

Chapter 18

Test 1

- Organisms are arranged or grouped by the science of **taxonomy**. Organizing or grouping things helps in dealing with life. (Ex: grocery store, dresser, closet). You organize them in similar ways by colors, economical values, temperature, etc.; however, they suffer from problems. The organization has to be easy, logistical, and equally able to understand by everyone.
 - **Taxonomy** is the branch of biology concerned with naming and classifying the diverse forms of life. Taxonomy started because they needed to classify the names that biologists would use.
- Classifying organisms in Planet Earth
 - **Naming**- Have to classify things so that everyone knows what we're talking about from the beginning.
 - **Classification Scheme**- Classification is based on characteristics that the organisms have. This started before there were biologists, possibly when they were cave people. Classification was based on things that were in our environment/around us. To reconstruct evolutionary histories, we name organisms and assign them to categories based on their evolutionary relationships.
 - **Plants vs. Animals**- one of the early classification systems placed the animals in 1 group and the plants in another. The bacteria, fungi, and many protists were considered plants, while some of the protists were grouped with the animals. The problem with this category is that they didn't know where to classify fungi. Eventually, they had to make a new one.
 - **Origin of Taxonomy**- It dates back to Aristotle. However, Linnaeus developed the foundation for modern classification, **binomial nomenclature** in the 1700s.
 - **Binomial Nomenclature**- It has 2 names. When a organism is discovered, if it's a like but different it gets the same first name and different last name. The first name is the genus name, and the second name is the species name. The genus name means that organisms share characteristics with it.
 - Organisms are classified or grouped into categories. These categories are further divided into smaller and smaller groupings creating an organizational **hierarchy**.
 - **Hierarchy**-
 - The lowest 2 categories of the taxonomic hierarchy (genus and species) make up the **scientific name** for an organism.
 - **Scientific Name**- Ex: we are *Homo sapiens* or Homo sapiens. The genus name is capitalized and the species name begins with a lowercase letter. The name is usually underlined or italicized.
 - The major taxonomic categories from most inclusive (biggest set) to least inclusive (smallest set) are...As you go up the categories are more broad, such as plants:

○ Domain	A HUMAN	
○ Kingdom	○ Eukarya	
○ Phylum/Division	○ Animalia	Did King Philip Come Over
○ Class	○ Chordate	For Good Spaghetti?
○ Order	○ Mammalia	
○ Family	○ Primates	
○ Genus	○ Hominidae	
○ Species	○ <i>Homo</i>	
	○ <i>sapiens</i>	

- We use systematics to organize organisms. A system/grouping that's based on utilizing the evolutionary history, **phylogeny**, in order to classify it. Evolution is the change of an evolutionary species over a period of time.
 - **Systematics** is the part of biology/practice that uses phylogeny to categorize the diversity of living organisms.
 - **Phylogeny** is the perceived evolutionary history of an organism.
 - Using systematic, the more categories two organisms have in common the more closely related the two organisms are in their phylogeny. It gives the power of inference (Ex: if you discover something about one organism, it may also relate to an organism that's related to the organisms)
 - Systematics depict evolutionary relationships in branching **phylogenetic trees** (see fig 18-2). But the problem is, we don't know the evolutionary history, so we guess.
 - **Phylogenetic Trees**- It always starts with an ancestral parent. The lineages evolve into themselves. The organisms that are closely related will be next to one another on the family tree.
 - Each branch point in the tree is a **node** that represents the divergence of species.
 - **Nodes**- A branch point in the tree. The node will represent an evolutionary event; we will only see the results of the divergence. Nodes closer to the ancestral lineage represent greater amounts of divergence than nodes farther from the ancestral lineage.
 - Phylogenetic history can be inferred from similarities in structures (both have 2 hands, 4 legs, ears that function same) and genes when compared among organisms. Generally, similar morphology (what they look like) and similar DNA sequences = closely related species. None of the organisms around today are related to us.
 - Shared characters are used to construct phylogenetic trees and **clades** to show phylogenetic relationships.
 - **Clades**- are groups of species that includes the ancestral species and all its descendants. It is the ancestor, the node, and all of the lineages that come from it. (figure 18-2 the dark purple is a clade). Frequently, they represent that organizational hierarchy we now use.

- Taxonomy/systematics/grouping is an inexact process. All grouping methods are subject to problems. We want logistical and easy to use models. Plants vs. animals was an imperfect system and as a result didn't last.

- **Robert Whittaker**- In 1969 he proposed a replacement for the plants vs animals system that had as it's largest grouping five **kingdoms**. At this time, the biggest group was the kingdom. Biologists accepted it for about 16 years.
- These five kingdoms each had observably different attributes that defined them.
- **Cell type**- eukaryotic (bigger, have organelles) prokaryotic (single, tinier, no organelles). He used cell type to characterize first kingdom, monera. He came up with more categories that were clear.
- Five Kingdoms and Characteristics-

Kingdom	Cell Type	Cell #	Nutritional Method
Monera	Prokaryotic	Unicellular	Absorption/photosynthesis
Protista	Eukaryotic	Unicellular	Absorption/photosyn./ingestion
Fungi	Eukaryotic	Multicellular	Absorption
Plantae	Eukaryotic	Multicellular	Photosynthesis
Animalia	Eukaryotic	Multicellular	Ingestion

o In this scheme each Kingdom is divided into either Phyla (plural of phylum) or Divisions. These categories are further divided into smaller and smaller groupings creating an organizational hierarchy.

- **Problems with Whittaker's System**- There were 2 problems with his system that became obvious once DNA technology improved in the 1980s. In the 1980s, we could look at the molecules of life (DNA, proteins, lipids) more carefully.
 - **Problem 1**- Based on the idea that when we started looking at the organisms within a single kingdom and comparing them based on DNA Sequences, we started seeing inside the individual kingdoms not all of the organisms were equally comparable.
 - ❖ The techniques of molecular biology have aided the taxonomist in the classification of organisms by allowing the **DNA sequences** from two organisms to be compared.(see Scientific inquiry pages 346) (Ex: DNA sequence of 2 siblings will be closer than their 2nd cousins')
 - **Problem 2**- Within the kingdom Monera, something we thought was a single grouping that shared this common cell type characteristics, we now saw that were actually 2 distinct groups. Kingdom Monera was based on putting together organisms that didn't have the same evolutionary relationships. The ability to examine the DNA sequences and genes of different organisms resulted in the kingdom Monera being separated into two distinct groups which are **polyphyletic**.
 - ❖ **Polyphyletic**- refers to a grouping, which contains organisms with different immediate ancestors.
- **Solutions to Whittaker's System's Problems**- Carl Woese proposed that these two groups of prokaryotes are as different from each other as they are from the eukaryotes and that these differences arose very early in the process of evolution. In order to accommodate these differences and place them in the appropriate evolutionary context, Woese and others proposed an "evolutionary tree" with three main branches (See fig 18-6). These branches were termed **domains** (which are higher level than kingdoms). There are two prokaryotic domains; **Bacteria** and **Archaea** and a eukaryotic domain; **Eukarya**. The domain of Eukarya branches into the separate eukaryotic kingdoms (see fig 18-7) Eukarya and Archaea are more closely related than any other domain. The second problem has yet to be resolved. If you examine the kingdoms within domain Eukarya you will see that the protist kingdom is also polyphyletic. This and other issues in taxonomy are in the process of being resolved.

- The more closely related two organisms are the smaller the differences between them. This often means very small anatomical differences are used to distinguish between two species. (see fig 18-3). The pressure of the environment causes problems because it can shape organisms to begin acting like one another. Some of these criteria can be misleading because very different organisms can have similar characteristics, or **homology**, which are the result of convergent evolution. Ex: shark vs. dolphin. Many criteria are used by biologists to group organisms:

- **Morphology** (size, shape, structure)
- **Anatomy** (organs, tissues)-
- **Developmental stage** (compare the embryos)
- **Cell structure** (chromosome number and structure)
- **Behavior** (does it fly? Swim? Quack?)
- **Lifecycle** (How long does it live? How often does it reproduce)