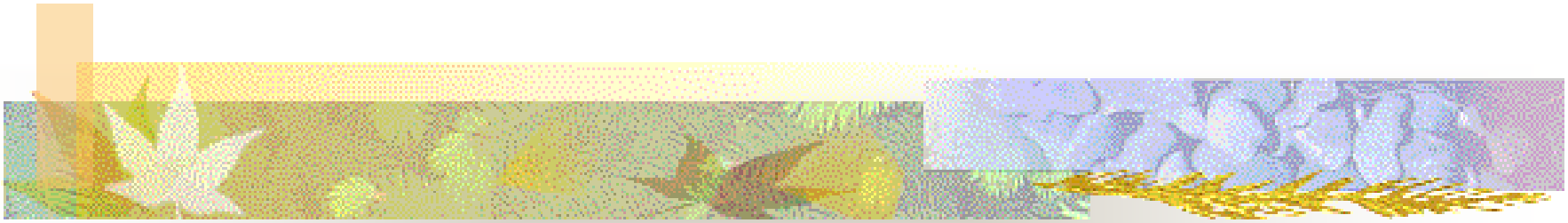
# WELCOME
# MASTER GARDENER CLASS



Catherine Wissner

UW Extension

Laramie County, Cheyenne

# What is Extension

- Federal
  - USDA.
- Land Grant University.
  - University of Wyoming.
- County.
  - Laramie County.

# Extension Staff

- Extension Agent or Educator
- 4-H
- F C S or Home Economics
- Horticulture
- Support Staff

# Master Gardener Program

- Brief History.
- In the early 1970s, interest in home gardening mushroomed. County Extension offices were overwhelmed with requests for horticultural information.

# Master Gardener Program

- First class was started in 1972 in King County, Washington.
- Since the inception of Washington State University Cooperative Extensions Master Gardener program, the concept has spread to all 50 states and four Canadian provinces.

# Mission Statement

- The Master Gardener Program within the University of Wyoming Cooperative Extension Service exists *to extend the University to the people of Wyoming via volunteer service in horticulture*.

# MG Requirements

- **First Year Master Gardeners.**
- **Must attend 17 of the 20 classes.**
- **Must take and pass the test at the end of the classroom session.**
- **Must complete 40 hours of volunteer service the same year.**

# MG Requirements

- Good News.....
  - **Must complete 10 hours of volunteer service each year after graduation to remain active.**

# Master Gardeners

- The Program provides research-based, horticulturally sound information to the public to solve problems in growing plants, determining the causes of problems with plants, and recommends procedures to follow for solving plant problems.

# Goals of the MG Program

- Our job is to try and give the homeowner the whole picture on how to manage their landscape plants, turf grass along with any insects or diseases in their yards.

# Goals of the MG Program

**To utilize University-based support for diagnosis and recommendations for managing horticultural plant problems.**

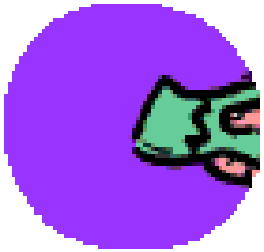
# Master Gardener Program

- **Policies**

- "Master Gardener" only to be used in UW CES MG program and when doing unpaid volunteer public service work in a UW CES sponsored program.
- "Master Gardener" **not** to be used for commercial publicity, political or private business.
- Master Gardener activities must be educational in nature as opposed to service oriented.

# Master Gardener Program

- Master Gardeners may not receive any funds for their services.



# MG Responsibility

- As a representative of the UWCES, your responsibility is to give the requested information correctly and unbiased, in a cordial manner.
- If you are uncertain about something, ask the caller to hold or ask to **call them back** while you double-check.
- Come to the Agent or another Master Gardener for help in locating answers - that's what we are here for.
- **DO NOT "fake" or guess at an answer.**

# Top 5 Questions

- What is it?
- What do I spray it with?
- How do I prevent it?
- How much water do I give it?
- Where do I buy it?

# Class

- Cell phones
  - Please turn them off during class.
- Breaks


©'08 STRST THE WYOMING TRIBUNE-EAGLE
REALLY? EXPERTS SAY LIFE ON MARS MAY HAVE SOMETHING IN COMMON WITH WYOMING? ED, YOU'VE GARDENED OVER 30 YEARS... DOES THAT REALLY SURPRISE YOU?

# Have Fun, Make New Friends

# Horticulture

- Horticulture in its strictest, literal sense means ‘cultivated garden’ or ‘culture of garden plant’.

- Today we define it as production and growing of ornamental plants as well as fruits and vegetables.

- In Wyoming, horticulture involves commercial production of:
  - Vegetables fruits.
  - Ornamental plants.
  - Woody plants.
  - Turf grass sod and seed.
  - Greenhouse production.

  - All these products are used or installed in local homes, businesses, or landscapes.

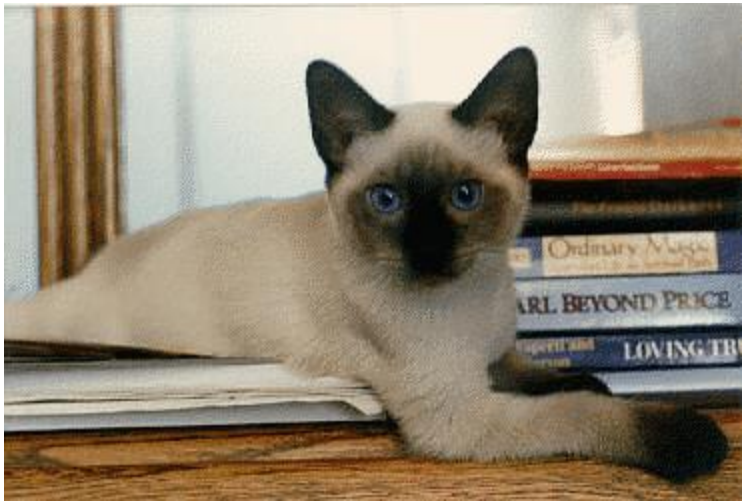
"Horticulture is set apart from agronomy and forestry because we grow and cultivate high value crops that require high inputs, intensive labor, and intensive management."



To the University of Wyoming

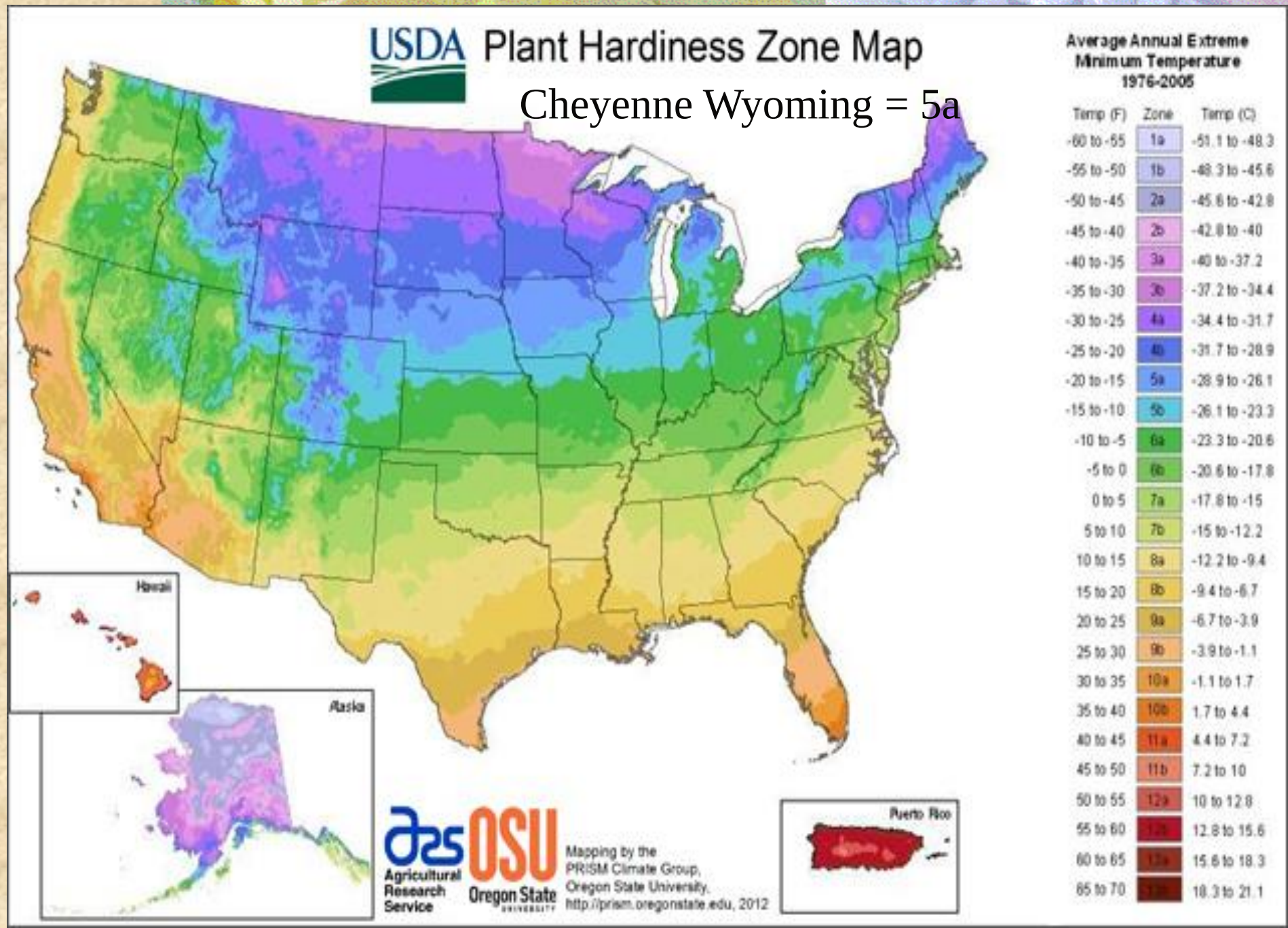
Laramie County Extension

**Master Gardener Program.**



# BOTANY

Catherine Wissner
UW Cooperative Extension
Laramie County
Master Gardener Program

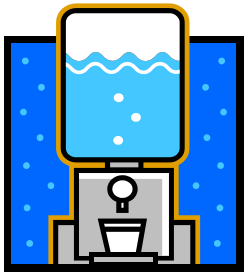

USDA Plant Hardiness Zone Map
Cheyenne Wyoming = 5a
Average Annual Extreme Minimum Temperature 1976-2005
Temp (F) Zone Temp (C)
-60 to -55 1a -51.1 to -48.3
-55 to -50 1b -48.3 to -45.6
-50 to -45 2a -45.6 to -42.8
-45 to -40 2b -42.8 to -40
-40 to -35 3a -40 to -37.2
-35 to -30 3b -37.2 to -34.4
-30 to -25 4a -34.4 to -31.7
-25 to -20 4b -31.7 to -28.9
-20 to -15 5a -28.9 to -26.1
-15 to -10 5b -26.1 to -23.3
-10 to -5 6a -23.3 to -20.6
-5 to 0 6b -20.6 to -17.8
0 to 5 7a -17.8 to -15
5 to 10 7b -15 to -12.2
10 to 15 8a -12.2 to -9.4
15 to 20 8b -9.4 to -6.7
20 to 25 9a -6.7 to -3.9
25 to 30 9b -3.9 to -1.1
30 to 35 10a -1.1 to 1.7
35 to 40 10b 1.7 to 4.4
40 to 45 11a 4.4 to 7.2
45 to 50 11b 7.2 to 10
50 to 55 12a 10 to 12.8
55 to 60 12b 12.8 to 15.6
60 to 65 13a 15.6 to 18.3
65 to 70 13b 18.3 to 21.1
Hawaii
Alaska
Puerto Rico
Agricultural Research Service
Oregon State University
Mapping by the PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, 2012

# Plants must adapt, or else….


- Plants are not able to move.
- The plant internal system is passive.
- Plants must respond to their environment in order to survive.
- Plants must manage extreme changes in temperatures, soil moisture, and nutrient availability.

# Plants are Autotrophic

Life sustaining processes from:



- Air
- Water
- Essential elements
- Sun
- Suitable temperature range (40-90◦F)

# Plants

- There are over 260,000 species of plants.
- Some plants are so small they can barely be seen.
- Others are taller than people or animals. One of the largest living plants on the earth is the Sequoia tree of California, some stand over 290 feet high and measure over 30 feet wide.

# Plants

- Certain characteristics of plants set them apart from other living things.
- Plant cells have thick, rigid walls that consist of a material called cellulose.
- Cellulose enables plants to stand upright without the aid of an internal or external skeleton.
- www.blueplanetbiomes.org

# CELL STRUCTURE

**Cell Wall ( Pectin, cellulose primary wall becomes lignin (trees).**

**Cytoplasm**

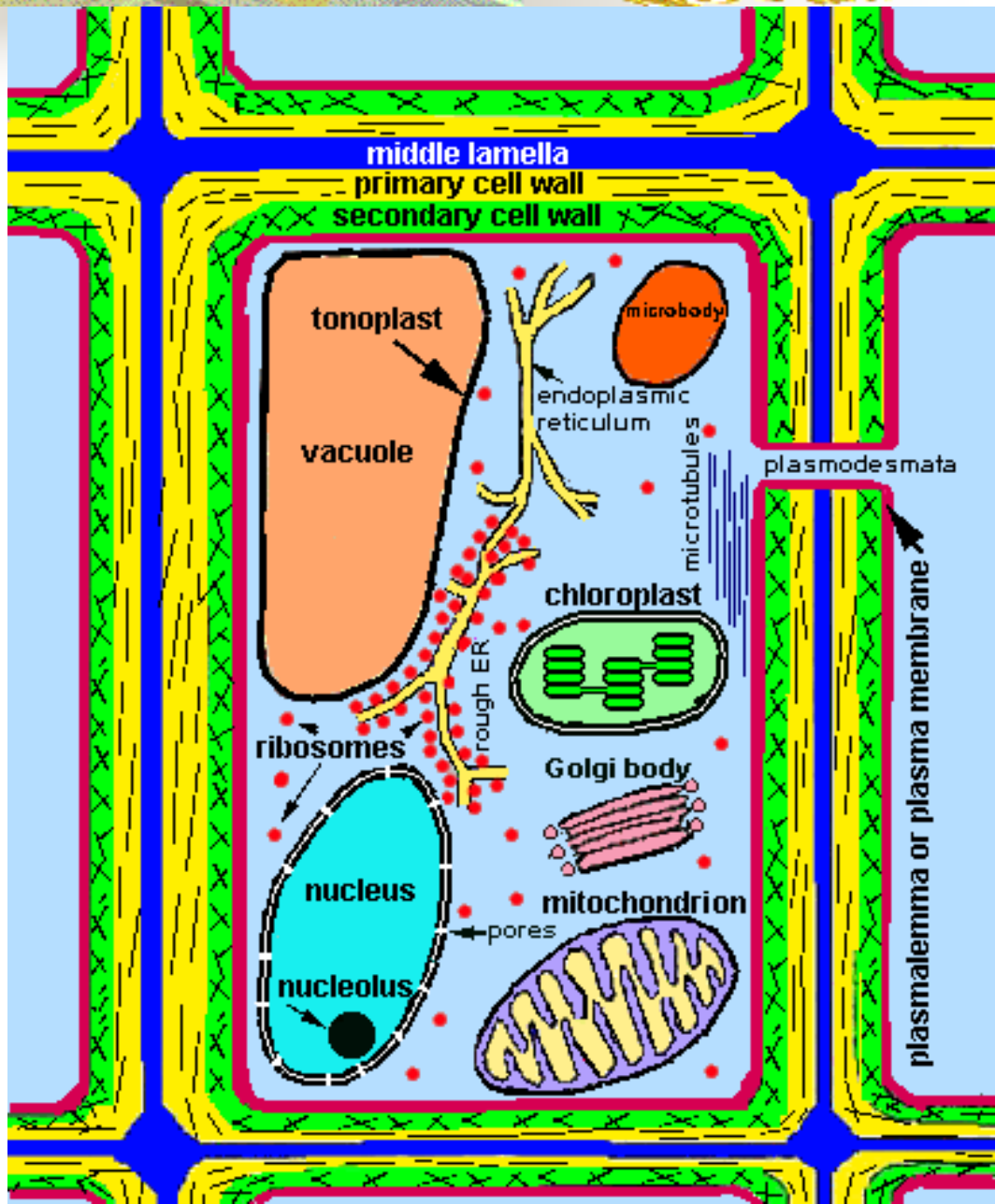
**Chloroplast /Chlorophyll**

**Organelles**

**Nucleus**

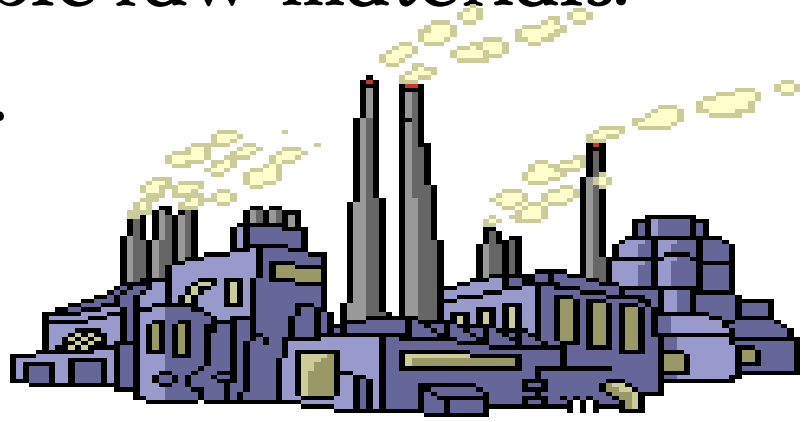
**Plasmodesmata**

**Vacuole**

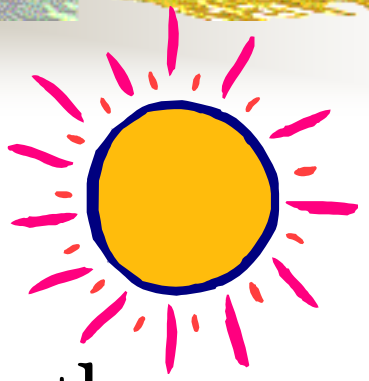


# CELL STRUCTURE

- To get an idea of what a typical plant cell is like and what it can do, think of a large factory, capable of manufacturing thousands of different and elaborate products from simple raw materials: water, air, and soil.



# CELL STRUCTURE



- The factory uses sunlight rather than electricity or oil as an energy source.
- It is designed to exert considerable autonomous control over what goes on within its boundaries.

# CELL STRUCTURE

- Whenever increased productivity is called for, it simply builds an exact copy of its entire physical structure within a day or two.
- Now, mentally squeeze the factory into a box, approximately 1/2,000 of an inch. That is a cell. Brian Capon, Botany for Gardeners.

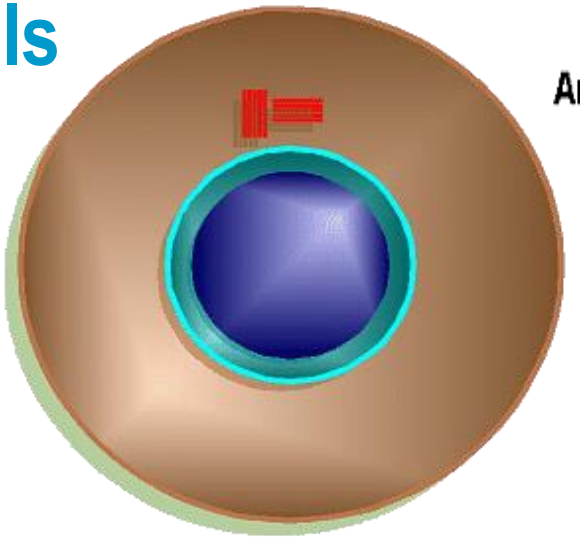
# CELL STRUCTURE

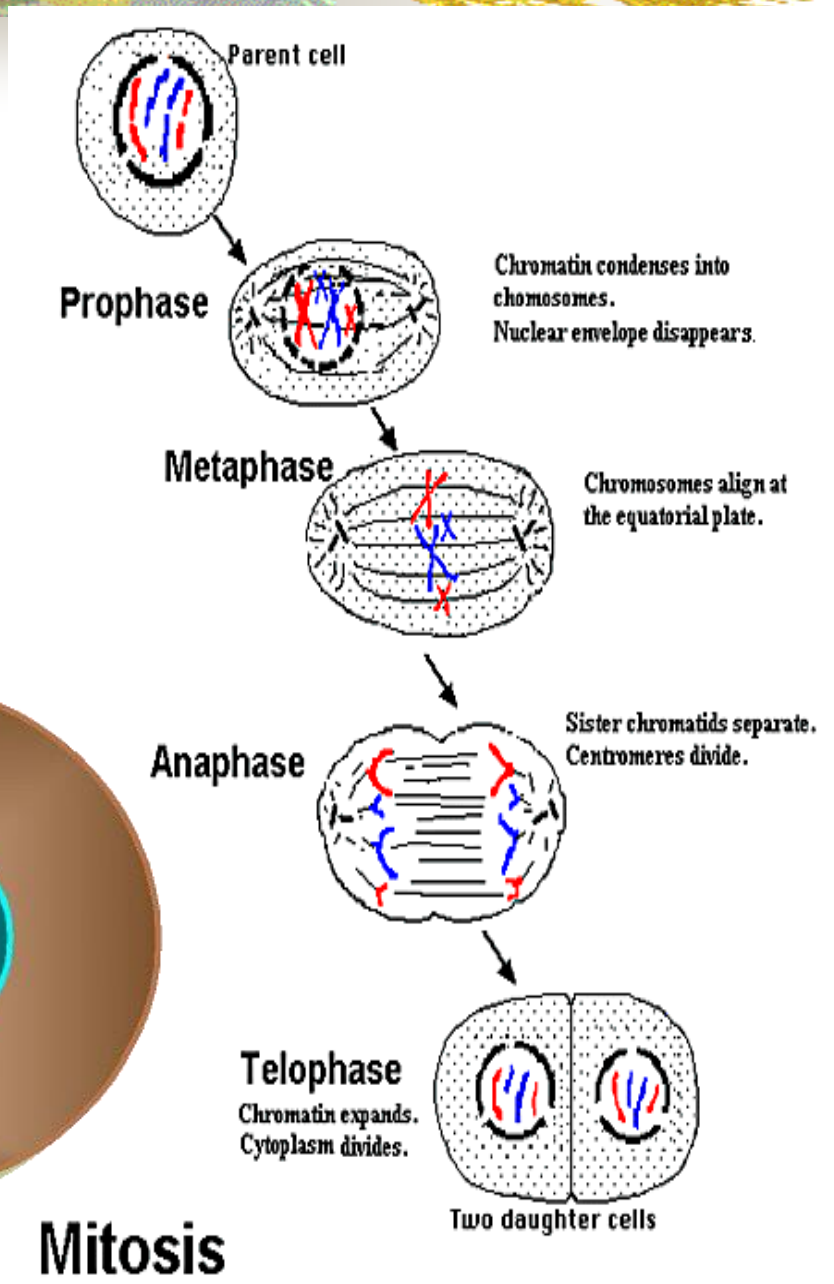
- A single cell contains all the material to do everything in a plant, but it becomes specialized for one purpose. = totipotent.

# Cell Structure

## Mitosis

- A cell duplicates itself so that each daughter cell receives an identical copy of its genetic material. Two cells instead of one identical to each other.





# Light

- Quantity – intensity or concentration of light.
- Quality – the color (wavelength) of light.
  - Plants absorb blue and red light.
  - Blue is responsible for vegetative growth, while red and blue combined encourages flowering.
- Duration – (photoperiod) the amount of time the plant is exposed to light.
  - The length of uninterrupted darkness is important for flowering.

# Light

- Short-day – flower only when day length is less than about 12 hours.
- Long-day – flower only when the day length exceeds 12 hours.
- Day-neutral – form flowers regardless of day length.

# Temperature

- Influences photosynthesis, transpiration, respiration, germination and flowering.
- Low temperatures reduce energy use and increase sugar storage.
- Thermoperiod – the daily temperature change
- Hardiness refers to plants that are adopted to the cold temperatures of their environment.
- Plants need water, even in the winter. Desiccation commonly occurs in Wyoming.

# Temperature

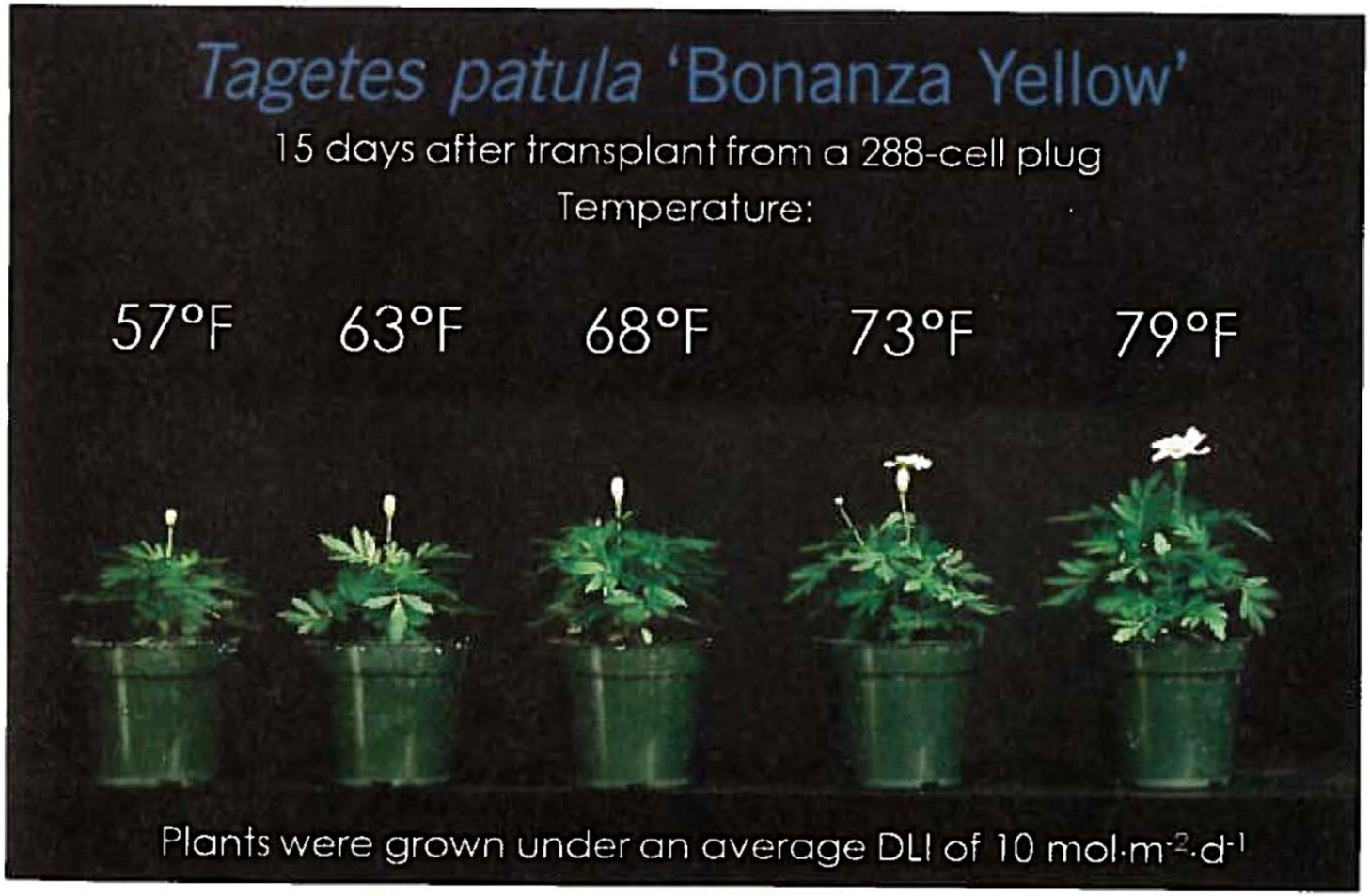


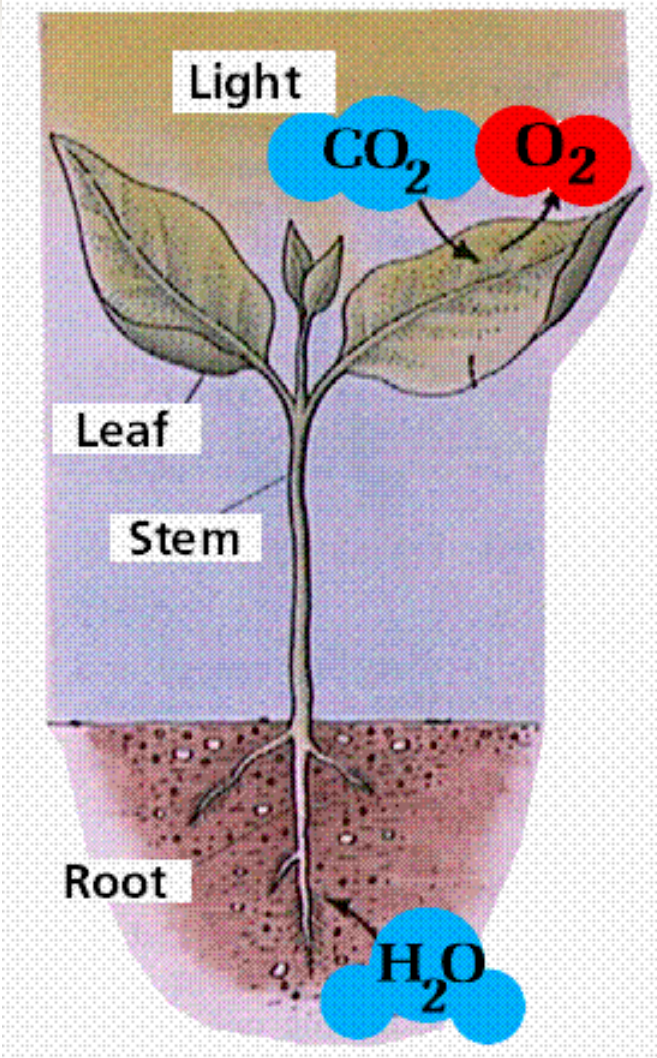

Figure 2. **The effect of average daily temperature on flowering of cold-tolerant marigolds. Photo courtesy of Lee Ann Moccaldi.**

# Humidity

- Relative humidity is the ratio of water vapor in the air to the amount of water the air can hold at the current temperature and pressure.
- RH = water in air / water air could hold at a given temperature.
- Winter in Cheyenne RH is 50%+/-

# Photosynthesis

- The food making process for plants.
- Three ingredients for photosynthesis:
  - Carbon dioxide (CO2)
  - Sun (light)
  - Water (H2O)




6CO2 + 12H20 + Light =

C6H12O6 +6O2 + 6H2O

# Respiration

- The method the plant uses for breaking down stored starches and sugars to produce energy.
- Used for the building of cells or growth.
- Respiration is the plant's form of breathing.

# Transpiration

- The process that allows water to move through the plant and carry nutrients where they are needed.
- Also acts as an evaporative cooling for the plant, helps maintain turgidity.

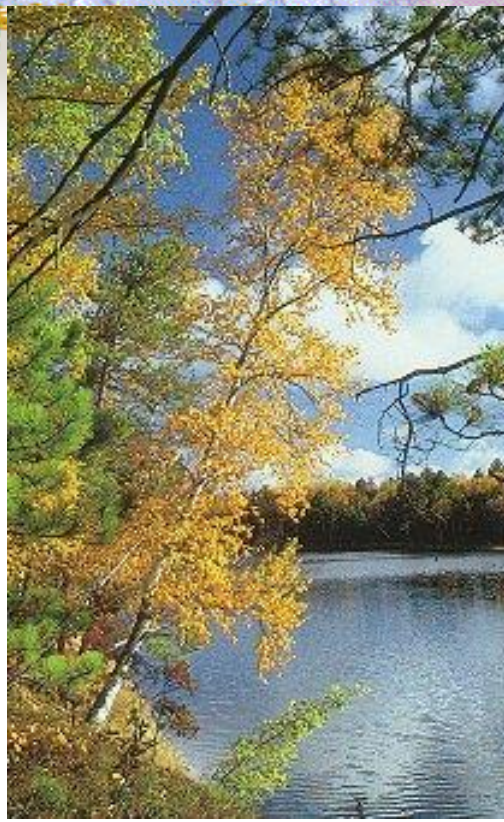
# Chlorophyll

- Light is absorbed by chlorophyll, converted into chemical energy.
- Energy is stored as carbohydrates.
- Energy drives the bio-chemical reaction that causes plants to grow, flower, and produce seed.

# Chlorophyll

- **Not a very stable compound**.
- Bright sunlight causes it to decompose.
- Continuously synthesized.

# Carotene



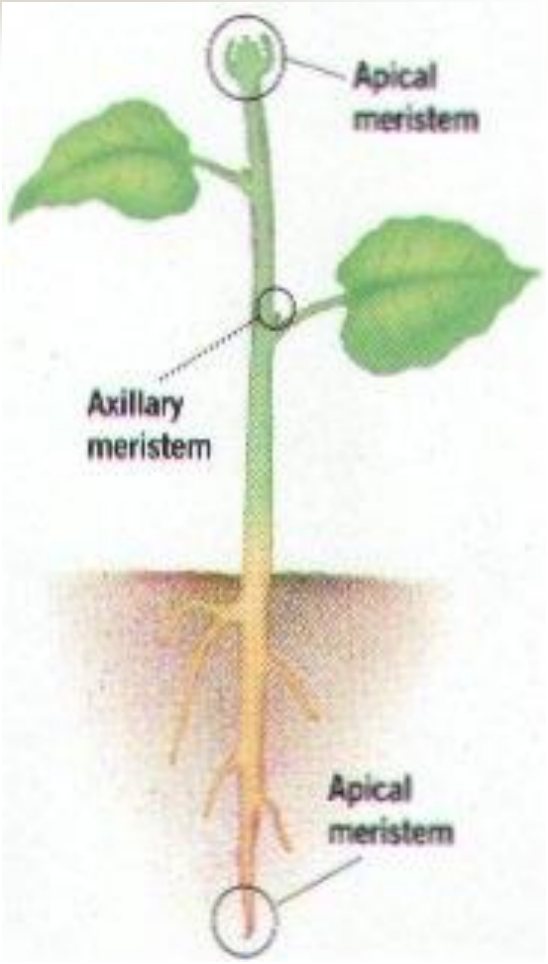
- The energy of light absorbed by carotene is transferred to chlorophyll.
- Much more stable.
- Persists in leaves when chlorophyll has gone.
- Causes the leaf to appear yellow.

# Anthocyanins

- Sensitive to the pH of the cell.
- Responsible for color of fruit skins.
- Low pH imparts a bright red color.
- Higher pH imparts a purple color.
- Formed by a reaction between sugars and proteins in the cell.
- Requires light, high sugar concentrations.

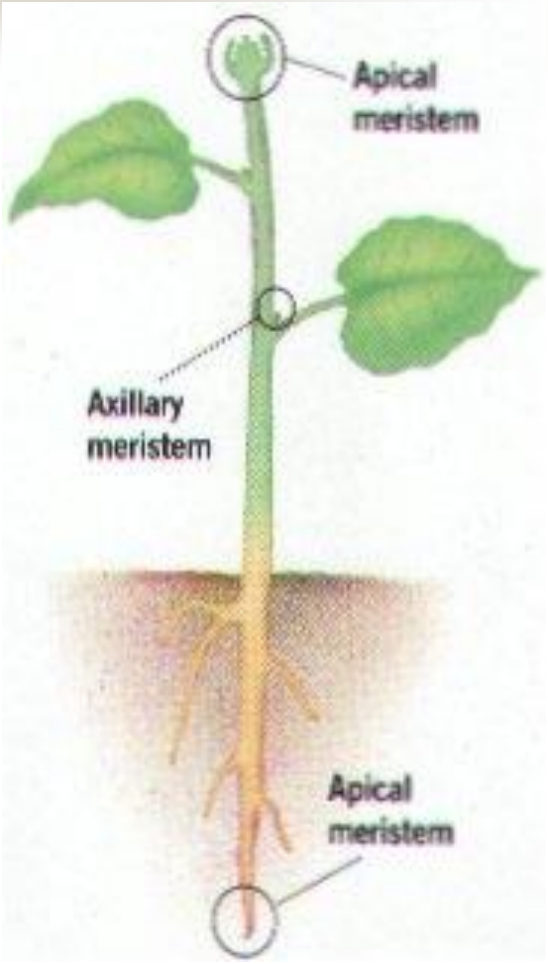
# Meristems, (Greek= Divided)

- These are four (4) growing points on a plant or four regions of meristems within a plant's system.



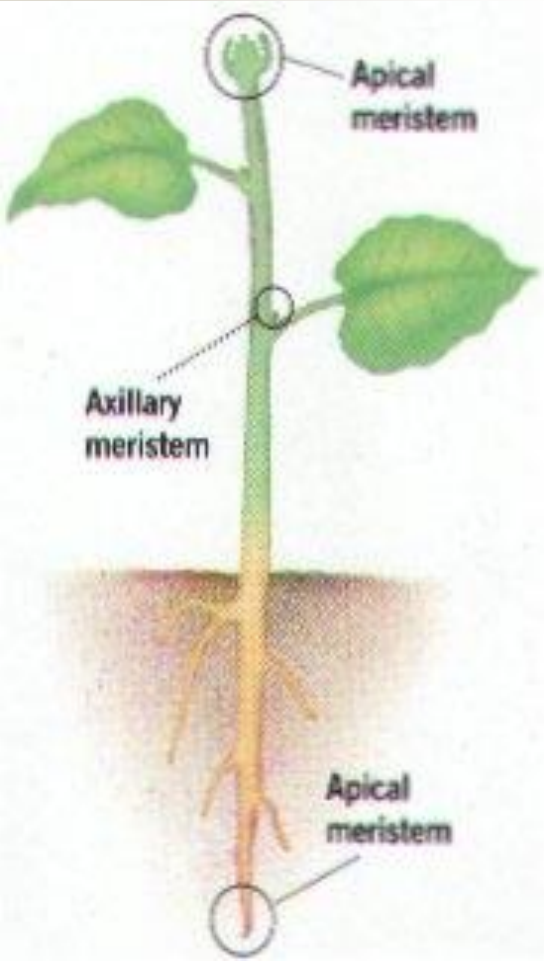
# Meristems, (Greek= Divided)

- The terminal bud or apical meristem.
- Makes the plant grow taller.



# Meristems, (Greek= Divided)

- Lateral buds also contain meristems, this allows the lateral branches to grow.
- Root tips have meristems. These meristems allow the root to "push" through the soil.



# Stem regions or structure

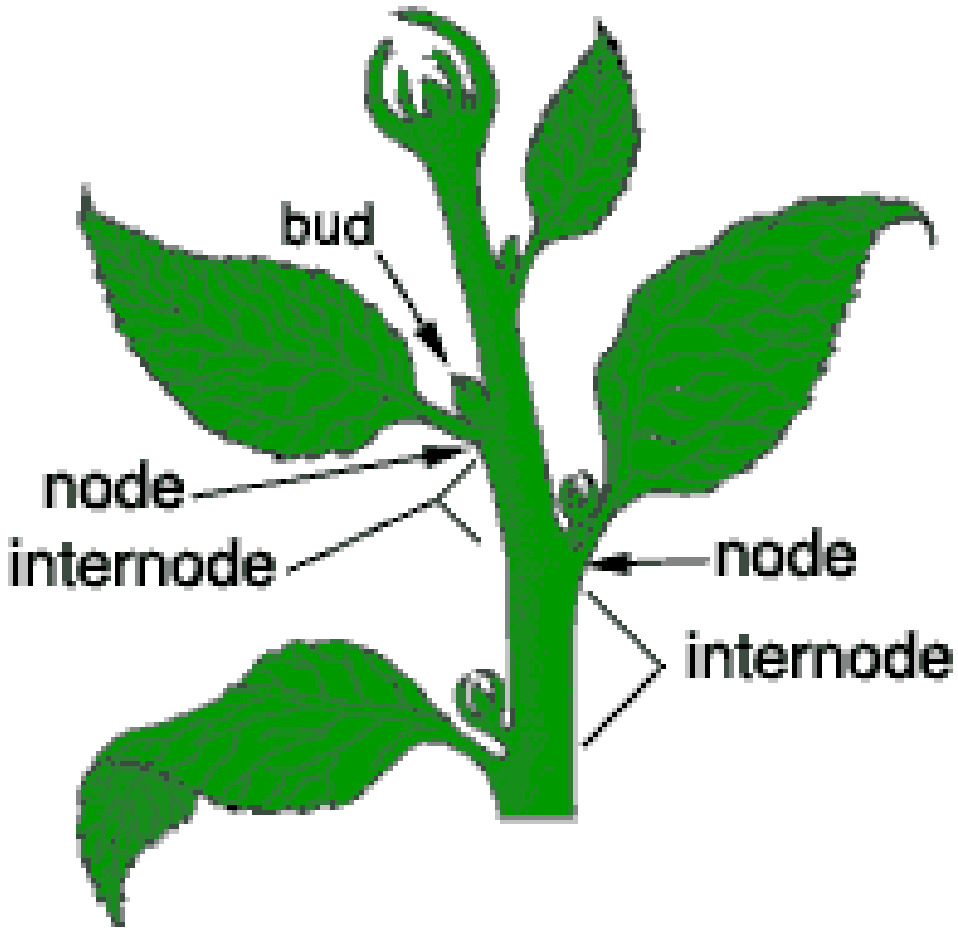
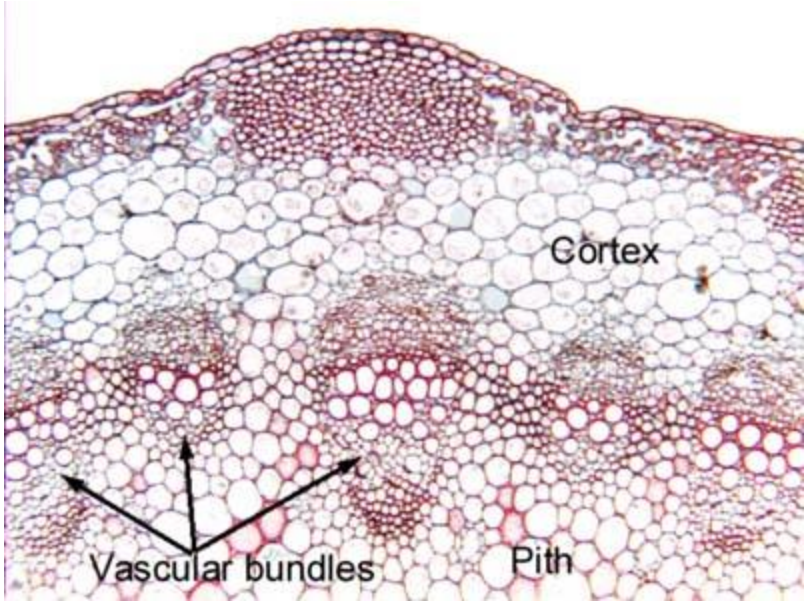



**Figure 6.** Stem structure

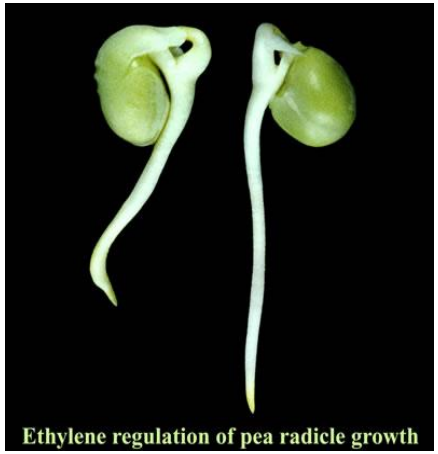
# Meristems

- Vascular cambium.
- This is around the vascular system that contains the xylem and phloem.
- This allows the stem of the plant to grow in width.



# Seed

- Is the survival mechanism of the plant.
- Within the seed is all the stored energy necessary for new life and growth.
- Seed coat.
- The first part of the plant to emerge from under the seed coat is the radical (Latin: radicula, small root).



# Seed

- Next are cotyledons (Greek: cup-like-hollow).

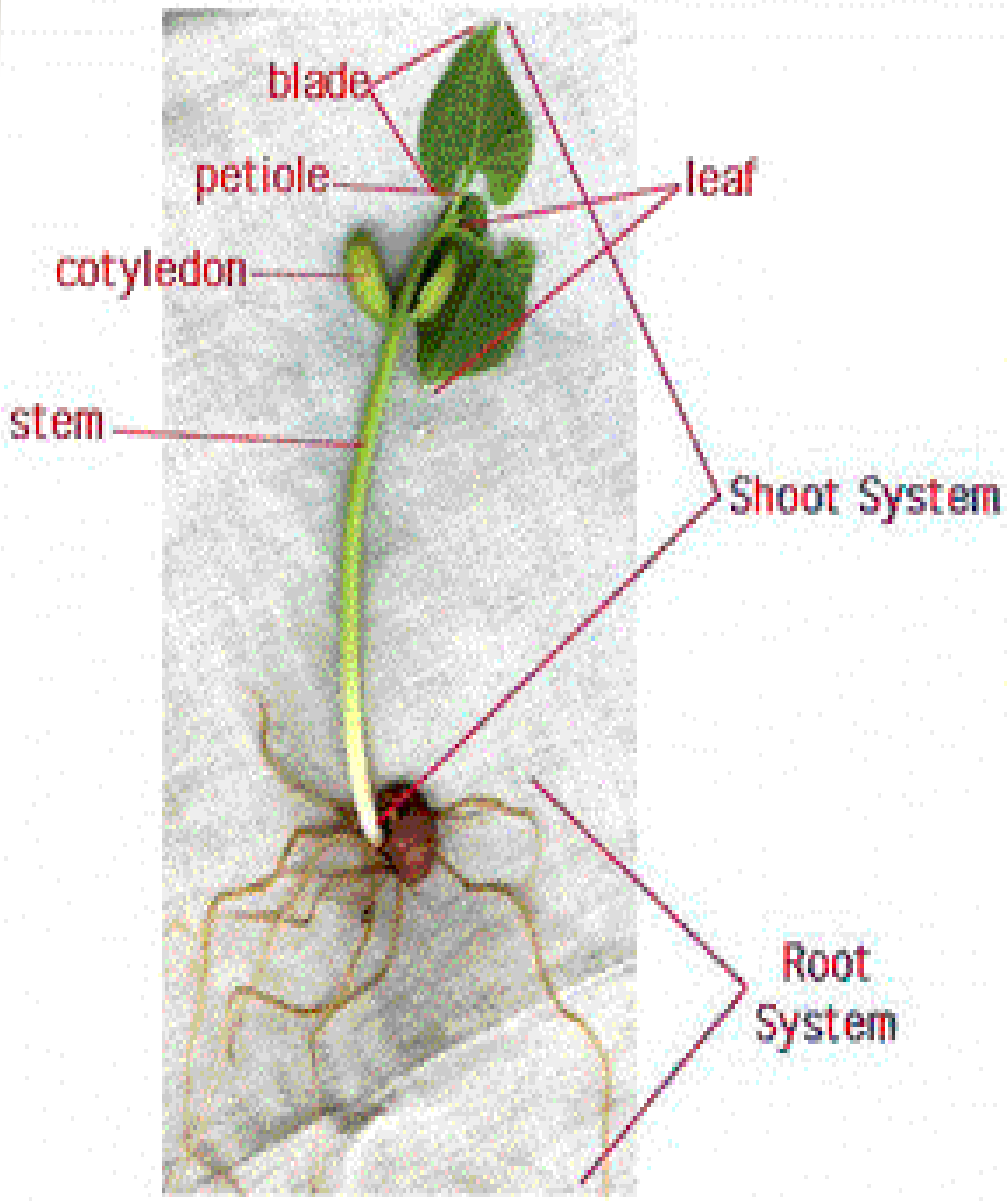
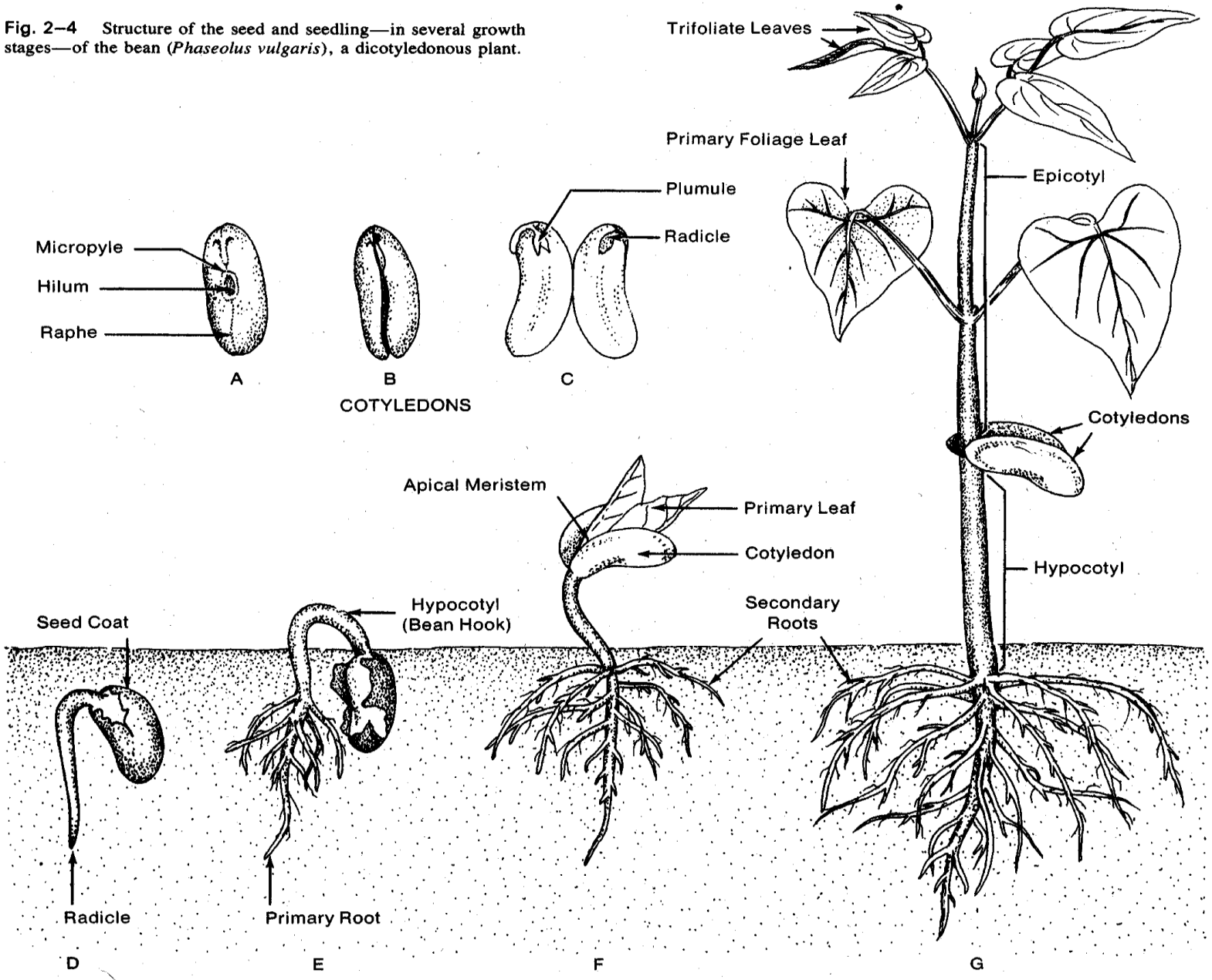


**Fig. 2–4** Structure of the seed and seedling—in several growth stages—of the bean (*Phaseolus vulgaris*), a dicotyledonous plant.

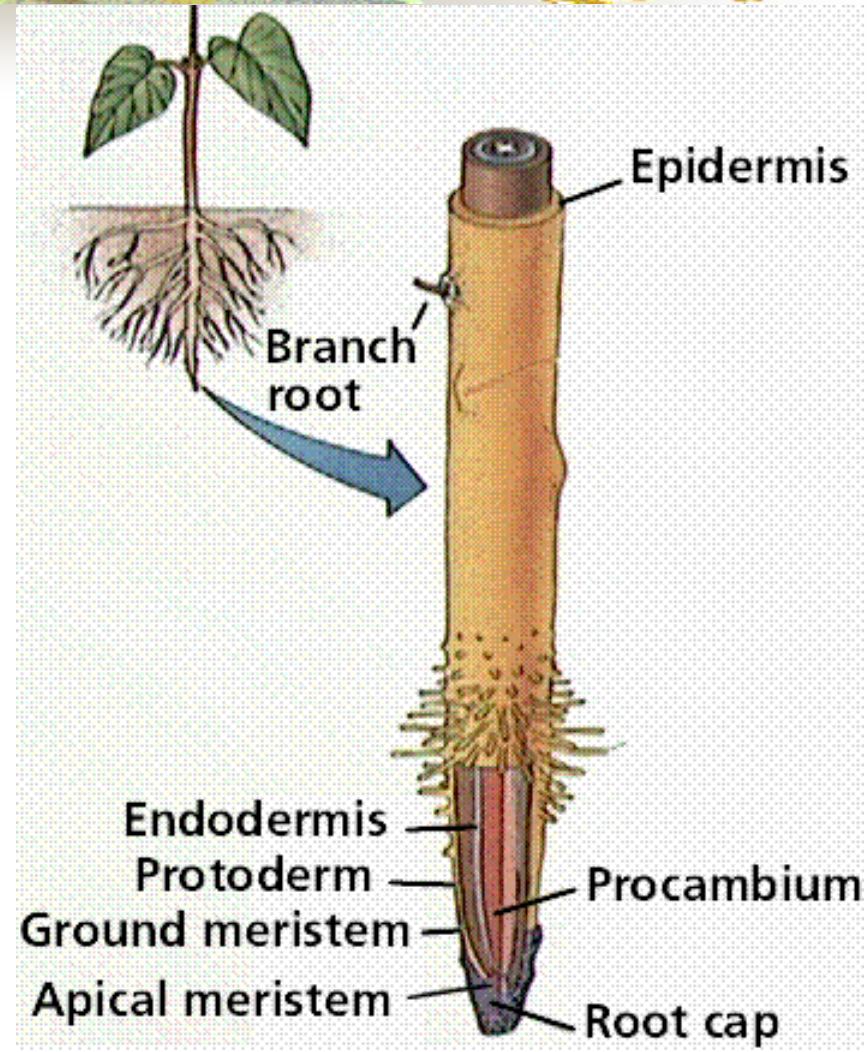


# Seed

- Seed age can greatly affect viability.
- Seeds must be planted at a proper depth.
- Seeds need to have a continual supply of water, but not too much that they rot.
- The soil must be conductive for seed germination.

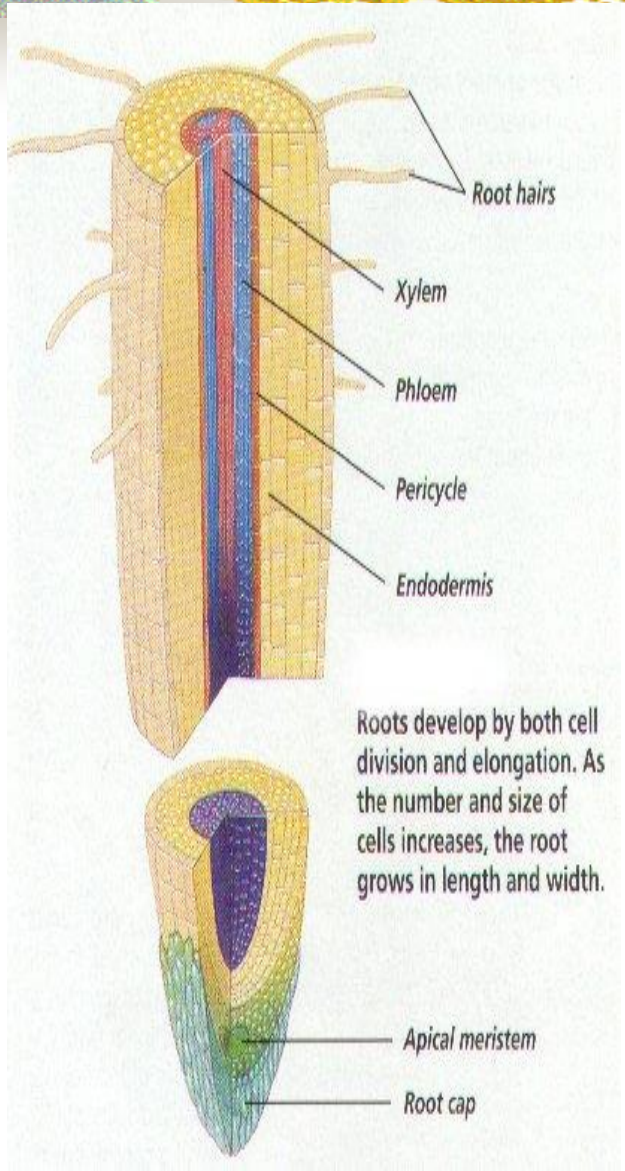
# Roots

- The roots provide support for the plant as they help anchor the plant in the ground when wind, animals, humans, or anything else moves the plant.



# Roots

- The roots also take up virtually all water and nutrients the plant needs and send it to the leaves.
- The sugars and starches that the leaves produce are stored in the roots to be used at later times.



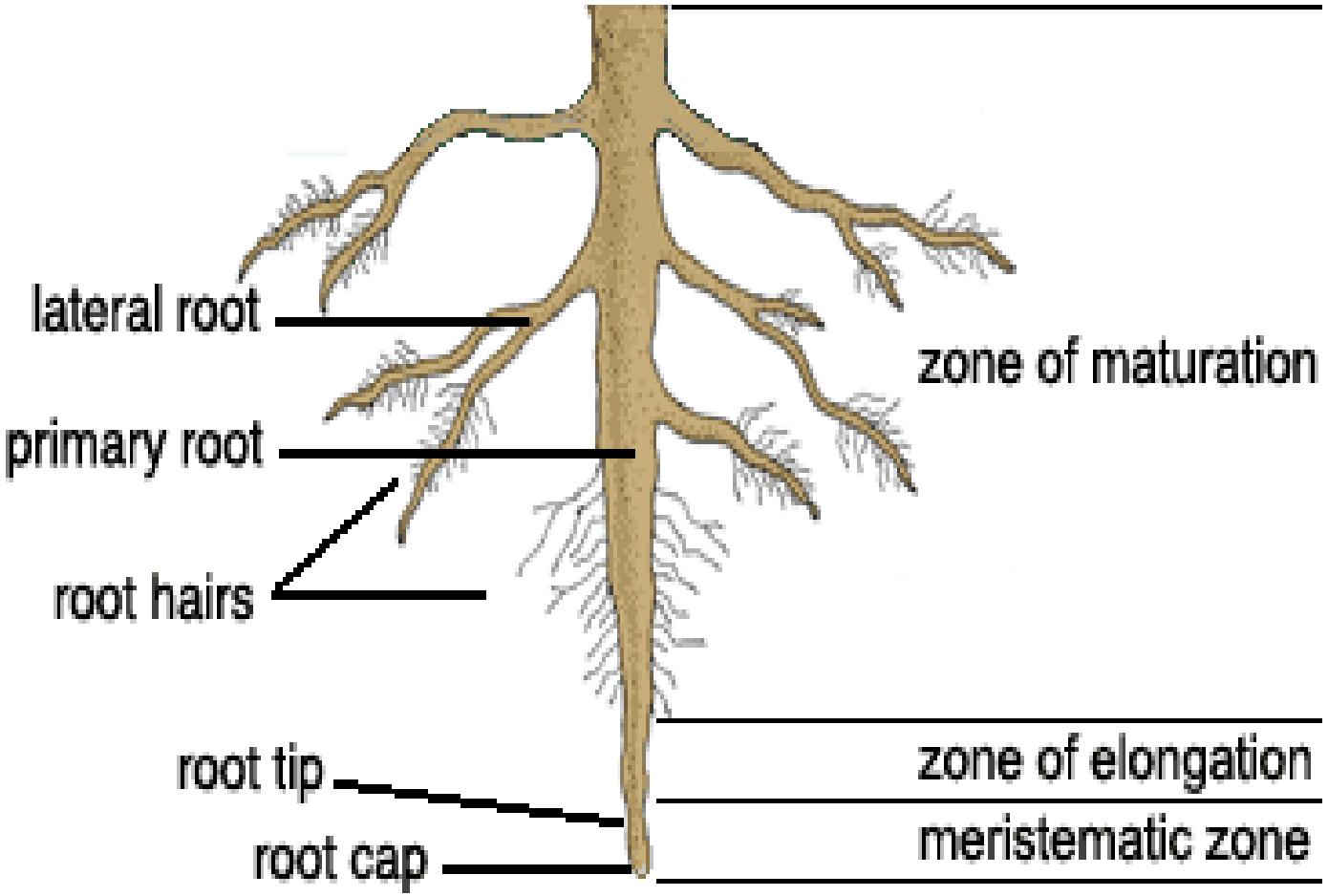
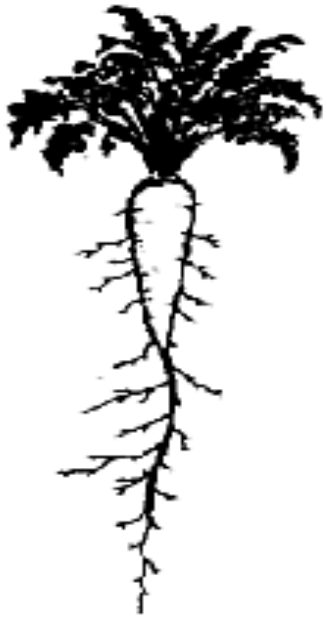



**Figure 2.** Root Structure

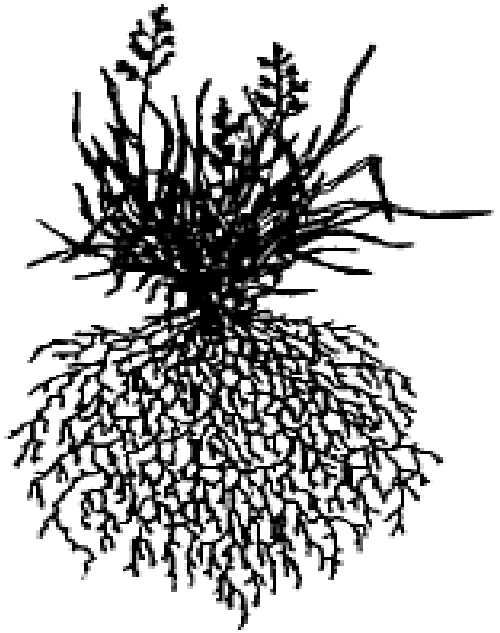
# Roots

- Two basic types of roots.

*Taproot of Carrot*



*Fibrous Root of Grass*



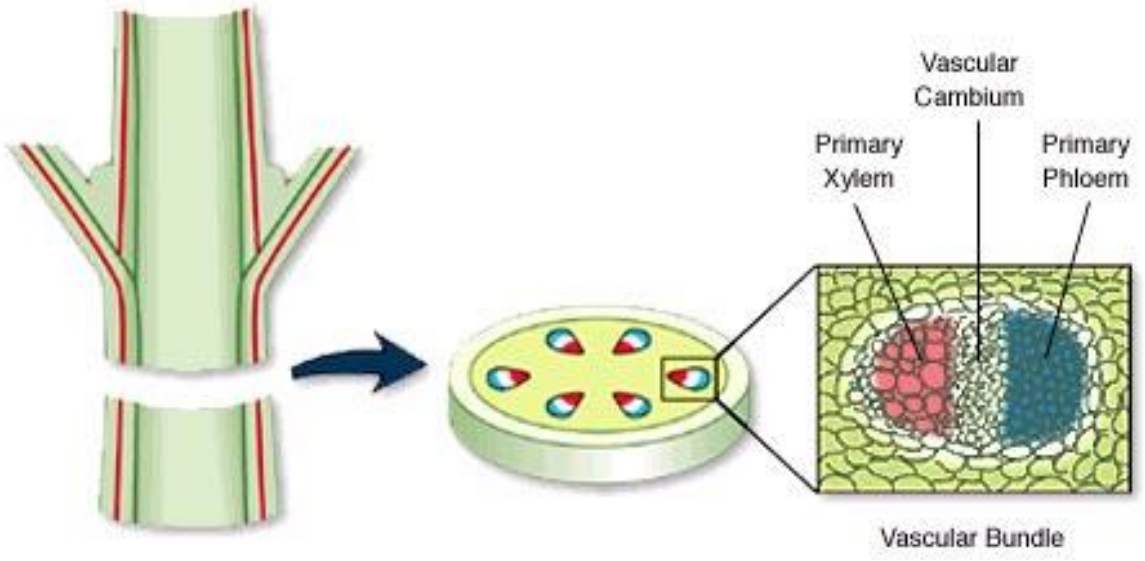
# A quick quiz

A potato is an edible _____.
A carrot is an edible _____.

- A potato is an edible below ground stem. A carrot is an edible taproot.

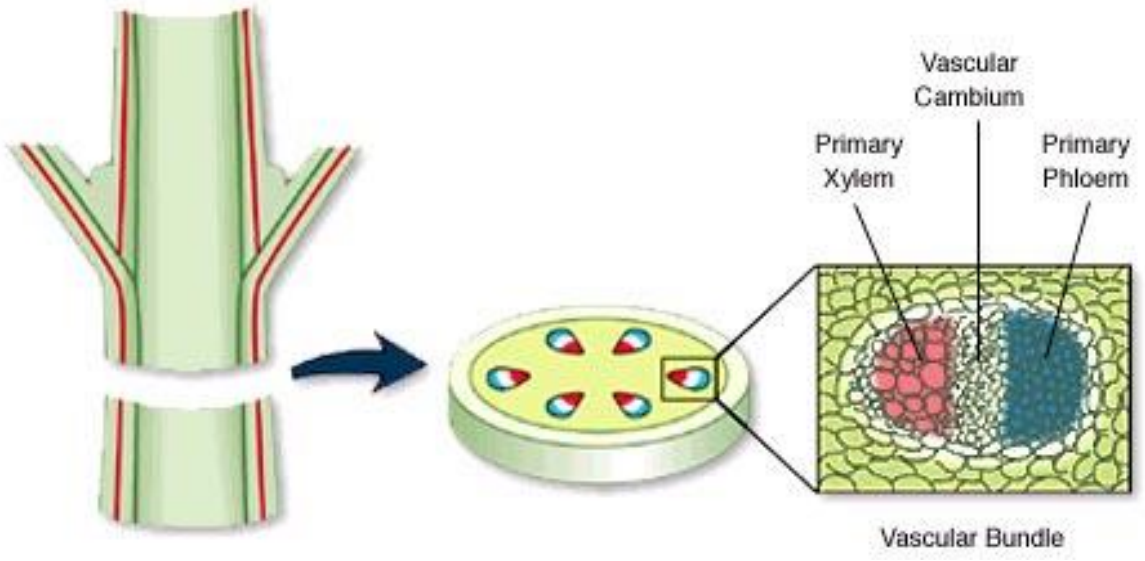
# Vascular Tissues

- A system that transports water and nutrients throughout the plant.
- Series of elements or cells that form tubes.
- Composed of two major conducting systems.



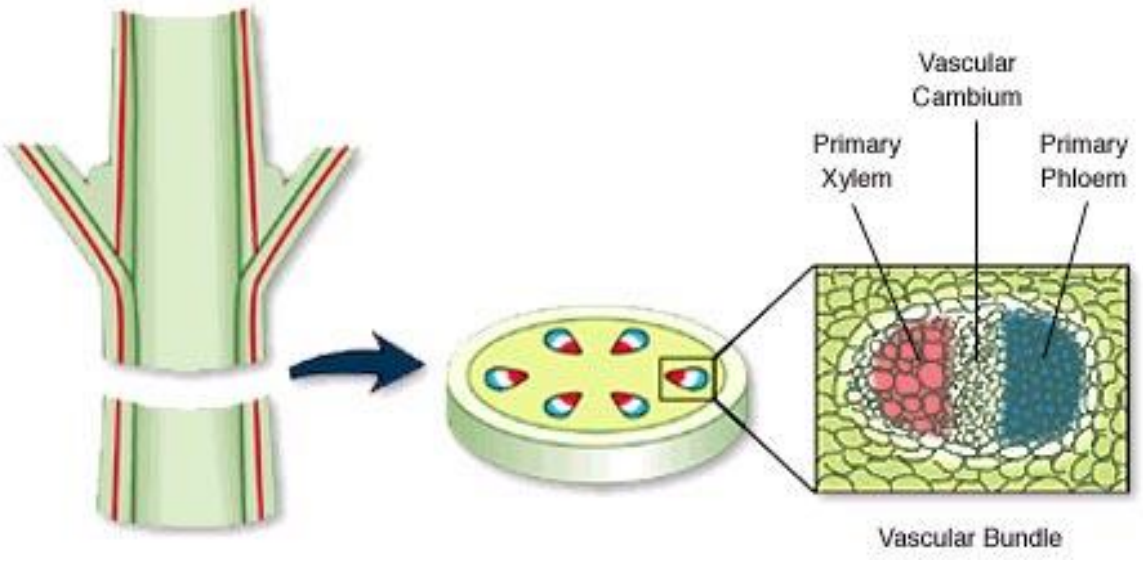
# Xylem Tissue

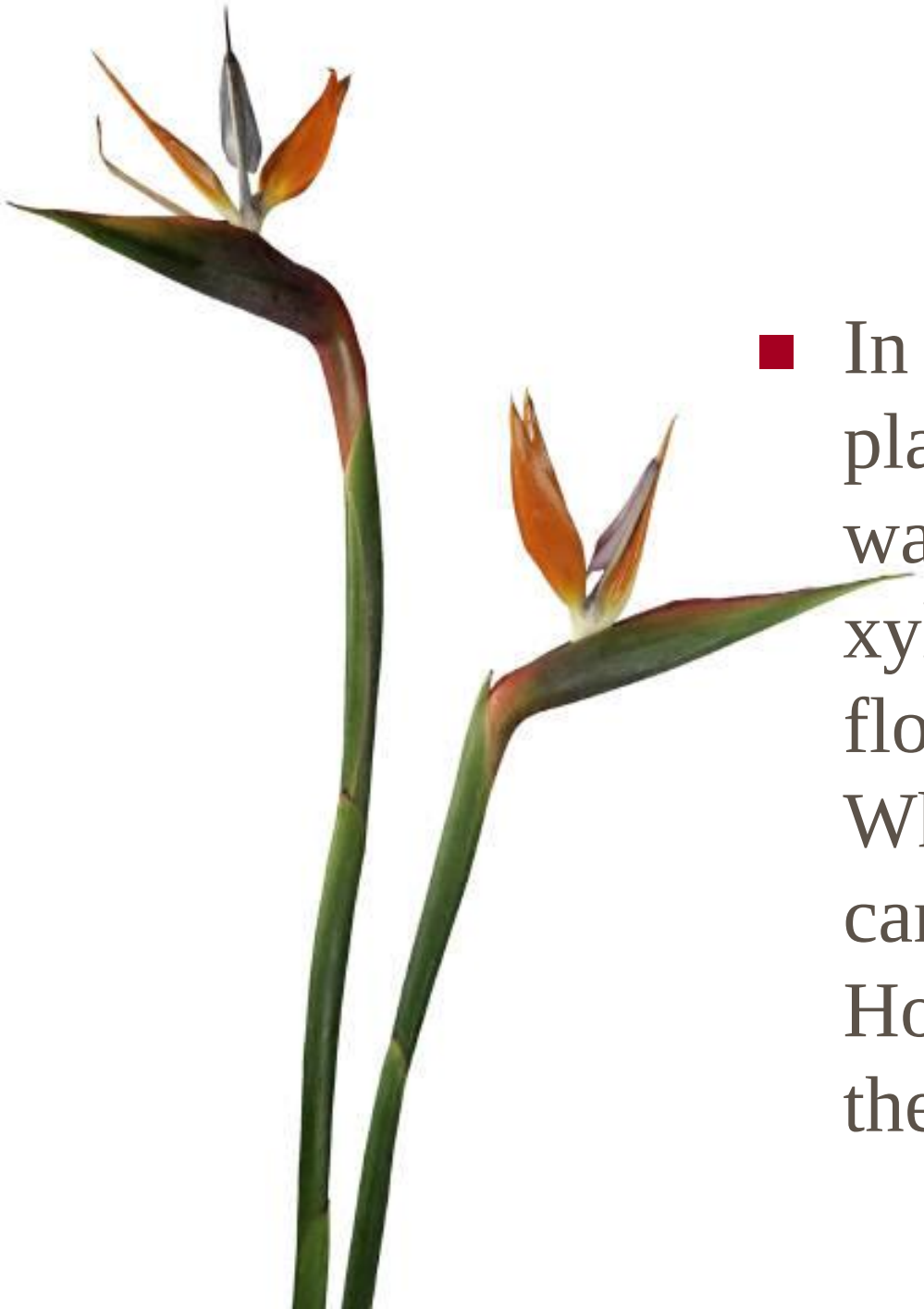
- Water conduction cells.
- Takes water and nutrients up from the roots.
- Non-living tissue.



# Phloem Tissue

- Food conducting cells.
- Takes food down.
- Living tissue.
- Moves nutrients within a plant's leaves.





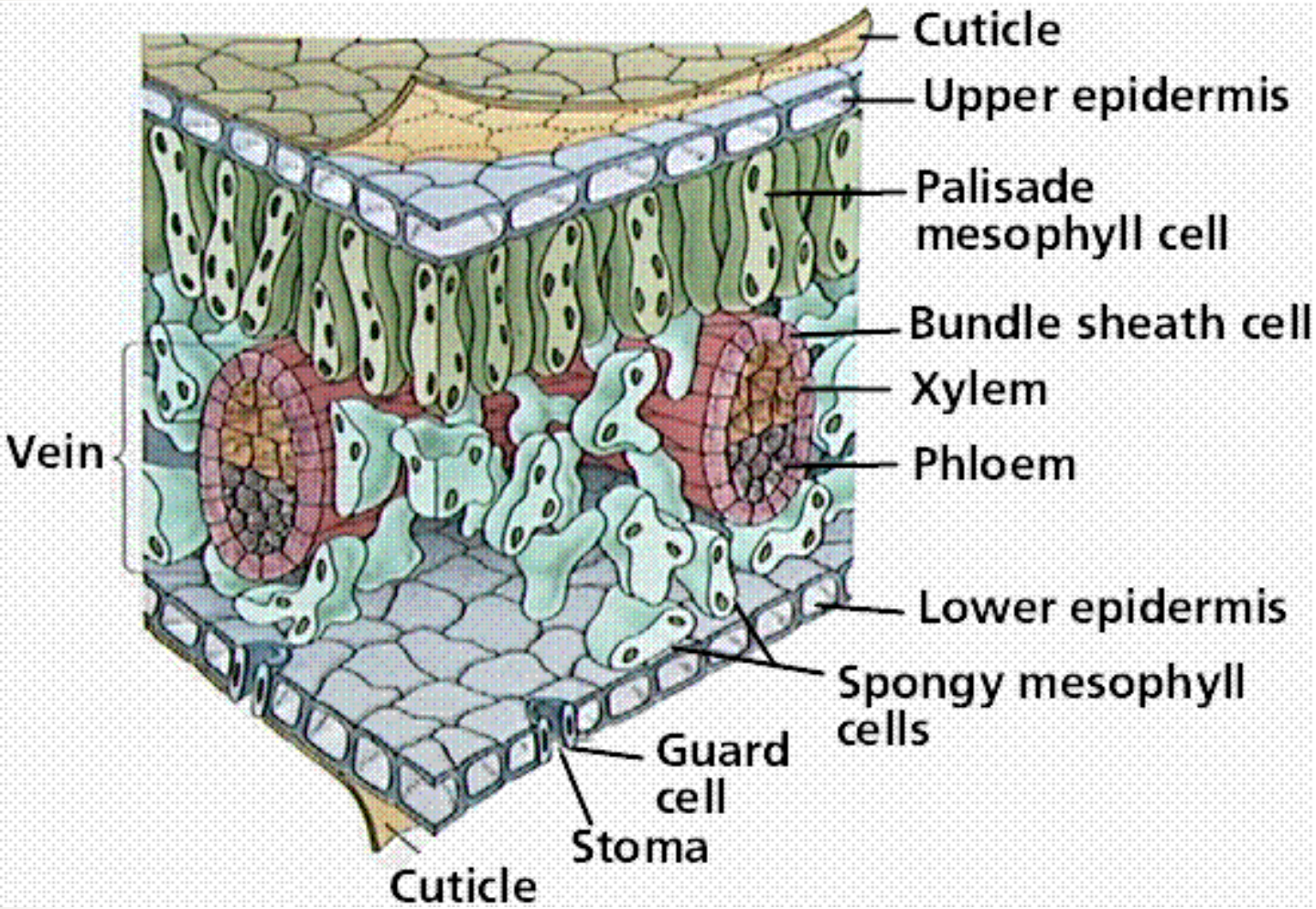
# A quick Quiz

- In this plant, which way is the xylem flowing? What is it carrying? How about the phloem?

Xylem – roots to leaves, carries water, minerals and nutrients

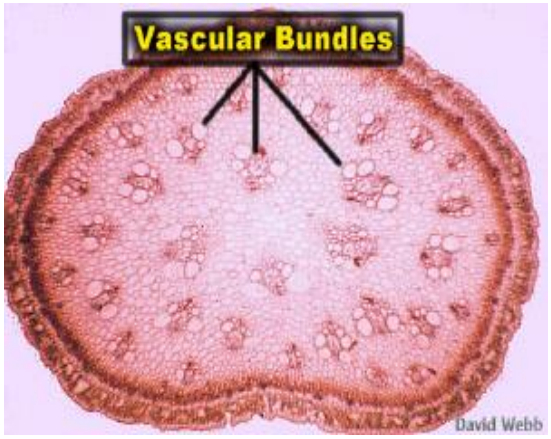
Phloem – leaves to roots, carries sugars.

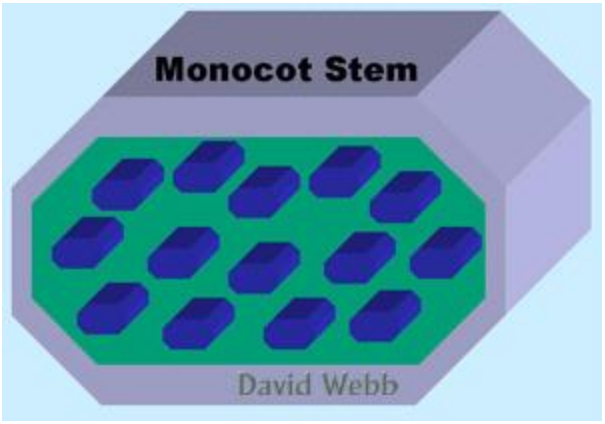
# Plant Diagram



# Monocot vs. Dicot

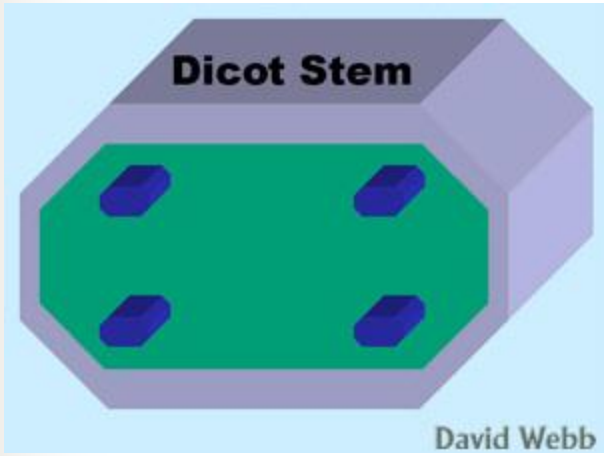
- **Monocot** has many vascular bundles arranged in a complex pattern within the stem.
- Leaf veins are usually parallel.
- Corn, palm trees.



# Monocot vs. Dicot

- **Dicot** typically forms a ring of vascular bundles around the stem.
- That ring surrounds a central region of cells known as **PITH**.
- Leaf veins are usually branched.



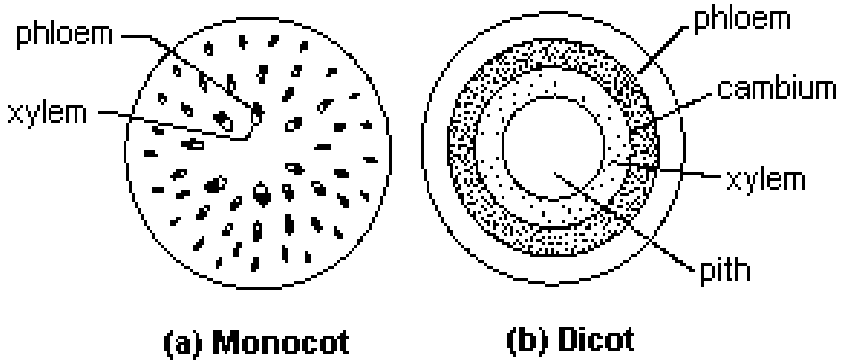
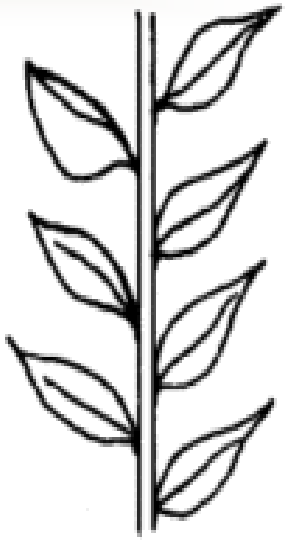
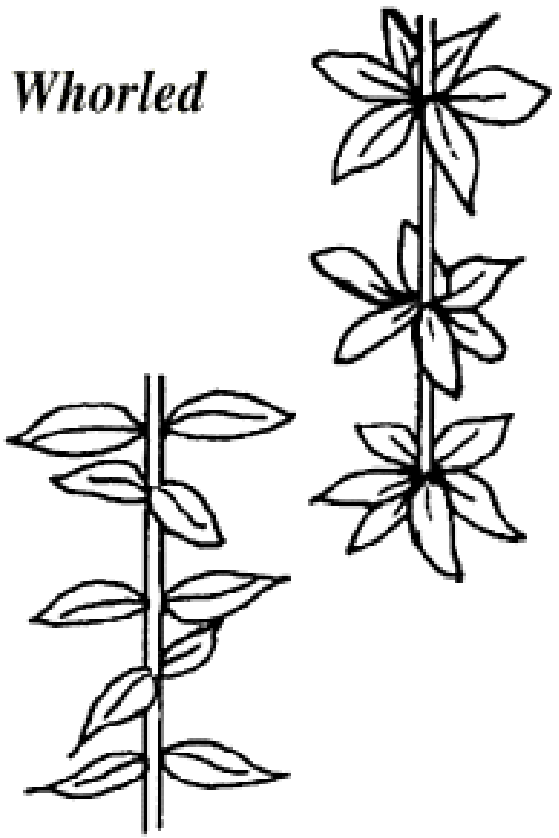




**Figure 5.** Cross sections of stems:
(a) discontinuous vascular system of a monocot stem.
(b) continuous vascular system of a woody dicot stem.

# Leaves

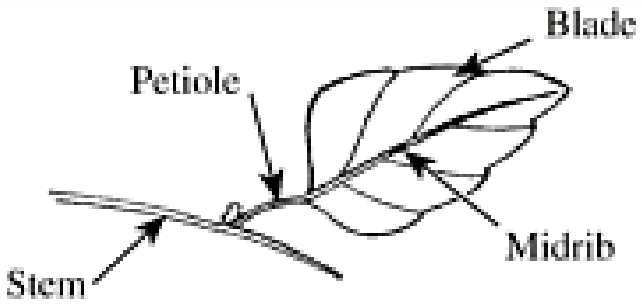
- Three basic types:
  - Alternate
  - Opposite
  - Whorled

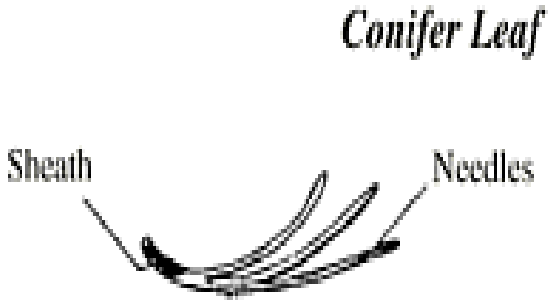


# Leaves

- Petiole
- Sheath
- Blade
- Midrib
- Auxiliary bud



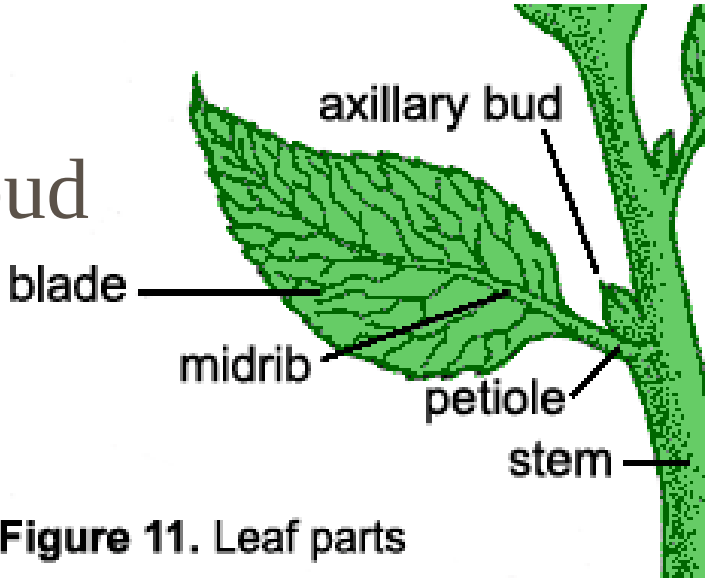




**Figure 11.** Leaf parts

# Leaves

1-Parallel venation

2-Netted venation

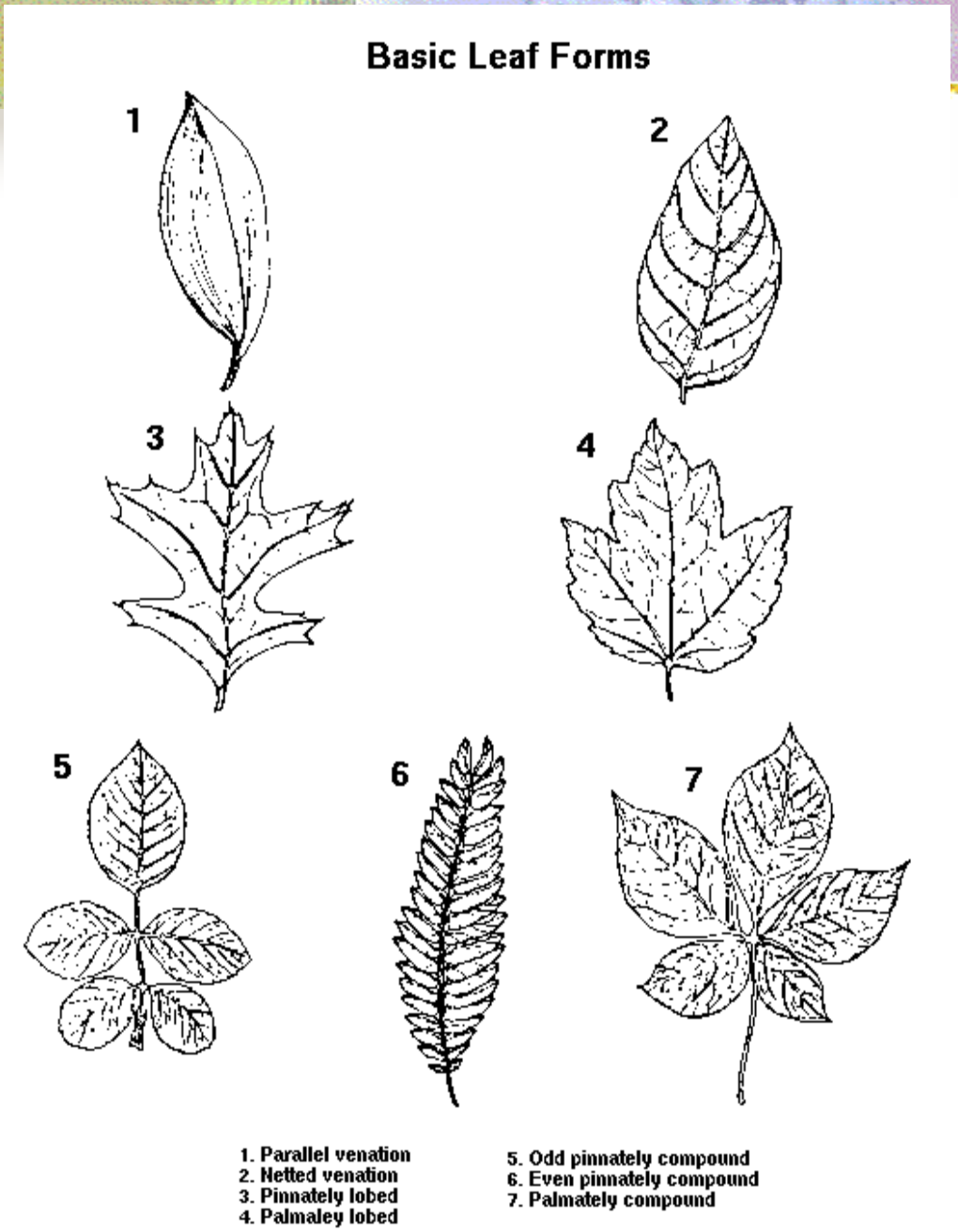
3-Pinnately lobed

4-Palmately lobed

5-Odd pinnately compound

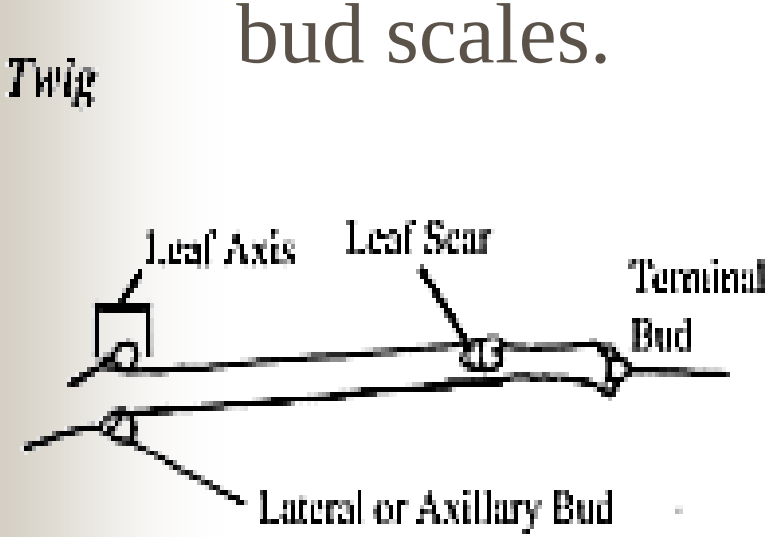
6-Even pinnately

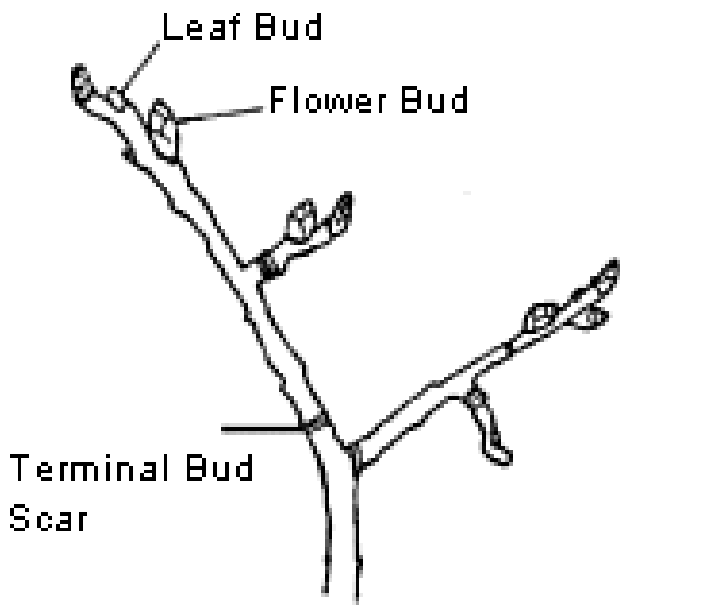
7-Palmately compound



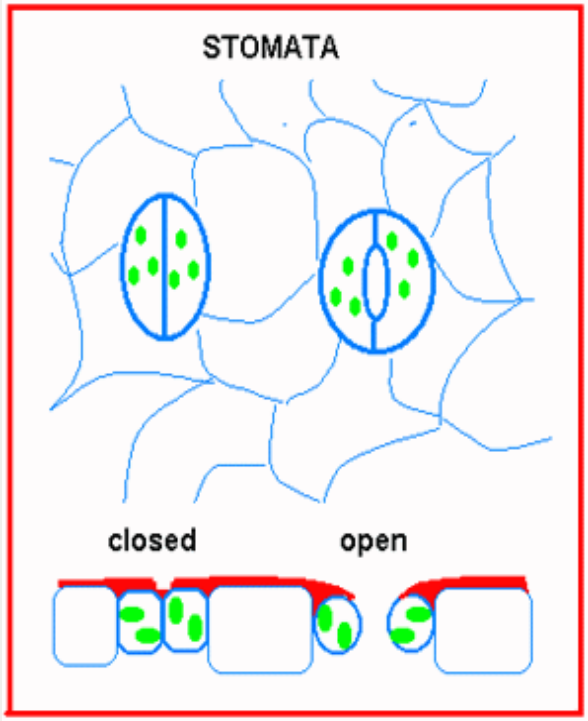
# Leaves - Buds

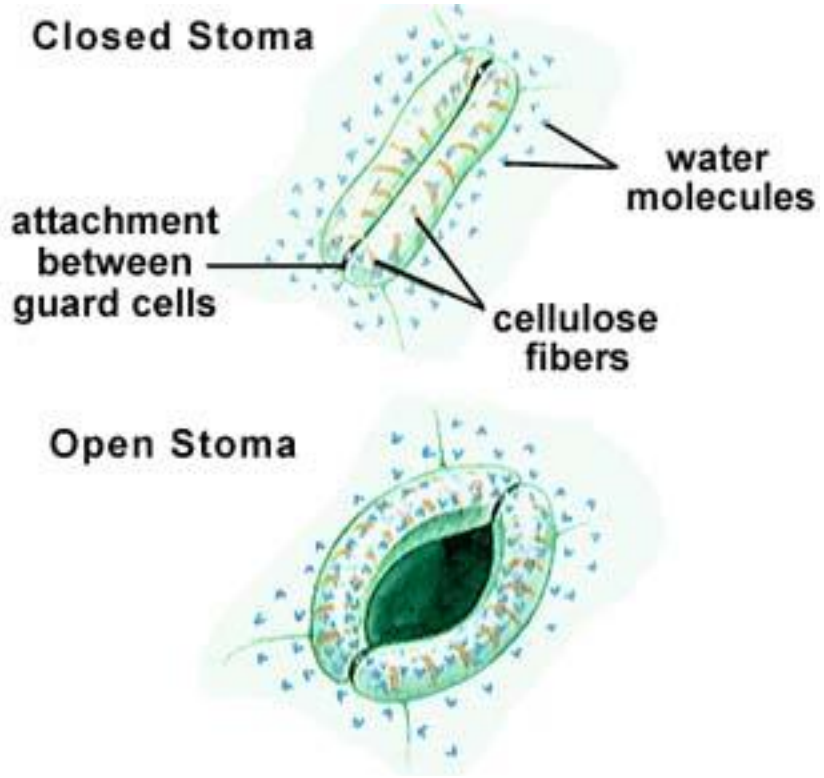
- Undeveloped shoot from which embryonic leaves or flower parts arise.
- Protective outer layer of small, leathery, bud scales.



# Stomata Cells




Butterflies taste with their feet.

# Leaves - Stomata

- Role in carbon dioxide intake for photosynthesis.
- Oxygen release.
- Water release.
- Balance that the plant must achieve between water loss and carbon dioxide uptake.

# Plant Hormones

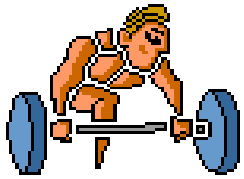
- Are synthesized in the cells of stems, leaves, roots, and flowers.
- Six primary plant hormones.

# Plant Hormones- Auxin

- Development of the embryo
- Leaf formation
- Phototropism
- Gravitropism
- Apical dominance
- Fruit development
- Abscission
- Root initiation

# Plant Hormones - Gibberellins

- Can influence the timing of flowering.
- Flower gender and flower size.
- Improves fruit set and fruit size.
- Improves seed germination, plant growth, and size.



# Plant Hormones - Cytokinin

- Promotes cell division.
- Delays the dying of leaves.
- First synthesized in roots and moves up the plant into leaves and fruits.

# Plant Hormones - Abscisic Acid

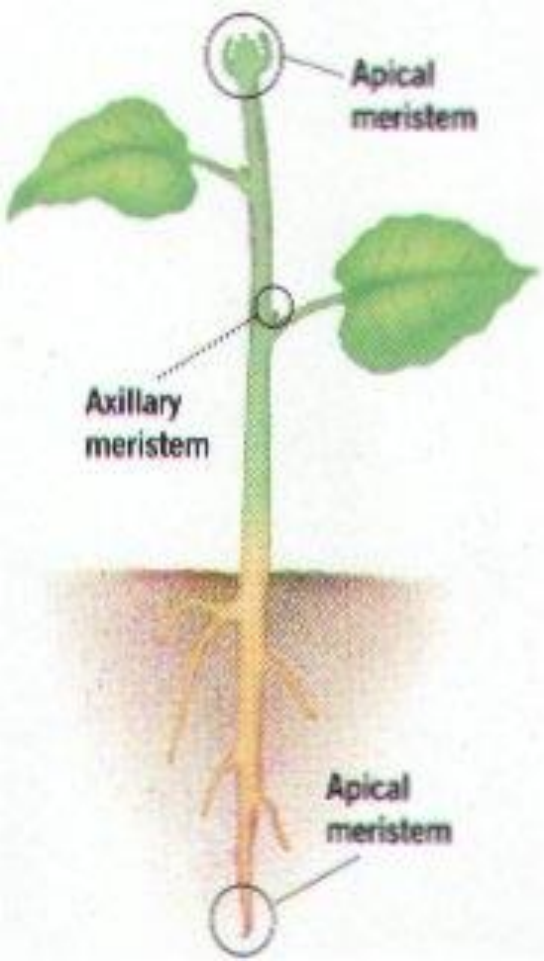
- Mediates stress tolerance responses.
- Regulates stomatal aperture.
- Regulates responses to pathogens and wounding.
- Promotes seed development.
- Embryo maturation.
- Synthesis of  proteins and lipids.
- Maintenance of dormancy.

# Plant Hormones - Ethylene

- Differs from other plant hormones in being a **Gas.**
- Promotes the ripening of the fruit.
- Abscission of leaves, fruits, and flower petals.
- Sprouting of potato buds.
- Flower formation in some species.

# Plant Hormones - Florigen

- Transmitted to the apical meristems to start their conversion into floral meristems.
- Photoperiodism i.e. production occurs only under certain light conditions.



# Quiz

- Mr. Gardener has found a wildflower that he wishes to propagate in his garden. He gathered seeds during the fall, but is having trouble getting them to germinate. He would like to try dipping the seeds in a hormone to promote germination. Which hormone should he try from your list?
- Gibberellic acid (GA)

# Length of Day - Photoperiodism

- Short day
  - Christmas cactus, poinsettia
- Long day
  - Various onions
- Day neutral
  - Corn, cucumber, tomatoes, grapes, peas

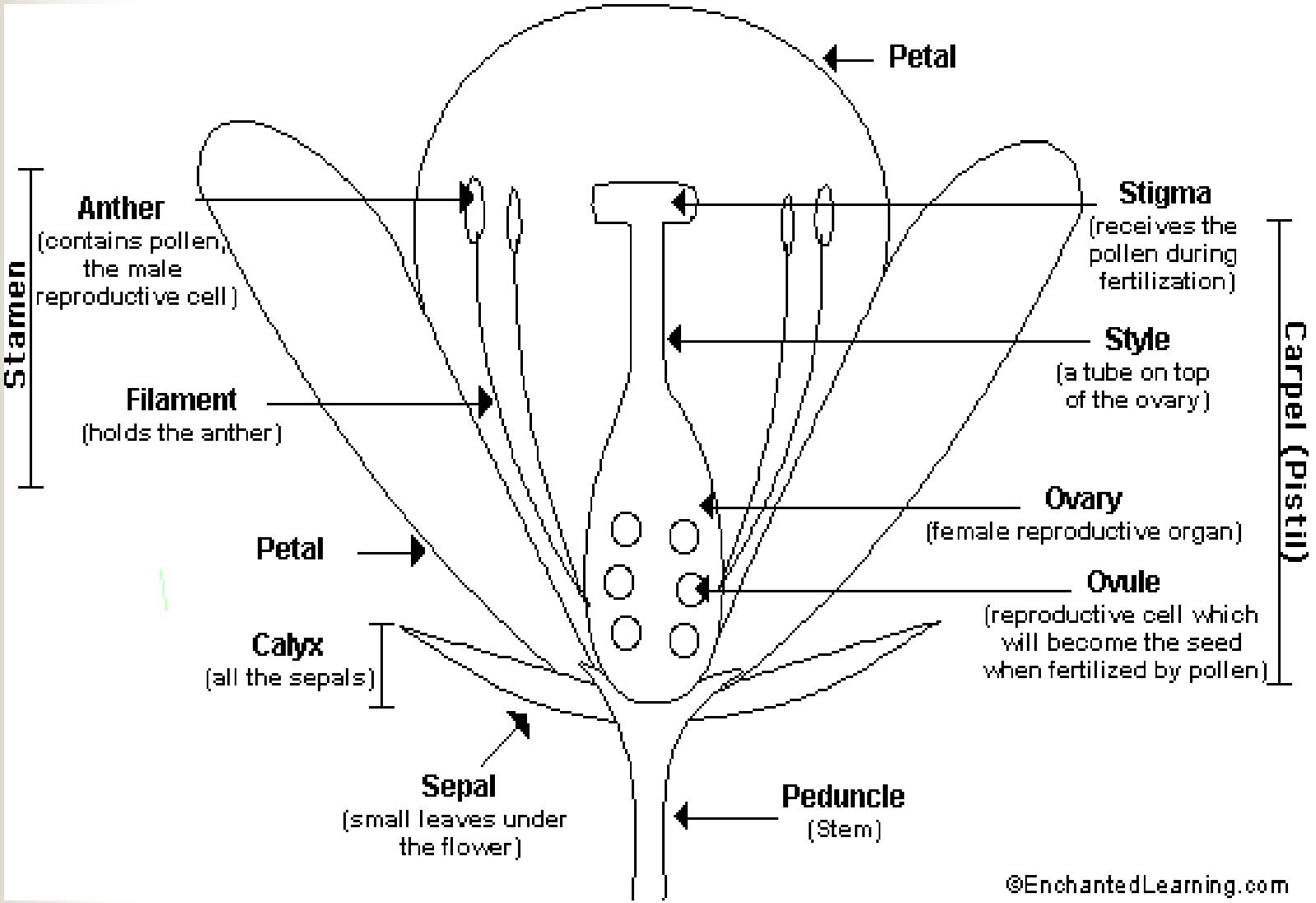
# Cold Harding

- First induced by a shortening photoperiod.
- Accumulation of sugars in the protoplasm.
- Increasingly lower temperatures.

# Flowers

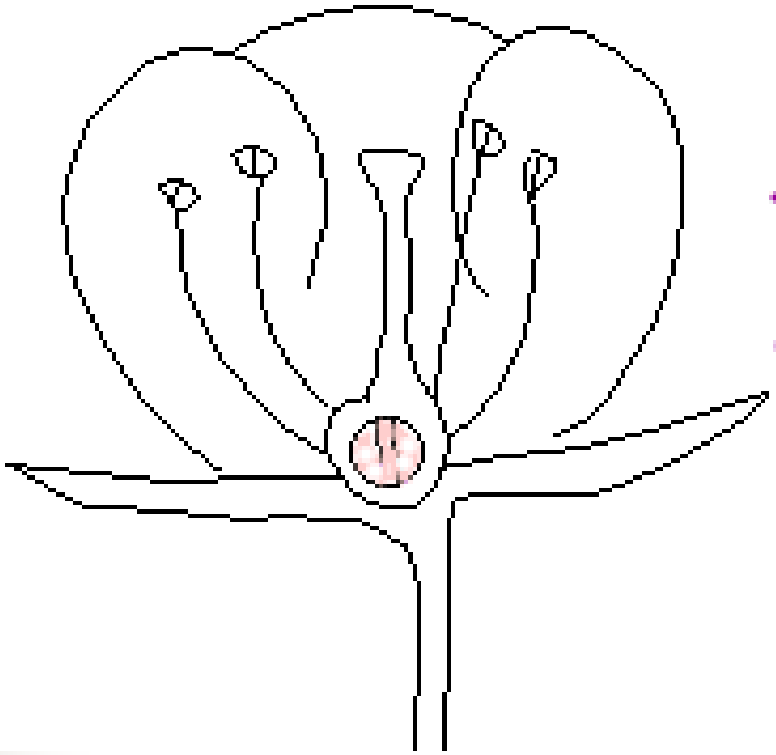
- A shoot modified for reproduction.
- Short branches bearing specially adapted leaves.
- Reproduction is the sole function for which the flower has evolved.

# Flowers - Anatomy



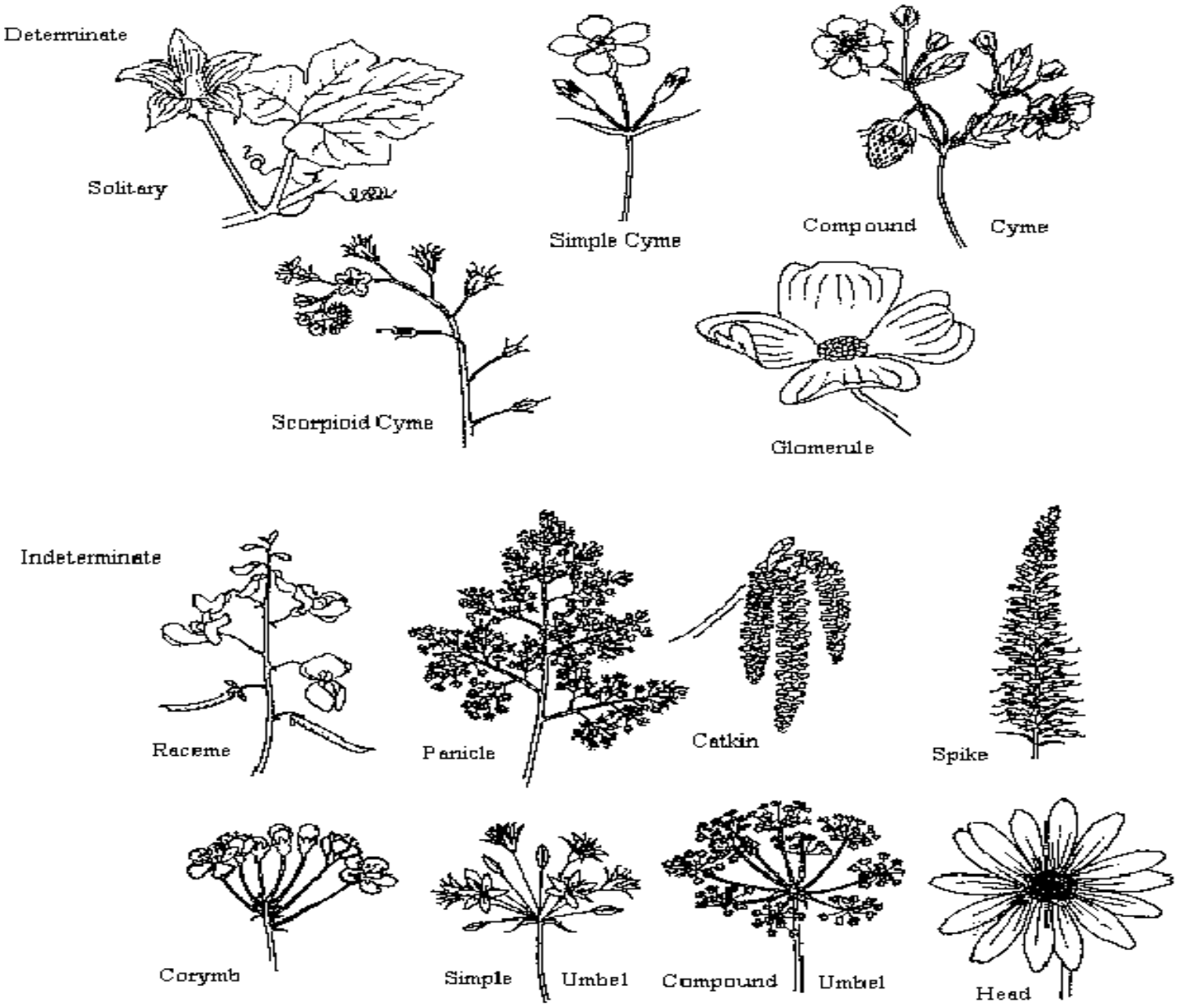
# Flowers - Anatomy

## Fertilization



Pollen lands on stigma

Tube grows down the style and enters the ovary


Determinate
Solitary
Simple Cyme
Compound Cyme
Scorpioid Cyme
Glomerule
Indeterminate
Raceme
Panicle
Catkin
Spike
Corymb
Simple Umbel
Compound Umbel
Head

# Types of Flowers

- Complete vs. Incomplete
- *Complete flower* has the staminate and pistillate (male and female).
- *Incomplete flower* has only the staminate or the pistillate but **not** both.

# Flowers

- Monoecious.
- Has separate staminate and pistillate flowers *on the **same plant***.
  - Corn, walnut, melons, squash, pine trees.

# Flowers

- Dioecious
  - Has single type of flower on one plant.
  - Has either staminate or pistillate flowers, **but not both, on the same plant.**
  - Pistachio, holly, kiwi.

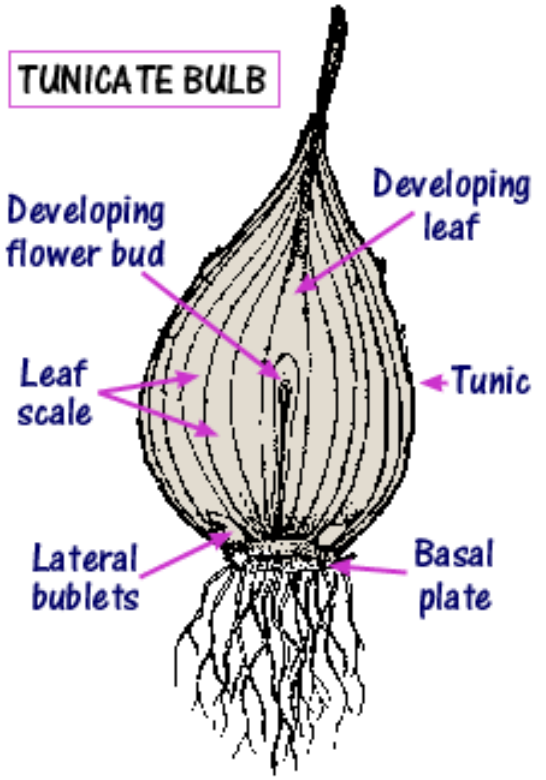
# Flowers

- Pollination based on symbiosis
  - Animal
  - Insect
  - Wind
  - Self
  - Water
  - Reward of nectar

# Are those red things petals?

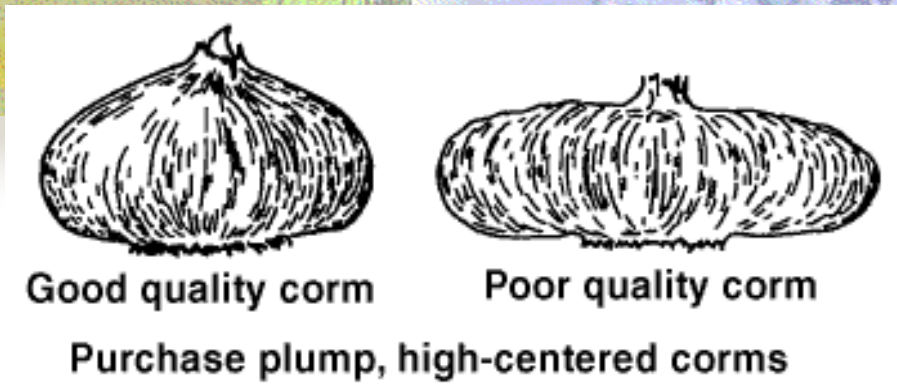
No, they are modified leaves. Bracts, to be exact. The flower is that small thing in the middle.

# True Bulbs

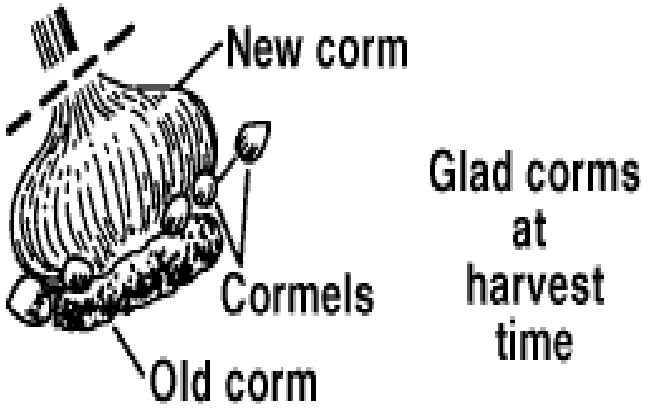



- Five major parts: basal plate, fleshy-scales, tunic, shoot, and lateral buds.
- Tunicate bulbs or imbricate bulbs.
- Tunicate bulb has a paper-like covering or tunic that protects the scales from drying: tulips, daffodils, hyacinths, grape hyacinths.
- Imbricate bulb does not have a tunic (papery covering) to protect the fleshy scales: lily.

# Corms

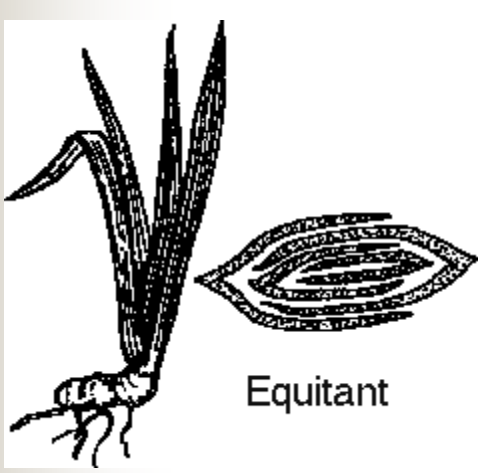



- In corms, most of the food is stored in an enlarged basal plate rather than the meaty scales, which in corms are much smaller.
- Corms generally tend to be flatter in shape than round, true bulbs.



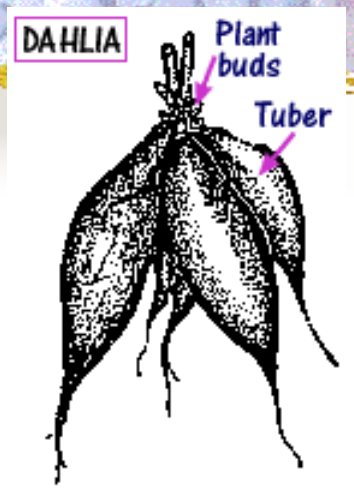
# Rhizomes

- Rhizomes differ from other storage structures by growing horizontally under the surface of the soil.
- A stem growing horizontally.





# Tuberous Roots

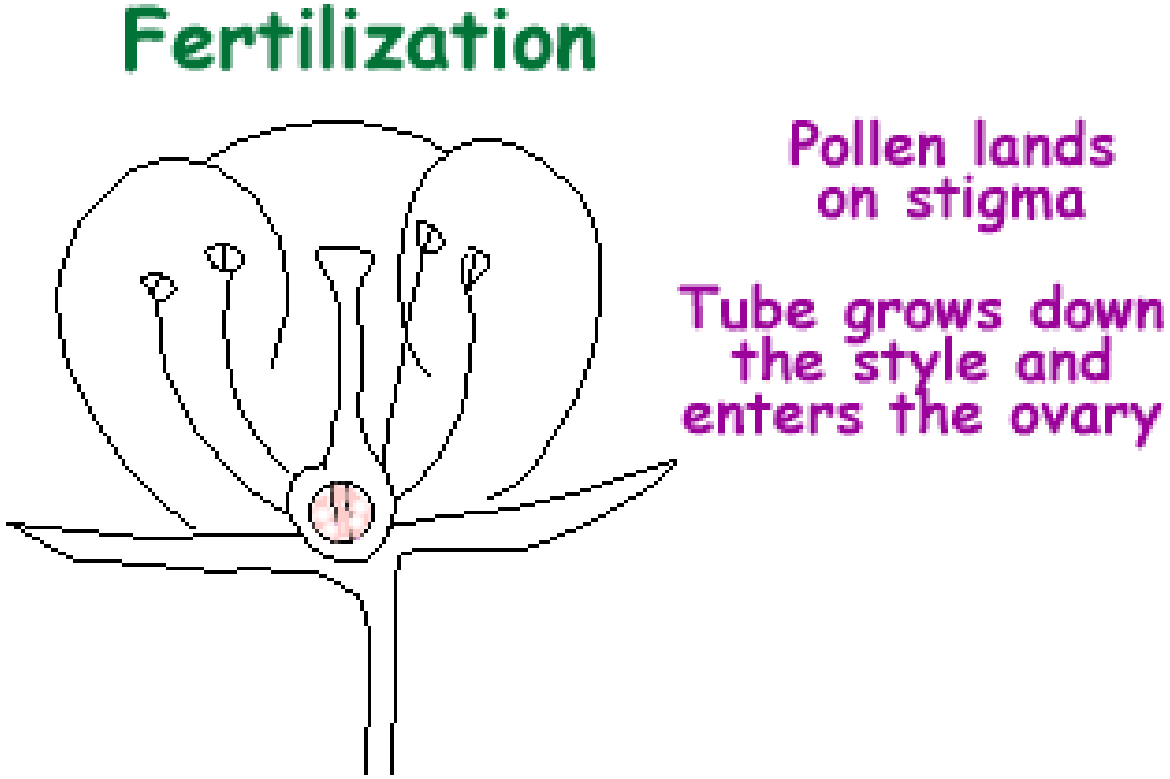



- The tuberous root differs from other root structures by the nutrient reserves being stored in an actual root instead of an enlarged stem.
- The root should be divided into sections with an eye bearing portion of the stem left with each section of the root.

# Fruits vs. Vegetables

- Generally, a **fruit** is the edible part of the plant that contains the seeds.
- A **vegetable** is the edible stems, leaves, and roots of the plant.

# Fruit Biology

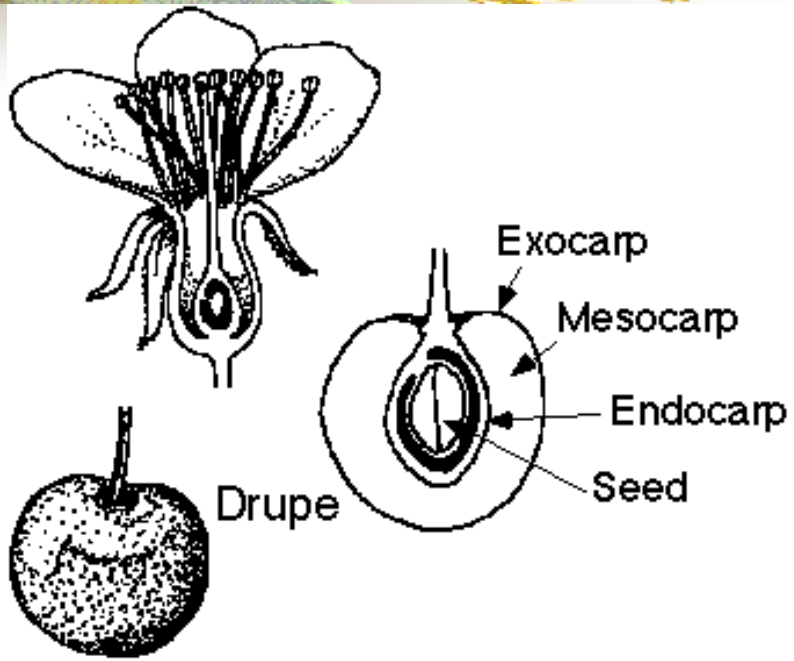


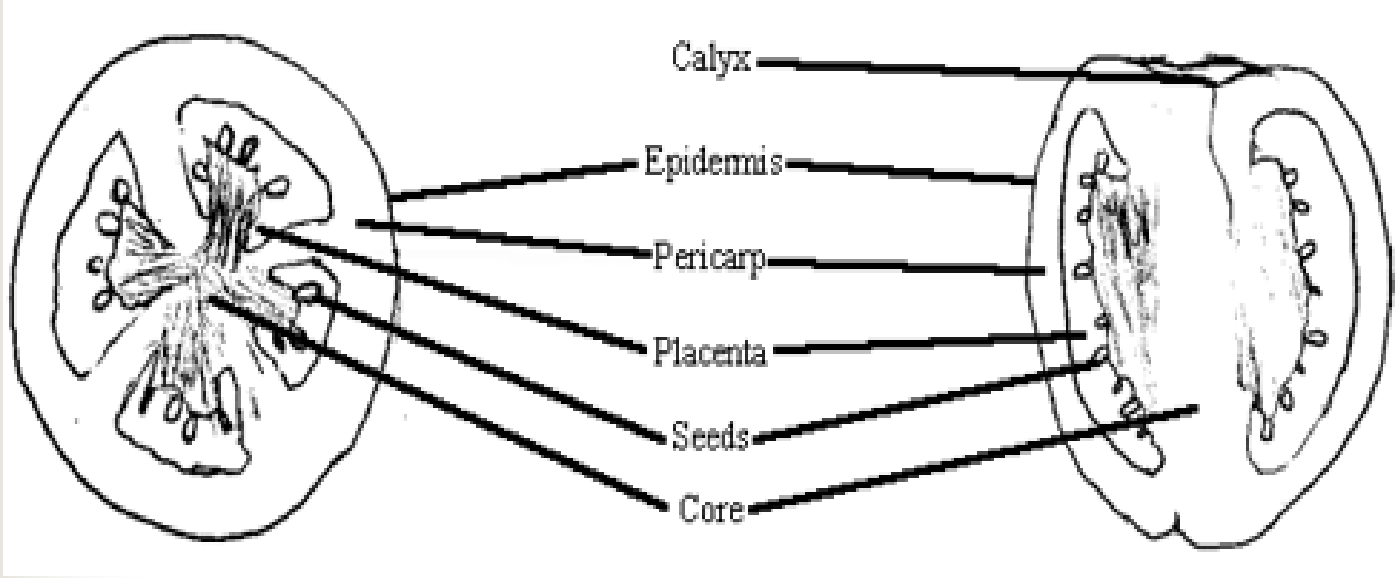
# Fruit Biology

- Pericarp is the ovary wall and is divided into three distinct layers: exocarp (outer), misocarp (middle) and endocarp (inner).
- Edible part of most fleshy fruit is pericarp tissue derived from the flower's ovary wall.

# Fruit Biology

- exocarp (outer).
- misocarp (middle).
- endocarp (inner).



# What Fruit is Called

- Berry
  - When all three layers of the pericarp are fleshy, the fruit is called a berry: tomato.
- Hesperidiums
  - The rind is the exocarp and mesocarp and the pulp is the endocarp: citrus fruits.

# What Fruit is Called

- Pepo
  - The rind is the exocarp.
  - The mesocarp is the watery portion,
  - Around the seeds is the endocarp: watermelon.

- Drupe
  - Simple fruits with a stony endocarp: cherry.
- Pome
  - Simple fruits with a papery endocarp: apple, pear.

# Simple Fruit

- A flower bearing a single ovary:
  tomato, orange, grape, melon.


# Aggregate Fruit

- Develops from separate but many ovaries formed within a single flower.  A collection of small fruits borne on a single receptacle: blackberry, raspberry, strawberry.

# Multiple Fruits

- The fusion of several ovaries each from a separate flower in the inflorescence.
- Pineapple: The segments on the surface of the fruit are actually separate pericarp, each derived from a flower with one ovary.

# Cost of Producing Fruit

- Plants (root) food reserves are used for the purpose of reproduction.
- Average annuals spend **20-30%** of their resources on flowering and fruiting.
- Perennials use about half that amount.

# Plant Classification –Chinese Hounds Tongue

- Kingdom — Plantae -Plant
- Phylum — Tracheobionta-Vascular plants
- Division — Spermatophyta- Seed plants
- Class — Magnoliophyta-Flowering plants
- Order — Lamiales
- Family — Boraginaceae-Borage family
- Genus — Cynoglossum L. Hound’s tongue
- Species — Cynoglossum Amabile
- Cultivar — Drummond

# Plant Nutrition

- **Osmosis**
  - Passage of water from a region of high water concentration through a semi-permeable membrane to a region of low water concentration.
- **Soil**
  - Mixture of inorganic materials such as decomposed rock, sand, silt, clay, and organic matter.

# Plant Nutrition - pH

- pH is a direct measurement of the balance between acidic hydrogen ions (H+) and basic hydroxide ions (OH-).

# Plant Nutrition

- 17 nutrients that are essential to plant growth.
  - An element is considered essential if it plays a specific role in growth or development and the plant cannot properly function without it.

# Plant Nutrition

- **Macro** nutrients
  - (needed in large amounts):

Nitrogen **N**

Phosphorus **P**

Potassium **K**

# N-P-K

- Fertilizer 10-10-10:
  - Nitrogen N:
    - 10% N x 10 pd bag = 1 pd/1000 sq ft total N.
  - Phosphorus P2O5:
    - 10% P2O5 x P(.44) x 10 pd bag = .44 pd/1000 sq ft total P.
  - Potassium K2O:
    - 10% K2O x K (.83 ) x 10pd bag =.83 pd/1000 sq ft total K.
    - Total of 2.27 pounds of fertilizer!

# Plant Nutrition

- Micro nutrients needed in trace amounts. Important as activators of key enzymes and proteins:
  - Magnesium (Mg)
  - Sulfur (S)
  - Chlorine (Cl)
  - Iron (Fe)
  - Molybdenum (Mo)
  - Calcium (Ca)
  - Manganese (Mn)
  - Zinc (Zn)
  - Copper (Cu)
  - Boron (B)
  - Silica (Si)

# Plant Nutrition - Nitrogen

- Involved with shoot development.
- A component of amino acids, chlorophyll, growth regulators and alkaloids.
- Involved in the regulation of uptake of other key nutrients.
- Helps give plants their dark green color.
- Nitrogen in the form of ammonium has an acidic reaction in the soil, while nitrogen as nitrates has an alkaline reaction.

# Plant Nutrition - Phosphorus

- Increases resistance of plants to disease.
- Improves balance of nutrients, accelerates crop maturity, constituent of RNA, DNA.
- Involved in energy metabolism of cells and photosynthesis.
- Formations of oils, sugars, starches, transfer of solar energy into chemical energy.
- Roots, fruit, and flowers.

# Plant Nutrition - Potassium

- Essential in all plant cellular functions.
- Builds protein.
- Involved with photosynthesis.
- Helps with fruit quality.
- Reduction of disease.
- Drought and cold tolerance.

# What's missing?

# Plant Nutrition

- **Magnesium:** integral element in chlorophyll, activator of enzyme systems.
- **Iron**: production of pigment, chlorophyll, aids in biochemical process.
- **Calcium**: needed to form pectin, integrity of cell membranes.
- **Sulfur**: protein synthesis, amino acids, leaf size.

# Plant Nutrition

- **Boron:** normal differentiation of cells and tissue in meristematic regions of the plant, involved in sugar transport.
- **Copper**: activator of several oxidative enzymes, (lignin, protein, chlorophyll).
- **Manganese:** essential for chlorophyll synthesis.
- **Molybdenum:** conversion of nitrate.
- **Zinc:** synthesis of auxin.

# Plant Nutrition

- Fertilizers can dissolve easily, such as materials used to make water-soluble fertilizer.
- They can have limited solubility and are typically added to the root medium in a granular form prior to planting.
- Resin-coated fertilizers are soluble fertilizers that are encapsulated to control release over time.

# Plant Nutrition

- Any time an element is in excess or deficient, the plant responds with some physiological symptom.

**Diagnosis can be difficult.**

# Plant Nutrition

**Nutrient deficiencies may occur because:**

- An insufficient amount in the soil.
- The nutrients are unavailable due to a high pH (alkaline soil).
- The nutrients may not be absorbed due to injured roots or poor root growth.

# Plant Nutrition General Observations

**Nutrition can:**

- Affect the plant's resistance to or tolerance to diseases and insects.
- Influence growth pattern, sugar and amino acid concentrations.
- Insects **will attack** plants with nutrition imbalances.

# Plant Nutrition General Observations

## Nutrition can:

- Inhibit fungal and bacterial produced enzymes, help detoxify oxygen radicals.
- If out of balance, production of anti-fungal compounds decreases.
- High N. levels attract insects like thrips and leafhoppers, and increase powdery mildew.

- By Laura Pottorff, CSU Diagnostic Plant Pathologist.

# Plant Nutrition

- **Chlorosis: a yellowing of leaf tissue due to a lack of chlorophyll.**
- Possible causes of chlorosis include: poor drainage, damaged roots, compacted roots, high alkalinity, cold wet soils.
- **Nutrient deficiencies** in the plant.

# Plant Nutrition -Deficiencies

**Not** Mobile in the Plant

- Sulfur : general chlorosis, subnormal leaf size.
- Copper : cupping of leaves, chlorosis, stunting, leaf drop.
- Iron : interveinal chlorosis, slow growth.
- Calcium : chlorosis, subnormal size of youngest leaves and margins.

# Plant Nutrition

Mobile in Plant

- Boron: chlorosis, subnormal leaf size, fusion of leaves, shoot dieback.
- Manganese: chlorosis, undersized leaves, wavy, crinkled or curled leaf margins, necrosis of leaves.
- Molybdenum: foliar stunting and deformity.
- Zinc: interveinal chlorosis, mottling, dwarfed leaves, crinkled leaf margins.

# Plant Nutrition

Mobile in the Plant

- Magnesium, chlorosis of older tissue first, early leaf drop.
- Phosphorus, general chlorosis, reddish purple pigment of new tissue.
- Potassium, slow growth, browning and chlorosis of tips and margins, sparse appearing foliage, sensitivity to freezing.
- Nitrogen, stunted growth, delayed maturity, light green leaves.

# Plant Adaptation and Protection

- **Dormancy:** prepares for the approach of seasons when combined adverse environmental conditions are bound to limit growth.
- **Cold Environments**: leaf cells are prevented from freezing by the presence of high sugar concentrations acting as antifreeze in the protoplasm.

# Plant Adaptation and Protection

- **Hot, dry environments:** short narrow leaves, extra thick cuticles, epidermal hairs.
- **Animals:** thorns, cactus spines, holly leaves with veins termination in spines. Tough lack of palatability, stinging hairs, pubescent leaves.
- **Camouflage:** cryptic coloration to disguise, i.e., living stones (lithops).

# Plant Adaptation and Protection

- **Chemical**: enzymes, tannins, alkaloids.
- **Wound Healing:** latex, known to have bactericidal, fungicidal and anti-herbivore properties.