SLIDE OUTLINE
JEFFERSON COUNTY MASTER GARDENERS
Presentation by Dan Jones
on Chapter 3, "Basic Botany" of
Alabama Master Gardener Program Volunteer Training Handbook

1. "Basic Botany" - Flower of *Passiflora incarnata* (Maypops)
2. Lily flower: Pedicel, sepals, petals, flower bud
   a. Complete flower = calyx, corolla, stamens and pistils (carpels)
   b. Incomplete flower = one or more of four whorls missing
3. Lily flower: receptacle, ovary, style, stigma, filament, anther
   a. Perfect flower = stamens and pistils (carpels present)
   b. Imperfect flower = either stamens or pistils (carpels) or both missing
   c. Plant monoecious = pistillate (carpellate) and staminate flowers on same plant
   d. Plants dioecious = pistillate (carpellate) and staminate flowers on different plants
4. The plant body has hierarchal construction: cells ➔ tissues ➔ organs
   a. Like animals, plants have organs composed of different tissues, which in turn are composed of cells
5. Plant Organs: 1. Roots 2. Stems 3. Leaves (4. flowers, if in reproductive stage)
   a. The organs are organized into a root system and shoot system.
6. Root System Types
   a. Development of monocot (oat or *Avena*) fibrous root system
   b. Taproot system of blazing star (*Liatris*). As plant matures, taproot system becomes more fibrous-like.
7. Root Functions: Anchors plant, absorbs water & minerals, often stores food, and may be reproductive
8. Root Hairs: Extension of epidermal cells. Absorption of water and minerals occurs near the root tips where vast numbers of tiny root hairs increase the surface area 10+-fold
9. Many plants have modified roots: eg., prop roots, storage roots
10. Or "Strangling" aerial roots or buttress roots
11. Stem Functions
    a. Support (of leaves, flowers, and fruits)
    b. Nutrient and water transportation in phloem (sugar translocation) and xylem tissues
    c. Storage of plant food (starch)
    d. Plant propagation

    Note: Buds may exhibit either: Free growth, i.e., initiate new structures & growth in current season, or fixed growth, wherein structures formed in previous season develop from bud
12. A stem consists of an alternating system of
    a. nodes, points at which leaves are attached, and
    b. internodes, stem segments between nodes
13. An axillary bud has the potential to form a lateral shoot, or branch; growth from the terminal bud, located at the shoot tip, elongates the stem
14. Many plants have modified stems: e.g., stolons, tubers
15. Or rhizomes, e.g., *Iris*, grasses
16. Close inspection of rhizomes reveals nodes and internodes of rhizome; roots are attached to this

modified stem (i.e., rhizome)

17. Bulbs with multiple overlapping leaves, e.g., onion, are modified stems.
18. Holly branch with buds, flowers and leaves at nodes
19. Monocots and eudicots differ in the arrangement of veins, the vascular tissue of leaves
    a. Most monocots (1 cotyledon) have parallel veins (many exceptions)
    b. Most eudicots (2 cotyledons) have branching veins (many exceptions)
20. Leaves generally consist of a flattened blade and a stalk, the petiole, which joins the leaf to the node of a stem.
    a. Simple leaf (blade in one piece)
    b. Compound leaf (blade separated into leaflets)
21. Doubly compound leaf of *Albizzia*: Leaflets and leafules do not have buds at their bases
22. Some plant species have developed modified leaves that serve various functions: e.g.,tendrils
23. Spines or storage leaves
24. Or bracts or reproductive plantlets
25. Plant Cell Structure : note plasmodesmata connecting cells
26. Cell Functions
    a. Absorbs and secretes materials
    b. Digests and transforms foods
    c. Respires and releases energy
    d. Transforms light energy into chemical energy (e.g., sugar)
    e. Synthesizes complex chemicals (e.g., starch)
    f. Synthesizes protoplasm (living substance of cells)
27. Plant Growth: A progressive and irreversible change in form involving the formation of (1) new cells, and (2) their enlargement and maturation. Cells must enlarge irreversibly to produce growth.
28. Plant Tissues
    a. Meristematic tissue = dividing cells
    b. Apical meristems are located at tips of roots and in buds of shoots.
        i. Apical meristems provide cells for shoots and roots elongation (primary growth)
29. Apical shoot meristem (at growing tip)
30. Root meristem (behind protective cap): Functions are a) protection, and b) senses gravity
31. Vascular Tissues
    a. Perform long-distance transport of materials between roots and shoots
    b. The <u>two</u> vascular tissues are xylem and phloem
        i. Xylem (tissue) conveys water and dissolved minerals upward from roots into the shoots
        ii. Phloem (tissue) transports organic nutrients from where they are made (source) to where they are needed (sink)
32. Secondary Growth
    a. Lateral meristems add thickness (diameter) to woody plants (secondary growth)
    b. There are two lateral meristems
        i. vascular cambium
        ii. cork cambium

c. The vascular cambium adds layers of vascular tissue called secondary xylem (wood) and secondary phloem.
d. The cork cambium replaces the epidermis with periderm, which is thicker and tougher.

33. In woody plants, primary and secondary growth occur simultaneously but in different locations.
34. Monocot stems have no cambium.
35. Dicot root with epidermis, cortex, stele, xylem, phloem
36. Monocot root with epidermis, cortex, stele, xylem, phloem, pith and lateral root
37. Requirements for Plant Growth
    a. Energy
        i. Light
        ii. Heat
    b. Water
    c. Elements
        i. Carbon
        ii. Hydrogen
        iii. Oxygen
        iv. Other Minerals
38. Factors Affecting Growth
    a. Heredity
    b. Water
    c. Mineral Nutrients
    d. Atmosphere
    e. Temperature
    f. Radiant Energy
    g. Photoperiodism
    h. Time
39. Leaf Functions: translocation
40. Leaf Functions: translocation, transpiration
41. In general, what percentage of water absorbed by the plant is lost through transpiration?
    A. 10%, B. 50%, C. 75%, D. 95%
42. Some actively growing plants may transpire about ten times their fresh weight daily.
43. Two guard cells of stoma on *Eucalyptus*.
    a. Wax on leaf surfaces (cuticle) occurs as filaments ("brush pile") – not as a continuous sheet.
    b. Stomata can be on top and/or bottom of leaf.
44. Stomata: "pores" in leaves (and stems). 90-95% of transpiration is through stomata, not cuticle.
45. Plants control when stomata are open or closed.
    a. Stoma is open when guard cells are turgid (pressurized with lots of water).
    b. Stoma is closed when guard cells are flaccid (limp due to limited water in them).
46. Environmental Factors Affecting Transpiration
    a. Light
    b. Temperature
    c. Soil water supply

d. Relative humidity
e. Wind
f. Soil fertility

47. Wilting may be temporary or permanent.
48. Transplanting can cause a water imbalance. Typically, the number of roots far exceeds shoot number, but transplanting destroys roots (and root hairs), causing a water imbalance (lack).
49. Leaf Functions: Translocation, transpiration, photosynthesis
50. Chloroplasts and cell wall
51. Photosynthesis: During photosynthesis plants **fix CO_2** (absorb CO_2 from the atmosphere and bond CO_2 molecules together to **<u>make food</u>** such as sugar and starch.
    a. $H_2O + CO_2 \rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow\rightarrow O_2 + (C_6H_{10}O_5)n$; need light and chlorophyll
    b. Photosynthesis provides oxygen for plants also.
52. Factors Affecting Photosynthesis
    a. Carbon dioxide concentration
    b. Plant water status
    c. Light intensity
    d. Leaf chlorophyll concentration
    e. Temperature
    f. Leaf age
53. Degree of shading (light intensity) affects rate of photosynthesis, if light is limiting.
54. Leaf Functions: Translocation, transpiration, photosynthesis, gaseous exchange
55. Factors Affecting Respiration Rate
    a. Type of tissue
    b. Temperature
    c. Oxygen
    d. Glucose supply
56. Comparison of Photosynthesis and Respiration
    a. Photosynthesis
        i. In green cells only
        ii. In light only
        iii. Uses H_2O and CO_2
        iv. Releases H_2O and O_2
        v. Solar energy converted into chemical energy
        vi. Results in weight increase
        vii. Food synthesized
    b. Respiration
        i. In every active (live) cell
        ii. In light and dark
        iii. Uses products of PHS
        iv. Releases H_2O and CO_2
        v. Chemical energy converted to heat and other energy forms
        vi. Results in weight decrease

vii. Food used and broken down (digested)

57. For growth to occur photosynthesis must be greater than respiration.
58. Environmental Factors That Can Affect Plant Growth
    a. Nutrients (availability affected by soil pH)
    b. Water and humidity
    c. Light
    d. Temperature
59. Calcium shortage may cause blossom-end rot in tomatoes.
60. Methods of Nutrient Uptake
    a. Interception = roots grow and encounter nutrients
    b. Mass flow = transfer of nutrients to root surface in soil water
    c. Diffusion = Concentration gradient develops if nutrients constantly being absorbed
    d. Nutrient availability MAY determine amount of growth.
61. Plant Responses to Light
    a. Photosynthesis
    b. Photoperiodism
    c. Phototropism
    d. Light requirement must take into consideration: quantity and quality of light and duration of exposure.
62. Phototropism: growth response due to uneven intensity (i.e., unilateral light). Both stems and roots respond to stimuli of light and gravity.
63. Etiolation: characteristics of plants grown in dark
64. Quality of light: spectrum
65. Photoperiodism (duration): can affect flowering time
66. Duration of Light
    a. onion = short-day plant
    b. potato = long-day plant
    c. strawberry = day-neutral
67. Chrysanthemum species: Short-day plant
68. *Spinach oleracea:* Long-day plant
69. Effects of Temperature on Plant Growth
    a. Photosynthesis rates (if carbon dioxide and light are not limiting)
    b. Respiration rates
    c. Transpiration rates
    d. Flower development
    e. Sugar storage
    f. Breaking dormancy
70. High temperatures can cause transpiration to become rapid and result in leaf-tip “burning” or drying.
71. Plant Growth Phenomena Related to Temperature
    a. Thermoperiod
    b. Forcing

c. Chilling requirements

72. Tomatoes prefer alternating day and night temperatures.
73. Can force bulbs to flower by exposing them to cold storage in October at 35 to 40 degrees. The bulb is said to “mature” in the cold.
74. Chilling requirement: hours of low temperature (32 - 45 degrees) needed by a cultivar to grow and develop properly (flower). Number of chilling hours required varies with variety. Many peaches need ~800 hr.; many apples need ~900 hours of chilling.
75. Thank you!