

Introduction to Cell Biology

Introduction to Cell Biology – Study Notes

1. What Is Cell Biology?

- **Definition:** The branch of biology that studies the structure, function, and behavior of cells—the basic units of life.
 - **Scope:**
 - Cellular components (organelles, membranes, cytoskeleton)
 - Cellular processes (metabolism, signaling, division)
 - Inter?cellular interactions and tissue organization
 - **Why It Matters:** All living organisms are made of cells; understanding cells explains development, disease, biotechnology, and evolution.
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2. The Cell Theory (Foundational Principles)

Principle	Description
1. All living things are composed of cells	Cells are the universal building blocks of life.
2. The cell is the basic unit of structure and function	All physiological processes occur within or because of cells.
3. All cells arise from pre?existing cells	Cell division (mitosis, meiosis) is the mechanism of reproduction.
4. (Modern addition) Cells contain hereditary information that is passed on during cell division.	DNA is the genetic material housed in the nucleus (eukaryotes) or nucleoid (prokaryotes).

3. Major Types of Cells

Feature	Prokaryotic Cells	Eukaryotic Cells
Nucleus	No true nucleus; DNA in nucleoid region	Membrane?bound nucleus
Size	0.1–5?μm	10–100?μm
Organelles	Few (ribosomes, sometimes thylakoids)	Many (mitochondria, ER, Golgi, lysosomes, etc.)

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Feature	Prokaryotic Cells	Eukaryotic Cells
Cell Wall	Usually peptidoglycan (bacteria) or pseudo-peptidoglycan (archaea)	Plants & fungi: cellulose or chitin; animals: none
Examples	Bacteria, Archaea	Animals, plants, fungi, protists

4. Cellular Structures & Their Functions

4.1 Plasma Membrane

- **Composition:** Phospholipid bilayer with embedded proteins, cholesterol (eukaryotes), glycolipids.
- **Functions:**
 - Selective barrier & transport (diffusion, facilitated transport, active pumps)
 - Cell signaling (receptors)
 - Cell adhesion & recognition

4.2 Cytoplasm

- **Cytosol:** Aqueous matrix containing ions, metabolites, enzymes.
- **Cytoskeleton:**
 - **Microfilaments (actin)** – cell shape, motility, cytokinesis.
 - **Intermediate filaments** – mechanical support.
 - **Microtubules** – chromosome segregation, intracellular transport, cilia/flagella.

4.3 Nucleus (eukaryotes)

- **Nuclear envelope:** Double membrane with pores.
- **Chromatin:** DNA + histone proteins.
- **Nucleolus:** Ribosomal RNA synthesis & ribosome assembly.

4.4 Organelles (selected)

Organelle	Primary Role
Mitochondria	ATP production via oxidative phosphorylation; apoptosis regulation.
Chloroplasts (plants & algae)	Light-dependent reactions & Calvin cycle ? photosynthesis.

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Organelle

Primary Role

Endoplasmic Reticulum (ER)	Rough ER – protein synthesis & folding; Smooth ER – lipid synthesis, detoxification, Ca ²⁺ storage.
Golgi Apparatus	Modification, sorting, and packaging of proteins/lipids