

Topic No.	Title	Page No.
4.1	<b>Microscopy and the Emergence of Cell Theory</b> <ul style="list-style-type: none"> <li>• Light Microscopy and Electron Microscopy</li> <li>• History of the Formulation of Cell Theory</li> <li>• Sub-Cellular or Acellular Particles</li> </ul>	89
4.2	<b>Cellular Structures and Functions</b> <ul style="list-style-type: none"> <li>• Cell Wall</li> <li>• Cell Membrane</li> <li>• Cytoplasm</li> <li>• Cell Organelles</li> <li>• Difference between Prokaryotic and Eukaryotic Cells</li> <li>• Relationship between Cell Function and Cell Structure</li> </ul>	96
4.3	<b>Cell Size and Surface Area to Volume Ratio</b>	113
4.4	<b>Passage of Molecules into and out of Cells</b> <ul style="list-style-type: none"> <li>• Diffusion</li> <li>• Facilitated Diffusion</li> <li>• Osmosis</li> <li>• Filtration</li> <li>• Active Transport</li> <li>• Endocytosis and Exocytosis</li> </ul>	116
4.5	<b>Animal and Plant Tissues</b> <ul style="list-style-type: none"> <li>• Animal Tissues</li> <li>• Plant Tissues</li> </ul>	124
*	<b>Review Questions</b> <ul style="list-style-type: none"> <li>• Multiple Choice Questions</li> <li>• Understanding the Concepts</li> <li>• Short Questions</li> <li>• The Terms to Know</li> </ul>	138
*	<b>Assignment</b> <ul style="list-style-type: none"> <li>• Let's Draw and Label</li> <li>• Self Test</li> </ul>	142

## 4.1 MICROSCOPY AND THE EMERGENCE OF CELL THEORY

### LONG QUESTIONS

**Q.1** Write a note on light microscope. (K.B)

**Ans:** LIGHT MICROSCOPE

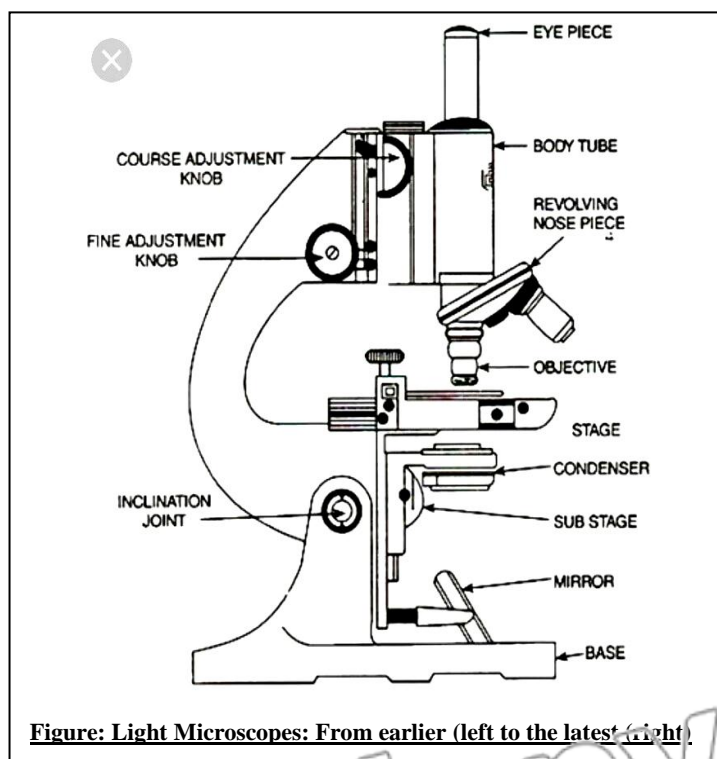
**Working:**

A **light microscope** works by passing visible light through a **specimen**. It consists of two glass lenses.

- One lens produces an **enlarged** image of the **specimen**.
- The **second lens magnifies** the image and projects it into the **viewer's eye** or **onto photographic film**.

**Micrograph:**

A photograph taken through a microscope is called a micrograph.



**Figure: Light Microscopes: From earlier (left) to the latest (right).**

**Magnification:**

A **light microscope** can magnify objects only **1500** times without causing **blurriness**. Its **magnification is 1500X**.

**Resolution or Resolving Power:**

Resolution of a light microscope is **0.2 micrometer (µm)**.

$$(1 \mu\text{m} = 1/1000 \text{ mm})$$

In other words, light microscope cannot resolve objects smaller than **0.2 µm**. It is about the **size of the smallest bacterium**.

The image of a **bacterium** can be magnified many times, but **light microscope cannot** show the details of its **internal structure**.

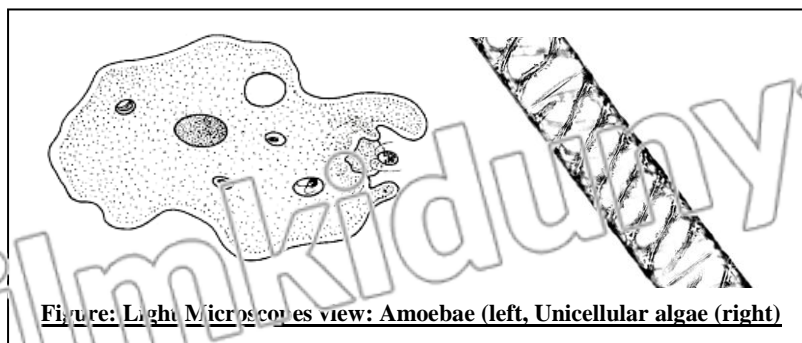


Figure: Light Microscopes view: Amoebae (left, Unicellular algae (right)

Write a note on electron microscope.

(K.B)

Ans:

### ELECTRON MICROSCOPE

#### Introduction:

It is the most advanced form of microscope.

#### Working:

In **electron microscope**, the **object** and the **lens** are placed in a **vacuum chamber** and a **beam of electrons** is passed through the object. Electrons pass through or are **reflected** from object and make image. **Electromagnetic lenses** enlarge and focus the image onto a screen or a **photographic film**.

#### Resolution:

Electron microscope has much higher **resolving power** than **light microscope**. The most modern **electron microscope** can distinguish objects as small as **0.2 nanometer** where,

$$1 \text{ nm} = 1/1000,000 \text{ mm}$$

It is a **thousand-fold** improvement over the **light microscope**.

#### Magnification:

Electron microscope can **magnify** objects about **250,000 times**.

#### Detection in Special Conditions:

Under special conditions, **electron microscope** can **detect individual atoms**. Cells, **organelles**, and even molecules like **DNA** and protein are much larger than single atoms.

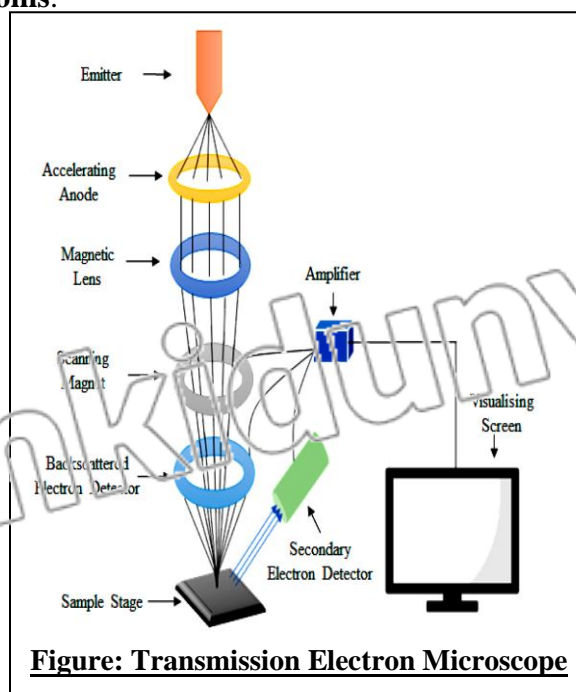


Figure: Transmission Electron Microscope

**Types of Electron Microscope:**

There are two types of electron microscope:

**Transmission Electron Microscope (TEM):**

In TEM, electrons are transmitted through the specimen.

**Usage:**

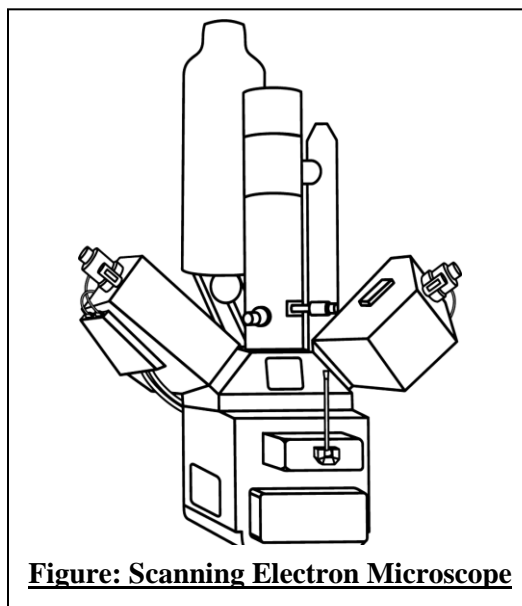
TEM is used to study the internal cell structure.

**Scanning Electron Microscope (SEM):**

In SEM, electrons are reflected from the metal coated surfaces.

**Usage:**

SEM is used to study the structure of cell surfaces.



**Figure: Scanning Electron Microscope**

**Q.2** Describe the history of formulation of cell theory. (K.B)

**Ans:** **HISTORY OF FORMULATION OF CELL THEORY**

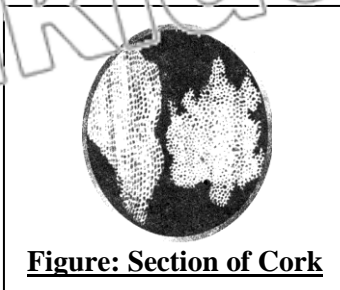
**Role of Aristotle:**

In the history of Biology, ancient Greeks were the first who organized the data of natural world.

Aristotle presented the idea that all animals and plants are somehow related.

**Role of Robert Hooke:**

Cells were first described by a British scientist, Robert Hooke in 1665. He used his self-made light microscope to examine a thin slice of cork. Hooke observed a 'honeycomb' of tiny empty compartments. He called those compartments in the cork as 'cellulae'. His term has come to us as cells.



**Figure: Section of Cork**

**Role of Leeuwenhoek:**

The **first living cells** were observed a few years later by **Dutch naturalist** Antonie van Leeuwenhoek. He observed tiny organisms from **pond water** under his microscope and called them ‘**animalcules**’.

**Role of Jean Baptist de-Lamarck:**

In 1809, **Jean Baptist de-Lamarck** proposed that:

‘No body can have **life** if its parts are not cellular tissues or are not formed by **cellular tissues**’.

**Role of Robert Brown:**

In 1831, a **British botanist Robert Brown** discovered nucleus in the cell.

**Role of Matthias Schleiden:**

In 1838, a **German botanist Matthias Schleiden** studied plant tissues and made the first statement of **cell theory**. He stated that:

‘**All plants are aggregates of individual cells which are fully independent**’.

**Role of Theodor Schwann:**

In 1839, a **German zoologist Theodor Schwann** reported that all animal tissues are also composed of individual cells.

**Role of Rudolf Virchow:**

In 1855, **Rudolf Virchow**, a **German physician**, proposed an important extension of cell theory. He proposed that, ‘**all living cells arise from pre-existing cells (Omnis cellula e cellula)**’.

**Role of Louis Pasteur:**

In 1862, **Louis Pasteur** provided experimental proof of **Virchow’s idea**.

**Postulates of Cell Theory:**

Cell theory **in its modern form**, includes the following principles,

- **All organisms are composed of one or more cells.**
- **Cells are the smallest living things, the basic unit of organization of all organisms.**
- **Cells arise only by divisions in previously existing cells.**

**Q.3** Write a note on sub-cellular or acellular particles.

*(Knowledge Based)*

**Ans:** SUB-CELLULAR OR ACELLULAR PARTICLES

According to the **first statement** of **cell theory**, all organisms are **composed** of one or more cells. The following organisms are **sub-cellular or acellular particles** and are not composed of cells:

- **Viruses**
- **Prions**
- **Viroids**

**Non-living Characteristic:**

They **do not run any metabolism inside them**.

**Living Characteristics:**

They show **some characteristics** of living organisms like:

- **They can increase in number.**
- **They can transmit their characters to the next generations.**

**Classification:**

Such acellular particles are not **classified** in any of the **five kingdoms** of organisms.

**Q.4 Devise a key table of scientist who helped in formulation of cell theory? (K.B)**

**Ans:**

Scientist	Contribution	Year
Zacharias Janssen	Invented microscope	1590
Robert Hooke	Discovered cell	1665
Antonie Van Leeuwenhoek	Observed microorganisms	1674
Jean Baptist de Lamarck	Proposed the importance of tissues	1809
Robert Brown	Discovered nucleus	1831
Matthias Schleiden	Studied plant tissues	1838
Theodor Schwann	Studied animal tissues	1839
Rudolf Virchow	Proposed "omnis cellula e cellula"	1855
Louis Pasteur	Proved Virchow's idea	1862

### SHORT QUESTIONS (Topic 4.1)

**Q.1 Define microscopy and describe the invention of first microscope. (K.B)**

**Ans:**

#### MICROSCOPY

**Definition:**

"The use of microscope is called microscopy."

**Invention:**

The first compound microscope was developed by Zacharias Janssen in Holland in 1595.

**Structure:**

It was simply a tube with lenses at each end and its magnification ranged from 3X to 9X.

**Q.2 What is meant by micrograph? (K.B)**

**Ans:**

A photograph taken through microscope is called a micrograph. Every micrograph contains a reading along the edge of the micrograph e.g. LM 109X. This reading tells about the type of microscope and magnification of object. As LM 109X shows that the photograph has been taken through Light microscope (LM) and the image has been magnified 109 times of the original size.

**Q.3 Define magnification. (K.B)**

(SWL 2014, SGD 2015, RWP 2015)

**Ans:** Page no 89.

**Q.4 Define resolving power or resolution. (K.B)**

(SGD 2015, RWP 2015)

**Ans:** Page no 89.

**Q.5 Describe the working of light microscope. (K.B)**

(GRW 2013)

**Ans:** Page no 89.

**Q.6 Compare the magnification and resolving power of light and electron microscope. (K.B)**

**Ans:**

#### COMPARISON BETWEEN LIGHT AND ELECTRON MICROSCOPE

A comparison between light and electron microscope is as follows:

Light Microscope	Electron Microscope
<b>Magnification</b>	
Magnification of light microscope is 1500X.	Magnification of electron microscope is 250,000 X.
<b>Resolving Power</b>	
The resolving power of light microscope is 0.2 micrometer. (µm)	The resolving power of electron microscopes is 0.2 nanometer. (nm)

**Q.7 Describe the working of electron microscope. (A.B)** (BWP 2015)

**Ans:** Page no 90.

**Q.8 What are the limitations of Electron microscope? (A.B)**

**Ans:** LIMITATIONS OF ELECTRON MICROSCOPE

Electron microscope cannot be used to study life processes, because the specimen must be held in a vacuum chamber i.e. all air must be removed.

**Q.9 What are the advantages of Electron microscope? (A.B)**

**Ans:** ADVANTAGES OF ELECTRON MICROSCOPE

- The specimen can be magnified up to 250,000X.
- Closely lying objects (as small as 0.2nm and 1nm) can be easily distinguished.
- Cells, organelles, molecules like DNA and protein and even individual atoms under special conditions can be detected.

**Q.10 What is difference between SEM and TEM? (K.B)**

(DGK 2014)

**Ans:** DIFFERENTIATION

The differences between SEM and TEM are as follow:

Scanning Electron Microscope	Transmission Electron Microscope
<b>Electrons</b>	
In SEM, electrons are reflected from the metal coated surfaces.	In TEM, electrons are transmitted through the specimen.
<b>Usage</b>	
It is used to study the structure of cell surfaces.	It is used to study the internal cell structure.

**Q.11 What is the contribution of Robert Hooke in formulation of cell theory? (K.B)**

**Ans:** Page no 91.

**Q.12 Discuss the role of Schleiden and Schwann in development of cell theory. (K.B)**

**Ans:** Page no 92.

**Q.13 State postulates of cell theory. (K.B)**

(LHR 2013, 2016, SGD 2015, RWP 2015)

**Ans:** Page no 92.

**Q.14 What is meant by “*Omnis cellula e cellula*”? (K.B)**

**Ans:** In 1858, a German physician Rudolf Virchow in his publication proposed “*Omnis cellula e cellula*”, a Latin saying means “all living cells arise from pre-existing cells. It proved an important extension of cell theory and experimentally proved by Louis Pasteur.

### **MULTIPLE CHOICE QUESTIONS (Topic 4.1)**

**1. The first compound microscope was developed by: (K.B)** (LHR 2014)

- (A) Robert Hooke (B) Leeuwenhoek  
(C) Zacharias Janssen (D) Aristotle

**2. Which of the following pair is not composed of cells? (A.B)**

- (A) Finger nail & Orange juice (E) Wood of pencil & a wing of butter fly  
(C) Meat & eye lashes (D) Sheet of glass and table salt

**3. The Magnification power of 1st Microscope, invented in Holland 1595, ranged from: (K.B)**

- (A) 3X - 6X (B) 3X - 9X  
(C) 109X - 1500X (D) 3X - 15X

**4. The increase in the apparent size of an object: (K.B)**

- (A) Resolution (B) Microscopy  
(C) Magnification (D) Micrograph

5. **The measure of the clarity of an image is called: (K.B)**  
(A) Magnification (B) Resolution  
(C) Microscopy (D) Micrograph
6. **The resolution of human eye: (K.B)** (D.G.K. 2013, M.T.N. 2015, C.H.R. 2016)  
(A) 0.1 mm (B) 0.2 mm  
(C) 0.3 mm (D) 0.4 mm
7. **The magnification of a light microscope: (K.B)**  
(A) 1000X (B) 1500X  
(C) 2000X (D) 2500X
8. **The resolution of light microscope is: (K.B)**  
(A) 0.1  $\mu$ m. (B) 0.2  $\mu$ m.  
(C) 0.3  $\mu$ m. (D) 0.4  $\mu$ m.
9. **A photograph taken through a microscope: (A.B)**  
(A) Micrograph (B) Photomicrograph  
(C) Electrocardiogram (D) EEG
10. **The magnification of an electron microscope: (A.B)** (GRW 2014)  
(A) 100,000X (B) 150,000X  
(C) 200,000X (D) 250,000X
11. **The resolution of electron microscope is (A.B)** (GRW 2014)  
(A) 0.2 nm (B) 0.3 nm  
(C) 0.4 nm (D) 0.5 nm
12. **Which type of microscope is better to study the movement of *Amoeba*? (U.B)**  
(A) Transmission electron microscope (B) Scanning electron microscope  
(C) Light microscope (D) Compound microscope
13. **What are the limitations of electron microscope? (U.B)**  
(A) Cannot show the details of external structure of specimen  
(B) Life processes cannot be studied  
(C) Image cannot be magnified more than 100,000 times  
(D) Electron beam is unable to pass through the specimens.
14. **The size of the smallest bacterium is (K.B)**  
(A) 0.2 $\mu$ m (B) 200nm  
(C) 0.0002mm (D) all of these
15. **How many lenses are used in construction of light microscope? (A.B)**  
(A) Four (B) Three  
(C) Two (D) Single
16. **The microscope used to study the changes in the shape of a human white blood cells: (U.B)**  
(A) Light microscope (B) Compound microscope  
(C) Scanning electron microscope (D) Transmission electron microscope
17. **Which type of microscope is used to study the surface texture of human hair? (U.B)**  
(A) Light microscope (B) Scanning electron microscope  
(C) Transmission electron microscope (D) Compound microscope
18. **The type of microscope used to study the detailed structure of a mitochondria in the cell of human liver: (U.B)**  
(A) Light microscope (B) Scanning electron microscope  
(C) Transmission electron microscope (D) Compound microscope



19. Cells were first described by a British scientist: (K.B)  
(SGD 2015, RW 2013, LHR 2013, SWL 2014)  
(A) Robert Hooke (B) Leeuwenhoek  
(C) Schleiden (D) Schwann
20. Who discovered nucleus in the cell? (K.B) (RWP 2015, MTN 2015, GRW 2015)  
(A) Aristotle (E) Robert Brown  
(C) Schwann (D) Schleiden
21. Who proposed that all living cells arise from pre-existing cells? (K.B) (RWP 2014)  
(A) Robert Brown (B) Rudolf Virchow  
(C) Louis Pasteur (D) Leeuwenhoek
22. A German botanist who studied plant tissues and made the first statement of cell theory: (K.B)  
(A) Robert Hooke (B) Robert Brown  
(C) Mathias Schleiden (D) Theodor Schwann

## 4.2 CELLULAR STRUCTURES AND FUNCTIONS

### LONG QUESTIONS

Q.1 Describe structure and function of cell wall in detail. (K.B) (Ex Q. No. 2)

Ans: CELL WALL

**Presence:**

It is found in plants, plant-like protists and fungi.

**Absence:**

It is absent in animals and animal-like protists.

**Non-living:**

Cell wall is a non-living and strong component of cell.

**Location:**

It is located outside plasma membrane.

**Functions:**

Cell wall provides:

- Strength
- Shape
- Protection
- Support

**Structure:**

**Primary Wall:**

The outer layer of plant cell wall is known as the primary wall. Cellulose is the most common chemical in it.

**Secondary Wall:**

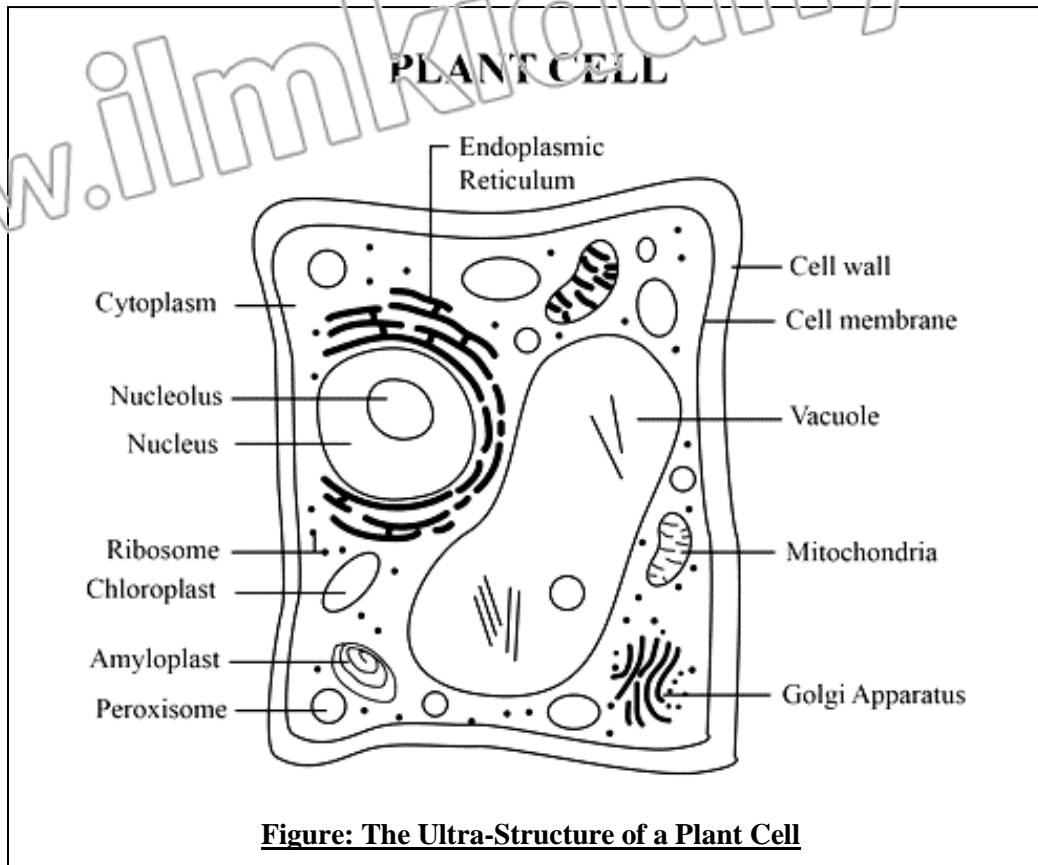
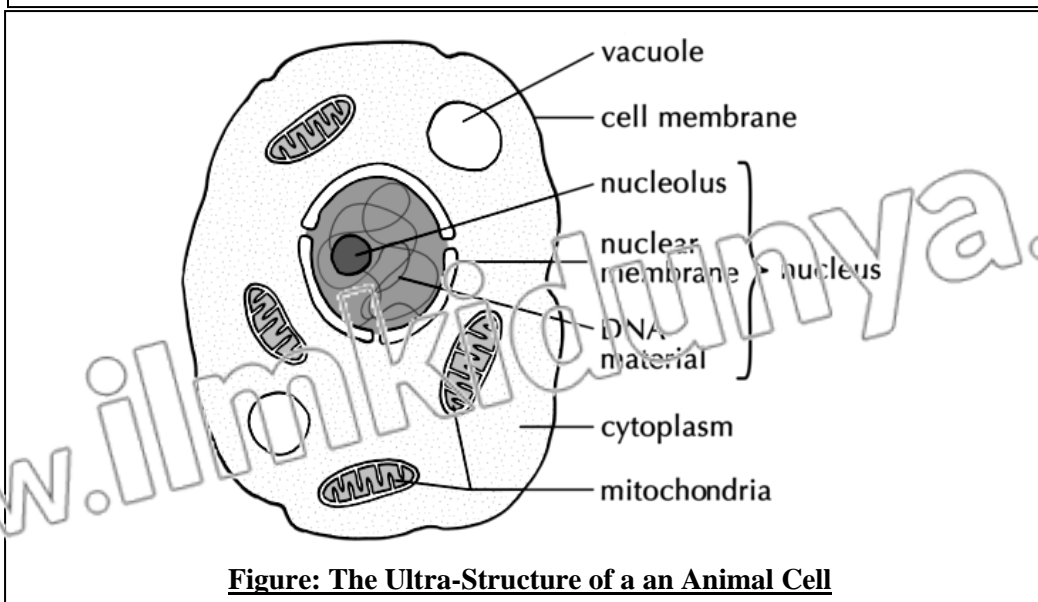
Some plant cells have secondary walls on the inner side of primary wall. It is much thicker and contains lignin and some other chemicals.

**Example:**

- Xylem cells

**Plasmodesmata:**

There are pores in the cell walls of adjacent cells, through which their cytoplasm is connected. These pores are called plasmodesmata.

**Chemical Composition of cell wall:****Plants:** The cell wall of plants is composed of cellulose.**Fungi:** Chitin is present in the cell wall of fungi.**Prokaryotes:** Prokaryotes have a cell wall composed of peptidoglycan that is a complex of amino acids and sugars.**Figure: The Ultra-Structure of a Plant Cell****Figure: The Ultra-Structure of a an Animal Cell**

Q.2 What do you know about cell membrane? Also discuss fluid mosaic model.

(K.B) (Ex Q. No. 1)

Ans:

### CELL MEMBRANE

#### Introduction:

All prokaryotic and eukaryotic cells have a thin and elastic cell membrane covering the cytoplasm.

#### Location:

It is the outer most boundary of animal cell and in plants, it is present after the cell wall.

#### Semi-permeable Barrier:

Cell membrane functions as a semi-permeable barrier, allowing a very few molecules across it while fencing a majority of chemicals inside the cell. In this way, it maintains internal composition of cell.

#### Chemical Sensor:

Cell membrane also senses chemical messages and can identify other cells.

#### Chemical Composition:

Chemical analysis reveals that cell membrane is mainly composed of the following:

- Proteins
- Lipids
- Small quantities of carbohydrates

#### Structure:

Electron microscopic examinations of cell membranes have led to the development of a fluid mosaic model of cell membrane.

#### Fluid Mosaic Model:

According to this model:

- There is a lipid bilayer in which proteins are embedded.
- The lipid bilayer gives fluidity and elasticity to the membrane.
- Small amounts of carbohydrates are also found in cell membranes. These are joined with proteins or lipids of the membrane.
- In eukaryotic cells, cholesterol is present in the lipid bilayer.

#### Membrane Bounded Organelles:

In eukaryotic cells many organelles are bounded by cell membranes:

- Mitochondria
- Chloroplasts
- Golgi apparatus
- Endoplasmic reticulum

#### Cell Membrane versus Plasma Membrane:

When we talk about all the membranes of a cell, we call them as cell membranes. When we talk about only the outer membrane of the cell, we refer to it as plasma membrane.

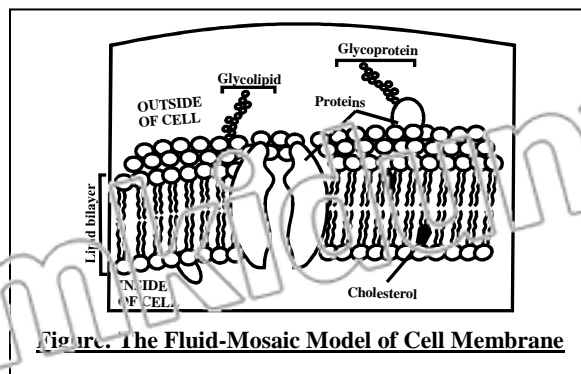


Figure. The Fluid-Mosaic Model of Cell Membrane

Q.3 Write a note on cytoplasm.

(Knowledge Based)

Ans:

### CYTOPLASM

#### Introduction:

Cytoplasm is the semi-viscous and semi-transparent substance.

#### Location:

It is present between plasma membrane (cell membrane) and the nuclear envelope.

#### Chemical Composition:

It contains many dissolved substances:

- Water
- Many organic molecules (proteins, carbohydrates, lipids)
- Inorganic salts

#### Functions:

Cytoplasm has the following important functions:

- It provides space for the proper functioning of the organelles.
- It is a site for many biochemical (metabolic) reactions.

#### Example:

Glycolysis (breakdown of glucose during cellular respiration) occurs in cytoplasm.

Q.4 Write a note on cytoskeleton.

(Knowledge Based)

Ans:

### CYTOSKELETON

#### Introduction:

Cytoskeleton is a network of microfilaments and microtubules.

#### Microtubules:

**Composition:** Microtubules are made up of tubulin protein.

**Function:** These help cells to hold their shape.

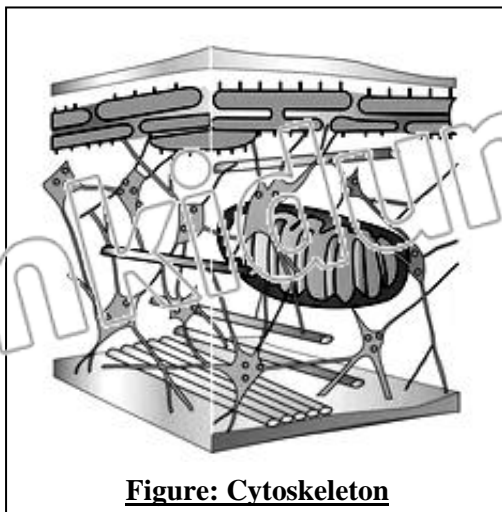
**Occurrence:** They are the major components of cilia and flagella.

#### Microfilaments:

**Size:** Microfilaments are thinner.

**Composition:** They are made up of actin protein.

**Function:** They help cells to change their shapes.



**Figure: Cytoskeleton**

**Q.5 Describe structure and function of nucleus with help of labeled diagram.**

(K.B) (LHR 2013) (Ex Q. No. 3)

**Ans:**

**NUCLEUS**

**Presence:**

A prominent nucleus occurs in eukaryotic cells.

**Location:**

**Animal cell:** It is located in the center.

**Plant cell:** Due to the presence of a large central vacuole, it is pushed to the side.

**Nuclear Envelope:**

Nucleus is bounded by a double membrane known as nuclear envelope. Nuclear envelope contains many small pores that enable it to act as a semi permeable membrane.

**Nucleoplasm:**

Inside the nuclear envelope, a granular fluid, nucleoplasm is present. Nucleoplasm contains one or two nucleoli (singular: nucleolus) and chromosomes.

**Nucleolus:**

Nucleolus is a dark spot and it is the site where ribosomal RNA are formed and assembled as ribosomes.

**Chromatin:**

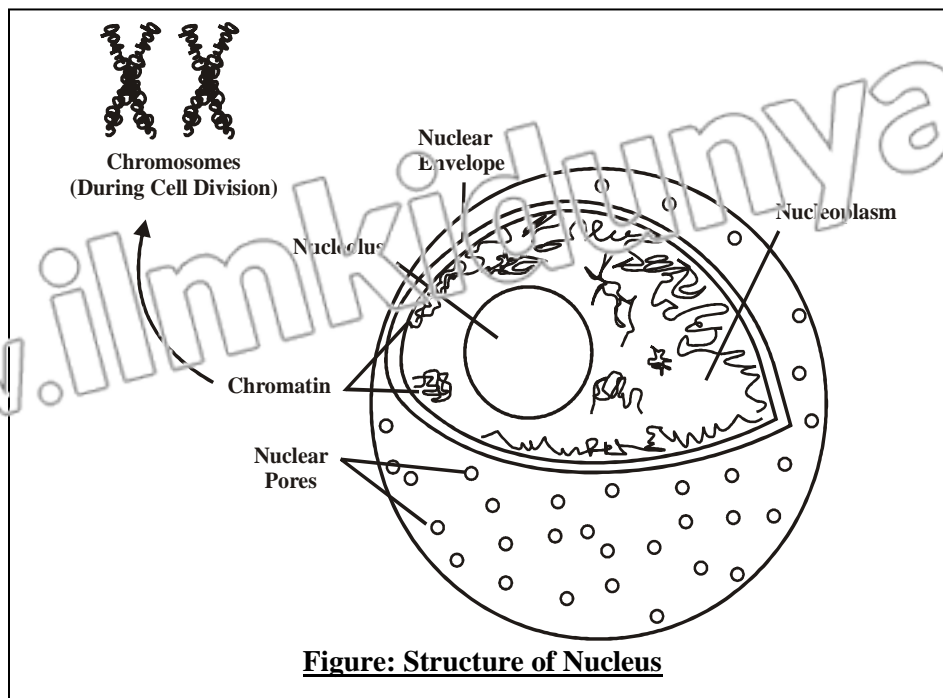
Chromosomes are visible only during cell division. During interphase, (non-dividing phase), they are in the form of fine thread-like structures called chromatin.

**Chromosomes:**

Chromosomes are composed of deoxyribonucleic acid (DNA) and proteins.

**Prokaryotic Cells:**

The prokaryotic cells do not contain prominent nucleus. Their chromosome is made up of DNA only and is submerged in the cytoplasm.



**Figure: Structure of Nucleus**

**Q.6** Write a note on ribosomes.

(K.B)

**Ans:**

### RIBOSOMES

#### Introduction:

Ribosomes are **tiny granular structures**.

#### Location:

They are either **freely floating in the cytoplasm** or are **bound to endoplasmic reticulum (ER)**.

#### Chemical Composition:

Each ribosome is made up of equal amounts of:

- **Proteins**
- **Ribosomal RNA (rRNA)**

#### Non-membranous:

**Ribosomes are not bound by membranes and are so found in prokaryotes**

#### Size:

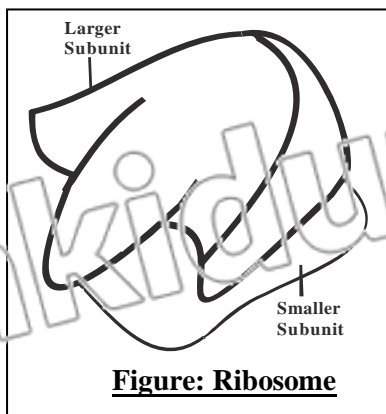
Eukaryotic **ribosomes are larger than prokaryotic ribosomes**.

#### Structure:

Ribosomes are composed of a **larger subunit** and a **smaller sub-unit**. When a ribosome is not working it **disassembles** into its subunits.

#### Function:

**Ribosomes are the sites of protein synthesis. Protein synthesis** is extremely important to cells, and so large numbers of **ribosomes** are found **throughout cells**.



Q.7 Write a note on mitochondria.

(K.B)

Ans:

### MITOCHONDRIA

#### Introduction:

Mitochondria are double membrane bounded structures found only in eukaryotic cell only.

#### Singular:

The singular of mitochondria is mitochondrion.

#### Function:

These are the sites of aerobic respiration and are the major energy production centers.

#### Structure:

A mitochondrion consists of the following parts:

#### Outer Membrane:

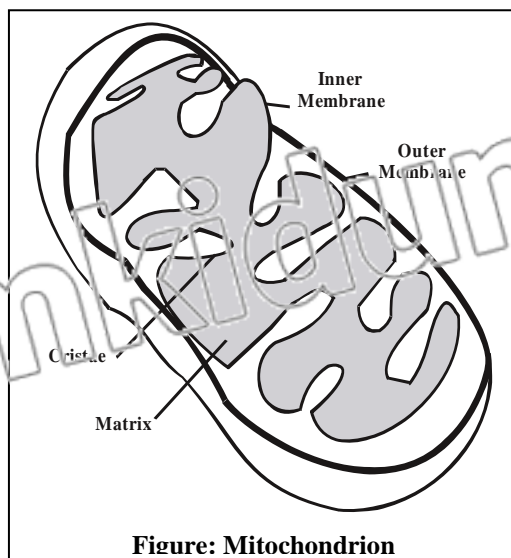
The outer membrane is smooth.

#### Inner Membrane:

The inner membrane forms many infoldings called cristae (**singular: crista**) in the inner mitochondrial matrix. This serves to increase the surface area on which membrane bound reactions can take place.

#### Mitochondrial Matrix:

Inside the inner membrane, fluid matrix is present.



**DNA and Ribosomes:**

**Mitochondria** have their own **DNA and Ribosomes**. The ribosomes of mitochondria are more **similar to bacterial ribosomes than to eukaryotic ribosomes**.

**Q.8** Briefly describe different types of plastids. (*Knowledge Based*) (GRW 2012)

**Ans:** **PLASTIDS**

**Introduction:**

Plastids are membrane bound organelles that only occur in the cells of **plants and photosynthetic protists (algae)**.

**Types:**

Plastids are of **three types**:

- i. **Chloroplasts**
- ii. **Chromoplasts**
- iii. **Leucoplasts**

**i. Chloroplasts:**

Like mitochondria, chloroplast is also bound by a double membrane. The outer membrane is smooth.

**Thylakoids:**

The inner membrane gives rise to sacs called **thylakoids**.

**Granum:**

The stack of thylakoids is called **granum**. (Plural: grana)

**Stroma:**

The grana float in the inner fluid of chloroplast, which is called **stroma**.

**Function:**

Chloroplasts are the sites of photosynthesis in eukaryotes. They contain chlorophyll (**the green pigment necessary for photosynthesis**) and associated pigments. These pigments are present in the **thylakoids of grana**.

**ii. Chromoplasts:**

The second type of plastids in plant cells are chromoplasts.

**Colour:**

They contain pigments associated with bright colors.

**Occurrence:**

They are present in the cells of flower petals and fruits.

**Function:**

Their function is to give colors to petals and fruits and thus help in pollination and dispersal of fruit.

**iii. Leucoplasts:**

Leucoplasts are the third type of plastids.

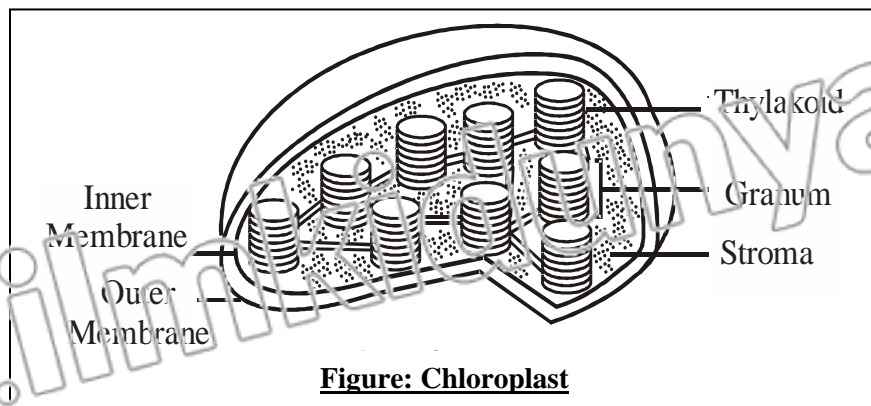
**Colour:**

They are colourless.

**Function:**

They store starch, proteins and lipids. They are present in the cells of those parts where food is stored.





**Figure: Chloroplast**

**Q.9** Write a note on endoplasmic reticulum. (Knowledge Based)

(LHR 2013) (Ex Q. No. 4)

**Ans:**

### ENDOPLASMIC RETICULUM

#### Introduction:

Endoplasmic reticulum is a network of interconnected channels that extends from cell membrane to nuclear envelope.

#### Types of Endoplasmic Reticulum:

The network exists in two forms:

- i. Rough Endoplasmic Reticulum (RER)
- ii. Smooth Endoplasmic Reticulum (SER)

#### i. Rough Endoplasmic Reticulum (RER):

It is named so because of rough appearance due to numerous ribosomes are attached to it.

#### Function:

Due to the presence of ribosomes, RER serves a function in protein synthesis.

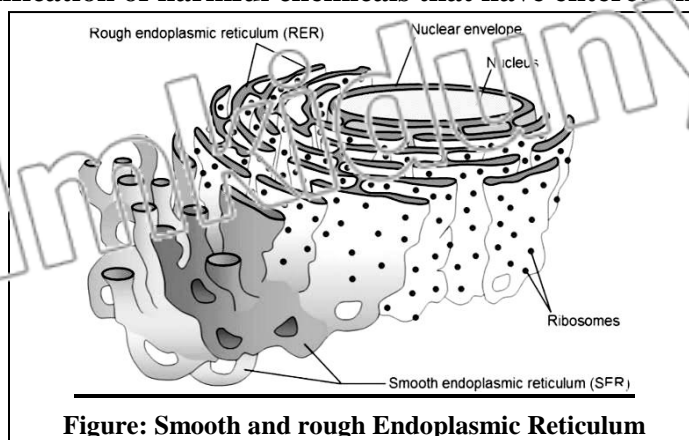
#### ii. Smooth Endoplasmic Reticulum (SER):

SER lacks ribosomes.

#### Functions:

It is involved in:

- Lipid metabolism
- Transport of materials from one part of cell to other.
- Detoxification of harmful chemicals that have entered the cell.



**Figure: Smooth and rough Endoplasmic Reticulum**

**Q.10** Write a note on Golgi Apparatus.

(Knowledge Based) (Ex Q. No. 4)

Ans:

**GOLGI APPARATUS**

**Discovery:**

An Italian physician, **Camillo Golgi** discovered a set of flattened sacs (**cisternae**) in cell and thus they were named after him. In **1906**, **Golgi** was awarded **Nobel Prize** for **physiology and medicine**.

**Occurrence:**

It is found in both animal and plant cells.

**Structure**

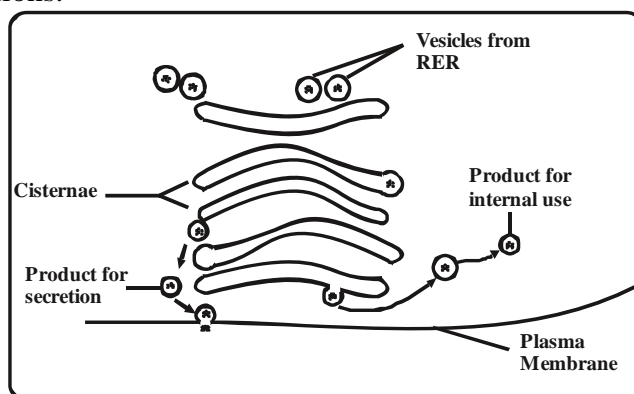
In this set, many **cisternae** are stacked over each other. The complete set of cisternae is called Golgi apparatus or Golgi complex.

**Function:**

It modifies molecules coming from rough **endoplasmic reticulum** and packs them into **small membrane bound sacs** called 'Golgi vesicles'.

**Golgi Vesicles:**

These sacs can be **transported to various** location within the cell or to **its exterior**, in the form of secretions.



**Figure: Functioning of the Golgi Apparatus**

**Q.11** Write a note on lysosomes. (Knowledge Based)

(LHR 2013) (Ex Q. No. 5)

Ans:

**LYSOSOMES**

**Discovery:**

In the **mid-twentieth century**, a **Belgian scientist Christian Rene de Duve** discovered lysosomes. **De Duve** won the **1974 Nobel Prize** for **physiology and medicine**.

**Structure:**

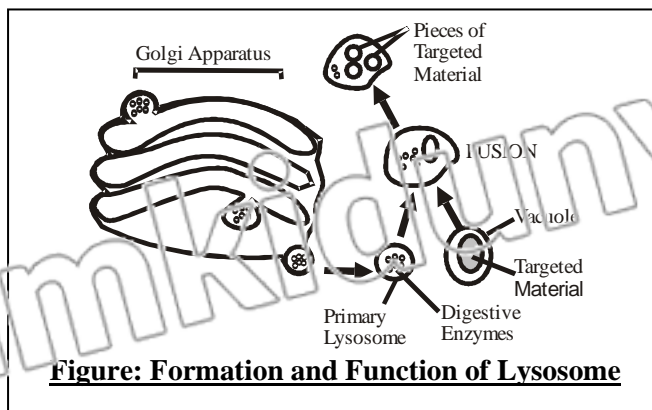
Lysosomes are **single membrane bound organelles**.

**Function:**

They contain **strong digestive enzymes** and work for the break down (**digestion**) of food and **waste materials** within the cell.

**Mechanism:**

During its function, a **lysosome fuses** with the **vacuole** that contains the **targeted material** and its **enzymes break down the material**.



Q.12 Write a note on centrioles.

(Knowledge Based)

Ans:

### CENTRIOLES

#### Introduction:

Animals and many unicellular organisms have hollow and cylindrical organelles known as centrioles.

#### Structure:

Each centriole is made up of nine triplets of microtubules.

#### Chemical Composition:

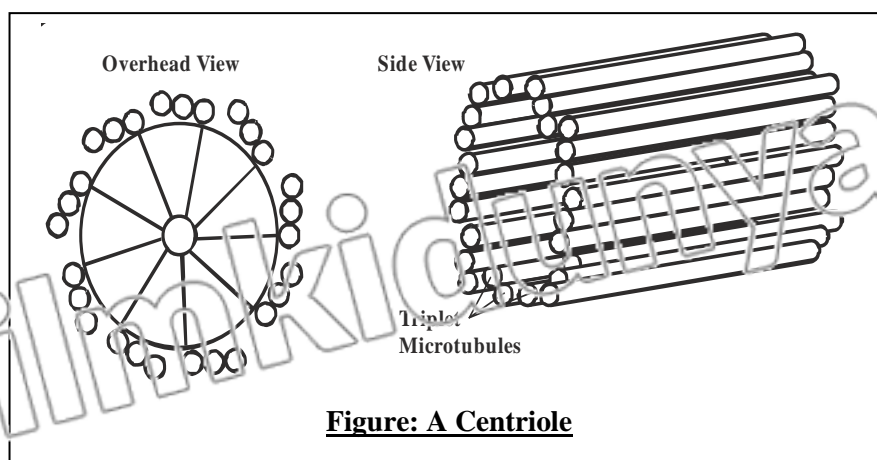
They are made up of tubulin protein.

#### Centrosome:

Animal cells have two centrioles located near the exterior surface of nucleus. The two centrioles are collectively called centrosome.

#### Functions:

- Their function is to help in the formation of spindle fibers during cell division.
- In some cells, they are also involved in the formation of cilia and flagella.



**Q.13 Write a note on vacuoles.**

*(Knowledge Based)*

**Ans:**

**VACUOLES**

**Introduction:**

Vacuoles are **fluid filled single membrane** bounded organelles. Cells have many small **vacuoles in their cytoplasm.**

**Plant Cells:**

When a **plant cell matures**, its small vacuoles absorb water and fuse to form a **single large vacuole** in center. The cell in this state **becomes turgid.**

**Food Vacuole:**

Many cells take in materials from outside in the form of **food vacuole** and then **digest** the material with the help of **lysosomes.**

**Contractile Vacuole:**

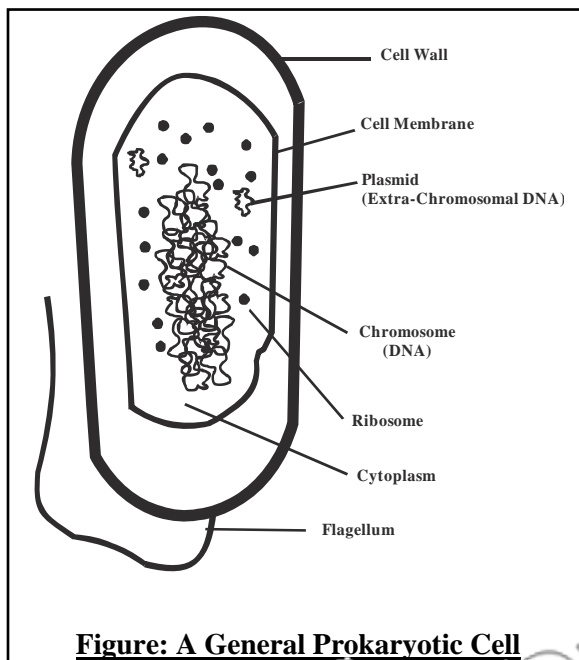
Some **unicellular organisms** use **contractile vacuole** for the **elimination of wastes** from their bodies.

**Q.14 Differentiate between eukaryotic and prokaryotic cells.**

*(Knowledge Based)*

*(LHR 2012, 2013, GRW 2012) (Ex Q. No. 12)*

**Ans: DIFFERENTIATION BETWEEN EUKARYOTIC AND PROKARYOTIC CELLS**



**Figure: A General Prokaryotic Cell**

The main differences between eukaryotic and prokaryotic cells are as follows:

Eukaryotic Cell	Prokaryotic Cell
<b>Nucleus</b>	
Eukaryotic cells have prominent nucleus (bounded by nuclear envelope).	Prokaryotic cells do not have prominent nucleus. Their chromosome consists of DNA only and it floats in cytoplasm near centre. This region is called nucleoid.
<b>Organelles</b>	
Membrane bounded organelles like mitochondria, ER, Golgi apparatus are present.	Membrane bounded organelles like mitochondria, ER, Golgi apparatus are absent.

Ribosomes	
Ribosomes are larger in size.	Ribosomes are smaller in size.
Size	
Eukaryotic cells are on average 10 times larger than prokaryotic cells.	Prokaryotic cells are 10 times smaller than eukaryotic cells.
Cell Wall Composition	
<b>Plant cells:</b> Cellulose <b>Fungi:</b> Chitin	Cell wall is made up of peptidoglycan (a large polymer of amino acids and sugars)
Examples	
<ul style="list-style-type: none"> <li>• Kingdom Protista</li> <li>• Kingdom Fungi</li> <li>• Kingdom Plantae</li> <li>• Kingdom Animalia</li> </ul>	Kingdom Monera <ul style="list-style-type: none"> <li>• Bacteria</li> <li>• Cyanobacteria</li> </ul>

### SHORT QUESTIONS (Topic 4.2)

**Q.1** Why sub-cellular or acellular particles are not included in five kingdoms of organism? (*U.B*)

**Ans:** SUB-CELLULAR OR ACELLULAR PARTICLES

According to the first statement of cell theory, all organisms are composed of one or more cells. The following organisms are sub-cellular or acellular particles and are not composed of cells:

- Viruses
- Prions
- Viroids

**Non-living Characteristic:**

They do not run any metabolism inside them.

**Living Characteristics:**

They show some characteristics of living organisms like:

- They can increase in number.
- They can transmit their characters to the next generations.

**Classification:**

Such acellular particles are not classified in any of the five kingdoms of organisms.

**Q.2** What is difference between primary and secondary cell wall? (*KB*) (GRW 2013)

**Ans:** DIFFERENTIATION

The difference between primary and secondary cell wall are as follow:

Primary Wall	Secondary Wall
Location	
Outer layer of plant cell wall is called as primary wall.	Some plants have additional wall on the inner side of primary wall called as secondary wall.
Composition	
Primary wall is composed of cellulose.	Secondary wall is composed of lignin.

**Q.3 Define plasmodesmata. (K.B)** (SWL 2014, 2015, BWP 2014)

**Ans:** Page no 96.

**Q.4 How chemical compositions of cell wall differ in different organisms? (U.B)**

**Ans: Fungi:** Cell wall is made up of chitin.

**Plants:** Cell wall is mainly composed of cellulose. (In some cases Lignin is also present.)

**Bacteria:** Cell wall is composed of peptidoglycan. (a complex of amino acids and sugars)

**Q.5 What is the role of cell membrane around the cells? (A.B)** (DGK 2015)

**Ans:** Page no 98.

**Q.6 Clarify that plasma membrane and cell membrane are two different terms. (K.B)**

**Ans:** Page no 98.

**Q.7 Define fluid mosaic model. (K.B)** (BWP 2014, MTN 2015)

**Ans:** According to this model:

- There is a lipid bilayer in which proteins are embedded.
- The lipid bilayer gives fluidity and elasticity to the membrane.
- Small amounts of carbohydrates, conjugated with lipids and proteins, are also found in it.
- Cholesterol is also present in lipid bilayer of eukaryotic membrane.

**Q.8 What is cytoplasm? (K.B)**

**Ans:** Page no 99.

**Q.9 Write down the functions of cytoplasm. (K.B)** (DGK 2014)

**Ans:** Page no 99.

**Q.10 What is difference between microtubules and microfilaments? (K.B)**

**Ans:** DIFFERENTIATION

The difference between microtubules and microfilaments is as follows:

Microtubules	Microfilaments
<b>Composition</b>	
Microtubules are composed of tubulin protein.	Microfilaments are composed of actin protein.
<b>Function</b>	
They are used by cells to hold their shape.	They help cells to change their shapes.

**Q.11 Define organelles. (K.B)**

**Ans:** ORGANELLES

**Definition:**

“The small structures within cells that perform dedicated functions are called organelles.”

**Number:**

There are about a dozen types of organelles commonly found in eukaryotic cells”.

**Examples:**

- Nucleus
- Ribosomes

**Q.12 What is meant by nucleolus and nucleoplasm? (K.B)**

**Ans: Nucleolus:**

Nucleolus is a dark spot and it is the site where ribosomal RNA are formed and assembled as ribosomes.

**Nucleoplasm:**

Inside the nuclear envelope, a granular fluid, nucleoplasm is present. Nucleoplasm contains one or two nucleoli and chromosomes.

**Q.13 What do you know about ribosomes? (K.B)** (LHR 2014, FSD 2014)

**Ans:** Page no 101.

**Q.14 Write the functions of mitochondria. (K.B)** (SWL 2014)

**Ans:** Page no 102.

**Q.15 What is special about mitochondria? (U.B)**

**OK**

**Why mitochondria are called as semiautonomous organelles of the cell? (K.B)**

**Ans:** Page no 103.

**Q.16 Define chloroplast. (K.B)** (FSD 2015)

**Ans:** Page no 103.

**Q.17 Where chromoplasts are located? What are their functions? (K.B)** (SWL 2015, DGK 2015)

**Ans:** Page no 103.

**Q.18 Differentiate between SER and RER. (K.B)** (RWP 2015, SGD 2015)

**Ans:** **DIFFERENTIATION**

The difference between SER and RER is as follows:

Smooth Endoplasmic Reticulum	Rough Endoplasmic Reticulum
<b>Appearance</b>	
It is smooth in appearance because it lacks ribosomes.	It is rough in appearance due to numerous ribosomes that are attached to it.
<b>Functions</b>	
<ul style="list-style-type: none"> <li>• It detoxifies the harmful chemicals that have entered cell.</li> <li>• It is involved in lipid metabolism.</li> <li>• It helps in transport of materials from one part of cell to other.</li> </ul>	<ul style="list-style-type: none"> <li>• It serves a function in protein synthesis.</li> </ul>

**Q.19 What do you know about Camillo Golgi? Discuss his contribution. (K.B)**

**Ans:** Page no 105.

**Q.20 What are lysosomes? Give their functions. (K.B)** (LHR 2015)

**Ans:** Page no 105.

**Q.21 Define centrosome. (K.B)** (LHR 2016)

**Ans:** Page no 106.

**Q.22 What can happen when a lysosome burst inside the cell and all its enzymes are released in cytoplasm? (U.B)**

**Ans:** **BURSTING OF LYSOSOME INSIDE CELL.**

If enzymes of lysosomes are released in cytoplasm then all the protein content of cell may be destroyed resulting in killing of cell.

**Q.23 What is the difference between food vacuole and contractile vacuole? (K.B)**

**Ans:** **DIFFERENTIATION**

The difference between food and contractile vacuole are as follows:

Food Vacuole	Contractile Vacuole
The food material is taken in by the cell in the form of food vacuole. Then the food material is digested with the help of lysosomal enzymes	<ul style="list-style-type: none"> <li>• Unicellular organisms use contractile vacuole for the elimination of wastes from their bodies.</li> </ul>

**Q.24 State any two differences between prokaryotic and eukaryotic cell. (K.B) (SGD 2014)**

**Ans:** DIFFERENTIATION

The difference between prokaryotic and eukaryotic cell are as follows:

Prokaryotic Cell	Eukaryotic Cell
<b>Nucleus</b>	
Prokaryotic cells do not have prominent nucleus and do not have nuclear envelope around the nucleus.	Eukaryotic cells have prominent nucleus bounded by nuclear envelope.
<b>Cell Wall Composition</b>	
Cell wall of prokaryotic cell is made of peptidoglycan.	Cell wall of eukaryotic cell is made of cellulose (in plants) or chitin (in fungi).
<b>Examples</b>	
<ul style="list-style-type: none"> <li>• Bacteria</li> <li>• Cyanobacteria</li> </ul>	<ul style="list-style-type: none"> <li>• Animals</li> <li>• Plants</li> <li>• Fungi</li> <li>• Protists</li> </ul>

### MULTIPLE CHOICE QUESTIONS (Topic 4.2)

- The cell wall of fungi is made up of: (K.B) (SWL 2015, GRW 2014)**  
 (A) Cellulose (B) Lignin  
 (C) Peptidoglycan (D) Chitin
- In the cell wall of plants, the chemical present is: (K.B) (MTN 2014, GRW 2015)**  
 (A) Cellulose (B) Chitin  
 (C) Sodium (D) Potassium
- The cell wall of prokaryotes is made up of: (K.B) (LHR 2014)**  
 (A) Cellulose (B) Lignin  
 (C) Peptidoglycan (D) Chitin
- Primary wall is made up of:- (K.B)**  
 (A) Cellulose (B) Lignin  
 (C) Chitin (D) Cutin
- Secondary wall is made up of: (K.B)**  
 (A) Cellulose (B) Lignin  
 (C) Chitin (D) Peptidoglycan
- Cell membrane is mainly composed of: (K.B) (DGK 2014, SWL 2014)**  
 (A) Proteins (B) Lipids  
 (C) Carbohydrates (D) All of these
- Which is not present in cell membrane? (K.B) (DGK 2014)**  
 (A) Carbohydrates (B) Proteins  
 (C) Lipids (D) DNA
- In eukaryotic cells, which of the following organelles are bounded by cell membranes? (K.B)**  
 (A) Mitochondria (B) Golgi apparatus  
 (C) Endoplasmic reticulum (D) All of these
- Microtubules are made up of: (K.B)**  
 (A) Tubulin (B) Tropomyosin  
 (C) Myosin (D) Actin



10. **Microfilaments are made up of:** (K.B)  
 (A) Tubulin (B) Tropomyosin  
 (C) Myosin (D) Actin
11. **Which organelles are involved in protein synthesis?** (U.B) (DCK 2015, SWL 2015, LHR 2016)  
 (A) Mitochondria (B) Lysosomes  
 (C) Ribosomes (D) Nucleus
12. **Ribosomes are formed in:** (K.F) (MTN 2015, BRW 2014, GRW 2013)  
 (A) Nucleus (B) Nucleolus  
 (C) Cytoplasm (D) Mitochondria
13. **Which organelles are involved in energy production?** (U.B) (SWL 2014, GRW 2015)  
 (A) Mitochondria (B) Lysosomes  
 (C) Ribosomes (D) Nucleus
14. **The mitochondrion functions in:** (K.B) (DGK 2014, MTN 2015, BRW 2015, LHR 2015)  
 (A) Lipids storage (B) Photosynthesis  
 (C) Protein synthesis (D) Cellular respiration
15. **Which of these organelles have their own DNA?** (U.B) (SWL 2015, LHR 2015)  
 (A) Lysosomes (B) Mitochondria  
 (C) Ribosomes (D) Golgi bodies
16. **Plastids are present in the cells of:** (U.B)  
 (A) Plants (B) Algae  
 (C) Both A and B (D) Fungi
17. **Function of Chloroplast is:** (K.B) (BRW 2015)  
 (A) Photosynthesis (B) ATP formation  
 (C) Protein formation (D) DNA replication
18. **The stack of thylakoids is called:** (K.B) (SGD 2014, GRW 2015)  
 (A) Cristae (B) Leucoplast  
 (C) Granum (D) Stroma
19. **Chromoplasts are associated with bright colours and help in:** (U.B)  
 (A) Pollination (B) Dispersal of fruits  
 (C) Store food (D) Both A and B
20. **Leucoplasts are colourless and store:** (K.B) (SGD 2014)  
 (A) Starch (B) Proteins  
 (C) Lipids (D) All of these
21. **The type of plastids that contain pigments associated with bright colours:** (K.B)  
 (A) Chloroplasts (B) Chromoplasts  
 (C) Leucoplasts (D) Plastids
22. **Smooth endoplasmic reticulum are involved in:** (K.B)  
 (A) Lipid metabolism (B) Transport of materials  
 (C) Detoxification of harmful chemicals (D) All of these
23. **Golgi was awarded Nobel Prize in:** (K.B) (GRW 2014)  
 (A) 1905 (B) 1906  
 (C) 1907 (D) 1908
24. **Flattened sacs, cisternae are found in:** (K.B) (LHR 2012)  
 (A) Mitochondria (B) Golgi apparatus  
 (C) Ribosomes (D) Plastids

25. Golgi was awarded Nobel Prize for: (K.B)  
 (A) Physiology (B) Medicine  
 (C) Both A and B (D) Morphology
26. Rene de Duve was awarded Nobel Prize in: (K.B)  
 (A) 1972 (B) 1973  
 (C) 1974 (D) 1975
27. Lysosomes were discovered by: (K.B) (BRW 2015)  
 (A) Camillo Golgi (B) Robert Hooke  
 (C) Christian Rene de Duve (D) A.F.A. King
28. Cell organelle which contain digestive enzymes: (U.B)  
 (A) Ribosomes (B) Lysosomes  
 (C) Centrioles (D) Endoplasmic reticulum
29. Animal cells have two centrioles near the exterior surface of nucleus collectively called: (K.B)  
 (A) Centrosome (B) Nucleosome  
 (C) Chromosome (D) Nucleolus
30. Centrioles are involved in the formation of: (K.B)  
 (A) Spindle fibres (B) Cilia  
 (C) Flagella (D) All of these

### 4.3 CELL SIZE AND SURFACE AREA TO VOLUME RATIO

#### LONG QUESTIONS

Q.1 Describe relationship between cell function and cell structure.

(Knowledge Based) (Ex Q. No. 11)

Ans: RELATIONSHIP BETWEEN CELL FUNCTION AND CELL STRUCTURE

The bodies of **animals and plants** are made up of **different cell types**. Each type performs specific function and all coordinated functions perform the life processes of **organism**.

Types of Cells:

**Human body** is made up of about **200 types of cells**. Cells of one type may differ from those of other types in the following respects:

Size and Shape:

**Red Blood Cells:** Red blood cells are round to accommodate globular haemoglobin

**Nerve Cells:** Nerve cells are long for the transmission of nerve impulses.

**Xylem Cells:** Xylem cells are tube-like and have thick walls for conduction of water and support.

Surface Area to Volume Ratio:

**Root Hair Cells:** Root hair cells have **large surface area** for maximum **absorption of water and salts**.

Presence or Absence of Organelles:

**Secretory Cells:** Cells involved in making **secretions** have more complex **ER** and **Golgi apparatus**.

**Photosynthetic Cells:** Cells involved in **photosynthesis** have **chloroplasts**.

Functions of Cells:

Individual cells contribute to the functioning of the **whole body**. It can be explained by the following examples of **human body cells**:

**Nerve Cells:**

Nerve cells conduct nerve impulses and thus contribute to the coordination in body.

**Muscle Cells:**

Muscle cells undergo contraction and share their role in movements in body.

**Red Blood Cells:**

Red blood cells carry oxygen and so contribute in the role of blood in transportation.

**White Blood Cells:**

White blood cells kill foreign agents and so contribute in the role of blood in defence.

**Skin Cells:**

Some skin cells act as physical barriers against foreign materials and some act as receptors for temperature, touch and pain.

**Bone Cells:**

The cells of bone deposit calcium in their extracellular spaces to make the bone tough and thus contribute to the supporting role of bones.

**Cells as an Open System:**

A cell works as an **open system**, i.e. it takes in substances needed for its **metabolic activities** through its **cell membrane**. Then it performs the metabolic processes assigned to it. Products and **by-products are formed in metabolism**. Cell either **utilizes the products** or transports them to other cells. The by-products are either stored or are **excreted out of the cell**.

**Q.2 Write a note on cell size and surface area to volume ratio. (Application Based) (Ex Q. No 13)**

**Ans:** **CELL SIZE AND SURFACE AREA TO VOLUME RATIO**

**Variation in Size:**

Cells vary **greatly in size**. Most cells lie in between these extremes.

**The Smallest Cell:**

The smallest cells are bacteria called '**Mycoplasmas**' with diameter between **0.1  $\mu\text{m}$  to 1.0  $\mu\text{m}$** .

**The Bulkiest Cell:**

The bulkiest cells are bird eggs.

**The Longest Cell:**

The longest cells are some muscle cells and nerve cells.

**Relationship of Size and Shape to Function:**

Cell size and shape are related to cell function as follow:

**Bird's Eggs:**

Bird eggs are **bulky** because they contain a **large amount** of **nutrients** for the developing young.

**Muscle Cells:**

Long muscle cells are efficient in **pulling different body parts together**.

**Nerve Cells:**

**Lengthy** nerve cells can **transmit messages between different body parts**.

**Red Blood Cells:**

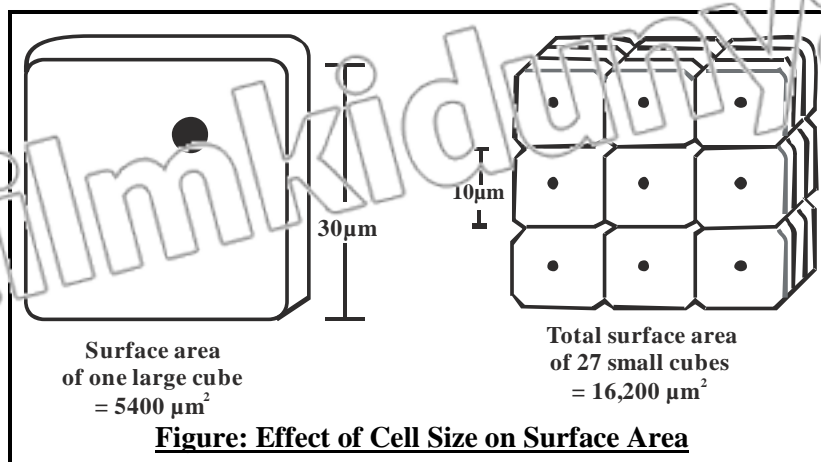
Human red blood cells are only **8  $\mu\text{m}$  in diameter** and therefore can move through our **narrowest blood vessels**, i.e. capillaries.

**Surface Area of Cells:**

Most cells are **small in size**. In relation to their **volumes**, **large cells have less surface area** as compared to **small cells**.

**Example:**

The figure shows 1 large cells and 27 small cells. In both cases, total volume is the same.

**Calculation of Volume:**

$$\text{Volume} = 30 \mu\text{m} \times 30 \mu\text{m} \times 30 \mu\text{m} = 27,000 \mu\text{m}^3$$

**Calculation of Surface Area:**

In contrast to the total **volume**, the total surface areas are very different. Because a **cubical shape** has 6 sides, its surface area is **6 times** the area of **1 side**. The surface area of cubes is as follows:

$$\text{Surface Area of 1 large cube} = 6 \times (30 \mu\text{m} \times 30 \mu\text{m}) = 5400 \mu\text{m}^2$$

$$\text{Surface Area of 1 small cube} = 6 \times (10 \mu\text{m} \times 10 \mu\text{m}) = 600 \mu\text{m}^2$$

$$\text{Surface Area of 27 small cubes} = 27 \times 600 \mu\text{m}^2 = 16,200 \mu\text{m}^2$$

**Conclusion:**

- Need of nutrients and rate of waste production are directly proportional to cell volume. Cell takes up nutrients and excretes wastes through its surface cell membrane. So a large volume cell demands large surface area. But a large cell has a much smaller surface area relative to its volume than smaller cells have.
- The membranes of small cells can serve their volumes more easily than the membrane of a large cell.

**SHORT QUESTIONS (Topic 4.3)**

**Q.1** How cell size and shape is related to function of cell? (A.B)

**Ans:** Page no 113.

**Q.2** Justify the statement. "A cell works as an open system." (U.L)

**Ans:** Page no 114.

**Q.3** Discuss relationship of cell volume with surface area. (A.B)

**Ans:** Page no 114.

**Q.4** How presence and absence of organelles is associated with the function and structure of cell? (U.B)

**Ans:** Function and structure of cell depends upon the presence and absence of organelles. For example:

- Cells involved in making secretions have more complex endoplasmic reticulum and Golgi apparatus.
- Cells involved in photosynthesis have chloroplasts.

**Q.5** How metabolic activities are associated to cell volume? (U.B)

**Ans:** Need of nutrients and rate of waste production is directly proportional to cell volume. Large volume demands large amount of nutrients and thus higher the rate of metabolism.

### MULTIPLE CHOICE QUESTIONS (Topic 4.3)

- Human body is made up of types of cells:** (K.B) (SWL 2014)  
(A) 50 (B) 100  
(C) 150 (D) 200
- The cells that contribute in coordination of the body:** (K.B) (SGD 2015, LHR 2014)  
(A) Nerve cells (B) Muscle cells  
(C) Red blood cells (D) Bone cells
- The cells that undergo contraction and share their role in movements of:** (U.B)  
(A) Nerve cells (B) Muscle cells  
(C) Bone cells (D) Cartilage cells
- The size of smallest bacterium is:** (K.B) (SGD 2015)  
(A)  $0.4\mu\text{m}$  (B)  $0.3\mu\text{m}$   
(C)  $0.2\mu\text{m}$  (D)  $0.1\mu\text{m}$
- The diameter of human red blood cells is:** (K.B) (FSD 2014, BRW 2014, LHR 2015)  
(A)  $4\mu\text{m}$ . (B)  $6\mu\text{m}$ .  
(C)  $8\mu\text{m}$ . (D)  $10\mu\text{m}$ .

## 4.4 PASSAGE OF MOLECULES INTO AND OUT OF CELLS

### LONG QUESTIONS

**Q.1** Describe passage of molecules in the and out of cells through diffusion and facilitated diffusion. (K.B)

**Ans:** DIFFUSION

**Definition:**

The movement of molecules from an area of **higher concentration** to the area of lower **concentration** i.e. along the **concentration gradient** is called diffusion.

**Explanation:**

The molecules of any substance, (**solid, liquid, or gas**) are in motion when that substance is above **0 degree kelvin or -273 degrees centigrade**. In a substance, majority of the molecules move from **higher to lower concentration**, although there are some that move from **low to high**.

The overall or net movement is thus from **high to low concentration**.

**Equilibrium State:**

Eventually, the **molecules** reach a state of equilibrium where they are **distributed equally** throughout the area.

**Importance:**

Diffusion is one principle method of movement of substances within cells, as well as across cell membrane. **Carbon dioxide, oxygen, glucose, etc.** can cross cell membranes by diffusion.

**Examples:**

- Gas exchange in gills and lungs occurs by diffusion.
- Movement of glucose molecules from the lumen into the blood capillaries of villi.

**Passive Transport:**

A cell does not **expend energy** when **molecules diffuse** across its membrane, the diffusion is type of **passive transport**.

### FACILITATED DIFFUSION

#### Introduction:

Many molecules **do not diffuse freely across** cell membranes because of their **size or charge**. Such molecules are taken into or out of cells with the help of **transport proteins** present in cell membranes.

#### Definition:

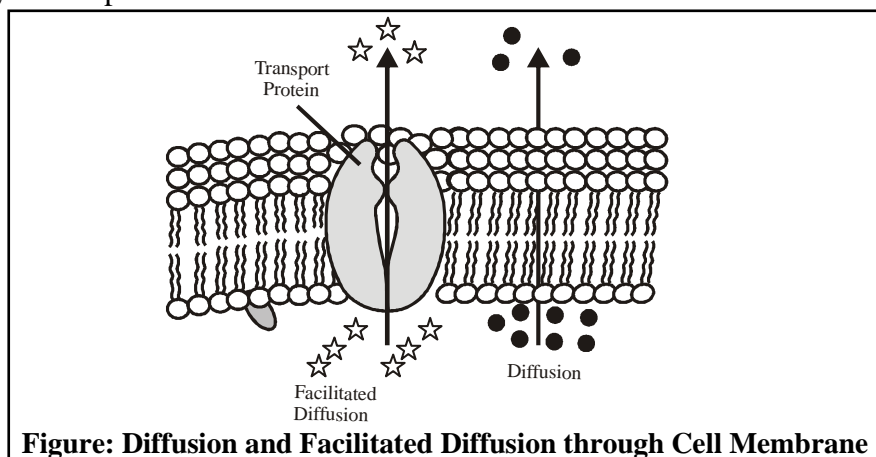
When a **transport protein** moves a substance from **higher to lower concentration**, the process is called facilitated diffusion.

#### Rate of Diffusion:

The rate of facilitated diffusion is **higher than simple diffusion**.

#### Passive Transport:

Facilitated diffusion is a type of **passive transport** because there is **no expenditure of energy** in this process.



**Figure: Diffusion and Facilitated Diffusion through Cell Membrane**

**Q.2** Write a note on osmosis and discuss water balance problems. (K.B) (Ex. Q. No. 6)

**Ans:**

### OSMOSIS

#### Definition:

“The **movement of water** across a **semi-permeable membrane** from a solution of **lesser solute concentration** to a solution of **higher solute concentration** is called osmosis”.

#### Tonicity of Solutions:

The term tonicity refers to the **relative concentration of solutes** in the solutions being compared.

#### Types of Solutions:

According to tonicity of solutions, the solutions can be categorized into **three types**:

#### Hypertonic Solution:

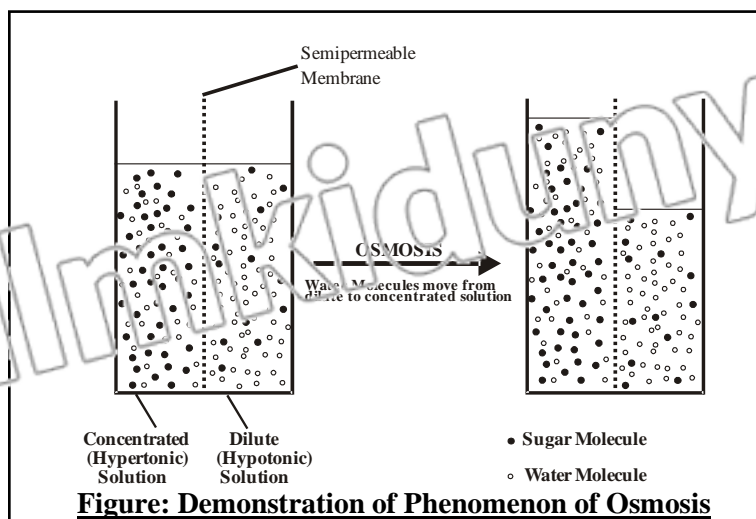
A **hypertonic solution** has relatively more solute.

#### Hypotonic Solution:

A **hypotonic solution** has relatively less solute.

#### Isotonic Solution:

An **isotonic solution** has equal concentrations of solutes.



### WATER BALANCE PROBLEMS ANIMAL CELL

#### Isotonic Solution:

When animal cell such as **red blood cell**, is placed in an **isotonic solution**, the cell volume remains constant because the **rate** at which water is **entering the cell** is equal to the **rate at which it is moving out**.

#### Hypotonic Solution:

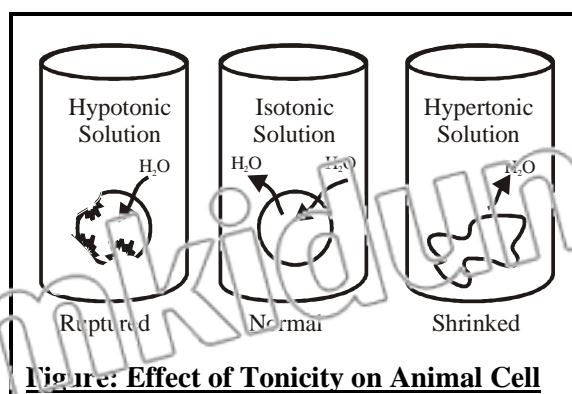
When a cell is placed in a hypotonic solution, **water enters** and **cell swells** and **may rupture like an over-filled balloon**.

#### Hypertonic Solution:

When an animal cell is placed in a hypertonic solution it will **lose water**, and **will shrink in size**.

#### Results:

So in hypotonic environments (e.g. fresh water) animal cells must **have ways to prevent excessive entry of water**, and in hypertonic environments, (e.g. sea-water) they must have ways to prevent excessive loss of water.



**WATER BALANCE PROBLEMS ANIMAL CELL**

Water-balance problems are somewhat different for plant cells because of their **rigid cell walls**.

**Hypotonic Solution:**

Most plant cells live in hypotonic environment, i.e. **there is low concentration of solutes** in extra-cellular fluids than in cells. As a result, **water first tends to move first inside cell** and then inside vacuole. When **vacuole increases in size**, **cytoplasm presses firmly against the interior of cell wall**, which expands a little. Due to the strong cell wall, plant cell wall does not rupture, but **instead becomes rigid**.

**Turgor Pressure:**

The **outward pressure on the cell wall** exerted by **internal water** is known as **turgor pressure** and the phenomenon is called turgor.

**Turgid:**

**The cell in turgor state is called turgid.**

**Importance of Turgor:**

The turgor of cells is responsible for **maintaining shapes of non – woody plants and soft portions of trees and shrubs**.

**Isotonic Solution:**

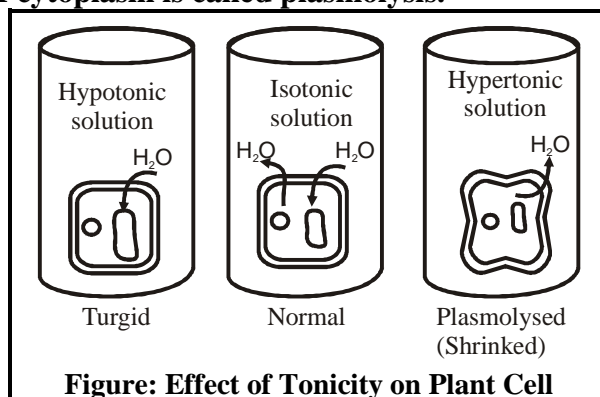
In isotonic environment, the **net uptake of water** is not enough to make the **cell turgid**, and **it is flaccid** (loose, not firm).

**Hypertonic Solution:**

In a hypertonic environment, a **plant cell loses water and cytoplasm shrinks**.

**Plasmolysis:**

**The shrinking of cytoplasm is called plasmolysis.**



**Q.3** Discuss the role of osmosis in turgidity of guard cells.

**Ans:**

**OSMOSIS AND GUARD CELLS**

(Knowledge Based)

**Guard Cells:**

Stomata, the openings in leaf epidermis are surrounded by guard cells.

**During Day Time/Opening of Stomata:**

During day time, **guard cells are making glucose**, and so are hypertonic (have a higher concentration of glucose) than their nearby epidermal cells. Water enters them from other cells and they swell. Hence they assume a **rigid bowed shape** and a **pore is created** between them.

**At Night Time/Closing of Stomata:**

At night, there is **low solute concentration in guard cells**, water leaves them and they become flaccid. In this form, **both guard cells rest against each other** and the opening is closed.



Q.4 Write a note on filtration. (A.B)

Ans:

### FILTRATION

#### Definition:

“A process by which small molecules are forced to move across semi-permeable membrane with the aid of hydrostatic (water) pressure, or blood pressure is called filtration.”

#### Example:

In the body of an animal, blood pressure forces water and dissolved molecules to move through the semi-permeable membranes of the capillary wall cells.

#### Fate of Large Molecules:

In filtration, the pressure cannot force large molecules, such as proteins, to pass through the membrane pores.

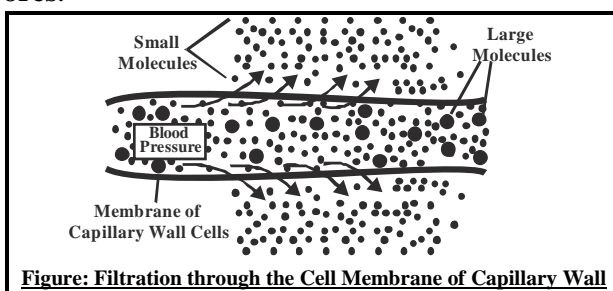


Figure: Filtration through the Cell Membrane of Capillary Wall

Q.5 Write a note on active transport. (K.B)

Ans:

### ACTIVE TRANSPORT

#### Definition:

“The movement of molecules from an area of lower concentration to the area of higher concentration, with the expenditure of energy in the form of ATP is called active transport.”

#### Concentration Gradient:

In active transport the movement is against the concentration gradient.

#### Utilization of Energy:

In this process, carrier proteins of cell membrane use energy to move the molecules against the concentration gradient.

#### Sodium-Potassium Pump:

The membranes of nerve cells have carrier proteins in the form of sodium-potassium pump. In a resting (not conducting nerve impulse) nerve cell, this pump spends energy (ATP) to maintain a higher concentrations of  $K^+$  and lower concentrations of  $Na^+$  inside the cell. For this purpose, the pump actively moves  $Na^+$  to the outside of the cell where they are already in the higher concentration. Similarly, it moves  $K^+$  from outside to inside where they are in higher concentration.

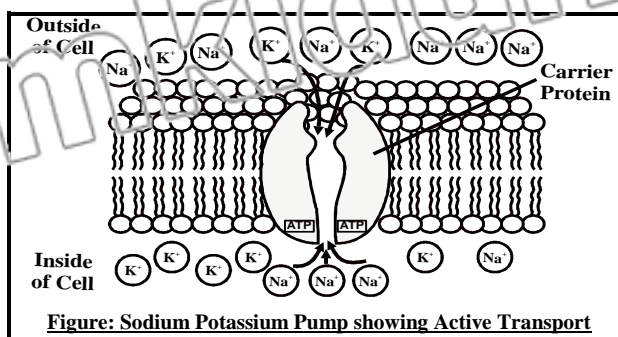


Figure: Sodium Potassium Pump showing Active Transport

**Q.6** Write a note on endocytosis and exocytosis.

(K.B)

**Ans:**

### ENDOCYTOSIS

#### Definition:

“The process of cellular ingestion of bulky materials by the infoldings of cell membrane is called endocytosis.”

#### Types of Endocytosis:

There are two forms of endocytosis:

#### Phagocytosis:

Cell takes in solid materials. It is also called as cellular eating.

#### Pinocytosis:

Cell takes in liquid in the form of droplets. It is also called as cellular drinking.

#### Membrane Loss:

During endocytosis, there is loss of plasma membrane that forms food vacuole.

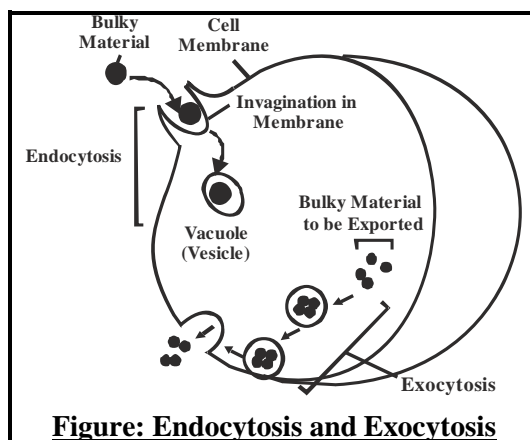
### EXOCYTOSIS

#### Definition:

“The process through which bulky material is exported outside the cell is called exocytosis.”

#### Significance:

This process adds new membrane which replaces the part of cell membrane lost during endocytosis.



**Figure: Endocytosis and Exocytosis**

## **SHORT QUESTIONS (Topic 3.4)**

**Q.1** Differentiate between diffusion and facilitated diffusion. (A.B)

(GPW 2014)

**Ans:**

### DIFFERENTIATION

The difference between diffusion and facilitated diffusion is as follows:

Diffusion	Facilitated Diffusion
<b>Definition</b>	
Movement of molecules from an area of higher concentration to an area of lower concentration is called diffusion.	When a transport protein moves a substance from higher to lower concentration the process is called facilitated diffusion.
<b>Rate</b>	
The rate of diffusion is less.	The rate of facilitated diffusion is higher than diffusion.

**Q.2 Define osmosis. (K.B)** (RWP 2015, BWP 2015)

**Ans:** Page no 117.

**Q.3 What is difference between diffusion and osmosis? (K.B)** (LHR 2013, DGK 2014)

**Ans:** DIFFERENTIATION  
The difference between diffusion and osmosis is as follows

Diffusion	Osmosis
<ul style="list-style-type: none"> <li>Movement of molecules from an area of higher concentration to an area of lower concentration is called diffusion.</li> </ul>	<ul style="list-style-type: none"> <li>Osmosis is the movement of water molecules across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration.</li> </ul>

**Q.4 What do you know about tonicity? (K.B)** (LHR 2013, 2016, SWL 2015)

**Ans:** Page no 118.

**Q.5 What will happen if a plant cell is placed in hypotonic solution? (U.B)**

**Ans:** Page no 118.

**Q.6 What is turgor? (K.B)** (GRW 2015, BWP 2015, SGD 2014, 2015)

**Ans:** Page no 119.

**Q.7 Define plasmolysis. (K.B)** (LHR 2015, GRW 2015, SWL 2014)

**Ans:** Page no 119.

**Q.8 What is role of osmosis in opening and closing of stomata? (A.B)**

**Ans:** Page no 119.

**Q.9 Discuss the application of semi-permeable membranes. (A.B)**

**Ans:** APPLICATION OF SEMI-PERMEABLE MEMBRANES  
The knowledge of semi-permeable membranes is applied for various purposes.

**Separation:**

Artificially synthesized semi-permeable membranes are used for the separation of bacteria from viruses because bacteria cannot cross a semi permeable membrane

**Filtration:**

In advanced water treatment technologies, membrane based filtration systems are used. In this process, semi-permeable membranes separate salts from water (reverse osmosis).

**Q.10 Define reverse osmosis. (A.B)** (LHR 2014)

**Ans:** REVERSE OSMOSIS

**Definition:**

“The process in which semi-permeable membranes separate salts from water is called reverse osmosis.”

**Q.11 Define filtration. (K.B)**

**Ans:** Page no 120.

**Q.12 Define active transport. (K.B)** (LHR 2015, DGK 2014)

**Ans:** Page no 120.

**Q.13 Differentiate between endocytosis and exocytosis. (K.B)**

(GRW 2013)

**Ans:**

**DIFFERENTIATION**

The difference between endocytosis and exocytosis is as follows:

Endocytosis	Exocytosis
<b>Definition</b>	
Endocytosis is the process of cellular ingestion of bulky materials by the infolding of cell membrane.	Exocytosis is a process through which bulky material is exported out of the cell.
<b>Membrane Loss</b>	
Some part of cell membrane is lost during endocytosis.	This process adds new membrane which replaces the parts of cell membrane during endocytosis.

**Q.14 Differentiate between phagocytosis and pinocytosis. (K.B)**

(LHR 2015, MTN 2014, DGK 2015, SGD 2015)

**Ans:**

**DIFFERENTIATION**

The difference between phagocytosis and pinocytosis is as follows:

Phagocytosis	Pinocytosis
<b>Type of Material</b>	
In phagocytosis cell takes in solid material.	In pinocytosis cells takes in liquid in the form of droplets.
<b>Other Name</b>	
It is also known as cellular eating.	It is also known as cellular drinking.

**MULTIPLE CHOICE QUESTIONS**

- Gaseous exchange in gills and lungs occurs by: (K.B)**  
 (A) Diffusion (B) Facilitated diffusion  
 (C) Effusion (D) Osmosis
- Facilitated diffusion is: (K.B)**  
 (A) Active transport (B) Passive transport  
 (C) Reverse osmosis (D) Exocytosis
- Which term refers to the relative concentration of solutes in the solution: (K.B)**  
 (A) Diffusion (B) Osmosis  
 (C) Tonicity (D) Turgor
- The solution that has relatively more solute: (U.B) (GRW 2014)**  
 (A) Hypertonic (B) Hypotonic  
 (C) Isotonic (D) All of these
- The shrinking of cytoplasm is: (K.B)**  
 (A) Endocytosis (B) Exocytosis  
 (C) Glycolysis (D) Plasmolysis
- The process in which semi-permeable membranes separate salts from water: (A.B)**  
 (A) Osmosis (B) Reverse osmosis  
 (C) Filtration (D) Diffusion

7. The movement of molecules from a region of lower concentration to higher concentration is called: (K.B) (LHR 2015)  
 (A) Active transport (B) Osmosis  
 (C) Diffusion (D) Filtration
8. Energy is required in: (K.B)  
 (A) Osmosis (E) Diffusion  
 (C) Filtration (D) Active transport

## 4.5 ANIMAL AND PLANT TISSUES

### LONG QUESTIONS

Q.1 Write a note on animal tissues.

(K.B) (Ex Q. No. 13)

Ans:

#### ANIMAL TISSUES

In the bodies of animals, there are **four major** categories of tissues:

- Epithelial tissue
- Connective tissue
- Muscle tissue
- Nervous tissue

#### EPITHELIAL TISSUE

(LHR 2012)

#### Location:

Epithelial tissue covers the **outside of the body** and **lines organs** and **cavities**.

#### Closely Packed Cells:

The cells in this tissue are **very closely packed together**.

#### Types:

The epithelial tissue has **many types** on the **basis of shape of cells** as well as the **number of cell layers**. Some types include:

#### Squamous Epithelium:

Squamous epithelium consists of a **single layer of flat cells**.

#### Location:

It is found in **lungs, heart** and **blood vessels**.

#### Function:

It allows the **movement of materials** across it.

#### Cuboidal Epithelium:

Cuboidal epithelium consists of a **single layer of cube-shaped cells**.

**Location:** It is found in **kidney tubes** and **small glands**.

**Function:** It makes **secretions**.

#### Columnar Epithelium:

Columnar epithelium has **elongated cells**.

**Location:** It is found in **alimentary canal** and **gall bladder**.

**Function:** It makes **secretions**.

#### Ciliated Columnar Epithelium:

Ciliated columnar epithelium has **elongated cells with cilia**.

**Location:** It is present in **trachea** and **bronchi**.

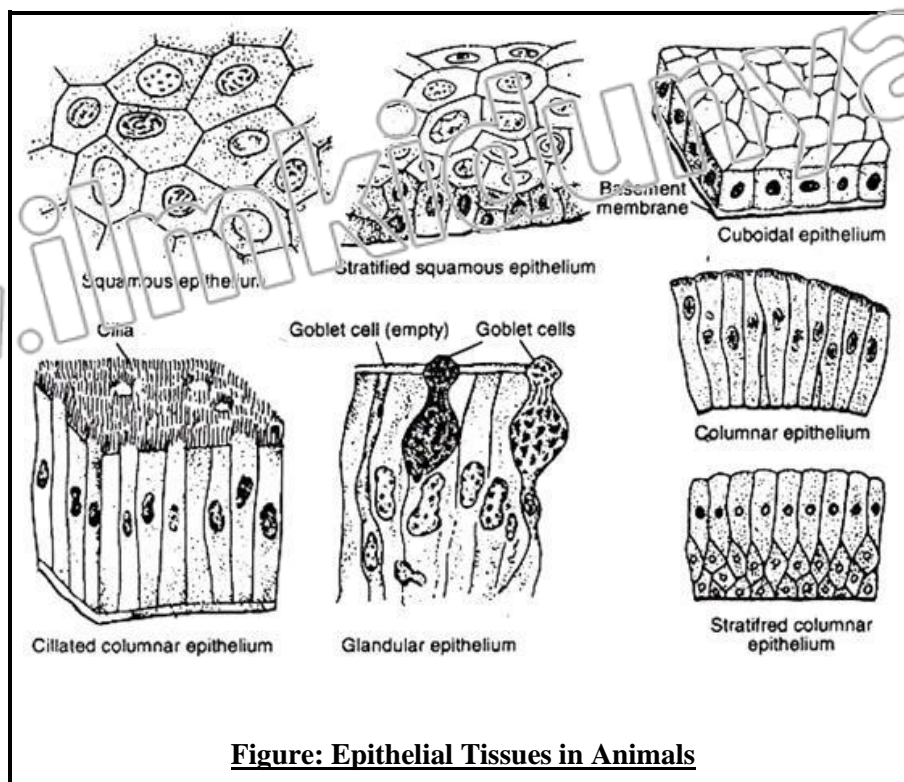
**Function:** It propels **mucous**.

#### Stratified Squamous Epithelium:

Stratified squamous epithelium has **many layers of flat cells**.

**Location:** It is present in the **lining of oesophagus** and **mouth** and also covers the skin.

**Function:** It protects inner parts.



**Figure: Epithelial Tissues in Animals**

### CONNECTIVE TISSUE

#### Structure:

The connective tissue has **cells scattered throughout an extracellular matrix.**

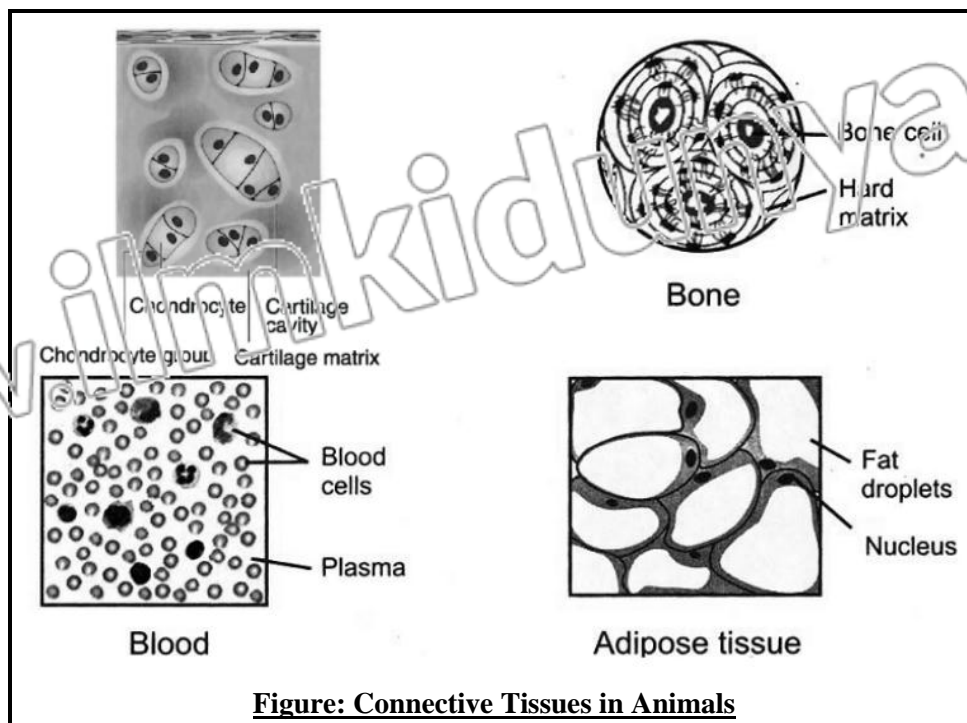
#### Function:

- The connective tissue serves a **connecting function.**
- It **supports and binds other tissues.**

#### Examples:

Common examples of connective tissue are:

- **Cartilage** (Found around the ends of bones, in external ear, nose, trachea)
- **Bone**
- **Blood**
- **Adipose tissue** (Found around kidneys, under skin, in abdomen. Adipose tissue provides energy and supports organs.)



**Figure: Connective Tissues in Animals**

### MUSCLE TISSUE

#### **Introduction:**

Muscle tissue is the **most abundant tissue** in an **animal**.

#### **Composition:**

Muscle tissue consists of **bundles of long cells** called 'muscle fibers'.

#### **Function:**

They have the ability to contract.

#### **Types of Muscle Tissues:**

There are three kinds of muscle tissue:

- i. Skeletal muscles
- ii. Smooth muscles
- iii. Cardiac muscles

#### **i. Skeletal Muscles:**

Skeletal muscles or striated muscles are **attached to bones**.

#### **Structure:**

The cells are striated (striped) and **contain many nuclei**.

#### **Function:**

They are responsible for the **movements of bones**

#### **ii. Smooth Muscles:**

Smooth muscles are found in the walls of:

- Alimentary canal
- Urinary bladder
- Blood vessels

#### **Structure:**

They contain **smooth (non-striated) cells**, each **with a single nucleus**.

#### **Function:**

They are responsible for the **movement of substances**.

**iii. Cardiac Muscles:**

Cardiac muscles are present in the wall of heart.

**Structure:**

Their cells are **striated** but with a **single nucleus** in each cell.

**Function:**

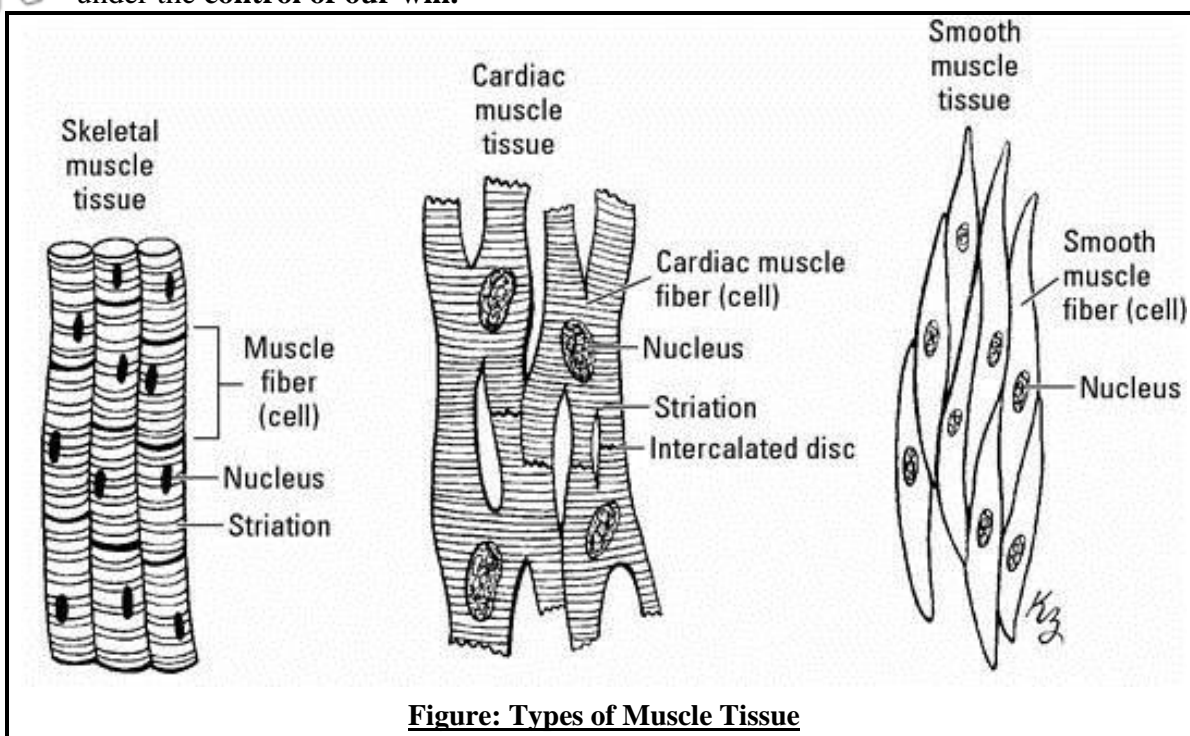
They **produce heartbeat**.

**Voluntary Muscles:**

**Skeletal muscles** are voluntary in action. i.e. **their contraction is under the control of our will.**

**Involuntary Muscles:**

**Smooth and cardiac muscles** are involuntary in action. i.e. **their contraction is not under the control of our will.**



**Figure: Types of Muscle Tissue**

**NERVOUS TISSUE****Survival of an Animal:**

An animal's survival depends on **its ability to respond approximately to the stimuli from the environment.** This ability **requires the transmission of information** among **body parts.** Nervous tissue forms a **communicating system** and performs this task.

**Composition:**

The nervous tissue is mainly **composed of nerve cells or neurons.**

**Function:**

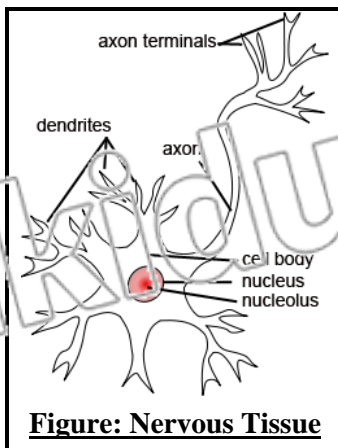
The **nerve tissue is specialized to conduct messages in the form of nerve impulses.**

**Location:**

Nervous tissue is found in:

- **Brain**
- **Spinal cord**
- **Nerves**





Q.2 Write a note on plant tissues.

(Knowledge Based) (Ex Q. No. 14)

Ans:

### PLANT TISSUES

The cells of plants are grouped into tissues with characteristic functions such as photosynthesis, transport etc.

#### Major Types:

There are two major categories of tissues in plants:

- Simple tissues
- Compound (Complex) tissues

#### SIMPLE TISSUES

#### Definition:

“The tissues which are made up of a single type of cells are called simple tissues.”

#### Types of Simple Tissues:

They are of two types:

- Meristematic tissues
- Permanent tissues

#### Meristematic tissues:

#### Characteristics:

Following are the main characteristics of the meristematic tissues:

- These tissues are composed of cells, which have the ability to divide.
- The cells are **thin walled**.
- These cells have **large nucleus**.
- They have small or **no vacuoles**.
- There **do not have intercellular spaces** among them.

#### Types of Meristematic Tissues:

There are two main types of meristematic tissues:

#### Apical Meristems:

#### Location:

Apical meristems are located **at the apices (tips) of roots and shoot**.

#### Function:

When they divide, they cause **increase in the length of plant**. Such growth is called **primary growth**.

#### Lateral Meristems:

Lateral meristems are located on the **lateral sides of roots and shoot**.

**Function:**

When they divide, they are responsible for **increase in the growth of plant**. Such **growth** is called **secondary growth**.

**Types:**

They are of further two types:

- **Vascular cambium** (located between xylem and phloem)
- **Cork cambium** (in the outer lateral sides of plant).

**Intercalary Meristem:**

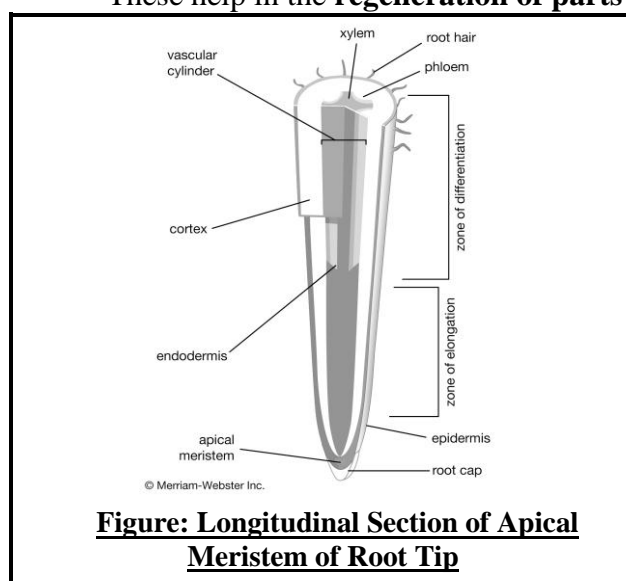
Intercalary meristem is in the **form of small patches among mature tissues**.

**Presence:**

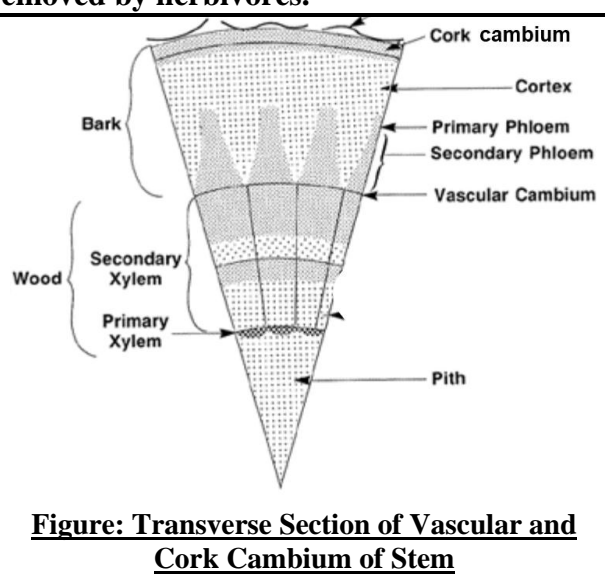
These are **common in grasses**.

**Function:**

These help in the **regeneration of parts removed by herbivores**.



**Figure: Longitudinal Section of Apical Meristem of Root Tip**



**Figure: Transverse Section of Vascular and Cork Cambium of Stem**

**PERMANENT TISSUES****Definition:**

“The **cells of the tissues** which **do not have the ability to divide** are called permanent tissues.”

**Origin:**

Permanent tissues originate **from meristematic tissues**.

**Types:**

Permanent tissues are classified into the following types:

- i. **Epidermal Tissues**
- ii. **Ground Tissues**
- iii. **Support Tissues**

**i. Epidermal Tissues:****Structure:**

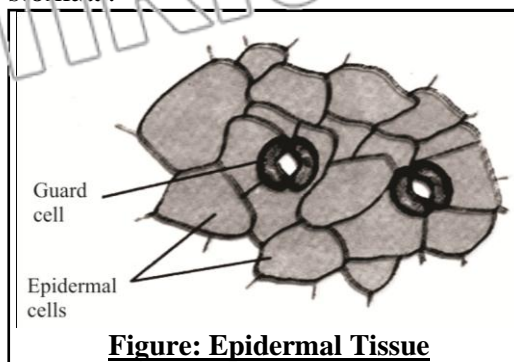
Epidermal tissues are **composed of a single layer of cells**.

**Location:**

They **cover the plant body**.

**Functions:**

- They act as **barrier** between **environment** and **internal plant tissues**.
- In roots, they are **responsible** for the **absorption of water and minerals**.
- On stem and leaves, they **also secrete cutin** (the coating of cutin is called cuticle) which **prevents evaporation**.
- **Specialized structures** are also **present** which **perform specific functions**, e.g. root hair and stomata.

**Figure: Epidermal Tissue****ii. Ground Tissues:****Parenchyma Cells:**

Ground tissues are **simple tissues** made up of **parenchyma cells**. **Parenchyma cells** are the most **abundant cells in plants**.

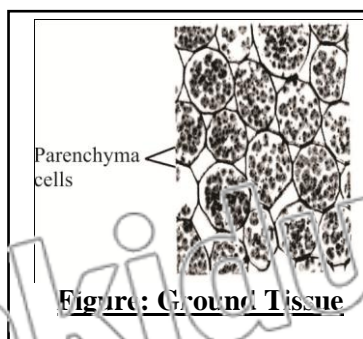
**Characteristics:**

Following are the main characteristics of ground tissues:

- They are **spherical** but **flat at the point of contact**.
- They have **thin primary cell walls**.
- They have **large vacuoles** for the **storage of food**.

**Functions:**

- In leaves, they are called **mesophyll** and are the **sites of photosynthesis**.
- In other parts, they are **sites of respiration** and **protein synthesis**.
- They also **store food in their vacuoles**.

**Figure: Ground Tissue****iii. Support Tissues:****Definition**

“The tissues that provide **strength** and **flexibility** to plants are called support tissues.”

**Types:**

They are further of **two types**.

**Collenchyma Tissue:**

They are **made up of elongated cells** with **unevenly thickened primary cell walls**.

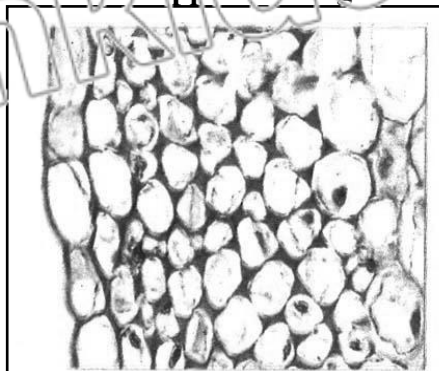
**Location:**

They are found in:

- **Cortex** (beneath epidermis) of young stems
- **Midribs of leaves**
- **Petals of flowers**

**Function:**

They are **flexible** and **function to support the organs where they are found.**



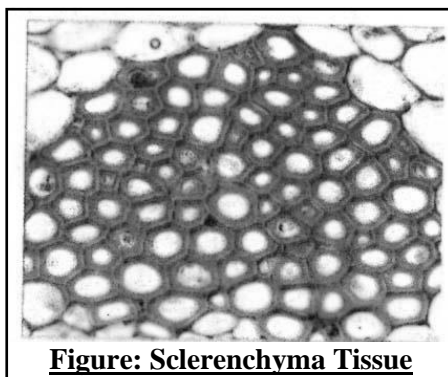
**Figure: Sclerenchyma Tissue**

**Sclerenchyma Tissue:**

They are **composed of cells with rigid secondary cell walls**. The cell walls are hardened with lignin, which is the **main chemical component of wood**.

**Mature Cells:**

Mature cells **cannot elongate and most of them are dead.**



**Figure: Sclerenchyma Tissue**

**COMPOUND/COMPLEX TISSUES****Definition:**

“A **plant tissue composed of more than one type of cell** is called a compound or complex tissue.”

**Occurrence:**

They are found only **in vascular plants.**

**Examples:**

- **Xylem**
- **Phloem**

**Xylem Tissue:**

Due to the presence of **lignin**, the **secondary walls of its cells are thick and rigid.**

**Types:**

**Two types of cells are found in xylem tissue.**

**Vessel Elements:**

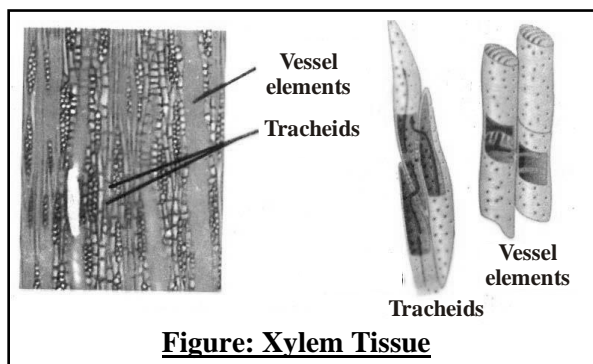
They have **thick secondary cell walls**. They lack end walls and **join together to make tubes**.

**Tracheids:**

They are **slender cells with overlapping ends**.

**Functions:**

- Xylem tissue is responsible for the transport of water and dissolved substances from roots to the aerial parts.
- It also provides support to the plant body due to the presence of lignin.



**Figure: Xylem Tissue**

**Phloem Tissues:**

Phloem tissues are composed of:

**Sieve Tube Cells:**

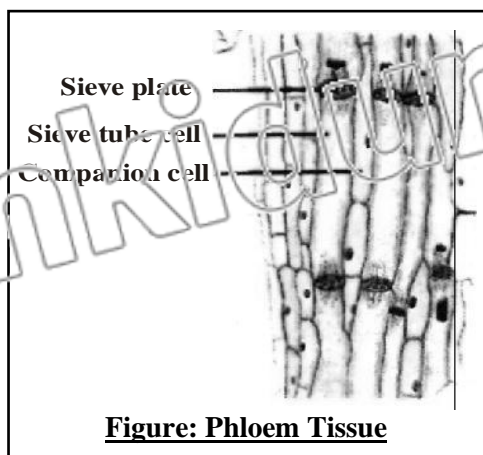
They are long and their end walls have **small pores**. Many **sieve tube cells** join to form **long sieve tubes**.

**Companion Cells:**

They make **proteins for sieve tube cells**.

**Function:**

Phloem tissue is responsible for the **conduction of dissolved organic matter (food)** between different **parts of plant body**.



**Figure: Phloem Tissue**

**SHORT QUESTIONS (Topic 4.5)**

**Q.1 Name the animal tissues with their types. (K.B)**

**Ans:** ANIMAL TISSUES

In the bodies of animals, there are four major categories of tissues.

**Epithelial Tissues:**

Some types of Epithelial tissues include:

- Squamous epithelium
- Cuboidal epithelium
- Columnar epithelium
- Ciliated columnar epithelium
- Stratified squamous epithelium

**Connective Tissue:**

Common examples of this tissue are:

- Bone
- Blood
- Adipose tissue

**Muscle Tissue:**

Some types of muscle tissues are:

- Skeletal muscles
- Smooth muscles
- Cardiac muscles

**Nervous Tissue:**

- Sensory, motor and inter neurons

**Q.2 What are epithelial tissues? (K.B)**

**Ans:** Page no 134.

**Q.3 What is the difference between skeletal and smooth muscle? (K.B)**

**Ans:** DIFFERENTIATION

The difference between skeletal and smooth muscle is as follows:

Skeletal Muscle	Smooth Muscle
<b>Location</b>	
Skeletal muscles are attached to bones.	Smooth muscles are found in the walls of alimentary canal, urinary bladder, blood vessels etc.
<b>Striation</b>	
There cells are striated.	There cells are non-striated.
<b>Nucleus</b>	
They contain many nuclei.	Each cell has single nucleus.
<b>Function</b>	
They are responsible for the movement of bones.	They are responsible for the movement of substances.
<b>Nature</b>	
These are voluntary in their action.	These are involuntary in their action.

**Q.4 Name the plant tissues with their types. (K.B)**

**Ans:** PLANT TISSUES

There are two major categories of tissues in plants.

**i. Simple Tissues:**

They are of two types:

**Meristematic Tissues:**

It is of further two main types:

- Apical meristems
- Lateral meristems

**Permanent Tissues:**

It is of further three types:

- Epidermal tissues
- Ground tissues
- Support tissues

**ii. Compound Tissues:**

These tissues are of two types:

- Xylem tissues
- Phloem tissues

**Q.5 Differentiate between apical and lateral meristems. (K.B)**

(LHR 2015)

**Ans:** DIFFERENTIATION

The difference between apical and lateral meristems is as follows:

Apical Meristems	Lateral Meristems
<b>Location</b>	
They are located at the apices (tips) of roots and shoots.	They are located on the lateral sides of roots and shoots.
<b>Function</b>	
When they divide, they cause increase in the length of plant. Such growth is called primary growth.	By dividing, they are responsible for increase in growth of plant parts. This growth is called secondary growth.

**Q.6 Define permanent tissues. (K.B)**

**Ans:** Page no 129

**Q.7 What is special about parenchyma cells? (L.B)**

**Ans:** Page no 130.

**Q.8 What do you know about xylem tissues? (K.B)**

(GRW 2012)

**Ans:** Page no 131.

**Q.9 What is the role of phloem tissues in plants? (K.B)**

(SWL 2015, MTN 2015)

**Ans:** Page no 132.

**MULTIPLE CHOICE QUESTIONS (Topic 4.5)**

1. Which one is not an animal tissue? (K.B)  
(A) Epithelial (B) Connective  
(C) Epidermal (D) Nervous
2. The muscles found in heart: (K.B)  
(A) Skeletal (B) Smooth  
(C) Cardiac (D) Ground
3. Cardiac muscles are present in the walls of: (K.B) (FSD 2014)  
(A) Heart (B) Lungs  
(C) Kidney (D) Stomach
4. Blood is an example of: (K.B) (LHR 2012)  
(A) Epithelial tissue (B) Connective tissue  
(C) Nervous tissue (D) Muscle tissue
5. Nervous tissues are found in: (K.B) (DGK 2014)  
(A) Brain (B) Spinal cord  
(C) Skin (D) All of these
6. Smooth muscles are found in the walls of: (K.B)  
(A) Alimentary canal (B) Urinary bladder  
(C) Blood vessels (D) All of these
7. Which of these muscles are voluntary in action? (K.B)  
(A) Skeletal muscles (B) Smooth muscles  
(C) Cardiac muscles (D) Smooth and cardiac
8. The muscles that are involuntary in their action are: (U.B)  
(A) Smooth muscles (B) Cardiac muscles  
(C) Skeletal muscles (D) Both A and B
9. The tissues present in lungs, heart and blood vessels are: (K.B)  
(A) Squamous epithelium (B) Cuboidal epithelium  
(C) Stratified squamous epithelium (D) Ciliated columnar epithelium
10. The tissues located at the tips of roots and shoots: (K.B)  
(A) Apical meristem (B) Lateral meristem  
(C) Cambium (D) Parenchyma



11. **The epidermal tissues contain: (U.B)**  
(A) Root hairs (B) Stomata  
(C) Both a and b (D) Lenticels
12. **Ground tissues are made up of: (K.B)**  
(A) Collenchyma (B) Sclerenchyma  
(C) Parenchyma (D) Tracheids
13. **The tissues present in the midrib of the leaves and in petals of flowers: (U.B)**  
(A) Collenchyma (B) Sclerenchyma  
(C) Parenchyma (D) Cambium
14. **The function of ground tissues is: (K.B)**  
(A) Food storage (B) Photosynthesis  
(C) Respiration and protein synthesis (D) All of these
15. **The cell walls of sclerenchyma tissues are hardened with: (K.B)**  
(A) Chitin (B) Cellulose  
(C) Peptidoglycan (D) Lignin
16. **A plant tissue composed of more than one type of cells: (K.B)**  
(A) Compound (B) Support  
(C) Meristematic (D) Ground
17. **Transport of water and soluble materials from roots to the aerial parts is done by: (A.B)**  
(LHR 2013)  
(A) Phloem tissue (B) Xylem tissues  
(C) Stomal tissues (D) Both A and B
18. **Tracheids are present in: (K.B)**  
(A) Xylem (B) Phloem  
(C) Epidermal tissue (D) Parenchyma
19. **Phloem tissues contain \_\_\_\_\_ cells: (K.B)** (GRW 2012)  
(A) Tracheids cells (B) Vessel cells  
(C) Fiber cells (D) Sieve tube cells
20. **Companion cells are present in: (K.B)**  
(A) Xylem (B) Phloem  
(C) Epidermal tissues (D) Parenchyma tissues

**ANSWER KEYS****MULTIPLE CHOICE QUESTIONS****4.1 MICROSCOPY AND THE EMERGENCE OF CELL THEORY**

1	C	6	A	11	A	16	A	21	B
2	D	7	B	12	C	17	B	22	C
3	B	8	B	13	B	18	C		
4	C	9	A	14	A	19	A		
5	B	10	D	15	C	20	B		

**4.2 CELLULAR STRUCTURES AND FUNCTIONS**

1	D	6	D	11	C	16	C	21	B	26	C
2	A	7	D	12	B	17	A	22	D	27	C
3	C	8	D	13	A	18	C	23	B	28	B
4	A	9	A	14	D	19	D	24	B	29	A
5	B	10	D	15	B	20	D	25	C	30	D

**4.3 CELL SIZE AND SURFACE AREA TO VOLUME RATIO**

1	D	4	D
2	A	5	C
3	B		

**4.4 PASSAGE OF MOLECULES INTO AND OUT OF CELLS**

1	C	5	D
2	B	6	C
3	C	7	A
4	A	8	D

**4.5 ANIMAL AND PLANT TISSUES**

1	C	6	D	11	C	16	A
2	C	7	A	12	C	17	B
3	A	8	D	13	A	18	A
4	B	9	A	14	D	19	D
5	D	10	A	15	D	20	B

**REVIEW QUESTIONS****MULTIPLE CHOICE QUESTIONS**

- Which of these clues would tell you whether a cell is prokaryotic or eukaryotic? (U.B)**
  - The presence or absence of a cell wall
  - Whether or not the cell is partitioned by internal membranes
  - The presence or absence of ribosomes
  - Whether or not the cell contains DNA
- There are \_\_\_\_\_ micrometers ( $\mu\text{m}$ ) in one millimeter (mm). (K.B)**
  - 10
  - 100
  - 1000
  - 1/1000
- The plasma membrane does all of these except: (K.B)**
  - Contains the hereditary material
  - Acts as a boundary or border for the cytoplasm
  - Regulates passage of materials in and out of cell
  - Functions in the recognition of cell
- Which of these materials is not a component of plasma membrane? (K.B)**
  - Lipids
  - Carbohydrates
  - Proteins
  - DNA
- Cell walls are found in these organisms except for: (K.B)**
  - Plants
  - Animals
  - Bacteria
  - Fungi
- The \_\_\_\_\_ is a major component of plant cell walls. (K.B)**
  - Chitin
  - Peptidoglycan
  - Cellulose
  - Cholesterol
- Plant cells have \_\_\_\_\_ and \_\_\_\_\_, which are not present in animal cells. (K.B)**
  - Mitochondria, chloroplasts
  - Cell membranes, cell walls
  - Chloroplasts, nucleus
  - Chloroplasts, cell wall
- The \_\_\_\_\_ is the membrane-enclosed structure in eukaryotic cells that contain the DNA of the cell. (U.B)**
  - Mitochondrion
  - Chloroplast
  - Nucleolus
  - Nucleus
- Ribosomes are constructed in the: (K.B)**
  - Endoplasmic reticulum
  - Nucleoid
  - Nucleolus
  - Nuclear pore
- Rough endoplasmic reticulum is the area in the cell where \_\_\_\_\_ are synthesized. (K.B)**
  - Polysaccharides
  - Proteins
  - Lipids
  - DNA

11. Smooth endoplasmic reticulum is the area in a cell where \_\_\_\_\_ are synthesized. (K.B)
- (a) Polysaccharides (b) Proteins  
(c) Lipids (d) DNA
12. The mitochondrion functions in: (K.B)
- (a) Lipid storage (b) Protein synthesis  
(c) Photosynthesis (d) Cellular respiration
13. The thin extensions of the inner mitochondrial membrane are known as: (A.B)
- (a) Cristae (b) Matrix  
(c) Thylakoids (d) Stroma
14. The chloroplast functions in: (A.B)
- (a) ATP synthesis (b) Protein synthesis  
(c) Photosynthesis (d) DNA replication
15. Which of these cellular organelles have their own DNA? (U.B)
- (a) Chloroplast (b) Nucleus  
(c) Mitochondrion (d) All of these

### ANSWERS KEY

1	b	2	c	3	a	4	d	5	b
6	c	7	d	8	d	9	c	10	b
11	c	12	d	13	a	14	c	15	d

### **UNDERSTANDING THE CONCEPTS**

1. **Explain the functions of cell membrane. (A.B)**  
**Ans:** See the LQ.2 of (Topic 4.2)
2. **Describe the structure of cell wall. (K.B)**  
**Ans:** See the LQ.1 of (Topic 4.2)
3. **Discuss nucleus structure and function. (K.B)**  
**Ans:** See the LQ.5 of (Topic 4.2)
4. **Describe the structure and function of endoplasmic reticulum and Golgi apparatus. (K.B)**  
**Ans:** See the LQ.9 and 10 of (Topic 4.2)
5. **Describe the formation and function of Lysosomes. (K.B)**  
**Ans:** See the LQ.11 of (Topic 4.2)
6. **Explain what would happen when a plant and animal cell is placed in a hypertonic solution? (K.B)**  
**Ans:** See the LQ.2 of (Topic 4.4)
7. **Describe the internal structure of a chloroplast and compare it with that of a mitochondrion. (K.B)**  
**Ans:** See the LQ.8 of (Topic 4.2)

#### STRUCTURAL COMPARISON

##### Similarities:

- Both are double-membranous organelles.
- Both have smooth outer membranes.
- Both have folded inner membranes.
- Both have an internal matrix.
- Both have their own DNA and ribosomes.
- Both are major energy centers, chloroplasts in plants and mitochondria in animals.

##### Differences:

- Chloroplasts have photosynthetic pigments while mitochondria do not possess any such pigment.
- The inner membrane of mitochondria does not form thylakoids in chloroplasts. It forms cristae.
- Mitochondria are sites of aerobic respiration while chloroplasts are sites of photosynthesis.

8. **Explain the phenomena involved in the passage of matter across cell membrane. (A.B)**

##### **Ans:** SEMI-PERMEABILITY OF CELL MEMBRANE

Cell membranes act as barriers to most but not all molecules. That is why cell membranes are called semi-permeable membranes. They maintain equilibrium inside cell as well as outside by exchanging matter with cell's environment according to needs. Cell membranes do it through the phenomena of:

- Diffusion
- Facilitated diffusion
- Osmosis
- Filtration
- Active transport
- Endocytosis
- Exocytosis

See the LQ.1, 2, 4, 5 and 6 of (Topic 4.4)

9. Describe how turgor pressure develops in a plant cell. (U.B)

Ans: **DEVELOPMENT OF TURGOR PRESSURE**

**Turgor Pressure:**

“The outward pressure on the cell wall exerted by internal water is known as turgor pressure.”

**Explanation:**

- Most plant cells live in hypotonic environment, i.e. there is low concentration of solutes in extra-cellular fluids than in cells.
- As a result, water first tends to move inside the cell and then inside the vacuole.
- When a vacuole increases in size, cytoplasm presses firmly against the interior of cell wall, which expands a little.
- Due to the strong cell wall, the cell does not rupture, but instead becomes rigid.

10. State the relationship between cell structure and cell function. (A.B)

Ans: See the LQ.1 of (Topic 4.3)

11. Describe the differences in prokaryotic and eukaryotic cells. (U.B)

Ans: See the LQ.14 of (Topic 4.2)

12. Explain how surface-area to volume ratio limits cell size. (U.B)

Ans: See the LQ.2 of (Topic 4.3)

13. Describe the major animal tissues in terms of their cell specificities, locations and functions. (K.B)

Ans: See the LQ.1 of (Topic 4.5)

14. Describe the major plant tissues in terms of their cell specificities, locations and functions. (A.B)

Ans: See the LQ.2 of (Topic 4.5)

### SHORT QUESTIONS

1. State the cell theory. (K.B)

Ans: See the SQ.12 of (Topic 4.1)

2. What are the functions of chromoplasts and leucoplasts? (K.B)

Ans: See the SQ.15 and 16 of (Topic 4.2)

3. Differentiate between diffusion and facilitated diffusion. (K.B)

Ans:

#### DIFFERENTIATION

The difference between diffusion and facilitated diffusion is as follows:

Diffusion	Facilitated Diffusion
<b>Definition</b>	
Diffusion is the movement of molecules from an area of higher concentration to the area of lower concentration i.e. along the concentration gradient.	Facilitated diffusion is a type of diffusion across cell membrane in which transport-proteins are used to transport the substance from higher to lower concentration.
<b>Size and Charge</b>	
Size and charge are not significant in simple diffusion.	Size and charge are important factors in facilitated diffusion.
<b>Carrier Proteins</b>	
No carrier proteins are required.	Carrier proteins are required.
<b>Rate</b>	
Slower rate of diffusion	Rapid rate of diffusion
<b>Examples</b>	
<ul style="list-style-type: none"> <li>• Gaseous exchange in gills</li> <li>• Movement of glucose from small intestine lumen into capillaries</li> </ul>	<ul style="list-style-type: none"> <li>• Movement of ions across cell membrane</li> <li>• Movement of several water-soluble molecules across cell membrane.</li> </ul>

4. What is meant by hypertonic and hypotonic solutions? (A.B)

Ans: See the SQ.4 of (Topic 4.4)

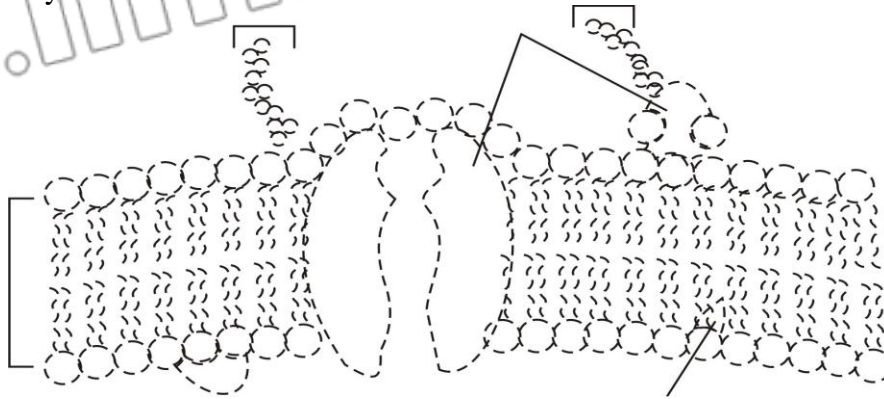
## KIPS ASSIGNMENT

### LET'S DRAW & LABEL

#### (A) The Fluid Mosaic Model of Cell Membrane

##### Instructions:

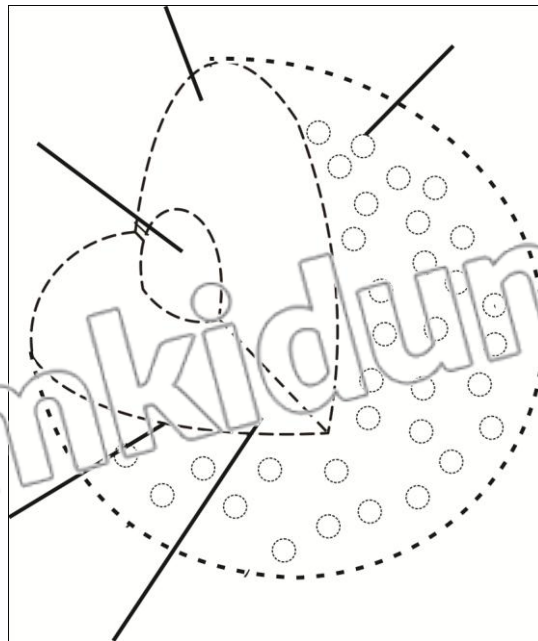
- Draw the circles first showing lipid bilayer.
- Now draw the proteins in the center as shown in diagram.
- Finally mark the labels.



#### (B) Structure of Nucleus

##### Instructions:

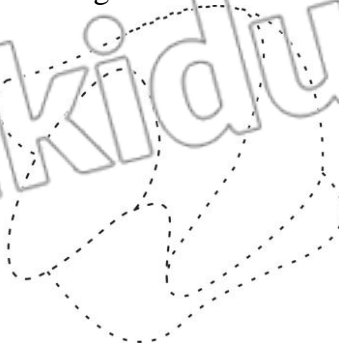
- Draw a circle showing nuclear envelope of nucleus.
- Now show dissection of nuclear envelope as shown in figure.
- Mark the labels as given in book.



**(C) Ribosome**

**Instructions:**

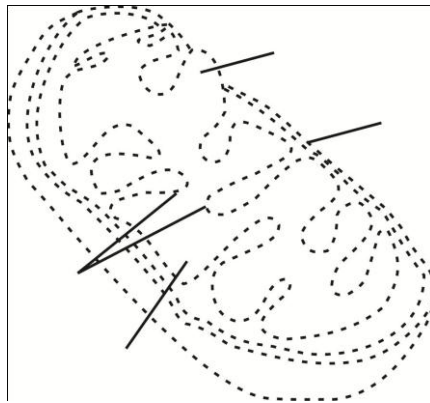
- Trace the pattern as shown in figure and mark the labels



**(D) Mitochondrion**

**Instructions:**

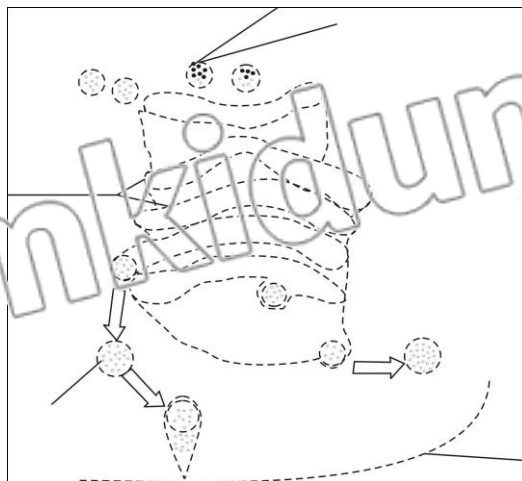
- Trace the pattern as shown in figure and mark the labels



**(E) Golgi Apparatus**

**Instructions:**

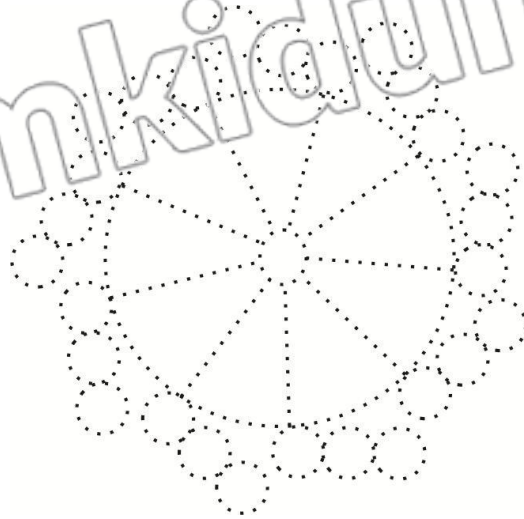
- Trace the pattern as shown in figure and mark the labels



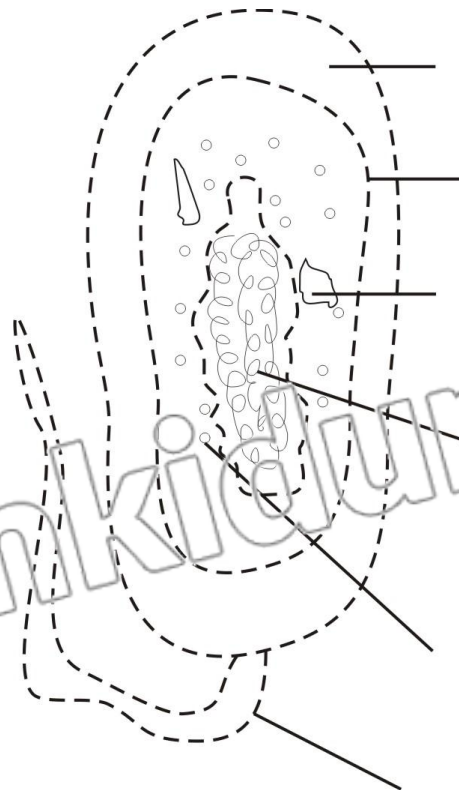


**(F) Centriole (Overhead view)****Instructions:**

- Trace the pattern as shown in figure and mark the labels.

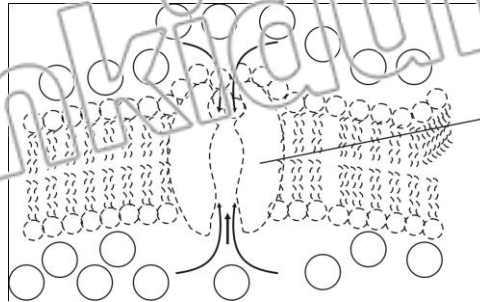
**(G) General Structure of a Prokaryotic Cell****Instructions:**

- Trace the pattern as shown in figure and mark the labels.

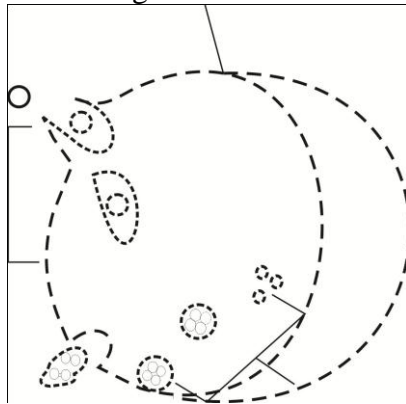


**(H) Sodium Potassium Pump, showing Active Transport****Instructions:**

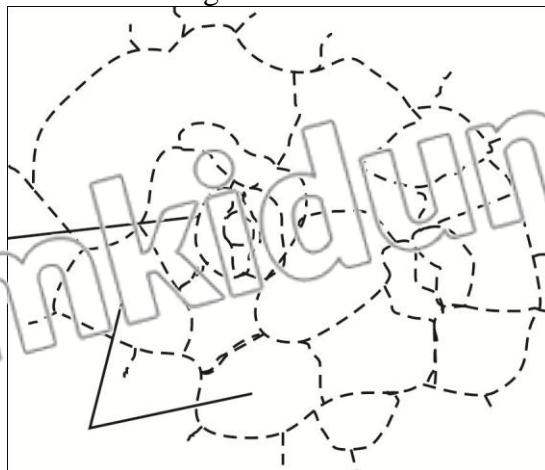
- Trace the pattern as shown in figure and mark the labels.

**(I) Endocytosis and Exocytosis****Instructions:**

- Trace the pattern as shown in figure and mark the labels.

**(J) Epidermal Tissue****Instructions:**

- Trace the pattern as shown in figure and mark the labels.





CUT HERE

**SELF TEST**

Time: 40 min

Marks: 25

**Q.1** Four possible answers A, B, C and D to each question are given, mark the correct answer. (6×1=6)

1. The increase in the apparent size of an object: (A,B)  
(A) Resolution (B) Microscopy  
(C) Magnification (D) Micrograph
2. Which type of microscope is better to study the movement of *Paramecium*? (U.B)  
(A) Transmission electron microscope (B) Scanning electron microscope  
(C) Light microscope (D) Compound microscope
3. The cell wall of bacteria is made up of: (K.B)  
(A) Cellulose (B) Lignin  
(C) Peptidoglycan (D) Chitin
4. Which organelles are involved in intracellular digestion? (K.B)  
(A) Mitochondria (B) Lysosomes  
(C) Ribosomes (D) Nucleus
5. Which one of the following is not the function of SER? (A.B)  
(A) Detoxification (B) Lipid metabolism  
(C) Protein synthesis (D) Transport of materials
6. A plant tissue composed of rapidly dividing cells: (K.B)  
(A) Compound (B) Support  
(C) Meristematic (D) Ground

**Q.2** Give short answers to following questions. (5×2=10)

- (i) Define microscopy and describe the invention of first microscope. (K.B)
- (ii) Write postulates of cell theory. (K.B)
- (iii) What is the role of cell membrane around the cells? (A.L)
- (iv) What are chromoplasts? (K.B)
- (v) Write cell wall composition of prokaryotic and eukaryotic cells. (K.B)

**Q.3** Answer the following questions in detail. (5+4=9)

- (a) Write a note on mitochondria. (K.B) (5)
- (b) Describe filtration in detail. (K.B) (4)

**Note:**

Parents or guardians can conduct this test in their supervision in order to check the skill of students.