Video Preview
Discovery Channel School
Mapping Earth's Surface

Focus on the
BIG Idea

S 6.7.f

What is one main source of energy for Earth's natural processes and living things?

Check What You Know

A flashlight beam and a ball can model how sunlight strikes Earth. Sunlight strikes Earth's equator directly. But sunlight is more spread out where it strikes Earth's polar regions. Explain how this uneven distribution of the sun's energy affects Earth's atmosphere and oceans.

Build Science Vocabulary

The images shown here represent some of the key terms in this chapter. You can use this vocabulary skill to help you understand the meaning of some key terms in this chapter.

Vocabulary Skill

High-Use Academic Words

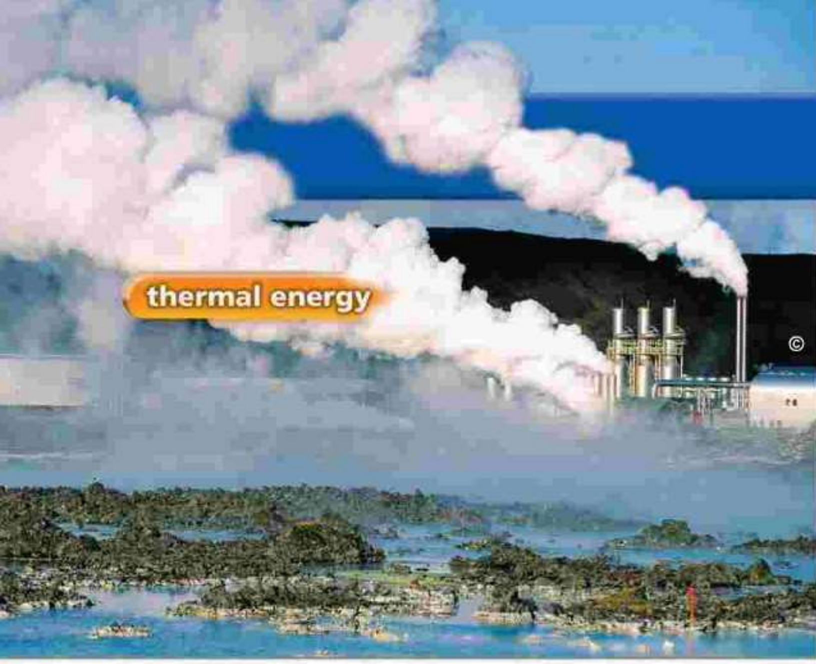
High-use words are words that are used frequently in academic reading, writing, and discussions. These words are different from key terms because they appear in many subject areas.

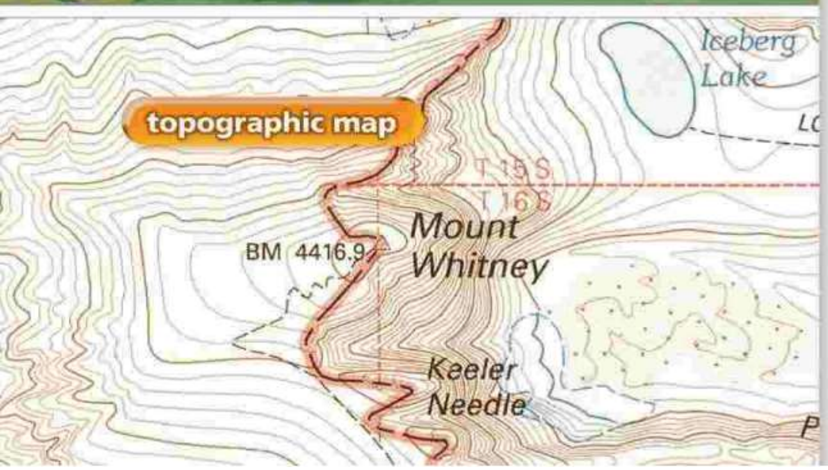
Word	Definition	Example Sentence
area (EHR ee uh) p. 21	*n.* A particular part of a place or surface	In what <u>area</u> of the city is your school located?
factor (FAK tur) p. 9	*n.* A fact to be considered	In a race, one <u>factor</u> to think about is the distance you will run.
occur (uh KUR) p. 37	*v.* To take place; to happen	The scientist predicted that an earthquake might <u>occur</u> at the site.

Apply It!

Choose the word from the table that best completes the sentence.

1. Keep your work _______ clean and safe during a laboratory experiment.
2. Accidents sometimes _______ in a science laboratory.
3. Price is a(n) _______ to be considered in buying baseball tickets.





Chapter 1 Vocabulary

Section 1 (page 6)

science
observing
inferring
predicting
scientific inquiry
hypothesis
controlled experiment
variable
manipulated variable
responding variable
data
scientific theory

Section 2 (page 13)

energy
atmosphere
hydrosphere
lithosphere
biosphere
matter
wave
heat
thermal energy
Earth science

Section 3 (page 21)

topography
elevation
relief
plain
mountain
plateau
map
scale
degree
latitude
longitude

Section 4 (page 28)

topographic map
contour line
contour interval
index contour

Interactive Textbook

Build Science Vocabulary *Online*

Use interactive flashcards

How to Read Science

Reading Skill

Preview Text Structure

The information in this science textbook is organized with red headings and blue subheadings. Before you read, preview each red and blue heading and ask a question to guide you as you read the topic.

Here are some tips.

- Write the heading in column 1.
- Look for key words in the heading to guide you in asking a question.
- Write your question in column 2.
- After you read, answer your question in a complete sentence.

Section 1: What Is Science?		
Heading	**Question**	**Answer**
Thinking Like a Scientist	What thinking skills do scientists use to learn about the natural world?	Scientists use the skills of observing, inferring, and predicting when learning about the natural world.

Apply It!

In Section 2, review the red heading Energy Transfer: A Big Idea. In your notebook, create a graphic organizer like the one above.

1. What question would you ask about the content under this red heading?
2. What question would you ask about the blue subheading Waves?

After you read Section 2, create a graphic organizer for The Structure of the Earth System. Before you read Section 4, create a graphic organizer to preview the headings.

Lab zone

Standards Investigation

S 6.7.f

Getting on the Map

For this investigation, you will select a small piece of land and draw a map of its physical features.

Your Goal

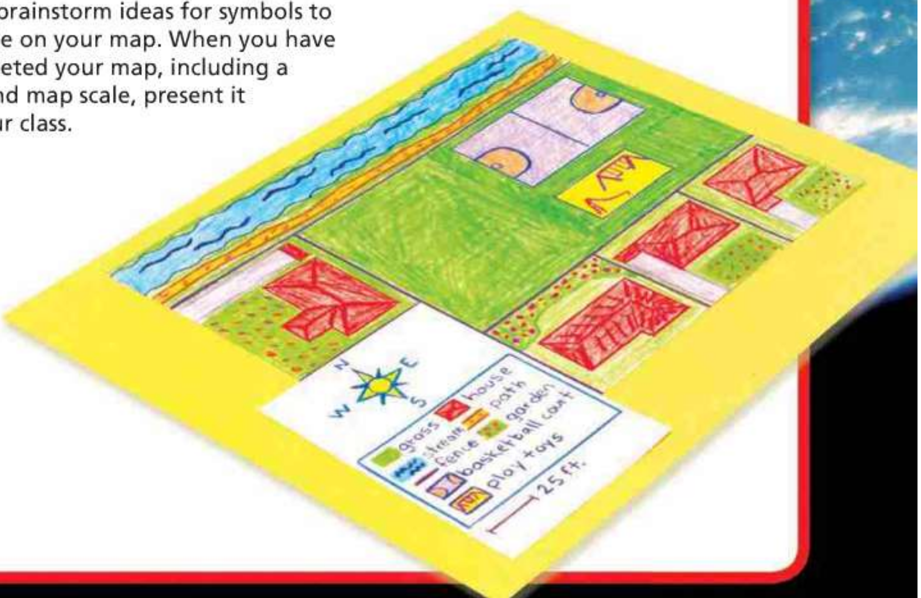
To create a scale map of a small area of your neighborhood

To complete this investigation, you must

- work with your teacher or an adult family member
- choose and measure a small square piece of land
- use a compass to locate north
- draw a map to scale
- use symbols and a key to represent natural and human-made features of the land
- follow the safety guidelines in Appendix A

Plan It!

Start by looking for a suitable site. Your site should be about 300 to 1,000 square meters in area. It could be part of a park, playground, or backyard. Look for an area that includes interesting natural features such as trees, a stream, and changes in elevation. There may be some human-made structures on your site, such as a park bench or sidewalk. Once you have chosen a site, measure its boundaries and sketch its physical features. Then brainstorm ideas for symbols to include on your map. When you have completed your map, including a key and map scale, present it to your class.



Section 1

What Is Science?

CALIFORNIA Standards Focus

S 6.7 Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

a. Develop a hypothesis.

c. Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.

- What skills do scientists use?
- What is scientific inquiry?
- How do scientific theories differ from scientific laws?

Key Terms

- science
- observing
- inferring
- predicting
- scientific inquiry
- hypothesis
- controlled experiment
- variable
- manipulated variable
- responding variable
- data
- scientific theory

Lab zone Standards Warm-Up

How Can Scientists Find Out What's Inside Earth?

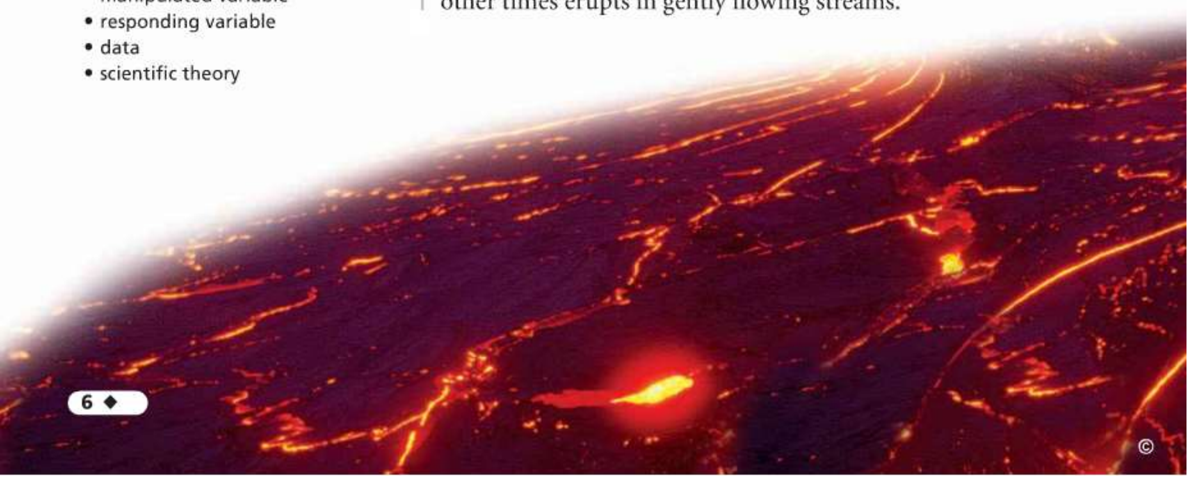
1. Your teacher will give you a spherical object, such as a sports ball. You can think of the sphere as a model of Earth.
2. Carefully observe your sphere. What characteristics of the sphere can you observe and measure directly?
3. What characteristics of the sphere cannot be directly observed and measured?

Think It Over

Posing Questions In your notebook, list several questions that you have about Earth. Which of these questions could you answer based on direct observation? Which questions would need to be answered based on indirect evidence?

A helicopter lands near the top of an erupting volcano. With care and speed, a team of scientists get out to do their work. "I've been out there sometimes when lava is shooting out of the ground 100 meters high," says Margaret Mangan, a scientist who studies volcanoes. "The main thing you're struck with is the sound. It's like the roaring of many jet engines. Then there's the smell of sulfur, which is choking. The wind can blow particles from the lava fountain over you, little bits of congealed lava. It feels like a hot sandstorm."

Dr. Mangan has observed many volcanic eruptions of Mount Kilauea in Hawaii. She studies the red-hot lava. She wants to know why lava sometimes erupts in huge fountains, but at other times erupts in gently flowing streams.



Thinking Like a Scientist

Watching a volcanic eruption, you might ask yourself questions such as: "What is lava?" and "Where does lava form?" In asking these questions, you are thinking like a scientist—a person who uses science to explore problems and answer questions about the natural world. **Science** is a way of learning about the natural world. Science is also the knowledge gained through that process. **As scientists seek to understand the natural world, they use skills such as observing, inferring, and predicting.**

FIGURE 1
Observing Volcanic Eruptions
Margaret Mangan studies samples of lava from Mount Kilauea, Hawaii.
Forming Operational Definitions
Based on the photograph, how would you define lava?

Observing Using one or more of your senses to gather information is **observing.** Your senses include sight, hearing, touch, taste, and smell. For example, Dr. Mangan not only saw lava erupting, but she heard the noise it makes, smelled volcanic gases, and felt the lava's heat.

Inferring When you explain or interpret the things you observe, you are **inferring,** or making an inference. Making an inference doesn't mean guessing wildly. An inference is based on reasoning from what you already know. For example, Margaret Mangan inferred that differences in the gas content of the lava result in different types of eruptions. But inferences are not always correct. There could be other factors that affect the strength of a volcanic eruption.

Predicting If Dr. Mangan's inferences are correct, her results may help scientists predict whether a volcanic eruption will be strong or gentle. **Predicting** means making a forecast of what will happen in the future based on past experience or evidence.

Reading Checkpoint **What is a prediction?**

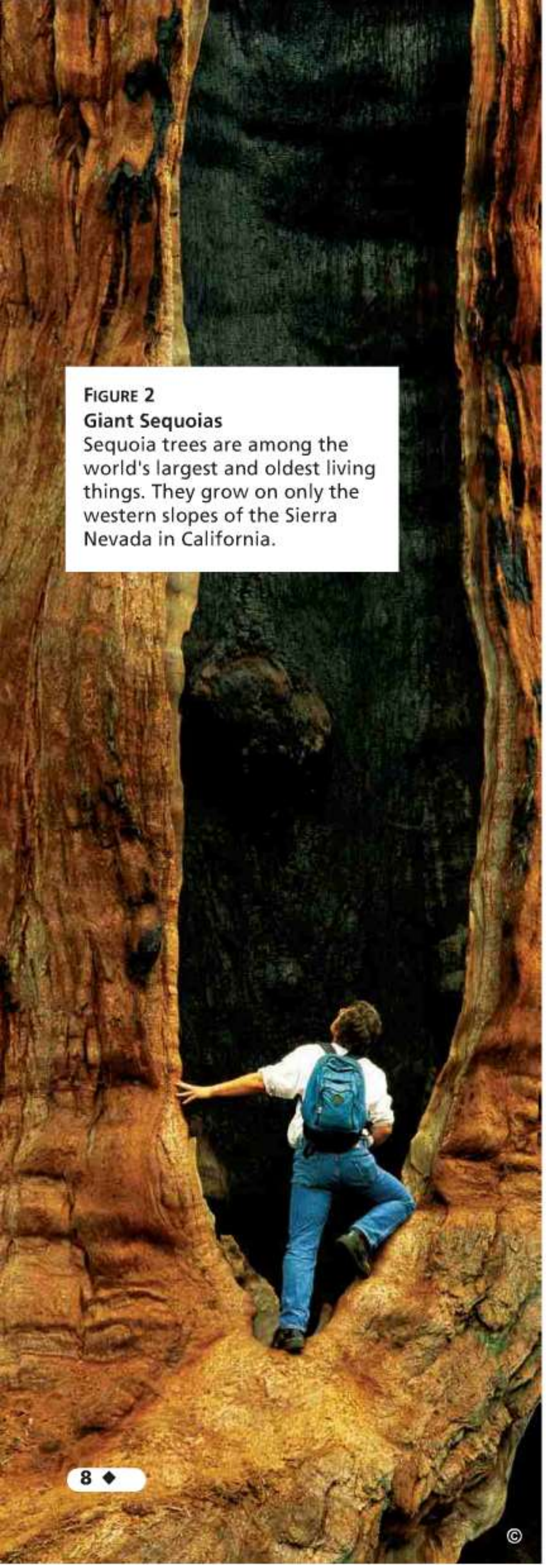


FIGURE 2
Giant Sequoias
Sequoia trees are among the world's largest and oldest living things. They grow on only the western slopes of the Sierra Nevada in California.

Scientific Inquiry

Asking questions about what you observe is the start of **scientific inquiry**. **Scientific inquiry refers to the many ways in which scientists study the natural world and propose explanations based on the evidence they gather.**

Posing Questions Scientific inquiry often begins with a problem or question about an observation. The questions may come from observations and inferences that you make, or just from curiosity. For example, scientists studying giant sequoia (sih KWOY uh) trees made an observation. They noticed that very few sequoia seedlings grew inside Sequoia National Park.

The scientists knew that these sequoias, shown in Figure 2, have been mostly protected from fire for more than 100 years. They also knew that sequoia seeds require fire in order to sprout. In the past, natural fires regularly burned in the sequoia groves. These fires did not kill the largest trees, but opened spaces between them. The fires also exposed bare soil. When seeds fell from cones in the remaining trees, the seeds could grow where they had sunlight and nutrients.

The scientists asked: What intensity, or strength, of fire would produce the greatest increase in sequoia seedlings? The answer to this question would help improve the use of controlled burns to get more seeds to sprout. A controlled burn is a fire that is set within a limited area to manage a forest.

Developing a Hypothesis The scientists' question about sequoia seedlings and fire can be stated as a hypothesis: The intensity of fires in sequoia groves affects the number of sequoia seedlings. A **hypothesis** (plural: *hypotheses*) is a possible explanation for a set of observations or answer to a scientific question. Hypotheses lead to predictions that can be tested. This means that scientists must be able to carry out investigations and gather evidence that will either support or disprove the hypothesis.

Designing an Experiment The scientists studying giant sequoias designed an experiment to test their hypothesis about fire and sequoia seedlings. They selected several sites where the National Park Service had used controlled burns. They compared these sites with similar sites that had not burned in more than 50 years. They rated each burned area according to the intensity of the burn. They also counted sequoia seedlings within a certain distance of mature sequoia trees in all the sites.

This experiment tested the scientists' hypothesis. A **controlled experiment** is a test of a hypothesis under conditions established by the scientist. In a controlled experiment, a scientist determines how one particular variable affects the outcome of the experiment. A **variable** is one of the factors that can change in an experiment. For example, in the experiment involving the sequoias, burn intensity was the variable that determined the outcome of the experiment.

In an experiment, the variable that a scientist changes is called the **manipulated variable.** The variable that changes because of the manipulated variable is the **responding variable**. In the sequoia experiment, the manipulated variable is burn intensity. The responding variable is the growth of sequoia seedlings. In a controlled experiment, scientists control, or keep constant, all other variables. By controlling variables, scientists can eliminate the effects of the other variables as factors in their results.

Reading Checkpoint **What is a variable?**

Lab zone Skills Activity

Controlling Variables

Suppose you are a scientist designing an experiment involving sequoia seedlings. You want to determine whether the seedlings grow better in ordinary forest soil or in soil covered with ash from a recent fire. What is your manipulated variable? What is your responding variable? What other variables would you need to control?

FIGURE 3
Controlled Burns
Scientists try to imitate the natural pattern of fires in sequoia groves by a program of carefully controlled burns.
Applying Concepts *What was the manipulated variable in the sequoia experiment? Explain.*

FIGURE 4
Sequoia Seedlings and Cones
After a fire, sequoia seeds can sprout and grow on the forest floor.

Collecting and Interpreting Data If you wanted to investigate the weather in your area, you would need to collect data. **Data** are the facts, figures, and other evidence gathered through observations. A data table provides an organized way to collect and record observations.

After all the data have been collected, they need to be interpreted. One useful tool that can help you interpret data is a graph. Graphs like the one in the Analyzing Data feature on this page can reveal patterns or trends in data.

In the sequoia experiment, the scientists' data were their observations of the effects of fires and of the numbers of sequoia seedlings. They interpreted these data by relating the number of seedlings to the different levels of fire intensity. The graph in the Analyzing Data feature below summarizes the scientists' observations.

Drawing Conclusions After you have gathered and interpreted your data, you can draw a conclusion about your hypothesis. A conclusion is a decision about how to interpret what you have learned from an experiment. You may decide that the data support the hypothesis. Or you may decide that the data show that the hypothesis was incorrect. Sometimes, no conclusion can be reached and more data are needed.

The scientists decided that their data showed that more seedlings sprouted around the sequoia trees after the more intense fires. Therefore, they concluded that their hypothesis was correct.

Reading Checkpoint **What is a conclusion?**

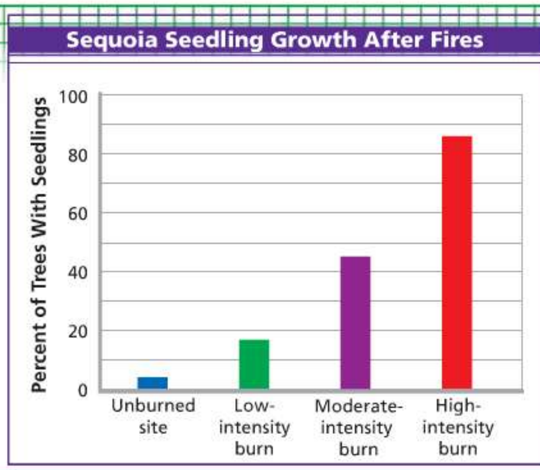
Mathematical Reasoning 6.2.4

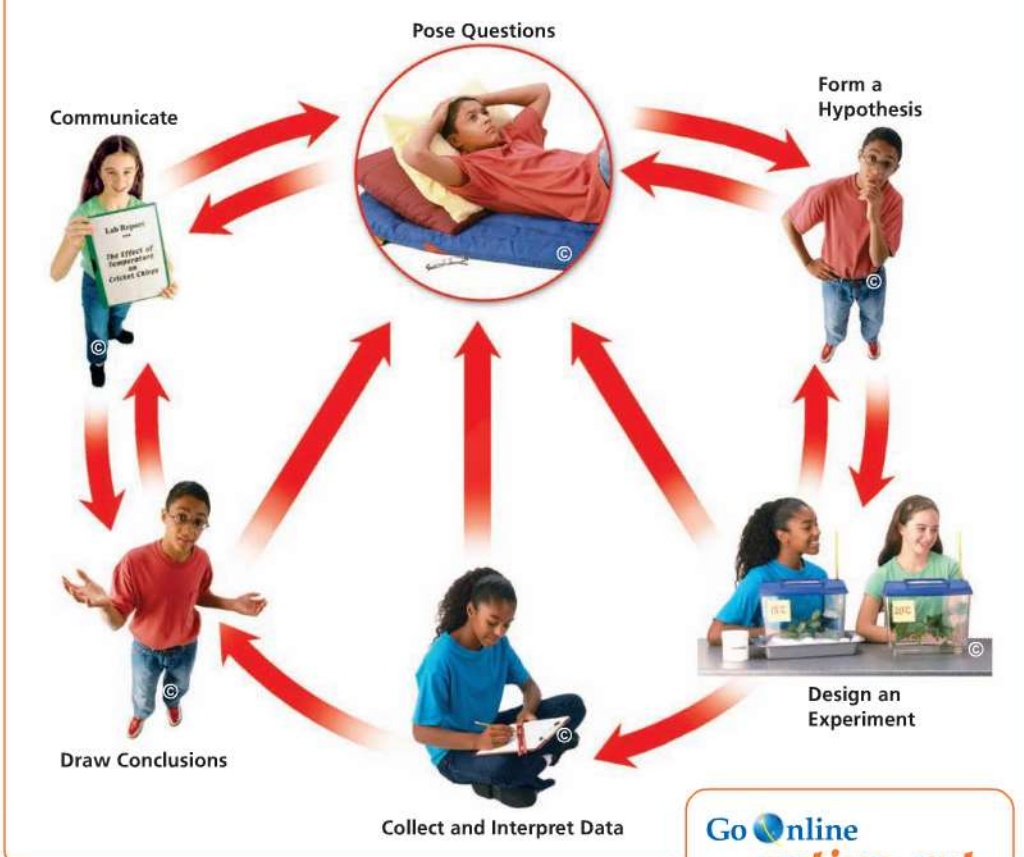
Math Analyzing Data

Sequoias and Fire

The graph shows the growth of sequoia seedlings in relation to the intensity of controlled burns. Use the graph to answer the questions.

1. **Reading Graphs** What do the bars on the graph represent?
2. **Reading Graphs** What does the height of each bar represent?
3. **Interpreting Data** Which level of burn intensity led to the most seedling production? The least seedling production?





Communicating An important part of scientific inquiry is communicating the results. Communicating is the sharing of ideas and experimental findings with others through writing and speaking. Scientists share their ideas in many ways. For example, they give talks at scientific meetings, exchange information on the Internet, or publish articles in scientific journals.

The scientists involved in the study of sequoias and fire presented their findings at a meeting of scientists and in a book. That made their results available to other scientists and to those who manage California's giant sequoias.

Posing New Questions Even after you have drawn a conclusion from one experiment, scientific inquiry usually doesn't end. Other scientists may repeat the experiment to determine if its results were correct. Often, the results of an experiment suggest new questions. These new questions can lead to new hypotheses.

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FIGURE 5
The Nature of Inquiry
Observations at any stage of a scientific inquiry may lead you to change your hypothesis or experiment. **Applying Concepts** *Why is observation important during scientific inquiry?*

FIGURE 6
Law of Gravity
The force of gravity pulls the water in this waterfall toward Earth's center.

Scientific Theories and Laws

As scientists study the natural world, they develop concepts that explain their observations. These concepts are called scientific theories. A **scientific theory** is a well-tested scientific concept that explains a wide range of observations. An accepted theory has withstood repeated tests. But if tests fail to support a theory, scientists change the theory or abandon it.

When scientists repeatedly observe the same result in specific circumstances, they may arrive at a scientific law. **Unlike a theory, a scientific law describes an observed pattern in nature, but does not provide an explanation for it.** A scientific law is a statement that describes what scientists expect to happen every time under a particular set of conditions. For example, the law of gravity states that the force of gravity acts between all objects in the universe. As a result of gravity, any two objects in the universe attract each other. Scientists have repeatedly tested this law and found it to be true.

Reading Checkpoint What is a scientific law?

Section 1 Assessment

S 6.7.a, 6.7.c E-LA: Reading 6.1.0, Writing 6.2.0

Vocabulary Skill **High-Use Academic Words** In a complete sentence, explain what happens in a controlled experiment. Use the word *factor* in your explanation.

Reviewing Key Concepts

HINT
HINT
HINT
HINT
HINT
HINT

1. a. **Reviewing** What is science?
   b. **Explaining** Explain three main skills that scientists use.
   c. **Applying Concepts** Can you make an inference without having made any observations? Explain your answer.
2. a. **Defining** Define the term *scientific inquiry*.
   b. **Explaining** You may have heard the saying "Red sky at morning, sailors take warning." This means that stormy weather may follow if the sky looks red at sunrise. Could you test this using scientific inquiry? Explain.
   c. **Problem Solving** To determine whether the saying in part (b) is true, what kinds of data would you need to collect?
3. a. **Defining** What is a scientific theory? What is a scientific law?
   b. **Comparing and Contrasting** How do scientific theories differ from scientific laws?

HINT
HINT

Writing in Science

Volcano Inquiry Look at the photograph in Figure 1. With a partner, think of a question about volcanoes that you would like to answer. Write your question in your notebook. List anything you already know about the topic of your question that might help you answer it. Then state your question as a hypothesis.

Section 2

Studying Earth

CALIFORNIA Standards Focus

S 6.3.a Students know energy can be carried from one place to another by heat flow or by waves, including water, light and sound waves, or by moving objects.

S 6.4.a Students know the sun is the major source of energy for phenomena on Earth's surface; it powers winds, ocean currents, and the water cycle.

- What are the parts of the Earth system?
- How is energy transferred in the Earth system?
- What are the branches of Earth science?

Key Terms

- energy
- atmosphere
- hydrosphere
- lithosphere
- biosphere
- matter
- wave
- heat
- thermal energy
- Earth science

Lab zone **Standards Warm-Up**

What Is the Source of Earth's Energy?

1. Pour 100 mL of tap water into a clear plastic jar and tighten the lid.
2. Place the jar in the sun for 10 minutes.
3. Move the jar to a shaded location and wait several minutes
4. Observe the sides of the jar. What do you see?

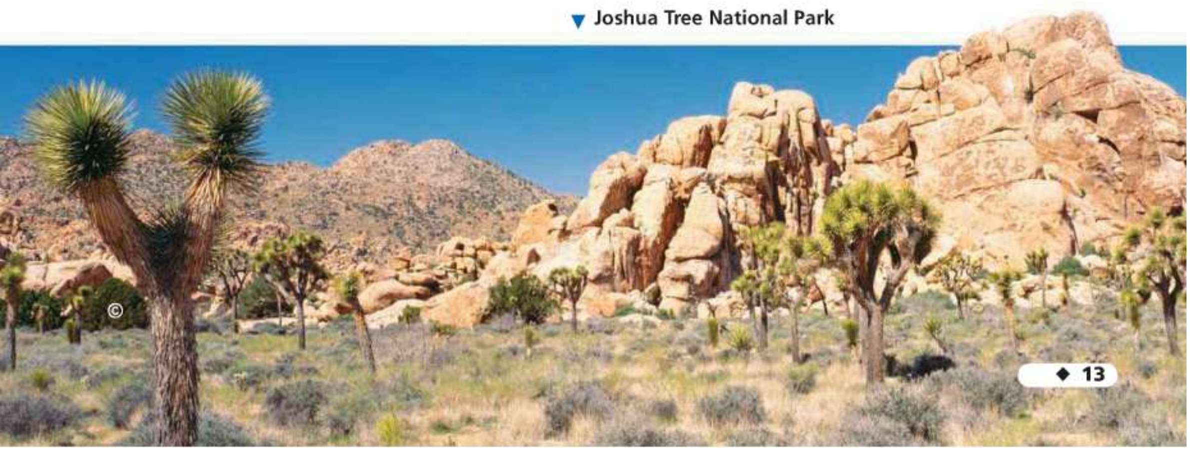
Think It Over

Inferring What can you infer about the energy source for the changes you observed in the bottle? Explain how the bottle could serve as model of Earth's ocean and atmosphere.

Joshua Tree National Park, in California's Mojave Desert, is a popular spot for people who enjoy the outdoors. If you visit the park, you can take a nature trail to observe desert animals and wildflowers. You can also ride a mountain bike past cactuses and Joshua trees, or explore huge granite boulders. But whatever you do, be sure to apply sunblock, wear a hat, and drink plenty of water!

When you get thirsty, you can pause in the cool shade of a boulder for a drink of water. But when you step out of the shade into the bright sun, your skin feels warm right away. You may wonder why you feel warmer in the sun than in the shade. To understand this, you need to know how sunlight is related to the concept of energy.

▼ Joshua Tree National Park



The Structure of the Earth System

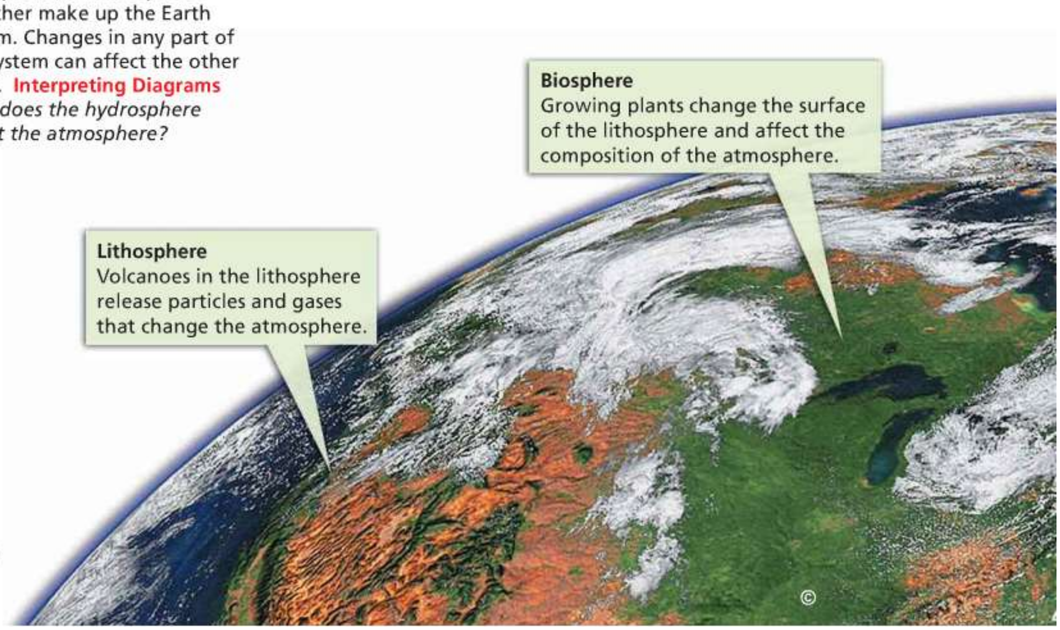
Sunlight heats up any surface it strikes, including your skin, because it is a form of energy. **Energy** is the ability to do work, or cause change. Energy from the sun is transferred to Earth as radiation, a form of energy that can move through space. When you stepped out of the shade, the sun's radiation hit you directly. That's why you felt warmer.

Every second, the sun's radiation transfers a huge amount of energy to Earth. Sunlight provides energy for many processes on Earth. For example, in the water cycle, water moves from the oceans, to the atmosphere, to the land, and back to the oceans. The sun provides the energy for the water cycle.

Earth as a System Although the sun is millions of kilometers away, it affects everything on Earth's surface. The sun is part of a system that includes Earth's air, water, land, and living things. A system is a group of parts that work together as a whole. As in the water cycle, a change in one part of the Earth system affects other parts of the system.

The Earth system has four main parts, or "spheres": the atmosphere, hydrosphere, lithosphere, and biosphere. As one source of energy for processes on Earth, the sun can also be considered part of the Earth system. Figure 7 shows some of the ways in which parts of the Earth system affect each other.

FIGURE 7
Earth as a System
The atmosphere, hydrosphere, lithosphere, and biosphere together make up the Earth system. Changes in any part of the system can affect the other parts. **Interpreting Diagrams** *How does the hydrosphere affect the atmosphere?*



Atmosphere The outermost sphere is the **atmosphere** (AT muh sfeer), the mixture of gases that surrounds the planet. By far the most abundant gases are nitrogen and oxygen, but the atmosphere also contains water vapor, carbon dioxide, and other gases.

Hydrosphere Earth's oceans, lakes, rivers, and ice form the **hydrosphere** (HY druh sfeer). Most of the hydrosphere consists of the salt water in the oceans, but fresh water is also part of the hydrosphere. Oceans cover more than two thirds of Earth.

Lithosphere Earth's solid, rocky outer layer is called the **lithosphere** (LITH uh sfeer). The lithosphere is made up of the continents as well as smaller landmasses called islands. The lithosphere extends under the entire ocean floor. The surface of the lithosphere varies from smooth plains to wrinkled hills and valleys to jagged mountain peaks.

The energy for some processes that shape the lithosphere comes from the heat of Earth's interior. For example, deep inside Earth, some rock melts, forming the lava that erupts from volcanoes.

Biosphere All living things—whether in the air, in the oceans or on and beneath the land surface—make up the **biosphere** (BY uh sfeer). The biosphere extends into each of the other three spheres.

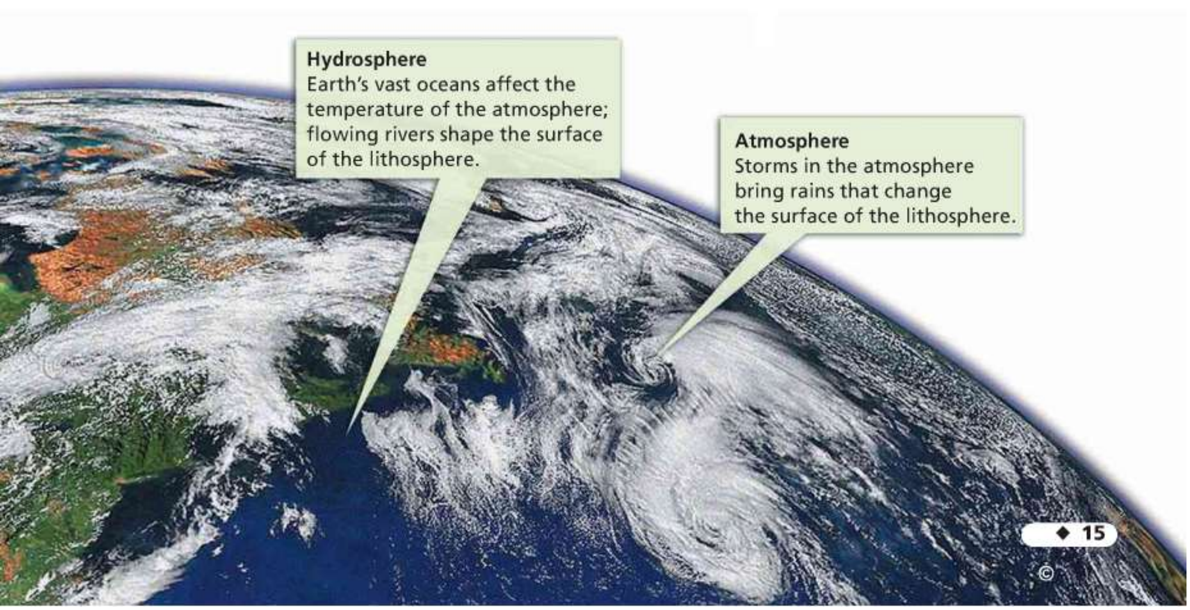
Reading Checkpoint What is the biosphere?

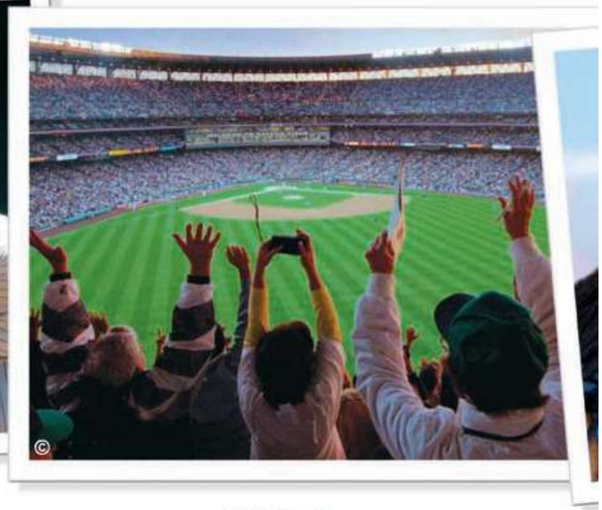
Lab zone Skills Activity

Classifying

Classify each of the events below according to which parts of the Earth system are involved in the event.

1. Heavy rain washes soil and rocks down a hillside.
2. Fog forms above a lake before dawn and then "burns off" after the sun rises.
3. The roots of a tree absorb water and nutrients from the soil.





Moving Objects ▲
A moving object such as this baseball transfers energy from the pitcher's arm to the catcher—or the hitter's bat.

Waves ▲
When the fans cheer, sound waves transfer energy as they move through the air.

FIGURE 8
Energy Transfer
The different forms of energy transfer occur around us constantly—even at a baseball game.
Applying Concepts *What type of energy transfer is involved when ice cream melts?*

Energy Transfer: A Big Idea

Matter and energy constantly move from one part of the Earth system to another. **Matter** is what makes up everything in the universe. Matter is made up of tiny particles called atoms. Two or more atoms that are joined and act as a unit make up a molecule. For example, a water molecule consists of two hydrogen atoms and one oxygen atom.

The movement of matter cannot occur without energy transfer. Energy transfer is the movement of energy from one location to another. **Energy can be transferred from place to place by moving objects, by waves, or by heat flow.**

Moving Objects Any moving object or particle transfers energy. When a pitcher throws a baseball, the baseball carries energy with it from the pitcher to the catcher. Many types of motion in Earth's systems transfer energy in this way. For example, wind and flowing water transfer energy through the movement of particles.

Waves Energy can also be transferred by waves. A **wave** is an up-and-down or back-and-forth motion that carries energy from place to place but leaves the matter behind. For example, sound waves from one vibrating object, such as a guitar string, can travel to your ear. In order to reach your ear, sound waves require a medium, such as air, to travel through. A medium is the material through which a wave travels.

Heat Flow ▲
Heat flow transfers energy from the warm air into the cold ice cream, causing the ice cream to melt.

▲ **Electromagnetic Waves**
Electromagnetic waves transfer energy as they carry the TV announcer's voice and image to people outside the ballpark.

Waves can travel through many different materials. In the ocean, water is the medium for the waves. Although the wave travels through the water, the water particles vibrate in place. The waves produced by an earthquake also require a medium. These waves transfer energy as they shake the lithosphere.

Electromagnetic Waves Electromagnetic waves are waves that transfer electrical and magnetic energy. You are probably most familiar with this type of energy in the form of visible light. The sunlight that warms your skin travels to Earth as electromagnetic waves. These waves do not require a medium to travel through.

Heat Flow Heat flow takes place whenever two objects of different temperatures are brought into contact. What is heat? **Heat** is the thermal energy transferred from one object to another as a result of the difference in temperature. **Thermal energy** is the total energy of all of the atoms that make up an object. Atoms possess thermal energy because they are in constant in motion. These vibrations contain energy.

If two objects have different temperatures, heat will flow from the warmer object to the colder one. The heat will continue to flow until the objects are at the same temperature. For example, when you hold an ice cube in your hand, heat from your hand warms the ice cube, causing it to melt.

Reading Checkpoint **What is heat?**

Lab zone Try This Activity

Energy on the Move

You can observe different forms of energy transfer.

1. Fill a rectangular pan with water to a depth of about 1 cm.
2. Wait until the water stops moving. Gently float a piece of paper 2 cm square in the middle of the pan.
3. When the paper stops moving, drop a metal washer into the water at one end of the pan.
4. Observe the water and the paper.

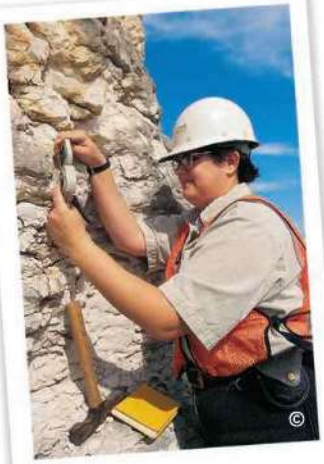
Inferring What forms of energy transfer did you observe? Explain.

FIGURE 9

Careers in Earth Science

If you worked as an Earth scientist, you might chip samples of rock from a mountain, explore the ocean floor, or use satellite data to track a storm.

Oceanographers ▲
These oceanographers are wearing scuba gear to observe the interactions of living things on the ocean floor.



Geologists ▲
The work of geologists often takes them outdoors—in this case, to a rocky mountainside.

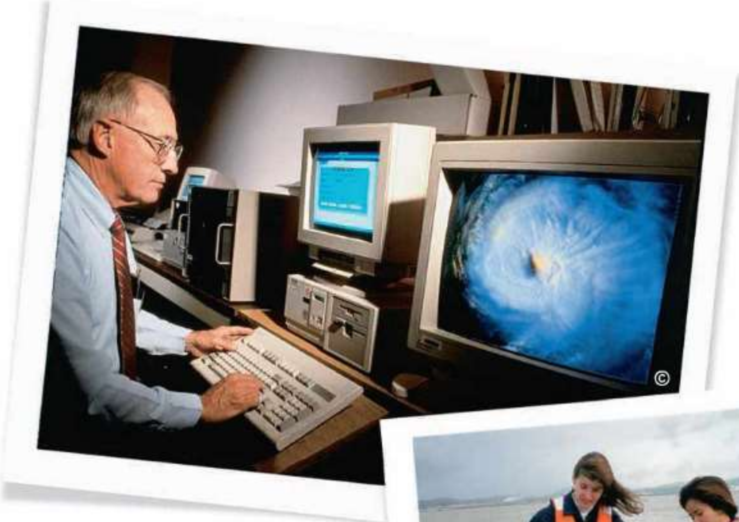
The Branches of Earth Science

Over thousands of years, scientists have built a body of knowledge about Earth and the forces that change our planet. **Earth science** is the term for this knowledge about Earth's land, air, water, and living things. **Earth science has several different branches. In this book, you will learn about geology, meteorology, and environmental science.**

Geology Geology is the study of the solid Earth. Geologists study the forces that have shaped Earth throughout its long history. Geologists study the constructive forces that build up mountains and landmasses. Geologists also study the destructive forces that wear away features on Earth's surface.

Meteorology Meteorology is the study of Earth's atmosphere. Meteorologists are scientists who forecast the weather based on data about conditions in the atmosphere.

Environmental Science Some Earth scientists, called environmental scientists, study Earth's environment and resources. Environmental scientists learn how human activities affect Earth's land, air, water, and living things.



Meteorologists Meteorologists use data from weather satellites to monitor storms such as hurricanes. Computers process and display weather data.

Environmental Scientists These environmental scientists are testing water samples to find evidence of environmental change or pollution.

Section 2 Assessment

S 6.3.a, 6.4.a; E-LA: Reading 6.2.0, Writing 6.2.2

Target Reading Skill **Preview Text Structure** In your graphic organizer, what question did you ask about the heading The Structure of the Earth System?

Reviewing Key Concepts

HINT
1. a. **Listing** What are the four "spheres" that make up the Earth system?

HINT
   b. **Relating Cause and Effect** Give an example of how one of the spheres of the Earth system can affect at least one of the other spheres.

HINT
2. a. **Listing** What are three different ways energy can be transferred from one location to another?

HINT
   b. **Explaining** In which direction does heat flow between two objects of different temperatures?

   c. **Predicting** Describe the flow of heat that occurs if you drop a block of ice into a pot of boiling water. HINT

3. a. **Reviewing** What are three branches of Earth science? HINT

   b. **Summarizing** What do geologists do? HINT

   c. **Classifying** What type of Earth scientist would probably study the effects of human activities on coral reefs? Explain. HINT

Writing in Science

A Day in the Life Research one of the Earth science careers in Figure 9. Based on your research, write a paragraph describing a typical workday for that type of Earth scientist. In your description, include the science inquiry skills the scientist would use on the job.

Lab zone **Skills Lab**
Guided Inquiry

S 6.4.a, 6.7.a, 6.7.d

Speeding Up Evaporation

Materials

2 plastic petri dishes


3 index cards


water


plastic dropper


lamp


stopwatch

Problem

What factors increase the rate at which water evaporates?

Skills Focus

developing hypotheses, controlling variables, drawing conclusions

Procedure

PART 1 Effect of Heat

1. How does heating a water sample affect how fast it evaporates? Record your hypothesis.
2. Place each petri dish on an index card.
3. Add a single drop of water to each of the petri dishes. Try to make the two drops the same size.
4. Position the lamp over one of the dishes as a heat source. Turn on the light. Make sure the light does not shine on the other dish. **CAUTION:** *The light bulb will become very hot. Avoid touching the bulb or getting water on it.*
5. Observe the dishes every 3 minutes to see which sample evaporates faster. Record your result.

PART 2 Effect of Wind

6. How does fanning the water affect how fast it evaporates? Record your hypothesis.
7. Dry both petri dishes and place them over the index cards. Add a drop of water to each dish as you did in Step 3.
8. Use an index card to fan one of the dishes for 5 minutes. Be careful not to fan the other dish.
9. Observe the dishes to see which sample evaporates faster. Record your result.

Analyze and Conclude

1. **Developing Hypotheses** Did the evidence support both hypotheses? If not, which hypothesis was not supported?
2. **Controlling Variables** What was the manipulated variable in this experiment? The responding variable?
3. **Drawing Conclusions** Make a general statement about factors that increase the rate at which the water evaporates.
4. **Communicating** Write a report explaining the steps and results from your investigation. Explain what everyday experiences helped you develop your hypotheses.

Design an Experiment

How does increasing the surface area of a water sample affect how fast it evaporates? Write your hypothesis and then design an experiment to test it. *Obtain your teachers permission before carrying out your investigation.*

Section 3

Exploring Earth's Surface

CALIFORNIA Standards Focus

S 6.2 Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment.

S 6.7.f Read a topographic map and a geologic map for evidence provided on the maps and construct and interpret a simple scale map.

- What does the topography of an area include?
- What are the main types of landforms?
- How do maps represent Earth's surface and help find locations?

Key Terms

- topography
- elevation
- relief
- plain
- mountain
- plateau
- map
- scale
- degree
- latitude
- longitude

Lab zone Standards Warm-Up

What Is the Land Like Around Your School?

1. On a piece of paper, draw a small square to represent your school. Choose a word to describe the land near the school, such as flat, hilly, or rolling, and write it next to the square.
2. Use a magnetic compass to determine the direction of north. Assume that north is at the top of your paper.
3. Choose a word to describe the land 1 km north of your school. Write that word to the north of the square.
4. Repeat Step 3 for areas 1 km to the east, south, and west.

Think It Over

Forming Operational Definitions What phrase could you use to describe the land in your area?

Suppose that you traveled from California's coast across the state to the Sierra Nevada mountains. On your trip, you would observe many changes in topography. **Topography** (tuh PAHG ruh fee) is the shape of the land. An area's topography may be flat, sloping, hilly, or mountainous.

The topography of an area includes the area's elevation, relief, and landforms. (A landform is a feature of topography, such as a hill or valley.) The height above sea level of a point on Earth's surface is its **elevation.** Look at the diagram below to see the changes in elevation on a trip across California. The difference in elevation between the highest and lowest parts of an area is its **relief.** The diagram includes both flat land, which has low relief, and mountains, which have high relief.

Elevations Across California ▼

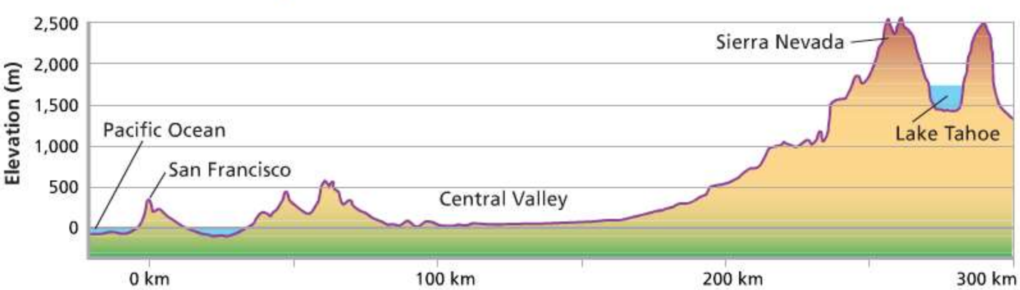


FIGURE 10
Landforms
Plains, mountains, and plateaus are just a few of the many landforms that make up the topography of Earth's surface.
Forming Operational Definitions *Based on this illustration, how would you define "mountains"?*

Types of Landforms

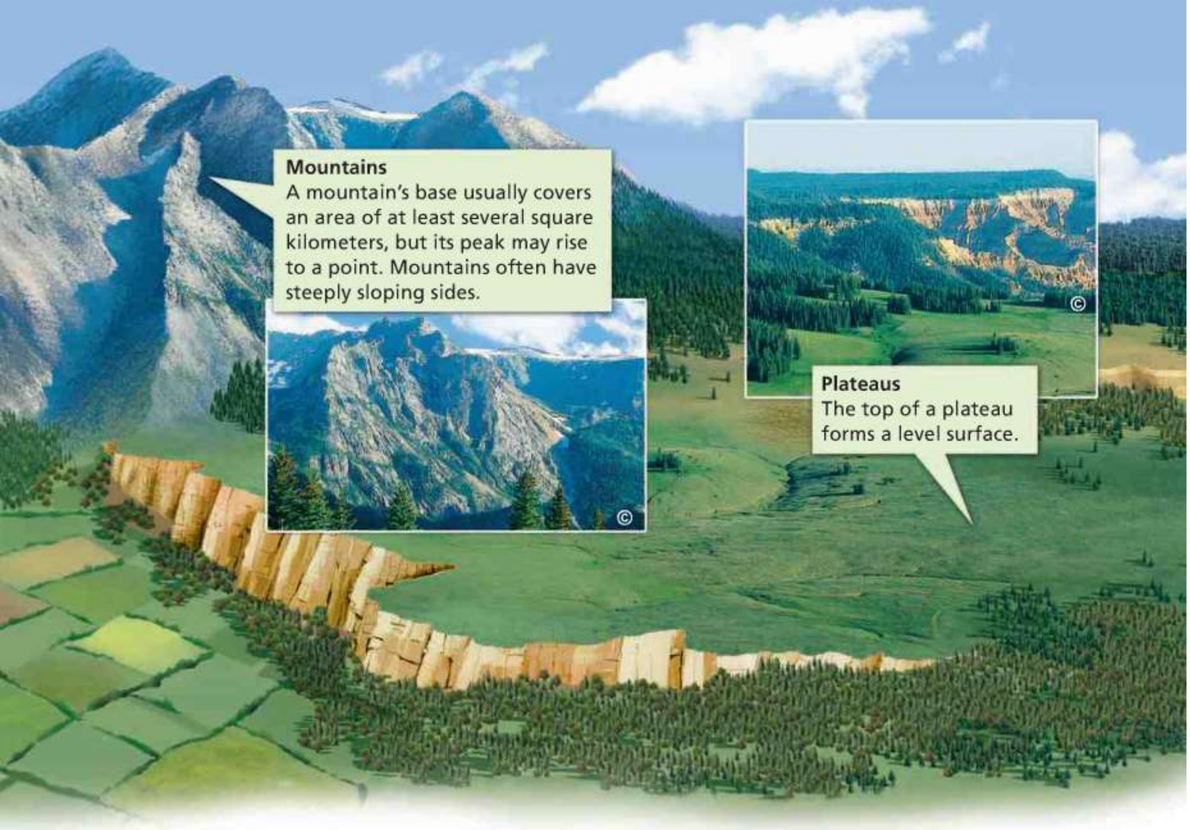
Different landforms have different combinations of elevation and relief. Landforms vary greatly in size and shape—from level plains extending as far as the eye can see, to low, rounded hills that you could climb on foot, to jagged mountains that would take you many days to walk around. **There are three main types of landforms: plains, mountains, and plateaus.**

Plains A **plain** is a landform made up of nearly flat or gently rolling land with low relief. A plain that lies along a seacoast is called a coastal plain. In North America, a coastal plain extends around the continent's eastern and southeastern shores. Coastal plains have both low elevation and low relief.

A plain that lies away from the coast is called an interior plain. Although interior plains have low relief, their elevation can vary. The broad interior plains of North America are called the Great Plains. The Great Plains extend north from Texas into Canada.

Reading Checkpoint What is an interior plain?

Go Online
SCI LINKS NSTA
For: Links on landforms
Visit: www.SciLinks.org
Web Code: scn-0711



Mountains A **mountain** is a landform with high elevation and high relief. Mountains usually occur as part of a mountain range. A mountain range is a group of mountains that are closely related in shape, structure, and age. For example, the Cascade Range is a mountain range that runs from Washington State through Oregon to northern California.

The different mountain ranges in a region make up a mountain system. In California, the Santa Lucia Mountains south of Monterey Bay are one mountain range in the mountain system known as the Coast Ranges.

Mountain ranges and mountain systems in a long, connected chain form a larger unit called a mountain belt. The Rocky Mountains are part of a great mountain belt that stretches down the western sides of North America and South America.

Plateaus A landform that has high elevation and a more or less level surface is called a **plateau.** A plateau is rarely perfectly smooth on top. Streams and rivers may cut into the plateau's surface. The Columbia Plateau in Washington State is an example. The many layers of rock that make up the Columbia Plateau are stacked about 1,500 meters thick.

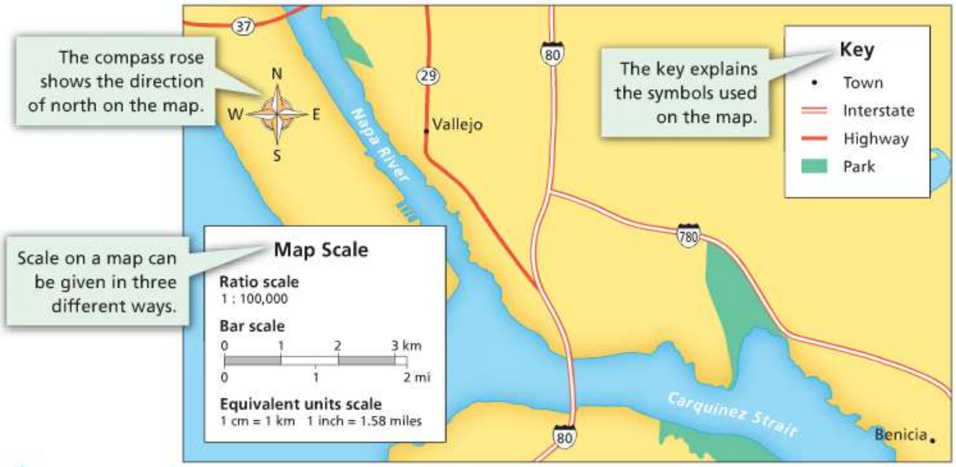


FIGURE 11
What's in a Map?
A map is drawn to scale, uses symbols explained in a map key, and usually has a compass rose to show direction. This map shows the area around Vallejo, California.
Interpreting Maps *What is the scale of this map?*

Math Skills

Scale and Ratios

A ratio compares two numbers by division. For example, the scale of a map given as a ratio is 1 : 250,000. At this scale, the distance between two points on the map measures 23.5 cm. How would you find the actual distance?

1. Write the scale as a fraction.

$$\frac{1}{250{,}000}$$

2. Write a proportion. Let *d* represent the distance between the two points.

$$\frac{1}{250{,}000} = \frac{23.5 \text{ cm}}{d}$$

3. Write the cross products.

$$1 \times d = 250{,}000 \times 23.5 \text{ cm}$$
$$d = 5{,}875{,}000 \text{ cm}$$

(*Hint:* To convert cm to km, divide *d* by 100,000.)

Practice Problem A map's scale is 1 : 25,000. If two points are 4.7 cm apart on the map, how far apart are they on the ground?

What Is a Map?

A **map** is a flat model of all or part of Earth's surface as seen from above. **Maps are drawn to scale and use symbols to represent topography and other features on Earth's surface.** A map's **scale** relates distance on a map to a distance on Earth's surface. Scale is often given as a ratio. For example, one unit on a map could equal 25,000 units on the ground. So one centimeter on the map would represent 0.25 kilometer. This scale, "one to twenty-five thousand," would be written "1 : 25,000." Figure 11 shows three ways of giving a map's scale.

Mapmakers use shapes and pictures called symbols to stand for features on Earth's surface. A symbol can represent a physical feature, such as a river, lake, mountain, or plain. A symbol also can stand for a human-made feature, such as a highway, city, or airport. A map's key, or legend, is a list of all the symbols used on the map with an explanation of their meaning.

Maps also include a compass rose or north arrow. The compass rose helps relate directions on the map to directions on Earth's surface. North usually is located at the top of the map.

Reading Checkpoint **What is a map's scale?**

Earth's Grid

When you play checkers, the grid of squares helps you to keep track of where each piece should be. To find a point on Earth's surface, you need a grid like the one on a checkerboard. Most maps and globes show a grid. Because Earth is a sphere, the grid curves to cover the entire planet.

Measuring in Degrees To locate positions on Earth's surface, scientists use units called degrees. You probably know that degrees are used to measure the distance around a circle. As you can see in Figure 12, a **degree** (°) is $\frac{1}{360}$ of the distance around a circle. Degrees can also be used to measure distances on the surface of a sphere. On Earth's surface, each degree is a measure of an angle formed by lines drawn from the center of Earth to points on the surface.

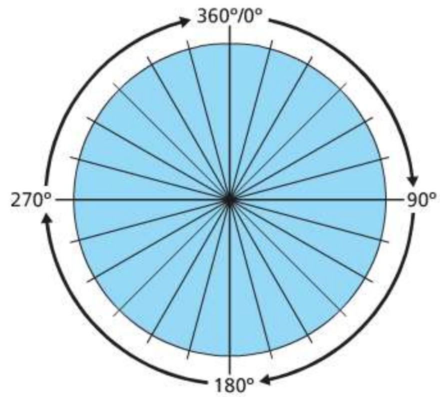


FIGURE 12
Degrees Around Earth
Distances around Earth are measured in degrees.

The Equator Halfway between the North and South poles, the equator forms an imaginary line that circles Earth. The equator divides Earth into the Northern and Southern hemispheres. A hemisphere (HEM ih sfeer) is one half of the sphere that makes up Earth's surface. If you started at the equator and traveled to one of the poles, you would travel 90 degrees. That is one quarter of the distance in a full circle.

The Prime Meridian Another imaginary line, called the prime meridian, makes a half circle from the North Pole to the South Pole. The prime meridian passes through Greenwich, England. Places east of the prime meridian are in the Eastern Hemisphere. Places west of it are in the Western Hemisphere. If you started at the prime meridian and traveled west along the equator, you would travel through 360 degrees before returning to your starting point.

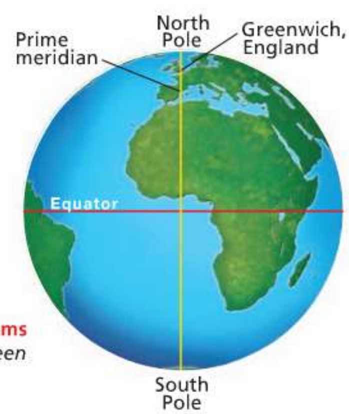


FIGURE 13
Equator and Prime Meridian
Two lines, the equator and prime meridian, are the baselines for measuring distances on Earth's surface. **Interpreting Diagrams** *How many degrees are there between the equator and the North Pole?*

Lab zone Try This Activity

Where in the World?

Using a globe, determine what city is found at each of the following points:

2° S, 79° W
38° N, 9° W
34° N, 135° E
34° S, 58° W
55° N, 3° W
1° N, 103° E

What word is spelled by the first letters of these cities?

Locating Points on Earth's Surface By using the equator and prime meridian, mapmakers have constructed a grid made up of lines of latitude and longitude. **The lines of latitude and longitude on a map form a grid that can be used to find locations anywhere on Earth.**

The equator is the starting line for measuring **latitude,** or distance in degrees north or south of the equator. The latitude of the equator is 0°. Between the equator and each pole are 90 evenly spaced, parallel lines called lines of latitude. Each degree of latitude is equal to about 111 kilometers.

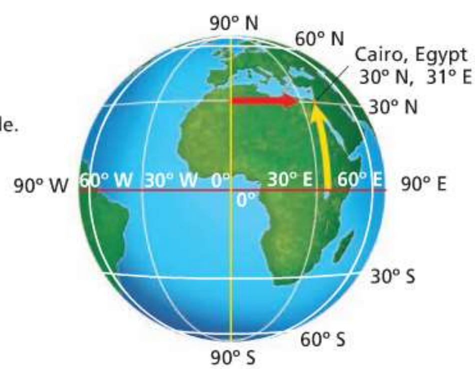
The distance in degrees east or west of the prime meridian is called **longitude.** There are 360 lines of longitude that run from north to south, meeting at the poles. Each line represents one degree of longitude. At the equator, a degree of longitude equals about 111 kilometers. But at the poles, where the lines of longitude come together, the distance decreases to zero.

The prime meridian, which is the starting line for measuring longitude, is at 0°. The longitude lines in each hemisphere are numbered up to 180 degrees.

Using Latitude and Longitude The location of any point on Earth's surface can be expressed in terms of the latitude and longitude lines that cross at that point. For example, you can see on the map in Figure 16 that New Orleans is located where the line for 30° North latitude crosses the line for 90° West longitude. Notice that each longitude line crosses the latitude lines, including the equator, at a right angle.

Reading Checkpoint How are longitude lines numbered?

FIGURE 14
Locating a Point
Points on Earth's surface can be located using latitude and longitude.



Cairo, Egypt, is located where the latitude line 30° N crosses the longitude line 31° E.

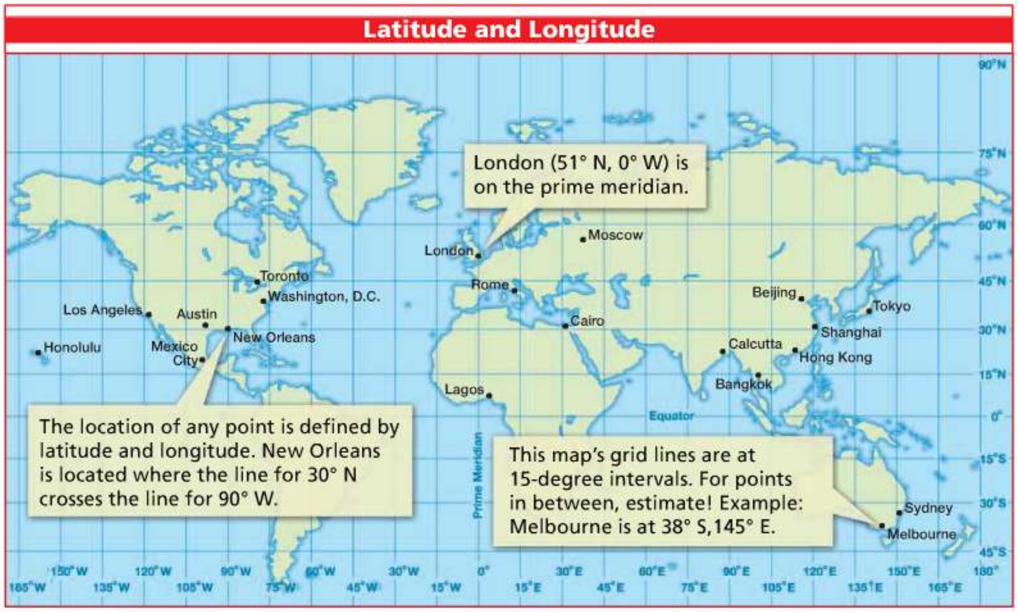


FIGURE 15
Every point on Earth's surface has a particular latitude and longitude.
Interpreting Maps *What are the latitude and longitude of Los Angeles? Of Sydney?*

Section 3 Assessment

S 6.2, 6.7.f; E-LA: Reading 6.1.0

Vocabulary Skill **High-Use Academic Words**
Use the word *area* correctly in a sentence explaining topography.

Reviewing Key Concepts

1. a. Defining What is topography?
   b. Comparing and Contrasting What is relief? How does it differ from elevation?
   c. Calculating What is the relief in an area where the highest point is 1,200 m above sea level and the lowest point is 200 m above sea level?

2. a. Listing What are the three main types of landforms?
   b. Describing What are the characteristics of a mountain?
   c. Sequencing Place these features in order from smallest to largest: mountain system, mountain range, mountain belt, mountain.

3. a. Identifying On a world map, what two lines are the starting lines for measurements on Earth's surface?
   b. Explaining How are these lines used to locate points on Earth's surface?

Math Practice

4. Scales and Ratios A globe has a scale of 1 : 40,000,000. Using a piece of string, you determine that the shortest distance between two cities on the globe is 7 cm. What is the actual distance between the two cities?

Topographic Maps

CALIFORNIA
Standards Focus

S 6.7.f Read a topographic map and a geologic map for evidence provided on the maps and construct and interpret a simple scale map.

- How do mapmakers represent elevation, relief, and slope?
- How do you read a topographic map?

Key Terms
- topographic map
- contour line
- contour interval
- index contour

Lab zone Standards Warm-Up

Can a Map Show Relief?

1. Carefully cut the corners off 8 pieces of cardboard so that they look rounded. Each piece should be at least 1 centimeter smaller than the one before.
2. Trim the long sides of the two largest pieces so that the long sides appear wavy. Don't cut more than 0.5 centimeter into the cardboard.
3. Trace the largest cardboard piece on a sheet of paper.
4. Trace the next largest piece inside the drawing of the first. Don't let any lines cross.
5. Trace the other cardboard pieces, from largest to smallest, one inside the other, on the same paper.
6. Stack the cardboard pieces beside the paper in the same order they were traced. Compare the stack of cardboard pieces with your drawing. How are they alike? How are they different?

Think It Over

Making Models If the cardboard pieces are a model of a landform, what do the lines on the paper represent?

An orienteering meet is not an ordinary race. Teams compete to see how quickly they can find a series of locations called control points. The control points are scattered over a large park or state forest. Orienteers choose a set number of control points and then visit the points in any order. In this sport, your ability to read a map and use a compass is often more important than how fast you can run. In a major meet, there may be several hundred orienteers on dozens of teams.

At the start of a meet, you would need to consult your map. But the maps used in orienteering are different from road maps or maps in an atlas—they're topographic maps. A **topographic map** (tahp uh GRAF ik) is a map showing the surface features of an area. Topographic maps use symbols to show the land as if you were looking down on it from above.

FIGURE 16
Orienteering
Orienteering helps people develop the skill of using a map and compass.

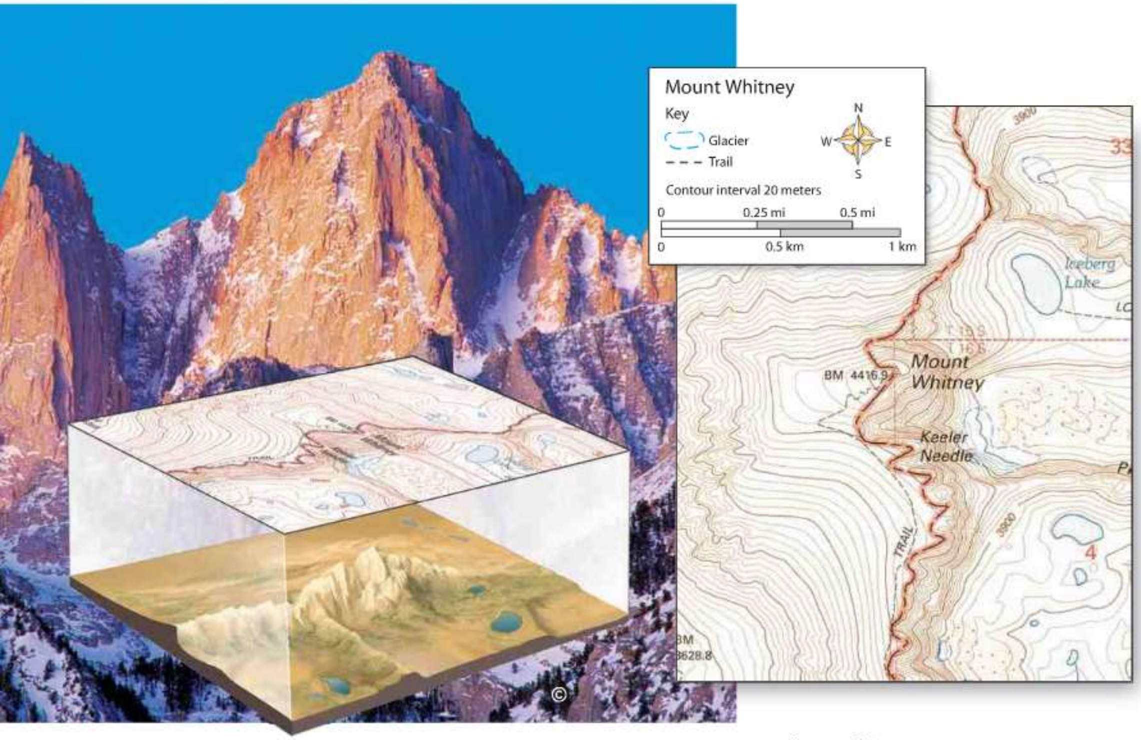


FIGURE 17
Contour Lines
The contour lines on a topographic map represent elevation and relief. **Forming Operational Definitions** *What information does the topographic map provide that the photograph does not?*

Mapping Earth's Topography

Topographic maps provide information on the elevation, relief, and slope of the ground surface. **Mapmakers use contour lines to represent elevation, relief, and slope on topographic maps.** On a topographic map, a **contour line** connects points of equal elevation. In the United States, most topographic maps give contour intervals in feet rather than meters.

The change in elevation from contour line to contour line is called the **contour interval.** The contour interval for a given map is always the same. For example, the map in Figure 18 has a contour interval of 20 meters. If you start at one contour line and count up 10 contour lines, you have reached an elevation 200 meters above where you started. Usually, every fifth contour line, known as an index contour, is darker and heavier than the others. **Index contours** are labeled with the elevation in round units, such as 1,600 or 2,000 meters above sea level.

Topographic maps have many uses. For example, geologists use them to identify landforms. You could use a topographic map to plan the route of a hike or bicycle trip.

Reading Checkpoint **What do all the points connected by a contour line have in common?**

Go Online
active art

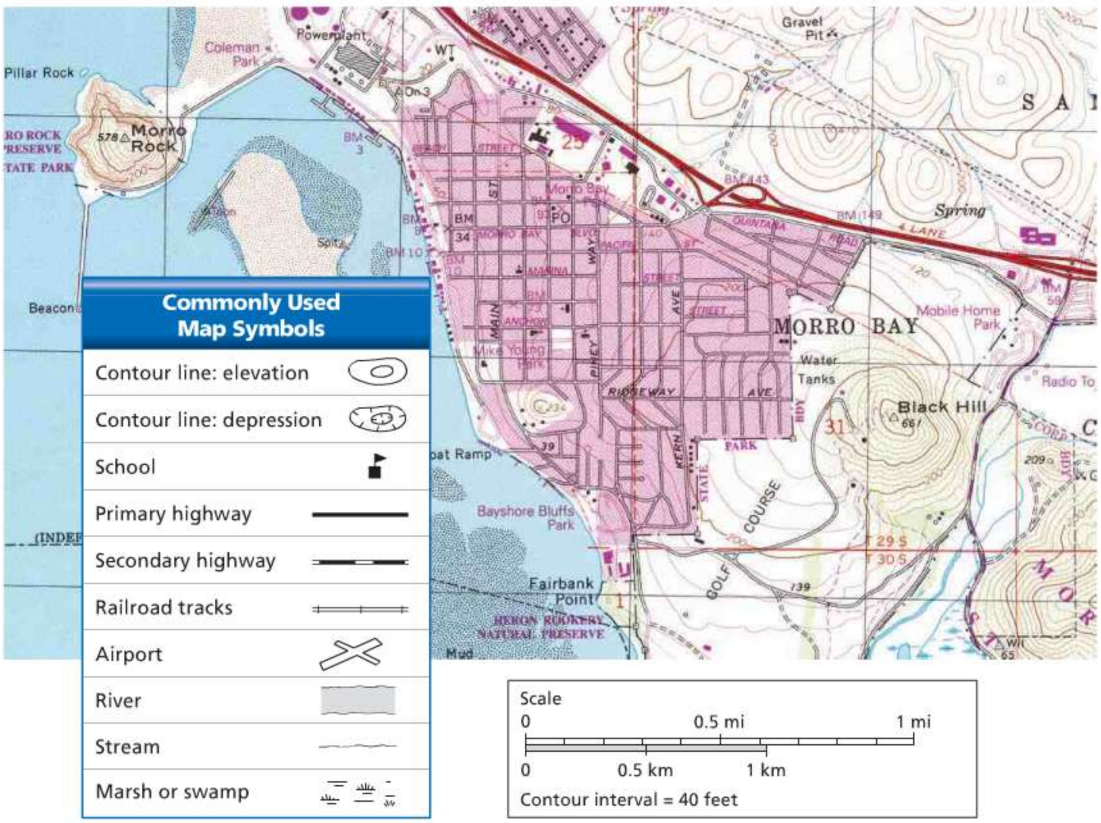
For: Topographic Map activity
Visit: PHSchool.com
Web Code: cfp-2014

Reading a Topographic Map

Looking at a topographic map with many squiggly contour lines, you may feel as if you are gazing into a bowl of spaghetti. But with practice, you can learn to read a topographic map like the one in Figure 18. **To read a topographic map, you must familiarize yourself with the map's scale and symbols and interpret the map's contour lines.**

Scale Topographic maps are usually large-scale maps. Large-scale maps show a close-up view of part of Earth's surface. In the United States, many topographic maps are at a scale of 1 : 24,000, or 1 centimeter equals 0.24 kilometers. At this scale, a map can show the details of elevation and features such as rivers and coastlines. Large buildings, airports, and major highways appear as outlines at the correct scale. Symbols are used to show houses and other small features.

FIGURE 18
Topographic Map
The different types of symbols on topographic maps provide data on elevation, relief, slopes, and human-made features. This United States Geological Survey map shows part of Morro Bay, California.



Symbols Mapmakers use a great variety of symbols on topographic maps. If you were drawing a map, what symbols would you use to represent a forest, a campground, an orchard, a swamp, or a school? Look at Figure 19 to see some commonly used map symbols.

Interpreting Contour Lines To find the elevation of a feature, begin at the labeled index contour, which is a heavier line than regular contour lines. Then, count the number of contour lines up or down to the feature.

Reading contour lines is the first step toward "seeing" an area's topography. Look at the map in Figure 19. The closely spaced contour lines are used for steep slopes. The widely spaced contour lines are used for gentle slopes or flatter areas. A contour line that forms a closed loop with no other contour lines inside it is used to show a hilltop. A closed loop with dashes inside shows a depression, or hollow in the ground.

The shape of contour lines also help to show ridges and valleys. V-shaped contour lines pointing downhill show a ridge line. V-shaped contour lines pointing uphill show a valley. A stream in the valley flows toward the open end of the V.

Video Field Trip
Discovery Channel School
Mapping Earth's Surface

Reading Checkpoint How are hilltops and depressions shown using contour lines?

Section 4 Assessment

S 6.7.f; E-LA: Reading 6.2.0, Writing 6.2.2

Target Reading Skill **Preview Text Structure** In your graphic organizer, what question did you ask about the heading Interpreting Contour Lines?

Reviewing Key Concepts

HINT **1. a. Defining** What is a topographic map?

HINT **b. Explaining** How do topographic maps represent elevation and relief?

HINT **c. Calculating** If the contour interval on a topographic map is 50 meters, how much difference in elevation do 12 contour lines represent?

HINT **2. a. Reviewing** What do you need to know about a topographic map in order to read it?

HINT **b. Comparing and Contrasting** Compare the way steep slopes are represented on a topographic map with the way gentle slopes are represented.

c. Inferring Reading a map, you see V-shaped contour lines that point uphill. What land feature would you find in this area? HINT

Writing in Science

Giving Directions Write a descriptive paragraph of a simple route from one point on the map in Figure 18 to another point. Your paragraph should provide the starting point, but not the end point. Include details such as distance, compass direction, and topography along the route. Share your paragraph with classmates to see if they can follow your directions.

Lab zone **Skills Lab**
Guided Inquiry

S 6.2, 6.7.f

A Map in a Pan

Materials


modeling clay


deep-sided pan


water and food coloring


clear, hard sheet of plastic


marking pencil


sheet of unlined white paper

Problem
How can you make and read a topographic map?

Skills Focus
making models, interpreting maps

Procedure

1. Place a lump of clay on the bottom of a pan. Shape the clay into a model of a hill.
2. Pour colored water into the pan to a depth of 1 centimeter to represent sea level.
3. Place a sheet of hard, clear plastic over the container.
4. Trace the outline of the pan on the plastic sheet with a marking pencil. Then, looking straight down into the pan, trace the outline the water makes around the edges of the clay model. Remove the plastic sheet from the pan.
5. Add another centimeter of water to the pan, bringing the depth of the water to 2 centimeters. Replace the plastic sheet exactly as before and then trace the water level again.
6. Repeat Step 5 several times. Stop when the next addition of water would completely cover your model.
7. Remove the plastic sheet. Trace the outlines that you drew on the plastic sheet onto a sheet of paper to make a topographic map.

Analyze and Conclude

1. **Interpreting Maps** Read your topographic map. How can you tell which parts of your model hill have a steep slope? A gentle slope?
2. **Interpreting Maps** How can you tell from the map which point on the hill is the highest?
3. **Interpreting Maps** Are there any ridges or valleys on your map? How do you know?
4. **Applying Concepts** Is there any depression on your map where water would collect after it rained? What symbol should you use to identify this depression?
5. **Communicating** Read your topographic map and compare it with the clay landform. Write a paragraph comparing your topographic map and landform model. In your paragraph, explain how the map and model are alike and how they are different.

More to Explore

Obtain a topographic map that includes an interesting landform such as a mountain, canyon, river valley, or coastline. After reading the contour lines on the map, make a sketch of what you think the landform looks like. Then build a scale model of the landform using clay or layers of cardboard or foamboard. How does your model landform compare with your sketch?

Section 5

Safety in the Science Laboratory

CALIFORNIA Standards Focus

S 6.7 Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

b. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.

- Why is preparation important when carrying out scientific investigations in the lab and in the field?
- What should you do if an accident occurs?

Lab zone Standards Warm-Up

Where Is the Safety Equipment in Your School?

1. Look around your classroom or school for any safety-related equipment.
2. Draw a floor plan of the room or building and clearly label where each item is located.

Think It Over

Predicting Why is it important to know where safety equipment is located?

You probably have a favorite summer outdoor activity. Some people enjoy watching baseball or picnicking at the beach. Others look forward to team sports or bicycling. But what if you wanted to try a new activity, such as canoeing? Before trying a new recreation, there are several things that you need to do to prepare. For example, before learning how to paddle a canoe, you would need to pass a swimming test. Then you would need to take a class to learn basic safety rules, such as always wearing a life vest.

Proper preparation for a canoe trip is important.

Go Online
SCI LINKS NSTA
For: Links on laboratory safety
Visit: www.SciLinks.org
Web Code: scn-1624

Safety in the Lab

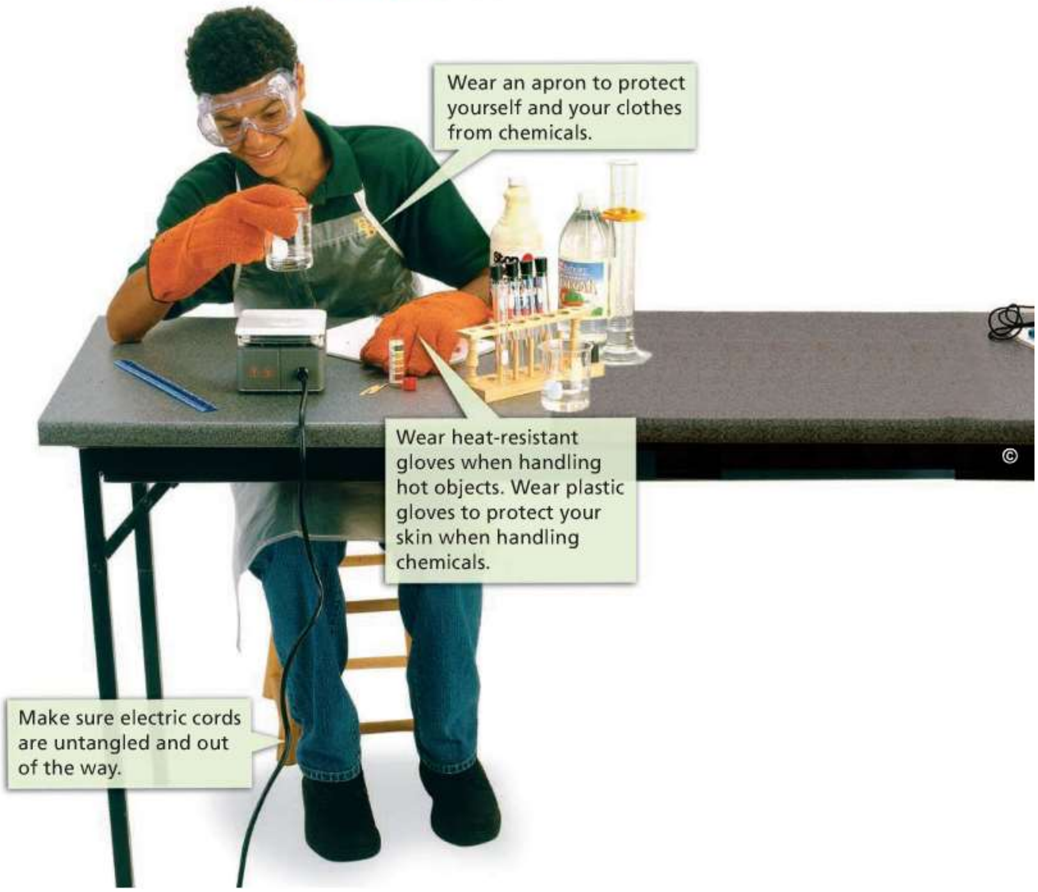
Just as when you go canoeing, you have to be prepared before you begin any scientific investigation. **Good preparation helps you stay safe when doing activities in the laboratory.**

Thermometers, balances, and glassware are some of the tools you will use in science labs. Do you know how to use these items? What should you do if something goes wrong? Thinking about these questions ahead of time is an important part of being prepared.

Preparing for the Lab Preparing for a lab should begin the day before you will perform the lab. It is important to read through the procedure carefully and make sure you understand all the directions. Also, review the general safety guidelines in Appendix A, including those related to the specific tools and other equipment you will use. If anything is unclear, ask your teacher about it before you begin the lab.

Reading Checkpoint **Why is it important to know how to use laboratory equipment?**

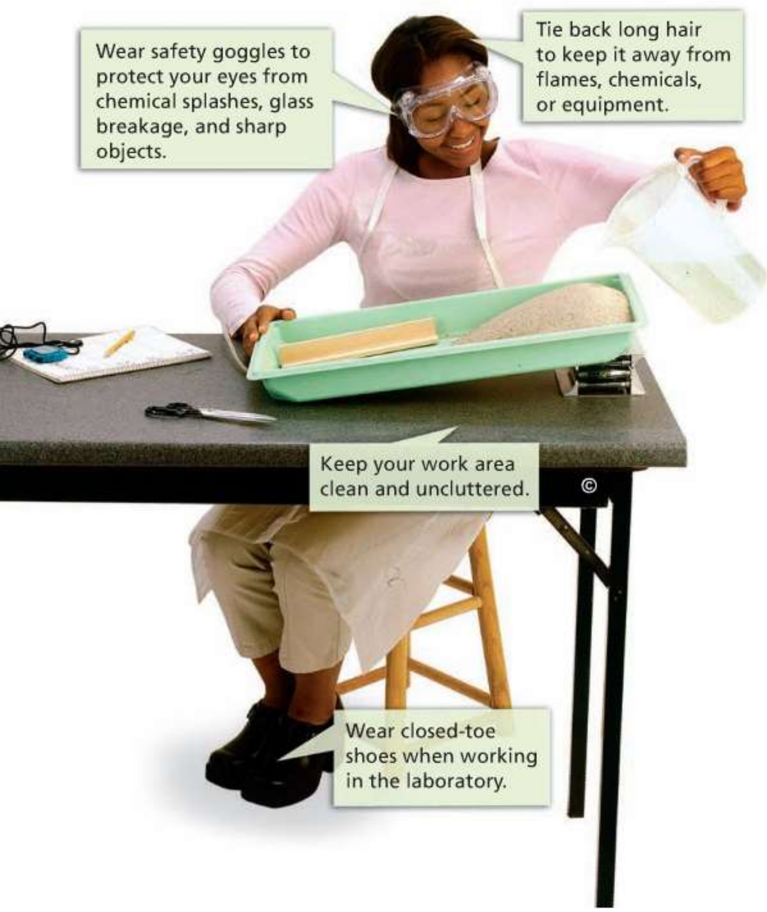
FIGURE 19
Safety in the Lab
Conducting careful investigations in the laboratory is important in science. It is also important to use and select appropriate tools and techniques to ensure safety.
Observing *List the equipment each student has selected to ensure safety while performing the labs.*



Performing the Lab Whenever you perform a science lab, your chief concern must be the safety of yourself, your classmates, and your teacher. The most important safety rule is simple: Always follow your teacher's instructions and the textbook directions exactly. You should never try anything on your own without asking your teacher first.

Labs and activities in this textbook series include safety symbols such as those at right. These symbols alert you to possible dangers in performing the lab and remind you to work carefully. They also identify any safety equipment that you should use to protect yourself from potential hazards. The symbols are explained in detail in Appendix A. Make sure you are familiar with each safety symbol and what it means.

Other things you can do to make your lab experience safe and successful include keeping your work area clean and organized. Also, do not rush through any of the steps. Finally, always show respect and courtesy to your teacher and classmates.



Safety Symbols

- Safety Goggles
- Lab Apron
- Breakage
- Heat-Resistant Gloves
- Plastic Gloves
- Heating
- Flames
- No Flames
- Corrosive Chemical
- Poison
- Fumes
- Sharp Object
- Animal Safety
- Plant Safety
- Electric Shock
- Physical Safety
- Disposal
- Hand Washing
- General Safety Awareness

End-of-Lab Procedures Your lab work does not end when you reach the last step in the procedure. There are important things you need to do at the end of every lab.

When you have completed a lab, be sure to clean up your work area. Turn off and unplug any equipment and return it to its proper place. It is very important that you dispose of any waste materials properly. Some wastes should not be thrown in the trash or poured down the drain. Follow your teacher's instructions about proper disposal. Finally, be sure to wash your hands thoroughly after working in the laboratory.

Safety in the Field

The laboratory is not the only place where you will conduct scientific investigations. Some investigations will be done in the "field." The field can be any outdoor area, such as a schoolyard, a forest, a park, or a beach. **Just as in the laboratory, good preparation helps you stay safe when doing science activities in the field.**

There can be many potential safety hazards outdoors. For example, you could encounter severe weather, traffic, wild animals, or poisonous plants. Advance planning may help you avoid some potential hazards. For example, you can listen to the weather forecast and plan your trip accordingly. Other hazards may be impossible to anticipate.

Whenever you do field work, always tell an adult where you will be. Never carry out a field investigation alone. Ask an adult or a classmate to accompany you. Dress appropriately for the weather and other conditions you will encounter. Use common sense to avoid any potentially dangerous situations.

FIGURE 20
Safety in the Field
These are some of the items that might come in handy when you are out in the field.
Applying Concepts *What other items might be useful on a field trip to a beach?*

In Case of an Accident

Good preparation and careful work habits can go a long way toward making your lab experiences safe ones. But, at some point, an accident may occur. A classmate might accidentally knock over a beaker or a chemical might spill on your sleeve. Would you know what to do?

When any accident occurs, no matter how minor, notify your teacher immediately. Then, listen to your teacher's directions and carry them out quickly. Make sure you know the location and proper use of all the emergency equipment in your lab room. Knowing safety and first-aid procedures beforehand will prepare you to handle accidents properly. Figure 21 lists some first-aid procedures you should know.

Reading Checkpoint **What should you do when an accident occurs?**

In Case of Emergency

ALWAYS NOTIFY YOUR TEACHER IMMEDIATELY

Injury	What to Do
Burns	Immerse burns in cold water.
Cuts	Cover cuts with a clean dressing. Apply direct pressure to the wound to stop bleeding.
Spills on Skin	Flush the skin with large amounts of water.
Foreign Object in Eye	Flush the eye with large amounts of water. Seek medical attention.

FIGURE 21
First-Aid Tips
These first-aid tips can help guide your actions during emergency situations. Remember, always notify your teacher immediately if an accident occurs.

Section 5 Assessment

S 6.7, 6.7.b; E-LA: Reading 6.1.0

Vocabulary Skill **High-Use Academic Words** Explain the meaning of the word *occur* in the following sentence: Follow lab safety rules so that an accident does not *occur*.

Reviewing Key Concepts

1. a. **Listing** List two things you should do ahead of time to prepare for a lab.
   b. **Summarizing** Summarize the key steps you should take to ensure that you can perform a science lab safely.
   c. **Making Generalizations** Why is it more difficult to prepare for a lab activity in the field than for one in a laboratory?
2. a. **Reviewing** Suppose during a lab activity you get a cut and start to bleed. What is the first thing you should do?
   b. **Sequencing** Outline in order the next steps you would take to deal with your injury.
   c. **Making Judgments** Some people feel that most accidents can be prevented with proper preparation and safe behavior. Do you agree or disagree with this viewpoint? Explain your reasoning.

Writing in Science

Safety Poster Make a poster of one of the safety rules in Appendix A to post in your lab. Be sure to include the safety symbol, clear directions, and additional illustrations.

Chapter 1 Study Guide

The BIG Idea Sunlight provides energy for many processes on Earth's surface that affect the land, air, water, and living things.

1 What Is Science?

Key Concepts S 6.7.a, 6.7.c

- Scientists use skills such as observing, inferring, and predicting.
- Scientific inquiry refers to the many ways in which scientists study the natural world and propose explanations based on the evidence they gather.
- Unlike a theory, a scientific law describes an observed pattern in nature, but does not provide an explanation for it.

Key Terms

science
observing
inferring
predicting
scientific inquiry
hypothesis
controlled experiment
variable
manipulated variable
responding variable
data
scientific theory

2 Studying Earth

Key Concepts S 6.3.a, 6.4.a

- The Earth system has four main parts, or "spheres": the atmosphere, hydrosphere, lithosphere, and biosphere. As a source of energy for processes on Earth, the sun can also be considered part of the Earth system.
- Energy can be transferred from place to place by moving objects, by waves, or by heat flow.
- The branches of Earth science covered in this book include geology, meteorology, and environmental science.

Key Terms

energy
atmosphere
hydrosphere
lithosphere
biosphere
matter
wave
heat
thermal energy
Earth science

3 Exploring Earth's Surface

Key Concepts S 6.2, 6.7.f

- The topography of an area includes the area's elevation, relief, and landforms.
- There are three main types of landforms: mountains, plains, and plateaus.
- Maps are drawn to scale and use symbols to represent topography and other features on Earth's surface.
- The lines of latitude and longitude on a map form a grid that can be used to find locations anywhere on Earth.

Key Terms

topography
elevation
relief
plain
mountain
plateau
map
scale
degree
latitude
longitude

4 Topographic Maps

Key Concepts S 6.7.f

- Mapmakers use contour lines to represent elevation, relief, and slope on topographic maps.
- To read a topographic map, you must familiarize yourself with the map's scale and symbols and interpret the map's contour lines.

Key Terms

topographic map
contour line
contour interval
index contour

5 Safety in the Science Laboratory

Key Concepts S 6.7, 6.7.b

- Good preparation helps you stay safe when doing science activities in the laboratory and in the field.
- When any accident occurs, no matter how minor, notify your teacher immediately. Then, listen to your teacher's directions and carry them out quickly.

Review and Assessment

Go Online PHSchool.com
For: Self-Assessment
Visit: PHSchool.com
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Target Reading Skill

Preview Text Structure Create a graphic organizer to preview the headings in Section 3.

Section 3: Exploring Earth's Surface		
Heading	Question	Answer
Topography	What is topography?	
Types of Landforms		
What Is a Map?		
Earth's Grid		

Reviewing Key Terms

Choose the letter of the best answer.

HINT 1. If you interpret something based on your experience, you are making a(n)
- **a.** hypothesis.
- **b.** prediction.
- **c.** inference.
- **d.** scientific law.

HINT 2. A possible explanation for a set of observations or answer to a scientific question is a
- **a.** variable.
- **b.** scientific theory.
- **c.** prediction.
- **d.** hypothesis.

HINT 3. The transfer of energy from the sun to Earth is an example of the movement of energy by
- **a.** moving objects.
- **b.** evaporation.
- **c.** waves.
- **d.** heat flow.

HINT 4. A landform that has high elevation but a mostly flat surface is a
- **a.** plain.
- **b.** mountain.
- **c.** mountain range.
- **d.** plateau.

HINT 5. A measurement based on distance north or south of the equator is called
- **a.** scale.
- **b.** latitude.
- **c.** longitude.
- **d.** contour interval.

HINT 6. On a topographic map, relief is shown using
- **a.** lines of latitude.
- **b.** lines of longitude.
- **c.** prime meridian.
- **d.** contour lines.

Complete the following sentences so that your answers clearly explain the key terms.

7. A scientist often conducts a **controlled experiment,** which is _________. HINT
8. Topography is partly made up of the land's **relief,** which is _________. HINT
9. One of Earth's four spheres is the **hydrosphere,** which is _________. HINT
10. If an airplane flew around Earth in a straight line from east to west, it would change its **longitude,** which is _________. HINT
11. When reading a topographic map, you might look for an **index contour,** which is _________. HINT

Writing in Science

Advertisement Suppose that you are a manufacturer of topographic maps. Write an advertisement that describes as many uses for your maps as you can think of.

Video Assessment
Discovery Channel School
Mapping Earth's Surface

Review and Assessment

Checking Concepts

12. In science, can a hypothesis be accepted as true after one test? Explain.

13. What is a controlled experiment?

14. What is the role of the responding variable in a controlled experiment?

15. What are three ways in which scientists communicate their ideas?

16. What do meteorologists do?

17. What is one source of energy for processes in Earth's lithosphere, hydrosphere, atmosphere, and biosphere?

18. Compare the elevation of a coastal plain with that of an interior plain.

19. What are five things you should do when you complete a lab experiment?

Thinking Critically

20. **Applying Concepts** Once an experiment is complete, what must a scientist do to determine whether the data support the hypothesis?

21. **Predicting** A volcano erupts in the Pacific Ocean and forms a new island. How could this change in the lithosphere lead to a change in the biosphere?

22. **Inferring** Auckland, New Zealand, is located at 37° S, 175° E. What two hemispheres is it in? Explain.

23. **Applying Concepts** Which would be more likely to show a shallow, 1.5-meter hollow in the ground: a 1-meter contour interval or a 5-meter contour interval?

24. **Interpreting Graphics** If you saw the safety icons below at the beginning of an experiment's procedure, what safety steps would you need to take?

Math Practice

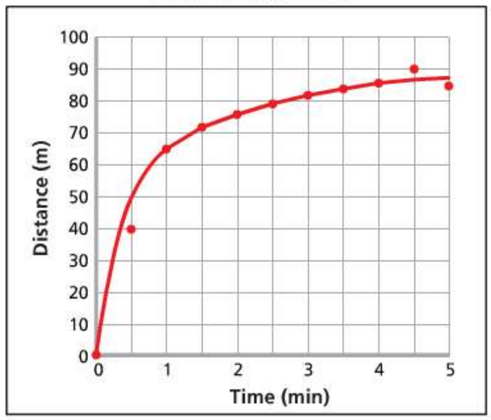
25. **Scale and Ratios** Earth's diameter is about 13,000 km. If a globe has a diameter of 0.5 m, write the globe's scale as a ratio. What distance on Earth would 1 cm on the globe represent?

Applying Skills

Use the graph to answer Questions 26–28.

A scientist measured the distance a lava flow traveled in 5 minutes and recorded the data in the graph below.

Volcanic Lava Flow



26. **Reading Graphs** What is plotted on each axis?

27. **Interpreting Data** Did the lava flow travel the same distance every minute?

28. **Predicting** Predict how far the lava will flow between 5 and 6 minutes.

Lab zone Standards Investigation

Performance Assessment Present your map to the class. What scale did you use? What symbols did you use to represent the natural and physical features of your site? How did you measure and locate them on your map? Does your map give others a clear idea of the topography of the land?

CALIFORNIA Standards Practice

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Choose the letter of the best answer.

1. What would a scientist usually do after conducting a controlled experiment?
A interpret the data from the experiment
B communicate the results of the experiment
C draw a conclusion and, if needed, revise the hypothesis
D all of the above **S 6.7.a**

2. In which of the following is energy transferred by particles moving from place to place?
A ocean waves
B sunlight
C wind
D earthquake waves **S 6.3.a**

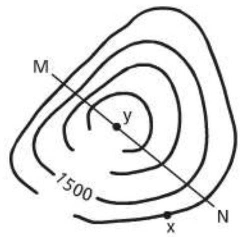
3. Which of the following is NOT a process for which the sun provides energy?
A a volcanic eruption
B the water cycle
C winds
D ocean currents **S 6.4.a**

4. In an experiment, the variable that the scientist changes is called the
A responding variable.
B inquiry variable.
C manipulated variable.
D controlled variable. **S 6.7.c**

5. Which phrase provides the best definition of *relief*?
A the elevation of the lowest point in an area
B the sum of the highest and lowest points in an area
C the elevation of the highest point in an area
D the difference in elevation between the highest and lowest points in an area **S 6.2**

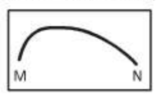
6. If an accident occurs in a science laboratory, the first thing you should do is
A determine the cause of the accident.
B notify your teacher.
C locate the first-aid kit.
D put a bandage on the affected area. **S 6.7.a**

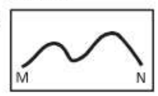
Use the map below and your knowledge of science to answer Questions 7 and 8.

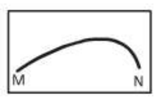


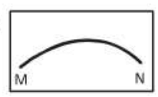
Contour interval = 15 meters

7. A topographic profile shows the shape or relief of the land along a given line. Along line M-N on the map, which of the following would the profile most closely resemble?

A


B


C


D


S 6.7.f

8. What is the elevation of the point marked *x* on the map?
A 1,400 meters **B** 1,500 meters
C 1,485 meters **D** 1,515 meters
S 6.7.f

9. On a map, what is the height above sea level of a point on Earth's surface called?
A topography **B** relief
C elevation **D** latitude **S 6.2**

Apply the BIG Idea

10. Choose one of the lithosphere, hydrosphere, atmosphere, or biosphere. Describe how you think the sun's energy affects that part of the Earth system. Then explain how a change in that part of the system might affect one of the other parts. **S 6.4.a**