PLANT STRUCTURE AND FUNCTION
Marijuana -- *Cannabis sativa*
THC content of 5%

Female plant with flower clusters

tetrahydrocannabinol
Clusters of female flowers with long styles
Trichomes on the leaves contain THC
Cannabis sativa leaf trichome

- Trichome consists of head and stalk cells
- THC is located in the head cell
HEMP

Cannabis sativa without the THC

Fibers are obtained from the stems

Hemp seeds contain a nutrient-rich oil
Natural Bast Fibers are strong, cellulosic fibers obtained from the phloem or outer bark of jute, kenaf, flax and hemp plants.
Flowering Plants are known as Angiosperms

- Angiosperm means covered seed
- Angiosperm seed is enclosed in a fruit
- There are more than 250,000 species of angiosperms
31.2 The two main groups of angiosperms are the monocots and the dicots

- There are about 70,000 species of monocots and 180,000 species of dicots
  - Monocots include: grasses, orchids, palms, lilies
  - Dicots include: roses, oaks, tomatoes, sunflowers

- Monocots and dicots differ in
  - Number of **cotyledons** (seed leaves)
  - Pattern of leaf venation
  - Arrangement of stem vascular tissue
  - Number of flower parts
  - Root structure
**MONOCOTs**

- **Seed leaves**: One cotyledon
- **Leaf veins**: Veins usually parallel
- **Stems**: Vascular bundles in complex arrangement
- **Flowers**: Floral parts usually in multiples of three
- **Roots**: Fibrous root system

**DICOTs**

- **Seed leaves**: Two cotyledons
- **Leaf veins**: Veins usually branched
- **Stems**: Vascular bundles arranged in ring
- **Flowers**: Floral parts usually in multiples of four or five
- **Roots**: Taproot usually present
31.2 The two main groups of angiosperms are the monocots and the dicots

- **Monocots**
  - One cotyledon
  - Parallel leaf venation
  - Scattered vascular bundles
  - Flower parts in 3s or multiples of 3
  - Fibrous roots
31.2 The two main groups of angiosperms are the monocots and the dicots

- **dicots**—most plants are dicots
  - Two cotyledons
  - Branched leaf venation
  - Ring of vascular bundles
  - Flower parts in 4s or 5s (or multiples)
  - Taproot system
31.3 A typical plant body contains three basic organs: roots, stems, and leaves

- Plants absorb water and minerals from soil through **roots**
- Plants absorb the sun’s energy and carbon dioxide from the air through **shoots** (**stems** and **leaves**)
- Plant roots depend on shoots for carbohydrates produced via photosynthesis
- Plant shoots depend on roots for water and minerals
31.3 A typical plant body contains three basic organs: roots, stems, and leaves

- **Plant roots**
  - Anchor plant
  - Absorb water and nutrients
  - Store food

- **Plant shoots**
  - Stems, leaves, and reproductive structures
  - Stems provide support
  - Leaves carry out photosynthesis
31.4 Many plants have modified roots, stems, and leaves

- Modifications of plant parts are adaptations for various functions
  - Food or water storage
  - Asexual reproduction
  - Protection
  - Climbing
  - Photosynthesis
31.4 Many plants have modified roots, stems, and leaves

- **Root modifications**
  - Food storage
    - Large taproots store starches
    - Examples include carrots, turnips, sugar beets, sweet potatoes
31.4 Many plants have modified roots, stems, and leaves

- Stem modifications
  - Stolon—asexual reproduction
  - Rhizomes—storage, asexual reproduction
  - Tubers—storage, asexual reproduction
  - Cactus stem—water storage and photosynthesis
Runners are Stem Adaptations for Asexual Propagation

Strawberry plant

Stolon or Runner
Rhizomes Adapted for Asexual Propagation
Potato Tuber Adapted for Food Storage and Asexual Propagation

- Taproot
- Rhizome
- Tuber
Potato Tubers are Stems not Roots because they have Lateral Buds that can produce new Shoots

Eyes of potato growing into new shoot

If potatoes are exposed to light they turn green and make toxic alkaloids
Rhizomes Adapted for Food Storage

Ginger plant

Rhizome

Ginger plant
Cactus Stem Modified for Water Storage
Many plants have modified roots, stems, and leaves

- **Leaf modifications**
  - Protection
    - Cactus spine
  - Climbing
    - Pea plant tendril

Grape tendrils
Many plants have modified roots, stems, and leaves

- **Leaf modifications**
  - Food Storage
    - Onion bulb scales
    - Celery petioles

Leaf, Stem, Root, or Flower?

LEAF!

Celery stalks are actually really large petioles!

REPRODUCTION OF FLOWERED PLANTS
31.9 The flower is the organ of sexual reproduction in angiosperms

- Flowers typically contain four types of highly modified leaves called floral organs
  - **Sepals**—enclose and protect flower bud
  - **Petals**—showy; attract pollinators
  - **Stamens**—male reproductive structures
  - **Carpels**—female reproductive structures
31.9 The flower is the organ of sexual reproduction in angiosperms

- A stamen has two parts
  - **Anther**—produces pollen, which house cells which develop into sperm
  - Filament—elevates anther

- A carpel has three parts
  - **Stigma**—site of pollination
  - **Style**—“neck” that leads to ovary
  - **Ovary**—houses **ovules**, which contain developing egg
31.9 The flower is the organ of sexual reproduction in angiosperms

- **Angiosperm life cycle overview**
  
  - Pollination is the transfer of pollen from the anthers of the stamen to the stigmatic surface of the carpel.
  
  - Fertilization is the union of egg and sperm and occurs in the ovule; the fertilized egg develops into an embryo encased in a seed.
  
  - The ovary develops into a fruit, which protects the seed and aids in dispersal.
  
  - The seed *germinates* under suitable conditions to produce a seedling, which grows into a mature plant.
Pollen Grains

• Pollen grains germinate and produce a pollen tube and sperm
• Pollen grains are transferred by wind or animals
Some Typical Plant Pollinators

Bees

Birds

Bats
Seeds Are Also Dispersed By Animals Or Wind
Ovary, containing ovule

Mature plant with flowers, where fertilization occurs

Fruit (mature ovary), containing seed

Embryo

Seed

Germinating seed

Seedling

Copyright © 2009 Pearson Education, Inc.
Common bean (dicot):
- Embryonic leaves
- Embryonic root
- Seed coat

Corn (monocot):
- Fruit tissue
- Cotyledon
- Embryonic leaf
- Sheath
- Seed coat
- Endosperm
- Embryonic Shoot
- Embryonic root
31.12 The ovary develops into a fruit

- Hormonal changes induced by fertilization trigger the ovary to develop into a **fruit**

- Fruits protect the seed and aid in dispersal

- Mature fruits may be fleshy or dry
  - Fleshy fruits—oranges, tomatoes, grapes
  - Dry fruits—beans, nuts, grains
Morphology of Fleshy Fruit

[Diagram of a cross-section of a tomato fruit, showing pericarp, mesocarp, endocarp, placenta, funiculus, and seed.]

[Hesperidium (a type of berry): Lemon (Citrus limon), showing pedicel, endocarp, mesocarp, exocarp, seed, oil gland, vesicle (juice sac), and remains of style.]

[Peach fruit anatomy: Skin (exocarp), seed, endocarp (stone), mesocarp (flesh), pericarp (exo-, meso-, and endocarp).]

[Diagram of an apple fruit, showing stigma, style, petal, stamen, ovule, ovary (in receptacle), apple flower, remains of stamens and styles, sepals, apple fruit, and receptacle.]
PLANT ANATOMY
31.5 Three tissue systems make up the plant body

- **Dermal tissue**
  - Outer protective covering

- **Vascular tissue**
  - Support and long-distance transport

- **Ground tissue**
  - Bulk of the plant body
  - Food production, storage, support
31.5 Three tissue systems make up the plant body

- **Dermal tissue**
  - Layer of tightly packed cells called the epidermis
  - First line of defense against damage and infection
  - Waxy layer called cuticle reduces water loss
31.5 Three tissue systems make up the plant body

- **Vascular tissue**
  - Composed of xylem and phloem
  - Arranged in bundles

- **Ground tissue**
  - Lies between dermal and vascular tissue
  - Dicot stem ground tissue is divided into pith and cortex
  - Leaf ground tissue is called mesophyll
31.6 Plant cells and tissues are diverse in structure and function

- Water conducting cells—tracheids and vessel elements
  - Both have thick secondary cell walls
  - Both are dead at maturity
  - Chains of tracheids and vessel elements form tubes that make up the vascular tissue called xylem
Pits

Tracheids

Vessel element

Openings in end wall

Pits
Food-conducting cells—sieve tube members

- No secondary cell wall
- Alive at maturity but lack most organelles

Companion cells

- Contain organelles
- Control operations of sieve tube members

Chains of sieve tube members, separated by porous sieve plates, form the vascular tissue called phloem
Cytoplasm
Primary cell wall
Companion cell
Sieve plate
Cytoplasm
PLANT GROWTH
31.7 Primary growth lengthens roots and shoots

- **Plant growth is indeterminate**
  - Growth occurs throughout a plant’s life
  - Plants are categorized based on how long they live
    - **Annuals** complete their life cycle in one year
    - **Biennials** complete their life cycle in two years
    - **Perennials** live for many years

- **Animal growth is determinate**
  - Growth stops after a certain size is reached
31.7 Primary growth lengthens roots and shoots

- Plant growth occurs in specialized tissues called meristems

- **Meristems** are regions of active cell division

- **Apical meristems** are found at the tips of roots and shoots
Microscopic view of a longitudinal shoot tip section

- Apical meristem
- Leaves
- Axillary bud meristems
APICAL DOMINANCE

The apical bud suppresses the growth of the lateral buds. Remove the apical bud and the lateral buds grow.
Testing Your Knowledge

Which of the following statements is false?

A. Plant roots need oxygen to absorb water and minerals from the soil
B. The tubers of a white potato are roots
C. The bulb scales of an onion are leaves
D. The rhizomes of a grass plant are stems

Click again for answer:

B
What type of vascular tissue cell in a plant conducts water

A. Companion cell
B. Sieve tube cell
C. Vessel cell
D. Bast Fiber cell
E. Meristematic cell

Click again for answer:

C
Testing Your Knowledge

- The female organ of a flower is
  A. Sepal
  B. Petal
  C. Stamen
  D. Carpel

- Click again for answer
  - D
Testing Your Knowledge

- Which of the following is a characteristic of a monocot

  A. Fibrous root system
  B. Flower parts in 4 or 5’s
  C. Long Taproots
  D. Vascular bundles in a ring pattern

- Click again for answer

- A