**Plant Diversity Guided Notes**

Plants have changed the world

Members of kingdom Plantae are nearly everywhere.

Plants harness the energy that sustains ecosystems. They also release O\_2, which consumers use for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Plants are essential for life

On land and in water, plants provide habitats and food to countless species of microbes, fungi, and animals.

Plants share a lineage with protists

All plants are multicellular, autotrophic eukaryotes that use photosynthesis to obtain energy.

Green algae are the closest relatives of plants

Charophytes are a group of modern green algae.

Biologists believe they are similar to the ancestors of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Green algae share many molecular features with plants

DNA sequences reveal a close evolutionary relationship.

Chloroplasts contain the same pigments.

Cell walls contain cellulose.

Both use starch as a storage molecule.

Green algae live in water, plants on land

The different environments select for different body types and reproductive strategies.

Plants are divided into four groups

Plants arose during the Paleozoic era and diversified into thousands of different species.

Modern-day plants include

Bryophytes

Seedless vascular plants

Gymnosperms

Angiosperms

Plants evolved key adaptations

The four plant groups are defined by a series of features that plants developed over time, including having vascular tissue, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and flowers/fruits.

A leaf is an adaption to life on land

Leaves capture sunlight and CO\_2 for photosynthesis. Plant leaves have evolved a cuticle to keep from drying out and stomata to allow gas exchanges.

Vascular tissue is an adaption to life on land

Plant vascular tissue is a bundle of tubes that transports water, minerals, and sugar throughout the plant.

A root is an adaption to life on land

Section 19.1

Roots below the ground absorb water and minerals while anchoring the plant in the soil.

All plants have similar life cycles

The similarity among plant life cycles is evidence that all plants share a common ancestor.

Plant reproduction is complex

Plant gametes and zygotes can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ grow into adult organisms and reproduce.

Plants alternate generations

A multicellular diploid stage alternates with a multicellular haploid stage.

The plant life cycle is called alternation of generations.

Sporophyte generation is diploid

A fertilized egg forms a diploid zygote, which develops by mitotic cell division into a multicellular, diploid plant called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Sporophytes produce spores

The sporophyte plant produces haploid spores by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Gametophyte generation is haploid

Spores divide by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into a multicellular, haploid gametophyte.

Gametophytes produce gametes

The haploid gametophyte produces gametes by mitosis.

Fertilization forms a zygote

The gametes fuse at fertilization, forming a diploid zygote and starting the cycle again.

The lifestyle of gametophytes varies through plant phyla

In simpler plants the gametophyte is larger and less dependent on the sporophyte; in more complex plants the reverse is true.

Pollen is an adaption to life on land

Seed plants produce \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which contains the male gametophyte. Pollination can occur without water, and often animals help spread the pollen to new plants.

A seed is an adaption to life on land

Seeds carry dormant plant embryos packaged with a food supply and protected from drying out. They can be dispersed long distances and remain dormant until conditions are favorable.

Flowers and fruit are adaptions to life on land

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ produce pollen and egg cells. Fruits develop after fertilization, to protect and disperse the plant offspring.

Bryophytes are the simplest plants

There are about 24,000 existing species of bryophytes, or “nonvascular” plants.

Mosses, hornworts, and liverworts are bryophytes.

Bryophytes are nonvascular and seedless

The earliest plants probably resembled modern bryophytes. Bryophytes have no vascular tissue, roots, leaves, seeds, or flowers.

Bryophytes are small, compact plants

Without vascular tissue and lignin (which strengthens the cell wall), bryophytes lack physical support.

Materials move from cell to cell within the plant by diffusion and osmosis.

They live in moist shady habitats where they will not dry out.

Bryophytes have a small sporophyte

The sporophyte is a stalk attached to the gametophyte.

The sporophyte produces spores that grow into new haploid gametophyte plants.

Bryophyte sexual reproduction requires water

Gametophytes have male and female structures that produce gametes (eggs and sperm). The sperm swim to the eggs.

Bryophytes also reproduce asexually

Mosses and liverworts produce structures called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which are small pieces of tissue that detach from the gametophyte and grow into new plants.

Seedless vascular plants have no seeds

There are about 12,700 existing species of plants with vascular tissue, but no seeds.

This phylum is composed of ferns and their close relatives.

Seedless vascular plants have true roots, stems, and leaves

Vascular tissue allowed these plants to grow much larger than bryophytes, which gave them an edge in competing for sunlight.

There are four groups of seedless vascular plants

Seedless vascular plants include:

Club mosses

Whisk ferns

Horsetails

True ferns

The earliest seedless vascular plants were probably modern club mosses

Fossil evidence suggests the first vascular plants originated around 425 million years ago. Club mosses are different from true mosses, which are bryophytes. They are placed in their own phylum.

Ferns and their relatives evolved later

Whisk ferns, horsetails, and true ferns make up a second phylum of seedless vascular plants that first appeared around 375 million years ago. Most, but not all, of these species live on land.

Seedless vascular plants have a conspicuous sporophyte

The sporophyte develops from a zygote, then grows up and out of the gametophyte.

As it matures, the sporophyte detaches and grows separately from the gametophyte.

Spores form under the leaves of the sporophyte

Haploid spores grow on the underside of sporophyte \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The spores form by meiosis and then develop into gametophytes.

Seedless vascular plants require water for reproduction

Gametophytes produce male and female gametes. Sperm swim to the eggs in water.

All plants alternate generations

In bryophytes and seedless vascular plants, the gametophyte is more prominent than the sporophyte.

In gymnosperms and angiosperms, the sporophyte is much more prominent than the gametophyte.

Gymnosperms have pollen and seeds

There are about 850 existing species of gymnosperms.

They evolved about 300 million years ago.

Gymnosperms are “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ seed” plants

New reproductive adaptations allowed gymnosperms to outcompete seedless vascular plants in many habitats. Gymnosperms produce seeds but do not enclose them in fruit.

Gymnosperms include cycads

Cycads were prevalent in the Mesozoic era, but many species are near extinction in the wild today. They have palmlike leaves and produce large cones.

Gymnosperms include the ginkgo

Only one species exists today, and it no longer grows wild in nature. The ginkgo tree has distinctive, fan-shaped leaves.

Gymnosperms include conifers

Conifers such as pine trees are familiar gymnosperms. Their leaves are needlelike and they produce egg cells and pollen in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Gymnosperms include gnetophytes

These plants have a mixture of traits that make them difficult to classify. Ephedra, shown here, has cones that resemble tiny flowers.

Gymnosperm sporophytes are large and conspicuous

The sporophytes of most gymnosperms are woody trees or shrubs. Reproductive structures and leaf types are diverse.

Sporophytes produce both male and female cones, where spores form by meiosis.

Gymnosperm sporophytes produce spores in cones

Male cones produce microspores on cone scales.

Ovules on female cone scales produce megaspores.

Gymnosperm gametophytes are microscopic

Male gametophytes are enclosed inside grains of pollen. Pollen can be dispersed by wind to settle on new plants.

The tiny female gametophytes stay in the cone, enclosed inside the ovule.

Pollination gets male and female gametophytes together

The male gametophyte produces a pollen \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that grows through the ovule until it reaches the egg cells inside.

Fertilization in gymnosperms does not require water

Sperm do not need to swim through water to eggs for fertilization.

Gymnosperms zygotes stay inside seeds

The zygote is the first cell of the sporophyte.

It grows mitotically into an embryo, inside a seed, on a female cone scale.

Seeds protect sporophyte embryos

Gymnosperm seeds have a tough outer coat and can be dispersed by wind or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

When conditions are favorable they will germinate into seedlings, which develop into mature sporophyte trees.

Angiosperms have flowers and fruit

95% of all living plant species are angiosperms.

They evolved about 144 million years ago and rapidly diversified into over 260,000 different species.

Angiosperms produce seeds in fruits

Angiosperms produce pollen and egg cells in flowers, which develop into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ after fertilization.

97% of angiosperms are either eudicots or monocots

Scientists classify the diverse angiosperms into several groups, notably the eudicots and monocots.

The other 3% of angiosperms are a paraphyletic group called basal angiosperms.

Most angiosperms are eudicots

Eudicots have two cotyledons, which are the first leaves to emerge during germination. Their pollen grains have three pores.

Examples include roses, daisies, sunflowers, oak trees, beans, and the model organism Arabidopsis.

Many angiosperms are monocots

Monocots have \_\_\_\_\_\_\_\_\_\_\_\_\_\_ cotyledon. Their pollen grains have one pore.

Examples include orchids, lilies, grass, bananas, rice, wheat, and corn.

Angiosperm sporophytes are large and conspicuous

Trees and other familiar angiosperms we see are the sporophytes.

Flowers are sporophyte reproductive structures in angiosperms

Pollen sacs in flowers produce microspores that develop into male gametophytes.

The ovule in the flower produces megaspores that develop into the female gametophytes.

Microscopic gametophytes get together at pollination

During pollination, a grain of pollen (male gametophyte) produces a pollen \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to reach the female gametophyte.

Female gametophytes consist of one egg and a central cell that contains two polar nuclei.

Angiosperms have double fertilization

Two sperm nuclei travel through the pollen tube.

One fertilizes the egg, forming a zygote. This is the first cell of the sporophyte.

The other sperm fertilizes the central cell’s polar nuclei. This will develop into the endosperm, which feeds the embryo inside the seed.

Seeds contain embryo and endosperm

In angiosperms, the ovule develops into a seed. At the same time, the ovary that surrounds the ovule develops into a fruit.

Angiosperm seeds germinate when conditions are favorable

Seeds germinate into young sporophytes.

Wind and animals assist angiosperm reproduction

Pollen is transported great distances by wind.

Plants with attractive nectar, petals, or bright colors \_\_\_\_\_\_\_\_\_\_\_\_-evolved with animals that pollinate them.