

FLOWERING PLANT REPRODUCTION

I. Reproduction in Flowering Plants

A. Two Prominent Phases in Flowering Plant Life Cycles:

1. Vegetative (Asexual): reproduction by growth of a parent plant's body or body fragments; involves no gametes nor spores.
 - a. occurs widely in nature or is artificially carried out by humans.
 - b. vegetative structures or organs include roots, stems, and leaves which are normally concerned with nutrition & growth of the plant body.
 - c. offspring are genetically identical (clones).
 - d. significant when environmental conditions are favorable and stable
2. Sexual: complex production and growth of the flower, pollination, production of gametes, fertilization, and development of the embryo, seed, and fruit.
 - a. chief advantage: forms new genetic combinations in each generation; not necessarily favorable.
 - b. seeds can disperse over a wide area utilizing fruit attractors.
 - c. the flower is the sexual organ comprised of a stem with a group of modified leaves specialized for reproduction.

B. Vegetative Reproduction

1. Sexually produced offspring are often less suited to the immediate environment than the parent plant due to its genetic makeup.
2. In many cases, it is advantageous for plants that are well adapted to their immediate environment to spread rapidly by vegetative growth & cover a surrounding area with individuals of the same genetic makeup (clones); Examples include cattails & many grasses.
3. Perpetuates a favorable combination of genes.
4. Most are based on the plant's ability to form adventitious roots or shoots.
 - a. adventitious: plant organs, such as shoots or roots, produced in an unusual position or at an unusual time of development. Examples: buds generally originate on stems rather than on roots; buds form on roots of cherry, pear, apple and black locust which can form aerial shoots called "suckers"; also, roots that sprout from stems.
5. Characteristics of vegetatively produced offspring:
 - a. remains attached to the parent plant for a time, then separates when the parent plant dies.
 - b. are larger than sexually produced offspring.
 - c. are almost always an evolutionary success, whereas seeds are risky.
 - 1) are adapted to the immediate local environment & can spread quickly where the parent plant is growing.
 - 2) seeds experience high mortality from predation & dispersal to unfavorable habitats.
 - d. when cultivated by humans, asexual propagation ensures the retention of desirable features.
6. Flowering plants have evolved many methods of asexual reproduction of which a great number of asexual structures are modified stems:
 - a. Rhizome: horizontal underground stem that may or may not be fleshy for storing food; resemble roots, but are really stems due to the presence of scalelike leaves, buds, nodes, & internodes; frequently branch in different directions; older portion dies through time separating the two branches into distinct plants; irises, bamboo, May apple, Solomon's seal, perennial grasses, cattails, and ferns.
 - b. tuber: underground stem greatly enlarged or swollen for storage; potato "eye" represents a lateral bud that forms at a node capable of growing into new roots and shoots.
 - c. bulb: shortened underground stem with attached fleshy storage leaves; globose or round, covered by paper-like bulb scales: lilies, tulips, onions, daffodils.
 - d. stolon: or runners are above ground horizontal stems (grow along surface) with long internodes; adventitious buds develop along a stolon with each giving rise to a new daughter plant: (new roots and shoots) strawberry, lily of valley, mints, perennial grasses, wild morning glory, water hyacinth, Boston fern, spiderplant, crabgrass, Kudzu, and the potato plant.
 - e. suckers: aboveground stems that develop from adventitious buds on the roots; each sucker grows roots at its base & becomes an independent plant when parent dies: black locust, pear, apple, cherry, red raspberry, blackberry; many weeds have this capability contributing to their difficulty to control.
 - f. corns: superficially resemble bulbs; has no fleshy leaves and consists mostly of stem with a few papery, brown nonfunctional leaves on the outside, and adventitious roots below; examples: gladioluses, crocuses, other popular garden plants.
 - g. cladophylls: flattened, photosynthetic stems that resemble leaves; cacti
7. Techniques of vegetative propagation:
 - a. Layering: propagating adventitious roots from stems that are still attached to the parent plant (suckers); examples: raspberries, blackberries, rhododendrons, rose, and honeysuckle.
 - b. Cuttings: a vegetative part, usually a stem or a root that has been removed and rooted in sand under the proper conditions of warmth and moisture: cacti

- 1) Cutting a potato (tuber) into pieces each containing an "eye" (bud) & then replanting.
 - c. Grafting: attaching a twig of one plant to a root or stem of another; examples: fruit trees, grape vines, rose bushes.
 - d. Spraying plant with hormones, such as auxins or gibberellin, to produce seedless fruit; examples: pineapples, bananas.
- C. Sexual Reproduction
1. Sexual organ is the flower: a stem containing a group of modified leaves specialized for reproduction.
 - a. cells in the apical meristem differentiate and become flower parts in response to hormonal changes triggered by:
 - 1) the length of light or dark period that a plant receives each day
 - 2) temperature and moisture
 - 3) a plant's stage of maturity
 2. Flower parts:
 - a. receptacle: base of the flower and its parts
 - b. sepals: outermost leaves, typically green, providing protection
 - c. petals: innermost leaves, typically large & showy, sometimes brilliantly colored to help attract pollinators.
 - d. inside the petals are found stamens: male structure containing microsporangium functioning to produce pollen (immature male gametophytes).
 - 1) Comprised of a stalk-like filament and an anther (chamber where pollen develops).
 - e. in the flower's center is found the pistil which is comprised of a single or fused carpel (female reproductive structure which may be separate or fused together with others into a single structure called a pistil; ovule-bearing; may be one or more)
 - 1) a carpel contains megasporangium (ovule) which functions to produce the female gametophyte.
 - 2) a carpel is comprised of three main parts:
 - a) stigma: sticky top part for receiving pollen
 - b) style: stalk connecting stigma to the ovary
 - c) ovary: encloses one or more ovules
 3. Seed Structure (Angiosperms): production of a young plant embryo complete with stored nutrients in a compact package
 - a. Seed coat on the exterior for protection; seeds may be further enclosed in a fruit
 - b. Endosperm food storage tissue (starchy) for nutrition: most striking difference is size or presence of endosperm which represents difference between monocots & dicots of angiospermae
 - 1) monocots retain endosperm
 - 2) dicot's endosperm is replaced by two cotyledons
 - 3) endosperm is triploid
 - c. Embryo (new diploid sporophyte)
 4. Monocot seed: Corn
 - a. Presence of one embryonic "seed leaf" or cotyledon (called a scutellum in corn and grasses) which functions to absorb digested food from the endosperm
 - b. Bulk of the seed is the starchy endosperm that forms separately from the embryo while the seed is still attached to the parent plant (female gametophyte)
 - 1) Embryo is either surrounded by or off to one side of the endosperm
 - c. Under the protective seed coat lies the aleurone layer, which functions as a digestive organ in seed germination
 - d. Monocot seeds with fruit (corn) have a pericarp, a part of the fruit, closely attached to the seed coat: the two peel off together as the "skin" of a corn kernel
 - e. Above the cotyledon is the shoot apex or plumule which includes the future shoot tip with the first foliage leaves (will develop into the first "leafy" leaves) wrapped above the apical meristem; a tough sheath, the coleoptile, protects the leaves and apical meristem from injury as the seedling pushes up through the soil; the leaves expand and rupture the coleoptile's tip.
 - f. The seedling's embryonic root is called the radicle (contains an apical meristem at its tips) and represents the first part of the plant to emerge when the seed germinates; the hypocotyl is located above the radicle and represents the short portion of the embryonic shoot connecting the radicle to the cotyledon
 - g. Grasses have the most complex seed of monocots
 5. Dicot seed: BEAN
 - a. Presence of two embryonic cotyledons attached to the embryo's main axis (in most dicots the cotyledons absorb the food-rich endosperm and serve as a large food storage organ; the endosperm is, therefore, absent.
 - b. Also found are the radicle and plumule
 - c. Presence of two apical meristems for growth and differentiation in the root and shoot system (one at the tip of the stem in the plumule, between the first foliage leaves for the shoot, and one at the tip of the radical for the root)
 - d. A hypocotyl is found above the radicle and is important in the initial plumule growth; it is the part of the embryo's main axis below the cotyledon's place of attachment.
 - e. Once the bean embryo has established roots in the soil, the shoot begins; the hook (due to hypocotyl growth) in the stem of the young seedling protects the delicate stem tip as it moves up through the soil.

6. Viable seeds do not germinate right after being shed, nor do they necessarily germinate during the following growing season
 - a. Seeds can lie dormant for many years before conditions are suitable for their germination
 - b. Different kinds of seeds require different internal or external stimuli to break dormancy and germinate
 - 1) most common factors are water, temperature, and light