

## **Secondary Thickening**

Any arising in plant thickness occur far away from the Apies occur as a result of secondary tissues formation & it represent secondary plant body. Secondary thickening occur in most of dicotyledonae & Gymnospermae & some of monocotyledonae as like as in Palmaceae.

Secondary thickening occur as a result of 2 kinds of secondary meristematic and they are:

- 1- Cork cambium —→ (explained in Periderm sub.)
- 2- Vascular cambium.

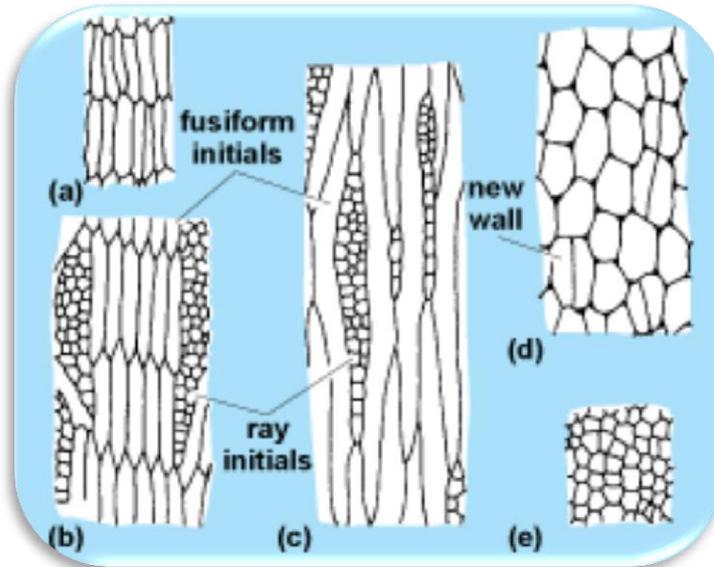
### **Vascular cambium:**

The lateral meristem that forms the secondary vascular tissues, it is located between the xylem & phloem in the stem & root, cylinder in shape, in most petioles & leaf veins it appears as strips. Vascular cambium cells characteristic are:

- 1- thin cell wall plasmodesmata, dense cytoplasm, dense endoplasmic reticulum, with many rhibosomes.
- 2- contain (1) nucleus its size in fusiform initials larger than in ray initials.
- 3- cambium cells appear in radial arrangement with the cell that produce it.
- 4- usually divide periclinal division and sometimes divide anti linal division.

Vascular cambium consist of 2 kind of cells:

- 1- **Fusiform initials / cell:** elongated cells with tapering ends (spindle – shaped).
- 2- **Ray cell/ initials:** small, isodiametric cells.



**Factors** that effect on vascular cambium activity: (1)photoperiod, (2)temperature, and (3) water available.

### **The Root**

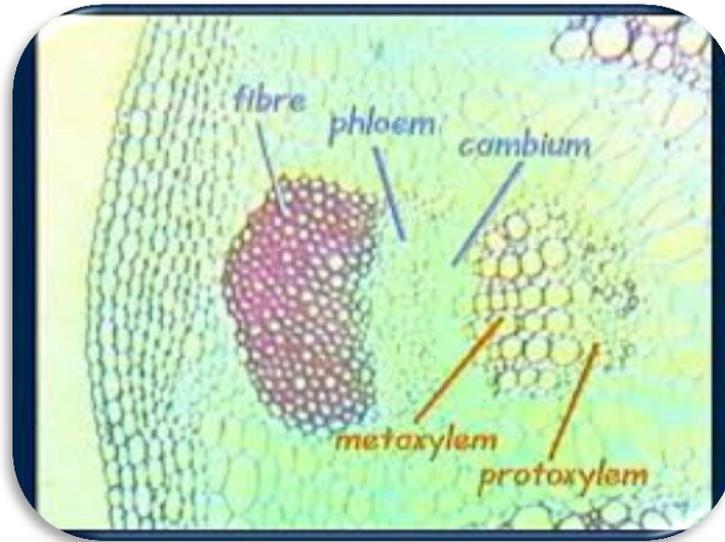
The underground part of plant axis specialized as an absorbing & anchoring organ.

Origin of the root is the radical which initiate from the hypocotyl of the embryo. The root functions are the absorption of water and other substances anchoring the plant in the substrate, store of vegetative reproduction.

### **Root characteristics:**

- 1- Absent of leaves, buds, nodes & internodes.
- 2- Occurrences of apical meristems covered with the (root cap.)
- 3- Lateral & adventitious roots are initiate from the epicycle.
- 4- Occurrence of piliferous layer.
- 5- Xylem & phloem arranged as alternate.
- 6- Absent of cuticle & absent of collenchyma.
- 7- The xylem is exarch type.

### **Primary structure of the root**



### 1. The Epidermis

The root epidermis consists of closely packed elongated cells with thin walls. Usually a layer or many layers occur externally of the cross section cells not covered with the cuticle because its function is the absorption. A typical characteristic of the root epidermis is the development of root hairs. Ordinarily, the root hairs are confined to a region between one & several cm. in length near the tip. A root hair is a tubular extent of the epidermal cells and called piliferous layer. In some plants, the old root hairs fall and the epidermis hair suberized and convert into exodermis, while in some plants like the orchids there is Velamen layer: a multi seriate epidermis initiate from the periclinal divisions of the protodermis, nonliving cells without intercellular spaces with lignified secondary cell walls consist of pits. Its function is absorption of humidity from the air.

### 2. Cortex:

Wide homogenous simple parenchyma layer, the degree of differential related to the longevity of the cortex. The cortex of seed plants roots differentiates as an endodermis & exodermis beneath the epidermis.

**Exodermis:** external layer of cortex formed after falling the root hair & suberization of the outer layer of the cortex.

**Endodermis:** inner layer of the cortex, cell wall thickened with suberin and arrange strip like called Casparian strips prevent water loosing from vascular bundle.

**3- Vascular cylinder:** Composed of :

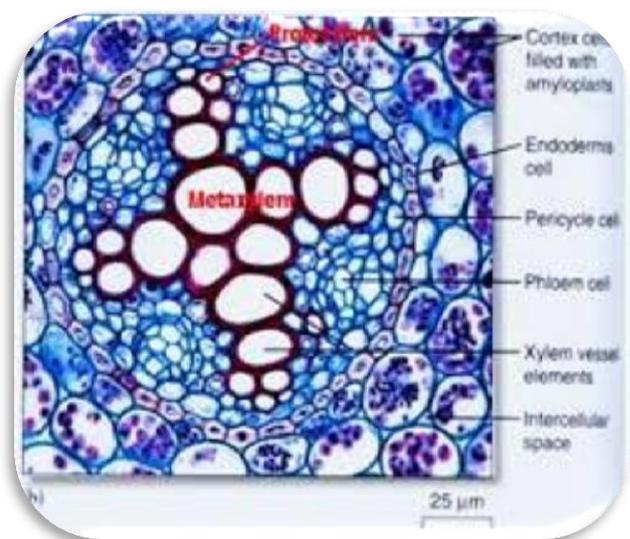
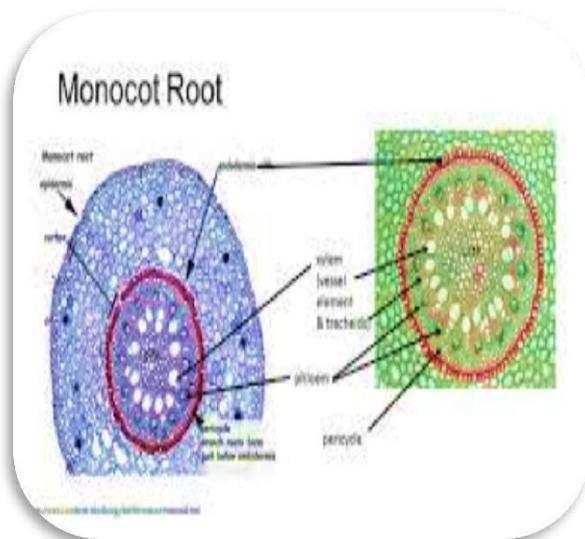
- 1- Pericycle, 2- Xylem tissue, 3- Phloem tissue, 4- Pith

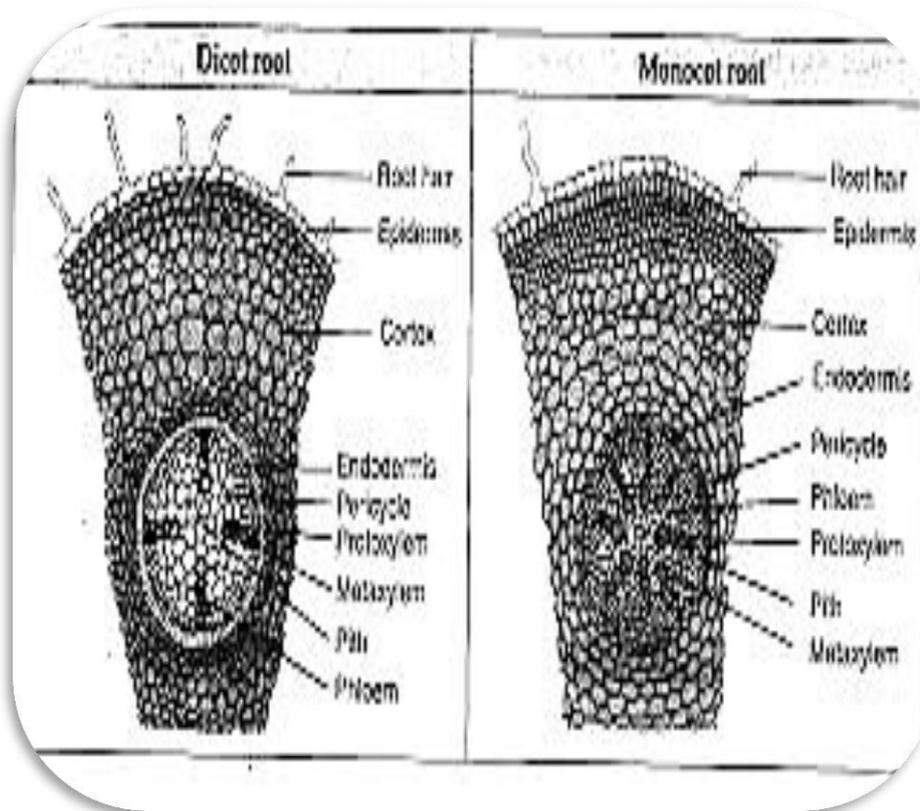
1- Pericycle : the external layer of vascular bundles and composed of one or two strips of parenchyma cells in a cyclic form a round vascular elements inspect of some regions which play a role in :

A : Branching of the root.

B : Secondary thickening.

2- Vascular tissues : Xylem and Phloem : It is composed of strips of primary xylem alternate with a mass of primary phloem , this kinds is called (Radial vascular bundles), parenchyma cells separate between xylem and phloem element which convert (unspecialized parenchyma) after that into vascular cambium. Phloem also composed of protophloem outside and metaphloem into inside



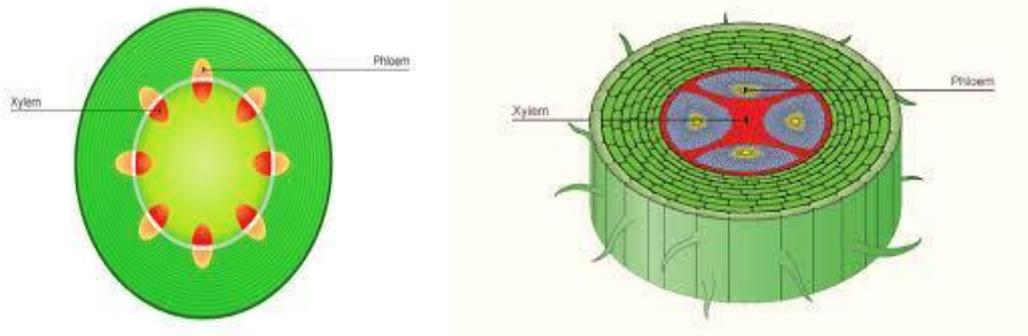


## The Stem

The part of plant which grow above the ground & bear the flowers, leaves and of the organs & transport nutrients & water to other parts of plant. In some cases, stem grew underground, the most common features among stems in plants are:

1. bearing buds leaves & flowers.
2. formed from nodes & internodes.
3. Branches are externally originates & occur in early stage of growth.
4. Apics does not covered with a cap.
5. Epidermis covered with cuticle.
6. Contain collenchyma & sclerenchyma in the cuticle.

7. Vascular bundle either collateral (xylem & phloem occur on one radial, or concentric: this type contain: (1) amphiversal (phloem in the center), (2) amphicribal (xylem in the center)



## **The primary Structure of the Stem**

### **A. Dicotyledonae Stem**

We can flow different tissues that form a mature stem in the primary growth stage from outside to inside.

#### **1- Epidermis:**

One layer of cells, covered with cuticle, may contain stomata or trichomes.

#### **2- Cortex:**

Under the epidermis directly, less thickness than the cortex in the roots, consist of parenchyma cells & collenchyma either in group forms or as continuous form its function is supporting some parenchyma contain chloroplasts. Commonly the cortex does not contain endodermis their for we can't distinguish the last layer. In few species of plant may contain casparian strip.

#### **3- Vascular cylinder:**

Consist of: (1) pericycle, (2) vascular bundles, (3) medullary rays, (4) pith.

### **1- Pericycle:**

If the endodermis is clear in the stem then the pericycle will be clear but almost pericycle mixed with cortex in most of Angiosperm & gymnosperm, in case of differentiate it, its composed of parenchyma & sclerenchyma as a cycles.

### **2- Vascular bundles:**

In most of Dicotyledonae, it is open collateral vascular bundles type/ or it is bicollateral vascular bundles type.

Phloem: sieve tubes, companion cells, parenchyma & fibers (phloem) + sclerides.

**Xylem:** occur in radial strips of xylem vessels which consist of metaxylem& (exarch) & protoxylem (endarch)

Vascular cambium: as a one strip of meristematic cells.

Vascular bundle either be as a separated units or continuous like a cylinder.

### **3- Medullary rays:**

Parenchymatic cells connect the cortex with the pith. Vascular bundle among these cells, it may be wide or thin.

### **4- Pith:**

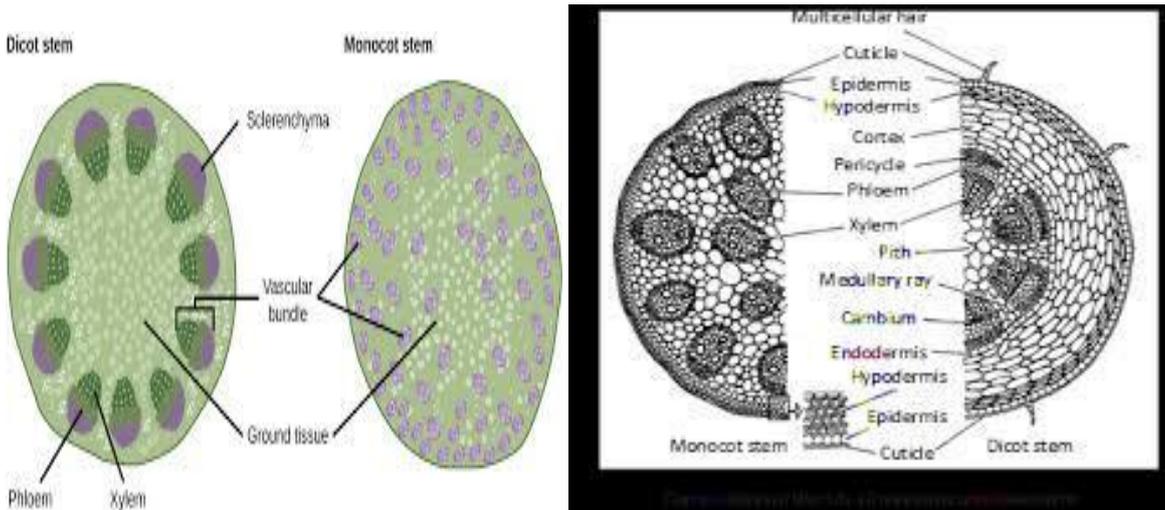
Parenchymatic cells large in size in the center of the stem. Pith occupies large space in the stem in compare with the root, in some plants pith cells analyzed during growth and became

## **Monocotyledon Stem Primary Structure**

We can see the following tissues from the outside to inside in mature stem:

**1- Epidermis:**

One layer of cells covered with cuticle, sometime contain chloroplasts & trichomes.



**2- Ground tissue:**

Cortex is not found but there is ground tissue composed of parenchymatic cells, vascular bundle diffuse within the ground meristem and the outer layers may be sclerids (fibrous).

**3- Vascular bundle:**

Occur in large number near the epidermis as well as small number in the center, vascular bundle in monocots are closed collateral vascular bundle & does not contain vascular cambium.

<i>Anatomical differences between dicot stem and monocot stem</i>	
<b>Dicot stem</b>	<b>Monocot stem</b>
1. Hypodermis is made up of collenchymatous cells.	1. Hypodermis is made up of sclerenchymatous cells.
2. Ground tissue is differentiated into cortex, endodermis, pericycle and pith.	2. Ground tissue is not differentiated, but it is a continuous mass of parenchyma.
3. Starch sheath is present.	3. Starch sheath is absent.
4. Pith is present.	4. Pith is absent.
5. Pericycle is present.	5. Pericycle is absent.
6. Medullary rays are present.	6. Medullary rays are absent.
7. Vascular bundles are open.	7. Vascular bundles are closed.
8. Vascular bundles are arranged in a ring.	8. Vascular bundles are scattered in the ground tissue.
9. Bundle cap is present.	9. Bundle sheath is present.
10. Protoxylem lacuna is absent.	10. Protoxylem lacuna is present.
11. Phloem parenchyma is present.	11. Phloem parenchyma is absent.