

Plant Kingdom

Characteristics of the Plant Kingdom;

- ❖ eukaryotic,
- ❖ multicellular,
- ❖ sexually reproducing organisms
- ❖ autotroph
- ❖ feed themselves by photosynthesis

Facts about members of this kingdom

- ❖ the dominant organisms on the surface of the earth
- ❖ about 263,500 species of plants today
- ❖ Today's plants probably came from green algae
- ❖ Originally all were aquatic organisms not well adapted to living on land

Adapting to Terrestrial Living

- ❖ how to absorb minerals?
- ❖ how to conserve water?
- ❖ how to reproduce on land?

Plants require relatively large amounts of 6 inorganic minerals:

- ❖ N
- ❖ K,
- ❖ Ca,
- ❖ Phosphorus,
- ❖ Mg,
- ❖ and Sulfur

Each of these minerals constitutes 1% or more of a plant's dry weight
Plants must absorb these materials, along with water, through their roots
the first plants were symbiotically involved with mycorrhizae

One of the key challenges to living on land is to avoid drying out

- ❖ a watertight outer covering called a cuticle
- ❖ water enters plants only through roots
- ❖ cuticle prevents water loss to the air
- ❖ specialized pores called stomata (singular, stoma)
- ❖ allow passage for H₂O through cuticle
- ❖ found in the leaves and, sometimes, the green portion of stem
- ❖ allow for the passage of CO₂ into the plant for photosynthesis and H₂O vapor and O₂ to pass out

Reproducing sexually on land presented special challenges

- ❖ as plants could not move, it was necessary for plants to pass gametes from one individual to another
- ❖ the first plants needed a film of water for a sperm to swim to an egg and fertilize it
- ❖ later, pollen evolved, providing a means of transferring gametes without drying out

Plant Evolution**key evolutionary advances in the evolution of the plant kingdom**

- ❖ Roots

- ❖ vascular tissue

- ❖ transports water and nutrients through the plant body and provides structural support

- ❖ seeds
 - provide nutrients and protection for the plant embryo until it encounters favorable growing conditions

- ❖ flowers and fruits
 - improved the chances of successful mating in sedentary organisms and facilitated dispersal of their seeds

Nonvascular Plants

- no vascular system
- size of the plant limited because all materials had to be transported by osmosis and diffusion
- only 2 phyla of living plants completely lack a vascular system
- liverworts (phylum Hepaticophyta)
- hornworts (phylum Anthocerotophyta)
- a third phylum of plants has a simple conducting tissue system of soft strands
- mosses (phylum Bryophyta)

Vascular Tissues: specialized cylindrical or elongated cells that form a network throughout a plant

the earliest vascular plants grew by cell division at the tips of the stem and roots

primary growth made plants longer or taller

later vascular plants developed a new pattern of growth in which a ring of cells could divide around the periphery of the plant

secondary growth: plant stem increased in diameter

Seedless Vascular Plants

- ❖ 2 phyla of living-seedless-vascular plants
- ❖ ferns (phylum Pterophyta)
- ❖ in ferns, the sporophyte generation is much larger and more complex than the gametophyte
- ❖ the leaves of the sporophyte are called fronds
- ❖ club mosses (phylum Lycopphyta)
- ❖ crucial adaptation to life on land
- ❖ protects the embryonic plant when it is at its most vulnerable stage

Seed plants produce two kinds of gametophytes, male and female, which develop completely within the sporophyte

- ❖ male gametophytes are called pollen grains
- ❖ they arise from microspores
- ❖ a female gametophyte contains the egg within an ovule
- ❖ it develops from a megaspore
- ❖ There is no need for free water in the fertilization process
- ❖ pollination by insects, wind, or other agents transfers pollen to an ovule
- ❖ the pollen grain then cracks open and sprouts as a pollen tube, bringing sperm cells directly to the egg

All seed plants are derived from a single common ancestor

gymnosperms

- in these seed plants, the ovules are not completely enclosed by sporophyte tissue at the time of pollination

angiosperms

- the most recently evolved of all plant phyla,
- the ovules are completely enclosed in sporophyte tissue called the carpel at the time of pollination

Parts of a Seed

- Embryo
- Endosperm: a source for food for the developing embryo
- in some seeds, the endosperm is used up by the embryo and stored as food in structures called cotyledons
- Outer Covering: drought resistant

How did seeds help plants adapt to land?

- Dispersal
 - facilitates the migration and dispersal into new habitats
 - dormancy
 - permits plants to postpone development until conditions are favorable
- germination
 - controls when the plant develops so that it can be synchronized with critical aspects of the plant's habitat
- nourishment
 - provisions the seed during the critical period just after germination

Seeds allow plants to bypass the dry season

- ❖ Hard seed coats crack when wet by the rains.
- ❖ Seeds will not germinate during the dry season.

Gymnosperms

- ❖ Four phyla constitute the gymnosperms
- ❖ conifers (phylum Coniferophyta)
 - trees that produce their seeds in cones and most have needle-like leaves
- ❖ cycads (phylum Cycadophyta)
 - have short stems and palmlike leaves
- ❖ gnetophytes (phylum Gnetophyta)
 - contains only three kinds of very unusual plants
- ❖ ginkgo (Ginkgophyta)
 - only one living species, the maidenhair tree, which has fan-shaped leaves

The life cycle of conifers is typical of gymnosperms

conifers form two types of cones

- seed cones contain the female gametophytes
- pollen cones contain the pollen grains (male gametophytes)
- conifer pollen grains are dispersed by wind to the seed cones
- the fertilized seed cones produce seeds, which are also wind-dispersed
- the germinated seed will grow into a new sporophyte plant

Rise of the Angiosperms

- ❖ 90% of all living plant species
- ❖ virtually all of our food is derived, directly or indirectly, from angiosperms
- ❖ angiosperms use flowers to use insects and other animals to carry pollen for them
- ❖ fertilization is assured in a direct pollination from one individual of a species to another

The basic structure of a flower

- 4 concentric circles, or whorls, connected to a base (receptacle)
- the sepals form the outermost whorl and typically protect the flower from physical damage
- the petals are the second whorl and serve to attract pollinators
- 3rd whorl: stamens, contains male parts that produce pollen
- anther at the tip and contains pollen
- innermost whorl is the carpel (contains the “female” parts that produce the egg)
- ovules occur in the ovary (bulging base of the carpel)
- stalk called the style rises from the ovary and ends with a sticky tip called a stigma
- the stigma receives pollen

Why Are There Different Kinds of Flowers?/ Co-Evolution of Plants and Insects

Insects are specialists: a particular insect carries pollen from one individual flower to another *of the same species*

bees are the most numerous insect pollinator

Birds also pollinate some flowers, especially red ones

Grasses and some other angiosperms have reverted to wind pollination

Double Fertilization:

- ❖ Angiosperms produce a special, highly nutritious tissue called endosperm within their seeds

- ❖ the pollen grain contains two haploid sperm

- ❖ the first sperm fuses with the egg at the base of the ovary

- ❖ the second sperm fuses with polar nuclei to form a triploid endosperm cell, which divides faster than the zygote and gives rise to the endosperm tissue

- ❖ the process of fertilization to produce both a zygote and endosperm is called double fertilization

- ❖ In some angiosperms, the endosperm is fully used up by the time the seed is mature

- ❖ food reserves are stored by the embryo in swollen, fleshy leaves called cotyledons, or seed leaves

Dicots and monocots

- ❖ dicots have two cotyledon

- ❖ monocots have one cotyledon

Fruits improve seed dispersal

- ✓ A mature ovary that surrounds the ovule becomes all or part of the fruit
- ✓ a fruit is mature ripened ovary containing fertilized seeds
- ✓ angiosperms use fruits to have animals aid in the dispersal of seeds
- ✓ although eaten by animals, the seeds within the fruit are resistant to chewing and digestion
- ✓ they pass out of the animal with the feces, ready to germinate at a new location far from the plant
- ✓ some fruits are dispersed by water or wind