5.2)

BACK

74. Thick piles of _____, _____, and _____ eroded from the mountains. (6.3.5)

SLIDE 3

75. Where was the sediment deposited? (6.3.5.3) _____

_____

76. Each terrane collision pushed up _____ to the _____. (6.3.5.3)

BACK BACK

6. 250 million years ago MORE INFO

77. 250 million years ago, the supercontinent _____ formed when North America and Africa collided. (6.3.6)

78. Match the areas of Virginia with the tectonic activity that occurred there about 250 million years ago.

_____ major mountain building	A. Western Virginia (Valley and Ridge and Appalachian Plateaus)
_____ intrusions	
_____ deposition of conglomerate	B. Blue Ridge and Piedmont
_____ coal beds form in swamps	
_____ deposition of sandstone and shale	
_____ metamorphism	

79. What valuable mineral resource formed in the swamps along the edges of the mountains? (6.3.6) _____

SLIDE 1

80. Circle the Virginia provinces affected by the mountain-building event that occurred in Virginia 250 million years ago. (6.3.6.1)

Coastal Plain Piedmont Blue Ridge

Valley and Ridge Appalachian Plateaus

BACK BACK

7. 225 to 200 million years ago MORE INFO

81. Pangaea began to _____ apart, starting a new Wilson Cycle about _____ million years ago. (6.3.7)

SLIDE 1

82. What features in eastern Virginia formed during this time? (6.3.7.1) _____

_____

83. Virginia was located below / above the equator at this time (circle one). (6.3.7.1)

BACK

84. As the continent stretched and broke, the rift basins in the eastern Virginia filled with _____ and _____ _____ rocks. (6.3.7)
85. Where in Virginia would you look to find rocks from this time? (6.3.7) _____

_____

SLIDE 2

86. List three rocks found in Virginia's Mesozoic Basins. (6.3.7.2)

_____ _____

_____

87. What type of environment do the mud cracks indicate? (6.3.7.2) _____

_____

BACK BACK

8. 200 million years ago to present MORE INFO

88. The _____ Ocean opened and widened. (6.3.8)

SLIDE 1

89. How long has it taken for the ocean to widen to its present width? (6.3.8.1) _____

_____

BACK

90. A passive margin formed along eastern _____ _____, and a thick pile of sedimentary rocks was deposited, forming the _____ _____. (6.3.8)

SLIDE 2

91. _____ continues today on the eastern edge of Virginia in the _____ _____. (6.3.8.2)

BACK

92. The Atlantic Ocean is growing smaller / larger (circle one). (6.3.8)

You have reached the end of the Plate Tectonics chapter. Click HOME to return to the Table of Contents, or click QUIT to exit the CD-ROM.