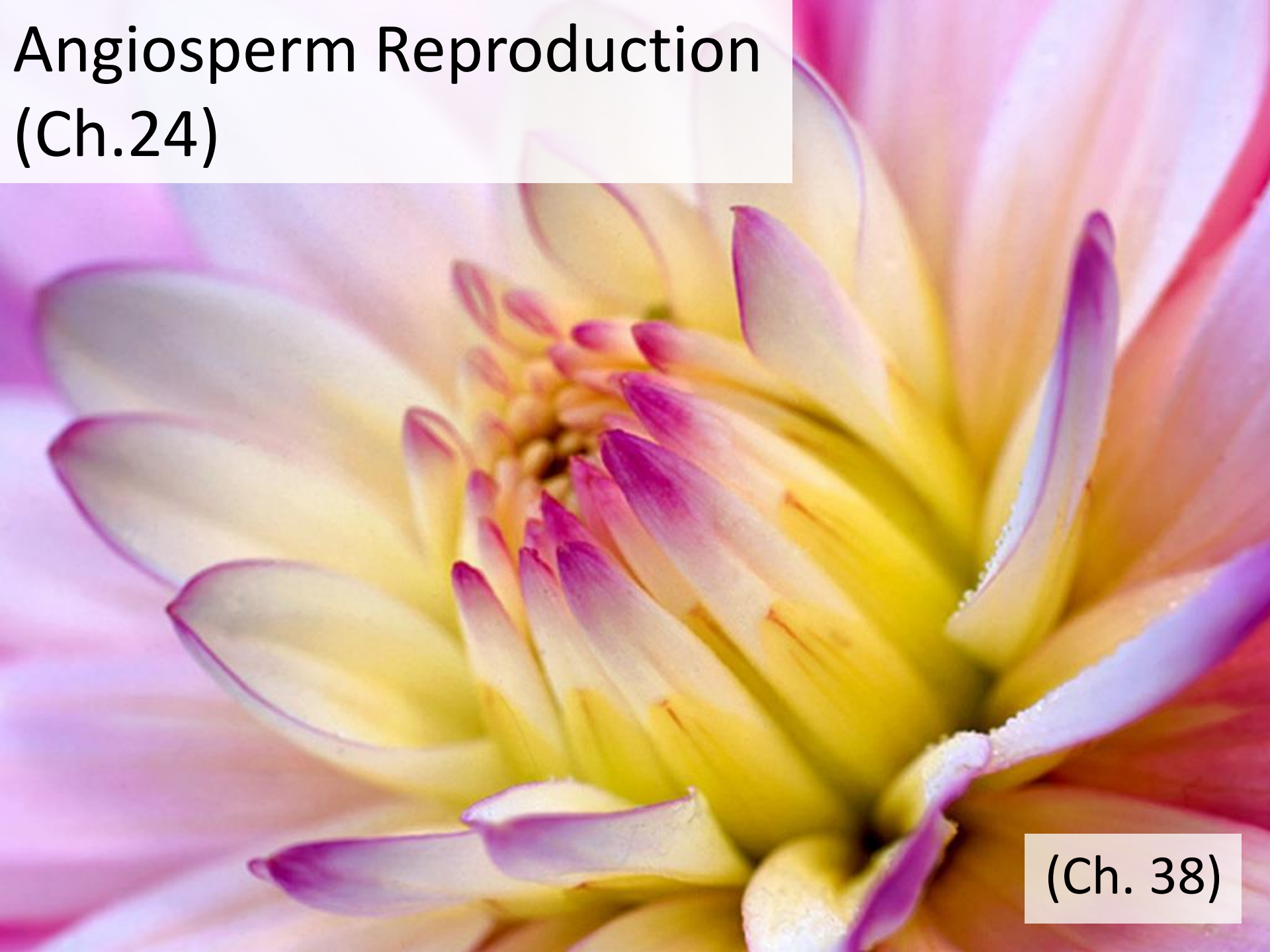
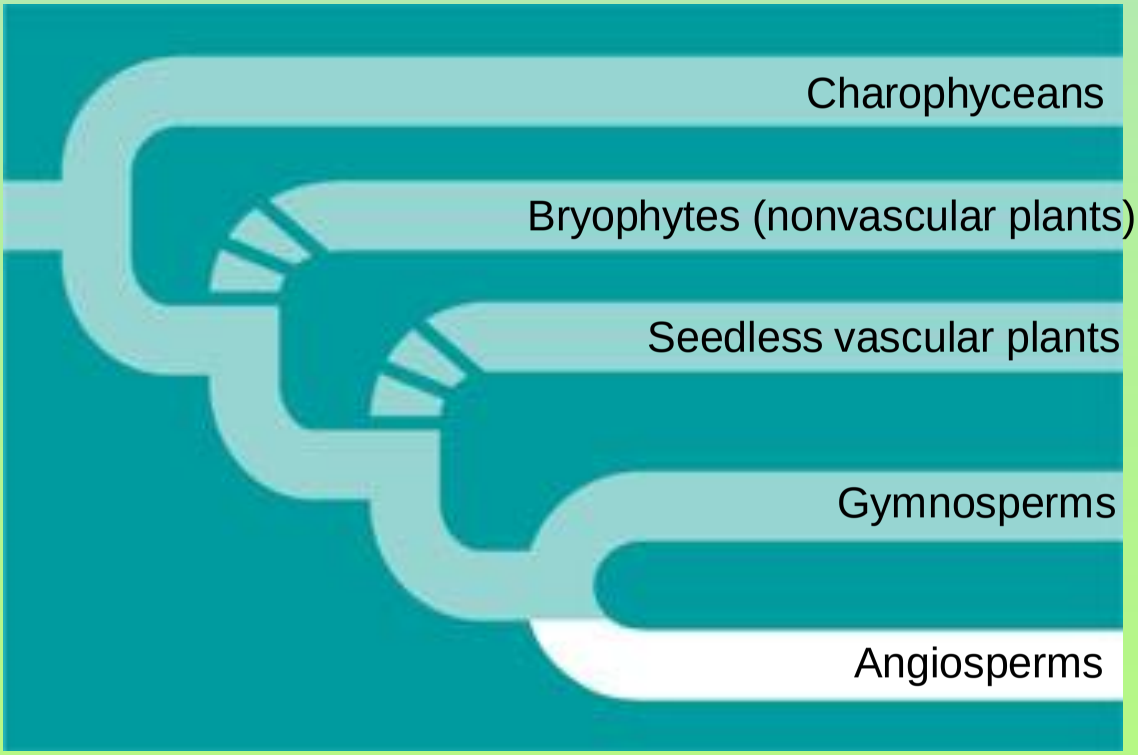
Angiosperm Reproduction (Ch.24)



(Ch. 38)


Charophyceans
Bryophytes (nonvascular plants)
Seedless vascular plants
Gymnosperms
Angiosperms

Rafflesia arnoldii, “monster flower” of Indonesia

MONOCOTS | **EUDICOTS**

Orchid (*Lemboglossum rossii*)

California poppy (*Eschscholzia californica*)

Monocot Characteristics		**Eudicot Characteristics**
 One cotyledon	**Embryos**	 Two cotyledons
 Veins usually parallel	**Leaf venation**	 Veins usually netlike
 Vascular tissue scattered	**Stems**	 Vascular tissue usually arranged in ring
 Root system Usually fibrous (no main root)	**Root**	 Taproot (main root) usually present
 Pollen grain with one opening	**Pollen**	 Pollen grain with three openings
 Floral organs usually in multiples of three	**Flowers**	 Floral organs usually in multiples of four or five

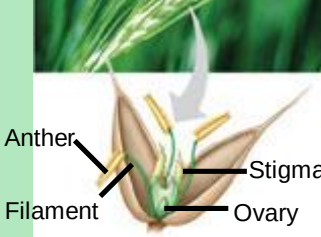
Pygmy date palm (*Phoenix roebelenii*)

Pyrenean oak (*Quercus pyrenaica*)

Lily (*Lilium* "Enchant-ment")

Barley (*Hordeum vulgare*), a grass

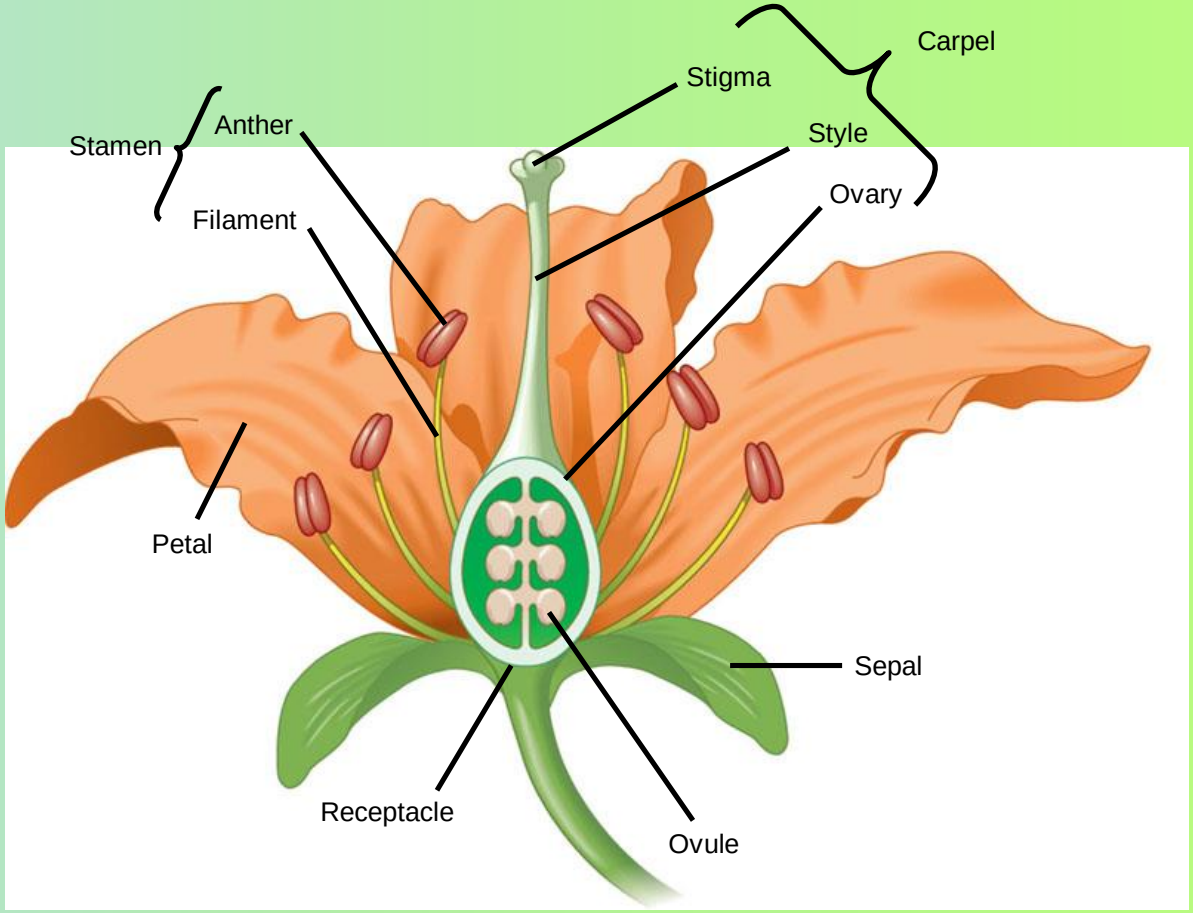
Dog rose (*Rosa canina*), a wild rose



Pea (*Lathyrus nervosus*, Lord Anson's blue pea), a legume

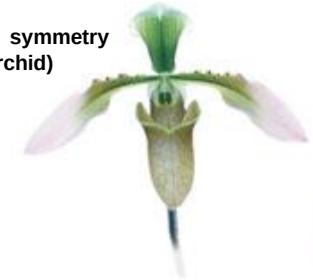
Zucchini (*Cucurbita Pepo*), female (left) and male flowers

The structure of an idealized flower



Floral Variations

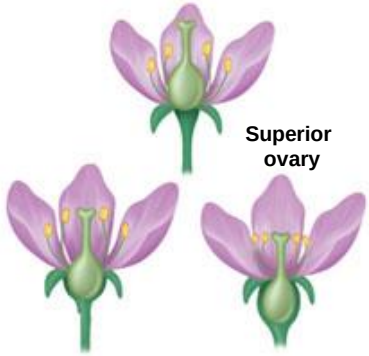
SYMMETRY



Bilateral symmetry (orchid)

Radial symmetry (daffodil)

OVARY LOCATION



FLORAL DISTRIBUTION

Lupine inflorescence

Sunflower inflorescence. A Sunflower's central disk actually consists of hundreds of tiny incomplete flowers. What look like petals are actually sterile flowers.

REPRODUCTIVE VARIATIONS

Maize, a monoecious species. A maize "ear" (left) consists of kernels (one-seeded fruits) that develop from an inflorescence of fertilized carpellate flowers. Each kernel is derived from a single flower. Each "silk" strand consists of a stigma and long style. The tassels (right) are staminate inflorescences.

Dioecious *Sagittaria latifolia* (common arrowhead). The staminate flower (left) lacks carpels, and the carpellate flower (right) lacks stamens. Having these two types of flowers on separate plants reduces inbreeding.

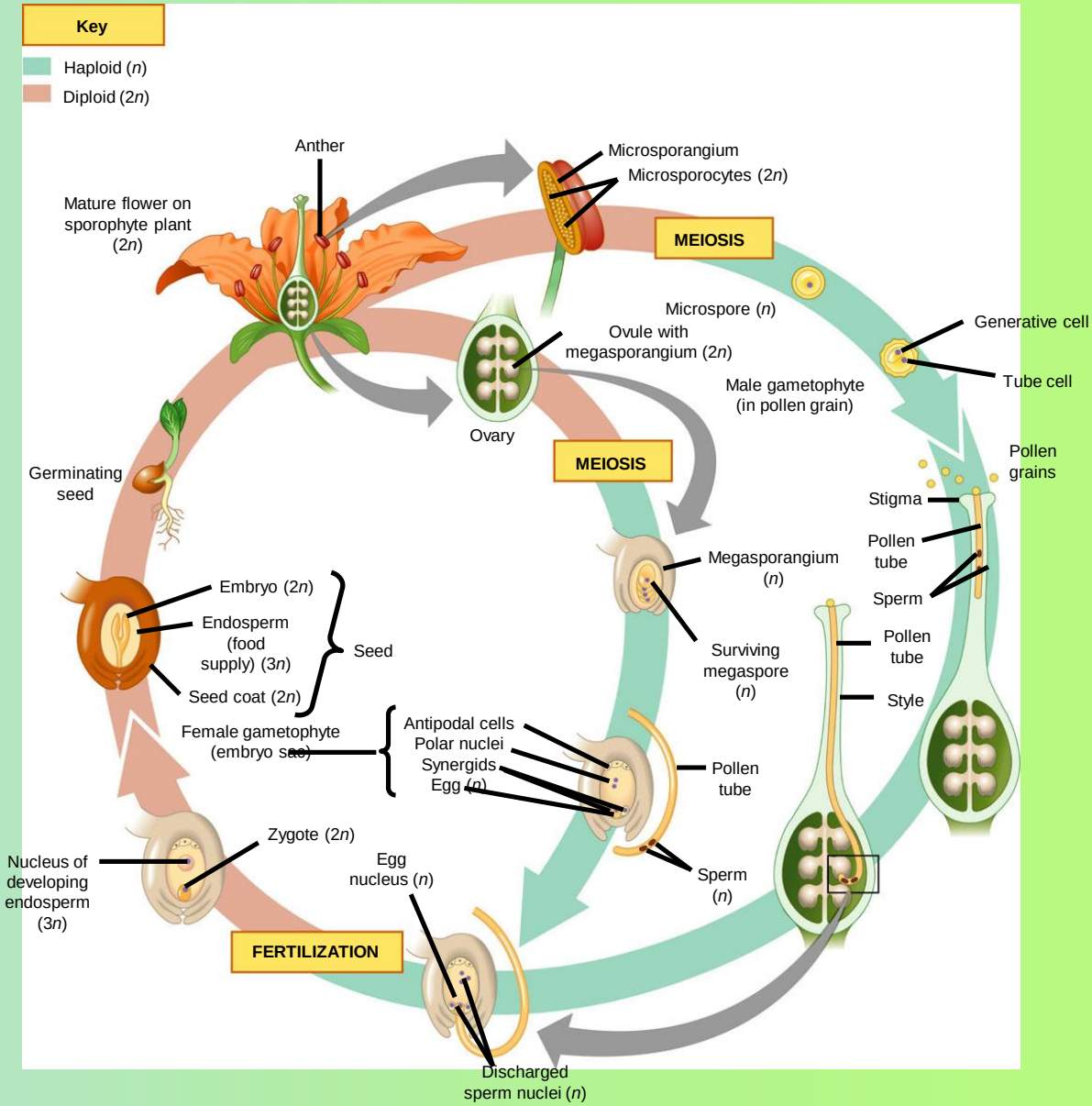
Asexual reproduction in aspen trees

Test-tube cloning of carrots

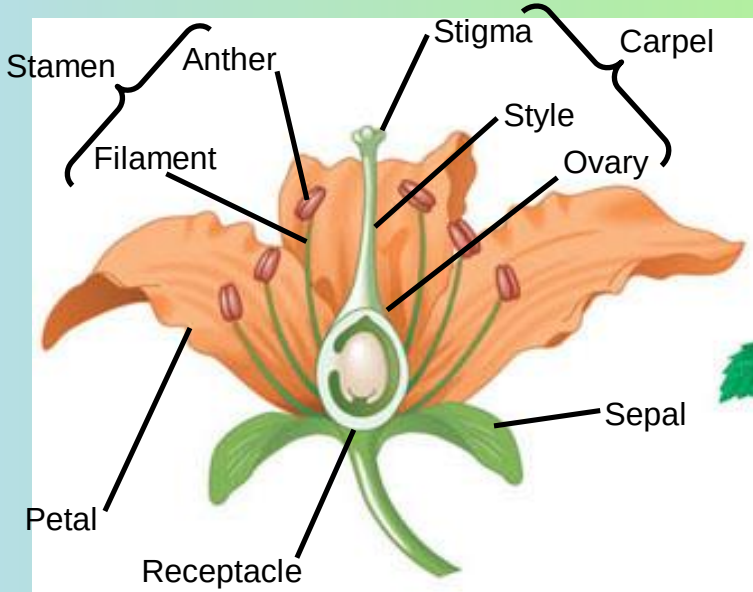
(a) Just a few parenchyma cells from a carrot gave rise to this callus, a mass of undifferentiated cells.

(b) The callus differentiates into an entire plant, with leaves, stems, and roots.

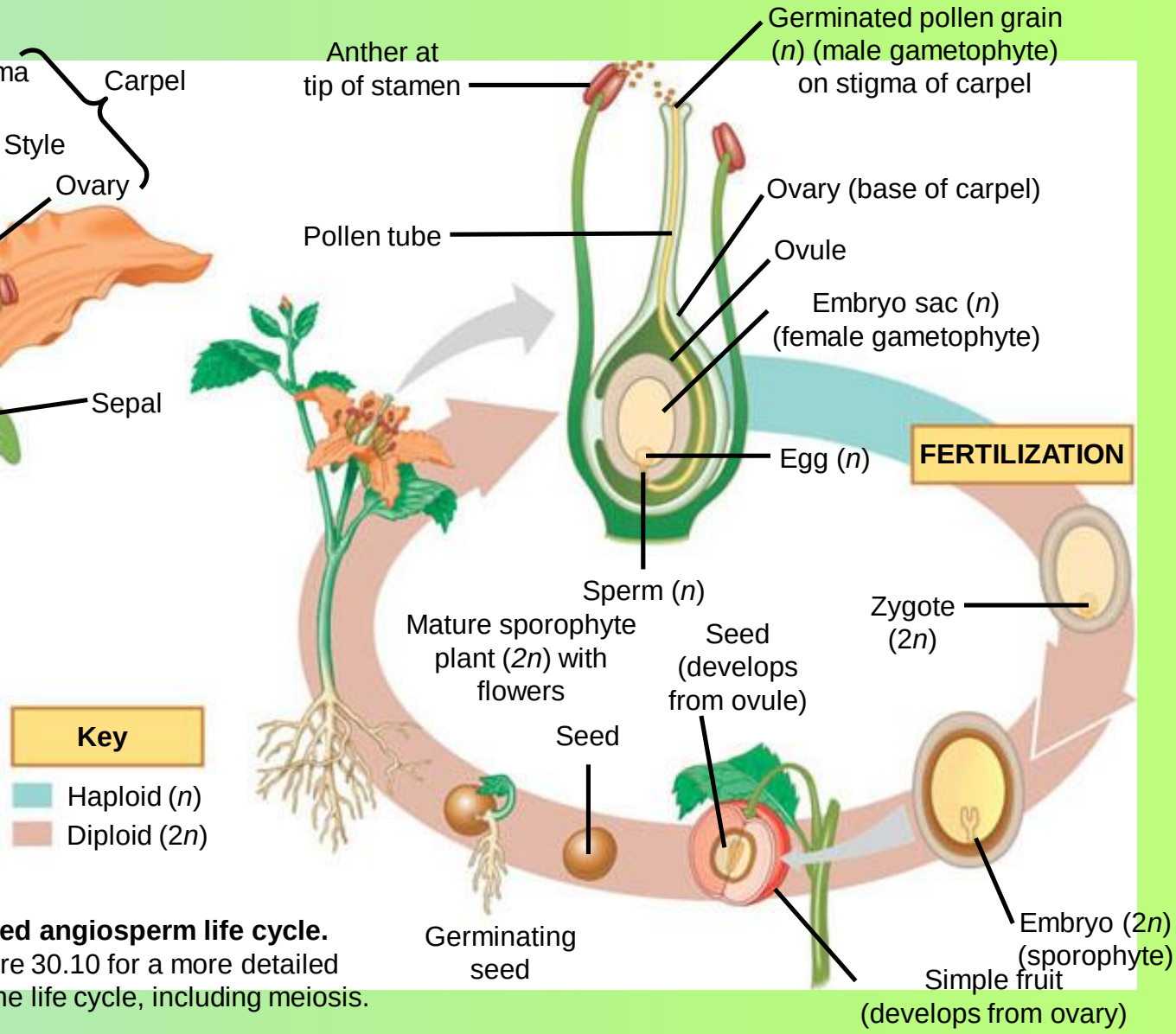
The life cycle of an angiosperm



An overview of angiosperm reproduction



(a) An idealized flower.



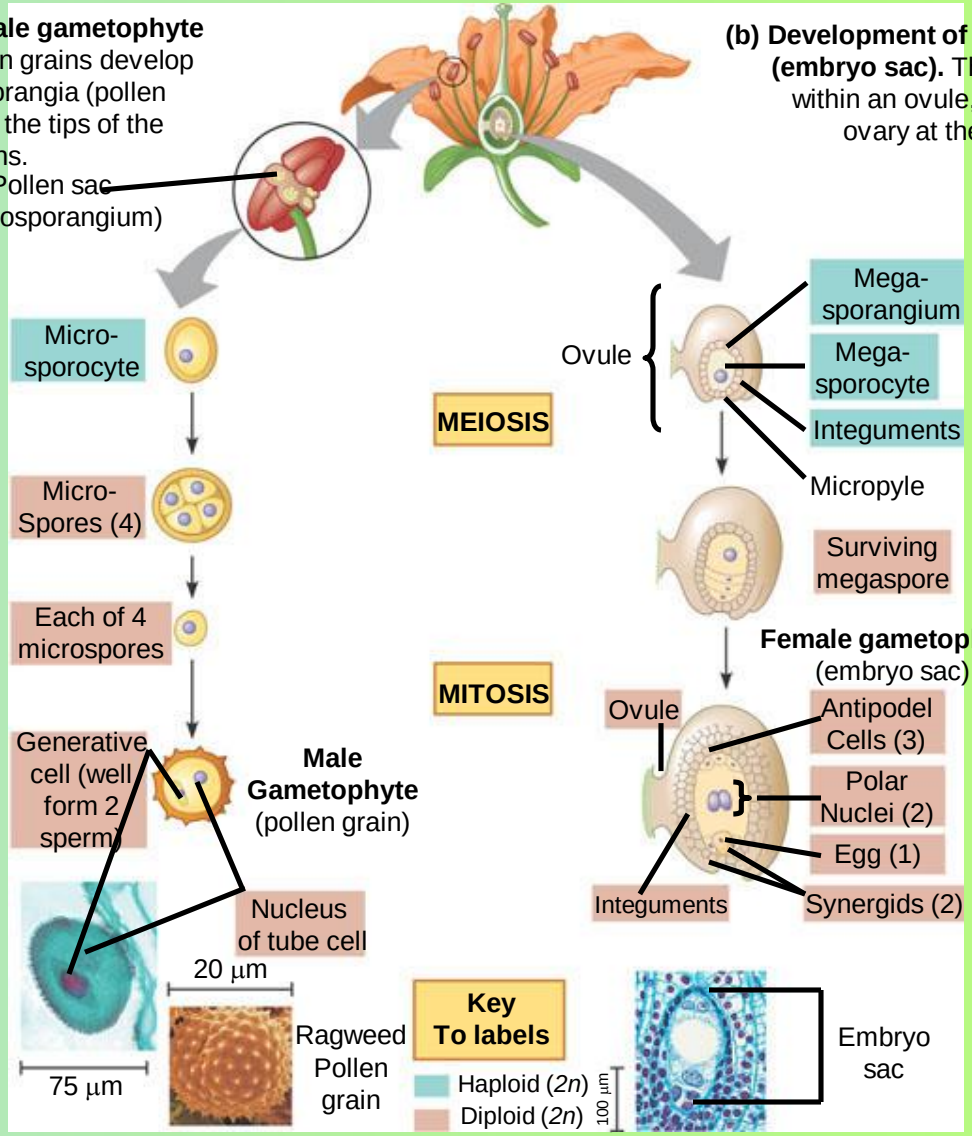
(a) Simplified angiosperm life cycle. See Figure 30.10 for a more detailed version of the life cycle, including meiosis.

The development of angiosperm gametophytes (pollen grains and embryo sacs)

(a) Development of a male gametophyte (pollen grain). Pollen grains develop within the microsporangia (pollen sacs) of anthers at the tips of the stamens.

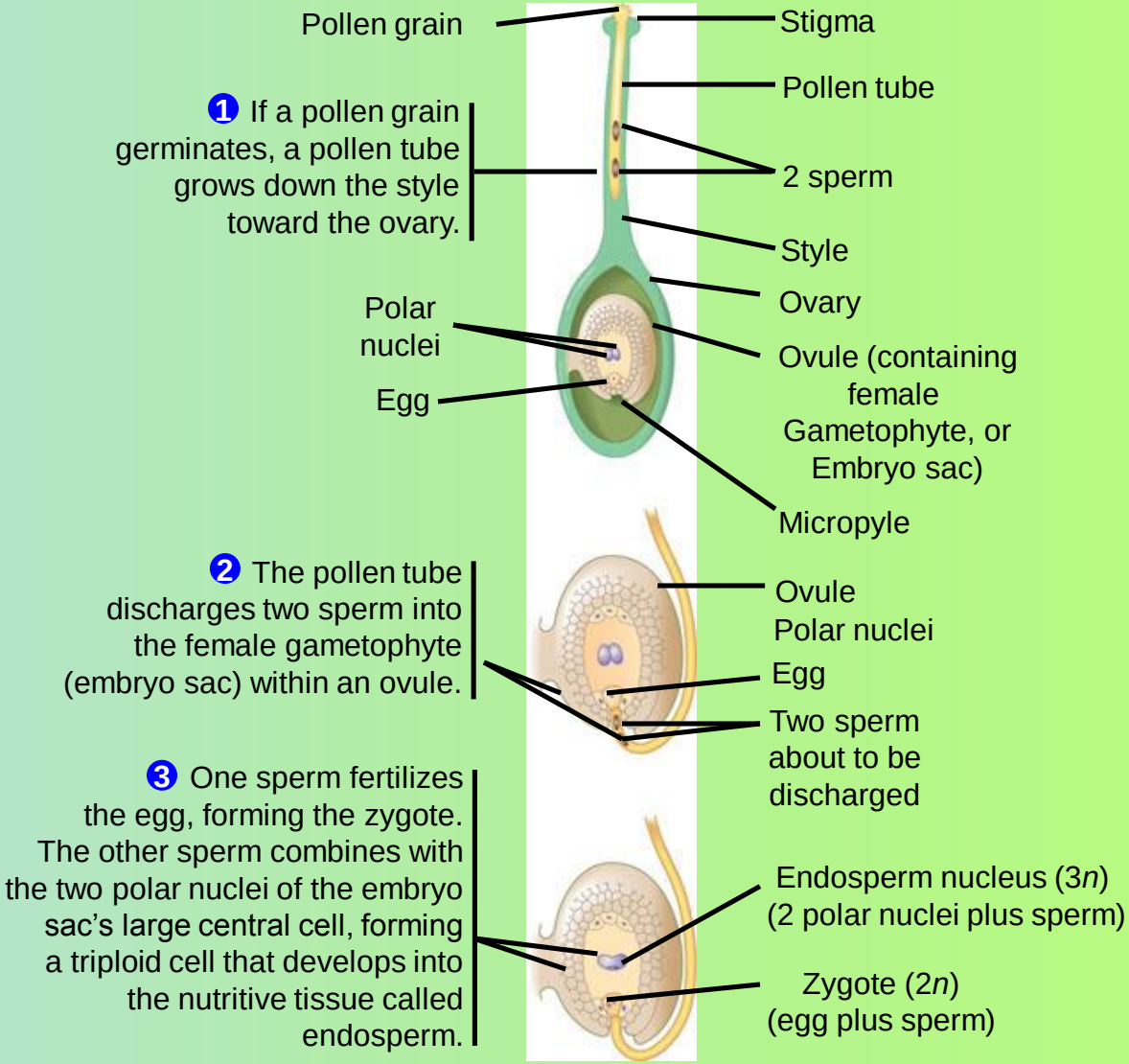
(b) Development of a female gametophyte (embryo sac). The embryo sac develops within an ovule, itself enclosed by the ovary at the base of a carpel.

1. Each one of the microsporangia contains diploid microsporocytes (microspore mother cells).
2. Each microsporocyte divides by meiosis to produce four haploid microspores, each of which develops into a pollen grain.
3. A pollen grain becomes a mature male gametophyte when its generative nucleus divides and forms two sperm. This usually occurs after a pollen grain lands on the stigma of a carpel and the pollen tube begins to grow. (See Figure 38.2b.)

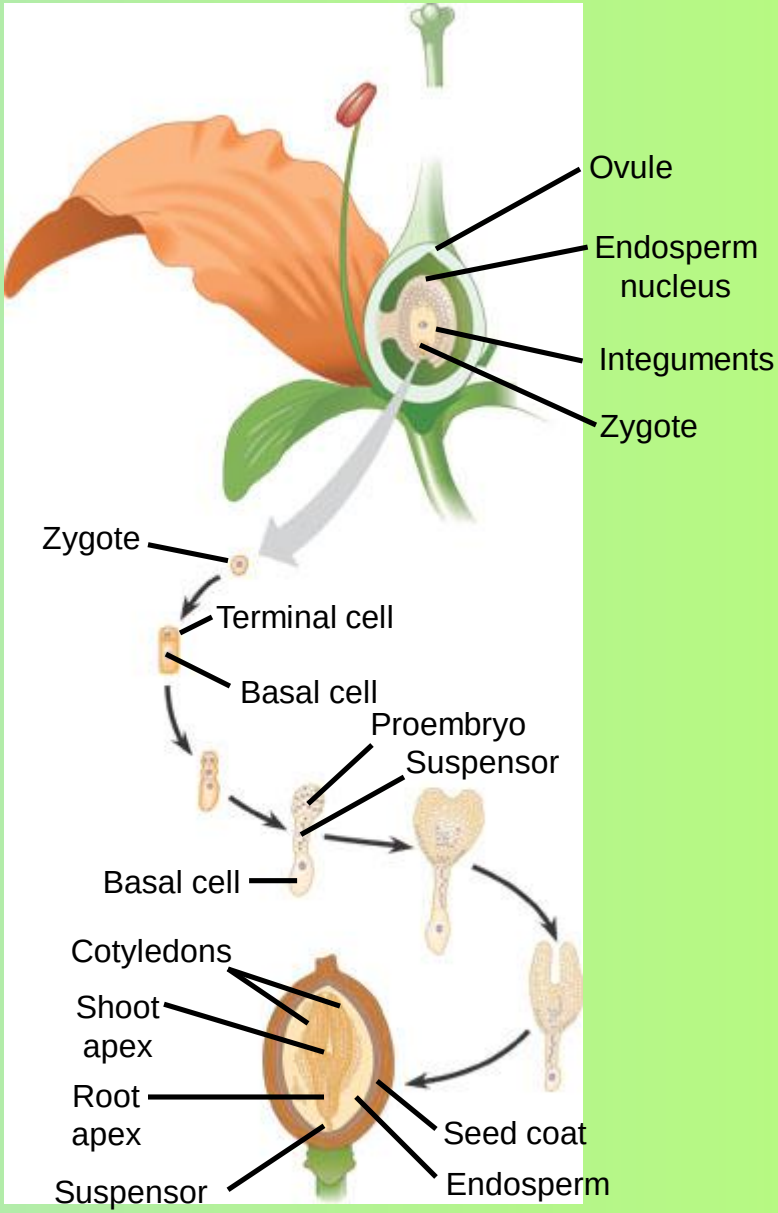


1. Within the ovule's megasporangium is a large diploid cell called the megasporocyte (megaspore mother cell).
2. The megasporocyte divides by meiosis and gives rise to four haploid cells, but in most species only one of these survives as the megaspore.
3. Three mitotic divisions of the megaspore form the embryo sac, a multicellular female gametophyte. The ovule now consists of the embryo sac along with the surrounding integuments (protective tissue).

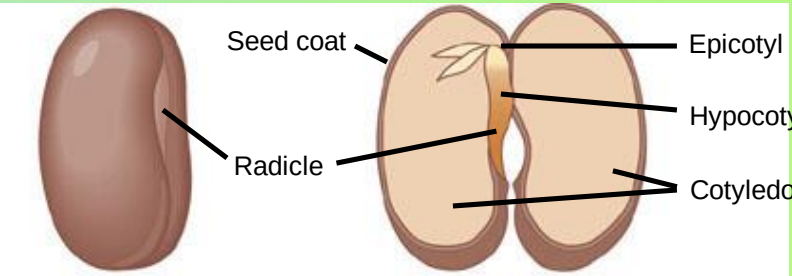
Growth of the pollen tube and double fertilization



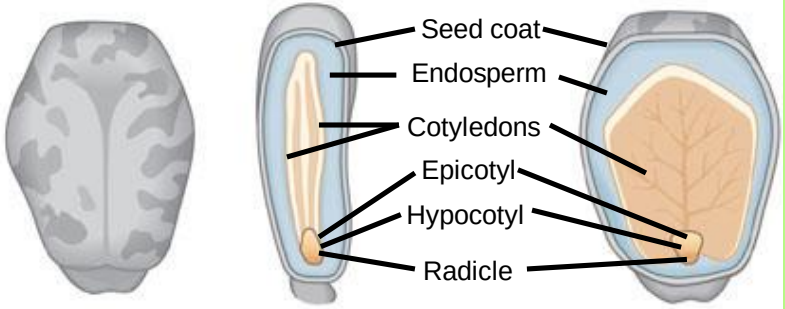
The development of a eudicot plant embryo



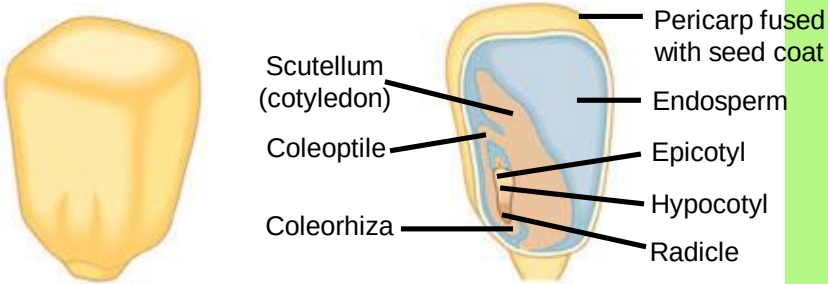
Seed structure



(a) Common garden bean, a eudicot with thick cotyledons. The fleshy cotyledons store food absorbed from the endosperm before the seed germinates.

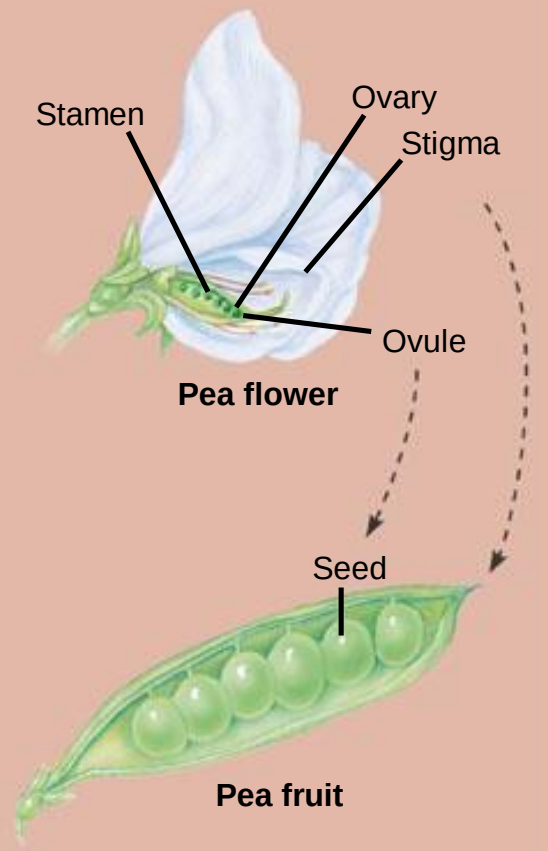


(b) Castor bean, a eudicot with thin cotyledons. The narrow, membranous cotyledons (shown in edge and flat views) absorb food from the endosperm when the seed germinates.

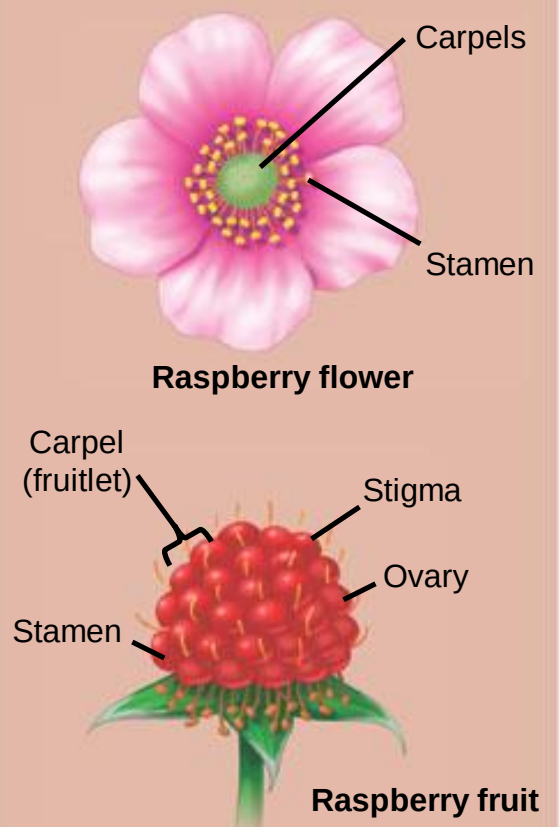


(c) Maize, a monocot. Like all monocots, maize has only one cotyledon. Maize and other grasses have a large cotyledon called a scutellum. The rudimentary shoot is sheathed in a structure called the coleoptile, and the coleorhiza covers the young root.

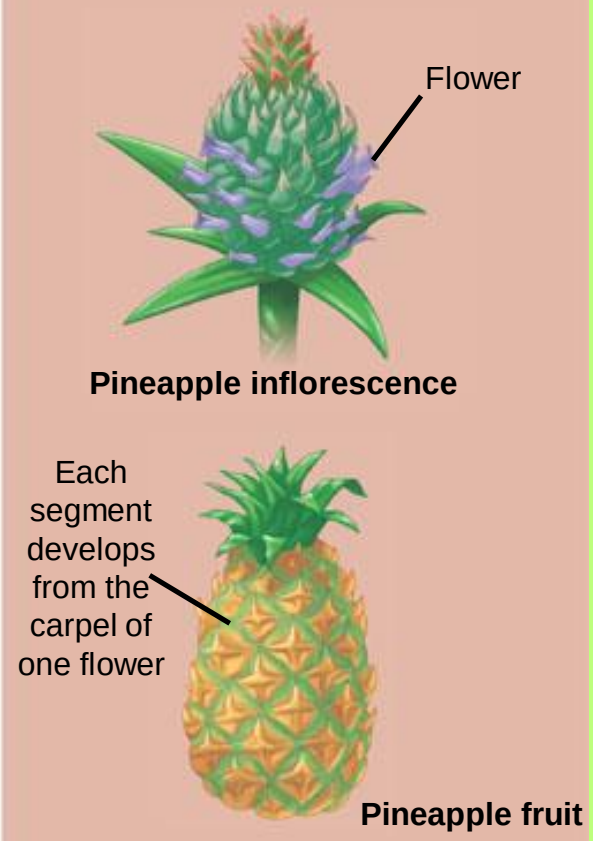
Developmental origin of fruits



(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).

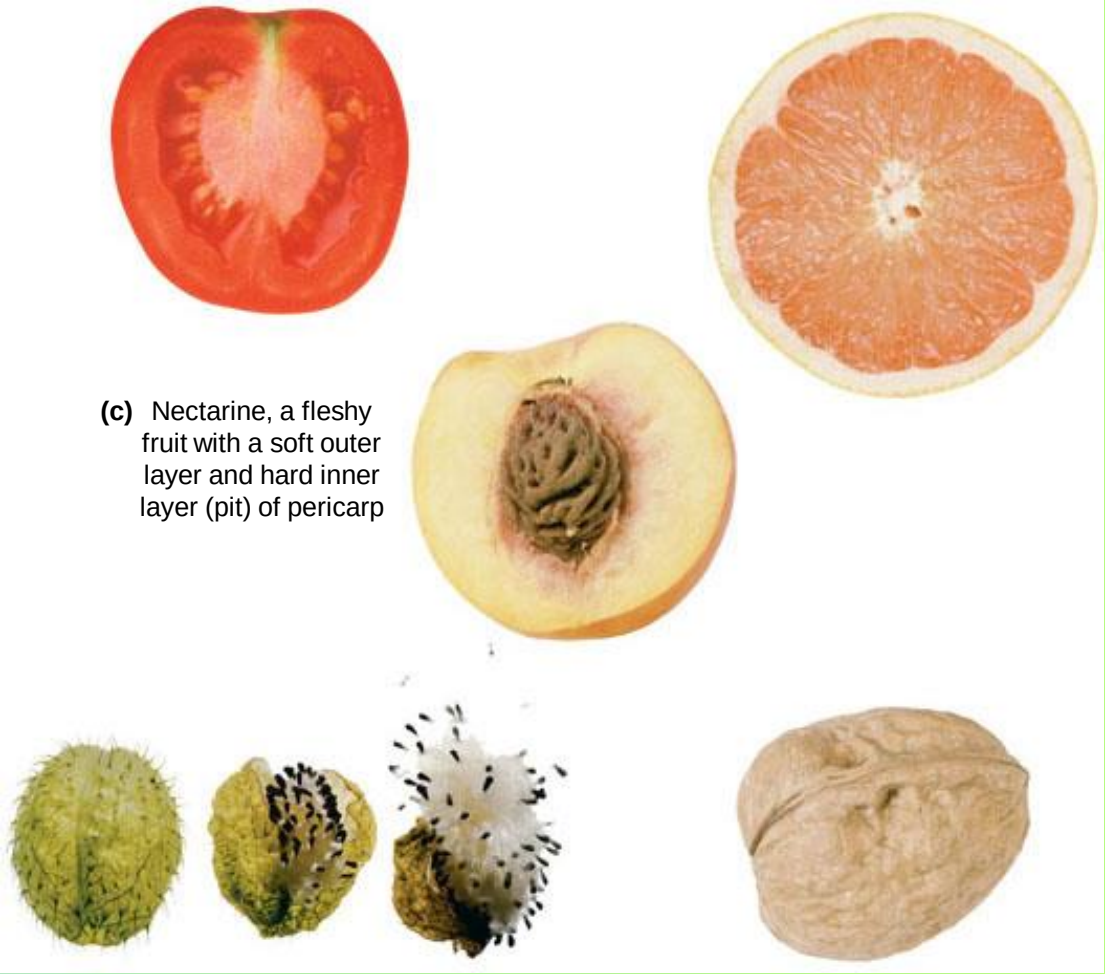


(c) **Multiple fruit.** A multiple fruit develops from many carpels of many flowers (examples: pineapple, fig).

Some variations in fruit structure

(a) Tomato, a fleshy fruit with soft outer and inner layers of pericarp

(b) Ruby grapefruit, a fleshy fruit with a hard outer layer and soft inner layer of pericarp

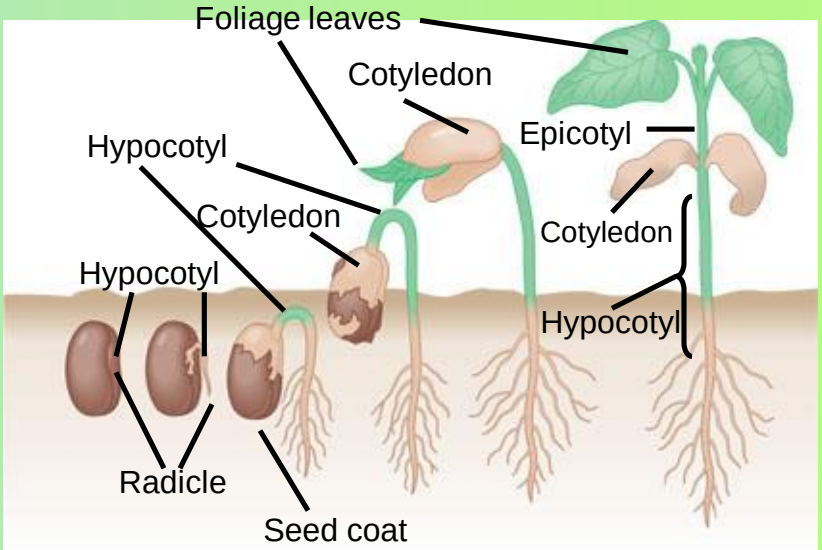


(c) Nectarine, a fleshy fruit with a soft outer layer and hard inner layer (pit) of pericarp

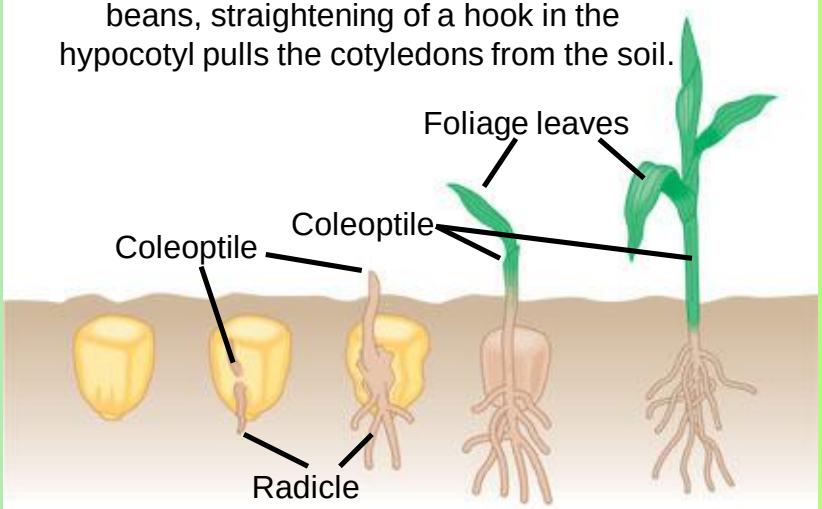
(d) Milkweed, a dry fruit that splits open at maturity

(e) Walnut, a dry fruit that remains closed at maturity

Two common types of seed germination



(a) Common garden bean. In common garden beans, straightening of a hook in the hypocotyl pulls the cotyledons from the soil.



(b) Maize. In maize and other grasses, the shoot grows straight Up through the tube of the coleoptile.

Flower-pollinator relationships

(a) A flower pollinated by honeybees. This honeybee is harvesting pollen and Nectar (a sugary solution secreted by flower glands) from a Scottish broom flower. The flower has a tripping Mechanism that arches the stamens over the bee and dusts it with pollen, some of which will rub off onto the stigma of the next flower the bee visits.

(b) A flower pollinated by hummingbirds. The long, thin beak and tongue of this rufous hummingbird enable the animal to probe flowers that secrete nectar deep within floral tubes. Before the hummer leaves, anthers will dust its beak and head feathers with pollen. Many flowers that are pollinated by birds are red or pink, colors to which bird eyes are especially sensitive.

(c) A flower pollinated by nocturnal animals. Some angiosperms, such as this cactus, depend mainly on nocturnal pollinators, including bats. Common adaptations of such plants include large, light-colored, highly fragrant flowers that nighttime pollinators can locate.

Fruit adaptations that enhance seed dispersal

(a) Wings enable maple fruits to be easily carried by the wind.

(b) Seeds within berries and other edible fruits are often dispersed in animal feces.

(c) The barbs of cockleburs facilitate seed dispersal by allowing the fruits to "hitchhike" on animals.

A Sampling of Medicines Derived from Seed Plants

Table 30.1 A Sampling of Medicines Derived from Seed Plants

Compound	Example of Source	Example of Use
Atropine	Belladonna plant	Pupil dilator in eye exams
Digitalin	Foxglove	Heart medication
Menthol	Eucalyptus tree	Ingredient in cough medicines
Morphine	Opium poppy	Pain reliever
Quinine	Cinchona tree (see below)	Malaria preventative
Taxol	Pacific yew	Ovarian cancer drug
Turbocurarine	Curare tree	Muscle relaxant during surgery
Vinblastine	Periwinkle	Leukemia drug

Cinchona bark, source of quinine

Review Questions

1. What is the relationship between pollination and fertilization in flowering plants? *

A. Fertilization precedes pollination.
B. Pollination easily occurs between plants of different species.
C. Pollen is formed within megasporangia so that male and female gametes are near each other.
D. Pollination brings gametophytes together so that fertilization can occur.
E. If fertilization occurs, pollination is unnecessary.

2. Assume that a botanist was visiting a tropical region for the purpose of discovering plants with medicinal properties. All of the following might be ways of identifying potentially useful plants *except*

A. observing which plants sick animals seek out.
B. observing which plants are the most used food plants.
C. observing which plants animals do not eat.
D. collecting plants and subjecting them to chemical analysis.
E. asking local people which plants they use as medicine.

The following questions relate to the following parts of a flower:

A. Petals
B. Sepals
C. Stamen
D. Stigma
E. Ovary

3. Site of pollen development
4. Site of fertilization
5. Used to attract pollinators
6. Recieves pollen