UNIT 7

Organization of Tissues

Learning Objectives

BQ2HCH

At the end of the lesson students will be able:

- To know the different types of tissues and their morphology.
- To identify how tissues are organized in specific patterns to form organs.
- To understand how these tissues work together in an integrated manner and perform life activities in plants and animals.
- To gain knowledge about the structural organisation of meristematic tissues, and permanent tissues of plants; epithelial tissues, connective tissues, muscular and nervous tissues of animals.
- To familiarize with the process, types and significance of cell division.

Introduction

Unicellular organisms, like bacteria and protozoans though made of single cells act as a site for diverse life activities such as digestion, respiration, excretion and reproduction. On the other hand, multicellular organisms, like higher plants and animals, are composed of millions of different types of cells that are grouped into different levels of organization. Multicellular organisms have specialized cells, tissues, organs and organ systems that perform specific functions. In this chapter, you will learn different types of plant and animal tissues and how they are modified to coordinate life activities.

Multicellular organisms usually develop from the zygote. Each zygote divides by the process of mitotic cell division. Repeated cell divisions produce large number of cells which undergo cellular differentiation. The process of cell division and cell differentiation lead to the development of specific organs consisting of specific groups of cells to perform specific functions in the body. Group of cells positioned and designed to perform a particular function is called a tissue. An organ is a structure made up of a collection of tissues that carry out specialized functions for example in plants the root, stem and leaves are organs; wherein tissues of leaves include epidermis, palisade tissue, spongy tissue, xylem and phloem. Similarly in animals stomach for example, is an organ that consists of tissues made of epithelial cells, gland cells and muscle cells.

7.1 Plant Tissues

Groups or mass of cells that are similar in origin, structure and function form a tissue. Plants are made up of vegetative and reproductive tissues.

In general plant tissues are classified into two types namely

i. Meristems or Meristematic tissues.

ii. Permanent tissues

7.2 Meristematic Tissues (Meristems)

The term "meristem" is derived from the greek word ' Meristos' which means divisible or having cell division activity. The term meristem was coined by Nageli (1858).

Meristematic tissues are group of immature cells that are capable of undergoing cell division. In plants, meristem is found in zones where growth can take place, for example, apex of stem, root, leaf primordia, vascular cambium, cork cambium, etc.,

Characteristic features of meristematic tissue

a) They are made of living cells

b) Cells are small, oval, polygonal or round in shape

c) They are thin walled with dense cytoplasm, large nuclei and small vacuoles.

d) They undergo mitotic cell division

e) They do not store food materials.

Meristems are classified based on (i) origin and development, (ii) origin of initiating cells (iii) position in plant body (iv) function

7.2.1 Types of Meristems

I. Classification based on origin and development:

Based on origin and development of initiating cells, meristems can be classified into three types namely i) Promeristem or primordial meristem ii) Primary meristem and iii) Secondary meristem

i) Promeristem or primordial meristem:

- A group of young meristematic cells of a growing organ.
- In plants, they occupy a small area at the tip of shoot and root.
- They further divide to form primary meristem.

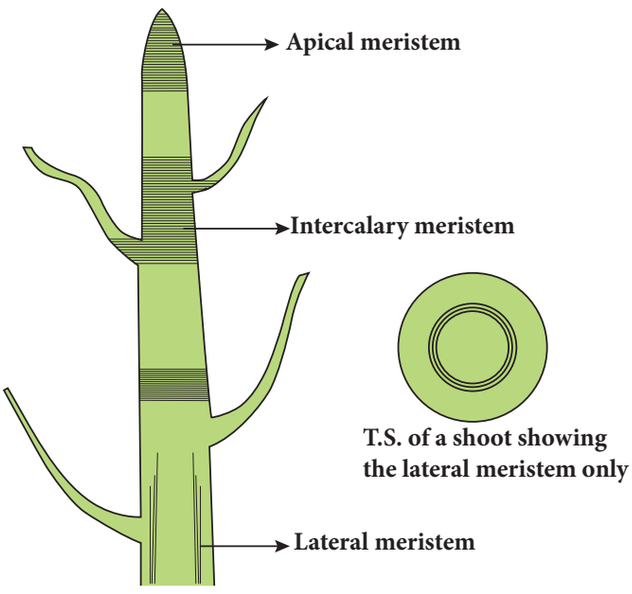


Figure 7.1 Longitudinal section of shoot apex showing location of meristems and young leaves.

ii) Primary meristem:

- They are present below the promeristem at shoot and root apices.
- These cells divide to form permanent tissues.

iii) Secondary meristem:

- It is derived from primary permanent tissues which have the capacity of division eg. cork-cambium, cambium of roots and inter fascicular cambium of stem.

II. Classification based on position:

On the basis of their position in the plant, meristems are of three types: i) Apical meristem ii) Intercalary meristem and iii) Lateral meristem.

i. Apical meristem:

- These are found at the apices or growing points of root, shoot and bring about increase in length. They include both pro-meristem as well as primary meristem.

ii. Intercalary meristem:

- It lies between the region of permanent tissues and is part of primary meristem which is detached due to formation of intermittent permanent tissues. It is found either at the base of leaf e.g. Pinus or at the base of internodes e.g. grasses.

iii. Lateral Meristem:

- These are arranged parallel to sides of origin and normally divide radially to give secondary permanent tissues. These increase the thickness of the plant part.

III. Classification based on function:

On the basis of their function, meristems have been classified into three types, namely: i) Protoderm meristem, ii) Procambium meristem and iii) Ground Meristem

i. Protoderm meristem:

- It is the outermost layer of the young growing region which develops to form epidermal tissues.

ii. Procambium meristem:

- It is composed of narrow, elongated, meristematic cells that give rise to the vascular tissues.

iii. Ground Meristem:

- It is composed of large, thick-walled cells which develop to form ground tissue system, e g. hypodermis, cortex and pith.

IV. Classification based on plane of divisions:

The growth pattern and plane of division of meristematic tissue is important to govern the mode of growth, On this basis tissues can be classified into three types, namely: i) Mass meristem ii) Rib or file meristem and iii) Plate meristem

i. Mass meristem:

In this type of meristem, cell divisions occur in all planes resulting in an increase in volume. It can be observed in meristems of cortex and pith.

ii. Rib or file meristem:

The cells divide only on one plane e.g. formation of filaments in algae.

iii. Plate meristem:

These cells divide in two planes resulting to an increase in the area of an organ e g. Leaf formation.

7.2.2 Functions of Meristematic Tissue:

Meristems are actively dividing tissues of the plant, that are responsible for primary (elongation) and secondary (thickness) growth of the plant.

7.3 Permanent Tissues

Permanent tissues are those in which, growth has stopped either completely or for the time being. At times, they become meristematic partially or wholly. Permanent tissues are of two types namely (i) simple tissue and (ii) complex tissue.

7.4 Simple Tissues

Simple tissue are homogeneous -composed of structurally and functionally similar cells. eg., Parenchyma, Collenchyma and Sclerenchyma.

7.4.1 Parenchyma

Parenchyma are simple permanent tissue composed of living cells. Parenchyma cells are thin walled, oval, rounded or polygonal in shape with well developed spaces among them. In aquatic plants, Parenchyma possesses intercellular air spaces, and is named as Aerenchyma. When exposed to light, parenchyma cells may develop chloroplasts and are known as Chlorenchyma.

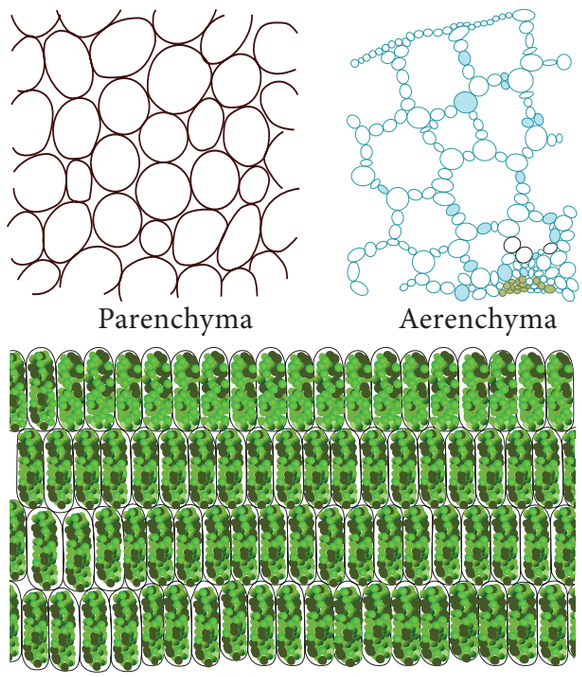


Figure 7.2 Types of Parenchyma

Functions:

Parenchyma may store water in many succulent and xerophytic plants. It also serves the functions of storage of food reserves, absorption, buoyancy, secretion etc.,

In potato, Parenchyma vacuoles are filled with starch. In Apple, parenchyma stores sugar

7.4.2 Collenchyma

Collenchyma is a living tissue found beneath the epidermis. Cells are elongated with unevenly thickened non-lignified walls. Cells have rectangular oblique or tapering ends and persistent protoplast. They possess thick primary non-lignified walls.

Functions:

They provide mechanical support for growing organs.

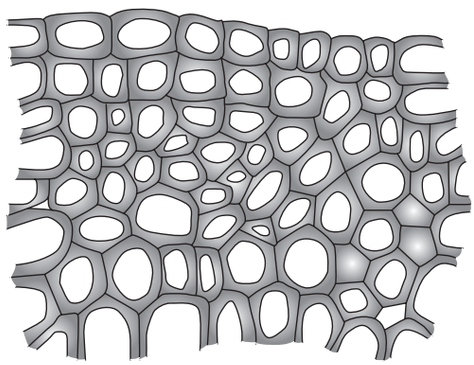


Figure 7.3 Collenchyma

7.4.3 Sclerenchyma

Sclerenchyma consists of thick walled cells which are often lignified. Sclerenchyma cells do not possess living protoplasts at maturity. Sclerenchyma cells are grouped into (i) fibres and (ii) sclereids.

Fibres are elongated sclerenchymatous cells, usually with pointed ends. Their walls

are lignified. Fibres are abundantly found in many plants. The average length of fibres is 1 to 3 mm, however in plants like *Linum usitatissimum* (flax), *Cannabis sativa* (hemp) and *Corchorus capsularis* (jute), fibres are extensively longer ranging from 20 mm to 550 mm.

Jute is used in making of rope and fabrics.

Sclereids

Sclereids are widely distributed in plant body. They are usually broad, may occur in single or in groups. Sclereids are isodiametric, with liginified walls. Pits are prominent and seen along the walls. Lumen is filled with wall materials. Sclereids are also common in fruits and seeds.

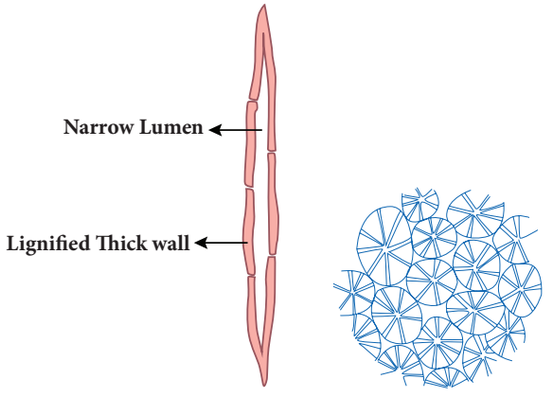


Figure 7.4 Sclerenchyma (a) Fibres, (b) Sclereids

Table 7.1 Differences between Parenchyma and Collenchyma

Parenchyma	Collenchyma
Cell wall is thin and uniform in thickness	It possesses well developed extra thickening at places adjacent to intercellular spaces
It serves as storage tissue.	It serves as mechanical tissue
It is found in outer and inner parts of plant organs	It is restricted to sub epidermal parts of plant organs.

Table 7.2 Differences between Collenchyma and Sclerenchyma

Collenchyma	Sclerenchyma
It consist of living cells	It consist of dead cells
Cells contain protoplasm	Cells are empty
Cell walls are made of cellulose	Cell walls are lignified
Thickening of cell wall is not uniform	Cell wall thickening is uniform
Lumen of the cell is wide	Lumen of the cell is narrow
Pits are simple straight	Pits are simple oblique sometimes branched
It provides mechanical support and elasticity to the plant body	It provides only mechanical support

Table 7.3 Differences between Sclereids and Fibres

Sclereids	Fibres
Usually broad	Elongated narrow thread like
End walls blunt	End walls tapering
Occur singly	Occur in bundles
Deep pits	Narrow pits

7.5 Complex tissues

Complex tissues are made of more than one type of cells that work together as a unit. Complex tissues consist of parenchyma and sclerenchyma cells. However, collenchymatous cells are not present in such tissues. Common examples are xylem and phloem.

Table 7.4 Differences between Meristematic tissue and Permanent tissue

Meristematic tissue	Permanent tissue
Component cells are small, spherical or polygonal and undifferentiated	Component cells are large, differentiated with different shapes
Cytoplasm is dense, and vacuoles are nearly absent	Usaually large central vacuole present in living permanent cells
Intercellular spaces absent	Intercellular spaces present
Cell wall thin and elastic	Cell wall thick
Nucleus is large and prominent	Nucleus is less conspicuous
Cells grow and divide regularly	Cells do not normally divide
Provides mechanical support and elasticity to the plant body	Provides only mechanical support

7.5.1 Xylem

Xylem is a conducting tissue which conducts water, mineral nutrients upward from root to leaves. Xylem is also meant for mechanical support to the plant body. Xylem is composed of different kinds of elements. They are (i) xylem tracheids (ii) xylem fibres (iii) xylem vessels and (iv) xylem parenchyma.

i. Xylem tracheids

They are elongated or tube-like dead cells with hard, thick and lignified walls. Their ends are tapering, blunt or chisel-like. These cells are devoid of protoplast. They have large lumen without any content. Their function is conduction of water and providing mechanical support to the plant.

ii. Xylem fibres

These cells are elongated, lignified and pointed at both the ends. Xylem fibres help in conduction of water and nutrients from root to the leaf and also provide mechanical support to the plant.

iii. Xylem vessels

They are long cylindrical, tube like structures with lignified walls and wide central lumen. These cells are dead as these do not have protoplast. They are arranged in longitudinal series in which the partitioned walls (transverse walls) are perforated, and so the entire structure looks-like a water pipe. Their main function is transport of water and minerals from root to leaf, and also to provide mechanical strength.

iv. Xylem parenchyma

Its cells are living and thin walled. The main function of xylem parenchyma is to store starch and fatty substances.

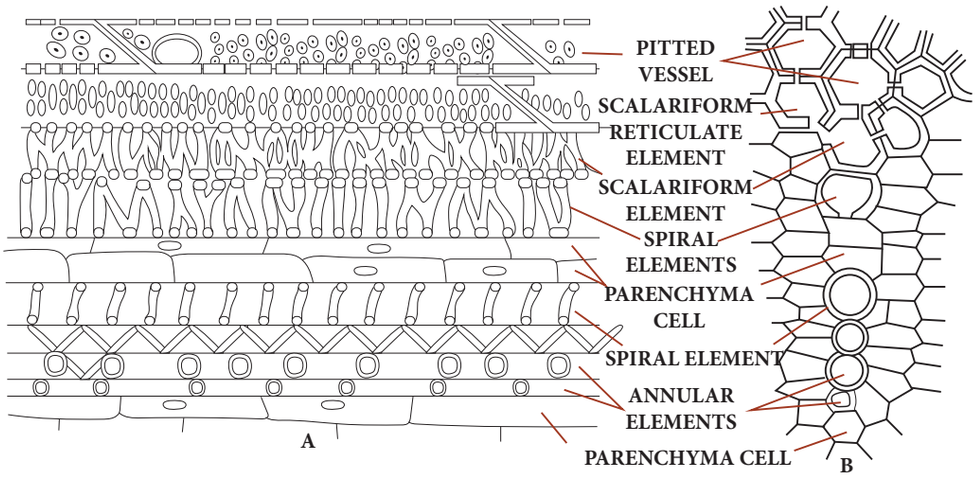


Figure 7.5 A. xylem longitudinal section B. xylem transverse section

7.5.2 Phloem

Phloem like xylem is a complex tissue and consists of the following elements.

(i) Sieve elements

(ii) Companion cells.

(iii) Phloem fibres

(iv) Phloem parenchyma

i. Sieve elements

The conducting elements of phloem are collectively called as Sieve elements. They may be segregated into less specialised sieve cells and more specialised sieve tube elements.

Sieve tubes are elongated, tube-like slender cells placed end to end. The transverse walls at the ends are perforated and are known as sieve plates. The main function of sieve tubes is translocation of food, from leaves to the storage organs of the plants.

ii. Companion cells

These are elongated cells attached to the lateral wall of the sieve tubes. A companion cell may be equal in length to the accompanying sieve tube element or the mother cell may be divided transversely forming a series of companion cells

iii. Phloem parenchyma

The phloem parenchyma are living cells which have cytoplasm and nucleus. Their function is to store food materials.

iv. Phloem fibers

Sclerenchymatous cells associated with primary and secondary phloem are commonly called phloem fibers. These cells are elongated, lignified and provide mechanical strength to the plant body.

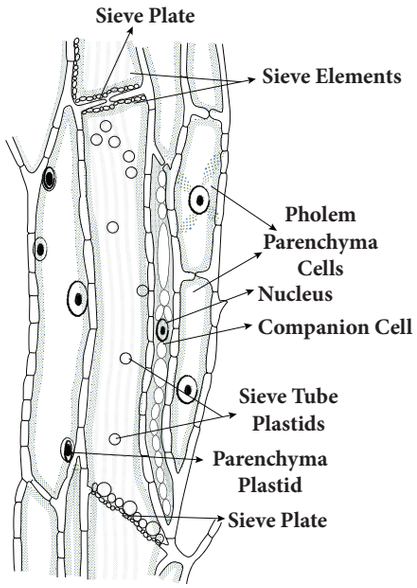


Figure 7.6 Longitudinal section of Phloem tissue

Activity 1

Take two glass jars and fill them with water. Now take two onion bulbs and place one in each jar as shown in figure given below:

i. Observe the growth of roots in both the bulbs for a few days.

ii. Measure the length of roots on day 1, 2 and 3

iii. On 3rd day cut the roots tips of the onion bulb in jar 2 by about 1 cm. After this observe the growth of roots in both the jars and measure their length each day for five more days and record the observations in tables like the table below.

	Length in mm				
	Day 1	Day 2	Day 3	Day 4	Day 5
Jar 1					
Jar 2					

From the above observation answer the following questions.

i. Which of the two onions has longer roots? Why?

ii. Do the roots continue growing even after we have removed their tip?

Activity 2

i. Take a plant stem and with the help of your teacher cut into very thin slices or sections.

ii. Now stain the slices with safranin. Place one neatly cut section on a slide and put a drop of glycerine.

iii. Cover with a cover slip and observe under a microscope. Observe the various types of cells and their arrangement.

Now answer the following on the basis of your observation.

i. Are all cells similar in structure?

ii. How many types of cells can be seen?

iii. Can we think of reasons why there would be so many types of cells.

We can also try to cut sections of plant roots. We can even try cutting sections of roots and stem of different plants.

Table 7.5 Differences between Tracheids and Vessels

Tracheids	Vessels
Formed from single cells	Made up of number of cells.
Ends are oblique and taper	ends are round and transverse.
Fraction of a cm in length	Several cms in length
Walls are thick, lumen-narrow	Walls are less thick, lumen- wide.

Table 7.6 Differences between Sieve cells and Sieve tubes

Sieve cells	Sieve tubes
Sieve cells have no companion cells	Sieve tubes always have companion cells
Sieve areas do not form sieve plates	Sieve areas are confined to Sieve plates
Cells are elongated and are unique long with tapering end walls	Cells consist of vertical cells placed one above the other forming long tubes connected at the walls by sieve pores
Sieve pores are smaller and numerous	Sieve pores are larger and fewer in number
Sieve cells are found in pteridophytes and gymnosperms	Sieve tubes are found in angiosperms

Table 7.7 Differences between Xylem and Phloem

Xylem	Phloem
Conducts water and minerals	Conducts organic solutes or food materials
Conduction is mostly unidirectional i.e., from roots to apical parts of the plant.	Conduction may be bidirectional from leaves to storage organs and growing parts or from storage organs to growing parts of plants.
Conducting channels are treacheids and vessels	Conducting channels are sieve tubes.
Component of xylem include Tracheid vessels, xylem parenchyma and xylem fibres.	Components are sieve elements, companion cells, phloem parenchyma and phloem fibres.

7.6 Animal Tissues

An assemblage of one or more types of specialized cells held together with extracellular material constitute the tissue. A group of cells that are similar in origin, form, structure and work together to perform a specific function is called a simple tissue, while a group of cells different in their structure and function but co-ordinate to perform a specific function is called a compound tissue. The study of cell is known as **Cytology** and tissues is known as **Histology**.

Animal tissues can be grouped into four basic types on the basis of their structure and functions.

a. Epithelial tissue.

b. Connective tissue

c. Muscular tissue

d. Nervous tissue

All these tissues originate in the embryonic stages from the three primary germ layers namely ectoderm, mesoderm and endoderm.

Discovery: Maher- 1819 coined the term Histology

Marie Francies Xavier Bichat – Anatomist and Pathologist – Father of Histology – distinguished 21 types of tissues from which the organs of human body are formed.

7.7 Epithelial Tissues

It is the simplest tissue. An epithelial tissue is composed of one or more layers of cells covering the external surface of the body and internal organs. The cells are arranged very close to each other with less extracellular material. Epithelial cells lie on a non-cellular basement membrane and contain a special form of matrix protein called collagen. The epithelial tissue generally lacks blood vessels. The epithelium is separated by the underlying connective tissue which provides it with nutrients. The skin and lining of buccal cavity, blood vessels, organs of the alimentary canal, digestive glands like the pancreas and liver, alveloli of lungs and kidney tubules are all made up of epithelial tissues.

Types of epithelial tissue

1. **Simple epithelium** is composed of single layer of cells resting on a basement membrane.
2. **Compound epithelium** are composed of several layers of cells. Only the cells of the deepest layer rest on the basement membrane.

Functions of epithelial tissues

i. The skin which forms the outer covering of the body is composed of epithelial cells.These cells protect the underlying cells from drying, injury and microbial infections.

ii. Inside the body, they are found lining the mouth and alimentary canal and give protection to the organs

iii. They help in absorption of water and nutrients

iv. They are involved in elimination of waste products

v. Some epithelial tissues perform secretory function. They secrete a variety of biochemical substances such as sweat, saliva, mucus and enzymes.

7.7.1 Simple Epithelium

It is formed of **single layer** of cells. It forms a lining for the body cavities and ducts. It is also found on the secretory and absorptive surfaces. On the basis of structural

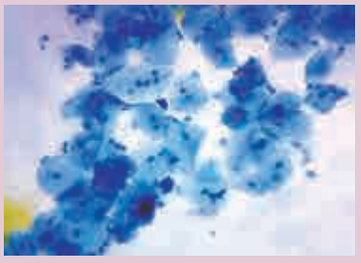
Activity 3

To identify an epithelial tissue

Given below are four steps for preparing a temporary mount of human cheek cell.

i. Rinse your mouth with water.

ii. Using a tooth pick or ice-cream stick, scrap superficial cells from inner side of the cheek and spread it on a clean glass slide.



iii. Dry the glass slide with the scrap cells taken from the inner side of cheek.

iv. Add two drops of methylene blue stain.

v. Identify the cells under low and high power of the microscope.

vi. Compare the cells observed under the microscope with the given picture. Name the type of epithelium.

modification of the cells, simple epithelium is further divided into following types.

(i) Squamous epithelium

(ii) Cuboidal epithelium

(iii) Columnar epithelium

(iv) Ciliated epithelium

(v) Glandular epithelium

DO YOU KNOW?

Epithelial tissue in the skin functions as a water-proof membrane

i. **Squamous Epithelium** is made up of thin, **flat** cells with prominent nuclei. These cells have irregular boundaries and bind with neighbouring cells. The squamous epithelium is also known as **pavement membrane**, which form delicate lining of the buccal cavity, alveoli of lungs, proximal tubule of kidneys, blood vessels and covering of the skin and tongue. It protects the body from mechanical injury, drying and invasion of germs. It also helps in filtration by forming a selectively permeable membrane surface.

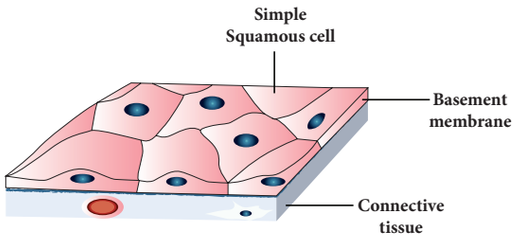


Figure 7.7 Squamous Epithelium

ii. **Cuboidal Epithelium** is composed of single layer of **cubical** cells. The nucleus is round and lies in the centre. This tissue is present in the thyroid vesicles, salivary glands, sweat glands and exocrine pancreas. It is also found in the intestine and tubular part of the nephron (kidney tubules) as microvilli that increase the absorptive surface area. Their main function is secretion and absorption.

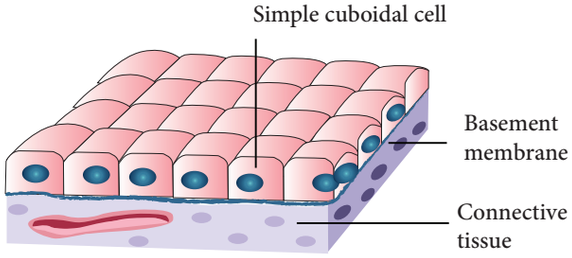


Figure 7.8 Cuboidal Epithelium

iii. **Columnar Epithelium** is composed of a single layer of **slender**, **elongated** and **pillar** like cells. Their nuclei are located at the base. It is found lining the stomach, gall bladder, bile duct, small intestine, colon, oviducts and also forms the mucous membrane. They are mainly involved in secretion and absorption.

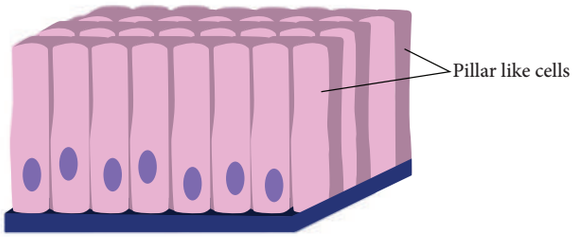


Figure 7.9 Columnar Epithelium

iv. **Ciliated Epithelium** Certain columnar cells bear numerous delicate hair like out growths called **cilia** and are called ciliated epithelium. Their function is to move particles or mucus in a specific direction over the epithelium. It is seen in the trachea of wind-pipe, bronchioles of respiratory tract, kidney tubules and fallopian tubes of oviducts.

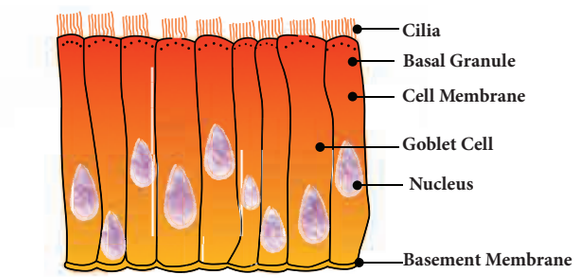


Figure 7.10 Ciliated Epithelium

v. **Glandular Epithelium** Epithelial cells are often modified to form **specialized gland** cells which secrete chemical substances at the epithelial surface. Sometimes a portion of the epithelial tissue folds inward to form a multicellular gland, which lines the gastric glands, pancreatic tubules and intestinal glands.

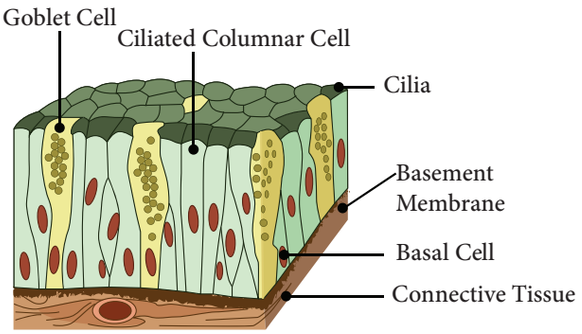


Figure 7.11 Glandular epithelium

7.7.2 Compound Epithelium

It consists of **more than one layer** of cells and gives a s**tratified appearance**. Hence , they are also known as stratified epithelial cells. Being multilayered, they have limited role in secretion and absorption. The main function of this epithelium is to give protection to the underlying tissues against mechanical and chemical stress. They also cover the dry surface of the skin, the moist surface of the buccal cavity and pharynx.

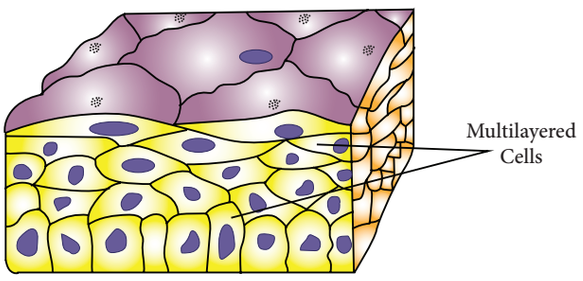


Figure 7.12 Compound Epithelium

7.8 Connective Tissue

It is one of the most abundant and widely distributed tissue. It provides **structural frame work** and gives **support** to different tissues forming organs. The components of the connective tissue are the intercellular substance known as the matrix, connective tissue cells and fibres. The matrix forms the main bulk of the connective tissue. The main function of the connective tissue is binding, supporting and packing together different organs of the body. It prevents the organs from getting displaced by body movements.

Connective tissue is classified as follows

i. Connective tissue proper (Areolar and Adipose tissue)
ii. Supportive connective tissue (Cartilage and Bone)
iii. Dense Connective tissue (Tendons and Ligaments)
iv. Fluid connective tissue (Blood and Lymph)

i. Connective tissue proper

Connective tissue proper consist of collagen fibres, elastin fibres and fibroblast cells.

a. Areolar tissue

It has cells and fibres loosely arranged in a semi fluid ground substance, matrix takes the form of fine threads crossing each other in every direction leaving small spaces called areolae. The matrix consists of collagen fibres, elastin fibres and fibroblast cells. It joins skin to muscles, fills space inside organs and is found around muscles, blood vessels and nerves. The matrix of this tissue plays an important role in diffusion of oxygen and nutrients from small blood vessels. It also helps in repair of tissues after injury and fixes skin to underlying muscles.

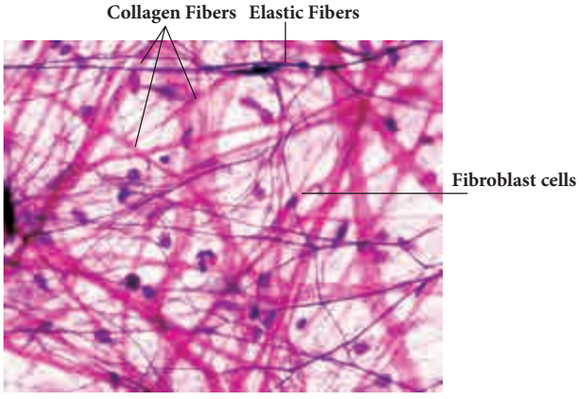


Figure 7.13 Areolar tissue

b. Adipose Tissue

Adipose tissue is the aggregation of **fat cells** or **adipocytes** and serves as fat reservoir. Each fat cell is a spherical or oval adipose cell and contains a large droplet of fat.

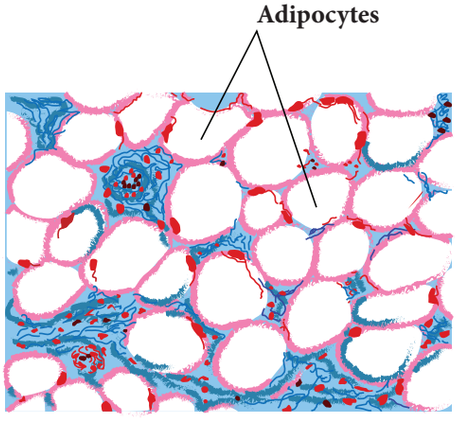


Figure 7.14 Adipose tissue

The fat cells are arranged into lobules separated by partitions of collagen and elastin fibres. They are found in subcutaneous tissue, between internal organs around the heart and kidneys. They keep the visceral organs in position and act as shock absorbers around the kidneys and eye balls. They also regulate the body temperature by acting as insulator.

DO YOU KNOW?

Number of fat cells in obese adults is about 60-100 billion while in non-obese adults is 30-50 billion.

ii. Supportive Connective Tissue

The supporting or skeletal connective tissues forms the endoskeleton of the vertebrate body. They support the body, protect various organs and help in locomotion. The supportive tissues include Cartilage and Bone.

a. Cartilage

They are soft, semi- rigid, flexible and are less vascular in nature. The matrix is composed of large cartilage cells called **chondrocytes**. These cells are present in fluid filled spaces known as **lacunae**.

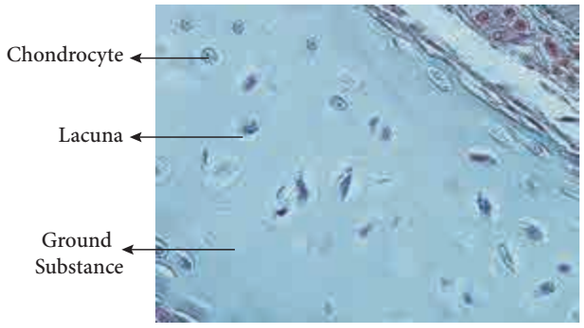


Figure 7.15a Cartilage

Cartilage is present in the tip of the nose, external ear, end of long bones, trachea and larynx. It smoothens the surface at joints. It provides support and flexibility to the body parts.

b. Bone

It is solid, rigid and strong, **non-flexible** skeletal connective tissue. The matrix of the bone is rich in calcium salts and collagen fibres which gives the bone its strength. The matrix of the bone is in the form of concentric rings called **lamellae**. The fluid filled spaces present between the lamellae are called lacunae in which are present the bone cells called **osteocytes** that communicate with each other by a network of fine canals called **canaliculi**. The hollow cavities of spaces are called marrow cavities filled with **bone marrow**. They provide shape and structural framework to the body. Bones support and protect soft tissues and organs.

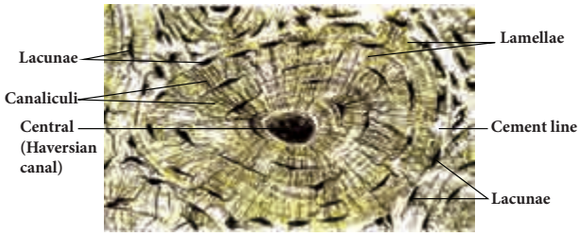


Figure 7.15b T.S of Bone

iii. Dense Connective Tissue

It is a fibrous connective tissue densely packed with fibres and fibroblasts. It is the principal component of tendons and ligaments.

a. Tendons

They are cord like, strong, structures that join skeletal muscles to bones. Tendons have great **strength** and **limited flexibility**. They consist of parallel bundles of collagen fibres, between which are present rows of fibroblasts.

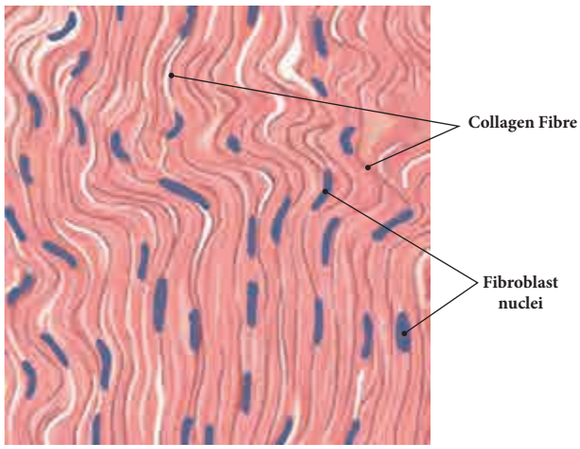


Figure 7.16 Tendon

b. Ligaments

They are **highly elastic** structures and have great strength which connect bones to bones. They contain very little matrix. They strengthen the joints and allow normal movement.

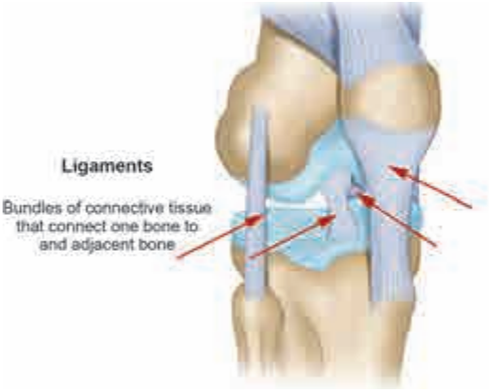


Figure 7.17 Ligament

DO YOU KNOW?

Protein fibres of matrix are made up of Yellow fibres of elastin and White fibres of collagen

Nano fibres - Sharpey's fibres are minute fibres of tendon which enter into peristomium of bone. Aponeurosis is similar to tendon but fibres are interwoven and thinner.

Sprain is caused by excessive pulling (stretching) of ligaments.

iv. Fluid connective tissue

The blood and the lymph are the fluid connective tissues which link different parts of the body. The cells of the connective tissue are loosely spaced and are embedded in an intercellular matrix.

a. Blood

Blood contains corpuscles which are red blood cells (**erythrocytes**), white blood cells (**leucocytes**) and **platelets**. In this fluid connective tissue, the blood cells move in a fluid matrix called plasma. The plasma contains inorganic salts and organic substances. It is a main circulating fluid that helps in the transport of substances.

BQ7QQ8

Red blood corpuscles (Erythrocytes)

The red blood corpuscles are oval shaped, circular, biconcave disc-like and **lack nucleus** when mature (mammalian RBC). They contain a respiratory pigment called **haemoglobin** which is involved in the transport of oxygen to tissues.

White blood corpuscles (Leucocytes)

They are larger in size, contain **distinct nucleus** and are **colourless**. They are capable of amoeboid movement and play an important role in body's defense mechanism. WBC's are of two types

i. Granulocytes (with granules in the cytoplasm)

ii. Agranulocytes (without granules in the cytoplasm).

Granulocytes have irregular shaped nuclei and cytoplasmic granules. They include the **neutrophils**, **basophils** and **eosinophils**. **Agranulocytes** lack cytoplasmic granules and include the **lymphocytes** which have a spherical nucleus and the **monocytes** which have a large nucleus indented on one side. They engulf or destroy foreign bodies and neutralise their harmful effects.

Blood platelets

They are minute, anucleated, fragile fragments of giant bone marrow called **mega karyocytes**. They play an important role in **blood clotting** mechanism.

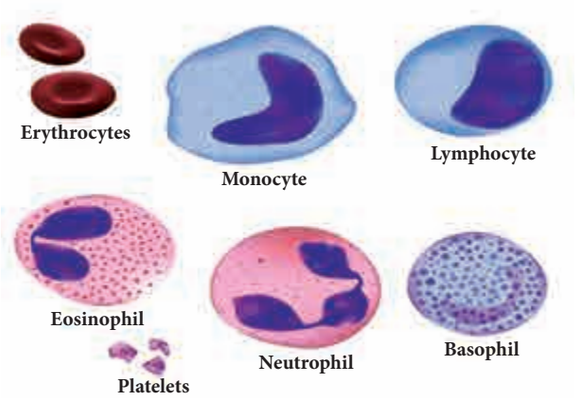


Figure 7.18 Blood cells

b. Lymph

Lymph is a colourless fluid filtered out of the blood capillaries. It consists of plasma and white blood cells. It mainly helps in the exchange of materials between blood and tissue fluids.

7.9 Muscular Tissue

Muscular tissues are made of muscle cells and form the major part of contractile tissue. The muscle cells are elongated, large sized and are composed of numerous **myofibrils**. Each muscle is made up of many long cylindrical fibres arranged parallel to one another. The movement of the body and limbs are brought about by the contraction and relaxation of **contractile proteins** present in muscle cells. According to their structure, location and functions, there are three main types of muscles

a. Skeletal muscle (or) striated muscle
b. Smooth muscle (or) non-striated muscle
c. Cardiac muscle

a.Skeletal muscle: These muscles are attached to the bones and are responsible for the body movements and are called skeletal muscles. They work under our control and are also known as **voluntary muscles**. The muscle fibres are elongated, non-tapering, cylindrical, unbranched and showing alternating dark and light bands, giving them the **striped** or **striated** appearance. These cells possess many nuclei (**multinucleate**). They occur in the muscles of limbs (biceps and triceps of arms).They undergo rapid contraction.

b.Smooth muscle: These muscles are spindle shaped with broad middle part and tapering ends. There is a single centrally located nucleus (**uninucleate**). These fibrils do not bear any stripes or striations and hence are called **non-striated**. They are not under the control of our will and so are called **involuntary muscles**. The walls of the internal organs such as the blood vessels, gastric glands, intestinal villi and urinary bladder contain this type of smooth muscle. Movement of food in the alimentary canal or the contraction and relaxation of blood vessels are involuntary movements.

c.Cardiac muscle: It is a contractile tissue present in the heart. The muscle fibres are **cylindrical**, **branched** and **uninucleate**. The branches join to form a network called as **intercalated disc** which are unique distinguishing features of the cardiac muscles. The intercellular spaces of the cardiac muscle are filled with loose connective tissue supplied with blood capillaries. The contraction of cardiac muscle is involuntary and rhythmic.

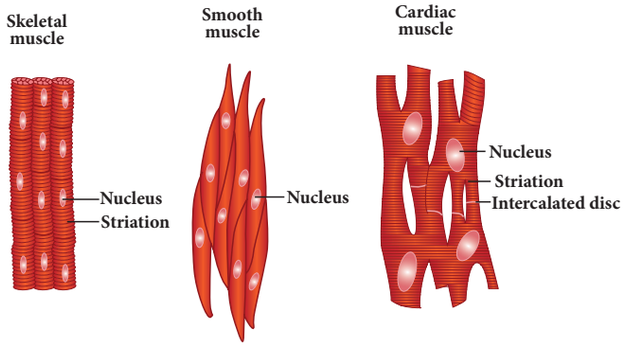


Figure 7.19 Muscle tissue

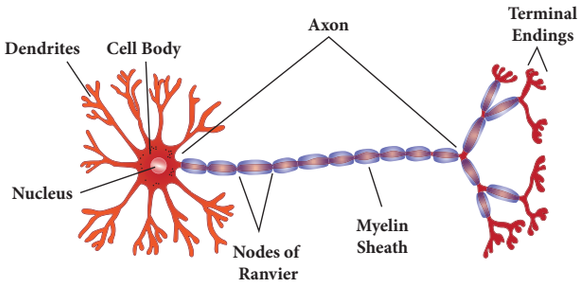


Figure 7.20 Neuron

Activity 4

Observe the picture and compare the structure of different types of muscle tissue. Identify their shape, number of nuclei and position of nuclei within the cell.

7.10 Nervous Tissue

Nervous tissue comprises of the nerve cells or neurons. They are the longest cells of the body. **Neurons** are the structural and functional units of the nervous tissue. The elongated and slender processes of the neurons are the nerve fibres. Each neuron consists of a **cell body** or **cyton** with nucleus and cytoplasm. The **dendrons** are short and highly branched protoplasmic processes of cyton. The **axon** is a single, long fibre like process that develops from the cyton and end up with fine terminal branches.

They have the ability to receive stimuli from within or outside the body and send signals to different parts of the body. Many nerve fibres are bound together by the connective tissue.

7.11 Cell division

Are you aware that all living organisms start their life from a single cell? You may wonder how a single cell then goes to form such a large organism. All cells reproduce by division, the division of cells into daughter cells is called cell division.

The growth and the development of every living organism depends on cell division. In 1846, Nageli pointed out that new cells are formed from the existing cells by division.

DO YOU KNOW?

Nerve cells do not undergo cell division due to the absence of centrioles, but they are developed from glial cells by neurogenesis

Microglia are modified neuroglial cells which are phagocytic in nature and found throughout the brain and spinal cord. These are also known as astroglea or oligodendroglea.

7.12 Types of Cell Division

The three types of cell division that occur in animal cells are

1. Amitosis - Direct Division
2. Mitosis - Indirect Division
3. Meiosis - Reduction Division

7.12.1 Amitosis

It is the simplest mode of cell division and occurs in unicellular animals, aging cells and in foetal membranes. During amitosis, nucleus elongates first, and a constriction appears in it which deepens and divides the nucleus into two, followed by this cytoplasm divides resulting in the formation of two daughter cells.

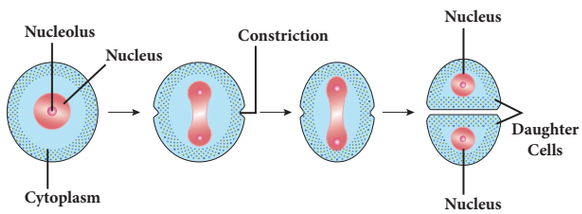


Figure 7.21 Amitosis

7.12.2 Mitosis

It was first discovered by Fleming in 1879. In this cell division one parent cell divides into two identical daughter cells, each with a nucleus having the same amount of DNA, same number of chromosomes and genes as the parent cells. It is also called as **equational division**.

Process of Mitosis

Mitosis consists of two events, they are

1. Karyokinesis
2. Cytokinesis

Interphase is the **resting phase** of the nucleus. It is the interval between two successive cell divisions. During this phase the cell prepares itself for the next division by synthesizing the substances essential for next cell division.

Karyokinesis

The division of the nucleus into two daughter nuclei is called Karyokinesis. It consists of four phases. They are:

a. Prophase
b. Metaphase
c. Anaphase
d. Telophase
e. Cytokinesis

a. Prophase (pro-first)

During this stage chromosomes become short and thick and are clearly visible inside the nucleus. Centrosome splits into two daughter centrioles, they move apart and occupy opposite poles of the cell. Each centriole is surrounded by radiating rays, termed as aster rays. Spindle fibres appear between the two centrioles. Nuclear membrane and nucleolus disappear gradually.

b. Metaphase (meta – after)

The duplicated chromosomes arrange on the equatorial plane and form the metaphase plate. Each chromosome gets attached to a spindle fibre by its centromere which is known as the chromosomal fibre. The centromere of each chromosome divides into two, each being associated with a chromatid.

c. Anaphase (ana – up, back)

The centromeres attaching the two chromatids divide and the two daughter chromatids of each chromosome separate and migrate towards the two opposite poles. The migration of the daughter chromosomes is achieved by the contraction of spindle fibres.

d. Telophase (tele – end)

Each chromatid (or) daughter chromosome lengthens, becomes thinner and turns into a network of chromatin threads. Spindle fibres breakdown and disappear. Nuclear membrane and nucleolus reappear in each daughter nucleus.

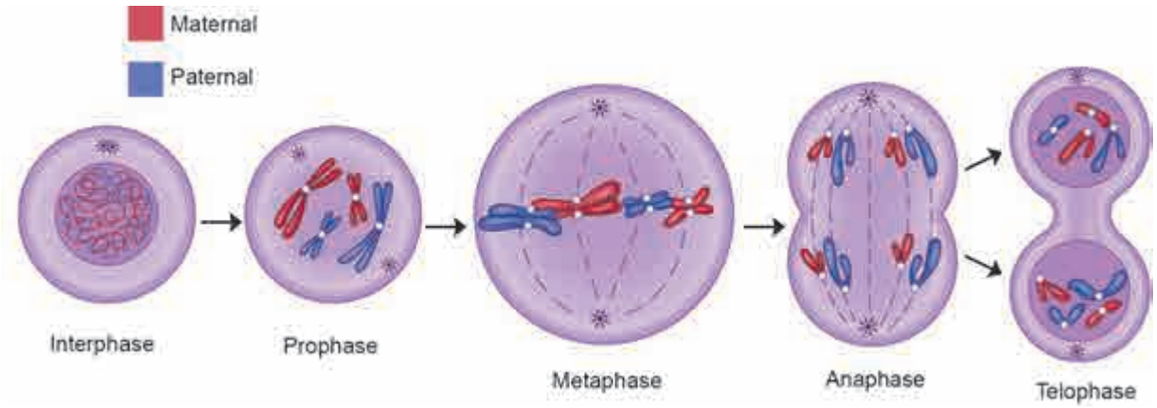


Figure 7.22 Events of Mitosis

e. Cytokinesis

The division of the cytoplasm into two daughter cells is called cytokinesis. A constriction appears in the middle of the cell membrane, which deepens and finally divides the cytoplasm into two, thus producing two new daughter cells from a parent cell.

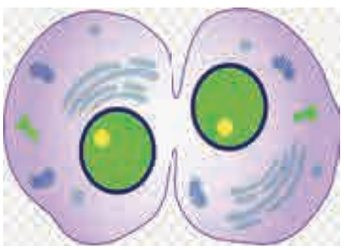


Figure 7.23 Cytokinesis

Significance of Mitosis

1. This equational division results in the production of diploid daughter cells with equal distribution of genetic material (DNA). It maintains the diploid (2n) number of chromosomes in daughter cells.
2. In multicellular organisms growth, organ development and increase in body size are accomplished through the process of mitosis
3. Mitosis helps in repair of damaged and wounded tissues by renewal of the lost cells.
4. It is involved in replacement of old and dead cells.

INFO BIT

Age of our body cells

- Cells of the eye lens, nerve cells of cerebral cortex and most muscle cells last a life time but once dead are not replaced.
- Epithelial cells lining the gut last only about 5 days.
- Average life of other gut cells is about 15 years.

Duration of cell replacement

- Skin cells- about every 2 weeks.
- Bone cells- about every 10 years.
- Liver cells- about every 300 – 500 days.
- Red blood cells last for about 120 days and are replaced.

7.12.3 Meiosis

The term meiosis was coined by Farmer in 1905. It is the kind of cell division that produces the sex cells or the gametes. It is also called reduction division because the chromosome number is reduced to haploid (n) from diploid (2n). Meiosis produces four daughter cells from a parent cell.

Meiosis consists of two divisions. They are,

A. **Heterotypic Division** or First Meiotic Division

B. **Homotypic Division** or Second Meiotic Division

A. Heterotypic division

It divides the diploid cell into two haploid cells. The daughter cells resulting from this division are different from the parent cell in the chromosome number (Heterotypic). This consists of 5 stages.

a. Prophase I

b. Metaphase I

c. Anaphase I

d. Telophase I

e. Cytokinesis I

a. Prophase I

Prophase I takes a longer duration and is sub divided into five stages.

1. Leptotene
2. Zygotene
3. Pachytene
4. Diplotene
5. Diakinesis

Leptotene

The chromosomes become uncoiled and assume long thread like structures and take up a specific orientation inside the nucleus. They form a **bouquet stage**.

Zygotene (Zygon-adjoining)

Two homologous chromosomes approach each other and begin to pair. Pairing of homologous chromosomes is called as **synapsis**.

Pachytene (Pachus-thick)

The chromosomes are visible as long paired twisted threads. The pairs so formed are called **bivalents**. Each bivalent now contains four chromatids (**tetrad stage**). Homologous chromosomes of each pair begin to separate, they do not completely separate, but remain attached together at one or more points by X- shaped arrangements known as **chiasmata**. The chromatids break at these points, broken segments maybe interchanged (crossing over). As a result, the **genetic recombination** takes place.

Diplotene

Each individual chromosome of each bivalent begins to split longitudinally into two similar chromatids. The homologous chromosomes repel each other and separate. Chiasmata begin to move along the length of the chromosome from the centromere towards the end resulting in **terminalization**.

Diakinesis

The paired chromosomes are shortened and thickened. The nuclear membrane and nucleolus begin to disappear. Spindle fibres make their appearance.

b. Metaphase I

The chromosomes move towards the equator and finally they orient themselves on the equator. The two chromatids of each chromosome do not separate as in Mitosis. The centromere does not divide.

c. Anaphase I

Each homologous chromosome with its two chromatids and undivided centromere move towards the opposite poles of the cell. This stage of the chromosome is called Diad.

d. Telophase I

The haploid number of chromosomes after reaching their respective poles become uncoiled and elongated. The nuclear membrane and the nucleolus reappear and thus two daughter nuclei are formed.

e. Cytokinesis I

The cytoplasmic division occurs and two haploid cells are formed.

B. Homotypic Division

In this division, the two haploid cells formed during first meiotic division divide into four haploid cells. The daughter cells are similar to parent cell in the chromosome number (Homotypic). It consists of five stages.

a. Prophase – II
b. Metaphase – II
c. Anaphase – II
d. Telophase – II
e. Cytokinesis – II

a. Prophase II

The centriole divides into two, each one moves to opposite poles. Asters and spindle fibres appear. Nuclear membrane and nucleolus disappear.

b. Metaphase – II

The chromosomes get arranged on the equator. Two chromatids are separated.

c. Anaphase - II

The separated chromatids become daughter chromosomes and move to opposite poles due to the contraction of the spindle fibres.

d. Telophase – II

The daughter chromosomes are centered. The nuclear membrane and the nucleolus appear.

e. Cytokinesis – II

It occurs after nuclear division and two cells are formed from each haploid daughter cell, resulting in the formation of four cells with haploid number of chromosomes.

Significance of Meiosis

i. The constant number of chromosomes in a given species is maintained by meiotic division.
ii. Crossing over causes genetic variations among the species from one generation to the next.

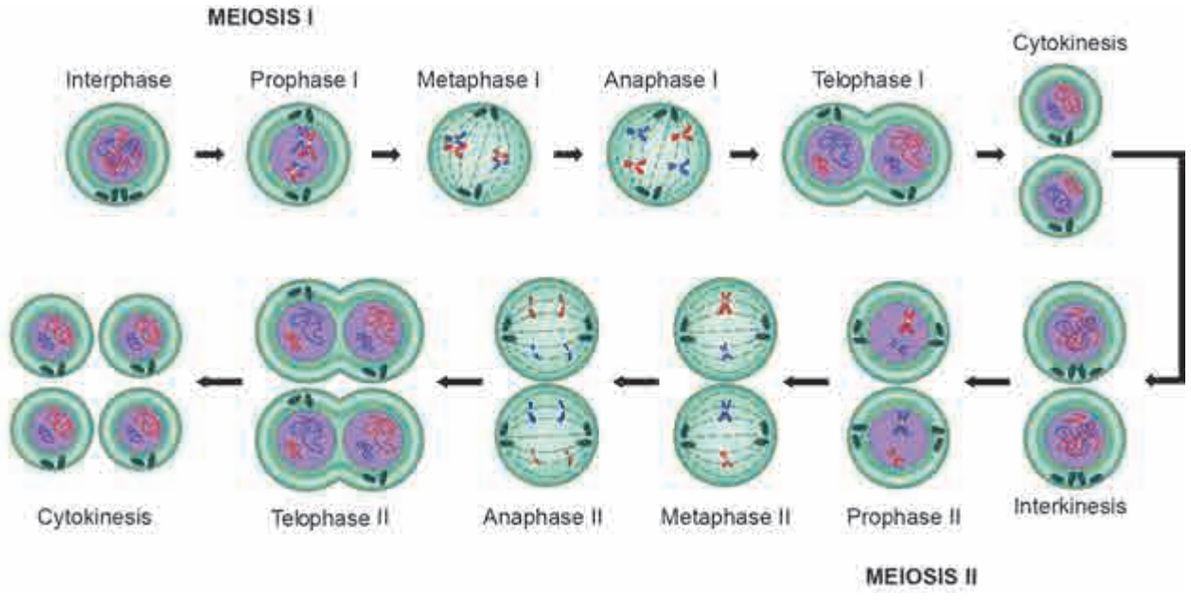


Figure 7.24 Events of Meiosis

Table 7.8 Differences between Mitosis and Meiosis

Mitosis	Meiosis
Occurs in somatic cells.	Occurs in reproductive cells
Involved in growth and occurs continuously throughout life.	Involved in gamete formation only during the reproductively active age.
Consists of single division	Consists of two divisions
Two diploid daughter cells are formed.	Four haploid daughter cells are formed.
The chromosome number in the daughter cell is similar to the parent cell (2n).	The chromosome number in the daughter cell is just half (n) of the parent cell.
Identical daughter cells are formed	Daughter cells are not similar to the parent cell and are randomly assorted.

Info bit

STEM CELLS

They are undifferentiated cells which undergo unlimited divisions and give rise to one or more different types of cells. Embryonic stem cells differentiate into different tissues and organs.

Stem cells are used in the treatment of certain degenerative diseases

In present days umblical cord blood is collected at the time of child birth and is being stored in stem cell banks to treat any diseases in the future

Activity 5

Search atleast 10 words related to the chapter

	Y	B	B	T	I	S	S	U	E		
E	E	M	O	S	X	Y	L	E	M		
G	S	E	N	E	L	C	S	U	M		
A	S	R	E	E	V	A	Z	H	A		
L	L	I	N	T	E	R	C	A	L	A	R	Y
I	E	S	A	D	I	P	O	S	E	A		
T	V	T	H	L	A	T	E	R	A	L		
R	E	E	N	E	U	R	O	N	A			
A	Y	M	C	A	M	B	L	U	M			
C	E	A	S	L	E	R	E	L	F	S		

Points to Remember

- Group of cells positioned and designed to perform particular function is called a tissue. An organ is a structure made up of a collection of tissues that carry out specialized functions
- Plants are made up of vegetative tissues and reproductive tissues. In general plant tissues are classified into two types namely Meristems or Meristematic tissues and Permanent tissues
- Meristems are actively dividing tissues of the plant, that are responsible for primary (elongation) and secondary (thickness) growth of the plant.
- Permanent tissues are of two types simple tissue and complex tissue. Simple tissue are homogeneous -composed of structurally and functionally similar cells. eg., Parenchyma, Collenchyma and Sclerenchyma
- Complex tissues are made of more than one type of cells that work together as a unit, they are Xylem and Phloem
- Animal tissues can be grouped into four basic types on the basis of their structure and functions. Epithelial tissue, Connective tissue, Muscular tissue, Nervous tissue.
- Simple epithelium is formed of single layer of cells is divided into following types. They are squamous epithelium cuboidal epithelium, columnar epithelium, ciliated epithelium and glandular epithelium
- Compound Epithelium consists of more than one layer of cells and gives a stratified appearance.
- The components of the connective tissue are the intercellular substance known as the matrix, connective tissue cells and fibres. They comprise areolar, adipose tissue, cartilage. bone, tendons, ligaments, blood and lymph
- The muscular tissues are made of muscle cells and form the major part of contractile tissue. Nervous tissue comprises of the nerve cells or neurons
- The three types of cell division that occur in animal cells are Amitosis (Direct division), Mitosis (Indirect division) and Meiosis (Reduction division)

A-Z GLOSSARY

Aerenchyma	Cortex of submerged roots of certain swamp plants aerating cortical tissue in floating portions of some aquatic plants.
Areolar tissue	It is a loose connective tissue made up of white fibres (made of collagen) and yellow fibres (made of elastin)
Bivalent	A pair of homologous chromosomes before their duplication in meiosis. It is also called diad
Blood	A red coloured fluid connective tissue consisting of plasma and blood cells (erythrocytes, leucocytes and platelets)
Cartilage	A non-porous connective tissue
Centromere	A particular structure in between chromosomal arms of chromosomes to which microtubules of the mitotic and meiotic spindle are attached. It is called kinetochore or primary constriction.
Chiasma	The point of contact and interchange between chromatids of two homologous chromosomes.
Chromatids	One of the two identical longitudinal halves of a chromosome which share a common centromere with a sister chromatid
Chromosome	They are elongated rod like structures formed during nuclear division. They represent the physical sites of nuclear genes which are arranged in linear order. Each species has a characteristic number of chromosome.
Collenchyma	Parenchymatous peripheral supporting tissue with cells more or less elongated and thickened either at the angles or on walls adjoining intercellular spaces or tangentially.
Companion cell	A narrow cell retaining its nucleus derived from a cell giving rise to sieve tube element in phloem of angiosperms.
Connective Tissue	Serves to 'connect' or 'bind' the cells of other tissues in the body and give them rigidity and support.
Crossing over	Process in which genes are exchanged between non-sister chromatids of homologous chromosomes
Diploid	An individual or cell having two complete sets of chromosomes
Fibroblasts	Cells of the connective tissue. They form ground substance and fibres
Haploid	An individual or cell having a single complete set of chromosome.

Histology	The branch of biology that deals with the study of tissues (Histo:Tissues. Logos, Study)
Homologous chromosome	Chromosomes occurring in pairs one derived from each of the two parents. Each member of such a pair is the homolog of the other.
Intercalary meristem	Situated between regions of permanent tissue at base of nodes and leaves in many monocotyledons.
Interphase	It is the longest resting phase of the cell between two cell divisions
Isodiametric	Having equal diameter of cells or other structures.
Ligament	Consists of yellow fibres and connect one bone to another bone.
Lymph	Fluid connective tissue consisting of plasma and mainly white blood cells.
Meristem tissue	Formed of cells all capable of diversification as found at growing points meristematic tissue
Neuron	Structural and functional unit of nerve cell. It comprises the cell body or cyton, dendrites, dendron and the axon.
Osteocytes	Bone cells present between the lamellae in fluid filled spaces called lacunae.
Parenchyma	Generally soft and thin walled relatively undifferentiated cells which may vary in structure and function as pith or mesophyll
Phloem parenchyma	Thin walled parenchyma associated with sieve tube of phloem
Sclerenchyma	Plant tissue of thickened end of the hard cells or vessels
Synapsis	Pairing of homologous chromosomes occurring in prophase -I of meiosis
Tendon	Made up of white fibres and connects muscle to bones
Tetrad	Four haploid cells arising from meiosis formed from four associated chromatids during synapsis.
Xylem woody tissue	Lignified portion of vascular bundle

ICT CORNER

Tissues and organs

Explore this activity to know about the various types of tissues.

Step 1: Copy and paste the link given below or type the URL in the browser. Allow 'Adobe Flash Player' to run in the system.

Step 2: Then choose an organ from the list to know about the tissues that are in a particular organ.

Step 3: Keep selecting the tissues by clicking the 'Use this' option, if you need that particular tissue for that organ.

Step 4: Once you finish selecting the tissues you will find a pop-up called 'Happy with this choice.' Click on it to know whether your choice is correct or you should try again. In this way you can build different organs.

Step1

Step2

Step3

Step4

Browse in the link:

URL: https://www.centreofthecell.org/learn-play/games/build-an-organ/

B467_SCI_9_T2_EM

TEXT BOOK EXERCISES

BQBDE5

Section A

Ia. Match the following

1.	Sclereids	Chlorenchyma
2.	Chloroplast	Sclerenchyma
3.	Simple tissue	Collenchyma
4.	Companion cell	Xylem
5.	Trachieds	Phloem

Ib. Match the contents of Column I, II and III

Column I	Column II	Column III
Columnar Epithelium	Absorption	Anchoring of muscle
Bones	Axon	Dendrites
Neurons	Body framework	Secretion
Areolar Tissue	Ground substance	Ciliated
Tongue	Trachea	Fibroblasts
Epithelium	Striated muscle	Visceral tissue

II. Choose the correct answer.

1. A meristematic tissue consists of
   a. Immature cells which are in a state of division and growth
   b. Mature cells
   c. Non-living cells
   d. Sclerenchyma cells
2. The tissue composed of living thin walled polyhedral cell is
   a. Parenchyma b. Collenchyma
   c. Sclerenchyma d. None of above
3. The fibres consists of
   a. Parenchyma b. Sclerenchyma
   c. Collenchyma d. None of above
4. Chlorenchyma is known to develop in the
   a. cytoplasm of chlorella
   b. mycelium of a green mould such as aspergillus
   c. spore capsule of moss
   d. pollen tube of pinus.
5. Companion cells are closely associated with
   a. sieve elements. b. vessel elements
   c. Trichomes d. guard cells.
6. Which of the following is a complex tissue.
   a. parenchyma b. collenchyma
   c. xylem d. sclerenchyma
7. Aerenchyma is found in
   a. Epiphytes b. hydrophytes
   c. halophytes d. xerophytes
8. Two long bones of the hand are dislocated in a person met who with an accident . Which among the following may be the possible reason.
   a. Tendon injury
   b. Break of skeletal muscle
   c. Ligament tear
   d. Rupture of Areolar tissue
9. Unstraited muscles are found in
   a. Blood vessels
   b. Gastrointestinal tract
   c. Urinary bladder
   d. All of these
10. Which of the following is not found in a neuron?
    a. Sarcolemma b. Dendrite
    c. Neurolemma d. Axon

11. Long, unbranched multinucleated cells are
    a. Striated muscle cells
    b. Smooth muscles
    c. Cardiac muscles
    d. None of the above.

12. White fibres of connective tissue are made up of
    a. Elastin b. Reticular fibres
    c. Collagen d. Myosin

13. Brush bordered epithelium is found in
    a. Stomach b. Small intestine
    c. Fallopian tube d. Trachea

14. Smooth muscles occur in
    a. Uterus b Artery
    c. vein d. All of the above.

15. Which muscles act involuntary?
    (i) Striated muscles
    (ii) Smooth muscles
    (iii) Cardiac muscles
    (iv) Skeletal muscles
    a. (i) and (ii) b. (ii) and (iii)
    c. (iii) and (iv) d. (i) and (iv)

16. Nerve cell does not contains
    a. Axon b. Nerve endings
    c. Tendons d. Dendrites

17. Tendon connects
    a. Cartilage with muscles
    b. Bone with muscles
    c. Ligament with muscles
    d. Bone with bone.

18. In a certain type of cell division the diploid number of chromosome is reduced to half. This kind of division occurs in
    a. Testis
    b. Ovary
    c. Both ovary and testis
    d. All body cells.

III. Fill in the blanks

1. The _____ tissues are made up of more than one type of cells and these wok together as a unit.
2. _____ tissues provides mechanical support to organs.
3. Parenchyma, collenchyma, Sclerenchyma are _____ type of tissue.
4. _____ and _____ are complex tissues.
5. Epithelial cells with cilia are found in _____ of our body.
6. Lining of small intestine is made up of _____.
7. The two types of skeletal connective tissues are _____ and _____.
8. Humans have 46 chromosomes. Their sperms and eggs will have _____ chromosomes each.
9. During pairing of chromosomes in meiosis,the _____ chromosomes come to lie side by side.

IV.State whether True or false. If false, write the correct statement

1. Epithelial tissue is protective tissue in animal body.
2. Epithelial layer does not allow regulation of materials between body and external environment.
3. Bone and cartilage are two types of areolar connective tissue.
4. Striated and non- striated tissues are types of epithelial tissues.
5. As growth occurs in an individual the skin cells divide only to replace such cells that are lost from the surface.
6. Parenchyma is a simple tissue.

7. Phloem is made up of Tracheids.
8. Vessels are found in collenchymas.

Section B

1. Very short answer questions

1. Give two types of Sclerenchyma.
2. Name the components of xylem and phloem.
3. Name the tissue that connects muscle to bone in humans.
4. Name tissue that stores fat in our body.
5. Name the connective tissue with a fluid matrix.
6. Name the tissue present in the brain.

II. Short answer Questions

1. What are intercalary meristems? How do they differ from other meristems?
2. How would you differentiate between meristematic and permanent tissue?
3. What is complex tissue? Name the various kinds of complex tissues.
4. Differentiate fibres from sclereids.
5. Mention the most abundant muscular tissue found in our body.State its function
6. Which tissue is the main component of tendons and ligaments? How do they differ in function?
7. What are the fibres present in the matrix of loose connective tissue ?
8. How are collagen fibres organized in dense connective tissues
9. What is skeletal connective tissue? How is it helpful in the functioning of our body?
10. Which tissue is called middleman between tissue cells and blood? Why?
11. Why should gametes be produced by meiosis during sexual reproduction?
12. In which stage of mitosis the chromosomes align in an equatorial plate? How?
13. Write one point of difference between
    a) Bone and cartilage
    b) Simple and compound epithelial tissue.
14. Why is blood considered to be a connective tissue?
15. Give the sequence of the events occurring during prophase of mitosis.
16. Why is meiosis called reductional division and mitosis as equational division?

III. Long Answer Questions :

1. What are permanent tissues? Describe the different types of simple permanent tissue.
2. What are meristems? Describe the distribution and functions of various types of meristems.
3. Write about the elements of Xylem
4. List out the differences between mitosis and meiosis.
5. Give one reason for the following
    a. Blood is fluid connective tissue
    b. Skeletal muscles contain contractile proteins
    c. Heart muscles are involuntary in nature

Section C

I. Assertion and Reason

Direction : In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of statements, given below, mark the correct answer as

a. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

b. If both Assertion and Reason are true that Reason is not the correct explanation of Asssertion.

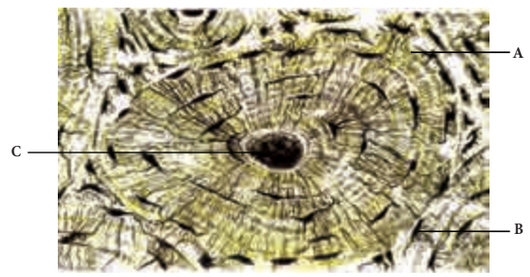
c. If Assertion is true but Reason is false.

d. If both Assertion and Reason are false

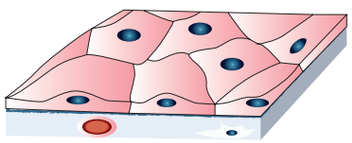
1. Assertion: Non-striated muscles are said to be voluntary in nature.
   Reason: Non-striated muscles are under the control of our will.
2. Assertion: Materials are exchanged between epithelial and connective tissues by diffusion.
   Reason: Blood vessels are absent in epithelial tissue.

II. Value Based Questions - Thinking Skills

1. What is the consequence that occur if all blood platelets are removed from the blood?
2. Which are not true cells in the blood? Why?
3. Identify the figure given below



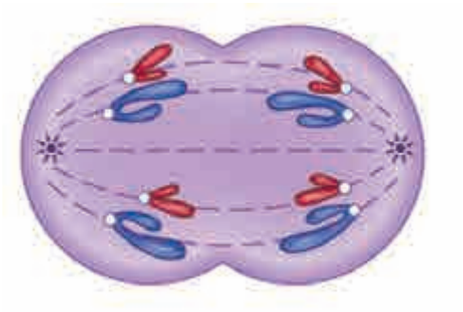
   (a) Label the parts a, b and c
   (b) What is the chemical composition of the tissue?
   (c) What is the function of c?
4. Identify figures A and B



A

B

   a. _____ epithelium forms the outer lining of the buccal cavity.
   b. _____ epithelium consist of cells that are tall and pillar-like.
   c. Which one allows diffusion of substances?
   d. Which is called pavement epithelium?
   e. Which epithelium lines the gastrointestinal tract and epiglottis?
5. If cell (A) has undergone one mitotic division and another cell (B) has completed its meiotic division. The number of cells produced in A and B would be
   Cell A : **Cell B :**
6. Identify the stage of mitosis from the following picture given below . List the chromosomal events in this stage.



7. Identify the following relationship

Cuboidal	:	Epithelial
Cardiac	:	_____
Granulocytes	:	_____
Osteocytes	:	_____

8. You are now familiarised with various plant and animal tissues. Point out any five differences between these tissues.

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