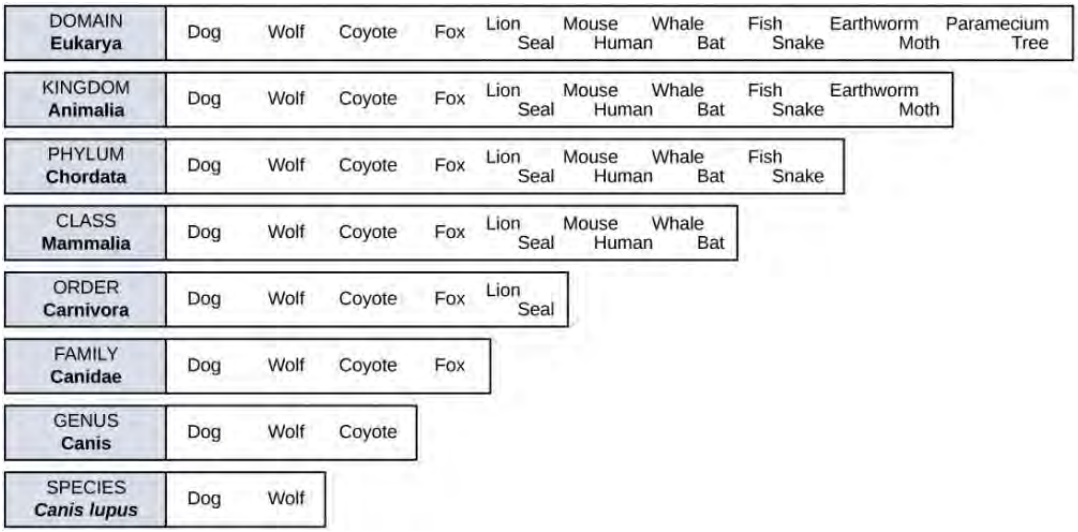

Figure 1.13 This diagram shows the levels of taxonomic hierarchy for a dog, from the broadest category—domain—to the most specific—species. (credit: Fowler et al./Concepts of Biology OpenStax)

The highest taxonomy level, **domain**, is a relatively new addition (1990's) to the system. Scientists now recognize three domains of life: the Eukarya, the Archaea, and the Bacteria. The domain Eukarya is very diverse and includes the kingdoms of fungi, plants, animals, and several kingdoms of protists. Humans, plants, yeast, and mushrooms are just a few representatives of the domain Eukarya. These organisms are classified as **eukaryotes** because they have nuclei and other membrane-bound organelles. Both the Archaea and Bacteria are single-celled organisms classified as prokaryotes (Figure 1.14). **Prokaryotes** are organisms that lack nuclei and other membrane-bound organelles. Prokaryotes, like eukaryotes, are very diverse and can be subdivided into phyla, class, order, etc.

Figure 1.14 These images represent different domains. The scanning electron micrograph shows (a) bacterial cells belong to the domain Bacteria, while the (b) extremophiles, seen all together as colored mats in this hot spring, belong to domain Archaea. Both the (c) sunflower and (d) lion are part of the domain Eukarya. (credit a: modification of work by Rocky Mountain Laboratories, NIAID, NIH; credit b: modification of work by Steve Jurvetson; credit c: modification of work by Michael Arrighi; credit d: modification of work by Frank Vassen / Concepts of Biology OpenStax)

Evolution in Action - Carl Woese and the Phylogenetic Tree

The evolutionary relationships of various life forms on Earth can be summarized in a phylogenetic tree. A **phylogenetic tree** is a diagram showing the evolutionary relationships among biological species based on similarities and differences in genetic or physical traits or both.

The pioneering research of American microbiologist Carl Woese at the University of Illinois has shown that life on Earth has evolved along three lineages, now called domains. The phylogenic tree in Figure 1.15 can be used to show the separation of living organisms into those three domains: Bacteria, Archaea, and Eukarya.

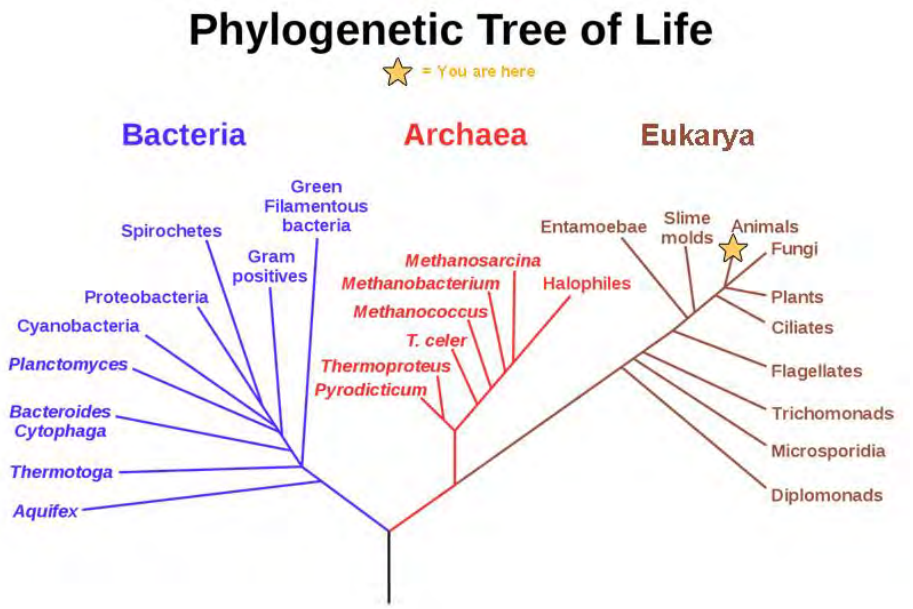

Figure 1.15 This phylogenetic tree was constructed by microbiologist Carl Woese using genetic relationships. (credit: modification of work by Eric Gaba/ Concepts of Biology OpenStax)

Branches of Biological Study

The scope of biology is broad and therefore contains many branches and sub-disciplines. For instance, molecular biology studies biological processes at the molecular level, including interactions among molecules such as DNA, RNA, and proteins. Microbiology is the study of the structure and function of microorganisms. It is quite a broad branch itself, and depending on the subject of study, there are also microbial physiologists, ecologists, and geneticists, among others.

Paleontology, another branch of biology, uses fossils to study life's history (Figure 1.16). Zoology and botany are the study of animals and plants, respectively. Biologists can also specialize as biotechnologists, ecologists, or physiologists, to name just a few areas.

Biotechnologists apply the knowledge of biology to create useful products. Ecologists study the interactions of organisms in their environments. Physiologists study the workings of cells, tissues, and organs. This is just a small sample of the many fields that exist within biology.

Figure 1.16 Researchers work on excavating dinosaur fossils at a site in Castellón, Spain. (credit: Mario Modesto/ Concepts of Biology OpenStax)

CAREER CONNECTION - Forensic Scientist

Forensic science is the application of science to answer questions related to the law. Biologists, as well as chemists and biochemists, can be forensic scientists. Forensic scientists provide scientific evidence for use in courts, and their job involves examining trace materials associated with crimes. Interest in forensic science has increased in the last few years, possibly because of popular television shows that feature forensic scientists on the job.

The development of molecular techniques and the establishment of DNA databases have updated the types of work that forensic scientists can do. Their job activities are primarily related to crimes against people, such as murder, rape, and assault. Their work involves analyzing samples such as hair, blood, and other body fluids, and processing DNA (Figure 1.17a) found in many different environments and materials. Forensic scientists also analyze biological evidence left at crime scenes, such as insect parts or pollen grains (Figure 1.17b). Students who want to pursue careers in forensic science will most likely be required to take chemistry and biology courses as well as some intensive math courses.

Figure 1.17a This forensic scientist works in a DNA extraction lab. (credit: U.S. Army CID Command Public Affairs/ Concepts of Biology OpenStax) b. This scientist uses microscopy for sample analysis. (credit: National Cancer Institute /Public Domain)