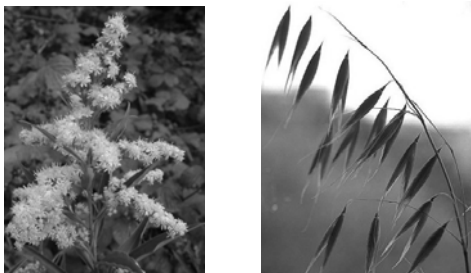
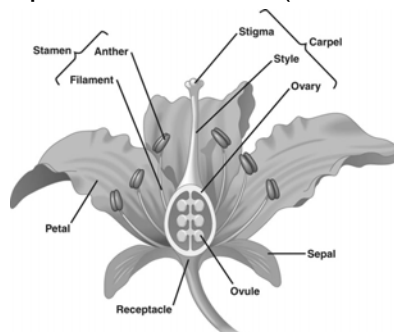


Plant Diversity II. The Evolution of Seed Plants: Angiosperms



A flower = a specialized reproductive shoot (strobilus)



Structure of an unspecialized flower

Sepals – generally green, leafy

Petals – brightly colored in animal-pollinated species

Stamens - these are microsporophylls

Filament

Stamen - contains microsporangia

Carpels - these are megasporophylls

Ovary contains ovules (megasporangia with integuments)

Stigma receives pollen

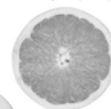
Style connects ovary and stigma

A fruit is a mature ovary (ovules have become seeds)

(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



Pericarp = the thickened ovary wall

(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



Angiosperm life cycle – key points (1)

- *Extreme reduction of gametophyte generation.*
- In microspores, mitosis produces microgametophytes
- Microgametophyte (male gametophyte) reduced to 2 cells:
 - Generative cell (produces 2 sperms)
 - Tube cell (produces pollen tube)
- Microgametophyte in microspore wall = a pollen grain

Angiosperm life cycle – key points (2)

- In megasporangium, one megasporocyte undergoes meiosis to produce 4 megaspores. One survives, 3 do not.
- In surviving megaspore, mitosis produces megagametophyte.
- Megagametophyte (female gametophyte, embryo sac) reduced to 8 cells/nuclei
 - 3 antipodal cells (function?)
 - 2 polar nuclei
 - 2 synergids (function?)
 - 1 egg

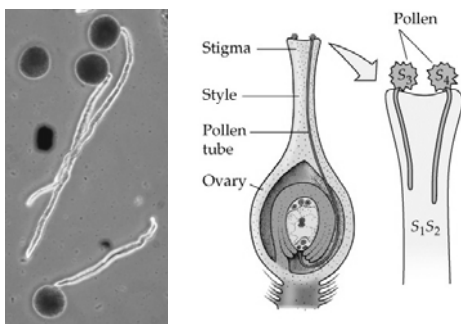
Angiosperm life cycle – key points (3)

- Fertilization occurs when
 - One sperm fuses with egg to produce diploid zygote (sporophyte)
 - The other sperm fuses with the 2 polar nuclei to produce triploid endosperm (develops into seed reserves)
- This is called *double fertilization* and synchronizes development of food storage and development of embryo

Angiosperm life cycle – key points (4)

- Pollination – transfer of pollen from anther to stigma
 - By animal vector (insects, hummingbirds, bats)
 - By wind (e.g. in grasses)
- Self fertilization is discouraged by a variety of mechanisms

The pollen tube delivers sperms to megagametophyte



Seed and fruit development

- Seed development
 - Zygote → embryo (sporophyte)
 - Endosperm → food reserves
 - Integuments of megasporangium → seed coat
- Fruit development
 - Ovules → seeds
 - Ovary wall → pericarp

Origin and evolution of the angiosperms

- Angiosperms arose ca. 140 MYA, coexisting with gymnosperms.
- Angiosperms became dominant in terrestrial vegetation ca. 65 MYA.
- Ancestor? An unknown gymnosperm.

What did early angiosperms look like?

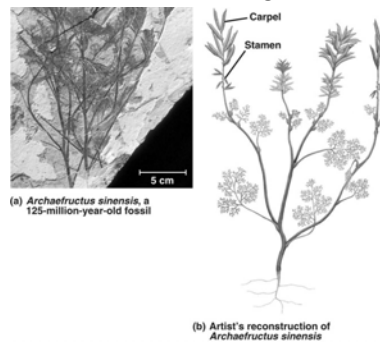


Figure 30.11

Angiosperm diversity

- Most angiosperms can be classified into two groups:
 - Monocots
 - Eudicots
- The remainder are classified into smaller groups which contain survivors of ancient lineages.

Monocot and Eudicot characteristics

	Monocots	Eudicots
Cotyledons	one	two
Venation	parallel	netted
Flower parts	in 3's	in 4's or 5's
Vascular tissue	scattered	In a ring

Based on Fig. 30.12, pp. 602-603

Angiosperm diversity

- There are about 250,000 described angiosperm species
- The four largest angiosperm families:
 - Asteraceae (sunflower family): 26,000 species
 - Orchidaceae (orchid family): 20,000 species
 - Fabaceae (pea family): 17,000 species
 - Poaceae (grass family): 9000 species

Asteraceae (sunflower family)



Orchidaceae (orchid family)



Fabaceae (pea or legume family)



Poaceae (grass family)



Angiosperm/Animal “Co-evolution”

- Reduction and protection of gametophytes to evade crawling herbivores.
- Evolution of flight in insects.
- Cooperation with pollinators.
- Cooperation with seed dispersers.
- Expansion of grasslands in Africa favored evolution of grazers and (perhaps) bipedalism in human ancestors.

Seed plants and human welfare

- Agriculture began ca. 13,000 YA
- Domestication and selection have modified crop species from their wild ancestors.
- Today ca. 93% of human caloric intake comes from 30 angiosperm crop species, ca. 66% from 8 grain species.
- Many medicines are derived from plant secondary compounds.