LESSON 1

What Is Life?

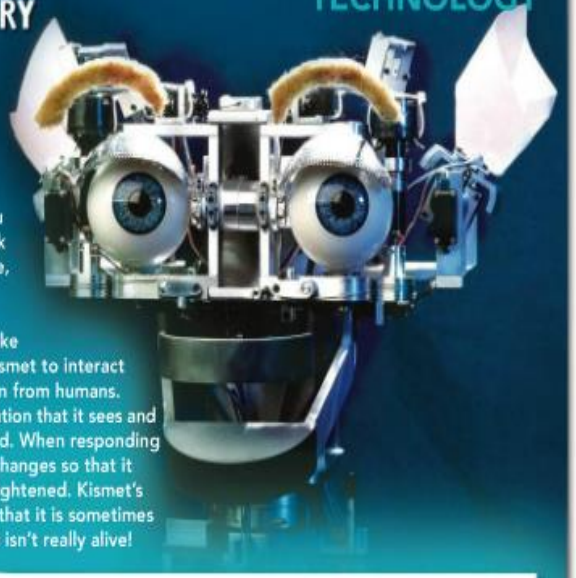
UNLOCK THE BIG Q

- What Are the Characteristics of All Living Things?
- Where Do Living Things Come From?
- What Do Living Things Need to Survive?

MY PLANET DIARY — TECHNOLOGY

It's Kismet!

If you hear a loud noise, do you turn toward the sound to see what caused it? When someone smiles at you, do you smile back? If somebody shook something in front of your face, would you back away? Most people react in these ways, and so does Kismet, a humanlike robot! Scientists developed Kismet to interact with, cooperate with, and learn from humans. Kismet can understand information that it sees and hears as if it were a young child. When responding to information, Kismet's face changes so that it seems interested, happy, or frightened. Kismet's expressions are so convincing that it is sometimes hard to remember that Kismet isn't really alive!



Answer the questions below.

1. What does Kismet do that makes it seem human?

2. What are some things you think Kismet might not be able to do that humans can?

PLANET DIARY Go to **Planet Diary** to learn more about living things.

Lab zone Do the Inquiry Warm-Up *Is It Living or Nonliving?*

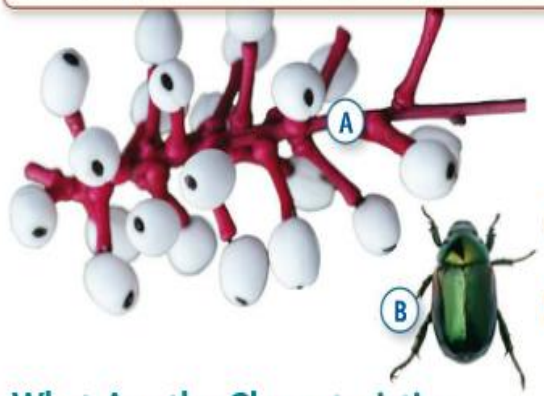
Vocabulary

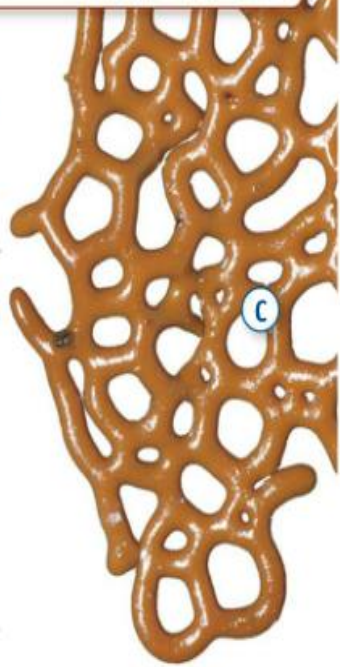
• organism • cell • unicellular • multicellular • metabolism • stimulus • response • development • asexual reproduction • sexual reproduction • spontaneous generation • controlled experiment • autotroph • heterotroph • homeostasis

Skills

Reading: Compare and Contrast

Inquiry: Control Variables





What Are the Characteristics of All Living Things?

If you were asked to name some living things, or **organisms**, you might name yourself, a pet, and 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 ooze across lawns. But all of these things are organisms that share several important characteristics with all other living things. **All living things have a cellular organization, contain similar chemicals, use energy, respond to their surroundings, grow and develop, and reproduce.**

FIGURE 1

It's Alive . . . or Is It?

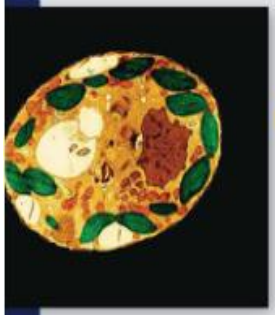
Look at the photos. Then answer the questions.

1. **Identify** List the letter of the photo(s) that you think show living thing(s). _____
2. **Describe** What characteristics helped you decide whether or not the things shown were living or nonliving?

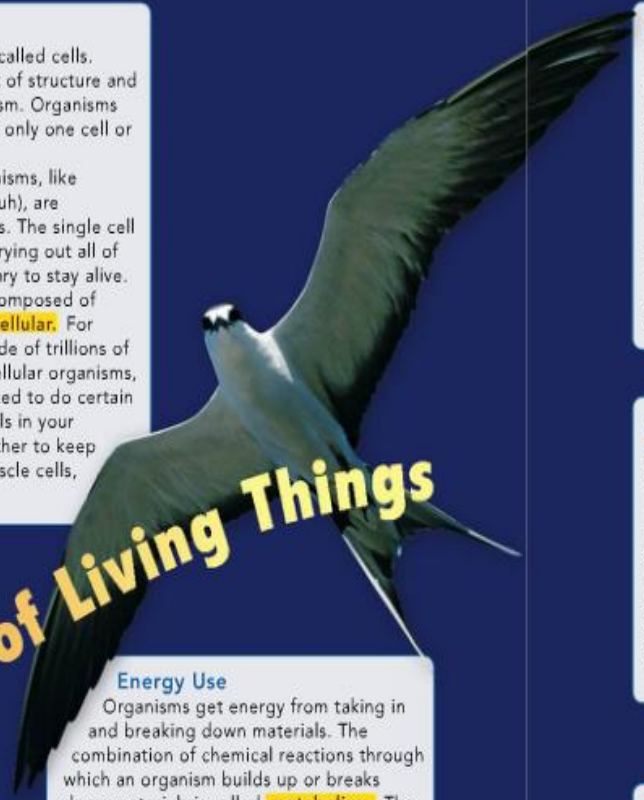
Characteristics of Living Things

Cellular Organization

All organisms are made of small building blocks called cells. A **cell**, like the one shown here, is the basic unit of structure and function in an organism. Organisms may be composed of only one cell or of many cells.

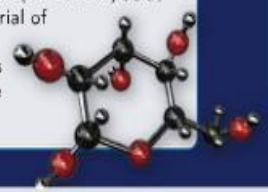


Single-celled organisms, like bacteria (bak TIHR ee uh), are **unicellular** organisms. The single cell is responsible for carrying out all of the functions necessary to stay alive. Organisms that are composed of many cells are **multicellular.** For example, you are made of trillions of cells. In many multicellular organisms, the cells are specialized to do certain tasks. Specialized cells in your body, such as muscle and nerve cells, work together to keep you alive. Nerve cells carry messages to your muscle cells, making your body move.



The Chemicals of Life

The cells of living things are made 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 and lipids, are the building materials of cells, much as wood and bricks are the building materials of houses. Finally, nucleic (noo KLEE ik) acids are the genetic material of cells—the chemical instructions that cells need to carry out the functions of life.



Energy Use

Organisms get energy from taking in and breaking down materials. The combination of chemical reactions through which an organism builds up or breaks down materials is called **metabolism.** The cells of organisms use energy to do what living things must do, such as grow and repair injured parts. An organism's cells are always hard at work. For example, as you read these words, not only are your eye and brain cells busy, but most of your other cells are working, too. Young sooty terns, like the one shown above, need lots of energy to fly. These birds can fly four to five years without ever setting foot on land!

FIGURE 2

Living Things

All living things share the same characteristics.

Make Judgments Which characteristic on these two pages do you think best identifies an object as a living thing? Explain your choice.

Response to Surroundings

If you've ever seen a plant in a sunny window, you may have observed that the plant's stems have bent so that the leaves face the sun. Like a plant bending toward the light, all 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 light, sound, and other factors.

An organism reacts to a stimulus with a **response**—an action or a change in behavior. For example, has someone ever knocked over a glass of water by accident during dinner, causing you to jump? The sudden spilling of water was the stimulus that caused your startled response.

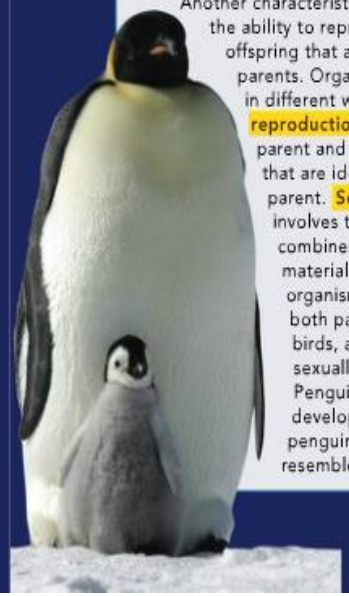
Lab zone Do the Quick Lab *React!*

Growth and Development

All living things grow and develop. Growth is the process of becoming larger. **Development** is the process of change that occurs during an organism's life, producing a more complex organism. As they develop and grow, organisms use energy and make new cells.

Reproduction

Another characteristic of organisms is the ability to reproduce, or produce offspring that are similar to the parents. Organisms reproduce in different ways. **Asexual reproduction** involves only one parent and produces offspring that are identical to the parent. **Sexual reproduction** involves two parents and combines their genetic material to produce a new organism that differs from both parents. Mammals, birds, and most plants sexually reproduce. Penguins lay eggs that develop into young penguins that closely resemble their parents.



Assess Your Understanding

1a. **Review** A change in an organism's surroundings is a (stimulus/response).

b. **Infer** A bird sitting in a tree flies away as you walk by. Which of the life characteristics explains the bird's behavior?

c. **CHALLENGE** Trees do not move like birds do, but they are living things. Why?

got it?

○ I get it! Now I know that all living things

○ I need extra help with

Go to **MY SCIENCE COACH** *online for help with this subject.*

Where Do Living Things Come From?

Today, when people see weeds poking out of cracks in sidewalks or find mice in their cabinet, as shown in **Figure 3,** they know that these organisms are the result of reproduction. **Living things arise from other living things through reproduction.**

Four hundred years ago, however, people believed that life could appear from nonliving material. For example, when people saw flies swarming around decaying meat, they concluded that flies were produced by 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.

FIGURE 3

Spontaneous Generation

Sometimes unexpected visitors, like this mouse, can be found in kitchen cabinets.

Answer the questions.

1. **Develop Hypotheses** If you lived 400 years ago, where might you think the mouse in the cabinet came from?

2. **CHALLENGE** Describe a way in which you could test your hypothesis.

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 maggots, which develop into new flies, do not arise from decaying meat. In a **controlled experiment,** a scientist carries out a series of tests that are identical in every respect except for one factor. The one factor that a scientist changes in an experiment is called the manipulated variable. The factor that changes as a result of changes to the manipulated variable is called the responding variable. Redi's experiment is shown in **Figure 4.**

FIGURE 4

Redi's Experiment

Francesco Redi designed one of the first controlled experiments. Redi showed that flies do not spontaneously arise from decaying meat. Here's how he did it:

STEP 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.

STEP 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.

STEP 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.

apply it!

Use **Figure 4** to answer the following questions about Redi's experiment.

1. **Control Variables** What is the manipulated variable in this experiment?

2. **Control Variables** What is the responding variable?

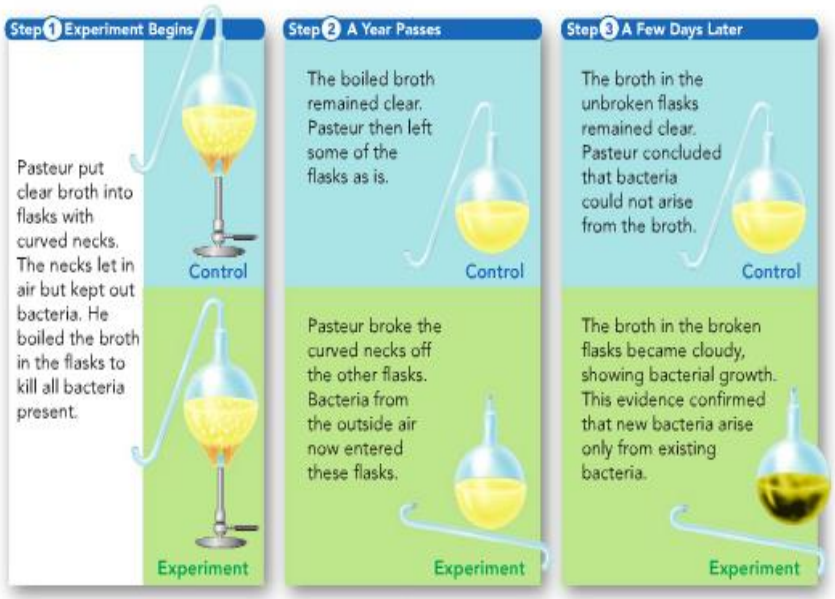
3. **Analyze Sources of Error** Name two factors that would need to be kept constant in this experiment to avoid causing error. Why?

Pasteur's Experiment Even after Redi's experiment, many people continued to believe in spontaneous generation. In the mid-1800s, Louis Pasteur, a French chemist, designed another experiment to test spontaneous generation. That experiment, shown in **Figure 5,** along with Redi's work, finally disproved spontaneous generation.

FIGURE 5

INTERACTIVE ART **Pasteur's Experiment**

Louis Pasteur's carefully controlled experiment demonstrated that bacteria arise only from existing bacteria. **Design Experiments Read each step of the experiment below. Why do you think flasks with curved necks were important?**



Lab zone Do the Quick Lab *Compare Broth Samples.*

Assess Your Understanding

2a. Identify A _____ is the one factor that changes in a controlled experiment.

b. Explain Why is the idea of spontaneous generation incorrect?

_____

_____

got it?

O I get it! Now I know that living things come from _____

O I need extra help with _____

Go to my science coach *online for help with this subject.*

What Do Living Things Need to Survive?

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 food, water, living space, and stable internal conditions.**

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). Heterotrophs obtain energy by feeding on other organisms. Some heterotrophs eat autotrophs for food. Other heterotrophs consume heterotrophs that eat autotrophs. They use the energy in the autotrophs' bodies. Therefore, a heterotroph's energy source is also the sun—but in an indirect way. Animals, mushrooms, and slime molds are examples of heterotrophs.

Compare and Contrast As you read, circle how autotrophs and heterotrophs are similar and underline how they are different.

Vocabulary Greek Word Origins The Greek word part hetero- means "other." How does this word help you to understand how heterotrophs get their food?

_____

_____

FIGURE 6

Food

This giraffe, a heterotroph, obtains its energy by feeding on trees and shrubs.

Identify From your own habitat, name two examples of autotrophs and two examples of heterotrophs.

_____

_____

_____

_____

_____

did you know?

During the summer, when desert temperatures can exceed 47°C, a camel only needs to drink water every five days. At that time, a camel can drink up to 189 liters of water in just a few hours!

FIGURE 7

Desert Oasis

You might be surprised to see so much green in the middle of a desert. In a desert oasis, there is water beneath the surface. The groundwater can bubble to the surface and create springs.

Draw Conclusions **How can a small area in the middle of a desert provide an organism what it needs to survive?**

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.

One property of water that is vital to living things is its ability to dissolve more chemicals than any other substance on Earth. In fact, water makes up about 90 percent of the liquid part of your blood. The food that your cells need dissolves in blood and is transported to all parts of your body. Waste from cells dissolves in blood and is carried away. Your body's cells also provide a watery environment for chemicals to dissolve.

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 Arctic 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.

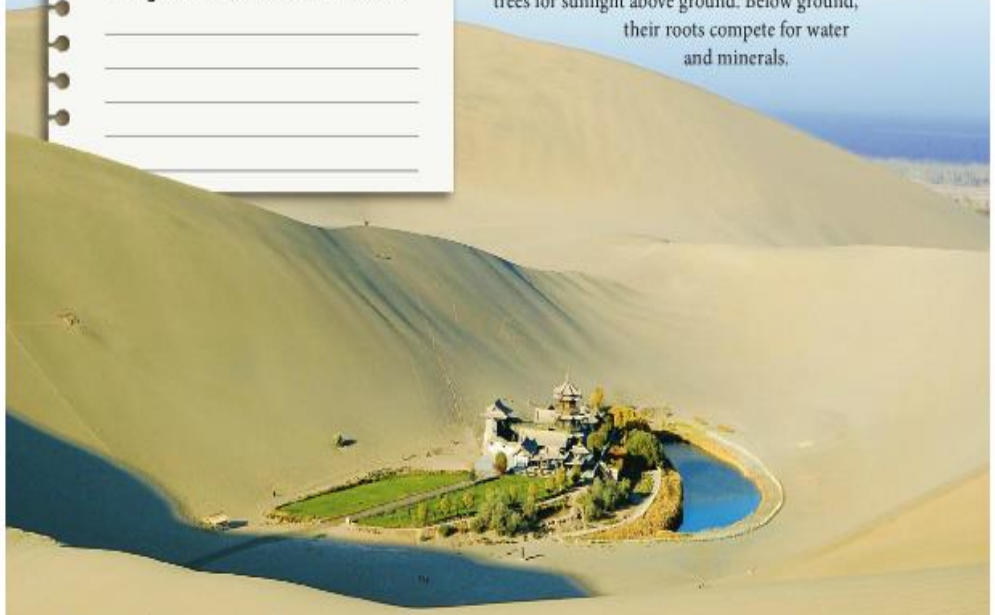


FIGURE 8

Homeostasis

During the winter months, birds rely on their feathers to maintain homeostasis. By fluffing its feathers, this bluebird is able to trap body heat to keep warm. **Make Generalizations** **How do people maintain homeostasis when exposed to cold temperatures?**

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, which cause 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. But at low tide, 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. Refer to **Figure 8** to see another example of how an organism maintains homeostasis.

Lab zone Do the Lab Investigation *Please Pass the Bread.*

Assess Your Understanding

3a. Describe Which basic need is a fox meeting by feeding on berries?

b. Apply 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?

got it?

○ **I get it!** Now I know that to survive, living things need _____

○ I need extra help with _____

Go to **my science coach** *online for help with this subject.*