Chapter 39

Reproduction in plants

- Most flowering plants display sexual reproduction
  - Two gametes fuse to produce offspring with a unique combination of genes
- They undergo Alternation of Generations
  - Two multicellular life cycle stages
  - diploid
    - Spore producing sporophyte
      - produces spores by meiosis
        - a type of cell division that results in four daughter cells each with half the number of chromosomes of the parent cell, as in the production of gametes and plant spores.
  - haploid
    - Gamete producing gametophyte
      - produces gametes by mitosis
        - a type of cell division that results in two daughter cells each having the same number and kind of chromosomes as the parent nucleus, typical of ordinary tissue growth.
- Egg is Female
- Sperm is Male

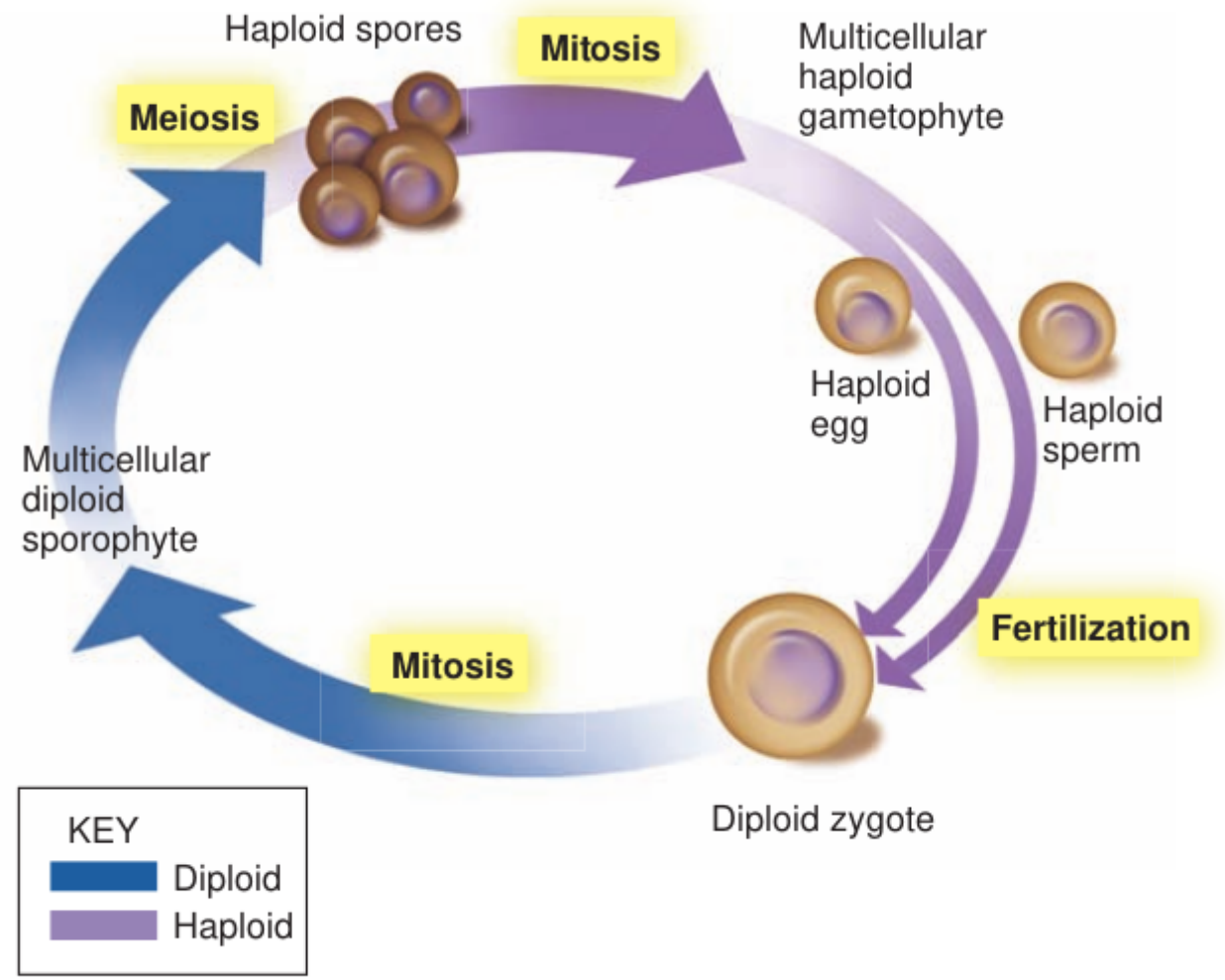
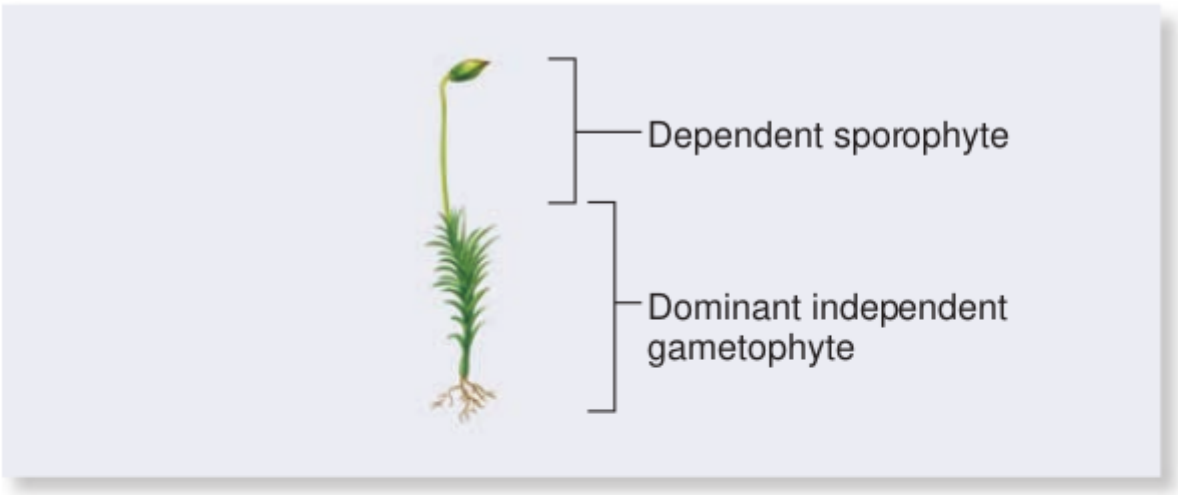


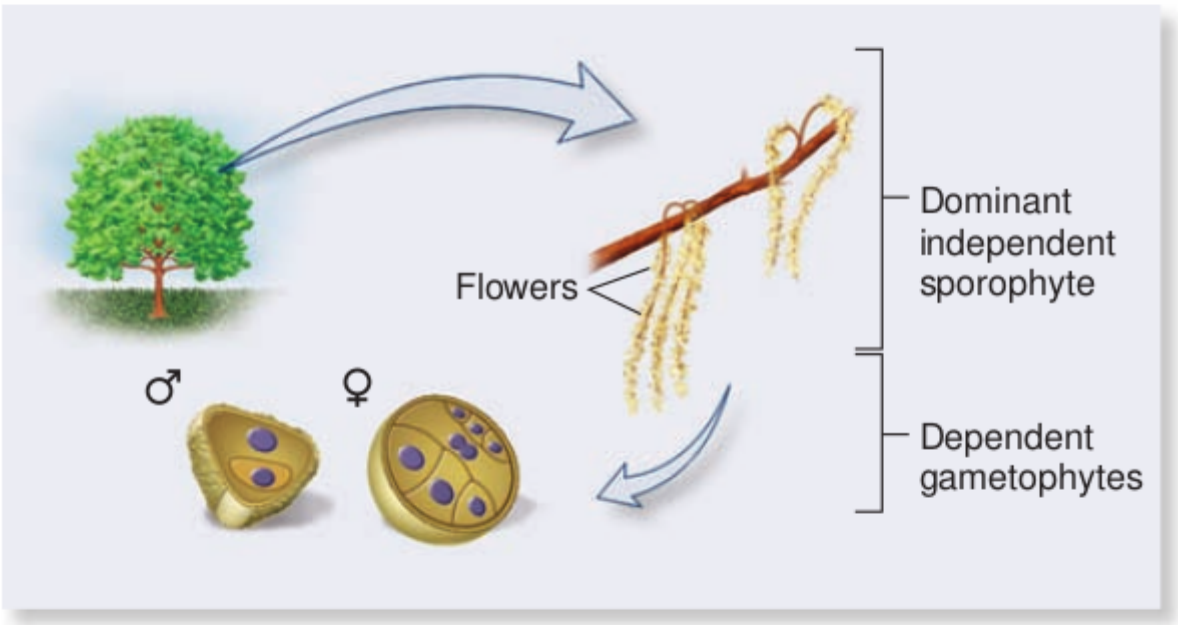
Figure 39.1 Alternation of generations, the plant life cycle.

Evolutionary Trends in the Plant Kingdom

- Sporophyte has become larger, more complex
  - Flowering plants
    - Sporophyte independent
    - Dependent gametophyte is only a few cells contained within flowers
- Gametophyte has become smaller, less complex
  - Moss
    - Sporophytes small and dependent on gametohyte (Dominant form)
- Female
  - 7 cells
- Male
  - 2-3 cells



(a) Gametophyte-dominant bryophyte (moss)



(b) Sporophyte-dominant flowering plant (oak)

Figure 39.2 **Evolutionary shift in plant life cycle stage dominance.** **(a)** In mosses, the gametophyte is the dominant life cycle stage, and the sporophyte is dependent on the gametophyte for resources. **(b)** In flowering plants such as oak trees, the sporophyte life cycle stage is dominant. Microscopic flowering plant gametophytes develop and grow within sporophytic flower tissues and are completely dependent on sporophytes.

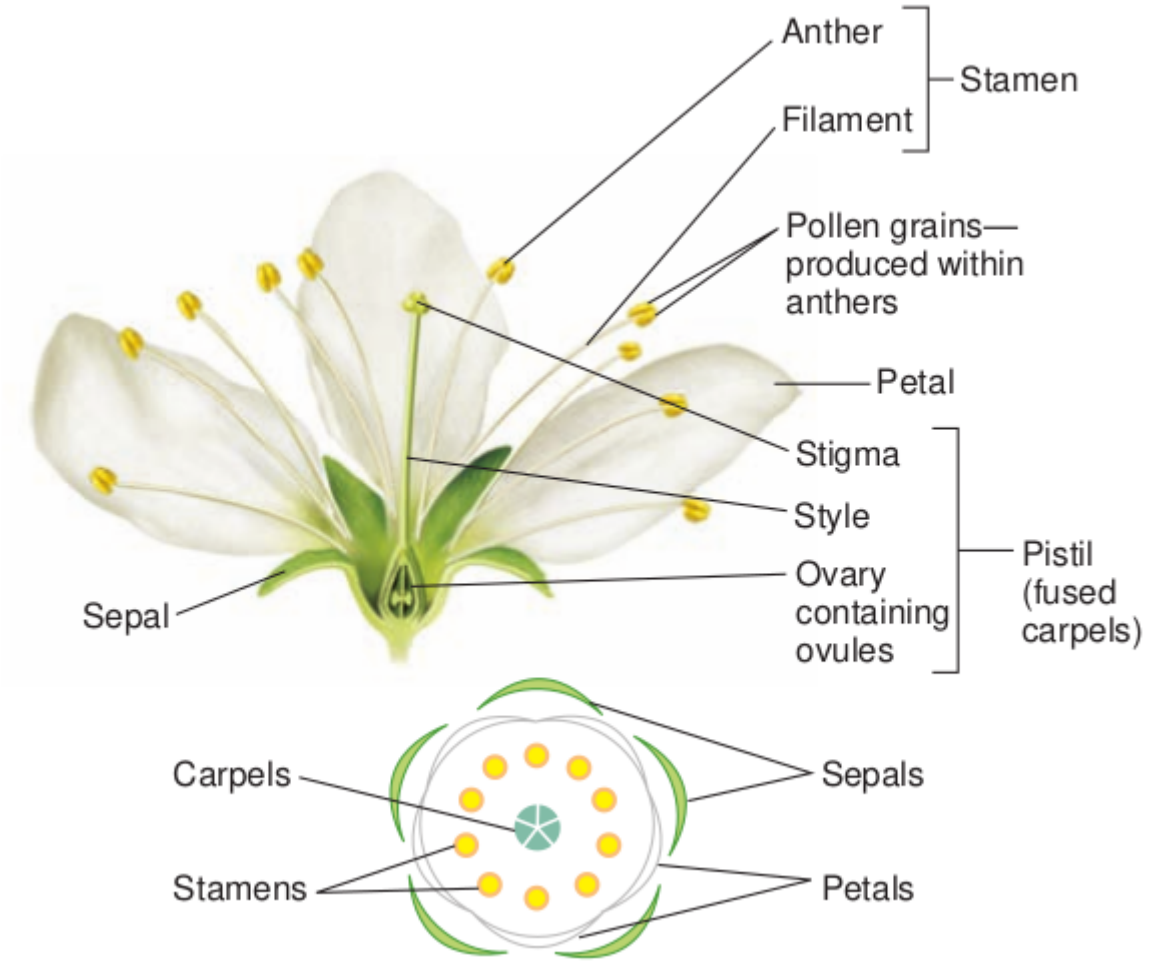
Concept check: *What advantages do flowering plants obtain by having such small and dependent gametophytes?*

Flower and Sexual Cycle

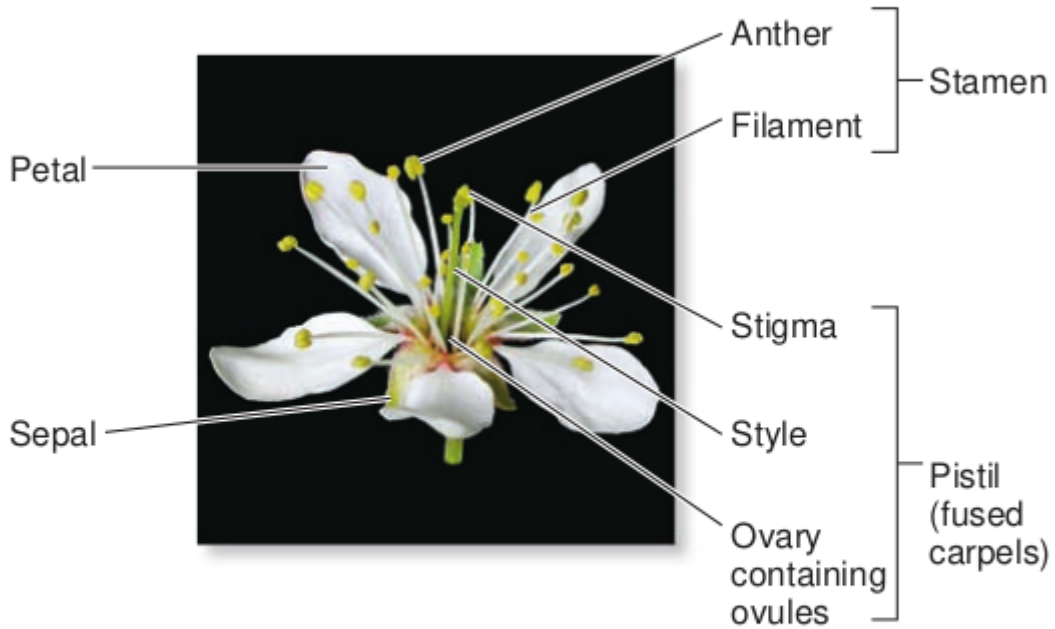
- Flowers
  - ONLY in angiosperms
  - All sizes, shapes, colors, and aromas
- Essential process of Sexual reproduction occurs within flowers
  - Meiosis/cytokenesis
    - reduces chromosome number
  - Syngamy (fertilization)
    - restores chromosome number

"Ideal" Flower

- Uses highly modified leaves arranged in whorls (circular) at the tip of a highly modified stem
- A flower is a highly modified determinate (short term) shoot system



(a) Flower parts



(b) *Prunus americana* (plum)

Figure 39.3 The structure of a typical flower.

Concept check: *Do all flowers have all of the structures illustrated here?*

- Pedical, receptical, 4 sets of highly modified leaves are all 2N and part of the sporophyte generation
- Pollen (sperm) and eggs of embryo sac are part of the 1N generation
- Pedical
  - flower stalk
- Recepticle
  - tip of modified stem with 4 whorls attached

Sexual Cycle

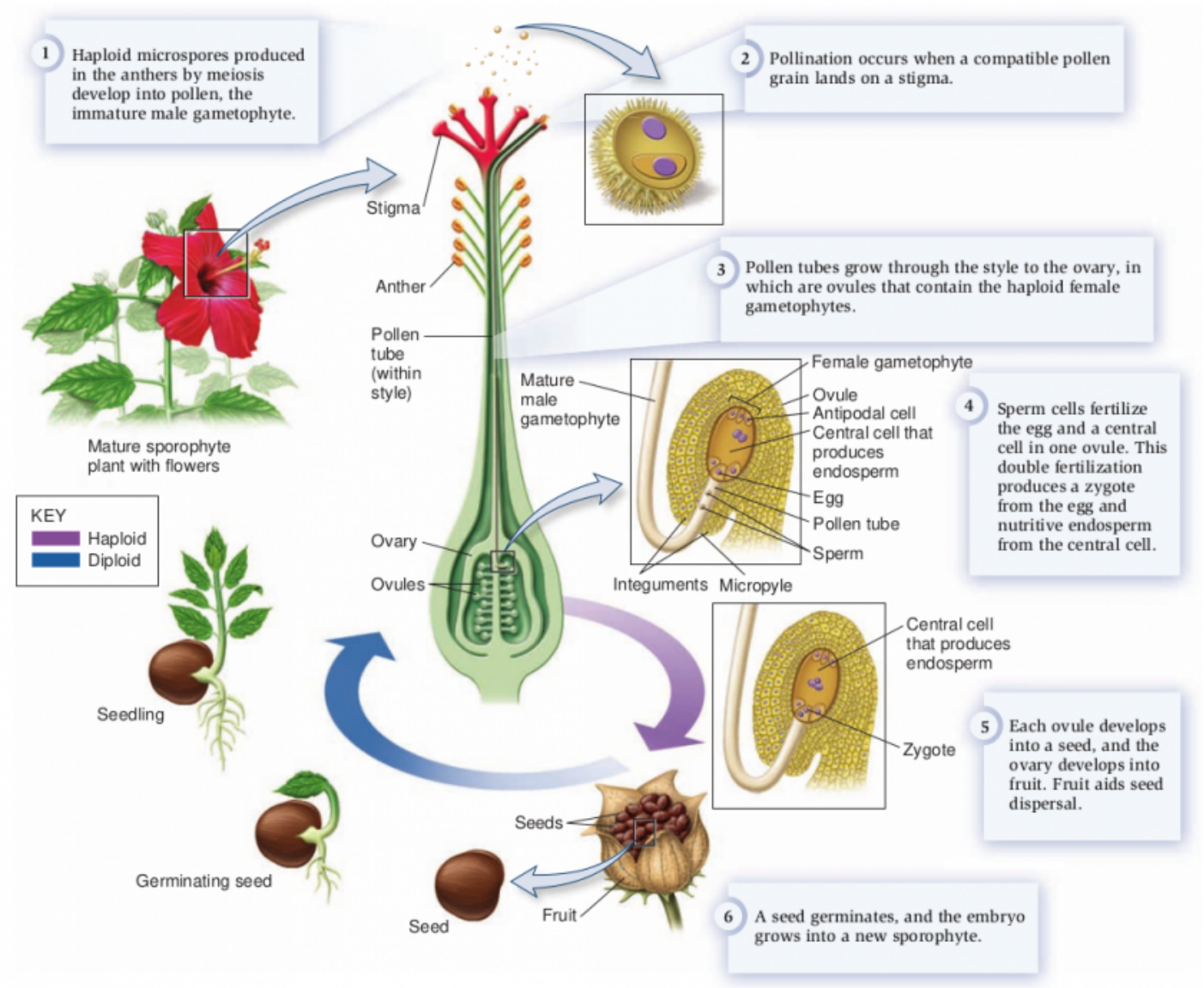
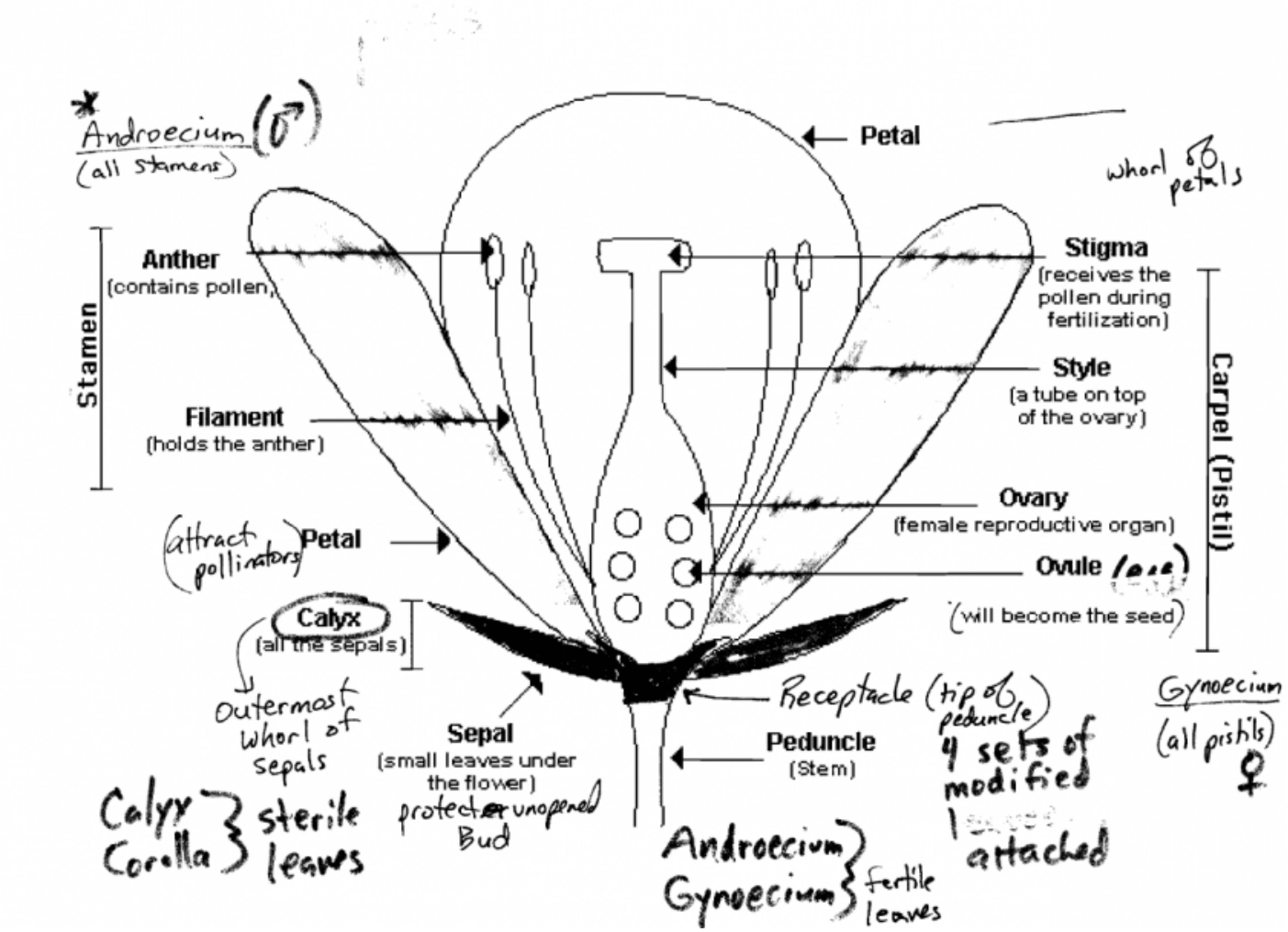


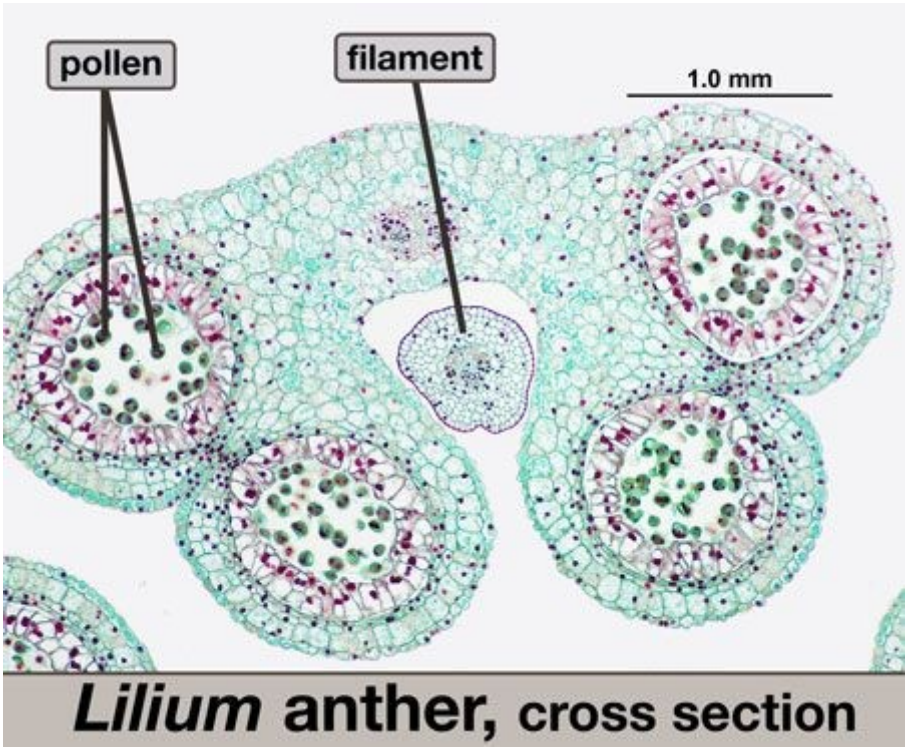
Figure 39.4 **The life cycle of a flowering plant.** The plant reproductive cycle is illustrated here by hibiscus.

Concept check: *What advantage does the hibiscus flower gain by clustering its stamens around the pistil?*



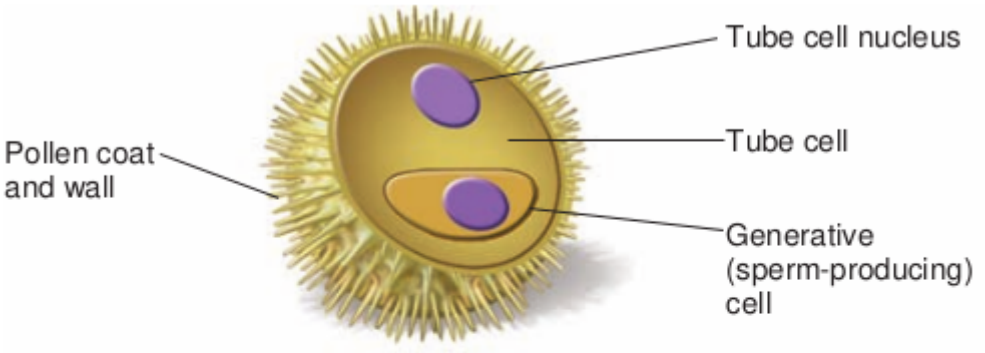
Male

- Pollen formation
  - occurs within the anther of stamen
- Anther
  - Bilobed with 2 pollen chambers per lobe

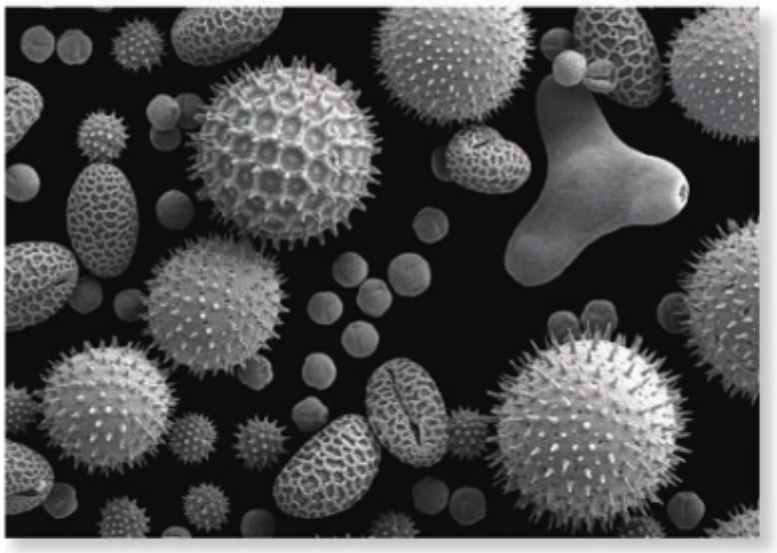


1. 2N microspore mother cell
2. meiosis/cytokenesis
3. 4 1N microspores
4. Each: mitosis/cytokenesis
   unequal and incomplete
5. 1N Generating cell
   1N Tubecell

Male Gametophyte



(a) A cut pollen grain showing immature male gametophyte



(b) SEM of whole pollen grains showing distinctive pollen wall ornamentation

Figure 39.11 **Pollen grains.** (a) Diagram of cut pollen grain. (b) SEM of whole pollen grains of different species.

Concept check: *What is the maximum number of cells in a mature male gametophyte of a flowering plant?*

Pollination

- Transfer of pollen from the anther to the stigma
- Self-pollination
  - Transfer with the same flower or between flowers on the same plant
- Cross-Pollination
  - Transfer between flowers of other plants

Pollinating Agents

Mechanisms utilized for transfer of pollen

1. Wind

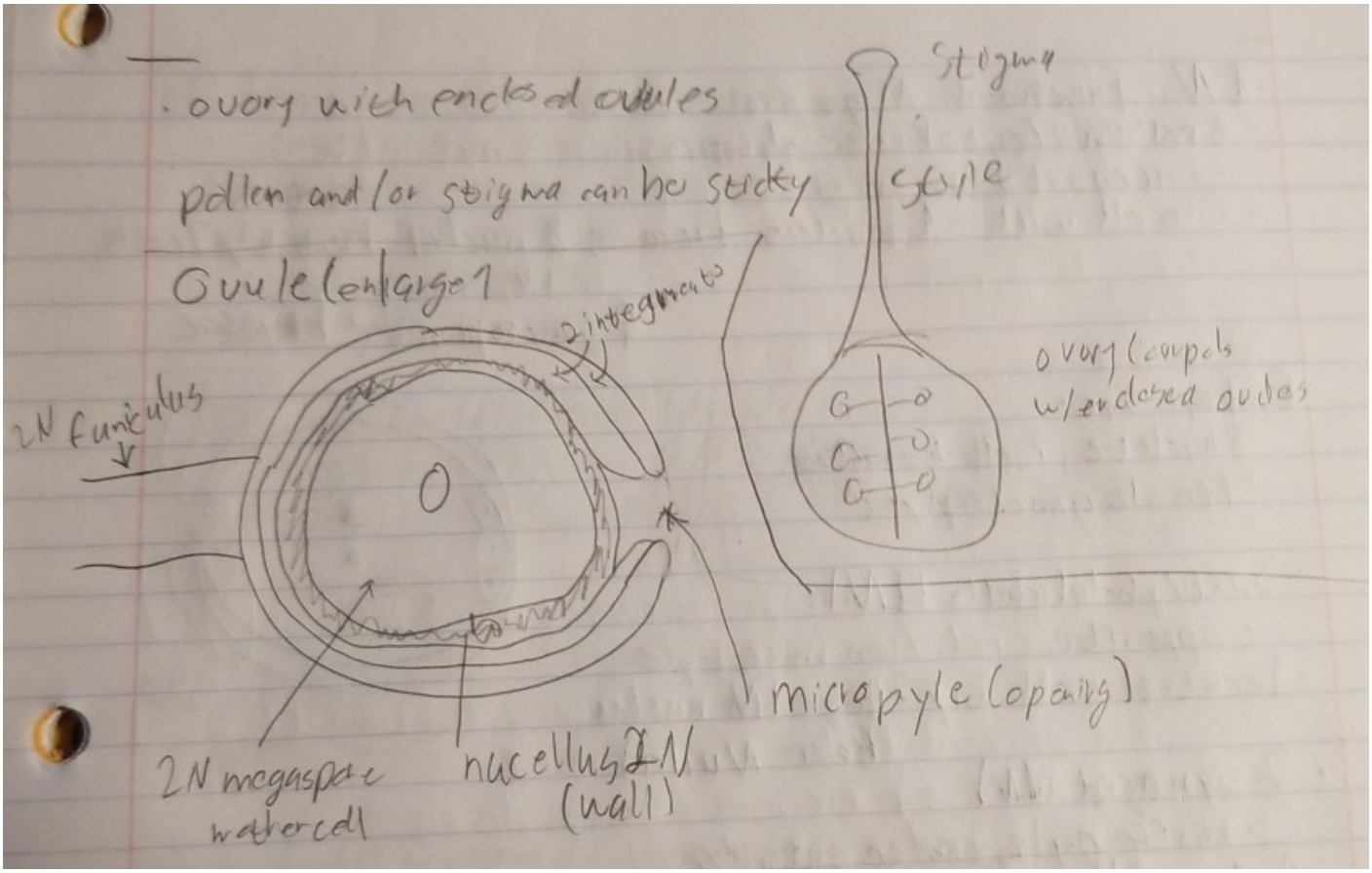
- small/lightweight pollen

2. Water
   - Transfer with a few aquatic plants
3. Animals
   - Majority of plants
   - Utilized as a "trick and reward" system
   - nectar, colors, and aromas to attract animals

Female

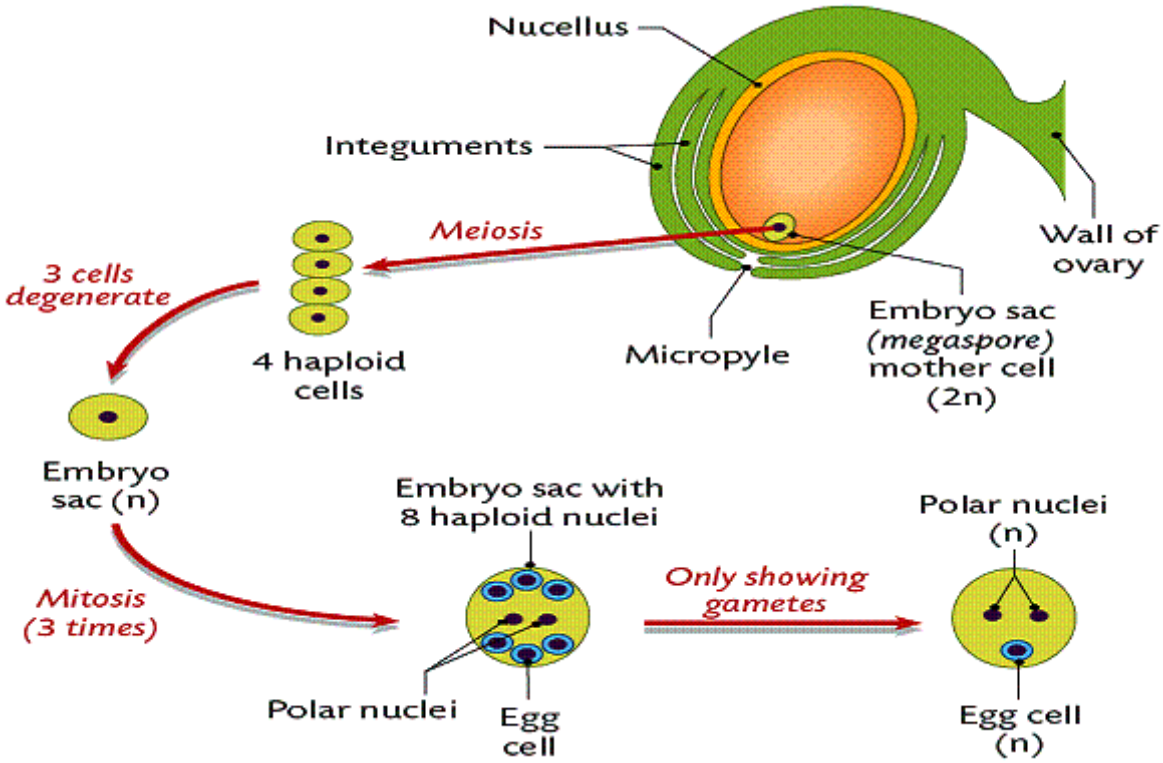
Ovule Development

- Ovule
  - future seed
- Enclosed within the ovary of pistol (carpel)
- One to many ovules per ovary
  - ovary will become fruit
- Ovule attached to central axis or to wall of hollow fruit
  - always enclosed
  - angiosperms
- within ovule is 1 large 2N cell
  - megaspore mother cell



1. 2N megaspore mother cell
2. meisos/sytokenesis
3. 4 1N Megaspores
4. 3 degrade
5. 2N Functional megaspore
6. Series of 3 mitosis/cytokenesis cycles
   Incomplete and unqueal
7. 7-celled embryo sac
   8 nuclei

Female gametophyte



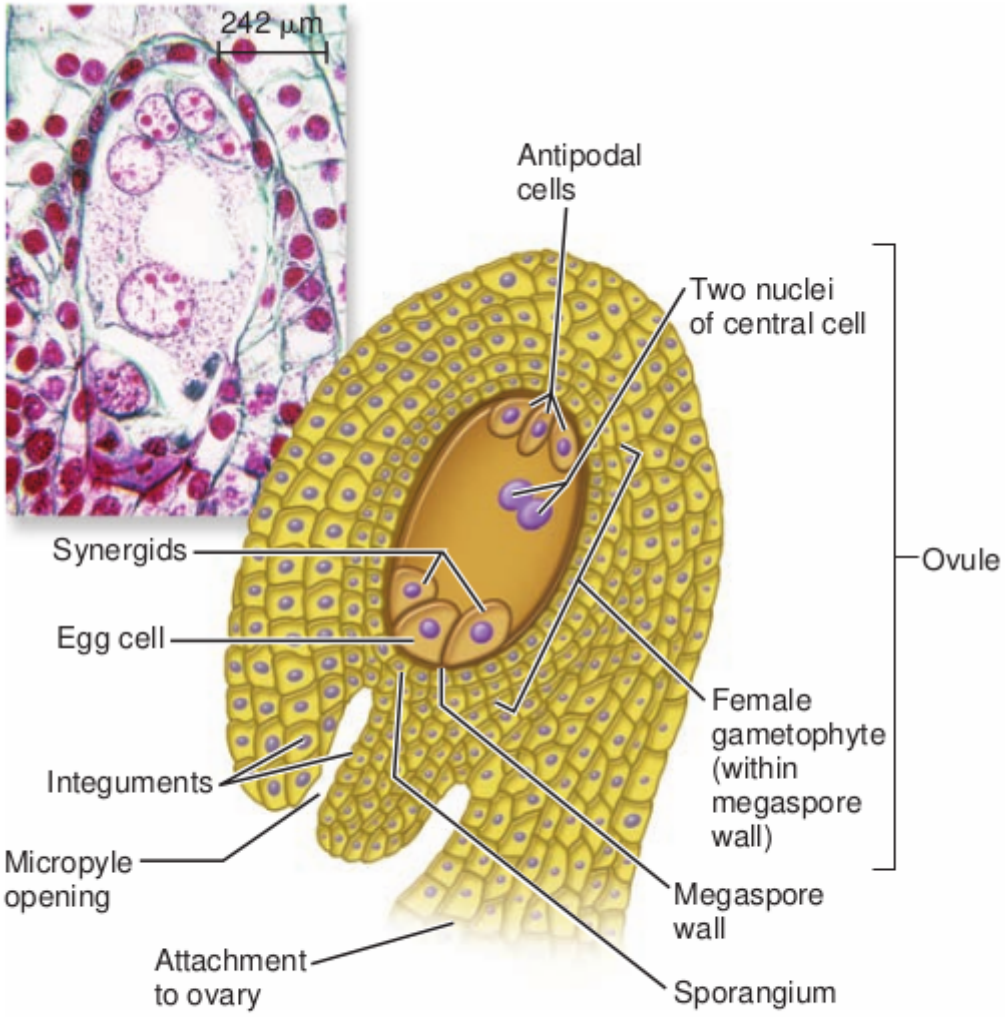


Figure 39.12 Female gametophyte within an ovule.

Concept check: *How do female gametophytes obtain nutrients?*

- 1N Functional megaspore
  - 3 mitosis/cytokenesis divisions
- One cell with 1 nucleus becomes 8 nuclei but only 7 cells

Embryo sac

- 8 nuclei, 7 cell structure
- female gametophyte
- 3 antipodal cells (1N)
  - opposite end from micropyle
- 1 central cell with 2 large 1N polar nuclei
- 2 Synergids (1N)
  - Micropyle end on outside
- 1 egg (1N)
  - Middle at micropyle end

Syngamy (fused gametes)

- 1N egg + 1N sperm = 2N zygote (single fertilized egg)
- Pollen grain germination
  - tube cells form pollen tube (delivers sperm)
  - generative cell divides by mitosis/cytokenesis to produce 2 sperm

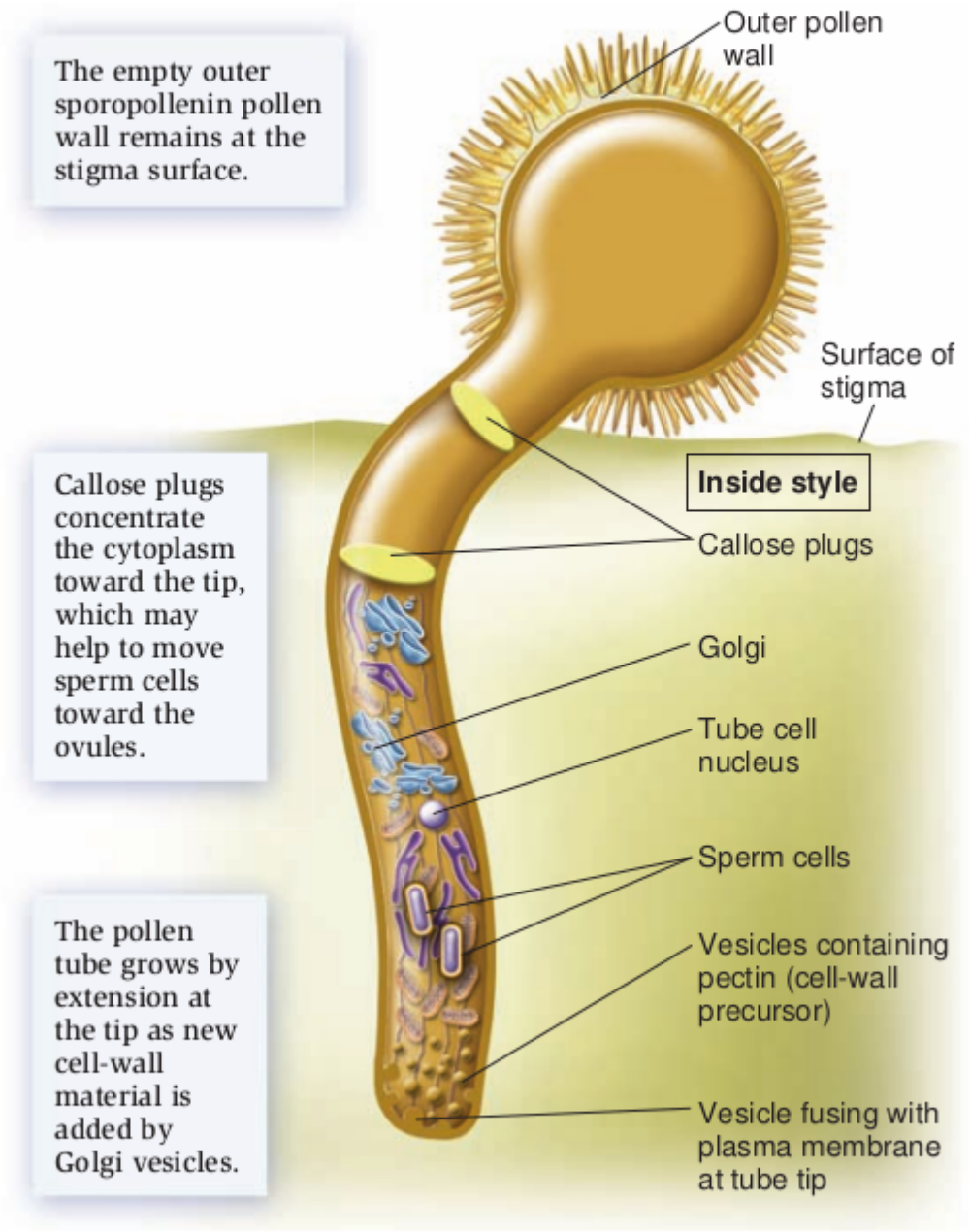


Figure 39.15 Tip growth by a pollen tube.

- Pollen tube enters micropyle
  - digests tube cell nucleus
- Pollen tube enters one synergid
  - releases it's content (sperm)

    - synergid ruptures
    - mycropyle closes

- "Double fertilization" (double fusion)
    - 1N egg +1N sperm = 2N zygote
    - 1N sperm +2 1N polar nuclei = 3N primary endosperm cell

- Post fertilization with ovule
- 2N zygote grows by mitosis/cytokenesis into 2N multicellular embryo
- 3N primary endosperm cell grows by mitosis/cytokenesis into 3N multicellular endosperm
    - nutrient tissue for embryo

- Ovule/ovary with 2N zygote mature/enlarges with sugars/H2O into a fruit (mature ovary) with enclosed seeds (mature ovules)
- Seed dispersal (seeds enclosed withing a fruit)
- agents
    - wind
    - water
    - animals - majority

Seed germination

- Seed with 2N embryo enters period of dormancy
- dormancy broken by a combination of internal (hormones) and external factors (environmental)
- radical (first root) emerges and grows down
- shoot emerges and grows up

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