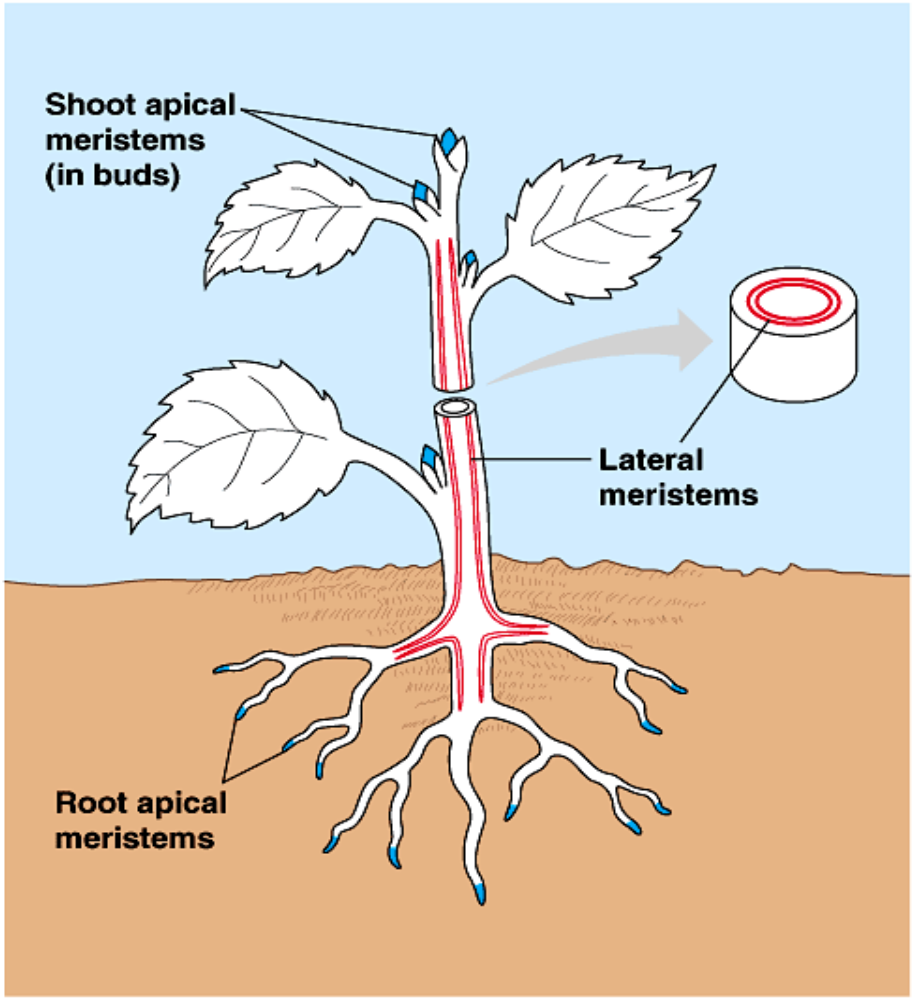
Plant Structures and Function

Meristematic Tissue

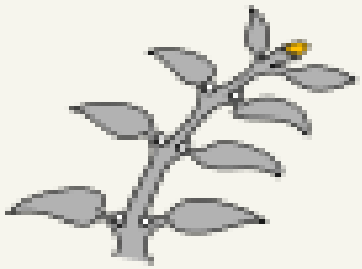
(Embryonic-can develop into different cells)



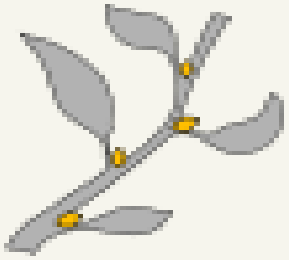
Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

Types of Buds

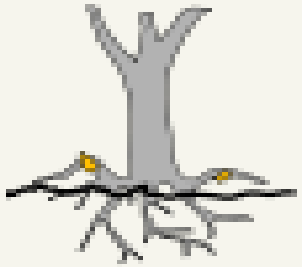
by Location



Terminal

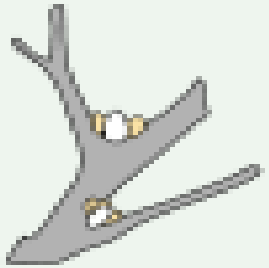


Axillary



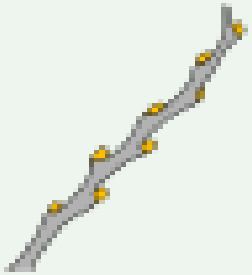
Adventitious

by Status



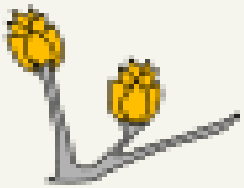
Accessory

Pseudoterminal

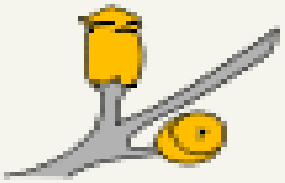


Dormant

by Morphology



Scaly



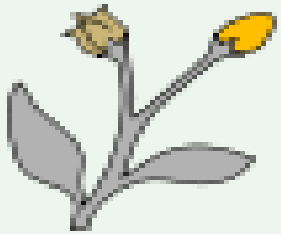
Covered

Hairy

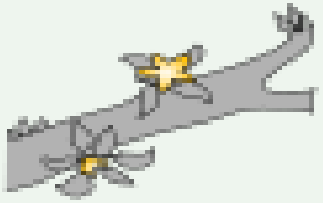
Naked

by Function

Vegetative



Reproductive

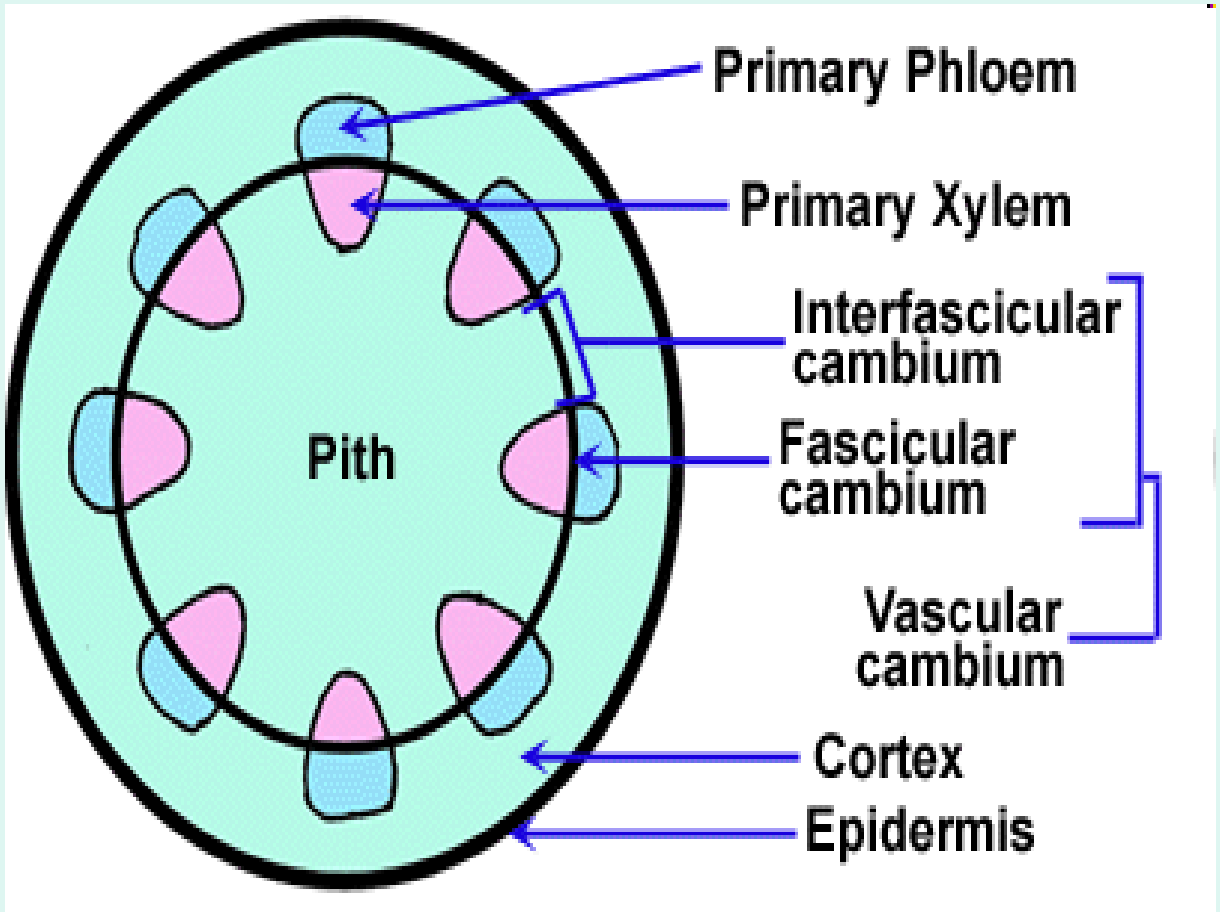


Mixed bud

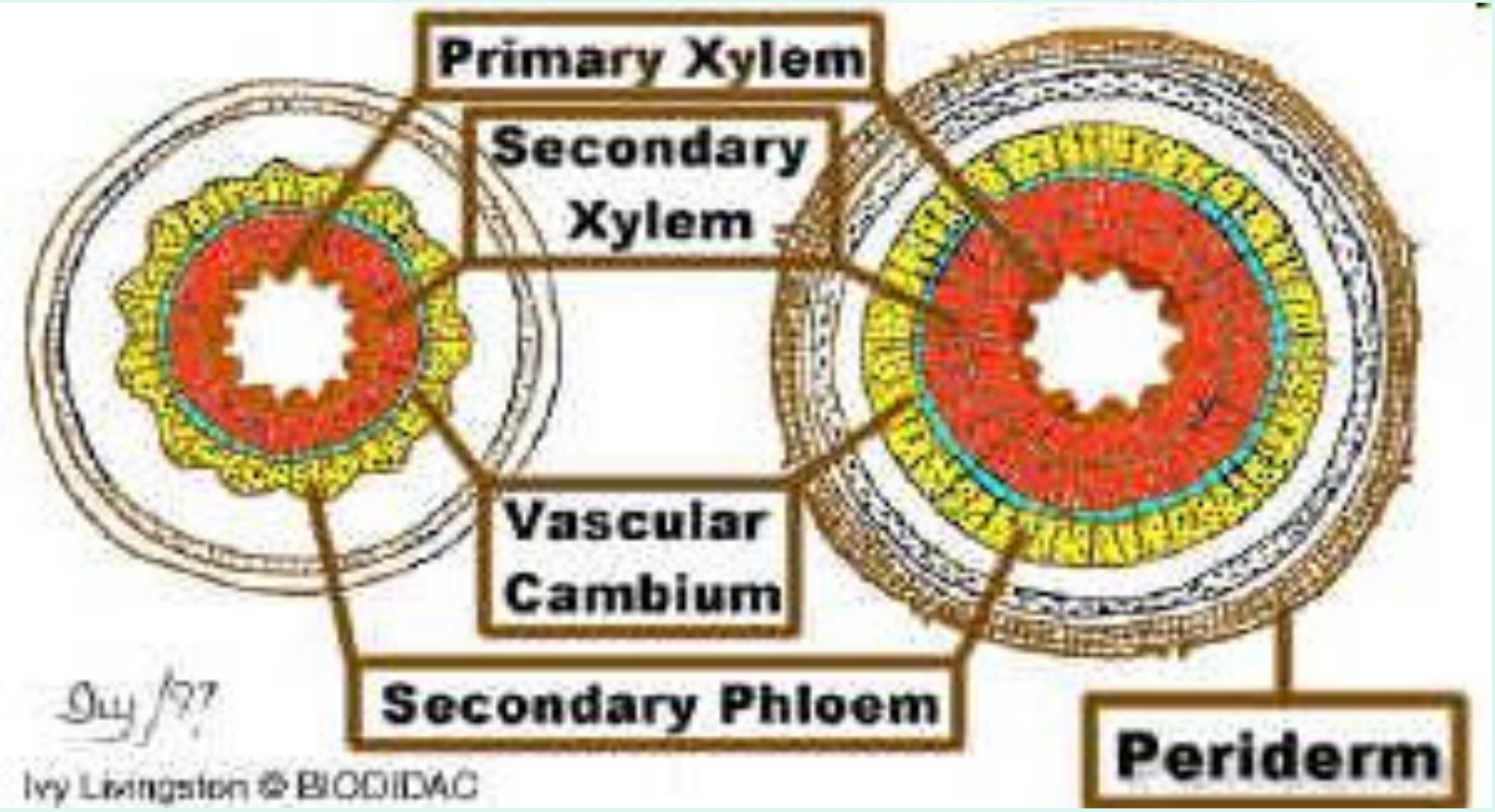
Meristematic Tissue (growth)

Type	Structure	Function
Apical Meristem	•**At root tip & buds of shoots** •Found in herbaceous plants, young shoots or youngest parts of woody plant	•Unspecialized plant tissue •From which all primary tissues (dermal, vascular, ground) are derived •Responsible for **primary growth (in length)**
Lateral Meristem	•2 types: **vascular cambium** (produce vascular tissue and ground tissue)& **cork cambium** (produce cork) •Cylinders of cells extending along length of roots and shoots •Never in leaves •In mature parts of woody plants (e.g. base of tree branch)	•Responsible for **secondary growth (in width/diameter/girth)** •Adds strength to plant structure •Accounts for formation of woody rings in tree trunks

Vascular Cambium in the vascular bundle (between xylem and phloem)

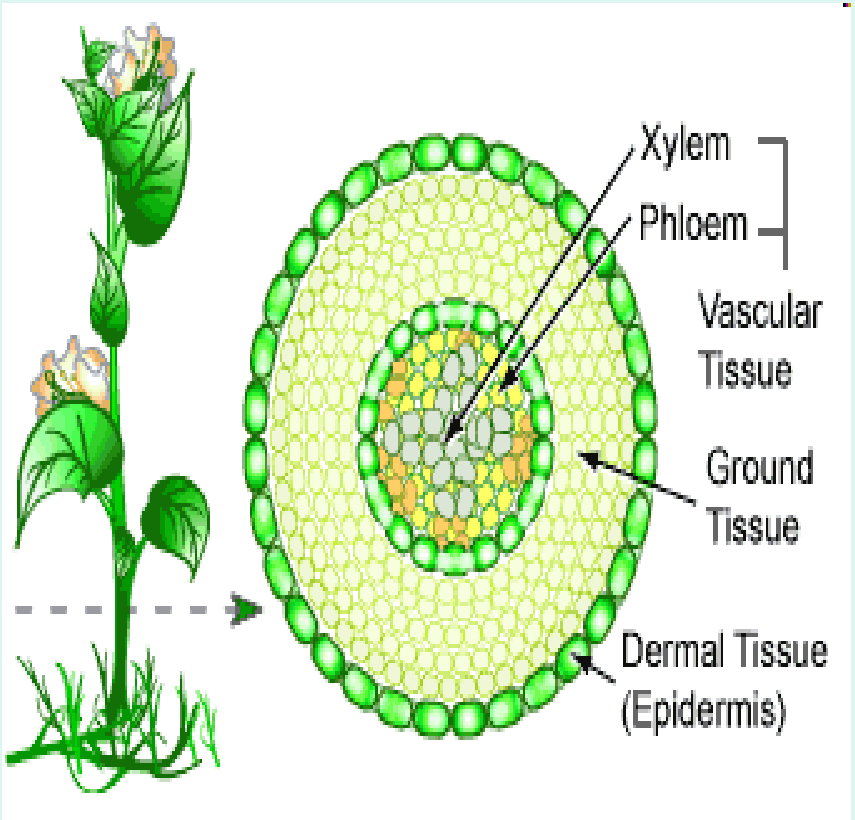


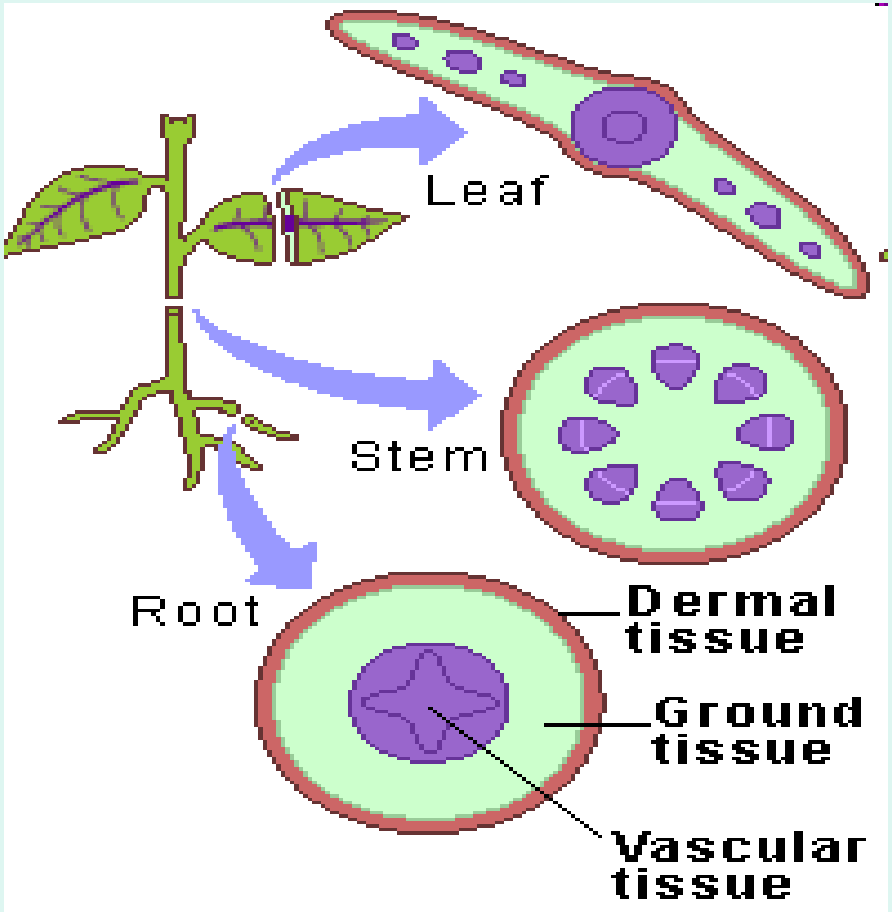
<u>Vascular Cambium</u> cells divide and form **secondary xylem** towards the inside & **secondary phloem** towards the outside. Seasonal climates produces growth rings because cells grow faster and are larger in the spring than later in the growing season.



Dermal, Vascular, and Ground Tissues

Dicot Root Cross-section

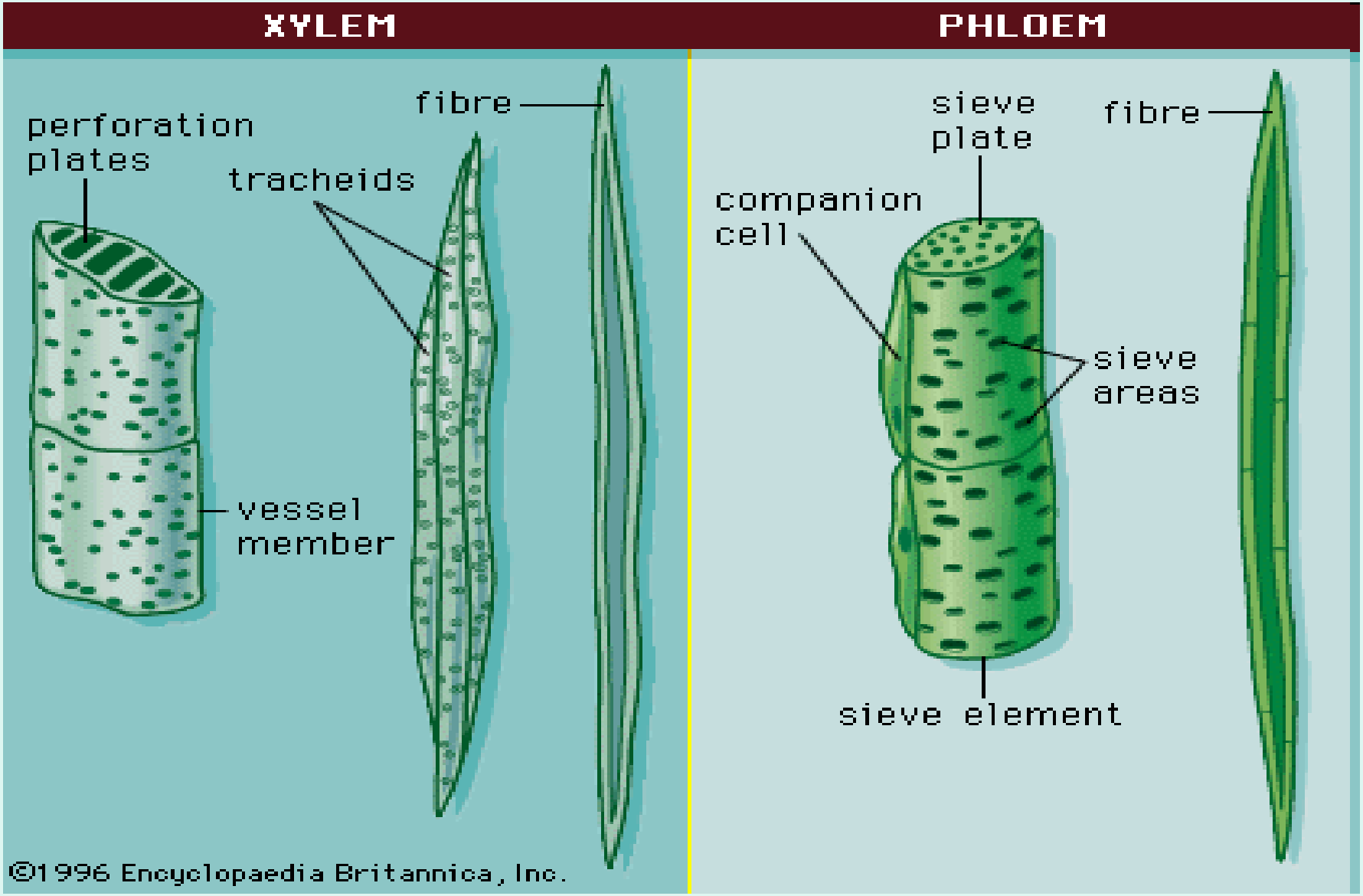




Dermal Tissue (protective)

Type	Structure	Function
Epidermis	•Flat rectangular cells •Layer is 1 cell thick •Outer layer •Surface covered with waxy layer (cutin/cuticle) •In leaves and herbaceous roots/stems	•Waterproofing (cuticle) •protection •Prevent from infection
Cork	•Dead and hollow cells •Covers surface of roots and stems •Replaces epidermis during secondary growth •In roots/stems of woody plants	•Waterproofs roots and stems

Vascular Tissue



Vascular Tissue (conductive)

Xylem

Structure	Function
•2 types: vessel elements (only in angiosperm) and tracheids •Long thin cylindrical cells •Dead and hollow •Perforated side and end walls •End-to-end arrangement of cells	•Transport of water and dissolved minerals from root to leaves

•Why dead cells? The cells need to be hollow to facilitate water flow, →cytoplasm dies and the cell has empty space, also the plant saves energy to maintain them.

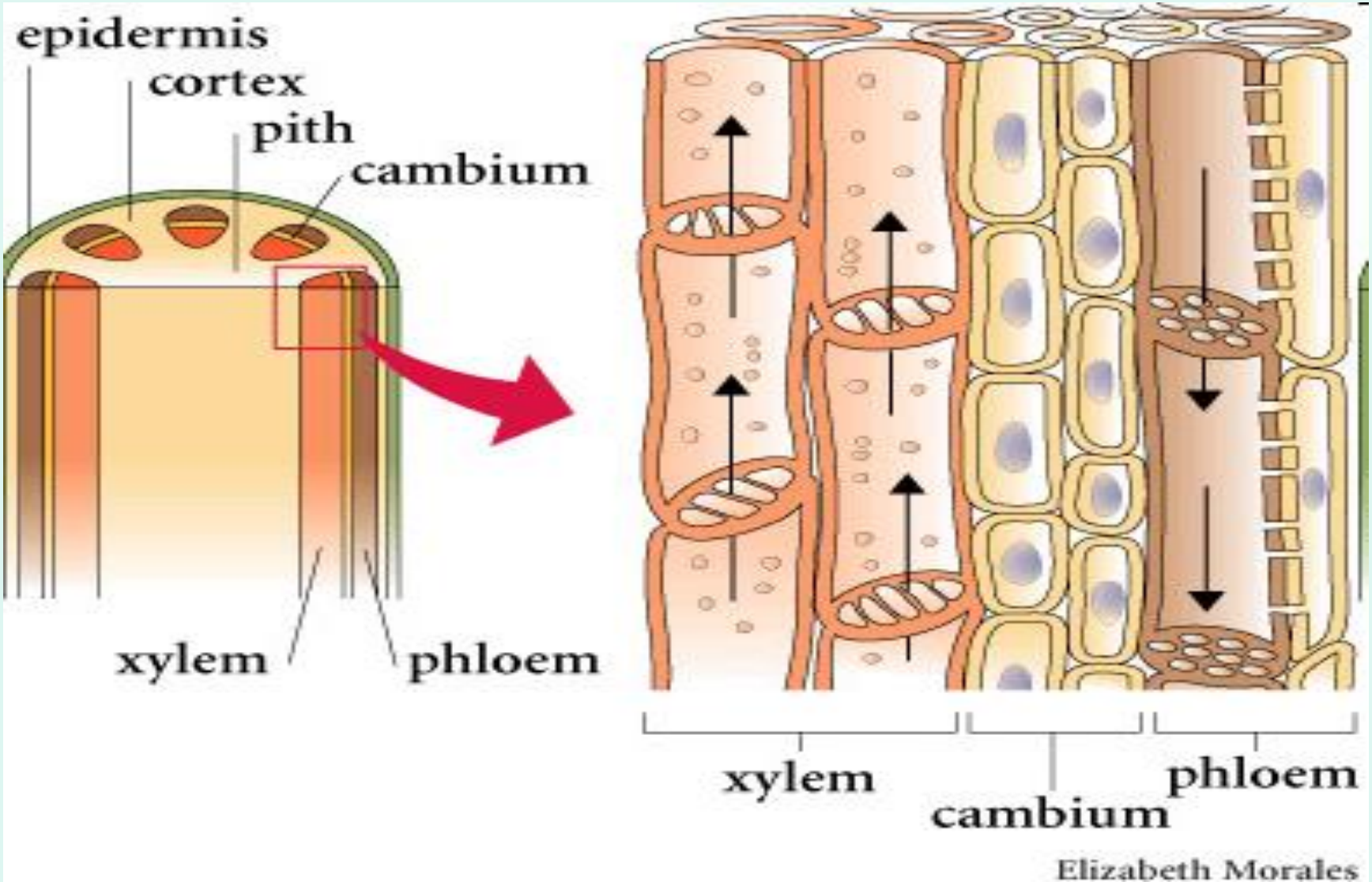
Phloem Structure and Function

Long cylindrical cells •Living, contains cytoplasm, no nucleus, •Perforated end (cytoplasm connected) •Companion cell adjacent to phloem, responsible for control activity in phloem	•Transport manufactured food from leaves to roots for storage and other parts for use •Transport hormones •Require energy from cellular respiration

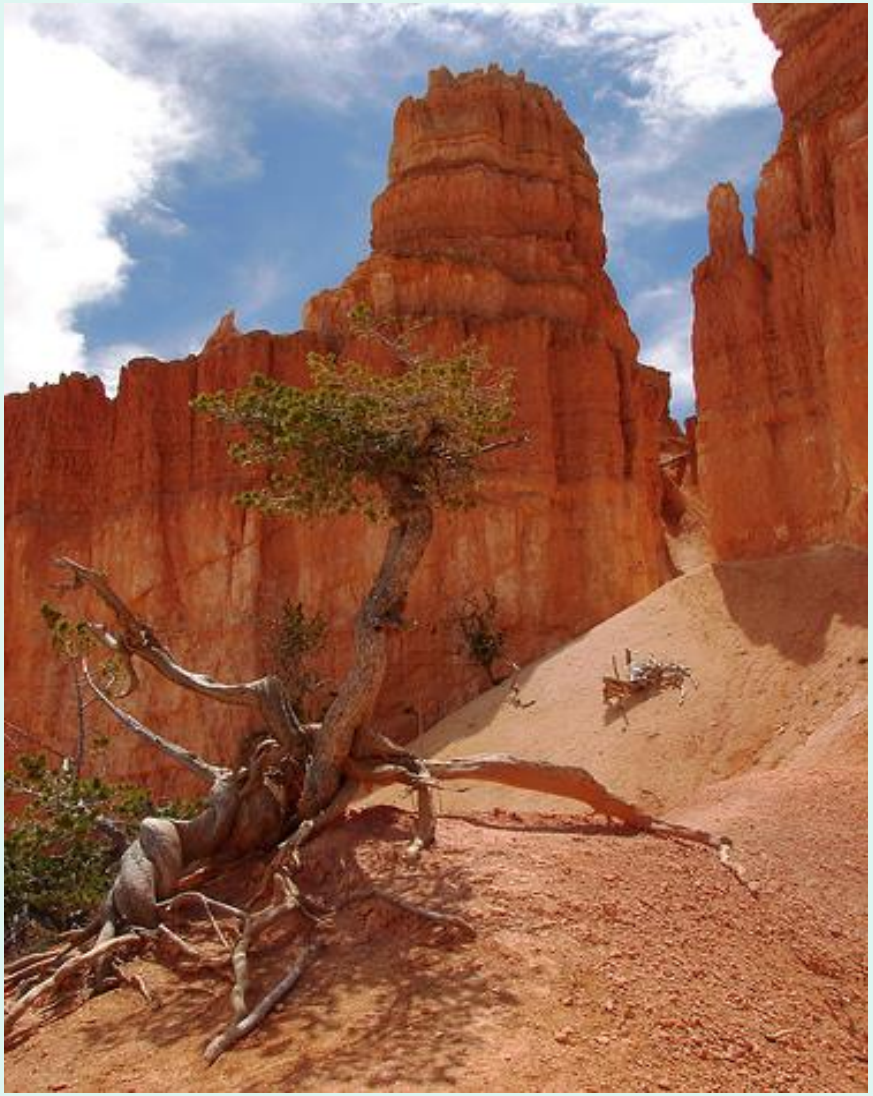
Ground Tissue (Fundamental)

Type	Structure	Function
Cortex	Root and stem	Storage of starch (root), structural support (stem)
Pith	Only in stem	Storage of water (stem)
Mesophyll	Leaf:palisade & spongy mesophyll cells	Varies depending on cell type **Photosynthesis**

Ground Tissue – cortex (root & stem) and pith (in stem)



Roots – Utah Canyons



Roots – Hawaii

Root Composition

- <u>3 main roles of roots:</u>

-anchor plant to ground

-absorb water and nutrients from soil

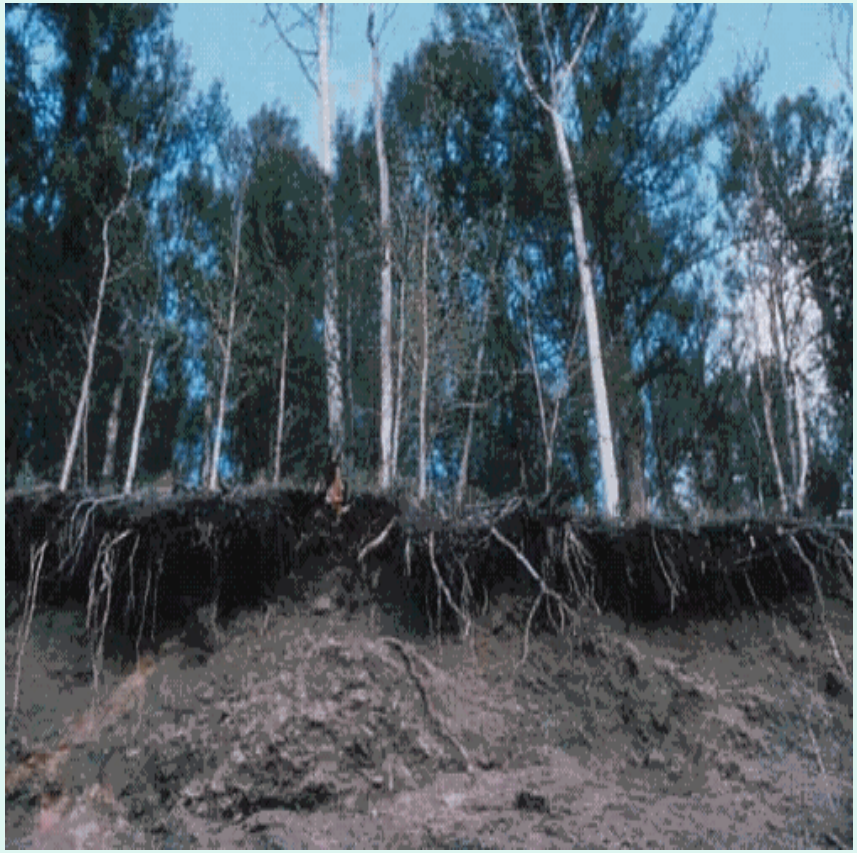
-starch storage

- <u>3 types of tissues</u> that make up the root from outer layer to the core:

-epidermis (dermal tissue)

-cortex (ground tissue)

-Vascular tissue (xylem/phloem)



Root

- Function of the root hairs:

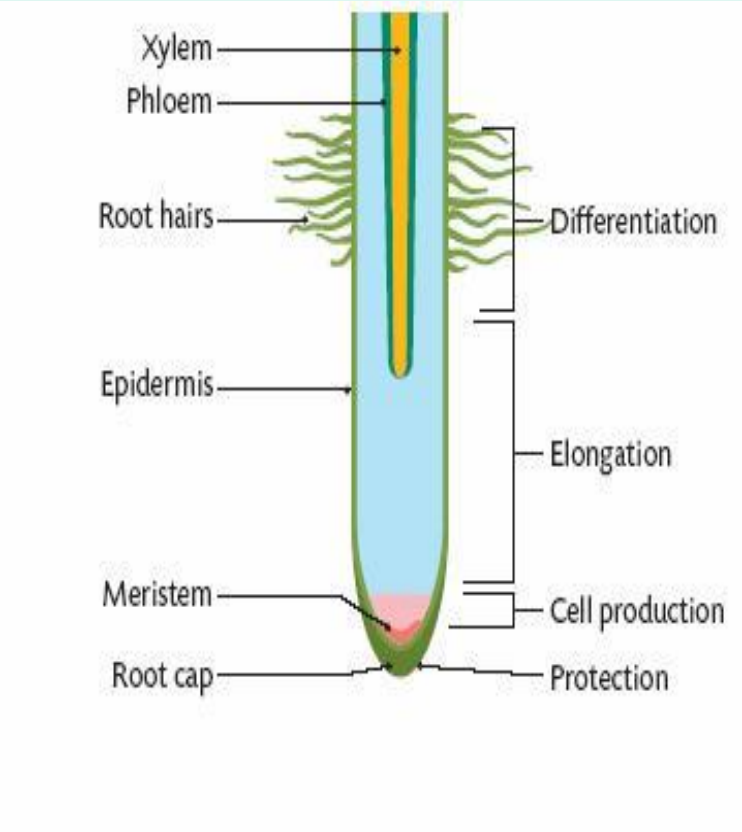
- absorption of water and minerals

→many hairs increase the surface area

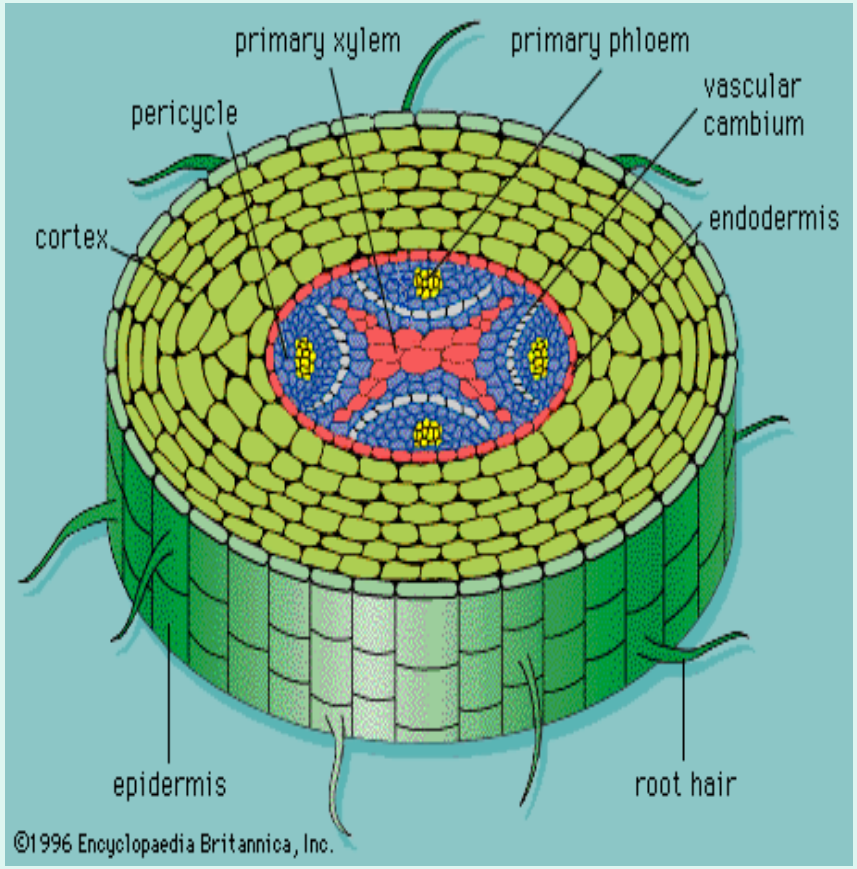
- Cells in the epidermis cannot perform photosynthesis as they do not possess chloroplasts
- Instead, epidermal cells undergo cellular respiration to obtain energy The GLUCOSE comes from the starch in the cortex of the root
    - $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy

4 Zones of the Root

1. Zone of maturation: cells differentiate into different types of cells.
2. Zone of elongation: allows the root to get deeper within the soil
3. Zone of Cell Division (Meristematic region): rapid mitosis of undifferentiated meristematic cells.
4. Root cap: protects the meristematic region.



Root



- Storage of starch in

-the cortex (ground tissue, under epidermis)

-the vacuole of each cell (cell organelle)

- Vascular tissues are clustered in the centre of the roots

Root Types

Advantages of the Two Types of Root System

- Fibrous root:

1) larger surface area for absorption
2) Holds topsoil in place

- Tap root:

1) Firm anchor
2) food storage
3) Locate water source far below ground

Ex) carrots, beets

Roots

- **Adventitious roots (monocot)**: emerge from tissues other than root (stem & leaf)

- **Endodermis (= innermost layer of the cortex)**

-surrounds the vascular tissue

-structure: thin continuous ring of cells

-function: filters materials entering vascular tissue (which will be transported to the rest of plant) with selectively permeable membrane (selects only desired molecules)

-**textbook figure 14.36 p.544**

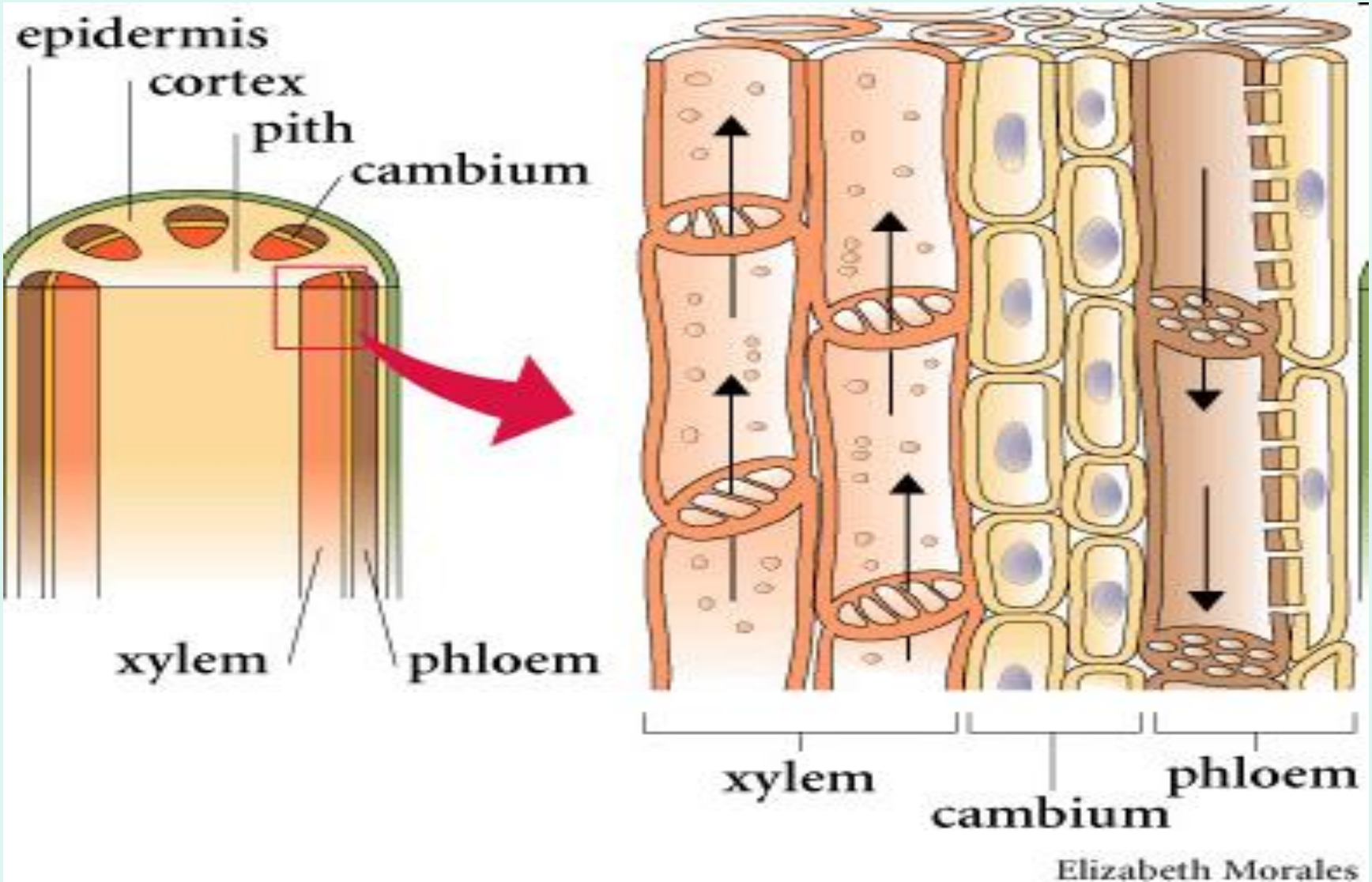
The STEM

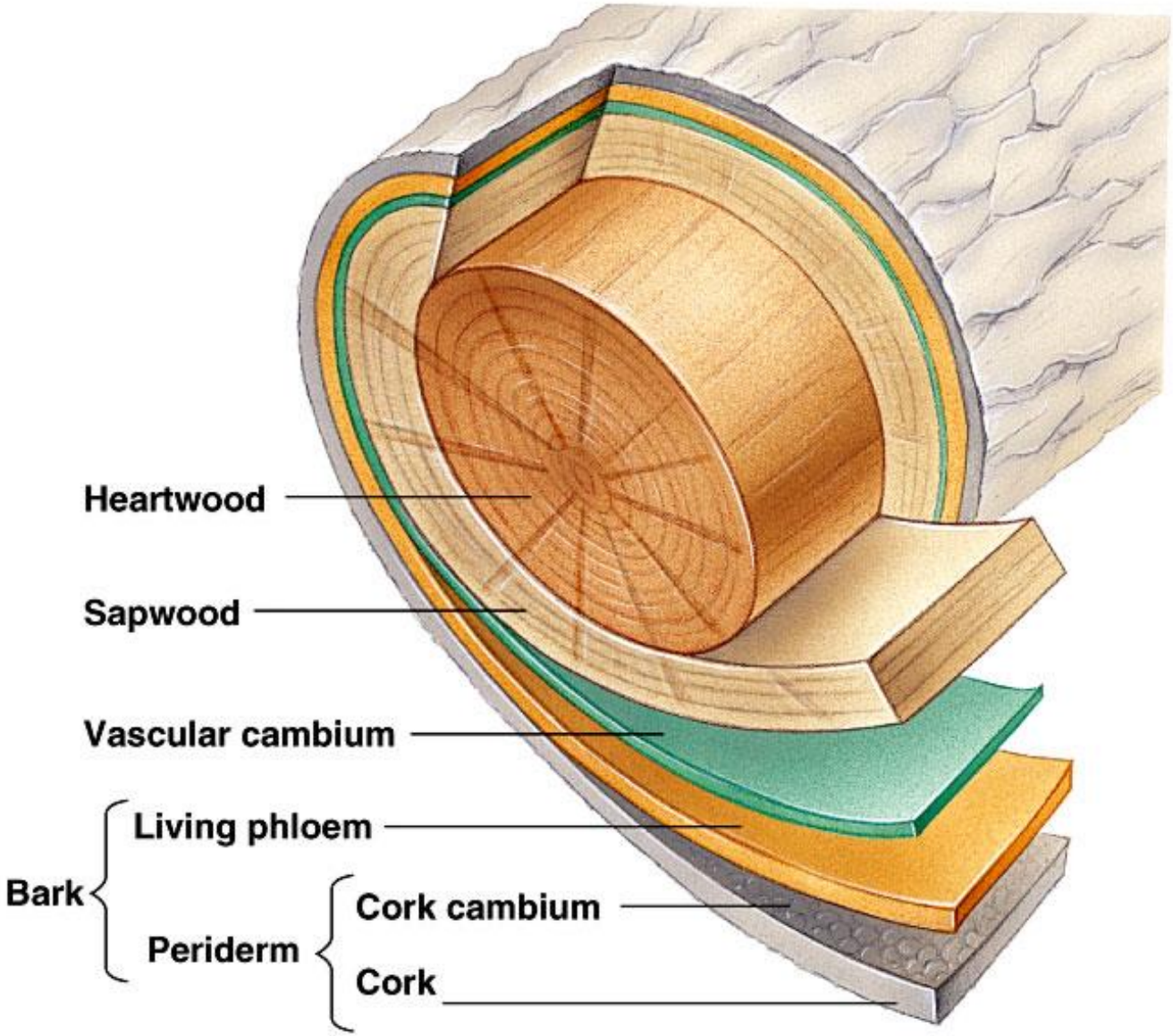
Stem - Logging

Stem - Hawaii

Stem - Grafting

Stem Structure:





Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

Stem Composition

- **Epidermis**:
  -protective layer
  -Contains chloroplasts, cuticle, stomata
  -Allows for photosynthesis to take place

- **Cortex**:
  -Layer of tissue surrounding the pith.
  -Rigid tissue, Structural support
  -Also stores water and some nutrients
- **Pith:**
  -Found in the center of the stem
  - Contains air spaces (spongy tissue)
  - Stores water and some nutrients.
- **Vascular tissue**
  -xylem and phloem

Stem Composition

- 2 main roles of stems:

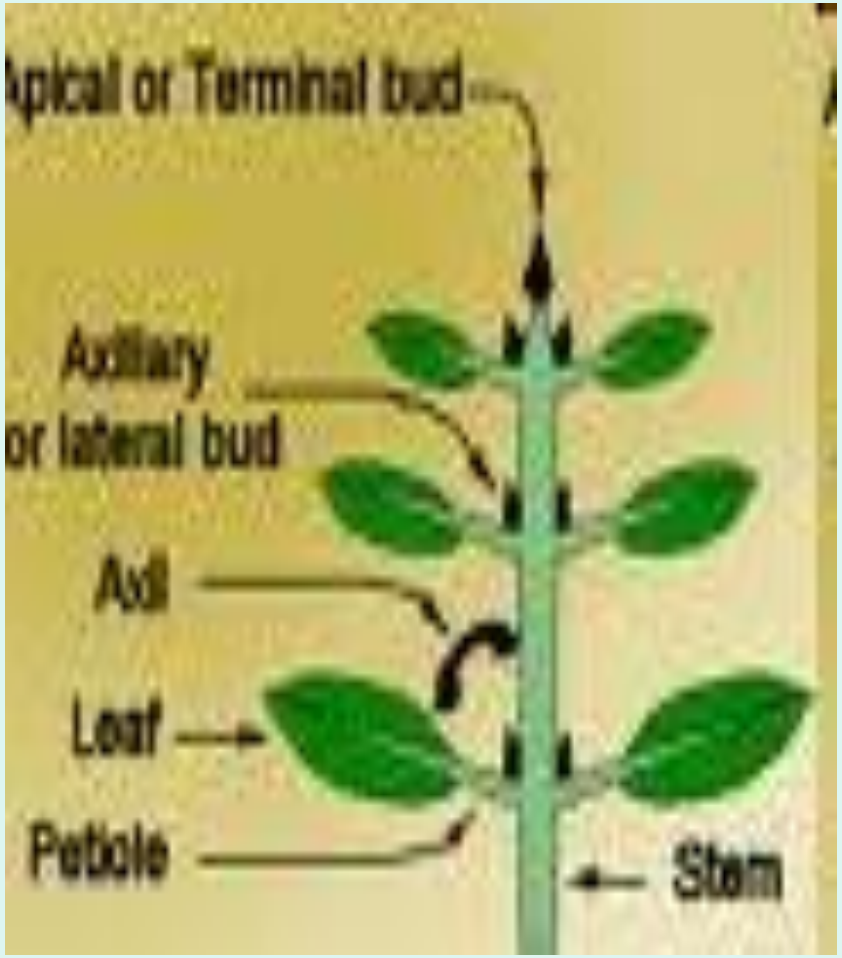
1) structural support
2) Water and nutrient transport

- An axillary bud: bud that has a potential to form a new stem →
- A terminal bud (apical bud): bud located at the tip of a plant stem (dominant in a young shoot),

- **Apical dominance**: terminal buds inhibit growth of axillary buds→ plant concentrates on growing taller for more light exposure

- Ex) when gardeners prune trees, they remove terminal buds which remove inhibition on axillary bud → axillary buds break dormancy and grow into new branches

Stem


Apical or Terminal bud
Axillary
or lateral bud
Axil
Leaf
Petiole
Stem

Modified stems

stolons (strawberries)

rhizome (ginger)

tuber (potato)

bulb (onion)

cactus -vertical stem (stores water)

Stem- Stolon

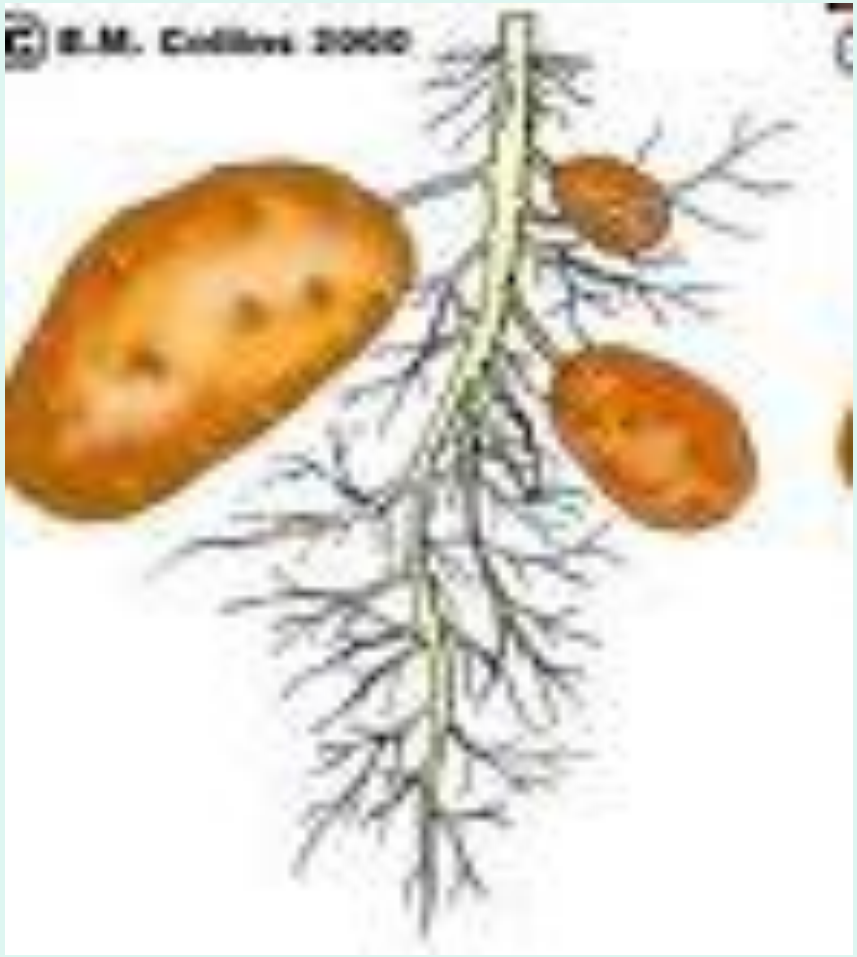
- Surface of ground
- Horizontal growth
- Buds can develop into stems of new plants
- Ex) strawberry

Stem - Rhizome

- Underground
- Horizontal growth
- Buds can develop into stems
- Ex) ginger
- Why aren't these roots?
  → main function of roots is absorption and roots do not have buds

Stem-tuber

- Swollen ends of rhizomes
- For food storage
- Buds can grow into new shoots above ground
- Ex) potato



Stem- bulb

- Underground
- Small stem
- Has paper-like cover
- Surrounded by layers of modified leaves
- Ex) onion, tulip

The Leaf

- The main role of the leaf : **photosynthesis**
  (to convert solar energy into chemical energy)

- Parts of the Leaf:

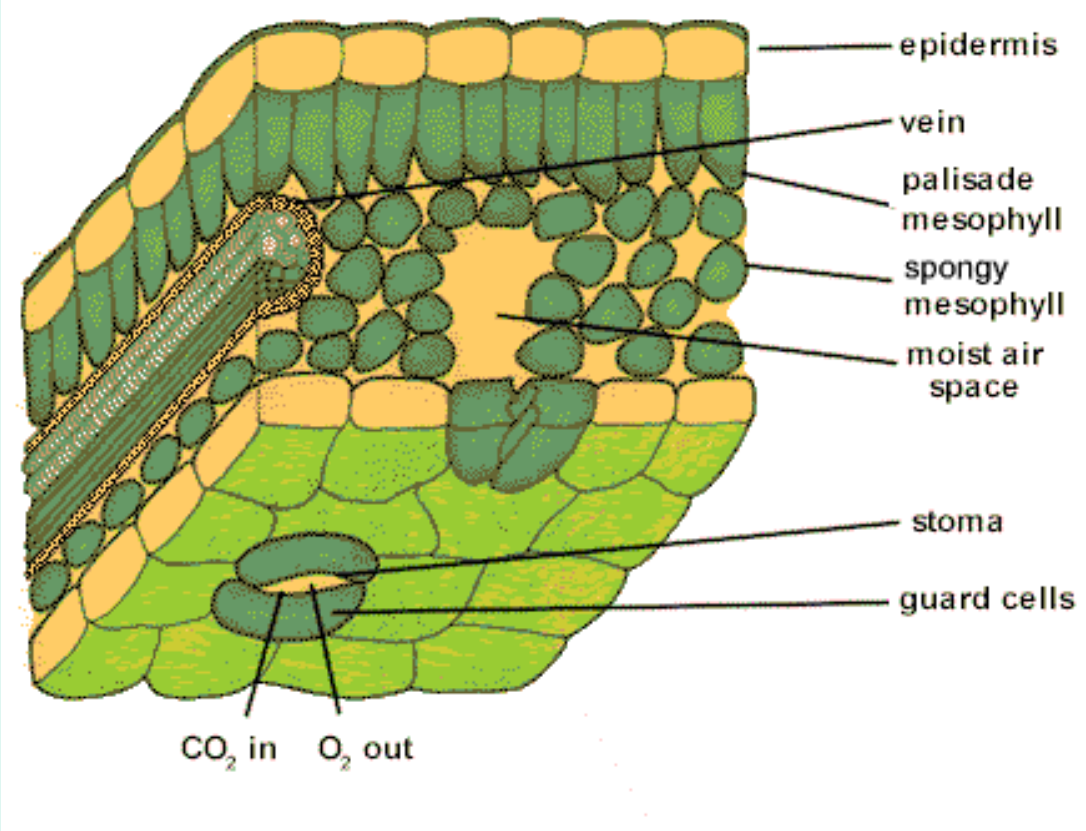
-Epidermis

-Palisade layer (mesophyll)

-Spongy layer (mesophyll)

- Vascular Tissue
- Stoma and guard cells

Diagram


epidermis
vein
palisade mesophyll
spongy mesophyll
moist air space
stoma
guard cells
CO_2 in
O_2 out

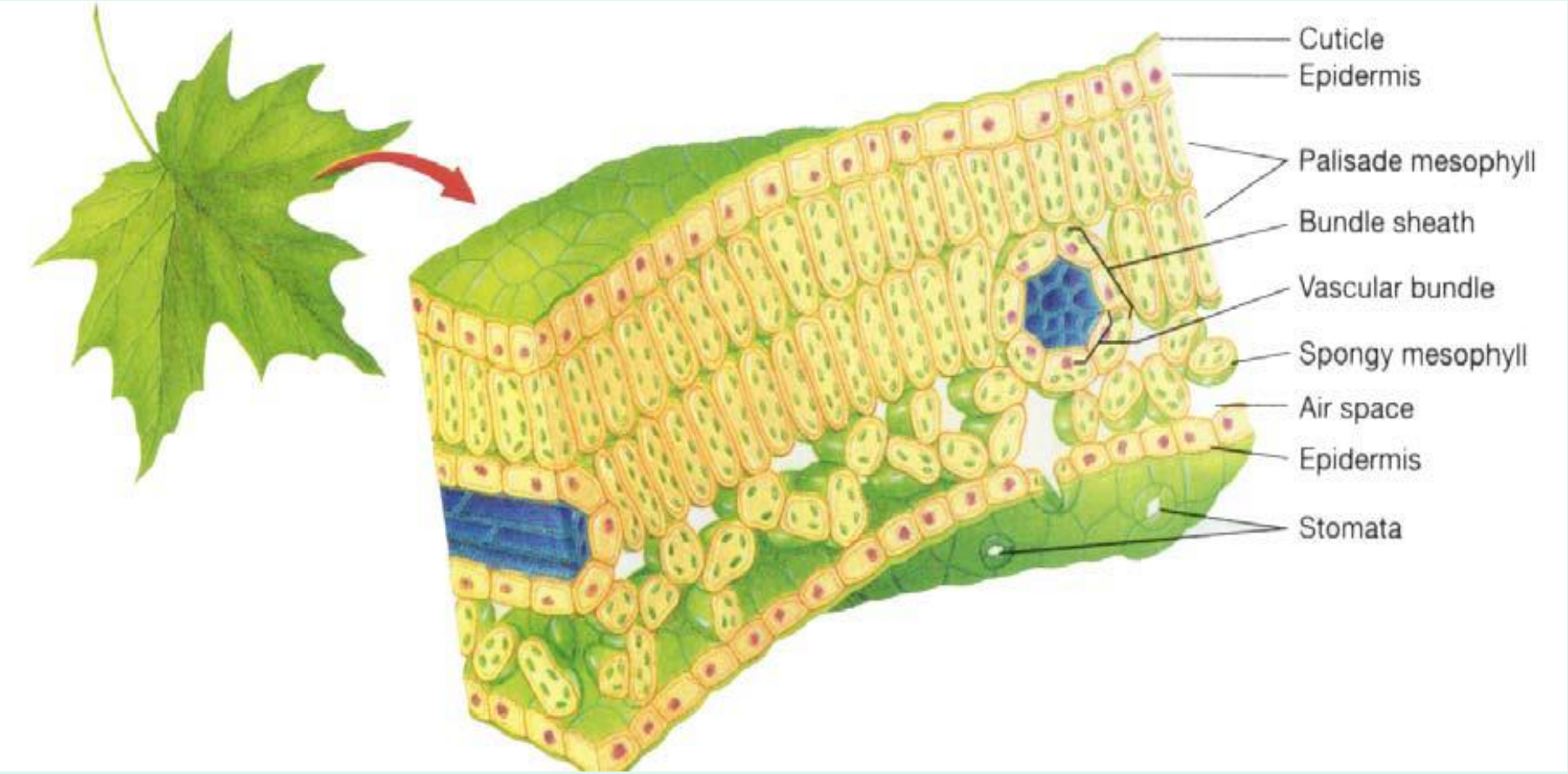
Zea Mays (Maize Corns)

Cuticle

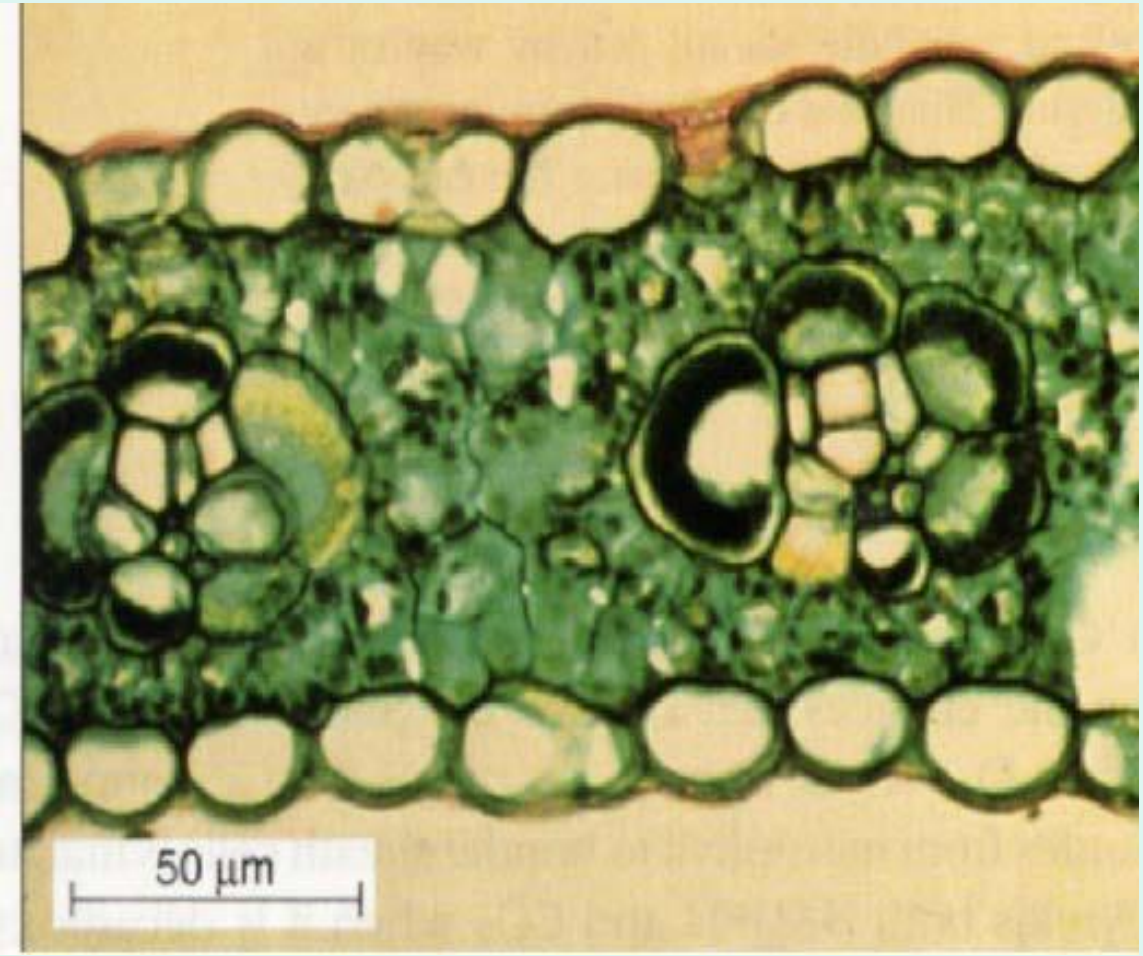
- Function: protection, prevent water loss
- Structure: waxy coating

- * Epidermal cells and cuticle are transparent to allow light to go through

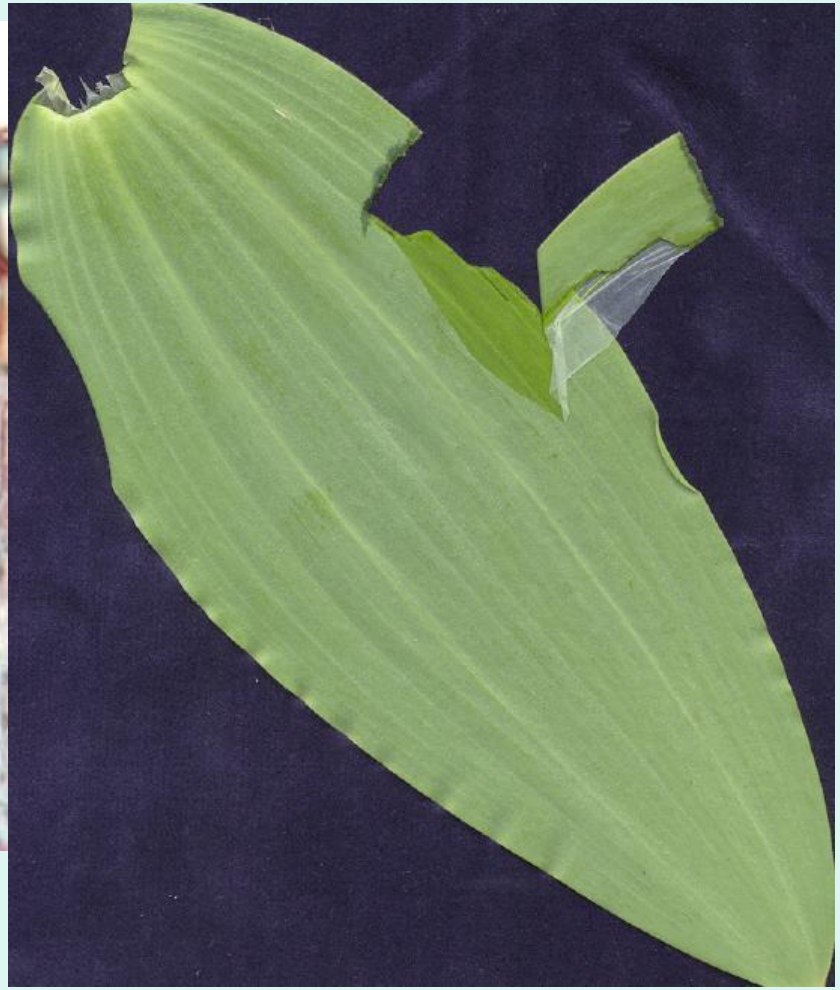
Dicot Leaf


Cuticle
Epidermis
Palisade mesophyll
Bundle sheath
Vascular bundle
Spongy mesophyll
Air space
Epidermis
Stomata

Monocot Leaf (*Zea)*



Leaf



Palisade Cells

- Function: **photosynthesis**
- Structure: long, thin cells packed up
- How is its structure related to its function?

  -top end of cell is exposed to light.

  -bottom end is exposed to the gases(CO_2) in the spongy layer.
- →pack cells into upper surface of leaf →maximizes collection of light

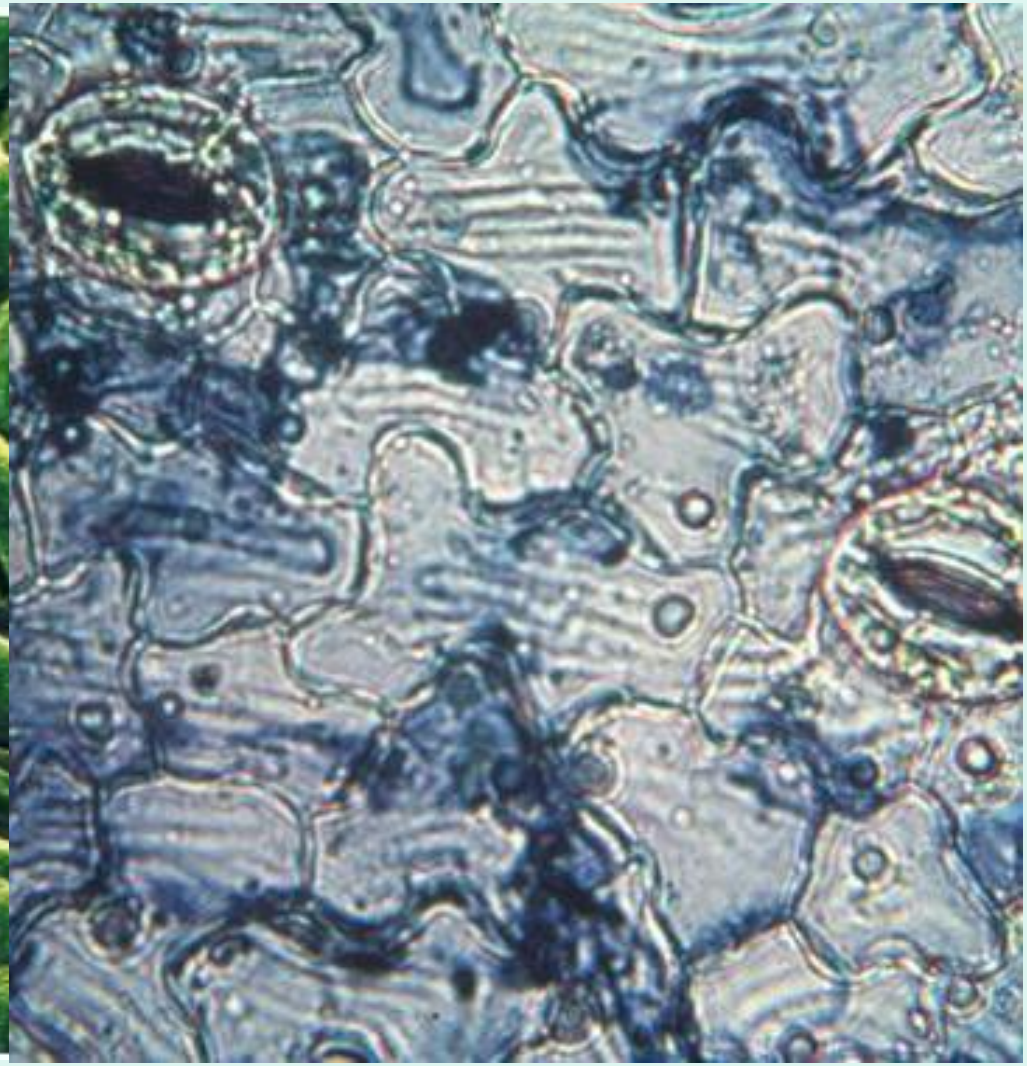
Spongy layer

- Contain mesophyll cells for photosynthesis
- Cells are not packed
- Has air space (contains CO2, O2, water vapour)

Stoma (in lower epidermis)

- from the Greek word “mouth”.
- Structure: pore-like openings in the plant’s epidermis.
- Function: to permit gas exchange between the leaf’s interior and external environment.
- The larger the opening, the faster the gas exchange
- opening is controlled by two guard cells.

Leaves - Stomata

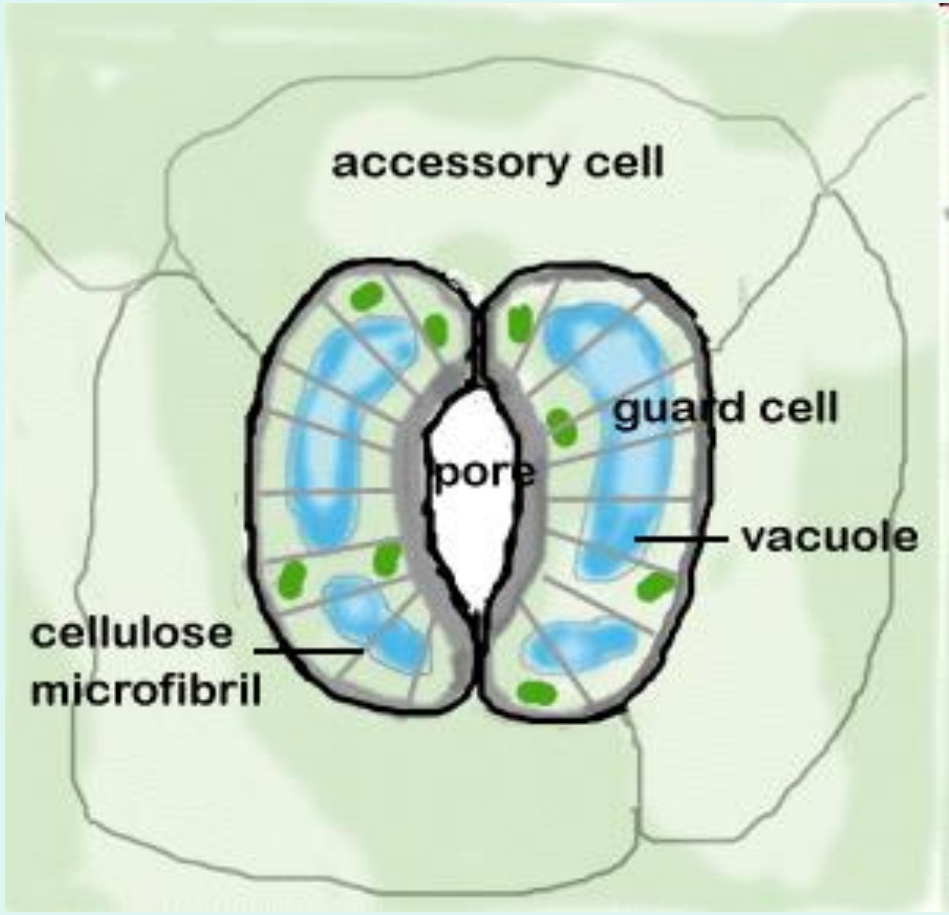


Guard Cells

- Structure: paired, thick inner wall, has microfibrils
- Function: controls the size of the stomata, the rate of gas exchange

How Guard Cells Work

- **<u>To open:</u>**
- Water flows into the guard cells, pushing out on the cell membrane →rings prevent increase of cell in diameter → cell increases in length → but <u>outer wall is more flexible and bulges outwards</u> → <u>inner wall is pulled</u> and stoma opens



Guard Cells

- To Close:
- Water flows out→ guard cells return to the resting position → inner walls relieved →stoma closes

- http://www.bcb.uwc.ac.za/ecotree/leaves/stomata.htm

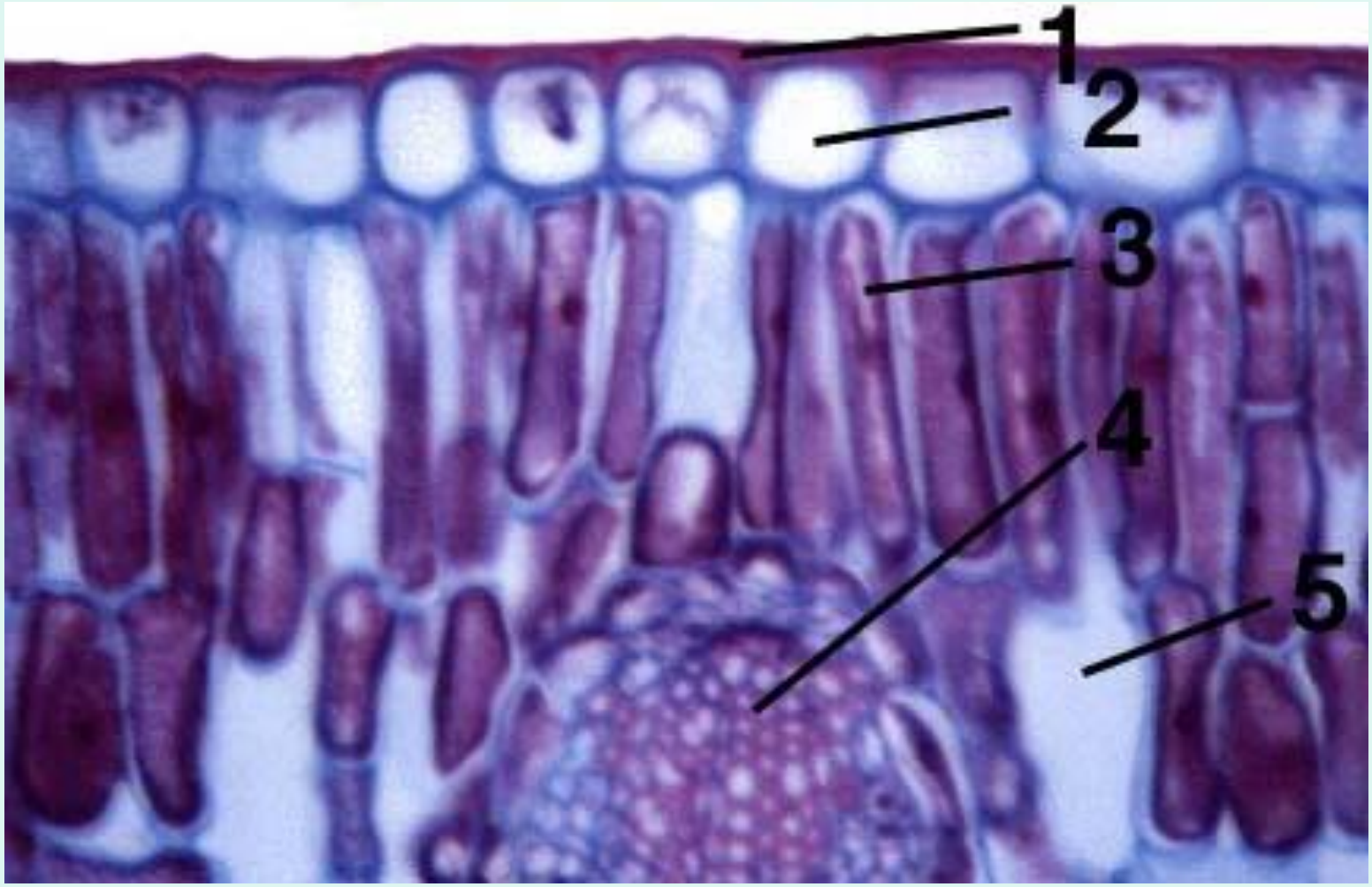
Vascular Tissue
Add row to your table

- The VEINS – made up of xylem and phloem which are bundled together in thin strands.
- Think back to the veins in a dicot and monocot flower. Which veins are parallel and which are net-like?
- They allow the movement of water and nutrients

Movement of Water

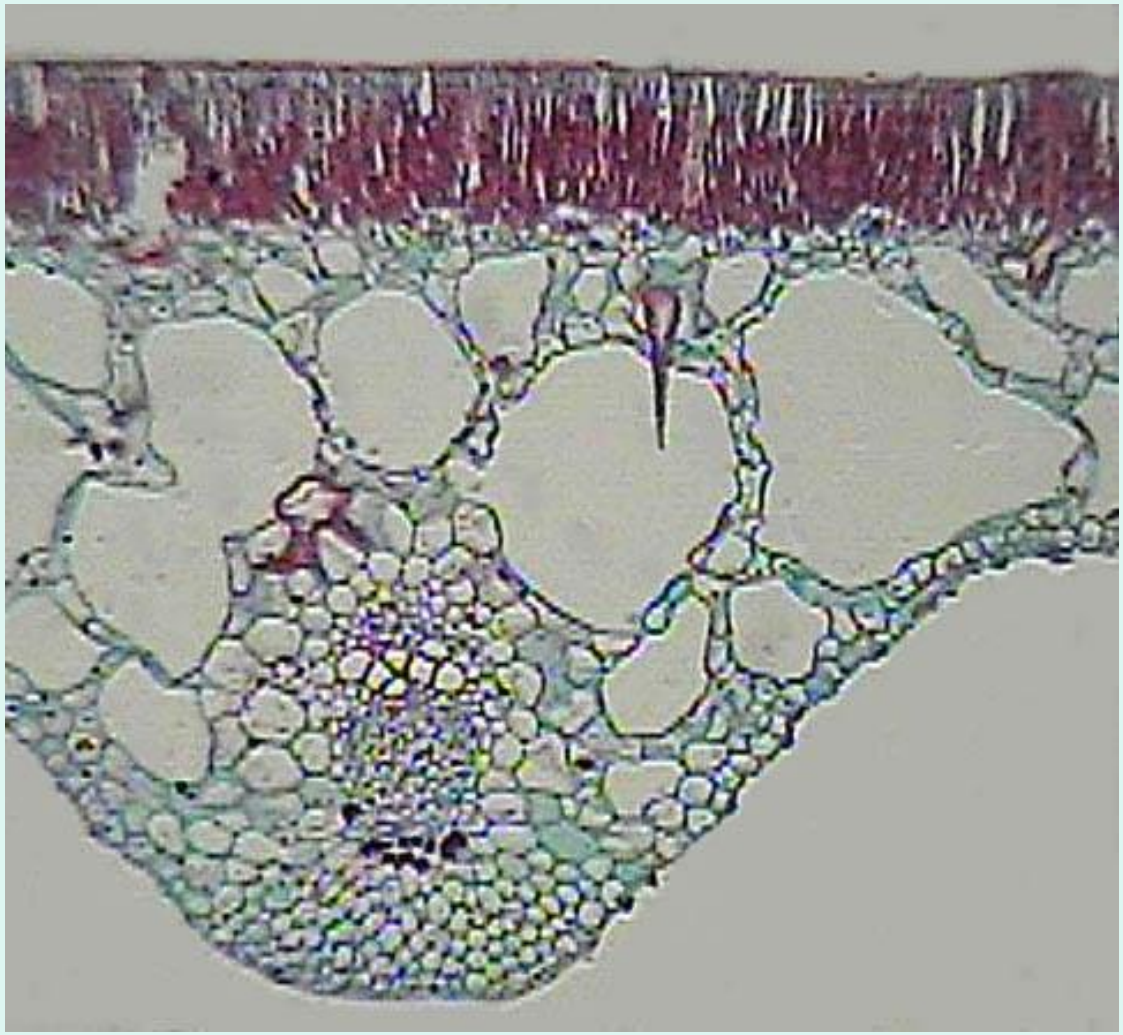
http://www.youtube.com/watch?v=J1PqUB7Tu3Y

Practice leaf(ing)

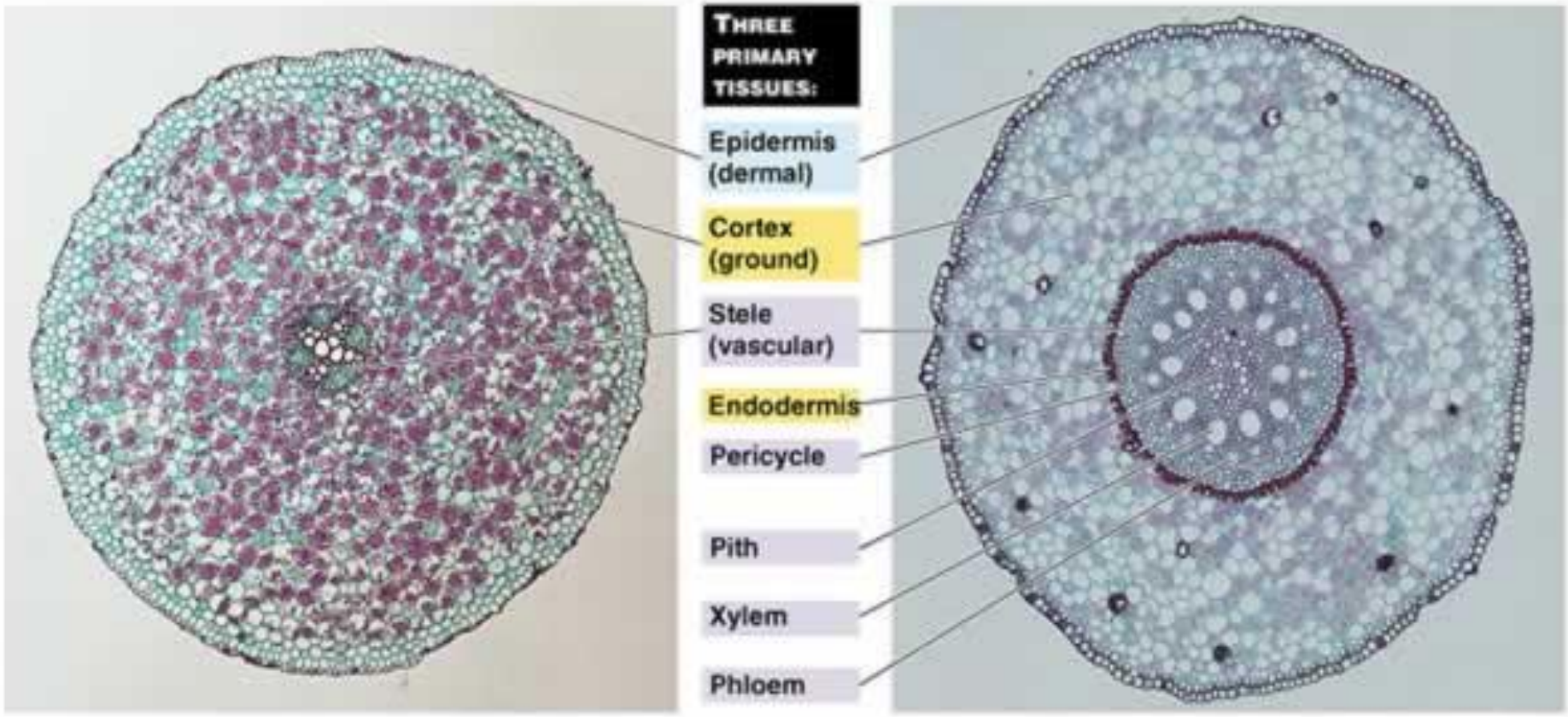


Practice Questions

Leaf – Cross section



Roots – Mangrove



(a) Cross section of a dicot root

(b) Cross section of a monocot root

Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.