

| 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 <sup>+</sup> , K <sup>+</sup> , Cl <sup>-</sup> , Ca <sup>2+</sup> , 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<br>Nucleoid = no membrane       |                                                                                                                                   |



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### 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 <sub>2</sub> → organic compounds (e.g., plants, chemoautotrophic bacteria) |

### Trophic Classifications (Energy & Carbon Sources) (cont)

|                                                      |                                                                         |
|------------------------------------------------------|-------------------------------------------------------------------------|
| Chemotroph: Chemicals (e.g., animals, some bacteria) | Heterotroph: Organic carbon from other organisms (e.g., animals, fungi) |
|------------------------------------------------------|-------------------------------------------------------------------------|

| Type           | Energy Source | Carbon Source   | Examples              |
|----------------|---------------|-----------------|-----------------------|
| Photoautotroph | Light         | CO <sub>2</sub> | Plants, cyanobacteria |

|                  |       |         |                         |
|------------------|-------|---------|-------------------------|
| Photoheterotroph | Light | Organic | Some protists, bacteria |
|------------------|-------|---------|-------------------------|

|                     |                 |                 |                             |
|---------------------|-----------------|-----------------|-----------------------------|
| Chemolithoautotroph | Inorganic chem. | CO <sub>2</sub> | Nitrifying, sulfur bacteria |
|---------------------|-----------------|-----------------|-----------------------------|

|                  |               |         |                               |
|------------------|---------------|---------|-------------------------------|
| Chemoheterotroph | Organic chem. | Organic | Animals, fungi, many bacteria |
|------------------|---------------|---------|-------------------------------|



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