How Plants Grow

HOME GARDENING
OSHER LIFELONG LEARNING
SPRING 2015
What is a plant?
What is a plant?

“Living organism that, unlike an animal, cannot move voluntarily, manufactures food from the sun’s energy and carbon dioxide and has no sense organs . . .”

Webster
How Plants Grow

Part 1:
Plant Anatomy and Structure
The Cell

Anatomy of the Plant Cell

- Chloroplast
- Mitochondria
- Plasma Membrane
- Peroxisome
- Golgi Apparatus
- Vacuole
- Cytoplasm
- Rough Endoplasmic Reticulum
- Nucleus
- Nucleolus
- Nuclear Envelope
- Cell Wall
- Smooth Endoplasmic Reticulum
- Ribosomes
- Plasmodesmata
Plant Tissues

- Groups of cells similar in appearance or function.
- Differentiate from meristematic tissues.
- Vascular tissue is an example.
Root Functions

- Anchor the plant in the soil
- Absorb nutrients and moisture
- Serve as food storage organs
- Provide a means of propagation
Roots

- Taproot
  - Primary root continues to elongate downward to the soil
  - Becomes dominant and most important root feature
- Lateral
  - Side or branch roots that grow from another, larger root
- Fibrous
  - Root system where primary root never existed or developed
  - Numerous smaller or lateral roots develop
  - Branching repeatedly to form absorptive fibrous root system
Types of Roots

Root Hairs

- Develop on root just behind zone of elongation
- Perform much of the work for water and nutrient absorption
Mycorrhizae

Mycorrhizae (white) growing on a root

2.5 mm
Mycorrhizae

- Fungus benefits from a steady supply of sugar donated by the host plant.
- Plant benefits from added absorptive surface area.
Stems

- Support leaves to maximize light absorption
- Part of conduit for transport of water, minerals, and organic solutes
- Storage
Stems

Herbaceous dicot

Cambium

Woody dicot

Monocot
Thorns- Develop as modified twigs on stem
Above Ground Modified Stems

- **Crowns**
  - Compressed stems having leaves /flowers on short internodes
    - Strawberries, dandelions, African violets

- **Spurs**
  - Short stubby stems, arise from the main stem
    - Pears, apples, cherries

- **Stolons**
  - Horizontal stems that are fleshy or semi-woody
  - Lie along top of the ground
    - Strawberry runners and spider plants
Modified Stems

- **Runners (strawberry)**
  - Nodes (axillary buds adjacent to leaf scars)

- **Tubers (potato)**
  - Stolen
  - Tuber (swollen tip of stolen)
Below Ground Modified Stems

- **Rhizomes**
  - Grow underground
  - Compressed and fleshy
- **Bulbs**
  - Short stem surrounded by fleshy leaves/scales
    - Tulips, lilies, daffodils, onions
- **Corms**
  - Solid, swollen stems with dry, scale-like leaves
    - Gladiolus
Modified Stems

- Bulbs (onion)
  - Fleshy leaves
  - Knob-like stem
  - Scale-like leaf at each node
  - Adventitious roots

- Rhizomes (iris)
  - Photosynthetic leaf
  - Rhizome
Buds

- Undeveloped shoot, containing leaves or flowers
- Protect from cold (scales)
- Require chilling to resume growth
- Classified by their location on the stem
The Leaf

Principal function is to absorb sunlight and manufacture sugars.
Leaf Modifications
(all leaves are modified stems)

• Cotyledons
  - Seed leaves; storage organs to feed seedling while true leaves develop

• Spines and tendrils
  - Protect the plant or assist in support
Leaf Modifications, cont.

- Bracts
  - Brightly colored; showy structures
- Storage leaves
  - Serve as storage organs containing starch and water in bulbs and other structures
The Flower
Types of Flowers

- Complete
  - Has stamens, pistil, petals, and sepals
- Perfect
  - Contains functional stamens and pistils
- Pistillate (Female)
  - Flower that possesses a functional pistil or pistils
- Staminate (Male)
  - Flower that contains stamens
- Dioecious
  - Male and female flowers on separate plants
- Monoecious
  - Male and female flowers on same plant
How Plants Grow

PART 2: PLANT PROCESSES AND ENVIRONMENTAL INFLUENCES
Plant Processes: Photosynthesis

- The process of a plant manufacturing its own food

\[6\text{ CO}_2 + 6\text{ H}_2\text{O} \xrightarrow[]{\text{Light energy}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{ O}_2\]
Factors Affecting PHO

- Light
- Carbon dioxide
- Temperature
- Water

Photosynthesis Illustrated
Respiration

- Chemical process by which sugars and starches produced by photosynthesis are converted to energy
- Energy is used to build new tissues and help the
PHO vs. Resp. and Plant Growth

- Photosynthesis
- Respiration

Graph shows the relationship between Photosynthesis and Respiration over time.
Transpiration

- Transpiration—loss of water vapor from the plant
- Process is a consequence of plants having stomata open to take in air containing carbon dioxide
Plant Growth and the Environment

![Diagram showing plant growth with labels for light energy, carbon dioxide, oxygen, and water.]
Environmental Influences: Water

- Primary component of cells
- Necessary for turgidity
- Solvent and transport agent
- Biochemical reagent
- Water-related conditions
  - Water stress
  - Drought tolerance
  - Excess moisture
Environmental Influences: Light

- **Quantity**
  - Up to a point, more sunlight the received by a plant the greater its capacity to produce food
  - If light intensity becomes too high, photosynthesis can actually be reduced
  - Intensity varies with the season of the year
Light: Quantity

- Low-light plants
- High-light plants
Light: Quality

Color or wavelength reaching the plant affects growth

Spectrum of electro-magnetic wave radiation

Photosynthesis- red and blue wavelengths

Photoperiodism- red and far-red wavelengths
Light: Duration

- **Photoperiod:**
  - Length of time that a plant is exposed to sunlight or darkness

- **Short-day:**
  - Length of uninterrupted darkness is critical to flowering

- **Long-day:**
  - Day lengths longer than a certain number of hours critical for flowering to occur

- **Day-neutral:**
  - Form flowers regardless of day length
Two short-day effects

Chrysanthemum

Sugar Maple
Environmental Influences: Temperature

- Affects productivity and growth
  - By affecting photosynthesis and respiration

- A plant's response:
  - Depends upon its needs
  - Adaptability to warm or cool season conditions
The Cardinal Temperatures

Temperature

Plant Growth

Minimum

Optimum

Maximum
Influence of Temperature

![Graph showing the relationship between temperature and growth rate. The graph illustrates the influence of temperature on photosynthesis and respiration. Photosynthesis increases with temperature up to a certain point, after which it decreases. Respiration increases continuously with temperature.](image-url)
High Temperature Stress

- Reduced PHO
- Starvation
- Plant injury
Low Temperature Stress

- Reduced PHO
- Poor growth
- Chill injury
- Freeze damage
USDA Cold-hardiness Map

Zone 5
(-10 to -20)

Zone 6
(0 to -10)

Zone 7
(0 to +10)
Heat Zones Map

Days hotter than 86° F

- 35-40
- 45-60
- 60-90
- 90-120
Environmental Influences: Air

- Contains nitrogen, oxygen, and carbon dioxide
  - Also water vapor or humidity
  - Number of other gaseous compounds
- 79% nitrogen
- 20% oxygen
- .04% carbon dioxide = 400 ppm
Why carbon dioxide?

Carbon dioxide

Water

Glucose

Oxygen

PHOTOSYNTHESIS
The Soil Atmosphere

- Air in the soil usually contains more carbon dioxide than atmospheric air.
Air Pollutants

- Many of the gases in the air will affect plant growth
Air Pollution Symptoms

Ozone: tissues become marked white to tan specks; destroys plant cells by damaging their membranes

Sulfur dioxide: causes dry, dead leaves at the leaf margins and between veins

Ethylene: drooping (epinastic) leaves - mostly occurs in greenhouses with malfunctioning heaters
Questions?

There's only one Mizzou