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To the Student

Comprehensive Science Assessment helps you prepare for your science tests by

- reviewing important science ideas
- recalling science vocabulary
- testing yourself
- practicing answering science questions

There are four kinds of pages in this book.

Lessons

- Lessons start with a question. The question tells you what you will read about in each lesson.
- Every lesson includes a picture, diagram, graph, or chart. These help you understand what you are reading.
- Each lesson ends with *Show What You Know*. Questions and activities in this part of the lesson help you review important science concepts.

Tests

Each test includes two kinds of questions—multiple-choice and short-response. Taking these tests helps you know what you have learned.

Test Answer Guides

There is a Test Answer Guide for each test in your book. It explains the correct answer for each item on the test.

Practice Test

At the back of your book, you will find a full-length practice test. Just like the other tests in your book, this test includes two kinds of questions—multiple-choice and short-response.

Cells

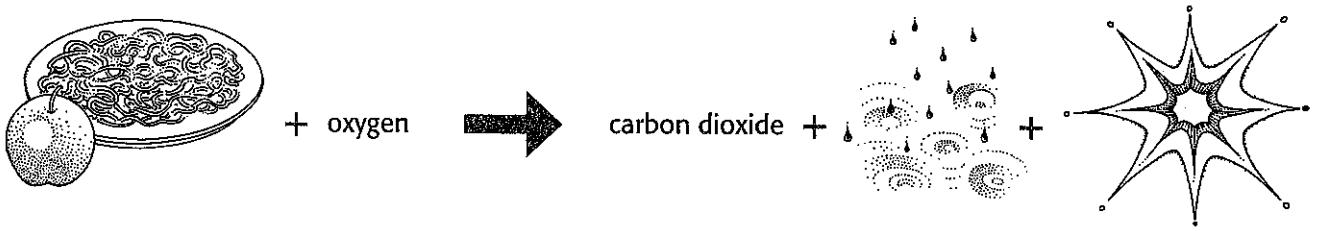
What are cells?

Living things are called **organisms.** Oak trees, cats and dogs, seaweeds, and bacteria are common examples of organisms. All organisms are made of cells. A **cell** is the smallest part of an organism that is alive. Cells have structure and function. A cell's **structure** is the way it is organized to do specific jobs. The jobs that a cell does to survive are its **functions.**

Cells in most organisms have many functions. They take in food and get rid of waste materials. They make new cells for growth, and they repair old cells. They release energy stored in food and use that energy to power all of their functions. Almost all cells get energy through **cellular respiration.** In cellular respiration, sugars in food are broken down and combined with oxygen. In the process, carbon dioxide and water are made and energy is released.

Most cells cannot be seen without a microscope because they are very small. In fact, cells were unknown until microscopes were invented in the 1600s. Once cells were discovered, scientists found them in all living things.

Cellular Respiration



Cells use oxygen to release the energy stored in sugars.

Show What You Know

1. List three functions of cells.

_____, _____, _____

2. Why didn't scientists know cells existed before microscopes were invented?

_____

LESSON 2

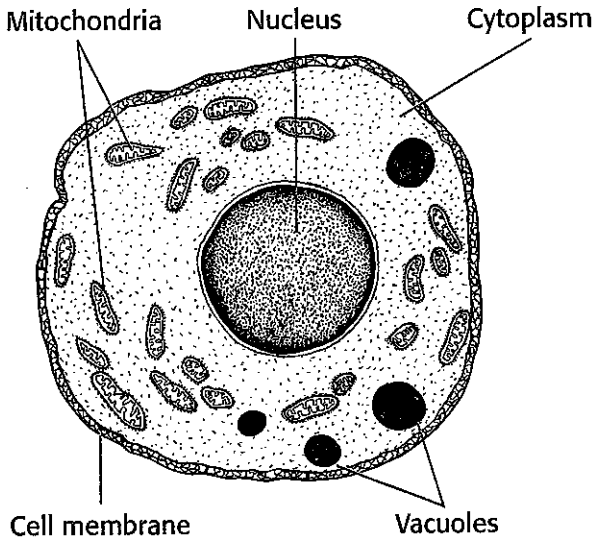
Animal Cells

What is inside an animal cell?

Almost all cells contain structures called **organelles.** Each organelle has a particular job to do that helps the cell survive. Some organelles are found in all cells. Others are found only in certain cells.

There are three cell parts found in almost all cells except bacteria. They are the cell membrane, cytoplasm, and the nucleus. A flexible **cell membrane** surrounds the cell and controls what goes in and out. **Cytoplasm** is the jellylike material that fills the cell and contains many chemicals that the cell needs. The **nucleus** is a large organelle that contains the cell's **chromosomes,** which are made of **DNA.** DNA tells the cell how to do its jobs. It also determines the characteristics of the entire organism.

Most animal cells contain mitochondria and vacuoles. Cellular respiration takes place in **mitochondria. Vacuoles** store material that has just entered the cell or wastes waiting to exit.



Show What You Know

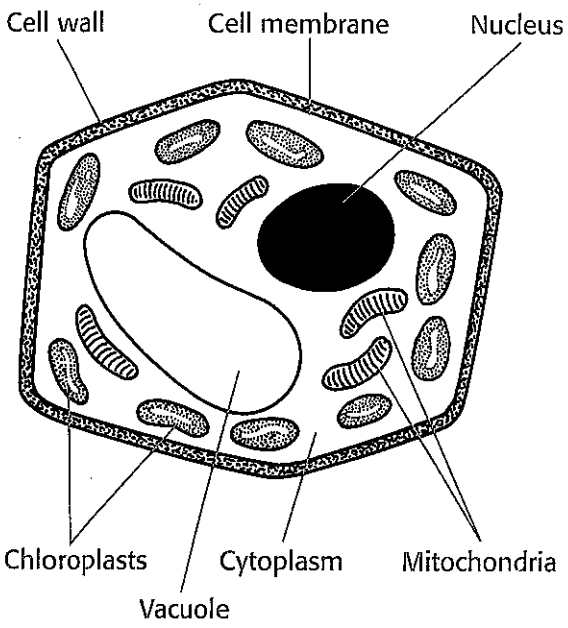
Complete the chart to identify the cell parts found in an animal cell.

Cell Part	Function
	Controls cell functions
	Holds cell together, controls what goes into and out of cell
	Holds organelles, contains dissolved chemicals the cell needs
	Where cellular respiration happens
	Stores food, water, and wastes

Plant Cells

What makes a plant cell different from an animal cell?

Plants are made of cells, too. Plant cells have a nucleus, a cell membrane, cytoplasm, and mitochondria. They also have vacuoles, but plant cell vacuoles are much larger than animal cell vacuoles. Instead of having many small vacuoles, a plant cell may have only one or two large ones.



Plant cells have two organelles that animal cells do not have. **Chloroplasts** are the organelles that make food for the plant. Chloroplasts contain **chlorophyll,** which captures the energy in sunlight. The energy is used to combine carbon dioxide and water to form sugars. This process is called **photosynthesis.** The sugars then travel to the mitochondria. There, they are broken down during cellular respiration. Stored energy is released, and the rest of the cell uses it for its many functions.

A **cell wall** is a rigid outer covering of a plant cell. It protects the cell and gives it support. If a plant is to grow as tall as a tree, it needs support from the stiff walls of its cells.

Show What You Know

Explain how chloroplasts and mitochondria work together in a plant cell.

Multiple Choice

Fill in the letter to show your answer.

1. **During cellular respiration, cells produce a waste product called**

   (A) sugar.

   (B) oxygen.

   (C) carbon dioxide.

   (D) nitrogen.

2. **A cell that requires large amounts of energy to do its job would probably contain many**

   (A) chloroplasts.

   (B) nuclei.

   (C) vacuoles.

   (D) mitochondria.

3. **The plant organ in which photosynthesis usually takes place is the**

   (A) leaf.

   (B) chloroplast.

   (C) root.

   (D) flower.

4. **The human heart contains three kinds of tissue. The heart is**

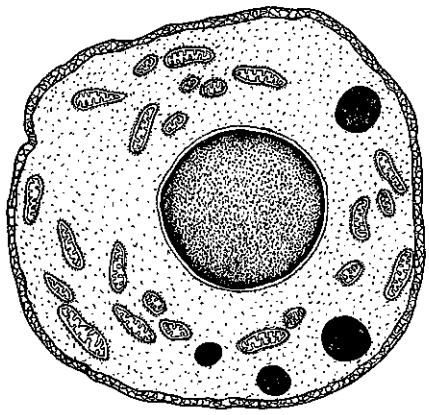
   (A) a tissue.

   (B) an organ.

   (C) an organ system.

   (D) an organelle.

5. Which life function would this cell not be able to perform?



Ⓐ cellular respiration

Ⓑ photosynthesis

Ⓒ food storage

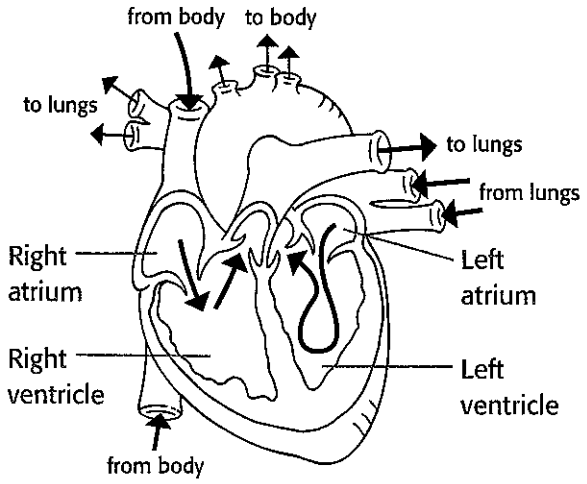
Ⓓ energy production

Short Response

6. Explain what would happen to a plant if the phloem tubes but not the xylem tubes in its stem were cut. Then explain what would happen if the xylem tubes but not the phloem tubes in its stem were cut.

The Circulatory System

What are the organs of the circulatory system?



The heart is the main organ of the circulatory system.

The **circulatory system** transports materials through the body. Its organs include the heart and blood vessels.

The human heart has four chambers. There are two **atriums,** or atria, and two **ventricles.** The right atrium receives blood containing wastes from body cells. This oxygen-poor blood goes to the right ventricle, which pumps it to the lungs. In the lungs, wastes are removed and oxygen is picked up. Oxygen-rich blood goes to the left atrium, then to the left ventricle. The left ventricle pumps it to all body parts.

Blood vessels called **arteries** carry blood away from the heart. The smallest arteries lead to tiny **capillaries**. In the capillaries, oxygen is dropped off and carbon dioxide is picked up at cells. **Veins** carry blood back to the heart, where it is pumped to the lungs.

Blood is a tissue. It contains blood cells and platelets floating in a liquid called **plasma.** Plasma carries nutrients and wastes. **Red blood cells** carry oxygen from the lungs to cells and carbon dioxide from cells to the lungs. **White blood cells** fight germs that cause disease. **Platelets,** tiny pieces of cells, repair blood vessels and help blood clot.

Show What You Know

Complete the chart listing the parts of the blood and their functions.

Part of the Blood	Function
Plasma	
	Repair blood vessels, help blood clot
Red blood cells	
	Fight germs that cause disease

LESSON 8

The Respiratory System

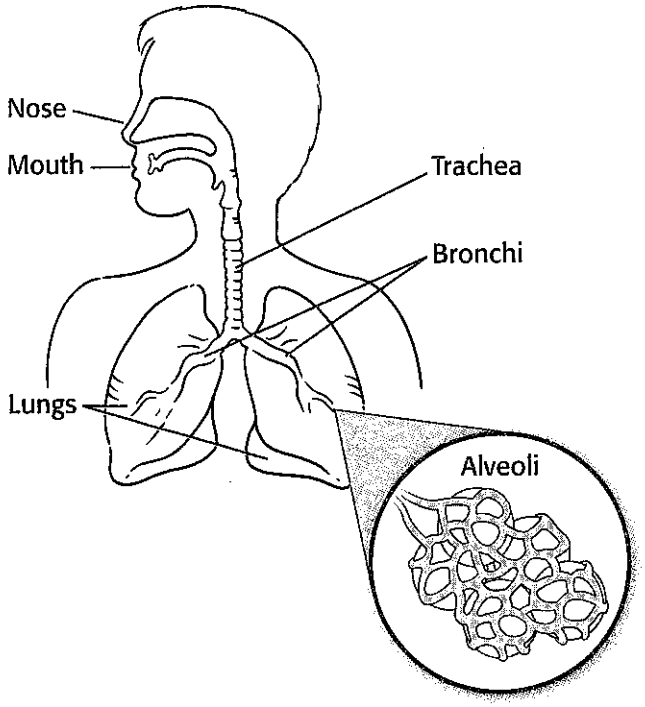
How does the respiratory system work with the circulatory system?

When you inhale, air enters your **respiratory system** through your nose and mouth. It then moves though the **trachea,** or windpipe. The trachea divides into two tubes called **bronchi,** and each tube leads into a lung. In the lungs, the bronchi branch into smaller and smaller tubes. These tubes end in tiny air sacs called **alveoli** (singular alveolus). The walls of the alveoli are only one cell thick and are surrounded by capillaries.

In the alveoli, the respiratory system works with the circulatory system. Blood in the capillaries contains carbon dioxide and water formed during cellular respiration in the body cells. These gases pass through the alveoli walls into the lungs. Oxygen in the lungs passes through the walls into the blood.

Once in the lungs, carbon dioxide and water follow the path of oxygen but in the opposite direction. They are released into the air when you exhale, or breathe out. The oxygen is carried by the red blood cells back to the heart and then to the body cells.

The **diaphragm** is a dome-shaped muscle that forms the bottom of your chest. When the diaphragm contracts, it moves downward. Air is pulled into your lungs, and you inhale. When the diaphragm relaxes, it moves upward. Air is pushed out of the lungs, and you exhale.



Oxygen is exchanged with carbon dioxide and water in the alveoli of the lungs.

Show What You Know

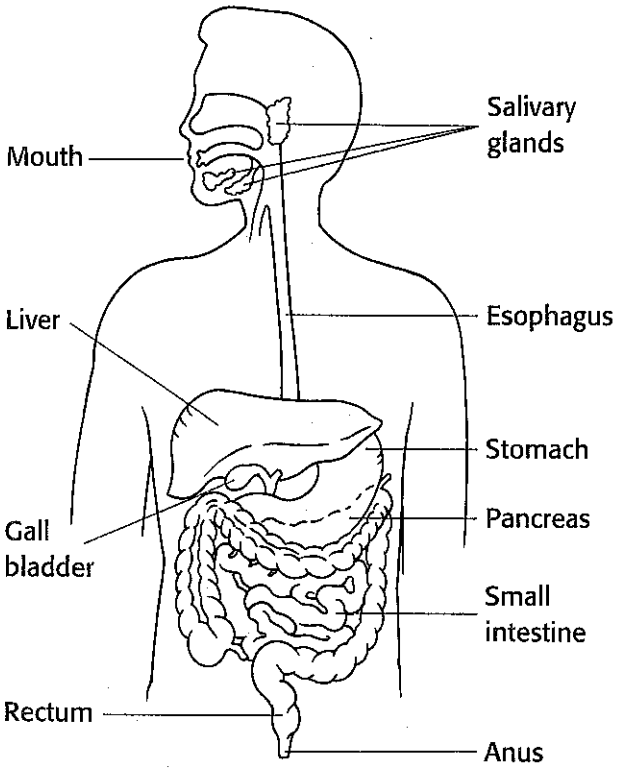
Rearrange the following terms to trace the path of oxygen from outside the body to the body cells: alveoli, body cells, trachea, nose and mouth, lung, capillaries, bronchi, red blood cells.

_____

_____

The Digestive System

How does digestion occur?



Digestive system

The **digestive system** changes food particles into nutrients that body cells can use. Food is ground up into tiny pieces and broken down by chemicals.

Digestion starts in the mouth. The teeth grind food into pieces small enough to swallow. **Salivary glands** in the mouth make saliva, which contains a chemical that starts to break down food. The tongue mixes the saliva and food.

From the mouth, food passes through the **esophagus.** Muscles in the esophagus push the food into the stomach. In the stomach, more chemicals break down the food further. Muscles in the stomach stir the food.

The partly digested food then moves into the **small intestine**. The liver makes a chemical called **bile.** Bile is stored in the gall bladder, which sends it to the small intestine. Chemicals from the pancreas and small intestine are added. Everything is mixed together with the food, and digestion is completed.

The inside walls of the small intestine are covered with finger-shaped villi. **Villi** absorb nutrients formed during digestion through their walls and into the blood. Blood transports them to body cells, where energy in the nutrients is released during cellular respiration.

The parts of food that cannot be digested move into the **large intestine,** where water is removed. What remains is solid waste that is stored in the rectum until it leaves the body.

Show What You Know

List two ways that food is changed in the digestive system.

1. _____

2. _____

LESSON 10

The Excretory System

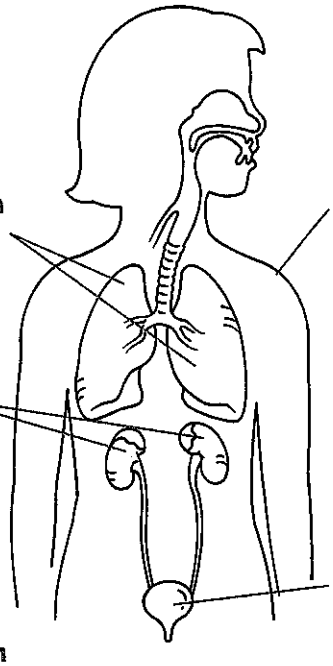
How does the body get rid of waste materials?

The **excretory system** has several parts: the lungs, skin, and the urinary system. Each part gets rid of certain wastes produced by body cells.

Kidneys are the main waste-removing organs of your **urinary system.** As blood flows through your two kidneys, tiny filters remove extra water, salts, and harmful wastes. Clean blood leaves the kidneys and returns to the body. A yellow liquid called **urine** flows from each kidney into the **bladder.** Urine is stored in this baglike organ until it can leave the body.

Another part of the excretory system is the **skin.** Extra water, salt, and other wastes exit the body as sweat, or perspiration. **Sweat** is produced by sweat glands in the skin. They release sweat through tiny pores, or openings, in the skin's surface. When the sweat on your skin evaporates, your body is cooled. This is how your body gets rid of extra heat.

Although the lungs are part of the respiratory system, they also remove wastes. The carbon dioxide and water made during cellular respiration leave the body through the lungs when you exhale.



The excretory system

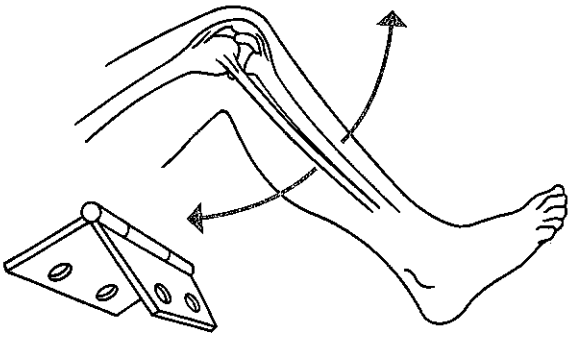
Show What You Know

Use terms from above to fill in the blanks.

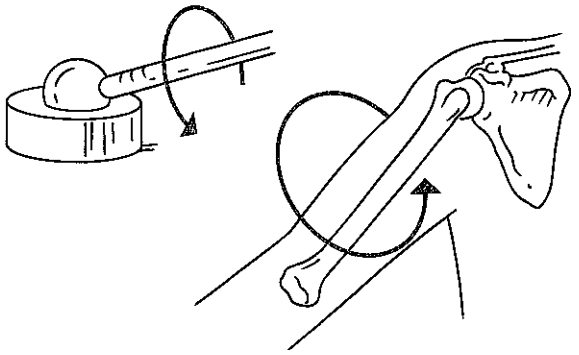
1. Carbon dioxide is removed from the blood by the _____.
2. Urine is produced in the _____.
3. The body is cooled when _____ is released from the skin's surface.

Bones and Muscles

How do the skeletal and the muscular systems work together?



Hinge joints in your knee and elbow allow back-and-forth motion.



Ball-and-socket joints in your shoulders and hips allow your arms and legs to move in a circle.

The **skeletal system** supports your body, gives it shape, and protects organs. It is made of bones and cartilage. **Bones** are strong and hard. **Cartilage** is the tough and flexible tissue that forms your outer ear and tip of your nose. It also covers and protects the ends of bones.

Bones meet at **joints.** Different kinds of joints allow different kinds of movements.

Ligaments are bands of connective tissue that hold the skeleton together. They attach bones to one another at joints. Bones are also attached to muscles. On each side of a joint, **tendons** connect muscles to bones. Bones work with muscles to make your body move.

The **muscular system** has three kinds of muscles: voluntary, smooth, and cardiac muscles. **Voluntary muscles** are also called skeletal muscles because they are attached to bones. These muscles work with bones to hold up your skeleton and move your body.

Smooth muscle is found in many of your organs. Your diaphragm is made of smooth muscle. So are the walls of organs of the digestive system. You cannot control smooth muscle.

Cardiac muscle is found only in the walls of the heart. You cannot control cardiac muscle. When it contracts, your heart beats and pumps blood to the body.

Show What You Know

Explain the difference between a tendon and a ligament.

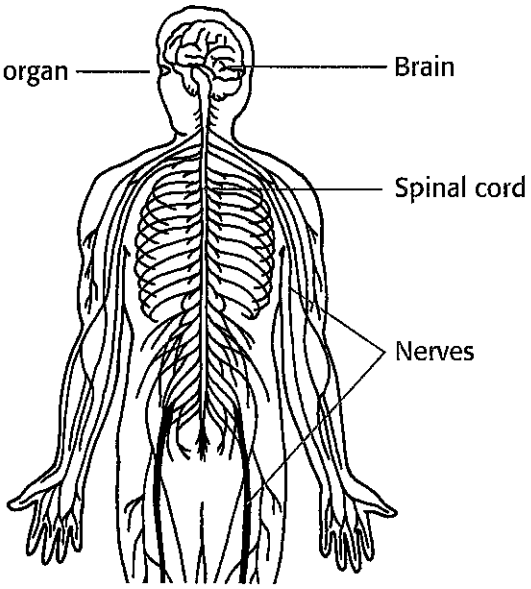
_____

_____

LESSON 12

The Nervous System

How does the nervous system control the body's activities?



The nervous system includes the brain, spinal cord, sense organs, and body nerves.

The nervous system connects all the tissues and organs in your body to your brain. The basic unit of the nervous system is the **neuron,** or nerve cell. Neurons are specialized cells that can send and receive signals. A **nerve** is a bundle of neurons. In a nerve, signals move from one neuron to another.

The central nervous system consists of the brain and the spinal cord. The rest of the nervous system includes the sense organs—such as the eyes and ears—and many body nerves.

Nerves carry signals about the body's environment from the sense organs to the spinal cord. The **spinal cord** is a long bundle of nerves that runs from the brain down your back. From the spinal cord, the signals are sent to the body's control center, the brain. The **brain** interprets the information in the signals and sends out reply signals to the spinal cord. Other nerves then carry the signals to the correct body parts, telling them how to react.

A **reflex** is a reaction that is not controlled by the brain. If you touch a hot stove, the nerves in your fingers send out a signal. In the spinal cord, the signal is relayed to the brain and also to a nerve that controls the muscles in your arm. Before your brain gets the signal, you have pulled your hand away.

Show What You Know

Explain why a reflex happens so quickly.

_____

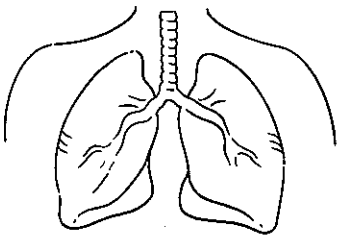
_____

_____

Multiple Choice

Fill in the letter to show your answer.

1. **The organ shown in the diagram is part of the**



   (A) digestive system.
   (B) circulatory system.
   (C) nervous system.
   (D) respiratory system.

2. **Nutrients move from the small intestine to the blood through the walls of the**

   (A) alveoli.
   (B) bronchi.
   (C) villi.
   (D) platelets.

3. **The function of red blood cells is to**

   (A) fight disease-causing germs.
   (B) transport gases.
   (C) transport nutrients.
   (D) help clot blood.

4. **Kidneys help the body by**

   (A) removing extra body heat.
   (B) removing carbon dioxide.
   (C) absorbing waste through the walls of villi.
   (D) filtering wastes from blood.

5. The muscle that contracts and relaxes so that you can breathe is the

(A) bronchi.

(B) alveolus.

(C) trachea.

(D) diaphragm.

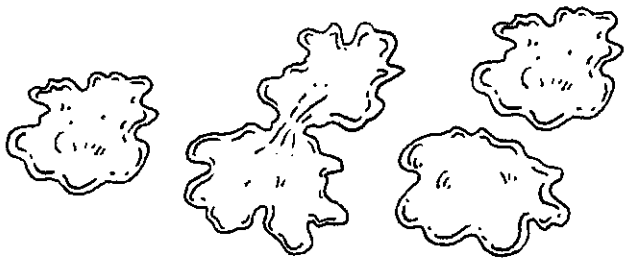
6. The cells of cardiac muscle tissue contain huge numbers of mitochondria. Explain why this is necessary.

7. How do the circulatory and respiratory systems work together to keep your body functioning?

Growth and Reproduction

How do organisms grow and produce young?

All organisms **reproduce**, or make more organisms of the same kind. The new organisms are called **offspring.**



Single-celled organisms divide in half to reproduce.

Most offspring must grow and develop into adults before they can reproduce. Many organisms get larger as they grow. **Growth** occurs when the cells of an organism's body divide to make more cells. **Development** describes the changes that take place in an organism as it grows. For example, a newborn kitten cannot see or walk. After about two weeks of growth, the kitten can see and walk.

Plants reproduce in many different ways. Most plants produce seeds. A **seed** contains a young plant and a food supply, which will feed the young plant until it can make its own food. Some plants, such as mosses and ferns, reproduce by forming spores. **Spores** contain a single cell that can grow into a new plant.

Different kinds of animals reproduce in different ways. Most mammals produce live young. Most birds, reptiles, amphibians, fish, and insects reproduce by forming eggs that hatch outside the body of the parent.

Birds lay eggs with hard shells. Reptile eggs have leathery shells. Fish and amphibians lay eggs without shells. These animals lay eggs in water.

Show What You Know

Match each term to the phrase that best describes it.

1. _____ Reproduction	**a.** plant reproduction
2. _____ Development	**b.** animal reproduction
3. _____ Growth	**c.** making more organisms
4. _____ Offspring	**d.** new organisms
5. _____ Spores	**e.** cell division
6. _____ Eggs	**f.** changes during growth

LESSON 16

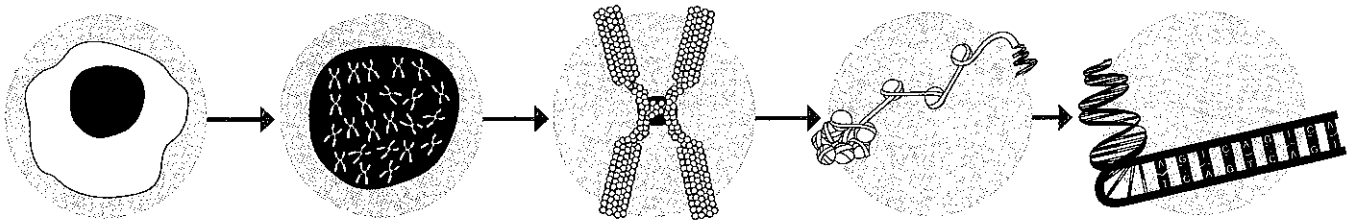
Inherited and Learned Traits

Why are offspring similar to their parents?

Offspring share many of their parents' characteristics. For example, you may have the same eye or hair color as one of your parents. A characteristic that a parent organism passes to its offspring is called an **inherited trait.** Other inherited traits include a plant's leaf shape and flower color, the shape and color of a bird's bill, and the length of a monkey's tail.

You inherited traits from your parents, who inherited those traits from their parents. Inherited traits are passed from parent to offspring, generation after generation.

Learned traits are behaviors that animal offspring learn by observing their parents or other animals. For example, kittens learn to hunt by watching their mother hunt. Birds learn to sing by imitating their parents. Children learn to ride a bike, read, and write. Learned traits are not inherited.



Genes contain the DNA code for each of an organism's inherited traits. Genes are found on chromosomes.

Show What You Know

Identify the following traits as inherited or learned.

1. _____ The shape of a woodpecker's beak
2. _____ A wolf's ability to hunt for food
3. _____ A person's ability to plant and harvest crops for food
4. _____ The number and shape of teeth in a horse's mouth
5. _____ A cow's ability to produce milk

Survival

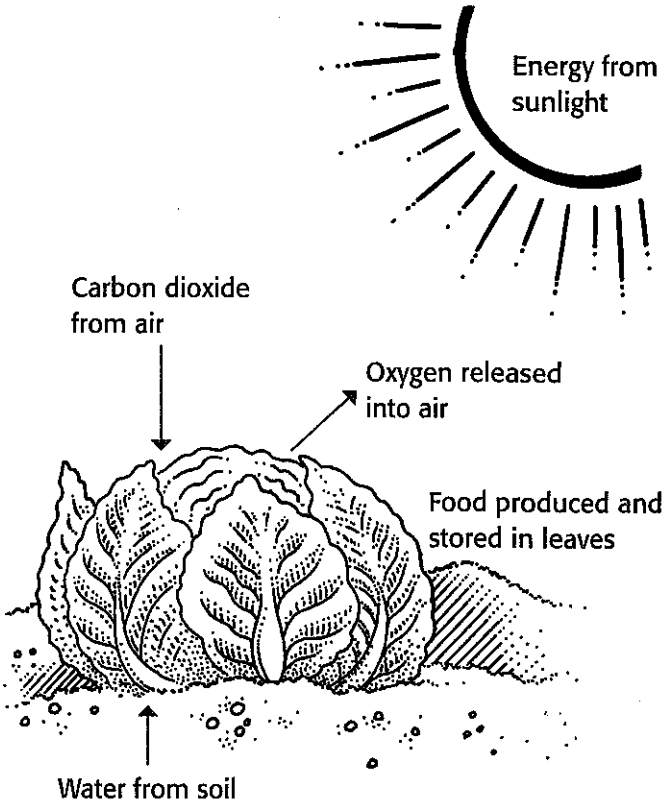
What do organisms need to stay alive?

To stay alive, all organisms need energy and nutrients in the form of food. Organisms also need water and shelter, and most organisms need oxygen.

Most of the energy used by living organisms comes from the sun. Plants trap energy from sunlight and use it to make food. **Food** contains energy and nutrients needed for life. Some animals get food by eating plants, and some get food by eating other animals. Most organisms also need **oxygen** to release the energy stored in food.

Water is necessary for all life. Nutrients and other important substances cannot be used by cells unless they are dissolved in water. The bodies of all organisms contain more water than any other substance.

Shelter protects organisms from harsh weather conditions. Shelter also provides organisms with a place to hide from danger.



In photosynthesis, carbon dioxide, water, and energy from sunlight are combined to produce energy-rich food. Photosynthesis also releases oxygen into the air.

Show What You Know

How does photosynthesis affect the lives of animals?

_____

_____

_____

LESSON 18

Adaptations

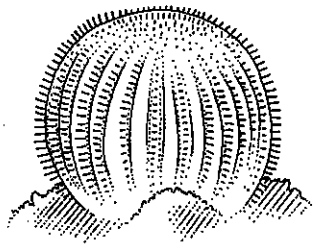
How do body structures and behaviors help organisms stay alive?

Any characteristic that helps an animal stay alive in its environment is called an **adaptation**. Adaptations help an animal live to adulthood and raise young.

Body parts are **physical adaptations** that help an animal survive. For example, seals have a thick layer of fat, called blubber, which helps them stay warm in very cold environments. Some adaptations help animals obtain food. Hawks have sharp claws, called talons, for grasping prey. Barn owls have sensitive ears that help them find prey. Frogs have long, sticky tongues for capturing insects. Cattle have large, flat teeth for chewing grasses.

Behavioral adaptations are ways in which organisms act in response to their environment. Some behavioral adaptations are learned, and some are instinctive. A **learned adaptation** is taught to the young by the parents. For example, seals and whales learn how to hunt for food from their parents.

An **instinctive adaptation** does not have to be learned. An **instinct** is a behavior an animal is born with. Bears instinctively build dens for hibernation. **Hibernation** is a sleeplike state that helps the bear survive during periods of very cold weather when food is scarce. Rabbits instinctively use their long hind legs to run away from a fox or other **predator**.



The thick stems of a cactus can store water during dry periods. The spines discourage animals from eating the plant.

Show What You Know

1. Describe a physical adaptation that helps a frog avoid being caught by a hungry bird.

_____

_____

2. The leaves of plants always grow toward sunlight. How does this behavioral adaptation help keep the plant alive?

_____

_____

Multiple Choice

Fill in the letter to show your answer.

1. **The process by which organisms make more organisms of the same kind is called**

   Ⓐ growth.

   Ⓑ development.

   Ⓒ reproduction.

   Ⓓ offspring.

2. **The part of a flower that develops into a fruit that contains seeds is the**

   Ⓐ ovary.

   Ⓑ stigma.

   Ⓒ stamen.

   Ⓓ pollen.

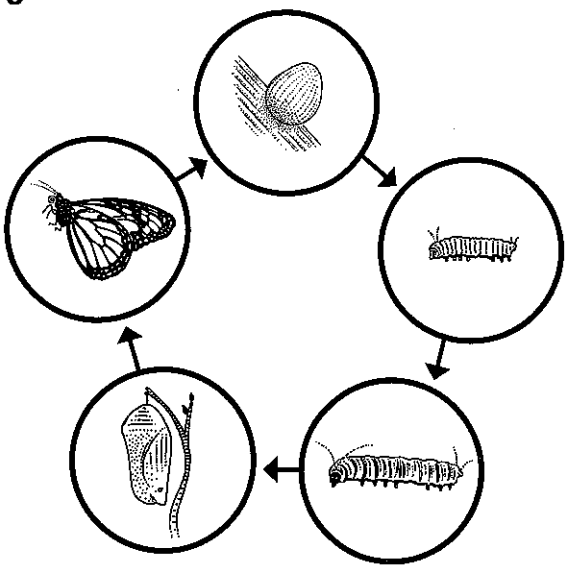
3. **At which stage of its life cycle is a butterfly able to produce offspring?**

   Ⓐ pupa

   Ⓑ adult

   Ⓒ egg

   Ⓓ larva



LIFE SCIENCE TEST C

4. **Inherited traits are passed from parents to offspring through**

   (A) vacuoles.

   (B) genes.

   (C) observing the parents.

   (D) the cytoplasm.

5. **To stay alive, all organisms need**

   (A) energy.

   (B) carbon dioxide.

   (C) sunlight.

   (D) seeds.

6. **Name one physical adaptation of an animal and explain how it helps the animal survive in its environment.**

_____

_____

_____

7. **How are learned and instinctive adaptations alike? How are they different?**

_____

_____

_____

_____

_____

Ecosystems

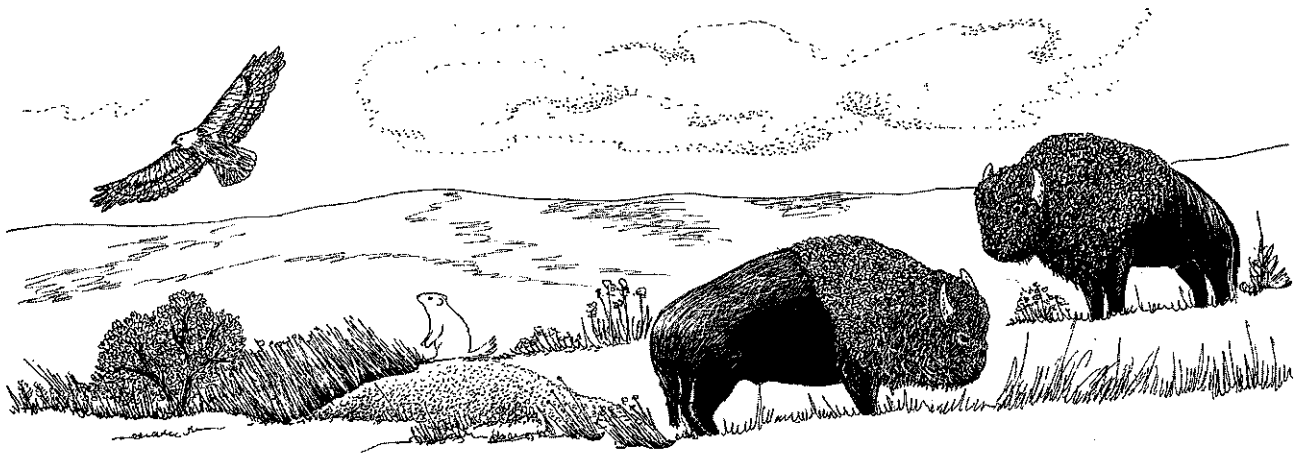
What is an ecosystem?

An **ecosystem** is the living and nonliving parts of the environment in a particular area. Living parts include all the organisms in an ecosystem, and any materials that come from them, such as wastes. The nonliving parts include water, air, soil, and sunlight. The study of how the living and nonliving parts of ecosystems work together is called **ecology.**

In an ecosystem, a **species** is a group of organisms that can mate to produce offspring like themselves. A **population** is all the members of a species that live together in the same place at the same time. A **community** is all the populations living in the same ecosystem at the same time.

There are many kinds of ecosystems on Earth. **Terrestrial ecosystems** are found on land. Forests, deserts, and grasslands are terrestrial ecosystems. **Freshwater ecosystems** include lakes, ponds, rivers, streams, marshes, and swamps. **Saltwater** ecosystems, such as coral reefs and kelp forests, are found in Earth's oceans.

A Grassland Ecosystem



Show What You Know

1. List three nonliving parts of the ecosystem shown in the drawing above.

_____, _____, _____

2. List three living parts of the ecosystem shown in the drawing above.

_____, _____, _____

LESSON 20

Habitats and Niches

How do organisms live together in an ecosystem?

The place where an organism lives is its **habitat.** Trees provide a habitat for squirrels and birds. Soil is a habitat for trees and earthworms. Every ecosystem on Earth contains many different habitats.

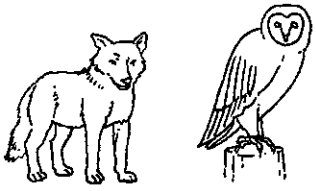
A **niche** is an organism's job. It includes the food it eats, the way it finds food, the way it finds or builds shelter, and the way it affects its environment. Squirrels build nests in trees and bury nuts in the ground for future meals. Buried nuts that are forgotten may sprout and grow into more trees, adding to the forest. Earthworms eat dead leaves and produce waste materials that enrich the soil. Many different species can share the same habitat, as long as each species has a different niche.

Producers are organisms that make their own food. They include plants, algae, and some single-celled organisms. Most producers make food through photosynthesis. Organisms that cannot make their own food depend on producers for the energy they need to live.

Consumers get energy by eating other organisms. Consumers cannot make their own food. Most animals are consumers. **Decomposers** get energy by breaking down, or decomposing, the remains of dead organisms. Bacteria and fungi are decomposers. Many decomposers are single-celled organisms.

Types of Consumers

Herbivores eat only plants.



Carnivores eat only or mostly animals.

Omnivores eat plants and animals.

Show What You Know

Write whether each organism is a producer, consumer, or decomposer.

1. _____ bacterium
2. _____ apple tree
3. _____ dog
4. _____ bird
5. _____ grass
6. _____ mushroom

Food Chains and Webs

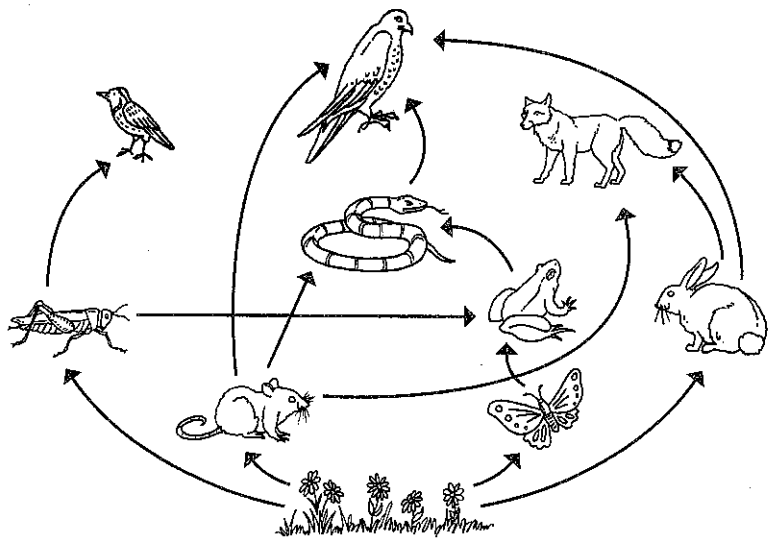
How does energy move through an ecosystem?

All organisms need energy to live. Energy is stored in food. A **food chain** shows how food energy moves from one organism to another in a community. In one food chain, a grass plant uses energy from sunlight to produce seeds. A mouse gets energy by eating the seeds. A hawk gets energy by eating the mouse. Each organism acts as the energy source for the next organism in the food chain. The first link in a food chain is always a producer.

A simple food chain shows only some of the ways organisms in a community depend on each other for food. Most animals depend on more than one source of food. A **food web** is a network of food chains that gives a more complete picture of how food energy moves through a community.

Removing one organism from a food web affects other organisms. If a species disappears, the populations that depend on it have more difficulty finding food and their population decreases. At the same time, any population that the missing species feeds on increases, because fewer individuals are eaten.

Grassland Food Web



Show What You Know

Use the diagram above to answer these questions.

1. Which organisms depend on rabbits for food?

_____

2. What would happen to the butterfly population if frogs disappeared?

_____

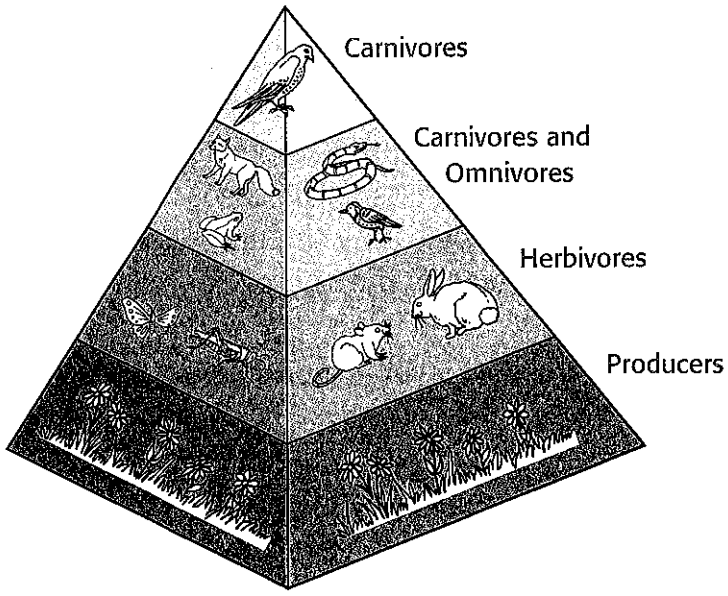
LESSON 22

The Energy Pyramid

How much energy passes from one level of a food web to another?

A food web starts with energy captured from the sun by producers. Some of this energy is used by the producers to live and grow. Only part of the energy captured by the producers is transferred to the herbivores on the next level of the food web. The herbivores use some of that energy, and some is transferred to consumers on the next level.

An **energy pyramid** shows how much energy is available to organisms at each level of a food web. Some energy is used up by the organisms at each level on the pyramid. As a result, less and less energy is available as you go higher up the energy pyramid. Energy pyramids usually have only three or four levels. Not enough energy is available to support more than five levels in any energy pyramid.



Only some of the energy from each level of an energy pyramid is transferred to the next higher level.

Show What You Know

1. Which level of an energy pyramid contains the least amount of energy?

_____

2. Why does the producer level of an energy pyramid contain the most energy?

_____

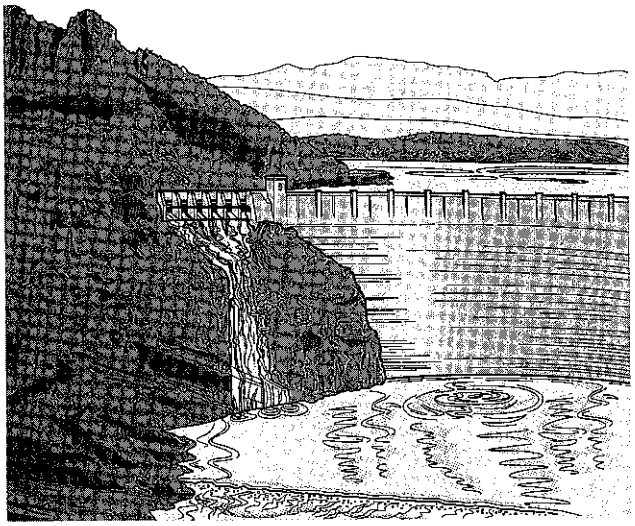
_____

_____

LESSON 24

Changes in Ecosystems

How can ecosystems change over time?



Dams built across rivers usually flood large areas of land behind them. Plants and animals that once lived there die or leave.

Ecosystems are constantly changing. Changes to an ecosystem may mean that organisms have to find new homes if they are to survive.

Natural changes to an ecosystem include changes in temperature, rainfall, or soil conditions. These changes can affect plant and animal populations living in the ecosystem. If conditions change enough, plants may no longer be able to grow in the ecosystem. Animals that depend on those plants for food are then forced to leave the ecosystem or die.

Some natural changes to ecosystems occur rapidly and are very destructive. Volcanic eruptions, floods, fires, hurricanes, tornadoes, droughts, and landslides can suddenly change or even destroy whole ecosystems. Once conditions return to normal, plants and animals may return to the area, creating new ecosystems.

Human activities can also affect ecosystems. During mining and construction, land is often stripped of its plant life. The exposed soil is easily eroded, and soon the land is no longer suitable for plant growth. Pollution from human activities can also damage an ecosystem, making it unusable by plants and animals.

Show What You Know

1. Name three natural changes to ecosystems.

_____, _____, _____

2. Name three human changes to ecosystems.

_____, _____, _____

Extinction

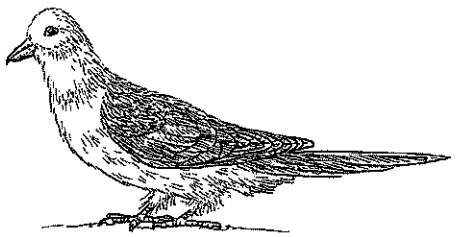
How do organisms become extinct?

Changes to ecosystems can cause a species to become extinct, or die out. **Extinction** is the loss of the last member of a species. It is a natural process that has occurred throughout the history of life on Earth. But human activities in the last 200 years have greatly increased the rate of extinction.

Today, **loss of habitat** causes most extinctions. For example, grizzly bears are in danger of becoming extinct because a growing human population has taken over much of their hunting territory. **Overhunting** is another cause of extinction. Up until the early part of the 20th century, billions of passenger pigeons lived in the forests of North America. But overhunting by American settlers drove the species to extinction.

An **introduced species**, or species brought into an ecosystem from another part of the world, can also cause extinctions. Often, an introduced species has no natural enemies. As a result, its population grows so large that it crowds out other species.

Climate change can cause extinction, too. Evidence shows that the dinosaurs may have become extinct after a giant asteroid fell to Earth, sending huge clouds of dust into the atmosphere. The dust blocked sunlight, creating cooler conditions in which dinosaurs and other species could not survive. Over time, Earth has experienced several ice ages, when large land surfaces were covered by ice, snow, and glaciers. Many species became extinct with the coming of each ice age.



Martha, the last passenger pigeon, died in 1914.

Show What You Know

Name four causes of extinction.

1. _____

2. _____

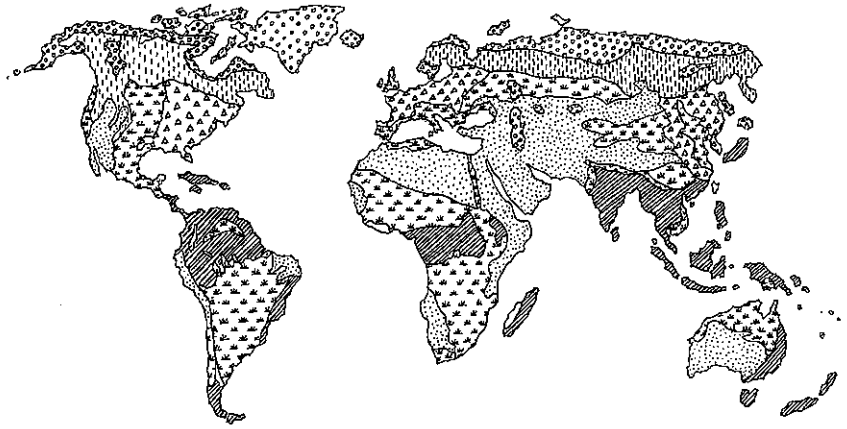
3. _____

4. _____

LESSON 26

Biomes

What are the characteristics of Earth's climate zones?



Some of Earth's Biomes

- Tropical rainforest
- Deciduous forest
- Desert
- Grassland
- Taiga
- Tundra

Ecosystems that have similar characteristics can be grouped together into **biomes**. Earth has several land biomes. Each land biome is associated with its own climate conditions.

Tropical rainforests are warm regions with heavy rainfall. Most rainforest life is found in the trees. Rainforest species include monkeys, sloths, orchids, and parrots.

Deciduous forests receive less rainfall than rainforests, and have warm and cold seasons. These forests contain trees such as maple and oak, which lose their leaves in winter. Animal species include woodpeckers, skunks, and deer.

Grasslands receive less rainfall than forests. They are covered with small plants that can survive periods of drought and hot summer weather. Grassland species in North America include prairie dogs, elk, and buffalo. African grassland species include gazelles and zebras.

Deserts receive very little rain and much of the soil is bare. Desert plants include cacti and hardy shrubs and trees. Desert animals include scorpions, coyotes, and roadrunners.

Taiga is forested land covered with evergreen trees, such as pine, fir, and spruce. The taiga is found in land areas not far below the North Pole. Animal species include lynx, hares, and reindeer.

Tundra is a cold, snowy region that circles the North Pole and has few trees. Only the top layer of soil thaws out during warmer months. Underneath is a layer of soil called **permafrost** that remains frozen all year round. Tundra animals include lemmings, snowy owls, and arctic foxes.

Show What You Know

On the map above, write the name of one plant or one animal found in each biome.

LIFE SCIENCE TEST D

Multiple Choice

Fill in the letter to show your answer.

1. **The organisms responsible for changing nitrogen gas into solid nitrogen compounds are**

   (A) plants.

   (B) animals.

   (C) fungi.

   (D) bacteria.

2. **Carbon dioxide is *not* released into the atmosphere during**

   (A) respiration.

   (B) burning of fossil fuels.

   (C) photosynthesis.

   (D) decomposition.

3. **A taiga is**

   (A) a forested biome near the North Pole.

   (B) a warm region with heavy rainfall.

   (C) a cold, snowy region that circles the North Pole.

   (D) a region with little rain and bare soil.

Short Response

4. **Explain the difference between a habitat and a niche.**

_____

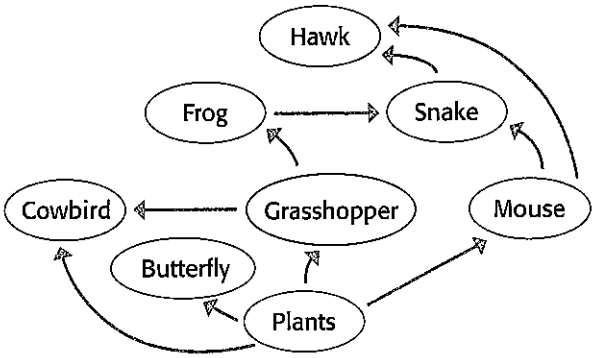
_____

_____

_____

LIFE SCIENCE TEST D

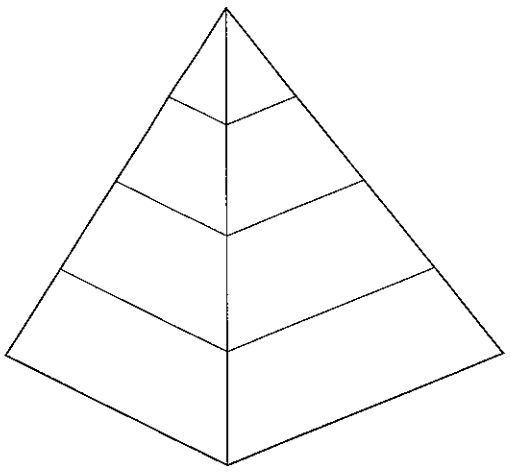
Use the drawing to answer Items 5-7.



5. **What would happen to the grasshopper population if all the frogs disappeared from the community represented in the diagram? Explain.**

6. **Identify the herbivores, carnivores, and omnivores in this food web.**

7. **Create an energy pyramid showing how much energy is available to organisms at each level of the food web.**



Check your answers for Life Science Test A on pages 11-12.

Multiple Choice

1. **During cellular respiration, cells produce a waste product called**

   C carbon dioxide.

   Carbon dioxide gas is given off as a waste product during cellular respiration.

2. **A cell that requires large amounts of energy to do its job would probably contain many**

   D mitochondria.

   Mitochondria are the organelles in which energy is released from sugars. The more energy a cell needs, the more mitochondria it needs to provide it.

3. **The plant organ in which photosynthesis usually takes place is the**

   A leaf.

   Leaves are the plant organs in which photosynthesis usually takes place.

4. **The human heart contains three kinds of tissue. The heart is**

   B an organ.

   Organs are structures that contain several kinds of tissues working together to do a job.

5. **Which life function would this cell not be able to perform?**

   B photosynthesis

   The cell shown is an animal cell. It has no chloroplasts and cannot perform photosynthesis.

Short Response

6. **Explain what would happen to a plant if the phloem tubes but not the xylem tubes in its stem were cut. Then explain what would happen if the xylem tubes but not the phloem tubes in its stem were cut.**

   Phloem tubes carry sugars from the leaves to the rest of the plant. If they were cut, the plant parts below the cut would not receive sugars that they need to release energy. If xylem tubes were cut, plant parts above the cut would not receive water and minerals. In both cases, the plant probably would die.

   Phloem and xylem tubes are part of a stem. The stem is an organ belonging to an organ system. The parts of the system work together to keep the plant alive.

Check your answers for Life Science Test B on pages 19-20.

Multiple Choice

1. The organ shown in the diagram is part of the

D respiratory system.

The diagram shows the lungs, which are part of the respiratory system. Carbon dioxide and water are exchanged for oxygen in the lungs.

2. Nutrients move from the small intestine to the blood through the walls of the

C villi.

Villi line the small intestine. Nutrients are absorbed through the walls of the villi into the blood.

3. The function of red blood cells is to

B transport gases.

The red blood cells pick up oxygen gas in the lungs and transport it to the body cells. There, they drop off oxygen and pick up carbon dioxide gas. They carry the carbon dioxide to the lungs, where it is exhaled.

4. Kidneys help the body by

D filtering wastes from blood.

The kidneys filter harmful wastes and salts out of the blood.

5. The muscle that contracts and relaxes so that you can breathe is the

D diaphragm.

You inhale when the diaphragm contracts and exhale when it relaxes.

Short Response

6. The cells of cardiac muscle tissue contain huge numbers of mitochondria. Explain why this is necessary.

Cellular respiration takes place in the mitochondria, where energy is released from sugars. Cardiac muscle works hard. This work requires a lot of energy, so many mitochondria are needed.

Cells that need more energy have more mitochondria.

7. How do the circulatory and respiratory systems work together to keep your body functioning?

The respiratory system brings oxygen into the body. The oxygen is carried by the circulatory system to all the cells of the body. The circulatory system also picks up wastes from the cells and brings them to the lungs. The respiratory system then gets rid of these wastes by exhaling.

The circulatory system provides transportation for the gases the respiratory system brings into and sends out of the body.

Check your answers for Life Science Test C on pages 27-28.

1. The process by which organisms make more organisms of the same kind is called

C reproduction.

Reproduction is the creation of new organisms. Offspring are the result of reproduction.

2. The part of a flower that develops into a fruit that contains seeds is the

A ovary.

Fruit and seeds develop from the ovary, which is a female part of a flower's reproductive system.

3. At which stage of its life cycle is a butterfly able to produce offspring?

B adult

Adult butterflies lay eggs that hatch and develop into new organisms.

4. Inherited traits are passed from parents to offspring through

B genes.

Genes contain DNA, which codes for all of an organism's inherited traits.

5. To stay alive, all organisms need

A energy.

Plants use the food they make for energy. Animals get energy by eating plants or other animals.

6. Name one physical adaptation of an animal and explain how it helps the animal survive in its environment.

Here is one example of a physical adaptation: A leopard's eyes have very large pupils that open wide to let light in, especially at night. The leopard uses its special night vision to capture food. This physical adaptation allows a leopard to hunt in darkness, when its prey cannot see as well.

A physical adaptation is a body part that helps an animal survive in its environment.

7. How are learned and instinctive adaptations alike? How are they different?

Both kinds of adaptations help an organism survive in its environment. An inherited adaptation doesn't have to be learned. Parents teach learned adaptations to their offspring.

Any characteristic that helps an animal stay alive is an adaptation. Some are inherited and others are learned.

Check your answers for Life Science Test D on pages 37-38.

Multiple Choice

1. The organisms responsible for changing nitrogen gas into solid nitrogen compounds are

D bacteria.

Plants and animals need solid nitrogen compounds made by bacteria to grow.

2. Carbon dioxide is *not* released into the atmosphere during

C photosynthesis.

During photosynthesis, carbon dioxide is taken in and oxygen is released.

3. A taiga is

A a forested biome near the North Pole.

Evergreen trees and animals like reindeer live in the taiga.

Short Response

4. Explain the difference between a habitat and a niche.

A habitat is the place in which an organism lives. A niche is an organism's job in that habitat.

Species can share a habitat if they have different niches. An organism's niche includes the way it finds food and shelter.

5. What would happen to the grasshopper population if all the frogs disappeared from the community represented in the diagram? Explain.

With no frogs, grasshoppers would not be eaten and their population would increase.

If a predator disappears, the population of its prey increases.

6. Identify the herbivores, carnivores, and omnivores in this food web.

Herbivores: butterflies, grasshoppers, mice

Carnivores: frogs, snakes, hawks

Omnivores: cowbirds

Herbivores eat only plants. Carnivores eat only or mostly animals. Omnivores eat plants and animals.

7. Create an energy pyramid showing how much energy is available to organisms at each level of the food web.

Hawk
Frog, snake, cowbird
Butterfly, grasshopper, mouse, cowbird
Plants

Only some of the energy from each level of an energy pyramid is transferred to the next higher level.

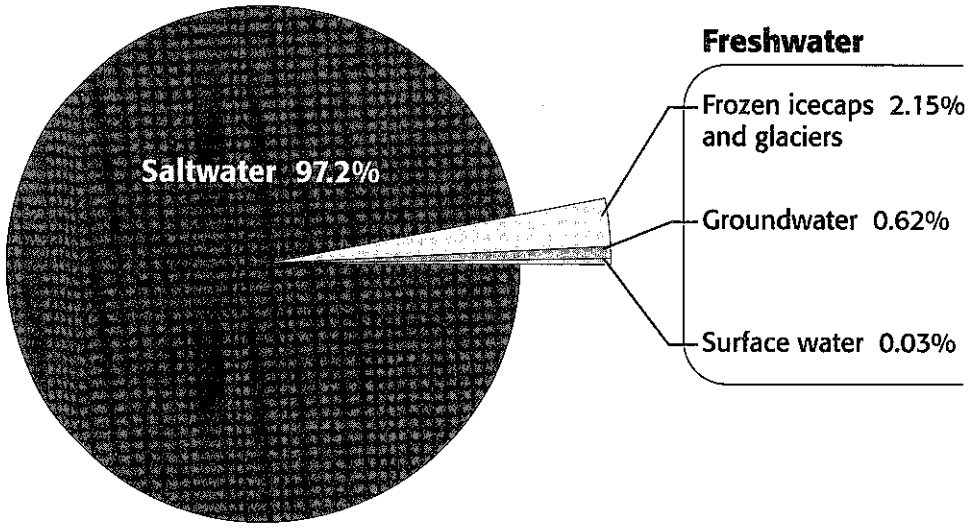
Water

Where is Earth's water located?

Water covers about $\frac{3}{4}$ of Earth's crust. Almost all of Earth's water is saltwater. Most of that saltwater is in the oceans.

Less than 3% of Earth's water is freshwater. Most of that freshwater is frozen in ice caps and glaciers. **Ice caps** are thick sheets of ice that cover areas around the North and South Poles. **Glaciers** are slow-moving rivers of ice.

Less than 1% of Earth's water is liquid freshwater. Liquid freshwater is found in groundwater and surface water. **Groundwater** is water that collects underground. **Surface water** includes lakes, ponds, rivers, and streams. A very tiny percentage of Earth's freshwater is in the form of water vapor in the atmosphere.



Earth's hydrosphere, or all of Earth's water

Show What You Know

Match the terms that describe each other.

1. _____ Groundwater	a. lakes and streams
2. _____ Surface water	b. oceans
3. _____ Saltwater	c. ice caps and glaciers
4. _____ Frozen water	d. underground water

LESSON 36

The Water Cycle

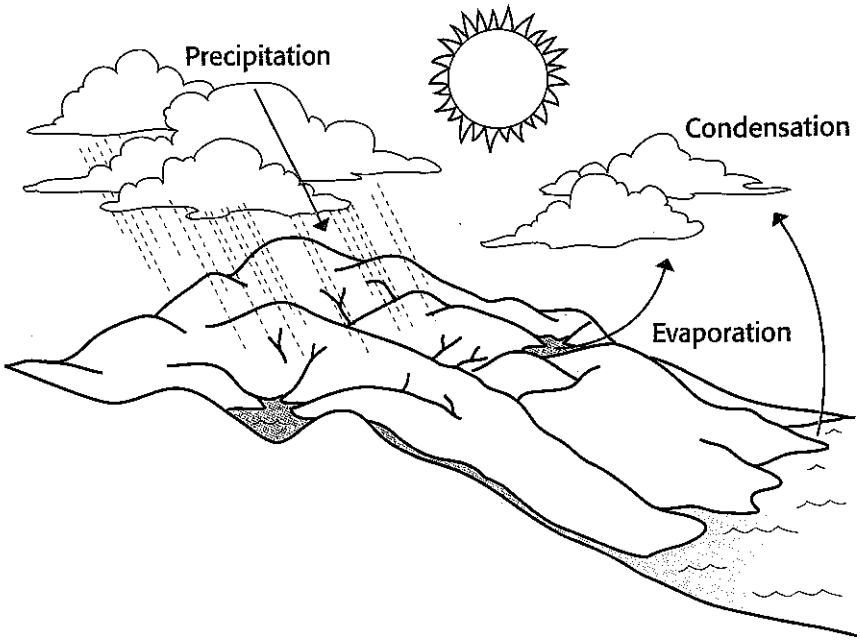
How is water recycled on Earth?

The water you drink today is the same water that has been on Earth for billions of years. Water is constantly recycled through the environment in the **water cycle.** Water goes through three main processes during the water cycle: evaporation, condensation, and precipitation.

Heat from the sun causes water to evaporate. **Evaporation** is the change from liquid water to a gas called water vapor. The water vapor rises into the atmosphere. Any substances dissolved in the water, such as salt, are left behind.

As air cools, the water vapor it contains condenses into droplets of liquid water. These water droplets can clump together to form clouds. **Condensation** is the change from water vapor to liquid water.

When water droplets in the atmosphere become large and heavy enough, they fall to the ground. **Precipitation** is water that falls to Earth's surface. Precipitation may be liquid or frozen. It can take the form of rain, snow, sleet, or hail.



Show What You Know

1. What process forms clouds?

_____

2. What is the source of energy that drives the water cycle?

_____

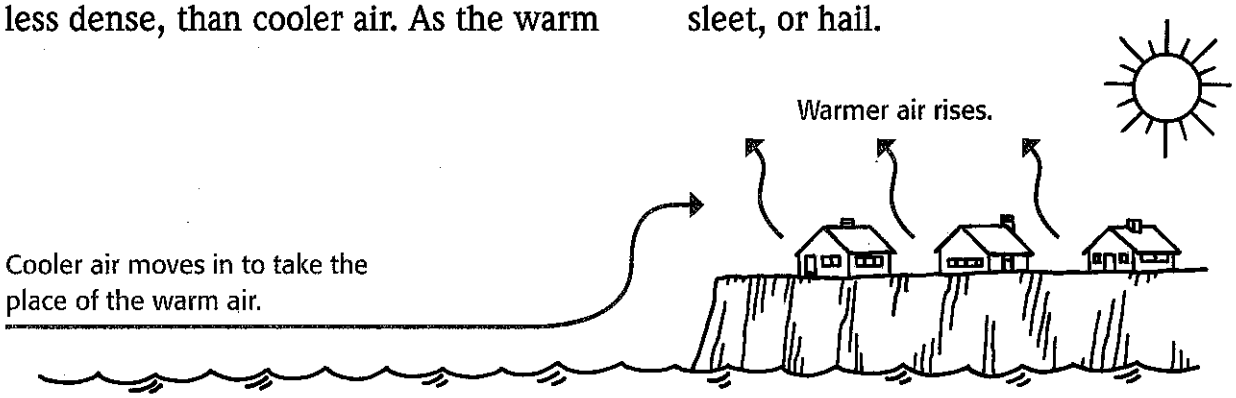
Weather

What causes the weather?

Weather is the condition of Earth's lower atmosphere at a certain time and place over a short period of time. Weather is caused by the uneven heating of Earth's surface by the sun. This uneven heating affects air movement and precipitation.

As the sun heats a portion of Earth's surface, the air above the surface also heats up. As the air gets warmer, it rises. That's because warmer air is lighter, or less dense, than cooler air. As the warm air rises into the atmosphere, nearby cooler air flows in to take its place. This movement of cooler air creates wind.

The **water cycle** also contributes to weather. When cooler air moves into an area, water vapor condenses into water droplets that form clouds. If the air is cool enough, the water droplets become too heavy and fall to the ground as rain. If the air temperature is below freezing, the droplets may freeze to form snow, sleet, or hail.



Most winds are produced by the uneven heating of Earth's surface.

Show What You Know

1. What is the energy source that drives most weather?

_____

2. Land heats up faster than water. The air above a beach warms and rises into the atmosphere. What happens to the air above the ocean water nearby? How does this action create wind?

_____

_____

_____

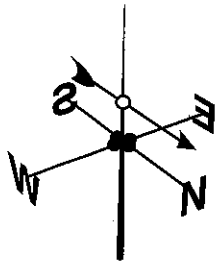
LESSON 38

Weather Instruments

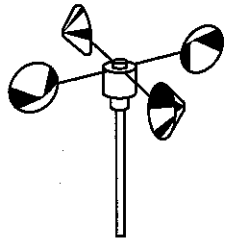
How are weather conditions measured?

Weather includes temperature, precipitation, air pressure, wind speed and direction, and humidity.

Air temperature is the hotness or coldness of the air. A **thermometer** measures air temperature. **Precipitation** is the amount of rain, snow, sleet, or hail that falls to the ground. A **rain gauge** measures the amount of precipitation that falls during a particular time period.



A wind vane points in the direction the wind is coming from.



An anemometer measures wind speed. The faster the wind blows, the faster the anemometer spins.

Humidity is the amount of water vapor in the air. The amount of water vapor the air can hold changes with air temperature. **Relative humidity** is the amount of water vapor that is actually in the air, compared to the amount of water vapor the air can hold at that temperature. A relative humidity of 100% means the air contains all the water vapor it can hold. Relative humidity is measured with an **hygrometer.**

Air pressure is the weight of air pressing on all sides of an object. A **barometer** measures air pressure. Air pressure is always changing. Warmer air has a lower pressure. Cooler air has a higher pressure. A change in air pressure means the weather is changing. Rising air pressure means clear weather. Falling air pressure means stormy or rainy weather.

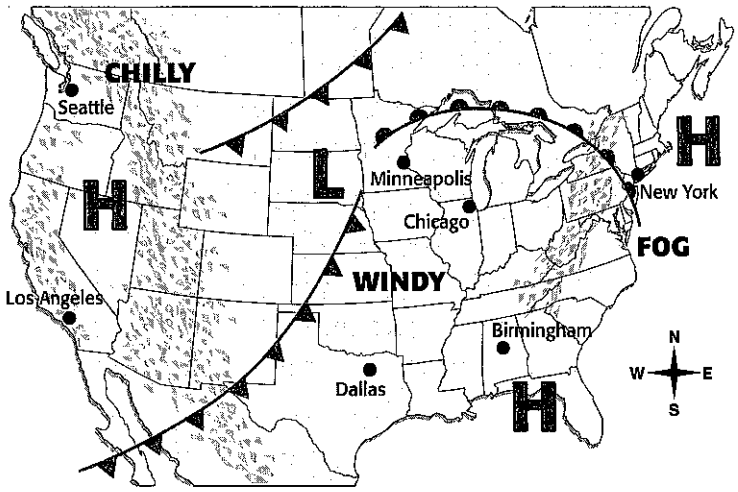
Show What You Know

Match the instrument with the weather condition it measures.

1. _____ hygrometer	**a.** air pressure
2. _____ anemometer	**b.** precipitation amounts
3. _____ wind vane	**c.** wind speed
4. _____ rain gauge	**d.** wind direction
5. _____ barometer	**e.** relative humidity

Weather Forecasting

How is weather predicted?



Weather scientists, or **meteorologists**, gather information about current weather conditions to make **weather forecasts.** These data are plotted on weather maps.

Weather maps show areas of high and low air pressure and the movements of fronts. High-pressure areas usually have fair weather. Low-pressure areas usually have clouds and precipitation. A **cold front** is the front edge of a mass of colder air. It is marked on a weather map as a line with triangles facing the direction in which the front is moving. A **warm front** is the front edge of a mass of warmer air. It is marked as a line with half circles facing the direction in which the front is moving.Weather maps may also show wind speed, wind direction, and rainfall.

Weather forecasts are important for predicting severe weather. **Thunderstorms** can occur when a cold air mass moves underneath a rising mass of warm, moist air. A **tornado** is a powerful funnel of very strong winds that can form during a thunderstorm. **Hurricanes** are huge tropical storms with high wind speeds and heavy rains. Hurricanes begin as thunderstorms that form over tropical ocean waters. **Blizzards** are snowstorms with high wind speeds and freezing air temperatures.

Show What You Know

According to the weather map, is the temperature in Dallas, Texas, likely to rise or fall? How do you know?

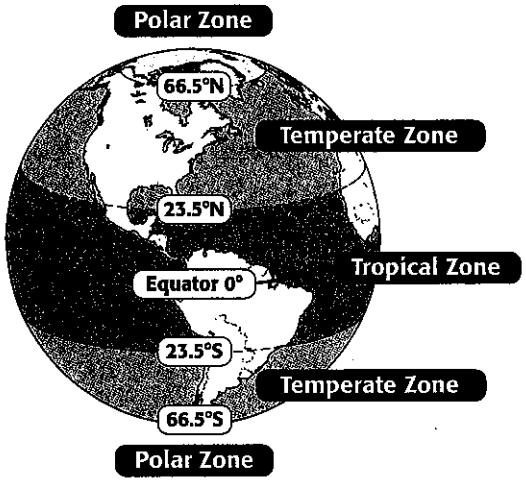
_____

_____

LESSON 40

Climate

What factors control climate?



World climate zones

Climate is the average weather in a large area over a period of many years. Earth can be divided into climate zones based on latitude, or distance from the equator. **Tropical** climates are warm and moist. They occur at low latitudes near the equator, where the sun shines directly overhead almost all year long. **Polar** climates are very cold, with large amounts of ice and snow. They occur at high latitudes near the poles, where the sun never shines directly overhead. **Temperate** climates have seasons. They occur at latitudes between the tropics and the poles. Temperate regions are tilted toward the sun during the warmer months of the year and away from the sun during the colder months of the year.

Mountain climates are colder than sea-level climates at the same latitude. The higher the mountain is, the colder its climate. **Desert** climates occur in any climate zone area where rainfall is scarce.

Global warming may be causing Earth's climate to get warmer. It is caused by the release of greenhouse gases such as carbon dioxide, which trap heat in Earth's atmosphere.

El Niño is a climate event that happens every few years and can change climate patterns around the world, causing floods and droughts. El Niño events begin with changes in ocean temperatures off the coast of Chile in South America.

Show What You Know

Use the diagram above to help you complete the chart.

Climate Zone	Latitude (°)	Average Weather Conditions
Tropical	0°–23.5°N and 23.5°S	
Temperate		
Polar		

Multiple Choice

Fill in the letter to show your answer.

1. **Most of Earth's freshwater is located in**

   (A) groundwater.

   (B) surface waters.

   (C) ice caps and glaciers.

   (D) the atmosphere.

2. **The process in the water cycle in which heat causes water to change from a liquid state to a gas is**

   (A) precipitation.

   (B) transpiration.

   (C) condensation.

   (D) evaporation.

3. **A temperature of 80 degrees and a relative humidity of 85% means**

   (A) the air contains 85% of the total water vapor it can hold at 80 degrees.

   (B) the air contains 15% of the total water vapor it can hold at 80 degrees.

   (C) the air contains 85% of the total water vapor it can hold at any temperature.

   (D) the weather is changing.

4. **The process in the water cycle in which the cooling of the air causes water vapor to change to a liquid is**

   (A) evaporation.

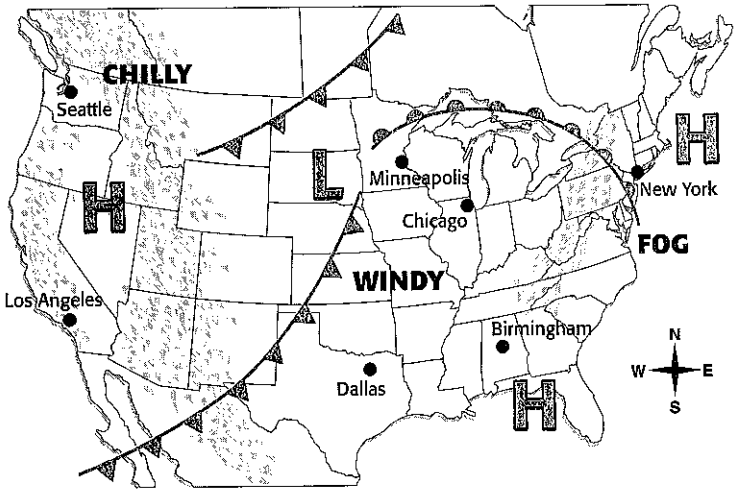
   (B) condensation.

   (C) precipitation.

   (D) transpiration.

Short Response

Use the following weather map to answer Item 5.



5. In what direction is the warm front moving? How do you know?

6. Explain how the uneven heating of Earth's surface causes wind.

LESSON 54

Properties of Matter

What are some properties of matter?

Matter has **physical properties.** Physical properties can be observed, measured, or changed without changing the substance itself. For example, you can cut a piece of paper into smaller pieces, but the pieces are still paper.

Matter also has **chemical properties.** A chemical property is the ability of a substance to change into a new substance with different chemical properties. When you burn wood, it turns into ash.

Properties of Matter

Property	Type of Property	Example
Conducts electricity	Physical	Copper conducts electricity. That means electricity moves easily through copper. Wood does not conduct electricity.
Conducts heat	Physical	Metals conduct heat well. That means heat moves easily through metals. Wood does not conduct heat.
Magnetic	Physical	Iron is magnetic. That means it is attracted to a magnet. Wood is not magnetic.
Density	Physical	A wooden ball floats in water. It is less dense than water. An iron ball sinks in water. It is denser than water.
Solubility	Physical	Salt dissolves in water. It is soluble. Sand does not dissolve in water.
Boiling point	Physical	The boiling point of water is 100°C.
Melting point	Physical	The melting point of ice is 0°C.
Burns	Chemical	Wood burns. Iron does not burn.
Rusts	Chemical	Iron rusts. Aluminum does not rust.
Reacts with acids	Chemical	Baking soda bubbles when vinegar (an acid) is poured on it. Sugar does not bubble.

Show What You Know

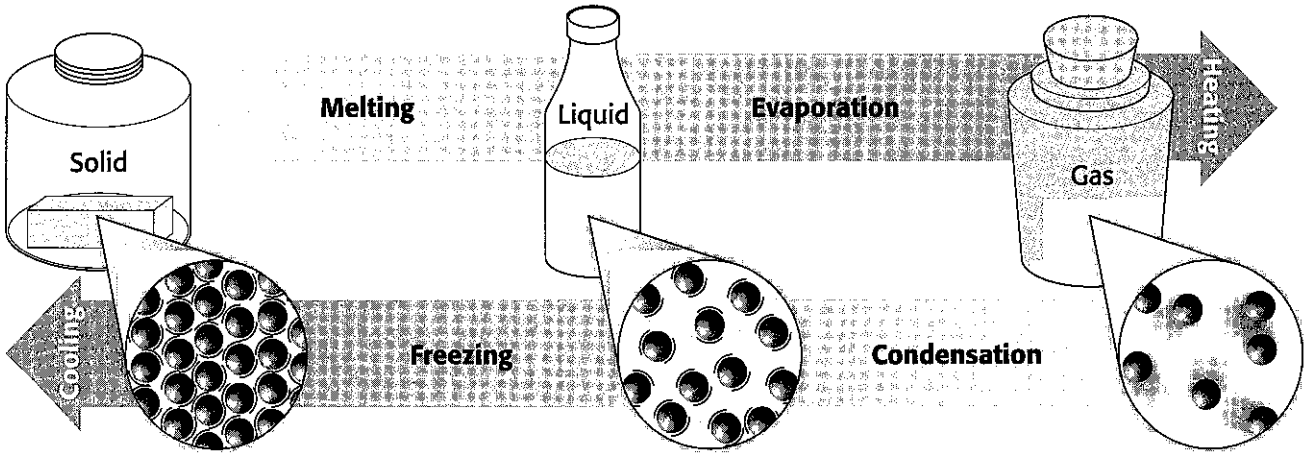
List the physical and chemical properties of wood.

Physical: _____

Chemical: _____

Solids, Liquids, Gases

What are the different forms of matter?



Solids have a definite shape and volume.

Liquids have a definite volume, but they take the shape of their containers.

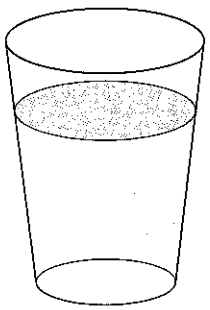
Gases don't have a definite shape or volume. They take the shape of their containers, and they expand to fill them.

Matter exists in one of three main states—**solid, liquid,** or **gas.** Which state a substance is in depends on how closely together its particles are and how much they move around. A solid's particles are the most tightly packed and move around the least. Particles in a gas are the least tightly packed and move around the most.

Matter can be changed from one state to another and back by heating or cooling. Such changes are physical changes. That is, they don't change the matter into another substance. Ice, water, and steam are all the same substance. Also, no matter is lost when matter is heated or cooled.

Show What You Know

1. What state of matter is shown below?



_____

_____

2. How could heating the substance in the glass change it?

_____

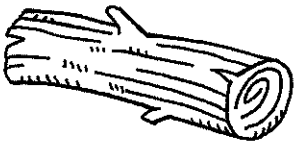
LESSON 60

Chemical Changes

What is a chemical change?

A **chemical change** occurs when one or more substances change into new substances. The new substances have different properties from the original substances. Iron turns to rust when exposed to air and water. Wood combines with oxygen to form ash when burned. Because their properties have changed, the new substances cannot turn back into the original substances. Rust cannot turn back into iron. Ash cannot turn back into wood. When substances change chemically into other substances, a **chemical reaction** has taken place.

Substances only react with certain other substances. Heating iron with a flame will not turn the iron into ash. Wood does not turn to rust when left outside in the rain.



Properties of wood: brown, hard

+

Properties of oxygen: colorless gas

+ heat energy ⟶

Properties of ash: grey, powdery

A chemical reaction causes a chemical change.

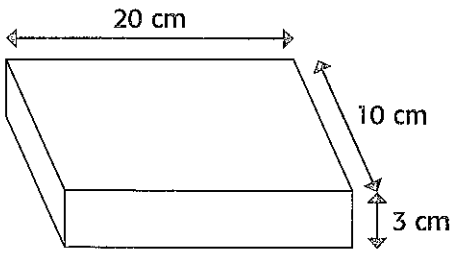
Show What You Know

How do you know when a chemical change has occurred?

Multiple Choice

Fill in the letter to show your answer.

1. **What is the volume of the block in the picture?**



   (A) 33 cubic centimeters
   (B) 60 cubic centimeters
   (C) 600 cubic centimeters
   (D) 600 cubic meters

2. **Which of the following is a chemical property of iron?**

   (A) conducts electricity
   (B) is magnetic
   (C) is denser than water
   (D) rusts

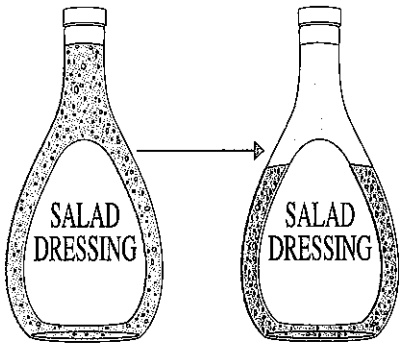
3. **An atom of magnesium has 12 protons. How many neutrons does it probably have?**

   (A) 24
   (B) 12
   (C) 6
   (D) zero

4. **You find an object that is shiny and solid. It conducts heat and electricity. What is it?**

   (A) a noble gas
   (B) a nonmetal
   (C) a metal
   (D) none of the above

Use the diagram below to answer Items 5-6.



5. What physical property has caused the substances in the bottle to separate?

Ⓐ density

Ⓑ boiling point

Ⓒ melting point

Ⓓ magnetism

6. The substance in the bottle is a

Ⓐ solution.

Ⓑ element.

Ⓒ compound.

Ⓓ mixture.

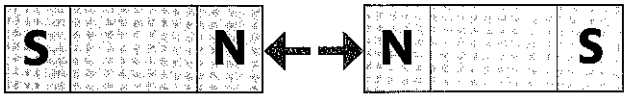
Short Response

7. An iron nail is melted. Why is melting an example of a physical change? Use the example of the nail in your explanation.

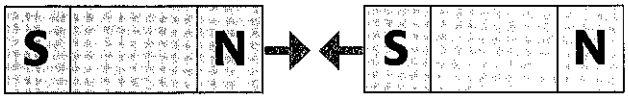
LESSON 62

Magnetism and Friction

What are magnetism and friction?



Like poles push away from each other.



Unlike poles pull toward each other.

How magnets work

Magnetism is the attraction between a magnet and a magnetic object. A magnet's force can pull a magnetic object toward it even from a distance. This is why a magnet can pull a nail without touching it. Magnets can also pull on and push each other. This is because magnets have two poles, north and south. Unlike poles **attract,** or pull toward, each other. Like poles **repel,** or push away from, each other.

Friction is a force that works against motion. It is produced when two objects rub against each other. The amount of friction two objects produce depends on how rough the objects are. If they are rough, like sandpaper, they produce more friction as they rub against each other. If they are smooth, like ice, they produce less friction. Wet surfaces act like smooth surfaces, so they produce less friction than dry surfaces. Friction also depends on how hard two objects are pushing against each other. Cars push against the road harder than bicycles, and so they produce more friction.

Show What You Know

1. How do two magnets affect each other?

_____

_____

2. Which produces less friction—a car braking on dry pavement or the same car braking on wet pavement? Explain your answer.

_____

_____

_____

Motion

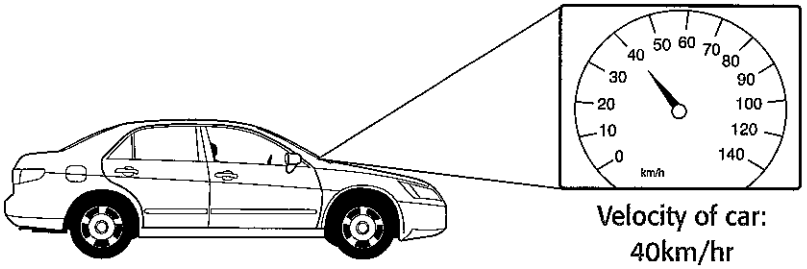
How do you describe motion?

Motion is a change in position. Forces cause motion. Gravity can cause a book to fall off your desk and onto the floor. Friction between a car's tires and the road can cause a car to slow down.

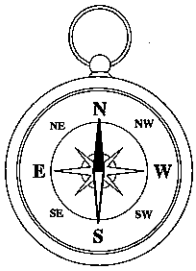
Motion is described in terms of distance, direction, speed, and velocity. **Distance** can be measured with a meterstick. **Direction** is measured with a compass. The points on a compass are N for North, S for South, E for East, and W for West.

Speed is the distance an object travels in a certain amount of time. You can use a stopwatch and a meterstick to measure speed. **Velocity** is an object's speed in a particular direction. To describe an object's velocity, you must include both its speed and the direction it is moving. So to measure velocity, you use a stopwatch, a meterstick, and a compass.

Acceleration occurs when an object speeds up, slows down, or changes direction. That means acceleration is a change in velocity. So, it can be measured with a stopwatch, a meterstick, and a compass.



Velocity of car: 40km/hr



Direction of car: North (N)

Velocity includes speed and direction.

Show What You Know

Match the following terms and definitions.

_____ 1. motion	a. a change in velocity
_____ 2. velocity	b. which way an object is going
_____ 3. direction	c. a change in position
_____ 4. speed	d. speed in a particular direction
_____ 5. acceleration	e. distance traveled in a certain amount of time

LESSON 64

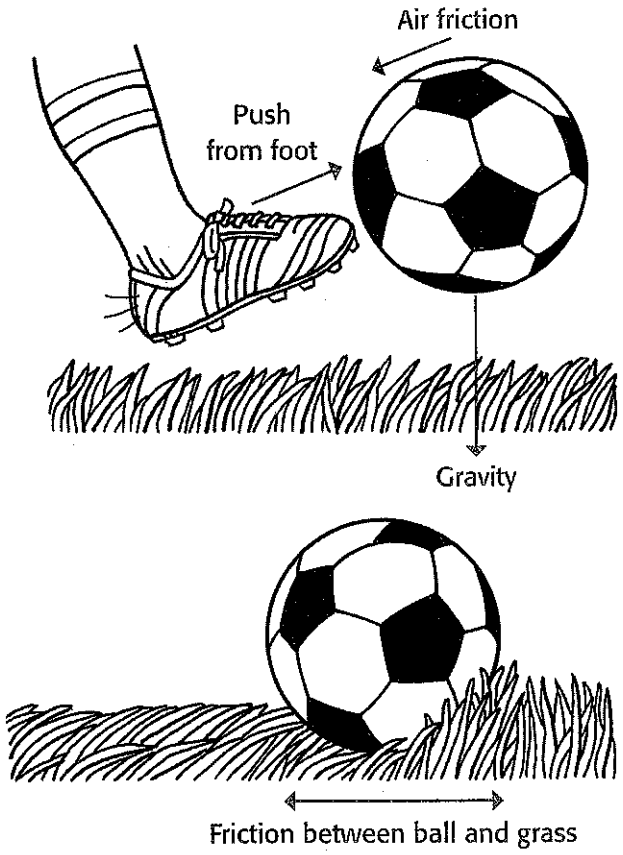
Inertia

How do objects start moving?

The tendency of an object to resist a change in motion is called **inertia.** Because of inertia, an object will not start or stop moving unless an outside force acts on it.

A soccer ball sitting in the middle of a field will not start moving unless a force acts on it. If someone kicks the ball, it will fly up into the air. But the ball will not stay in the air forever. Gravity pulls the ball toward Earth. Friction between the ball and air molecules slows the ball's forward motion. Eventually, the ball falls to the ground and rolls for awhile. Friction between the ball and the grass finally makes the ball stop moving.

An object's inertia is related to its mass. The more mass an object has, the more inertia it has. A big truck has more inertia than a car. It is harder to get a truck moving, and harder to stop it.



Forces act to change the motion of a soccer ball.

Show What You Know

1. What do you have to do to an object to make it start moving?

_____

_____

2. What makes a moving object stop moving?

_____

_____

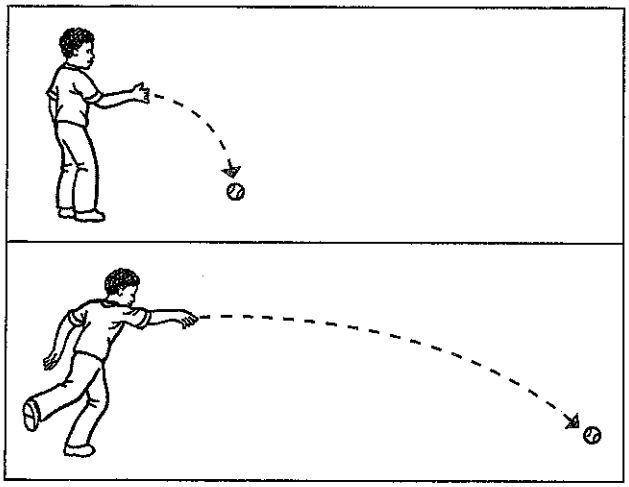
Force, Mass, and Motion

What causes motion to change?

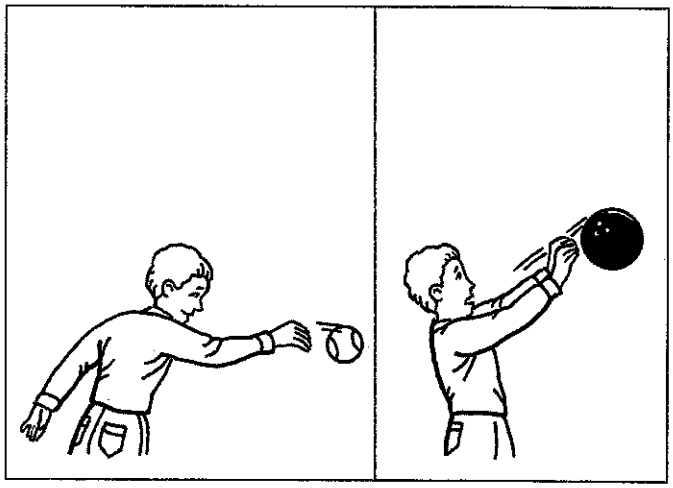
Acceleration is a change in velocity. Forces cause acceleration. For example, pushing on your little brother's training bike causes both your brother and the bike to accelerate forward.

How much an object accelerates depends on the size of the force applied to the object. If you throw a softball really hard, it will go faster and farther than if you throw it gently.

How much an object accelerates also depends on the mass of the object. Imagine throwing a softball and a bowling ball with the same force. The bowling ball would accelerate less than the softball because it has more mass. You'd have to throw a bowling ball much harder to make it accelerate as much as the softball.



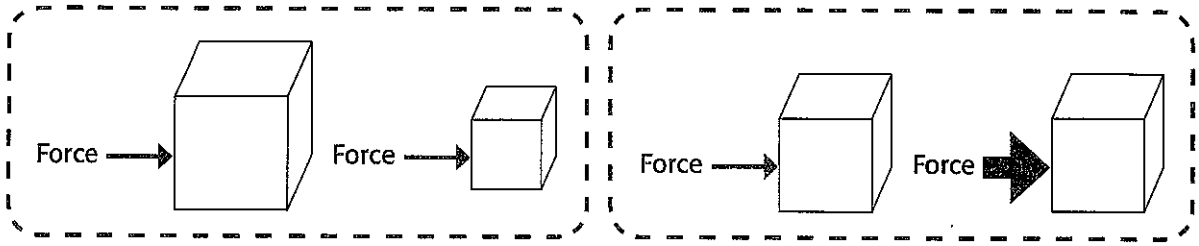
A bigger force will produce more acceleration.



It takes more force to accelerate a larger mass.

Show What You Know

Look at the two pairs of boxes. Circle the box in each pair that accelerates more when pushed.

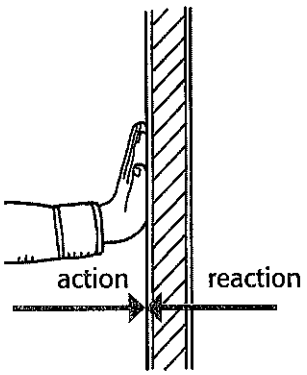


LESSON 66

Action and Reaction

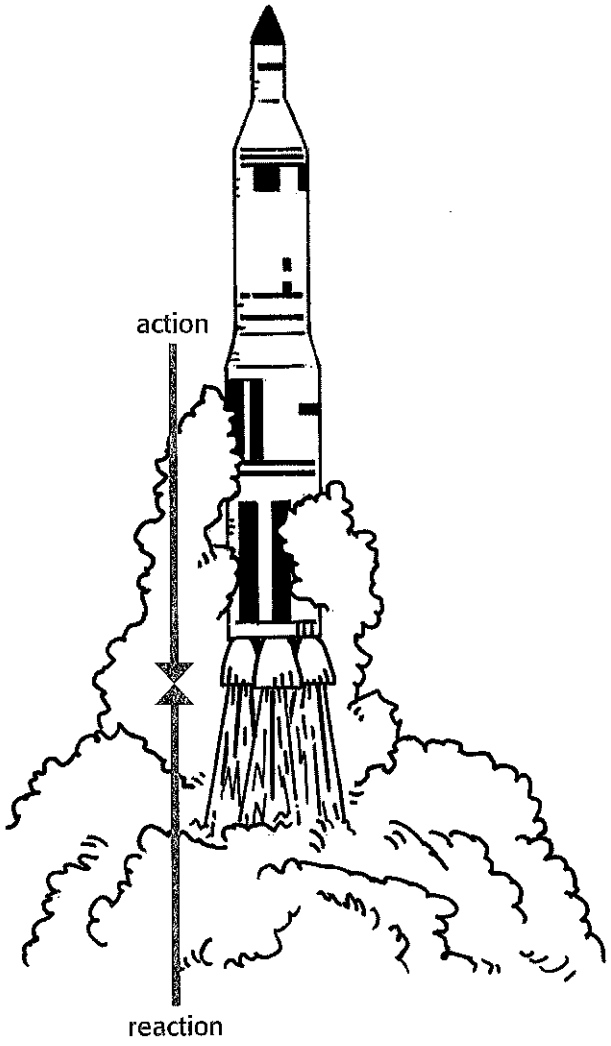
How do forces work in pairs?

Forces work in pairs. When one object pushes on a second object, the second object pushes back with equal force. For every **action** there is an equal and opposite **reaction.** When you push on a wall, the wall pushes back with equal force. If it did not, the wall would collapse.



Forces work in pairs.

Paired forces help explain how rockets are launched into space. A rocket's engine pushes exhaust gases out the back end of the rocket. The exhaust gases push back on the rocket with an equal and opposite force. This push moves the rocket upward. The rocket engine provides the action force. The exhaust gases provide the reaction force. The two forces are equal and opposite in direction.



How a rocket works

Show What You Know

Think about stubbing your toe on the ground. Explain why it hurts in terms of action and reaction forces.

_____

_____

_____

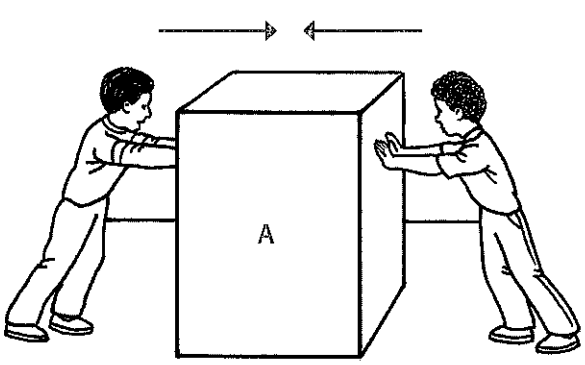
Balanced and Unbalanced Forces

When do forces cause a change in motion?

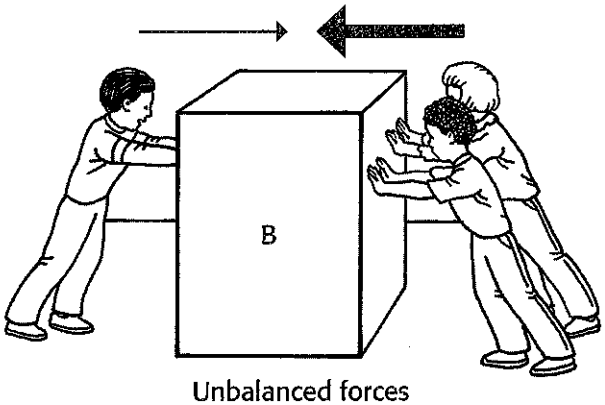
More than one force can act on an object at the same time. If the forces are equal and opposite, they are said to be **balanced forces.** Balanced forces cancel each other out, so motion does not change. An object that is not moving remains motionless. An object that is moving continues to move at the same speed and in the same direction.

Forces that are not equal and opposite are **unbalanced forces.** Unbalanced forces don't cancel each other out. They cause a change in motion. For example, imagine that you and a friend are pushing on a heavy box with equal force from opposite sides. The forces acting on the box are balanced. But when a second friend helps you push the box from your side, the forces acting on the box become unbalanced. This causes a change in motion, and the box moves.

Balanced and Unbalanced Forces



Balanced forces



Unbalanced forces

Show What You Know

Draw two pictures—one showing an object with balanced forces acting on it and one showing the same object with unbalanced forces acting on it. Use arrows to show the forces acting on the object in each picture.

Balanced Forces	Unbalanced Forces

Multiple Choice

Fill in the letter to show your answer.

Use the diagram below to answer Item 1.

1. **What is happening between the two magnets?**

   (A) The magnets pull toward each other because like poles attract.

   (B) The magnets push away from each other because like poles attract.

   (C) The magnets pull toward each other because like poles repel.

   (D) The magnets push away from each other because like poles repel.

2. **A boat floats on water because of**

   (A) magnetism.

   (B) gravity.

   (C) buoyant force.

   (D) friction.

3. **A kicked soccer ball slows down and eventually stops moving because of**

   (A) inertia and gravity.

   (B) inertia and friction.

   (C) friction and gravity.

   (D) gravity and magnetism.

PHYSICAL SCIENCE TEST B

4. **Which force causes a bicycle to take longer to stop on a wet surface than a dry one?**

   (A) friction

   (B) magnetism

   (C) gravity

   (D) inertia

5. **What will happen to an object if unbalanced forces are acting on it?**

   (A) It will speed up.

   (B) It will slow down.

   (C) It will change direction.

   (D) Any of the above.

6. **Which of the following simple machines is used to chop wood?**

   (A) inclined plane

   (B) wedge

   (C) lever

   (D) pulley

7. **Why does it take more force to move a heavy box than a light box?**

_____

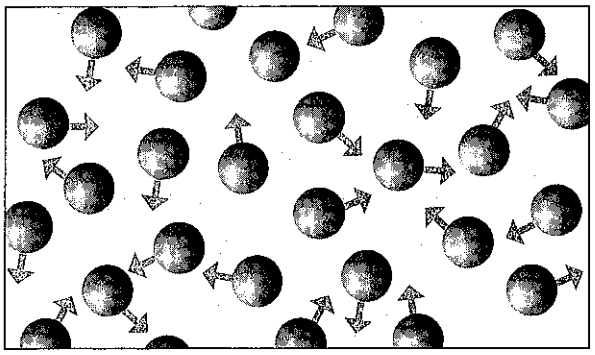
_____

_____

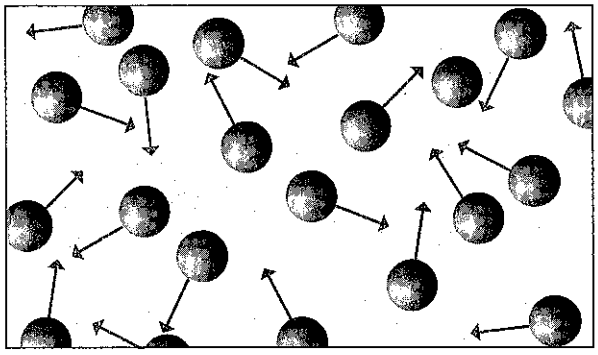
_____

Heat Energy

What is heat?



Molecular motion in cold water



Molecular motion in hot water

Solids, liquids, and gases are made of molecules that are always moving. How fast these molecules move depends on how much energy they have. **Heat energy** is the energy moving particles have. Heat energy is sometimes called **thermal energy.**

When heat energy is added to matter, the molecules in the matter move faster. When you heat water on a stove, you add heat energy to the water. The added heat energy makes the water molecules move faster.

If you could see the molecules in a glass of water, you would see that some molecules move faster than others. **Temperature** is a measure of the average energy of these moving molecules. If heat energy is added to the water, the temperature goes up because the molecules move faster. If heat energy leaves the water, the molecules move more slowly and the temperature goes down.

A **thermometer** measures temperature. Two common units for temperature are degrees Fahrenheit (°F) and degrees Celsius (°C).

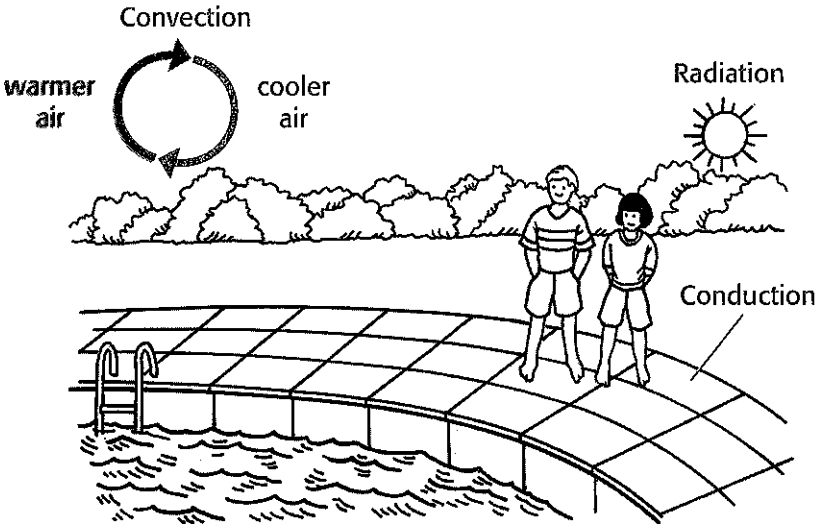
Show What You Know

Why does hot cocoa have a higher temperature than cold milk? Explain in terms of molecules and energy.

LESSON 70

Transfer of Heat Energy

How does heat move from one place to another?



Heat can be transferred by conduction, radiation, or convection.

Imagine going to a swimming pool on a sunny day. You step onto the concrete and soon your feet feel hot. **Conduction** is the transfer of heat from a warmer to a cooler object when the objects touch each other. Because the concrete was warmer than your feet, heat moved from the concrete to your feet.

Some materials conduct heat better than other materials do. Materials that conduct heat well are called **conductors.** Metals, such as iron and copper, are good conductors. Materials that do not conduct heat well are **insulators.** Plastic, wood, and air are good insulators.

After standing in the sun by the pool for a few minutes, you start to sweat. The energy in sunlight travels a great distance through space before it warms you. Energy moves through space by **radiation.**

As air around the pool touches the concrete, heat conducts from the concrete to the air. As the molecules of air warm, they move faster and become farther apart. This makes the air less dense, or lighter. Lighter air rises. As a current of warm air rises, cooler, heavier air falls. This movement of heat currents in a gas or a liquid is called **convection.** Convection currents keep the air by a pool warm.

Show What You Know

List the three methods of heat transfer and give an example of each.

1. _____ Example: _____

2. _____ Example: _____

3. _____ Example: _____

Multiple Choice

Fill in the letter to show your answer.

1. **Temperature is a measure of**

   (A) the total number of molecules in a substance.

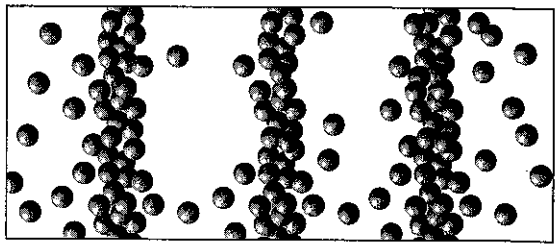
   (B) the total energy of all the molecules in a substance.

   (C) the average energy of all the molecules in a substance.

   (D) the distance between the molecules in a substance.

Use the diagram to answer Items 2-3.

2. **What does the diagram show?**



   (A) a sound wave

   (B) a light wave

   (C) a heat wave

   (D) a convection current

3. **What are the dark and light areas called?**

   (A) troughs and crests

   (B) wavelengths and frequencies

   (C) compressions and rarefactions

   (D) hills and valleys

4. **Light wave A has a greater frequency than light wave B. What is true about the wavelengths of waves A and B?**

   (A) The wavelengths are equal.

   (B) Wave A has a longer wavelength.

   (C) Wave B has a longer wavelength.

   (D) Wavelength does not depend on frequency.

5. **A sound wave has compressions that are very close to each other. What is true about this sound wave?**

   (A) It has a low pitch because it has a high frequency.

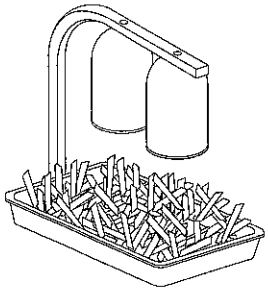
   (B) It has a low pitch because it has a low frequency.

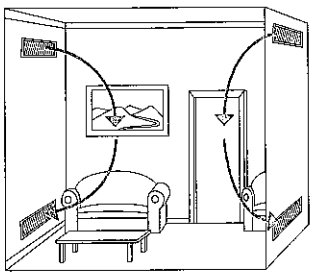
   (C) It has a high pitch because it has a high frequency.

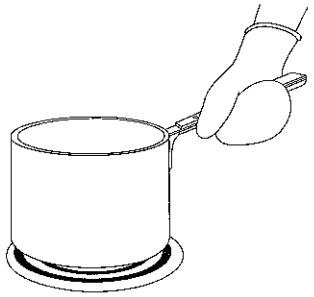
   (D) It has a high pitch because it has a low frequency.

Short Response

Use the pictures to answer Item 6.







a. _____ b. _____ c. _____

6. **Label each picture with the term that describes how heat energy is being transferred.**

   Conduction Radiation Convection

7. **Why does grass look green to us? Use the terms *reflect* and *absorb* in your answer.**

_____

_____

_____

_____

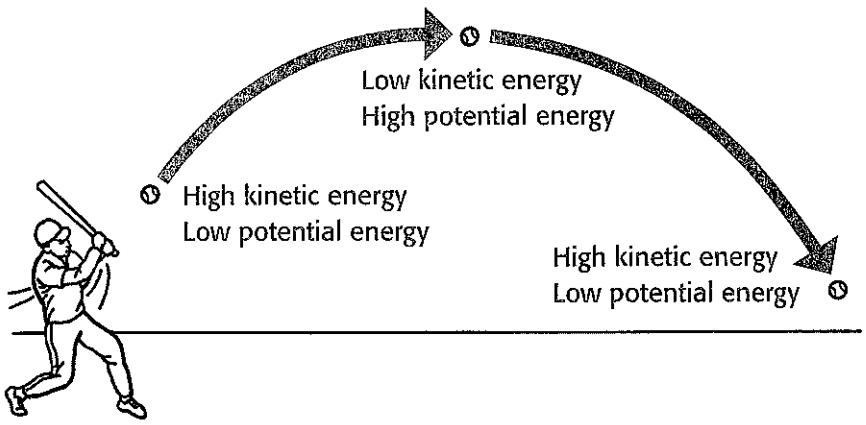
Kinetic and Potential Energy

How are kinetic and potential energy related?

Kinetic energy is the energy of motion. A log rolling down a hill has kinetic energy because it is moving. The amount of kinetic energy an object has depends on the mass and the speed of the object. A slow-moving truck can have more kinetic energy than a fast-moving ball because the mass of the truck is so much greater than the mass of the ball.

Potential energy is energy based on an object's position. If a log is at the top of a hill, it has potential energy because it could start rolling down the hill.

An object can have both kinetic and potential energy. And potential energy and kinetic energy can be changed from one to the other. Suppose a toy car is rolled down a ramp. Before it is released, it has only potential energy. As it starts to move, it has both potential and kinetic energy. At the bottom of the ramp, it has only kinetic energy.



Potential and kinetic energy

The diagram shows another change between potential energy and kinetic energy. As the ball climbs higher, its kinetic energy changes into potential energy. As it begins to fall, its potential energy changes back into kinetic energy.

Show What You Know

Imagine a circus performer juggling three balls. Explain the changes in potential and kinetic energy that happen as the balls rise and fall.

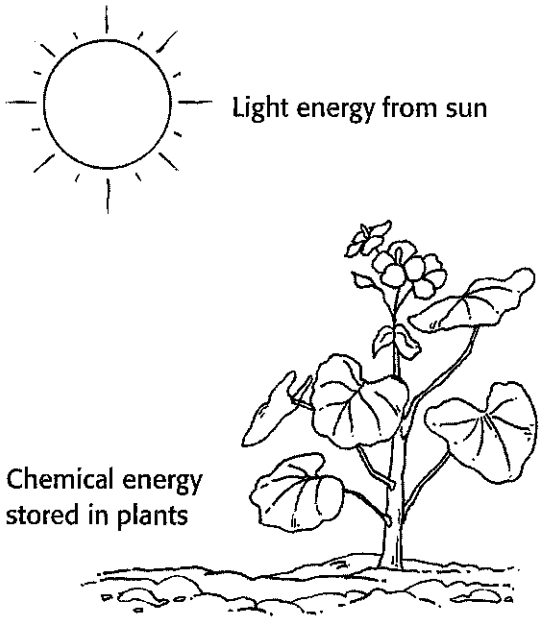
LESSON 80

Energy Changes

How does energy change?

Although it may seem that energy is created or used up, it isn't. It just changes from one form to another.

Many examples of energy change involve chemical energy. **Chemical energy** is the energy stored in molecules. Food and fuels contain chemical energy. Your body changes the chemical energy stored in food into kinetic and heat energy. The chemical energy stored in candle wax changes to heat and light energy when a candle burns. When gasoline burns in a car engine, chemical energy changes to heat energy. This heat energy then changes to kinetic energy as parts of the motor move. Remember that light energy from the sun helps green plants make food. Light energy becomes chemical energy stored in the food made by green plants.



Light energy becoming food

Many other energy changes involve electrical energy. In a battery, chemical energy changes to electrical energy. In a motor, electrical energy changes to kinetic energy. In a lamp, electrical energy changes to light and heat energy. A CD player changes electrical energy to sound energy.

Show What You Know

For each example given below, write the energy change that takes place:

1. People eating food: _____
2. CD player playing music: _____
3. Candle burning: _____
4. Motor running: _____

Multiple Choice

Fill in the letter to show your answer.

1. **How are static charges and electric current different?**

   (A) Static charges are negative, and electric current moves positive charges.

   (B) Static charges are positive, and electric current moves negative charges.

   (C) Static charges remain on an object, and electric current flows between objects.

   (D) Static charges flow, and electric current remains on an object.

2. **Two magnets are placed near each other. They pull toward each other. What might be true?**

   (A) Both north poles are near each other.

   (B) Both south poles are near each other.

   (C) One north pole and one south pole are near each other.

   (D) Magnets always pull toward each other.

3. **A family wants to produce their own electricity. What should they use?**

   (A) a generator

   (B) a motor

   (C) an electromagnet

   (D) a permanent magnet

4. **When a piece of paper burns, chemical energy changes to _____ energy.**

   (A) mechanical

   (B) kinetic and potential

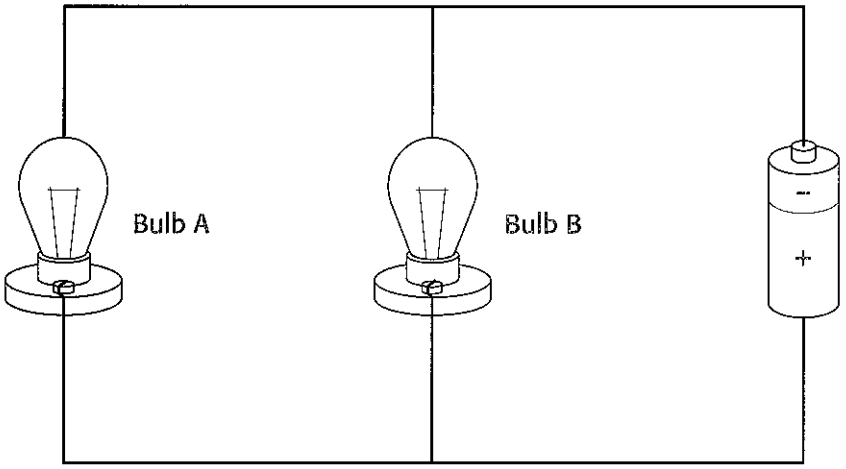
   (C) heat and light

   (D) electrical

PHYSICAL SCIENCE TEST D

Short Response

Use the diagram to answer item 5.



5. **Switches control whether the bulbs in this circuit light up. On the picture, do the following:**

   a. Write an *X* at a place on the wire where you could put an open switch that would keep Bulb A from lighting. Bulb B would light up.

   b. Write a *Y* at a place on the wire where you could put an open switch that would keep Bulb B from lighting. Bulb A would light up.

   c. Write a *Z* at a place on the wire where you could put an open switch that would keep both Bulb A and Bulb B from lighting.

6. **Explain the changes in kinetic and potential energy that occur as a bicycle stopped at the top of a hill rolls to the bottom of the hill.**

Check your answers for Physical Science Test A on pages 89-90.

1. **What is the volume of the block in the picture?**

   C 600 cubic centimeters

   To find volume, multiply length times width times height.

2. **Which of the following is a chemical property of iron?**

   D rusts

   When exposed to air and water, iron forms a new substance called rust. So the ability to rust is a chemical property.

3. **An atom of magnesium has 12 protons. How many neutrons does it probably have?**

   B 12

   The number of neutrons is usually equal to the number of protons.

4. **You find an object that is shiny and solid. It conducts heat and electricity. What is it?**

   C a metal

   The properties of metals include the ability to conduct heat and electricity. Metals are also shiny and solid at room temperature.

5. **What physical property has caused the substances in the bottle to separate?**

   A density

   Oil is less dense than vinegar, so it floats on the vinegar.

6. **The substance in the bottle is a**

   D mixture.

   The oil and vinegar do not remain mixed together throughout. Also, the properties of the two substances, oil and vinegar, do not change when they are mixed together. Therefore, they form a mixture, not a solution or compound.

7. **An iron nail is melted. Why is melting an example of a physical change? Use the example of the nail in your explanation.**

   Melting is a physical change. A melted iron nail keeps all the properties of iron. It can be cooled and made into a nail again.

   Heating or cooling a substance can cause a physical change. During a physical change, a substance does not change into a new substance.

Check your answers for Physical Science Test B on pages 99-100.

Multiple Choice

3. **What is happening between the two magnets?**

D The magnets push away from each other because like poles repel.

Like poles of a magnet repel, or push away from, each other.

4. **A boat floats on water because of**

C buoyant force.

Buoyant force is the upward push of a liquid (water) on an object (the boat). It works in the opposite direction from gravity.

5. **A kicked soccer ball slows down and eventually stops moving because of**

C friction and gravity.

Friction between the soccer ball and air molecules slows down the soccer ball. Gravity pulls it toward Earth. Eventually it stops moving.

6. **Which force causes a bicycle to take longer to stop on a wet surface than on a dry one?**

A friction

Wet surfaces are like smooth surfaces. They produce less friction than dry surfaces.

8. **What will happen to an object if unbalanced forces are acting on it?**

D Any of the above.

Unbalanced forces cause a change in velocity—slowing down, speeding up, or changing direction.

9. **Which of the following simple machines is used to chop wood?**

B wedge

A wedge can be used to split objects apart. An ax is an example of a wedge.

Short Response

7. **Why does it take more force to move a heavy box than a light box?**

A heavy box has more mass than a lighter box. It takes more force to accelerate objects with more mass than it does to accelerate objects with less mass.

How much an object accelerates depends on the size of the force applied to the object and the object's mass. It takes more force to accelerate a larger mass.

Check your answers for Physical Science Test C on pages 107–108.

Multiple Choice

1. **Temperature is a measure of**

   C the average energy of all the molecules in a substance.

   As molecules move faster, temperature increases. As molecules slow down, temperature decreases.

2. **What does the diagram show?**

   A a sound wave

   Sound waves are made of areas where air molecules are close together and areas where they are far apart.

3. **What are the dark and light areas called?**

   C compressions and rarefactions

   Areas in a sound wave where the air molecules are bunched together are called compressions. Areas where the molecules are far apart are called rarefactions.

4. **Light wave A has a greater frequency than light wave B. What is true about the wavelengths of waves A and B?**

   C Wave B has a longer wavelength.

   Waves with a lower frequency have a longer wavelength.

5. **A sound wave has compressions that are very close to each other. What is true about this sound wave?**

   C It has a high pitch because it has a high frequency.

   Close compressions means high frequency. Sounds with high frequency have high pitch.

Short Response

6. **Label each picture with the term that describes how heat energy is being transferred.**

   a. Radiation—*Heat moves through space from the lights to the food.*
   b. Convection—*Heat moves in currents as warm air rises and cool air sinks.*
   c. Conduction—*Heat moves from the warmer pot to the handle that it touches.*

7. **Why does grass look green to us? Use the terms *reflect* and *absorb* in your answer.**

   Grass is green because grass reflects green light and absorbs all other colors.

   The color of an object is the color or colors of light that it reflects. All other colors are absorbed. We don't see the colors that are absorbed.

Check your answers for Physical Science Test D on pages 115–116.

Multiple Choice

1. How are static charges and electric current different?

C Static charges remain on an object, and electric current flows between objects.

Static charges are positive or negative charges that remain on an object. Negatively-charged electrons move in an electric current.

2. Two magnets are placed near each other. They pull toward each other. What might be true?

C One north pole and one south pole are near each other.

Like poles repel and unlike poles attract.

3. A family wants to produce their own electricity. What should they use?

A a generator

A generator produces electricity by moving a wire through a magnetic field.

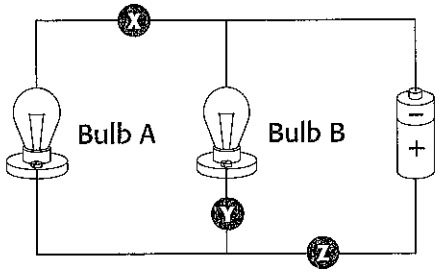
4. When a piece of paper burns, chemical energy changes to _____ energy.

C heat and light

Burning causes chemical energy in the molecules of the paper to change to heat and light energy.

Short Response

5. Switches control whether the bulbs in this circuit light up.



An open switch at location X leaves the circuit for Bulb B closed. Bulb A won't light, but Bulb B will.

An open switch at location Y leaves the circuit for Bulb A closed. Bulb B won't light, but Bulb A will.

An open switch at location Z opens the circuit for both bulbs. Neither bulb will light.

6. Explain the changes in kinetic and potential energy that occur as a bicycle stopped at the top of a hill rolls to the bottom of the hill.

While stopped, the bicycle has only potential energy. When it starts to roll, some potential energy changes to kinetic energy. When the bicycle reaches the bottom of the hill, it's moving as fast as it will move. At the bottom of the hill, it has its greatest amount of kinetic energy.

As an object's potential energy decreases, its kinetic energy increases.

Scientific Inquiry

How do scientists learn about the natural world?

Scientific inquiry involves observing, studying, and understanding the natural world. A **scientific investigation** is the search for an answer to a clear, well-defined question about the natural world.

The table below shows the steps used to conduct a scientific investigation.

Keep in mind that each investigation is different. So, scientists do not always follow the steps in the exact order listed below. Still, you can use these steps to guide you when you are doing investigations.

Steps of a Scientific Investigation

Step	What You Do in This Step
1. Identify a question.	Ask *How, What, When, Where,* or *Why*.
2. Research the question.	Use books, the Internet, and other sources to learn more about your question.
3. Make an hypothesis, or possible answer.	Suggest a possible answer to the question.
4. Plan an investigation.	Decide how to test your hypothesis.
5. Conduct the investigation.	Carry out your plan.
6. Collect and record data, or information.	Make observations and measurements. Organize data in graphs, drawings, or tables.
7. Analyze the data and draw conclusions.	Decide what the data mean and if they support the hypothesis.

Show What You Know

Think of a clear, well-defined question about the natural world that you could answer through a scientific investigation.

_____

_____

_____

LESSON 82

Hypotheses

What is an hypothesis?

A **hypothesis** is a possible answer to a question. It can be based on things you have learned or **observations** you have made. For example, you may have noticed that grass becomes brown if it does not rain for a long time. Your hypothesis might be: Plants need water to live.

You should always write your hypothesis in the form of a sentence. Also, you must be able to test your hypothesis. The results of your experiment will help you to decide if your hypothesis is correct. Think about the hypotheses in these investigations:

1. Jose placed two pieces of cloth under a bright lamp. One piece of cloth was dark-colored. The other piece was light-colored. After 30 minutes, he recorded the temperature of the cloths. The dark-colored cloth had a higher temperature than the light-colored cloth.

2. Jared used a scale to weigh an empty balloon. He recorded the measurement in a data table. Then he filled the balloon with air and weighed it again. Jared recorded the measurement and then analyzed his data. He noted that the balloon with air weighed more than the empty balloon.

3. Maria divided a piece of steel wool into two equal halves. She put one piece in a bowl of water for five minutes, and then placed it on a paper towel. She put the other piece of steel wool next to the wet piece. She let both pieces of steel wool sit overnight. The next day, she observed that the dry steel wool was unchanged. But the wet steel wool had turned a rusty color.

Show What You Know

Write the hypothesis in each investigation above.

1. Hypothesis: _____

2. Hypothesis: _____

3. Hypothesis: _____

Designing an Experiment

How do you plan an experiment?

After forming a hypothesis, you must do an experiment to test it. In an experiment, it is important to follow a procedure. A **procedure** is a step-by-step plan of the experiment. It shows how you will test your hypothesis. Each step in a procedure is listed in logical order.

In your procedure, you should also list the materials you will use and how you will use them to carry out the experiment. Let's say you want to see if running water erodes soil. You would need a pan, water, soil, paper, and a pencil. To save time, gather the materials before beginning the experiment.

A procedure also describes what safety precautions you will use. If you use a lamp, for example, you would want to be sure to keep it away from water. For most experiments, you should wear safety goggles to protect your eyes and a lab apron to protect your clothes. Safety precautions help make sure that no one is harmed during an experiment.

Hypothesis
Running water erodes soil.

Materials
soil, water hose, shallow pan, paper, pencil

Procedure
1. Place soil in the pan. Tilt the pan.
2. Attach a hose to a water faucet. Hold the other end of the hose at the top of the pan.
3. Slowly, turn on the faucet. Record observations.

Show What You Know

Give a reason for doing each of the following things.

1. Planning a procedure

_____

2. Listing materials

_____

3. Following safety precautions

_____

LESSON 84

Variables

What is an independent variable?

During your experiment, you must always control variables. A **variable** is anything that can change in an experiment. For example, there are several variables in an experiment to test the effect of sunlight on plants. They include sunlight, water, soil, and type of plants. All variables, except the one you are testing, must be the same. The variable that changes—in this case, sunlight—is the **independent variable.** Controlling variables lets you know for certain that your results are caused by the variable you tested. Think about the independent variables in these investigations.

1. Jose placed two pieces of cloth under a bright lamp. One piece of cloth was dark-colored. The other piece was light-colored. After 30 minutes, he recorded the temperature of the cloths. The dark-colored cloth had a higher temperature than the light-colored cloth.

2. Jared used a scale to weigh an empty balloon. He recorded the measurement in a data table. Then he filled the balloon with air and weighed it again. Jared recorded the measurement and then analyzed his data. He noted that the balloon with air weighed more than the empty balloon.

3. Maria divided a piece of steel wool into two equal halves. She put one piece in a bowl of water for five minutes, and then placed it on a paper towel. She put the other piece of steel wool next to the wet piece. She let both pieces of steel wool sit overnight. The next day, she observed that the dry steel wool was unchanged. But the wet steel wool had turned a rusty color.

Show What You Know

Identify the independent variable in each investigation above.

1. Independent variable: _____

2. Independent variable: _____

3. Independent variable: _____