

# LABORATORY 2

## RECOGNITION OF PLANT STRUCTURES



## **BACKGROUND**

A thorough knowledge of plant structure is absolutely essential to all horticulturists. A knowledge of plant structure is required for the successful propagation of plants by cuttings, specialized structures, layering and grafting; for the proper pruning and pinching of plants to obtain the desired growth habit; for determining the best harvest time, storage conditions and quality control of fruits and vegetables; for the ability to recognize flower structures for manually pollinating flowers (plant breeding), and for the taxonomic identification of plants.

Plants can be divided into three vegetative organs: 1) stems, 2) roots, and 3) leaves, and one reproductive organ, the flower. The flower is in reality a highly modified stem (the peduncle and pedicel) with highly modified leaves (the sepals, petals, pistils and stamens) specialized for sexual reproduction, and hence, some would not classify the flower as a separate organ.

Each of these organs has a typical structure, and in addition, each may be modified into specialized structures. For example, Irish potato tubers and corms are modified stems; carrots and sweet potatoes are modified roots; celery stalks are modified petioles; tendrils, spines, poinsettia bracts and cabbage heads are modified leaves; and cauliflower and broccoli are modified flowers.

Botanically, vegetables are structures that develop from one of the 3 vegetative organs (stems, roots or leaves); for example potato, carrot and onion. Whereas, fruits develop from the ovary of the flower, for example, tomato, bell pepper, string beans, strawberry, corn, figs, pineapple and apple. Horticulturally, many of these true fruit examples are commonly called vegetables, such as tomato. Seeds are differentiated from fruits in that they develop only from the ovule, and occur alone only when the fruit wall (ovary wall of the flower) has been removed; ex. shelled peas, beans and peanuts. Many dry fruits are incorrectly called seeds, such as sunflower seeds, corn, pecans, walnuts and acorns.

## **TAKE HOME LESSONS**

- 1) To recognize and identify the types of roots and root modifications based on origin, structure or function.
- 2) To recognize and identify the typical parts of leaves, leaf types and leaf modifications.
- 3) To recognize and identify the typical parts of stems and stem modifications.
- 4) To recognize and identify the parts of flowers, and which parts develop into fruits and seeds.
- 5) To recognize and identify the parts and types of fruits and fruit modifications.
- 6) To learn how to recognize the difference between botanical vegetables, fruits and seeds, and horticultural vegetables, fruits and seeds.

## **MATERIALS NEEDED**

fresh samples of plant parts	forceps
hand lens or stereo microscope	needles
knives	

**PROCEDURES**

- 1) Closely review the information and diagrams on roots, leaves, stems, flowers and fruits contained in the lab manual.
- 2) Closely study the living samples supplied and compare them to the definitions and diagrams in the lab manual.
- 3) Be sure to be able to recognize and identify all the types of structures, their parts and modifications.

## ROOTS

### Root Classification - based on origin

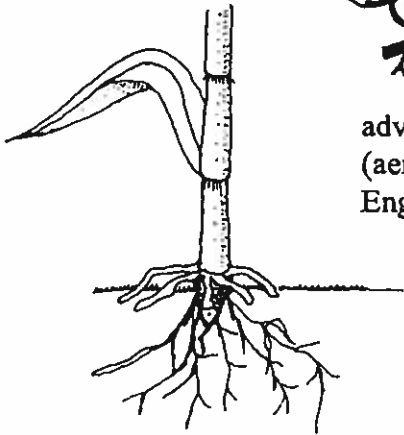
- 1) **primary** - roots that developed as a continuation of the radicle of the embryo (seedling roots).
- 2) **secondary** - roots arising from a pre-existing root, also called a lateral or branch root.
- 3) **adventitious** - roots arising from other than their normal place of origin (for example, from stem or leaf cuttings, aerial roots on vines, brace roots on corn)

### Root Types - based on structure or function

- 1) **taproot** - a primary root that persists and remains the dominant root (pine, pecan).
- 2) **fibrous** - all roots of approximately equal length and thickness (coleus, azalea).
- 3) **storage** - a root modified for storage
  - a) **taproot** - a primary root (taproot) that develops thickened storage tissue (usually the cortex) (carrot, radish, turnip, beet).
  - b) **tuberous or fleshy** - a secondary or lateral root that develops thickened storage tissue (usually the cortex) (sweet potato, dahlia).



adventitious  
(aerial) root  
English Ivy



brace root  
Corn



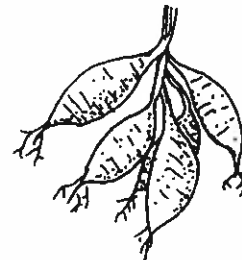
taproot  
Pecan



fibrous root  
Coleus

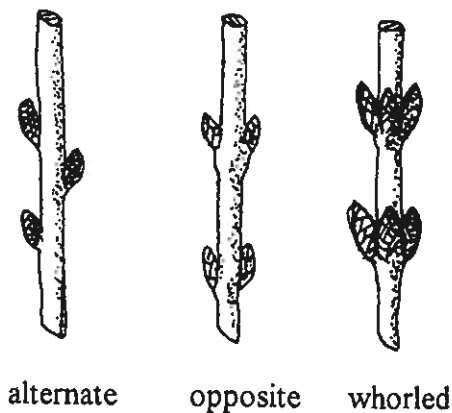
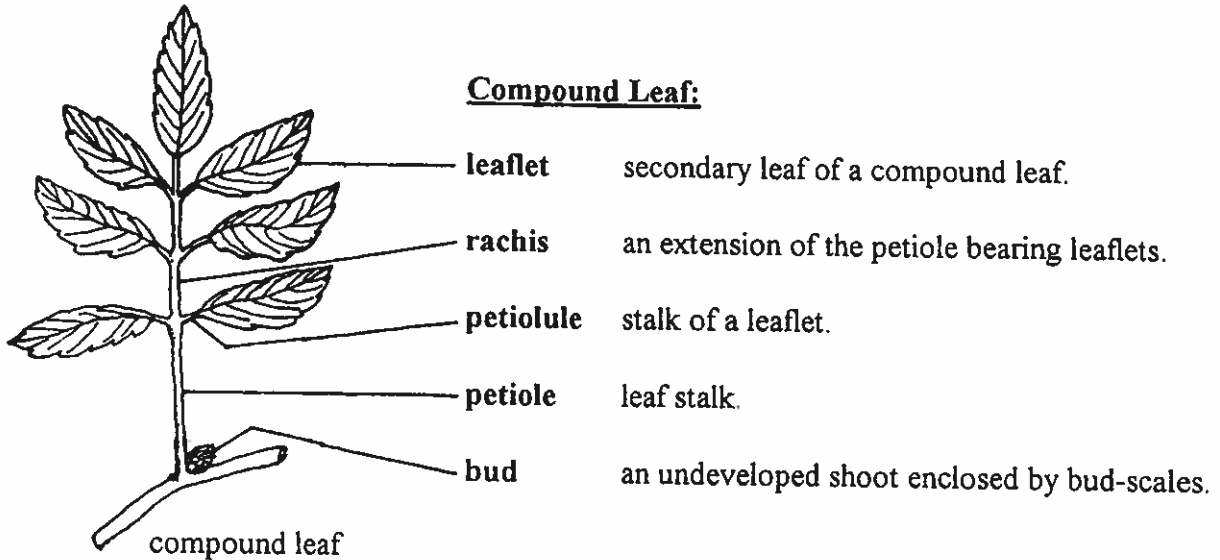
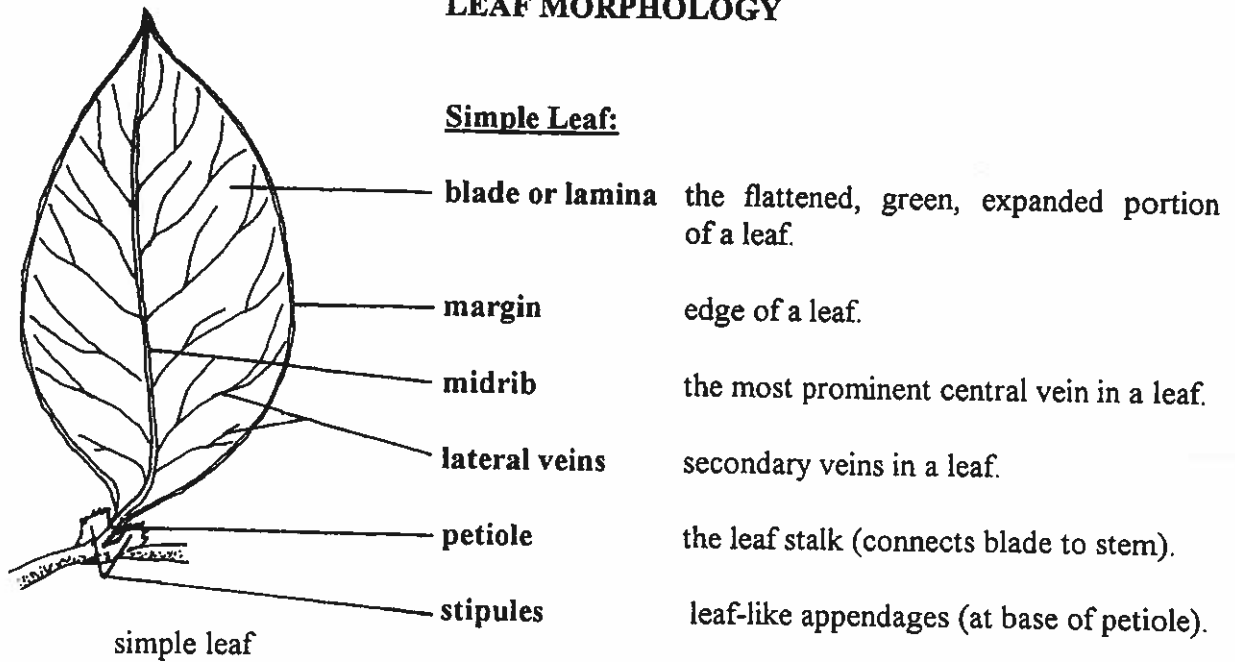


storage taproot  
Carrot



storage tuberous or fleshy root  
Sweet Potato

## LEAF MORPHOLOGY



### Leaf Arrangements

- alternate** one leaf per node, usually staggered (spiral) along stem.
- opposite** two leaves (a pair) per node, usually opposite each other.
- whorled** three or more leaves per node, usually equally spaced around the node.

## LEAF TYPES

A) **Simple Leaf**- blade as one unit; not divided into leaflets.

Type based on Venation (arrangement of veins)

1) **pinnate** - feather-like, net venation with lateral veins extending from a central midrib (dicots - elm, oak).

2) **palmate** - finger-like, net venation with several major veins diverging from the union of the petiole and the leaf blade (dicots- maple).

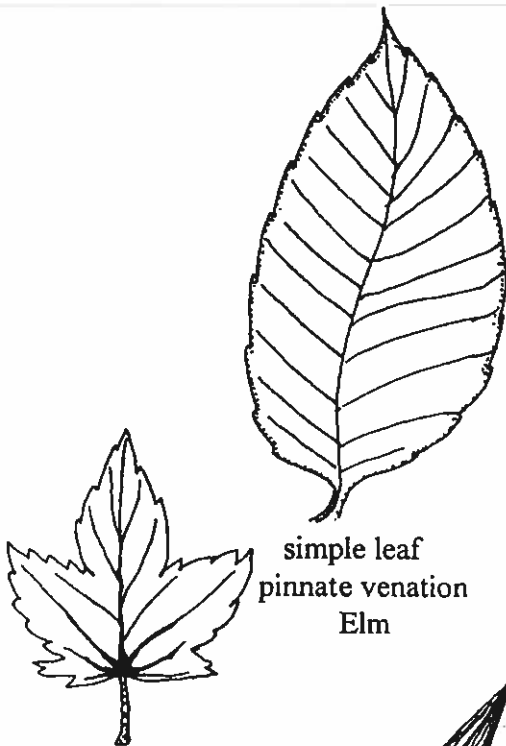
3) **parallel** - principal veins parallel to the axis of the leaf (monocots - grasses).

B) **Compound Leaf** - blade divided into leaflets.

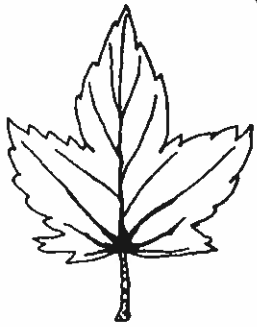
Type based on Arrangement of Leaflets

1) **pinnate** - leaflets arising from along both sides of the rachis (rose, pecan).

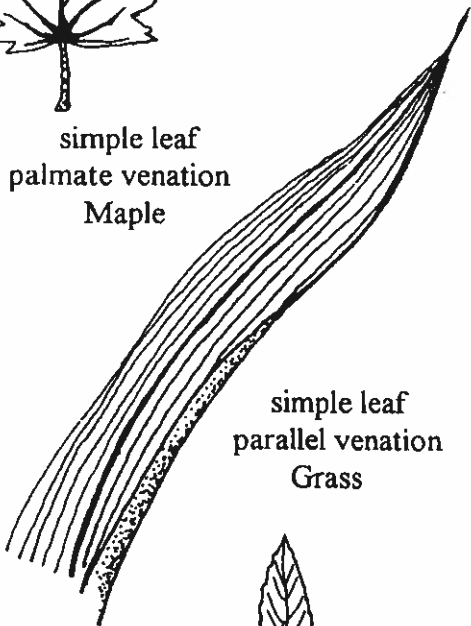
2) **palmate** - leaflets all arising from the same location at the top of the petiole (buckeye, schefflera).



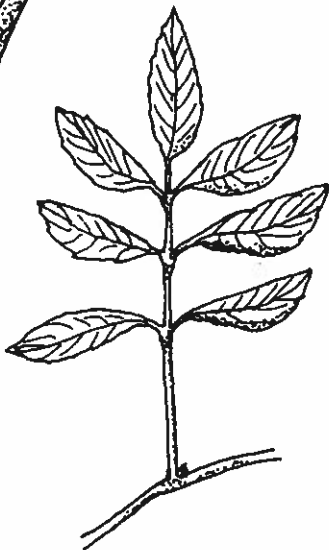
simple leaf  
pinnate venation  
Elm



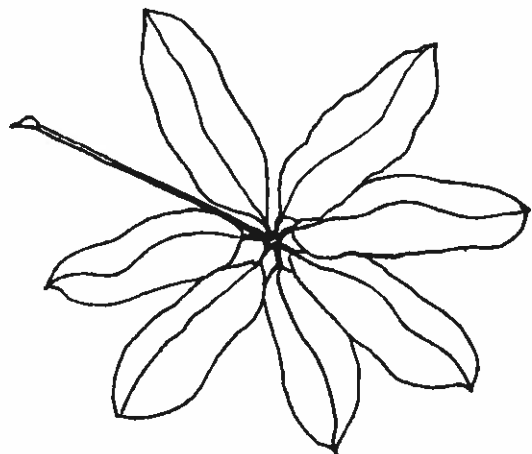
simple leaf  
palmate venation  
Maple



simple leaf  
parallel venation  
Grass



pinnately compound leaf - Rose

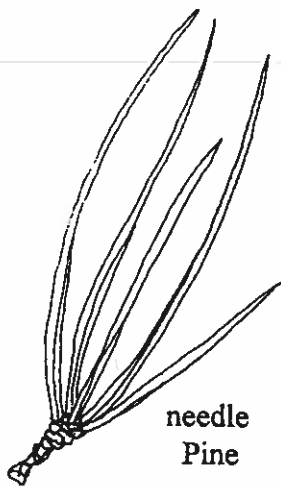


palmately compound leaf - Schefflera

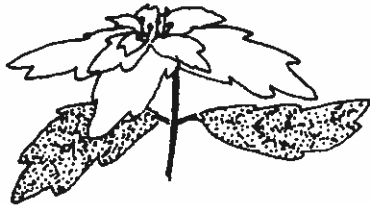
**MODIFIED LEAVES**



scale-like  
Juniper



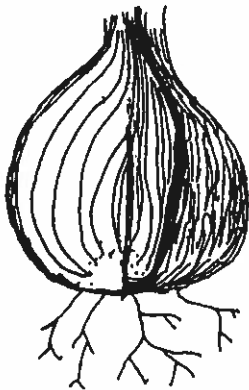
needle  
Pine



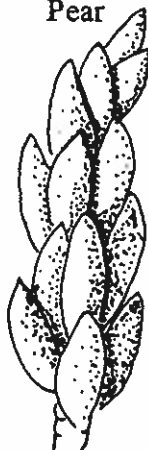
bract  
Poinsettia



cataphyll  
(bud scale)  
Pear



storage (bulb)  
Onion



succulent  
Sedum

**scale-like** - leaf shaped like a small scale or awn (juniper, cedar).

**needle** - long, slender, tubular or triangular leaf (pine, fir).

**bract** - a modified (often reduced) leaf subtending a flower or flower cluster, usually colored (poinsettia, dogwood).

**cataphyll** - reduced leaf usually modified for protection, such as bud scales or rhizome scales (most buds and rhizomes).

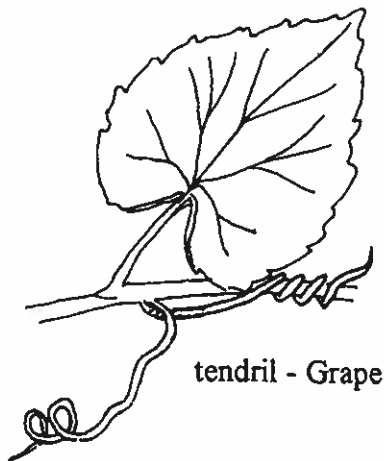
**storage** - leaf modified for food storage (onion, garlic, tulip, lily).

**succulent** - thick, fleshy leaf, usually modified for water storage (crassula, portulaca, sedum, aloe vera).

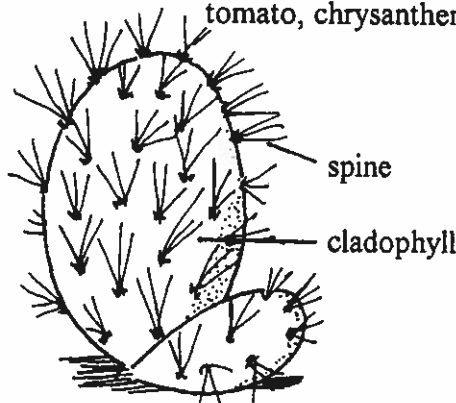
**tendrils** - slender, twining modified leaf (or stem) used for clinging to objects for support (grape, cucumber).

**spine** - a leaf or leaf-part (tips, margins or stipules) modified into a sharp point (cactus, locust, holly).

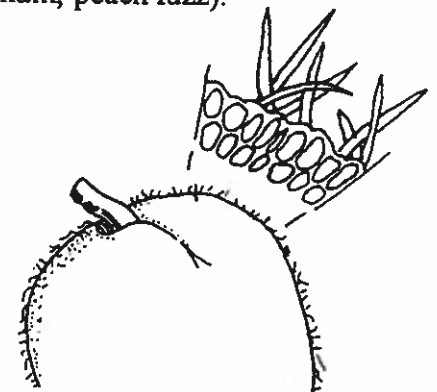
**trichome or hair** - hair-like outgrowths of epidermal cells of leaves (geranium, tomato, chrysanthemum, peach fuzz).



tendrils - Grape

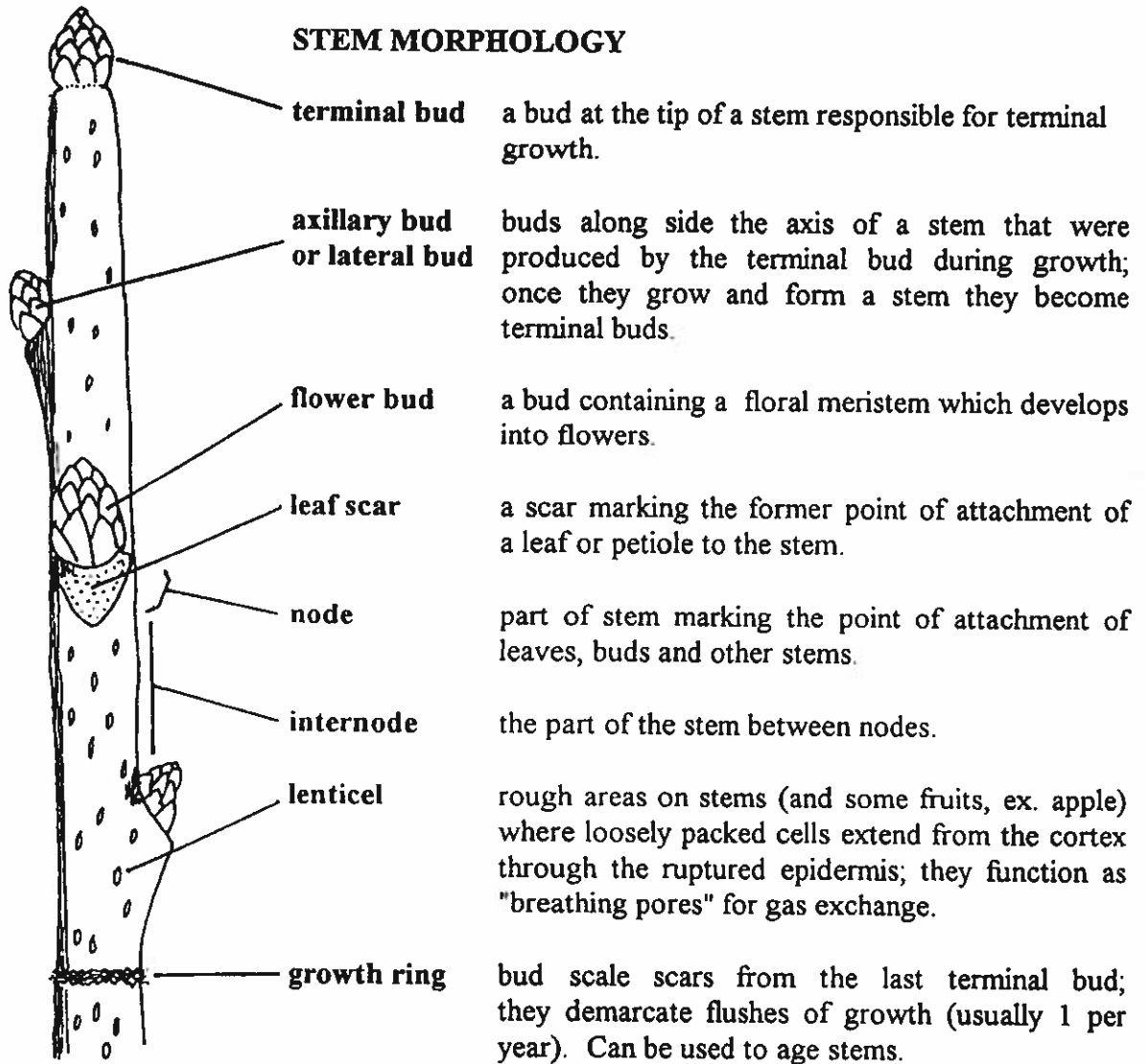


spine - Cactus



trichome or hair - Peach

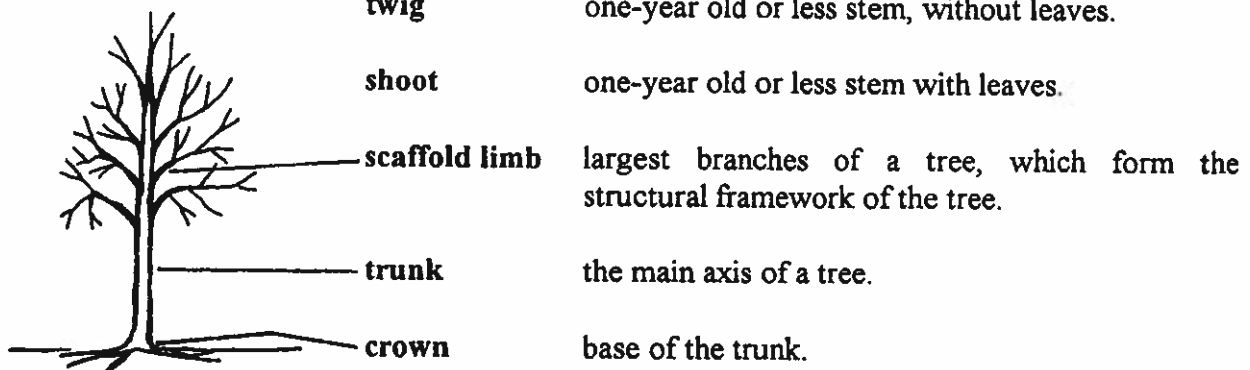
## STEM MORPHOLOGY



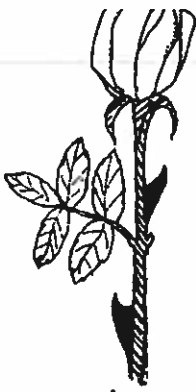
**bud** an underdeveloped and unelongated stem composed of a short axis with compressed internodes, a meristematic apex, and primordial leaves and/or flowers.

**twig** one-year old or less stem, without leaves.

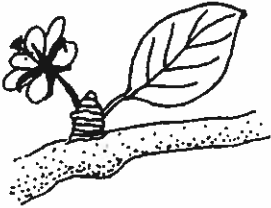
**shoot** one-year old or less stem with leaves.



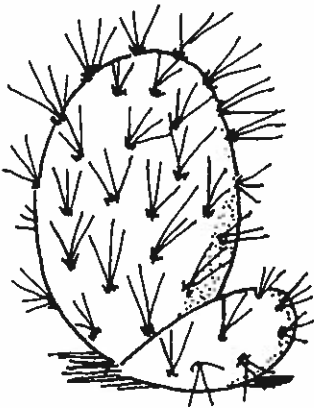




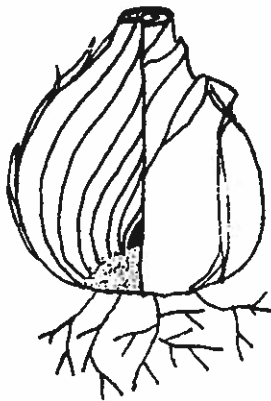
thorn  
Rose



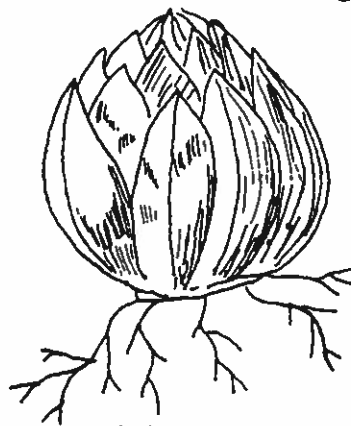
spur  
Apple



cladophyll  
Cactus



concentric bulb - Onion



scale bulb - Lily



pseudobulb - Orchid

## MODIFIED STEMS

**thorn** a stem modified into a short (usually), sharp point (rose, pyracantha).

**spur** a compressed stem with short internodes, usually bearing leaves, flowers and/or fruit. Many fruit trees bear flowers and fruit on spur shoots (apple, pear, ginkgo).

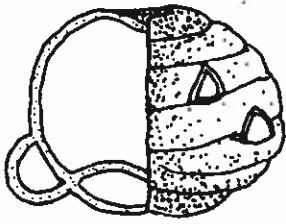
**cladophyll** stems, usually flattened, specialized for photosynthesis (cactus).

**bulb** a specialized storage organ (usually underground) composed of a compressed plate-like stem enclosed by fleshy or papery leaves or leaf bases.

**concentric or tunicate bulb** - stem enclosed by concentric or sheathing leaves or leaf bases (onion, garlic, amaryllis, tulips).

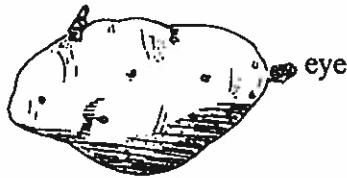
**scale or non-tunicate bulb** - stem enclosed by separate, thick (usually fleshy) scale-like leaf bases (lily).

**pseudobulb** thickened bulb-like leaf (or stem) bases resembling a bulb, i.e. a "false bulb" (orchid).



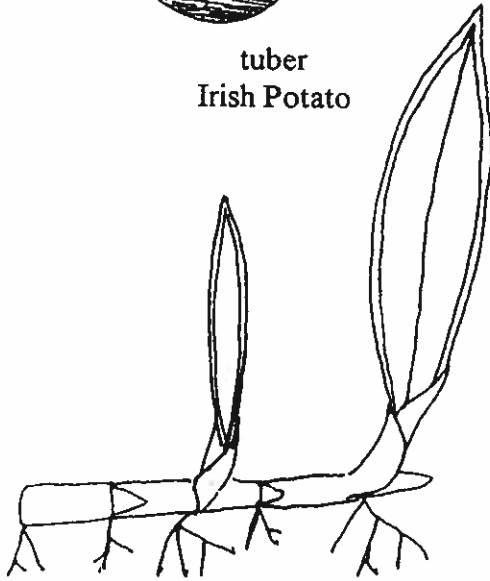
corm  
Crocus

**corm** short, thickened, underground stems with few nodes and short internodes, usually enclosed by dry, scale-like leaves (gladiolus, crocus).



tuber  
Irish Potato

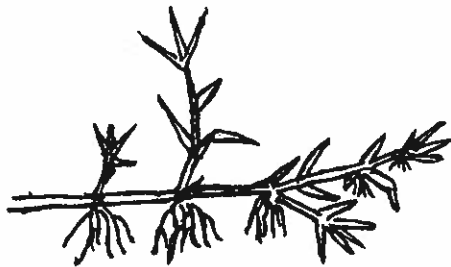
**tuber** large underground storage organs formed by thickening or swelling of the subapical portion of an underground stem (potato, caladium, Jerusalem artichoke).



rhizome  
Sansevieria

**rhizome** horizontal stems, usually thickened, that grow partially or entirely underground (iris, canna, sansevieria).

**stolon** horizontal stems, usually thin, that grow above ground, and which usually form roots and plantlets at nodes that contact the ground (grasses).



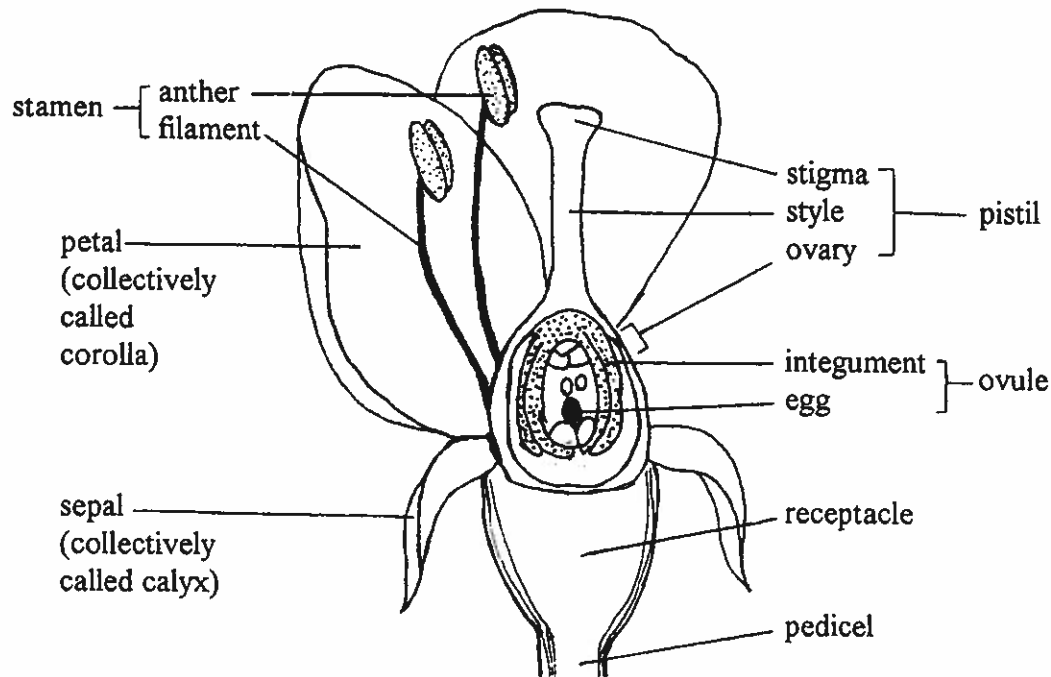
stolon - Bermudagrass

**runner** a slender stem with elongated internodes (strawberry, chlorophytum).



runner - Strawberry

## DIAGRAM OF A TYPICAL FLOWER



**perianth** - collective term for **corolla** and **calyx**; called a **hypanthium** if fused.

**inflorescence** - a cluster of individual flowers on a common axis called the **peduncle**.

### FRUIT CLASSIFICATION

**fruit** - a ripened or mature ovary and its contents, plus any accessory tissue (a **seed** is a ripened ovule).

**simple fruit** - a fruit derived from a single flower and a single pistil (ovary).

**aggregate fruit** - a fruit derived from a single flower which contains many pistils (ovaries) on a common receptacle (blackberry, strawberry).

**multiple fruit** - a fruit derived from several or multiple flowers which are clustered together along the same axis (the peduncle) (fig, pineapple, mulberry).

### FRUIT PARTS

**pericarp** - the fruit wall (derived from the ovary wall of the pistil), which is composed of the exocarp, mesocarp and endocarp (the 3 layers are not always recognizable, for example, on dry fruits).

**endocarp** - the innermost layer of the pericarp (often hard, stony or papery).

**mesocarp** - the middle layer of the pericarp (often fleshy).

**exocarp** - the outermost layer of the pericarp (often like a skin or peel).

**rind** - tough, leathery covering on many fruits either composed of the exocarp (pepo- ex. melons) or the exocarp and mesocarp (hesperidium - ex. orange).

**accessory tissue** - fruit parts not directly derived from the ovary, for example, receptacle tissue of pomes (apple) and the husk of nuts (acorn, pecan).

## CLASSIFICATION OF FRUITS

A) **Simple Fruit** - derived from a single flower with a single ovary (pistil).

1) **dry dehiscent fruit** - pericarp dries and splits open at maturity.

a) **legume or pod** - contains one locule that splits along 2 sutures (bean, pea, mimosa).

b) **follicle** - contains one locule that splits along one suture (larkspur, sweet gum, magnolia).

c) **capsule** - contains 3 or more locules that split along 3 or more sutures (okra, golden rain tree, tallow tree).

2) **dry indehiscent fruit** - pericarp dries, but does not split open at maturity.

a) **samara** - 1- or 2-seeded with pericarp flattened into wings (maple, elm, ash).

b) **caryopsis or grain** - one seeded fruit with seed fused to the pericarp (wheat, corn, grain).

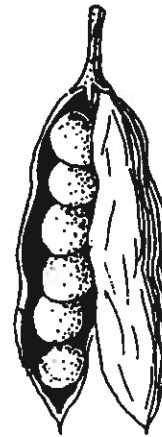
c) **achene** - one seeded fruit with seed free from pericarp (sunflower).

d) **nut** - similar to an achene, but one seeded by abortion, and partially (acorn) or wholly (pecan, walnut) enclosed by a husk.

3) **fleshy fruit** - pericarp does not dry at maturity.

a) **berry** - entire pericarp is fleshy (grape, tomato).

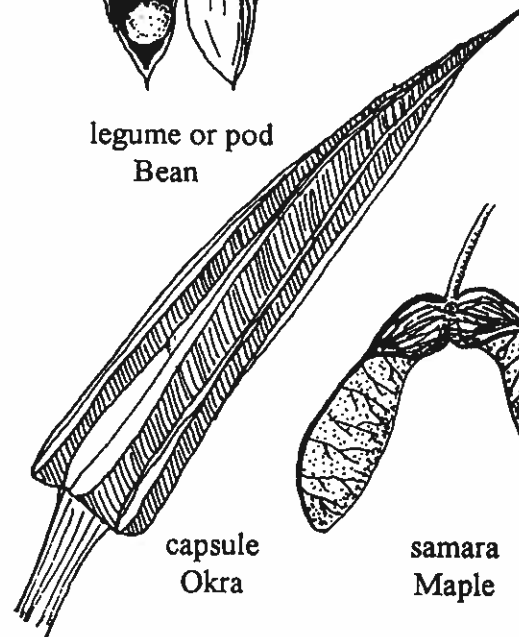
b) **pepo** - a type of berry, with the exocarp as a hard rind (melon, cucumbers).



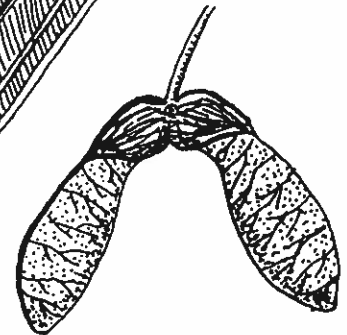
legume or pod  
Bean



follicle  
Larkspur



capsule  
Okra



samara  
Maple



achene  
Sunflower



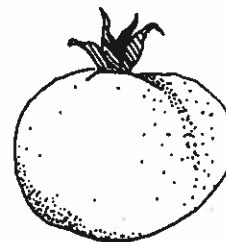
caryopsis or grain  
Corn



nut - Acorn



nut - Pecan

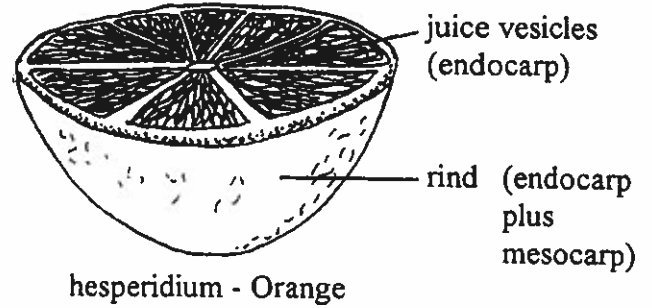


berry - Tomato

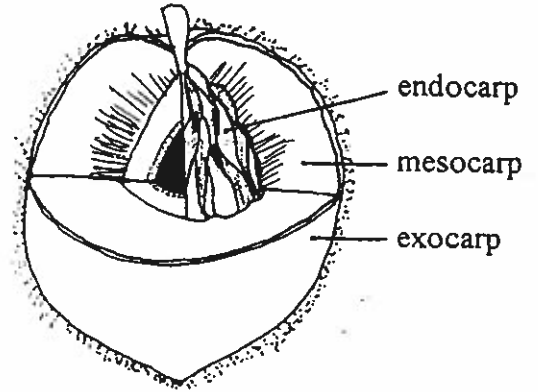


pepo - Squash

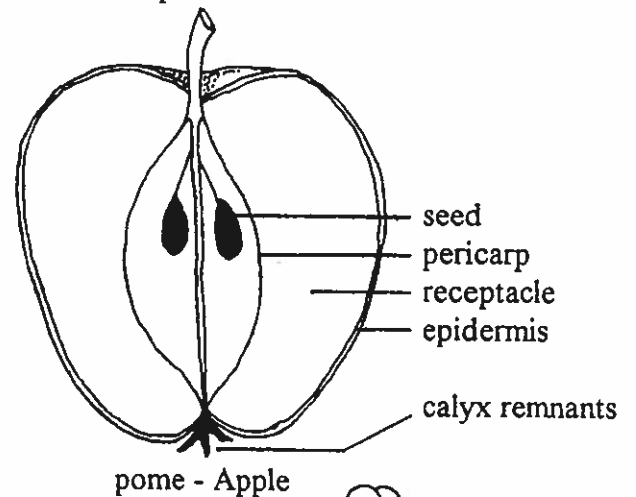
c) **hesperidium** - a type of berry, with the exocarp and mesocarp as a hard rind and the endocarp composed of juice vesicles (citrus - orange, lemon, lime).



d) **drupe or stone** - a single-seeded fruit with a skin-like exocarp (fuzzy or smooth), fleshy mesocarp and a hard stony endocarp (peach, cherry, plum, coconut).



e) **pome** - a paper-like pericarp contained in a thickened, fleshy receptacle or hypanthium (apple, pear, pomegranate).



B) **Aggregate Fruit** - a fruit derived from a single flower with many pistils (blackberry, strawberry).

C) **Multiple Fruit** - a fruit derived from several or multiple flowers clustered along a common axis (mulberry, fig, pineapple).

Both aggregate and multiple fruits are composed of many simple fruits. For example, a strawberry is composed of many achenes on a fleshy receptacle and a mulberry is composed of many small berries clustered together on a common axis.

