Chapter

2 Living Things

The BIG Idea

Cell structure and function

Q **How does the structure of a cell allow it to carry out the basic processes of life?**

Georgia Performance Standards

S7CS4 Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities.

S7CS8 Students will investigate the characteristics of scientific knowledge and how it is achieved.

S7L1 Students will investigate the diversity of living organisms and how they can be compared scientifically.

a. Demonstrate the process for the development of a dichotomous key.

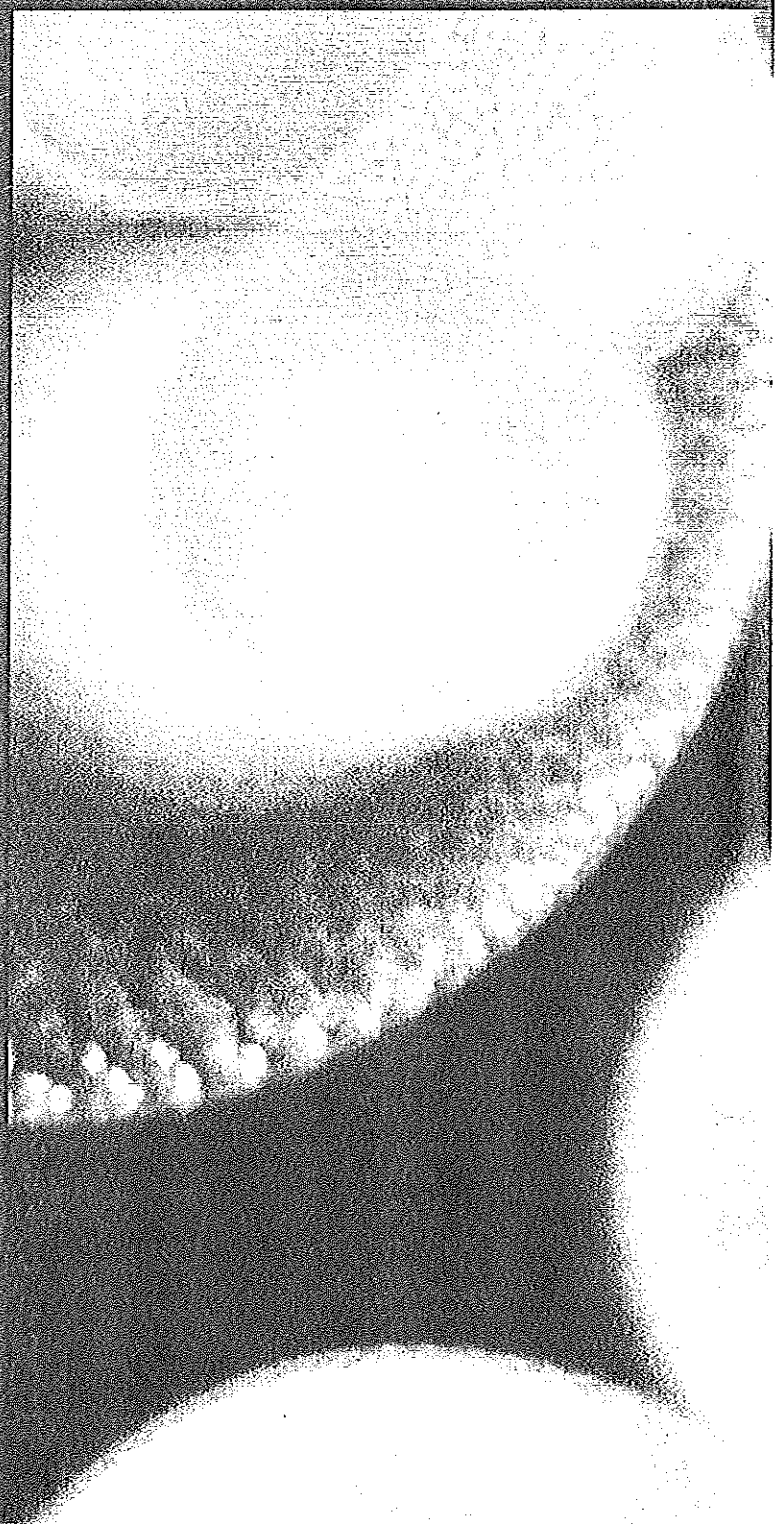
b. Classify organisms based on physical characteristics using a dichotomous key of the six kingdom system (archaebacteria, eubacteria, protists, fungi, plants, and animals).

S7L2 Students will describe the structure and function of cells, tissues, organs, and organ systems.

a. Explain that cells take in nutrients in order to grow and divide and to make needed materials.

b. Relate cell structures (cell membrane, nucleus, cytoplasm, chloroplasts, mitochondria) to basic cell functions.

c. Explain that cells are organized into tissues, tissues into organs, organs into systems, and systems into organisms.



Each transparent ball is a tiny freshwater organism known as a *Volvox*.

Discovery Channel School

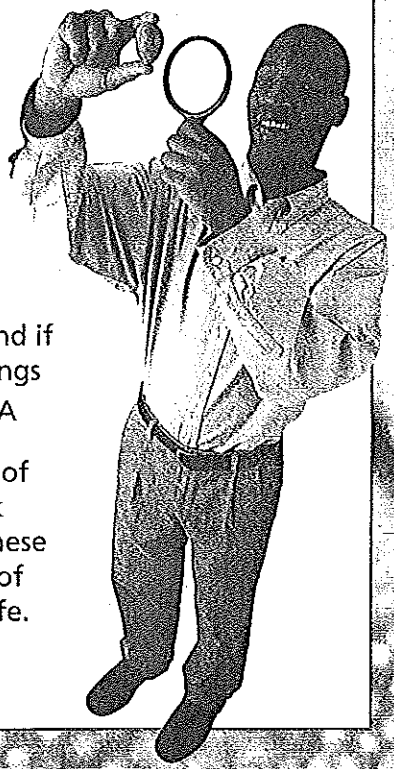
Cell Structure and Function

- ▶ Video Preview
- Video Field Trip
- Video Assessment

Lab zone™ Chapter Project

Mystery Object

It's not always easy to tell whether something is alive. In this chapter, you will learn the characteristics of living things. As you study this chapter, your challenge will be to determine whether or not a mystery object is alive.



Your Goal To study a mystery object for several days to determine whether or not it is alive

To complete the project, you must

- care for your object following your teacher's instructions
- observe your object each day, and record your data
- determine whether your object is alive, and if so, to which domain and kingdom it belongs
- follow the safety guidelines in Appendix A

Plan It! Before you get started, create a list of characteristics that living things share. Think about whether nonliving things also share these characteristics. Also, think about what kind of tests you can carry out to look for signs of life. Create data tables in which to record your observations.

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

Prefixes

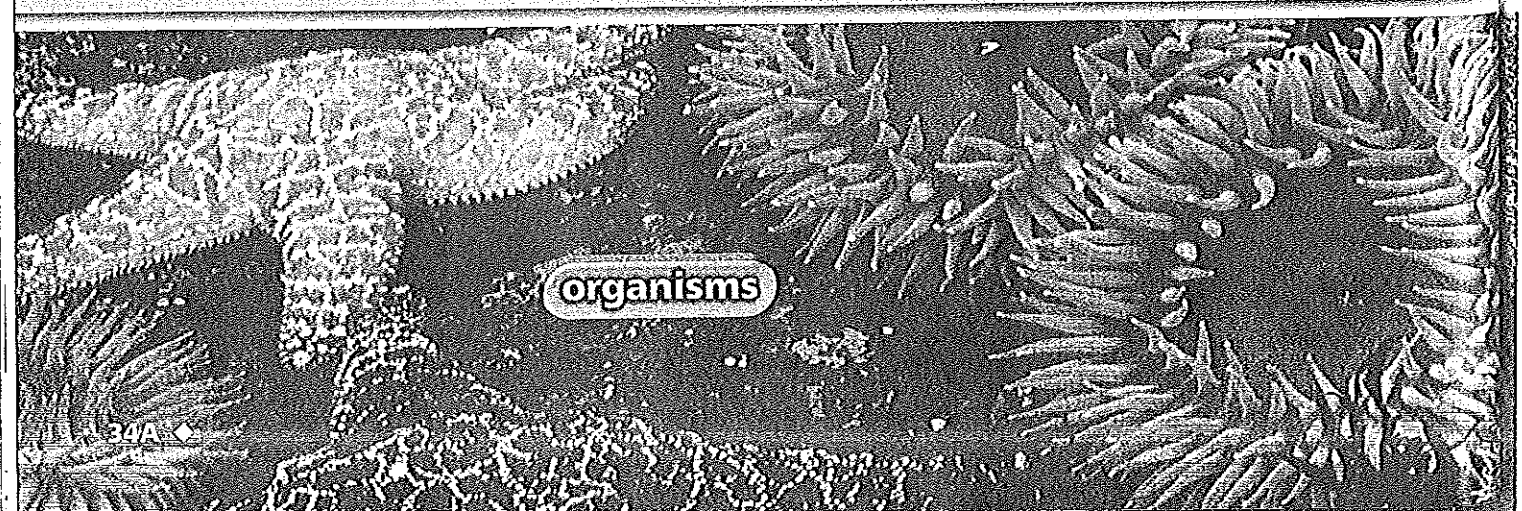
Words can sometimes be divided into parts. A root is the part of the word that carries the basic meaning. A prefix is a word part that is placed in front of the root to change the word's meaning. In the word *multicellular,* for example, *-cellular* is the root and *multi-* is the prefix. The prefix *multi-* means "many." *Multicellular* means "having many cells."

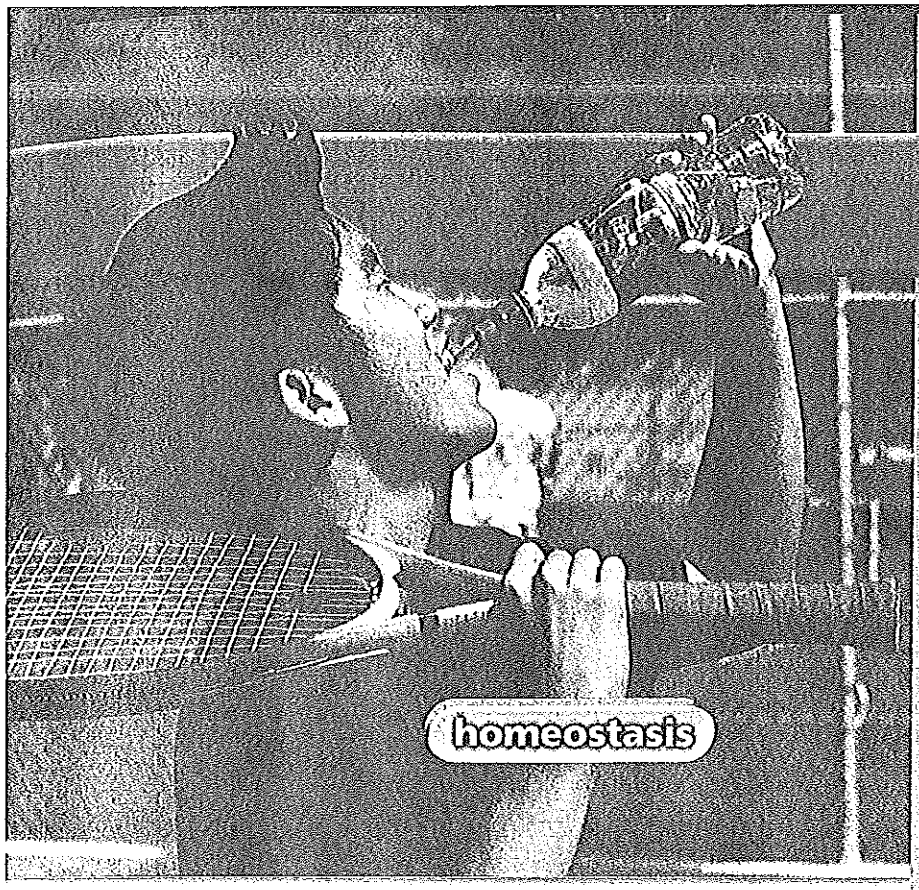
The prefixes below will help you understand some key terms.

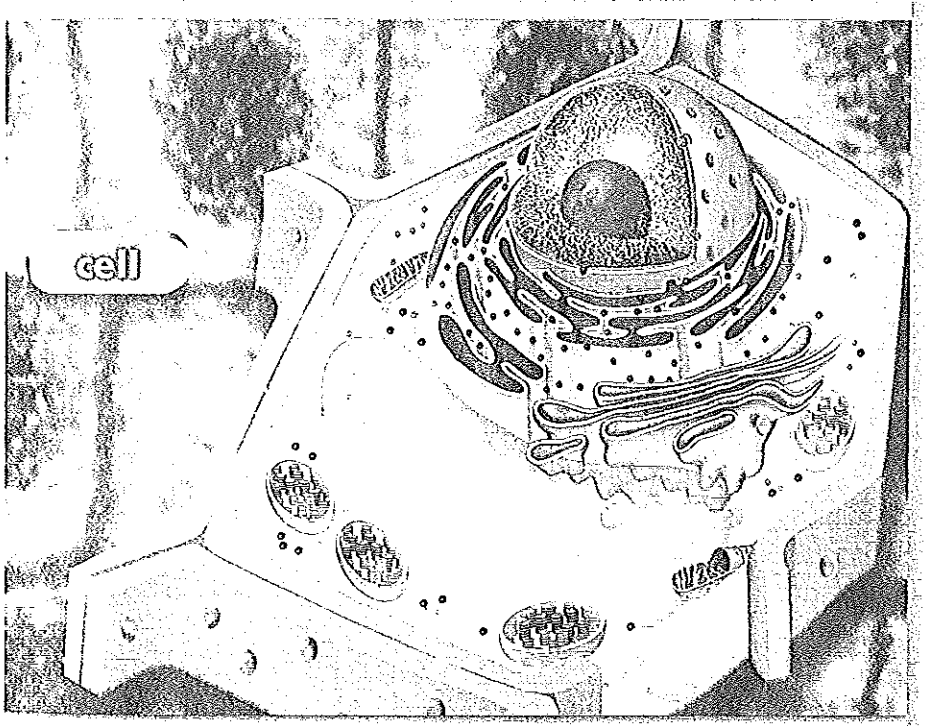
Prefix	Meaning	Example Word
chlor-	green	**chloroplast** A cellular structure that captures energy from sunlight
cyto-	cell	**cytoskeleton** The framework inside a cell
multi-	many	**multicellular** Having many cells
uni-	one	**unicellular** Having one cell

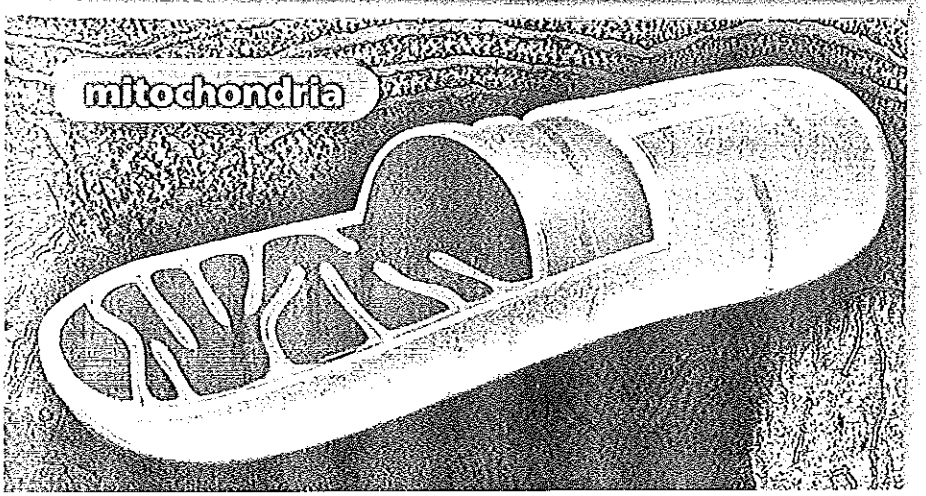
Apply It!

1. A **chloroplast** is a structure in plant cells. What color do you think a chloroplast is?
2. What clue within the word **cytoplasm** lets you know that the word has something to do with cells?









Chapter 2 Vocabulary

Section 1 (page 34)

organism
cell
unicellular
multicellular
stimulus
response
development
spontaneous generation
autotroph
heterotroph
homeostasis

Section 2 (page 42)

classification
taxonomy
binomial nomenclature
genus
species
prokaryote
nucleus
eukaryote

Section 3 (page 52)

cell
microscope
cell theory

Section 4 (page 60)

organelle
cell wall
cell membrane
cytoplasm
mitochondria
endoplasmic reticulum
ribosome
Golgi body
chloroplast
vacuole
lysosome

Go Online
PHSchool.com

For: Build science vocabulary
Visit: PHSchool.com
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Section 1

What Is Life?

Reading Preview

Key Concepts

- What characteristics do all living things share?
- Where do living things come from?
- What do living things need to survive?

Key Terms

- organism • cell • unicellular
- multicellular • stimulus
- response • development
- spontaneous generation
- autotroph • heterotroph
- homeostasis

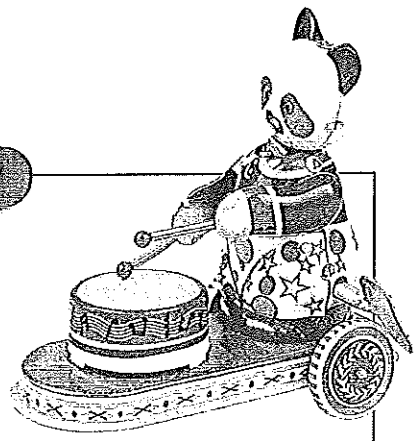
Target Reading Skill

Using Prior Knowledge Look at the section headings and visuals to see what this section is about. Then write what you already know about living things in a graphic organizer like the one below. As you read, write what you learn.

What You Know
1. Living things grow. 2.

What You Learned
1. 2.

Lab zone **Discover Activity**



Is It Living or Nonliving?

1. Your teacher will give you and a partner a wind-up toy.
2. One of you will look for evidence that the toy is alive and the other will look for evidence that the toy is not alive.
3. Observe the toy. List the evidence that supports your position about whether or not the toy is alive.
4. Share your lists with your classmates.

Think It Over

Forming Operational Definitions Based on what you just learned, create a list of characteristics that living things share.

If you were asked to name some living things, or **organisms,** you might name yourself, a pet, and maybe some insects or plants. You would probably not mention a moss growing in a shady spot, the mildew on bathroom tiles, or the slime molds that oozed across lawns. But all of these things are organisms.

The Characteristics of Living Things

Living things share important characteristics. **All living things have a cellular organization, contain similar chemicals, use energy, respond to their surroundings, grow and develop, and reproduce.**

Cellular Organization All organisms are made of small building blocks called cells. A **cell** is the basic unit of structure and function in an organism. Cells are so small that you need a microscope to see them.

Organisms may be composed of only one cell or of many cells. **Unicellular,** or single-celled organisms, include bacteria (bak TIHR ee uh), the most numerous organisms on Earth. **Multicellular** organisms are composed of many cells that are specialized to do certain tasks. For example, you are made of trillions of cells. Specialized cells in your body, such as muscle and nerve cells, work together to keep you alive.

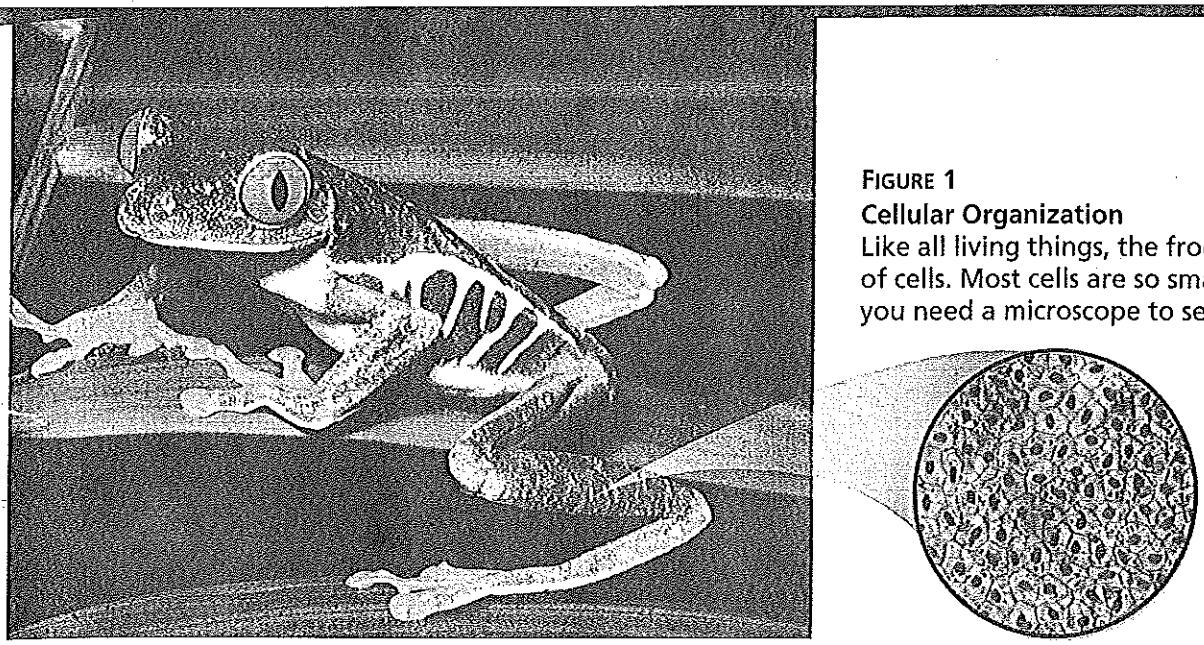


FIGURE 1
Cellular Organization
Like all living things, the frog is made of cells. Most cells are so small that you need a microscope to see them.

The Chemicals of Life The cells of all living things are composed of chemicals. The most abundant chemical in cells is water. Other chemicals, called carbohydrates (kahr boh HY drayts), are a cell's main energy source. Two other chemicals, proteins (PROH teenz) and lipids, are the building materials of cells. Nucleic (noo KLEE ik) acids are the genetic material—the chemical instructions that direct the cell's activities.

Energy Use The cells of organisms use energy to do what living things must do, such as repairing injured parts. An organism's cells are always hard at work. For example, as you read this paragraph, your eye and brain cells are at work. Your blood cells are busy moving chemicals around your body.

Response to Surroundings Have you noticed that plant stems bend toward the light? Plants and all other organisms react to changes in their environment. A change in an organism's surroundings that causes the organism to react is called a **stimulus** (plural *stimuli*). Stimuli include changes in temperature, light, sound, and other factors. An organism reacts to a stimulus with a **response**—an action or change in behavior. For example, has the sound of a car horn ever startled you? The sound was a stimulus that caused your response.

Growth and Development Living things also grow and develop. Growth is the process of becoming larger. **Development** is the process of change that occurs during an organism's life to produce a more complex organism.

Reproduction Another characteristic of organisms is the ability to reproduce, or produce offspring that are similar to the parents. For example, robins lay eggs that develop into young robins that closely resemble their parents.

Lab zone **Try This Activity**

React!

1. Have a partner clap his or her hands together about 10 centimeters in front of your face. Describe how you react.
2. Look at one of your eyes in a mirror. Cover the eye with your hand for a minute. While looking in the mirror, remove your hand. Observe how the size of your pupil changes.
3. Bring a slice of lemon close to your nose and mouth. Describe what happens.

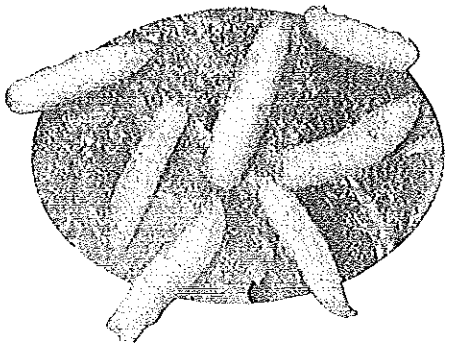
Classifying For each action performed, name the stimulus and the response.

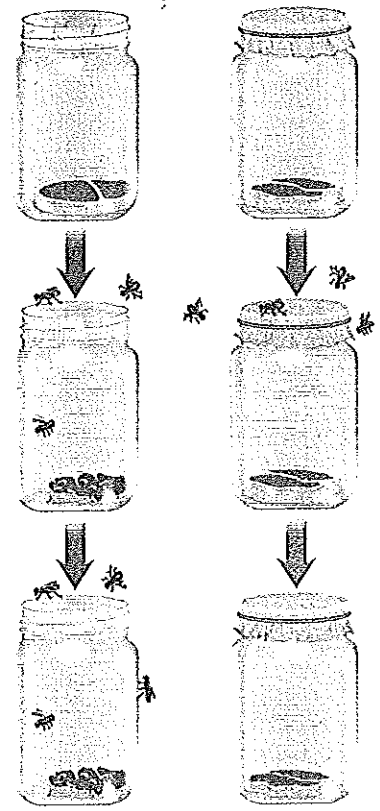
FIGURE 2

Redi's Experiment

Francesco Redi designed one of the first controlled experiments. In his experiment, Redi showed that flies do not spontaneously arise from decaying meat.

Controlling Variables *What is the manipulated variable in this experiment?*





1. Redi placed meat in two identical jars. He left one jar uncovered. He covered the other jar with a cloth that let in air.

2. After a few days, Redi saw maggots (young flies) on the decaying meat in the open jar. There were no maggots on the meat in the covered jar.

3. Redi reasoned that flies had laid eggs on the meat in the open jar. The eggs hatched into maggots. Because flies could not lay eggs on the meat in the covered jar, there were no maggots there. Redi concluded that decaying meat did not produce maggots.

Go Online
active art

For: Redi's and Pasteur's Experiments activity
Visit: PHSchool.com
Web Code: cep-1011

Life Comes From Life

Today, when people see moths fly out of a closet or weeds poking out of cracks in the sidewalk, they know that these organisms are the result of reproduction. **Living things arise from living things through reproduction.** However, four hundred years ago, people believed that life could appear from nonliving material. For example, they thought that flies could arise from rotting meat. The mistaken idea that living things can arise from nonliving sources is called **spontaneous generation.** It took hundreds of years of experiments to convince people that spontaneous generation does not occur.

Redi's Experiment In the 1600s, an Italian doctor named Francesco Redi helped to disprove spontaneous generation. Redi designed a controlled experiment to show that flies do not arise from decaying meat. Recall that in a controlled experiment, a scientist carries out two tests that are identical in every respect except for one factor. The one factor that a scientist changes is called the manipulated variable.

Lab zone Skills Activity

Designing Experiments

Your teacher will give you a slice of potato. Predict what percentage of the potato's mass is water. Then come up with a plan to test your prediction. For materials, you will be given a hair dryer and a balance. Obtain your teacher's approval before carrying out your plan. How does your result compare with your prediction?

The Needs of Living Things

Though it may seem surprising, flies, bacteria, and all other organisms have the same basic needs as you. **All living things must satisfy their basic needs for water, food, living space, and stable internal conditions.**

Water All living things need water to survive. In fact, most organisms can live for only a few days without water. Organisms need water to obtain chemicals from their surroundings, break down food, grow, move substances within their bodies, and reproduce.

Food Recall that organisms need a source of energy to live. They use food as their energy source. Organisms differ in the ways they obtain energy. Some organisms, such as plants, capture the sun's energy and use it to make food. Organisms that make their own food are called **autotrophs** (AW toh trohfs). *Auto-* means "self" and *-troph* means "feeder." Autotrophs use the food they make to carry out their own life functions.

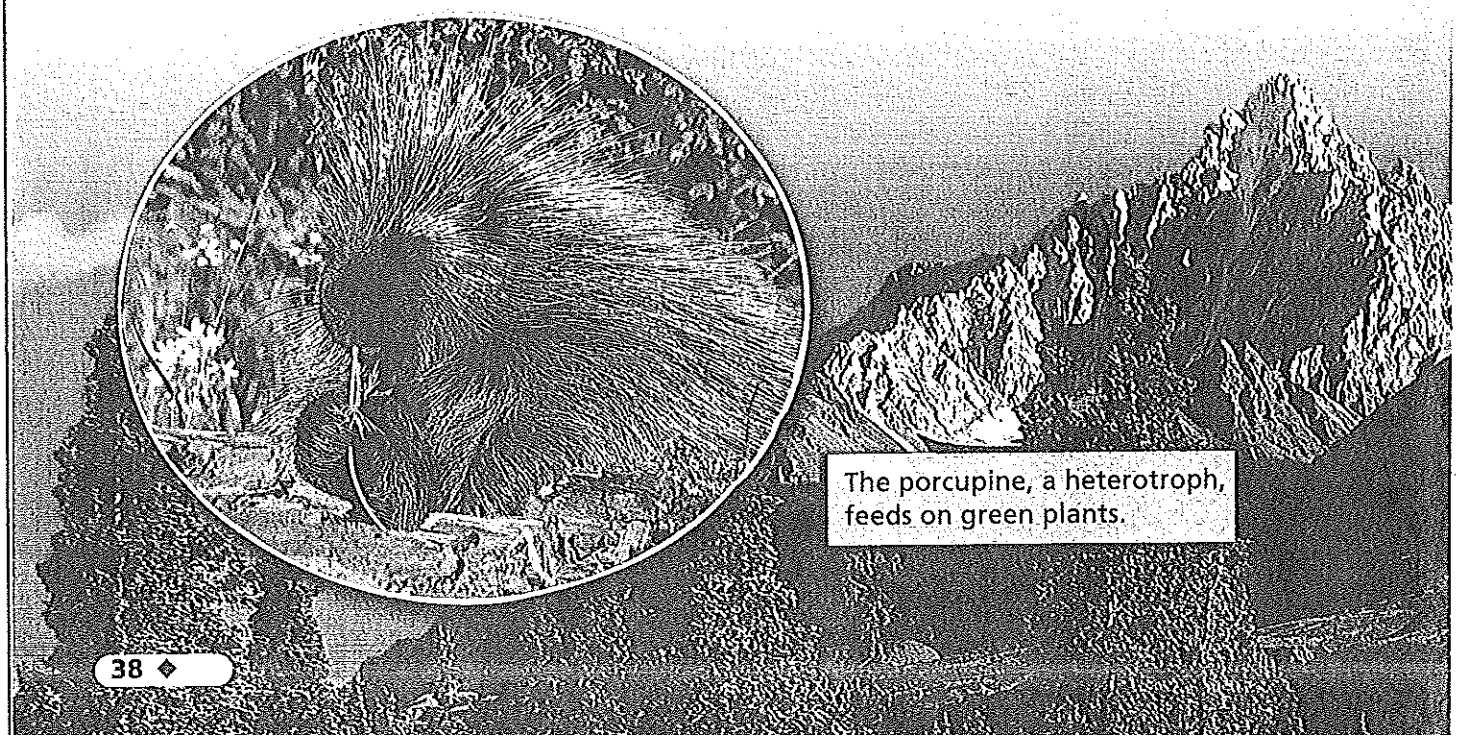
Organisms that cannot make their own food are called **heterotrophs** (HET uh roh trohfs). *Hetero-* means "other." Heterotrophs obtain their energy by feeding on others. Some heterotrophs eat autotrophs and use the energy in the autotroph's stored food. Other heterotrophs consume heterotrophs that eat autotrophs. Therefore, a heterotroph's energy source is also the sun—but in an indirect way. Animals, mushrooms, and slime molds are examples of heterotrophs.

Reading Checkpoint **Why are plants called autotrophs?**

FIGURE 4

Water, Food, and Living Space

This environment meets the needs of the many animals that live there. Inferring *How do plants meet their needs for food?*



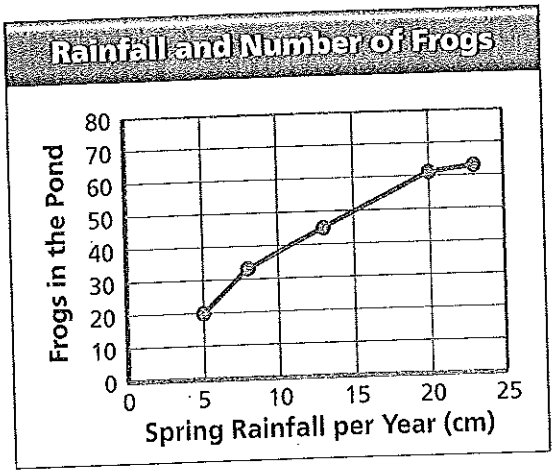
The porcupine, a heterotroph, feeds on green plants.

Math Analyzing Data

Frogs and Rainfall

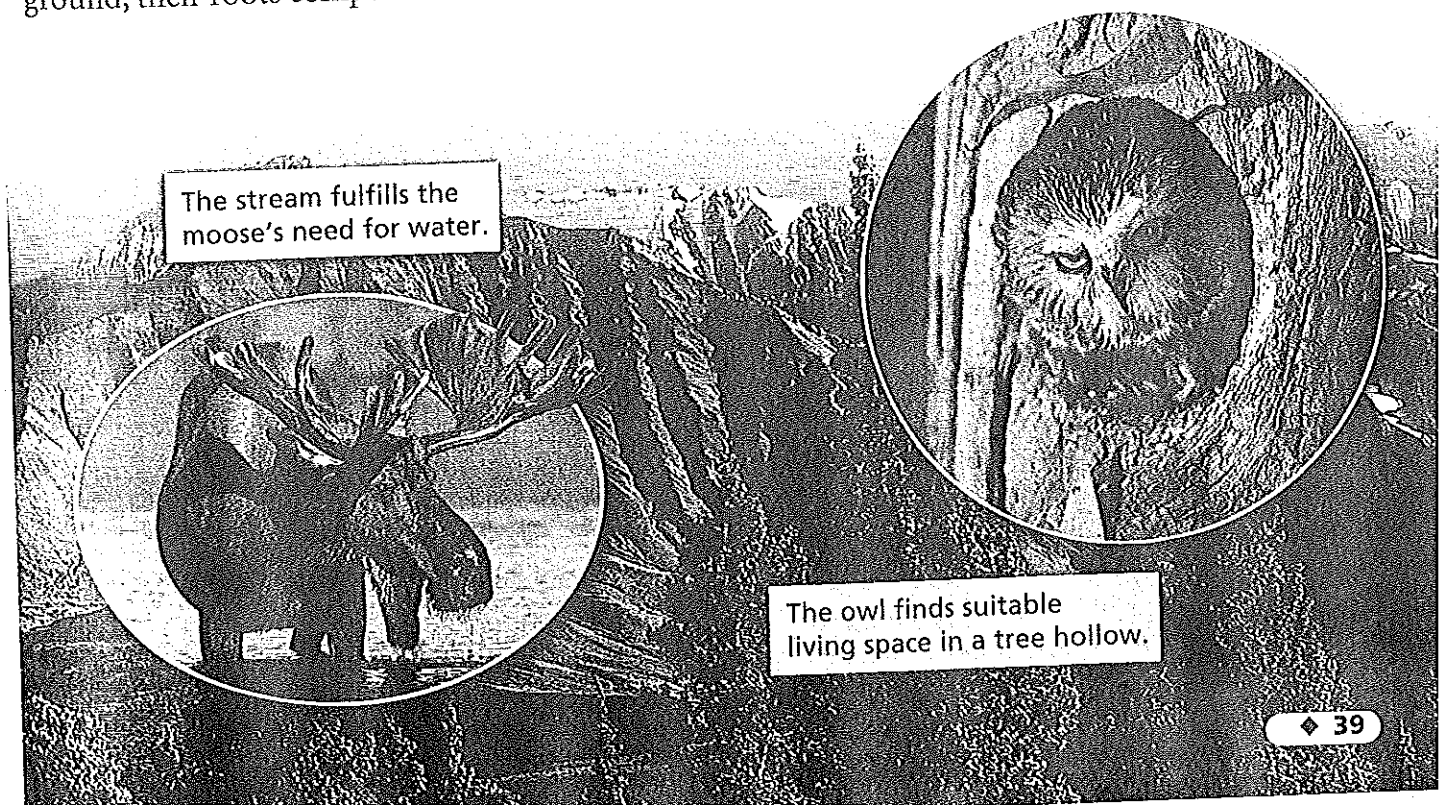
Frogs need a moist environment, such as a pond, to survive. For five years, a scientist counted the frogs in a pond. The scientist also measured the spring rainfall.

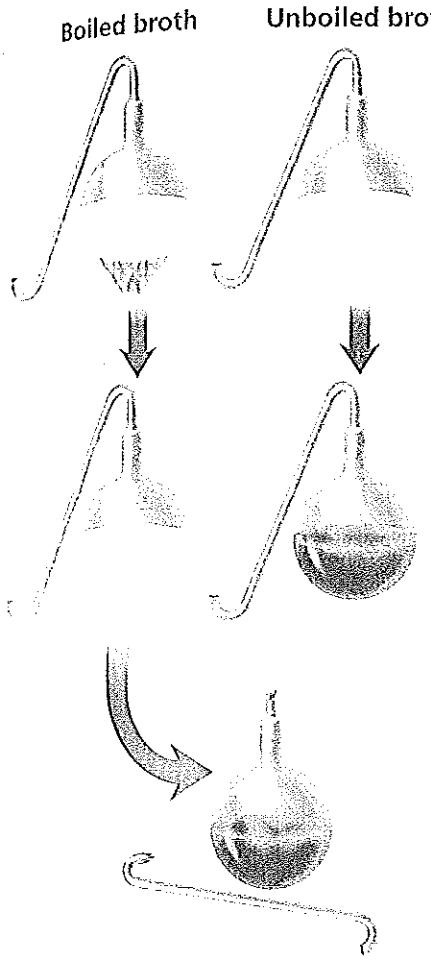
1. Reading Graphs What data are plotted on the horizontal axis? What units were used?
2. Interpreting Data What was the greatest number of frogs that the scientist recorded? How much rain fell that spring?
3. Making Generalizations What is the relationship between the number of frogs and the amount of spring rain? What do you know about living things that might help explain that relationship?



Living Space All organisms need a place to live—a place to get food and water and find shelter. Whether an organism lives in the freezing Antarctic or the scorching desert, its surroundings must provide what it needs to survive.

Because there is a limited amount of space on Earth, some organisms must compete for space. Trees in a forest, for example, compete with other trees for sunlight above ground. Below ground, their roots compete for water and minerals.





1. Pasteur put clear broth into two flasks with curved necks. The necks would let in oxygen but keep out bacteria from the air. Pasteur boiled the broth in one flask to kill any bacteria in the broth. He did not boil the broth in the other flask.

2. In a few days, the unboiled broth became cloudy, showing that new bacteria were growing. The boiled broth remained clear. Pasteur concluded that bacteria do not spontaneously arise from the broth. New bacteria appeared only when living bacteria were already present.

Later, Pasteur took the flask with the broth that had remained clear and broke its curved neck. Bacteria from the air could now enter the flask. In a few days, the broth became cloudy. This evidence confirmed that new bacteria arise only from existing bacteria.

FIGURE 3
Pasteur's Experiment
Louis Pasteur's carefully controlled experiment demonstrated that bacteria arise only from existing bacteria.

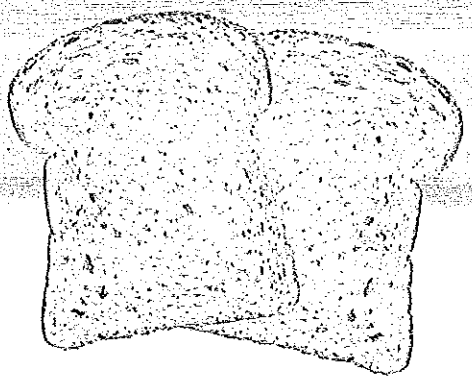
▲ Pasteur in his laboratory

In Redi's experiment, shown in Figure 2, the manipulated variable was whether or not the jar was covered. Flies were able to enter the uncovered jar and lay their eggs on the meat inside. These eggs hatched into maggots, which developed into new flies. The flies could not enter the covered jar, however. Therefore, no maggots formed on the meat in the covered jar. Through his experiment, Redi was able to conclude that rotting meat does not produce flies.

Pasteur's Experiment Even after Redi's work, many people continued to believe that spontaneous generation could occur. In the mid-1800s, the French chemist Louis Pasteur designed some controlled experiments that finally rejected spontaneous generation. As shown in Figure 3, he demonstrated that new bacteria appeared in broth only when they were produced by existing bacteria. The experiments of Redi and Pasteur helped to convince people that living things do not arise from nonliving material.

Reading Checkpoint **What is a controlled experiment?**

Lab zone Skills Lab



Please Pass the Bread!

Problem

What factors are necessary for bread molds to grow?

Skills Focus

observing, controlling variables

Materials

- paper plates
- plastic dropper
- bread without preservatives
- sealable plastic bags
- tap water
- packing tape

Procedure

1. Brainstorm with others to predict which factors might affect the growth of bread mold. Record your ideas.
2. Place two slices of bread of the same size and thickness on separate, clean plates.
3. To test the effect of moisture on bread mold growth, add drops of tap water to one bread slice until the whole slice is moist. Keep the other slice dry. Expose both slices of bread to the air for one hour.
4. Put each slice into its own sealable bag. Press the outside of each bag to remove the air. Seal the bags. Then use packing tape to seal the bags again. Store the bags in a warm, dark place.
5. Copy the data table into your notebook.
6. Every day for at least five days, briefly remove the sealed bags from their storage place. Record whether any mold has grown. Estimate the area of the bread where mold is present. **CAUTION:** *Do not unseal the bags. At the end of the experiment, give the sealed bags to your teacher.*

Analyze and Conclude

1. Observing How did the appearance of the two slices of bread change over the course of the experiment?
2. Inferring How can you explain any differences in appearance between the two slices?
3. Controlling Variables What was the manipulated variable in this experiment? Why was it necessary to control all other variables except this one?
4. Communicating Suppose that you lived in Redi's time. A friend tells you that molds just suddenly appear on bread. How would you explain to your friend about Redi's experiment and how it applies to molds and bread?

Design an Experiment

Choose another factor that may affect mold growth, such as temperature or the amount of light. Set up an experiment to test the factor you choose. Remember to keep all conditions the same except for the one you are testing. *Obtain your teacher's permission before carrying out your investigation.*

Data Table

	Moistened Bread Slice		Unmoistened Bread Slice	
Day	Mold Present?	Area With Mold	Mold Present?	Area With Mold
1				
2				

FIGURE 5
Homeostasis
Sweating helps your body maintain a steady body temperature. Your body produces sweat during periods of strenuous activity. As the sweat evaporates, it cools your body down.

Stable Internal Conditions Organisms must be able to keep the conditions inside their bodies stable, even when conditions in their surroundings change significantly. For example, your body temperature stays steady despite changes in the air temperature. The maintenance of stable internal conditions is called **homeostasis** (hoh mee oh STAY sis).

Homeostasis keeps internal conditions just right for cells to function. Think about your need for water after a hard workout. When water levels in your body decrease, chemicals in your body send signals to your brain, causing you to feel thirsty.

Other organisms have different mechanisms for maintaining homeostasis. Consider barnacles, which as adults are attached to rocks at the edge of the ocean. At high tide, they are covered by water. At low tide, however, the watery surroundings disappear, and barnacles are exposed to hours of sun and wind. Without a way to keep water in their cells, they would die. Fortunately, a barnacle can close up its hard outer plates, trapping some water inside. In this way, a barnacle can keep its body moist until the next high tide.

Reading Checkpoint **What is homeostasis?**

Section 1 Assessment

Vocabulary Skill Prefixes Complete the following sentences with key terms.

Because bacteria each have only one cell, bacteria are _____ organisms. Animals have many cells. Therefore, animals are _____ organisms.

Reviewing Key Concepts

1. a. Reviewing List the six characteristics of living things.
   b. Inferring A bird sitting in a tree flies away as you walk by. Which of the life characteristics explains the bird's behavior?
   c. Applying Concepts Explain why the tree, which does not move away, is also considered a living thing.
2. a. Defining What was meant by the idea of *spontaneous generation*?
   b. Explaining Why is this idea incorrect?
   c. Summarizing How did Pasteur's experiment help show that spontaneous generation does not occur?
3. a. Identifying What four things do all organisms need to survive?
   b. Describing Which need is a fox meeting by feeding on berries?
   c. Applying Concepts The arctic fox has thick, dense fur in the winter and much shorter fur in the summer. How does this help the fox maintain homeostasis?

Lab zone At-Home Activity

Observing Life With a family member, observe a living thing, such as a family pet, a houseplant, or a bird outside your window. Record your observations as you study the organism. Prepare a chart that shows how the organism meets the four needs of living things discussed in this section.