HSP Science

Lab Manual

Grade 5

Teacher Edition

Harcourt
SCHOOL PUBLISHERS

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Safety in Science

Doing investigations in science can be fun, but you need to be sure you do them safely. Here are some rules to follow.

1. **Think ahead.** Study the steps of the investigation so you know what to expect. If you have any questions, ask your teacher. Be sure you understand any caution statements or safety reminders.
2. **Be neat.** Keep your work area clean. If you have long hair, pull it back so it doesn't get in the way. Roll or push up long sleeves to keep them away from your experiment.
3. **Oops!** If you should spill or break something, or get cut, tell your teacher right away.
4. **Watch your eyes.** Wear safety goggles anytime you are directed to do so. If you get anything in your eyes, tell your teacher right away.
5. **Yuck!** Never eat or drink anything during a science activity.
6. **Don't get shocked.** Be especially careful if an electric appliance is used. Be sure that electric cords are in a safe place where you can't trip over them. Don't ever pull a plug out of an outlet by pulling on the cord.
7. **Keep it clean.** Always clean up when you have finished. Put everything away and wipe your work area. Wash your hands.



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Name _____

Date _____

Science Safety Checklist

____ I will study the steps of the investigation before I begin.

____ I will ask my teacher if I do not understand something.

____ I will keep my work area clean.

____ I will pull my hair back and roll up long sleeves before I begin.

____ I will tell my teacher if I spill or break something or get cut.

____ I will wear safety goggles when I am told to do so.

____ I will tell my teacher if I get something in my eye.

____ I will not eat or drink anything during an investigation unless told to do so by my teacher.

____ I will be extra careful when using electrical appliances.

____ I will keep electric cords out of the way and only unplug them by pulling on the protected plug.

____ I will clean up when I am finished.

____ I will return unused materials to my teacher.

____ I will wipe my area and then wash my hands.

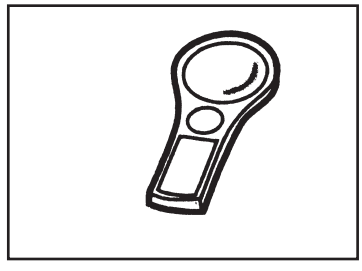
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Using Science Tools

In almost every science inquiry in this lab manual, you will use tools to observe, measure, and compare the things that you are studying. Each tool is used for a different thing. Part of learning about science is learning how to choose tools to help you answer questions. Here are some tools that you might use and some rules on how to use them.

Using a Hand Lens

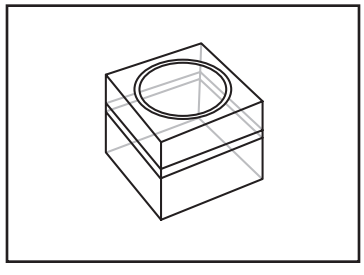
Use a hand lens to magnify an object. You can observe more details with a hand lens.



1. Hold a hand lens about 12 centimeters (5 inches) from your eye.
2. Bring the object toward you until it comes into focus.

Using a Magnifying Box

Use a magnifying box to magnify something on a flat surface. You can put things inside the box to observe. The magnifying box can be used to observe small living things such as insects. You can observe the insect and then release it.



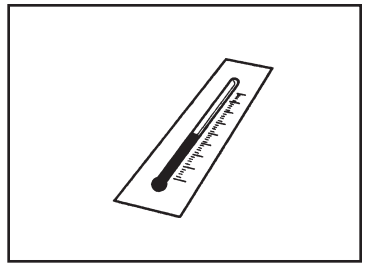
1. Place the magnifying box on top of a flat surface.
2. Place the object you want to observe inside the box. Put on the lid.
3. Look through the lid at the insect or object.

Safety: Do not use a hand lens or magnifying box that is cracked or damaged. If one breaks, do not try to clean up the broken pieces. Call your teacher for help.

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Using a Thermometer

Use a thermometer to measure temperature. Temperature is measured in degrees Celsius or degrees Fahrenheit.



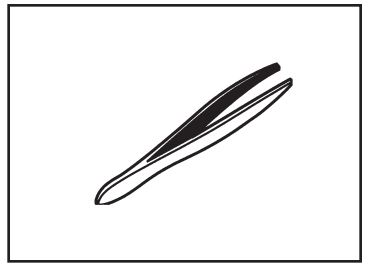
1. Place the thermometer in the liquid. Never stir the liquid with the thermometer. Don't touch the thermometer any more than you need to. When you are measuring the temperature of the air, stand between the thermometer and bright lights, such as the sun or a lamp.
2. When you are measuring a material that is not being heated or cooled, wait about five minutes for the temperature reading to stop changing.
3. When the material you are measuring is being heated or cooled, you will not be able to wait before reading the temperature. Read the temperature as quickly as you can.
4. To read the temperature, move so that your eyes are even with the liquid in the thermometer. Find the scale line that meets the top of the liquid in the thermometer, and read the temperature.

Safety: If a thermometer breaks, do not touch it. Call your teacher for help.

The thermometers you use in science activities should never be used to measure body temperature. Never place one in your mouth or under your arm.

Using Forceps

Use forceps to pick up and hold on to objects.

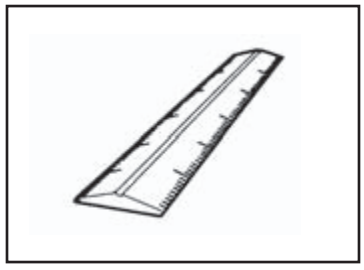


1. To pick up an object, place the tips of the forceps around the object you want to pick up. Press the forceps' handles together with your thumb and first finger to grab the object.
2. Move the object to where you want to place it. Stop pressing with your thumb and first finger. The forceps will let go of the object.

Safety: The tips of forceps can be sharp. Handle it with care.

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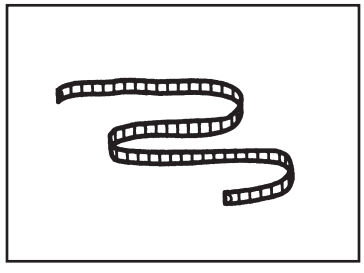
Using a Ruler or Meterstick



Use a ruler or a meterstick to measure dimensions of objects and distances in meters (m), centimeters (cm), and millimeters (mm).

1. Place the zero mark or end of the ruler next to the left end of the object you want to measure.
2. On the other end of the ruler, find the place next to the right end of the object.
3. Look at the scale on the ruler next to the right end of the object. This will show you the length of the object.
4. A meterstick works the same way. You can use it to measure longer objects.
5. You also can use a ruler or meterstick to measure the distance between two places.

Using a Tape Measure



Use a tape measure to measure around curved objects or to measure much longer distances than with a ruler or meterstick.

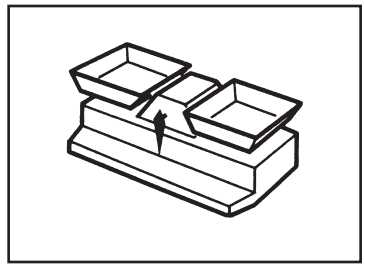
1. Place the tape measure around the object or along the distance you would like to measure.
2. Read the tape measure the same way you would read a ruler or meterstick.
3. When you are measuring long distances with a tape measure, you will need a lab partner to hold one end while you stretch the tape measure to the other end of the distance.

Safety: Some rulers and metersticks can have sharp edges. Be careful not to cut yourself. Never point a ruler or meterstick at another person.

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Using a Balance

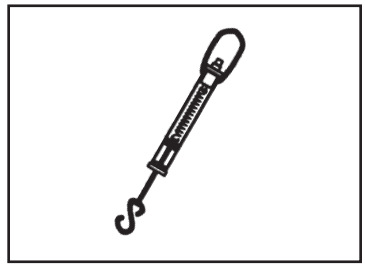
Use a balance to measure mass. Mass is measured in kilograms (kg) and grams (g).



1. Look at the pointer on the base to see that it points at the middle mark of its scale.
2. Place the object that you wish to measure in the pan on the left side of the balance. The pointer should move away from the middle scale mark.
3. Add standard masses to the pan on the right side of the balance. As you add masses, you should see the pointer move back toward the middle scale mark. When the pointer stays at the middle mark, the pans are balanced.
4. Add the numbers on the standard masses that you placed in the pan on the right side of the balance. The total is the mass of the object you measured.

Using a Spring Scale

Use a spring scale to measure an object's weight or a force. Force is measured in newtons (N).



Measuring Weight

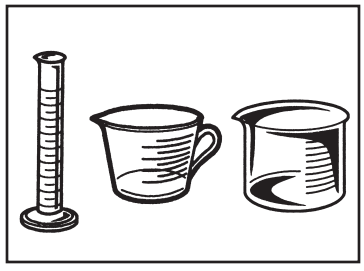
1. Hook the spring scale to the object.
2. Lift the scale and object with a smooth motion. Do not jerk the object upward.
3. Wait until the spring stops moving. Then read the force on the scale.
4. You can measure objects that will not fit on the hook. Put the object in a light plastic bag. Hang the bag on the hook.

Measuring the Force to Move an Object

1. With the object resting on a table, hook the spring scale to the object.
2. Pull the object smoothly across the table. Do not jerk the object.
3. As you pull, have a lab partner read the force on the scale.

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Using a Measuring Cup, a Beaker, or a Graduated Cylinder



Use a measuring container to measure the volume of a liquid or a loose solid, such as a powder. Volume is measured in liters (L) and milliliters (mL).

Measuring Liquids

1. Pour the liquid you want to measure into a measuring container. Put your measuring container on a flat surface, with the measuring scale facing you.
2. Look at the liquid through the container. Move so that your eyes are even with the surface of the liquid in the container.
3. To read the volume of the liquid, find the scale line that is even with the surface of the liquid.
4. When the surface of the liquid is not exactly even with a line, estimate the volume of the liquid. Decide which line the liquid is closer to, and use that number.
5. A graduated cylinder has smaller lines between the numbered lines. Each of these lines equals one milliliter. Look at the first numbered line below the level of the liquid. Count the number of smaller lines between the numbered line and the level of the liquid. Add this to the number on the numbered line. The total is the volume of the liquid in milliliters.

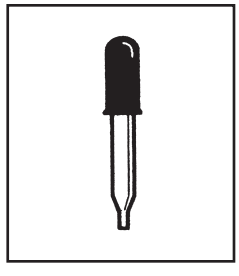
Measuring Solids

- You can measure a solid such as sand or sugar in the same way that you measure a liquid. You will have to smooth out the top of the solid until it is flat and even before you can read the volume of the solid.

Safety: Some measuring cups, beakers, and graduated cylinders are made of glass. Be careful not to drop one, or it could break.

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Using a Dropper



Use a dropper to move tiny amounts of liquid.

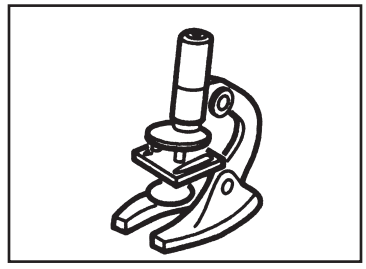
1. Hold the dropper upright. Put the tip of the dropper in the liquid.
2. Gently squeeze the bulb on the dropper. Stop squeezing to allow the liquid to fill the dropper.

3. Hold the dropper over the place where you want to put the liquid. Gently squeeze the bulb to release one drop at a time.

Safety: Never put a dropper in your mouth. Do not use a dropper that you use in science class for medicine, especially eye drops.

Using a Microscope

Use a microscope to magnify very small objects. A microscope is much more powerful than a simple hand lens.



Caring for a Microscope

- Carry a microscope with two hands or use a rolling cart to move it.
- Never touch any of the lenses of a microscope with your fingers.

Using a Standard Microscope

1. Raise the eyepiece as far as you can by turning the coarse-adjustment knob. Place your slide on the stage.
2. Turn the lowest power lens into place. The lowest power lens is usually the shortest. Carefully use the adjustment knobs to lower the eyepiece and lens to the lowest position it can go without touching the slide.
3. Look through the eyepiece, and raise the eyepiece and lens with the coarse-adjustment knob until the thing on the slide is close to being in focus. Then use the fine-adjustment knob to focus.
4. When you need to magnify the thing on the slide even more, turn the higher-power lens into place, watching carefully to make sure that the lens will not hit the slide. Use only the fine-adjustment knob when looking through a higher-power lens.

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Name _____

Date _____

Unit Inquiry Log

Use these pages to plan and conduct a science experiment to answer a question you may have.

1. Observe and Ask Questions

Make a list of questions you have about a topic. Then circle a question you want to investigate.

_____

2. Form a Hypothesis

Write a hypothesis. A hypothesis is a scientific explantion that you can test. You must be able to test the hypothesis.

_____

3. Plan an Experiment

Identify and Control Variables

To plan your experiment, you must first identify the important variables. Complete the statements below.

The variable I will change is

_____.

The variables I will observe or measure are

_____.

The variables I will keep the same, or *control*, are

_____.

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Name _____



Develop a Procedure and Gather Materials Write the steps you will follow to set up an experiment and collect data.

Use extra sheets of blank paper if you need to write down more steps.

Materials List Look carefully at all the steps of your procedure, and list all the materials you will use. Be sure that your teacher approves your plan and your materials list before you begin.

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Name _____

4. Conduct the Experiment

Gather and Record Data Follow your plan and collect data. Make a table or chart to record your data. **Observe** carefully. **Record** your observations and be sure to note anything unusual or unexpected. Use the space below and additional paper if necessary.

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Name _____

Interpret Data Make a graph of the data you have collected. Plot the data on a sheet of graph paper or use a software program.

5. Draw Conclusions and Communicate Results

Compare the hypothesis with the data and the graph. Then answer these questions.

1. Given the results of the experiment, do you think the hypothesis is true? Explain.

_____

_____

2. How would you revise the hypothesis? Explain.

_____

_____

3. What else did you **observe** during the experiment?

_____

_____

Prepare a presentation for your classmates to communicate what you have learned. Display your data tables and graphs.

Investigate Further

Write another hypothesis that you might investigate.

_____

_____

_____

_____

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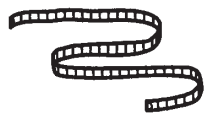
Name _____

Date _____

Investigate Log

Measuring Up!

Materials








tape measure balloon hand lens spring scale string ruler

Procedure

1. **Observe** the empty balloon with a hand lens. **Record** your observations in the chart.
2. **Measure** the length and circumference of the balloon. **Record** your observations.
3. Use the spring scale to **measure** the weight of the balloon. **Record** its weight.
4. Now, blow up the balloon.
5. Match a length of string to the length of the balloon. **Measure** that string with a ruler or tape measure. **Record** the length.
6. **Measure** the circumference of the balloon as in Step 5. **Record** your measurement.
7. **Measure** the weight of the balloon with the spring scale. **Record** your measurement.

	Balloon	Balloon with Air
Hand Lens		
Length		
Circumference		
Weight		

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

Variables are factors that can change or be kept the same during an experiment or investigation. A good experiment only changes one variable at a time.

1. How did the measurements change after you blew up the balloon? Why? **Students should find that all of the measurements increased. They should conclude that air takes up space and has weight.**

2. Do you think that your measurement of the length of the empty balloon or the blown-up balloon was more accurate? Why? **Possible answer: The full balloon was more accurate because the balloon was stretched out and easier to measure.**

3. **Inquiry Skill—*Identify Variables*** Work with another group to **identify variables** in your measurements. What variables caused your group and the other groups to get different measurements? **Students should suggest that the size of the balloon, the amount of air they put in the balloon, the way they attached the balloon to the spring scale, and how tightly they pulled the string when they measured were all variables.**

Investigate Self-Assessment	Agree	Not Sure	Disagree
I observed the balloon with and without air.			
I measured distance with the tape measure and measured distance with the ruler.			
I **identified variables** in my measurements.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

How can you find the volume of a blown-up balloon? Plan and conduct a simple investigation to find out.

Materials

Here are some materials that you might use. List additional materials that you need.

- tape measure
- ruler
- water
- balloon
- string
- measuring cup

1. Explain how you plan to measure the volume of the balloon.

Possible answer: measure the volume of water the balloon displaces, fill the balloon with water and measure the volume of that water, research a formula for the volume of a sphere (if the balloons are spherical) and use the formula

2. Conduct your experiment for finding the volume of the balloon. Show your measurements and calculations in the space below.

Check that students' answers are accurate and consistent with their method of finding the volume.

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3. Based on your conclusions, do you feel that your method was a good way of finding the volume of a blown-up balloon? Explain.

Students should explain whether they feel their method of finding the volume of the balloon was successful. They should note any problems they encountered.

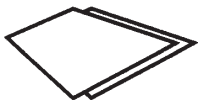
Name _____

Date _____

Investigate Log

Design an Airplane

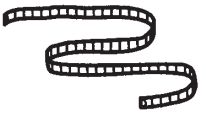
Materials



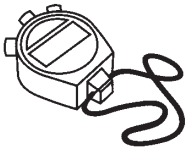
thick paper



tape



ruler or tape measure



stopwatch

Procedure

1. Design a paper airplane. Fold a sheet of thick paper to make the plane.
2. **Measure** a distance of 10 m in an open area. Mark one end of the distance as a starting line, and place a stick or stone every half meter from the starting line.
3. Test-fly your plane. Have a partner start the stopwatch as you're releasing the plane and stop it when the plane lands. **Record** the flight time in the table shown below.
4. **Measure** the distance the plane flew. **Record** the distance in the table.
5. Repeat Steps 3 and 4 for a second trial.
6. Make a second airplane with wings half as wide as your first plane.
7. Test-fly your plane two times. **Record** your measurements in the table.

Trial		Airplane 1	Airplane 2
1	time		
	distance		
2	time		
	distance		

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Name _____

Investigate Log

Draw Conclusions

1. How did changing the width of the wings affect the way your plane flew?

   Possible answer: The plane with the wider wings flew farther. The plane with the narrow wings flew faster.

2. **Inquiry Skill—*Write a Hypothesis*** Why did some students' planes fly farther or longer than those of others? **Write a hypothesis** to explain your thinking.

   Possible answer: More air could get under the wider wings, so it floated better.

Inquiry Skill Tip

A good **hypothesis** explains as many of the facts, measurements, and observations as possible. Before you write a hypothesis, summarize the information you know. After you write the hypothesis, check that it is consistent with the information in the summary.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I built and tested two paper airplanes.			
I used the ruler or tape measure to determine how far the airplane flew.			
I **wrote a hypothesis** to explain why some students' planes flew farther or longer than others.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

On one of your planes, add a paper clip weight to your plane. Then fly the plane. What happens to the distance and time it flies? Infer the weight's effect on the plane.

Materials

- thick paper
- paper clip
- stopwatch
- ruler or tape measure
- tape

1. Predict how the paper clip will affect the flight time and distance of the plane.

Students may predict that the plane will travel a shorter distance. Others may predict that careful placement of the paper clip will help the plane stay in the air longer.

2. Test the plane. Record your measurements below.

	Trial 1	Trial 2
time		
distance		
time		
distance		

3. Infer how the paper clip affected the flight of the plane.

Students may measure that the plane traveled farther and stayed in the air a longer time. They may infer that the paper clip kept the airplane steadier so that the air flowed smoothly along the wings.

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Investigate Log

Build a Rocket!

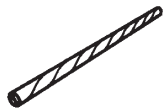
Materials



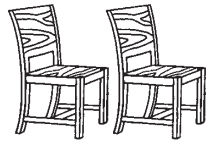
goggles



string, 5 m



drinking straw



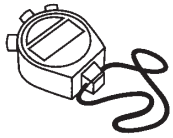
2 chairs



balloon



tape



timer/stopwatch



tape measure

Procedure

1. **CAUTION**: **Wear safety goggles**. Thread one end of the string through a straw.
2. Place two chairs about 4 m apart, and tie one end of the string to each chair.
3. Blow up the balloon, and pinch it closed.
4. Have a partner tape the balloon to the straw, with the balloon's opening near one chair.
5. Release the balloon. Use the stopwatch to time how long it keeps going.
6. **Measure** and **record** the distance the balloon traveled. Also record its travel time.
7. Repeat Steps 3–6 with more air in the balloon. Then repeat Steps 3–6 with less air in the balloon than on the first trial.

Trial	Time (sec)	Distance (cm)
1		
2 (more air)		
3 (less air)		

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Name _____

Investigate Log

Draw Conclusions

1. Why did the balloon move when you released the opening?

Students may say that the air leaving the balloon pushed the balloon forward. [In reality, this is an example of Newton's third law—action-reaction.]

2. How did the amount of air in the balloon affect the time and distance it traveled?

Students should suggest that the more air there is in the balloon, the farther the balloon will travel.

3. **Inquiry Skill**—***Predict*** Would changing the shape of the balloon affect the distance it travels? **Predict** what would happen if you use a large round balloon and a long skinny balloon with the same amount of air.

Students may predict that the long skinny balloon will go faster and farther because the air can shoot out straight out the back.

Inquiry Skill Tip

Predict means to use information, data, measurements, and observations from the past to make an educated guess about the future. When you make a prediction, say what you think will happen and give a reason why.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions to build a balloon rocket.			
I followed safety guidelines by wearing goggles.			
I **predicted** whether a large round balloon or a long skinny balloon would travel farther.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Plan an investigation to find out how the angle of the string affects the time and distance the balloon travels. How do you think the results will change?

Materials

- goggles
- balloon
- tape
- string
- tape measure
- timer/stopwatch
- drinking straw

1. Predict how the angle of the string will affect the travel time and distance of the balloon rocket.

Possible answer: Raising the string at an angle from the ground will reduce the travel time and distance.

2. Test the balloon rocket with the string at different angles. Make a table to record your measurements.

Sketch of String Angle	Time (s)	Distance (cm)

3. Draw a conclusion about how the angle of the string affects the travel time and distance of the balloon rocket.

Check that students' answers are consistent with their results.

Possible answer: The balloon rocket travels less time and distance the higher the angle of the string is from the ground.

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Date _____

Unit Inquiry Log

Unit A

Plant Growth

1. Observe and Ask Questions

How do plants respond to light? For example, does a plant grow toward a light source? Make a list of questions you have about plants and light. Then circle a question you want to investigate.

Do plants respond to light?

Do different colors of light make plants grow differently?

How does the amount of light affect plant growth?

2. Form a Hypothesis

Write a hypothesis. A hypothesis is a scientific explantion that you can test. You must be able to test the hypothesis.

A plant will grow toward a light source.

3. Plan an Experiment

To plan your experiment, you must first identify the important variables. Complete the statements below.

Identify and Control Variables

The variable I will change is

the position of the light source.

The variable I will observe or measure is

the plants' movement or growth.

The variables I will keep the same, or *control*, are the

type of plant, amount of water the plants receive, and temperature.

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Unit Inquiry Log

Develop a Procedure and Gather Materials Write the steps you will follow to set up an experiment and collect data.

a. Cut a hole about 2 inches wide in the middle of one end of a shoe box.

b. Divide the box into thirds by taping two cardboard squares inside the box. One square will extend from the left side of the box to the middle of the box. The other square will extend from the right side of the box to the middle.

c. Put one plant in the box at the end opposite the hole.

d. Place the lid on the box. Put the box in a sunny location so that the hole is facing the light source.

e. Place the second plant beside the box.

f. Observe the growth of the plants daily and record all observations.

Use extra sheets of blank paper if you need to write down more steps.

Materials List Look carefully at all the steps of your procedure, and list all the materials you will use. Be sure that your teacher approves your plan and your materials list before you begin.

two potted lima bean seedlings, light source or sunny location, shoe box with lid, cardboard, tape, scissors

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Name _____

4. Conduct the Experiment

Gather and Record Data Follow your plan and collect data. Use the chart below or a chart you design to record your data. **Observe** carefully. **Record** your observations, and be sure to note anything unusual or unexpected.

Observation Log

	Plant Observations						
Plant	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
In Box							
Control							

	Plant Observations						
Plant	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
In Box							
Control							

Observations

_____

_____

_____

_____

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Name _____

Interpret Data Make sketches that illustrate the appearance of the plants on Day 14. Use the sketches to make a Venn diagram comparing and contrasting the physical traits of the plants.

5. Draw Conclusions and Communicate Results

Compare the hypothesis with your observations, and then answer these questions.

1. Was your hypothesis supported by the results of the experiment? Explain.

   Students should justify their responses with data and observations.

2. How would you revise the hypothesis? Explain.

   Students may revise their hypotheses to match the results of the experiment more closely.

3. What else did you observe during the experiment?

   Students should use their notes and be as specific as possible.

Prepare a presentation for your classmates to communicate what you have learned. Display your data table.

Investigate Further

Write another hypothesis that you might investigate.

Responses will vary depending on experiment outcomes and student interest.

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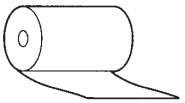
Investigate Log

Observing Cells

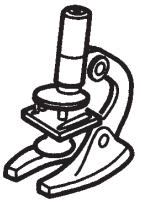
Materials



dropper



paper towels



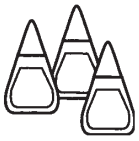
microscope



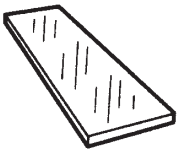
coverslip



colored pencils



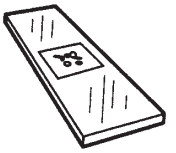
red food coloring



microscope slide



slice of onion



prepared slide of animal skin cells

Procedure

CAUTION: Food coloring stains. Avoid getting it on your clothing.

1. Use the dropper to place one drop of food coloring in the center of the slide. Break the onion slice, and pull off a piece of onion skin. Put the onion skin in the drop of food coloring. Gently lower the coverslip at an angle so that it spreads the food coloring. Use a paper towel to remove any excess food coloring.
2. **Observe** the onion skin cells under the microscope. Use the colored pencils to **record** your observations in a drawing.
3. **Observe** the prepared slide of the animal skin cells. Use colored pencils to **record** your observations in another drawing.

Plant Cell	Animal Cell

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

When scientists **observe**, they watch something very closely, gathering information by using their senses and scientific instruments.

1. **Compare** the onion skin cells and the animal skin cells.

A plant cell has a thick outer wall, while the outer layer of an animal cell is much thinner.

2. **Inquiry Skill—*Observe*** When scientists **observe,** they use their senses to learn about objects and events. In the center of most cells are structures that direct how the cells function. Look for these structures. Based on what you **observe,** how many directing structures do you think each cell needs?

Every cell has a single structure that directs its function.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I was careful to avoid staining anything with food coloring.			
I used the microscope to **observe** a directing structure in each cell.			

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Investigate Log

Independent Inquiry

In what ways do you think all plant cells are alike? Design and conduct a simple experiment to test your ideas.

Materials

Here are some materials that you might use. List additional materials that you need.

- prepared slide of animal skin cells
- red food coloring
- microscope slide
- paper towels
- slice of onion
- colored pencils
- dropper
- microscope
- coverslip

1. Describe the steps of your experiment. What do you hope to learn?

Experiments should support the idea that all plant cells have certain parts in common.

2. **Conduct your experiment.** What similarities do you observe in all the plant cells?

Students should note the similar structures, such as the nucleus (directing structure) and the cell wall, present in all plant cells.

3. What conclusions can you draw from your experiment?

Possible answer: All plant cells have certain parts in common, such as the nucleus and cell wall.

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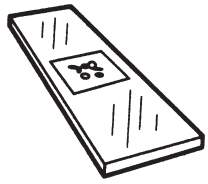
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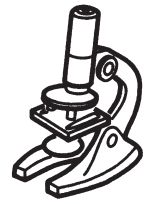
Investigate Log

Cells and Tissues

Materials



prepared slides of plant root, a plant leaf, and a plant stem



microscope



colored pencils

Procedure

1. Place the slide of plant root on the stage of the microscope. Turn the focus knob until you can see the cells clearly. **Observe** the root cells. Use the colored pencils to **record** your observations in a drawing.
2. Repeat Step 1, using the slide of the plant leaf. Again, use the colored pencils to **record** what you observe.
3. Repeat Step 1, using the slide of plant stem. **Record** your observations.

4. **Compare** the different parts of a plant. What similarities did you **observe**? What differences?

Possible answers: The plant cells all had a cell wall and a nucleus. The leaf cells had more green structures than the stem cells. No green structures were visible in the root cells.

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Investigate Log

Draw Conclusions

1. You **observed** cells from three different parts of a plant. Based on your observations, what conclusion can you draw about cells that look similar in all three parts?

They probably have the same function.

2. **Inquiry Skill—*Compare*** When scientists **compare** objects, they often infer reasons for any differences. What can you infer about why leaf cells contain more green structures than do stem cells?

Since food is made in the leaves, the green structures must have something to do with making food.

Inquiry Skill Tip

Recording your observations of objects enables you to **compare** them and infer reasons for the differences. When you infer, you use what you observe to explain those differences.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for observing plant cells.			
I obeyed class rules for using a microscope.			
I was able to **infer** reasons for plant cell differences.			

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Date _____

Investigate Log

Independent Inquiry

Form a hypothesis about similarities and differences among animal cells. Using prepared slides of animal cells, test your hypothesis.

Materials

Here are some materials that you might use. List additional materials that you need.

- **prepared slides of animal cells**
- **microscope**
- **colored pencils**

1. Write your hypothesis about similarities and differences among animal cells.

   Students will probably hypothesize that, like plant cells, animal cells appear different because they have different functions.

2. Test your hypothesis by observing different types of animal cells. Make drawings below to record your observations.

3. Explain how the outcome of this investigation supported or failed to support your hypothesis.

   Students will probably find that observations supported the hypothesis because the appearance of cells and the structures within them depend on the cell function.

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Date _____

Investigate Log

Testing Reaction Time

Materials



metric ruler

reaction time chart, on page 73 in the textbook

Procedure

1. Sit with your arm resting on a table and your wrist hanging over the edge. Hold your hand sideways, ready to catch the ruler in your fingers.
2. Have your partner hold the ruler above and perpendicular to your hand, so you will be able to catch it.
3. Have your partner let go of the ruler. Try to catch it as quickly as possible.
4. Note the measurement on the ruler where you caught it. **Compare** this number to the reaction time chart to find out how long it took you to catch the ruler. **Record** your results.

Trial	Reaction Time (sec)
1	
2	
3	

5. Repeat Step 4 three times, and then trade places with your partner. **Make graphs** to compare your results.

Along the left-hand side of the graph (*y*-axis), students can write the times from the reaction time chart in separate rows. Across the *x*-axis, they can write Trial 1, Trial 2, and Trial 3 in separate columns.

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

You can **infer** based on what you observe and record or on other information you have on a subject.

1. How did your reaction time change with each trial? Why?

Students may find that their reaction times improve due to practice or decline due to fatigue.

2. **Inquiry Skill—*Infer*** What can you **infer** about the messages your brain receives and sends to enable you to catch the ruler?

The eyes must "tell" the brain that the ruler is falling. The brain must "tell" the fingers to catch it.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I worked with my partner to follow directions for this investigation.			
I used the metric ruler to determine reaction time.			
I was able to **infer** about messages the brain receives.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Now that you know how to measure reaction time, hypothesize how you might improve yours. Plan an experiment that would test your hypothesis.

Materials

Here are some materials that you might use. List additional materials that you need.

- **metric ruler**
- **reaction time chart**

1. What is your hypothesis for a way you might improve your time?

Students may hypothesize that they can improve reaction time by practicing many times before making the actual measurements or by looking more closely at the ruler.

2. **Conduct your experiment.** Record your new reaction times in the table below.

Trial	Reaction Time (sec)
1	
2	
3	

3. Did your experiment support your hypothesis? Explain.

Students may find that the experiment supported the hypothesis because they improved their method of measurement or their ability to observe the ruler's movement.

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Date _____

Investigate Log

Classify Shoes

Materials



newspaper



shoes

Procedure

1. Work on the floor, or cover a table with newspaper. Take off one of your shoes. Put it in a pile with your classmates' shoes.
2. Make a list of all the characteristics of shoes that you can **observe.** An example is whether the shoe has laces.
3. Think of a way to divide the shoes into two groups, based on a characteristic you can **observe**. For example, you might make one group of shoes with laces and another group of shoes without laces.
4. Use another characteristic to divide both groups into even smaller groups.
5. Continue to **classify** the shoes, based on their characteristics, until each shoe is in a division of its own.

Shoe Characteristics	
1. has laces	**6.**
2.	**7.**
3.	**8.**
4.	**9.**
5.	**10.**

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Name _____

Investigate Log

Draw Conclusions

1. What characteristics did you use to make your groups?

Students should be able to identify the characteristics of shoes that distinguish each group, such as color, size, and type.

2. In what other ways might you classify shoes?

Possible answers: whether the shoes are for girls or boys, thickness of the soles, whether they have more than one color on them.

3. **Inquiry Skill—*Classify*** Scientists **classify** organisms to find similarities and differences. Why must you compare and contrast things when you classify them?

Students should realize that they contrast (use differences) to separate the shoes into groups. They compare (use similarities) to include shoes in a particular group.

Inquiry Skill Tip

Objects can be **classified** in many ways, based on their characteristics. Often you will **classify** objects based on physical characteristics. You can also **classify** objects based on how they are used, the materials from which they are made, or how they react in certain situations.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I made a list of characteristics of the shoes.			
I **classified** the shoes based on characteristics.			

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Date _____

Investigate Log

Independent Inquiry

Gather ten or more small objects from home or from your classroom. Then develop a way to classify them.

Materials

- objects to be classified

1. What objects will you classify?

Possible answers: buttons, toy cars, dried beans, pencils, crayons, balls

2. List the characteristics you observe that can be used to classify the objects.

Object Characteristics	
1.	6.
2.	7.
3.	8.
4.	9.
5.	10.

3. Describe how you classify your objects.

Answers will depend on the objects. Possible answer: Dried beans may be classified according to size, shape, color, and whether the student likes to eat them.

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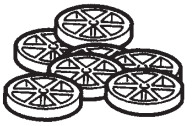
Investigate Log

Build a Model Backbone

Materials



chenille stick



wagon-wheel-shaped pasta pieces



soft candy rings

Procedure

CAUTION: Never put any materials you use in an Investigate in your mouth.

1. Bend one end of the chenille stick. Thread a piece of pasta onto the other end, and push it down to the end.
2. Thread more pieces of pasta onto the stick. Push them together. When the stick is full, bend the end.
3. Gently bend the chenille stick with its pasta pieces. What do you **observe**?
4. Straighten one end, and remove all but one piece of pasta. Repeat Step 2, but add candy rings between the pieces of pasta. Gently bend the chenille stick again. Now what do you **observe**?

Object	Observations
Pasta	The pasta pieces prevent the chenille stick from being damaged.
Pasta and Candy	The candy allows the chenille stick with pasta to bend easily.

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Investigate Log

Draw Conclusions

1. A real backbone has a spinal cord, individual bones called *vertebrae*, and soft discs between the vertebrae. What does each part of your model represent?

The chenille stick represents the spinal cord, the candy rings are the discs, and the pasta pieces are the vertebrae.

2. **Inquiry Skill—*Communicate*** Scientists need to **communicate** their results to other scientists. Use your model to **communicate** how a real backbone works.

A real backbone allows the upper body to bend and twist. It makes the body flexible, while providing support for the head.

Inquiry Skill Tip

Models are useful for helping you **communicate** your observations during an investigation. The model should be chosen carefully so that it has the main characteristics of the real object. You can then use the model to show others how the real object would react in certain situations.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I did not put any materials used in the investigation into my mouth.			
I **communicated** the ways that my model moves like a real backbone.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Think about how a chicken's neck supports the chicken's head while letting it move. Then plan and conduct an investigation to test your ideas.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **cooked chicken neck**

1. Describe how you will conduct your investigation and what you expect to find.

Students may decide to make a model based on their observations of a cooked chicken. They may expect to find that a chicken's neck is flexible enough to twist and turn but it cannot turn all the way around.

2. Describe your observations.

Students will probably find that the chicken's neck must be strong to support the head. It must be flexible to turn from side to side.

3. How were your observations different from what you expected to find?

Students may not have considered that the chicken's neck cannot turn all the way around. They may also have learned that the neck must be made of small parts that are connected together to allow it to twist and turn.

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Name _____

Date _____

Investigate Log

Vascular Plant Parts

Materials



potted plant



newspaper



ruler



hand lens

Procedure

1. Hold the potted plant upside down over the newspaper. Tap the pot gently until the plant comes out. Shake the soil from the roots so you can see them clearly.
2. **Observe** the leaves of the plant. **Measure** their length and width. Use the hand lens to **observe** the leaves more closely. **Record** your observations.
3. **Observe** the stem. Use the hand lens to see it in more detail. Does it bend? Does it have branches? **Record** your observations.
4. **Observe** the roots. Notice their shape. **Measure** their length. Use the hand lens to **observe** them more closely. **Record** your observations.
5. Make a drawing of the plant. Label all the parts.
6. Put the soil and the plant back into the pot, and water the plant lightly.

Plant Part	Details	Observations
Leaf	Length: Width:	
Stem	Bend: yes / no (circle one) Branches: yes / no (circle one)	
Roots	Shape: Length:	

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Name _____

Investigate Log

Draw Conclusions

1. What did you **observe** about each part of the plant?

Possible answers: The leaves are waxy or slick, have veins, and are flat. The stem is thicker than the veins of the leaves. It connects the leaves to the roots. The roots cling to the soil, have many tiny hairs, and are branched.

2. **Inquiry Skill—*Infer*** What can you **infer** about the functions of roots, stems, and leaves?

Possible answers: Roots cling to the soil, hold the plant in the ground, and get water from the ground. Stems hold up the leaves. Leaves are flat so they can get lots of sun. Veins are tubes that go to all parts of the leaves and probably go through the stem and roots.

Inquiry Skill Tip

When you **infer**, you draw conclusions about your observations. You should also use information you already know, but be careful. Recheck facts for accuracy before using them because its easy to have them mixed up.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for observing parts of the plant.			
I washed my hands after handling the plant and soil.			
I **inferred** the functions of roots, stems, and leaves.			

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Investigate Log

Independent Inquiry

Look at a carrot that has its leaves attached. Compare it to the potted plant. Draw a picture of a carrot growing in soil.

Materials

Here are some materials that you might use. List additional materials that you need.

- **carrot with leaves attached**
- **potted plant**
- **ruler**
- **hand lens**

1. Describe the steps of your investigation.

Possible answer: First, I got a carrot and observed the taproot. Next, I let the carrot grow for a few days before I observed it again. Then, I compared the carrot to the potted plant.

2. Use the space below to record your observations and to draw a picture of the carrot plant.

Observations	Picture of Carrot Plant

3. How is the carrot plant similar to the potted plant? How is it different?

Possible answers: Alike: Both have green leaves, roots, and root hairs. Different: The carrot has a taproot, but the potted plant has fibrous roots.

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Investigate Log

Spores and Seeds

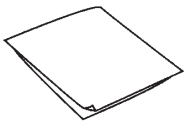
Materials



fern frond



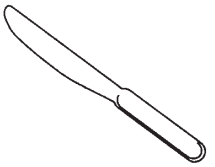
hand lens



white paper



apple



plastic knife

Procedure

CAUTION: Be careful when handling sharp objects such as knives.

1. **Observe** the fern frond, or leaf. Look at both sides of the frond, using the hand lens.
2. Hold the frond over a sheet of white paper. Rub the underside of the frond so that the contents of the spots on the frond fall onto the paper.
3. **Observe** the paper with the hand lens. There should be one or more clusters of small objects on the paper. Notice if there are dustlike particles on the paper. These particles are spores.
4. **Observe** the apple closely. Use the knife to cut the apple through the middle, vertically. Look at the inside of the apple with the hand lens.
5. Take the seeds out of the apple. **Observe** them with the hand lens. How many seeds are there? **Record** all your observations.

Plant	Observations	Number of Seeds or Spores
Fern		
Apple		

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

Don't confuse a **hypothesis** with an inference or a conclusion. A **hypothesis** is a possible explanation for observations.

1. How do the seeds of an apple **compare** to the spores of a fern?

Possible answer: Apple seeds are inside the fruit, but fern spores are outside, on the undersides of leaves. There are many more fern spores than apple seeds. Fern spores grow in clusters, but apple seeds are individual.

2. **Process Skill—*Hypothesize*** Based on your observations, **hypothesize** about the function of an apple.

Possible answer: The apple protects the seeds inside. Students may also think, erroneously, that the fruit feeds the seeds.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for observing the fern and the apple.			
I washed my hands after handling the fern and the apple.			
I **hypothesized** about the function of an apple.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Dissect a flower such as a lily to observe its parts. Separate the pieces of the flower, and cut open any parts you can.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **flower**
- **hand lens**
- **sharp knife**
- **white paper**

1. Before dissecting the flower, write a hypothesis about what the flower will look like inside.

Answers will vary. Students may hypothesize that they will find ovules inside the flower's ovary.

2. After dissecting the flower, use the space below to record your observations and draw a picture of the inside of the flower.

Observations	Picture of Flower's Inside

3. Was your hypothesis correct? Explain.

Students may find that their hypotheses were correct but that they were able to see more parts than they expected.

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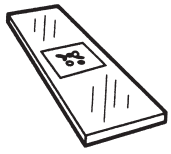
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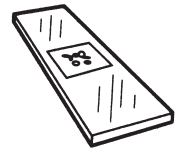
Investigate Log

Cell Reproduction

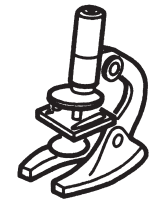
Materials



prepared slide of plant mitosis



prepared slide of animal mitosis



microscope

Procedure

1. Place the plant mitosis slide on the microscope stage. Focus until you see cells clearly. **Observe** the cells that show division.
2. Make drawings to **record** what you see in different cells.
3. Replace the plant mitosis slide with the animal mitosis slide. **Observe** the cells that show division.
4. Make drawings to **record** what you see in different cells.
5. **Compare** your drawings of plant cell division with your drawings of animal cell division. How are they alike? How are they different? **Record** your comparisons.

Alike: _____

Different: _____

Plant Mitosis

Animal Mitosis

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Name _____

Investigate Log

Draw Conclusions

1. What part of a cell changes as the cell divides? What changes take place? The nucleus changes as the cell divides. In some cells, the nucleus seems to have disappeared. Some structures seem to have lined up in the center of some cells. These structures seem to have separated in some cells. Some cells look as if they're splitting into two cells.

2. How many new cells does each cell division produce?

two

3. **Inquiry Skill**—***Observe*** Scientists **observe** and ask questions based on their observations. What questions do you have about cell division, based on your own observations?

Answers will vary. Students may wonder how cells "know" when to divide or how they are able to make two nuclei out of one.

Inquiry Skill Tip

When you **observe** details during an investigation, you should be like a detective. Notice how properties have changed and what caused the changes.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used the microscope for my observations.			
I **observed** how plant and animal cells divide.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Now that you've observed cells dividing, make models showing the stages of cell division.

Materials

Here are some materials that you might use. List additional materials that you need.

- prepared slide of plant mitosis
- prepared slide of animal mitosis
- microscope
- clear plastic bags
- chenille sticks
- cardboard boxes

1. Explain the cell division steps that you will model. **Answers will vary, but the steps students model should show that they understand the duplication of chromosomes, the separation of chromosomes, and the division of the cell cytoplasm.**

2. Describe the materials that you will use to make your models.
Answers will vary. Students may make their models out of different colors of construction paper, modeling clay, or yarn glued to poster board.

3. What differences did you model between the plant and animal cells as they divided?
Possible answer: Plants have a cell wall which is replaced during cell division. Animal cells are complete after cytoplasm divides. New plant cells remain joined by common cell walls, whereas animal cells separate completely.

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Name _____

Date _____

Investigate Log

Inherited Characteristics

Materials



mirror

Procedure

1. Use the table below for your investigation.
2. Stick out your tongue, and try to roll its edges up, toward the middle. Use the mirror to help you make your **observation**. **Record** the result in the table.
3. Use the mirror to **observe** the shape of your earlobes. Are they attached to your face, or do they hang free? **Record** the result in the table.
4. Fold your hands in front of you. **Observe** which of your thumbs falls naturally on top. **Record** the result in the table.
5. Your teacher will now ask all students to report their results. Tally the results in the table as students report them. Then find the number of students that have each trait. **Use numbers** to calculate the fraction of the class that has each trait. Then make a graph of the class results.

Characteristic	Result (Circle one.)		Class Totals
Tongue rolling	yes	no	
Earlobes	attached	free	
Folded hands	left	right	

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Name _____

Investigate Log

Draw Conclusions

1. Which trait in each pair occurred more often in your class?

Students will probably find that most students are able to roll their tongue, have free earlobes, and place their left thumb on top because these traits are dominant.

2. **Inquiry Skill**—***Infer*** Scientists often infer an idea after making observations. **Infer** whether a person could learn to roll his or her tongue. Explain.

Students may infer that because tongue rolling is impossible for some classmates, it cannot be learned. A person is born able to do it or not.

Inquiry Skill Tip

When you think about what you can **infer** from your investigation, first consider your observations. How can you explain them? Try to interpret them based on your prior knowledge.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used the mirror to help make my **observations**.			
I **inferred** whether a person could learn to roll his or her tongue.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Predict whether the results will be the same for another group. Then gather data to test your prediction.

Materials

- **mirror**

1. What is your prediction about whether the results of your investigation will be the same for another group?

Students may predict that the results will be the same for another group.

2. Use the data table below to record your observations.

Characteristic	My Class Totals	Second Group Totals
Tongue rolling	yes:	yes:
	no:	no:
Earlobes	attached:	attached:
	free:	free:
Folded hands	left:	left:
	right:	right:

3. Explain why you believe the results of your investigation are the same as your prediction or different.

Students may find that the results are the same as their prediction. They may realize that the results would be the same for most groups because of the dominance of certain traits.

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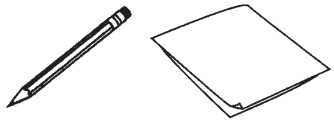
Name _____

Date _____

Investigate Log

Learned and Inherited Behaviors

Materials



pen and paper

Procedure

1. Look at the table below.
2. The left-hand column lists behaviors. Some of these are skills you learned how to do. Others are behaviors you inherited.
3. Think about each behavior. Then **record** which behaviors you learned and which you inherited. The first one is classified for you.
4. Think about activities you've done in the past few hours. Then add four behaviors to the table. **Record** which behaviors you learned and which you inherited.

Behavior	Learned	Inherited
Waking up		X
Brushing teeth		
Eating		
Walking		
Sleeping		
Reading		
Using a computer		

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

Your **inferences** should be based on observations, but you also use your prior beliefs. Be sure these beliefs are accurate. Ask your teacher if you aren't sure.

1. **Compare** the number of learned behaviors to the number of behaviors you inherited.

The numbers of learned and inherited behaviors will vary depending on the behaviors students add to the table.

2. Choose one of the behaviors you learned. **Communicate** to a classmate how you learned that behavior.

Students should describe how they learned the chosen behavior. For example, they may describe how a parent or dentist demonstrated the proper way to brush teeth.

3. **Inquiry Skill**—***Infer*** Scientists often infer the reason for something, based on their observations. **Infer** whether most human behaviors are learned or inherited. Explain.

Most human behaviors are learned, but some, such as sleeping, are largely inherited. Some human behaviors, such as walking and eating, may be just partly learned.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I **recorded** which behaviors were learned and which were inherited.			
I **inferred** whether most human behaviors are learned or inherited.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Research hunting behavior in lions. Is it inherited, learned, or both? Compare this behavior to some of your behaviors, such as eating and walking.

Materials

- pen and paper

1. What question will your research answer?

Students' research should answer whether hunting behavior in lions is inherited, learned, or both.

2. Describe what you learn in your research.

Students should find that the hunting behavior in lions is both learned and inherited.

3. Compare the hunting behavior in lions to some of your behaviors, such as eating and walking.

Students should realize that the lion hunting behavior and some human behaviors are both learned and inherited.

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Unit Inquiry Log

Unit B

Removing Pollution from Water

1. Observe and Ask Questions

Does the type of material used in a water filter affect how clean filtered water becomes? Make a list of questions you have about how to remove pollutants. Then circle a question you want to investigate.

Will layers of pebbles, fine sand, and paper towel clean water better than layers of gravel, coarse sand, and cotton?

2. Form a Hypothesis

Write a hypothesis. A hypothesis is a scientific explantion that you can test. You must be able to test the hypothesis.

Water that seeps through layers of pebbles, fine sand, and paper towel will be cleaner than water that seeps through layers of gravel, coarse sand, and cotton.

3. Plan an Experiment

To plan your experiment, you must first identify the important variables. Complete the statements below.

Identify and Control Variables

The variable I will change is

the materials used to make a water filter.

The variable I will observe or measure is

how clean the water becomes.

The variables I will keep the same, or *control*, are

the mixture of polluted water, the amount of water poured into each filter, and the number and thickness of layers.

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Name _____

Unit Inquiry Log

Develop a Procedure and Gather Materials Write the steps you will follow to set up an experiment and collect data.

1. Construct a filter from one of the bottles with the bottom cut off as follows: a. Punch a hole into the cap of the bottle and screw the cap in place; b. Turn the bottle upside down and place it in a large plastic cup; c. Place a folded paper towel into the neck of the bottle; d. Pour a layer of fine sand on top of the paper towel; e. Pour a layer of pebbles on top of the fine sand.

2. Using the second 2-liter bottle, repeat the procedure above using cotton, coarse sand, and gravel as the filter layers.

3. Pour water into the last 2-liter bottle until it is about 2/3 full. Add the soil and debris to the water. Put the cap on the bottle and shake it until the contents are thoroughly mixed.

4. Alternate pouring the water mixture into each of the filters, ensuring that a near-equal amount is poured each time, until the bottle is empty. Shake the mixture between pouring as needed to keep the water, soil, and debris thoroughly mixed.

5. Allow the water to seep through the filter layers and collect in the plastic cups.

6. Observe how clean each collected water sample is.

Use extra sheets of blank paper if you need to write down more steps.

Materials List Look carefully at all the steps of your procedure and list all the materials you will use. Be sure that your teacher approves your plan and your materials list before you begin.

3 two-liter bottles (2 with bottoms cut off), gravel, pebbles, coarse sand, fine sand, cotton, paper towel, scissors, 2 clear plastic cups, water, soil, bits of debris

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Name _____

Unit Inquiry Log

4. Conduct the Experiment

Gather and Record Data Follow your plan and collect data. Use the chart below or a chart you design to record your data. **Observe** carefully. **Record** your observations and be sure to note anything unusual or unexpected.

Water Filter Observations

Water Filter Layers	Description of Filtered Water
Pebbles, fine sand, and paper towel	
Gravel, coarse sand, and cotton	

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Name _____

Unit Inquiry Log

Interpret Data Compare the two samples of water collected from the two water filters.

5. Draw Conclusions and Communicate Results

Compare the hypothesis with your observations, then answer these questions.

1. Based on the results of the experiment, do you think the hypothesis is true? Explain.

   Students should justify their responses with observations.

2. How would you revise the hypothesis? Explain.

   Students may revise their hypotheses to match the results of the experiment more closely.

3. What else did you **observe** during the experiment?

   Encourage students to use their notes and to be as specific as possible.

Prepare a presentation for your classmates to communicate what you have learned. Display your collected water samples.

Investigate Further

Write another hypothesis that you might investigate.

Water that seeps through double layers of pebbles, fine sand, and paper towel will be cleaner than water that seeps through one layer of pebbles, fine sand, and paper towel.

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Name _____

Date _____

Investigate Log

Using Carbon Dioxide

Materials



safety goggles



bromothymol blue (BTB)



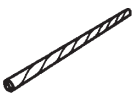
2 test tubes with caps



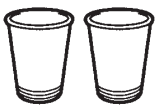
Elodea



water



plastic straw



2 plastic cups



dropper



funnel

Procedure

1. **CAUTION: Wear safety goggles.** Fill one cup about two-thirds full of water. Use the dropper to add BTB until the water is blue.
2. Put the straw into the cup and blow into it. **CAUTION: DO NOT suck on the straw. If the solution gets in your mouth, spit it out and rinse your mouth with water.**
3. **Observe** and **record** changes in the water. The solution turns yellow.
4. Put the *Elodea* in one test tube. Use the funnel to fill both test tubes with the BTB solution. Cap both tubes.
5. Turn the tubes upside down, and put them in the empty cup. Place the cup on a sunny windowsill. **Predict** what changes will occur in the test tubes.
6. After 1 hour, **observe** both tubes, and **record** your observations.

Prediction: The solution with *Elodea* will change color again.

Solution	Observations
With *Elodea*	The solution changes from yellow back to blue.
Without *Elodea*	The solution stays yellow.

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

Your **predictions** during an investigation should be based on your observations and on the scientific knowledge you already have.

1. What changes did you **observe** in the BTB solution during the activity? Students should observe that the solution turns yellow when they blow into it. Then the water in the tube with *Elodea* turns back to blue. The other tube of water stays yellow.

2. **Inquiry Skill—*Predict*** Scientists use what they know to **predict** what will happen. After you blew into the water, how did your **observations** help you **predict** what would happen next?

Students observed that the water changed colors when they blew into it. This should help them predict that it might change color again, as *Elodea* uses carbon dioxide during photosynthesis.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I wore safety goggles.			
I **predicted** what would happen when the *Elodea* was placed in the BTB solution.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Plan and conduct an experiment to test the effect of sunlight on the changes in the BTB solution. Predict what will happen. Then carry out your experiment.

Materials

Here are some materials that you might use. List additional materials that you need.

- safety goggles
- bromothymol blue (BTB)
- 2 test tubes with caps
- water
- dropper
- plastic straw
- *Elodea*
- funnel

1. Predict what changes you will observe when *Elodea* in BTB solution is exposed to different amounts of sunlight. **Students may predict that the solution changes back to a blue color faster in more direct sunlight. Alternatively, they may predict that the solution changes back to blue more completely if exposed to sunlight for a longer period.**

2. Draw a data table below for your experiment. Use it to record your observations.

3. What conclusions can you draw from your experiment?

Answers will depend on the experiment that students conduct. They may find that the solution changes back to a blue color faster in more direct sunlight.

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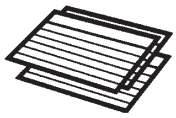
Name _____

Date _____

Investigate Log

Ordering What Eats What

Materials



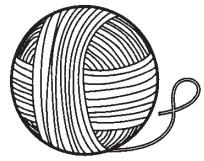
index cards



markers



bulletin board



yarn



pushpins

Procedure

1. You will be assigned an organism. On an index card, draw it, write its name, or both.
2. Research to **classify** your organism. Is it a producer, a plant-eating consumer, or a meat-eating consumer? Or is it a consumer that eats both plants and meat? Or is it an organism that gets its energy from the remains of dead organisms?
3. Work with members of your group to put your cards in an **order** that shows what eats what.
4. Pin your team's cards in **order** on the bulletin board. Connect your cards with yarn to show what eats what. Then use yarn to show which of your team's organisms eat organisms from other teams.

Organism: _____

Classification: _____

	Organism: _____	Organism: _____	Organism: _____
Characteristic: _____			
Characteristic: _____			
Characteristic: _____			
Characteristic: _____			

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Name _____

Investigate Log

Draw Conclusions

1. **Classify** each organism on your group's cards. In which group does it belong? Each group should have at least one organism from each of the food levels listed: plant, plant-eating animal, meat-eating animal, and so on.

2. **Inquiry Skill—*Classify*** When scientists **classify** things, they better understand the relationships between them. Could you put your team's cards in another order? Why or why not? Which card must always be first? Which card must always be last?

Students might be able to reorder some of their group's cards, but the sequence must always begin with a producer and end with a decomposer.

Inquiry Skill Tip

When you **classify** organisms, it may help to make a table with a column for each organism. Make a row for different characteristics, and describe how the organisms are alike and different.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for researching an organism and working with my group to order the organisms.			
I obeyed safety rules when using the pushpins.			
I **classified** my organism as a producer, a consumer, or a decomposer.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Classify and make a drawing of what eats what in the ocean. Share your drawing with the class.

Materials

- paper
- colored pencils

1. Describe how you will conduct your research.

Students may use the Internet, encyclopedias, or library books.

2. Use the space below for your drawing of what eats what in the ocean.

3. What can you conclude about organisms that are first and last in ocean food webs?

Students should conclude that food webs begin with a producer and end with a decomposer.

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Name _____

Date _____

Investigate Log

Using Color to Hide

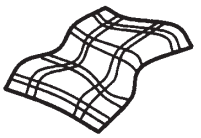
Materials



hole punch



red, blue, green, and yellow sheets of acetate



large green cloth



clock or watch with a second hand

Procedure

1. Use the table below for this investigation.
2. Using the hole punch, make 50 small "insects" from each color of acetate.
3. **Predict** which color would be the easiest and which would be the hardest for a bird to find in grass. **Record** your predictions.
4. Spread the green cloth on the floor, and randomly scatter the insects over it.
5. At the edge of the cloth, kneel with your group. In 15 seconds, you will each pick up as many insects as you can, one at a time.
6. Count the numbers of each color your group collected. **Record** the data in the table.
7. Repeat Steps 5 and 6 three more times. Then total each column.

Number of Insects Found				
	Red	Blue	Green	Yellow
Hunt 1				
Hunt 2				
Hunt 3				
Hunt 4				
Total				

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

After an experiment, compare your **predictions** with your results. If they are different, try to understand why. Many scientific discoveries have been made through unexpected results.

1. Which color did you **predict** would be easiest to find? Which color was collected most often? Least often? Why?

Students probably predicted that yellow or red would be collected most often and green would be collected least often because this color is hard to see in the "grass." Any color that contrasts with the grass should be collected most often, while green should be collected least often.

2. **Inquiry Skill—*Predict*** Scientists predict what they expect to happen and then observe what happens. **Predict** what might happen to green insects if the grass turns brown.

Green insects would be easier to see in brown grass than in green grass and would probably be spotted and eaten by birds.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I worked with my group to collect "insects."			
I used a clock or watch to measure the collection time.			
I **predicted** what might happen to green insects if the grass turns brown.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Predict how different body shapes might help insects hide in grass. Then plan and conduct an experiment to test your prediction.

Materials

Here are some materials that you might use. List additional materials that you need.

- red, blue, green, and yellow sheets of acetate
- clock or watch with a second hand
- scissors
- grassy lawn

1. What is your prediction?

Students may predict that an insect has a better chance of hiding in grass if it has a body shape similar to a blade of grass.

2. Draw a data table to use for your investigation. Record your data in the table.

3. Were your predictions correct? Why or why not?

Answers will depend on students' predictions and investigations. Students should find that an insect has a better chance of hiding in grass if it has a body shape similar to a blade of grass.

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Name _____

Date _____

Investigate Log

Observing Changes

Materials



potting soil



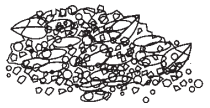
plastic dishpan



water



duckweed



birdseed



ruler

Procedure

1. **Make a model** of a pond by spreading 5 cm of potting soil in the dishpan. Dig out a low space in the center, leaving 1 cm of soil. Pile up the soil around the low space to make sides about 10 cm high.
2. Slowly pour water into the low spot until the water is 4 cm deep. Put duckweed in the "pond."
3. Sprinkle birdseed over the soil. Do not water it. Make a drawing or take a photograph to **record** how your pond looks.
4. After three or four days, **measure** and **record** the depth of the water in the pond. **Record** how the pond looks now.
5. Sprinkle more birdseed over the soil, and water it lightly.
6. Wait three or four more days, and observe how your pond has been changed. **Measure** and **record** the depth of the water. **Compare** your three observations.

Day	Water Depth (cm)	Observations
1	4	

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Name _____

Investigate Log

Draw Conclusions

1. What caused the changes you observed?

Possible answers: The water soaked into the soil. The soil eroded into the water. The seeds sprouted. The pond dried up.

2. **Inquiry Skill—*Make Models*** Scientists often **make models** and **observe** changes, just as you did. Which of the changes you **observed** might occur in a real pond? What other changes do you think might occur in a real pond?

Possible answers: The pond could dry up. The bank of a pond could erode. Plants could sprout around the edge of the pond. The changes would occur slowly in a real pond.

Inquiry Skill Tip

It is often useful to **make a model** for an investigation, but think carefully about the changes you see in a model. Sometimes the changes wouldn't occur in a real situation. Other changes might occur in the real situation but not in the model.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I washed my hands after working with the plants and soil.			
I **made a model** of a pond and observed changes.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Make a model of another ecosystem, such as a forest floor. If possible, include some insects. Observe and record the changes that take place over time.

Materials

Here are some materials that you might use. List additional materials that you need.

- **potting soil**
- **plastic dishpan**
- **water**
- **camera (optional)**

1. Describe the model you made of an ecosystem.

Answers will vary, depending on the ecosystems students choose. If they model a forest floor, their models may include rotting leaves, insects, and new plant growth.

2. What changes did you **observe** in your model?

Students may notice leaves falling apart or being eaten by insects, soil becoming dry, and plant growth dying.

3. How are the changes you observed in your model different from the changes that might occur in a real ecosystem?

Possible answer: Students may realize that in a real ecosystem, changes occur over a much longer time. As a result, they might mention such changes as rotting vegetation, plant growth, and erosion.

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Date _____

Investigate Log

Observing Effects of Fertilizer

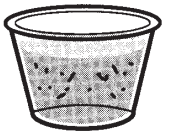
Materials



marker



4 cups with lids



pond water



dropper



liquid fertilizer

Procedure

1. Use a marker to number the cups 1–4.
2. Fill each cup with the same amount of pond water.
3. Use a dropper to put 10 drops of liquid fertilizer in cup 1, 20 drops in cup 2, and 40 drops in cup 3. Do not put any fertilizer in cup 4.
4. Put lids on the cups, and place them in a sunny window.
5. **Observe** the cups every day for twelve days, and **record** your observations.

Day	Observations	Day	Observations
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	

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Name _____

Investigate Log

Draw Conclusions

1. Which cup had the most plant growth? Which had the least? What **conclusions** can you **draw** about fertilizer and plant growth?

Cup 3 should have the most plant growth, and Cup 4 should have the least. Fertilizer encourages plant growth.

2. As organisms die and decay in water, they use up the oxygen in the water. Which cup do you **infer** will eventually contain the least amount of oxygen? Explain your answer.

Cup 3 would have the least amount of oxygen, because the dead and decaying plants in this cup would use up the oxygen.

3. **Inquiry Skill—*Identify and Control Variables*** Scientists **identify and control variables** in their experiments so they can **observe** the effects of one variable at a time. Which variables did you control in all four cups? Which variable did you change?

The amount and kind of water, its temperature, and the amount of sunlight were the controlled variables. The variable I changed was the amount of fertilizer.

Inquiry Skill Tip

You can only obtain meaningful results in an investigation if you **identify and control variables.** The variable you choose to change depends on the goal of your investigation. Sometimes you may want to change more than one variable. If so, you should plan an investigation for each variable you change.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed all directions.			
I obeyed safety rules when working with the pond water and liquid fertilizer.			
I **identified and controlled variables** in the investigation.			

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Date _____

Investigate Log

Independent Inquiry

Suppose you want to study the effect of sunlight on fertilizer in pond water. Plan an experiment that will identify and control the variables. Then carry out your experiment.

Materials

Here are some materials that you might use. List additional materials that you need.

- marker
- pond water
- liquid fertilizer
- 4 jars with lids
- dropper

1. How do you plan to conduct your experiment?

Answers should include varying the level of sunlight each cup gets, but keeping the amount of fertilizer in each cup the same.

2. Use the data table below to record observations during your experiment.

Day	Observations	Day	Observations
1		8	
2		9	
3		10	
4		11	
5		12	
6		13	
7		14	

3. Compare the appearance of the jar of water that received the most sun with the appearance of the jar that received the least sun.

Jars that received the most sun will show the most plant growth. Jars that received no sun will show the least.

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Date _____

Unit Inquiry Log

Unit C

Buffering Ability of Soils

1. Observe and Ask Questions

A buffer is a substance that resists change in its pH. Many substances can be buffers, including some soils. Make a list of questions you have about how soils can act as a buffer. Then circle a question you want to investigate.

Will soil from my backyard act as a buffer and help neutralize acid rain?

2. Form a Hypothesis

Write a hypothesis. A hypothesis is a scientific explantion that you can test. You must be able to test the hypothesis.

Acid filtered through soil from my backyard will become less acidic.

3. Plan an Experiment

Identify and Control Variables

To plan your experiment, you must first identify the important variables. Complete the statements below.

The variable I will change is

the acidity of the solution being poured into the soil.

The variables I will observe or measure are

the acidity of the solution after being filtered through the soil.

The variables I will keep the same, or *control*, are

the amount of acid, the amount of soil, and the location the soil was collected.

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Name _____

Unit Inquiry Log

Develop a Procedure and Gather Materials Write the steps you will follow to set up an experiment and collect data.

1. Choose an acidic substance such as lemon juice or vinegar. Wear goggles and gloves at all times.
2. Determine the pH of the acid using pH paper.
3. Clamp a coffee filter to a beaker or other glass.
4. Measure out a set mass of soil and place it on a coffee filter.
5. Measure out a set volume of acid and pour it slowly over the soil.
6. When the acid has run through the soil and finished dripping, use a piece of pH paper to determine the pH of the liquid in the beaker.
7. Repeat Steps 2–6 several times after diluting the acid by mixing it with water. Always pour the acid into the water.

Use extra sheets of blank paper if you need to write down more steps.

Materials List Look carefully at all the steps of your procedure, and list all the materials you will use. Be sure that your teacher approves your plan and your materials list before you begin.

- Lemon Juice, Vinegar, or other Acid
- Soil Sample
- Coffee Filter
- Clamps
- Beakers
- Balance
- Water
- Goggles and Gloves

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Name _____

4. Conduct the Experiment

Gather and Record Data **Follow your plan and collect data. Use the chart below or a chart you design to record your data. Observe carefully. Record your observations and be sure to note anything unusual or unexpected.**

Amount of Soil in Each Test: _____

Amount of Acid in Each Test: _____

Beginning pH	Ending pH	Change in pH

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Name _____



Interpret Data Make a graph of the data you have collected. Plot the data on a sheet of graph paper or use a software program.

5. Draw Conclusions and Communicate Results

Compare the hypothesis with the data and the graph. Then answer these questions.

1. Given the results of the experiment, do you think the hypothesis is true? Explain.

_____

_____

2. How would you revise the hypothesis? Explain.

_____

_____

3. What else did you **observe** during the experiment?

_____

_____

Prepare a presentation for your classmates to communicate what you have learned. Display your data tables and graphs.

Investigate Further

Write another hypothesis that you might investigate.

_____

_____

_____

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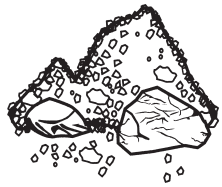
Name _____

Date _____

Investigate Log

Mineral Properties

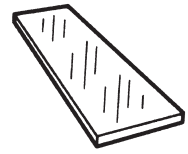
Materials



6 labeled mineral samples



hand lens



streak plate



steel nail



pre-1983 penny

Procedure

1. Use the table below for this investigation.
2. Use a hand lens to **observe** each mineral's color. **Record** your observations in the table.
3. With each mineral, draw a line across the streak plate. What color is each mineral's streak? **Record** your observations.
4. **CAUTION: Use caution with the nail. It's sharp.** Test the hardness of each mineral. Try to scratch each mineral with your fingernail, the penny, and the steel nail. Then try to scratch each mineral with each of the other minerals. **Record** your observations in the table.
5. **Classify** the minerals based on the properties you tested: color, streak, and hardness. Make labels that list all three properties for each mineral.

Mineral Sample	Color	Streak	Hardness
1			
2			
3			
4			
5			
6			

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Name _____

Investigate Log

Draw Conclusions

1. How are the mineral samples different from one another?

They vary in color, streak, and hardness.

2. **Inquiry Skill—*Classify*** Scientists **classify** objects to make them easier to study. How do you think scientists classify minerals?

Scientists classify minerals according to their properties. Students may also say that minerals are classified on the basis of color, streak, and hardness.

Inquiry Skill Tip

When you **classify** objects, first observe their properties. Compare and contrast them with properties of other objects. Group the objects according to the properties that they share.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I followed safety rules when using the steel nail.			
I **classified** each mineral according to its color, streak, and hardness.			

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Date _____

Investigate Log

Independent Inquiry

Obtain five additional mineral samples. Classify each sample according to its hardness, color, streak, and one new property.

Materials

Here are some materials that you might use.
List additional materials that you need.

- 5 mineral samples
- streak plate
- pre-1983 penny
- hand lens
- steel nail

1. What new property will you use to classify the mineral samples? List some terms that describe this property.

Possible answer: Another property for classifying the samples is luster. Terms describing this property include metallic, dull (earthy), nonmetallic, glassy, and waxy.

2. Record your observations of each mineral sample. Write the new property in the last column.

Mineral Sample	Color	Streak	Hardness	
1				
2				
3				
4				
5				

3. How does observing additional properties help better classify minerals?

Possible answer: There are many kinds of minerals. The more properties are observed, the more is known about the minerals. It helps people identify one mineral from another, especially those that have many properties in common.

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Investigate Log

Identifying Rocks

Materials



hand lens



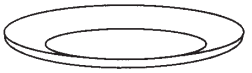
5 labeled rock samples



safety goggles



dropper



paper plate



vinegar

Procedure

1. Make a table like the one below to record your observations. Draw a picture of each rock in the *Picture* column.
2. Use the hand lens to **observe** each rock. **Record** the color of each rock.
3. Look at the grains that make up each rock. Notice their sizes. Are their edges rounded or sharp? How do the grains fit together? **Record** your observations under *Texture*.
4. **CAUTION: Put on safety goggles.** Vinegar makes bubbles form on rocks that contain calcite. Put the rocks on a paper plate. Use the dropper to slowly drop some vinegar onto each rock. **Observe**, and **record** your findings.
5. **Classify** the rocks into two groups based on similar properties.

Rock Sample	Picture	Color	Texture	Bubbles?
1				
2				

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Name _____

Investigate Log

Draw Conclusions

1. What properties did you use to **classify** the rocks?

Possible answer: color, texture, whether calcite is present

2. **Inquiry Skill—*Classify*** Scientists **classify** objects to make them easier to study. One way scientists classify rocks is by how they form. Choose one of the rocks, and describe how it might have formed.

Lead students to conclude that some rocks (sedimentary) form by grains sticking together. Other rocks (igneous) form as melted rock hardens. Still other rocks (metamorphic) form as existing rocks are somehow changed.

Inquiry Skill Tip

You can **classify** the same objects by different properties. Rocks, for example, can be classified by color, by texture, or by how they formed. A certain type of rock may fall into two or more different categories, depending on how you classify it.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I followed safety rules when using the vinegar.			
I recorded the properties of each rock sample and then **classified** the rocks into two groups.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Hypothesize about the best property to use to identify rocks. Plan and conduct an investigation to test your hypothesis.

Materials

Here are some materials that you might use. List additional materials that you need.

- hand lens
- safety goggles
- several labeled rock samples
- dropper
- vinegar
- paper plate
- paper towels

1. Write your hypothesis.

Students may hypothesize that color, composition, or texture is the best property to use for classifying rocks.

2. Conduct an investigation to see whether the property you chose is best for classifying rocks. Make a table to record your observations.

3. Did your investigation support your hypothesis? Explain.

Students' experiments should show that composition and texture are better properties to use than color.

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Investigate Log

Molding Rocks

Materials



small objects—gravel, sand, pieces of paper, several fake gems



2 aluminum pie pans



3 pieces of modeling clay, each a different color

Procedure

1. Suppose the small objects are minerals. Press two different "minerals" into each piece of clay. Now you have three different "igneous rocks."
2. What happens when wind and water wear down rocks? To **model** this process, break one of the rocks into pieces and drop the "sediment" into a pie pan filled with water.
3. On top of the sediment pile, drop pieces of the second rock. Then drop pieces of the third rock. Press the layers together using the bottom of the empty pie pan. Now what kind of rock do you have?

   sedimentary rock

4. Squeeze and mold the new rock between your hands to warm it up. What is making the rock change?

   The rock changes because of heat and pressure.

   Which kind of rock is it now?

   The rock is now a metamorphic rock.

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Name _____

Investigate Log

Draw Conclusions

1. How did the igneous rocks change in this activity?

They were first worn down. Then the sediments were squeezed together, forming sedimentary rock. It was changed into metamorphic rock by heat and pressure.

2. **Inquiry Skill—*Use Models*** Scientists often **use models** to help them understand processes that occur in nature. What process did you **model** in Step 4 of this activity?

the action of the heat and pressure that produces metamorphic rocks

Inquiry Skill Tip

You can **use a model** to show how an object looks at a certain time. You can also use a model or a sequence of models to show how an object changes over time.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used the clay and small objects to model an igneous rock.			
I **used a model** to show how igneous rock can change into sedimentary and metamorphic rock.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Can any type of rock change into any other type? Make a model to explore this question.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **small objects—gravel, sand, pieces of paper, several fake gems**
- **3 pieces of modeling clay, each a different color**
- **2 aluminum pie pans**

1. Hypothesize whether any rock type can change into any other type.

Students may hypothesize that all rocks types are interchangeable. They may instead hypothesize that some types of rocks cannot be changed into other types of rocks.

2. Model each rock type changing into each of the other types. Make a table to record whether each change is possible.

3. What can you conclude from the models about how rocks can change from one type to another?

Students' models should lead them to conclude that any type of rock can be changed into any other type of rock by natural processes within Earth. Note to Teachers: Have students save their rock models for the Insta-Lab.

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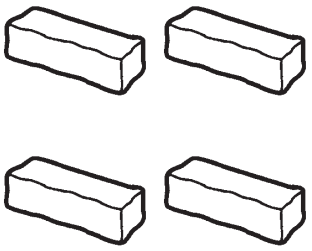
Name _____

Date _____

Investigate Log

Reading Fossil Records

Materials



4 colors of modeling clay



clear plastic cup



2 small seashells

Procedure

1. Place a layer of clay at the bottom of a cup.
2. Cover the first clay layer with a clay layer of a different color.
3. Press a shell into the clay, keeping the shell against the side of the cup. Using clay of a third color, add a layer on top of the shell and the clay already in the cup.
4. Add another layer made from clay of a fourth color. Then add the second shell as you did the first shell.
5. Make the top layer out of a color of clay that you already used once. Press the clay firmly on top of all the shells and clay in the cup.

Reading Fossil Records	
Layer	**Observations**
1	
2	
3	
4	
5	

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

Scientists make inferences based on things they **observe**. Be sure to make careful observations before you **infer**.

1. Which layer of the model can you **infer** represents the present time in Earth's history? How do you know?

The top layer represents the present time; it is the most recent layer to be added.

2. Scientists often **make models** to understand processes that are difficult to **observe**. How does the model you made represent what happens on Earth?

Earth builds up in layers. This process is too slow to observe from day to day. The model shows the buildup on a small scale.

3. **Inquiry Skill**—***Infer*** Suppose each layer in your cup represents 100 years worth of deposition of sediment. Which layer can you **infer** is oldest? How old is the older shell? Explain why.

Older things are closer to the bottom. The older shell is about 300 years old.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I made a model that included five layers and two shells.			
I used the materials according to the instructions for the investigation.			
I made **inferences** about the ages of the layers and the shells.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Research the five eras of Earth's history. Infer which layer of clay could represent each era. Make a labeled drawing of the eras.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **encyclopedia or books about Earth's history**
- **colored pencils**

1. What are the five eras in Earth's history?

Archean, Proterozoic, Paleozoic, Mesozoic, Cenozoic

2. Use this space to make your labeled drawing.

Note: These five eras are a classic division of the geologic time scale. Some newer classification systems use a different naming system.

3. What does your labeled drawing tell about Earth's history?

Answers will vary. Students might say that the drawing shows that Earth's history covers billions of years or that the oldest layers of fossils are buried deep below the more recent layers.

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Name _____

Date _____

Investigate Log

Classifying Fossils

Materials



hand lens

8 fossils

Procedure

1. Scientists classify living things by their characteristics, such as whether they are plants or animals, where they live, and how they look. Use the hand lens to **observe** characteristics of each fossil.
2. **Classify** the fossils. First, decide which categories you will use. Write your categories in the chart below.
3. **Record** which fossils fit into each category. Use the information that came with the fossils if necessary.
4. In your chart, **compare** each fossil with living things from today. Include another section that compares features of fossils with features of modern organisms.

Fossil	Category 1: _____	Category 2: _____	Category 3: _____	Compare (living things)	Compare (organisms)
#1					
#2					
#3					
#4					
#5					
#6					
#7					
#8					

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Name _____

Investigate Log

Draw Conclusions

1. Based on what you **observed**, how do you think these fossils formed? Different ones formed as molds or casts, were petrified, or are the remains of what they were originally.

2. Which fossils are similar to plants or animals of today?
Possible answer: The petrified wood looks like a piece of wood from today. The snail looks like a snail from today, and the corals look the same as corals do today.

3. **Inquiry Skill**—***Classify*** Scientists classify organisms to determine their similarities and differences. **Classify** the fossils, by what you can **infer** about their structures. Explain your classification. Possible answer: I classified them into the following groups: plants that support themselves with woody stems; animals with outer shells (trilobite, crinoid, brachiopod); and corals, which have rocklike skeletons to support them. The shark tooth from the shark would have the same support structure as sharks today.

Inquiry Skill Tip

When you **classify** objects, you sort them into groups. You can start by dividing a large collection into two groups and then dividing those groups into smaller groups.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I observed and classified the fossils according to the directions for the investigation.			
I handled the fossils carefully.			
I used my observations of the support structures to **classify** the fossils.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Studying fossils requires careful observation. Observe one fossil especially closely. Infer as much as you can about it. Research the fossil to check your inferences.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **hand lens**
- **fossil**
- **encyclopedias and other reference books**
- **Internet access**

1. What do you observe about the fossil?

Answers will vary, depending on the fossil chosen. Students may note the size, color, shape, and surface details of the fossil, as well as features of the rock it may be embedded in and the fossil's resemblance to modern species.

2. Use this table to record your observations and inferences.

Observation	Inference	Was the inference correct?

3. How did your inferences compare to the information you researched about the fossil? **Answers will vary, depending on the fossil chosen and the inferences made. Students might infer, for example, that a fossilized animal once lived in the sea or that a plant had woody tissue that could form a fossil. Their research findings should confirm or refute their inferences.**

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Date _____

Investigate Log

Modeling Earth's Landforms

Materials



clay



plastic tray



forceps



cup

Procedure

1. With a partner, form clay into pea-size balls. Use the balls to model a landform, such as a mountain or a plain, in the tray.
2. One partner closes his or her eyes. Then the other partner changes the landform by removing one clay ball with forceps and putting the ball into the cup.
3. After the ball is removed, the partner whose eyes were closed **observes** the landform carefully. Can that person see any change? Switch roles and repeat Step 2.
4. Take turns removing clay balls and **observing** until one of you can describe a change in the landform.
5. Count the clay balls in the cup. If each ball represents a change that takes place over 1000 years, how long did it take before a change was observed?

Data Table	
Number of Clay Balls Removed	**Observations of Landform**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

You can **use a model** to see all of the features of a large object at the same time or to enlarge the details of a small object.

1. Why might changes in hills and mountains be seen sooner than changes in plains? **Hills and mountains have complex shapes, making changes easier to see. Flat areas have the same shape throughout, so small changes are harder to see.**

2. **Inquiry Skill—*Use Models*** Scientists often **use models** to help them understand natural processes. Why might a model be useful for understanding how landforms change?

Possible answer: Earth's land features are very large and difficult to see all at once. By making a small model, scientists can see changes taking place on the whole feature.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used clay balls to model a landform.			
I **used the model** to observe changes in the landform.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Build a model of a landform. Show how the landform may look in 10,000 years.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **clay**
- **plastic tray**

1. What landform will you build? Describe its main features.

Student answers will vary. Students may choose mountains (very tall and peaked), hills (tall and rounded), or plains (large and flat).

2. Sketch the model as it would look today. Sketch the model showing how the landform might look 10,000 years later.

3. Explain why you would expect to see the changes in the landform that you drew.

Students' models should show that features become smaller and smoother over 10,000 years because the rocks and soil might fall, blow, or wash away.

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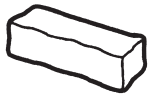
Investigate Log

Rivers and Sand

Materials



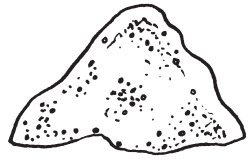
paint tray



clay



plastic cup



clean sand



water



spoon



kitchen baster

Procedure

1. Cover the slope of the paint tray with a thin layer of clay. Press and mold the clay to form a shoreline and a beach. Form a channel in the clay to model a riverbed.
2. Add equal amounts of sand and water to the cup. Stir the mixture so the sand becomes suspended in the water. Then fill the kitchen baster with the mixture.
3. Place the baster at the top of the river channel. Squeeze the bulb to release a flow of the sand-and-water mixture.
4. Release the mixture several times, changing the speed of the flow. **Observe** the behavior of the sand and water as the mixture runs down the channel.

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Data Table		
Trial	**Speed of the Flow**	**Observations**
1		
2		
3		
4		
5		

Name _____

Investigate Log

Draw Conclusions

1. What happened to the sand when it reached the mouth of the river in your **model**?

The sand spread out.

2. How was the speed of the mixture related to the deposition of the sand?

When the mixture moved more slowly, the sand was deposited closer to the river's mouth.

3. **Inquiry Skill—*Observing*** Scientists learn by **observing**. You observed how sand is deposited in water. What does this tell you about the way water changes land?

Water can form new land at the mouth of a river by depositing sand and soil.

Inquiry Skill Tip

Observing means collecting information about events and their effects. You can observe by watching, listening, smelling, counting, and measuring.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I used clay to model a riverbed.			
I squeezed a sand-and-water mixture at different speeds into the channel.			
I used the model to **observe** how the speed of the flow affects the behavior of the sand-and-water mixture.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

How do continuing deposits of sediment affect a river? Plan and conduct a simple investigation that answers this question.

Materials

Here are some materials that you might use. List additional materials that you need.

- paint tray
- plastic cup
- water
- kitchen baster
- clay
- clean sand
- spoon

1. Describe how you will conduct your investigation.

Students may describe that they will slowly squeeze a sand-and-water mixture into the channel ten times, and then observe changes in and around the bottom of the channel.

2. Make a table to record the data you collect.

3. What can you conclude about the effects of continuing deposits of sediment on a river?

Students' experiments should show that long-term deposition can eventually clog the mouth of a river.

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Investigate Log

Modeling a Volcanic Eruption

Materials


teaspoon


pie pan


safety goggles


plastic gloves


film canister with lid

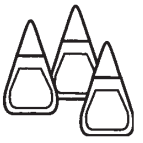


effervescent antacid


newspaper



potting soil


red food coloring



light corn syrup

Procedure

1. **CAUTION: Put on safety goggles and plastic gloves.** Cover your workspace with newspaper, and place a pie pan on the paper.
2. Fill a film canister halfway with antacid.
3. Add some potting soil to the canister. Put the lid on, and shake the canister.
4. Open the canister, and add 10 drops of food coloring to the mixture.
5. Put the canister in the center of the pan. Add several handfuls of clean potting soil to the pan. Heap the soil against the canister to **model** the sides of a volcano.
6. Add some corn syrup to the canister. **Observe** what happens. It may take a few moments for the "lava" to start flowing.

Modeling a Volcanic Eruption	
	Observation
Before eruption	
During eruption	
After eruption	

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Name _____

Investigate Log

Draw Conclusions

1. Did you **observe** clear paths in the lava flow? Explain.

The lava should have flowed down any existing channels in the soil around the canister.

2. **Inquiry Skill—*Use Models*** Scientists **use models** to help them understand the dangers of certain natural processes. How might your model help communicate the potential danger of living near volcanoes?

Using a model enables scientists to predict the path a lava flow may take. This information could be used to warn people living near the predicted path.

Inquiry Skill Tip

When you **use a model** to help predict events, think about which parts of the model are realistic and which are not. Your results depend on the difference between your model and the real thing.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I wore safety goggles and gloves, and obeyed safety rules.			
I **used a model** of the volcano to observe the paths of the lava.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

To protect against lava flows, people often construct barriers. Hypothesize how a barrier might help protect a community.

Materials

Here are some materials that you might use. List additional materials that you need.

- newspaper
- pie pan
- teaspoon
- potting soil
- safety goggles
- effervescent antacid
- film canister with lid
- plastic gloves
- red food coloring
- light corn syrup

1. Hypothesize how a barrier might protect a community from lava flows.

Students may hypothesize that a barrier will stop a lava flow or redirect it away from a community.

2. Construct a 3-inch-long barrier of clay or other material and place it on the volcano model. Start the lava flowing. Record how the barrier affects the lava flow. Repeat the activity with the barrier at different locations.

Barrier Location	Observations of Lava Flow

3. Did your investigation support your hypothesis? Identify at least one limitation of this model for predicting what will happen in real life.

Possible answer: The investigation supports the hypothesis, because the barrier redirects the "lava" flow. Unlike the "lava" in the model, however, real lava is extremely hot and powerful. It may melt, push, or roll over a barrier.

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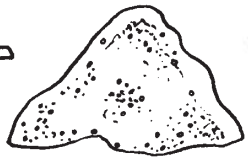
Date _____

Investigate Log

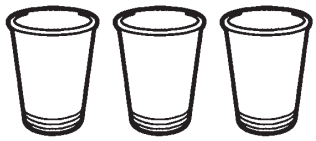
Cleaning Water

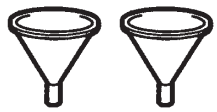
Materials


spoon

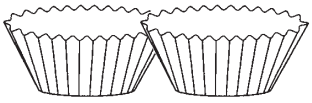

soil


water


3 clear plastic cups


2 funnels


cotton balls


coffee filters


charcoal


pea-size gravel

Procedure

1. Stir one spoonful of soil into a cup of water until the water is cloudy.
2. Place a funnel in a clean cup. Think about how to clean the water with the materials you have. Then place two of the possible cleaners (cotton ball, coffee filter, charcoal, gravel) in layers in the funnel.
3. Pour the dirty water through the funnel. **Observe** the water after it has passed through the cleaners. **Record** your results.
4. Prepare a second cup of dirty water. **Control variables** by changing just one of the cleaners you used the first time.
5. Pour the dirty water through the funnel into a clean cup. **Observe** the water, and **record** your results.
6. **Compare** the cleaning systems.

Cleaners Used	Results

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Name _____

Investigate Log

Draw Conclusions

1. How do your water-cleaning systems **compare** with those used in community water treatment plants? Students might respond that their systems are similar because water treatment plants use filters to clean water. Their systems are different because their cleaners are not as effective.

2. **Inquiry Skill—*Identify Variables*** **Identify the variable** you tested with your two cleaning systems. **Compare** the effectiveness of the cleaners that varied.
Answers will depend on the cleaning systems used. For example, students may conclude that using gravel and cotton balls is less effective than using gravel and coffee filters because the water caught in the cup was dirtier.

Inquiry Skill Tip

When you **identify the variable** that you will test in an investigation, decide which variables will remain unchanged and which variable will change. By changing only one variable, you can conclude that the changed variable is responsible for the results of the investigation.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for making water cleaning systems.			
I washed my hands after working with the dirt, charcoal, and gravel.			
I **identified the variable** that I tested so that I could **compare** the effectiveness of the cleaning systems.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Plan and conduct an investigation in which you identify and control variables to find the best system to clean dirty water.

Materials

Here are some materials that you might use.
List additional materials that you need.

- 3 clear plastic cups
- 2 funnels
- charcoal
- spoon
- soil
- pea-size gravel
- coffee filters
- cotton balls
- water

1. What will your investigation test?

Students will test different water cleaning systems to determine which is the best.

2. Use the table below to record your observations.

Cleaners Used	Results

3. What conclusions can you draw from your investigation?

Answers will depend on the cleaning systems that students test. Students might conclude that a combination of charcoal, gravel, and coffee filter does the best job of cleaning the dirty water.

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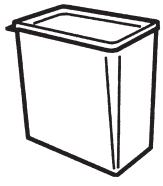
Investigate Log

Growing Plants in Water

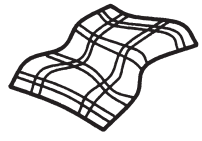
Materials



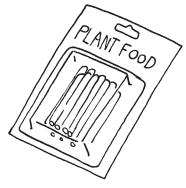
scissors



plastic food container with lid



soft, absorbent cloth



dry plant food



water



measuring spoon



liter bottle



radish seeds

Procedure

1. Carefully use the scissors to cut a slit in the lid of the food container. Then cut a hole in the lid, large enough to pour water through.
2. Cut a rectangle of cloth that will fit through the slit and touch the bottom of the container when the lid is in place. The cloth should be long enough to allow about 2 cm of it to lie on top of the lid.
3. Push the cut cloth through the slit in the lid, leaving the end of the cloth on top.
4. Follow the instructions on the package of plant food to make 1 L of plant-food solution. Half-fill the container with the solution. Snap the lid closed on the container.
5. Place the seeds on the cloth.
6. Place the container in a sunny window. Add more plant food as necessary to keep the cloth moist.

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Name _____

Draw Conclusions

1. Why do you need to use plant food to grow seeds without soil?

Water does not contain the nutrients that most plants need.

2. **Inquiry Skill—*Draw Conclusions*** **Draw a conclusion** about why this method of growing plants would be useful in desert areas.

Deserts don't have much soil, and closed containers would limit evaporation of water.

Inquiry Skill Tip

You may be able to **draw a conclusion** after you have experimented and collected data. Before you begin, review your observations and measurements. Think about how they work together. If you are unable to draw a conclusion, you may need to carry out more tests and make more observations.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for growing a plant in water.			
I did not place any of the materials used in this investigation into my mouth.			
I **drew a conclusion** about why this method of growing plants would be useful in desert areas.			

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Date _____

Investigate Log

Independent Inquiry

Plan and conduct a simple investigation for growing large plants without soil.

Materials

Here are some materials that you might use.
List additional materials that you need.

- plastic food container with lid
- soft, absorbent cloth
- measuring spoon
- radish seeds
- dry plant food
- water
- liter bottle
- scissors

1. What will your investigation solve?

Students will investigate how large plants can grow in regions where there is little or no soil.

2. Describe your investigation and observations.

Students may try one or more methods of testing the ability of a large plant to thrive without soil. They should find that the plant can grow as long as it has sufficient water, sunshine, and nutrients.

3. What conclusion can you draw from your investigation?

Students should conclude that large plants can be grow in water as long as there is sufficient sunshine and nutrients.

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Name _____

Date _____

Unit Inquiry Log

Unit D

Beach Protection

1. Observe and Ask Questions

Do artificial structures built along beaches change the shoreline? Do larger artificial structures have the same effect on a beach as smaller structures do? Make a list of questions you have about how artificial structures might affect a beach. Then circle a question you want to investigate. Will large, artificial structures affect how moving water deposits sand along a shoreline in the same way as smaller structures will?

2. Form a Hypothesis

Write a hypothesis. A hypothesis is a scientific explantion that you can test. You must be able to test the hypothesis.

Jetties will cause a beach to become larger.

3. Plan an Experiment

To plan your experiment, you must first identify the important variables. Complete the statements below.

Identify and Control Variables

The variable I will change is

the size of the artificial structure.

The variable I will observe or measure is

how much sand is deposited and eroded around the barrier.

The variables I will keep the same, or *control*, are

the size of the beach and of the waves.

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Name _____

Unit Inquiry Log

Develop a Procedure and Gather Materials Write the steps you will follow to set up an experiment and collect data.

a. Use the sand and water to make a model beach in the stream table.

b. Place the long plastic block at right angles to the shoreline.

c. When the water is calm and the sand has settled, use the ruler to generate waves that strike the beach at approximately a 45° angle. Continue this motion until a "longshore current" develops.

d. Carefully observe and sketch how the amount of sand changes when it is upcurrent, as well as downcurrent from the structure.

e. Make another model beach that is the same as the first.

f. Place the small plastic block at right angles to the shoreline.

g. Repeat steps c and d.

Use extra sheets of blank paper if you need to write down more steps.

Materials List Look carefully at all the steps of your procedure, and list all the materials you will use. Be sure that your teacher approves your plan and your materials list before you begin.

stream table; water; sand; ruler; large, interlocking plastic blocks; small interlocking plastic blocks

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Name _____

Unit Inquiry Log

4. Conduct the Experiment

Gather and Record Data Follow your plan and make careful observations. Use the space below to draw and label changes in the beach that result from placing the large artificial structure at right angles to the beach. Draw and label the changes in the beach that result from placing the smaller structure at right angles to the beach. Below each drawing, **summarize** your **observations**.

Changes to Beach As a Result of the Large Structure

Changes to Beach As a Result of the Small Structure

Other Observations

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Name _____

Unit Inquiry Log

5. Draw Conclusions and Communicate Results

Compare your hypothesis with your drawings, and then answer these questions.

1. Was your hypothesis supported by the results of the experiment? Explain.

Students should justify their responses with data and observations.

2. How would you revise the hypothesis? Explain.

Students may revise their hypotheses to match the results of the experiment more closely.

3. What else did you **observe** during the experiment?

Students should use their notes and be as specific as possible.

Prepare a presentation for your classmates to communicate what you have learned. Display your drawings and obserations.

Investigate Further

Write another hypothesis that you might investigate.

Responses will vary depending on experiment outcomes and student interest.

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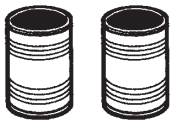
Name _____

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Investigate Log

The Uneven Heating of Earth

Materials



2 aluminum cans



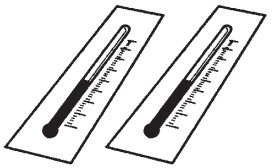
water



dry soil



spoon



2 thermometers

Procedure

1. Fill one can about ¾ full of water and the other can about ¾ full of soil.
2. Place one thermometer in the can of water and the other in the can of soil. Put the cans in a shady place outside. Wait 10 minutes, and then **record** the temperatures of the water and of the soil.
3. Put both cans in sunlight. **Predict** which can will heat faster. **Record** the temperature of each can every 10 minutes for 30 minutes.

   Prediction: _____

4. Put the cans back in the shade. **Predict** which can will show the faster temperature drop. Again, **record** the temperature of each can every 10 minutes for 30 minutes.

   Prediction: _____

5. Make line graphs to show how the temperatures of both materials changed as they heated and cooled.

	Temperature (in °C)								
	Shade	Sunlight				Shade			
	10 min	0 min	10 min	20 min	30 min	0 min	10 min	20 min	30 min
Water									
Soil									

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Name _____

Investigate Log

Draw Conclusions

1. How did your results match your predictions?

Predictions will vary, but results should show that the can of soil heated up faster and cooled off faster than the can of water.

2. Which would you **predict** heats up faster—oceans or land? Which would you predict cools off faster? Explain.

Based on the results, students should predict that land heats up faster and cools off faster than oceans.

3. **Inquiry Skill**—***Predict*** Scientists learn by **predicting** and then **experimenting** to test their predictions. How did you test your predictions in this Investigate?

Students tested their predictions by measuring the temperatures of the water and soil as they heated and cooled.

Inquiry Skill Tip

When you **predict**, you combine what you already know with what you have observed in the investigation so far. A prediction may turn out to be incorrect, but it can still guide your investigation. Even if the results show that your prediction was not correct, you have learned something new.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used thermometers to measure the temperatures of the water and soil.			
I **predicted** whether the water or soil would change temperature faster.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Predict how fast moist soil, sand, and salt water will heat up and cool down. Then plan and conduct a simple experiment to test your ideas.

Materials

Here are some materials that you might use.
List additional materials that you need.

- 2 aluminum cans
- water
- dry soil
- sand
- salt
- spoon
- 2 thermometers

1. What is your prediction for which will heat up and cool off fastest?

Predictions will vary, but students should state which they believe will heat up fastest and which will cool off fastest.

2. Record your measurements in the data table below.

	Temperature (in °C)								
	Shade	Sunlight				Shade			
	10 min	0 min	10 min	20 min	30 min	0 min	10 min	20 min	30 min
Moist soil									
Sand									
Salt Water									

3. What conclusions can you draw from the results of your investigation?

Students should find that salt water takes the longest time to heat up and cool off. Soil takes the least time to heat up and cool off.

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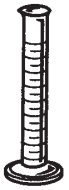
Name _____

Date _____

Investigate Log

Water, Water Everywhere

Materials



graduated cylinder



water



small plastic cup



zip-top plastic bag

Procedure

1. Using a graduated cylinder, **measure** and pour 100 mL of water into a cup.
2. Open a plastic bag and carefully put the cup inside. Then seal the bag. Be careful not to spill any water from the cup.
3. Place the sealed bag near a sunny window. **Predict** what will happen to the water in the cup.
4. Leave the bag near a window for 3 to 4 days. **Observe** the cup and the bag each day. **Record** what you see.
5. Remove the cup from the bag. **Measure** the water in the cup by pouring it back into the graduated cylinder. By **using the numbers** you recorded, find any difference in the amount of water poured into the cup and the amount of water removed from the cup.

Day	Observations	Amount of Water (mL)
1		100
2		
3		
4		
	Difference in amount of water:	

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

You can think of **inferring** as solving a puzzle. If you put together several things that you know, what else is probably true?

1. What did you **observe** during the time the cup was inside the bag?

   Possible answer: Water collects on the inside of the bag.

2. What happened to the water in the cup?

   The amount of water in the cup decreased.

3. **Inquiry Skill**—***Infer*** Scientists often **infer** the cause of what they **observe**. What can you **infer** about where the water in the bag came from? Possible answer: The amount of water in the bag seems the same as the amount of water missing from the cup. I infer that the water in the bag came from the cup.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used the graduated cylinder to measure the water.			
I **inferred** where the water in the bag came from.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Is the amount of water in the bag the same as the amount of water missing from the cup? Plan and conduct a simple investigation to find out.

Materials

Here are some materials that you might use.
List additional materials that you need.

- measuring cup
- water
- small plastic cup
- zip-top plastic bag

1. What is the hypothesis for the investigation?

Students may hypothesize that the amount of water in the bag is the same as the amount of water missing from the cup.

2. Draw a data table for your investigation. Record your observations in the table.

3. Did your results support your hypothesis? Explain any differences.

Students will likely find that the amount of water they can obtain from the bag is less than the amount missing from the cup. Some of the water is in the air, and it may be difficult to collect every drop of water from the bag.

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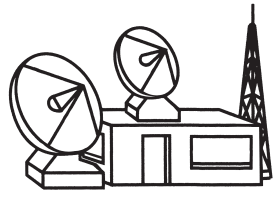
Name _____

Date _____

Investigate Log

Measuring Weather Conditions

Materials



weather station

Procedure

1. Copy the Weather Station Daily Record table from your textbook. You will use it to **record** the weather each day for five days. Try to **gather data** about weather conditions at the same time each day.
2. Place the weather station in a shady spot about 1 m above the ground. Be sure the rain gauge will not collect runoff from any buildings or trees. Be sure the wind vane is located where wind from any direction can reach it.
3. **Record** the amount of rain or snow (if any).
4. **Record** wind direction and speed. Identify wind by the direction it is blowing from.
5. **Observe** and **record** the cloud conditions. Draw a circle, and shade part of it to show the fraction of the sky that is covered with clouds.
6. **Record** the temperature. Make a line graph showing how the temperatures change from day to day.

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Name _____

Investigate Log

Draw Conclusions

1. **Compare** weather conditions you observed on two different days.

Students might notice differences in temperature, amount of precipitation, wind direction, and cloud conditions.

2. **Inquiry Skill—*Gather Data*** Scientists learn about the weather by **measuring** and **gathering data**. From the data you gathered, how might you **predict** the weather for tomorrow?

Possible answer: I could look for patterns in weather conditions and use the patterns to predict the weather.

Inquiry Skill Tip

Data are the facts that you obtain during an investigation. **Gathering data** often involves **measuring**, which can be done in many ways. In some cases, you gather data by **observing**. The most important part of gathering data is to be as accurate as possible.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for using the weather station.			
I used the thermometer, the rain gauge, and the wind vane to make measurements.			
I **gathered data** about temperatures, amounts of rain or snow, wind directions, and cloud conditions.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Plan and conduct an investigation to see if clues about tomorrow's weather can be found in today's weather data. Are there specific observations that can help you predict upcoming weather?

Materials

- weather station

1. Write a hypothesis about whether clues from one day can help you predict the next day's weather. **Students may hypothesize that types of clouds, wind direction, and color of the sunset help them predict the next day's weather.**

2. Use the table below to record your predictions and observations. Continue the table on another sheet of paper if you need more space.

Day	One Day's Observations	Next Day's Weather
1		
2		
3		
4		
5		
6		
7		

3. What observations, if any, helped you predict the next day's weather?
Possible answers: Before there is rain, birds fly inland, airplanes leave "tails" behind them, and dark clouds gather.

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Name _____

Date _____

Investigate Log

Ice Water

Materials



2 plastic measuring cups



thermometer



wax pencil



teaspoon



ice cubes



salt



water

Procedure

1. Copy the table.
2. Use a wax pencil to label the cups A and B. Fill each cup with ice cubes. Then add equal amounts of water to the cups.
3. Wait five minutes, and then use the thermometer to **measure** the temperature of the water in each cup. **Record** the data.
4. Stir two teaspoonfuls of salt into Cup B.
5. Wait two minutes, and then **measure** and **record** the temperature in each cup again.
6. Repeat Steps 4 and 5 two more times.

Water Temperatures			
Cup A		Cup B	
Spoonfuls of salt	Temp.	Spoonfuls of salt	Temp.
0		0	
0		2	
0		4	
0		6	

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

When you **draw conclusions** about an investigation, consider the overall problem. Examine all of your data, and think about what the results mean.

1. What was the difference between the final temperatures?

   Students should subtract to find the answer.

2. What happened to the temperature of the salt water as more salt was added?

   The temperature of the water went down.

3. **Inquiry Skill—*Draw Conclusions*** After reviewing the data, scientists **draw conclusions** about an experiment. What **conclusion** can you draw about the freezing temperature of salt water compared with that of fresh water?

   Students should conclude that the freezing temperature of salt water is lower than the freezing temperature of fresh water.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used the thermometer to **measure** the temperature of the water.			
I was able to **draw conclusions** about how the temperature of salt water compares to the temperature of fresh water.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Write a hypothesis and then plan and conduct a simple investigation about how salt affects the boiling temperature of water.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **thermometer**
- **salt**
- **wax pencil**
- **teaspoon**
- **water**

1. What is your hypothesis for this investigation?

Possible answer: Salt increases the boiling point of water.

2. Use the table below to record the measurements for your investigation.

Water Temperatures	
Spoonfuls of salt	Boiling Temperature (˚C)
0	
2	
4	
6	

3. What conclusion can you draw from your investigation?

Students should find that salt increases the boiling point of water.

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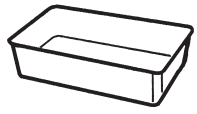
Name _____

Date _____

Investigate Log

Making Waves

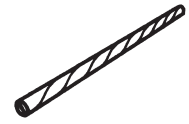
Materials



rectangular pan



water



straw

Procedure

1. Fill the pan halfway with water. The pan of water represents an ocean.
2. Hold the straw near one side of the pan, and gently blow across the surface of the water. What happens? Remember to blow across the water, not downward into the water.
3. **Observe** the height of the waves and how fast they move. **Record** your observations.
4. Repeat Step 2 several times, blowing a little harder each time. What do you **observe** about the waves? **Record** your observations about the height and speed of each set of waves.

Trial	Observations
1	Small ripples moved across the water.
2	The waves were bigger and moved faster.
3	The waves were even bigger and faster than before.

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Name _____

Investigate Log

Draw Conclusions

1. What can you **conclude** about the relationship between how hard you blew and the height of the waves?

The harder you blew, the higher the waves.

2. What can you **conclude** about the relationship between how hard you blew and the speed of the waves?

The harder you blew, the faster the waves moved across the pan.

3. **Inquiry Skill—*Make Inferences*** Scientists often **make inferences** from their observations. From your observations, what can you **infer** about the cause of ocean waves?

Ocean waves are caused by winds.

Inquiry Skill Tip

Use your own knowledge and experiences when you **make inferences** in an investigation. An inference is a statement about what you believe is true, based on your observations.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I made observations that helped me with this investigation.			
I obeyed safety rules when using the straw.			
I **made an inference** about the cause of ocean waves.			

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Date _____

Investigate Log

Independent Inquiry

Write a hypothesis about how wave heights differ on calm days and on stormy days. Plan and conduct a simple investigation to test your hypothesis.

Materials

Here are some materials that you might use. List additional materials that you need.

- rectangular pan
- ruler
- water
- watering can
- fan with speed settings

1. What is your hypothesis for this investigation? **Possible answer: Wave height is higher and more variable on stormy days with strong gusts of wind than on calm days with light, steady winds.**

2. Use the table below to record the measurements for your investigation.

Conditions	Observations

3. What conclusion can you draw from your investigation?

Conclusions will depend on the investigation that students conduct. Possible answer: Wave height is higher and more variable on stormy days with strong gusts of wind than on calm days with light, steady winds.

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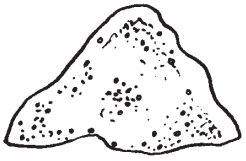
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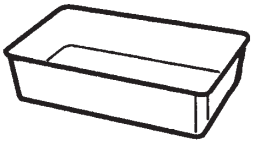
Investigate Log

The Effects of Waves on a Beach

Materials



sand



large flat, shallow pan



water

Procedure

1. Use sand to **make a model** of a beach at one end of the pan. The beach should have a gentle slope down toward the other end.
2. Add water until the pan is about half full. Add the water slowly so that you do not disturb the beach.
3. Lift the sand end of the pan about 2 cm above the tabletop. Then quickly but gently put it down to make wave. What do you **observe** about the beach and the water?
4. Repeat Step 3 several times. **Record** your observations.
5. Repeat Steps 1–4, but this time, build a beach that is much steeper than the first one. **Record** your observations.

Height of Beach	Observations
2 cm	1st trial: 2nd trial: 3rd trial:
4 cm	1st trial: 2nd trial: 3rd trial:
6 cm	1st trial: 2nd trial: 3rd trial:

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Investigate Log

Draw Conclusions

1. Use your observations to explain how waves affect a beach.

Waves carry away sand, making the beach smaller.

2. Does the slope of a beach make a difference in the effect of the waves on it? Explain your answer.

The slope does make a difference. A beach with a steep slope wears away faster than one with a gentle slope.

Inquiry Skill Tip

When you **observe** things that happen during an investigation, pay attention to details. Think about how changing a variable affects what you see.

3. **Inquiry Skill—*Observe*** When scientists study something carefully, they make observations. What could you not **observe** about wave action by using your model?

Waves can move sand away from a beach. The model did not show the effects of wave action over a long period of time.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I dropped the pan gently to produce waves.			
I **observed** effects of the waves on the sand.			

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Date _____

Investigate Log

Independent Inquiry

Make a model of a coast by using different materials. Make a prediction about how waves affect different kinds of coastlines. Plan and conduct a simple investigation to test your prediction.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **sand**
- **large flat, shallow pan**
- **water**

1. What is your prediction about how waves affect different kinds of coastlines?

Possible answer: Heavier materials, such as gravel, experience less erosion than lighter materials.

2. Use the table below to record your observations for this investigation.

Type of Coastline	Observations

3. What conclusion can you draw from your investigation?

Possible answer: Rocky coastlines that are not very steep experience less erosion than steep coastlines made from light materials.

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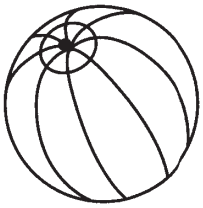
Name _____

Date _____

Investigate Log

Moving Through Space

Materials



beach ball



baseball



table-tennis ball

Procedure

1. Work in a group of four. You will **use a model** to show the **time and space relationships** among Earth, the moon, and the sun. One person should hold the beach ball (the sun). Another should stand far away and hold the baseball (Earth). A third person should hold the table-tennis ball (the moon) near the baseball. The fourth person should **record** the movements.
2. For the **model**, Earth should move around the sun in a circle and spin at the same time. The real Earth spins about 365 times during each complete path around the sun.
3. While the model Earth moves, the model moon should move around Earth in a nearly circular path. The real moon spins once during each complete path around Earth. Earth spins about 29 1/2 times from one new moon to the next.

Observations
Students should describe their observations of the moon moving around Earth as Earth moves around the sun.

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Investigate Log

Draw Conclusions

1. One movement in the **model** represented a year. Which movement was that?

   Earth moving once around the sun

2. **Inquiry Skill**—***Use Time/Space Relationships*** Use your understanding of **time and space relationships** to compare the moon's and Earth's movements. How are they alike? How are they different?

   Possible answer: The moon and Earth both spin, but at different rates; the moon circles Earth, and Earth circles the sun.

Inquiry Skill Tip

You have to think about **time and space relationships** to understand the movement of objects in space. Consider the position of objects at one time, then consider their position at some later time. In this investigation, your model sun doesn't move. The real sun spins on its axis and moves along with other stars.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for working with my group.			
One member of my group recorded our observations.			
I determined **time and space relationships** among the Earth, moon and sun.			

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Investigate Log

Independent Inquiry

Make a model to show how the amount of sunlight reaching different parts of Earth changes during the year.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **beach ball**

1. Describe the model you plan to make.

Answers will vary. Students may use a flashlight or lamp as a light source. By changing the angle of the light source, they can observe the light that falls on a ball and see how the sunlight reaching different parts of Earth changes throughout the year.

2. Describe your observations.

Students should observe that the amount of sunlight that reaches each area of Earth depends on the angle of sunlight, as well as Earth's revolution about its axis and rotation around the sun.

3. Based on your observations, what can you conclude about how Earth's movement affects the number of hours of sunlight each day during summer and winter?

Students should realize that the area of Earth facing the sun has more hours of sunlight each day. Summer days are longer because that area of Earth is more directly facing the sun.

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Date _____

Investigate Log

Making Craters

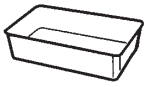
Materials



safety goggles



newspaper



aluminum pan



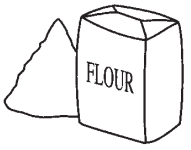
apron



large spoon



½ cup water



1 cup flour



marble



meterstick

Procedure

1. Make a table like the one below for your investigation.
2. Spread the newspaper on the floor. Place the pan in the center.
3. Put on the apron. Use the spoon to mix the water and most of the flour in the pan. Spread out the mixture. Lightly cover the surface of the mixture with dry flour to **make a model** of the moon's surface.
4. **CAUTION: Put on safety goggles to protect your eyes.** Drop the marble from a height of 20 cm. Carefully remove the marble.
5. **Measure** the width of the crater, and **record** it in the table. Repeat Step 4, and measure and record again.
6. Now drop the marble twice from each of the heights 40 cm, 80 cm, and 100 cm. **Measure** and **record** the crater's width after each drop.

Trial	Height	Width of Crater
1	20 cm	
2	20 cm	
3	20 cm	
1	40 cm	
2	40 cm	

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Name _____

Investigate Log

Draw Conclusions

1. How did height affect crater size?

The greater the height from which the marble was dropped, the larger was the crater.

2. **Inquiry Skill**—***Use Models*** Scientists use models to study space. From **using a model**, what did you learn about how the moon's craters may have been formed?

Possible answer: The moon's craters may have been formed by objects from space that struck the moon.

Inquiry Skill Tip

Models help you understand objects or events when you can't easily test the real thing. When you **use models**, remember that your results depend on the differences between your model and the real thing. You should always try to make your model as realistic as possible.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I wore safety goggles and obeyed safety rules.			
I **used a model** to study the moon's craters.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

How would dropping objects of different sizes affect the size and shape of the craters? Plan and conduct a simple investigation to find out.

Materials

Here are some materials that you might use. List additional materials that you need.

- safety goggles
- newspaper
- aluminum pan
- 1/2 cup water
- 1 cup flour
- objects to drop
- apron
- meterstick
- large spoon

1. Describe the steps of your investigation.

Answers will vary. Students will probably use steps similar to those for the first investigation, but they will test objects of different sizes.

2. Draw a data table below. Record your observations in the table.

3. What conclusions can you draw from your investigation?

For the conditions of this investigation, students will probably find that crater width depends on object size and height from which it is dropped. Crater depth depends on object weight and height from which it is dropped.

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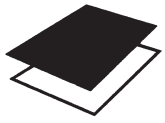
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Investigate Log

Make a Telescope

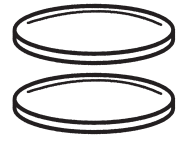
Materials



2 sheets of construction paper



tape



2 convex lenses



modeling clay

Procedure

1. Roll and tape a sheet of construction paper to form a tube slightly larger in diameter than the lenses. Make a second tube just large enough for the first tube to fit inside it.
2. Slide most of the smaller tube into the larger tube.
3. Use some of the clay to hold one of the lenses in one end of the smaller tube. This will be the telescope's eyepiece.
4. Use clay to hold the other lens in the far end of the larger tube. This will be the lens closest to the object you are viewing.
5. Choose three distant objects to view. **CAUTION: Do not look at the sun.** Slide the smaller tube to focus on each object.
6. **Observe** each object twice, once without the telescope and once with it. **Record** each observation in a drawing.

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Name _____

Investigate Log

Draw Conclusions

1. **Compare** the drawings made with and without the telescope. Why do they differ?

The drawings made with the telescope should show the objects larger and in more detail. The telescope makes objects look larger.

2. **Inquiry Skill**—***Observe*** How was your **observing** similar to using a space telescope?

Both the telescope made here and a space telescope can be used to observe objects in the sky, and both can increase the amount of detail that can be seen.

Inquiry Skill Tip

Observing means more than just recording results. When you **observe**, you should look for details and changes. Think about what characteristics or events are important to your investigation.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for making a telescope.			
I was careful not to look at the sun through my telescope.			
I **observed** objects with and without the telescope.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Use your telescope to observe the brightest object in the eastern night sky. List details you can see with the telescope but not without it.

Materials

- 2 sheets of construction paper
- tape
- 2 convex lenses
- modeling clay

1. Predict how your view of the object will change when you look at it through your telescope.

Students will probably predict that they will see more details and that the view of the object will be larger.

2. List details you can see with the telescope, but not without it.

Answers will vary. Students may be able to distinguish the object's shape and smaller objects around it with the telescope.

3. Describe how the results of your investigation are the same or different from your predictions.

Students may be able to see more or fewer details than they expected to see with their telescopes.

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Unit Inquiry Log

Unit E

Make Your Own Paper

1. Observe and Ask Questions

One way to conserve natural resources is by recycling used paper. Make a list of questions you have about how to recycle paper. Then circle a question you want to investigate.

Is there a difference between recycled newspaper, recycled loose leaf paper, and recycled printer paper?

2. Form a Hypothesis

Write a hypothesis. A hypothesis is a scientific explantion that you can test. You must be able to test the hypothesis.

Recycled printer paper will be stronger than recycled loose leaf paper, which will be stronger than recycled newspaper.

3. Plan an Experiment

To plan your experiment, you must first identify the important variables. Complete the statements below.

Identify and Control Variables

The variable I will change is

the type of paper being recycled.

The variable I will observe or measure is

the strength of the recycled paper.

The variables I will keep the same, or *control*, are

the amount of used paper I recycle, the process of recycling the paper, the process of testing strength of the paper.

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Name _____

Unit Inquiry Log

Develop a Procedure and Gather Materials Write the steps you will follow to set up an experiment and collect data.

1. Collect and save used sheets of paper and store each type in separate piles.
2. Tear the used paper into pieces that are about 4cm by 4cm.
3. Measure a set amount of torn paper and place it in a bucket. Add a set amount of warm water. Let the mixture sit for at least 30 minutes.
4. Dump the mixture into a blender and blend until a smooth slurry is formed.
5. Stretch nylon netting or mesh screening over an embroidery hoop. Pour a set amount of the slurry onto the embroidery hoop. Press out any excess water.
6. Gently peel the new sheet of paper from the embroidery hoop and lay it on a stack of dry newspaper. Cover it with more dry newspaper and set a stack of books on top to help press it flat. Make several sheets of paper.
7. Repeat the process for the other types of paper you are recycling.
8. Once all of the recycled paper is dry, test its strength. Tape the paper to the wall and cut a small slit in the side of the paper. Hang weights from the bottom of the paper and record how much weight the paper can hold before it rips.

Use extra sheets of blank paper if you need to write down more steps.

Materials List Look carefully at all the steps of your procedure, and list all the materials you will use. Be sure that your teacher approves your plan and your materials list before you begin.

sheets of used paper, blender, water, large embroidery hoop, mesh screening or nylon netting, measuring cup, stack of books, tape, scissors, weights.

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Unit Inquiry Log

4. Conduct the Experiment

Gather and Record Data Follow your plan and collect data. Use the chart below or a chart you design to record your data. (Make additional copies of the chart as needed for testing additional strings or other instruments.) **Observe** carefully. **Record** your observations, and be sure to note anything unusual or unexpected.

Type of Paper	Sheet Number	Mass the Paper Could Hold (g)
Newspaper		

Average Mass Held: _____

Type of Paper	Sheet Number	Mass the Paper Could Hold (g)
Loose Leaf		

Average Mass Held: _____

Type of Paper	Sheet Number	Mass the Paper Could Hold (g)
Printer Paper		

Average Mass Held: _____

Other Observations

_____

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Name _____

Unit Inquiry Log

Interpret Data Make a bar graph of the data you have collected. Plot the graph on a sheet of graph paper, or use a software program.

5. Draw Conclusions and Communicate Results

Compare the hypothesis with your observations, and then answer these questions.

1. Was your hypothesis supported by the results of the experiment? Explain.

   Students should justify their responses with data and observations.

2. How would you revise the hypothesis? Explain.

   Students may revise their hypotheses to match the results of the experiment more closely.

3. What else did you **observe** during the experiment?

   Students should use their notes and be as specific as possible.

Prepare a presentation for your classmates to communicate what you have learned. Display your data table.

Investigate Further

Write another hypothesis that you might investigate.

Responses will vary depending on experiment outcomes and student interest.

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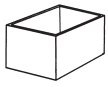
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Investigate Log

Mystery Boxes

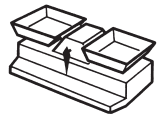
Materials



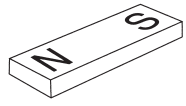
sealed box provided by your teacher



ruler



balance



magnet

Procedure

1. Look carefully at your box. Move it around and listen. Is there one object inside, or are there several? **Record** what you hear.

   What do you hear?

   _____

2. Use your ruler to **measure** the height, length, and width of your box. **Record** your observations.
3. Use your balance to **measure** the mass of your box. **Record** your data.
4. Put the magnet on the box, and tilt the box. Does the magnet attract any objects? Repeat, with the magnet in different positions. **Record** your findings.

   Does the magnet attract objects?

   _____

5. **Predict** what the number, size, and nature of the objects inside your box will prove to be. Open your box. Were your predictions correct?

   Predictions about contents:

   _____

6. Remove the objects from the box. Repeat Steps 2 and 3. **Record** your data.

Box	Height (cm)	Length (cm)	Width (cm)	Mass (g)
Sealed				
Empty				

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Name _____

Investigate Log

Draw Conclusions

1. Which observations and measurements led you to correct predictions? Which led you to incorrect predictions? Why?

Student answers will vary. Students should relate each prediction to specific data they collected and state why each prediction was correct or incorrect. Students should note that what they heard was helpful. Measurements of the box were not very helpful.

2. **Inquiry Skill—*Compare*** **Compare** the masses and volumes of the box with and without the objects inside. How were these measurements affected by the objects? Students should use their measurements to conclude that the objects changed the mass of the box because the objects' mass was included in the first measurement of the box's mass. After the box was emptied, the objects' mass was not included in the measurement. The volume of the box did not change, however.

Inquiry Skill Tip

Recording your measurements and observations in a table makes **comparing** easier. You can easily see which properties are the same and which are different when you place them side by side.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for making observations of the box.			
I used the ruler to measure the height, length, and width of the box.			
I **compared** the masses and volumes of the box with and without the objects inside.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Predict what will prove to be inside a mystery box that a classmate makes for you. Observe and measure to test your prediction.

Materials

- sealed box provided by a classmate
- balance
- ruler
- magnet

1. What do you predict will be inside the box?

   Student answers will vary. Students may predict that the box contains at least one heavy, magnetic object.

2. Record your observations and measurements, and then make a new prediction about the contents of the box.

What do you hear?

_____

Did the magnet attract objects?

_____

Predictions about contents:

_____

Box	Height (cm)	Length (cm)	Width (cm)	Mass (g)
Sealed				
Empty				

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Date _____

Investigate Log

Changing States of Matter

Materials


goggles


2 ice cubes


glass beaker

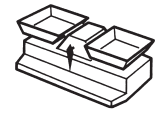

measuring cup

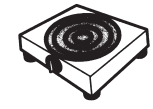

cold water


plastic spoon


thermometer


zip-top plastic bag


balance


hot plate

Procedure

1. Place the ice cubes in the beaker. Add 1 cup of cold water.
2. Stir with the plastic spoon. Use the thermometer to **measure** and **record** the temperature.
3. Pour the contents of the beaker into the zip-top bag. Seal the bag.
4. Use your balance to **measure** the mass of the bag and its contents. **Record the data**.
5. Set the bag in a warm place. Leave it there until the cubes disappear. Describe what happened to the cubes. **Record** your inference.
6. Repeat Step 4.
7. Pour the contents of the bag back into the beaker. Repeat Step 2.
8. **CAUTION**: Put on the safety goggles. Your teacher will boil water and measure its temperature. **Record data** and inferences.

	Temperature (°C)	Mass (g)	Inference
Bag of ice cubes			
Bag of melted water			
Boiling Water			

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Name _____

Investigate Log

Draw Conclusions

1. Water can exist in three states: solid, liquid, and gas. Use your data to tell the temperature at which water changes state. Students should relate their data to the state of water: solid ice at around 0°C; boiling water (and the change to the gas state) at around 100°C. Their liquid water will be at a temperature somewhere between 0°C and 100°C.

2. **Inquiry Skill—*Compare*** Use your data to **compare** the mass of the bag and its contents before and after the ice melted. Students should find that the mass of the bag and its contents did not change after the ice cubes melted.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for measuring the temperature and mass of the water and ice.			
I wore safety goggles and obeyed safety rules.			
I **compared** the mass of the bag and its contents before and after the ice melted.			

Inquiry Skill Tip

When you **compare** measurements that you have made during an investigation, don't expect the masses and temperatures that you record to be exact. For example, you may measure an object's mass several times and get a slightly different number each time. These differences may occur because of the way you make a measurement, or because the balance is not precise. If you are concerned about a measurement, you should repeat it several times.

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Date _____

Investigate Log

Independent Inquiry

Put 1 cup of water into each of two different containers. Leave them out until the water disappears. Where did the water go? Hypothesize why the water disappeared from one sooner than it did from the other.

Materials

- wide, shallow container
- narrow, deep container
- measuring cup
- water

1. What will your investigation test?

Students will compare the rates at which water disappears from a wide, shallow container and a narrow, deeper container.

2. What are your observations during the investigation?

Students should observe that the water disappears first from the wide, shallow container.

3. Where did the water go? Why do you believe the water disappeared from one container sooner than from the other?

Students should realize that the water evaporated. The liquid water changed to gaseous water, or water vapor. They should also note that the water disappeared from the wide, shallow container first because a greater surface area is exposed to air.

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Investigate Log

Chemical Properties

Materials

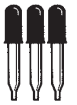

apron


9 test tubes


3 plastic spoons



iodine solution


3 droppers


water



vinegar



cornstarch



baby powder



baking soda


safety goggles

Procedure

1. **CAUTION:** Put on the apron and the safety goggles.
2. Label one test tube *water*, a second *vinegar*, and a third *iodine*. Use a plastic spoon to put a *tiny* bit of baking soda into each of the test tubes.
3. To the first test tube, add 3 drops of water. **Record your observations.**
4. To the second test tube, add 3 drops of vinegar. **Record your observations.**
5. To the third test tube, add 3 drops of iodine solution. **Record your observations.**
6. Using a clean spoon, put a tiny bit of cornstarch in each of 3 test tubes. Repeat Steps 3–5.
7. Using a clean spoon, put a tiny bit of baby powder in each of 3 test tubes. Repeat Steps 3–5.

	Baking Soda	Cornstarch	Baby Powder
Water	no reaction	no reaction	no reaction
Vinegar	bubbles form	no reaction	no reaction
Iodine	no reaction	turns dark blue	no reaction

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Name _____

Investigate Log

Draw Conclusions

1. What effect did vinegar have on the baking soda? Did any other combination show the same effect? The mixture of vinegar with baking soda produces bubbles. (The bubbles are actually carbon dioxide gas produced by a chemical reaction.) None of the other combinations produce bubbles.

2. **Inquiry Skill—*Infer*** In which combinations of a solid with a liquid can you **infer** that a chemical change took place? Explain.

The two obvious chemical changes are evidenced by the reactions of baking soda-vinegar (bubbles are produced) and cornstarch-iodine (turns blue, black, or deep violet). If students notice that baking soda dissolves in water, remind them that this is a physical change.

Inquiry Skill Tip

Think about causes and effects when you **infer** why something happens in an investigation. Make a list of causes. These may be things that you change or procedures that occur during the investigation. Next to each cause, write its effect, or what happens because of it.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for testing each of the materials.			
I obeyed safety rules and wore an apron and goggles during the entire investigation.			
I **inferred** in which mixtures of a solid with a liquid a chemical change took place.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Get a "mystery powder" from your teacher. Test with liquids, and use your observations to infer what the powder actually is.

Materials

- safety goggles
- iodine solution
- mystery powder from your teacher
- 3 test tubes
- plastic spoon
- 3 droppers
- apron
- water
- vinegar

1. What will you determine in your investigation? What procedures will you use? Students will determine the identity of a mystery powder (a combination of two of the original substances). They will test the powder using water, vinegar, and iodine. By comparing their results to the results of the Investigate, they can determine the powder's identity.

2. Record your observations in the table below.

	Mystery Powder
Water	no reaction
Vinegar	no reaction
Iodine	turns dark blue

3. What can you infer about the powder's identity? Explain.
Answers will depend on the composition of the mystery powder. For example, students may infer that it is a combination of baking soda and cornstarch because it reacts to both vinegar and iodine.

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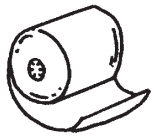
Name _____

Date _____

Investigate Log

Going Up!

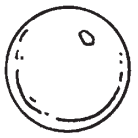
Materials



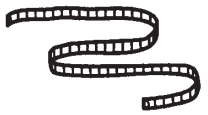
paper strip, 100 cm long



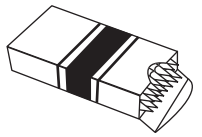
tape



rubber ball



tape measure



colored pencils

Procedure

1. Work with a partner. Tape the paper to the wall as shown. Using the tape measure, mark the paper strip at 10-cm intervals. Start with 0 cm at the floor, and end with 100 cm at the top.
2. Have your partner hold the ball next to the 50-cm mark. You should sit facing the paper, with your eyes at the level of the 50-cm mark.
3. Have your partner drop the ball while you **observe** how high it bounces. **Record** the height with a colored mark on the paper.
4. Repeat Steps 2 and 3 two more times. **Record** each height in a different color.
5. Switch roles with your partner. This time, drop the ball from the 100-cm mark and **record the height.** Repeat twice.

Drop Height	Trial	Height of Bounce (cm)
50 cm	1	
	2	
	3	
100 cm	1	
	2	
	3	

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Name _____

Investigate Log

Draw Conclusions

1. How did your results change when you dropped the ball from 100 cm?

The ball bounced higher when dropped from 100 cm.

2. **Inquiry Skill—*Draw Conclusions*** For this experiment, you dropped the ball from 50 cm and 100 cm. **Draw conclusions** about what was different when you dropped the ball from 100 cm.

The ball had more energy when it was dropped from 100 cm.

Inquiry Skill Tip

When you **draw conclusions**, first review the record you made of your observations, then consider what the observations mean. If you have difficulty drawing conclusions, discussing your results with your teacher or other students may help.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used the tape measure to determine the heights that the ball bounced.			
I **drew conclusions** about what was different when I dropped the ball from 100 cm.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Write a hypothesis about how far the ball will bounce if it's dropped from a height of 200 cm. Then experiment to see if your hypothesis is correct.

Materials

- paper strip, 200 cm long
- colored pencils
- rubber ball
- tape measure
- tape

1. Write your hypothesis about how far the ball will bounce when dropped from a height of 200 cm. Students may hypothesize that the ball will bounce higher than when it was dropped from a height of 100 cm.

2. Record your observations for how high the ball bounces.

Trial	Height of Bounce (cm)
1	
2	
3	

3. Was your hypothesis correct? Explain.

Students may have correctly hypothesized that the ball would bounce higher than it did when dropped from 100 cm, but the exact height of their prediction may not be correct.

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Name _____

Date _____

Investigate Log

Warmer or Cooler?

Materials



safety goggles



measuring cup



water



plastic cup



thermometer



plastic spoon



calcium chloride

Procedure

1. Use the table below for this investigation.
2. **CAUTION: Put on safety goggles. Do not touch the calcium chloride.** **Measure** 50 mL of water, and pour it into the plastic cup.
3. Using the thermometer, **measure** the temperature of the water. Then **record** the temperature in your table.
4. Add 2 spoonfuls of calcium chloride to the water, and stir until the calcium chloride is dissolved. Wait 30 seconds.
5. **Measure** the temperature of the water, and **record** it in your table.
6. Repeat Step 5 one minute and two minutes after the calcium chloride has dissolved.

Time	Temperature (°C)
Before dissolving calcium chloride	
30 seconds after dissolving	
1 minute after dissolving	
2 minutes after dissolving	

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Name _____

Investigate Log

Draw Conclusions

1. How did the temperature of the water change after you added the calcium chloride?

   The temperature increased.

2. **Inquiry Skill**—***Infer*** What energy change can you **infer** takes place when calcium chloride dissolves in water?

   Heat is given off.

Inquiry Skill Tip

When you **infer** about things that happen during an investigation, consider the causes and effects of changes in variables. Changes in your dependent variables are the effects, or the results. Changes that you make to the independent variable are the causes of changes in the dependent variable.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for observing changes in the water temperature.			
I wore safety goggles during the investigation.			
I **made an inference** about the energy change that takes place when calcium chloride is dissolved in water.			

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Date _____

Investigate Log

Independent Inquiry

Write a hypothesis about what will happen if the amount of water is increased to 100 mL. Then plan and conduct a simple investigation to test your hypothesis.

Materials

- safety goggles
- measuring cup
- water
- plastic cup
- thermometer
- plastic spoon
- calcium chloride

1. Write your hypothesis for the investigation.

Students may hypothesize that the water temperatures will be lower throughout the investigation.

2. Record your observations in the table below.

Time	Temperature (°C)
Before dissolving calcium chloride	
30 seconds after dissolving	
1 minute after dissolving	
2 minutes after dissolving	

3. Did your results support your hypothesis? Explain.

Students may have correctly hypothesized that the temperatures of the water would be lower. The heat given off by the calcium chloride is spread out in more water.

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Name _____

Date _____

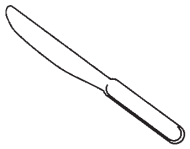
Investigate Log

Hot Buttered Knives

Materials

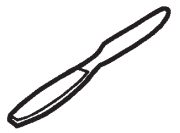


cold butter


metal knife


large plastic foam cup


hot water


plastic knife

Procedure

1. Place two pats of butter on the blade of the metal knife—one in the middle and one near the tip. Place the knife, handle first, in the cup to check that both pats of butter are above the rim on the cup. Remove the knife.
2. **CAUTION: Be careful when pouring the hot water.** Fill the cup with hot water. Carefully place the knife, handle first, back in the cup.
3. **Observe** the knife and the pats of butter for 10 minutes. **Record** your observations.
4. Repeat Steps 1–3, substituting the plastic knife for the metal one. **Record** your observations.

Type of Knife	Observations
Plastic	
Metal	

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Name _____

Investigate Log

Draw Conclusions

1. On which knife did the butter melt faster? On that knife, which pat of butter melted faster?

The butter on the metal knife melted faster. The pat at the middle of the knife melted faster than the one at the tip.

2. **Inquiry Skill—*Draw Conclusions*** **Draw a conclusion** about which material—metal or plastic—transfers heat more quickly.

Metal transfers heat more quickly than plastic.

Inquiry Skill Tip

For this investigation, you can **draw a conclusion** based on a comparison of observations. Think about how your observations for the two events are alike and how they are different. Then think about what caused the differences.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for observing the rates at which the butter melted.			
I was careful when pouring the hot water.			
I was able to **draw a conclusion** about whether metal or plastic transfers heat more quickly.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Write a hypothesis about which knife will lose heat more quickly. Then plan and conduct a simple investigation to test your hypothesis.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **cold butter**
- **hot water**
- **metal knife**
- **plastic knife**
- **large plastic foam cup**

1. Write your hypothesis about which knife will lose heat more quickly.

Students will hypothesize that either the plastic or the metal knife will lose heat more quickly.

2. Draw a data table for your investigation below. Record your observations.

3. Did your observations support your hypothesis? Explain.

Answers will depend on students' hypotheses. Students should conclude that the metal knife lost heat more quickly than the plastic knife.

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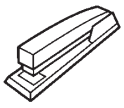
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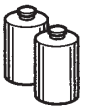
Investigate Log

Water Power

Materials


stapler


pencil



10-g mass (paper clip, weight)


2 plastic disks

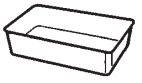

masking tape


scissors


string, 100 cm


meterstick


2 washers


basin


water


stopwatch

Procedure

1. **CAUTION: Be careful with the scissors.** Staple the plastic disks at their centers. Cut four 3-cm slits as shown. On the opposite side of each slit, fold the disks in opposite directions to form a vane.
2. Carefully pierce a small slit through the center of both disks. Insert the pencil.
3. Tape one end of the string to one end of the pencil. Tie or tape the mass to the string.
4. Slide a washer onto each end of the pencil. Hold your water wheel by the washers so it can turn freely. Hold it horizontally over the basin, with the closed ends of the vanes pointing away from you.
5. Have a partner slowly pour water from a height of 10 cm onto the vanes. **Measure** and **record** the time it takes for the mass to be wound up to the pencil. Repeat, but pour the water from 15 cm and 20 cm.

Height (cm)	Time (s)
10	
15	
20	

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Name _____

Investigate Log

Draw Conclusions

1. What **variable** did you **control**? What variable did you change?

The mass was a controlled variable; the height of the water was changed.

2. **Inquiry Skill**—***Draw Conclusions*** What can you **conclude** about the effect of the distance the water fell on the speed at which the water wheel turned?

The farther the water fell, the faster the wheel turned.

Inquiry Skill Tip

When you **draw conclusions**, make a list of changes that occured during the investigation. Beside each one, list differences that might have caused the change.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I was careful when using the scissors.			
I **drew a conclusion** about the effect of height on the speed at which the water wheel turned.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Write a hypothesis about how the rate of the water's flow is related to the speed of the water wheel. Then plan and conduct an experiment to test your hypothesis.

Materials

Here are some materials that you might use.
List additional materials that you need.

- stapler
- pencil
- 10-g mass (paper clip, weight)
- 2 plastic disks
- masking tape
- scissors
- meterstick
- string, 100 cm
- permanent marker
- 2 washers
- basin
- water
- stopwatch

1. Write your hypothesis for the investigation.

Students may hypothesize that the rate of the water's flow increases when the speed of the water wheel increases.

2. Make a data table for the investigation. Record your observations on the table.

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3. Did your investigation support your hypothesis? Explain.

Students may have correctly hypothesized that the rate of the water's flow increases when the speed of the water wheel increases.

Name _____

Date _____

Investigate Log

Build an Electromagnet

Materials



3 m of insulated copper wire



iron nail 15 cm long



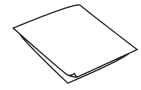
battery holder for D-cell



paper clips



D-cell battery



sheet of paper

Procedure

1. Wrap the wire in a tight coil around the nail. Leave about 20 cm of wire free at each end.
2. Connect the ends of the wire to the battery holder.
3. Put a small pile of paper clips on your desk. Hold the nail above the pile, and lower it toward the clips. **Observe** what happens.
4. Turn on your electromagnet by putting the battery into the battery holder.
5. Hold the nail above the pile of paper clips, and lower it slowly. **Observe** what happens.
6. While you hold the nail and paper clips above a sheet of paper, have your partner remove the battery from the battery holder. **Observe** what happens. Count and **record** the number of paper clips your electromagnet picked up.

	Paper Clips Picked Up	Other observations
Without battery		
With battery		
Without battery		

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Name _____

Investigate Log

Draw Conclusions

1. How did the nail change when the D-cell was connected?

The nail became a magnet.

2. **Inquiry Skill—*Compare*** Electromagnets are used on construction cranes to pick up steel. **Compare** a construction crane's electromagnet with yours?

The cranes used to lift steel would need a bigger piece of iron in place of the nail and more wire to wrap around it. Students may also note that it would need a bigger power source than one D-cell battery.

Inquiry Skill Tip

Compare means to tell how things are alike and different. When you are asked to compare a model to real life, try to identify how each piece of the model differs from the real thing.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions to connect the wire, nail, battery holder, and battery.			
I disconnected the battery as soon as I finished the investigation so that it wouldn't become too warm.			
I **compared** the electromagnets used on construction cranes with my model.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

What would happen if you added another D-cell to your electromagnet? Plan and conduct a simple experiment to find out.

Materials

Here are some materials that you might use. List additional materials that you need.

- 3 m of insulated copper wire
- iron nail, 15 cm long
- battery holder for D-cell
- paper clips
- D-cell battery
- sheet of paper

1. Write your hypothesis for this investigation.

Possible answer: If you add another battery to the electromagnet, the nail will pick up twice as many paper clips.

2. Conduct the investigation. Use the table below to record your results.

	Paper Clips Picked Up	Other Observations
Without batteries		
With batteries		
Without batteries		

3. Explain why adding another battery led to the results you found in the investigation.

Adding another battery makes the electromagnetic stronger because there is more current. (Students may say that there is "more electricity" or "more power" from two batteries than one.)

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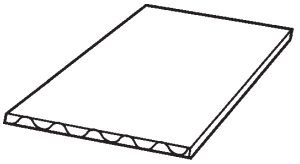
Investigate Log

Make an Electroscope

Materials



steel paper clip



cardboard, 10 cm by 10 cm



tape



aluminum foil



wide-mouth glass jar



plastic comb



wool cloth

Procedure

1. Straighten one end of a paper clip to form a J-shaped hook.
2. Push the paperclip's straight end through the middle of the piece of cardboard. Tape it in place so that 2 or 3 cm of the straight end extend above the cardboard.
3. Cut two strips of foil, 1 cm wide and 4 cm long. Push the hook through the foil strips so that they hang together from it.
4. Set the cardboard on the jar, with the hook inside, and tape it in place. You have completed your electroscope.
5. Hold the comb near the end of the paper clip. **Observe** what happens.
6. Rub the comb with the cloth. Repeat Step 5. **Observe** what happens as you move the comb away from and toward the paper clip.

	Observations
Comb not rubbed with the cloth	
Comb rubbed with the cloth	

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

The best predictions are based on data you already have. Analyze what you know from the investigation in order to **predict** what will happen in the future.

1. What happened as you moved the rubbed comb toward or away from the electroscope? As the comb was moved toward the electroscope, the pieces of foil moved apart. As the comb was moved away from the electroscope, the pieces of foil returned to the starting position.

2. **Inquiry Skill—*Predict*** Scientists often predict what they think will happen in a certain situation. **Predict** what you think would happen to the foil if you rubbed the comb with the cloth and held the cloth near the electroscope. Then test it. Was it correct?

Students may predict that the foil will move in the same way because the cloth is also charged. Or they may predict that the foil would move in the opposite way because the charge is opposite that of the comb.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions to build the electroscope.			
I **observed** how the comb affected the electroscope.			
I **predicted** what would happen to the foil if I rubbed the comb with the cloth and held the cloth near the electroscope.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

What do you think will happen if you touch the comb, the cloth, or your finger to the paper clip? Plan and conduct a simple experiment to test your ideas.

Materials

- steel paper clip
- cardboard, 10 cm by 10 cm
- tape
- aluminum foil
- wide mouth glass jar
- plastic comb
- wool cloth

1. Hypothesize what will happen when you touch each of the objects to the paper clip.

Students should hypothesize that touching the comb, the cloth, and a finger to the paper clip will make the foil leaves either move apart or move together.

2. Use the table below to record your observations.

Object That Touches the Paper Clip	Observations
comb	The foil leaves move apart.
cloth	The foil leaves move apart.
finger	The foil leaves fall back to a neutral position.

3. What do you think caused each of the observations you made in the investigation?

Students may correctly answer that the comb and the cloth charge the foil leaves of the electroscope. Touching a finger to the paper clip drains the charge.

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Name _____

Date _____

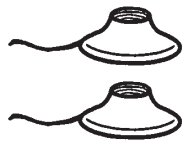
Investigate Log

Build an Electric Circuit

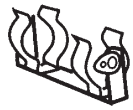
Materials



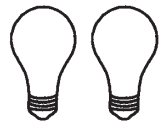
3 lengths of insulated wire with bare ends



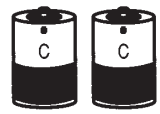
2 light-bulb holders



battery holder



2 light bulbs



batteries

Procedure

1. Use the wire to connect the light-bulb holders and the battery holder as shown in the diagram on page 627 of your textbook. Have your teacher check to make sure that you have assembled the parts correctly.
2. Screw the light bulbs firmly into the holders.
3. Insert the batteries into the battery holder. **Observe** and **record** what happens.
4. Remove the batteries from the holder. **Observe** and **record** what happens.

	Observations
With batteries	
Without batteries	

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Name _____

Investigate Log

Draw Conclusions

1. What happened when you put the batteries into the battery holder?

   The lights turned on.

2. What happened when you took the batteries out of the battery holder?

   The lights went out.

3. Think about the path you made for the electric current. How did putting the batteries into the holder affect this path?

   The batteries completed the path for the electric current.

4. **Inquiry Skill—*Make a Model*** Draw a diagram of the path you made for the electric current. **Make a model** of how the current in one room of your home might move through various appliances, such as lamps or the TV. Draw a diagram of your model.

   The diagram should show the circuit passing through lights and appliances. The source of electrical energy will not be included, but students should show that the circuit is not closed within the room.

Inquiry Skill Tip

Even though you may understand how something works, if you **make a model** you may be surprised to discover things you didn't know before. In the process of making a model, you have to think about each part of an object and how the parts fit together.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for building the circuit.			
I **observed** the light bulbs with and without the batteries in the circuit.			
I **made a model** of how the current in one room of my home might move through appliances.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Is there another way to connect two light bulbs and a battery of cells? Plan and conduct a simple experiment to find out.

Materials

Here are some materials that you might use. List additional materials that you need.

- 4 lengths of insulated wire with bare ends
- 2 light-bulb holders
- battery holder
- 2 light bulbs
- batteries

1. Draw a diagram showing how you will connect the two light bulbs and a battery in a different way.

Students will probably draw a circuit with the light bulbs in parallel rather than in series.

2. Think of a way to test your circuit. Describe your observations.

Students may test whether the light bulbs will shine if either is missing from the circuit. In a parallel circuit, one bulb will continue to shine if the other is removed.

3. Based on your observations, what is an advantage of the way you connected the light bulbs and battery in this experiment?

Students should realize that one light bulb will stay on when the other is disconnected. This is an advantage because all fixtures attached to a circuit don't have to be on for the circuit to be complete.

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Name _____

Date _____

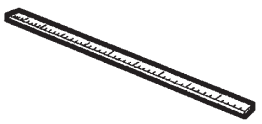
Investigate Log

Making Sound

Materials



2 metal spoons



meterstick



2 pieces of string, 100 cm each

Procedure

1. Tie one end of each piece of string to one of the spoons.
2. Wrap the other end of each piece of string around one of your index fingers. One finger on each hand should be wrapped with a string. Gently place the wrapped fingers in your ears.
3. Let the spoons hang freely. Have a partner **measure** the string lengths between your fingers and the spoon. Wrap more string around your fingers until the lengths are 75 cm each.
4. Have your partner gently tap the spoon with the other spoon. **Record** your observations.
5. Repeat Steps 2, 3, and 4, but shorten the string lengths to 50 cm.
6. Repeat Steps 2, 3, and 4, but shorten the string lengths to 25 cm.

Length of String	Observations
75 cm	Tapping the spoon produces a ringing sound.
50 cm	The ringing sound is higher.
25 cm	The ringing sound is even higher.

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Name _____

Investigate Log

Draw Conclusions

1. What did you hear in Step 4 of the activity?
   Students should have heard a ringing sound.

2. Did the sound change when you shortened the strings? If so, how?
   The sound should have been higher with shorter strings.

3. **Inquiry Skill—*Identify Variables*** Before scientists conduct an experiment, they must **identify the variables** to be tested. What variable did you test in this activity?
   length of the string

Inquiry Skill Tip

When you **identify variables** in an investigation, you think about all of the properties you could observe and all of the measurements you could make. You then test one of these variables by changing it and observing the results.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used the meterstick to measure the length of the string.			
I **identified the variable** that I tested in the activity.			

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Date _____

Investigate Log

Independent Inquiry

Plan and conduct a simple experiment to find out if the sound changes with plastic objects instead of metal spoons.

Materials

Here are some materials that you might use. List additional materials that you need.

- **2 pieces of string, 100 cm each**
- **2 metal spoons**
- **meterstick**

1. What will you test in your experiment?

Students will test the sound made when the metal spoons used in the Investigate are replaced by plastic objects. They will compare this to their previous observations.

2. Record your observations in the table below.

Length of String	Observations
75 cm	**Tapping the plastic produces a dull, thud-like sound.**
50 cm	**The thud-like sound is slightly higher.**
25 cm	**The thud-like sound is even higher.**

3. Compare the sounds you hear with the plastic objects and the sound you hear with the metal spoons.

The metal spoons produce a ringing sound. The plastic objects produce a duller sound. Both the metal and plastic sounds get higher as the strings get shorter.

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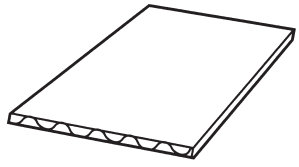
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Investigate Log

The Path of Reflected Light

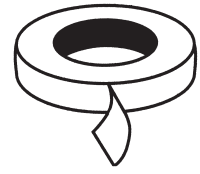
Materials



piece of corrugated cardboard, 10 cm × 10 cm



3 pushpins of different colors



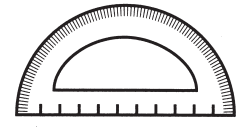
masking tape



small mirror



ruler



protractor

Procedure

1. Lay the cardboard flat, and use tape to stand the mirror vertically at one end of the cardboard. Push two of the pins into the cardboard, about 5 cm in front of the mirror.
2. Position yourself at eye level with the pins. Align yourself so that your view of one pin lines up with the reflection of the other pin. Push a third pin into the cardboard, at the edge of the mirror, right in front of where you see the reflection. The first pin, the third pin, and the reflection of the second pin should appear to be in a straight line.
3. Draw lines on the cardboard to connect the third pin with the others. These lines show how the light from the second pin traveled to your eye.
4. Draw a line along the front of the mirror, and remove the mirror from the cardboard. Using the protractor, **measure** the angle between each line and the edge of the mirror. **Record** your results.

Results will vary, but the angles should have the same measure.

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Name _____

Investigate Log

Draw Conclusions

1. **Compare** the two angles you **measured**.

The measures of the angles should be the same.

2. **Inquiry Skill—*Predict*** Suppose you know the angle at which light hits a mirror. **Predict** the angle at which the light will reflect.

Students should predict that the angle of reflection will be the same as the given angle.

Inquiry Skill Tip

When you **predict** what will happen in an investigation, don't just guess. Based on your observations and what you already know, decide what is the most reasonable thing that will happen.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used the protractor to measure the angle between each line and the edge of the mirror.			
I **predicted** the angle at which light will reflect if you know the angle at which it hits a mirror.			

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Date _____

Investigate Log

Independent Inquiry

Predict how light will be reflected by a mirror that isn't flat. Then plan and conduct an experiment to test your prediction.

Materials

Here are some materials that you might use. List additional materials that you need.

- piece of corrugated cardboard, 10 cm by 10 cm
- 3 pushpins of different colors
- masking tape
- ruler
- protractor
- curved mirror

1. What is your prediction about how light will be reflected by a mirror that isn't flat? Students should predict how the images in the convex and concave mirrors will be different from the image reflected in the flat mirror.

2. Describe your observations.
Answers will depend on the mirrors that students test and the distance from the mirror. If they test a convex mirror, they may find that the image size is increased. If they test a concave mirror, they may find that the image size is decreased.

3. Did your results agree with your prediction? Explain.
Students should describe whether their predictions and results match. They may describe how the curved mirror changes the size of the image.

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Date _____

Unit Inquiry Log

Unit F

Modern Rocket Stages

1. Observe and Ask Questions

Does the arrangement of the stages of a rocket affect how far the rocket will travel? For example, will a rocket with stages arranged on top of each other travel farther than a rocket with stages arranged side by side? Make a list of questions you have about the arrangement of rocket stages.

Will a rocket with stages that are side by side travel farther than a rocket with stages arranged on top of each other?

2. Form a Hypothesis

Write a hypothesis. A hypothesis is a scientific explantion that you can test. You must be able to test the hypothesis.

A rocket with stages that are side by side will travel farther than a rocket with stages arranged on top of each other.

3. Plan an Experiment

To plan your experiment, you must first identify the important variables. Complete the statements below.

Identify and Control Variables

The variable I will change is

the arrangement of stages in a model rocket.

The variable I will observe or measure is how far each rocket travels on the same amount of fuel (the volume of air in the balloons).

The variables I will keep the same, or *control*, are the total volume of air in each fuel cell (balloon), and the slope of the fishing line and how tightly it is drawn.

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Name _____

Unit Inquiry Log

Develop a Procedure and Gather Materials Write the steps you will follow to set up an experiment to test two model rockets.

1. For the first model, use the pump to inflate two balloons with the same volume of air. Tightly close the balloons.
2. Carefully tape the balloons to each other (or side by side) and to the straw so they are all parallel to each other, with the straw sandwiched in the middle.
3. Thread the straw onto the piece of fishing line. Line up the side-by-side balloons at the starting line.Release the balloons at the same time.
4. Observe the rocket. Use the meterstick to measure the distance it traveled.
5. For the second model, use the pump to inflate the other two balloons. Tightly close the balloons.
6. Cut the foam cup in half horizontally to produce a ring. Tuck the neck of one of the balloons through the ring. Keep the neck of this balloon twisted as you insert the ring and the first balloon neck about midway up the second balloon. The pressure from the second balloon against the foam ring will hold the first balloon in place and closed. The first balloon should be mounted behind the second balloon, with the twisted neck held in place by the cup ring. Tape both balloons to a straw.
7. Thread this model rocket onto the piece of fishing line. Line up the balloons at the starting line.
8. Release the second balloon. Observe the rocket. Measure the distance this rocket traveled.

Use extra sheets of blank paper if you need to write down more steps.

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Materials List Look carefully at all the steps of your procedure and list all the materials you will use.

4 balloons, bicycle pump, straws, scissors, small foam cup, fishing line, tape, meterstick

Name _____

Unit Inquiry Log

4. Conduct the Experiment

Make Observations Follow your plan and make careful **observations**. Use the space below to draw and label your two model rockets. Below the drawings, **summarize** your **observations**.

Rocket with Two Stages Side by Side

Rocket with Two Stages One Behind the Other

Observations

Students will observe that the model rocket whose stages are mounted one on top of the other travels farther with the same volume of fuel (air) than the model rocket whose stages are in a side-by-side arrangement.

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Name _____

Unit Inquiry Log

5. Draw Conclusions and Communicate Results

Compare your hypothesis with your observations, and then answer these questions.

1. Based on your results, do your observations support your hypothesis? Explain.

Students should use their observations to support or revise their hypotheses.

2. How would you revise the hypothesis? Explain.

Students may revise their hypotheses so that they match the observations made in this experiment.

3. What else did you **observe** during the experiment? Encourage students to use their notes and be as specific as possible. One observation might be that the model rockets traveled forward because of the air escaping from the necks of the balloons.

Prepare a presentation for your classmates to communicate what you have learned. Demonstrate your two model rockets.

Investigate Further

Write another hypothesis that you might investigate.

Answers will vary but might include investigating how far one large rocket will travel when compared with several smaller rockets with the same arrangement of stages.

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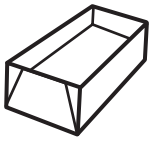
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Investigate Log

On a Roll

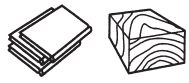
Materials



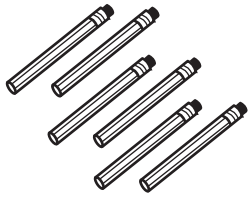
shoe box without a lid



20-cm piece of string



blocks or other heavy objects



unsharpened pencils



spring scale

Procedure

1. Punch a small hole in one end of the box, near the center.
2. Thread the string through the hole. Tie the string to itself. You should be able to pull the box by the string.
3. Place some blocks, weights, or other heavy objects in the box.
4. Line up the pencils on a tabletop. The pencils should be close to one another but not touching. Keep the pencils parallel.
5. Place the box on a smooth, flat surface. Attach the string to the spring scale, and use the scale to pull the box. **Observe** the amount of force you must use to move the box.
6. Place the box on the array of pencils. Pull it again. **Observe** the amount of effort you must use to move the box.

Setup	Force (N)
Box sliding directly on the table	
Box sliding on the pencils	

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Investigate Log

Draw Conclusions

1. Is the box easier to move with the pencils or without them? Why?

It's easier to pull with pencils; when the box rolls, there is less friction than there was between the table and the box.

2. **Inquiry Skill—*Communicate*** Scientists **communicate** to share ideas. Why does putting wheels on heavy objects make them easier to move?

Rolling friction eliminates one surface from sliding along another surface while still allowing movement.

Inquiry Skill Tip

Scientists rely on good communication to share ideas and to learn from the experiences of others. When you **communicate** the results of an investigation, you should describe your results and explain what you believe the results mean.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for arranging the box and the pencils.			
I used the spring scale to measure the force required to pull the box.			
I was able to **communicate** why putting wheels on heavy objects makes the objects easier to move.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Investigate to compare the amounts of force needed to move the box on different surfaces. What kind of surface makes the box easiest to pull?

Materials

Here are some materials that you might use.
List additional materials that you need.

- **shoe box without a lid**
- **blocks or other heavy objects**
- **20-cm piece of string**
- **unsharpened pencils**
- **spring scale**

1. What will your investigation test?

Students may say that they will use the spring scale to measure the force required to pull the box across different surfaces, such as sandpaper, carpet, wax paper, foil, newspaper, and asphalt.

2. Use the data table below to record your measurements.

Surface	Force (N)

3. What conclusion can you draw from your investigation?

Possible answer: Less force is required to move the box across smooth surfaces than across rough surfaces.

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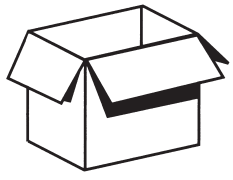
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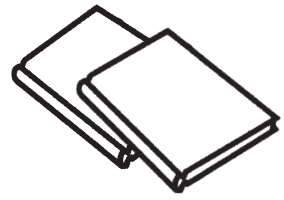
Investigate Log

Predict the Force

Materials



medium-size cardboard box



2 books



2 spring scales

Procedure

1. Place the cardboard box on a flat surface such as a table or on the floor.
2. Hook the first spring scale to one side of the empty box. Gently pull the spring scale until the box begins to move. **Record** the force as the box begins to move.
3. Repeat Step 2 with one book placed inside the box. **Record** the force. Repeat Step 2 with both books placed inside the box. **Record** the force. Remove the books from the box.
4. Attach the second spring scale to the opposite side of the empty box. Gently pull the box, using the first spring scale. **Predict** the amount of force needed to stop the movement of the box.
5. Have a partner pull in the opposite direction with the second spring scale. **Record** the force shown on the second spring scale as the box stops moving.
6. Repeat Steps 4 and 5 with one book and then two books inside the box.

Balanced and Unbalanced Forces			
	1st Spring Scale	Prediction	2nd Spring Scale
Empty box			
Box with 1 book			
Box with 2 books			

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Name _____

Investigate Log

Draw Conclusions

1. What was the amount of force needed to move the box? What was the amount of force needed to stop the box?

Possible answer: Answers will vary depending on the size of the box and books used.

2. **Inquiry Skill**—Scientists **infer** to explain events. What can you **infer** about the amount of force needed to stop the box's movement?

It is the same as the amount of force needed to move the box.

Inquiry Skill Tip

Think carefully about the results of an investigation before you **infer** an explanation. Ask yourself, "What caused this to happen?" "What does this mean?" and "Why did I get these results instead of other results?"

Investigate Self-Assessment	Agree	Don't Know	Disagree
I followed directions to carry out the Investigate.			
I accurately read the spring scale.			
I recorded my results.			
I interpreted my data to make inferences about the force needed to cause an object to move and to stop.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

What would happen if you used two spring scales on one side of a box and one spring scale on the opposite side? Plan and conduct a simple investigation to find out.

Materials

- medium-size cardboard box
- 2 books
- 3 spring scales

1. Place the cardboard box on a flat surface such as a table or on the floor.
2. Attach two spring scales to one side of the box. Attach the third spring scale to the opposite side of the empty box. Gently pull the box, using the two spring scales. Predict the amount of force the third scale will need to stop the movement of the box.

   Possible answer: Students may predict that the third scale will need to exert the same force as the force applied by both of the other scales added together.

3. One person should pull with the first two spring scales, while the partner should pull in the opposite direction with the third spring scale. Record the force on the third spring scale as the box stops moving.
4. Repeat Steps 2 and 3 with one book and then two books inside the box.

Object	Force of Spring Scale #1 + Spring Scale #2	Force of Spring Scale #3
Empty box		
Box with 1 book		
Box with 2 books		

5. Summarize your findings. How did applying force with two spring scales affect the amount of force you needed to apply with the third in order to stop the box?

   Possible answer: I needed to apply the same amount of force with the third spring scale as was applied with the first two combined.

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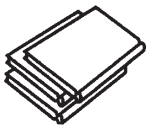
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Investigate Log

Lifting Things the Easy Way

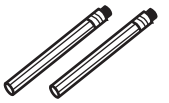
Materials



several small books



ruler



2 unsharpened pencils

Procedure

1. Stack several small books, at one edge of your desk.
2. Slide your little finger under the stack.
3. Keep your hand palm up, and move just your little finger to lift the stack of books as far as you can.
4. Stack more books, and repeat Steps 1–3 until you can barely lift the stack with your little finger. **Observe** and **measure** how far you can raise the stack of books.
5. Now make a lever. To do this, put an unsharpened pencil under your stack. Put another unsharpened pencil under and at right angles to the first pencil.
6. Lift the books by pressing down on the outer end of the top pencil with your little finger. **Observe** and **measure** how high you can lift the books.

Method of Lifting	Height Books Were Lifted
With finger only	
With pencil lever	

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Name _____

Investigate Log

Draw Conclusions

1. Did you use more force when you lifted the books with only your finger or when you used your pencil lever?

More force was used when only the little finger was used.

2. **Inquiry Skill—*Predict*** Scientists **predict** to understand what might happen in a situation, based on observations. What do you **predict** would happen if you lifted the books with a meterstick?

Possible answer: It would take less force to lift the books with a meterstick because it is a longer lever than the pencil.

Inquiry Skill Tip

When you **predict** what will happen in an investigation, you should do more than just guess. Look for patterns and causes that will help you decide what is most likely to happen.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I followed the directions for this investigation.			
I used the ruler to measure how high I was able to lift the books.			
I **predicted** what would happen if I lifted the books with a meterstick.			

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Name _____

Date _____

Investigate Log

Independent Inquiry

Explore how levers work by comparing distances between the load end and the other end of levers of different lengths.

Materials

Here are some materials that you might use.
List additional materials you need.

- several small books
- 2 unsharpened pencils
- ruler

1. Predict the results of your investigation.

Students may predict that the farther an object is from the end of a lever, the more the lever has to move to lift the object a given height.

2. Draw a data table in the space below. Record the results of your investigation in the data table.

3. What can you conclude about the distance between an object and the end of a lever?

Possible answer: The farther away an object is from the end of a lever, the more the lever has to move to lift the object a given height.

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Name _____

Date _____

Investigate Log

Changes in Motion

Materials



clear, 1-L plastic bottle with cap



water



small piece of soap

Procedure

1. Fill a bottle with water, but leave just enough space for a small air bubble. Add a small piece of soap. Cap the bottle tightly.
2. Lay the bottle on its side on a flat surface. You should see one small bubble in the bottle. Hold the bottle steady until the bubble moves to the center of the bottle and stays there.
3. **Predict** what will happen to the air bubble if you turn the bottle to the left or right. Turn the bottle, and **observe** what happens. **Record** your observations.
4. Repeat Step 3, but this time, move the bottle forward at a steady speed.
5. Repeat Step 4, but this time, increase the speed.

Action	Prediction	Observation
Move the bottle		The bubble moves in the direction that the bottle moves.
Move the bottle at a steady speed		The bubble moves at a steady speed in the direction that the bottle moves.
Move the bottle at an increased speed		The bubble moves quickly in the direction that the bottle moves.

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

To make it easier to **infer** why something happens, write a description of the conditions before and after the action occurs.

1. **Compare** the results of all these types of movement with one another. Were they similar to or different from one another?

The bubble moved in the same direction as the bottle was turned. A change in speed caused the bubble to move in the direction of the change. The movements were the same because the bubble always turned in the direction of the change.

2. **Inquiry Skill—*Infer*** Scientists often form inferences to explain why something happened. **Infer** why the bubble moved the way it did.

Students should infer that the bubble moves in reaction to the water. As the bottle moves, the water tends to stay where it is at first, pushing the bubble in the direction of the movement.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I turned the bottle according to the directions for this investigation.			
I was careful to cap the bottle tightly.			
I **inferred** why the bubble moved the way it did.			

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Date _____

Investigate Log

Independent Inquiry

Hypothesize what will happen to the air bubble if the bottle is moving at a steady speed and its direction changes. Plan and conduct a simple investigation to test your hypothesis.

Materials

- clear, 1-L plastic bottle with cap
- water
- small piece of soap

1. Write your hypothesis for the investigation.

Students may hypothesize that the air bubble will move in the direction that the bottle moves.

2. Use the table below to record your observations. Try the same action several times.

	Action	What happens to the air bubble?
1		
2		
3		

3. Did your investigation support your hypothesis? Explain.

Answers will vary, depending on what students hypothesize and how they conduct their investigations. Students should find that the bubble moves in the direction of the change in movement.

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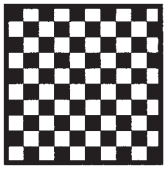
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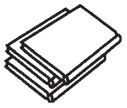
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Investigate Log

Momentum Crash Test

Materials


game board


several books


meterstick


small toy car


dime



quarter

Procedure

1. Make a ramp by setting one end of a game board on a stack of books about 15 cm high. Place another book as a barrier about 10 to 15 cm from the bottom of the ramp. Be sure the barrier is lower than the front end of car.
2. Put the car at the top of the ramp. Put a dime on the front end of the car. Let the car roll down the ramp and hit the barrier. **Observe** what happens to the dime. **Measure** and **record** the dime's distance from the barrier. Repeat several times.
3. Repeat Step 2, but use a quarter. Repeat several times.
4. **Predict** how the results would differ if you make the ramp higher. Add another book to the stack under the ramp. Repeat Steps 2 and 3 several times. Was your prediction correct?

	Distance Between Dime and Barrier (cm)	Distance Between Quarter and Barrier (cm)
Low ramp trial #1		
Low ramp trial #2		
Low ramp trial #3		
High ramp trial #1		
High ramp trial #2		
High ramp trial #3		

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Name _____

Investigate Log

Draw Conclusions

Inquiry Skill Tip

When you do an investigation, you need to identify and **control variables**. Check your setup to make sure that everything stays the same except the variable you are testing.

1. Put your data in the table. **Compare** data for the dime with data for the quarter. How does a coin's mass relate to the distance it travels?

   The quarter traveled farther than the dime. Students should infer that the greater the coin's mass, the farther it traveled.

2. What happened when you made the ramp higher? **Infer** why this happened.

   Both coins traveled farther. Making the ramp higher increases the car's velocity, which increases the momentum of the coins.

3. **Inquiry Skill—*Control Variables*** What was the **controlled variable** in Steps 2 and 3? What was the tested variable?

   The controlled variable was the ramp and barrier setup. The tested variable was the mass of the coins.

Investigate Self-Assessment	Agree	Not Sure	Disagree
I set up the ramp and ran the car according to the directions for this investigation.			
I used the meterstick according to the instructions for this investigation.			
I identified and **controlled variables** within the investigation.			

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Date _____

Investigate Log

Independent Inquiry

Experiment with several ways of keeping the coin on the car when it strikes the barrier. Conduct several trials for each method that you test.

Materials

Here are some materials that you might use.
List additional materials that you need.

- **game board**
- **meterstick**
- **dime**
- **several books**
- **small toy car**
- **quarter**

1. What are you testing in this investigation?

Answers will vary, depending on the choices students make for ways to secure the coin.

2. Use the table below to record your observations.

	Results		
	Method #1: _____	Method #2: _____	Method #3: _____
Trial #1			
Trial #2			
Trial #3			

3. What conclusions can you draw from this investigation? Answers will vary, depending on results. Students may note which materials worked better in securing the coin or how the position of the coin influenced the results. Students may find that the coin stays on the car better if it can be held more tightly (a rubber band may hold more tightly than string) or if it is held by a material that doesn't slide (such as clay or tape).

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Science Fair Project Ideas

Giant Cell

After you have studied the parts and processes of a cell, observe diffusion and osmosis through a chicken egg. You can dissolve the shell of the egg by using vinegar. The cell membrane will be exposed and will allow materials to move across it. Experiment to see what materials move into the egg and what materials cause cytoplasm to move out.

Twigs Tell the Story

After studying how plants are classified, design your own system to sort and classify plants by using twigs and leaves. Once you have set up your own system, you will use classification guide books to compare your system to the accepted classification scheme.

Look-Alikes

After studying heredity, observe how traits are passed from one generation to the next. Choosing an observable trait, such as tongue rolling or folded hands, you can trace this trait through two or three generations of a family.

Next Generation

After you have learned about plant reproduction, design your own experiments to sprout seeds from different kinds of fruits. Determine what conditions are necessary to initiate germination.

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Science Fair Project Ideas

Plants in a Bag

After studying the nitrogen, carbon–oxygen, and water cycles, you can do an experiment to see if plants can survive in a closed system. You should grow bean or pea plants. Test what happens to the growth of a plant if it's sealed in a plastic bag. Determine which cycles continue inside the bag and which are interrupted.

Bring the Outside Inside

After studying the interactions of living organisms, you can design an experiment in which you will monitor an ecosystem near your school. Outside observations can continue until the weather becomes too cold. Then cut out part of the ground, plant it in a plastic tub, and bring it into the classroom. You can compare the growth of the "inside" and "outside" ecosystems.

Life in a Biome

After studying biomes, you can study your own biome, analyzing the climate, the plants, and the animals. Hypothesize what would happen if these plants and animals were taken out of this biome and placed in a biome 500 miles farther north. Use a refrigerator or freezer to simulate this new biome.

People, Plants, and Pollution

After studying ecosystems, you can experiment to see the effect pollution has on plant growth. You can grow bean and pea plants. Once the plants have started growing, you can observe what happens when soapy water is used to water the plants.

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Science Fair Project Ideas

Change in the Neighborhood

Find places in your neighborhood to observe for several months. Locate permanent landmarks for frames of reference. Using as many senses as possible, you can observe the areas weekly. Note any changes that occur, and whether the changes are natural or caused by humans.

Homegrown Rocks

After studying the rock cycle, you can gather and identify the rocks found in your area. Make a key to help identify these rock samples.

Weather Prediction

Make weather observations for several weeks, using your own weather instruments or using information from other sources. Then predict the weather for the next week. Note which weather factors are most helpful in making a prediction.

Saltwater Density

After studying the differences in ocean currents, make a hydrometer to measure the densities of fresh water and salt water. (A simple hydrometer can be made with a straw and a large paper clip. Fold one end of the straw several times and clip it with the paper clip. Use a permanent marker to calibrate the straw.) Once you have made your hydrometers, you can test solutions of varying densities. You can also demonstrate density differences by placing a raw egg (in its shell) in fresh water and in salt water.

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Science Fair Project Ideas

Weigh-In

Compare the gravitational forces of Earth and the other planets of the solar system. Using this information, compute your weight on different planets. Then predict how each planet's gravity would affect your abilities to jump and run. Make graphs to show your predicted results.

Shadows, Time, and Seasons

After studying the sun, you can compare your actual height and the lengths of your shadow during different times of the day and different seasons of the year. You will need to discuss various ways to control variables so that you can fairly compare change over time. Graph your results and look for seasonal trends.

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Science Fair Project Ideas

A Change Due to Weather?

Design an experiment that will model acid rain's effect on building materials. You should gather materials such as roofing tiles; metal, wood, or vinyl siding; and marble window sills. Various mixtures of vinegar and water can be used to represent acid rain. You can use real rain from your area as one of the test solutions.

Conductors and Insulators

After you have learned about some of the properties of metals and nonmetals, design a test for electric conductivity. Using an open circuit as the testing device, gather and test a variety of materials. Once data has been gathered, check the results by identifying the material's placement on the periodic table.

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Science Fair Project Ideas

Toy Force

After you have learned about magnetism and balanced forces, gather and study toys which use magnetism. Then make your own magnetic toys. Your toys may be modifications of existing toys, or totally new ideas.

Balls and Bats

After you have studied the principles of motion, compare several sports balls. You can compare the distances different balls travel when hit with the same kind of bat. Research the "liveliness" of materials used in different balls. Graph your results.

Electric Quiz Board

After you have studied electric circuits, design your own quiz boards. Your quiz boards should light up when completed circuits are made by matching correct answers and questions.

Are We Running Out?

Compare the current use of different fossil fuels using a graph. Then predict remaining amounts for each type of fuel.

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