Classifying Organisms

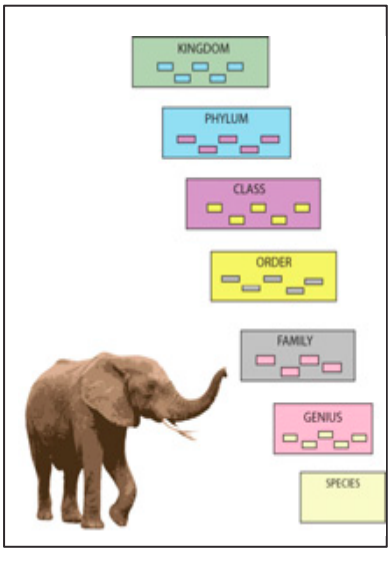
Reflect

Take a look at the pictures on the right. Think about what the two organisms have in common. They both need food and water to survive. They both grow and reproduce. They both have similar body organs such as lungs and a heart. Are these similarities enough to classify the organisms into the same group? If you answered yes, you are correct! Both organisms are classified as animals. If you answered no, you are also correct! The organisms have differences that scientists use to further classify these animals into smaller, different groups. The elephant is classified as a mammal, and the lizard is classified as a reptile. What process do scientists use to classify all forms of life?

History of Classification

Humans have always categorized their world in various ways. As early as 300 BCE, Aristotle classified animals by the place they lived (land or water) and by what they looked like (two legs or four legs). Carolus Linnaeus developed the binomial naming system in the 1700s, which gave each organism its scientific name. The broader levels of kingdom, phylum, class, and order were developed in the late 1700s.

Until 1937 there were only two kingdoms—Plantae and Animalia—but with further study it was decided that a third kingdom was needed. Kingdom Protista was added at that time, and since then, two more kingdoms—Monera and Archaea—have been added.



Taxonomy is the process of classifying organisms based on similarities.

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 with nuclei are eukaryotes. Eukaryotes also have organelles, or specialized structures bound in a membrane. They are in a different group than prokaryotes—organisms that do not have nuclei. Also, many unicellular organisms are in a different group from multicellular organisms. For example, bacteria are unicellular organisms. They are in a different group from animals, which are multicellular.

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

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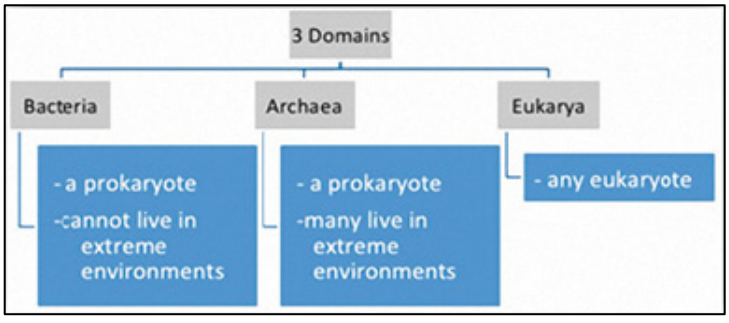
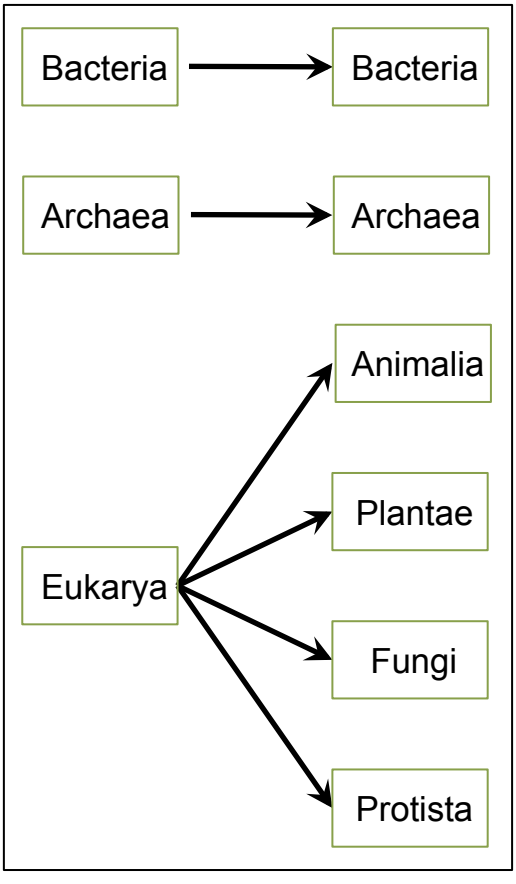
Organisms' method of reproduction can be used to classify them into even smaller groups. The two main reproductive methods are asexual and sexual. In asexual reproduction, only one parent is involved in producing offspring. In sexual reproduction, two parents—a male and female—are involved.



Scientists use a branching system of classification. The broadest group is the domain. Each domain is subdivided into kingdoms, followed by phylum, 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 (they make their own food), but most are heterotrophs (they consume their food.)

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.

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 asexually or sexually.

Kingdom Fungi includes organisms such as mushrooms and molds. Most fungi are multicellular and can reproduce asexually or sexually. 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 one 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 whiplike 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.

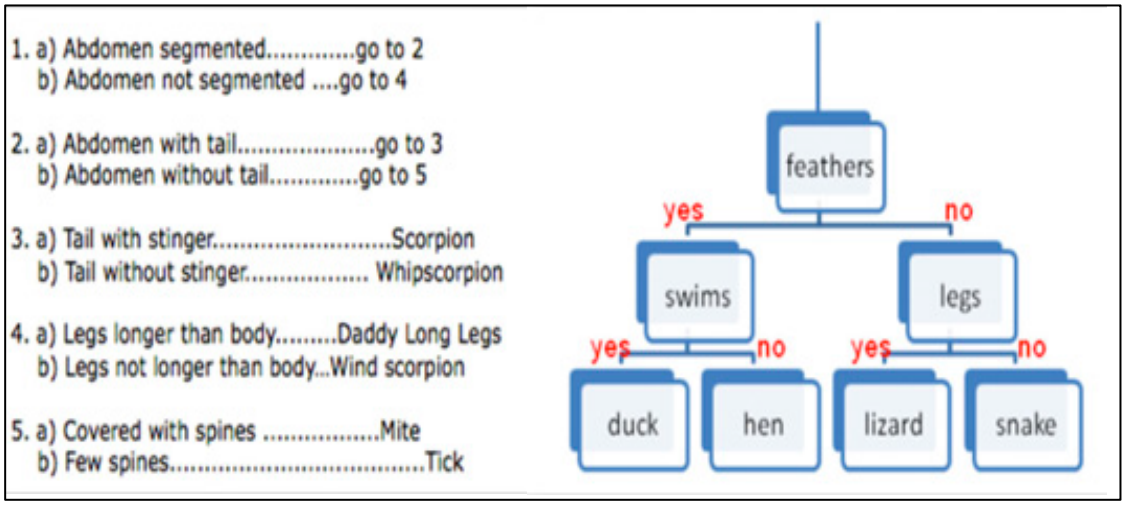
What Do You Think?

Look at the chart below. It lists the taxonomic groups for three different organisms, beginning with order. Which two organisms are most similar? Explain your reasoning below.

Common Name	Order	Family	Genus and Species
Human	Primates	Hominoidea	*Homo sapiens*
Eastern Gorilla	Primates	Hominoidea	*Gorilla beringei*
Ring-Tailed Lemur	Primates	Lemuridae	*Lemur catta*

Dichotomous Keys

Identifying an organism's taxonomic group or common name sometimes requires a dichotomous key. A dichotomous key is used to sort organisms. The key is based on questions about the traits and structures of the organisms. The word "dichotomous" means "cut in two." When using a dichotomous key to identify an organism, "cut in two" means that a choice must be made about a characteristic at each two-fork branch in the key. Basically, you have two options, and you have to decide one way or the other. The characteristics get more specific at each branch of the key. Dichotomous keys may either be written, as shown below on the left, or presented in a graphic, as shown on the right.



Let's take a closer look at the graphic dichotomous key. It shows the method for identifying four different organisms by common name: duck, hen, lizard, and snake. The first step of the key, at the top, refers to the question, "Does the organism have feathers?" If the answer is yes, move to the left side of the key; if the answer is no, move to the right side of the key. Following the left side of the key, the next branch refers to the question, "Does the organism with feathers swim?" If the answer is yes, the organism is a duck. If the answer is no, the organism is a hen. Following the right side of the key, the next branch refers to the question, "Does the organism without feathers have legs?" If the answer is yes, the organism is a lizard. If the answer is no, the organism is a snake.

Any type of dichotomous key must be detailed enough for the user to be able to observe an organism and determine which branch choice is the best match to the organism. The dichotomous keys above are very basic. However, some dichotomous keys are quite complex and contain numerous questions to help identify an organism's binomial classification.

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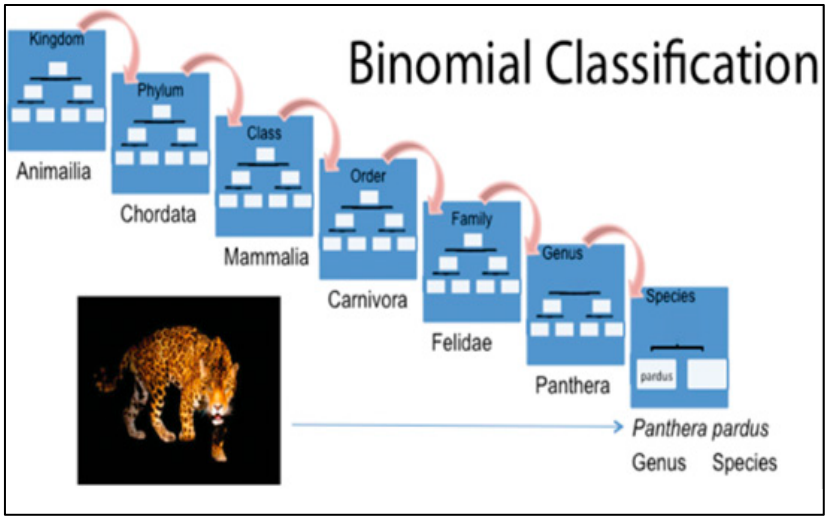
Binomial classification is the system of naming an organism (starting with its kingdom) by its genus and species. So many different species exist within a particular kingdom or phylum. Therefore, the best dichotomous keys focus on a specific bioregion. For example, a dichotomous key may be developed only for the types of organisms that live in oceans. You can see an example of binomial classification for a single species below.

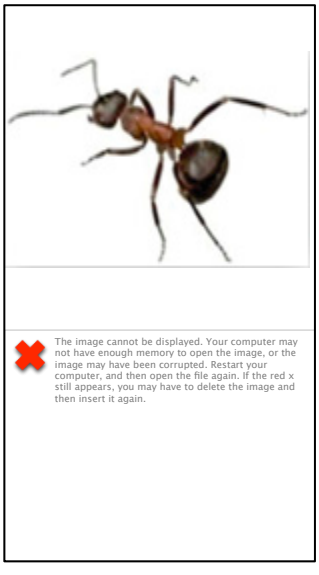


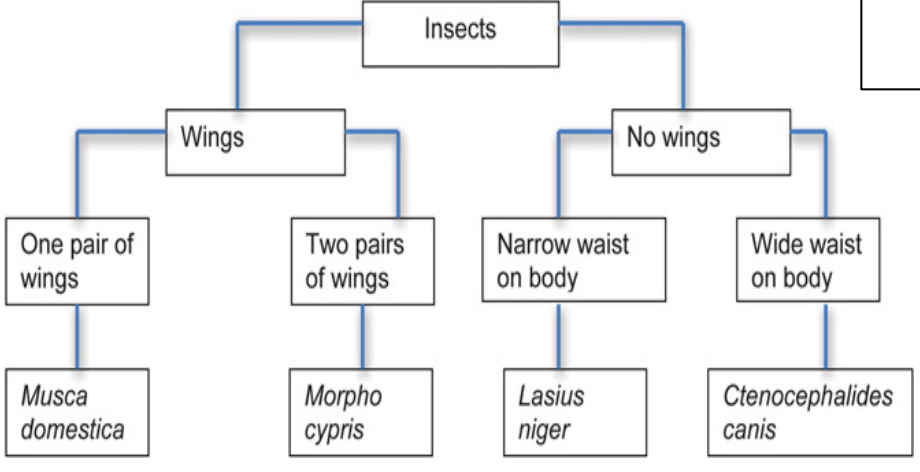
The binomial classification of the animal shown here is *Panthera pardus*. Panthera is the genus name, and pardus is the species name.

What do you know?
Study the pictures of the insects on the right. Then use the dichotomous key below to identify the binomial classification of each insect. Write your answers on the line next to each insect.

Ant_____

Butterfly_____





Connecting With Your Child

Creating a Dichotomous Key for Identifying Plants

To help your child learn more about the identification of organisms, work together to create a dichotomous key that can be used to identify various plants.

For this activity, search for images of different plants on the Internet or in old magazines. Try to find at least six different plants with varying characteristics (such as a pine tree, palm tree, strawberry plant, etc.), and print out pictures of each plant. If you are not able to print the images, have your child draw sketches of each plant.

Write down at least five distinguishing characteristics for each plant. Characteristics to consider include leaf shape, leaf vein pattern, presence or absence of a trunk, habitat (land or water, jungle or desert, etc.), and any other defining characteristics you would use when describing the plant to another person. If possible, write down the binomial classification (genus and species name) of each plant as well. If you are not able to find the binomial classification, write down the common name of each plant.

Create a list of "yes-no" questions that address the characteristics identified in at least one plant.

Cut the index cards or construction paper into squares, and write the name (genus and species or common name) and a description of a single species on each card.

Next, write the "yes-no" questions on another set of index cards, one question per card. It might be useful to use a different color pen for the questions.

Using the "yes-no" questions as a guide, start sorting the piles into a branching tree. Be sure that each branch only has two options for answers. You may need to rearrange your questions until you arrive at a dichotomous key in which the questions become increasingly restrictive and the plants make up the bottom row. Once you are satisfied with your key, draw it on a piece of paper.

Here are some questions to discuss with your child:

1. Why are only inherited traits used to classify the plants?
2. • Look at the final dichotomous key. Did you end up grouping any plants together? If so, do these plants have any differences?
3. • How are dichotomous keys helpful to scientists when they discover what they think might be a new species?