

Kingdom *Plantae*

1. General
 - a. Basic characteristics of Kingdom *Plantae*
 - i. Plants are multicellular, autotrophic, eukaryotes.
 - ii. Possess cell walls made of a carbohydrate called **cellulose** and store food in the form of **starch**.
 - (1) The cell wall gives the plant cell strength and remains after the cell dies. In trees we call this wood.
 - iii. Have **chloroplasts** containing **chlorophyll** and other pigments.
 - iv. Most plants are terrestrial although there are some exceptions.
 - v. Plant life cycles have two alternating phases, a **haploid** (n) phase and a **diploid** (2n) phase. The diploid phase is called the **sporophyte** and produces spores, while the haploid is called the **gametophyte** and produces gametes. The term diploid means having a complete set of chromosomes. Haploid means having half a set of chromosomes.
 - b. The evolution of modern plants occurred in several stages:
 - i. Plants evolved from plant-like protists.
 - ii. **Non-vascular** plants (*e.g.*, mosses) have no system for transporting water or nutrients.
 - iii. **Vascular** plants have a system through which they can transport water and nutrients throughout the plant. This allowed the plants to be taller and live further from water.
 - (1) **Seedless** plants (*e.g.*, ferns) have a vascular system but reproduce using spores.
 - (2) **Seed** plants reproduce using seeds
 - (a) **Gymnosperms** (*e.g.*, pine) have seeds that are not enclosed.
 - (b) **Angiosperms** (*i.e.*, flowering plants) have seeds that are enclosed, usually in a fruit. This is, by far, the most successful group of plants. Angiosperms can be arranged in two groups:
 - (i) **Monocots** (*e.g.*, grasses, palms)
 - 1) Leaves have parallel veins.
 - 2) Embryos have one cotyledon.
 - 3) Root system fibrous.
 - 4) Flower parts are in multiples of three.
 - (ii) **Dicots** (*e.g.*, trees, most common plants)
 - 1) Leaves exhibit netlike veins.
 - 2) Embryos have two cotyledons.
 - 3) One main taproot.
 - 4) Flower parts are in multiples of four or five.
 - c. Inhabiting terrestrial habitats posed several problems in the evolution of plants.
 - i. Support
 - (1) Water holds a plant up but on land a support system is required.
 - ii. Getting water and nutrients.
 - (1) Large plant-like protists (*i.e.*, seaweeds) are surrounded by water and nutrients so most cells can just absorb them the environment. Terrestrial

- plants require a system for collecting and transporting water.
- (2) Plants developed root systems that can collect and transport water. Some plants have shallow roots which spread out to collect water.
 - (3) Water and minerals from the roots can travel to all parts of the plant and food made in the leaves can travel to nonphotosynthetic parts of the plant.
 - (4) The **Vascular tissue** conducts materials throughout plant.
 - (a) **Xylem**
 - (i) Dead at maturity, the hard walls provide support for the plant
 - (ii) The hollow cells form a continuous channel through the plant from the roots to the leaves and conduct water and minerals upward from the roots.
 - (b) **Phloem**
 - (i) Carry sugar from where it is made to nonphotosynthetic parts of the plant.
 - (ii) These cells are softer than xylem and are living at maturity.
 - (5) Transpiration is the loss of water from the leaves of plants.
 - (a) **Cohesion** is the property of water molecules to be attracted to one another. As water molecules move, they pull on neighboring molecules. This creates a continuous chain of water molecules from the tips of the roots to each stomata in the leaves.
 - (b) The majority of water taken up by roots is lost to the air through the stomata in form of water vapor. Water moving into the mesophyll cells pulls water from leaf veins. These water molecules are replaced by those moving from the stem, which are, in turn, replaced by molecules absorbed by the roots. In order to perform photosynthesis, plants must have continual source of water.
 - (c) In plants, this pulling of water molecules on other water molecules by cohesion is called the **transpiration-cohesion-tension** theory of how water moves up a plant.
 - (6) Absorption of water by roots
 - (a) Most water enters through root hairs.
 - (b) The solutes in root hairs maintain the movement of water into the roots by osmosis. This is called **root pressure**. Transpiration-cohesion-tension then keeps the water moving upward through the plant.
 - (c) Remember that the solutes in the roots are taken up by active transport.
 - (7) **Translocation** is the movement of food from one part of the plant to another. It is described by the **pressure-flow** hypothesis.
 - (a) Sugar is loaded into phloem of leaf veins by active transport. Water follows by osmosis, increasing the pressure in the phloem tube.
 - (b) The pressure pushes the sugar solution through the phloem. As more sugar is loaded in and more water enters, the process continues.
 - (c) As the solution moves throughout the plant, cells that need the sugar remove it from the phloem. Water moves out by osmosis. This makes space for more solution to flow to those cells.
 - (d) Loading and unloading the sugar requires energy but the movement

- of the solution is passive.
- (e) The result is that the sugar made by photosynthesis moves throughout the plant from where it is made (the **source**) to where it is stored or used (the **sink**).
 - (f) The sugar can be used as energy by cells or can be stored. In the spring, trees begin moving sugar from the roots back up to the shoot system as energy until leaves develop.
- iii. Drying out
- (1) **Epidermis** is the outermost layer and serves as a protective covering for the plant.
 - (2) In the above ground parts of the plant, the epidermis is covered by the waxy **cuticle**. The cuticle prevents water loss and infection.
 - (3) Openings in the leaves called **stomata** allow passage of gases for photosynthesis but can be closed when it is too warm.
 - (4) Gymnosperms have very narrow leaves (the needles) to minimize water loss.
- iv. Spreading reproductive cells
- (1) Plants progressed from a dominant gametophyte to a dominant sporophyte because the gametophyte produces gametes which require water to swim.
 - (2) **Spores** - Tiny reproductive cells that be carried long distances by the wind.
 - (3) **Seeds** - The seed is surrounded by a tough, drought-resistant, protective covering for the embryo. Food packaged in the seed provides energy for the young plant until it can grow above the soil and begin photosynthesizing.
- d. The success of angiosperms is due to the flower and the fruit as well as their co-evolution with insects to improve pollination.
- i. Flowers increase the efficiency of pollination.
 - (1) Pollinators locate flowers by odor, shape, color, and texture. The pollen is also a food source for bees which attracts them to the flower. While collecting pollen, bees get it on their legs and carry it to another plant. Some flowers are pollinated by insects such as butterflies and moths which have mouthparts specialized for collecting nectar.
 - (2) Flowers are often shaped so that non-pollinators cannot reach nectar or pollen. For example, hummingbird-pollinated flowers are long, and shaped like the bill of a hummingbird.
 - (3) Wind-pollinated flowers are small, have no petals and little color and do not produce nectar.
 - ii. Adaptations of seeds help in their dispersal.
 - (1) Some seeds are carried by wind or water, while others stick to the fur of animals or are eaten.
 - iii. Fruit is a very efficient way of dispersing seeds.
 - (1) Fruit is very attractive to animals and when they eat the fruit, they also ingest the seeds. The indigestible seeds pass through the animal's digestive tract and are deposited elsewhere.