Chapter 9-Stems and Material Transport

Vascular plants are those plants that have a conducting system.

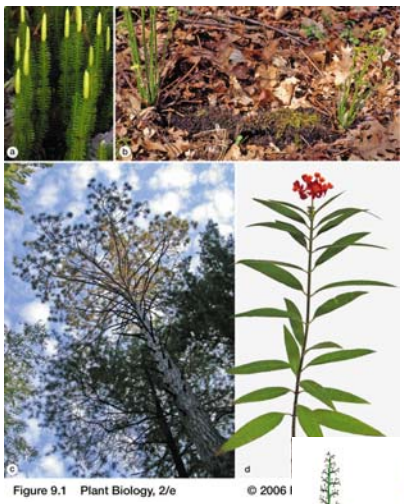


Figure 9.1 Plant Biology, 2/e © 2006

Some of the earliest fossils of vascular plants have stems, but not roots and leaves.

Figure 9.2 Plant Biology, 2/e © 2006 Pearson Education

<u>Stems are fundamental plant organs with multiple functions.</u>

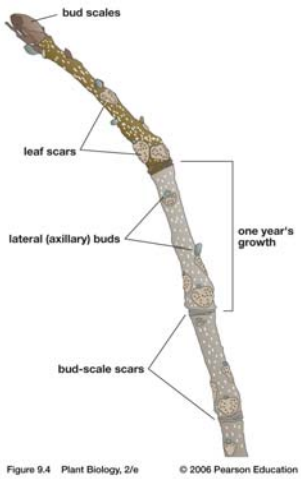


Figure 9.4 Plant Biology, 2/e © 2006 Pearson Education

Twigs bear distinctive scars where leaves and bud scales were formerly attached.

Stems are fundamental plant organs with multiple functions.

Xylem is a complex tissue involved in the transport of water and (usually) dissolved mineral nutrients.

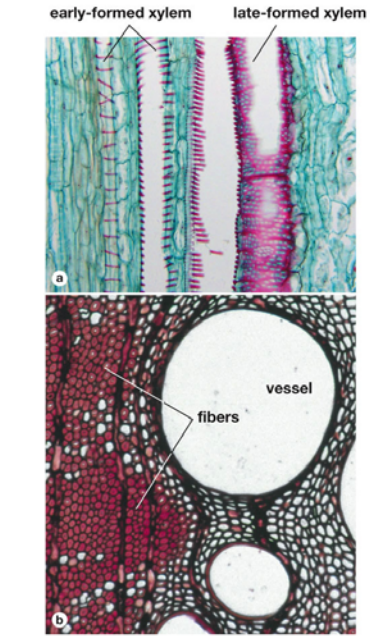


Figure 9.5 Plant Biology, 2/e © 2006 Pearson Education

Phloem is the second complex tissue of the vascular system.

The function of phloem is primarily the movement of sugar from one part of the plant to another.

Xylem

Lignin is a tough polymer constructed of phenolic secondary compounds.

Lignin

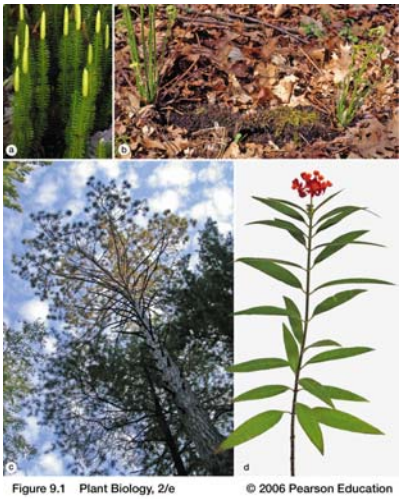


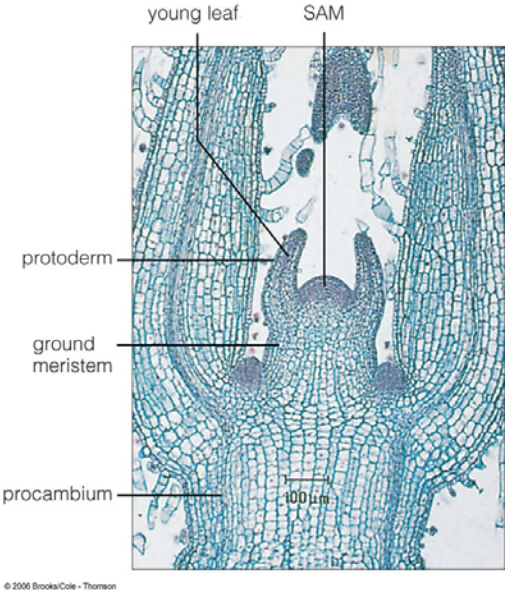
Figure 9.1 Plant Biology, 2/e © 2006 Pearson Education

Vascular plants have true stems, because xylem and phloem are present.

Mosses and other bryophytes lack true stems, leaves, and roots because


Figure 9.6 Plant Biology, 2/e © 2006 Pearson Education

In herbaceous (nonwoody) stems and young stems of woody plants, xylem and phloem tissues differentiate from procambium.



Mature conducting tissues formed in this process:

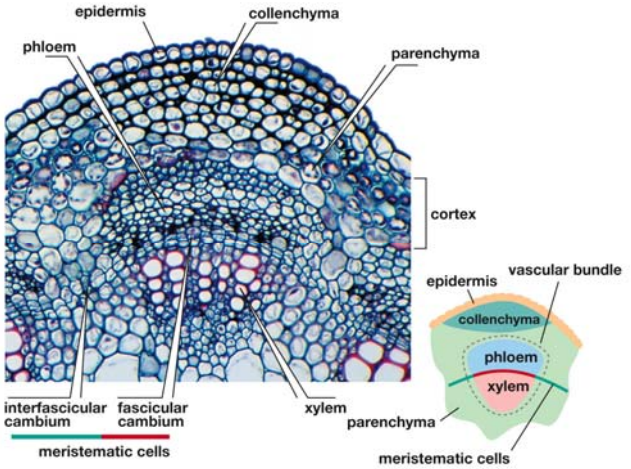


Figure 9.7 Plant Biology, 2/e © 2006 Pearson Education

The vascular bundles are arranged differently in monocots and dicots.

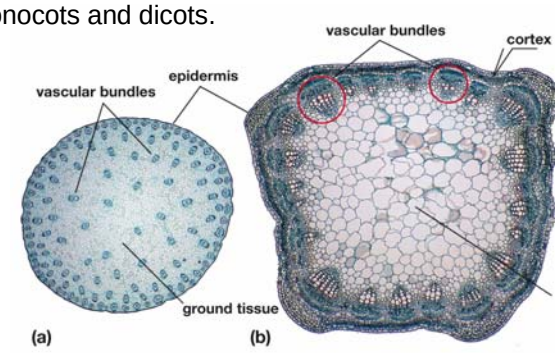


Figure 9.8 Plant Biology, 2/e

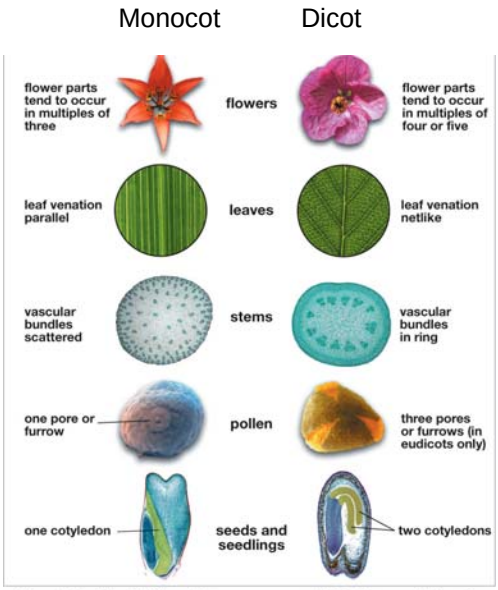


Figure 23.3 Plant Biology, 2/e © 2006 Pearson Education

Xylem and phloem are located within vascular bundles.

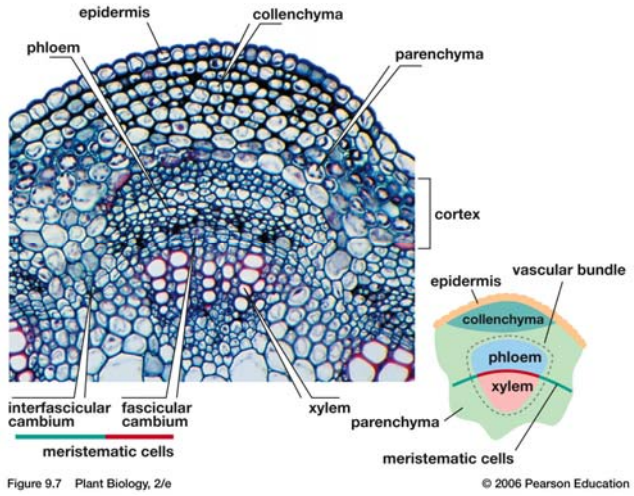


Figure 9.7 Plant Biology, 2/e © 2006 Pearson Education

The conducting cells in xylem and phloem are arranged end-to-end to form a pipeline structure.

Phloem tissues include sieve elements

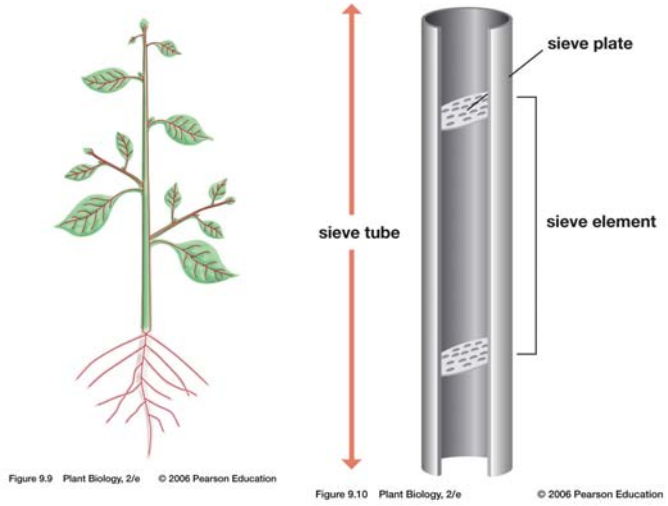
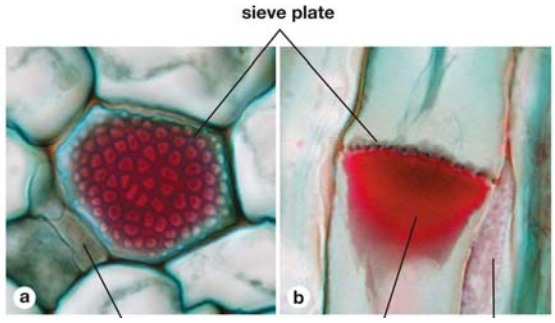


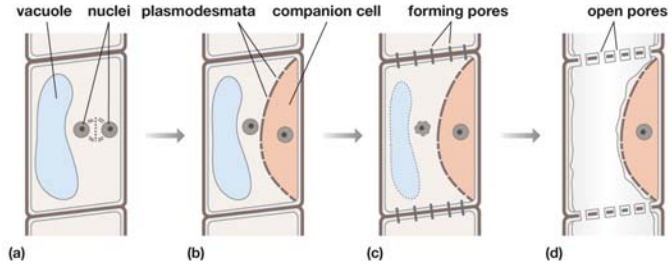
Figure 9.9 Plant Biology, 2/e © 2006 Pearson Education

Figure 9.10 Plant Biology, 2/e © 2006 Pearson Education

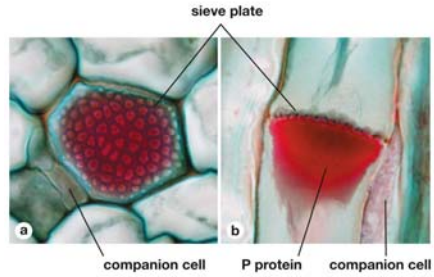
The pores develop from expansions of plasmodesmata and allow phloem sap to move from one cell to the next.



Phloem sieve elements are alive at maturity (cell membrane, ER, mitochondria, and plastids).



Sieve elements require the help of adjacent companion cells in order to function.



Stem phloem is continuous with phloem of root, leaves, and other plant organs.

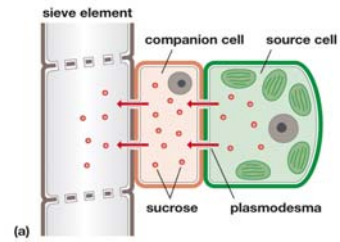
The direction of movement of materials in the phloem is from "source to sink."

Figure 9.9 Plant Biology, 2/e © 2006 Pearson Education

How does sugar enter the phloem?

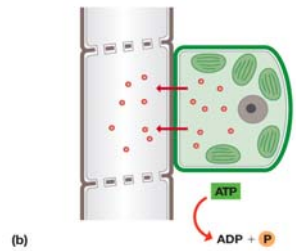
Symplastic loading:

In some plants, sugars are loaded directly



Apoplastic loading:

Other plants load from intracellular spaces which requires energy (ATP)



Organic compounds move within the phloem by pressure flow or mass flow.

As sugars are loaded into sieve elements, the high concentration of sugar causes water to move from the xylem to the phloem by osmosis.

This reduces the sugar concentration so that water can move into the xylem and be transported back upward

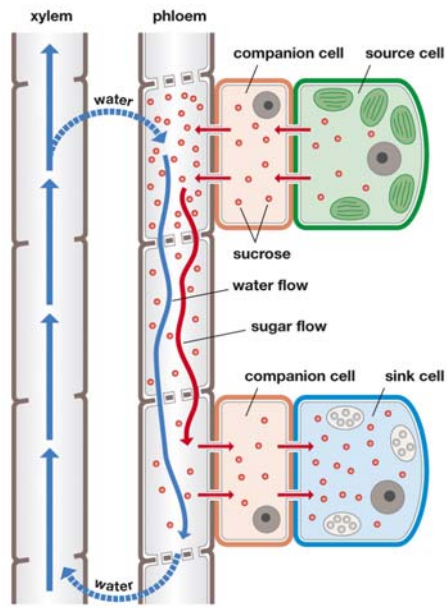


Figure 9.14 Plant Biology, 2/e © 2006 Pearson Education

Xylem tissues of flowering plants include two types of elongate cells:

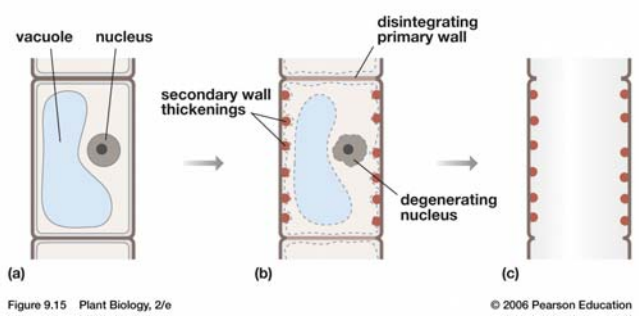
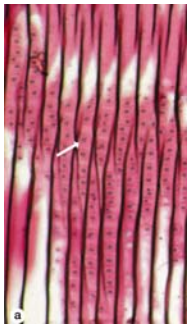
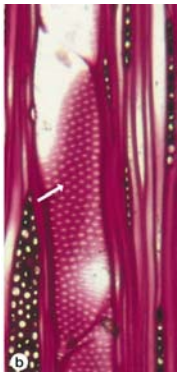


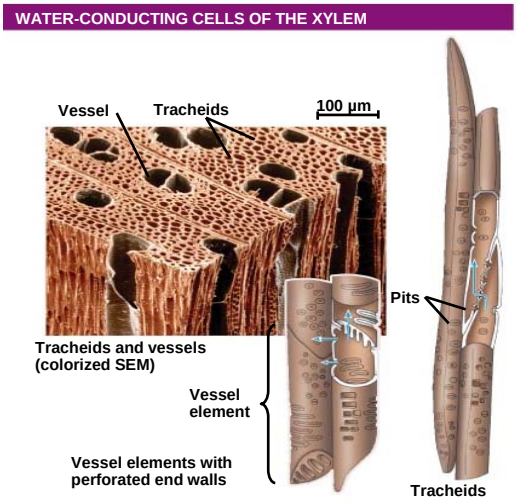
Figure 9.15 Plant Biology, 2/e © 2006 Pearson Education

Both tracheids and vessel elements undergo programmed cytoplasmic death.

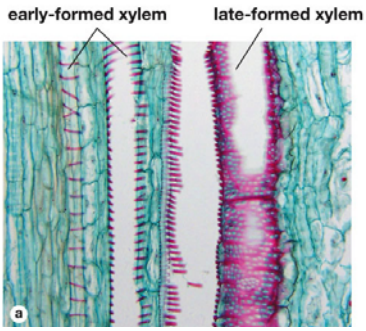
Vessel elements have large perforations in their end walls and are stacked to form pipelinelike arrays known as vessels.







The sidewalls of tracheids and vessels are strengthened by lignin.



Pits allow water movement into and out of water-conducting cells through sidewalls.

Plants obtain water and minerals from the soil, and move these materials via root xylem into the stem.

In order to meet the increased demand for sugar by growing shoots in springtime, xylem also transports sugary solutions.


Figure 9.17 Plant Biology, 2/e © 2006 Pearson Education

Woody plants produce wood tissue and bark through the activity of secondary meristems:

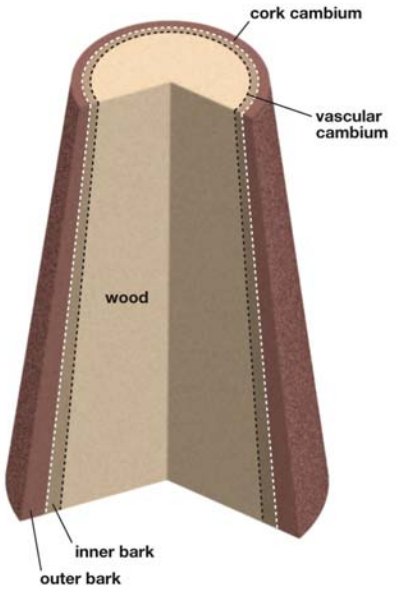


Figure 8.8 Plant Biology, 2/e

The secondary meristem result in growth in a lateral direction, such as the increase in girth of a tree.

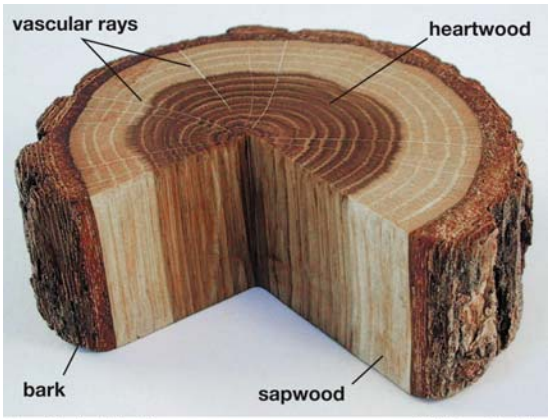


Figure 9.22 Plant Biology, 2/e

Woody plants include:

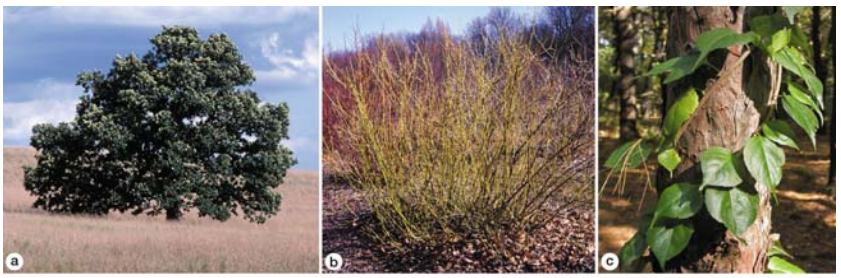


Figure 9.18 Plant Biology, 2/e

Vascular cambium

The vascular cambium develops from meristematic cells between xylem and phloem.

Fascicular

Interfascicular

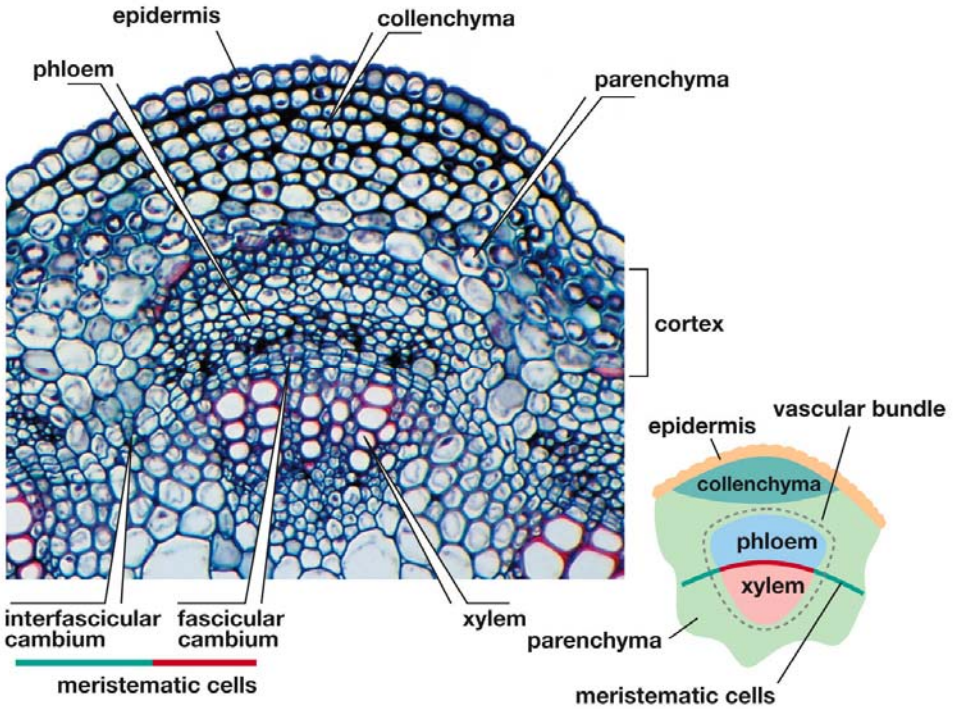
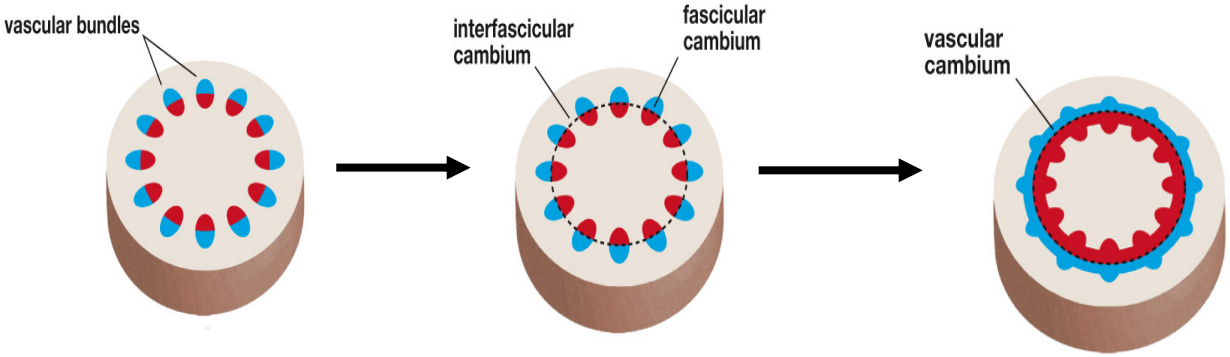
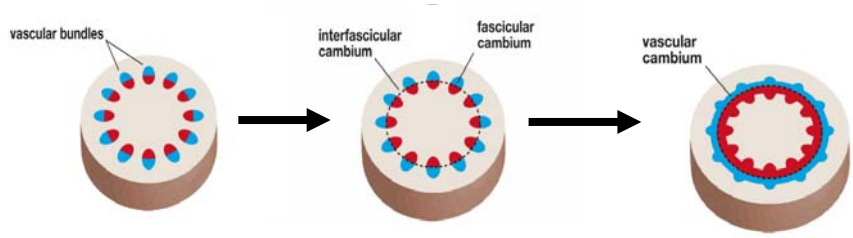


Figure 9.7 Plant Biology, 2/e



Vascular cambium



The vascular cambium produces lignin-rich secondary xylem tissue to the inside (wood) and secondary phloem to the outside (inner bark).

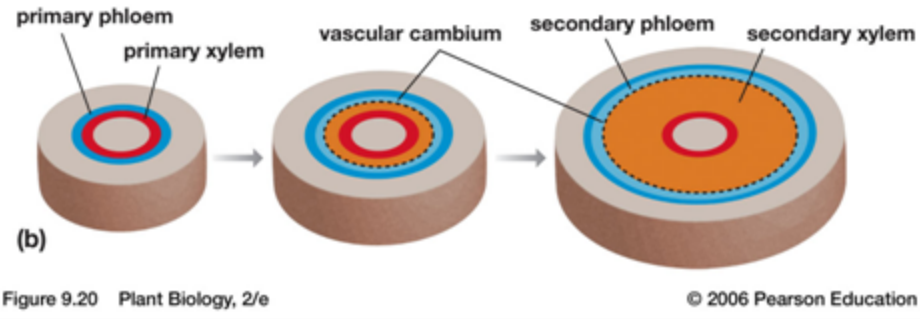


Figure 9.20 Plant Biology, 2/e © 2006 Pearson Education

Two types of cells in the vascular cambium:

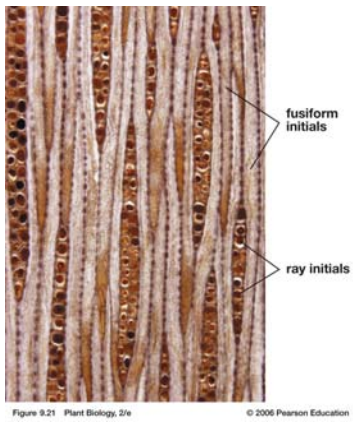
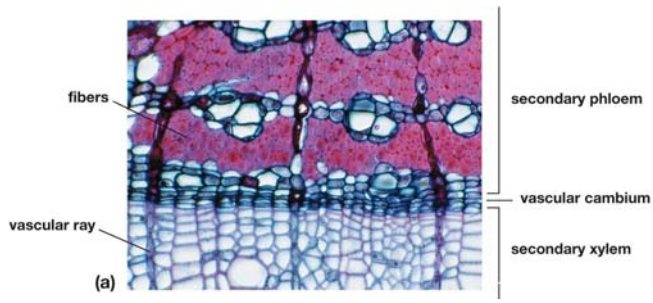


Figure 9.21 Plant Biology, 2/e © 2006 Pearson Education



Division of fusiform initials generate:

•secondary xylem

•secondary phloem

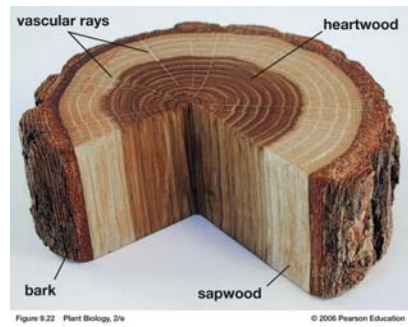


Figure 9.22 Plant Biology, 2/e © 2006 Pearson Education

Ray initials produce ray parenchyma cells and ray tracheids that form the vascular rays.

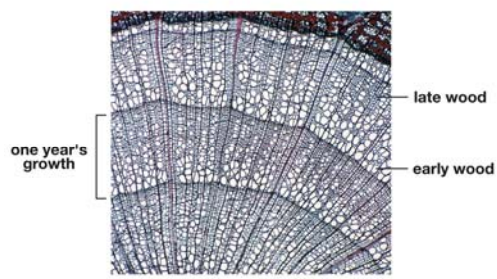


Figure E9.2A Plant Biology, 2/e © 2006 Pearson Education

As young woody stems enlarge, the epidermis ruptures and is replaced by the cork.

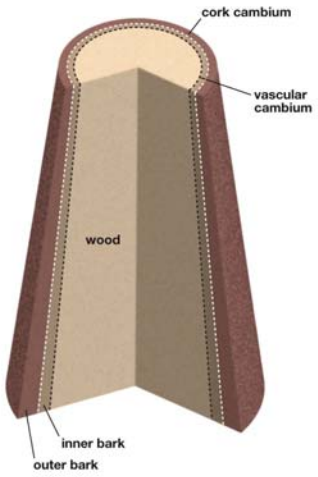


Figure 8.8 Plant Biology, 2/e © 2006 Pearson Education

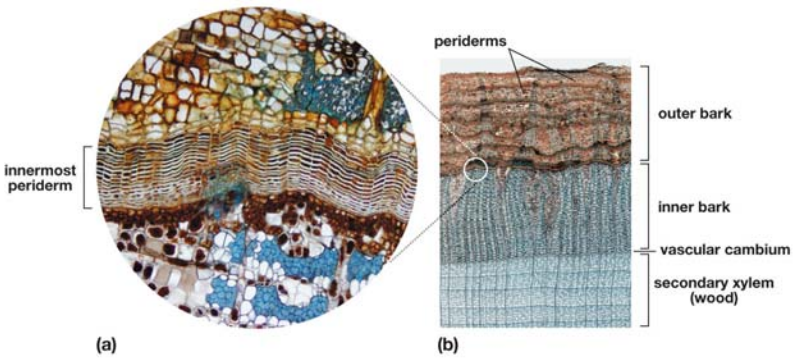
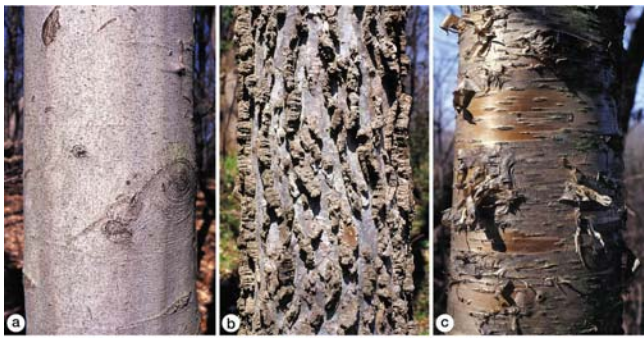


Figure 9.24 Plant Biology, 2/e © 2006 Pearson Education

As a plant grows older, a series of additional periderms may form until remnants of several are visible in the outer bark.



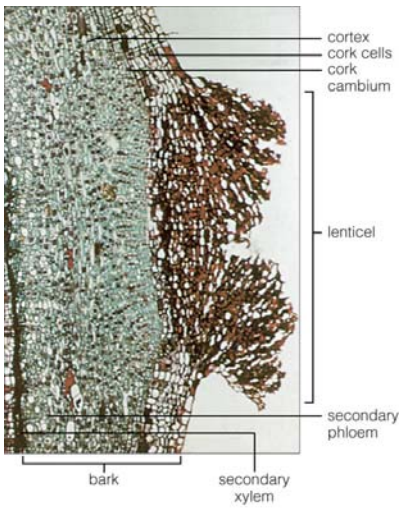
The periderm(s) can take on different appearances

The walls of the cork cells are well-equipped to protect the stems from pathogens and other damages.

Suberin is composed of:

Cork tissues also contain:

The bark often includes openings called <u>lenticels</u> that allow gas exchange for the respiration of the cells of the bark.



Humans use stems in many ways

Figure 9.29 Plant Biology, 2/e © 2006 Pearson Education

Paper

Papyrus is made from thick stems of the papyrus plant, *Cyperus papyrus*.

Ancient Egyptians used papyrus to make:

Today, most paper is made from wood pulp generated from trees grown in plantations.

Genetic engineers have succeeded in producing normally structured aspen trees with:

Cork

Quercus suber (cork oak)

Commericial cork is obtained by stripping the outer bark when the tree is 20-25 years old.

Cork is widely used for:


Figure 9.30 Plant Biology, 2/e © 2006 Pearson Education

Wood

Modern humans use wood from many types of trees for:

Study outline-Chapter 9-Stems and Material Transport

Study outline for Chapter 9-Stems and Material Transport

-Know the definition of a vascular plant and the groups of plants included

-Understand the multiple functions of stems

-Know the anatomy of a twig

-Know examples of modified stems

-Know terms- fleshy stem, corm, tendril, rhizome

-Understand function and structure of xylem and phloem

-Know terms-xylem, phloem, tracheids, vessel elements, lignin

-Understand different functions of lignin

-Understand why moss and other bryophytes are not vascular plants

-Understand which tissues xylem and phloem differentiate from.

-Know terms primary xylem and secondary xylem

-Understand the structure and function of vascular bundles in stems of dicots and monocots (Fig. 9.7; 9.8)

-Understand the difference between dicots and monocots in general (Fig. 23.3)

-Know structure of different specialized cells of the phloem-sieve elements, sieve cells, sieve tube members, sieve plates and companion cells
-Understand that materials move in the phloem from source to sink (Fig. 9.14)
-Know terms-symplastic loading (Fig. 9.13a) and apoplastic loading (Fig. 9.13b) , pressure flow
-Know different specialized cells of the xylem-tracheids, vessel elements, vessels, pits
-Understand that water moves in the xylem as a result of transpiration
-Understand that woody plants produce wood tissue and bark through secondary meristems
-vascular cambium and cork cambium
-Know terms-tree, shrub, vine
-Understand how the vascular cambium develops
-Know terms-fascicular cambium, interfascicular cambium, secondary xylem (wood), secondary phloem (inner bark)
-Know structure and function of two types of cells in the vascular cambium-fusiform initials and ray initials
-Understand the importance of the cork cambium
-Know terms-cork, periderm
-What three types of cells make up the periderm?
-Understand the functional difference between inner bark and outer bark
-Know function of suberin and lignin in the walls of the cork cells.
-What are lenticels?
-Understand the different human uses of stems- paper, cork, and wood (Know examples)