CHAPTER

1

Introduction to Biochemistry

1.1. DEFINITION

It is the study of all aspects of life, including coordination and control inside a living thing. Carl Neuberg, the founder of biochemistry, first used this phrase Biochemistry in the year 1930. This subject acts as a link betwen biology and chemistry to investigate the chemical composition of life.

It illustrates the following:

- Chemical makeup of living things.
- Chemical changes that take place within the body during digestion, absorption, and excretion.
- Chemical alterations that take place as organisms expand and reproduce.
- Changes in the shapes of chemical components
- Such transformations include energy shifts from one form to another.

1.2. SCOPE OF BIOCHEMISTRY IN LIFE SCIENCES

- The study of biomolecules' chemical nature, structure, and functions is covered by biochemistry.
- There are many different biomolecules, including lipids, proteins, carbohydrates, and nucleic acids. Biochemistry research has shown the dynamic changes that occur in the biomolecules.
- Biochemical reactions of these biomolecules are surprisingly in a similar manner among all living beings
- Biochemistry has identified the variations in various species metabolism and their connection to so many diseases.
- Through dietary changes or genetic manipulation, biochemistry has helped in treating certain disorders.
- Estimating enzymes and other biomolecules supports the diagnosis of a variety of disorders.

1.3. FIELDS OF BIOCHEMISTRY

1. **Enzymology:**
   - The study of enzymes called enzymology.

- They act like biological catalytic agents.
- Metabolic process becomes fast in the catalyst presence.

2. **Bioenergetics:**
   - It is concerned with how an organism uses and transforms energy.
   - In a living organism energy is liberated by the digestion and metabolism of carbohydrates, proteins, and lipids in food.
   - The energy liberated is utilized for various metabolic activities in the form of ATP.
3. **Molecular Biology:**
   - It involves a detailed study of nucleic acids (DNA & RNA) and protein synthesis.
   - It is also closely related to genetics.
   - Molecular cloning.
   - PCR.
   - Reverse transcription.
4. **Clinical Biochemistry:**
   - Clinical biochemistry also known as chemical pathology or medical biochemistry.
   - It is a branch of biochemistry which involves a variety of investigations.
   - This investigation is widely utilized in various disease diagnoses.

1.4. CELL AND BIOCHEMICAL ORGANIZATION

Cell Definition: The basic units of life are the cells. These form the basis of life. They contain all the elements and components necessary for the survival of the organisms as a whole and as well as of individual cells. The nucleus, the cytoplasm and the cell membrane are the same three components found in all eukaryotes, despite the fact that distinct cells have various subcellular architecture.

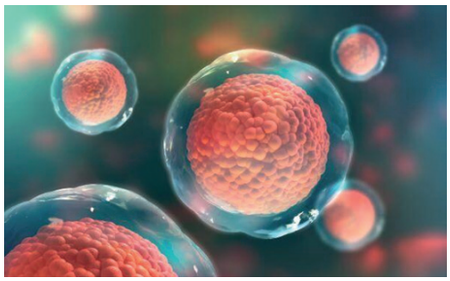

Fig. 1.1: Outer surface of cell

Every eukaryotic cell is made up of three essential parts. They are the cell membrane, the cytoplasm, and the nucleus. The cytoplasm occupies the area between the nucleus and cell membrane. The cytoplasm contains many organelles, which are tiny subcellular structures. The extracellular fluid (ECF) is what surrounds the outside the cell, whereas inside the cell is filled with intracellular fluid.

Organelles in animal cells: Similar organelles can be found in both plant and animal cells. They are made up of the golgi apparatus, lysosomes, endoplasmic reticulum, cell membrane, ribosomes, and nucleus.

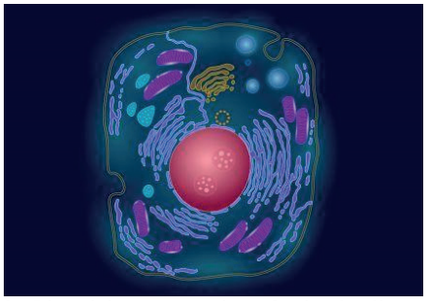

Fig. 1.2: Pictorial representation of animal cell organelles

Cell Organelles: The tiny organs of a cell are called organelles. They are distinctive, specialized structures designed to carry out the vital tasks required for cell survival. Almost all cell types contain some organelles, such as the mitochondria, ribosomes, and nucleus. Others such (as the cell wall and chloroplasts) are exclusively present in specific cell types, such as plant and algae.

Cell Membrane: The cell membrane, also referred to as the plasma membrane, physically separates the interior of the cell from its external environment. Its semipermeable lipid bilayer regulates the flow of materials in and out of the cell.

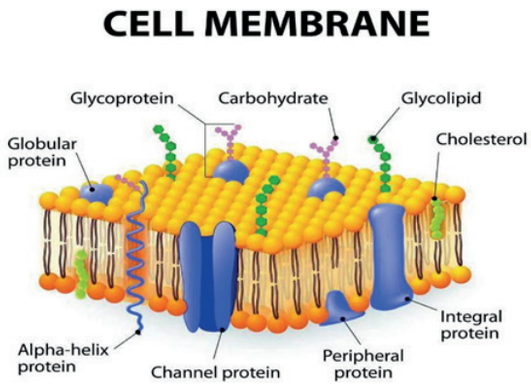

Fig. 1.3: Pictorial representation of cell membrane

1. **Cytoplasm:** The cytoplasm, a substance that resembles jelly, is found inside every cell. These organelles support and protect all the other organelles and a variety of chemical reactions takes place within the cell. The majority of the cytoplasm is made up of water, although salts and other chemical substances are also present in it.
2. **Nucleus:** Nucleus is in the middle of the cell and it contains DNA and genetic code.

The nuclear envelope, a double membrane that separates it from the cytoplasm and it is responsible for all cellular functions, including cell division, protein synthesis, growth, and metabolism.

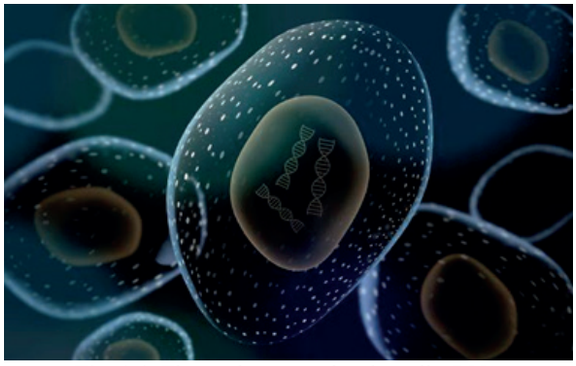

Fig. 1.4: The nucleus contains the cell's DNA

3. **Mitochondria:** Cell breathes through their mitochondria. They discharge the energy needed to fuel every other cellular function.
4. **Ribosomes:** Production of proteins occurs within ribosomes. These organelles use the genetic code's instructions to 'read' and construct polypeptide chains from amino acids.
5. **The Endoplasmic Reticulum:** The primary duties of ER, a large, continuous, membrane-bound organelle, are the processing and transportation of recently synthesized components. Ribosomes are located throughout the rough ER, which is where the proteins are processed and transported. The production of lipids and hormones is primarily carried out by smooth ER, which lacks ribosomes.
6. **Golgi Apparatus:** Materials are moved from the Endoplasmic Reticulum to the Golgi apparatus, where they are packaged and sent to the proper locations. Some are integrated into the membrane, while other substances pass through the plasma membrane and disappear from the cell.
7. **Lysosomes:** Small, spherical organelles called Lysosomes use digestive enzymes to get rid of waste. They are crucial in **apoptosis** (programmed cell death), and may be utilized to recycle old or damaged cell parts or invasive infections.

1.5. FUNCTIONS OF CELL

Major functions that a cell performs are essential for the growth and development of an organism.

Following are some crucial cell functions:

1. **Offers Structure and Support:** All living things are composed of cells. They provide the framework for all living things. The cell wall and the cell membrane are the main components that support and structure the organism. For instance,

the skin has a large number of cells. Vascular plants' xylem, which is made up of cells, supports the structural integrity of the plant.

2. **Promote Growth Mitosis:** During the mitotic phase, the parent cell divides into the daughter cells. Cells multiply as a result, which helps an organism to grow.
3. **Permits the Transportation of Substances:** To carry out a variety of chemical processes occurring inside the cell, the cells import various nutrients. The waste products left over from chemical reactions are taken out of the cells through active and passive transport. Little oxygen, carbon dioxide, and ethanol molecules diffuse through the cell membrane along the gradient of concentration. The larger molecules travel over the cell membrane by active transport, and use a significant amount of energy from the cells.
4. **Production of Energy:** Cells require energy to perform a variety of chemical processes. The photosynthesis process is how the cells of both plants and animals produce this energy.
5. **Helps in Reproduction:** A cell is responsible for reproduction by two processes i.e mitosis and meiosis. The cells receive various nutrients to carry out the multiple chemical reactions occurring inside the cell. Mitosis means the division of a parent cell into daughter cells, it is also called as asexual reproductive process. Meiosis results in genetic variations between the daughter cells and the parent cells.

Thus, it is evident why cells are considered as a basic component of life. This is because they provide a shape to the organisms and perform a variety of activities necessary for survival of life.