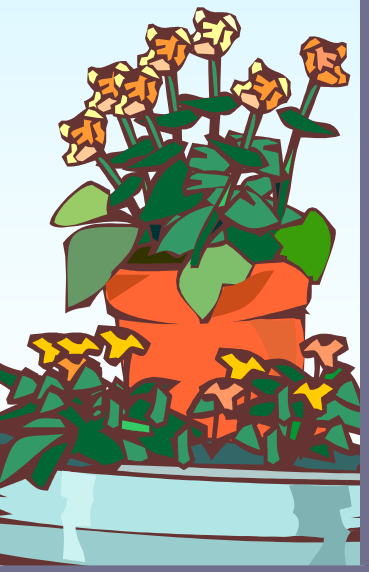
Basic Botany for Master Gardeners



Vascular Plants

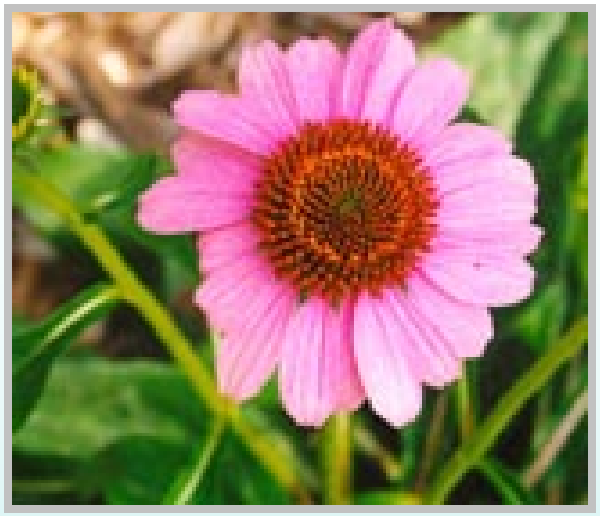
- Almost horticultural plants
- Contain tissues which transport water and dissolved materials.
- Most produce seeds as a way to propagate or reproduce themselves.
- The vascular plants that reproduce by seed can be divided into two classes:

gymnosperms

angiosperms

I. Gymnosperms

- do not have true flowers
- seeds are not enclosed in fruits
- most seeds are produced in cones



II. Angiosperms

- produce flowers
- develop fruits that contain seeds

A. Monocotyledons (Monocots)

- produce 1 seed leaf (cotyledon)
- flower parts generally in multiples of 3
- leaves long and narrow with parallel veins
- vascular system arranged in bundles (tulips, corn, spider plant)

B. Dicotyledons (Dicots)

- produce 2 seed leaves
- flower parts generally in multiples of 4 or 5
- diversely shaped leaves with netted veins
- vascular system forms rings inside the stem (rose, maples, cucumbers)

Annuals

Pass through entire life cycle from seed germination to seed production in one growing season.

Biennials

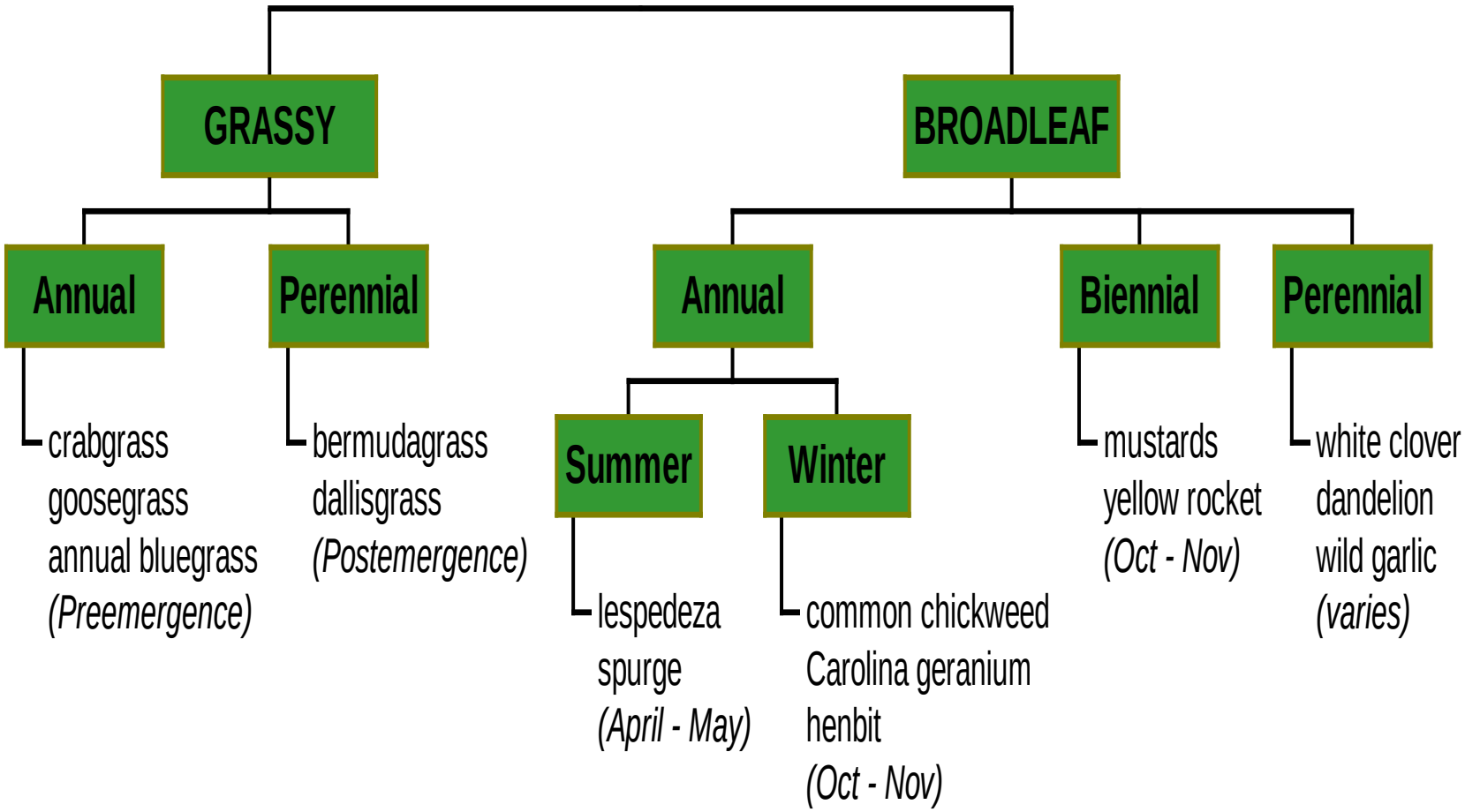
Start from seed to produce vegetative structures and food storage organs the first season. Winter's cold temperatures stimulate the production of flowers, fruit and seeds the second season (to complete the life cycle).

Perennials

Plants that live for 3 or more years. Once mature, they generally produce flowers and seeds each year.

- **Herbaceous:** tops die back to the ground each winter and new stems grow from the roots each spring.
- **Woody:** Top growth persists from year to year and develops woody tissue.

Types of Weeds



Plant Taxonomy

- Binomial nomenclature (genus, species).
- Developed by Carl von Linne in 1700's.
- Classification based on the flowers and/or reproductive parts of a plant.

Binomial System of Nomenclature

Basis for defining species (a self-perpetuating population that is isolated genetically)

Each species is given 2 names in botanical Latin--the scientific name

Sugar Maple (family *Aceraceae*)

Botanic Variety

Exhibit differences which are inheritable occur naturally

Acer saccharum var. *conicum*

Cultivar

Contractrion for "cultivated variety" (L.H. Bailey)

Usually asexually propagated, but also lines (from a selected seed source) and hybridization

Acer saccharum 'Columnare' or cv. Columnare

Principal Plant Parts

1. **Vegetative:**

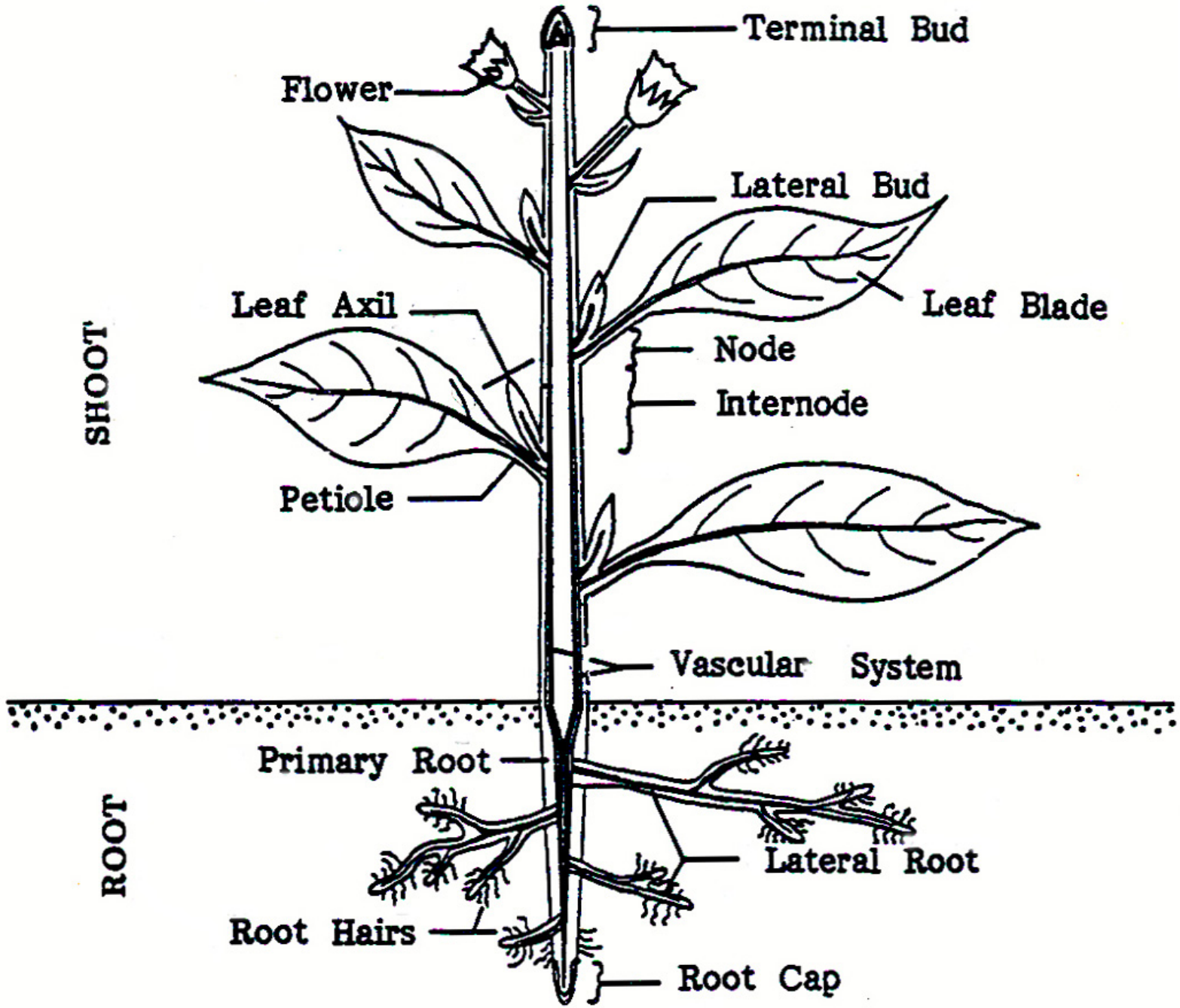
Plant parts are NOT involved in the production of seed.

stems *buds*
leaves *roots*

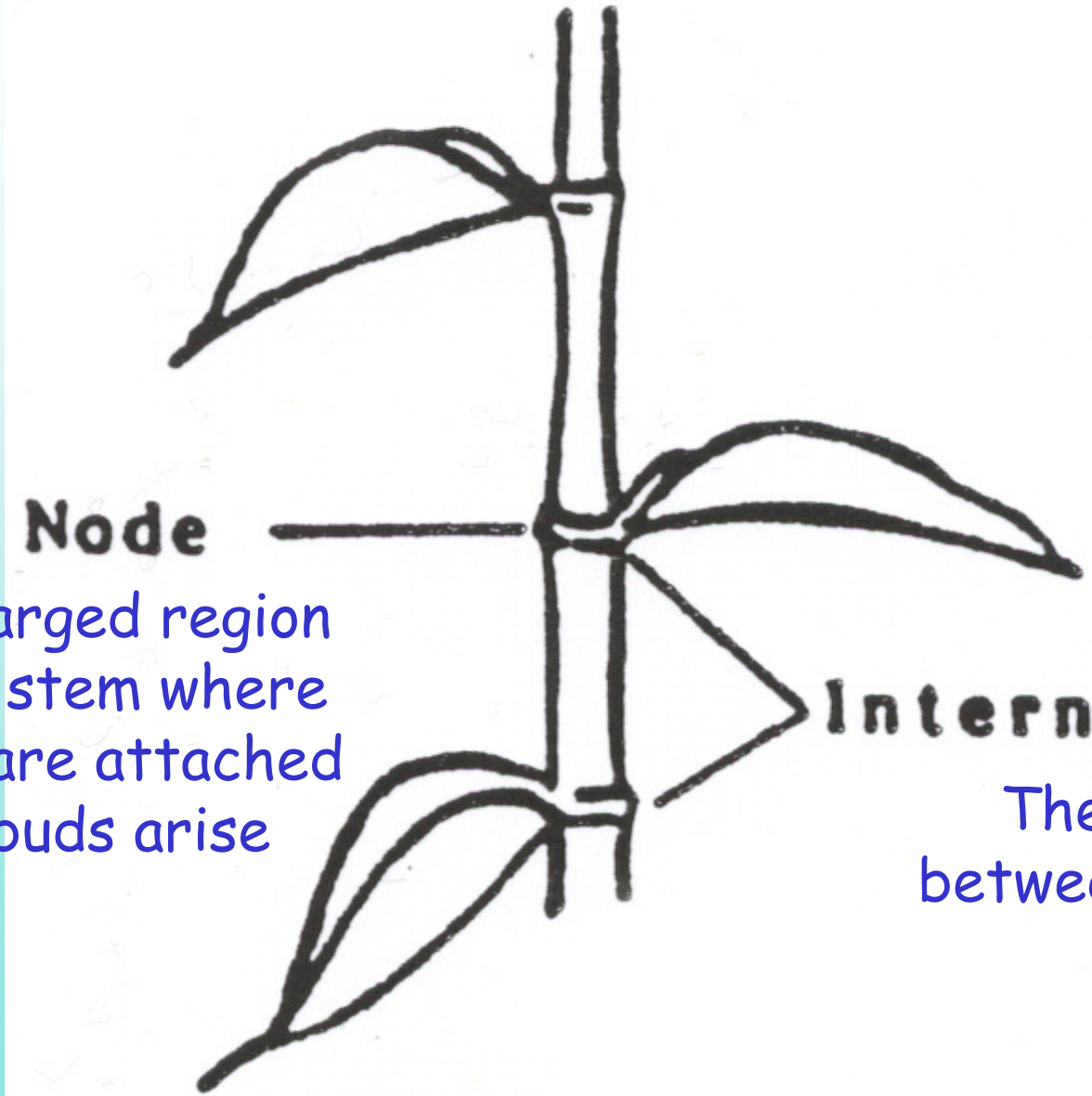
2. **Reproductive:**

Plant parts are involved in the production of seed.

flower buds *fruits*
flowers *seeds*


Terminal Bud
Flower
Lateral Bud
Leaf Axil
Leaf Blade
SHOOT
Node
Internode
Petiole
Vascular System
Primary Root
ROOT
Lateral Root
Root Hairs
Root Cap

Parts of a Stem



An enlarged region of the stem where leaves are attached and buds arise

The region between 2 nodes

Internode length can vary

- Decreasing fertility can decrease internode length.
- Low light levels can cause plant to "stretch" (etiolation).
- Internode length decreases as the growing season draws to its end.
- Plants growing rapidly tend to have greater internode lengths than less vigorous plants.
- Internode length varies with competition from surrounding foliage or developing fruit.

Growth Habit

Stems help us define/describe a plant's habit of growth.

Trees

- perennial woody plant
- 1 main stem called a trunk
- usually over 12 feet tall

Shrubs

- perennial woody plant
- 1 or main stems
- less than 12 feet

Stems

- main axis giving plants their upright form
- support buds and leaves
- serve as conduits for carrying water, minerals and sugars

Stems As Conduits

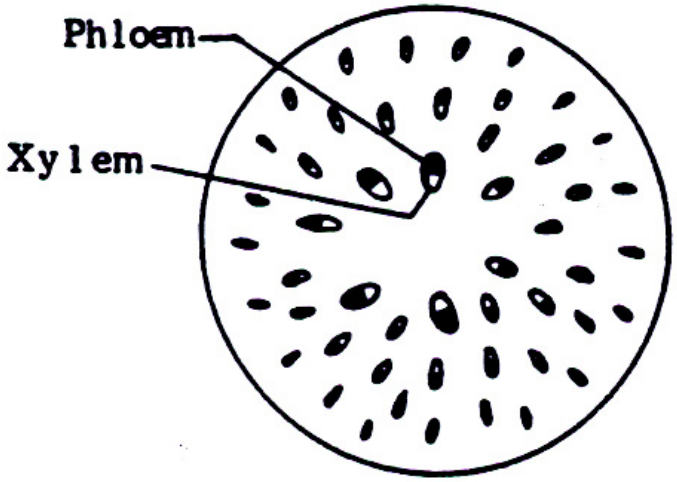
The vascular system is composed of 2 types of tissue:

1. Xylem: Conducts water and minerals upward.

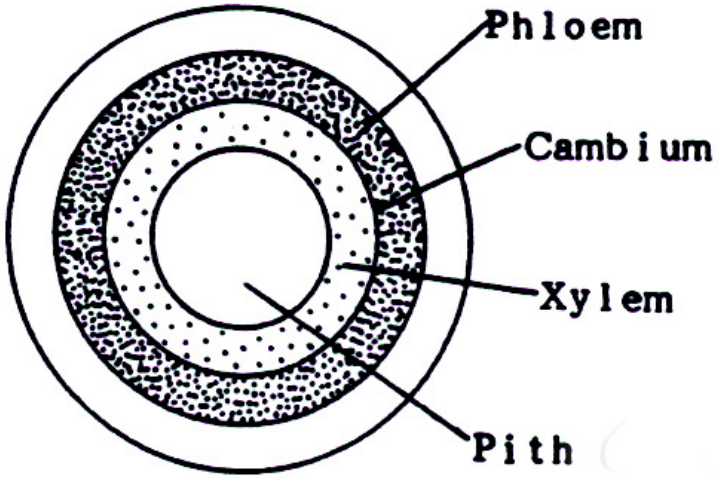
2. Phloem: Conducts synthates (starches, sugars) manufactured in the plant to wherever they are needed.

In older dicot stems (example: trees) the vascular cambium is located between the xylem and pholem. It is the site of cell division and active growth and is responsible for the stem's increase in girth.

Cross-section of a Stem



Bundle system of a monocot stem



Ring system of a dicot stem

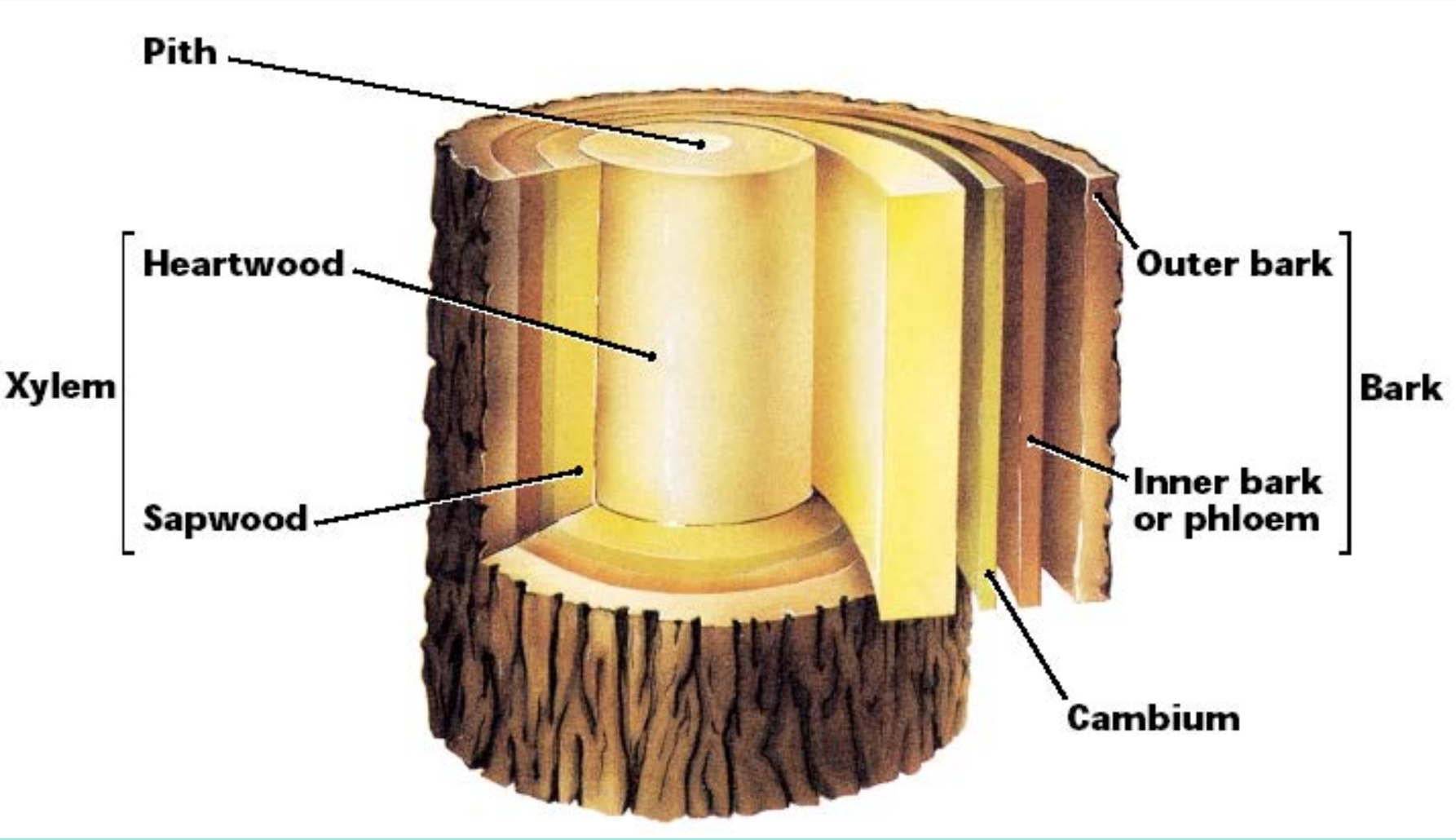
Monocots

Xylem and phloem are arranged in bundles that are dispersed throughout the stem

Dicots and Gymnosperms

Xylem and phloem form rings inside the stems. The phloem is nearest the bark; the xylem forms the inner rings and develops into wood in woody plants.

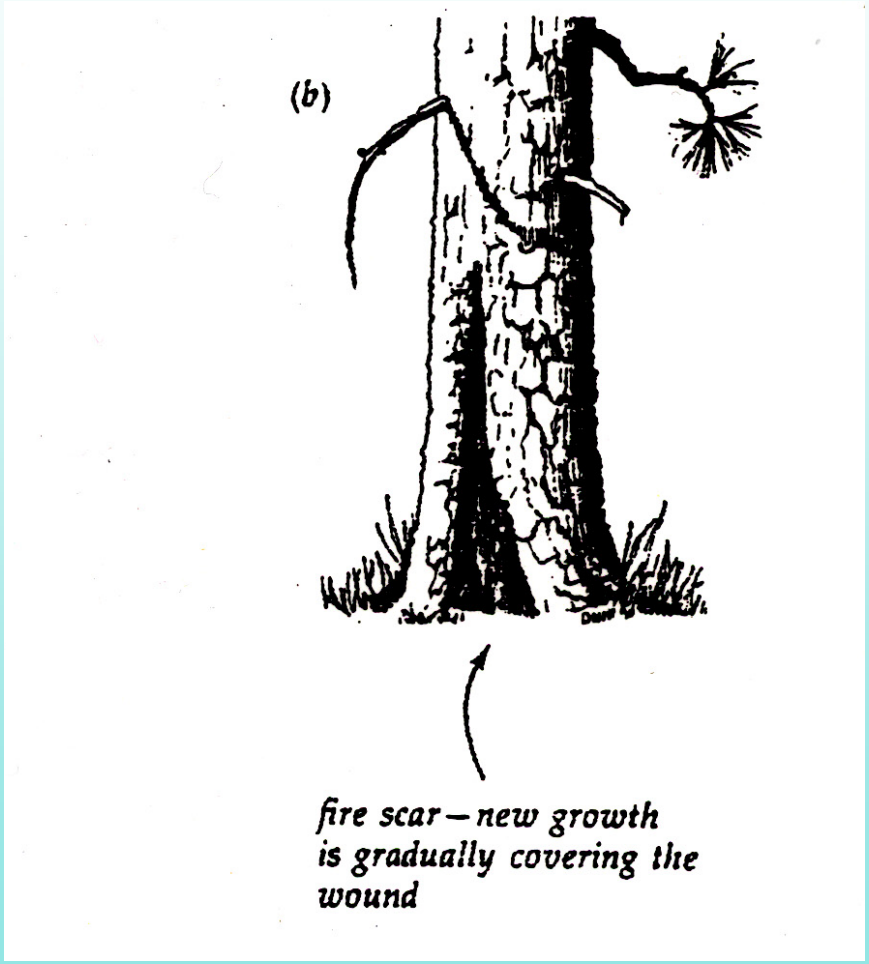
Parts of a Woody Stem

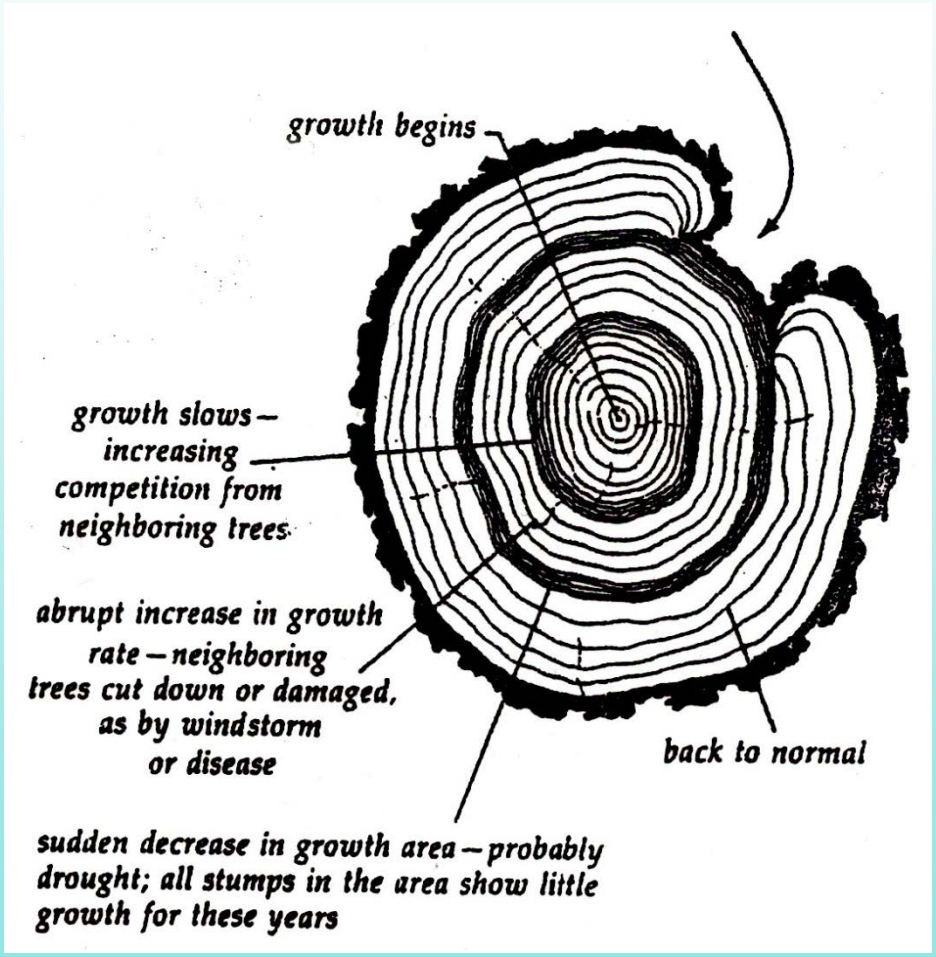


<u>Annual Rings</u> = xylem rings

* Spring Xylem is wide & light brown (grows rapidly)
* Summer Xylem is thin & darker (grow slower)
* Each pair of light & dark rings = one year's growth.

Tree Wounds


(b)
fire scar—new growth is gradually covering the wound


growth begins
growth slows—increasing competition from neighboring trees
abrupt increase in growth rate—neighboring trees cut down or damaged, as by windstorm or disease
back to normal
sudden decrease in growth area—probably drought; all stumps in the area show little growth for these years

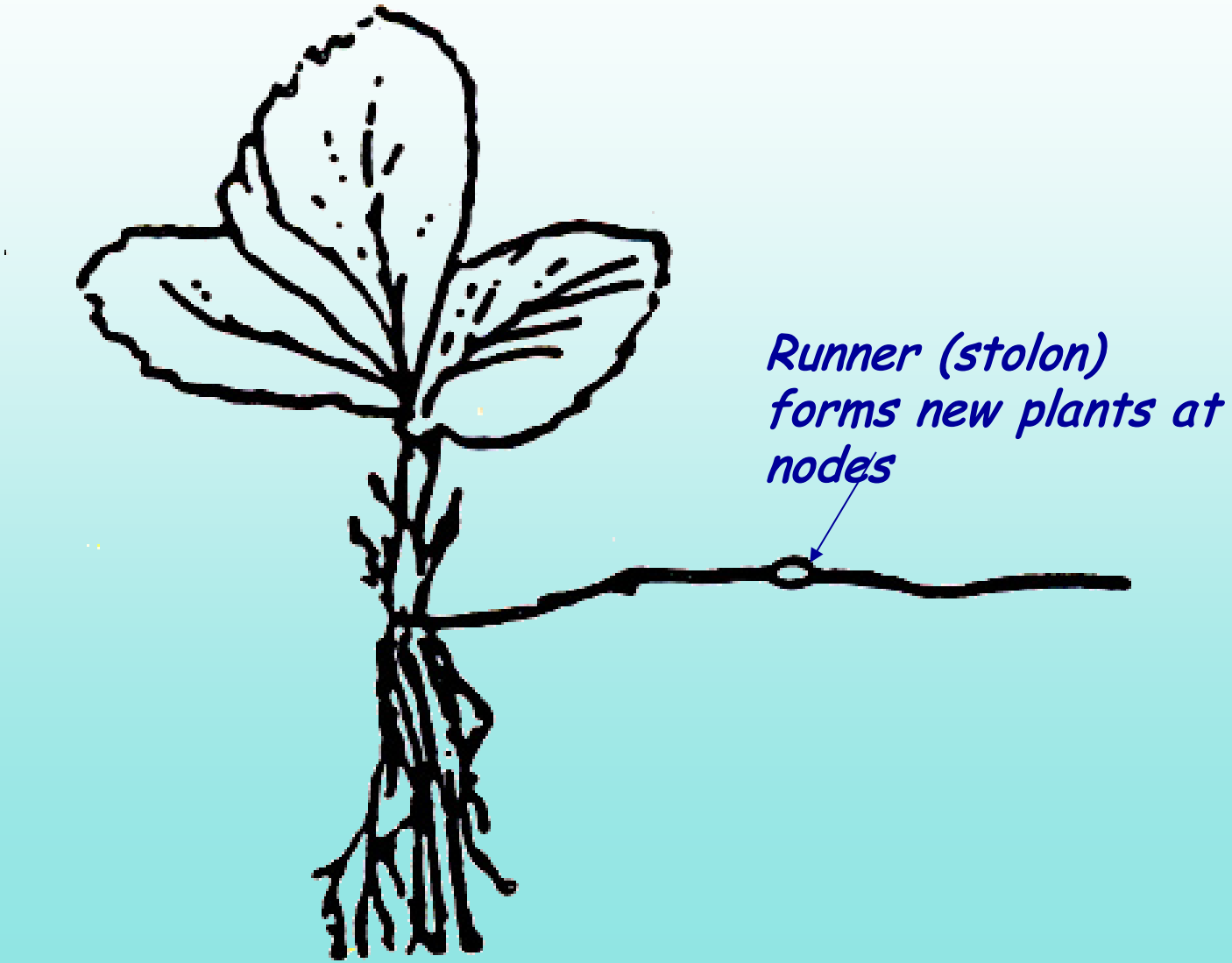
Diversified Stem Development

All stems have one thing in common. They all have nodes divided by internodes.

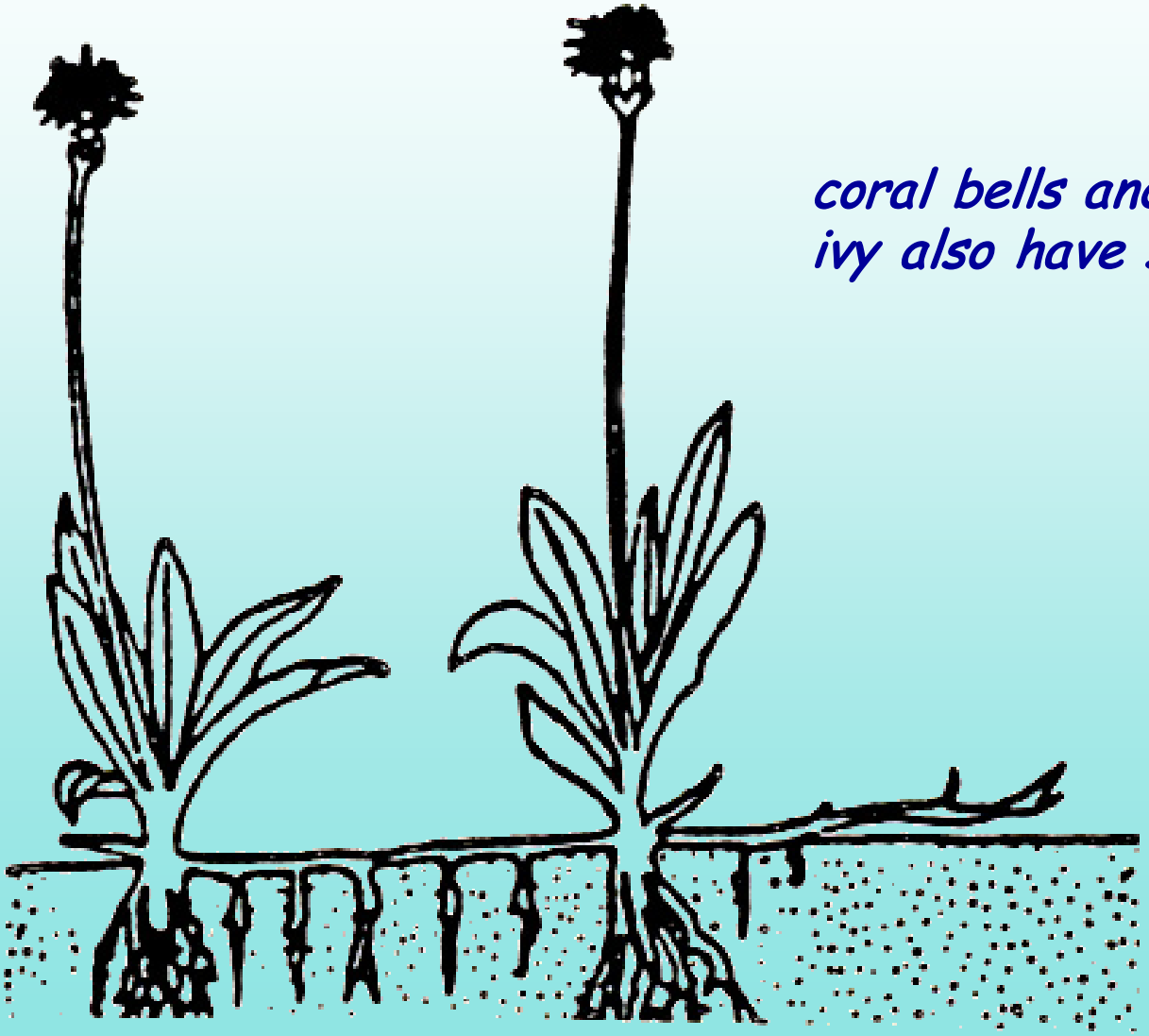
Above-ground: Crowns, Stolons, Spurs

Below-ground: Bulbs, Corms, Rhizomes, Tubers

Crowns: Compressed stem with short internodes. Examples: Strawberries, Dandelions and African Violets.

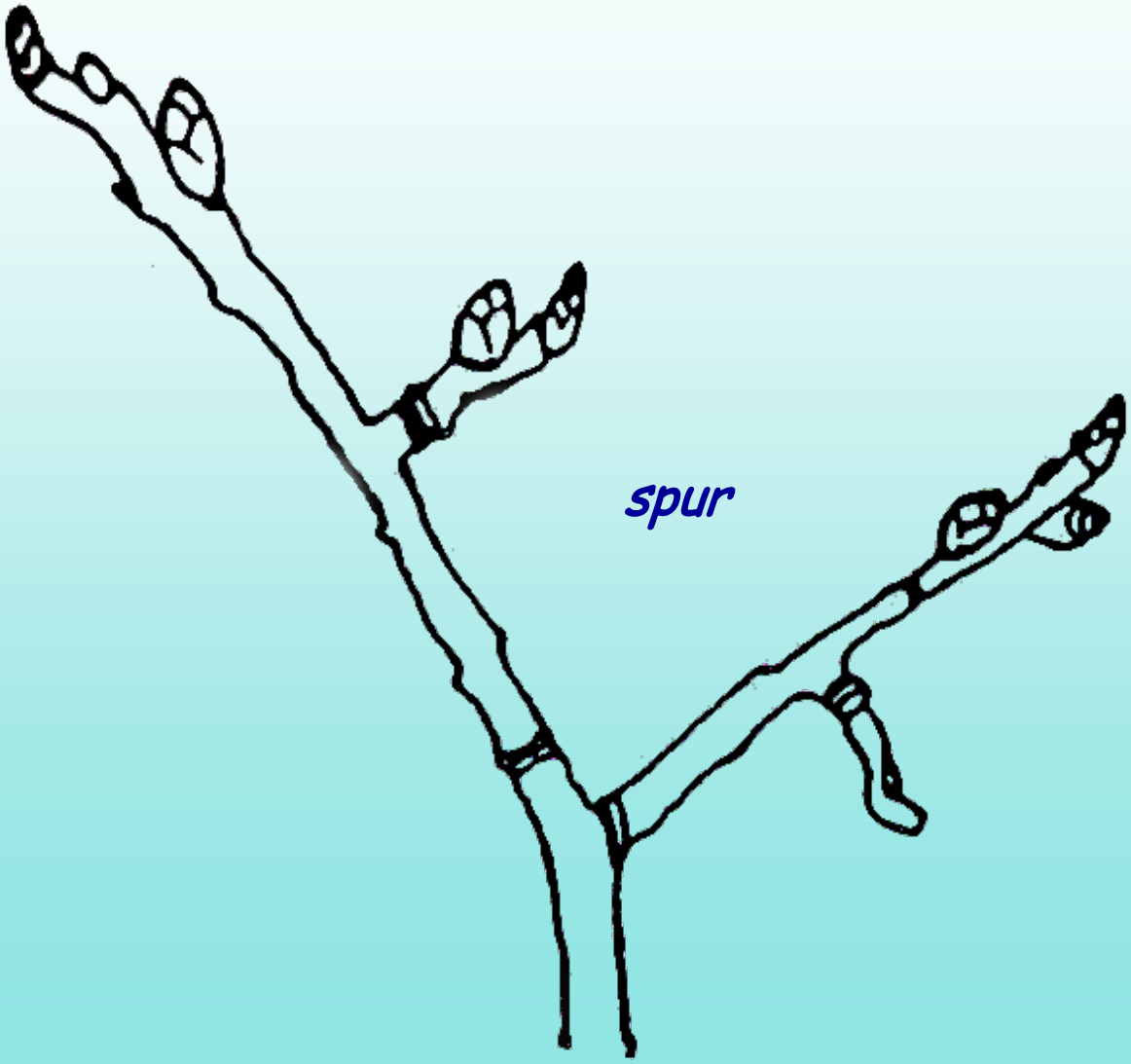


Stolons: Horizontal stem that lies along the top of the ground. Examples: Strawberries and Spider Plants.



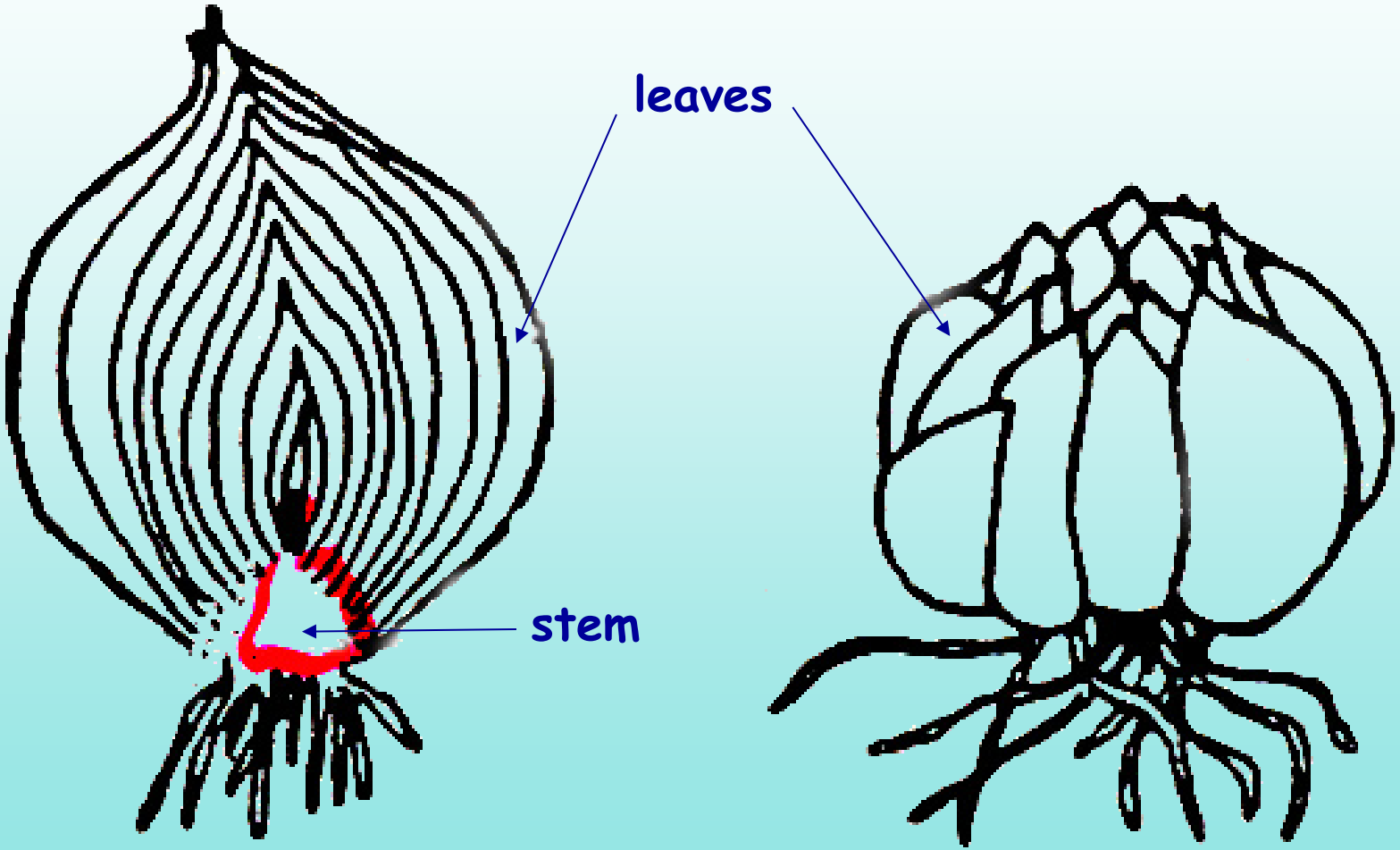
coral bells and ground ivy also have stolon

Spurs: Short, stubby side stems that arise from the main stem; common on apple, pear and cherry trees where they bear fruit.

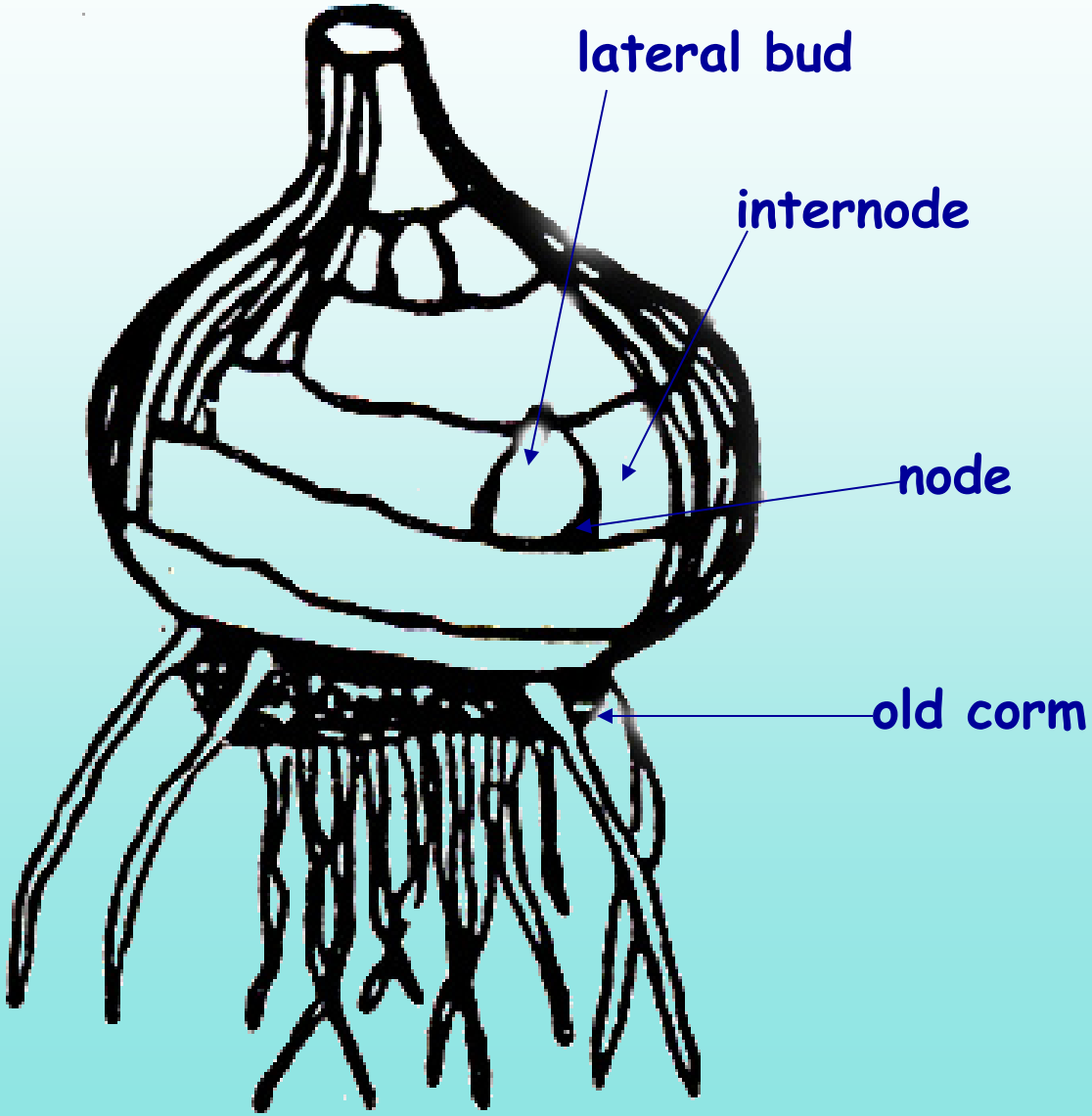


Bulbs: Shortened, compressed, underground stems surrounded by fleshy leaves that envelop a central bud located at the tip of the stem.

Examples: Tulips, Lilies, Daffodils and Onions.

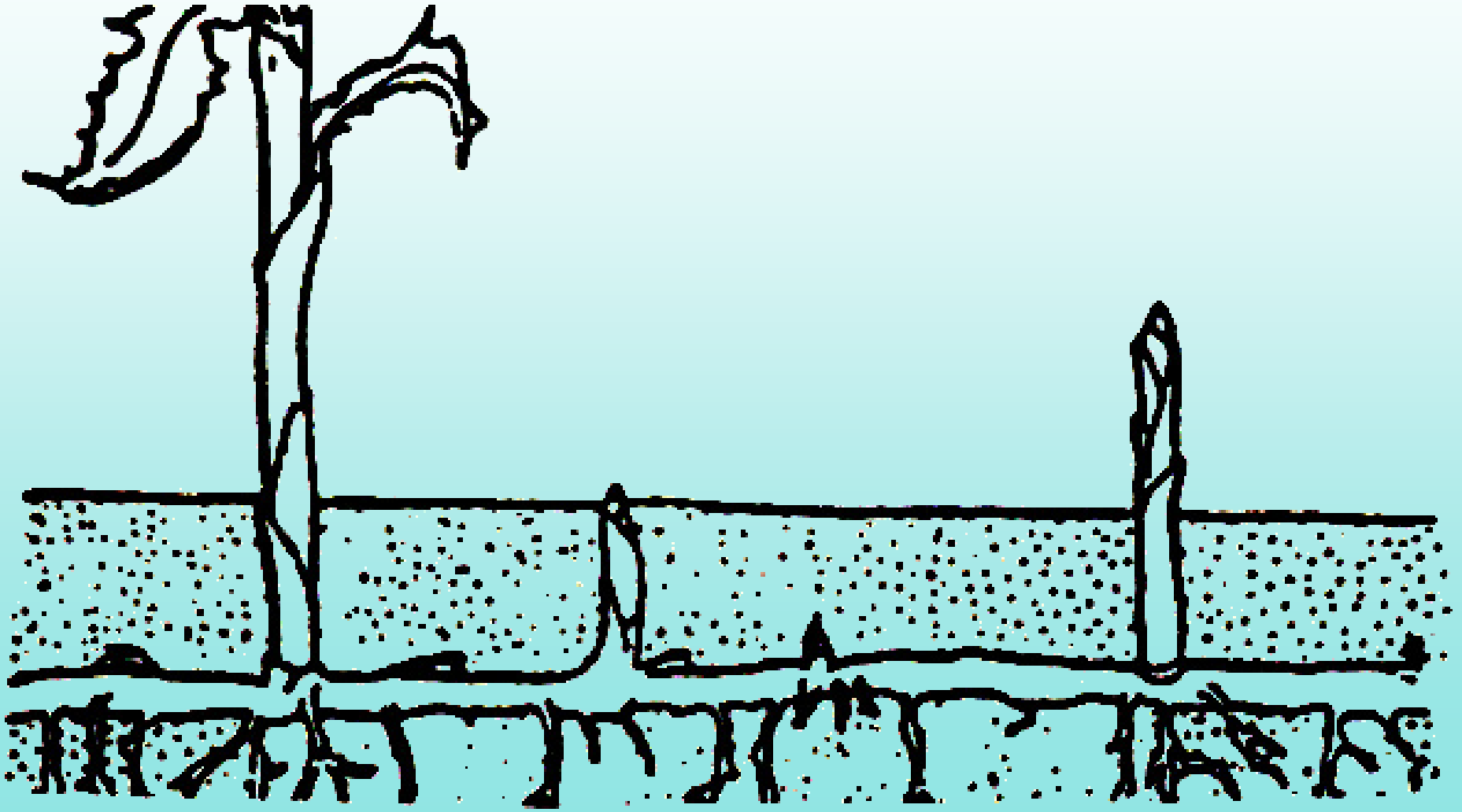


Corm: A solid swollen stem whose scales have been reduced to a dry, leaf-like covering.
Examples: Gladiolus and Crocus.



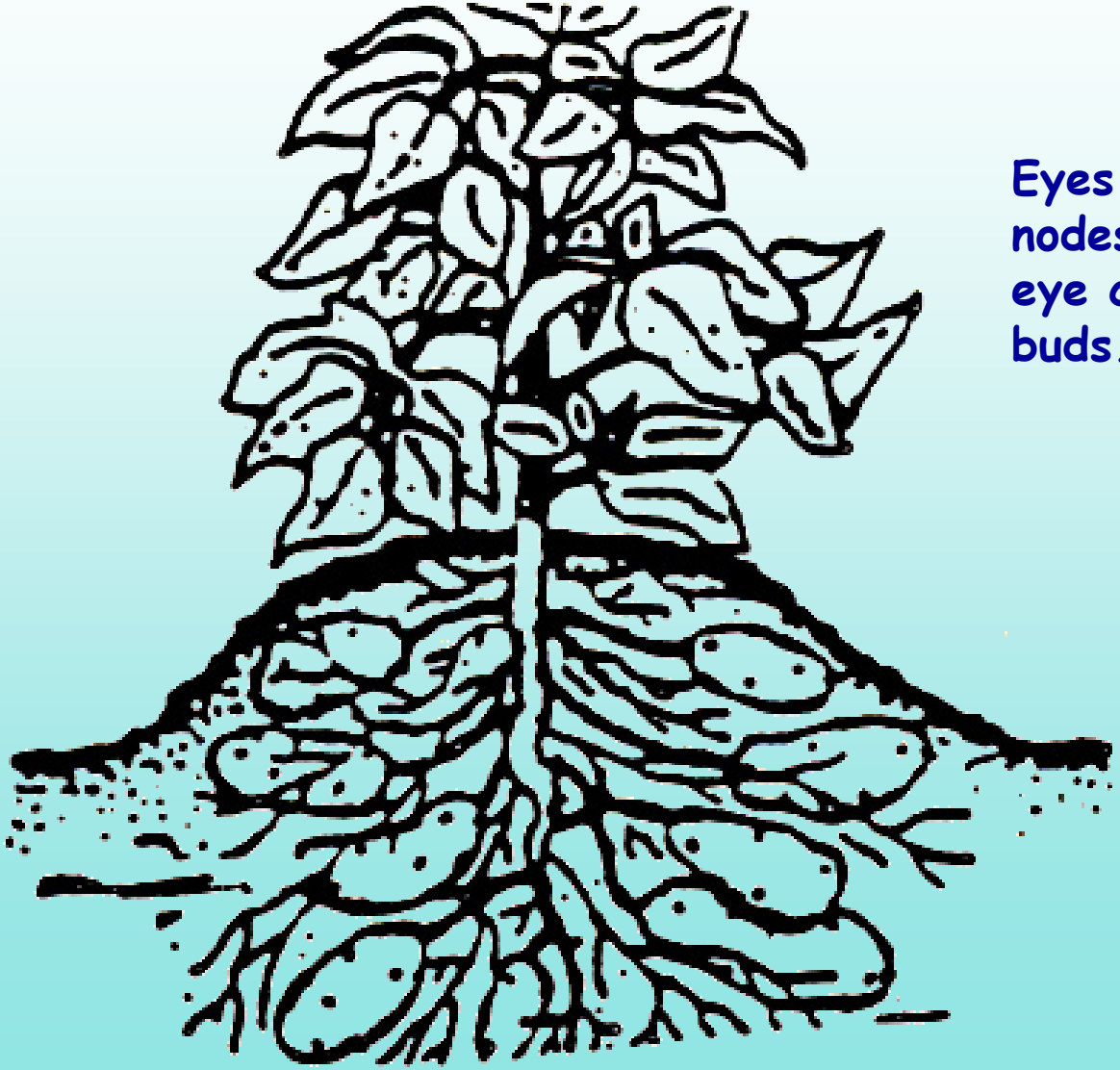
Rhizomes: Stems which grow horizontally at or just below the soil surface.

Examples: Iris and Quackgrass.



Tubers: An enlarged portion of an under-ground stem.

Example: White Potatoes



Eyes are actually the nodes on the stem; each eye contains a cluster of buds.

Modified Roots

Sweet Potato - Tuberous Root

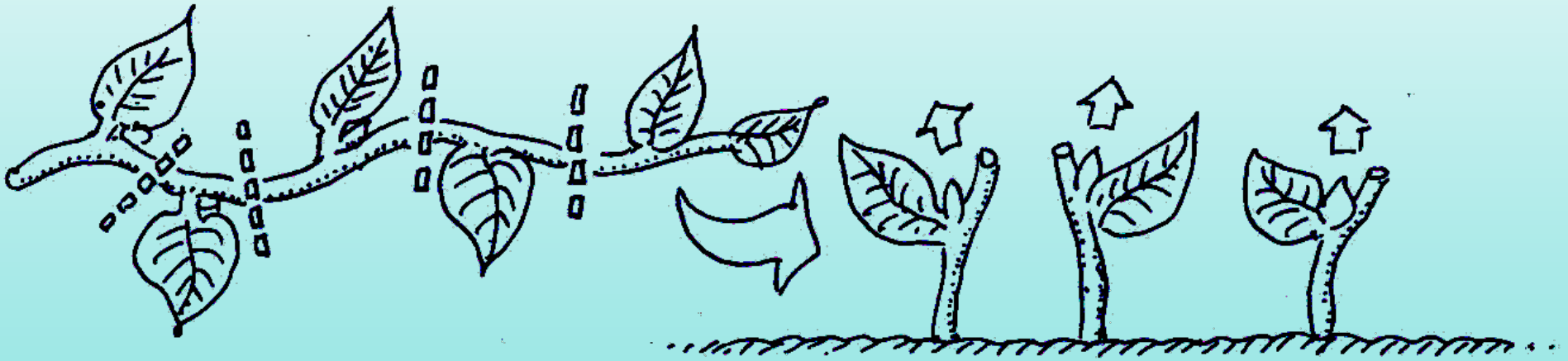
Tuberous Roots

Underground storage organs without nodes and internodes; they are true roots.

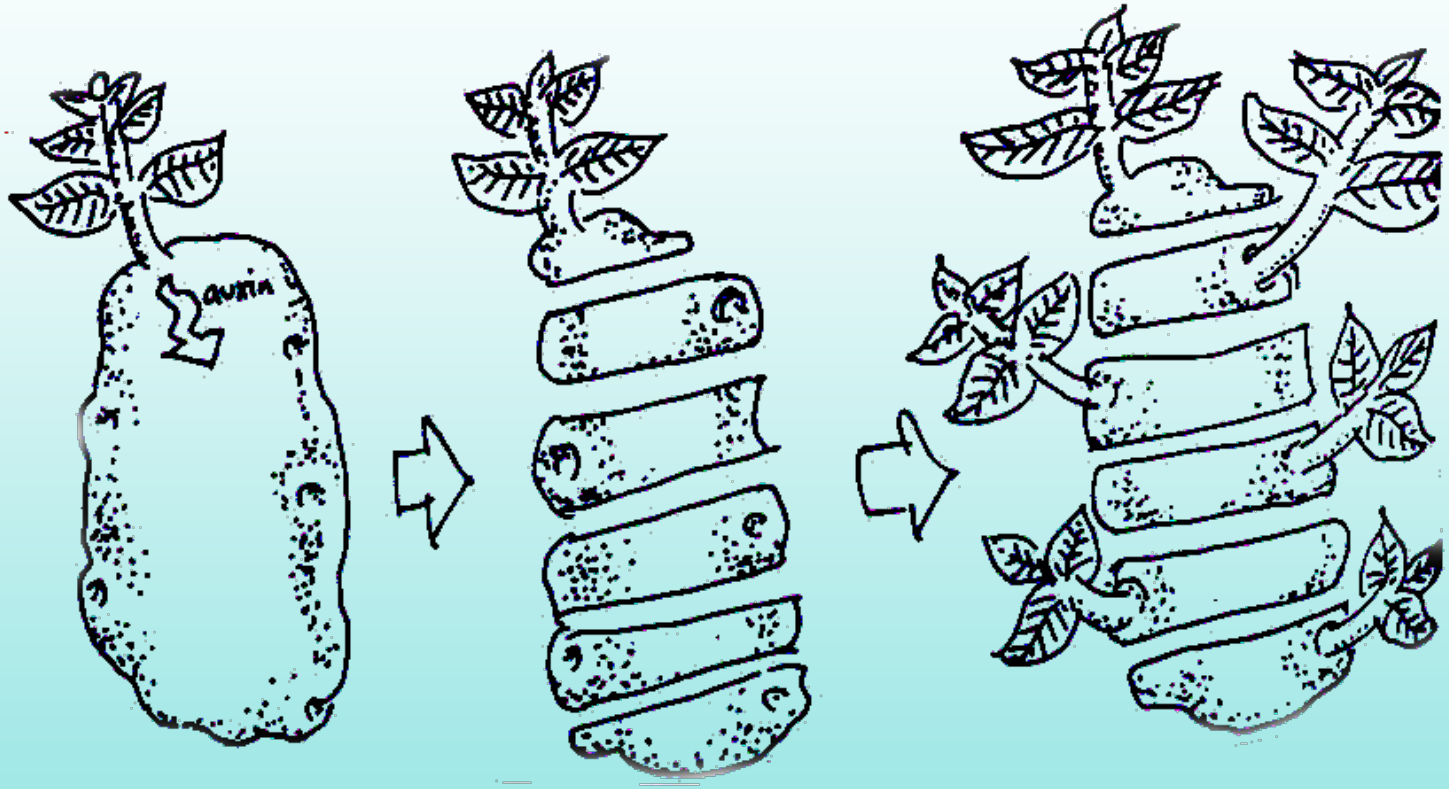
Examples: Dahlia and Sweet Potato

Plant Propagation

Stem Cuttings: Dividing above-ground stems into sections with nodes and internodes in order to produce new plants with roots.



Below-Ground Stems: Tubers can be cut into pieces containing "eyes" (buds).



Rhizomes, bulbs and corms all propagate themselves vegetatively as well as by seed.

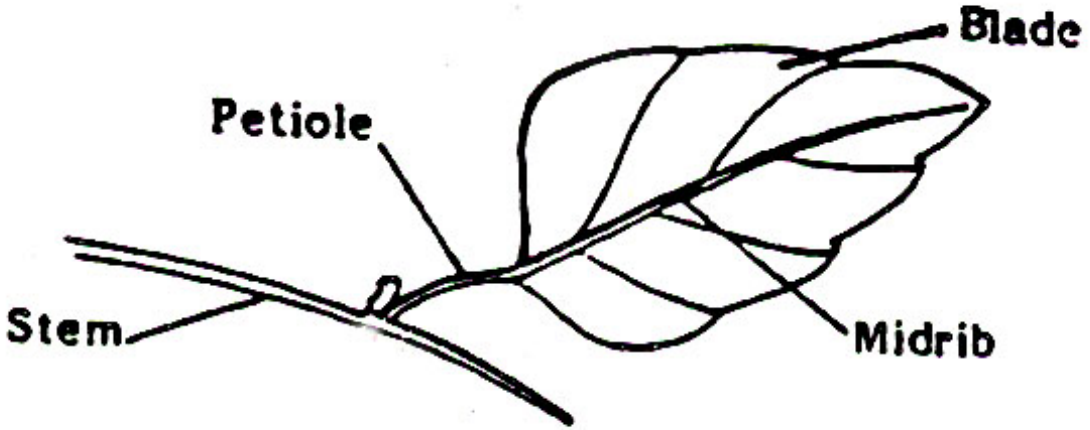
Leaves

The primary functions of leaves is to photosynthesize, or capture energy from the sun and convert it to sugars for later use.

- Leaves are green because they contain chlorophyll (the green pigment involved in photosynthesis.
- Leaves are broad to intercept a maximum amount of sunlight.

Parts of a Leaf

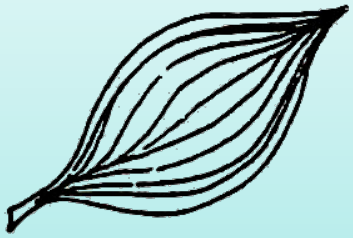
Broadleaf



Conifer Leaf

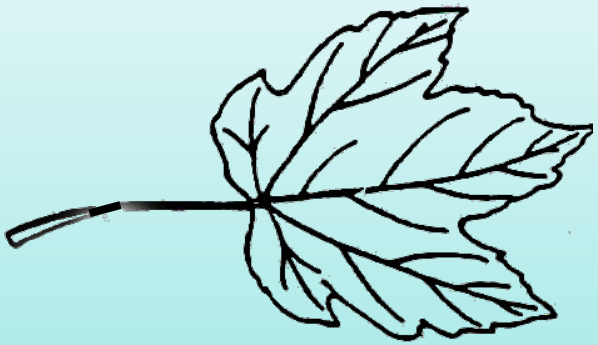
Types of Venation

- parallel-veined
- net-veined



Parallel

Pinnate



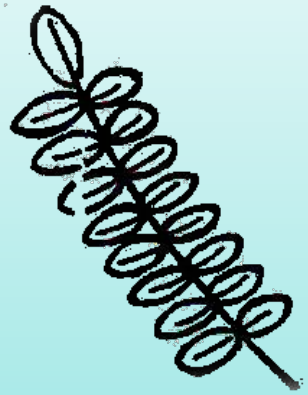
Net-veined

Leaves as a Means of Identifying Plants

- simple
- compound

Simple

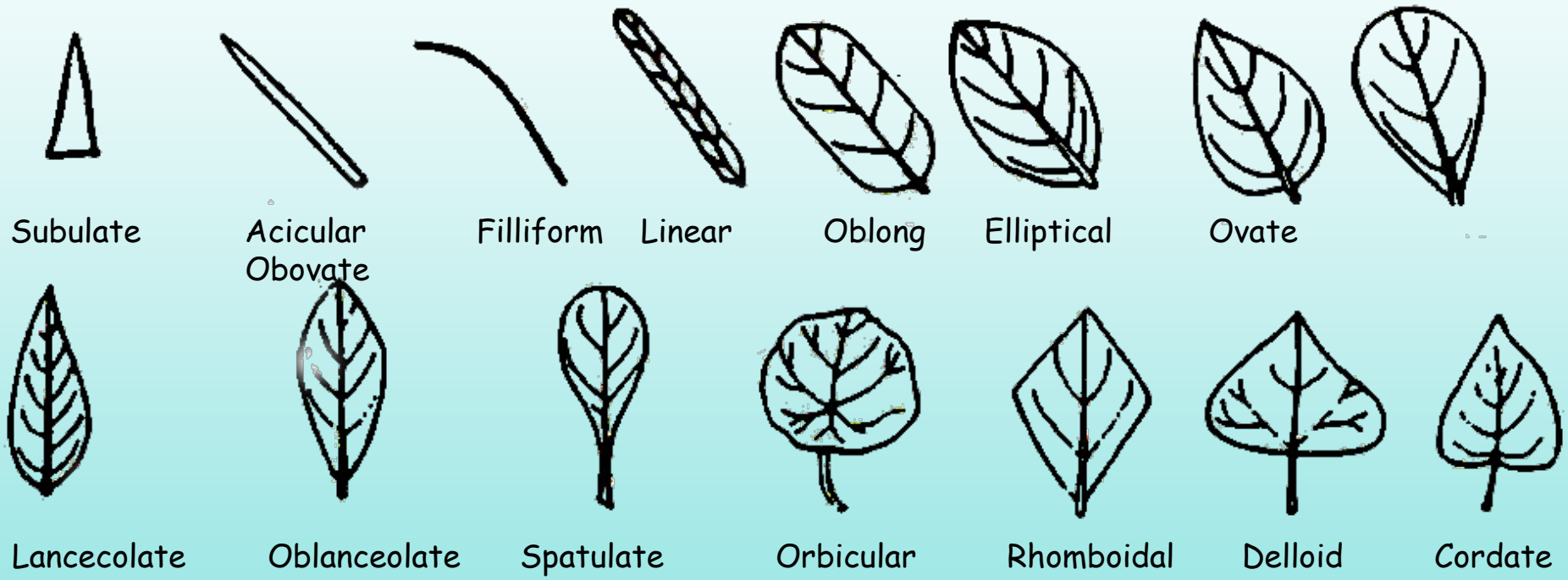
Palmate Compound



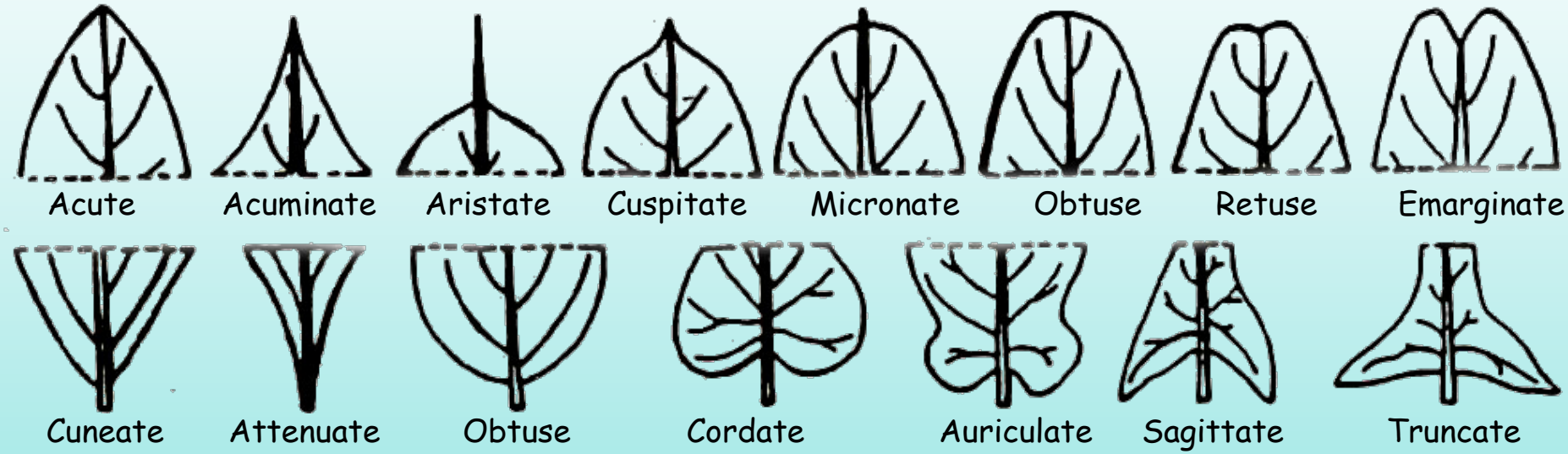
Pinnate Compound

Double Pinnate Compound

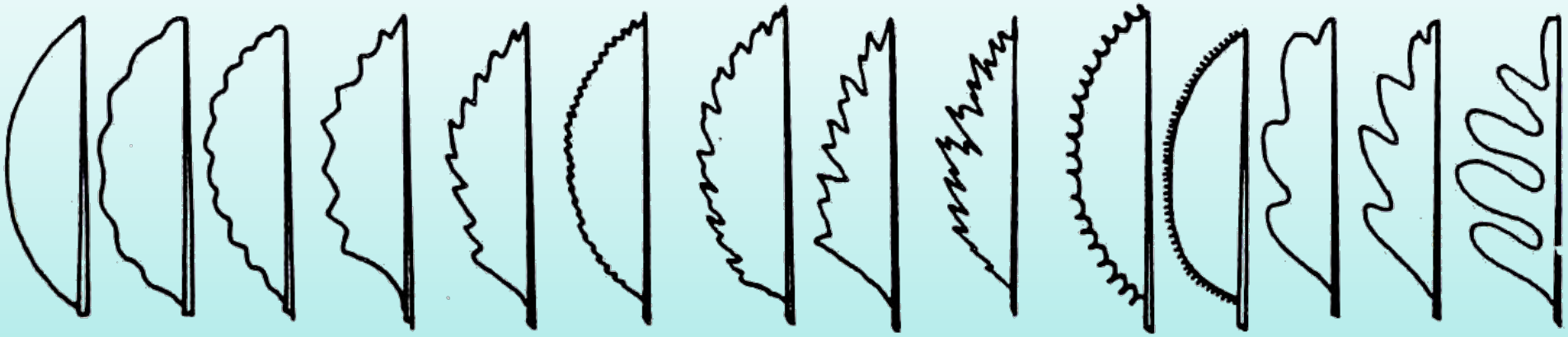
Shape of The Leaf Blade



Shape of The Blade Ends

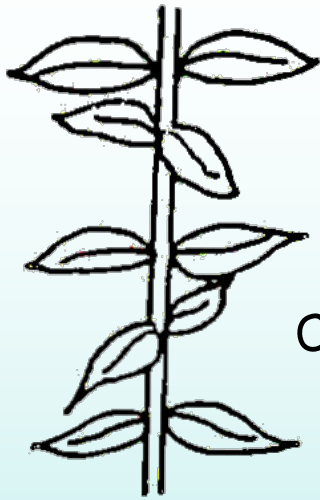


Leaf Margins

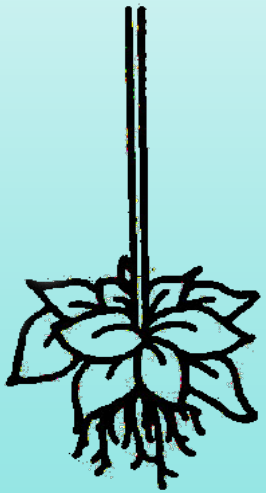


Types of Leaf Arrangement

Alternate



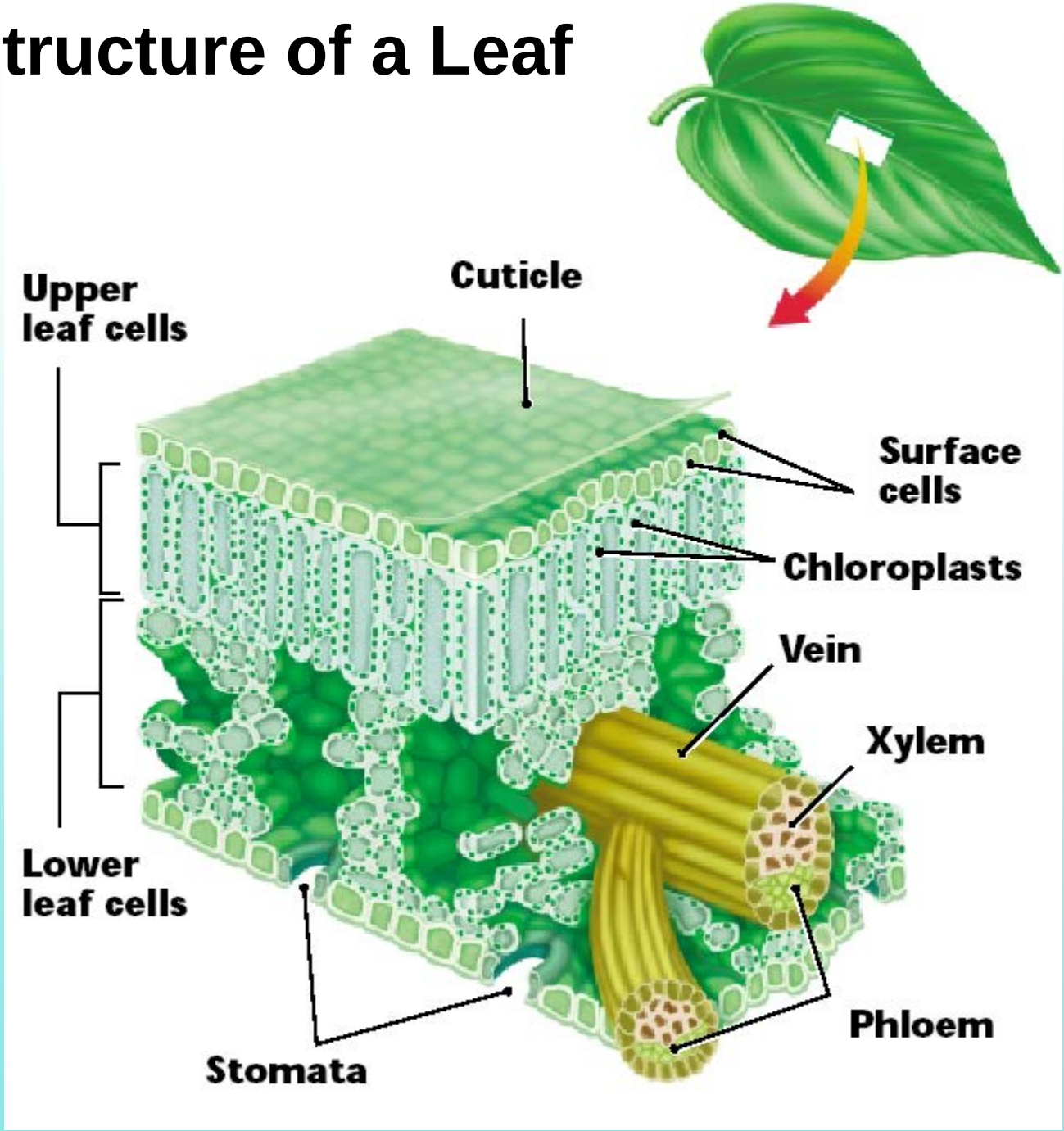
Opposite



Rosulate

Whorled

The Structure of a Leaf



- Epidermis: Layer of protective cells on both the top and bottom of a leaf.

- Cuticle: Layer covering the epidermis composed of a waxy substance called cutin that protects that leaf from dehydration.

- Guard Cells: Pairs of epidermal cells on the underside of leaves that surround openings to the interior of the leaf. Guard cells regulate the interior of the leaf. Guard cells regulate the passage of H_2O, O_2 and CO_2 through the leaf.

- Stomates: An opening or pore in the epidermis of leaves; opening and closing determined mostly by weather.

- Mesophyll: Middle layer of the leaf located between the upper and lower epidermis. Photosynthesis occurs in the mesophyll. It is divided into the palisade layer and the parenchyma layer. The cells in these two layers contain chloroplasts - the actual site of photosynthesis

Plant Growth and Development

Three major plant functions essential for growth and development.

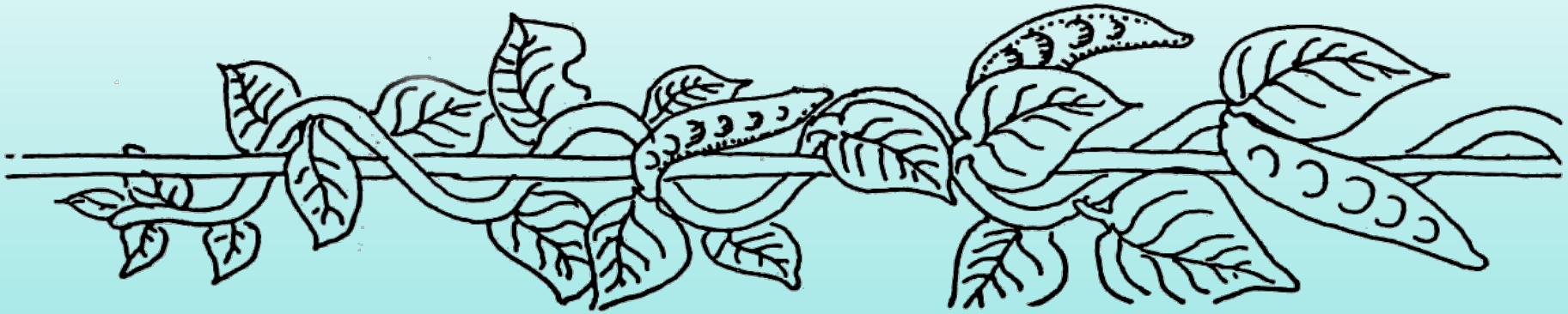
- Photosynthesis
- respiration
- transpiration

1. **Photosynthesis** means to put together with light.

6 CO_2 +12 H_2O in the presence of light and chlorophyll $C_6H_{12}O_6$ + 6O_2 + 6 H_2O

2. **Respiration** is the process by which sugars and starches are oxidized to release energy.

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



Differences and Similarities

Photosynthesis

Building Process

1. Produces food
2. Stores energy
3. Occurs in cells containing chloraplasts
4. Releases oxygens
5. Uses and produces water
6. Uses carbon dioxide
7. Rate is dependent on light
8. Rate is somewhat dependent on temperature

Respiration

Breaking-down process

1. Uses food for plant energy
2. Releases energy
3. Occurs in all cells
4. Uses oxygen
5. Uses and produces water
6. Produces carbon dioxide
7. Rate is independent of light
8. Rate is very dependent upon temperature

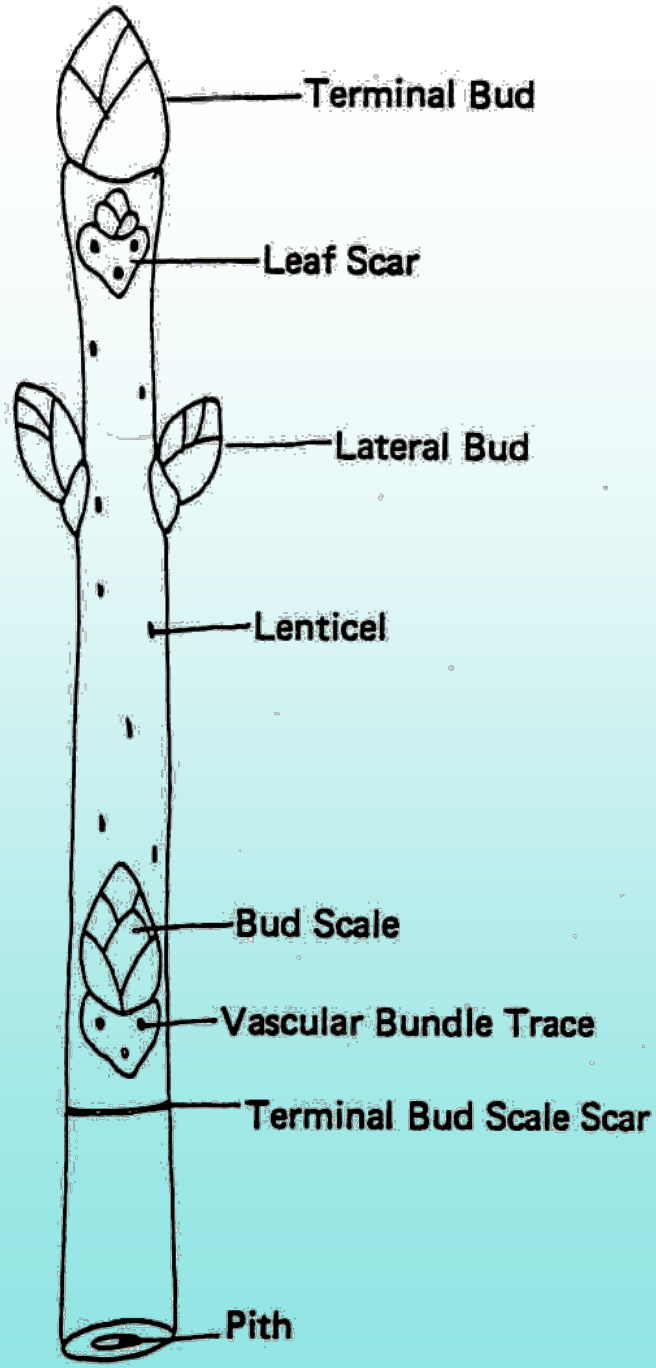
3. Transpiration is the process by which a plant loses water, primarily through leaf stomates.

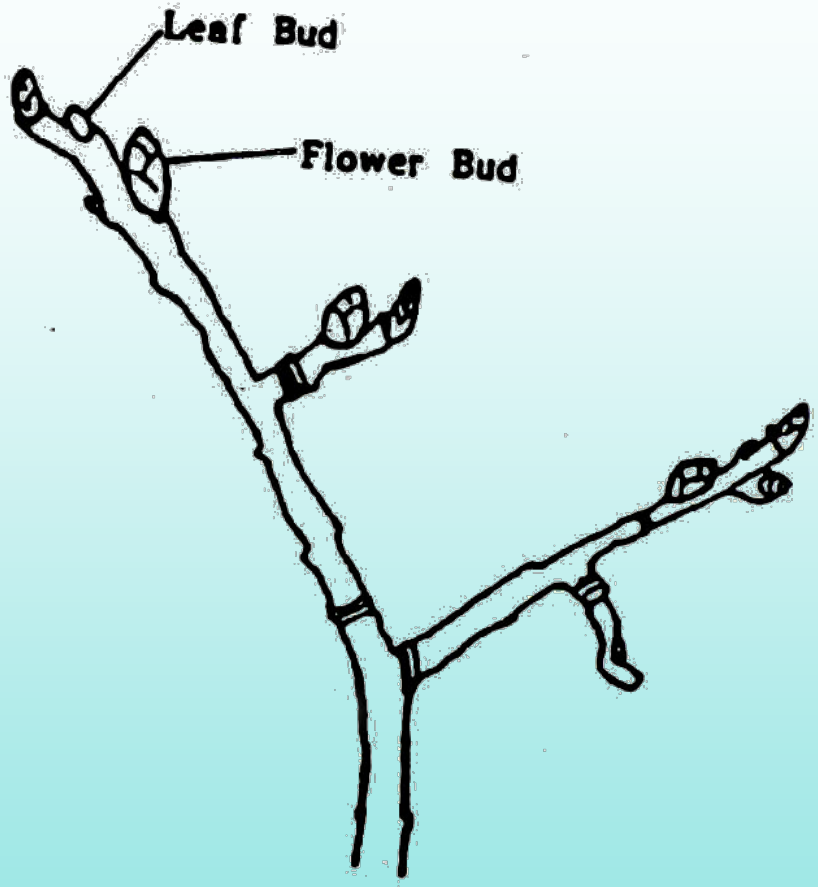
- temperature
- humidity
- wind

Transpiration is a necessary process by which about 90% of the water that enters plant roots is lost through the stomates. Water is pulled up into plants providing for mineral transport form the soil into the plant, for cooling of plant parts through evaporation, for the translocating of sugars and plant chemicals, and maintaining turgor pressure.

Buds

- terminal
- lateral (axillary)
- leaf bud
- flower bud
- adventitious


Terminal Bud
Leaf Scar
Lateral Bud
Lenticel
Bud Scale
Vascular Bundle Trace
Terminal Bud Scale Scar
Pith


Leaf Bud
Flower Bud

Roots

The below-ground portion of a plant

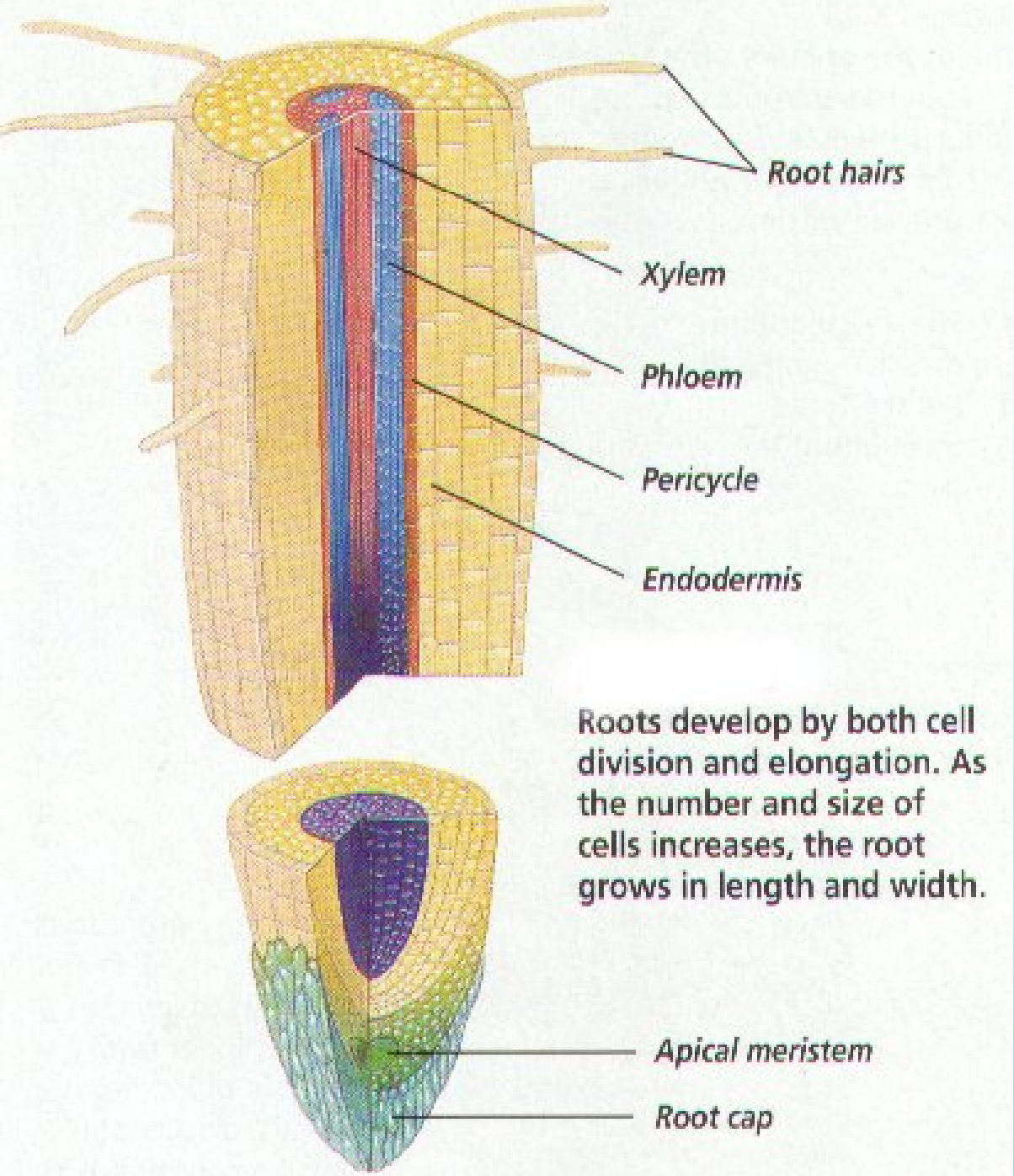
Principle Functions of Roots

- to absorb nutrients and water
- to anchor
- to furnish physical support for the stem
- to serve as food storage organs
- to propagate

Types of Roots

Taproot

Fibrous



Root Structure

1. **Root cap:** Covers and protects the root tip or meristem which manufactures new cells.

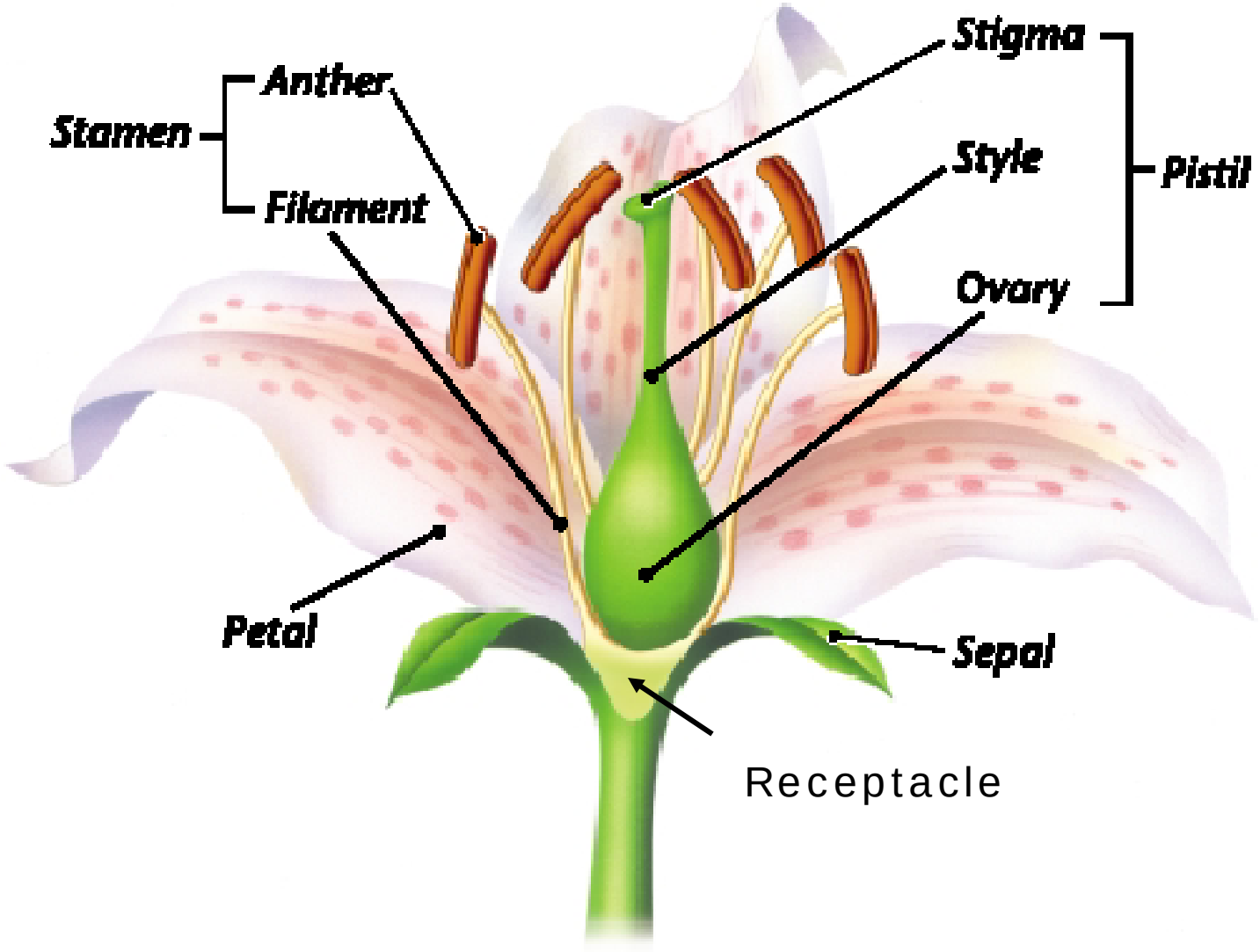
2. **Meristem (root tip):** Area of cell division and growth.

3. **Zone of Elongation:** Cells increase in size through food and water absorption; cells responsible for pushing the root through the soil.

4. **Maturation Zone:** Where cells change into specific tissues like epidermis and vascular tissue.

Root hairs perform much of the nutrient and water uptake.

The Structure of a Flower



Types of Flowers

Complete: Have a pistil, stamen, petals and sepals.

Incomplete: Flowers that lack one of these parts.

Perfect: Flowers with functional pistils and stamens.

Imperfect: Flowers lacking either pistils or stamens.

Pistillate (female): Have a functional pistil, but lack stamens.

Staminate (male): Have functional stamens, but no pistil.

One House or Two?

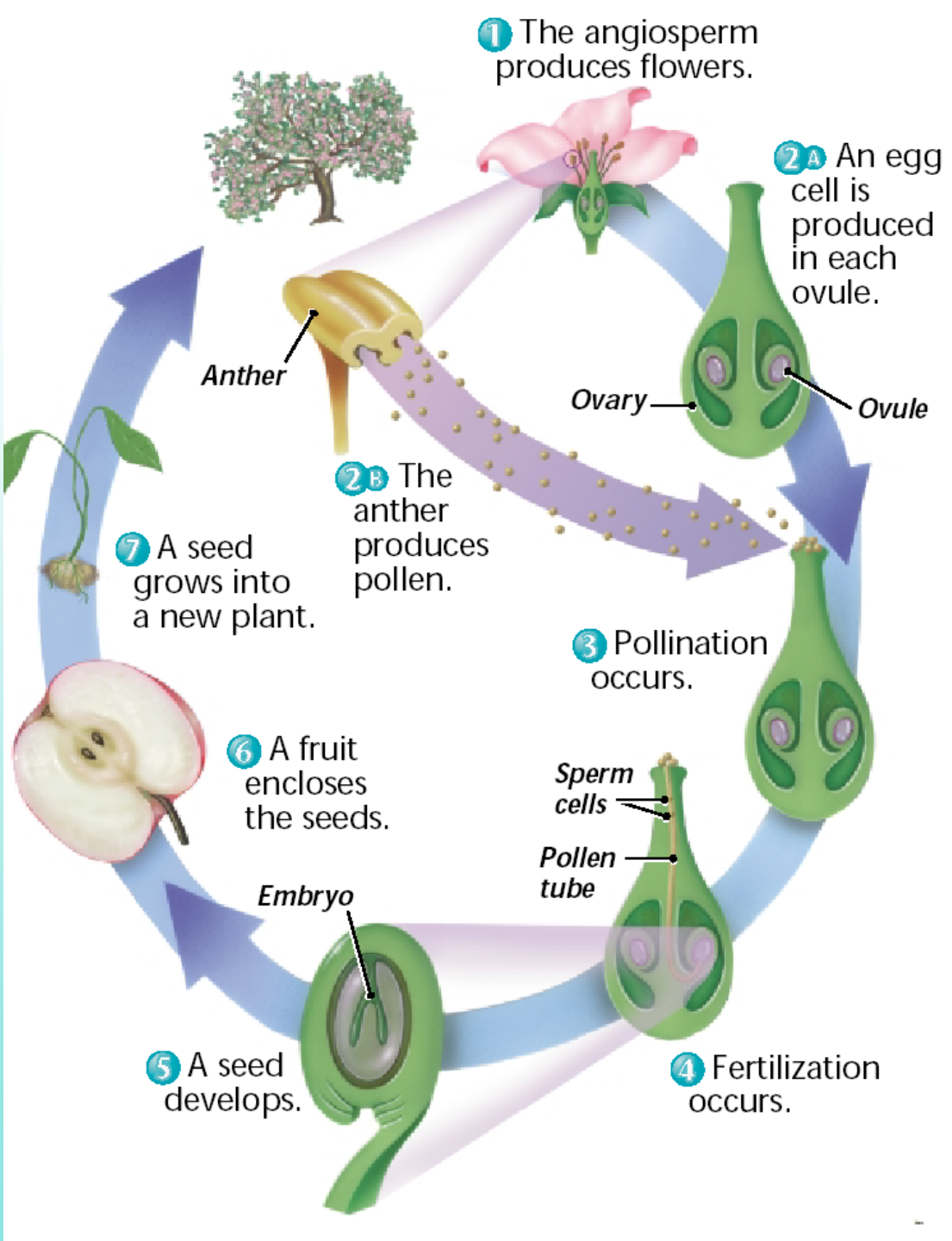
- Monoecious: Plants in which pistillate and staminate flowers occurs on the same plant. (Corn, pecans; cucumbers and squash – male flowers followed by female flowers.)

- Dioecious: Pistillate and staminate flowers occurs on separate plants. (Hollies)

Pollination is the transfer of pollen from an anther to a stigma.

- bats
- insects
- birds
- wind
- rain

Life Cycle Of an Angiosperm

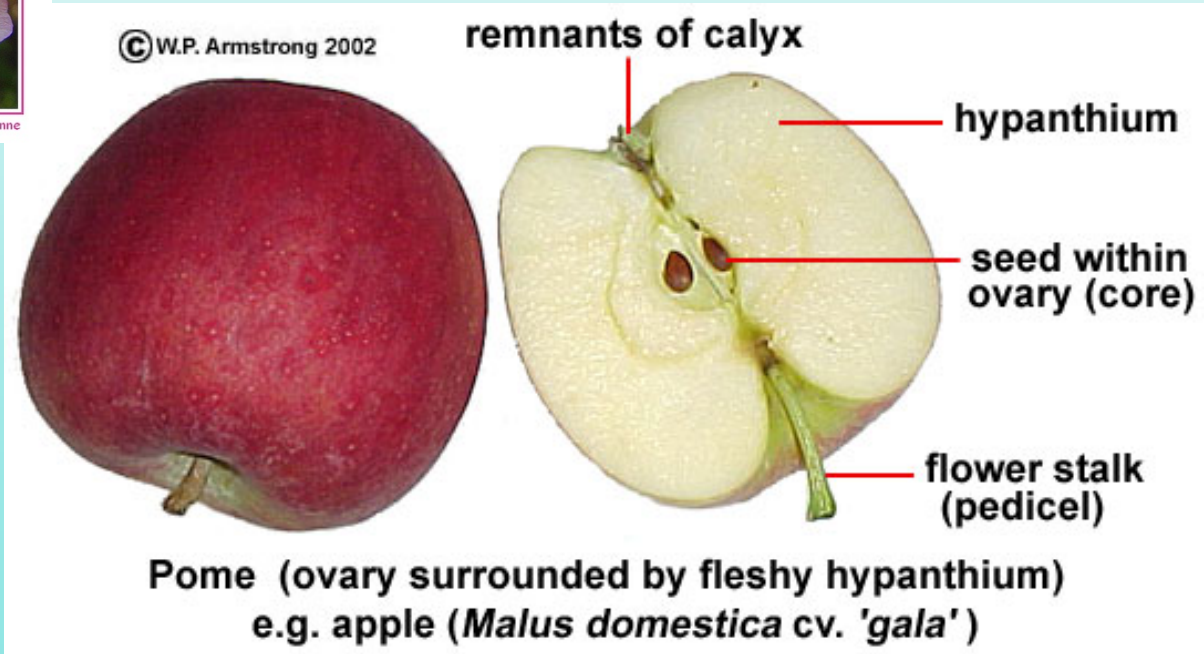


A fruit is the enlarged ovary around the newly developed seeds.

Simple fruits develop from a single ovary

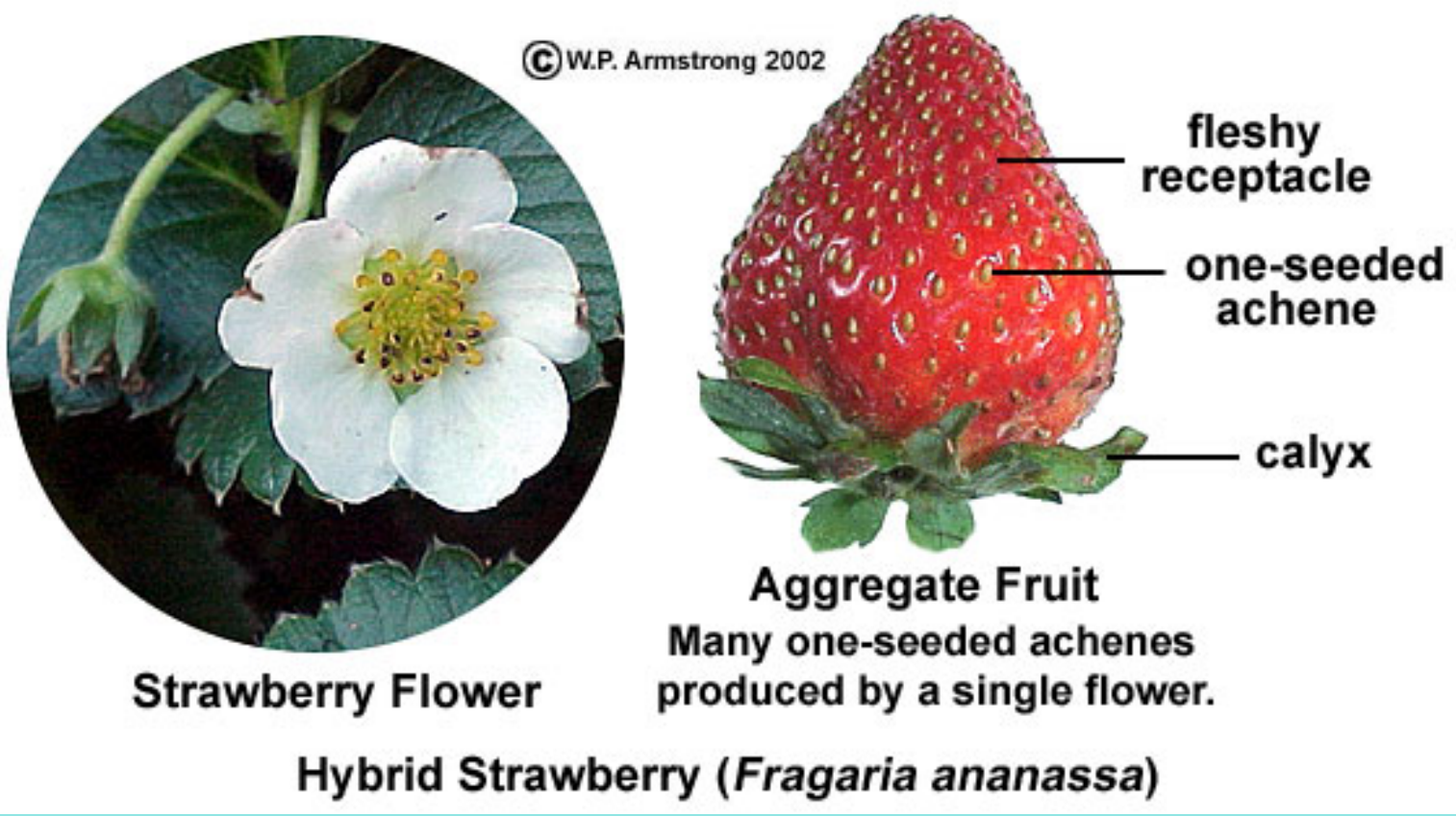
- drupes
- pomes
- berries
- legumes
- capsule
- samara
- nuts

Apple Flower and Fruit



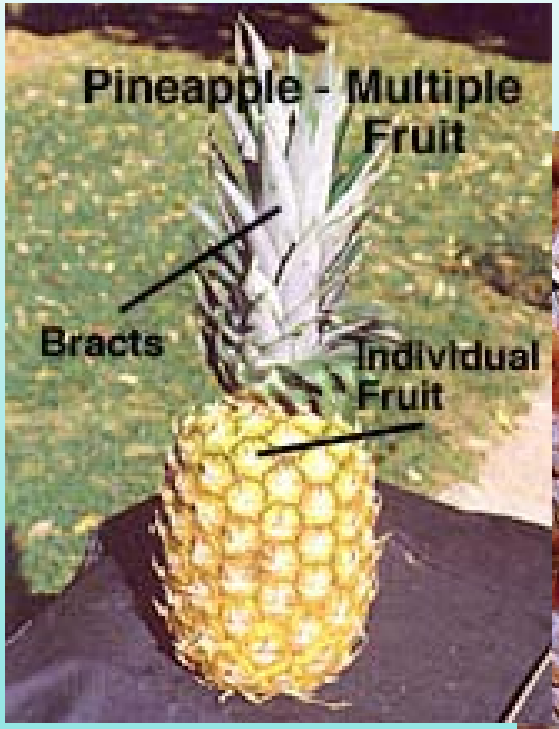
Aggregate fruits develop from a single flower which has many ovaries

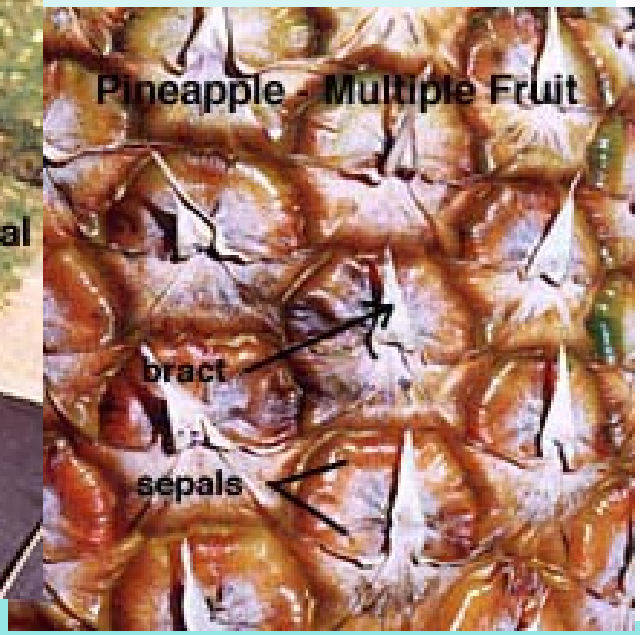
- strawberry
- raspberry
- blackberry

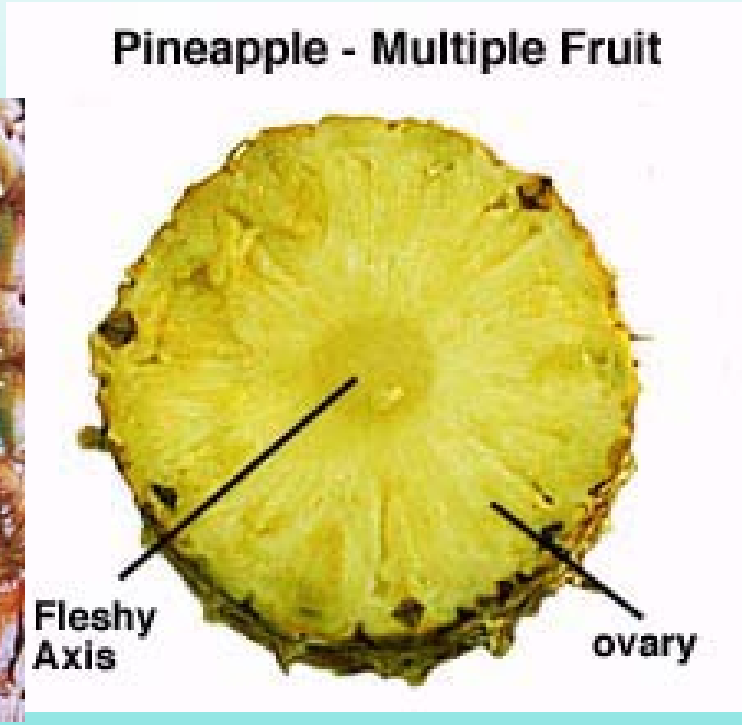


Multiple fruits develop from a tight cluster of separate, independent flowers borne on a single structure

- beet
- pineapple
- fig







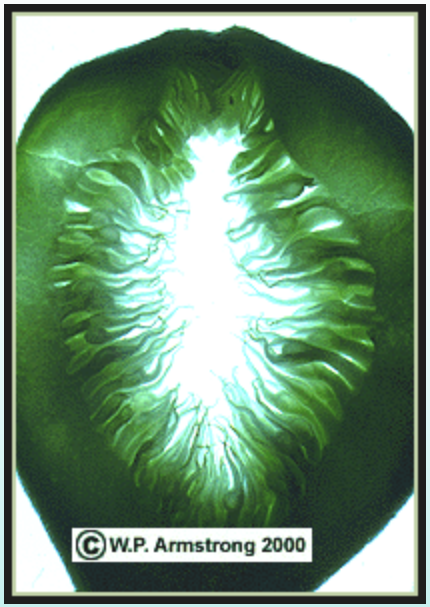
Beet "Seeds"

Actually a cluster of seeds in a dried fruit. Several seedlings may grow from each fruit.

Beet Seed Plant

The root is the size of a football at harvest, has an extremely woody consistency, and is completely unsuitable for consumption.

Figs

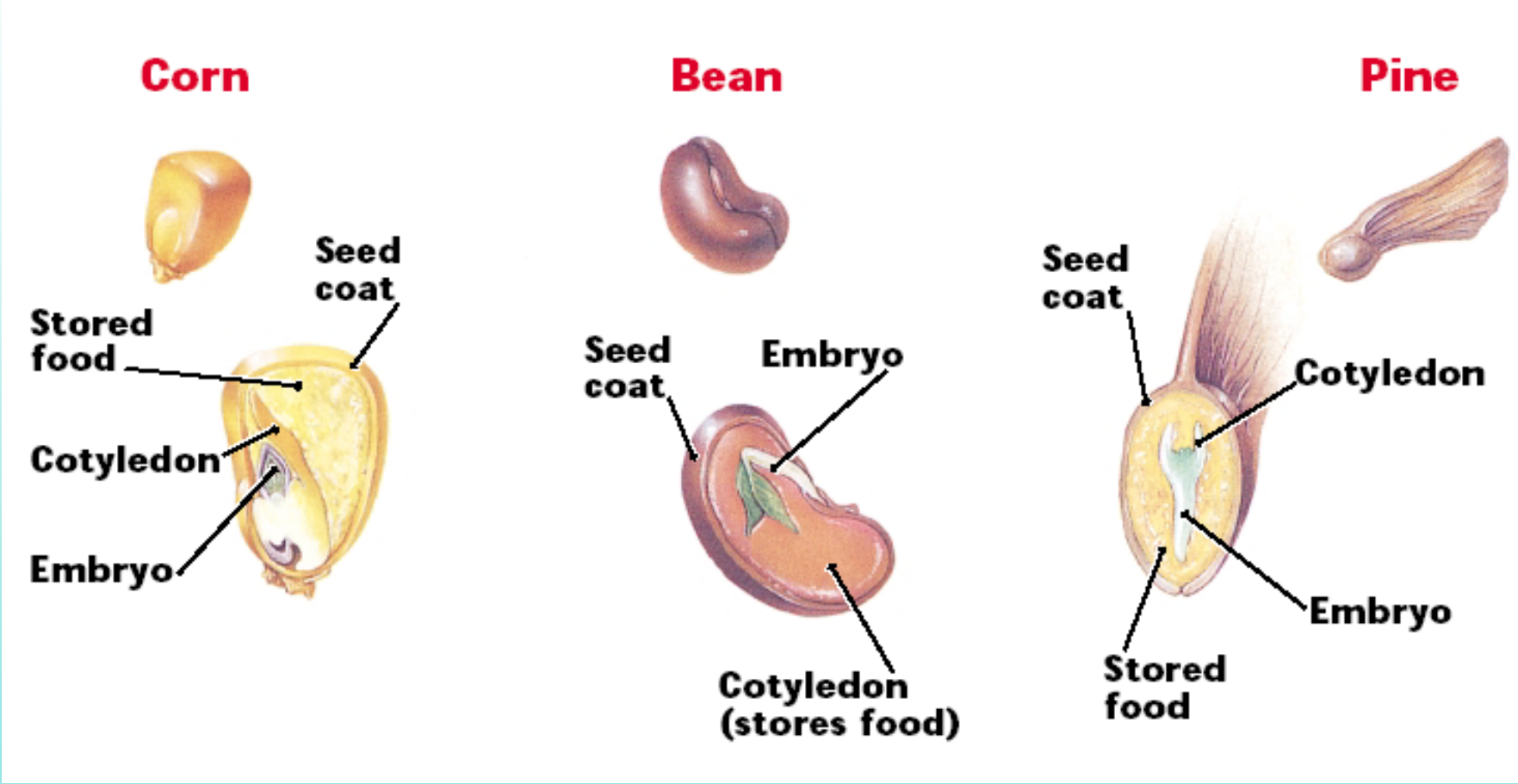


The fig's edible structure is actually stem tissue. The fig fruit is an inverted flower with both the male and female flower parts enclosed in stem tissue (syconium). At maturity the interior of the fig contains only the remains of these flower parts, including small gritty structures commonly called "seeds", which are really unfertilized ovaries that failed to develop.

Seed

- Embryo: A miniature plant in an arrested state of development.
- Endosperm: Built-In food supply made up of proteins, carbohydrates and/or fats.
- Seed Coat: Hard outer covering which protects the seed from diseases and insects, and prevents water from entering the seed.

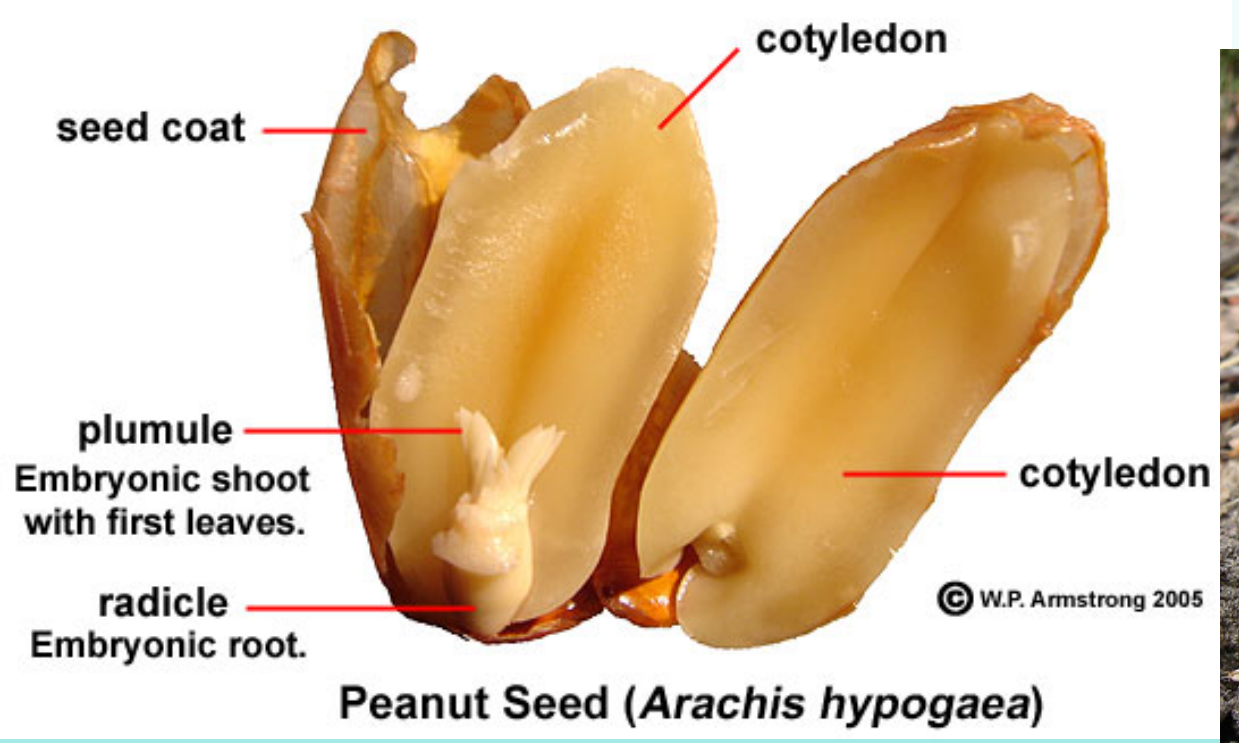
The Structure of Seeds



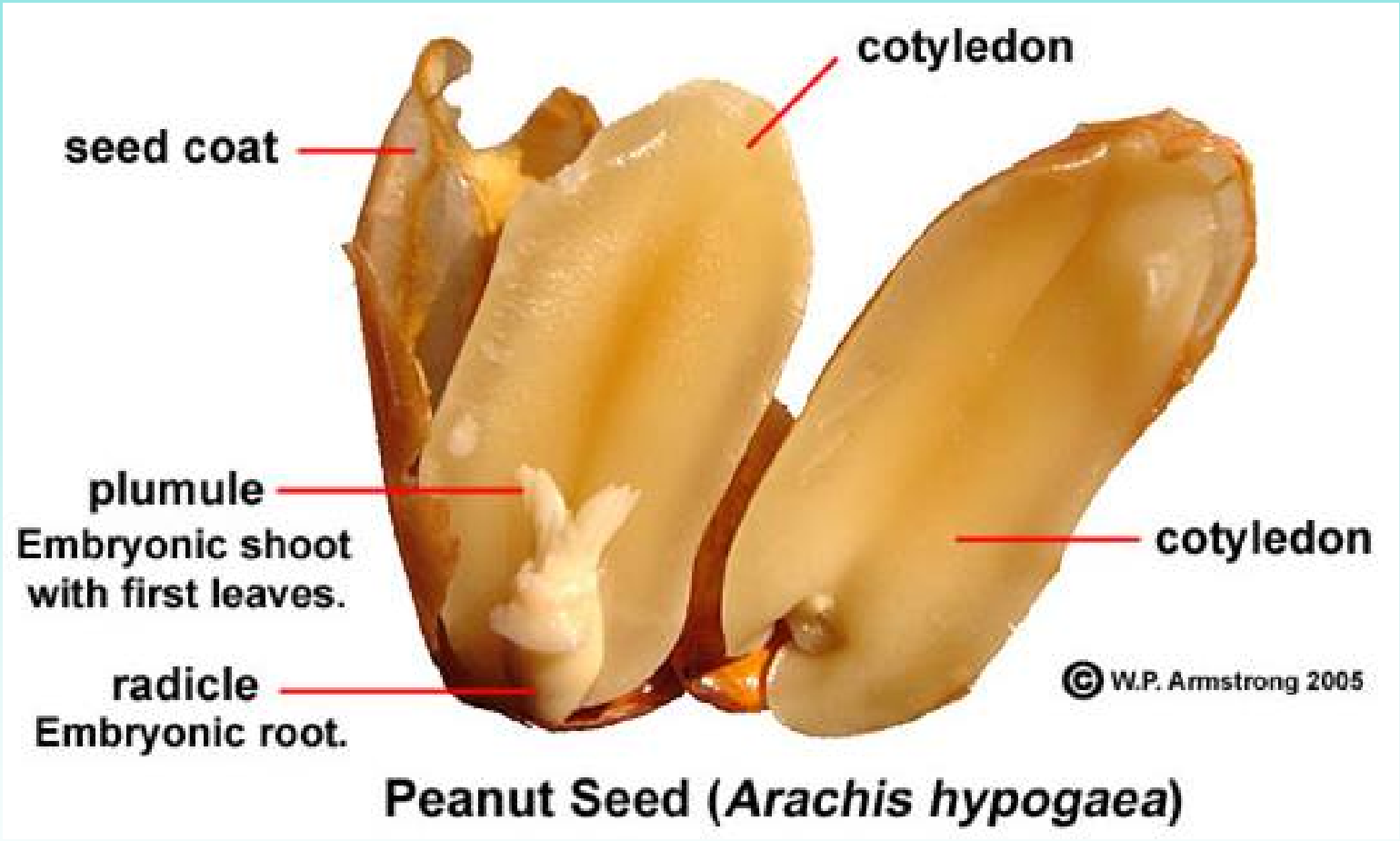
Peanut Plant

- An annual plant native to South America
- Grows to about 2 ft tall.
- Small yellow flowers that bloom for about 12 hours; self-pollinating.
- 4 days later, a stem (also called a peg) will grow from the flower and head into the soil.
- At the end of each stem, the seed pods (peanuts in the shell) will develop.

Peanut Seed



Peanut Seed (*Arachis hypogaea*)



Peanut Seed (*Arachis hypogaea*)