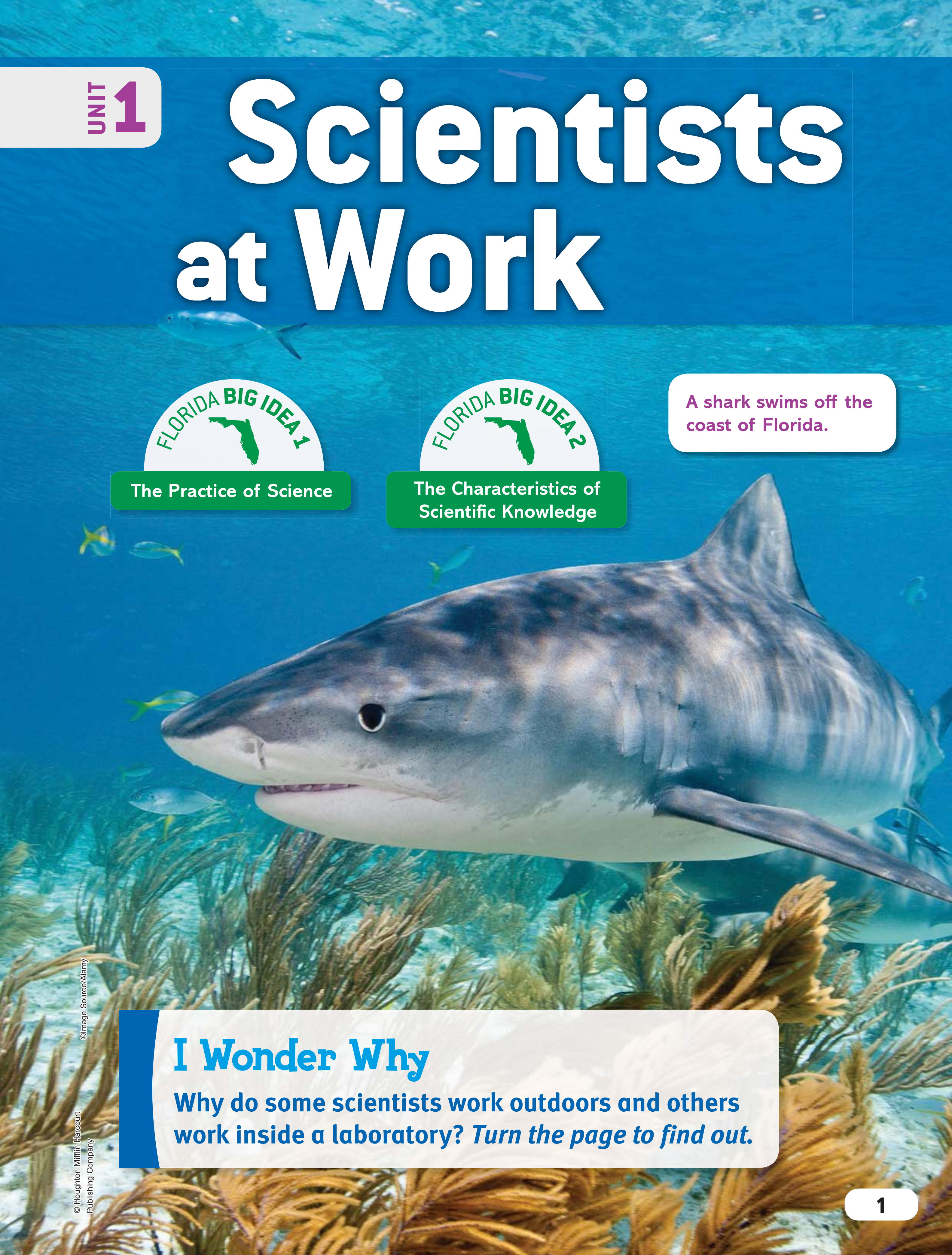
UNIT 1

Scientists at Work



FLORIDA BIG IDEA 1
The Practice of Science

FLORIDA BIG IDEA 2
The Characteristics of Scientific Knowledge

A shark swims off the coast of Florida.

I Wonder Why

Why do some scientists work outdoors and others work inside a laboratory? ***Turn the page to find out.***

Here's Why

Scientists work to answer questions. Some questions can be answered with outdoor investigations. Others require tools in a lab.

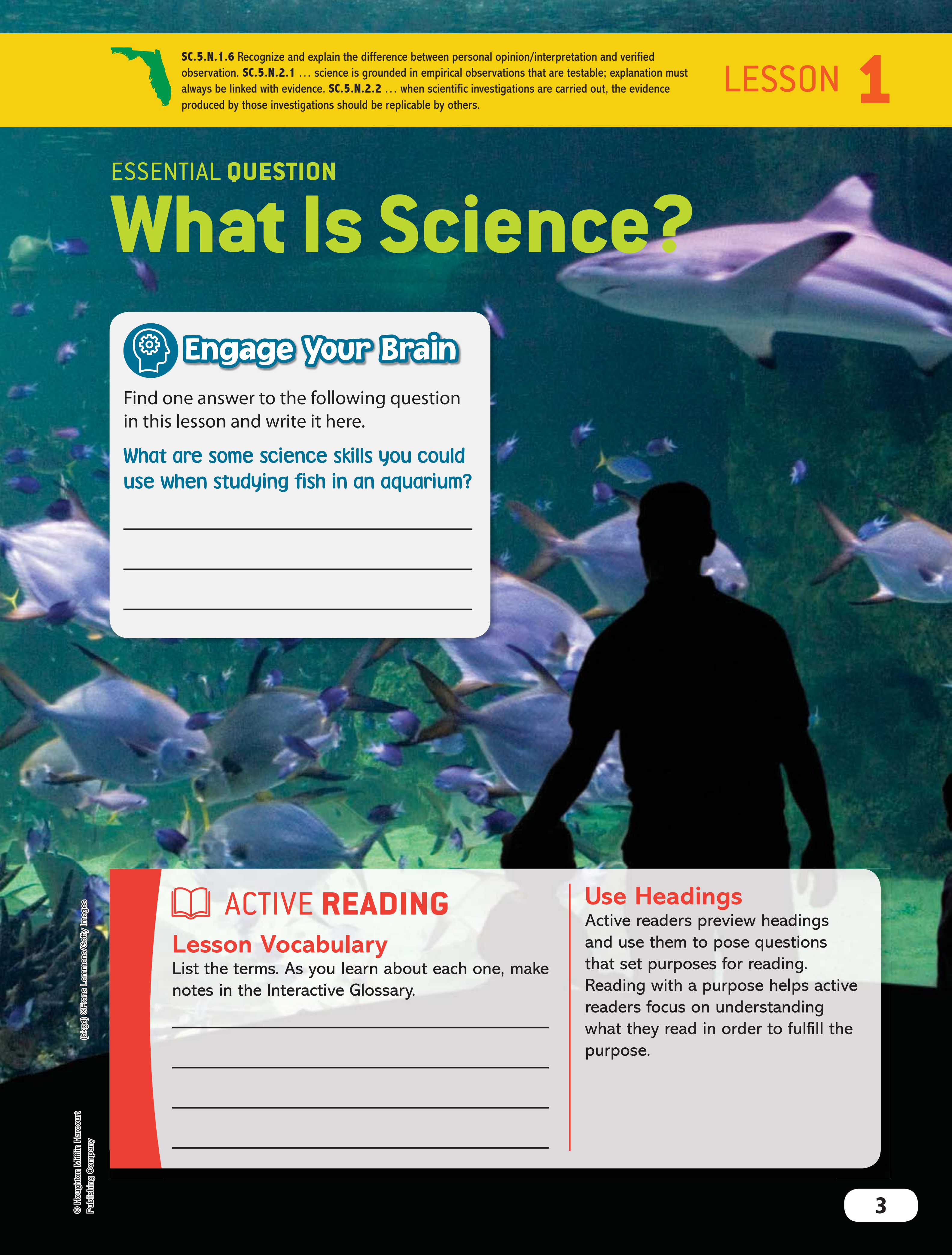
Essential Questions and Florida Benchmarks

SC.5.N.1.6 Recognize and explain the difference between personal opinion/interpretation and verified observation. SC.5.N.2.1 … science is grounded in empirical observations that are testable; explanation must always be linked with evidence. SC.5.N.2.2 … when scientific investigations are carried out, the evidence produced by those investigations should be replicable by others.

LESSON 1

ESSENTIAL QUESTION

What Is Science?



Engage Your Brain

Find one answer to the following question in this lesson and write it here.

What are some science skills you could use when studying fish in an aquarium?

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ACTIVE READING

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

____

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Use Headings

Active readers preview headings and use them to pose questions that set purposes for reading. Reading with a purpose helps active readers focus on understanding what they read in order to fulfill the purpose.

(bkgd) ©Frans Lemmens/Getty Images

What All Scientists Do

Digging up fossils. Peering through telescopes. Mixing chemicals in a lab. Using computers to make weather predictions. These are only a few of the things scientists do.

ACTIVE READING As you read these two pages, turn the heading into a question in your mind, and underline sentences that answer the question.

Does solving puzzles and searching for buried treasures sound like fun? If so, you might like being a paleontologist. Paleontologists are scientists who study the history of life on Earth. Like all scientists, they try to explain how and why things in the natural world happen. They answer questions by doing investigations. An **investigation** is a procedure carried out to carefully observe, study, or test something in order to learn more about it.

In addition to knowing a lot about living things of the past, paleontologists have to use many skills. In fact, all scientists use these skills. All scientists **observe**, or use their five senses to collect information. And all scientists **compare**, finding ways objects and events are similar and different.

Observe

Write one observation you could make about the fossil.

____

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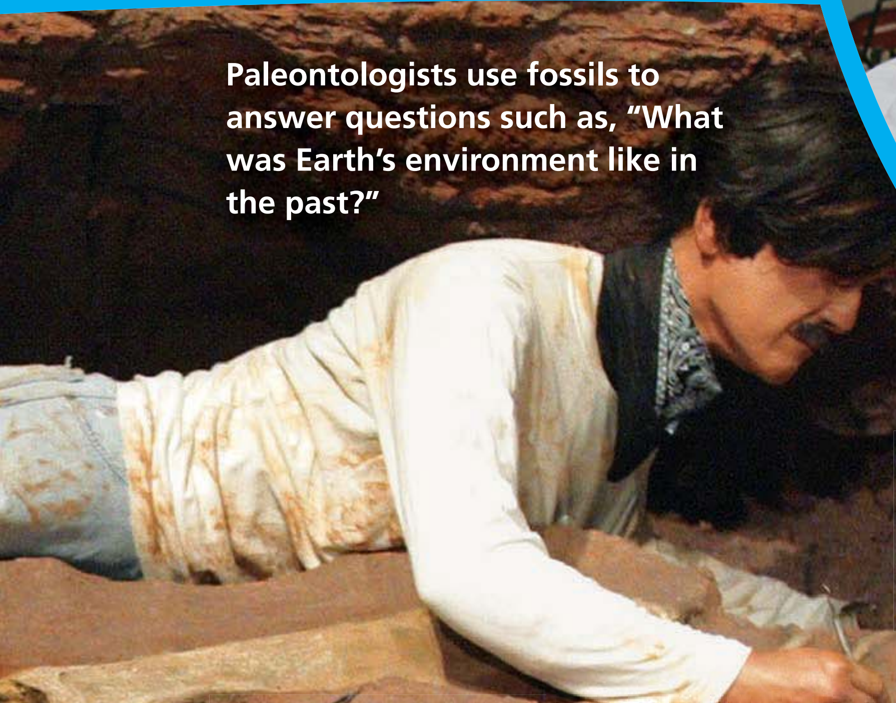

Paleontologists use fossils to answer questions such as, "What was Earth's environment like in the past?"

Paleontologists also work in labs, cleaning and studying fossils.

This paleontologist needs to observe the landscape to predict where fossils might be hidden. Once he finds the fossils, he compares them to fossils found in other parts of the world.

Paleontology is just one branch of science. **Science** is the study of the natural world and involves making observations and performing investigations. Scientists learn by thinking critically about the results of their investigations.

Compare

Observe these two skulls. List two ways they are and two ways they are different.

Similarities	Differences
______	______
______	______
______	______

Prove It!

Rotten Meat turns into Maggots!

In the 1600s, there were not many ways to keep meat fresh. Rotting meat quickly filled with squirming, worm-like maggots. Yuck! Where did the maggots come from?

ACTIVE READING On these two pages, circle the examples of evidence.

▶ **Draw a large *X* through the explanation that was shown *not* to be true.**

Travel back in time to the 1660s. Most people think flies, worms, and mice come from nonliving objects and rotting food. As evidence, or proof, they show how a dead animal's body soon becomes loaded with squirming maggots.

To a scientist, **evidence** is information collected during a scientific investigation. Some evidence, such as seeing a fossil dinosaur skull, is direct evidence that the dinosaur existed. Evidence can be indirect, such as finding a fossil footprint of a dinosaur.

Meet Dr. Francesco Redi, a scientist in Italy. A book Dr. Redi reads leads him to think maggots come from the eggs of flies. Redi **plans and conducts investigations** to gather evidence. He

Redi placed fresh meat in two jars. He covered one jar and left the other jar uncovered.

The meat in the open jar soon became "wormy," while the meat in the sealed jar did not.

traps some maggots inside jars with pieces of meat. He watches the maggots turn into adult flies. He observes adult flies laying eggs and more maggots come out of these eggs.

Redi then sets up an experiment. He places meat in several jars. Some jars are sealed and others are left open to the air. Redi observes that only the meat in jars he left open have maggots.

Redi experiments many times over. He tries dead fish, frogs, and snakes. All the evidence supports his claim: Living insects can only come from other living insects.

▶ Fill in the blanks in this sequence graphic organizer.

Make observations and ask ________________.

↓

Plan and conduct ________________.

↓

Use ________________ to make claims.

A Sticky Trap

Humans are too big to get stuck in a spider's web. But there are some sticky traps you need to avoid when thinking like a scientist.

ACTIVE READING As you read these two pages, turn the main heading into a question in your mind. Then underline sentences that answer the question.

▶ Look at the words in the spider web below. Star the things you *should* use to draw conclusions properly. Cross out the others.

How to Draw Conclusions

Scientists **draw conclusions** from the results of their investigations. Any conclusion must be backed up with evidence. Other scientists judge the conclusion based on how much evidence is given. They also judge how well the evidence supports the conclusion.

Don't jump to conclusions too quickly. That's a sticky trap in science! As Dr. Redi did, repeat your investigations. Think about what you can **infer** from your observations. And then—only then—draw your conclusions.

Suppose you spend a week observing spiders. You might conclude that all spiders build webs to catch their food. This may be true of the spiders you observed, but it's not true of all spiders. Some spiders, such as wolf spiders, hunt for their prey instead.

Observation Information collected by using the senses	The insect is stuck in the spider web.
Inference An idea or a conclusion based on an observation	A spider is going to use the bug for food later.
Opinion A personal belief that does not need proof	Spiders are really gross!

Opinion or Evidence?

An **opinion** is a belief or judgment. It doesn't have to be proved, or backed up with evidence. It might be your opinion that spiders are gross and disgusting. Others may disagree, but you are welcome to stick with your opinion!

Personal feelings and opinions should not affect how you do investigations. Nor should they affect your conclusions. It's hard to do, but science is about keeping an open mind. For example, don't ignore evidence just because you don't like what it means.

▶ **Write one observation, one inference, and one opinion about what you see in the photo.**

Observation	
Inference	
Opinion	

Knowledge Grows

How is a man investigating electricity and wires almost 300 years ago connected to the latest video game release?

Stephen Gray, a scientist born in 1666, was working at home when he discovered that electrical energy could move along a short metal wire. Gray carried his materials to friends' homes. He showed them how the materials worked and, together, they made the wire longer and longer.

Today there are so many ways for scientists to **communicate**, or share, the results of investigations. When scientists communicate clearly, others can repeat their investigations. They can compare their results with those of others. They can expand on one another's ideas. In these ways, scientific knowledge grows.

Communicate

List several ways you can communicate.

____

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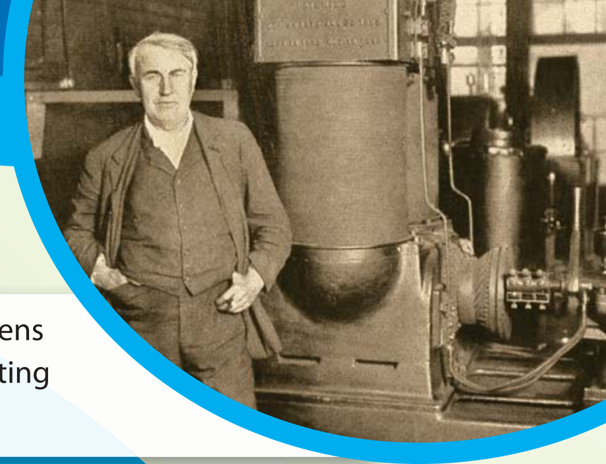
1729 Stephen Gray shows that electrical energy can be carried through a wire.



1882 Thomas Edison opens the first electricity generating station.

Knowledge grows when it is communicated. Each science discovery leads to new questions. More is learned and new things are invented.

The first video game was invented in 1958. The inventor was a scientist named William Higinbotham. The reason? To make Visitor's Day at his lab more interesting for the public! Hundreds of people lined up to play the game.

Take a look at the timeline. The science behind Higinbotham's game goes back hundreds of years or more.

1947 The transistor, needed to make radios and computers, is invented.

1953 The first computer is sold.

1958 William Higinbotham invents the first video game.

1967 First handheld calculator invented.

The first arcade games were not very complex.

1971 First coin-operated arcade video games in use.

1972 The first home video game systems are sold.

1977 The first handheld video games are sold.

2015 Video games are quickly moving from systems to cloud-based apps.

The video games of today are fast, complex, and interactive.

Meet Scientists

There are more people working as scientists today than ever before in history. Yet, there are plenty of unanswered questions left for you to answer!

ACTIVE READING As you read these two pages, underline what each type of scientist studies.

Astronomer

Astronomers ask questions about how the universe works. Because novas, black holes, and galaxies are so far away, they use time/space relationships to investigate them. For example, astronomers measure space distances in units called light-years. That's how far light can travel in one Earth year.

DO THE MATH

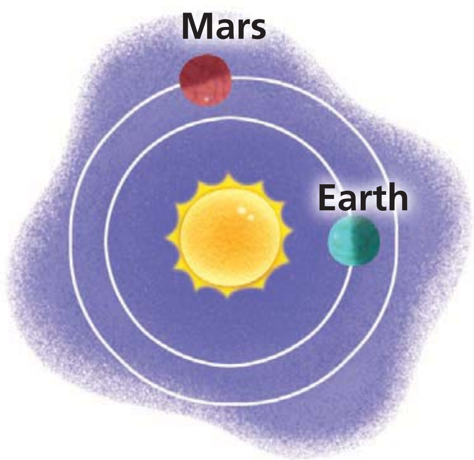
Use Fractions

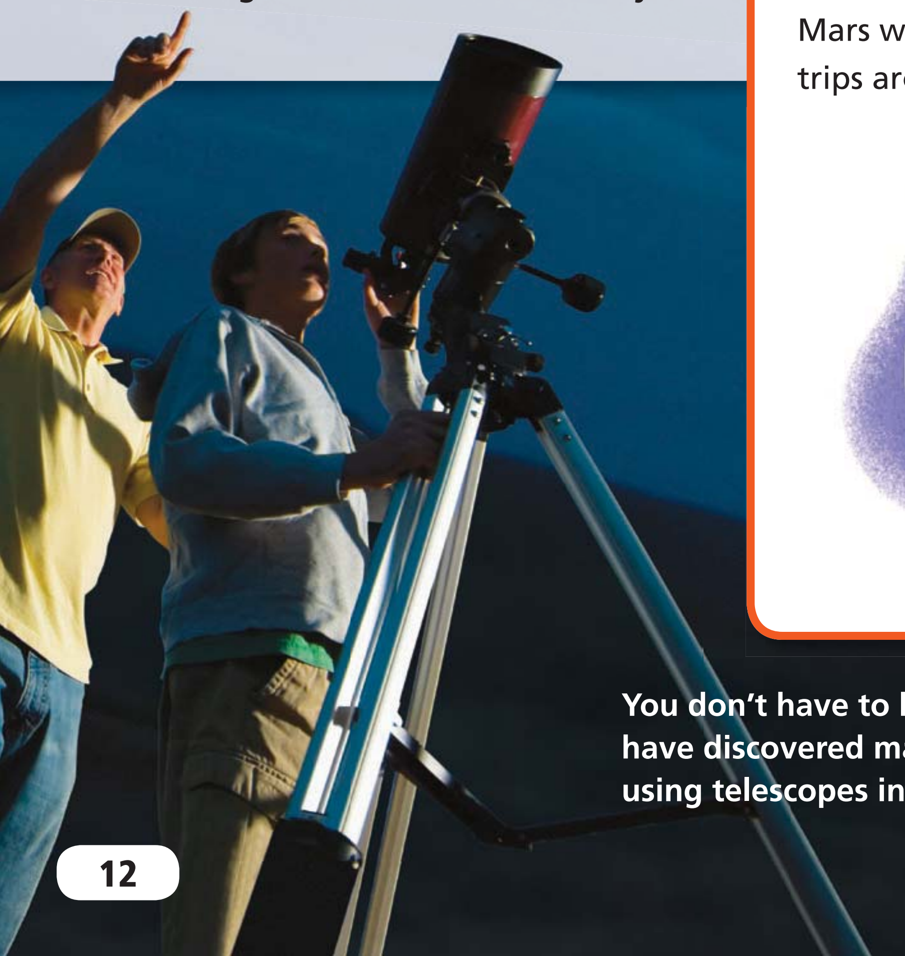
Earth and Mars travel around the sun. Each time Earth makes one complete trip, Mars makes about $\frac{1}{2}$ of its trip.

1. How many trips does Earth make around the sun in the time it takes Mars to make one trip?

____

2. In the drawing below, put an *X* where Mars will be after Earth completes five trips around the sun.





You don't have to be a pro to do astronomy. People have discovered many comets and exploding stars using telescopes in their back yards!

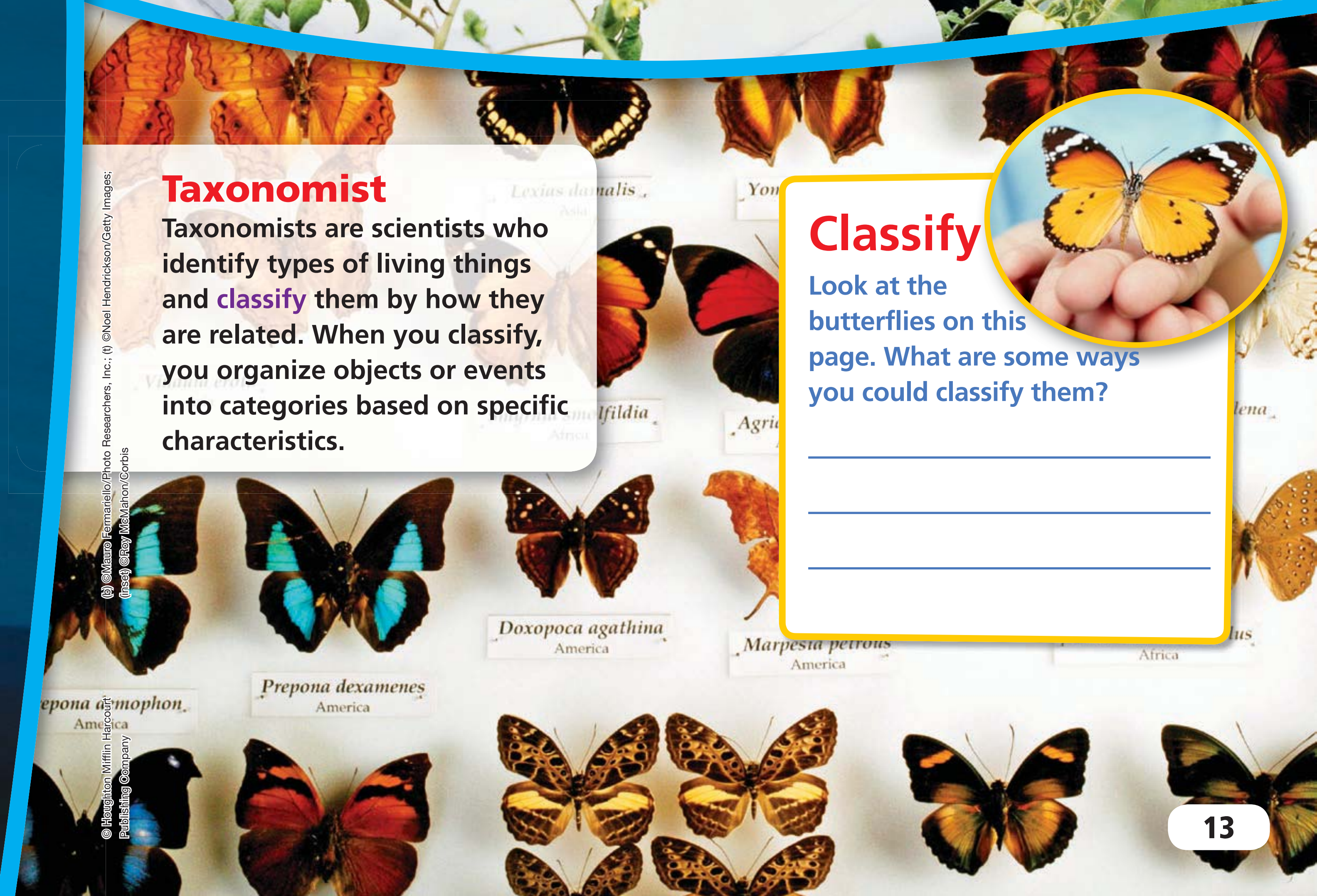
Order

When you **order**, you place objects or events one after another in the correct sequence. Write the numbers *1*, *2*, *3*, and *4* to show the order of the images below.

____ ____ ____ ____

Botanist

Botanists investigate questions about plants. For example, some botanists study how environmental conditions affect a plant's life cycle.



Taxonomist

Taxonomists are scientists who identify types of living things and **classify** them by how they are related. When you classify, you organize objects or events into categories based on specific characteristics.

Classify

Look at the butterflies on this page. What are some ways you could classify them?

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Sum It Up »

Read the summary, and fill in the missing words.

The goal of a scientist is to understand the natural world. To do this, a scientist plans and conducts 1. ________________ .

Scientists use the 2. ________________ they gather to draw 3. ________________ .

A good scientist does not let his or her personal beliefs, or 4. ________________, influence his or her study.

There are many important skills that scientists use. For example, when scientists 5. ________________ , they use their observations and prior knowledge to determine what is happening.

Read each of the statements below. Write the science skill that each student used.

6. Angela made a list of how the two planets were alike.

____

7. Krystal sorted the rocks into five groups based on their color.

____

8. Robbie explained the results of his investigation to his classmates.

____

9. Dmitri noted how the feathers looked and felt.

____

10. Juan organized the steps of the process from first to last.

____

Brain Check

Name ______________________________

Vocabulary Review

1 Draw a line from each term to its definition or description.

1. evidence*	A. the study of the natural worldthrough investigation
2. inference	B. collecting information by using the senses
3. classify	C. an idea or conclusion based on an observation
4. investigation*	D. facts and information collected over time
5. knowledge	E. to put things into groups
6. opinion*	F. to arrange things by when they happened or by their size
7. observing	G. the sharing of information
8. communication	H. the observations and information that support a claim
9. science*	I. the process of studying or testing something to learn more about it
10. order	J. a belief or a judgment

*Key Lesson Vocabulary

Apply Concepts

2 Compare these two birds. List how they look similar and different.

Similarities:

____

____

Differences:

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____

3 Suppose someone tells you they saw a bird never before seen in your state. What kinds of evidence would you ask for?

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____

4 What, in your opinion, is the scariest animal on Earth? How should this affect your investigations?

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5 One morning you see an outdoor garbage can tipped over. Plastic bags are torn open. What could you infer?

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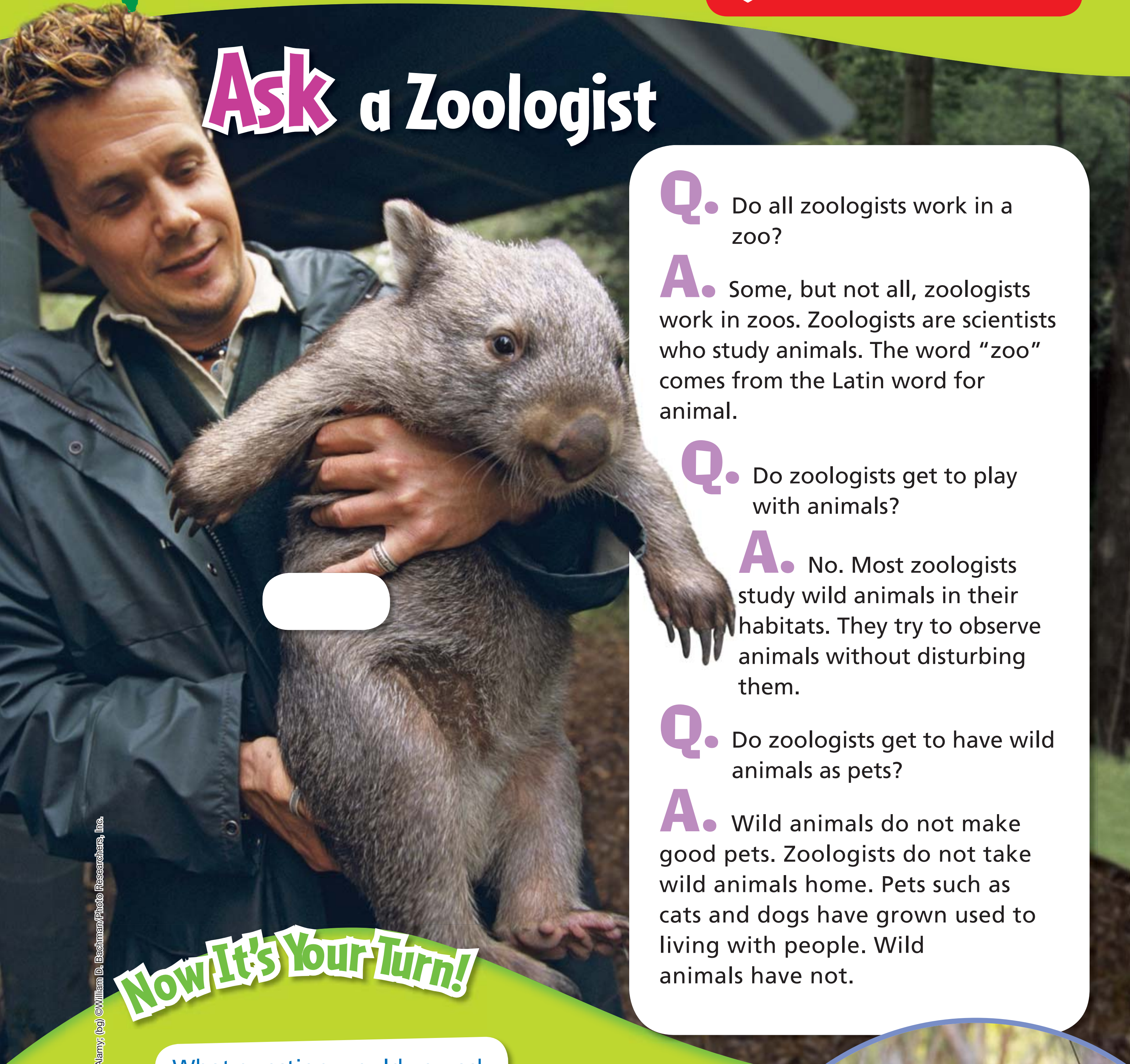
Take It Home!

See *ScienceSaurus*® for more information about scientific investigations

SC.5.N.1.1 ... plan and carry out scientific investigations of various types such as: ... collecting and organizing data....

CAREERS IN SCIENCE

Ask a Zoologist



Q. Do all zoologists work in a zoo?

A. Some, but not all, zoologists work in zoos. Zoologists are scientists who study animals. The word "zoo" comes from the Latin word for animal.

Q. Do zoologists get to play with animals?

A. No. Most zoologists study wild animals in their habitats. They try to observe animals without disturbing them.

Q. Do zoologists get to have wild animals as pets?

A. Wild animals do not make good pets. Zoologists do not take wild animals home. Pets such as cats and dogs have grown used to living with people. Wild animals have not.

Now It's Your Turn!

What question would you ask a zoologist?

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Wombats live in Tasmania and southeastern Australia.

Animals That Start with "K"

Some zoologists study animal behavior, or how animals act. A zoologist spotted some interesting behaviors in Australia and wrote these journal entries. Match the sentences with the pictures by entering the day of the journal entry near the picture it describes.

Day 1 This afternoon we saw an adult koala carrying a young koala on its back.

Day 2 Today our team saw a kangaroo. It had a joey (a young kangaroo) in its pouch.

Day 3 Our team saw a kangaroo hopping quickly. We measured its speed—nearly 24 kilometers per hour!

Day 4 This morning we saw a koala. It was eating leaves from a eucalyptus tree.

Day 5 We saw two kangaroos boxing with each other.

Day ______

Day ______

Day ______

Day ______

Day ______

Name ______________________________

ESSENTIAL QUESTION

How Do Scientists Learn About the Natural World?

Materials

origami weather predictor sheet
scissors
pencil
weather forecast from a newspaper

EXPLORE

Scientists learn about the natural world by making observations and performing investigations. In this activity, you'll compare predictions made with—and without—using scientific evidence.

Before You Begin—Preview the Steps

1. Tear out the origami weather predictor sheet from your student book. Think about the weather where you live. Write eight different weather predictions. One prediction might be *sunny, windy,* and *hot.*

2. Follow the directions to make the origami weather predictor.

3. Use the origami predictor to forecast, or predict, the weather for the next week. Then, find the forecast made by a scientist. Record both forecasts.

4. For one week, compare the actual weather to both forecasts.

Set a Purpose

What will you learn from this experiment?

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Think About the Procedure

How did you choose what predictions to write on your origami predictor?

____

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____

____

Name ______________________________

Record Your Data

In the table below, record your results.

Date	Origami Prediction	Weather Service Prediction	Actual Weather

Draw Conclusions

Of the two kinds of weather predictions, which one was more likely to be correct? Explain.

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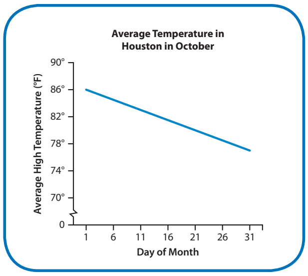
Claims • Evidence • Reasoning

1. Interpret your data. Write a claim about how your results would look if you continued your investigation for a month.

2. How do you think the weather service makes its predictions?

3. Provide reasoning for why is it important that scientists make good weather predictions?

4. The line graph shows average October air temperatures in Houston, TX. Can you use this evidence to predict the air temperature in Houston next October?

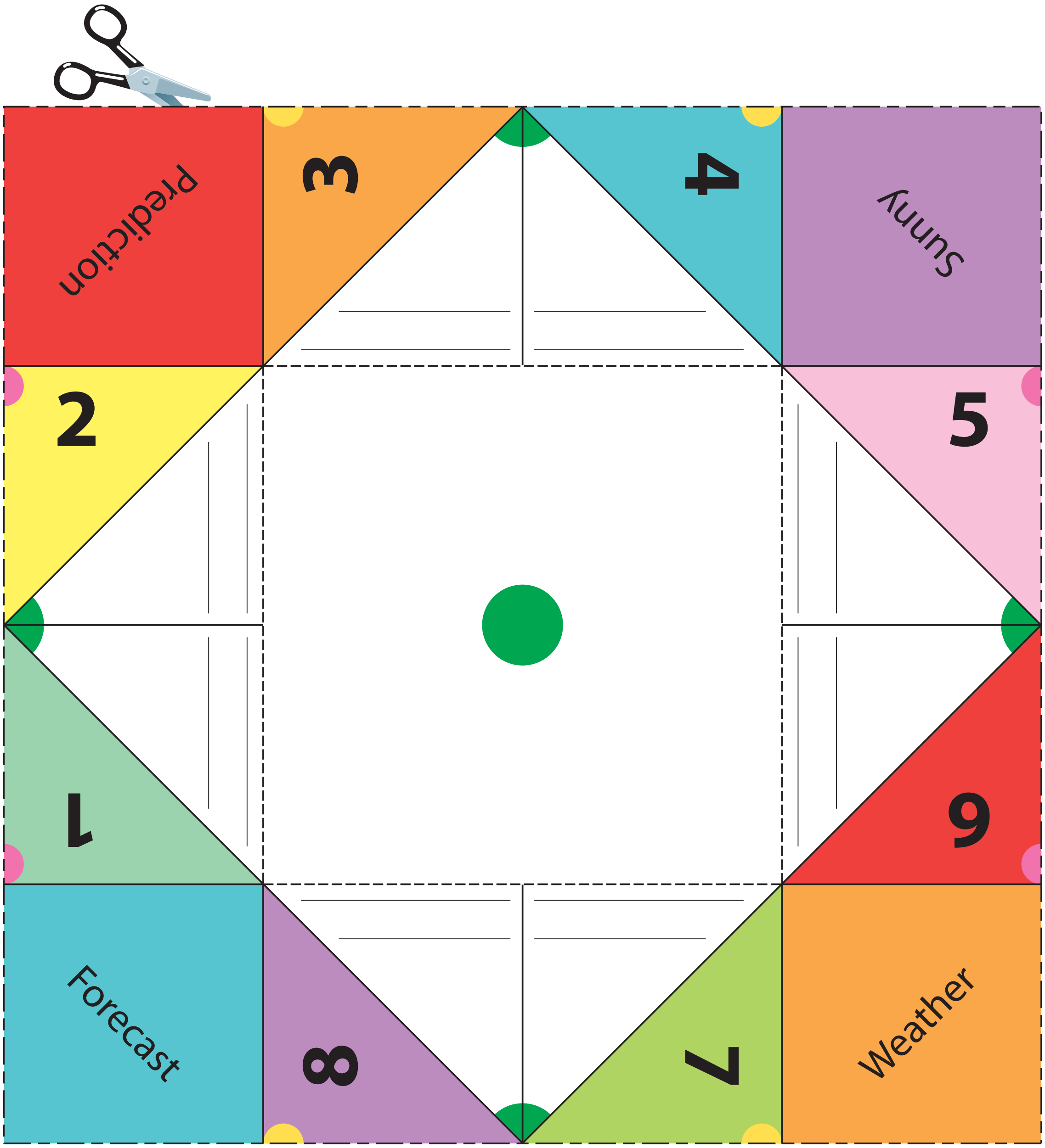


5. What else would you like to find out about how scientists make predictions? Write each idea as a question.

Name ______________________________

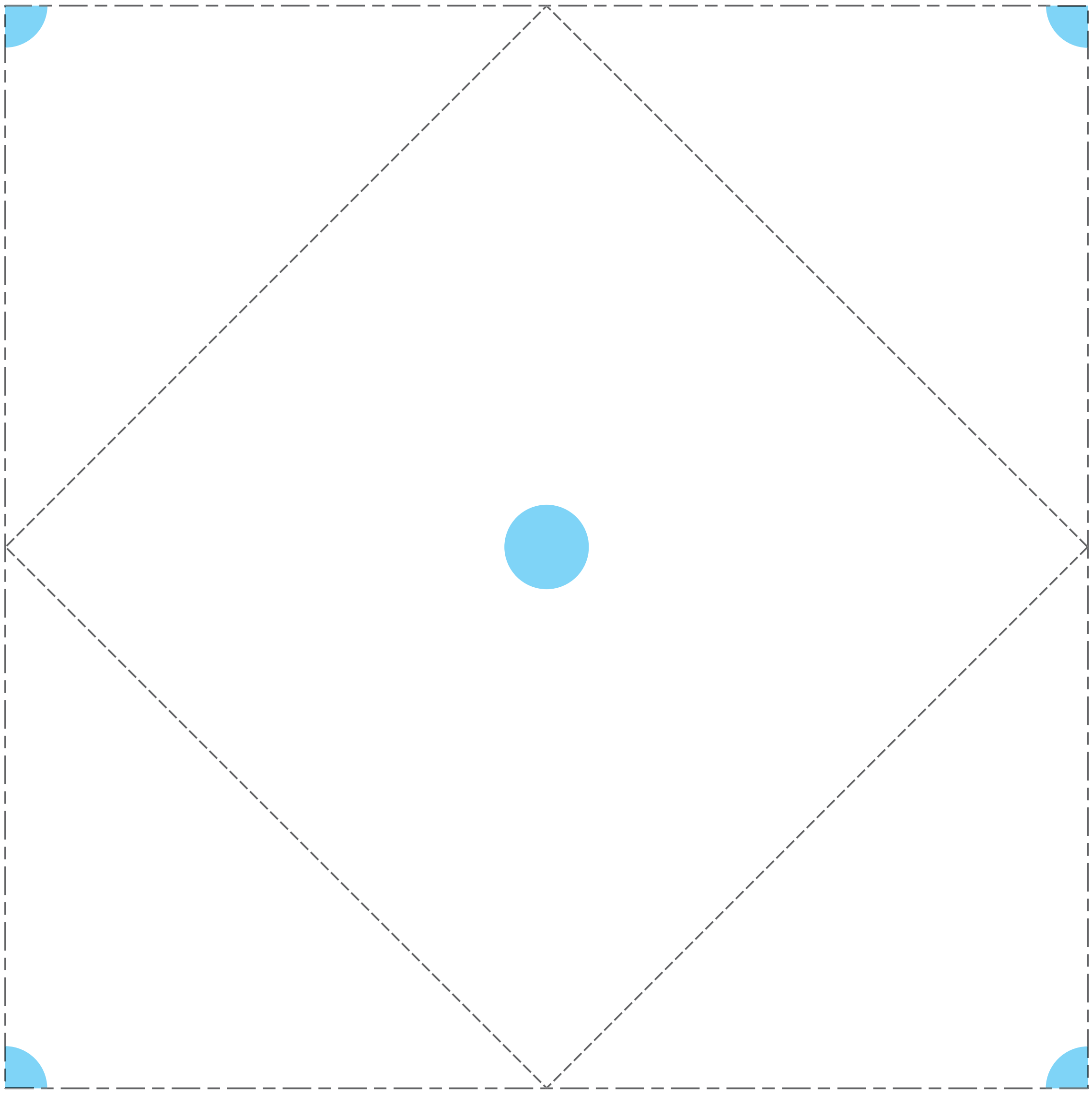
Directions

1. Carefully tear this page out of your book.
2. Cut out the square below. You will use it to make your origami weather predictor.
3. On each set of lines, write a weather prediction.
4. Follow the instructions on the back of this page to fold and use your origami weather predictor.



Directions (continued)

5. Fold the blue dots into the blue circle. Turn the paper over, and fold the green dots into the green circle.
6. Fold the paper in half so that the yellow dots touch each other. Make a crease, and unfold the paper. Fold it in half again, so that the pink dots touch each other.
7. Put your fingers under the colorful squares. With your group, make a plan to use this tool to predict the weather.



SC.5.N.1.1 … plan and carry out scientific investigations.… **SC.5.N.1.2** Explain the difference between an experiment and other types of scientific investigation. **SC.5.N.1.3** Recognize and explain the need for repeated experimental trials. **SC.5.N.1.4** Identify a control group and explain its importance.… **SC.5.N.1.5** … scientific investigation frequently does not parallel the steps of "the scientific method."

LESSON 3

ESSENTIAL **QUESTION**

What Are Some Types of Investigations?

Engage Your Brain

Find the answer to the following question in this lesson and record it here.

What did this scientist do prior to starting her experiment with plants?

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____

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ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

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Main Ideas

The main idea of a paragraph is the most important idea. The main idea may be stated in the first sentence, or it may be stated elsewhere. Active readers look for main ideas by asking themselves, What is this paragraph mostly about?

A Process *for* Science

Testing bridge models, mapping a storm's path, searching the sky for distant planets—each of these investigations uses scientific methods.

How does the shape of the room affect the sound of a voice?

ACTIVE READING As you read these two pages, draw a line under each main idea.

How does having a cold affect a person's singing?

How high a note can a singer sing?

Can a human voice shatter glass?

Start with a Question

Scientists observe the world and then ask questions that are based on their observations. But not all questions are the same. A good scientific question is one that can be answered by investigation. A scientific investigation always begins with a question.

Plan an Investigation

Once a scientist has a testable question, it is time to plan an investigation. **Scientific methods** are ways that scientists perform investigations. There are many ways that scientists investigate the world. But all scientific methods use logic and reasoning.

▶ **Suppose you've just heard an opera singer warm up her voice. Write your own science question about the sounds a singer makes.**

____

____

Experiments

In an experiment, scientists control all the conditions of the investigation. Scientists study what happens to a group of samples that are all the same except for one difference.

Repeated Observations

Scientists use repeated observation to study processes in nature that they can observe but can't control.

Using Models

Scientists use models when they cannot experiment on the real thing. Models help scientists investigate things that are large (like a planet), expensive (like a bridge), or uncontrollable (like the weather).

Investigations Differ

The method a scientist uses depends on the question he or she is investigating. An **experiment** is an investigation in which all of the conditions are controlled. Models are used to represent real objects or processes. Scientists make repeated observations to study processes in nature without disturbing them.

Drawing Conclusions

Whatever scientific methods are used, scientists will have results they can use to draw conclusions. The conclusions may answer the question they asked before they began. They may point to other questions and many more ideas for investigations.

▶ Write the type of investigation you should use to answer the following questions.

How do different bridge designs react to strong winds?

____

How fast does the wind blow where a bridge will be built?

____

Which type of paint works best to keep a bridge from rusting?

____

Explosive Observations

How does a hurricane affect animals? Are coral reefs dying? How do whales raise their young? These are some science questions that can be answered with repeated observation.

ACTIVE READING As you read these two pages, place a star next to three examples of repeated observation.


Old Faithful

Some science questions can only be answered by making observations. This is because some things are just too big, too far away, or too uncontrollable for experiments. However, much can be learned from repeated observation.

In Yellowstone National Park, heated water and steam shoots out of holes in the ground. This is called a geyser. Old Faithful is a famous geyser that erupts about every hour. Observations of the geyser collected over many years can be used to predict when the next eruption will occur. A prediction is a statement, based on information, about a future event.

The time until Old Faithful's next eruption is affected by how long the previous eruption lasted. Suppose the last eruption was at 3:05 p.m. and lasted 3 minutes 15 seconds. Predict when it will erupt next.

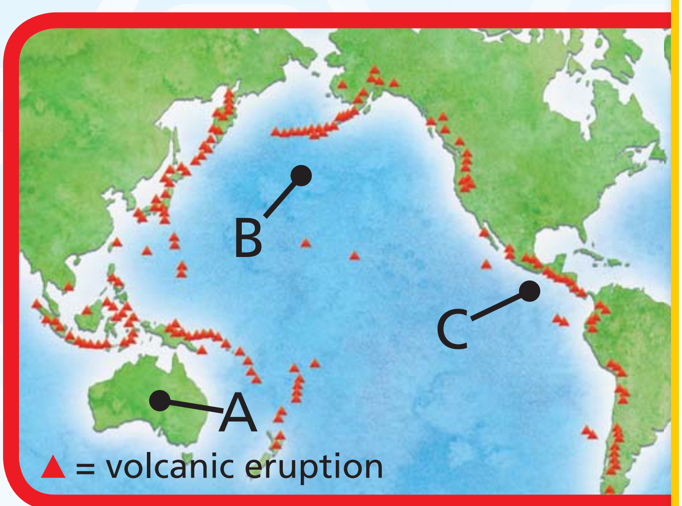
____

How long an eruption lasts	1 min 30 sec	2 min	2 min 30 sec	3 min	3 min 30 sec	4 min	4 min 30 sec	5 min
Time until next eruption	50 min	57 min	65 min	71 min	76 min	82 min	89 min	95 min

The first observation of a whale is often its spout.

Scientists have many questions about whales—the largest mammals on Earth. How long do whales live? How do they communicate? How do they care for their young? How far can they travel in a year? These questions can be answered with repeated observation.

For example, the tail flukes of whales are different from one whale to another. Scientists take photos of the flukes and use them to identify individual whales. Once they know which whale is which, they can recognize them each time they are seen in the ocean.



Predict

Scientists have observed and recorded volcanic eruptions for hundreds of years. The map to the left shows that data. Which location—A, B, or C— is most likely to have a volcanic eruption? _____ Why do you think scientists call this region the "Ring of Fire"?

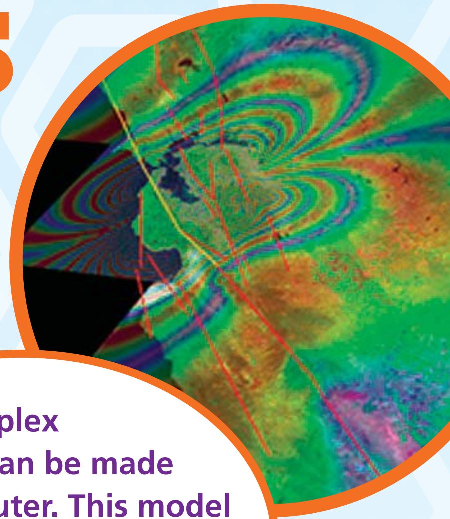
____

____

____

Super Models

How does a bat fly? How might Saturn's rings look close up? How does a heart work? These are some science questions that can be answered with models.



Complex models can be made on a computer. This model shows where the most damage would occur if an earthquake were to strike.

ACTIVE READING Circle different types of models that are described on these two pages.

When Modeling Is Needed

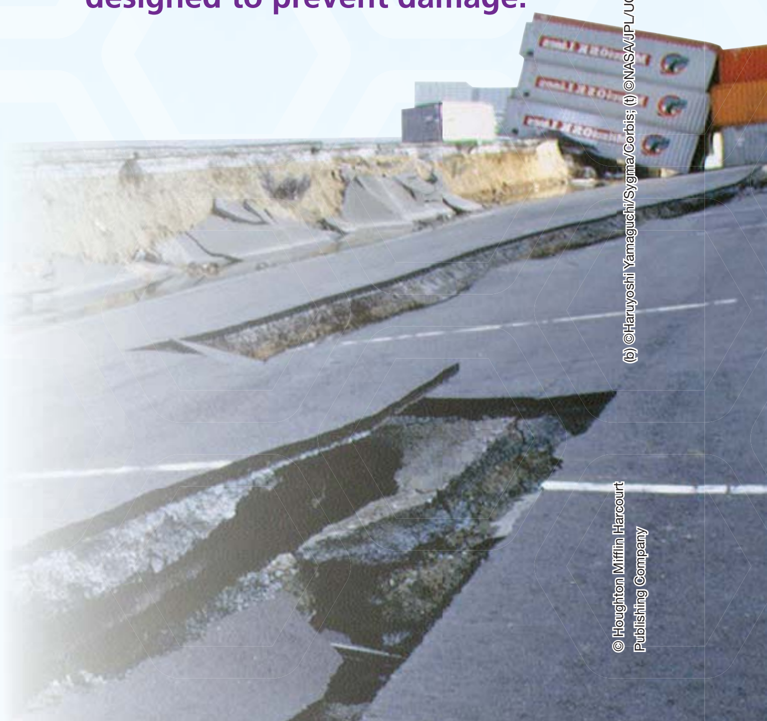
When scientists cannot experiment with the real thing, they can use models. Scientific models are needed to understand systems that have many hidden parts, such as an ant colony or the Internet. Scientists draw conclusions and make predictions by studying their models.

The closer the model represents the real thing, the more useful it is. So scientists change their models as they learn more.

Types of Models

Models are made in different ways. One way is to build a physical model. An earthquake shake table with model buildings on it is a physical model. Another way is to program computer simulation models. Scientists can speed up time in computer models so that they can see what might happen long in the future. Drawing diagrams and flow charts is a third way to make models. These two-dimensional models can be used to show how ideas are related.

Earthquakes are difficult to predict, and they can cause damage. New structures are designed to prevent damage.



Scientists build "shake tables" that model the motion of real earthquakes. This photo shows two types of houses being tested. Which house seems to be safer in an earthquake?

Use Models

How is an earthquake model made of gelatin like a real earthquake? How is it unlike a real earthquake?

Alike: ______________________________

____

Different: ______________________________

____

____

You can model the effects of an earthquake, using gelatin for the ground and buildings made of blocks.

How to Excel *in* Experimentation

You're enjoying a frozen juice pop. The heat of your tongue melts the pop. As you slurp the liquid, you think about how different substances freeze.

ACTIVE READING As you read the next four pages, circle lesson vocabulary each time it is used.

Ask Questions

You know a freezer is cold enough to freeze water. You also know that juice is mostly water. You ask "Does adding substances to water affect its freezing point?"

Many science questions, including this one, can be answered by doing experiments. An **experiment** is a procedure used to test a *hypothesis*. It's a good idea to make some observations before stating a hypothesis. For example, you might put a small amount of orange juice in a freezer. Then you'd check it every few minutes to look for changes.

Hypothesize

A hypothesis is a statement that can be tested and will explain what can happen in an investigation. In the case of the freezing question, you think about what you already know. You can also talk to other people. And you can do research such as asking an expert.

You find out that the freezing point and melting point of a material should be the same temperature. An expert suggests that it is better to measure the melting point than the freezing point.

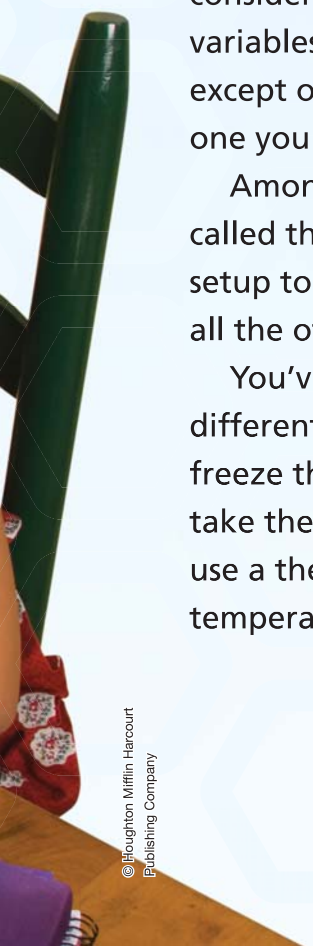
Design an Experiment

A well-designed experiment has two or more setups. This allows you to compare results among them. For the freezing/melting experiment, each setup will be a cup of liquid.

A **variable** is any condition in an experiment that can be changed. In most experiments, there are many, many variables to consider. The trick is to keep all variables the same in each setup, except one. That one variable is the one you will test.

Among the setups should be one called the control. The **control** is the setup to which you will compare all the others.

You've decided to dissolve different substances in water and freeze them. Then you plan to take them out of the freezer and use a thermometer to check their temperatures as they melt.



Hypothesize

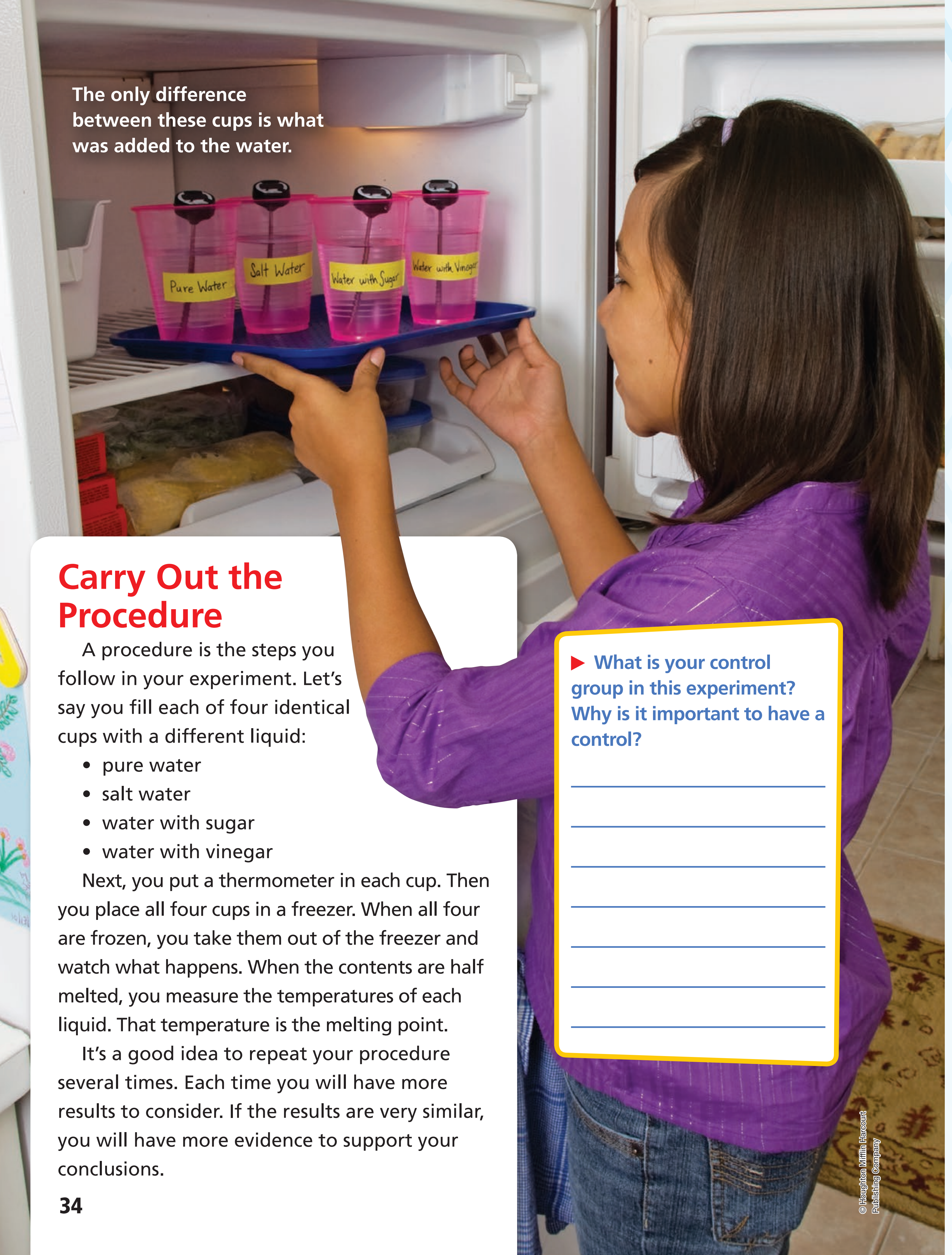
Fill in the blank in the hypothesis.

Any substance dissolved in water will ____________________ the temperature at which the mixture freezes and melts.

Identify and Control Variables

When you identify and control variables, you determine which conditions should stay the same and which one should be changed. Circle the variable that will be tested. Underline the variables that will remain the same.

- the kinds of cups
- the amount of water
- the material that is dissolved in the water
- the temperature of the freezer
- the types of thermometers
- the amount of time you leave the cups in the freezer



The only difference between these cups is what was added to the water.

Carry Out the Procedure

A procedure is the steps you follow in your experiment. Let's say you fill each of four identical cups with a different liquid:

- pure water
- salt water
- water with sugar
- water with vinegar

Next, you put a thermometer in each cup. Then you place all four cups in a freezer. When all four are frozen, you take them out of the freezer and watch what happens. When the contents are half melted, you measure the temperatures of each liquid. That temperature is the melting point.

It's a good idea to repeat your procedure several times. Each time you will have more results to consider. If the results are very similar, you will have more evidence to support your conclusions.

▶ **What is your control group in this experiment? Why is it important to have a control?**

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Record and Analyze Data

You could write down your observations as sentences. Or you could make a table to fill in. No matter how you do it, make sure you record correctly. Check twice or have a team member check.

Once the experiment is completed and the data recorded, you can analyze your results. If your data is in the form of numbers, math skills will come in handy. For example, in the data table below, you'll need to know how to write, read, and compare decimals.

Melting Point Experiment

Substance	Melting Point (°C)
Pure water	0.0
Salt water	–3.7
Sugar water	–1.8
Vinegar water	–1.1

Draw Conclusions and Evaluate the Hypothesis

You draw conclusions based on your results. Remember that all conclusions must be supported with evidence. The more evidence you have, the stronger your conclusion.

Once you've reached a conclusion, look at your hypothesis. Decide if the hypothesis is supported or not. If not, try rethinking your hypothesis. Then design a new experiment to test it. That's what scientists do—build on what they learn.

Draw Conclusions

What conclusion can you draw based on this experiment?

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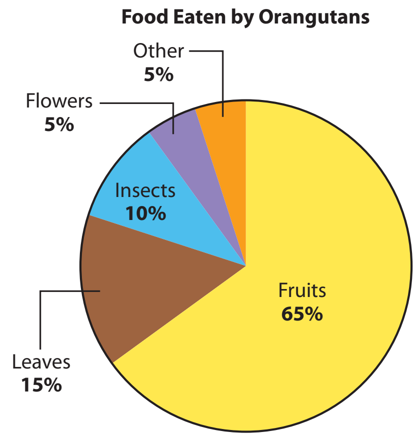
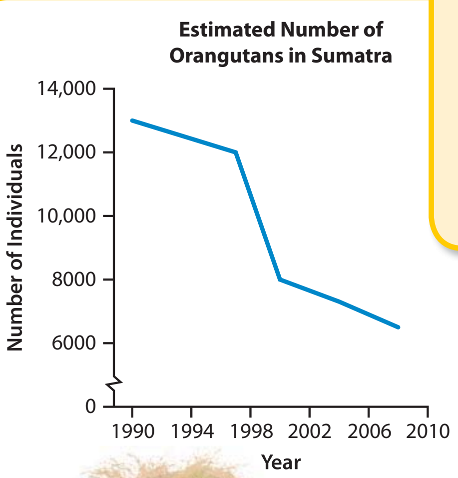
Special Delivery: Data Displays

Once you've completed a science investigation, you'll want to share it. What's the best way to communicate the data you collected?

As part of their investigations, scientists collect, record, and interpret data. There is more than one way to display, or communicate, your data. Some kinds of displays are more suited to certain kinds of data than others.

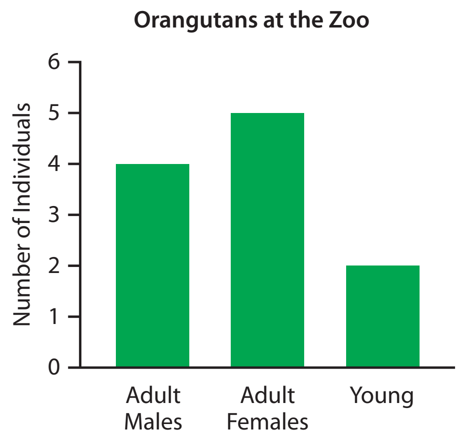


Circle graphs are suited to comparing parts to the whole. If you want to show fractions or percents, use a circle graph.



Line graphs are suited to show change over time, especially small changes. If you want to show how much you grow each year, use a line graph.

Diagrams are suited to show data that do not include numbers. This diagram shows how an orangutan uses a tool to eat seeds in fruit.



Bar graphs are suited to compare things or groups of things. When your data are in categories, use a bar graph.

DO THE **MATH**

Draw a Bar Graph

Draw a bar graph on this page. Use the data in the table below. Decide whether you want the bars to be vertical or horizontal. Carefully label the intervals on each axis. Draw the bars. Then title and label all the parts of your graph.

Number of Orangutans Counted	
Day	**Number**
Monday	7
Tuesday	13
Wednesday	10
Thursday	2
Friday	6

Sum It Up >>

The outline below is a summary of the lesson. Complete the outline.

I. Scientific Methods

  A. All start with a question

  B. Investigations differ

    1. experiments

    2. (1) ______________________

    3. (2) ______________________

  C. All have results from which to (3) ______________________

II. Repeated Observations

  A. Some things are just too big, too far away, or too uncontrollable for experiments

  B. Examples

    1. volcanoes

    2. (4) ______________________

III. Using Models

  A. Needed to understand systems that have many hidden parts

  B. Types of models

    1. diagrams and flow charts

    2. (5) ______________________

    ____

    3. (6) ______________________

IV. Controlled Experiments

  A. Ask questions

  B. Hypothesize

  C. (7) ______________________

  D. Carry out the procedure

  E. (8) ______________________

  F. Draw conclusions

V. Organizing and Displaying Data

  A. Data displays help communicate

  B. Kinds of data displays

    1. circle graphs

    2. (9) ______________________

    3. (10) ______________________

    4. (11) ______________________

Brain Check

LESSON 3

Name ____________________

Vocabulary Review

1 **Use the clues to fill in the missing letters of the words.**

1. ______ t i ___ ___ h o __	all the ways scientists do investigations
2. _ o ____	These should be as similar as possible to the real thing.
3. ___ t r __	the part of an experiment used to compare all the other groups
4. _ s _ ________ n _	what scientists do that is the basis for their investigations
5. ______ b __	any condition in an experiment that can be changed
6. _ i __ __ a __	a type of graph suited to show change over time
7. _ y ____ e ___	a statement that can be tested and that explains what you think will happen in an experiment
8. __ o ___ u __	the steps you follow in your experiment
9. p ______ t	to use patterns in observations to say what may happen next
10. _______ m e __	an investigation that is controlled

Apply Concepts

2 For each question, state which kind of investigation works best: repeated observations, using models, or controlled experiments. Then explain how you would do the investigation.

What kinds of birds visit a feeder at different times of the year?

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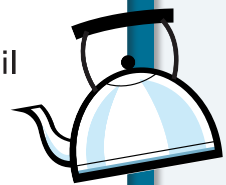
Does hot water or cold water boil faster?



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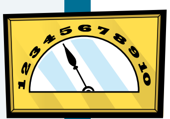

What are the parts of an elevator and how does it work?

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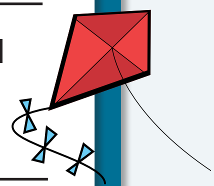
How does the length of a kite's tail affect the way it flies?



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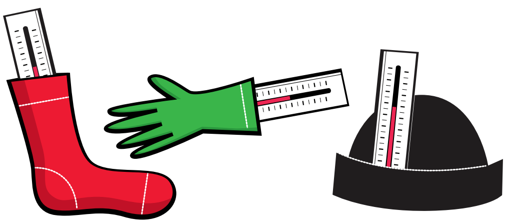
3 Ryan hypothesizes that darker colors heat up faster. He places a thermometer inside a red wool sock, a green cotton glove, and a black nylon hat. What's wrong with his procedure?



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Take It Home!

Help your family enjoy a healthy snack. Design an experiment to find out if coating apple slices in lemon juice can stop them from turning brown. What is your control group in this experiment? What are your variables? Why is it important to identify a control? Perform your experiment and record your results.

SC.5.N.1.2 Explain the difference between an experiment and other types of scientific investigation. **SC.5.N.1.5** Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method."

INQUIRY LESSON 4

Name ______________________________

ESSENTIAL QUESTION

How Do You Perform a Controlled Experiment?

Materials

small ball
meter stick
various floor surfaces

EXPLORE

A controlled experiment takes thought, care, and time. Let's see if you have what it takes!

Before You Begin—Preview the Steps

1. Place a meter stick against a wall so that the 0-cm mark touches the floor. Record what the floor is made from.
2. Drop the ball from the 100-cm mark. Record the height the ball bounces. Do this five times.
3. Find two more types of surfaces to test. Repeat Steps 1 and 2.
4. For each surface, find the average of the five trials.

Set a Purpose

What will you learn from this experiment?

Think About the Procedure

What is the tested variable in this experiment?

Why is it important to control all other variables in an experiment?

Each time you try the same test, it is called a trial. Why is it important to do repeated trials of this experiment?

Name ____________________

Record Your Data

In the table below, record your results.

Surface Material	Height Ball Bounced					
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average

Draw Conclusions

What can you conclude based on your experiment?

____

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Claims • Evidence • Reasoning

1. Think about the materials the ball bounced on. Make a claim regarding how their characteristics affected the height of the bounce. Provide evidence to support your claim and explain how the evidence supports the claim.

2. What other floor materials could you test? What evidence could you use to predict the results?

3. Tennis is played on three types of surfaces: grass, packed clay, and hard courts. Hard courts are often made from asphalt, the black road surface material, with paint on top. What evidence could you use to predict how these surfaces would affect ball bounces? Then, do some research. Find the pros and cons of each type of surface.

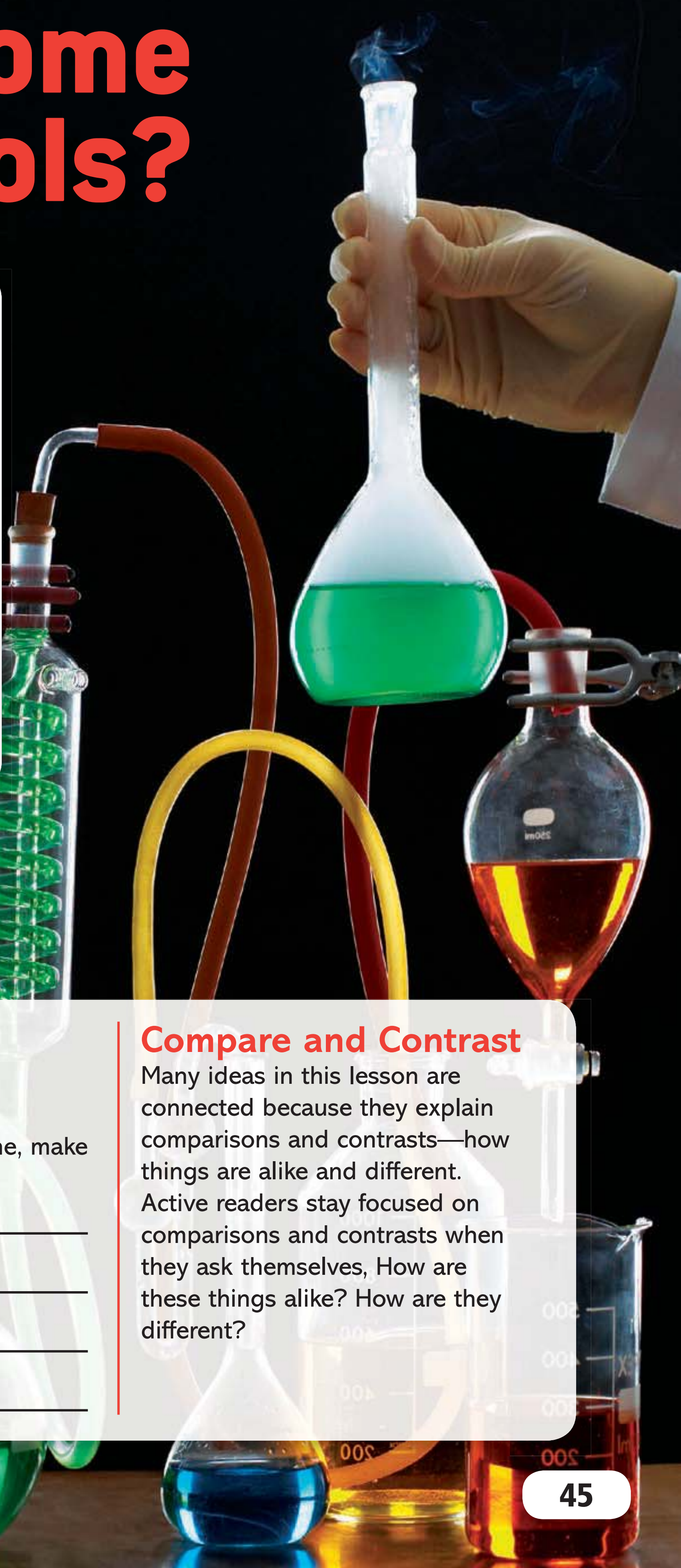
4. What else would you like to find out about how balls bounce?

SC.5.N.1.1 Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

LESSON 5

ESSENTIAL QUESTION

What Are Some Science Tools?



Engage Your Brain

Find the answer to the following question in this lesson and write it here.

This scientific equipment is filled with liquids. What tools can scientists use to measure the volume of a liquid?

____

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ACTIVE READING

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

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Compare and Contrast

Many ideas in this lesson are connected because they explain comparisons and contrasts—how things are alike and different. Active readers stay focused on comparisons and contrasts when they ask themselves, How are these things alike? How are they different?

Field Trips

If you like school field trips, you might want to become a field scientist. Field scientists travel around the world studying science in the wild. They pack their tools and take them along.

ACTIVE READING As you read these two pages, box the names of all the science tools.

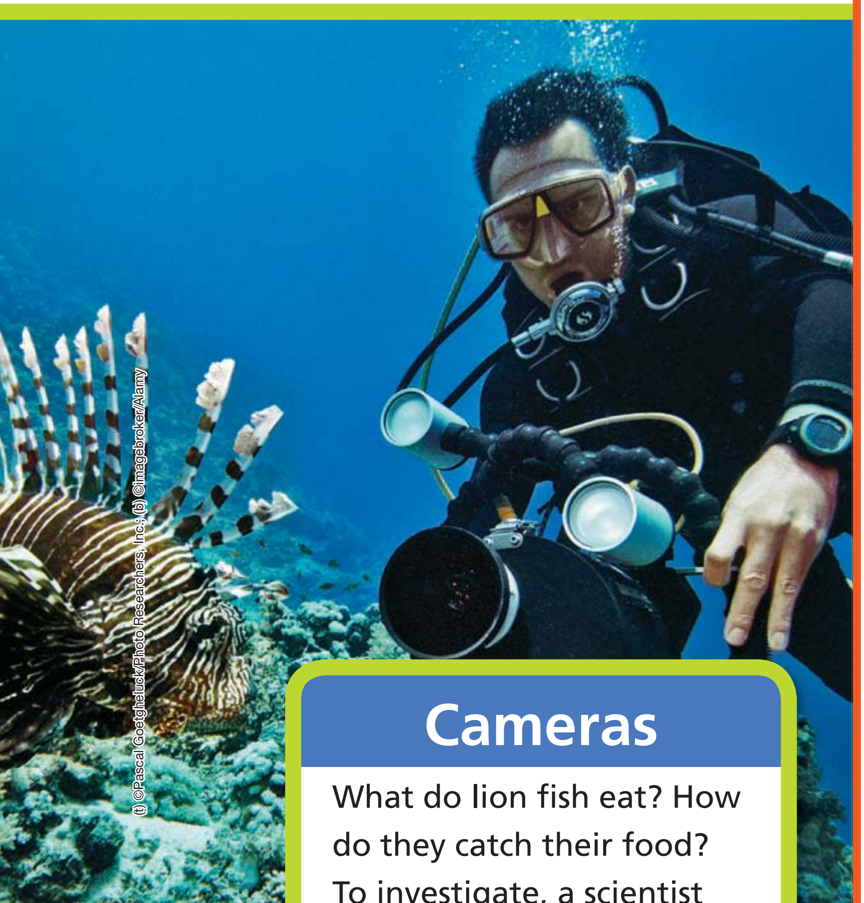
Field scientists go "on location" to investigate the natural world. Their investigations are often in the form of repeated observations. They use tools to increase the power of their senses. Their choices of tools depend on the questions they ask.

Collecting Net

What kinds of animals swim near the shore of a pond? A scientist might use a collecting net and an observation pan to answer this question. By carefully pulling the net through the water, they can catch small animals without harming them.

Hand Lens

How does an ant move? How does it use its mouthparts? A hand lens might help answer these questions. Hold the hand lens near your eye. Then move your other hand to bring the object into view. Move the object back and forth until it is in sharp focus.

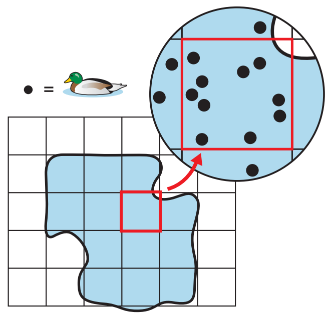


Cameras

What do lion fish eat? How do they catch their food? To investigate, a scientist might use an underwater video camera. Cameras help scientists record events.

DO THE MATH

Estimate by Sampling



Scientists photograph ducks from a plane and then draw a grid over the photo. How many ducks do you estimate are on the whole lake?

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Why might your estimate differ from the actual number of ducks?

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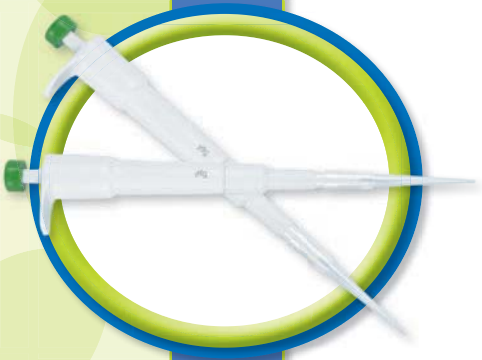


Into the Lab

What's living in a drop of pond water? Lots of tiny critters! Some behave like animals. Others are like plants. All are too small to be seen with only a hand lens.

ACTIVE READING As you read these two pages, draw lines connecting the pairs of tools being compared to each other.

Science tools can be heavy and expensive. If you want to observe the tiniest pond life, you'll need science tools that are too big or too delicate to be carried into the field. For example, scientists use computers to record and analyze data, construct models, and communicate with other scientists.

Use Numbers

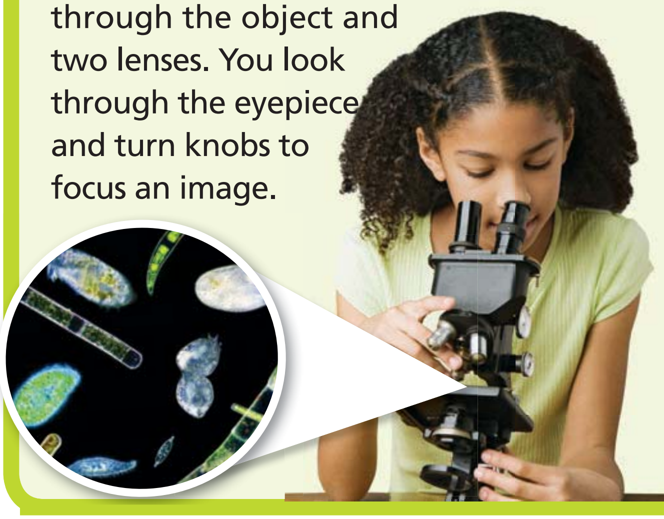
Some tools help scientists count things. Some scientists estimate, while others perform complex mathematical calculations. All scientists must be comfortable **using numbers**.

▶ **To find the magnification of a light microscope, multiply the power of the eyepiece lens by the power of the objective lens. The letter X stands for how many times bigger objects appear.**

Eyepiece Magnification	Objective Magnification	Total Magnification
10X	40X	
15X	60X	
8X	100X	

Light Microscope

The tiny living things in pond water are **microscopic**, or too small to see with just your eyes. A light microscope magnifies things, or makes them look bigger. The object to be viewed is placed on a clear slide. Light passes through the object and two lenses. You look through the eyepiece and turn knobs to focus an image.

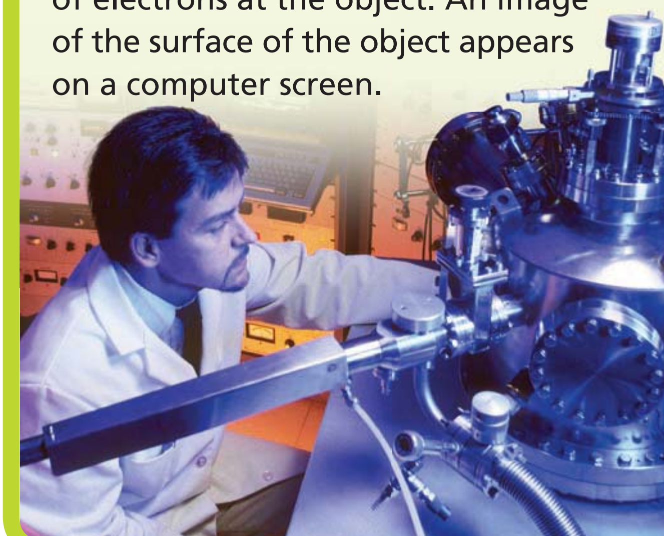


Dropper

A dropper is a tube with a rubber bulb on one end. Squeeze the bulb and then dip the tip into a liquid. Release the bulb, and the liquid will be sucked up the tube. When you slowly squeeze the bulb, the liquid drops out.

Electron Microscope

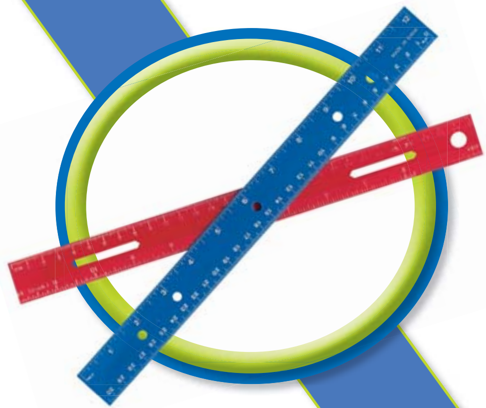
Light microscopes have been around for 500 years. But technology, or people's use of tools, has improved. Today a scanning electron microscope (SEM) can magnify an object up to one million times. The SEM shoots a beam of electrons at the object. An image of the surface of the object appears on a computer screen.



Pipette

A pipette is a tool like a dropper, but it's more exact. It is used to add or remove very small amounts of liquids. Pipettes often have marks on the side to measure volume. One kind of pipette makes drops so tiny that they can only be seen with a scanning electron microscope!

Measuring Up



What do a digit, a palm, a hand, a dram, a peck, a rod, and a stone have in common? They all are, or were at one time, units of measurement!

ACTIVE READING As you read the next four pages, circle all the units of measurement.

When you **measure**, you make observations involving numbers and units. Today most countries use the International System (SI) units in daily life. If you were to visit these countries, you'd purchase fruit or cheese by the *kilogram*. In the United States, most everyday measurements use units from the time when English colonists lived in America. However, scientists around the world—including those in the United States—use the SI, or metric system.

The metric system is based on multiples of 10. In the metric system, base units are divided into smaller units using prefixes such as *milli-*, *centi-*, and *deci-*. Base units are changed to bigger units using prefixes such as *deca-* and *kilo-*.

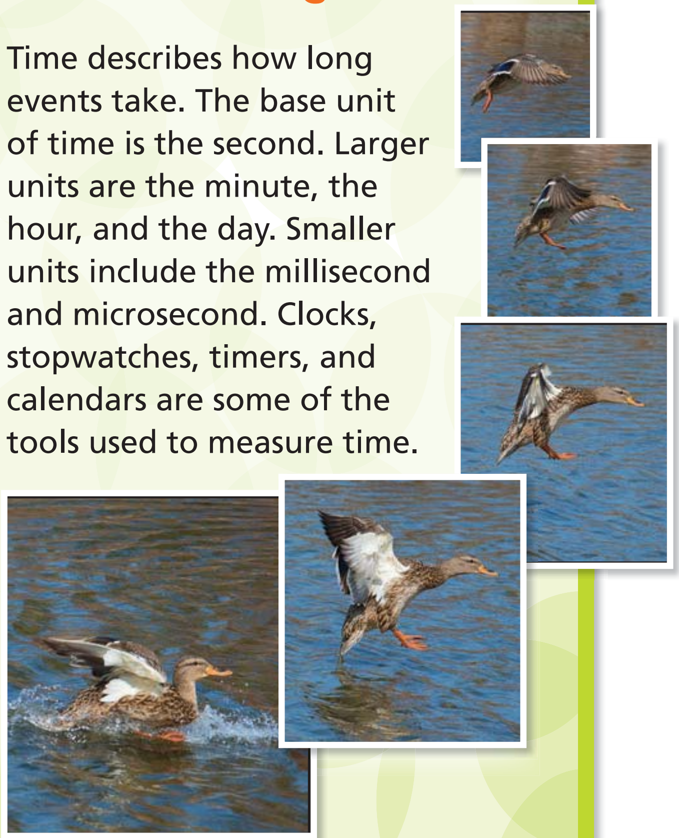
Measuring Length

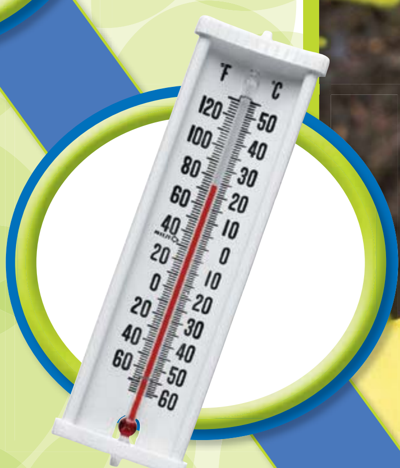
Length is the distance between two points. The base metric unit of length is the *meter*. Rulers, metersticks, and tape measures are tools used to measure length.

A caliper can be used to measure the distance between the two sides of an object.

Measuring Time

Time describes how long events take. The base unit of time is the second. Larger units are the minute, the hour, and the day. Smaller units include the millisecond and microsecond. Clocks, stopwatches, timers, and calendars are some of the tools used to measure time.





Measure Your Science Book

Use a metric tool and units to measure the length, width, and thickness of your science book.

Length: ______________________

Width: ______________________

Thickness: ______________________

Measuring Temperature

Temperature describes how hot or cold something is. Thermometers are used to measure temperature. Scientists measure temperature in degrees Celsius. So do most other people around the world. In the United States, degrees Fahrenheit are used to report the weather, to measure body temperatures, and in cooking.

With this balance, you can directly compare the masses of two objects. Put one object in each pan. The pan that sinks lower contains the greater mass.

Pan Balance

A **balance** is a tool used to measure mass. *Mass* is the amount of matter in an object. The base unit of mass is the kilogram. One kilogram equals 1,000 grams.

To measure in grams, place an object in one pan.

Add gram masses to the other pan until the two pans are balanced. Then add the values of the gram masses to find the total mass.

Always carry a balance by holding its base.

This pan balance has drawers where the masses are stored.

Three Beams

A triple-beam balance measures mass more exactly than the pan balance. It has one pan and three beams. To find the number of grams, move the sliders until the beam balances.

Digital Mass

An electronic balance calculates the mass of an object for you. It displays an object's mass on a screen.

How Strong?

A **spring scale** is a tool used to measure force. Force is a push or a pull. When an object hangs down from the scale, the force of gravity, or weight, is measured. When the spring scale is used to pull an object, it measures the force needed to move the object. Either way, the base unit is called a newton.

▶ **Draw lines to match the tools to what they measure and the units.**

Tool	What It Measures	Units
	• force •	• seconds, minutes, hours, days, years, etc.
	• temperature •	• grams, milligrams, kilograms, etc.
	• length •	• newtons
	• mass •	• degrees Celsius, degrees Fahrenheit
	• time •	• meters, kilometers, millimeters, etc.

More Measuring

It's a hot day and you're thirsty. How much lemonade would you like? 1,000 milliliters or 1,000 cubic centimeters? Not sure? Read on!

ACTIVE READING As you read the next two pages, circle important words that are defined, and underline their definitions.

Units of Volume

Volume is the amount of space a solid, liquid, or gas takes up. There are two base metric units for measuring volume. A *cubic meter* is one meter long, one meter high, and one meter wide. The *liter* is the base unit often used for measuring the volume of liquids. You're probably familiar with liters because many drinks are sold in 1-liter or 2-liter bottles. These two metric units of volume are closely related. There are 1,000 liters (L) in one cubic meter (m^3).

▶ One cubic centimeter (cm^3) is equal to 1 milliliter (mL). Both are equal to about 20 drops from a dropper. Which is greater—1,000 mL or 1,000 cm3?

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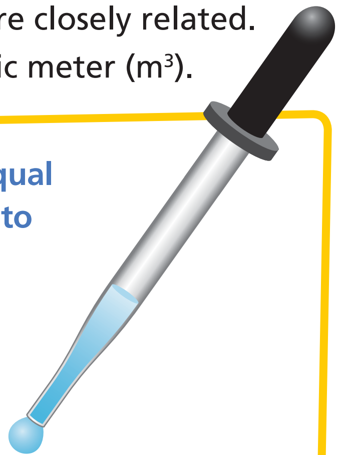
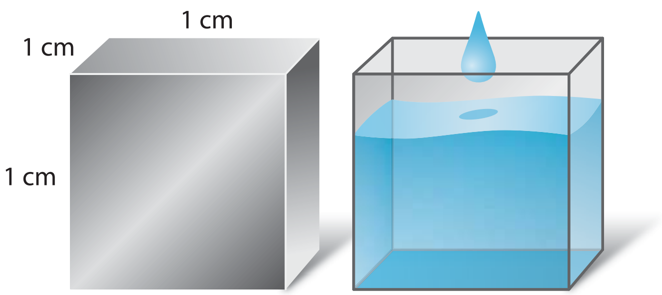
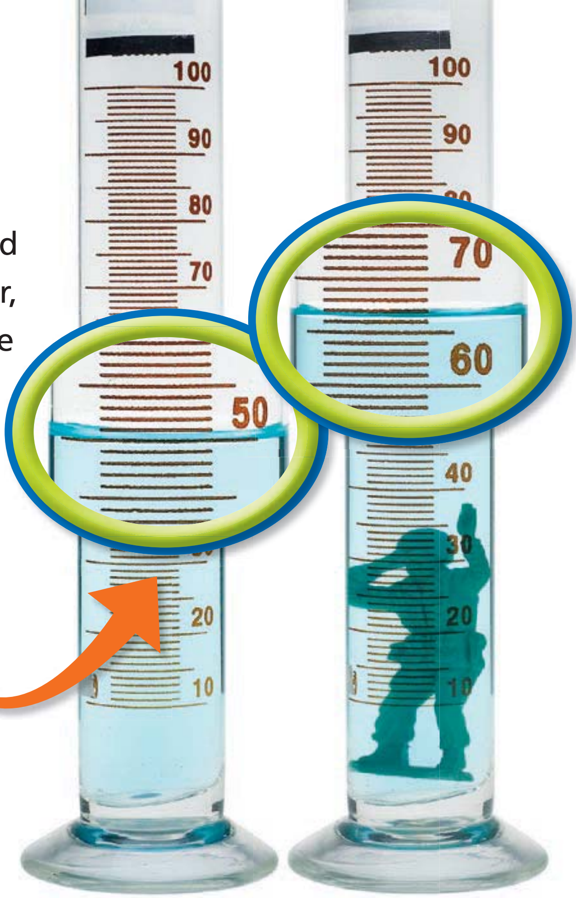




Finding Volume

You can find the volume of a rectangular prism by multiplying length times width times height. To find the volume of a liquid, use a measuring cup, beaker, or graduated cylinder. Use water to find the volume of an irregular solid. Put water in a graduated cylinder. Note the volume. Then drop the object in and note the new volume. Subtract the two numbers to find the volume of the object.



The surface of a liquid in a graduated cylinder is curved. This curve is called a *meniscus*. Always measure volume at the bottom of the meniscus.

Accurate Measurements

When a measurement is close to the true size, it is **accurate**. Try to measure as accurately as you can with the tools you have. Make sure a tool is not broken and that you know how to use it properly. Also pay attention to the units on the tools you use. Accurate measurements are important when doing science investigations, when baking, and when taking medicines.

Follow these tips to improve your accuracy:

- ☑ Handle each tool properly.
- ☑ Use each tool the same way every time. For example, read the measurement at eye level.
- ☑ Measure to the smallest place value the tool allows.
- ☑ Measure twice.
- ☑ Record your measurements carefully, including the units.

▶ **Write the math sentence for finding the volume of the toy.**

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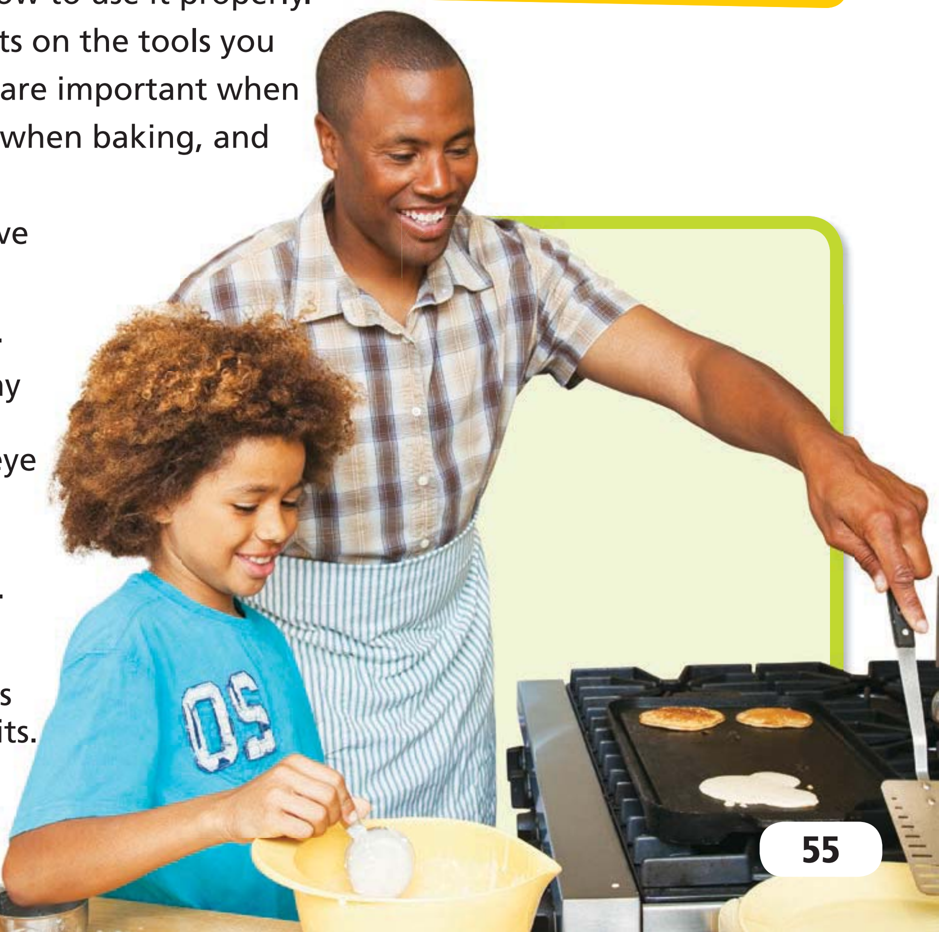
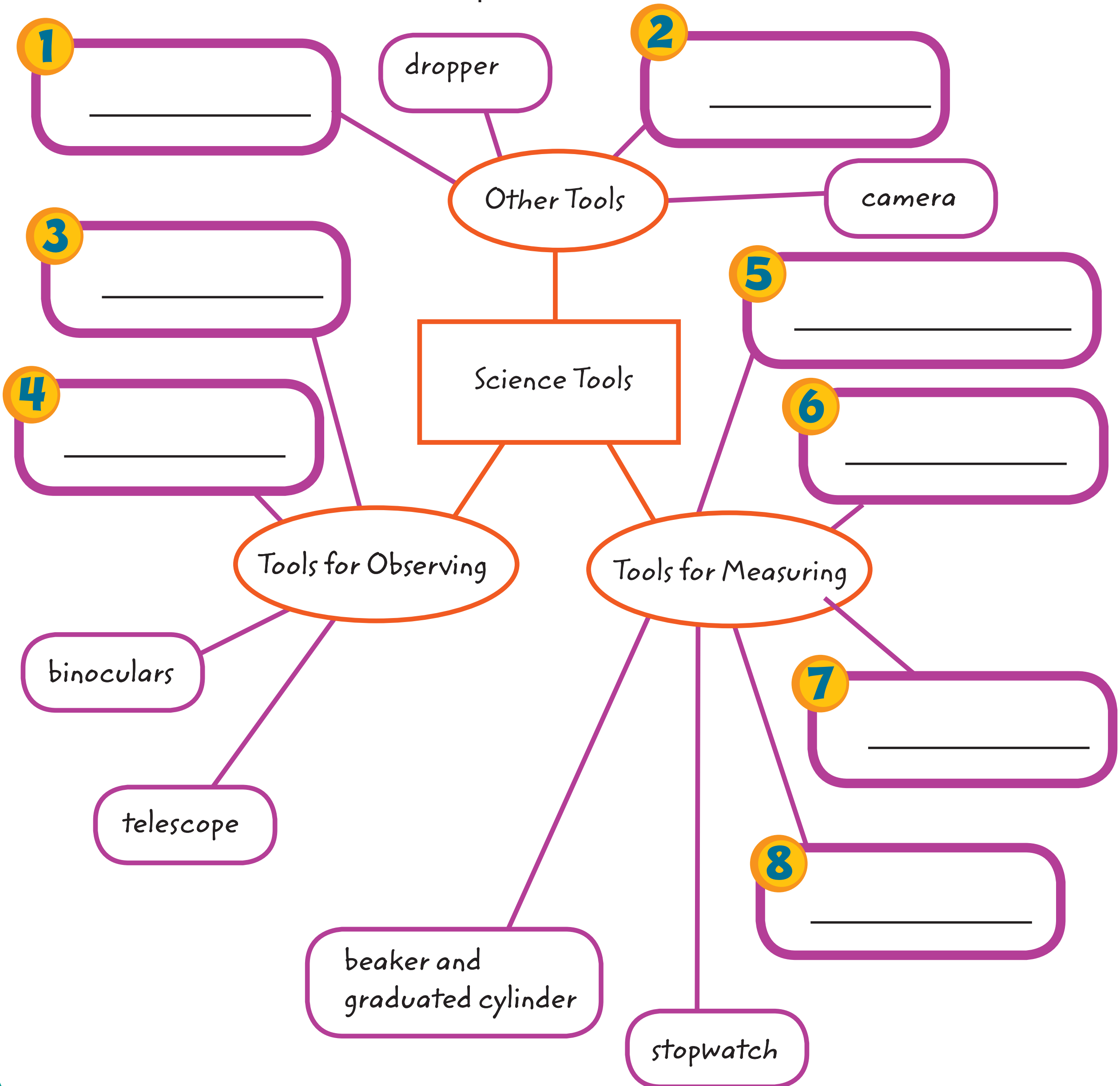


Sum It Up »

When you're done, use the answer key to check and revise your work.

There are many kinds of tools that scientists use. Tools help scientists observe, measure, and study things in the natural world.
Fill in the blank boxes with examples of tools that scientists use.



Brain Check

LESSON 5

Name ____________________

Vocabulary Review

1 **Put the scrambled letters in order to spell a science term.**

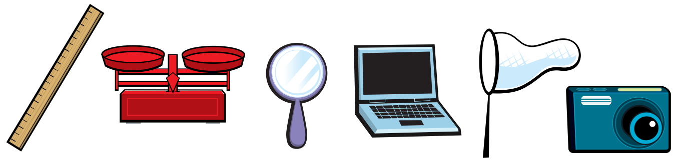
	Scrambled	Answer	Clue
1.	treem	◯ _ _ ◯ _	A metric unit of length
2.	amrg	_ _ ◯ _	A metric unit of mass
3.	rdsgeee seCisul	_ _ _ _ _ _ ◯ _ _ _ _ _ ◯ _	A metric unit for temperature
4.	taceurca	_ _ _ _ ◯ _ ◯	A measurement close to the true size
5.	townne	_ _ _ ◯ _ _	A unit used to measure force
6.	trile	_ _ _ _ ◯	A metric unit of volume
7.	pignrs ecsla	_ _ _ _ _ _ _ _ _ _ ◯	A tool used to measure force
8.	nap cablane	_ ◯ _ _ _ _ _ _ _ _	A tool used to measure mass
9.	dceson	◯ _ _ _ _ _	A metric unit of time
10.	veumol	_ _ _ ◯ _ _	The amount of space a solid, liquid, or gas takes up
11.	tagurdade lycnidre	_ _ ◯ _ _ _ _ _ _ _ _ _ _ _ _ ◯ _	A tool used to measure volume

Riddle: Place the circled letters in order to solve the riddle below.

Why did the captain ask for a balance?
He wanted to _ _ _ _ _ _ _ _
the mass of the _ _ _ _ _ _ _ _ _ _.

Apply Concepts

2 Tell how you use one or more of these tools to investigate each question.



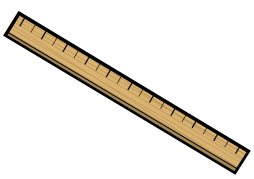
How are two fossil teeth similar and different?

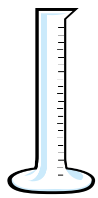
Which kinds of butterflies are found in a field?

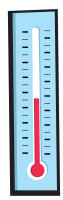
What do scientists already know about the bottom of the ocean?

Does the mass of a ball affect how far it rolls?

3 Identify what each tool measures and the metric units it uses.







Take It Home!

At your school or public library, find a book about how scientists work or the tools they use. Read and discuss the book with your family. Prepare a brief summary to present to your classmates.

Name ______________________________

ESSENTIAL QUESTION

How Can Scientists Learn from Observations?

Materials

soil sample
white paper
measuring spoons
hand lens
measuring cup
coffee filter
pan balance
mesh sieve
small container
graduated cylinder
paper bag

EXPLORE

Sometimes you can't do an experiment. But you can still answer by investigating. In this activity, you'll learn about soils by simply making observations.

Before You Begin—Preview the Steps

1. On a sheet of white paper, place a teaspoon of soil. Use the hand lens to observe it. Record your observations.
2. Place 100 mL of soil in a coffee filter. Find and record its mass. Place the filter in a mesh sieve above a small container. Fill a graduated cylinder with 100 mL of water. Slowly pour water onto the soil. When the soil can no longer hold water, record the amount you poured.
3. Place 200 mL of soil in a paper bag, and record the mass of the bag. Place the bag in a dry place for a week. Then find the bag's mass again.
4. Compile your data in a class data table. In a small group, discuss ways to classify the soil samples.

Set a Purpose

What will you learn from this investigation?

____

____

____

Think About the Procedure

What planning must I do before this investigation?

____

____

____

____

What tools are used in this investigation? What measurements, if any, are taken with them?

____

____

____

____

____

Name ______________________________

Record Your Data

In the space below, record your results.

Soil sample: ____________________

My observations:

Amount of water held by 100 mL of soil: ________________

Mass before drying: ____________

Mass after drying: ____________

Draw Conclusions

Compare your data with the data from other groups. What can you conclude?

____

____

____

____

____

Claims • Evidence • Reasoning

1. Make a claim about why it is important that soils be able to hold some water.

2. Why would a farmer want to know about the soil on his or her farm? Explain your reasoning.

3. How was this investigation different from a controlled experiment?

4. Make a claim about why it was important to know the mass of the soil before it was dried for one week.

5. What else would you like to find out about different types of soils?

UNIT 1

Benchmark Review

Name ________________________________

Vocabulary Review

Use the terms in the box to complete the sentences.

balance control experiment variable

1. An investigation in which all conditions are controlled is a(n) ______________________.

2. Jane wants to measure the mass of a rock.

   The tool she should use is a(n) ______________________.

3. Any condition in an experiment that can be changed is a(n) ______________________.

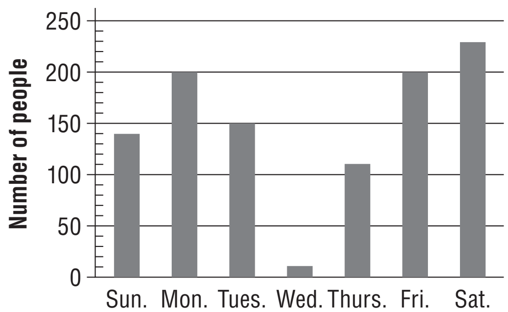
4. The setup to which you compare all the others in an experiment is the ______________________.

Science Concepts

Fill in the letter of the choice that best answers the question.

5. Gabrielle counts the number of people who visit the community pool each day for 1 week. She displays her data using a bar graph.

   Number of Pool Visitors



   How many more people did Gabrielle observe at the pool on Sunday than on Thursday?

   Ⓐ 20
   Ⓑ 30
   Ⓒ 75
   Ⓓ 100

6. Observations are made using our five senses. We can then use those observations to draw conclusions. Which of the following is an example of a conclusion?

   Ⓕ "The object is flat."
   Ⓖ "The flower smells like mint."
   Ⓗ "Crickets chirp to attract mates."
   Ⓘ "The food is both sweet and salty."

7. Asa watches his mom rub soap on her finger to help her get a ring unstuck. He thinks that soap must reduce friction. He designs an investigation to test his theory. He pulls a weight across a board and records the force with a spring scale. He then puts soap on the board and pulls the weight again. Which of the following variables is Asa measuring?

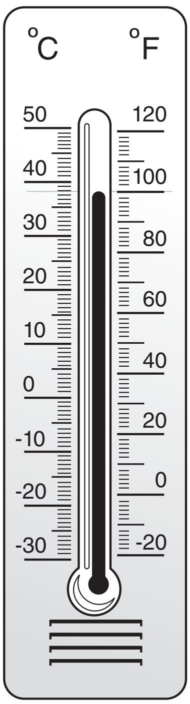
   Ⓐ the speed with which the weight is pulled

   Ⓑ the amount of weight being pulled

   Ⓒ the force needed to pull the weight

   Ⓓ the type of surface the weight is being pulled across

8. Erica is learning how to accurately read a thermometer. She places the following thermometer in the sun for 1 hour.



   What temperature does Erica read on the thermometer?

   Ⓕ 38° Celsius

   Ⓖ 100° Celsius

   Ⓗ 38° Fahrenheit

   Ⓘ 105° Fahrenheit

9. Different systems for making measurements use different units. Which system of measurement is generally used by scientists?

   Ⓐ customary　　Ⓒ Imperial

   Ⓑ English　　Ⓓ metric

10. Joshua has been growing plants that receive ½ cup of water two times per week. Now, he wants to see what happens to the plants when the amount of water is reduced, as shown in the chart.

Plant	Amount of water
1	no water
2	½ cup once every two weeks
3	½ cup once per week
4	½ cup two times per week

   Which plant is the control?

   Ⓕ 1　　Ⓗ 2

   Ⓖ 3　　Ⓘ 4

11. Scientists want to determine if walls that are painted a certain color will raise a person's blood pressure. They plan to set up four rooms. Which variable should change in each room?

   Ⓐ the color used

   Ⓑ the type of room used

   Ⓒ the instruments used to test the blood pressure

   Ⓓ the amount of time the person spends in the room

Name ____________________

12. Sandy observes the phases of the moon during a two-week period. She sketches and labels the phases and shares her drawings with the class. Which statement best describes Sandy's investigation?
    - (F) It involves modeling.
    - (G) It involves experimentation.
    - (H) It involves repeated observations.
    - (I) It involves both experimentation and repeated observations.

13. Scientists include controls in their experiments. Why is a control important?
    - (A) It helps scientists share results.
    - (B) It helps scientists form their first hypothesis.
    - (C) It helps scientists record their repeated observations.
    - (D) It helps scientists compare their results to a standard.

14. A teacher writes the following note on a student's experimental design: "You did not identify and control variables." Why is it important to identify and control variables?
    - (F) because a scientist must observe data
    - (G) because a scientist must form a hypothesis
    - (H) because a scientist must know which variable causes change
    - (I) because a scientist must know which variable to use for making a model

15. Michael rides a bike made by Company A. Luis rides a bike made by Company B. How can Michael and Luis determine in a scientific way whose bike has tires that last longer?
    - (A) Read information about the tires from each manufacturer.
    - (B) Ask ten classmates who ride each bike which tires last longer.
    - (C) Have each student ride their own bike for 25 days, then compare the tires.
    - (D) Use a machine to test the bikes in the same way for 25 days, then compare the tires.

16. A doctor says that drinking two glasses of milk in the morning will give students more energy. Which of the following would be good scientific evidence for or against the doctor's claim?
    - (F) a brochure from the doctor stating the benefits of milk
    - (G) data from scientific investigations about drinking milk in the morning
    - (H) a TV advertisement that drinking milk in the morning gives people plenty of energy
    - (I) statements from five people about how drinking milk in the morning gives them energy

17. When Andrew conducts an investigation, he repeats the investigation several times. Why does Andrew do this?
    - (A) to create inventions
    - (B) to get consistent results
    - (C) to do the work very safely
    - (D) to be sure the work is correct

Apply Inquiry and Review the Big Idea

Write the answers to these questions.

18. Aaliya knows that sliced apples turn brown when left out in the open air. She also knows that pouring certain liquids on them will keep this from happening. Aaliya thinks that water, ginger ale, or lemon juice may do the trick. How could Aaliya set up an experiment to gather evidence to support a claim about these liquids? What are the variables? What will she use as a control?

19. Yamil is observing a fossil insect preserved in amber.

    What can Yamil learn about the fossil through observation? What tools might she use to make her observations?