

College of Biomedical Engineering

Biology

First Stage

Lecture Four

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Cell Structures

Introduction:

Cells are the fundamental building blocks of life, and each cell is equipped with various structures that help it perform its specific functions. These structures are called **organelles**, and they work together to maintain the cell's health, reproduction, and overall function. Let's take a look at some of the most important organelles and cell structures.

1. Cytoplasm

- **Definition**: The cytoplasm is the jelly-like substance that fills the interior of the cell and surrounds all organelles.
- **Function**: It plays a role in supporting the organelles and providing a medium for the chemical reactions that take place in the cell.
- **Components**: The cytoplasm includes both the **cytosol** (the liquid portion) and the organelles suspended in it.

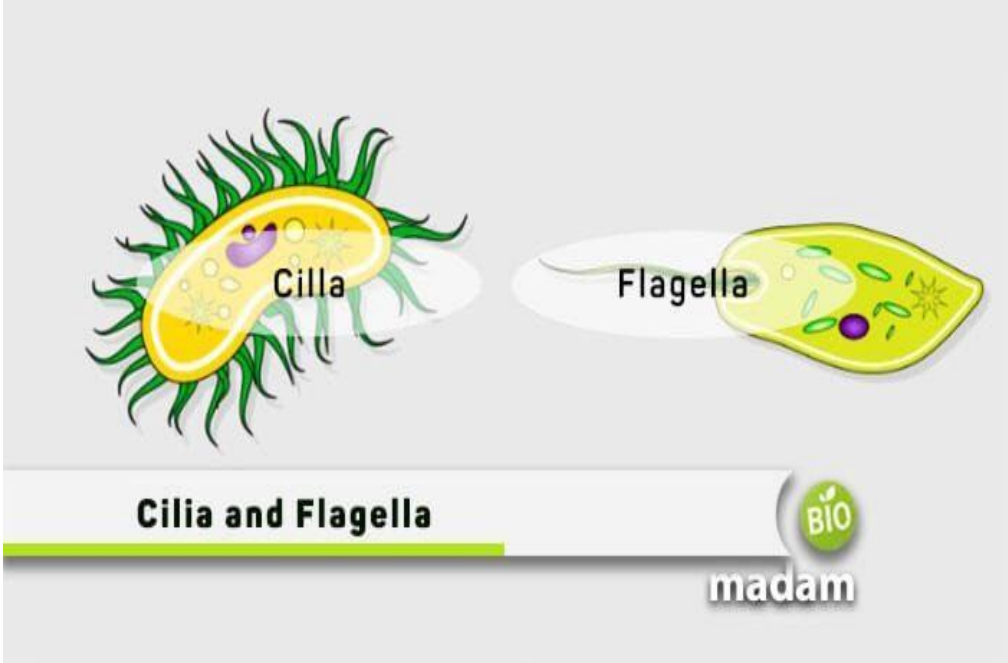
2. Cytoskeleton

- **Definition**: The cytoskeleton is a network of protein fibers that provides structural support to the cell.
- **Function**: It helps the cell maintain its shape, facilitates movement, and plays a role in cell division.
- **Components**: The cytoskeleton consists of three main types of fibers:
    - **Microfilaments**: Thin fibers that assist in cell movement and shape changes.
    - **Intermediate filaments**: Provide mechanical strength to the cell.

- **Microtubules**: Hollow tubes that help with intracellular transport and cell division.

3. Cilia and Flagella

- **Definition**: Cilia and flagella are hair-like projections that extend from the surface of some cells.
- **Function**:
  - **Cilia**: Short, numerous projections that move in a coordinated manner to move substances along the surface of the cell (e.g., in the respiratory tract).
  - **Flagella**: Longer and fewer in number, flagella are responsible for propelling the cell itself through its environment (e.g., sperm cells).



4. Ribosomes

- **Definition**: Ribosomes are small, non-membranous structures made of RNA and proteins.
- **Function**: Ribosomes are responsible for protein synthesis. They translate genetic information from mRNA to create polypeptide chains, which fold into functional proteins.
- **Location**: Ribosomes can be found either floating freely in the cytoplasm or attached to the rough endoplasmic reticulum.

5. Endoplasmic Reticulum (ER)

The **endoplasmic reticulum** (ER) is a network of membranes involved in protein and lipid synthesis. There are two types:

- **Rough ER**: Studded with ribosomes, it is involved in the synthesis and folding of proteins.
- **Smooth ER**: Lacks ribosomes and is responsible for lipid synthesis, detoxification, and calcium storage.

6. Golgi Apparatus

- **Definition**: The Golgi apparatus is a series of flattened, membrane-bound sacs.
- **Function**: It modifies, sorts, and packages proteins and lipids received from the ER. These molecules are then transported to their destination, either within or outside the cell.
- **Role in secretion**: The Golgi apparatus is particularly important in the secretion of substances like hormones or enzymes.ز

7. Lysosomes

- **Definition**: Lysosomes are membrane-bound organelles filled with digestive enzymes.
- **Function**: Lysosomes are involved in breaking down waste materials, cellular debris, and foreign substances (e.g., bacteria) within the cell. This process is known as **phagocytosis**.
- **Role in autophagy**: Lysosomes also help in the recycling of the cell's components through a process called **autophagy**.

8. Peroxisomes

- **Definition**: Peroxisomes are small, membrane-bound organelles that contain enzymes.
- **Function**: They are involved in the breakdown of fatty acids and detoxifying harmful substances. Peroxisomes also produce hydrogen peroxide (H_2O_2) during these processes, which is then broken down into water and oxygen.

9. Proteasomes

- **Definition**: Proteasomes are large, cylindrical protein complexes.
- **Function**: Proteasomes are responsible for degrading damaged or unneeded proteins by breaking them down into smaller peptides. This process helps regulate the concentration of specific proteins in the cell and prevents the accumulation of defective proteins.

10. Mitochondria

- **Definition**: Mitochondria are double-membraned organelles known as the "powerhouses" of the cell.
- **Function**: Mitochondria generate most of the cell's energy in the form of **ATP** (adenosine triphosphate) through the process of **cellular respiration**.
- **Unique Features**: Mitochondria have their own DNA and ribosomes, and they can replicate independently within the cell. This suggests that mitochondria evolved from ancient bacteria.