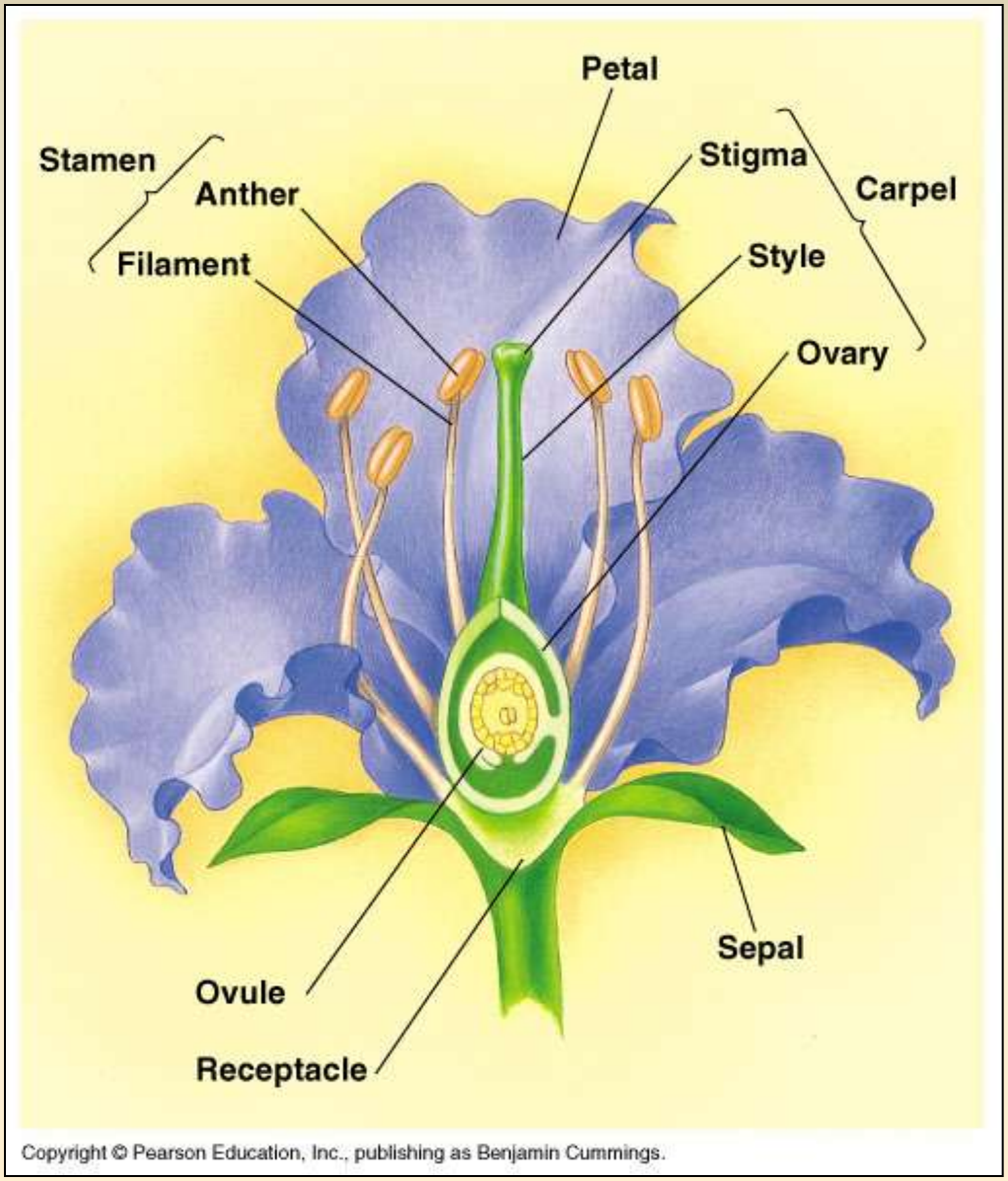
Plant Life Cycle: Flowers



Stamens and Carpels are the Reproductive Organs

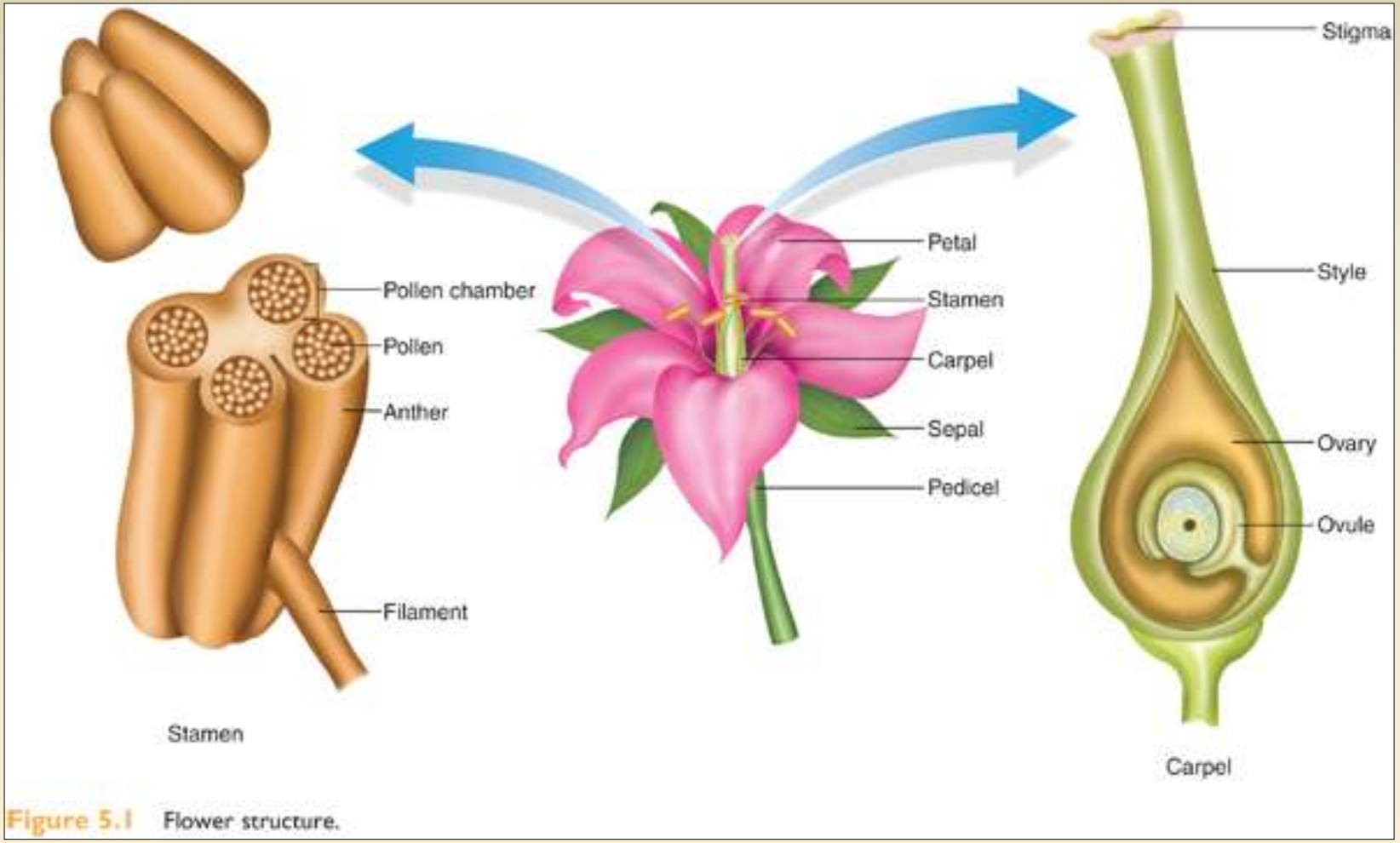
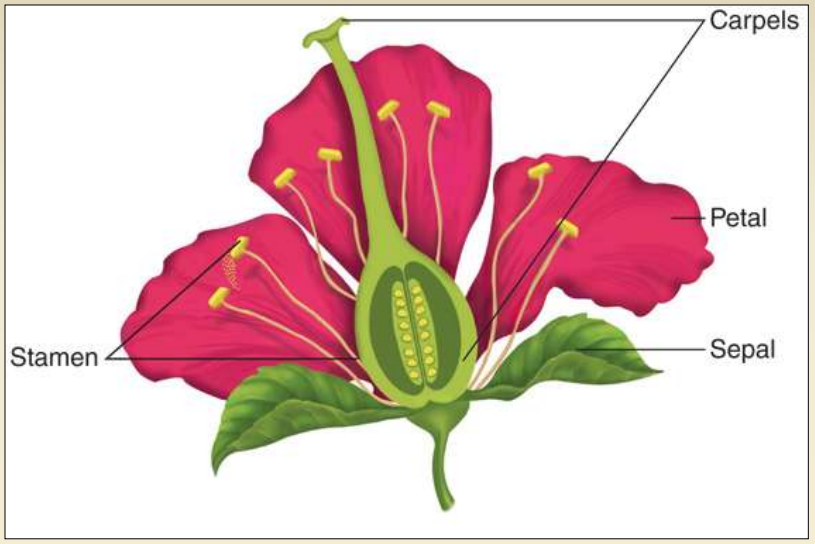


Figure 5.1 Flower structure.

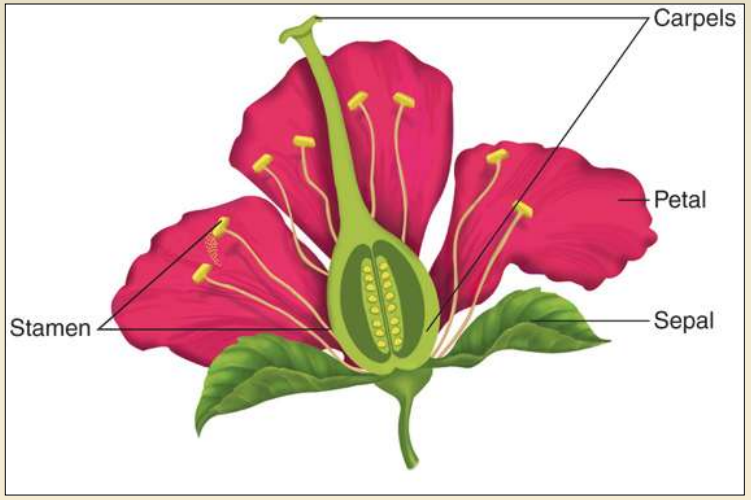
Flower Structure

- Complete flowers have four major parts.
- **Sepals** – located at base of flower; surround and protect the bud.
  - Dicot sepals are usually green and leaf-like.
  - Monocot sepals often resemble petals (called tepals).



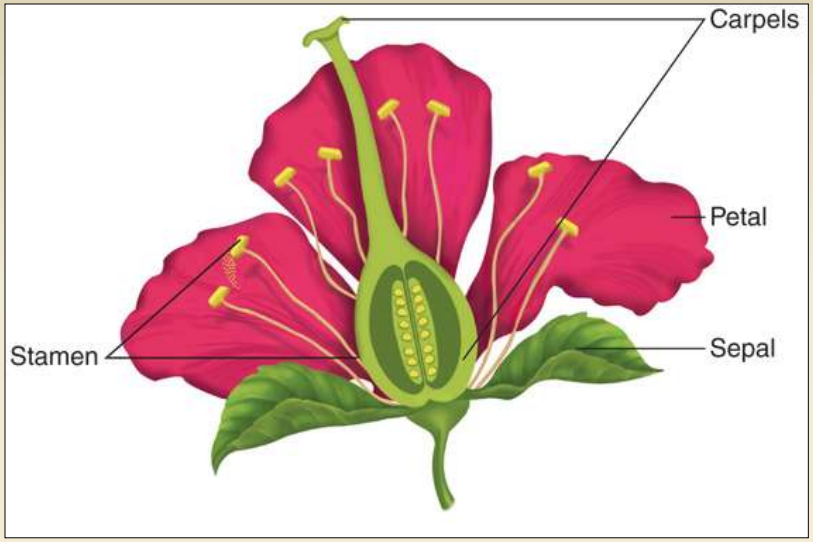
Flower Structure

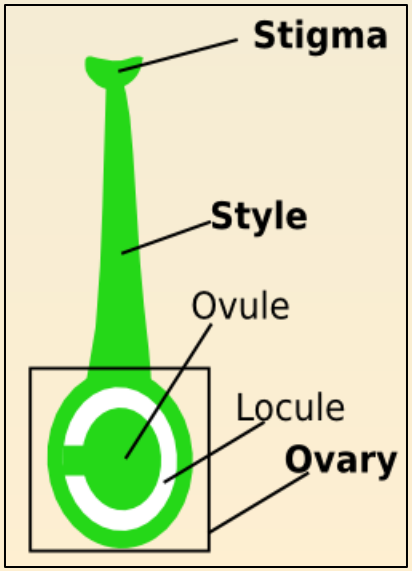
- **Petals** – located above sepals; usually brightly colored and fragrant (attract pollinators).
- **Stamens** (male reproductive structures) – attached above petals.
  - Each consists of a **filament** (stalk) and **anther** (produces pollen).



Flower Structure

- **Carpel** (female reproductive structure) – centrally located
  - Each consists of a sticky **stigma** (catches pollen), an elongate **style**, and a bulbous **ovary** containing one or more **ovules.**
    - Ovules develop into seeds.
    - Ovary develops into a **fruit.**





Cross Section of Carpels
Ovules

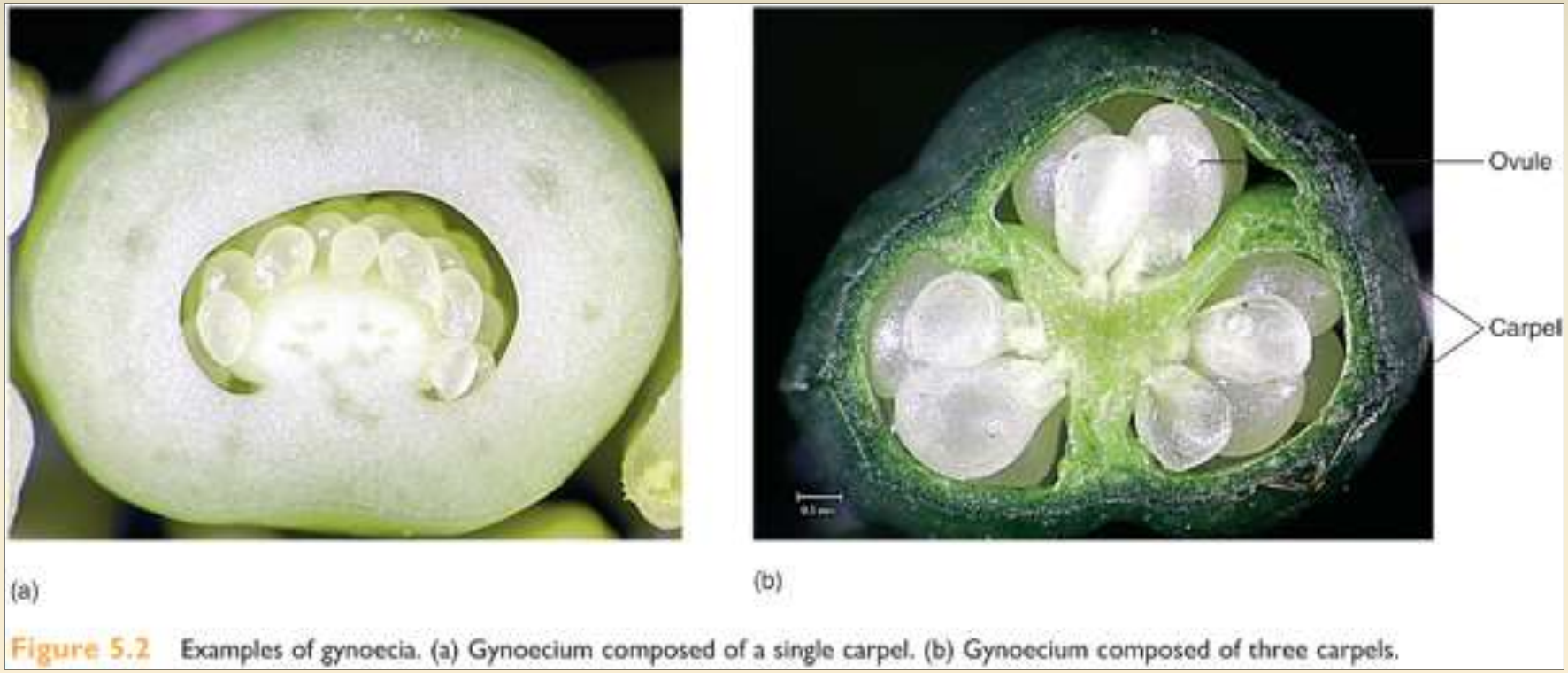


Figure 5.2 Examples of gynoecia. (a) Gynoecium composed of a single carpel. (b) Gynoecium composed of three carpels.

Carpels and Ovaries

- Flowering plants always have enclosed ovary wrapped in a carpel - nonflowering plants don't - this is the vessel of the angiosperm
- Carpel is highly modified leaf - a simple pistil is one ovary
- Pistil may be made up of one carpel or several fused carpels
- Often the bottom part called the ovary, with stigma at top to receive pollen, style connects them - fused carpels may have separate style and stigma or they may all be fused

Dicot Flower parts in 5's

Monocot Flower parts in 3's tepals

(a)

(b)

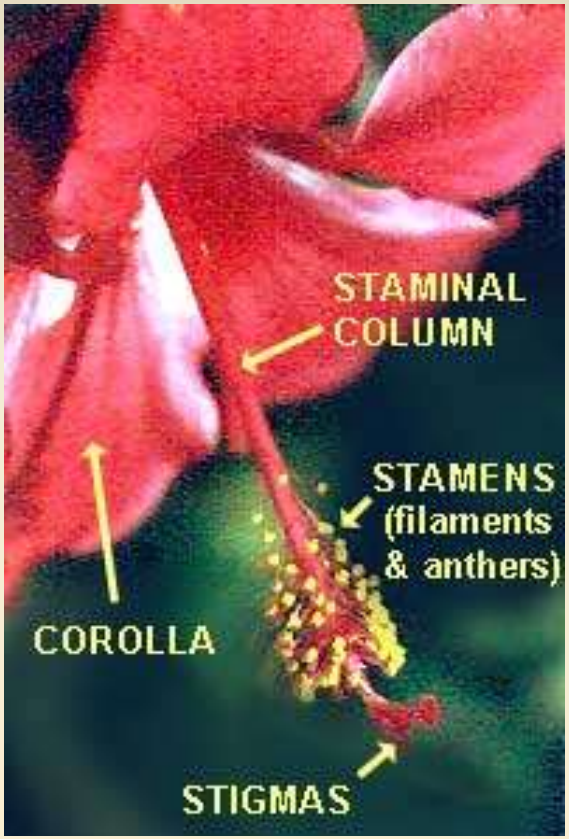
Figure 5.3 Monocot and dicot flowers. (a) Coast rose gentian, *Sabatia arenicola*, illustrates a dicot flower with flower parts in multiples of five. (b) Michigan lily, *Lilium michiganense*, a monocot, shows flower parts in multiples of three.

Flower Structure: *Lilium,* a monocot
Tepals – when whorl of sepals are petal-like

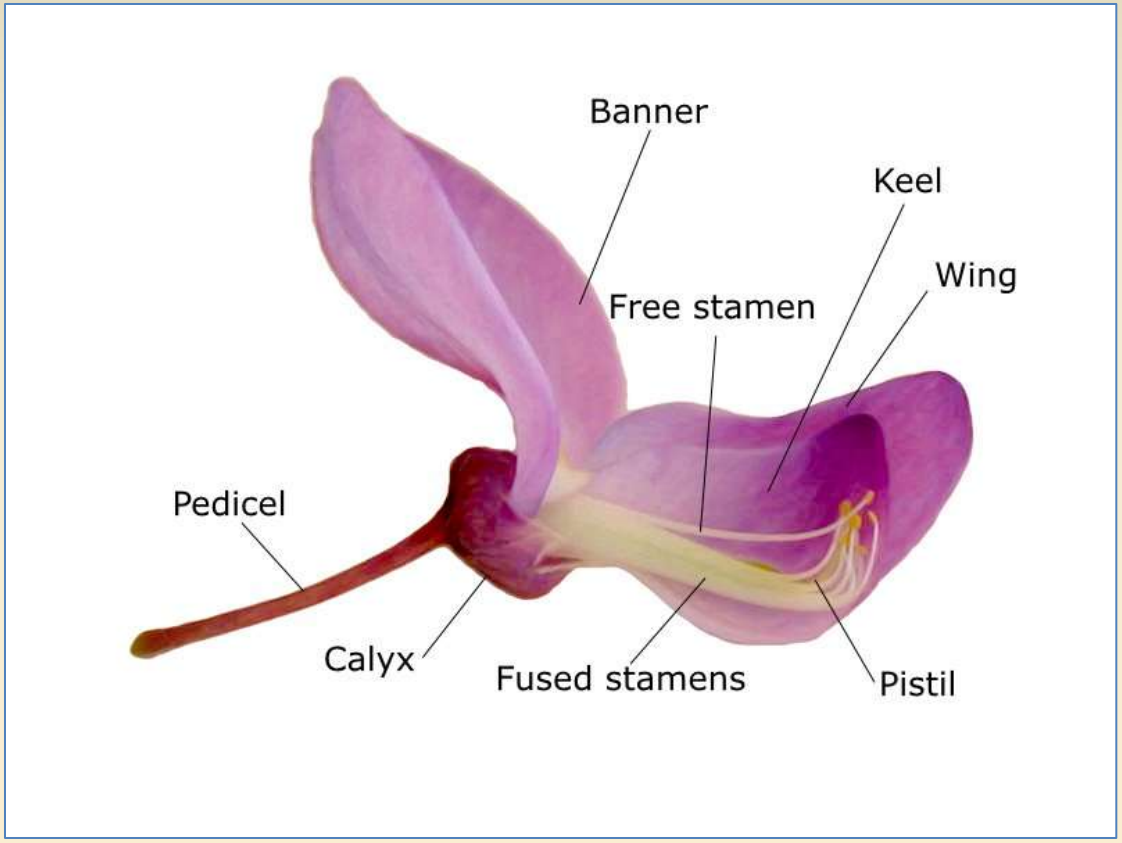
***Malus* – crab apple – typical flower structure (inferior ovary)**

***Helleborus* – five separate carpels**

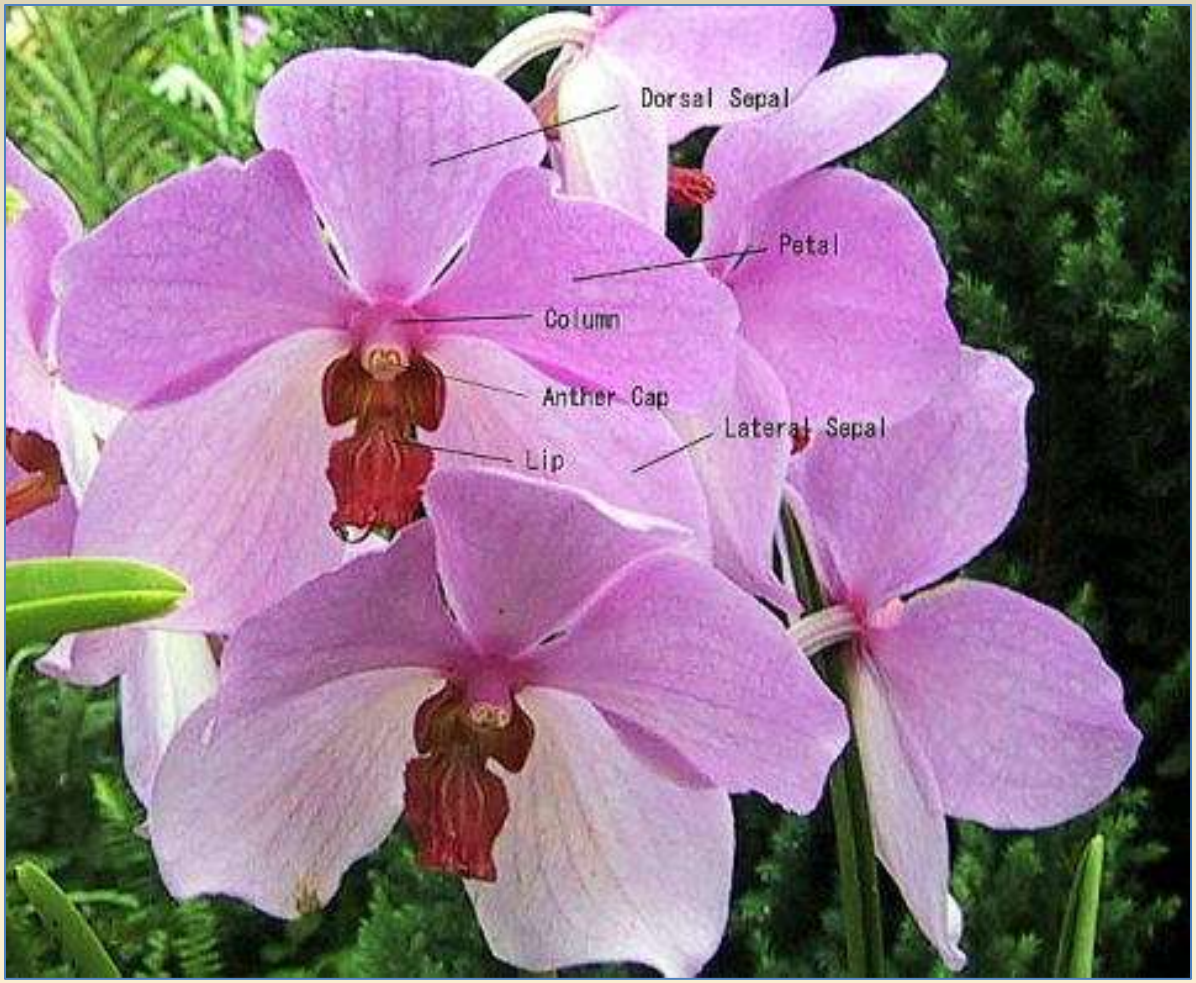
Hibiscus – Mallow Family
Filaments fused, monadelphous



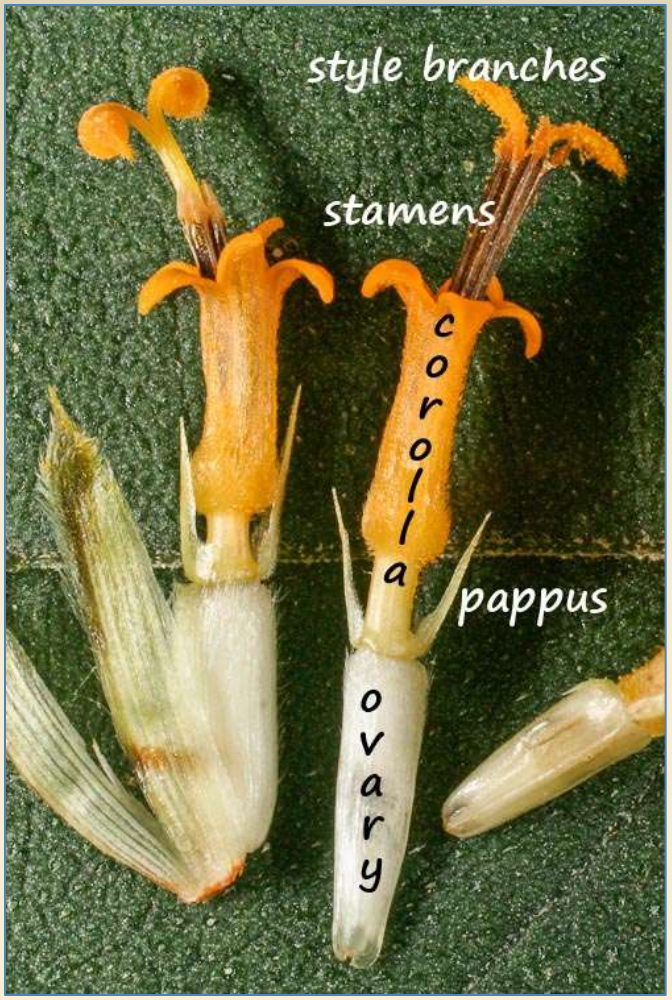
Flower Structure – Wisteria, a dicot, legume family
Papilionoid - wings

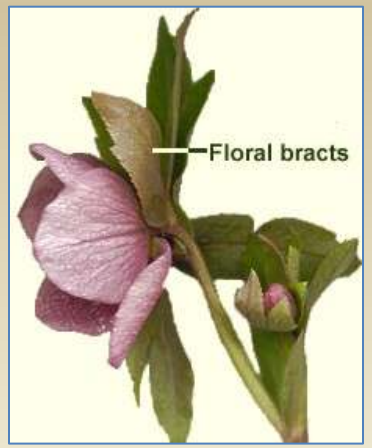


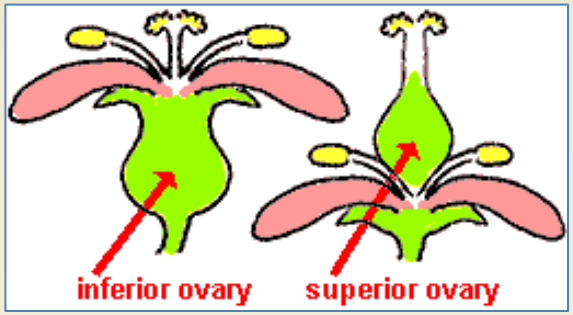
Orchid Flowers – zygomorphic, stamens fused in column



Asteraceae (Compositae) – Sunflower Family
Flowers in a Head







Actinomorphic
Regular
Radial

Zygomorphic
Irregular
Bilateral

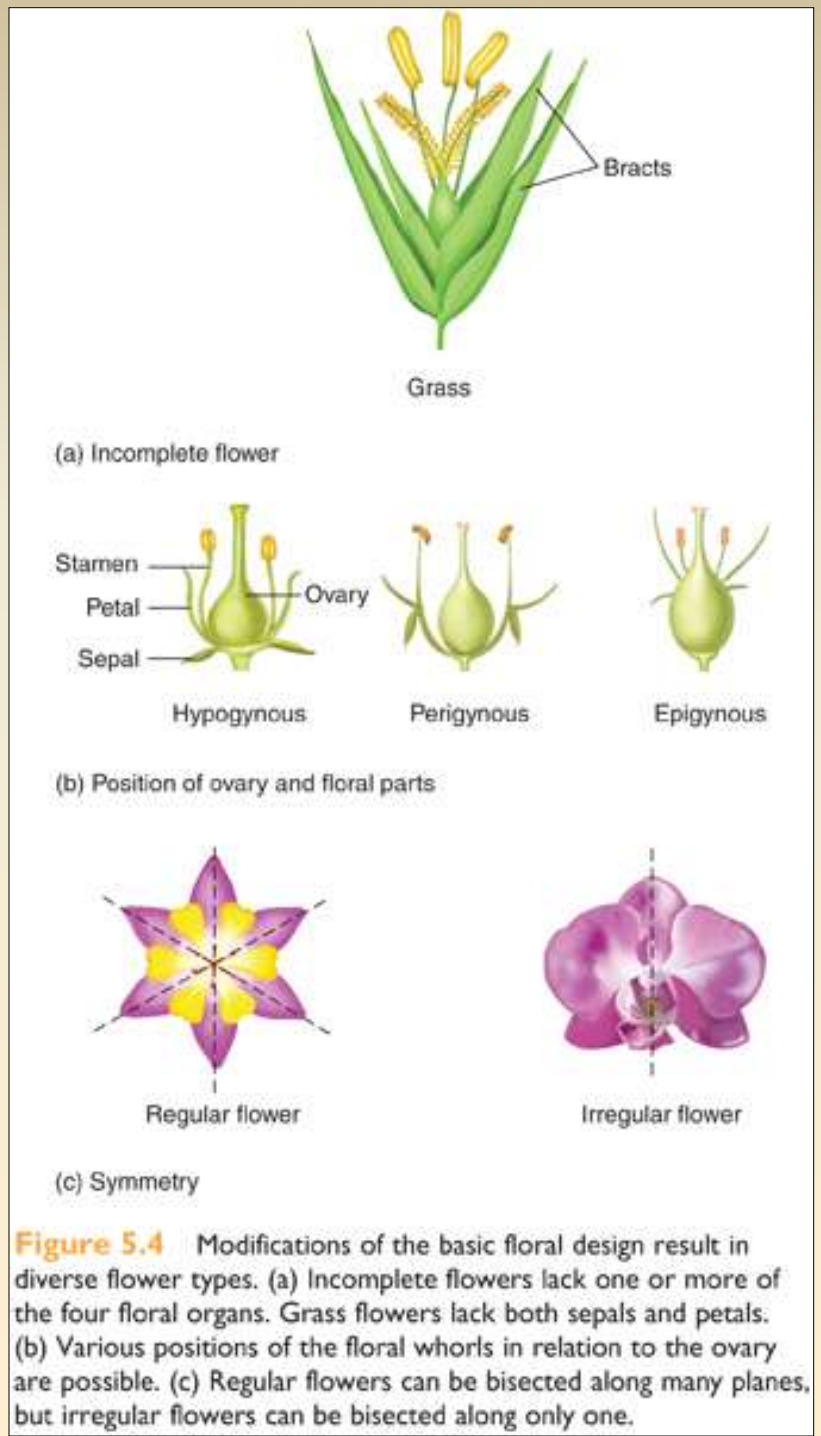


Figure 5.4 Modifications of the basic floral design result in diverse flower types. (a) Incomplete flowers lack one or more of the four floral organs. Grass flowers lack both sepals and petals. (b) Various positions of the floral whorls in relation to the ovary are possible. (c) Regular flowers can be bisected along many planes, but irregular flowers can be bisected along only one.

Plant Sexuality

- **Monoecious** - separate flowers for male and female both on one plant - corn
- **Dioecious** - male and female plants are separate - separate sexes - gingko
- **Perfect flower** - flower has stamens and carpels – bisexual flowers
- **Imperfect flower** - lacks either stamens or carpels - will be staminate or carpellate (pistillate)
- **Complete** - has sepals, petals, stamens and carpels
- **Incomplete** - lacking one of the 4 main flower parts

Jatropha – monoecious but insect pollinated
Female left, male right

Dioecious - Holly

Female flower

Male flower

Berries on female

Wild oats – Whole plant

Wild oat flower – close up

Basic Inflorescence Types

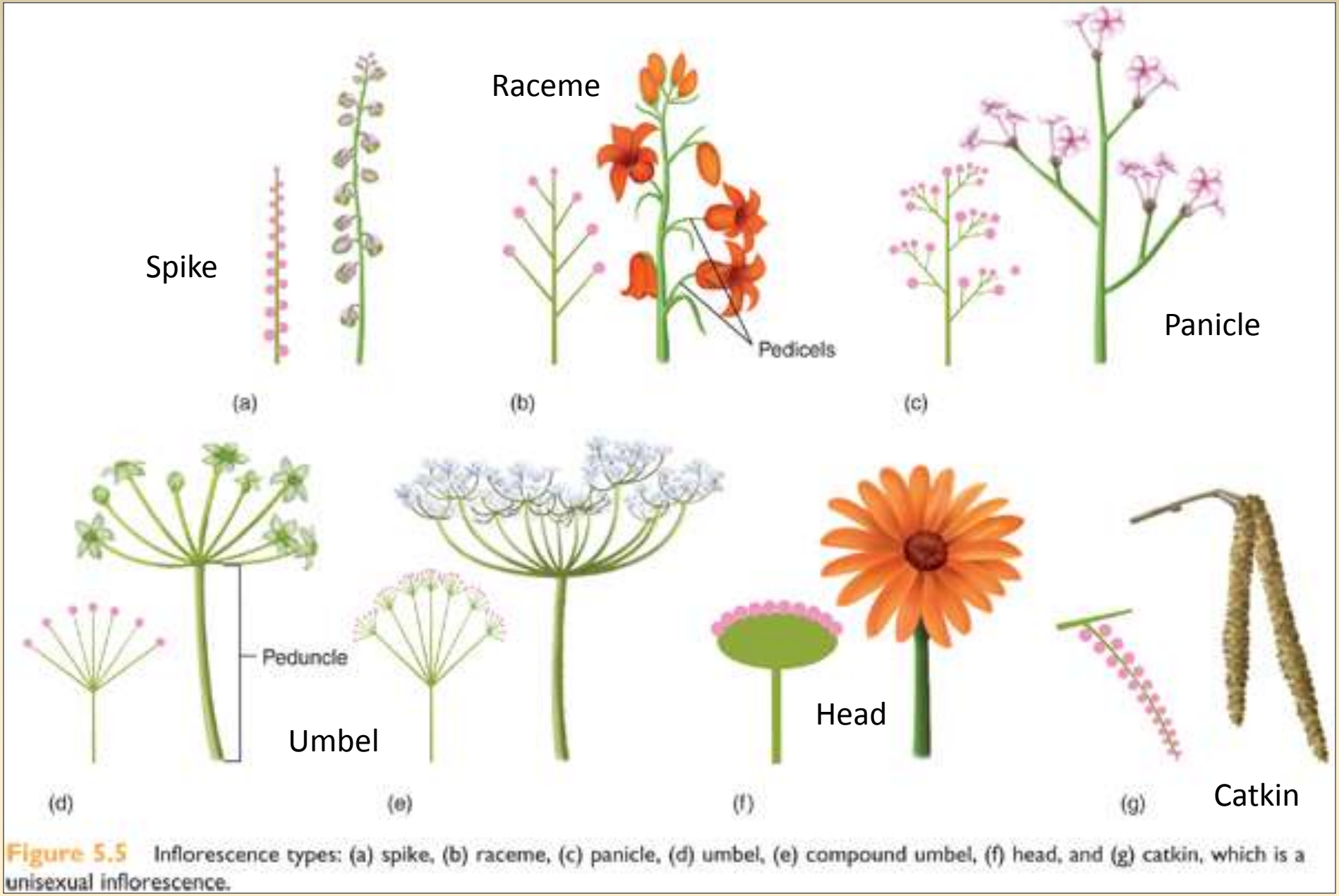
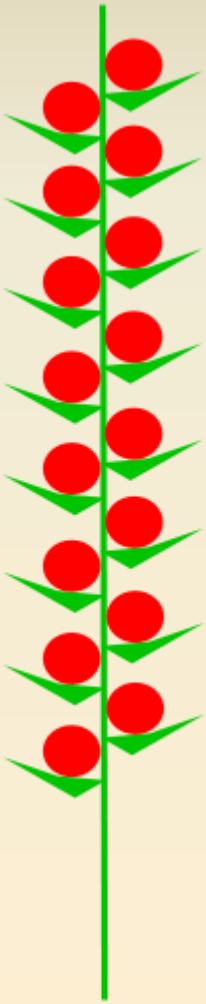


Figure 5.5 Inflorescence types: (a) spike, (b) raceme, (c) panicle, (d) umbel, (e) compound umbel, (f) head, and (g) catkin, which is a unisexual inflorescence.

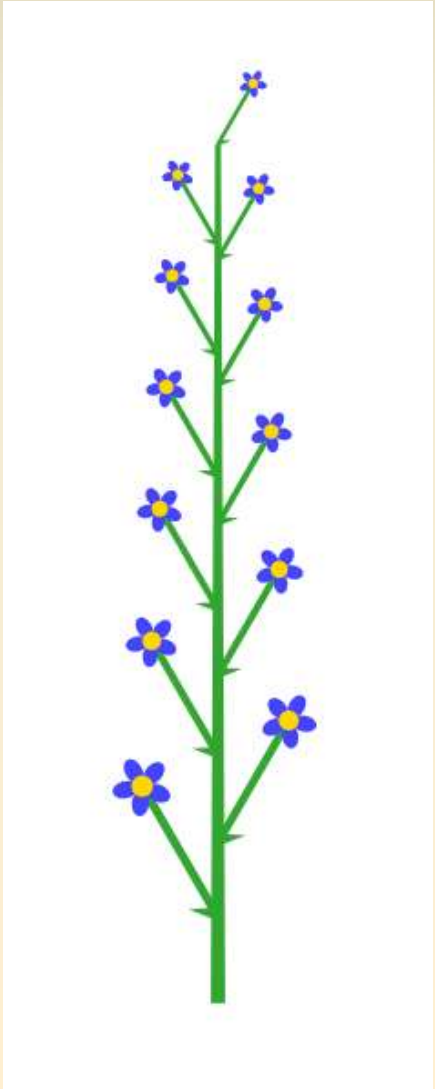
Inflorescence terms

- Often flowers, especially small flowers, are gathered into a structure known as an inflorescence – an aggregation of flowers on a single flowering branch
- **bract** - more or less modified leaf that subtends flower or flower groups - bract can look like normal leaf
- bract can also look like petal - petalous - dogwoods have big white "petals" that are really petaloid bracts
- **peduncle** - stalk of cluster of flowers
- **pedicel** - stalk of individual flower
- **petiole** - leaf stalk

Spike – unbranched inflorescence consisting of a main stalk with sessile flowers attached along its length

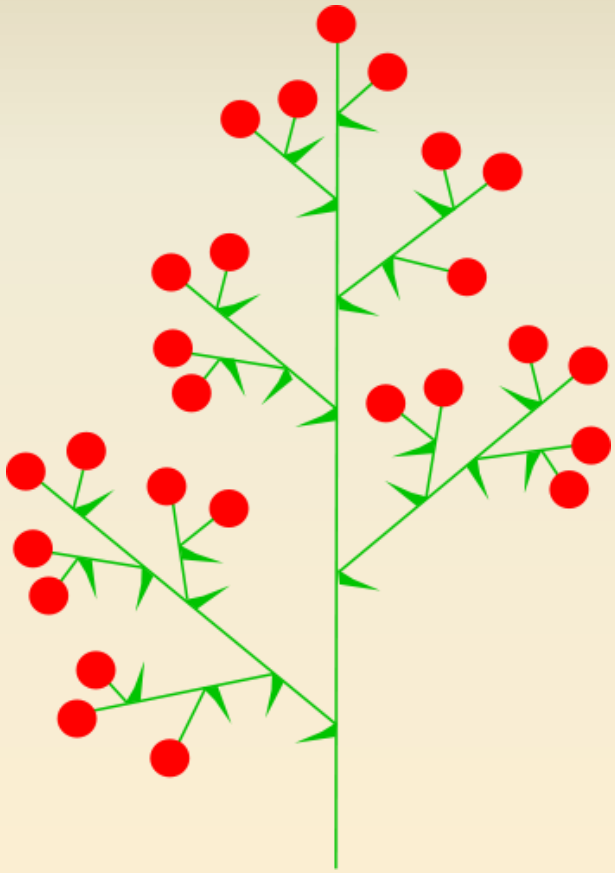


Raceme - unbranched main stalk with flowers attached along its length by short pedicels



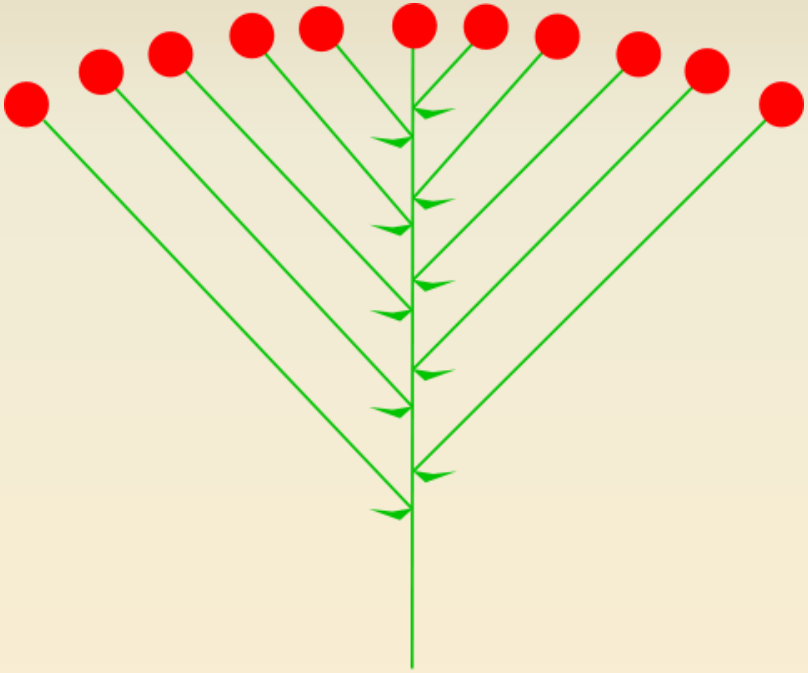
Larkspur

Panicle - loosely branched, pyramidal inflorescence form

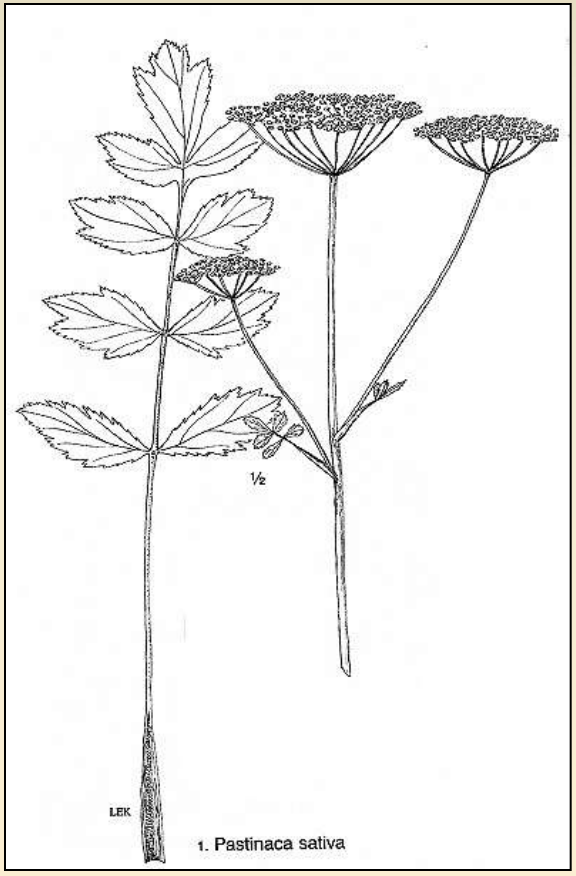


Panicum - switchgrass

Corymb – flat-topped raceme



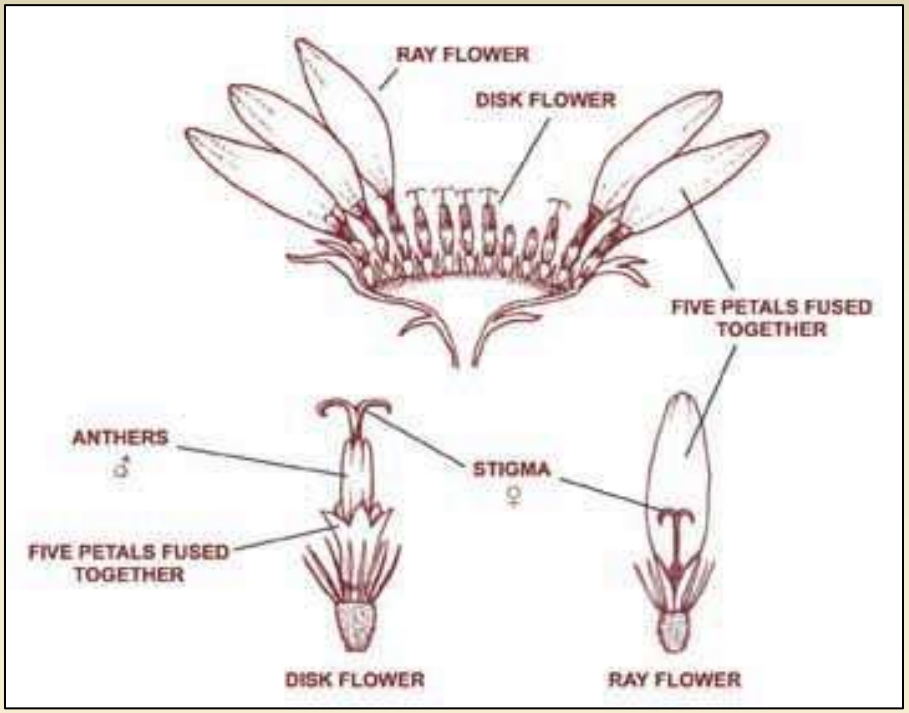
Umbel – umbrella-shaped, having pedicels radiating from one point



Wild parsnip

Queen Anne's Lace

Head - a dense inflorescence of small, often stalkless flowers



Sunflower –
Compositae head

Catkin - an elongated inflorescence of unisexual flowers on a woody plant, willow, oak, walnut, birch

Alder catkin

Scorpoid Cyme – curled like scorpion's tail

Onosmodium

Spathe and Spadix – large bract surrounding dense fleshy spike

Xanthosoma sagittifolium

Plant Reproduction : Alternation of Generations

Diploid
Sporophyte
2n

Haploid
Gametophyte
1n

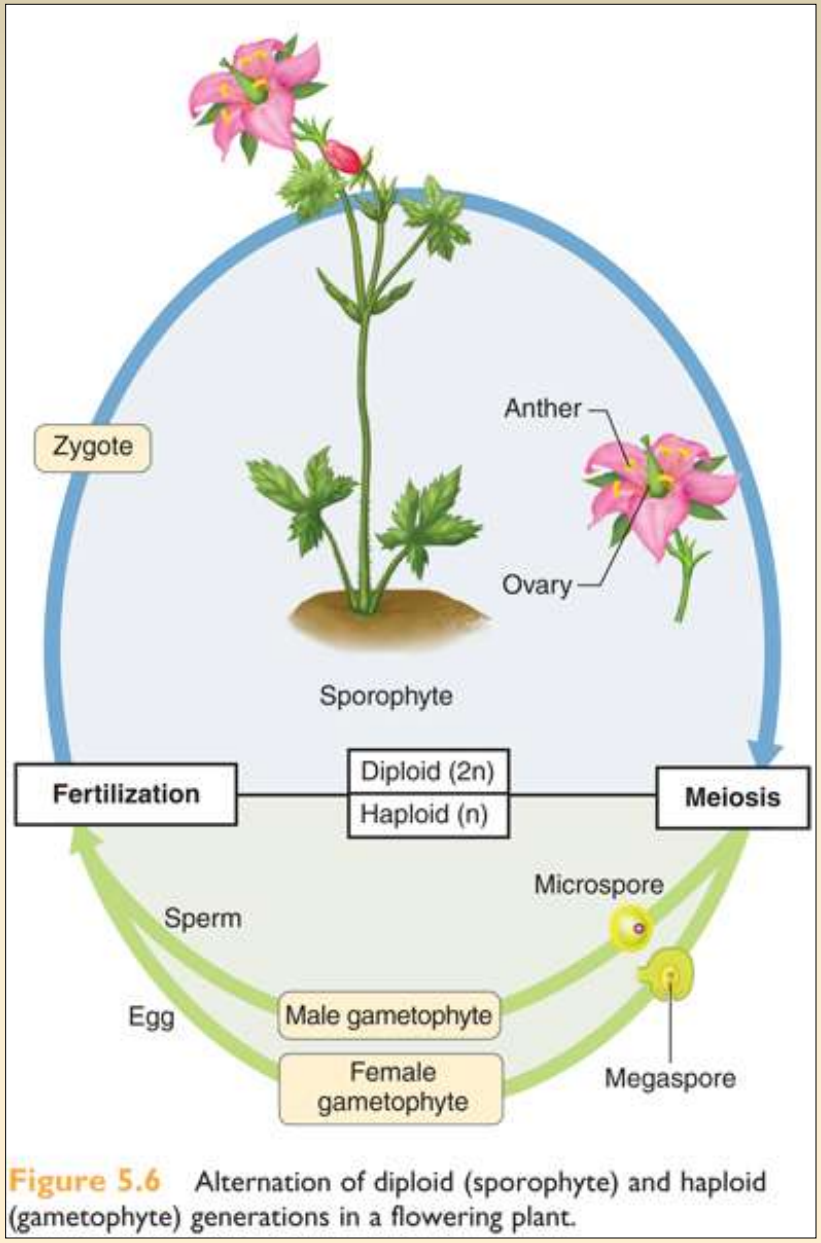
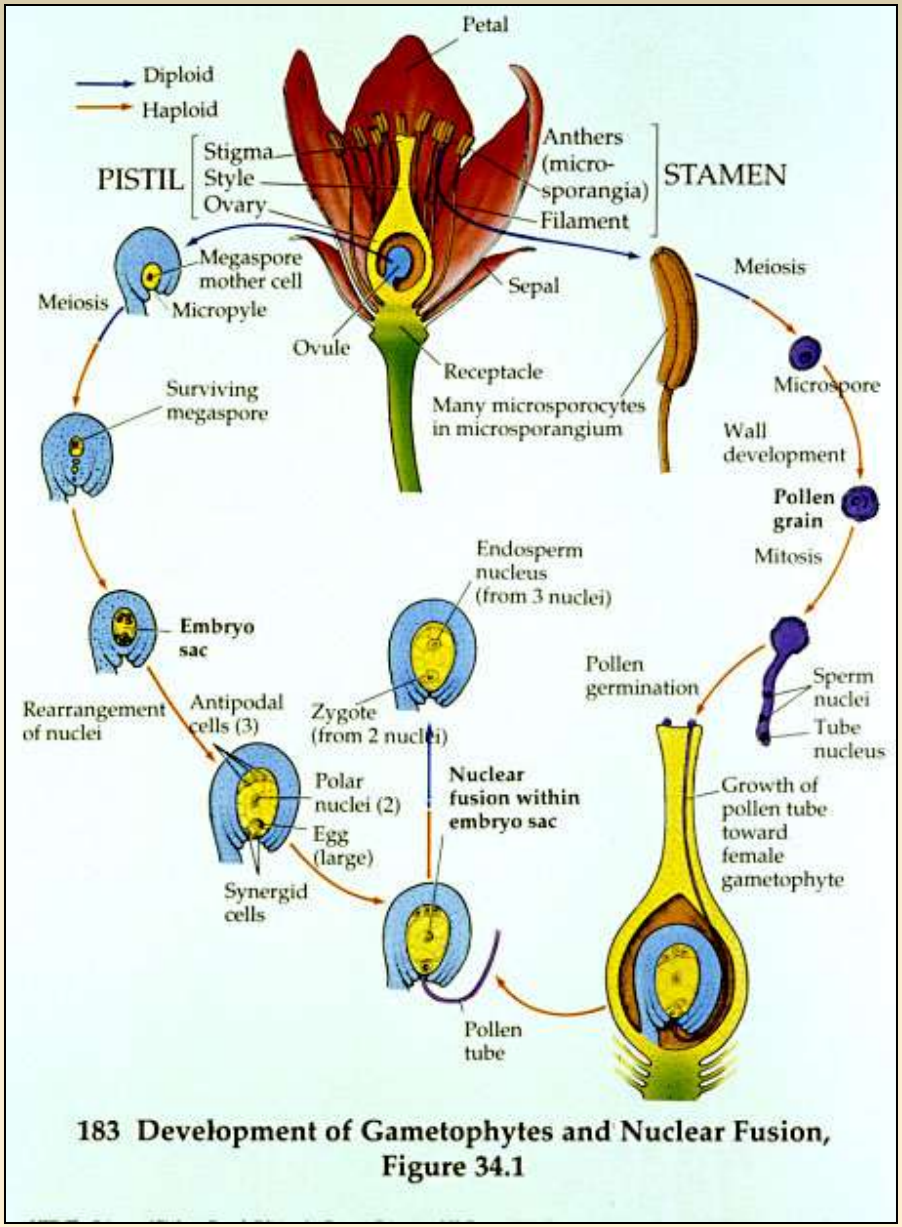


Figure 5.6 Alternation of diploid (sporophyte) and haploid (gametophyte) generations in a flowering plant.

Plant Reproduction

Megasporogenesis formation of haploid egg cell in ovule



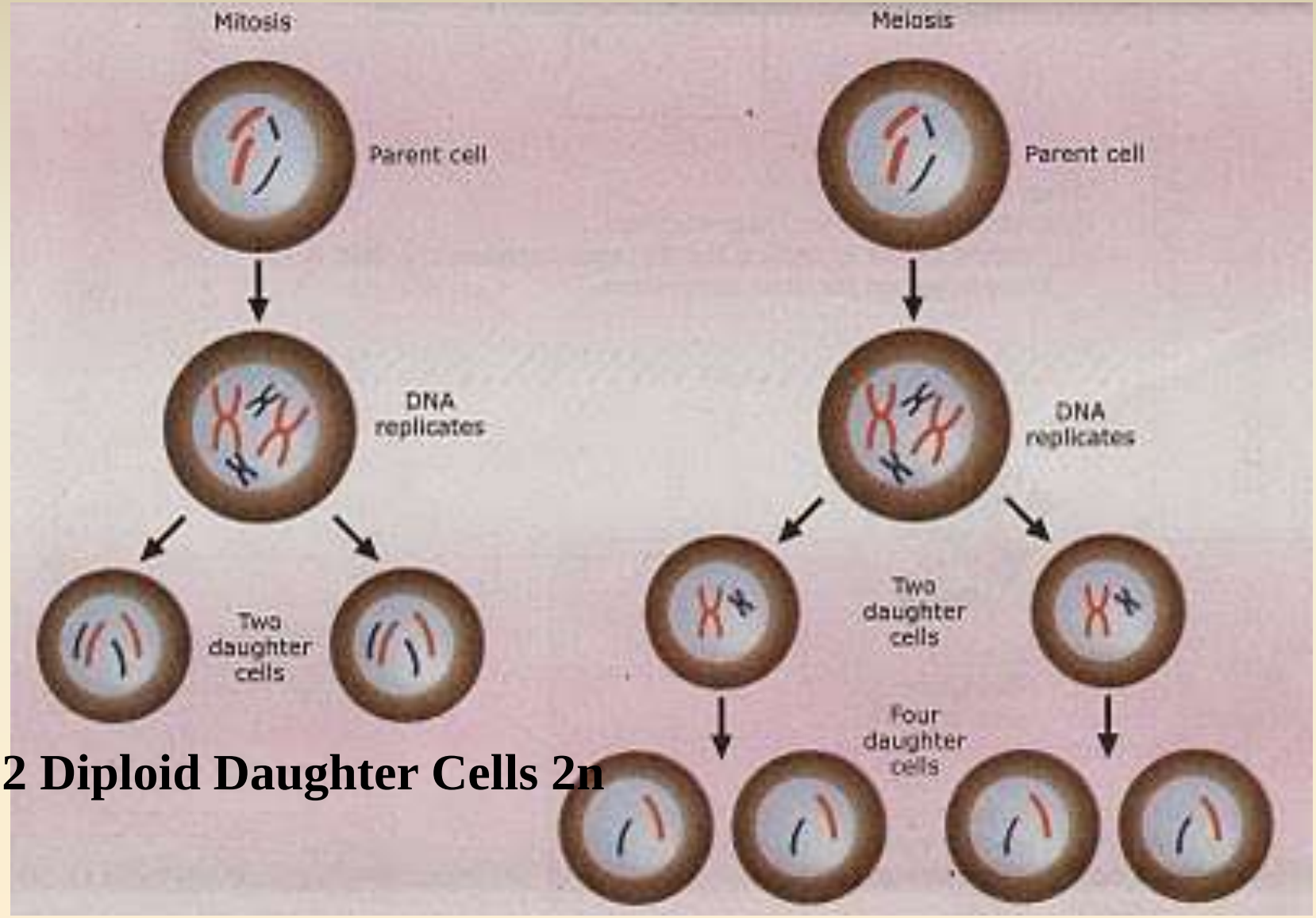
183 Development of Gametophytes and Nuclear Fusion, Figure 34.1

Microsporogenesis

formation of haploid pollen grains in anther

Mitosis

Meiosis



2 Diploid Daughter Cells 2n

4 Haploid Gametes 1n

Meiosis I and Meiosis II

DNA duplicates once, divides twice

Diploid to haploid cells

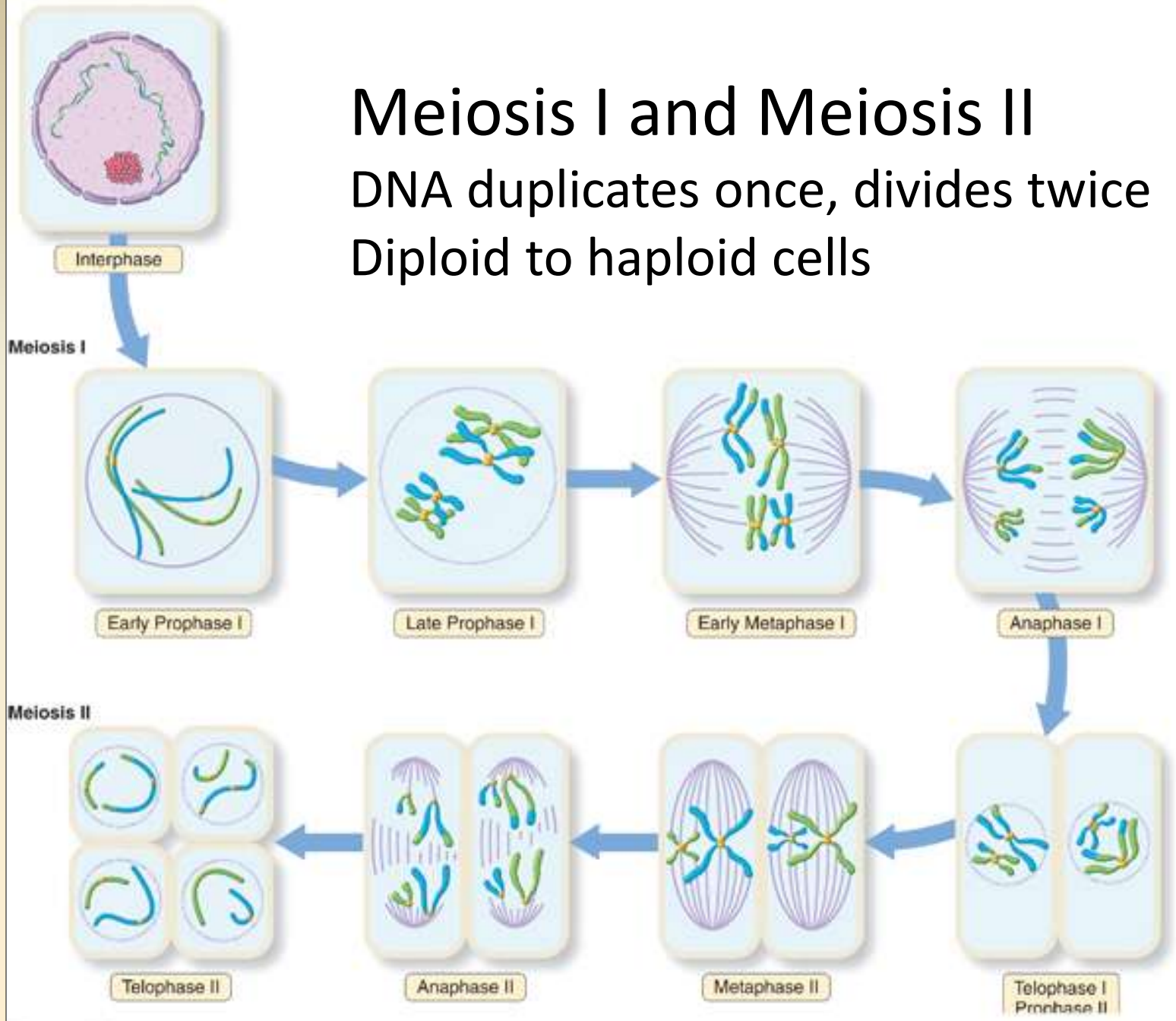
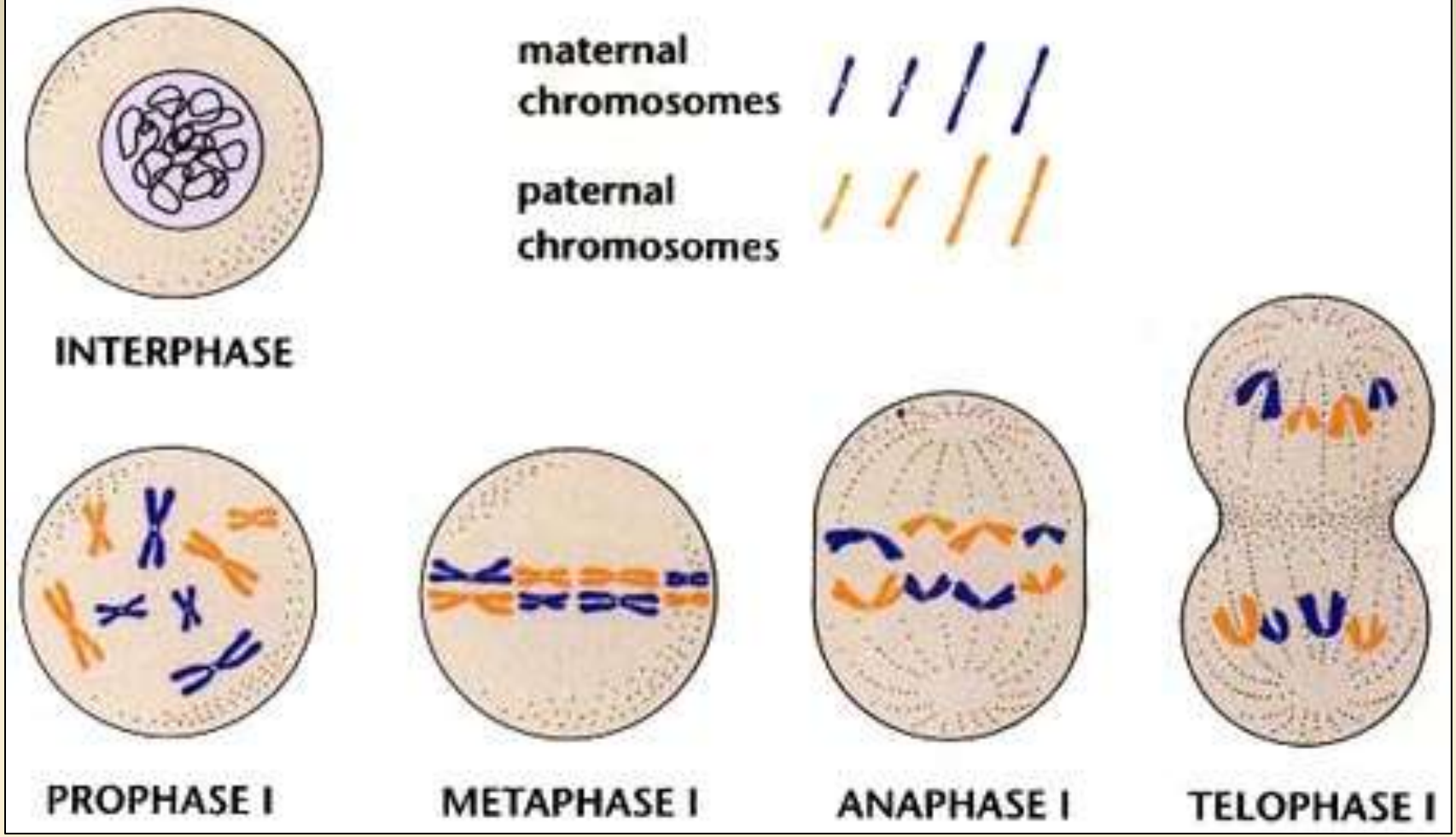
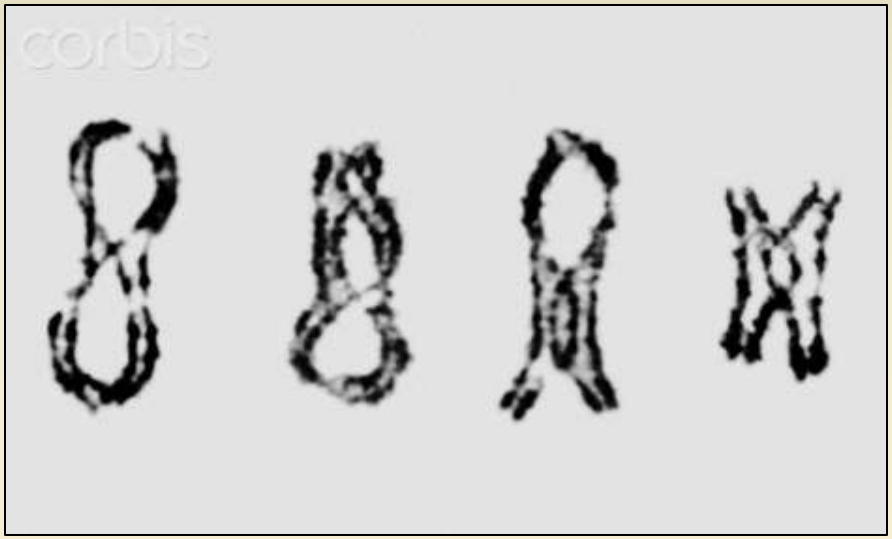


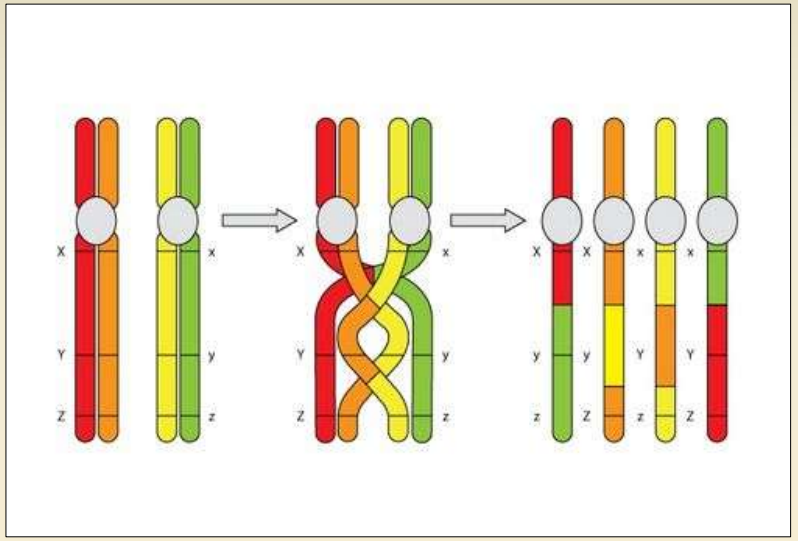
Figure 5.7 Stages of meiosis.

First Division of Meiosis



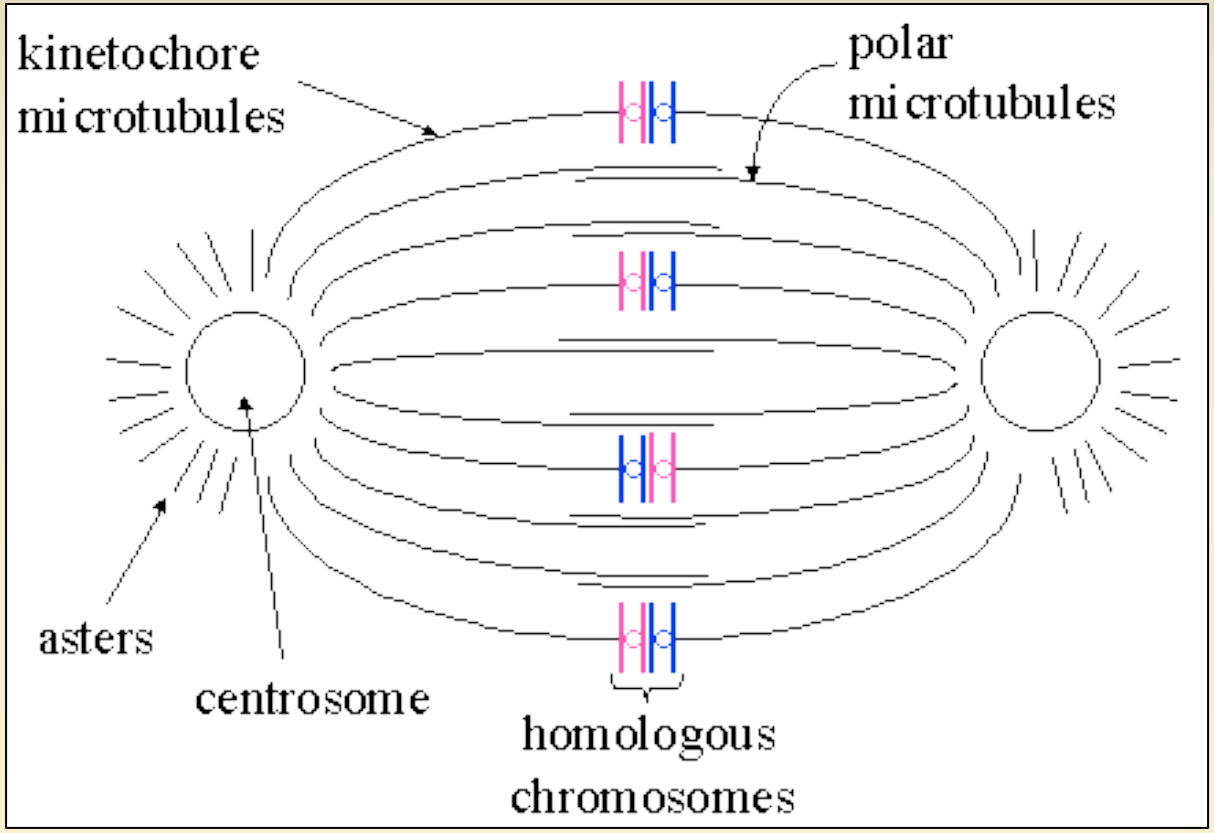
Chiasma and Crossing Over
DNA sections exchanged between chromosomes





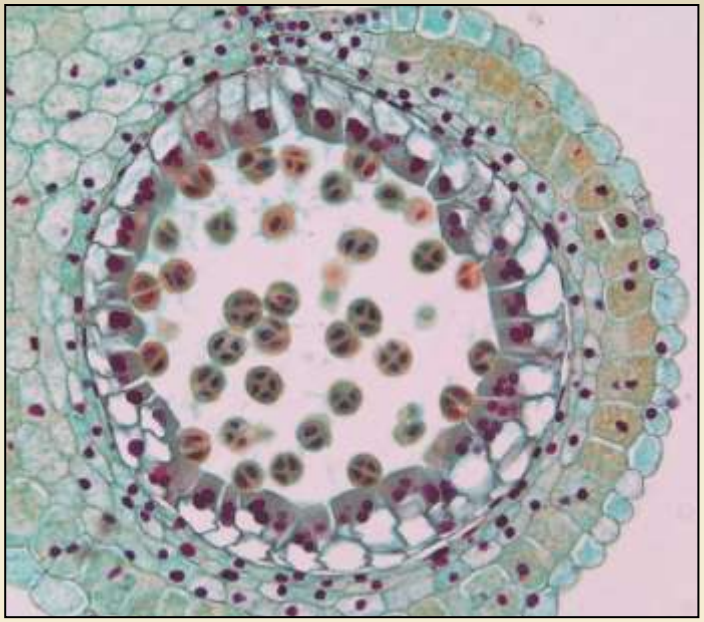
Leads to genetic variation in offspring

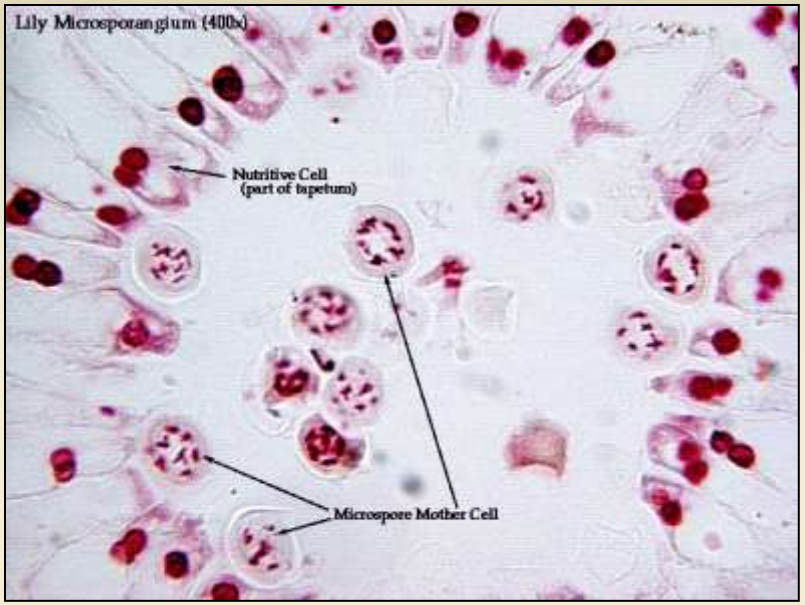
Metaphase I – random orientation of homologous pairs
Chromosomes from parents get mixed up in offspring

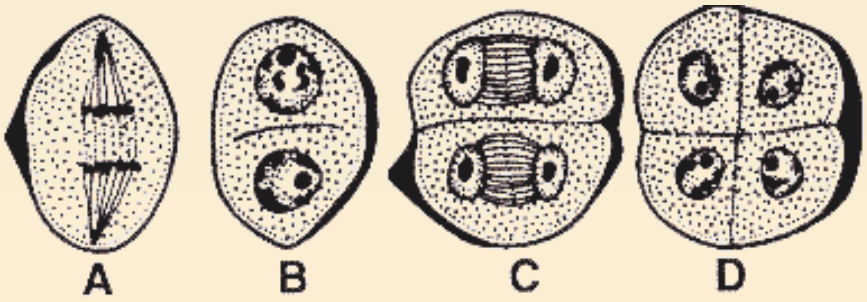


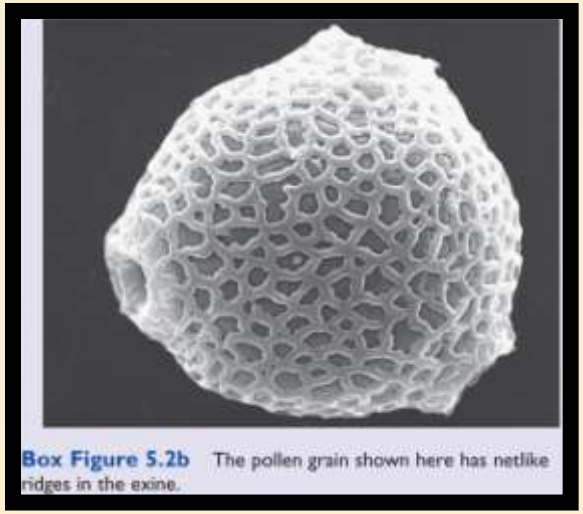
Leads to genetic variation in offspring

Pollen Mother Cells in Anthers
Undergo meiosis, produce 4 haploid pollen grains

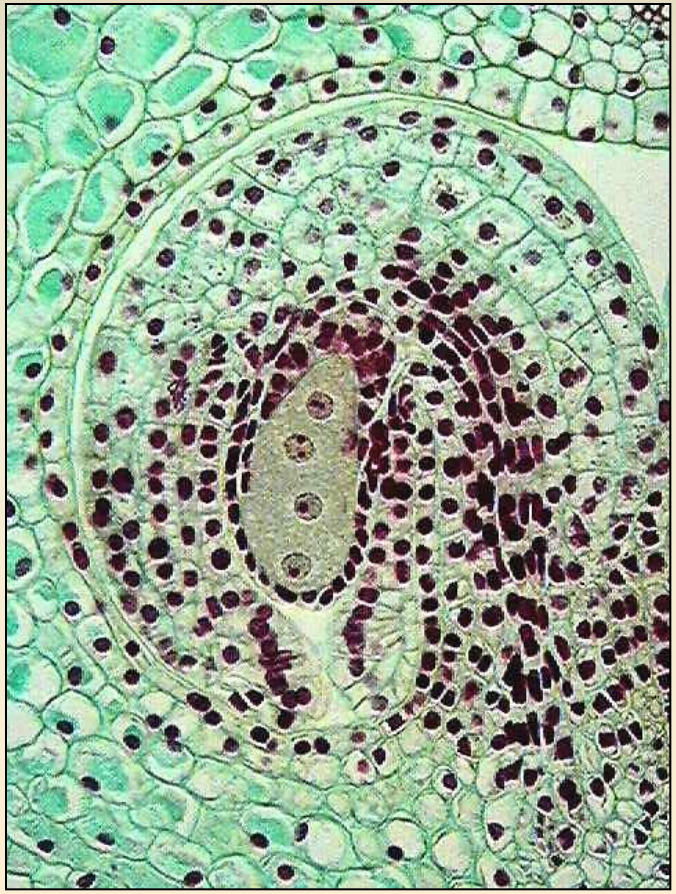








Megaspore mother cell in ovule undergoes meiosis
Produces haploid egg cell in embryo sac



Pollination

bees, birds, butterflies, moths, insects, wind,

(a)

(b)

Figure 5.9 Flowers and their animal pollinators. (a) Butterfly-pollinated flowers have a broad expanse for the butterfly to land. (b) Hummingbird-pollinated flowers are often tubular, allowing the bird to insert its beak to reach the nectar.

Bee Pollination

Bumblebee pollinating beebalm – Monarda sp.

Nectar guides for honeybees

With visible light **with UV light**

Bees can see in the UV spectrum

Fly Pollination

Cyrtid fly pollinating a composite

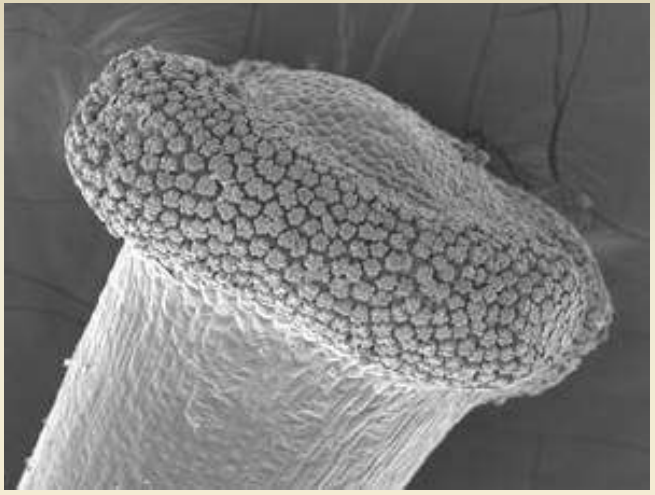
Hummingbird pollination

Bat Pollination

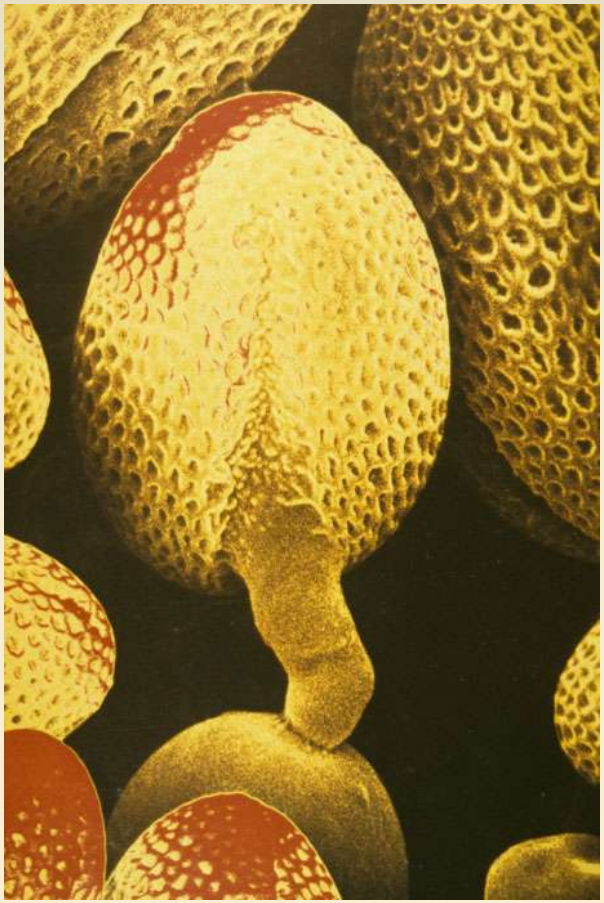
Wind Pollination

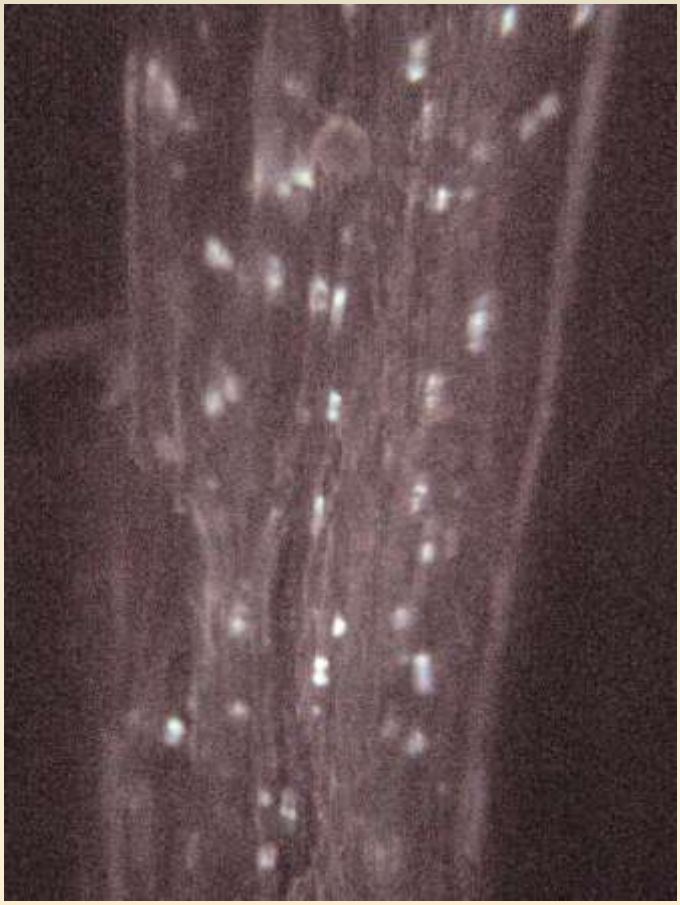
Box elder – wind pollinated – female left, male right

Stigmas - with pollen grains

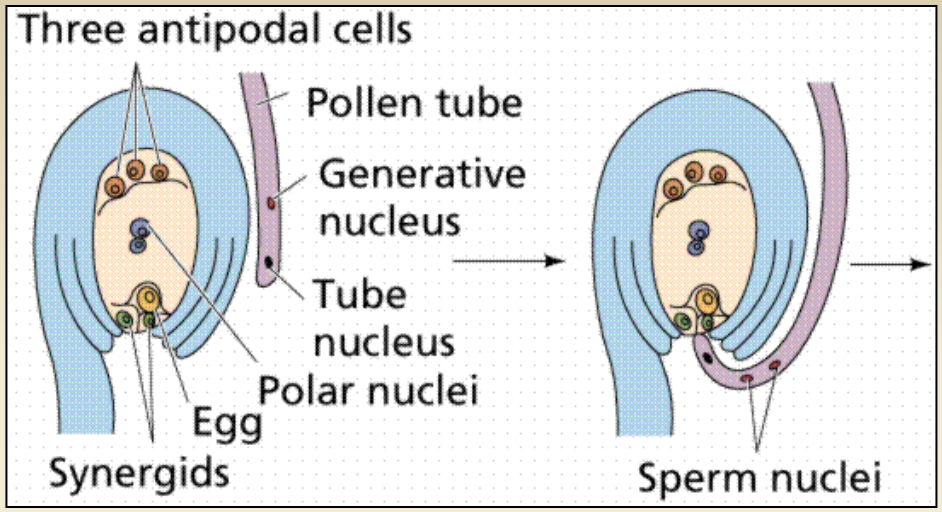


Pollen germination on Stigma
Pollen tube growth, sperm nuclei move to egg cell in ovule

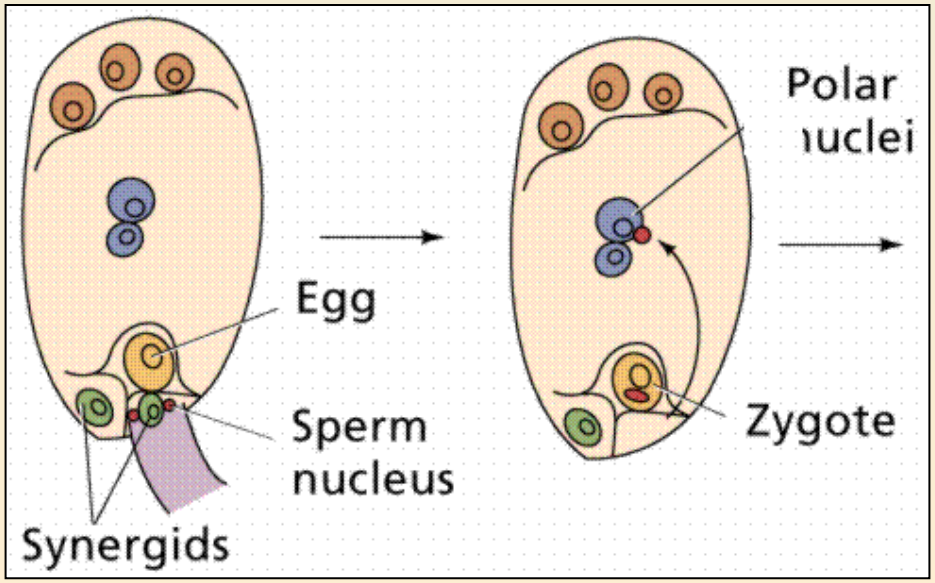




Double Fertilization – characteristic of Angiosperms

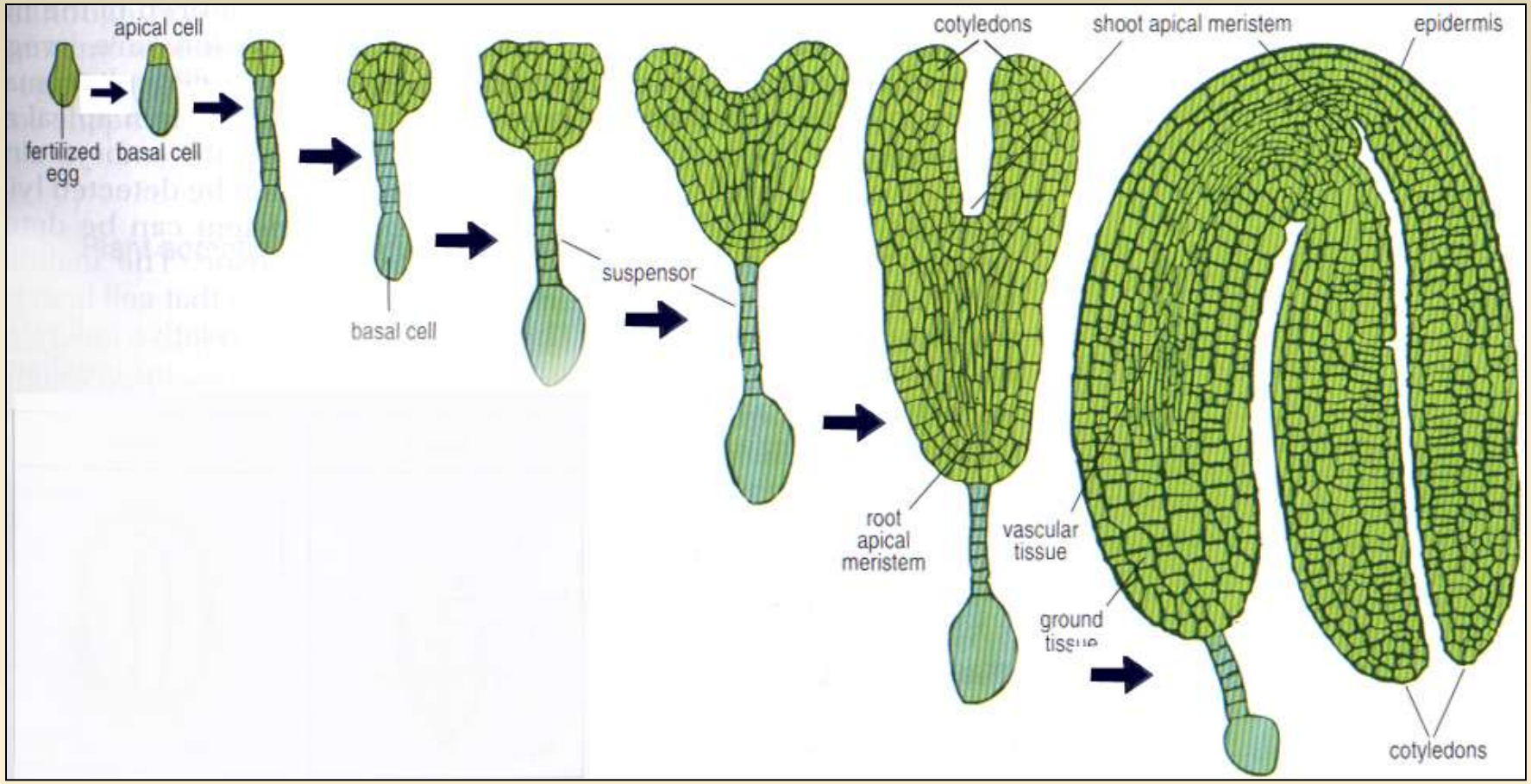


Fertilized egg becomes the embryo



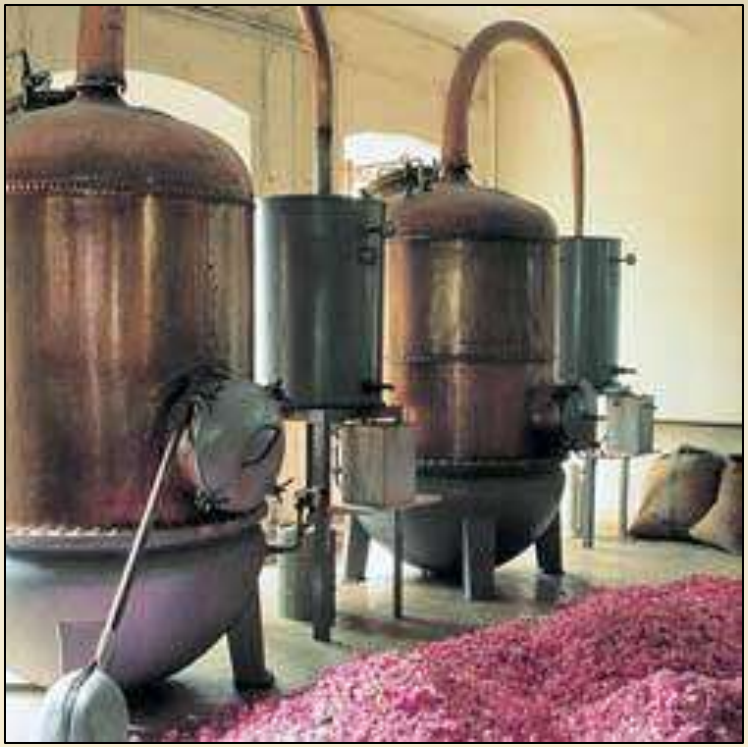
Fertilized polar nuclei become triploid endosperm

Growth and Development of Embryo



Flower Scents to attract Pollinators
Essential Oils for Perfume Industry

Box Figure 5.3 Rose petals undergo distillation to extract rose oil, one of the perfume industry's most valued scents.



Nectar, Pollen and Pollinators

Box Figure 5.2c Pollen has symbolic meaning to several Native American tribes. This painting by Harrison Begay illustrates a Navajo woman gathering corn pollen. ("Navajo woman and child gathering corn pollen," Harrison Begay, 0237.48 from the Collection of the Gilcrease Museum, Tulsa.)

Bee Hives and Orchard Crops

End