

PUC I YEAR SEMESTER-II
UNIT–IV. INTERNAL ORGANIZATION IN PLANTS
Module 18 : SIMPLE TISSUES

AN INTRODUCTION TO PLANT TISSUES

The plant parts and their modifications are discussed in earlier modules. Regardless of their form, each organ is composed of different types of **tissues**. Tissue is a group of cells have a common origin and perform a common function. The group of cells may be alike or different.

TYPES OF TISSUES

The tissues can be classified according to their structure, origin or function into two main groups: 1. **Meristematic** tissue or **meristems**, 2. **Permanent tissue**. This broad classification is based on the ability of cells to divide further or not.

MERISTEMATIC TISSUE

The plants have permanent region of growth called **meristems** or **meristematic** tissues which is absent in animals. It is an undifferentiated tissue from which new cells are formed. The group of cells of meristematic tissue is always in a state of division and persists from **embryonic stage**. Differentiated plant cells generally cannot divide or produce cells of a different type.

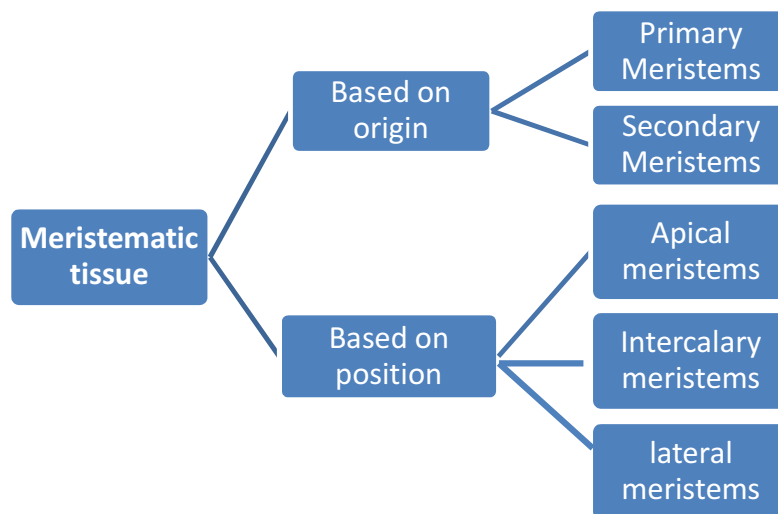
Therefore, cell division in the meristems is required to provide new cells for expansion and differentiation of tissues and initiation of new organs, providing the basic structure of the plant body.

Meristematic tissues are composed of cells which have capacity to divide and to grow. The permanent tissues are composed of cells which cease to divide but able perform certain definite function.

They occur in different parts of the plant body. The meristems are derived from the Greek word “meristos” which means ‘to divide’. The term meristem was coined by Nageli (1858).

The cells of the meristem are small in size and isodiametric. They are arranged compactly without **intercellular spaces**. The cell walls are thin and made of **cellulose**. The cytoplasm is dense and abundant. The nucleus is conspicuous and the vacuoles are small or sometimes absent. The plastids are in proplastid form and without ergastic substances.

CLASSIFICATION OF MERISTEMS



The meristems are classified on the basis of their position in the plant body and also on the basis of their origin. The meristems which occur at the tips of roots and shoots produce primary tissues called **apical meristems**. Root apical meristem occupies the tip of a root (behind the root cap) while the shoot apical meristem occupies the distant most region of the stem axis.

Apical meristems are differentiated into three kinds of primary meristem:

- i. **Protoderm** – these meristematic cells are present in the region towards outside of the stem and develop into the epidermis.
- ii. **Procambium** - lies just inside of the **protoderm** and develops into **primary xylem** and **primary phloem**. It also produces the **vascular cambium**, a **secondary meristem**.

- iii. **Ground meristem** develops into the **pith**. It produces the cork cambium, another secondary meristem.

These meristems are responsible for primary growth, or an increase in length or height.

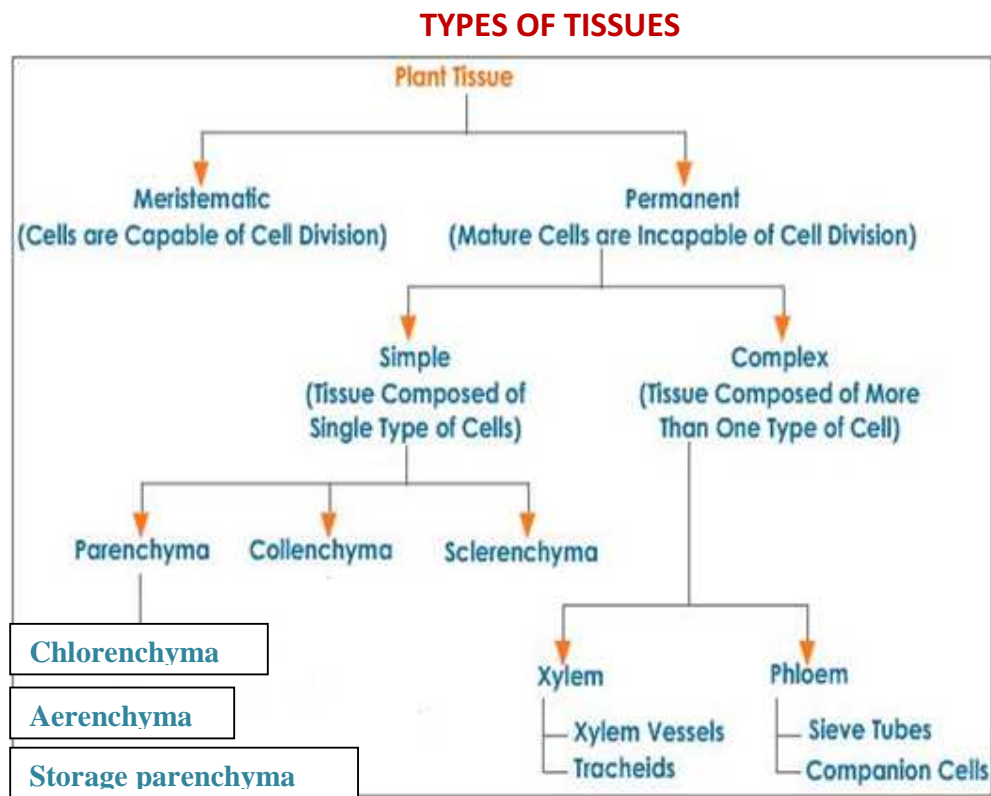
The meristem which occurs between mature tissues is known as **intercalary meristem**. They occur in grasses and regenerate the parts removed by the grazing herbivores. Both apical meristems and intercalary meristems are **primary meristems** because they appear early in life of a plant and contribute to the formation of the primary tissues that causes an increase in the plant body length. The meristem that occurs in the mature regions of roots and shoots of many plants, particularly those that produce woody axis and appear later than primary meristem is called the **secondary or lateral meristem**. They are cylindrical. **Fascicular vascular cambium (or intrafascicular cambium)**, **interfascicular cambium** and **cork-cambium** are examples of lateral meristems. These are responsible for producing the secondary tissues and thereby increasing the diameter of the plant body resulting in the increase of the girth of roots and stems.

The cells newly formed by both primary and secondary meristems become structurally and functionally specialized. Such cells lose the ability to divide. They are called **permanent** or mature cells of the tissues.

PERMANENT TISSUES

There are other tissues in plants that do not actively produce new cells. These tissues are called **non meristematic tissues** or **permanent tissues**. Non meristematic tissues are made of cells that are produced by the meristems and appear in various shapes and sizes depending on their function in the plant. The cells of the permanent tissues generally do not divide further. The permanent tissues having all cells similar in structure and function are called **simple tissues**. The tissues having many different types of cells are called **complex tissues**. There is a third kind of permanent tissue

which is commonly referred to as **secretory tissue** or special tissue. It is functionally different from the above two types.



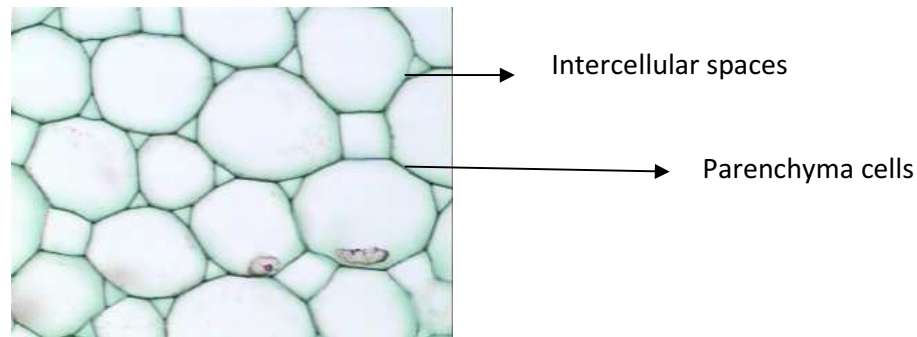
SIMPLE PERMANENT TISSUES

A simple tissue is made of only one type of cells. The various simple tissues in plants are **parenchyma**, **collenchyma** and **sclerenchyma**. Except sclerenchyma the other two tissues are living.

Parenchyma

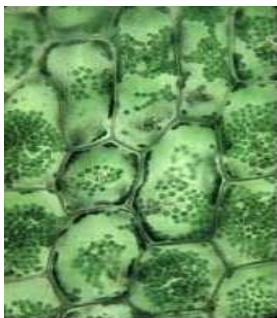
It forms the major component within the organs. The body of the lower organisms (e.g.: bryophytes) is wholly made up of this tissue. Therefore, it is known as **ground or fundamental tissue**. The cells of the parenchyma are generally **isodiametric**. They may be spherical, oval, round, polygonal or elongated in shape. Their walls are thin and made up of

cellulose. They may either be closely packed or have small intercellular spaces. The mature cells have **vacuoles**.



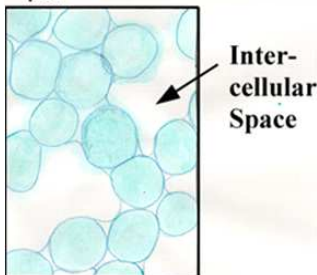
Parenchyma is found in different forms in higher plants. Parenchyma cells having chloroplasts (as found in leaves) are referred to as **chlorenchyma**. Parenchyma with large intercellular spaces forming network (as in water lilies and other aquatic plants) is called **aerenchyma**. Parenchyma meant for storage of food material like starch, protein or oils (soft edible parts of fruits, vegetables and seeds) or mucilaginous substances and water as in xerophytes is called **storage parenchyma**.

Chlorenchyma

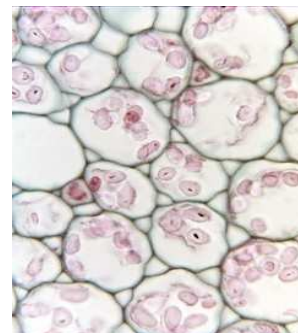


Aerenchyma

-Parenchyma cells with extensive connected air spaces



Storage parenchyma



Functions of parenchyma:

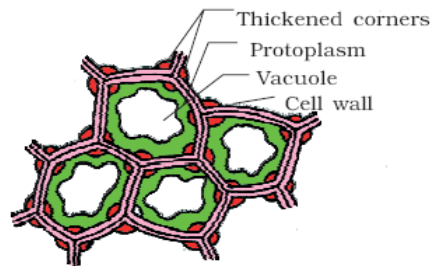
- The parenchyma performs photosynthesis, storage, secretion and buoyancy.
- Sometimes parenchyma undergoes dedifferentiation to become meristematic.
- It helps in healing the wounds.
- The epidermal cells which are essentially parenchymatous offer protection.

Collenchyma

It occurs in layers below the epidermis in stems and petioles of dicotyledonous plants. It is in the form of continuous or discontinuous ring. It consists of cells which are much thickened at the corners due to the deposition of **cellulose**, **hemicellulose** and **pectin**. The cells are elongated, round, cylindrical and vacuolated. Collenchymatous cells may be oval, spherical or polygonal and often contain chloroplasts. Apart from chloroplasts they contain tannins. Collenchyma may be of angular, lacunar, or lamellar type.

Functions of collenchyma:

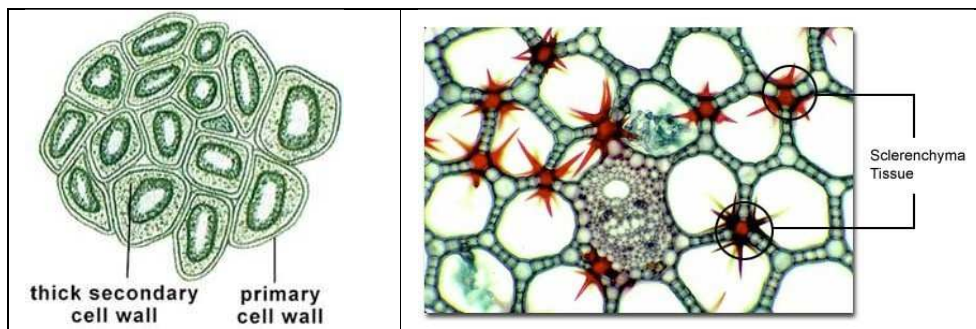
- It gives flexibility and elasticity for growing organs and mature organs.
- It offers mechanical strength.
- Carries out photosynthesis when chloroplasts are present.



Sclerenchyma

It is a mechanical tissue composed of dead cells (without protoplasts at maturity). It is present in different parts of the plant body and helps in overcoming stress and weight.

It consists of long, narrow cells with thick and lignified cell walls having a few or numerous pits. The cell wall is made up of **cellulose** and **lignin**. Inside the cell there is a long narrow **lumen** in the centre.



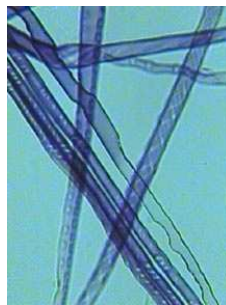
On the basis of variation in form, structure, origin and development, sclerenchyma occurs as either **fibres** or **sclereids**. The fibres generally occur in groups in various parts of the plant. The fibres are thick-walled, elongated and pointed cells much longer than the width; having proportionately tiny cavity. The **lumen** runs throughout the length of the fiber. Fibers are commercially useful in the manufacturing of cloth, threads, ropes etc.

The **sclereids** or **stone cells** are spherical, oval or cylindrical, highly thickened dead cells with very narrow cavities (lumen). These are commonly found in the fruit walls of nuts; pulp of fruits like guava, pear and sapota; seed coats of legumes and leaves of tea. On the basis of shape the sclereids are classified into Brachy, Osteo, Astero, Macro and Trichosclereids.

Stone cells



Sclerenchyma fibers



Functions of sclerenchyma:

- Sclerenchyma provides mechanical support to organs
- They protect the plant parts from stretching, bending, weight and pressures.

Check points

- Tissue is a group of cells have a common origin and perform a common function. The group of cells may be alike or different.
- The tissues can be classified according to their structure, origin or function into two main groups: meristematic tissue and permanent tissue.

- Meristems comprise of actively dividing cells. These are present at the tip of stems and roots called apical meristems which are responsible for primary growth.
- The permanent tissues arise from meristematic tissues are of two types 1. Simple tissues and 2. Complex tissues.
- Parenchyma, collenchyma and sclerenchyma are simple tissues.
- Parenchyma is present in roots, stems and leaves. The cells are undifferentiated thin-walled, large vacuole; often contain secreted material (starch, oils, tannins, crystals).
- Aerenchyma is a type of parenchymatous tissue with extensive intercellular air spaces (e.g., water lilies and spongy mesophyll of leaves).
- Chlorenchyma is another type of parenchyma with numerous chloroplasts (common in leaves).
- Collenchyma cells are thick-walled but flexible and strong, usually present below the epidermis of a leaf or stem, used for support in stems and leaves.
- Sclerenchyma cells have thick walls impregnated with lignin; usually dead at maturity and their function is support.
- Sclereids, stone cells and fibers are different types of sclerenchyma.
- Fibers are much longer in length than width. These are commercially useful in the manufacturing of cloth, threads, ropes etc.

Short answer Questions:

- 1) What is a meristem? Describe briefly the apical meristem.
- 2) Give the classification of meristems.
- 3) What are permanent tissues? Give different types of permanent tissues.
- 4) Describe the structure of parenchyma.
- 5) Describe the structure and aerenchyma.
- 6) Write an account of collenchyma?
- 7) Write about
 - (a) Lateral meristems and
 - (b) Intercalary meristems.

- 8) Give characters of sclerenchyma.
- 9) Give differences between simple tissues.
- 10) Write about economic importance of fibers.
- 11) What is the difference between Sclereids and fibers? Give examples of both types.
- 12) How the simple tissues are different from permanent tissues?

Long answer Questions:

1. What is a meristem? Describe the structure and functions of different types of meristems.
2. Give an account of the structure and functions of parenchyma.

MCQS

1. Groups of cells that perform a common function.
 - A. Organs
 - B. Tissues**
 - C. Body
 - D. Compounds
2. Which of the following contain undifferentiated tissue, where plant growth will occur usually
 - A. epidermis**
 - B. Internodes
 - C. hypodermis
 - D. Lateral meristem
3. The cells of a plant that are least specialized, tend to be thin and flexible, have a large central vacuole, and act in food storage
 - A. Parenchyma cells**
 - B. Collenchyma cells
 - C. Sclerenchyma Cells
 - D. Tracheid cells
4. Parenchyma is a type of _____.
 - A. Simple tissue**
 - B. Nervous tissue
 - C. Muscle tissue
 - D. Complex tissue
5. _____ tissue forms new cells in plants.
 - A. Meristematic**
 - B. Permanent
 - C. Simple

- D. Sclerenchymatous
6. The cell walls of these tissues have lignin and help in giving strength
- A. Parenchyma
 - B. Sclerenchyma**
 - C. Collenchyma
 - D. Cambium
7. The fiber cells of plants are a type of
- A. Parenchyma
 - B. Collenchyma
 - C. Sclerenchyma**
 - D. Xylem cell
8. Primary growth in plants is initiated by the
- A. Apical meristems**
 - B. Vascular meristems
 - C. Lateral meristems
 - D. Ground meristems
9. The tissue most likely to provide flexible support is the:
- A. Epidermis
 - B. Sclerenchyma
 - C. Parenchyma
 - D. Collenchyma**
10. Plant length is increased by _____.
- A. Lateral meristems
 - B. Apical meristems**
 - C. Cambium
 - D. Parenchyma
11. The cell division is restricted to _____.
- A. Meristematic cells**
 - B. Permanent cells
 - C. Secretory cells
 - D. All the above