

SECTION 2 **Domains and Kingdoms**

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How are prokaryotes classified?
- How are eukaryotes classified?

National Science Education Standards
LS 1f, 2a, 4b, 4c, 5b

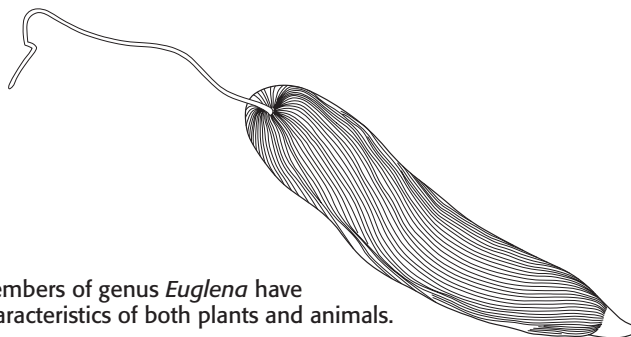
How Do Scientists Classify Organisms?

For hundreds of years, all organisms were classified as either plants or animals. However, as more organisms were discovered, scientists found some organisms that did not fit well into these two kingdoms. Some animals, for example, had characteristics of both plants and animals.

What would you call an organism that is green and makes its own food? Is it a plant? What if the organism moved and could also eat other organisms? Plants generally do neither of these things. Is the organism a plant or an animal?



List As you read this section, make a list of the domains and kingdoms scientists use to classify organisms.



Members of genus *Euglena* have characteristics of both plants and animals.

The organism above belongs to genus *Euglena*. Its members show all of the characteristics just described. As scientists discovered organisms, such as *Euglena*, that didn't fit easily into existing groups, they created new ones. As they added kingdoms, scientists found that members of some kingdoms were closely related to members of other kingdoms. Today, scientists group kingdoms into *domains*.

All organisms on Earth are grouped into three domains. Two domains, Bacteria and Archaea, are made up of prokaryotes. The third domain, Eukarya, is made up of all the eukaryotes. Scientists are still working to describe the kingdoms in each of the three domains.

Critical Thinking

1. Apply Concepts In which domain would multicellular organisms be classified? Explain your answer.

SECTION 2 Domains and Kingdoms *continued*

How Are Prokaryotes Classified?

A prokaryote is a single-celled organism that does not have a nucleus. Prokaryotes are the oldest group of organisms on Earth. They make up two domains: Archaea and Bacteria.

DOMAIN ARCHAEA

Domain **Archaea** is made up of prokaryotes. The cell walls and cell membranes of archaea are made of different substances than those of other prokaryotes. Many archaea can live in extreme environments where other organisms could not survive. Some archaea can also be found in more moderate environments, such as the ocean. ✓

READING CHECK

2. Compare How are members of Archaea different from other prokaryotes?

READING CHECK

3. Explain Are all bacteria harmful? Explain your answer.

TAKE A LOOK

4. Apply Concepts What kind of prokaryotes do you think could live in this spring? Explain your answer.

DOMAIN BACTERIA

All bacteria belong to domain **Bacteria**. Bacteria can be found in the air, in soil, in water, and even on and inside the human body!



We often think of bacteria as bad, but not all bacteria are harmful. One kind of bacterium changes milk into yogurt. *Escherichia coli* is a bacterium that lives in human intestines. It helps break down undigested food and produces vitamin K. Some bacteria do cause diseases, such as pneumonia. However, other bacteria make chemicals that can help us fight bacteria that cause disease. ✓

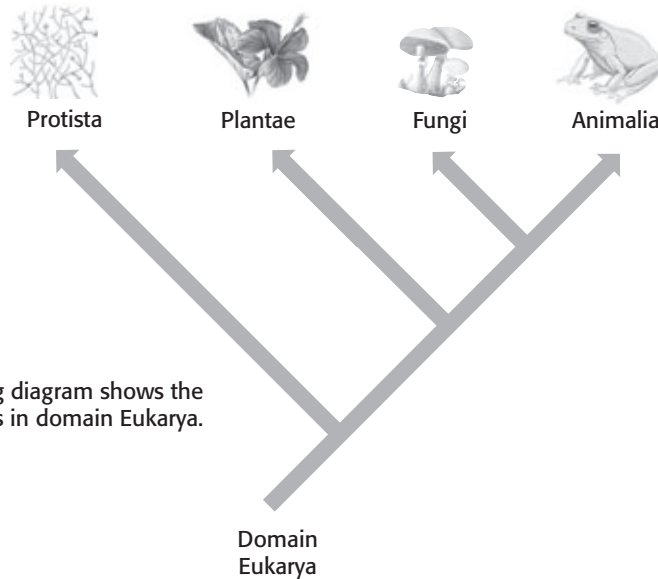


The Grand Prismatic Spring in Yellowstone National Park contains water that is about 90°C (190°F). Most organisms would die in such a hot environment.

SECTION 2 Domains and Kingdoms *continued*

How Are Eukaryotes Classified?

Organisms that have cells with membrane-bound organelles and a nucleus are called *eukaryotes*. All eukaryotes belong to domain **Eukarya**. Domain Eukarya includes the following kingdoms: Protista, Fungi, Plantae, and Animalia.

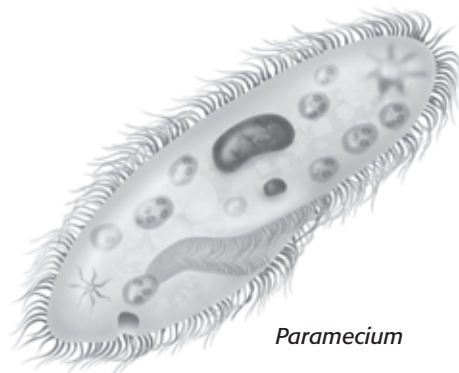


This branching diagram shows the four kingdoms in domain Eukarya.

KINGDOM PROTISTA

Members of kingdom **Protista** are either single-celled or simple multicellular organisms. They are commonly called *protists*. Scientists think that the first protists evolved from ancient bacteria about 2 billion years ago. Much later, plants, fungi, and animals evolved from ancient protists.

Kingdom Protista contains many different kinds of organisms. Some, such as *Paramecium*, resemble animals. They are called *protozoa*. Plantlike protists are called *algae*. Some algae, such as phytoplankton, are single cells. Others, such as kelp, are multicellular. Multicellular slime molds also belong to kingdom Protista.



Paramecium

STANDARDS CHECK

LS 5a Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

Word Help: selection
the process of choosing

Word Help: variation
a difference in the form or function

5. Identify Based on the branching diagram, which two kingdoms in Eukarya evolved most recently? How do you know?

SECTION 2 Domains and Kingdoms *continued*

KINGDOM FUNGI

Molds and mushrooms are members of kingdom **Fungi**. Some fungi (singular, *fungus*) are unicellular. That is, they are single-celled organisms. Yeast is unicellular. Most other fungi are multicellular. Unlike plants, fungi do not perform photosynthesis. However, they also do not eat food, as animals do. Instead, fungi use digestive juices to break down materials in the environment and absorb them. ✓

✓ **READING CHECK**

6. Describe How do fungi get food?



Amanita is a poisonous fungus. You should never eat wild fungi.

KINGDOM PLANTAE

Although plants differ in size and appearance, most people can easily identify the members of kingdom Plantae. Kingdom **Plantae** contains organisms that are eukaryotic, have cell walls, and make food by photosynthesis. Most plants need sunlight to carry out photosynthesis. Therefore, plants must live in places where light can reach.

The food that plants make is important for the plants and also for other organisms. Many animals, fungi, protists, and bacteria get nutrients from plants. When they digest the plant material, they get the energy stored by the plant. Plants also provide homes for other organisms.

Math Focus

7. Calculate The average student's arms extend about 1.3 m. How many students would have to join hands to form a human chain around a giant sequoia?

The giant sequoia is one of the largest members of kingdom Plantae. A giant sequoia can measure 30 m around the base and grow more than 91 m tall!



SECTION 2 Domains and Kingdoms *continued*

KINGDOM ANIMALIA

Kingdom **Animalia** contains complex, multicellular organisms. Organisms in kingdom Animalia are commonly called *animals*. The following are some characteristics of animals:

- Their cells do not have cell walls.
- They are able to move from place to place.
- They have sense organs that help them react quickly to their environment.



TAKE A LOOK

8. Identify Which animal characteristic from above can be seen in this bald eagle?

STRANGE ORGANISMS

Some organisms are not easy to classify. For example, some plants can eat other organisms to get nutrition as animals do. Some protists use photosynthesis as plants do but also move around as animals do.

Red Cup Sponge



Critical Thinking

9. Apply Concepts To get nutrients, a Venus' flytrap uses photosynthesis and traps and digests insects. Its cells have cell walls. Into which kingdom would you place this organism? Explain your answer.

What kind of organism is this red cup sponge? It does not have sense organs and cannot move for most of its life. Because of this, scientists once classified sponges as plants. However, sponges cannot make their own food as plants do. They must eat other organisms to get nutrients. Today, scientists classify sponges as animals. Sponges are usually considered the simplest animals.

Section 2 Review

NSES LS 1f, 2a, 4b, 4c, 5b

SECTION VOCABULARY

<p>Animalia a kingdom made up of complex, multicellular organisms that lack cell walls, can usually move around, and quickly respond to their environment</p> <p>Archaea in a modern taxonomic system, a domain made up of prokaryotes (most of which are known to live in extreme environments) that are distinguished from other prokaryotes by differences in their genetics and in the makeup of their cell wall; this domain aligns with the traditional kingdom Archaeobacteria</p> <p>Bacteria in a modern taxonomic system, a domain made up of prokaryotes that usually have a cell wall and that usually reproduce by cell division. This domain aligns with the traditional kingdom Eubacteria</p> <p>Eukarya in a modern taxonomic system, a domain made up of all eukaryotes; this domain aligns with the traditional kingdoms Protista, Fungi, Plantae, and Animalia</p>	<p>Fungi a kingdom made up of nongreen, eukaryotic organisms that have no means of movement, reproduce by using spores, and get food by breaking down substances in their surroundings and absorbing the nutrients</p> <p>Plantae a kingdom made up of complex, multicellular organisms that are usually green, have cell walls made of cellulose, cannot move around, and use the sun's energy to make sugar by photosynthesis</p> <p>Protista a kingdom of mostly one-celled eukaryotic organisms that are different from plants, animals, bacteria, and fungi</p>
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1. Compare What is one major difference between domain Eukarya and domains Bacteria and Archaea?

2. Explain Why do scientists continue to add new kingdoms to their system of classification?

3. Analyze Methods Why do you think Linnaeus did not include classifications for archaea and bacteria?

4. Apply Concepts Based on its characteristics described at the beginning of this section, in which kingdom would you classify *Euglena*?
