



ST. MARY'S CO-ED SCHOOL HARDA

CLASS-IX BIOLOGY

CHAPTER-5

FUNDAMENTAL UNIT OF LIFE

Introduction

- The body of all organisms is made up of tiny microscopic units called cell.
- The cell is a fundamental, structural and functional unit of living organisms and basic unit of life.
- All living organisms are made up of cells. Cells make tissues, tissues together make organ, organs make organ system and organ systems make body of organisms. So, cell is called structural unit of life.
- All the basic functions of the body like respiration, excretion etc. are carried out by cell through its cell organelles, so cell is called functional unit of life.
- **Cell biology** is the study of cells in all aspects of structure and functions.

Discovery of cell:

- Cell was first discovered by Robert Hook in 1665. He observed the cell in a cork slice with the help of a primitive microscope.
- Anton Von Leeuwenhoek (1674) was the first to observe free cells, like bacteria, protozoa, red blood cells and sperms in his home-made microscope.

• Cell theory:

- The cell theory, that all the plants and animals are composed of cells and that the cell is basic unit of life, was presented by **two biologists, M. Schleiden (1838) and T. Schwann (1839).**
- The cell theory was further expanded by a German physiologist, Rudolf Virchow (1855). He gave the phrase Omnis cellule-e-cellular, i.e., all cells arise from pre-existing cells.
- Modified cell theory is termed as cell principle or modern cell theory which postulates that:

All living organisms are composed of cells or cell products.

- All living cells arise from pre-existing cells.
- All cells are basically alike in chemical composition and metabolic processes.

The functions of an organism as a whole is the result of the activities and interaction of the constituent cells.

Shape, size and number of cells:



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Cell shape:

- The shape of cells is related to the specific function they perform.
- Some cells like Amoeba and WBCs have changing shapes.
- In some cases, the cell shape could be more or less fixed and peculiar for a particular type of cell; for example, nerve cells have a typical shape.

Cell size:

The size of the cell also varies considerably in different animals and plants.

- The average cell size varies from 0.5 to 20 μ (μ = micrometre).
- In human body, the smallest cell is RBC and the longest one is the nerve cells.

Cell number:

The number of cells in living beings differs from the one in unicellular organisms to many in multicellular forms.

- The number of cells is not definite in multicellular organisms, and may increase along with the growth and volume of organism.

Types of Cells:

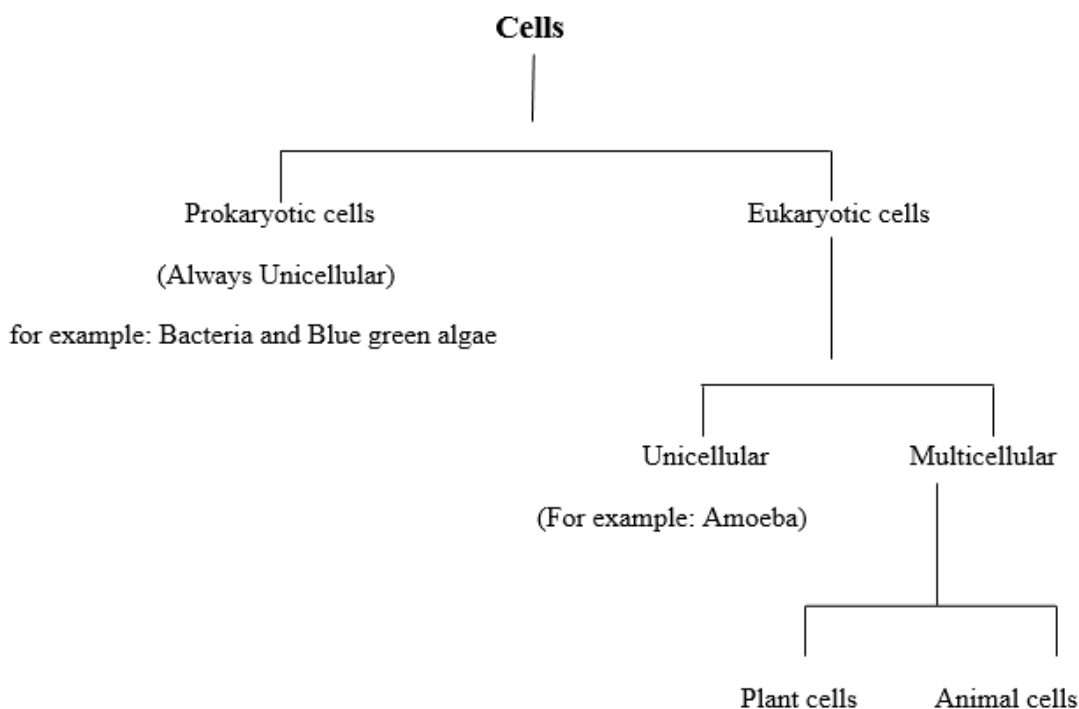


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Differences between Prokaryotic and Eukaryotic cells:

S. No.	Prokaryotic cell	Eukaryotic cell
1	primitive and incomplete cells	Advance and complete
2	Prokaryotes are always unicellular organisms.	Unicellular and multicellular
3	Nucleus is not well defined and known as nucleoid	Well defined nucleus is present
4	membrane bound organelles, such as Mitochondria, Golgi complex etc. are absent.	membrane bound organelles, such as Mitochondria, Golgi complex etc. are also present.
5	Ribosomes are smaller and scattered randomly in the	Ribosomes are bigger. They are either attached to endoplasmic reticulum or are

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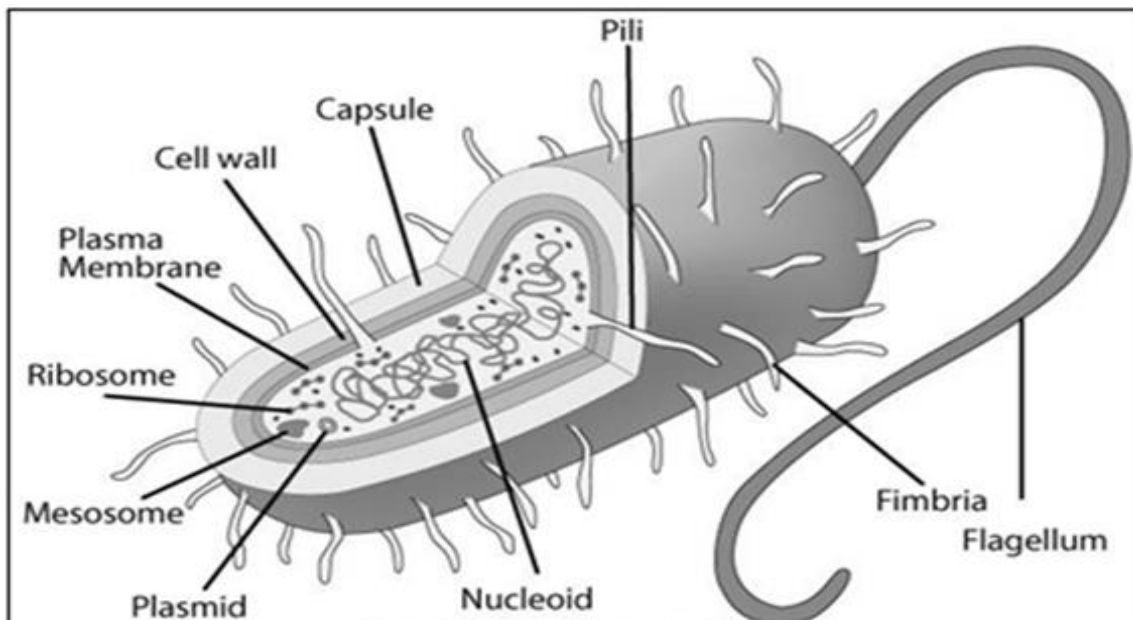
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	cytoplasm.	found free.
6	The prokaryotes include archaeobacteria, bacteria and cyanobacteria (blue green algae).	Eukaryotes include all living organisms, except bacteria and blue-green algae

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Prokaryotic cell

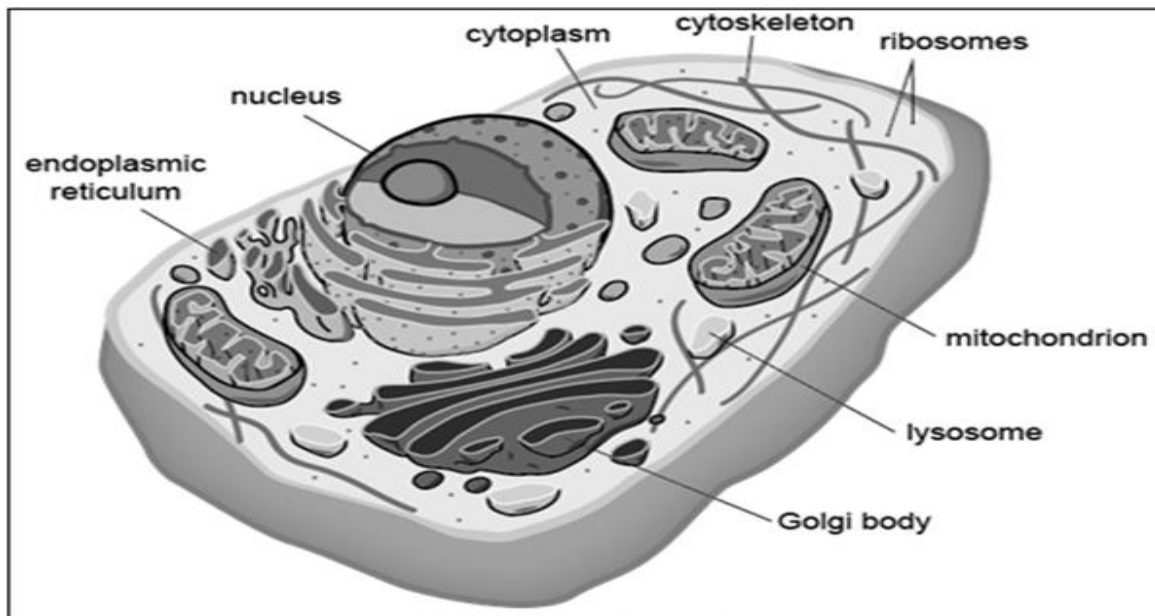


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Eukaryotic cell

Structure of cell:

Structurally the cell is formed of three major parts:

1. **Plasma membrane or cell membrane**
2. **Cytoplasm and its contents**
3. **Nucleus**

Plasma membrane (cell membrane):

- Plasma membrane is the outermost covering of the cell that separates the contents of the cell from its external environment.
- Plasma membrane is living, thin, delicate, elastic, selectively permeable membrane.
- The plasma membrane is flexible and made up of organic molecules called lipids and proteins.

Functions:

- Plasma membrane permits the entry and exit of some materials in the cells. It also prevents movement of some other material. Therefore, the plasma membrane is called a selectively permeable membrane.
- Substances can pass across a membrane by two processes- diffusion and osmosis.

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Diffusion: Some substances like carbon dioxide or oxygen can move across the cell membrane by a process called diffusion.

- “Diffusion is the spontaneous movement of molecules from a region of its higher concentration to a region of its lower concentration.”

Example: movement of carbon dioxide and oxygen during respiration in organisms.

Osmosis:

The movement of water molecules through a selectively permeable membrane from a region of higher water concentration to a region of lower water concentration is called osmosis.

A. Let us see what will happen if you put an animal cell or plant cells into solution of sugar or salt prepared in water?

1. If the medium surrounding the cell has a higher water concentration than the cell, i.e., if solution is a very diluted solution, the cell will gain water by osmosis. Such a dilute solution is called **hypotonic solution**.

Water molecule will pass across the plasma membrane in both directions, but more water molecules will enter the cell than will leave. The cell will therefore, swell up and increase in volume. This process is called **endosmosis**.

2. If the medium surrounding the cell is exactly the same water concentration as the cell, there will be no net movement of water across the plasma membrane resulting in no change in the size of the cell. Such a solution is called **isotonic solution**.
3. If the medium has a lower concentration of water than the cell, i.e., if it is very concentrated solution, the cell will lose water by osmosis. Such a concentrated solution is called **hypertonic solution**.

In this case too, water crosses the plasma membrane in both the directions, but this time more water leaves the cell than enter it. The cell will therefore, shrink and reduce in volume. This process is known as **exosmosis**.

Cell wall:

- In plant cells, there occurs a rigid cell wall which lies outside the plasma membrane.
- Cell wall is thick, non-living and permeable covering made up of cellulose. Cellulose is a kind of carbohydrate (polysaccharide) and it provides structural strength to the plant.

Functions:

1. Cell wall protects cell membrane and the internal structures of the cell.
2. It provides rigidity and determines the shape of the plant cell.
3. It prevents drying of the cell and helps it to bear unfavourable conditions.
4. It provides mechanical strength to the plant cells.



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Protoplasm:

- All cells contain living substance called protoplasm. It is jelly-like, viscous, colourless semi-fluid substance in which various cell organelles and inclusion remains in colloidal form.
- Protoplasm can be distinguished in two forms:
 - Cytoplasm: it is that part of protoplasm which surrounds the nucleus.
 - Nucleoplasm: it is that part of protoplasm which is located inside the nucleus.

Protoplasm = cytoplasm + nucleoplasm

Cytoplasm

The part of the cell which occurs between the plasma membrane and nucleus envelop is called the cytoplasm

- Cytoplasm consists of an aqueous ground substance, the cytosol, containing a variety of cell organelles and other inclusions such as insoluble waste and storage product (starch, lipid, etc.).
- Chemically cytoplasm contains about 90% water, 7% proteins, 2% carbohydrates and lipids and 1% inorganic minerals, minerals vitamins, etc.

Cell organelles:

- A cell has to perform different functions with the help of its various membrane-bound cell organelles.
- Cell organelles are “small organs” of the cell and are found embedded in the cytosol. They form living part of the cell and each of them has a definite shape, structure and function.

NAME OF THE ORGANELLE	STRUCTURE	FUNCTIONS
Ads by optAd360 ENDOPLASMIC RETICULUM	It is absent in prokaryotic cells and matured RBCs of mammals. ER occurs in three forms: Cisternae (i.e., closed, fluid-filled sacs), vesicles and tubules. ER is of two types: 1. Rough endoplasmic reticulum (RER) with ribosomes attached on its surface.	- It forms intracellular transporting system. - SER takes part in the synthesis of lipids. - RER is concerned with the transport of proteins which are synthesized by ribosomes on their surface.



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	2. Smooth endoplasmic reticulum (SER) which is without ribosomes.	
GOLGI COMPLEX (GOLGI APPARATUS OR GOLGI BODY)	Golgi complex was discovered by Caomillo Golgi (1898). It occurs in almost all eukaryotic cells. It is not found in prokaryotic cells. Golgi apparatus consists of a set of membrane-bounded, fluid-filled vesicles, vacuoles and flattened cisternae.	1. It is known as packaging and dispatching unit of the cell. 2. It is involved in the synthesis of cell wall, plasma membrane and lysosomes. 3. It is involved in the formation of cell plate during cell division.
Ads by optAd360 RIBOSOMES	They are present both in prokaryotic and eukaryotic cells. Ribosomes are dense, spherical and granular particles which occur freely in cytoplasm or remain attached to the endoplasmic reticulum (RER). Chemically ribosomes are made up of ribonucleic acid (RNA) and proteins. Ribosomes are of two types: 70S and 80S	Ribosome is the site of protein synthesis so it is known as protein factory of the cell.
MITOCHONDRIA	They are present in eukaryotic cell but absent in prokaryotic cells. Mitochondria exist in variable shapes. It is a double membranous organelle. Outer membrane is smooth and inner membrane forms folds like structure called cristae. The cristae consist of F1 particles on its surface. The matrix inside it contains ribosomes, respiratory enzymes and a circular DNA.	1. Mitochondria generate energy in the form of ATP (Adenosine Tri Phosphate), that is why it is called powerhouse of the cell. 2. Mitochondria have their own ribosomes and DNA, they can synthesize their own proteins, and they are self-duplicating units. So, they are regarded as semiautonomous organelles.



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LYSOSOMES	Lysosomes are dark, spherical, single membrane bound sacs containing several digestive enzymes. These enzymes are capable of digesting or breaking down all organic materials. Lysosomes are formed by Golgi complex. They are found in the cytoplasm of eukaryotic cell, mostly in animal cells.	1. Lysosomes are involved in intracellular digestion. 2. During starvation or aging, the cell digests its own organelles through lysosomal enzymes, a process called autophagy. 3. Lysosomes help to keep the cell clean by digesting any foreign material as well as worn out cell organelles. 4. When a cell is destined to die, the lysosomal enzymes digest the whole cell, a process called autolysis. Therefore, lysosomes are also known as 'suicide bags' of the cell.
PLASTIDS (The term 'plastid' was given by Haeckel in 1866. Plastids occur in most plant cells and are absent in animal cells. Ads by optAd360 CHLOROPLAST	They are spherical or discoidal in shape and are enclosed in double membrane. Inside a plastid, two definite regions are clearly visible- Grana and Stroma. Grana are stacks of membrane-bounded, flattened discoid sacs containing the molecules of chlorophyll. Stroma is the homogeneous matrix in which grana are embedded. Plastids contain their own DNA and ribosomes i.e., they have their own protein synthesizing machinery. They are also self-replicating organelles. On the basis of colour, plastids are of following three types: 1. Chloroplasts: Green-coloured plastids containing chlorophyll.	1. Chloroplasts are photosynthetic organelles. The chlorophyll present in them trap solar energy for the purpose of synthesizing food for the plant. So, chloroplasts are the 'Kitchens of the cells.' 2. Leucoplasts help in storing food products like starch, protein and lipids. 3. Chromoplasts provide colour to flower which in turn attracts insects for pollination.



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	2. Leucoplasts: Colourless plastids. 3. Chromoplasts: Coloured plastids (except green colour).	
CENTROSOMES	Centrosome is found only in animal cells. It is not bounded by any membrane but consists of two granule-like centrioles. Centrioles are hollow cylindrical structures which are made up of microtubules.	1. Centrosome helps in cell division in animal cells. During cell division centrioles migrate to the poles of animal cells and are involved in the formation of the spindle. 2. They produce basal bodies from which cilia and flagella arise.
Ads by optAd360 VACUOLES	Vacuoles are fluid-filled or solid-filled and membrane bound spaces in the cytoplasm. Vacuoles are small sized in animal cells while plant cells have very large vacuoles. The vacuole is bounded by a membrane, called tonoplast. The vacuole is filled with cell sap which is watery solution rich in sugar, amino acids, proteins, minerals and metabolic wastes.	1. Vacuoles are meant for the storage of food, water and other substances. 2. Vacuoles help to maintain the osmotic pressure in a cell (osmoregulation). 3. Vacuoles provide turgidity and rigidity to the plant cells.
PEROXISOMES	Peroxisomes are small and spherical organelles containing powerful oxidative enzymes. They are bounded by a single membrane.	Peroxisomes are specialized for carrying out some oxidative reactions, such as detoxification or removal of toxic substances from the cell.

Nucleus:



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- The nucleus is a major, centrally located spherical cellular component. It is the centre from where all cellular activities are controlled. It is the carrier of hereditary material in the cell.
- It is bounded by two membranes, both forming a **nuclear envelope**. The nuclear envelope contains many pores known as **nuclear pores** and encloses the liquid ground substance, the **nucleoplasm**.
- The nucleopores allow transfer of materials between the nucleoplasm and the cytoplasm. Within nucleoplasm are embedded two types of nuclear structures- nucleolus and chromatin material.

Nucleolus:

- The nucleolus may be one or more in number and is not bounded by any membrane.
- Nucleolus consists of DNA, RNA and protein.
- It is the site of ribosome formation. Nucleolus is known as **factory of ribosomes**.
-

Chromatin material:

The chromatin is a thin, thread-like intermingled mass of chromosome material and composed of the genetic substance DNA (deoxyribonucleic acid) and proteins (i.e., histones).

- DNA stores all the information necessary for the cell to function (metabolism), to grow and to reproduce further cells of the next generation.
- The chromatin is condensed into two or more thick ribbon-like chromosomes during the division of cell.
- Functional segments of DNA are called **genes**.
- Genes carry information for protein synthesis, which in turn control the development of characters. Since genes are present on chromosomes and chromosomes pass from one generation to the next through, genes are called **hereditary units**.

Functions of nucleus:

1. The nucleus controls all metabolic activities of the cell. If the nucleus is removed from the cell, the protoplasm ultimately dries up and dies.
2. It regulates the cell cycle.
3. It is the **storehouse of genes** which are concerned with the development and manifestation of all the body characters.
4. Nucleus helps in the formation of ribosomes and RNA.
5. It helps in the transmission of characters from one generation to the next.



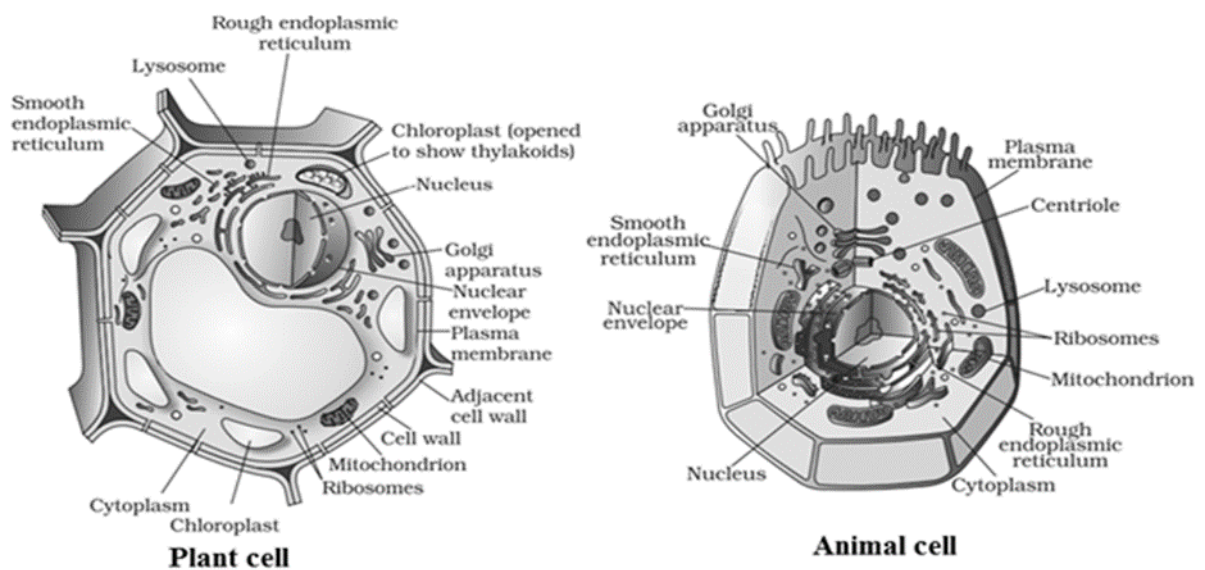
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DIAGRAM OF PLANT AND ANIMAL CELL



Test your Knowledge

Fill in the blanks 1) _____ are “small organs” of the cell and are found embedded in the cytosol.

2) _____ discovered Golgi complex in _____

3) _____ apparatus consists of a set of membrane-bounded, fluid-filled vesicles, vacuoles and flattened cisternae.

4) _____ are present both in prokaryotic and eukaryotic cells.

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- 5) Chemically ribosomes consists of _____ and _____
- 6) _____ is the site of protein synthesis so it is known as protein factory of the cell.
- 7) _____ is a double membranous organelle
- 8) Mitochondria have their own ribosomes and _____, they can synthesize their own proteins, and they are self-duplicating units.
- 9) _____ are dark, spherical, single membrane bound sacs containing several digestive enzymes.
- 10) _____ helps in the formation of ribosomes and RNA.
- 11) When a cell is destined to die, the lysosomal enzymes digest the whole cell. This process is known as _____
- 12) PLASTIDS term is given by _____ in _____
- 13) _____ are spherical or discoidal in shape and are enclosed in double membrane.
- 14) _____ is the homogeneous matrix in which grana are embedded.
- 15) Chloroplasts are Green-coloured plastids containing _____.
- 16) The chlorophyll present in Chloroplasts trap solar energy for the purpose of synthesizing food for the _____.
- 17) _____ carry information for protein synthesis, which in turn control the development of characters.
- 18) _____ are small and spherical organelles containing powerful oxidative enzymes and are specialized for carrying out some oxidative reactions, such as detoxification or removal of toxic substances from the cells
- 19) The _____ is a major, centrally located spherical cellular component.
- 20) The nuclear envelope contains many pores known as nuclear pores and encloses the liquid ground substance, the _____
- 21) Nucleolus made of _____, RNA and protein.
- 22) Nucleolus is called as _____ of ribosomes.
- 23) The _____ is a thin, thread-like intermingled mass of chromosome material and composed of the genetic substance DNA (deoxyribonucleic acid) and proteins
- 24) Functional segments of _____ are called genes.
- 25) _____ are fluid-filled or solid-filled and membrane bound spaces in the cytoplasm.
- 26) Lysosomes are formed by _____ complex. They are found in the cytoplasm of eukaryotic cell, mostly in animal cells.