Principles of Taxonomy

1. Why is a system of classification needed?
   a. Organize species into groups and discuss them.
   b. Identify new organisms.
   c. Show relationships between organisms.

2. Taxonomy
   a. **Taxonomy** is the science of classifying organisms.
   b. The **Binomial system**, also called **binomial nomenclature**, involves each organism being given a two part name using Latin as a standard language.
      i. Developed by Carolus Linnaeus (1707-1778).
      ii. Provides a uniform means of communication for all people. This avoids the confusion caused by organisms with different common names in different areas.
      iii. The format is *Genus species* or *G. species*. *e.g.*, *Castor canadensis* (beaver)
         (1) The **genus** name is capitalized and may be abbreviated by the first initial. The **species** name is not capitalized and cannot be used alone. *e.g.*, *C. canadensis.*
      iv. The 2 part name gives clues about relationships between organisms.
         (1) For instance, *Ursus americanus, U. horribilis, U. arctos*, and *U. maritimus* are all related.
      v. Names were based largely on physical appearances but modern taxonomists use genetic information, molecular biology, and phylogeny (evolutionary relationships) as other criteria for classifying.
         (1) The work of Charles Darwin introduced the idea of considering evolutionary history.
   c. The binomial classification system is a hierarchy
      i. The levels of organization are **kingdom, phylum, class, order, family, genus,** and **species**. In plants, fungi and algae phyla also called divisions. Each of these levels is called a **taxon** (plural, taxa).
      ii. Note that the genus and species name are italicized because they are Latin. When handwriting, underline the words. Other levels are capitalized but no special print features are used.
   d. What is a species?
      i. Capable of reproducing with one another. Individuals from different species do not generally reproduce with one another.
      ii. Individuals of one species may appear quite dissimilar.
      iii. Offspring may appear different from one another.
      iv. Estimates on the number of species range from 2 to 100 million species on the planet although about 1.4 million species are currently named and described. Note that this is for eukaryotic species only. It is much more difficult to estimate the number of prokaryotic species.

3. The six kingdoms (3 domains) system
    a. Originally there were only two kingdoms recognized by Linnaeus: animals and plants.
    b. Later, these two were divided into five: animals, plants, fungi, protists, and bacteria. Each kingdom evolved from different single-celled ancestors.
    c. Recent DNA evidence and comparisons of proteins have shown how long groups of organisms have been evolving independently. This has ben used to place organisms into domains.
    d. Most people now recognize 6 kingdoms:
        i. Two prokaryotic (formally, Kingdom Monera) - reproduce asexually
            (1) **Kingdom Archaebacteria** (**Domain Archaea**) are very ancient bacteria.
            (2) **Kingdom Eubacteria** (**Domain Bacteria**) are more modern bacteria.
                (a) Inhabit nearly every known habitat
                (b) Consumers, producers, and decomposers
                (c) Some cause disease but most are harmless
        ii. Four eukaryotic (**Domain Eukarya**) - sexual reproduction is predominant
            (1) **Kingdom Protista**
                (a) Contains mostly unicellular organisms, including algae, although there are some exceptions. Members have been lumped together in this kingdom because they don't seem to fit anywhere else.
                (b) Some show characteristics of animals, some of fungi, and some of plants.
                (c) Some taxonomists have abandoned the idea of a kingdom because they feel that protists are too diverse to even fit into our current classification system. Their taxonomy is changing considerably.
            (2) **Kingdom Fungi**
                (a) Contains multicellular species and single-celled yeasts.
                (b) Have some characteristics of plants but differ in that they are not photosynthetic - they are decomposers.
            (3) **Kingdom Plantae**
                (a) Multicellular
                (b) Producers
            (4) **Kingdom Animalia**
                (a) Multicellular
                (b) Consumers
                (c) Motile
    e. There are greater differences between prokaryotes and eukaryotes than between plants and animals. Also, there is greater diversity between the two prokaryotic groups than among all eukaryotic groups.
    f. Evolution of kingdoms
        i. Bacteria first appeared over 3 billion years ago and were the only organisms on Earth for about 2 billion years.
        ii. Fungi, plants and animals are well-defined evolutionary groups, each having arisen from different unicellular ancestors.
        iii. These groups are mostly multicellular, and derived from protist ancestors.

4. Viruses - Where do they fit?
    a. General
        i. Viruses are unusual enough that they are not included in any of the six kingdoms.
        ii. Viruses are tiny structures and are called particles rather than cells and there is considerable debate as to whether they are alive or not.
        iii. Viruses are tiny particles made of nucleic acid (either DNA or RNA), protein, and in some cases, lipid. The typical virus has the nucleic acid at the core surrounded by a protein coat called the **capsid**.
            (1) Simple viruses have only a few genes while the most complex still have no more than a few hundred.
    b. Reproduction
        i. They have no organelles, no membrane of their own, and they do not divide. They use the host organelles to reproduce.
        ii. The capsid includes proteins that binds to the host cell membrane. Because viruses must attach to specific proteins on the host cell membrane, most are able to infect only a specific type of cell in a species or related species.
        iii. Once inside the host cell, the viral genes take over the cell organelles and direct them to make new viruses.
        iv. When new viruses are made they must be released
            (1) Some viruses cause the cell to burst so that the new virus particles can escape to infect surrounding cells.
            (2) Other viruses remain hidden inside the host cell indefinitely and become active only when the right conditions trigger them.
    c. Viral diseases - viruses cause disease by attacking and destroying certain cells in the body, causing the symptoms of the disease. Vaccines can be used to prevent viral infections but once infection occurs, it is normally quite difficult to treat.