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Basic Botany

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This module was developed by Phyllis Turner, PhD, Extension Master Gardener; Virginia Cooperative Extension / Master Gardener Program; Updated 11/2023

Introduction to ‘Basic Botany’

This module is foundational to everything else that you will learn. A basic knowledge of botany will give you the “why” of many of the principles taught in other modules.

- Read Chapter 1, in your Master Gardener Handbook before viewing these slides
- Browse the Suggested Readings at the end of these slides. They contain online sources that will be helpful for your learning
- The Test Your Knowledge section is for fun and review
- When you are ready, take the quiz, you can print out a copy by clicking on “Printable Copy of Quiz” on the first slide to get a copy to work on

What I Will Learn in this Module (Objectives)

- Sexual and reproductive parts of a plant
- Function of a stem; Function of leaves
- Differences between a root and a stem
- Description of leaf arrangements along a stem
- Principal functions of roots; Sole function of flower
- Parts and function of the flower
- Conditions necessary for germination and description of the first stages of seed growth
- Description of photosynthesis, respiration, and transpiration
- How environmental factors affect plant growth: light, temperature, water, humidity, and nutrition

Continued on next slide...

What I Will Learn in This Module

Definitions of the following terms:

monocotyledon (monocot)	parallel	palmate
dicotyledon (dicot)	pinnate	sessile
leaf blade	whole leaf	lateral bud
petiole	simple leaf	flower
compound leaf	node	branch
axillary bud	alternate leaves	
deciduous opposite leaves	whorled leaves	bract
simple leaf	compound leaf	

buds: leaf, flower, terminal, lateral, axillary, and adventitious

dioecious and monoecious plants

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What I Will Become Familiar with

- Definitions of typical and modified stems, including both above and below ground stems
- Types of leaves; Venation of leaves
- Shape of leaf blades
- Definitions of the different types of flowers: complete, incomplete, perfect, imperfect, pistillate, and staminate
- Description and function of binomial nomenclature
- Description of how pollination occurs and seeds form
- Parts of fruits
- Descriptions and examples of types of fruit: simple, aggregate, and multiple

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Basic Botany
Biological classification

Photo Credits: P. Turner, EMG

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Botany

is the study of plants

Taxonomy is “putting into groups” and is a science that is used in Botany (and other life sciences) to help make sense of the large number of living things.

Carolus Linnaeus is often called the “Father of Taxonomy.”

Linnaeus organized living things into groups that became more and more alike. These groups are called Taxa.

Photo Credit: Encyclopedia Britannica

There are 7 major taxa into which organisms are placed:

	Example of pink flowering dogwood
Kingdom	Plant
Phylum (divisions)	Tracheophyta
Class	Angiospermae
Order	Cornales
Family	Cornaceae
Genus	Cornus
Species	C.Florida
Variety	C. florida var. rubra

Linnaeus divided all the things in the world into either Plant or Animal Kingdom.

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Plant Kingdom

Plant Kingdom is made up of living things that are:

1. photosynthetic (can make their own food)
2. eukaryotes (have a nucleus & organelles) and
3. have cell walls (have cell walls with cellulose in them)

Phylum (Division): Tracheophytes

Kingdoms are further divided into Phyla or **Divisions.**

Master Gardeners are mostly interested in the Division called Tracheophytes.

These are the plants with trachea or…"little pipes" which carry food and water throughout the plant.

Classes

Phyla or divisions are divided into classes.

Of the tracheophytes, we are mostly interested in the classes:

Photo credit: P. Turner, EMG

Angiospermae: fruit covered seeded plants (flowering plants)

and

Gymnospermae: the naked seeded plants include the conifers, cycads, and ginkgo.

Photo credit: Wikimedia

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There are two types of Angiosperms:

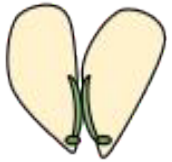
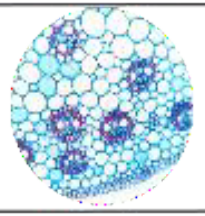
MONOCOT	DICOT
Single Cotyledon 	Two Cotyledon 
Long Narrow Leaf Parallel Veins 	Broad Leaf Network of Veins 
Vascular Bundles Scattered 	Vascular Bundles in a Ring 
Floral Parts in Multiples of 3 	Floral Parts in Multiples of 4 or 5 

Photo credit Wikimedia

What is a **cotyledon?** It is part of the **embryo** within the **seed**; may become the embryonic first **leaves**. The number of **cotyledons** is one way to classify the flowering plants (angiosperms). Species with one cotyledon are called **monocotyledonous** (or, "monocots"). Plants with two embryonic leaves are termed **dicotyledonous** ("dicots").

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Scientific Names

Scientific names are made up of 2 parts:
The genus name and the species name

1. The **genus** name is like your last name and places the plant in a particular group

   Your Name: Jones =Jones group

   Genus name: Acer = maple group

2. The **species name** is like your first name

   Your Name: Gregory

   Species name: Acer rubrum= maple, red

   (Tells which genus we are talking about)

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Species are **kinds** or **types** of organisms

A more technical definition of species is a group of interbreeding organisms that do not ordinarily breed with members of other groups and which produce offspring that can also reproduce.

So…a species is 1 kind of living thing.

Common Names

Can be confusing :

Some plants have the same common name

Some plants have no common name

Some plants have more than one common name

Common names differ from place to place

That’s why we suggest you learn scientific names

Scientific Names

...Are the only way to communicate which plant you mean in any culture or in any location.

Scientific names are rather fun if you learn a few ways to know how they are used and how they are put together.

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Scientific Names

The genus name is Capitalized and either underlined or italicized.

The species name is not capitalized, but it is underlined or italicized.

Example: *Cornus florida* = flowering dogwood

(*genus*) (*species*)

Scientific Names

Various methods are used to pick the genus and species names:

A. Adjectives
B. Classical Latin
C. Greek names
D. Names from Latin or Greek myths

Scientific Names

A. Examples of adjectives:

- Magnolia virginiana, "Virginian magnolia" (sweet bay)
- Camellia japonica, "Japanese camellia“
- Quercus alba, “White oak“
- Pinus palustris, “Swamp pine" (longleaf pine)

These adjectives must match the genus name in gender, number, and case.

Photo: P. Turner, EMG

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Scientific names

Some Latin terms used as adjectives

- acaulis = stemless
- alba = white
- barbata = bearded, hairy
- canadensis = from Canada
- digitata = (leaves) like a hand, with five lobes
- edulis = edible
- flava = yellow
- hirsuta = hairy

The Meaning of Latin Plant Names

Scientific Names

B. Classical Latin plant names

Quercus (oak)

Rosa (rose)

Pinus (pine)

Acer (Maple)

White Oak

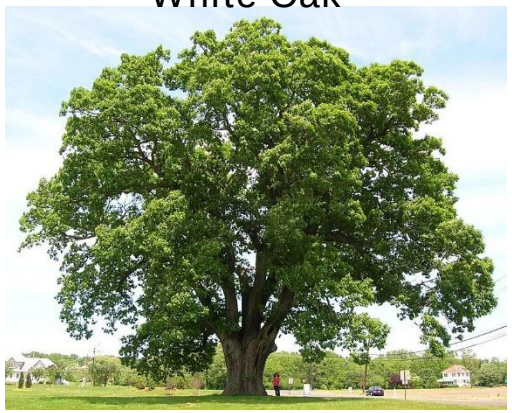

Photo credit: Wikimedia

Photo: P. Turner, EMG

Photo credit: P. Turner EMG

Maple leaf

Photo credit: B. Kovach, EMG Rockbridge Co.

Scientific Names

C. Classical Greek plant names

- Rhododendron (rhododendron, azalea)
- Narcissus (daffodil)
- Thuja (arbor vitae)
- Carya (hickory)
- Typha (cattail)
- Zea (corn)

Scientific Names

D. Names from Latin and Greek myths
   - Nyssa (tupelo, gum)
   - Andromeda (andromeda)
   - Liriope (monkey grass)
   - Iris (iris)

Other Scientific Names

Besides the genus and species names there are often other distinctive names added to scientific names.

Buxus microphylla var. japonica is the name for the variety of Japanese boxwood.

Cornus florida 'White Cloud' is the name for a cultivar of flowering dogwood.

Variety

A variety is a group of plants in a natural population that has distinctive features. A variety is propagated sexually and comes true from seeds.

The varietal name is added after the name of the species and is preceded by the abbreviation "var“.

For example,

Buxus microphylla var. japonica is the name for the variety

of Japanese boxwood

Cultivar

A cultivar is a plant selected by someone for one or more unique traits and usually is propagated vegetatively in order to maintain those traits.

If a new type of tomato was developed by cross pollination in a breeding program, it would be a cultivar.

A cultivar name follows the species name and is enclosed within single quotation marks, not underlined or italicized, and each word begins with capital letters.

Example: *Cornus florida* 'White Cloud' White Cloud flowering dogwood

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[Cultivar vs Variety]

Words Which Describe Plants:

Habitat

- *aquaticus* = in water
- *pratensis* = in meadows
- *sylvestris* = in woods

Geography

- *americanus* = Americas
- *canadensis* = Canada
- *carolinianus* = Carolinas
- *occidentalis* = western
- *orientalis* = eastern
- *virginianus* = Virginia

Plant Attributes

- *annuus* = annual
- *communis, vulgaris* = common
- *officianales* = medicinal
- *rugosus* = wrinkled

Color

- *albus* = white
- *coccineus* = scarlet
- *flavus = yellow*
- *glaucus* = whitish with a bloom
- *niger* = black
- *ruber* = red
- *sanguineus* = blood red
- *variegatus* = variegated
- *viridis* = green

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Words Which Describe Plants:

Prefixes

- *uni* = one
- *bi* = two
- *tri* = three
- *quadri, tetra* = four
- *quinque* = five
- *multi* = many
- *a* = without, lacking

Parts

- *caulis* = stem
- *carpus* = fruit
- *florus* = flower
- *follium* = leaf

Identifying Plants Using Keys

Keys are wonderful ways of finding out what your plant is, if you do not know. They make use of particular features to identify the plant you may not know.

"A dichotomous key is a tool that allows the user to determine the identity of items in the natural world, such as trees, wildflowers, mammals, reptiles, rocks, and fish. Keys consist of a series of choices that lead the user to the correct name of a given item. "Dichotomous" means "divided into two parts". Therefore, dichotomous keys always give two choices in each step.

The website below gives an example of a dichotomous key.

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Dichotomous Key

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Plant parts and function

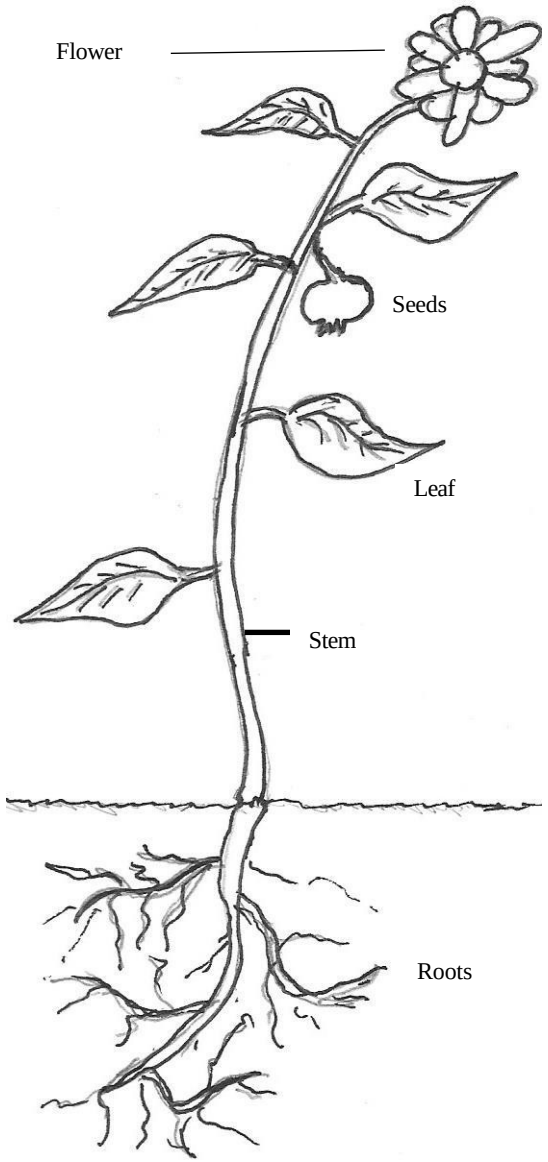

Image: B. Turner

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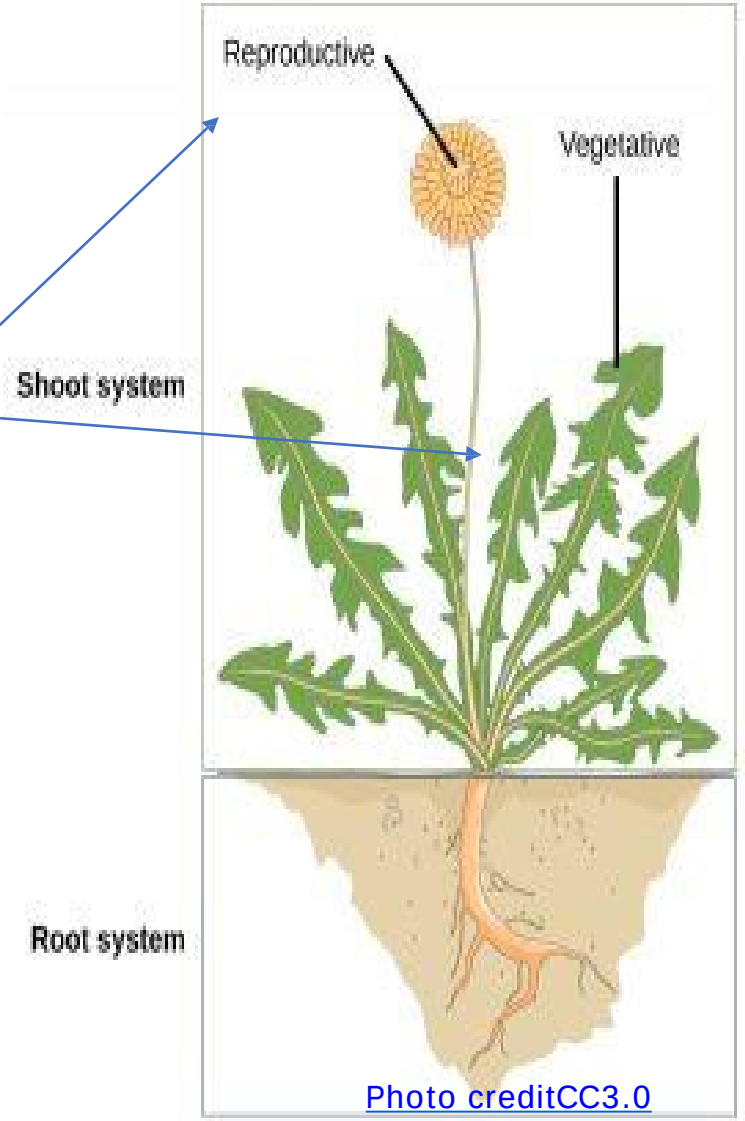
Categories of Plant Parts

Plants have

Vegetative parts

and

Sexual parts



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Vegetative Plant Parts

Roots

Stems

Leaves

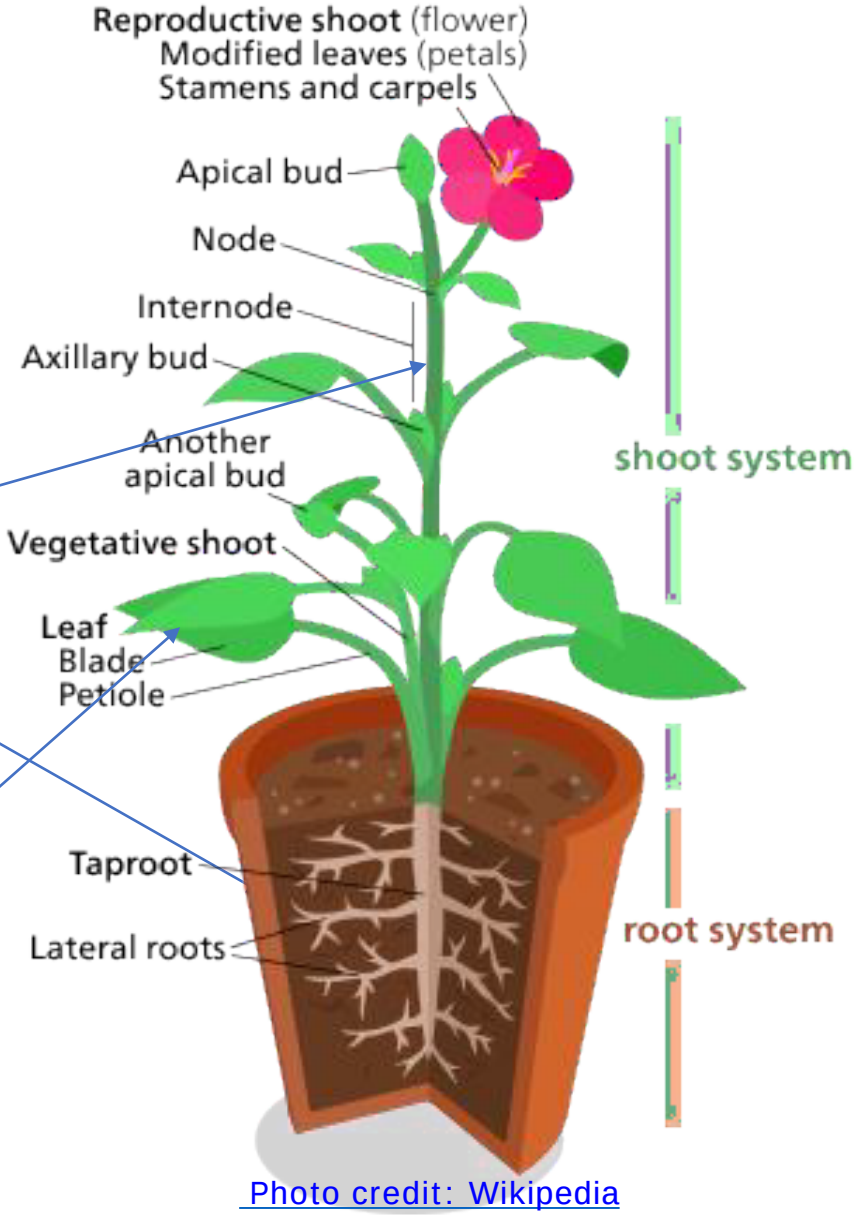

Photo credit: Wikipedia

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Roots

Function

- anchor plant
- absorb water and minerals
- transport food and water
- store food

Photo credit: P. Turner, EMG

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Roots

There are two major types of root systems in plants:

- Taproot systems have a stout main root with a limited number of side-branching roots

- Fibrous root systems have many, finely branched roots

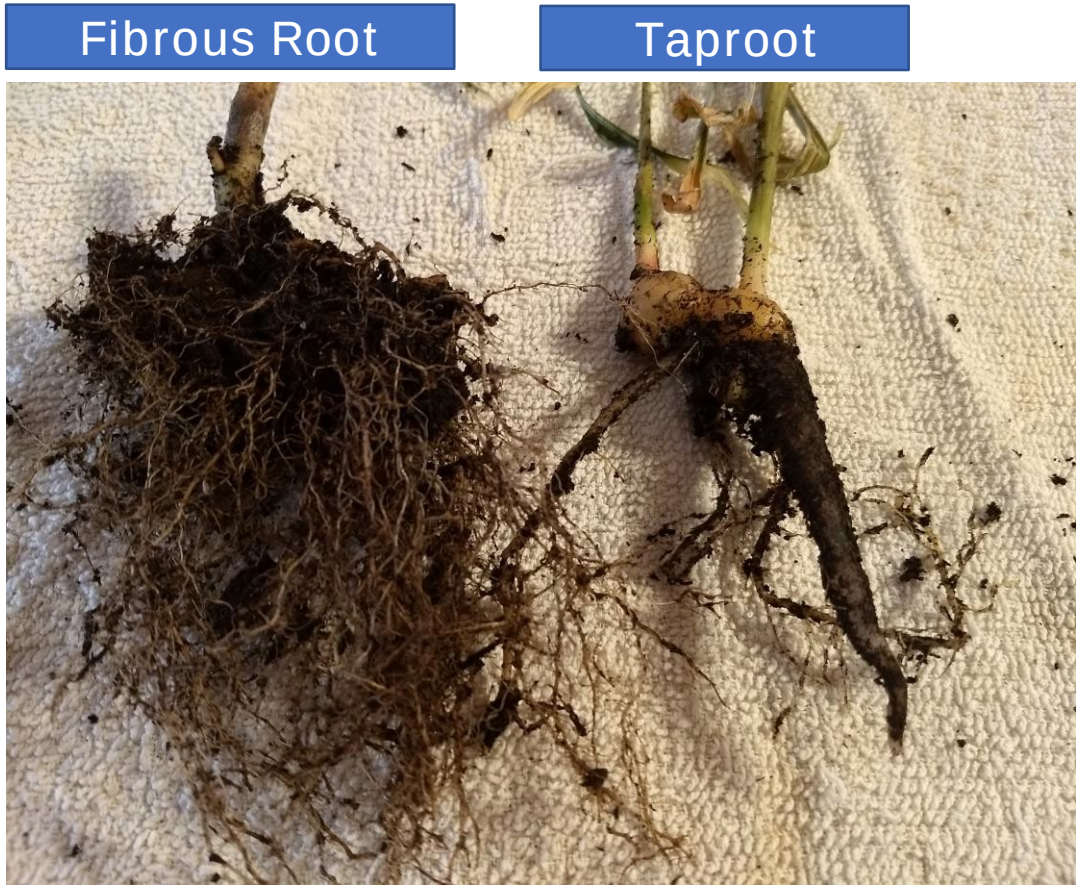

Photo credit: P. Turner EMG

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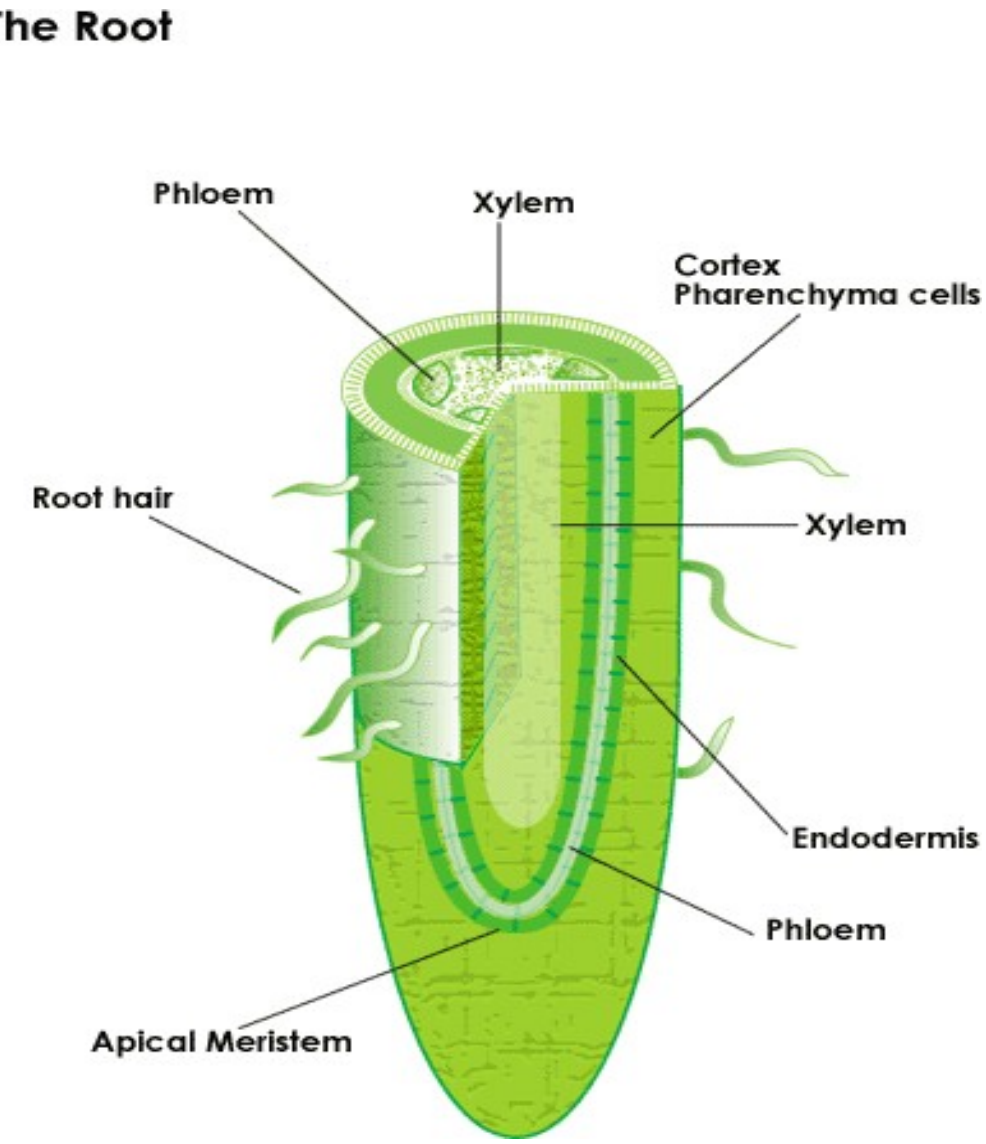
Roots

E*pidermis* is the outermost layer of cells of the root.

These cells are responsible for absorbing water and minerals.

Cortex cells are involved in moving water from the epidermis to the vascular tissue (xylem and phloem) and in storing food.

Vascular tissue is located in the center of the root and conducts food and water.



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Root Hairs

Root hairs are small hair-like extensions of the outer layer of root cells that increase the surface area of the roots, increasing the capacity to absorb nutrients and water.

Root hairs are often destroyed when a plant is dug from the soil. New root hairs will quickly form as long as the roots themselves are undamaged.

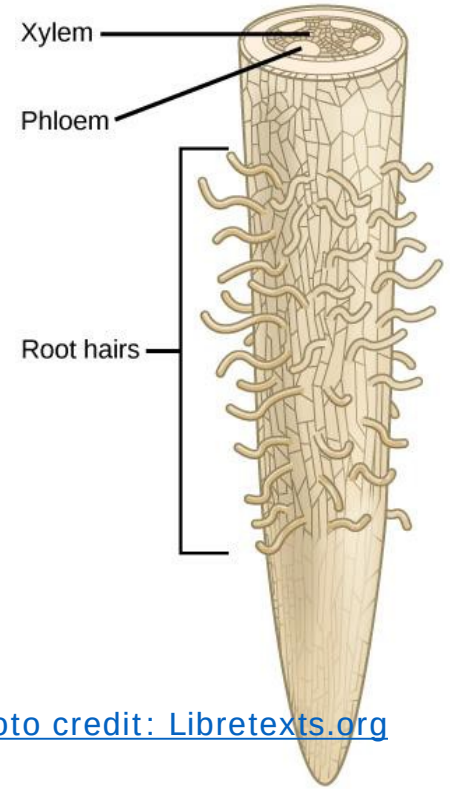

Photo credit: Libretexts.org

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Stems

- Stems are generally upright and above ground
  However, many stems grow below ground or are ground hugging
- A stem is recognizable because it includes buds and sometimes leaves
- Buds and shoots generally develop on stems
  In some cases, stems also store food

Tomato Stem

Photo credit: CC BY ND

Ginger: an underground stem

Photo credit: Britannica

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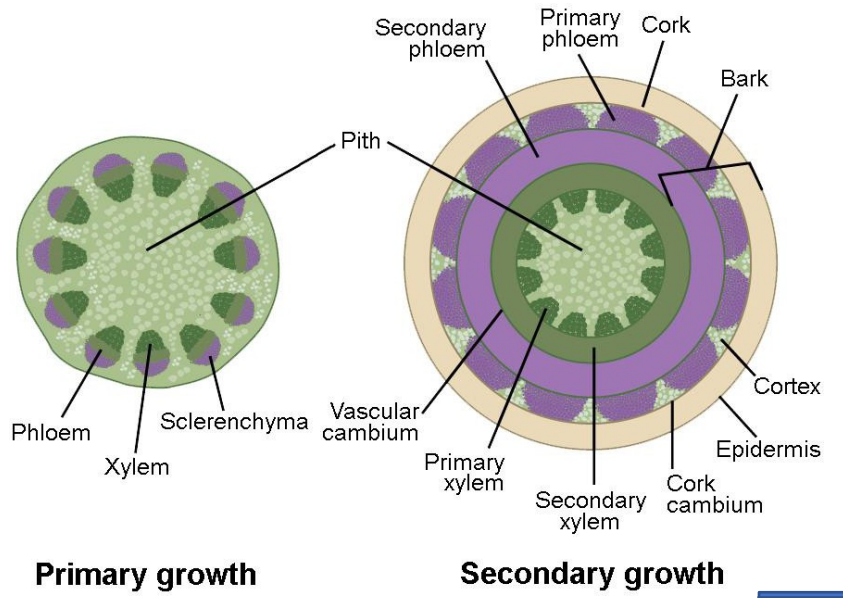
Stem

- One of the major functions of the stem is to move water, nutrients, and food through the plant.
- The internal tubes in stems act like the plumbing in a house or the blood vessels in people. As in humans, this system is called the vascular system.
- The food-moving part of the vascular system is called the **phloem** (from leaves to roots).
- The water-and-mineral-moving system is called the **xylem** (from roots to leaves).
- The cambium is responsible for the stem growth.

Photo credit: Lumen learning



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Stems

Nodes are places on the stem where leaves are attached and buds form.

I**nternodes** are the segments of the

stem between nodes.

The quality and amount of available light and temperature affect the length of the

internode. Plants grown under poor light conditions may

be spindly, with very long, thin, and weak internodes.

Roots often form at nodes of creeping plants and when cuttings are taken for propagation.

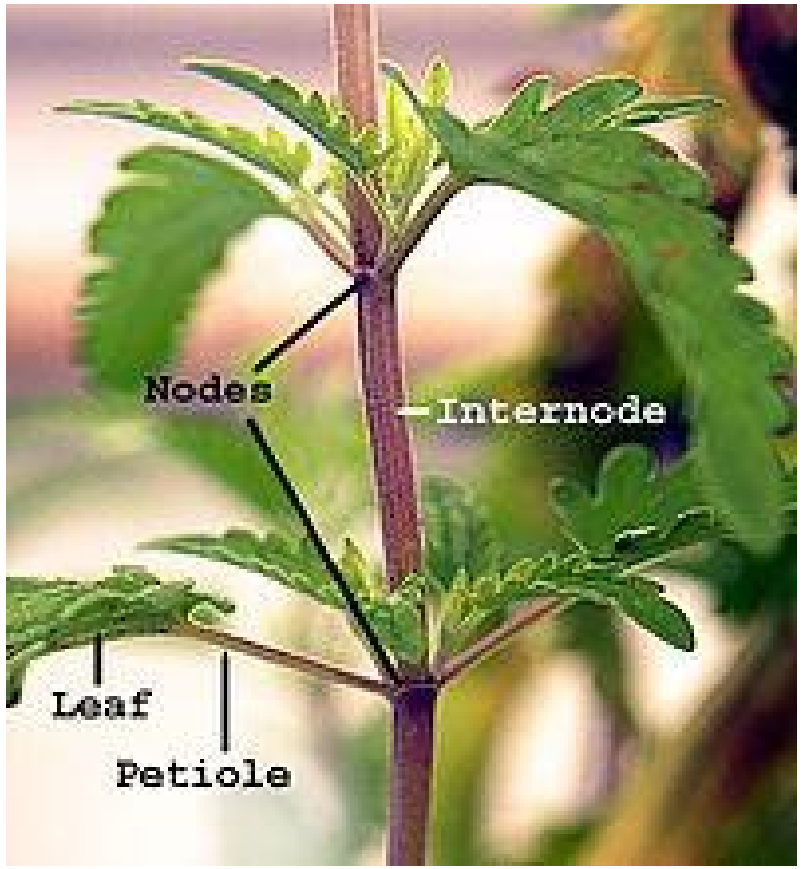

Photo credit: CC SA

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Stems

Terminology

- ***Shoot*** - A young stem (1 year old or less) with leaves
- ***Twig*** -A young stem (1 year old or less) that is in the dormant winter stage (has no leaves)
- ***Branch*** -A stem that is more than 1 year old, typically with lateral stems radiating from it
- ***Trunk*** -A woody plant's main stem

Stems

There are many stem variations in plants.

Some variations are used as food, such as potatoes and asparagus.

Others are sold in dormant condition for planting in the landscape, such as crocus corms and tulip bulbs.

Many stem modifications provide opportunities for propagation.

Modified Stems

A ***bulb*** has a flattened stem at the base with fleshy leaves making up most of the structure.

Photo: P. Turner, EMG

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Modified Stems

A ***corm*** is an upright swollen stem, often enclosed in papery leaves.

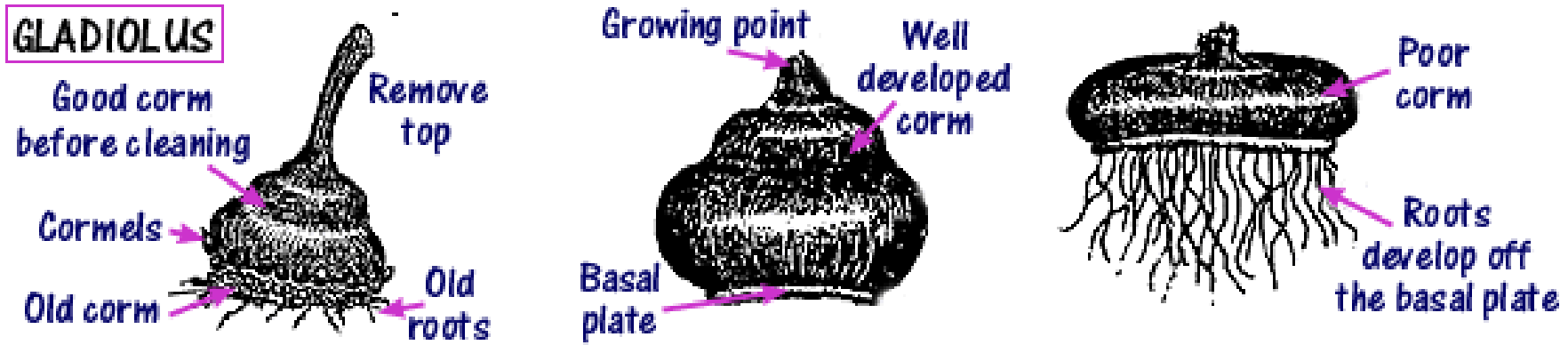

Photo credit

Modified Stems

A ***stolon*** is a stem that grows along the ground surface, such as a strawberry runner.

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Modified Stems

A ***rhizome*** is a horizontal underground stem, such as in bent grass or some irises.

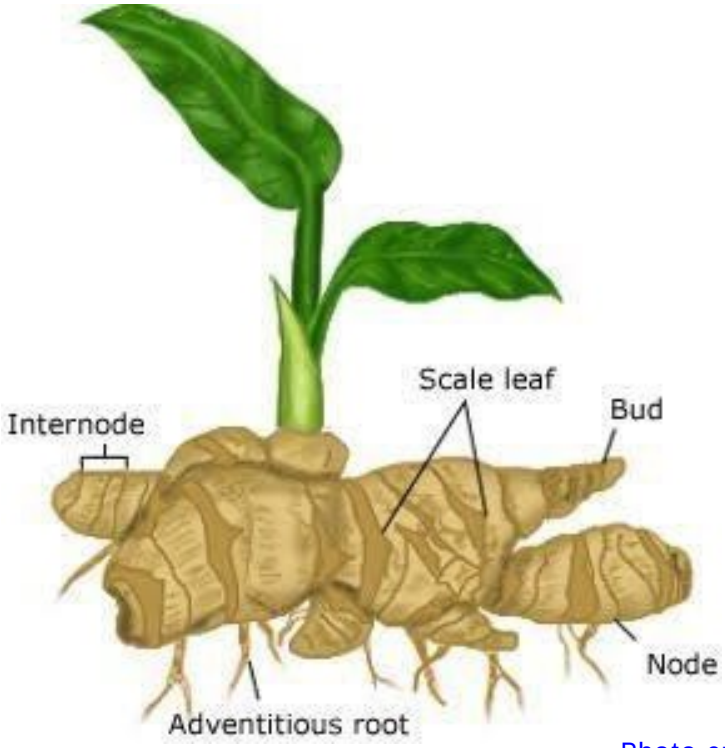

Photo credit: Quora

Meristems

There are two areas of cell division or **MERISTEMS** contributing to the growth of a stem:

- The **apical meristem** at the tip increases the length of stem and produces new leaves and buds
- The other meristem is the **CAMBIUM** that produces new phloem and xylem
- In most plants (dicots) this is a ring of cells that increases the girth of the stem
- In plants such as lilies and grasses (monocots) the cambium is scattered through the stem and does not remain active, so they cannot increase in girth

Girdling of a tree may kill the cambium layer, resulting in lack of growth.

Stems

Names for stems based on how long they live:

- **Perennial** lives more than 2 years
- **Annual** passes through their whole life cycle in one growing season
- **Biennial** uses a 2 year growing season

Name for stems based on texture and growth:

- **Woody** contain relatively large amounts of hardened xylem tissue and are typical of trees and shrubs
- **Cane** is a stem with a relatively large pith (central core) and usually lives only one or two years
- **Herbaceous or succulent** contain only small amounts of xylem tissue and usually live for only one growing season

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Leaves

Leaves are lateral outgrowths from the stem, most commonly flat, broad,

and green. This maximizes their function of absorbing sunlight and

transforming it into food.

Leaves have evolved into many shapes and sizes, reflecting adaptations to the environment.

Leaves generally consist of a **PETIOLE** (also known as stalk) and a **LAMINA** (also known as Blade).

In simple leaves the lamina is in one piece. In compound leaves, several pieces of lamina are joined to one petiole.

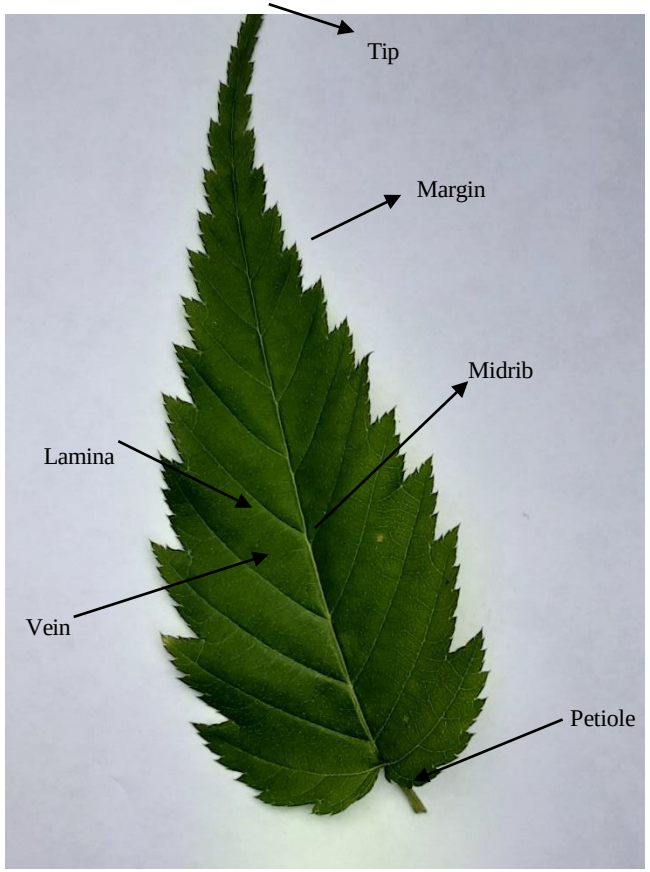

Photo: P. Turner, EMG

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Types of Leaves

- Foliage. Most common; manufacturing centers where photosynthesis takes place
- Scale. Found on rhizomes; small leathery protective leaves; enclose buds
- Seed. Cotyledons; modified leaves found on embryonic plants; serve as storage
- Spines and tendrils. Protect and support stems
- Storage. Found on bulbous plants and succulents; serve as storage
- Bracts. Brightly colored; example poinsettias

Leaves

Simple Leaves have a single continuous unit. Margins can be entire (free from indentations), serrated, or lobed – See A, B, C to the right

Compound Leaves have several separate leaflets arising from the same petiole; They may be pinnate (D in the picture) like a feather, or palmate (E & F in the picture), like the palm of the hand.

Example of palmate is grape and maple.

Example of pinnate is apple, cherry, peach.

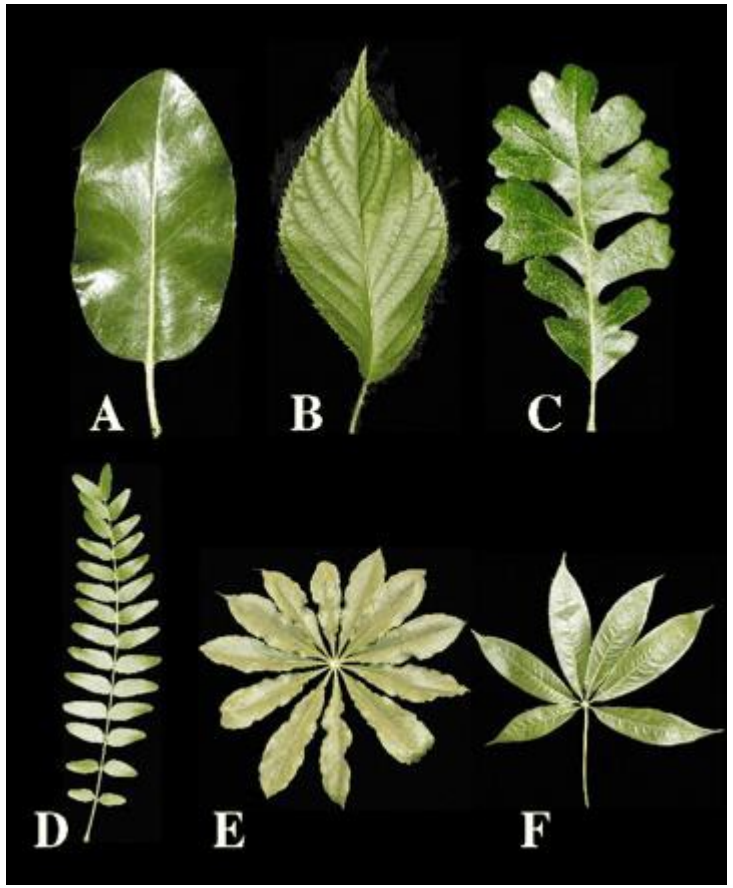

Photo credit: dev biologists

Leaf Arrangements

Alternate. Most common' Spiral leaves arranged in alternate steps along the stem with only one leaf at each node

Opposite. Positioned across the stem from each other; two leaves at each node

Whorled. Arranged in circles along the stem; three or more leaves at the same node

Photo credit Britannica

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Leaf Venation

Parallel. Those with numerous veins that run essentially parallel to each other and are connected laterally by Photominute straight veinlets; Typical of grasses (monocots)

Photo credit: ucanr.edu

Net. Reticulate-veined; veins branch from the main ribs then subdivide into finer veinlets; enmeshed veins

Identification: Characteristics of Broadleaves

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Leaf Margins

Leaf margins are used in visual identification because they are consistent within a species or group. Different sources identify different numbers of types of leaf margins (from 4 to 16 different types). However, others describe some of these as subsets of other types.

1. Wikipedia describes 12 different leaf margins
2. University of Illinois describes 13 different leaf margins

VT.edu identifies four types of leaf margins

Entire

Dentate

Serrate

Lobed

VT.edu pictures four types of leaf margins (entire, dentate, serrate, lobed)

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Leaves

The first leaves to appear when the seed germinates are often the seed leaves or ***cotyledons***.

There can be only one cotyledon in monocots, and two in dicots.

Photo credit: garden.org

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Specialized Leaves

Leaves are often modified for special functions such as climbing, storage, protection, trapping food

SPINES function to protect the plant (e.g. barberry)
TENDRILS support the stems of climbing plants
BRACTS are leaves associated with flowers; they may be green or brightly colored and mistaken for petals

Photo credit: Encyclopaedia Britannica

Bract: Photo credit: P. Turner, EMG

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Sexual Parts of Plants

Buds

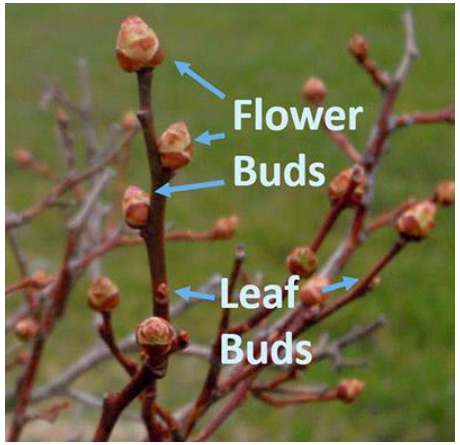


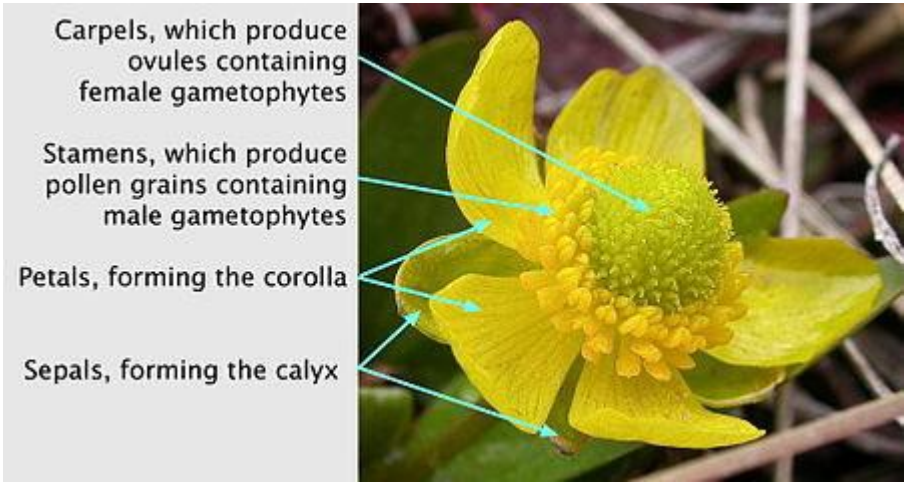
Photo credit: canr.msu.edu

Fruit

Photo credit: Wikipedia

Flower

Photo credit: Wikipedia



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Buds

- Buds are undeveloped shoots and flowers: classified as terminal (apical) or lateral
- Terminal buds can be identified by their location at the tip of a stem
- Lateral buds are located at the sides of the stem (example: brussels sprouts)
- Flower buds are normally larger than vegetative buds (example: broccoli)

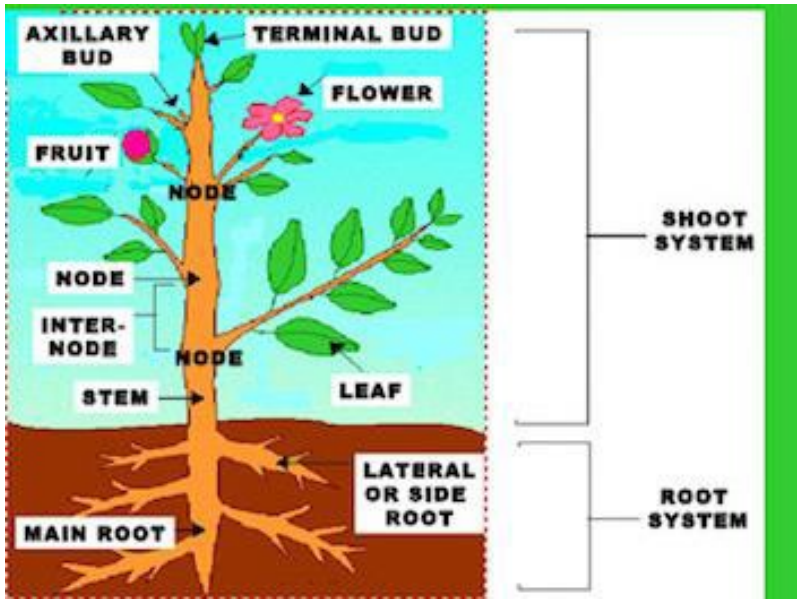

Photo credit: study.com

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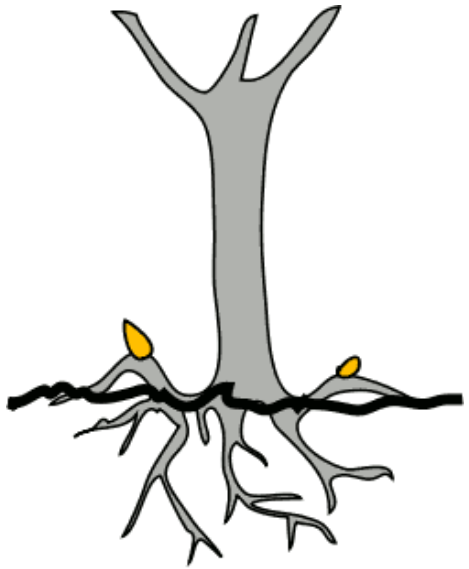
Buds

ADVENTITIOUS (ad-ven-TISH-us) buds, form at any other location. Adventitious buds may form on the internode of the stem, at the edge of a leaf or at the cut on a stem or root. Stem and leaf cuttings can develop adventitious buds which also send down roots to form a complete new plant.



Adventitious

Photo credit: Wikimedia

Flower

The flower is the reproductive unit of some plants (angiosperms)

Parts of the flower include:

- Petal
- Sepal
- Pistil (the female reproductive organs collectively known as carpels)
  - Stigma – receives the pollen during fertilization
  - Style – tube on top of the ovary
  - Ovary – where ovules are produced
  - Ovule – reproductive cells; eggs
- Stamens (the male reproductive organ)
  - Anther (produces pollen, male reproductive cells)
  - Filament

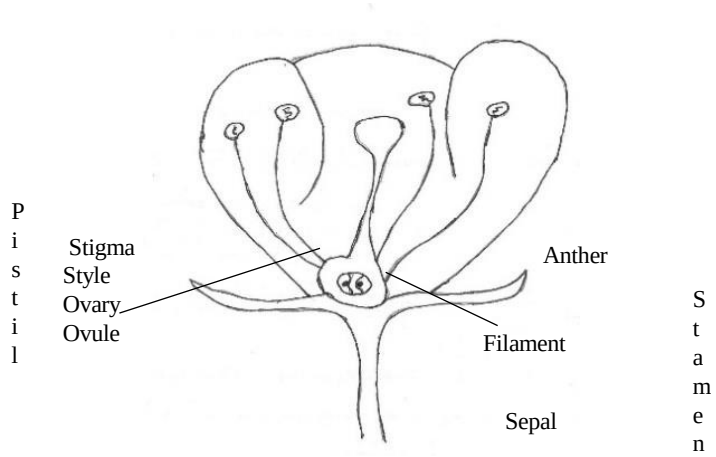


Photo image: B. Turner

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Monoecious and Dioecious Plants

Dioecious plants have male (staminate) flowers on one plant, and female (pistillate) flowers on another plant (examples: Ilex or Hollies).

Monoecious plants have separate male and female flowers on the same plant (examples: Quercus or Oaks).

Flowers

Complete flower has all four parts of the flower present:
Sepals, petals, pistil and stamen

Staminate - having stamens and no pistils; a male flower

Pistillate - having pistils and no stamens; a female flower

Pistillate flower

Photo credit
Accessed 11/19/21

Perfect vs Imperfect

- Perfect flower: It has the stamen and the pistil in the same flower
- An imperfect flower has the male sex organs or the female sex organs, but not both on the same flower

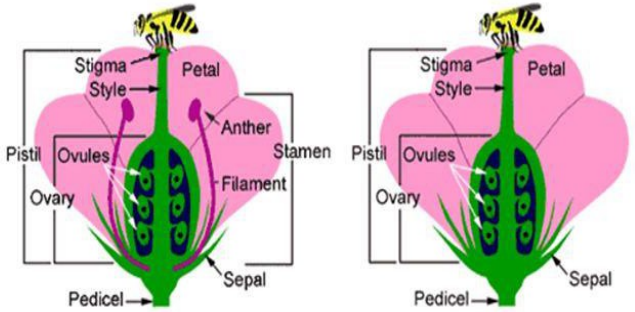

Figure 20. Complete flower structure

Imperfect (pistillate) flower structure

Photo credit

Staminate flower

Photo credit

Fruit

Seed-bearing structure of a flowering plant. A fruit is actually a ripened ovary, a component of the flower's female reproductive structure.

Did you know that these are all ripened ovaries and are really fruits – the products of fertilization

Cucumbers

Tomatoes

Photo credits: P. Turner

[Plant Parts: Fruit]

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Fruit

Fruits can be divided into:

- Fleshy fruits: with the pericarp fleshy throughout and seeds inside the fruit
  Examples: Berry, Orange, Cantaloupe

Oranges

Photo Credit: P. Turner, EMG

Blackberries

- Dry fruits: which split along definite lines to release seeds at maturity
  Examples: legumes, nuts

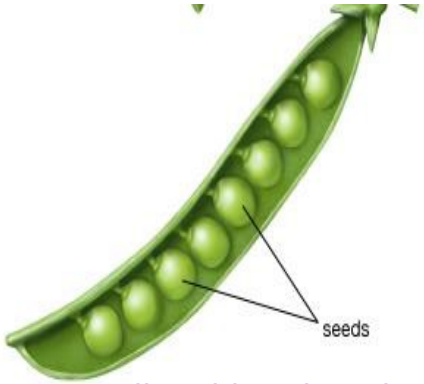

Photo credit: Kids Britannica

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Fruit

Fleshy Fruits:

Pome - a fleshy fruit (as an apple or pear) consisting of an outer thickened fleshy layer and a central core with usually five seeds enclosed in a capsule (apple)

Stone (or) Drupe - a fleshy fruit, usually one seeded; the seed is enclosed in a stony endocarp (core) (peach)

Fruits

Dry Dehiscent Fruits - dry

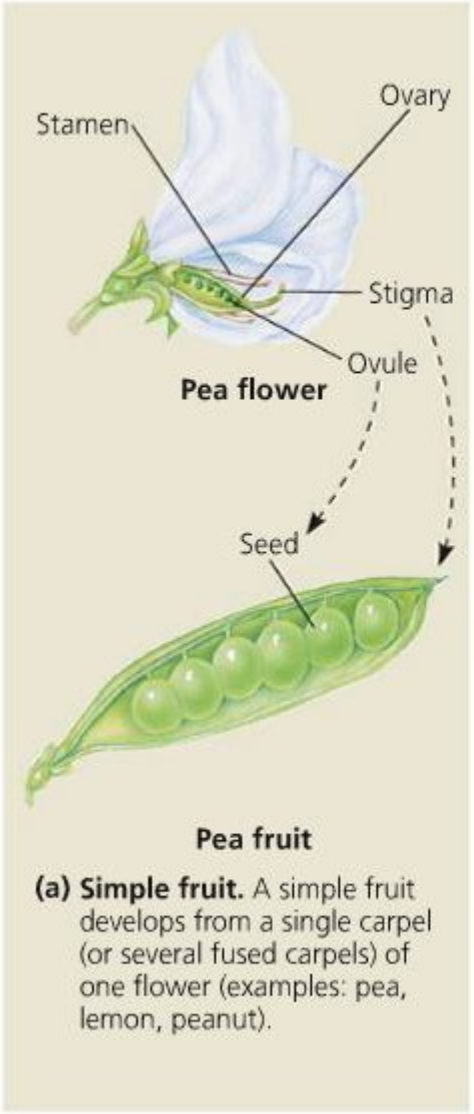
- Legume - single celled, splits along two sutures releasing the seeds (peas, beans)
- Silique - consists of two cells, splits along two sutures releasing the seeds (cabbage, turnip)
- Capsule - short and rounded fruit, consists of more than one carpel (cotton, witch hazel)

Fruits

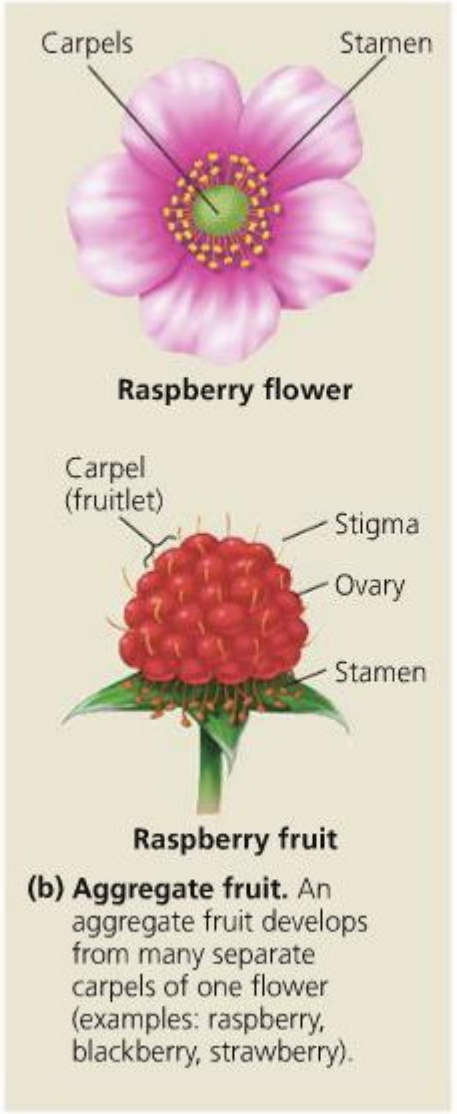
Dry Non-dehiscent Fruits - dry fruits which do not split along definite lines to release seeds at maturity

- Acorn - single celled, single seeded fruit of oaks
- Samaras - a dry, non-dehiscent, winged fruit

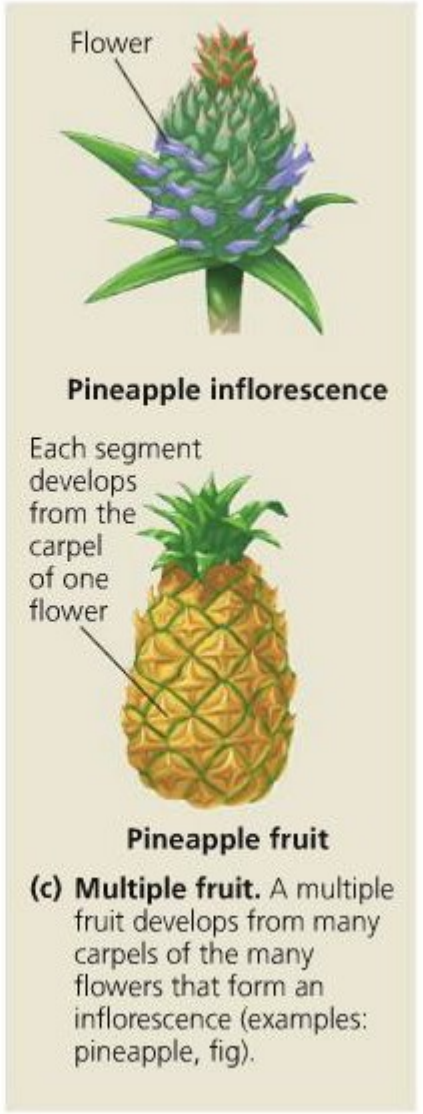
Fruits



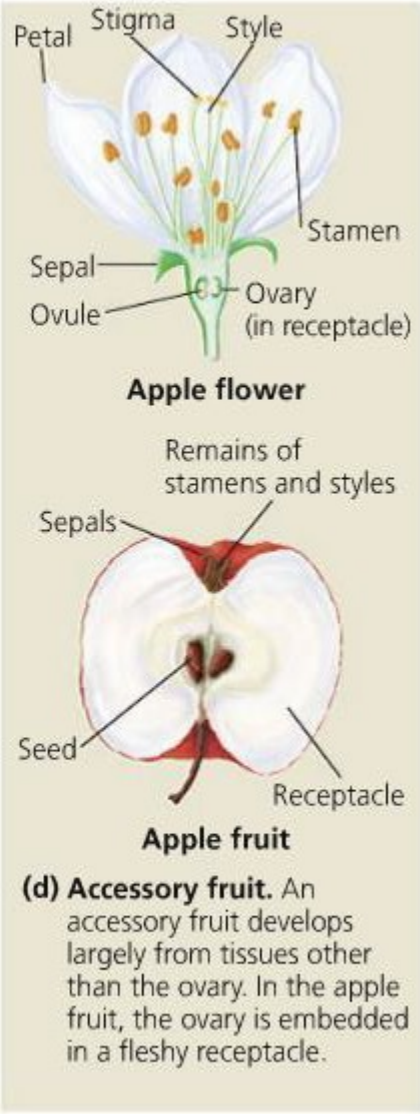
(a) Simple fruit. A simple fruit develops from a single carpel (or several fused carpels) of one flower (examples: pea, lemon, peanut).



(b) Aggregate fruit. An aggregate fruit develops from many separate carpels of one flower (examples: raspberry, blackberry, strawberry).



(c) Multiple fruit. A multiple fruit develops from many carpels of the many flowers that form an inflorescence (examples: pineapple, fig).



(d) Accessory fruit. An accessory fruit develops largely from tissues other than the ovary. In the apple fruit, the ovary is embedded in a fleshy receptacle.

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Photo credit: Eden by the Bay

Plant Processes

There are 4 major processes that plants depend on for growth and reproduction:

1. photosynthesis
2. respiration
3. transpiration
4. sexual reproduction

Photosynthesis

The process by which light energy is utilized to convert carbon dioxide and water into food to be used by plants. Oxygen is released into the air during the process.

Light or solar energy is captured by chlorophyll, the green pigment in leaves. It is then converted into chemical energy which is stored as starch or sugar. They are available to the plant as food or fuel.

Respiration

The process of converting stored food into usable energy is called respiration. It is similar to burning wood to release stored energy as heat and light.

Respiration, or the "breaking down“ of stored sugars, requires oxygen to release energy for new growth. Water and carbon dioxide are released during plant respiration.

Respiration is essentially the opposite of photosynthesis. It uses food plus oxygen to change chemical energy into heat and an energy form usable by the plant. Light is not needed in this process.

Transpiration

Transpiration is the loss of water by evaporation. As leaves open their stomata to take in carbon dioxide for photosynthesis, they lose water by evaporation.

The loss of water through the stomata in the leaf pulls water up through the plant from the roots. The stream of water moving through the xylem also carries nutrients from the roots to other parts of the plant.

When additional water is unavailable to the roots, as in winter or drought, wilting and plant damage can occur.

Reproduction

Seed formation begins when the pollen is moved from the male part of the flower (the stamen) to the female part (the pistil).

Pollination is the transport of pollen from the anther onto the stigma. Pollen can be carried by insects, other animals, or wind.

When pollen touches the stigma, a long tube (the pollen tube) grows from the pollen down through the style until it reaches the ovary.

Male sex cells travel down the pollen tube and unite with female sex cells in the ovary. This union of a male and female cell is called fertilization.

Fertilization

Self-fertile plants may be pollinated with pollen from the same flower or other flowers on the same plant. Most plants are self-fertile.

Some plants are self-sterile and cannot be fertilized by their own pollen. Pears, plums, and some apples are self-sterile. They require the presence of another variety of apple tree, a "pollinator“, for fertilization.

Fertilization results in an embryo which develops inside protective layers of tissue. The embryo and protective layers are called a seed.

Seed

A seed consists of:

- Embryo
- Endosperm (Storage Tissue)
- Seed Coat

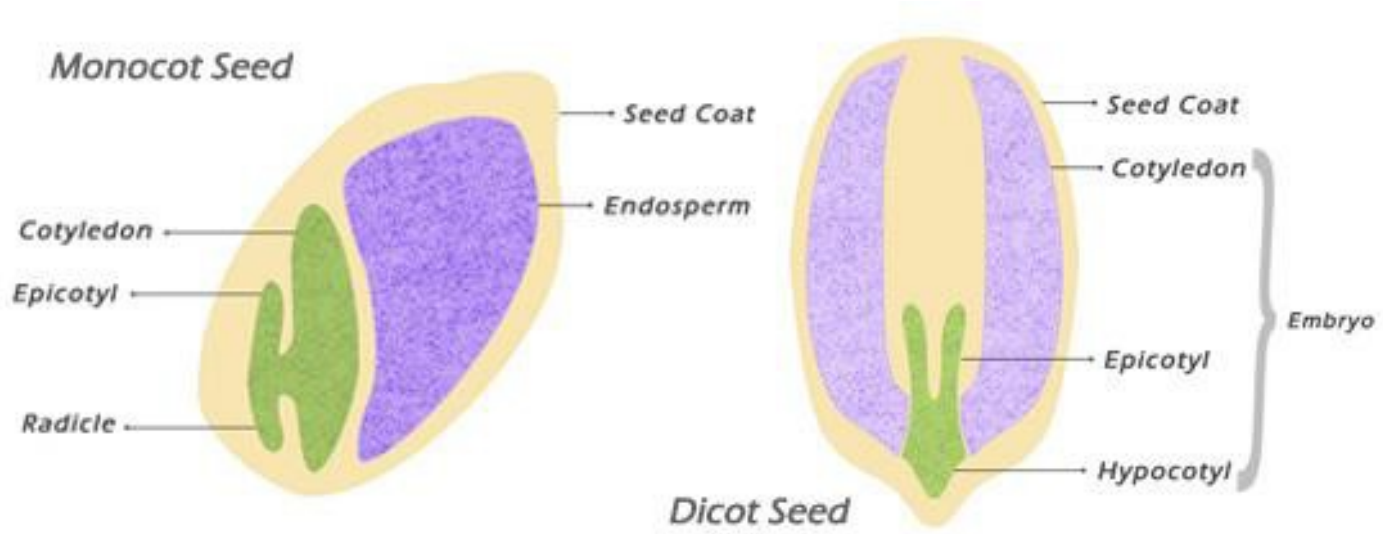

Photo credit: CC SA 2.5

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Germination

Some seeds sprout with just water and warm temperatures. Such seeds are often referred to as "seeds lacking dormancy."

Wild species usually have some kind of deeper dormancy to avoid sprouting in late summer/fall when the seeds are dispersed. This dormancy assures that tender seedlings are not frozen at a young age. For these species it takes something more than just water and warmth to germinate.

Dormancy

Seeds remain dormant or inactive until conditions are right for germination. All seeds need water, oxygen, and proper temperature in order to germinate. Some seeds require proper light also. Some germinate better in full light while others require darkness to germinate.

When a seed is exposed to the proper conditions, water and oxygen are taken in through the seed coat. The embryo's cells start to enlarge. Then the seed coat breaks open and a root or radicle emerges first, followed by the shoot or plumule that contains the leaves and stem.

Environmental Factors Impact a Plant's Growth and Health

Light

Temperature

Water

Nutrition

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Light

- Quantity (intensity); quality (wavelength); duration (photoperiod; the length of uninterrupted darkness)
- Up to a point, the more sunlight a plant receives, the greater its capacity for producing food via photosynthesis
- Day-neutral plants form flowers regardless of day length

Temperature

- Influences photosynthesis, transpiration, respiration, germination, and flowering. As temperature increases (up to a point), photosynthesis, transpiration, and respiration increase
- Combined with day-length, temperature affects the change from vegetative to reproductive growth
- Low temperatures reduce energy use and increase sugar storage
- Adverse temperatures cause stunted growth and poor-quality vegetables

Water

- A primary component in photosynthesis and respiration
- A solvent for minerals and carbohydrates moving through the plant
- Responsible for cooling leaves as it evaporates from leaf tissue during transpiration
- A regulator of stomatal opening and closing, thus controlling transpiration and, to some degree, photosynthesis
- The source of pressure to move roots through the soil
- The medium in which most biochemical reactions take place

Plant Nutrition

Macronutrients Needed by Plants

- Nitrogen. Leaches from the soil; is mobile in plants; Excess leads to dark green color, weak spindly growth and few fruits; Deficiency causes reduced growth, yellowing (chlorosis), and reduced lateral branching

- Phosphorus. Mobile in plants; Deficiency leads to reduced growth, intense color, browning, thin stems, loss of lower leaves and reduced flowering; important for young plant and seedling growth

- Potassium. Leaches from soil; Excess causes nitrogen deficiency; Deficiency leads to reduced growth, shortened internodes, marginal burn (brown leaf edges) and dead spots in the leaf

Macronutrients Needed by Plants

- Magnesium. Leaches from soil; Excess interferes with Calcium uptake; Deficiency leads to reduced growth, marginal chlorosis or interveinal chlorosis (between veins) of older leaves, reduction in seed production and cupped leaves

- Calcium. Moderately leachable from soil; Excess leads to high pH which precipitates may of micronutrients so they become unavailable to plant; Deficiency inhibits bud growth, causes death of root tips, leads to cupping of maturing leaves, weak growth, blossom end rot; water stress (too little or too much) can affect calcium in the plant

- Sulfur. Leachable from the soil; not mobile in plant; rarely deficient

End of Slide Set

This is the end of the slides on Botany.

You can continue to next slide: ‘Suggested Readings’

OR

Click on the house below to return to the Navigation Page

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Suggested Readings

Chapter 1 MG Handbook

Basic Botany fun quiz

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Tests of Knowledge

Basic Botany Word Search

Click to test your knowledge about Roots

Typical Help Desk Questions

Apply What You Have Learned

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Apply What you Have Learned, in your yard

1. Identify 2 plants in our yard/garden by their scientific name (family, genus, species, variety)
2. List a plant you have that is “hirsuta”
3. List a plant you have that is “edulis”
4. List a plant you have that is “officianalis”
5. List a plant you have that is “rugosus”
6. List a plant you have with rhizomes
7. List a plant you have that has whorled leaves
8. List a pome you have (hint: fruit)
9. List a fruit you have that is a drupe
10. List a fruit you have that is self-sterile

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Click this box to return to ‘Tests of Knowledge

BASIC BOTANY WORD SEARCH

Find as many Botany related words as you can in the grid. The words may flow frontward, backward, sideway, upward, or a combination – including turning one or more corners .[*phloem, radicle, fruit, cambium,, xylem, node, drupe, axil, corm, sepal, dicot, linnaeus, seed, stigma, stolon, taxonomy]*

1. This is the first part of a seedling to emerge during germination.
2. His efforts revolutionized plant classification.
3. The part of stem structure that conducts water and minerals
4. The part of stem structure that conducts food
5. This mature ovule has three parts: embryo, endosperm, _____coat
6. A horizontal stem that is fleshy or woody and lies along the top of the ground
7. A ripened ovary
8. A meristem: site of cell division and active growth located between the xylem and phloem
9. The science of biological classification
10. Small green, leaf-like structure on base of flower that protects the flower bud
11. One of the three parts that make up the female part of a plant (the pistil). The other two parts are the style and the ovary
12. One type of simple fruit which develops from a single ovary (e.g. cherry and peach)
13. A distinct part of a stem where leaves are attached
14. A plant whose vascular system is arranged in rings
15. The leaf _____is the angle between stem and bud/flower
16. A solid, swollen stem whose scales have been reduced to a dry, leaf-like covering (It's similar to a bulb)

S	E	P	A	L	Z	X	Y	L
C	A	M	B	I	U	M	S	E
D	G	R	S	N	O	D	E	M
I	C	O	T	N	F	R	E	E
R	I	C	O	A	R	U	D	O
A	D	X	L	E	U	P	A	L
S	A	I	O	U	I	E	M	H
T	Q	L	N	S	T	I	G	P

Answers on next slide

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2. His efforts revolutionized plant classification. Linnaeus
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11. One of the three parts that make up the female part of a plant (the pistil). The other two parts are the style and the ovary stigma
12. One type of simple fruit which develops from a single ovary (e.g. cherry and peach) drupe
13. A distinct part of a stem where leaves are attached node
14. A plant whose vascular system is arranged in rings dicot
15. The leaf axil is the angle between stem and bud/flower
16. A solid, swollen stem whose scales have been reduced to a dry, leaf-like covering (It's similar to a bulb) corm

S	E	P	A	L	Z	X	Y	L
C	A	M	B	I	U	M	S	E
D	G	R	S	N	O	D	E	M
I	C	O	T	N	F	R	E	E
R	I	C	O	A	R	U	D	O
A	D	X	L	E	U	P	A	L
S	A	I	O	U	I	E	M	H
T	Q	L	N	S	T	I	G	P

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what do you know about roots? (Answers on next slide)

1. Which of these is not a job of the root of the plant?
    a. To make food
    b. To hold the plant in place
    c. To take in water and minerals from the soil
2. In this system there is a main primary root larger than the other branching roots.
    a. tap root
    b. diffuse root
    c. edible root
3. In this system there are many thin roots with smaller root branching out..
    a. tap root
    b. diffuse root
    c. edible root
4. Roots tend to grow in length rather than width.
    a. True
    b. False
5. The root system of a plant or tree can be larger underground than the plant itself above ground.
    a. True
    b. False

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What do you know about roots? Answers

1. Which of these is not a job of the root of the plant?
    a. To make food
    b. To hold the plant in place
    c. To take in water and minerals from the soil

2. In this system there is a main primary root larger than the other branching roots.
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    b. diffuse root
    c edible root

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    b. diffuse root
    c. edible root

4. Roots tend to grow in length rather than width.
    a True
    b False

5. The root system of a plant or tree can be larger underground than the plant itself above ground.
    a. True
    b. False

1. a
2. a
3. b
4. a
5. a

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Help Desk Questions

1. I bought a tree at a nursery ‘going out of business’ sale that is labeled “Quercus Alba”. What kind of tree is it?

2. I bought a shrub that says it is a “cultivar”. What does “cultivar” mean?

3. My azalea loses all of its leaves in the fall but comes back out in the spring. What is wrong with it?

4. I bought some plants that are labeled “biennial.” What does that mean?

Answers on next slide

Click this box to return to ‘Tests of Knowledge

Help Desk Questions (Answers)

1. I bought a tree at a nursery 'going out of business' sale that is labeled "Quercus Alba". What kind of tree is it?

- Answer: White Oak. Quercus means oak and alba means white.

2. I bought a shrub that says it is a "cultivar". What does "cultivar" mean?

- Answer: A cultivar is a plant selected by someone for one or more unique traits and usually is propagated vegetatively in order to maintain those traits. For example, if a new type of tomato was developed by cross pollination in a breeding program, it would be a cultivar. A cultivar name follows the species name and is enclosed within single quotation marks, not underlined or italicized, and each word begins with capital letters. Example: *Cornus florida* 'White Cloud' is a White Cloud flowering dogwood.

3. My azalea loses all of its leaves in the fall but comes back out in the spring. What is wrong with it?

- Answer: Nothing is wrong. You have a deciduous azalea. Deciduous woody plants lose their leaves in the winter. Azaleas may be either deciduous or evergreen.

4. I bought some plants that are labeled "biennial." What does that mean?

- Answer: Biennials are plants that start from seeds and produce vegetative structures and food storage organs the first season; keep some leaves in the winter; develop flowers, fruit and seeds the second season; then die. Examples include Hollyhock, Canterbury Bells, Sweet William, onions and celery.

End of Questions

COPY OF QUIZ

1. All of the following are functions of roots EXCEPT:
   a. Repel insects b. Absorb water and minerals c. Anchor plant d. Store food
2. The water and mineral moving system in a plant stem is called the:
   a. Phloem b. Xylem c. Root hair d. Dioeceous
3. Which of the following are specialized leaves and are often confused for petals of flowers? a. Tendrils b. Bracts c. Corms d. Rhizomes
4. Which of the following are vegetative plant parts?
   a. Leaves b. Roots c. Stems d. All of the above
5. In a flower, the _____is the female part of the plant and consists of the stigma, the style, ovula and ovary. a. Pistil b. Stamen c. Filament d. Stem
6. An apple is an example of a: a. Drupe b. Pome c. Carp d. Pistil
7. A seed consists of _____.
   a. Seed coat b. Storage tissue c. Embryo d. All of the above
8. **A perfect flower** contains both pistil (female) and stamen (male). a. True b. False
9. The environmental factors that impact plant growth include:
   a. Water b. Light c. Nutrition d. Temperature e. All of the above
10. Which ONE of the following is true of a plant 'cultivar'?
    a. It is usually propagated sexually b. It is selected for specific traits c. Its name is always italicized d. It is less hardy than a non-cultivar
11. Some variations of stems may be used as food: a. True b. False