

# CLASSIFICATION OF ORGANISMS

## reflect

Organization helps us make sense of our surroundings. Some people organize their sock drawers by color. Books in a library are often organized by topic. Food in a grocery store is organized so we to know just where to find something.

For scientists, organization is an essential tool. The organization of similar organisms into groups helps scientists understand how living things are related. It also allows scientists to communicate about all forms of life. For example, suppose a scientist in the United States writes about a specific group of animals. Other scientists around the world will know exactly which group of animals the writer is referring to. But how do scientists decide which organisms to group together? Do they use a particular process?

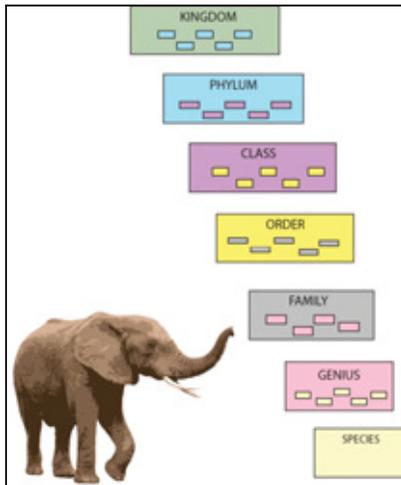
### Scientists classify organisms in different ways.

Scientists organize the living world using a process called *taxonomy*, which is the science of classifying organisms based on shared structures, functions, and relationships to other organisms. For example, organisms can be classified based on their cellular structure. Organisms that have **nuclei** are *eukaryotes*. Eukaryotes also have *organelles*, or specialized structures bound in a membrane. They are in a different group than *prokaryotes*, which are organisms that do not have nuclei. Also, many **unicellular** organisms are in a different group than **multicellular** organisms. For example, bacteria are unicellular organisms. They are in a different group than animals, which are multicellular.

**nuclei:** plural for nucleus; part of a cell that holds structures which control cell activities

**unicellular:** made up of one cell

**multicellular:** made up of more than one cell



Taxonomy is the process of classifying organisms based on similarities.

Living things also can be classified according to the way in which they obtain food. Think about the differences between plants and animals. Plants make their own food and are called *autotrophs*. Animals must consume other organisms and are called *heterotrophs*. This difference classifies plants and animals into two separate groups.

Method of reproduction can be used to classify organisms into even smaller groups. The two main reproductive methods are asexual and sexual reproduction. In asexual reproduction, only one parent is involved in producing offspring. In sexual reproduction, two parents are involved: a male and a female.

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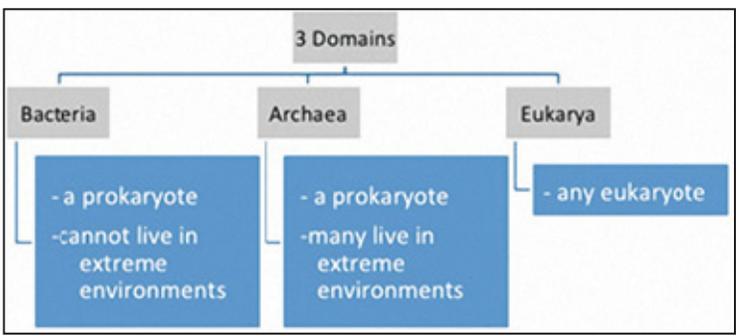
## what do you think?

Take a look at the images to the left. Which organisms would you group together? Why? What additional information would you need to know about the organisms to improve how you classified them?



### Scientists Classify Organisms into Three Domains.

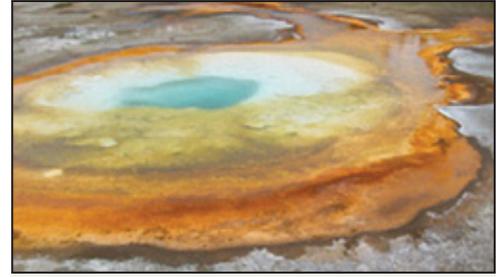
Scientists use a branching system of classification. The broadest group is the domain. Each domain is subdivided into kingdoms, followed by phyla, class, order, family, genus, and species. We will focus on domains and kingdoms.



All living organisms are classified into one of three domains: Bacteria, Archaea, and Eukarya. Domain Bacteria includes organisms commonly referred to as *bacteria*, which are unicellular prokaryotes. They are tiny organisms that reproduce asexually. Some bacteria are autotrophs (make their own food), but most of them are heterotrophs (consume their food.)

# CLASSIFICATION OF ORGANISMS

The organisms in Domain Archaea are a specialized group of unicellular prokaryotes. Scientists discovered these unique organisms living in areas of extreme conditions. Some archaea are found in hot springs and are called thermophiles (“heat loving”). Other archaea are found in very salty conditions and are called halophiles (“salt loving”). Similar to bacteria, archaea reproduce asexually. Some archaea are autotrophs and others are heterotrophs. You might wonder why archaea and bacteria are divided into separate domains. After all, they are both unicellular prokaryotes. In the 1970s, a study revealed that the cellular structures of archaea are so different from bacteria they deserved their own domain. For example, archaea have a unique plasmid membrane structure not found in any other organisms.



Some of the first archaea were discovered in hot springs like this one. Hot springs are natural pools of extremely hot water.

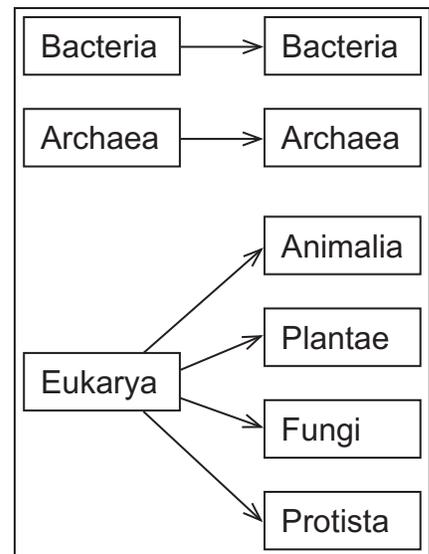
Domain Eukarya includes all eukaryotes. This is a diverse group of organisms. It includes plants, animals, fungi, and protists. These organisms are classified together because they are made up of eukaryotic cells. Characteristics like structure, function, and method of reproduction further classify the organisms into smaller groups called kingdoms.

## Scientists Classify Organisms into Six Kingdoms.

The three domains are further divided into six Kingdoms. The first two Kingdoms are easy to remember. Domain Bacteria has just one Kingdom: Bacteria. Kingdom Archaea also has just one Kingdom: Archaea. Identifying the organisms in Domain Eukarya is when classification gets more complicated.

Domain Eukarya has four Kingdoms: Animalia, Plantae, Fungi, and Protista. They are classified based on the complexity of their cellular organization, their ability to obtain nutrients, and their mode of reproduction.

Organisms in Kingdom Animalia are the most complex and are commonly referred to as animals. They are multicellular heterotrophs. Most reproduction in this Kingdom is sexual, although a few animals can reproduce asexually. For example, if you divide a flatworm in half, each of the two halves will grow into a new flatworm.



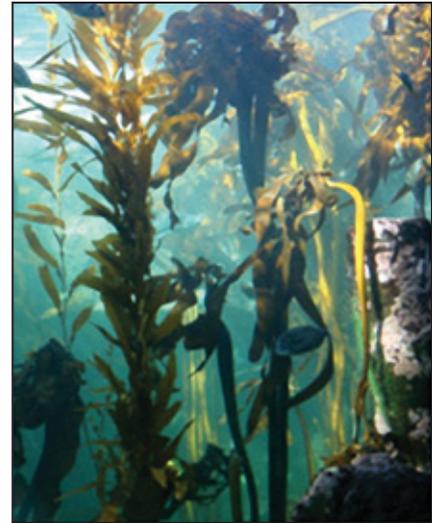
The three domains are divided into six Kingdoms.

# CLASSIFICATION OF ORGANISMS

In the Kingdom Plantae, the organisms are referred to as plants and are also very complex. Plants are autotrophs, since they make their own food. They are multicellular and can reproduce sexually or asexually.

Kingdom Fungi includes organisms such as mushrooms and molds. Most fungi are multicellular and can reproduce sexually or asexually. All fungi are heterotrophs. However, the way in which they obtain food is unique. Fungi absorb nutrients from the environment. Think about a piece of moldy bread. The mold is a fungus that releases chemicals to break down the bread into smaller substances. The mold can then absorb these smaller substances, using them as nutrients. This characteristic makes fungi different from animals.

Kingdom Protista includes organisms with fairly simple structures compared to other eukaryotes. There is great diversity among the protists. Most of them are unicellular. However, some protists are multicellular. Some are autotrophs, in which case they resemble plants. Other protists are heterotrophs, more closely resembling animals. They swim through water and consume nutrients from their environment. Their simple organization keeps them in a separate kingdom from plants and animals.



The simple organization of seaweed places them in Kingdom Protista.

## look out!

Protists have been the most difficult group of organisms for scientists to classify. Some protists like green algae have the photosynthetic pigment chlorophyll that gives them a green color similar to plants. Other protists behave more like animals, with whip-like structures that allow them to zoom around in the water. You can think of protists as the “other” category. They are single-celled organisms with a nucleus, but their structures are too simple to qualify them as plants or animals.

## reflect

People often say that dogs are “man’s best friend.” How closely related are dogs and humans? To complete this activity, you will need a computer with Internet connection, a piece of paper, a pen or pencil, and crayons or markers.

1. Search the Internet to find the taxonomy of the domestic dog and humans, from domain through species. Check at least three different sources to make sure the information you find is correct. Try using websites that end in .gov or .edu because they are usually reliable.
2. Create a chart listing the taxonomy of each species side-by-side, similar to the chart shown on the next page.

# CLASSIFICATION OF ORGANISMS

	Domestic dog	Human
Domain		
Kingdom		
Phylum		
Class		
Order		
Family		
Genus		
Species		

3. Circle classifications that are the same for dogs and humans using one color of crayon or marker. Circle the classifications that are different using another color of crayon or marker.
4. What does this information tell you about similarities and differences between dogs and people?

## Discover Science: A Changing Classification System

The classification system we use today has changed many times over the years as new information was discovered. Swedish scientist Carl Linnaeus is known for creating the first version of the modern taxonomy system in the 1700s. He classified organisms into two Kingdoms: Animalia and Plantae. Years later, as scientists were able to use better microscopes and observe organisms more closely, they added three more kingdoms to the system: Monera (unicellular prokaryotes), Protista, and Fungi. In recent years, the classification shifted again and is now the three-domain system you've just learned about. The new system is based on information from cell studies and the fairly recent discovery of archaea. Do you think the system will change again in the future? If you answered yes, you are probably right! Scientists are always making new discoveries. Some of these discoveries will likely encourage them to rethink the current three-domain system.

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## What do you know?

Organisms are classified into domains and kingdoms based on specific characteristics. Take a look at the pictures below and read the characteristics in the boxes. Decide how you would classify each organism into a domain and a kingdom based on this information. Write your answers in the spaces below the pictures.

		
Domain:  Kingdom:	Domain:  Kingdom:	Domain:  Kingdom:
<ul style="list-style-type: none"> <li>• Eukaryote</li> <li>• Heterotroph</li> <li>• Reproduces sexually</li> </ul>	<ul style="list-style-type: none"> <li>• Prokaryote</li> <li>• Heterotroph</li> <li>• Reproduces asexually</li> <li>• Cannot live in extremely harsh environments</li> </ul>	<ul style="list-style-type: none"> <li>• Eukaryote</li> <li>• Autotroph</li> <li>• Simple organization</li> </ul>
		
Domain:  Kingdom:	Domain:  Kingdom:	Domain:  Kingdom:
<ul style="list-style-type: none"> <li>• Prokaryote</li> <li>• Lives in extreme environments</li> <li>• Reproduces asexually</li> </ul>	<ul style="list-style-type: none"> <li>• Eukaryote</li> <li>• Heterotroph</li> <li>• Reproduces sexually and asexually</li> </ul>	<ul style="list-style-type: none"> <li>• Eukaryote</li> <li>• Autotroph</li> <li>• Complex organization</li> </ul>

# CLASSIFICATION OF ORGANISMS

## connecting with your child

### Classifying Organisms

When your child first learns how to classify organisms, there are a few categories that instinctively make sense. Most students can identify plants and animals, and some may be familiar with fungi. The three remaining kingdoms (Bacteria, Archaea, and Protista) are more difficult to grasp, as students probably do not have firsthand experience observing these organisms.

Spend some time searching the Internet and/or educational books for pictures and information about the six kingdoms, focusing more time on Bacteria, Archaea, and Protista. Have your child choose one organism from each kingdom to sketch. Below each sketch, your child should list the organism's main characteristics including cell structure, food gathering method, and method of reproduction.

Here are some questions to discuss with your child:

- Where do organisms in Kingdom Archaea typically live?
- What kinds of bacteria do you encounter every day? Are they helpful or harmful?
- Where would you expect to find protists? How are these organisms similar to organisms in other kingdoms?
- Is the organism in each kingdom:
  - eukaryotic or prokaryotic?
  - unicellular or multicellular?
  - autotrophic or heterotrophic?
- Does each organism reproduce sexually or asexually?