

General Biology 1

BIO1201 RM 1021

Syllabus & Textbook:

<https://openlab.citytech.cuny.edu/oer-biology/lecture-schedule/>

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Email: mgotesman@citytech.cuny.edu

Grade Breakdown:

Lecture (60%)

Exams (4): 22.5% Each

Pop Quizzes (?): 10% Average

Lab (40%) – Lab Instructor

<u>Letter Grade</u>	<u>Numerical Ranges</u>
A	93-100
A-	90-92.9
B+	87-89.9
B	83-86.9
B-	80-82.9
C+	77-79.9
C	70-76.9
D	60-69.9
F	59.9 and below

Gymnosperms and Angiosperms

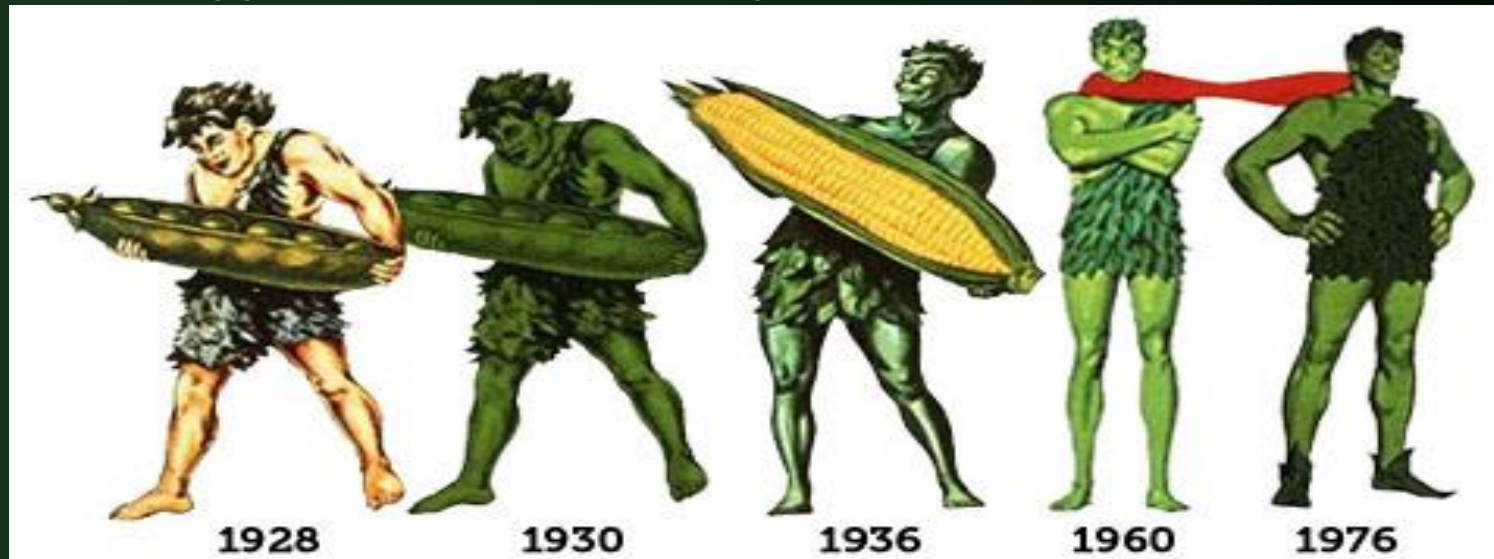
Angiosperms Adaptations and Reproduction



Chap. 25 & 27

Outline

- Evolution of Seed Plants: Full Adaptation to Land
- Organs of Flowering Plants
- Diversity and adaptations of Roots, Stems and Leaves in angiosperms
- Angiosperm Sexual Reproductive Strategies
- Seed Development
- Fruit Types and Seed Dispersal



Vascular Plants with Seeds

- Most **seedless vascular plants** are homosporous
 - grow into bisexual gametophytes (producing both male and female gametes)
 - Windblown spores are dispersal agents
- All **seed plants are heterosporous** and have male and female gametophytes
 - Seeds disperse offspring

Seed Plants

- Seed plants are the most plentiful plants in the biosphere
 - Seed coat and stored food allow an embryo to survive harsh conditions during long period of dormancy
 - **Heterosporous** (two types of spores, male and female)
 - Drought-resistant pollen grains
 - Ovule develops into seed

Non-Flowering Seed Plants

Gymnosperms

Conifers

Cycads

Ginkgoes



a. A northern coniferous forest of evergreen trees



b. Cones of lodgepole pine, *Pinus contorta*



c. Fleshy seed cones of juniper, *Juniperus*

- Modern conifers are **monoecious**, meaning that both ovule-bearing and pollen cones can develop on the same plant.
- **Ginkgo biloba** and the living Ginkgoes are **dioecious**, meaning that individual trees produce only ovules or spores.

Gymnosperms

- Gymnosperms have ovules and seeds exposed on the surface of sporophylls

The *Ginkgo* Tree

- Conifers
- Cycads
- Ginkgoes
 - One surviving species
 - (*Ginkgo biloba*)



- Gnetophytes (contain vessel elements in Xylem)
 - A vessel element or vessel member (trachea) is one of the cell types found in xylem, the water conducting tissue of plants.

Welwitschia mirabilis

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d. *Welwitschia mirabilis*, a type of gnetophyte

Conifers

- Conifers, as well as other gymnosperm phyla, bear cones
 - Tough, needlelike leaves of pines conserve water with a thick cuticle and recessed stomata
 - Considered a “soft” wood because it consists primarily of xylem tissue

Pine Life Cycle

1. Pollen Cone (smaller/male like)
2. Seed Cone (larger/female like)

7. The sporophyte:
After fertilization, the ovule matures and becomes the seed composed of the embryo, reserve food, and a seed coat. Finally, in the fall of the second season, the seed cone, by now woody and hard, opens to release winged seeds. When a seed germinates, the sporophyte embryo develops into a new pine tree, and the cycle is complete.

6. The zygote:
Once a pollen grain reaches a seed cone, it becomes a mature male gametophyte. A pollen tube digests its way slowly toward a female gametophyte and discharges two nonflagellated sperm. One of these fertilizes an egg in an archegonium, and a zygote results.

5. The female gametophyte:
Only one of the megaspores undergoes mitosis and develops into a mature female gametophyte, having two to six archegonia. Each archegonium contains a single large egg lying near the ovule opening.

1. The pollen cones:
Typically, the pollen cones are quite small and develop near the tips of lower branches.

The seed cones:
The seed cones are larger than the pollen cones and are located near the tips of higher branches.

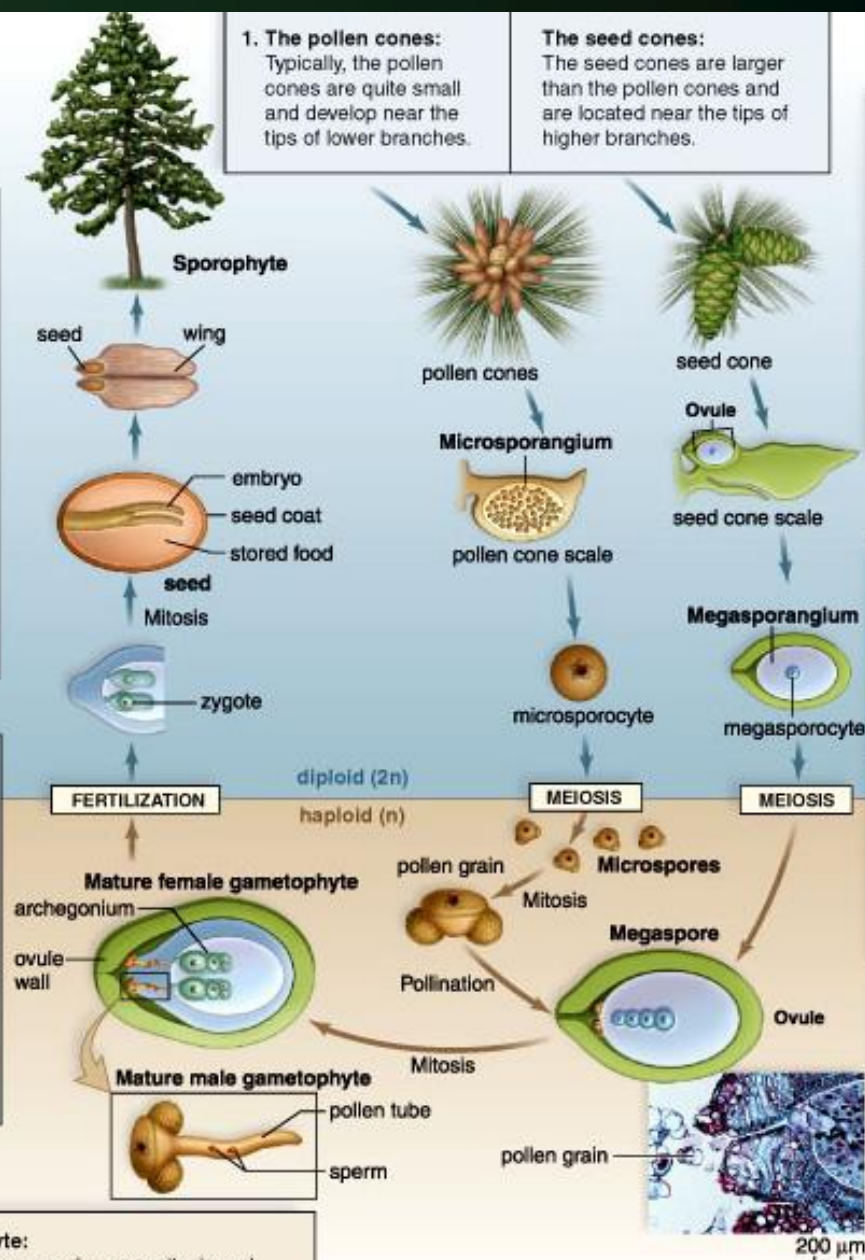
2. The microsporangium:
A pollen cone has two microsporangia that lie on the underside of each scale.

The megasporangium:
The seed cone has two ovules that lie on the upper surface of each scale. An ovule contains a megasporangium.

3. Microspores:
Within microsporangia, each microsporocyte (microspore mother cell) undergoes meiosis and produces four microspores.

Megaspore:
Within an ovule, a megasporocyte (megaspore mother cell) undergoes meiosis, producing four megaspores.

4. The pollen grain:
The pollen grain has two wings and is carried by the wind to the seed cone during pollination.



The Uses of Pine

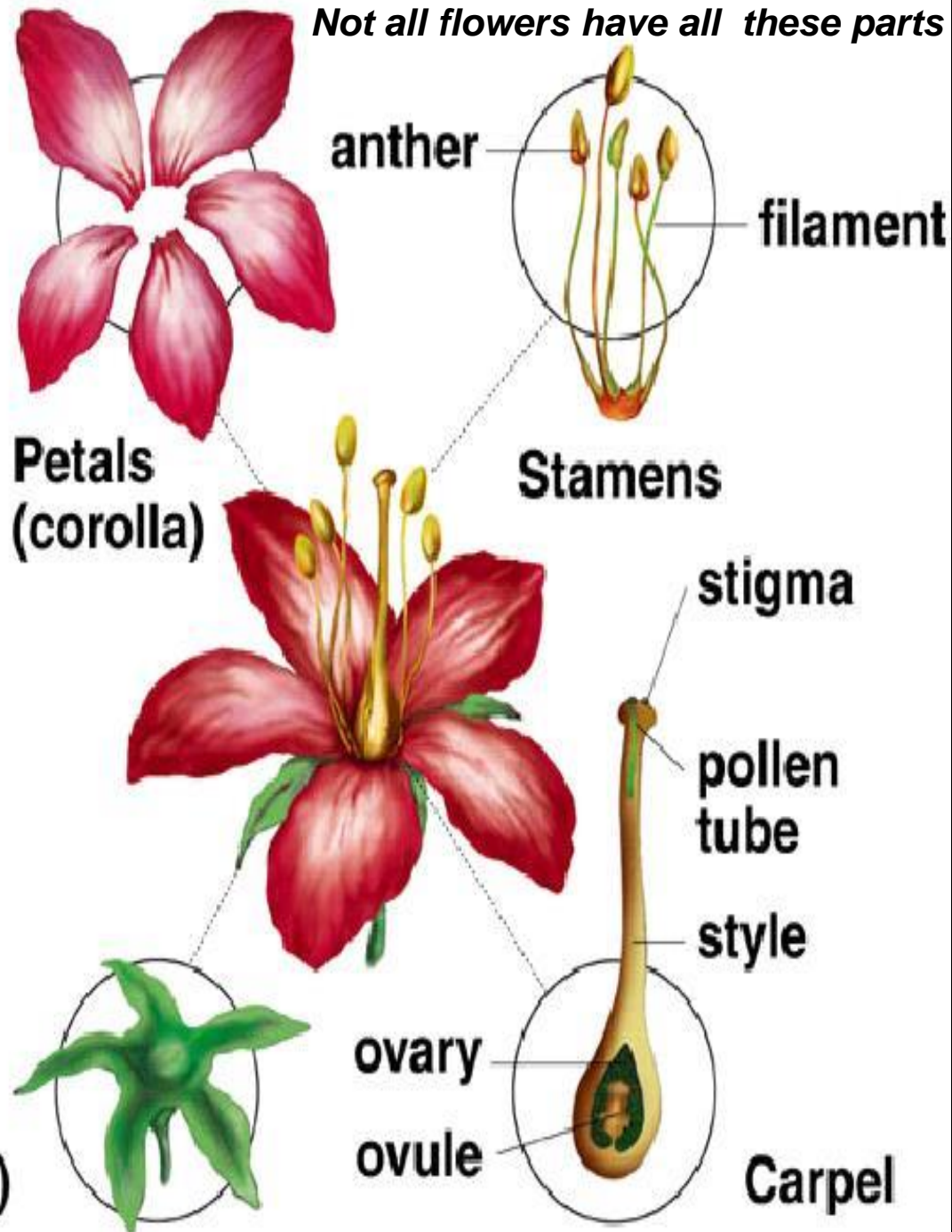
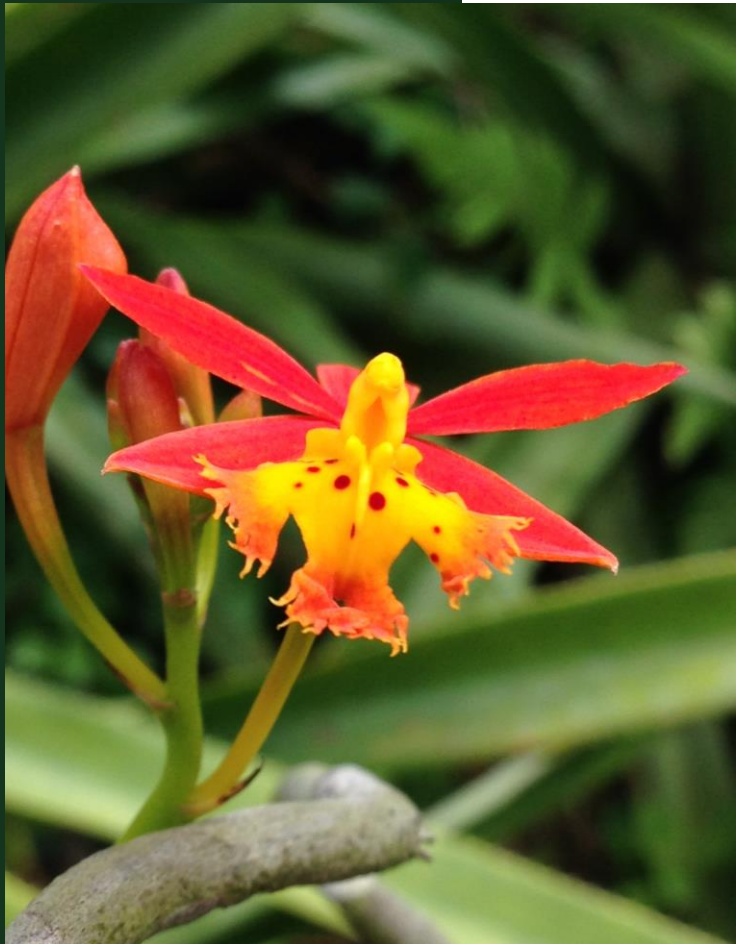
- Used in construction of all sorts.
 - Although technically a softwood, some pinewoods are actually harder than so-called hardwoods.
 - The foundations of the Brooklyn Bridge are made of Southern yellow pine.
- Used for parks and gardens, and Christmas decorations.
- Pine needles are rich in vitamins A and C.
 - Used as a medicine
- Pine oil is distilled from the twigs and needles of Scotch pines and used to scent a number of household and personal care products

Angiosperms

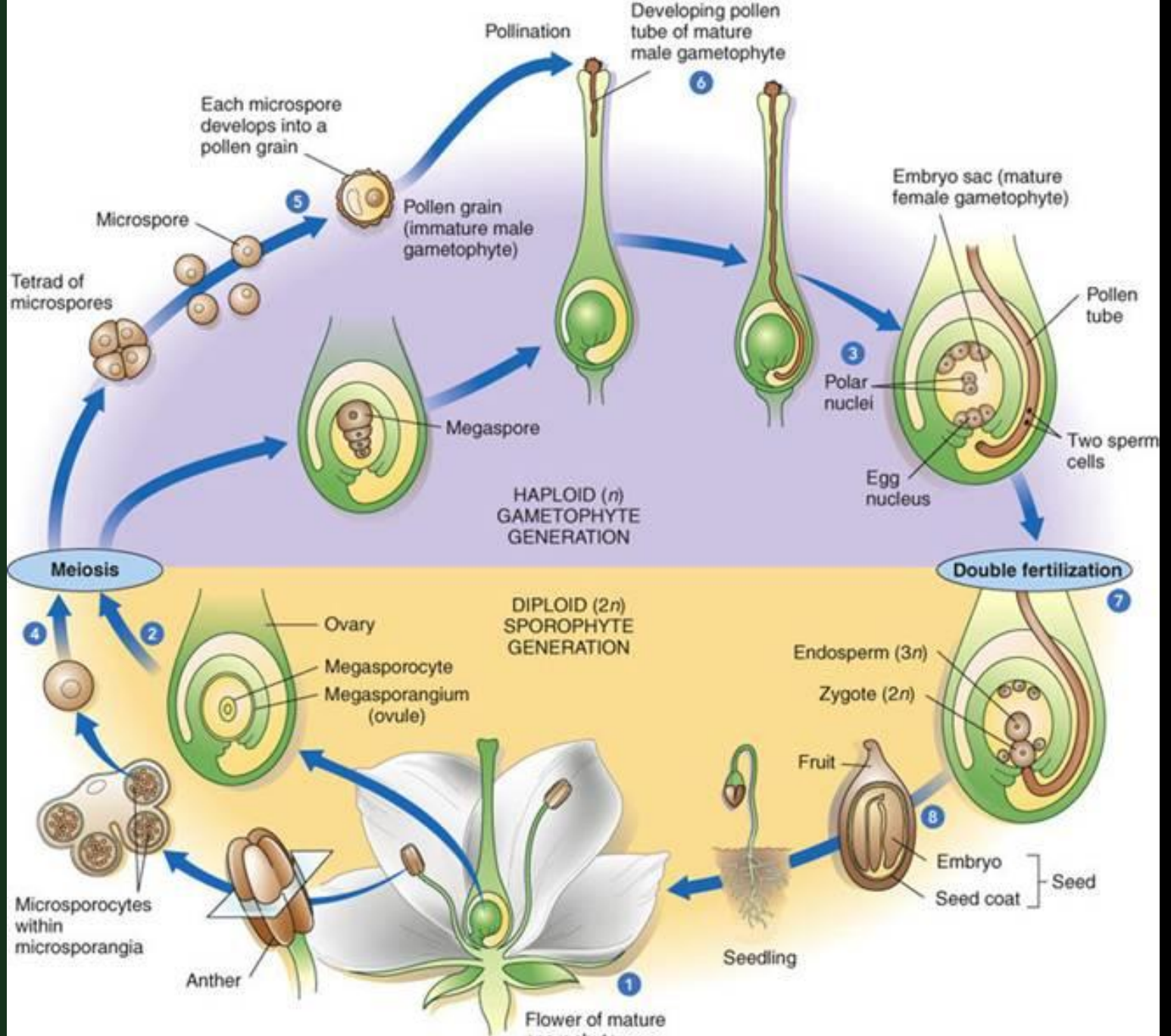
- Angiosperms (phylum Anthophyta)
- An exceptionally **large and successful group of plants**
- Ovules are always enclosed within diploid tissues
- Became dominant group of plants in the late Cretaceous (145 -65 mya) and early Paleocene (65 -55 mya) periods
- MYA – Million Years Ago

Flowers

Not all flowers have all these parts

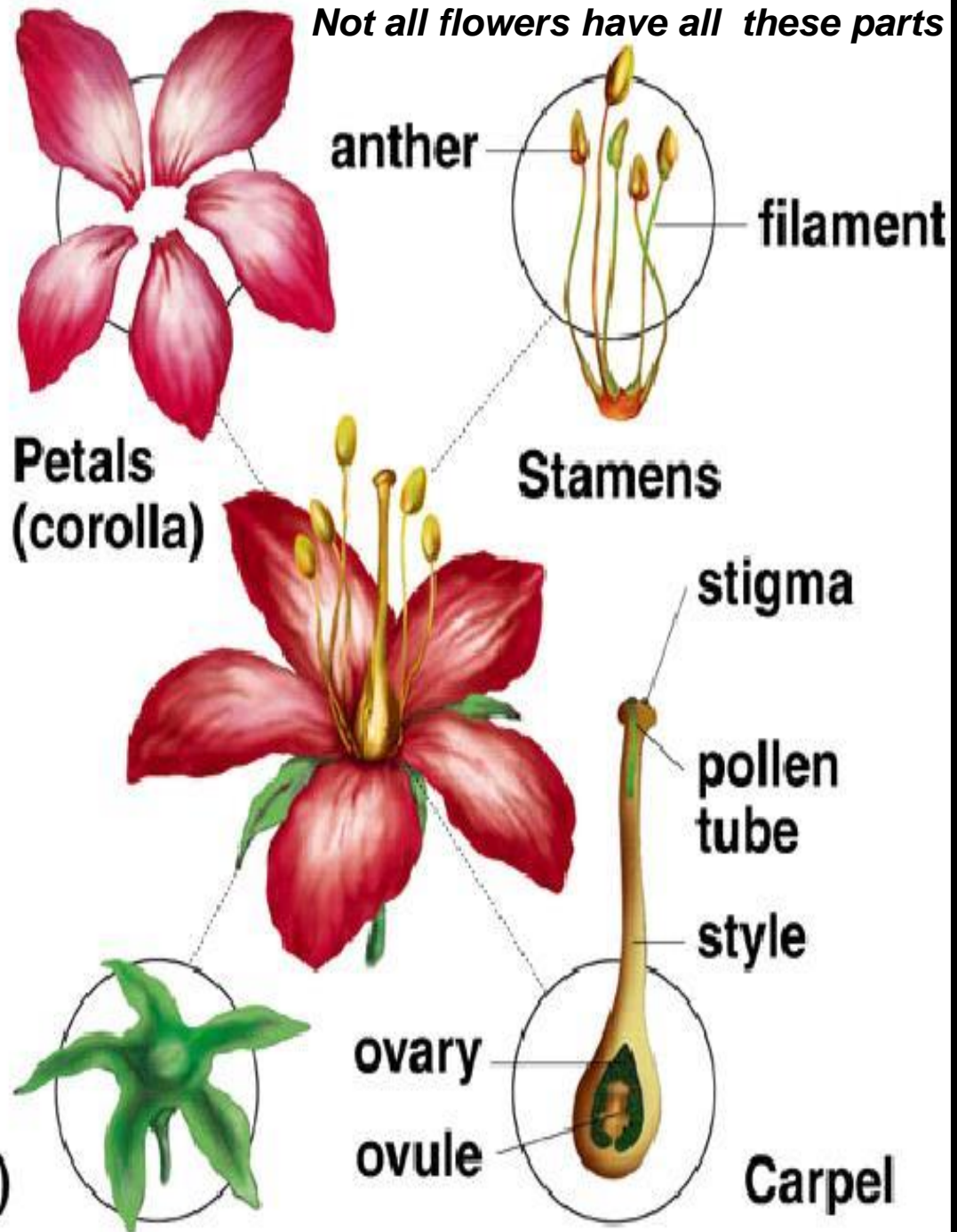
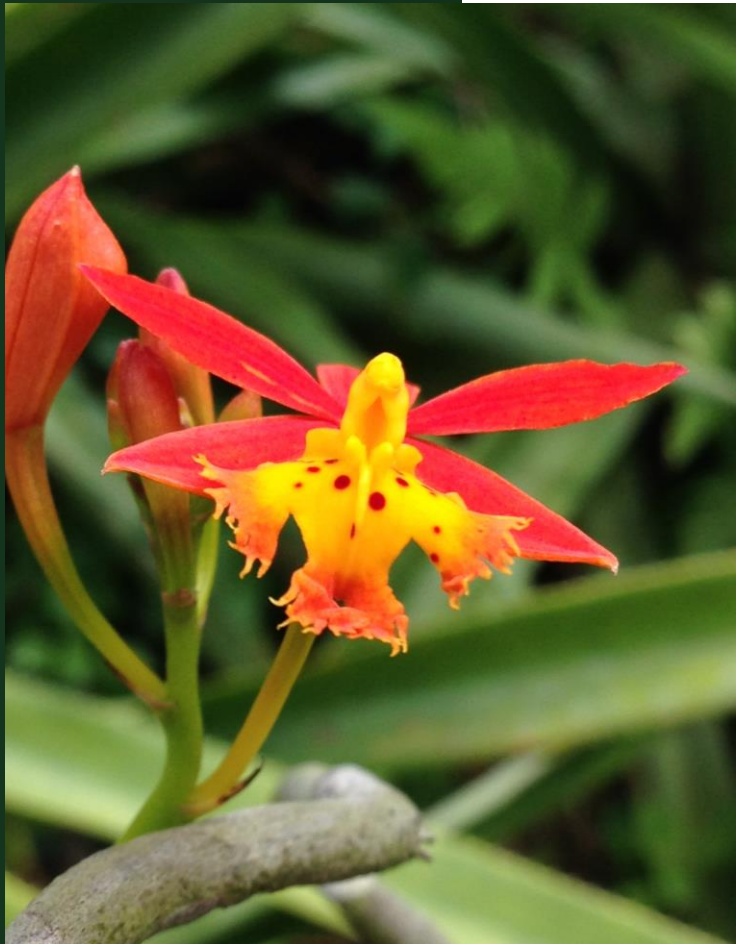


Sepals (calyx)



Flowers

Not all flowers have all these parts

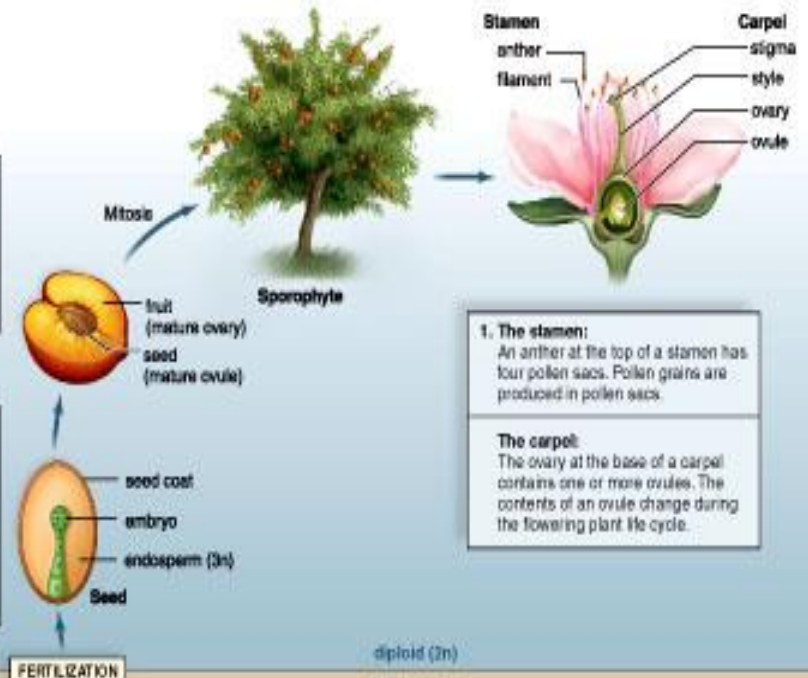


Sepals (calyx)

Flowering plant life cycle

7. The sporophyte:
The embryo within a seed is the immature sporophyte. When a seed germinates, growth and differentiation produce the mature sporophyte of a flowering plant.

6. The seed:
The ovule now develops into the seed, which contains an embryo and food enclosed by a protective seed coat. The wall of the ovary and sometimes adjacent parts develop into a fruit that surrounds the seed(s).

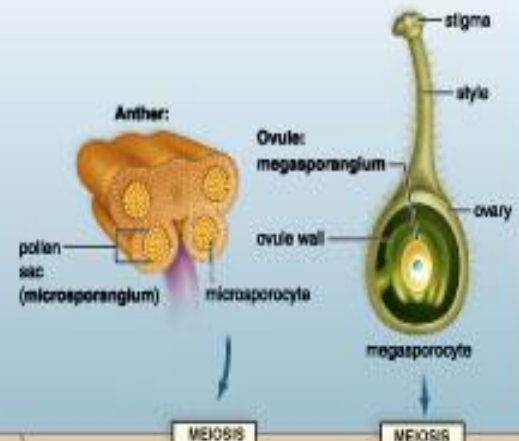


1. The stamen:
An anther at the top of a stamen has four pollen sacs. Pollen grains are produced in pollen sacs.

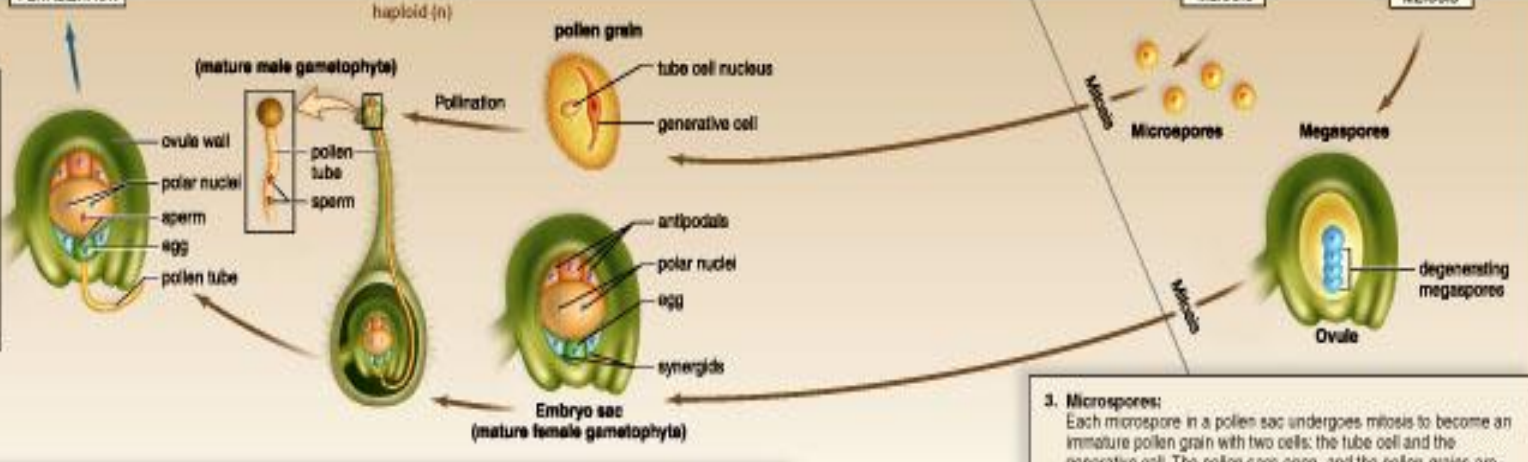
The carpel:
The ovary at the base of a carpel contains one or more ovules. The contents of an ovule change during the flowering plant life cycle.

2. The microsporangia:
Pollen sacs of the anther are microsporangia, where each microsporocyte undergoes meiosis to produce four microspores.

The megasporangium:
First, an ovule within an ovary contains a megasporangium, where a megasporocyte undergoes meiosis to produce four megaspores.



5. Double fertilization:
On reaching the ovule, the pollen tube discharges the sperm. One of the two sperm migrates to and fertilizes the egg, forming a zygote; the other unites with the two polar nuclei, producing a 3n (triploid) endosperm nucleus. The endosperm nucleus divides to form endosperm, food for the developing plant.



4. The mature male gametophyte:
A pollen grain that lands on the carpel of the same type of plant germinates and produces a pollen tube, which grows within the style until it reaches an ovule in the ovary. Inside the pollen tube, the generative cell nucleus divides and produces two nonflagellated sperm. A fully germinated pollen grain is the mature male gametophyte.

The mature female gametophyte:
The ovule now contains the mature female gametophyte (embryo sac), which typically consists of eight haploid nuclei embedded in a mass of cytoplasm. The cytoplasm differentiates into cells, one of which is an egg and another of which contains two polar nuclei.

3. Microspores:
Each microspore in a pollen sac undergoes mitosis to become an immature pollen grain with two cells: the tube cell and the generative cell. The pollen sacs open, and the pollen grains are windblown or carried by an animal carrier, usually to other flowers. This is pollination.

Megaspores:
Inside the ovule of an ovary, three megaspores disintegrate, and only the remaining one undergoes mitosis to become a female gametophyte.

Flowers and Diversification

- Wind-pollinated flowers are usually not showy
- Bird-pollinated flowers are often colorful
- Night-blooming flowers attract nocturnal mammals or insects
 - Usually white or cream-colored
- Fruits of flowers protect and aid in dispersal
 - Utilize wind, gravity, water, and animals for dispersal

Uses of Flowering Plants

- Plants define and are the producers in most ecosystems.
- Humans derive most of their sustenance from three flowering plants: wheat, corn, and rice
- Simple carbohydrate such as sugar comes almost exclusively from two plants: sugarcane and sugar beets
- Our most popular drinks—coffee, tea, and cola are also from flowering plants

Planting some seeds

- 1. Use a diagram of the pine life cycle to point out significant features**
- 2. Compare and contrast the differences & similarities between seed and seedless plants**
- 3. What are the advantages / purposes of**
 - a. Seeds**
 - b. pollen**
 - c. flowers**
 - d. fruits**

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Office Hours: Wednesday 11:30 - 12:30 PM

Room: A 302

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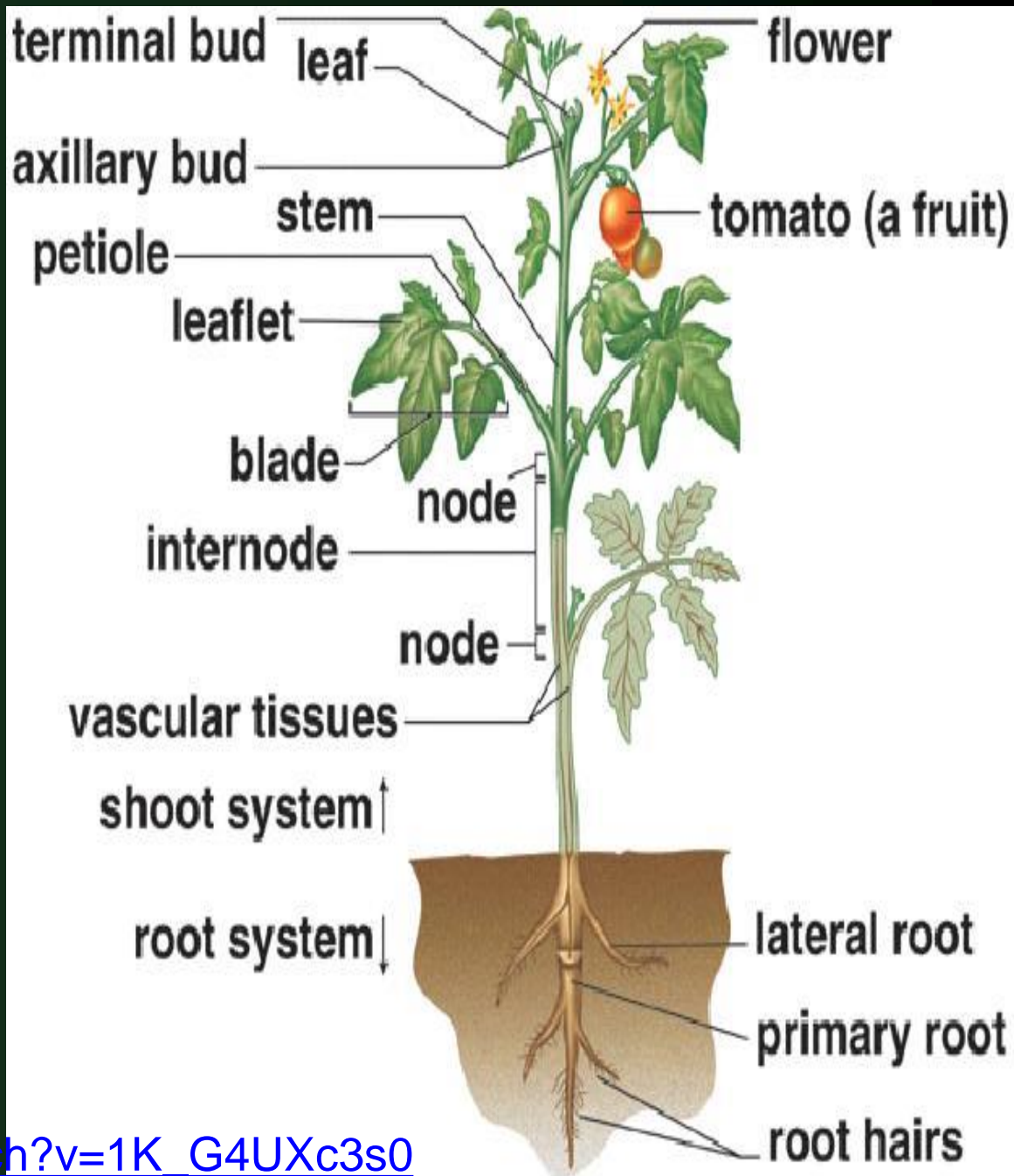
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Organs of Flowering Plants

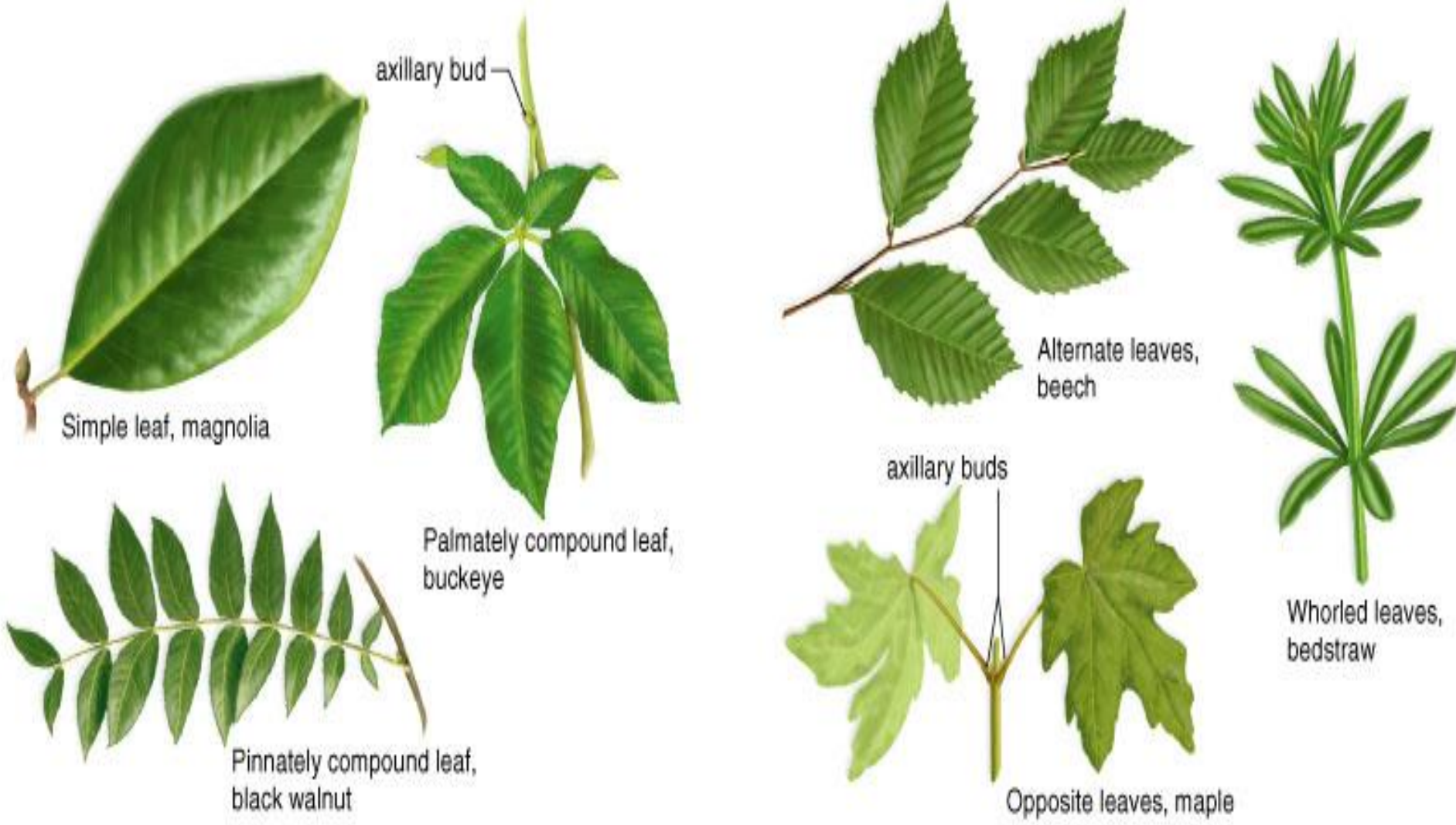
- Most flowering plants possess a root system and a shoot system
 - The **root system** simply consists of the roots,
 - The **shoot system** consists of the stem and leaves.
- A typical plant features three vegetative **organs**
 - The roots,
 - The stems, and
 - The leaves
- **Vegetative organs** are concerned with growth and nutrition
- Flowers, seeds, and fruits are structures involved in **reproduction**.

Organization of Plant Body



Classification of Leaves

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a. Simple versus compound leaves

b. Arrangement of leaves on stem

Leaf Diversity

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a. Cactus, *Opuntia*

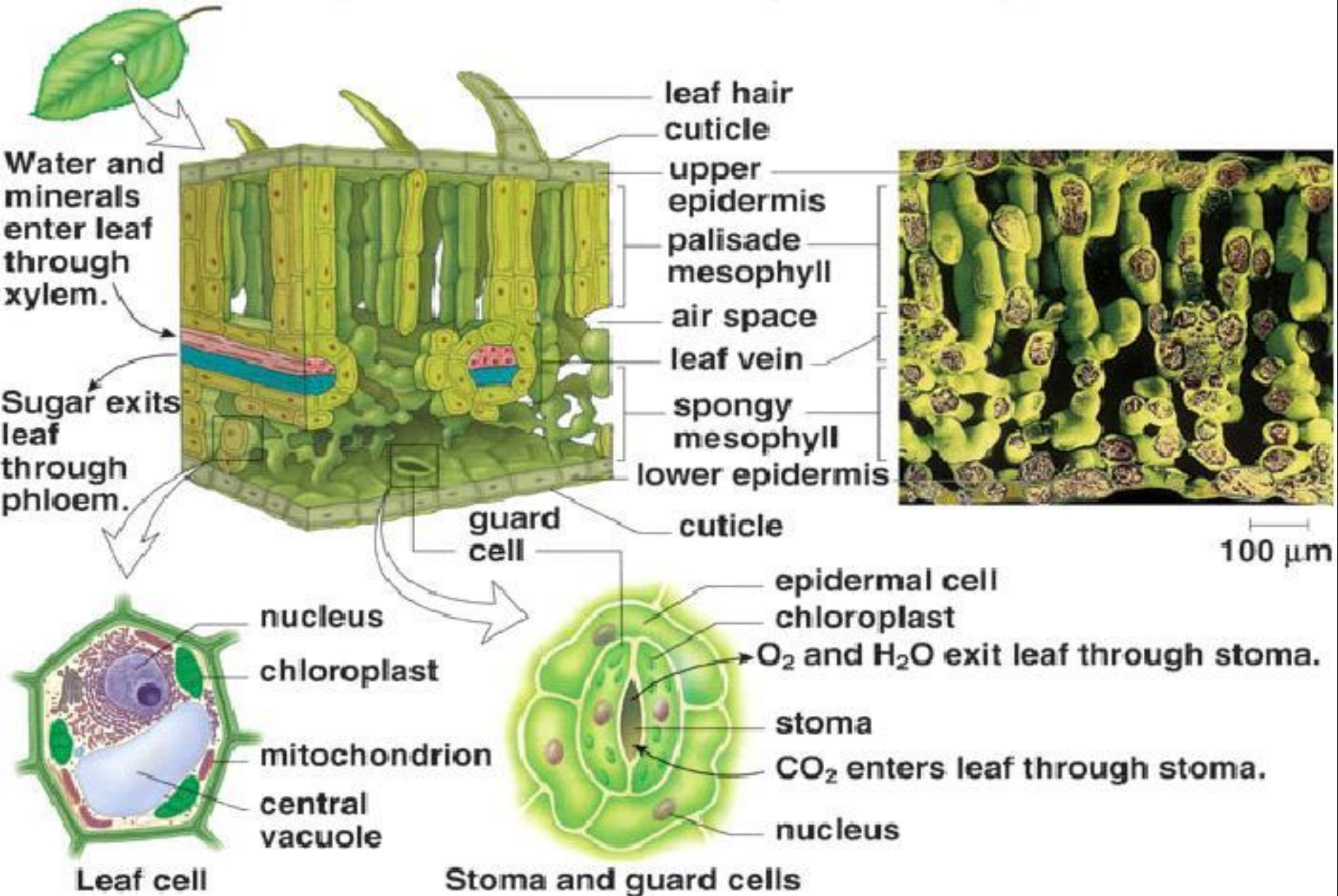


b. Cucumber, *Cucumis*



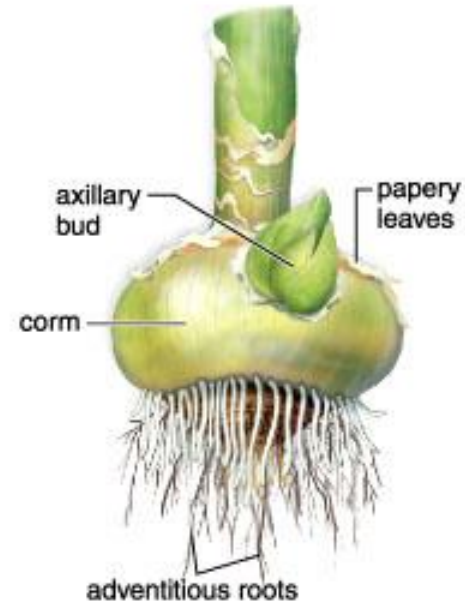
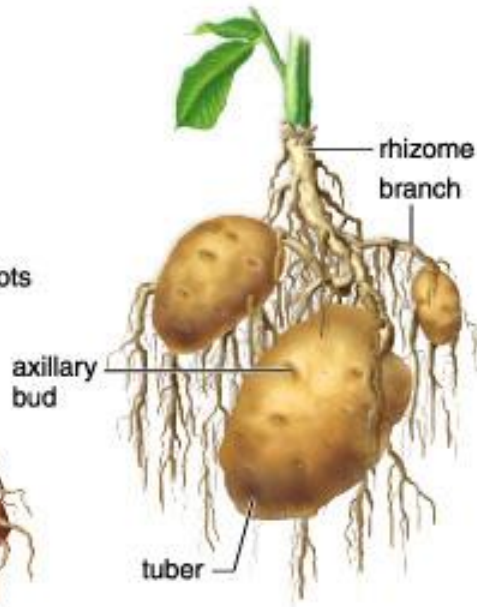
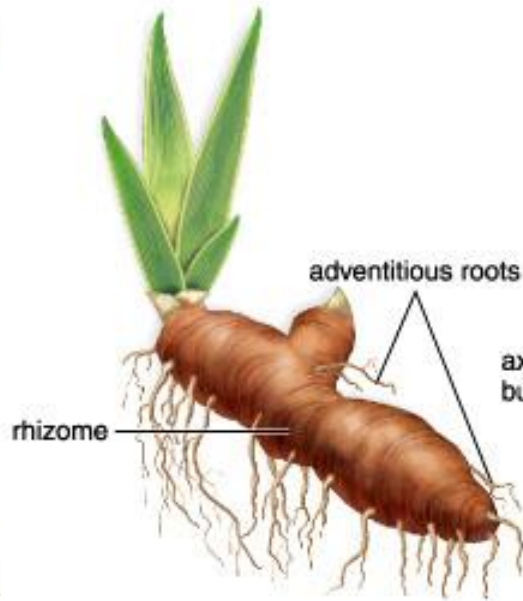
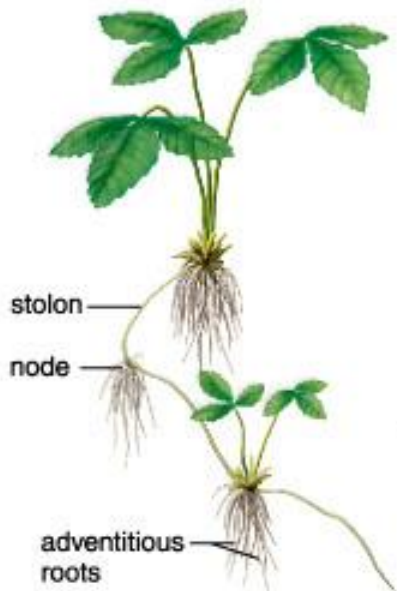
c. Venus's flytrap, *Dionaea*

Leaf Structure



Stem Diversity

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a. Stolon



b. Rhizome



c. Tuber



d. Corm

<https://www.youtube.com/watch?v=DyiQIDmaNIY>

Root Diversity



a. Taproot



b. Fibrous root system



c. Prop roots, a type of adventitious root



d. Pneumatophores of black mangrove trees

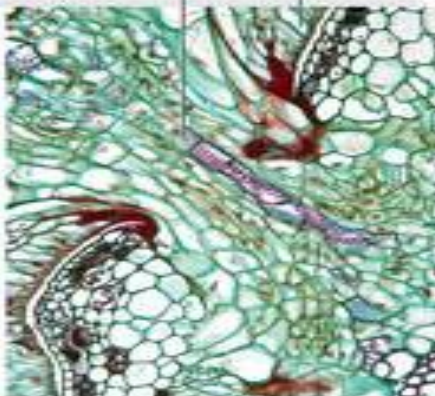
dodder

haustorium

dodder



e. Dodder

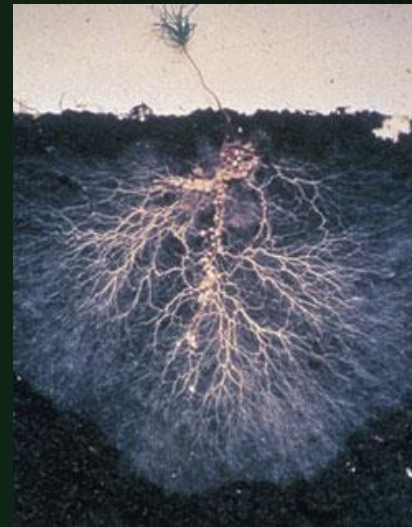
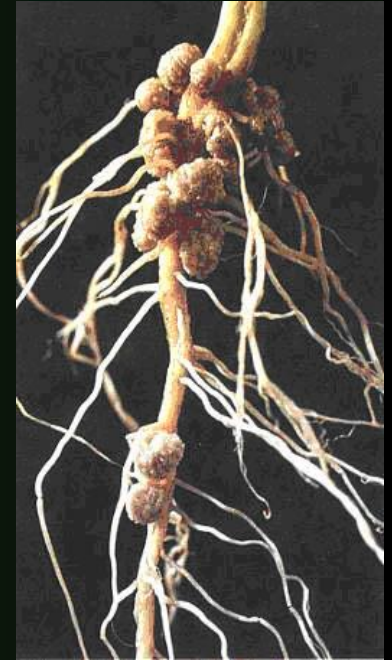


host's vascular tissue

<https://www.youtube.com/watch?v=AhchhZ5r2Ok>

Adaptation of Roots for Mineral Uptake

- Important Symbiotic Relationships
 - *Rhizobium* bacteria fix atmospheric nitrogen
 - Live in root **nodules**
 - Mycorrhizal association between fungi and plant roots
 - Ectomycorrhizae
 - Endomycorrhizae



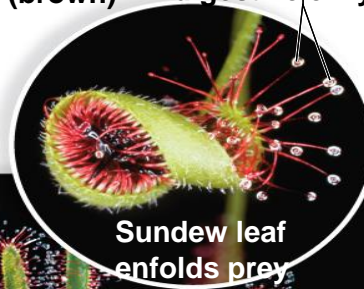
Other Ways to Acquire Nutrition



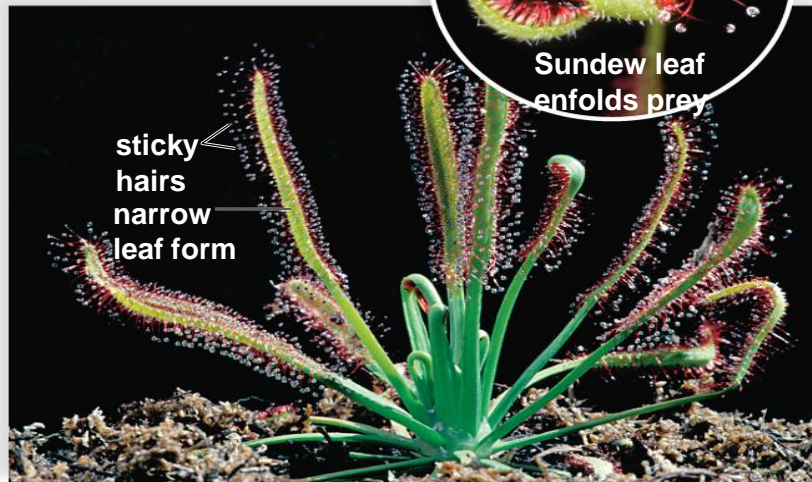
<https://en.wikipedia.org/wiki/Cuscuta>

a. Dodder, *Cuscuta* sp.

dodder (brown) bulbs release digestive enzymes



Sundew leaf enfolds prey

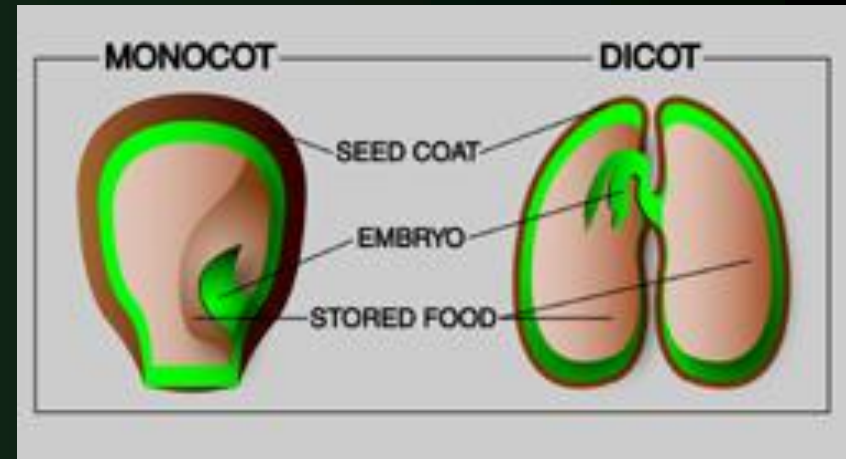


sticky hairs
narrow leaf form


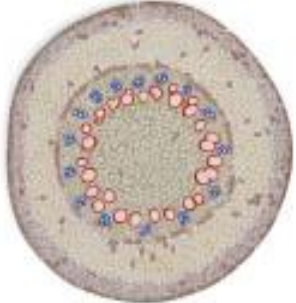





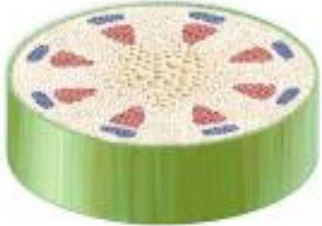


b. Cape sundew, *Drosera capensis*

Monocots and Eudicots

- Two classes of flowering plants
 - Monocotyledones (Monocots)
 - One cotyledon in seed
 - Eudicotyledones (Dicots)
 - Two cotyledons in seed



Flowering Plants: Monocots or Eudicots

	Seed	Root	Stem	Leaf	Flower
Monocots	 <p>One cotyledon in seed</p>	 <p>Root xylem and phloem in a ring</p>	 <p>Vascular bundles scattered in stem</p>	 <p>Leaf veins form a parallel pattern</p>	 <p>Flower parts in threes and multiples of three</p>
Eudicots	 <p>wo cotyledons in seed</p>	 <p>Root phloem between arms of xylem</p>	 <p>Vascular bundles in a distinct ring</p>	 <p>Leaf veins form a net pattern</p>	 <p>Flower parts in fours or fives and their multiples</p>

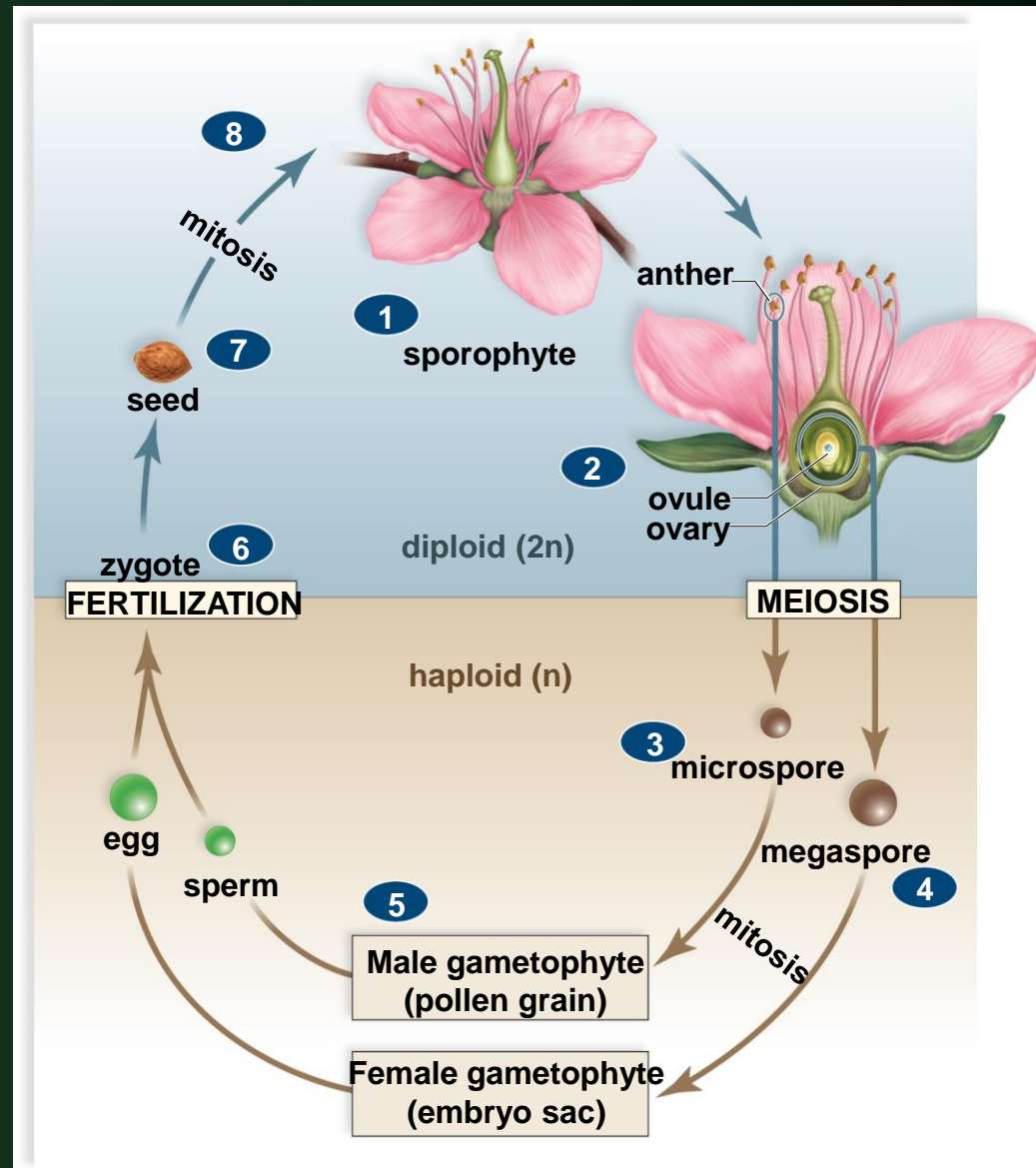
Growing Roots?

- 1. Compare the structure and function of roots, stems and leaves**
- 2. List and explain adaptations of these vegetative organs**
- 3. List some adaptations of plants/roots for mineral uptake**
- 4. Compare monocots and eudicots**

Reproductive Strategies

- All plants have a **two-stage, alternating life cycle**
 - Sporophyte produces haploid spores by meiosis
 - Spores divide mitotically to become haploid gametophytes
 - Gametophytes produce gametes
 - Gametes fuse to produce zygote
 - Zygote divides mitotically to become diploid sporophyte

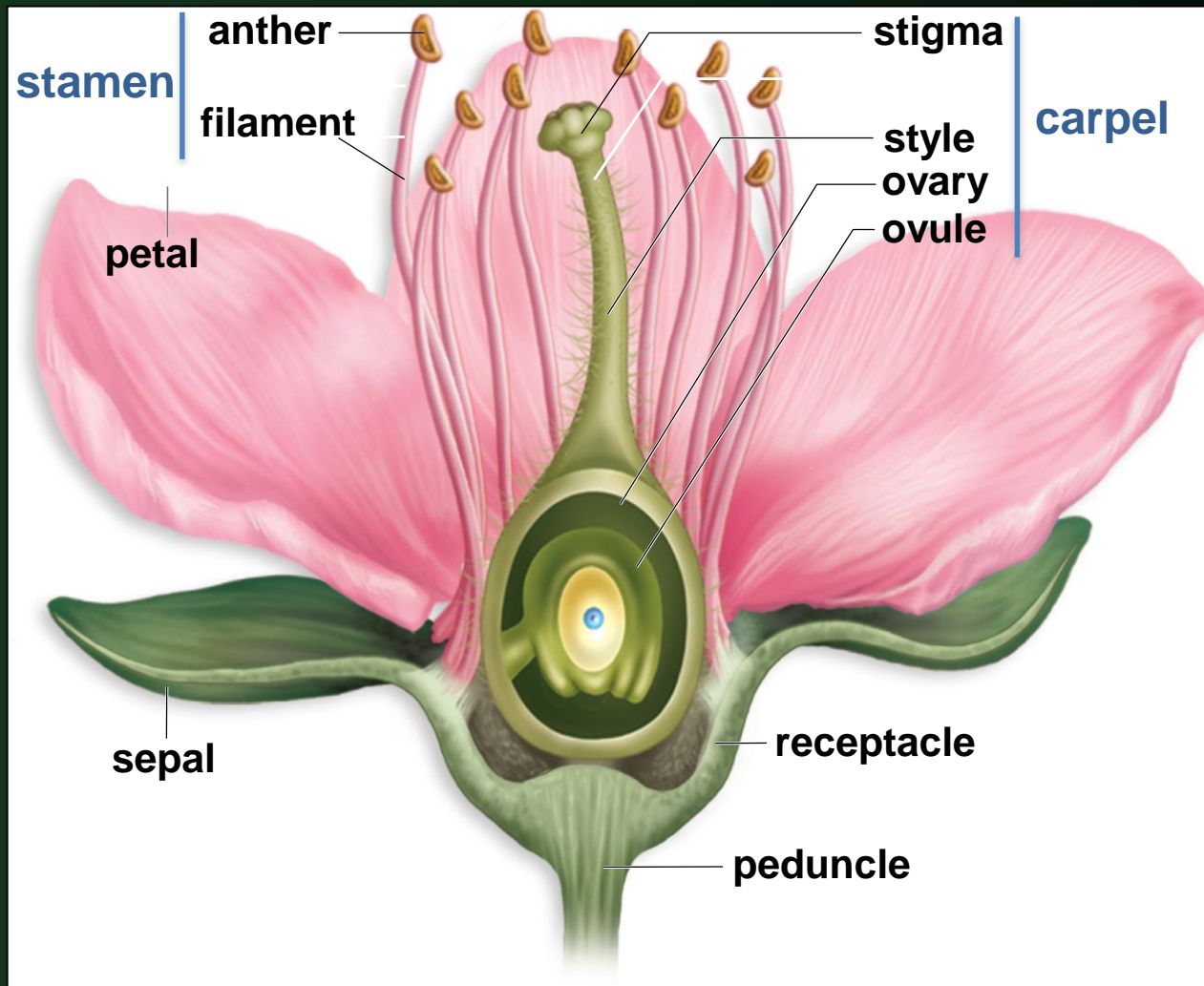
Alternation of Generations in Flowering Plants



Reproductive Strategies

- Flower produces two types of spores
 - Microspore - Male gametophyte
 - Undergoes mitosis
 - Becomes pollen grain
 - Megaspore - Female gametophyte
 - Undergoes mitosis
 - Becomes embryo sac within an ovary, within an ovule
 - Ovule becomes seed

Anatomy of a Flower



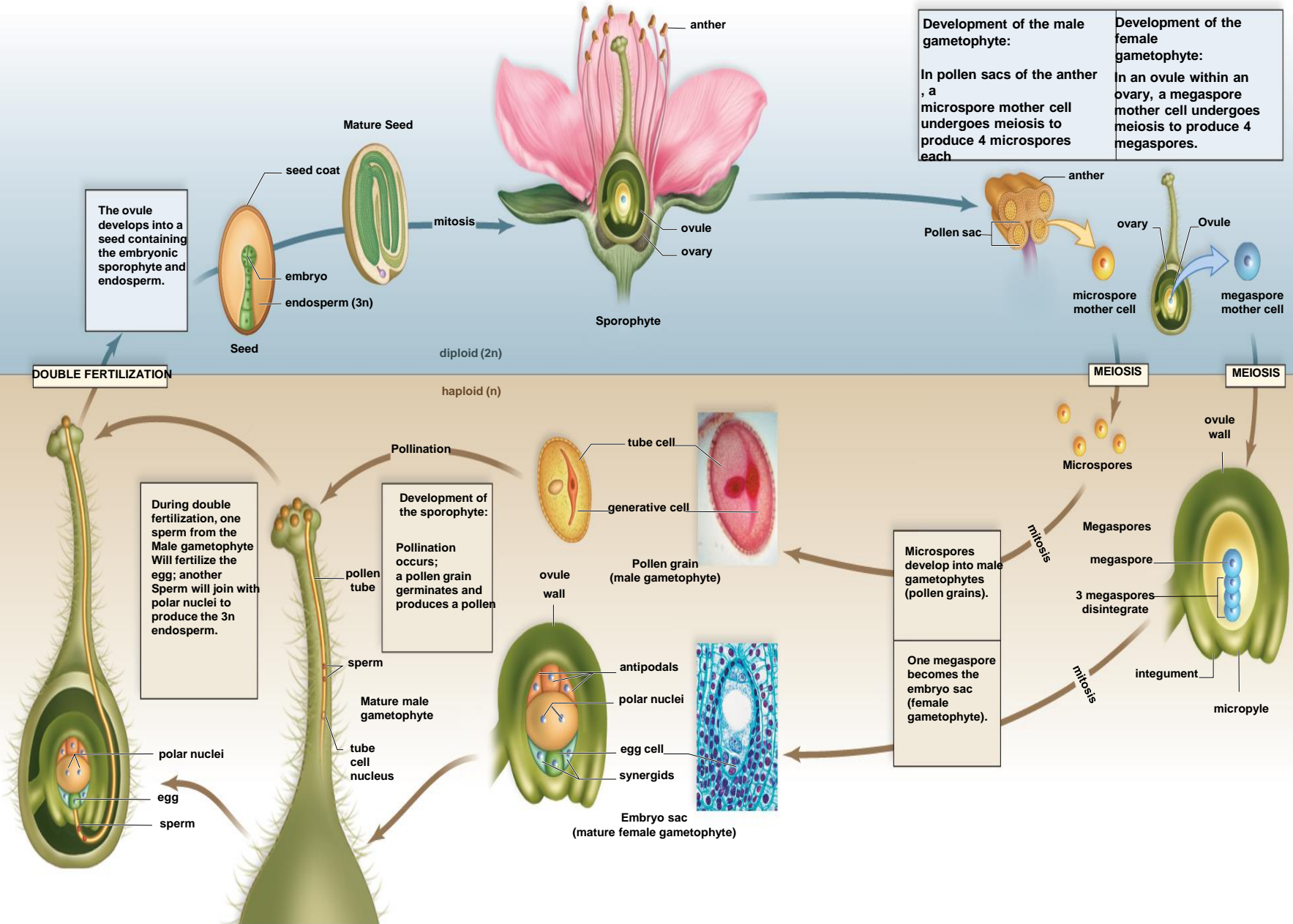
Flowers

- Stamens are male portion of flower
 - Anther - Saclike container
 - Filament - Slender stalk
- Carpel/pistil is female portion of flower
 - Stigma - Enlarged sticky knob
 - Style - Slender stalk
 - Ovary - Enlarged base enclosing ovules

Flowers

- Complete vs. incomplete flowers:
 - Complete flowers have sepals, petals, stamens, and a carpel
 - Incomplete flowers missing one or more of above
- Bisexual vs. unisexual flowers:
 - Bisexual flowers have both stamens and carpel
 - Unisexual flowers have one but not the other
- Monoecious vs. dioecious plants
 - Monoecious plants have staminate flowers and carpellate flowers on the same plant
 - Dioecious plants have all staminate or all carpellate flowers

Life Cycle of Flowering Plants



Production of Male Gametophytes (pollen grains)

- Male Gametophytes
 - Microspores are produced in anthers
 - Each anther has four pollen sacs, each with many **microsporocytes**
 - Undergoes meiosis to produce **microspores**
 - Mitosis produces pollen grains

Production of Female Gametophyte (embryo sac)

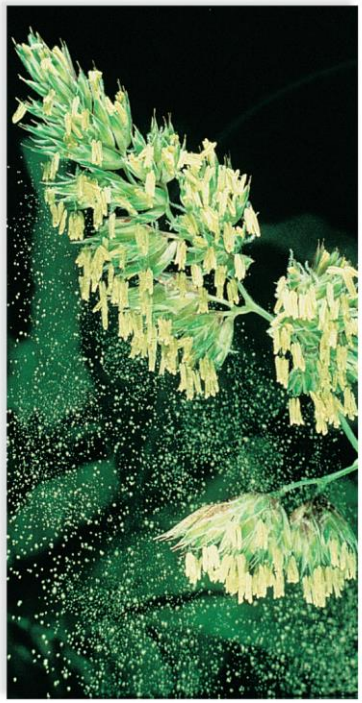
- Ovary contains one or more ovules
 - Ovule has mass of parenchyma cells
 - One cell enlarges to become **megasporocyte**
 - Undergoes meiosis and becomes four haploid **megaspores**
 - Functional megaspore divides mitotically until there are eight nuclei of a female gametophyte

Pollination

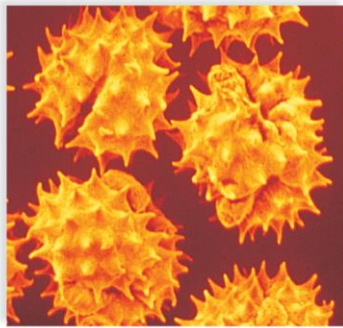
- Pollination is the transfer of pollen from an anther to the stigma of a carpel
 - **Self-pollination** occurs if the pollen is from the same plant
 - **Cross-pollination** occurs if the pollen is from a different plant



Pollen & Pollinators



a.



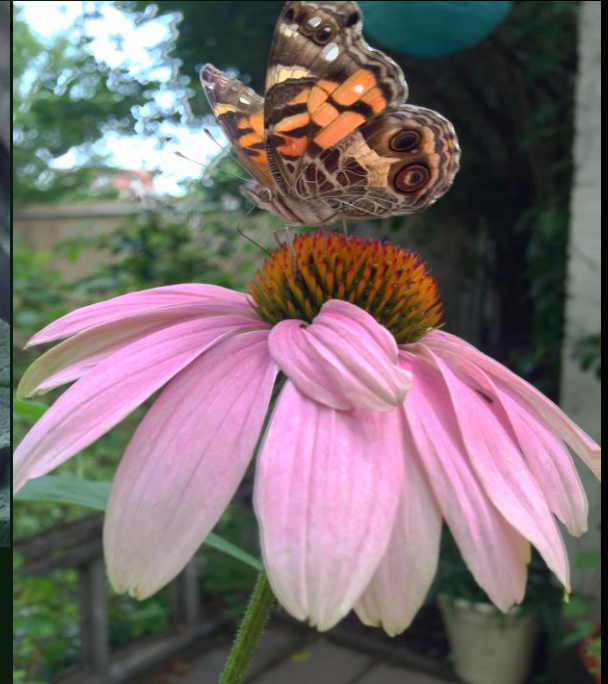
b.

118 μm



c.

8 μm



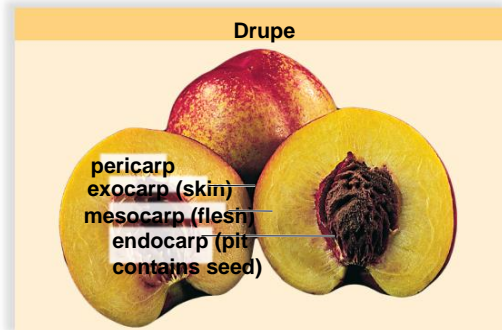
Fertilization

- When pollen grain lands on stigma, it germinates forming a pollen tube
- Passes between the stigma and style to reach the micropyle of the ovule
- **Double fertilization** occurs
 - One sperm nucleus unites with the egg nucleus, producing a zygote
 - Other sperm nucleus unites with the polar nuclei, forming a $3n$ endosperm cell

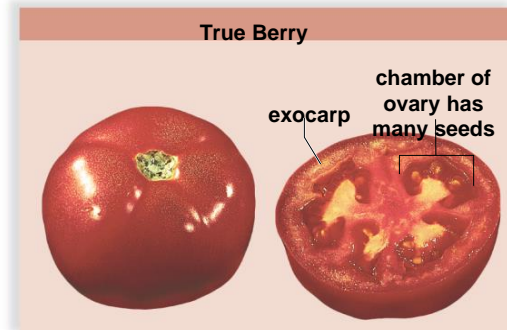
Fruit Types

- **Simple Fruits**
 - Simple fruits are derived from single or several united carpels
 - Fleshy or dry
- **Accessory fruit** - Bulk of fruit is not from ovary, but from receptacle (ex: apples)
- **Compound fruits** develop from several individual ovaries
 - Aggregate Fruits
 - Ovaries are from a single flower, ex: Blackberry
 - Multiple Fruits
 - Ovaries are from separate flowers clustered together

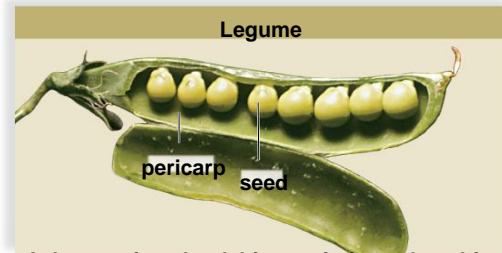
Fruits



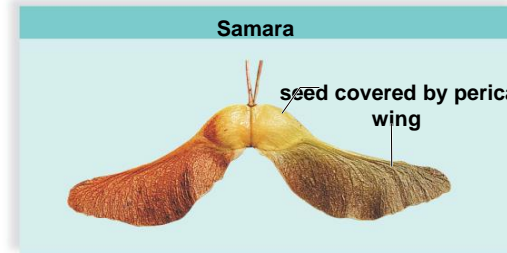
a. A drupe is a fleshy fruit with a pit containing a single seed produced from a simple ovary.



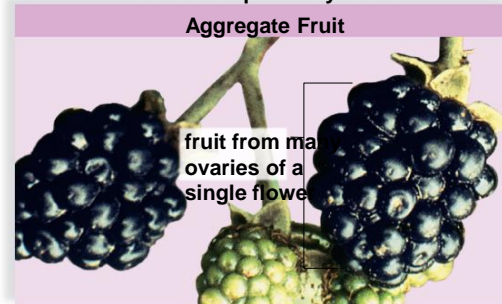
b. A berry is a fleshy fruit having seeds and pulp produced from a compound ovary.



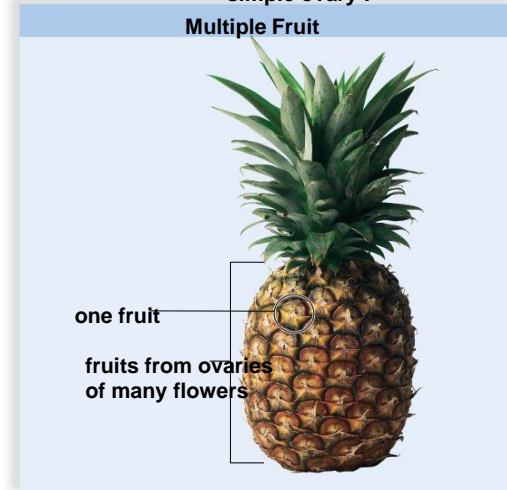
c. A legume is a dry dehiscent fruit produced from a simple ovary.



d. A samara is a dry indehiscent fruit produced from a simple ovary.



e. An aggregate fruit contains many fleshy fruits produced from simple ovaries of the same flower.



f. A multiple fruit contains many fused fruits produced from simple ovaries of individual flowers.

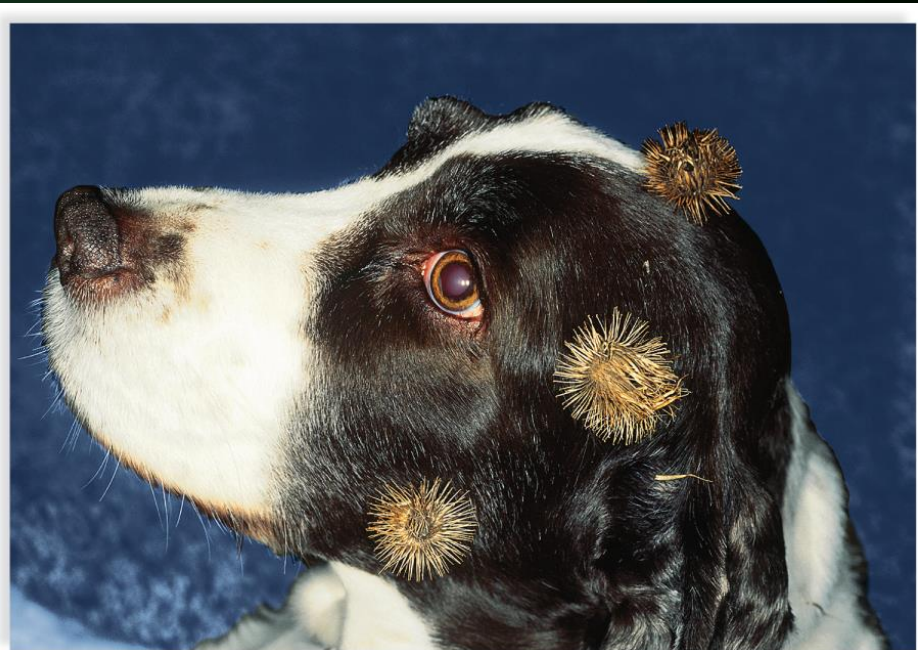
Fruit / Seed Dispersal

Many seeds are dispersed by wind

Woolly hairs, plumes, wings

Fleshy fruits - Attract animals and provide them with food

Peaches, cherries, tomatoes



Seed Germination

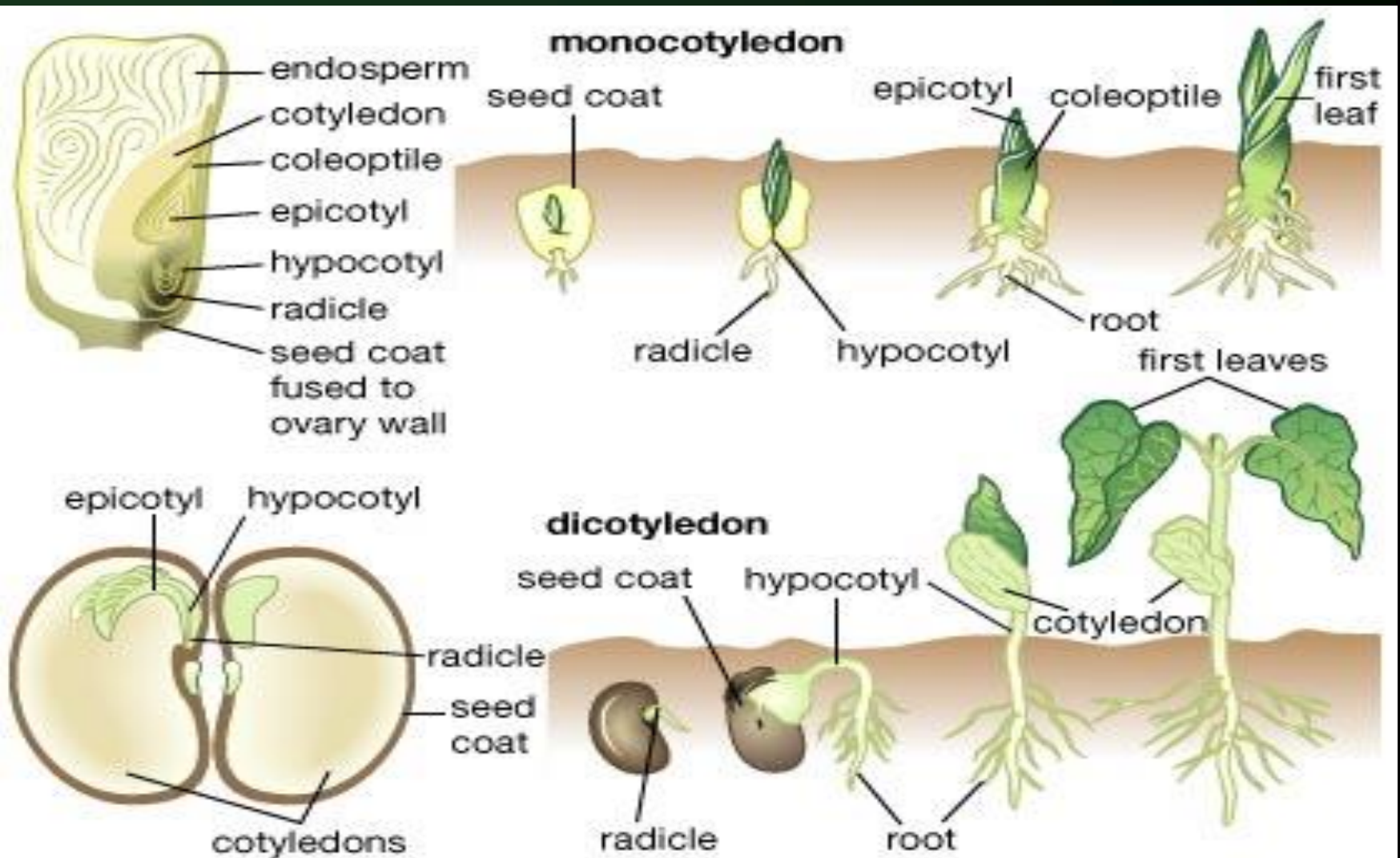


- When seed germination occurs, the embryo resumes growth and metabolic activity
- Length of time seeds retain their viability is quite variable
 - Some seeds do not germinate until they have been through a **dormant** period
 - Temperate zones - Cold Weather
 - Deserts - Rain

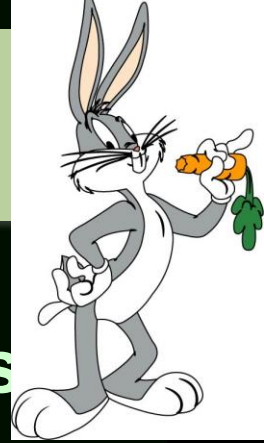
Seed Germination

- Environmental requirements for seed germination
 - Availability of oxygen for metabolic needs
 - Adequate temperature for enzyme activity
 - Adequate moisture for hydration of cells-
- **Imbibition**
 - Light (in some cases)
- Respiration and metabolism continue throughout dormancy, but at a reduced level

Monocot vs Eudicot



Quick Check



1. Name the parts of a flower and its functions
2. Contrast the formation of male and female gametophytes
3. What is the difference between pollination and fertilization?
4. What's the advantage of pollen?
5. What is double fertilization?
6. Describe different types of flowers; different types of fruits and their role
7. What are the requirements for seed germination?

2: Questions:

What are fruits?

Where do they come from?

What are they made of?

Use phylogeny to classify the Passion fruit
(DKPCOFGS)

Passion Fruit:

Domain: Eukaryote

Kingdom: Plantae

Phylum: Tracheobionta

(Vascular & 2N)

Class: Magnoliopsida

(dicotyledon)

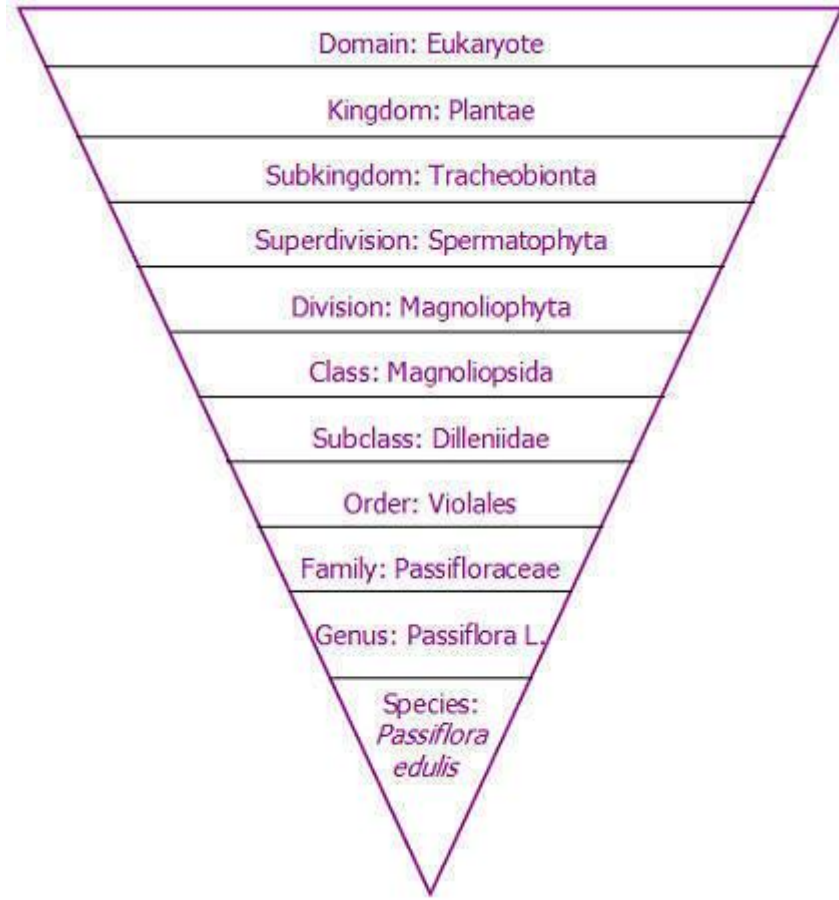
Order: Violales

unilocular (having a single compartment)

Family: Passifloraceae (tropical)

Genus: Passiflora (Shrubs)

Species: edulis



Food for thoughts

- What are “vegetables”?

