Bachelor 2: Plant physiology

Lesson 1: PLANT CELLS, TISSUES, ORGANS

BASIC STRUCTURE AND FUNCTION

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Learning outcome

By the end of this course, students are able to:

- Analyze the differences of structure and function between plant cell and animal cell
- Describe the structure of some specific organelles in plant cell such as cell wall, chloroplast and vacuole.
- Describe the structure of dermal tissue, vascular tissue, ground tissue and meristeme tissue
- Analyze the structure of root, shoot and leaf in correlating to their function

Main contents

Structure (related to the functions) of:

- Plant cell
- Plant tissue
- Plant organ

Concept

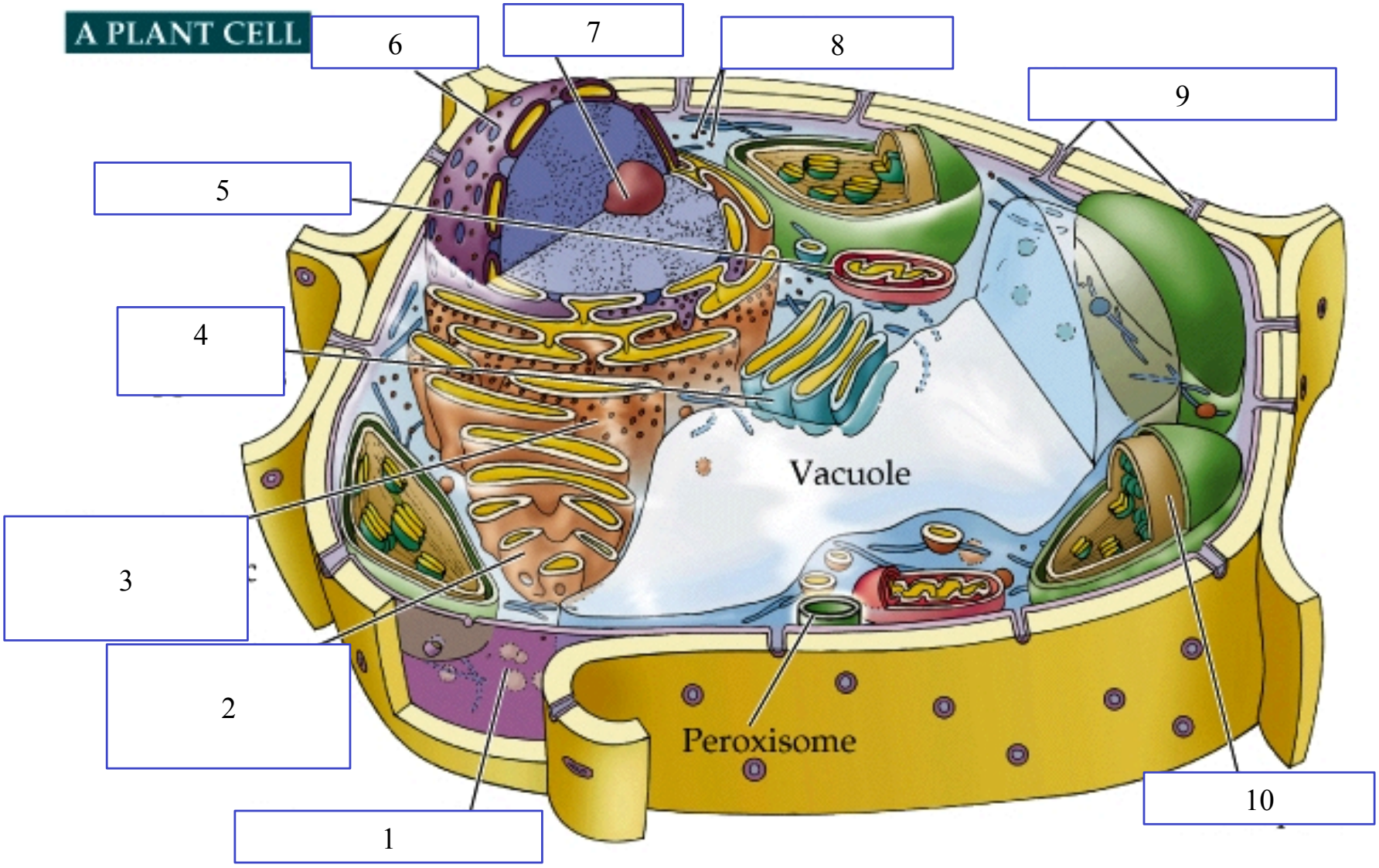
- Plant ANATOMY: study of the **structure** of organisms… looking at cells, tissues.

- Plant PHYSIOLOGY: study of the **function** of cells, tissues, organs of living things;

  and the physics/chemistry of these functions…

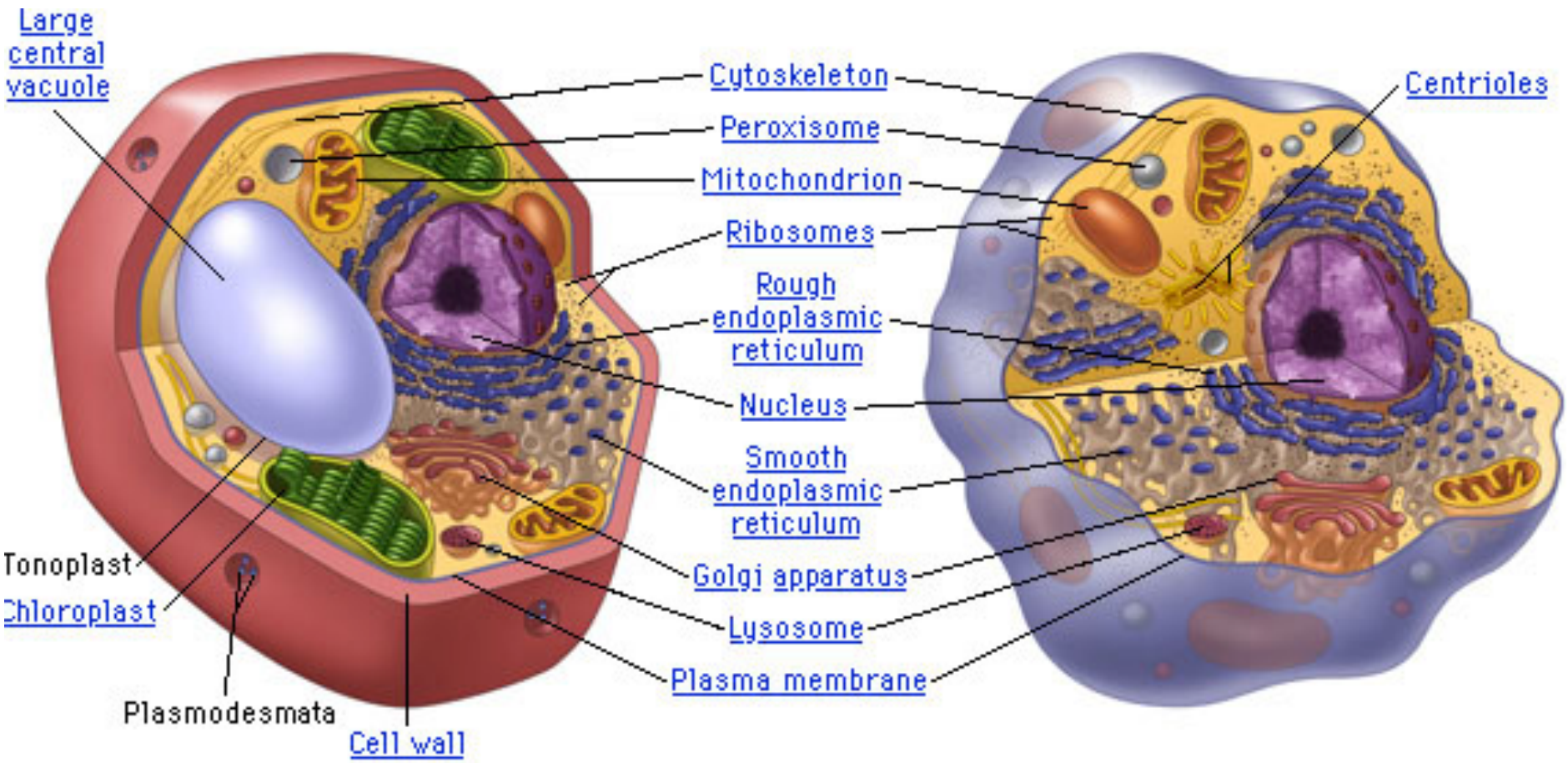
Always keep in mind:
"**Structure** correlates to **function**"

1. Plant cell


A PLANT CELL
6
7
8
9
5
4
3
2
1
10
Vacuole
Peroxisome
© 2001 Sinauer Associates, Inc.

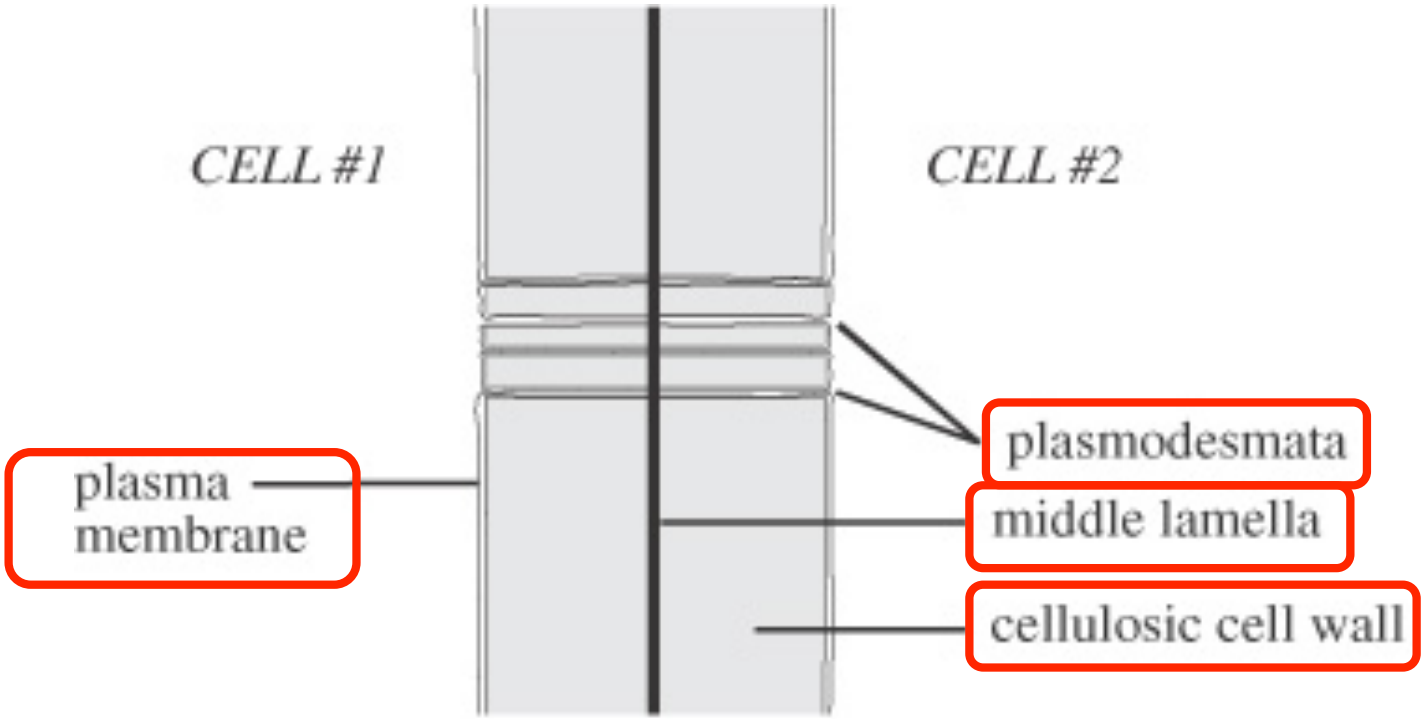
1. Plant cell

1. Plant cell: compare to animal cell



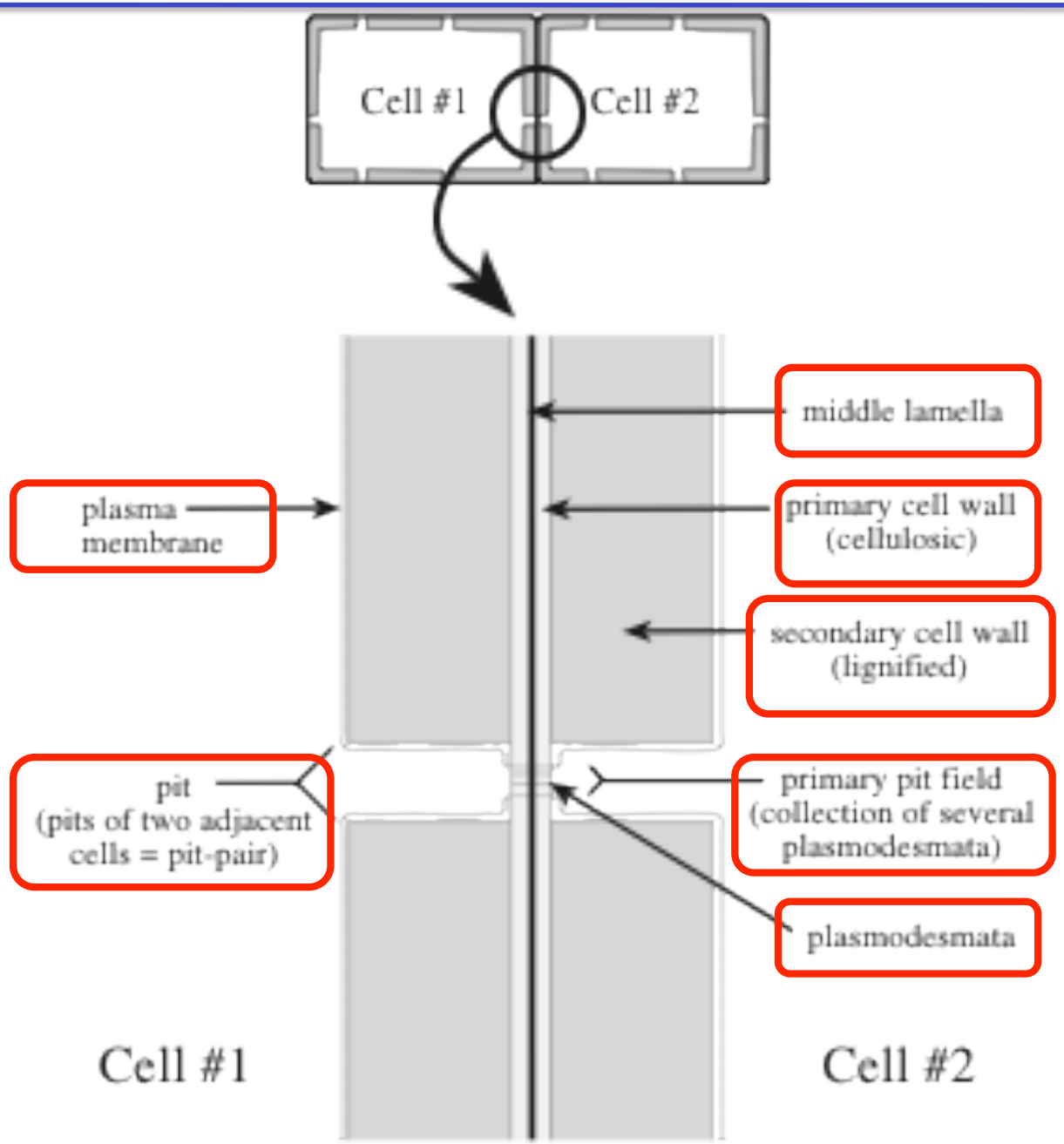
1. Plant cell: specific organelle

1. Plant cell: cell wall

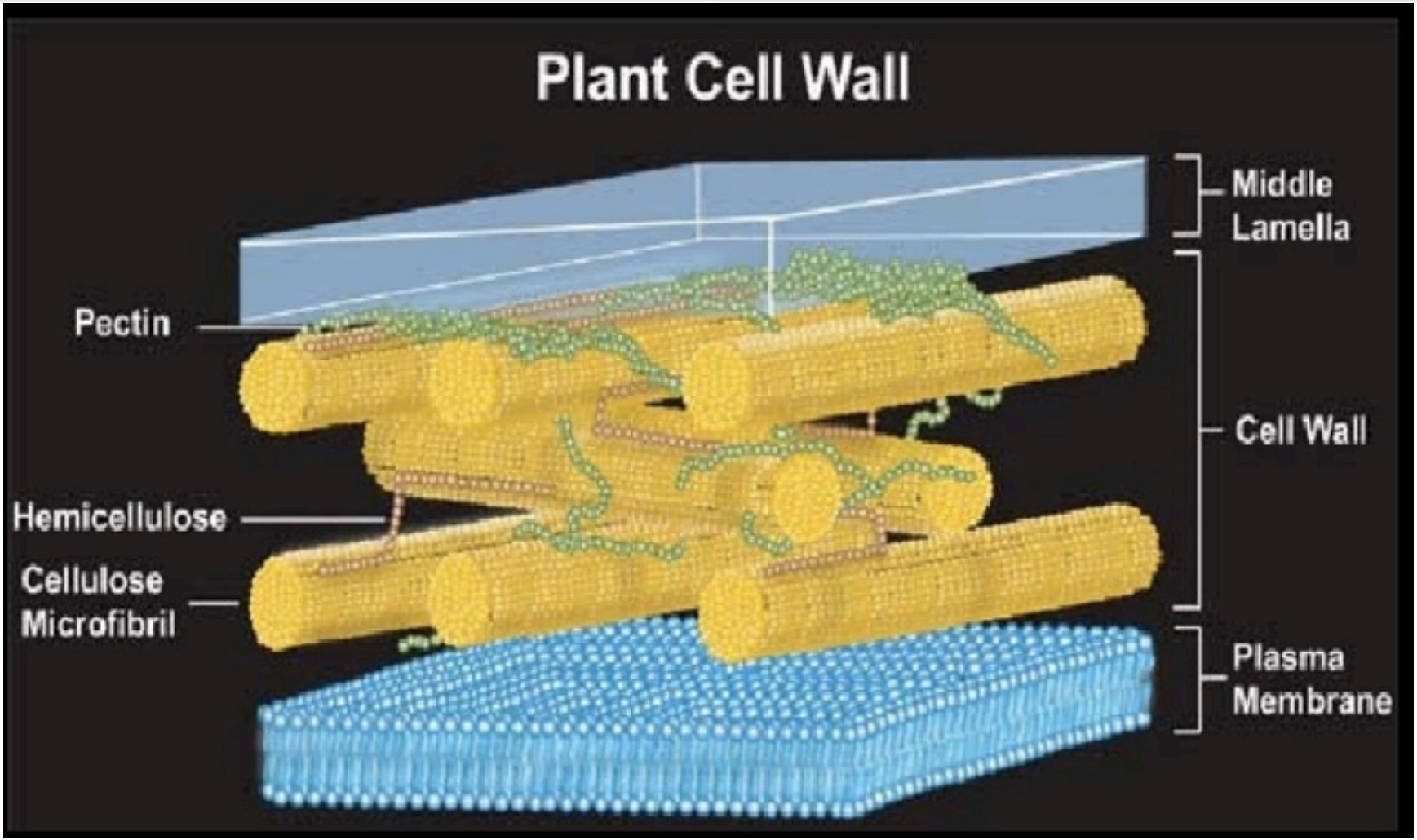


mainly **cellulose**:
beta-1,4-glucopyranoside

1. Plant cell: lignin – secondary cell wall

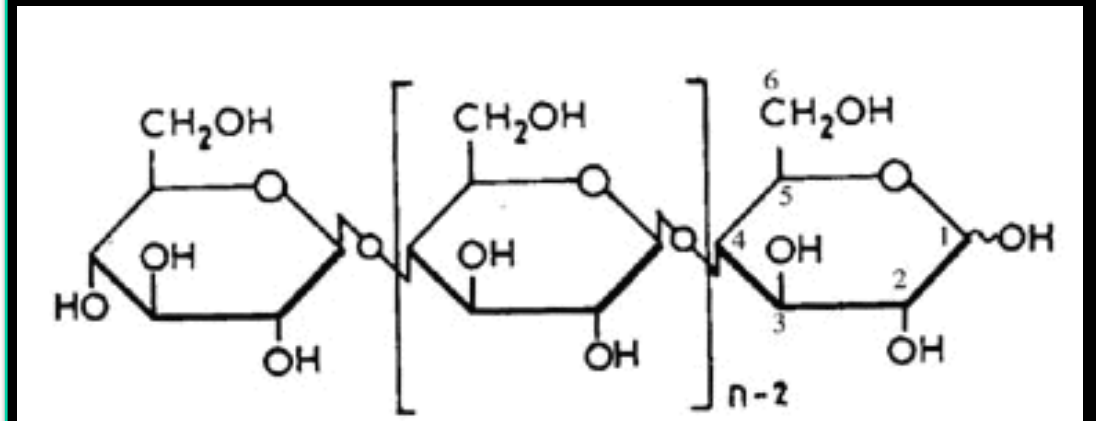


1. Plant cell: cell wall

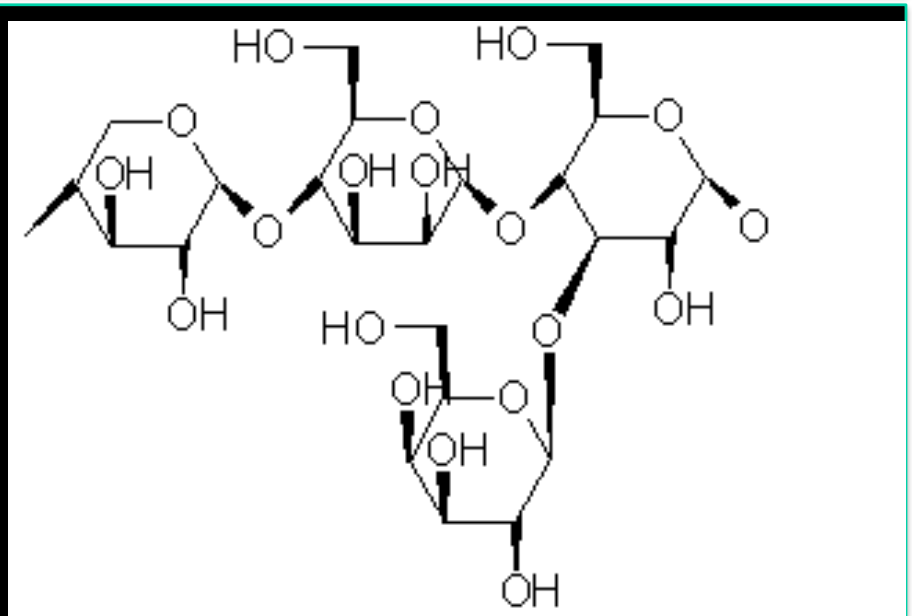


Provides and maintains the shape of cells and serves as a protective barrier

1. Plant cell: cell wall

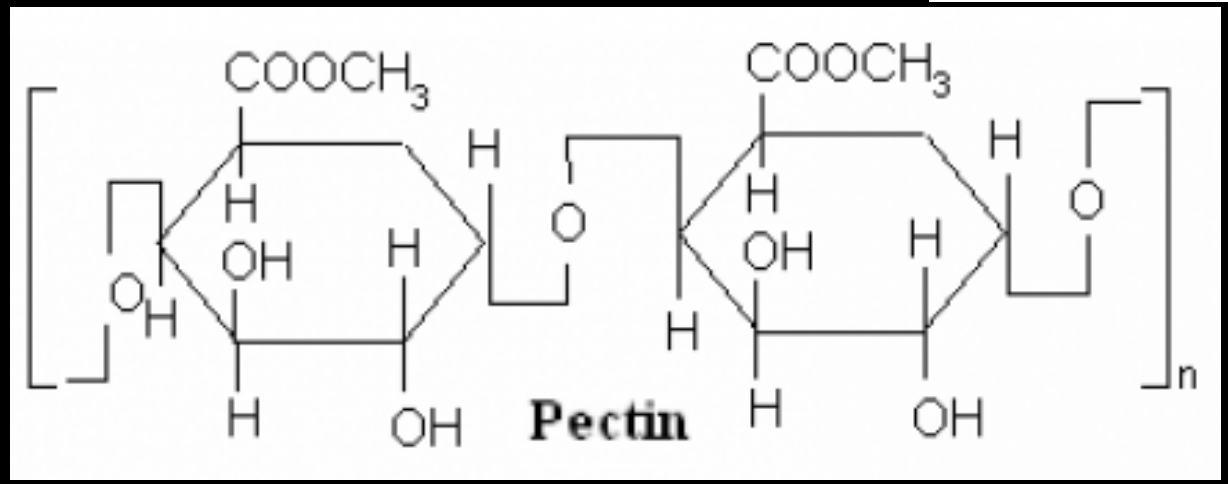


Cellulose

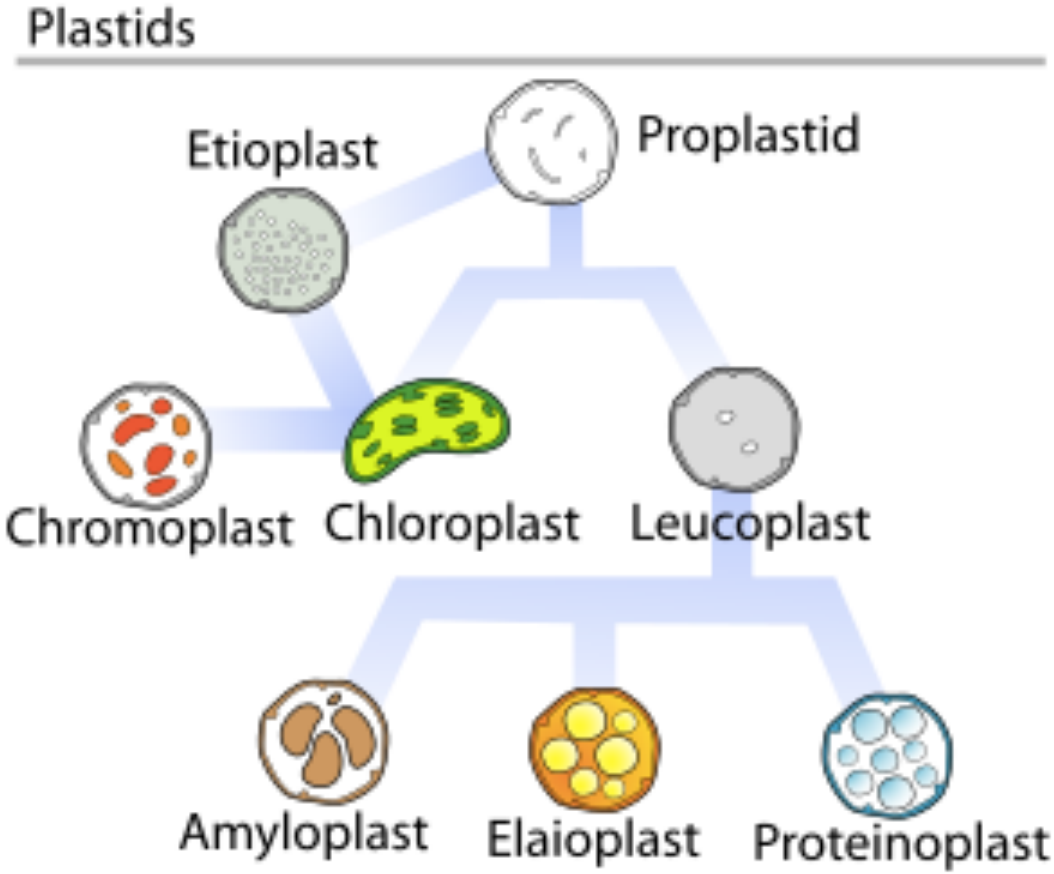


- Xylose - ß(1,4) - Mannose - ß(1,4) - Glucose -
- alpha(1,3) - Galactose

Hemicellulose



1. Plant cell: plastid



The synthesis and storage of foods

1. Plant cell: plastid

Etioplast……

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Chromoplast……

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Chloroplast……

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Leucoplast……

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Amyloplast……

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Elaioplast……

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Proteinoplast……

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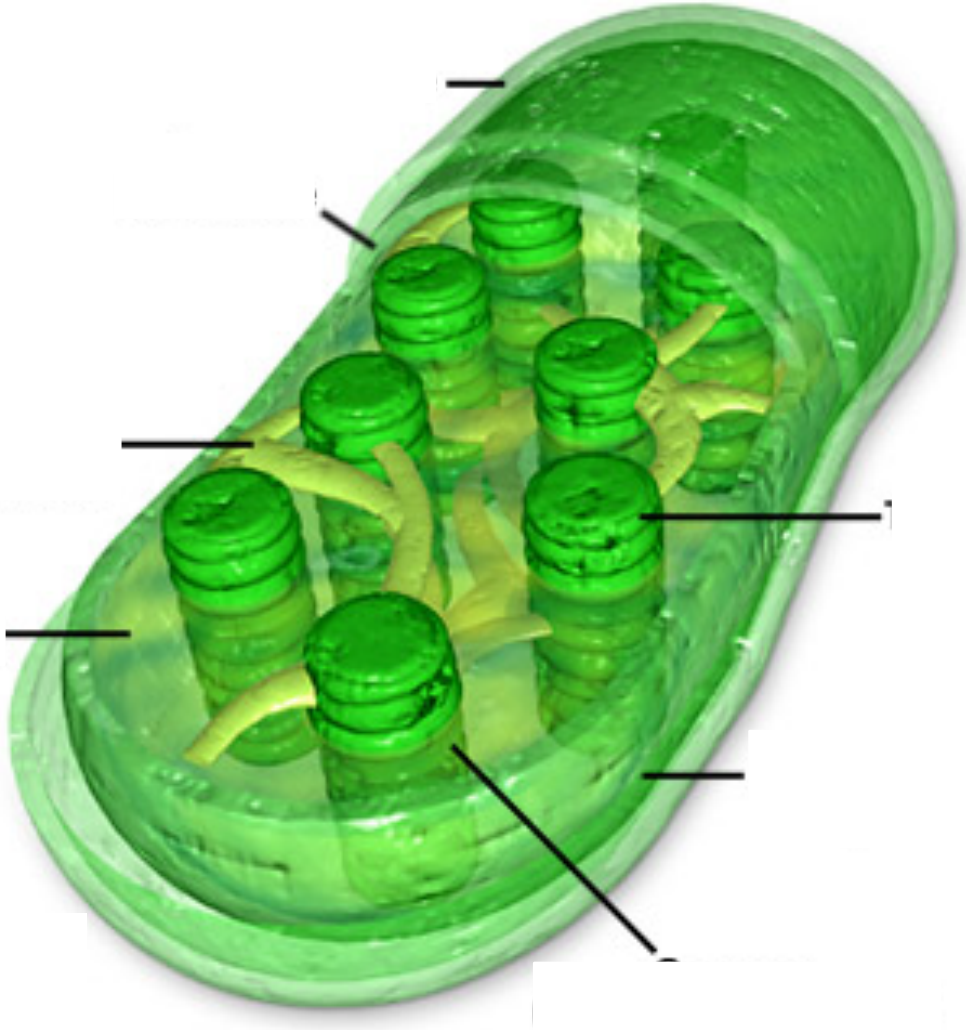
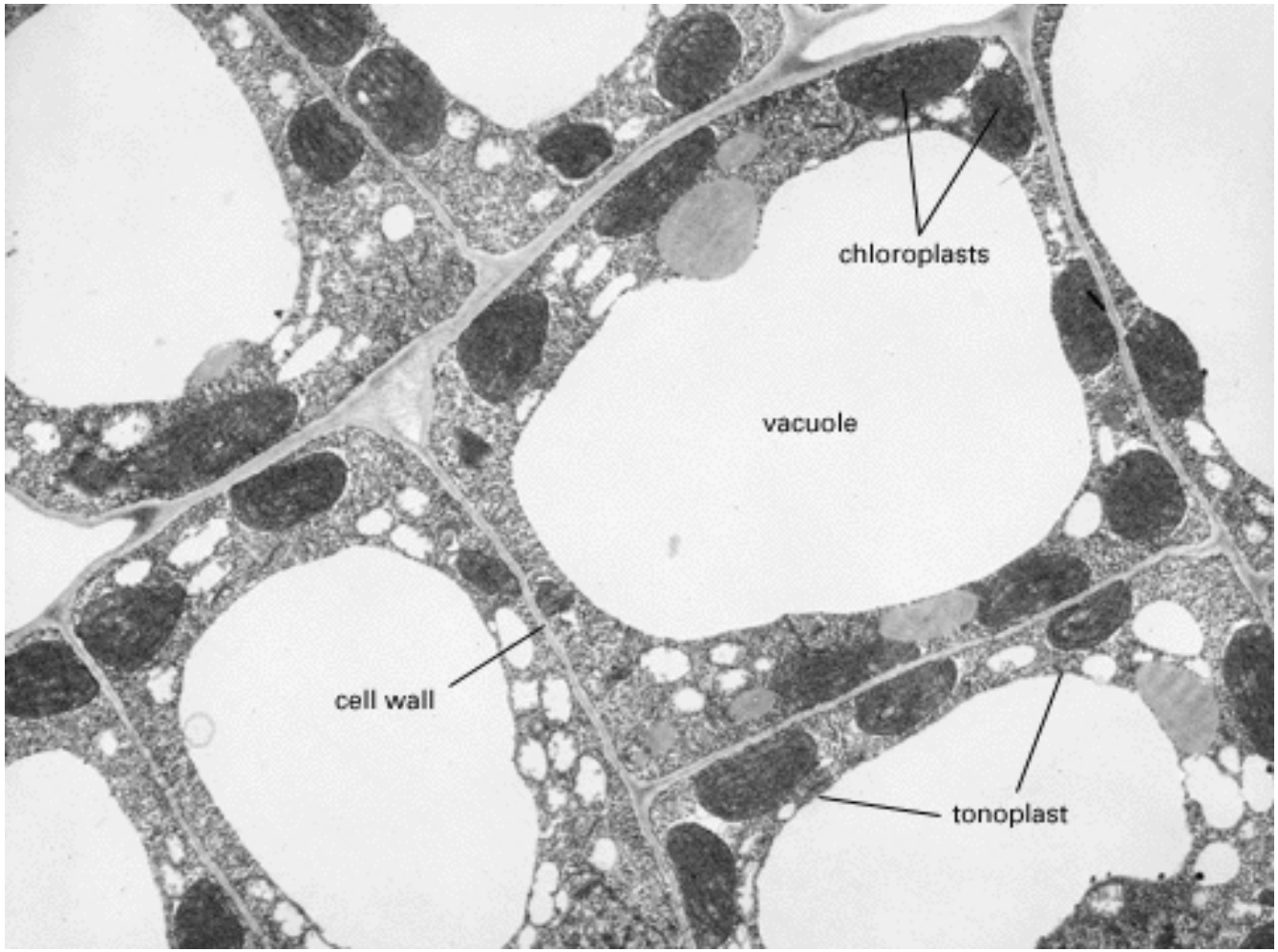
1. Plant cell: chloroplast



1. Plant cell: chloroplast

1. Plant cell: vacuole



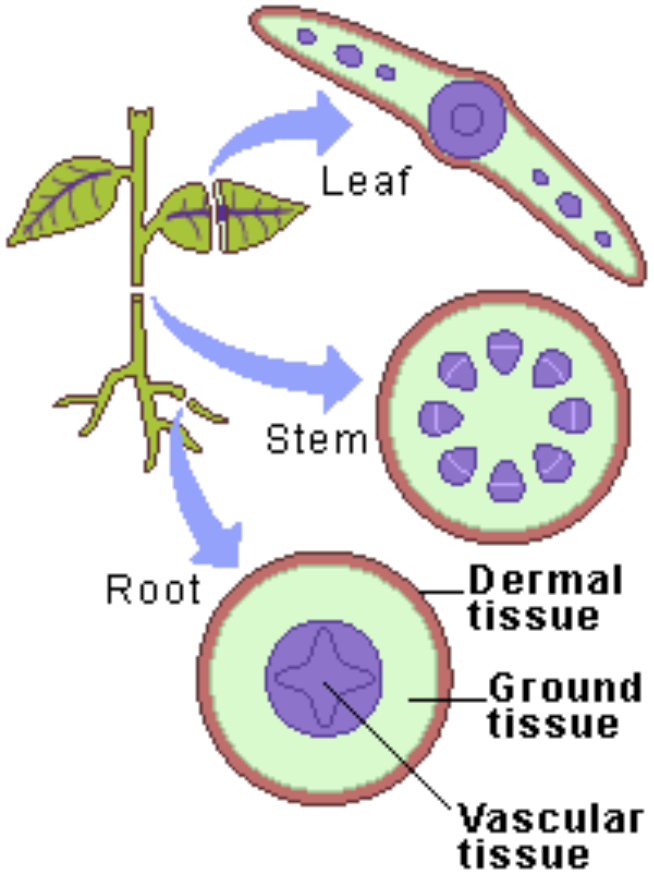
Release of cellular waste product; storage of nutrient reserves; cellular growth

2. Tissues

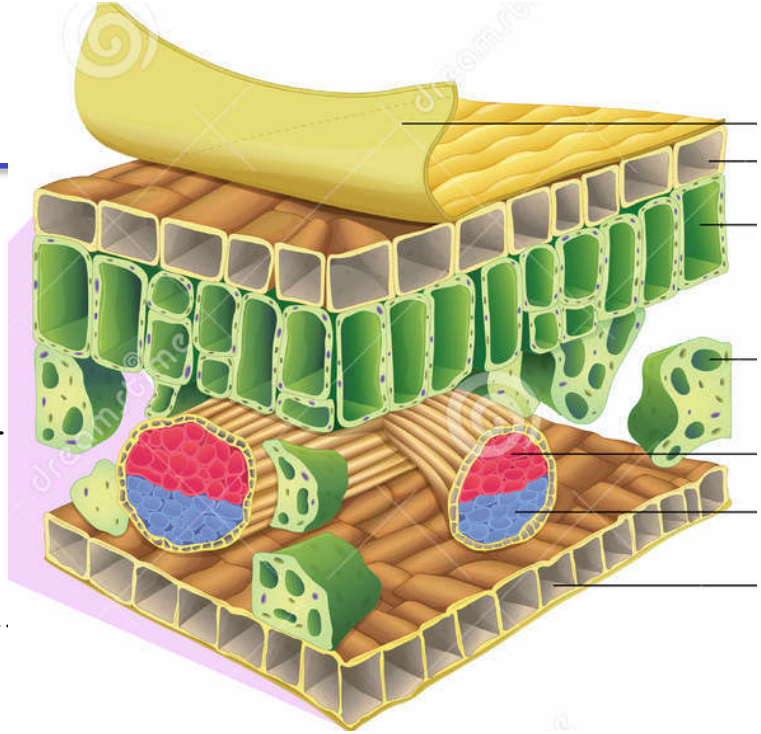
- Tissue: group of cells with common function or structure

- Types of tissue:
  1) Dermal - outside layer(s)
  2) Vascular – conduction
  3) Ground - between dermal and vascular,
  4) Meristem

- The study of tissue is known as "histology"



2. Tissues: Dermal tissue



Epidermis:

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Cuticle: ……

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Stomata: ……

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Root hairs: ……

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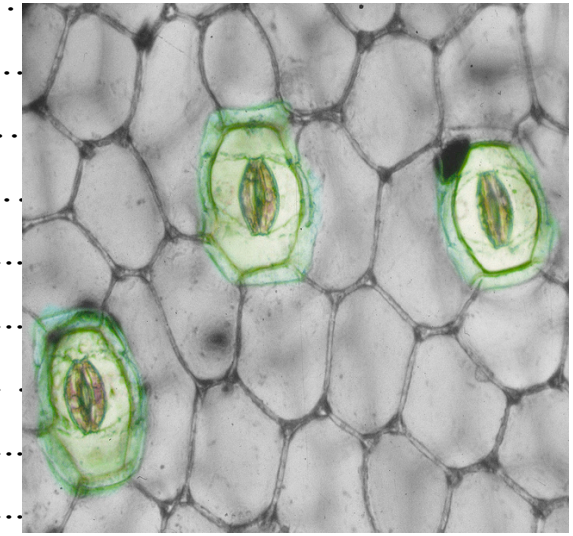
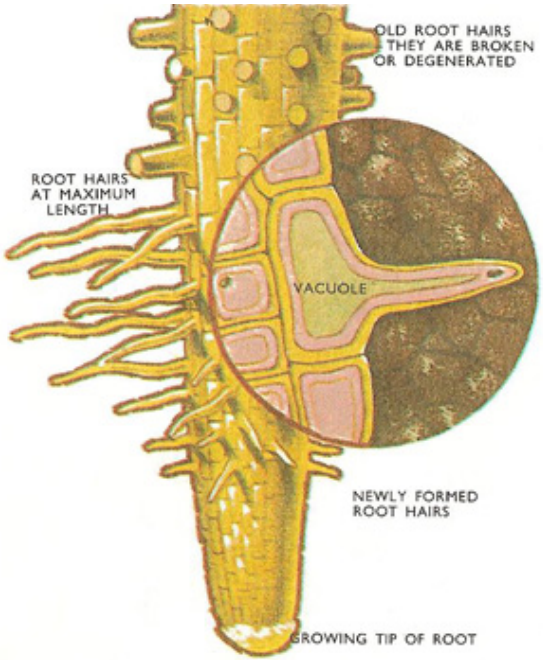
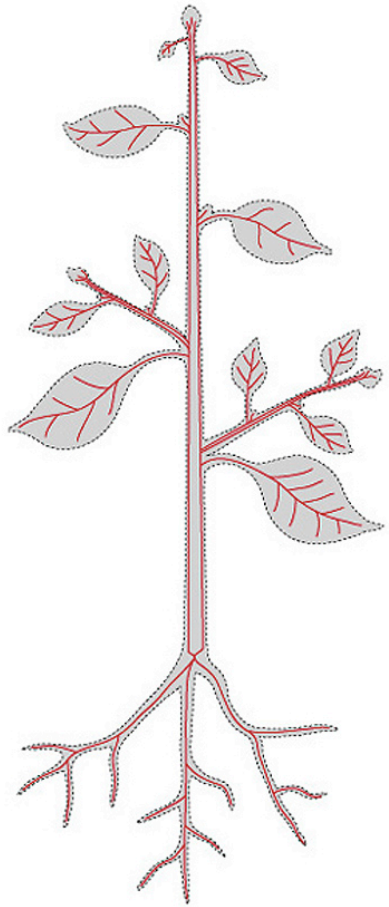




2. Tissues: Vascular tissue

- Transportation throughout the plant
- **Xylem** – transports water and dissolved ions from the root to the stem and leaves.



- **Phloem** – carries dissolved sugars from leaves to rest of the plant

2. Tissues: Vascular tissue - xylem

- **Similarities:** .....
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Tracheids	Vessel elements
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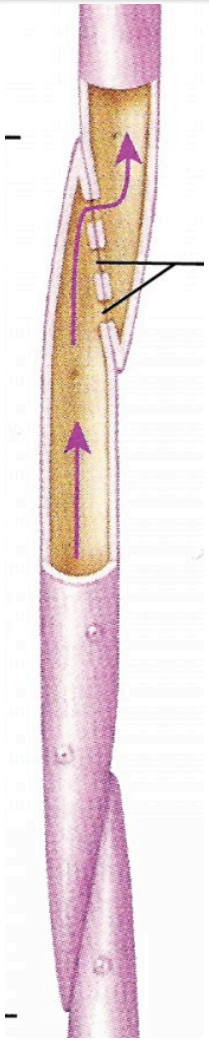
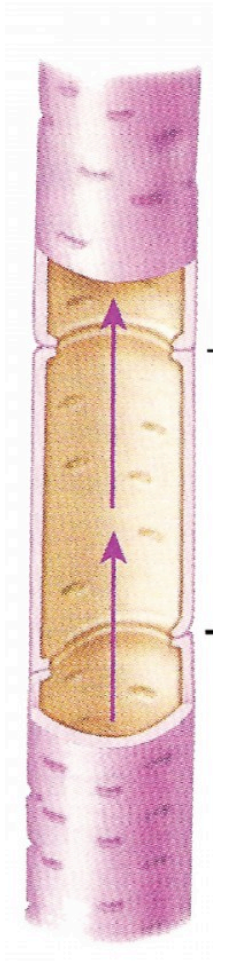
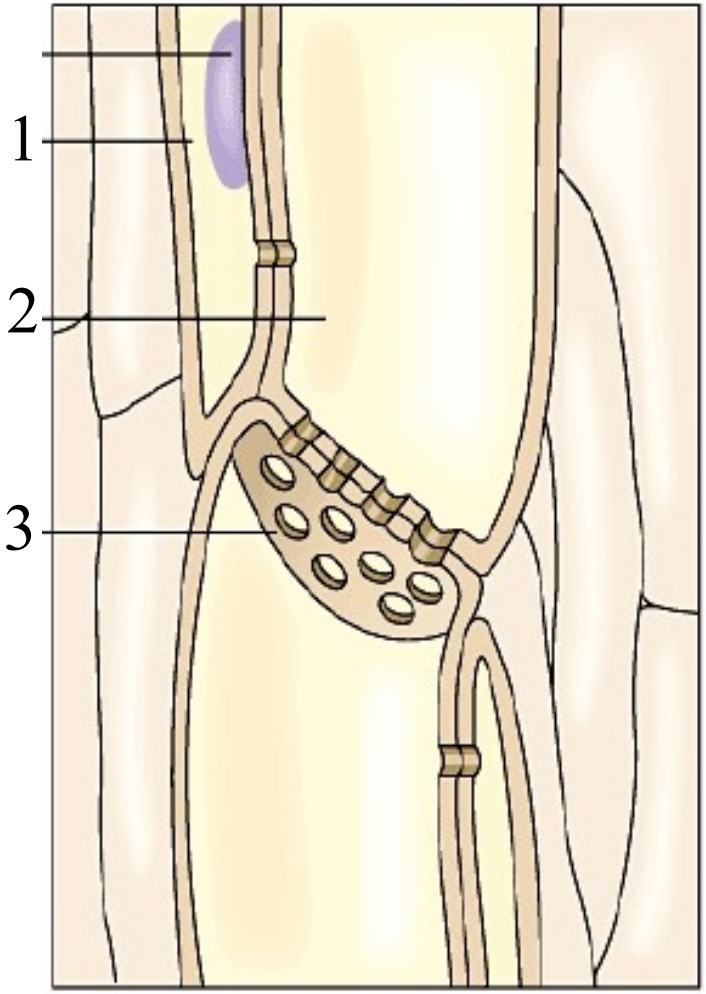


Tracheids



Vessel elements

2. Tissues: Vascular tissue - phloem



• Composing ..... (1)
and ..... (2)

• **Companion cells** (1): .....
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• **STM** (2): .....
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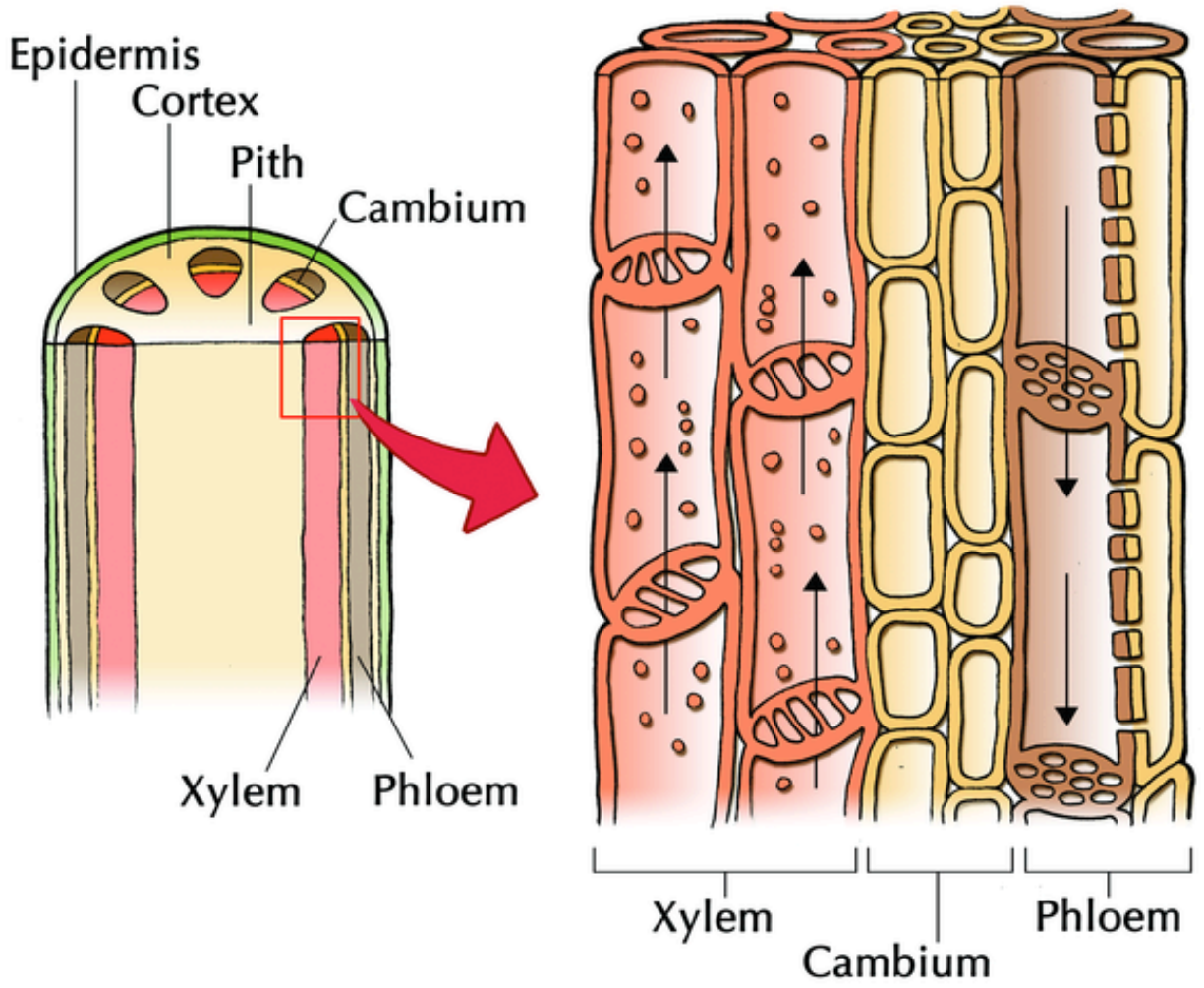
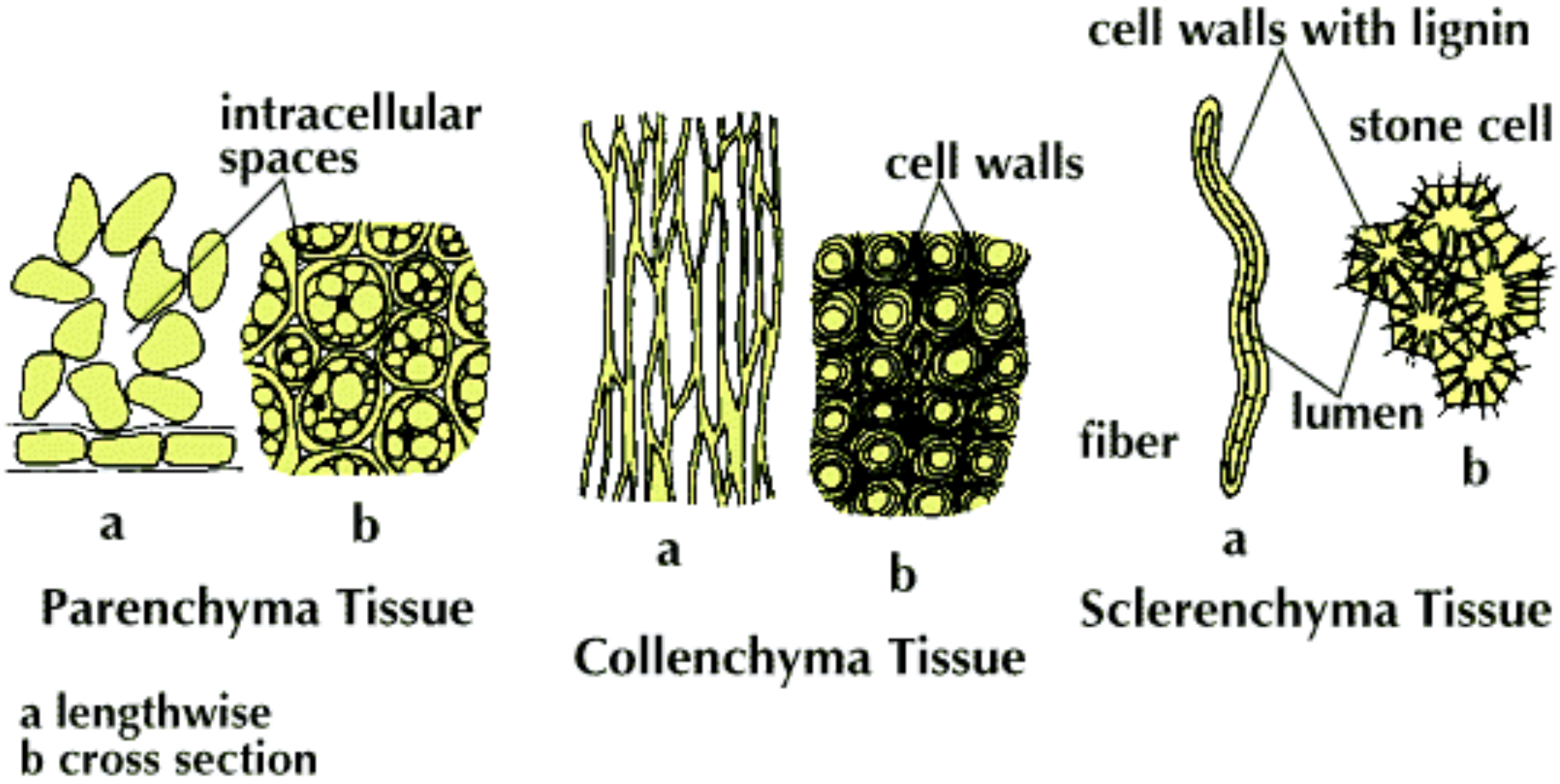
• Phloem cells are ALIVE! Lacking of nucleus, organelles

2. Tissues: Vascular tissue



2. Tissues: Ground Tissue



2. Tissues: Ground Tissue

	Parenchyma	Collenchyma	Sclerenchyma
Living/dead cell			
Primary cell wall			
Secondary cell wall			
Location in plant			
Function			

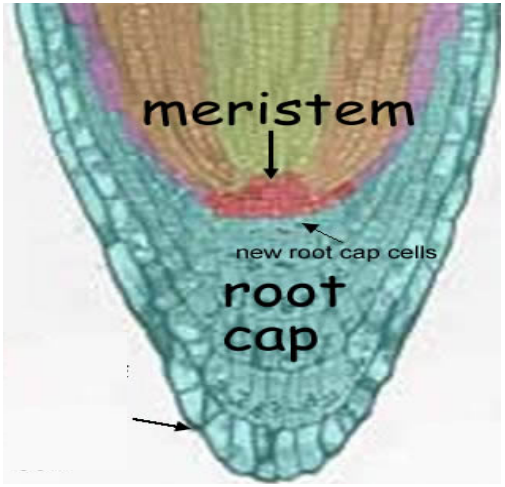
2. Tissues: Meristem

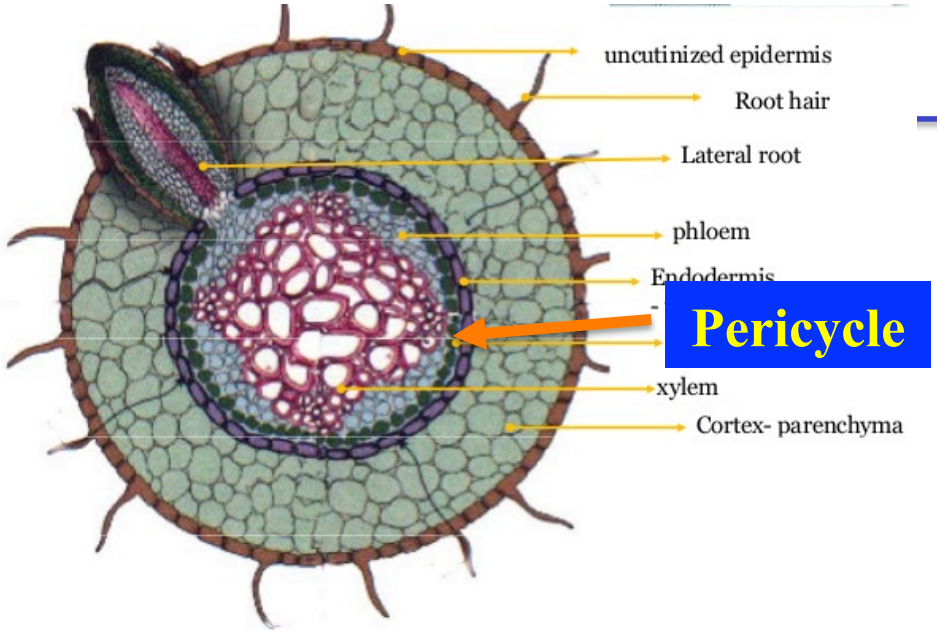
Meristem = merizein = to divide

Function:

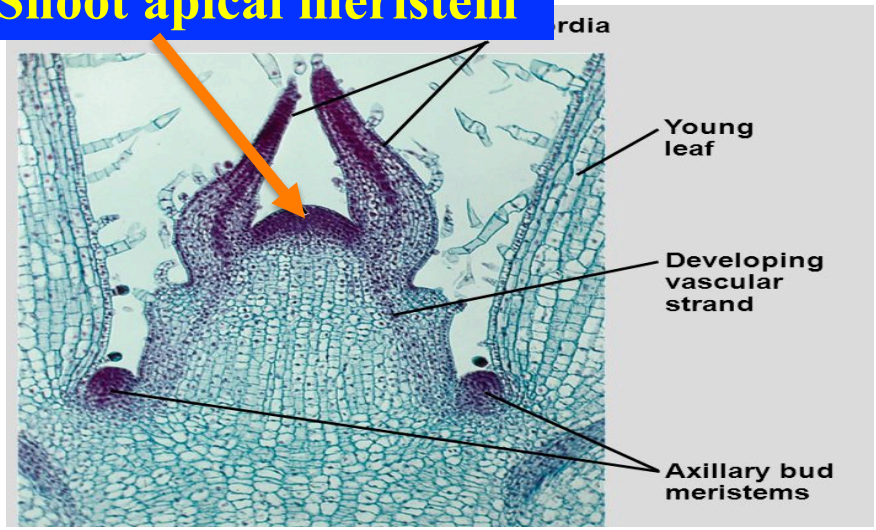
Location:

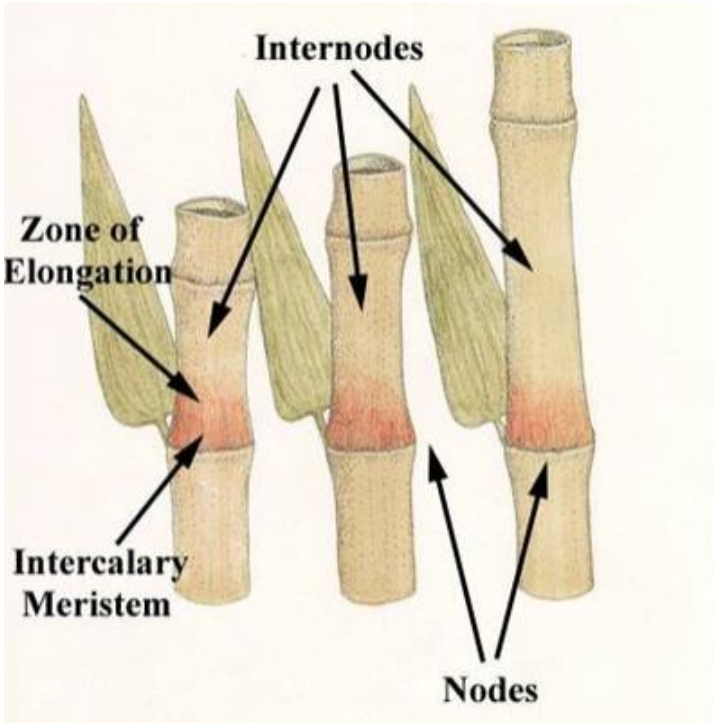
2. Tissues: Meristem





Shoot apical meristem





2. Tissues: Meristem fate

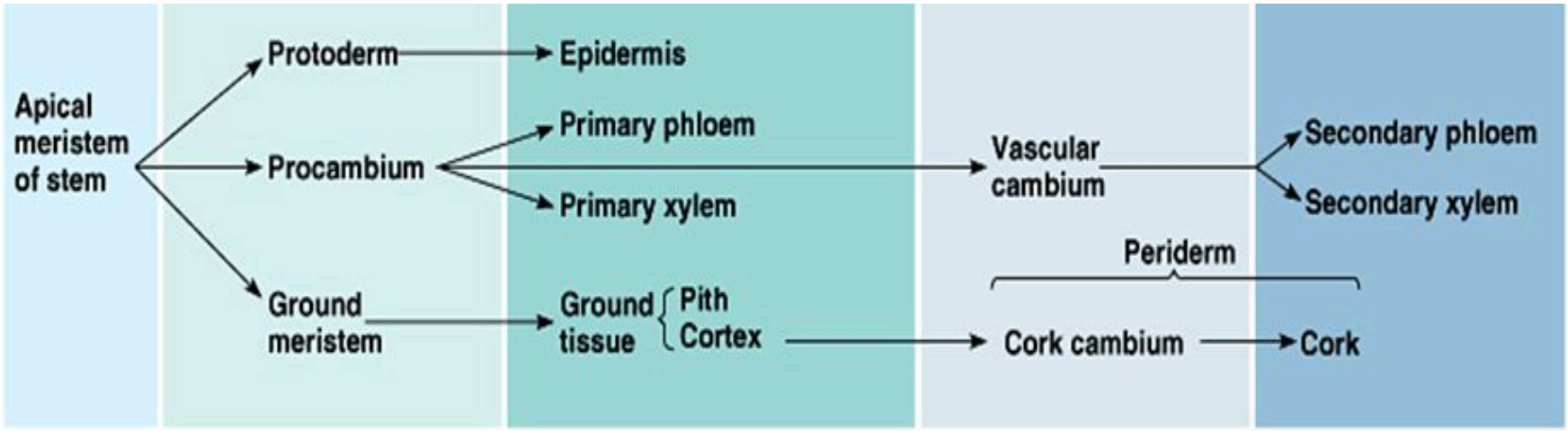
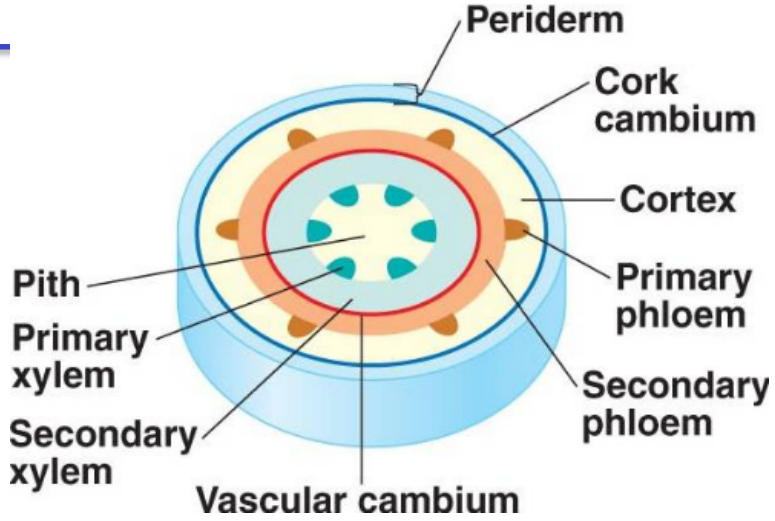
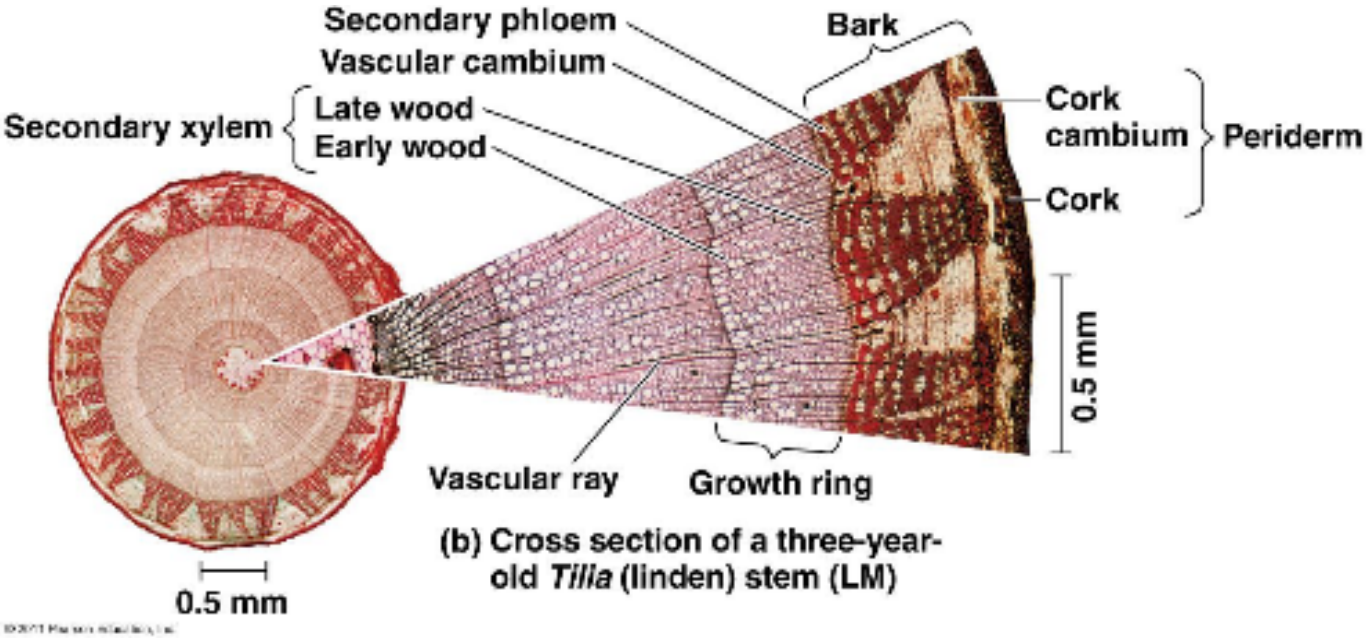


Fig. 35.24

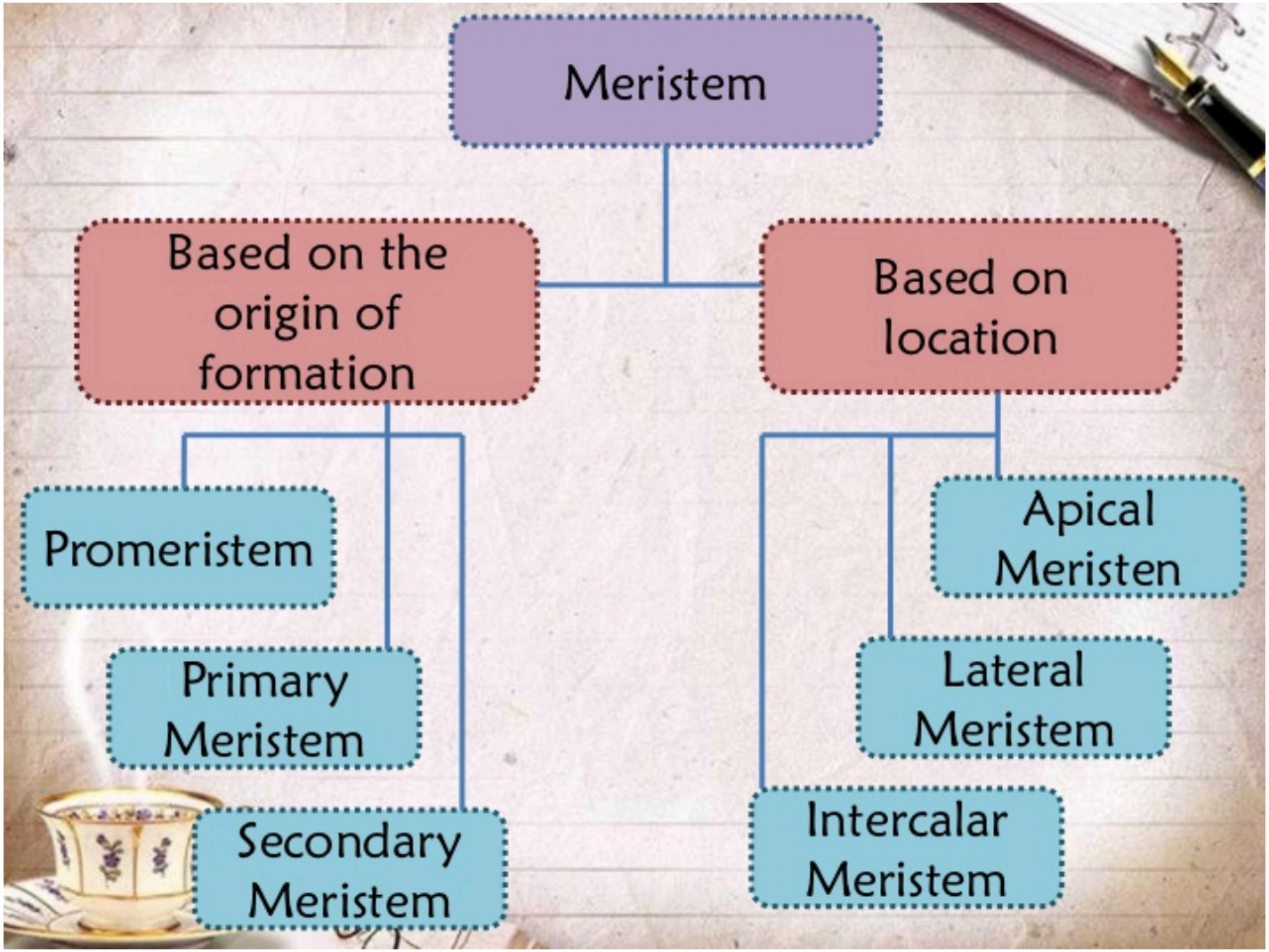
2. Tissues: Lateral meristem





(b) Cross section of a three-year-old *Tilia* (linden) stem (LM)

2. Tissues: Meristem - classification

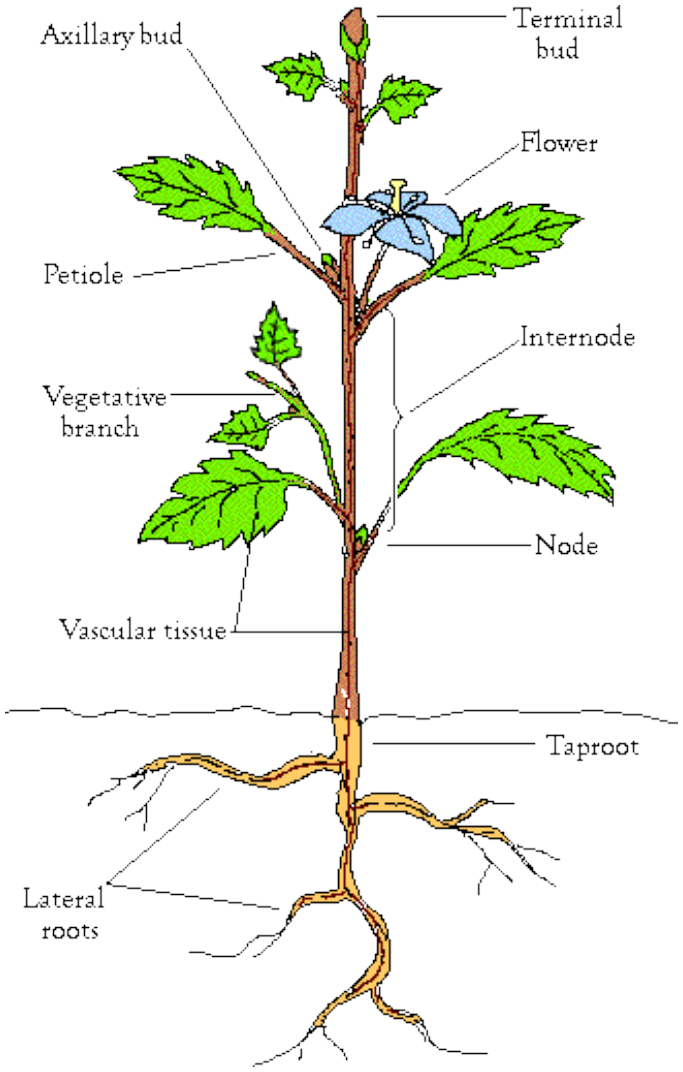


2. Tissues: Meristem - classification

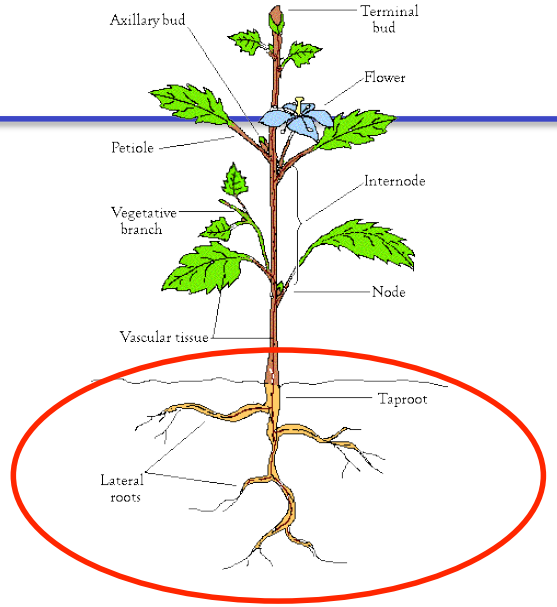
3. Organs

Organs: tissues that act together to serve a specific function

- Roots
  - Dermal
  - Vascular
  - Ground
- Stems
  - Dermal
  - Vascular
  - Ground
- Leaves
  - Dermal
  - Vascular
  - Ground

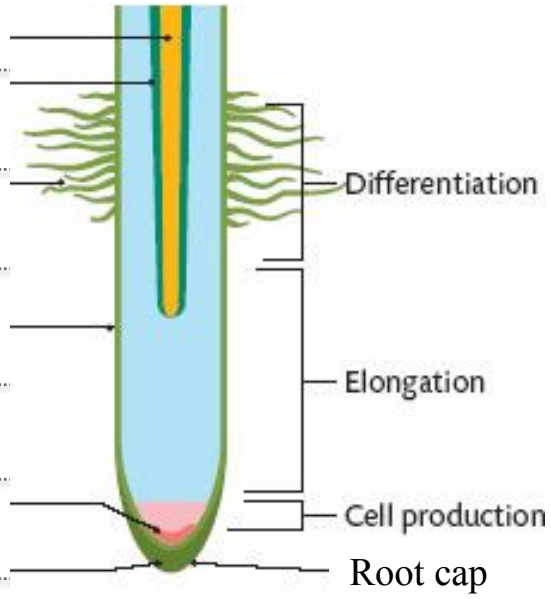


3. Organs: roots "the hidden half"



Functions:

Structure: divided in to 3 main zones



3. Organs: root

Dicot

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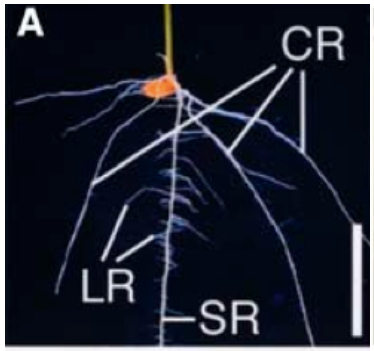
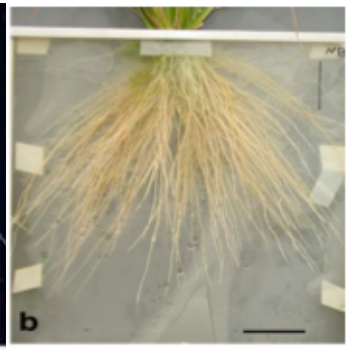
monocot





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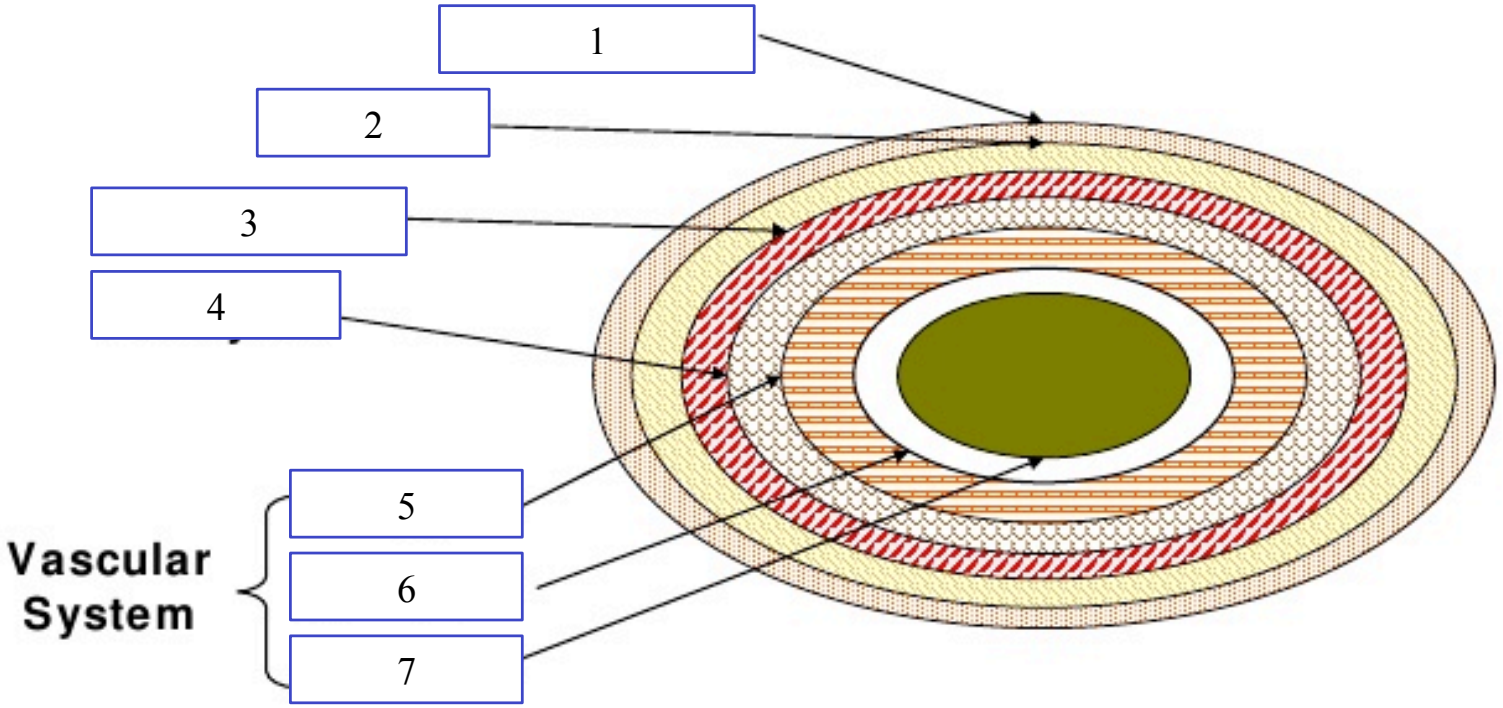
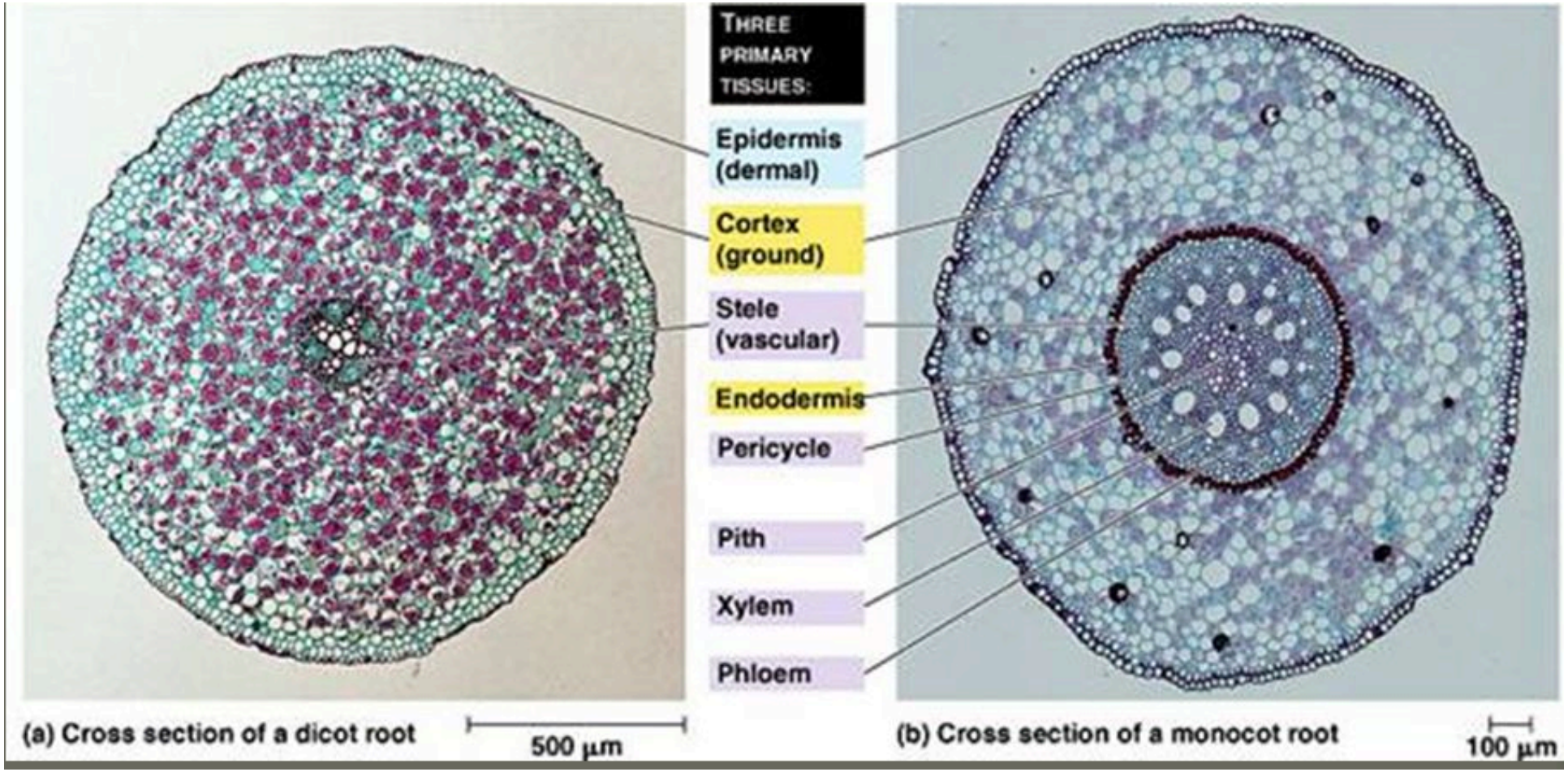
3. Organs: root histology

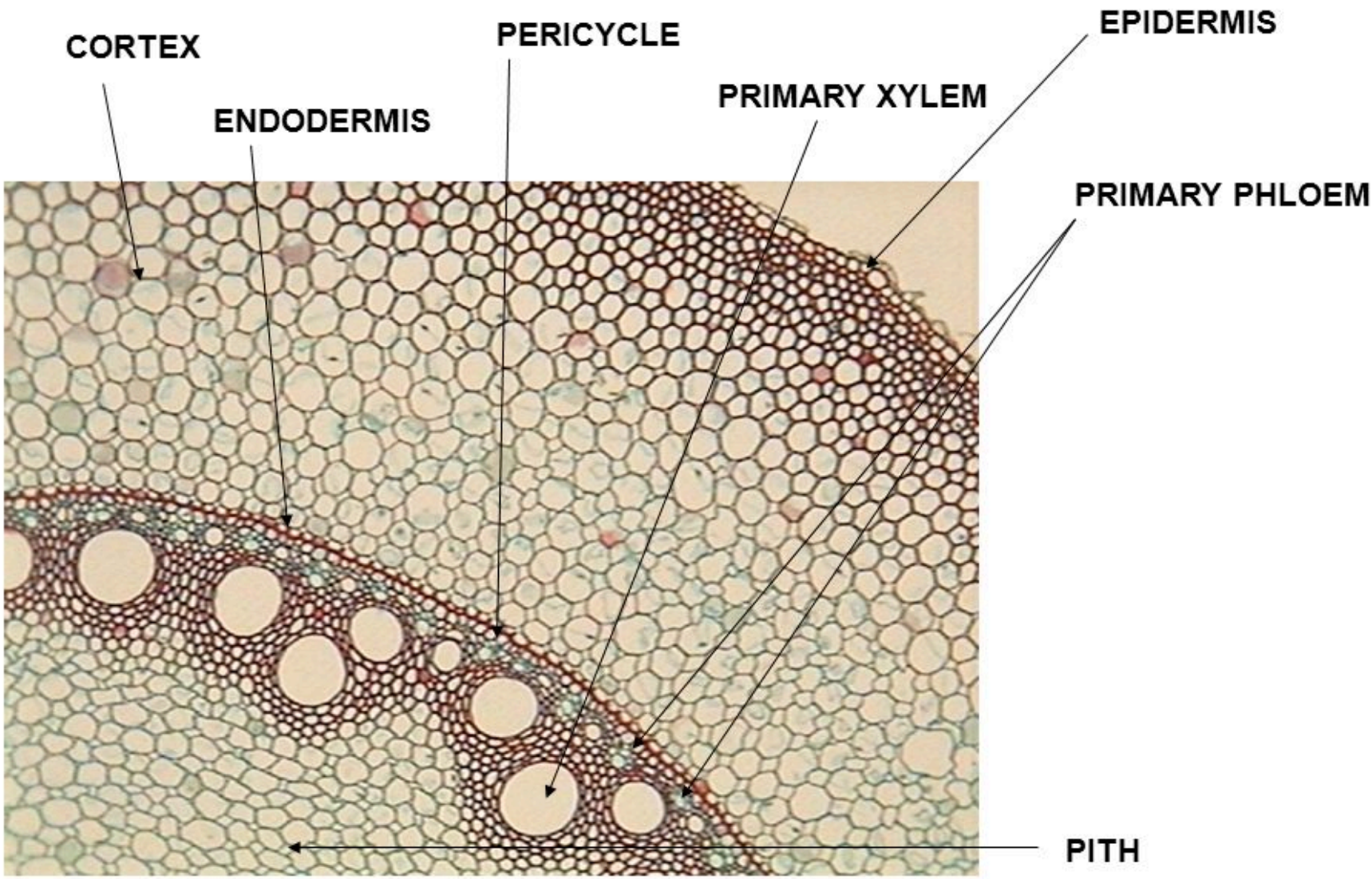
Root tissues can be regarded as a series of concentric rings of different tissues



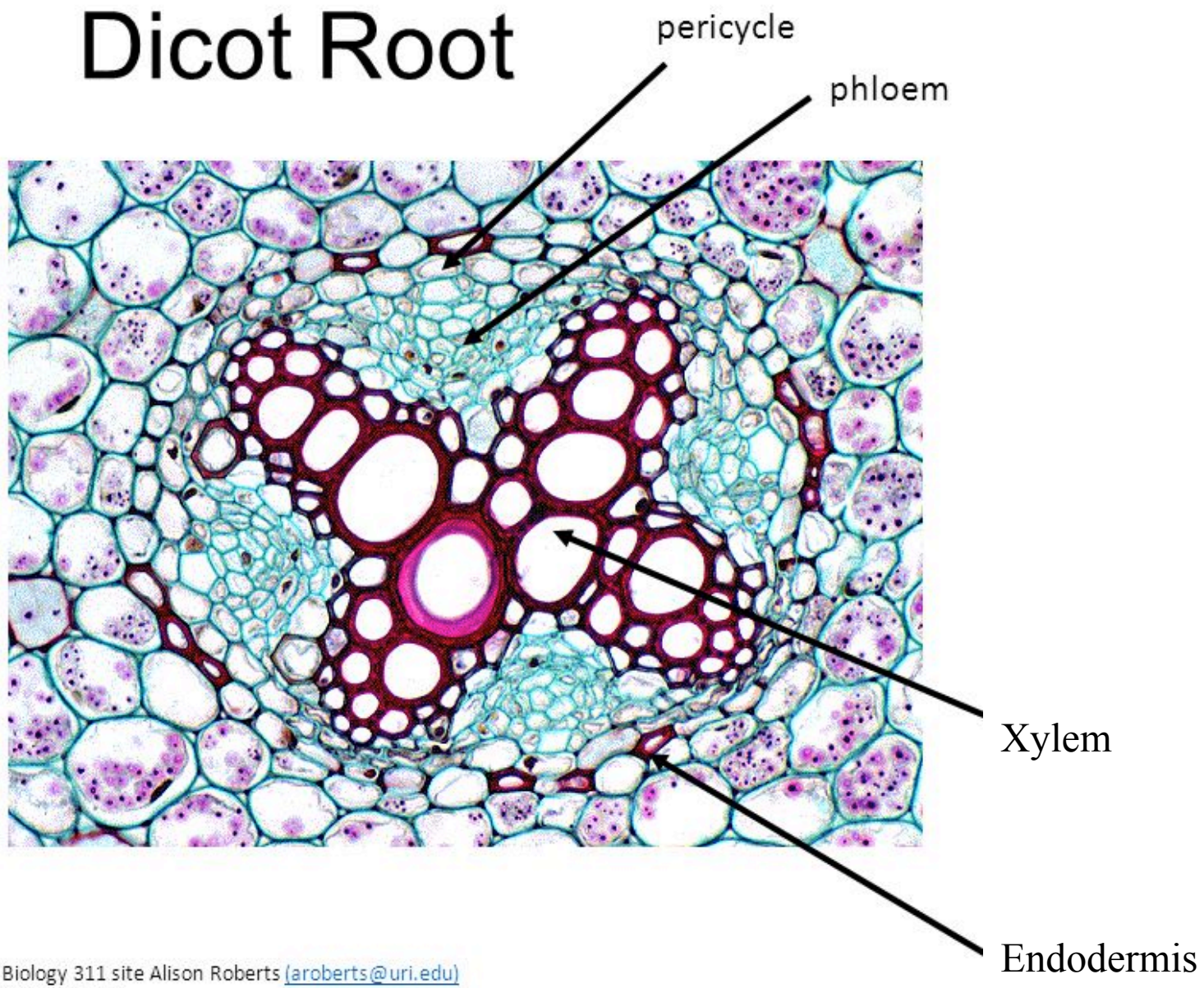
3. Organs: root histology



3. Organs: monocot root histology



3. Organs: root histology



from Biology 311 site Alison Roberts (aroberts@uri.edu)

3. Organs: root histology

Similarities: ……

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Monocot	**Dicot**
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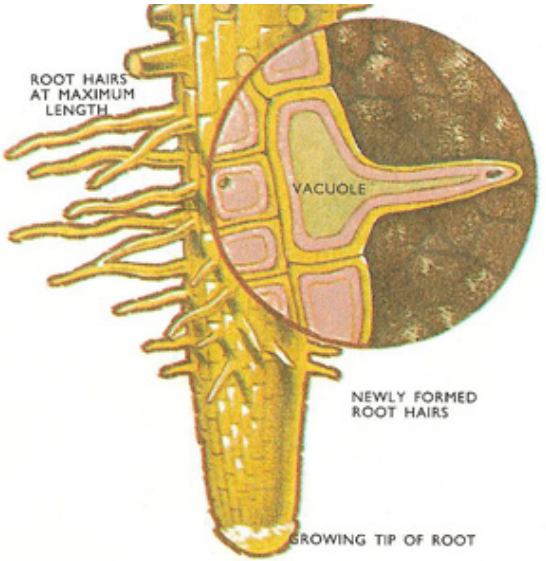
3. Organs: root epidermis



Function:

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Root hair:

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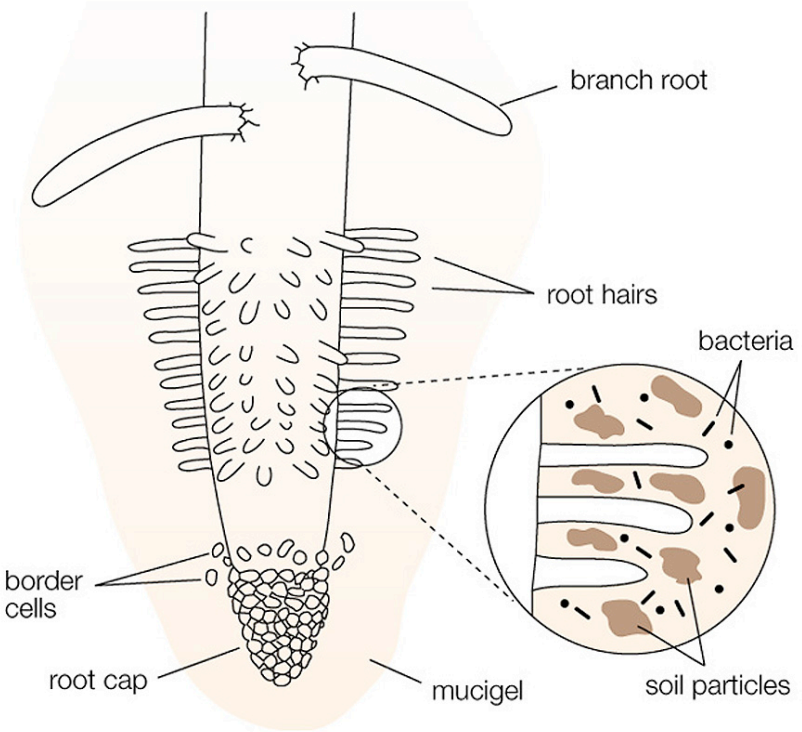

3. Organs: root cortex

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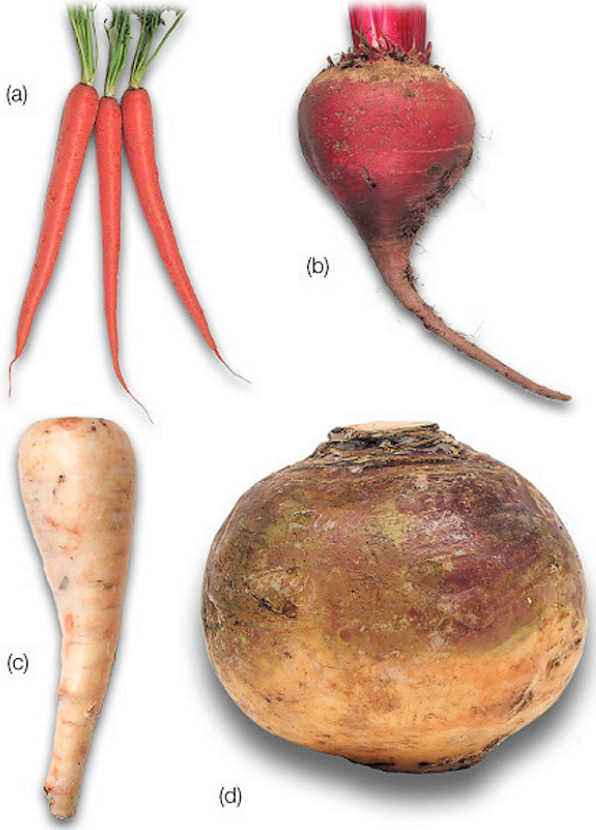
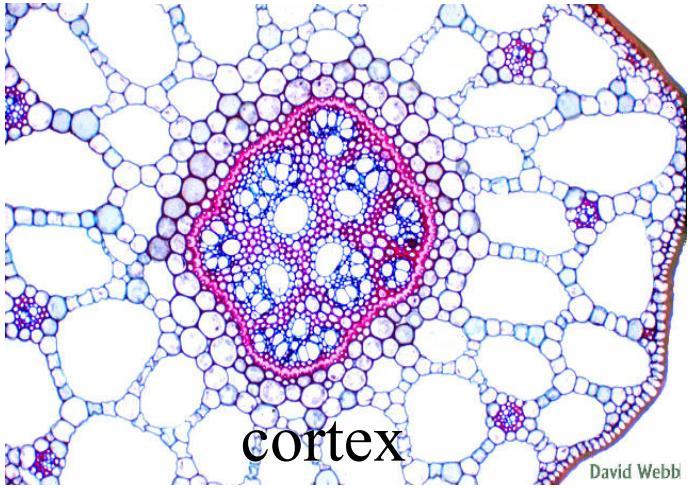
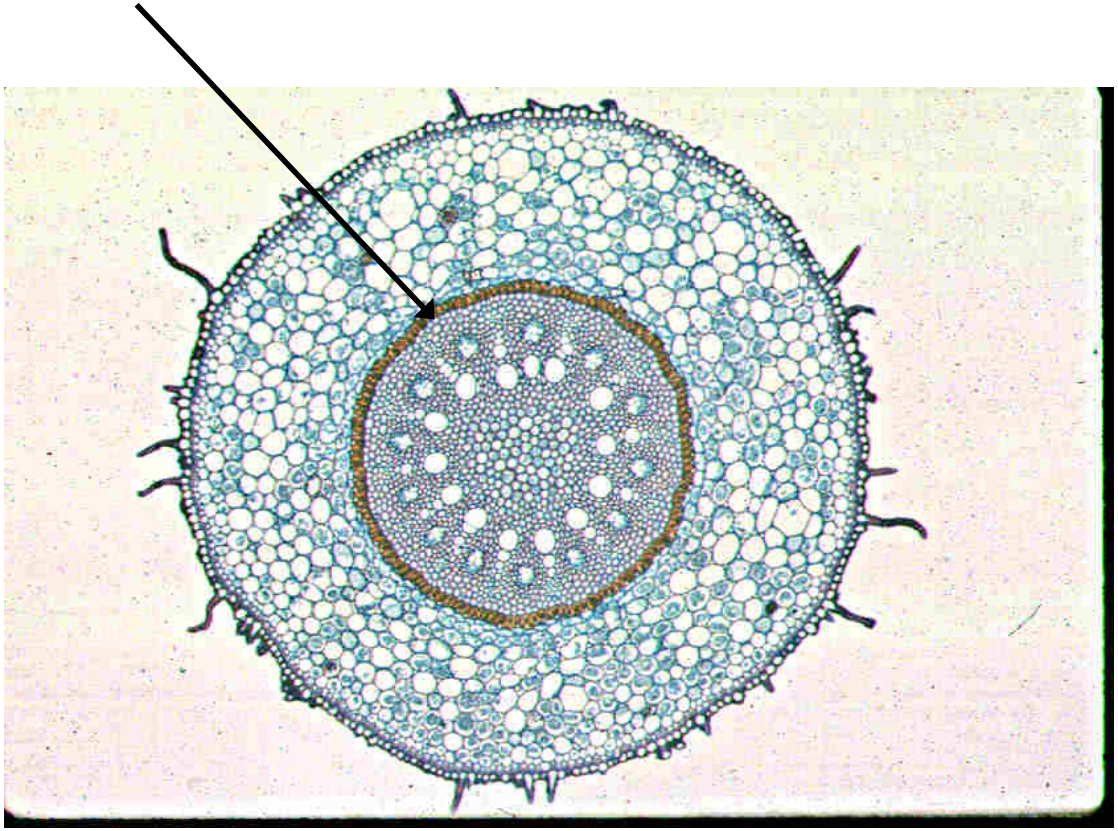


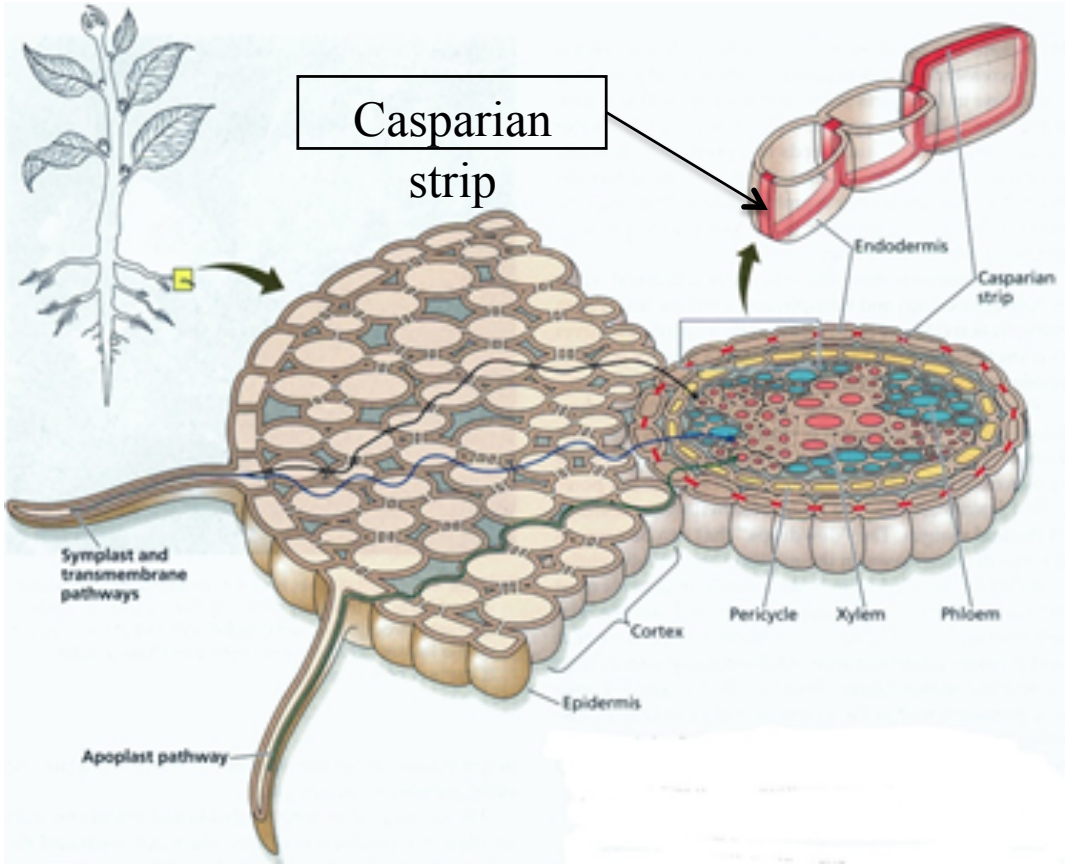


3. Organs: root cortex_endodemis

- **Endodermis**: the innermost layer of the cortex



3. Organs: root cortex _ Casparian strip



Casparian strip is……

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Function:

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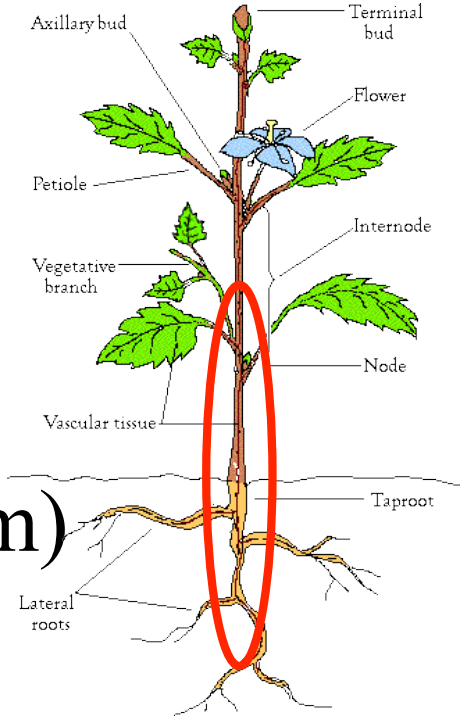
3. Organs: Stems

- Above-ground organs (usually)
- Support leaves and fruits
- Conduct water and sugars throughout plant (xylem and phloem)

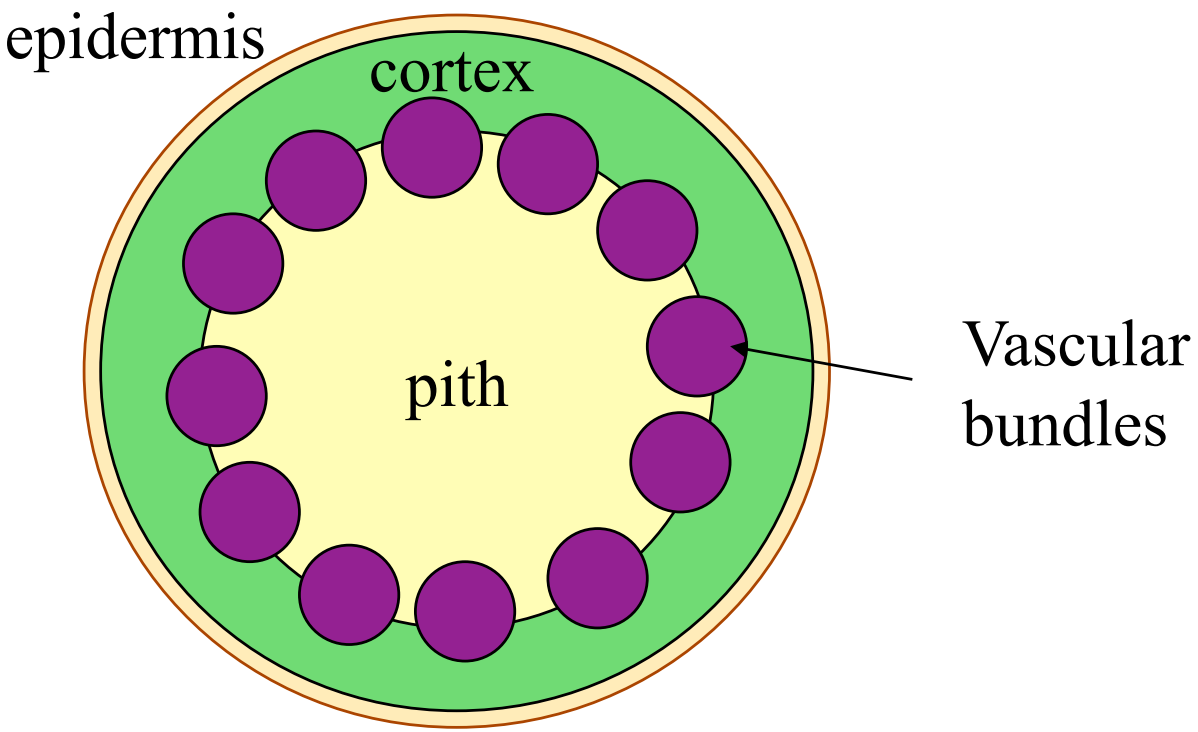


3. Organs: Stems_ different types

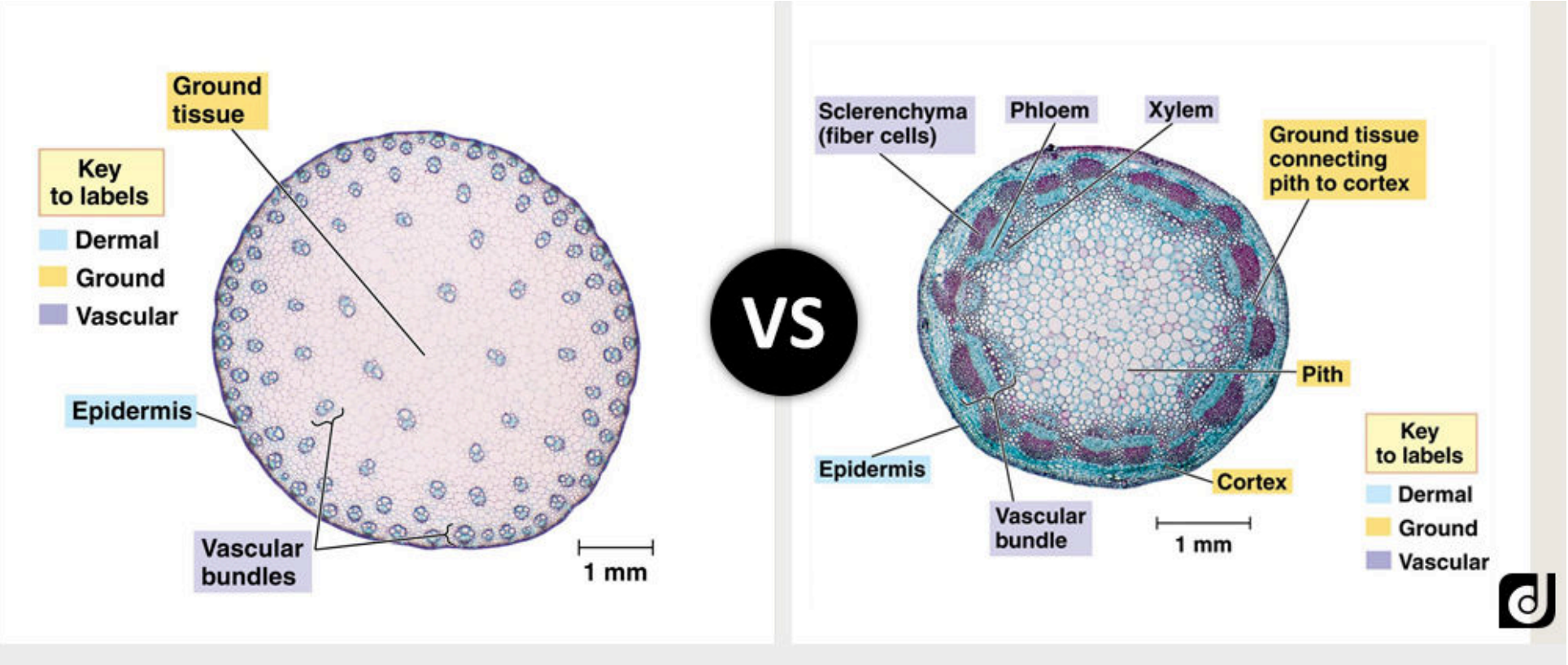
- Herbaceous *vs.* Woody stems

3. Organs: Stems

- Dermal, ground and vascular tissues…



3. Organs: Stems_ different types

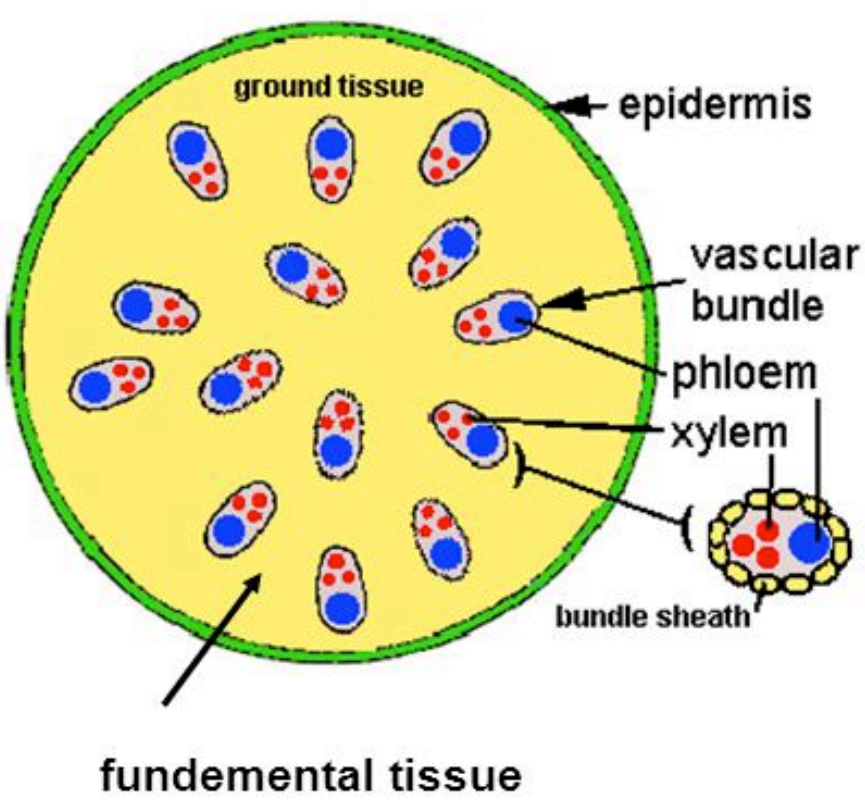


Monocot stem

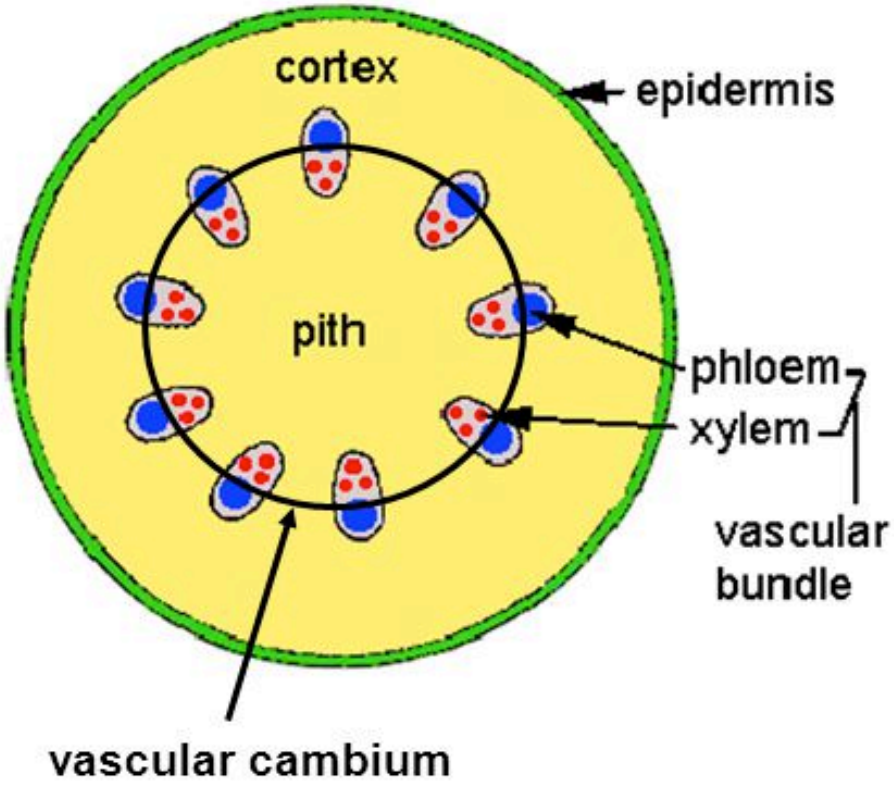
Dicot stem

3. Organs: Stem histology

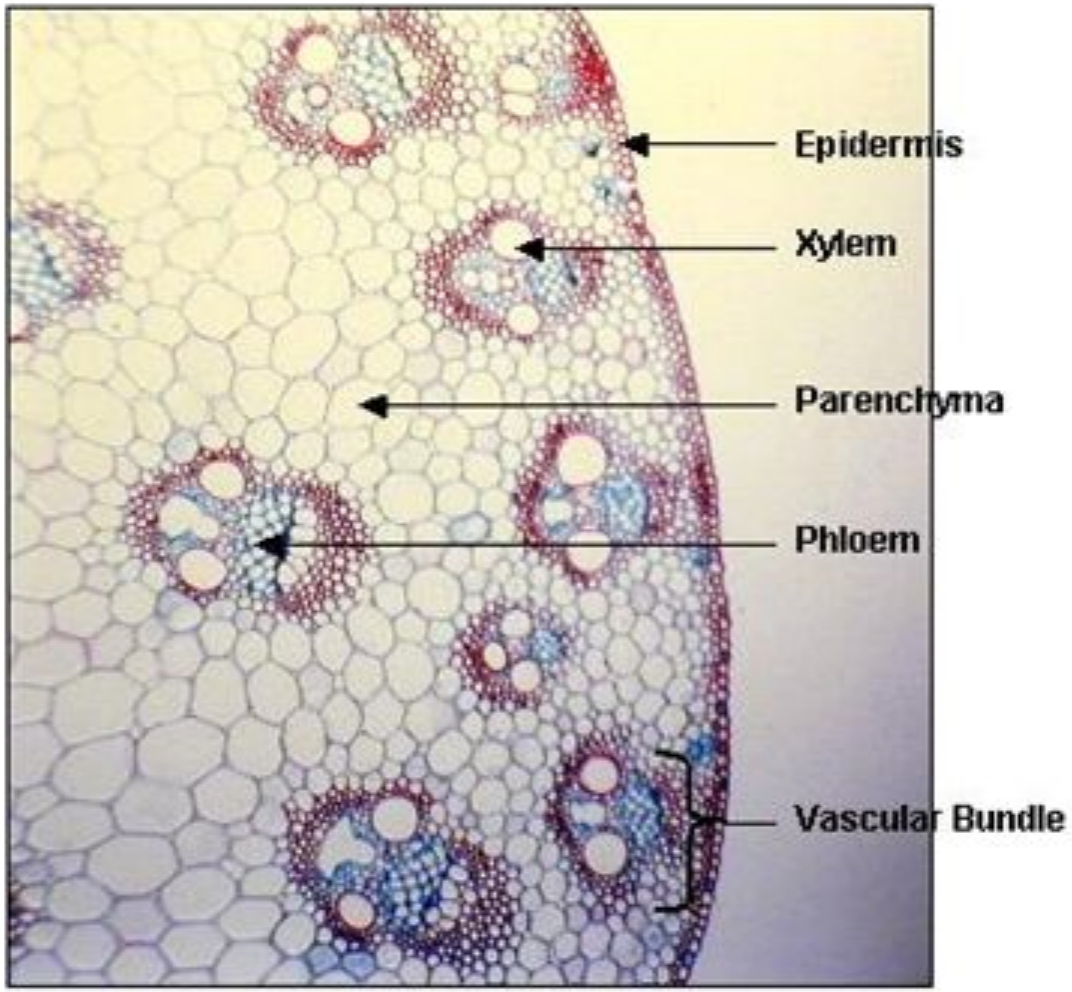
Monocot stem



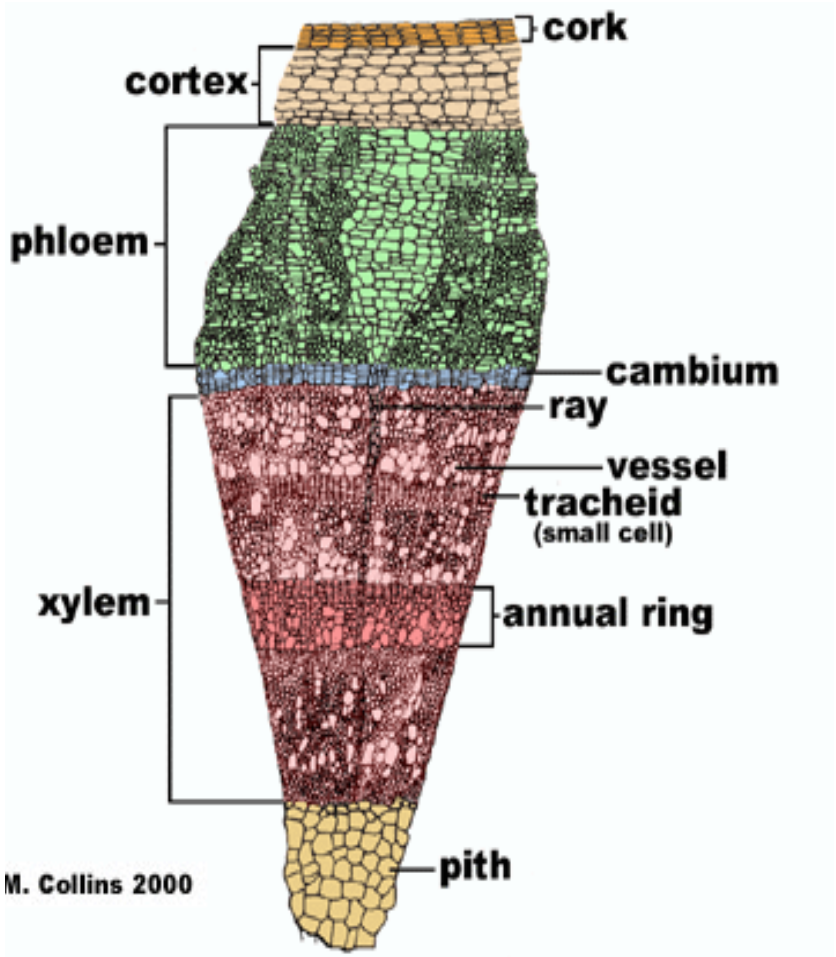
Dicot stem



3. Organs: Stem histology



Monocot stem



Dicot stem

3. Organs: stem histology

Similarities: .....

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Monocot	**Dicot**
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3. Organs: Leaves

Function:

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Leaf morphological structure:

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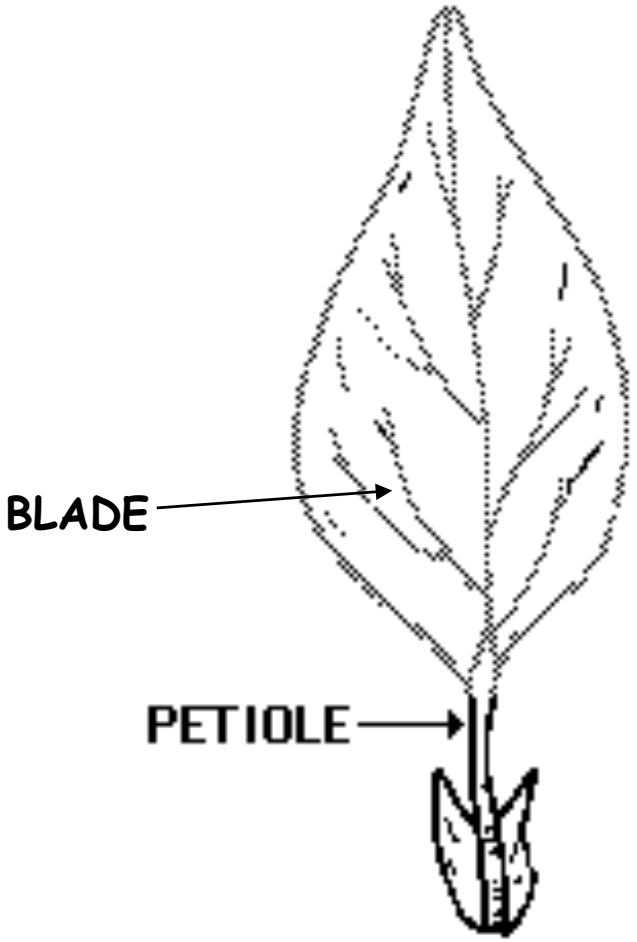
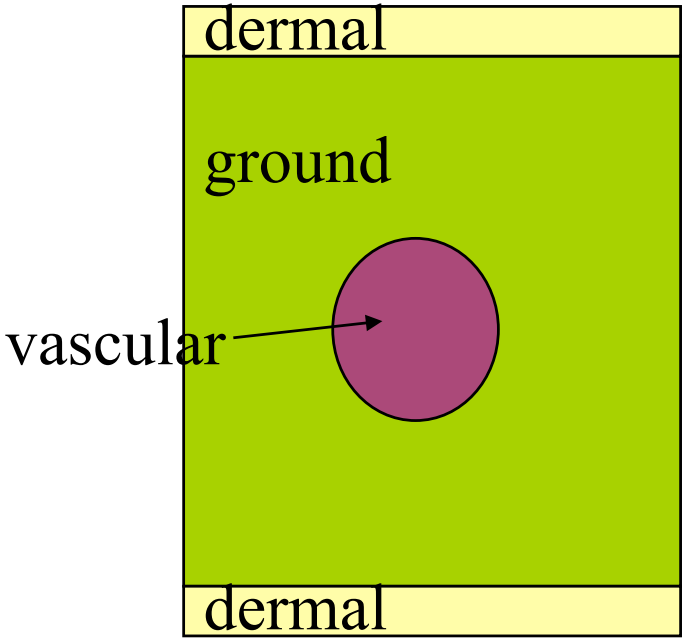
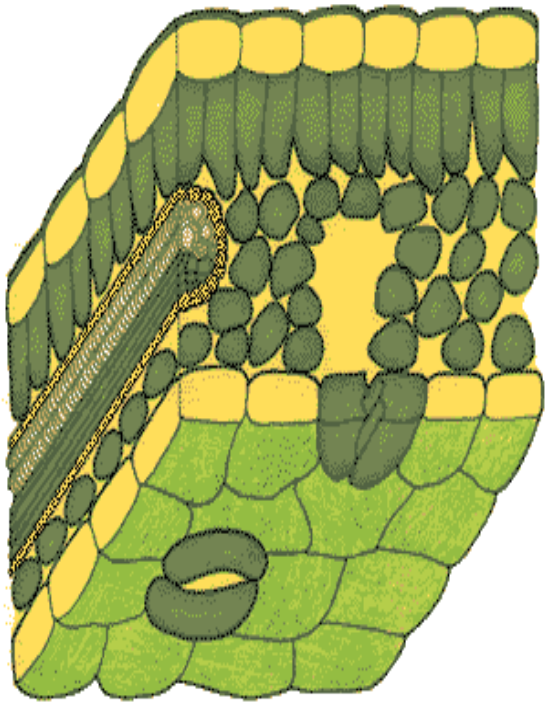


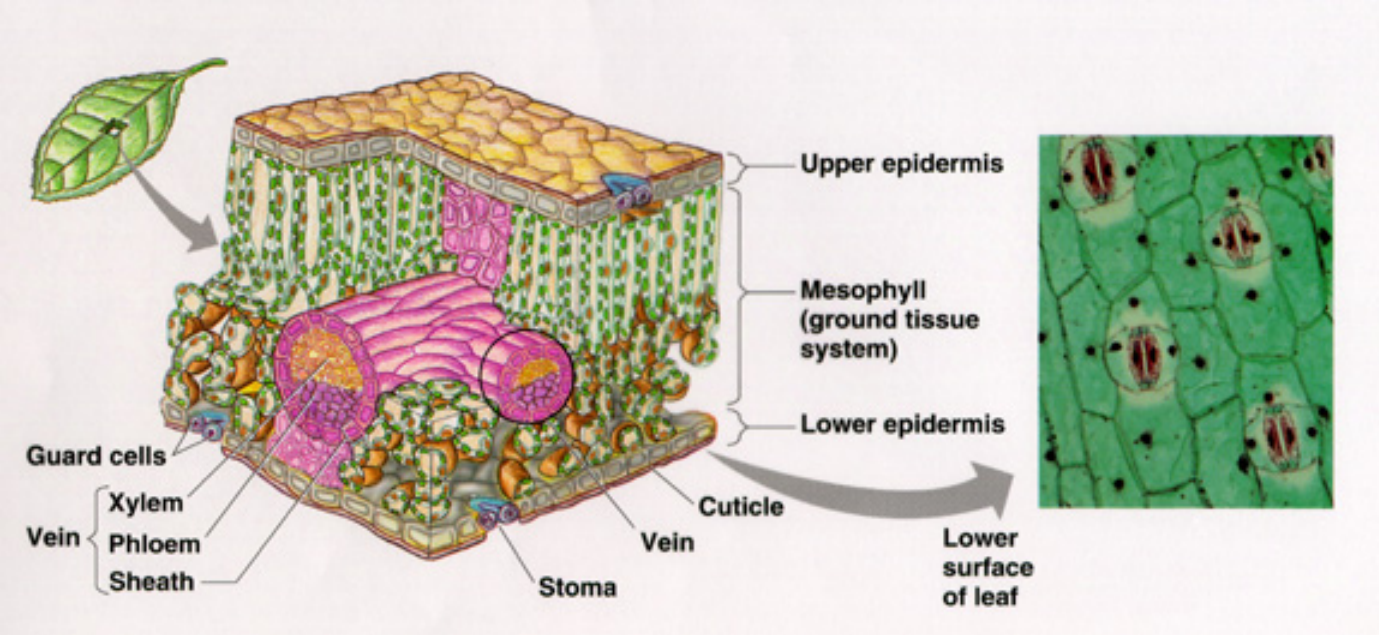
3. Organs: Leaves anatomy

- Leaf anatomy is correlated to photosynthesis

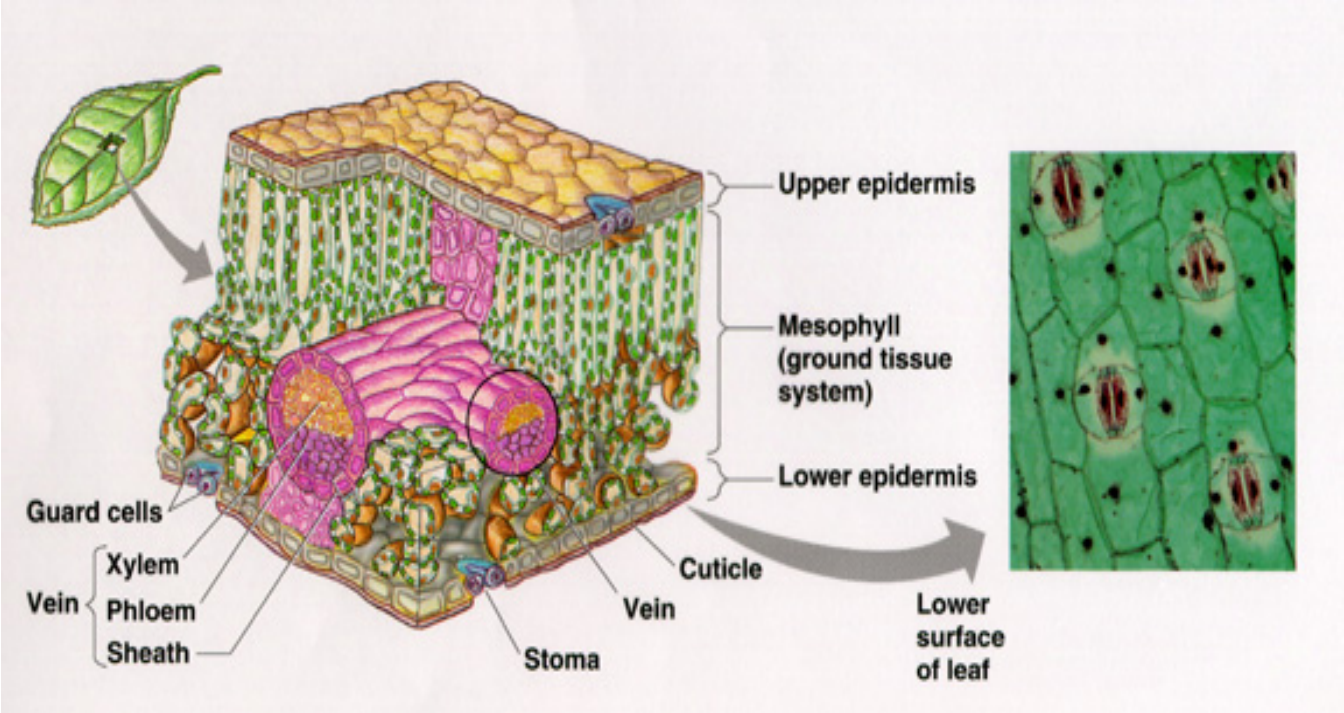




3. Organs: Leaves epidermis



3. Organs: Leaves vascular tissue



3. Organs: Leaves mesophyll

Definition:

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Types of cell

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Summary_ take home message

- Typical structure of plant cell: having cell wall, plastid and large vacuole
- Tissue is a group of cells with common function or structure. There are 4 types of plant tissues including Dermal, Vascular, ground and meristem tissue.
- There are 3 types of plant organ including root, stem and leaf
- Root and stem are organized centrically including epidermis, ground tissue, endodermis, vascular tissues and pith; Leaf is not organized centrically
- With every level of organization (cell, tissue and organ), the structure is usually correlated to the function

Summary_ take home message