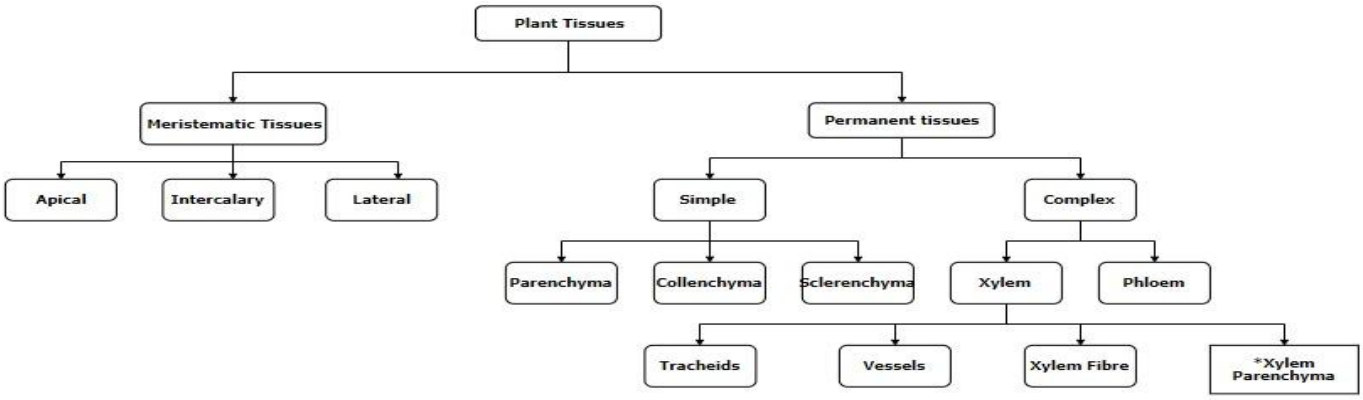
Plant Tissue



Plant Tissues are categorized broadly into three tissue systems: the epidermis, ground tissue and the vascular tissue..

Criteria for Classification of Plant Tissues

The 2 Major Criteria for the Classification of plant tissues are given below.

1. Based on part of the plant, they are present in.
2. Based on the kind of cells they contain.

Classification of Plant Tissues – Based on its location in the Plant

1. Epidermal tissues – It covers the outside of a plant in a single layer of cells.
2. Ground tissues – It covers the interiors of a plant.
3. Vascular tissues – Transports water and dissolved substances inside the plant.

Classification of Plant Tissues – Based on the kind of cells they contain.

1. Meristematic – There are 3 major types in this.
2. Permanent – There are 2 major types under this named as Simple and Complex. Simple is further subdivided into 3 types named parenchyma, collenchyma, and sclerenchyma. The complex is further subdivided into 2 types named Xylem and Phloem.

Meristematic Tissues

Meristematic tissue consists of actively dividing cells and leads to increase in length and thickness of the plant. The primary growth of a plant occurs only in certain, specific regions, such as in the tips of stems or roots. It is in these regions that meristematic tissues are present. Cells in these tissues are roughly spherical or polyhedral, to rectangular in shape, and have thin cell walls.
The growth in length and diameter of plants is carried out by this tissue. They are broadly classified as follows:

1. Apical Meristem – It is present at the apical portion of stems and roots. It is responsible for the growth in the length of the plants.
2. Lateral Meristem – It is present at the radial portion of the stems and roots. It is responsible for the growth in the thickness of the plants.
3. Intercalary Meristem – It is present at the internodes or the base of the leaves.

Characteristics of Meristematic Tissue

The characteristics of meristematic tissue are as follows:

1. The cells of these tissues are commonly called meristems.
2. The meristematic tissue has the quality of self-renewal. Every time the cell divides, one cell remains identical to the parent cell, and the others form specialized structures.
3. They have very small and few vacuoles.
4. The meristematic tissue is living and thin-walled.
5. The protoplasm of the cells is very dense.
6. The meristematic tissues heal the wounds of an injured plant.

7. The cells of the meristematic tissue are young and immature.
8. They do not store food.
9. They exhibit a very high metabolic activity.
10. They possess a single, large and prominent nucleus.

Types of Meristematic Tissue

The meristematic tissue is of the following types:

Meristematic Tissue On the basis of Origin

Promeristem

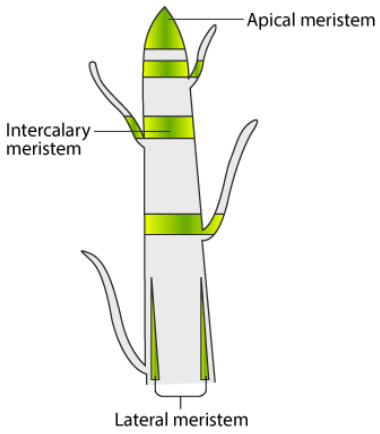
- The earliest and youngest meristematic tissue.
- It originates from the embryo.
- The primary meristem arises from the promeristem.
- It is found in the root and the shoot tips.

Primary Meristem

- It arises from the promeristem.
- Cells divide actively.
- It is present below the promeristem and forms the permanent tissue.

Secondary Meristem

- It originates from the primary meristem.
- The permanent tissue forms from the secondary meristem.



Apical Meristem

- These are present at the tips of the roots and shoot and help in the increase of the height of the plants.
- Various cell divisions facilitate the growth of the cells in the roots and shoots and help in cellular enlargement.
- Apical meristem is divided into-promeristem zone, which contains actively dividing cells, and the meristematic zone, which contains protoderm, procambium and ground meristem.

Intercalary Meristem

- It is located in the leaves and internodes at the intercalary position.
- These help to increase the length of the internode.
- It is found in grass, monocots and pines.
- It is a part of apical meristem and adds to the height of the plant.

Lateral Meristem

- It is located in the stems and roots on the lateral side.
- It increases the thickness of the plant.
- Vascular cambium and cork cambium are the two lateral meristems.
- These divide preclinically or radially and give rise to secondary permanent tissues.

Annual rings

Annual rings, the growth layers of wood that are produced each year in the stems and roots of trees and shrubs. In climates with well-marked alternations of seasons (either cold and warm or wet and dry), the wood cells produced when water is easily available and growth is rapid (generally corresponding to the spring or wet season) are often noticeably larger and have thinner walls than those produced later in the season when the supply of water has diminished and growth is slower. There is thus a sharp contrast between the small, thick-walled late-season wood cells produced one year, and the large, thin-walled cells of the spring wood of the following year results. Where the climate is uniform and growth continuous, as in wet, tropical forests, there is usually little or no gross visible contrast between the annual rings, although differences exist. When rings are conspicuous, they may be counted in order to obtain a reasonably accurate approximation of the age of the tree. They are also reflective (by their range of thickness) of the climatic and environmental factors that influence growth rates. The science of dendrochronology is based upon the phenomenon of variability in the thickness of annual rings.

Permanent Tissues

Permanent tissues are a group of living or dead cells made by meristematic tissue that have lost their ability to divide and permanently have been placed at fixed positions in the plant body. Meristematic tissues which have a specific role lose their ability to divide. This process is called a cellular differentiation where a tissue takes up a permanent shape, size and function

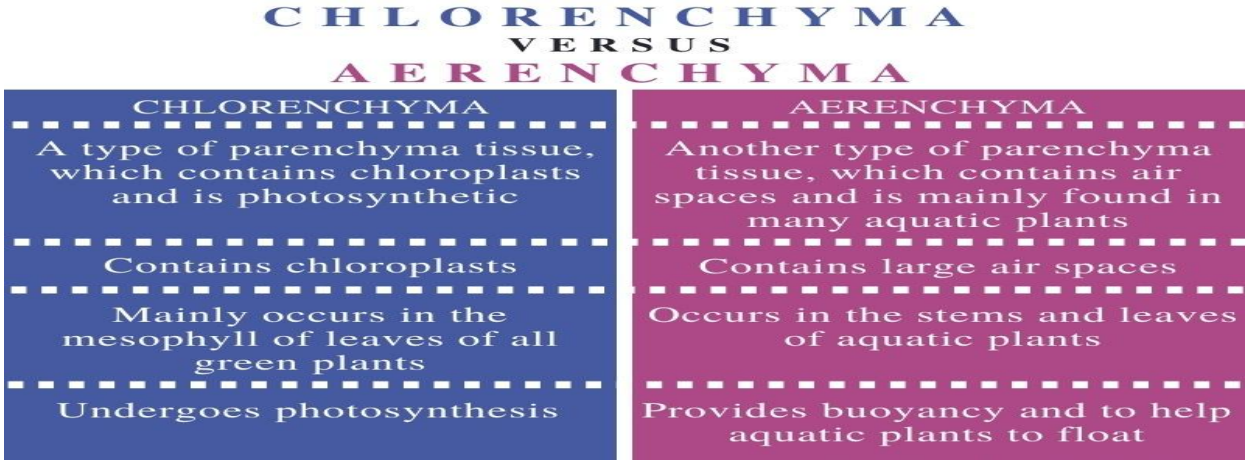
There are 3 types of permanent tissues:
1. Simple permanent tissues
2. Complex permanent tissues
3.Special or secretory tissues (glandular).

Simple Permanent tissues
A group of cells which are similar in origin; similar in structure and similar in function are called simple permanent tissue. They are of three types:
1. Parenchyma
2. Collenchyma
3. Sclerenchyma

Parenchyma

These are alive, polygonal cells with a big central vacuole, and have intercellular spaces amidst them. Parenchymatous cells create ground tissue and pith.

1. Parenchyma consisting of chloroplasts are termed as chlorenchyma. The chlorenchyma helps in photosynthesis.
2. Parenchyma which consists of big air voids is called aerenchyma. Buoyancy is the main purpose the aerenchyma.
3. Some parenchymatous cells perform as storage chambers for starch in vegetable and fruits.



Chlorenchyma

Chlorenchyma is a type of parenchyma cells; especially, containing chloroplasts. Here, the parenchyma is a type of ground tissue with living cells and whose main function is to fill spaces in different parts of the plant body. However, as chlorenchyma contain chloroplasts, its main function is to undergo photosynthesis.

Aerenchyma

Aerenchyma is another specialized form of parenchyma, containing large air intercellular air spaces or air channels. Usually, this type of air spaces can occur in the leaves, stems, and roots as well. However, these air-filled cavities permit efficient gas exchange by providing low-`resistance internal pathways. Furthermore, aerenchyma especially occurs in the leaves and stems of aquatic plants. Thus, this helps to float plants by providing buoyancy**.**

Collenchyma

Collenchyma is a cellular tissue which, along with parenchyma, composes the bulk of plant tissues.
Unlike parenchyma, collenchyma cells are living cells. They have cellulose cell walls and are filled with water – which helps the plants to keep their shape.
Collenchyma cells also contain flatter chloroplasts than parenchyma cells and they give plants elasticity and rigidity by joining together to form fibers in bundles or bundles in strips throughout the plant's body.

Collenchyma cells are made of strong, thick cellulose strands twisted around each other and cemented together. They have the ability to store water and can swell up to 200% when they absorb water.

Collenchyma cells are constantly growing in plants, which is why they are found on the outside of roots and stems. These cells allow plants to grow as they provide support for all other tissues and help with water absorption.

Roles and Function of Collenchyma Cell in Plants

Collenchyma cells are found in the secondary phloem of plants. Functions of these cells include: protection of the plant against mechanical injury, provide support for the vascular tissue, and act as a sheath that regulates water flow.

Sclerenchyma

Sclerenchyma is a kind of protective tissue found in plants. Sclerenchyma is a thick, lignified secondary walls which are seen throughout all plant tissues.

Sclerenchyma Characteristics

- It is made up of long and narrow cells.
- Cells are usually dead without protoplasts.
- The cell wall is thick and lignified with a few or numerous pits.
- They possess both primary and secondary cell walls.
- The secondary cell wall is highly thickened and has pits to allow the exchange of substances.
- The secondary walls are rich in lignin along with cellulose, hemicellulose and pectin.
- They possess narrow lumen due to highly thickened cell walls.
- At maturity, they lose their ability to stretch or elongate.
- At functional maturity, cells are often dead.
- They are of two types of sclerenchyma cells. They are sclereids and fibres.
- Sclerenchyma tissues are located in several areas. E.g. Sclereids are found in the shells of nuts, stones of fruits and fibres are abundantly found in the inner bark, wood, leaf veins, etc.

Types of Sclerenchyma

Sclerenchyma is classified into two types based on their structure, origin and development. They are

- **Sclereids**
- **Fibres**

Sclerenchyma Function

The main function of sclerenchyma is to provide mechanical support and strength to the plants.

- They provide structural support to the plant organs.
- They form protective coverings around nuts and seeds.
- They are also a part of vascular bundles and form conductive tissues.
- The xylem vessels and tracheids are sclerenchymatous cells.
- They form the hypodermis of some xerophytic plants and reduce water loss.
- Many fibres such as bastfibres, seed hairs are used as raw materials for textiles.

Xylem and Phloem

Xylem and Phloem are two different types of vascular tissues, which are mainly involved in the transportation process. These tissues form a vascular bundle and these work together as a unit. The movement of xylem is unidirectional, while the movement of phloem is bidirectional.

Xylem	Phloem
Definition	
Xylem tissues are the tubular-shaped structure, with the absence of cross walls. This tissue resembles the shape of a star.	Phloem tissues are tubular-shaped, elongated, structures with the presence of walls with thin sieve tubes.
Location	
It is located in the centre of the vascular bundle.	It is located on the outer side of the vascular bundle.
Fibres	
Xylem fibres are smaller.	Phloem fibres are larger.
Found In	
They are present in roots, stems and leaves.	They are present in stems and leaves, which later transports and grow in roots, fruits and seeds.
Movements	
These tissues move in a Unidirectional. (only in one direction – upward direction)	These tissues move in a Bidirectional. (both ways – up and down)
Comprises	
They live with hollow dead cells.	They live with cytoplasm without the nucleus.
No of Tissues	
The total amount of xylem tissue is more.	The total amount of phloem tissue is less.

Features	
It consists of tracheids, vessel elements, xylem parenchyma, xylem sclerenchyma and xylem fibres.	It consists of four elements: companion cells, sieve tubes, bastfibres, phloem fibres, intermediary cells and the phloem parenchyma.
Functions	
Transports soluble mineral nutrients and water molecules from the roots to the aerial parts of the plant.	Transports food and other nutrients including sugar and amino acids from leaves to storage organs and growing parts of the plant.
Vascular Bundles	
Forms vascular bundles with phloem.	Forms vascular bundles with xylem.
Functions	
Provides mechanical strength to the plant and helps in strengthening the stem.	Translocates the synthesized sugars by the photosynthetic areas of plants to storage organs like roots, bulbs and tubers.
Functions	
It is responsible for replacing the total amount of lost water molecules through transpiration and photosynthesis.	It is responsible for transporting proteins and mRNAs throughout the plant.

Xylem Tissues

Xylem is one of the important tissues of the vascular system of plants. The main activity of this tissue is to transport minerals and water from roots and carry them to other parts of the plants. It has two separate chambers, tracheids and vessels for transporting minerals and water.

Phloem Tissues

Phloem is also important as the xylem tissues for the vascular system of plants. The main activity of this tissue is to transport nutrients and food from leaves to other growing parts of plants.