How Plants Grow & What We Call Them

A Horticultural Refresher

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TEXAS A&M AGRILIFE EXTENSION

Topics For Today

Plant Growth & Development

Plant Growth Strategies & Nomenclature

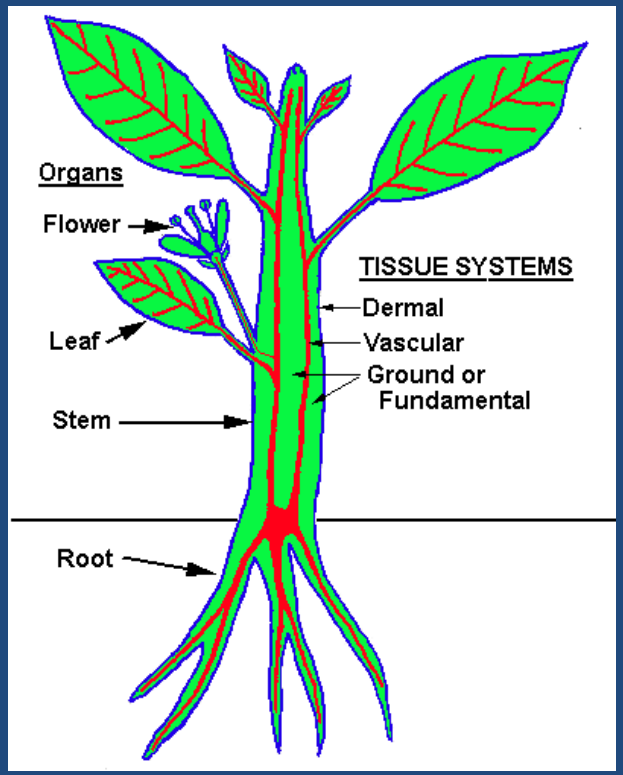
Plant Hormones

TEXAS A&M AGRILIFE EXTENSION

Plant Growth & Development

Texas A&M AgriLife Extension

ORGANS AND TISSUE SYSTEMS IN PLANTS



1) Dermal Tissue System

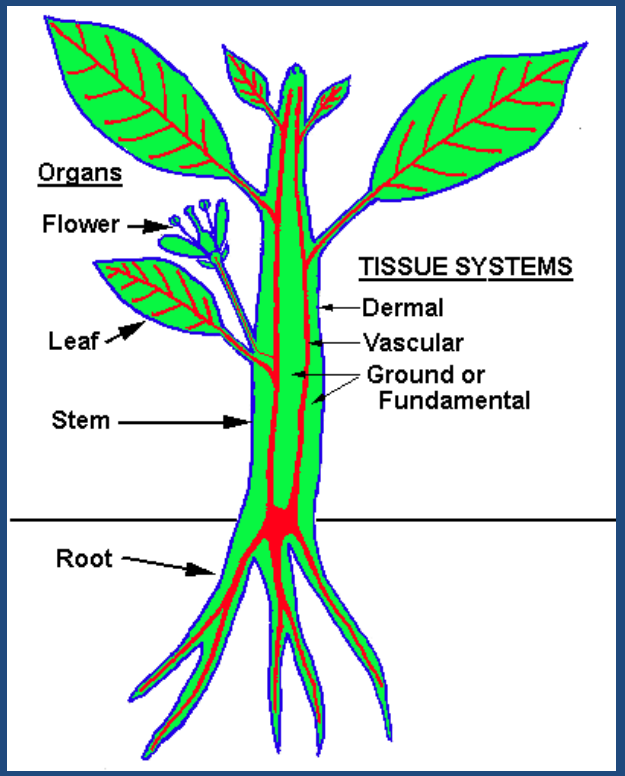
Function:
Protection from the environment and water
loss.

Tissues:

a) epidermis –
single layer of cells on primary (herbaceous) plant parts.

b) periderm or bark –
a corky tissue that replaces epidermis
on secondary (woody) plant parts.

ORGANS AND TISSUE SYSTEMS IN PLANTS



2) Vascular Tissue System

Function:
Conduction of water, nutrients, sugars, and hormones throughout the plant.

Tissues:

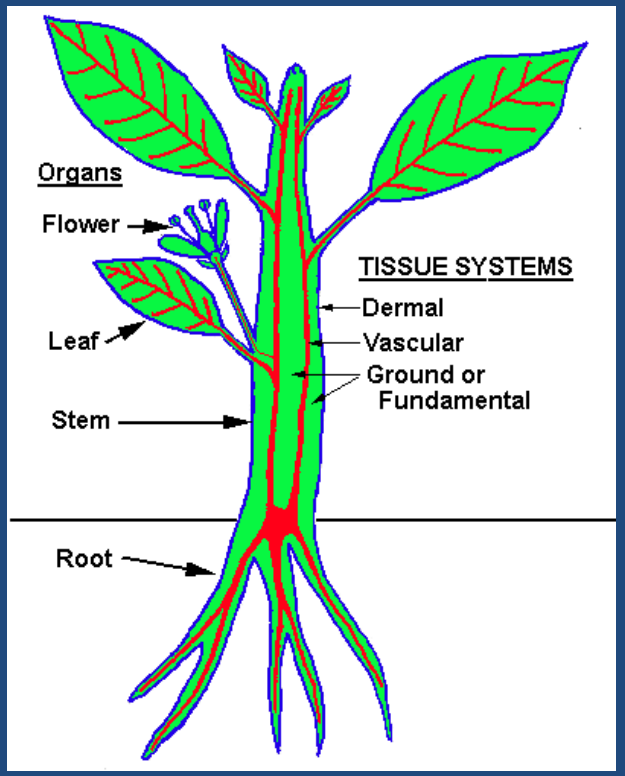
a) xylem –

conducts water and nutrients up roots, stems and leaves.

b) phloem –

conducts water, sugar, hormones, etc. down and up roots, stems and leaves; moves from where produced (called sources) to where needed (called sinks).

ORGANS AND TISSUE SYSTEMS IN PLANTS



3) Ground or Fundamental Tissue System

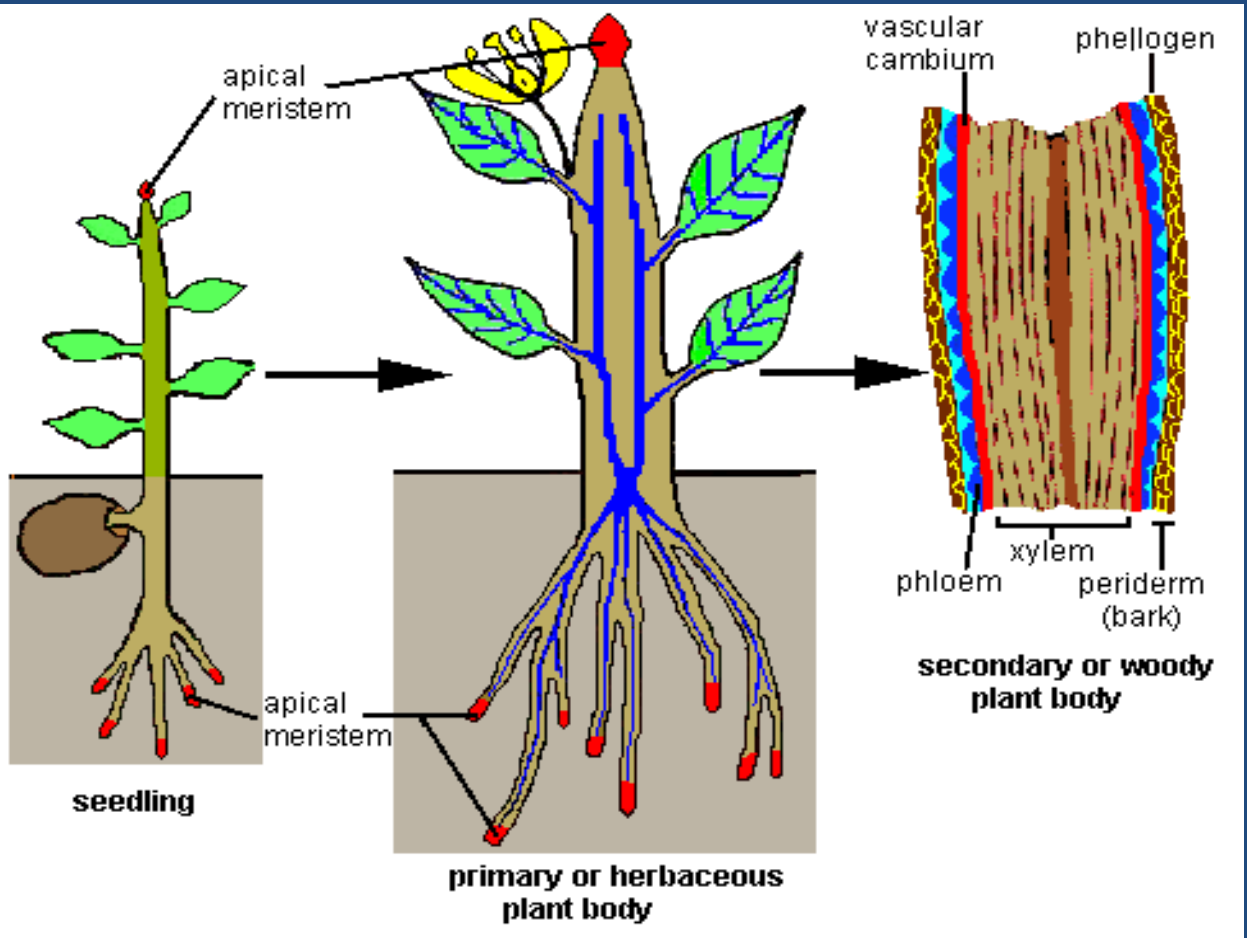
Function:
Storage, support, filler tissue and site of photosynthesis.

Tissues:
a) cortex –
outer region of stems and roots

b) pith –
center of stems

c) mesophyll –
middle of leaves and flower petals

MERISTEMS AND GROWTH



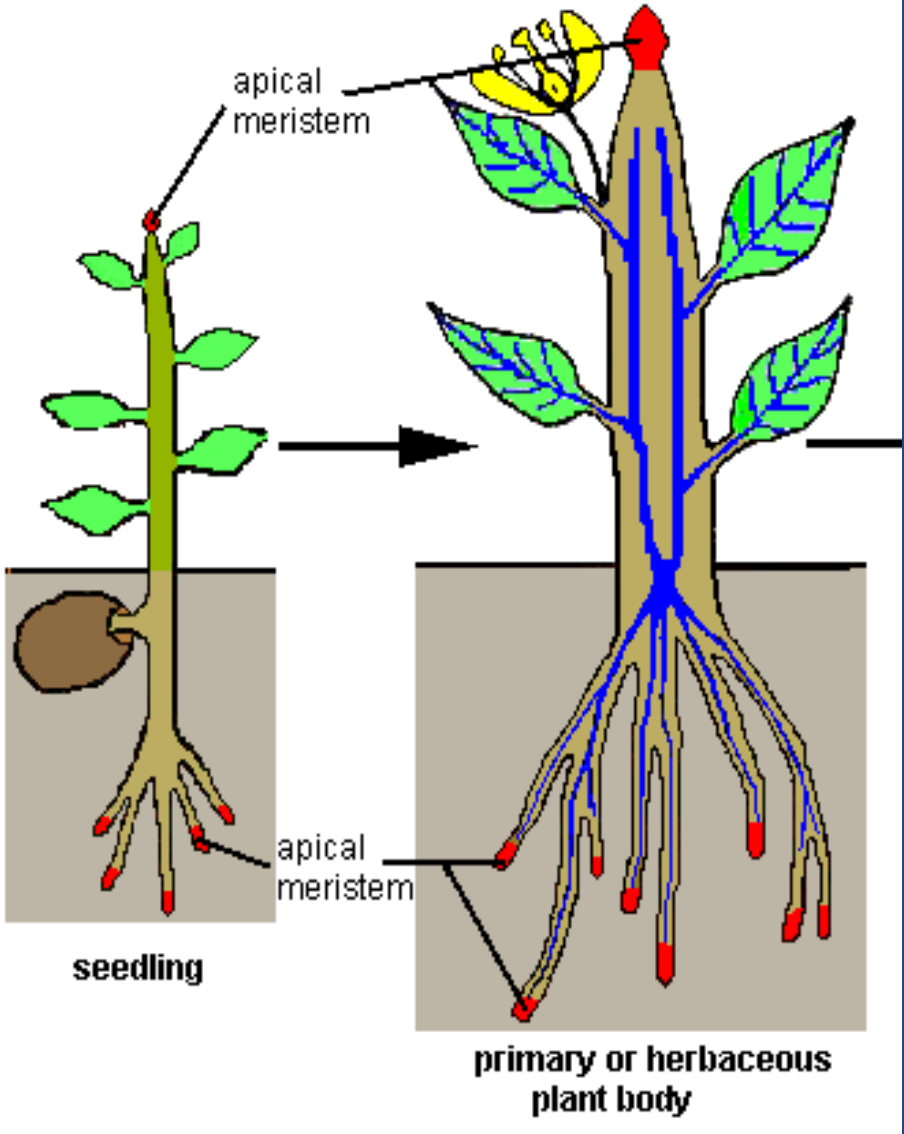
HOW DO PLANTS GROW?

Plants grow from localized areas called meristems.

meristem - discrete regions or groups of cells that possess continued cell division for the life of the plant or that organ.

PLANTS EXHIBIT TWO TYPES OF GROWTH

PRIMARY GROWTH



Growth in length that gives rise to primary (herbaceous) tissues called the primary plant body

Two (2) types of meristems give rise to primary growth:

a) apical meristem or apex- the growing points located at the tips of stems and roots

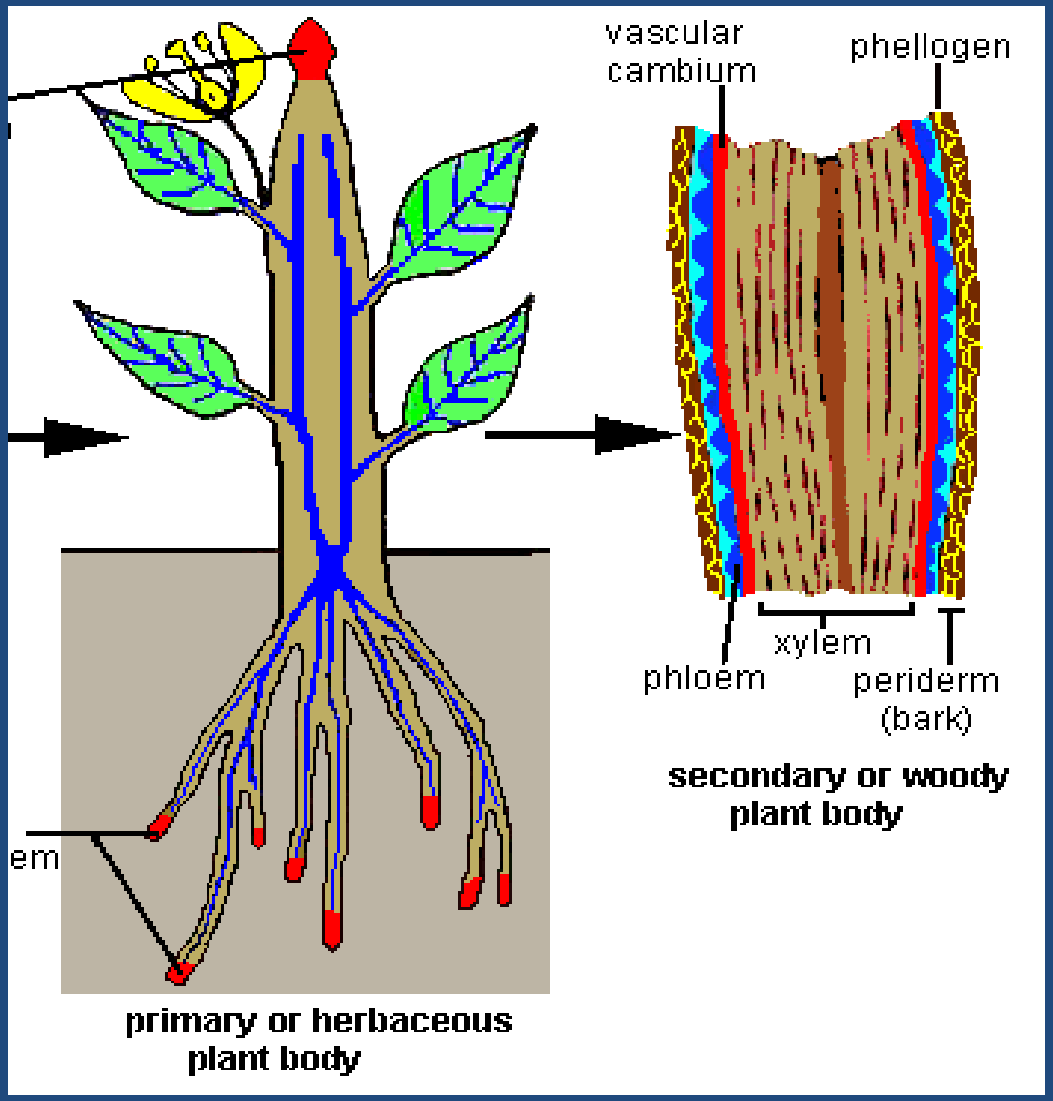
b) intercalary – the growth region at the base of grass leaves that causes leaves to elongate

SECONDARY GROWTH

2) Secondary Growth – growth in width or diameter that gives rise to secondary (woody or corky) tissues called the secondary plant body

Secondary growth is due to lateral meristems

lateral meristem – meristematic regions along the sides of stems and roots.

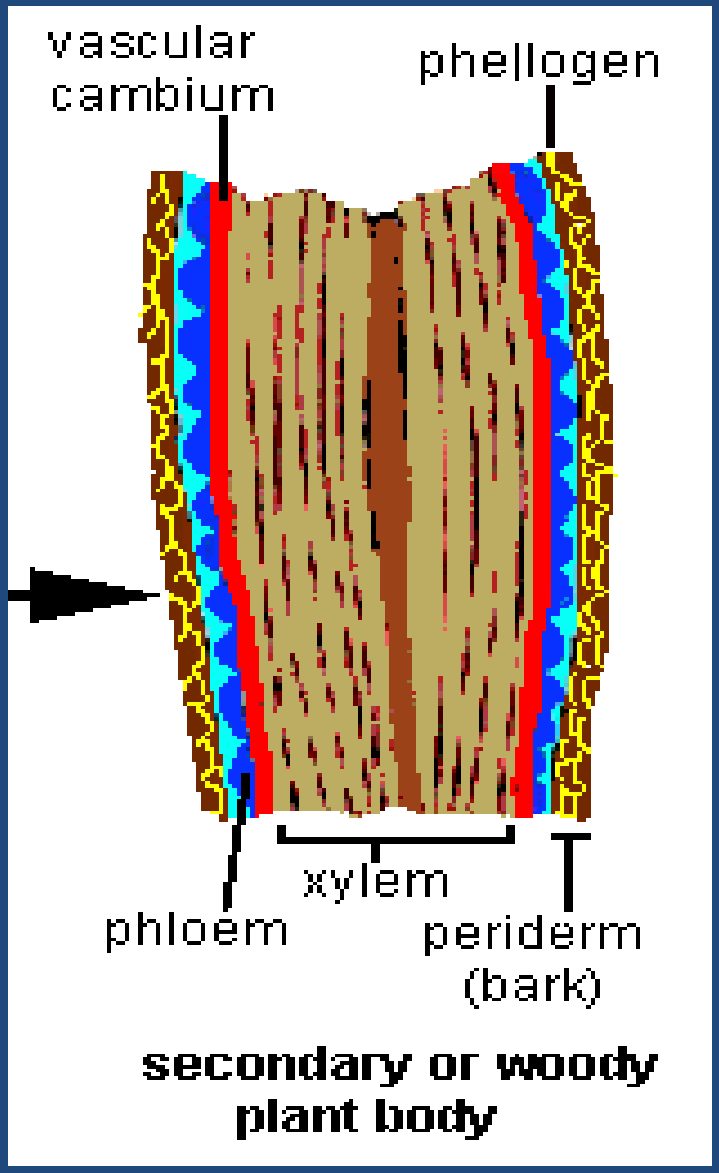


SECONDARY GROWTH

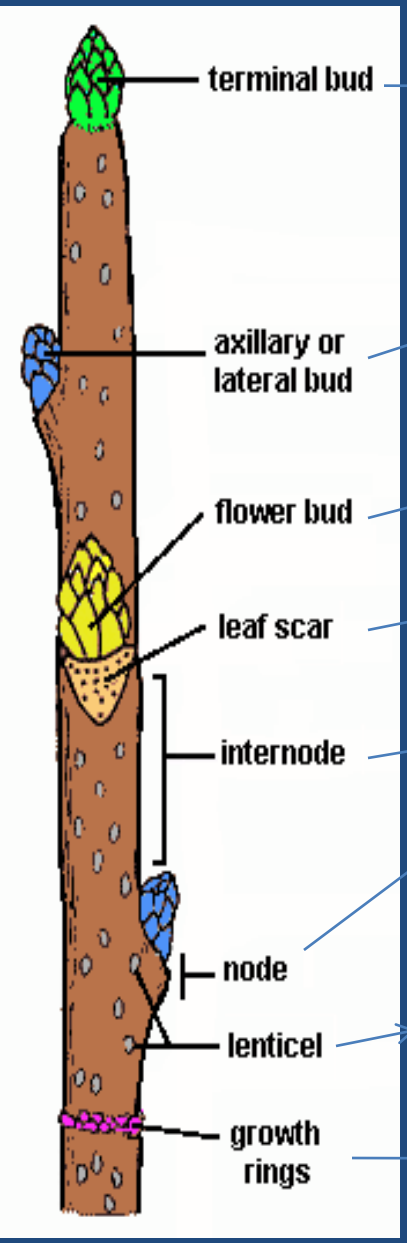
Two (2) types of lateral meristems give rise to secondary growth:

a) vascular cambium or cambium – a sheet-like meristem between the bark and wood along the sides of woody stems and roots; it gives rise to secondary xylem (commonly called wood) on the inside and secondary phloem on the outside.

b) cork cambium or phellogen – gives rise to the periderm (commonly called bark).



STEM MORPHOLOGY



A bud at the tip of a stem responsible for terminal growth.

Buds along side the axis of a stem that were produced by the terminal bud during growth; once they grow and form a stem they become terminal buds.

A bud containing a floral meristem which develops Into flowers.

A scar marking the former point of attachment of a leaf or petiole to the stem.

The part of the stem between nodes.

Part of stem marking the point of attachment of a leaf, buds and other stems.

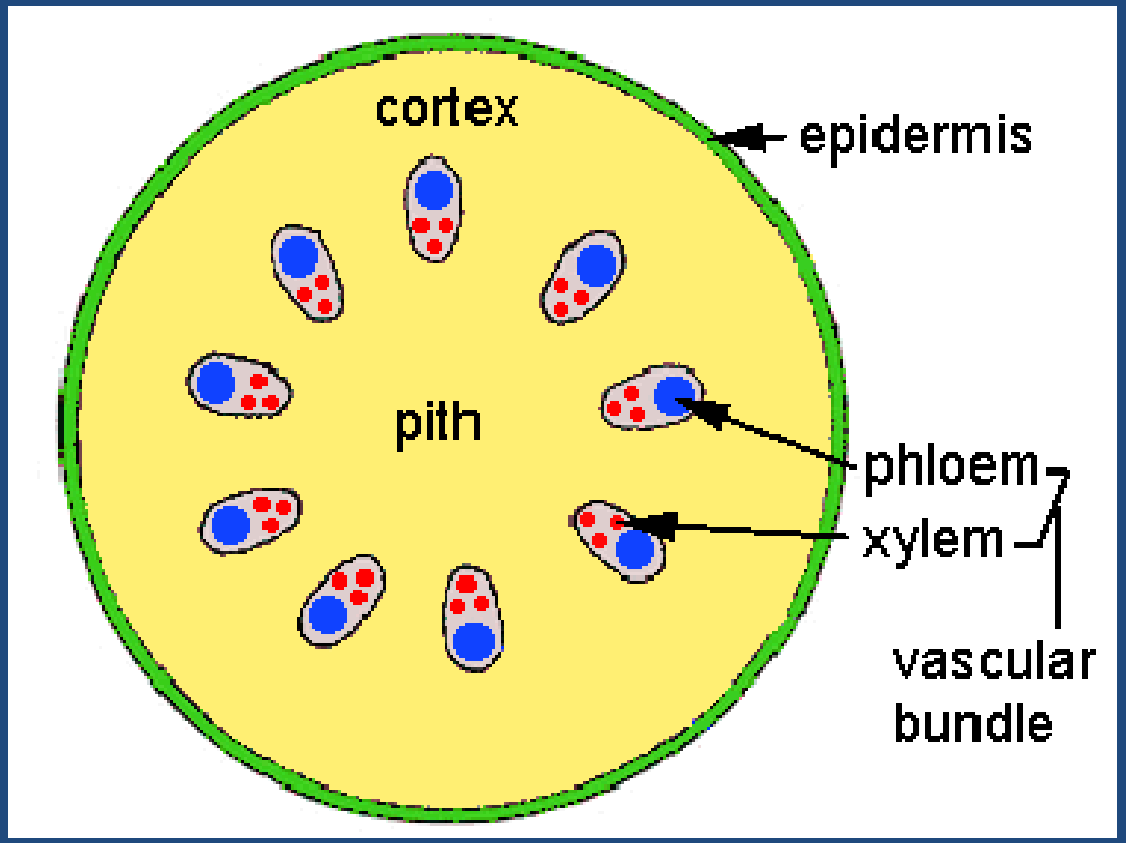
Rough areas on stems (and some fruits, ex. apple) where loosely packed cells extend from the cortex through the ruptured epidermis; they function as "breathing pores" for gas exchange.

Bud scale scars from the last terminal bud; they demarcate flushes of growth (usually 1 per year). Can be used to age stems.

DICOT OR GYMNOSPERM IN PRIMARY GROWTH

Vascular bundles are arranged as a ring between the cortex and pith. The pith and cortex are usually comprised of parenchyma cells.

Inside each vascular bundle, the phloem is orientated towards the outside and xylem towards the inside of the stem. The outer surface is covered by the epidermis.

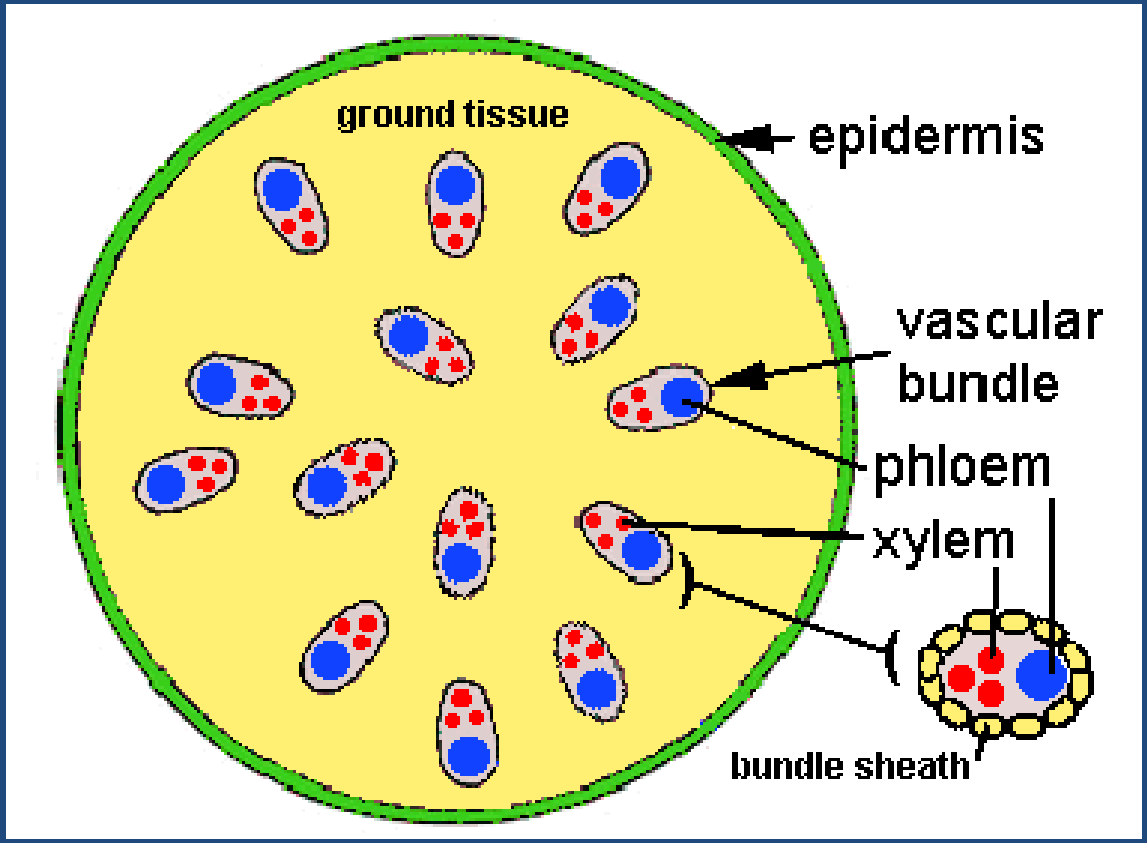


MONOCOT IN PRIMARY GROWTH

The vascular bundles are randomly scattered in the ground tissue (usually comprised of parenchyma cells).

Each vascular bundle is surrounded by a bundle sheath and contains xylem orientated towards the inside and phloem towards the outside of the stem.

The outer layer is epidermis.



Plant Growth Strategies & Nomenclature

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SYSTEMS FOR CLASSIFYING PLANTS

There are 3 main systems that have been used to classify plants:

1. ARTIFICIAL

2. NATURAL

3. PHYLOGENIC

Today, we'll be concentrating on the artificial system.

ARTIFICIAL SYSTEMS

Plants are classified into groups based on characteristics such as growth habit, appearance or use. The artificial system does not consider any evolutionary or genetic relationship.

Examples of commonly used artificial classifications

A. Based on Length of Life Cycle

B. Based on Leaf Retention

C. Based on Numerical Classification of the Reproductive (Flower) Parts

ARTIFICIAL SYSTEMS

A. Based on Length of Life Cycle

Annual

Biennial

Perennial

ANNUALS

Plants that complete their life cycle in one year or less.
For example, marigolds, petunia, corn, and squash.

BIENNIALS

Plants that complete their life cycle within two years.
The first year they grow vegetatively , over-winter, the second year and die.
For example, radish, cabbage, onions, mustard, and bluebonnets.

PERRENIALS

Plants that live more than 2 years, and do not die after flowering. For example, woody shrubs, trees, and many grasses.

ARTIFICIAL SYSTEMS, cont.

B. Based on Leaf Retention

Deciduous

Evergreen

Semi-evergreen

DECIDUOUS

Perennial plants that shed their leaves every year during the fall and winter.

For example, maple, elm, willow, apple, and pear.

EVERGREEN

Perennial plants that retain their leaves for 2 or more years.

For example, pine, juniper, photinia and holly.

SEMIEVERGREEN

Perennial plants that shed their leaves when the new leaves are emerging in the spring.

For example, live oak.

ARTIFICIAL SYSTEMS, cont.

C. Based on Numerical Classification of the Reproductive (Flower) Parts

Linnaeus developed this system in the late 1700's, and classified plants based on similarities in their reproductive structure, the flower.

This system considers characteristics such as number of pistils, stamens, petals, sepals or carpels and their morphology, placement and organization.

Linnaeus introduced the binomial system of nomenclature, where each plant is given two names, genus and specific epithet.

PRESENT DAY CLASSIFICATION OF THE PLANT KINGDOM
Plant Nomenclature (Systematics)

Present day plant classification utilizes artificial, natural and phylogenic classifications to achieve an overall classification of the Plant Kingdom.

The Plant Kingdom is divided into categories called taxa (singular taxon).

The taxa are:

- Kingdom
- Division
- Class
- Order
- Family
- Genus
- Specific Epithet

Plant Nomenclature

As an example, the position of Sansevieria trifasciata var. Laurentii, commonly called the Gold Banded Sansevieria or Mother-in-Law's Tongue, in the Plant Kingdom:

Sansevieria trifasciata var. Laurentii	
Kingdom	Plantae
Division	Spermatophyta (seed bearing plants)
Subdivision	Angiospermae (flowering plants with enclosed seed)
Class	Monocotyledoneae (seeds with one cotyledon)
Order	Liliales
Family	Liliaceae (Lily family)
Genus	Sansevieria
Species	trifasciata
Variety	Laurentii
Common Name	Gold Banded Sansevieria or Mother in Law's Tongue

Back to Plant Growth & Development which will lead us to Plant Hormones

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DORMANCY

Dormancy is a state of inactive growth.

Purpose – to survive adverse conditions.

TWO TYPES OF DORMANCY

1) Quiescence – dormancy imposed by external or environmental conditions.

2) Rest – dormancy imposed by internal or physiological conditions.

QUIESCENCE

What triggers quiescence?

a) Unfavorable environmental conditions
- too dry
- too hot
- too cold, etc

b) External factors
- hard seed coat
- dry seed, etc

REST

Rest or Physiological Dormancy – dormancy imposed by internal or physiological conditions.

Response is triggered by the environment:

- short days
- long days
- decreasing temperatures
- increasing temperatures

REST

What causes?

Internal physiology is unfavorable for growth:

a) low level of growth promoting hormones (e.g. auxin or gibberellic acid)

and/or

b) high level of growth inhibiting hormones (e.g. ABA)

REST

Rest is very common amongst temperate perennial plants, which are perennial plants that are native to the Temperate Climatic Zone.

Rest is a mechanism the plant uses to go dormant starting in the fall in order to survive the cold of winter.

Rest also assures flowering, vegetative growth and/or seed germination at the proper time in the spring.

REST

The initiation of fall color is a sign of plants going into rest, and the emergence of flowers on fruit trees in the spring is a sign of plants coming out of rest.

Cold weather, sometimes combined with winter moisture, satisfies rest.

If a plant that is in rest is not exposed to the proper amount of cold it may grow abnormally in the spring and/or may eventually die.

Chilling requirement – the number of hours of cold temperatures between 32-45 ^{0}F (0-7 ^{0}C) required to overcome rest.

Plant Hormones

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PLANT HORMONES AND GROWTH SUBSTANCES

Hormone

An endogenous or naturally-occurring compound that is produced or synthesized in one part of the plant and causes a change in physiology, growth or development in another part of the plant.

Usually present in very small quantities.

Growth Substance

All naturally-occurring or synthetically produced substances that affect the physiology, growth and development of plants.

AUXIN

1) Tropism - response of plants to environmental or physical stimuli.
   e.g. light, gravity and touch

2) Apical dominance - determined by apical bud, partly due to auxin

3) Fruit set - low concentrations stimulate

4) Fruit or flower thinning - high concentrations cause

5) Herbicides - 2,4-D at high concentrations

6) Adventitious root formation
   a) stem and leaf cuttings
   b) tissue culture

CYTOKININ

1) Leaf aging or abscission - may delay

2) Seed germination - may overcome dormancy or stimulate germination

3) Adventitious shoot formation
   a) leaf and root cuttings
   b) tissue culture

GIBBERELLIC ACID (GA)

1) Rosette or dwarf plants - lack of endogenous GA often causes
growth retardants - chemicals that block GA synthesis
used in greenhouse and bedding plant production to
produce compact plants.

2) Flowering - may cause bolting in biennials

3) Fruit size - increases size of seedless grapes

4) Bud dormancy - may overcome and substitute for cold treatment

5) Seed germination - may increase or speed up

6) Sex expression - favors male flower formation on monoecious plants

ETHYLENE

1) Fruit ripening - stimulates in many fruits, ex. Banana

2) Flowering - triggers flowering in some bromeliads, ex. pineapple.

3) Flower longevity - causes senescence (death) of cut flowers

4) Leaf abscission (leaf drop) - causes in some plants

5) Leaf epinasty (curling and contortion of leaves) - causes in some plants

6) Sex expression - favors female flower formation on monoecious plants

ABSCISIC ACID (ABA)

1) Dormancy - causes bud or seed dormancy

2) Leaf abscission (leaf drop) - may cause in some plants

3) Stomata - causes stomata to close (a response to drought stress)
Stomata are the pores through which plants lose water and take in carbon dioxide

Questions?

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