#1 Going Green with Groceries

Background Information

According to the U.S. Environmental Protection Agency, each person in the United States throws away almost 4.5 pounds of trash per day. About one-third of that trash is packaging, mostly in the form of paper and plastics.

Time Required

30 minutes outside the classroom, plus **1** to **1.5** class periods to complete the activity

Objectives

- Observe the packaging associated with some grocery store items.
- Discuss the purpose of the packaging.
- Suggest ways to reduce the amount of packaging associated with a trip to the grocery store.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

computers and Internet access

triple beam balances

FOR EACH STUDENT

1 pair non-latex gloves

science notebook

Vocabulary

going green adopting practices that reduce your overall impact on the environment

packaging the wrapping or covering material(s) used on a product

recycling using items over and over, or turning old products into new ones

SAFETY INFORMATION

Students should go to the store only with a responsible adult family member. If you choose to carry out the Explore More part of this activity, provide students with non-latex gloves to use to sort through the packaging materials.

#1 Going Green with Groceries continued

Procedure

A OBSERVE AND RECORD

Review the vocabulary terms with students.

Have students make a list of 20 items. If students are unable to go to the store, have them survey the groceries brought into their houses. Alternatively, have them use the Internet to find photos of grocery store items and their packaging.

If necessary, walk students through the steps of using the computer to create a data table. If computers are not available, have students draw and complete the tables in their science notebooks. Remind students to eliminate any duplicate items from their lists when compiling the items into the table. A sample table "Going Green at the Grocery Store" is shown below.

B QUESTION

Students should be able to infer that packaging is used to contain, display, advertise, and protect the products from contamination, spoilage, and damage. In grocery stores, packaging is also used to provide nutritional information.

C PLAN

You might want to discuss the packaging of items such as toys and games.

D EXPLORE MORE

Tell students at least one week in advance that they should bring food packaging from one family trip to the grocery store. You might want to participate in this exercise as well by bringing in your own packaging. Also, have extra bags of packaging available for those students who are unable to bring their own.

Students should rinse off any food from the packaging and clean it with soap and water if necessary. Combine the packaging and determine the mass of all of the materials that were brought to class. Then have students divide this by the number of students in the class to get an average mass. Show students how to use a triple beam balance.

Discuss with students ways that their families can "go green" at the grocery store. For instance, they might say that they could buy food in bulk and stay away from single-serving items.

E ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Going Green at the Grocery Store

Item	Type of Packaging	Reason for the Packaging	A Greener Alternative
Mixed, chopped up lettuce	Plastic bag	To protect the food; to make the food convenient	Buy head of lettuce without packaging
Individual servings of applesauce	Plastic cups, foil lids, and cardboard holder	To create six servings	Buy large jar of applesauce
Cherry tomatoes	Plastic mesh container with plastic wrap	To protect the food	Buy several large tomatoes without packaging

#1 Going Green with Groceries continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: some sort of plastic, such as produce bags and plastic containers, bottles, and jugs
2. Answers will vary. Sample answer: Much of the packaging used is unnecessary. For example, many people put their meats, which are already sealed with plastic, into plastic produce bags. If the package isn't leaking, the second bag isn't needed. Many people also put bunches of bananas into plastic bags. Since the pieces of fruit are joined and will not roll around, the plastic bag isn't needed.
3. Answers will vary. Sample answer: buying in bulk rather than choosing single-serving sized packages; using cloth and other reusable bags to carry groceries, rather than those provided at the checkout line; not putting items in plastic bags that are already wrapped (such as iceberg lettuce); choosing products with little or no packaging; refusing bags for large items, such as milk and large potato chip bags; buying products packaged in easily recyclable materials; and buying concentrated refills for cleaning products

Quiz Answer Key

1. C
2. to contain, display, advertise, and protect the products being sold
3. Answers will vary. Sample answer: Single-sized servings that are bundled as one unit generally use the most packaging.
4. Most paper, some plastics (such as for that used for water bottles, labeled #1), glass, steel, and aluminum are easily recycled. Foam is not easily recycled.

Name ______________________________ Date ____________ Class ____________

#1 Going Green with Groceries

Quiz

1. What does the phrase “going green” mean?
A. using only green-colored products
B. buying only green-colored foods
C. reducing your impact on the environment
D. using many layers of packaging to protect a product

2. What are the purposes of the packaging materials used in grocery stores?

____

____

____

____

3. Which types of foods generally use the most packaging?

____

____

____

____

4. In your neighborhood, which types of packaging are easily recycled? Which types of packaging cannot be recycled?

____

____

____

____

____

____

Name ______________________ Date ____________ Class ____________

#1 Going Green with Groceries

Procedure

A OBSERVE AND RECORD

1. Go to the grocery store with an adult in your family.
2. Observe how foods and other items in the store are packaged.
3. In your science notebook, make a list of 20 items and describe how they are packaged. Make sure to include items in the produce section, as well as items in every aisle. Don't forget to include dairy and other refrigerated products on your list, too.
4. Compare the items on your list, and their packaging, with the items on the lists of two other students. Then use a word processing program to combine your lists into one data table. Your table should be similar to the one shown. Be sure to include enough rows for all the items, but do not include duplicates.

B QUESTION

5. Why are the items listed in your data table packaged the way they are? For example, you might decide that eggs are in cartons to prevent breakage while they are transported to the store and that cartons prevent the eggs from rolling around in the refrigerator.

C PLAN

6. Discuss ways to reduce or eliminate the packaging of each item in your table. Record your suggestions in the last column of the data table. Discuss other items and their packaging.

D EXPLORE MORE

1. Save all of the packaging that results from one trip to the grocery store with your family. This will likely include boxes, bags, wrappers, cans, bottles, and other containers. Rinse off any food from the packaging, and clean the packaging if necessary. Bring the packaging to school.
2. Find the mass of all the packaging material. Sort out any packaging that can be recycled. Then find the mass of the remaining packaging.
3. With the class, discuss ways to reduce this amount even more on your family's next trip to the grocery store.

Name ________________________________ Date ______________ Class ______________

#1 Going Green with Groceries continued

Going Green at the Grocery Store

Item	Type of Packaging	Reason for the Packaging	A Greener Alternative

Name ______________________ Date ____________ Class ____________

#1 Going Green with Groceries continued

E ANALYZE AND CONCLUDE

1. According to your table, what type of packaging is used the most?

2. Are all the packaging materials used for the items in your data table really needed? Explain your answer.

3. Name at least five ways that you and your family can reduce the amount of packaging when you buy groceries.

#2 Investigating Nutrition Labels

Background Information

What is a "serving"? Since 1990, due to the implementation of the Nutrition Labeling and Education Act, food products are required to have certain information on the box, can, or other container to help consumers understand the contents. One such piece of information is the serving size. Each package must identify the size of a serving as well as the approximate number of servings per package. With this, the nutritional breakdown can be figured based on the amount per serving, not per package.

It is easy to miscalculate a serving size when judging it by sight alone. It is also easy to assume a serving is larger than it actually is.

The Nutrition Facts label includes other important information, such as number of calories, calories from fat, sodium, carbohydrates, sugars, and protein.

Time Required

1 class period

Objectives

- Predict how much of a particular food is a "serving."
- Observe and record predicted amount.
- Compare predicted amount to actual amount as listed on the Nutrition Facts label.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

several boxes of cereal (enough for entire class) in which a serving is 1 cup (250 mL), with Nutrition Facts labels covered

several measuring cups showing various capacities

several metric platform scales

FOR EACH STUDENT

1 disposable cereal bowl

1 calculator, optional

Vocabulary

calorie a measure of the energy in food

consumer a living thing that obtains energy through a food source

nutrition provides everything a living thing needs to grow

#2 Investigating Nutrition Labels continued

Procedure

A PREDICT

Share information regarding the requirement that commercial foods must have nutritional information on their labels. Ask students if they have ever noticed this before when eating pretzels, cereal, or other packaged foods. Review the vocabulary. Cover up the Nutrition Facts labels on the cereal boxes. Make sure that a serving size for the cereal is 1 cup.

B OBSERVE AND RECORD

After students have weighed their serving in grams and recorded the weight, remove the covering from the Nutrition Facts labels. Then have students record in the data table the actual size and amount of grams that should be in one serving.

Tell students that people easily misjudge the amount in a serving and that knowing and following the suggested serving sizes on labels might change the health of consumers. Discuss why Nutrition Facts label information is important.

C ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Student Sheet Answer Key

1. Answers will vary.
2. Answers will vary. Sample answer: People who have larger appetites might think a serving is larger than it really is.
3. Answers will vary. Sample answer: Following serving sizes on labels will help a consumer better balance their meals. They also might keep from eating too much sugar or fat.

Quiz Answer Key

1. A
2. a measure of the energy in food
3. on the Nutrition Facts label found on a box, can, or other food container
4. Answers will vary. Sample answers can include calories, serving size, calories from fat, sugars, carbohydrates, and sodium.
5. Answers will vary. Sample answer: It can help people plan more balanced meals.
6. Answers will vary. Sample answer: A company can measure, weigh, and examine its product frequently to make sure the information stays accurate.

Name ______________________________ Date ____________ Class ____________

#2 Investigating Nutrition Labels

Quiz

1. A consumer is a living thing that
A. gets energy by eating other living things.
B. breaks down dead plants and animals.
C. makes its own food by photosynthesis.
D. gets its energy from heat vents beneath the ocean.

2. A calorie is ______________________________.

3. Where can a consumer find information about the nutritional contents of a serving of food?

____

____

____

4. What are two types of information you can find on a Nutrition Facts label?

____

____

5. Why do you think it is helpful to be familiar with the Nutrition Facts label?

____

____

____

____

6. What can a company do to make sure its Nutrition Facts labels are accurate?

____

____

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#2 Investigating Nutrition Labels

Procedure

A PREDICT

Have you ever poured yourself a bowl of cereal? How much do you put into the bowl? Your teacher will provide you with a box of cereal with the Nutrition Facts label covered. Pour yourself what you think is one serving.

B OBSERVE AND RECORD

1. Use a measuring cup to see how many cups (or fraction of a cup) your serving is. Write your answer in data table. On the scale, weigh your serving in grams, and record the weight. Now look at the cereal box with the cover removed from the label. Record the actual size and amount of grams that are in one serving according to the label.

2. Record the number of calories in a serving (without milk) as listed on the Nutrition Facts label.

3. Calculate how many calories are in your serving. Do this by following these steps:

If your serving is larger than an actual serving:

- Divide the number of grams in an actual serving into the number of grams in your serving.
- Multiply the answer by the amount of calories of an actual serving.
- This answer will be the number of calories in your serving. Record your answer in the data table.

If your serving is smaller than an actual serving:

- Divide the number of grams in your serving into the number of grams in an actual serving. The answer will be a fraction (or a decimal).
- Multiply the answer by the amount of calories in an actual serving.
- This answer is the amount of calories in your serving. Record your answer in the data table.

4. To weigh 1 cup of cereal, pour it into the platform scale's pan. Then see if the amount of grams you find matches the amount listed on the Nutrition Facts label. This will let you know if the information on the label is accurate.

A serving of cereal, as weighed by me, is ______________________ grams. Is this the same as what is given on the box? If not, what is the difference in grams?

____

____

According to your findings, is the weight of one serving as listed on the Nutrition Facts label accurate?

____

Name ______________________________ Date ____________ Class ____________

#2 Investigating Nutrition Labels continued

What Is a Serving?

	Serving Size, in Cups	Serving Size, in Grams	Number of Calories
My serving			
Nutrition Facts label serving			

Name ______________________ Date ____________ Class ____________

#2 Investigating Nutrition Labels continued

C ANALYZE AND CONCLUDE

1. Compare your predicted serving size with those of two or three other students. How did their servings compare with yours? How many were larger? How many were smaller? How many were the same size?

2. Why do you think people have different ideas about the size of a serving?

3. How might knowing and following serving sizes on labels be helpful to the consumers who buy the product?

#3 think box

Background Information

In science, many objects or concepts cannot be observed directly. As a result, much of the knowledge gained about these objects or concepts is inferred. An inference is an educated guess that is based on careful observations. For example, scientists who study dinosaurs cannot examine live animals, only their skeletons. They must make inferences about each species' outer appearance based on observations of their skeletons and an understanding about the bodies of modern animals.

In this activity, students will use a Think Box to infer how strings are connected inside the box. They will make their inferences by observing what happens when various beads attached to the strings are pulled under specific conditions.

Time Required

1 class period

Objectives

- Manipulate strings of a Think Box to observe how pulling on different strings affects other strings.
- Use the results to infer how the strings are connected.

Materials *Materials available at www.carolina.com*

PREPARATION

1 small shipping box per group; 12 in. x 4 in. x 4 in. (sizes may vary, but length should be at least twice the width; i.e., long and narrow)

2 1-m pieces of string per group

4 1.9-cm diameter, drilled wooden beads, each of a different color (e.g., red, green, blue, orange); 1 set per group

1 3-cm metal washer per group

masking tape

FOR THE TEAM

1 Think Box

colored pencils

FOR EACH STUDENT

metric ruler

science notebook

Vocabulary

inference a conclusion made about something that cannot be seen based on something that can be seen

observation information that is learned by using the senses

#3 think box continued

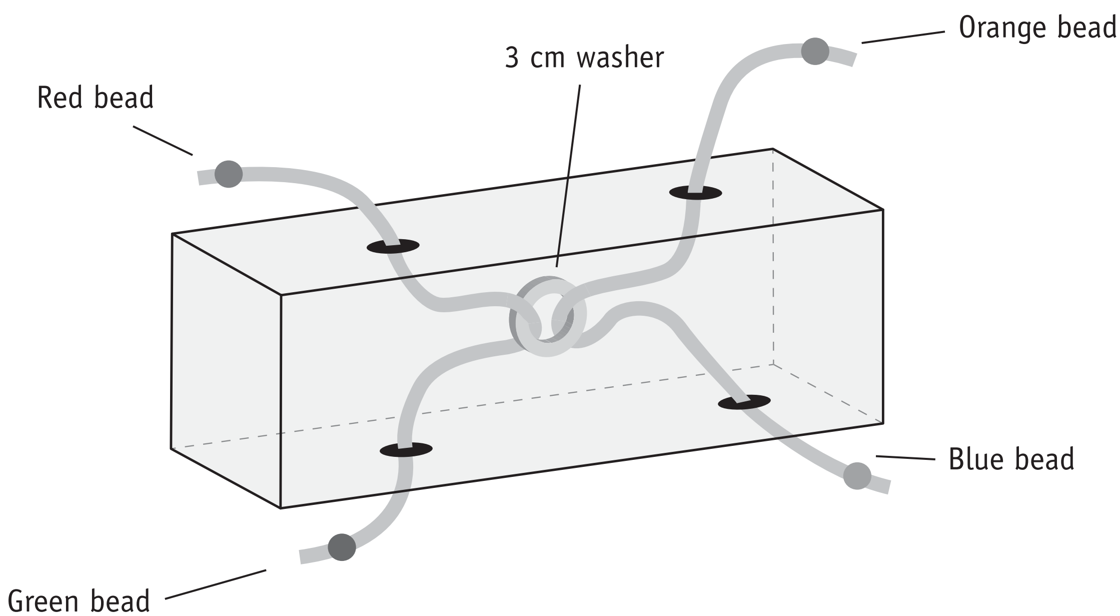
Preparation

Make one Think Box for each team of students.

Pierce four holes into each box as shown in the diagram below. The holes should be large enough for the string to pass through easily but not large enough for the bead on the end of the string to pass through. The two holes on each side should be placed as far apart as possible—at least six inches apart.

Thread one string through a hole into the center of the box, through one washer, and through the hole on the opposite side of the box. With another piece of string, repeat the process for the other set of holes, passing the string through the same washer.

Tie one colored bead to the end of each cord according to the diagram. Make sure that the strings move freely through the holes and washer. When operating properly, close the box and tape it shut.



#3 think box continued

Procedure

A OBSERVE AND RECORD

Ask students to observe the box without pulling any beads. After studying the box, instruct students to use colored pencils and the metric ruler to make a drawing of the box, strings, and beads in their science notebook.

B EXPLORE AND RECORD

EXPERIMENT 1

Tell students to set up the box by pulling the red and blue beads until the orange and green beads are tight against the box. Ask one student in each team to hold the box in the middle while another student pulls *down* on the *blue* bead. At this point they should make a drawing of the box, beads, and strings.

Now have one student in each team pull *down* on the *red* bead and draw their results.

EXPERIMENT 2

Tell students to reset the box by pulling the red and blue beads until the orange and green beads are tight against the box.

Next, a student should hold the box in the middle with one hand and then place the thumb of the other hand over the *red* string so that it does not move.

Have someone else pull *up* on the *green* bead. Ask them to draw their results.

While still holding the *red* string, ask someone to pull *down* on the *blue* bead. Ask them to draw their results.

EXPERIMENT 3

Reset the box again as described above.

Next, ask a student to hold the box in the middle with one hand and then place the thumb of the other hand over the *blue* string so that it does not move.

Have someone else pull *up* on the *orange* bead. Ask them to draw their results.

While still holding the *blue* string, ask someone to pull *down* on the *red* bead. Ask them to draw their results.

C ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#3 think box continued

Student Sheet Answer Key

1. When the blue bead was pulled down, the red bead went up. When the red bead was pulled down, the blue bead went up.
2. When the green bead was pulled up, the blue bead went up. When the blue bead was pulled down, the green bead went down.
3. When the orange bead was pulled up, the red bead went up. When the red bead was pulled down, the orange bead went down.
4. The blue and red beads appear to be connected.
5. The green and blue beads appear to be connected.
6. The red and orange beads appear to be connected.
7. Student predictions will vary.
8. Answers will vary. Sample answer: If the red string is held in place and the orange bead is pulled up, then the blue bead goes up.

Quiz Answer Key

1. C
2. An inference would be made when you can see what an object does, but not how it does it.
3. Some drawings will likely match the actual arrangement of the strings. After students complete their drawing, ask them to open up their box to see the actual setup.

Name ______________________________ Date ____________ Class ____________

#3 think box

Quiz

1. An inference is a type of

A. prediction.

B. observation.

C. conclusion.

D. hypothesis.

2. When would you make an inference about how an object works?

____

____

____

____

3. Make an inference about how the strings inside your Think Box are connected. Draw a picture of your inference below.

____

____

____

____

Name ________________________ Date ____________ Class ____________

#3 think box

Procedure

A OBSERVE AND RECORD

1. Your teacher will provide you with a Think Box that contains strings tied to beads.
2. Observe the box without pulling any beads.
3. Use colored pencils and your metric ruler to make a drawing of the box, strings, and beads in your science notebook.

B EXPLORE AND RECORD

EXPERIMENT 1

4. Hold the box in the middle. Have another person pull *down* on the *blue* bead. In your notebooks, make a drawing of the box, beads, and strings.
5. Now have the person pull *down* on the *red* bead. Draw your results.

EXPERIMENT 2

6. Reset the box by pulling the red and blue beads until the orange and green beads are tight against the box.
7. Hold the box in the middle with your left hand. Hold your right thumb on the *red* string.
8. Have someone else pull *up* on the *green* bead. Draw your results.
9. Keep holding the *red* string. Have someone pull *down* on the *blue* bead. Draw your results.

EXPERIMENT 3

10. Reset the box again.
11. Hold the box in the middle with your left hand. Hold your right thumb on the *blue* string.
12. Have someone else pull *up* on the *orange* bead. Draw your results.
13. Keep holding the *blue* string. Have someone pull *down* on the *red* bead. Draw your results.

Name ______________________________ Date ____________ Class ____________

#3 think box continued

C ANALYZE AND CONCLUDE

1. Describe what happened when you pulled the blue bead and the red bead in Experiment 1.

2. Describe what happened when you pulled the green bead and the blue bead in Experiment 2.

3. Describe what happened when you pulled the orange bead and the red bead in Experiment 3.

4. Carefully study your drawings of the results of Experiment 1. What can you infer about the red and blue beads?

5. Carefully study your drawings of the results of Experiment 2. What can you infer about the green and blue beads?

Name ______________________________ Date ____________ Class ____________

#3 think box continued

6. Carefully study your drawings of the results of Experiment 3. What can you infer about the red and orange beads?

____

____

____

____

7. Predict what would happen if you held the red string and pulled up on the orange bead, then down on the blue bead.

____

____

____

____

8. Try the experiment in Question 7. Did your prediction match your results? Explain.

____

____

____

____

#4 Classifying Matter

Background Information

Physical properties are those that can be observed or measured without changing the composition of the object or material. Some physical properties of matter include color, shape, texture, and mass, among others. Mass is the amount of matter in an object or material. Mass is measured with a balance and is usually measured in units of grams or kilograms.

Time Required

1 class period

Objectives

- Observe and record some physical properties of common objects.
- Predict the mass of the objects.
- Measure and record the actual masses of the objects.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 pan balance or triple beam balance

common objects, such as a glass marble, round wooden bead, cotton ball, foil ball, small pieces of rocks such as granite and pumice, a penny, game piece such as a checker, plastic building block, plastic or wooden game die

Vocabulary

mass the amount of matter in an object

matter anything that has mass and takes up space

physical property a characteristic that can be observed or measured without changing the chemical composition of an object or material

#4 Classifying Matter continued

Procedure

A OBSERVE

Have students work in small groups of three or four students to do this activity. Explain that each student must observe and record the color, shape, and texture of each object as well as predict the mass of each item. Also tell students that they will take turns determining the actual mass of each object. If needed, explain that texture is how something feels to the touch.

B PREDICT

Even at this level, many students have trouble predicting mass and other common measures with any accuracy. To give them a starting point, provide each student with a paper clip and inform students that a paper clip has a mass of about 1.0 g. Have students hold the paper clip in one hand and the object being tested in the other to compare the heft of each so that they can get a sense of the mass of each of the objects being used in this activity.

C EXPLORE

Demonstrate how to correctly use the balance that students will be using in this activity.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Some Physical Properties of Some Common Objects

Object	Color	Shape	Texture	Predicted Mass (g)	Actual Mass (g)
Glass marble	Yellow	Spherical	Smooth	20	18.6
Wooden bead	Red	Spherical	Smooth	15	11.2
Cotton ball	White	Spherical	Soft, fluffy	5	1.1
Foil ball	Silver	Spherical	Bumpy	2	1.0
Granite	Black, white	Irregular	Jagged	28	47.6
Pumice	Gray	Irregular	Scratchy	20	16.6
Penny	Copper	Flat disk	Smooth with some relief	5	2.6
Checker	Black	Flat disk	Smooth with some ridges	3	3.1
Plastic block	Pink	Cube	Bumpy	8	7.6
Die	Gold and black	Cube	Smooth with indentations	10	12.9

#4 Classifying Matter continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: Students might classify the objects by shape into those that are spherical (marble, bead, cotton ball, and foil ball) and those that are not spherical (granite, pumice, penny, checker, plastic block, and die.
2. Answers will vary. Sample answer: Students might classify the objects by texture into those that are smooth (the marble and the bead) and those that are not smooth (cotton ball, foil ball, granite, pumice, penny, checker, plastic block, and die.
3. Answers will vary. Sample answer: Objects with masses between 0 and 10.0 g, which are the cotton ball, foil ball, penny, checker, and plastic block and objects with masses 10.1 to 50.0 g, which include the marble, bead, rocks, and die.
4. No. Changing the shape of the foil, for example, will not change the foil's mass. Mass is the amount of matter in an object or material.
5. Mass is determined by the types and numbers of atoms that make up an object or material.

Quiz Answer Key

1. D
2. how an object or material feels
3. Answers will vary. Sample answer: The cotton ball, the foil ball, the penny, and the checker all have masses less than 5.0 g.
4. Students' estimates will vary. A cube of modeling clay the size of a game die has a mass of about 16 g.

Name ______________________________ Date ____________ Class ____________

#4 Classifying Matter

Quiz

1. All of these are physical properties of matter EXCEPT
   A. color.
   B. mass.
   C. texture and shape.
   D. chemical reaction.

2. Texture is a physical property of matter that describes ______________________________
   ______________________________.

3. Which objects had masses of less than 5.0 g?
   ____
   ____
   ____
   ____

4. Based on your results, estimate the mass of a cube of modeling clay that is about the size of a game die.
   ____
   ____
   ____

Name ______________________ Date __________ Class __________

#4 Classifying Matter

Procedure

Ⓐ OBSERVE

1. Observe the objects provided by your teacher. Record your observations in the data table.

Ⓑ PREDICT

2. Predict how much mass each object has and record your predictions in the data table.

Ⓒ EXPLORE

3. Use the balance to determine the mass of each object. Record each mass in the last column of your data table.

Name ______________________ Date ____________ Class ____________

#4 Classifying Matter continued

Some Physical Properties of Some Common Objects

Object	Color	Shape	Texture	Predicted Mass (g)	Actual Mass (g)

Name ______________________ Date __________ Class __________

#4 Classifying Matter continued

D ANALYZE AND CONCLUDE

1. Classify the objects into two groups using one physical property. In the space below, draw the objects in each group. Below each group, write the physical property you used to classify the objects.

Name ____________________ Date ____________ Class ____________

#4 Classifying Matter continued

2. Classify the objects into two groups using another physical property. Again, draw the objects in each group. Below each group, write the physical property you used to classify the objects.

Name ________________________ Date ____________ Class ____________

#4 Classifying Matter continued

3. Draw a picture to classify the objects into two groups based on their actual masses. Below each group, write the mass ranges you used.

Name ______________________ Date ____________ Class ____________

#4 Classifying Matter continued

4. Is the mass of an object related to its color, shape, or texture? Explain.

5. What determines an object's mass?

#5 Determining Density

Background Information

Density is a physical property of all matter. Density is a measure of the mass of an object divided by its volume. The units of density can be expressed as grams per cubic centimeter or kilograms per cubic meter. You can calculate density using this formula:

density (g/cm^3) = mass (g)/volume (cm^3)

In other words, the mass (g) of the volume (cm^3) of an object is its density (g/cm3). Water has a density of 1.0 g/cm^3.

An item will float or sink depending on its density. For instance, a ship has a large mass, but it also has a large volume. Therefore, the density of a ship is less than the density of water, which causes it to float.

Time Required

1 class period

Objectives

- Predict whether or not ten cubes made of different materials will float or sink in water.
- Use a triple beam balance to determine the mass of each cube.
- Use a metric ruler to determine the volume of each cube.
- Calculate the density of each cube.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 set of 2.5-cm cubes of each of the following materials: aluminum, steel, copper, brass, PVC, nylon, acrylic, and three different woods, such as oak, pine, and poplar

1 triple beam balance

Note: Density Cube Set available from Carolina.com

FOR EACH STUDENT

1 metric ruler

1 calculator

Vocabulary

density a measure of how much mass there is in a given volume

mass the amount of matter in an object; mass is measured with a balance

volume the amount of space that an object occupies

#5 Determining Density continued

Procedure

A PREDICT

Review the vocabulary terms with students. If the cubes are not marked, use a fine-tipped permanent marker to number each cube. Keep a reference list for yourself.

Divide the class into three teams. Provide each team with a set of cubes. Explain that each student should determine the mass and volume of each cube, but that cubes will be shared within the team.

Suggest that students heft each cube to get an idea of its density and whether it will float or sink. The denser cubes will feel heavier than the less dense cubes. Make sure that students understand that objects with a large mass, but also a large volume, will not sink.

B OBSERVE AND RECORD

Review with students how to use a triple beam balance.

For Step 5, stress that students be as precise and accurate as possible. They should be measuring the sides of the cubes to the nearest millimeter.

Have students practice finding density using their calculators.

C ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#5 Determining Density continued

Student Sheet Answer Key

1. The copper cube has highest density; the poplar cube has the lowest density.
2. poplar, pine, oak, nylon, acrylic, PVC, aluminum, steel, brass, copper
3. Answers will vary. Some students may have been surprised to find that the polymers (acrylic, nylon, and PVC) had much lower densities than the metals (copper and aluminum) and alloys (steel and brass).
4. Oil has less density than the water and vinegar and so it stays at the top of the bottle until the bottle is shaken.
5. 54 g/20 cm^3 = 2.7 g/cm^3
6. pine, poplar

Quiz Answer Key

1. D
2. a physical property of matter that is calculated by dividing the mass of an object by its volume
3. by multiplying the width of the cube by the length of the cube by the height of the cube
4. Answers will vary. Sample answer: The densities of the cubes are different because each cube has a different mass. You can find the density of a cube by dividing the mass of an object by its volume.

Relative and Actual Densities of Various Materials

Cube/Material	Float or Sink?	Mass (g)	Volume (cm^3)	Density (g/cm^3)
Pine		7.0	15.6	0.3-0.6
Poplar		6.2	15.6	0.3-0.5
Oak		11.2	15.6	0.6-0.9
Nylon		17.1	15.6	1.1
Acrylic		18.7	15.6	1.2
PVC		20.3	15.6	1.3
Aluminum		42.1	15.6	2.7
Steel		121.7	15.6	7.8
Brass		133.4	15.6	8.4-8.7
Copper		138.8	15.6	8.9

Note: Masses might vary slightly, depending on the purity of the cubes.

Name ________________________________ Date ____________ Class ____________

#5 Determining Density

Quiz

1. Density is measured in
   A. grams.
   B. centimeters.
   C. cubic centimeters.
   D. grams per cubic centimeter.

2. Density is

____

____

____

____

3. How do you find the volume of a cube?

____

____

____

____

4. All of the cubes have the same volume, but they have different densities. Why?

____

____

____

____

____

____

____

____

Name ____________________ Date ____________ Class ____________

#5 Determining Density

Procedure

A PREDICT

1. Can you tell if an object will sink or float by looking at it? In this activity, you will find the density of various cubes. Density is measured in grams per cubic centimeter.
2. Water has a density of 1.0 g/cm^3. Objects that have a higher density than water will sink. Objects that have a lower density than water will float.
3. Observe the cubes provided by your teacher. In the data table, write the type of material the cube is made of. Then predict whether the cube will float or sink in water. Record your predictions in the data table.

B OBSERVE AND RECORD

4. Use the triple beam balance to find the mass of each cube to the nearest tenth. Record your measurements in the data table.
5. Use a metric ruler to find the volume of each cube. Record the volumes in the table.
6. Calculate the density of each cube to the nearest tenth using the formula below:
   density (g/cm^3) = mass (g)/volume (cm^3)

Name ______________________ Date ____________ Class ____________

#5 Determining Density continued

Densities of Various Materials

Cube/Material	Float or Sink?	Mass (g)	Volume (cm^3)	Density (g/cm^3)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

#5 Determining Density continued

C ANALYZE AND CONCLUDE

1. Which cube has the greatest density? Which has the lowest?

2. Rank the cubes from least dense to most dense.

3. Compare your predictions with the actual density of each cube. Are you surprised by any of the densities? Explain your answer.

Name ______________________________ Date ____________ Class ____________

#5 Determining Density continued

4. Use your results to explain why the oil in a bottle of vinaigrette salad dressing sits at the top of the bottle until you shake the bottle.

5. An object has a mass of 54 grams and a volume of 20 cm^3. What is the object's density? Use the space to show your work.

6. Based on the information in the data table, which cubes will float in water?

#6 Conductors and Insulators

Background Information

Materials that easily allow electricity or thermal energy (heat) to move through them are called conductors. Metals, such as copper and aluminum, are conductors. Solutions that contain metal ions are also conductors. An ion is an atom that has an electrical charge. Tap water is an example of a solution that conducts electricity. It conducts electricity because it contains metal ions such as calcium. The ions come from minerals that are dissolved in the water.

Conductors have varying levels of conductivity; materials such as copper and aluminium have high conductivity, while tap water has low conductivity. This will be demonstrated in the activity by the relative brightness of the bulb when a circuit is made.

Materials that resist the flow of electric charges and thermal energy are called insulators. Glass, plastic, rubber, and wood are just a few materials that are classified as insulators. These materials are often used to insulate conductors to protect us from electrical shock or thermal burns. The plastic coating on electrical wiring is an example of an insulator.

Time Required

1.5 class periods

Objectives

- Follow instructions to build a simple circuit.
- Use the circuit to test various materials to determine if they allow electricity to move freely through them.
- Analyze the results to classify the materials into two groups: conductors and insulators.
- Test other materials around the classroom for conductivity.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 D cell battery and holder

1 3-V lightbulb with socket

2 metal paper brads or fasteners

3 pieces of 18-22 gauge insulated copper wire, each about 20 cm long

testing materials such as paper clips, chalk, toothpicks, marbles or glass rods, plastic drinking straws (cut in half), sponges, metal bottle caps, plastic buttons, rectangular rubber erasers, and a penny or a dime

#6 Conductors and Insulators continued

Vocabulary

conductivity the degree to which a material can transfer electrons or thermal energy from one material to another; may be high or low

conductor a material that allows electrons and thermal energy to pass freely through it

insulator a material the resists the flow of electricity and thermal energy

SAFETY INFORMATION

Remind students to be careful when attaching the wires to the tester to avoid pricking their fingers with the exposed metal. Stress that students test only materials approved by you.

Procedure

A SET UP

Strip about 1.5 cm of both ends of the copper wire prior to distributing it. Build and test a circuit like the one shown below before explaining to students how to do so. Make sure to securely attach the wire to both the light and the battery nodes.

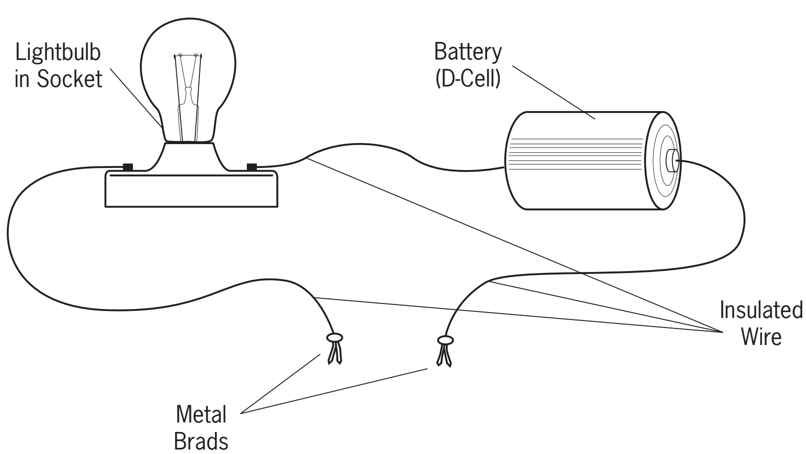
Make sure that the batteries are fresh. Have a few replacement bulbs on hand should a bulb burn out.

B PREDICT

Divide the class into teams of four or five students for this activity. Insist that each member of the team work to build the device and test at least two of the materials listed in the table. Each team should test all of the items.

Use the circuit you built as a model, or make a new circuit as you walk students through the procedure of making one.

Check each of the circuits before students attempt to use them.



#6 Conductors and Insulators continued

C OBSERVE AND RECORD

Suggested materials include metal cutlery, metal keys, coins not used in Part C, plastic pens and rulers, a stapler that contains steel parts, plastic bags, a computer mouse pad, the metal spirals on notebooks, the metal part of a pencil, and the pencil lead, among others.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Conductors and Insulators

Material	Conductor or Insulator?	Results
Paper clip	Predictions will vary	conductor
Chalk	Predictions will vary	insulator
Toothpick	Predictions will vary	insulator
Glass marble	Predictions will vary	insulator
Drinking straw	Predictions will vary	insulator
Sponge	Predictions will vary	insulator
Bottle cap	Predictions will vary	conductor
Button	Predictions will vary	insulator
Rectangular eraser	Predictions will vary	insulator
Coin	Predictions will vary	conductor

#6 Conductors and Insulators continued

Student Sheet Answer Key

1. Answers will vary depending on students' knowledge of conductors and insulators.
2. The paper clip, bottle cap, and coin are conductors. The chalk, toothpick, marble, sponge, button, and eraser are insulators.
3. The foil and the wire are conductors because they are metal. The rubber band, paper, and block of wood are insulators because they will not make the lightbulb light up when they are used to complete the circuit.
4. Answers will vary depending on the materials chosen. Sample answer: The wood of a pencil will not conduct electricity, but the metal rim will. A plastic ruler or pen will not conduct electricity, but a metal stapler will. A mouse pad will not conduct electricity, but a nail or a metal key will.

Quiz Answer Key

1. B
2. The lightbulb turned on as the material completed the circuit.
3. Answers will vary depending upon the conductors tested. Sample answer: The lightbulb should burn more brightly for conductors with higher conductivities than for conductors with lower conductivities.
4. Yes. Liquids that contain metal ions or compounds will conduct electricity.

Name ______________________________ Date ____________ Class ____________

#6 Conductors and Insulators

Quiz

1. A material that resists the flow of electricity and heat is a(n)

A. conductor.
B. insulator.
C. circuit.
D. inductor.

2. I knew that a material was a conductor when

____

____

3. Could you tell which material has the highest conductivity? Explain.

____

____

____

4. Do you think a liquid can be a conductor? Why or why not?

____

____

____

Name ______________________________ Date ____________ Class ____________

#6 Conductors and Insulators

Procedure

A SET UP

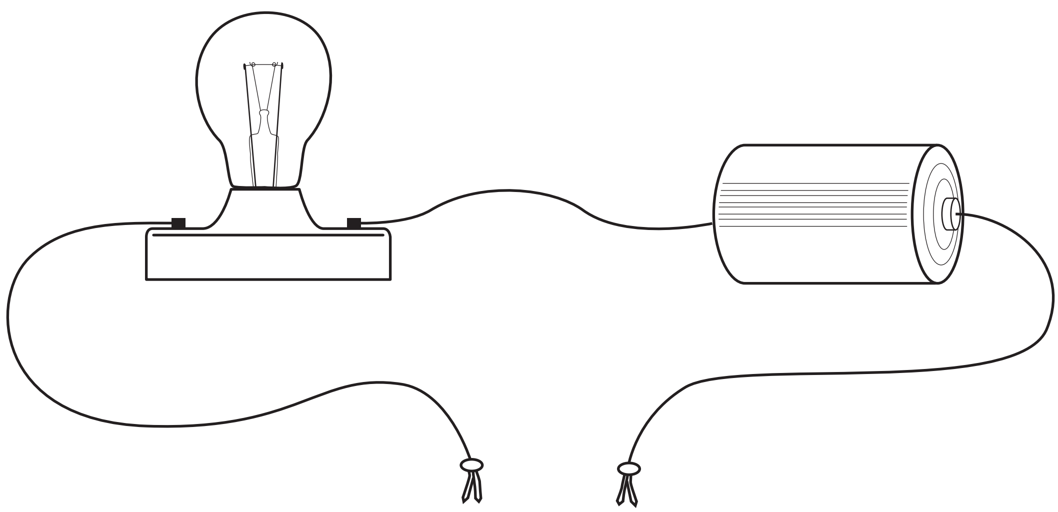
1. Follow the instructions from your teacher to make a simple circuit like the one shown below. Do ***not*** let the metal brads on the ends of the wires touch.

B PREDICT

2. A *conductor* is a material that allows electrical energy or thermal energy to move through it. An *insulator* is a material that does not allow electricity or heat to move through it.
3. Study the materials you will use to complete the circuit.
4. Predict which materials you think are conductors and which ones are insulators. Record your predictions in the data table.

C OBSERVE AND RECORD

4. Test each material by placing it between the free ends of the wire to complete the circuit. Make sure that both brads are in contact with each material you test. Observe and record what you see in your data table.



Name ______________________________ Date ____________ Class ____________

#6 Conductors and Insulators continued

Conductors and Insulators

Material	Conductor or Insulator?	Results
Paper clip		
Chalk		
Toothpick		
Glass marble		
Drinking straw		
Sponge		
Bottle cap		
Button		
Rectangular eraser		
Coin		

Name ______________________________ Date ____________ Class ____________

#6 Conductors and Insulators continued

D ANALYZE AND CONCLUDE

1. How did your predictions compare with your test results?

____

____

____

2. Sort each of the materials you tested into two groups: conductors and insulators.

____

____

____

3. Infer which of the following materials are conductors and which are insulators in an electrical circuit: a rubber band, a strip of aluminum foil, a piece of copper wire, a sheet of paper, and a block of wood. Explain your choices.

____

____

____

4. Find and test three or four more materials in your classroom to see if they are conductors or insulators. ***Note: Have your teacher approve the materials you choose BEFORE you test them. Record your results on the lines below.***

____

____

____

____

____

____

#7 Swingin'

Background Information

All objects and matter have energy. The total energy of an object or matter is called mechanical energy. Mechanical energy is the sum of the object or matter's potential energy and its kinetic energy. Potential energy is the energy an object or matter has because of its position or condition. Kinetic energy is the energy of an object or matter in motion. Potential energy is converted to kinetic energy when an object changes its position.

Time Required

1 class period

Objectives

- Make and observe a pendulum.
- Define the mechanical energy of an object, such as a pendulum, as the sum of the object's potential and kinetic energy.
- Understand the energy changes that take place as a pendulum moves.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 25-cm length of string
1 stopwatch or clock with a second hand
small metal washers or sinkers
masking tape

FOR EACH STUDENT

1 pair safety goggles
science notebook

Vocabulary

energy the ability to make things change or move
kinetic energy energy in motion
mechanical energy the sum of an object's kinetic and potential energy
potential energy energy that is waiting to happen; stored energy

SAFETY INFORMATION

Students should wear their safety goggles during this activity. Remind students NOT to exert any forces on the pendulums that would cause them to move erratically.

#7 Swingin' continued

Procedure

A THINK

Make sure students don't confuse the everyday use of the term *mechanical energy*, which is used to describe anything in motion or motions that cause change, with the scientific use of the term, which is the total energy in an object or a quantity of matter. Likewise, many students at this age often associate the term *energy* only with motion, and as a result, will incorrectly think that because an object is at rest, it does not have energy. Remind students that any object has some sort of energy as the result of its position or condition.

Also review the law of conservation of energy at this time, which states: Like matter, energy cannot be created or destroyed; it simply changes form.

B SET UP

Precut the string for students ahead of time. If needed, walk students through the steps to make the simple pendulums using weights and string.

Students can make pendulums by tying the washers or sinkers to one end of the string and tying the other end of the string to a pencil. The line should be suspended over the edge of a desk or table, and the pencil should be secured to the desk or table with masking tape. The pendulum must be able to move freely back and forth.

Have students work in pairs for this activity. One student can watch the time while the other student counts the number of swings.

C EXPLORE

For Steps 5 and 6, remind students to simply raise the weight (while keeping the string taut) and let it go without exerting any downward forces on the weight.

Sample number of swings: 128 and 137, respectively.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#7 Swingin' continued

Student Sheet Answer Key

1. The pendulum swung back and forth.
2. The pendulum swung back and forth more times during the second trial—when the string was parallel to the work area.
3. The pendulum has the most potential energy when the string is parallel to the desk and the weight is either to the left or to the right of the resting position of the line.
4. The moving pendulum has the most kinetic energy when the string is perpendicular to the desk.
5. The kinetic energy of the pendulum increased as the string moved from the starting position down toward its resting position.
6. The kinetic energy of the pendulum decreased as the string moved upward from its resting position.
7. A person pushes the swing back, giving it potential energy. The swing will naturally move forward and back until it comes to rest. However, the person can pump his or her legs—adding energy to the system—to keep the swing moving.

Quiz Answer Key

1. C
2. B
3. Mechanical energy is an object's potential energy plus its kinetic energy.
4. The pendulum had more potential energy in the second trial because the weight was farther away from the resting position than it was in the first trial.

Name ______________________________ Date ______________ Class ______________

#7 Swingin'

Quiz

1. What is potential energy?
   A. the total energy of an object
   B. the energy of a moving object
   C. the energy that is waiting to happen
   D. the energy of motion

2. What is kinetic energy?
   A. the total energy of an object
   B. the energy of the moving object
   C. the energy of an object due to its position
   D. the energy of motion

3. What is mechanical energy?

____

____

4. Why did the pendulum in the second trial swing back and forth more times than it did in the first trial?

____

____

____

____

Name ______________________ Date ____________ Class ____________

#7 Swingin'

Procedure

A OBSERVE

Like most kids, you probably enjoyed swings when you were younger. You might still like moving back and forth on these playground favorites. Like all objects at rest, energy is needed to set a swing in motion. Some of this energy is potential energy. Potential energy is the energy of an object that is due to the object's position or condition. Once the swing is in motion, it has kinetic energy. Kinetic energy is the energy of motion. The potential energy of any object, including a swing, plus the object's kinetic energy equals the mechanical energy of the object.

B SET UP

1. Tie one end of the string to a metal washer or sinker.
2. Tie the other end of the string to a pencil.
3. Tape the pencil to the top of a table or desk. Be sure the pendulum can swing freely.
4. In your science notebook, make a drawing of your pendulum at rest.

C EXPLORE

5. Pull up on the weight of the pendulum so that the string makes a 45-degree angle with the table or desk.
6. Let go of the weight and count how many full swings (back and forth) the pendulum makes in two minutes.
7. Use a stopwatch to keep track of the time.
8. Record this number in the data table.
9. Stop the pendulum if it is still moving.
10. Repeat steps 5–9 two more times.
11. Now pull up on the weight so that the string is parallel to your table or desk.
12. Let go of the weight and count how many full swings the pendulum makes in two minutes.
13. Record this number in the data table.
14. Repeat steps 11–13 two more times. Be sure to record your results in the data table.

Swingin' Pendulum Data Table

Trial Number	Number of swings 45° angle (Steps 5 through 9)	Number of swings parallel to table (Steps 11 through 13)
1		
2		
3		

Name ______________________________ Date ____________ Class ____________

#7 Swingin' continued

D ANALYZE AND CONCLUDE

1. What happened when you let go of the pendulum's weight?

____

____

2. During which trial did the pendulum swing back and forth more times?

____

____

3. On your drawing in your science notebook, label the two positions where the pendulum has the most potential energy with the letter P.

4. On your drawing, label the position where the pendulum has the most kinetic energy with the letter K.

5. When was the kinetic energy of your pendulum increasing?

____

____

6. When was the kinetic energy of your pendulum decreasing?

____

____

7. Compare your results of this activity to what happens on a swing.

____

____

____

____

____

____

#8 The Flow of Electricity

Background Information

Electrical charges move along a circular path called an electric circuit. If there is a break in the path at any point, the circuit is open. If the path is complete, the circuit is closed. An electrical charge, or current, cannot move through an open circuit. Metal wire is most often used to conduct electricity in a circuit. The measurement of how well something conducts electricity is called its resistance. High resistance materials do not conduct electricity very well. The higher the resistance of an object, the hotter it will become. In the lightbulbs used in the activity, electric current runs to a coiled tungsten wire. The thin tungsten wire has high resistance. It becomes very hot and produces incandescent light.

If an insulator blocks the circuit at any point along the path, the circuit will open. Common insulators are rubber, plastic—even the plastic coating covering the wire used in the activity—glass or ceramic materials.

In the activity the students will connect two AA batteries. Then they will use a copper wire to connect the positive pole of one battery to the negative pole of the second battery. The connection is the circuit. The resulting flow of electric charge is the current. Students will connect a lightbulb, a buzzer, and a switch along the circuit. When the switch is turned on, the circuit will close. When the switch is turned off, the circuit will open.

Time Required

1.5 class periods: **.5** period to explain electric circuits to the class, to answer any questions students may have, and to divide the students into teams of three or four; **1** period to perform and review the activity

Objectives

- Understand the difference between an open circuit and a closed circuit.
- Demonstrate how a closed electric circuit can produce light, heat, and sound.
- Identify common insulators and conductors and observe how they affect the flow of electrical energy in a circuit.
- Build simple electronic devices that produce light, heat, and sound.

#8 The Flow of Electricity continued

Materials *Materials available at www.carolina.com*

FOR THE TEAM

2 AA batteries (1.5V each)

1 3V lightbulb

1 3V piezoelectric buzzer (piezo buzzer)

1 lightbulb socket

electrical tape

insulated wire

wire stripper

knife switch

assorted materials that are electrical insulators, such as a rubber ball, a wooden toothpick, a plastic paper fastener, a ceramic tile

assorted materials that are electrical conductors, such as a steel washer, a penny, an iron nail, a metal paper clip

Vocabulary

circuit a closed system along which electric current continually flows

conductor a material that allows electric current to flow through it easily

current the constant flow of electric charge

electricity energy that results from the movement interaction of positively and negatively charged atoms

incandescent something that can give off light energy if it is heated to a high enough temperature

insulator a material that does not allow electric current to flow through it easily

law of electric charges the law that says positive charges push away from each other and negative charges push away from each other, and a positive charge and a negative charge pull toward each other

series circuit a type of circuit in which the loads are connected in a line and share the available voltage; a circuit with only one path for electric current

SAFETY INFORMATION

Students should exercise caution when cutting and stripping the wire. You may wish to strip the wire for the students and distribute the stripped wire during the activity. **Emphasize** that students should never use household current when building their circuits.

#8 The Flow of Electricity continued

Procedure

A THINK

Review the terms used in this activity. Make sure that students understand the difference between a *conductor*, which allows electrical current to flow, and an *insulator*, which will slow or block the flow of electrical current.

B PLAN

Ask the students to carefully consider the placement of the switch, the lightbulb and the buzzer to build a complete circuit. Since charge will flow from the negative pole to the positive pole, the switch must be closest to the negative pole.

Encourage students to draw their plans carefully. Team members should take turns explaining to other students how their device will work. This will help you identify any misconceptions that students may have about electricity and electrical circuits. If students are familiar with the conventions used in diagramming simple electrical circuits, encourage them to use them in their drawings.

C EXPLORE

Students may not immediately realize that the lightbulb produces heat as well as light. Ask students if they have ever seen a heat lamp used to keep food warm. Explain that a toaster and an incandescent lightbulb operate according to the same principle; electrical resistance can produce heat and light.

Have extra lightbulbs and buzzers on hand in case a device does not work because a component does not function.

D PREDICT

You may wish to have students suggest additional objects that could serve as conductors or insulators.

E EXPLORE MORE

Students should never use household current in this activity.

Students may also enjoy using a magnetic compass to prove that when electric current flows through their device, it induces a magnetic field. This extension would be a good introduction to electromagnetism and its applications.

F OBSERVE AND RECORD

Observations should be consistent for all student teams. If a student team has difficulty obtaining the correct result, make sure that the lightbulb and switch are functioning.

G ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#8 The Flow of Electricity continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: The first device we built did not work because we attached both wire ends to the same end of the buzzer. The circuit was blocked. When we reattached the wires to both ends of the buzzer the circuit closed and the device worked.
2. the lightbulb
3. Answers will vary. Sample answer: The switch enabled us to open and close the circuit. When the switch was closed, electrical energy could flow through the circuit. When the switch was open, electrical energy could not flow through the circuit. Some of the materials we tested were insulators, so they functioned like an open switch. Other materials were conductors, when they were placed in the circuit they functioned like a closed switch.
4. Answers will vary. Sample answer: If we used just one battery, the device might not work. There would not be enough electrical current to power two devices. The lightbulb and the buzzer share the voltage. Using two batteries in a series circuit increased the voltage from 1.5V to 3V. The lightbulb and the buzzer are rated for 3V.
5. Answers will vary. Sample answer: Both lightbulbs and toasters convert electrical energy into light and heat. In a lightbulb a metal filament becomes so hot that it gives off light and a moderate amount of heat. The wires in a toaster are also high resistance. They do not conduct electrical current very well. They become very hot and toast the bread. They also give off a little bit of light.

Quiz Answer Key

1. B
2. heat
3. A switch opens and closes the circuit. When the switch is closed, electrical energy can flow through the circuit. When the switch is open, electrical energy cannot flow through the circuit.

Name ______________________________ Date ____________ Class ____________

#8 The Flow of Electricity

Quiz

1. When electricity flows through a circuit, the circuit is
   A. controlled.
   B. closed.
   C. kinetic.
   D. open.

2. An incandescent lightbulb converts electrical energy into light and ____________________.

3. What is the function of a switch in an electrical circuit?

____

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#8 The Flow of Electricity

Procedure

(A) THINK

Electrical energy can be converted into other types of energy. The lightbulb in a lamp converts electrical energy into light energy. The engine in a car converts electrical energy into mechanical energy. Electrical energy is converted into sound and light in your television.

In this lab you will build a device that converts electrical energy into light, heat and sound.

(B) PLAN

1. Review electric circuits. Examine the lab materials. Think about how to build a series circuit to convert electrical energy into light, heat and sound. Remember, electric current may be converted into more than one form of energy.
2. Work with your team. Draw a diagram to show how you will use your materials to make a circuit. Your device will include an energy source (the batteries), a conductor, a switch, a lightbulb and a buzzer. Label the parts of your drawing.

(C) EXPLORE

3. Work with your team to make the device.
4. Does your device convert electrical energy into light, heat, and sound? If not, revise your design.

(D) PREDICT

5. Examine the materials your teacher provided. Predict whether each material is a conductor or an insulator. Record your predictions in the table.

(E) EXPLORE MORE

6. Work with your team. Test each material.
   - Make sure the switch on your device is turned off. Use the wire stripper to cut the wire in one place. Strip the two exposed ends of the wire.
   - Tape one of the materials to each of the exposed ends of the wire. Turn the switch on. If the material is a conductor the circuit will be closed. The device will operate. If the material is an insulator the circuit will be open. The device will not operate.
   - Test each material.

(F) OBSERVE AND RECORD

7. Record your observations in the table. Repeat with each material. Turn the switch off when you change the material.

Name ______________________________ Date ____________ Class ____________

#8 The Flow of Electricity continued

Conductor or Insulator?

Material	Prediction	Test Result
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Name ______________________________ Date ____________ Class ____________

#8 The Flow of Electricity continued

G ANALYZE AND CONCLUDE

1. Did the device you built differ from your original plans? Explain.

2. Which part of the device converted electrical energy into light and heat?

3. What was the function of the switch in the device you built? How is the switch similar to the materials you tested in the Explore More?

4. Would your device work if you used just one battery? Explain.

5. Based on what you learned in this lab, compare the way an incandescent lightbulb works to the way a toaster works.

#9 fossils and fossil fuels

Background Information

Fossils are the remains or traces of ancient life forms. Most fossils are preserved in sedimentary rocks. Others are preserved in ice (glaciers), tar pits, or amber (fossilized tree sap). Sedimentary rocks form as loose pieces of rocks, minerals, and organic remains are compacted and cemented together. Some sedimentary rocks either contain fossils or fossil fuels. Many porous sandstones and shales are rich in oil and/or natural gas. Coal is a fossil fuel that formed in ancient swamps. All fossil fuels can be burned to produce thermal energy and light.

Time Required

3–4 class periods: **1** period to conduct research, **1** period to observe actual fossils and to construct the dioramas, **1** period to observe actual fossils and model the processes that result in the formation of sandstone, and **1** period for presentations

Objectives

- Observe actual fossils or replicas and research one type of ancient organism.
- Make a diorama that shows the ancient organism in its environment.
- Research fossil fuels and use the information to compare and contrast coal, petroleum (oil), and natural gas.
- Research sedimentary rocks to find out how they form and how they are classified.
- Observe sedimentary rock samples.
- Model the formation of a sandstone that contains fossils.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 hand lens

1 pair safety goggles

actual fossils and/or replicas

various sedimentary rocks

coarse-grained play sand, small (bathroom-sized) paper cups, craft stick, white glue, and small twigs and dead leaves for the model sandstones

FOR EACH STUDENT

science notebook

reference books and/or computers with Internet access

colored pencils, paints, markers, construction paper, craft sticks, glue, tape, and other art supplies for making the dioramas

#9 fossils and fossil fuels continued

Vocabulary

coal a solid fossil fuel formed from prehistoric swampy plants
fossil the traces or remains of living things that died a long time ago
fossil fuel a form of energy formed from plants and animals that died a long time ago
natural gas a fossil fuel formed from the remains of small marine organisms
petroleum (oil) a fossil fuel made from the remains of ancient ocean organisms
sedimentary rock rock made up of layers of sediment that have been squeezed together over millions of years

SAFETY INFORMATION

If students are using the Internet to conduct research, review your school's Internet safety policy and rules before they go online. Also, remind them to use only reputable sources such as educational and government sites and online encyclopedias. Have students wear safety goggles when working with the loose sand.

#9 fossils and fossil fuels continued

Procedure

A RESEARCH

Since this activity has multiple parts to explore several topics, you might want to divide the class into six teams. Have the students number from one to three within their teams. Have all of the 1s become a new team to research fossils. Have all of the 2s become a new team to research fossil fuels, and have all of the 3s become a team to do the sandstone research. Then when students go back to their original teams, there will be one or two "experts" in the original team for each of the research areas. They can share their knowledge and then work on their dioramas and model the formation of a sandstone. After each team has completed its tasks, allow the teams to present their results for the rest of the class.

A good starting point for finding out information about coal, petroleum (oil), and natural gas is the U.S. Energy Information Administration's Energy Kids webpage: http://www.eia.doe.gov/kids

Data Table 1: Fossils

Type	Description
Mold	impression of organism
Cast	fossil formed when mold is filled in
Trace	evidence of animal behavior (footprint, nest, burrow)
True form fossil	fossil of actual animal or organism

#9 fossils and fossil fuels continued

Data Table 2: Fossil Fuels

Name of Fossil Fuel	How It Forms	Some States Where It Is Found	Uses
Petroleum (oil)	from the organic remains of marine organisms	Texas, Oklahoma, Louisiana	fuel, used in plastic and fertilizer
Natural gas	from the organic remains of marine organisms	Texas, Wyoming, California	heating homes, powering electrical plants
Coal	in non-marine settings, from the remains of land vegetation	Montana, Illinois, West Virginia	fuel, electricity

Data Table 3: Sedimentary Rock

Types	How It Forms	Where it is Found	Examples
Clastic	bits of broken rock that have cemented together in layers over time	streams, deserts, muddy lakes	sandstone, shale
Chemical	carbonate, evaporate	places where water has evaporated	limestone, halite, gypsum
Organic	bits of shells, plant fragments, or other natural material	deep underground where plants or animals lived	coal

#9 fossils and fossil fuels continued

B EXPLORE

Ask each student or group of students to bring in a shoebox with its lid for the diorama.

Provide students with a variety of fossils of both plants and animals to observe. Try to include remains, as well as traces and imprints. Identify or provide students with keys so that they know what they are observing.

C OBSERVE AND RECORD

Explain to students that their drawings of the sedimentary rocks should show the overall texture of each. Texture refers to the size of a rock's components as well as the way in which the components are arranged.

Have students keep texture in mind when they are observing the actual rock samples.

Watch students as they model the basic processes that lead to the formation of sedimentary rocks. Students' procedures should show a knowledge of erosion (the transport of sediment), the layering of sediment, compaction, and finally, cementation (when they add glue to the sand mixture). The model rocks should be left to dry and harden overnight before students attempt to remove them from the paper cups.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Each team can share their findings with the class. Include class discussion.

#9 fossils and fossil fuels continued

Student Sheet Answer Key

1. Answers will vary, but students should show an understanding that fossils are the remains or traces of ancient life forms that are preserved in certain Earth materials, including sedimentary rocks, ice, tar, and amber.
2. Answers will vary depending on the fossil chosen.
3. Answers will vary. Sample answer: All three are substances made from the remains of organisms that lived on Earth millions of years ago. All can be burned to provide light and heat and to produce electricity. Oil and gas are liquid and gaseous fuels, respectively. These fossil fuels formed in Earth's ancient oceans as tiny plants, animals, and other organisms died, became buried with sediment, and underwent various chemical and physical changes. Coal is a solid fuel that formed in a similar way from ancient swamp plant remains.
4. Answers should show an understanding of the basic processes in the formation of sedimentary rock. Weathering and erosion break rocks apart to produce sediment. Over time, the sediment is compacted and cemented to form rocks such as sandstone and shale.
5. Answers will vary. Sample answer: Modern sharks live in the ocean. Sharks likely lived in oceans long ago, too. Fossilized shark teeth indicate that an area was once covered by ocean water. The teeth became buried in sediment and preserved in the rock that eventually formed when the sediment was compacted and cemented.
6. Answers will vary. Sample answer: Fossil fuels take millions of years to form. Once they are used, they cannot be replaced.

Quiz Answer Key

1. B
2. Answers will vary. Sample answer: ancient organisms and the environments in which they lived
3. Answers will vary. Sample answer: Petroleum (oil) and natural gas formed when ocean organisms died and were buried by sediment. Over millions of years, chemical and physical processes changed the remains into fossil fuels. Coal formed in a similar way, but it formed from ancient plant swamps.
4. Answers will vary. Sample answer: Clastic sedimentary rocks form when sediment and/or organic remains are compacted and cemented to form rocks. Chemical sedimentary rocks form when minerals come out of solutions and form rocks. Organic sedimentary rocks form from organic remains.

Name ________________________________ Date ____________ Class ____________

#9 fossils and fossil fuels

Quiz

1. Fossils are

A. any type of organic remains.
B. evidence of ancient organisms.
C. anything that can be burned as fuel.
D. important resources.

2. Fossils give clues about

____

____

3. How did the fossil fuels we use today form?

____

____

____

____

4. Briefly explain how each type of sedimentary rock forms.

____

____

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#9 fossils and fossil fuels

Procedure

A RESEARCH

1. Your teacher will assign one of the following topics for each team to research:
   - Fossils (Use Data Table 1.)
   - Fossil Fuels (Use Data Table 2.)
   - Sedimentary Rock (Use Data Table 3.)

   Use reference books or online resources to do your research.
2. Make a table using a word processing program, draw one in your science notebook, or use the correct data table to summarize your findings.

Data Table 1: Fossils

Type	Description
Mold	
Cast	
Trace	
True form fossil	

Name ______________________ Date ____________ Class ____________

#9 fossils and fossil fuels continued

Data Table 2: Fossil Fuels

Name of Fossil Fuel	How It Forms	Some States Where It Is Found	Uses

Data Table 3: Sedimentary Rock

Types	How It Forms	Where it is Found	Examples

Name ______________________ Date ____________ Class ____________

#9 fossils and fossil fuels continued

B EXPLORE

3. Use a hand lens to observe the fossils provided by your teacher. Make a drawing of each fossil in your science notebook. Label the drawings with the names of the organisms.
4. In your notebook, summarize what you found in your research from Step 1. Also print a picture or make a drawing of the organism and where it lived.
5. Use your research to make a diorama of the organism in its environment.

C OBSERVE AND RECORD

6. Use reference books or online resources to find out about sedimentary rocks and how they form. Your research should include information about the three main groups of sedimentary rocks.
7. Summarize your research from Step 1. Use colored pencils to make and label drawings of each type of sedimentary rock in your science notebook.
8. Use the hand lens to observe the sedimentary rocks provided by your teacher.
9. Model some rock-forming processes to make a sandstone that contains “fossils.”

D ANALYZE AND CONCLUDE

1. Define the term *fossil* in your own words.

____

____

____

2. Describe the fossil you chose to model and the environment in which it lived.

____

____

____

____

3. Compare and contrast oil, natural gas, and coal.

____

____

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#9 fossils and fossil fuels continued

4. Explain how sedimentary rocks form.

____

____

____

____

____

____

5. Suppose you found some fossilized shark teeth in some rocks near your house. What do these fossils tell you about your area long ago?

____

____

____

6. Why is it important to conserve fossil fuels?

____

____

#10 Motions of Earth and the Sun

Background Information

In the morning the Sun appears to rise in the eastern sky. In the evening the Sun appears to set in the western horizon. At noon the sun appears to be directly overhead. In fact, the Sun does not move. Earth rotates during the course of a day—so slowly that we don't notice the motion. The side of Earth facing the Sun is in daylight, and the side turned from the Sun is dark. It is the movement of Earth that causes sunrise and sunset. The Sun only seems to move across the sky from east to west.

Time Required

10 minutes during each of **7** consecutive hours on a sunny day for each team to measure shadows; **1** class period to model day and night and answer the activity questions

Objectives

- Use a model to demonstrate that Earth's rotation causes night and day.
- Observe and measure shadows to describe the Sun's apparent motion across the daytime sky.
- Use the shadow lengths (or a photograph of them) to predict what the length of the meterstick's shadow will be at 4 p.m.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

1 meterstick

1 directional compass

1–2 pieces of sidewalk chalk

wristwatch or other timepiece

digital camera

large, open paved area on a sunny day

FOR EACH TEAM

1 10-cm diameter foam ball

1 sharpened wooden pencil, or a wooden skewer

1 flashlight or gooseneck lamp

#10 Motions of Earth and the Sun continued

Vocabulary

axis an imaginary line that runs through Earth from the North Pole to the South Pole; the imaginary line around which a planet spins

day the time it takes for Earth to make one full rotation on its axis; 24 hours

orbit the path of one object around another object; the movement of Earth around the Sun

rotation the spin of Earth on its axis

Sun the star around which the planets in our solar system orbit

SAFETY INFORMATION

Remind students not to poke themselves or others with the skewer or the pencil point. Students must never look directly at the Sun as this can permanently damage their eyes. Also stress that they should not shine the flashlight directly into anyone's eyes, including their own.

#10 Motions of Earth and the Sun continued

Procedure

A THINK

Make sure students understand the difference between a real movement and an apparent movement.

B EXPLORE

Have pairs of students work together to model how Earth's rotation causes day and night. Answer any questions the students may have. Make sure students realize that in Step 3, the Sun (light source) must remain stationary as Earth (the ball on the skewer or pencil) rotates slowly from east to west.

Note: This activity does not take the 23.5° tilt of Earth's axis into account.

C EXPLORE MORE

Divide the class into seven teams for the shadow measurement part of the activity. Make sure team members have permission to go outdoors to take measurements. Explain that the team must be in place and have the shadow drawn on the hour or very close to it.

Review, if necessary, how to read a directional compass as the first team of students orient themselves. Stress the need for accuracy when measuring the length of each shadow with the meterstick.

The digital photo will help students visualize the apparent movement of the Sun as Earth rotates. However, you may wish to have students make a data table that summarizes the times of day and measurements of the shadows.

You could use a computer screen or a SMART Board to project the photograph of all of the shadows so that students can use it for reference. Ask a volunteer to point out the compass directions on the image.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#10 Motions of Earth and the Sun continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: I modeled the rotation of Earth. As the side of the ball with the X faced the light source it modeled the hemisphere in daylight. When it faced away from the light source it modeled the hemisphere at night.
2. The shadows increased in length from 8 a.m. until almost 10 a.m. At 10 a.m. the shadows began to decrease in length. The shortest shadow was made at about noon. At about 2 p.m. the shadows began to get longer.
3. The shadow will be approximately the same length at 4 p.m. as it was at 8 a.m.
4. The Sun appeared to be directly overhead at about noon, when the meterstick's shadow was the shortest.
5. The Sun appeared to move from east to west across the daytime sky. This happened because Earth rotates on its axis from east to west. When I examine the photo I can see that the shadows became shorter as the time got closer to noon, and then began to get longer after noon.

Quiz Answer Key

1. B
2. one day; almost 24 hours.
3. Answers will vary. Sample answer: At 2 p.m. on a sunny day my shadow would be to my right. The right-hand side of my body would be toward the east. The afternoon sun would come from the west, so my shadow would fall to the east.

Name ______________________________ Date ____________ Class ____________

#10 Motions of Earth and the Sun

Quiz

1. In the western hemisphere we experience night when

A. the Sun is directly above the Earth.

B. the eastern hemisphere is facing the Sun.

C. the western hemisphere is facing the Sun.

D. the sun moves to the eastern hemisphere.

2. How long does Earth take to make one complete rotation on its axis?

____

3. Imagine you are standing in a sunny, open area. It is 2 p.m. You are facing north. Where is your shadow? Explain.

____

____

____

Name ______________________________ Date ____________ Class ____________

#10 Motions of Earth and the Sun

Procedure

A THINK

Running to the school bus is a real motion. Being inside the bus and watching traffic next to the bus move make the bus seem like it is moving. This movement is called an apparent motion. Why? The bus seems, or appears, to move in relation to other objects near it.

Earth and the Sun constantly move through space. Earth spins, or rotates, on its axis. Earth's rotation is a real motion. The movement of the Sun across the daytime sky is an apparent motion.

B EXPLORE

Work as a team. Use the ball and the light source to demonstrate how Earth rotates around its imaginary axis.

1. Mark an X on one side of the foam ball. Attach the ball to the pencil or skewer. You should be able to use the pencil as a handle for the ball.

2. Use the handle to hold the ball in front of a light source such as a flashlight or lamp. The side with the X should face the light source. It will be day on that side.

3. Slowly turn the handle of the ball. The movement of the ball is like the movement of Earth as it rotates. Eventually, the side with the X will be opposite the light source. It will be night on that side.

Note: This activity does not take the 23.5˚tilt of Earth's axis into account.

C EXPLORE MORE

4. Begin this activity at 9 a.m. and end at 3 p.m. The first team to take measurements will establish the observation point. Take a meterstick and a piece of chalk outdoors to the area chosen by your teacher. Use a directional compass to locate the direction south. Face due south. Step slightly to the left of the meterstick so that you do not prevent sunlight from reaching the stick.

5. Have one person on the team use the chalk to trace the outline of your shoes. Then hold the meterstick completely vertical. Have the team member trace the outline of the end of the stick on the pavement.

6. Double check that your feet and the meterstick are correctly inside the outlines. Then have a team member carefully trace the shadow made by the stick. Have that team member write the time of day beneath the shadow.

7. Now have a team member use the meterstick to measure the length of the shadow. Write the measurement of the length of the shadow above the shadow.

8. Steps 6 and 7 will be repeated each hour by a different team. Each team should be in place and take measurements as close to the hour as possible. Each team will step inside the original chalk outlines of shoes and place the meterstick inside the original outline to measure the shadow.

9. When all of the shadows have been drawn for the day, use a digital camera to take a clear picture of the chalk lines and measurements.

Name ______________________ Date ____________ Class ____________

#10 Motions of Earth and the Sun continued

D ANALYZE AND CONCLUDE

1. What natural event was modeled using the foam ball and light source?

2. Examine the photograph of the chalk lines. Describe how they changed over time.

3. Based on the shadow patterns you observed, predict the length of the shadow at 4 p.m.

4. Use the shadow lengths to infer the time when the Sun was apparently directly overhead.

5. Examine the photo of the shadows. How did the Sun appear to move across the daytime sky? What caused this apparent motion?

#11 The Sun-Earth-Moon System

Background Information

Our solar system consists of a central star, the Sun, eight planets and their natural satellites, and thousands of relatively small objects called asteroids, comets, and dwarf planets. Within this system is Earth and its Moon. Both of these objects rotate about imaginary axes and revolve around the Sun. Many of the natural phenomena on our planet, including tides, day and night, and seasons, are the result of interactions among the Sun, Earth, and the Moon.

The Sun is farther away than it looks in the sky because it is so large. The diameter of Earth is about four times bigger than the diameter of the Moon. The Sun is about 100 times wider in diameter than Earth is. The Sun is a star made up of gases. Earth has water and an atmosphere that help sustain life.

Time Required

2–2.5 class periods: **1** period to conduct research; **1** to **1.5** class periods to make and set up the models

Objectives

- Research and record characteristics and the relative positions of the Sun, Earth, and the Moon.
- Research scale diameters of the Sun, Earth, and the Moon
- Research scale distances between the Sun, Earth, and the Moon.
- Use the research and scale values to make a model of the Sun-Earth-Moon system.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 meterstick and/or tape measure

1 red pencil

reference books and/or computers with Internet access

polystyrene foam balls in a variety of sizes

string

colored pencils

newspaper (or rolls of butcher paper)

safety scissors

tape

poster paints and paint brushes

calculators (optional)

FOR EACH STUDENT

1 pair non-latex gloves

science notebook

#11 The Sun-Earth-Moon System continued

Vocabulary

moon a natural satellite of a planet

planet a spherical object in space that orbits a star, but is not a satellite, and has enough mass to have a nearly round shape and clears the space around its orbit

star an enormous sphere of burning gases

SAFETY INFORMATION

Review your school's Internet safety rules with students.

Procedure

A RESEARCH

Divide the class into teams of three or four students per team. Have students research the physical characteristics of the Sun, Earth, and the Moon.

- What is the diameter of the Sun, Earth, and the Moon?
- Students should know that Earth rotates once every 24 hours producing day and night.
- Students should note that the Moon and Earth have craters and rocks.
- Earth and the Sun both have layers and an atmosphere.

Note: NASA has an excellent website on our solar system. It can be accessed at the following URL: http://solarsystem.nasa.gov/planets/profile.cfm?Object=SolarSys

#11 The Sun-Earth-Moon System continued

B PREDICT

Provide each team with polystyrene foam balls in a variety of different sizes. Ask each team to choose two balls that they think best represent the relative sizes of Earth and the Moon.

Have students measure the diameter of each ball and label the two balls. They should record their predictions in the table. Explain that the diameter is the line that goes through the center of the object.

After they have recorded their predictions, explain that Earth is four times as large as the Moon. How many teams were close to the actual sizes? Have students replace any balls that were the incorrect size.

Some Characteristics of the Sun, Earth, and Moon

object	Type of object	Diameter (km)	Composition	Average distance (km) from _______	Surface features and Structure
Sun	Yellow star	1,391,000	Made mostly of hydrogen with some helium		• Solar flares and sunspots • 6 layers: core, radiative zone, convective zone, photosphere, chromosphere, corona
Earth	Inner planet	12,756	Made mostly of minerals containing silicon, oxygen, aluminum, and iron	the Sun 150,000,000	• Mountains, valleys, and plains; ¾ of planet is covered by water • 3 layers: two part iron-and-nickel core, thick mantle, thin crust
Moon	Natural satellite	3,475	Made mostly of minerals containing silicon, oxygen, aluminum, and iron	Earth 384,400	• Thin, rocky crust covered with numerous craters and highlands; gray dust covers the surface • 3 layers: dense core, thick mantle, thin crust

#11 The Sun-Earth-Moon System continued

C EXPLORE MORE

You will probably need to go outside to show the relative distance between the Sun, Earth, and the Moon.

1. Use the table provided to give students the scaled measurements to draw the Sun, Earth, and the Moon.
2. Demonstrate how to use string to draw circles onto the sheets of newspaper.
   A. Tie one end of the string to the red pencil.
   B. Starting at the pencil, measure off half the scaled diameter of the object and mark that distance on the string.
   C. Hold the string at the mark and have a student pull the string taut as you hold the mark firmly against the center of the newspaper.
   D. Use the pencil to draw a circle with the correct diameter. Note that students will have to tape several sheets of newsprint together to make the circle that will represent the Sun.
3. Give students the correct distance. The distance between Earth and the Moon is 385,000 km. Earth's diameter is 12,756 km and 384,400 divided by 12,756 km is approximately 30. So 30 Earth models laid end-to-end is the scaled distance between Earth and the Moon.

How many teams were close to the actual distance? Have students use metersticks or tape measures to figure out how far away the Moon model should be placed from the Earth model.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Actual and Scale Diameters and Distances of the Sun, Earth, and Moon

object	Diameter (km)	Scale Diameter (cm)	Average distance (km) from _______	Scale Distance (cm)
Sun	1,391,000	1,400	_____	_____
Earth	12,756	12.8	the Sun 150,000,000	1,500
Moon	3,475	3.5	Earth 384,400	3.8

Size Scale: 1 cm = 1,000 km; Distance Scale: 1 cm = 100,000 km

#11 The Sun-Earth-Moon System continued

Student Sheet Answer Key

1. The Sun is the largest of the three objects. The Moon is the smallest.
2. Earth and the Moon are rocky objects that have similar compositions. The Sun is a star, which is a giant ball of burning gases.
3. The Sun has six layers. Earth and its Moon each have three layers: a thin, outer crust, a thick mantle, and a dense core.
4. At a scale distance of 1 cm = 1,000 km, the average scale distance between Earth and the Sun is 150,000 cm, or 1,500 m, and the average scale distance between Earth and the Moon is 384 cm. While the Earth-Moon distance could have been easily modeled in the classroom or a long hallway, the average scale distance between Earth and the Sun could not have been.

Quiz Answer Key

1. A
2. three
3. The Sun is made mostly of gases. Earth and its Moon are made mostly of solids called minerals.

Name ________________________________ Date ____________ Class ____________

#11 The Sun-Earth-Moon System

Quiz

1. The largest object in the Sun-Earth-Moon system is
A. the Sun.
B. Earth.
C. the Moon.

2. Earth and its Moon each have ______________________________ distinct layers.

3. Contrast the compositions of the Sun with that of Earth and its Moon.

____

____

____

Name ______________________________ Date ____________ Class ____________

#11 The Sun-Earth-Moon System

Procedure

A OBSERVE

1. Earth, its Moon, and the Sun make up a small system in space. Use the Internet and reference books to find out about this system.
   What type of object is the Sun?
   What type of object is Earth?
   What type of object is the Moon?
   What are characteristics of each object?
2. Record your research in Data Table 1.

B PREDICT

1. Working with your team, choose two different sized foam balls that you think best represent the relative sizes of Earth and the Moon. Label each.
2. Use a meterstick to measure the two balls you've chosen. Record your predictions in Data Table 1.
3. What is the actual difference in size between Earth and the Moon? How close were your choices to the actual sizes? Record your actual sizes in Data Table 2.
4. Exchange any balls that were the wrong size.

Data Table 1: Some Characteristics of the Sun, Earth, and Moon

object	Type of object	Diameter (km)	Composition	Average distance (km) from ______	Surface features and Structure
Sun					
Earth					
Moon					

Name ______________________________ Date ____________ Class ____________

#11 The Sun-Earth-Moon System continued

Data Table 2: Actual and Scale Diameters and Distances of the Sun, Earth, and Moon

Object	Diameter (km)	Scale Diameter (cm)	Average distance (km) from ______	Scale Distance (cm)
Sun	1,391,000	1,400	_____	_____
Earth	12,756	12.8	the Sun 150,000,000	1,500
Moon	3,475	3.5	Earth 384,400	3.8

Size Scale: 1 cm = 1,000 km; Distance Scale: 1 cm = 100,000 km

C EXPLORE

1. You will work with other students to make a scale model of the Sun-Earth-Moon system. Your teacher will provide the diameter of each object for you.
2. Use a meter stick, string, a red pencil, and newspaper to draw each object in the system. Use scissors to trim the circles. Use colored pencils or paint to add some surface features to each object.
3. Take your objects, Data Table 2, and a meterstick to an area that is large enough to set up your model. Arrange the objects as they appear in space using your scale distances.
4. What is the actual distance between Earth and the Moon?
5. Use metersticks or tape measures to determine the diameter of the Earth model. Then figure out how far away the Moon model should be placed from the Earth model.

Name ______________________ Date ____________ Class ____________

#11 The Sun-Earth-Moon System continued

D ANALYZE AND CONCLUDE

1. How does the Sun compare to Earth and the Moon in size? In composition?

2. Contrast the structures of the three objects.

3. What would have been your scale distances had you used the same scale that you used for the objects' diameters? Is there anywhere you could have set up your model at this other scale? Explain.

#12 Comparing Adaptations

Background Information

A species is a group of similar organisms that can produce fertile offspring. Adaptations are structures and behaviors that make it possible for the individuals in the species to live and survive in their environments. All members of a species share many of the same adaptations. Adaptations allow organisms to obtain food and water. Some make it possible for organisms to move about or protect themselves. Still others help organisms find mates or maintain proper body temperature.

Some adaptations are behavioral. These are things an organism does in order to survive. Sunflowers bend with the Sun. Bears seek out caves in which to hibernate during the cold months. Salmon swim upstream against the current to spawn.

Other adaptations are structural. These adaptations are physical features that help the organism survive. Over time the greenbrier vine has developed spines that prevent some animals from eating it. A duck has webbed feet that make it easier to paddle quickly and smoothly through water. Beavers have sharp teeth with which they chew wood.

Time Required

1 to **1.5** class periods

Objectives

- Examine pictures of organisms and identify structural adaptations.
- Predict the functions of the noted adaptations and justify reasoning.
- Compare structures and functions of adaptations of different species.

Materials *Materials available at www.carolina.com*

FOR EACH STUDENT

science notebook

colored pencils

Vocabulary

adaptation a change in a structure or behavior that helps an organism survive and live in its environment

behavior an organism's response to a change in its environment

species a group of similar organisms that can produce fertile offspring.

structure the way something, such as an animal, is put together

#12 Comparing Adaptations continued

Procedure

A THINK

Write the vocabulary terms on the board. Pronounce or ask volunteers to pronounce each word. Discuss examples of adaptations such as migration, hibernation, nest-building, beak shapes, and teeth shapes.

B RESEARCH AND RECORD

Arrange for computer time in the library or the computer lab if there are no computers in your classroom. If you want students to print some or all of their findings, also arrange for printer access. Alternatively, arrange for library time and allow students to do their research using library materials.

To begin this activity, instruct students to type each species' name one at a time into the search engine along with the term "adaptations." If desired, you can prepare a list of websites you prefer your students to use in advance.

Students may work alone or in pairs.

C ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Species and Their Adaptations

Organism	Obtaining Food or Water	Movement from Place to Place	Protection from the Environment
White pine	roots; photosynthesis	do not move	thin, waxy needles; thick bark and high branches for fire protection
White oak	roots; photosynthesis	do not move	leaves die and fall off during the fall; tree goes dormant; poor fire resistance
Ruby-throated hummingbird	long, thin, beak; lower beak flexible; long tongue	wings that allow them to change directions and hover; muscles adapted for long periods of flight	can go into sleep-like state (torpor) to survive cold weather or poor food supply
Mallard	broad, flat bill that filters water, ability to dive	wings and muscles designed for long-distance flight and webbed feet for swimming	camouflage coloring; behaviors to protect young from predators; can take off vertically from water to escape danger; migratory

#12 Comparing Adaptations continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: Both trees get food from sunlight and water from roots. Neither species can move to find food or escape predators.
2. Answers will vary. Sample answer: Pines are conifers, so they have thin, waxy needles that they keep year round. Oaks are deciduous, so they lose their leaves in the fall and the tree goes dormant during fall and winter. The pine is more wildfire-resistant than the oak.
3. Answers will vary. Sample answer: Both birds have muscles and wings adapted for flying long periods of time. The males of both bird species have showy feathers and the females have feathers colored for camouflage.
4. Answers will vary. Sample answer: The hummingbird has a long, thin beak and tongue. The lower beak is also flexible. The duck's bill is broad and flat, and can filter water. The duck has webbed feet, but the hummingbird does not.
5. The white pine has needles that it does not lose in the fall. Because it does not lose its leaves in the fall, it can make food from sunlight all year round. The white oak tree loses its leaves in the fall, so it cannot make food until new leaves grow in the spring.
6. The ruby-throated hummingbird is adapted for eating during flight. Its wings are designed for hovering, so it can drink nectar from flower blossoms without landing. Its wings are also designed to change directions in flight quickly. This adaptation, along with a flexible lower beak, allows the hummingbird to catch small bugs in mid-air.
7. Animals and plants develop new adaptations when their environments change.
8. The species either moves to a new habitat or it dies out.

Quiz Answer Key

1. C
2. survive and live in its environment.
3. Its leaves are long, thin, waxy needles instead of being broad and flat. The shape helps keep the tree from losing too much water to the air during dry winter months.
4. Different animals eat different kinds of foods. (Additional acceptable answer: Animals live in many different places and so will have different foods available.)

Name ____________________ Date ____________ Class ____________

#12 Comparing Adaptations

Quiz

1. Which of the following behaviors helps an organism survive in its environment?

A. a dog playing with a ball
B. a cat watching a butterfly
C. a bear hibernating in winter
D. a child reading a book

2. An adaptation is a change in a structure or behavior that helps an organism

____

3. What adaptation allows a pine tree to survive during the winter?

____

____

____

4. Why don't all animals have the same adaptations for obtaining food? Explain your answer.

____

____

____

Name ______________________________ Date ______________ Class ______________

#12 Comparing Adaptations

Procedure

A THINK

All organisms have *adaptations* that help them live and survive. What is an adaptation? An adaptation is a change in an animal's body or the way it acts. Some animals grow thicker fur in the winter. This is a change in the animal's body. Other animals hibernate in the winter. Hibernation is a change in the way the animal acts. Both changes are adaptations.

B RESEARCH AND RECORD

1. Follow your teacher's instructions to start your research.
2. Look up information about the adaptations that help the organism listed in the table survive.
3. Complete the table by listing at least one adaptation in each column for each organism.
4. Draw a picture of each organism in your science notebook and label its adaptations.

Name ____________________ Date ____________ Class ____________

#12 Comparing Adaptations continued

Species and Their Adaptations

Organism	Obtaining Food or Water	Movement From Place to Place	Protection from the Environment
White pine			
White oak			
Ruby-throated hummingbird			
Mallard			

Name ______________________ Date ____________ Class ____________

#12 Comparing Adaptations continued

D ANALYZE AND CONCLUDE

1. How are the white pine and white oak similar?

2. How are the white pine and white oak different?

3. How are the ruby-throated hummingbird and mallard similar?

4. How are the ruby-throated hummingbird and mallard different?

5. Which tree's leaves are adapted for making food all year round? Explain your answer.

#12 Comparing Adaptations continued

6. Which bird has adaptations that allow it to eat while flying? Explain your answer.

7. Why do you think animals and plants develop new adaptations?

8. What do you think happens when a species cannot adapt to a change in its environment?

#13 Microscopic Marvels

Background Information

Ponds, puddles, and pools of standing water contain diverse groups of insects and larvae, as well as algae, bacteria, microbes, and other forms of microscopic life. These microorganisms have developed unique methods of survival. Some microorganisms are exposed to light and oxygen, and are able to convert sunlight into energy through photosynthesis. Other organisms are in deeper and darker water, and feed on decaying organic materials. Some ponds have very little dissolved oxygen, and organisms breathe sulfate instead.

Time Required

1 class period and **10**-minute observation periods once a week for **4–10** weeks

Objectives

- Use a microscope and a hand lens to observe microorganisms in a water sample.
- Use a dichotomous key to identify microorganisms in a water sample.
- Identify and explain the roles that producers and consumers play in aquatic ecosystems.
- Observe succession in aquatic ecosystems.

Materials *Materials available at www.carolina.com*

FOR EACH TEAM

1 small jar or 2 L bottle
sample of pond water
masking tape
marker
small pieces of cut hay
laboratory thermometer
hand lens
pipette
microscope
microscope slides
cover slips
eyedropper
simple dichotomous key

#13 Microscopic Marvels continued

Vocabulary

consumer an organism that gets energy by eating other organisms

dichotomous key a tool that helps identify an object by answering a set of questions

food web all of the paths that energy can take through an ecosystem

habitat the area where an organism lives

microorganism any organism that is too small to be seen with the unaided eye

multicellular organism an organism with two or more cells

producer an organism that can make its own food and provides food for other organisms

succession the process by which communities of organisms living in an area change over time

unicellular organism an organism with only one cell

SAFETY INFORMATION

Before beginning this activity make sure you know of any allergies students may have. Students should work in teams when gathering water samples from water bodies. Students should be supervised by adults whenever working in or near bodies of water. You may wish to eliminate the collection step by obtaining water samples beforehand. Students should exercise caution when using microscope slides and cover slips. We recommend using plastic slides and cover slips to minimize the risk of breakage. Make sure that students wash their hands thoroughly after handling the water samples. Students should immediately report any cuts, scrapes, or broken glass.

#13 Microscopic Marvels continued

Procedure

A RESEARCH

The dichotomous key provided is extremely basic. It can be used as a starting point for students to develop more detailed keys. As students prepare their dichotomous key, you may find it more appropriate for them to identify different phyla, rather than individual species.

You may have students research common types of pond life, or you may provide a labeled key to various types of pond life.

The purpose of this exercise is for students to become familiar with a methodology for identifying organisms, rather than for them to develop a comprehensive key. Encourage students to refine their keys as they make more observations.

B EXPLORE

Water samples obtained from near the water surface or close to the pond bottom will have the highest number of microorganisms. Also, make sure that students fill each bottle 2/3 full. The air space in the bottle will help maintain the health of the aquatic community.

You could modify this lab by having each team obtain water samples from different water bodies. This would give student teams the opportunity to test hypotheses about the different types of environments in which microorganisms live.

You may ask students to loosen the caps on the water samples during the course of the investigation. Leaving the caps loose will keep the samples from evaporating excessively.

C OBSERVE AND RECORD

Students may record information on the table provided, or you may wish to record all of the data from the student teams on a master table or spreadsheet.

D EXPLORE MORE

Over time the water sample will develop an unpleasant odor, even if it is aerated regularly. Students should still see a rich diversity of microorganisms in the water after several weeks. In the later weeks of this project, students may find that amoebas are more common at the bottom of their water samples than at the surface.

E ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#13 Microscopic Marvels continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: There were many different ways that the microorganisms moved. Some organisms moved using cilia, which are tiny hairs. Others used flagella, which are like whips. Amoebas moved using pseudopods, which are like temporary feet. Other microorganisms did not have a way to move themselves. They just moved in the direction the water flowed.
2. Answers will vary. Sample answer: At first I noticed just a few microorganisms in the water. As the hay decayed, it provided nutrients for bacteria. The bacteria nourished a variety of protozoa.
3. Some of the organisms, such as algae, are producers. They obtain energy from the Sun. Other organisms, such as amoebas, rotifers, and bacteria, are consumers. They obtain energy from other organisms.
4. Answers will vary. Sample answer: Students should mention that producers, such as trees and grasses, are most similar to the algae in the water sample.
5. Answers will vary. Sample answer: Many organisms need oxygen to survive. As bacteria in the water decompose matter, they consume oxygen in the water. Other microorganisms consume oxygen in the water too. If the water is not aerated, the oxygen level in the water will decrease, and the water will not be able to support a diversity of life.
6. I used the low power objective first because it made it easier to find organisms to observe. Starting with the low power objective let me reposition the slide to magnify parts of the sample.

Quiz Answer Key

1. C
2. Answers will vary. Sample answer: Producers are at the base of the food web in an aquatic ecosystem. They convert the energy in sunlight into food. Primary consumers obtain energy by eating producers.
3. A

Name ______________________ Date ____________ Class ____________

#13 Microscopic Marvels

Quiz

1. What is used to observe single-celled organisms?

A. stethoscope
B. oscilloscope
C. microscope
D. telescope

2. What is the role of producers in aquatic ecosystems?

____

____

____

____

3. Which of the following microorganisms are multicellular?

A. rotifers
B. protozoa
C. amoebas
D. bacteria

Name ______________________________ Date ____________ Class ____________

#13 Microscopic Marvels

Procedure

A RESEARCH

In this activity you will use a microscope to identify the organisms in a pond water habitat. One of the best tools you can use to identify organisms is a dichotomous key. Research the types of organisms that are commonly found in pond water. Work as a team to revise and improve your key as you learn more about microorganisms. You can also supplement this key with labeled drawings of the most common microorganisms in pond water.

B EXPLORE

1. With your class, go to a nearby pond or lake to obtain a water sample. Fill a small jar or 2 L bottle 2/3 full of water. You will probably gather the most microorganisms by obtaining a water sample from the edge of the water body near the water's surface or near the bottom.
2. Add several pieces of cut hay to the water. Seal the jar.
3. Use the thermometer to determine the temperature of the water body. Then use the masking tape and the marker to label your water sample. On the masking tape, write your team name, the location where you sampled the water, the date, and the water temperature.
4. Remove the seal or cap from the jar. Your teacher may ask you to loosen the seal and leave it in place. This will help prevent evaporation of the sample. Place the water sample in a warm area of the classroom. The temperature of your sample should remain as close as possible to the original temperature.

SIMPLE DICHOTOMOUS KEY FOR POND LIFE

1 Is it the smallest organism in your field of view? If yes, it is probably a bacterium. If no, go to 2.

2 Is it moving using its own power? If yes, go to 3. If no, it may be a non-mobile form of algae, such as filamentous algae and some diatoms.

3 Is it surrounded by many tiny hairs? If yes, it is a ciliate. Common ciliates are *Paramecium*, *Blepharisma*, and *Vorticella*. If no, go to 4.

4 Does it have one or more large, whip-like appendages? If yes, is a flagellate. It could be *Euglena*, *Volvox*, or *Peranema*. If no, go to 5.

5 Does it look like a large, slow-flowing "blob"? If yes, it is probably an amoeba. If no, go to 6.

6 Does it look like a little insect? Is it made up of many cells? If yes, it could be a rotifer or daphnia, commonly known as a water flea.

Name ________________________________ Date ____________ Class ____________

#13 Microscopic Marvels continued

C OBSERVE AND RECORD

5. Examine the sample. Describe the water quality. Is the water clear, or cloudy? Does the water have a color? Does the water have an odor?

6. Examine the water sample using a hand lens. Look for larger organisms such as insects, and make general observations about the water quality. Record your observations in the table.

7. Use the eyedropper to take a few drops of water from the water sample. Place a drop of the water in the center of a microscope slide. Carefully place the cover slip on top of the water drop. If there are any air bubbles between the cover slip and the microscope slide, gently press on the cover slip to remove the air bubbles.

8. Carefully place the microscope slide on the microscope stage. Observe the organisms in the water. Be sure to wash your hands after handling the water sample.

9. On a separate sheet of paper, sketch each organism you observe. You may sketch the organisms in your science notebook. Try to identify the organisms using the dichotomous key your team prepared. You may also compare your observations or drawing to a labeled key of microorganisms. Record your observations in a table.

Name ________________________ Date ____________ Class ____________

#13 Microscopic Marvels continued

Pond Life

Date	Water Quality	Water temperature	organism	Number observed

Name ______________________________ Date ______________ Class ______________

#13 Microscopic Marvels continued

D EXPLORE MORE

10. Keep your water sample in a warm area. Use a pipette to quickly aerate the water every day. Use the thermometer to measure the water temperature daily. Make sure that your water sample is close to the temperature written on the label.

11. After two to three weeks, add a few pieces of hay to feed the bacteria in the water. Every week, repeat and record your observations. You should notice that the number and types of organisms will change every week, and that your skills using a microscope and identifying microorganisms will steadily improve!

E ANALYZE AND CONCLUDE

1. What differences did you notice in the ways that the microorganisms moved?

____

____

____

2. How did the aquatic environment change over time?

____

____

____

3. Describe two sources of energy in the aquatic community you observed.

____

____

4. Which land organism is most similar to the algae in the water sample you observed?

____

5. Why was it important to make bubbles in the water with the pipette?

____

____

____

6. Why do you use the low power objective first when you examine a specimen with a microscope?

____

____

____

#14 Crunching Science Numbers

Background Information

Calculators, which save time and increase accuracy, are essential tools for many aspects of science work. In addition to the stand-alone variety, calculators can be found within computers or on cell phones. However, a general understanding of calculators is more important than learning to use a specific calculator.

The functions available on a calculator can vary greatly, from the four basic mathematical operations—addition, subtraction, multiplication, and division—to complicated graphing procedures.

Time Required

1 class period

Objectives

- Use a calculator to compute.
- Use a calculator to construct a table.
- Use a calculator to analyze quantitative data.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 1,000-mL beaker

1 triple beam balance

1 metric measuring cup

2 liters of water (approximately)

FOR EACH STUDENT

1 calculator

Vocabulary

calculate complete math computations

calculator a tool that provides technology for use in math computations

percent a rate of proportion per 100 units

SAFETY INFORMATION

Remind students to handle beakers carefully so as to prevent breakage; review class procedures in the case of broken glass. Have students keep calculators away from water.

#14 Crunching Science Numbers continued

Procedure

A THINK

This activity will give students a chance to practice using calculators to generate numbers needed to fill in tables during science experiments.

Make sure that students know how to use a calculator. Identify the keys needed for each of the four mathematical operations and for calculating percentages.

B SET UP

Review with students how to use a triple beam balance. You might want to tell students that some people incorrectly think that mass and weight are the same. Mass is how much matter an object has and weight is the pull of gravity on an object.

Place students into teams of three or four. Make sure that students understand that they should record the beaker's mass without water in the first column for Trials 1, 2, and 3.

C RECORD

Direct students to follow the data table headings so that they can independently make calculations in the data table using the two masses each team previously recorded. Explain that they will use the four basic mathematical operations in addition to percentages. Help students understand that subtracting the mass of the beaker from the total mass gives you the mass of the water.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Number Crunches

Trial	Mass of Beaker	Total Mass of Water in Beaker plus Beaker	Subtract Mass of Beaker from Total Mass	Multiply Water Mass x 5	Add 150	Divide the Previous Total by 4	Find 8% of the Previous Total
1	(n = mass of beaker)	250 g + n	250 g	1, 250 g	1,400 g	350 g	28 g
2	(n = mass of beaker)	375 g + n	375 g	1,875 g	2,025 g	506.25 g	40.8 g
3	(n = mass of beaker)	875 g + n	875 g	4,375 g	4,525 g	1,131.25 g	90.5 g

#14 Crunching Science Numbers continued

Student Sheet Answer Key

1. You subtract the mass of the beaker so that you know the actual mass of the water.
2. Answers will vary. Sample answer: It would save me at least 15 or 20 minutes. This amount of time matters a lot because in my science class I have to work fast to get my experiments completed before the class is over.
3. Answers will vary. Sample answer: It is a good idea for team members to compute and then compare because it provides a good check on whether or not the answers are correct.
4. Answers will vary. Sample answer: Because I'm pretty good at math, the most important benefit to me is saving time.
5. Answers will vary. Sample answer: A calculator works well as long as the person using it knows how to use it.

Quiz Answer Key

1. D
2. 149.3
3. 821.10
4. 255
5. Answers will vary. Sample answer: I would choose one of the calculators that I have and know how to use.

Name ______________________________ Date ____________ Class ____________

#14 Crunching Science Numbers

Quiz

1. Why is a calculator a useful tool in science work?
A. A calculator is the only way that you can calculate math.
B. A calculator is slower than doing math calculations by hand.
C. A calculator is a tool that can be used to create data.
D. A calculator provides a means of saving a great deal of time.

2. Use a calculator to find an answer to this math problem:

330 – 180.7 = ______________________________.

3. Use a calculator to find an answer to this math problem:

48.3 × 17 = ______________________________.

4. Use a calculator to find an answer to this math problem:

30% of 850 = ______________________________.

5. People have access to handheld calculators, calculators on phones, calculators in computers, and calculators within software. How would you decide which type of calculator to use?

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#14 Crunching Science Numbers

Procedure

Ⓐ THINK

A calculator is a tool used for mathematical accuracy and can save us a great deal of time.

Ⓑ SET UP

1. Find the mass of your beaker. In the data table, record the mass in all three cells of the first column.
2. Pour 250 mL of water into your beaker. Find the mass of the beaker. In the Trial 1 row, record the beaker's mass with the water in the second column of your table.
3. Add 125 mL of water to your beaker. Find the mass of the beaker with the extra water. In the Trial 2 row, record the beaker's mass in the second column of your table.
4. Add an additional 500 mL of water to your beaker. Find the mass of the beaker with the extra water. In the Trial 3 row, record the beaker's mass in the second column of your table.

Ⓒ RECORD

1. Follow the directions in your data table headings to fill in all the table cells using your calculator.
2. When all team members have finished their tables, compare calculations. Use a calculator to check calculations and reconcile any differences.

Name ______________________________ Date ____________ Class ____________

#14 Crunching Science Numbers continued

Number Crunches

Trial	Mass of Beaker	Total Mass of Water in Beaker plus Beaker	Subtract Mass of Beaker from Total Mass	Multiply Water Mass x 5	Add 150	Divide the Previous Total by 4	Find 8% of the Previous Total
1							
2							
3							

Name ______________________ Date __________ Class __________

#14 Crunching Science Numbers continued

D ANALYZE AND CONCLUDE

1. Why is it important to subtract the mass of the beaker from the total mass?

2. How much time do you think you saved by using a calculator to fill in the data table instead of calculating by hand? Explain why you think this might be important.

3. Why do you think it is a good idea for team members to each compute all numbers and then compare?

4. There are several benefits to using a calculator. Which benefit do you think is most important? Explain your answer.

5. What do you think is meant by the statement "A calculator works well as long as it is used by a skilled calculator"?

#15 Monarch Butterflies in Migration

Background Information

The migration of the Monarch butterflies is amazing—both in vision and concept. The picture of a tree laden with migrating Monarchs is not one easily forgotten.

The Monarch is a large, deep orange butterfly with black and white markings. Its larvae feed on the leaves of milkweed.

Monarch butterflies migrate south because they cannot survive the winter in colder climates. In fact, they become paralyzed in cold weather. Also, their food becomes scarce as temperatures drop.

Native to southern Canada and the northern United States, the Monarch is the only butterfly that migrates great distances—up to 3,000 miles. In August the butterflies begin to gather and prepare for their long flight south. The adult butterflies feed on the nectar of asters and other flowering plants to provide them with energy for the journey.

The Monarchs follow one of three different routes: Monarchs west of the Rocky Mountains overwinter in eucalyptus trees, Monterey pines, and cypress trees in southern California. Monarchs from the middle Canadian provinces and the U.S. Midwest migrate to the Transvolcanic Mountain Range in Mexico, passing over Texas in a huge cone-shape formation. Monarchs in the East will group together and fly to Mexico to areas about 10,000 feet above sea level, where it is moist and cool.

Time Required

Varies: **1** class period to explain Monarch migration and portions of class periods for recording sightings as they come in

Objectives

- To track the migration of Monarch butterflies.
- To communicate with students in other states and Mexico about the migration of Monarch butterflies.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

1 large wall map of North America

computer(s) with Internet connection

map pins or sticky pads

FOR EACH STUDENT

science notebook

#15 Monarch Butterflies in Migration continued

Vocabulary

migrate to move from one place to another

SAFETY INFORMATION

Students should communicate with other students through school addresses or school e-mails only. Review Internet safety rules.

Procedure

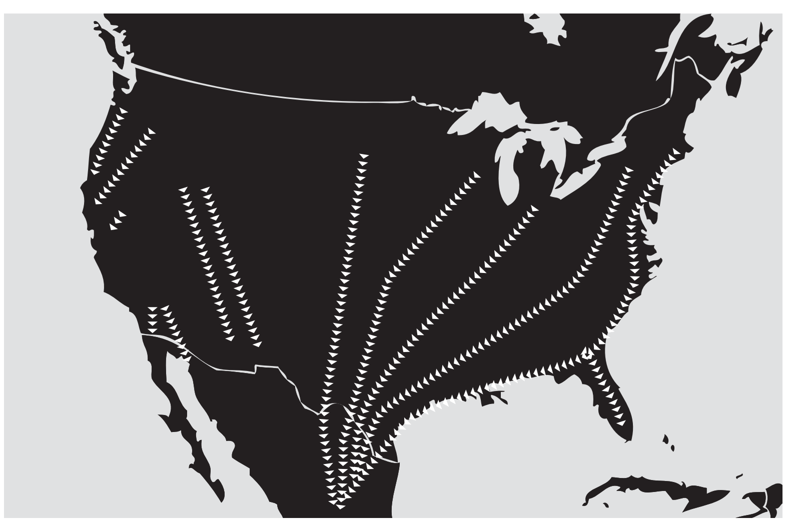
A PLAN

Place students into teams of three or four. Post a large wall map of North America.

Decide on a migration route depending on your location. Contact several schools from school districts along the migration route to find teachers willing to participate in this activity. Ask students and students at other schools to be sure to include the dates of the sightings and any conditions that might influence the migration. Unusually cold temperatures, excessive precipitation, or large forest fires could affect the migratory path.

You can refer to the "Journey North" website at http://www.learner.org/jnorth/monarch/index.html for information on tracking Monarch butterflies.

Determine a start and end date for the activity. You might want to pick a date in early September, for instance, and have students track the butterflies through the end of October.



Map of Monarch Butterfly Migration

#15 Monarch Butterflies in Migration continued

B OBSERVE AND RECORD

Use the chart to find the approximate midpoints of Monarch migration and the period of peak abundance by latitude for your area. ***Note: If you Google your city's name, followed by the word* latitude*, you will find your city's latitude.***

Help students take notes for each sighting. They might want to note how many butterflies they saw, the behavior of the butterflies (were they laying eggs?), the number of butterflies that were seen, and how long the butterflies roosted.

C ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Peaks of Migration by Latitude

Latitude	Peak in monarch abundance
49	18–30 August
47	24 August–5 September
45	29 August–10 September
43	3–15 September
41	8–20 September
39	14–26 September
37	19 September–1 October
35	24 September–6 October
33	29 September–11 October
31	4–16 October
29	10–22 October
27	15–27 October
25	20 October–1 November
23	27 October–8 November
21	3–15 November
19.4*	10–22 November

***This latitude represents the general vicinity of the over-wintering colonies.**

***Source:* http://www.MonarchWatch.org/tagmig/peak.html**

#15 Monarch Butterflies in Migration continued

Student Sheet Answer Key

1. the northeastern United States
2. Answers will vary. Sample answer: The notes give information about the weather, about whether the school is in a city or the country, and how many butterflies were seen. These details are very helpful in understanding butterfly migration.
3. Answers will vary. Sample answer: Monarchs gather close together in trees to stay warm.
4. Answers will vary. Sample answer: not enough food, predators, weather, illness, or death

Quiz Answer Key

1. D
2. southern Canada; the northern United States
3. southern California and Mexico
4. Monarch butterflies migrate because they cannot survive in cold weather and there is less food for them as it gets cooler.

Name ______________________________ Date ____________ Class ____________

#15 Monarch Butterflies in Migration

Quiz

1. Monarch butterflies begin to prepare for their journey south in
   A. early spring.
   B. mid-winter.
   C. early winter.
   D. late summer.

2. The Monarch butterfly is native to ______________________________
   and ______________________________.

3. What two places do Monarch butterflies spend the winter?
   ____
   ____

4. Why do Monarch butterflies migrate?
   ____
   ____
   ____

Name ____________________ Date ____________ Class ____________

#15 Monarch Butterflies in Migration

Procedure

A PLAN

1. Work with your team to write an e-mail message that explains your Monarch butterfly tracking project. Explain that you will contact everyone on your list when a new sighting is reported. That way, schools that are interested can also tract the migration.
2. Send this e-mail to the list of schools that your teacher provides to you.

B OBSERVE AND RECORD

1. Use a data table similar to the one below to track the Monarchs. Or set up tracking information in your science notebook in a way that is meaningful to you.
2. As the sighting information comes in, identify them on the class map, either with a pin or a sticky note. Fill in the data table with the first day, peak, and last day of the sightings.

Butterfly Tracking

Name of School, City, State	First Sighting	Last Sighting	Notes

Name ____________________ Date ____________ Class ____________

#15 Monarch Butterflies in Migration continued

C ANALYZE AND CONCLUDE

1. From which area in the United States do monarchs travel the farthest to get to their winter home?

____

2. Look at the notes you took when you recorded the sightings. What other information, besides place and date, do your notes provide? What does this tell you about the importance of taking detailed notes in science?

____

____

____

____

3. Why do you think Monarchs gather close together in trees?

____

____

____

____

4. Not all Monarchs make it to their winter home in the south. What do you think prevents them from getting there?

____

____

____

____

#16 Scissors, Paper, Rock

Background Information

Scientific data can often be interpreted in various ways. Faulty reasoning, which can lead to errors in science, often causes people to think that gravity, the force that pulls everything toward Earth's center, acts differently on different objects. However, the mass of an object does not affect the rate at which it falls to the ground.

Time Required

1 class period

Objectives

- Predict how three different objects will fall when released from the same position at the same time.
- Attempt to explain the results of the activity.
- Infer what might happen in a similar situation.
- Research what caused the results.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

safety scissors
rubber band
sheet of notebook paper
small, lightweight rock
meterstick
computers with Internet access

FOR EACH STUDENT

science notebook

Vocabulary

predict to state what will happen in the future

SAFETY INFORMATION

Tell students to be careful when handling the scissors. Remind students to make sure other students' feet are not in the path of their falling objects.

#16 Scissors, Paper, Rock continued

Procedure

A PREDICT

Write student predictions on a whiteboard. Ask students to explain why they made these predictions.

B TASK

Place students into teams of four. Have one student watch the other three students drop the rock, paper, and scissors at the same time from the same height. Then have students crumple the paper into a ball and redo the experiment. Have students watch the *Apollo 15 Hammer-Feather Drop* movie without the audio at this website: http://nssdc.gsfc.nasa.gov/planetary/lunar/apollo_15_feather_drop.html

C RESEARCH

Arrange for either library time or computer lab time so that students can conduct research. Tell students that each of them must complete the research, but that they can discuss their findings within their groups. Make sure that students understand that mass does not affect the rate at which objects fall to the ground. Gravity causes all objects to fall toward Earth at a constant rate, but a type of friction called air resistance can cause an object to fall more slowly.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Student Sheet Answer Key

1. Many students will have correctly predicted that the rock and scissors would hit the floor at about the same time and that the paper would fall more slowly. However, most will not realize that the paper was slowed down by air resistance.
2. Answers will vary, but many students will likely (incorrectly) state that objects with greater masses (the scissors and rock, in this case) will fall faster than objects with less mass (the piece of paper).
3. Answers will vary. Possible answer: The crumpled paper hit the ground at about the same time as both the rock and the scissors.
4. Gravity is the force that causes all objects to fall toward Earth at a constant rate.

Quiz Answer Key

1. A
2. Answers will vary. Sample answer: No, scientific data can be explained in many ways.
3. Answers will vary. Sample answer: because the data helps scientists interpret the data correctly

Name ______________________________ Date ______________ Class ______________

#16 Scissors, Paper, Rock

Quiz

1. To predict means
   A. to state something about the future.
   B. to question something about the future.
   C. to explain something about the future.
   D. to study something about the future.

2. Is there only one way to explain the meaning of scientific data?

   ____

3. Why do you think scientists need to collect as much data as possible?

   ____

   ____

   ____

Name ______________________ Date ____________ Class ____________

#16 Scissors, Paper, Rock

Procedure

A PREDICT

1. In the hand game "Rock, Paper, Scissors," scissors beats paper, paper beats rock, and rock beats scissors. In this activity, you will play another type of rock, paper, scissors game. Predict the order in which a pair of safety scissors, a piece of paper, and a rock will hit the ground if all are dropped from the same height at the same time.

B TASK

3. Carefully wrap the rubber band around the blades of the safety scissors so that they won't separate when the scissors are dropped.
4. Work with your team to drop all of the items at the same time from a height of 2 meters. ***Caution: Drop the items so that they won't land near anyone's feet. Also, drop the scissors so that the blades are parallel to the floor.***
5. Crumple the paper into a ball, and redo the experiment.

C RESEARCH

6. Find out what force causes everything to fall toward Earth at a constant rate. Write this force in your science notebook.
7. Find out why the sheet of paper fell more slowly than when it was crumpled into a ball. Write your findings in your science notebook.

Name ____________________ Date ____________ Class ____________

#16 Scissors, Paper, Rock continued

D ANALYZE AND CONCLUDE

1. How did your prediction compare with your result? Explain why you think the objects fell as they did.

____

____

____

2. Why do you think the paper fell more slowly than the rock and scissors?

____

____

____

3. What happened when you crumpled the paper into a ball?

____

____

____

4. What force causes everything to fall to Earth at a constant rate?

____

____

____

#17 WIND, RAIN, OR SHINE

Background Information

Weather is the condition of Earth's atmosphere at a given time and place. Factors that influence weather include air temperature and pressure, humidity, and wind velocity. A thermometer measures air temperature in Fahrenheit and Celsius. A barometer measures air pressure in millibars. A psychrometer consists of two thermometers and is used to measure relative humidity. An anemometer measures wind speed in kilometers per hour and miles per hour. A wind vane measures wind direction. A rain gauge is used to capture and measure, in millimeters, the amount of liquid precipitation that falls to Earth.

Time Required

10 minutes on **5** consecutive days; plus **1** class period to analyze data, make a prediction, and answer questions

Objectives

- Observe and record local weather conditions for five consecutive days.
- Conduct research to find local weather maps for the observational period.
- Use the maps and data collected to predict the local weather.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 Celsius thermometer

1 aneroid barometer

1 psychrometer and relative humidity chart

1 anemometer and wind vane

1 rain gauge

FOR EACH STUDENT

science notebook

scissors

glue or tape

#17 WIND, RAIN, OR SHINE continued

Vocabulary

anemometer an instrument used to measure wind speed

barometer an instrument used to measure air pressure

cold front a front that forms when a cold air mass collides with a warm air mass; brings stormy weather into an area

high pressure system an area in which winds blow outward resulting in fair weather

humidity the amount of water vapor in the air

low pressure system an area in which winds blow into the area causing clouds that produce precipitation to form

relative humidity the amount of water vapor in a volume of air at a specific temperature compared to the amount of water vapor that the volume of air can hold

thermometer an instrument used to measure air temperature

warm front a front that forms when a warm air mass moves into a cold air mass; can bring rain or snow

wind vane an instrument used to determine the direction from which wind blows

#17 WIND, RAIN, OR SHINE continued

Procedure

A OBSERVE AND RECORD

Review the definitions of the weather-related terms on the student page.

Have students begin this activity on a Monday and collect data through Friday.

If students will be using maps from the local newspaper, ask each student to collect and bring in a week's worth of maps on Friday. If your paper arrives late in the day, obtain, copy, and distribute Friday's map to each student prior to the end of the day.

Have pairs or small groups of students work together to complete the data collection part of this activity. However, have each student make his or her own prediction and answer the questions on his or her own.

Demonstrate how to read and use each of the weather instruments. Have volunteers identify which instruments are used to measure or determine each weather condition. Make sure that students understand the meaning of degrees, millibars (mb), kilometers per hour (kph), and centimeters (cm).

Remind students to record both temperatures on the psychrometer each day. Have a standard relative humidity chart available for students to use to determine this weather factor. If necessary, show students how to use the chart.

B RESEARCH

Arrange for computer time if students will not be using the newspaper to obtain their maps.

C PREDICT

Remind students to be as detailed as possible in their predictions and give quantitative values, or a range of numerical values, when predicting temperature, air pressure, wind speed, and volume of precipitation.

Also remind students on Friday that a part of their homework over the weekend will be to check the weather for Saturday and Sunday and compare their predictions with the actual weather.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student sheet. Include class discussion.

#17 WIND, RAIN, OR SHINE continued

Student Sheet Answer Key

1. Answers will vary with the time of day and year during which the data were collected. Make sure students note any trends in either factor.
2. Answers will vary with your location.
3. Answers will vary, but students' predictions of temperature and air pressure should have been very close to the actual weather conditions. Have students compare their predictions to actual weather maps or forecasts for the two days following the data collection period.
4. Answers will vary. Sample answer: A high pressure system moved into the area, which produced windy weather.
5. Answers will vary. Sample answer: A cold front was in the area and produced thunderstorms.

Quiz Answer Key

1. B
2. rain gauge
3. Answers will vary. Sample answer: Relative humidity is measured with a psychrometer, which consists of two thermometers. The temperature of each thermometer is recorded. The two temperatures are compared on a psychrometer chart.
4. Answers will vary. Sample answer: A cold front is when a cold air collides with warm air. A warm front is when warm air collides with cold air.

Name ______________________ Date ____________ Class ____________

#17 WIND, RAIN, OR SHINE

Quiz

1. Air pressure is measured in
A. degrees with a thermometer.
B. millibars with a barometer.
C. kilometers per hour with an anemometer.
D. centimeters with a rain gauge.

2. To measure the amount of liquid precipitation that falls to Earth, I would use a(n) ______________________.

3. How is relative humidity determined?

____

____

____

____

4. What is the difference between a cold front and a warm front?

____

____

____

____

Name ______________________ Date ____________ Class ____________

#17 WIND, RAIN, OR SHINE

Procedure

A OBSERVE AND RECORD

1. Weather is the condition of the air outside at a given time and place. Use the weather instruments (Celsius thermometer, aneroid barometer, psychrometer, anemometer and wind vane, and rain gauge) to measure weather conditions for five consecutive days at the same time of day. Record your measurements and observations of the weather in the data table.

B RESEARCH

2. Use the Internet or a local newspaper to find weather maps of your area for the five-day period. Print the maps and their keys or cut them out of the paper. Glue the maps and map keys into your science notebook. Remember to write the date for each map below it.

C PREDICT

3. Use the data you collected, the maps, and what you know about weather to predict what the weather will be like in your area Saturday and Sunday. Write your prediction on the lines below.

____

____

____

Weather Conditions

Date	Temperature (°C)	Air Pressure (mb)	Relative Humidity	Wind Speed (kph) & Direction	Precipitation: Type & Amount (cm)

Name ______________________ Date ____________ Class ____________

#17 WIND, RAIN, OR SHINE continued

D ANALYZE AND CONCLUDE

1. How did temperature and air pressure change during the five days you observed the weather?

2. Was there any precipitation during the observation period? If so, which type and how much?

3. How did your prediction compare with the actual weather?

4. Did either a low or a high pressure system move into your area as you conducted your observations? If so, how did the system affect your local weather?

5. Were any weather fronts in your area as you carried out this activity? If so, how did they affect your local weather?

#18 Local Landforms

Background Information

Earth's crust is covered by landforms. Mountains, plains, and plateaus are the three major types of landforms. Valleys and hills, beaches and buttes, and cliffs and caves are just a few other types of landforms. Some landforms form as wind, water, ice, and gravity change the surface. Others form as Earth's tectonic plates collide, pull apart, or slide past each other.

Time Required

3 class periods: **1** period to complete and summarize the research; **1** period to make the models; **1** period to present the models

Objectives

- Use credible online sites to find out about the landforms in your state.
- Summarize the research and use it to answer questions.
- Use the research to construct a three-dimensional model of one or more landforms in your state.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 piece of corrugated cardboard, plywood, or foam board, no larger than 25 cm x 25 cm to serve as a base for the models

computers with Internet access and one or more printers

pencils or pens

any appropriate craft materials to make the three-dimensional models—foam sheets, modeling clay, construction paper, polystyrene sheets and cones

colored pencils

scissors

serrated plastic knives

tape

glue

FOR EACH STUDENT

science notebook

#18 Local Landforms continued

Vocabulary

landform a natural geological feature on Earth's surface
mountain an area of land that is significantly higher than the surrounding land
plain a flat area of land at a low elevation
plateau a flat area of land at a high elevation; plateaus are usually marked by valleys, mesas, and other landforms
tectonic plate an enormous slab of Earth's crust and rigid upper mantle that moves slowly over time; plates can collide, diverge, or slide laterally against each other

SAFETY INFORMATION

Review your school's Internet safety policy with students before they begin this activity. Remind students to use scissors and plastic knives with care to avoid cutting themselves. You might want to provide students with lab aprons if they are going to work with modeling clay. Remind students to wear safety goggles.

#18 Local Landforms continued

Procedure

A THINK

1. Ask students to work together to answer the questions listed in the Think section of the student activity sheet provided.
2. Direct students to write or draw their answers in their science notebooks or directly on the student activity sheet.
3. After sufficient time, ask students to share their answers with the class.

B RESEARCH

Students utilize the Internet and available print resources to research the landforms in their area and/or state. Students can visit this site to see photographs of a variety of landforms. *http://science.nationalgeographic.com/science/earth/surface-of-the-earth/*

C EXPLORE

1. Divide the class into small groups of three or four students per group.
2. After a class discussion encourage teams to choose one or two different landforms in your state. Instruct each group to work together to build a model of a landform(s).
3. Remind each group to put together a short presentation about its landform(s) as they work on their models.
4. Allow each group three to five minutes to present and explain their models. If space allows, display the landforms for a day or two after the presentations so that students can observe the models made by other groups.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Student Sheet Answer Key

1. Answers will vary with your location.
2. Drawings will vary. Assess them for scientific accuracy rather than artistic ability.
3. Answers will vary. Sample answer: Surface processes, such as weathering and erosion, together with tectonism formed the landform. Weathering and erosion are constantly changing the landform.

Quiz Answer Key

1. Answers will vary, but students should be able to identify several landforms such as mountains, beaches, cliffs, caves, forests, volcanoes, or waterfalls. They should also know that some landforms are formed by wind, water, ice, and gravity. Other landforms are formed as Earth's tectonic plates collide, pull apart, or slide past each other.
2. Answers will vary with your location.
3. Answers will vary with your location.

Name ____________________ Date __________ Class __________

#18 Local Landforms

Quiz

1. What do you know about landforms?

2. List two landforms found in your area.

3. Describe how the landforms in your area formed. Write or draw your answer.

Name ______________________________ Date ____________ Class ____________

#18 Local Landforms

Procedure

Ⓐ THINK

1. Work together to answer these questions:

- What do you know about landforms?

- What landforms are near your school?

- What landforms are near your town or city?

- Now think about your state. Are there any national parks or monuments in your state that feature landforms?

Write or draw your answers in your science notebook.

Name ________________________________ Date ____________ Class ____________

#18 Local Landforms continued

B RESEARCH

1. Use an Internet search engine to find out about the landforms in your state and how they formed. Print out this information or take notes in your science notebook.
2. Find and print a map that shows the landforms in your state.
3. Write at least three paragraphs to summarize your research. Make sure to include the map in your summary.
4. Use your research to answer the questions in the Analyze and Conclude section below.

C EXPLORE

Work with your team to make a three-dimensional model of one or more of the landforms in your state. Use the materials provided by your teacher. Present your model(s) to the class. Be prepared to answer questions about the landform.

Name ______________________ Date ____________ Class ____________

#18 Local Landforms continued

D ANALYZE AND CONCLUDE

1. List the landforms in your state. Use another sheet of paper, if needed.

____

____

____

____

2. Pick one landform in your state and make a colored drawing of it in the space below.

Name ______________________________ Date ______________ Class ______________

#18 Local Landforms continued

3. Summarize how the landform you chose in Question 2 formed. What processes are changing the landform today?

#19 our Water supply

Background Information

According to the U.S. Environmental Protection Agency (EPA), a watershed is an area in which all the water under the area and all the water that drains off the area ends up in a common waterway. This waterway can be a stream, river, lake, estuary, wetland, aquifer, or even the ocean. There are 21 main watershed areas in the United States and 2,267 local watersheds or watershed sub-basins in the United States and Puerto Rico. Most areas get the freshwater they need from a local watershed (or sub-basin).

Most water pollutants in a watershed come from various sources and are called nonpoint-source pollutants. Nonpoint-source water pollutants include bacteria from leaky septic tank systems and pet wastes, fertilizers and pesticides used on lawns and on farms, sediment from construction, wastes from recreational and commercial boats and ships, urban runoff, and thermal wastewaters from factories and plants, among others.

Water treatment involves filtration, a process that separates solids from a liquid. Particles are removed from water by passing the water through a material, such as sand or coal or a membrane similar to a coffee filter.

Time Required

2 class periods: **1–1.5** periods to collect and organize information about your local watershed and **.5** period to test filter materials and answer questions about the activity

Objectives

- Define the term *watershed*.
- Use the Internet to identify and find out about the local watershed.
- Hypothesize which filtering material will remove the most pollutants from water.
- Test the hypothesis and use the results to infer which filter might remove more pollutants from the dirty water.

#19 our Water supply continued

Materials *Materials available at www.carolina.com*

FOR THE CLASS

1 large container for polluted water

1 roll of fine-mesh screen to use as a sieve, cut into squares

computers (printer optional)

filtering materials—coffee filters, paper towels, cotton balls, cotton fabric squares, coarse brown or white play sand, gravel

paper towels or lab rags to wipe up spills

pollutants—red food coloring, pepper, cooking oil, green liquid dish soap, colored aquarium sand, uncooked rice, and any other nontoxic substances that can be used to model actual water pollutants

warm tap water

wide rubber bands

FOR EACH STUDENT

1 500-mL beaker

1 graduated cylinder

colored pencils

science notebook

Vocabulary

pollutant any substance that contaminates water, air, land, or other natural resource

watershed an area of land in which all the bodies of water on it or under it empty into the same waterway

SAFETY INFORMATION

Remind students to report and wipe up any spilled water immediately.

#19 our Water supply continued

Procedure

A RESEARCH

Arrange for computer time in the library or the computer lab if there are no computers in your classroom. If you want students to print some or all of their findings, also arrange for printer access.

To begin this activity, send students to the EPA's main "Watersheds" page at *http://water.epa.gov/type/watersheds/index.cfm*. Then instruct students to click on the link "Surf Your Watershed." They should follow the directions given to find out about your watershed.

While students are doing their research, make the "polluted" water by adding approximately 100 mL of each "pollutant" to each 3000 mL of warm tap water. Stir the solution just before giving it to students so that at least some of the solids are suspended.

Note: Make enough dirty water so that each student has 250 mL to filter.

B THINK

If necessary, review the meaning of the term *hypothesis* as well as how a hypothesis should be worded.

C EXPLORE

In this task, students explore which materials are best at filtering water in order to make it clean.

Instruct students to line the sieve with his or her filtering material. If a student chooses the play sand or gravel as a filtering material, tell the student to fill the sieve only about three-quarters full.

Note: Allow at least one student to use the sieve alone without any filtering material.

Remind students to slowly pour the "polluted" water through their filter and to wait until all of the water is captured in the beaker before removing the filter to observe the water.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#19 our Water supply continued

Student Sheet Answer Key

1. Answers will vary depending on the filter material chosen. Sample answer: The coffee filters, cotton balls, cotton squares, play sand, and gravel removed many of the solid pollutants as well as some of the dish soap and cooking oil.
2. Answers will vary depending on which filter materials are compared. Sample answer: The coffee filters, cotton squares, and cotton balls removed many of the solid pollutants as well as some of the dish soap and cooking oil. The play sand and gravel also trapped some of the solid pollutants.
3. Answers will vary. Sample answer: I could build a multi-layered filter using three different kinds of materials to filter the polluted water. This is how it's made: First, cut apart an empty 2L plastic bottle into three sections and label them 1, 2, and 3. Cover the bottom section (section 1) with one kind of filtering material, and stack section 2 on top. Then cover section 2 with a different filtering material. Stack section 3 on top of that, and cover it with another kind of filtering material. Pour the water into the top of section 3. The dirty water flows down through the filtering materials into the bottom of section 1.
4. Answers will vary. Sample answer: We could use Earth-friendly cleaning products, recycle or properly dispose of harmful materials rather than dump them down the drain or into the sewers, and buy products from companies that minimize the pollutants used or generated during manufacturing.

Quiz Answer Key

1. D
2. Answers will vary with your location. Students need only to identify the major bodies of water in the watershed, unless they know the names of local creeks and streams.
3. Answers will vary. Sample answer: Paper towels, coffee filters, cotton balls, cotton squares, sand, and gravel removed most or all of the solid pollutants. Paper towels, coffee filters, and cotton balls also removed some of the oil and dish soap from the dirty water.
4. Answers will vary depending on students' choices of filtering materials. However, all students should state that the food coloring was not removed during filtering because it had dissolved in the water.

Name ______________________________ Date __________ Class __________

#19 our Water supply

Quiz

1. A watershed is

A. any river in your state.
B. a stream or river that drains into a pond.
C. a polluted body of water.
D. an area of land that drains to a common body of water.

2. Our watershed is called the ____________________ Watershed, and includes the following bodies of water:

____

____

____

____

3. Which filter material removed the most pollutants from the dirty water? How do you know? What is the evidence?

____

____

____

____

____

____

____

4. Which pollutants were NOT filtered from the water? Can you explain why?

____

____

____

____

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#19 our Water supply

Procedure

A RESEARCH

1. Follow your teacher's instructions to find the EPA website.
   A. Scroll over the map of the United States, and click on your state.
   B. Use the state map to identify the watershed that includes your city or town.
   C. Write the name of your watershed at the top of an empty page in your science notebook. Then either draw and label the watershed or print a copy of it. If you print a copy, trim the paper and glue the image under the name of your watershed.
2. Use the Internet to find out more about your watershed, including the names of the major rivers and lakes in the watershed. Add this information to your picture of the watershed.
3. Research to find out if the waters in your watershed are polluted. Record what you find in your notebook.

B THINK

1. Observe the "polluted" water provided by your teacher.
2. Look closely at the filter materials.
3. Choose one material that you think will remove the most pollutants from the dirty water.
4. Write a hypothesis about the filter material you chose.

C EXPLORE

1. Use a graduated cylinder to measure 250 mL of the polluted water.
2. Slowly pour the water through the filter material and into a clean beaker.
3. Observe both the filter material and the water in the beaker.
4. Record your observations in your science notebook.

Name ______________________________ Date ____________ Class ____________

#19 our Water supply continued

D ANALYZE AND CONCLUDE

1. Which "pollutants" were removed by filtering the water with the material you chose?

2. Compare the filter and "clean" water to the filters and water of at least two other students who used different filtering materials. Describe any differences.

3. Based on your results and your answer to Question 2, explain how you could build a filter that would remove more pollutants than the single material did. Then make and label a drawing of your proposed filter.

Use next page to make your drawing for Question 3.

Name ______________________ Date __________ Class __________

#19 our Water supply continued

Use this page to make your drawing for Question 3.

4. Name at least three ways that you and your family can reduce or prevent pollution in your watershed.

#20 Classifying Local Plants

Background Information

Plants can be found growing in most places on Earth. Currently, more than 300,000 species of plants have been identified in the world, with new plants being discovered annually. Scientists classify plants, as well as other organisms, to make them easier to study. Plants include flowering plants, conifers and other naked seed plants, ferns and horsetails, mosses, and red and green algae.

All plants make their own food through the process of photosynthesis. Plants store food as sugars and starches. Plants, unlike animals, are unable to move from place to place under their own power. Plants vary greatly in size and structure and adapt to their environment with special features. An example is a desert plant that might have a thick stem in order to absorb water more easily. Plant characteristics include waxy or furry leaves, large root systems, thorns, and brightly colored flowers.

Time Required

Time in field will vary. Time in class: **1.5** class periods to group plants and make posters

Objectives

- Explore local area for plants.
- Observe and record plant features.
- Classify plants into groups and subgroups.
- Share and justify classifications.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 piece of corrugated cardboard, plywood, or foam board, no larger than 25 cm x 25 cm to serve as a base for the models

1 hand lens

1 ruler

1 poster board (or art/drawing paper)

1 pack of crayons, colored pencils, or markers

FOR EACH STUDENT

1 trowel

1 pair of non-latex gloves

1 bag, such as a plastic grocery bag

science notebook

#20 Classifying Local Plants continued

Vocabulary

classification a system that groups organisms by how much they are alike
classify to group organisms according to similar features
flower the part of a plant that holds the seeds
leaf plant structure connected to stems; the part of a plant where photosynthesis takes place
root the part of a plant that absorbs water and nutrients from the soil and holds the plant up
seed the part of a flowering plant that can grow into a new plant
stem the part of a plant that connects the leaves to the roots

SAFETY INFORMATION

Before beginning the activity, familiarize students with plants in the area that may be troublesome and should be left alone, such as poison ivy, poison oak, and poison sumac. Make sure that all students wear protective gloves while collecting plants. See the box "Working Safely Outside" on page 29 in the *Science Magnifier*. Also, have students watch out for insects such as bees.

Procedure

A THINK

Explain to students that in order to study plants (or other organisms), scientists first classify, or group, them. Show pictures of different types of plants. Ask students to help you make a list of the plants' various features, such as types of stems, flowers, and roots.

Review the vocabulary terms. Discuss the parts of a plant and their purpose.

B EXPLORE

This task gives students the opportunity to examine and group plants according to similar characteristics.

Take students on a walking field trip to gather the plants (or ask them to collect plants near their home). Remind students to only collect where they have permission to do so, to take only those plants they need, and to record in their science notebook where each plant was found. Also remind students to be respectful of the area and not to trample plants. Students should collect at least five samples each.

C OBSERVE AND RECORD

Put students into teams of three or four. Have the teams observe the plants with the naked eye, a ruler, and a hand lens.

Have teams share their classifications and posters with the class. Ask students which teams had similar classifications.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#20 Classifying Local Plants continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: The wind moves seeds to new places so that a new plant can grow.
2. Answers will vary. Sample answer: Classifying plants helps us to name and organize them.
3. Answers will vary. Students might have found some plants easier to group than other plants.
4. Answers will vary. Sample answer: Some plants have thorns on the stem, which protect the plant from being eaten by animals.

Quiz Answer Key

1. Scientists classify organisms because it makes them easier to study.
2. C
3. Answers will vary. Sample answer: leaves, stem, seeds, flowers, color, and height and length
4. Answers will vary. Sample answer: magnifying glass, gloves, ruler, computer, books, bags

Name ______________________ Date ____________ Class ____________

#20 Classifying Local Plants

Quiz

1. Why do scientists classify organisms?

____

____

____

2. A leaf is the part of the plant that

A. holds the seeds.

B. holds the plant up.

C. uses sunlight to make its own food.

D. absorbs water from the soil.

3. Name at least three features a scientist might look at in order to classify plants in an area.

____

____

____

4. What tools might a scientist use in order to collect and examine plants in order to classify them?

____

____

____

Name ______________________________ Date ____________ Class ____________

#20 Classifying Local Plants

Procedure

A THINK

Scientists classify, or group, living things based on how much they look alike. This makes it easier to study them. Now it's your turn.

B EXPLORE

1. With your class (or at home), collect samples of approximately five small plants or portions from larger plants. You can use the trowel to dig the plant if necessary. Make sure that you wear protective gloves because your skin might be sensitive to some of the plants. You might be able to collect only a portion of some plants. Do not collect plants in any area in which you do not have permission, and respect private property.
2. As you collect, write down in your science notebook where each plant was found.

C OBSERVE AND RECORD

1. With your team, lay out all the plants you collected on a desk or table.
2. Look closely at your plants. Then use a hand lens and ruler. Make notes of what you see in your science notebook. Here are some questions to ask:
   - Does the plant have broad leaves?
   - Does the plant have needles?
   - What color is the plant?
   - Are the plant's leaves smooth, rough, or fuzzy?
   - Does the plant have flowers?
   - Does the plant have thorns?
   - Is the plant's stem thick or thin? Is it short or long?
3. Divide your plants into two or three main groups based on the plants' similarities. Give each main group a name, keeping in mind the similar features. Write the group names and characteristics in your notebook.
4. Now divide each larger group into two subgroups. Give each subgroup a name based on similar characteristics of the plants. Make sure each subgroup has a name based on the plants' similar characteristics. Write the subgroup names and characteristics in your notebook.
5. Choose one subgroup. Make a poster that includes the name and similar characteristics of the plants. Draw colorful pictures of the plants in this subgroup.

Name ________________________ Date ____________ Class ____________

#20 Classifying Local Plants continued

D ANALYZE AND CONCLUDE

1. Did you find any plants with seeds? If so, how do you think the seeds could move to new places in order to grow?

2. Why do you think we classify plants?

3. Did your group find it easy to agree on how to group your plants? Explain your answer.

4. Select one subgroup of plants. Then choose one of the similar characteristics of this subgroup. Tell how you think this characteristic would help this group of plants survive and live in the area where you found it.

#21 Local Animals: A Closer Look

Background Information

Scientists have discovered and named about 1.5 million species of animals. Some scientists project there might be as many as 500,000 more to find, whereas others believe there may be many millions more. This is one of the adventures of science—the discovery of new organisms. The animal kingdom includes mammals, birds, fish, reptiles, amphibians, and invertebrates, which are animals without backbones such as insects and worms. More than 1,000,000 of the known animal species on Earth are insects.

Insects live in almost all regions of Earth. Some insects are common in many areas, whereas others are specific to a particular climate or habitat. In this activity, students will collect local invertebrates (insects) and make a terrarium in order to observe the structures and behaviors of these local animals.

Time Required

Time in field will vary. Time in class: **1** class period to set up terrarium and **10** minutes during **1–4** class periods that follow

Objectives

- Explore local area for invertebrates (insects).
- Set up terrariums.
- Research insects.
- Observe insect structures and behaviors.
- Record data.
- Share data.

#21 Local Animals: A Closer Look continued

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 field guide to insects

1 hand lens

1 digital camera

1 forceps

1 hand trowel

1 small- to medium-size glass terrarium with a fine-mesh screen cover

4 or 5 small living plants (preferably local plants)

1 eyedropper

plastic containers, such as margarine tubs, with holes punched in the lids to hold insects

paper towels

soil, enough for a 2-inch-deep layer in the terrarium

pebbles, enough to have a thin layer at the base of the terrarium

small rocks

charcoal, enough to have a thin layer at the base of the terrarium

Note: Young Entomologist Field Pack (contains collecting tools and field guide) available at www.carolina.com

FOR EACH STUDENT

1 pair of non-latex gloves

1 pencil or pen

1 ruler

1 science notebook

Vocabulary

classification arrangement into a group
classify to group according to similar features
habitat the natural home of an animal, plant, or other living thing
insect a small invertebrate that has six legs and usually one or two pairs of wings
invertebrate an animal that has no backbone or internal skeleton
terrarium a small container in which plants and sometimes small animals live in a balanced environment

SAFETY INFORMATION

Before beginning the activity, familiarize students with local invertebrates that may be harmful and should be left alone, such as bees. Remind students that animals are fragile and should be handled with care.

#21 Local Animals: A Closer Look continued

Procedure

A THINK

Review the insect field guides with students, and identify some common insects found in the area in which they live. Make sure all students have latex or latex-free gloves to wear during collection. Put the vocabulary on the board and review the terms.

B EXPLORE

Place students in teams of three or four. Give them the animal collecting packs. Take students on a walking field trip around the school to collect samples of invertebrates (insects). Have students use the hand trowel to dig carefully in the soil and under stones to locate the animals. The butterfly net can be used to gather insects such as beetles, ants, butterflies, and moths. Put damp paper towels in the plastic containers for the insects. Remind students that these small animals are delicate and need to be handled with care. Also remind students to be respectful of the area by not trampling on the plants and taking only what they need. Each student should collect at least two animals. Remind students to record in their data table where they find each animal.

C SET UP

Have each team prepare their terrarium.

D RESEARCH

Have students use their field guide or the Internet to learn more about the animals they collected.

E OBSERVE AND RECORD

1. Have groups research (using field guide or online) the types of animals they collected. Ask students to find out and record the following in their science notebook:
   - the name of the animal
   - a picture from the digital camera
   - what the animal eats and the feature it uses to catch and eat its food
   - the life span of the animal
   - how the animal protects itself
   - what their antennae are used for
   - how the presence of insects affects the environment
   - what feature the insect uses to move
2. Have students observe and measure the length of the animals with their ruler and record their findings in the data table.
3. Have students provide food for the animals over the period of the activity, based on information in field guide.
4. Over the days that follow, have students spend at least ten minutes per class period observing and recording the animals' behaviors, such as movement, eating, and digging. They should record their findings in their notebook. Students could also add more pictures depicting animal behavior.
5. At the end of the activity period, have students present their findings. Discuss their findings with the class.
6. Release the animals where they were found.

F ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#21 Local Animals: A Closer Look continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: The ants move around the most.
2. Answers will vary. Sample answer: The pill bug (wood lice) crawled under a rock and stayed there. ***Note: It is possible students will collect pill bugs. That's fine, but just make sure students know that pill bugs aren't actually insects, but isopods.***
3. Answers will vary. Sample answer: The ants have jointed legs. The pill bug has jointed legs. The grasshopper has jointed legs and wings. The sulfur butterfly has jointed legs and wings.
4. Answers will vary. Sample answer: The ants have mandibles that look like pinchers that can bite and pull food. The pill bugs have small mouth parts that scrape and chew leaves and rotting plants. The grasshopper has a mandible that holds and crushes food. The butterfly has a long tube called a proboscis that it uses to drink things like nectar and sap.
5. Answers will vary. Sample answer: Antennae are sense organs that help an insect smell and sense its environment
6. Answers will vary. Sample answers: Insects are food for some animals. Some insects eat other insects. Some insects pollinate plants. When insects die, they help fertilize the soil.
7. Answers will vary. Sample answer: I don't think the pill bugs we collected could live in a desert. They need a damp area with rotted plants or tender plants to eat. I also learned that they breathe through gills, so they need to be in a very moist habitat.

Quiz Answer Key

1. D
2. jointed legs; wings
3. Antennae are sense organs that help an insect smell and sense its environment.
4. Answers will vary. Sample answer: Animals that eat insects die off or need to move in order to find food. Plants that depend on insects to pollinate them would not be able to produce seeds.

Name ______________________ Date ____________ Class ____________

#21 Local Animals: A Closer Look

Quiz

1. An insect is
  A. a small animal with wings.
  B. a small invertebrate with eight legs.
  C. a small animal that has jointed legs and no internal skeleton.
  D. a small invertebrate that has six legs and usually has one or two pairs of wings.

2. What are two main features most insects have that allow them to move from place to place?

____

____

3. How do antennae help an insect live and survive?

____

____

____

____

4. If all the insects in an area died off, how might that affect the other living things in that area?

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#21 Local Animals: A Closer Look

Procedure

A THINK

Insects are invertebrates, which means they are animals that don't have a backbone or an internal skeleton like you do! There are more insects than any other type of animal on Earth. There are more than 1,000,000 species of insects. All insects have six jointed legs, and most insects have one or two pairs of wings.

B EXPLORE

1. You're going to go on an insect hunt to learn more about insects that live in your area. With your class, collect samples of insects. These animals are very delicate, so collect them with care.
2. Make sure that you wear protective gloves, and use the collecting tools you have been given.
3. As you collect, write down where each animal was found. Be specific. Was it found in a tree? Where? Under a rock? On a bush or a blade of grass?
4. Taking a picture of the animal in its surrounding environment will help you remember the details.

Name ______________________ Date __________ Class __________

#21 Local Animals: A Closer Look continued

C SET UP

With your team, set up your terrarium:

1. Wash and dry the terrarium.
2. Making thin layers, add first the charcoal, then the pebbles, and then the soil. Soil should be deep enough to support a small plant, about 2 inches deep.
3. With a finger, dig a small hole big enough for the plant's roots. Place the plant in the hole, and gently pat in into place. Do not put plants too closely together.
4. Add rocks to the terrarium for the insects to use.
5. Carefully add the animals to the terrarium.
6. Cover the terrarium with a screen top.
7. Place the terrarium near light, such as a window, but do not place directly in the Sun.
8. Water the terrarium with an eyedropper just enough to make it damp. Do not overwater. Check the soil each day, and water as needed.
9. Next, use your hand lens and ruler to carefully measure your insects. Fill in the data table on what you find.

D RESEARCH

To find out more about the insects you collected, use your field guide or go online.

E OBSERVE AND RECORD

Provide your insects with food. Over the next few days, observe the animals in your terrarium for at least ten minutes. Complete the data table, and then answer the questions on the worksheet.

Name ______________________________ Date ____________Class ____________

#21 Local Animals: A Closer Look continued

Local Animals We Found

Name of Animal	Length of Animal	Color(s) of Animal	How Many of This Animal Did You Collect?

Name ______________________ Date __________ Class __________

#21 Local Animals: A Closer Look continued

F ANALYZE AND CONCLUDE

1. Which animal is the most active?

____

____

2. Which animal is the least active?

____

____

____

3. Name each animal and describe the features each has for getting from place to place.

____

____

____

____

____

____

____

____

____

____

____

Name ______________________ Date ____________ Class ____________

#21 Local Animals: A Closer Look continued

4. Name each animal and describe the features each has for catching and eating food.

5. Do any of your animals have antennae? How do you think antennae help an insect live and survive? (You may need to look this up!)

6. What important role(s) do you think insects play in their natural habitats?

7. Choose one of the insects you collected. Do you think this animal could live in a different area of the country, where it is colder or hotter, or wetter or drier than your area? Explain your answer.

#22 States of Matter

Background Information

Three states of matter are solid, liquid, and gas. A solid has a definite size and shape and is often hard. A liquid has no specific shape. It will take the shape of the container it is in or will spread out if spilled on the ground. A liquid has a definite volume that can be measured. A gas has no specific shape and no specific volume. It will completely fill whatever container it is in.

All matter is made up of tiny particles (atoms and molecules). In a solid, the particles are packed closely together and barely move. This helps the solid keep its shape. In a liquid, the particles are still somewhat close together, but not as close together as they are in a solid. They can slide past each other, which is why a liquid takes the shape of the container it is in. The particles in a liquid move faster than the particles in a solid. In a gas, the particles move so quickly that they form no definite shape at all. They completely fill a container or they spread out in the air in all directions.

Temperature affects the particles in matter. When the temperature increases, the particles move faster. When the temperature decreases, the particles slow down.

Time Required

1 class period

Objectives

- To observe water in three states of matter.
- To observe and generalize how matter changes from a solid to a liquid to a gas.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

1 triple beam balance

5 large ice cubes

1 heat-safe beaker (500 mL or sufficient to hold 5 ice cubes)

1 hot plate

1 set of heat-resistant mitts

FOR EACH STUDENT

1 pair of safety goggles

#22 States of Matter continued

Vocabulary

gas a state of matter that does not have shape or volume

liquid a state of matter that keeps its volume but not its shape and can be poured from one container into another

solid a state of matter that keeps its shape, even when it moves

SAFETY INFORMATION

Students should wear safety goggles throughout the activity. Caution students with long hair or in loose-fitting clothing to be especially careful when they are using the hot plates. Students should not touch anything with their bare hands; those students who handle the heated beakers should wear heat-resistant mitts to prevent burning. Be sure to keep the hot plates away from water to avoid the chances of electric shock, and make sure all electric cords are not frayed and untangle them so that no one can trip on them.

#22 States of Matter continued

Procedure

A THINK

Review the vocabulary terms. Make sure that students understand the three states of matter.

B OBSERVE AND RECORD

Place students into teams. Demonstrate how to use the triple beam balance to figure mass. Explain to students that water exists in three states of matter. Water can be a solid (ice), a liquid, and a gas (water vapor). When they drink a cool beverage on a warm day, drops of water will form on the outside of the glass. These drops of water come from the water vapor in the air. Make sure that students understand that they should use the heat-resistant mitts whenever handling the heated beaker. Also make sure that the hot plates are turned off when not in use and to never leave a working hot plate unattended. Remind students to not allow the water in their beakers to completely boil off. Make sure that hot plates are in perfect working order. Take into consideration the maturity level of the students before starting this activity. You might want to demonstrate the activity for the class as a whole.

C ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

States of Matter

Material	Mass (with Beaker)	Observations
Ice cubes (solid)	Answers will vary.	Ice has a definite shape and does not change shape. It makes a loud sound when it hits the side of the beaker. It is cold.
Water (liquid)	Measurement should closely match that of beaker and ice cubes.	Water takes the shape of the beaker. It has a wavelike motion. It is not as cold as the ice.
Water after boiling (water vapor)	Measurement should be less than that of the beaker and water before boiling.	The water appears to disappear after boiling. You cannot see it when it goes into the air as water vapor.

#22 States of Matter continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: The water became a gas and went into the air as water vapor.
2. Answers will vary. Sample answer: The higher temperature caused the particles to speed up and change its state. When I heated the ice cube, it changed from a solid to a liquid to a gas.
3. Answers will vary. Sample answer: The ice changed form.
4. Answers will vary. Sample answer: The water in the puddle becomes a gas. The water vapor goes into the air. But the water is not gone. It has just changed into another state.

Quiz Answer Key

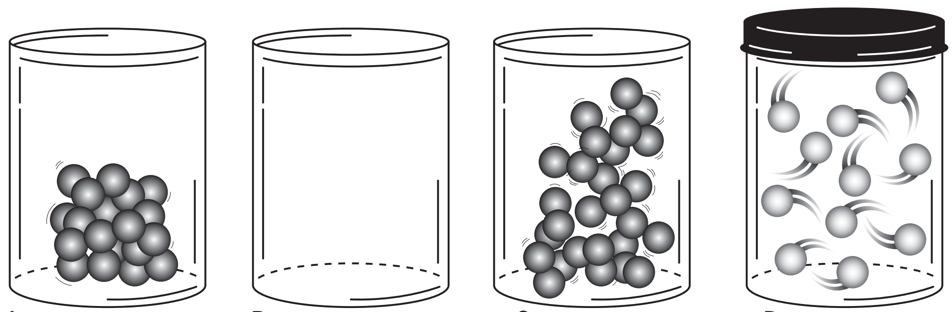
1. C
2. A
3. faster
4. Answers will vary. Sample answer: Both should weigh the same. When matter moves from liquid to solid, the particles slow down. The particles do not disappear.

Name ____________________ Date __________ Class __________

#22 States of Matter

Quiz

1. Which image below most likely shows a liquid?



A. B. C. D.

2. In which of the following are the particles closest together?

A. a solid
B. a liquid
C. gas at low temperature
D. gas at high temperature

3. When ice changes to water, the particles move ______________________.

4. One morning you weigh a tray filled halfway with water. Then you put the tray and water in the freezer. The next morning you take the tray out and the water is frozen. You weigh the tray again. Will the tray and frozen water weigh more, less, or the same as it did the morning before? Explain your answer.

____

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#22 States of Matter

Procedure

A THINK

Did you know that water exists in three states of matter? Water can be a solid, such as ice. It can be a liquid, such as a lake. It can also be a gas called water vapor.

B OBSERVE AND RECORD

1. Put on your safety goggles.
2. With your team, place five ice cubes inside of the beaker.
3. Using the triple beam balance, weigh the beaker and ice cubes. Record this measurement in the data table.
4. Look at the ice cubes. Describe how the ice cubes look. What happens when you tilt the beaker with the ice inside? Record your observations in the table.
5. Place the beaker with the ice cubes on the hot plate. Heat the ice until it melts and becomes water.
6. When all of the ice is completely melted, turn off the hot plate. Remove the beaker using heat-resistant mitts. Then weigh the beaker and water. Record the measurement in the table.
7. Look at the water. Describe how the water looks. What happens when you tilt the beaker with the water inside? Record your observations in the table.
8. Put on the heat-resistant mitts. Place the beaker and water back on the hot plate, and turn it back on. Heat the water until it boils. As the water boils, it will slowly disappear.
9. When the water is almost completely gone, turn the hot plate off. Remove the beaker using heat-resistant mitts. Then weigh the beaker and water. Record the measurement in the table.
10. What happened to the water? Record your observations.

States of Matter

Material	Mass (with Beaker)	Observations
Ice cubes (solid)		
Water (liquid)		
Water after boiling (water vapor)		

Name ______________________ Date ____________ Class ____________

#22 States of Matter continued

C ANALYZE AND CONCLUDE

1. The weight of the beaker and water should have been less after most of the water boiled off. What do you think happened to most of the water?

2. How do you think temperature affects the speed of the particles in matter?

3. Think of what you observed when the ice cube changed to water. What can you conclude?

Name ______________________ Date ____________ Class ____________

#22 States of Matter continued

4. Think of the water that was missing from the beaker after the water boiled. Then think about a puddle of water that dries up on a warm day. What can you conclude about why the puddle disappears? Are the water particles gone forever? Explain your answer.

#23 Reduce, Reuse, Recycle

Background Information

Although students of this generation have been raised with the concepts of the 3 R's, and recycling bins are a common site in most communities, it is always a good idea to revisit the concept of conservation. Why do we do it? Why do we care? What are the consequences of not caring? Is there a better way?

To *reduce* means to use less of something so that there is less waste in the end. An example of reducing would be to buy fewer things. Americans buy three to five more items on average than people from other countries. Our excess ends up in landfills. Things we could do to reduce include buying items with less packaging, buying items in bulk, and refusing junk mail.

To *reuse* means to use something over again, sometimes in a different way. There are many simple ways we can reuse an item:

- Take a travel mug to a fast food restaurant rather than use the disposable cup provided.
- Wash and reuse plastic cups and utensils when you take them on outings. They are convenient, lightweight, and easy to transport, but unless they break, they don't need to be thrown away.
- Fix large items, such as appliances, bikes, and sports equipment, when they break; sell them at a yard sale; or give them to a family member, friend, or charitable organization.
- Buy used rather than always opting for new.
- Don't buy gift wrapping. Instead, use the comics from the Sunday newspaper or rolls of wallpaper that might be sitting in your basement. Cut up a paper grocery bag and decorate it with your own art.
- Buy vintage clothes. There are endless possibilities for deconstruction and reconstruction of these types of clothes, which can be found at resale shops or yard sales. All that is needed are scissors and needle, embellishments, and, sometimes, a sewing machine.
- Reuse store bags by taking them with you when you go shopping.

To *recycle* generally means to take an item to a center where it is made over into the same item or into new items. Most cities have established recycling programs that are set up for things such as paper, glass, and aluminum. Other items, such as batteries, electronics, oil-based paint, and other hazardous waste, require special treatment. Special recycling events can be found in many communities. Call your local city or county government to find out information about recycling.

Time Required

2 class periods: **1** class period to find examples of reducing, reusing, and recycling and **1** class period to discuss student conservation projects

#23 Reduce, Reuse, Recycle continued

Objectives

- To demonstrate an understanding of the ongoing importance to reduce, reuse, and recycle our natural resources.
- To examine current personal and classroom conservation practices.
- To choose one area of conservation in which to make a change for improvement and to implement that change in the home or in the classroom.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

computers with Internet access

FOR EACH STUDENT

science notebook

Vocabulary

recycle to dispose of an item in an environmentally friendly manner

reduce to use less of an item

reuse to use something again, or to find a new use for the item

waste anything released into the environment in a manner or quantity that could have a negative impact

SAFETY INFORMATION

If students plan on handling waste materials, they should wear protective gloves. All materials should be recycled in the proper manner. Point out the dangers of glass shards and sharp metal pieces, as necessary.

#23 Reduce, Reuse, Recycle continued

Procedure

A QUESTION

Make sure that students understand the terms *reduce*, *reuse*, and *recycle*.

B RECORD

Divide the classroom into teams of two or three. Direct students to discuss with their teams the types of items found in their homes and in your school that could be reduced, reused, or recycled. This should be a general discussion—enough to jump-start some ideas beyond the obvious responses. Then have teams use the Internet to find additional ways to reduce, reuse, and recycle.

C EXPLORE MORE

Direct students to their data tables, and tell them that they will be working individually to identify an item to reduce, reuse, or recycle in their homes. (Or have students work with their teams in the classroom.) Students should choose one item to reduce, reuse, or recycle, set up a plan to do this, and analyze their findings. Have students report back to class when they have completed the assignment.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Items to Reduce, Reuse, and Recycle

Item	Method	Internet Ideas
Clothing	Reuse: Buy from used clothing shops	Give clothing to charity
Bags	Reduce: Use cloth bags at grocery stores instead of plastic bags	Refuse bags at grocery store if possible
Bottles	Recycle: Toss in recycling bin	Collect bottles in neighborhood and take to recycling center

#23 Reduce, Reuse, Recycle continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: My plan is to have my family buy used clothing. I needed to find stores that sell used clothing and ask my family members to shop there.
2. Answers will vary. Sample answer: The most difficult part was talking my siblings into buying used clothing because they were afraid the clothes wouldn't fit or look "in."
3. Answers will vary. Sample answer: It was easy to find used clothing shops in the phonebook or on the Internet.
4. Answers will vary. Sample answer: Yes, I think it would be easy for Americans to reduce, reuse, and recycle. Americans are used to recycling, and many families trade their outdated things with other families. Also, cloth bags are becoming very popular.

Quiz Answer Key

1. B
2. reduce
3. Answers will vary. Sample answer: The best way to conserve Earth's resources is to buy and use less. Americans buy three to five times more than the rest of the world. This stresses Earth's resources and landfills.
4. Answers will vary. Sample answer: Recycling is the most accepted because many towns have recycling programs. Reusing things is not as common in American life and is the least accepted. Most people like to buy new things rather than buy something that someone else owned.

Name ______________________ Date ____________ Class ____________

#23 Reduce, Reuse, Recycle

Quiz

1. To find a new purpose for an old item is to
   A. reduce.
   B. reuse.
   C. recycle.
   D. waste.

2. To ______________________ means to use less of something so that there is less waste in the end.

3. What is the best way to conserve Earth's resources? Explain your answer.

4. In your opinion, which of the three R's—reduce, reuse, recycle—is the most accepted and recognized element of American society? Which is the least? Explain your answer.

Name ______________________________ Date __________ Class __________

#23 Reduce, Reuse, Recycle

Procedure

A QUESTION

1. What do you think it means to reduce, reuse, and recycle?
2. How does your family reduce, reuse, and recycle at home? What evidence can you see of reducing, reusing, and recycling at school?

B RECORD

3. With your team, complete the data table using as many examples of reducing, reusing, and recycling as you can think of. Be creative, but be realistic.
4. On the Internet, research these items and see what additional ideas you can find for reducing, reusing, and recycling.

C EXPLORE MORE

5. Look at the items in your data table. Think about all of the ideas you have discussed. Then choose one reduce, reuse, and recycle idea that you can carry out at home or at school.
6. Create a plan for your project. Decide how you will put this plan in motion and what you want the outcome to be. Write down ideas about your plan in your science notebook.
7. Put your plan into place. What do you need to do first?
8. Report back to your class about your plan and how it works.

Items to Reduce, Reuse, and Recycle

Item	Method	Internet Ideas

Name ______________________ Date __________ Class __________

#23 Reduce, Reuse, Recycle continued

D ANALYZE AND CONCLUDE

1. Describe your conservation plan.

2. What was most difficult about putting your plan into place? Explain your answer.

3. What was easy about putting your plan together? Explain your answer.

4. Do you think it is possible for Americans to efficiently reduce, reuse, and recycle? Explain your answer.

#24 Modeling the Solar System

Background Information

Our solar system consists of the Sun, eight planets, dwarf planets, many moons, comets, and asteroids. The planets vary in size and in distance from the Sun. The four inner planets are small and dense and made of rock and metal. The four outer planets are less dense and made of gas and ice.

It is difficult to make a model that shows both size and distance because the Sun is much larger than other bodies in the solar system and the solar system is very large and consists mostly of empty space.

Time Required

1 class period

Objectives

- Create scale models that show the size and position of astronomical bodies in the solar system.
- Explain why it is difficult to make a scale model that shows both the relative sizes and positions of bodies in the solar system.
- Draw conclusions about the vast size of objects in the solar system and their distance from the Sun.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

10 wooden stakes

1 50 m measuring tape

4 cups white flour or cornmeal

string

FOR THE TEAM

1 meterstick or metric ruler

1 round white coffee filter or 1 piece of newsprint

1 index card

scissors

tape

#24 Modeling the Solar System continued

Vocabulary

astronomical body a naturally occurring object that exists in outer space
inner planets the four planets closest to the Sun (Mercury, Venus, Earth, and Mars)
outer planets the four planets farthest from the Sun (Jupiter, Saturn, Uranus, and Neptune)
scale model a representation of an object or system that is proportionally larger or smaller than the original
solar system the system that includes the Sun and all the objects that revolve around the Sun

SAFETY INFORMATION

Identify any gluten allergy problems for each student to foresee potential hazards when using flour. Remind students to be careful when using scissors. They should immediately report to you any cuts, scrapes.

#24 Modeling the Solar System continued

Procedure

A PREDICT

Provide students with definitions of the vocabulary terms. If students have difficulty understanding what scale models are, provide some common examples to generate discussion. You could show students a doll, a map, and a toy car. Have students discuss other examples of scale models.

B EXPLORE

This activity works best in a large open area such as an athletic field. It can also be adapted for a long school hallway, a gymnasium, or a cafeteria. To minimize waste, students can mark the position and size of astronomical bodies using a biodegradable material such as white flour or cornmeal. You may wish to demonstrate Step 4 for the class and then challenge student teams to model other bodies in the solar system. Students can use the stake, string, and flour/cornmeal method for large planets such as Jupiter, but they can model smaller planets by cutting them from scrap paper. It will be easier for students to dispense the flour/cornmeal if it is poured into a small plastic or paper bag beforehand.

Students can step inside the circle that represents the Sun. They can model the size of the other planets and Pluto inside the circle.

C EXPLORE MORE

Students may enjoy developing other ways to make a scale model of the solar system. For example, they can make models using marbles, dried peas, and inflated balloons to indicate the size of the planets. Also, students can model the amount of time each astronomical body takes to orbit the Sun. For example, if Earth takes 1 minute to orbit the Sun, it would take Pluto 248 minutes!

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#24 Modeling the Solar System continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: My predictions about the size of the planets were not accurate. I also did not correctly predict the size of the solar system model.
2. Answers will vary. Sample answer: My predictions about the size of the planets were not accurate. The planets are much smaller than the Sun. I also did not correctly predict the size of the solar system model. The solar system is much larger than I thought.
3. Scale models show a larger or smaller version of something. The models we built were scale models because the size and position of astronomical bodies in the solar system were reduced by an equal amount in each model.
4. The inner planets are much smaller than the outer planets. In addition, the inner planets are much closer to the Sun than the outer planets.
5. Answers will vary. Sample answer: Models are useful to represent things that are very big or very small. A model helps people see the parts of something more clearly. Models can be changed easily, and they can be useful when direct observation is unsafe or is very costly. However, models simplify objects and systems, so they can be misleading or inaccurate.
6. Answers will vary. Sample answer: The models we made were limited because they were two-dimensional. The Sun and the planets are actually spherical. However, it would have been difficult to build a sphere with a diameter of 10 m.
7. It is difficult to make a model that shows both size and distance because the Sun is much larger than other bodies in the solar system and the solar system is very large. For example, if the Sun were 10 m wide, Pluto would be more than 42,000 m from the Sun.

Quiz Answer Key

1. D
2. C
3. A

Name ____________________ Date ____________ Class ____________

#24 Modeling the Solar System

Quiz

1. A(n) __________ model is smaller or larger than the object or system it represents.
   A. computer
   B. hypothetical
   C. experimental
   D. scale

2. Which are the three largest planets?
   A. Uranus, Neptune, Earth
   B. Earth, Venus, Jupiter
   C. Uranus, Saturn, Jupiter
   D. Neptune, Mercury, Venus

3. Which of the following planets has the shortest orbit?
   A. Mercury
   B. Venus
   C. Earth
   D. Uranus

Name ______________________________ Date ____________ Class ____________

#24 Modeling the Solar System

Procedure

A PREDICT

In the class model, the Sun is 10 m wide.

- If the Sun is 10 m wide, how large will Earth be?
- How large will Jupiter be?
- How far from the Sun would Earth be?
- How far from the Sun would Pluto be?

Record your predictions and then share them with the class.

B EXPLORE

1. In addition to the eight planets in the solar system, you will also be modeling the Sun and Pluto. Form teams and choose an astronomical body to model. Each team should model a different astronomical body.
2. The table below shows the radius of the astronomical bodies in your model. Find the astronomical body your team has chosen.
3. On an index card, write the name of the astronomical body, its radius in the model, and its actual radius.
4. Next, your teacher will take your class to a large open area. The team that is modeling the Sun should place a wooden stake in the ground and tie one end of the string to the stake.
5. Then one team member should stretch the string until it is 500 cm (5 m) from the stake.
6. The team member should cut the string and begin walking slowly around the stake, holding the string tight. As the team member walks, he or she should deposit flour or cornmeal on the ground, marking a large circle. This circle represents the circumference of the Sun.
7. Your team should cut a circle from the coffee filter or scrap paper that represents the size of the body you are modeling.
8. Attach the circle to your team's wooden stake with tape. If the body is small, you can tape it to the top of the stake. If it is larger, you can lay it flat on the ground.
9. Tape the index card label you prepared to the stake.
10. Explore the model and note how small the planets are when compared to the Sun.

Modeling Size

Astronomical Body	Actual Radius (km)	Diameter in Model (cm)	Astronomical Body	Actual Radius (km)	Diameter in Model (cm)
Sun	69,5950	1,000.0	Jupiter	71,492	102.7
Mercury	2,433	3.5	Saturn	58,219	83.7
Venus	6,053	8.7	Uranus	23,470	33.7
Earth	6,371	9.2	Neptune	22,716	32.6
Mars	3,380	4.9	Pluto	1,137	1.6

#24 Modeling the Solar System continued

C EXPLORE MORE

1. Now you are going to model the relative distance of astronomical bodies in the solar system. You will not be modeling the size of the bodies because, in this model, the Sun would be 1 cm wide, and Jupiter would be about 1 mm wide.
2. The group that is modeling the Sun should attach the end of the meter tape to the stake that represents the center of the Sun. They should then unroll the meter tape in a straight line away from the Sun.
3. Other groups should find their distance from the Sun in the table below. Place the stake that represents the planet or body you are modeling at the correct distance from the Sun.
4. Explore your model, and note the position of the inner and outer planets.

Modeling Distance

Astronomical Body	Actual Distance from Sun (km)	Distance in Model (m)
Sun	—	—
Mercury	57,950,000	0.4
Venus	108,110,000	0.8
Earth	149,570,000	1.1
Mars	227,840,000	1.6
Jupiter	778,140,000	5.6
Saturn	1,427,000,000	10.3
Uranus	2,870,300,000	20.6
Neptune	4,499,900,000	32.3
Pluto	5,913,000,000	42.5

Name ________________ Date ________ Class ________

#24 Modeling the Solar System continued

D ANALYZE AND CONCLUDE

1. Were the predictions you made about the size of the planets and their distance from the Sun accurate?

2. Explain how your predictions were accurate or inaccurate.

3. Describe why the models you built in this activity were scale models.

4. The inner planets are Mercury, Venus, Earth, and Mars. The outer planets exist beyond Mars. Describe two differences between the inner planets and the outer planets that you noticed in the model.

Name ______________________ Date ____________ Class ____________

#24 Modeling the Solar System continued

5. Describe the advantages and limitations of using models to represent objects or systems.

____

____

____

____

____

6. Describe one limitation of the scale models you made.

____

____

____

____

____

7. Why would it be difficult to make one solar system model that accurately shows the size of the planets and their distance from the Sun?

____

____

____

____

____

#25 Metal or Nonmetal?

Background Information

The elements on the periodic table can be classified as metals, nonmetals, and metalloids. Comparing the physical properties of a material can help determine whether it is a metal, a nonmetal, or a metalloid.

Metals have luster, are malleable, and conduct electricity. Metals are solid at room temperature, except for mercury, which is liquid. Some metals are attracted to magnets. Examples of metals include magnesium, zinc, iron, lead, tin, silver, gold, platinum, and potassium.

Nonmetals do not have luster, are not malleable, and are not attracted to magnets. Only one nonmetal element, graphite, conducts electricity. Nonmetals can be solid, liquid, or gas. Examples of nonmetals include hydrogen, nitrogen, carbon, helium, oxygen, and sulfur.

Metalloids have some physical properties of metals and some of nonmetals. Examples of metalloids include boron, silicon, and arsenic.

Time Required

1 class period

Objectives

- Observe various substances and determine their luster, malleability, electrical conductivity, and magnetic attraction.
- Use physical characteristics to determine whether each substance is a metal or a nonmetal.
- Draw conclusions about how the physical characteristics of metals and nonmetals make them useful for specific applications.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 hand lens

1 multimeter (to test conductivity)

1 magnet

examples of elements: copper, tin, iron, aluminum, silicon, tin, carbon, etc. (A hardware store is a good, inexpensive source of materials, such as zinc-plated screws, iron washers, copper wire, and so on.)

examples of nonmetals, such as wood, chalk, and plastic (It is acceptable to use compounds in addition to elements.)

#25 Metal or Nonmetal? continued

Vocabulary

conductor a material that allows heat or electric current to flow through it easily

luster describes the way the surface of a mineral reflects light

malleability the physical property of a substance that allows it to be bent easily without breaking

SAFETY INFORMATION

Make sure that students use adequate hand protection when evaluating malleability. Remind students to immediately report any cuts or scrapes.

Procedure

A THINK

Students do not need to be familiar with the periodic table to complete this activity. However, this activity is a good way to reinforce differences between groups of elements in the periodic table. You might want to have a copy of the periodic table available to show students.

Provide students with the definitions of the properties they will be testing, and discuss the vocabulary terms. Make sure students understand the differences between metals and nonmetals. You might mention that most living (and once living) things are made mostly of the elements carbon, hydrogen, oxygen, and nitrogen and that these are nonmetal elements.

B PLAN

Place students into teams of three or four. Help students plan how they want to organize their teams. For instance, each student could test a specific property or a student could conduct each of the tests on one or more samples. Show students how to use the hand lens and multimeter.

C OBSERVE AND RECORD

Try to obtain at least ten examples for students to test. If possible, provide different kinds of samples of each element. For example, you could provide a piece of copper wire and a copper-plated penny with a dull finish. Providing two samples of a substance will prompt student debate and reinforce the idea that conducting many different tests will help them accurately identify a substance.

Be sure to allow enough time for teams to discuss their results. If you would like to extend instruction, you could have teams make a simple dichotomous key or flow chart that depicts their testing plan. This also makes an effective post-activity assessment for individual students.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#25 Metal or Nonmetal? continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: I tested a piece of copper wire, and because it has a luster, can be bent, is a good conductor of electricity, and is attracted to magnets, it is a metal. I also tested a piece of wood, and because it does not have a luster, cannot be bent, does not conduct electricity, and is not attracted to magnets, it is a nonmetal.
2. Answers will vary. Sample answer: The physical characteristics of a substance can be difficult to find. You need to perform several different tests to figure out the identity of a substance.
3. Answers will vary. Sample answer: I think metalloids have some properties of metals and some properties of nonmetals.
4. Answers will vary. Sample answer: Metals are malleable, which enables them to be bent easily. Metals also conduct electricity, which makes them useful for electronic devices.

Quiz Answer Key

1. B
2. C
3. malleable
4. arsenic
5. Answers will vary. Sample answer: Water does not pass the other tests: It does not have luster, it is not malleable, and it is not attracted to magnets. Also, water is not an element.

Name ______________________________ Date ____________ Class ____________

#25 Metal or Nonmetal?

Quiz

1. Which of these is a metal?
  A. silicon
  B. lead
  C. carbon
  D. glass

2. If a substance is a nonmetal, which of the following statements is true?
  A. It is attracted to magnets.
  B. It is never a gas.
  C. It is dull.
  D. It is solid at room temperature.

3. A substance is ______________________________ if it can be easily bent.

4. What is one example of a metalloid?

____

5. Water conducts electricity. Explain why water is not considered a metal.

____

____

____

Name ____ Date ____________ Class ____________

#25 Metal or Nonmetal?

Procedure

A THINK

How do you know whether something is a metal or a nonmetal? Read the following physical properties of both:

Nonmetals	Metals
Nonmetals do not have luster (dull).	Metals have luster (shine).
Nonmetals are not malleable (brittle).	Most metals are malleable (flexible).
Only one nonmetal element conducts electricity.	All metals conduct electricity and heat.
Nonmetals are not attracted to magnets.	Some metals are attracted to magnets.

B PLAN

1. With your team, plan how you will test each sample. Make sure that you record the test results accurately in the data table.
2. Write down the name of each object in the "Sample" column of the table.

C OBSERVE AND RECORD

1. Look closely at each object with the hand lens to find its luster. In the data table, record whether it is shiny or dull.
2. Determine the malleability of each sample by trying to bend it. Record its malleability in the table.
3. Use the multimeter to find the electrical conductivity of each sample. Record its conductivity in the table.
4. Use the magnet to find whether each sample is attracted to magnets. Record the result in the table.
5. As a team, use the information you recorded in the table to determine whether each sample is a metal or a nonmetal.
6. Share your results with the class.

Properties of Metals and Nonmetals

Sample	Luster	Malleability	Electrical Conductivity	Magnetic Attraction	Metal or Nonmetal?

Name ______________________ Date ____________ Class ____________

#25 Metal or Nonmetal? continued

D ANALYZE AND CONCLUDE

1. Choose two samples. Describe how you determined whether the sample is a metal or a nonmetal.

2. Why do you need to perform several different tests to determine whether a substance is a metal or a nonmetal?

3. Elements in the periodic table are divided into metals, nonmetals, and metalloids. Based on what you learned in this activity, what do you think the properties of metalloids are?

4. Describe two qualities of metals that make them useful for making electrical wire.

#26 Calculating Density

Background Information

Density is a measure of how much mass there is in a given volume. Everything has density. The formula to calculate density is *density = mass/volume*. Mass is the amount of matter in an object. Volume is the amount of space something takes up.

Time Required

1 class period

Objectives

- Measure and record the mass and volume of common objects.
- Use a calculator to determine the density of common objects.
- Use a table to compare the density of common objects.
- Draw conclusions about the relationship between an object's mass, volume, and density.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 digital balance or triple beam balance

1 graduated cylinder

water

an assortment of common objects of different densities: dice, marbles, keys, rubber balls, small pebbles, sand, paper clips, sunflower seeds

FOR EACH STUDENT

1 pair safety goggles

Vocabulary

density the amount of mass per unit of volume

mass the amount of matter that makes up an object

volume the amount of space occupied by an object

SAFETY INFORMATION

Remind students to wear their safety goggles when using glassware. Also remind them to clean up any water spills immediately. Students should immediately report any cuts, scrapes, or broken glass.

#26 Calculating Density continued

Procedure

A THINK

Provide students with the definitions of mass, volume, and density. Then share the formula for determining density (*density = mass/volume*).

B PREDICT

Encourage group discussion so that student preconceptions about density, mass, and volume are shared. If students are having difficulty explaining their reasoning, try leading a whole class discussion by asking questions such as: *How do you know that a bag full of feathers is less dense than a bag full of sand?*

C OBSERVE AND RECORD

Make sure that students practice making measurements with the digital balance and the graduated cylinder. If necessary, demonstrate how to use these tools in class.

Be sure the graduated cylinder has enough water in it so that each object tested will be completely submerged, but not so much water that the water level will be above the cylinder markings when the object is placed in the cylinder. Make sure that groups measure and record the initial volume of water in the cylinder before measuring the volume of each object. To calculate the volume of any object, subtract the volume of the water alone from the volume of the water with the object.

Remind students not to drop the objects into the graduated cylinder. Water could splash out and change the recorded volume of the water.

Finally, groups may have difficulty removing the objects from the graduated cylinder. Consider providing each group with a bucket or shallow tub into which they can pour the contents of the graduated cylinder after measuring the volume of each object. If teams do so, they must refill the graduated cylinder with water and again record the volume of the water before measuring the volume of the next object.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#26 Calculating Density continued

Student Sheet Answer Key

1. Students should state that the objects displaced a certain amount of water in the graduated cylinder. They measured the amount of water that the objects displaced to determine the object's volume
2. Answers will vary.
3. Answers will vary. Sample answer: Students may have assumed that objects with more mass are denser than objects with less mass. They may have also assumed that objects with smaller volumes are denser than objects with larger volumes. Students should conclude that density is a measurement of mass per unit of volume.
4. mass and volume
5. by compressing the object so that it has less volume

Quiz Answer Key

1. C
2. A
3. The object's volume can be determined by dividing its mass by its density.

Name ______________________________ Date ____________ Class ____________

#26 Calculating Density

Quiz

1. Volume is
   A. the sound produced by an object.
   B. the amount of matter that makes up an object.
   C. the amount of space that an object occupies.
   D. the weight of an object.

2. Which of these units is used to measure density?
   A. g/mL
   B. kg/cm
   C. m^2
   D. cm/L

3. If an object's density and mass are known, how can its volume be determined?

____

____

Name ______________________ Date ____________ Class ____________

#26 Calculating Density

Procedure

A THINK

Calculating the density of an object is easy if you can measure its dimensions. But how would you calculate the density of a paper clip? In this lab, you will use water and a graduated cylinder to determine the volume of solids when you cannot easily measure their length, width, or height.

B PREDICT

1. Observe the objects provided by your teacher. As a group try to predict which object is most dense and which object is least dense. In the table below, rank each object according to its density.
2. Discuss how you made your predictions. Consider the following questions:
   - Are heavier objects denser than lighter objects?
   - Are larger objects less dense than smaller objects?
   - Does an object's color affect its density?
   - Does an object's shape affect its density?

   In the table below, record why you ranked each object as you did.

Density Table

Mineral Number/ Name	Object Name	Explanation
Least Dense		
Most Dense		

Name ______________________________ Date ____________ Class ____________

#26 Calculating Density continued

C OBSERVE AND RECORD

3. Measure the mass of each object using the digital balance or triple beam balance.
4. Record the mass of each object in the table below.
5. Use the graduated cylinder filled with water to determine each object's volume. Begin by measuring the starting volume of the water in the cylinder.
6. Carefully place an object in the graduated cylinder and measure the volume of the water in the cylinder.
7. To determine the volume of the object, subtract the starting water volume from the final water volume.
8. Record the volume of the object in the table below.
9. Repeat Steps 3–5 for each object your team is measuring.
10. Calculate the density of each object by dividing its mass by its volume.

Calculating Density

Object Name	Mass	Volume	Density

Name ______________________________ Date ____________ Class ____________

#26 Calculating Density continued

D ANALYZE AND CONCLUDE

1. How did the graduated cylinder help you determine the volume of the objects? Explain.

___

___

___

2. Which object was the most dense? Which object was the least dense?

___

___

3. Were your predictions accurate? Why or why not? How are your predictions the same as your results? How are they different?

___

___

___

___

4. Which two units are used to describe density?

___

5. If the amount of mass that makes up an object is not changed, how could the object be made denser?

___

___

#27 Testing Mineral Properties

Background Information

More than 3,500 minerals have been identified on Earth. Some minerals look very similar; others look very different. Minerals can be identified by testing both chemical and physical properties.

The way in which a mineral absorbs visible light determines the mineral's *color*. A mineral's *luster* can be metallic or nonmetallic. Metallic minerals resemble polished metal. Nonmetallic minerals can have glassy, earthy, pearly, silky, or brilliant luster, among others.

Using common minerals and objects, the relative hardness, which is also known as Mohs' hardness, of a mineral can be determined. Hardness is tested by attempting to scratch a mineral with a mineral whose hardness is known or with some common objects. If the mineral being tested is harder than the other mineral or object, it will not be scratched. If the mineral being tested is softer than the other mineral or object, the mineral with known hardness or the object will scratch the mineral. Mohs' scale and the objects commonly used to determine relative hardness are shown in the table. Talc is the softest mineral on the scale; diamond is the hardest.

Streak is tested by dragging the edge of a mineral across a streak plate, which is a piece of unglazed porcelain tile. If a mineral is softer than a streak plate, it will leave a streak. If a mineral is harder than a streak plate, the mineral will scratch the plate. The streak of some minerals matches the color of a hand sample of the mineral. Sometimes, however, the streak is a very different color than the mineral sample itself.

Mohs' Hardness Scale and Hardnesses of Common Objects

Mineral	Mohs' Hardness	Common Object and Its Hardness
Talc	1	
Gypsum	2	Fingernail 2.5
Calcite	3	Penny 3.5
Fluorite	4	
Apatite	5	Glass plate ~5.5
Orthoclase feldspar	6	Steel File ~6.5
Quartz	7	Streak Plate ~6.5
Topaz	8	
Corundum	9	
Diamond	10	

#27 Testing Mineral Properties continued

Time Required

1–2 class periods: **1–1.5** periods for testing the mineral samples and **.5** class period to identify the minerals using a table of mineral properties

Objectives

- Observe some common minerals and state the *color* of each.
- Define and determine some physical properties of minerals, including *hardness*, *luster*, and *streak*.
- Use a table to determine the Mohs' hardness of each of the mineral samples.
- Use a table to identify each mineral by name.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

1 minerals sample set to include quartz, calcite, talc, feldspar, fluorite, hematite (specular variety), galena, pyrite, bornite, and mica

Note: Label each sample with a number and keep a key for reference.

FOR EACH STUDENT

1 pair safety goggles
1 streak plate
1 glass plate
1 penny
1 steel file
1 labeled quartz sample
1 copy of Mohs' hardness scale

Vocabulary

hardness a mineral's resistance to being scratched

luster the way in which a mineral reflects light from its surface

mineral naturally occurring, inorganic solid with a definite structure and chemical composition

streak the color of a mineral in its powdered form

SAFETY INFORMATION

Remind students to wear their safety goggles throughout the activity. Also remind them that the steel file and glass plate are sharp and to use these tools carefully. Students should immediately report any cuts, scrapes, or broken glass.

#27 Testing Mineral Properties continued

Procedure

A THINK

Provide students with the definitions of the mineral properties they will be testing. Address any questions students might have.

B OBSERVE AND RECORD

Demonstrate how to test and determine both a mineral's hardness and its streak. Use the feldspar to show that this particular mineral will scratch your fingernail, a penny, and the glass plate, but will not scratch the steel file or the labeled piece of quartz.

You might want to provide students with the terms commonly used to describe nonmetallic luster, including glassy, earthy, pearly, silky, and dull.

C EXPLORE MORE

If needed, pronounce the name of each mineral listed in the table for students. ***Note: You might want to distribute Data Table 2 to students only after they have completed their own observations and tests.***

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Student Sheet Answer Key

1. Answers will vary. Most students will state that metallic luster is easier to observe and identify.
2. If the suggested minerals are used, quartz is the hardest and talc is the softest.
3. The colors of some metallic minerals don't match their streak colors. Specular hematite, for example, is silvery gray, but its streak is reddish brown. Pyrite is a brassy yellow, but its streak is greenish black.
4. Answers will vary. Sample answer: Different minerals, such as quartz and fluorite, can be the same color. Thus, color is not always useful when trying to identify a mineral.
5. A mineral whose hardness is greater than about 6.5 won't leave a streak. Instead, it will scratch the streak plate. In this activity, only quartz was harder than the streak plate and therefore did not leave a streak.
6. Some minerals are the same color. Others have the same luster or the same hardness. Therefore, all of the properties should be observed or tested to accurately identify the mineral.

Quiz Answer Key

1. B
2. Diamond
3. Feldspar, quartz, topaz, corundum, and diamond will scratch apatite. Apatite will also be scratched by the glass plate, the steel file, and the streak plate.
4. The hardness of the mineral is between 6.5 and 8.

Name ______________________ Date __________ Class __________

#27 Testing Mineral Properties

Quiz

1. Luster is

A. the color of a mineral sample.
B. the way a mineral reflects light.
C. the color of a mineral as a powder.
D. a mineral's resistance to being scratched.

2. ____________________ is the hardest mineral on the Mohs' scale.

3. Which of the minerals and objects on the Mohs' scale will scratch apatite?

____

____

____

____

4. A mineral scratches a glass plate and a steel file, but does not scratch topaz. What is the mineral's hardness?

____

____

____

____

Name ______________________ Date ______________ Class ______________

#27 Testing Mineral Properties

Procedure

A THINK

There are thousands of known minerals on Earth. How can you tell them apart? Minerals can be identified by observing and testing physical properties. Some of these properties are *color*, *hardness*, *luster*, and *streak*.

B OBSERVE AND RECORD

1. Observe the minerals provided by your teacher. Record the color of each mineral in Data Table 1.
2. Observe and record the luster of each mineral in the data table.
3. Test the hardness of each mineral. Record a relative hardness value for each mineral in the table.
4. Test and record the streak color for each mineral.

Note: If a mineral does not leave a streak, write "no streak" in the table for that mineral.

Data Table 1: Mohs' Hardness Scale and Hardnesses of Common Objects

Mineral Number	Name	Color	Luster	Hardness	Streak
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Name ______________________________ Date ____________ Class ____________

#27 Testing Mineral Properties continued

C EXPLORE MORE

5. Data Table 2 lists the names and properties of the minerals you observed and tested in this activity. Analyze your results and use the table to identify each mineral. Record the name of each mineral in Data Table 1.

Data Table 2: Some Common Minerals and Their Properties

Mineral	Common Colors	Luster	Mohs' Hardness	Streak
Bornite	Various colors; tarnishes to blue or purple	Metallic	3	Grayish black
Calcite	Colorless, white, yellow, pink	Glassy or pearly	3	White
Feldspar	White, pink, tan	Dull glassy	6	White
Fluorite	Purple, yellow, green, colorless	Glassy; dull	4	White
Galena	Lead gray	Metallic	2.5	Lead gray
Specular hematite	Silvery gray	Metallic	5-6	Reddish brown
Mica	White, black	Pearly or glassy	2-2.5	White
Pyrite	Pale brassy yellow	Metallic	6-6.5	Greenish black
Quartz	Colorless, milky white, yellow, purple, rose, green, blue	Glassy	7	None
Talc	Colorless, white, pale green	Pearly	1	White

Name ______________________ Date __________ Class __________

#27 Testing Mineral Properties continued

D ANALYZE AND CONCLUDE

1. Which type of luster do you think is easier to observe—metallic luster or nonmetallic luster? Explain.

2. Which mineral tested is the hardest? Which is the softest?

3. Which minerals have streaks that do not match the color of the mineral samples?

4. Why do you think color is not very useful when trying to identify an unknown mineral?

5. Why didn't all of the minerals leave a streak on the streak plate?

6. Why is it important to test more than one property when you are trying to identify a mineral?

#28 Energy Resources

Background Information

Natural resources come from Earth's environment and are the "ingredients" of almost everything we use in daily life. An energy resource is one type of natural resource. Energy resources produce energy, such as electricity. Energy resources have advantages and disadvantages, as shown in the data table.

Time Required

4 class periods: **2** to **2.5** class periods to conduct research; **1** class period to debate the findings and students' opinions; **.5** class period to answer the Student Sheet questions

Objectives

- Use the Internet to research various energy resources.
- Compile the findings in a table.
- Evaluate the findings.
- Debate the advantages and disadvantages of obtaining and using the resources

Materials *Materials available at www.carolina.com*

FOR THE CLASS

computers with Internet access

printers (optional)

FOR EACH STUDENT

science notebook

pen or pencil

Vocabulary

geothermal energy energy that comes from heat stored in Earth

hydropower energy produced from moving water

nonrenewable resource a natural resource that cannot be replaced or would take too long to replace naturally

OTEC (ocean thermal energy conversion) the process of running a heat engine using differences in ocean water temperatures

renewable resource a natural resource that can replace itself

SAFETY INFORMATION

Review your school's policy on using the Internet safely.

#28 Energy Resources continued

Procedure

A RESEARCH

In this activity, students will research nine natural resources used to generate electricity. Findings will include whether the resource is renewable or nonrenewable and the pros and cons of using the resource. Students will use their research to debate which fuels they think are the best to use.

Remind students as they research to use only credible sources, such as online encyclopedias, government sites, and most educational websites. A good starting point for students is the U.S. Energy Information Administration's "Energy Kids" webpage, which includes information on energy in general, energy resources, and using and saving energy, among other topics.

B PLAN

If students are having trouble evaluating the information collected, ask some general questions based on the information given in the teacher version of the data table to get them started.

C TASK

Assign students to teams. Review, if needed, how to conduct an actual debate. You might want to assign a moderator to each team to keep participants on task and constructive in their arguments.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Energy Resources

Resource	Renewable or Nonrenewable?	Advantages	Disadvantages	Rank
Coal	Nonrenewable	It is currently inexpensive to mine, transport, and use; it is the most abundant fossil fuel produced in the U.S.	It pollutes the air when burned; mining can harm the environment, and it poses risks to miners.	
Oil (petroleum)	Nonrenewable	It is currently inexpensive to obtain, transport, and use.	It pollutes the air when burned; drilling can harm the environment, and it poses risks to people who work on the platforms; oil leaks cause pollution.	
Natural gas	Nonrenewable	It is currently inexpensive to obtain, transport, and use.	It pollutes the air when burned; drilling can harm the environment and can pose risks to people who work on the platforms; gas leaks cause pollution.	

Table continued on next page

#28 Energy Resources continued

Energy Resources *continued*

Resource	Renewable or Nonrenewable?	Advantages	Disadvantages	Rank
Nuclear power (uranium)	Nonrenewable	Small amounts of uranium decay to produce large volumes of energy; nuclear power plants do not add carbon dioxide to the air.	Decay produces hazardous wastes that must be stored; uncontrolled decay can pollute the air and water with radioactive materials.	
Biomass (wood and certain trash, crops, and wastes)	Renewable	Crops can be grown; wastes are constantly produced; biomass fuels reduce the amount of trash taken to landfills; ash created during combustion can be "recycled" and used in landfills and to make roads and cement blocks.	Burning biomass or fuels made from biomass pollutes the air; the ash produced can contain harmful substances.	
Wind	Renewable	It does not pollute the air or water; it will always exist.	Wind farms may cause noise pollution; can harm birds in flight; may be unsightly to some people; can only be used in certain locations and at certain times of the day or year.	
Hydropower	Renewable	It does not pollute the air; it can be used along some rivers as well as along coastlines (tides and waves); OTEC uses thermal energy from the ocean to produce electricity.	Dams (and the reservoirs that form behind them) can harm fish and other organisms and change the physical and chemical properties of the water; dams can also cause flooding upstream and water shortages downstream.	
Geothermal energy	Renewable	Geothermal plants do not pollute the air; scrubbers remove harmful gases found in the hot water and steam.	It can be used only in places where magma is relatively close to the surface; many "hot spots" are in natural parks.	
Solar energy	Renewable	It is inexhaustible; can be used at almost any scale (one house or entire neighborhoods).	Amount of energy depends on location and time of day, season, and the weather; harmful chemicals are used to make some of the parts in a solar thermal system; large solar plants can harm desert ecosystems; nearby water sources can be harmed.	

#28 Energy Resources continued

Student Sheet Answer Key

1. Answers will vary. Students may have chosen nonrenewable fossil fuels over renewable resources because fossil fuels are relatively inexpensive to produce, transport, and use. Other students likely chose renewable resources because they can be replaced once they have been used.
2. Answer will vary depending on students' knowledge of the availability of each resource and its effects on the environment.
3. Answers will vary. Some students will likely state that they or their team could have collected more facts for the debate. Some students might also state that they or their team could have debated more constructively with the other team.
4. Students' answers should show an understanding of both the advantages and disadvantages of all of Earth's natural resources as well as the need to recycle them, reuse them, and reduce their use of them.

Quiz Answer Key

1. C
2. A
3. Answers will vary. Sample answer: Uranium is the best natural resource to generate electricity because small amounts produce large volumes. Also, nuclear power does not add carbon dioxide to the atmosphere.
4. Answers will vary. Sample answer: Wind is the worst natural resource to generate electricity because it is very costly to produce wind farms, which can only be used in certain locations and at certain times of the day or year.

Name ______________________________ Date ____________ Class ____________

#28 Energy Resources

Quiz

1. Which group of natural resources includes only resources that are renewable?
   A. coal, oil, and natural gas
   B. uranium, the Sun, and geothermal energy
   C. biomass, wind, and hydropower
   D. biomass, natural gas, and wind

2. Which group of natural resources includes only resources that are nonrenewable?
   A. coal, oil, and natural gas
   B. uranium, the Sun, and geothermal energy
   C. biomass, wind, and hydropower
   D. biomass, natural gas, and wind

3. In my opinion, ______________________________ is the BEST natural resource to use to generate electricity because
   ____
   ____
   ____
   ____
   ____
   ____

4. In my opinion, ______________________________ is the WORST natural resource to use to generate electricity because
   ____
   ____
   ____
   ____
   ____
   ____

Name ______________________________ Date ____________ Class ____________

#28 Energy Resources

Procedure

A RESEARCH

1. Use the Internet to research all of the energy resources listed in the data table. Complete your table as you do your research. Be as detailed as possible when recording the advantages and disadvantages of each energy resource.

B PLAN

2. When you have finished your research, carefully read the information you collected.
3. Use your research to rank the resources from 1 (the best) to 9 (the worst) based on the advantages and disadvantages of each.

C TASK

4. Team up with two or three other students with the same or very similar ratings. Then debate another team whose energy resource rankings are different from yours.
5. Remember that in any debate your statements should be based on facts and presented constructively.

Energy Resources

Resource	Renewable or Nonrenewable?	Advantages	Disadvantages	Rank
Coal				
oil (petroleum)				
Natural gas				

Table continued on next page

Name ______________________ Date ____________ Class ____________

#28 Energy Resources continued

Energy Resources *continued*

Resource	Renewable or Nonrenewable?	Advantages	Disadvantages	Rank
Nuclear power (uranium)				
Biomass (wood and certain trash, crops, and wastes)				
Wind				
Hydropower				
Geothermal energy				
Solar energy				

Name ______________________ Date ____________ Class ____________

#28 Energy Resources continued

D ANALYZE AND CONCLUDE

1. What are your top three energy resources? Explain your answer.

2. What are your bottom three choices? Explain your answer.

3. Evaluate your personal performance as well as your team's performance in the debate. If you could debate again, would you do anything differently? Why or why not?

4. Explain why it is important to conserve all of Earth's natural resources.

#29 Managing Energy Resources

Background Information

"Reduce, Reuse, Recycle" should now be a familiar slogan to students. *Reduce* the amount of goods that are purchased because most people just don't need as much as they buy. Result: fewer unused goods end up in landfills.

Reuse items such as appliances, sports equipment, and clothing that can be repaired, repurposed, or passed along through gifting or resale. Plastic or paper bags can be reused for groceries or other items. Cardboard boxes can be reused for storage.

Finally, *recycle*. Paper, glass, and aluminum usually have collection areas already established in schools and households. There is more that can be done, and it can be done with minimal extra effort. Students will see that they can make a difference by cooperating and working together toward a common goal.

Time Required

1 class period to introduce the activity; **15**-**30** minutes per week per student if the activity is extended

Objectives

- Learn about local recycling opportunities and regulations.
- Demonstrate an understanding of the importance of conserving resources by establishing recycling centers.
- Draw conclusions about the success of the activity.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

recycling bins

poster board

marking pens

computer and telephone access

#29 Managing Energy Resources continued

Vocabulary

recycle to reuse old materials in a new way
reduce to use fewer materials
reuse to find another use for a material

SAFETY INFORMATION

Students should make phone calls and e-mail contacts under the supervision of an adult. Hazardous waste materials should not be collected in a school environment. Common household hazardous waste includes oil-based paints and stains, pesticides and herbicides, fertilizers, motor oil, and some cleaning supplies.

Procedure

A THINK

Have students discuss the concept of "reduce, reuse, recycle" and suggest materials that can be recycled or reused. Have a student volunteer write a list of materials on a whiteboard. Ask students if they know where any of these materials are recycled in your local area.

Commonly Recycled Materials

batteries
building materials
chemicals
electronic equipment
lead
metal
newspapers/papers
motor oil
oil-based paints
steel cans
glass
aluminum cans
tires
appliances
wood
yard waste
cell phones
prescription glasses
toner and/or ink cartridges

#29 Managing Energy Resources continued

B RESEARCH

You may have students interview other students and teachers about their in-school resources. What items are thrown away that could be reused?

Examples:

partially used pens and pencils

sheets of paper used on one side only

3-ring binders

folders

metersticks, rulers, protractors, etc.

Students will learn that they use recycled products every day. For example, lead, gold, copper, some plastics, and other components from old computers are recycled and used to make new computers. Newsprint and other paper can be recycled into new paper and packing materials. Steel cans become part of new cars. Old gym shoes can be ground up to make playground and gym surfaces.

C EXPLORE

Students will learn how their city or town government works as they make phone calls or write e-mails to gain information on local recycling facilities and regulations for these materials.

Students may also gather information on civic groups, communities, and charities that collect such items as cell phones and eyeglasses for reuse.

C EXPLORE MORE

The activity can be extended as a class project. Make sure that students obtain all necessary permissions before beginning their assignments.

Students may work in groups or as a class to set up and operate a recycling program at school. Students will set up recycling stations at school. They will make signs and posters, make announcements over the school public address system, and find other ways to communicate the recycling effort to fellow students. All students will make sure that the recycled materials reach the appropriate recycling center. Students will cooperate and support each other as they work.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#29 Managing Energy Resources continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: Recycling was new. People were not accustomed to saving paper and they did not see the value or need to do so. Recycling was difficult in areas where there was no curbside pickup. Collecting cans and stacking newspapers for collection was inconvenient and took up a lot of space.
2. Answers will vary. Sample answer: Recycling has become easier. Many communities have curbside pickup of recyclable materials. Recycling is the accepted norm and most people understand the value of recycling.
3. Some communities do not have facilities for recycling hazardous household materials. Many people are unaware that dangerous materials such as lead, automotive fluids, fertilizers and pesticides, and paints and varnish can contaminate the water supply if they are poured down a drain or disposed of in a landfill.
4. Answers will vary. Sample answer: Cell phones are often reused. They are programmed with emergency numbers and given to senior citizens, people with low incomes, and others who need to call for help in an emergency. Prescription eyeglasses are often reused by people who would not otherwise have corrective lenses.

Quiz Answer Key

1. A
2. Answers will vary. Sample answer: playground surface
3. Answers will vary. Sample answer: Some materials, such as appliances and cars, are too large to be collected in a public place. Some materials, such as household chemicals, are too dangerous to collect in an open area. Other items, such as paper, would be difficult to recycle if they were blown away by wind or soaked by rain in an open area.

Name ______________________ Date ____________ Class ____________

#29 Managing Energy Resources

Quiz

1. Which of the following items cannot be recycled?
   A. carbon paper
   B. glass food containers
   C. printer ink cartridges
   D. motor oil

2. What can ground-up old gym shoes be made into?
   ____

3. Why do you think all recyclable materials are not collected in large open areas?
   ____
   ____
   ____

Name ______________________________ Date ____________ Class ____________

#29 Managing Energy Resources

Procedure

A THINK

1. Join in the class discussion. What materials are reusable? Discuss reusable items used in your school such as paper, binders, and pens and pencils. What materials are recyclable? Do you know where any of these materials are collected in your area? Add those locations to your list of collection sites.
2. Discuss which items are already recycled in your school. What additional items, such as cell phones, batteries, eyeglasses, and gym shoes and clothing, could be collected at school for reuse or recycling?

B RESEARCH

3. Investigate what happens to the materials that are recycled in your community. For instance, what happens to paper, motor oil, steel and aluminum cans, and construction debris? What recycled products do you use every day?
4. What organizations in your community collect items for reuse? Do you know of collection sites for eyeglasses, cell phones and chargers, and computers?

C EXPLORE

5. Were you able to identify collection sites in your area for all of the materials on your list? If not, use the Internet and phone to locate local collection sites. Collection sites may not be available in your area for all reusable or recyclable materials.

C EXPLORE MORE

6. You may extend the activity to collect reusable and recyclable materials at your school. Make arrangements to deliver them to collection sites and recycling centers. Make sure that your school administration is aware of your efforts, and obtain all necessary permissions.
7. Your teacher may divide the class into work groups. If you are in a recycling station set-up group, your teacher will tell you which station you will set up, who you must contact for permission, and other details.
8. Other students will arrange advertising and publicity to encourage students to use the recycling stations. You may make signs and posters. You may also make public service announcements over the school public address system. You may be able to make announcements over a school radio station. Investigate additional ways to get your message out.

Name ____________________ Date ____________ Class ____________

#29 Managing Energy Resources continued

D ANALYZE AND CONCLUDE

1. In the early days of recycling, few people took part. Why do you think this was?

2. Why do you think so many people now recycle paper, glass, and cans?

3. Why don't more people recycle hazardous items such as fertilizers and pesticides, household chemicals, and oil-based paint?

4. Give two examples of items that may be reused before they are recycled.

#30 Potential and Kinetic Energy

Background Information

All types of energy can be divided into two basic groups—potential energy and kinetic energy. Potential energy is stored energy or energy that is waiting to happen. Kinetic energy is energy in motion. It represents the release of the energy.

A bike sitting in the garage has potential energy. A bike being ridden on a bike trail has kinetic energy. It is in motion. The lights in the classroom have potential energy when they are turned off and kinetic energy when they are turned on. Once the electric current is completed and the lightbulbs give off light and heat, the energy is kinetic. A pencil sitting on a desk is an example of potential energy. A pencil in hand writing the answers to math problems is an example of kinetic energy.

An understanding of the difference between potential and kinetic energy is essential to the general study of energy. Ask students to give additional examples of potential and kinetic energy. Make sure they grasp the concept before continuing with the lesson.

Time Required

1–2 class periods

Objectives

- Compare and contrast potential and kinetic energy.
- Observe what happens as potential energy becomes kinetic energy.
- Analyze the results of an experiment.

Materials *Materials available at www.carolina.com*

FOR EACH STUDENT

1 sheet of heavy-weight construction paper

1 sharpened pencil

1 protractor

safety scissors

markers or crayons (optional)

#30 Potential and Kinetic Energy continued

Vocabulary

energy the ability to make things change or move

kinetic energy energy in motion

potential energy stored energy; energy waiting to happen

SAFETY INFORMATION

The balloon activity should be done outside. Balloons can be a choking hazard. To prevent choking or any allergic reaction to latex, this activity should be demonstrated by the teacher. Remind students to take care when using protractors and scissors.

#30 Potential and Kinetic Energy continued

Procedure

A THINK

1. Take students outside for this activity. To prevent choking or an allergic reaction to latex, this activity should be demonstrated by the teacher.
2. Explain that the deflated balloon represents potential energy.
3. Blow up the balloon and hold the opening closed. Do not tie off the ends.
4. Ask students what happened when you transferred air from your lungs into the balloon. Explain that you transferred energy.
5. Now release the balloon, directed up, not horizontally.
6. Ask students what kind of energy is represented by the ascending balloon. Explain that kinetic energy is represented.
7. Before returning to the classroom, be sure to collect all balloons. Tell the students that balloons are attractive to birds and present a deadly choking hazard to birds and small animals.

B OBSERVE AND RECORD

1. Distribute a sheet of heavy-weight paper to each student.
2. Instruct students to use their protractors to draw large circles on their paper. Cut out the circles. Carefully cut a small hole in the exact center of the circle. Holes must be slightly smaller than the circumference of a pencil.
3. If they wish, students may decorate their circles with markers or crayons.
4. Instruct students to insert pencils into the center of the circle so they have what looks like a child's top or spinning disk. Point out that this object represents potential energy.
5. Instruct students to set the pencil point on their desks, top upright, and to spin. What happens? Ask what kind of energy is represented. Explain that kinetic energy is represented.
6. Point out that students can stop their tops in mid-spin, release, and that they will spin again. If the potential energy has not been exhausted, it is still available for use.
7. Supervise cleanup.

C ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#30 Potential and Kinetic Energy continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: The top is an example of potential energy when it is resting on the desk. It has the energy to spin, but it won't spin until I put it in motion.
2. Answers will vary. Sample answer: The balloon flying up into the sky is an example of kinetic energy because that is an object that is in motion.
3. Answers will vary. Sample answer: When the top is stopped in mid-spin and then let go, the second half of the spin is slower. It slows because there is less energy. The greatest release of energy is in the initial spin and it gradually slows to a stop.

Quiz Answer Key

1. potential energy
2. kinetic energy
3. Answers will vary. Sample answer: A bike resting at the top of a hill is an example of potential energy because it has the potential to move, but it is still.
4. Answers will vary. Sample answer: A bike racing to the bottom of that hill is kinetic energy because it is in motion.
5. They are both forms of energy. All energy can be classified into one of these two forms. They are different because they are opposite in nature. Potential energy is stored energy; kinetic energy is energy in motion.

Name ______________________________ Date ______________ Class ______________

#30 Potential and Kinetic Energy

Quiz

1. Energy that is stored and ready to use is called ______________________.

2. Energy in motion is called ______________________.

3. Give an example of potential energy. Explain why it is potential energy.

4. Give an example of kinetic energy. Explain why it is kinetic energy.

5. How are potential and kinetic energy alike? How do they differ? Explain.

Name ______________________________ Date ____________ Class ____________

#30 Potential and Kinetic Energy

Procedure

A THINK

1. Your teacher is holding a balloon. What do you think the deflated balloon represents?
2. Watch your teacher blow up the balloon. What happened to the air that your teacher transferred from his or her lungs into the balloon.
3. When your teacher releases the balloon into the sky, what kind of energy is represented by the rising balloon?
4. Note your observations in your science notebook.
5. Collect all balloon pieces before you return inside, so that they do not harm wildlife. Do not touch the balloons if you have an allergy to latex.

B OBSERVE AND RECORD

1. Use your protractor to draw a circle on the paper your teacher hands out.
2. Cut a small hole in the center of the circle.
3. Decorate the circle with markers or crayons, if you wish.
4. Insert a sharpened pencil into the center hole.
5. Hold your newly constructed “top” upright and spin it on the pencil.
6. Stop the top in mid-spin. Remove your hand and observe what happens.
7. Record all of your observations in your science notebook.
8. Clean up your activity space.

Name ______________________ Date ____________ Class ____________

#30 Potential and Kinetic Energy continued

C ANALYZE AND CONCLUDE

1. Look at the observation notes you took when you were participating in the activities. Find an example in your notes that describes potential energy. Explain why it is an example of potential energy.

2. Look at the observation notes you took when you were participating in the activities. Find an example in your notes that describes kinetic energy. Explain why it is an example of kinetic energy.

3. Did anything unexpected occur during your activities? If so, describe it here. Do you have a theory for what and why it happened? Check your theory with your teacher.

#31 Speed and Motion

Background Information

Position is the location of an object. When an object changes position, it is in motion. Speed is the rate at which an object changes position. Speed can be calculated by dividing the distance an object travels over the time it took to move that distance: *average speed = total distance/ total time*. The units for distance can be any unit of length and the units for time include seconds, minutes, and hours, among others.

Time Required

1.5 class periods: **.5** class period to construct the track and complete Parts A and B; **1** class period to complete Part C and answer questions

Objectives

- Describe how a marble changes position, direction, and speed when released from the top of a ramp.
- Understand that these changes are the result of unbalanced forces acting on the marble.
- Calculate an average speed for the marble rolling down the ramp.
- Measure and graph the time it takes the marble to reach certain locations on the track.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

2 metersticks

1 glass marble

1 stopwatch that will keep a running time and split or lap times

safety scissors

cardboard tubes (wrapping paper tubes, paper towel tubes)

masking tape

books or other objects to make the ramp

#31 Speed and Motion continued

Vocabulary

average speed total distance an object travels divided by the total amount of time that lapsed

balanced forces forces that act on an object but cancel each other

motion any change in the position of an object

position the location of an object at any given time

speed how fast or slow something moves

unbalanced forces forces that act on an object and cause a change in motion

SAFETY INFORMATION

Remind students that when a marble leaves the track it should be picked up immediately to avoid potential falls.

#31 Speed and Motion continued

Procedure

A SET UP AND OBSERVE

Set up teams of 3-4 students. Suggest that two members of each team work to construct the track. One should cut the cardboard tubes to form half-pipes, while the other student tapes the pieces together to form a two-meter run. Use the metersticks to accurately measure the distance.

Whether using wrapping paper tubes and/or paper towel tubes, stress the importance of having channels the same width. Be sure the ramp's incline is not higher than 5 cm.

Have students test the pieces of the track by gently rolling the marble along the channels and removing any bumps that prevent the marbles from rolling as smoothly as possible.

Some students might not realize that they are making scientific observations in Part A. If this happens, review the definitions of the applicable terms for this activity with them.

B EXPLORE

Before they actually start collecting data, have teams members practice timing how long it takes the marble to reach the end of the ramp.

If necessary, show students how to operate the stopwatches and their lap functions, which will be used in Part C. Sample answers are given in the data table below.

Data Table 1

Marble Run	Time (s)	observations
1	2.79	Smooth run
2	2.80	Marble moved from side to side
3	2.78	Smooth run
4	2.80	Marble bounced a little

#31 Speed and Motion continued

C EXPLORE MORE

Explain that the channels must be perfectly aligned so that the marble does not jump the track.

As before, have teams practice Step 8 before they actually record any values. Sample answers are given in the data table below.

As the marble rolls quickly down the ramp, each student on the team should have a specific role that is determined prior to attempting to collect the data.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

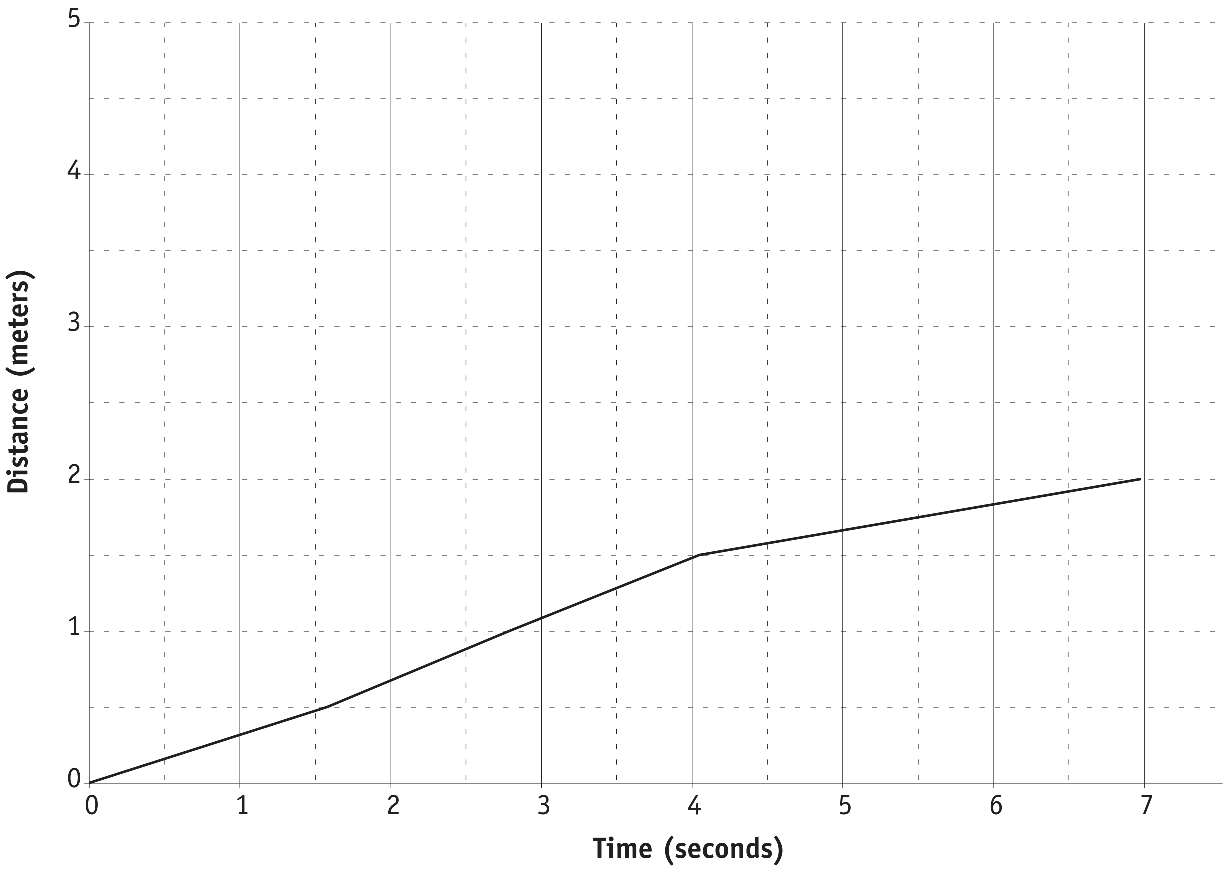
Data Table 2

Distance	Time (s)
2 m	6.98
1.5 m	4.05
1 m	2.79
0.5 m	1.58

#31 Speed and Motion continued

Student Sheet Answer Key

1. When the marble was released at the top of the ramp, it changed its position and speed. When it reached the end of the ramp, it changed its speed as well as its direction.
2. An object changes position, direction, or speed when unbalanced forces act on it. Because nothing was holding the marble back, gravity caused it to move down the track.
3. Answers will vary. Sample times: 2.79 s, 2.80 s, 2.78 s, 2.80 s; average time = (2.79 s + 2.80 s + 2.78 s + 2.80 s)/4 = 11.17 s/4 = 2.79 s; average speed = distance/average time = 1 m/2.79 s = 0.36 m/s>
4. Answers will vary. Sample data: (0 s, 0 m), (1.58 s, 0.5 m), (2.79 s, 1.0 m), (4.05 s, 1.5 m), (6.98 s, 2.0 m)



5. The marble had a nearly constant speed until it passed the first meter. After that, it slowed down.

Quiz Answer Key

1. A
2. B
3. Objects change position, direction, or speed when outside forces act on them.

Name ____________________ Date __________ Class __________

#31 Speed and Motion

Quiz

1. Which of the following BEST defines the speed of an object?
   A. the rate of change in the object's position
   B. the direction in which the object is moving
   C. any change in the direction of the object
   D. the original location of the object compared to its final location

2. Motion is
   A. the rate of change in an object's position.
   B. any change in the speed of an object.
   C. the distance an object moves divided by the time it took to move.
   D. the average speed of an object.

3. Why does any object change its position, direction, or speed?

   ____

   ____

Name ______________________ Date ____________ Class ____________

#31 Speed and Motion

Procedure

A SET UP AND OBSERVE

1. Cut cardboard tubes lengthwise to create half-pipes.
2. Tape half-pipes together to form a two-meter run. Use the metersticks to accurately measure the length of the track. Cut away any excess tubing. Whether using wrapping paper tubes and/or paper towel tubes, be sure the channels for the marbles are the same width.
3. Prop up one end of the marble run 5 cm from the floor with a book or other object to make a ramp.
4. Release the marble from the top of the ramp and observe what happens. Use your observations to answer Questions 1 and 2 in Analyze and Conclude.

B EXPLORE

5. Hold the marble at the top of the ramp again. When the timekeeper on your team gives you the signal, release the marble and have the timekeeper stop the stopwatch at the exact moment that the marble reaches the bottom of the ramp. In Data Table 1, record the time it took the marble to reach the end of the ramp. Also record any observations.
6. Repeat Step 4 three more times. Don't forget to record the times and observations in your table.

Data Table 1

Marble Run	Time (s)	observations
1		
2		
3		
4		

Name ______________________ Date ____________ Class ____________

#31 Speed and Motion continued

C EXPLORE MORE

7. Tape a small, leftover piece of cardboard in place at the 1.5 m marking to stop the marble at this point. Use a meterstick for an accurate measurement.
8. Using the lap function on the stopwatch, release the marble from the top of the ramp, and determine the time it takes the marble to reach the 1.5 m mark.
9. Repeat Steps 7 and 8 for the 1.0 m and 0.5 m positions on the track.
10. Record the lap times at each distance from the top of the ramp in Data Table 2.

Data Table 2

Distance	Time (s)
2 m	
1.5 m	
1 m	
0.5 m	

Name ______________________ Date ____________ Class ____________

#31 Speed and Motion continued

D ANALYZE AND CONCLUDE

1. Describe what happened to the marble in Step 4 in terms of position, direction, and speed.

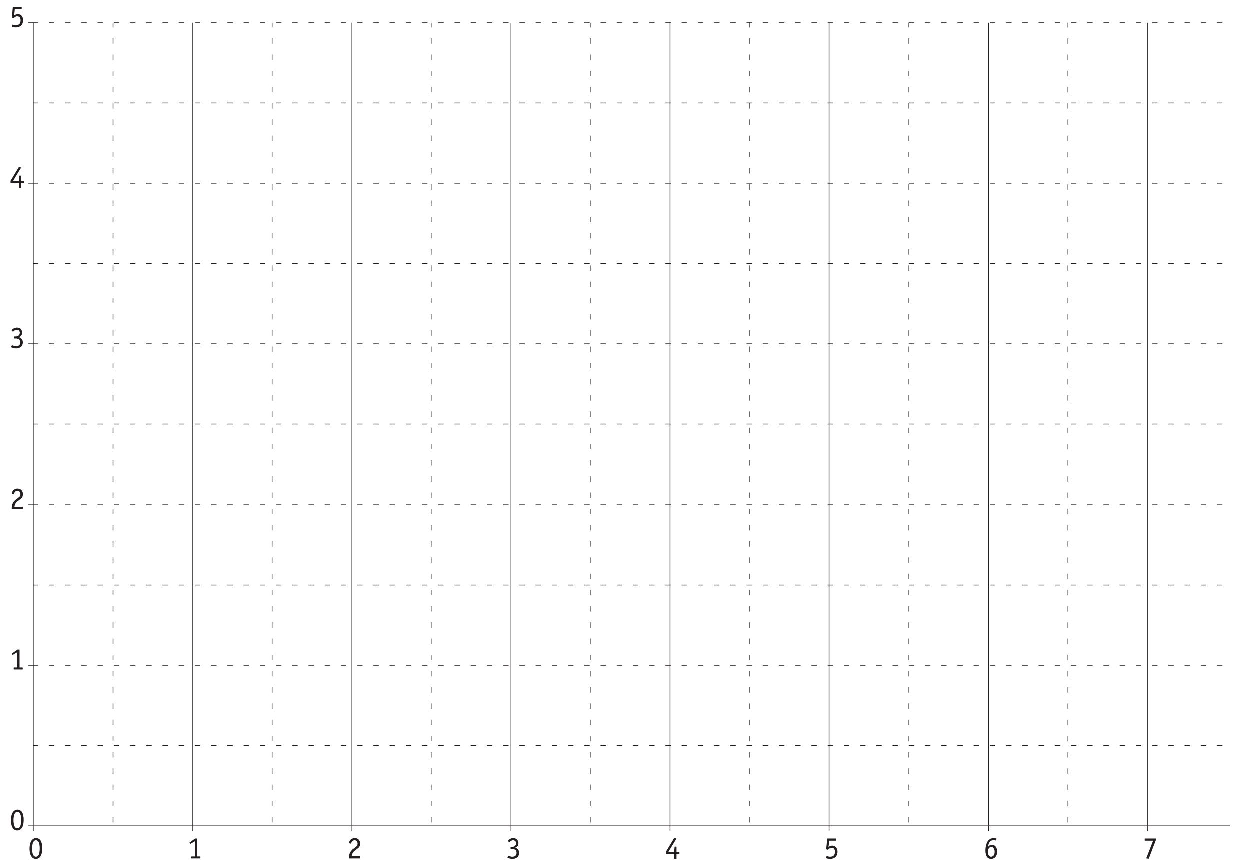
2. Why did the marble roll down the ramp when you released it?

3. Use the data your team collected in Part B to calculate an average speed of the marble as it rolled down the ramp. Show your work.

Name ______________________________ Date ____________ Class ____________

#31 Speed and Motion continued

4. In the space below, graph your data from Part C. Remember to give your graph a title and to label both axes with the variable and its units.



5. Use your graph to describe the motion of the marble in Part C.

____

____

____

#32 May the Force NOT Be with You

Background Information

People make life easier by using these six simple machines: lever, inclined plane, pulley, screw, wedge, and wheel and axle. Simple machines are called "simple" because they involve only one or two parts. A simple machine makes it easier to move a load because a single force is used against the load. The greater the distance over which the force is applied, the less force is needed to do the work.

One type of simple machine is an inclined plane. An inclined plane is a slanted surface. A steep slope on an inclined plane requires more work than a slope that is less steep because it takes more effort to move an object higher per distance moved forward. A longer approach requires less work because a longer approach spreads out the work since less height is achieved per forward distance moved.

A typical pulley is a wheel with a groove that allows a rope to run around the outside circumference of the wheel without slipping off. This wheel rotates freely on its axle. This type of simple machine is used to raise or move a load. The movement of the wheel increases the distance over which the force is applied.

Time Required

2 class periods: **1** class period for students to investigate how pulleys and inclined planes help to move and/or lift loads; and **1** class period for students to use their new skills and knowledge about simple machines to design and implement their simple-machine system to solve the class problem (Set up a class problem as something that can be solved in many different ways, and allow student teams time to experiment to find their own solutions. The goal should be to use the least effort as indicated by the spring scale.)

Objectives

- Understand how to use simple inclined planes and pulleys to lessen the force needed to move objects.
- Use logical reasoning and critical thinking to solve a problem.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 pull spring scale (spring scale, 1-10 N × .2 N)

1 plastic jug with a snug-fitting lid and handle and filled with 500 mL of water

1 measuring tape

2–3 double sheave pulleys (50 mm diameter)

rope or Mason twine (about 8 meters)

books, desks, and other classroom items to use as risers for the inclined planes

various lengths of 2×4s (enough boards in lengths of about 1 m, 2 m, and 3 m so that each team has the option of using short, medium, and long boards)

#32 May the Force NOT Be with You continued

Vocabulary

inclined plane a simple machine that uses a slanted surface to do work

pulley a simple machine that uses a rope over a wheel to do work

work force times distance; the amount of force (push or pull) acting upon an object in an effort to move the object

SAFETY INFORMATION

Caution students to take great care not to hit others when moving the boards. Remind students to securely attach the ropes to the water jugs.

#32 May the Force NOT Be with You continued

Procedure

A PLAN

Discuss with students the relationship between force, pulleys, inclined planes, and movement. Make sure that students investigate moving objects with both types of simple machines (a pulley and an inclined plane). Some students might catch on quickly—you might ask them early on to combine the two simple machines to move a load. For instance, they could use a pulley to lift the jug from the floor to a nearby desk and then use an inclined plane to move the jug from the desk to the countertop.

Also, you might set up a base test that has someone using a half meter of rope and the spring scale to lift the water from the floor to the countertop. This will allow students to see immediately that the pulley and plane require less work.

B SET UP

Assign students to teams. Set up a beginning point that is on the floor and a finishing point that is on a countertop. Clear a path between the two. Make the path wide enough to accommodate the number of participating teams, or if your classroom is large enough, create one equivalent path for each team.

In addition to the boards, allow students to use other objects in the room as inclined planes.

C OBSERVE AND RECORD

Explain the class problem at the beginning of the second class period after students have had an opportunity to investigate how pulleys and inclined planes can be used to do work. On the second day, tell teams that they are to use as little force as possible to move their water jugs from the starting point to the finishing point. Also explain that all movement must use either a pulley or an inclined plane. Have teams record the force they use in each situation. Declare that the “Force” is NOT with the group that uses the least amount of force.

As students experiment (trying different numbers of times they make a “loop” between the pulley wheels), they will discover that using twice as much rope to make two trips between the jug handle and pulley instead of one, will reduce the amount of effort (in Newtons on the spring scale) by about half! So, let’s say it took two pulls and 500 N to raise the jug off the floor with the rope going from the jug handle over the wheel and down again (that counts as one rope supporting the load). Now let us have the rope going from the jug handle around the pulley plus back through the jug handle and around a second pulley (two trips counting as two ropes supporting the load). It will still take two pulls to raise the jug off of the floor; however, the amount of effort will read about 250 N on the spring scale.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the student sheet. Continually check for understanding by asking probing questions and include all of the vocabulary words in the class discussions.

#32 May the Force NOT Be with You continued

Example showing one trip around the pulley.

Example showing two trips around the pulley.

#32 May the Force NOT Be with You continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: They used a longer ramp.
2. Answers will vary. Sample answer: We could wrap the pulley rope around a second double pulley and through the jug handle up to two more times.
3. Answers will vary. Sample answer: I saw a team using a ramp from the floor to the counter instead of going to a lower spot in between first.
4. Answers will vary. Sample answer: A higher inclined plane needs more force. A longer inclined plane needs less force. By making a high inclined plane longer, you can reduce the force needed to move an object up to a higher point.
5. Answers will vary. Sample answer: I have a high bed at home, so I could use steps—which are a type of an inclined plane—to get into it instead of pulling myself up with my arms and swinging my leg onto the bed.

Quiz Answer Key

1. C
2. A
3. more
4. Answers will vary. Sample answer: The needed force is spread out over a longer distance and over two pulleys.
5. Answers will vary. Sample answer: A short ramp provides less distance over which the force can be spread.

Name ______________________________ Date ____________ Class ____________

#32 May the Force NOT Be with You

Quiz

1. Which of the following is a naturally occurring inclined plane?
A. tree limb used for a swing
B. stones in a shallow creek used to cross the creek
C. a snowy hill used for sledding
D. a pond used for swimming

2. Which of the following is an example of a pulley?
A. a crane being used at a construction site
B. a car moving down the road
C. a drill going through a board
D. a jar lid screwing onto a jar

3. A higher inclined plane requires ____________________ force than a lower one.

4. Explain why less force is needed to lift a jug with water if you were to wrap the rope around the pulley and back through jug handle a second time.

____

____

____

5. Explain why more force is needed to move a jug with water up an inclined plane if the inclined plane were to have a short ramp instead of a long ramp.

____

____

____

Name ______________________________ Date ____________ Class ____________

#32 May the Force NOT Be with You

Procedure

A PLAN

1. With your team, design a plan to move your jug with water from the starting point to the finishing point. You can use any combination of inclined planes and up to two pulleys, but you must use at least one inclined plane and one pulley. Your plan should use the least amount of force possible.

B SET UP

1. Make your pulley system for moving the jug with water using any of the materials your team was given.
2. An inclined plane can be made with the boards provided as well as anything else in the room.

C OBSERVE AND RECORD

1. With your team, choose a length of rope to attach to the group pulley system. Then use the measuring tape to measure its length. Attach one end of the rope to the spring scale, and go around a wheel on the pulley and out to the point where the other end of the rope is attached to the jug handle. If you are using both wheels on the pulley, make sure the rope goes from a wheel and down through the jug's handle twice. Record the rope's length in data table 1.
2. Measure the length and height of the inclined plane, and record the information in data table 2.
3. When you lift your load (the jug with water), record how many times you pulled on the rope in data table 1.
4. Move the jug by pulling on the scale. You might use one pulley or more than one. For each pulley, read the measurement on the scale to find the amount of force you have used. Record the number in data table 1.
5. As the jug moves to the inclined plane, record the force reading on the pull scale in data table 2. You might use one inclined plane or more than one, so be sure to record all the force readings.
6. In data table 3, record the forces for all inclined planes and pulleys used. Then add the inclined plan and pulley forces together for your team's Total Force Used, and record this number in data table 3.
7. Compare your data to the data of other teams. Discuss why one team had the force NOT with them by how they were able to decrease their force the most.

Name ______________________ Date __________ Class __________

#32 May the Force NOT Be with You continued

Data Table 1
Pulleys Used

Pulleys	Length of Rope	Number of Pulls on Spring Scale Rope End	Force Used
1			
2 (optional)			

Data Table 2
Inclined Planes Used

Inclined Planes	Length of Inclined Plane	Height of Inclined Plane	Force Used
1			
2 (optional)			
3 (optional)			

Data Table 3
Total Forces Used

Forces Used with Pulleys	Forces Used with Planes	Total Force Used

Name ______________________ Date ____________ Class ____________

#32 May the Force NOT Be with You continued

D ANALYZE AND CONCLUDE

1. Identify the team that used the least amount of force. What did the team do to decrease the force needed to move the jug?

____

2. If you did the activity again, what could your team do differently to decrease the needed force?

____

____

3. What is one choice that either your team or another team made that increased the amount of force that was used?

____

____

4. What conclusion could you make about the combination of length and height in the force needed to move an item up an inclined plane?

____

____

____

5. Describe a situation in which you could use a pulley or an inclined plane to make your life easier.

____

____

____

#33 transferring Thermal Energy

Background Information

Ice floats in water. This is because water is less dense in its solid form than it is in its liquid form. However, as a liquid, cold water is denser than warm water. This means that cold water is heavier than warm water. Colder water will sink, and warmer water will rise.

When ice is placed into water, it melts. Melting is the process of changing a substance from a solid form to a liquid form. Melting is an endothermic process. This means that heat energy, also called thermal energy, must be absorbed for it to occur. Thermal energy moves in a predictable pattern from warmer to cooler until all the substances attain the same temperature. In the case of ice in water, the thermal energy comes from the water. Water has more energy and a higher temperature than the ice. Through this temperature difference thermal energy is transferred, causing the ice to melt while the temperature of the surrounding water decreases. Eventually, the water attains the same temperature.

An ice cube placed into water will melt. As the bottom of the cube melts, the top of the cube will become top heavy, causing the ice cube to roll over. This is an example of a thermal transfer—heat energy in the water is transferred to the ice. A floating ice cube is less dense than the water in which it floats, but the very cold, newly melted water is denser than the surrounding water, causing the cube to sink. As the cold, melted water receives thermal energy from the warmer surrounding water, it warms and rises, blending with the rest of the water.

Time Required

2.5 class periods: **1** class period for day 1, **0.5** class period for day 2, and **1** class period for day 3

Objectives

- Demonstrate an understanding of thermal energy.
- Research the reason ice floats.
- Explore how heat energy is transferred.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

1 package of assorted food colors
freezer in which to place ice cube trays
sticky notes
computers with Internet access
room temperature water (approximately ½ liter)
very cold water (approximately ½ liter)
warm water (approximately ½ liter)

FOR THE TEAM

1 ice cube tray
1 eyedropper
1 small paper cup
1 pair small metal tongs
1 clear acrylic cup
1 thermometer

#33 transferring Thermal Energy continued

Vocabulary

convection the flow of heat energy through the movement of atoms in fluids

melting point the temperature at which a frozen substance will melt

thermal energy heat; the vibration and movement of the atoms and molecules within substances (As an object is heated up, its atoms and molecules move and collide faster.)

transfer to cause to pass from one place to another

SAFETY INFORMATION

Remind students that the ice cubes should be handled with tongs to prevent it from melting and to keep hands or fingers from getting too cold.

#33 transferring Thermal Energy continued

Procedure

A PREDICT

This activity will demonstrate the transfer of thermal energy and convection.

Ask students to share what they have seen happen when ice is placed into water and left for a period of time. They will probably note that the ice began to melt. Ask students why they think ice melts in water. Then ask what happens to the water when the ice melts. Tell them they are going to take part in an experiment that explores these questions.

B RESEARCH

Share with students the vocabulary words and their definitions. Explain that thermal energy moves in a predictable pattern from warmer to cooler until all the substances attain the same temperature. In the case of ice in water, the thermal energy comes from the water. Water has more energy and a higher temperature than the ice. Through this temperature difference thermal energy is transferred, causing the ice to melt while the temperature of the surrounding water decreases. Eventually, all the water becomes the same temperature.

On day 1, have students use the Internet to do their research. Students should find that water freezes and ice begins to melt at 0 degrees Celsius (32 degrees Fahrenheit). They also should learn that because ice is less dense than water, the ice will float in the water.

C SET UP

Day 1—Place students in small teams. The added food coloring will make it easier to see the top and bottom of the ice cube as it rolls and to see the water melt away from the cube. Tell students that they can pick any color they like, but that yellow might not show up quite as well as blue, green, or red. You might want to have students label their ice cube trays with sticky notes so that they can identify their trays the next day.

Day 2—Allow time for students to add very cold water on top of the now-frozen water/food coloring mixture to fill the ice cube section. Ask students why they added very cold water instead of room temperature or warm water.

D OBSERVE AND RECORD

Day 3—Make sure that students use tongs when handling the ice so that their warm hands don't melt it. Remind them that the ice floats because it is less dense than the water it is in. Have students individually record their findings in the data table.

E ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion. Ask students: What happened? How did the temperature readings of the water change?

Water Temperature

Recording	Temperature of Water (C)	Time Temperature Taken
1	18°	1:30 p.m.
2	11°	1:35 p.m.
3	9°	1:40 p.m.

#33 transferring Thermal Energy continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: The ice melted because heat energy is being transferred to the ice from the warm water.
2. Answers will vary. Sample answer: The bottom of the ice melted. This made the top heavy, so it flipped over.
3. Answers will vary. Sample answer: The cold water sank downward. It did this because cold water is denser, or heavier, than warm water.
4. Answers will vary. Sample answer: Thermal energy will always move from warmer substances to colder substances until all of them are the same temperature.

Quiz Answer Key

1. C
2. 0 degrees Celsius (32 degrees Fahrenheit)
3. convection
4. Answers will vary. Sample answer: When ice is put into water it melts. This is because the thermal energy from the warm water is transferred to the ice. Thermal energy always moves from warmer to colder until all the substances are the same temperature.

Name ______________________________ Date ______________ Class ______________

#33 transferring Thermal Energy

Quiz

1. Thermal energy is

A. energy found in water.

B. energy found in food.

C. heat energy.

D. light energy.

2. What is the freezing temperature for water?

____

3. ______________________________ is the flow of heat energy through the movement of atoms in fluids.

4. What happens to ice when it is placed into warm water? What causes the reaction?

____

____

____

Name ______________________ Date ____________ Class ____________

#33 transferring Thermal Energy

Procedure

A PREDICT

Have you ever had a drink with ice in it? Have you ever left the drink sitting around for a while? What happened to the ice?

Most likely, you noticed that the ice melted. Can you guess why this happened? What happens to the temperature of water when ice melts in it?

B RESEARCH

1. On day 1, use the Internet to find out the temperature at which water freezes. Record your answer here:

   ____

2. Use the Internet to find out why ice floats. Record your answer here:

   ____

C SET UP

Day 1

1. Time to make some ice! Put five drops of water and three drops of food coloring in a paper cup. Mix well.
2. Pour the colored water into one section of an ice cube tray.
3. Place your tray in the freezer.

Day 2

4. Add enough very cold water on top of the now-frozen water/food coloring mixture to fill up the ice cube section.
5. Replace your tray in the freezer.

D OBSERVE AND RECORD

Day 3

1. Fill a clear cup with warm water. Put the thermometer into the water. Take a first temperature recording, and write it, along with the time you took the temperature, in the data table.
2. Remove the ice cube from the tray with tongs. Place the cube into the cup. You will see that it floats. Notice which side of the ice is up—the colored side or the clear side. It doesn't matter which. Having one clear side and one colored side will help you see what happens as the ice melts.
3. After five minutes, take a second temperature recording of the water in the tumbler. Your ice cube will slowly turn over as it melts.
4. After the ice cube is completely melted, take a final temperature recording.

Water Temperature

Recording	Temperature of Water (C)	Time Temperature Taken
1		
2		
3		

Name ______________________________ Date ____________ Class ____________

#33 transferring Thermal Energy continued

E ANALYZE AND CONCLUDE

1. Why did the ice melt?

____

____

____

2. Why do you think the ice turned over and over?

____

____

____

3. In which direction did the cold water move once it melted from the ice cube?

____

____

____

4. Why does the cold water warm up and the warm water cool down until all the water is the same temperature?

____

____

____

#34 transforming Energy

Background Information

Energy is the ability to do work. Energy is neither created nor destroyed but always exists in one form or other. Energy can be stored (potential energy) or kinetic (energy an object possesses due to its motion). There are many forms of energies, including chemical, sound, electrical, light, heat or thermal, mechanical, solar, and nuclear.

Energy changes forms all the time. When the engine in an automobile burns gasoline, it converts the chemical energy in the gasoline to mechanical energy. When a hair dryer is turned on, electrical energy is transformed into thermal (or heat) energy. When the light energy from the Sun shines on a green plant, solar energy is transformed into chemical energy through photosynthesis, providing the plant with food.

Time Required

1 class period

Objectives

- Demonstrate an understanding of the different types of energy.
- Predict how energy can be transformed.
- Explore the uses of solar energy.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

EXPERIMENT 1

1 jingle bell

1 piece of string or ribbon

EXPERIMENT 2

1 piece of plastic wrap

1 small plastic cup

1 rubber band

1 large spoonful of small dried grain such as uncooked rice

1 metal pan

1 large metal spoon

EXPERIMENT 3

1 small table lamp with shade removed and 60 watt bulb in place (for heat source)

1 aluminum pie pan

1 toothpick

1 45-cm piece of thread or string

scissors

EXPERIMENT 4

1 voltmeter with accompanying insulated wires and alligator clips

1 copper penny

1 galvanized, 2-inch nail

1 large fresh, ripe lemon

scissors

FOR EACH STUDENT

pen or pencil

#34 transforming Energy continued

Vocabulary

chemical energy a type of potential energy stored in chemicals such as fruit juice and other acids
electric energy the energy that comes from electricity
energy the ability to make things move or change
mechanical energy the energy of motion (Things that are moving or have moving parts have mechanical energy.)
sound energy the energy produced by sound vibrations as they travel through a solid, a gas, or a liquid
thermal energy the energy that produces heat; the vibration and movement of the atoms and molecules within substances (As an object is heated up, its atoms and molecules move and collide faster.)
transformation the change from one form to another

SAFETY INFORMATION

Remind students that they should be careful with the scissors and to use them only while seated and put them down when finished. Tell students to be careful when cutting the aluminum pan, as the edges will be a little sharp and could cut them. Students should also be reminded that the bulb is hot and should be left in place in the socket and not touched, or looked at, directly.

#34 transforming Energy continued

Procedure

A THINK

This activity will allow students to demonstrate four simple yet clear examples of energy transformations: mechanical energy to sound energy, sound energy to mechanical energy, heat energy to mechanical energy, and chemical energy to electrical energy.

Note: If time is limited, select two or three of the four experiments for students to complete.

Ask the class to define the word *energy*, and write the definition on a whiteboard. Make sure that students understand the vocabulary terms. Tell the class that they will be exploring how energy can change from one form to another.

Have students predict what will happen if they rub their hands together fast and hard for 15 seconds. Then ask students to rub their hands together hard and fast for 15 seconds. What did they notice happened? Most will say their hands grew warm. Others may notice that they could hear the sound of their hands rubbing together.

Explain that they just took part in an energy demonstration. When they moved their hands back and forth against each other, they were using mechanical energy. The mechanical energy used when rubbing their hands together was transformed into two other kinds of energy—thermal (or heat) energy and sound energy. Explain that energy cannot be created or destroyed, but that it is constantly changing form.

B SET UP

Place students into small teams. Set up each team's station with all the materials for the experiments. Prior to performing each experiment, teams should record what they think will happen in the data table.

Energy Transformations

Experiment	What I Think Will Happen	What Happened	Beginning Energy Form and Final Energy Form
1	The bell will ring.	The bell rang.	Mechanical energy transformed to sound energy.
2	The rice will bounce around.	The rice bounced around.	Sound energy transformed to mechanical energy.
3	The spiral will spin.	The spiral spun.	Heat energy transformed to mechanical energy.
4	The meter will show there is electricity going through the wires from the lemon.	The meter showed there was electricity.	Chemical energy transformed to electrical energy.

#34 transforming Energy continued

C OBSERVE AND RECORD

As teams complete each experiment, have them fill in the rest of the experiment's columns in the data table. Then have students share their findings. Make sure that students understand what energy transformation occurred with each experiment.

Experiment 1

The shaking of the bell (mechanical energy) caused the clacker inside the bell to strike the bell itself, creating sound vibrations (sound energy).

Experiment 2

The noise (sound energy) of the pan when it was struck vibrated the plastic wrap, causing it and the rice to move (mechanical energy).

Experiment 3

The heat (thermal energy) from the lightbulb caused warmed air to move upward. This struck and turned the aluminum spiral (mechanical energy).

Experiment 4

The citric acid (chemical energy) inside the lemon reacted with the two metals. The different metals made it possible for atoms from one metal to move through the lemon to the other metal. As the atoms moved, they lost electrons, which flowed through the wires, producing electricity.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Ask students to brainstorm other ways that energy is transformed from one kind to another. As enrichment, have students select one example of energy transformation and create an illustrated poster to describe the transformation.

#34 transforming Energy continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: A grapefruit has citric acid, too. The acid is a chemical, so it could create electricity.
2. Answers will vary. Sample answers: Trees use the Sun's energy to make food. The solar energy is transformed into chemical energy. People use solar panels to capture energy from the Sun and transform it into electrical energy. Plants use solar energy and transform it into chemical energy to make food. People open their curtains or shades during the day to let solar energy help heat and light their homes.

Quiz Answer Key

1. C
2. potential
3. Answers will vary. Sample answer: The hands of the clock move to keep time. Electrical energy is transformed into mechanical energy.
4. Answers will vary. Sample answer: Mechanical energy is transformed into sound energy.

Name ______________________________ Date ____________ Class ____________

#34 transforming Energy

Quiz

1. Energy

A. can be created and destroyed.

B. is made of heat and light.

C. cannot be created or destroyed, but can change form.

D. cannot be created or destroyed, and cannot change form.

2. Energy that can be stored is called ______________________________ energy.

3. What happens when a working electric clock is plugged into an outlet? What kind of energy transformation takes place?

____

____

4. What is one kind of energy transformation that takes place when you rock back and forth on a squeaky chair?

____

____

____

Name ________________________________ Date ____________Class ____________

#34 transforming Energy

Procedure

A THINK

Whenever something happens, energy is used. Nothing happens without energy. When you laugh, when you go for a swim, and when you breathe, you use energy. When the battery powers a flashlight and when a fire burns the wood in a campfire, energy is used. When the clothes dry on the line in the Sun, energy is used.

Energy is not created or destroyed. It always exists in one form or other, and it changes form often. When you exercise, chemical energy from the food you eat makes it possible for you to move. The chemical energy is transformed into mechanical energy. The mechanical energy in your body is then transformed into heat energy. That is why your muscles feel warm.

B SET UP

Experiment 1

1. Tie a jingle bell to a piece of string or ribbon.
2. In the data table, write what you think will happen when you hold the ribbon and shake the bell.

Experiment 2

1. With your team, place a piece of plastic wrap over the top of a plastic cup. Make sure the plastic is stretched tightly. Secure the plastic with a rubber band around the top of the cup.
2. Sprinkle about 20 grains of rice (or other grains) on top of the plastic wrap.
3. In the data table, write what you think will happen to the grains (if anything) when you hold the pan close to the cup (without bumping it) and strike the pan with the spoon to make a loud sound.

Experiment 3

1. Have one student on your team cut off the rim of the aluminum pie pan and then cut the pan into a long spiral shape about 2.5 cm wide.
2. At the end of the spiral (at what was the center of the plate), poke a hole through the aluminum with a toothpick. Push the string or thread through and tie it so that the pan can be held up by the string over the lightbulb. In the data table, write what you think will happen when the lightbulb is turned on and the aluminum spiral is held over the bulb.

Experiment 4

1. With the scissors, carefully cut a small slit at one end of a large, ripe lemon. Insert a penny so that half of it remains protruding. Push a nail into the other end of the lemon so that about 2.5 cm of the nail is sticking out.
2. In the data table, write what you think will happen when you attach a voltmeter clip to the penny and another clip to the head of the nail.

Name ______________________________ Date ____________ Class ____________

#34 transforming Energy continued

C OBSERVE AND RECORD

Experiment 1

1. Shake the bell.
2. Fill in the last two columns for Experiment #1 in the table.

Experiment 2

1. Bang the pan with the spoon.
2. Fill in the last two columns for Experiment #2 on your chart.

Experiment 3

1. Turn on the lightbulb.
2. Hold the spiral over the bulb about 12 inches over the lightbulb.
3. Wait a few minutes. Then fill in the last two columns for Experiment #3 in your table.

Experiment 4

1. Attach one voltmeter clip to the penny and one voltmeter clip to the head of the nail.
2. Look at the voltmeter for a reading. Then fill in the last two columns for Experiment #4 in your table.

Name ______________________ Date ____________ Class ____________

#34 transforming Energy continued

Energy Transformations

Experiment	What I Think Will Happen	What Happened	Beginning Energy Form and Final Energy Form
1			
2			
3			
4			

Name ______________________ Date ____________ Class ____________

#34 transforming Energy continued

D ANALYZE AND CONCLUDE

1. What other fruits or vegetables might be able to power a voltmeter? Why do you think so?

2. Solar energy is energy that comes from the Sun. What is one way people or other living things use the energy from the Sun? What kind of energy transformation occurs when solar energy is used in that way?

#35 Modeling Earth's Layers

Background Information

Earth has three distinct layers—a thin, outer crust, a thick mantle, and a dense core. The core has two parts—an outer liquid core and a solid inner core. Earth's crust and the rigid 100 km of the upper mantle make up Earth's lithosphere. Much of the remaining mantle flows like a soft plastic (or putty). This molten part of the mantle is called the asthenosphere.

Time Required

1–2 class periods: **1–1.5** periods for testing the mineral samples; **0.5** period to identify the minerals using a table of mineral properties

Objectives

- Research and record information on Earth's structural layers—the crust, the mantle, the core, the lithosphere, and the asthenosphere.
- Use the research to build a clay model of Earth's layers.
- Analyze the model for its limitations.
- Compare the model to other objects used to model Earth's layers.

Materials *Materials available at www.carolina.com*

FOR EACH STUDENT

6 different colors of modeling clay (about 110 g of each color)

1 serrated plastic knife (must be sharp enough to provide a clean cut through the models) or dental floss

toothpicks and small self-sticking notes

plastic wrap to separate the layers of the model if you would like to reuse the clay

colored pencils

#35 Modeling Earth's Layers continued

Vocabulary

asthenosphere the partially molten part of the mantle
core the central part of Earth that has two parts: a liquid, outer part and a solid inner part
crust the thinnest, outermost layer of Earth
lithosphere Earth's crust and rigid upper mantle
mantle the thick, middle layer of Earth

SAFETY INFORMATION

Remind students to be careful when using the knife or dental floss and the toothpicks.

#35 Modeling Earth's Layers continued

Procedure

A RESEARCH AND RECORD

Provide students with earth science reference books, or have them use the Internet to collect their data on Earth's structure.

Make sure students understand that by *state* you mean state of matter.

B THINK

If you want to be able to reuse the modeling clay, instruct students to place a layer of plastic wrap between adjacent layers in the model.

While students will not be able to build true scale models of Earth's layers from the clay, stress that they do keep some sort of scale in mind when deciding on how thick to make each layer.

C OBSERVE

Make sure that the knife is sharp enough to cut through the models without squashing them too much. Demonstrate, if needed, how to saw back and forth to minimize squashing the spheres. Dental floss may also work to cut the clay.

Make sure students label the crust, the lithosphere, the mantle, the asthenosphere, the outer core, and the inner core on both their clay models and the drawings in their notebooks.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

Earth's Layers

Layer	Thickness (km)	State of Matter	Composition
Crust	0-100; averages 35 km	Solid	Mostly granite and basalt
Lithosphere	Varies between 60 km and 250 km	Solid	Granite, basalt, and dunite
Mantle/ Asthenosphere	2,900 km	Solid, but flows like soft plastic or putty	Dunite and other igneous rocks
Outer core	2,200 km	Liquid	Mostly iron with some nickel
Inner core	1,278 km	Solid	Mostly iron with some nickel

#35 Modeling Earth's Layers continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: Earth's layers, from the inside out are the inner core, the outer core, the mantle, part of which is called the asthenosphere, and the crust, which together with the upper rigid part of the mantle makes up Earth's lithosphere.
2. Answers will vary. Sample answer: The crust is the thinnest, outermost layer of Earth. The crust is the solid part of Earth. The mantle is the thickest part of Earth. Much of this layer is partly melted. The core has two parts. The outer core, which is about 2,200 km thick, is a liquid made mostly of iron. The inner core, which is 1,278 km thick, is solid. It is also made mostly of iron.
3. Answers will vary but should show a clear understanding that, like Earth, the models are layered. However, the models are not to scale and do not show the actual composition or state of matter of each layer of Earth.
4. This question should prompt students to think about the limitations of any model. Their answers will vary but should be supported by factual statements. The skin and flesh of a peach best model the thicknesses of the crust and mantle, and its seed models the two-part core. The skin and flesh do not accurately model the rigidity of the crust or the partly molten mantle. Also, the outer part of the seed is not a liquid like the outer core. The egg's shell correctly models the thin, brittle crust, the albumin models the thick, partly melted asthenosphere, and the yolk models the core. A raw egg, however, does not model the two-part core.

Quiz Answer Key

1. A
2. B
3. Both are very dense and are made mostly of iron with some nickel. However, the outer core is liquid; the inner core is solid.
4. The asthenosphere is a part of the mantle that is made up of partially molten rock and flows very slowly over time.

Name ______________________________ Date ____________ Class ____________

#35 Modeling Earth's Layers

Quiz

1. The thinnest layer of Earth is the
A. crust.
B. mantle.
C. outer core.
D. inner core.

2. Which of these BEST describes the mantle?
A. hard and rocky
B. thick and partly melted
C. thin and solid
D. thick and liquid-like

3. Compare and contrast the two parts of Earth's core.

____

____

____

____

4. Describe the asthenosphere.

____

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#35 Modeling Earth's Layers

Procedure

A RESEARCH AND RECORD

1. Use reference books or online sources to find out about Earth's three main layers—the crust, the mantle, and the core. Also, find out about Earth's lithosphere and the asthenosphere.
2. In your science notebook, make a data table in which to record the name of each layer, its thickness, its state, and its composition.

B THINK

3. Use your data and modeling clay to make a model that BEST fits the data you have collected.

C OBSERVE

4. Use the knife and slowly saw back and forth to cut your model in half, taking care not to squash the model. Dental floss may also work to cut the clay.
5. Use the toothpicks and self-sticking notes to label your model.
6. Make and label a drawing of your model in your science notebook.

Name ______________________ Date ____________ Class ____________

#35 Modeling Earth's Layers continued

D ANALYZE AND CONCLUDE

1. Write one or two sentences that use all of the following terms: *the outer core, the inner core, the asthenosphere, the mantle, the crust,* and *the lithosphere*.

2. Contrast the main parts of Earth—the crust, the mantle, and the core—in terms of thickness and state of matter.

3. How is your model like Earth? How does your model differ from our planet?

4. Which of the following BEST models Earth's layers—a peach or a raw egg? Explain your choice.

#36 Classifying Rocks

Background Information

Rocks are classified according to how they form. There are three main groups of rocks: igneous, sedimentary, and metamorphic.

Igneous rocks form as magma or lava cool and crystallize. Some igneous rocks have large mineral grains that interlock like the pieces of a puzzle. Granite is an example of an igneous rock with large mineral grains. Other igneous rocks have very small mineral grains that often cannot be seen without a microscope. Basalt, pumice, and scoria are examples of igneous rocks with small mineral grains.

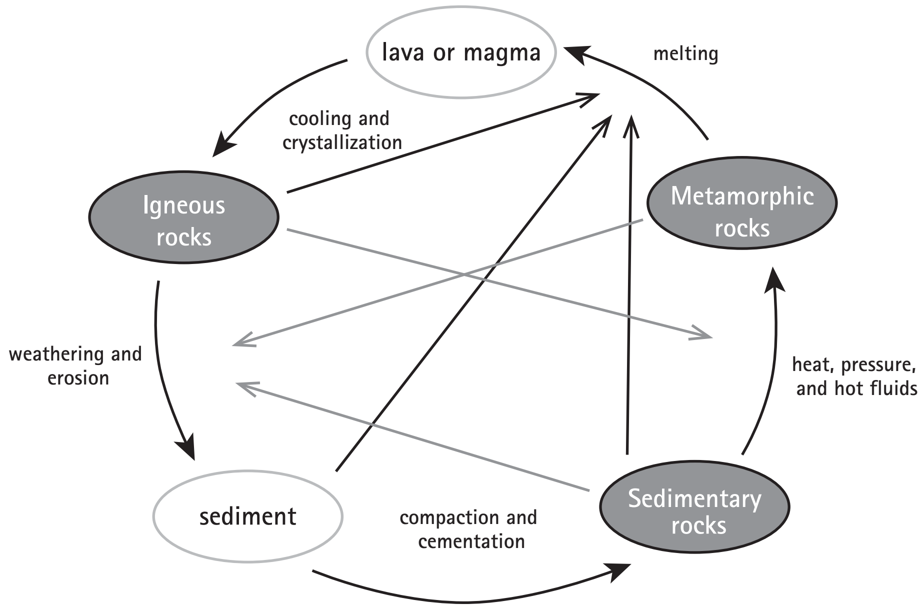
Sedimentary rocks form from sediment or pieces of sediment. Sediment is matter that is deposited by water or wind. Pieces of sediment are called *clasts*. Clastic sedimentary rocks are made of pieces of sediment, or clasts, which are bound by a finer-grained cement. Rocks with rounded, boulder-sized clasts are called conglomerates. Rocks with sand-sized clasts are sandstones. Rocks with clasts that are smaller are either siltstones or shales. Chemical sedimentary rocks form when minerals precipitate from water or when mineral-rich solutions evaporate. Limestone is a chemical sedimentary rock that often contains fossils. Organic sedimentary rocks are rocks that form from organic remains, such as plants or marine animals. Bituminous coal and chalk are organic sedimentary rocks.

Metamorphic rocks are formed from sedimentary rocks exposed to heat, pressure, or hot fluids. They can be foliated or nonfoliated. Foliated metamorphic rocks are rocks in which minerals are aligned in bands. Most foliated rocks form as the result of changes in pressure. Gneiss, schist, and slate are some foliated metamorphic rocks. Nonfoliated metamorphic rocks are not banded and generally form as the result of changes in temperature and/or contact with hot fluids. Marble, quartzite, and anthracite are nonfoliated metamorphic rocks.

Texture describes both the size and arrangement of the minerals or sediment in any type of rock. Coarse-grained rocks are composed of large mineral grains or clasts. Fine-grained rocks are made of relatively small components. In igneous and nonfoliated metamorphic rocks, minerals interlock like the pieces of a jigsaw puzzle. In clastic rocks, sediment appears as if it has been glued together. Foliated metamorphic rocks and some sedimentary rocks are layered.

#36 Classifying Rocks continued

The Rock Cycle



Rocks constantly change as the result of natural processes occurring at or near Earth's surface as well as deep within the planet. These changes make up the rock cycle, which is shown above.

Time Required

1 class period

Objectives

- Observe various rock samples and make drawings of each.
- Classify each rock as igneous, sedimentary, or metamorphic.
- Know how rocks form and change via the rock cycle.

#36 Classifying Rocks continued

Materials *Materials available at www.carolina.com*

FOR THE CLASS

hand lenses

colored pencils

metric rulers

Rock samples:
- igneous rocks—granite and basalt
- sedimentary rocks—conglomerate or coarse sandstone and limestone
- metamorphic rocks—gneiss and marble

Note: Label each rock with a number before distributing them.

Vocabulary

chemical sedimentary rock rock that forms when minerals come out of water that is rich in minerals or when minerals are left behind when water evaporates

clastic sedimentary rock rock made of pieces of sediment called clasts

foliated metamorphic rock banded rock that forms when an existing rock is changed by pressure

nonfoliated metamorphic rock nonbanded rock that forms when an existing rock is changed by heat or hot fluids

organic sedimentary rock rock made of dead organisms

#36 Classifying Rocks continued

Procedure

A THINK

Write the three main types of rocks on the board. Pronounce or ask a volunteer to correctly pronounce each word. Discuss the origin of each term, and explain how each type of rock forms.

B OBSERVE AND RECORD

Draw simple sketches either on the board or on an overhead transparency to show differences among the rock textures discussed in the background information.

Remind students to use their rulers to accurately show the sizes of the minerals or clasts in their rocks as well as the thicknesses of any observable layers.

C ANALYZE AND CONCLUDE

If necessary, provide students with a copy of the rock cycle diagram provided in the teacher background information to help them answer Question 5.

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#36 Classifying Rocks continued

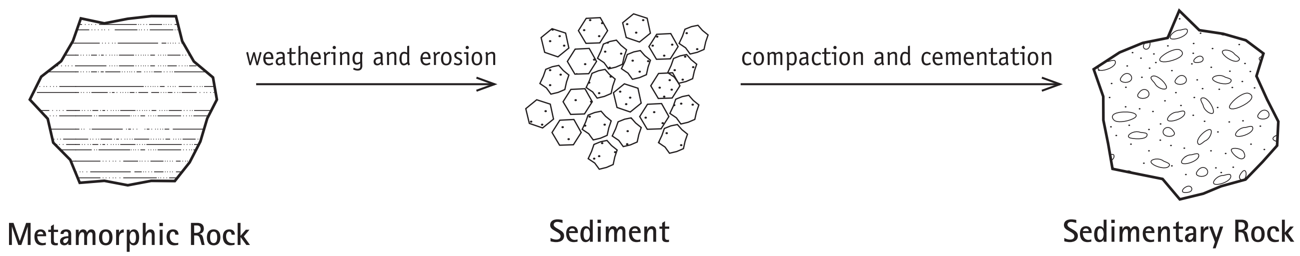
Classifying Rocks

Rock	Draw Picture	observations	Type of Rock
granite		coarse grain, large crystals	igneous
pumice		looks like a sponge, very lightweight	igneous
gneiss		foliated rock, can be light or dark in color, hard rock	metamorphic
marble		nonfoliated rock, may be fine-grained or coarse-grained	metamorphic
sandstone		tiny sand pieces that have cemented together, easy to see layers	sedimentary
limestone		powdery rock, pieces of shells and bones that have been compacted together into rock, may be able to see fossils	sedimentary

#36 Classifying Rocks continued

Student Sheet Answer Key

1. I classified granite and pumice as igneous rocks based on their textures.
2. Conglomerate, sandstone, and limestone are sedimentary rocks.
3. Gneiss and marble are metamorphic rocks. Gneiss is a foliated metamorphic rock. Marble is a nonfoliated metamorphic rock.
4. The grains in the sedimentary rock look as if they have been glued together. The grains in an igneous rock interlock like the pieces of a puzzle.
5. Drawings will vary but should show how weathering and erosion break apart metamorphic rock into sediment that compacts together to become sedimentary rock.



Quiz Answer Key

1. D
2. A
3. Metamorphic rocks form when heat, pressure, or hot fluids change existing rocks. Changes in pressure usually produce foliated rocks. Changes caused by heat usually produce nonfoliated rocks.
4. The minerals in granite are arranged like the pieces of a puzzle. The minerals in gneiss form alternating bands.

Name ______________________ Date ____________ Class ____________

#36 Classifying Rocks

Quiz

1. Igneous rocks form when
  A. rocks become layered.
  B. sediment is bound together.
  C. rocks are changed by hot fluids.
  D. lava or magma cools and hardens.

2. Sedimentary rocks form when
  A. pieces of rocks or minerals are cemented together.
  B. existing rocks are changed by great pressure.
  C. rocks are changed by hot fluids.
  D. lava or magma cools and hardens.

3. How do metamorphic rocks form?

____

____

____

____

____

4. Granite and gneiss are two rocks that can be made of the same minerals. How can you tell the difference between these two rocks?

____

____

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#36 Classifying Rocks

Procedure

A THINK

Rocks are solid earth materials made of one or more minerals. Rocks are classified into three main groups according to how they form. Igneous rocks form when lava or magma cools and crystallizes. Sedimentary rocks form when bits of rocks and minerals called sediment are joined together with a natural cement. Metamorphic rocks form when heat, pressure, or hot fluids change existing rocks.

B OBSERVE AND RECORD

1. Use the hand lens to carefully observe each rock. Record your observations in the second column of the data table.
2. Use colored pencils and a metric ruler to make a detailed drawing of each rock. Make your drawings in the first column of your data table.
3. Use the information provided by your teacher to classify each rock as *igneous*, *sedimentary*, or *metamorphic*. Write the rock type in the last column of your data table.

Name ______________________ Date __________ Class __________

#36 Classifying Rocks continued

Classifying Rocks

Rock	Draw Picture	observations	Type of Rock

Name ______________________________ Date ______________ Class ______________

#36 Classifying Rocks continued

C ANALYZE AND CONCLUDE

1. Which rocks did you classify as igneous rocks? Explain why.

____

____

____

____

____

____

2. Which rocks did you classify as sedimentary rocks?

____

____

____

____

____

____

3. Which rocks are metamorphic rocks? How do they differ?

____

____

____

____

____

____

Name ______________________________ Date ____________ Class ____________

#36 Classifying Rocks continued

4. Suppose you found two rocks near your school. You are sure one is a sedimentary rock and the other is an igneous rock. How can you tell which rock is which?

5. Rocks are constantly changing. Make and label a drawing to show how a metamorphic rock might become a sedimentary rock.

#37 Gravity in the Solar System

Background Information

Gravity is the force of attraction between any two objects in the universe. Planets orbit the Sun because of gravity. Planets do not fall into the Sun because of the speed at which they are traveling. Be sure students understand the role that gravity plays in determining the movement of bodies in the solar system.

An orbit is the path that one object in space takes around another object. Orbital speed is how fast an object is orbiting. Orbital radius is the distance an object is from the object it is orbiting. Since orbits are elliptical, the orbital radius can vary at any given point.

Time Required

1 class period

Objectives

- Model the effect that gravity has on the motion of objects in the solar system.
- Simulate the effect that mass has on gravitational attraction.
- Draw conclusions about how planetary orbits are a balance between inertial forces and the force of gravity.
- Explain why planets that are closer to the Sun travel faster in their orbits than planets that orbit farther from the Sun.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

1 digital balance or triple beam balance

1 small empty soda bottle with the bottom cut off

1 tennis ball with slit

1 thick wooden craft stick

1 empty plastic bottle (such as a shampoo bottle)

1 metric ruler

1 felt-tipped marker

1 stopwatch

1 calculator

heavy string or cord that will not easily break (2 m)

sand (300 g)

FOR EACH STUDENT

1 pair safety goggles

science notebook

#37 Gravity in the Solar System continued

Vocabulary

gravity the force of attraction between masses

orbit the path an astronomical body follows as it revolves around another body

SAFETY INFORMATION

All students should wear safety goggles during the activity.

Procedure

A THINK

Provide students with definitions of the vocabulary terms. A planet's orbit balances the gravitational attraction of the Sun with the momentum of the planets. If the planets were not attracted to the Sun, they would travel in a straight line through space. If they did not have momentum, they would travel in a straight line toward the Sun. Orbits balance these two forces.

B EXPLORE

Use a safety knife to carefully remove the bottom from each soda bottle. Use the safety knife to carefully make a slit in each tennis ball and in the bottom of each of the smaller plastic bottles. Make sure that students exercise caution when passing the knotted string through the slit. Students should use the wooden craft stick to carefully and slowly push the knot through the opening. The size of the slit can be fairly large to make this step easier. Alternatively, you can perform this step beforehand.

The thickness of the string used will affect the size of the knots that students can tie. If you use thin-diameter string or cord, consider making a small hole in the soda bottle cap and attaching it to the bottle. The string or cord can be threaded through the hole in the cap and students should be able to make a knot large enough to prevent the string from passing through the cap. Alternatively, students can tie a washer to the end of the string.

Student volunteers should be extremely careful when swinging the tennis ball around their heads. Team members should sit on the ground and watch while a volunteer swings the tennis ball. One member of each team should be responsible for checking the apparatus each time before it is tested.

C EXPLORE MORE

Student measurements will be more accurate if they practice measuring the amount of time it takes for the tennis ball to complete 10 revolutions. As an extension, students may also enjoy designing an experiment to test whether the mass of the sand affects the radius of the tennis ball's orbit.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#37 Gravity in the Solar System continued

Student Sheet Answer Key

1. The bottle of sand represented the gravitational attraction between the Sun and a planet. The tennis ball represented a planet. The bottle of sand pulled the tennis ball toward the center of the system in the same way that the force of gravity pulls planets toward the Sun.
2. The tennis ball orbited the bottle in a circular path because its orbit was a balance between the inward pull of the bottle of sand and the momentum of the tennis ball.
3. The tennis ball would have traveled outward in a straight line before falling toward Earth.
4. Planets that orbit closer to the Sun must travel faster to balance the pull of gravity.
5. Answers will vary. Sample answer: If the Sun had more mass, the gravitational attraction between the planets and the Sun would be stronger. The planets would be pulled closer to the Sun. In order to maintain their current orbital distance, the planets would have to travel much faster than they currently travel.
6. Answers will vary. Sample answer: The model was accurate because it showed how the momentum of the planets balances the gravitational attraction of the Sun. However, it was inaccurate because it did not simulate the elliptical path of planetary orbits.

Quiz Answer Key

1. B
2. All objects in the solar system orbit the Sun because the Sun has more mass than any other object in the solar system.
3. A

Name ______________________________ Date ______________ Class ______________

#37 Gravity in the Solar System

Quiz

1. A planet completes one revolution around the Sun in a

A. day.
B. year.
C. season.
D. month.

2. Why do all objects in the solar system orbit the Sun?

____

____

____

____

____

____

3. If the planets were not attracted to the Sun by the force of gravity, which of the following would best describe the motion of the planets?

A. a straight line
B. a curved line
C. an elliptical path
D. a circular path

Name ______________________________ Date ____________ Class ____________

#37 Gravity in the Solar System

Procedure

A THINK

If every object in the solar system is attracted to the Sun by the force of gravity, why aren't the planets pulled into the Sun?

The planets orbit the Sun in an elliptical path. Which force balances the force of gravity to make planetary orbits elliptical?

What direction would planets travel if they were not attracted to the Sun by the force of gravity?

Think about these questions, and try to answer them in your science notebook. Discuss your explanations in class, and then get ready to build a planetary orbit simulator that will help you answer these questions!

B EXPLORE

1. Pass the string through the soda bottle. Tie strong knots in both ends of the string.
2. Find the end of the string that passed through the neck of the bottle. Use the wooden craft stick to push the string knot through the small slit in the tennis ball. Test to make sure that the knot does not pull out of the tennis ball. If it does, make a larger knot and try again.
3. Tie another knot in the string about 1.5 m from the tennis ball. This knot should be large enough to prevent the end of the string from pulling through the neck of the bottle.
4. Fill a small plastic bottle with sand until the bottle and sand have a mass of 100 g. Cover the slit on the bottom of the bottle while adding the sand. Seal the bottle. Push the knot at the other end of the string through the slit in the bottom of the bottle. The bottle should hang upside down.
5. Congratulations, you have now built your planetary orbit simulator! Your team can now go outside to an open area and test it out. Hold the bottle above your head and loosely hold onto the end of the string that exits the bottom of the bottle. Pull down on the string and begin slowly spinning the tennis ball above your head. Gradually loosen your hold on the string, letting the tennis ball's "orbit" widen until you have completely let go of the string.
6. Record your observations in Data Table 1. Did the weight of the sand balance the force exerted by the orbiting tennis ball? Test the effect that different masses have on the orbiting tennis ball.

Data Table 1: Mass Observations

Mass of Sand (g)	Observations
50	
100	
150	
200	
250	

Name ______________________ Date __________ Class __________

#37 Gravity in the Solar System continued

C EXPLORE MORE

7. Now you are going to explore how orbital speed is affected by orbital radius. Remove the small bottle from the end of the string and untie the knot in the middle of the string.

8. Enlarge the knot at the end of the string so that it is large enough to prevent the string from passing through the neck of the bottle.

9. There should be a little less than 2 m of string between the tennis ball and the knot at the end of the string. Measure this distance and divide it into four equal segments. Mark each segment with a felt-tipped marker.

10. Now test the effect that orbital radius has on orbital speed. Try swinging the tennis ball around your head when the orbital radius is 200 cm. Practice a few times until the tennis ball is traveling at the minimum speed needed to maintain orbit at an even level.

11. Then have a team member use the stopwatch to determine the amount of time it takes the tennis ball to complete 10 orbits. Use a calculator to divide this number by 10, and record the results in Data Table 2.

12. Repeat Step 9 for each of the distances marked on the string.

Data Table 2: Orbital Observations

Orbital Radius (cm)	Orbital Period (revolutions/s)
50	
100	
150	
200	

Name ______________________________ Date ____________ Class ____________

#37 Gravity in the Solar System continued

D ANALYZE AND CONCLUDE

1. What did the bottle of sand and the tennis ball represent in this model?

2. Why did the tennis ball orbit the bottle in a circular path?

3. What would have happened if the string that held the tennis ball broke while the tennis ball was orbiting the bottle?

Name ______________________________ Date ______________ Class ______________

#37 Gravity in the Solar System continued

4. Why is the speed that a planet orbits the Sun affected by its distance from the Sun?

5. How would planetary orbits be affected if the Sun had twice as much mass as it currently has?

6. Describe one benefit and one limitation of the model that you used in this activity.

#38 Cells: EuKaryotic or Prokaryotic?

Background Information

All cells share certain characteristics, such as having a cell membrane, cytoplasm, and DNA. However, there are some major differences between prokaryotic and eukaryotic cells. The primary difference is that although both cell types have DNA, only eukaryotic cells have DNA that is contained by a nucleus. Prokaryotic DNA occurs in a loop that is not confined to a certain part of the cell. Eukaryotic cells have a variety of other membrane-bound organelles in addition to a nucleus. Prokaryotes have no membrane-bound organelles at all. Also, eukaryotic cells are generally much larger than prokaryotic cells. Organisms that have prokaryotic cells are in Domain Bacteria and Domain Archaea. These unicellular organisms take a variety of cell shapes including round, rod, and spiral. A third domain, Eukarya, includes organisms with eukaryotic cells. These organisms can be further classified as protists, fungi, plants, and animals. Most of these organisms are multicellular, but protists include unicellular and multicellular organisms.

Time Required

2 class periods: **1** period to introduce the concepts and for students to write instructions and **1** period for model construction and analysis

Objectives

- Distinguish between prokaryotic and eukaryotic cells.
- Write instructions for other students to create models of prokaryotic and eukaryotic cells.
- Make models of prokaryotic and eukaryotic cells.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

plastic food containers with lids

plastic eggs

plastic bags

yarn

beans

buttons

images of bacteria, archaea, and eukaryotic cells (from a classification kit, a science textbook, or another source)

chalk

Note: Cell Model Making Kit and Classification of Organisms Kit are available at www.carolina.com

#38 Cells: EuKaryotic or Prokaryotic? continued

Vocabulary

cell the smallest unit of life
eukaryotic a type of cell that has membrane-bound organelles, including a nucleus that contains DNA
nucleus the command center of the cell
organelles the parts within a cell that do the work
prokaryotic type of cell in which DNA is not contained in a nucleus, and that has no membrane-bound organelles

SAFETY INFORMATION

Remind students to be careful when handling any sharp materials.

#38 Cells: EuKaryotic or Prokaryotic? continued

Procedure

A THINK

Describe the similarities and differences between prokaryotic and eukaryotic cells. Explain to students what types of organisms have each type of cell. Show students images of each cell type, using cards from a classification kit, images from your textbook, or any other source you prefer. Draw a simple image on the whiteboard that shows the two types of cells. Point out that both types of cells share similar characteristics. Both have a cell membrane, cytoplasm, and DNA. Eukaryotic cells are larger, have a variety of membrane-bound organelles, and have DNA contained in a nucleus.

B OBSERVE AND RECORD

Introduce students to the materials. Demonstrate use of the materials to create models of a prokaryotic cell and a eukaryotic cell. Tell students to take notes on each step so they will be able to provide instructions for others to use.

For the prokaryotic cell: Make a loop of DNA by tying a long piece of yarn into a loop. Put this into a plastic egg (the cell membrane).

For the eukaryotic cell: Make a nucleus full of DNA by condensing a mass of yarn (DNA) in a plastic bag (nuclear membrane). Tie the bag shut. Put the bag of yarn into a plastic container (the cell membrane). Add beans and buttons (other membrane-bound organelles).

C TASK

Ask students to write instructions for another student to create models of a prokaryotic cell and a eukaryotic cell.

D EXPLORE MORE

Collect the pages of instructions. Pass out one set of instructions to each student. Allow students to create cell models by following the instructions written by a classmate.

E ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#38 Cells: EuKaryotic or Prokaryotic? continued

Student Sheet Answer Key

1. A. yarn; B. plastic bag; C. plastic container; D. beans and buttons; E. plastic egg
2. size, presence of a nucleus, presence of other membrane-bound organelles
3. Both have a cell membrane and DNA.
4. Answers will vary. Sample answer: The eukaryotic cells are much larger than the prokaryotic cells.
5. Answers will vary. Sample answer: It is very important to be specific and clear when writing out steps to a procedure.

Quiz Answer Key

1. C
2. prokaryotic
3. The DNA in a prokaryotic cell is inside the cell membrane, in the cytoplasm. The DNA is not contained in a nucleus.
4. Answers will vary. Sample answer: Both prokaryotic and eukaryotic cells have cell membranes, cytoplasm, and DNA.

Name ______________________________ Date ______________Class ______________

#38 Cells: EuKaryotic or Prokaryotic?

Quiz

1. A major difference between prokaryotic and eukaryotic cells is that
   A. only prokaryotic cells have a nucleus.
   B. only prokaryotic cells have cytoplasm.
   C. only eukaryotic cells have a nucleus.
   D. only eukaryotic cells have DNA.

2. Bacteria are organisms that have ______________________________ cells.

3. Where is DNA located in a prokaryotic cell?

____

____

4. What are three characteristics that prokaryotic and eukaryotic cells have in common?

____

____

____

Name ______________________ Date ____________ Class ____________

#38 Cells: EuKaryotic or Prokaryotic?

Procedure

A THINK

All living things are made up of cells. All cells have similarities. But there are many differences between different kinds of cells.

How are prokaryotic cells different from eukaryotic cells? Prokaryotes and eukaryotes have two very different cell types. Eukaryotic cells have membrane-bound organelles. One of these organelles is the nucleus, which contains the cell's DNA. Prokaryotic cells do not have membrane-bound organelles. Their DNA is loose inside the cell.

Your cells are eukaryotic. All animals have eukaryotic cells. So do plants and some other organisms. Many unicellular organisms, such as bacteria, have prokaryotic cells.

B OBSERVE AND RECORD

1. Watch as your teacher demonstrates how to construct models of a prokaryotic cell and a eukaryotic cell.
2. Take notes on the steps your teacher demonstrates.

Name ____________________ Date ____________ Class ____________

#38 Cells: EuKaryotic or Prokaryotic? continued

3. Use this space to take notes on how to model a prokaryotic cell.

Notes for How to Model a Prokaryotic Cell

Name ______________________ Date ____________ Class ____________

#38 Cells: EuKaryotic or Prokaryotic? continued

4. Use this space to take notes on how to model a eukaryotic cell.

Notes for How to Model a Eukaryotic Cell

Name ____________________ Date __________ Class __________

#38 Cells: EuKaryotic or Prokaryotic? continued

C TASK

5. Write careful instructions for making a model prokaryotic cell.

How to Model a Prokaryotic Cell

Name ______________________ Date __________ Class __________

#38 Cells: EuKaryotic or Prokaryotic? continued

6. Write careful instructions for making a model eukaryotic cell.

How to Model a Eukaryotic Cell

Name ______________________________ Date ____________ Class ____________

#38 Cells: EuKaryotic or Prokaryotic? continued

D EXPLORE MORE

7. Follow instructions written by another student. Use the materials provided to construct a model prokaryotic cell.

8. Follow instructions written by another student. Use the materials provided to construct a model eukaryotic cell.

E ANALYZE AND CONCLUDE

1. What material represents each of the following in your models? Write your answer on the line.

A. DNA ______________________________

B. Nucleus ______________________________

C. Eukaryotic cell membrane ______________________________

D. Eukaryotic organelles ______________________________

E. Prokaryotic cell membrane ______________________________

2. What are three major differences between your model of a prokaryotic cell and your model of a eukaryotic cell?

____

____

____

3. What two similarities between prokaryotic and eukaryotic cells can you see in your models?

____

____

4. What is the most obvious difference you can see between the prokaryotic and eukaryotic cell models?

____

____

5. What did you learn about writing instructions as you followed instructions written by another student?

____

____

#39 what makes an Organism?

Background Information

The system for classifying living things changes over time as people learn more about the relationships between different kinds of organisms. Currently, many scientists classify life first into three domains: Domain Bacteria, Domain Archaea, and Domain Eukarya.

Bacteria and archaea are prokaryotes. Most prokaryotes are unicellular. Living things in both of these domains undergo asexual reproduction by binary fission, but can exchange genetic material—for example, by conjugation. Prokaryotes have many strategies for getting the energy and carbon they need. Some are autotrophs—they make their own food from sunlight or chemical energy; and some are heterotrophs—they depend on other living things for food. Differences between bacteria and archaea include materials in the cell wall and cell membrane, the number of RNA polymerases, and their genetic similarity to Eukaryotes (archaea are more similar). Additionally, some archaea are extremophiles that can live in extreme environments such as hot springs or deep ocean vents.

Eukarya are further classified into four kingdoms: Protista, Plantae, Fungi, and Animalia. All are eukaryotic, but they vary greatly beyond this characteristic.

Kingdom Protista

Some living things are classified as protists simply because they do not fit into any other group. There is much debate over classification of species in this kingdom. Protists can be unicellular or multicellular. Most protists use asexual reproduction, but some can also use sexual reproduction. Some protists are autotrophic and some are heterotrophic. Some species can use both strategies.

Kingdom Plantae

Plants are multicellular organisms that conduct photosynthesis, an autotrophic strategy for making food. Organisms in Kingdom Plantae use both sexual and asexual reproduction.

Kingdom Fungi

Fungi are multicellular, heterotrophic organisms that get energy by absorbing it from the soil or other surroundings. Both sexual and asexual reproduction occur within Fungi.

Kingdom Animalia

Animals are multicellular, heterotrophic organisms. Animals get energy by eating organic material that they absorb after it has been ingested into the body. The vast majority of animals reproduce sexually.

Time Required

2 class periods: **1** period to introduce the concepts and fill out the table and **1** period for students to quiz each other on identification and description of organism images and answer related questions

#39 what makes an Organism? continued

Objectives

- Understand what characteristics are used to identify kinds of organisms.
- Differentiate between prokaryotic and eukaryotic cells, and heterotrophic and autotrophic organisms.
- Create a table of characteristics to understand the differences between organisms in different kingdoms.

Materials *Materials available at www.carolina.com*

FOR THE CLASS

images of bacteria, archaea, protists, plants, fungi, and animals cut from magazines or other sources

Note: Classification: Where Do You Fit? Bio Cards are available at www.carolina.com

Vocabulary

asexual reproduction a type of reproduction by which a single individual produces offspring; the offspring are genetically identical to the parent

autotrophic able to make food using light or chemical energy

eukaryotic a type of cell that has membrane-bound organelles, including a nucleus that contains DNA

heterotrophic being dependent on organic materials for food

multicellular organism an organism with two or more cells

prokaryotic a type of cell in which DNA is not contained in a nucleus, and that has no membrane-bound organelles

sexual reproduction a type of reproduction by which two individuals produce offspring; the offspring share genetic material with each parent

unicellular organism an organism with only one cell

#39 what makes an Organism? continued

Procedure

A THINK

Introduce the following characteristics of organisms, and explain that these features help scientists identify kinds of organisms:

- Prokaryotic organisms have a single cell. The cell does not have a nucleus. Eukaryotic organisms have one cell or many cells. The cells have a membrane-bound nucleus.
- Unicellular organisms are made up of a single cell. Multicellular organisms are made up of many cells.
- Autotrophic organisms get nourishment directly from sunlight or chemical energy. Heterotrophic organisms feed on other organisms or their byproducts.
- Some organisms reproduce asexually. A single parent has offspring that is identical to the parent because there is a single set of genetic material. Most animals reproduce sexually. Genetic information from more than one parent is combined. The offspring share the genetic material of each parent.

B OBSERVE AND RECORD

Tell students that you are going to describe the characteristics of each major group of organisms. Explain that students should follow along and fill in the table with the proper information as you describe the content.

Describe the characteristics of bacteria, archaea, protists, plants, fungi, and animals, including the four features outlined for each kind of organism.

Characteristics of Different Kinds of Organisms

Ask		Archaea	Bacteria	Protista	Fungi	Plantae	Animalia
What kind of cells does it have?	Prokaryotic	yes	yes	no	no	no	no
	Eukaryotic	no	no	yes	yes	yes	yes
How many cells does it have?	Unicellular	yes	yes	some	no	no	no
	Multicellular	no	no	some	yes	yes	yes
How does it get food?	Autotrophic	some	some	some	no	yes	no
	Heterotrophic	some	some	some	yes	no	yes
How does it reproduce?	Asexual	yes	yes	some	some	some	no
	Sexual	no	no	some	some	some	yes

#39 what makes an Organism? continued

C TASK

Organize the class into pairs. Pass out a set of cards with images of organisms to each pair of students. Each set should include two examples of each of the six groups of organisms. Make sure that the back of each card identifies the organism that is pictured, because it may be difficult for students to identify some images.

Examples:

Archaea Many forms of archaea live in extreme environments where it is extremely hot, cold, salty, or acidic. Archaea do not need sunlight or oxygen.

Methanopyrus kandleri—produces methane gas; found in wetlands and thrive in the digestive tracts of humans and other animals
Halobacteria—salt-loving archaea that live in very, very salty water such as that in the Great Salt Lake in Utah
Sulfolobus—lives in superheated, acidic environments such as Mud Volcano in Yellowstone National Park

Bacteria Bacteria are found in soil and water. Thousands of species (billions of bacteria) live in the human body. Many bacteria perform vital functions, such as producing vitamins.

Staphylococcus—grows on your skin, nasal passages, gastrointestinal tract; cause acne and "food poisoning"
Escherichia coli (frequently written *E, coli*)—helps produce Vitamin K in the body; it can sometimes contaminate water or undercooked food and cause infections
Salmonella enterica—can contaminate food and cause serious illness; one type of salmonella causes typhoid fever
Lactobacillus—produces lactic acid; *Lactobacillus delbrueckii* is used to make yogurt

Protista Protista includes mostly unicellular organisms that do not fit into other categories.

amoeba—lives in freshwater, salt water and damp soil
paramecium—a slipper-shaped protist that uses hairlike cilia to move
plasmodium—a type of protist that lives in mosquitoes and causes malaria in humans
algae—protists that look like plants; they live in colonies in moist environments

Fungi Fungi are eukaryotic organisms that break down substances from their environment for food. Some fungi are microorganisms.

Stachybotrys—a type of mold; lives on materials that contain cellulose; *Stachybotrys chartarum*, called black mold, can cause severe health problems
Ascomytota—yeasts have been used by humans for thousands of years to make bread rise and to ferment grapes
mushrooms—any of several species fungus with a stem, cap, and gills; *Agaricus bisporus* is the familiar white button mushroom
Penicillium—a type of fungi that is used to make a group of antibiotics called penicillin

Plantae Kingdom Plantae is made up of multicellular, eukaryotic organisms that have cell walls. They are autotrophic—they use energy from the Sun to make food through photosynthesis.

Animalia Kingdom Animalia is made up of multicellular, eukaryotic organisms without cell walls. Animals are heterotrophic—they use energy from other organisms.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#39 what makes an Organism? continued

Student Sheet Answer Key

1. C, B, D, A
2. Some plants reproduce asexually, and no animals reproduce asexually. Plants are autotrophic and animals are heterotrophic.
3. Protista
4. The organism is unicellular, eukaryotic, and autotrophic. She found a protist.
5. How many cells does it have? What kind of cells does it have? How does it get food? How does it reproduce?

Quiz Answer Key

1. B
2. multicellular
3. Autotrophic organisms can make their own food using light or chemical energy.
4. B

Name ______________________________ Date ____________ Class ____________

#39 what makes an Organism?

Quiz

1. ______________________ and ______________________ have prokaryotic cells.
   A. Animals, plants
   B. Bacteria, archaea
   C. Protists, fungi
   D. Archaea, protists

2. An organism made up of a many cells is a(n) ______________________ organism.

3. Explain how autotrophic organisms get food.

   ____

   ____

4. How many genes does an animal share with each parent?
   A. all
   B. one-half
   C. one-fourth
   D. none

Name ______________________________ Date ____________ Class ____________

#39 what makes an Organism?

Procedure

A THINK

All living organisms can be classified by their characteristics.

1. **Does the organism have a nucleus?** Some organisms have cells that are prokaryotic. Prokaryotic cells don't have membrane-bound organelles. Their DNA is loose inside the cell. Other organisms have cells that are eukaryotic. Eukaryotic cells have membrane-bound organelles. One of these organelles is a nucleus that contains the cell's DNA.
2. **How many cells does the organism have?** Some organisms are unicellular. They are made up of a single cell. Others are multicellular. They are made up of many cells.
3. **How does the organism get food?** Some organisms are autotrophic. They can make their own food using sunlight or chemical energy. Other organisms are heterotrophic. They can't make their own food. They depend on other organisms or their byproducts for food.
4. **How does the organism reproduce?** All organisms reproduce. Some use asexual reproduction, which means one individual can reproduce alone. Other organisms use sexual reproduction, which means that two individuals combine genetic material to produce new individuals with a unique combination of genes.

B OBSERVE AND RECORD

5. Listen as your teacher describes the different kinds of organisms. Use the table to record the characteristics of each kind of organism. Write *yes*, *no*, or *some* in each box to indicate whether the organism has the characteristic listed.

Characteristics of Different Kinds of Organisms

Ask		Archaea	Bacteria	Protista	Fungi	Plantae	Animalia
What kind of cells does it have?	Prokaryotic						
	Eukaryotic						
How many cells does it have?	Unicellular						
	Multicellular						
How does it get food?	Autotrophic						
	Heterotrophic						
How does it reproduce?	Asexual						
	Sexual						

Name ______________________ Date ____________ Class ____________

#39 what makes an Organism? continued

C TASK

6. Your teacher will pass out a set of images to student pairs. With your partner, take turns holding up images of organisms to quiz each other. First, identify the organism. Ask: "What is this organism?" If you don't know what it is, read the kingdom written on the back of the card.

7. Then determine the characteristics of that organism. Ask: "What kind of cells does it have?" "How many cells does it have?" "How does it get food?" "How does it reproduce?" In some cases, you will find the answer on your table because all species within a kingdom share the same characteristic. In other cases, you won't be able to answer because not all species within the kingdom share the same characteristic.

Name ______________________________ Date ______________ Class ______________

#39 what makes an Organism? continued

D ANALYZE AND CONCLUDE

1. Match the kind of organism on the left with the correct characteristic described on the right by drawing a line between each matching pair.

Animals	**A.** All are autotrophic.
Protists	**B.** Some are unicellular and some are multicellular.
Bacteria	**C.** All use sexual reproduction.
Plants	**D.** All are prokaryotic.

2. What are two differences between plants and animals?

____

____

3. Which kingdom of organisms includes some species with each of these characteristics: eukaryotic, autotrophic, heterotrophic, unicellular, multicellular, asexual, and sexual?

____

4. Suppose your friend wants you to identify an organism she has discovered in the pond behind her house. She has used a microscope to determine that it is made up of a single cell, and it has a nucleus. She also found that when it is kept in sunlight this organism survives, but when it is kept in the dark the organism dies. Is the organism unicellular or multicellular? Prokaryotic or eukaryotic? Autotrophic or heterotrophic? What kind of organism did she find?

____

____

5. If you found an organism in your backyard that you did not recognize, what are four questions about its characteristics that you should ask to help you identify it?

____

____

____

____

#40 Organization to Ecosystem Pyramid

Background Information

An ecosystem is a complex organization made up of a variety of organisms, populations, and communities.

An organism is a single animal or plant, such as a ground squirrel or an oak tree.

A population is a group of organisms of the same animal or plant, such as a group of ground squirrels or a group of oak trees, that lives in the same place at the same time.

A community is a group of populations that interact with each other in a given location. For example, a prairie community might include ground squirrels, raccoons, pheasants, grasses, birds, trees, ants, beetles, trees, snakes, and other living organisms. The members of a community rely on each other for food, shelter, and other functions.

Together, a community and nonliving things, such as air, the Sun, water, rocks, and soil, make up an ecosystem. Ecosystems can be all different sizes: They can be as small as a sandbox or as large as a desert.

Time Required

2 class periods: **1** class period to research an ecosystem and **1** class period to create an ecosystem pyramid

Objectives

- Understand the levels of the organization within an ecosystem.
- Recognize how an individual animal is part of a population, a community, and an ecosystem.
- Gather needed information and images to create the levels of an ecosystem.

Materials *Materials available at www.carolina.com*

FOR THE TEAM

10 index cards
computers
magazines
whiteboard or poster board

FOR EACH STUDENT

glue or tape
scissors
colored pencils or markers
science notebook

#40 Organization to Ecosystem Pyramid continued

Vocabulary

community includes all the populations in one area

ecosystem a large natural system, which includes a community and the nonliving things in it

organism anything that is alive, such as a single animal or plant

population a group of organisms of the same species that live in the same place at the same time

SAFETY INFORMATION

Remind students to use scissors responsibly. If students are looking online for images, guide them to visit only school-approved sites. Check district policy on Internet use.

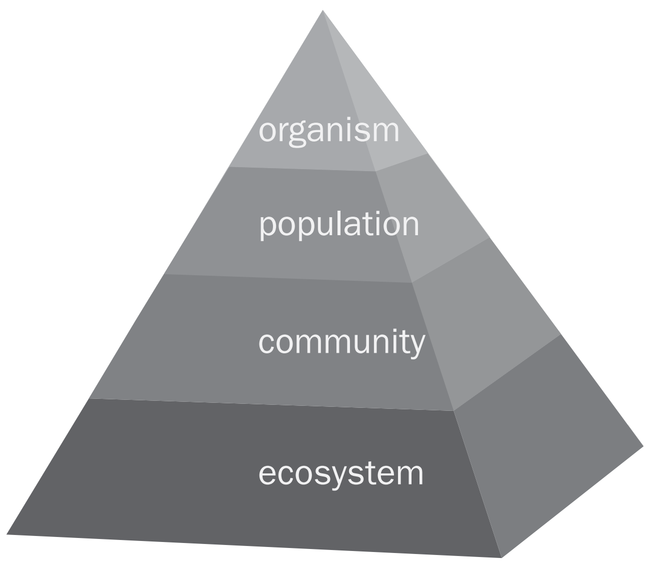
#40 Organization to Ecosystem Pyramid continued

Procedure

A THINK

Review the vocabulary words with students. Discuss different types of ecosystems and what living and nonliving things can be found in each.

Draw an isosceles triangle on the board, and then draw three horizontal lines to divide it into four equal sections. Ask a volunteer to give an example of an organism, and write its name in the top section of the triangle. Ask another volunteer to describe a population that the organism is part of. Write the name of the population in the second section of the triangle. Ask a volunteer to describe a community that the population might be part of, and write it in the third section of the triangle. Finally, ask a volunteer to describe an ecosystem where the community would be found, and write it in the bottom section of the triangle. Make sure each example is accurate to assure that students understand the differences between the levels of an ecosystem.



B RESEARCH

Place students into teams of two or three, and have them choose an animal. Teams should choose different animals. Provide computers for students to do their research.

C TASK

Give each team a set of ten index cards. Tell students that they can use the Internet to find images of their animal. Or provide magazines or other resources with appropriate images. Students can also use markers or colored pencils to draw the images they need. Then have each team present their ecosystem pyramid on a whiteboard. (Or have students glue or tape the index cards to a poster board.) Make sure the teams explain to the class how the living and nonliving things in the ecosystem are connected.

D ANALYZE AND CONCLUDE

Have students complete the activity and record responses and observations on the Student Sheet. Include class discussion.

#40 Organization to Ecosystem Pyramid continued

Student Sheet Answer Key

1. Answers will vary. Sample answer: A community includes the living parts of an ecosystem. But an ecosystem is made up of not only a community but also nonliving things, such as sunlight, rocks, and air.
2. Answers will vary. Sample answer: No. Every animal is a member of a population, which consists of other animals like it. The animal's population lives with other animal and plant populations to form a community. And the community and nonliving things form an ecosystem.
3. A single dandelion is an organism.
4. Answers will vary. Sample answer: I belong to the population of human beings.

Quiz Answer Key

1. B
2. D
3. A population is made up of one type of organism. A community is made up of many kinds of populations.
4. Answers will vary. Sample answer: trout, turtles, mayflies

Name ______________________________ Date ____________ Class ____________

#40 Organization to Ecosystem Pyramid

Quiz

1. Which of these statements is correct?
A. An animal begins life in a population, then moves to a community.
B. An animal exists within a population, a community, and an ecosystem at the same time.
C. Some animals live in ecosystems, but not in communities.
D. Young animals live in communities, and older animals live in ecosystems.

2. A group of zebras is an example of
A. a community.
B. an ecosystem.
C. an organism.
D. a population.

3. How is a population different from a community?

____

____

____

4. Name three organisms that you think might exist in a river community.

____

____

____

Name ______________________________ Date ______________ Class ______________

#40 Organization to Ecosystem Pyramid

Procedure

A THINK

1. Do you know what parts make up an ecosystem? Think about the different levels of an ecosystem and how all the levels are connected.

B RESEARCH

1. With your team, choose an animal you would like to study.
2. Research your animal on the Internet. Look for information such as the living things that live with and near your animal, the food your animal eats, and the nonliving things that the animal depends upon. Write this information in your science notebook.

C TASK

1. With your team, you will create an ecosystem pyramid with ten index cards. At the top of one index card, write “Organism.” Write “Population” on two index cards, “Community” on three index cards, and “Ecosystem” on four index cards.
2. Use the Internet to find images of your animal, or look through magazines or other resources your teacher provides.
3. Glue or draw an image of your animal on the “Organism” card. On the back of the card, write the name of your animal.
4. Glue or draw several images of your animal on the “Population” cards. On the backs of the cards, write the name of the animals.
5. On the “Community” cards, glue or draw images of plants and other animals that would be in a community with your animal. Write the names of the plants and animals on the backs of each card.
6. On the “Ecosystem” cards, glue or draw images of the nonliving things in the ecosystem where you would find your animal’s community. These images could include the Sun, water, rocks, and soil. Write the nonliving things on the backs of each card.
7. Present your ecosystem pyramid to the class.

Name ______________________ Date __________ Class __________

#40 Organization to Ecosystem Pyramid continued

D ANALYZE AND CONCLUDE

1. How is the community in your ecosystem different from the ecosystem?

____

____

2. You chose an animal and then showed the animal in a population, community, and ecosystem. Is there any animal you could have chosen that would not have a natural population, community, and ecosystem? Explain your answer.

____

____

____

____

3. To which level does a single dandelion belong in the organism-population-community-ecosystem organization?

____

4. To what population do you belong?

____