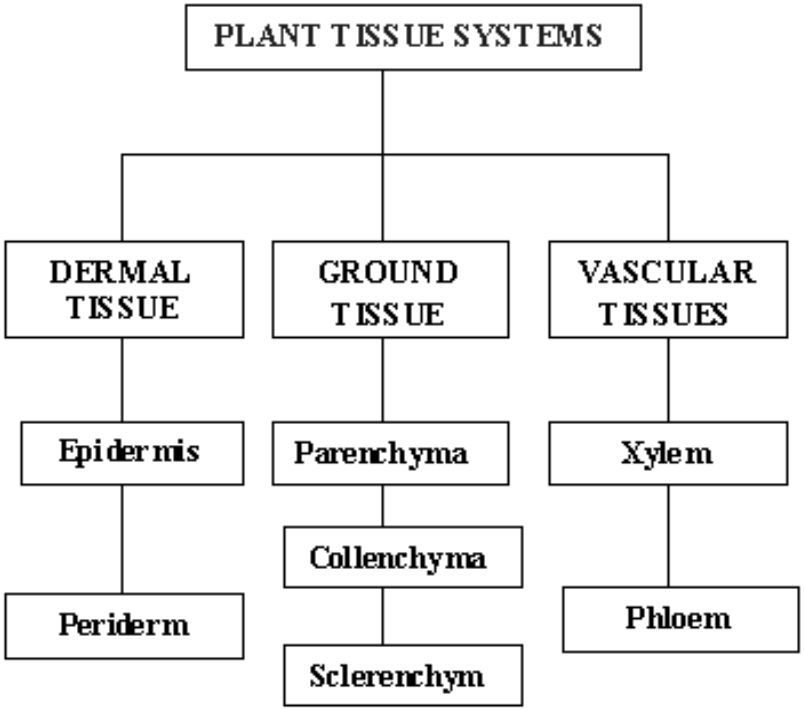
Anatomy of Flowering Plants

K C Meena
PGT Biology

Tissues

- A group of similar cells performing same function.
- Types of plant tissues - Meristematic tissues and permanent tissues.



Meristematic tissues

- Have power of cell division

- **Characteristics features**
- Cells are thin walled
- No intercellular places
- Abundant cytoplasm
- Retains power of cell division

- **Classification based on position. Three types**
- Apical meristem
- Lateral meristem
- Intercalary meristem

- **Based on the origin – three types**
- Promeristem- embryo/ seedlings
- Primary meristem
- Secondary meristem

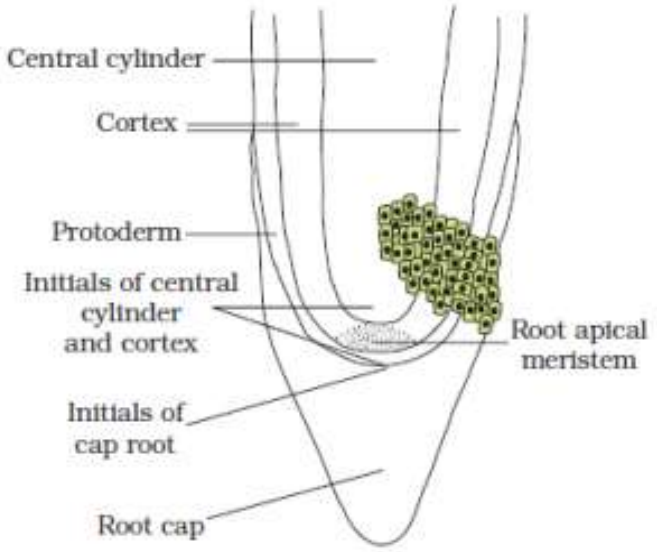


Figure 6.1 Apical meristem: (a) Root

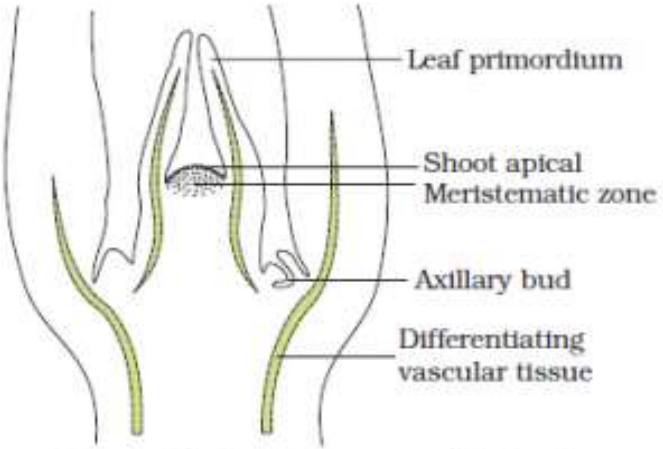


Figure 6.1 Apical meristem: (b) Shoot

- Growth in plants is largely restricted to specialized regions of active cell division called meristem.
- Apical meristems are the meristems which occur at the tips of roots and shoots and produce primary tissues
- Intercalary meristem are the ones which occur between mature tissues
- Lateral meristem occurs in mature regions of roots and shoots and appear later than primary meristem

Permanent tissues:

- The newly formed cells from primary and secondary meristems which become structurally and functionally specalised and lose the ability to divide are permanent tissues

Simple permanent tissues

- Parenchyma(storage)-living
- Collenchymas (support) below epidermis, living
- Sclerenchyma – sclereids and fibres- dead

Compound permanent tissues

- Xylem- xylem vessels, xylem tracheids, xylem parenchyma, xylem fibres
- Phloem – sieve tubes, sieve cells, companion cells, phloem parenchyma

Simple tissues

Made up of only one type of cells

***Parenchyma* -**

- Major component within organs Isodiametric,spherical, oval,round polygonal,elongated in shape.
- Thin cell walls made of cellulose.
- Closely packed or have intercellular spaces
- Function-Photosynthesis, storage, secretion.

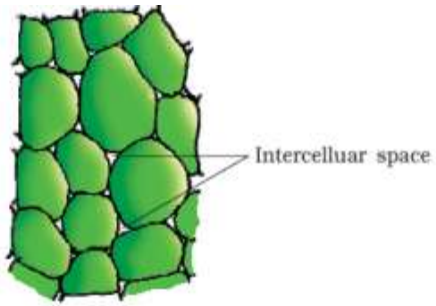


Figure 6.2 Simple tissues : (a) Parenchyma

Collenchymas –

- occurs in layers below epidermis, either in homogeneous layer or in patches
- Thickened at the corners due to pectin, cellulose oval, spherical, polygonal
- Assimilate food when chloroplasts is present
- Intercellular spaces absent- function. Mechanical support

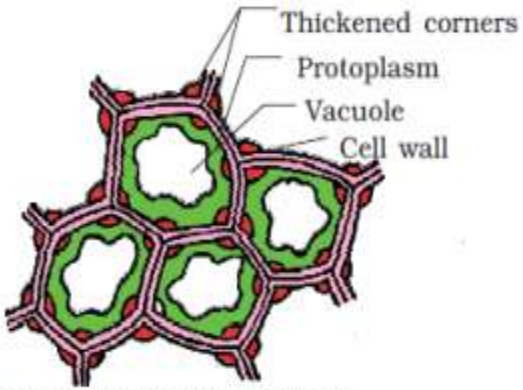


Figure 6.2 Simple tissues : (b) Collenchyma

Sclerenchyma -

- long narrow cells, lignified walls, with pits
- Dead- fibers-thick walled, elongated, pointed
- Sclereids- spherical, dead, narrow cavity-lumen
- Found in – guava, pear, sapota
- Function. Mechanical support

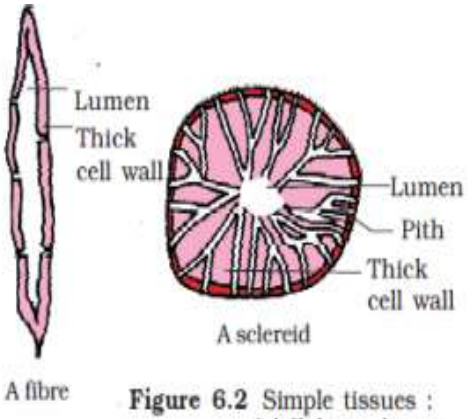


Figure 6.2 Simple tissues : (c) Sclerenchyma

Complex tissues

- **More than one type of cells**
- ***Xylem.***
- *Conducting tissue for water and minerals*
- *Tracheids. Elongated or tube like cells, dead, main water transporting element*
- *Vessels. Long cylindrical, lignin in cell walls, large central cavity, devoid of protoplasm.*
- *Xylem fibres- lumens present, septate/aseptate*
- *Xylem parenchyma- living thin- walled, cell walls, cellulose, store food as starch or fat,* tannins

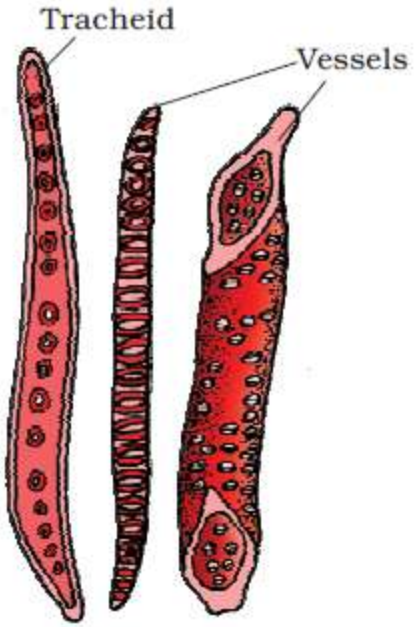


Figure 6.3 (a) Xylem

Phloem - (transports food material)

- *Sieve tubes- long, tube like, perforated, forms sieve plates*
- *Companion cells – pit is present , helps in maintenance of pressure gradient in the sieve* tubes
- *Phloem parenchyma – elongated, tapering, dense cytoplasm, cell wall, cellulose, pits*
- *Phloem fibres - unbranched, pointed, quite thick.*

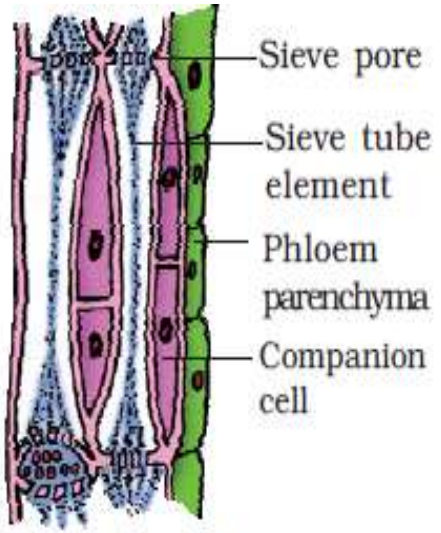


Figure 6.3 (b) Phloem tissues

Tissue system :

Epidermal tissue system

- Cuticle present- contains stomata (guard cells, subsidiary cells, stomatal apparatus)
- Trichomes – (on stem) multicellular, secrete oils. Root hairs- single celled.

Ground tissues

- Tissues except epidermal and vascular tissues.
- Mesophyll. (collenchymas, sclerenchyma, parenchyma)

Vascular tissue system

- Cambium. (lateral meristem)
- Radial vascular bundle – in roots
- Conjoint open vascular bundle - in dicot stem and leaves
- Conjoint closed vascular bundle – in monocot stem and leaves

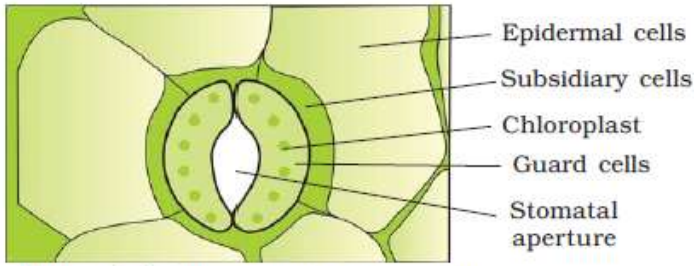


Figure 6.4 Diagrammatic representation: (a) stomata with bean-shaped guard cells

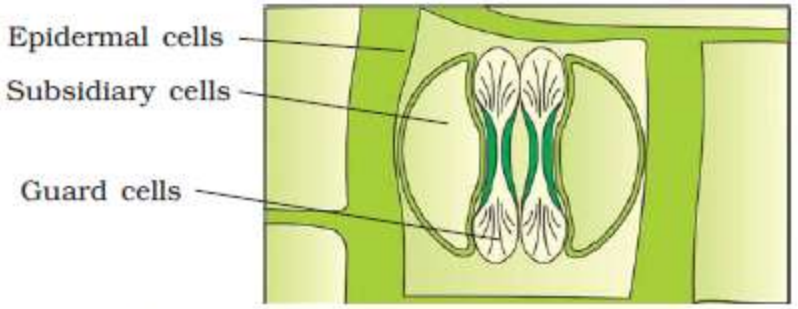


Figure 6.4 Diagrammatic representation: (b) stomata with dumb-bell shaped guard cell

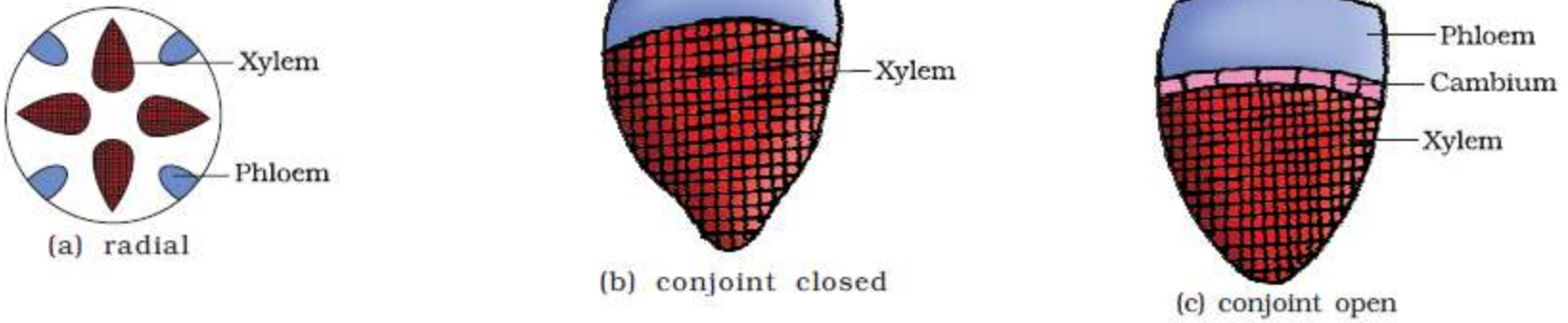


Figure 6.5 Various types of vascular bundles : (a) radial (b) conjoint closed (c) conjoint open

Anatomy of Dicotyledonous root

- Epidermis – root hair – cortex (Parenchyma) endodermis – suberin layer as casparian strips
- Pericycle (lateral roots) pith is small – conjuctive tissues (between xylem and phloem)
- Cambium ring (2-4 xylem and phloem)
- Stele (endodermis, pericycle, vascular bundle and pith)

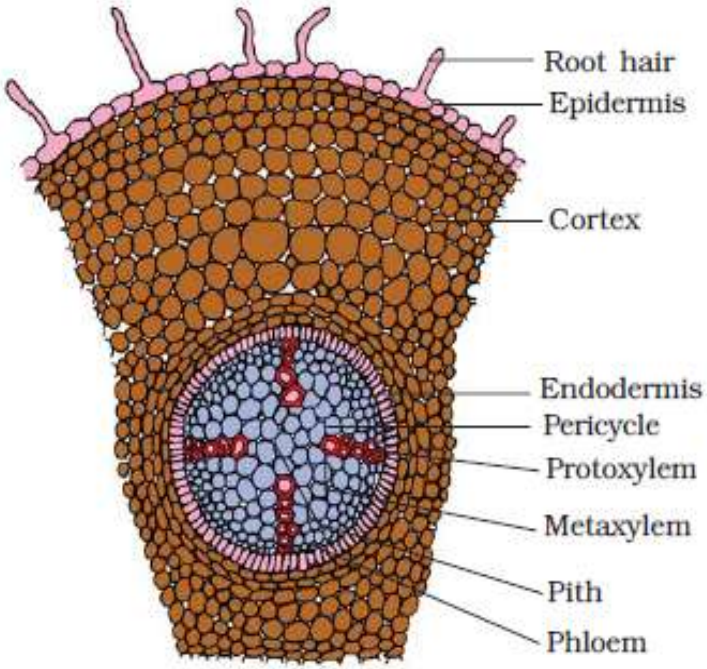


Figure 6.6 T.S (a) Dicot root (Primary)

Monocotyledonous root

- No cambium in the vascular bundles. (6 vascular bundles and are scattered) called polyarch -
- pith is large – since no cambium, and no secondary growth

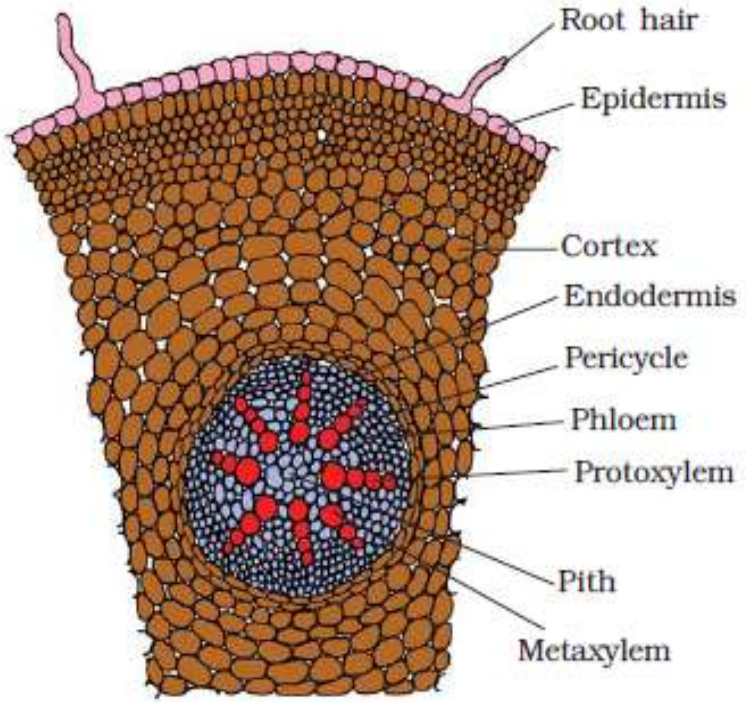


Figure 6.6 T.S (b) Monocot root

Dicotyledonous stem

- Epidermis, cuticle, trichomes, hypodermis (collenchymas)
- Cortical layer (parenchyma) endodermis(starch sheath)
- Pericycle - vacular bundles – medullary rays
- Vascular bundles are in a ring ,Conjoint, open, and endarch protoxylem
- Pith is larger (parenchyma)

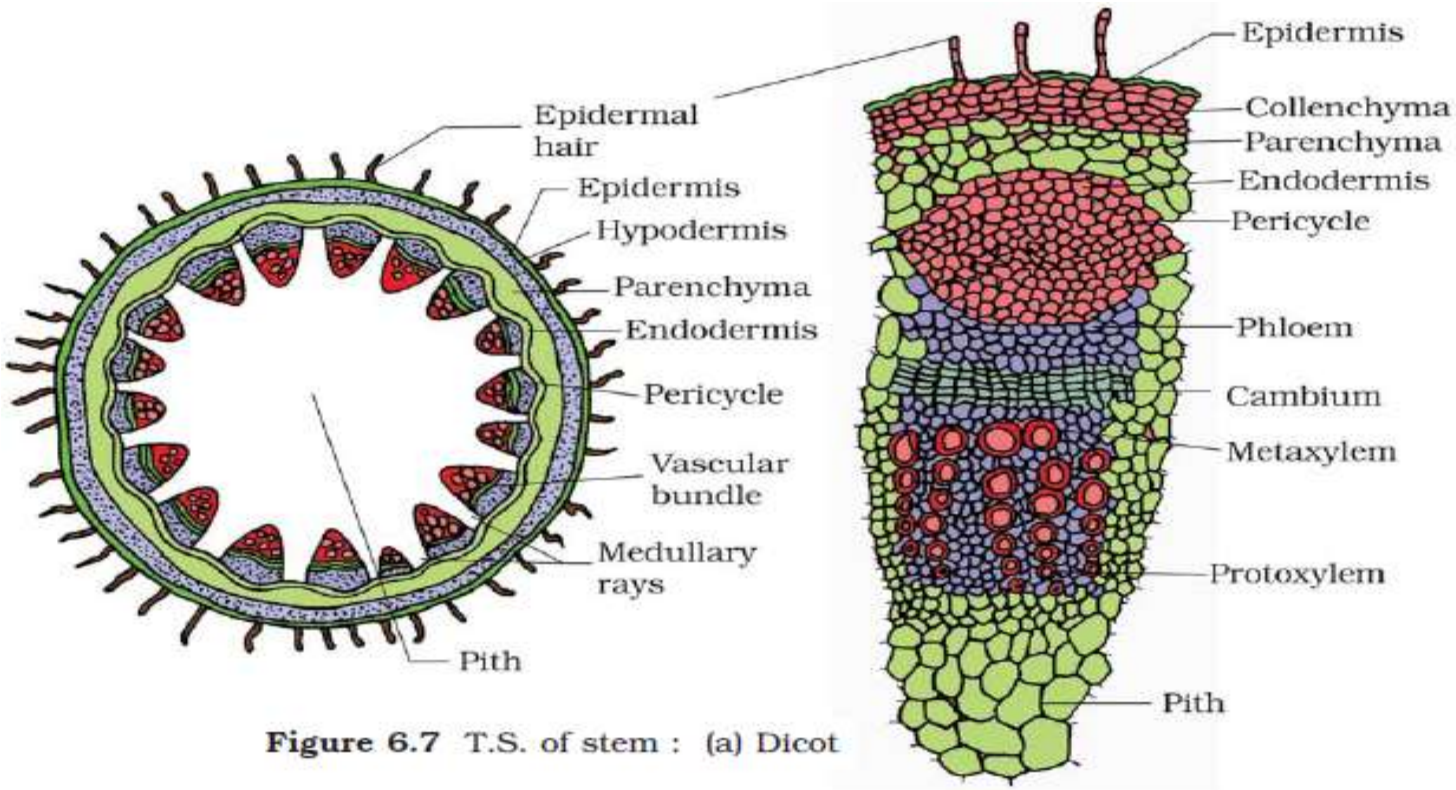


Figure 6.7 T.S. of stem : (a) Dicot

Monocotyledonous stem

- Epidermis – hypodermis (sclerenchyma) scattered vascular bundles, sclerenchyma.
- Bundle sheath – vascular bundles are conjoint, closed, no cambium Peripheral vascular bundle are smaller than central
- No secondary growth- no trichomes
- Water containing cavities are present- no distinct pith

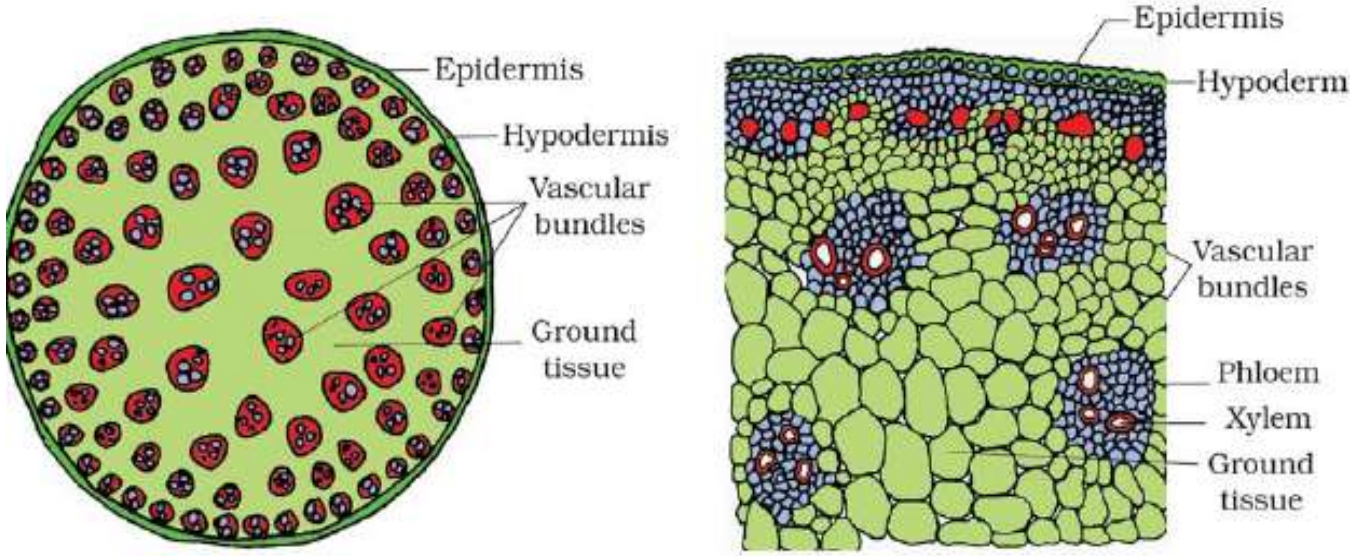


Figure 6.7 T.S. of stem : (b) Monocot

Dorsiventral leaf /dicot leaf:

- Epidermis are adaxial epidermis (upper) and abaxial epidermis (lower)
- Cuticle – stomata is more on lower epidermis
- Mesophyll – it has two types of cells , palisade parenchyma and spongy parenchyma
- Vascular system vascular bundle are present in vein and midrib
- Reticulate venation –vascular bundle are surrounded by bundle sheath

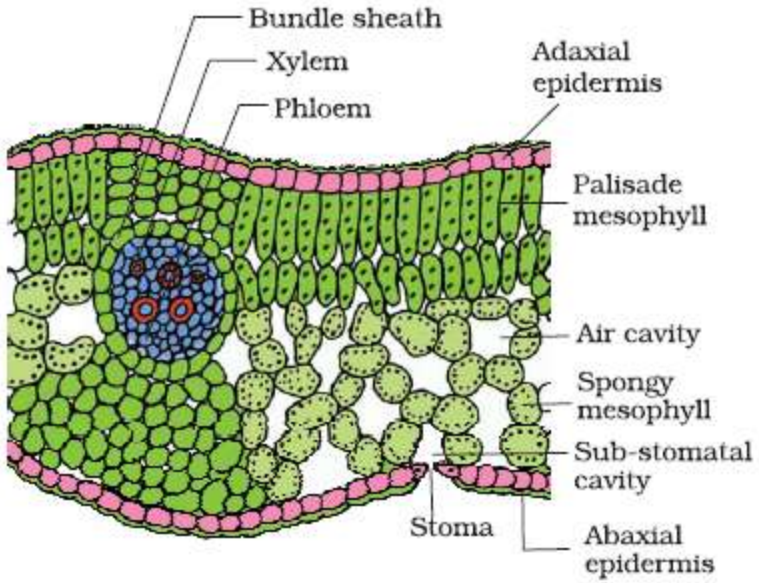


Figure 6.8 T.S. of leaf : (a) Dicot

Isobilateral / monocot leaf:

- Same anatomy – but no spongy parenchyma and stomata on both side
- Bulliform cells – parallel venation

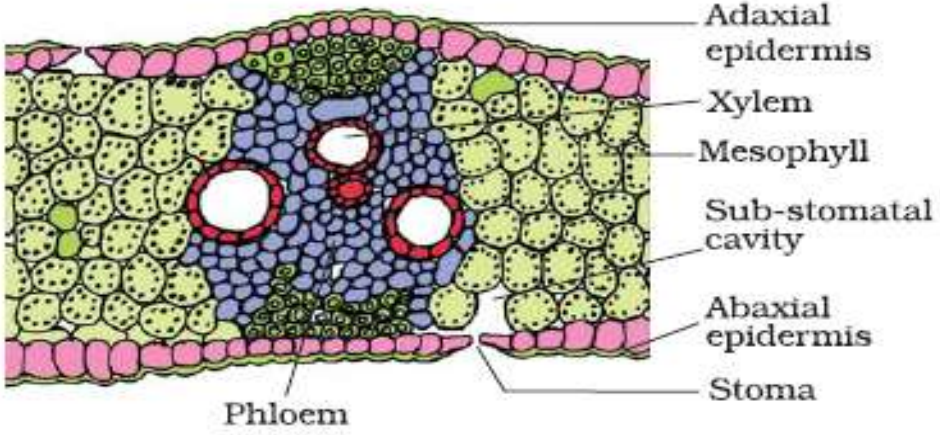


Figure 6.8 T.S. of leaf : (b) Monocot

Secondary growth:

- Primary growth- apical meristem (grows length wise)
- Secondary growth –increase in girth
- It involves lateral meristem vascular cambium and cork cambium
- Vascular cambium
- *Formation of cambial ring*
- Intrafacicular cambium
- Interfascicular cambium
- Activity of cambial ring
- Formation of secondary xylem secondary phloem
- More active on the inner side so more xylem

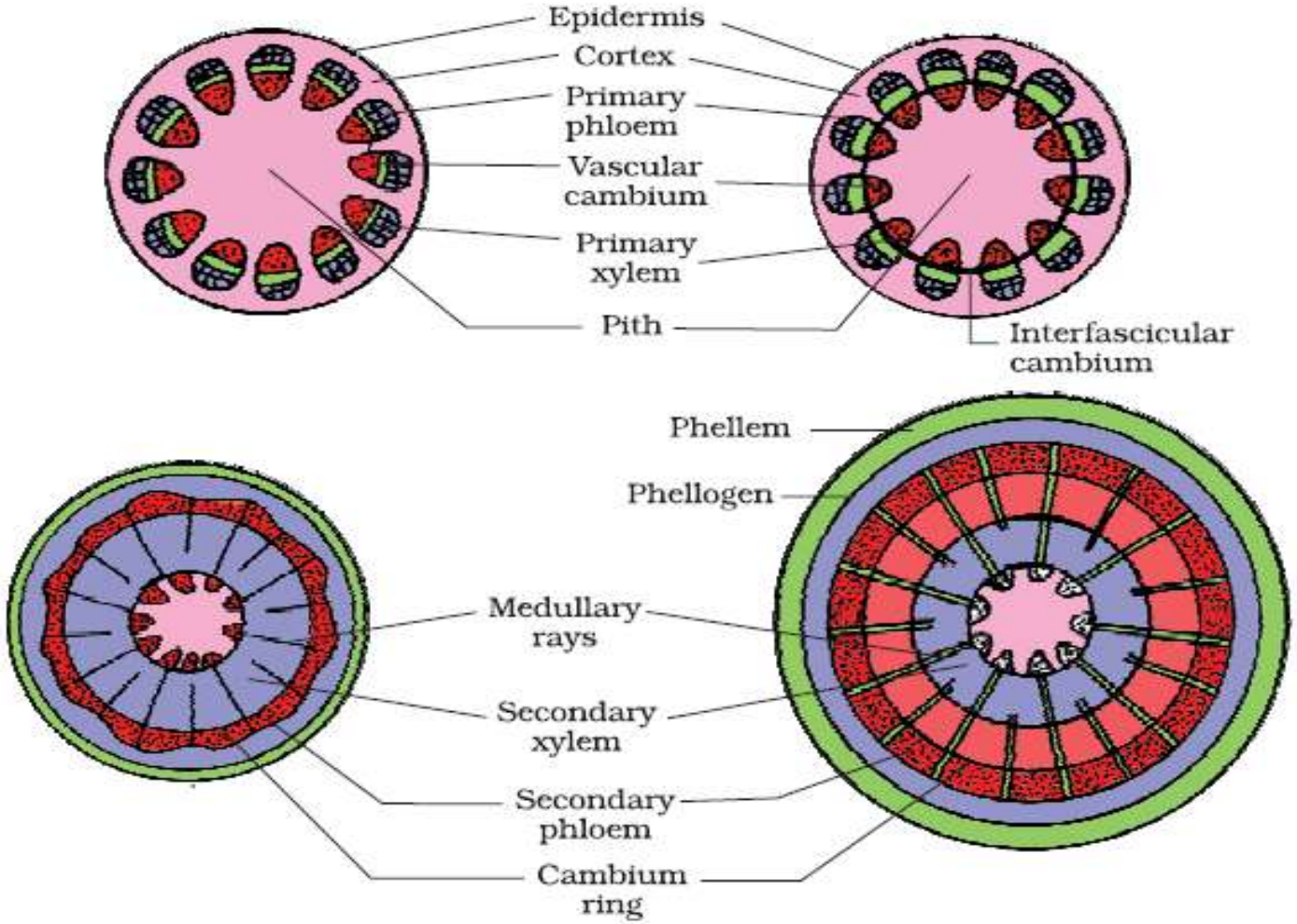


Figure 6.9 Secondary growth in a dicot stem (diagrammatic) – stages in transverse views

- ***Spring early wood –more active and light coloured***
- ***Autumn late wood – less active and dark coloured***
- The two kinds of wood that appear as alternate concentric rings, constitute an annual ring
- ***Heart wood – dead, elements, highly lignified provides mechanical support***
- ***Sap wood – peripheral region , secondary xylem, light in colour, conduction of water and*** minerals

Cork cambium:

- Cortical and epidermis layer get broken
- Replaced to provide new protective cell layers
- ***Cork cambium/ phellogen –****develop in cortex region and produce new cells towards both sides*
- ***Outer cells form cork / phellum***
- ***Inner cells form secondary cortex / phelloderm***
- Bark - soft early bark – formed early in the season
- Late / hard bark – formed late in the season
- *Lenticels. Lens shaped openings helps in exchange of gases*

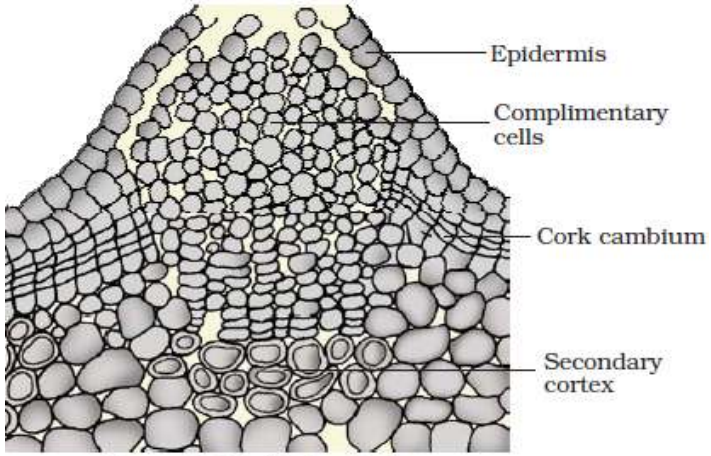


Figure 6.10 (a) Lenticel

Figure 6.10 (b) Bark

Secondary growth in roots:

- Wavy ring – later becomes circular
- Secondary growth occurs in gymnosperms too (except in monocots) as monocot do not have cambium.

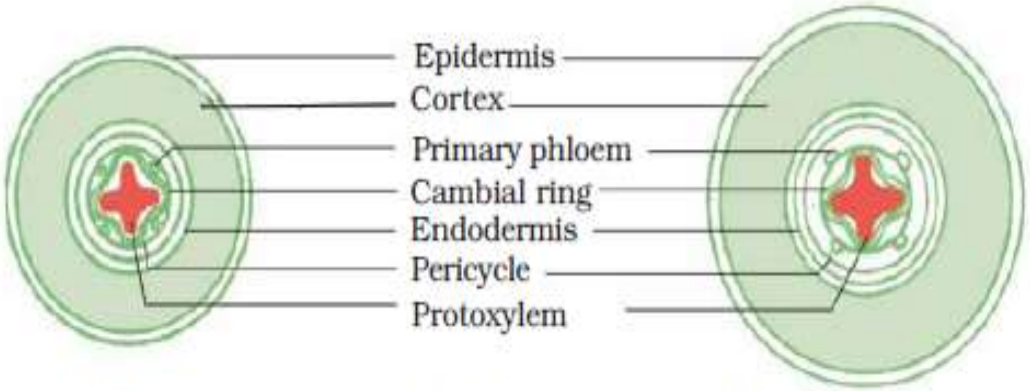


Figure 6.11 Different stages of the secondary growth in a typical dicot