Introduction to Botany

Jan Zientek
Senior Program Coordinator
Cooperative Extension of Essex County

zientek@njaes.rutgers.edu
Basic Botany

• The study of the growth, structure and function of plants
BOTANY

• Evolution
• Taxonomy
• Plant morphology
• Plant physiology and cell biology
• Plant reproduction
• Plant hormones and growth regulators
<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>Bacteria</th>
<th>Archaea</th>
<th>Eukarya</th>
<th>Eukarya</th>
<th>Fungi</th>
<th>Eukarya</th>
<th>Plantae</th>
<th>Animalia</th>
</tr>
</thead>
<tbody>
<tr>
<td>KINGDOM</td>
<td>Eubacteria</td>
<td>Archaeabacteria</td>
<td>Protista</td>
<td>Eukaryote</td>
<td>Eukaryote</td>
<td>Eukaryote</td>
<td>Plantae</td>
<td>Animalia</td>
</tr>
<tr>
<td>CELL TYPE</td>
<td>Prokaryote</td>
<td>Prokaryote</td>
<td>Eukaryote</td>
<td>Eukaryote</td>
<td>Eukaryote</td>
<td>Eukaryote</td>
<td>Eukaryote</td>
<td>Eukaryote</td>
</tr>
<tr>
<td>CELL STRUCTURES</td>
<td>Cell walls with peptidoglycan</td>
<td>Cell walls without peptidoglycan</td>
<td>Cell walls of cellulose in some; some have chloroplasts</td>
<td>Cell walls of chitin</td>
<td>Cell walls of cellulose; chloroplasts</td>
<td>No cell walls or chloroplasts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NUMBER OF CELLS</td>
<td>Unicellular</td>
<td>Unicellular</td>
<td>Most unicellular; some colonial; some multicellular</td>
<td>Most multicellular; some unicellular</td>
<td>Multicellular</td>
<td>Multicellular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODE OF NUTRITION</td>
<td>Autotroph or heterotroph</td>
<td>Autotroph or heterotroph</td>
<td>Autotroph or heterotroph</td>
<td>Heterotroph</td>
<td>Autotroph</td>
<td>Heterotroph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXAMPLES</td>
<td>Streptococcus, Escherichia coli</td>
<td>Methanogens, halophiles</td>
<td>Amoeba, Paramecium, slime molds, giant kelp</td>
<td>Mushrooms, yeasts</td>
<td>Mosses, ferns, flowering plants</td>
<td>Sponges, worms, insects, fishes, mammals</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PLANTAE

- Eukaryotic (with a nucleus)
- Cell walls with cellulose
- Food stored as carbohydrate
- Multi-cellular autotrophs

- Chloroplasts (green)
- Non-motile
- Several phylum
- Development of pollen
Plant phylums

Mosses
Liverworts
Hornworts
Club mosses
Horsetails
Ferns

Cycads
Ginkgoes
Gnetophytes
Conifers
Common Name vs Scientific Name

Foxglove

• Maybe local name
• General

Digitalis purpurea

• Universally recognized
• Specific
<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire bush</td>
<td><em>Hamelia patens</em></td>
</tr>
<tr>
<td>Scarlet bush</td>
<td></td>
</tr>
<tr>
<td>Texas firecracker</td>
<td></td>
</tr>
<tr>
<td>Corail (or is it Koray?)</td>
<td></td>
</tr>
<tr>
<td>Polly red head</td>
<td></td>
</tr>
<tr>
<td>Hummingbird bush</td>
<td></td>
</tr>
<tr>
<td>Ix-canan</td>
<td></td>
</tr>
</tbody>
</table>
Plant Types

- Monocots: have a single cotyledon, flower parts in multiples of three, parallel venation of leaves, scattered vascular bundles in stems.
Dicots: have two cotyledons, flower parts in multiples of 4 or 5, netted veins, and stems which are organized in a ring pattern.
Humans sort things many different ways

- Plants can be classified by the type of their seed structure
  - Gymnosperm: “naked seed”
  - Angiosperm: seed within a fruiting body
Lifecycles help gardeners distinguish between plants:

- **Annuals**
- **Biennials**
- **Perennials**
Annuals complete life cycles in one season.
Biennials live for 2 years, flower, then die.
Perennials live for 3 or more years, flower each year and usually do not die after flowering.
Structures of Plants

Roots
Stems
Leaves
Flowers
Seeds
Bean Seed (dicot)

- Epicotyl
- Two Cotyledons
- Embryo
- Seed Coat

Corn Seed (monocot)

- Seed Coat
- Endosperm
- Single Cotyledon
- Epicotyl
- Embryo
Examples of Stem Structure
Herbaceous monocot and dicot stem

**Monocot**
(magnification: 10×)

**Dicot**
(magnification: 13×)

- Epidermis
- Vascular bundles
- Ground tissue
- Cortex
- Pith
A root consists of a central vascular cylinder.
Modified stems (Figure 31.8)

(a) Stolon

(b) Rhizome

(c) Taproot, Tuber, Rhizome

(d) Vegetative leaf, Storage leaf, Stem
• Apical meristem: point of vigorous cell division and growth.
Leaves

- Are the center of food production in the plant
  - Photosynthesis and respiration occur there
  - Leaves are either simple (one blade) or compound (multiple blades)
COMPOUND

Pecan  Locust  Ash
Carbon dioxide enters, while water and oxygen exit, through a leaf's stomata.
Stomata

- **Guard cells**
- **Inner cell wall**

**Stoma Open**

**Stoma Closed**
Photosynthesis

- Is the chemical process that creates complex sugars from water, carbon dioxide and sunlight.
- Photosynthesis occurs in the chloroplast
- Chlorophyll is the green pigment that allows photosynthesis to occur.
Light

 Chloroplast

 Carbon dioxide (CO₂)

 Water (H₂O)

 Oxygen (O₂)

 Sugar (C₆H₁₂O₆)
PHOTOSYNTHETIC EQUATION

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

(Carbon dioxide) (Water) Chlorophyll (Sugar) (Oxygen) (Water)
EQUATION FOR CELLULAR RESPIRATION

\[ C_6H_{12}O_6 + 6O_2 + 6H_2O \rightarrow 12H_2O + 6CO_2 + \text{ENERGY} \]

(sugar) (oxygen) (water) (water) (carbon dioxide)
RESPIRATION
The transformation of stored chemical energy to usable energy for growth and development

\[ C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy} \]

TRANSPERSION
The uptake and release of liquids and gases, especially water and CO\textsubscript{2}, by plants.
Important in the regulation of water within the plant (wilt, turgor, stomatal activity, etc.)
Flowers

- Are sexual organs
- Inflorescence
- Perfect flower
- Imperfect flower
- Monoecious
- Dioecious
The Flower
Hormones

Chemical substances that control patterns of growth and development, and responses to environmental conditions
Influencing Plant Growth

Auxin – phototropism, gravitropism, apical dominance
Gibberellins – increased plant and fruit size
Cytokinins – cell division, sprouting
Dormin – accelerates abscission, promotes dormancy
Ethylene – fruit ripening, senescence
• Gardeners use hormones to induce flowering, fruiting, root cuttings, induce or break dormancy, ripen fruit or seeds, chemically “prune” plants, and control growth.
http://www.5min.com/Video/Plant-Physiology-Phototropic-Response-1354341
References


*Botany for Gardeners*, by Capon, Timber Press, Portland, OR, 2005
