Domains of Life

Bacteria	Archaea	Eukarya
Cell type: Prokaryotic	Cell type: Prokaryotic	Cell type: Eukaryotic
Structure: No nucleus; circular DNA in a nucleoid	Structure: Similar to bacteria but with unique membrane lipids and genes more closely related to eukaryotes	Structure: True nucleus and membrane-bound organelles
Habitat: Soil, water, inside living/dead organisms	Habitat: Extreme environments (hot springs, salt lakes, deep sea vents)	Organisms: Animals, plants, fungi, and protists
Examples: E. coli, Streptococcus	Examples: Methanogens, halophiles, thermophiles	Examples: Humans, yeast, algae

Chemical Composition of a Typical Cell

Major Components by Mass:
Water (~70%): Main solvent; critical for biochemical reactions and molecular movement.
Proteins (~15%): Enzymes, structural support, signaling. Made of amino acids.
Nucleic Acids (~7%): DNA (genetic material) and RNA (protein synthesis).
Lipids (~2%): Membranes (phospholipids), energy storage (triglycerides), signaling (steroids).
Polysaccharides (~3%): Energy (glycogen, starch) and structural (cellulose in plants).
Ions & Small Molecules (~1%): Na^+, K^+, Cl^-, Ca^{2+}, metabolites, vitamins, cofactors.
By Elemental Composition (by % of total atoms):
Hydrogen (H) – ~63%
Oxygen (O) – ~25.5%
Carbon (C) – ~9.5%
Nitrogen (N) – ~1.4%
Trace: Phosphorus (P), Sulfur (S), Sodium (Na), Potassium (K), Magnesium (Mg), Calcium (Ca), Chlorine (Cl), Iron (Fe), etc.

CHONPS = Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus, Sulfur — the 6 essential elements in biomolecules.

Cytosol vs. Cytoplasm

Cytoplasm	The entire contents within the cell membrane, excluding the nucleus (in eukaryotes). Includes the cytosol and organelles.
Cytosol	The fluid portion of the cytoplasm. Aqueous, gel-like solution where many metabolic reactions occur. Does not include organelles.

Cytoplasm = Cytosol + Organelles (excluding the nucleus)

Nucleoid vs. Nucleus

Nucleoid	A region in prokaryotic cells where the circular DNA (chromosome) is located. It is not surrounded by a membrane.
Nucleus	A membrane-bound organelle in eukaryotic cells that contains linear chromosomes (DNA) and controls gene expression.

Nucleus = membrane-bound
Nucleoid = no membrane

Most Abundant Elements in Living Organisms

CHON — make up ~96% of living matter:

C = Carbon

H = Hydrogen

O = Oxygen

N = Nitrogen

Living organisms are primarily composed of four elements—carbon, hydrogen, oxygen, and nitrogen (CHON)—because they form stable, versatile bonds necessary for complex biological molecules. Carbon is central to life's chemistry due to its unique ability to form diverse and stable molecular structures essential for metabolism, growth, and reproduction.

Trophic Classifications (Energy & Carbon Sources)

Energy Source	Carbon Source
Phototroph: Light (e.g., plants, algae)	Autotroph: CO_2 → organic compounds (e.g., plants, chemoautotrophic bacteria)
Chemotroph: Chemicals (e.g., animals, some bacteria)	Heterotroph: Organic carbon from other organisms (e.g., animals, fungi)

Trophic Classifications (Energy & Carbon Sources) (cont)

Type	Energy Source	Carbon Source	Examples
Photoautotroph	Light	CO_2	Plants, cyanobacteria
Photoheterotroph	Light	Organic	Some protists, bacteria
Chemoautotroph	Inorganic chem.	CO_2	Nitrifying, sulfur bacteria
Chemoheterotroph	Organic chem.	Organic	Animals, fungi, many bacteria