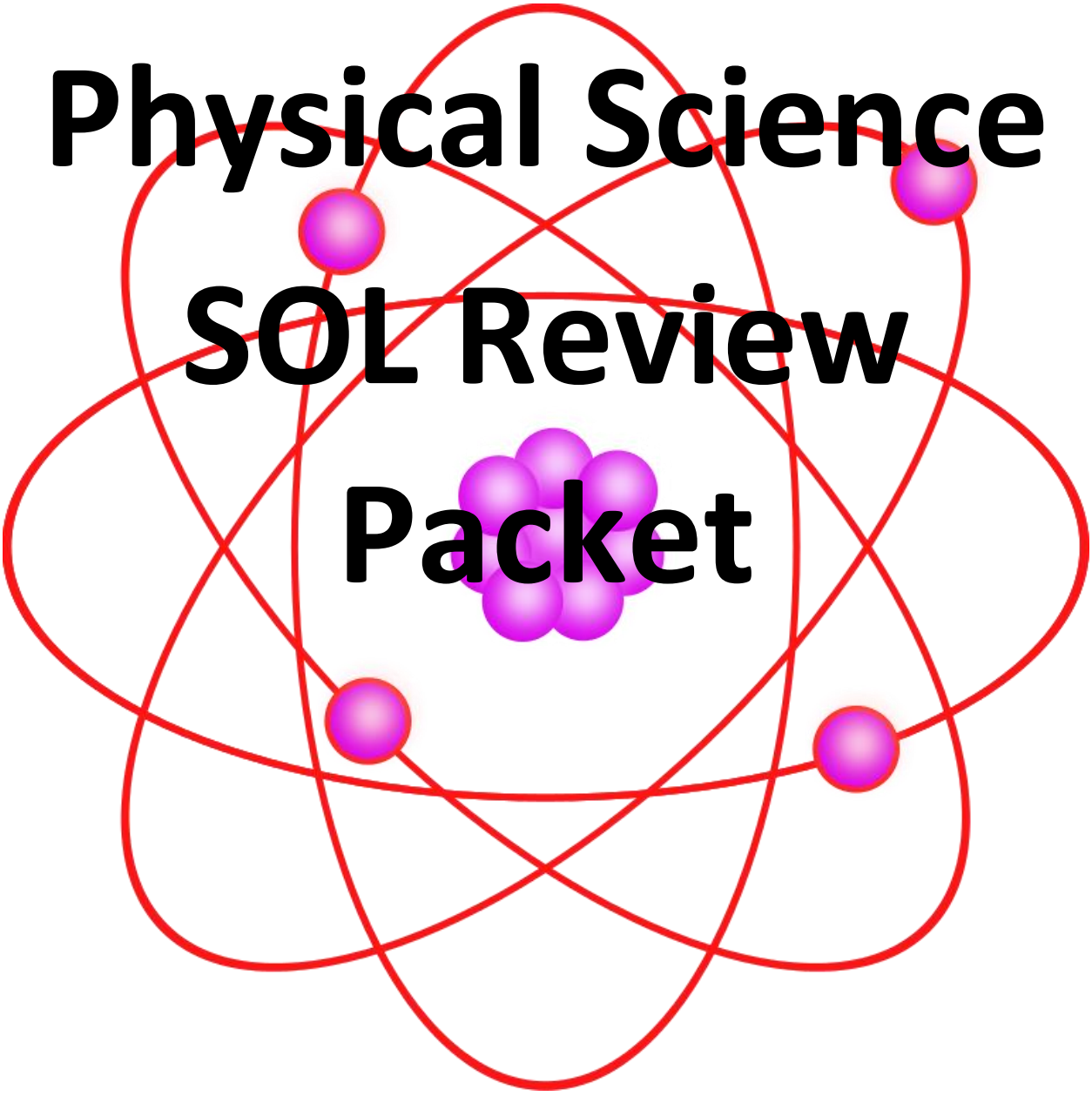
Grade 8

Physical Science

SOL Review

Packet



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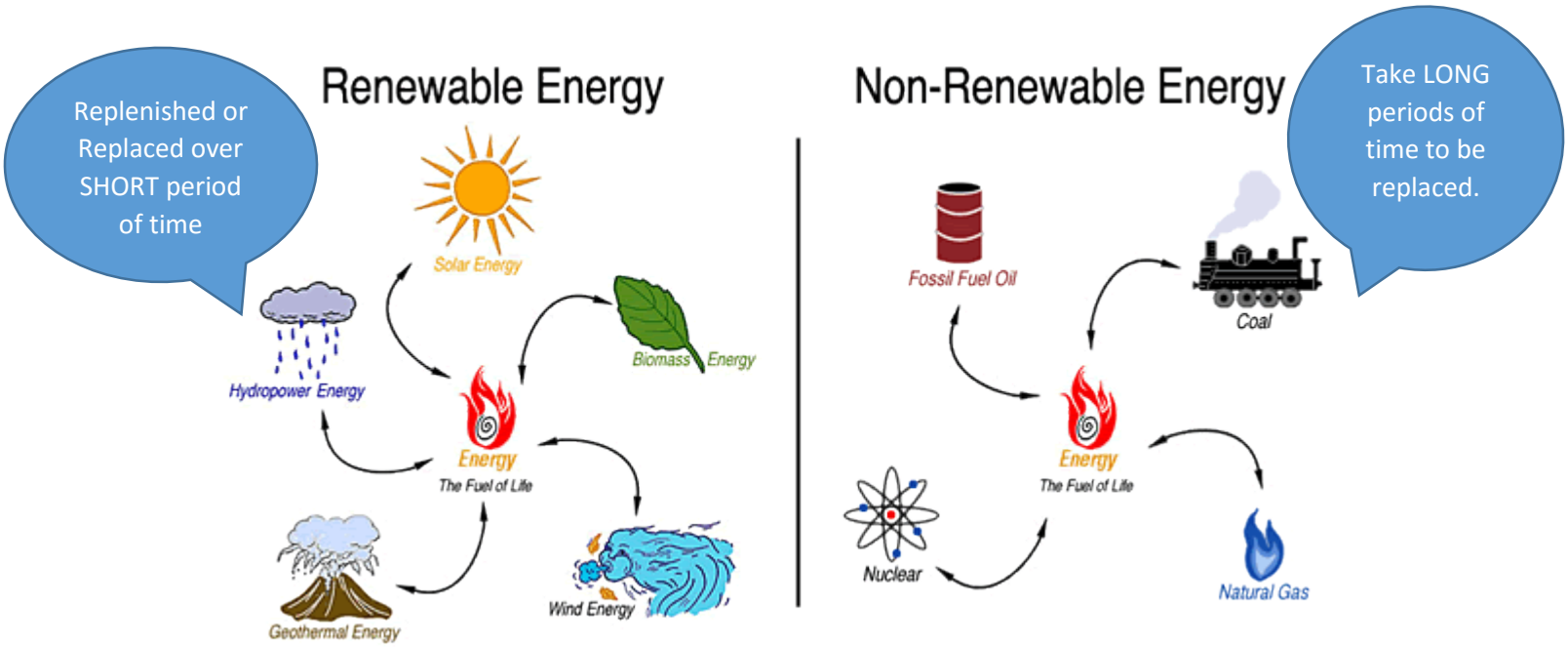
Grade 6 SOL CONTENT REVIEW

ENERGY

Two Kinds of Energy

Potential Energy	Kinetic Energy
Not "in use"	"in use"
Stored	In motion
	

Renewable and Nonrenewable Resources



Advantages of Renewable Energy	Disadvantages of Renewable Energy
• Sustainable • Produces little waste products • Clean air resource	• Generates less quantities of electricity than nonrenewable energy resources. • Many sources rely mostly on weather conditions • Renewable energy technology is more than traditional forms of energy
Advantages of Nonrenewable Energy	**Disadvantages of Nonrenewable Energy**
• Readily available and cheap in some areas • Large amounts of electricity can be generated from fossil fuels	• Will eventually run out • Produces photochemical pollution • Produces greenhouse gases

Coal, oil and natural gas are types of fossil fuels that we use for most of our energy needs, from heating our homes and electricity to fuel for our automobiles and transportation. Unfortunately, **nonrenewable energy resources** are **limited in supply** and will one day be depleted. **Fossil fuels formed from plants and animals** that lived hundreds of millions of years ago and became buried underneath the Earth's surface where their remains transformed into the materials used for our fuel.

What is the role of the sun in the formation of most energy sources on Earth?

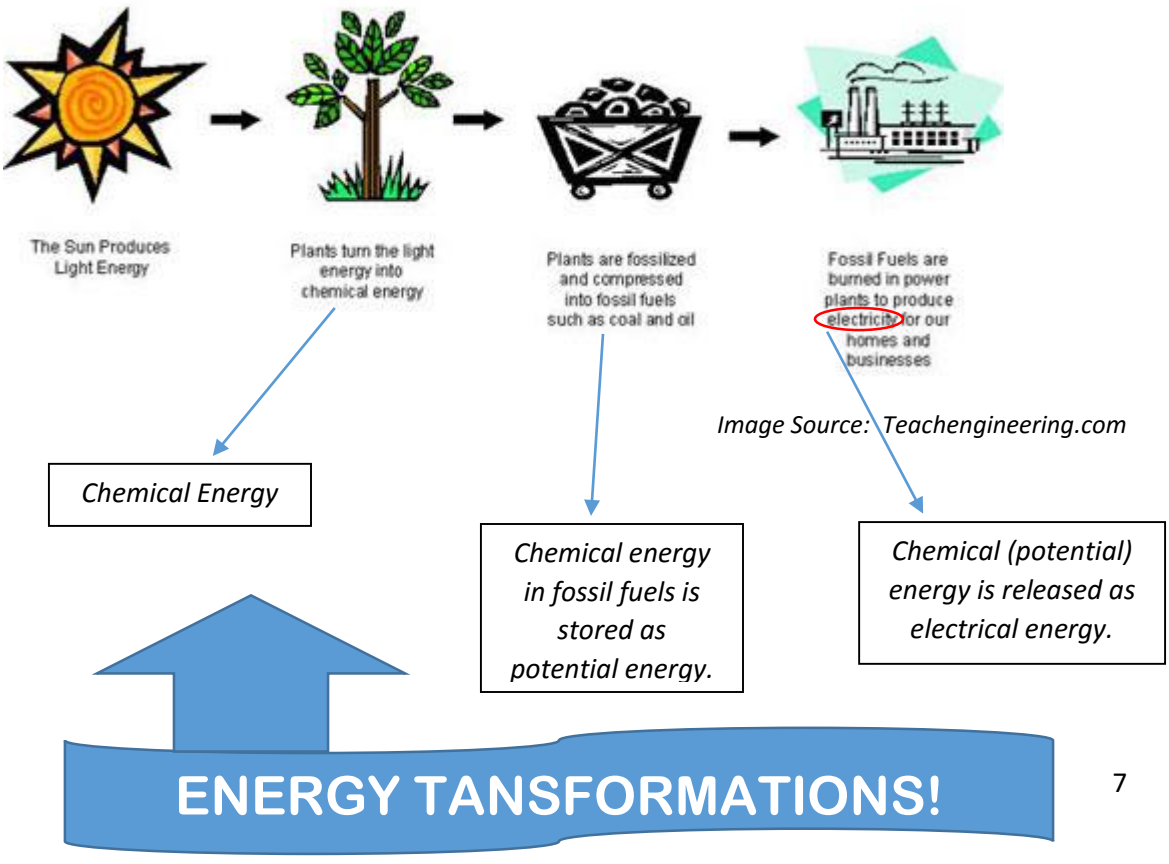


Image Source: Teachengineering.com

Energy Source	Description	Example
Electrical energy	Moving electric charges	Power lines provide electrical energy for televisions.
Thermal energy	Total energy due to movement or vibration	Thermal energy from a stove heats a metal pot.
Chemical energy	Stored in chemical compounds	Chemical energy is stored in the food you eat.
Radiant energy	Light	The light you see each day is radiant energy.
Mechanical energy	Associated with motion or position	The bus you ride to school has mechanical energy
Nuclear energy	Stored in nucleus of atoms	Nuclear fusion occurs in the sun and stars.

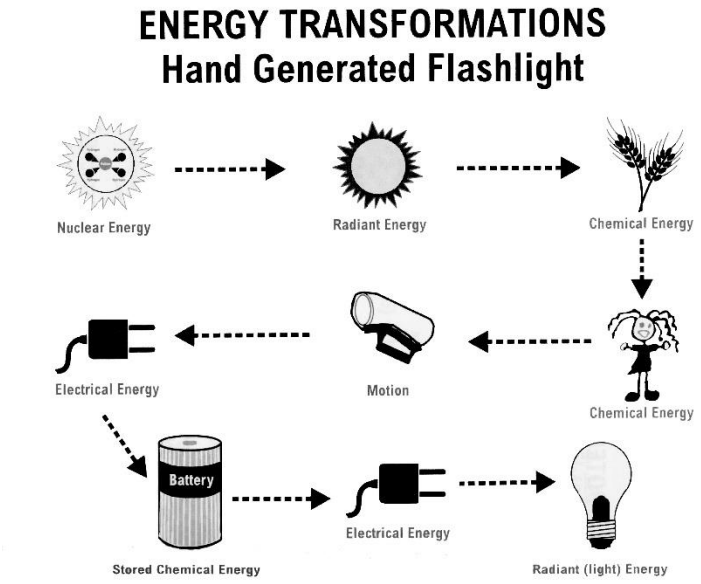
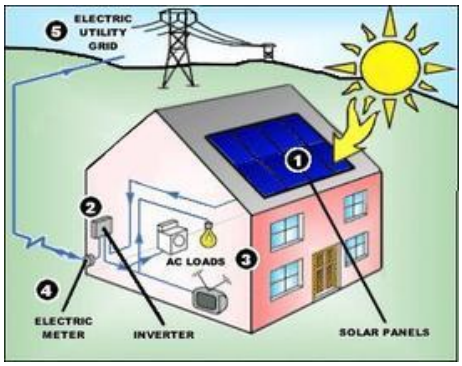


Image Source: pic2fly.com

Can you name any energy transformations which are or can occur in the below picture?



_____

_____

_____

ENERGY CONSUMPTION DATA CHART

TABLE 2.2 RESIDENTIAL SECTOR ENERGY CONSUMPTION

Annual | Monthly | 2010 | 2014 | DOWNLOAD

	2010	2011	2012	2013	2014
Primary Consumption					
Fossil Fuels					
Coal	NA	NA	NA	NA	NA
Natural Gas	4878.111	4804.579	4242.094	5022.942	5237.259
Petroleum	1120.751	1047.582	891.619	970.171	1009.265
Total	5998.861	5852.161	5133.712	5993.113	6246.524
Renewable Energy					
Geothermal	36.8	39.6	39.6	39.6	39.6
Solar/PV	114.075	153.425	186.177	218.981	251.828
Biomass	440	450	420	580	580
Total	590.875	643.025	645.777	838.581	871.428
Total Primary	6589.736	6495.186	5779.49	6831.694	7117.952
Electricity Retail Sales	4932.757	4854.597	4689.844	4759.099	4801.395
Electrical System Energy Losses	10321.499	10054.223	9496.007	9605.328	9639.007

Image Source: http://www.eia.gov

SOL Released Questions:

1. **Which energy transformation occurs first in a coal-burning power plant? (2009)**
   A. Chemical energy to thermal energy
   B. Thermal energy to mechanical energy
   C. Thermal energy to electrical energy
   D. Mechanical energy to electrical energy

2. **This picture shows a radiometer. It is designed to be placed in a sunny window. One side of each thin blade of the radiometer is painted black, and the other side is painted white. The Sun's rays strike the blades, and the device begins to spin. The device is powered by which kind of energy? (2009)**
   A. Wind
   B. Solar
   C. Electrical
   D. Geothermal

3. **Which of the following is an example of potential energy? (2009)**
    A. A glass jar sitting on a shelf
    B. A flag waving in the wind
    C. A ball rolling along a sidewalk
    D. A battery powering a radio

4. **As the energy needs for Virginia increase, new sources of energy are required to replace or supplement the nonrenewable sources of energy now in use. Two sources of energy that are renewable and available in Virginia are _____. (2009)**
    A. natural gas and wind power
    B. coal and hydropower
    C. petroleum and solar power
    D. wind power and solar power

5. **What is one advantage of using a hydroelectric plant? (2009)**
    A. It is expensive to build.
    B. It provides renewable energy to human populations.
    C. It has little effect on water flow.
    D. It has little effect on wildlife when being constructed.

6. **Which of the following is a nonrenewable energy source? (2009)**
    A. Solar collector
    B. Wind turbine
    C. Fossil fuel
    D. Hydroelectric generator

7. **A major concern over nuclear energy is how to ___. (2015)**
    A. deal with the large amounts of fossil fuels
    B. reduce the high levels of carbon dioxide emitted into the air
    C. prevent the depletion of the ozone layer
    D. store the waste products safely

8. **Which action will most reduce the use of nonrenewable energy resources in a school district? (2015)**
    A. Installing low-facets and toilets
    B. Recycling worksheets and other paper products
    C. Limiting the sweeping and mopping of classrooms to once a month
    D. Replacing current lighting with more

EARTH'S ENERGY BUDGET

Most of the energy that is in Earth's atmosphere is in the form of **solar energy**, energy from the **sun**. The **energy travels** to Earth as **electromagnetic waves**. The energy which reaches Earth is mostly in three forms; visible light, infrared radiation, and ultraviolet radiation.

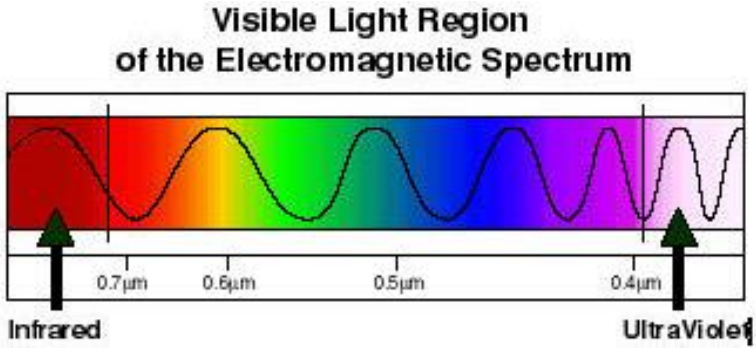
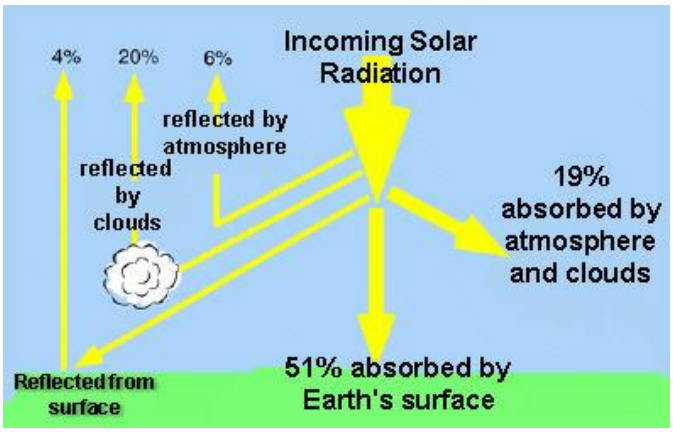


Image Source: serc.carleton.edu

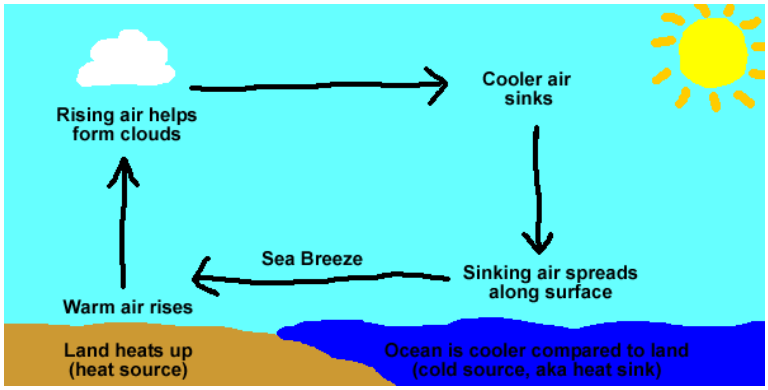
1. **Visible light** – ROYGBIV
2. **Infrared radiation** – Wavelengths longer than red light
3. **Ultraviolet radiation** – Wavelengths shorter than violet light

As the sun passes through Earth's atmosphere; some is **absorbed** in the atmosphere and some is **reflected**. Clouds, dust, and gas particles reflect solar energy back to space.



About 1/3 of the sun's incoming energy is reflected back out to space. About 1/2 of the energy striking Earth is absorbed by Earth's surface!

As you can see some of the sun's energy strikes Earth's surface and is **reflected** back into the atmosphere. Keep in mind, there is a portion of energy which is **absorbed** by land and water and changed into heat. According to NASA, it's this equilibrium of incoming and outgoing radiation that makes the Earth habitable.



Unequal Heating of Earth's surface

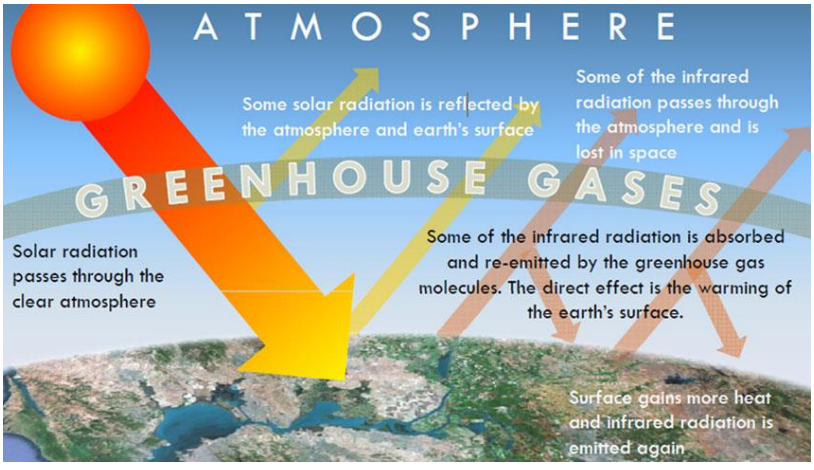
As the air or water is heated, the particles move faster and further apart, decreasing the density and causing them to rise. The cooler air or water becomes slower and denser and move closer together. As the cooler air becomes dense it sinks. The **rising of warm air** and **sinking of cool air** is known as **convection.** The exchange of incoming and outgoing radiation that warms the Earth is described as the **greenhouse effect** because of the similarity to a "*Greenhouse*".

How does a greenhouse work?

Incoming ultraviolet (UV) radiation easily passes through the glass walls of a greenhouse and is absorbed by the plants and hard surfaces inside. Weaker infrared radiation (IR) radiation, however, has difficulty passing through the glass walls and is trapped inside, warming the greenhouse. This effect lets plants grow inside a greenhouse, even during a cold winter (http://www.livescience.com/37743-greenhouse-effect.html).

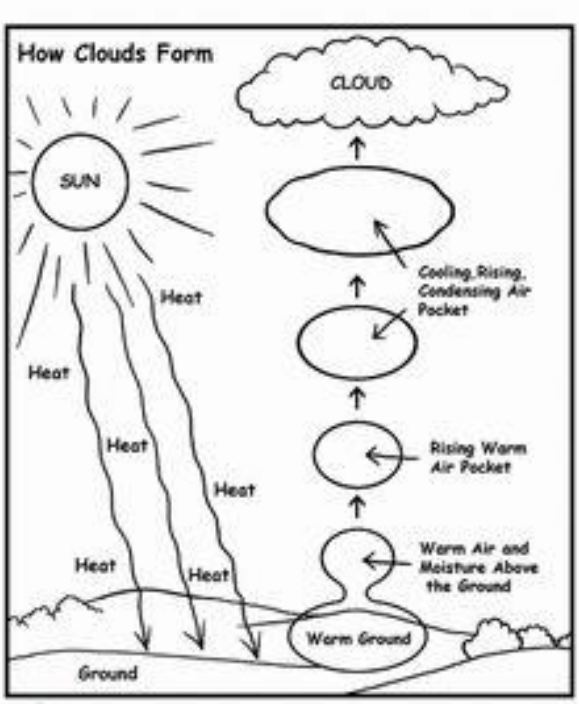
How is the heating of Earth similar to the greenhouse effect?

The sun passes through the atmosphere. Earth's surface is heated by the sunlight during the day. The Earth will then cool at night and release heat (infrared radiation) back into the atmosphere. Some of the heat will be trapped by greenhouse gases. These gases form a blanket around Earth, holding in the heat. **The greenhouse effect is the process by which gases hold or "trap" heat in the atmosphere**. It keeps our atmosphere at a temperature suitable for most organisms.



Cloud Formation:

1. Warm air rises
2. Air cools
3. Water vapor condenses
4. Water droplets form
5. Droplets of water
6. attach to dust
7. particles to form
8. clouds



STORMS:

How do thunderstorms and hurricanes differ?

Thunderstorms	Hurricanes
Form within cumulonimbus clouds	Begins over warm water as a low pressure area or tropical disturbance
Heavy rainstorms with thunder & lightning	Includes high winds and heavy rains
Most form when warm air front is forced upward a cold air front. Can also form on hot, humid days. (Moisture + Unstable air + Lift)	Forms mostly in the Atlantic Ocean north of the equator. Tropical disturbance → Tropical storm → Hurricane
Some formed when land is strongly heated	Ocean temperatures of 82°F (27°F) or warmer

RELEASED SOL QUESTIONS:

1. **Clouds are formed when millions of drops of water become suspended in the air. Which of the following is a step in the process of cloud formation? (2009)**
   A. Expansion of cold air
   B. Formation of carbon dioxide
   C. Condensation of water vapor
   D. Breakdown of atmospheric ozone

2. **Energy from the Sun is distributed around Earth by _____. (2009)**
    A. subduction and rift zones
    B. radiation and convection
    C. tectonic plates
    D. solar flares

MATTER

Matter is anything that has **mass** and **takes up space**. **Mass** is the **amount of matter** (how much stuff) an object contains. The mass of an object will not change if the force of gravity on it changes. For mass, the SI unit is kilogram (kg). The **amount of space** that matter occupies is the **volume**. Common units of measurement for volume include cm^3, liter (L), and milliliter (mL). Matter is made of smaller particles. **Elements** are smaller particles of matter, made of **one kind of atom** that cannot be broken down into other substances by chemical or physical means. **Atoms** are the **smallest units of an element** that has the properties of that element. Atoms are made of subatomic particles (protons, neutrons, and electrons):

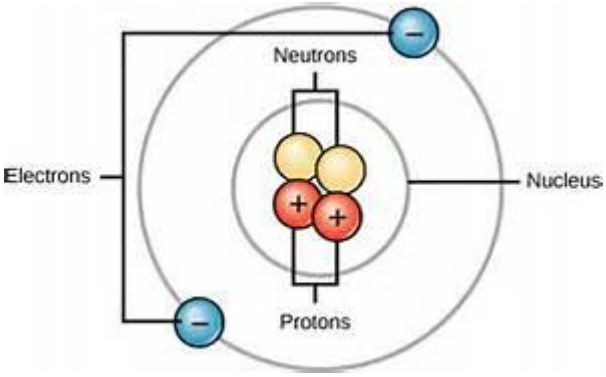


Image Source: voer.edu.vn

John Dalton, a scientist, is known for his "Atomic Theory". Here are Dalton's main conclusions (Science Explorer, p.37) which still hold true until today:

- Atoms can't be broken into smaller pieces. Atoms are indivisible.
- In any element, all the atoms are exactly alike.
- Atoms of different elements are different.
- Atoms of two or more elements can combine to form compounds.
- Atoms of each element have a unique mass.
- The masses of the elements in a compound are always in a constant ratio

Elements

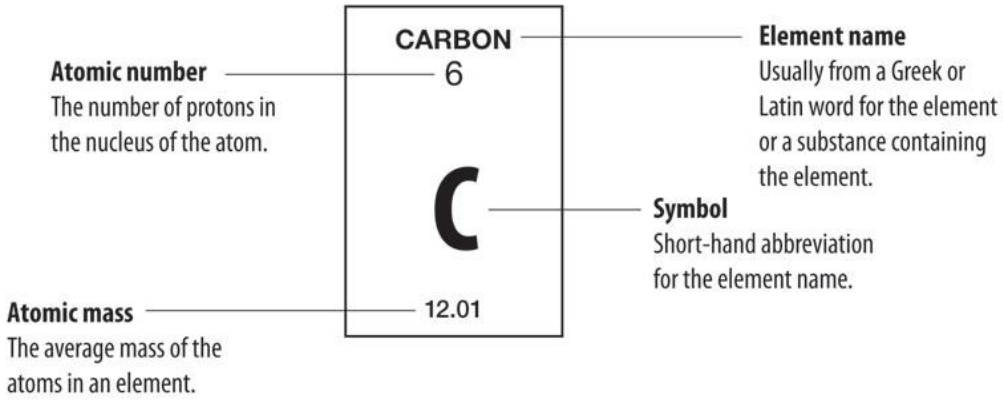


Image Source: Middle School Chemistry.com

Chemical symbols are abbreviations used to represent over 100 known elements. Chemical symbols use one or two letters. The first letter is always capitalized and the second, if there is one, is always lowercase. Usually these are the first two letters of the element's name but this is not always possible, because it would sometimes cause the same letter(s) to be used more than once.

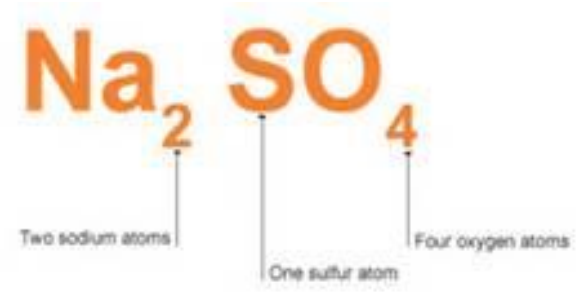
Common elements which form the largest portion of Earth's crust, living matter, the oceans, and the atmosphere:

Element Name	Chemical Symbol
Carbon	C
Hydrogen	H
Oxygen	O
Nitrogen	N
Silicon	Si
Aluminum	Al
Iron	Fe
Sodium	Na
Calcium	Ca
Potassium	K
Magnesium	Mg

Which is the correct symbol for Magnesium? Place a check in the correct box.

MG	mg	Mg	mG

Chemical symbols are used in writing chemical formulas, in which the symbols represent the atoms of the elements present in a compound.



What information can be learned from the chemical formula?

- The elements that are present in the compound
- The ratio of the elements in the compound

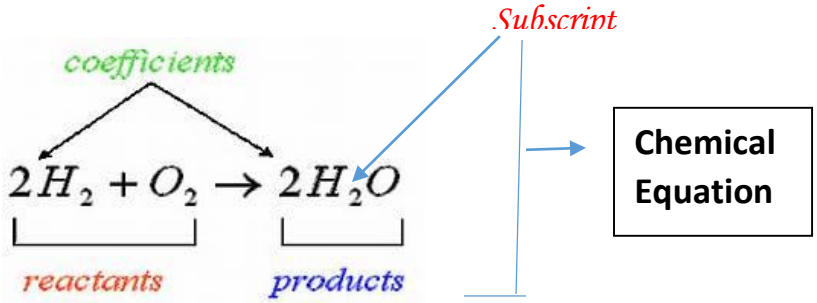
Compounds are pure substances that are made up of *two or more elements that are chemically combined* in fixed mass ratios. The elements in the compound are joined together by chemical bonds.

The properties of a compound are **unique** and differ from the elements that make up the compound.

A chemical equation is a *written representation of* the process that occurs in a *chemical reaction*. A chemical equation is written with the *reactants on the left side* of an arrow (yield symbol) and the *products* of the chemical reaction *on the right side* of the equation.

The arrow usually points toward the right or toward the product side of the equation.

The elements in an equation are represented by their chemical symbols. Coefficients next to the symbols indicate the *number of molecules*. Subscripts are used to indicate the *number of atoms of an element* present in a chemical.



In the below equation; Identify the name and number of each element present, number of atoms and indicate if the equation is balanced:

$$2SO_2 + O_2 \longrightarrow 2SO_3$$

Name of element(s): _____

Number of each element: _____

Number of atoms: _____

Balanced? _____

SOL RELEASED QUESTIONS:

1. **Which of these substances is an element? (2009)**
   a. Steel
   b. Chlorine
   c. Plastic
   d. Sugar

2. **A student makes a drawing of a carbon atom. Which of these should the student show in the nucleus of the atom? (2009)**
   a. Ions
   b. Protons
   c. Neutrons
   d. Molecules

3. **According to this equation, what happened to the carbon and oxygen? (2009)**

   $C + O_2 \longrightarrow CO_2$

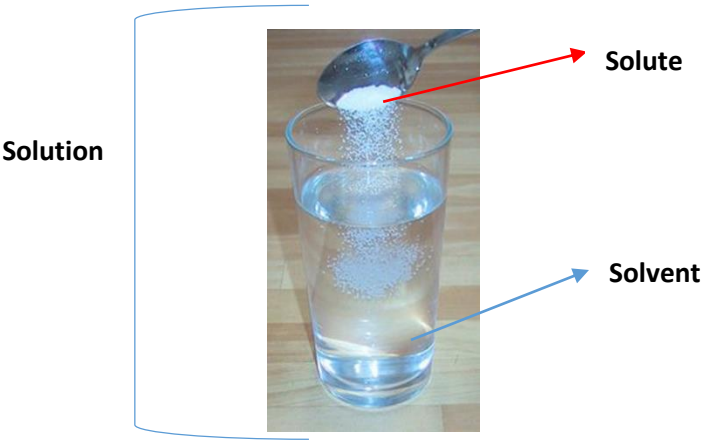
   a. They combined chemically to form a new compound.
   b. They combined chemically to form carbon and oxygen.
   c. They combined physically to form a new mixture.
   d. They combined physically to form a new element.

4. **How many different elements are involved in the chemical reaction? (2015)**

   $Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$ **Answer:** _____

PROPERTIES AND CHARACTERISTICS OF WATER

- A **mixture** is a material composed of two or more elements physically mixed together.
- A **solution** is a mixture of two or more substances in which the molecules of the substances are evenly distributed.
- **Solute** – the substance that is dissolved (smallest amount)
- **Solvent** – the substance in which the solute dissolves (largest amount)



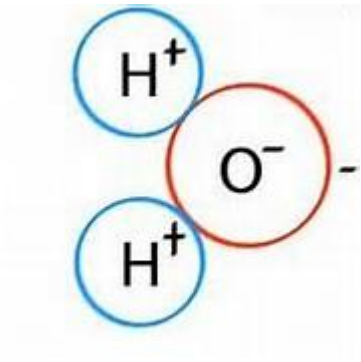
- **<u>Suspension</u>** is a **mixture** of water and **undissolved materials**.

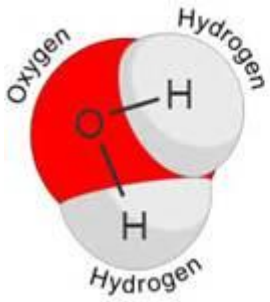
Water is known as a **<u>universal solvent</u>** because it **dissolves most** things.

Why is water so good at dissolving things?

Because <u>water is</u> a <u>polar</u> molecule and is shaped like a wedge, it is able to break up substances into smaller pieces (dissolve).

<u>Structure of Water</u>





Water Chemical Symbol:
H_2O

<u>Properties of Water:</u>

- A **<u>polar molecule</u>** is a molecule that has **electrically charged** areas.

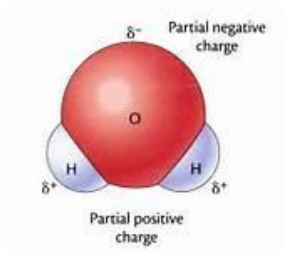
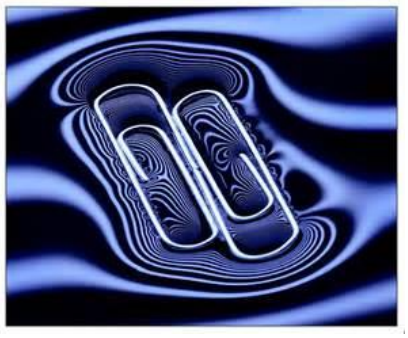


Image Source: ths.talawanda.org

- *Why can a water strider cross the surface of water without sinking?* **<u>Surface tension</u>** is the **tightness across the surface of water** that is caused by the polar molecules pulling on one another. It makes the surface act like a solid.



- **Cohesion** is the **attractive force between water** molecules. Because water is a polar molecule, it is attracted to itself.

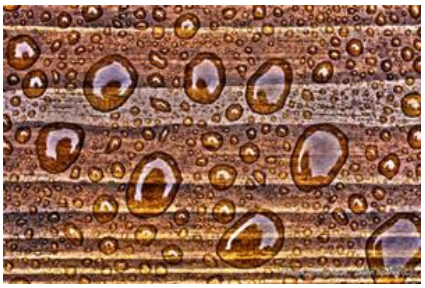


Image Source: photocommunique.blogspot.com

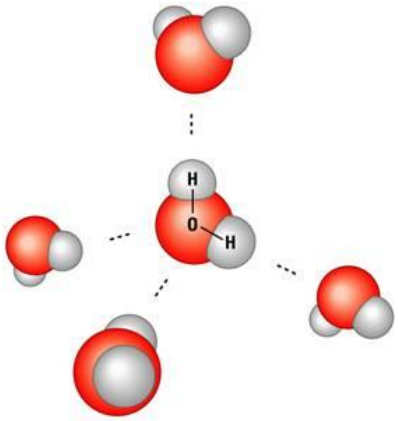


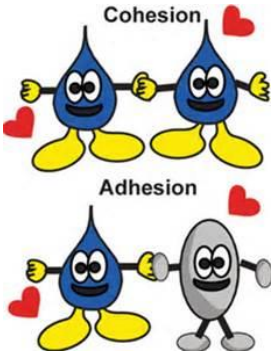
Image Source: facweb.bhc.edu

- **Adhesion** occurs when molecules of water are attracted to other substances. Because water is a polar molecule, it is attracted to other substances.

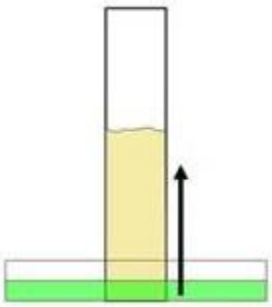
Image Source: flickr.com

Image Source: bobbybioblog4815162342.blogspot

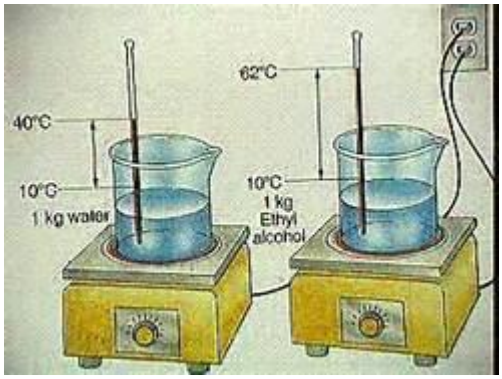
- *How do adhesion and cohesion differ?* **<u>Cohesion</u>:** Water is **attracted to water**. **<u>Adhesion</u>:** Water is **attracted to other** substances**.**



- *What happens when adhesion and cohesion combine?* **Capillary action** is the **combined force of attraction** among water molecules and with the molecules of the surrounding material (**Cohesion + Adhesion**).



- Water has a really HIGH **specific heat.** That means it takes **a lot of energy** for water **to increase its temperature**. This is because of the STRONG ATTRACTION between water molecules. **Specific Heat** = the **amount of energy needed to increase the temperature** of something 1 degree C.



Why does ice float in water? **Ice floats due to its density and molecular structure**. That's why even the biggest blocks of ice, known as icebergs, can float in arctic waters without sinking to the bottom. The two hydrogen atoms stick to the oxygen atom, but push away from each other, creating a triangular (crystal lattice) shaped molecule. In ice, the molecules squish very close to one another, but still leave lots of empty space between them. That is, even though ice feels solid, it's really full of tiny holes. Every molecule in the world has a density. **Density** describes **how many molecules** are squished **into the same amount of space**. Because **frozen water is less dense than liquid water**, the frozen water will not sink. Water's triangular molecule shape, combined with it's lower density allow it to float. (http://www.whsd.k12.pa.us/userfiles/1666/Classes/21126/Why%20does%20ice%20float.pdf)

THREE STATES OF WATER:

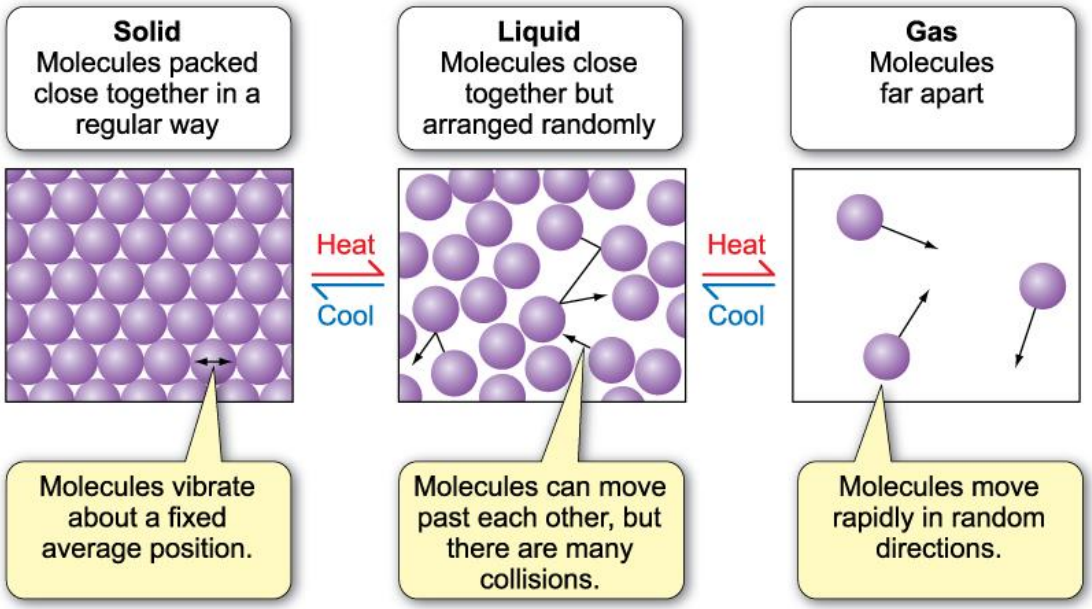


Image Source: dr-illustration.co.uk

How do the states of water relate to the water cycle?

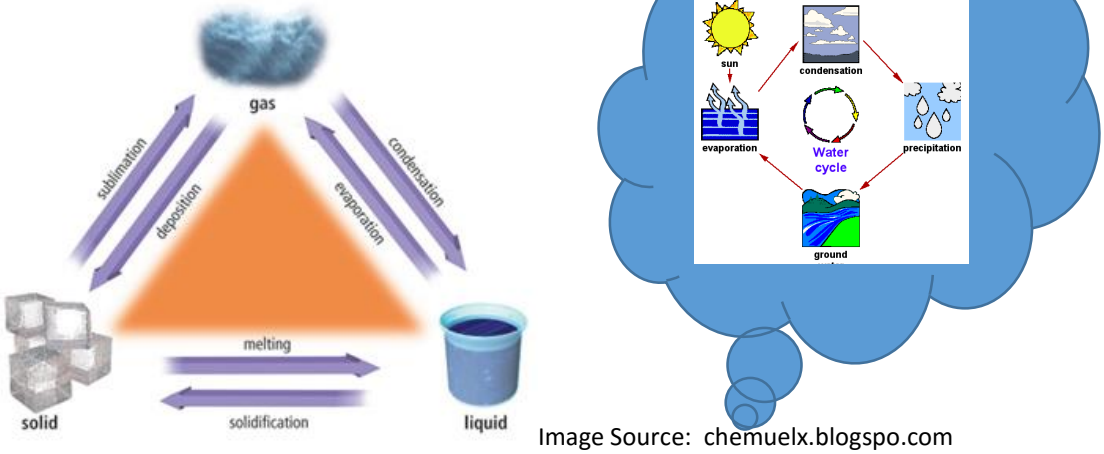
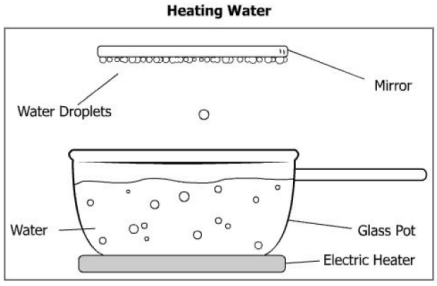


Image Source: chemuelx.blogspo.com

SOL RELEASED QUESTIONS:

1. **Why is water known as the universal solvent? (2015)**
   a. It dissolves all known substances
   b. It dissolves only solid substances
   c. It dissolves the greatest amount of substances
   d. It dissolves substances faster than all other solvents

2. **The volume of water in the pot decreases during this investigation. Water droplets form on the mirror when positioned over the pot. In this setup, water ____. (2015)**

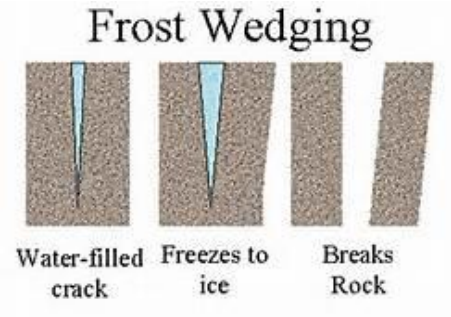


a. Vaporizes and then freezes
b. Vaporizes and then condenses
c. Condenses and then vaporizes
d. Freezes and then vaporizes

WEATHERING:

There are two types of weathering; physical and chemical weathering.

- **Physical Weathering**, also known as **mechanical weathering**, is the process by which rocks are **broken into smaller pieces** without changing their chemical composition. Some examples of physical weathering include; **freezing and thawing, ice/frost wedging, release of pressure, growth of plants, actions of animals, and abrasion** (grinding away of rock by rock particles carried by water, ice, wind, or gravity. Mnemonic device – When will I grow?



- **Chemical weathering breaks down rocks** through **chemical changes**. Chemical weathering is caused by water, oxygen, carbon dioxide, organisms, and acid rain.

SOL RELEASED QUESTION:

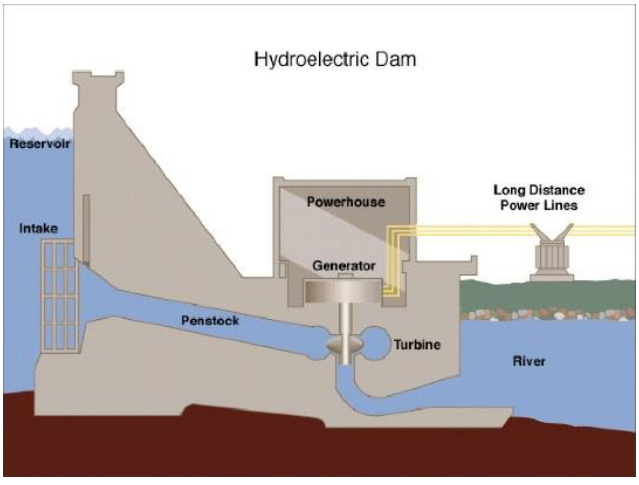
1. **Physical and chemical weathering processes are responsible for breaking down rocks. Which of these is an example of chemical weathering by water? (2015)**
    a. Mineral crystals form as water evaporates from rocks
    b. Limestone reacts with acid rain and dissolves
    c. Water freezes in rock cracks and cause the rock to split
    d. Moss collets and grows on the surface of rocks

ABSORPTION OF THERMAL ENERGY

Water is able to **absorb heat energy** without showing relatively large changes in temperature. Large bodies of water act to **moderate the climate** of surrounding areas by absorbing heat in summer and slowly releasing that heat in the winter. For this reason, the climate near large bodies of water is slightly **milder** than areas without large bodies of water. (This explains why cities and counties along the Chesapeake Bay and Atlantic coast have average winter temperatures that are milder than areas in central and western Virginia. (http://www.solpass.org/6-8Science/6s/standards/study6.5.htm)

IRRIGATION AND POWER GENERATION:

- Water is essential for **agriculture**. Crops watered by reliable **irrigation** systems are more productive, and harvests more dependable.
- Water is an important resource used in **power generation**. Hydroelectric power plants make use of the **kinetic energy** of water as it flows through turbines. Water is also used in power plants as the water is heated and turned to steam. The **steam** is used to **turn turbines** that generate electricity. (http://www.solpass.org/6-8Science/6s/standards/study6.5.htm)



CLEAN WATER AND HEALTH:

- Most of Earth's water is salt water in the oceans (97%). Non-frozen, fresh water makes up less than 1% of the water on Earth.

Image Source: sites.google.com

- In the past, streams and rivers were often used to dispose of human **waste**, and open **sewers** were common. During the mid-1800s public health officials recognized the connection between **disease outbreaks** and **contamination** of public wells and drinking water. Advances in **water treatment** and sanitary sewers have helped eliminate diseases associated with human waste. (http://www.solpass.org/6-8Science/6s/standards/study6.5.htm)
- Water is one of our most important resources, as every living thing needs water to survive. **Water conservation** means using less water or recycling used water so that it can be used again. Some ways to conserve water; use less water when washing dishes and doing laundry, reducing water usage when watering the lawn and rinsing produce, saving water when flushing the toilet and using the shower, take shorter showers, turn off the water after you wet your toothbrush, and making it easier to save water by making home improvements and repairs.

EARTH'S ATMOSPHERE:

Do you remember what is meant by the term "mixture"? Air is a mixture of gaseous elements and compounds. These include nitrogen, oxygen, water, argon and carbon dioxide. Nitrogen makes up the largest proportion of air.

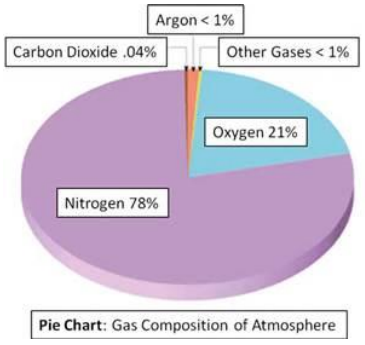
Components of the Atmosphere

The atmosphere consists of the mixture of gases that surround the earth. It extends from the surface of the Earth to more than 600 kilometers into space. Many of the gases are used by living organisms and are essential to life. These gases also filter damaging rays from the sun, destroy particles from space, and trap heat. The atmosphere is a fluid. A fluid is any material that can flow and takes the shape of its container. Two gases, nitrogen and oxygen, make up 99% of the atmosphere.

The following is a breakdown of the gases that compose our atmosphere:

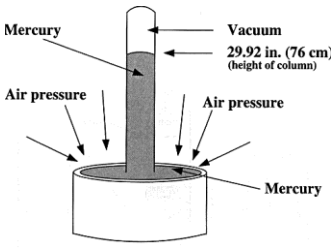
- 78% Nitrogen
- 21% Oxygen
- l% Other (argon, carbon dioxide, hydrogen, methane, carbon monoxide, helium, neon, krypton, xenon, water vapor)

Look at the circle graph to analyze air's composition:

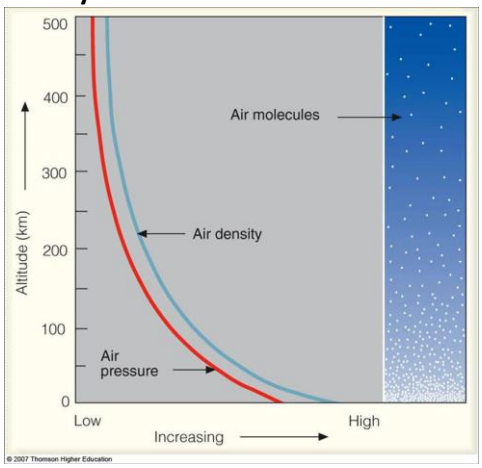


Atlasfreshair.blogspot.com

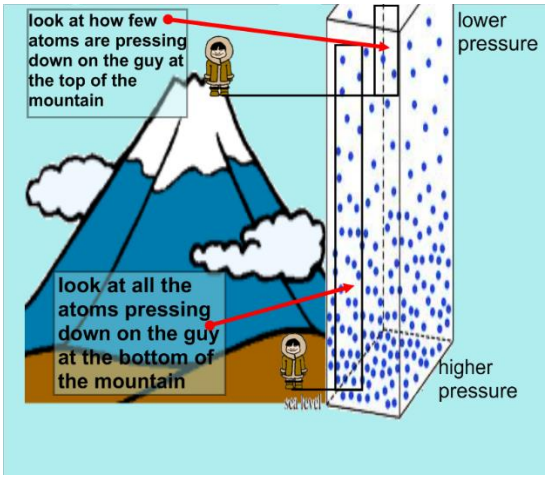
Does air have mass? Since air consists of atoms and molecules that have mass, air has mass. The amount of **mass in a given volume** of air (D = M/V) is **density**. The **force pushing on an area** or surface is called **pressure**. Air pressure is the result of the weight of a column of air pushing down on an area. Since air pressure pushes in all directions, air pressure does not "crush" objects. A **barometer** is an instrument used to **measure air pressure**. Two common **types of barometers** are **mercury** barometers and **aneroid** barometers.



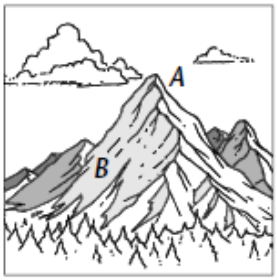
Altitude, or elevation, is the **distance above sea level**. **Air pressure decreases** as **altitude increases**. As **air pressure decreases**, **so does density**.



*Use the picture below to help understand the relationship between **altitude and air pressure**:*



Use the below photo to answer the questions:



Altitude is greater at point _____.

Air pressure is greater at point _____.

Density of the air is greater at point _____,

Why doesn't air pressure crush objects? _____

_____

Water is in the air all around us. **Humidity** is the **amount of water vapor** (water in the form of a gas) in the atmosphere**.** Two terms used to describe humidity are **absolute humidity** and **relative humidity**. **Absolute humidity** is the **amount of water vapor divided by the amount of dry air in a certain volume of air at a particular temperature**. The hotter the air is, the more water vapor it can hold.

Relative humidity is the **ratio of the current absolute humidity to the highest possible absolute humidity**, which will depend upon the current air temperature. A relative humidity of 100% means that the air can't hold any more water vapor. It's totally saturated.

Layers of the Atmosphere:

Earth's atmosphere is a relatively thin layer of gases that protects the planet and allows life to exist. If Earth were compared to an apple, the atmosphere would be the thickness of the peel. The atmosphere is made up of five layers.

The ***troposphere*** is the layer that is **closest to Earth's surface**, starting at the surface and rising to between 8 and 14.5 km high. It is the only layer in which **life exists** and virtually **all weather** occurs. It contains 99% of the water vapor in the atmosphere. Due to Earth's gravitational pull, most of the air molecules that make up the atmosphere are found in the troposphere; therefore, **atmospheric pressure**

is highest in the troposphere. As altitude increases, atmospheric pressure *decreases* because fewer and fewer molecules are present. Temperature in the troposphere also *decreases* as altitude increases.

The ***stratosphere*** starts just above the troposphere and rises to about 50 km above Earth's surface. The stratosphere is dry and much less dense than the troposphere. The **ozone layer**, which absorbs and scatters solar ultraviolet radiation, is in this layer. Temperature in the stratosphere generally *increases* as altitude increases due to increasing absorption of ultraviolet radiation. The troposphere and stratosphere together contain 99 percent of the air molecules in the atmosphere.

The ***mesosphere*** starts just above the stratosphere and extends to about 85 km above Earth's surface. Temperature in this layer *decreases* to as low as −93°C as altitude increases. Most meteors from space burn up in this layer.

The ***thermosphere*** starts just above the mesosphere and extends to around 500 km above Earth's surface. Temperature in this layer can soar to as high as 1,727°C due to solar activity. The thermosphere and the upper mesosphere contain the ionosphere, which is a large number of electrically-charged particles (ions). Chemical reactions occur much more quickly here than on the Earth. Light displays, called ***auroras,*** occur here.

The ***exosphere*** starts at the top of the thermosphere and continues upward until it merges with **outer space**. In this layer, hydrogen and helium are the main gases present.
Resource:http://www.doe.virginia.gov/testing/sol/standards_docs/science/2010/lesson_plans/grade6/matter/sess_6-6ac.pdf

Layer	Mass of Air	Altitude	Air Pressure	Temperature	Description
Troposphere	75% of atmosphere	8 to 14.5 km thickness, depending on the season	Highest pressure in the atmosphere, due to gravity: 100 to 1,000 mb	*Decreases* as altitude increases; Range: 17°C to –52°C	• Layer where weather occurs • Densest layer with most gases • Layer where life exists • Contains 99% of the water vapor in atmosphere
Stratosphere	24% of atmosphere	14.5 to 50 km (31 mi.) high	Low pressure: 1 to 100 mb	*Increases* as altitude increases; Range: –52°C to –3°C, due to absorption of ultraviolet radiation	• Contains ozone layer, which absorbs ultraviolet radiation • Dry and less dense than troposphere
Mesosphere	A few molecules	50 to 85 km (53 mi.) high	Low pressure: 0.01 to –1 mb	*Decreases* as altitude increases; Range: –3°C to –93°C	• Layer where shooting stars burn
Thermosphere	Very few molecules	85 to 500 km (372 mi.) high	Very low pressure	–93°C to as high as 1,727°C due to the activity of the sun	• Contains ionosphere—large number of electrically charged particles (ions) • Light displays, called auroras, over poles (Northern lights)
Exosphere	Only helium and hydrogen molecules at very low density	500 to 800 km (372 to 500 mi.) high; merges with space	Extremely low pressure; very few molecules	1,100°C to 270°C	• Satellites, Hubble telescope, and space station orbit here. • Merges with vacuum of outer space
Other Information					

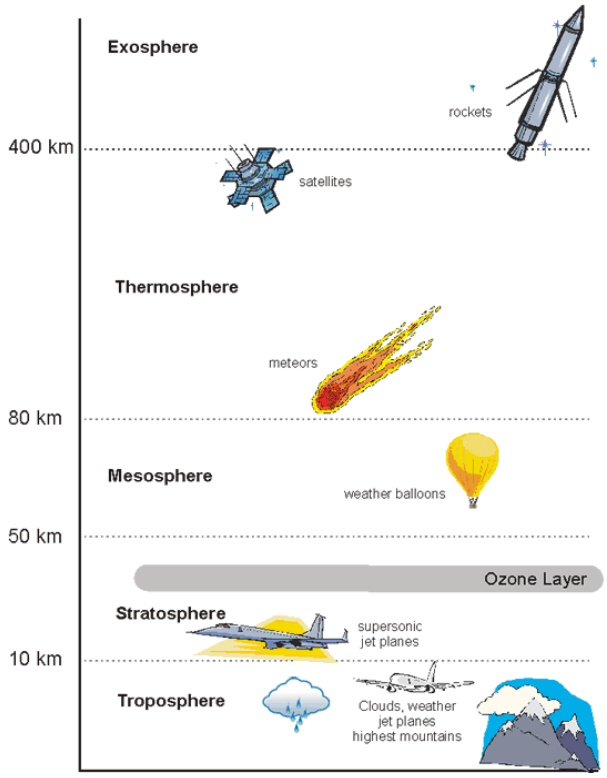


Image Source: miprimerzarzablog.blogia.com

RELEASED SOL QUESTION:

1. **Which statement correctly describes a difference between mesosphere and the stratosphere? (2015)**
    a. The mesosphere has more active weather than the stratosphere
    b. The mesosphere contains fewer oxygen molecules than the stratosphere
    c. Air pressure is lower in the stratosphere than in the mesosphere
    d. Temperatures decrease with altitude only in the stratosphere

Human Caused Changes to the Atmosphere:

Humans have impacted the Earth's atmosphere by aiding in the production of greenhouse gases. Remember greenhouse effect? Carbon dioxide and methane are two of the primary contributors to the **greenhouse effect**, which causes the atmosphere to **trap heat** more effectively. According to the U.S. National Oceanic and Atmospheric Administration, the concentrations of carbon dioxide in the atmosphere have increased by 38 percent since 1750, while methane concentrations have gone up 148 percent during the same period. Many scientists attribute this increase to the widespread combustion of **fossil fuels**.

Another part of the atmosphere that humans have directly affected is the **ozone layer**. This protective layer of the atmosphere **helps block ultraviolet radiation**, but in 1985, scientists from the British Antarctic Survey discovered that something was destroying ozone molecules above Antarctica. Study of the problem traced the **destruction to chlorofluorocarbons and other ozone-depleting chemicals**, and in 1987, countries around the world signed the Montreal Protocol to **discontinue the use of CFCs**.

Humans can also affect the atmosphere through **air pollution**. Some of the compounds released by fossil fuel combustion can react together to create ozone molecules at the ground level, which can prove a threat to those with breathing difficulties and damage the lungs with long-term exposure. The U.S. Environmental Protection Agency regularly publishes air quality alerts for affected areas, and advises that people with breathing conditions or environmental sensitivities stay inside on days where ozone concentrations are highest.

The British Antarctic Survey estimates that the hole in the ozone layer may take as many as 50 years to disappear, provided no new threats to the ozone come into play. Studies by the Intergovernmental Panel on Climate Change suggest that **even if we cut carbon output levels by 50%, we would still see a net increase in atmospheric carbon dioxide over the next century due to the changes already in motion**.

RELEASED SOL QUESTIONS:

1. **Which of these is a way that a person can help improve air quality? (2015)**
    a. Build a compost pile
    b. Carpool with several people
    c. Burn leaves in the fall
    d. Use a gas-powered lawn mower
2. **It is important to protect air quality because ____. (2009)**
    a. storms worsen as air pollution decreases
    b. acid rain is caused by air pollution
    c. wind currents change when the air is polluted
    d. energy produced by the Sun decreases when air is polluted

CLOUDS:

Clouds form in three basic patterns:

- **Cirrus**, from *cirro,* meaning curly or fibrous
- **Stratus**, from *strato,* suggesting sheets or layers
- **Cumulus**, from *cumulo,* indicating heaped or piled

High clouds: Cirrus, cirrostratus and cirrocumulus clouds are **wispy** clouds that are located at altitudes above 20,000 feet and composed of ice crystals, because at such altitudes temperatures are below freezing. Cirrostratus is a thin cloud layer that causes a halo to appear around the sun and moon. It is often seen 12 to 18 hours in advance of an unsettled weather system. Cirrocumulus clouds look like many small tufts of cotton, rippled sand or even the scales of a fish (hence the term “mackerel sky”).

Middle clouds: Altostratus, altocumulus and nimbostratus clouds are typically found between 6,000 and 20,000 feet above the ground. Altostratus resembles a smooth gray sheet across the sky. Sometimes the sun shines through the layer as a diffuse ball as if you were looking at it through a pane of frosted glass. Altocumulus clouds can appear in a wide variety of different shapes. When these clouds are very thin or semi-transparent, you might see a series of colored rings appearing immediately around the moon or sun, causing an atmospheric effect called a corona. Nimbostratus clouds are

smooth layers of gray, which often cannot be seen clearly because of the precipitation falling from them.

Low clouds: Stratus, cumulus and stratocumulus clouds are based at altitudes of 6,000 feet or lower. **Stratus** clouds appear as smooth, even sheets; light rain and drizzle often fall from them; light snow or freezing drizzle during the winter. Fog is merely a stratus cloud reaching to, or forming on the ground. Cumulus clouds can range in size from resembling balls of cotton to big heaps of mashed potatoes in the sky. They are often referred to as "**fair weather clouds**," because they usually are not associated with precipitation, but occasionally they can grow into thunderstorms (cumulonimbus). Stratocumulus clouds are similar to altocumulus in that they can appear in a wide variety of different shapes and textures.

The **cumulonimbus clouds**, often called a thunderhead because torrential rain, vivid lightning and thunder come from it. The tops of such clouds may reach up to 60,000 feet or more into the sky; ice crystals become sheared off and are carried away by strong winds aloft forming a flattened shield of cirrus that spread out in the shape of an anvil. Sometimes hail or more rarely, a tornado comes from a cumulonimbus cloud. *Resource:* *http://www.srh.noaa.gov/srh/jetstream/clouds/cloudwise/types.html*

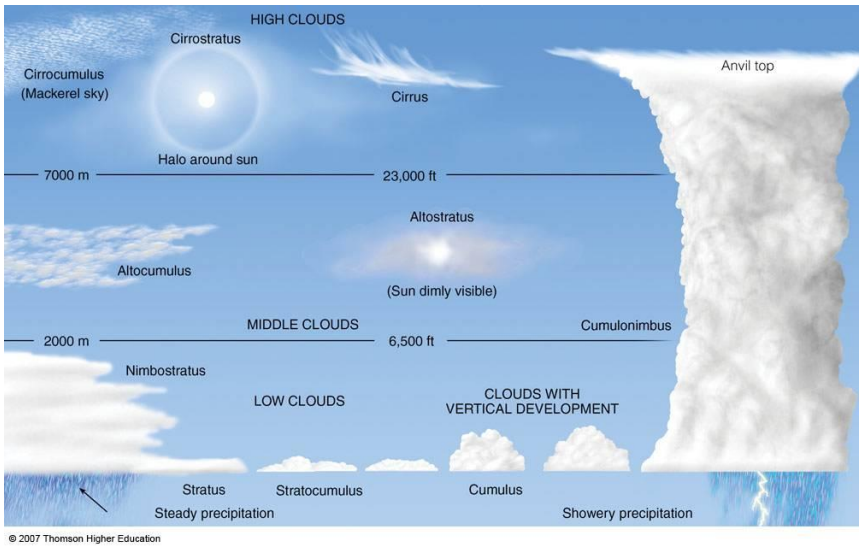


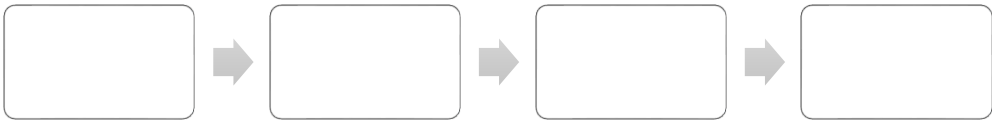
Image Source: gasbung.tk

RELEASED SOL QUESTIONS:

1. **Clouds are formed when millions of drops of water become suspended in the air. Which of the following is a step in the process of cloud formation? (2009)**
   - **a.** Expansion of cold air
   - **b.** Formation of carbon dioxide
   - **c.** Condensation of water vapor
   - **d.** Breakdown of atmospheric ozone

2. **What are the ordered steps of cloud formation? (2015)**

CLOUD FORMATION



STEPS

Water vapor cools	**Liquid water evaporates**
Water condenses	**Warm water vapor rises**

Types of Weather Fronts:

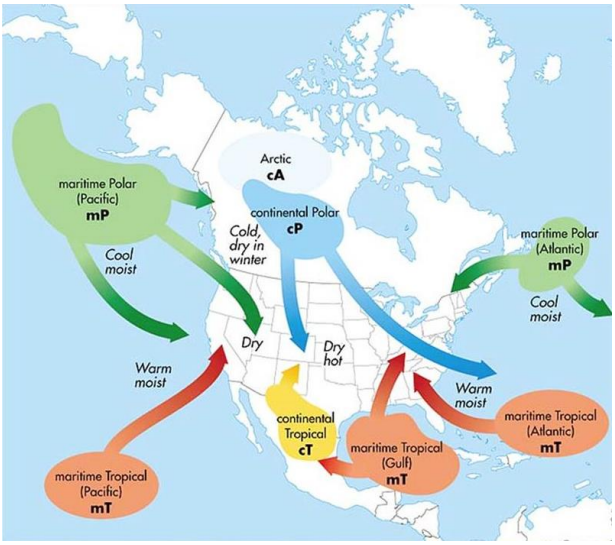
An air mass is a large body of air that has similar temperature and moisture properties throughout. There are two main characteristics that define air masses - temperature and moisture content. Generally, the temperature and moisture content of air masses are abbreviated as two letters. The first letter is a lower case letter and is used to symbolize the overall moisture in the air. The second letter used to symbolize a type of air mass is capitalized.

Types of Air:

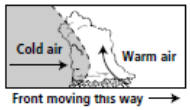
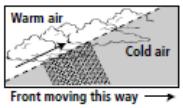
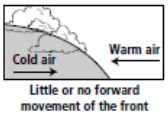
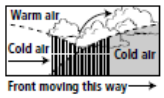
- continental air - *c*
- maritime air - *m*
- Tropical air - *T*
- Polar air - *P*

The different types of continental air masses that impact North America include:

- **continental polar (cP):** Cold and Dry
- **continental tropical (cT):** Hot and dry
- **maritime polar (cP):** Cold and humid (winter), Cool and humid (summer)
- **maritime tropical (cT):** Warm and humid



A **<u>weather front</u>** is where **two air masses meet** with different temperatures and densities collide, **but do not mix**.

Type of Front	How It Forms	Weather It Brings
Cold front 	Forms when a cold air mass pushes under a warm air mass, forcing the warm air to rise.	Thunderheads can form as the moisture in the warm air mass rises, cools, and condenses. As the front moves through, cool, fair weather is likely to follow.
Warm front 	Forms when a moist, warm air mass slides up and over a cold air mass.	As the warm air mass rises, it condenses into a broad area of clouds. A warm front brings gentle rain or light snow, followed by warmer, milder weather.
Stationary front 	Forms when warm and cold air meet and neither air mass has the force to move the other. They remain *stationary*, or "standing still."	Where the warm and cold air meet, clouds and fog form, and it may rain or snow. Can bring many days of clouds and precipitation.
Occluded Front 	Forms when a warm air mass gets caught between two cold air masses. The warm air mass rises as the cool air masses push and meet in the middle.	The temperature drops as the warm air mass is *occluded*, or "cut off," from the ground and pushed upward. Can bring strong winds and heavy precipitation.

Types of Precipitation:

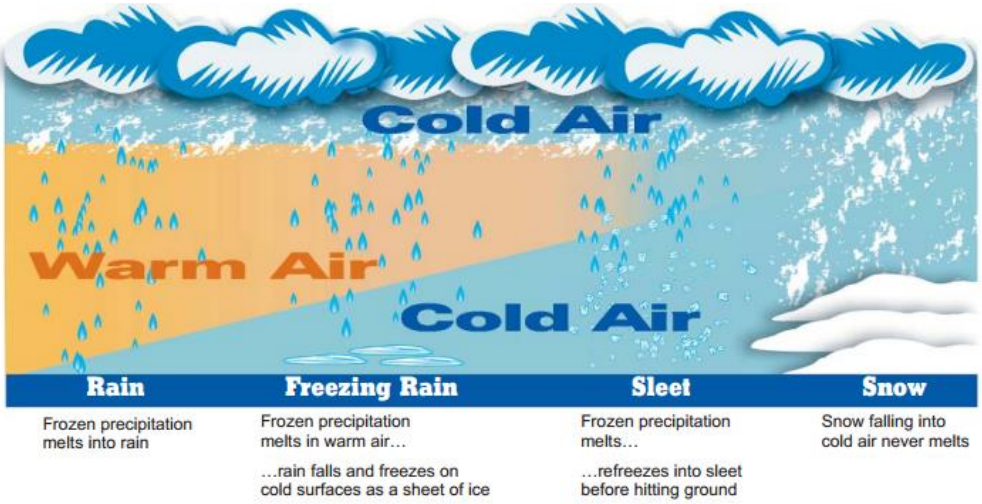
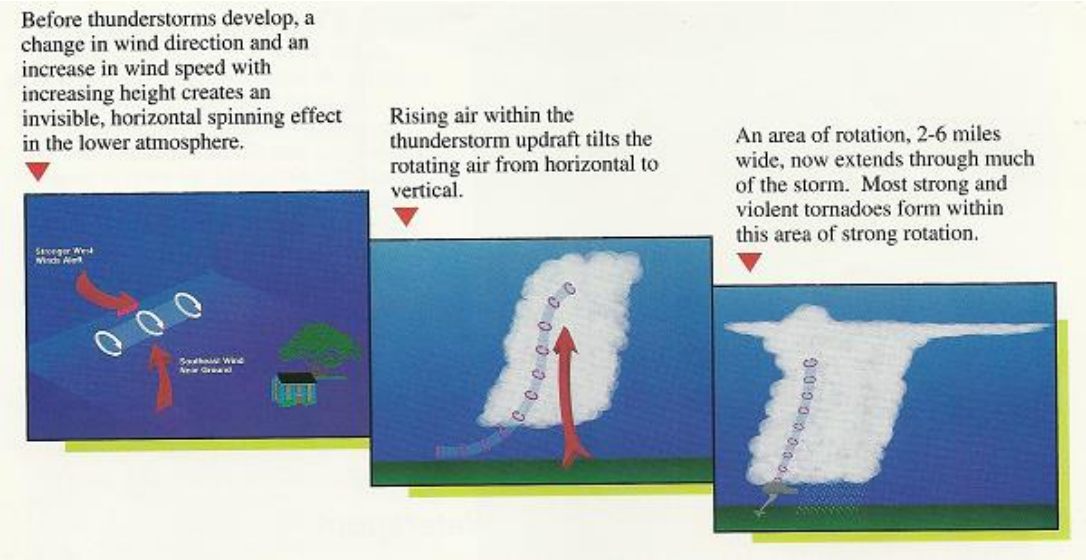


Image Source: srh.noaa.gov

WEATHER RELATED PHENOMENA

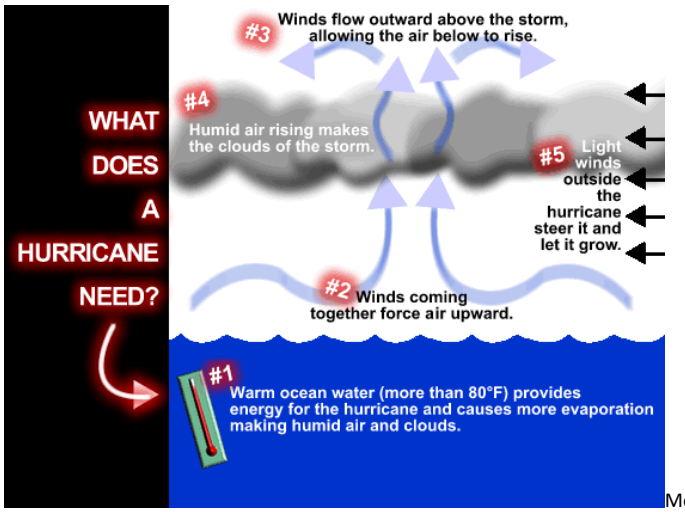
A **thunderstorm** is a storm with lightning and thunder. It's produced by a cumulonimbus cloud, usually producing gusty winds, heavy rain and sometimes hail. The basic ingredients used to make a thunderstorm are moisture, unstable air and lift. You need moisture to form clouds and rain. You need unstable air that is relatively warm and can rise rapidly. Finally, you need lift. This can form from fronts, sea breezes or mountains.

A **tornado** is a violent rotating column of air extending from a thunderstorm to the ground. Most tornadoes form from thunderstorms. You need warm, moist air from the Gulf of Mexico and cool, dry air from Canada. When these two air masses meet, they create instability in the atmosphere. A change in wind direction and an increase in wind speed with increasing height creates an invisible, horizontal spinning effect in the lower atmosphere. Rising air within the updraft tilts the rotating air from horizontal to vertical. An area of rotation, 2-6 miles wide, now extends through much of the storm. Most strong and violent tornadoes form within this area of strong rotation.



A **hurricane** is a huge storm! It can be up to 600 miles across and have strong winds spiraling inward and upward at speeds of 75 to 200 mph. Each hurricane usually lasts for over a week, moving 10-20 miles per hour over the open ocean. Hurricanes gather heat and energy through contact with warm ocean waters. Evaporation from the seawater increases their power. Hurricanes rotate in a counter-clockwise direction around an "eye" in the Northern Hemisphere and clockwise direction in the Southern Hemisphere. The center of the storm or "**eye**" is the calmest part. It has only light winds and fair weather. When they come onto land, the heavy rain, strong winds and large waves can damage buildings, trees and cars.

Hurricanes only form over really warm ocean water of 80°F or warmer. The atmosphere (the air) must cool off very quickly the higher you go. Also, the wind must be blowing in the same direction and at the same speed to force air upward from the ocean surface. Winds flow outward above the storm allowing the air below to rise.

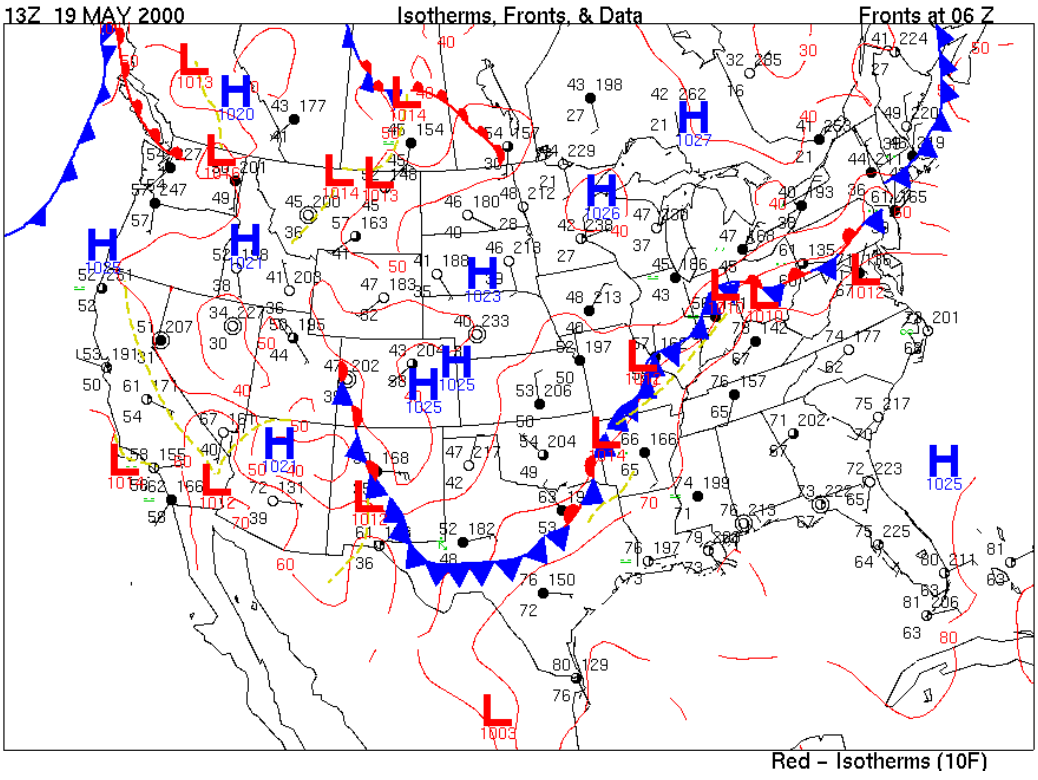


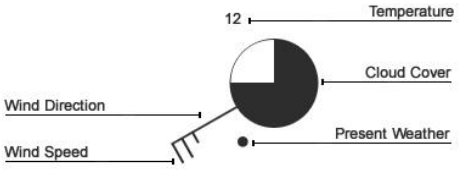
Modified from: http://www.weatherwizkids.com/weather-tornado.htm

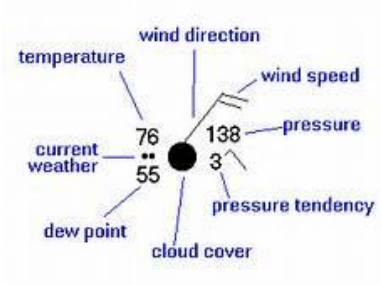
Interpret Basic Weather Maps

Isobars (iso = equal, bar = pressure) are the plain lines that curve across the map. They join together places with the same mean sea level air pressure. When they enclose an area of low pressure this is called a 'Low' or 'depression' and its centre is labelled on a weather map with an 'L'. When isobars enclose an area of high pressure this is called a High or anticyclone and its centre is labelled on a weather map by an 'H'.

What information can learn by looking at a weather map?





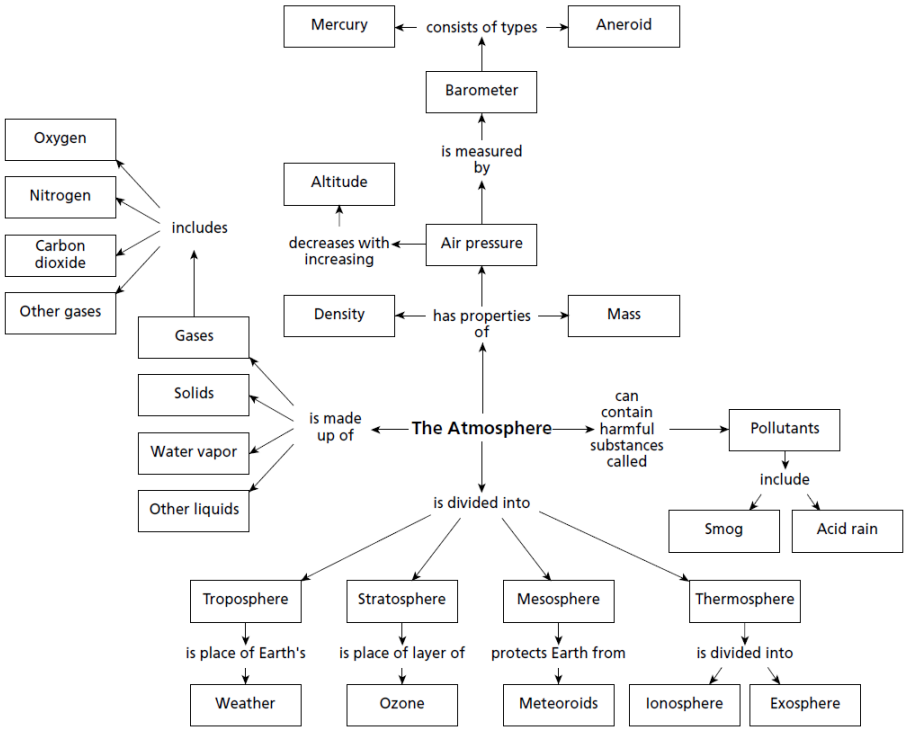


SYMBOLS USED IN PLOTTING REPORT

Precipitation	Wind speed and direction	Sky coverage	Some types of high clouds
Fog	0 calm	No cover	Scattered cirrus
Snow	1–2 knots	1/10 or less	Dense cirrus in patches
Rain	3–7 knots	2/10 to 3/10	Veil of cirrus covering entire sky
Thunder-storm	8–12 knots	4/10	Cirrus not covering entire sky
Drizzle	13–17 knots	½	
Showers	18–22 knots	6/10	
	23-27 knots	7/10	
	48-52 knots	Overcast with openings	
	1 knot = 1.852 km/h	Complete overcast	

Some types of middle clouds	Some types of low clouds	Fronts and pressure systems
Thin altostratus layer	Cumulus of fair weather	(H) or High (L) or Low Center of high or low pressure system
Thick altostratus layer	Stratocumulus	Cold front
Thin altostratus in patches	Fractocumulus of bad weather	Warm front
Thin altostratus in bands	Stratus of fair weather	Occluded front
		Stationary front

Here's what we reviewed about our atmosphere:

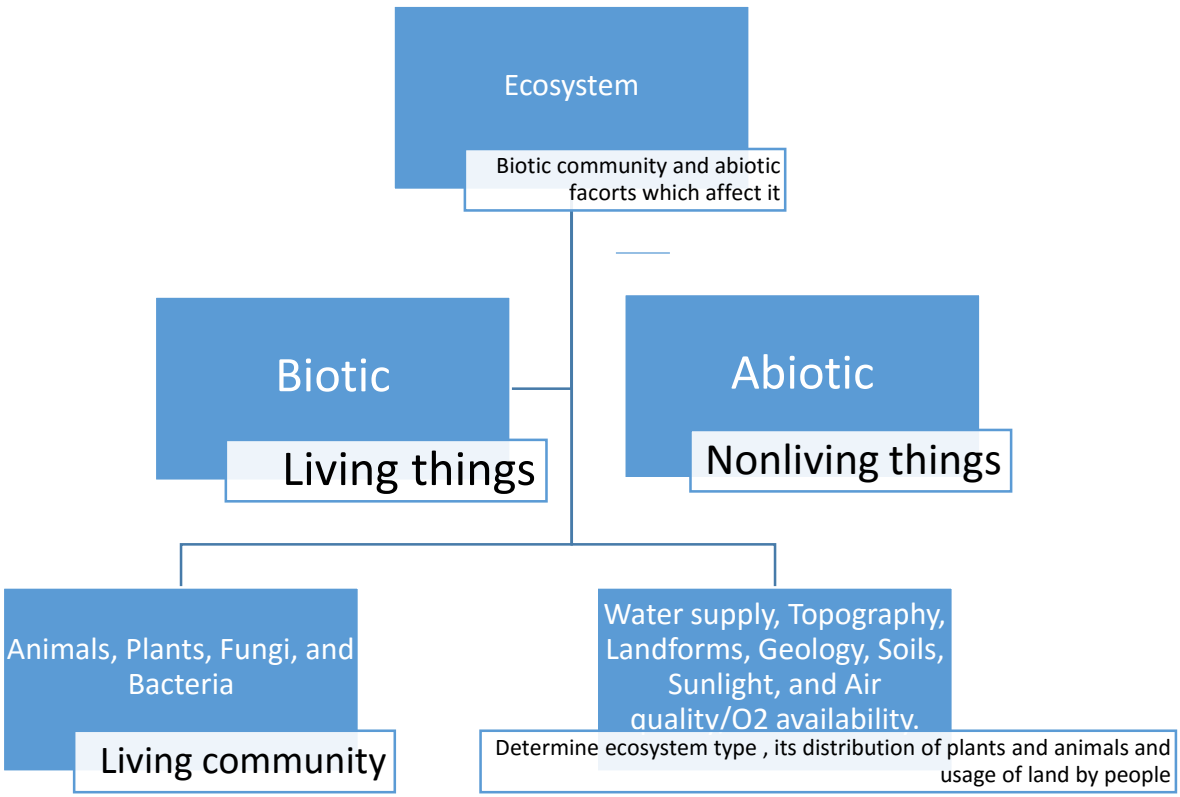


SOL RELEAESED QUESTIONS:

1. **Hurricanes form in tropical waters between 8 and 20 degrees north and south of the equator. Hurricanes rarely form at higher latitudes because the water is too ___ (2015)**
   a. warm
   b. deep
   c. shallow
   d. cold
2. **A cold air mass moves underneath a warm air mass causing the warm air to rise. This event is best described as ____. (2015)**
   a. a cold front
   b. a warm front
   c. an occluded front
   d. a stationary front

LIVING SYSTEMS

Ecosystems

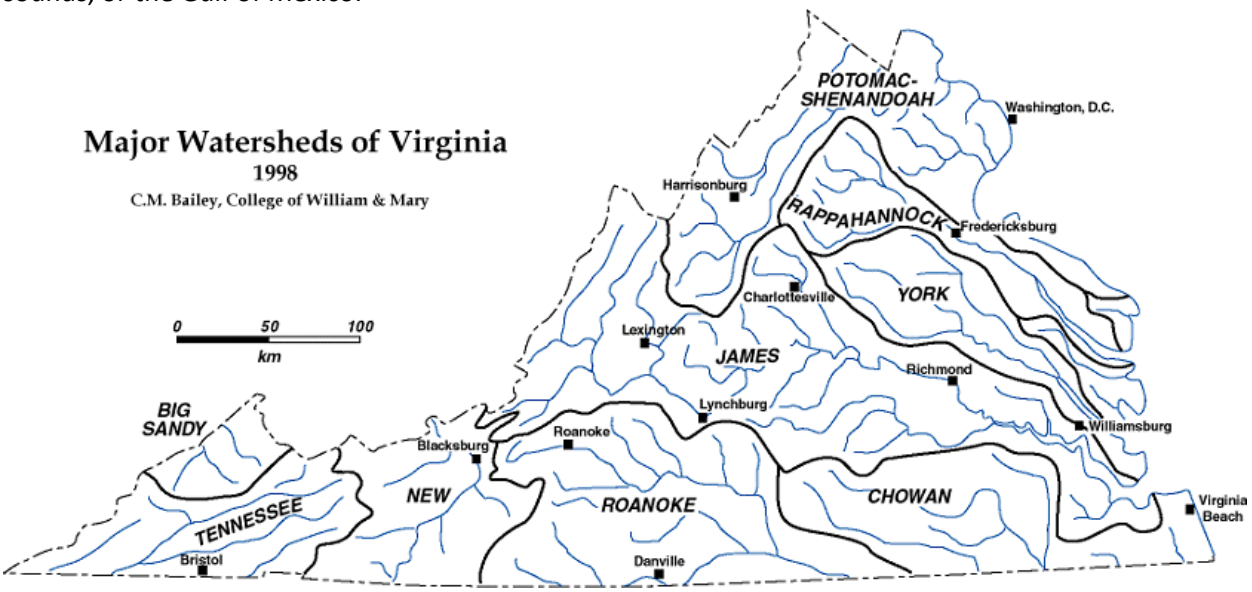


SOL RELAESED QUESTIONS:

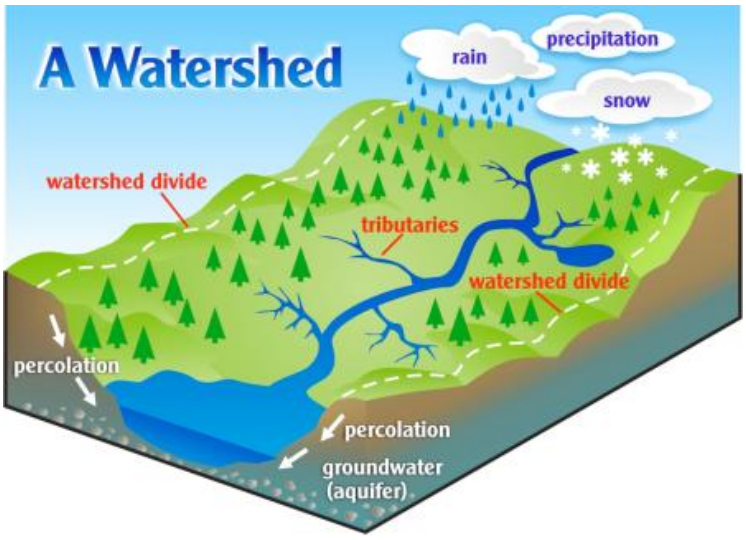
1. **Otters have adaptive traits that allow them to survive by eating shellfish and crustaceans. If changes in biotic factors of the ecosystem result in reduced numbers of shellfish and crustaceans, the otters will most likely — (2009)**
   - **a.** experience a population decline
   - **b.** adapt to a different ecosystem
   - **c.** change the genetic makeup of their bodies
   - **d.** increase reproduction rates
2. **Which is am abiotic change in an ecosystem? (2015)**
   - **a.** Plant photosynthesis rates increase
   - **b.** Fish species populations increase
   - **c.** Aquatic predator survival rates increase
   - **d.** Annual rainfall totals for an area increase

VIRGINIA'S WATERSHED SYSTEM

A **watershed** is the **land that water flows across or through** on its way to a stream, lake, wetland, or other body of water. Areas of higher elevations, such as ridgelines and **divides**, **separate watersheds**. The three major regional watershed systems in Virginia lead to the Chesapeake Bay, the North Carolina sounds, or the Gulf of Mexico.



River systems are made up of **tributaries of smaller streams** that join along their courses. Rivers and streams generally have **wide, flat, border areas**, called **flood plains**, onto which water spills out at times of high flow. Rivers and streams carry and deposit sediment. As water flow decreases speed, the size of the sediment it carries decreases.

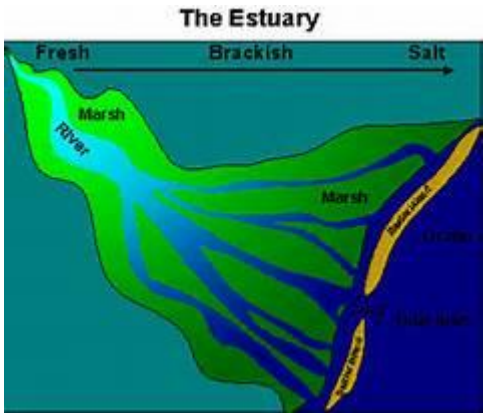


Wetlands form the **transition zone between dry land and bodies of water** such as rivers, lakes, or bays. Wetlands are areas where land and water ecosystems come together. They are important for **acting like sponges** to regulate the flow of water.

Benefits of wetlands:

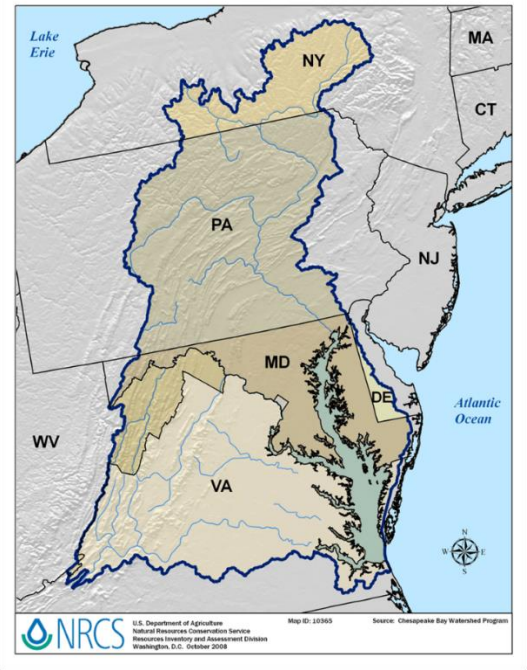
- regulating runoff by storing flood waters;
- reducing erosion by slowing down run-off;
- maintaining water quality by filtering sediments, trapping nutrients,
- breaking down pollutants
- recharging groundwater
- provide food and shelter for wildlife and fish
- provide nesting and resting areas for migratory birds.

Estuaries and their surrounding wetlands are bodies of water usually found where rivers meet the sea. **Estuaries** perform important functions such as providing habitat for many organisms and serving as nurseries for their young.



What is brackish water?

The **Chesapeake Bay** is **estuary where fresh and salt water meet and are mixed by tides**. It is the **largest estuary in the contiguous United States** and one of the most productive.



Water quality monitoring is **collection of water samples** to analyze chemical and/or biological parameters.

Parameters include:

- pH
- temperature
- salinity
- dissolved oxygen
- turbidity
- presence of macroinvertebrate organisms

SOL RELEASED QUESTIONS:

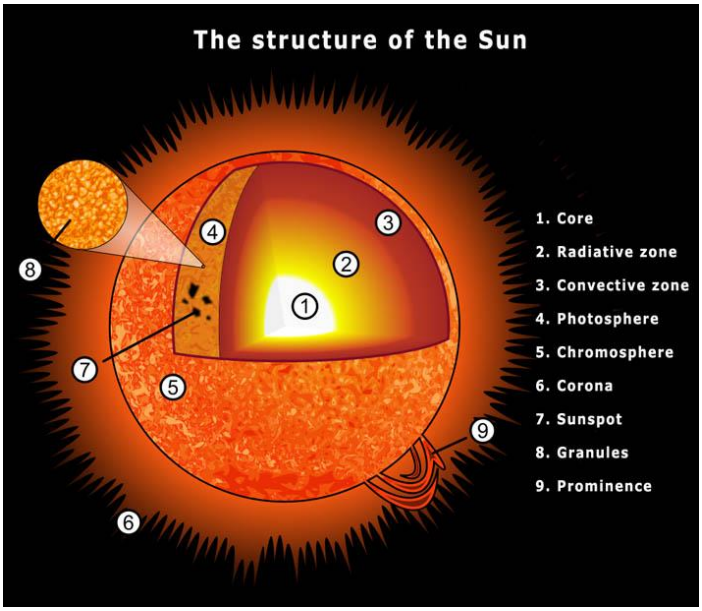
1. **Which body of water is often protected naturally from storms by barrier islands and also contains a mixture of fresh water and salt water? (2015)**
    a. Estuary
    b. Ocean
    c. Lake
    d. Pond

OUR SOLAR SYSTEM

The solar system consists of the sun, moon, Earth, other planets and their moons, meteors, asteroids, and comets. Each body has its own characteristics and features.

The Sun:

The **sun is the ultimate source of all life on Earth**. Radiant energy from the sun helps plants make their food, it heats the planet and it affects the weather. The sun is a self-illuminating ball of gas, and it **produces heat and light that will last for billions of years**. The sun's **strong gravity holds the planets in their orbits**. Its mass **makes up over 99% of the mass of the entire solar system**. The sun has an atmosphere and an interior. It differs from other objects in the solar system because **all the layers are gaseous**. The sun does not have a solid core like the earth.

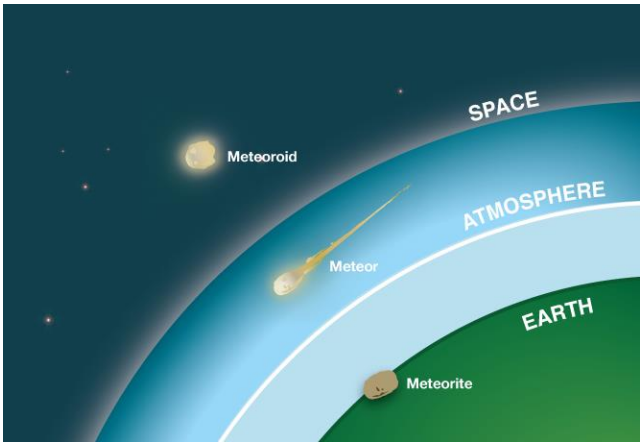


Features of the sun include **sunspots, prominences, and solar flares**. A **sunspot** is an area of the sun's surface that is **cooler than the area around it**. Sunspots appear as dark spots on the sun. **Reddish loops of gas** that appear to connect sunspots are called **prominences**. An **explosion of gas from the sun's surface** occurs when loops in sunspot regions suddenly connect. They are known as **solar flares**. Solar flares can affect communication on earth by disrupting radio, telephone, and satellite signals.

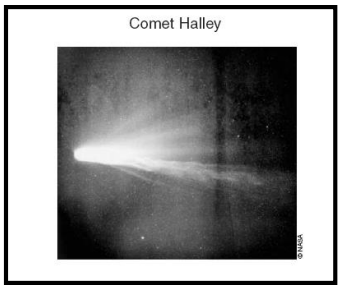
Other Rocky Bodies

<u>Moons</u> are natural satellites that revolve around a more massive body such as a planet. Moons exist because they are caught by the gravitational pull of a larger object. The Earth has one moon. Some planets, such as Mercury and Venus, have none. Other planets, such as Saturn, have over 20. Most moons do not have an atmosphere, and therefore do not experience a lot of weathering.

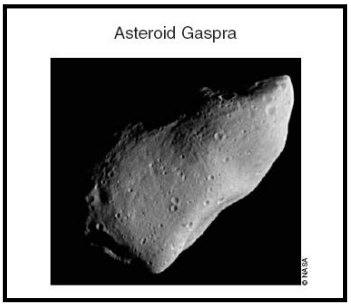
There is a difference between the following three words: **meteor, meteoroid,** and **meteorite**. While the object **orbits out in space** it is called a **<u>meteoroid</u>**. As it **burns up when it enters Earth's atmosphere**, it gives off light and is called a **<u>meteor or "shooting star"</u>**. **<u>Meteorites</u>** are fragments from space that survive the trip through the Earth's atmosphere and **land on Earth**. *Craters on Earth indicate that meteorites have hit Earth in the past.*



<u>Comets</u> are large bodies of **ice, gas, rock and dust** that travel around the sun in an elliptical orbit. Because of their composition, comets are sometimes called "dirty snowballs". If they come close enough to Earth, they can be seen as a shooting star with a long, glowing tail. A comet has three main parts, the **nucleus, coma and tails**. The nucleus is mostly solid with ice and dust mixed in. The coma is located around the nucleus and is a dense cloud of water and gases. Flowing behind the head is the comet's tail. It is composed of the dust tail and the ion tail. The tail is caused by solar winds blowing back matter from the coma. The dust tail is what is usually seen in the night sky. Some take only a few years to orbit the sun while others may take thousands of years to orbit the sun. One comet, named Hale-Bopp, has chemicals that are similar to those that might have formed life on Earth.



<u>Asteroids</u> are **pieces of rock made of minerals** similar to those found on rocky planets or moons. An asteroid belt exits between Mars and Jupiter. This belt orbits the sun. The word asteroid means "star-like".



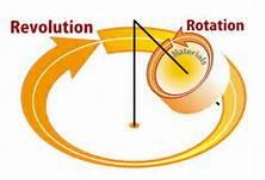
Planets

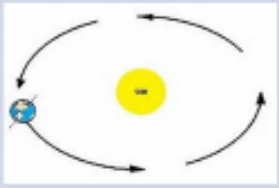
The solar system can be organized into the **<u>inner planets</u>** and **<u>outer planets</u>**. Mercury, Venus, Earth and Mars are known as the **<u>inner planets</u>** because they are **located within the asteroid belt**. These planets are **small, dense, and rocky**. As a result of these features, they are also referred to as **terrestrial planets**. Jupiter, Saturn, Uranus, Neptune, and Pluto are referred to as the **<u>outer planets</u>** because they are **located outside of the asteroid belt**. They are the largest planets. It is also believed that their surfaces are a liquid or slush surrounded by extensive gaseous atmospheres.

What is a dwarf planet? A **dwarf planet** is an object the size of a **planet** but that is neither a **planet** nor a moon or other natural satellite.

One mnemonic that could be used to help remember the order of the planets from the sun outward into space is "**M**y **v**ery **e**ducated **m**other **j**ust **s**erved **u**s **n**achos." The distances between the sun and the planets are so great that a measurement known as an astronomical unit or *AU* is used. An *AU* is 150 million kilometers, which is the average distance from the Earth to the sun. If something is 6 *AU* away from the sun, then the object is six times farther from the sun than the Earth is. Those planets closest to the sun have shorter revolutions, or years, compared to Earth. Those furthest from the sun have longer revolutions.

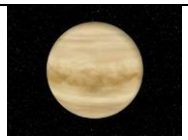
<u>What is the difference between rotation and revolution?</u>

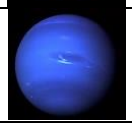


	Revolution	Rotation
Time to complete	365 ¼ or 1 year	24 hours or 1 day
What does it cause	Seasons	Day & Night
Sketch		

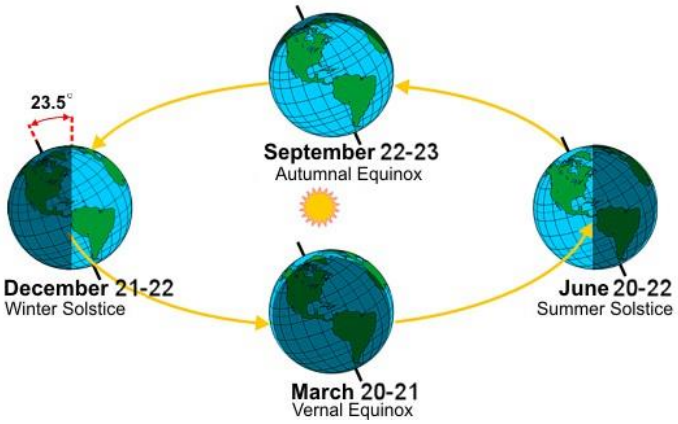
Gravity is the **force** pulling together all matter (which is anything you can physically touch). The more matter, the more **gravity** - things that have a lot of matter such as planets and moons and stars pull more strongly.

- It holds the planets in orbit around the Sun, and moons in orbit around the planets.
- The gravitational pull of the Sun and Moon creates the tides on Earth.

Planet	Photo	Inner/Outer Planet	Important Characteristics
Mercury		Inner	▪ small, rocky ▪ no atmosphere ▪ closest to the sun ▪ no moon
Venus		Inner	▪ "Earth's Twin" ▪ hottest planet due to thick atmosphere (greenhouse effect) ▪ clockwise on axis ▪ no moon
Earth		Inner	▪ home! ▪ water in all states ▪ only planet in solar system known to have life
Mars		Inner	▪ known as the "red planet" due to high iron content ▪ has large volcanic systems, including largest volcano in solar system, Olympus Mons ▪ frozen water at polar ice caps

Jupiter		Outer	▪ gas giant ▪ largest planet ▪ has a giant storm called the Great Red Spot ▪ has many moons ▪ has a ring system
Saturn		Outer	▪ gas giant ▪ known for extensive ring system made of gases, dust, ice ▪ most moons
Uranus		Outer	▪ gas giant ▪ rotates on its side compared to other planets
Neptune		Outer	▪ gas giant ▪ characteristic blue color due to gases ▪ sometimes the furthest from the Sun

What causes seasons? The **seasons** are **caused** by the tilt of the Earth's rotational axis away or toward the sun as it travels through its year-long path (revolution) around the sun.

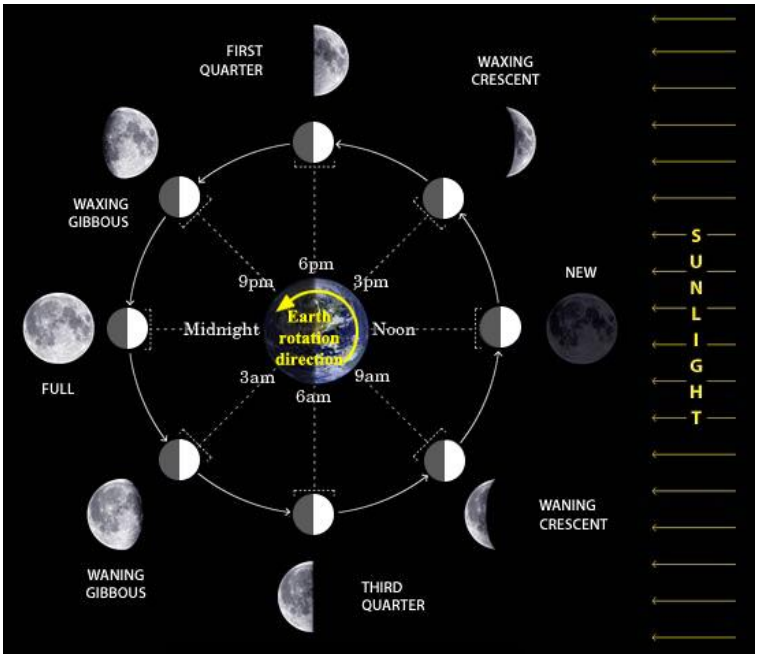


Solar System review adapted from www.neisd.net/curriculum/SchImprov/science/6th

The Moon

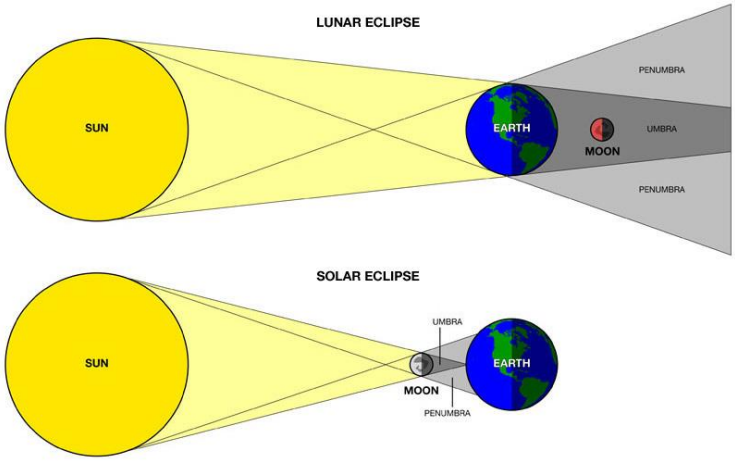
The moon goes through a complete moon phase cycle in about one month. That's true, but it's not exactly one month. It takes the moon about 27.3 days to revolve around Earth. The moon rotates on its axis about every 27.3 days. A day and a year on the moon is the same length. Moon phases occur as the moon makes one revolution around Earth. The phases of the moon we see are due to the position of the sun, Earth, and moon. How much of the reflected surface we see of the moon depends on the positions of the sun, Earth, and moon. The visible portion of the moon that we see each night follows a pattern starting with the new moon. The phases of the moon are the changing shape of the bright part of the Moon that we see is called its phase.

What causes part of the moon to be lit up*?* The moon is illuminated because it reflects the light from the sun. The part of the moon facing the sun is lit up. The part facing away from the sun is in darkness.



ECLIPSES

An eclipse occurs when one object gets in between you and another object and blocks your view. From Earth, we routinely experience two kinds of eclipses: an eclipse of the moon and an eclipse of the sun. Sometimes, as the Earth orbits the sun, it comes between the sun and the moon. When this happens, the Earth throws a dark shadow across the moon. This is known as an eclipse of the moon, or **a lunar eclipse**. Sometimes, the moon passes between the Earth and the sun. The moon blocks the light of the sun and a shadow of the moon is cast on the Earth's surface. This is an eclipse of the sun, or a **solar eclipse**.



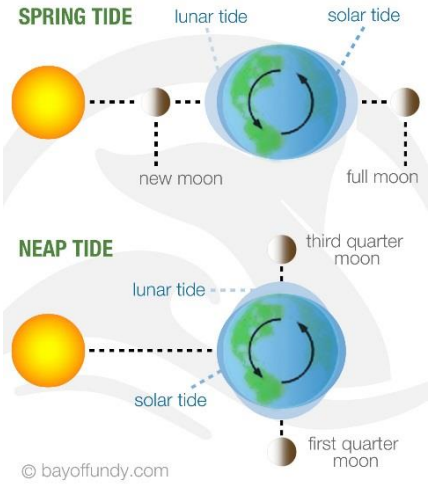
TIDES

A *gravitational pull occurs between the Earth and the moon*. The Earth's seasons do not affect the moon's gravitational pull. What are **tides**? Tides are the **periodic swelling, or rising, and falling of bodies of water** on the Earth's surface. Climate factors can affect the tides, as well as earthquakes. However, besides climate, the gravitational attraction that exists between the Earth and the moon also greatly affect the rise and fall of water levels. As the Earth is rotating while the moon orbits it, there are two high tides and two low tides each day. The tidal cycle, therefore, runs every 24 hours and 50 minutes.

TYPES OF TIDES

Spring Tides: The strongest gravitational forces occur when the **moon and the sun are aligned**. The gravitational pull causes the water levels to be either extremely high or extremely low. When the water levels are extremely high or extremely low, they are known as Spring Tides. **Spring Tides occur during the New Moon and the Full Moon**.

Neap Tides: When the **moon and the sun are not aligned**, the gravitational pull is much weaker. This causes the level of the high and low tides to be far less severe in nature. These types of tides are then known as Neap Tides. Neap Tides occur during the 1st Quarter Moon and the 3rd Quarter Moon.



Source: http://www.educationquizzes.com/us/grade-6/science/the-moon-and-tides/

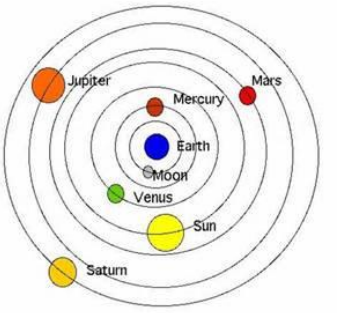
SOL RELEASED QUESTIONS:

1. **During which phase does the Moon receive sunlight only on the side facing away from Earth? (2009)**
    a. Full Moon
    b. New Moon
    c. Waning gibbous
    d. Waxing gibbous
2. **Which of the following best describes why the Moon orbits Earth? (2009)**
    a. The distance the Moon and Earth are from the Sun
    b. The energy reflected from the surface of Earth
    c. The winds generated on Earth by the energy of the Sun
    d. The gravitational attraction between the Moon and Earth

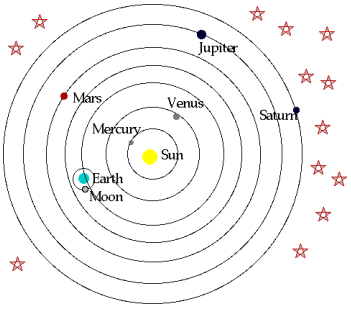
3. **Earth is different from the other planets in our solar system because it _____. (2009)**
    a. orbits a star
    b. has collided with meteorites
    c. has oceans and lakes
    d. makes up the majority of the mass of our solar system
4. **Which of these has the strongest gravitational field? (2015)**
    a. Sun
    b. Earth
    c. Saturn
    d. Jupiter
5. **Which characteristic is common to the four outer planets in our solar system? (2015)**
    a. Low mass
    b. High density
    c. Fast revolution
    d. Gaseous composition

DEVELOPMENT OF OUR UNDERSTANDING OF THE SOLAR SYSTEM

- Ptolemy – Thought the Earth is at the center of the Solar System (Geocentric)

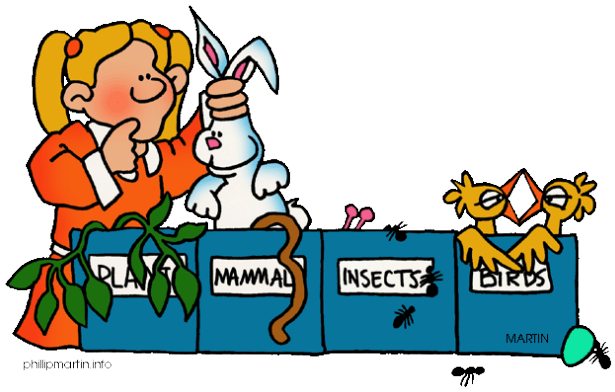


- Aristotle – Believed the universe was finite and the Earth was at its center
- Copernicus – Believed the sun is at the center of the Solar System (heliocentric)



- Galileo – Used telescope to gather evidence to support Copernicus' heliocentric model

GRADE 7 SOL CONTENT REVIEW



CELLS

Cells are the basic units of structure and function.

History of the Cell

Date	Event
1665	**Cell first observed** Robert Hooke, an English scientist, discovered a honeycomb-like structure in a cork slice using a primitive compound microscope. He only saw cell walls as this was dead tissue. He coined the term "cell" for these individual compartments he saw.
1670	**First living cells seen** Anton van Leeuwenhoek, a Dutch biologist, looks at pond water with a microscope he made lenses for.
1683	**Miniature animals** Anton van Leeuwenhoek made several more discoveries on a microscopic level, eventually publishing a letter to the Royal Society in which he included detailed drawings of what he saw. Among these was the first protozoa and bacteria discovered.
1833	**The center of the cell seen** Robert Brown, an English botanist, discovered the nucleus in plant cells.
1838	**Basic building blocks** Matthias Jakob Schleiden, a German botanist, proposes that all plant tissues are composed of cells, and that cells are the basic building blocks of all plants. This statement was the first generalized statement about cells.
1839	**Cell theory** Theodor Schwann, a German botanist reached the conclusion that not only plants, but animal tissue as well is composed of cells. This ended debates that plants and animals were fundamentally different in structure. He also pulled together and organized previous statement on cells into one theory, which states: 1 - Cells are organisms and all organisms consist of one or more cells 2 - The cell is the basic unit of structure for all organisms
1840	**Where does life come from** Albrecht von Roelliker discoveres that sperm and eggs are also cells.
1845	**Basic unit of life** Carl Heinrich Braun reworks the cell theory, calling cells the basic unit of life.
1855	**3rd part to the cell theory added** Rudolf Virchow, a German physiologist/physician/pathologist added the 3rd part to the cell theory. The original is Greek, and states Omnis cellula e cellula. This translates as all cells develop only from existing cells. Virchow was also the first to propose that diseased cells come from healthy cells.

Source: http://www.softschools.com/timelines/cell_theory_timeline/96/

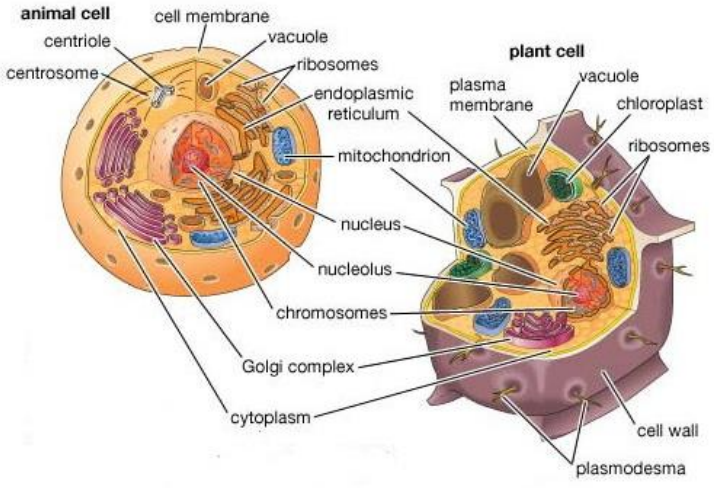
Cell Theory

The development of cell theory can be attributed to the major discoveries of many scientists. The development of cell theory has been dependent upon improvements in the microscope technologies and techniques. Advances in microscopes have increased the understanding of cell organelles and their functions. Many of these organelles can now be observed with a microscope (light, electron). (*VDOE Curriculum Framework*)

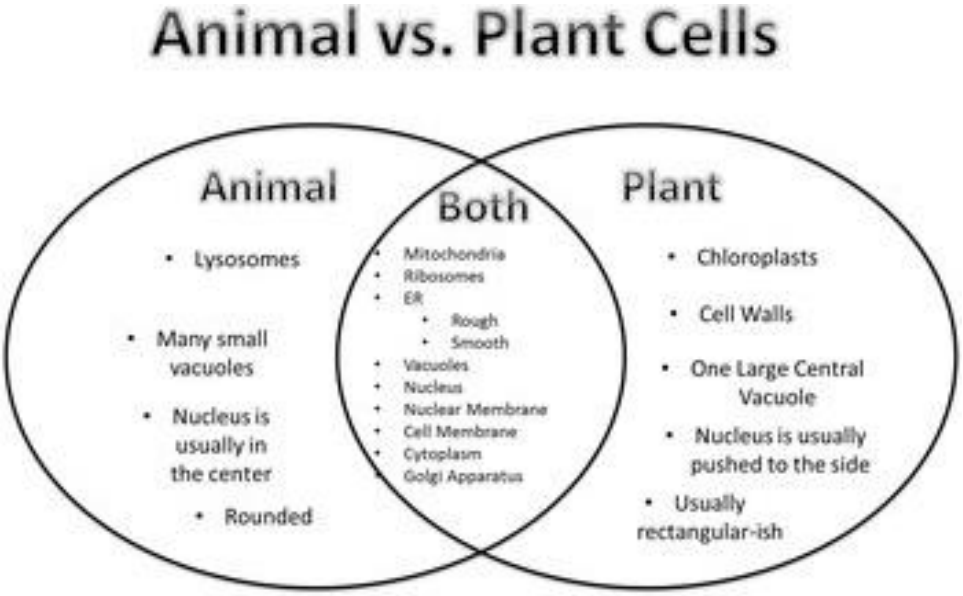
1. All living things are composed of cells
2. Cells are the smallest unit (structure) of living things that can perform the processes (functions) necessary for life
3. Living cells come only from other living cells

Cell Structures	Function
Cell Wall	• Protect & support cell
Cell Membrane	• Controls movement of materials into and out of the cell • Barrier between cell and its surrounding environment • Site of photosynthesis
Mitochondria	• Breaks down sugar molecules
Endoplasmic Reticulum	• Carries materials through the cell
Chloroplasts	• Uses energy from the sun to make food for the plant
Vacuoles	• Store food, water and waste
Nucleus	• Controls cells' activities
Cytoplasm	• The jelly-like fluid that fills a cell is called cytoplasm • Contains all organelles and cell parts

PLANT AND ANIMAL CELLS



How do animal and plant cells differ?

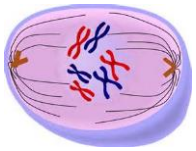


<u>THE CELL CYCLE:</u>

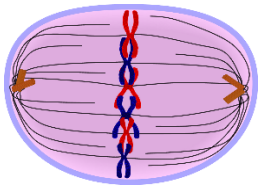
<u>Cell division</u> is the processes of **growth and division**.

The cell cycle is the process through which cells grow and replicate.

1. **Interphase:** the phase between cell divisions, the cell spends most of its time during this phase
    a. **Growth**
    b. **DNA replication**
    c. **Preparation for division**
2. **Mitosis – Division of the nucleus (PMAT)** and produces **two identical daughter cells**
    a. **Prophase**
        i. Chromosomes coil
        ii. Nucleolus disappears
        iii. Nuclear membrane disappears
        iv. Spindle forms



    b. **Metaphase**
        i. Chromosomes line up at the center of the cell (called the metaphase plate)



c. Anaphase

i. Centromeres split

- *Centromeres: Point where chromatids attach*

ii. Chromatids are pulled to opposite poles of the cell

- *Chromatids: The copies of a chromosome*

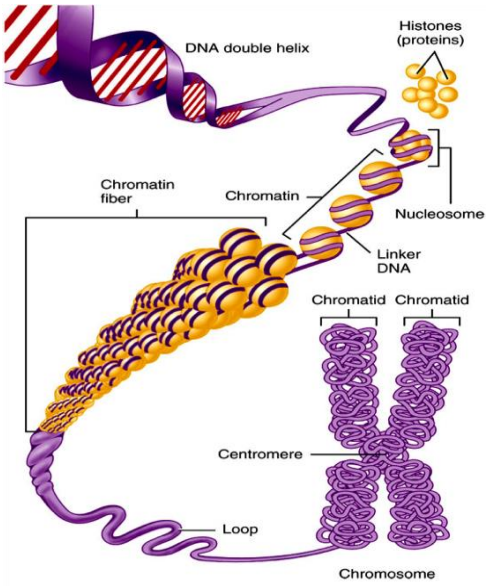
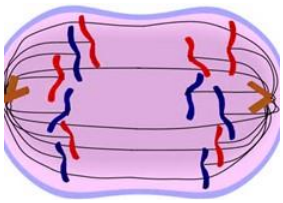


Figure 03.25 Tortora - PAP 12/e



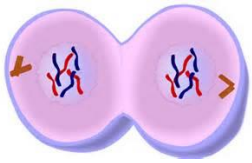
d. Telophase

i. Chromosomes uncoil

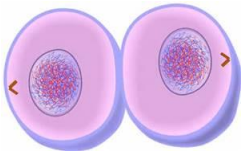
ii. Nuclear membrane reappears

iii. Nucleolus reappears

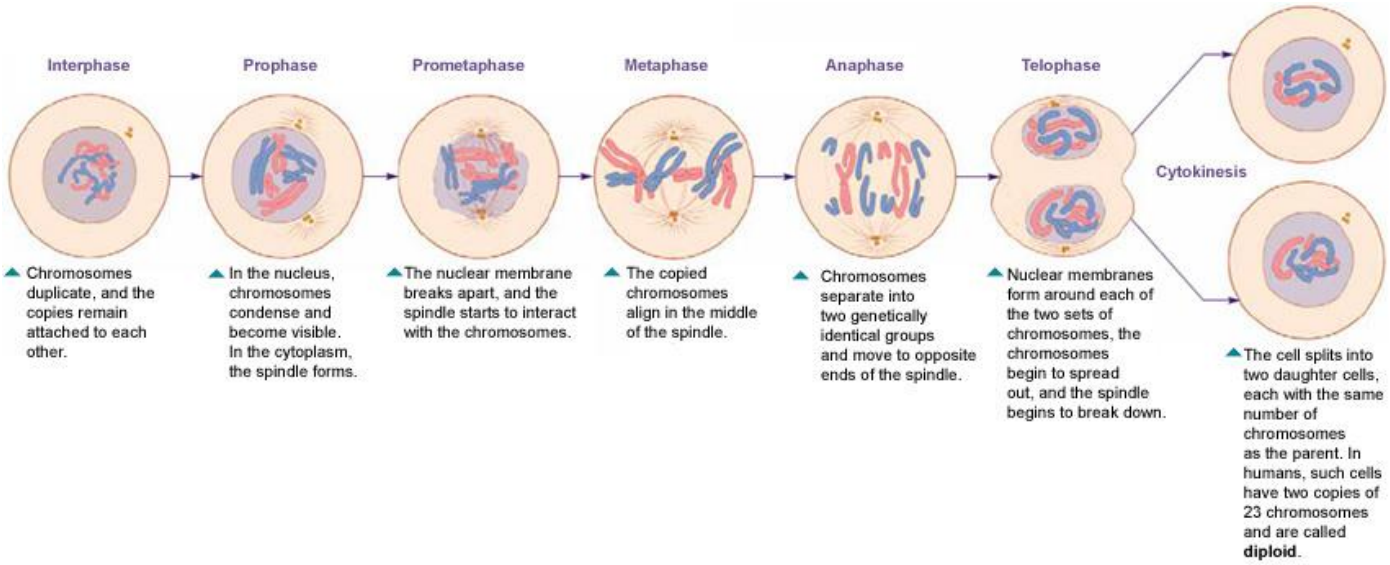
iv. Spindle breaks down



3. Cytokinesis – Division of the cytoplasm



Cell Cycle at a Glance



What is meiosis? Meiosis is the production of sperm and egg cells.

What is a similarity and difference between the purpose of mitosis and meiosis?

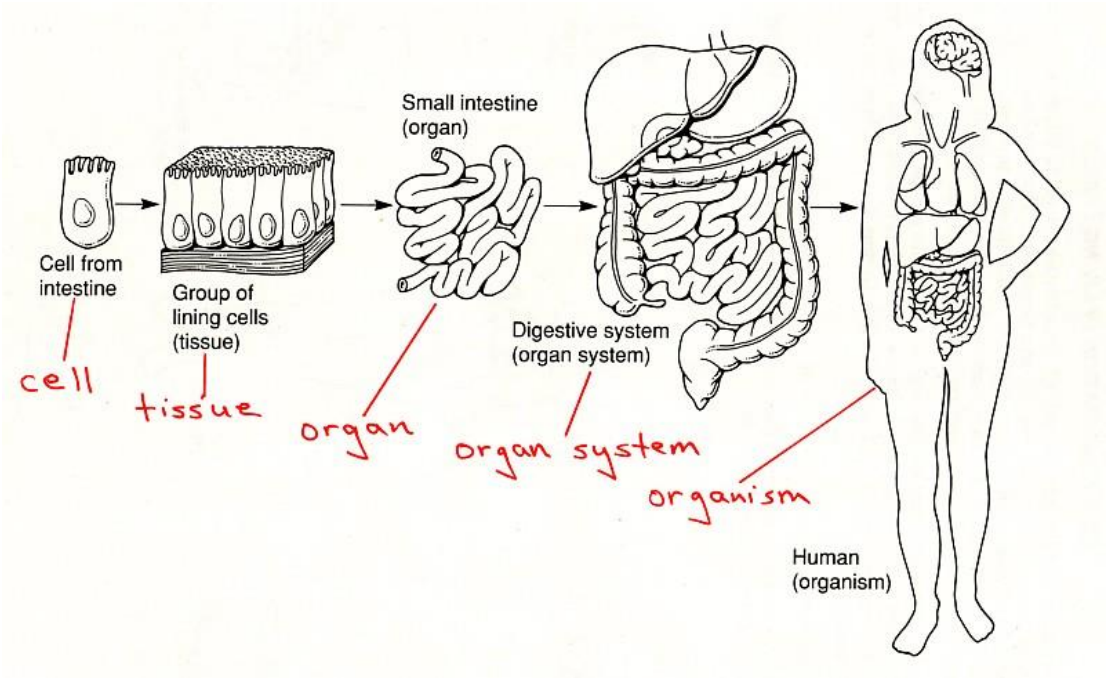
Similarity:

Mitosis and Meiosis describes the process by which the body prepares cells to participate in either asexual or sexual reproduction to make an entire organism.

Difference:

Mitosis is the reproduction of skin, heart, stomach, cheek, hair etc. cells. These cells are "Autosomal" cells. This is also a form of "Asexual" reproduction, where one organism or cell reproduces itself. **Meiosis** is the production of sperm and egg cells. These cells are "Gamete" or "Sex" cells. Each cell has to go through the division process twice in order for the cell to end up with half the number of chromosomes. The cells pass on genetic information to the offspring. This is a form of "Sexual" reproduction, where one organism or cells reproduces by crossing with another organism or cell. ***The purpose of mitosis is to produce new cells for growth and repair that are identical to the parent cell. The purpose of meiosis is to produce reproductive (sex) cells that carry half the genetic material of the parent.***

PATTERNS OF CELLULAR ORGANIZATION

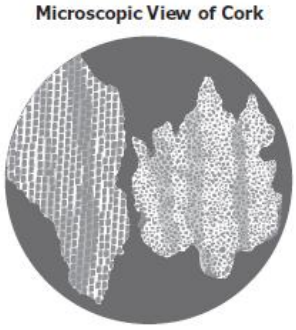


How do unicellular and multicellular differ?

Unicellular organisms are made up of one cell (prokaryotes), while multicellular organisms are made of more than one cell.

SOL RELEASED QUESTIONS:

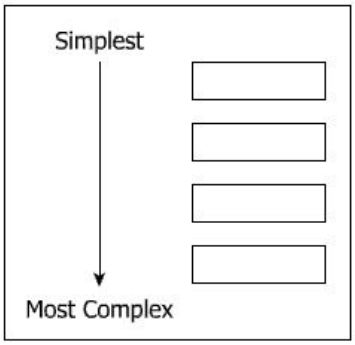
1. **Robert Hooke looked at a piece of cork under a microscope. The little boxes he saw in the cork are called — (2009)**

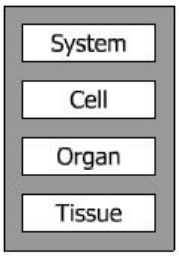


A. Cells
B. Genes
C. Nuclei
D. Chromosomes

2. **The quality of pond water can be determined by identifying the number and types of organisms found living in the water. Which piece of equipment will best help students identify some of these organisms? (2009)**
    - **A.** Microscope
    - **B.** pH paper
    - **C.** Binoculars
    - **D.** Pan balance
3. **Chloroplasts are found only in organisms that are able to _____. (2009)**
    - **A.** generate their own energy
    - **B.** grow to a larger size
    - **C.** migrate to other ecosystems
    - **D.** hunt for prey

4. **Place the terms in the order of the simplest level of organization to the most complex (2015)**





5. **During human fertilization, an egg and a sperm cell unite. Which structures in these cells carry the genes that will be transferred to the offspring? (2015)**
    A. Vacuoles
    B. Ribosomes
    C. Chromosomes
    D. Cell membranes
6. **When comparing a plant cell to an animal cell, only the plant cell will contain __. (2015)**
    A. Ribosomes
    B. Chromosomes
    C. Chloroplasts
    D. Mitochondria

Life Processes

Life Process	Role	Organ System
Ingestion	Intake of food from various sources in the environment	Digestive System
Digestion	Converts complex food substances to simpler ones.	Digestive System
Removal of waste	The body rids itself of products which are not needed	Excretory System

Stimulus response	A condition (stimulus) which causes an organism to have a reaction (response)	Nervous System
Growth and repair	Humans obtain energy and materials for body repair and growth. *Cell division is involved in growth, development, and repair	All body systems work together
Gas exchange	We need to get oxygen from the air into the blood, and we need to remove waste carbon dioxide from the blood into the air.	Respiratory System
Reproduction	Process by which new individual organisms – "offspring" – are produced from their "parents".	Reproductive system

Body Systems

System	Major structures	Functions
Skeletal	bones	provides structure; supports and protects internal organs
Muscular	muscles (skeletal, cardiac, and smooth)	provides structure; supports and moves trunk and limbs; moves substances through body
Integumentary	skin, hair, nails	protects against pathogens; helps regulate body temperature
Circulatory	heart, blood vessels, blood	transports nutrients and wastes to and from all body tissues
Respiratory	air passages, lungs	carries air into and out of lungs, where gases (oxygen and carbon dioxide) are exchanged
Immune	lymph nodes and vessels, white blood cells	provides protection against infection and disease
Digestive	mouth, esophagus, stomach, liver, pancreas, small and large intestines	stores and digests food; absorbs nutrients; eliminates waste
Excretory	kidneys, ureters, bladder, urethra, skin, lungs	eliminates waste; maintains water and chemical balance
Nervous	brain, spinal cord, nerves, sense organs, receptors	controls and coordinates body movements and senses; controls consciousness and creativity; helps monitor and maintain other body systems
Endocrine	glands (such as adrenal, thyroid, and pancreas), hypothalamus	maintains homeostasis; regulates metabolism, water and mineral balance, growth and sexual development, and reproduction
Reproductive	ovaries, uterus, mammary glands (in females), testes (in males)	produces offspring

SOL RELASED QUESTIONS:

1. **Human sweat is the direct result of which life functions? (2009)**
   - **a.** Respiration and cellular growth
   - **b.** Digestion and disease prevention
   - **c.** Reproduction and cellular transport
   - **d.** Waste removal and temperature control

2. **Which gas do animals need to carry out life processes? (2009)**
    - **a.** Oxygen
    - **b.** Carbon monoxide
    - **c.** Helium
    - **d.** Carbon dioxide

CLASSIFICATION

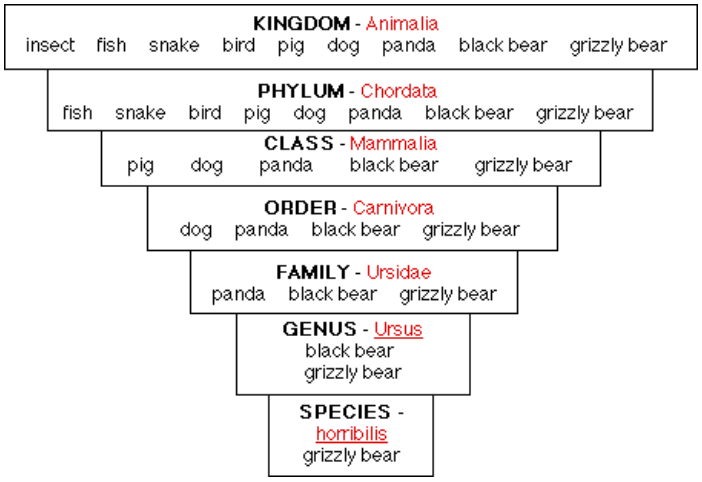
Current classification systems now generally recognize the categorization of organisms into three domains:

1. **Archaea**- Prokaryotic cells that often live in extreme environments.
2. **Bacteria** - Bacteria are prokaryotic cells that include other bacteria including cyanobacteria.
3. **Eukarya** - The eukaryotic cells and are subdivided into the following Kingdoms: Protista, Fungi, Plantae, and Animalia.

Biological classification is arranging organisms into groups. This is part of scientific taxonomy. The classification system starts with a group with a wide variety of organisms and becoming more selective as the groups get more specific. Carolus Linnaeus, "Father of Taxonomy" organized and classified organisms into groups by similar characteristics. He used a method called **binomial nomenclature**. This is the basis for modern Taxonomy**.**

Every organism can be classified at 7 different levels - kingdom, phylum, class, order, family, genus and species. Each level contains organisms with similar characteristics. The kingdom is the largest group and very broad. Kingdom has the most number of organisms. Each successive group contains fewer organisms, but the organisms are more similar. The species is the smallest group and is very narrow. Organisms within a species are able to mate and produce fertile offspring.

The following chart traces the classification of a grizzly bear through each of the 7 levels of classification. At each level, be aware of the characteristics the different organisms share.



Source: http://utahscience.oremjr.alpine.k12.ut.us/sciber99/7th/classify/sciber/7levels.htm

How can you remember the levels of classification?

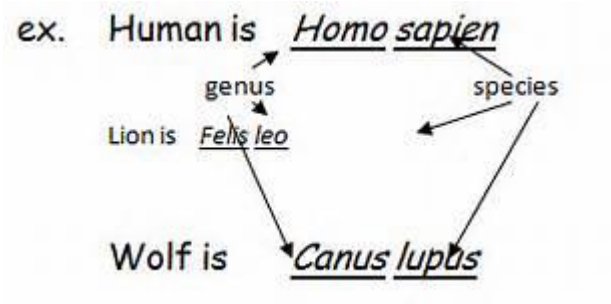
Did **K**ing **P**hillip **c**ome **o**ver **f**or **g**ood **s**paghetti?

The levels in the currently accepted hierarchy include domain, kingdom, phylum, class, order, family, genus, and species.

What is meant by Linnaeus' system of naming organisms?

Binary nomenclature is a formal system of naming organisms and consists of two Latinized names, the genus and the species. Each organism is given two names, a 'generic name,' which is called the genus and a 'specific name,' the species. Together the generic and specific name of an organism is its scientific name. Having a universal system of binomial nomenclature allows scientists to speak the same language when referring to living things. When writing the scientific name of organisms, there are some things you MUST remember:

- ✓ The first part of the name is the genus and the second part of the name is the species.
- ✓ When written, a scientific name is always either italicized, or, if hand-written, underlined.
- ✓ The genus is capitalized and the species name is lower case.

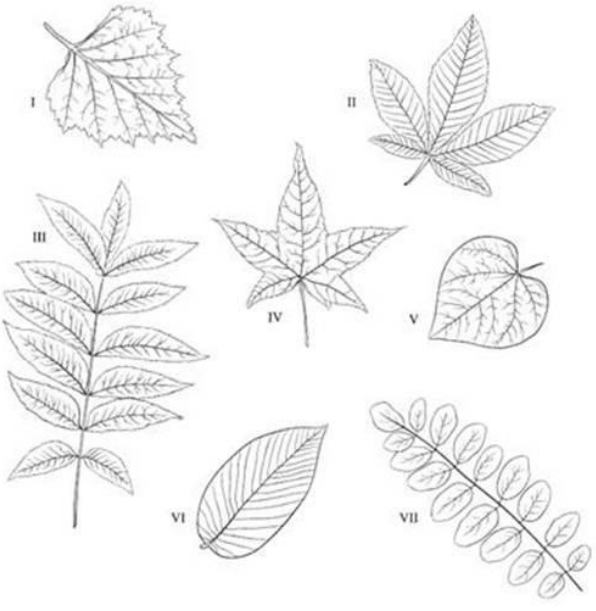


Classification of Living Things						
Domain	Archaea	Bacteria	Eukarya			
Kingdom	Archaebacteria	Eubacteria	Protista	Fungi	Plantae	Animalia
Cell Type	Prokaryote	Prokaryote	Eukaryote	Eukaryote	Eukaryote	Eukaryote
Cell Wall?	Yes	Yes	Yes	Yes	Yes	No
Number of Cells	Unicellular	Unicellular	Mostly Unicellular, some Multicellular	Mostly Unicellular, some Multicellular	Multicellular	Multicellular
Nutrition	Autotroph or Heterotroph	Autotroph or Heterotroph	Autotroph or Heterotroph	Heterotroph	Autotroph	Heterotroph
Example(s)	Halophiles	Streptococcus	Amoeba, Paramecium	Mushrooms, Yeast	Mosses, Ferns, Flowering plants	Sponges, worms, fish, mammals

Phylum	Major Characteristics	Examples
Cnidarians	• Tentacles surround the mouth • One body opening & radial symmetry • Tentacles have stinging cells • Reproduce sexually & asexually • Polyp & medusa body forms	• Sea anemone • Jellyfish
Mollusks	• Soft-bodied invertebrates • Bilateral symmetry • 1 or 2 shells • Most live in water	Snail, Cuttlefish, Scallops, Clams, Oysters, and Squid
Annelids	• Soft bodies • Bilateral symmetry • Have three tissue layers organized into organs and organ systems	Segmented worms • leeches • earthworms
Arthropods	• Jointed appendages • Bilateral symmetry • Segmented bodies • Exoskeleton • Digestive system with two openings	• Insects • Centipedes • Millipedes • Crabs • Shrimp • Crayfish
Echinoderms	• "Spiny" skinned • Hard endoskeleton covered by a bumpy epidermis • Radially symmetrical • Found in oceans	• Sea star • Sea cucumbers • Sea urchins • Sand dollars
Chordates	4 characteristics present at some stage of development: • A notochord • Post anal tail • Nerve cord • Pharyngeal pouches	• Fish • Amphibians • Reptiles • Mammals

Plant Groups (Divisions)	Characteristics	Example(s)
Mosses	Nonvascular plants Grow on tree trunks, rocks and/or ground Commonly found in damp areas Have green leaf-like growths around a central stalk	
Ferns	Seedless vascular plant Have seeds, stems, and roots Leaves are called “fronds”	
Conifers	Produce cones	Pines, firs, spruces, redwoods, and junipers
Flowering Plants	Have a wide variety of flowers and fruits	Peach tree, Orchid, and Petunia

They use the dichotomous key which asks questions about the characteristics of the organism to place it in the correct group.



Dichotomous Key for Leaves

1. Compound or simple leaf
   - 1a) Compound leaf (leaf divided into leaflets) .....go to step 2
   - 1b) Simple leaf (leaf not divided into leaflets) .....go to step 4
2. Arrangement of leaflets
   - 2a) Palmate arrangement of leaflets (leaflets all attached at one central point) .....*Aesculus* (buckeye)
   - 2b) Pinnate arrangement of leaflets (leaflets attached at several points) .....go to step 3
3. Leaflet shape
   - 3a) Leaflets taper to pointed tips .....*Carya* (pecan)
   - 3b) Oval leaflets with rounded tips .....*Robinia* (locust)
4. Arrangement of leaf veins
   - 4a) Veins branch out from one central point .....go to step 5
   - 4b) Veins branch off main vein in the middle of the leaf.....go to step 6
5. Overall shape of leaf
   - 5a) Leaf is heart-shaped.....*Cercis* (redbud)
   - 5b) Leaf is star-shaped .....*Liquidambar* (sweet gum)
6. Appearance of leaf edge
   - 6a) Leaf has toothed (jagged) edge .....*Betula* (birch)
   - 6b) Leaf has untoothed (smooth) edge .....*Magnolia* (magnolia)

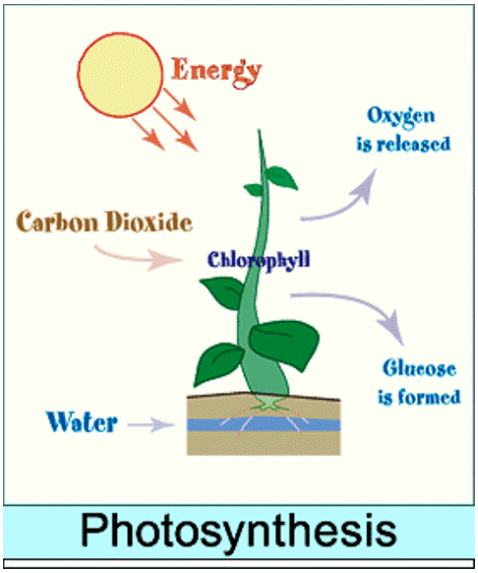
RELEASED SOL QUESTIONS:

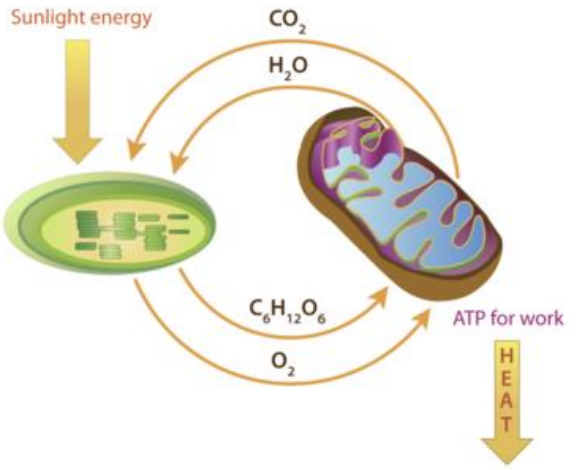
1. **Which characteristic is used to classify frogs into a different phylum from squid, snails, and jellyfish? (2009)**
    a. Frogs and predators
    b. Frogs breathe oxygen
    c. Frogs have backbone
    d. Frogs live on land
2. **Which of these is the best description of a typical organism in the Plant kingdom? (2015)**
    a. Is unicellular
    b. Lacks a nucleus
    c. Makes its own food
    d. Lacks a cell wall

Photosynthesis

Photosynthesis occurs in eukaryotic cell structures called **chloroplasts**. A **chloroplast** is a type of **plant cell organelle**. A chloroplast contains a **green pigment** called **chlorophyll**, which **absorbs light energy for photosynthesis**. Hence, the name chloroplast indicates that these structures are chlorophyll containing structures. Plant chloroplasts develop mainly in cells **located in plant leaves**.

In **photosynthesis**, the sun's **solar energy is converted to chemical energy**. The chemical energy is stored in the form of glucose (sugar). Carbon dioxide, water, and sunlight are used to produce glucose, oxygen, and water. Photosynthesis occurs in two stages. These stages are known as the light reaction stage and the dark reaction stage.





Photosynthesis	*Cellular respiration*
• It takes place in a chloroplast.	• It takes place in a mitochondrion.
• Carbon dioxide and water react, using light energy, to produce glucose and oxygen.	• Glucose and oxygen react to produce carbon dioxide, water, and energy (ATP).
• Light energy from the sun changes to chemical energy in glucose.	• Chemical energy in glucose changes to chemical energy in ATP.

Photosynthesis

Word equation

Carbon dioxide + Water $\xrightarrow{\text{Light, Chlorophyll}}$ Glucose + Oxygen

Symbol equation

$6CO_2 + 6H_2O \xrightarrow{\text{Light, Chlorophyll}} C_6H_{12}O_6 + 6O_2$

What are the products of photosynthesis? _____

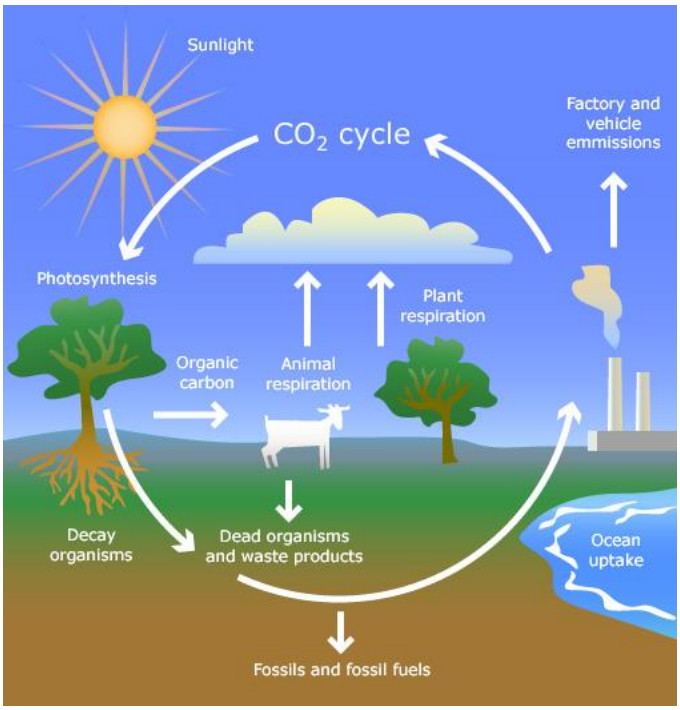
What are the reactants/raw materials of photosynthesis? _____

RELEASED SOL QUESTIONS:

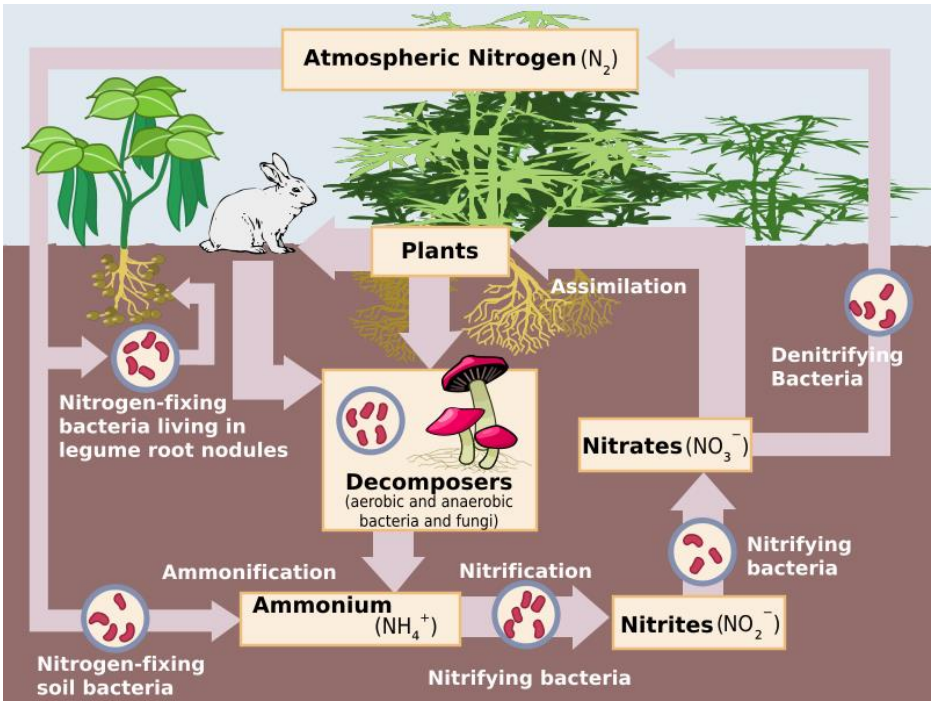
1. **The equation for photosynthesis is shown. Which of these is required to complete the equation for photosynthesis? (2009)**
   a. Carbon
   b. Oxygen
   c. Nitrogen
   d. Hydrogen

CARBON, WATER, and NITROGEN CYCLES

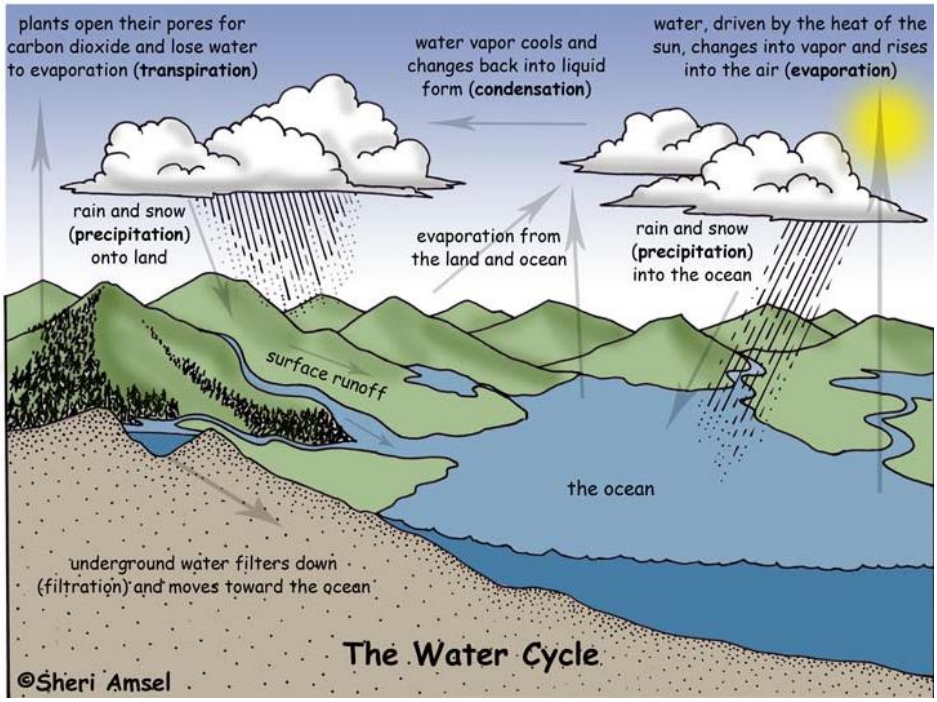
Carbon Cycle:



Nitrogen Cycle:



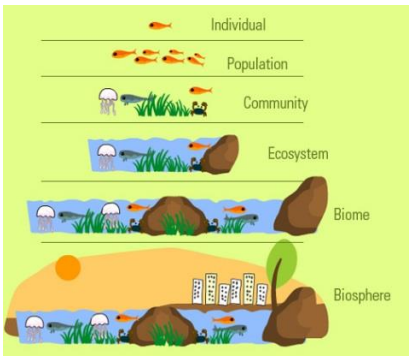
Water Cycle:



ECOSYSTEMS

The Earth's biosphere is the largest ecosystem. Within each ecosystem there are populations of living things (biotic), with their own particular habitat that best supports their lives. The habitat may support several populations of organisms that interact with one another and form a particular community or association. The habitat must supply the needs of the community from the non-living things (abiotic) in the form of food, water, nutrients, sunlight, and temperature. Plants are unable to move from a habitat where their needs are not met, but many have evolved mechanisms of adaptation. The plants are best adapted to particular **niches** (role) within the community where the greatest number of their needs is met. Animals, on the other hand, are able to move to more suitable niches if their needs are not met. Since two or more species of plants or animals cannot occupy the same niche at the same time, it follows that **competition**, **predation**, **cooperation**, and **symbiosis** may occur, and consequentially, the plants and animals evolve strategies to deal with these processes. Therefore, each biotic population has its own specific niche, sharing a general habitat with other populations to different degrees of cooperation and competition, and all utilizing the available abiotic resources.

Source: *https://www.youthgo.gov/sites/default/files/exploring_ecosystems_in_the_classroom2.pdf*

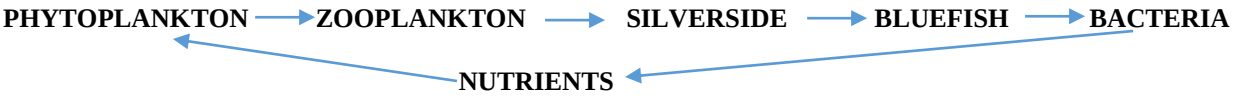


Food Chains

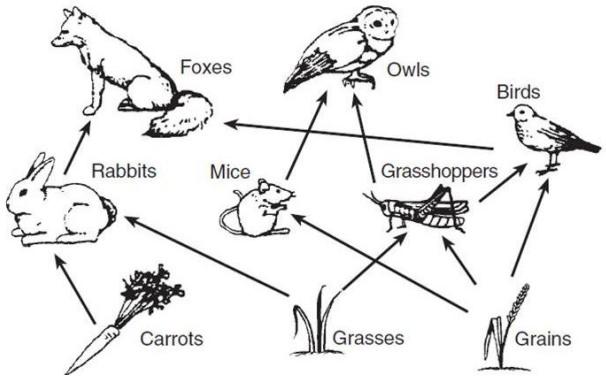
All living organisms (plants and animals) must eat some type of food for survival. Plants **make their own food** through a process called **photosynthesis**. Using the energy from the sun, water and carbon dioxide from the atmosphere and nutrients, they chemically make their own food. Since they make or produce their own food they are called **producers**.

Organisms which do not create their own food must **eat either plants or animals**. They are called **consumers**. Some animals get their energy from eating plants while other animals get energy indirectly from plants by eating other animals that already ate the plants. Animals that **eat only plants** are called **herbivores**. Animals **that eat both plants and other animals** are called **omnivores**. Animals that **eat only other animals** are called **carnivores**. Some animals **eat only dead or decaying materials** and are called **decomposers**.

Food chains show the relationships between producers, consumers, and decomposers, showing who eats whom with arrows. The arrows show the movement of energy through the food chain. For example, in the food chain shown below, the small fish (silverside) gets its energy by eating the plankton and the large fish (bluefish) gets its energy by eating the small fish. Finally, the bacteria eats the fish after it dies, getting its energy from the large fish. The bacteria also returns nutrients back to the environment for use by the phytoplankton.



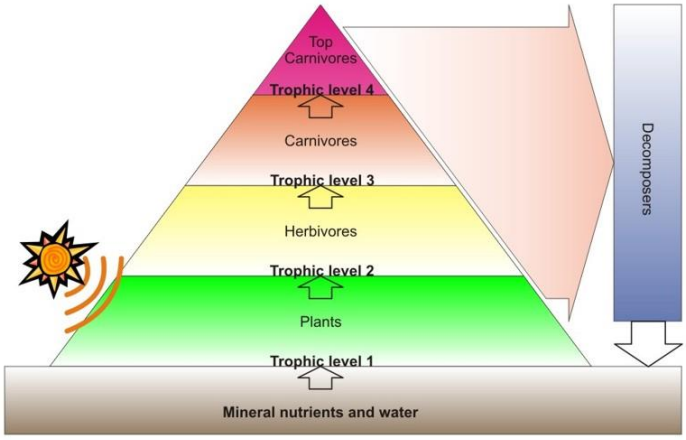
A **food web** is made up of interconnected food chains. In a food web nutrients are recycled in the end by decomposers. Decomposers work at every level, setting free nutrients that form an essential part of the total food web.

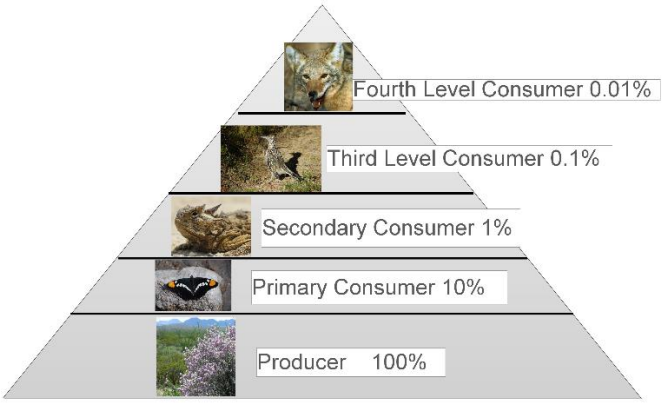


In a food chain, energy is lost in each step of the chain in two forms:

1. By the organism producing heat and doing work
2. By the food that is not completely digested or absorbed.

Therefore, the food web depends on a constant supply of energy from producers and nutrients that are recycled by the decomposition of organisms. As food is passed along the food chain, ***only about 10% of the energy is transferred to the next level***. From one level to the next about 90% of the energy used by the previous level is lost. This means that ***there has to be a lot more organisms at the lower levels than at the upper levels***. The number of organisms at each level makes a pyramid shape and is called an energy pyramid. To better understand this energy loss, it is helpful to look at an energy pyramid.

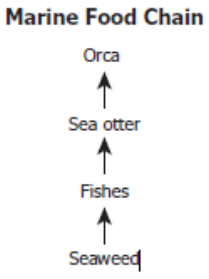




Modified from: *http://www.epa.gov/sites/production/files/documents/foodchainsandfoodwebs.pdf*

RELEASED SOL QUESTIONS:

1. **What is the role of the Orca in the food chain? (2009)**



a. Producer
b. First-order consumer
c. Second-order consumer
d. Third-order consumer

SYMBIOSIS

Symbiosis describes a **relationship between different species**. At least one species will benefit in a symbiotic relationship. These relationships are often necessary for the survival of one or both organisms. There are three types of symbiotic relationships: **mutualism**, **communalism**, and **parasitism**.

- **Mutualism** is a symbiotic relationship in which **both species benefit**.

- **Commensalism** is a symbiotic relationship in which **one species benefits** while the other is not affected.

- **Parasitism** is a symbiotic relationship in which the **parasitic species benefits** while the **host species is harmed**.

Modified from: http://www.ck12.org/life-science/Symbiosis-in-Life-Science/lesson/Symbiosis-Basic/

PREDATOR AND PREY RELATIONSHIPS

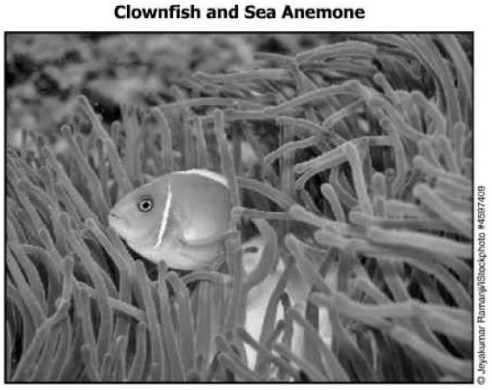
Predation is when a predator **organism feeds on another living organism** or organisms, known as **prey**. **Predator-prey relationships** are essential to maintaining the balance of organisms in an ecosystem. Examples of predator-prey relationships include the lion and zebra, the bear and fish, and the fox and rabbit.

Prey also have adaptations for avoiding predators. Prey sometimes avoid detection by using camouflage. **Camouflage** means that species have an appearance (color, shape, or pattern) that helps them **blend into the background**. **Mimicry** is a related adaptation in which a species uses **appearance to copy or mimic** another species. (http://www.ck12.org/life-science/Predation-in-Life-Science/lesson/Predation-Basic/)

Camouflage	***Mimicry***
	

SOL RELASED QUESTIONS

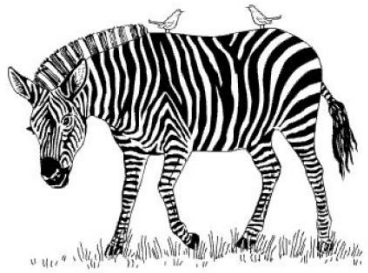
1. **Sea anemones are poisonous. However, the clownfish has developed an outer layer of mucus which provides protection from the stinging cells of the sea anemone. The mucus is best described as ___ (2015)**



   a. An adaptation
   b. A relationship
   c. An energy requirement
   d. A social hierarchy

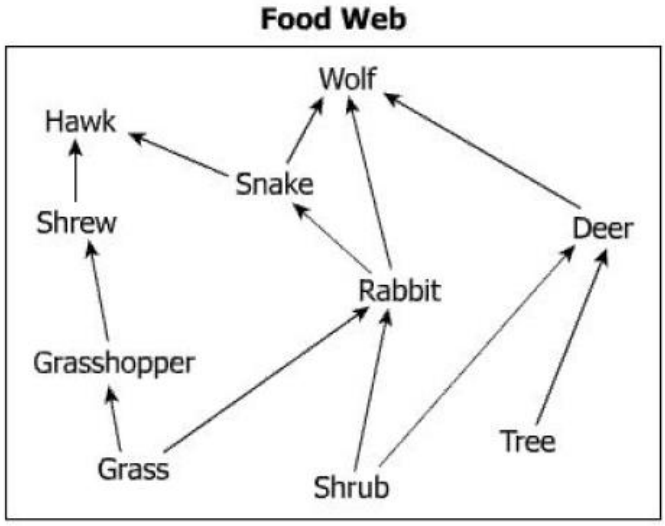
2. **Which of these is most likely the result of weasels and foxes depending on the same food source? (2015)**
   a. The populations will compete with each other
   b. One of the populations will become herbivores
   c. Birthrates for both populations will increase
   d. New species of prey will evolve the area

3. **This picture shows a zebra with two tick birds on its back. The tick birds alert the zebras that predators are near as well as remove and eat ticks found on zebras. What is the primary type of interaction between the tick birds and zebras? (2015)**



   a. Mutualism
   b. Parasitism
   c. Competition
   d. Commensalism

4. **Which organisms are producers in this food web? (2015)**



Biome Summary Chart

Biome	Location	Climate	Soil	Plants	Animals
Desert	midlatitudes	generally very hot days, cool nights; precipitation less than 10 inches a year	poor in animal and plant decay products but often rich in minerals	none to cacti, yuccas, bunch grasses, shrubs, and a few trees	rodents, snakes, lizards, tortoises, insects, and some birds. The Sahara in Africa is home to camels, gazelles, antelopes, small foxes, snakes, lizards, and gerbils
Tundra	high northern latitudes	very cold, harsh, and long winters; short and cool summers; 10-25 centimeters (4-10 inches) of precipitation a year	nutrient-poor, permafrost layer a few inches down	grasses, wildflowers, mosses, small shrubs	musk oxen, migrating caribuou, arctic foxes, weasels, snowshoe hares, owls, hawks, various rodents, occasional polar bears
Grassland	midlatitudes, interiors of continents	cool in winter, hot in summer; 25-75 centimeters of precipitation a year	rich topsoil	mostly grasses and small shrubs, some trees near sources of water	american grasslands include prairie dogs, foxes, small mammals, snakes, insects, varous birds. African grasslands includeelephants, lions, zebras, giraffes.
Deciduous Forest	midlatitudes	relatively mild summers and cold winters, 76-127 centimeters (30-50 inches) of precipitation a year	rich topsoil over clay	hardwoods such as oaks, beeches, hickories, maples	wolves, deer, bears, and a wide variety of small mammals, birds, amphibians, reptiles, and insects.
Taiga	mid- to high latitudes	very cold winters, cool summers,; about 50 centimeters (20 inches) of precipitation a year	acidic, mineral-poor, decayed pine and spruce needles on surface	mostly spruce, fir, and other evergreens	rodents, snowshoe hares, lynx, sables, ermine, caribout, bears, wolves, birds in summer
Tropical Rainforest	near the equator	hot all year round, 200-400 centuimeters (80-100 inches) of rain a year	nutrient-poor	greatest diversity of any biome; vines, orchids, ferns, and a wide variety of trees	more species of insects, reptiles, and amphibians than anyplace else; monkeys, other small and large mammals, including in some places elephants, all sorts of colorful birds

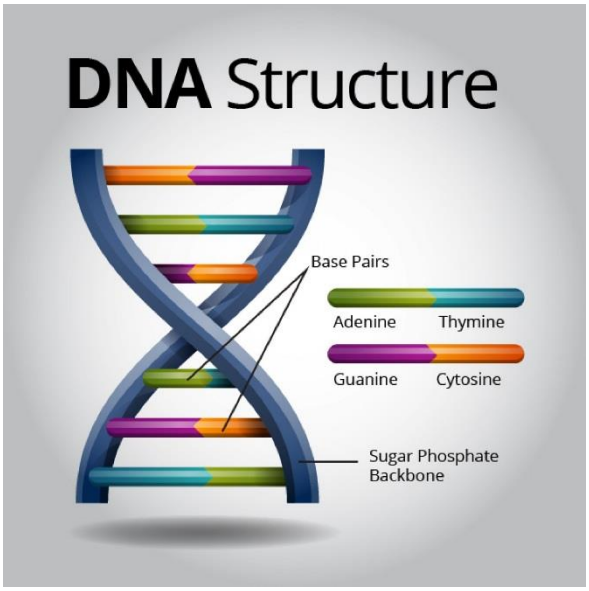
Released SOL Question:

1. **For separate ecosystems to be classified as the same type of biome, they must — (2009)**
   - **a.** have deciduous forests
   - **b.** be located along the equator
   - **c.** have similar organisms and climates
   - **d.** be at least one hundred square meters in area

GENETICS

The importance of DNA became clear in 1953 thanks to the work of James Watson, Francis Crick, and Rosalind Franklin. By studying X-ray diffraction patterns and building models, the scientists figured out the double helix structure of DNA - a structure that enables it to carry biological information from one generation to the next.

Appearance of DNA
DNA is found inside a special area of the cell called the nucleus. Because the cell is very small, and because organisms have many DNA molecules per cell, each DNA molecule must be tightly packaged. This packaged form of the DNA is called a chromosome. DNA is made of chemical building blocks called nucleotides.



These building blocks are made of three parts **DNA is a molecule that includes different components – sugars, nitrogenous bases, and phosphates.**

What are the nitrogenous bases? The four types of nitrogen bases found in nucleotides are:

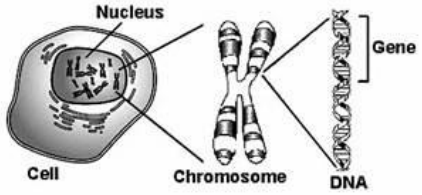
- adenine (A)
- thymine (T)
- guanine (G)
- cytosine (C)

The order, or sequence, of these bases determines what biological instructions are contained in a strand of DNA.

ROLE OF DNA
DNA contains coded instructions that store and pass on genetic information from one generation to the next.

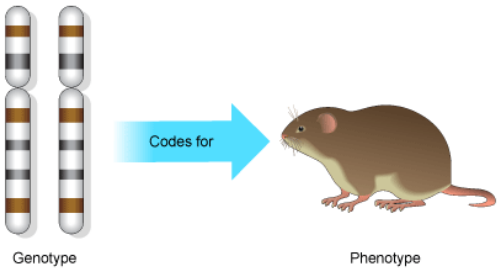
Why is it necessary for DNA to replicate (copy)?
DNA must replicate (copy) itself so that each resulting cell after mitosis and cell division has the same DNA as the parent cell. All these cells, the parent cell and the two new daughter cells, are genetically identical.

GENES – CHROMOSOMES – ALLELES



VARIATION

Our genetic make-up, the sum total of our genes, is called a **genotype**, but the characteristics which show up in our appearance are called a **phenotype**.



Genetic variation gives rise to differences between individuals that are inherited. For example, our eye color is inherited from our parents. Our phenotype is also affected by environmental variation such as:

- climate
- diet
- physical accidents
- culture
- lifestyle

RELEASED SOL QUESTIONS

1. **White-footed mice having thicker fur than cactus mice is probably influenced most by differences in the ___. (2015)**
   - **a.** food that they eat
   - **b.** time of day they are active
   - **c.** environmental climates where they live
   - **d.** amount of predators they encounter
2. **A physical expression of a trait in an organism is known as the ___. (2015)**
   - a. chromosome
   - b. genotype
   - c. phenotype
   - d. double helix

DISTINGUISH BETWEEN DOMINANT AND RECESSIVE

Genes have different forms called alleles. An allele can be recessive or dominant. A **recessive** allele only shows if the individual has two copies of the recessive allele. For example, the allele for blue eyes is recessive. You need two copies of the allele to have blue eyes. A **dominant** allele always shows, even if the individual only has one copy of the allele. For example, the allele for brown eyes is dominant. You only need one copy of the allele to have brown eyes (and two copies will still give you brown eyes).

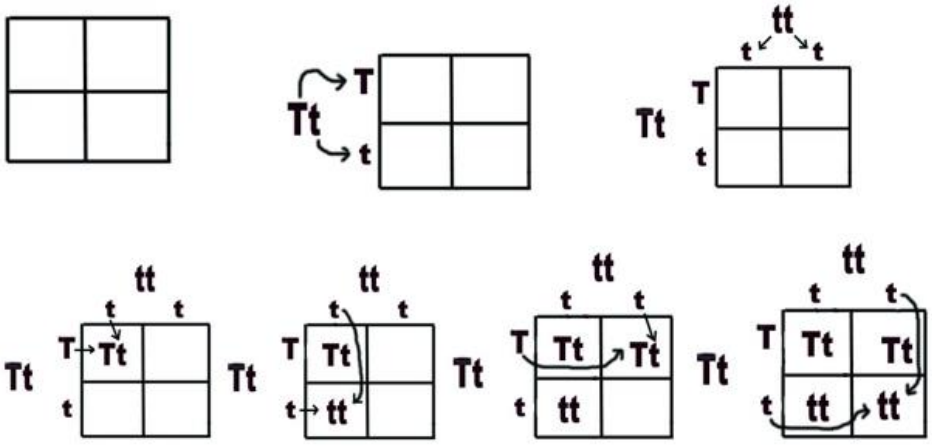
SOURCE: http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel_pre_2011/genes/genesrev2.shtml

PUNNETT SQUARES

How can I complete a Punnett square?

1. Determine the genotypes of the parent organisms
2. Write down your "cross" (mating)
3. Draw a Punnett square
4. "Split" the letters of the genotype for each parent & put them "outside" the p-square determine the possible genotypes of the offspring by filling in the p-square
5. Summarize results (genotypes & phenotypes of offspring)

How can I complete a Punnett Square for Tt x tt?



Summarize results:
What are the possible genotypes? _____
What are the phenotypes? _____

MENDELIAN GENETICS

To **inherit** is to **receive** something **(genetic information)** from someone who came before you. For example, you can inherit a parent's eye color, hair color, or even the shape of your nose and ears! **Genetics** is the **study of inheritance**. The field of genetics seeks to explain how traits are passed on from one generation to the next.

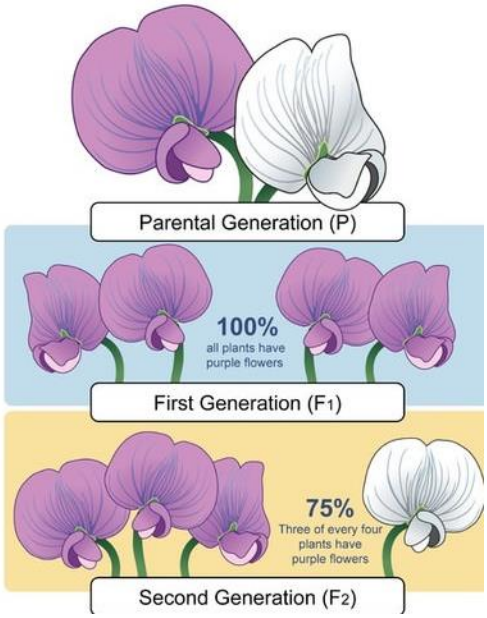
An Austrian monk named Gregor Mendel performed the first genetics experiments. To study genetics, Mendel chose to work with pea plants because they have easily identifiable traits. Furthermore, pea plants grow quickly, so he could complete many experiments in a short period of time.

Seed		Flower	Pod		Stem	
Form	Cotyledon	Color	Form	Color	Place	Size
Round	Yellow	White	Full	Green	Axial pods	Tall
Wrinkled	Green	Violet	Constricted	Yellow	Terminal pods	Short
1	2	3	4	5	6	7

Mendel also used pea plants because they can either **self-pollinate** or be **cross-pollinated**. Self-pollination means that only one flower is involved; the flower's own pollen lands on the female sex organs. Cross pollination is done by hand by moving pollen from one flower to the stigma of another (just like bees do naturally). As a result, one plant's sex cells combine with another plant's sex cells. This is called a "cross." These crosses produce **offspring** (or "children"), just like when male and female animals mate. Since Mendel could move pollen between plants, he could carefully control and then observe the results of crosses between two different types of plants.

He studied the inheritance patterns for many different traits in peas, including round seeds vs. wrinkled seeds, white flowers vs. purple flowers, and tall plants versus short plants. Because of his work, Mendel is considered the "Father of Genetics."

Mendel's First Experiment



SOURCE: http://www.ck12.org/life-science/Mendels-Pea-Plants-in-Life-Science/lesson/Mendels-Pea-Plants-Basic/

RELEASED SOL QUESTIONS:

1. **All of these can be inherited by people EXCEPT —**
    a. Height
    b. Eye color
    c. Blood type
    d. Language

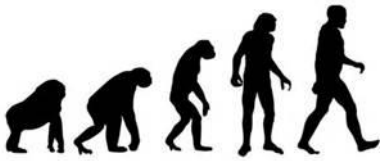
EVOLUTION

- What is a **species**? A group of **similar organisms** that can **mate** with each other and **produce fertile offspring**.

- Who was Charles Darwin? Darwin presented a wealth of evidence of **evolution**. He said that all living things on Earth today are descendants with modifications of earlier species.

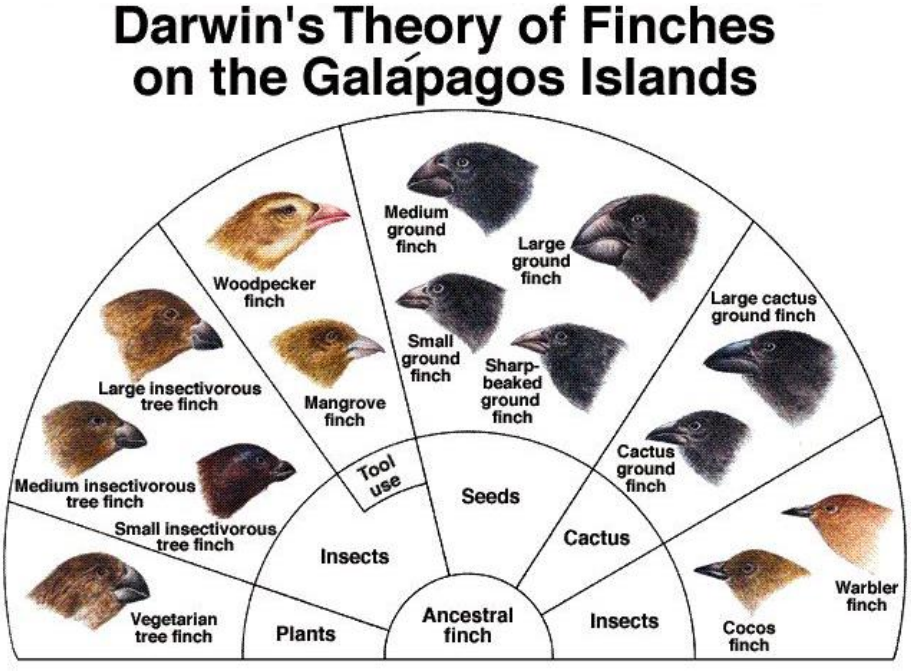
  He proposed a mechanism, **natural selection**, to explain how evolution takes place.

- How can we define **evolution**? The **gradual** change over time.



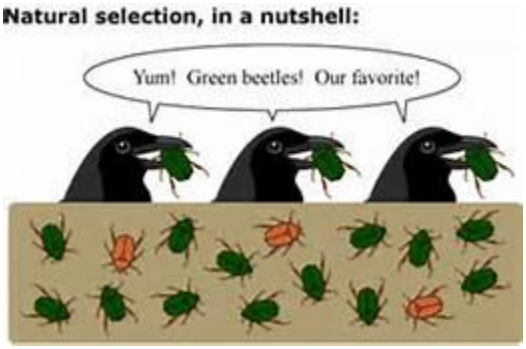
- What does evolution involve? Evolution involves adaptation and speciation.

- What is **adaptation**? Over the course of time species **modify** their phenotypes to help them to **survive** and **reproduce**.



- What is speciation? Single species can give rise to two or more descendant species.

- What is natural selection? The process by which individuals that are best adapted to the conditions of their life are most likely to survive and reproduce themselves **("survival of the fittest"**).



- What factors affect the process of natural selection? overproduction, competition, and variations
- What is **overproduction**? Species produce **more offspring than can survive**.
- What is **competition**? Offspring must **compete** with each other **for survival**, since resources are limited.
- What is **variation**? **Difference** between individuals of the same species.
- How do new species form? If a group is geographically isolated from its species, members are unable to mate with its species.
- What is the "Continental Drift" Pangea, a supercontinent, separated over millions of years and affected the evolution of species.

Evidence of Evolution

What is a **fossil**? A **fossil** is the preserved **remains** or traces of an organism that lived in the past.

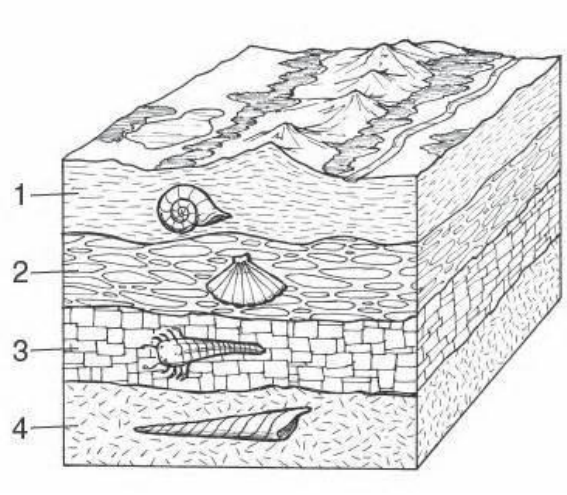
When do most fossils form? When organisms die and become buried in sediments.

What is sediment? Sediment includes soil and rock particles.

What **type of rock** are **fossils** found in? **Sedimentary** rock

How do scientists determine a fossil's age? Relative dating and absolute dating

Why do scientists use **relative dating**?	To determine **which** of two **fossils is older**.
Which rock layers of a canyon contain younger fossils?	The layers of the sedimentary rock on the top of the canyon.



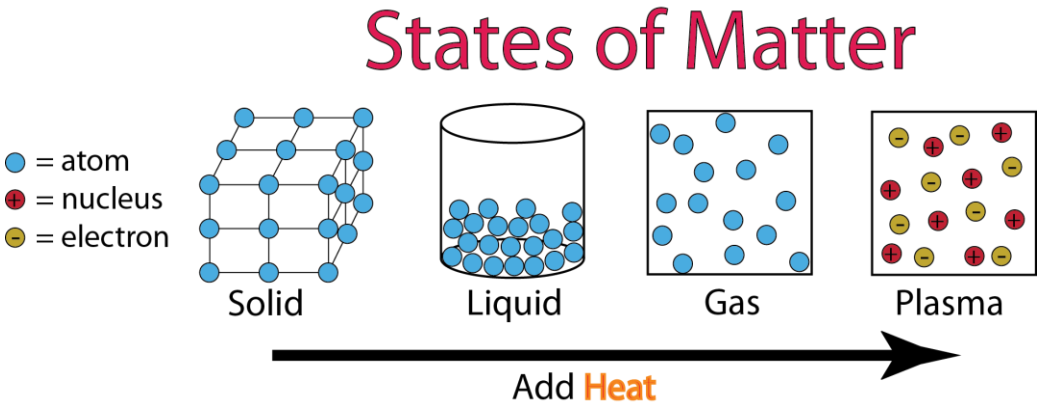
Why do scientists use **absolute dating**?	To determine the **actual age** of fossils.
What do the rocks that fossils are found near contain?	Radioactive elements
What are **radioactive elements**?	Radioactive elements decay gradually into other elements. The original element is called the parent, and the result of the decay process is called the daughter element.
What is the **half-life** of a radioactive element?	Each radioactive element has a half-life, which tells **how long it takes for half of the element to decay**.
Why are fossils important?	We learn about the lives of extinct species.
When is a species considered to be extinct?	When **no members** of that species **are still alive**.

GRADE 8 Physical Science Content Review

PARTICLE THEORY OF MATTER

- All matter is made up of tiny particles called atoms.
- Particles of matter are constantly in motion.
- Particles of matter attract each other.
- Particles of matter have spaces between them.
- As temperature increases, particles of matter move faster.
- Atoms of the same element are essentially identical.
- Atoms of different elements are different.

STATES OF MATTER



	Solids	Liquids	Gases
Arrangement	Tightly Compacted	Close together	Occupy all the space available
Movement	Vibrate back and forth	Slide past one another	Move freely at high speeds
Shape/Volume	Definite shape & volume	No definite shape, definite volume	No definite shape or volume

Matter can be classified as:

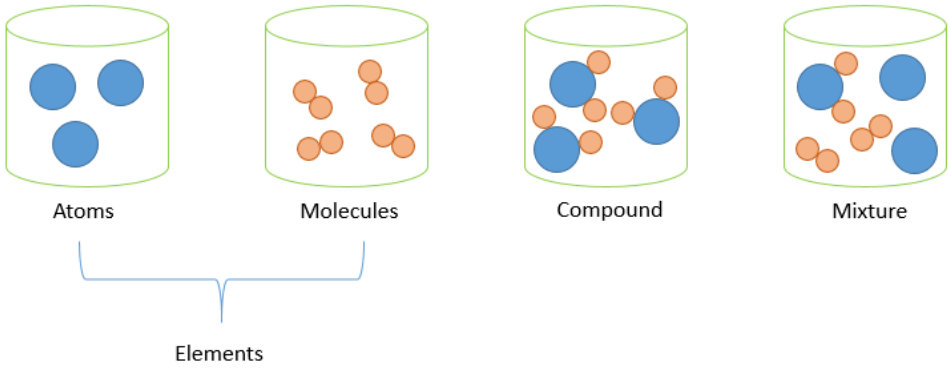
- Elements
- Compounds
- Mixtures

The atoms of any element are alike but are different from atoms of other elements. **Compounds** consist of **two or more elements** that are **chemically combined** in a fixed ratio. **Mixtures** also consist of **two or more substances**, but the substances are **not chemically combined**.

How can you determine whether a substance is an element, compound or mixture?

- An element contains just one type of atom
- A compound contains two or more types of atom joined together

- A mixture contains two or more different substances that are not joined together
- The different substances in a mixture can be elements or compounds

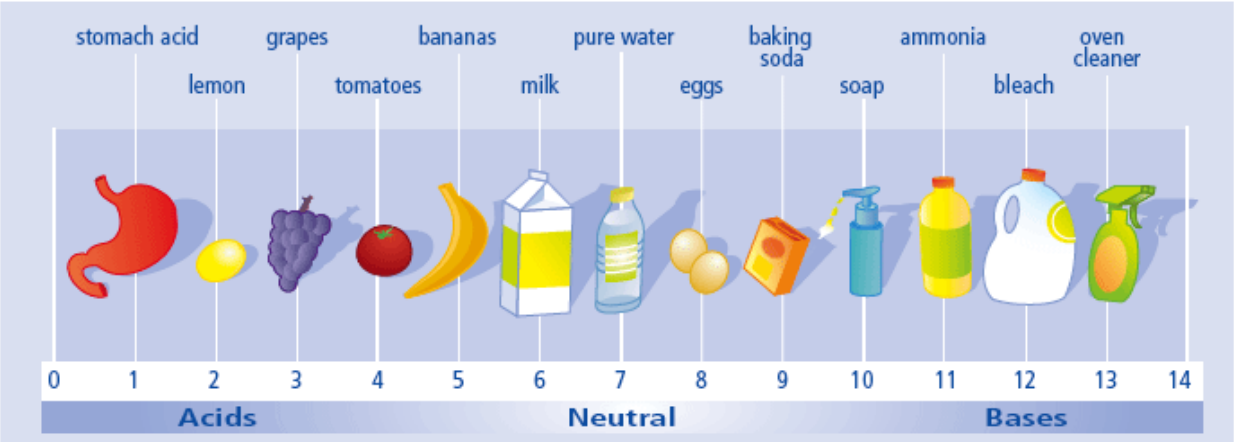


Compounds can be classified in several ways, including:

- acids, bases, salts
- inorganic and organic compounds.

ACIDS AND BASES

pH is the **hydrogen ion concentration** in a water-based solution. The **pH scale** measures **how acidic or basic** a substance is. It ranges from 0 to 14. A pH of 7 is neutral. A pH less than 7 is **acidic**, and a pH greater than 7 is **basic**.

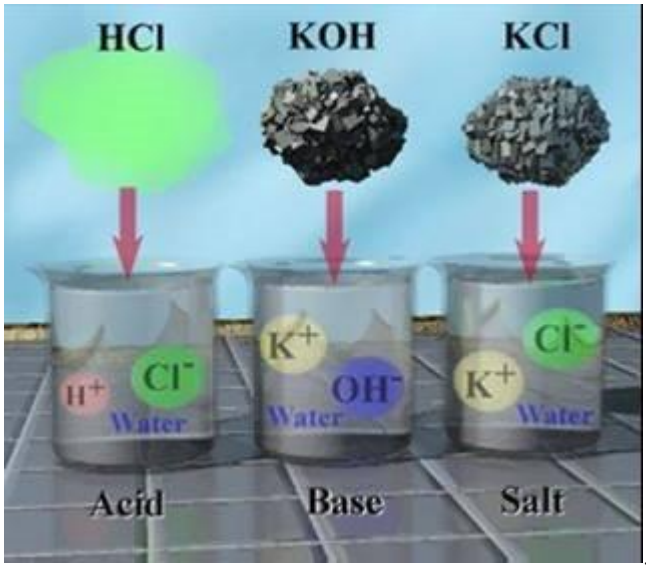


Acids	Bases
Less than 7 (pH scale)	More than 7 (pH scale)
Taste sour	Taste bitter and feel slippery
H+ ions when dissolved in water	OH- ions when dissolved in water
Changes blue litmus paper red	Changes red litmus paper blue

<u>Neutralization Reaction</u> A reaction between an **acid and a base**.

What is a salt?

- Salts form by the combination of acid and base through neutralization reaction.
- When an acid reacts with a base, a salt is formed, along with water.
- The acidic and basic nature of salts depends on the acid and base combined in neutralization reaction.



Source: Globalspec.com

- ***What is the difference between organic and inorganic compounds?***
  - **<u>Organic</u>** compounds **contain carbon**.

Matter can be described by its <u>physical properties</u> (properties of matter which can be perceived or observed **without changing the chemical identity** of the sample)**:**

Physical Property	Description
Shape	External form or appearance characteristic; the outline of an area or figure:
Density	Mass per unit volume of an object (D = M/V)
Solubility	Ability to dissolve
Odor	Fragrance
Melting point	Temperature at which it changes state from solid to liquid
Boiling point	Temperature at which a liquid boils and turns to vapor.
Color	Byproduct of the spectrum of light, as it is reflected or absorbed, as received by the human eye

Matter can also be described by its **chemical properties** (**properties** of matter that may only be observed and measured by performing a **chemical change** or **chemical** reaction):

Chemical Property	Description
Acidity	The level of acid in substances
Basicity	**Condition of being a base**
Combustibility	Capable of catching fire and burning
Reactivity	The rate at which a chemical substance tends to undergo a chemical **reaction**

SOL RELEASED QUESTIONS:

1. **Students conducted an experiment to determine if unknown liquids were acids or bases. What was the independent variable in this investigation? (2009)**

Unknown Liquids Data

Sample	Indicator	Color Change	Identification
Unknown 1	Litmus Paper	Red	Acid
Unknown 2	Litmus Paper	Pink	Acid
Unknown 3	Litmus Paper	Pink	Acid
Unknown 4	Litmus Paper	Blue	Base

   a. Sample
   b. Indicator
   c. Color change
   d. Identification

2. **Which of the following are products of combustion?**
   a. Heat and light
   b. Newly discovered elements
   c. Liquid and solid water
   d. Additional atoms

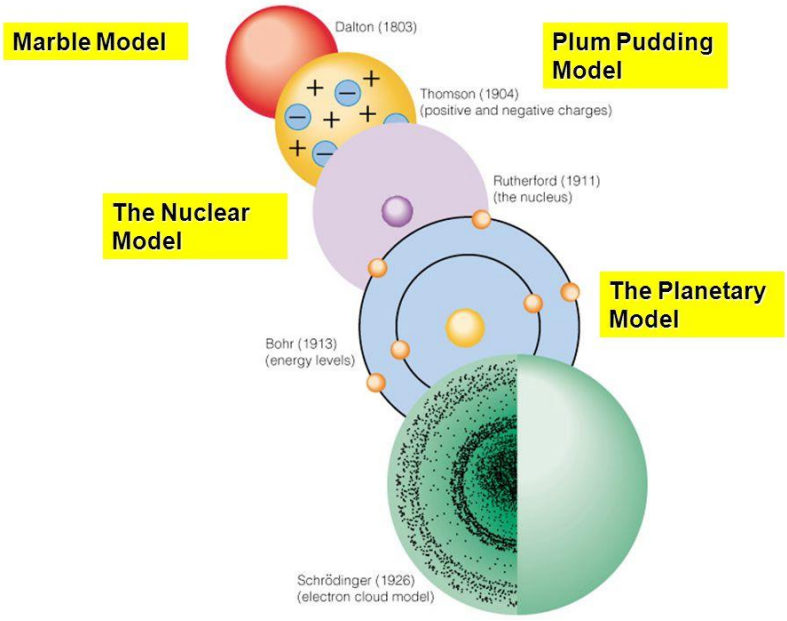
3. **Students placed steel wool in beakers of four different liquids in order of the most acidic to neutral. The students recorded their observations in the table. Which is the best conclusion in the table?**

Observations of Steel Wool in Four Liquids

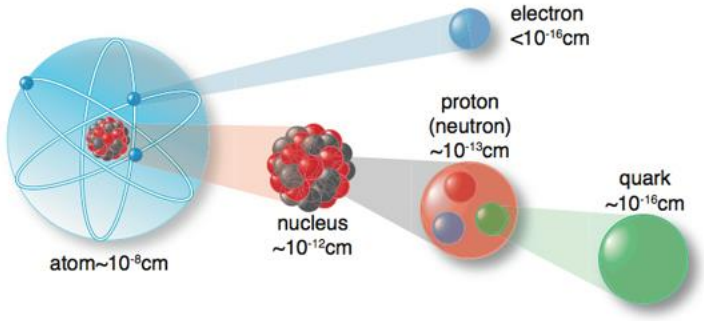
pH of Liquid	Observation of Liquid	Observation of Steel Wool
2	Bubbles appear quickly	Color turns brown
3	Bubbles appear moderately quickly	Color turns brown
5	A few bubbles appear slowly	No change in color
7	No bubbles appear	No change in color

   a. The more acidic the substance, the faster it reacts with wool
   b. The more acidic the substance, the faster the steel wool turns to a gas
   c. The less acidic the substance, the faster the steel wool becomes covered with air bubbles
   d. The less acidic the substance, the faster the steel wool changes color

HISTORICAL DEVELOPMENT OF THE ATOM



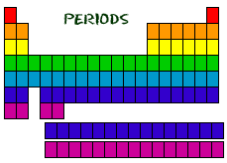
MODERN MODEL OF ATOM



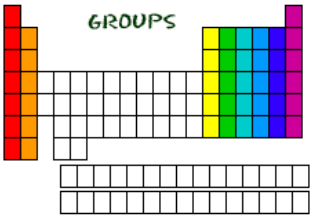
ORGANIZATION OF PERIODIC TABLE

The Russian scientist Dmitri Mendeleev discovered a set of patterns in the properties of the elements. He noticed that a pattern of properties appeared when he arranged the elements in order of increasing atomic mass. The **atomic mass** of an element is the average mass of all the isotopes of that element. After protons were discovered, elements were **rearranged according to <u>atomic number</u>**.

Each **element** is placed in a specific location because of its atomic structure. The periodic table has rows (left to right) and columns (up and down). Each row and column has specific characteristics. All of the rows read left to right. Each row is called a **period**. All of the elements in a period have the same number of **atomic orbitals**. For example, every element in the top row (the first period) has one orbital for its **electrons**.

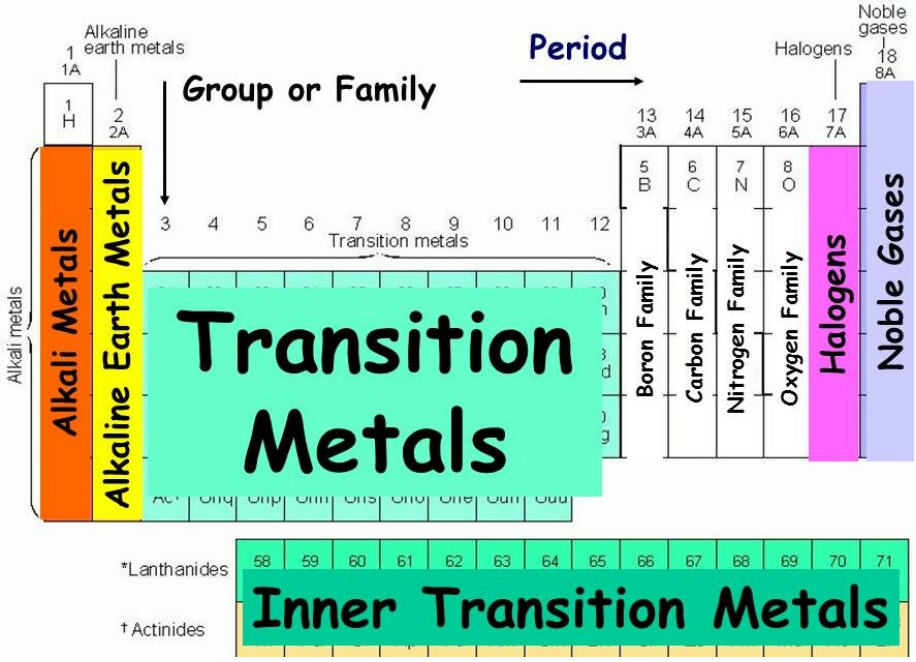


- Each column is called a **group or family**. The elements in each group have the same number of electrons in the outer **orbital**. Those outer electrons are also called **valence electrons**. They are the electrons involved in chemical bonds with other elements.



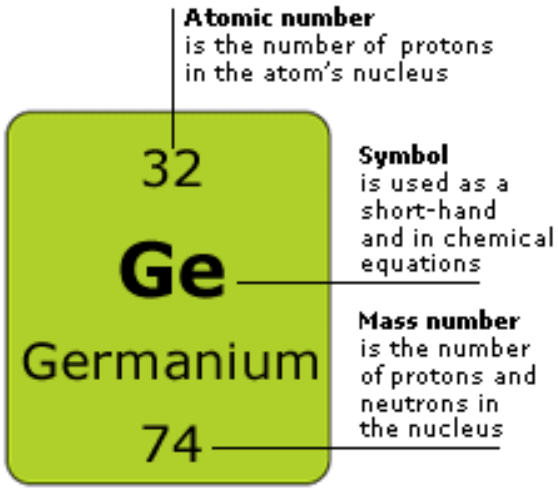
Modified Source: http://www.chem4kids.com/files/elem_pertable.html

The family name of a group is typically the name of the first element in the column. Elements in each group have similar characteristics.



Hydrogen (H) and helium (He) are special elements. **Hydrogen** can have the electron traits of two groups: one and seven. **Helium** (He) is different from all of the other elements. It is very stable with only two electrons in its outer orbital (valence shell). Even though it only has two, it is still grouped with the **noble gases** that have eight electrons in their outermost orbitals. The noble gases and helium are all "happy," because their valence shell is full.

Modified Source: http://www.chem4kids.com/files/elem_pertable.html



Atomic Number = number of protons or number of electrons
Atomic Mass = Atomic Number/Number of Protons/Number of Electrons – Number of Neutrons

Elements of the periodic table are grouped as metals, metalloids or semimetals, and nonmetals. The metalloids separate the metals and nonmetals on a periodic table. Also, many periodic table have a stair-step line on the table identifying the element groups. The line begins at boron (B) and extends down to polonium (Po). Elements to the left of the line are considered *metals*. Elements just to the right of the line exhibit properties of both metals and nonmetals and are termed *metalloids* or *semimetals*.

Elements to the far right of the periodic table are *nonmetals*. The exception is hydrogen (H), the first element on the periodic table. At ordinary temperatures and pressures, hydrogen behaves as a nonmetal.

Properties of Metals

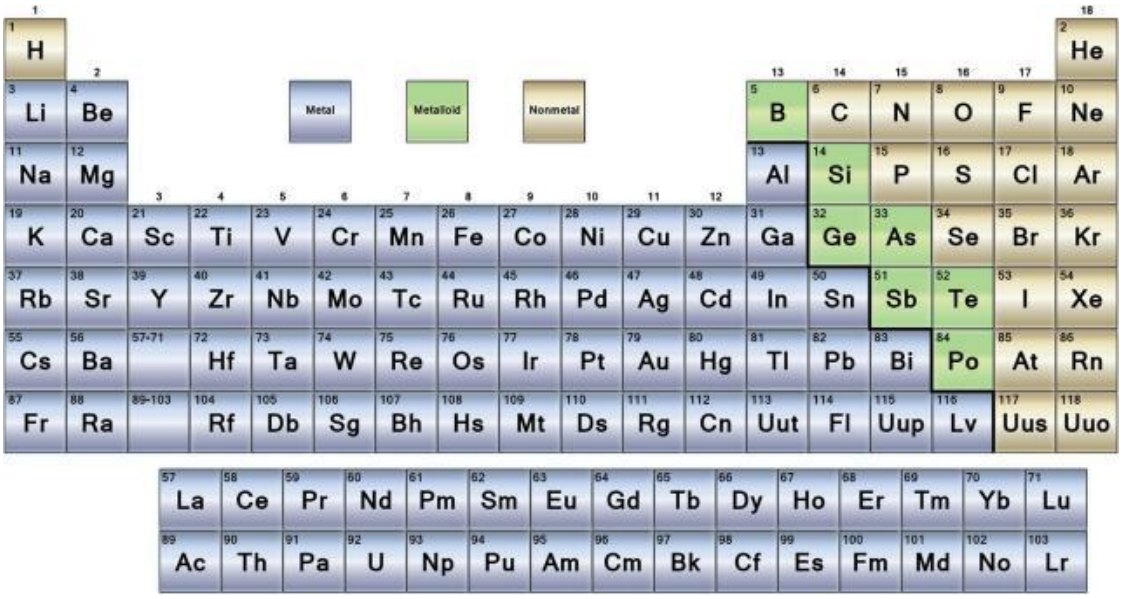
- usually solid at room temperature (mercury is an exception)
- high luster (shiny)
- metallic appearance
- good conductors of heat and electricity
- malleable (can be bent and pounded into thin sheets)
- ductile (can be drawn into wire)

Properties of Metalloids or Semimetals.

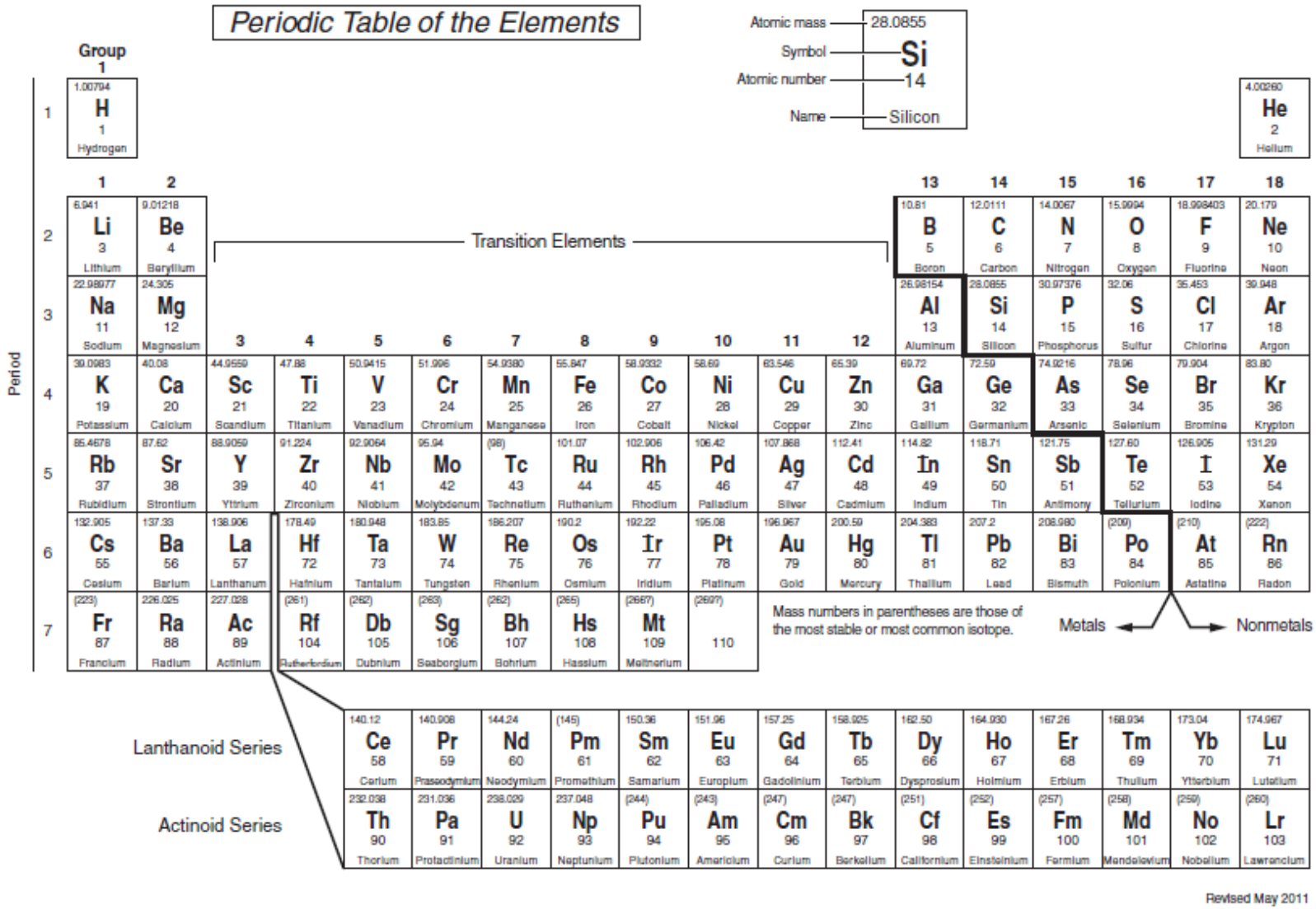
- dull or shiny
- usually conduct heat and electricity, though not as well as metals
- often make good semiconductors
- often ductile
- often malleable

Properties of Nonmetals

- dull appearance
- usually brittle
- poor conductors of heat and electricity


Metal
Metalloid
Nonmetal
H
He
Li
Be
B
C
N
O
F
Ne
Na
Mg
Al
Si
P
S
Cl
Ar
K
Ca
Sc
Ti
V
Cr
Mn
Fe
Co
Ni
Cu
Zn
Ga
Ge
As
Se
Br
Kr
Rb
Sr
Y
Zr
Nb
Mo
Tc
Ru
Rh
Pd
Ag
Cd
In
Sn
Sb
Te
I
Xe
Cs
Ba
57-71
Hf
Ta
W
Re
Os
Ir
Pt
Au
Hg
Tl
Pb
Bi
Po
At
Rn
Fr
Ra
89-103
Rf
Db
Sg
Bh
Hs
Mt
Ds
Rg
Cn
Uut
Fl
Uup
Lv
Uus
Uuo
La
Ce
Pr
Nd
Pm
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Ac
Th
Pa
U
Np
Pu
Am
Cm
Bk
Cf
Es
Fm
Md
No
Lr

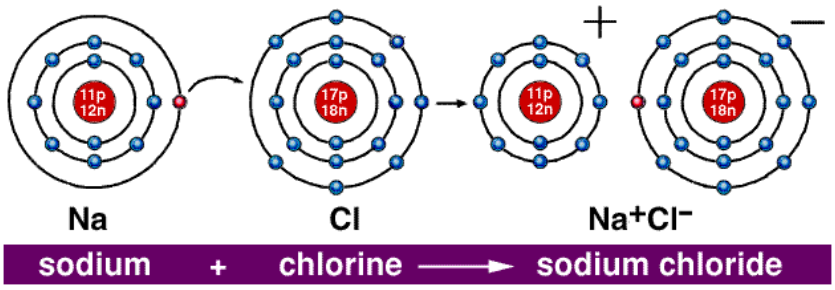
Periodic Table of the Elements
For Assessments Based on the 2010 Chemistry Standards of Learning



Revised May 2011

IONIC and COVALENT BONDING

An atom by itself generally has a neutral charge, because the positive charge from the protons in its nucleus is balanced by the negative charge of its electrons. However, when many types of atoms come into contact with one another, **electrons can be transferred** from one atom to another. A **negative ion** is created when one atom **gains electrons**. Conversely, a **positive ion** is created when an atom **loses electrons**. The **oppositely charged ions attract** one another, creating **an ionic bond**, and a neutrally charged compound.



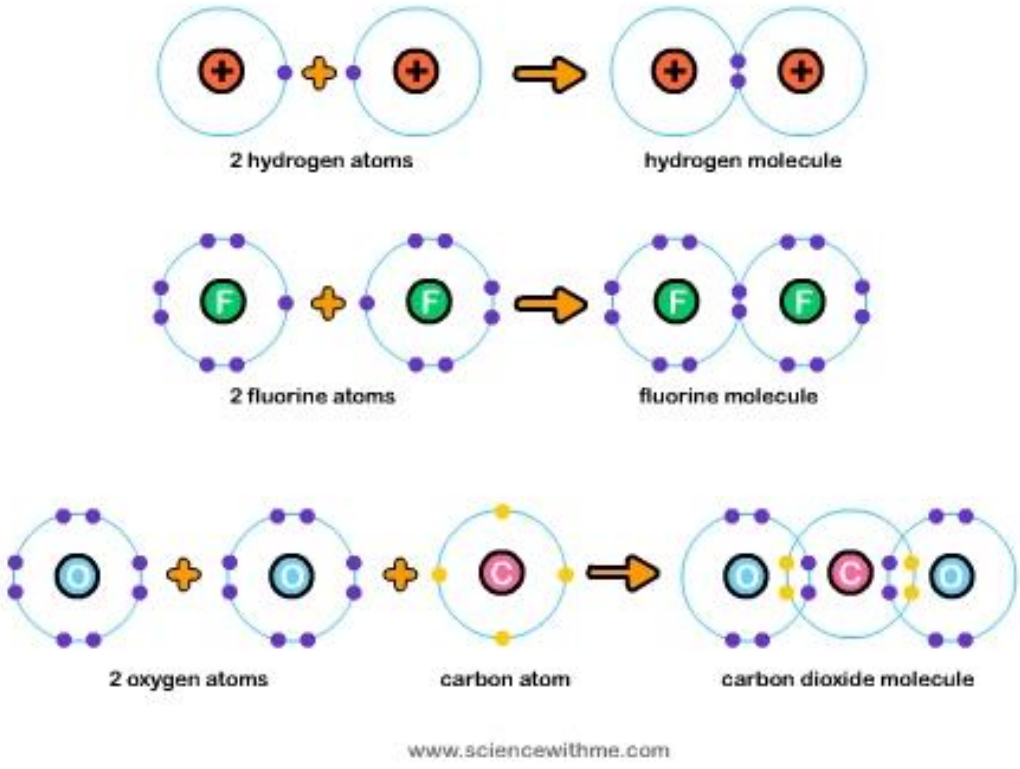
An everyday example of an ionic compound is table salt—sodium chloride (NaCl). Table salt is sodium and chloride ions joined together with ionic bonds.

According to the atomic model, electrons orbit the nucleus at specific levels, or shells. Electrons fill shells, starting from the innermost, going to the outermost. Atoms are **more stable** when their **outer shell is filled**, and therefore, atoms will lose, gain, or share electrons to complete their outer shells. **Electrons in the outermost shell**, which are involved in bonding, are known as **valence electrons**.

When two atoms vary significantly in electronegativity (the measure of the ability of atoms to attract electrons), they tend to form ionic bonds. Some atoms tend to lose electrons, while others are more likely to gain them. Elements with **low electronegativity**, such as metals, have outer **shells that are almost empty** and give up electrons fairly easily. Elements with **high electronegativity**, such as nonmetals, have outer **shells that are mostly full** and tend to hold on to their electrons. In general, elements on the **left of the periodic table** have **low electronegativities,** whereas elements on the **right side of the periodic** have **high electronegativities**.

Sodium has relatively low electronegativity, with only one electron in its outer shell. With most of its outer shell full, chlorine has relatively high electronegativity and needs only one extra electron to fill its shell. When sodium and chlorine atoms come together, the sodium atom lends its outer electron to the chlorine atom. The positively charged sodium ion is then attracted to the negatively charged chloride ion and creates an ionic bond.

When atoms have **similar electronegativity**, a **<u>covalent bond</u>** forms. Covalent bonds differ from ionic bonds in that instead of transferring electrons, the atoms **share electrons**.



Source: *http://www.pbslearningmedia.org/resource/lsps07.sci.phys.matter.ionicbonding/ionic-bonding/*

CHANGES IN MATTER

Types of Changes	Description	Examples
Physical	Physical changes, the chemical composition of the substances does not change.	• Energy stored in the Any phase change • Grinding something into powder
Chemical	Different substances are formed	• Iron rusting • Gasoline burning
Nuclear	Energy stored in the nucleus of an atom.	• Joining nuclei together (fusion) • Splitting nuclei (fission),

Nuclear Changes:

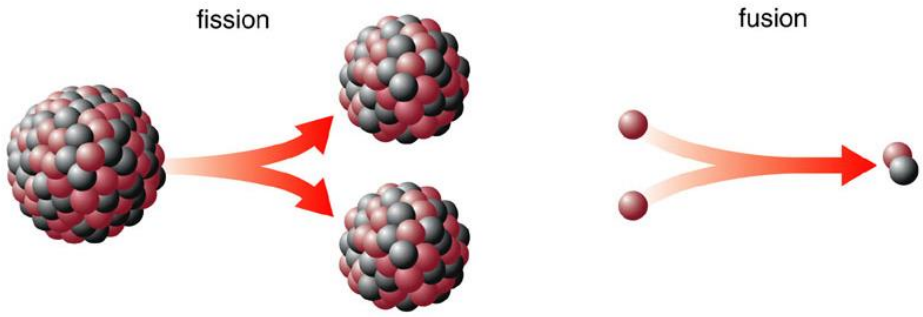
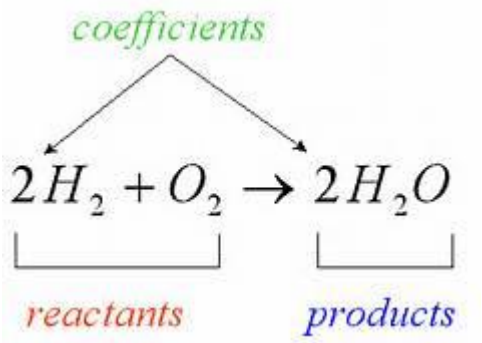


Image Source: Pearson Education

BALANCING SIMPLE EQUATIONS

A chemical equation is a written symbolic representation of a chemical reaction. The reactant chemical(s) are given on the left-hand side and the product chemical(s) on the right-hand side. The law of conservation of mass states that no atoms can be created or destroyed in a chemical reaction, so the number of atoms that are present in the reactants has to balance the number of atoms that are present in the products.

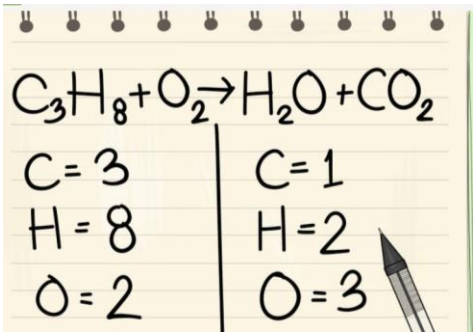
Remember the parts of a chemical reaction from 6th grade science?



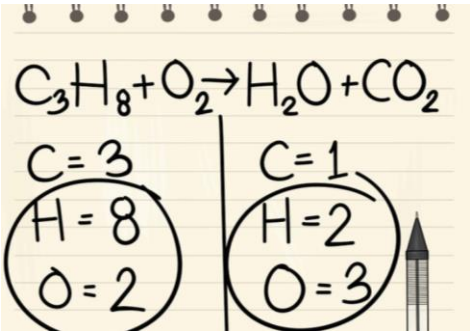
Is it balanced?

Write down the equation:

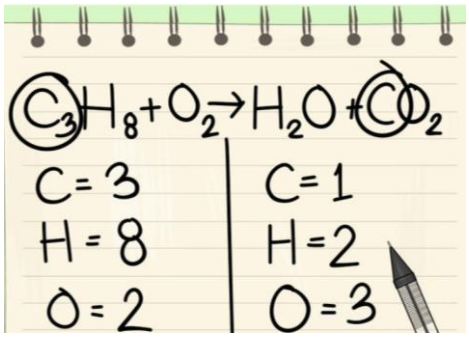
1. $C_3H_8 + O_2 \dashrightarrow H_2O + CO_2$
    - This reaction occurs when propane (C_3H_8) is burned in the presence of oxygen to produce water and carbon dioxide.
2. **Write down the number of atoms per each element that you have on each side of the equation.** Look at the subscripts next to each atom to find the number of atoms in the equation.
    - Left side: 3 carbon, 8 hydrogen and 2 oxygen.
    - Right side: 1 carbon, 2 hydrogen and 3 oxygen.



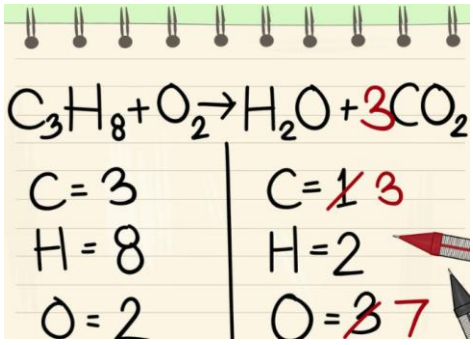
3. **Always leave hydrogen and oxygen for last.**



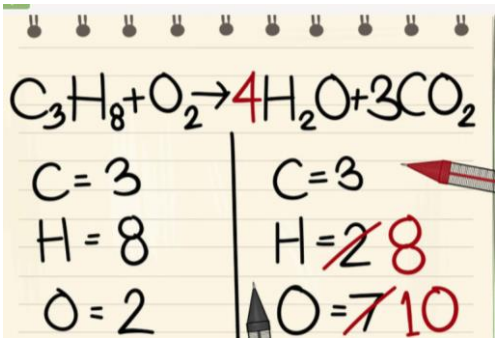
4. **If you have more than one element left to balance:** select the element that appears in only a single molecule of reactants and in only a single molecule of products. This means that you will need to balance the carbon atoms first



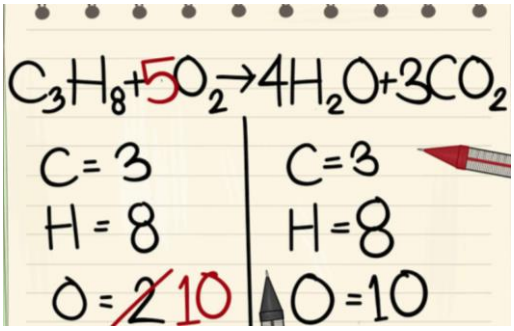
5. **Add a coefficient to the single carbon atom on the right of the equation to balance it with the 3 carbon atoms on the left of the equation.**
    - $C_3H_8 + O_2$ --> $H_2O + 3CO_2$
    - The coefficient 3 in front of carbon on the right side indicates 3 carbon atoms just as the subscript 3 on the left side indicates 3 carbon atoms.
    - In a chemical equation, you can change coefficients, but you must never alter the subscripts.



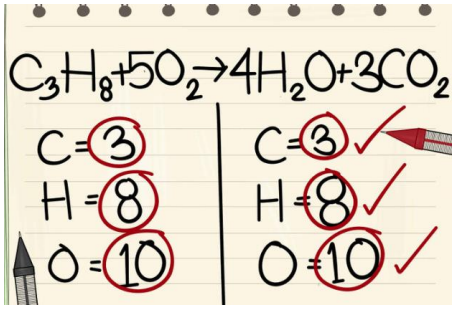
7. **Balance the hydrogen atoms next.** You have 8 on the left side. So you'll need 8 on the right side.
    - $C_3H_8 + O_2$ --> $4H_2O + 3CO_2$
    - On the right side, you now added a 4 as the coefficient because the subscript showed that you already had 2 hydrogen atoms.
    - When you multiply the coefficient 4 times by the subscript 2, you end up with 8.
    - The other 6 atoms of Oxygen come from $3CO_2$.(3x2=6 atoms of oxygen+ the other 4=10)



8. **Balance the oxygen atoms.**
    - Because you've added coefficients to the molecules on the right side of the equation, the number of oxygen atoms has changed. You now have 4 oxygen atoms in the water molecule and 6 oxygen atoms in the carbon dioxide molecule. That makes a total of 10 oxygen atoms.
    - Add a coefficient of 5 to the oxygen molecule on the left side of the equation. You now have 10 oxygen molecules on each side.
    - $C_3H_8 + 5O_2 \rightarrow 4H_2O + 3CO_2$.



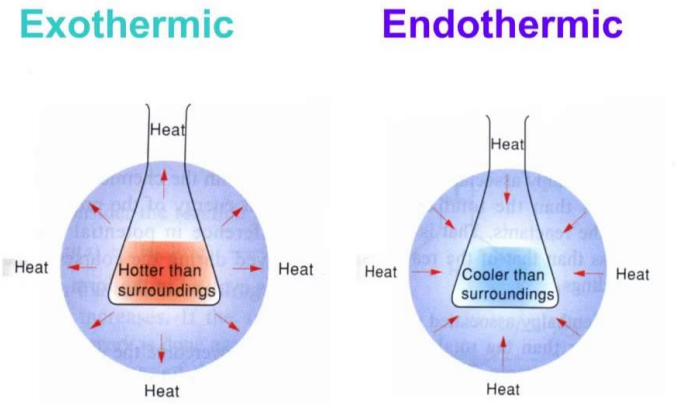
9. The carbon, hydrogen, and oxygen atoms are balanced.



Source: http://www.wikihow.com/Balance-Chemical-Equations

<u>TYPES OF CHEMICAL REACTIONS:</u>

1. Exothermic
    - Releases energy
2. Endothermic
    - Requires continuous input of energy



SOL RELEASED QUESTIONS:

$C + O_2 \longrightarrow CO_2$

1. **According to this equation, what happened to the carbon and oxygen (2009)**
   - **a.** They combined chemically to form a new compound.
   - **b.** They combined chemically to form carbon and oxygen.
   - **c.** They combined physically to form a new mixture
   - **d.** They combined physically to form a new element.
2. **How is the modern model of an atom different from the Bohr atomic model? (2009)**
   - **a.** The masses of the atomic particles are different.
   - **b.** The numbers of electrons are different.
   - **c.** The shapes of the nuclei are different.
   - **d.** The arrangements of the electrons are different.
3. **Which of these substances is an element? (2009)**
   - **a.** Steel
   - **b.** Chlorine
   - **c.** Plastic
   - **d.** Sugar

$$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$$

4. **How many different elements are involved in the chemical reaction above? (2015) ____**

Partial Periodic Table of the Elements

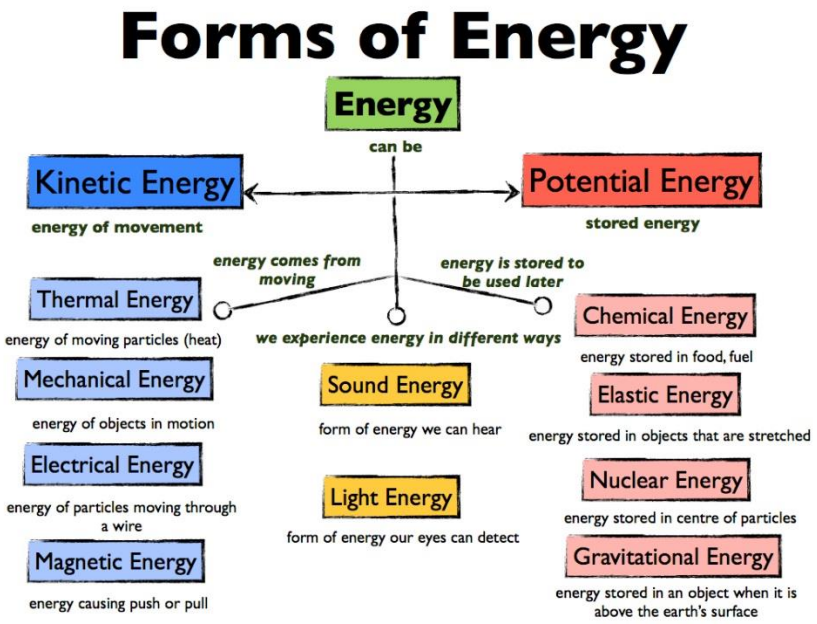
1 H 1.0																	2 He 4.0
3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 48.0	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.0	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 181.0	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po 209.0	85 At 210.0	86 Rn 222.0
87 Fr 223.0	88 Ra 226.0	89 Ac 227.0	104 Rf 261	105 Db 262	106 Sg 263	107 Bh 262	108 Hs 265	109 Mt 266	110 Ds 269								

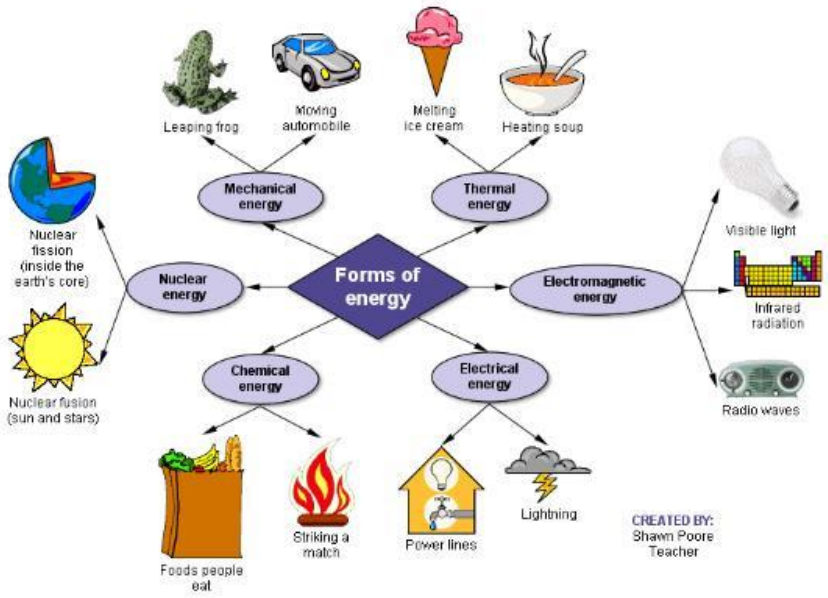
5. **The shaded row in the table is called the _____.**
   - a. Column
   - b. Family
   - c. Group
   - d. Period

ENERGY

Energy is the **ability to do work**.

States of Energy	Description	Amount Depends on…
Potential energy	Stored energy based on position or chemical composition	Object's position
Kinetic energy	Energy of motion.	The mass and velocity of the moving object





ENERGY TRANSFORMATIONS (CONVERSIONS)

Energy can be **transformed (changed)** from one type to another. In any energy conversion, some of the energy is lost to the environment as thermal energy.

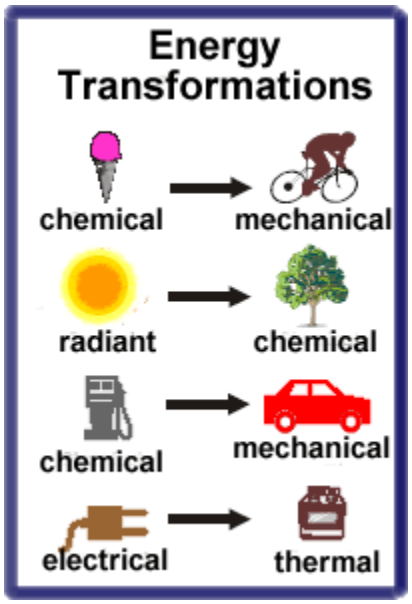
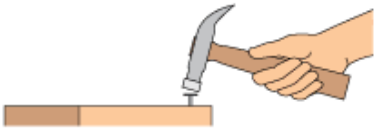


Image Source: Thoughtyoumayask.com

Changing forms of energy

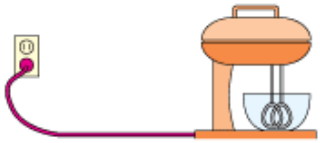
An automobile engine changes chemical energy to mechanical and heat energy.

A tree changes radiant energy to chemical energy.

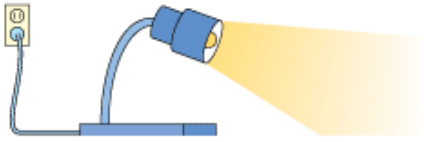


Hammering a nail changes mechanical energy to deformation and heat energy.

A thermonuclear reaction changes nuclear energy to radiant and heat energy.



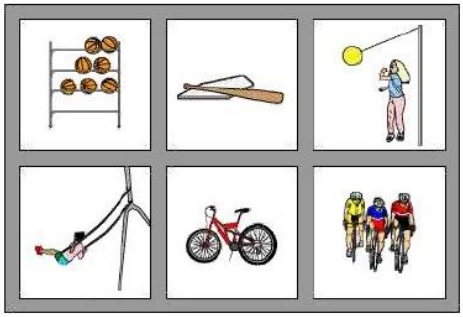
An electric mixer changes electrical energy to mechanical and heat energy.



A lamp changes electrical energy to radiant and heat energy.

RELEASED SOL QUESTIONS

1. **Which of the following is an example of potential energy? (2009)**
   - **a.** A glass jar sitting on a shelf
   - **b.** A flag waving in the wind
   - **c.** A ball rolling along a sidewalk
   - **d.** A battery powering a radio
2. **Which energy transformation occurs first in a coal-burning power plant? (2009)**
   - **a.** Chemical energy to thermal energy
   - **b.** Thermal energy to mechanical energy
   - **c.** Thermal energy to electrical energy
   - **d.** Mechanical energy to electrical energy
3. **Which of the three drawings best represent objects with kinetic energy? (2015)**



(*CIRCLE)*

HEAT

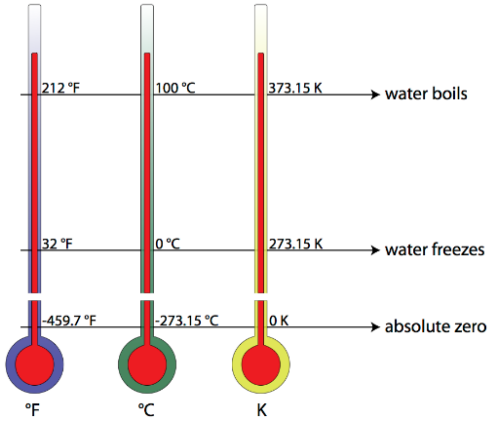
How do heat and temperature differ?

Heat is the amount of energy and is measured in Joules. Temperature is measure of the average kinetic energy of molecules and is measured in °F, °C, or K. Heat is the transfer of thermal energy between substances of different temperatures. As thermal energy is added, the temperature of a substance increases. Increased temperature means greater average kinetic energy of the molecules in the substance being measured, and most substances expand when heated.

Absolute Zero

The temperature of absolute zero (–273oC/0K) is the theoretical point at which molecular motion stops

TEMPERATURE SCALES



Here is the formula to convert Kelvin into Celsius:

°C = K - 273.15

All that is needed to convert **Kelvin to Celsius** is one simple step.

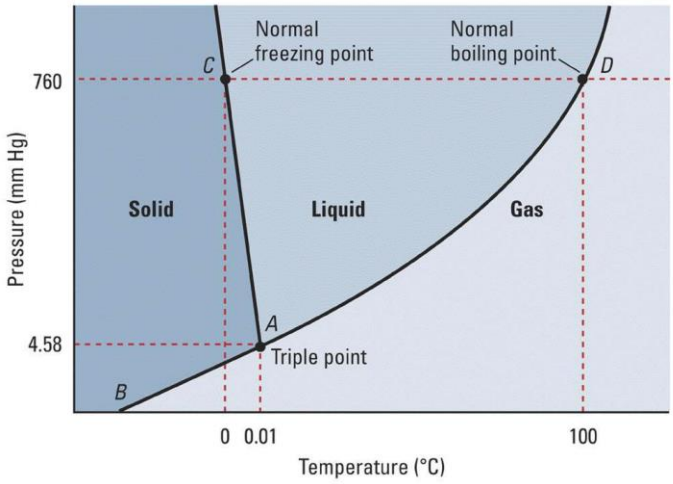
Take your **Kelvin temperature and subtract 273.15**. Your answer will be in Celsius. While there is no degree symbol for Kelvin, you need to add the symbol to report a Celsius temperature.

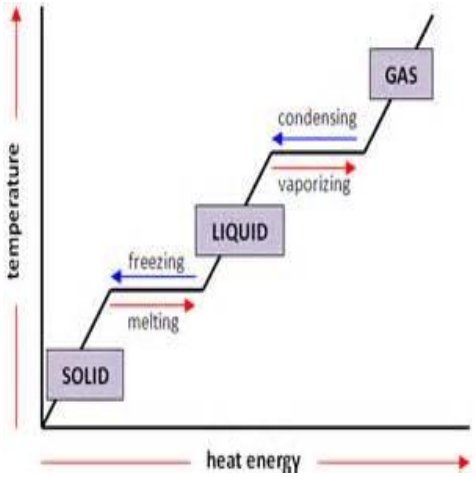
How many degrees Celsius is 500K?

°C = K - 273.15
°C = 500 - 273.15
°C = 226.85°

PHASE CHANGE DIAGRAMS

Can you interpret the phase change diagrams?



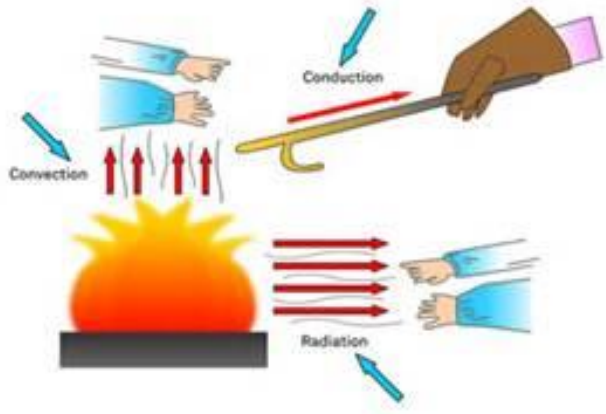


HEAT TRANSFER

Heat will flow from the hotter object to the colder. The molecules in the hotter object will slow down and the molecules in the colder object will speed up. Eventually they will get to the point where they have the same temperature. When something gets hotter it will expand, or get bigger. At the same time, when something gets colder it will shrink. **Heat can be transferred from place to place by conduction, convection and radiation.**

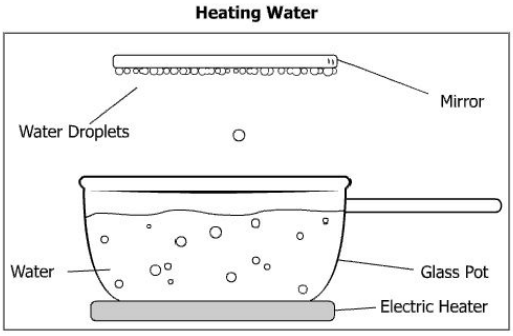
TYPES OF HEAT TRANSFER

1. When heat **transfers from one object to another**, this is called **<u>conduction</u>**.
2. Liquids and gases are fluids. The **particles in these fluids can move from place to place**. **<u>Convection</u>** occurs when particles with a lot of heat energy in a liquid or gas move and take the place of particles with less heat energy.
3. All objects give out and take in **thermal radiation**, which is also called **infrared radiation**. The hotter an object is, the more infrared radiation it emits. Infrared radiation is a type of **electromagnetic radiation that involves waves**. No particles are involved, unlike in the processes of conduction and convection, so radiation <u>*can even work through the vacuum of space*</u>.



RELEASED SOL QUESTIONS:

1. **Which of these best describes the particle motion taking place as gas is exposed to freezing temperatures? (2009)**
    a. The particles decrease in speed.
    b. The particles move with more force.
    c. The motion of the particles becomes random.
    d. The motion of the particles is unchanged.
2. **A metal spoon was placed in a dish of ice cream and became cool. Which correctly describes the heat transfer process that resulted in the cooling of the spoon?**
    a. Conduction, because the spoon was in contact with the cold ice cream
    b. Convection, because the spoon was in contact with the cold ice cream
    c. Conduction, because cold air currents affected the temperature of the spoon
    d. Convection, because cold air currents affected the temperature of the spoon
3. **Which of these properties of an unknown liquid can be found using a beaker, hot plate, and a temperature probe?**
    a. Density
    b. Boiling point
    c. Oxygen level
    d. Chemical composition
4. **The volume of water in the pot decreases during this investigation. Water droplets form n he mirror when positioned over the pot. In this setup, water ____.**

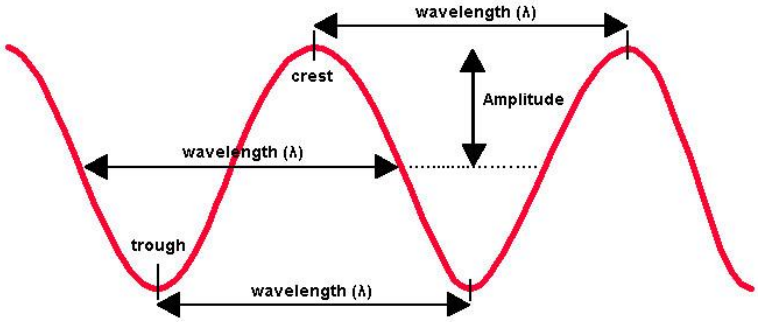


    a. Vaporizes and then freezes
    b. Vaporizes and then condenses
    c. Condenses and then vaporizes
    d. Freezes and then vaporizes
5. **Which of these represents the freezing point of water in correct SI units?**
    a. 0°C
    b. 0°F
    c. 32°F
    d. -273°C

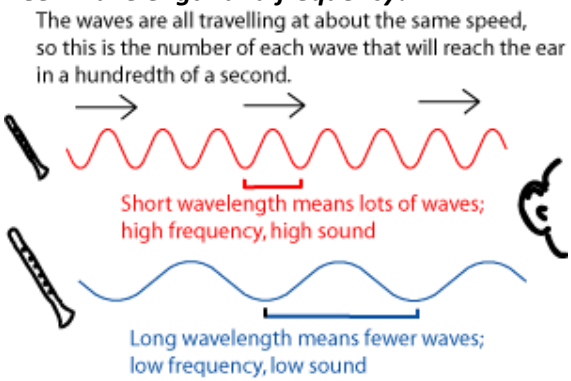
SOUND WAVES

Sound is produced by vibrations and is a type of mechanical energy. Sound travels in compression waves and at a speed much slower than light. It needs a medium (solid, liquid, or gas) in which to travel. In a compression wave, matter vibrates in the same direction in which the wave travels. (VDOE Grade 8 Physical Science Curriculum Framework).

All waves exhibit certain characteristics: wavelength, frequency, and amplitude. As wavelength increases, frequency decreases.

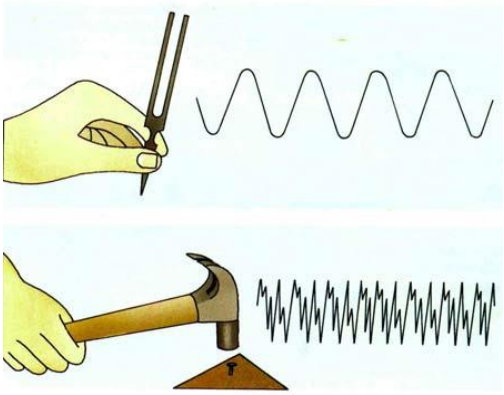


What is the relationship between wavelength and frequency?



As wavelength increases, frequency decreases.

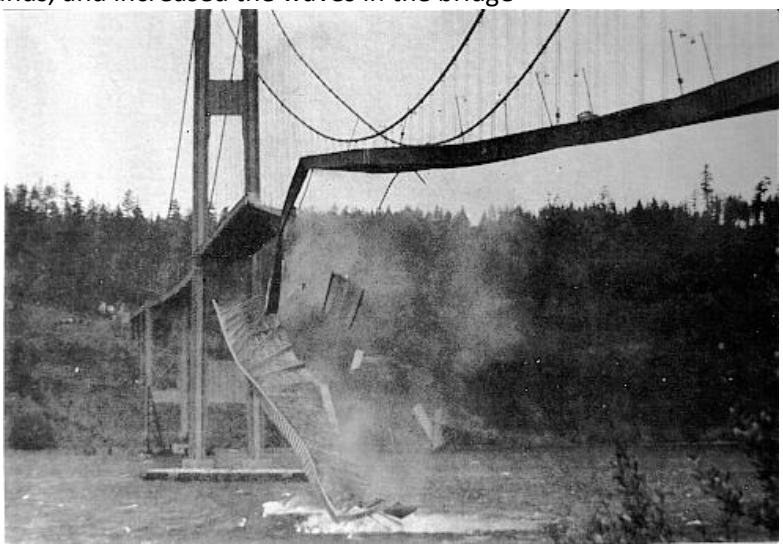
The speed of sound depends on two things: the medium through which the waves travel and the temperature of the medium.



Resonance is the tendency of a system to **vibrate at maximum amplitude** at certain frequencies.

Examples of resonance:

The Tacoma Narrows Bridge collapsed due to wind induced resonance on November 7th, 1940. In this case the identical frequency was caused by strong wind gusts blowing across the bridge, creating regions of high and low pressure above and below the bridge (Bernouli's principle). This produced violent waves in the bridge leading to its collapse. Simply put, the wind was forced either above or below the bridge, causing the bridge to be moved up or down. This tensed or relaxed the supporting cables, which acted much like rubber bands, and increased the waves in the bridge



Modified from: http://faculty.plattsburgh.edu/margaret.campion/seconded/second/kent/kent.html

Resonance is the cause of sound production in musical instruments. Musical instruments produce their selected sounds in the same manner. Brass instruments typically consist of a mouthpiece attached to a long tube filled with air. The metal tube serves as a container for a column of air. It is the vibrations of this column that produces the sounds that we hear. Brass instruments involve the blowing of air into a mouthpiece. The vibrations of the lips against the mouthpiece produce a range of frequencies. One of the frequencies in the range of frequencies matches one of the natural frequencies of the air column inside of the brass instrument. This forces the air inside of the column into resonance vibrations. The result of resonance is always a big vibration - that is, a loud sound.

Woodwind instruments operate in a similar manner. Only, the source of vibrations is the vibration of a reed or wooden strip. When air is blown through the reed, the reed vibrates producing turbulence with a range of vibrational frequencies. When the frequency of vibration of the reed matches the frequency of vibration of the air column in the straw, resonance occurs. And once more, the result of resonance is a big vibration - the reed and air column sound out together to produce a loud sound. A vibrating reed

forces an air column to vibrate at one of its natural frequencies. Only for wind instruments, the length of the air column is controlled by opening and closing holes within the metal tube.

Source: http://www.physicsclassroom.com/Class/sound/U11l5a.cfm

Crystal Stemware

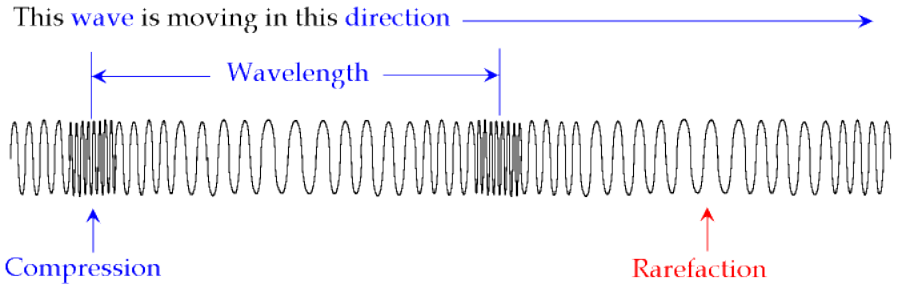
When a vibrating system is set into motion, it vibrates at its natural frequency. When an outside force is applied to a system, this results in a forced vibration. This effect is known as resonance, or resonant frequency. In simpler terms, when you drag your finger around the edge of a wine glass, it is causing a forced vibration which results in the "singing" or resonant frequency that is heard. Dragging your finger on the rim creates friction, which then causes the glass to vibrate and create resonance. If you add water to the glass it essentially makes the glass heavier so it takes it longer to vibrate back and forth so vibration is slower and therefore the pitch is lower.

Modified Source: http://tuhsphysics.ttsd.k12.or.us/Research/IB12/AlbeKastGard/index.htm

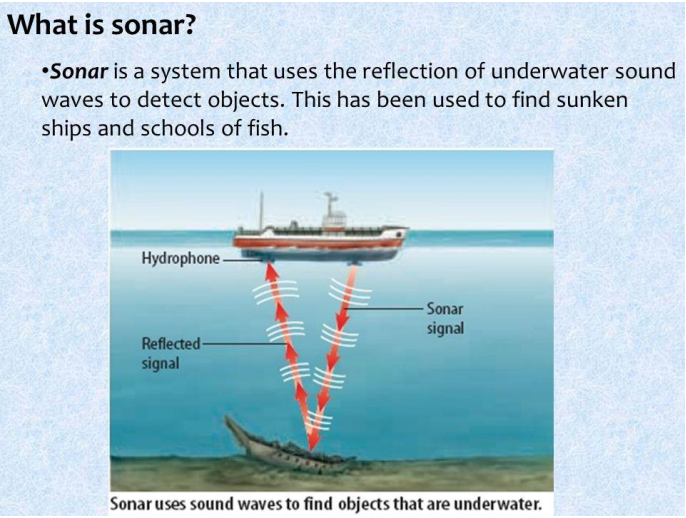
LONGITUDINAL WAVES

In longitudinal waves, the oscillations are along the **same direction as the direction of travel and energy transfer**. Sound waves and waves in a stretched spring are longitudinal waves. P waves (relatively fast moving longitudinal seismic waves that travel through liquids and solids) are also longitudinal waves.

Longitudinal waves show area of compression and rarefaction.



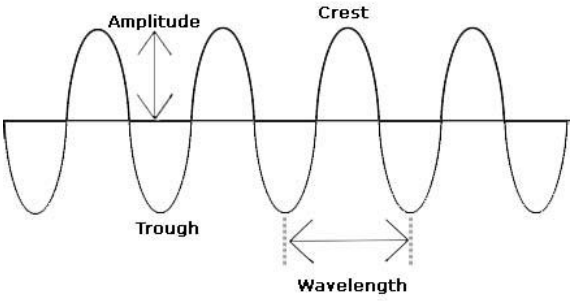
SOUND & TECHNOLOGY

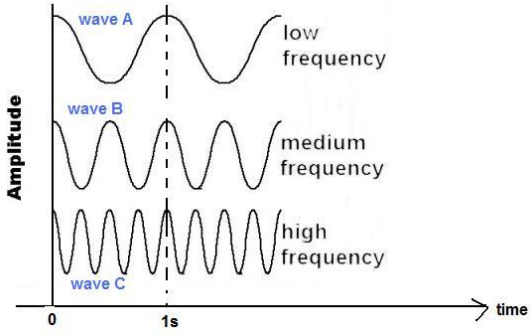


SOURCE: http://images.slideplayer.com/13/3866830/slides/slide_40.jpg

TRANSVERSE WAVES

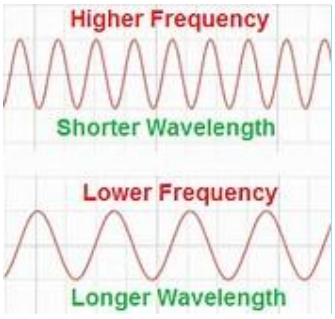
How would you describe these characteristics of waves? (Use the vocabulary as a guide)



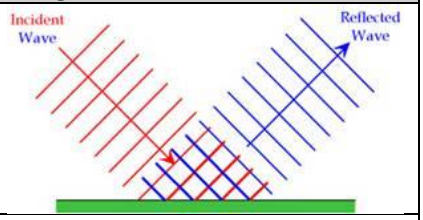
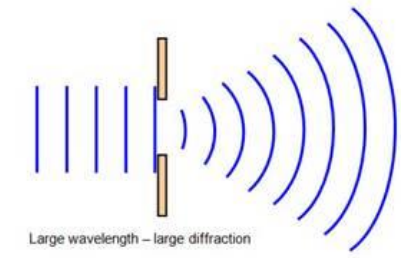
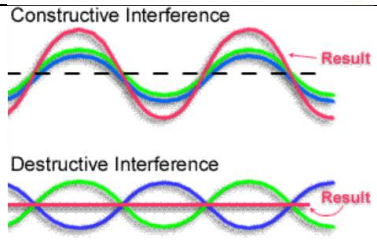


WAVE BEHAVIOR of LIGHT

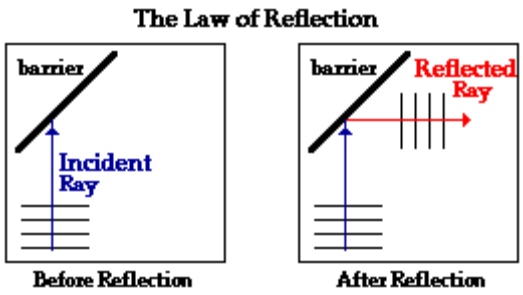
As wavelength increases, frequency decreases. There is an inverse relationship between frequency and wavelength.



Radiant energy travels in straight lines until it strikes an object where it can be **reflected**, **absorbed**, or **transmitted**. As visible light travels through different media, it undergoes a change in speed that may result in **refraction**.

Wave Behavior	Description	Image
Reflection	• The bouncing back of a wave when it hits a surface through which it cannot pass.	
Refraction	• **Refraction** of waves involves a change in the direction of waves as they pass from one medium to another. • Refraction, or the bending of the path of the waves, is accompanied by a change in speed and wavelength of the waves.	
Diffraction	• When light waves strike an obstacle and new waves are produced.	
Interference	• When two waves meet while traveling along the same medium. • When two or more waves overlap and combine as a result of diffraction	

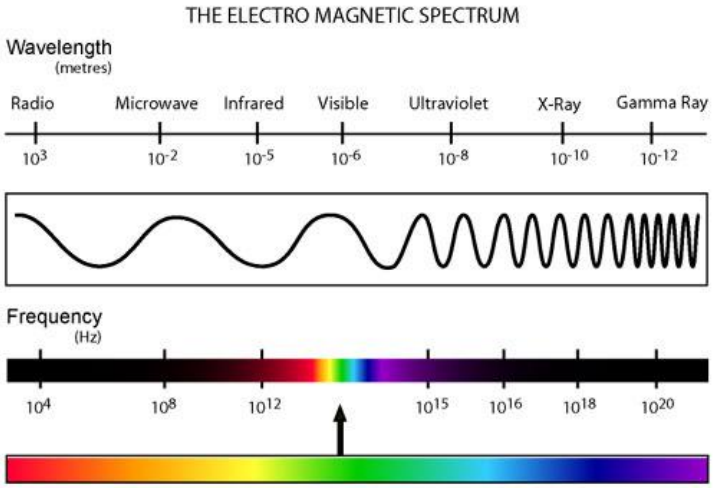
The waves will always reflect in such a way that the angle at which they approach the barrier equals the angle at which they reflect off the barrier. This is known as the **law of reflection**.



Modified Source: http://www.physicsclassroom.com/class/waves/Lesson-3/Reflection,-Refraction,-and-Diffraction

ELECTROMAGNETIC SPECTRUM

The **electromagnetic spectrum** describes the various types of electromagnetic radiation based on their wavelengths. Electromagnetic waves are arranged on the electromagnetic spectrum by wavelength. All types of electromagnetic radiation travel at the speed of light, but differ in wavelength. The electromagnetic spectrum includes gamma rays, X-rays, ultraviolet, visible light, infrared, and radio and microwaves.

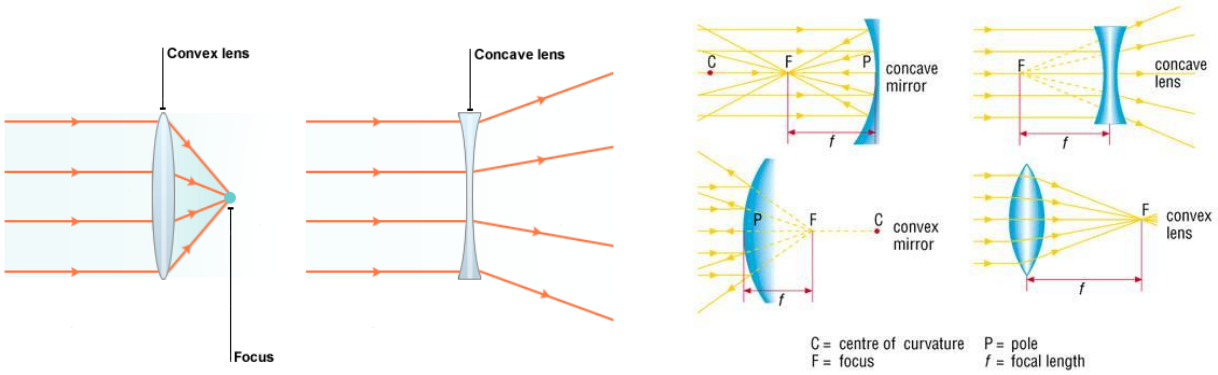


Analyze the electromagnetic spectrum and answer the following questions:

1. _____ have the longest wavelength and the lowest frequency.
2. _____ are the highest energy waves and have the shortest wavelength and the highest frequency.
3. Visible light lies in between and makes up only a small portion of the electromagnetic spectrum.

LENSES AND MIRRORS

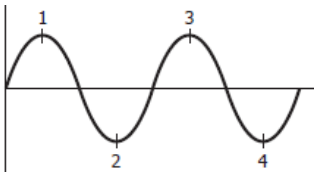
Lenses bend light in useful ways. Convex lenses converge (focus) light. Concave lenses will diverge (spread out) light rays.



Plane, concave, and convex mirrors all reflect light. **<u>Convex mirrors</u> diverge** light and produce a **smaller, upright image**. **<u>Concave mirrors</u> converge** light and produce an **upright, magnified** image if close and an inverted, smaller image if far away.

<u>SOL RELEASED QUESTIONS:</u>

1. **As the frequency of a wave decreases, the wave's ____. (2015)**
   a. period decreases
   b. amplitude increases
   c. speed decreases
   d. wavelength increases
2. **Sound waves are unable to travel through ___. (2015)**
   a. air
   b. a vacuum
   c. water
   d. a rock
3. **During a fireworks show, a family sees the spray of sparkles from an exploding firework high in the sky and, a moment later, hears the pop. Which of these best explains why the pop and spray do not seem to occur at the same time?**
   a. Light and sound travel through air.
   b. Sound travels through a vacuum.
   c. Sound travels slower than light.
   d. Light and sound travel at the same speed.
4. **The illustration shows a wave. The wave's wavelength is the distance between points __ (2009)**
   a. 1 and 2
   b. 1 and 4
   c. 2 and 3
   d. 2 and 4



WORK, FORCE, and MOTION

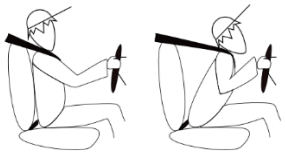
ACCELERATION

Acceleration is the change in velocity per unit of time. An object moving with constant velocity has no acceleration. A decrease in velocity is negative acceleration or deceleration. Objects moving with circular motion are constantly accelerating because direction (velocity) is constantly changing.

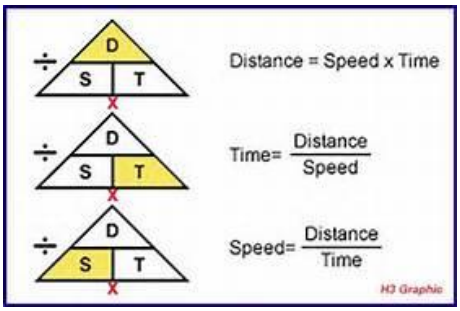
NEWTON'S LAWS OF MOTION

Newton's three laws of motion describe the motion of all common objects:

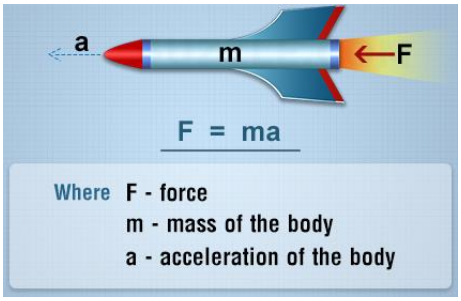
1. Newton's First Law of Motion states that an object at **rest** tends to stay at rest, and an object in **motion** tends to stay in motion, with the same direction and **speed**.

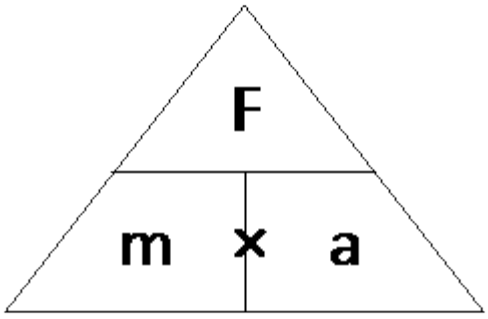


How can speed be calculated?

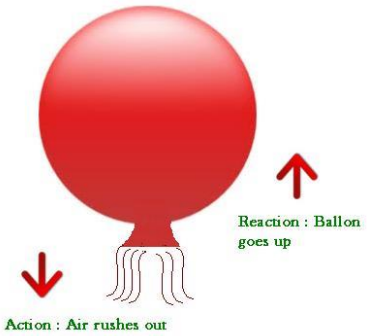


2. Newton's Second Law of Motion states when a force acts on an object, the object accelerates in the direction of the force. Force and acceleration are directly proportional, while mass and acceleration are inversely proportional.





3. Newton's Third Law of Motion states that for every action (force) there is an equal and opposite reaction (force).



MASS AND WEIGHT

What is the difference between mass and weight?

Think…  compared to… 

Mass is the **amount of matter** in a given substance and is measured using grams. **Weight** is a **measure of the force due to gravity** acting on a mass and is measured in newtons.

FORCE, SPEED, and VELOCITY

A **force** is a **push or pull**. Force is measured in newtons. Force can cause objects to move, stop moving, change speed, or change direction. **Speed** is the **change in position** of an object **per unit of time**. **Velocity** may have a positive or a negative value depending on the **direction of the change in position**, whereas speed always has a positive value and is non-directional.

Be familiar with the following formulas:
Speed = distance/time (s = d/t)
Force = mass × acceleration (F = ma)

WORK

Work is done when an object is moved through a distance in the direction of the applied force.

Is work being done?

Be familiar with the following formulas:

Work = force × distance (W = Fd)
Power = work/time (P = W/t)

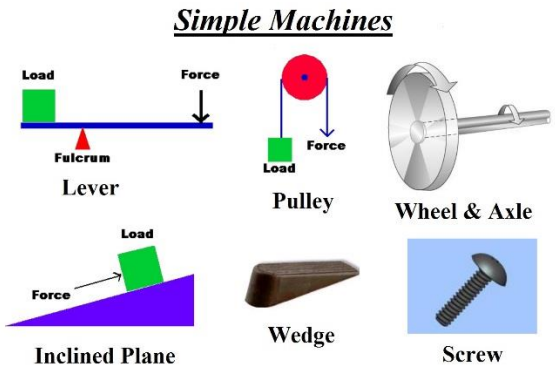
A **<u>simple machine</u>** is a device that **makes work easier**. While the output work of a simple machine can never be greater than the input work, a simple machine can multiply input forces OR multiply input distances. Simple machines have different purposes:

- To **change the effort** needed (**<u>mechanical advantage</u>**)

$$MA = \frac{f_{output}}{f_{input}}$$

- To change the direction or distance through which the force is applied
- To change the speed at which the resistance moves, or a combination of these.

Due to friction, the work put into a machine is always greater than the work output. The ratio of **work output to work input** is called **<u>efficiency</u>**.



RELEASED SOL QUESTIONS:

1. **Which is the result of using a more powerful motor to run an elevator? (2015)**
    a. The same amount of work is done in less time
    b. Less work is done in the same amount of time
    c. The same amount of time is needed to move the same distance
    d. A longer time is needed to move a shorter distance
2. **To complete a project, 200,000 Joules of work are needed. The time taken to complete the project is 20 seconds. How much power is needed? (2009)**

P = W/T

    a. 0.0001 J/s
    b. 10,000 J/s
    c. 200,020 J/s
    d. 1,000,000 J/s
3. **A car manufacturer reduces the mass of a car by 250 kg. If the new design is otherwise identical to the old design, how will the new car compare to the old car? (2009)**
    a. It will have a greater gravitational attraction to the road
    b. It will require more fuel to operate.
    c. It will need less force to move.
    d. It will release more gas emissions.

ELECTRICITY AND MAGNETISM

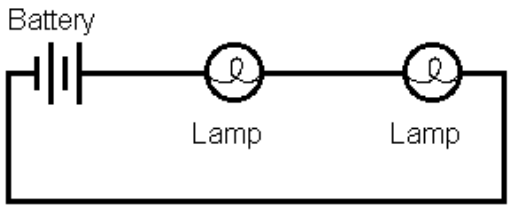
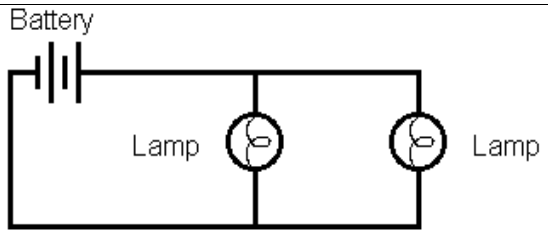
Several factors affect how much electricity can flow through a system. Resistance is a property of matter that affects the flow of electricity. Some substances have more resistance than others.

Conductors	Insulators	Semiconductors
• Transfers eletricty well • Copper, Silver, Aluminum, and Gold	• Does not transfer an electric current • Plastic, Wood, Paper, and Wax	• In-between a conductor and an insulator • The diode is a semiconductor device that acts like a one way valve to control the flow of electricity in electrical circuits. Solar cells are made of semiconductor diodes • Transistors are semiconductor devices made from silicon, and other semiconductors.

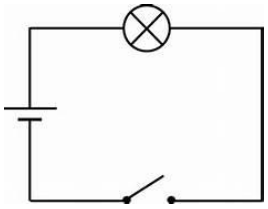
Friction can cause electrons to be transferred from one object to another. These static **electrical charges can build up on an object** and be discharged slowly or rapidly. This is often called **static electricity**. A **static charge** is formed **when two surfaces touch each other and the electrons move from one object to another**. One object will have a **positive charge and** the other a **negative charge**. Rubbing the items quickly, like when you rub a balloon fast over something or your feet on the carpet, will build up a large charge. Items with different charges (positive and negative) will attract, while items with similar charges (positive and positive) will push away from each other.

SOURCE: http://www.ducksters.com/science/static_electricity.php

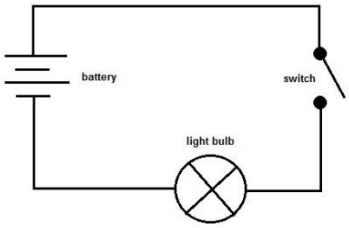
CIRCUITS

Series Circuit	Parallel Circuit
The bulbs are connected in such a way that an individual charge would pass through each one of the light bulbs	The light bulbs are placed within a separate branch line
Charge passes through every light bulb	A single charge passing through the external circuit would only pass through one of the light bulbs
As more and more light bulbs are added, the brightness of each bulb gradually decreases. This indicates that the current within the circuit is decreasing. (as more resistors are added the overall current within the circuit decreases.	As the number of resistors increases, the overall current also increases. This increase in current is consistent with a decrease in overall resistance.
If one of three bulbs in a series circuit is unscrewed from its socket, then it is observed that the other bulbs immediately go out.	If an individual bulb in a parallel branch is unscrewed from its socket, then there is still current in the overall circuit and current in the other branches.
	

Can you label a simple circuit?



Electricity is related to magnetism. Magnetic fields can produce electrical current in conductors. Electricity can produce a magnetic field and cause iron and steel objects to act like magnets.

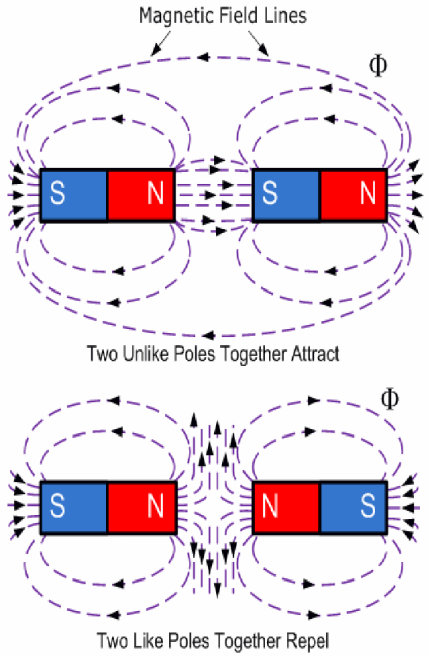


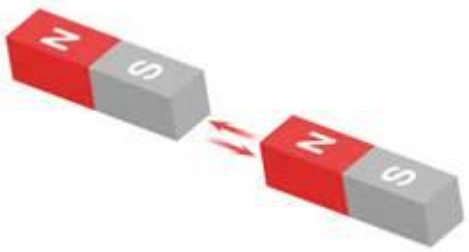
What is the relationship between voltage, resistance, and current in a simple circuit?

The relationship between **Voltage**, **Current** and **Resistance** forms the basis of Ohm's law. In a linear circuit of fixed resistance, if we increase the voltage, the current goes up. If we decrease the voltage, the current goes down. This means that if the voltage is high the current is high, and if the voltage is low the current is low. Current and voltage have a direct proportional relationship.

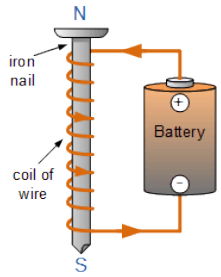
If we increase the resistance, the current goes down for a given voltage and if we decrease the resistance the current goes up. Which means that if resistance is high, current is low and if resistance is low current is high. Current and resistance have an inversely proportional relationship.

MAGNETISM





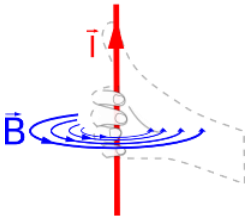
<u>Electromagnets</u> are **temporary magnets** that lose their magnetism when the electric current is removed.



When an electronic current flows through a wire, it generates a magnetic field. ***The magnetic field can be increased by coiling the wire***. This allows more current to flow through a smaller distance and increases the magnetic field.

Right-Hand Rule

When current is flowing through a wire, the magnetic field rotates around the wire. The direction of the current determines the direction of the magnetic field. You can figure out the direction of the magnetic field using the "right-hand rule".



Motors

One of the important applications of electromagnetism is the electric motor. An electric motor **converts electrical energy into physical movement (mechanical energy)**. Electric motors generate magnetic fields with electric current through a coil. The magnetic field then causes a force with a magnet that causes movement or spinning that runs the motor.

Generators

Electric generators convert mechanical energy into electrical energy using induction. As a coil of wire is spun between two opposite magnets, an electric current is generated that can be used to power electronic devices.

<u>SOL RELEASED QUESTIONS:</u>

1. **Which of the following is an example of static electricity? (2009)**
    a. A dry-cell battery connected to wires lights up a light bulb.
    b. A balloon sticks to a wall after it is rubbed with a piece of wool.
    c. A magnet sticks to a refrigerator door made of metal.
    d. A light switch that is turned on runs a ceiling fan.

2. **Laundry in a clothes dryer often becomes charged with static electricity while drying. Which of these best explains why a clothes dryer often generates static electricity? (2009)**
    - **a.** Short circuits in the dryer charge the laundry.
    - b. Clothes with metal pieces conduct electricity in the dryer.
    - c. Electrons are transferred as clothes rub against each other in the dryer.
    - d. Heat from the dryer charges the air and produces lightning.
3. **A group of campers travels to a cabin which has no electrical power. In order to provide the power for a heater and lights, which device would be appropriate?**
    - a. A resistor
    - b. An insulator
    - c. A generator
    - d. A voltmeter
4. **What change will most likely increase the strength of a magnetic field produced by an electromagnet?**
    - a. Reduce the number of turns of the coil
    - b. Switch the direction in which the battery is connected
    - c. Remove the iron nail
    - d. Add a battery