

# Cellular Nature of Life (Review)

## I. Cell structure

### A. **plasma membrane** and separating cell from the environment

1. made of **phospholipid bilayer**
  - a. hydrophilic cover exposed to aqueous external and internal environments
  - b. hydrophobic center shields internal cell from contact with external environment in which it could easily dissolve
2. **glycoproteins** and **glycolipids** function in membrane to:
  - a. link to other cells (as in tissues)
  - b. identify themselves to other cells (as in immune responses)
3. membrane functions to allow cell control over what enters and exits
  - a. channel proteins facilitate the passage of specific molecules through the plasma membrane (**facilitated diffusion**)
  - b. other membrane structures require energy to obtain molecules against a concentration gradient (**active transport**)

Example: Sodium-potassium pump

c. **Endocytosis and exocytosis:** membrane may engulf multiple molecules/substances and import (or export) them *en masse*

## II. Cell types:

### A. **Prokaryotes** - simple with few cellular "organs" called organelles

1. external: protects from environment, provides mobility and anchoring
  - a. plasma membrane;
  - b. polypeptide or polysaccharide cell wall;
  - c. capsule;
  - d. flagella.
2. internal: metabolism and reproduction
  - a. single, naked chromosome;
  - b. free-floating ribosomes (made of RNA and protein);
  - c. liquid medium of cytosol.
3. limitations: depend on diffusion so very limited in size (bacteria)

**B. Eukaryotes** - complex cellular and multicellular organisms

1. external: protects from environment, some mobility, macrostructure
  - a. plasma membrane;
  - b. cell wall - cellulose in plants, chitin in fungi.
  
2. internal: larger in volume, highly organized (allowing larger volume)
  - a. **cytoplasm:** liquid suspension medium
  - b. **cytoskeleton:** protein-based, 3-dimensional lattice-work allowing for greater organization of internal chemistry and metabolism
  
  - c. **nucleus:** 'the brain' of the cell
    - i. generates RNA for protein synthesis
    - ii. controls reproduction
  
  - d. **nuclear envelope:** bilayer phospholipid membrane enclosing **chromosomes** (DNA, the genes) and **nucleolus** (DNA-RNA structure where ribosomes are assembled)
  
  - e. **endomembranal system:** membrane system that interconnects organelles of cell - the assembly line and distributional infrastructure of the cell; comprised of:
    - i. nuclear envelope,
    - ii. endoplasmic reticulum (the "ER"),
    - iii. Golgi complex, and
    - iv. plasma membrane.
  
  - f. **endoplasmic reticulum:** convoluted membrane
    - i. Rough ER: attachment of many ribosomes near nuclear envelope for protein synthesis from RNA constructed within the nuclear envelope;
    - ii. Smooth ER: fewer ribosomes (so smooth) but site of attachment of other proteins that generate other molecular products like carbohydrates and lipids.
  
  - g. **Golgi complex:** membrane-enclosed structures where many cellular components (protein, lipid and carbohydrate) are generated and packaged in vesicles for transport throughout the cell.
  
  - h. **vesicles:** membrane enclosed containers where cellular metabolism is localized / concentrated, gene products are stored, and raw materials and waste products are stored
    - i. **food vesicles** - endocytosis
  
    - ii. **lysosomes** - digestive enzyme organelles where food and worn out cellular components are digested or recycled into raw

materials

iii. **peroxisomes** - digestion and detoxification of metabolic wastes

i. **energy organelles:** where cellular energy currencies (glucose, ATP) are generated

i. **mitochondria:** cellular power stations extracting the greater share of usable energy from glucose molecules

ii. **chloroplasts:** in plants and algae, the organelle which makes photosynthesis possible, thus creating usable organic energy (glucose) from inorganic molecules ( $\text{CO}_2$  and  $\text{H}_2\text{O}$ ) using