

STAAR Science Tutorial 42 **TEK 6.12D: Classification**

TEK 6.12D: Identify the basic characteristics of organisms, including prokaryotic or eukaryotic, unicellular or multicellular, autotrophic or heterotrophic, and mode of reproduction, that further classify them in the currently recognized Kingdoms.

The Classification System

- **Classification** is the system used by scientists to name and group living organisms based on their shared traits. The branch of science that studies how living organisms are classified is called taxonomy. The modern classification system, called binomial nomenclature, was originally developed by the Swedish scientist Carolus Linnaeus in the 1750's. In this system, each identified organism has a unique genus-species name. The genus name is capitalized, while the species name is not, and both words are either underlined or in italics. The genus/species name for humans is *Homo sapiens*. The genus name is sometimes abbreviated, as in *H. sapiens*.
- The classification system created by Linnaeus has evolved over time as scientists have discovered and named new organisms, and learned more about organisms function on a microscopic and genetic level. Most scientists today recognize an eight-level classification system, with three domains (Eukarya, Bacteria and Archaea) at the top level, and six kingdoms at the second highest level, further described in the next section.
- The eight tiered levels of classification, listed from the broadest to the most specific, are (1) Domain; (2) Kingdom; (3) Phylum; (4) Class; (5) Order; (6) Family; (7) Genus; and (8) Species. They can be remembered with the mnemonic "Dear King Phillip Came Over For Good Spaghetti." The chart below shows the eight classification levels, and the specific classification of three different animals, humans, the domestic cat, and lions:

Classification Level	Human	Domestic Cat	Lion
Domain	Eukarya	Eukarya	Eukarya
Kingdom	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Chordata
Class	Mammalia	Mammalia	Mammalia
Order	Primates	Carnivora	Carnivora
Family	Homindae	Felidae	Felidae
Genus	Homo	Felis	Panthera
Species	sapiens	domesticus	leo

- Notice that all three animals in the chart above share much of their general classification. All three are eukaryotes (domain eukarya-having a nucleus and organelles in their cells), are animals (kingdom Animalia-multicellular heterotrophs) with a backbone and spinal cord (phylum-chordata) who nurse their young (class mammalia). Domestic cats and lions are carnivores (order-carnivora), while humans are primates (order primates). Other carnivores include dogs and wolves. Other primates include chimpanzees and gorillas.
- The main traits that separate the domains and kingdoms are organism complexity, cell structure, method of obtaining food, and mode of reproduction.
- The two categories of organism complexity are unicellular and multicellular. **Unicellular** organisms are made of only one cell. **Multicellular** organisms consist of many cells working together to maintain the conditions needed for the health of the entire organism. In the most complex organisms such as humans, these cells are organized into tissues, organs, and organ systems. There are many trillions of cells in large, complex organisms.
- There are two kinds of cell structure found in all living organisms. **Prokaryotes** have no nucleus or membrane-enclosed organelles. **Eukaryotes** have a membrane-enclosed nucleus containing all of the cell's genetic material (made of the chemical DNA, divided into chromosomes and genes), and have distinct organelles such as mitochondria, chloroplasts and ribosomes. See *STAAR Tutorial 48-Cell Organelles* for more information about cell organelles. See *STAAR Tutorial 50-Genes and Chromosomes* for more information about the system used by all living organisms to store genetic information.
- Organisms have two basic methods of obtaining food. **Autotrophs** make their own food by capturing energy from sunlight through the process of photosynthesis, or from chemicals present in the environment through the process of chemosynthesis. **Heterotrophs** get their energy by eating other once-living organisms. See *STAAR Tutorial 16-Food Web Energy Flow* for more information about how organisms get their energy.
- Organisms can either reproduce **sexually**, by combining the genetic material from two parents, or **asexually**, by making an exact copy of one parent's genetic material. See *STAAR Tutorial 49: Sexual and Asexual Reproduction* for more information on how organisms reproduce.

The Six Kingdoms

- The current classification system recognizes six kingdoms: archaeobacteria, eubacteria, protists, fungi, plants and animals.
- **Archaeobacteria** are all unicellular (single-celled) prokaryotes (without nucleus and organelles). They all reproduce asexually, and can either be autotrophs or heterotrophs. Many archaeobacteria are extremophiles, meaning that they live in extreme environments such as hot springs or near volcanic deep-sea vents. If there is life outside of Earth in our solar system, it will likely be archaeobacteria.
- **Eubacteria** share most of the same characteristics as archaeobacteria: they are unicellular prokaryotes which reproduce asexually, and can either be autotrophs or

heterotrophs. This is the form of bacteria that lives in animal intestines, helping digest food, and that acts as decomposers in the environment. Most bacterial diseases that affect animals are eubacteria. The differences between archaeobacteria and eubacteria are found in their internal chemical makeup and genetic variations. At this level, archaeobacteria are more closely related to eukaryotes than to bacteria.

- **Protista** (protists) are usually unicellular, although some very simple multicellular organisms are included within this kingdom. Unlike archaeobacteria and eubacteria, they are all eukaryotes, meaning that their cells have a nucleus and organelles. They all reproduce asexually, but can either be autotrophs or heterotrophs. Examples of protists are amoebas and paramecium. In the future, the Protista kingdom will likely be subdivided into several different kingdoms, because of the great variety within this kingdom.
- **Fungi** such as mushrooms are usually multicellular, though some such as yeast are unicellular. All fungi are heterotrophs, but they absorb their food externally through root-like structures, not internally as in animals. Fungi can reproduce either asexually or sexually. Most fungi act as decomposers in the environment, but some act as parasites on living organisms (fungi cause most plant diseases), or as mutualistic symbionts (in a mutualistic symbiotic relationship), such as in lichen.
- **Plantae** (plants) are all multicellular autotrophs. They can either reproduce sexually or asexually. Some plants supplement their photosynthesis-produced food by digesting other organisms, such as the insect-eating venus fly-trap.
- **Animalia** (animals) are all multicellular heterotrophs that digest their food internally. Most animals reproduce sexually, and are capable of moving themselves through their environment.

Practice Questions

1. Why do scientists classify living organisms? _____

2. What is the broadest level of the classification system? _____
What are the three different classifications within this broadest level? _____

3. List the eight levels of the classification system, starting with the broadest level and ending with the most specific. (1) _____; (2) _____;
(3) _____; (4) _____; (5) _____;
(6) _____; (7) _____; (8) _____.
4. What is the difference between a unicellular and multicellular organism?

5. What is the difference between a prokaryote and a eukaryote? _____

6. What is the difference between an autotroph and a heterotroph? _____

7. Describe the characteristics of eubacteria. _____

8. Describe the characteristics of archaebacteria. _____

9. Describe the characteristics of protists. _____

10. Describe the characteristics of fungi. _____

11. Describe the characteristics of plants. _____

12. Describe the characteristics of animals. _____
