The cell can be understood by studying its complexity and functions. In the beginning the term itself was coined by the invention of the simple microscope by Anton Von Lewenhock and Jenssenis and the subsequent invention of the microscope by Robert Hooke in 1665; he introduced the term Cell while describing the microscopic texture of the cork.

The term Cell comes from the Latin word *Cellula*, which means small compartments. The improvement in microscopes and the techniques of staining helped us examining the structure and content of the cell.

The structural living unit other than the virus is the cell, which consists of smaller structures called Organelles, namely:

- Cell Wall.
- Plasma Membrane.
- Cytosol, Cytoplasm
- Golgi Bodies
- Endoplasmic Reticulum,
- Ribosomes.
- Cytoskeletal structure.
- Mitochondria.
- Chloroplasts.
- Lysosomes and Peroxisomes and
- Nucleus.

Each organelle has a specialised function within the cell. A Cell containing these organelles and a well defined nucleus is called a Eukaryotic Cell.
The cells of bacteria and blue green algae lack a definite nucleus and organelles like eukaryotes, and are called prokaryotes. Many plants and animals exist as single cells; hence, the cell is the basic unit.

Three requirements have to be fulfilled for a cellular organisation. These are:

(i) a selectively permeable boundary separating the cellular components from the outside.
(ii) a metabolic system which would allow a series of enzyme catalysed reactions, and
(iii) a genetic information system which would store and transmit hereditary information for future generations.

However, viruses are exceptional as they possess a molecule containing the information required for reproduction and a capsular coat around this molecule. Viruses, however, cannot reproduce without a larger host which has an efficient biological machinery. For this reason they do not conform to a truly living system, and may be called semi living particles. Viruses have simple life histories. While the capsular coat is made up of protein, the information molecule is a nucleic acid DNA or RNA.

**EUKARYOTES**

They are highly evolved cells, possessing specialised organelles viz., endoplasmic reticulum; the endoplasmic reticulum may be granular or agranular. Ribosomes are deposited on the granular endoplasmic reticulum. Golgi complex, consisting of stacks of lamellae and vesicles of different shapes and sizes act as an intracellular pump to regulate fluid movement, expulsion of excretory products.

Lysosomes, phagosomes and pinocytosomes appear as irregular vesicular bodies. Lysosomes are rich in hydrolytic enzymes which carry on cellular digestion. Phagosomes contain semisolid or solid nutritive materials which are engulfed by the plasma membrane. Pinocytosomes are microscopic vesicles, pinched off from the plasma membrane like phagosomes; they too contain nutritive material but in liquid phase.

Mitochondria are most important organelles; they may be capsule or rodlike in shape. They are enveloped by a double membrane. The inner membrane, invaginates to form compartments. The mitochondria are responsible for cellular respiration. They also function as energy transducing organelles; contain enzymes of electron transport chain; sites for oxidation of carbohydrates, lipids and amino acids.

Plastids, which are characteristic of plant cell are another cell organelle; plastids without pigment are known as leukoplasts and those possessing colored pigments are known as chromoplasts. The plastids possessing green chlorophyll pigments are known as chloroplasts, which takes part in the photosynthetic activity of the cell. The leucoplasts serve for storage of starch, oil droplets and proteins.
The cytoplasm of the cell also contains vacuoles, which are large in plant cells but in animal cells they are small. The vacuoles are filled with liquid matter.

Another major component of eukaryotic cells is membrane bound nuclear complex. The nucleus consists of the nucleoplasm in which chromosomes and nucleolus are present. The nuclear membrane is double layered, with minute pores and nuclear membrane has direct contact with granular endoplasmic reticulum. Deoxyribonucleic acid (DNA) and the basic protein called histone are present in the chromosomes.

The Centriole is another organelle, that participates in cell division. They are spherical in shape located near the nucleus.

THE CELL THEORY

In 1665 Robert Hooke suggested the term “cell” while describing the microscopic texture of the cork. This was followed by illustrations conforming to cellular nature of living organisms by a number of workers during the next two centuries.

Schleiden and Schwann are generally accredited as the exponents of the “cell theory”, which states that both plants and animals are made up of aggregations of basic units called cells.

Schleiden and Schwann writing in the 19th century, introduced the cell theory, which can be summarised as follows:

(i) Organisational cells are differentiated into distinct cell types.
(ii) Nucleus is a common feature of all cells with the exception of viruses and red blood cells.
(iii) The protoplasm is the living content of the cell, and determines the activity of the cell and of the whole organism.
(iv) New cells originate from pre-existing cells through division.

Life can be considered as a unique and complex interaction of matter and energy that assumes a hierarchy of structural order. The biological continuity, thus, consists of different levels of biological organisation. Atoms, the smallest units of matter, interact to form molecules that may be variously joined to form more elaborate macromolecules characteristic of living organisms. The interacting macromolecules often result into structures called organelles and the next higher level of organisation is the cell. The cell is the smallest unit of interacting matter and energy that exhibits properties of life.

However, the chemical components of the living cells are qualitatively quite different from those of the physical environment. Majority of the molecules in living cells are organic compounds, which occur in great variety and complexity.

For example in *Escherichia coli* bacterium (Fig. 1.1), there are more than 5,000 types of organic molecules, of which 3,000 are proteins and 1,000 are nucleic acids. *Homo sapiens*, i.e., Man is known to have more than 1,00,000 types of proteins. This immense variety of organic compounds is reducible to
a surprising simplicity; all proteins are composed of 20 types of linearly arranged amino acids. Similarly all nucleic acid molecules are composed of four types of nucleotides.

Fig. 1.1 A typical Escherichia coli cell showing prokaryotic organisation

These building blocks, thus, serve as the raw material for macro-molecular synthesis and perform various functions. Amino acids, for example, also serve as the raw material for macromolecular synthesis and perform various functions.

Further, Amino acids also serve as precursors of hormones, alkaloids, pigments, etc. Strange as it may appear, the building blocks are identical in all living organisms. Therefore, the following generalisations can be formulated:

(A) There is an underlying simplicity in the molecular organisation of all living cells.

(B) There is an underlying principle of molecular economy in living cells.

(C) All living organisms have a common ancestor.

PARAMETERS OF LIFE

Though it is not possible to define life, a set of properties can be suggested which characterise life.

(a) Self Organisation: Living systems are self organising, whereby specialised structures would have metabolic cooperation in an organised manner.

(b) Self Regulation Capacity: Self regulation of metabolic processes should be expressed by living systems. Proteins, which also function as enzymes, are capable of performing polymeric synthesis and degradation

(c) Mechanism of Energy Transfer: Living systems obey laws of thermodynamics. They have the capacity to liberate energy which is released through degradation of food materials, and are conserved in the form of ATP. Energy of these phosphate groups is utilised for different metabolic activities.
(d) **Self Reproducing Capacity:** All living organisms reproduce their own kind during their limited lifespan. DNA molecule helps in this process and also in passing genetic information to daughter cells.

(e) **Isothermal Open System:** Living organisms are capable of exchanging matter and energy within the environment; chemical transformations of matter occur at a temperature of around 37°C in majority.

(f) **Adaptation Capacity:** Genetically, living systems are capable of adapting to new environments or improving their efficiency within the same environment and causing evolutionary variations.

Life could be considered as a unique and complex interaction of matter and energy which possesses a sequence of structural order. The biological continuation consists of various levels of biological organisation. Atoms, the smallest units of matter interact to form molecules that may join to form more complicated macromolecules characteristic of living organisms.

Interacting larger molecules often result into structures called organelles and the higher level of organisation is the cell. The cell thus is the smallest unit of interacting matter and energy that exhibits properties of life.

Cells obey the laws of thermodynamics. The first law, which is also known as the law of conservation of energy, states that energy can neither be created nor destroyed; it can, however, be transformed. Living cells could only transform one form of energy into another. Cells absorb the useful form of energy, i.e. free energy, and return an equivalent amount of less useful form of energy to the environment.

The second law states that all physical and chemical processes proceed always with an increase in disorderliness of the universe. This is how cells follow the principle. Living cells neither create nor destroy energy, but transform into a useful form. Cells maintain their orderliness at the cost of their environment which they make more disorderly.

**SUMMARY**

It is believed that the ancestral organisms both plants and animals gained their energy from chemotrophs and later specialised in synthesising own food through photosynthesis.

Structural life unit other than the virus is the cell. A cell consists of smallest structures called organelles, each having a specialised function within the cell. A cell consisting of cellular organelles and well defined nucleus is called eukaryotic cell.

The cell of blue green algae, and bacteria take a definite nucleus and organelles like eukaryotes; they are thus called prokaryotes. As many plants and animals exist as unicellular organisms.

Several cell theories proposed are discussed.
QUESTIONS

1. Why we should not consider virus as a living entity?
2. What are the three main requirements for a cellular organisation?
3. Explain in detail the cell theory?
4. Write shortnotes on:
   (a) Prokaryotes
   (b) Eukaryotes
   (c) Parameters of life.