Basic Botany

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Green Poster AD-475-A –May 2022 version

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Overview

- Part I. Introduction
  - What is Botany?
  - What is Horticulture
  - What is a plant?
  - Why are plants important?
  - Plant Processes
- Part II. Plant Classification
  - Plant Taxonomy
  - Plant Naming
- Part III. Plant Morphology
  - Leaves
  - Stems
  - Flowers
  - Fruits
  - Roots

What is Botany?

- The scientific study of plants…
  – classification
  – evolution
  – structure
- Internal structure = anatomy
- external structure = morphology – physiology – ecology – uses

- Also known as plant science or plant biology

What is Horticulture?

The art and science of cultivating plants, including ornamentals, fruit, and vegetables.

What is a Plant?

- A photosynthetic,multicellular organism…

– Containing photosynthetic pigments called **chlorophylls**

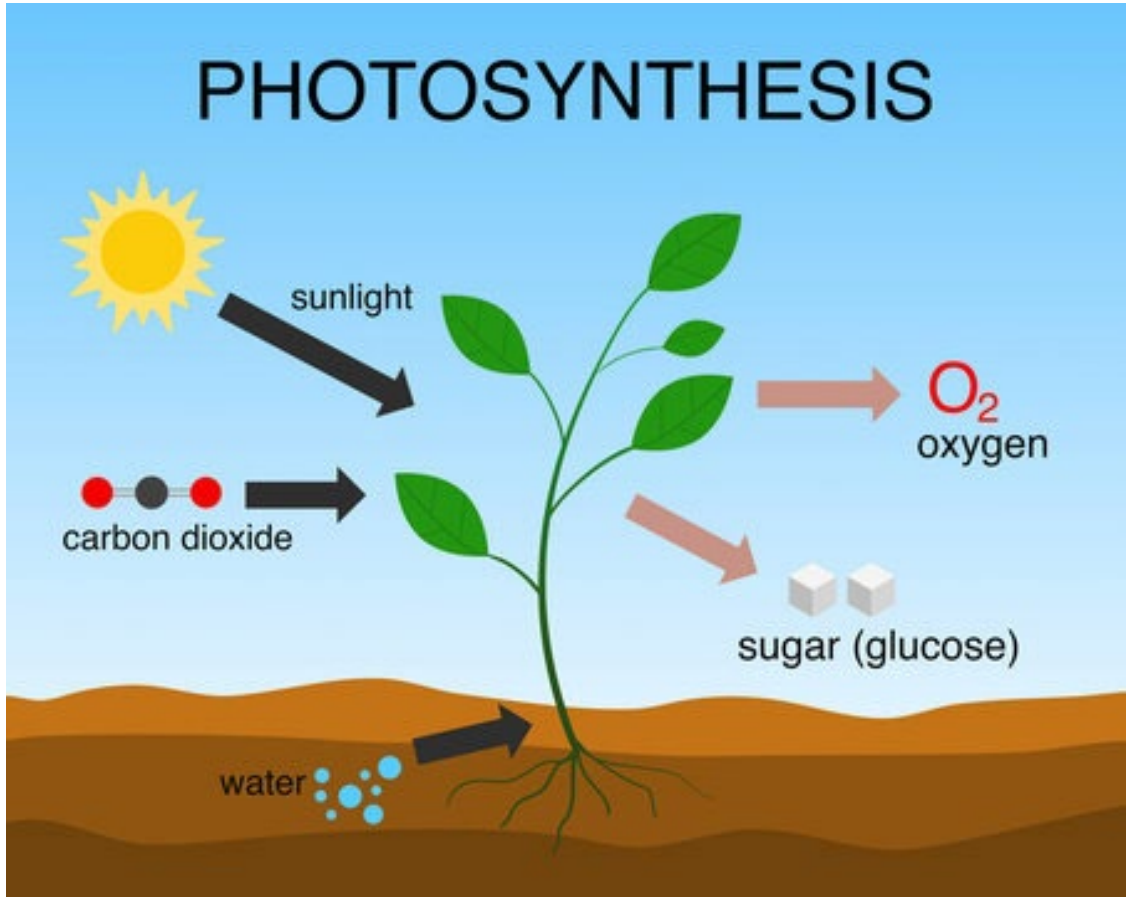
– Capable of making its own food (**sugar**)……and storing it, usually in the form of starch

Why are Plants Important?

- Plants are the primary source of food for humans and animals
- Plants play an essential role in producing oxygen
- Plants keep us cool
- Plants renew the air
- Provide a home for wildlife
- Beautify our surroundings
- Furnish building materials and fuel

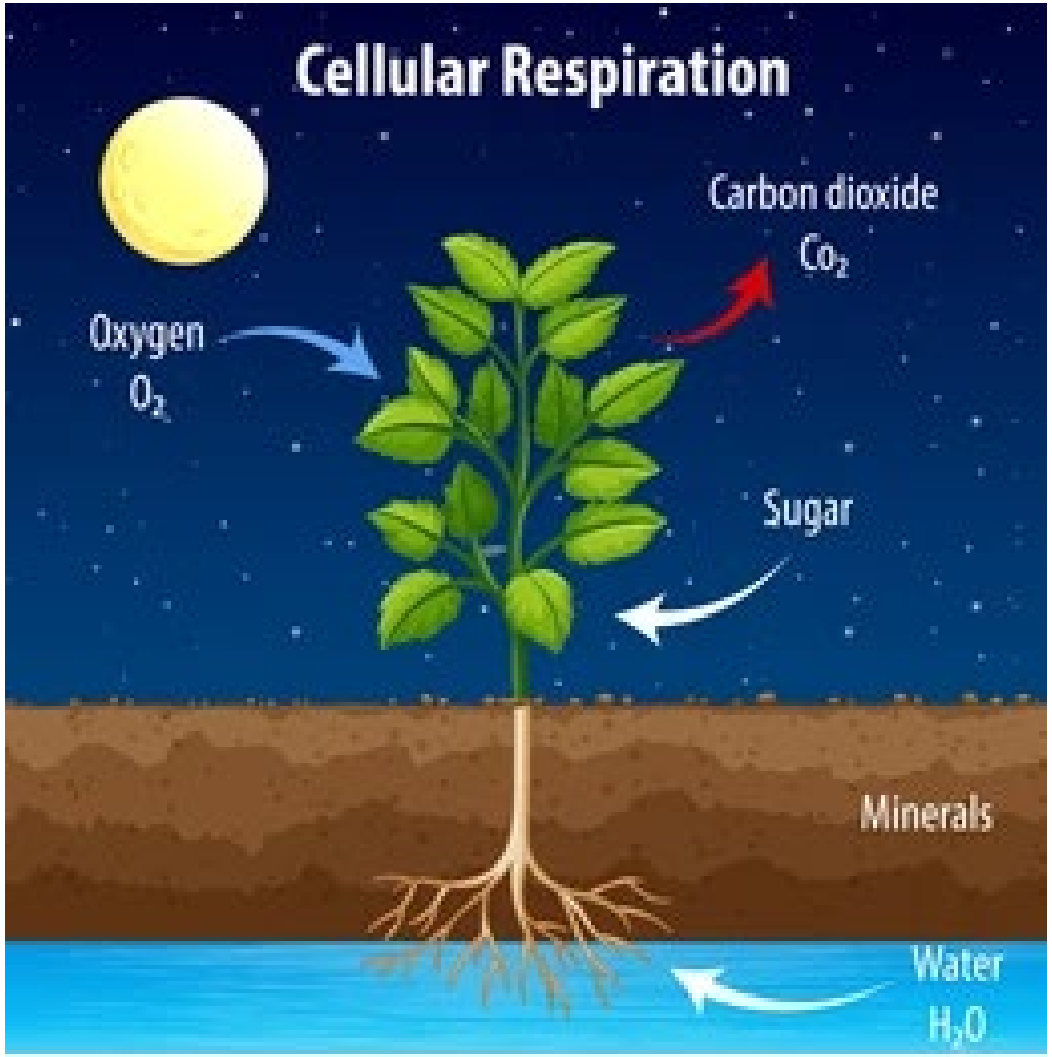
Plant Processes

- **Photosynthesis**– The process of turning light energy into carbohydrates that can be transported and stored by the plant
- 6 CO2 + 6 H2O + light →C6H12O6(sugar) + 6 O2 (oxygen)
- - Produces food
- - Energy is stored
- - Occurs in cells with chlorophyll
- - Oxygen is released
- - CO2 is used
- - Occurs in light



Plant Processes

- **Respiration**– The process where carbohydrates are broken down into energy the plant can use
- C6H12O6 + 6 O2 → 6 CO2 + 6 H2O + Energy
- - Uses food for energy
- - Energy is released
- - Occurs in all cells
- - Oxygen is used
- - CO2
- is produced
- - Occurs in dark or light



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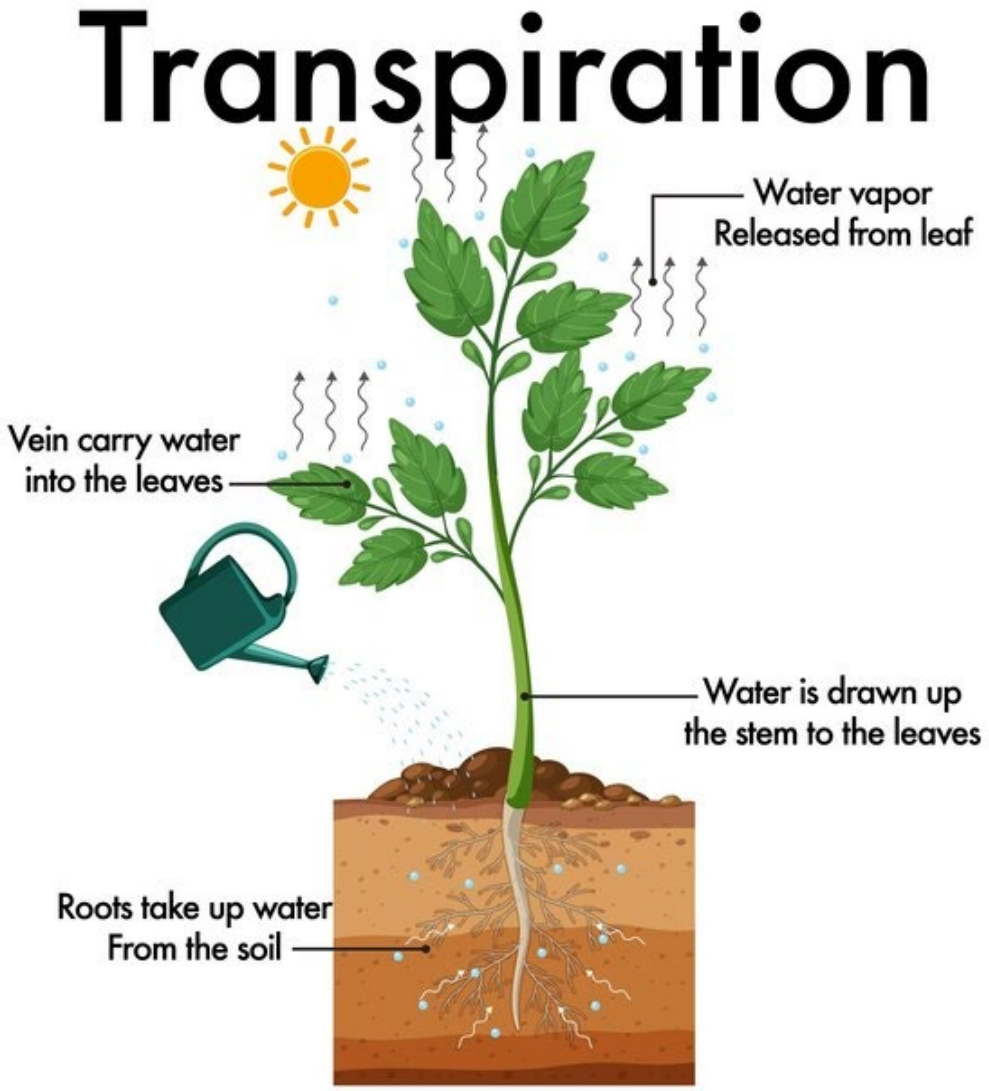
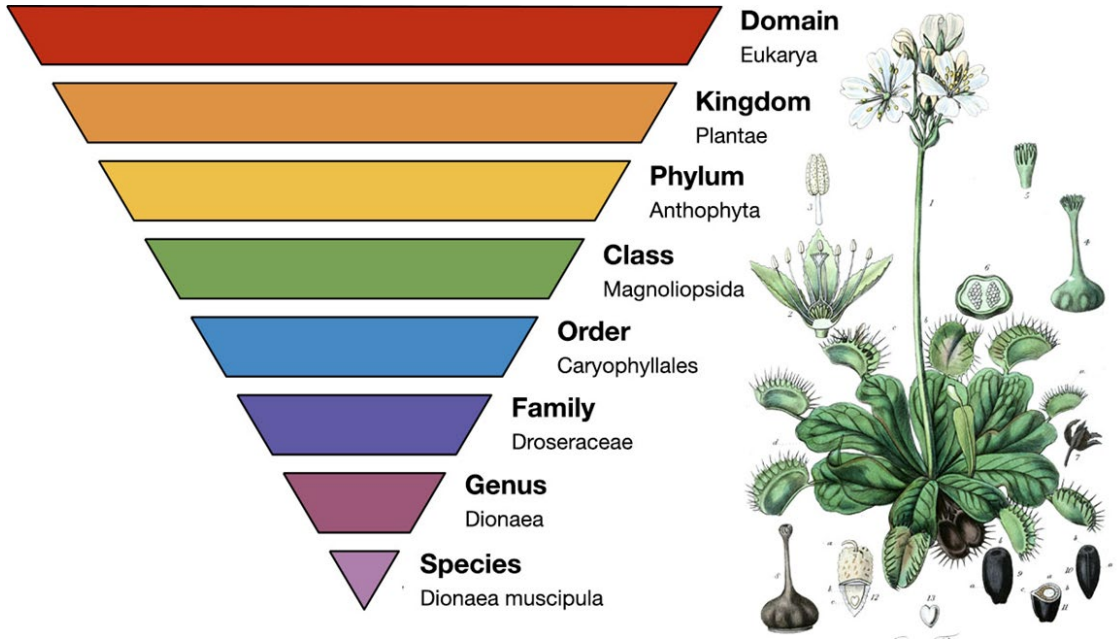
Plant Processes

- **Transpiration**– The process by which moisture is carried through plants from roots to small leaf pores (stomates) where it is released as vapor into the atmosphere.
- Factors that increase transpiration:
    - Warm temperature
    - Bright sunlight
    - Low relative humidity
    - Wind
    - Moist soil



Plant Taxonomy

- **Taxonomy**- The study of plant names and the identification of plants
- Taxonomist- Scientist who identify and classify plants
- To most gardeners, the family, genus, and species are the most relevant.
- Genus is capitalized *(Italicize)*
- Species is lowercase *(Italicize)*



Example of Plant Taxonomy:

- Kingdom-plant
- Division/Phyllum-Spermatophyla
- Class-Angiospermae (Seeds in Fruit)
- Order- Acerales
- Family- Aceraceae
- Genus- *Acer*
- Species-*rubrum*
- Variety or cultivar- var. ‘October Glory’

How Plants are Named:

- Carolus Linnaeus (1707-1778)- Swedish botanist who developed the binomial system (two-name) for naming plants.
- Genus- First name, is capitalized, noun
- Specific epithet- Second name, is lower case, adjective
- Cultivar/Variety- The subspecies or cultivated species
- Example- *Acer rubrum* ‘October Glory’ or Japanese Maple ‘October Glory’
- Example- *Prunus persica* var. *Nucipersica* or Peach Tree var. Nectarine

How Plants are Named:

- Plants can be named for a person, place, and description of plant
- *Betula lutea*- Yellow birch
- *Quercus virginiana*- Live Oak
- *Magnolia macrophylla* vs. *Magnolia grandiflora*

Plant Taxonomy: Divisions of the Plant Kingdom

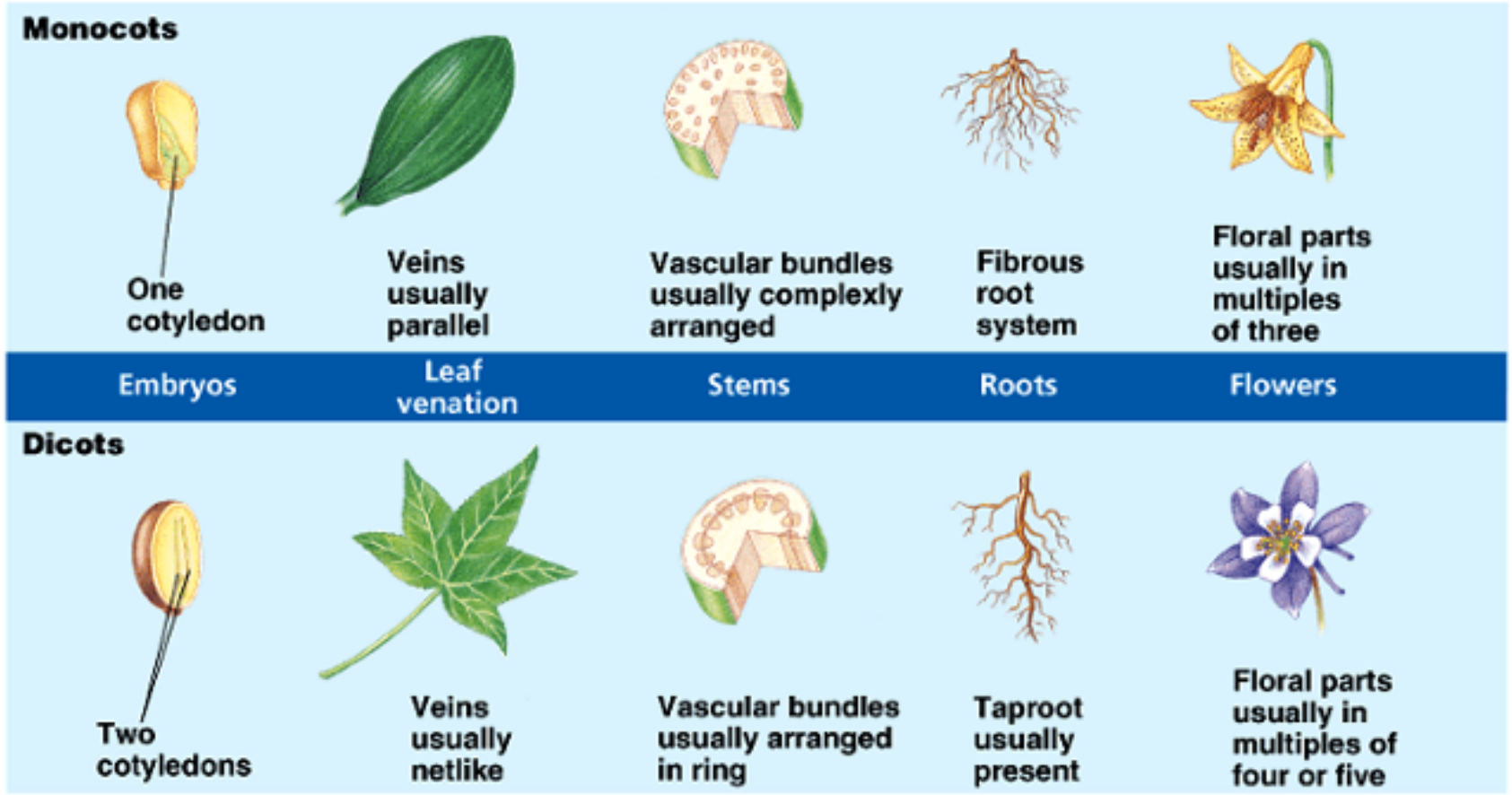
- **Thallophytes** (Algae)
- **Bryophytes** (Mosses and Liverworts)
- **Pteridophytes** (Ferns)
- **Spermatophytes** (Seed bearing, roots, stems, leaves, and vascular system)

Plant Taxonomy: Subdivision within Spermatophytes

- **Gymnosperm**- Naked seed, Narrow leafed plants
  - Examples- Palms, Cycads, Pines

- **Angiosperms**- Covered seed, Broad leafed plants
  - Examples-Oaks, Daisy, Basil, Boxwood etc.

Plant Taxonomy: Class within Subdivision Angiosperm



Other Ways Plants are Classified:

- Life cycle (annual, biennial, perennial)
- Life stages (embryonic, juvenile, transitional, reproduction, dormancy and senescence)
- Latitude (arctic, temperate, subtropical, tropical)
- Usage (fruit, vegetable, ornamental, fiber, dye, medicinal, forage)
- Growing or flowering season (warm season vs. cool season, wet season vs. dry season)

5 Basic Parts of a Plant

LEAVES

STEMS

FLOWERS

FRUIT

ROOTS


Leaves

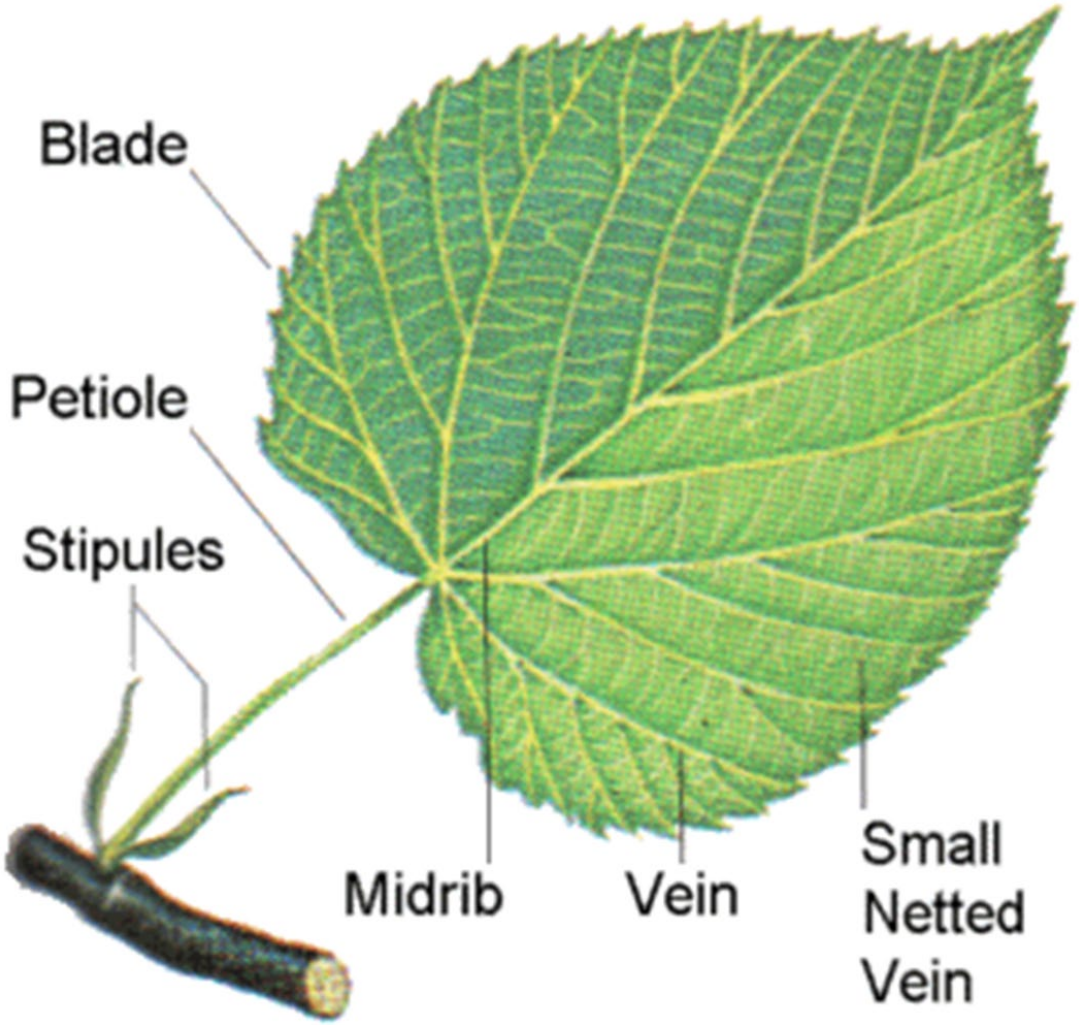
Leaves

- Functions:
  - 1. Absorption of sunlight
  - 2. Photosynthesis (production of sugars from sunlight, carbon dioxide, and water)
  - 3. Gas exchange (absorb C02, release 02)
  - 4. Transpiration (loss of water)
  - 5. Storage of photosynthates

  - In some plants leaves may be modified for climbing (tendrils), for plant defense (spines), or for pollination (petal-like bracts attract pollinators)

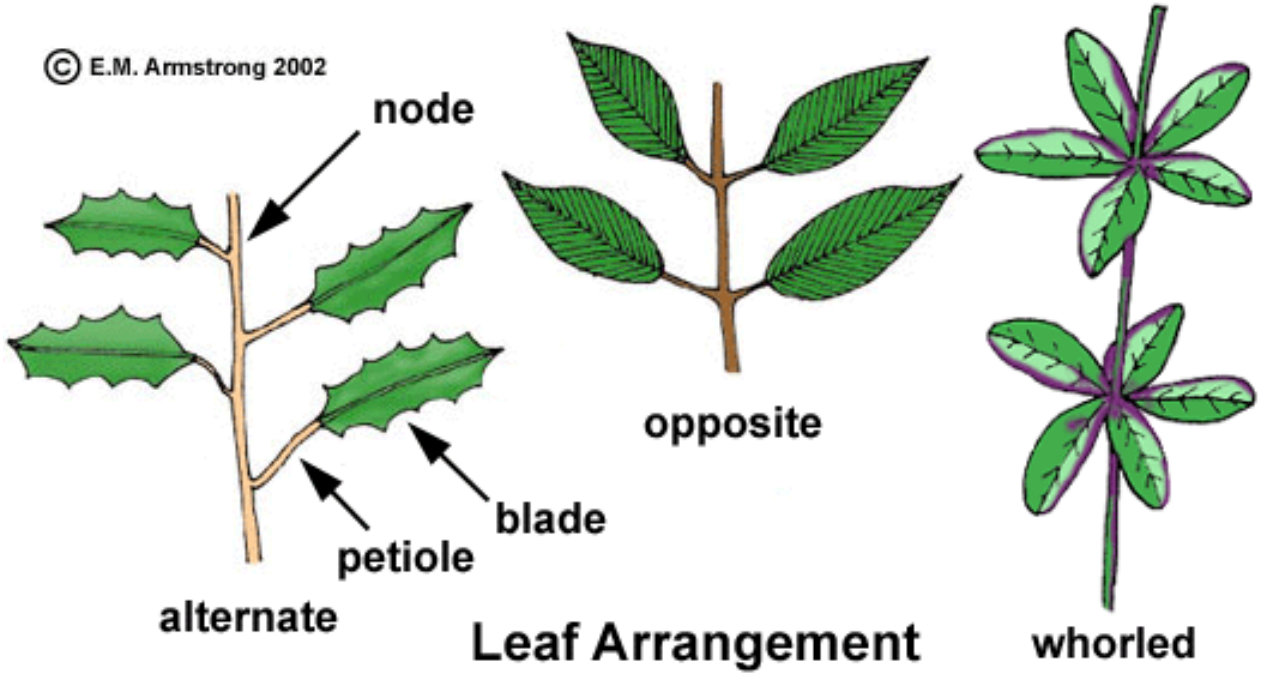
Leaf Morphology

- Blade: flattened, expanded part
- Petiole: the leaf stalk
- Stipules: leaf-like appendages at the base of petiole
- Base: blade portion closest to stem
- Tip or Apex: blade portion furthest from stem
- Margin: edges of the blade
- Midrib or Primary Vein: the most prominent central vein
- Secondary or Lateral Veins: veins



Common Leaf Arrangements

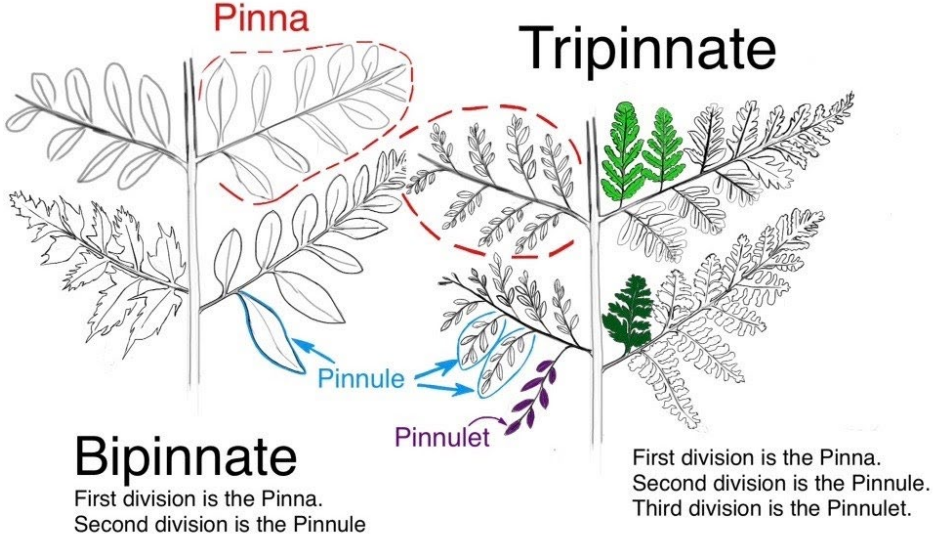
- Leaf arrangement – what is the placement of leaves on the stem
- Arrangement at a **node-**this point of attachment where the stem and leaf meet.
  - –**Alternate**: 1 leaf per node
  - –**Opposite**: 2 leaves per node
  - –**Whorled**: 3 or more leaves per node



Simple vs. Compound Leaves

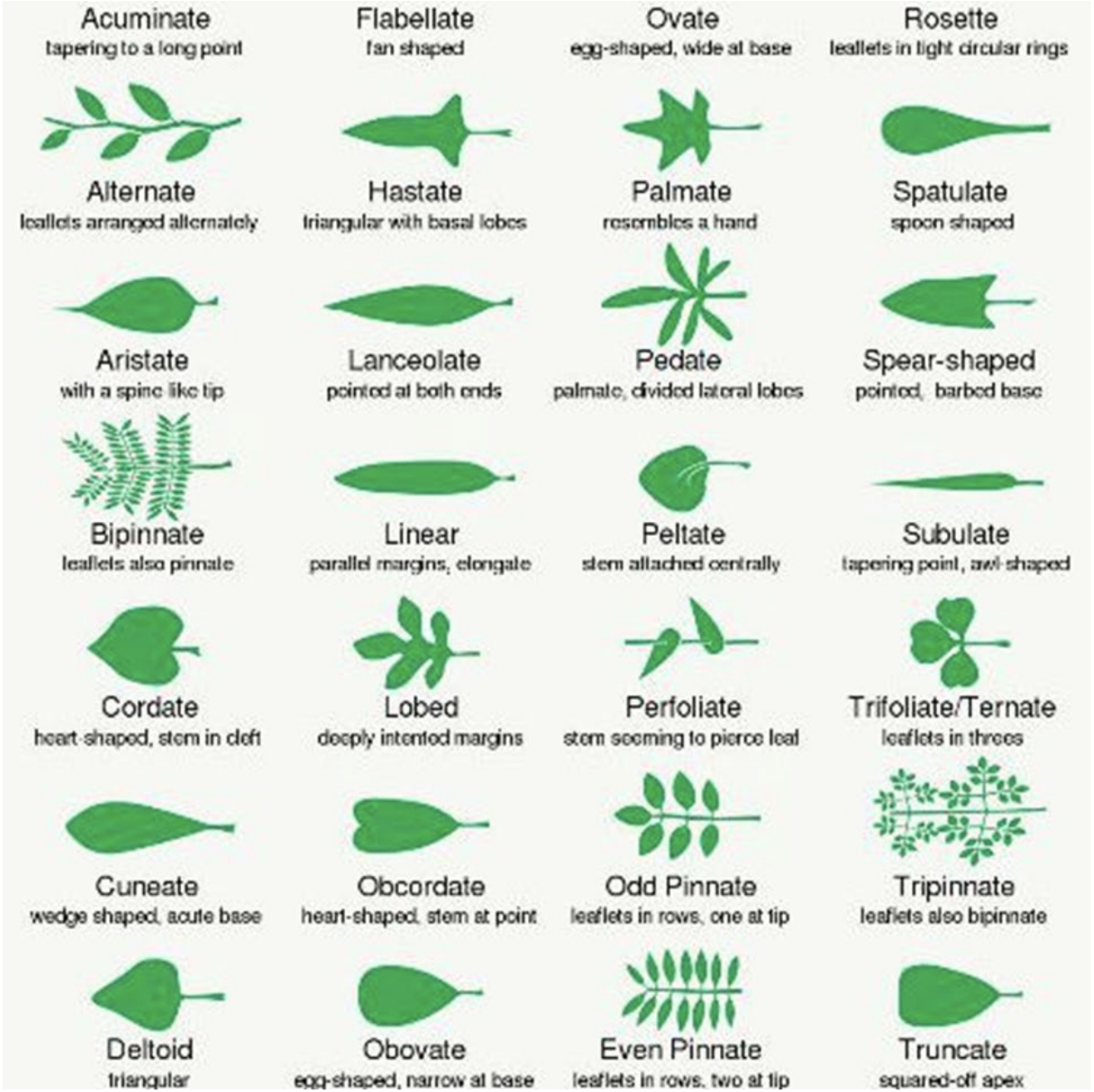
- a. **simple** = leaf is single with petiole attaching to stem

- b. **compound** = 3 or more leaflets attached to a single petiole
  - Bipinnately
  - Tripinnately



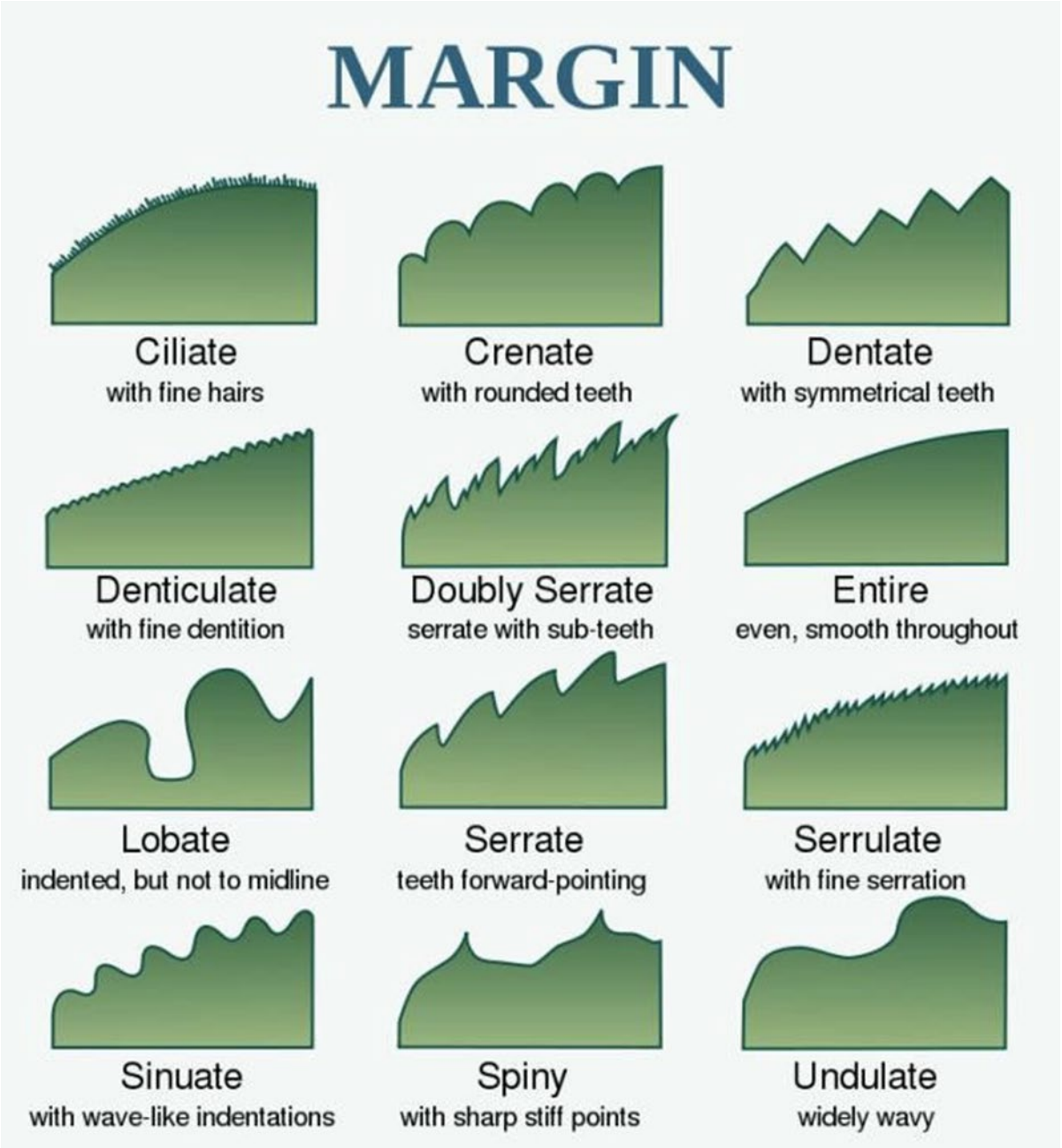
Leaf Shape

- Leaf shape- the shape of the leaf
- Main Types-oval, needle, cordate, ovate, round, spatulate, lanceolate, linear, lobed, pinnate, and palmate



Leaf Margin

- **Leaf margins**– what do the edges of the blade look like
- Main Types- Ciliate, Crenate, Dentate, Denticulate, Doubly Serrate, Entire, Lobed, Serrate, Serrulate, Sinulate, Spiny, and Undulate



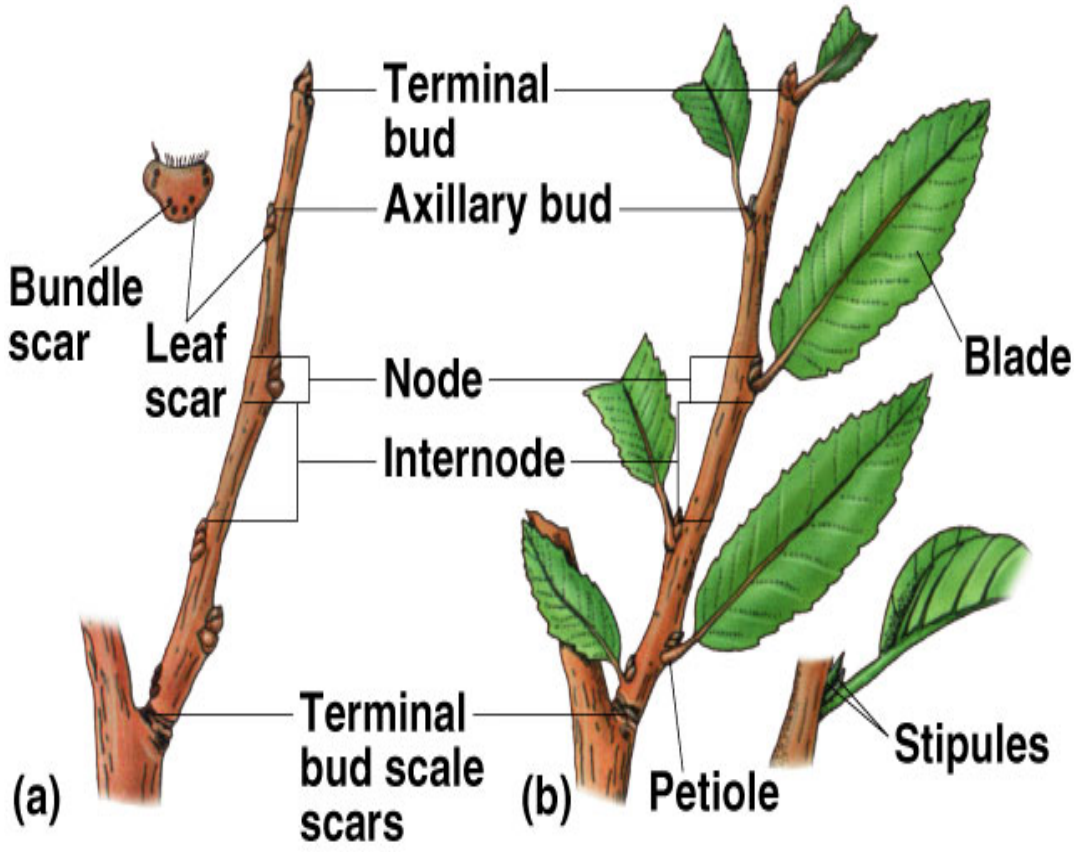
Stem

Stem Functions

- 1. Conductance via xylem and phloem
- 2. Support and elevate the leaves, flowers, and fruit
- 3. Storage of water and carbohydrates In some stems may also play a role in:
  - - Photosynthesis (eg., cacti)
  - - Gas exchange (lenticels)
  - - Plant defense (thorns)

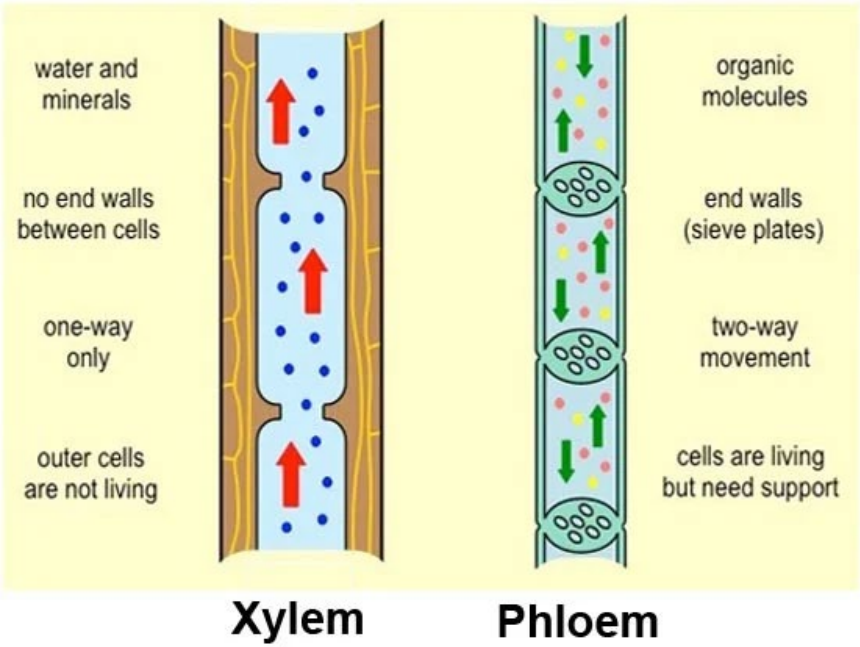
Stem Morphology

- 1. **Terminal buds**-end of stem
- 2. **Axillary buds**-on the side of stems
- 3. **Node**-area of leaf attachment
- 4. **Internode**-area of stem between nodes



Inside the Stem

- **Phloem** – conducts photosynthetic products bidirectionally
- **Xylem** – conducts water and minerals unidirectionally from roots to entire plant
- Both tissues are produced by the vascular cambium



Modified stems

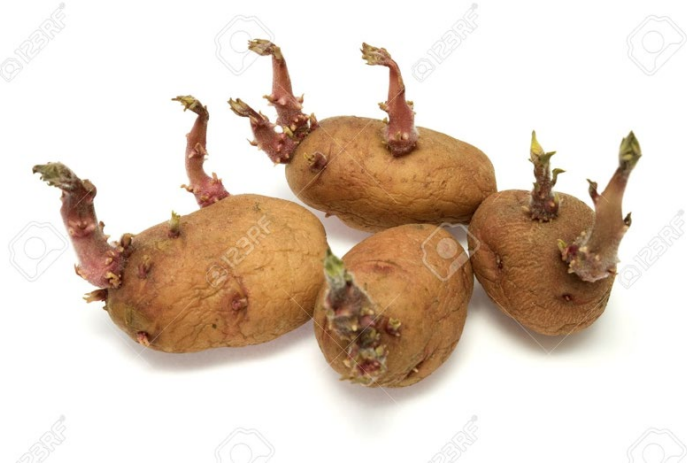
- 1. **Bulbs** - Large buds surrounded by numerous fleshy leaves, with a small stem at lower end
  - Store food
  - Example- Onions, lilies, hyacinths, tulips

- 2. **Rhizomes** - Horizontal stems that grow below-ground and have long to short internodes
  - Example- Irises, some grasses, ferns

Modified Stems

- 3. **Runners**- Horizontal stems that grow above ground and have long internodes.
    - Example- Strawberry

- 4. **Tubers**- Swollen, fleshy, underground stem
    - Store food
    - Example- Potatoes- Eyes of potato are nodes



Modified stems

- 5. **Stolons**- Produced above the surface of the ground and tend to grow in different directions.
    - Example-Turf grass
- 6. **Cladophylls**-Flattened, leaf-life stems
    - Example- Greenbriars, Orchids, and prickly pear cactus


Flowers

Flower Functions

- 1. Attract pollinators-petals (and sometimes petaloid sepals or bracts) lure pollinators.
- 2. Reproduction-fertilized ovary develops into fruit which contains seeds.

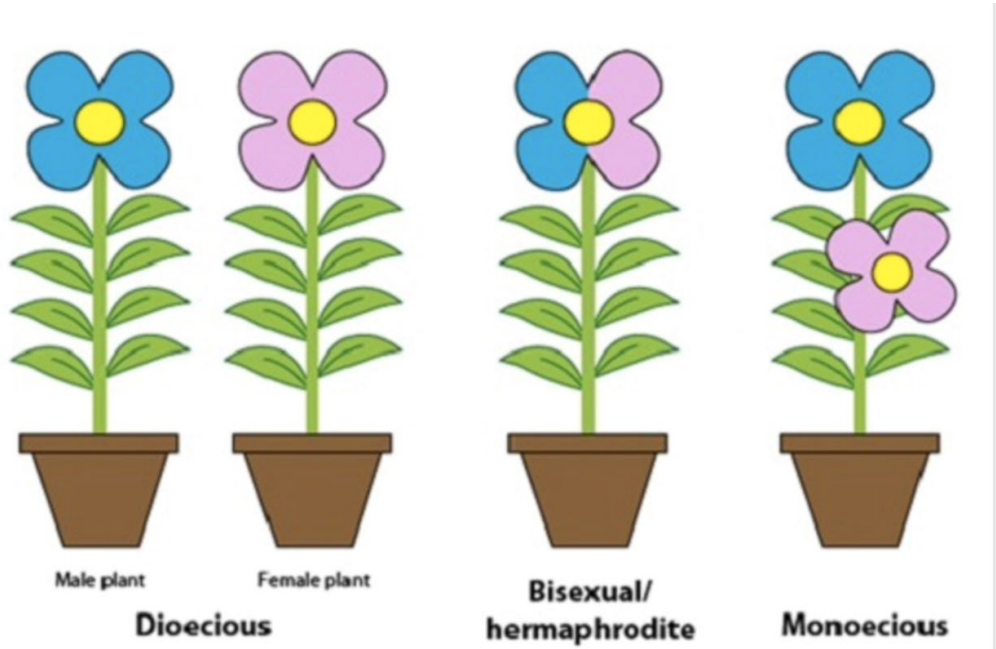
Plant life cycles

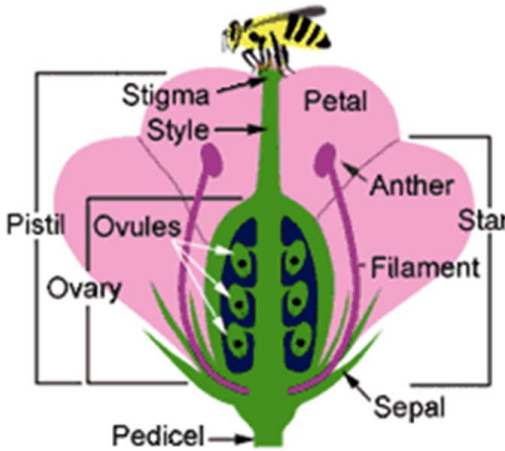
- Flowers are also broken down into 3 life cycle groups:
  - A. **Annuals**-plants that grow from seed, flower and then die in 1 growing season
  - B. **Biennial**- a plant that grows from seed, flowers and dies in 2 growing seasons
  - C. **Perennials**-plants that grow for many seasons before flowering, or many will flower each growing season.

Flower Morphology

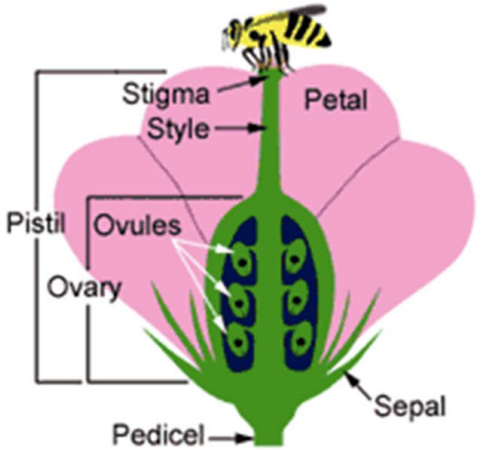
Flowers are broken into 3 classes:

1. **Monoecious**- is translated as “single house,” meaning that male and female flowers are found on a single individual.
   - **Complete Flower**- Has all the parts of a flower.
2. **Bisexual/Hermaphrodite**- Flowers have both the male and female part. Known as a **Perfect Flower**.
   - **Complete Flower**- Has all the parts of a flower.
3. **Dioecious**-which is “double house.” This means that male flowers are on one plant and female flowers are on another plant.
   - **Complete Flower**- Has all the parts of a flower.
   - **Incomplete Flower**- Is missing part of a flower.





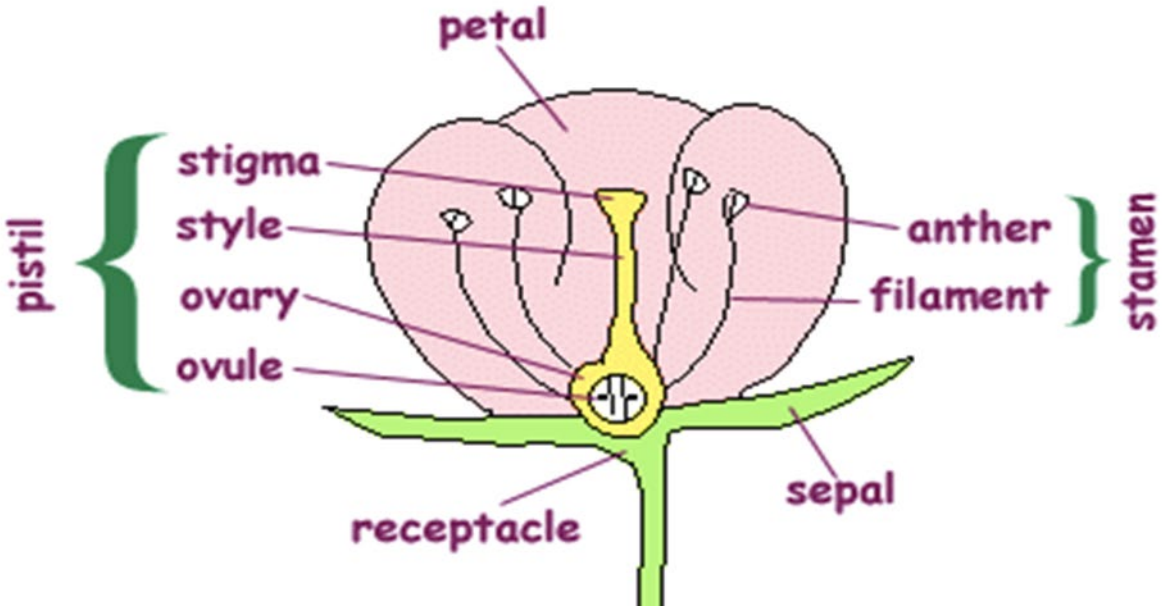
Monoecious (complete) flower



Dioecious (incomplete) flower
gynoecious flower (has only ovules)

Flower Morphology

- Sepals - calyx
- Petals – corolla
- Perianth = S and P
- Stamen – filament – anther (produces pollen/male)
- Pistil – stigma – style – ovary (female)
- Receptacle – is the swollen portion at the tip of the peduncle that contains the flower parts



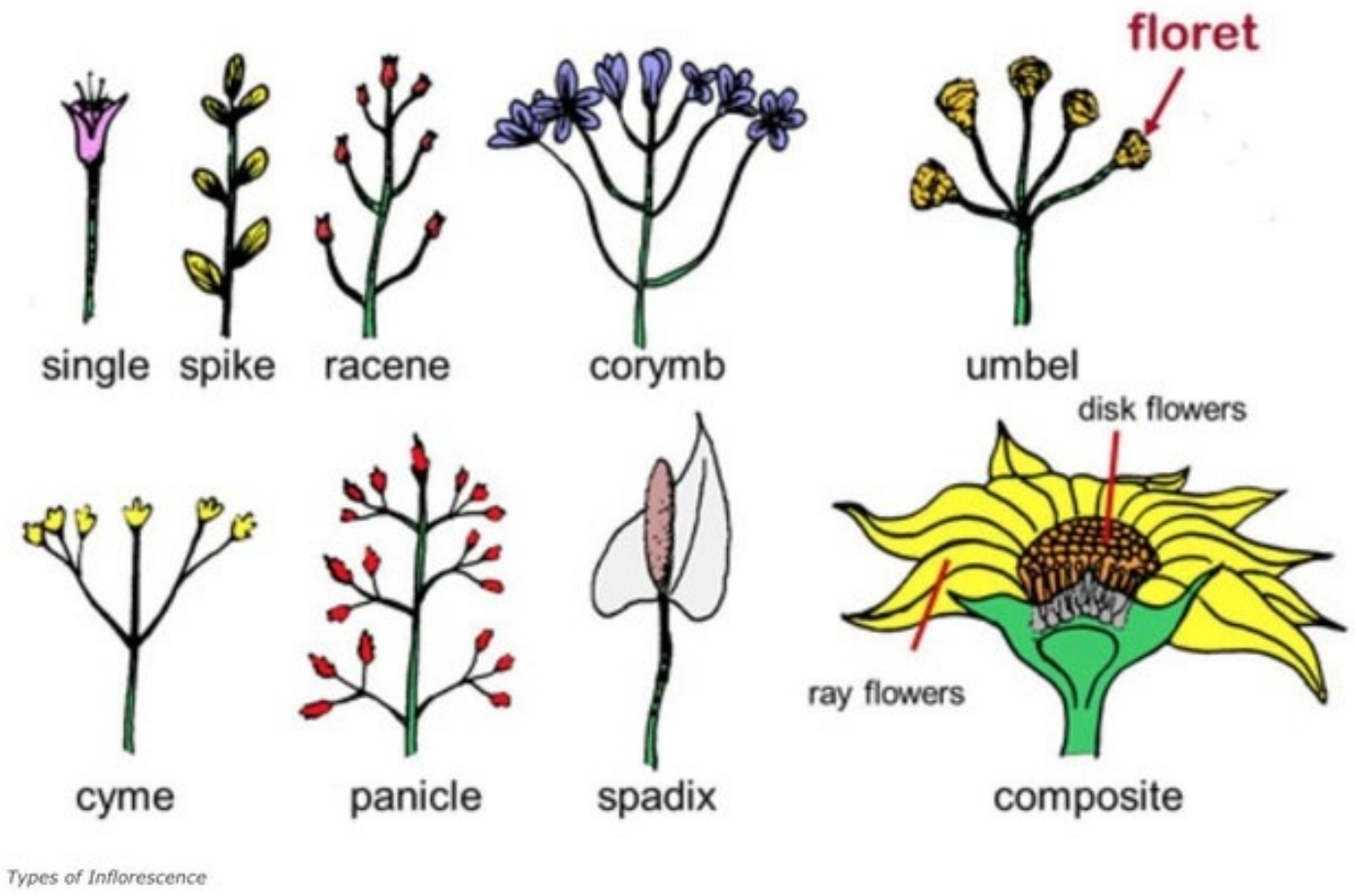
Flowers: Solitary or Grouped?

- Solitary – A single flower borne at the end of a peduncle

- Inflorescence – A flower cluster borne on a peduncle
  - May be branched or unbranched
  - Individual flowers may be sessile (unstalked) or borne on pedicels (flower stalks)

Common Types of Inflorescence

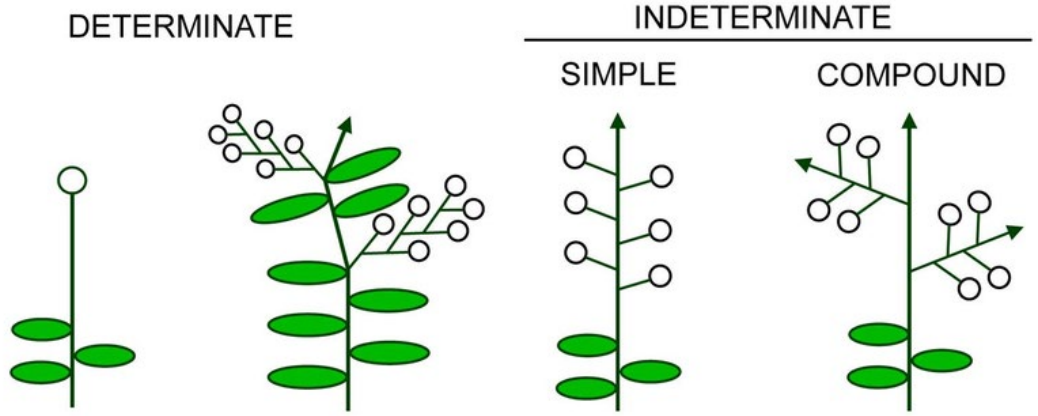
- Spike
- Raceme
- Spadix
- Cyme
- Umbel
- Panicle
- Corymb
- Ray and Disc



Inflorescence: Determinate or Indeterminate?

- **Determinate**: terminal flower blooms first, halting elongation of the inflorescence axis

- **Indeterminate**: lower or outer flower blooms first, allowing for elongation of the inflorescence axis as the flowers develop




Fruit

Fruit Functions

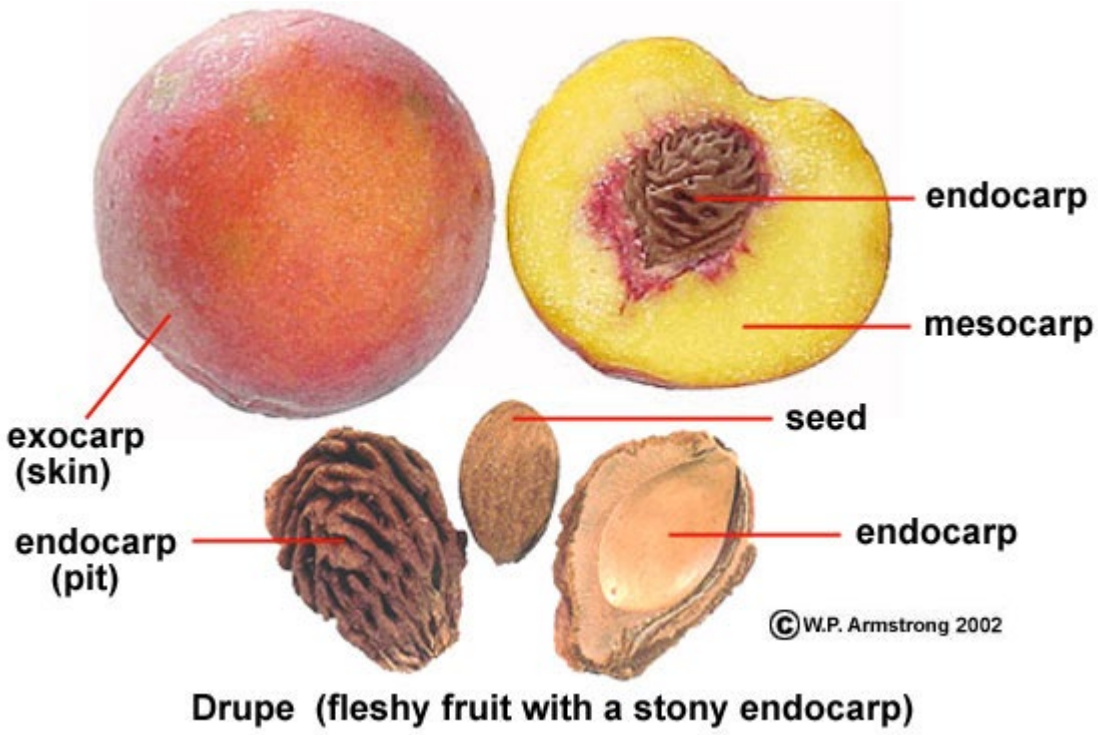
- 1. Protect developing seeds (physical barrier between immature seeds and the environment)
- 2. Aid in dispersal of mature seeds

Fruits Are……

- Ripened, seed-bearing ovaries of flowers
- Nearly as varied in color, form, size, texture, and number as flowers
- Can be used as the distinguishing characteristic of a species or cultivar
- Divided into four large categories
    1. Dry
    2. Fleshy
    3. **Dehiscent** (splitting open)
    4. **Indehiscent** (doesn't naturally split open)

Fruit Morphology

- Pericarp (fruit wall)
- Exocarp (skin)
- Mesocarp (flesh)
- Endocarp (pit)
- Placenta (the part of the ovary to which the seeds are attached)
- Seed (mature ovule, contains embryo and, in angiosperms, endosperm)

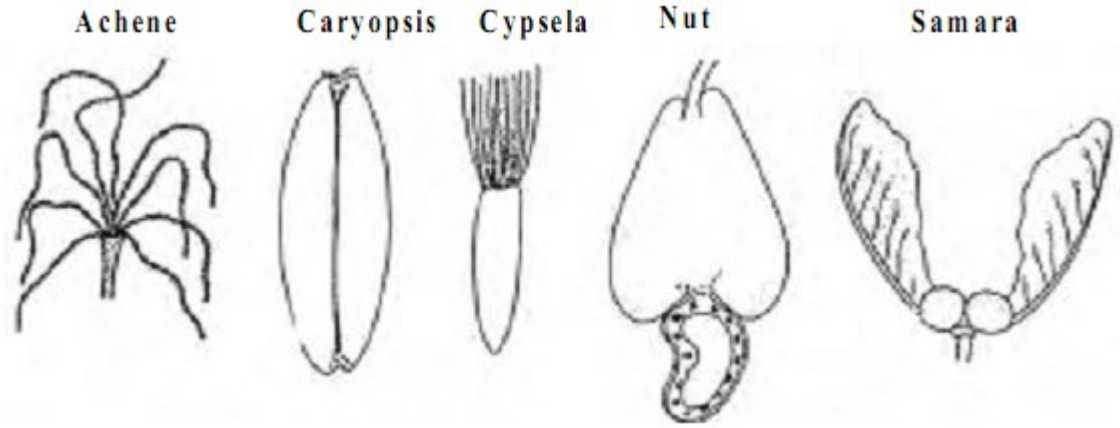


Drupe (fleshy fruit with a stony endocarp)

Dry Fruits

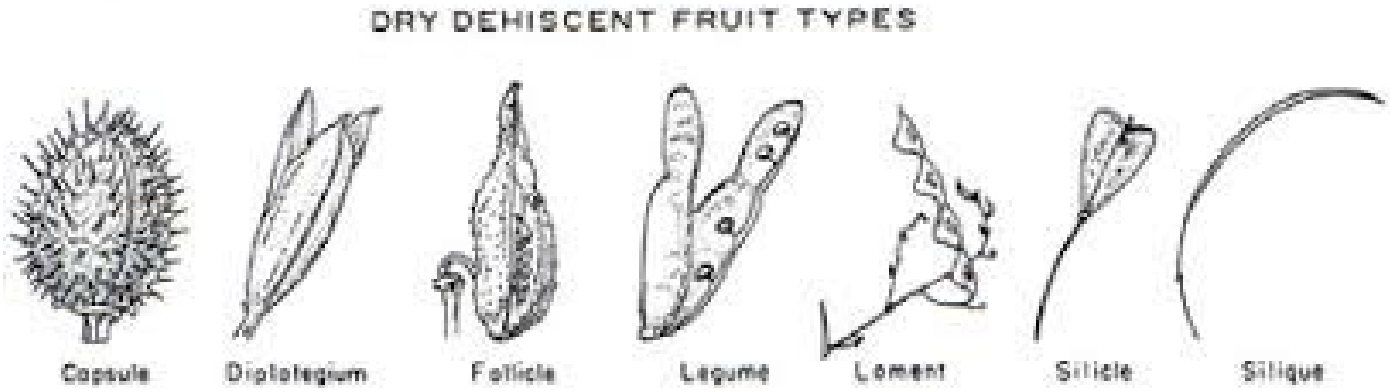
Indehiscent- do not naturally split open.

- Achene (i)
- Samara (i)
- Nut (i)
- Caryopsis (i)



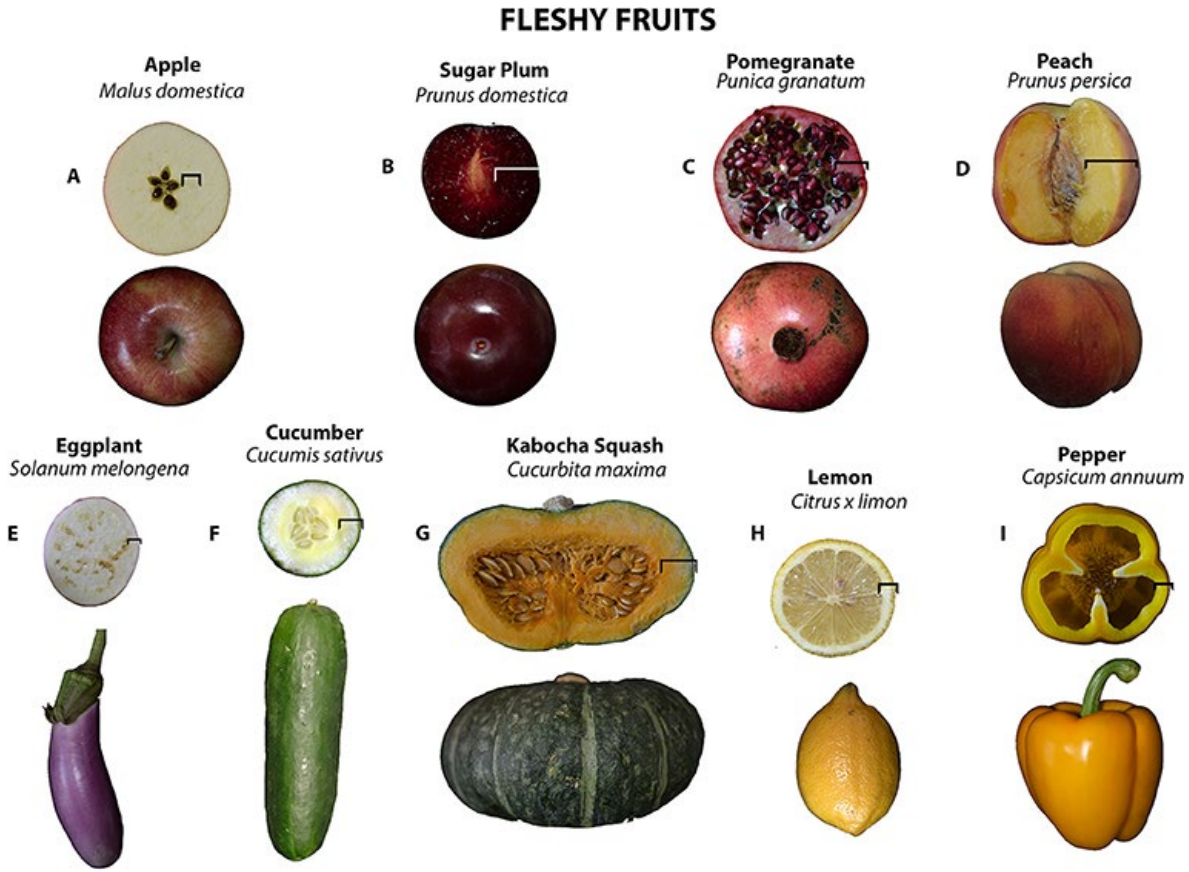
Dehiscent- Naturally split open.

- Capsule (d)
- Silique (d)
- Legume (d)
- Follicle (d)



Fleshy Fruit

- Simple
  - Drupe (peach)
  - Berry (tomato)
  - Hesperidium (lemon)
  - Pome (apple)
  - Pepo (squash)

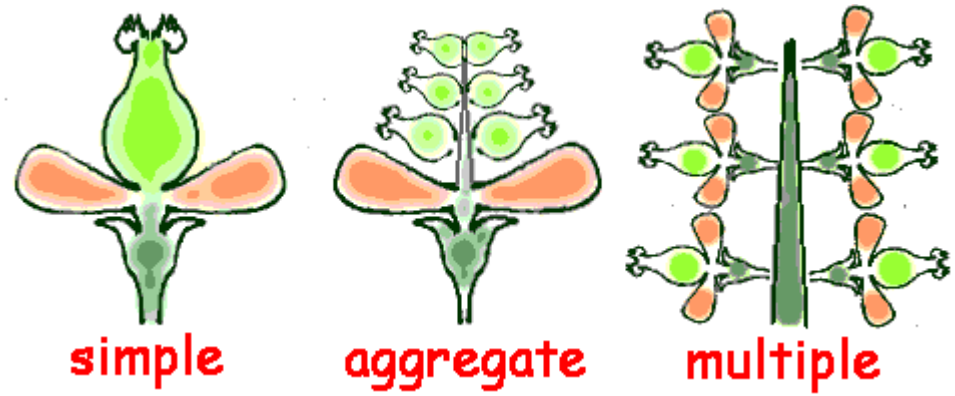


Fleshy Fruit continued

- Compound

  – Aggregate (from separate carpels of one flower, eg., blackberry, magnolia, strawberry)

  – Multiple (from pistils of several clustered flowers, eg. , pineapple, mulberry, sycamore)



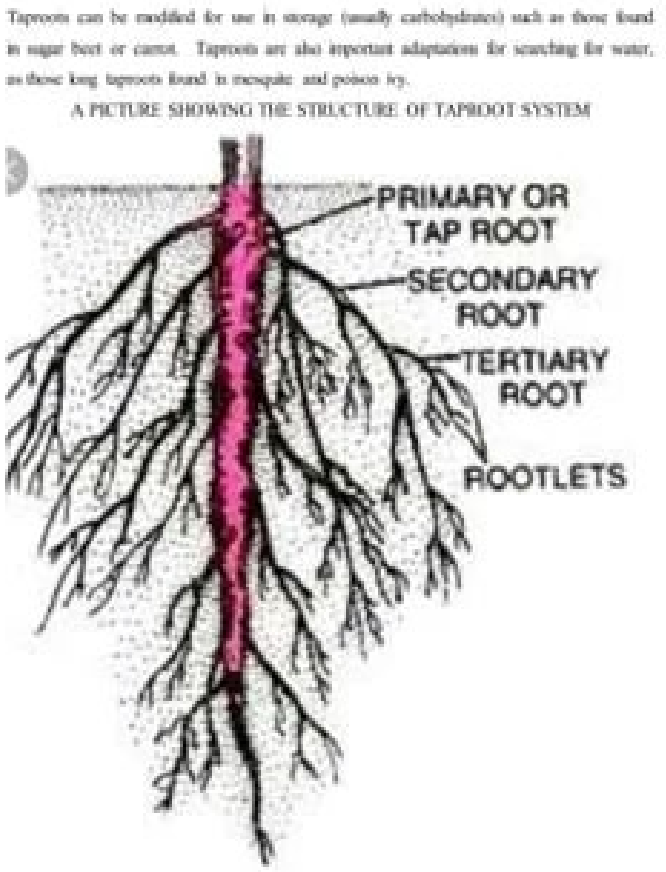

Roots

Root Functions

- 1. Absorption of water & minerals
- 2. Anchoring plant in place
- 3. Conductance (water and minerals move up via xylem, sugars move up and down via phloem)
- 4. Storage of water and carbohydrates

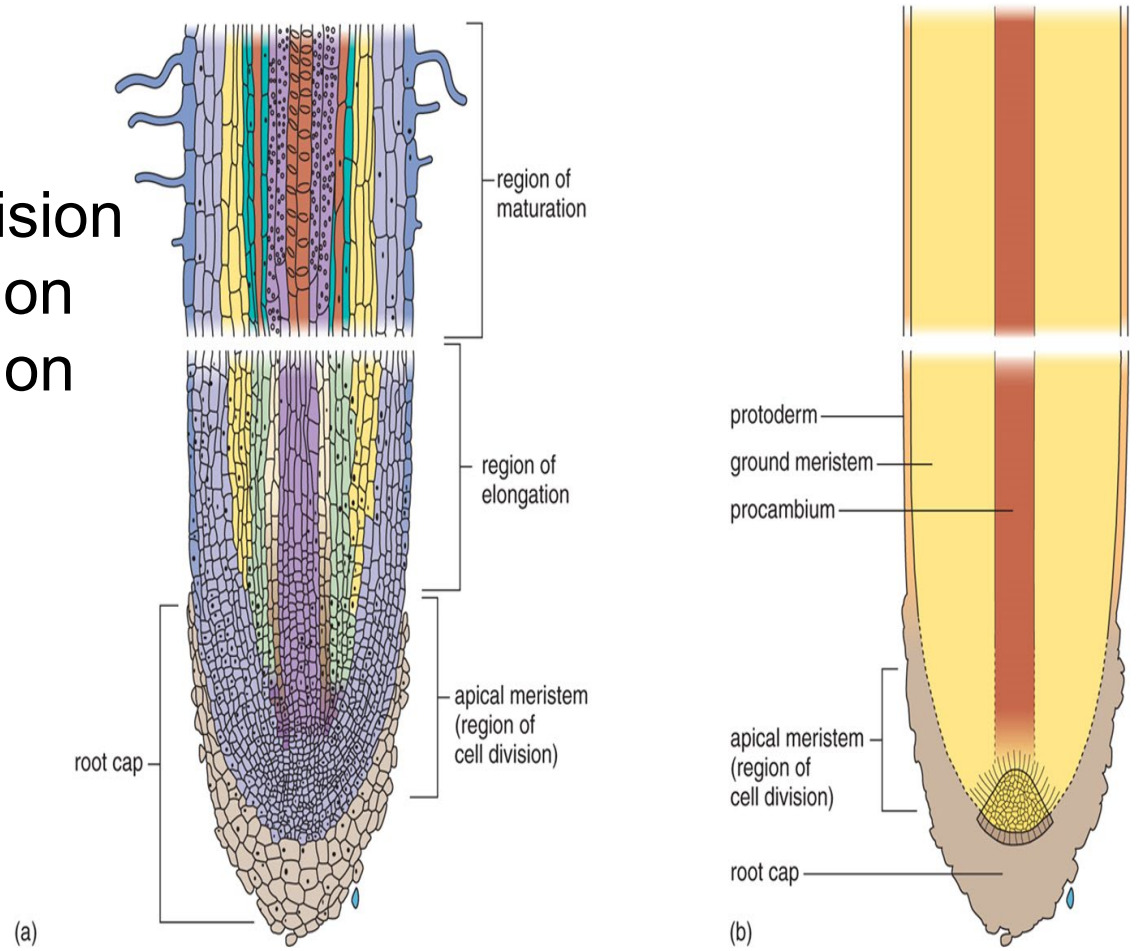
Root Morphology

- primary root = taproot
- secondary roots = fibrous roots
- adventitious roots = arise from a stem or other plant part (not from a root)
- root hairs = tiny outgrowths that absorb water/minerals by osmosis



4 Root Structures

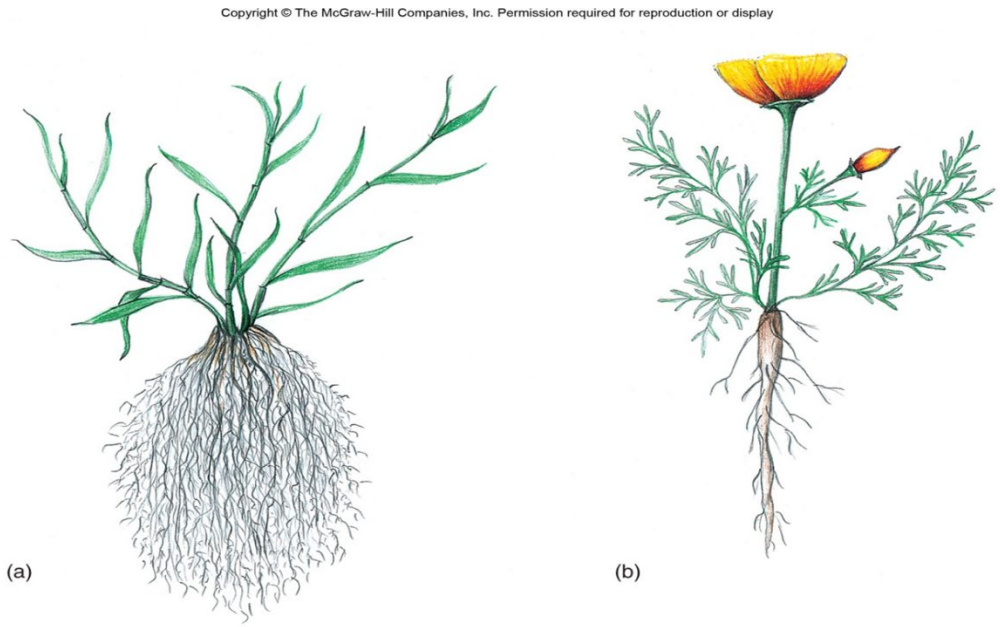
1. Root Cap
2. Region of Cell Division
3. Region of Elongation
4. Region of Maturation
a. Surface Cells
b. Cortex
c. Endodermis
d. Vascular Cylinder



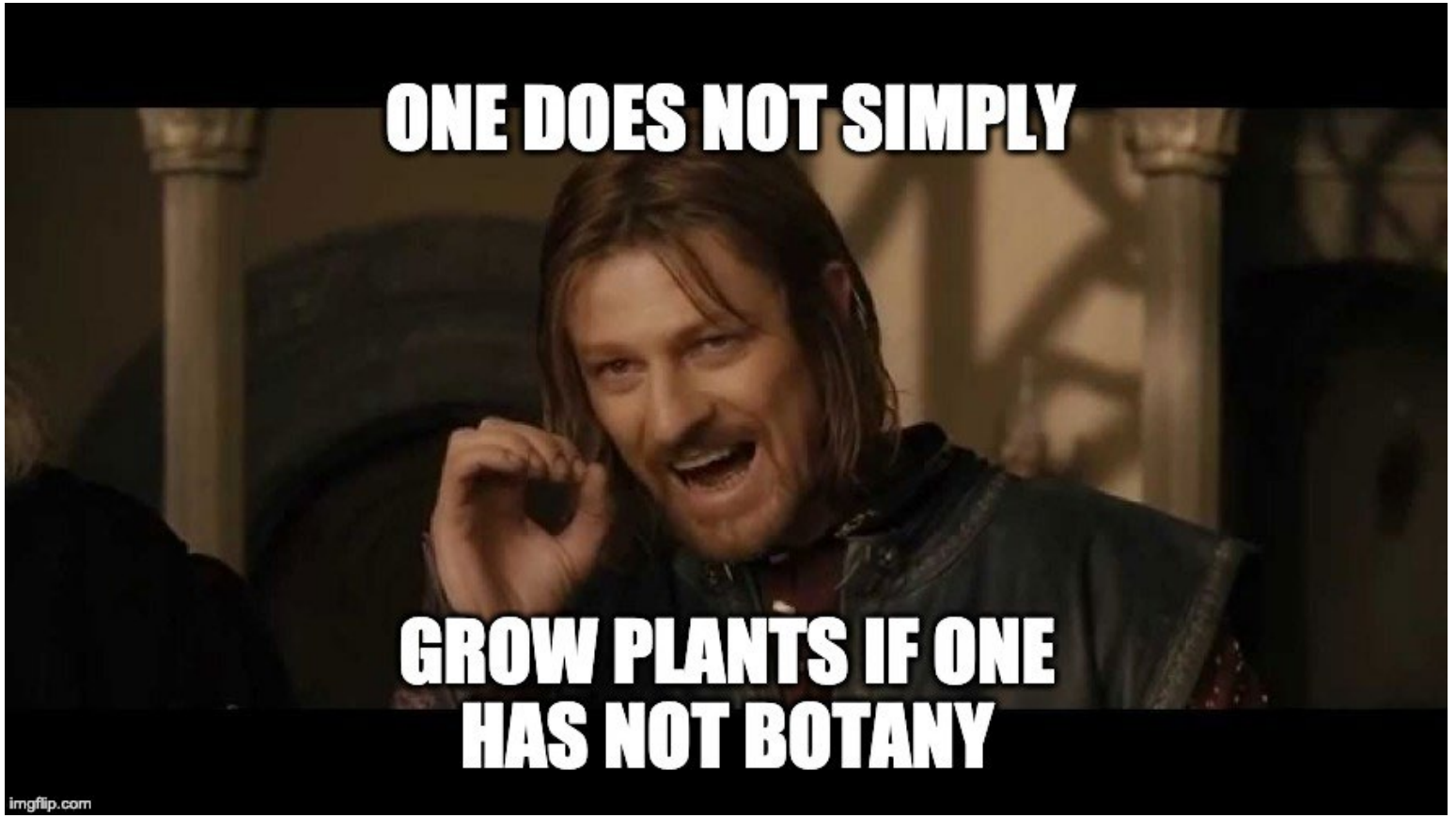
2 Types of Root System

1. **Fibrous**
- Shallowly-rooted
- More susceptible to drought but are quick to absorb surface and irrigation water.
- Can respond quickly to fertilizer application.
- Most common in monocots

2. **Tap**
- Deeply-rooted
- Enables the plant to anchor better to the soil and obtain water from deeper sources.
- Most common in dicots



Thank you very much!



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