BLY 122
Chapter 40 Plant reproduction

I. An Introduction to Plant Life Cycles

A. Sexual Reproduction in Angiosperms
1. Sexual reproduction involves two processes.
a. Meiosis—a reduction division that generates haploid gametes.
b. Fertilization—fusion of gametes.
c. Gametes are formed in flowers.
2. Location of male and female reproductive organs is variable.
a. Flowers with both male and female organs are perfect.
b. Flowers with either male or female organs are imperfect.
c. In monoecious plants, separate male and female flowers are located on the same plant.
d. In dioecious plants, male and female flowers are located on different plants.

B. Plant Life Cycles—an Alternation of Generations
1. Two multicellular generations comprise the plant life cycle.
a. The generation composed of diploid cells is the sporophyte.
b. The generation composed of haploid cells is the gametophyte.
2. Relationship between the generations varies between plant groups.
a. In mosses and liverworts the sporophyte generation is small, short-lived, and dependent on the gametophyte for nutrients.
b. In flowering plants the gametophyte generation is small, short-lived, and dependent on the sporophyte for nutrients.

C. Asexual Reproduction
1. Asexual reproduction leads to new individuals without meiosis and fertilization.
2. Offspring produced are clones—genetically identical to the parent plant.
a. Same pairs of alleles are found in same combinations as in parents.
b. No new alleles are introduced from other individuals.
3. Asexual reproduction is efficient and rapid.
a. Asexually produced offspring can grow quickly and fill niches before competitors arrive.
b. Parent plant can provide nutrients for early development.
4. Plants reproduce asexually in various ways.
a. Rhizomes are horizontal underground stems with nodes that produce shoots and roots.
b. Corms are belowground stems that form new individuals.
c. Plantlets are formed from meristematic tissue on leaf margins of some plants
5. Genetic similarity of asexually produced individuals makes them more vulnerable to disease-causing agents.

II. Initiation of Flowering—Depends on External and Internal Signals

A. External Cues
1. Effect of day length
2. Moisture plays a significant role, especially when day length is not a cue.

B. Internal Cues
1. Hormones
2. Nutritional status

III. Flower Anatomy

A. Flowers are composed of four basic parts.
1. Sepal—outermost whorl of floral parts arranged around the receptacle
a. Green, slightly thickened leaflike structures
b. May protect young buds from damage

2. Petals—collectively called the corolla
    a. Brightly colored parts arranged in whorl interior to sepals
    b. Advertise flower to animals
    c. May have nectary with sugary nectar gathered by animals
3. Stamens—male reproductive structures
    a. Anther—terminal portion of stamen where meiosis occurs and male gametophytes form
    b. Filament—stalk that supports the anther
4. Carpels—female reproductive structures
    a. Stigma—terminal portion of carpel
    b. Style—stalk of the carpel
    c. Ovary with one or more ovules inside
    d. Ovule is location of meiosis and female gametophyte formation.

IV. Pollination and Fertilization

A. Pollination is the transfer of pollen from anther to stigma.
1. Male gametophyte and female gametophyte are brought together.
2. Self-pollination, a type of inbreeding, refers to the fusion of gametes from the same individual.
    a. Self-pollination has advantages and disadvantages.
    b. Some plants genetically block self-pollination to ensure outcrossing.
    c. Outcrossing occurs when gametes from different individuals of the same species fuse.
3. Animals, especially insects, are common vectors that transfer pollen from one individual to another.
4. Relationship between animal pollinators and flowers is mutualism.
5. Some plants use "deceit pollination" to trick pollinators without receiving a reward.
6. Pollination by wind occurs in conifers and some angiosperms.

B. Pollination was an important innovation in plant evolution.
1. The first lineages of plants to evolve had flagellated male gametes that swam to the female gamete.
2. Extant mosses, liverworts, ferns, and other plant groups that require water for fertilization are dependent on wet habitats.
3. The evolution of pollination enabled plants to colonize and survive in drier environments.
4. Pollination by animals made sexual reproduction a more precise and more efficient process.
5. Insect pollination is associated with the evolution of new flower and insect species.

C. Pollen-tube growth is followed by double fertilization.
1. Compatible pollen germinates on stigma and forms a pollen tube.
2. Generative cell within pollen tube divides by mitosis to form two sperm nuclei.
3. Pollen tube enters ovule at the micropyle and releases sperm nuclei.
4. Double fertilization occurs.
    a. One sperm nucleus fuses with egg nucleus to form a diploid zygote; the zygote divides by mitosis to form an embryo.
    b. One sperm nucleus fuses with polar nuclei to form a triploid cell; the triploid cell divides by mitosis to form the endosperm, a nutritive tissue.

V. Seed and Fruit Development

A. Embryo develops within ovule.
1. Zygote divides to form two daughter cells.
    a. Terminal cell produces cells of embryo.
    b. Bottom cell forms row of cells that transport nutrients from parent to embryo.

B. Ovary develops into a fruit.
1. Ovary cells surrounding the developing seeds form the pericarp.
2. Mature pericarp with seeds inside is the fruit.
3. Fruit has a variety of functions:
    a. Protect seeds from mechanical damage and seed predators.

b. Provide nutrients for early seedling development in some plants.
c. Aid in dispersal from the parent plant.

C. Seed Dormancy and Seed Germination

1. Dormancy occurs in seeds of plants that grow in seasonal environments.
   a. Seeds can remain viable until conditions are favorable for growth.
   b. No single factor is responsible for initiating and maintaining dormancy.
2. Numerous environmental cues break dormancy.
   a. Scarification (breaking) of the seed coat
   b. Cold, wet conditions
   c. Light: red-light exposure for small seeds
   d. Chemical requirement: a component in smoke from fires
3. Germination occurs when dormancy is broken and environmental conditions are favorable.
   a. Three phases of water uptake occur during germination.
   b. Monocot and dicot seedlings germinate differently.
   b. Seedling is established when it is photosynthetically independent and no longer relies on stored food reserves in the seed.

Chapter Vocabulary

flowers
seeds
angiosperms

sexual reproduction
meiosis
fertilization
sperm
egg
zygote
outcrossing
self-fertilization
inbreeding
self-incompatible

haploid
diploid
alternation of generations
sporophyte
gametophyte
sporangia
gametangia
spore
gamete

asexual reproduction
clones
rhizome
stolon
runner

corms
plantlets

florigen
reporter gene

perfect
imperfect
pollination
monoecious
dioecious

sepals
petals

receptacle
corolla
nectary
nectar
stamen
anther
filament
pistil
stigma
style

female gametophyte
megasporocyte
megasporangium
megaspores
ovary
ovule

embryo sac
micropyle

male gametophyte
microsporocyte
microsporangium
microspores
pollen grain
vegetative cell
generative cell
pollen tube

germination
double fertilization
endosperm
seed
seed coat
fruit
pericarp
cotyledons
hypocotyl
radicle
epicotyl
dormancy
scarify
abscisic acid
cross pollination
outcrossing
self-pollination