Introduction to Horticulture

University of California Cooperative Extension

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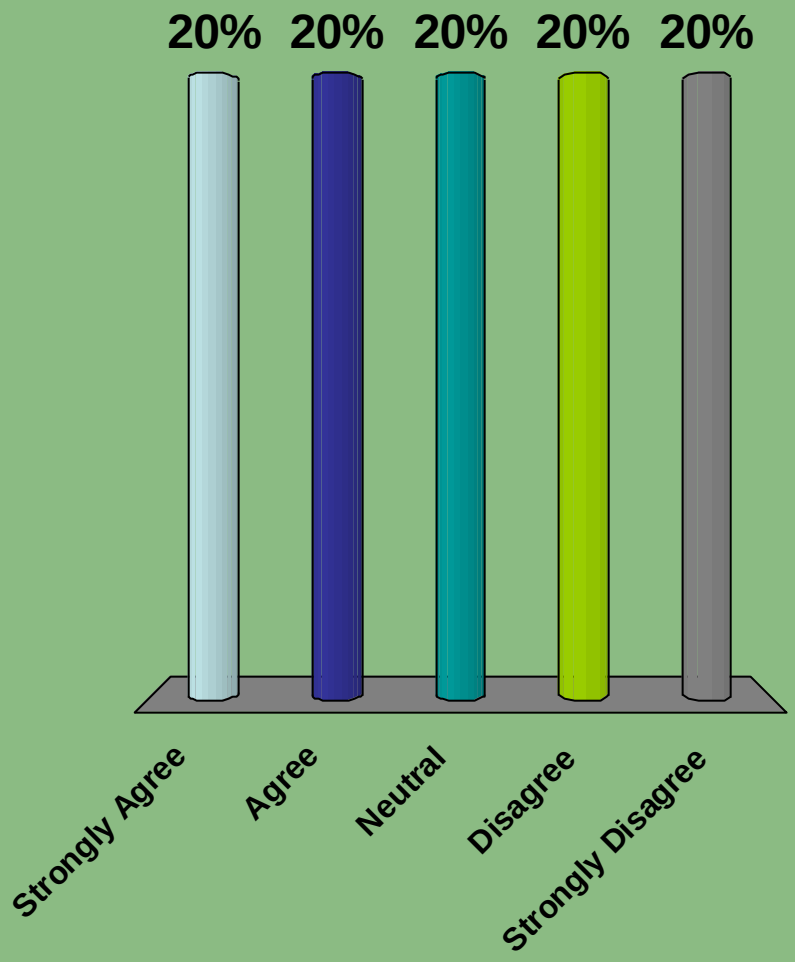
Special Thanks to Mary Bianchi, Farm Advisor SLO County

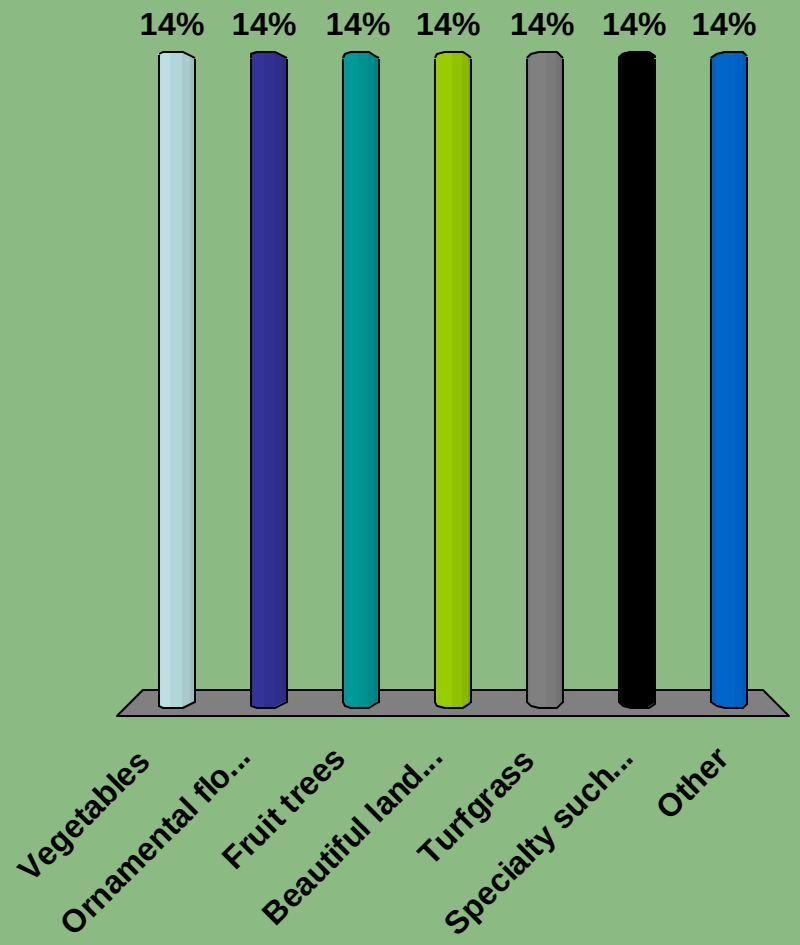
I am a knowledgeable gardener?

1. Strongly Agree
2. Agree
3. Neutral
4. Disagree
5. Strongly Disagree



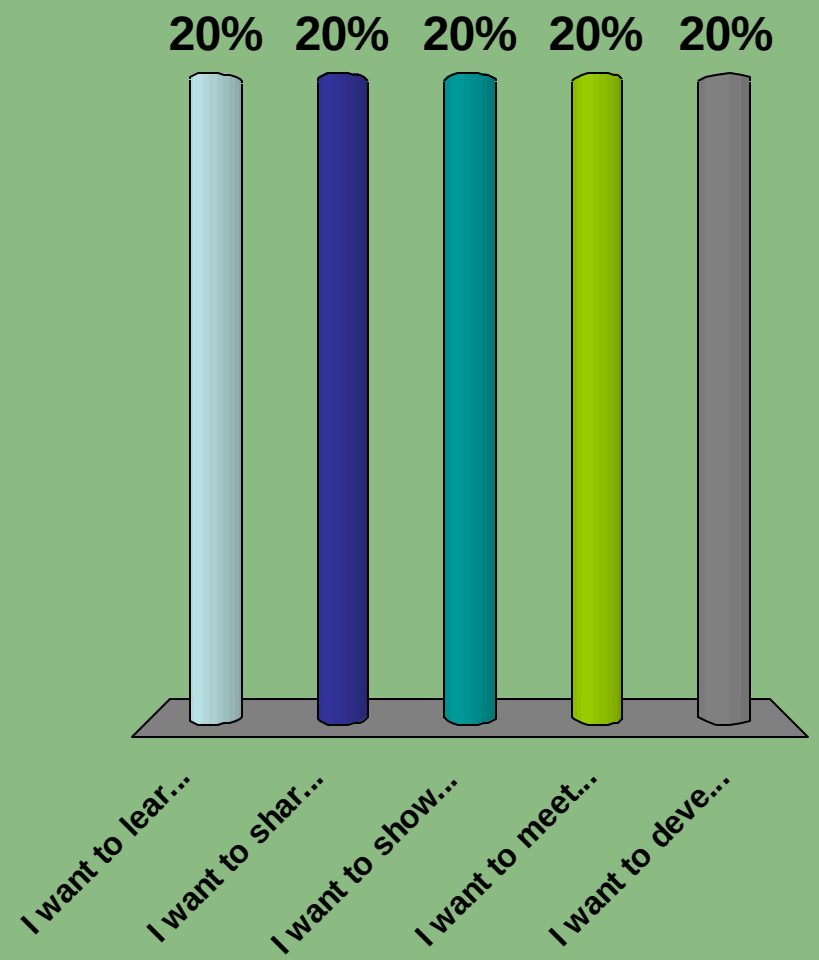
My favorite type of gardening is:

1. Vegetables
2. Ornamental flowers
3. Fruit trees
4. Beautiful landscapes
5. Turfgrass
6. Specialty such as bonsai, topiary etc.
7. Other



I want to be a Master Gardener because:

1. I want to learn more about gardening
2. I want to share my knowledge with my community
3. I want to show off to my neighbors
4. I want to meet new friends
5. I want to develop skills for employment



Introduction to Horticulture

Learning Objectives:

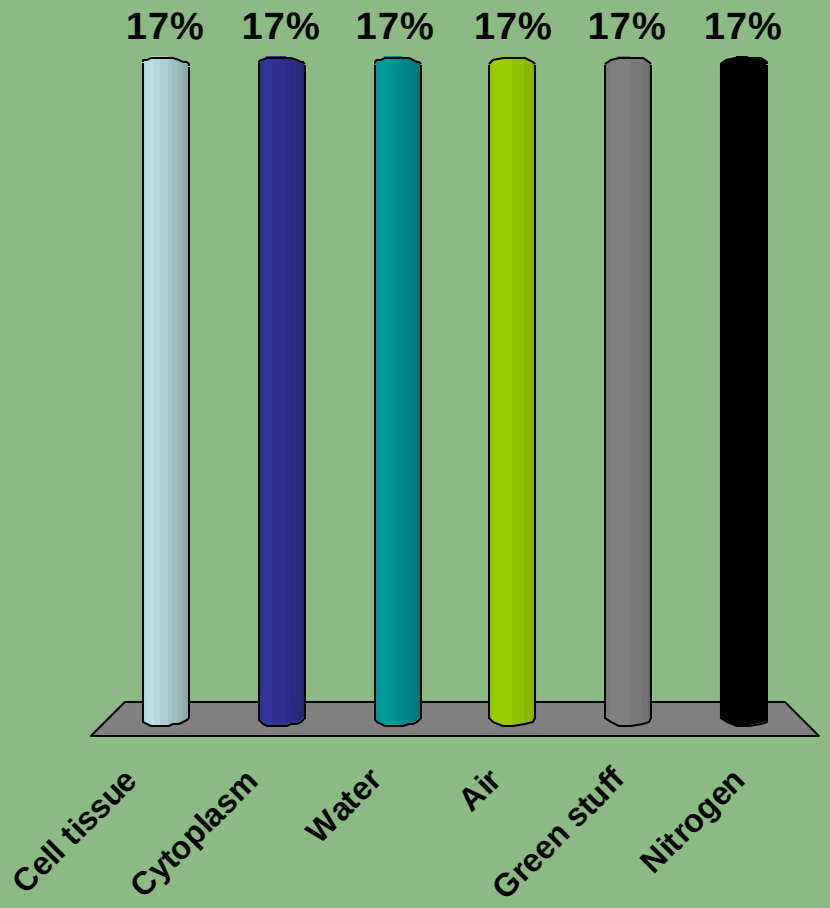
- **Learn principal characteristics of green plants, their structures, and common horticultural terminology.**
- **Understand general vegetative and reproductive growth processes and factors that influence them.**
- **Learn classic applications of fundamental horticultural knowledge.**

INTRODUCTION TO HORTICULTURE

- Botany
  - Structure and life phenomena exhibited by plants
  - Agronomy
  - Horticulture
    - hortus (garden)
    - colere (to cultivate)

What is the main component of a plant?

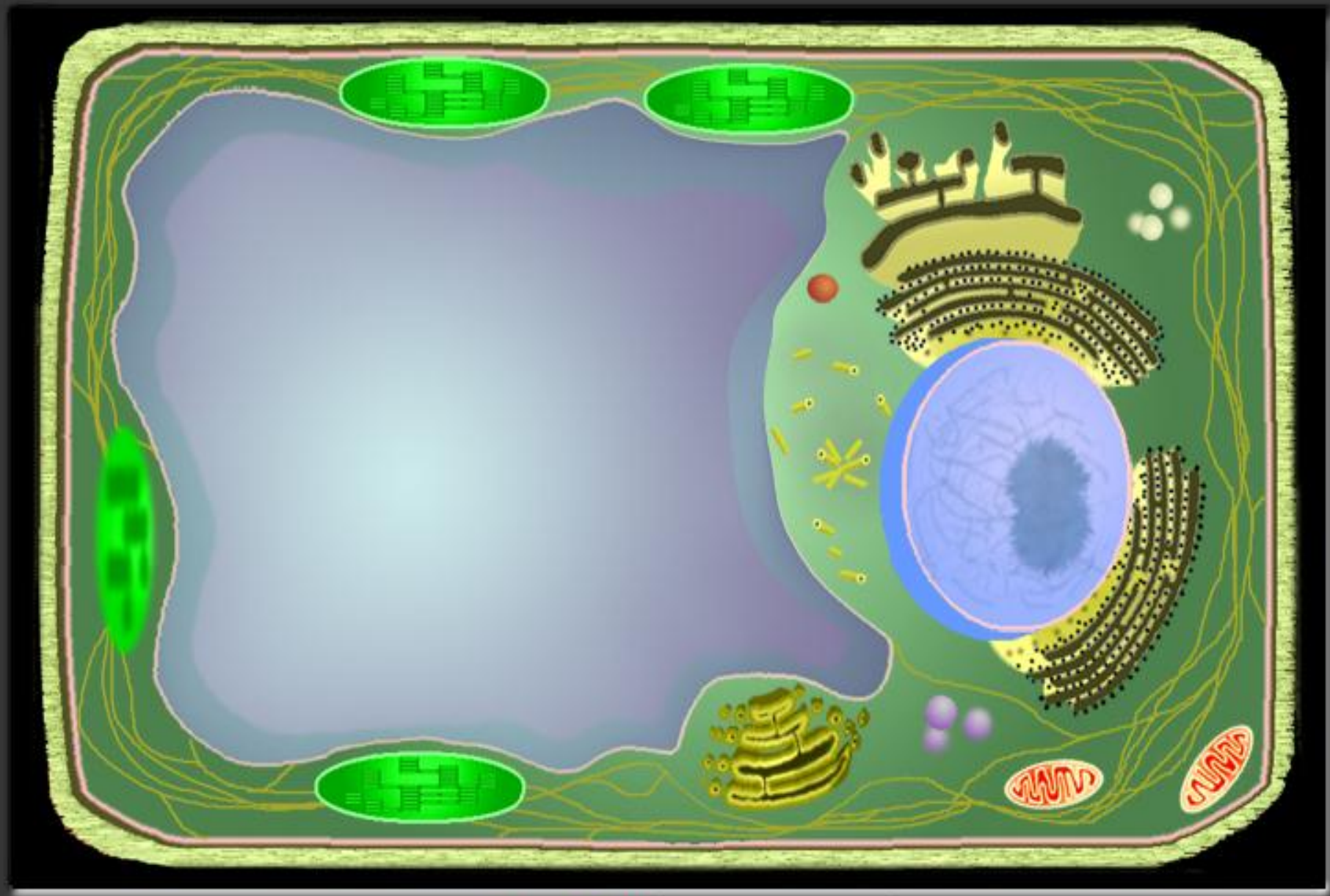
1. Cell tissue
2. Cytoplasm
3. Water
4. Air
5. Green stuff
6. Nitrogen



INTRODUCTION TO HORTICULTURE

- What makes up a plant?
  - living factories that produce their own food
  - serve as food source for nearly all other living organisms
    - Cells http://www.cellsalive.com/cells/cell_model.htm
    - photosynthesis
    - water (85 - 90 % by weight)
      - Solvent for mineral and sugar transport

CELLS *alive!* Interactive Animal and Plant Cells



Nucleus Golgi Animal Cell Plant Cell

INTRODUCTION TO HORTICULTURE

External plant parts-roots, stems, buds, leaves, flowers, fruits and seeds

Leaves, stems, roots, flowers, fruits, and seeds are known as plant organs. Each organ is an organized group of tissues that work together to perform a specific function.

Sexual reproductive parts produce seed; they include flower buds, flowers, fruit, and seeds.

Vegetative parts include roots, stems, shoot buds, and leaves; they are not directly involved in sexual reproduction. Vegetative parts often are used in asexual forms of reproduction such as cuttings, budding, or grafting.

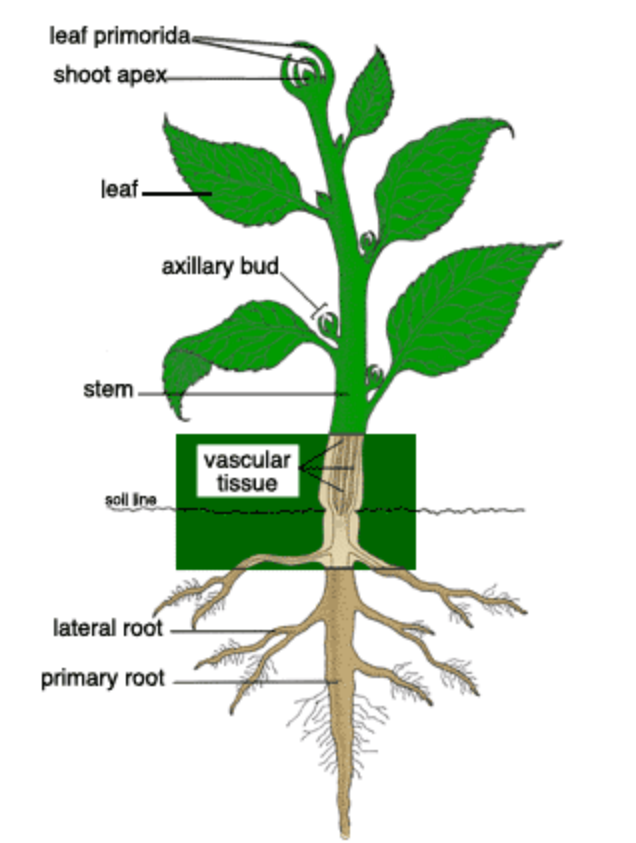
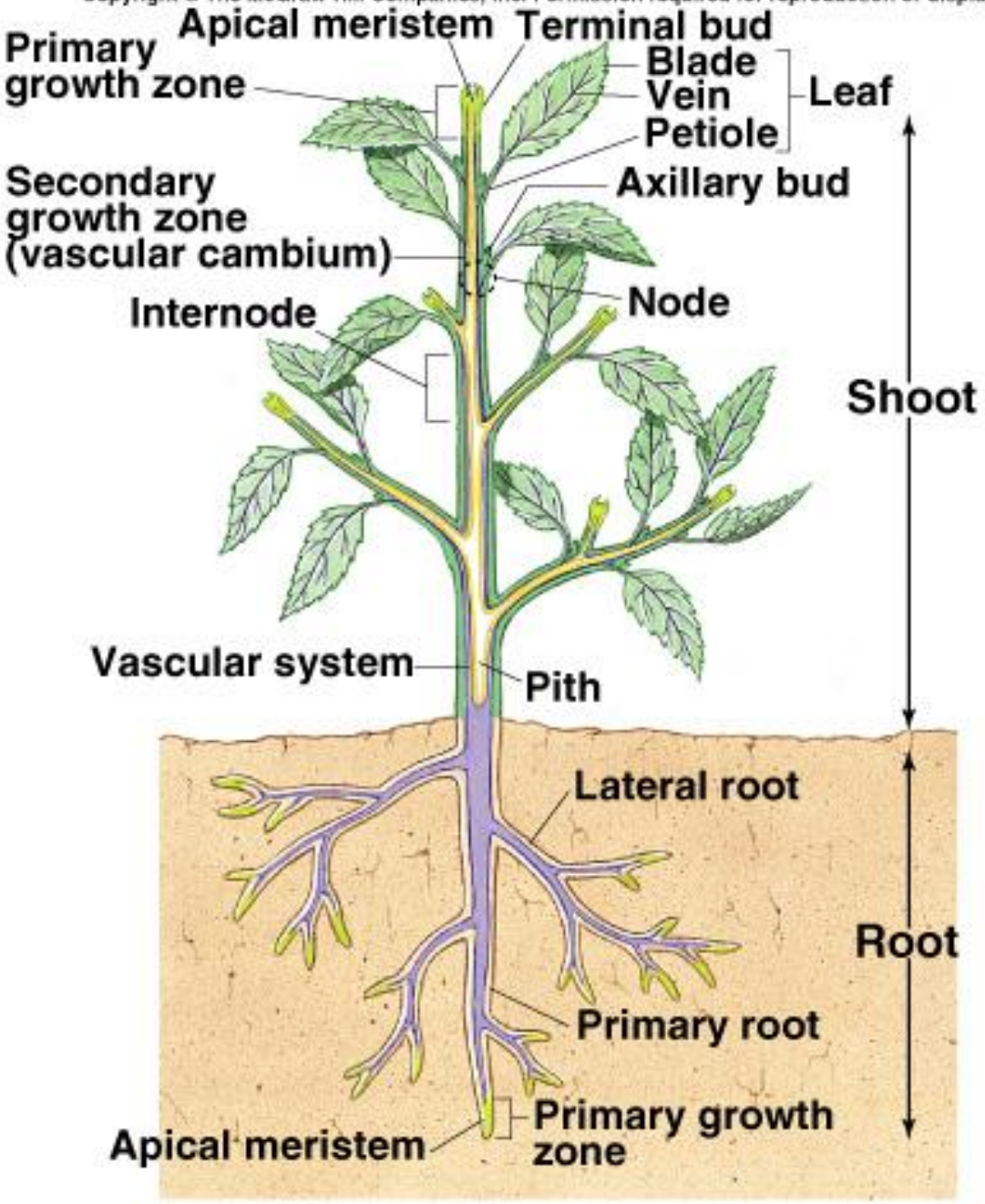
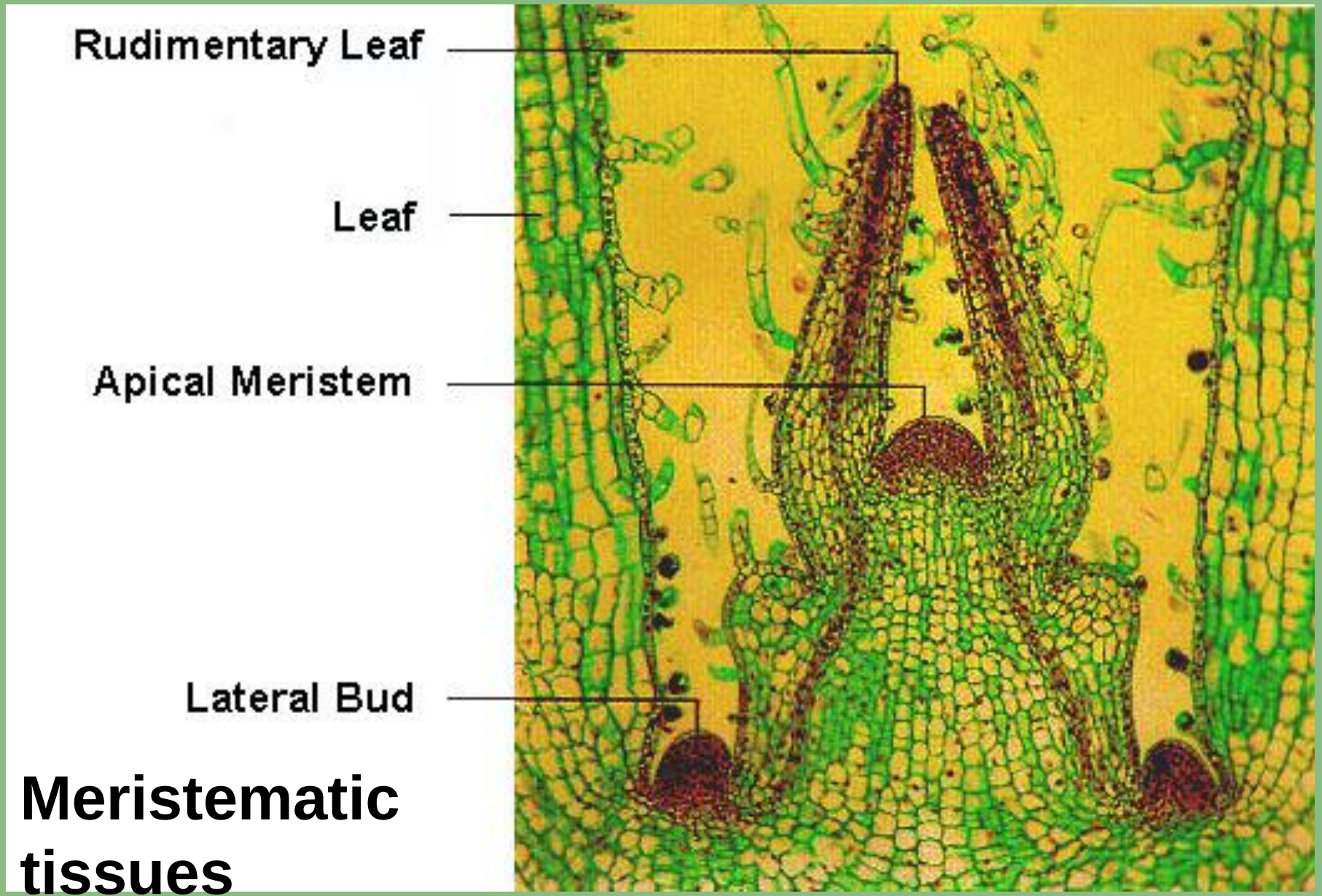


Figure 1. Principal Parts of a Vascular Plant





Meristematic tissues

http://botany.csdl.tamu.edu/FLORA/tfplab/vegchar.htm

Lab 2: Vegetative Characters

Objectives for this lab:

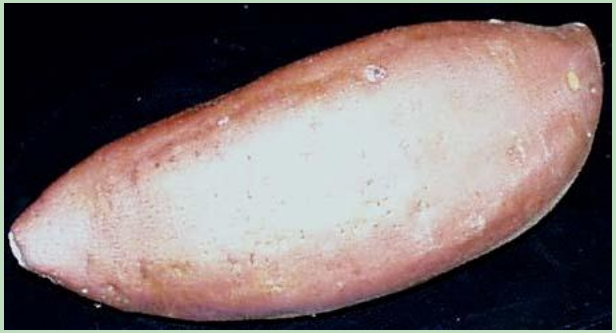
- learn the different root types
- learn to recognize and name different stem modifications
- learn to recognize and interpret simple and compound leaves
- become familiar with leaf shapes, bases, apices, margins, arrangements, forms, and textures and the terms that describe these features
- learn to recognize different growth forms--herbs, vines, trees, shrubs
- learn to recognize vegetative features such as thorns, spines, prickles, tendrils
- examine and learn to recognize different types of trichomes (plant hairs)
- practice keying with a key that uses vegetative characters

Safety concerns for this lab: Be careful of plants with sharp parts, don't eat the samples, and be careful where you step when walking on campus.

This lab deals with characters of the vegetative parts of a plant--roots, stems, twigs, and leaves.

Most items have a visual link, but some do not. This topic is covered fully in *Vascular Plant Taxonomy* by Walters and Keil .

ROOTS



- Tap root--main root enlarging and growing downward
- Fibrous roots--thin, thread-like roots, usually without a primary root present
- Adventitious root--root growing from something other than root tissue, e.g. stem, etc.
- Tuberous root---root enlarged for storage of food reserves, eg. sweet potato
- Aerial root--adventitious root produced above ground, often for climbing

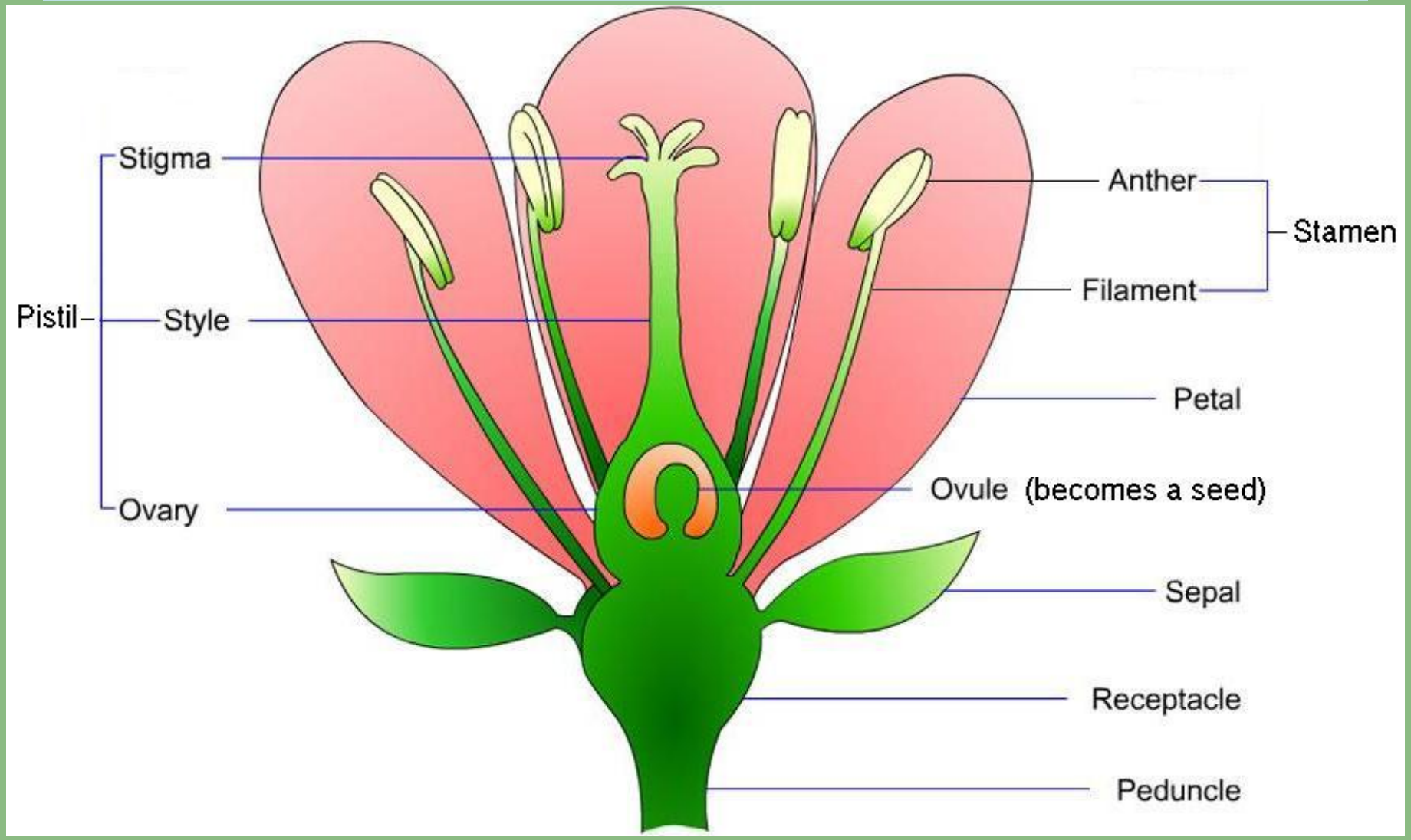
STEM ANATOMY

- Bud--A compressed, undeveloped shoot. Buds may be lateral or terminal.
- Node--point on the stem where leaf or bud is borne. The space between two nodes is an internode
- Leaf scar--mark left on the stem where a leaf was attached
- Bud scale scar--mark on the stem where a bud scale was attached. When the terminal bud sprouts and its scales fall off, growth rings are formed. The portion of a stem between two sets of growth rings indicates one season's growth.
- Pith--the spongey tissue in the center of a stem or twig. Pith can be solid, chambered, or diaphragmmed.
- Lenticel--a "breathing pore" in the skin or bark of a stem.

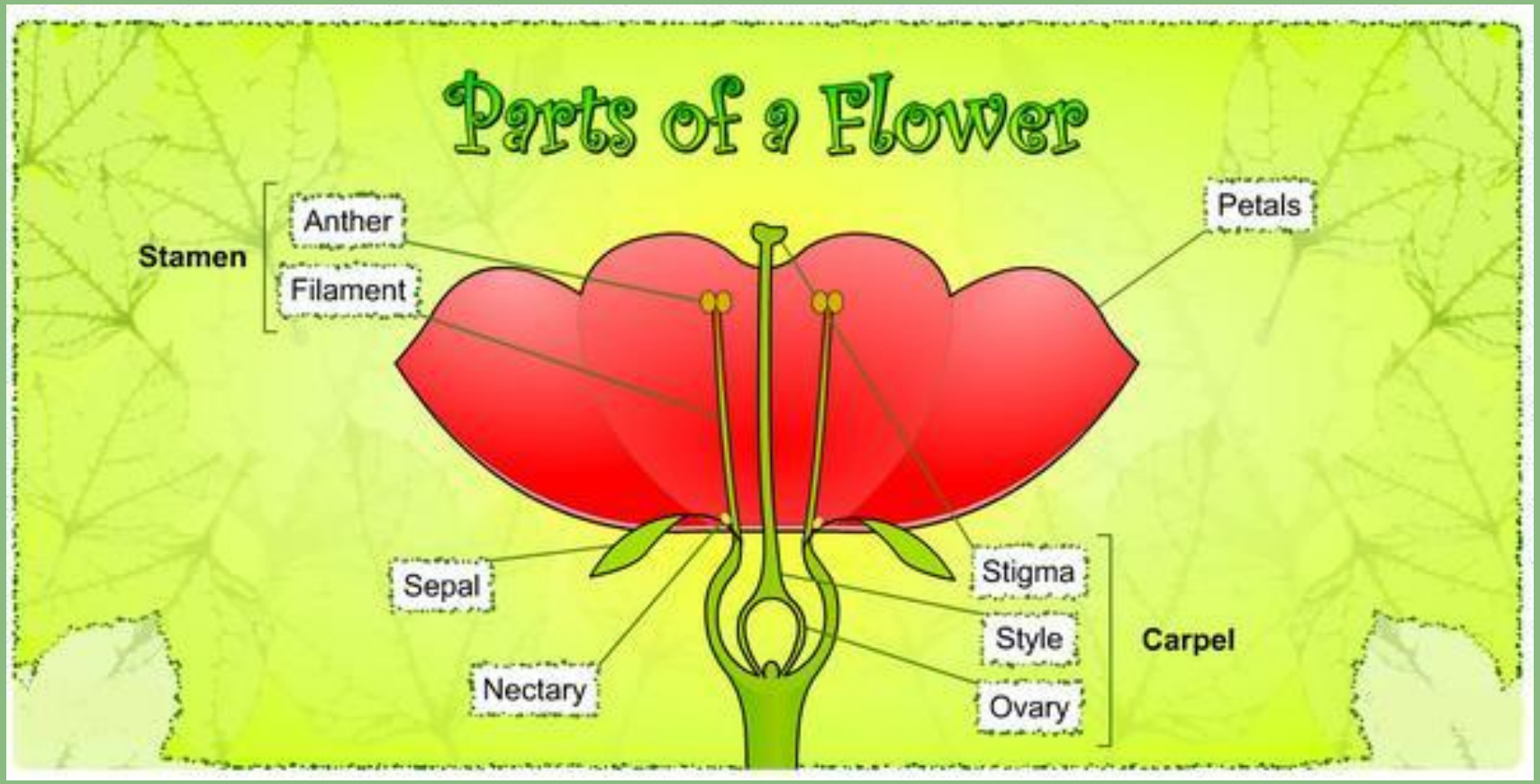
STEM MODIFICATIONS

- Tuber--underground stem enlarged for storage of food--has nodes (unlike tuberous root)
- Rhizome--underground stem, often has buds which sprout to form new shoots
- Stolon

Flower Parts



Flower Parts



INTRODUCTION TO HORTICULTURE

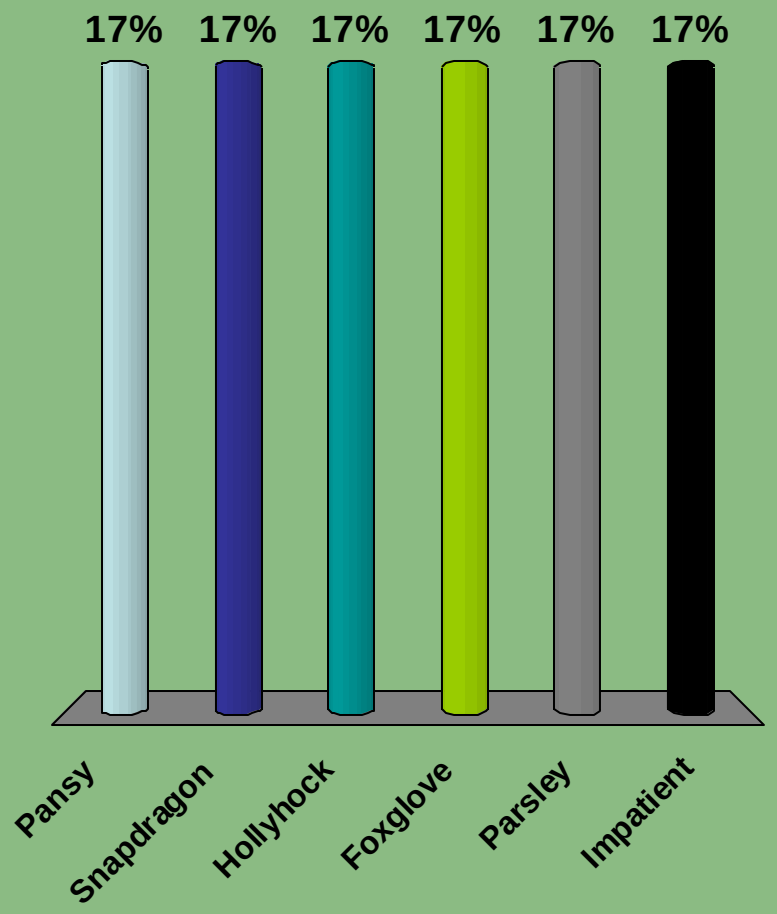
- Plant Classification
  - Growth Habit
  - Structure or Form
  - Leaf retention
  - Climatic Adaptation
  - Use
  - Botanical or Scientific Classification

INTRODUCTION TO HORTICULTURE

- Plant Classification
  - Growth Habit
    - Annuals
      - complete a life cycle (seed to flowering to re-seeding) in one growing season and then die
    - Perennials
      - may go through repeated flowering and seeding cycles before dying
      - may grow for several years before flowering and dying
    - Biennials
      - two growing seasons to complete life cycle.

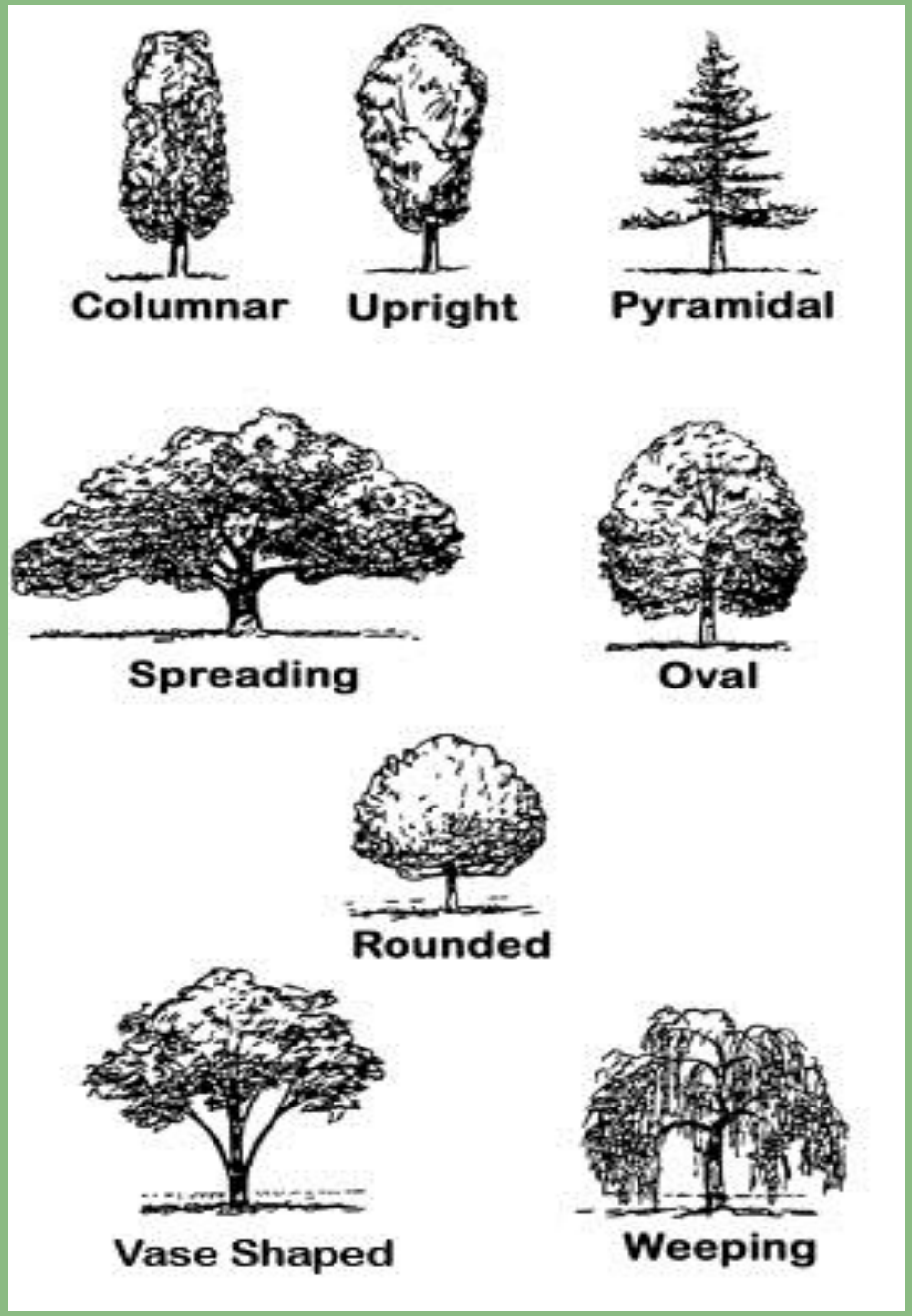
Which of the following plants would be considered a Biennial?

1. Pansy
2. Snapdragon
3. Hollyhock
4. Foxglove
5. Parsley
6. Impatient



INTRODUCTION TO HORTICULTURE

- Plant Classification
  - Structure or Form
    - Herbaceous -- tender stemmed species
    - Woody -- hard fibrous stems
      - Form
        - » Vine
        - » Shrub
        - » Tree (includes tree shape also…weeping, vase, etc.)

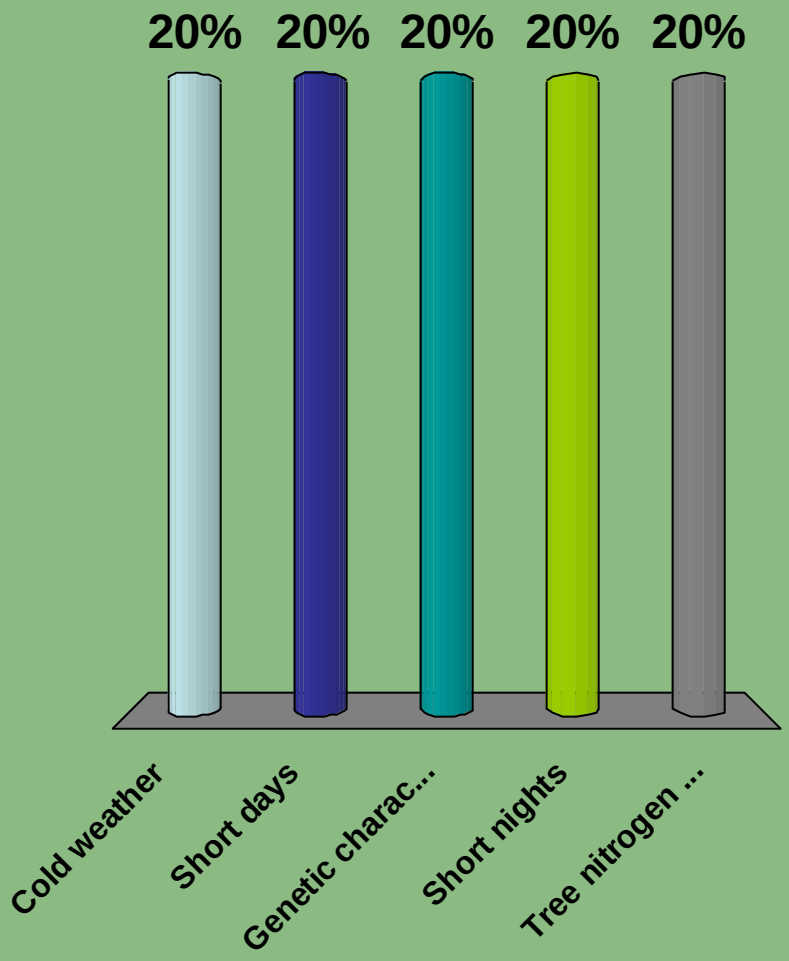

Columnar
Upright
Pyramidal
Spreading
Oval
Rounded
Vase Shaped
Weeping

INTRODUCTION TO HORTICULTURE

- Plant Classification
  - Leaf retention
    - Deciduous
    - Evergreen
      - broad-leaved -- azaleas, some magnolias
      - needle-leaved -- pine, redwood

What factor most influences the loss of leaves in the fall?

1. Cold weather
2. Short days
3. Genetic character of the species
4. Short nights
5. Tree nitrogen status



INTRODUCTION TO HORTICULTURE

- Plant Classification
  - Use
    - Fruits
    - Herbs
    - Vegetables

INTRODUCTION TO HORTICULTURE

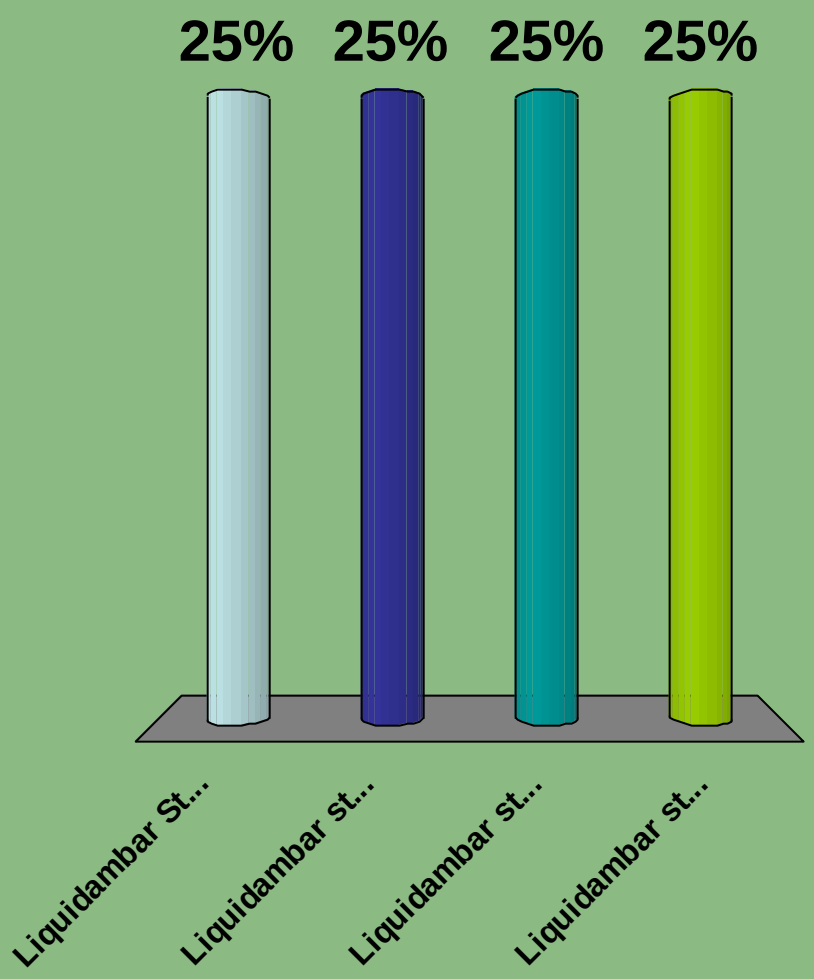
- Plant Classification
  - Climatic Adaptation
    - Perennial plants are classified according to minimum temperatures they will tolerate
      - tropical, subtropical, temperate
    - Cool- and warm-season plants
      - cool season grow best with average daytime temperatures of 55^{o} to 75^{o} F (carrot, asparagus, spinach, broccoli)
      - warm season grow best with average daytime temperatures of 65^{o} to 95^{o} F (tomato, sweet corn)

INTRODUCTION TO HORTICULTURE

- Plant Classification
  - Botanical or Scientific Classification
    - Genus + specific epithet (species)
      - Red Raspberry (common name)
      - *Rubus idaeus*, or Rubus ideaus
      - Or...*Rubus ideaus* var “Heritage”
    - Grouped according to similarities in morphology

Which of the following is the correct way to write out a Latin name?

1. Liquidambar Styraciflua var. ‘Burgundy’
2. Liquidambar styraciflua burgundy
3. *Liquidambar styraciflua* cv. “Burgundy”
4. Liquidambar styraciflua var burgundy

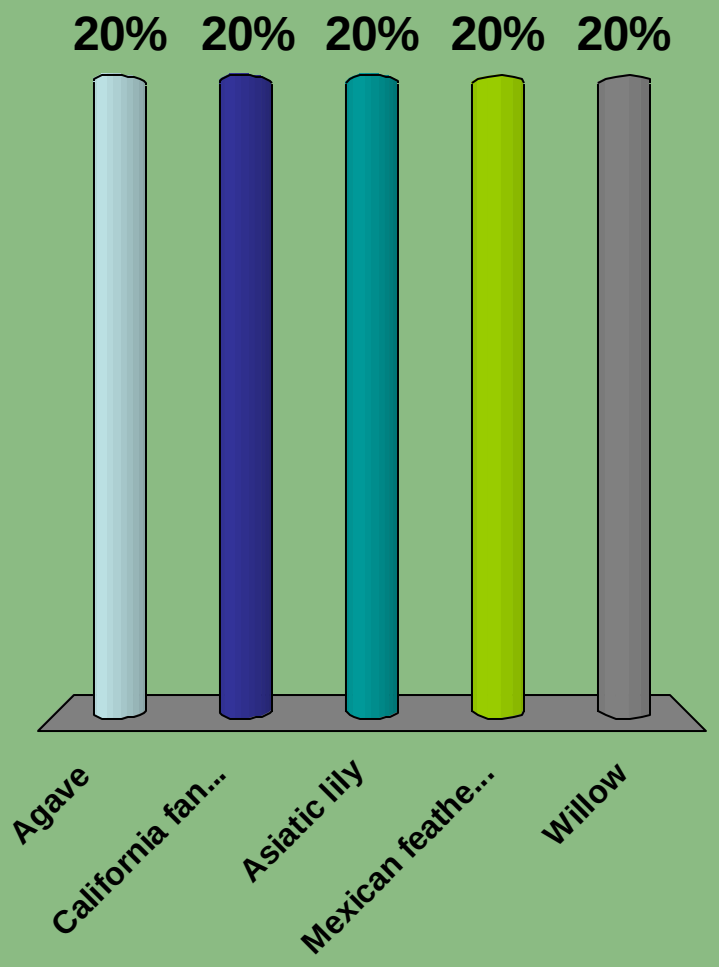


INTRODUCTION TO HORTICULTURE

- Plant Classification
  - Botanical or Scientific Classification
    - Varieties
    - Cultivars
    - Clone

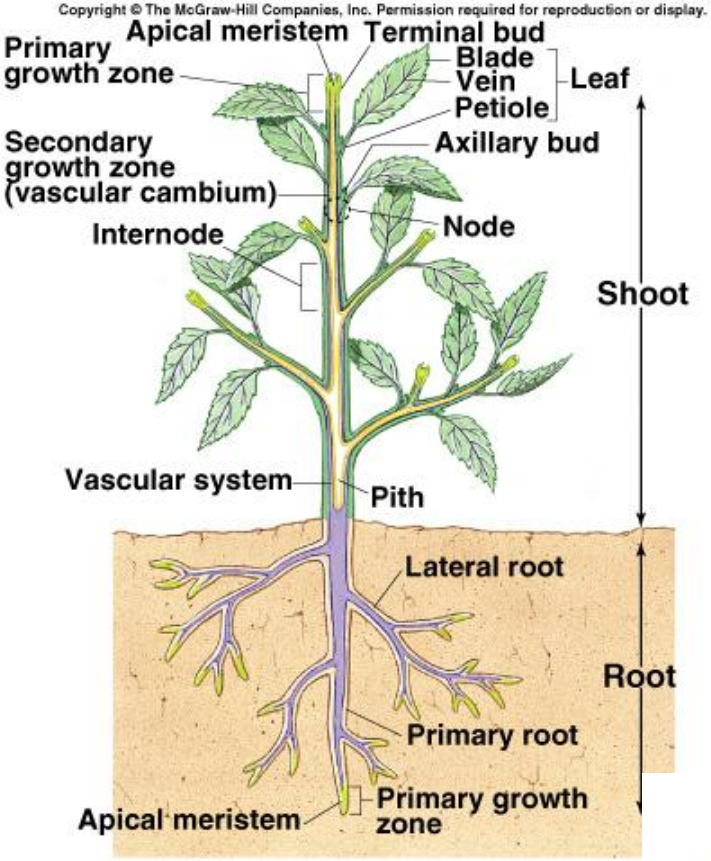
Which of the following is NOTa monocot?

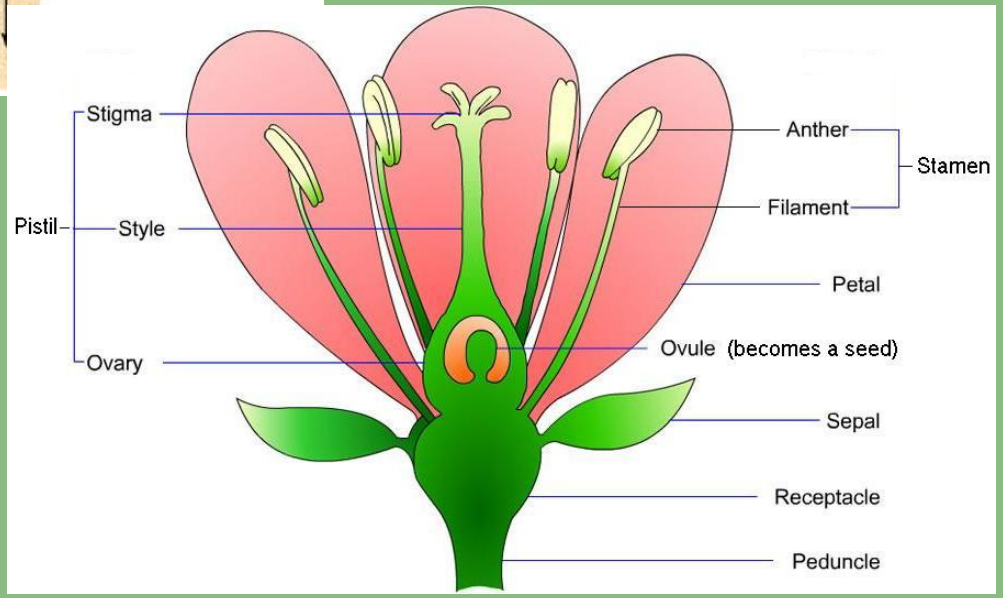
1. Agave
2. California fan palm
3. Asiatic lily
4. Mexican feather grass
5. Willow



Exercise I

1. Pair up with someone not from your county.
2. Collect your tools: cutting board and single edge razor blade
3. Collect one piece of vegetation
4. Dissect and name the plant parts…





INTRODUCTION TO HORTICULTURE

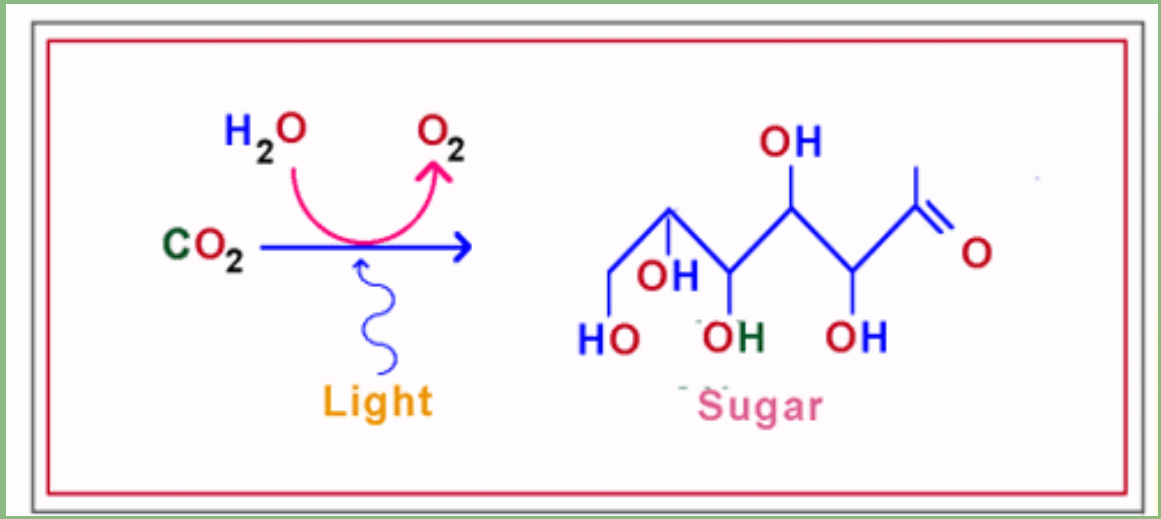
- Plant Growth
  - Irreversible increase in plant size due to increased cell number and/or size
- Three Critical Processes for Growth
  - Photosynthesis
  - Respiration
  - Transpiration

INTRODUCTION TO HORTICULTURE

- Plant Growth
  - Photosynthesis
    - Process by which green plants produce their own carbohydrates and obtain chemical energy
    - Plant cells, in presence of chlorophyll and light, convert carbon dioxide (CO2) and water (H2O) to carbohydrates
    - Net result is transformation of light energy into chemical energy
    - Energy is stored in the chemical bonds of the carbohydrate molecules

INTRODUCTION TO HORTICULTURE

A model of Photosynthesis



Courtesy of Ohio State University

INTRODUCTION TO HORTICULTURE

- Plant Growth
  - ***Photosynthesis***
    - Energy is “stored’ in chemical bonds
    - By-product is evolution of free oxygen (O2)

INTRODUCTION TO HORTICULTURE

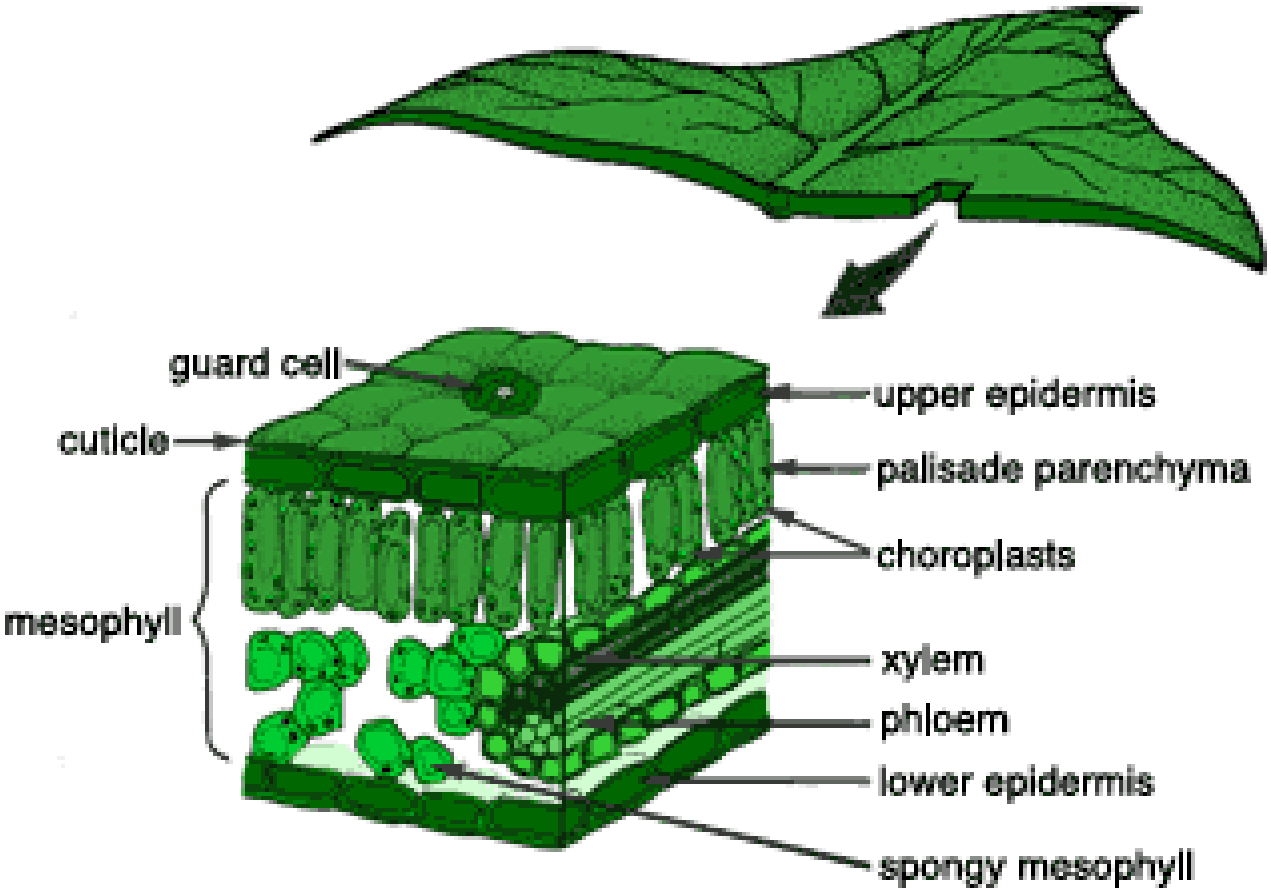
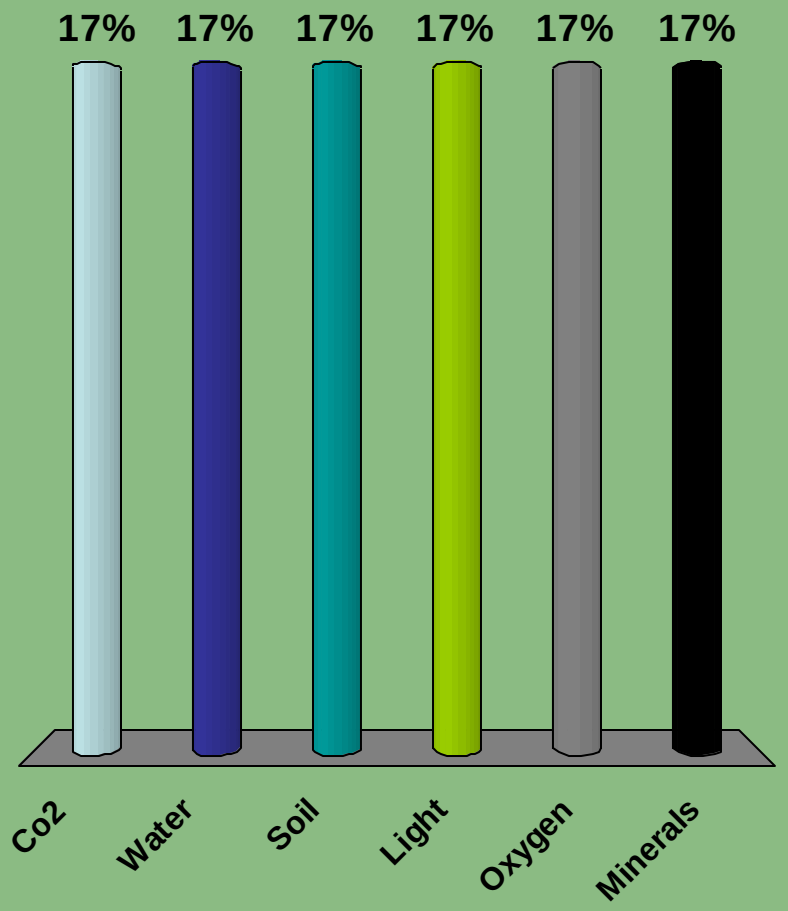


Figure 12a. Leaf cross section

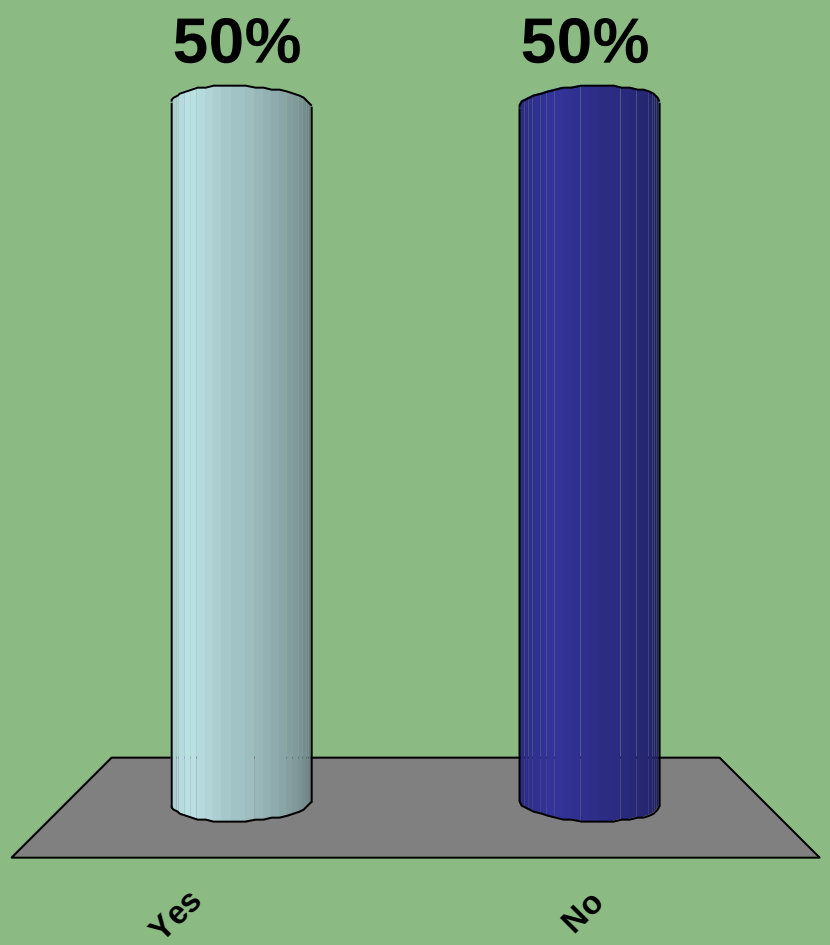
What, of the following, is NOT required for photosynthesis?

1. Co2
2. Water
3. Soil
4. Light
5. Oxygen
6. Minerals



Does photosynthesis occur at night?

1. Yes
2. No

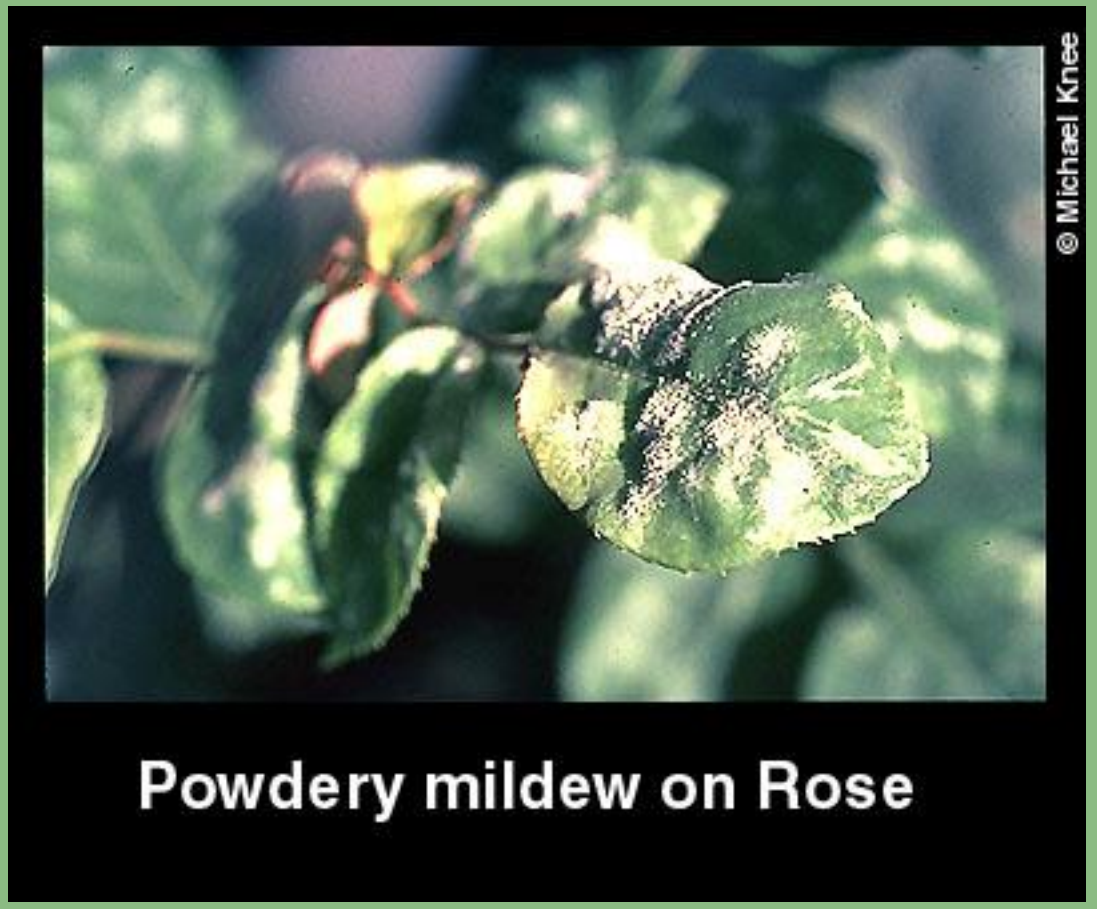


INTRODUCTION TO HORTICULTURE

- Plant Growth
  - Photosynthesis
    - Requirements
      - Stomata must be open to allow CO_2 to enter leaf
      - Adequate light must reach leaf
      - Water must be available to the plant
      - Mineral nutrients must be available to plant

INTRODUCTION TO HORTICULTURE

How might this affect plant growth?



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INTRODUCTION TO HORTICULTURE

- Plant Growth
  - ***Photosynthesis***
    - Fate of carbohydrates produced
      - combined with minerals to synthesize more complex compounds for cell growth
      - converted to more complex carbohydrates (sugars and starches) or fats and stored (where?)
      - biologically combusted to release stored chemical energy, a process called respiration

INTRODUCTION TO HORTICULTURE

- Plant Growth
  - ***Respiration***
    - occurs in cells through complicated series of reactions regulated by enzymes
    - uses oxygen
    - releases CO2 and water

$$C_6H_{12}O_6 + 6\ O_2 \xrightarrow{\text{energy}} 6\ CO_2 + 6\ H_2O + \text{Energy}$$

INTRODUCTION TO HORTICULTURE

- Plant Growth
  - ***Respiration***
    - rate dependent on
      - temperature
      - availability of oxygen and carbohydrates
    - occurs at all times in living material, even after harvest
    - post-harvest respiration affects how fruits and vegetables are stored

INTRODUCTION TO HORTICULTURE

- Plant Growth
  - Cycling of Photosynthesis and Respiration
    - What conditions would impact cycling?

INTRODUCTION TO HORTICULTURE

- Plant Growth
  - Cycling of Photosynthesis and Respiration
    - Photosynthesis requires light, and ceases at night
    - Respiration occurs all the time, but is driven by temperature
      - it nearly doubles for every 18^{o}F rise in temperature between 40^{o}F and 96^{o}F

INTRODUCTION TO HORTICULTURE

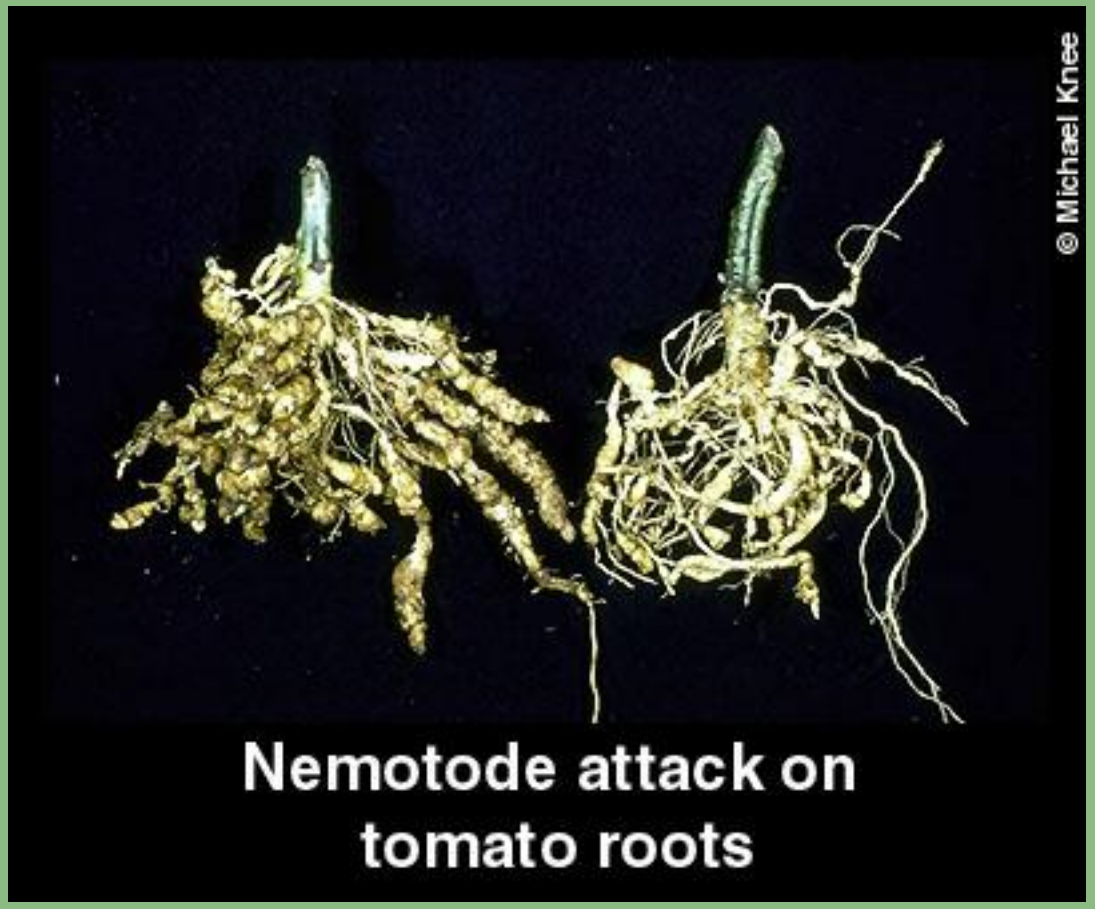
- Plant Growth
  - Cycling of Photosynthesis and Respiration
    - Rate of photosynthesis must exceed rate of respiration
    - Why?
    - What happens when water is limited?

INTRODUCTION TO HORTICULTURE

- Plant Growth
  - Water and Nutrient Uptake
    - Most of water and nutrient uptake occurs in roots
    - Some nutrient uptake requires roots to expend energy
    - Water uptake is largely passive and in response to a gradient

INTRODUCTION TO HORTICULTURE

How might this affect water and nutrient uptake?



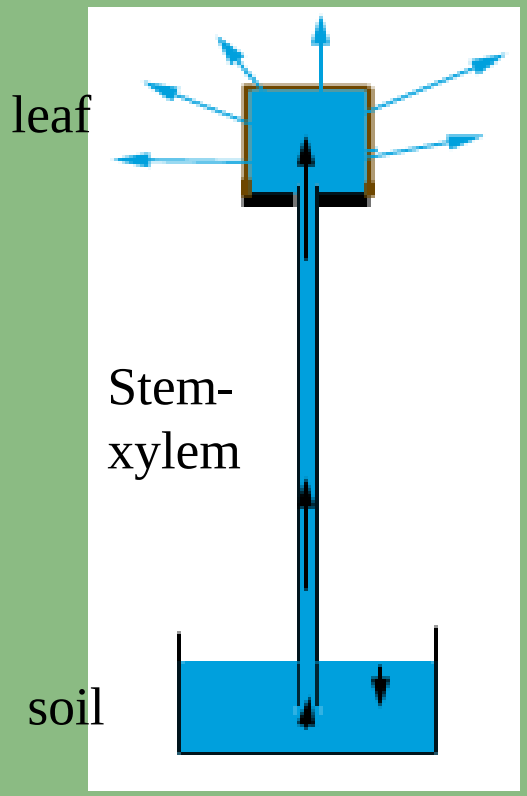
Courtesy of Ohio State University

INTRODUCTION TO HORTICULTURE

- Plant Growth
  - ***Transpiration***
    - Evaporative loss of water vapor from plant leaves through stomata
    - Related to ***translocation*** through xylem

INTRODUCTION TO HORTICULTURE

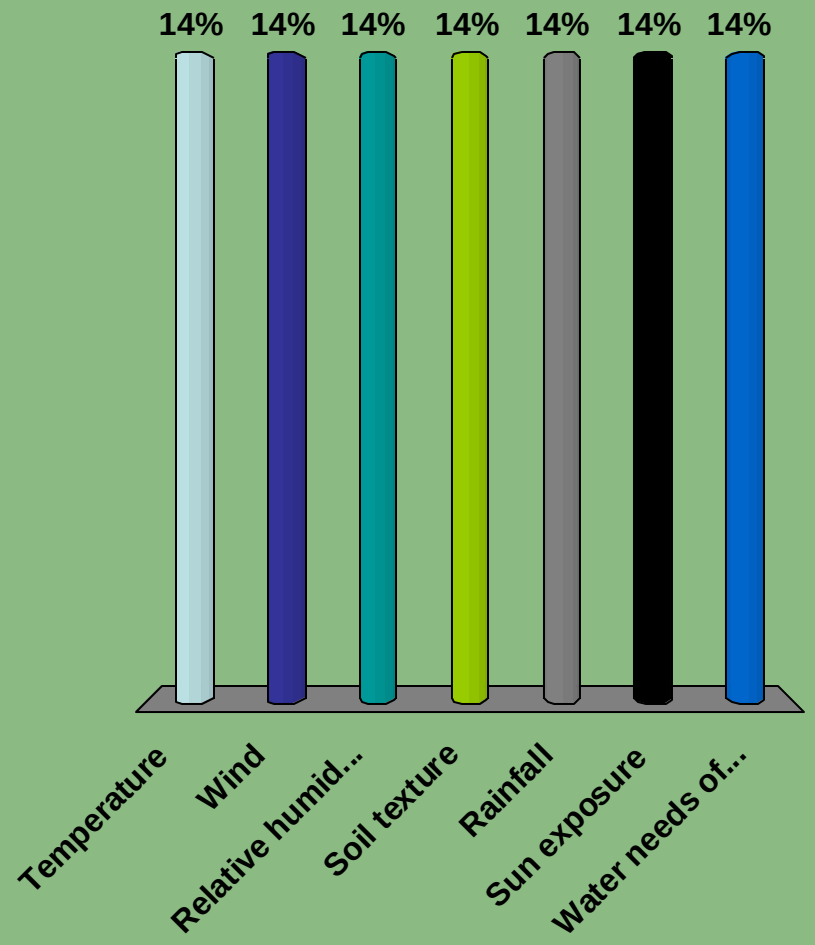
Porous pot analogy to plant transpiration



Courtesy of Ohio State University

What factors has the lease effect on transpiration?

1. Temperature
2. Wind
3. Relative humidity
4. Soil texture
5. Rainfall
6. Sun exposure
7. Water needs of the plant species



INTRODUCTION TO HORTICULTURE

- Plant Growth
  - Transpiration
    - Rate depends on
      - environmental factors (which ones?)
      - degree of stomatal opening
      - amount of available soil water

INTRODUCTION TO HORTICULTURE

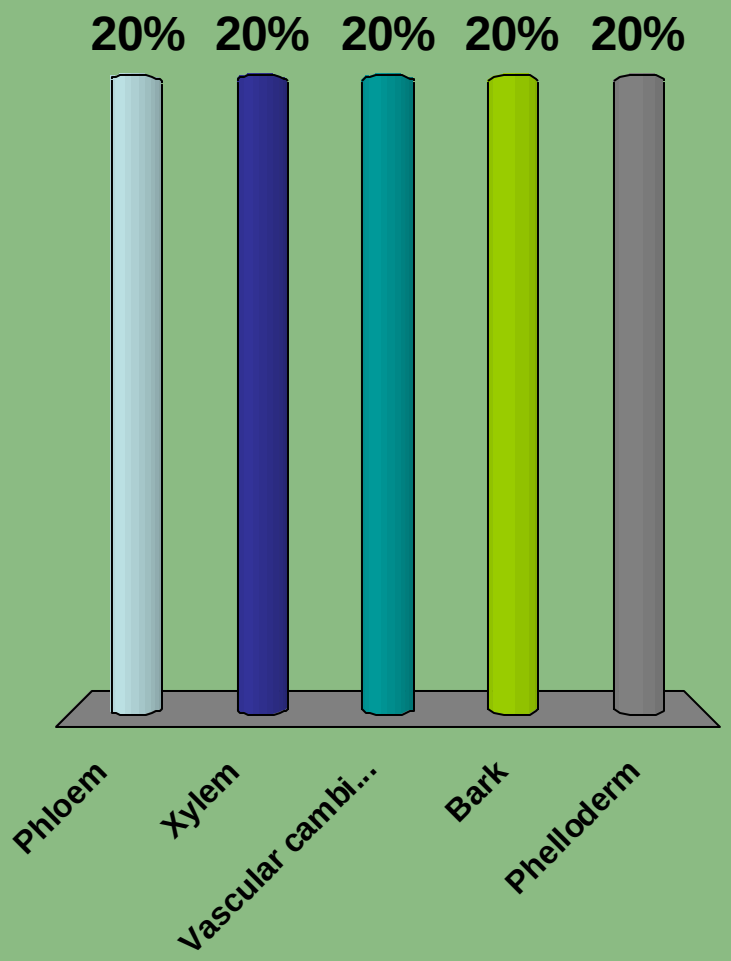
- Plant Growth
  - Transpiration
    - In temperate plants transpiration ceases.
      - When?
      - Why?
    - How is transpiration different in succulents?
    - Transpiration is affected by wind….

INTRODUCTION TO HORTICULTURE

- Plant Growth
  - Transpiration
    - Helps to cool plants during day
    - Transports minerals from soil and organic compounds produced in roots

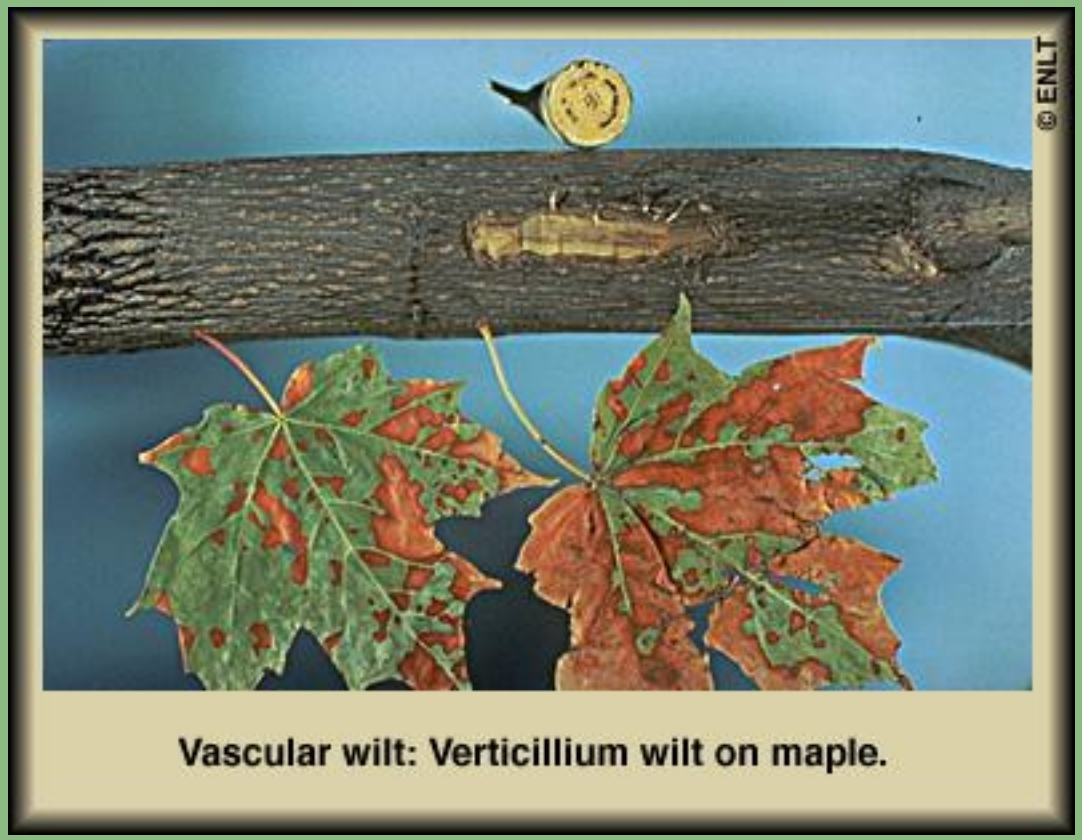
In what plant tissue is water and minerals transported in the plant?

1. Phloem
2. Xylem
3. Vascular cambium
4. Bark
5. Phelloderm



INTRODUCTION TO HORTICULTURE

Impacts of a vascular wilt disease on maple



Vascular wilt: Verticillium wilt on maple.

Courtesy of Ohio State University

INTRODUCTION TO HORTICULTURE

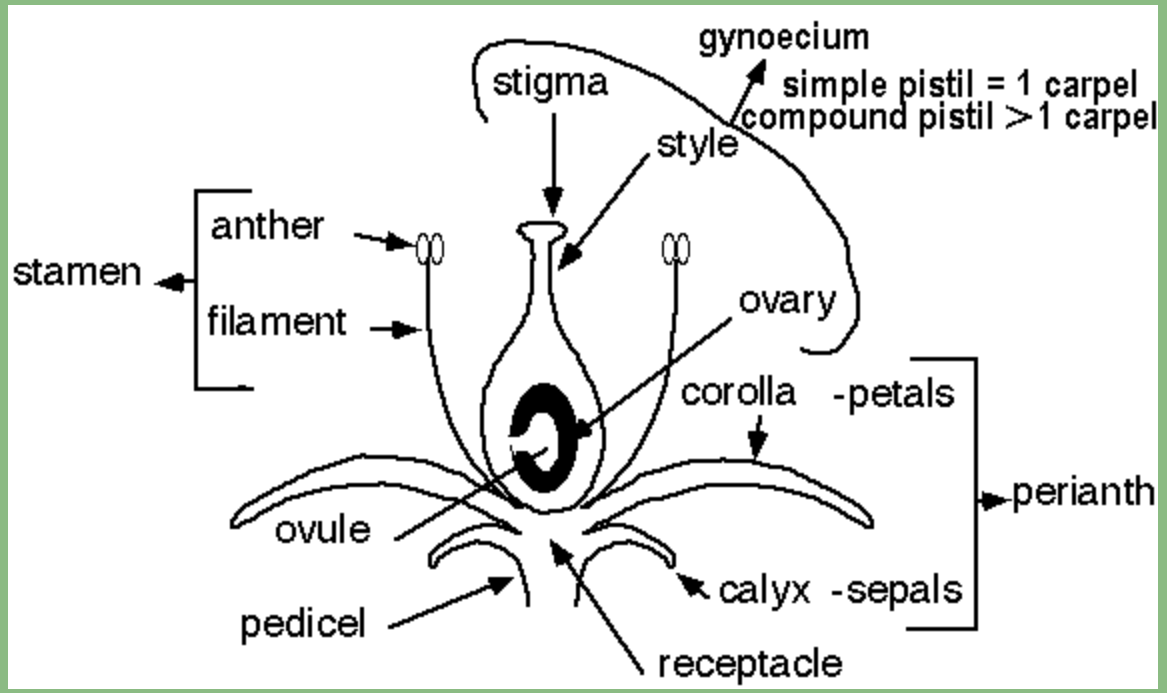
- Plant Growth
  - Translocation
    - Movement of water, nutrients, food etc. from one part of the plant to another
    - Can occur from cell to cell, and in intercellular spaces
    - Mostly occurs in xylem (water and nutrients) and phloem (carbohydrates)
    - Why are many insects phloem feeders?

INTRODUCTION TO HORTICULTURE

- Plant Development
  - Dormancy
    - Plant parts that are alive but not growing
    - Mechanism to survive adverse conditions
    - In order to survive, must contain stored food reserves to support what process?
    - Can be physical or physiological
      - Day length --Hard seed coat
      - Chill hours --Closed cone

INTRODUCTION TO HORTICULTURE

- Reproductive Development
  - The goal for many horticultural plants
    - Flowers
    - Fruits
    - Seeds



INTRODUCTION TO HORTICULTURE

- Reproductive Development
  - Flower Induction
    - From our old friend the meristem
    - Timing differs among species
      - annuals may flower within weeks of germination
      - many woody perennials initiate flowers in previous year
      - Why is this important for your lilacs?

INTRODUCTION TO HORTICULTURE

- Reproductive Development
  - Fruit Quality and Ripening
    - Sugars and aromatic compounds begin to accumulate
    - Some fruits picked when physiologically mature but not fully ripe
      - Tomato, banana, avocado, apples
    - Other fruits must be allowed to mature on plant
      - grapes, citrus, strawberries
    - What conditions promote ripening? (Hint - our old friend photosynthesis)

INTRODUCTION TO HORTICULTURE

- Reproductive Development
  - Flower and Fruit Development
    - Controlled by day length, light intensity, temperature, soil moisture content, nutritional status of plant
    - Pollination - self-, cross- (wind, insect)
    - Fertilization
      - Only fraction of flowers normally mature
      - “drop” at petal fall
      - “June drop” 4 to 6 weeks after petal fall
  - Fruit Quality and Ripening

INTRODUCTION TO HORTICULTURE

- How Plants Function
  - Describe plant responses to
    - Day length
    - Light intensity
    - Light quality
    - Temperature
      - Interactions of photoperiod and temperature
    - Soil moisture conditions
    - Carbon dioxide and oxygen concentrations
    - Nitrogen nutrition
    - Stress

INTRODUCTION TO HORTICULTURE

- How Plants Function
  - Plant responses to
    - Daylength
      - affects flower initiation, vegetative development, or onset of dormancy in some plants
      - Plant leaves are sensors of critical photoperiods
        - » Short-day plants - light period less than 12 hours long (chrysanthemum, poinsettia, strawberry)
        - » Long-day plants - light period more than 14 hours long (fuchsia, spinach, perennial ryegrass)
        - » Day neutral - processes not affected by day length (fruits and nuts, grapes, corn)

INTRODUCTION TO HORTICULTURE

- How Plants Function
  - Which of these requirements can we change in the garden?
    - daylength
    - light – intensity and quality
    - temperature
    - soil moisture conditions
    - carbon dioxide and oxygen concentrations
    - nitrogen nutrition
    - stress

Plant responses to stress: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Leaf Edema Caused by Flood-induced Aeration Deficit

Marginal Necrosis

Sunburn on Tree Trunk

Acute Lack of Water


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INTRODUCTION TO HORTICULTURE

Review:

- Plant Classification
- Photosynthesis
- Respiration
- Transpiration
- Translocation
- Plant Reproduction

Thank You---Any Questions?