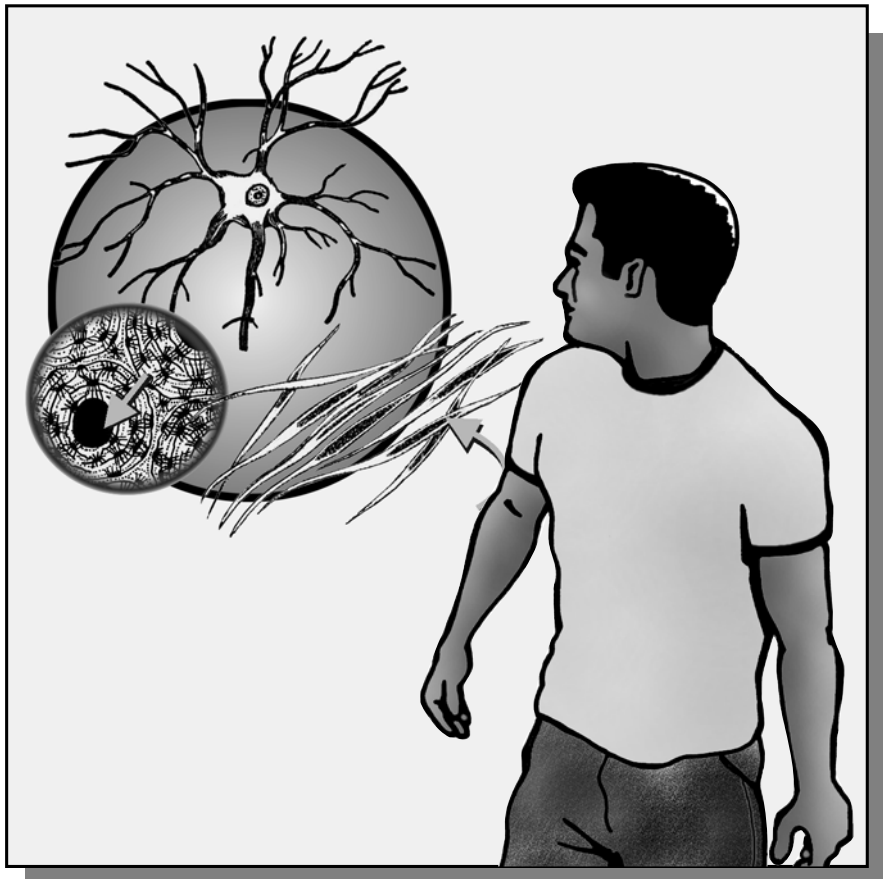
Basic Science Mysteries



Chapter 2

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Chapter 2

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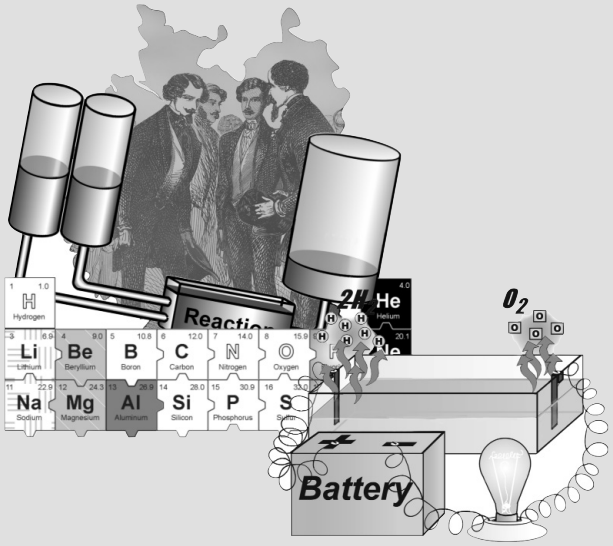
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"By knowledge, understanding and wisdom the true mysteries of life unfold as they are studied line by line and precept upon precept." —Ronald E. Johnson, C.Ph.D.



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Lesson 1
Biology

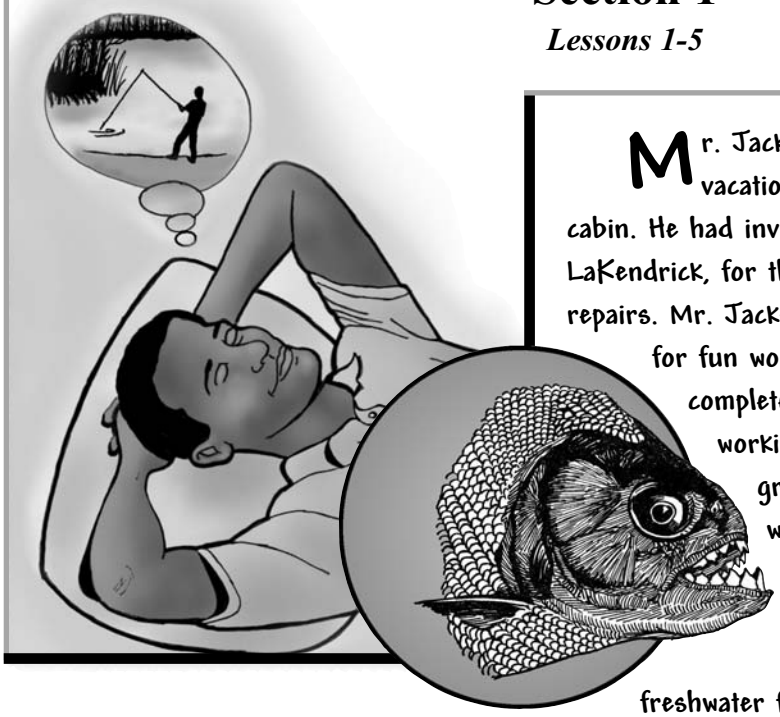
Chapter 2

Fish

Section 1

Lessons 1-5

THE ADVENTURE BEGINS



Mr. Jackson was taking his two-week summer vacation time to make repairs on his lake cabin. He had invited you to join him and his son, LaKendrick, for the two weeks if you would help with repairs. Mr. Jackson assured you that plenty of time for fun would be available once the work was completed. Your mom thought the idea of a working vacation with your classmate was great. You were really excited, but you wondered what the two weeks would be like. You never had been fishing or even ridden in a boat.

LaKendrick had caught common freshwater fishes such as crappie (crop-pee), bass or catfish. Bass are fun to catch and taste great if you know how to cook them. LaKendrick's dad planned to show you how to prepare the fish for scrumptious meals.

Mr. Jackson said he would arrive early the next morning. Your mom reminded you to go to bed early. However, you were so excited that you tossed and turned until you finally fell asleep and dreamed of piranhas and sharks.

Fishermen usually try to sleep the night before embarking upon a fishing adventure, however, the sportsmen's sleep may be tinged with dreams about big, trophy fish. Sleep is a lowered state of mental and physical activity. During sleep, you are much less aware of your environment. Your mental activity decreases, although your brain remains active.

Sleep usually follows a pattern. Part of the time you dream. That is when your brain is most active during sleep. Most people are in a non-dream state in the first phase of sleep. After one to two hours, people begin dreaming. Then, they will enter another non-dream phase. During the dream

VOCABULARY

Carnivores: organisms that eat only animals (meat)
Herbivores: organisms that eat only vegetation (plants)
Amphibians: animals that live both on land and in water
Spawn: to deposit or lay eggs (refers only to female fish, amphibians and other aquatic creatures)
Debris (deb-ree): trash or rubbish including fallen tree limbs, rocks and weeds
Barbed: sharp and pointed, such as barbs on barbed wire

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phase, rapid eye movement occurs, even though your eyelids are closed. This is called *REM* for Rapid Eye Movement. If you awaken during this phase, you will usually remember your dream. If you awaken during the non-dream phase, you usually do not remember what you dreamt during the night.

North American sportsmen need not have bad dreams nor worry about finding sharks or piranhas in freshwater lakes. Sharks are fish that live in saltwater. Most fish are designed either to survive in saltwater or in freshwater. Sharks need an oceanic, saltwater environment. Most lakes in the world have freshwater. Only a very few inland bodies of water contain saltwater. One inland body of saltwater is the Great Salt Lake in Utah.

Piranhas live in freshwater but are native only to South America. Some are ***carnivores***, which means they eat only meat. Some species are ***herbivores***, which means they eat only plants. The carnivorous species are the best known. Carnivorous piranhas have powerful jaws with sharp, wedge-shaped teeth that cut flesh from victims. Carnivorous piranhas usually eat ***amphibians*** and birds as well as some mammals. Piranhas travel in large schools (groups) and are attracted to the scent of blood. Piranhas will attack a mammal in the water and quickly rip the flesh away with sharp teeth, leaving only the skeleton.



If you fish on a river that empties into the ocean, you might see some fish that travel briefly between saltwater and freshwater. Only a few are capable of doing that. The American eel lives in freshwater but travels to the ocean, which contains saltwater, to ***spawn*** or lay eggs. The Pacific salmon is just the opposite. Salmon live in the ocean but regularly enter freshwater to spawn. A few other fish also do this, but the vast majority of fish live permanently in either freshwater or saltwater.

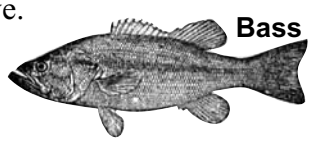
FISH	HABITAT	BREEDING LOCATION
American eel	freshwater	saltwater
Pacific salmon	saltwater	freshwater
bass	freshwater	freshwater
crappie	freshwater	freshwater
catfish	freshwater/ saltwater	freshwater/ saltwater

The majority of freshwater fishes reproduce when the female lays eggs that are fertilized by the male. Most fish eggs are left to hatch without any care. Sunfishes and catfishes are slightly different. The female prepares a place where she deposits the eggs. This is referred to as a *nest*, but it is not like a bird's nest. The female fish simply selects a spot at the bottom of the lake, removes lightweight ***debris*** and hollows-out a place in the mud. There, she deposits her eggs. The male guards the eggs until they hatch. Both the male and female adult fish will continue to guard the young fish for a limited time after they hatch.

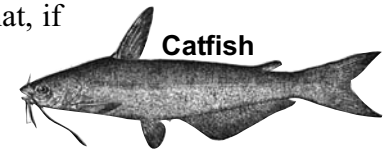


Fish are identified by size, color, shape and fin placement. Fins correspond to arms and legs of humans and help the fish to move. Fins are structures supported by rays or spines. Most fins are hard and sharp. The fins of a catfish are usually ***barbed*** and poisonous. You will want to remember that, if you ever catch a catfish.









You awoke

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when your mom shook your shoulder. The time was 6:30 a.m. You knew you needed to hurry. Mr. Jackson and LaKendrick planned to arrive at 7 a.m. All you could think about was the fun you would have fishing and swimming during the next two weeks. You were an excellent swimmer. As for fishing—well, you could learn. You ate a nutritious breakfast and put your camping gear next to the door. At 7 a.m., you heard the doorbell ring and LaKendrick's voice call to you. Your adventure was about to begin!

You remembered that Mr. Jackson needed your help to repair the cabin. At least you had some experience with that. You decided not to worry about what you did not know about fishing, but to think of things you did know how to do. You and your mom had repaired just about every place you had ever resided. Your grandfather taught you to sand a surface, clean it and paint it. He helped you buy a tool set to use on your bike when you needed to adjust the brakes and handlebars. You had helped your grandfather repair lawn mowers and hedge trimmers. You thought that experience would be useful as you worked with LaKendrick and his dad. LaKendrick mentioned that the motor that controlled the lift in the boathouse was broken. You knew that if the motor was anything like a lawn mower motor, you might be able to fix it so the boat could be lowered and raised. You smiled at Mr. Jackson and really looked forward to an adventure at the lake cabin.

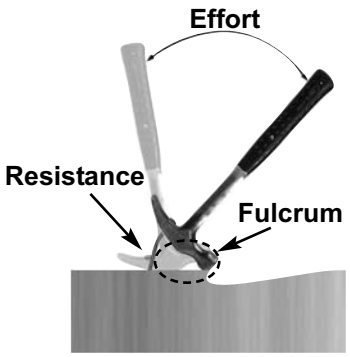
Life Principle

"Do not let fear stop you from learning new things."

—Anonymous



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Lesson 2
Physics

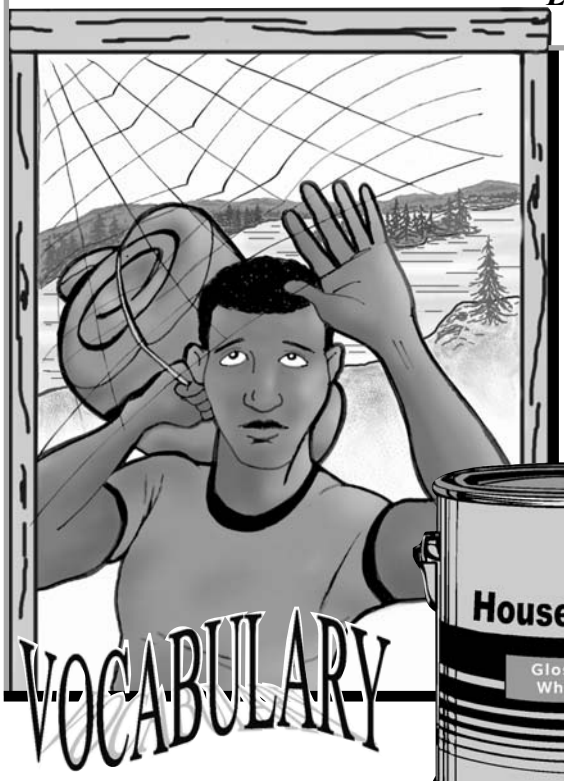
Chapter 2

Simple Machines

Section 1

Lessons 1-5

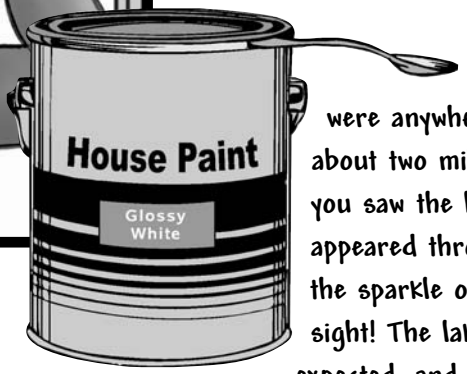
HARD WORK



The ride to Hidden Lake was 30 minutes from your house. Hidden Lake received its name because if you did not know where the lake was, you could not see it. The lake was in a valley behind a cliff that blocked the view of the lake on one side. Trees blocked the view of the lake on the other side. Mr. Jackson followed a winding road that digressed from the main highway for about a mile, then made a sharp turn onto a narrow road leading through a heavily wooded area. No other cars were anywhere in sight. You traveled about two miles on the narrow road before you saw the lake. Suddenly, a clearing appeared through the trees, and you saw the sparkle of water. What a beautiful sight! The lake was bigger than what you expected, and the shore was lined with trees. The early morning sun reflected off the water to produce a diamond-like sparkle. Mr. Jackson turned into a long driveway that led to a cabin situated on a cove at the north end of the lake.

LaKendrick and his dad started unloading supplies from the pickup truck: tools, equipment, food, bedrolls and fishing gear. The cabin was dark. As Mr. Jackson unlocked the door, you noticed a mouse run across the kitchen countertop. A large spider and his even larger web blocked the entrance. Mr. Jackson caught, then released the harmless spider on the ground across the yard and used a broom to remove the web. The sunlight streaming through the front door revealed dusty furniture and sagging cabinets. You shivered as you heard movement from one

Compound machine: made of two or more simple machines
Simple machine: made of only one part
Lever: a simple machine made of a bar that may or may not have a pivot point (fulcrum)
Fulcrum: a pivot point on a lever
Effort: the input force, or force used to move an object
Resistance: the output force or weight of an object moved by a machine
Inclined plane: a simple machine that reduces the effort needed to move an object upward



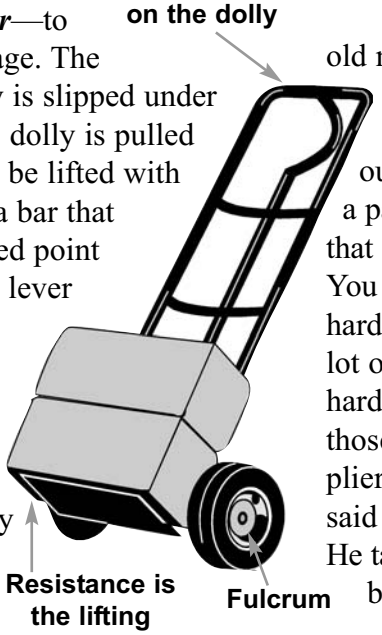
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of the bedrooms. Mr. Jackson walked toward the noise, and another mouse scurried for cover. Mice did not bother you. You and your mom had caught many mice in traps until you plugged the holes in your kitchen. You did worry about the spider webs that you saw everywhere. Mr. Jackson pulled up the shades and opened the windows to allow in light and fresh air. Instantly, the cabin did not seem quite so scary.

Mr. Jackson cleared the spider webs and swept the floor in the family room so you and LaKendrick could stack items from the truck. You carried in most of the equipment, but some boxes were too heavy for you to lift. Mr. Jackson told you to get a board and the two-wheel dolly from the garage.

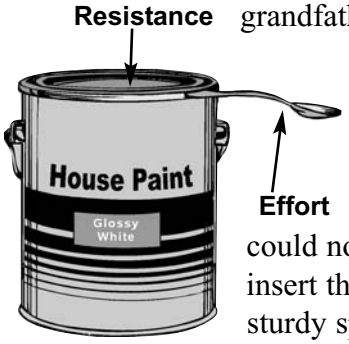
Mr. Jackson placed one end of the board on the truck tailgate and the other end on the ground. He then slid the boxes from the truck to the ground. This simple machine, an ***inclined plane***, reduced the work needed to unload the boxes and place them on the dolly.

A dolly is a ***compound machine*** that uses a ***simple machine*** device—a ***lever***—to give mechanical advantage. The bottom edge of the dolly is slipped under a box, and the top of the dolly is pulled back, causing the box to be lifted with relative ease. A *lever* is a bar that turns, or *pivots,* on a fixed point called a ***fulcrum***. In this lever system, the wheels and axle part of the dolly function as the *fulcrum*.

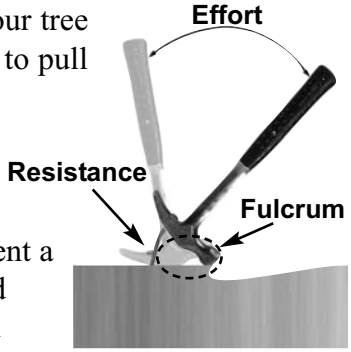


Every machine is used to make work easier. A two-wheel dolly makes moving boxes easier. Two kinds of forces are involved when you use a machine. The *input force* is called the ***effort***. The *output force* is called the ***resistance***. LaKendrick applied effort when he pulled back on the handle of the dolly. The lifting of the boxes was the resistance. Because he used a lever system, LaKendrick was able to lift the heavy boxes with relative ease. LaKendrick dramatically reduced his work load.

Last summer, you used a spoon as a simple machine when you helped your grandfather paint his kitchen. He had asked you to open a new can of paint. You had tried to pry open the lid with your fingers but could not. He told you to insert the handle of the old, sturdy spoon on his work-bench under the rim of the lid. As you pushed down on the spoon, the lid had been easily pried loose. In that case, the spoon served as the *lever*, and the edge of the can was the *fulcrum*. You provided the effort by pushing down on the spoon. The prying of the lid was the resistance.



Another time, you used a lever to pull old nails from a board your grandfather was using to build your tree house. You tried to pull out the nails with a pair of pliers, but that did not work. You could not pull hard enough. You spent a lot of time, effort and hard work pulling on those nails with the pliers, until your grandfather saw you. He said using a hammer would be much easier. He taught you to use the claw part on the back of the hammer to hook the head of



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the nail. Then you understood that the hammer was acting as a *lever*. Applying pressure to the handle of the hammer was the *effort* force. The head of the hammer on the board served as the *fulcrum*. The pulling of the nails was the *resistance*.

Using a lever in all three cases made the work easier. The dolly helped LaKendrick move the heavy boxes, the spoon helped you open the paint can, and the back of the hammer helped you remove the nails.

When you arrived at the steps of Mr. Jackson's porch, you saw a board ramp that he had made. He had placed one end of the board on the ground and placed the other end on the porch. What Mr. Jackson actually had made was another inclined plane. Remember, an *inclined plane* is a ramp or slope that reduces force needed to lift something. This ramp served as an inclined plane, which allowed LaKendrick easily to push the dolly to the top of the porch. The longer the ramp, the less effort is required to push an object upward.

You wondered how Mr. Jackson and your grandfather were so smart. They both knew how to make hard work much easier. You remembered that your grandfather suggested building a ramp for his neighbor to use to push his wife's wheelchair into their house. Grandfather had watched his neighbor struggle to lift the wheelchair over the front steps and knew that an inclined plane would solve the problem. Your grandfather had designed and built the ramp last spring, and you had helped paint the ramp.

Later, you would learn about another simple machine, a *pulley*. Mr. Jackson's boat house used a block and tackle (a combination of two or more pulleys) to raise and lower the boat in and out of the water. You will also use a *wedge* to kill a dangerous snake. A wedge is a simple machine with two slanted edges. Another commonly used simple machine is the *screw*. You will use a screw while helping Mr. Jackson reopen some kitchen cupboards.

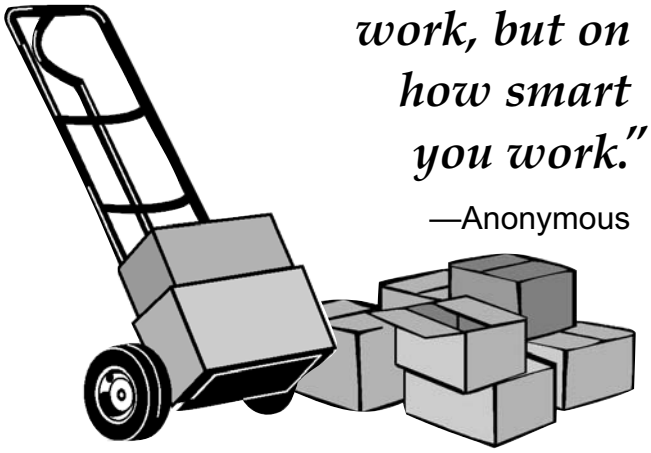
Before the end of your adventure with LaKendrick, you will use all six simple machines: the lever, the wheel and axle, the pulley, the inclined plane, the wedge, and the screw.

After you helped unload everything from the truck and neatly stacked the items in the cabin, you put the dolly back into the garage next to the circuit breaker. Mr. Jackson told you and LaKendrick to take a break. You both jogged to the cove. The water was deep enough for you to jump off the dock by the boathouse. The water felt cool and refreshing. You and LaKendrick played water tag. As you hid from LaKendrick by the edge of the boathouse, you noticed some movement at the rear of the cabin, but you could not see who or what it was. You thought Mr. Jackson was inside working on the electricity. Maybe he went outside to check on something. Your thoughts were interrupted as LaKendrick tagged you. You had to work hard to tag him back!

Life Principle

"Sometimes, success depends not on how hard you work, but on how smart you work."

—Anonymous



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Lesson 3
Physics

Chapter 2

Electricity

Section 1

Lessons 1-5

CONNECTIONS



When you and LaKendrick finished swimming, you spread your towels on the grass beside the boathouse and laid down. The sun felt good. You looked toward the water's edge and noticed that you were not the only ones enjoying the sun. Five turtles had crawled onto a log and were stretching their long necks upward. You watched as two more turtles worked to pull themselves out of the water to join the others. Little swirls started to appear in the water. LaKendrick told you to look closely. Suddenly, you saw a school of minnows swimming toward the boathouse. LaKendrick grabbed a net and threw it toward the swirling water. You were surprised that he caught ten minnows. He grabbed a covered minnow bucket and into it skillfully dropped the minnows. Securing the bucket with a rope to the boathouse, he lowered the bucket carefully into the water. LaKendrick explained that the minnows could be used as bait. The bucket was designed to fill partially with water to keep the minnows alive.

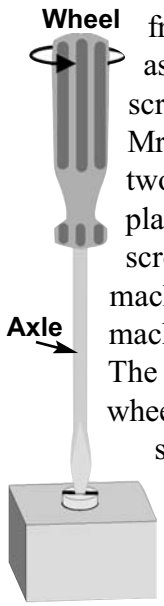
You both dried in the sun then walked to the cabin. Mr. Jackson was working on the light in the kitchen. He put a new bulb in the ceiling fixture, but the bulb did not ***illuminate***. Mr. Jackson told you and LaKendrick to go to the garage to find the ***circuit breaker box*** to turn off the electrical currents, just to be safe. You knew exactly where that box was because you had put the dolly next to the box before going swimming. Once in the garage, you noticed that the dolly had been moved. In fact, it was against the opposite wall from where you had left the dolly. Maybe Mr. Jackson had used it. Anyway, that's what you told yourself.

VOCABULARY

Illuminate: to light up, to shine
Circuit breaker box: a metal box mounted on an inside wall and that contains the control switches (circuit breakers) for regulating the flow of electricity in a building or certain area
Wheel and axle: a simple machine in which a wheel is attached to a shaft or rod (axle)
Conductors: materials that allow electricity to pass through easily
Insulator: material that does not allow electricity to flow easily
"Hot" electric wire: a wire through which electricity is flowing
Disinfectant: cleaning solution that kills germs as it cleans
Vertebrates: animals with backbones
Omnivores: organisms that eat both plants and animals

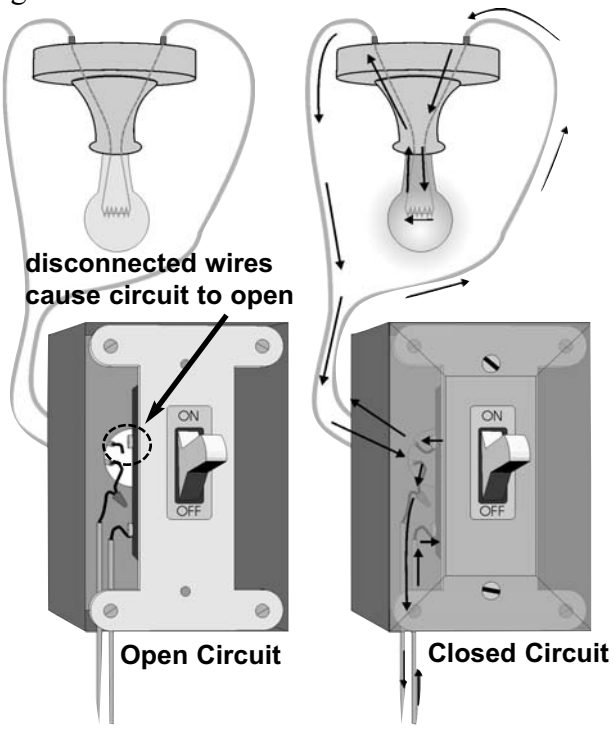
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Once the circuit breaker switch was thrown to the "off" position, you and LaKendrick returned to the cabin. Mr. Jackson suspected that the problem was with the light switch; but before he could examine it, he had to remove the cover from the light switch box. He asked LaKendrick to get a screwdriver out of the toolbox. As Mr. Jackson started to remove the two screws that held the cover in place, he explained that a screwdriver is another simple machine. This type of simple machine is called a ***wheel and axle***. The handle of the screwdriver is the wheel, and the shaft of the screwdriver is the axle. The screwdriver makes work easier by increasing the force applied to the shaft when the handle turns. A screwdriver allows you to turn a very tight screw that could never be turned barehanded.



After Mr. Jackson removed the switch cover, he was able to examine the wires. He was very careful to touch only the part of the wires covered with insulation. Some materials are ***conductors*** that allow electricity to be transmitted easily. Most metals are good conductors. That is why metal wires are used to carry electricity. An ***insulator*** is a material that does not easily transmit electricity. Some materials are good insulators. Plastic, wood and rubber are examples of good insulators. A screwdriver handle is made of plastic to help protect the worker from electrical shock in case the metal shaft of the screwdriver accidentally touches a ***"hot" electric wire***. The wires Mr. Jackson was examining had rubber coatings as insulation. Being shocked is very dangerous. It can result in death. Mr. Jackson cautioned you to be careful anytime you worked with electricity.

Mr. Jackson was right. One of the wires had come loose from the switch. This caused the circuit to be opened. For electricity to work, a circuit must be closed. All the wires must be connected for the electricity to flow. Mr. Jackson explained that making the right connections in an electrical circuit was necessary if you wanted to use electricity. The loose wire in the light switch prevented the electricity from reaching the light bulb.



Mr. Jackson reconnected the wire to the switch. When LaKendrick flipped on the circuit breaker switch, the lights *illuminated*. Mr. Jackson told you and LaKendrick to check the lights in the two bedrooms. One bedroom light worked, but the other did not. You and LaKendrick fixed the problem yourselves. You remembered to turn off the electricity at the circuit breaker box. That prevented any electrical current from entering the cabin. You used a screwdriver to remove the cover to the light switch. As you suspected, a wire was loose. You reconnected it and replaced the switch cover. LaKendrick turned

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on the electricity at the circuit breaker box. You flipped the light switch, and the light illuminated. You felt good that you could fix the problem.

You and LaKendrick then helped Mr. Jackson in the kitchen. That is where he wanted to start the repairs to the cabin. First, you cleaned the refrigerator with a ***disinfectant***. That helped remove mold and mildew which had begun to accumulate. Mr. Jackson said the refrigerator door should have been left open after the unit was shut off the last time it was used. The mold and mildew would not have had the warmth and moisture needed to grow.

The refrigerator was old, but it still operated efficiently. A thorough cleaning made it look much better. The musty smell disappeared. Mr. Jackson told you to turn it on, let it cool for 30 minutes, then transfer the food from the ice chest to the refrigerator. As you filled the refrigerator with tomatoes, carrot and celery sticks, cheese, turkey bacon, eggs, hamburger meat and other food, you realized that you were hungry. Mr. Jackson grilled hamburgers for you and LaKendrick. You walked out to the cove to eat your lunch.

The turtles were sunning themselves again, so you threw a little of your bread into the water and watched the turtles scramble off the bank. They dove deeply into the water and resurfaced a few minutes later. Turtles are reptiles. Reptiles are cold-blooded ***vertebrates***. A turtle has a backbone connecting the neck and tail, but the vertebrae is hidden under the shell. Turtles hatch from eggs. The shell a turtle has at birth remains with it for life and grows with the turtle's body. Turtles have lungs, breathe air and are generally ***omnivores***. They eat small fish, tadpoles, snails and insects whether dead or alive. However, turtles sometimes will eat plants and seeds. The turtles seemed to like the bread you tossed into the lake.

LaKendrick showed his dad the minnows in the bucket. Minnows are very small and usually in great abundance in most lakes and ponds. Minnows are valuable food for larger fish. Within a lake's ecosystem, minnows are an important part of the food chain. Minnows feed on almost every type of food found in a lake. Some minnows are mud feeders, eating organic material found in mud. Such organic material would include rotting plant life and dead fish. Other minnows eat tiny water bugs and insects. Minnows are used as bait for larger fish. Many commercial bait industries breed, raise and sell minnows for bait. Bait shops are a big business around many lakes. Each time LaKendrick and his dad went to the lake, they caught a number of minnows to use as bait for catfish, bass and crappie. Mr. Jackson promised that in a couple of hours the three of you would take a break and do some fishing. However, for the time being, more repairs were needed in the cabin.

Mr. Jackson asked you to get the dolly from the garage to move a heavy box of books located in one of the bedroom closets. You went to the garage and were surprised to find that the dolly was again next to the circuit breaker box. Perhaps LaKendrick had moved the dolly while you were fixing the bedroom light switch. Maybe you were observing a connection between the dolly being moved and the movement you saw earlier near the garage. Maybe not. You were too excited about fishing to worry about the mysterious dolly.

Life Principle



"Wise people take advantage of right connections."

—Anonymous

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Lesson 4
Health

Chapter 2

Health and Bacteria

Section 1

Lessons 1-5

BEING CAREFUL



You, LaKendrick and Mr. Jackson concentrated your efforts on the kitchen during the afternoon. You had been given the assignment of re-hanging the cabinet doors. Most of them had fallen off their hinges. You spent most of your time putting on new hinges with a screwdriver. Mr. Jackson had a nice tool set. Using a screwdriver sure made the work go faster. You remembered times when you had used a penny to turn a screw. Understanding the wheel and axle science principle helped you realize how simple machines make work easier.

LaKendrick had been given the job of cleaning the stove and the oven. His dad was pleased with the cleaning job you did on the refrigerator and expressed concern that a clean refrigerator was as important as a clean stove. Mr. Jackson seemed to be very particular about keeping areas clean where food was prepared and stored. He told you that people could become ill unless ***precautions*** were taken with food during preparation, cooking and storing. So, LaKendrick used a disinfectant to clean the stove just as you did to clean the refrigerator.

VOCABULARY

Precautions: preventive measures
Contaminated: infected; impure
Toxins: poisons
Bacterium: singular form of *bacteria*; a germ
Density: how much mass is in a certain volume of matter
Mass: the amount of matter in an object
Volume: the amount of space an object occupies

Mr. Jackson was wise to be concerned about proper treatment of food as well as food preparation and storage areas. Food poisoning results from eating food ***contaminated*** by bacteria, or their ***toxins***, which are the poisonous proteins that bacteria produce. Bacteria are commonly referred to as *germs* and are too small to be seen without a microscope. Often the

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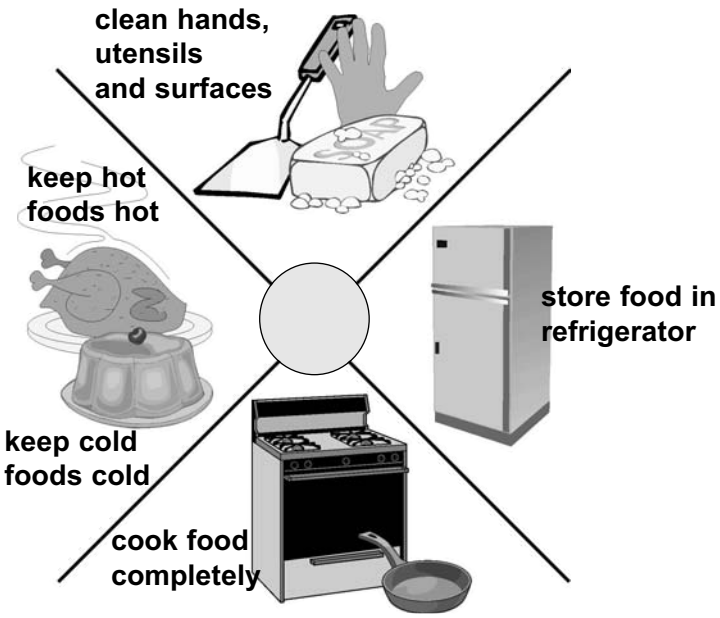
food that is contaminated with bacteria does not smell or look poisonous. Bacteria also can accumulate on counter tops, cooking surfaces and utensils.

To keep foods free from bacteria, you should wash hands, work surfaces and utensils with hot, soapy water. Keeping foods at the proper temperature also helps prevent contamination. One toxin-producing ***bacterium*** is *staphylococcus* which grows readily in foods stored at room temperature. To prevent staphylococcus, cooked foods should be kept hot and cold foods should be kept cold until served. That was why Mr. Jackson asked you first to clean the refrigerator so the food could be taken from the ice chest and placed in the frigid atmosphere. He knew that the ice was melting in the ice chest and soon would not keep the food cold at a safe temperature. You noticed that when Mr. Jackson made the sandwiches for lunch that he placed the unused foods immediately back into the refrigerator. He did not leave the foods on the counter.

Meat should be cooked thoroughly to kill any bacteria. Eating raw meat or under-cooked meat can lead to serious illness. *Escherichia coli* (E-coli) is a type of bacteria that may lead to blood poisoning. It is caused by eating undercooked beef. Several years ago, a fast-food restaurant served undercooked hamburgers that caused a number of people to get the E-coli type of food poisoning. *Trichinosis*, a disease caused by an intestinal roundworm, can be transmitted when a person eats pork that has not been cooked properly.

Other types of food poisoning include *botulism*, which results from eating improperly canned foods. Certain types of *salmonella* may be spread to food by mice or rats, or by humans who fail to wash their hands after using a toilet. Most food poisoning can be avoided if you wash your hands, carefully store and cook food and clean food preparation areas.

Protection from Contamination



Mr. Jackson knew a lot about food safety because in the army he had served as a cook's assistant. He promised to cook the fish you caught during the two-week visit. LaKendrick said anything his dad cooked was delicious.

After the kitchen was cleaned to Mr. Jackson's satisfaction, he suggested that the three of you go fishing. You planned to fish in the cove by the boathouse, at the edge of Mr. Jackson's property. After you put the screwdriver back into the toolbox in the garage, you walked onto the long dock where Mr. Jackson had prepared his tackle box and rods and reels.

Mr. Jackson explained that to catch fish, you had to put the bait where the fish were feeding. You had a choice of using live baits, such as worms or minnows, or the many kinds of artificial baits that simulate, or look like, live baits. The artificial baits could be used in different depths of water where fish might be feeding. Sometimes fish feed on the water's surface, sometimes fish feed in the middle, and sometimes they feed close to the bottom. Mr. Jackson was prepared for any level at which the fish were feeding. He had top-water baits, mid-runners and bottom baits.

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Seasons, temperatures and times of day affect where fish look for food. ***Density*** of the bait and any attached weights are important in order to attract fish at different water levels. The density of an object is the ***mass*** of the object in relation to its ***volume***. If two objects have the same volume, the one that is denser will weigh the most. For example, a brick of lead is denser than a brick of Styrofoam of the same size. The brick of lead will weigh more.

Water has a certain density. Objects less dense than water will float. Objects more dense than water will sink. The brick of lead is denser than water. Lead dropped into water will sink. The Styrofoam brick is less dense than water and will float if thrown into water. If a gust of wind blows an empty Styrofoam cup into the water, the cup floats because it is less dense than water.

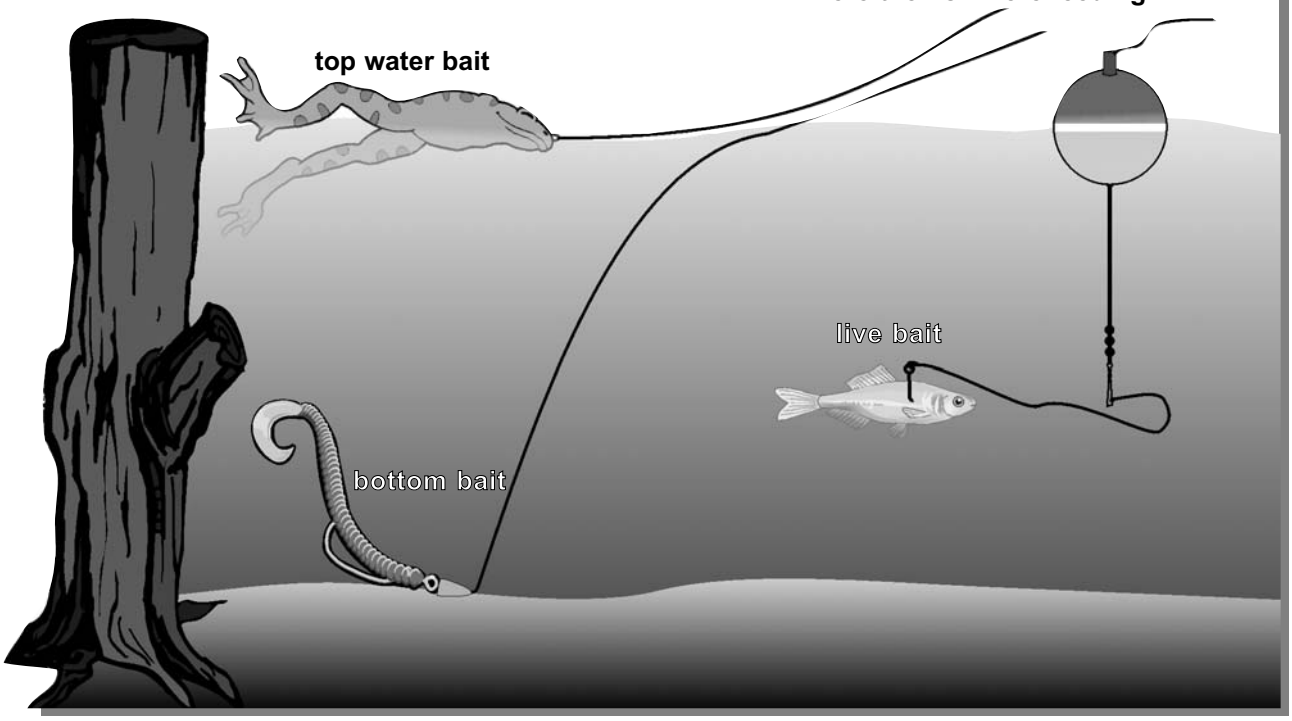
Mr. Jackson selected an artificial frog that was less dense than water. Mr. Jackson was hoping that the fish that afternoon would be feeding at the surface of the water. He explained that because the plastic frog was less dense than water, the bait would simulate a real frog swimming across the top of the water.

Mr. Jackson put a plastic worm on LaKendrick's hook and attached a lead weight close to the worm's head. The lead made the worm sink to the bottom because of the density of the lead.

You selected as your bait one of the minnows LaKendrick had caught earlier that morning. Mr. Jackson showed you how to put the live minnow on the hook in such a way that the minnow could move and swim through the water by way of a line attached to a "bobber" or small, round, floating ball. The density of the minnow was near the density of water, allowing the minnow to swim at different levels.

As LaKendrick reeled in his line, he bent over for a closer look, and his cap fell into the water. In a panic, he started to jump in the water to retrieve his cap until he realized that it was floating. The density of the cap was less than the water, thus the cap floated. LaKendrick easily scooped up the cap with his fishing rod.

"...to catch fish, you had to put the bait where the fish were feeding."



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LaKendrick cast out his plastic worm again and reeled it in slowly to cause the worm to bounce along the bottom of the lake. In the hot summer, bass tend to stay in cool water near the bottom. Before long, a fish spotted and swallowed the worm. LaKendrick felt a tug on his line and excitedly reeled in a nice, two-pound bass. You watched as LaKendrick carefully took the bass off the hook and put the catch on a stringer. Then, he secured the end of the stringer to the boathouse and lowered the bass into the water. Mr. Jackson changed his artificial frog and your minnow to plastic worms. He tied a small lead weight to each so they would sink to the bottom. After several casts, you felt a tug on your line and jerked it to set the hook. You reeled in a bass slightly larger than LaKendrick's. Mr. Jackson showed you how to remove the bass from your hook and place the fish on the stringer. Mr. Jackson reminded you to be careful to avoid the hook and the fins. He did not want you to get hurt.

The three of you fished for approximately an hour, each catching a few bass. Mr. Jackson released all but the three biggest fish. Yours was the largest! You could not remember a time when you had had so much fun. Mr. Jackson asked you to go to the garage and carefully get his fish fillet knife out of the toolbox. You were eager to be helpful. When you entered the garage, you noticed that the toolbox was open. You remembered closing it when you had put away the screwdriver.

You looked for the dolly to see whether it had been moved again. It had not, but a shovel was leaning against the dolly. You had not seen a shovel anywhere in the garage earlier. Because of the fresh dirt on the bottom of the shovel, you thought maybe Mr. Jackson had used the shovel to dig for worms. You found the knife and carried it carefully back to the boathouse. You were planning to ask Mr. Jackson about the shovel, but you forgot when you saw something that made you stop abruptly in your tracks. You were fortunate to have a knife in your hand. You were going to need it!

Life Principle

"Wise people take time to be careful."

—Anonymous



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Lesson 5
Biology

Chapter 2

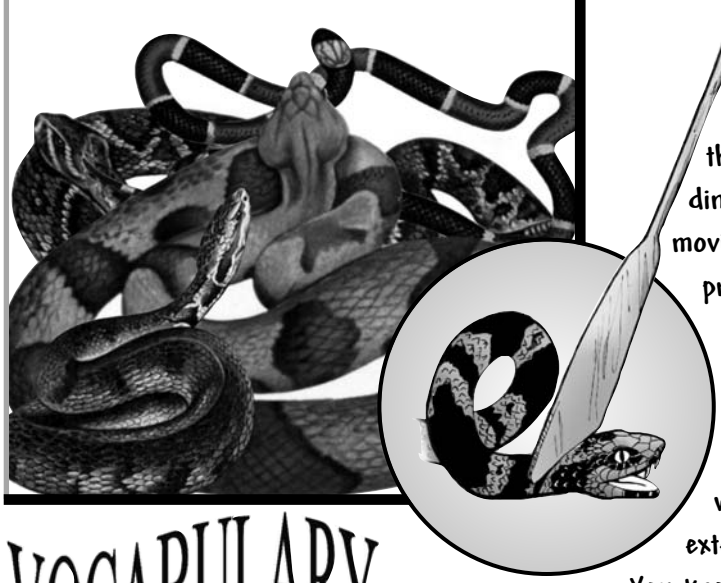
Snakes

Section 1

Lessons 1-5

DANGER

The sight before you caught you by surprise! Wrapped around one of the posts on the boathouse was a water moccasin snake! Mr. Jackson could not see the snake. Mr. Jackson was leaning over the side of the boathouse dock about to pull up the stringer of fish. Apparently, the snake thought those bass were his dinner, because he was in the process of moving from the post to the stringer. The only problem was that Mr. Jackson's hand was about to be in the way. You knew that "cottonmouth" was a common name for a water moccasin, and now you could see why. His mouth was open wide, revealing a white ***interior***. The moccasin's fangs were extended, ready to strike. Terror gripped you. You knew you had to do something, fast!



You screamed, "Freeze!" Mr. Jackson could tell by the tone of your voice that something really was wrong. He remained motionless, looking at you while you picked up an ***oar*** and carefully walked toward the snake. The cottonmouth was so intent on the bass and Mr. Jackson's hand that the snake did not sense your approach. You got as close as you thought you could. Your heart was pounding wildly. You were sure the snake could sense your fear. In one powerful thrust, you pinned the head of the snake against the post. The cottonmouth started to fight against the pressure. Mr. Jackson grabbed a second oar to help you. He moved to get a better angle on the snake, but the reptile wiggled free. Looking for an escape route, the snake slithered in the opposite direction which, unfortunately, was toward you! Using

VOCABULARY

Interior: inside
Oar: a long, wooden shaft with a broad end, used as a lever for rowing a boat; a boat paddle
Camouflage: patterned skin or material/clothing that makes an animal or person less visible
Hibernate: to withdraw to a secluded place and experience a lowered state of activity during winter
Dens: caves or holes in the ground

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your oar, you pinned the snake at your feet. You tossed Mr. Jackson the knife. In one swift motion, he severed the snake's head from its body.

You felt immediate relief. Mr. Jackson gave a big shout. He was proud of you for acting so quickly. LaKendrick peered from the cabin when he heard the shouting. While you were in the garage, LaKendrick had gone inside to get some sodas from the refrigerator. He missed the excitement and wanted to know what had happened. You and Mr. Jackson laughed in relief. After you stopped laughing, you told LaKendrick about the encounter with the reptilian predator. Mr. Jackson had been in a very dangerous situation. Your quick thinking prevented a possible injury from a poisonous snake.

Snakes are reptiles. More than 2,700 different kinds of snakes exist in the world. Most of these live on the ground or in holes. Some snakes live in water. Some snakes live in trees. Snakes abound in various sizes and colors. One of the largest snakes ever identified was an Anaconda weighing over 600 pounds. The longest type of snake is a reticulated python measuring over 32 feet long. No one is certain how many years snakes can live, but at least one boa constrictor in a zoo was known to have lived over 40 years.



anaconda



boa constrictor

Snakes continue to grow, no matter how old they are. This is very different from humans who usually reach maximum height by the early twenties. A snake's skin is very important to the snake's survival. Hard scales protect the snake from injury. The color serves as ***camouflage***, allowing a snake to hide from predators and sneak toward prey. The snake's skin will not stretch to keep up with the snake's growth; therefore, a snake will often outgrow its old skin as soon as the new skin is in place. When this happens, the snake sheds its old skin.

Because snakes do not see very well, they use their tongues to detect surroundings. Snakes have no eyelids, cannot blink and usually can see something only when it moves. Snakes flick their tongues in and out, gathering specks of dust from the air and ground. This helps the reptiles detect the presence of near-by animals.

Snakes do not hear well. They have no outer ears. Sounds must pass through the snake's skin to be heard by the inner ear. Sound usually travels along the jawbone to reach the inner ear.

Temperature determines where a reptile lives, when it will be active, and when it will mate. Unlike cold-blooded reptiles, humans are warm-blooded. Our bodies remain at constant temperatures regardless of our environment. On a cold winter day, we may feel cold, but our bodies are working hard to maintain a constant temperature of approximately 98.6 degrees Fahrenheit. A reptile's body temperature changes with the temperature of the surrounding air. On a cold winter day, a snake's body temperature lowers considerably. When that occurs, the behavior of the snake is significantly affected. In fact, some snakes in winter can even appear to be dead.

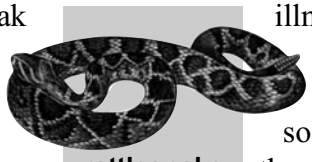
In cold weather, snakes must find a way to keep warm. This actually becomes a life or death matter. Many snakes ***hibernate*** in caves or ***dens*** during the winter. Many snakes of the same species will occupy the same area. As many as one hundred snakes may share the same den during cold weather.

When the weather warms, the snakes become active again and leave the den in search of food. After months of hibernation, the snakes are very hungry and often strike at anything that moves close to them. For this

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reason, extra care should be taken when hiking in early spring.

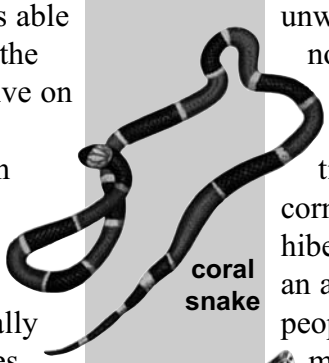
Snakes are carnivores. They usually do not chase their prey, but rather sneak up and surprise it. Sometimes snakes hide and wait until their prey is close enough to be captured. Snakes eat many animals that humans consider as pests, including rats and mice. Some snakes constrict, or squeeze, their prey to death. Then, the snake swallows the prey whole. Snakes' teeth are not made for chewing. Most snakes are able to open their mouths extremely wide because the jaws are loosely connected to each other. Therefore, a snake is able to swallow something larger than the snake's own head. Some snakes live on a diet of bird eggs and are able to swallow several large eggs at each feeding. Farms are often visited by "chicken snakes" that feast on eggs intended for sale.



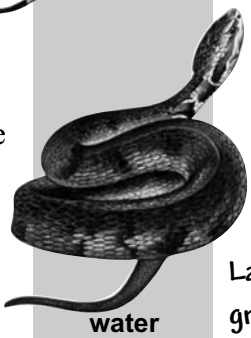
rattlesnake



copperhead



coral snake



water moccasin

In the spring, a snake usually searches for a mate. Female snakes lay eggs that are usually tough and leathery to protect the babies. However, sometimes the egg is so tough that the baby snake has a hard time hatching. To help with this, baby snakes are equipped with special teeth to "peck" through the shell. Some snakes give birth to live babies. In such cases, the mother carries an egg sack filled with baby snakes inside her own body until the birth process begins. Then, the mother pushes the sack out of her body, and the baby snakes break out of the sack. Some snakes birth as many as 80 live babies at a time.

Of the 2,700 types of snakes in the world, about 400 types are poisonous. Fewer than 50 varieties are really dangerous to humans. Only four poisonous snakes are native to the United States: water moccasins, copperheads, rattlesnakes and coral snakes. A bite from any of these can cause serious illness or even death if medical help is not available. Coral snakes have red, yellow and black color bands; so do nonpoisonous king snakes, but the color sequence is different. A coral snake has red and yellow bands that come together. A good way to remember which is which is the rhyme, "Red on yellow kills a fellow; Red on black is a friend of Jack."

The vast majority of snakes are nonpoisonous and are actually very helpful in ridding an area of unwanted pests. Some farmers keep nonpoisonous snakes in barns to keep rats from eating grain.

Snakes are generally very timid around humans unless cornered, startled or emerging from hibernation. Snakes will usually leave an area as soon as the snakes sense that people are nearby. Snakes are often more afraid of people than people are of snakes.

Mr. Jackson decided that you and LaKendrick had done enough work for one day. Mr. Jackson cleaned the three bass and cooked them for dinner. LaKendrick was right. Mr. Jackson was a great cook! After supper, the three of you sat on the deck overlooking the cove. Mr. Jackson told LaKendrick that you were brave. Mr. Jackson measured the body of the water moccasin. It was over three feet long! Mr. Jackson threw the snake into the water for the turtles to eat. Mr. Jackson explained that just because you saw one snake, did not mean others were nearby. He did not want you to be afraid to enjoy the lake. He told you to swim

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and fish just as you had planned. However, he cautioned you that the lake was home to many species of animals, some of which were friendly to humans, some of which were not. You and LaKendrick agreed to use common sense and practice safety precautions. You remembered how afraid you had been and how fast your heart had beat when you first saw the water moccasin. Mr. Jackson admitted that he had been afraid, too, because a dangerous situation had suddenly arisen. But, Mr. Jackson said that an even more dangerous situation was to allow fear to ruin a good vacation or circumstance in life.

You wondered if you really were brave. You were not aware at that moment that you would soon have another opportunity to test your courage. Something much more dangerous than a snake was waiting for you! You learned more about that later.

Life Principle



"Fear is healthy if it causes us to be cautious."

—Ronald Johnson

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Lesson 6
Physics

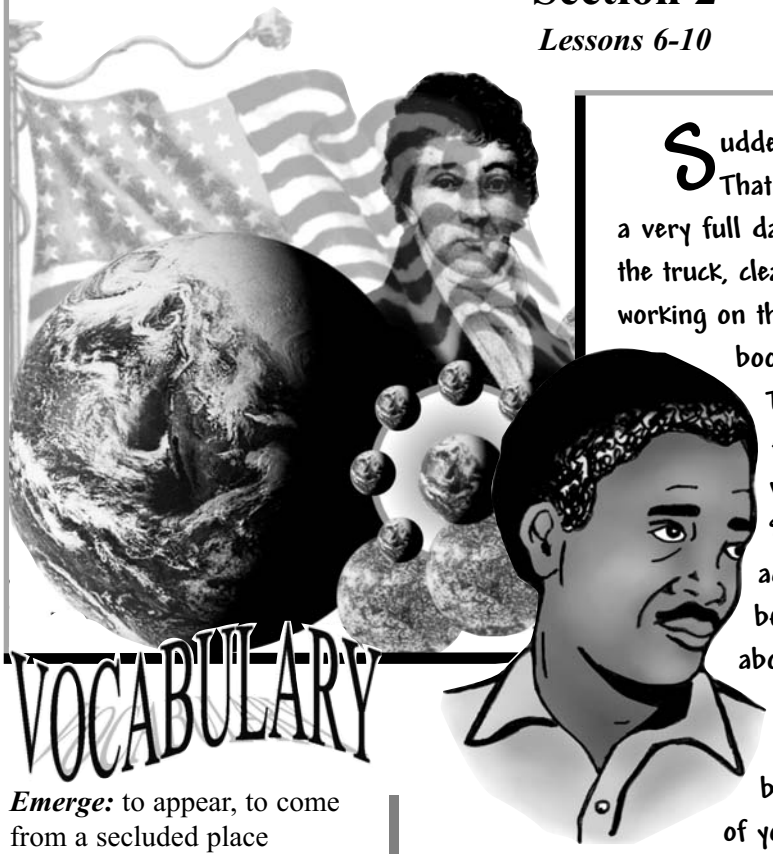
Chapter 2

Sun and Moon

Section 2

Lessons 6-10

DARKNESS



Suddenly, you realized that you were tired. That was no surprise. You had experienced a very full day with a lot of hard work. Unloading the truck, cleaning the kitchen, repairing the cabinets, working on the electricity and moving a heavy box of books to the garage had kept you busy. Then with the swimming, fishing and excitement of the snake . . . well, no wonder you were ready to relax. The Sun began to set, casting a pink glow across the cove. Before long, the night became dark, and you began to think about going to bed.

Mr. Jackson had brought ample supplies to the cabin, but he did not bring a television or a radio. The three of you talked for a while as you continued to sit on the deck, watching the stars ***emerge***. LaKendrick asked if both of you could sleep outside. Mr. Jackson told you to bring two cots from the bedroom and assemble the make-shift beds on the deck. Mr. Jackson gave you a flashlight before he went inside the cabin to sleep. A breeze helped keep away the mosquitoes and bugs. When you turned off the flashlight, darkness ***engulfed*** you. The Moon had not risen, but the stars seemed brighter than you had ever seen them. You tried to count them, but that was impossible. Your eyelids began to close. Before you realized, you fell into a peaceful sleep.

VOCABULARY

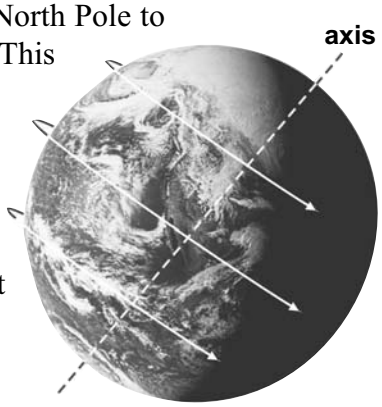
Emerge: to appear, to come from a secluded place
Engulfed: overtaken, surrounded or completely overcome
Revolve: a motion in which one object circulates in a wide orbit around another object
Theorized: to have made an educated presumption supported by factual or known data
Anthem: a song of patriotic or religious devotion, often including references from Scripture; a hymn
Terminology: words belonging to a certain subject
Fatigued: worn out, exhausted, stressed beyond a safe limit
Stimuli: things that attract attention

The Earth and Sun interact as a system to cause day and night. This division of daytime and nighttime is a result of Earth's rotation as the Earth ***revolves*** around the Sun.

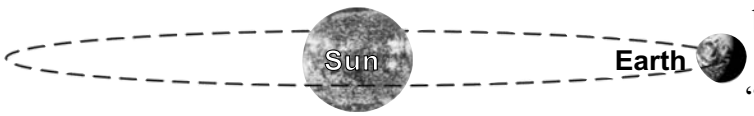
Rotation is a motion of spinning or turning in a circle on an axis. *Revolution* is an orbital motion around a fixed

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point. An imaginary line is drawn through Earth from the North Pole to the South Pole. This imaginary line is called Earth's axis. The Earth rotates from west to east on the *axis* while at the same time revolving in a larger circle around the Sun.



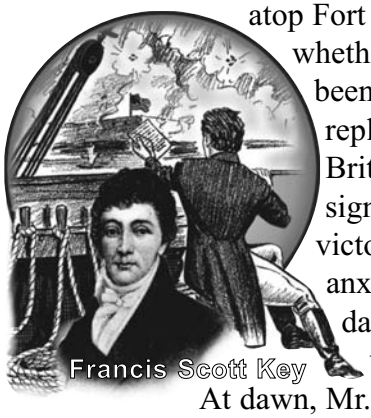
Although the Sun does not move, people often say that the Sun "rises and sets." In reality, Earth moves, and the Sun remains stationary, only appearing to rise and set. For centuries, people believed that the Sun, planets and stars revolved around Earth. People in ancient days considered the Earth as the center of the universe. In the 16th century, Nicolaus Copernicus, a Polish astronomer, developed a theory that the Sun was at the center of the universe. Copernicus also ***theorized*** that Earth spun on its axis and rotated daily. Copernicus' Theory was that Earth revolved around the Sun in one year's time. Additionally, Copernicus said that the planets also circled the Sun. Although we now know that Copernicus' Theory was correct, it was rejected for many years by scientists of that time. In the days of Copernicus, people firmly believed that the Earth was the center of the universe. The public ridiculed and persecuted anyone with different ideas.



The period of time required for one rotation of Earth on its axis is counted as a day. Earth makes one complete rotation every 24 hours. The period of time when a side of Earth is toward the Sun is referred to as *daytime*. The period of time when that side of Earth is away from the Sun is referred to as *nighttime*.

The first sight of daylight in the morning is called *dawn*. The first light of day is seen in the east. The last few moments of light before night are referred to as *twilight*. *Dusk* is a darker part of twilight.

When Francis Scott Key wrote the words for the "Star-Spangled Banner," darkness had settled over the battle taking place in Baltimore Harbor during the War of 1812. Mr. Key, an American lawyer, was on board a British ship arranging for the release of a prisoner when the British began bombarding Fort McHenry. In the darkness, Mr. Key could not see whether the American flag remained atop Fort McHenry or whether the flag had been torn down and replaced with a British flag, signaling British victory. Mr. Key anxiously waited for dawn and a clear view of the flag.



At dawn, Mr. Key was so inspired by the sight of the American flag still flying over Fort McHenry that the lawyer began a poem with these words: "Oh say, can you see, by the dawn's early light, what so proudly we hailed at the twilight's last gleaming?" He was saying that at twilight, he had still proudly seen the American flag. His hope was that at dawn, that flag would still be flying. And, of course, it was! The "Star-Spangled Banner" became the official United States' National ***Anthem*** in 1931.

Just as the ***terminology*** for day and night are based on the Earth-Sun system, so are divisions of the calendar. A *day* is a 24-hour period based on the time required for

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Earth to make one complete rotation on its axis. A *year* is the time required for Earth to revolve one time around the Sun. A year is 365 1/4 days. The length of each month is approximately one-twelfth of a year. Each year is 12 months.

Most people are very active during the daytime and spend much of the nighttime sleeping. Your body is designed in such a way that it requires about seven to nine hours of sleep each night. Without the proper amount of sleep, you will be ***fatigued***, irritable and unable to concentrate. Fatigue can cause blurred vision and slowed reaction time.

During sleep, your blood pressure lowers, your breathing slows, and the rate of your heartbeat decreases. Your brain does not shut down completely during sleep. However, all of your senses are dulled, and you will not respond as quickly to ***stimuli*** as when you are awake.

In various cultures, people go to bed as soon as darkness covers the land and awaken at sunrise. Darkness is a time for sleep and rest for most living things. Many plants will close their flower blooms at night and open them again with daylight.

You and LaKendrick were sleeping soundly during the darkness of the night. Neither of you were aware of the activity occurring just a few feet from your cots. Not everyone was asleep that night, as you learned the next morning.

Life Principle



"The night is darkest just before dawn."

—Hebrew Axiom

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Lesson 7
Biology

Chapter 2

Nocturnal Creatures

Section 2

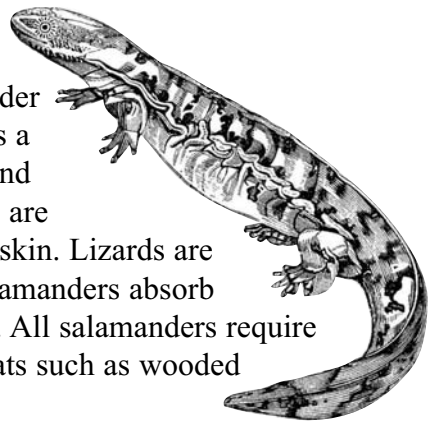
Lessons 6-10

NIGHT LIFE



As the first rays of the Sun appeared in the sky, you turned over and pulled the sheet over your face. You were not quite awake. Although you had slept well, the day was still too early for you to arise. You drifted back to sleep, unaware of those around you who had not slept at all. In your sleep, you thought you heard the muffled sound of the garage door as it closed, but the sound was not loud enough to waken you. Two men quietly replaced the shovel and tools in the garage. Then, the men slipped to their car, hidden down the winding road that led to the highway. You turned over and blinked your eyes. You thought you heard a car in the distance, but you were too tired to wake up completely. You closed your eyes and drifted back to sleep.

The two men were not the only ones who were busy that night. Some animals are ***nocturnal***. They are more active during the night than during the day. Numerous nocturnal creatures lived around the Jackson's cabin.



As they searched for food, several salamanders waddled under your cot during the night. A salamander is a nocturnal creature that resembles a lizard. Most salamanders are small and slender, with long tails. Salamanders are amphibians and have smooth, moist skin. Lizards are reptiles and have dry, scaly skin. Salamanders absorb water and breathe through their skin. All salamanders require moisture, thus they live in wet habitats such as wooded areas near water.

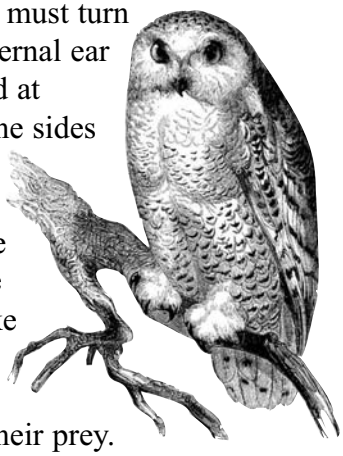
VOCABULARY

Nocturnal: active during the night
Immobile: unable to move
Talons: sharp claws
Scavengers: feed on dead, decaying things
Barbels: "whiskers" on a catfish
Sonar: method of using sound to locate objects
Echolocation: reflected sound

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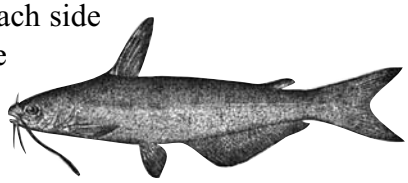
A salamander's skin secretes mucus that keeps the body moist. Salamanders feed mostly at night on worms, slugs, snails and other small creatures. Salamanders are usually brightly colored. In China and Japan, a certain type of salamander can grow to four feet in length. Fortunately for you, the Jackson's cabin was not in China or Japan. You would not welcome a four-foot salamander under your cot, but the little salamanders at the cabin did not disturb your sleep.

As you slept, other nocturnal creatures were busy. An owl set on a perch atop a tall oak tree near the cabin. From there, the owl flew over the area looking for prey. Owls have large, ***immobile*** eyes that are set facing forward. To look around, owls must turn their heads. Their external ear openings are mounted at different heights on the sides of their heads. This helps owls judge the direction and distance of sounds. Owls have soft feathers that make little or no noise during flight, allowing the owls to surprise their prey.



Owls swoop toward their prey, grabbing them with long, sharp ***talons***. An owl will swallow small prey whole. If the prey is too large, the owl will use its strong, hooked beak to tear the prey into smaller pieces. Owls will eat large insects, small mammals, reptiles, amphibians, spiders, scorpions, earthworms and snails. Some owls will eat fish and smaller birds. All the cleaning and repair work in the cabin caused some of the mice living inside to move outside. While you slept, the owl ate one of the mice for a midnight snack.

The waters of the cove also offered plenty of activity during the night. Catfish are nocturnal ***scavengers***, feeding on all manner of animal food and plant material. Catfish will eat almost anything. They spend the night looking for prey. Catfish are easily identified by broad, flat heads and long ***barbels*** extending from each side of the mouth. The barbels look like whiskers on a cat, which suggests how the fish were named. They use their barbels to locate food. The female spawns in the spring or early summer, depositing eggs in a watery nest. The male cares for the eggs and guards the young catfish for several weeks after hatching.



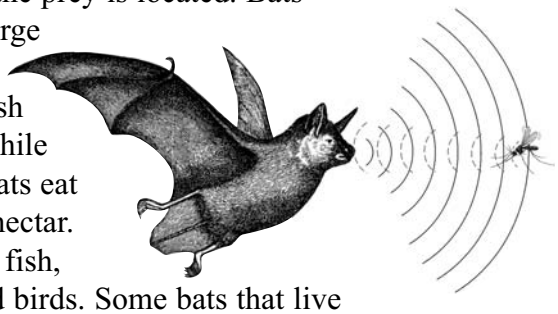
Catfish is served in many restaurants throughout the United States. Many farmers develop ponds called catfish farms strictly for the breeding and raising of catfish to sell to suppliers of restaurants. You do not have to go to a fish farm to catch catfish. They are common in most large lakes. Some catfish weigh hundreds of pounds. Those would feed many people!

Other nocturnal creatures shared your area that night. You saw them as you drifted to sleep, but you did not know what they were. They looked like small patches of dark clouds floating in and out of the trees. Occasionally, the patches would block some of the stars you were trying to count. You did not think much about the patches because you were falling asleep. You thought you were imagining those fleeting images. But, what you saw were bats hunting for night-flying insects. Bats eat hundreds of insects, which is one reason you were not bothered by mosquitoes at night. Some people think bats are birds, but they are mammals. Bats are the only mammals that can fly. Like other mammals, bats are warm-blooded, have fur and give birth to live babies rather than hatching them from eggs.

Some bats are small. Others are large. The largest bat weighs about two pounds and has a wingspan of six feet. The smallest bat

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is the size of a bumblebee and weighs about as much as a penny. Both of those types of bats live in Asia. The bats around LaKendrick's cabin were about the size of blackbirds and flew in and around trees and other obstacles while searching for insects. Most bats are designed with a kind of natural ***sonar*** that directs the animals toward prey. Rather than using their eyes, bats rely upon their hearing for guidance. Using a process called ***echolocation***, the bat sends out a pulse of sound toward the intended prey. The sound bounces off the prey and back to the bat. When it hears the echo, the bat knows exactly where the prey is located. Bats need to eat a large quantity of food to replenish energy spent while flying. Some bats eat only fruit and nectar. Larger bats eat fish, frogs, mice and birds. Some bats that live in South America feed on the blood of large animals. Most bats are content with eating insects. Bats need water to drink and will fly low over the lake to dip their mouths into the surface. Bats are actually helpful because they decrease the mosquito population. Bats sleep during the day and prefer to stay in caves, abandoned buildings or other dark, secluded places. By the time you woke up, the bats had vanished from sight.



The Sun's rays hit your eyes, and this time, you sat up. LaKendrick was starting to wake up. You smelled bacon and eggs cooking. Mr. Jackson called for you and LaKendrick to prepare to eat. The country air made you especially hungry, and all you could think about was breakfast. You soon would be thinking about what happened during the night because clues were all around you.

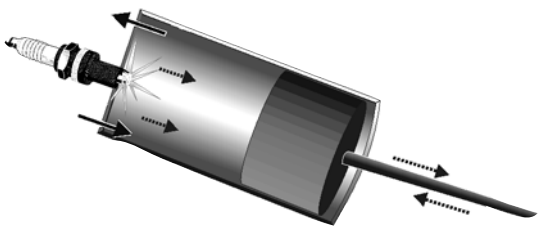
Life Principle



"Variety is the mother of enjoyment."

—Benjamin Disraeli

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Lesson 8
Physics

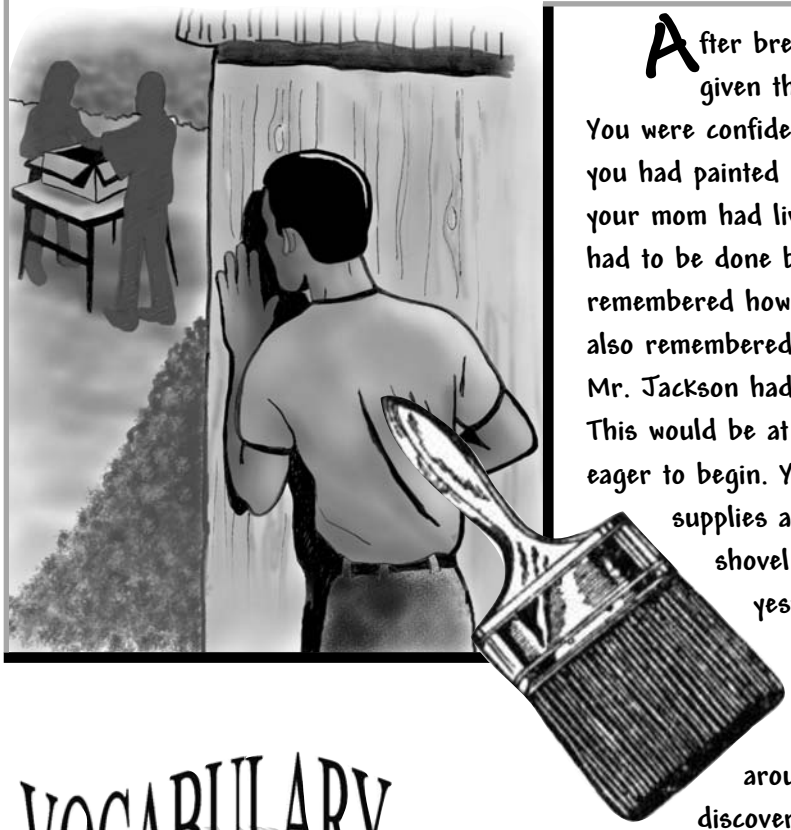
Chapter 2

Electric and Combustion Motors

Section 2

Lessons 6-10

MOTORS



After breakfast, you and LaKendrick were given the job of painting the two bedrooms. You were confident about this responsibility because you had painted rooms in the last two places you and your mom had lived. You knew what preparation work had to be done before painting began. You remembered how to clean and sand surfaces. You also remembered how to repair and patch sheetrock. Mr. Jackson had all the necessary supplies and tools. This would be at least a three-day project. You were eager to begin. You went to the garage to get the supplies and noticed that fresh dirt was on the shovel again. Your memory was triggered to yesterday when you realized that the shovel had been moved and the tool chest left open. You decided to look around for an explanation. Walking around to the back of the cabin, you discovered a mound of freshly dug dirt. Apparently, several holes had been dug and refilled just under one of the bedroom windows. You also saw a number of large footprints in the dirt. After studying the prints, you observed that two individuals had made the footprints. One set of prints was from a shoe or boot with an unusual marking. The individuals had not tried to climb through the bedroom window. Instead, the footprints led from the back of the cabin to the garage. There, the ground was firmer, and the footprints were harder to distinguish. You decided to mention your discovery to Mr. Jackson.

Mr. Jackson was concerned but offered an explanation. He had recently purchased the cabin from a family who lived in another state. The cabin had been closed for twenty years except

VOCABULARY

Armature: a revolving part of a motor
Electromagnets: magnets that can be turned on and off with electricity
Compresses: squeezes things together
Navigated: to have steered a boat or other craft around or through an area

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for a caretaker who occasionally opened and ventilated the cabin. Mr. Jackson thought that perhaps the caretaker had returned to check on the conditions of the property. The caretaker was a friend of the family that formerly had owned the cabin. Mr. Jackson told you not to worry. Perhaps the caretaker was finishing a project in the yard that should have been completed earlier. You decided to agree with Mr. Jackson.

You and LaKendrick cleaned and sanded the bedroom. Mr. Jackson was impressed with your work and complimented your attention to detail. You would be able to apply the first coat of paint the next day. In the late afternoon, Mr. Jackson told you and LaKendrick to join him at the boathouse to try to lower the boat.

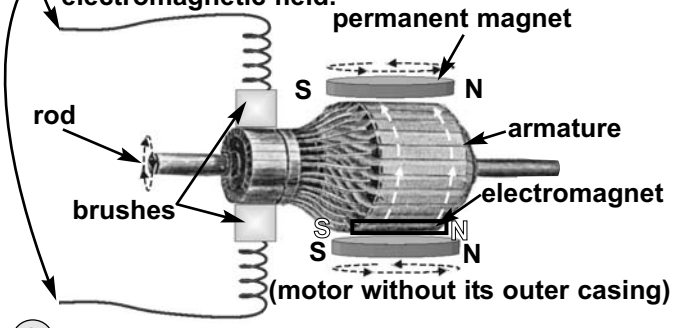
The boat in the boathouse was fastened above the water on two slings. Ropes connected the slings to a long bar that was attached to some gears and an electric motor. When Mr. Jackson turned on the switch to lower the boat, the electric motor hummed but did not turn. The motor was old but could probably be repaired.

Electric motors work on the principle of magnetism. You have probably played with magnets and observed how they sometimes attract each other, and at other times, they push away from each other. A magnet has a north pole and a south pole. If you bring opposite poles (south and north) close to each other, the opposites will attract and stick together. If you try to put like poles close together (south on south, or north on north), they will repel, or push away from each other.

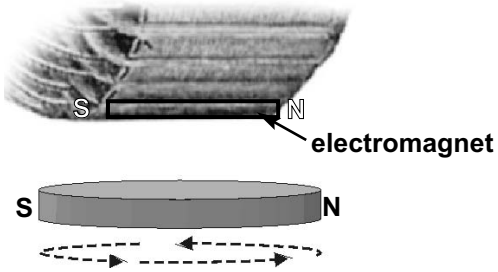
Inside an electric motor, an ***armature*** that has ***electromagnets*** rotates. Above and below the armature are permanent magnets. Connected to the armature are little metal tabs called brushes. When electricity is sent to the armature, the brushes touch electrical wires that turn on the electromagnets. (See illustrations.)

When electromagnets are turned on, the like poles in the electromagnets and permanent magnets repel each other, causing the armature to spin and turn the rod in the center of the armature. The spinning rod turns anything connected to the rod, such as the gears on the boathouse lift. When a motor has run for a long time, sometimes the brushes will wear out, stopping the flow of electricity to the armature, which stops the motor from turning. When this happens, either the motor is taken apart and the brushes replaced, or a new motor is obtained. Mr. Jackson replaced the brushes. Then, by flipping on the switch, the motor was able to lower the boat.

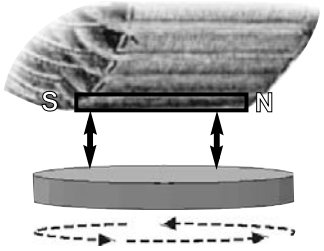
1 **Electricity is sent to the armature which turns on the electromagnets & creates an electromagnetic field.**



2 **As the armature passes the permanent magnet, the electromagnetic field turns each of the small metal bars on the armature into an electromagnet.**

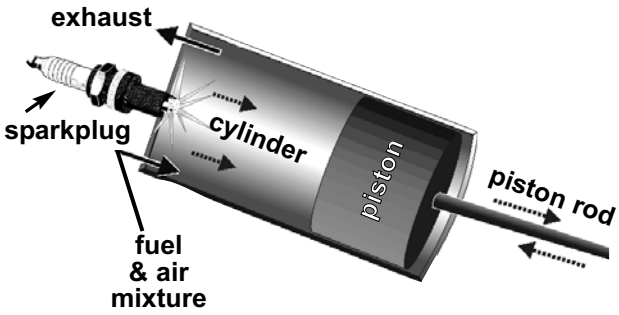


3 **The like poles of the electromagnets and permanent magnets repel each other, turning the armature.**



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Mr. Jackson asked you to try to start the motor on the boat. He knew that you had worked with gasoline engines with your grandfather. Gasoline engines operate differently than electrical motors. Gasoline engines are called internal combustion engines, because an actual explosion takes place inside the engine to make it operate. Inside the engine is a piston that slides up and down in a cylinder. Gasoline and oxygen must be mixed and pumped into the cylinder at just the right time. The piston ***compresses*** this mixture, heating it. A spark from the spark plug ignites the fuel and causes combustion. This explosion pushes down the piston. The piston is connected to a rod that turns the drive shaft. In the case of the boat motor, the drive shaft turns the propeller that pushes the boat.



To reduce friction of all these metal parts in a motor, oil is used to lubricate the moving parts. Some motors require an oil and gasoline mixture. Other motors require the oil and gasoline to be added separately. This boat motor required the oil to be mixed with the gasoline. Mr. Jackson brought a full tank of premixed fuel. You connected the gasoline tank to the motor and tried to start it. It did not start. You tried several times, without success. From your experience with lawn mowers, you determined that the motor was not receiving any fuel. You suspected the fuel line was clogged. You retrieved the extra fuel line from the boathouse and replaced the old fuel line. Then, when you pulled the starter rope on the engine, the motor roared to life.

The Sun was setting, but Mr. Jackson wanted to try the boat. You and LaKendrick put on life jackets. Mr. Jackson ***navigated*** the cove and steered toward the open lake. The motor ran smoothly, and the boat planed out on the tops of the waves as it picked up speed. The sunset filled the sky with beautiful shades of reds and pinks. Mr. Jackson turned the boat back to the cove, promising to fix the lights on the boat so the three of you could night-fish.

After a quick dinner of sandwiches, you and LaKendrick decided to sleep outside again. Only this time, you were not very sleepy. LaKendrick fell asleep as soon as his head hit the pillow. You lay awake remembering how much fun the boat was and how pleased Mr. Jackson was with your work earlier that day. Suddenly, you heard a muffled noise. It sounded like the garage door was opening. This time you decided to see for yourself if the caretaker had returned. You quietly walked to the edge of the deck and peered toward the garage. Two men were talking in hushed voices and reaching for the box of books you had carried from the bedroom closet. You wondered what was so special about an old box of books.

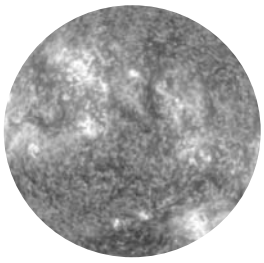
Life Principle

"Successful people are self-starters who keep moving."

—Ronald Johnson



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Lesson 9
Physics

Chapter 2

Moon Phases

Section 2

Lessons 6-10

MOONLIGHT



Suddenly, the Moon appeared from behind a cloud, and you could see clearly the two men sorting through the books and carefully lifting them from the box. The men were dressed in dark clothing. One man was wearing an unusual pair of boots. The designs on the sides of the boots looked like twisted ropes. Both men wore hats that cast shadows over their faces. The men did not speak, but hurriedly flipped through each book before picking up the next one. After searching through the books, the men pulled from the bottom of the box several newspapers. The men obviously had not found what they had hoped to find. They replaced the newspapers and books in the box and picked up the shovel. You pressed firmly against the side of the cabin, hoping the intruders would not notice you in the bright moonlight.

Taking the shovel, the men returned to the side of the cabin next to the bedrooms and began digging. You silently followed and watched as the men dug for approximately 15 minutes before the shovel struck something hard. It was a small metal box. One of the men opened it and pulled out a folded piece of paper. As they studied the paper, you heard the men speaking excitedly in hushed tones about trying to find the other half. Suddenly, an owl hooted in the distance. The men became nervous at the sound. They quickly replaced the dirt but kept the metal box and its contents. The men returned the shovel to the garage, crossed the yard and faded into the shadows. You followed the

VOCABULARY

Emit: to give out or put forth
Elliptical: oval shaped
Axis: a straight line around which a body revolves
Waxing: becoming more visible, increasing in size and brightness
Waning: becoming less visible, decreasing in size and brightness

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strangers to the road where they left in a truck. A cloud had covered the Moon, so you could not see the type of truck. You made your way back to the deck to get your flashlight. Footprints revealed that these men were the same ones who were at the cabin the previous night! The print with the unusual markings was made by the man wearing the boots with the twisted rope designs.

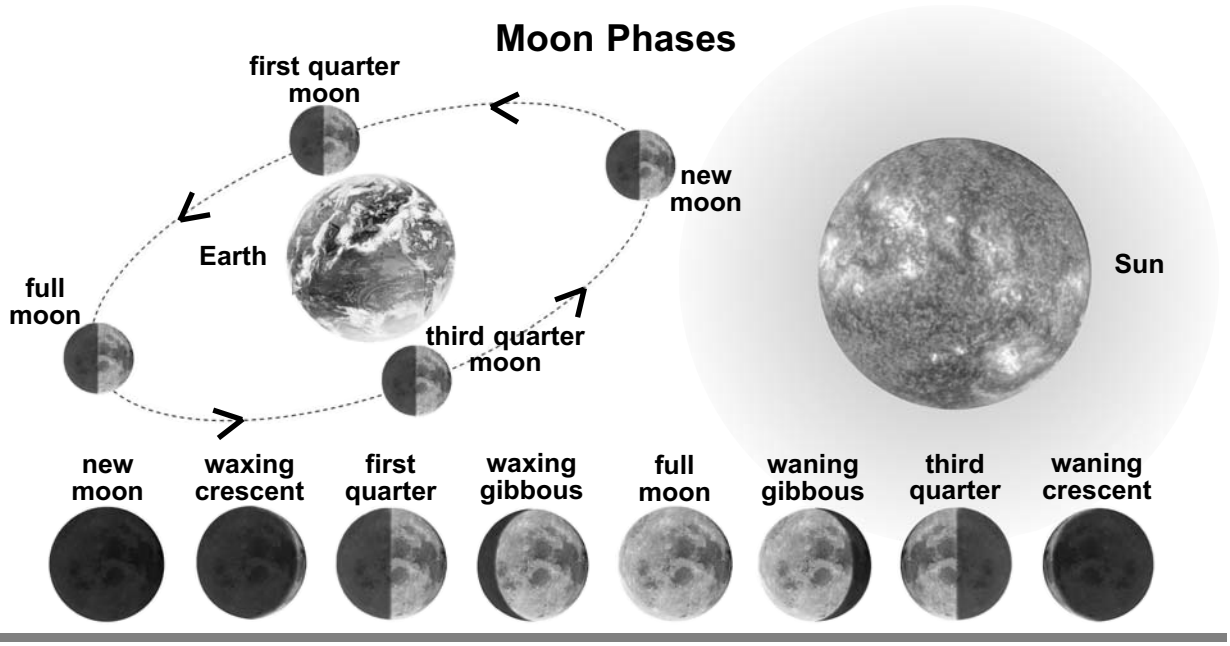
The Moon appeared again. You decided not to disturb Mr. Jackson and LaKendrick from a good night's sleep. Nothing could be done just then, anyway. You decided to tell your friends the next morning. You began to sort through the books. The moonlight was bright enough for you to read. You looked at the Moon. It was a big, bright, full circle. You were glad for a full moon. It had not seemed nearly as big or bright the previous night. Maybe the brightness of the Moon and the hooting of the owl would keep the men from returning.

The Moon is a natural satellite of Earth and revolves in an orbit around the Earth. The Moon is about one-fourth the size of Earth but does not ***emit*** light; rather, the Moon reflects light from the Sun. The appearance of the Moon changes because you see different parts of its surface lighted by the Sun. These different views of the Moon are called *phases*. The phase you see depends upon the position of the Moon in relation to both the Earth and the Sun.

The Moon completes one revolution in an ***elliptical*** orbit around the Earth in 27 days, 7 hours, 43 minutes and 11.5 seconds, or approximately 27 1/2 days. The Moon rotates on its ***axis*** at approximately the same speed the Moon revolves around the Earth. Because of this, the same side of the Moon is always turned toward the Earth.

At any one time, you can see only half of the Moon's entire surface. Half of the Moon is always in sunlight. The phases of the Moon, as viewed from Earth, depend upon how much of the sunlit half of the Moon can be seen at any one time.

In the phase called the *new moon*, the side of the Moon facing Earth is completely in the shadow of the Sun. Remember, that the same side of the Moon always faces Earth. The Moon is there, but you cannot always see it. The Moon appears to disappear from view, because the side that is not lighted is facing the Earth.



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As the Moon continues to revolve around Earth, more of the Moon's lighted side becomes visible. You will see a thin slice of the Moon, which increases into the shape of a crescent (crescent moon). About a week later, the Moon is in its first quarter. You can see half of the lighted side (¼ of the Moon or quarter moon). As more of the Moon becomes visible, it enters the ***waxing*** *gibbous* phase. About a week later, you can see the whole lighted half of the Moon. This is called the full moon phase. This is when the Moon appears biggest and brightest as a full circle. After the full moon phase, the Moon appears to become smaller. As it does, it reaches the ***waning*** *gibbous* phase. A week later, in the third quarter, the Moon appears as a half-circle (quarter moon). A week later, the Moon becomes a *waning crescent*, then returns to the new moon phase and appears absent from view. The entire cycle repeats each lunar month or every 27 1/2 days.

The full moon gave plenty of light for you to look through the books. You were disappointed that you did not find anything unusual that might prove to be a clue as to what the men wanted. The books were about some of the old west legends like the Dalton Gang and Billy the Kid. The newspapers were dated twenty years ago. You were not sleepy, so you took some of the newspapers to your cot on the deck to read. The headlines were interesting. Apparently, twenty years ago, a shipment of gold coins discovered in a cave near the Mexican border was to be on display in the bank in your town. According to the article, the Dalton Gang had robbed a bank in Oklahoma about 100 years ago and had escaped to Mexico. Before they crossed the border, they had hid the gold in a cave. The gang members had been captured and never reclaimed the gold. Twenty years ago, someone had discovered the gold and received a substantial reward for the effort. The authorities returning the gold to Oklahoma had stopped in several towns to display the coins. Your town was one of the locations selected for the display.

You had trouble deciphering some of the words in the article. Some words were circled. Others were crossed out. The clouds again obscured the Moon and blotted your light. You detected motion just above your head and realized that something small and dark was flying near you. You dropped the newspaper and covered your head with your sheet. The evening was late, and before long, you fell asleep.

Life Principle



"Truthfulness is a light that helps you overcome a dark past."

—Ronald Johnson

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Lesson 10
Biology

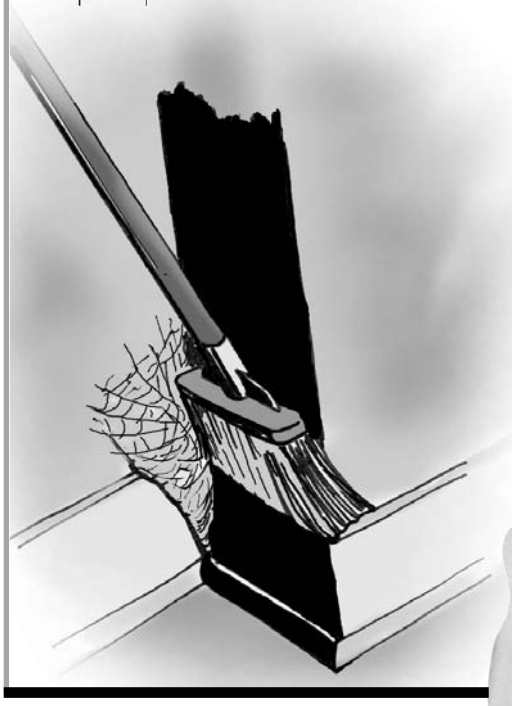
Chapter 2

Spiders

Section 2

Lessons 6-10

LEGS



You opened your eyes. You knew instantly that something was unusual. Two legs were protruding from LaKendrick's pillow. You looked again. Apparently, LaKendrick had turned completely around on his cot. His legs were where his head should have been. You laughed and pulled on his feet. He sat up, confused. He was not the only one who was confused. You were confused about all that happened the previous night. You were not sure what it all meant. You told LaKendrick about the two men, the box of books, the shovel and the metal box. You both decided to tell Mr. Jackson, who was in the kitchen setting out cereal and milk for breakfast.



Mr. Jackson was concerned, but not afraid. He did not believe any harm would come to you or LaKendrick. However, he did not like two strangers on the property, especially after dark. He promised to investigate the matter if anything else happened. Hopefully, the men had found what they wanted in the metal box. Mr. Jackson believed the men would not return.

You were satisfied with Mr. Jackson's response. You and LaKendrick continued working in the bedroom. You had only a little more cleaning, sanding and repairing to complete before you began painting. As you were working in the closet of the bedroom, you found a few more old newspapers. You put them on the deck with the other newspapers you had read the previous night. Returning to the closet, you began to brush away cobwebs with

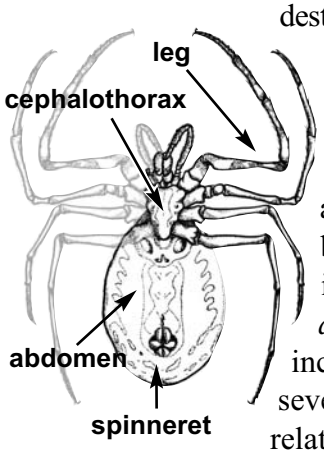
VOCABULARY

Abdomen: belly
Segments: parts or divisions
Thorax: part of the body between the head and belly of arthropods
Cephalothorax: the combined head-thorax segment of spiders and other arachnids
Spinneret: an opening in the hind part of the spider's body designed to spin the silk produced by glands inside
Snare: webbed trap
Insecticide: poison designed to kill insects

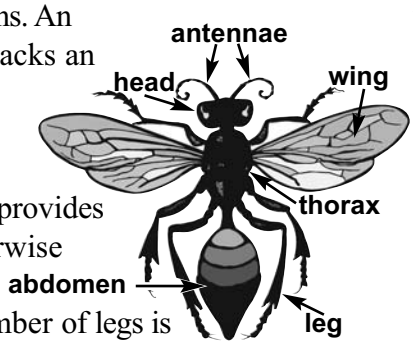
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your hands when you noticed a small, shiny black spider. LaKendrick was concerned and wanted a closer look with a flashlight. On the spider's fat ***abdomen*** was a small, red mark in the shape of an hourglass. The spider was a black widow whose poisonous bite can be very harmful to humans, sometimes fatal.

More than 30,000 different species of spiders are known. Approximately 2,000 species live in the United States. While most spiders are somewhat poisonous, only about 20 kinds are really harmful to people. In fact, most spiders are quite helpful, eating flies and mosquitoes and other types of insects that destroy crops.



Spiders and insects (such as wasps) are *arthropods*. The arthropod class can be divided between insects and *arachnids* that include spiders and several other close relatives such as ticks, mites and scorpions. An arthropod's body lacks an internal skeleton. The body is encased in a hard outer coating that provides the structure otherwise provided by a skeleton. The number of legs is an important clue in distinguishing a spider from an insect. An insect has six legs. A spider has eight legs. Another difference between a spider and insect is the number of body ***segments***. An insect has three distinct parts: head, ***thorax*** and abdomen. The head of a spider is fused with the thorax to form two main divisions, the ***cephalothorax*** and abdomen. Insects usually have wings. Spiders do not. A spider usually has simple eyes. An insect has compound eyes.



Some people are afraid of spiders. The word *arachnophobia* means a fear of spiders and others in the arachnid class.

Spiders are able to produce silk. The production glands are located in the abdomen, and the strands of silk come out of the ***spinneret*** at the hind end of the spider. Webs are made of silk, but spiders have many other uses for silk. Spiders use silk for draglines, ballooning lines, egg sacs and for entangling prey. The spider has a number of glands that produce the silk in liquid form. When it is drawn outside the body, the silk hardens. The spider can spin quickly or slowly and can make a strand thin or thick, dry or sticky.

Black widow spiders, most common to the Southern United States, are easily recognized by their shiny black color with a red hour glass mark on the abdomen. Black widows usually spin webs outside, but occasionally they spin webs inside houses. A black widow's web is an irregular, small ***snare*** of coarse silk. Usually, the web is close to the ground. Whether inside or outside, black widows prefer to spin their webs in dark locations.



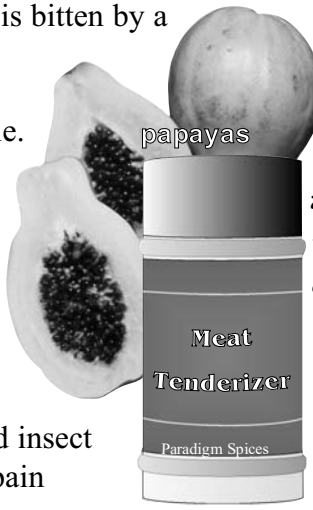
The black widow spider received its name because the female kills her mate which is smaller, differently marked and nonpoisonous. The black widow is not the only creature to kill her mate, but is perhaps the most well known for this behavior. After mating, the female wraps the male in silk and kills him with her powerful venom. Then, she devours him for nourishment. The female's body is only about half an inch in length, but her bite is poisonous and very painful, causing swelling,

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faintness, difficulty in breathing and nausea.

Another small, poisonous spider is the brown recluse. Its identifying mark is a dark violin shape on the tan colored upper cephalothorax. The spider's abdomen is darker brown. The brown recluse is so named because of its reclusive habit of living in dark, secluded places inside or outside of buildings. If not treated immediately, the bite of a brown recluse causes serious illness and extensive tissue damage.

Whenever someone is bitten by a poisonous spider or insect, medical attention should be sought as quickly as possible. If you are far from medical help, a good first-aid measure is to apply the papaya enzyme, papain, either in the form of a slice of fresh papaya or in powdered form as found in meat tenderizers. Spider and insect poison is protein-based. Papain digests and dissolves protein. Therefore, papain may neutralize the poison if applied immediately. (If using the powder, first wet the bitten area with water, then sprinkle generously with the powder.)



LaKendrick used his good common sense when he stopped you from using your hand to brush away a spider's web. You could have received a very painful bite from a poisonous spider. Mr. Jackson sprayed the spider and the inside of the closet with an ***insecticide***. Mr. Jackson cautioned you to use a broom to clear away spider webs.

As you entered the kitchen, you noticed a long-legged spider on the window sill. Mr. Jackson identified the creature as a "daddy long legs." Many people call daddy long legs spiders; but, they really are not. The whole body structure consists of a single unit rather than two units. Mr. Jackson did not want the daddy long legs disturbed, because it is harmless and eats insects. You watched its long legs as it moved gracefully across the window sill. You understood how the creature received its name.

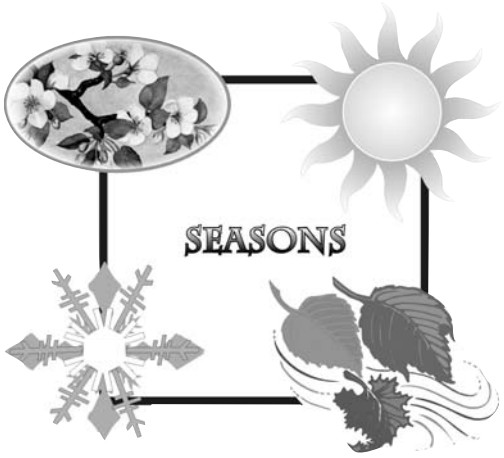
Mr. Jackson asked you to help him in the kitchen while the bedroom ventilated after being sprayed with insecticide. You crawled under the sink to examine a pipe while Mr. Jackson fixed the faucet. While under the sink, you heard the kitchen door open and a man's voice say, "hello!" You peeked from under the sink and saw two long legs. Unfortunately, an unusual pair of boots was attached to those long legs. You recognized those boots. On their sides were twisted rope designs!

Life Principle

"Treat the unknown with caution."

—Anonymous

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Lesson 11
Meteorology

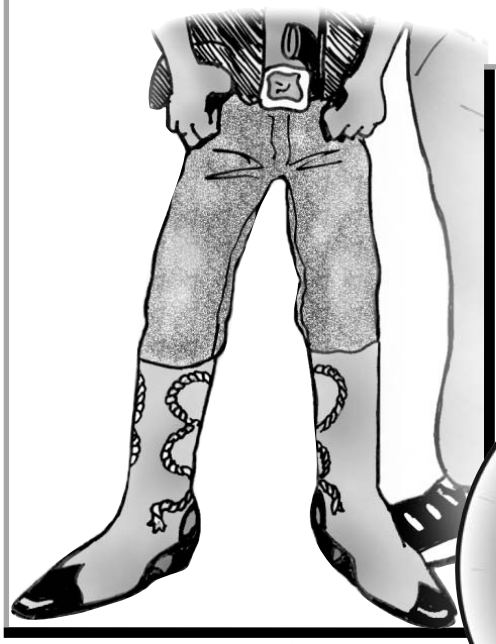
Chapter 2

Earth's Tilt and Orbit

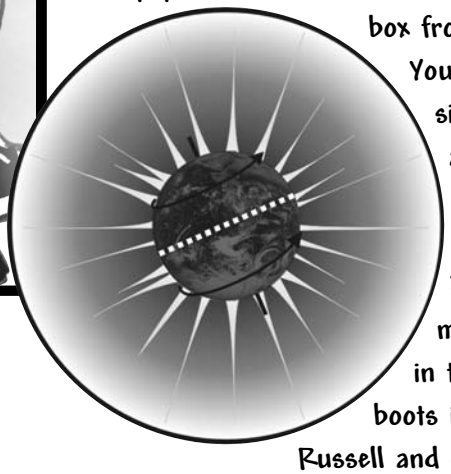
Section 3

Lessons 11-15

SEASONS



The twisted rope design on the boots of the man standing in the kitchen confirmed what you suspected last night. The two men still wanted something at the cabin. That man was one of the men who had been in the garage looking through the box of books and newspapers. He was the one who had dug up the metal box from the side of the cabin. You stayed under the kitchen sink, hidden by the cabinet, as you listened to the conversation between the man in boots and Mr. Jackson. The other man must have been somewhere in the vicinity. The man in boots introduced himself as Mack Russell and explained that he was a relative of the family who used to own the cabin that the Jackson's had bought. Mr. Russell said that a box of books belonging to the family was mistakenly left and that he would like to have it. He explained that the books had no monetary value, but because he had enjoyed reading the books as a child, he would like to have the books for sentimental reasons.



You started to sweat under the sink because the temperature was so hot. Although Mr. Jackson had placed fans around the cabin, you were not receiving any of the circulated air under the sink. However, from your ***vantage point***, you could see most of Mr. Russell. Mr. Jackson told Mr. Russell to take the box of books from the garage. You noticed that Mr. Jackson seemed somewhat uneasy. You wanted to tell Mr. Jackson that Russell was one of the men who came to the cabin at night; but somehow,

VOCABULARY

Vantage point: view point
Tilted: slanted
Perpendicular: at right angles to any given line
Equidistant: equally distant
Summer solstice: on or about June 21, marks longest day of the year in Northern Hemisphere
Winter solstice: on or about December 21, marks shortest day of the year in Northern Hemisphere
Equinox: either of two times a year when the length of day and night are approximately equal

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you thought Mr. Jackson realized that. As he turned to go to the garage, Mr. Russell's jacket caught on the corner of the kitchen cabinet. For a brief moment, you distinctly saw a pistol shoved into a holster attached to his belt. He quickly grabbed his jacket and buttoned it before walking to the garage.

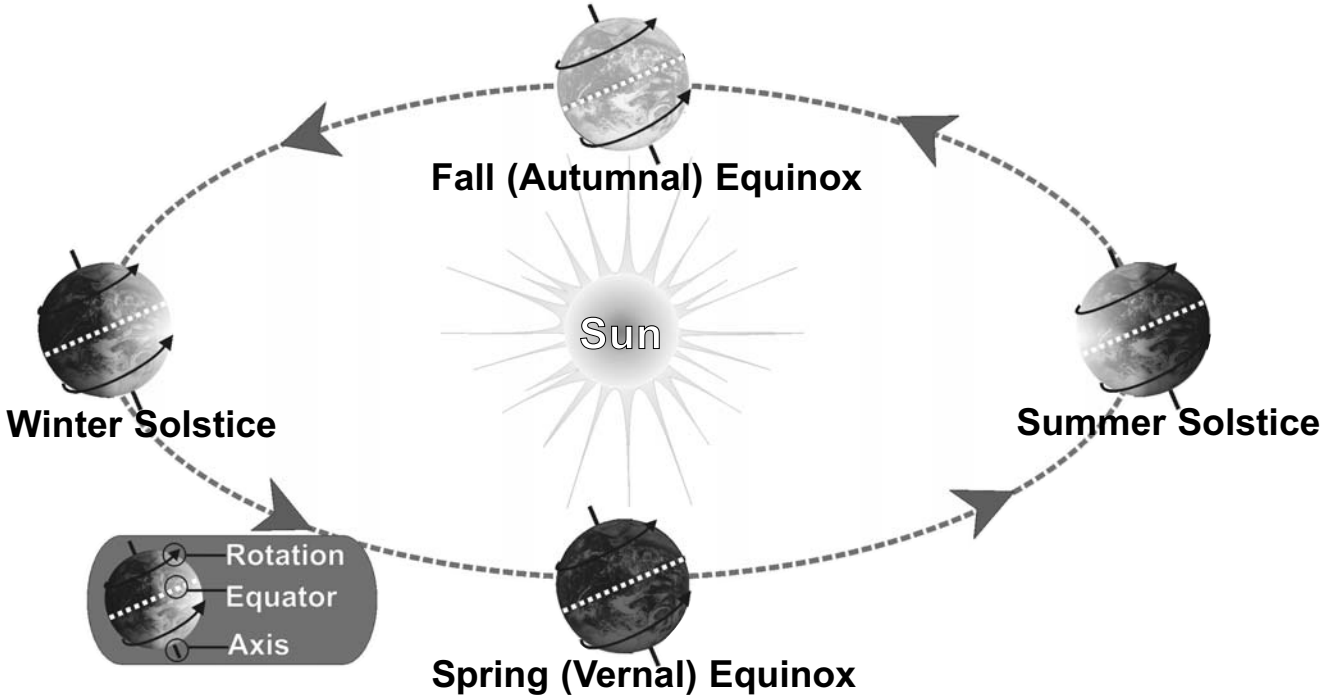


You crawled from the cabinet and peered into the garage. Mr. Russell picked up the box of books and left immediately in a truck. Mr. Jackson appeared worried. He wiped the sweat from his forehead and returned to the cabin to sit by the fan to discuss the incident.

LaKendrick returned from the boathouse and joined you as you told Mr. Jackson about the pistol. Mr. Jackson was concerned, but thought everyone was safe because Mr. Russell had what he wanted.

The temperature was becoming hotter, so Mr. Jackson wanted to work as much as possible until noon. He wanted you to help him work on the plumbing in the kitchen. He told LaKendrick to clean the cabinets and add new shelf paper. In the heat of the afternoon, Mr. Jackson planned for the three of you to take the boat to the big part of the lake to swim and then to fish in the late afternoon. In the evening, he wanted you and LaKendrick to paint the bedroom. Mr. Jackson set up two fans in the kitchen. One of the fans he positioned so that it blew under the sink where you were working. The temperature was already hot, but the fan made a nice difference.

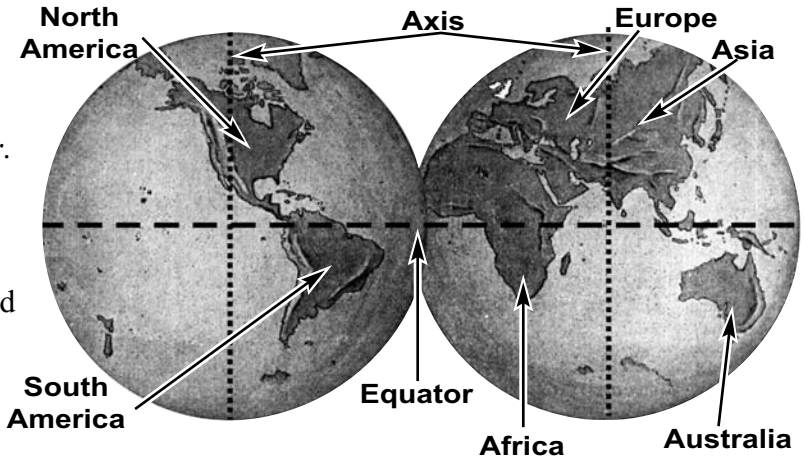
Summer is the hottest season of the year. Winter is the coldest season of the year. The change in temperature is due to the rays of the Sun hitting the Earth differently in summer than in winter. When direct rays strike the Earth, the temperature is hotter. When angled rays strike the Earth, the temperature is colder. You know that the Earth revolves around the Sun. As Earth revolves, it is ***tilted*** on its axis at a 23½ degree angle. Because of the tilt, the Earth's



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North and South Poles are not ***perpendicular*** to the Sun. The part of the Earth that is tilted toward the Sun receives direct sunlight, so that part of Earth will be warmer. The part of Earth that is tilted away from the Sun receives less sunlight, making that part of the Earth cooler. The angle of sunrays, the tilt of the Earth and the motion of the Earth cause the change in seasons: winter, spring, summer and fall.

Think of the Earth divided into halves: north and south. The dividing line is an imaginary line called the *equator*. The equator is ***equidistant*** from the North Pole and the South Pole. The equator divides Earth into the Northern Hemisphere and the Southern Hemisphere.

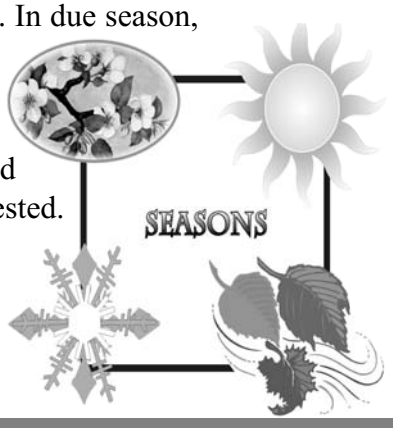


Summer begins on or about June 21 when the Northern Hemisphere is tilted toward the Sun. June 21 or 22 marks the ***summer solstice*** and is the longest day of the year in the Northern Hemisphere. At the same time, the Southern Hemisphere experiences winter, because that part of the Earth is tilted away from the Sun. The ***winter solstice***, when winter begins, is on or about December 21 and is the shortest day of the year in the Northern Hemisphere.

On or about March 21, both hemispheres equally face the Sun, dividing day and night into two equal parts. This is called the *vernal* or spring ***equinox*** and occurs when the Sun's rays shine directly on the equator. In the Northern Hemisphere, this is the beginning of spring. The temperatures will begin to warm as summer approaches. In the Southern Hemisphere, on or about March 21 marks the beginning of fall. The temperatures will begin to cool as winter approaches.

On or about September 21, the *autumnal* or fall equinox is reached, and the Sun's rays again shine directly on the equator. Day and night are again of equal length. In the Northern Hemisphere, on or about September 21 is the beginning of fall, causing temperatures to cool as winter approaches. In the Southern Hemisphere, September 21 is the beginning of spring, and temperatures will begin to warm as summer approaches.

The seasons follow a regular pattern of a 365 1/4-day revolution around the Sun, because the tilt of the Earth on its axis never changes. Due to absolute laws of the universe, spring will always follow winter. Summer will always follow spring. Fall will always follow summer. Winter will always follow fall. Farmers have been feeding the people of the world based on the regularity of the seasons ever since the world began. Farmers know that they have to plant in one season to harvest the next. In due season, their crops will grow and be harvested.



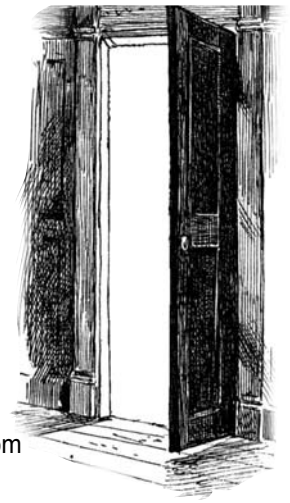
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The day passed quickly for you, LaKendrick and Mr. Jackson. You helped Mr. Jackson replace the faucet on the kitchen sink and repair a leaky pipe. The afternoon was the best time of the day because Mr. Jackson let you navigate the boat down the cove and toward the big part of the lake. You and LaKendrick spent your mid-afternoon time swimming and your early evening time fishing. Mr. Jackson cooked for dinner the fish you caught. While Mr. Jackson prepared supper, you and LaKendrick put the first coat of paint on the bedroom walls. Mr. Jackson moved his cot from the bedroom to the deck so he could escape the paint fumes. Because the summer evening was hot with no breeze, Mr. Jackson brought one of the fans to the deck. The three of you talked about the day as the Sun set. Mr. Jackson told you not to worry about Mack Russell. Mr. Jackson's philosophy was that if Mack Russell was doing something unlawful, he would be caught in due time. Mr. Jackson and LaKendrick decided to go to sleep, but you were not quite ready. You noticed the pile of newspapers you had found in the closet and decided to read them, using the flashlight Mr. Jackson had given you. As you read, you discovered that the gold shipment recovered from the cave near Mexico did make it to your town and had been displayed for two days. However, on the last day, something eventful happened. One of the cases of gold coins was stolen. The article was hard to read because some of the words were circled and some letters were crossed out. You thought that was sort of odd, because you remembered that the article from the paper you read the previous night was marked in the same way. Maybe in due time, you would realize that these newspapers held an important clue about Mack Russell.

Life Principle

"Truth will be revealed in due season."

—Middle East Axiom



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Lesson 12
Chemistry

Chapter 2

Metals

Section 3

Lessons 11-15

GOLDEN TOUCH



VOCABULARY

Malleable: ability of an element to be hammered or pressed into a thin sheet without breaking
Ductile: ability of an element to be pulled into a wire without breaking
Tensile strength: resistant to breakage
Elements: basic units of matter that are each made up of just one kind of atom
Corrosion: a chemical change in which a metal combines with elements such as when rust occurs
Prospector: person who searches for gold

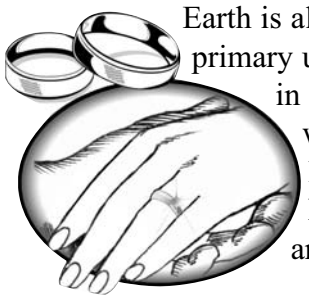
After breakfast, you and LaKendrick put the second and final coats of paint on the bedroom walls. While the paint was drying, you started the process again in the second bedroom. This time, you were careful to use a broom to brush away spider webs in the closet. You did not find any spiders, but you did find another newspaper stuffed between two boards at the top of the closet in the same way you had found the newspaper in the other closet. The headlines were about the robbery of the gold coins. The article revealed a statement by the security guard, Mark Russell, that the robber had worn a mask and used a gun to demand the coins. Mr. Russell claimed that he had been bound by the robber and that by the time Mr. Russell was freed, the robber and the gold coins were gone. You read the article again, taking notice of the security guard's name. The man in the boots had stated his name as Mack Russell. You wondered if the two men were related. This article had two words circled: "gold coins."

You retrieved the other newspapers from the deck where you had left them. One of the articles stated, "The coins were originally hidden by the Dalton Gang in a cave near the Mexican border." You noticed that the words "hidden" and "cave" were circled. The next article printed this statement: "Lots of people are kind of excited to see the gold coins up close." Some of the letters were underlined and others marked out so that the article

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appeared to read, "Lots of people are kind of excited to see the gold coins up close." You looked carefully at the words and realized that the underlined letters spelled the word "Lake." You wondered what the words "gold" "coins" "hidden" "lake" and "cave" had in common. You also wondered why gold coins were so valuable. You had heard your grandfather talk about the time when coins like dimes and quarters were made of fine silver. Now dimes, quarters and fifty-cent pieces are mixtures of various metals. You knew that pennies were made mostly of copper. You had helped Mr. Jackson install copper pipes under the kitchen sink. You wondered why copper was used for pipes and pennies. You also questioned why gold was more valuable than copper.

Copper, silver and gold are all metals. Several properties are common to most metals. Many metals are ***malleable***, which means that they can be hammered or pressed into shape without breaking. Many metals are also ***ductile***. That means they can be pulled and stretched into a long, thin wire shape without breaking. Many metals are shiny solids. Many metals are good conductors of electricity. Most metals are very strong and are resistant to different types of stresses. Metals have high ***tensile strength***, which means they are resistant to breakage. These properties allow metals to be used for many items such as pipes, jewelry, coins or golf clubs.

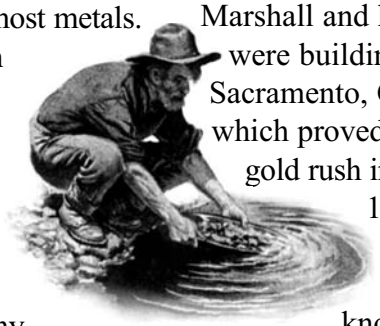


The most common metal found on Earth is aluminum. Some of the primary uses of aluminum are in soft drink cans, foil wrap and siding for houses. Gold is one of Earth's rarest metals and ranks 75th in order of abundance of the ***elements*** in the Earth's crust. Pure gold is the most malleable and ductile of all the metals. It has a high luster, which means it is very shiny. Gold is bright yellow. Gold is unaffected by air, heat, moisture and most solvents. Gold has been highly valued since ancient times because of its beauty, rarity, resistance to ***corrosion*** and ability to be hammered, pressed or pulled into various shapes. These properties make gold highly desirable for jewelry.



James Marshall

Gold is distributed throughout the Earth but is very rare in comparison to other elements. Throughout history, people have expended great effort to discover gold. In 1848, James W. Marshall noticed flakes of yellow metal on the South Fork of the American River near a sawmill that Mr. Marshall and his partner, John A. Sutter, were building just northeast of Sacramento, California. This discovery, which proved to be gold, led to the greatest gold rush in United States history. In 1849, people from all over the world came to California to try to find gold. These people were known as "forty-niners" because the year was 1849 when the gold rush started. Many prospectors did discover gold. Others were not successful but stayed in California to pursue other occupations.



The simplest process for mining gold is called panning. The ***prospector*** uses a shallow circular metal pan resembling a large pie pan with wide sloping sides. Gravel and sand, usually from a riverbed, are scooped into the pan, and water is swished over the gravel. The lighter gravel and sand will be washed away. The heavier flakes of gold will settle to the bottom of the pan. Gold is also found in underground deposits of gold-bearing rocks. These are brought to the surface where

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gold is separated from the rock. The rarest form of gold is a nugget.



Since ancient times, gold and silver have been used for ornamental purposes and as a form of money. In the United States, the Coinage Act of 1792 provided two standards of value, a silver dollar and a gold dollar. The gold dollar was a very small coin. Gold coins have ranged in value from a one-dollar to a twenty-dollar gold piece. The last regular-issue gold coins were minted in 1933. After 1964, the silver coins that contained 90% silver were replaced by copper coins which were only coated with silver. Since 1933, the United States has issued silver and gold commemorative coins only to mark certain memorable events.

Copper, silver and gold are called coinage metals because they can be easily shaped and stamped into coins. Copper is used as a base for many coins. Sometimes, a more expensive metal is used to cover the copper. The Susan B. Anthony dollar is a copper base covered by nickel. The nickels in use today are actually 25 percent nickel and 75 percent copper. Most pennies are not pure copper, but also have zinc (also a metal) in them.



Susan B. Anthony dollar coin

Copper is not as valuable as gold because copper is not as rare. Copper is one of the most widely used metals. Throughout history, copper has been used for many articles and has been discovered in the ruins of ancient civilizations. Copper has been used as coins, jewelry, cooking utensils and ornamental objects. Today, copper is used primarily in electrical wiring because of copper's high conductivity and because it is very ductile. It has great tensile strength. Copper's strength and resistance to corrosion makes copper highly useful in pipes and plumbing accessories.

Your grandfather had shown you his collection of silver coins, which had been minted before 1964. His collection included some dimes, about 20 quarters, several 50-cent pieces and two silver dollars. You had never seen a gold coin, and you had not seen much gold jewelry. Your mom did not have much jewelry of any kind. She did have a gold wedding ring which she kept in a box in her dresser drawer. She told you that she took it off the day your father left. You were just a baby when that happened, and you never knew your dad. Your mom told you that you were the best thing that had ever happened to her. She worked hard to support the two of you and to let you know that you were special to her.

You spent most of the day painting the second bedroom and helping Mr. Jackson repair the bathroom plumbing. He was installing copper pipes just as he did in the kitchen. When he smiled really big, like the time he inspected your paint job in the bedroom, you could see his gold tooth. Your relationship with Mr. Jackson and with LaKendrick was important to you. They were beginning to seem more like family than just friends.

Mr. Jackson planned a special adventure for the evening. The three of you were going in the boat to fish for bass. Just as the Sun started to set, you and LaKendrick loaded the boat with fishing gear, life jackets, flashlights and plenty of fresh bait. Bass like to feed on fresh fish, so you caught several minnows to use as bait. As Mr. Jackson navigated the boat from the cove into the open waters, he steered near the cliffs, looking for

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shallow areas where the bass might be feeding. As darkness approached, you noticed a great commotion of flapping wings from the side of the cliff. Bats were swarming from the direction of the sound. You looked back toward the cliffs and wondered where the bats stayed during the day. If you could remember that information, then you would understand what a significant clue was contained in the old newspapers you found. But just then, you felt a tug on your line. Mr. Jackson said you had a golden touch with a rod and reel. Every time you picked one up, you seemed to catch a fish. Yes! You felt a definite pull on your line and gave a quick jerk to set the hook. You were about to net a big, wide-mouth bass! You forgot all about the bats.

LIFE PRINCIPLE



"All that glitters is not gold."

—William Shakespeare

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Lesson 13
Astronomy

Chapter 2

Telescopes

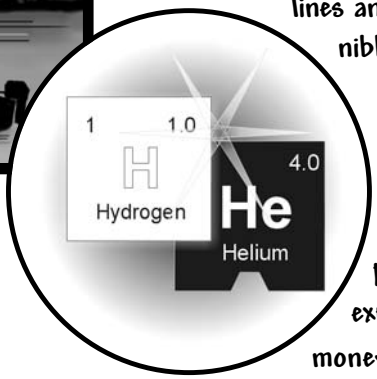
Section 3

Lessons 11-15

BRIGHT LIGHTS



For having never fished before this trip, you really learned quickly! You caught seven bass just as quickly as you replaced fresh bait on your hook. LaKendrick caught five. Mr. Jackson spent most of his time navigating the boat away from the cliffs but close enough to the shore where the fish were feeding. Occasionally, he fished but mostly seemed content to help you and LaKendrick. The fish quit biting for awhile, and the three of you cast your lines and reeled them back without a nibble.



While the fishing slowed for a time, you asked Mr. Jackson about the cabin. You were curious about the previous owners. Mr. Jackson explained that he had saved his money for about five years hoping to buy a cabin on a lake, when he noticed a small advertisement in a newspaper about this cabin for sale at a very low price. He thought the price was a misprint, but it was not. He never met the owners. He just worked with a realtor who represented the owners. The realtor said the owners lived in a different state and wanted a quick sale. That was why the price was so low. The owners had not used the cabin for twenty years. A caretaker had maintained the yard since the family left but had not fixed anything inside the cabin. That was why the inside needed so many repairs. Over time, the interior had deteriorated, as most things do without proper care. Mr. Jackson knew that the name of the previous owner was Russell. That was why Mr. Jackson believed Mack Russell, the man in the boots, when he said the box of books

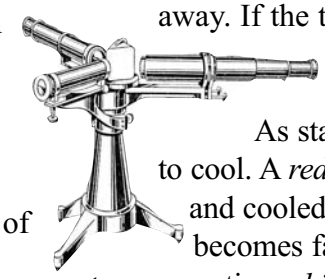
VOCABULARY

Sphere: globe; a round ball
Spectroscope: a device that separates light into a band of colors
Spectrum: band of colors
Core: central or innermost part
Constellations: groups of stars with special names
Astronomers: scientists who study objects in outer space
Refracting telescope: a telescope that uses lenses instead of mirrors
Concave: lens that is rounded inward
Convex: lens that is rounded outward
Reflecting telescope: a telescope that uses concave mirrors

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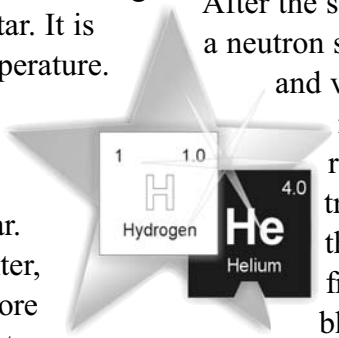
belonged to his family. You knew a connection existed somewhere to everything, but you just had not seen it yet. You laid back in the boat and gazed at the stars. They were like bright, twinkling lights. The night was so clear that you could see thousands of stars. Some seemed like holiday lights, blinking on and off. Others were dim and seemed to fade in and out.

The light released by a star can identify the gases in a star. A star is actually a hot, glowing ***sphere*** of gases. When gas is heated enough, it emits light. Using a ***spectroscope***, a device that separates light into bands of colors, scientists can determine what gases are present on individual stars. Each gas has a unique ***spectrum*** or band of colors. Scientists have found that most stars consist mainly of hydrogen and helium.



spectroscope

Although stars look like white twinkling lights, they actually are a variety of colors. The temperature of the star affects its color. Bluish-white stars are the hottest. Red stars are among the coolest. Our Sun is a yellow star. It is considered to have a medium temperature. The ***core*** temperature of our Sun is about 15 million degrees Celsius. It is hotter than a red star but not as hot as a bluish-white star. The hottest part of a star is its center, or core. As heat moves from the core to the surface of a star, the temperature drops somewhat; however, the star is still so hot that the heat radiates into space.



Stars appear in a variety of sizes. Our Sun is a medium-sized star. Some stars have diameters possibly 100 times that of our Sun. Some stars are as small as or even smaller than Earth.

Stars differ in brightness. The brightness of a star is referred to as its *magnitude*. A star's magnitude depends on three things: size, temperature and distance from Earth. Because of these variables, the apparent brightness of a star may not be the actual brightness of a star.

A star may appear brighter or dimmer from Earth than the actual brightness of the star in space. In other words, a small star that is rather cool, but is close to Earth, may appear brighter than a hotter star farther away. If the two stars were the same size and distance from Earth, the hotter star would appear brighter.

As stars burn, they use energy and start to cool. A *red giant* is a star that has enlarged and cooled. As helium is released, the star becomes fainter and shrinks to become a tiny *white dwarf*. As the white dwarf cools, it becomes a *black dwarf*. A black dwarf does not release any light. It is a dead star.

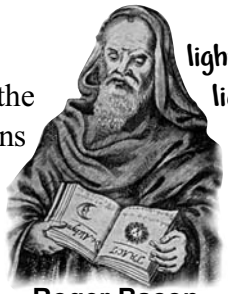
Some massive stars do not enter the white dwarf stage but collapse after finishing the red giant stage. This collapse is violent and results in a *supernova* that shines more brightly than millions of stars combined. After the supernova stage, a star may become a neutron star. A *neutron star* is very small and very dense. The supernova may also result in a *black hole* that is a small region in space with such tremendous gravitational attraction that nothing can escape it. Even light from other stars may be absorbed by a black hole.

Since ancient times, stars have been sources of fascination, inspiration and assistance. Travelers have used stars as reference points to chart movement. Philosophers have identified groups of stars that seem to resemble certain images. These groups of stars are called ***constellations*** and are named for certain figures and symbols from ancient history and mythology.

Astronomers have studied stars to

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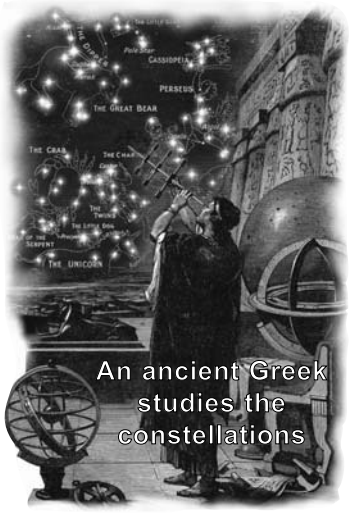
answer questions about the universe. With the invention of the telescope, many discoveries and new insights became possible. In the 13th century, English scientist Roger Bacon first described the optical principles of the telescope. Hans Lipperhey, a Dutchman, is actually credited with inventing the telescope in 1608. He made a ***refracting telescope*** by mounting a ***concave*** and a ***convex*** lens in a tube. The refracting telescope bends light rays. His telescope was used mainly for military purposes to detect the advancing enemy on the battlefield.



Roger Bacon

Italian scientist Galileo is credited with the first use of the telescope for scientific observations of celestial objects. In 1609, he made a telescope based upon Lipperhey's invention. Galileo's telescope also refracted and could magnify objects to 20 times their size. Galileo was the first person to see four of Jupiter's moons, the craters on our Moon, the rings of Saturn and dark spots on the Sun.

In 1663, Scottish astronomer James Gregory conceived the idea of changing the principle design of the telescope from a refracting telescope that used concave and convex lenses to bend light rays to a ***reflecting telescope*** that used a curved mirror to reflect light rays and bring them to a focus.



An ancient Greek studies the constellations

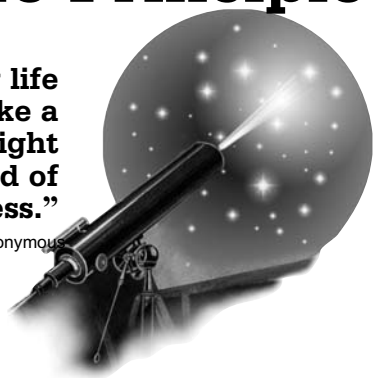
Acclaimed as the greatest scientist of all time, Isaac Newton was the first to build a reflecting telescope in 1688. This reflecting type of telescope produced much better images and led to many significant discoveries about the universe.

The horizon was dotted with distant lights from other cabins. Between the bright lights of the stars and the bright lights of the cabins, the lake at night seemed to glow with a holiday appearance. You felt another tug on your line. The fish were biting again. You asked Mr. Jackson why more people were not out on the lake fishing at night. Mr. Jackson told you that not many people even knew about the lake. He reminded you that it was hidden from view behind cliffs on one side and by tall trees on the other side. That was why the lake was called Hidden Lake. Hidden Lake? Those two words were circled in one of the articles from the 20-year old newspapers! Could the gold coins have something to do with Hidden Lake? One of the other circled words was "cave." What did a cave have to do with Hidden Lake? A bright light suddenly came on in your mind! Bats! Where do bats like to stay during the day? You remembered—they liked to stay in caves! Could a cave be near Hidden Lake? You found out the next day.

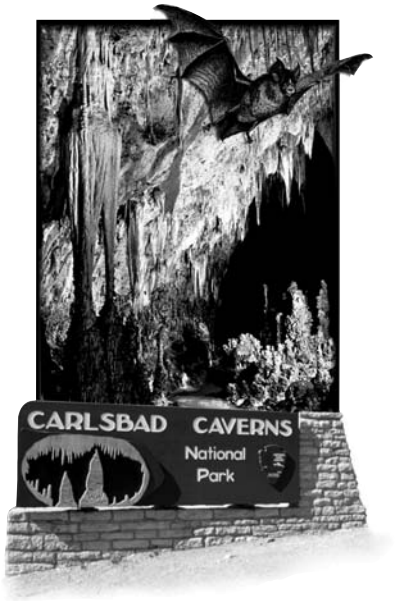
Life Principle

"Your life can be like a bright light in a world of darkness."

—Anonymous



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Lesson 14
Geology

Chapter 2

Caves

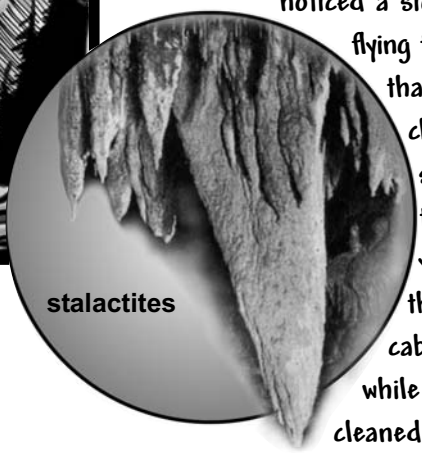
Section 3

Lessons 11-15

EXPLORING



The fish kept biting most of the night. You were too excited to be tired. Between the good fishing and the possibility of discovering a clue, you were wide awake. Just as dawn was breaking, Mr. Jackson steered the boat toward the cove. About a mile from where the cove and the lake converged, you noticed a significant number of bats flying toward the cliffs. You guessed that a cave must be in those cliffs! You visually marked the spot where the bats seemed to disappear and decided that you would return later. When the three of you reached the cabin, you unloaded the boat while LaKendrick and his dad cleaned the fish. You and the Jacksons had caught enough fish for several dinners. Mr. Jackson decided that everyone needed sleep to recuperate from the all-night fishing adventure. By then, you were so tired that even the excitement of finding a cave would have to wait.



VOCABULARY

Spelunkers: people who explore caves for a hobby
Speleologists: scientists who study caves
Speleology: the study of caves for scientific purposes
Geology: the study of the earth's crust and rocks
Archaeology: the study of ancient civilizations
Biology: the study of living things
Guano: bat waste droppings
Stalactites: dissolved lime carbonate forms, hanging like icicles from the roofs of caves
Stalagmites: dissolved lime carbonate forms which extend upward from the cavern floor

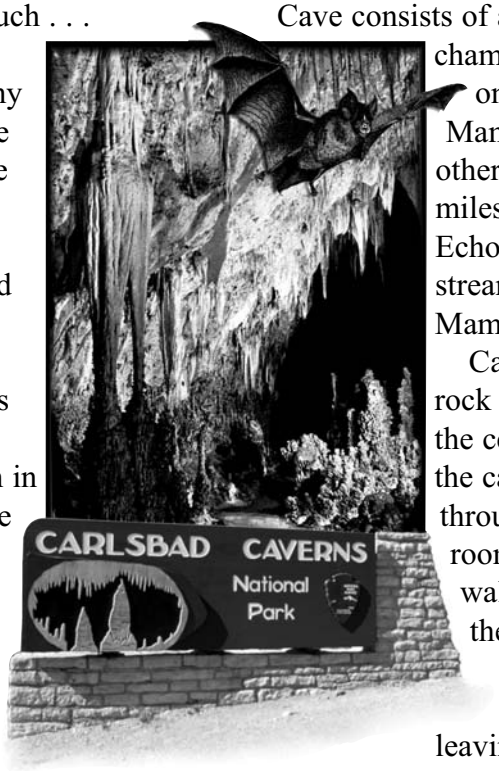
Caves have fascinated explorers for centuries, so naturally you were excited about the possibility of locating a new cave. People who explore caves are called ***spelunkers***. Scientists who study caves are called ***speleologists***. The study of caves is known as ***speleology***. In studying caves, speleologists can learn much about ***geology***, ***archaeology*** and ***biology***. *Geology* is the study of Earth's crust, rocks and fossils. *Archaeology* is the study of ancient people, cultures and their artifacts or things made by them. *Biology* is the study of living things.

Carlsbad Caverns in New Mexico is a series of connecting underground chambers on three different levels. Its largest

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chamber is called the "Big Room" with a floor space of fourteen acres and a ceiling that arches 255 feet overhead. In a 1923 U.S. Land Office survey report, Robert Holley was at a loss for words to describe the awesome sights: ". . . I am wholly conscious of the feebleness of my efforts to convey in words . . . the Divine Creator's work which presents to the human eye such . . . natural wonders."

Each evening as many as half a million bats emerge from the huge main entrance and fly in the direction of Black River. The waste droppings from bats is called ***guano***. Prior to 1941, when Carlsbad Caverns National Park was established, miners removed more than 100,000 tons of guano. Guano is rich in nitrogen and is very valuable as fertilizer. The guano also serves as a food source for beetles, earthworms, snails and millipedes.



Caves are formed in several ways. One type of cave is formed when water combines with carbon dioxide to form carbonic acid, which dissolves limestone. This type of cave is known as a cave of *solution*. Water is the most effective solvent known. This means that more things dissolve in water than in anything else. The process for forming a solution cave begins when rainwater falls to the ground. Falling rain absorbs carbon dioxide from the atmosphere. In the ground, the drops of rain gather more carbon dioxide from decaying plants and animals. The carbon dioxide mixes with water to form a chemical compound called carbonic acid. Carbonic acid is very weak but is strong enough to tunnel through beds of limestone and certain types of rock, hollowing out huge caverns under the Earth. This process is very slow and takes a long time. The process will continue as long as water travels through the tunnels in the rock. Some solution caves are enormous. Mammoth Cave in Kentucky is the longest known cave system in the world. Mammoth Cave consists of a series of limestone chambers and narrow passages on five separate levels. Mammoth Cave connects to two other cave systems to form 348 miles of charted passageways. Echo River is an underground stream which flows through Mammoth Cave.

Caves of solution produce rock formations which hang from the ceiling or build upward from the cave floor. Water drips through the ceiling of the cave room and trickles down the walls. Some water drips onto the floor. Other drops of water cling to the ceiling. The drop of water will evaporate, leaving behind a tiny circle of lime. A second drop of water deposits lime in the same place. Then, a third drop of water, a fourth, and so on continue to leave lime deposits until over the years, the lime deposits grow longer and longer or taller and taller. When these formations extend from the ceiling of the cave downward, the formations are called ***stalactites***. They look like stone icicles.

When the formations build from the floor of the cave upward, the formations are called ***stalagmites***. These usually have broad bases and blunt tips. They may resemble candles with wax dripping down the sides. Stalactites and stalagmites require years, even centuries, to form. Sometimes stalactites and

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stalagmites will meet, forming a column. You can remember which formations are the stalactites by thinking they must hang on tightly to the cave ceiling.

Erosion or abrasion can also form caves. This commonly occurs along a river where a strong current rubs into the side of a cliff or rock. Over the years, the river erodes the rock to form a cave. Sea caves are formed when the waves pound a crack in the cliffs that line the shore. Broken bits of rock, pebbles and sand and the force of the waves wear hollows in the cliffs. Over time, the hollows widen until caves are formed.



In some cases, water is not necessary to form a cave. When a volcano erupts, hot molten rock, called lava, is spewed in liquid form. It solidifies when it cools. A lava cave is formed when the outer surface of the lava hardens before the inner part does. The inner part continues to flow, leaving behind a hard outer shell. Lava caves exist in various parts of the world, but many are located in the Hawaiian Islands, which were formed from volcanic eruptions.

Around noon, you and LaKendrick put a lantern and two flashlights in the boat and motored toward the area of the cliffs where you saw the bats. You tied the boat securely to a tree near the shoreline and climbed up a steep embankment. You thought that if a cave was there, it was not easy to see! Then, you stepped in something squishy. You observed parts of beetles and earthworms in it. You thought about the bats. Ugh! It must be guano. You knew you were close. Trees and overgrown weeds and bushes were in front of you. Had you not recognized the guano, you would have walked right by the weeds and bushes and missed the entrance. You pulled aside the tree branches and bushes to discover an opening! Spider webs hung in the corners of the opening. You studied the spiders, looking for the red hour glass shapes on the abdomens. None of the spiders were black widows. Just to be on the safe side, you used a tree branch to clear away the webs. You and LaKendrick shined your flashlights inside the cave before entering. The entryway appeared to be level and large enough to walk through without stooping.

Once inside the cave, you felt the air temperature drop dramatically. You could hear underground water trickling through the floor of the cave. LaKendrick shined his light, and you saw huge stalactites just in front of you. They were fascinating, resembling giant icicles hanging from the ceiling. Beyond the stalactites was a large chamber. Above your head, you saw hundreds of bats attached to the ceiling. They seemed undisturbed by your visit. To your left you saw several stalagmites. They looked like enormous candles with wax dripping down their sides.

Several chambers were in this cave, each on a lower level. As you descended, you started to shiver. You were not sure whether the shivering was from the cold or from the excitement. On each level, you were so fascinated by the elaborate stalactites and stalagmites that you forgot to look for the gold coins. LaKendrick was the first to notice an unusual formation. One of the stalagmites resembled a birdbath. It looked like a bowl sitting on a pedestal. In the glow of the lantern's light, something in the bowl of the

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stalagmite glittered. You could not believe your eyes! Gold coins filled the bowl! You had found the location of the gold taken in the robbery twenty years ago! And you thought you knew who was behind the robbery, too!

You and LaKendrick pocketed as many gold coins as possible. You wanted to show Mr. Jackson what you had found. You had no way to carry the rest of the treasure. You carefully replaced the bushes at the entrance to the cave and navigated the boat back to the cabin. Mr. Jackson was nowhere in sight, but his truck was in the driveway. You sat on your cot on the deck to think about what to do. Suddenly, you noticed that the old newspapers you had been reading were gone. A sense of unease warned you that things were not right. You and LaKendrick walked back to the boathouse where you were surprised to see a boat with two men puttering toward you. The two men told you they were interested in buying some land in the area and wanted to know if the fishing was good at the lake. You suspected that these men were not interested in fishing, and you were right. The next question they asked was about the area itself. They wanted to know if any caves were around the lake. You avoided answering the question by telling them that you and LaKendrick did not live in the cabin, but that you lived in Sparsville and were just in the area to help with repairs. The men's faces were not familiar to you, but something else was. One of the men was wearing boots with twisted rope designs! The men decided that you did not know anything, and they left. You and LaKendrick were relieved, but you still had several problems to solve. You were concerned about Mr. Jackson's absence. Time was running out. You had to hurry before you were too late!

Life Principle



**"You will never find treasure . . .
unless you hunt for it."**

—Anonymous

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Lesson 15
Meteorology

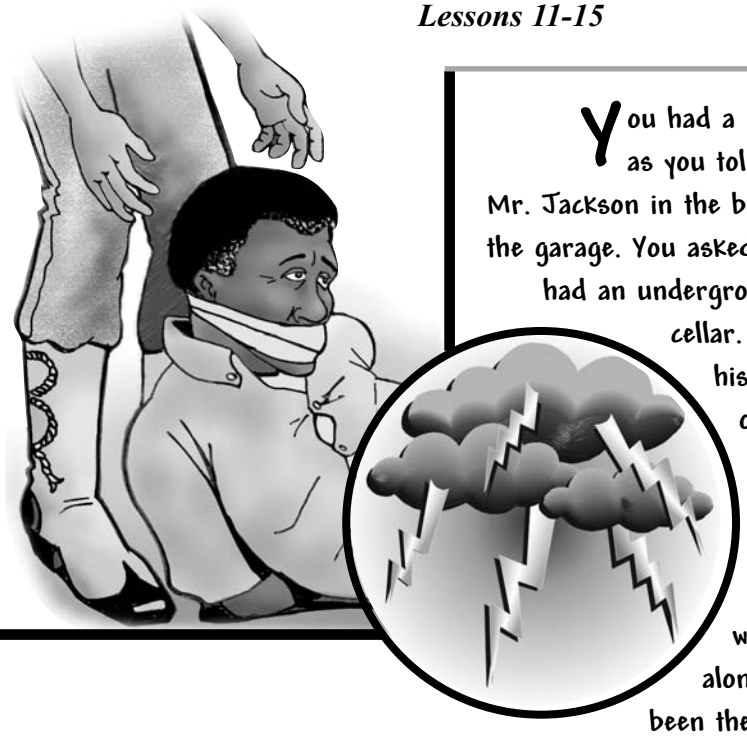
Chapter 2

Thunderstorms

Section 3

Lessons 11-15

THE RIGHT STUFF



You had a sense of urgency in your voice as you told LaKendrick to search for Mr. Jackson in the bedrooms while you searched the garage. You asked LaKendrick if the property had an underground storage area like a storm cellar. He told you that the only thing his father had shown him was an old, unused well that had been partially filled with dirt. The well was located in the wooded area beyond the long driveway. As LaKendrick led you to the well, you noticed fresh tire tracks along the way. A vehicle had just been there. The well had a cover held in place by a huge boulder. LaKendrick remarked that the boulder was never there before. As muffled sounds escaped from under the cover, you both realized that Mr. Jackson must be in the well! You and LaKendrick pushed on the boulder, but it would not move. You decided that the men must have moved the boulder to the well with a truck or a tractor. You wanted to use Mr. Jackson's truck to push the boulder off the well cover. LaKendrick ran back to the cabin to get his dad's keys to the truck. LaKendrick looked every where, but he could not locate the keys. Then, he remembered that his dad always kept the keys to the truck in his pocket.

Frustrated, you stopped to think about the situation. You knew what to do. You had to increase your strength to move the boulder. But how? You needed some type of mechanical advantage. You thought you had the problem solved by using Mr. Jackson's truck; but because you could not use the truck, you had to find another method to provide the mechanical advantage you needed.

VOCABULARY

Atmosphere: the mixture of gases that surround the Earth
Collide: to strike together
Molecules: small particles of matter
Statute of Limitations: a rule established by a legislature defining the time period within which legal action on a matter may be taken
Spelunking: exploring a cave

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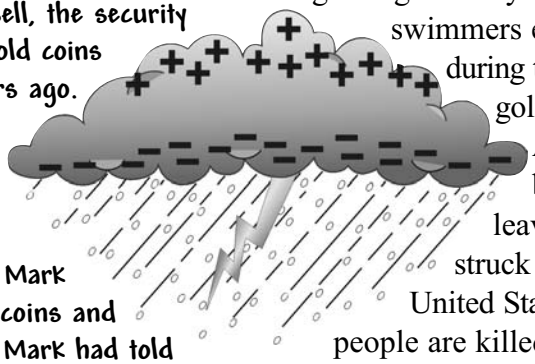
Then, you remembered how you had removed the paint can lids when they had been stuck. You had used the handle of a spoon as a lever for mechanical advantage, and the lids were pried loose. You told LaKendrick that you needed something long and strong for a lever. LaKendrick found a long, sturdy wooden pole by the garage and brought it to you. You used a large rock for a fulcrum. You placed the end of the pole at the base of the boulder and positioned the fulcrum under the pole. You and LaKendrick pushed down on the opposite end. As the two of you exerted effort force on the lever, the boulder moved slightly. You continued exerting effort force by lifting up and pushing down on the pole. Finally, the boulder inched off the well cover. You removed the cover from the old well and discovered an angry, but otherwise unhurt, Mr. Jackson. His mouth was gagged, and his hands were tied behind his back.

Once Mr. Jackson was freed, he explained that when he had awakened from his nap, two men had been on the deck looking through the newspapers. Upon seeing Mr. Jackson, they charged and over-powered him. Then, they had gagged him, tied his hands and thrown him into the well. He said that one of the men was the one who had visited the cabin and identified himself as Mack Russell.

You told Mr. Jackson that you thought the other man was Mark Russell, the security guard at the bank where the gold coins had been displayed twenty years ago. You suspected that Mack Russell had robbed the bank with help from his cousin, Mark, who had been on duty, supposedly guarding the coins. Mark had allowed Mack to steal the coins and bind Mark to the chair. Then, Mark had told the police that he had never seen the face of the robber or which way he had gone. Your only question was why Mark and Mack did not know the location of the cave where the coins were hidden. You concluded a third person must have been involved.

Mr. Jackson called the sheriff to report the events that happened that day. The sheriff and several of his deputies met with you, LaKendrick and Mr. Jackson. You and LaKendrick agreed to lead the officers to the cave where the gold coins were hidden. But that would have to wait. Dark clouds were signaling a fierce thunderstorm. Everyone went inside the cabin to wait out the storm.

Thunderstorms form when hot, humid air is rapidly pushed high into the cold, upper ***atmosphere***. Thunderstorms consist of lightning, thunder and (often) hail. Lightning is actually a discharge of electricity from a cloud to the Earth. The lighter particles of water in the cloud ***collide*** with heavy particles, such as hail. During the collision, the lighter particles become positively charged and drift to the top of the cloud. The heavier, negatively charged particles fall to the bottom of the cloud. Because it is a conductor of electricity, the Earth attracts charges from the cloud. Lightning is a visible discharge of electricity in the atmosphere and occurs when the Earth attracts the charges in a cloud. The shorter the distance from the ground to the cloud, the easier electrical discharges can take place. You need to avoid being in a place where lightning is likely to strike. That is why swimmers exit swimming pools during thunderstorms, and why golfers leave golf courses. Additionally, people in boats on lakes should leave lakes to avoid being struck by lightning. In the United States, approximately 100 people are killed by lightning strikes each year. Lightning starts 40% of farm fires and approximately 75,000 forest fires each year. Lightning is very dangerous because the electricity in lightning has a potential of 100



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million volts. Most people who are struck by lightning die. Only a few ever survive.

As a lightning bolt passes through the air, the air ***molecules*** push away from the bolt, creating an empty tunnel (vacuum) as the bolt travels downward. When the bolt stops, the air molecules collide back together, creating a sound wave. This sound wave is called thunder. Thunder can be very loud, depending on the nearness of the lightning.

The thunderstorm lasted about 30 minutes. When the sky cleared, you and LaKendrick got in the sheriff's boat. Mr. Jackson and the deputies rode in Mr. Jackson's boat, as you led the way to the cave. The men were amazed that you could locate the cave, because it was so well hidden. You told the officers that the bats had shown you the way! Inside, you and LaKendrick led the men down the three levels to the large stalagmite shaped like a birdbath. The deputies carefully placed the gold coins in briefcases.

On the return trip to the cabin, LaKendrick spotted the Russells in their boat. Mr. Jackson identified the Russells as the men who had tied him up and put him in the well. The sheriff navigated his boat to the Russell's boat and boarded it with three deputies. The Russells were arrested and handcuffed without struggle. A deputy drove the Russell's boat back to the cabin. LaKendrick steered the sheriff's boat. Once inside the cabin, the Russells confessed to the robbery of the coins and named the caretaker of the cabin as the third accomplice.

After the robbery, all three thieves had agreed to hide the gold at the cabin and wait to use it until the twenty-year ***statute of limitations*** had expired. At a predetermined time, the three would meet to share the gold. In the meantime, the Russells left the area. The caretaker became ill. Unable to locate the Russells, the caretaker hid the gold in the cave. Just before he died, the caretaker left an ambiguous letter for the Russells about the location of the gold. The caretaker put clues to the gold's location in a box of books in the cabin and in a metal box buried in one of the flower beds just under the bedroom windows. The Russells had dug up the metal box and found the word "cave" on a piece of paper. They needed the other half of the clue to reveal the location of the cave. The other half of the clue was found in the newspapers in the box of books. The Russells were not good at problem solving and never could determine the exact location of the cave—they did not know that bats could have shown the way.

The Russells had sold the cabin thinking that they could retrieve the gold coins and leave the area without anyone discovering their connection to the robbery. They did not count on you and LaKendrick being so observant.



Burned trees after a forest fire

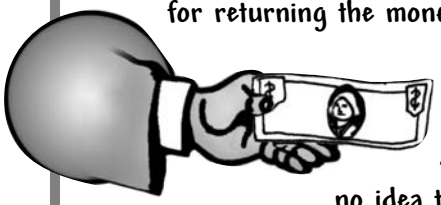
The sheriff called a bank official to examine the gold coins. The official confirmed that the coins were the ones stolen twenty years ago from the display area of the bank and were the same coins stolen approximately 100 years before by the Dalton Gang. The official counted the coins. Only ten were missing. He did not seem concerned about them and thought that they must have been lost years ago. Then you remembered. You and LaKendrick had put some in your pockets! You had a decision to make. You had to decide whether or not to tell that you had some of the coins.

Your grandfather had taught you that honesty was the best policy. When you were younger, you remembered seeing your grandfather return money to a cashier who had given too much change. Your grandfather had told you he did that because it was right.

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You did not have to think long. Neither did LaKendrick. You both emptied your pockets and produced the ten missing coins. The bank official was elated; the sheriff was impressed; Mr. Jackson was very proud of you both!

You felt good about what you did. You knew you had done the right thing. You were still thinking about the excitement of the day when the bank official made an announcement. He told you and LaKendrick that a reward was posted for returning the money. You each would receive one thousand dollars! What a surprise! You had no idea that a reward was involved.



The next few days were filled with activities. The newspaper published a picture of you and LaKendrick with the gold coins. You both were on the evening television news. The reporter asked you lots of questions about the gold coins and the cave. A speleologist contacted you about the discovery of the cave and asked if you and LaKendrick wanted to help explore the rest of the chambers. Your mother put most of your money aside in a savings plan for college. You kept enough to purchase yourself a new rod and reel and tackle box; and you insisted on buying your mother a gold locket. She did not want you to spend any of your money on her; but, you did anyway. You knew she would appreciate and treasure the locket.

After things settled down, you returned to the cabin to help Mr. Jackson finish the repairs. Each afternoon you and LaKendrick enjoyed swimming, fishing and ***spelunking***. Mr. Jackson said that you had the "right stuff" to be anything you wanted to be. You told him that you just wanted to be the greatest fisherman Hidden Lake had ever known. He laughed and told you that if you caught the fish, he would cook them. That was the "right stuff" for a great vacation!

Life Principle



"Knowing what is right is good; doing what is right is better."

—Middle East Proverb

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