

1.1 The Study of Life

VOCABULARY

biosphere
biodiversity
species
biology
organism
cell
metabolism
DNA

KEY CONCEPT Biologists study life in all its forms.

MAIN IDEAS

- ▶ Earth is home to an incredible diversity of life.
- ▶ All organisms share certain characteristics.

Connect to Your World

It's a warm summer evening. Maybe you're laughing and joking while waiting to eat at a family barbecue. As you sit down for dinner, mosquitoes flying around have the same idea. But their dinner is you, not the barbecue. Probably the most attention that you pay to mosquitoes is when you take careful aim before smacking them. Biologists have a somewhat different view of mosquitoes, unless of course they are the ones being bitten. But from a less emotional perspective, a biologist can see a mosquito as just one example of the great diversity of life found on Earth.

▶ MAIN IDEA

Earth is home to an incredible diversity of life.

In Yellowstone National Park, there are pools of hot water as acidic as vinegar. It might be difficult to believe, but those pools are also full of life. Life is found in the darkness of the deepest ocean floors and in thousands-of-years-old ice in Antarctica. Not only are living things found just about anywhere on Earth, but they also come in a huge variety of shapes and sizes. Plants, for example, include tiny mosses and giant redwood trees on which moss can grow. There are massive animals such as the blue whale, which is the largest animal living on Earth. There are tiny animals such as the honeypot ant in **FIGURE 1.1**, which

can store so much food for other ants that it swells to the size of a grape.



FIGURE 1.1 Honeypot ants live in deserts where food and water are scarce. Some of the ants in the colony act as storage tanks for other ants in the colony.



The Biosphere

All living things and all the places they are found on Earth make up the **biosphere**. Every part of the biosphere is connected, however distantly, with every other part of the biosphere. The biosphere includes land environments such as deserts, grasslands, and different types of forests. The biosphere also includes saltwater and freshwater environments, as well as portions of the atmosphere. And different types of plants, animals, and other living things are found in different areas of the biosphere. Even the inside of your nose, which is home to bacteria and fungi, is a part of the biosphere.

Biodiversity

Across the biosphere, the variety of life is called biological diversity, or **biodiversity**. Biodiversity generally increases from Earth's poles to the equator. This means that greater biodiversity is found in warmer areas. Why is biodiversity greater closer to the equator? More living things are able to survive in consistently warm temperatures than in areas that have large temperature changes during a year. Because more living things, especially plants, can survive in warm areas, those areas provide a larger, more consistent food supply for more species.

There are several different ways *species* can be defined. One definition of **species** is a particular type of living things that can reproduce by interbreeding among themselves. About 2 million different living species have been identified, but biologists estimate that tens of millions of species remain to be discovered. Over half of the known species are insects, but no one knows how many insect species actually exist.

Every year, biologists discover about 10,000 new species. In contrast, some scientists estimate that over 50,000 species die out, or become extinct, every year. Occasionally, however, a species thought to be extinct is found again. For example, the ivory-billed woodpecker was thought to have become extinct in 1944, but a team of scientists reported seeing it in Arkansas in 2004.

Apply Describe biodiversity in terms of species.

▶ MAIN IDEA

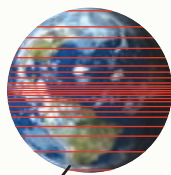
All organisms share certain characteristics.

Biology is the scientific study of all forms of life, or all types of organisms. An **organism** is any individual living thing. All organisms on Earth share certain characteristics, but an actual definition of life is not simple. Why? The categories of living and nonliving are constructed by humans, and they are not perfect. For example, some things, such as viruses, fall into a middle range between living and nonliving. They show some, but not all, of the characteristics of living things.

Cells All organisms are made up of one or more cells. A **cell** is the basic unit of life. In fact, microscopic, single-celled organisms are the most common forms of life on Earth. A single-celled, or unicellular, organism carries out all of the functions of life, just as you do. Larger organisms that you see every day are made of many cells, and are called multicellular organisms. Different types of cells in a multicellular organism have specialized functions, as shown in **FIGURE 1.2**. Your muscle cells contract and relax, your stomach cells secrete digestive juices, and your brain cells interpret sensory information. Together, specialized cells make you a complete organism.

VISUAL VOCAB

Across the **biosphere**, the variety of life is called **biodiversity**.



Biodiversity is **greater** closer to the equator.

biosphere = everywhere life exists

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PREMIUM CONTENT
Biodiversity

READING TOOLBOX

TAKING NOTES

Use a two-column chart to help you summarize vocabulary terms and concepts.

term or concept	meaning

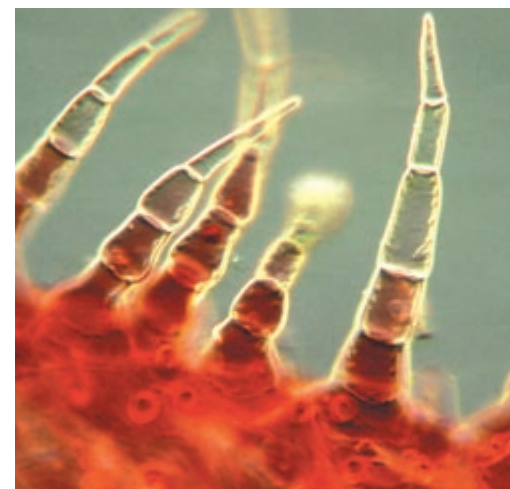


FIGURE 1.2 Cells can work together in specialized structures, such as these leaf hairs that protect a leaf from insects. (LM; magnification 700×)

CONNECT TO

CELLS AND ENERGY

You will read in **Cells and Energy** about different processes used by cells to capture and release energy—photosynthesis, chemosynthesis, and cellular respiration.

FIGURE 1.3 Reproductive strategies differ among species. The male gold-specs jawfish protects unhatched eggs by holding them in his mouth.



Need for energy All organisms need a source of energy for their life processes. Energy is the ability to cause a change or to do work. The form of energy used by all living things, from bacteria to ferrets to ferns, is chemical energy. Some organisms use chemicals from their environment to make their own source of chemical energy. Some organisms, such as plants, algae, and some bacteria, absorb energy from sunlight and store some of it in chemicals that can be used later as a source of energy. Animals get their source of energy by eating other organisms. In all organisms, energy is important for **metabolism**, or all of the chemical processes that build up or break down materials.

Response to environment All organisms must react to their environment to survive. Light, temperature, and touch are just a few of the physical factors, called stimuli, to which organisms must respond. Think about how you respond to light when you leave a dimly lit room and go into bright sunlight. One of your body's responses is to contract the pupils of your eyes. Your behavior might also change. You might put on sunglasses or raise your hand to shade your eyes. Other organisms also respond to changes in light. For example, plants grow toward light. Some fungi need light to form the structures that you know as mushrooms.

Reproduction and development Members of a species must have the ability to produce new individuals, or reproduce. When organisms reproduce, they pass their genetic material to their offspring. In all organisms, the genetic material is a molecule called deoxyribonucleic acid (dee-AHK-see-RY-boh-noo-KLEE-ihk), or **DNA**.

Single-celled organisms can reproduce when one cell divides into two cells. Both new cells have genetic information that is identical to the original cell. Many multicellular organisms, such as the gold-specs jawfish in **FIGURE 1.3**, reproduce by combining the genetic information from two parents. In both cases, the instructions for growth and development of organisms, from bacteria to people, are carried by the same chemicals—DNA and ribonucleic acid (RNA). The process of development allows organisms to mature and gain the ability to reproduce.

Summarize What characteristics are shared by all living things?

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1.1 Formative Assessment

REVIEWING MAIN IDEAS

1. How are **species** related to the concept of **biodiversity**?
2. How do the characteristics of living things contribute to an **organism's** survival?

CRITICAL THINKING

3. **Apply** Describe the relationship between **cells** and organisms.
4. **Synthesize** How does biodiversity depend on a species' ability to reproduce?



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PREMIUM CONTENT

CONNECT TO

HUMAN BIOLOGY

5. You respond automatically to many different stimuli, such as loud noises. Why might a quick response to a sound be important?