Plant Histology

I. The 3 Tissue System
II. Types of Plant Tissues
    1. Meristematic Tissues
        a. Apical Meristem
        b. Lateral Meristem
        c. Intercalary Meristem
    2. Permanent Tissues
        a. Simple Permanent Tissues
        b. Complex Permanent Tissues
III. Economical Uses

Objectives:

At the end of the class, the students should be able to:

- to identify the types and components of plant tissues
- to analyze the functions of some tissues
- to know the economical values/uses of plant tissues

I. The 3 Tissue System

-each plant organ- root, stem, or leaf has dermal, vascular and ground tissues. Each of this categories forms a tissue system, a functional unit connecting all of the plant's organ.

Dermal Tissue System

The dermal tissue system consists of the epidermis and the periderm. The epidermis is generally a single layer of closely packed cells. It both covers and protects the plant. It can be thought of as the plant's "skin."

I. The 3 Tissue System

- **Dermal Tissue System**

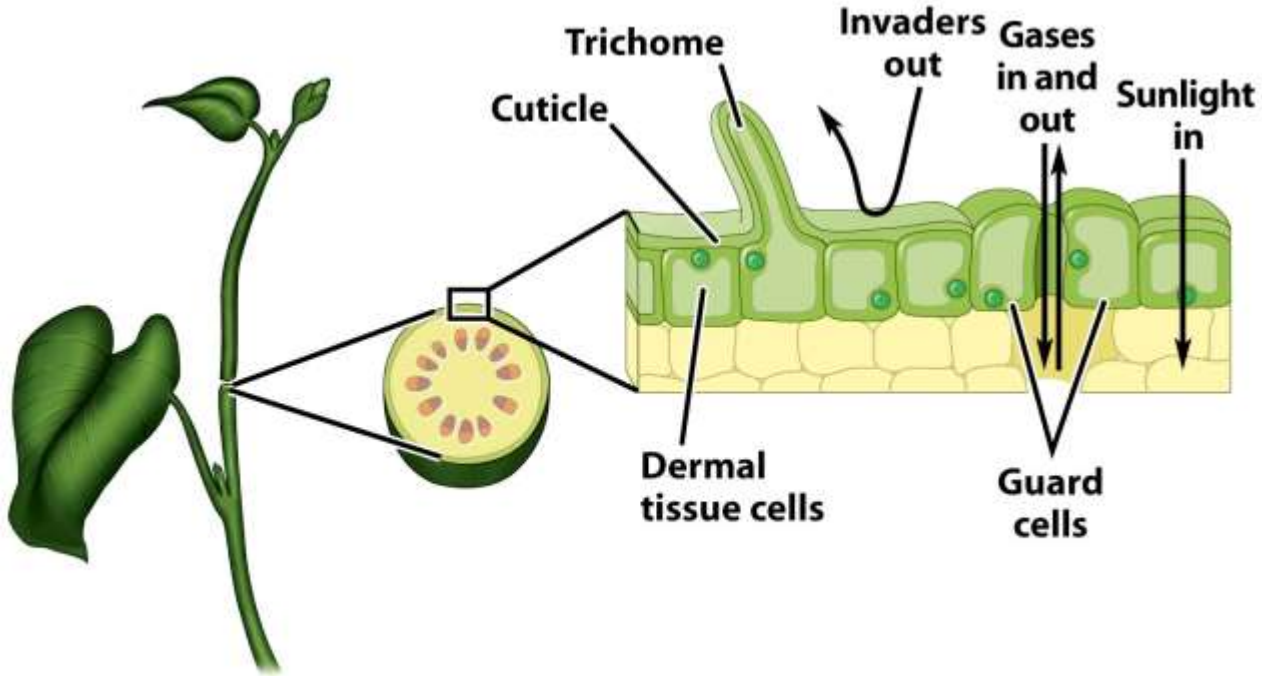

Figure 31-3 part 1 Discover Biology 3/e
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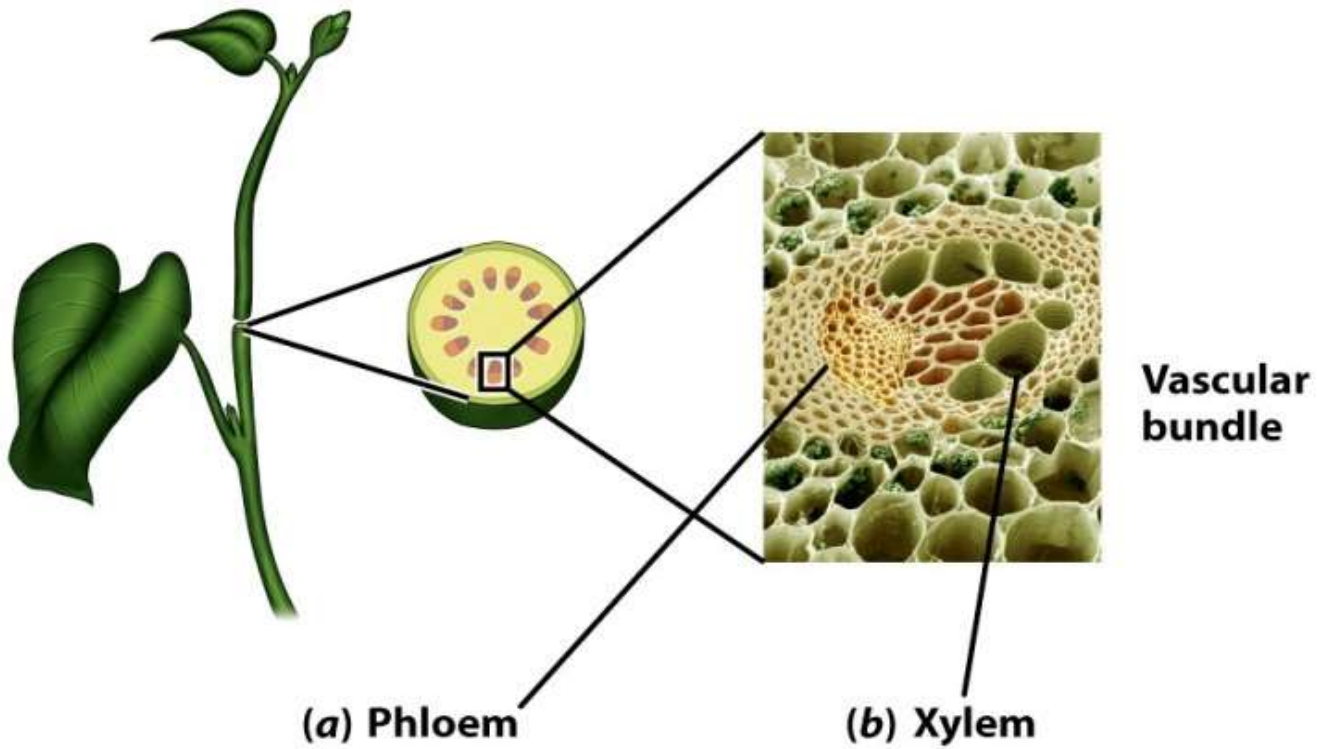
The epidermis and its waxy cuticle provide a protective barrier against mechanical injury, water loss, and infection. Various modified epidermal cells regulate transpiration, increase water absorption, and secrete substances.

Retrieve from: http://www.csus.edu/indiv/l/loom/preview%2013.htm

- **Vascular Tissue System**

  It is a complex conducting tissue. Xylem and phloem, throughout the plant, make up the vascular tissue system. They allow water and other nutrients to be transported throughout the plant.



The cells in differentiated vascular tissues are:

- typically long and slender
- conducts water, minerals and nutrients from the roots throughout the plant.

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Ground Tissue System

It is mostly made up of parenchyma cells and found between dermal and vascular tissues

The ground tissue system:

- synthesizes organic compounds,
- supports the plant and;
- provides storage for the plant.

I. The 3 Tissue System

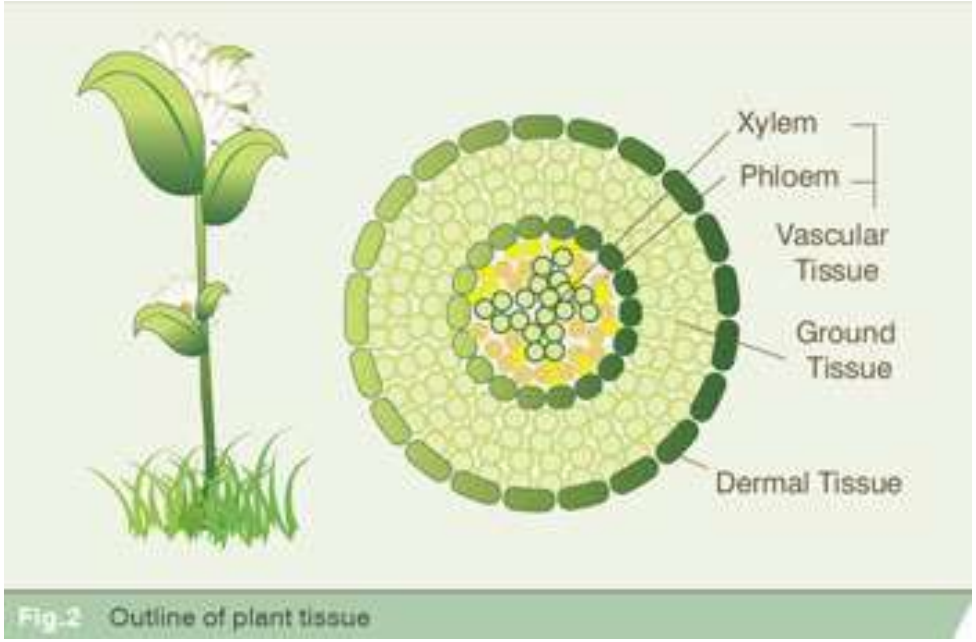


Fig.2 Outline of plant tissue

Retrieved from : http://editions.sciencetechnologyaction.com/lessons2-14731.php

II. Types of Plant Tissues

Plants are capable of *indeterminate* growth because they have perpetually undifferentiated tissues called *meristems* that divides when conditions permits, leading to new cells that can elongate or grow in circumference.

Meristems are classified by their location in the plant as:

- Apical- located at root and shoot tips,
- Lateral- in the vascular and cork cambia and;
- Intercalary- at internodes, or stem regions between the places at which leaves attach, and leaf bases, especially of certain monocotyledons—*e.g.*, grasses.

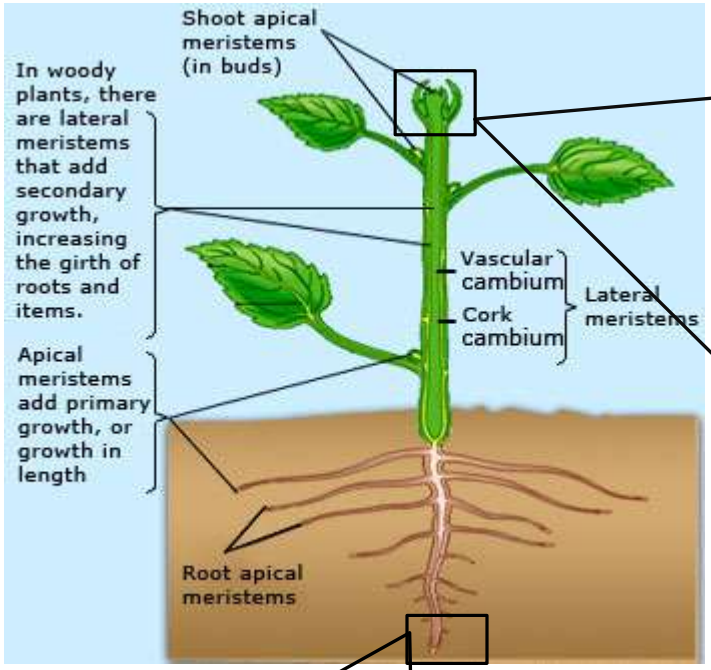
1. Meristematic Tissues

a. Apical (primary) Meristem-

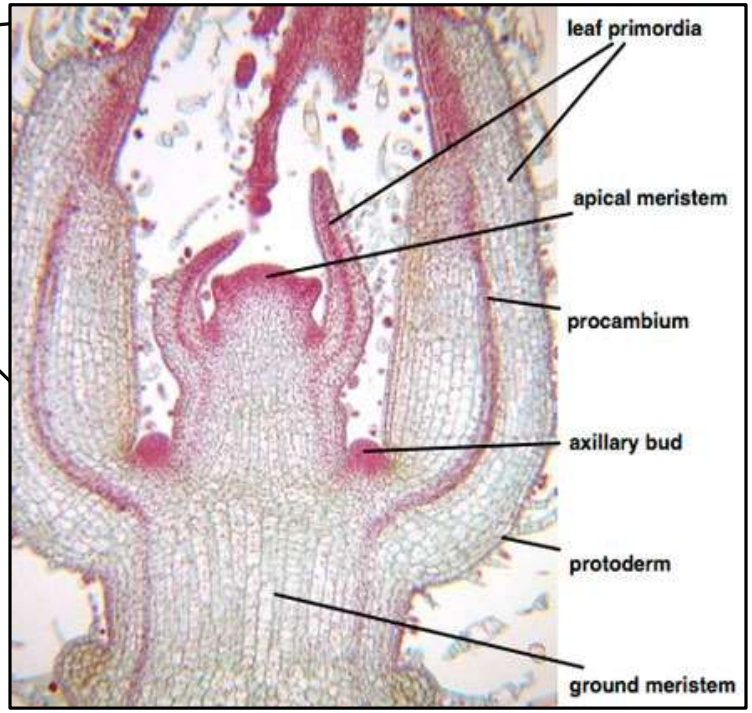
- In young vascular plants, it produces three kinds of primary meristem: *(a)* the protoderm *(b)* ground meristem and *(c)* procambium.
  These in turn produce primary tissues.
- provides additional cells that enable growth, in length, a process known as primary growth.

II. Types of Plant Tissues

- **Meristematic Tissues**



a.



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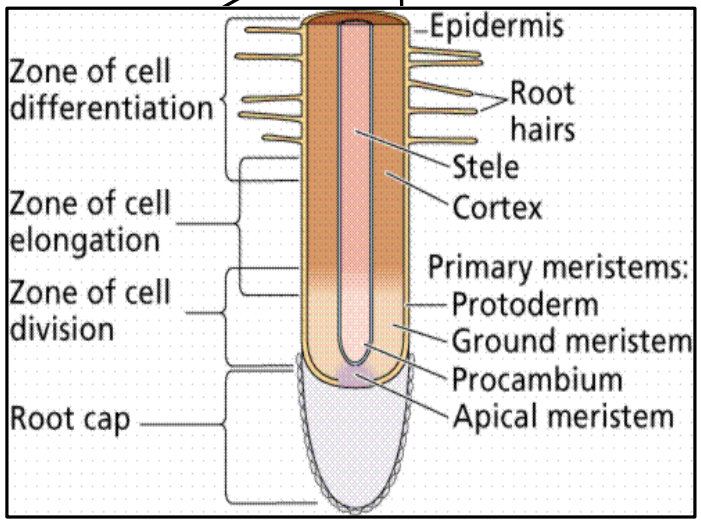


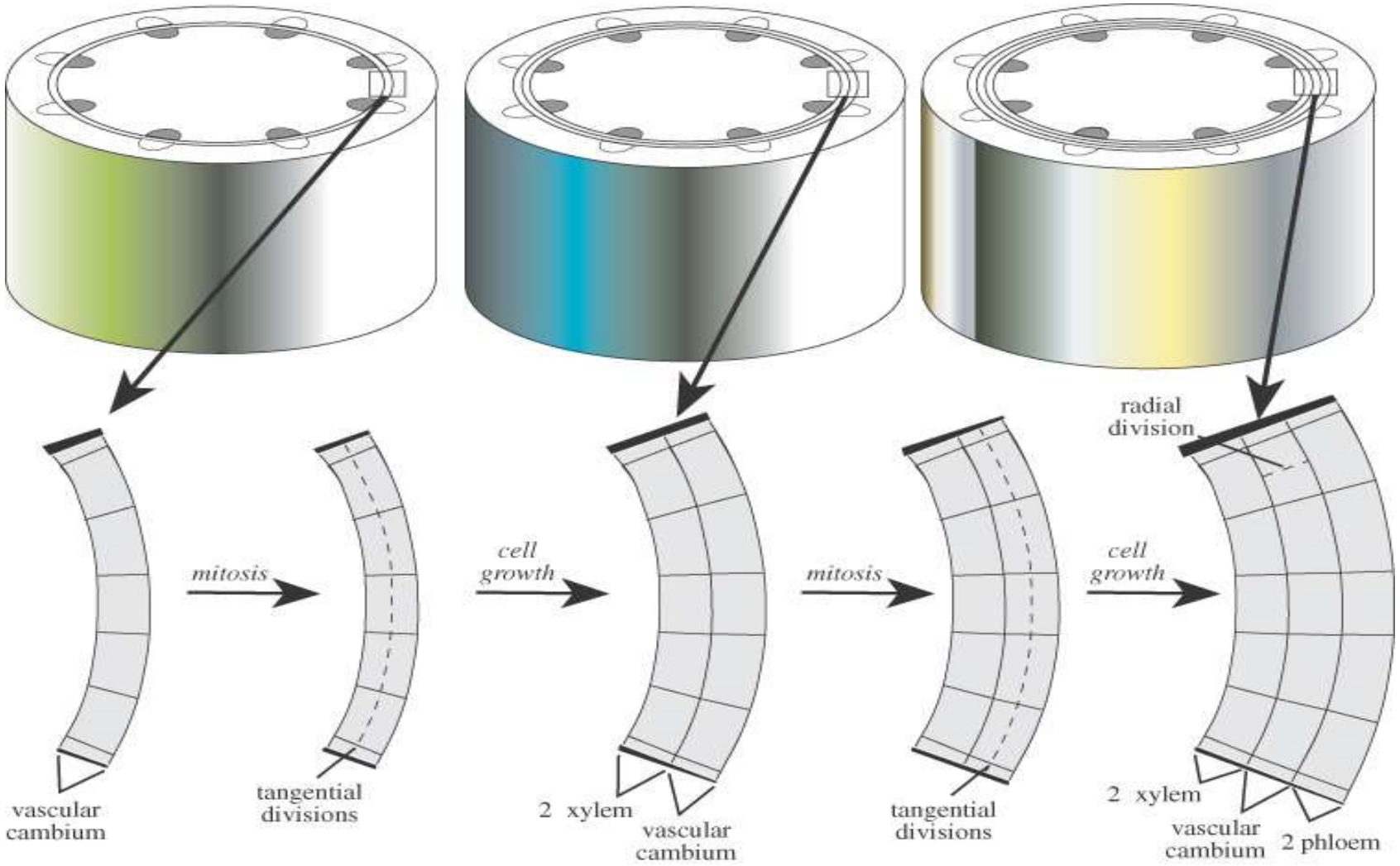
Figure : Longitudinal view of (*a)* the shoot tip of *Coleus* (LM) (*b)* the root.

b. Lateral (secondary) Meristem-

- surrounds the established cylindrical stem of a plant;
- gives rise to secondary xylem and secondary phloem, which enables plants to grow in diameter, process called secondary growth.

II. Types of Plant Tissues

- **Meristematic Tissues**



Vascular Cambium- A cylindrical layer of delicate meristematic tissue between the phloem and xylem of woody plants.

Cork Cambium- a cylindrical layer of meristematic tissues in cortex of the stems and roots of woody plants.

Also called Phellogen

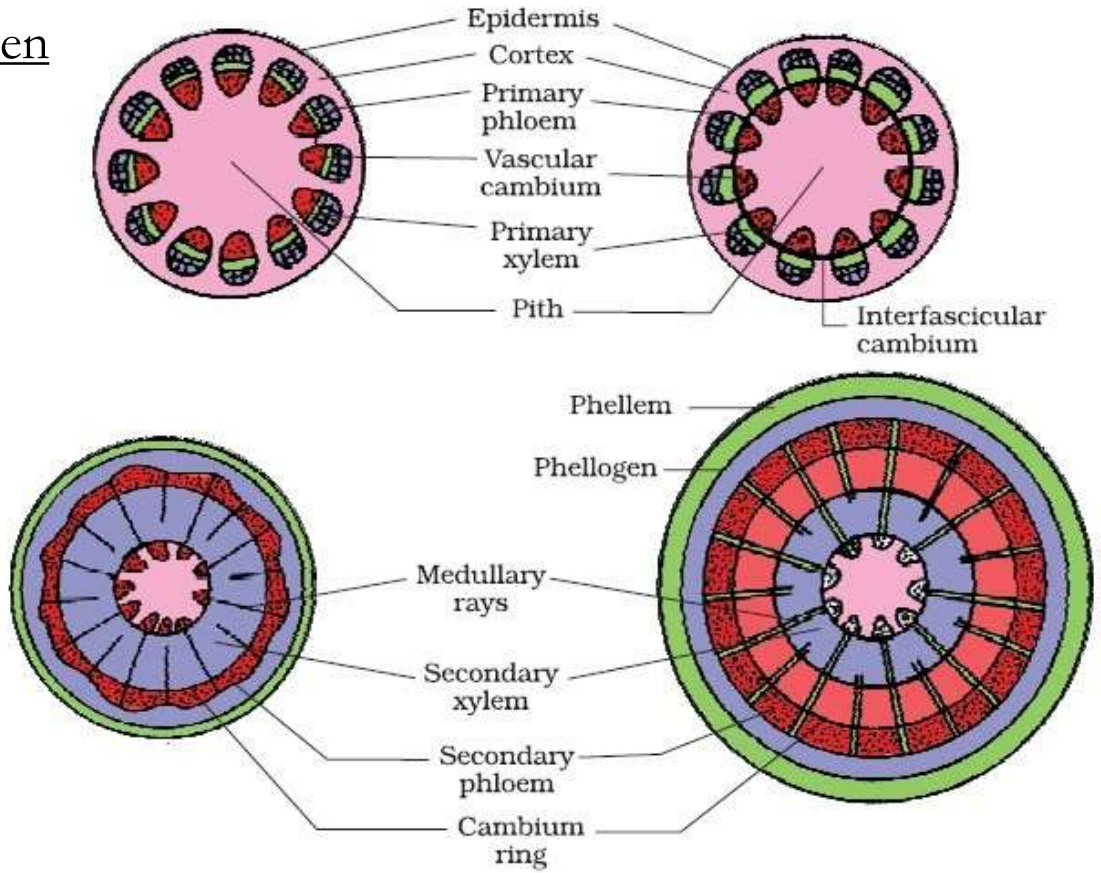
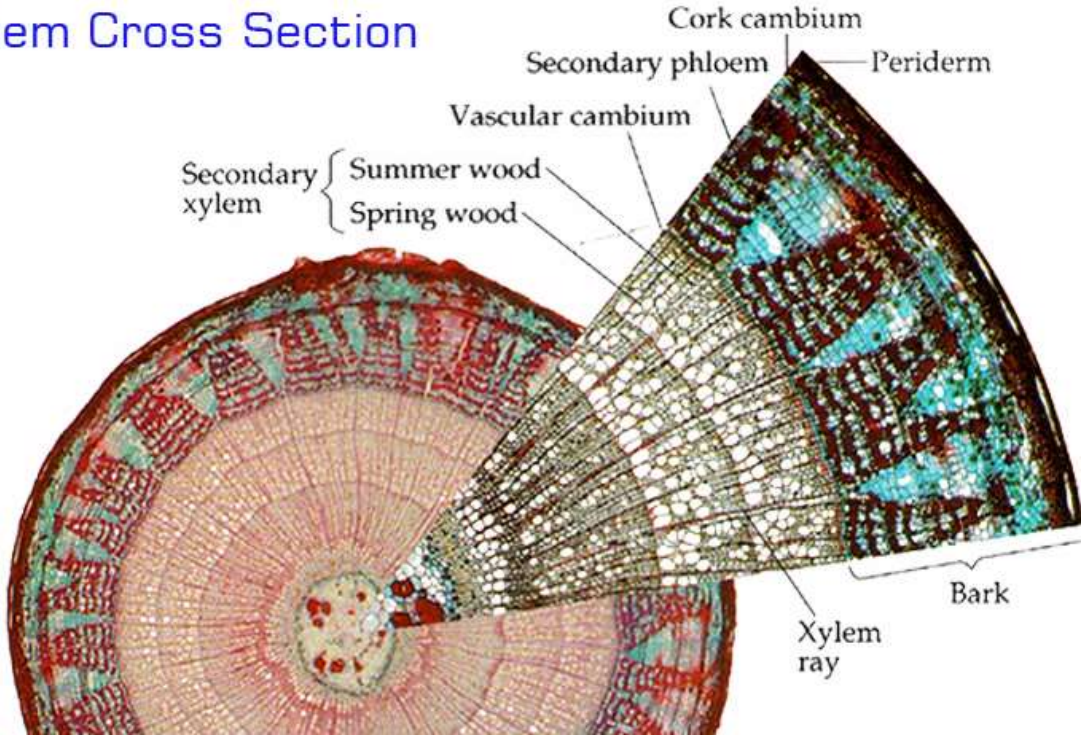


Figure . Secondary growth in a dicot stem (diagrammatic) – stages in transverse views

Retrieved from: http://www.kshitij-school.com/Study-Material/Class-11/Biology/Anatomy-of-flowering-plants/Secondary-growth.aspx

Figure. Organization of tissues

Tilia Stem Cross Section

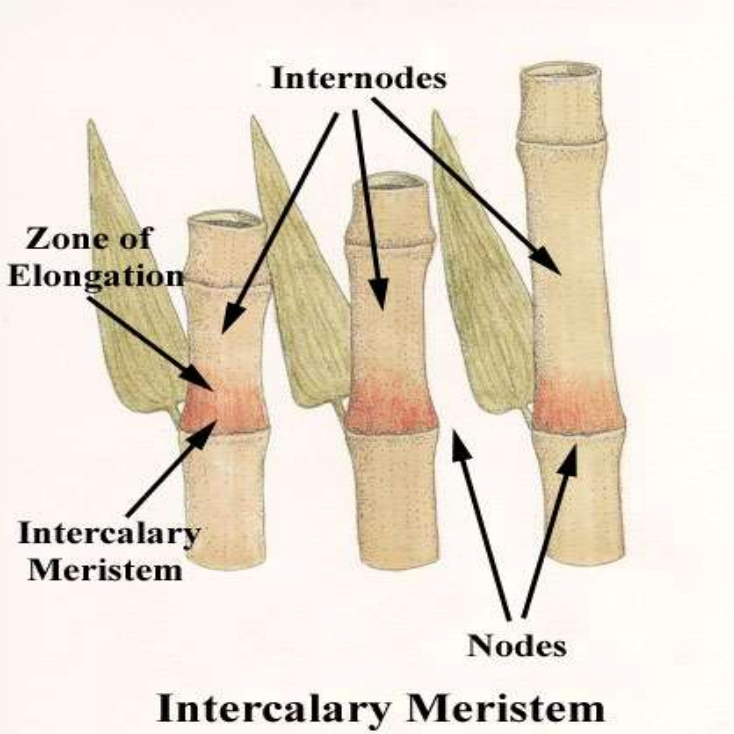


Woody dicot stem (tree rings)

- determine how many years old this tree was when cut down;
- differentiate **early wood** (spring wood) from **late wood** (summer wood).

c. Intercalary Meristem-

- The meristematic tissue that occurs between permanent tissues. It represents the remnant of the apical meristem.
- The intercalary meristem contributes towards the increase in length as it brings about elongation of the internodal regions.
- Common in most grasses.



It is particularly common at the nodal regions. It may also occur at the base of the leaves. Intercalary meristem is responsible for the formation of branches at the nodal regions. Retrieved from: http://www2.puc.edu/Faculty/Gilbert_Muth/botglosi.htm

II. Types of Plant Tissues

o Meristematic Tissues

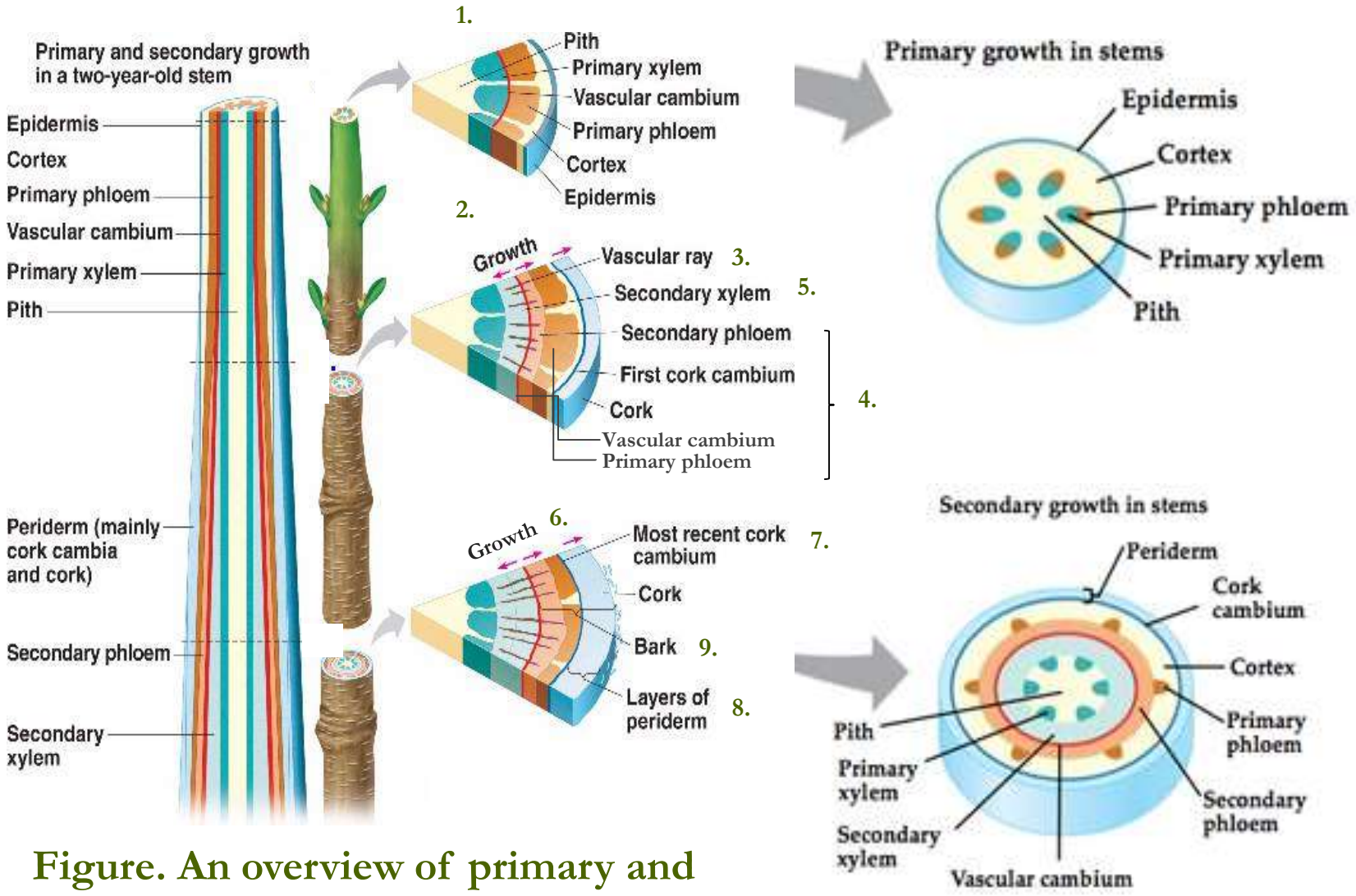


Figure. An overview of primary and secondary growth of a woody stem.

II. Types of Plant Tissues

- **Meristematic Tissues**

1. Primary growth from the activity of the apical meristem is nearing completion. The vascular cambium has just formed.
2. Although primary growth continues in apical bud, only secondary growth occurs in this region. The stem thickens as the vascular cambium forms secondary xylem to the inside and secondary phloem to the outside.
3. Some initials of the vascular cambium give rise to the vascular rays.
4. As the vascular cambium diameter increases, the secondary phloem and other tissues external to the vascular cambium can't keep pace because their cells no longer divides. As a result, the tissues, including the epidermis, will eventually rapture. A second lateral meristem, the cork cambium, develop from parenchyma cells in the cortex. The cork cambium produces cork cells, which replace the epidermis.
5. In year 2 of secondary growth, the vascular cambium produces more secondary xylem and phloem, and the cork cambium produces more cork.
6. As the stem's diameter increases, the outermost tissues exterior to the cork cambium rupture and are sloughed off.
7. In many cases, the cork cambium re-forms deeper in the cortex. When none of the cortex is left, the cambium develops from phloem parenchyma cells.
8. Each cork cambium and the tissues it produces form a layer of periderm.
9. Bark consists of all tissues exterior to the vascular cambium.

II. Types of Plant Tissues

The cells of permanent tissues do not have the ability to divide. These cells are already differentiated in different tissue types and is now specialized to perform specific functions.

They are subdivided into two groups: (a) **simple permanent tissues** and; (b) **complex permanent tissues**

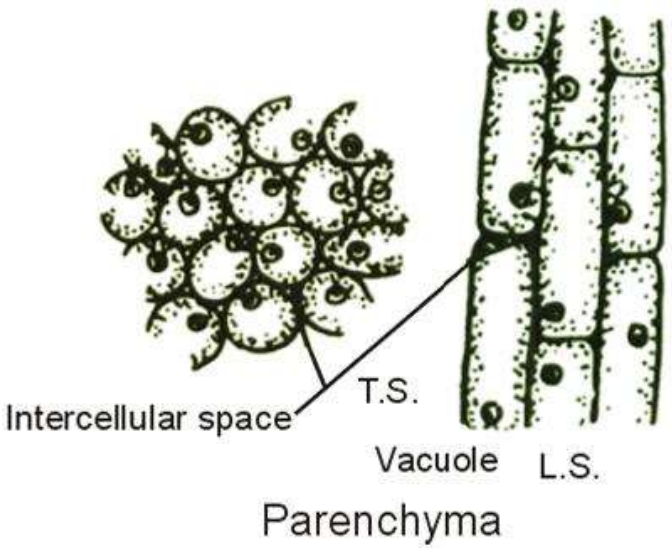
Permanent Tissues

a. **Simple permanent tissues-** is the collection of similar cells performing similar function. It is further divided into three different types on the nature of cell: parenchyma, collenchyma, and sclerenchyma.

b. **Complex permanent tissues-** is collection of dissimilar cells which perform cell function. It forms vascular or conducting tissue in the plant. They are of two types: xylem (water- conducting) and phloem (sugar- conducting).

Parenchyma Tissues

- is the **most common plant tissue**. It is relatively unspecialized.
- makes up a substantial part of the volume of a herbaceous plant and of the leaves, flowers and the fruits of woody plants.
- The **thin-walled** parenchyma cells have **large vacuoles and distinct intercellular spaces.**

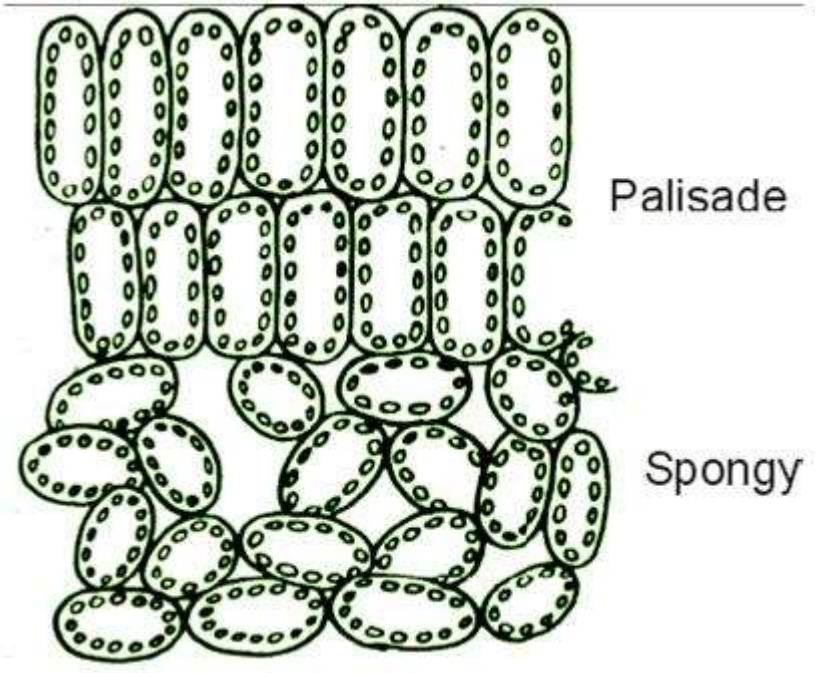


Functions:

- the most important function of the parenchyma cells of roots and stem is the *storage of food (e.g. starch) and water*,
- the *intercellular air spaces permit gaseous exchange*

Collenchyma Tissues

- are mainly **found under the epidermis** in young stems in the large veins of leaves.
- the cells are composed of **living, elongated cells** running parallel to the length of organs that it is found in.
- have **thick cellulose cell walls** which **thickened** at the corners.
- **sometimes, they contain chloroplasts**.

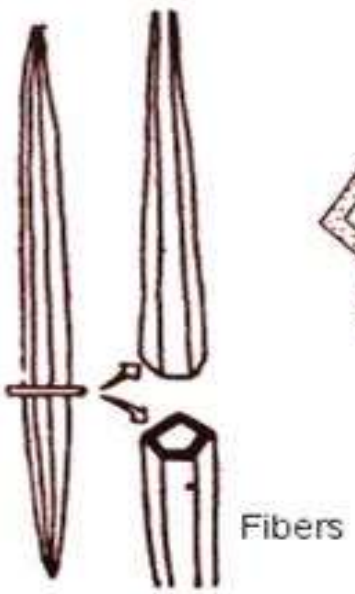


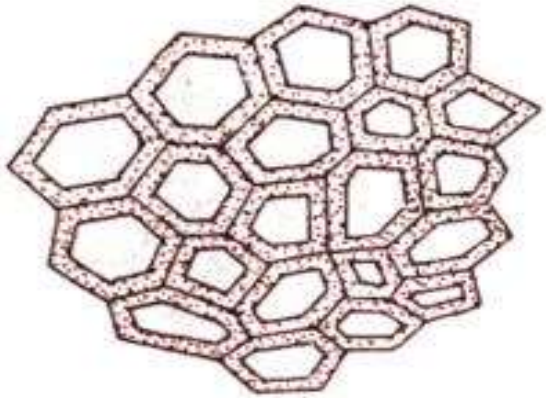
Functions:

- the collenchyma serve as *supporting and strengthening tissue.*
- in collenchyma *with chloroplasts, photosynthesis* takes place

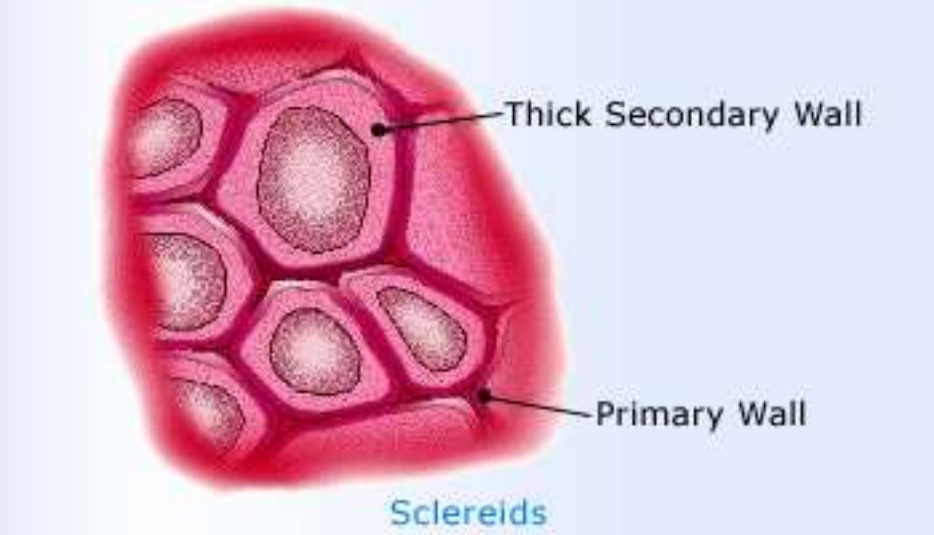
Sclerenchyma Tissues

- Mature sclerenchyma cells are dead
- have secondary cell walls thickened with cellulose and usually impregnated with lignin.
- sclerenchyma is elastic.
- There are two types of sclerenchyma cells, namely **sclereids** and **fibers**.





Fibers: cells that are needle-shaped with pointed tips, thick walls impregnated with lignin, and rather small lumen.



Sclereids: cells that are irregular in shape. The cell walls are thick, hard and lignified which makes the lumen very small. Sclereids are commonly found in fruit and seeds.

Functions:

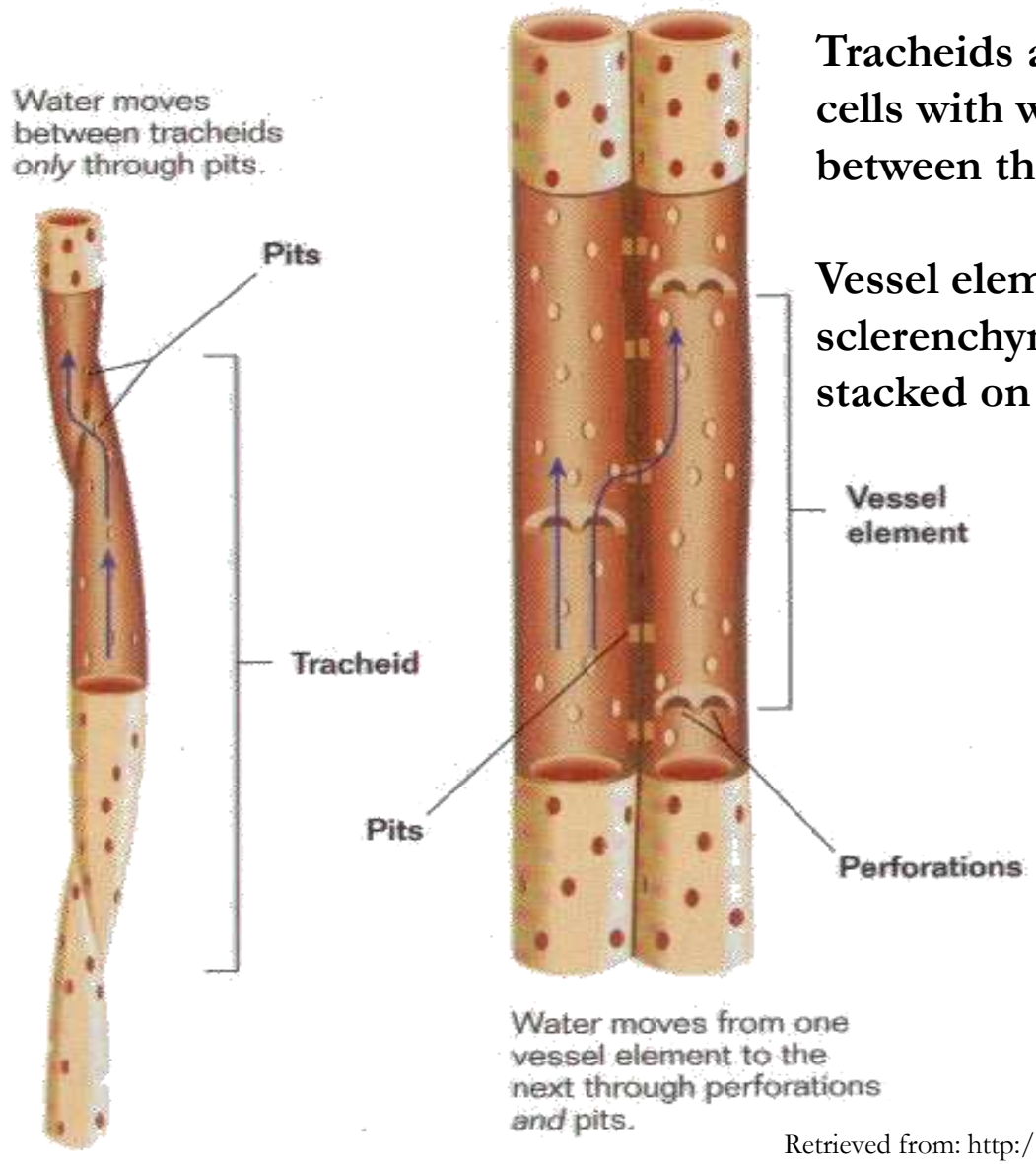
- sclerenchyma is an important supporting tissue in plants,
- sclereids are responsible for the hardness of dates seeds and the shell of walnut,
- fibers play a role in the transport of water in the plant,
- starch granules are stored in the young, living fibers

Xylem (Water- conducting)

- in botany, a part of the vascular system that conveys water and dissolved minerals from the roots to the rest of the plant and
- it also furnish mechanical support.
- Xylem consists of specialized water-conducting tissues made up mostly of narrow, elongated, hollow cells.
- the wood of a tree is composed of xylem.

II. Types of Plant Tissues

- **Complex permanent tissues**



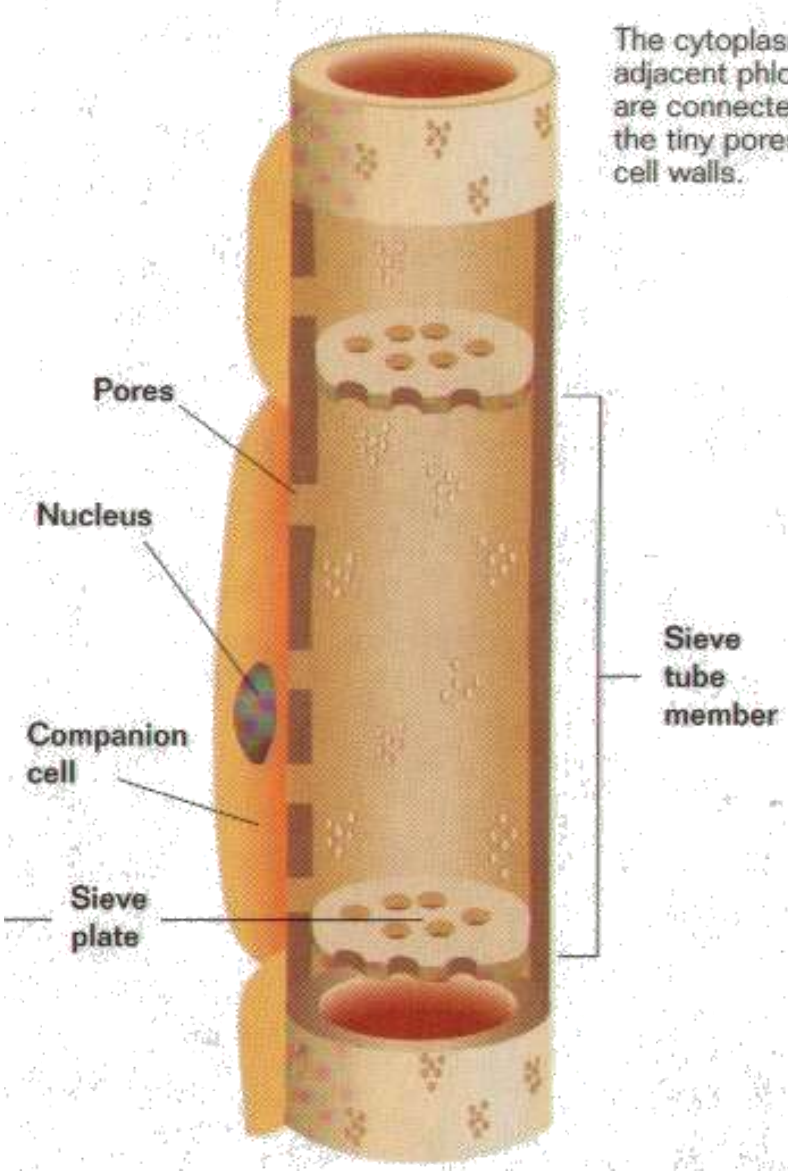
Tracheids are long, narrow sclerenchyma cells with walls and pits for water to move between them.

Vessel elements are short, wide sclerenchyma cells without end walls stacked on top of each other

Retrieved from: http://www.biologyjunction.com/plant_structure_bi1.htm

Phloem (Sugar- conducting)

- also called **bast**, is the living tissue that carries organic nutrients (known as photosynthate), in particular, sucrose,
- Phloem tissue consists of: conducting cells, generally called **sieve elements**; **parenchyma** cells, including both specialized **companion cells** and unspecialized cells; and supportive cells.



Sieve tube members are stacked to form tubes called sieve tubes with porous sieve plates between the cells for movement of sugars.

Companion cells are along each sieve tube member & help in loading sugar into the sieve tube

III. Economical Uses

- Food
- Used for furniture making.
- Clothing, fibers are extracted from the plants.
- Tissue cultivation for production of new and improved vegetable crops, fruit crops, floriculture and even in woody species. (Horticulture)
- Through tissue culturing, endangered plant species are conserved, like **Sinkhole Cycad (*Zamia prasina*)**(http://sospecies.org/sos_projects/plants/belizean_sinkhole_cycads/?14583/Expedition-leads-to-discovery-of-major-population-of-Sinkhole-Cycad).


Vitality and
beauty are gifts of
Nature for
those who live according to its