Ch 11- Leaves: Photosynthesis and Transpiration

Leaves occur in a vast range of forms

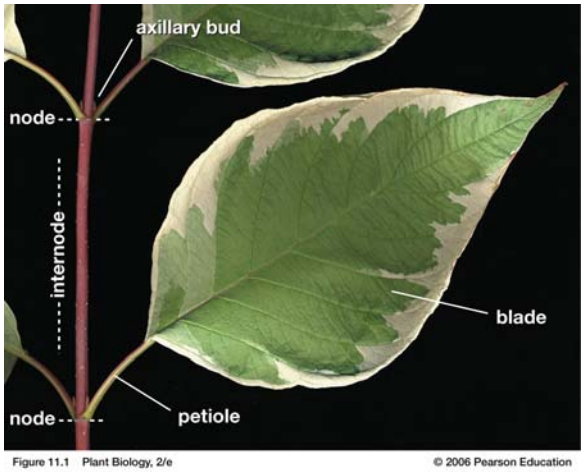


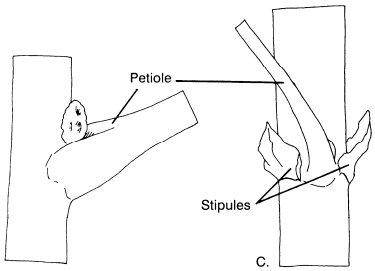
Figure 11.1 Plant Biology, 2/e © 2006 Pearson Education

In eudicots, the typical foliage leaf consists of:

<u>blade</u>

-<u>petiole</u>

Many leaves also have stipules at the base of the petiole.



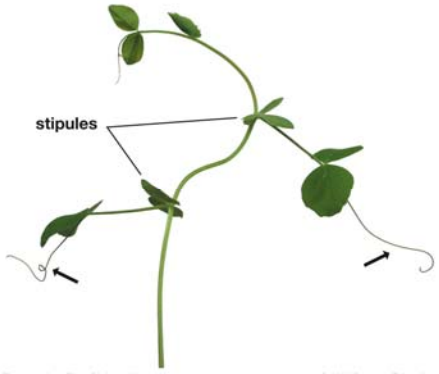
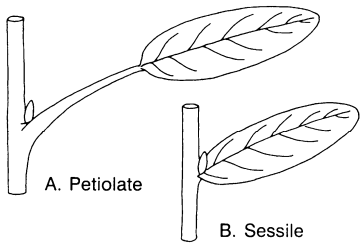


Figure 11.21 Plant Biology, 2/e © 2006 Pearson Education

<u>axil</u>



In monocots, such as lilies and grasses, the leaf expands out in a sheath.

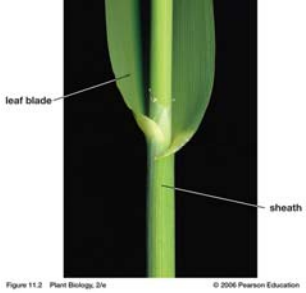


Figure 11.2 Plant Biology, 2/e © 2006 Pearson Education

Leaf blade variation

-<u>simple</u>

-<u>compound</u>

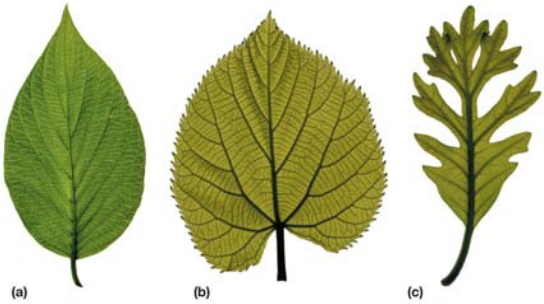


Figure 11.3 Plant Biology, 2/e © 2006 Pearson Education

Figure 11.4 Plant Biology, 2/e © 2006 Pearson Education

There are 2 types of compound leaves:

<u>Pinnately compound leaves</u>:

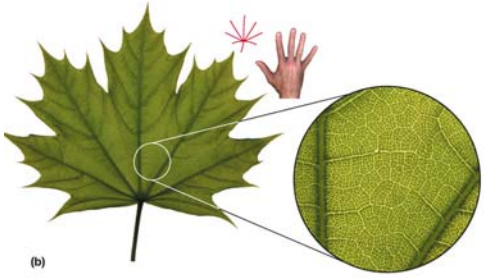
<u>Palmately compound leaves</u>:

Leaves also possess a wide variety of patterns of veins which contain xylem and phloem

<u>Pinnately netted veins</u>

<u>Palmately netted veins</u>


Figure 11.5 Plant Biology, 2/e © 2006 Pearson Education



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Leaves can be arranged along a stem in a number of different ways

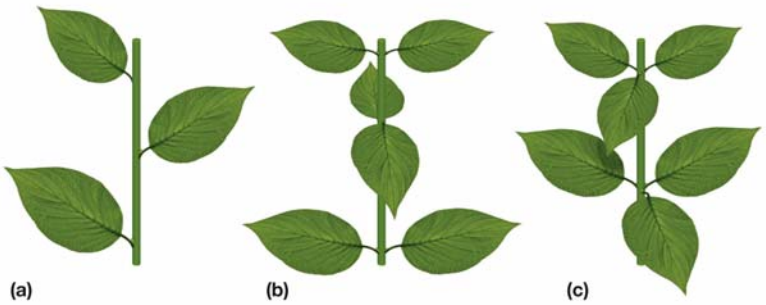


Figure 11.7 Plant Biology, 2/e © 2006 Pearson Education

Leaves are complex structures composed of 4 main types of tissues:

-epidermis

-mesophyll

-xylem

-phloem

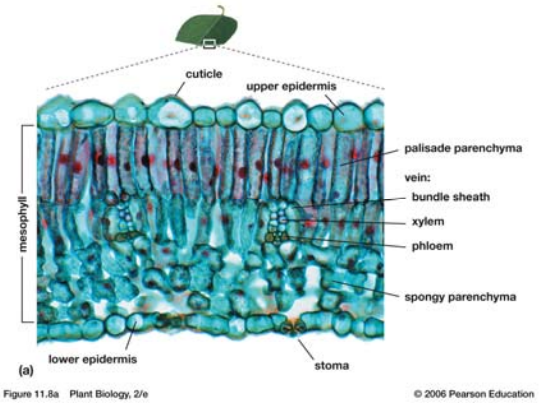


Figure 11.8a Plant Biology, 2/e © 2006 Pearson Education

The structure of the leaf is dependent on the plant's environment

<u>hydrophytes</u>

<u>xerophytes</u>

<u>mesophytes</u>

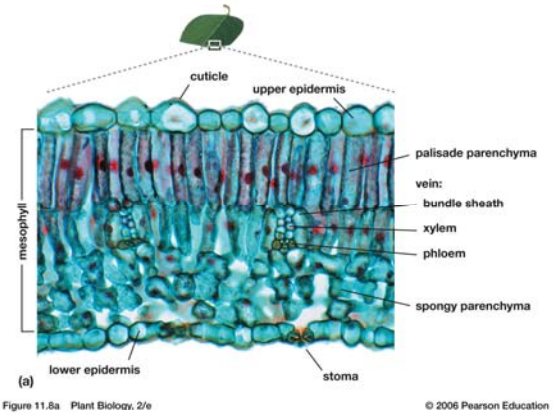
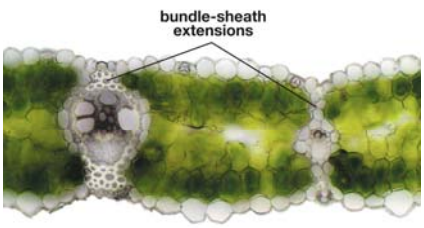


Figure 11.8a Plant Biology, 2/e © 2006 Pearson Education

<u>Epidermis</u>

The epidermis is composed of tough compact cells that cover the upper and lower surface of the leaves



Epidermal cells secrete a waxy layer (<u>cuticle</u>) which help retard water loss

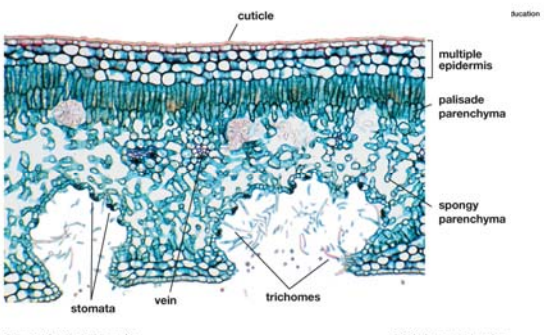


Figure 11.9 Plant Biology, 2/e © 2006 Pearson Education

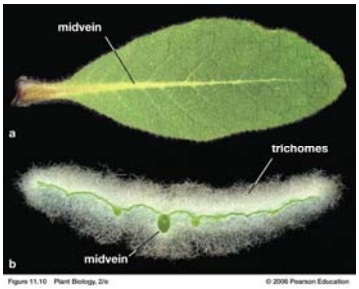
<u>Mesophytes</u>

<u>Hydrophytes</u>

<u>Xerophytes</u>

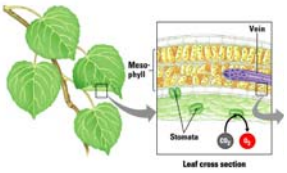
Epidermis

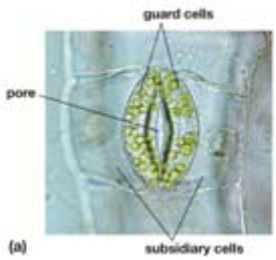
Epidermal cells may be specialized to form hairs called trichomes.



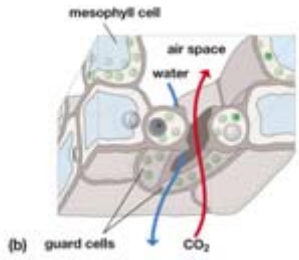
Trichomes serve a variety of functions:

Epidermal tissue typically contains many thousands of minute pores called stomata (sing. stoma).





Each stoma consists of a pore surrounded by two guard cells



Mesophyte

Hydrophyte

Xerophytes

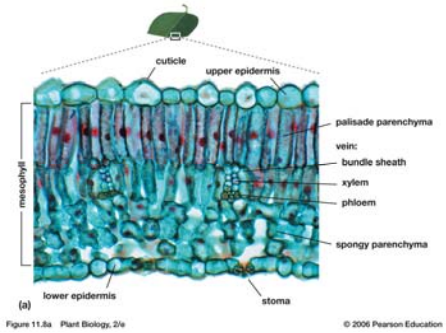


Figure 11.8a Plant Biology, 2/e © 2006 Pearson Education

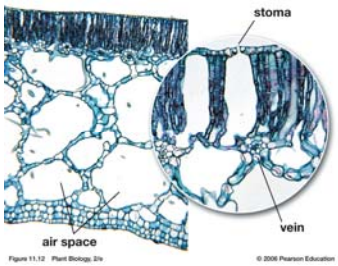


Figure 11.12 Plant Biology, 2/e © 2006 Pearson Education

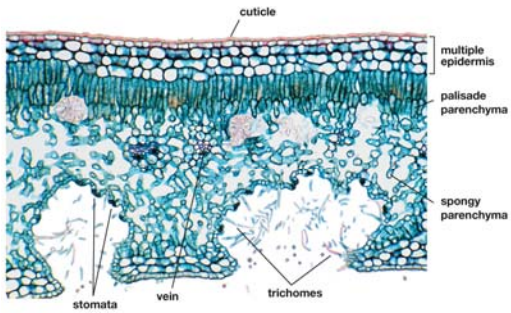


Figure 11.9 Plant Biology, 2/e © 2006 Pearson Education

The upper epidermis of grass leaves has another specialized type of cell- bulliform cell.

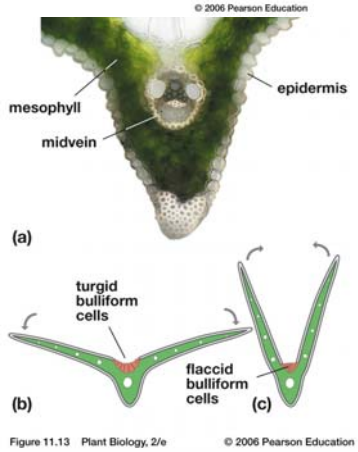
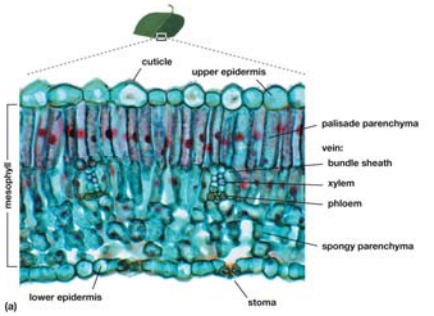


Figure 11.13 Plant Biology, 2/e © 2006 Pearson Education

Mesophyll is located between the upper and lower epidermis

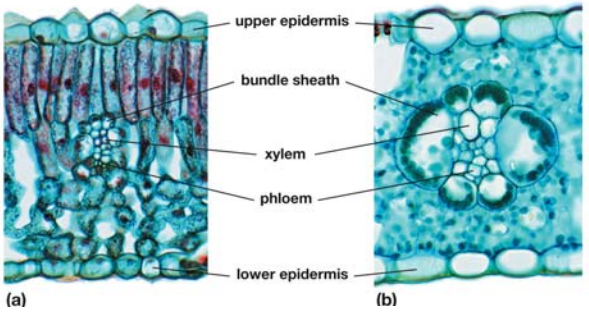
Mesophyll cells are:



The intracellular spaces facilitates gas exchange and is connected to the external atmosphere by stomata

Mesophyll tissue is organized in 2 layers:

Eudicots Monocots



Xylem and phloem are the conducting tissues of leaf veins

Xylem conducts water and dissolved minerals to the leaf tissues

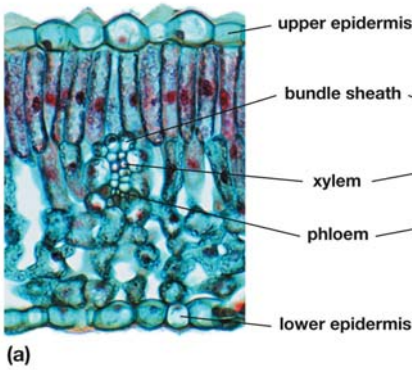


Figure 11.14 Plant Biology, 2/e

Veins are surrounded by bundle-sheath which are made up of parenchyma cells.

In some leaves, the bundle-sheath is connected to the upper and lower epidermis by bundle-sheath extensions.

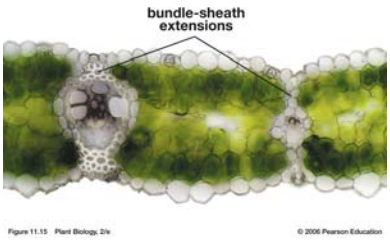
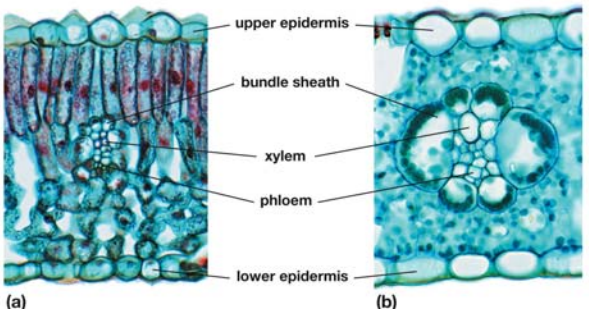


Figure 11.15 Plant Biology, 2/e

Eudicots Monocots



Plants lose large quantities of water through transpiration

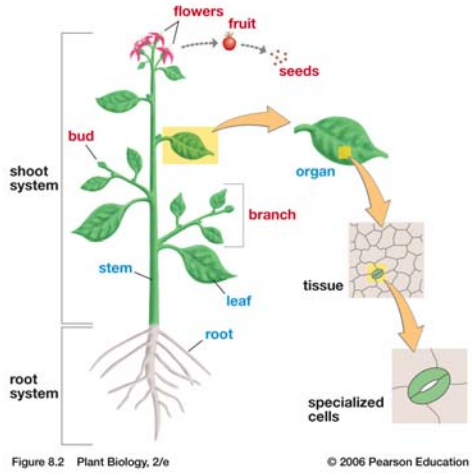


Figure 8.2 Plant Biology, 2/e

Transpiration is the evaporation of water from plant surfaces via epidermal pores, or stomata.

Plants transpire large amounts of water during photosynthesis

Plants need:

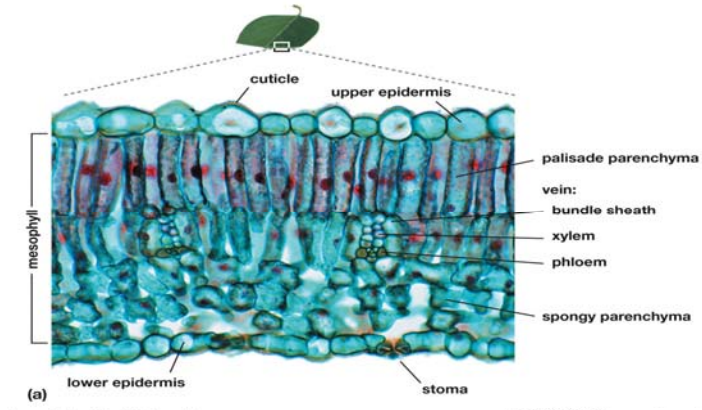
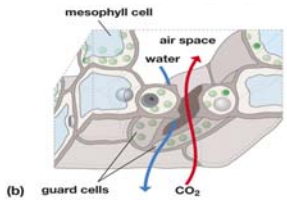


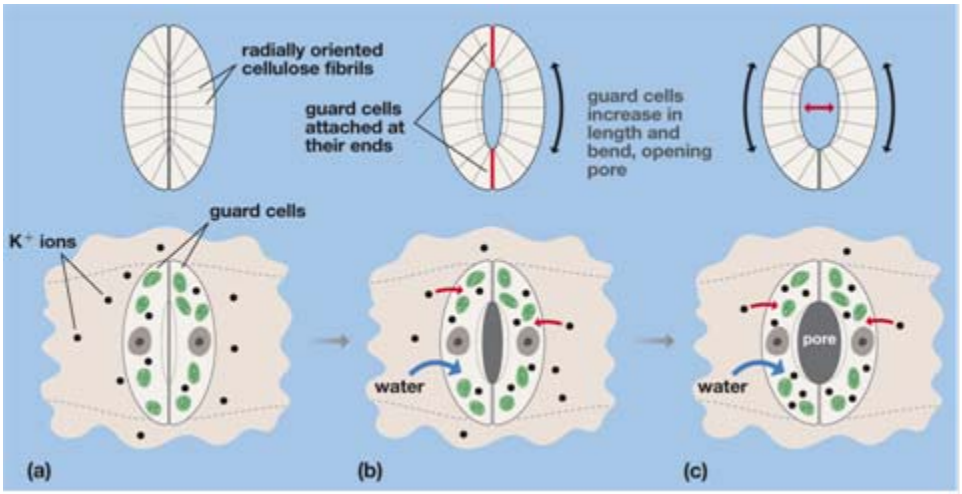
Figure 11.8a Plant Biology, 2/e



The open and closing of the stomata is important in the regulation of transpiration

CO_2 is needed when sunlight is available for photosynthesis, most plants open stomata when transpiration is greatest.

Stomatal movement control transpiration



a)K+ accumulate in the guard cells during the daylight

b)

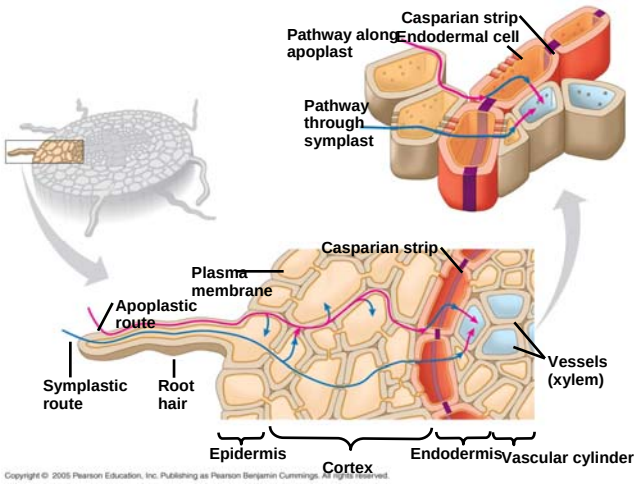
c) The build-up of water creates turgor pressure that causes he guard cells to bend and the pore to open.

Movement of water through plants

Two possibilities for water movements:

Pushing Xylem Sap: Root Pressure

•At night, when transpiration is very low, root cells continue pumping mineral ions into the xylem of the vascular cylinder



Root pressure sometimes results in guttation

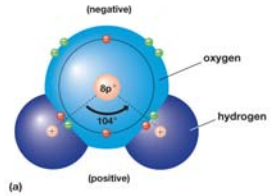
Water is pulled up by the leaves

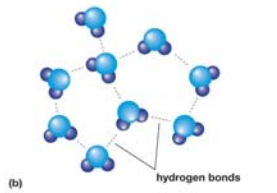
Pulling Xylem Sap: The Transpiration-Cohesion Tension Mechanism

•Water is pulled upward by negative pressure in the xylem

•The transpirational pull on xylem sap is transmitted all the way from the leaves to the root tips and even into the soil solution

•Transpirational pull is facilitated by cohesion and adhesion





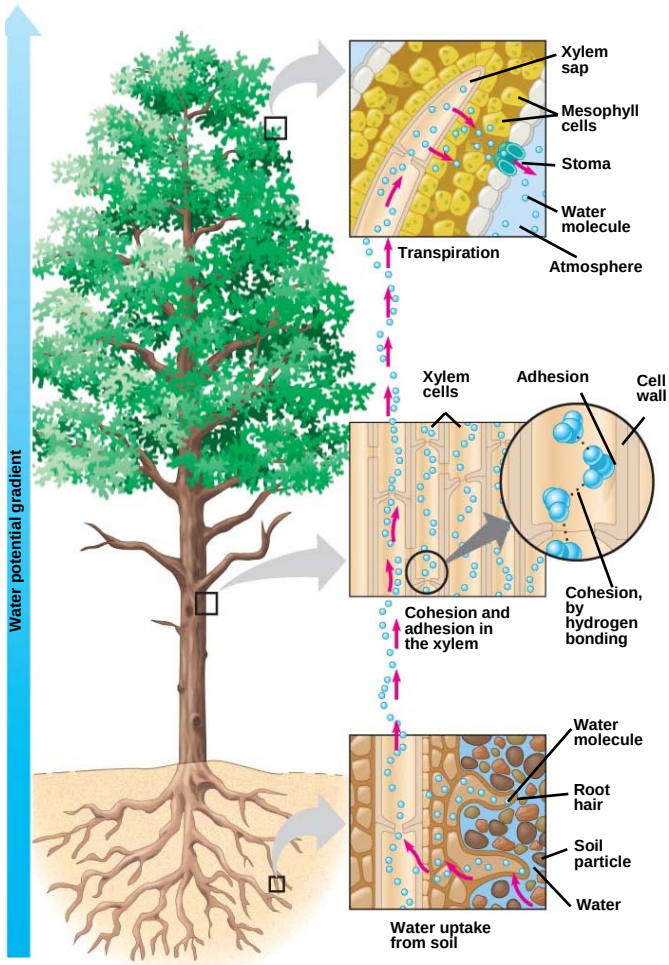
Cohesion and Adhesion in the Ascent of Xylem Sap

Water has a high degree of cohesion due to hydrogen bonding that links together adjacent water molecules.

Cohesion

Adhesion

As water evaporates from the surface of mesophyll cells in the leaf, the water at the surface is replaced by water from the interior of the mesophyll.



Leaf senescence in temperate deciduous trees and shrubs

-Occurs in plants as a whole, e.g., annual plants that live only one season.

-Occurs only in parts of plants

-Eliminate leaves before winter

-Declining day length is the signal that triggers aging and death

Leaf abscission-complex process that results in dropping of leaves

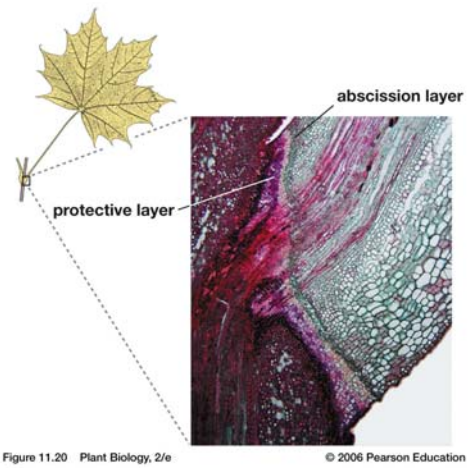


Figure 11.20 Plant Biology, 2/e © 2006 Pearson Education

1. Abscission zone is formed at the base of the petiole

2.

3.Cork layer forms inside the separation layer to seal wound when leaf falls.

4.

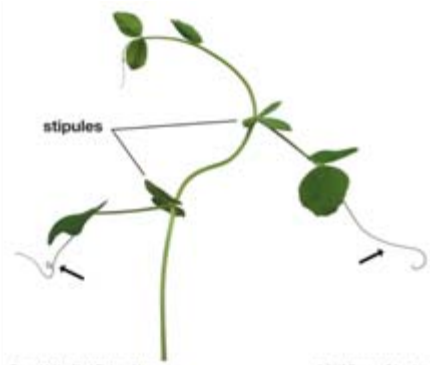
Leaves perform many functions in addition to photosynthesis

Modifications of leaves

tendrils

bud scales-

bracts



Some leaves are specialized for water or food storage

Familiar garden plants have leaves modified to store nutrients

cabbage

lettuce and spinach

edible parts of celery and rhubarb

onions

Leaves are modified for defense in some plants

-leaves are reduced to form sharp, non-photosynthetic spines

spines

thorn

prickles

Leaves of some plants capture animal prey

-Carnivorous plants which trap live animal prey

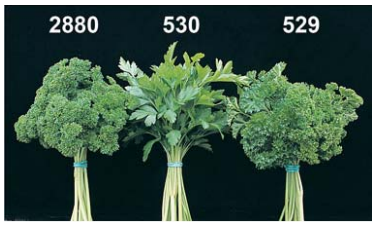
Humans use leaves in many ways

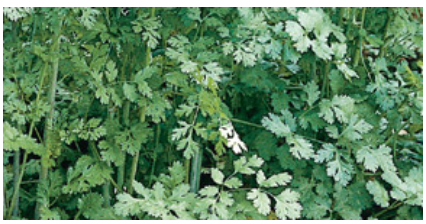
Botanically- herb- any nonwoody plant

Herbs used in seasoning foods consists of fresh or dried leaves from a variety of woody and nonwoody plants.

Mint family (Lamiaceae)

Carrot family (Apiaceae)





Different processes are used to extract fragrant oils for perfumes.

Perfume notes derived from leaves include oils of:

Waxes

Ex: *Copernica cerifera*- palm from NE Brazil

Source of carnauba wax which is used in waxes and shoe polish

Beverages

Natural dyes and fibers can be obtained from the leaves of number of different plant species.

Most commercial leaf fibers are obtained from only two tropical genera:

-*Agave* –ropes and twines

-*Musa textiles* – relative of the banana plant

Study outline-Chapter 11-Leaves: Photosynthesis and Transpiration

-Know basic terminology of leaves-blade, petiole, stipule, axil, sheath,

-Know differences in leaf blade variation-simple-toothed, smooth, deeply lobed
-compound-pinnately vs palmately

-Know different venation patterns in leaves-eudicot vs. monocot – netted vs. parallel
palmately netted vs. pinnately netted

-Know different leaf arrangement-opposite, alternate, and whorled

-Know the four main types of tissues in leaves-epidermis, mesophyll, xylem, phloem (Fig. 11.8)

-Know terms-mesophyte, hydrophyte, and xerophyte

-Understand the structure and function of the epidermis

-Know terms-cuticle, stomata, trichomes, guard cells

-Where are the stomata on a hydrophyte vs mesophyte vs xerophyte?

-How is the cuticle different between a mesophyte, hydrophyte, and xerophyte?

-What are bulliform cells and how do they function?

-Understand structure and function of the mesophyll tissue

-The mesophyll tissue is organized into which 2 layers?

-Know the difference in mesophyll tissue between monocots and eudicots.

-Know the structure, function, and position of xylem and phloem in the leaf.

-Understand the structure of Kranz anatomy.

-Understand how stomatal movement controls transpiration (Fig. 11.16)

-Understand the movement of water through plants
-pushing xylem sap-root pressure- Know term-guttation
-water is pullled upward by negative pressure in the xylem- Know terms-cohesion, adhesion, cohesion-tension theory

-Understand senescence
What types of plants senesce?
What parts of the plant senesce?
Why does the plant eliminate leaves in the winter?
What happens in the process of senescence. –Know terms-abscission zone, ethylene

-Know different leaf modifications and be able to recognize them

-Know terms-tendril, bud scale, bract

-Know examples of leaves that are specialized for water or food storage.
-Know terms-succulents, epiphytes

-Know examples of garden plants with modified leaves for food storage

-Know examples of leaves that are modified for defense
-Know terms-spine, thorn, and prickle

-Know examples of leaves of some plants that capture animals
-Know terms-carnivorous plants, active trap, passive trap

-Know examples of human uses of leaves
-Know terms-herb, wax, perfume note

-Know examples of mint famiy (Lamiaceae) and carrot family (Apiaceae)

-Know examples of perfume notes derived from oil of leaves.

-Know plant source examples of waxes, beverages, natural dyes, and plant fibers.