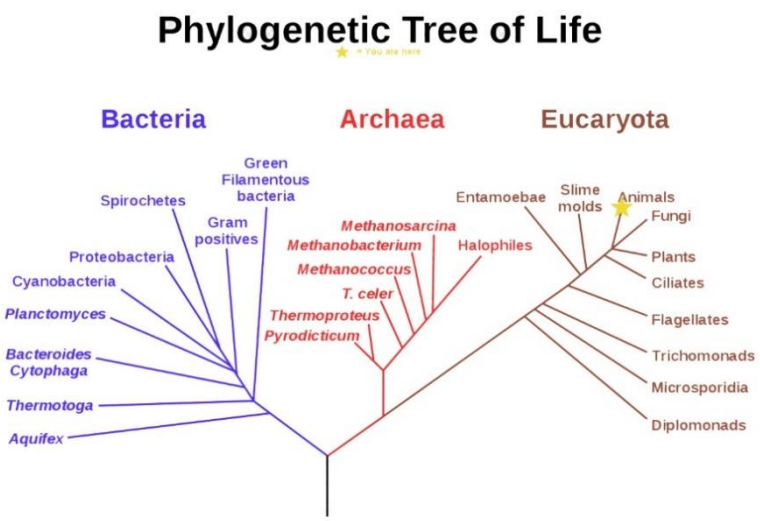
Cell Structure and Function

The cell is the basic fundamental unit of life and all living things are composed of cells. And while life varies dramatically in its complexity and its diversity the processes and essential functions that sustain life have much in common across the domains. Before discussing commonalities let's first look at how biologists describe the diversity of life. Carl Woese proposed a phylogenetic tree of life (see below) with 3 major evolutionary branches or Domains, the Bacteria, the Archaea and the Eukarya or Eucaryota. The Bacteria and Archaea are composed of small, prokaryotic, single-celled organisms. Prokaryotic means the organism lacks a nuclear membrane and other double membrane-bound organelles. The Archaea are primitive and are found in very unusual environments like hot springs, volcanic vents and deep in the ocean. The Bacteria will be discussed more thoroughly elsewhere. The hallmark of organisms within the Domain Eukarya is that their cells have a nuclear membrane. This Domain is certainly the most diverse. It includes single-celled organisms such as protozoans and algae, and multicellular organisms such as mushrooms, redwoods, whales and humans.



While organismic structure can vary dramatically between and within Domains the functions of individual cells share many common functions. There are 3 primary functions that are common to all cells and are associated with specific cell structures. The 3 primary functions are heredity, homeostasis and metabolism. Everything a cell does, every metabolic reaction and process falls into one of these three functions. Heredity is the passing on of genetic traits from one generation to the next. Homeostasis is the ability to maintain constant internal conditions. Metabolism encompasses all of the chemical reactions that occur in the cell. Heredity is a function of the cell's genome (chromosomes). In the Domain Eukarya, the cell's chromosomes are found within the nucleus as multiple linear strands. In the Domains Bacteria and Archaea, heredity is governed by a single circular chromosome clustered in a region of the cytoplasm called the nucleoid. Homeostasis is an essential function for all cells. Maintaining constant internal conditions enables the cell's molecules to function under optimal conditions. The primary mediator for homeostasis in cells from all Domains is the plasma membrane or cell membrane. The cell membrane maintains homeostasis by controlling what enters and what leaves the cell. Similarly, metabolism in all Domains is a function of the cytoplasm. The cytoplasm of eukaryotic cells is chock full of organelles which have specific functions in the cell. Bacteria and Archaea lack organelles but have the mechanisms needed to perform all the necessary functions to maintain a living state.