

Module 04: Cellular Function — Keys to Success

Key Learning Objectives

1. Cell Theory and Types of Cells

- State and explain the **three principles of cell theory**:
- All living things are made of cells
- Cells are the basic units of structure and function in living things
- New cells are produced from existing cells
- Compare and contrast **prokaryotic and eukaryotic cells** (size, complexity, organelles)
- Identify distinguishing features of **plant, animal, and bacterial cells**
- Recognize examples of prokaryotes (bacteria, archaea) and eukaryotes (protists, fungi, plants, animals)

2. Cell Organelles and Their Functions

- Identify and describe the function of **major organelles**:
- **Nucleus** — contains DNA, controls cell activities
- **Ribosomes** — protein synthesis (found in all cells)
- **Endoplasmic Reticulum (ER)** — rough ER (protein processing), smooth ER (lipid synthesis)
- **Golgi Apparatus** — modifies, packages, and ships proteins
- **Mitochondria** — cellular respiration, ATP production ("powerhouse")
- **Chloroplasts** — photosynthesis (plant cells only)
- **Lysosomes** — digestion and waste removal
- **Vacuoles** — storage (central vacuole in plants)
- Understand the relationship between **structure and function** of each organelle

3. The Nucleus and Genetic Control

- Describe the **structure of the nucleus**: nuclear envelope, nuclear pores, nucleolus, chromatin/chromosomes

- Explain why the nucleus is called the "**control center**" of the cell
- Understand the basic flow of genetic information: **DNA → RNA → Protein**
- Describe the role of the nucleolus in ribosome production

4. The Endomembrane System

- Trace the **pathway of proteins** through the endomembrane system:
- Rough ER → Golgi apparatus → vesicles → plasma membrane or lysosomes
- Explain how the **ER, Golgi apparatus, vesicles, and plasma membrane** work together
- Describe the role of **lysosomes** in cellular digestion and recycling
- Understand the difference between rough ER and smooth ER functions

5. Energy Organelles and Endosymbiotic Theory

- Compare **mitochondria and chloroplasts** in structure and function:
- Both have double membranes and their own DNA
- Mitochondria: cellular respiration (glucose → ATP)
- Chloroplasts: photosynthesis (light → glucose)
- Explain the **endosymbiotic theory** and evidence supporting it:
- Own circular DNA, similar to bacteria
- Double membranes
- Self-replicating
- Ribosome similarity to bacterial ribosomes
- Understand why plant cells have **both mitochondria and chloroplasts**

6. Cytoskeleton and Cell Movement

- Describe the **three components of the cytoskeleton**:
- **Microfilaments** (actin) — cell shape, muscle contraction
- **Intermediate filaments** — structural support, anchor organelles
- **Microtubules** — cell division, organelle movement, cilia/flagella
- Explain how the cytoskeleton supports **cell structure, shape, and movement**
- Identify the roles of **cilia** (short, numerous, wavelike motion) and **flagella** (long, few, whiplike motion)
- Understand the role of **centrosomes and centrioles** in cell division

Study Tips

1. **Label diagrams** — Practice identifying all organelles in plant and animal cell diagrams
2. **Create function flashcards** — One card for each organelle with structure on front, function on back
3. **Use the "cell as factory" analogy:**
4. Nucleus = CEO's office (control center)
5. Ribosomes = assembly line workers (make products)
6. ER = manufacturing department (process and modify)
7. Golgi = shipping department (package and send)
8. Mitochondria = power plant (generate energy)
9. Cell membrane = security gate (controls what enters/exits)
10. **Compare cell types in a table** — Create a three-column table comparing plant, animal, and bacterial cells
11. **Trace protein pathways** — Follow a protein from ribosome through ER, Golgi, to final destination
12. **Review endosymbiotic evidence** — List the four key pieces of evidence supporting this theory
13. **Practice with diagrams** — Draw and label the endomembrane system pathway