CALVERT™ PUBLICATIONS

4th grade

SCIENCE

SCIENCE 401
PLANTS

Pre-reading Activity

1.11 Before reading How Plants are Used, brainstorm all the plants you can think of that can be eaten. Share your list with your teacher. How many did they think of?

Teacher check:

Initials _____ Date _____

How Plants are Used

There are many ways we can use plants. Among the many ways plants are used, four uses of plants will be discussed in this section. Plants are used for food, for shelter, for enjoyment (of their beauty), and for state symbols.

For food. In the following story about Rick and Mary's visit with their Uncle George, you will learn with them how plants are used for food.

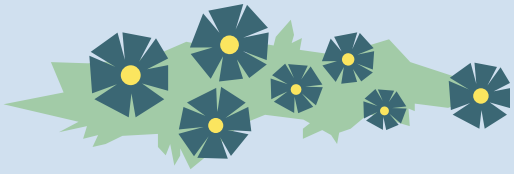
Rick and Mary came dashing into the house.

"Have you heard the news?" Rick asked.

Mother glanced up from the counter where she was working.

"What's happened?" she asked, smiling at the children.

The Farmers' Almanac is an annual American periodical that has been published since 1818. Read the Almanac's description below of the meaning behind a special flower.



WHAT DO FORGET-ME-NOT FLOWERS SYMBOLIZE?

The forget-me-not flower symbolizes true love and respect. When you give someone a blossom, it is like a promise that you care about them and always keep them in your thoughts.

Do these activities.

1.48 What state chose the forget-me-not for its state flower?

_____

1.49 Select *one* flower from your list of state flowers and write a short paragraph about it below.

_____

_____

_____

_____

_____

_____

Review the material in this section to prepare for the Self Test. The Self Test will check your understanding of this section. Any items you miss on this test will show you what areas you will need to restudy in order to prepare for the unit test.

How Plant Parts Function

Study the **diagram** of the wheat plant. If you have ever seen a geranium plant or a wheat field, you know that plants are not alike, but their parts are very much alike. How are the two plants alike? How are they different?

Roots and root hairs. The part of the wheat plant and the geranium plant that is below the ground is called the root system. The root system of a plant is in charge of the water supply. The tips of the roots are always reaching out to collect water. They are also collecting minerals.

At the very end of each root is a tough little cap. This cap protects the root tip as it pushes its way through the bits of soil. These bits of soil act like rough sandpaper.

In the back of the root cap is the growing part—the section of the root that stretches longer and longer.

Behind the growing part are the root hairs. They reach out and grasp the soil, soaking up moisture and minerals through their thin walls.

Many root hairs are on one plant. A scientist once grew a rye plant in a box. When he dug up the plant, he washed off the soil and measured the length of each root and the root hairs. What do you think was their total length? The total length of the roots on just one plant was 387 miles (622 kilometers). When the root hairs were measured, they totaled 7,000 miles (11,263 kilometers).

If he could have put these root hairs end to end, they would have reached all the way across the United States and back again!

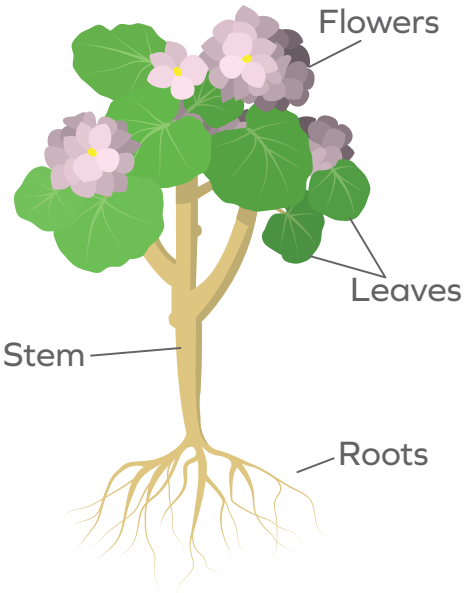


Figure 1 | Parts of a geranium plant

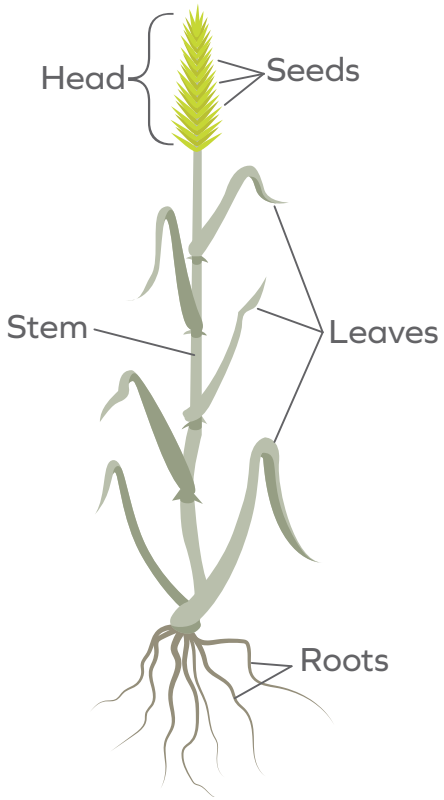


Figure 2 | Parts of a wheat plant

Stems. The *stems* are a very important part of plants. You will remember that the roots and root hairs take in water and minerals from the soil. The water moves up through tubes in the stem of the plant and food moves down. Look at this drawing of a stem.

In this drawing of a stem (Figure 4), we see tubes that are formed from living cells in the growing stem. The tubes are joined to the leaves through the trunk or stem. Look again at the drawing of the large stem. Inside the stem are the tubes and the bud. The outside is made up of bark and wood. The bud is the future leaf and flower. Within the bud is the growing plant.

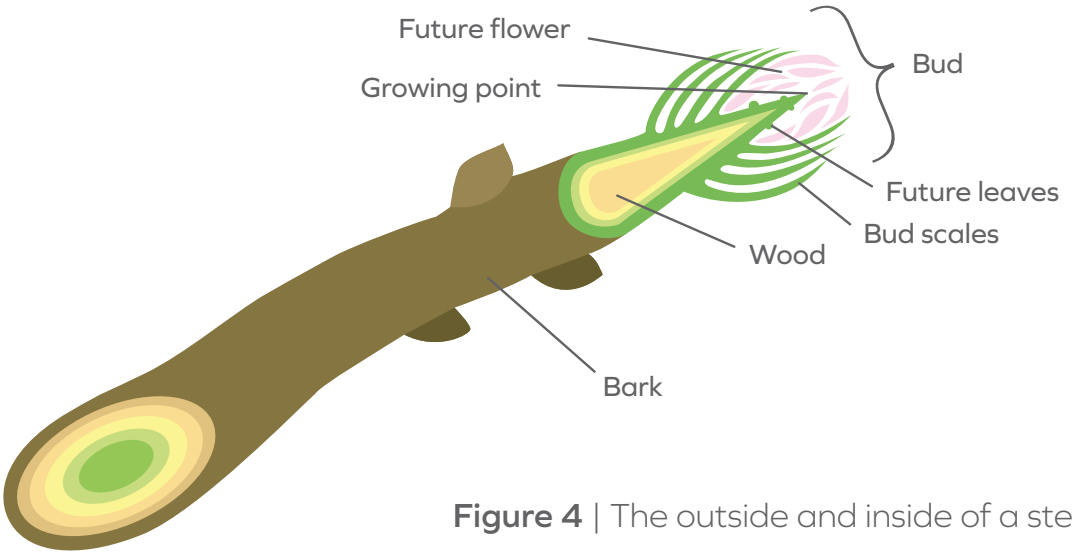


Figure 4 | The outside and inside of a stem

Copy the words alphabetically from the box at the right. These name the seven main parts of the geranium stem.

2.10 _____

2.11 _____

2.12 _____

2.13 _____

2.14 _____

2.15 _____

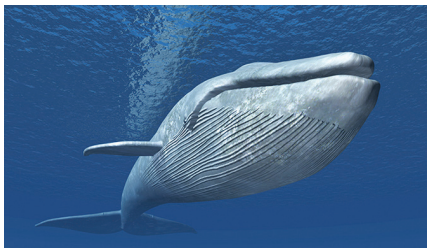
2.16 _____

bud
future flower
future leaf
bud scales
wood
bark
growing point

SCIENCE 402
ANIMALS

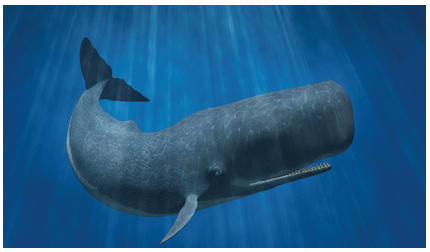
Do this library research. Look up *whale* in an encyclopedia or search online for *identifying whales*. Write your answer to the question in the space provided. Use complete sentences.

1.29 How can whale watchers tell the difference among these three kinds of whales?
a. The blue whale b. The right whale c. The sperm whale



| Blue Whale

| Right Whale



| Sperm Whale

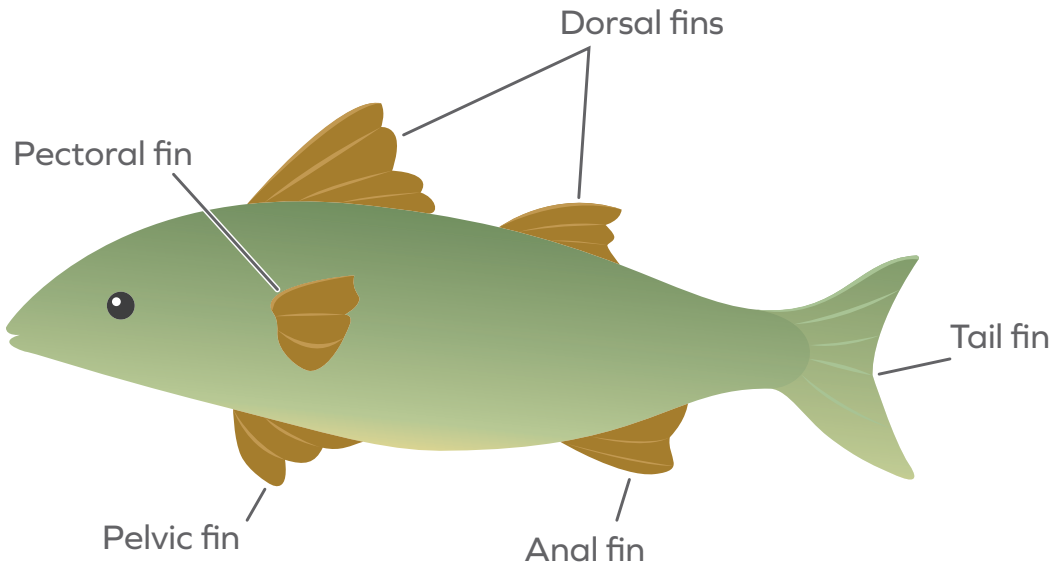
Did you ever hear the cry of wild geese as they were flying south? They were on their way to warmer land. They were **migrating**. Geese fly in a pattern forming a V.

Wild geese are the highest-flying birds in the world. Some have been known to fly as high as 29,000 feet (9,000 m). This distance is the highest ever recorded for birds. However, most birds remain under the clouds when they are migrating.

The ability of birds to **navigate** long distances is amazing. Birds make their long trips without the help of chart or compass. One little bird called the **wheatear**, about the size of a sparrow, travels every year all the way from Africa to Greenland. It travels on a fixed **schedule**. Nearly all of its trips are made at night. The bird flies over great stretches of water and wilderness. Who tells the bird where to go and when?

Fish are animals with backbones that live and move in the water. They have several fins to help them travel from place to place in rivers, lakes, and oceans. The fins are like broad paddles. They help to move and guide the fish through the water. As fish move their bodies, they use their tail fins like oars on a boat. The other fins are used as **rudders** and brakes to keep the fish upright in the water and guide its movement.

Take a few minutes to look at the fish in the schoolroom **aquarium** or in one you may have at home.



Answer the following questions in complete sentences.

1.61 How do the parts of fish help them live and move within water?

_____

_____

1.62 How does a fish swim?

_____

_____

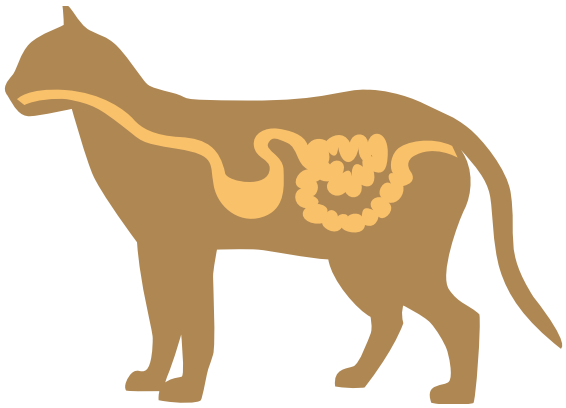
How Animals Eat and Digest Food

All cats, including the house cat, are meat-eaters. They have long, sharp teeth. Members of the cat family tear the meat from the bone and chew it before swallowing it. Tigers, lions, leopards, and house cats are all members of the cat family.

A dog's jaws and teeth are like the other meat-eating animals' jaws. The dog's teeth help prepare the food for digestion by chewing and grinding it.

The teeth of the sheep are made for eating grass. When we compare the jaws of the cat or dog with those of a sheep, we see that cats and dogs have long, sharp teeth. Sheep have no cutting teeth on their upper jaw.

Digestion takes place in the stomach. The food is broken into small pieces, and special juices break it into a liquid. This liquid is then absorbed into the blood and taken to all parts of the body.



| Digestive system of a cat

Answer these questions in a few words.

1.67 After a cat eats its food, where does the food go to be digested?

_____

1.68 A pet cat is related to what wild animals? (Name as least two.)

_____

1.69 Why do members of the cat family have sharp teeth?

_____

1.70 In what way are the teeth of a sheep different from those of a cat or dog?

_____

_____

| Salmon jumping up a waterfall

In about seventy-five days (or about two and one-half months), the eggs begin to hatch. The tiny salmon stay in the quiet stream until they are about a year old. By then, they are about five inches long. Something within tells them that it is time to move downstream. They start toward the great Pacific Ocean, which they have never seen. Many are caught and eaten on the way, but some will live. By that time, they are eight to ten inches long. At that stage, they are called *smolts*. After a long, dangerous journey, some of the smolts reach the salty ocean. There, the little fish find plenty of food and grow bigger and bigger. After four or five years have gone by, they will have grown to weigh as much as twenty pounds (9 kg). At that time, they are full-grown salmon.

Then, something within the adult salmon causes it to want to seek the same stream from which it came. It starts the long, dangerous trip up the same river on its way to the **spawning ground** where it was hatched. While the trip downstream was dangerous, the journey upstream is much more difficult. Besides swimming against the current, the salmon must leap over many waterfalls. At times, it leaps as much as fifteen feet (5 m) to push itself over the top. Finally, it finishes its travels and reaches the spawning ground.

There the cycle of life begins all over again. The male fish seeks out a partner, the female fish lays eggs, and another group of salmon will be born.

SCIENCE 403
HUMANS AND THEIR ENVIRONMENT

Everyone in Mrs. Turner's class at Good Hope School was busy. Today was a special day. The award for the most cans was being presented. Stacks of cans were in front of the building. Boxes of cans lined the driveway. In every corner cans peeked out of sacks, garbage cans, and containers of every size.

Mrs. Turner, the teacher, said to the class, "Why did you collect all these cans?" No one spoke.

Then Ken raised his hand and said, "My mother was glad to have the cans taken away from the house."

Kim added, "My neighbors wanted the alley cleaned up."

"We should use things again and again. These cans will be used to make other cans," said Jane.

"You are right," said Mrs. Turner.

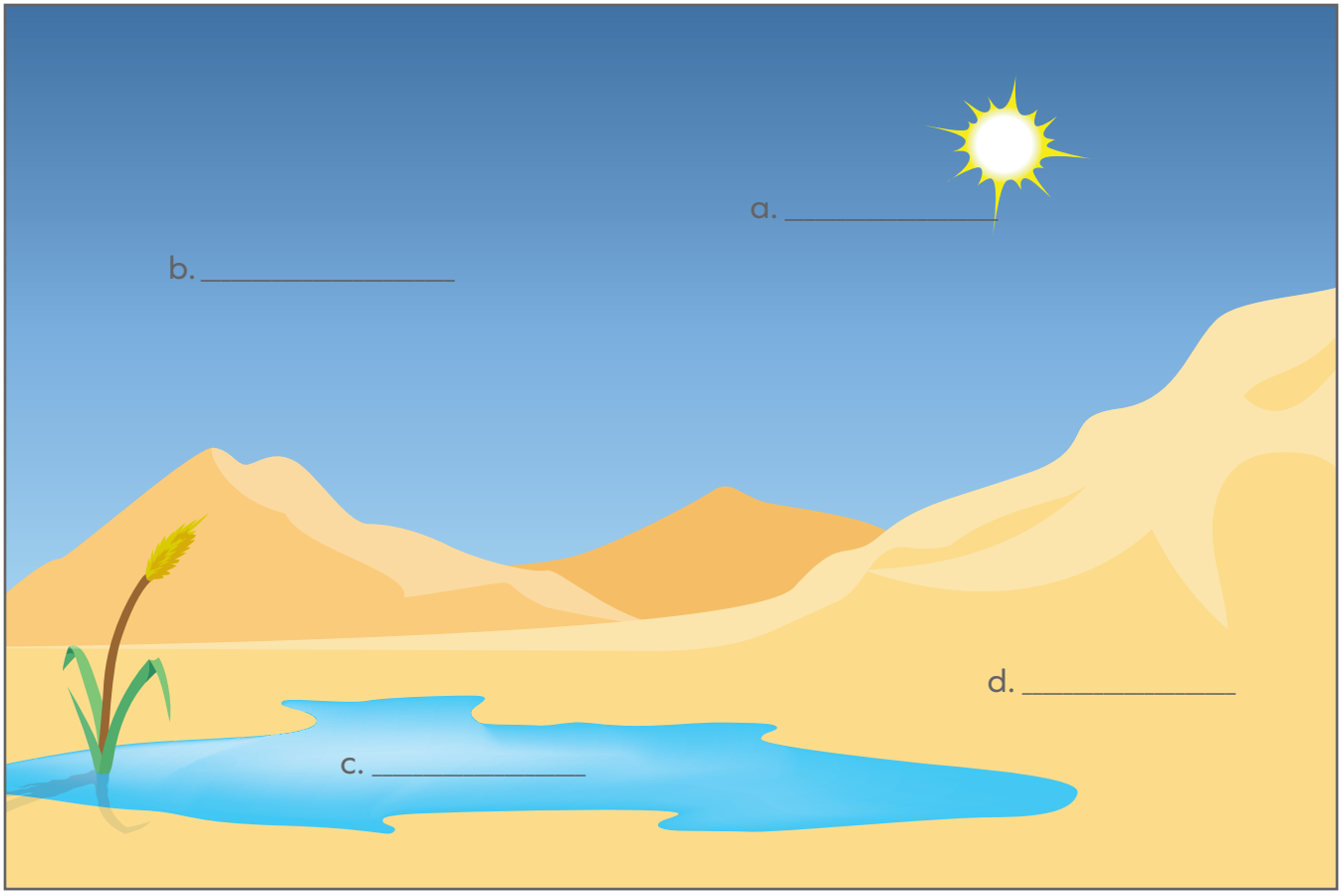
Ecology

You have heard the word **ecology** used often. When the air is dirty, when rivers are not clean, when beaches are covered with oil, are times that you hear ecology mentioned. You have probably collected cans, plastic bottles, cardboard, or paper to be **recycled**. People are concerned about the world. Ecology is the study of the way all living things relate to each other in the world.

Ecology comes from two Greek words which mean *the study or science of the home*. Home doesn't mean just your home but the homes and **environments** of all plants and animals and how they are related to each other.

Look at the picture.

1.25 On the lines write the name of each resource that living things need.



Think and draw.

1.26 What is your environment like? Does it include natural things and people-made things? Does it include people and animals? Does it include pleasant and unpleasant things? On a sheet of drawing paper, make a picture of your environment. When you have finished it, put it in your unit at this page. You will want to look at it again when you study about human communities.

Teacher check:

Initials _____ Date _____

Make four food chains from the plants and animals in this picture.

Example:

owl | mouse | grass | sun

1.30

FIELD TRIP!

Learn about stillwater life.

Stillwater ponds and marshes offer another treasure chest of living things. Catch some animals and bring them to your classroom. In this way, you can observe them closely. This project is one that you should work on with several other classmates and with the permission of your teacher.

What to do before you go: In your library or online, find books or articles about pond and marsh communities. Read about the kinds of life on the list. See what the animals look like in different stages of growth. Find as many pictures as you can so that you will be able to recognize what you see on your field trip. Compare what you find with the information your classmates find.

Young dragonflies	Tadpoles	Water bugs	Parasites
Water striders	Crayfish	Beetles	Turtles
Snails	Snakes	Algae	

Write your findings on other paper. Keep your papers with this page in your unit.

Since you do not want to hurt the animals you bring in, you will want to be careful how you catch them and care for them.

These supplies are needed:

one or more kitchen strainers (or a fine fish net)—lengthen the handles by attaching them to long sticks or broom handles

a number of wide-mouthed jars or plastic bottles—one-liter, two-liter, and four-liter sizes

pans

an aquarium or terrarium if one is available

a hand magnifying glass

some cloth or netting to put over jars

some string, heavy cord

a microscope—when you are back in the classroom

Note: If this activity is not possible, your teacher can set up either the protozoa culture kit or the sea monkey ocean zoo as an alternative.

The oil that is used must be conserved. To use wisely the oil that is left is very difficult. Some people are buying cars that use less gasoline. Others are sharing rides to work with their friends. Some people are keeping their homes cooler in winter. These efforts are only a few ways to help save oil.

Think and write.

3.11 Make a list with a friend of ways to save energy. Use other paper.

Teacher check:

Initials _____ Date _____

Scientists are looking for ways to provide other kinds of energy. Rich underground deposits of coal can be used. Coal is mined before it is used for energy. Power plants in some parts of the country are being run by **nuclear** energy. Another kind of energy is very clean. Scientists are trying to learn how to trap it and use it. They are working on ways to use the energy from the sun, called **solar** energy, to heat houses and water.

| Solar panels

In Israel, water is heated in many homes by solar energy. For ten months a year, the heat from the sun is hot enough to heat water. The water runs through pipes called solar collectors. The warm water is stored in a container on the roof of a home.

Solar ovens have been invented, too. Many mirrors are used to aim the heat from the sun onto the middle of the oven. Of course, the oven has to be outside. People are trying to find ways to save expensive energy and to use clean energy like solar energy.

SCIENCE 404
MACHINES

Think about things!

1.9 Your energy comes from the life within you. Think about how you use your energy to do work every day and write down an example of a task that uses energy every day.

_____

_____

1.10 Can you use your energy as a force to do work? _____

1.11 When do you store energy? _____

1.12 When does stored energy become energy in action?

_____

EXPERIMENT

Try this experiment. Answer the questions as you complete each step.

1.13 Rub your hands together, long and hard. What do you feel? _____ _____ The heat you feel is caused by friction. Friction happens when two things are rubbed together.

1.14 **Think**: When a shuttle enters the atmosphere, it needs a "heat shield" to keep it from burning up. This is because friction from the air has caused _____ .

Look up the facts!

1.15 In your encyclopedia or online, look up James Watt. Find out how he put the steam engine to work. Write a short paragraph about his experiments on a sheet of paper.

Teacher check:

Initials _____ Date _____

science class.

"An important simple machine is the **lever**. The seesaw over in the playground is a lever."

"When your school class went on a rowboat ride at the lake, the oars that you used to row the boat were levers."

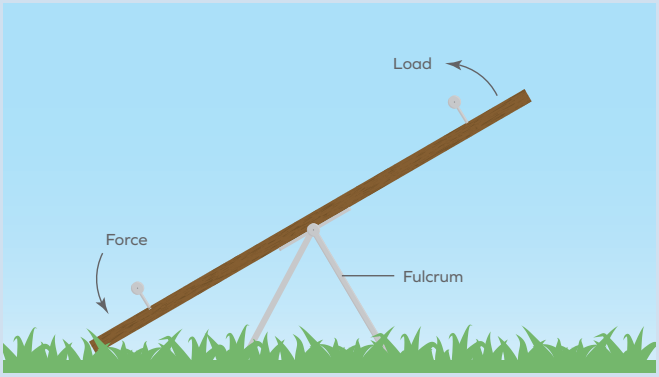
"The carpenter pulling out the nail from the board, is using the hammer as a lever."

"Even your two arms are levers."

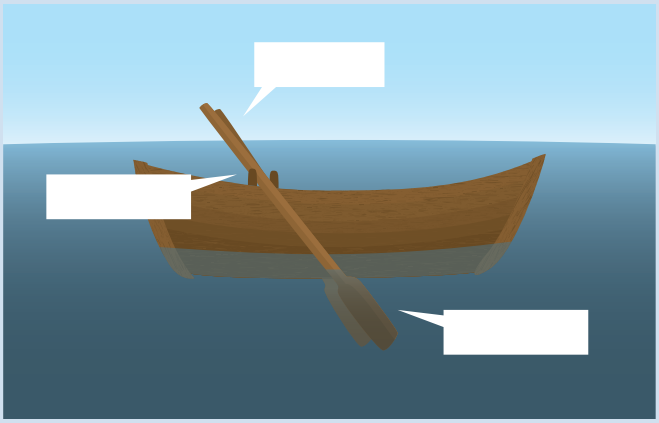
"Every lever has three parts that are the same," said Mr. Miller. Every lever has to be pushed down. The end that is pushed is called the *force*. The end of the hammer handle that is held is the force. The lever rests on the board. Where the lever rests is called the **fulcrum**. The hammer is the fulcrum. Whatever is being moved is the **load**. The nail is the load.

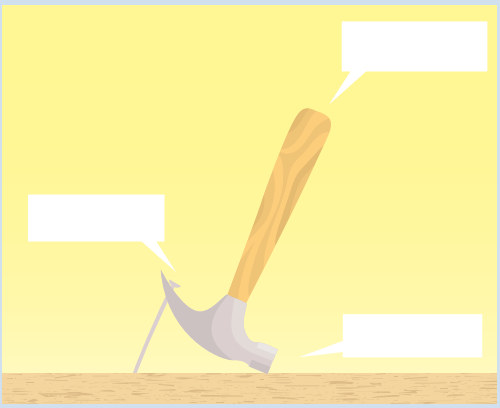
"Do all levers have a force, a fulcrum, and a load?"asked Joe.

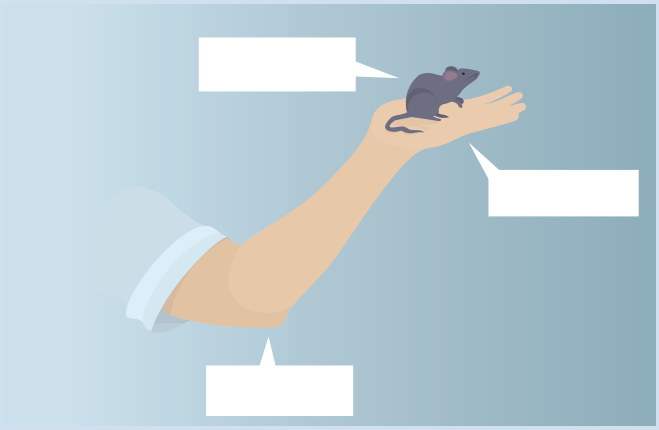
"Yes," said Mr. Miller. "In the seesaw, the load and force change each time you ride up or down. As you ride up, you are the load, Joe. When you have to push down, Bill, you are the force. But as you ride up, Bill, you become the load, and Joe is the force pushing you down."



| Seesaw





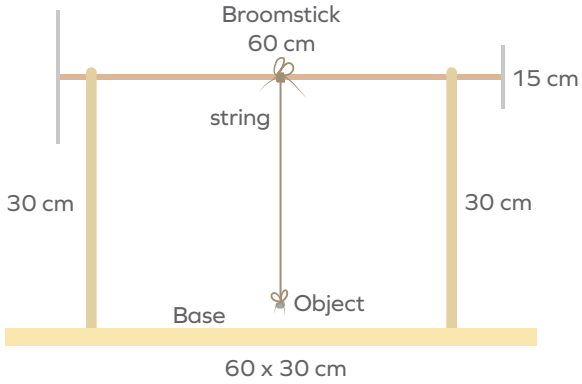


Follow these directions. Check the boxes as you do each step. Answer the questions.

☐ 1. On your 60 x 30 cm piece of wood, find the center line (15 cm from each long edge). Draw a line down the center.
This is your baseboard.

☐ 2. Now, measure 10 cm from each end on the center line and make an X on that spot.

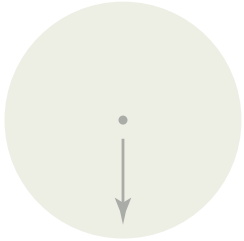
☐ 3. Nail one of your notched posts on each x. Be sure the notches run the same direction as the center line. Your broomstick will lay in these notches and become the axle.



☐ 4. Set your drawing compass at 15 cm and make a circle on the cardboard.

☐ 5. Set the compass again at 7 1/2 cm and make another circle on the cardboard.

☐ 6. Draw an arrow at some point on each wheel.



☐ 7. Cut these circles out and nail one on each end of the broomstick. Be sure your nail is at the exact center of the circle (where the compass point made a hole). If you do not have a compass, tie a piece of string on a nail and do steps 8, 9, and 10. (Otherwise, go now to #11.)

SIMPLE MACHINE CHART

SIMPLE MACHINES	WHAT IT IS...	HOW IT HELPS US WORK	EXAMPLES
Lever	A stiff bar that rests on a support called a fulcrum	Lifts or moves loads	Shovel, nutcracker, seesaw,crowbar, elbow, tweezers, bottle opener
Inclined Plane	A sloping surface connecting a lower level to a higher level	Things move up or down it	Slide, stairs, ramp, escalator, slope
Wheel and Axle	A wheel with a rod (called and axle), through its center; both parts move together	Lifts or moves loads	Car, wagon, doorknob, pencil sharpener, bike
Screw	An inclined plane wrapped around a pole	Holds things together or lifts	Screw, jar lid, vise, bolt, drill, corkscrew
Pulley	A grooved wheel with a rope or cable around it	Moves things up, down, or across	Curtain rod, tow truck, mini-blind, flag pole, crane
Wedge	An object with at least one sloping side ending in a sharp edge	Cuts or spreads an object apart	Knife, pin, nail, chisel, axe, snowplow, front of a boat

Review the material in this section to prepare for the Self Test. The Self Test will check your understanding of this section and will review the previous section. Any items you miss on this test will show you what areas you will need to restudy in order to prepare for the unit test.

SCIENCE 405
ELECTRICITY AND MAGNETISM

ELECTRICITY AND MAGNETISM

Have you ever combed your hair on a cold day and heard the snap of electricity? Your hair may have stood on end! Maybe you discovered that your comb would pick up bits of paper right after you combed your hair. Have you helped your mother take clothes out of the dryer, and seen them cling together? Have you shuffled your feet across a rug, and then taken hold of a doorknob? Did you feel a tingle or a shock? You may have seen a spark. In each case, some things were rubbed together. If an object can attract other objects to itself after it has been rubbed, it is said to be *charged*, or made electric.

In this unit, you will study about electricity. You will read about some men and their discoveries. You will also make discoveries of your own. When you have finished the unit, you will have learned some amazing things. You will also know how to make use of electrical power.

You use electricity in many ways in your daily life. You are comfortable using it, but you still must respect its power. You must use electricity carefully and safely.

From Current to Circuit

We know that lightning is a form of electricity. We still do not know how to make use of lightning. Lightning comes and goes in a split second. To be useful, electricity must flow, not come and go. Electricity that flows without stopping is **current electricity**.

| A dry cell

Electric cells. In the late eighteenth century, an Italian scientist named Alessandro Volta made a discovery. Volta discovered that when two different metals were placed in certain liquids, an electric charge would flow. The charge would flow through a wire **connecting** the metals.

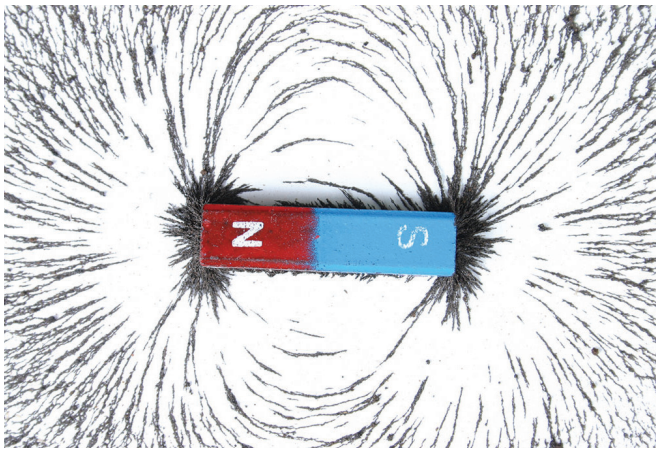
The two pieces of metal were called electrodes. The liquid was called an electrolyte. Volta had made an electric cell. He used copper and zinc as the electrodes for the electric cell. He used an electrolyte of salt water. Volta's cell was called a wet cell. Today a dry cell is used.

Electric cells are used to make current electricity. Current electricity is made in very large amounts to supply our lights, toasters, washing machines, and other everyday equipment. Current electricity is also used to run factories of many kinds.

Complete this sentence.

1.20 The three parts of an electric cell are one a. _____ and two b. _____ .

Magnetic poles. The ends of a magnet are called poles. All magnets have a north pole and a south pole. The poles of the magnet are able to attract magnetic materials with the greatest amount of force.



| A magnet with iron filings

FIND THE NORTH POLE AND SOUTH POLE OF A MAGNET

These supplies are needed:

some iron fillings
a bar magnet
one sheet of paper

Follow these directions and answer the question. Put a check mark in the box when each step is completed.

- ☐ 1. Lay one sheet of paper over the bar magnet.
- ☐ 2. Sprinkle iron filings lightly over the part of the paper covering the magnet.
- ☐ 3. Watch the filings move into patterns.

2.9 Where are the filings the thickest? _____

Teacher check:

Initials _____ Date _____

Generators. When you experimented with a magnet to make electricity, you made only a small amount of electric current.

Machines have been invented to make current flow in greater amounts. A machine that makes electricity in large amounts is called a **generator**. Huge generators are used in power plants. Some generators are much larger than your house. These large generators work in the same way as the small generator that you made.

After electricity is generated in the power plant, it leaves the generator through wires. Electricity for a whole city can be made. The wires connect with other wires leading to other parts of the city. Some of these wires are strung on poles high in the air. In most areas of new housing, however, wires are now laid underground.

| Generators

The wires leading out from the generator must lead back to the generator. The circuit must be complete or the electricity cannot travel.

SCIENCE 406
PROPERTIES OF MATTER

Water as a Solid

Normally, we think of water as a liquid; however, water changes with temperature changes. Water can be a solid, a liquid, or in a gas form. When water freezes, it is a solid—ice. At room temperature, water is liquid. When heated, water becomes a gas—**steam**.

Freezing water **expands**, taking up more space. You may be surprised to learn that ice is lighter than water. Because it is lighter, ice floats in liquid water. In cold winter months, ice forms on top of streams, ponds, and some lakes. Because ice floats, animals and plants in streams and ponds are able to survive the freezing winter months. Animals escape below the ice to the liquid water nearer the bottom of the pond or stream where plants remain alive.

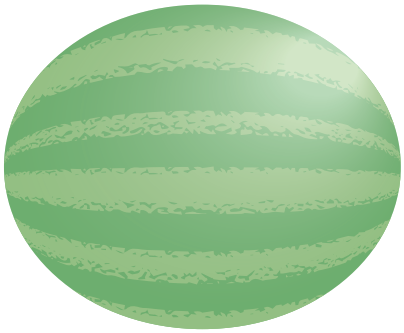
A **glacier** is a large ice formation on land. These huge ice formations can move down the slope of a mountain or across a land area. The word *glace* means *ice*. People can see a large glacier in Montana's Glacier National Park.

Sometimes, large chunks of ice break away from land and move out into the oceans. These floating mountains of ice are **icebergs**. The word *berg* means *mountain*. An iceberg is an "ice mountain." Only about one-tenth of an iceberg is above the surface of the ocean. The rest of the iceberg is under the ocean's surface.

Two types of thermometers are used for measuring the temperature of water. The first is known as the **Fahrenheit** thermometer. This thermometer was named for Gabriel Daniel Fahrenheit (1686-1736), a German scientist

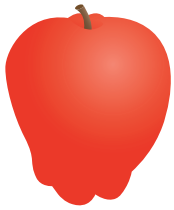
| A glacier

| An iceberg

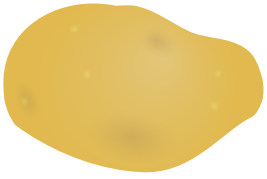


watermelon: $\frac{9}{10}$

milk: $\frac{9}{10}$

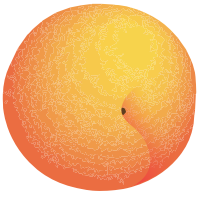


apple: $\frac{8}{10}$



potato: $\frac{8}{10}$

egg: $\frac{7}{10}$



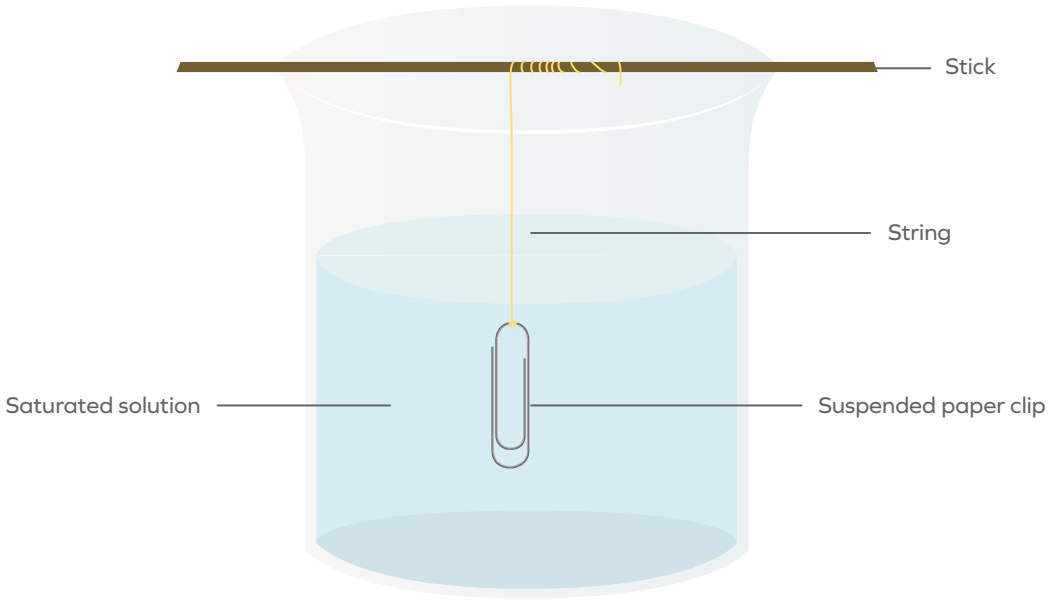
peach: $\frac{9}{10}$

| Amount of Water In Some Food

These tiny pieces of materials captured by the rain go into the soil and are used by plants as food. In the plants, water acts as a delivery system, moving the food to all parts of the plants. The roots take water from the soil. Small tubes carry the water from the roots through the stems and to the leaves.

Just as in a plant, water works as a delivery system for humans and animals. Water dissolves food into nutrients so it can be used by the body. Water carries nutrients to all parts of the bodies of people and animals. Your blood is about 50 percent water and carries food to all parts of the body. Water also cleanses the inside of the body by carrying off body wastes.

All living things need water. It keeps plants, animals, and people alive.



Method of Making Crystals

☐ 6. Show some of your crystals to someone if you are successful.

Teacher check:

Initials _____ Date _____

Do these activities. The same method used for making salt or sugar crystals in the previous experiment is used for making alum crystals.

1.61 Use the dictionary, encyclopedia, or the internet to answer this question: What is alum used for?_____

_____

_____

Find these words. In the word maze below are the names of some elements. They may be up, down, across, or backwards. Circle the words in the maze when you find them.

2.24

iron	gold	hydrogen	
zinc	tin	silver	helium
argon	oxygen	iodine	cobalt

O	A	C	W	C	H	A	L	Z	O
X	C	B	C	L	E	F	K	Y	C
Y	Q	R	V	S	L	L	M	L	T
G	B	Z	C	N	I	Z	N	G	R
E	V	C	L	R	U	I	R	O	N
N	O	G	R	A	M	N	S	L	T
I	O	D	I	N	E	C	F	D	A
N	E	G	O	R	D	Y	H	T	U
C	Q	L	H	S	I	L	V	E	R
B	V	C	I	W	Y	G	S	R	L
N	C	T	F	C	O	B	A	L	T
T	I	N	V	W	R	U	S	U	V

Fill in the blanks, using words from the Word Bank.

penny	100	atom	compound
H	O	silver	elements

2.25 The basic materials that make up the earth are called _____ .

2.26 There are over _____ kinds of elements in the world.

2.27 One kind of element is _____ .

2.28 A(n) _____ contains the element copper.

2.29 Elements are made from one kind of _____ .

2.30 The symbol for the element hydrogen is _____ .

2.31 The symbol for the element oxygen is _____ .

2.32 Water is made from two elements which form a(n) _____ .

Do these activities.

2.33 Write a short report (less than one page) on some states and properties of water. Use an encyclopedia or the internet to find information.

Teacher check:

Initials _____ Date _____

2.34 The letter *r* controls vowels. The letter *r* tells a vowel in front of it to say another sound. The letter *r* does not change the vowel sound that goes after it.

Write words from the list on the lines under the bird and the car.
Write the words that say /ar/ as in *car* under the picture of the car.
Write the words that say /ir/ as in *bird* under the picture of the bird.

third	scarlet	star	farm
guitar	girl	stir	shirt
skirt	circle	large	hard

The Sounds /ar/ in Car and /ir/ in Bird

a. _____ g. _____

b. _____ h. _____

c. _____ i. _____

d. _____ j. _____

e. _____ k. _____

f. _____ l. _____

SCIENCE 407
WEATHER

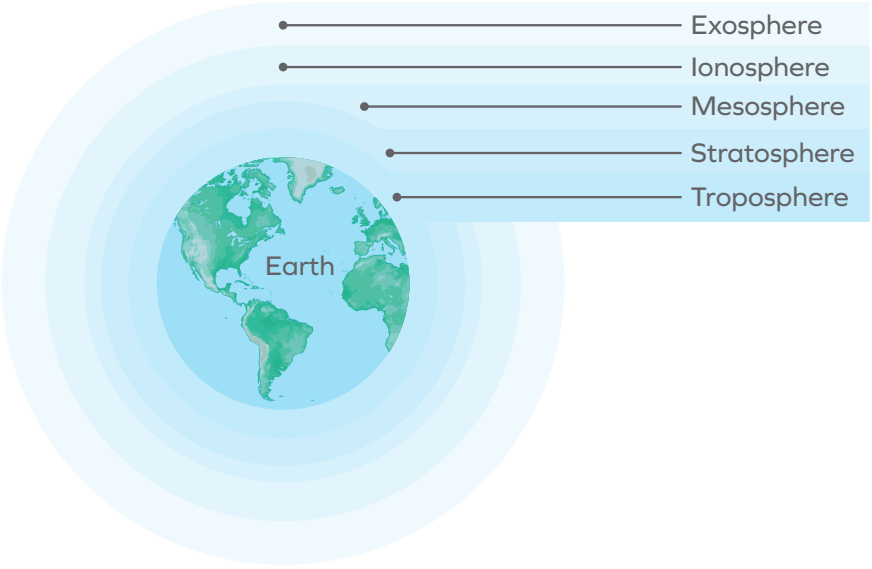
Atmosphere

Do you know that when you came to school this morning, you were walking through an ocean of air? You live at the bottom of a huge ocean of air called the **atmosphere**.

You cannot see the air. Scientists do not know exactly how far into space the air **extends**. Scientists do know that the airplanes that take off and land every day at busy airports depend upon air. Clouds float on air. Birds fly through it. All living things, including humans, animals, and plants, have to have air in order to live.

You feel air moving when you go outdoors. You see the result of air when you look at the swaying treetops or at rustling corn. You feel the air blowing across your face. Sometimes you see the damage it can cause to buildings and trees that happen to be in its path when it blows with force.

Although scientists do not know the exact limits of our atmosphere, they know that air is about one thousand miles (1,600 kilometers) in all directions around our earth. By using weather balloons, planes, and rockets, weathermen have studied the atmosphere. They have found out many exciting facts about it, and they are learning more every year.



| Layers of the atmosphere

Scientists have named the levels of the atmosphere. Air nearest the earth is called the **troposphere**. The word *troposphere* comes from a Greek word that means to *turn* and *mix*. In this **layer** the mixing and turning of the air takes place. The troposphere contains almost all the air and most of the water **vapor** in the atmosphere. The great wind belts, the clouds, and the weather are all part of the troposphere.

The lower part of the troposphere, which is the earth's weather zone, extends only about ten miles (about 16 kilometers) in all directions from the earth. The air not only moves across the land, but it moves up and down, causing wind belts.

Complete the following sentences.

1.18 Heat travels from the sun to earth by _____ .

1.19 Rays of sunlight come through the _____ to the earth.

1.20 Anything that lets light through it so that objects can be seen easily is said to be _____ .

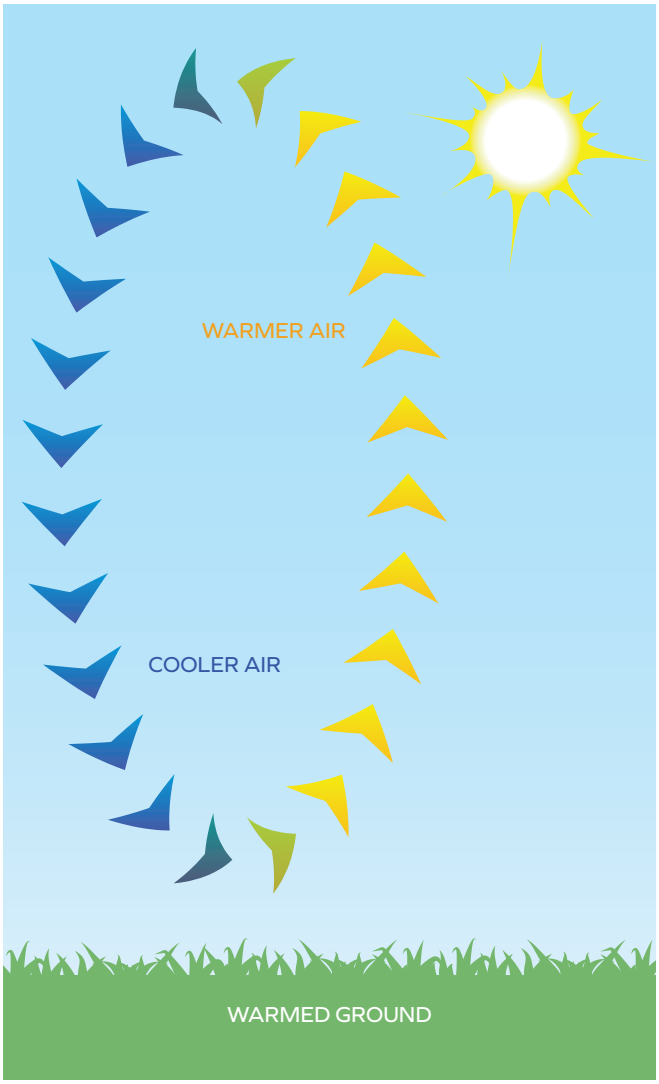
1.21 Glass is _____ .

1.22 The air that is _____ to the ground is usually warmest.

1.23 When we go to the mountains, the temperature is often several degrees _____ there.

1.24 The temperature, in normal weather conditions, drops _____ degrees Fahrenheit for every 1,000 feet of altitude.

1.25 This temperature (in question 1.24) is the same as _____ degrees Celsius.



| Air goes up when warmed by the earth

Rainstorms, Thunder, and Lightning

Strong winds are starting to blow. The sun is retreating behind a cloud—or so it seems. The huge, dark cloud is getting bigger and bigger until it seems to be covering the whole sky. Suddenly a bright flash of light darts across the darkened sky. A few seconds pass. Then it happens! A loud clap of thunder crashes through the clouds. The thunderstorm is getting nearer.

You wonder how far away the storm is. You can find out if you remember that light travels faster than sound. Light travels at 186,000 miles (300,000 kilometers) per second. Sound travels more slowly, at about 1,000 feet (330 meters) per second. Because of this difference in the speed of light and the speed of sound, you can count the number of seconds between the flash of light and the time when you hear the thunder.

Count the number of seconds between the time you see the flash and the time you hear the thunder. Divide that number by five. The answer will be the distance in miles between you and the flash. Count the seconds slowly: one-one-hundred, two-one-hundred, three-one-hundred, and so forth. This table shows how far away lightning is when you count the seconds.

NUMBER OF SECONDS FROM THE TIME YOU SEE THE FLASH TO THE TIME YOU HEAR THE THUNDER	NUMBER OF MILES THE LIGHTNING IS AWAY FROM YOU
5	1
10	2
15	3
20	4
25	5
30	6

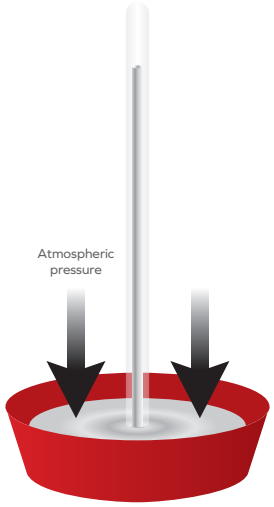
As you already guessed, the thunder is caused by the lightning. The flash of lightning heats the air in its path to about 27,000 degrees Fahrenheit (15,000 degrees Celsius) in a tiny part of a second. The air expands and rushes in all directions and causes the sound of thunder.

If you are in a car during a thunderstorm, stay there. Lightning does not usually strike a closed car. If you are out-of-doors, take shelter from the storm in a building. If you cannot do that, crouch in a low place. Since lightning often strikes high trees, you should not stand under a tree. If you are in a boat or swimming, get to land as soon as possible.

Barometers. Another instrument that is used to study weather is the **barometer**. The barometer shows what the air pressure is at any one time. The air pressure changes often.

In 1644, an Italian scientist by the name of Torricelli found that he could measure air pressure. He filled a small dish with mercury. He placed a mercury-filled glass tube, closed at the upper end, into the dish. As the air pressure changed, the mercury in the tube rose or fell.

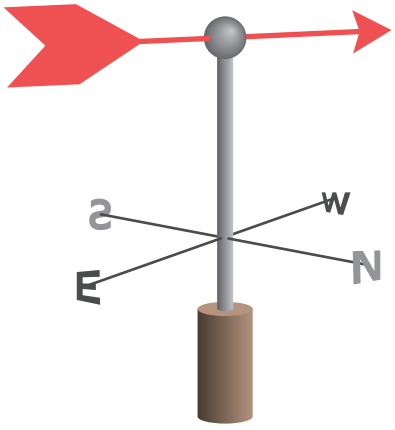
He found that if the column of mercury began to go down rapidly, bad weather was ahead. After a storm was over, the mercury would rise in the tube again. Meteorologists use this type of barometer today.



| Liquid Barometer

Another type of barometer is the **aneroid** barometer. This kind of barometer is without liquid. A small one can be carried in a pocket. It looks somewhat like a clock. It has a small metal box in which all the air has been taken out. The side of the box moves in and out as the pressure changes. A pointer attached to box shows the air pressure on a dial.

Weather vane. You probably know that the quickest way to tell the direction of the wind is to wet your finger, hold it up, and decide which side of the finger becomes cool. The side that is cool tells you from which direction the wind is coming. The wet side of your finger is cooled by air movement. Another way to tell wind direction is by using a weather **vane**. An instrument called a weather vane, or wind vane, can be easily made from scrap wood or metal. It can be mounted in such a way that it will move freely with the wind. Watching it will tell you the direction from which the wind is blowing. Books in the library or instructions found online will help you to make such an instrument at home.



| Weather Vane

SCIENCE 408
OUR SOLAR SYSTEM AND THE UNIVERSE

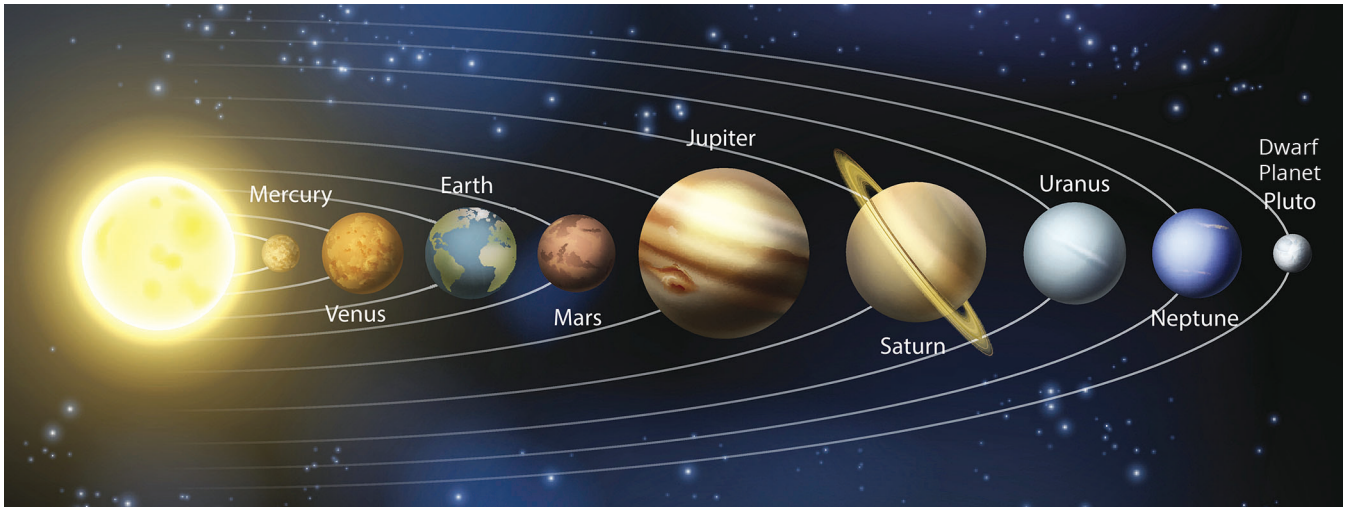
Our Solar System

Are you ready for a trip through our **solar** system? Then jump into your imaginary spaceship. Buckle your seatbelt. Turn on the oxygen supply. Give the signal to blast off!

We leave planet Earth at the speed of light. Light travels 186,282 miles (299,792 kilometers) per *second*. As we leave the Earth's **atmosphere**, we notice that the sky is *black* and the stars can be seen all day.

In less than two seconds, we reach our nearest neighbor, the moon. While we do not plan to stop here, we get a quick glimpse as we whiz by. We take a quick snapshot of the moon's surface from our window. We notice the moon's deep **craters**, broad, dark plains, and lofty mountains.

At the moon, we are about 240,000 miles (386,160 kilometers) from Earth. Our navigator takes another "sighting" of the stars and charts a course that will take us toward the planets but away from the sun. Because the sun is a glowing ball of hot gases with a surface temperature of 11,000 degrees Fahrenheit (6,092° centigrade), we will be careful to pass it at a safe distance.



| Our Solar System

As we travel away from the sun, we shall leave behind two planets —**Mercury** and **Venus**. Mercury is the second smallest of the planets. Mercury and Venus are closer to the Sun than Earth. Ahead of us are five more planets — **Mars**, **Jupiter**, **Saturn**, **Uranus**, and **Neptune**. All of the planets revolve around the sun. About four minutes after leaving Earth, we pass Mars. We notice what looks like a dust storm blowing over a desert. These desert areas probably give Mars its red look as we view it through a **telescope** from Earth.

Make a model.

2.67 Make a model of our solar system. Use a large sheet of construction paper as the background. From scraps of colored paper, cut out the sun and the planets. Remember the facts you read about in this section: Jupiter is the largest planet, Mars looks red, asteroids are between Mars and Jupiter, and Saturn has rings. Include these facts in your model. Glue the sun and planets in correct order on the large sheet of construction paper. Label each planet. Show the model to your teacher when you have completed it. Perhaps you can display your model on a bulletin board in your classroom.

Teacher check:

Initials _____ Date _____

Our Moon

Planet Earth has one natural satellite or moon. The moon is our nearest neighbor in space, making it easiest to study.

Distance from the Earth. The most difficult problem in astronomy is measurement of distance. To know whether one is looking at a bright object in the sky a long way off, or at one nearby is difficult. About 300 BCE, the Greeks discovered a way to find the distance of the moon from the earth. This discovery was a great achievement for people with simple instruments. Today, astronomers use a radio telescope. Radio signals are bounced off the moon to measure the distance from the earth. They also measure other heavenly bodies in the same way. Earlier in your unit, you learned that

**In previous units, references to dates have included BC and AD. Modern historians typically use BCE and CE, which are abbreviations for Before Common Era and Common Era. The abbreviations refer the the same time periods as BC and AD.*

PHASES OF THE MOON

These supplies are needed:

- flashlight
- rubber ball (about 6 inches in diameter)
- large white sheet of paper
- three other students

Follow these directions and answer the questions. Check the boxes as you do each step.

☐ 1. On the sheet of paper write the word "Earth." Give the sign to one student and who then stands in the middle of the room.

☐ 2. Give the rubber ball to another student. The ball will represent the moon. The student holds the ball in front of them and stands five feet behind the "Earth." They might have to stand a few inches to one side of the "Earth."

☐ 3. A third student holds the lit flashlight and stands five feet in front of the student labeled "Earth." The flashlight represents the sun.

2.68 If the student labeled "Earth" looks toward the rubber ball how much of it is receiving the light? _____

_____

2.69 What phase is the moon in when we see its whole face? _____

☐ 4. Move the student with the ball so they are five feet in front of the "Earth."

2.70 Now how much of the moon can be seen from the earth?

_____

2.71 What do we call this phase of the moon? _____

☐ 5. Move the student with the ball to the left of the earth.

2.72 How much of the moon's lighted surface can the earth see now?

_____

This phase is called the first quarter. When the ,oon is on the right of the earth, the phase is called the last quarter.

☐ 6. Try moving the moon in other positions and note how much of the moon's surface is lit from the earth's point of view.

For navigation. There is one star in the night sky that does not seem to move because it is almost directly above Earth's rotational axis. It's called Polaris, or the North Star. The North Star is directly over the North Pole, so whenever we point toward a spot on the earth's horizon right below the North Star, we are pointing north. Sailors sometimes use the North Star as a navigational tool.

Tracking seasons. From Earth, the stars appear to change location during different seasons. The stars do not really change. Due to the revolution of the earth they seem to change. In the Northern Hemisphere, we can see groups of stars called **constellations**. Many, many years ago, people imagined they saw pictures in the sky. They made up stories about these "star pictures." We call these pictures constellations. Each constellation appears at a different season of the year. For instance, in April, May, and June, one can see the constellation Leo.
This group of stars is imagined to take the shape of a roaring lion.

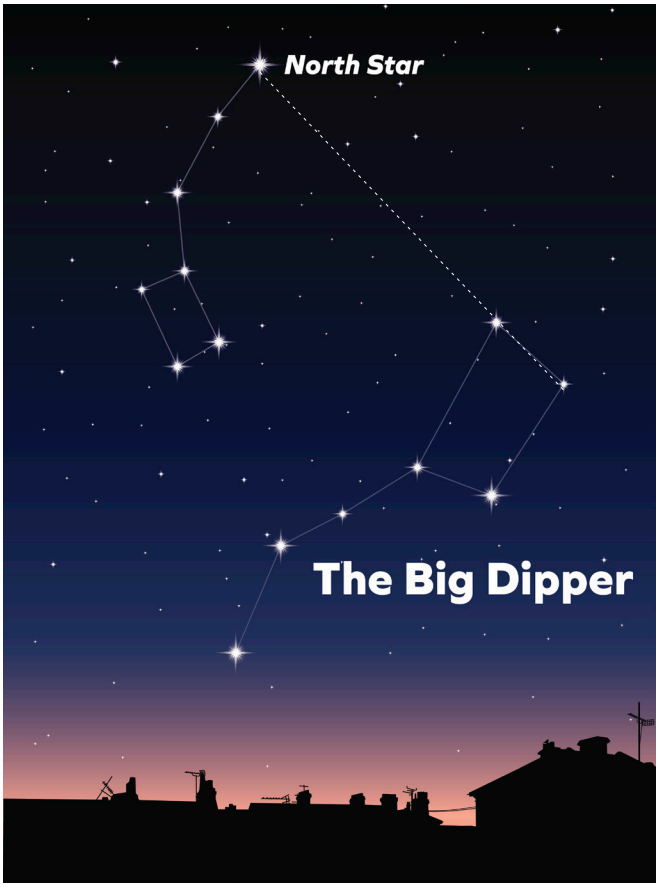
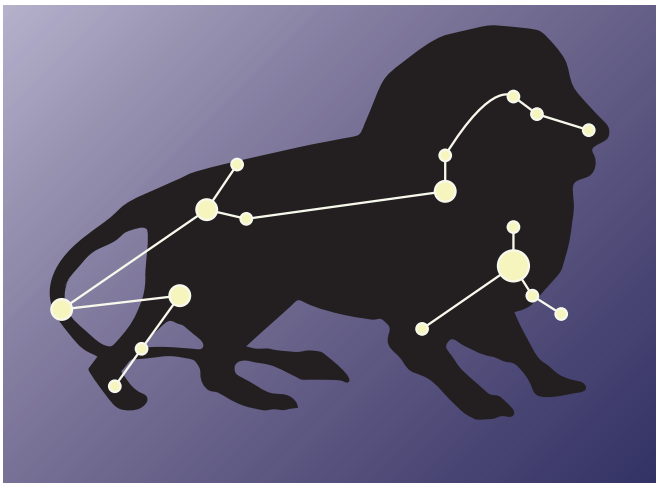


Figure 2 | the Big Dipper and the North Star



| "Star Picture" Leo the Lion

Do this activity.

3.23 If you were to study something in space, what would you study? Write about what you would like to study and explain why.

Complete the puzzle.

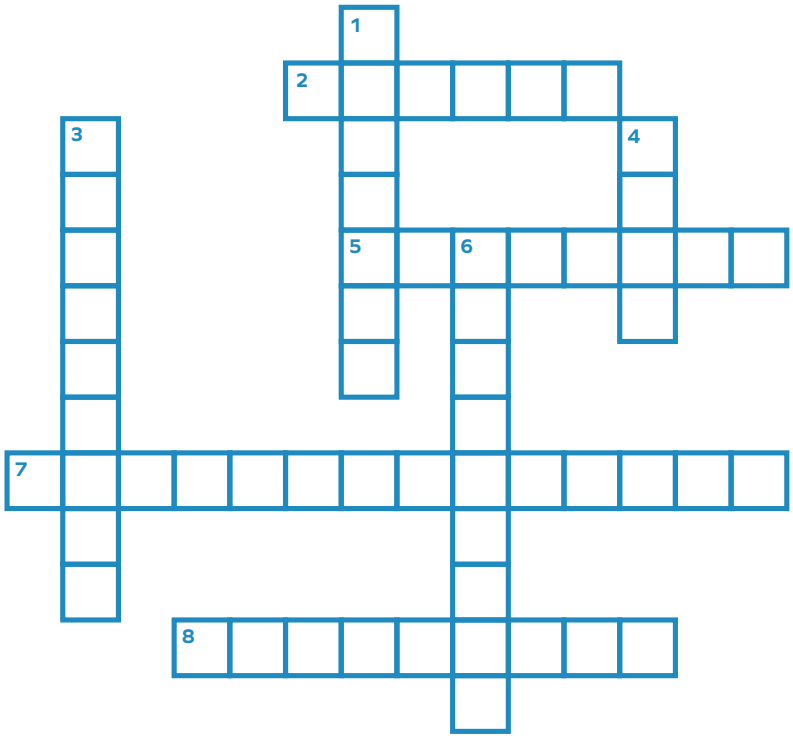
3.24 Use the clues to find the words for the puzzle.

Across

2. a large group of stars far out in space
5. having no limits or boundaries
7. star pictures imagined by the ancients
8. the scientific study of the universe beyond the earth

Down

1. to decorate
3. a false science or superstition
4. imaginary line
6. the sky



SCIENCE 409
THE PLANET EARTH

Write an answer from the list to complete each sentence.

one-fifth	nitrogen	earth	Joseph Priestley
oxygen	mixture	Antoine Lavoisier	

1.8 Oxygen was discovered by _____ .

1.9 Air is part of the _____ .

1.10 The atmosphere is made up of a(n) _____ of gases.

1.11 The element in air most needed for breathing is _____ .

1.12 The element that makes up about four-fifths of the air is _____ .

1.13 Oxygen makes up about _____ of the air.

Complete this activity.

1.14 Color the balloon red that stands for oxygen, the one for nitrogen yellow, and the one for neon, argon, and carbon dioxide blue.

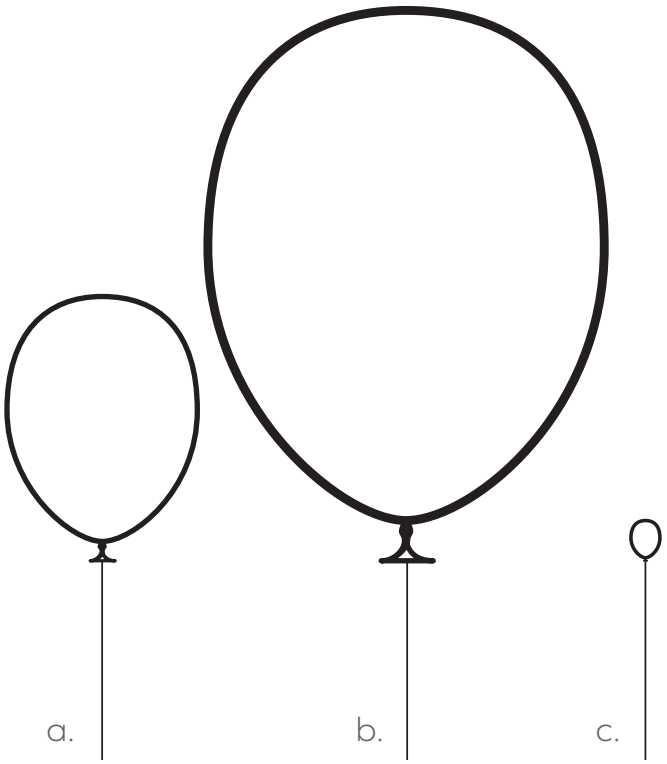


Figure 3 | Amount of gases in our air

2. THE WATER (HYDROSPHERE)

All of the bodies of water on Earth are called the hydrosphere. *Hydro* means *water* and *sphere* means *globe*. All of the oceans, lakes, rivers, and ponds are part of the hydrosphere. Most of Earth is covered by water. In fact, 71 percent (71 parts of 100), or almost three-fourths, of Earth's surface is covered by water. Yet, 97.2 percent of the hydrosphere is salt water.

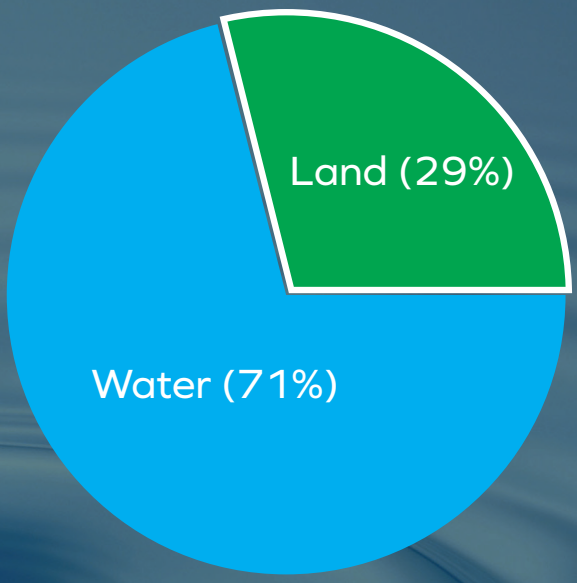


Figure 6 | Amounts of water and land on Earth

Having all of this water on Earth helps us in many ways. One way it helps is by making a place for all of the sea creatures and plants to live. Also, a lot of heat from the sun is stored in Earth's water. Storing the sun's heat keeps the land warmer and prevents the land from becoming too cooled by the air. Another thing the water does is to provide a place for ships to travel. The ships carry goods between nations. Shipping makes it possible for us to buy many things such as toys, electronics, and oil from other countries. Lastly, fresh water is necessary for personal survival. Adults need about 8 liters of water each day.

Make a drawing to illustrate each word. Color each one.

2.6 lake

2.7 pond

2.8 river

Teacher check:

Initials _____ Date _____

eclipse (i klips'). A complete or partial blocking of light passing from one heavenly body to another. For example, an eclipse of the sun occurs when the moon is between the earth and the sun, it cuts off all or part of the sun's light.

fault (fôlt). A break in the crust of the earth.

granite (gran' it). A hard, fire-made rock.

gravity (grav' u te). The natural force that causes objects to move or tend to move toward each other.

horizon (hu rī' zun). The line where the earth and sky seem to meet.

plain (plān). A flat stretch of land less than 2,000 feet above sea level.

plateau (pla tō'). A large, flat stretch of land over 2,000 feet above sea level.

revolve (ri volv'). To move in a circle around a point.

rotate (rō' tāt). To move around a center, or axis.

sphere (sfir). A round, solid figure.

tilt (tilt). To tip, slope, or slant.

Pronunciation Key: h**a**t, **ā**ge, c**ã**re, f**ä**r; l**e**t, **ē**qual, t**ė**rm; **i**t, **ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u̇**t, r**ü**le; **ch**ild; lo**ng**; **th**in; /ŦH/ for **th**en; /zh/ for mea**s**ure; /u/ or /ə/ represents /a/ in **a**bout, /e/ in take**n**, /i/ in penc**i**l, /o/ in lem**o**n, and /u/ in circ**u**s.

Layers of the Earth

The planet Earth is made up of many different substances. These substances and materials are organized in certain ways. The earth is not the same from the center to the outside surface. It is divided into four main layers: crust, mantle, and two core parts. You will learn about these layers in this section.

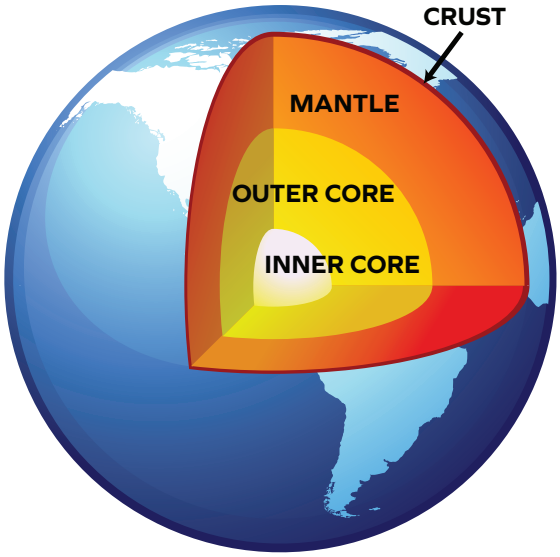


Figure 10 | Layers of the earth

Crust. The part of the earth just under your feet and around you is the crust. The crust is the outer surface of the earth. The outer surface is made up of mountains, plains, valleys, and seas. The crust often looks very bumpy and uneven. If you were to look at the surface of the earth from far out in space, it would look very smooth. It would look as smooth as the skin of a peach.

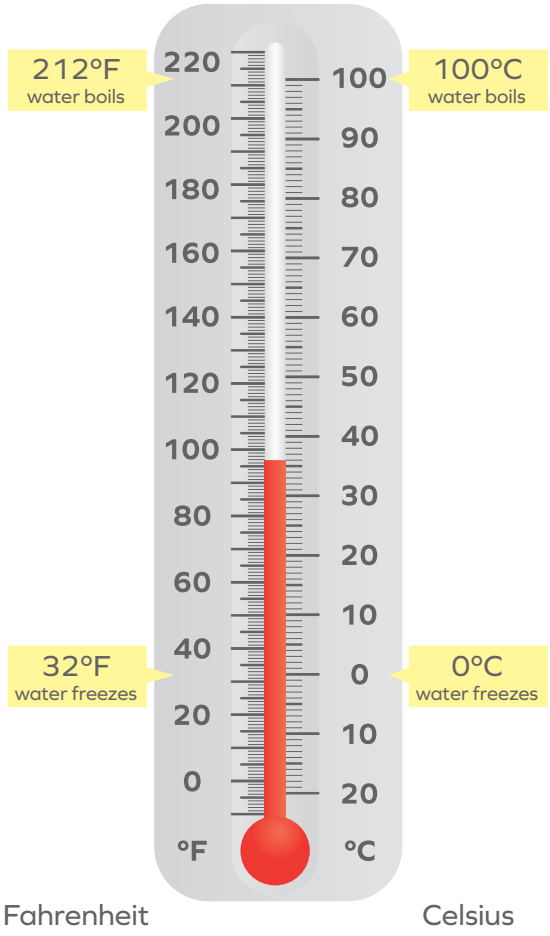
SCIENCE 410
UNDERSTANDING OUR EARTH & SOLAR SYSTEM

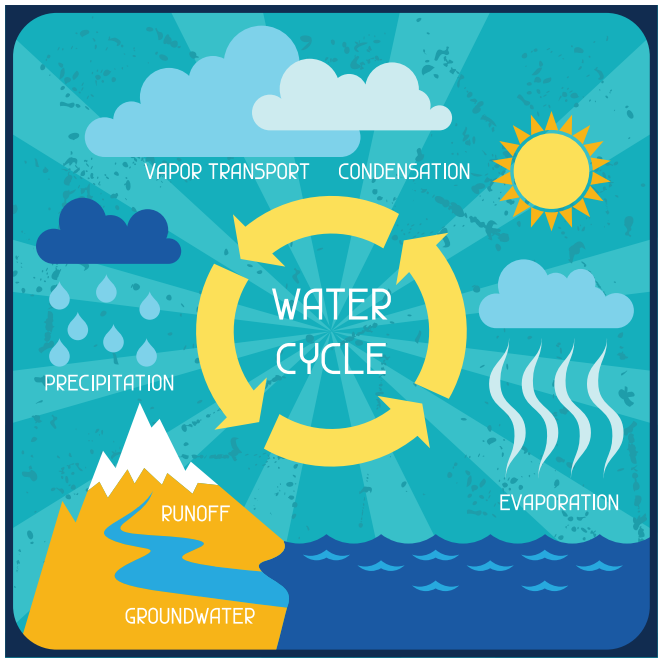
Forms. When the temperature changes, water changes its form. When water become very cold (32 degrees F or 0 degrees C), it freezes and becomes a solid. When the temperature gets warmer, the ice melts and becomes a liquid. When the water boils (212 degrees F or 100 degrees C), it becomes steam, which is gas.

From studying Science 407, you will recall that the two most common thermometers are the Fahrenheit and Celsius thermometers. The Fahrenheit thermometer was named after the German scientist, Gabriel Fahrenheit. The Celsius thermometer is divided into one hundred equal parts between the freezing point and the boiling point of water at sea level. The boiling point of water on the Celsius scale is 100 degrees, and on the Fahrenheit scale it is 212 degrees. All scientists use the Celsius thermometer in their work.

The food you eat contains a great deal of water. Cucumbers, peaches, and watermelon are more than nine-tenths (nine of ten parts) water. Apples and potatoes contain eight-tenths water. Water is all around you. Water is in the air. It is in the leaves and trunks of trees. Your body is seven-tenths (seven of ten parts) water.

Sources. The chief sources of water are rain and melting snow. When the sun warms the oceans, lakes, and streams, it causes water to evaporate. The water changes from a liquid to water vapor. This water vapor rises with the air and forms





| Water cycle

| Sir Isaac Newton under an apple tree

The laws of gravity were first discovered by Sir Isaac Newton. He said the idea came to him while he was in the garden drinking tea. An apple fell to the ground at his feet. He realized that the same force which drew the apple to the ground keeps the moon in its orbit around the earth.

While scientists know about the laws of gravity and how they work, they do not yet know or understand the cause of gravity. Why one body in the universe attracts another is still a mystery to them. But from Newton's discovery and scientific studies since then, we do know that every object in the universe that has mass attracts any other object in the universe that has mass.

Answer these questions.

3.34 What is a conductor? _____

_____

3.35 What is an insulator? _____

_____

3.36 What is usually used to break a circuit? _____

_____

Electricity has many uses. If it is used correctly, it is helpful in doing many kinds of work. It lights our homes. It moves large trains. It helps lift heavy loads. If it is not used correctly, it can be very harmful. Some rules to remember when working with electricity are listed in the box.

Rules and Safeguards to Follow

1. Have dry hands before touching a switch, electric cord, fuse, or any type of electrical equipment.
2. Do not allow any part of your body to touch a water pipe or faucet while working with electricity.
3. Do not stand in water or on a wet surface when working with electricity.
4. Check all cords to see that they are properly insulated.

Do this activity.

3.71 Complete this chart by writing the correct word under each heading.

pulley, wheel and axle, crane, clock, automobile, typewriter, lever, bicycle, hammer, wedge, ax, oars, inclined plane, eggbeater, block and tackle, dredge, pile driver, seesaw, ramp, windlass

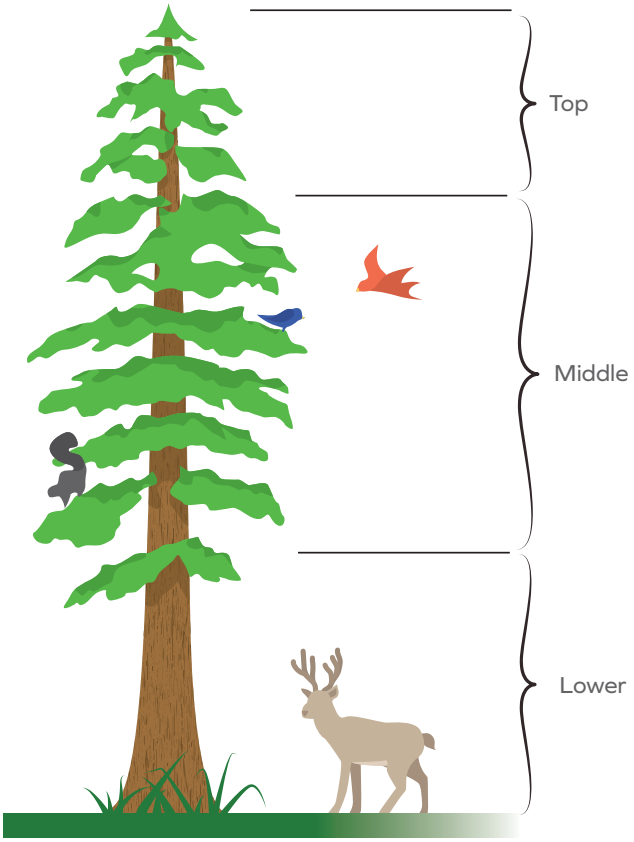
SIMPLE MACHINES	COMPLEX MACHINES
a.	l.
b.	m.
c.	n.
d.	o.
e.	p.
f.	q.
g.	r.
h.	s.
i.	t.
j.	
k.	

Review the material in this section to prepare for the Self Test. The Self Test will check your understanding of this section and will review the other sections. Any items you miss on this test will show you what areas you will need to restudy in order to prepare for the unit test.

and dry, animals living there get most of their moisture from their food.

A forest is a very special kind of community. Here plants and animals live on three levels. The tree branches are at the top level, plants are at the middle level, and ferns and berries are found at the lower level. Among the forest dwellers you would find squirrels, chipmunks, porcupines, raccoons, and opossums. You might also find grouse, deer, foxes, and bears. Many kinds of birds, insects, and flowers inhabit the forest.

In the human community, you are dependent upon other humans for many needs of life. You also depend upon plants and animals for food.



| Forest community

Answer this question.

4.9 What are the six kinds of natural communities described in this unit?

a. _____ b. _____

c. _____ d. _____

e. _____ f. _____

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