

<b>Subject Code</b>	BIO 1	Biology 1
<b>Lesson Guide Code</b>	4.0	Classification of Organisms
<b>Lesson Code</b>	4.2	Schemes of Biological Classification
<b>Time Frame</b>		30 minutes



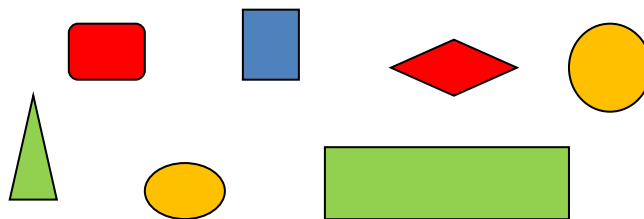
## **TARGET**

After completing this learning guide, you are expected to:

1. identify and apply the distinguishing characteristics of domains and kingdoms;
2. describe the three-domain system of classification; and
3. identify organisms based on the correct hierarchy of organization using the six-kingdom/ three-domain system of classification

## **HOOK**

Look at the figures below. How would you separate these figures into different groups? Try to group them into three groups.



What characteristics of the figures did you base your groupings on? Shape of the figure? Number of sides? Color? Did you know that just like what you did, scientists use different characteristics to classify organisms into different groups?

The bases for classification have changed as technology became more advanced resulting in organisms being grouped and regrouped under different schemes. Thus, the schemes for classifying organisms change as more discoveries are made and better technology is invented.



## **IGNITE**

### **Linnaean Classification**

**Carl Linnaeus**, a Swedish botanist, published a system for classifying organisms in the 1700s which became the basis for the modern classification systems. His classification system, referred to as the **Linnaean classification** system, consists of a hierarchy of groupings called taxa (singular, taxon) (see Figure 1). These are the **kingdom, phylum, class, order, family, genus** and **species**. The **kingdom** is the largest group and the most inclusive while the **species** is the smallest and most exclusive group.

Aside from the classification system, Linnaeus also developed a method of naming organisms. This method gives each organism a unique two-word Latin name, a genus name and a species name, hence the name for the method, **binomial nomenclature**. This way of naming organisms ensures the unique identification of the species. For his classification system and method in naming organisms, Linnaeus is known as the father of taxonomy, the science of classifying organisms.

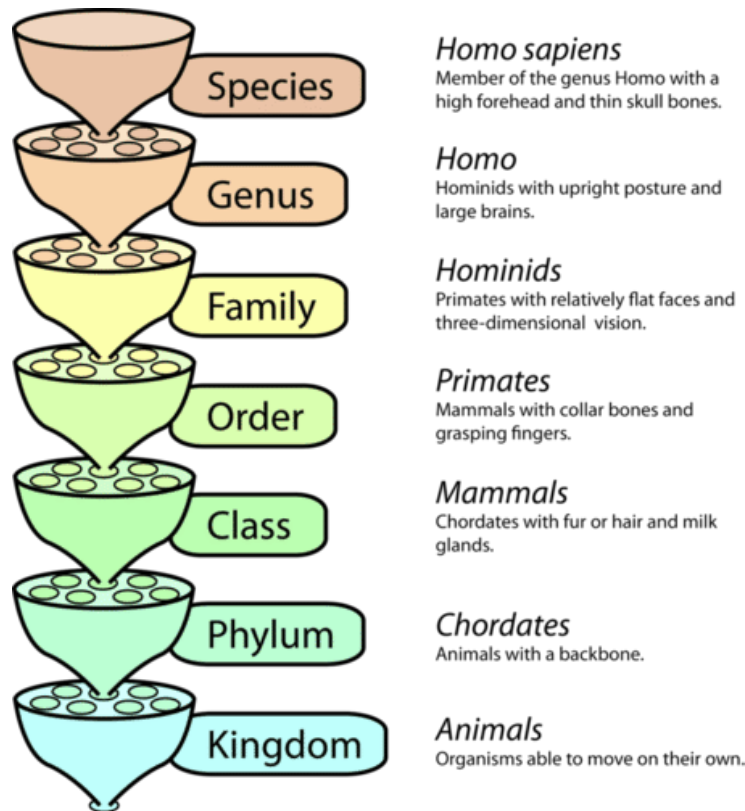


Figure 1. The Linnaean Classification System. From *Classification* by CK-12 Foundation(a), 2020, <https://www.ck12.org/book/ck-12-biology-concepts/section/5.10/>. CC BY-NC-SA 3.0

## Revisions in the Linnaean Classification

Over the years, the Linnaean classification system underwent major revisions. The following are the systems that were proposed and adopted.

### Two – Kingdom System

The two-kingdom classification system was introduced in 1735 by Linnaeus in his book, *Systema Naturae*. Linnaeus distinguished two kingdoms of living things: *Animalia* for animals and *Plantae* for plants. The organisms were basically classified based on nutrition and locomotion.

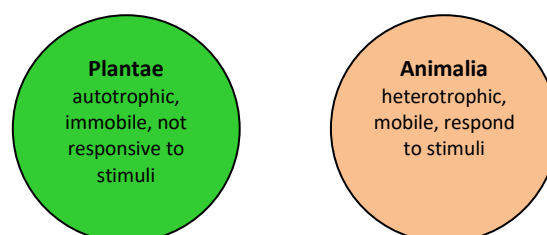


Figure 2. The two-kingdom system of classification.

### *Three – Kingdom System*

**Ernst Haeckel**, a German zoologist, introduced the three-kingdom system in the 1860s. He distinguished the organisms into three kingdoms: Animalia, Plantae, and Protista. This was to accommodate the organisms that exhibited characteristics common to both plants and animals or were absent in the kingdoms introduced by Linnaeus. The organisms were classified based on morphological complexities and tissue system, division of labour, and mode of nutrition. Organisms that exhibited a diverse type of modes of nutrition and lacked complex morphology, tissue system and division of labor were put under the kingdom Protista.

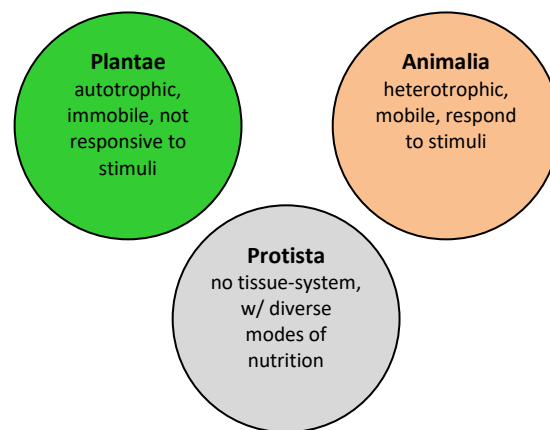


Figure 3. The three-kingdom system of classification.

### *Four – Kingdom System*

With the discovery of the electron microscope, the differences in the characteristics of unicellular organisms became more obvious. In 1956, **Herbert Copeland** suggested a fourth kingdom, kingdom Monera, which was composed of the prokaryotes (bacteria and blue-green algae). These were the organisms that lack membrane-bound organelles. Those organisms that have membrane-bound organelles and a nucleus, the eukaryotic unicellular organisms, are retained under Protista.

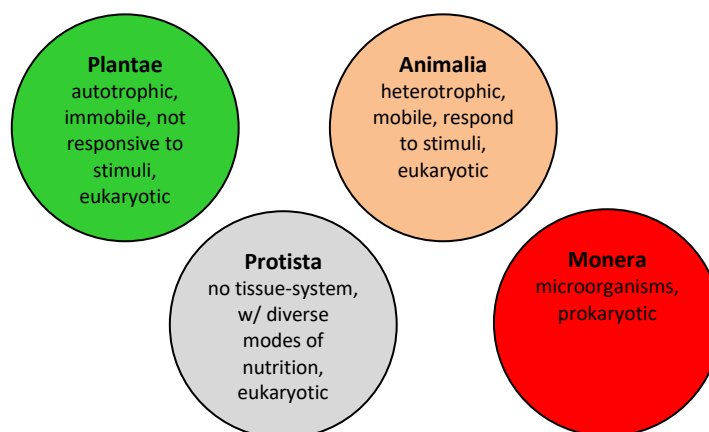


Figure 4. The four-kingdom system of classification.

### *Five – Kingdom System*

The five-kingdom system was introduced by **Robert Whittaker**, an American taxonomist in 1969. It consisted of the kingdoms Monera, Protista, Fungi, Plantae and Animalia. He added the kingdom,

Fungi, to accommodate those organisms that were non-photosynthetic and exhibited a distinct mode of nutrition – absorptive. He based his classification on the following characteristics:

- a) complexity of cell structure
- b) complexity of body organization
- c) mode of nutrition
- d) ecological role and
- e) phylogenetic relationship.

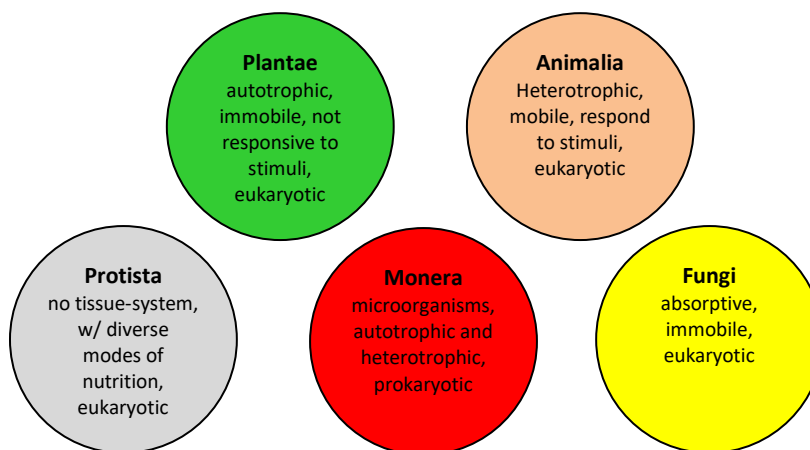


Figure 5. The five-kingdom system of classification.

### Six – Kingdom System

In 1977, **Carl Woese**, a microbiologist and biophysicist, and his colleagues proposed a six-kingdom system. They divided the original bacteria kingdom, Monera, into two – Archaeobacteria and Eubacteria. This was based on their research on ribosomal RNA base sequences from which they discovered that there were actually two different groups of organisms that comprise bacteria. They found out that although the two groups of prokaryotes looked similar in appearance, the organisms' ribosomal RNA sequences were very different.

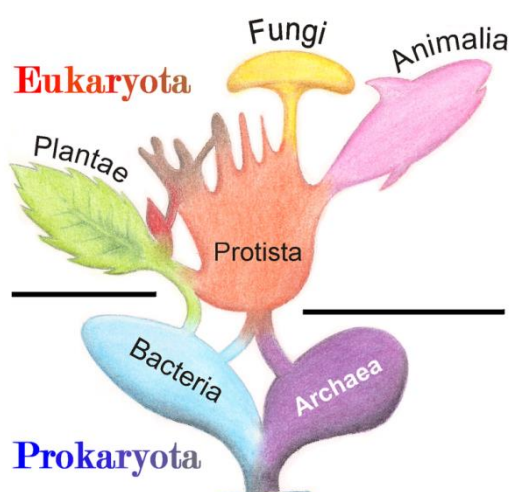


Figure 6. The six-kingdom system of classification. From *Tree of Living Organisms* by Doridi, 2013, <https://www.ck12.org/book/ck-12-biology-concepts/section/5.10/>. License: [CC-BY-SA-3.0](#)

### Three – Domain System

Currently, the three-domain system is being followed by most biologists. The system was also proposed by Carl Woese and his colleagues in 1990. This system was adopted when it was observed that some prokaryotes differed from other prokaryotes as they did from eukaryotes. Woese was not satisfied with the six-kingdom system because it did not show the closer relationship of the eukaryotes to each other as compared to the prokaryotes. In the current system, a larger and more inclusive taxon, the **domain**, was added thus, placing groups into one larger group instead of separating them into different kingdoms as was done in the previous revisions of the Linnaean classification.

In the three-domain system, the organisms are classified into three major groups: **Bacteria**, **Archaea**, and **Eukarya**. By placing them under one domain, the close evolutionary relationship among organisms placed in different kingdoms is emphasized. In the previous systems, without the domain grouping, it would seem that the organisms under the different kingdoms have no evolutionary relationships; that is, the plants are as different from the animals, the animals from the bacteria, and so on. But the three-domain system shows that the eukaryotic kingdoms are more closely related to each other than to the bacteria and that the bacteria are as different from each other as they are from the eukaryotes.

Three kingdoms (Plantae, Animalia, and Fungi) from the five-kingdom system are retained and placed under Eukarya (see Figure 6). The kingdom Protista is no longer recognized since it includes members that are closely related to plants, fungi or animals. For example, microsporidians, once considered amitochondriate protists and placed under Kingdom Protista, are now classified as fungi. Eukarya consists of all the organisms that possess cells containing true nuclei, both multicellular and unicellular organisms.

The domain Bacteria now contains most of the known prokaryotes previously placed under kingdom Monera such as the cyanobacteria, spirochetes and gram-positive bacteria. The domain Archaea is composed of a diverse group of prokaryotic organisms that can inhabit a wide variety of environments some of it extreme; examples are the methanogens and halophiles. Bacteria differ from archaea in many structural, biochemical, and physiological characteristics. Like for example, peptidoglycan in the cell wall is present in bacteria but not in archaea. Histones associated with DNA, on the other hand, is absent in bacteria but present in some species of archaea.

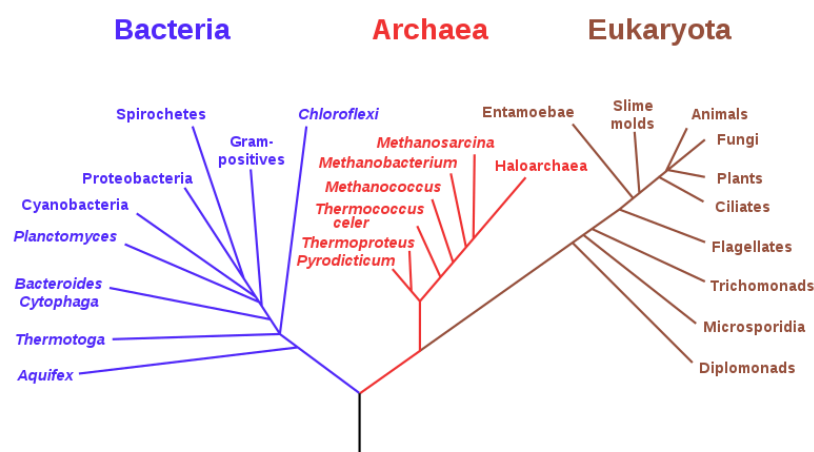


Figure 6. The three-domain system of classification. A phylogenetic tree of living things, based on RNA data and proposed by Carl Woese, showing the separation of bacteria, archaea, and eukaryotes. From *Phylogenetic Tree* by Gaba, 2006, [https://en.wikipedia.org/wiki/Three-domain\\_system](https://en.wikipedia.org/wiki/Three-domain_system). Public domain.



Answer the following items regarding the classification of organisms. (non-graded)

1. Summarize the differences in cell type and mode of nutrition classifying organisms by filling in the following table. On the last row, add another characteristic and fill in the differences among the different groups of organisms.

Table 1. Characteristics of Organisms.

DOMAIN	Bacteria	Archaea	Eukarya			
KINGDOM	(Eubacteria)	(Archaeobacteria)	Protista	Fungi	Plantae	Animalia
Cell type						
Mode of nutrition						

2. Identify the taxa to which the following organisms belong to. Fill in the table provided below.

A.



B.



Table 2. Classification of Organisms.

TAXA	A	B
Domain		
Kingdom		
Phylum		
Class		
Order		
Family		



Throughout the years, the Linnaean classification has undergone various revisions from the two-kingdom system to the currently adopted three-domain system. The system of classification now

has three major groups: **Archaea**, **Bacteria**, and **Eukarya**. All eukaryotes (plants, animals, fungi and protists) are placed under Eukarya while all prokaryotes are placed under Archaea or Bacteria depending on their structural, chemical and physiological characteristics. Although much of the Linnaean classification has been changed, many concepts proposed by Linnaeus have been retained specifically; the hierarchical organization of organisms from the most inclusive (kingdom) to the most exclusive (species) and the method of naming organisms, the binomial nomenclature.

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