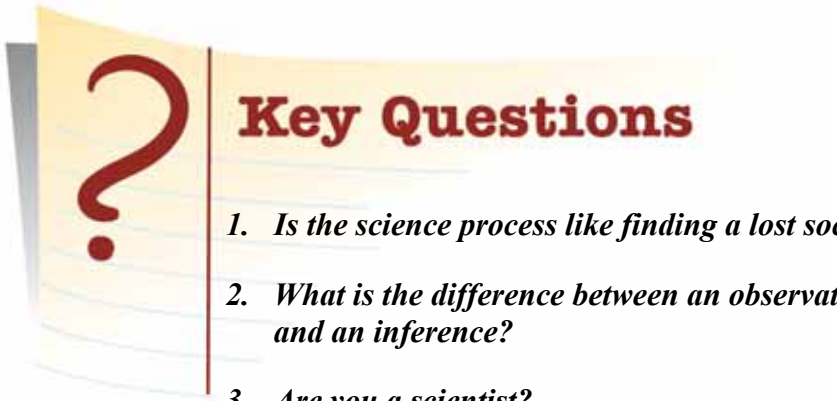
Chapter 1

Science Is Everywhere

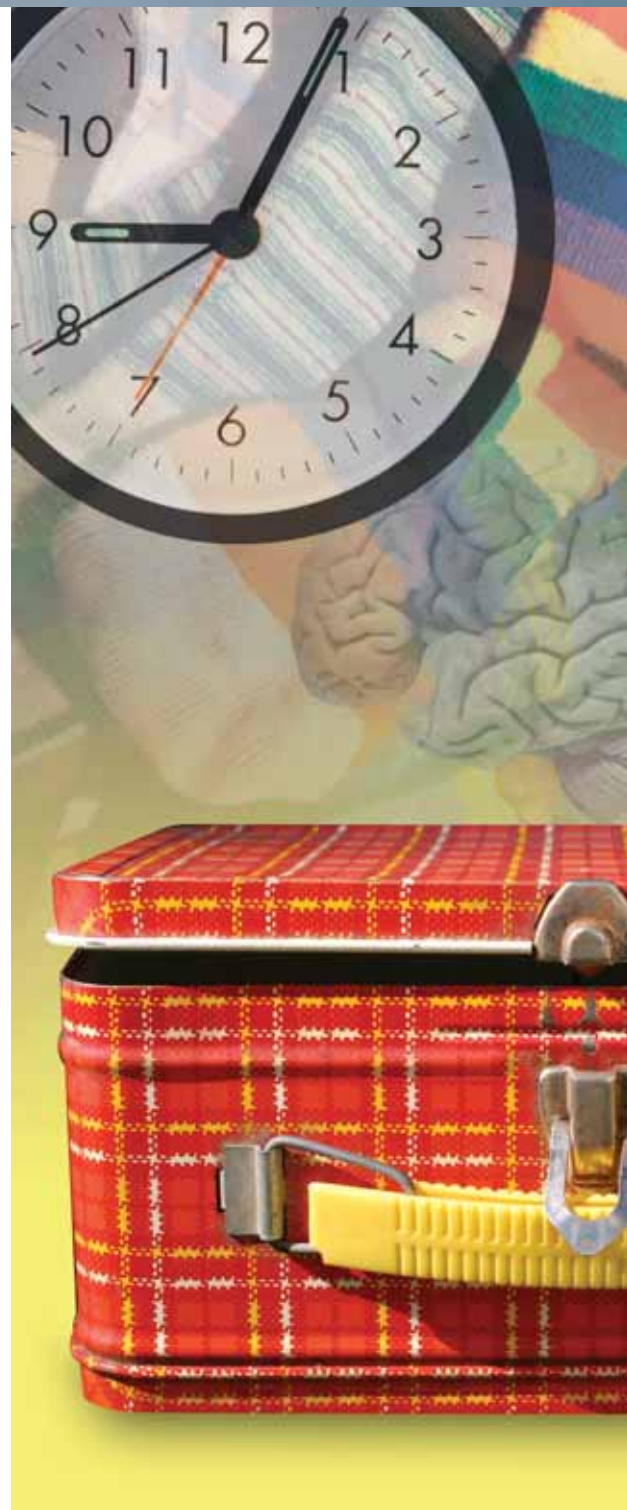
Your brain processes information all the time. You use this information to make choices and solve problems. What choices do you make when you eat lunch? How do you solve a problem like finding a missing sock?

Think about the title of this chapter. Is it true? Is science everywhere? Read Chapter 1 to find out!



Key Questions

1. ***Is the science process like finding a lost sock?***
2. ***What is the difference between an observation and an inference?***
3. ***Are you a scientist?***



1.1 Learning about Science

How do you find a lost object? For example, what do you do if you can't find one of your favorite socks? Most likely you predict where it is based on your experience. A statement based on your experience is called an **inference**. You hear the clothes dryer running. Is your missing sock in the dryer? Asking questions and making inferences are important parts of the science process (Figure 1.1).

Figure 1.1: *The science process is like looking for a lost sock.*

What is science?

Observe **Science** is a process for answering questions. You start the science process by making observations. For example, look at the picture below. One observation about this picture is that the girl is reading a book. Another observation is that the girl is smiling.

Question Once you've made your observations, you continue the science process by forming a question. Why is the girl smiling?

Hypothesis Based on your observation, you might propose that the girl in the picture is smiling because she likes to read. An explanation, or a possible answer to a scientific question based on observations, is called a **hypothesis**. A hypothesis is not necessarily true or correct though. How can you find out if your hypothesis is correct?

VOCABULARY

inference - a statement based on experiences.

science - a process for answering questions.

hypothesis - a possible answer to a scientific question based on observations.

The scientific method

A testable hypothesis

Another quality of a hypothesis is that it must be testable. A hypothesis is tested to see if it is correct or not. Pieces of information that are collected to test a hypothesis are called **data**.

Collecting data

Scientists collect data to find out if a hypothesis is correct or not. You could ask the girl why she is smiling. She might say, "I like to read!" Or, you could ask her friends whether or not she likes to read. By collecting data, you learn if your hypothesis is correct.

Types of data

There are many different types of data. *Qualitative* data are in the form of words. *Quantitative* data are in the form of numbers. Here are some examples of data.

Examples of qualitative data	Examples of quantitative data
The girl likes to read science-fiction books.	The girl read 5 science-fiction books and 4 mystery novels last summer.
Some of the apples are red and some of the apples are green.	25 apples are red and 50 apples are green.
Some of the tomato plants are tall and some are short.	There are 40 tall tomato plants and 20 short tomato plants.
We caught a large fish.	The mass of the fish was 5 kilograms.

The scientific method

Scientists observe, form a question, state a hypothesis, and collect data by performing an experiment. Once these steps occur, the scientist studies the results of the experiment and reaches a conclusion. All together these steps are called the **scientific method**. The scientific method is summarized in Figure 1.2.

VOCABULARY

data - pieces of information collected to test a hypothesis.

scientific method - a series of steps including observation, forming a question, stating a hypothesis, collecting data, and reaching a conclusion.

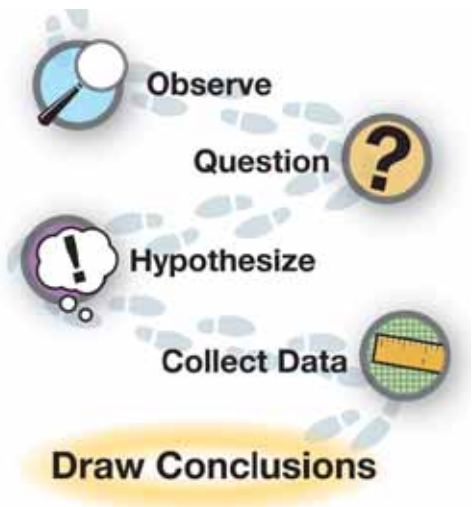


Figure 1.2: *Basic steps in the scientific method.*

What is it like to be a scientist?

Looking through a keyhole

Jacques Cousteau, a famous marine biologist, described a scientist as a curious person who looks through a keyhole. What did he mean by this? When you look through a keyhole, you cannot see *everything,* only a few things (Figure 1.3). An experiment is like looking through a keyhole.

Figure 1.3: *Can you tell what is happening on the other side of this keyhole? Performing an experiment is like looking through a keyhole. The results of the experiment give you only a small amount of information.*

Experiments

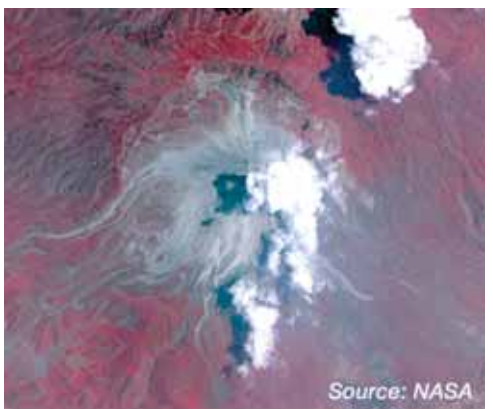
An **experiment** is an activity performed to support or refute a hypothesis. Once a hypothesis is known to be correct or incorrect, it is time to perform another experiment. Scientists perform many experiments to understand complex issues. For example, many experiments have been performed to understand how to cure human diseases.

Anyone can be a scientist

Anyone can be a scientist. You have worked like a scientist if you have performed an experiment. Scientists are curious and they enjoy solving problems.

What is it like to be a scientist?

Scientists share information gained from experiments. A scientist might travel around the world. To study volcanoes, for instance, scientists may travel to locations where volcanoes are common like Iceland or Mexico. Scientists study volcanoes to learn how to predict eruptions. The work of scientists and local officials helped people evacuate in time when the Colima Volcano of Fire erupted in Mexico in June of 2005 (see photo at right).



A bird's eye view of the erupting Colima volcano, *June 2005.*

VOCABULARY

experiment - an activity performed to support or refute a hypothesis.

Fields of science

A list of sciences Figure 1.4 lists some fields of science. Below you'll find examples of what scientists do in each field. All fields of science use the scientific method. Which field of science is most interesting to you?

Physics Physics is the study of how and why things move. Physicists study motion, electricity, light, and sound. Marie Curie was a physicist who studied radioactive substances. In a physics class you might measure how fast something moves or learn how sound is made.

Chemistry Chemistry is the study of matter. Here are some examples of matter: air, water, a book, a cat, and you! These things are all made up of small particles called *atoms*. Chemists are involved in activities like making new medicines and figuring out the best way to refine oil to make gasoline. In a chemistry class, you might study the properties of water or learn to perform chemical reactions.

Biology Biology is the study of living things. Living things include bacteria, insects, fish, plants, animals, and people. If you take a biology class, you might learn about DNA or about how you digest your lunch!

Astronomy Astronomy is the study of stars and planets and anything else that is in space. Astronomers discover new planets and galaxies and study objects that would take thousands of years to travel to.

Earth science Earth science is the main focus of this textbook. Earth science includes the study of how Earth's surface changes, the study of rocks and rock formations, and the study of fossils.

Ecology Ecology is the study of living things and how they interact with each other and their environment. Like earth science, ecology is taught in this textbook. You will have a good start on becoming an earth scientist or ecologist after you read this textbook!

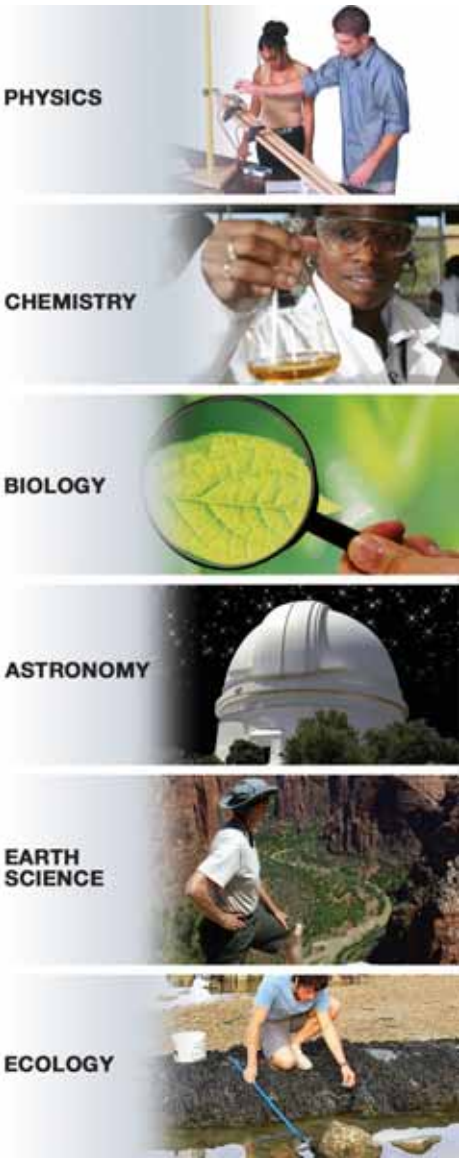


Figure 1.4: *Different fields of science.*

How science affects your life

Science in the morning Brushing your teeth is a daily activity that involves science. The fluoride in your toothpaste strengthens your tooth enamel so that you get fewer cavities (Figure 1.5). A chemist figures out how much fluoride to add to your toothpaste. Too much fluoride can discolor your teeth and too little will not help keep them strong.

Science at school Check out your pencil. Making a pencil involves a range of sciences. A basic pencil is made of rubber, metal, wood, and graphite (Figure 1.5). The rubber for the eraser might be from a rubber plant or it could be a product derived from petroleum. Earth scientists often work in the petroleum industry. The wood of your pencil was probably harvested from a forest. Biologists play an important role in understanding the growth cycle of trees so that forests used for industry are sustainable. The "lead" of your pencil is a mixture of clay and graphite. The right mixture of these two materials was probably determined by a chemist.

Science after school What kinds of activities do you do after school that involve science? If you play a sport, you'll be affected by the laws of physics. If you have a doctor or dentist appointment, you are benefiting from the science of biology. As you travel around your town, you might see mountains, lakes, ponds, forests, or other natural features that are studied by a range of scientists such as earth scientists and ecologists.

Science at meals Do you eat a variety of foods each day? To help you make healthy choices, visit the website of the U.S. Department of Agriculture (USDA): http://www.mypyramid.gov. MyPyramid is based on the 2005 Dietary Guidelines set by the federal government, recommendations by the National Academy of Sciences, and the current eating patterns of people in the United States (Figure 1.5). MyPyramid is science in action to help you eat well!

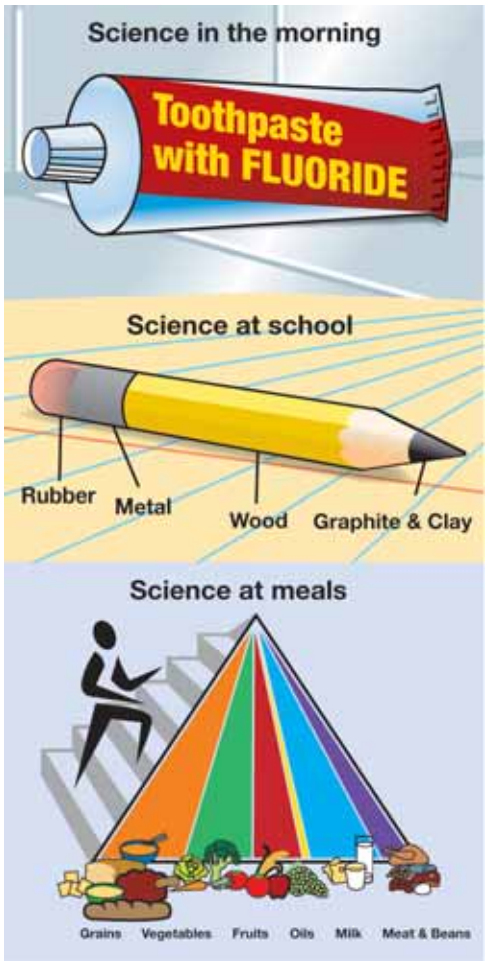


Figure 1.5: *Science during the day.*

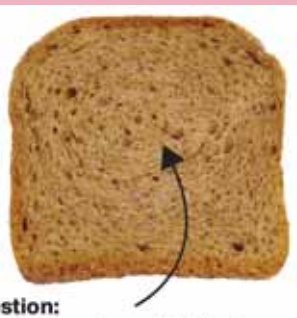
1.1 Section Review

1. Write a short paragraph about how the science process is like finding a lost sock.
2. What is an inference?
3. Make inferences regarding the following situations:
   a. It is the start of a new school year. Make an inference about when the school day will end. On what experience is this inference based?
   b. Tomorrow is Saturday morning. What will you be doing at 10 a.m.? On what experience is this inference based?
4. You notice that the leaves on your houseplant are limp. Why are the leaves limp? Come up with a hypothesis.
5. List the steps of the scientific method. Draw a picture to illustrate each step. Write a caption for each picture.
6. Describe an experiment you have done on your own or in a science class. Be sure to include each of the steps of the scientific method in your description.
7. In 1847, Maria Mitchell discovered the Nantucket comet. It was the first time a comet had been discovered by a U.S. citizen and the first time a comet had been discovered by a woman. What kind of scientist was Maria Mitchell? How do you know?
8. Recently, scientists found that wolves are important as top carnivores in Banff National Park in Alberta, Canada. The scientists learned that in areas without wolves, the elk populations are 10 times higher. The elk eat all the plants, making it harder for other animals to survive. When wolves are around, they eat some of the elk. This means that more plants are available for other animals. What kind of scientists are studying the wolves in Banff National Park?

CHALLENGE

When you look at a slice of bread, you see little holes in it. Make a hypothesis about what causes these little holes.

Hint: Study a bread recipe to learn about the ingredients that are used to make a loaf of bread.



Question:
What causes these little holes in a slice of bread?

1.2 Observing the World

Chances are you have heard a person yell, "Watch me!" as he or she jumps off a diving board (Figure 1.6). Science involves observing events, but most things that you study in science, like a tree or a fish, don't yell, "Watch me!" Yet, you'll find that trees and fish do fascinating things if you use your senses to observe them. Use all of your senses to observe—sight, hearing, touch, taste, and smell!

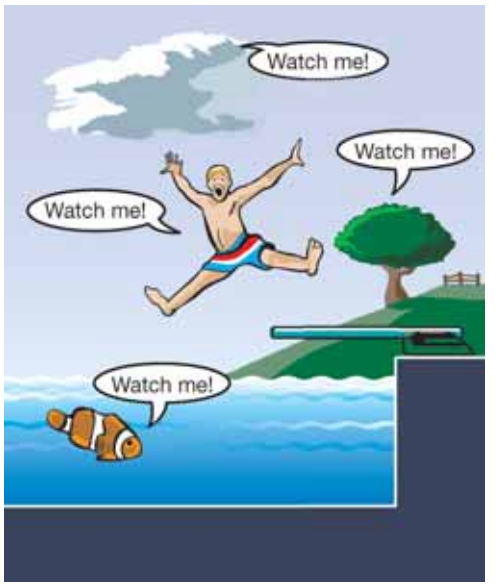


Figure 1.6: *People say "Watch me!" but fish, trees, and clouds, three things in nature that are worth studying, only say "Watch me!" in cartoons!*

Powers of observation

Making observations

An observation is an accurate description of a thing or an event. "The sky is blue" is an observation. However, if you look at the sky every day, you will observe that it is not always blue. Some days it is grey, or it may be streaked with shades of red during a sunset.

Observations versus opinions

What happens when a weather report predicts rain? Most likely, you form an opinion. Some people, especially farmers, like rain. A baseball team or a person who wants to have a yard sale might grumble, "I don't like rain!" What is your opinion when it rains?

- An observation is: It is raining.
- An opinion is: I like rain!

When practicing science, it is important to make observations without making opinions. Why do you think this is important?

An observation example

Let's imagine your school wants to pick new school colors. The principal's opinion might be that the colors should be purple and red. A survey of all the students would allow the principal to pick the school colors based on an observation rather than his or her opinion. A survey might reveal that 90% of the students prefer blue and gold, 5% prefer blue and green, and 5% prefer purple and red. With the results of the survey, the principal can make the observation that the majority of students prefer blue and gold.

MY JOURNAL

Interview a scientist or read about one. Write a paragraph about something you have learned.

Using all of your senses

The five senses The five senses are seeing, hearing, touching, tasting, and smelling. Each of these senses is valuable in making observations. Making observations includes the use of one or all of the five senses depending on what you are observing.

Seeing An astronomer looks through a telescope to see objects that are millions of miles away. A microbiologist looks through a microscope to study small organisms like amoebas and bacteria that are millions of times smaller than you are.

Hearing *Acoustics* is the science of designing objects based on how sound travels. Hearing is important in this field of science. Hearing is also important in *ornithology,* the study of birds. Because birds are sometimes hard to see, they often have to be identified by their sound. Roger Tory Peterson, an ornithologist, had a keen ability to listen to nature. He once stated that he was able to identify nearly every bird in North America just by listening to their calls.

Touch Geerat J. Vermeij, Ph.D., is a marine biologist who is blind. He relies on his sense of touch to study the shells of marine mollusks (Figure 1.7). His observations, based on touch, have helped him understand how mollusks protect themselves from predators.

Taste and smell The senses of taste and smell are used when scientists develop new food products. How food tastes and smells determines whether it is enjoyable to eat. Let's say a company wants to develop a new brand of sugarless, cinnamon-flavored gum. Food scientists use chemistry to determine how to make the gum sugarless, taste good, and taste and smell like cinnamon. Look at some food labels. Can you tell which ingredients are added to improve the taste and which might be added to enhance the smell?

Figure 1.7: *Geerat Vermeij uses his sense of touch to study the shells of marine mollusks. Examples of mollusks include snails, clams, conchs, and even those without shells like octopi!*

Use your powers of observation when you read. Look through the chapter for all the main titles and headings. Read those first before you begin reading paragraphs.

Each paragraph has a sidenote that highlights the main idea. Use this sidenote to form a question. Then ask yourself if you can answer the question after you have read the paragraph.

Recording observations

Keeping a notebook

Scientists write their observations in a notebook. A notebook is an important tool in science. Figure 1.8 shows Thomas Edison, inventor of the modern light bulb, writing in his notebook.

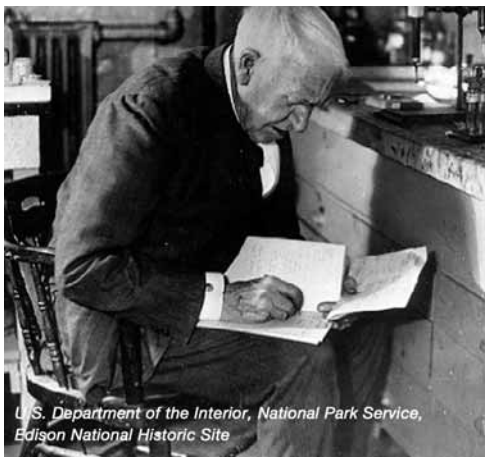


Figure 1.8: *Thomas Edison wrote his ideas in a notebook.*

Format

A scientist's notebook contains observations, experiments, and drawings (Figure 1.9). The notebook may also contain mistakes! Mistakes show a thought process. Some mistakes spark new ideas or discoveries. When a mistake is made, a line is drawn through it so that the word or number is still readable (see example below).

SPEED DATA

Draw a line through mistakes.

Distance (cm)	Time (seconds)	Speed (cm/second)
16	0.1	160
32	0.3	~~170~~ 107

What do I write?

The science process helps you know what to write. First you record your observations, a question, and a hypothesis. Then you record the experiment procedure and data. Data can be descriptions or measurements. The table below lists measurements that you might make during an experiment. The table also lists the tools needed to make these different measurements. You write your conclusions last. Now, your experiment can be repeated by you or by other people because you have recorded everything you did!

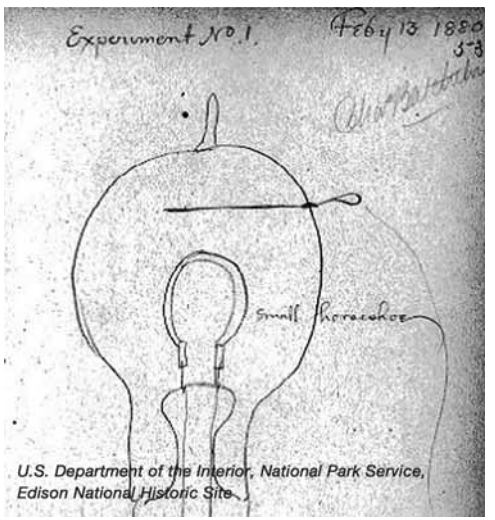


Figure 1.9: *Here is a page from one of Thomas Edison's notebooks. Thomas Edison invented the modern light bulb.*

If you need to measure...	Use a...
distance, length, or height	ruler, meter stick, or tape measure
mass and weight	balance or scale
volume	beaker or graduated cylinder
temperature	thermometer
time	stopwatch, watch, clock

1.2 Section Review

1. Choose an environment in which you can make observations. Write down as many observations as you can in one minute.
2. What is the difference between an observation and an opinion?
3. Think about your favorite food.
   a. Write an observation about your favorite food.
   b. Write an opinion about your favorite food.
4. List the five senses that you can use to collect data. List one observation for each sense.
5. Spend 10 minutes recording observations using all of your senses. Share your observations with your class.
6. Why is it important for a scientist to keep a notebook?
7. Why should you not erase mistakes from your science notebook? Make a list of reasons. Discuss these reasons with a partner or the class.
8. The word *science* is derived from a Latin word that means "to know."
   a. How does science help us know about the world?
   b. How is practicing science different from watching TV as a way to learn about the world?

CHALLENGE

In the United Kingdom, there is a store that hires a person to travel the world to buy the world's best chocolate. This job requires that the person be good at judging the chocolate by taste! To do this job well, the person has to taste about a pound of chocolate a day!

Imagine that your job is to taste samples of your favorite food. You have five samples to taste and you have to pick the best one.

Examples:

- Which candy maker makes the best chocolate?
- You are the judge in a pie-baking contest. Which apple pie is the best?
- Which pizza parlor in your neighborhood makes the best pizza?

Write a description that explains how you would use the scientific method to pick the best sample.

Hint: Are there other senses in addition to taste that might be useful for picking the best sample?

1.3 Using the Scientific Method

Once you have made observations, how do you make a hypothesis? In this section, you will learn more about how to develop a hypothesis. You will also learn the difference between a scientific fact and a scientific theory.

Begin with an observation

An observation and a question

Your friend Sam notices that the grass on the school ground is not green everywhere. In one place, where students wait for the bus, the grass is brown. Sam makes a diagram to illustrate his observations (Figure 1.10). His question is: Why is the grass brown near the bus waiting area?

The hypothesis

Based on his observation, Sam states a hypothesis: *Students walk on the grass near the bus waiting area.* After making his hypothesis, Sam can complete the steps of the scientific method by collecting data and drawing conclusions (Table 1.1).

Table 1.1: Steps to the scientific method

1. Make observations	The grass is brown at the bus waiting area (location A) and green in an area closer to the school building (location B) (Figure 1.10).
2. Ask a question	Why is the grass brown near the bus waiting area?
3. State a hypothesis	The grass is brown at Location A (the bus waiting area) because students walk on the grass there.
4. Collect data	For his experiment, Sam observes students for three days while they wait for the bus. During this time, he records that students walk on the grass at location A, and no students walk on the grass at location B.
5. Draw conclusions	Sam concludes that his hypothesis is correct. The grass is brown at location A because students are walking on the grass.

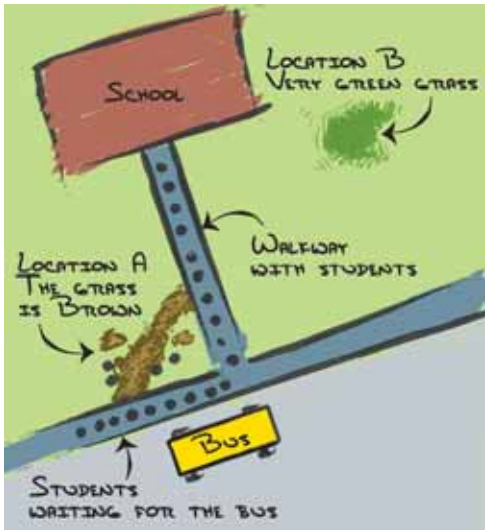


Figure 1.10: *Sam's diagram of the schoolyard.*

CHALLENGE

Communicating research

Sam used the scientific method to learn why the grass in the school yard is brown. Imagine that you are on the student council. The student council wants to know the results of Sam's research. They also want to know what to do to make the grass green again.

Write an essay that explains Sam's research and list three ideas for protecting the grass.

What is a good hypothesis?

Making a good hypothesis

Sam's hypothesis was good because it could be tested with an experiment. Sam tested his hypothesis by observing the students while they waited for the bus. Below are other testable hypotheses that Sam could have made.

The grass near the walkway is brown because:

1. It is not getting enough water.
2. It is not getting enough fertilizer.

Inference

A good hypothesis is based on your experiences. As you have learned, an *inference* is a statement based on your experiences.

Here are some examples of inferences:

- For 5 weeks, the cafeteria has served ice cream on Friday. Therefore, my inference is that the cafeteria will serve ice cream next Friday.
- I have gone to 10 birthday parties. At each party, people sang *Happy Birthday to You*. My inference is that when I go to another birthday party, people will sing *Happy Birthday to You*.

What happens next?

Sam made a hypothesis and documented evidence that his hypothesis was correct. Sam's next step might be to report the results of the experiment in a lab report (Figure 1.11). A lab report follows the steps of the scientific method.

What if your hypothesis is incorrect?

An incorrect hypothesis is another piece of information that you can use to answer scientific questions. Let's say Sam wants to know why the grass near the school is so healthy. His question might be: What kind of treatment is applied to the grass? His hypothesis might be that the grass is fertilized. If this hypothesis is incorrect, Sam can use data from his experiment to make a new hypothesis about why the grass is healthy and run a new experiment.

MY JOURNAL

Pick one of the hypotheses listed at the left. Write a paragraph that describes what you would do to test this hypothesis in an experiment.

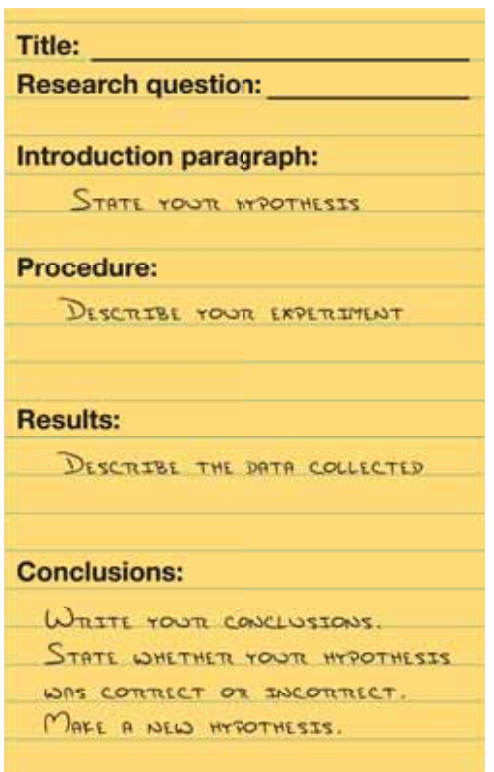


Figure 1.11: *An example of a lab report. Note that the format of the lab report follows the steps of the scientific method.*

Scientific facts, laws, and theories

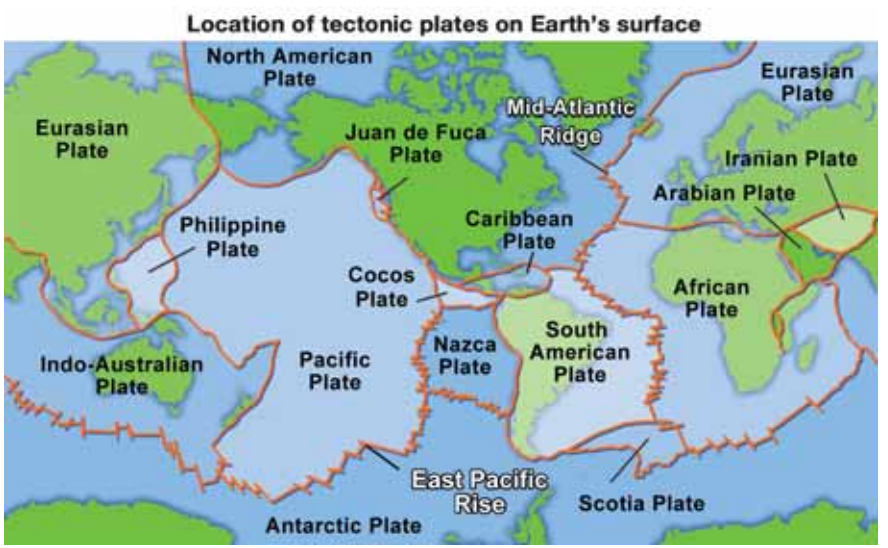
What is a scientific fact?

Scientific facts are statements that are accepted as being true because the facts have been repeatedly measured or observed. Here are some scientific facts:

- The ocean is salty.
- It takes 365.25 Earth days for Earth to orbit around the Sun.
- Earth has one moon.

Scientific laws and theories

Knowledge about a topic grows based on the results of experiments. Over time this knowledge may support a *scientific law* or *theory*. Both a **scientific law** and a **scientific theory** are statements that are supported by observations and evidence collected from many experiments performed by many different people. Scientific laws describe but do not explain an observed phenomenon. An example of a scientific law is the *law of gravity*. Scientific theories address more complex topics. An example of a scientific theory is the *theory of plate tectonics*. Scientific laws and theories are always being tested by experiments.



VOCABULARY

scientific law - a statement that describes an observed phenomenon; it is supported by evidence collected from many observations and experiments.

scientific theory - a statement that explains a complex idea; it is supported by evidence collected from many experiments.

What is the law of gravity?

The law of gravity states that objects attract other objects. Your pencil falls to the ground when you drop it because the mass of the pencil and the mass of Earth attract each other!

What is plate tectonics?

The surface of Earth is broken into many pieces like a giant jigsaw puzzle. These pieces are called tectonic plates. The graphic in the text (left) illustrates the location of the plates on Earth's surface.

The theory of plate tectonics describes how the plates move on Earth's surface. You'll learn about plate tectonics in Unit 3.

1.3 Section Review

1. Are you a scientist? The answer is yes! Each day you do things that are related to investigating the world in a scientific way. Write down activities that you did today that answer the questions in the table below.

	What did you do today?
What observations did you make?	
What questions did you ask?	
What problems did you solve?	
Did you make a hypothesis? If so, what was it?	
Did you perform an experiment and collect data? What data did you collect?	
What conclusions did you make today?	

2. Give an example of a scientific fact about the human body.
3. Give an example of an inference. Use your experiences from your favorite subject in school to come up with an inference.
4. You see small yellow flowers on a tomato plant. You also see that bees are attracted to these flowers. In a few weeks, you notice that the tomato plant has red tomatoes. What can you infer from this scenario?
5. Give an example of a question that you would like to answer by doing an experiment. State a hypothesis for your question.
6. What is the difference between a scientific fact and a scientific theory?
7. A very famous and important scientific law is the law of gravity. What is gravity? Do a test to see if gravity exists.

CHALLENGE

Before scientists accepted the theory of plate tectonics, another scientist, Alfred Wegener, proposed the idea of *continental drift.* This idea stated that continents like Africa and South America were once connected. The idea also stated that the continents pushed through the ocean floor when they moved apart.

Use the Internet or reference books to find out why continental drift was not accepted by scientists. Or you can read ahead to Unit 3!

GEOLOGY CONNECTION

Dr. Rosaly Lopes—Volcano Scientist

What is it that you love? Playing baseball? Video games? Math? Spelling? Drama club? Singing? In-line skating? Volcanoes? Volcanoes! That just happens to be Rosaly Lopes's passion. She is a planetary volcanologist who searches for and studies volcanoes on Earth and elsewhere in the solar system. And at the National Aeronautic and Space Administration's Jet Propulsion Laboratory in Pasadena, California, she is considered an expert.

Dr. Rosaly Lopes standing on the Pu'u O'o eruption of the Kilauea volcano on Hawaii's Big Island.

Rosaly Lopes was born in Brazil and dreamed of being a scientist. As a child, she was fascinated by the study of space and the areas beyond Earth. At 18, she went to study astronomy at the University of London. Her original goal was to be an astronaut, but she found herself greatly influenced by a geology teacher who had visited Mount Etna, Europe's largest volcano, on the Italian island of Sicily. Lopes got hooked on the idea of traveling the world to study volcanoes.

She went on at the university to receive her doctorate degree in planetary geology and volcanology. In 1979, she found herself on Sicily doing fieldwork when Mount Etna erupted, killing several people. The experience taught her to truly appreciate and respect the power of volcanoes.

Thinking scientifically

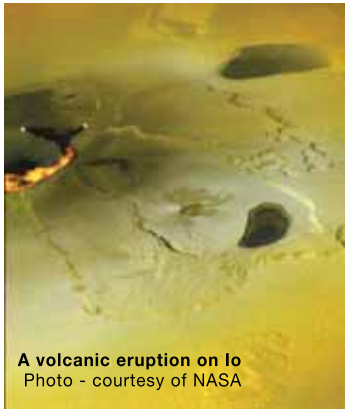
Like most scientists, Dr. Lopes follows the scientific method in her research. The first step is to ask questions. For example, why are volcanoes important to understand? Scientists study volcanoes on Earth in the hope of being able to predict eruptions. Millions of people live near volcanoes. Their eruptions can cause great harm to local communities and the wider region. A volcano's eruption can cause climate changes and affects not only people, but also plants and animals.

Volcanoes are an important feature on Earth and other planets. Our planet has the most volcanoes in the solar system. Yet for Dr. Lopes, studying volcanoes on Earth was not enough. She recognized that by studying volcanoes on other planets, she could ask even more questions, and different kinds of questions. Meaningful questions can lead to a better understanding of the universe in which we live.

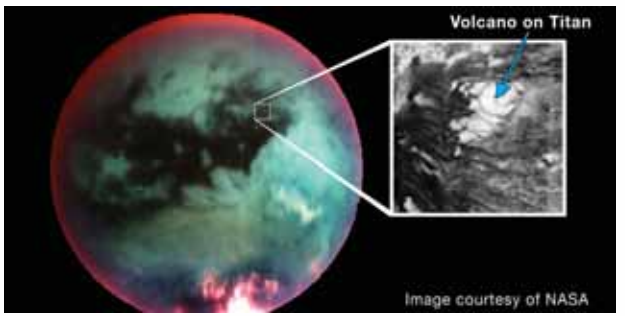
Mt. Etna, Sicily, Italy

Gathering data

On Earth, a lot of volcanic data is gathered by using satellites and aircraft. In space, volcanoes are studied mostly by using spacecraft, satellites, and radar images. NASA's Galileo mission to Jupiter provided information about that planet's moon Io. Dr. Lopes learned that the lava temperature on Io is nearly 2600 degrees Fahrenheit. She was amazed because this is almost 500 degrees hotter than lava here on Earth.


A volcanic eruption on Io
Photo - courtesy of NASA

Today, NASA's Cassini mission is gathering information about Saturn's largest moon, Titan. Dr. Lopes has learned that Titan has cold volcanoes with lava that is a slushy mixture of water, ice, and ammonia.



Presenting data

Scientists communicate their findings in many ways. Dr. Lopes writes papers that are published in scientific journals. She gives talks at scientific meetings. An important part of her job is speaking to the public and she often presents seminars at universities and astronomy clubs.

Television and books are ways to reach an even wider public. Dr. Lopes has appeared on the Discovery Channel and ABC News Nightline. She has filmed a program with National Geographic. She has written "The Volcano Adventure Guide" (Cambridge University Press, 2005) to advise people who want to safely explore some of the most famous volcanoes on Earth and explorers who may never get any closer to a volcano than in the pages of her book.

A record-breaking mom

Stop and think about what you could do to get in the Guinness World Records. Hop on one foot for a long time? Eat a lot of pies? What do you think Dr. Lopes did to get into the Guinness book?

She (not surprisingly) discovered volcanoes. Lopes's discovery of 71 active volcanoes on Io—which is about 500 million miles away from her Pasadena lab—is a world record. Her son thinks it is great to have his mom in the Guinness World Records.

When asked what is "the best part of her work," Dr. Lopes says: "The knowledge that I am exploring new places and seeing places that nobody has seen before. The thrill of discovery drives many of us scientists. It is not always a 'Wow, look at that,' though there is certainly plenty of that. Often discovery is the painstaking analysis of data, not unlike a detective unraveling a mystery."

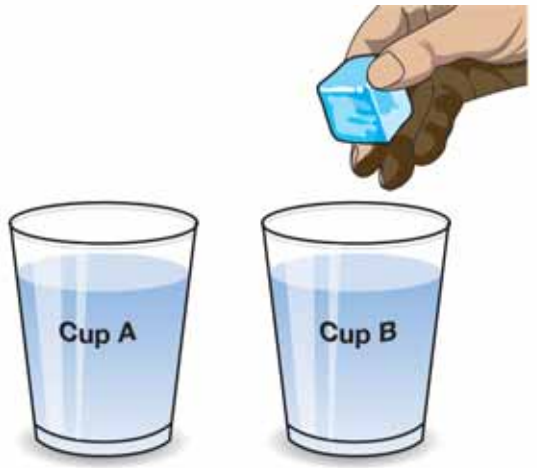
Questions:

1. Why do scientists like Dr. Lopes study volcanoes?
2. How are volcanoes on Earth studied, compared with volcanoes on the other planets?
3. How does Dr. Lopes communicate her findings?
4. List the roles that Dr. Lopes has in her life.

CHAPTER ACTIVITY Observing The World Around You

One thing that all scientists have in common is that they make countless numbers of observations in their work. In order to be a scientist, you must practice the skill of making observations. It is a good idea to leave space for writing observations in your lab notebook.

During this activity, you will be asked to make as many observations as you can of what your teacher does in front of the classroom. The classroom needs to be silent so that all students can concentrate and be the best scientists they can be!



Procedure

1. Make a table like the one on this page on a separate sheet of paper.
2. There are two cups in front of the room, labeled A and B. There is a liquid in each of the cups. Write down your observations about these two liquids in the first row of your table. These are your initial observations before your teacher has conducted tests.
3. Now, your teacher will begin a series of tests on each of the liquids.
4. For each test, record your observations in the correct column. In the column labeled cup A, write observations about cup A. In the column labeled cup B, write observations about cup B.
5. Share your observations as a class. Your teacher will write all observations on the board.

	Observations	
Events conducted by the teacher	**Cup A**	**Cup B**
Initial observations (before any tests)		
Test 1		
Test 2		
Test 3		

Questions

a. How many senses did you use when making observations? Which sense/senses did you use the most?
b. How successful were you at making observations? What was your biggest problem?
c. What is the difference between an observation and an inference?
d. What are some inferences you could come up with about the various tests that were done in this experiment?
e. Was the liquid in cup A the same as the liquid in cup B? Explain your answer.

Chapter 1 Assessment

Vocabulary

Select the correct term to complete the sentences.

science	data	experiment
inference	scientific method	scientific theory
hypothesis	scientific law	

Section 1.1

1. You look up at the sky and see dark clouds. You predict that it might rain. A statement like this based on experience is called a(n) _____.
2. _____ is a process for answering questions. Astronomy is an example. Astronomy is a process for answering questions about stars and planets.
3. A(n) _____ is a predicted answer to a question based on observations. It must be testable and isn't always correct.
4. _____ are information that is collected in order to answer a question.
5. The _____ is a series of steps including observation, forming a question, stating a hypothesis, collecting data, and reaching a conclusion.
6. If you want to prove or disprove a hypothesis, you perform a(n) _____.

Section 1.2

There are no glossary words in this section.

Section 1.3

7. A(n) _____ is a statement that explains a complex idea such as a process for how Earth's surface has changed over time.
8. A(n) _____ is a statement that describes an observed phenomenon such as why an object falls when you drop it.

Concepts

Section 1.1

1. In the morning, you see a full glass of water on the kitchen table. By nighttime, the glass is almost empty. Is this statement a hypothesis or an observation?
2. In the morning, a jar is filled with water. By the afternoon the water level is lower. You propose that the water level has gone down because it was evaporated by the sun. Is this statement a hypothesis or an observation?
3. What are the different types of data that scientists collect during experiments? Give an example of each type of data.
4. Why is it important to perform many experiments?
5. Write a short paragraph that describes two characteristics that are important for a scientist to have.

Section 1.2

6. You are a judge at a contest to pick the best cake. Which senses do you use for making your observations? Explain how each sense that you list would be useful.
7. How is an observation different from an opinion? Give an example of an observation and an opinion.
8. What information should be recorded in a science notebook? Explain why each thing is important.

Section 1.3

9. Identify each statement as an observation or inference. If a statement is an inference, write an observation on which it may be based. If a statement is an observation, write an inference based on that observation.
   a. John is wearing red.
   b. The students will work hard during class tomorrow.
   c. It is going to be hot and humid tomorrow.
   d. Katie is smiling.

10. You observe that the plant in the window is turning brown. State a hypothesis to answer the question: Why is the plant in the window turning brown? Explain how you could test your hypothesis.
11. What do these three terms have in common: scientific fact, scientific law, and scientific theory?

Math and Writing Skills

Section 1.1

1. Choose two things that you do every day and explain how science relates to these things.
2. Write a paragraph about a famous scientist or a scientist whom you may know! In what field of science does this person work? How are you similar to this person?
3. In Section 1.1, you will find a bird's eye view of the erupting Colima volcano. This image shows what the volcano looks like if you were flying above it (like a bird). Draw a sketch that shows what this volcano might look like from the side.

Section 1.2

4. Write a story about a nature experience you have had at school, home, or on a trip. After you have written your story, list three observations and three opinions in your story.
5. Choose an interesting object from your home and gather measuring tools (such as a ruler, scale, and a calculator).
   a. Observe the object for 5 minutes. Write down everything you observe.
   b. Then, spend 5 minutes making measurements and recording those.

Section 1.3

6. Pretend you are Sam from Section 1.3. Write up a lab report based on the experiment he did.
7. Make an observation about something that happens in your classroom often. Formulate a hypothesis about why this thing or event happens. Design an experiment to test your hypothesis.
8. The text describes the law of gravity in words. What is the law of gravity in terms of a formula. See if you can find out the answer to this question by looking through resources including text books, the Internet, or in your school library. The complete name (to help you with your research) is the *Universal Law of Gravitation*.

Chapter Project—Observing Nature

Pick anything in nature at or outside your home. You may choose to observe the sunset, a tree, a garden, or even soil. There are countless things in nature that you can observe! Your teacher will approve your choice before you begin. Observe your piece of nature for 10 minutes every day for one week. Without stating what the object is, record all observations in your science notebook as words and drawings. Also, write down any questions you have throughout the observation period.

After you have collected your observations choose one of the questions you had, and answer it. You will need to use evidence from all of your observations to form inferences and opinions. Also, make predictions (based on your observations) about what will happen to that piece of nature over the next couple of months.

At the end of the week, bring your notebook of observations to class. Your teacher will collect your observations and redistribute them to other students. You will look at five other students' notebooks, and see if you can guess what other students have observed!