

Chapter 44

Plant Reproduction and Development



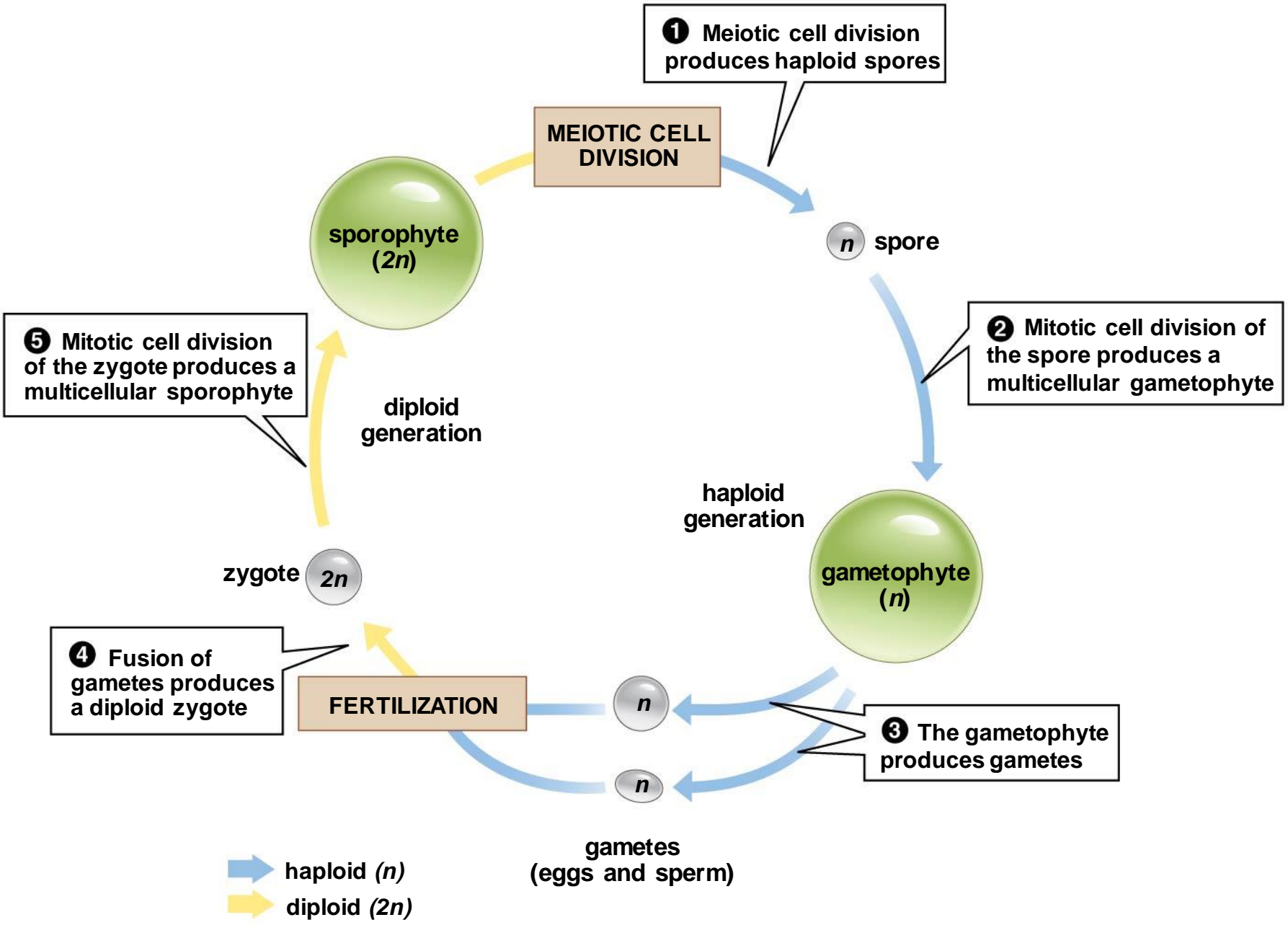
Chapter 44 At a Glance

- 44.1 How Do Plants Reproduce?
- 44.2 What Are the Functions and Structures of Flowers?
- 44.3 How Do Fruits and Seeds Develop?
- 44.4 How Do Seeds Germinate and Grow?
- 44.5 How Do Plants and Their Pollinators Interact?
- 44.6 How Do Fruits Help to Disperse Seeds?

44.1 How Do Plants Reproduce?

- Many plants can reproduce either sexually or asexually
 - asexual reproduction,
 - mitotic cell division
 - genetically identical to the parent
 - BUT most eukaryotes reproduce sexually at least some of the time
 - alternation of generations

Figure 44-1 Alternation of generations

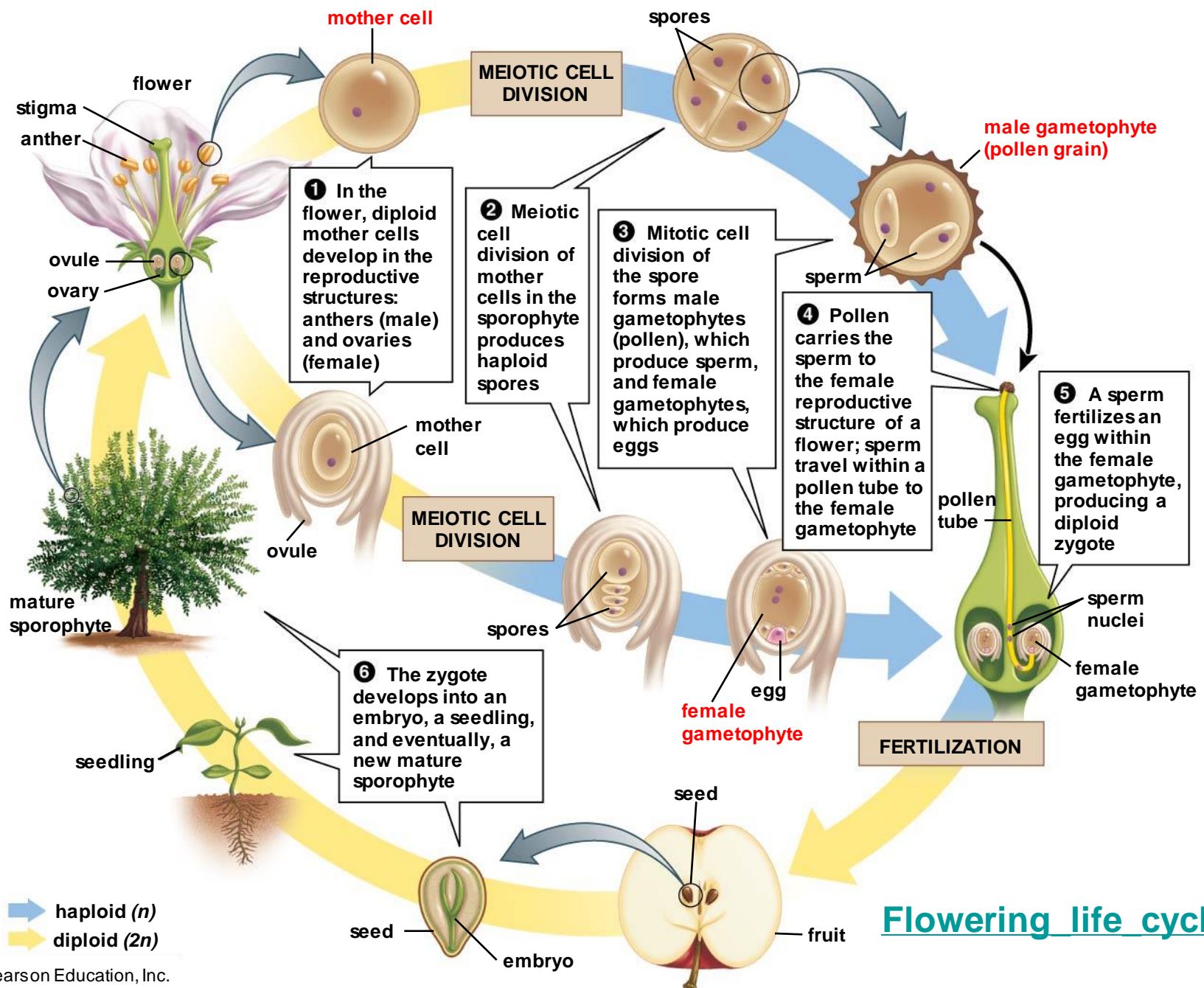


44.1 How Do Plants Reproduce?

The **relative size, complexity, and life span** of the sporophyte and gametophyte stages vary considerably among different types of plants

- gymnosperms (裸子植物) and angiosperms (被子植物)
 - the diploid sporophyte stage is dominant
 - The haploid gametophyte stage is never a free-living, independent plant
 - ✓ Female gametophyte of angiosperms?
 - ✓ Male gametophyte of angiosperms?

Figure 44-3 The sexual life cycle of a flowering plant



[Flowering life cycle.swf](#)

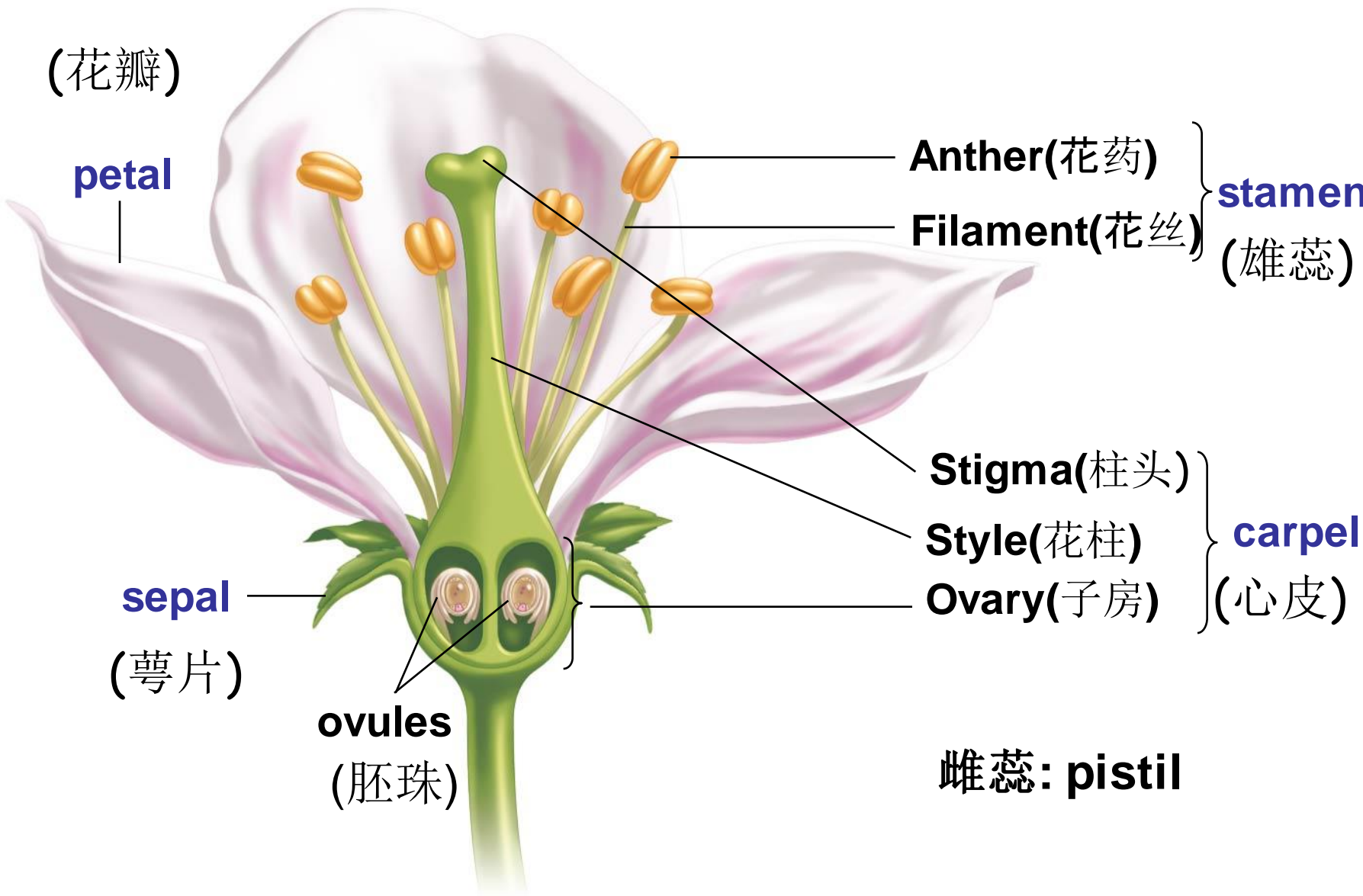
Summary I

- Plants can reproduce asexually or sexually
- In gymnosperms and angiosperms, the diploid sporophyte stage is dominant, gametophyte is highly degenerated.
- The male gametophyte is the pollen grain and the female gametophyte consists of only 7 cells

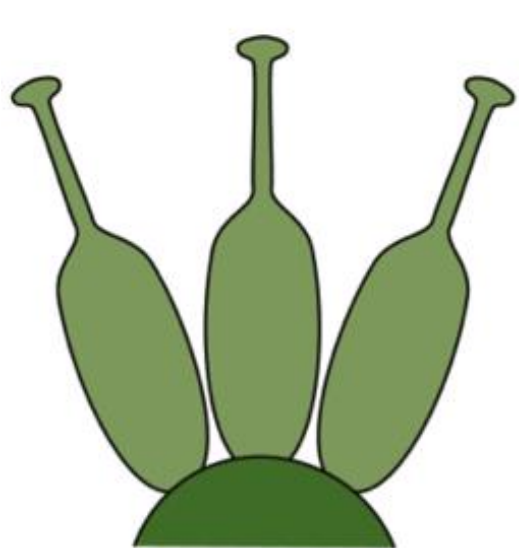
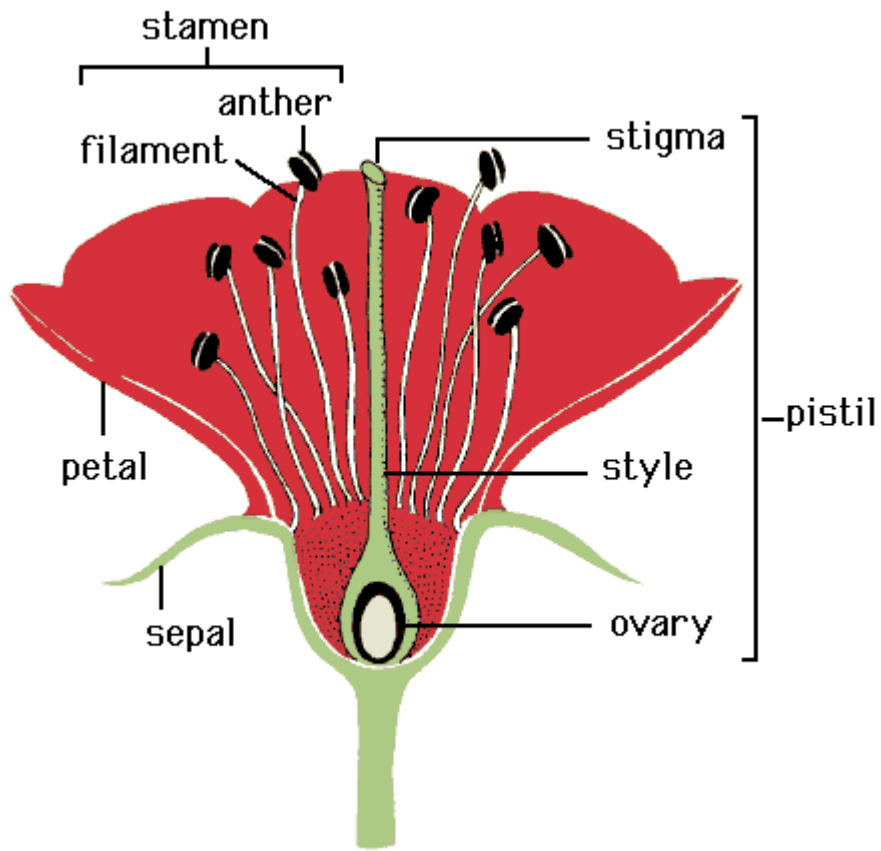
44.2 What Are the Functions and Structures of Flowers?

- **Flowers** are the **sexual** reproductive structures of angiosperms
 - A **complete flower** consists of four sets of modified leaves
 - the sepals (萼片)
 - petals (花瓣)
 - stamens (雄蕊)
 - carpels (心皮)

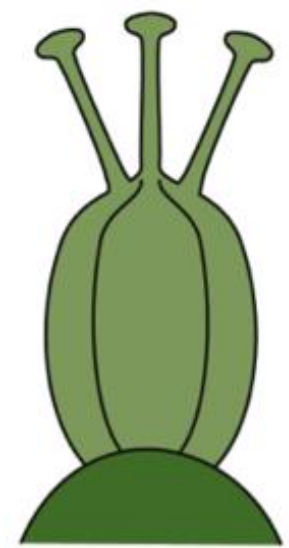
Figure 44-4a A representative dicot flower



(a) A representative dicot flower



3 carpels, distinct
3 simple pistils

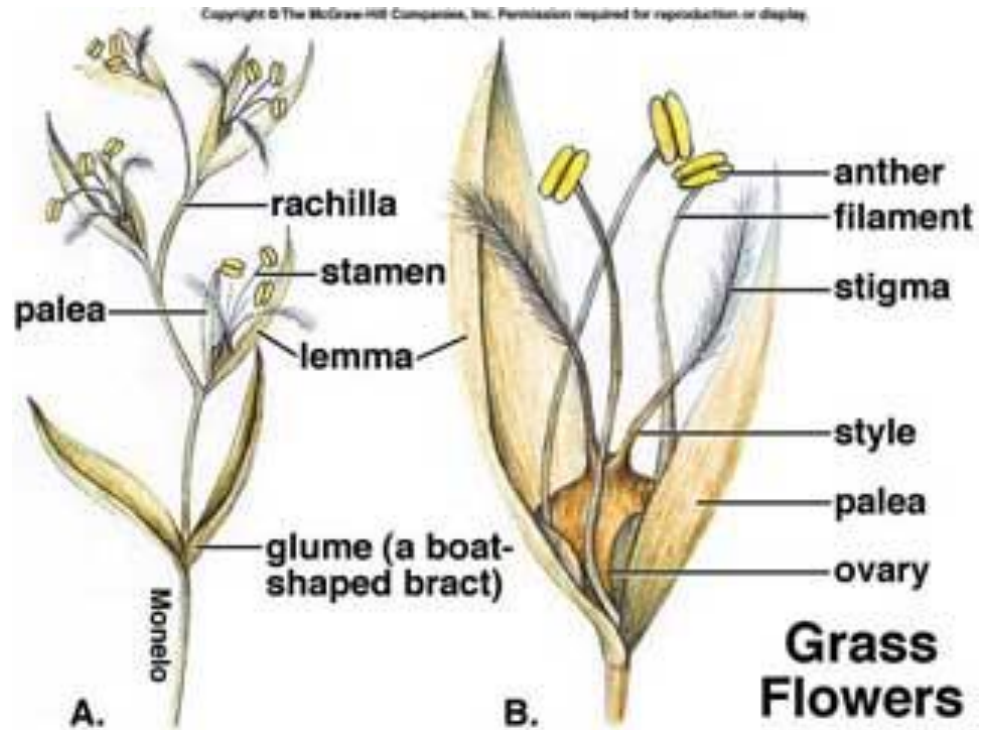


3 carpels, connate
1 compound pistil

PLANT SYSTEMATICS, Third Edition, Figure 4.19

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Have you seen a rice flower?



Palea: 内稃
Lemma: 外稃
Glume: 颖片

44.2 What Are the Functions and Structures of Flowers?

- **Incomplete flowers** lack one or more of the four floral parts
 - For example, grass flowers lack both petals and sepals
 - If an incomplete flower lacks **either stamens or carpels**, it is called an **imperfect flower**

zucchini



Male gametophyte development

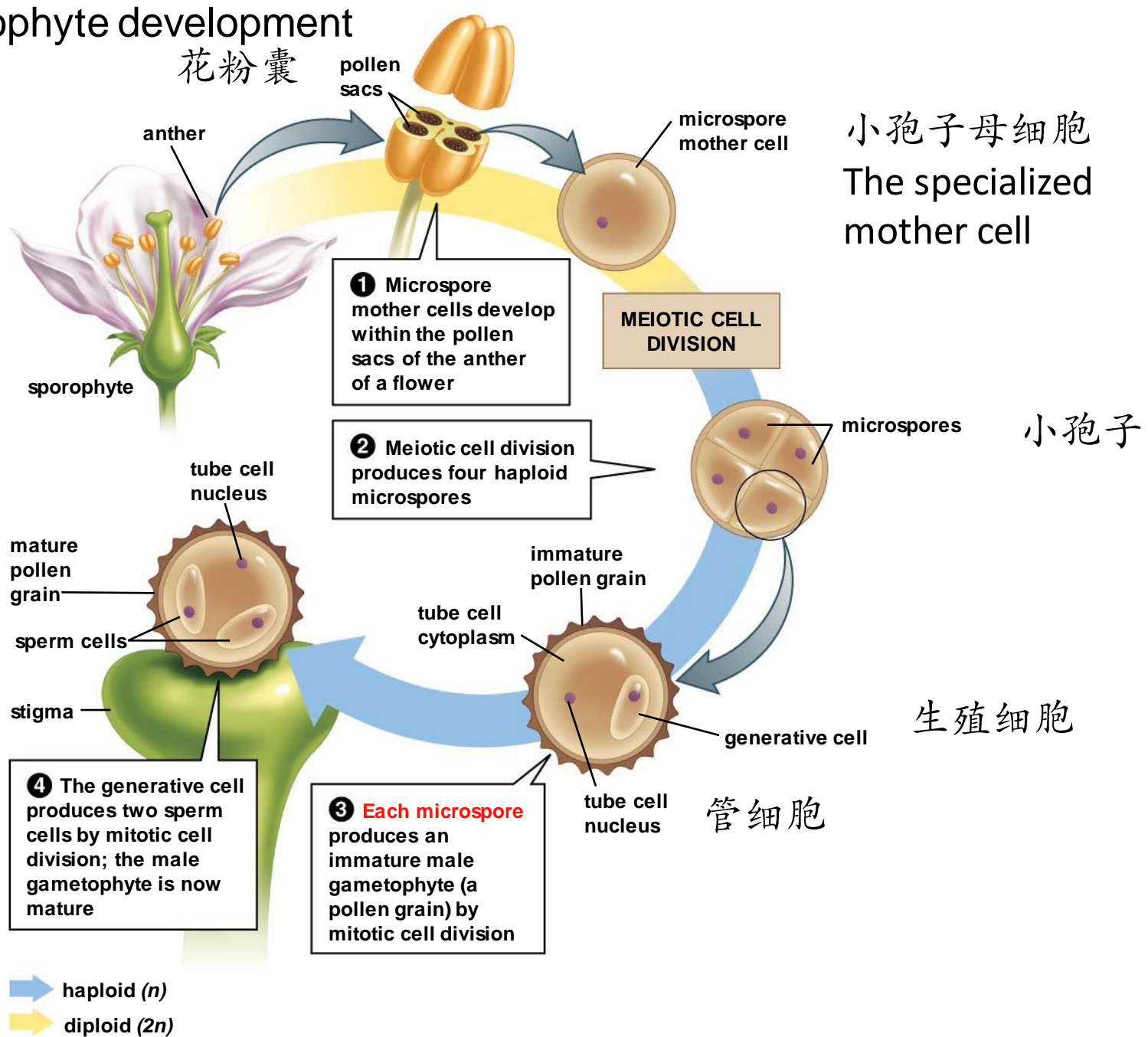
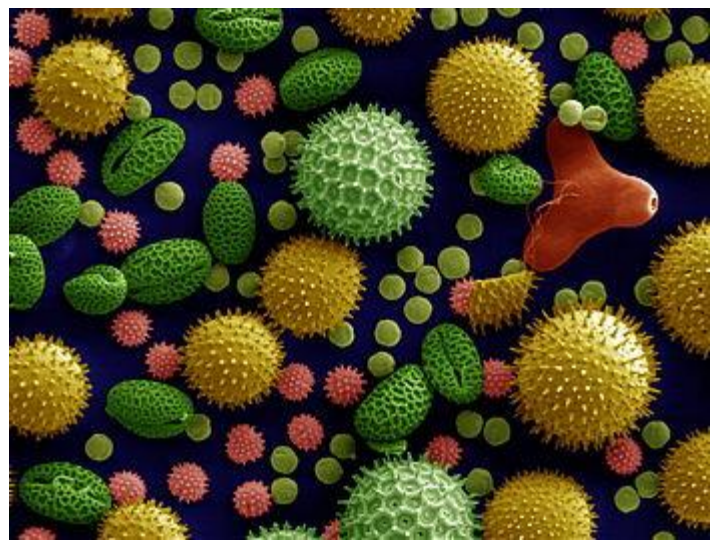


Figure 44-7 Pollen grains



44.2 What Are the Functions and Structures of Flowers?

- gymnosperms
 - pollen is carried by the **wind**
- selective advantage of the flowers
 - **entice animals**, particularly insects, to carry pollen from one plant to another
 - 10% of today's flowering plants have evolved greatly reduced flower
 - pollen?



Ragweed: 豚草属, 猪草
1 plant: a billion pollen

Each year, in North
American: a million ton

Travel: 400 miles out to
the sea, 2 miles up in the
atmosphere



Female gametophyte development

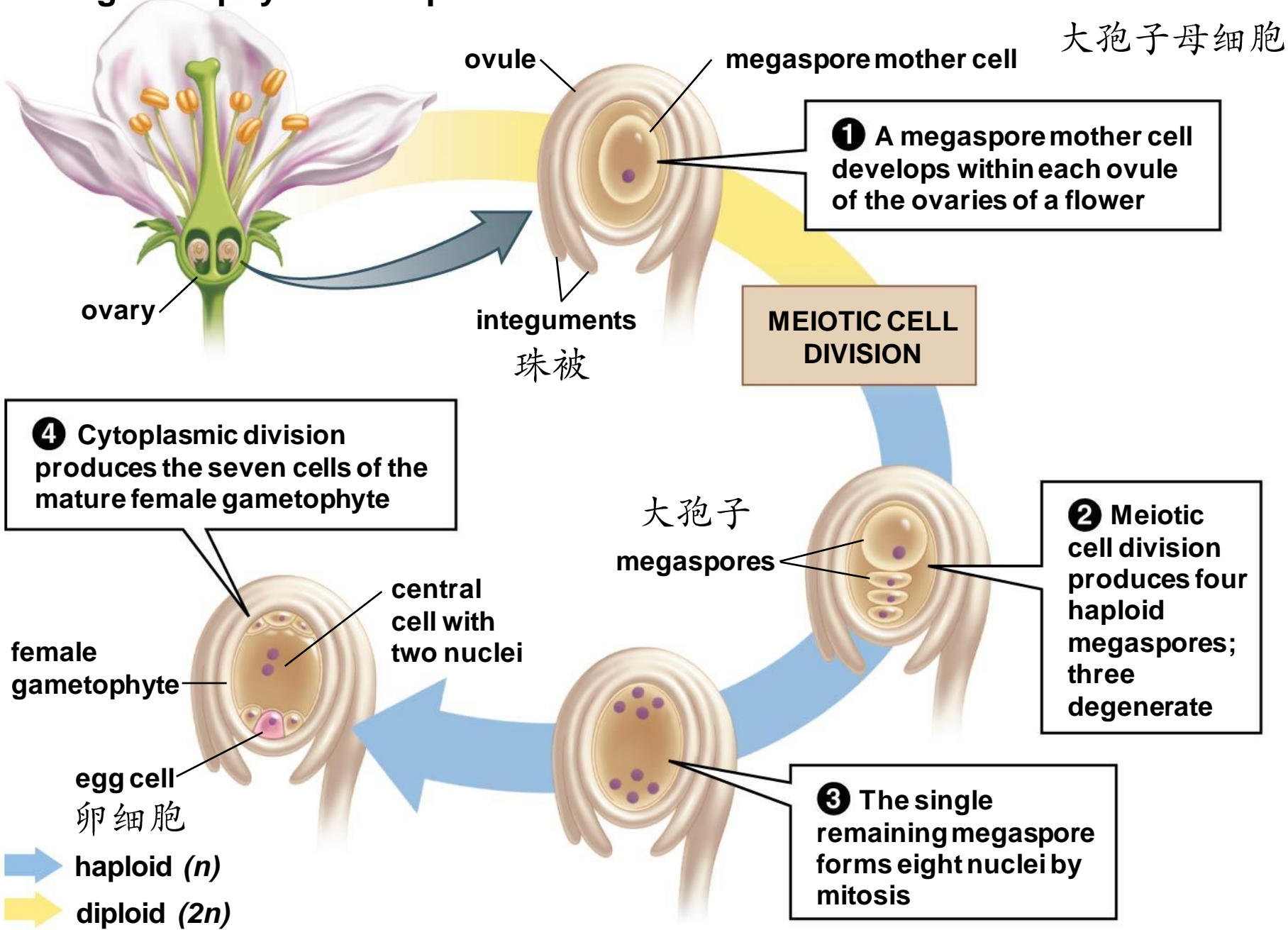
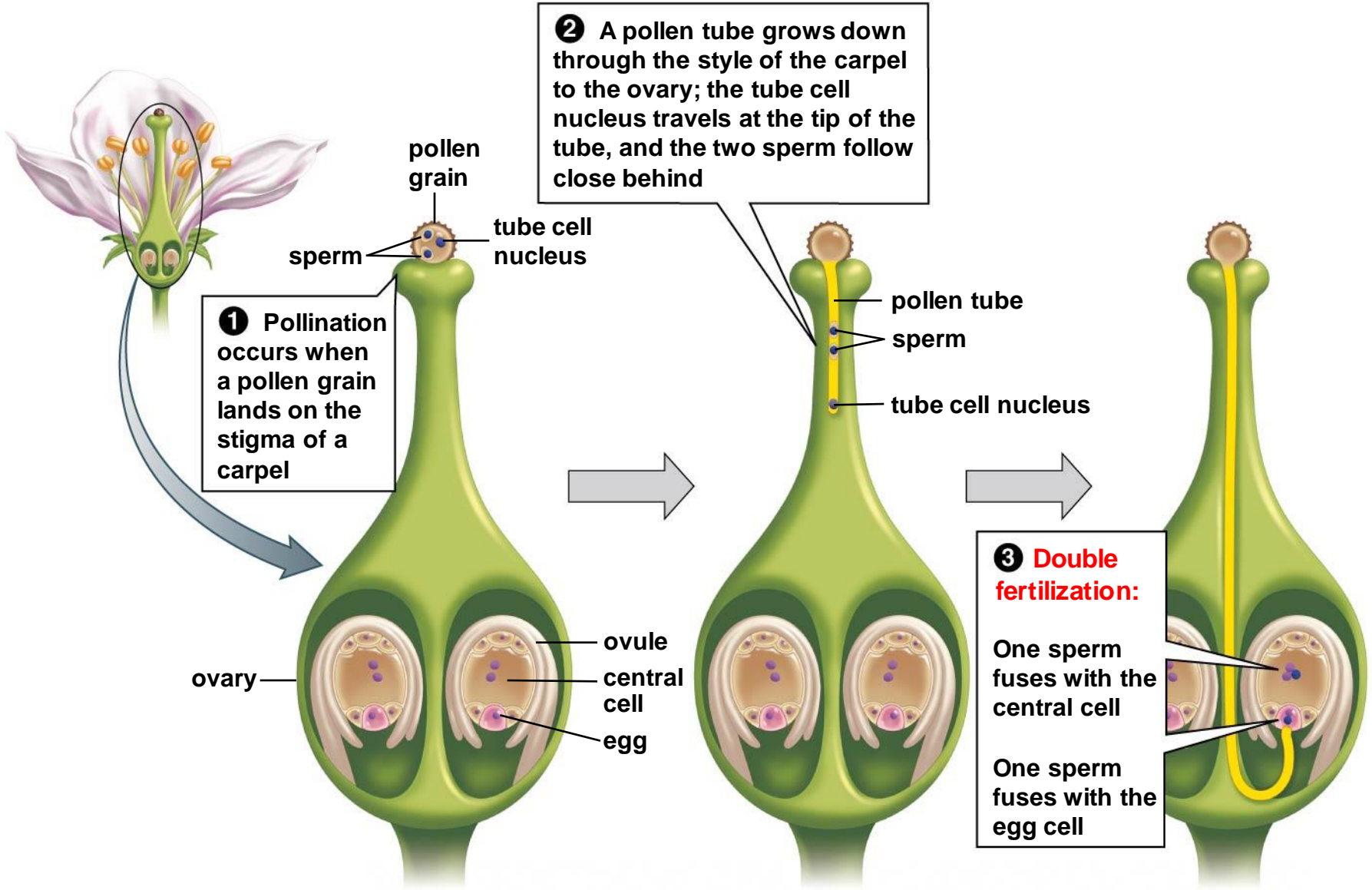
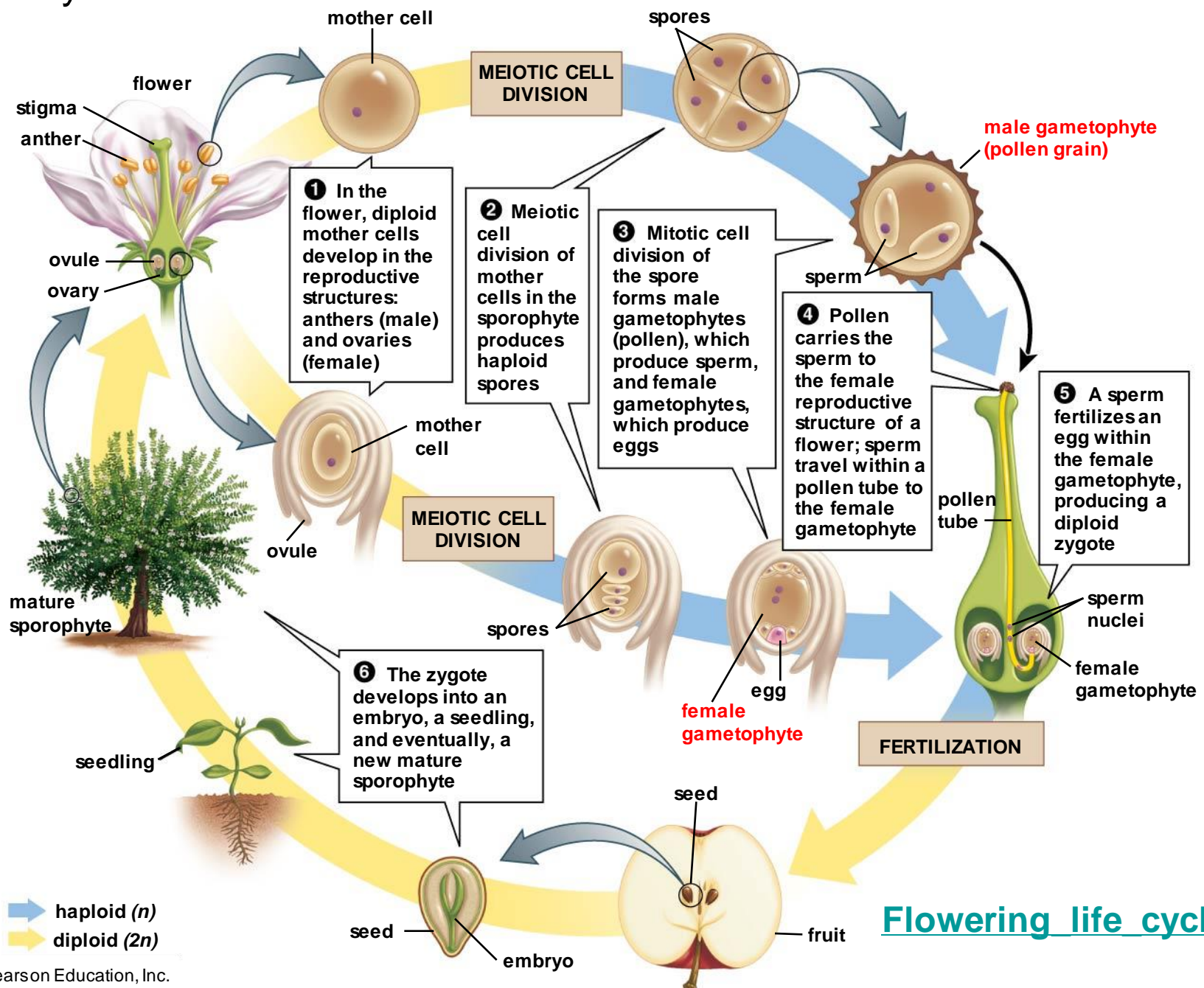


Figure 44-10 Pollination and fertilization of a flower



Double fertilization (双受精)

Summary II



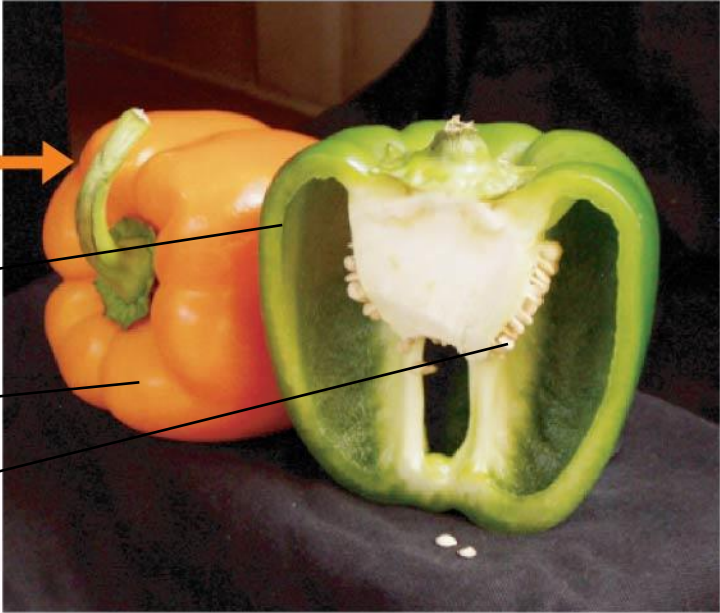
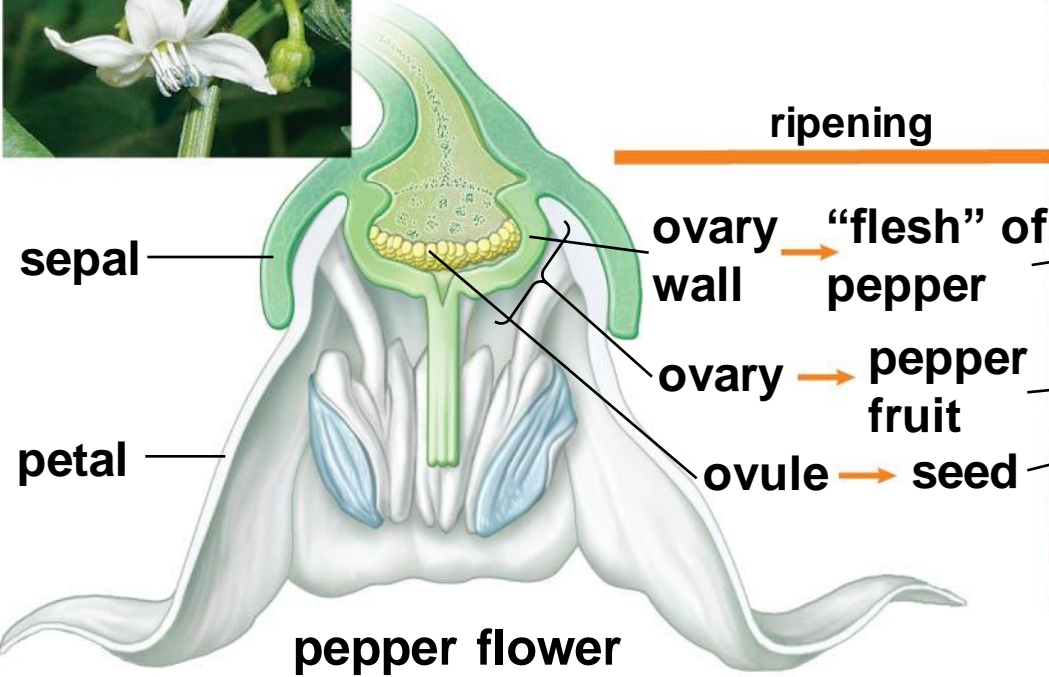
[Flowering life cycle.swf](#)

44.3 How Do Fruits and Seeds Develop?

- Ovule (胚珠)->
 - The seed
- Ovary (子房)->
 - fruit
- The petals and stamens
 - shrivel and fall away as the fruit enlarges

44.3 How Do Fruits and Seeds Develop?

- Ovary -> fruit



pepper fruits



雌蕊

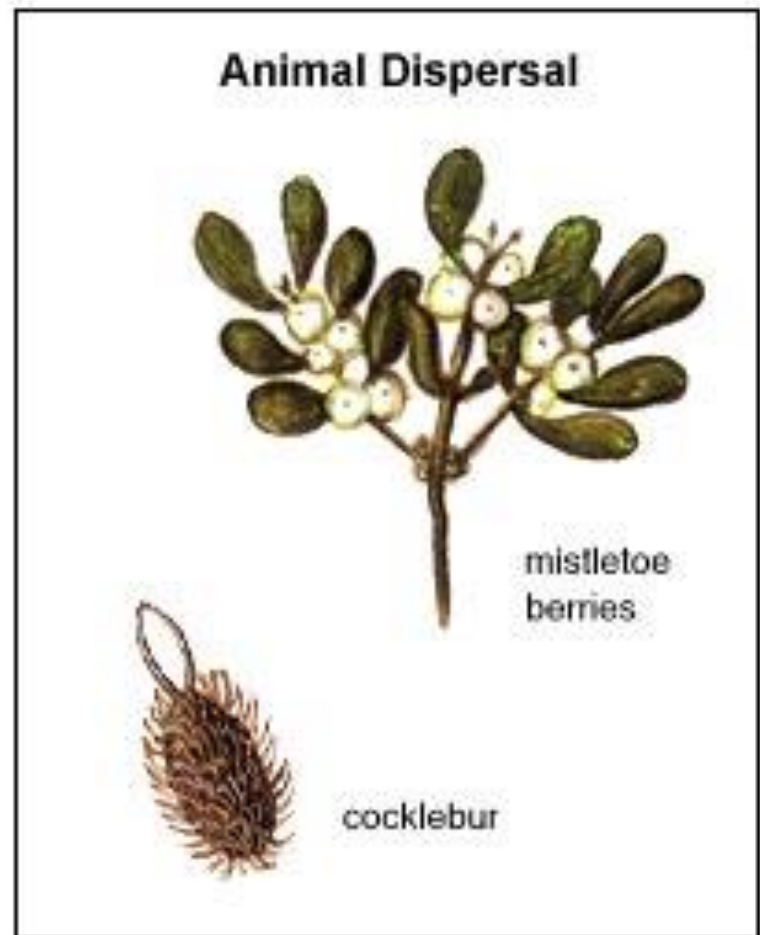
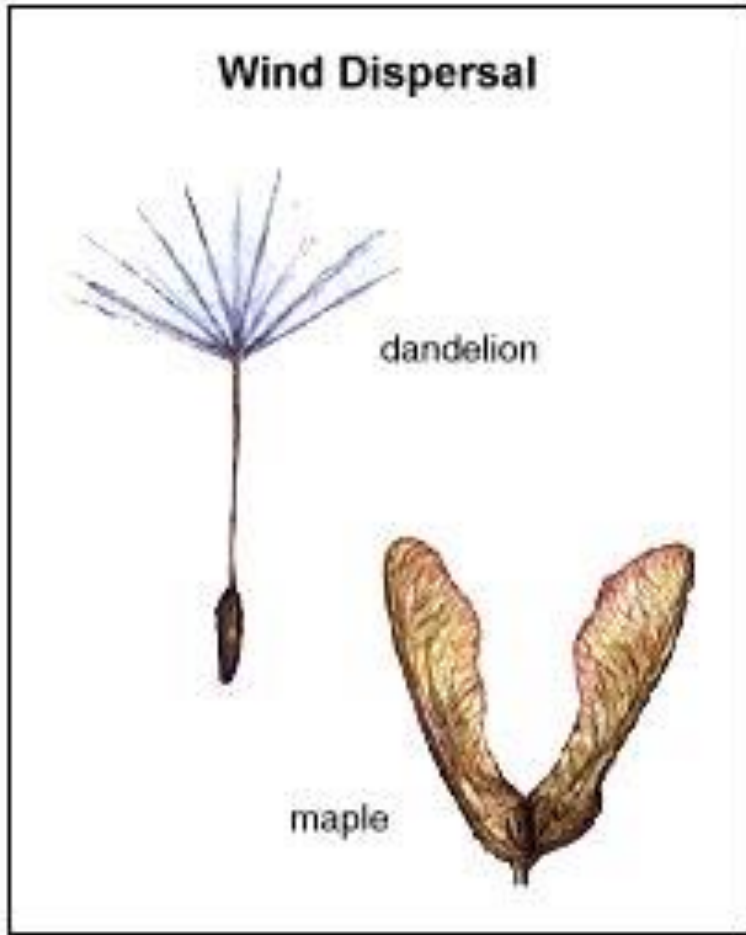
果实

雄蕊

花托

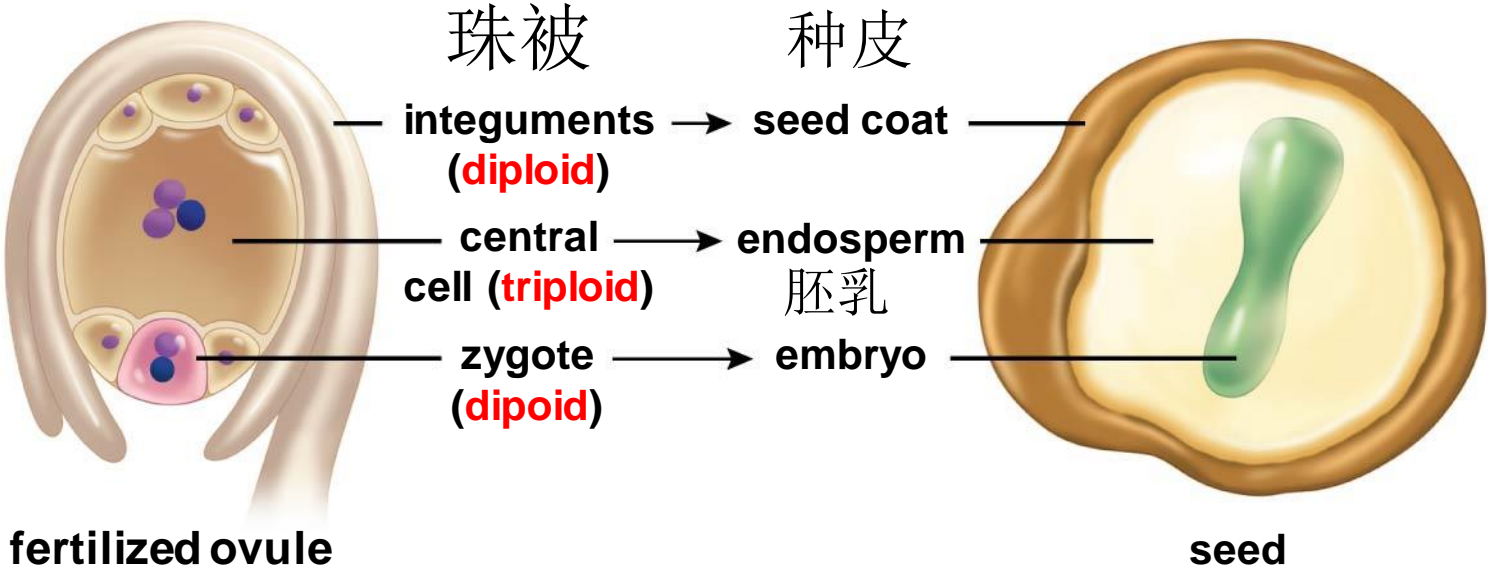


Fruits are not always edible



44.3 How Do Fruits and Seeds Develop?

Seed development

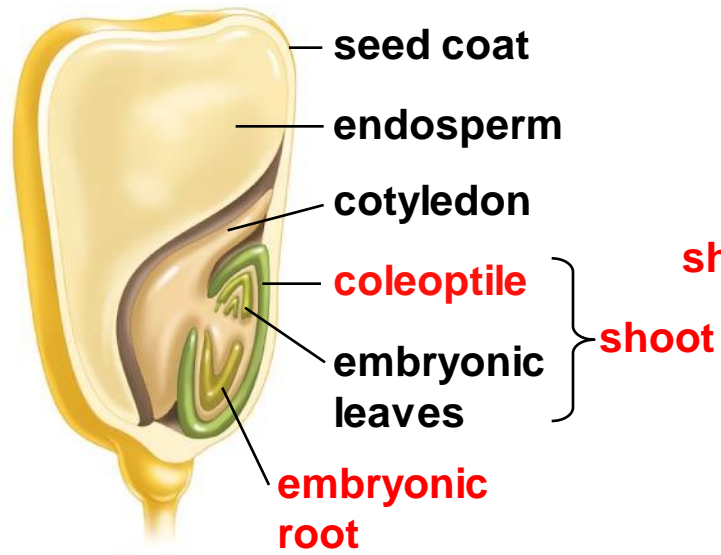


fertilized ovule

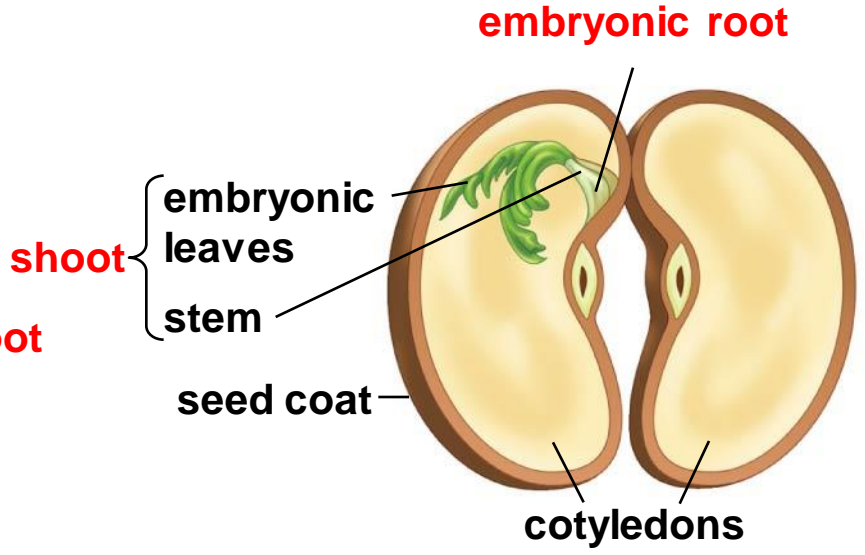
seed

(a)

Early development of the seed



(b) Corn seed (monocot)



(c) Bean seed (dicot)

Coleoptile (胚芽鞘)

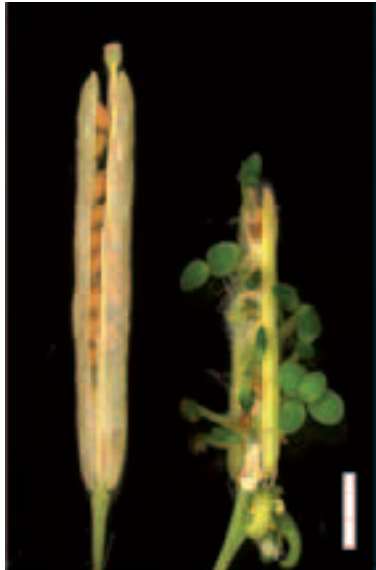
Cotyledons (子叶), or "seed leaves,"

44.4 How Do Seeds Germinate and Grow?

■ Germination (萌发)

Seeds **need** warmth and moisture to germinate,

- Dormancy (休眠)
 - resist adverse environmental conditions such as **freezing and drying**



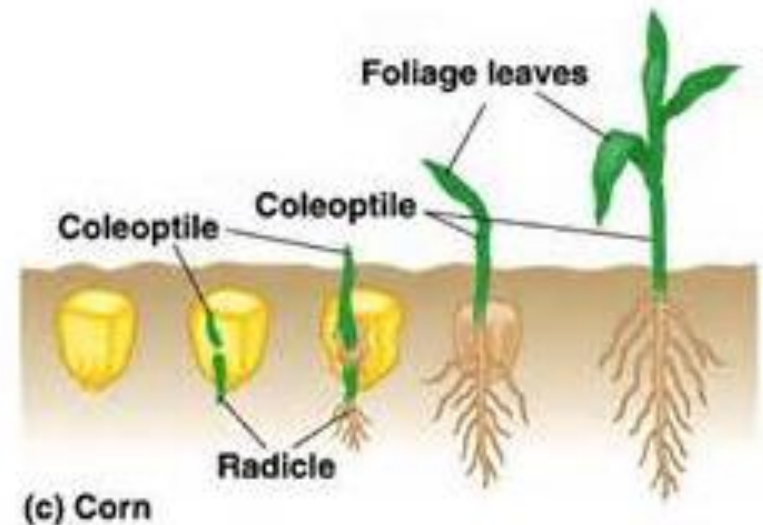
44.4 How Do Seeds Germinate and Grow?

- The three most common requirements to break seed dormancy
 - Drying
 - Cold
 - Seed coat disruption

44.4 How Do Seeds Germinate and Grow?

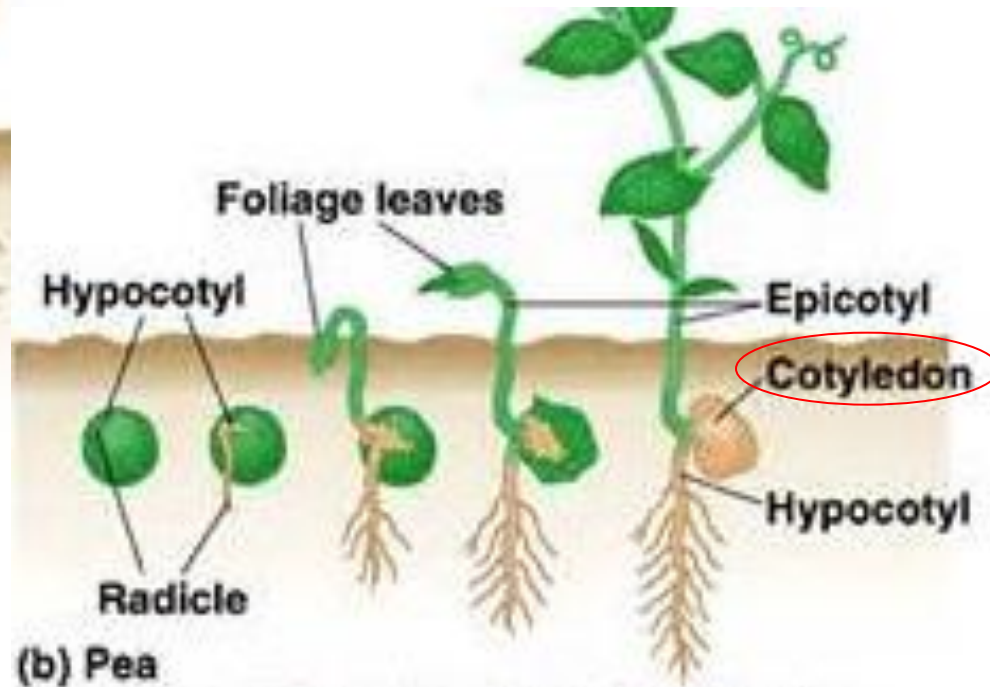
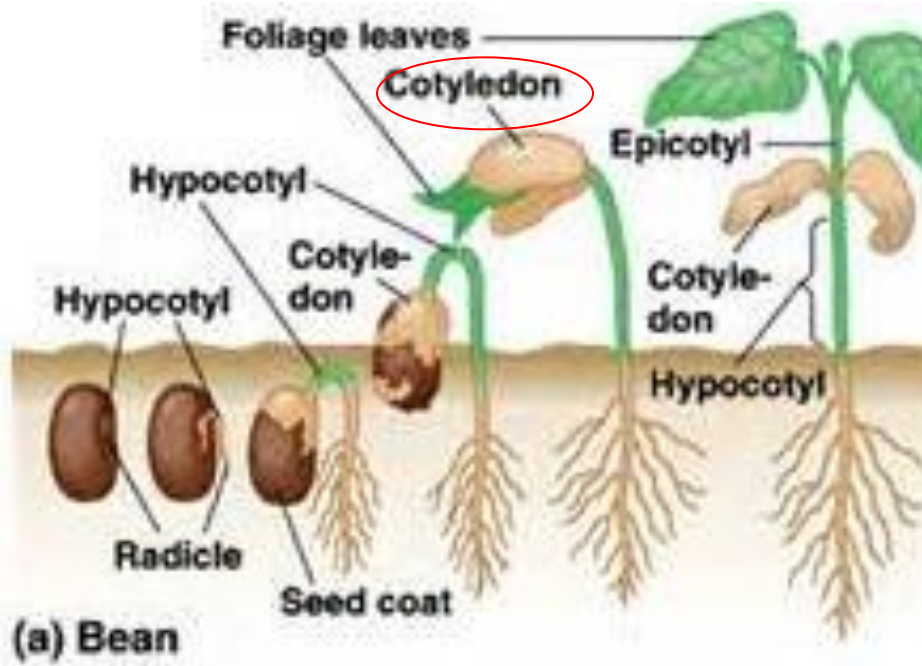
■ Germination

- swell (吸胀)
- root growth → shoot growth → push upward
- energy for germination: ultimately comes from endosperm
- protection of apical meristem
 - coleoptile (胚芽鞘)
 - apical hook (顶端弯钩)

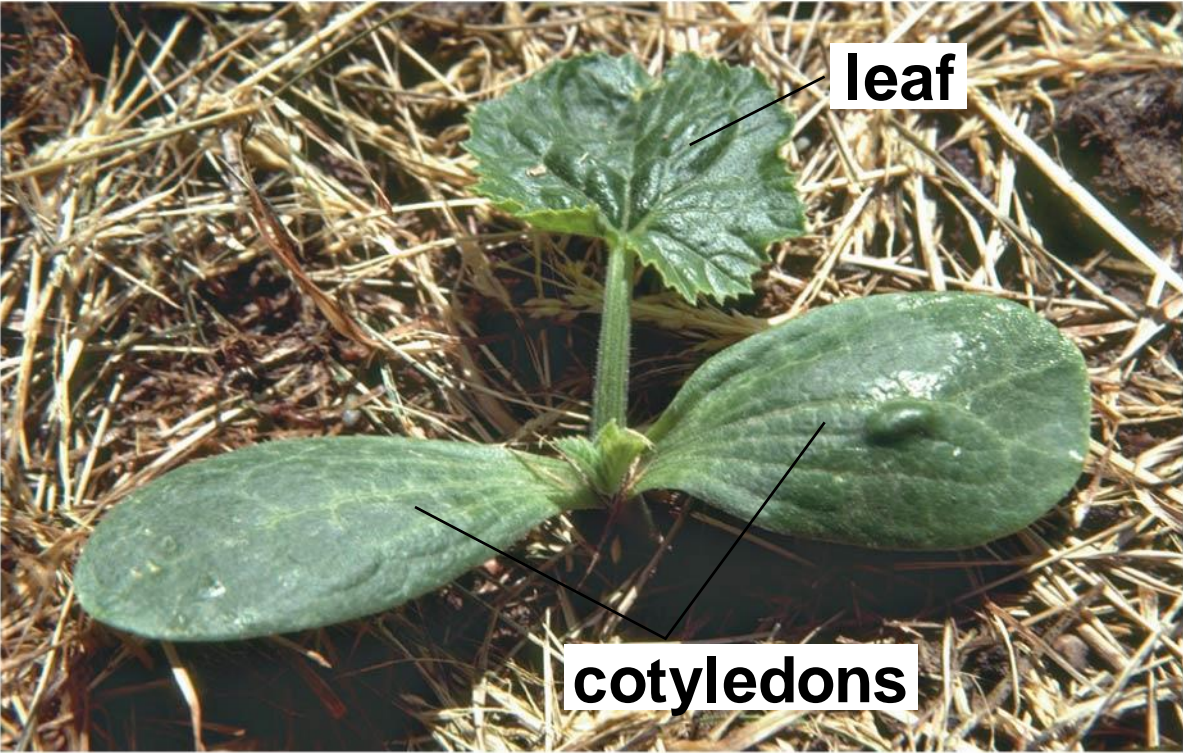


44.4 How Do Seeds Germinate and Grow?

- Dicots form a hook in the embryonic shoot, either in the **hypocotyl** (下胚轴), or in the **epicotyl** (上胚轴)



44.4 How Do Seeds Germinate and Grow?



44.5 How Do Plants and Their Pollinators Interact?

- Plants and their pollinators have **coevolved**
 - Animal-pollinated flowers: **attract useful pollinators and frustrate undesirable visitors**
 - The pollinators: **evolved senses and behaviors**
 - Classification of animal-pollinated flowers (benefits)
 - food
 - Sex
 - Nursery (托儿所; 温床)

44.5 How Do Plants and Their Pollinators Interact?

- Some flowers provide food for pollinators
 - Flowers evolve
 - structures suitable for or to ensure pollination
 - color
 - smell
 - behaviour

44.5 How Do Plants and Their Pollinators Interact?

Structures



(a) A bee on a Scotch broom flower



(b) The flower deposits pollen on the bee

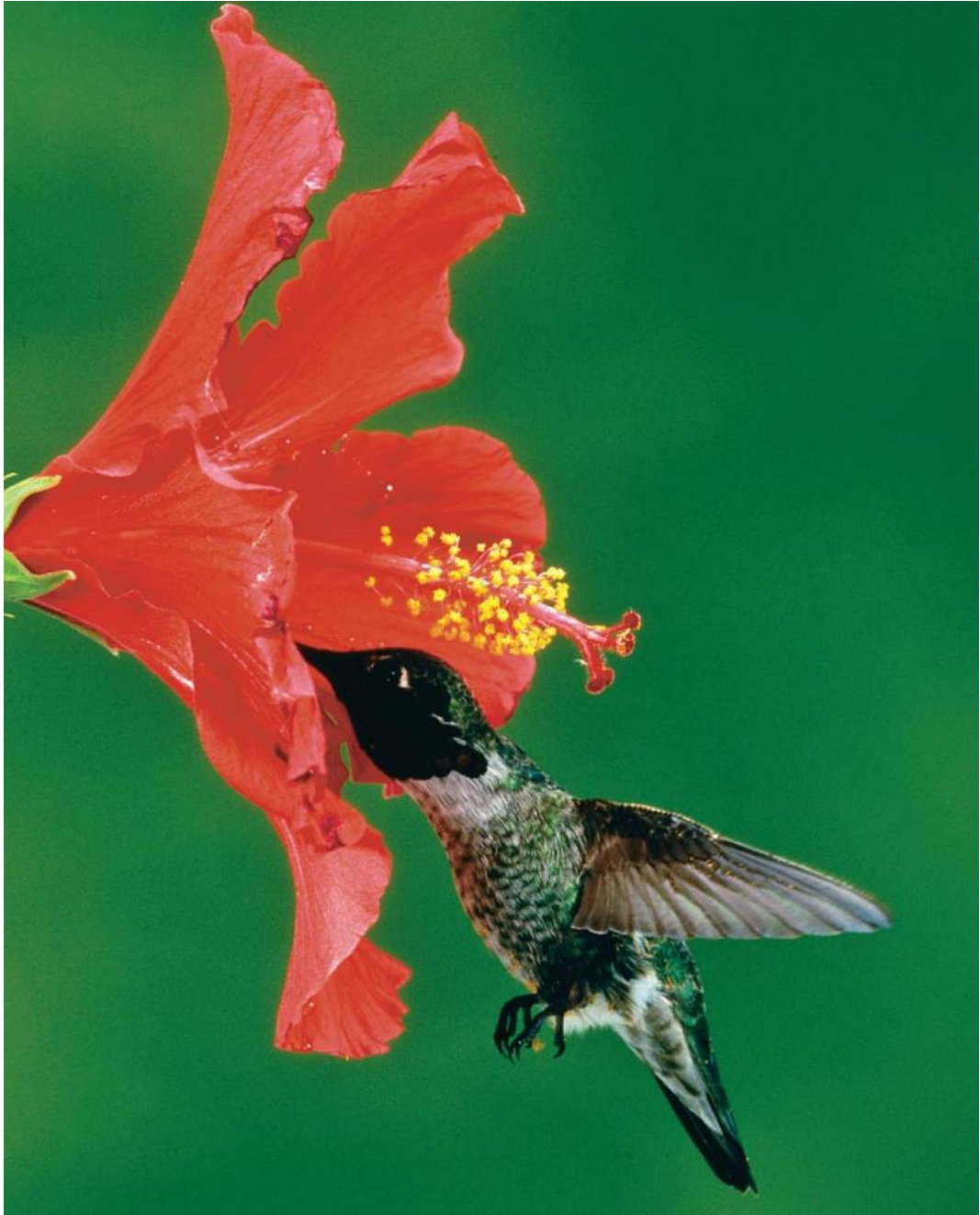
44.5 How Do Plants and Their Pollinators Interact?

- moth and butterfly pollinators have long tongues



nectar-containing tubes

Figure 44-17 Hummingbirds are effective pollinators

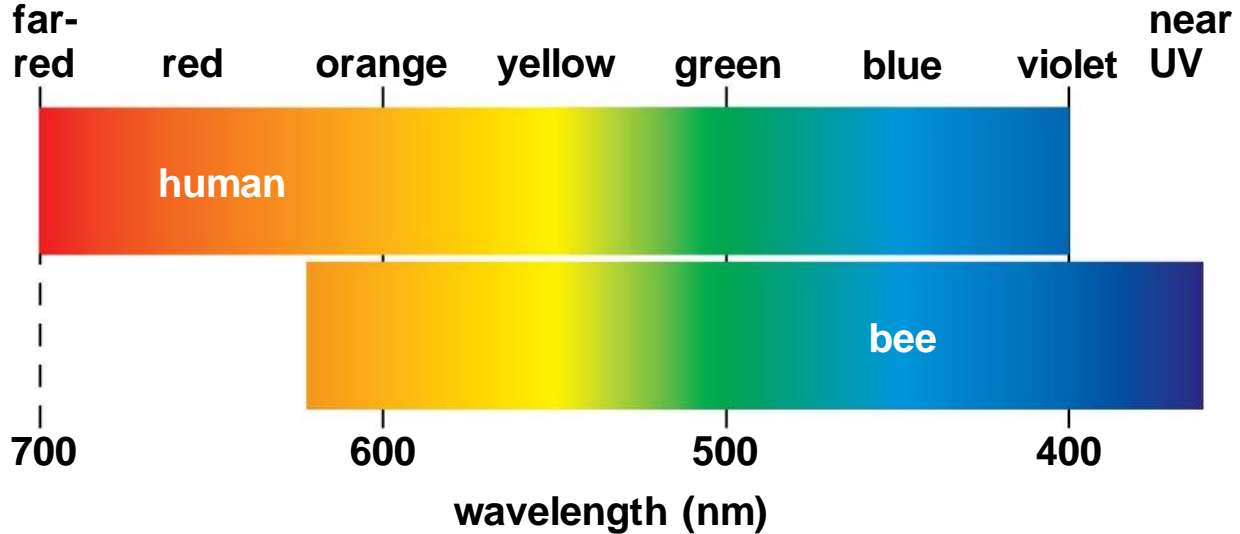


44.5 How Do Plants and Their Pollinators Interact?

Color

- How do most flying pollinators locate flowers?
- What color would you choose to be a bee-pollinated flower?

Figure 44-15 Ultraviolet patterns guide bees to nectar



(a) A comparison of color vision in humans and bees



human vision



bee vision

(b) Flower color patterns seen by humans and bees

R+G+B

UV

UV+G+B

UV+R+G+B



Bee-pollinated flowers are usually white, blue, yellow or orange, but not red.

R+G+B

UV

UV+R+G+B



44.5 How Do Plants and Their Pollinators Interact?

Smell



Beetles



flies

44.5 How Do Plants and Their Pollinators Interact?


Smell



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World's largest single flower over 3 feet (one meter) in diameter.

Spadix over 8 feet (2.4 m) tall. This is an enormous inflorescence.



Raffesia arnoldii
(Rafflesiaceae)

Amorphophallus titanum
(Araceae)

Hydnum africanum
(Hydnoraceae)

Stinky, the stink weed

Carrion (腐肉的) Flowers

44.5 How Do Plants and Their Pollinators Interact?

Behaviour



Floral clock



flowering time+colour+smell

44.5 How Do Plants and Their Pollinators Interact?

- Some flowers are mating decoys (圈套)
 - take advantage of the mating drives of male wasps, bees, and flies
 - These orchid flowers mimic female wasps, bees, or flies both in scent and shape



Figure 44-18 Sexual deception promotes pollination



Fly orchid



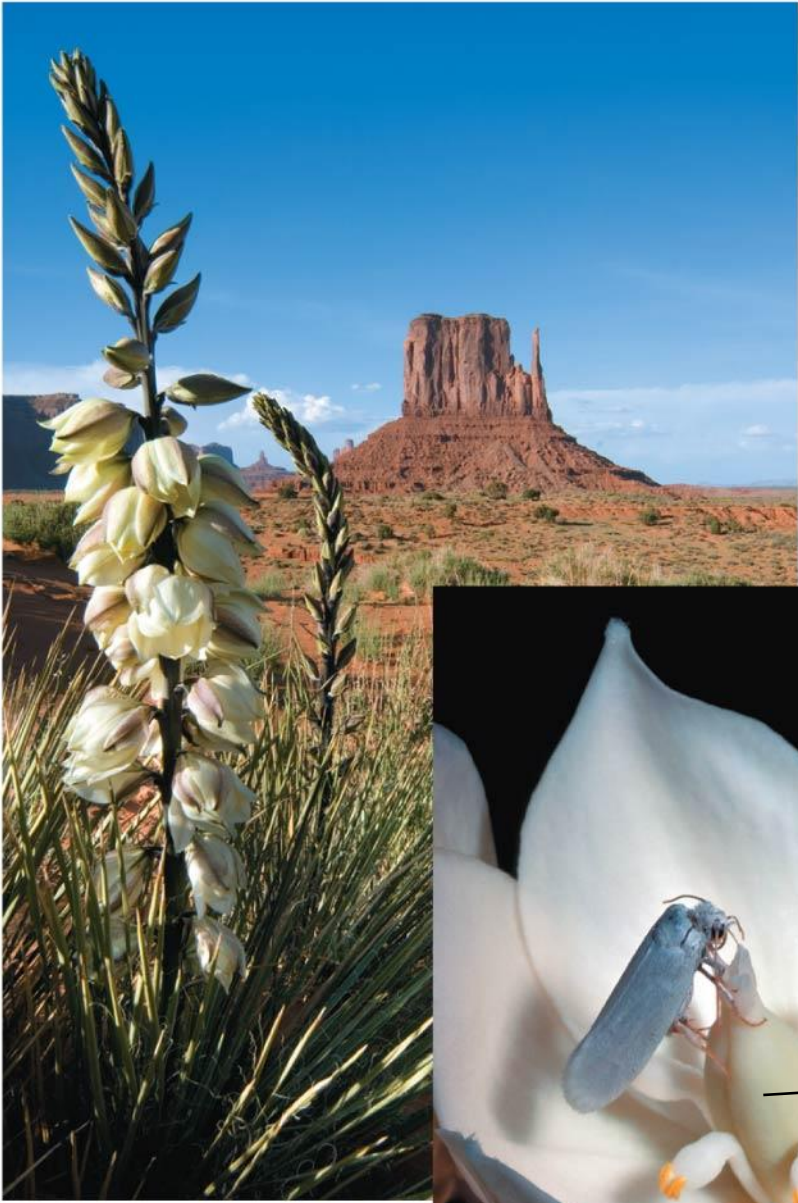
Bee orchid



44.5 How Do Plants and Their Pollinators Interact?

- Some flowers provide nurseries for pollinators
 - insects fertilize a flower and then lay their eggs in the flower's ovary
 - This arrangement occurs between
 - milkweeds (野参类) and the milkweed bugs,
 - figs (无花果) and fig wasps,
 - yuccas (丝兰) and yucca moths

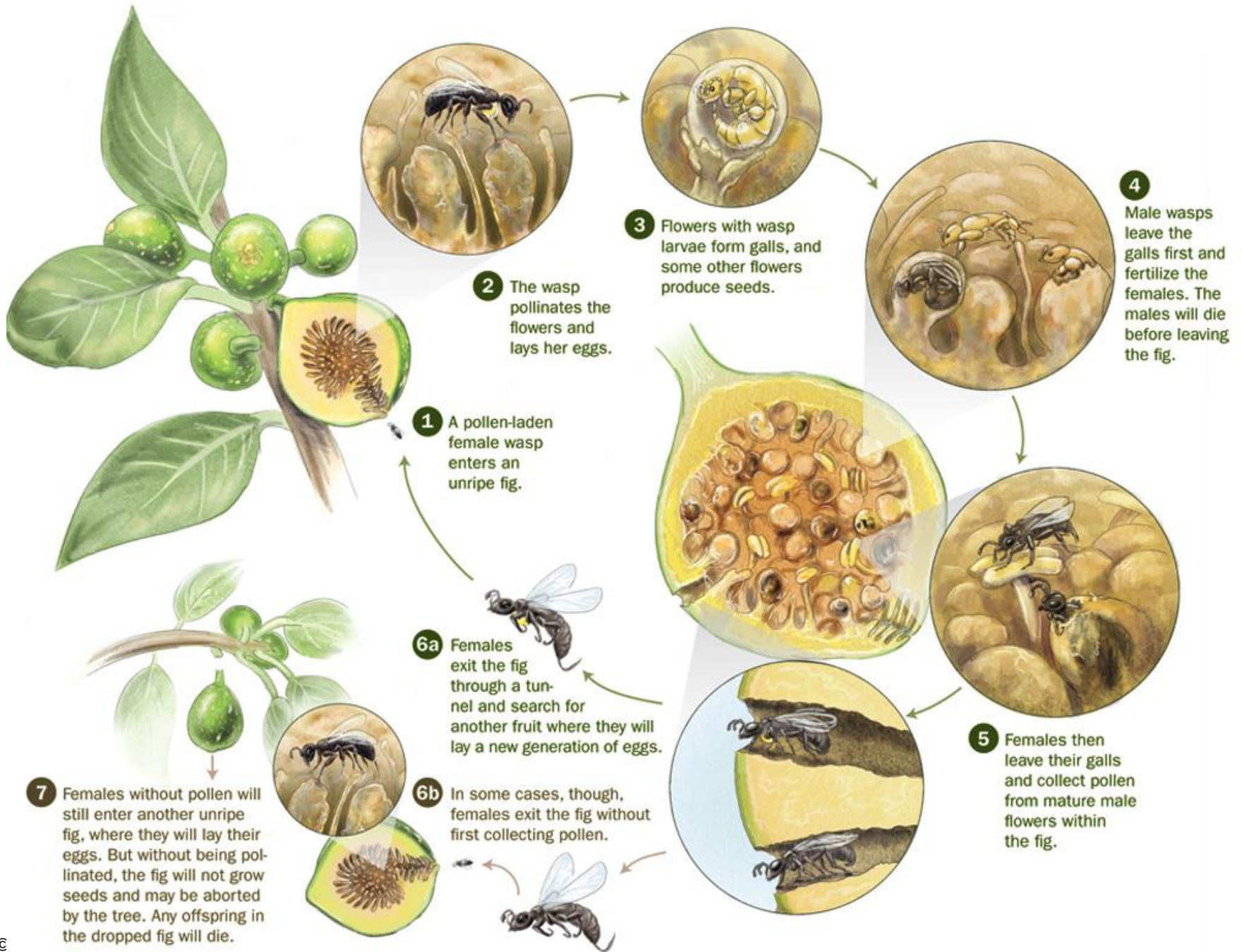
Figure 44-19 A mutually dependent relationship



Yucca and yucca moth



stamen
carpel



44.6 How Do Fruits Help to Disperse Seeds?

- A plant benefits if its seeds are dispersed far enough away
- Why?
 - so that its offspring don't compete with it for light and nutrients
 - Survive from an attack by nearby predators.
- How?
 - fruit

44.6 How Do Fruits Help to Disperse Seeds?

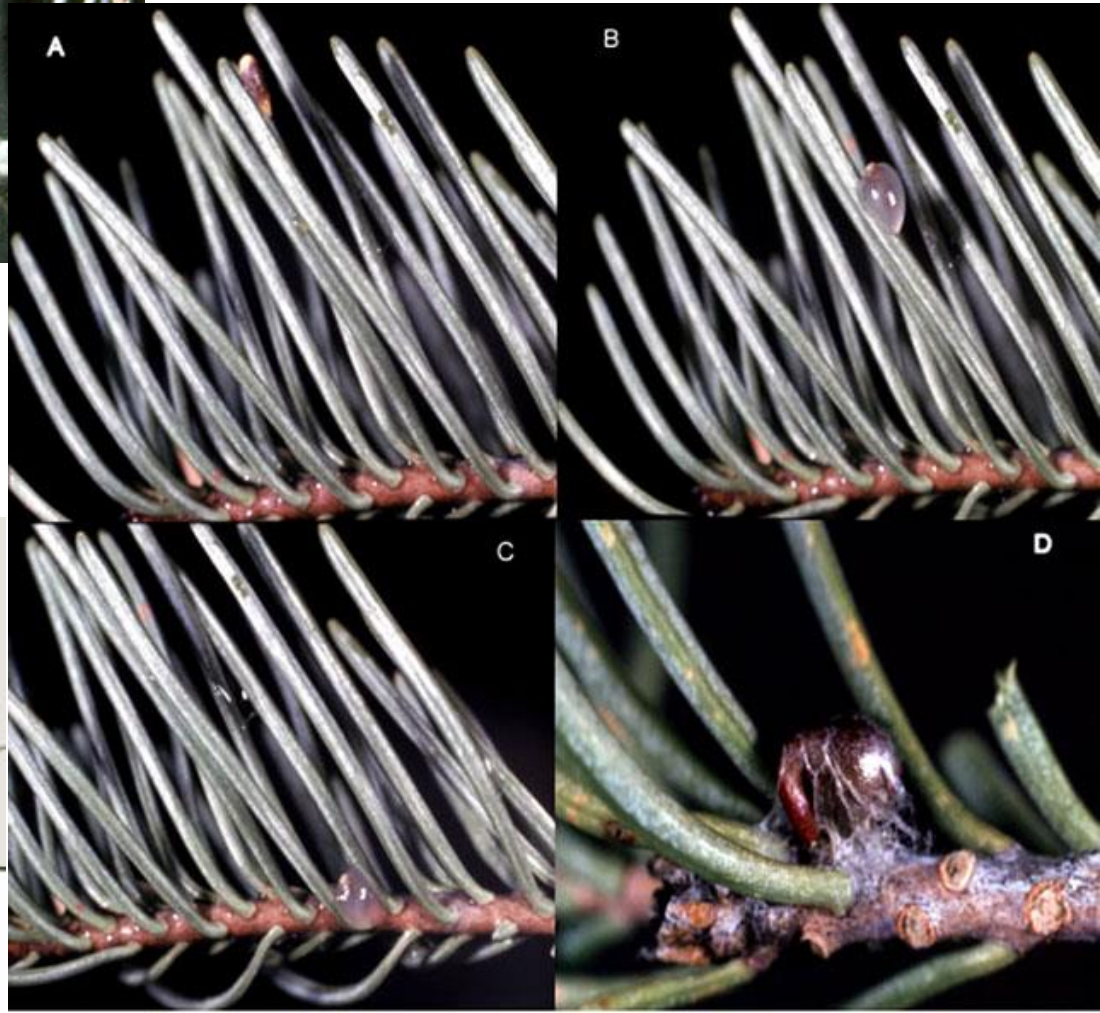
- Explosive fruits shoot out seeds

Dwarf mistletoes
(矮槲寄生)





The initial velocity of the seed is about $27 \text{ m}\cdot\text{sec}^{-1}$ (97 km/hour) . Maximum dispersal distance is about 16 m



Seed Dispersal

6



Touch-me-not



2Y8713 [RM] © www.visualphotos.com

witch hazel 金縷梅



squirting cucumber, 噴瓜

44.6 How Do Fruits Help to Disperse Seeds?

- Lightweight fruits may be carried by the wind
 - Dandelions, milkweeds, elms, and maples produce lightweight fruits with large **wind-catching surfaces**



(a) Dandelion fruits



(b) Maple fruits

44.6 How Do Fruits Help to Disperse Seeds?

- Floating fruits allow water dispersal



44.6 How Do Fruits Help to Disperse Seeds?

- Clingy or edible fruits are dispersed by animals



44.6 How Do Fruits Help to Disperse Seeds?

- Edible fruits benefit both the plant and the animal disperser
 - fruits have sugars, starches, and appealing flavors
 - seeds
 - large, hard seeds
 - small seeds
 - It is often important for the right type of animal to eat the fruit and seeds



Figure 44-23 The colors of ripe fruits attract animals



The end!

