Most plants do not move in the same way animals do. Only parts of the plants move. The stems of many plants, for example, bend toward sunlight so the leaves on the plants can catch the sun's rays.

Living Things Perform Complex Chemical Activities

Building up and breaking down is a good way to describe the chemical activities that are essential to life. During some of these activities, simple substances combine to form complex substances. These substances are needed by an organism to grow, store energy, and repair or replace cells and other body parts. During other activities, complex substances are broken down, releasing energy and usable food substances. Together, these chemical activities are called **metabolism** (muh-TAB-uh-lih-zuhm). Metabolism is another characteristic of living things.

Metabolism is the sum total of all the chemical reactions that occur in a living thing. But before metabolism can begin, most organisms must perform a physical activity—taking in food.

INGESTION All living things must either take in food or produce their own food. For most animals, **ingestion,** or eating, is as simple as putting food into their mouths.

Green plants do not have to ingest food. Green plants are able to make their own food. Using their roots, green plants absorb water and minerals from the soil. Tiny openings in the underside of their

ACTIVITY DOING

Stimulus-Response Reactions

1. Hold your hands close to a friend's face. Quickly clap your hands while observing your friend's eyes.

2. While standing in front of a mirror, cover one of your eyes with your hand for a minute. Remove your hand and immediately look into the mirror and note any changes in your eye.

3. With a knife, cut a slice of lemon. **Caution**: *Be careful when using a knife.* Bring the lemon slice close to your mouth or put it in your mouth.

In a data table, describe the stimulus and the response for each of these activities.


Figure 1–14 *Green plants can make their own food, but animals must eat food. The grasshopper is feeding on a sunflower plant. The gecko, however, prefers a meatier dinner.*

Activity Bank

Hydra Doing?, p. 106

leaves allow carbon dioxide to enter. The green plants use the water and carbon dioxide, along with energy from the sun, to make food in the process called photosynthesis.

DIGESTION Getting food into the body is a first step. Now the process of metabolism can begin. But there is a lot more to metabolism than just eating. The food must be digested in order to be used. **Digestion** is the process by which food is broken down into simpler substances. Later some of these simpler substances are reassembled into more complex materials for use in the growth and repair of the living thing. Other simple substances store energy that the organism will use for its many activities.

RESPIRATION All living things require energy to survive. To obtain energy, living things combine oxygen with the products of digestion (in animals) or the products of photosynthesis (in green plants). The energy is used to do the work of the organism. The process by which living things take in oxygen and use it to produce energy is called **respiration**. You get the energy you need by combining the foods you eat with the oxygen you breathe.

EXCRETION Not all the products of digestion and respiration can be used by an organism. Some products are waste materials that must be released. The process of getting rid of waste materials is called **excretion.** Like ingestion, excretion is a physical process. Without excretion, the waste products of digestion and respiration will build up in the body and eventually poison the organism.

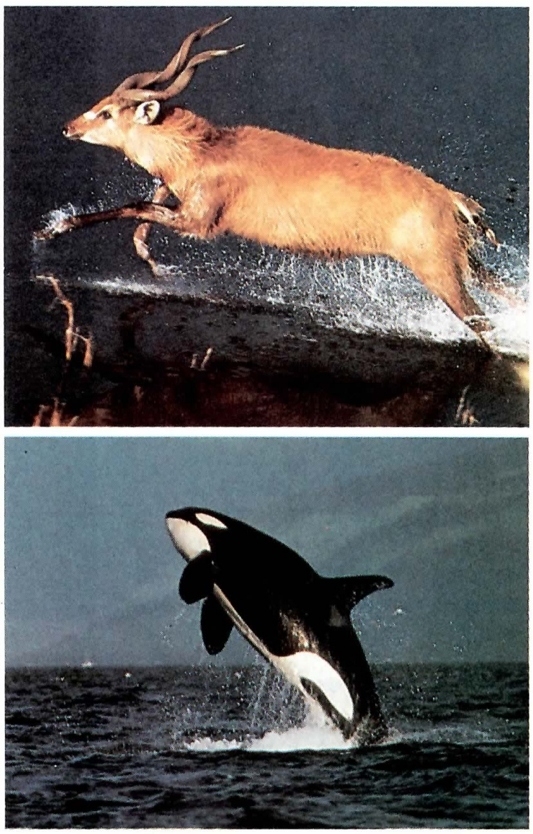

Figure 1–15 *The gazelle obtains the energy it needs to run away from a predator by combining oxygen with food in a process called respiration. Although the killer whale spends most of its time under water, it must return to the surface to take in the oxygen it requires for respiration. Where do fish obtain the oxygen they require?*

Living Things Grow and Develop

The concept that living things grow is certainly not new to you. In fact, at this moment you are in the process of growth yourself. (How many times have you been told "When you grow up you can . . ."?)

When you think of growth, you probably think of something getting bigger. And that is certainly one part of growth. But growth can mean more than just an increase in size. Living things also become more complex, or develop, during the growth process. Sometimes this development results in dramatic changes. A tadpole, for example, swims for weeks in

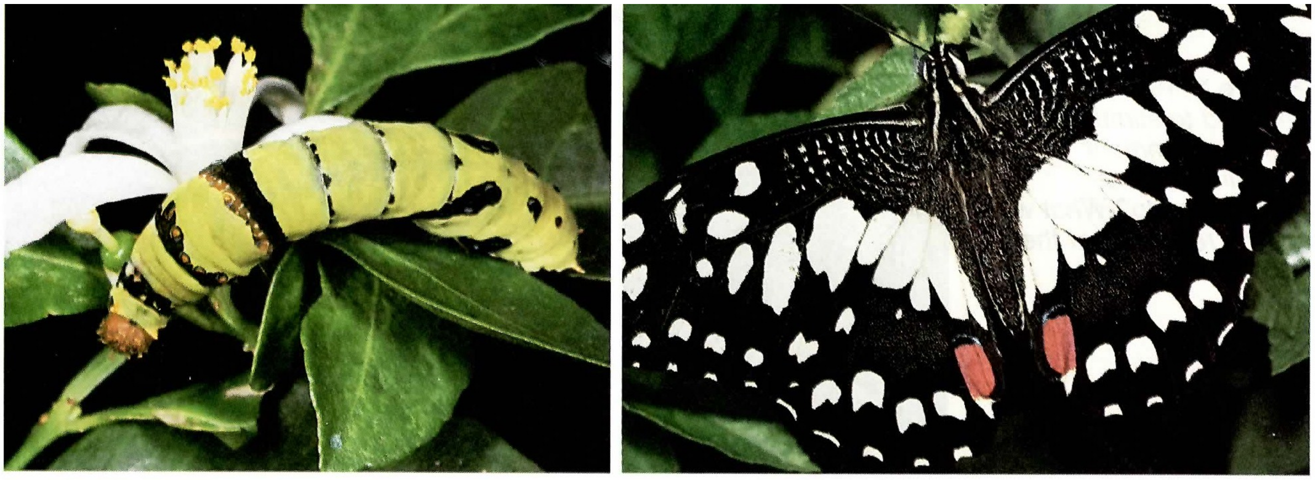

Figure 1–16 *All living things grow and develop. Usually growth means simply getting larger, not changing form. But that is not always the case. This caterpillar will grow and develop into an adult lime butterfly.*

a summer pond. Then one day that tadpole becomes the frog that sits near the water's edge. And surely the caterpillar creeping through a garden gives little hint of the beautiful butterfly it will soon become. So both growth and development must be added to the list of characteristics of living things.

One of the important aspects of growth and development is **life span**. Life span is the maximum length of time a particular organism can be expected to live. Life span varies greatly from one type of organism to another. For example, an Indian elephant may live to be 80 years old. A bristlecone pine tree may live to be 5500 years old!

Living Things Respond to Their Environment

Scientists call each of the signals to which an organism reacts a **stimulus** (plural: stimuli). A stimulus is any change in the environment, or surroundings, of an organism that produces a **response** by that organism. A response is some action, movement, or change in behavior of the organism.

Figure 1–17 *In certain organisms, growth and development take up most of the life span. The mayfly spends two years in lakes, growing and developing into an adult. The adult, however, lives for only one day, during which it finds a mate, reproduces, and then dies. The life span of the bristlecone pine, on the other hand, can last up to 5500 years.*

Figure 1–18 *Living things respond to stimuli from their environment. What stimuli is the bat responding to? What will be the response of the frog?*

Some stimuli come from outside an organism's body. For example, smells and noises are stimuli to which you respond. So is tickling. Light and water are stimuli to which plants respond. Other stimuli come from inside an organism's body. A lack of oxygen in your body is a stimulus that often causes you to yawn.

Some plants have special responses that protect them. For example, when a gypsy moth caterpillar chews on a leaf of an oak tree, the tree responds by producing bad-tasting chemicals in its other leaves. The chemicals discourage all but the hungriest caterpillars from eating these leaves. Can you think of responses that help you protect yourself?

ACTIVITY DOING

The Great Redi Experiment

1. Obtain 3 wide-mouthed jars. In each jar, place a piece of raw meat about the size of a half dollar.

2. Cover one jar with plastic wrap and another with two thicknesses of cheesecloth. Use rubber bands to hold the plastic wrap and cheesecloth in place. Leave the third jar uncovered.

3. Put the jars in a warm sunny place outdoors where they will remain undisturbed for 3 days. *Do not merely place the jars on a windowsill.*

4. After 3 days, examine the meat in each jar.

In which jar did you find maggots (young flies that resemble worms)? Did you find eggs in or on any of the jars? What does this activity tell you about spontaneous generation?

Living Things Reproduce

You probably know that dinosaurs lived millions of years ago and are now extinct. Yet crocodiles, which appeared on Earth before the dinosaurs, still exist today. An organism becomes extinct when it no longer produces other organisms of the same kind. In other words, all living things of a given kind would become extinct if they did not reproduce.

The process by which living things give rise to the same type of living thing is called reproduction. Crocodiles, for example, do not produce dinosaurs; crocodiles produce only more crocodiles. You are a human—not a water buffalo, duck, or tomato plant—because your parents are humans. An easy way to remember this is *like produces like.*

There are two different types of reproduction: **sexual reproduction** and **asexual reproduction**. Sexual reproduction usually requires two parents. Most

Figure 1–19 *The process by which living things give rise to the same type of living things is called reproduction. Does the bison reproduce through sexual or asexual reproduction?*

multicellular forms of plants and animals reproduce sexually.

Some living things reproduce from only one parent. This is asexual reproduction. When an organism divides into two parts, it is reproducing asexually. Bacteria reproduce this way. Yeast forms growths called buds, which break off and then form new yeast plants. Geraniums and African violets grow new plants from part of a stem, root, or leaf of the parent plant. All these examples illustrate asexual reproduction.

Sexual and asexual reproduction have an important function in common. In each case, the offspring receive a set of special chemical "blueprints," or plans. These blueprints determine the characteristics of that living thing and are passed from one generation to the next.

1–2 Section Review

1. List and describe the characteristics of living things. Which of these characteristics is not necessary for the survival of an organism?
2. Describe Redi's experiment on the spontaneous-generation theory.
3. Define metabolism. What are the main parts of metabolism?
4. Compare sexual and asexual reproduction.

Critical Thinking—*Applying Concepts*

5. A snowball rolling over fresh snow will grow larger. Explain why a rolling snowball is not a living thing.

ACTIVITY
DISCOVERING

Living or Nonliving?

1. Obtain 6 mL of gelatin solution and 4 mL of gum arabic solution from your teacher. Add these solutions together in a test tube.

2. Stopper the test tube. Gently turn it upside down several times to mix the two solutions. **Note:** *Do not shake the test tube.*

3. Remove the stopper from the test tube and add 3 drops of weak hydrochloric acid. **CAUTION:** *Be careful when using acid.*

4. Dip a glass rod into the mixture. Touch a drop of the mixture onto a piece of pH paper. Compare the color of your pH paper to the color scale on the package of pH paper. Repeat steps 3 and 4 until the mixture reaches a pH of 4.

5. Place 2 drops of the mixture on a glass slide. Cover the slide with a coverslip and examine it under low power. Record your observations.

■ In what ways do the droplets seem to be living? In what ways do they seem to be nonliving?