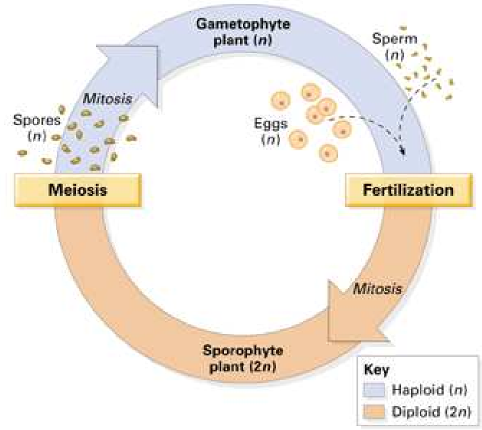
PLANT SURVEY



All plants have a life cycle in which a diploid sporophyte generation alternates with a haploid gametophyte generation. This cycle is called alternation of generations. Gametophyte plants produce male and female gametes – sperm and eggs. When the gametes join, they form a zygote that begins the next sporophyte generation. In some plants, the two stages of the life cycle are distinct, independent plants. In most ferns, for instance, the gametophyte is a small, heart-shaped plant that grows close to the ground. The sporophyte is the familiar fern plant itself made up of graceful fronds.

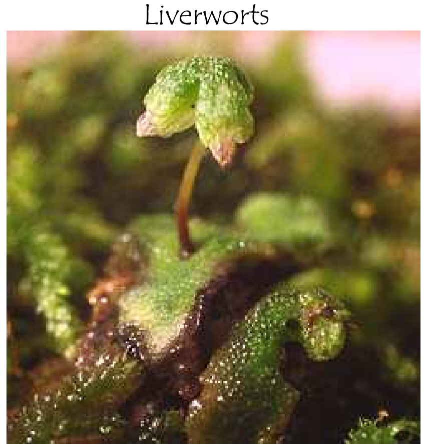
Bryophytes or Nonvascular plants

In the cool forests of the northern woods, the moist ground is carpeted with green. When you walk, this soft carpet feels spongy. Look closely and you will see the structure of this carpet – mosses. Mosses and their relatives are generally called bryophytes, or nonvascular plants. Unlike all other plants, these organisms do not have vascular tissues, or specialized tissues that conduct water and nutrients.

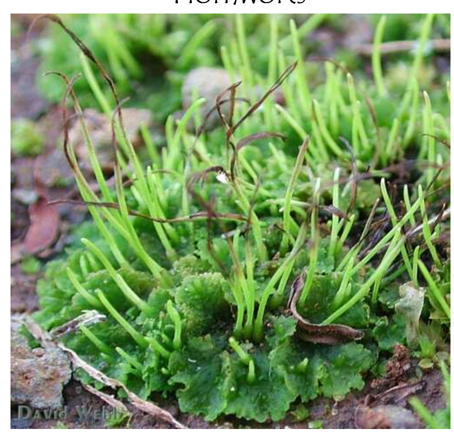
The most recognizable feature of bryophytes is that they are low-growing plants that can be found in moist, shaded areas where water is in regular supply. Bryophytes lack vascular tissue and; therefore, draw up water by osmosis only a few centimeters above the ground. This arrangement keeps them relatively small. Bryophytes include mosses, liverworts, and hornworts.

Mosses

Liverworts



Hornworts



Mosses

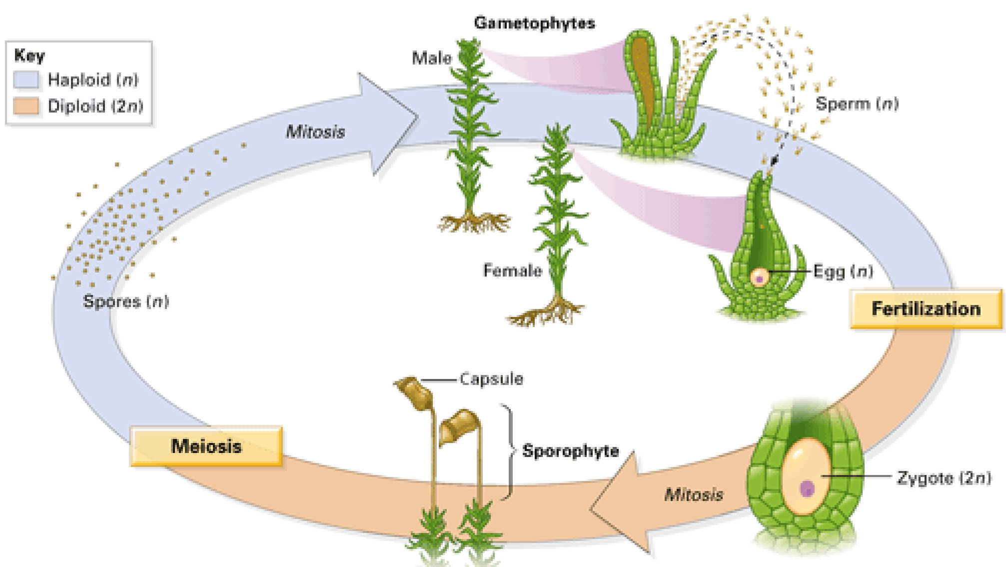
The most common bryophytes are mosses, which are members of the phylum Bryophyta. Mosses vary in appearance from miniature evergreen trees to small, filamentous plants that together form a threadlike carpet of green. Bryophytes are well adapted to life in wet habitats and nutrient-poor soils. Many mosses can tolerate low temperatures, allowing them to grow in harsh environments where other plants cannot. In fact, mosses are the most abundant plants in the polar regions.

Mosses grow most abundantly in areas with water—in swamps and bogs, near streams, and in rain forests. Each moss plant has a thin, upright shoot that looks like a stem with tiny leaves. These are not true stems or leaves, however, because they do not contain vascular tissue. Because the "leaves" of mosses are only one cell thick, these plants lose water quickly if the surrounding air is dry. The lack of vascular tissues also means that mosses do not have true roots. Instead, they have rhizoids, which are long, thin cells that anchor them in the ground and absorb water and minerals from the surrounding soil. Water moves from cell to cell through the rhizoids and into the rest of the plant.

Life Cycle

Like all plants, bryophytes reproduce with alternation of generations. The moss plants that you might have observed on a walk through the woods are actually clumps of gametophytes growing close together. When mosses reproduce, they produce thin stalks, each containing a capsule. This is the sporophyte stage. In bryophytes, the gametophyte is the dominant, recognizable stage of the life cycle and is the stage that carries out most of the plant's photosynthesis. The sporophyte is dependent on the gametophyte for supplying water and nutrients.

For fertilization to occur, the sperm of a bryophyte must swim to an egg. The sperm may swim through standing water or through a coating of water left by dew. Sometimes raindrops can splash sperm from one plant to another. Because of this limit to reproduction, bryophytes must live in habitats where water is available.



The life cycle of a moss, shown above, helps illustrate how bryophytes reproduce. When a moss spore lands in a moist place, it germinates and grows into a mass of tangled green filaments called a protonema. As the protonema grows, it forms rhizoids that grow into the ground and shoots that grow into the air. These shoots grow into the familiar green moss plants, which are the gametophyte stage of its life cycle.

Gametes are formed in reproductive structures at the tips of the gametophytes. Sperm with whiplike tails are produced in antheridia and egg cells are produced in archegonia. Some species produce both sperm and eggs on the same plant, whereas other species produce sperm and eggs on separate plants.

Once sperm are released and reach egg cells, fertilization produces a diploid zygote. This zygote is the beginning of the sporophyte stage of the life cycle. It grows directly out of the body of the gametophyte and actually depends on it for water and nutrients.

The mature sporophyte is a long stalk ending in a capsule that looks like a saltshaker. Inside the capsule, haploid spores are produced by meiosis. When the capsule ripens, it open and haploid spores are scattered to the wind to start the cycle again.

Seedless Vascular Plants

The first vascular plants had a new type of cell that was specialized to conduct water. Tracheids are the key cells in xylem, a form of vascular tissue that carries water upward from the roots to every part of a plant. Tracheids are hollow cells with thick cell walls that resist pressure. Within a plant, they are connected end to end like a series of drinking straws. Tracheids allow water to move through a plant much more efficiently than by diffusion alone.

Vascular plants also possess a second type of vascular tissue called phloem. Phloem transports solutions of nutrients and carbohydrates produced by photosynthesis. Like xylem, the main cells of phloem are long and specialized to move fluids throughout the plant body.

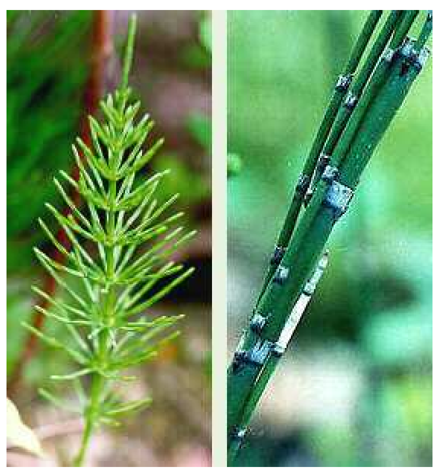
Vascular plants also produce lignin, a substance that makes cell walls rigid, allowing plants to grow upright and reach great heights.

Ferns & their Relatives

Like other vascular plants, ferns and their relatives have true roots, leaves, and stems. Roots are underground organs that absorb water and minerals. Water-conducting tissues are located in the center of the root. Leaves are photosynthetic organs that contain one or more bundles of vascular tissue. This vascular tissue is gathered into veins made of xylem and phloem. Stems are supporting structures that connect roots and leaves, carrying water and nutrients between them.

Club moss

Horsetails



Fern

Ferns

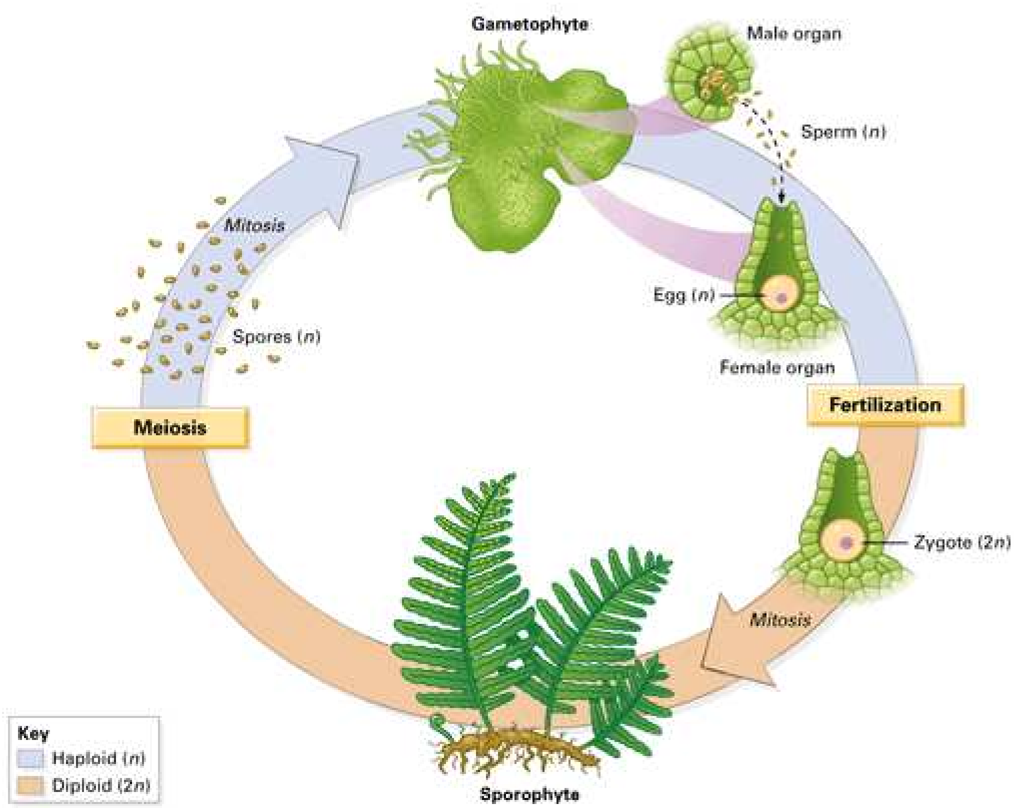
Ferns have true vascular tissues, strong roots, creeping or underground stems called rhizomes, and large leaves called fronds. Ferns can thrive in areas with little light. They are most abundant in wet, or at least seasonally wet, habitats around the world. They are often found living in the shadows of forest trees, where direct sunlight hardly penetrates the forest's leafy umbrella. Ferns are found in great numbers in the rain forests of the Pacific Northwest. In tropical forests, some species grow as large as small trees.

Life Cycle

Ferns and other vascular plants have a life cycle in which the diploid sporophyte is the dominant stage. Fern sporophytes produce haploid spores on the underside of their fronds in tiny containers called sporangia. Sporangia are grouped into clusters called sori. Spores released from sporangia may be carried by wind and water over long distances.

When the spores germinate, they develop into haploid gametophytes. The small gametophyte first grows a set of root-like rhizoids. It then flattens into a thin, heart-shaped, green structure that is the mature gametophyte. Although it is tiny, the gametophyte grows independently of the sporophyte.

The antheridia and archegonia are found on the underside of the gametophyte. As in bryophytes, fertilization requires at least a thin film of water, allowing the sperm to swim to the eggs. The diploid zygote produced by fertilization immediately begins to grow into a new sporophyte plant. As the sporophyte grows, the gametophyte withers away. Fern sporophytes often live for many years. In some species, the fronds produced in the spring die in the fall, but the rhizomes live through the winter and sprout again the following spring.



Seed Plants

Whether they are acorns, pine nuts, dandelion seeds, or kernels of corn, seeds can be found everywhere. Seeds are so common, in fact, that their importance may be overlooked. Over millions of years, plants with a single trait –the ability to form seeds – became the most dominant group of photosynthetic organisms on land.

Seed plants are divided into two groups: gymnosperms and angiosperms. Gymnosperms bear their seeds directly on the surfaces of cones, whereas angiosperms, which are also called flowering plants, bear their seeds within a layer of tissue that protects the seed.

Like all plants, seed plants have a life cycle that alternates between a gametophyte stage and a sporophyte stage. Unlike mosses and ferns, however, seed plants do not require water for fertilization of gametes. As a result, seed plants can live just about anywhere –from moist habitats that are often dominated by seedless plants, to dry and cold habitats where most seedless plants cannot survive. Adaptations that allow seed plants to reproduce without water include flowers or cones, the transfer of sperm by pollination, and the protection of embryos in seeds.

Cones & Flowers

The gametophytes of seed plants grow and mature within sporophyte structures called cones, which are the seed-bearing structures of gymnosperms, and flowers, which are the seed bearing structures of angiosperms.

Pollen

In seed plants, the entire male gametophyte is contained in a tiny structure called a pollen grain. Sperm produced by this gametophyte do not swim through water to fertilize the eggs. Instead, the pollen grain is carried to the female gametophyte by wind, insects, birds, small animals, or sometimes even bats. The transfer of pollen from the male gametophyte to the female gametophytes is called pollination.

Seeds

A seed is an embryo of a plant that is encased in a protective covering and surrounded by a food supply. An embryo is the early developmental stage of the sporophyte plant. The seed's food supply provides nutrients to the embryo as it grows. The seed coat surrounds and protects the embryo and keeps the contents of the seed from drying out. Seeds may also have special tissues or structures that aid in their dispersal to other habitats. Some seed coats are textured so that they stick to the fur or feathers of animals. Other seeds are contained in fleshy tissues that are eaten and dispersed by animals.

After fertilization, the zygote contained within a seed grows into a tiny plant –the embryo. The embryo often stops growing while it is still small and contained within the seed. The embryo remains in this condition for weeks, months, or even years. When the embryo begins to grow again, it uses nutrients from the stored food supply. As a result of this strategy, seeds can survive long periods of bitter cold, extreme heat, or drought – beginning to grow only when conditions are once again right.

Seed Plants – Gymnosperms
The most ancient surviving seed plants are the gymnosperms. Gymnosperms include the conifers, such as pines and spruces, as well as palm-like plants called cycads, ancient ginkgoes, and the very weird gnetophytes. These plants all reproduce with seeds that are exposed – gymnosperms means "naked seed."

Conifers
By far the most common gymnosperms, with more than 500 known species, are the conifers. The phylum Coniferophyta includes pines, spruces, firs, cedars, sequoias, redwoods, and yews. Some conifers, such as the bristlecone pine tree can live for more than 4000 years. Other species, such as giant redwoods, can grow to more than 100 meters in height.

Today, conifers thrive in a wide variety of habitats: on mountains, in sandy soil, and in cool, moist areas such as the temperate rain forest of the Pacific Northwest. Conifer leaves have special adaptations for dry conditions. For example, conifers have leaves that are long and thin, called pine needles. This shape reduces the surface area from which water can be lost by evaporation. Another water-conserving adaptation is the thick, waxy layer that covers conifer leaves.

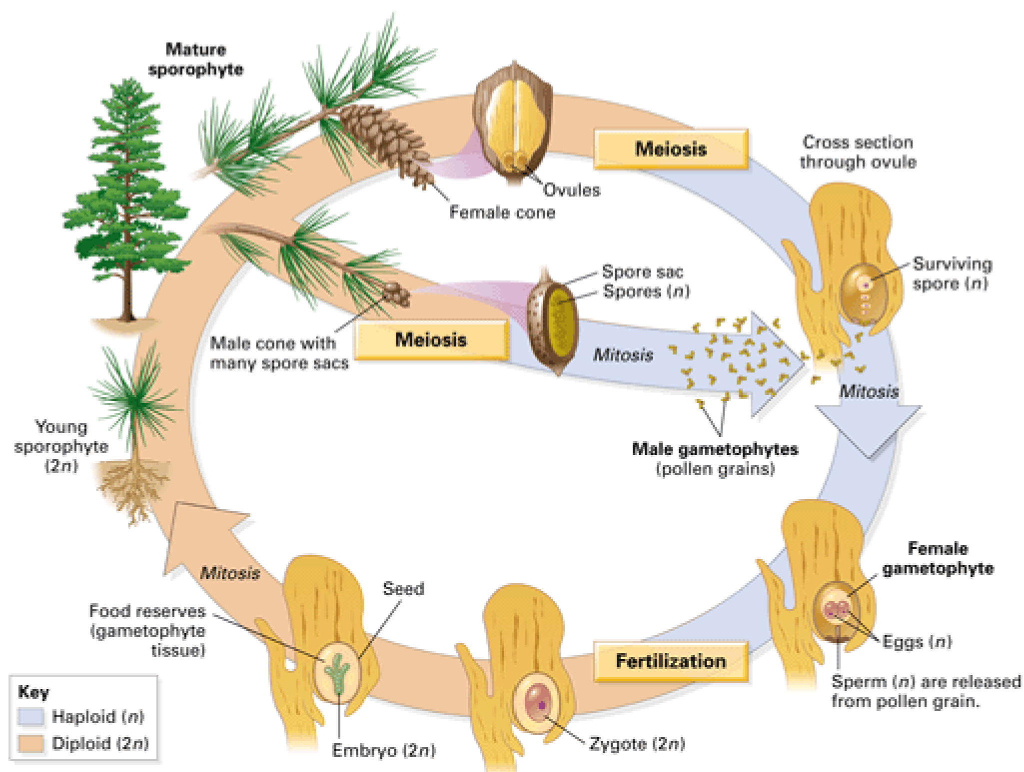
Most conifers are "evergreens" – that is, they retain their leaves throughout the year. The needles of most conifer species remain on the plant for 2 to 14 years. Older needles are gradually replaced by new needles, so the trees never become bare. However, not all species are evergreen. Larches and balk cypresses, for example, lose their needles every fall.

Life Cycle
In gymnosperms, the diploid sporophyte generation is much more highly developed and obvious than the haploid gametophyte generation. A pine tree, for example, is actually a sporophyte on which the tiny gametophytes live in cones.

Gymnosperms produce two types of cones: pollen cones and seed cones. Pollen cones are also called male cones. Pollen cones produce the male gametophytes, which are called pollen grains. As tiny as it is, the pollen grain makes up the entire male gametophyte stage of the gymnosperm life cycle. One of the haploid nuclei in the pollen grain will divide later to produce two sperm nuclei. The more familiar seed cones, which produce female gametophytes, are generally much larger than pollen cones. Near the base of each scale are two ovules in which the female gametophytes develop. Within the ovules, meiosis produces haploid cells that grow and divide to produce female gametophytes. These gametophytes may contain hundreds or thousands of cells. When mature, each gametophyte contains a few large egg cells, each ready for fertilization by sperm nuclei.

The gymnosperm life cycle typically takes two years to complete. The cycle begins in the spring as male cones release enormous numbers of pollen grains. This pollen is carried by the wind. Some of these pollen grains reach female cones. There, some pollen grains are caught in a sticky secretion on one of the scales of the female cone. This sticky material, known as a pollination drop, ensures that pollen grains stay on the female cone.

If a pollen grain lands near an ovule, the grain splits open and begins to grow a structure called a pollen tube, which contains two haploid sperm nuclei. Once the pollen tube reaches the female gametophyte, one sperm nucleus disintegrates, and the other fertilizes the egg contained within the female gametophyte. If sperm from another pollen tube reaches the female gametophyte, both egg cells may be fertilized, but just one embryo grows. Fertilization produces a diploid zygote – the new sporophyte plant. This zygote grows into a small embryo. During this time, it is encased within what will soon develop into a seed.



Seed Plants – Angiosperms

The angiosperms are an incredibly diverse group. Not surprisingly, there are many different ways of categorizing these plants. These include monocots and dicots, woody and herbaceous plants, and annuals, biennials, and perennials. However, some angiosperms can fall into more than one category. For example, an iris is a monocot plant that is also an herbaceous perennial.

Monocots and Dicots

There are two classes within the angiosperms: the Monocotyledonae, or monocots, and the dicotyledonae, or dicots. Monocots and dicots are named for the number of seed leaves, or cotyledons, in the plant embryo. Monocots have one seed leaf, and dicots have two. Monocots include corn, wheat, lilies, orchids, and palms. Dicots include roses, clover, tomatoes, oaks, and daises.

Woody and Herbaceous plants

The flowering plants can be subdivided into various groups according to the characteristics of their stems. One of the most important and noticeable stem characteristics is woodiness. Woody plants are made primarily of cells with thick cell walls that support the plant body. Woody plants include trees, shrubs, and vines.

Plant stems that are smooth and non-woody are characteristic of herbaceous plants. Herbaceous plants do not produce wood as they grow. Examples of herbaceous plants include dandelions, zinnias, petunias, and sunflowers.

Annuals, Biennial, and Perennials

There are three categories of plant life spans: annual, biennial, and perennial. Some plants grow from seed to maturity, flower, produce seeds, and die all in the course of one growing season. Flowering plants that complete a life cycle within one growing season are called annuals. Annuals include many garden plants, such as marigolds, petunias, pansies, zinnia, wheat, and cucumbers.

Angiosperms that complete their life cycle in two years are called biennials. In the first year, biennials germinate and grow roots, very short stems, and sometimes leaves. During their second year, biennials grow new stems and leaves and then produce flowers and seeds. Once the flowers produce seeds, the plant dies. Evening primrose, parsley, celery, and foxglove are biennials.

Flowering plants that live for more than two years are called perennials. Some perennials, such as peonies, asparagus, and many grasses, have herbaceous stems that die each winter and are replaced in the spring. Most perennials, however, have woody stems. Palm trees, sagebrush, maple trees, and honeysuckle are examples of wood perennials.

Structure of Flowers

You may think of flowers as decorative objects that brighten the world. However, flowers are reproductive organs that are composed of four kinds of specialized leaves: sepals, petals, stamens, and carpals.

Sepals and Petals

The outermost circle of floral parts contains the sepals, which in many plants are green and closely resemble ordinary leaves. Sepals enclose the bud before it opens and they protect the flower while it is developing. Petals, which are often brightly colored, are found just inside the sepals. The petals attract insects and other pollinators to the flower.

Stamens and Carpels

Within the ring of petals are the structures that produce male and female gametophytes. The male parts consist of an anther and a filament, which together make up the stamen. The filament is a long, thin stalk that supports the anther. At the tip of each filament is an anther, an oval sac where meiosis takes place, producing haploid male gametophytes – pollen grains. In most angiosperms, each flower has several stamens. If you rub your hand on the anthers of a flower, a yellow-orange dust may stick to your skin. This is pollen, which consist of thousands of individual pollen grains.

The innermost floral parts are carpels, also called pistils, which produce the female gametophytes. Each carpel has a broad base forming an ovary, which contains one or more ovules where female gametophytes are produced. The diameter of the carpel narrows into a stalk called the style. At the top of the style is a sticky portion known as the stigma, where pollen grains frequently land.

Flowers vary greatly in shape, color, and size. A typical flower produces both male and female gametophytes. In some plants, however, male and female gametophytes are produced in separate flowers on the same individual. Corn, for example, has separate male and female flowers on the same plant. The tassel is a flower that produces male gametophytes, and the silk is the style of a flower that contains the female gametophyte.

Life Cycle

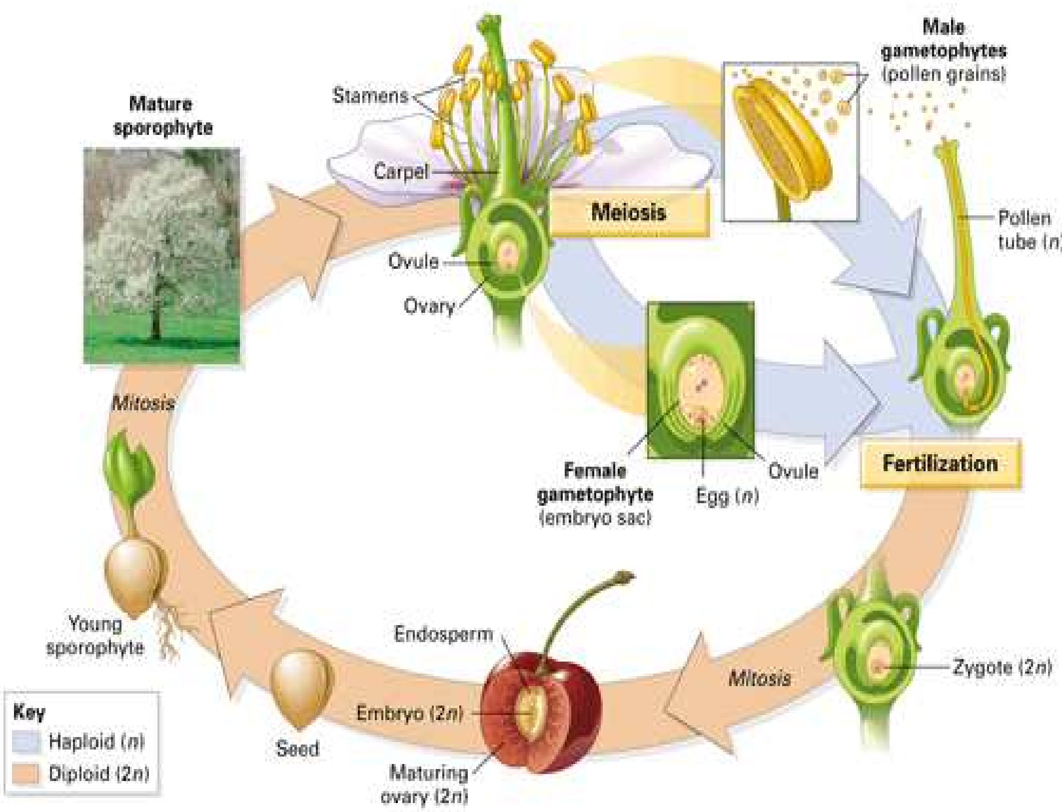
The angiosperm life cycle begins when the mature sporophyte produces flowers. Each flower contains anthers and an ovary. Inside the anthers –the male part of the flower – each cell undergoes meiosis and produces four haploid spore cells. Each of these cells becomes a single pollen grain. The wall of each pollen grain thickens, protecting the contents of the pollen grain from dryness and physical damage when it is released from the anther. The nucleus of each pollen grain undergoes one mitotic division to produce two haploid nuclei. The pollen grain, which is the entire male gametophyte, usually stops growing until it is released from the anther and deposited on a stigma.

The ovary of the flower contains the ovules, in which the female gametophyte develops. A single diploid cell goes through meiosis to produce four haploid cells, three of which disintegrate. The remaining cell undergoes mitosis to produce eight nuclei. These eight nuclei and the surrounding membrane are called the embryo sac. The embryo sac, contained within the ovule, is the female gametophyte of a flowering plant. One of the eight nuclei, near the base of the gametophyte, is the egg nucleus – female gamete. If fertilization takes place, this cell will become the zygote that grows into a new sporophyte plant.

Once the gametophytes have developed inside the flower, pollination takes place. Pollination in angiosperms is mainly carried out by animals such as insects, birds, and bats. Animal –pollinated plants have a variety of adaptations, such as bright colors and sweet nectar, to attract animals. Animals have developed behaviors to help them find flowers and have body shapes that enable them to reach the nectar deep within certain flowers.

If a pollen grain lands on the stigma of an appropriate flower, it begins to grow a pollen tube. The nucleus within the pollen grain divides and forms two sperm nuclei. The pollen tube now contains a tube nucleus and two sperm nuclei. The pollen tube grows into the style. There, it eventually reaches the ovary and enters the ovule.

Inside the embryo sac, two distinct fertilizations take place. First, one of the sperm nuclei fuses with the egg nucleus to produce a diploid zygote. The zygote will grow into the new plant embryo. Second, the other sperm nucleus does something truly remarkable – it fuses with two endosperm nuclei in the embryo sac and will grow into a food-rich tissue known as endosperm. The endosperm will nourish the seedling as it grows. Because two fertilization events take place between the male and female gametophytes, this process is known as double fertilization.



BRYOPHYTES OR NONVASCULAR PLANTS
NOTES

Name ____ Hour _______________

1. Explain alternation of generations in a plant life cycle.

2. What is the most common bryophytes?

3. Bryophytes are low growing plants that can be found in moist, shaded areas where water is in regular supply. What characteristic is responsible for their small size?

4. Draw a picture of a moss plant. Be sure to label the gametophyte and sporophyte generation.

5. In what generation, gametophyte or sporophyte, does the moss live the majority of its life?

6. Why are the roots, stems, and leaves not considered true roots, stems, and leaves?

7. How is water essential in the life cycle of a bryophyte? Explain.

8. A friend of yours lives in a desert area of New Mexico. She wants to grow a garden of mosses and liverworts. What environmental conditions would she need to maintain in her garden for it to be successful?

Seedless Vascular Plants
Notes

Name ____ Hour ____________

1. What are the two types of vascular tissue? Describe the function of each.

2. Why are ferns considered to have true roots, stems, and leaves?

3. What are the leaves of a fern called?

4. What is a rhizome?

5. In what generation, gametophyte or sporophyte, does the fern spend the majority of its life?

6. In the life cycle of a bryophyte, the sporophyte generation was dependent on the gametophyte generation. How is that different in the life cycle of a fern?

7. Moss plants are small. Ferns can grow as tall as a small tree. Explain why this is so.

Seed Plants – Gymnosperms
Notes

Name ____ Hour _______________

1. What is the difference between a gymnosperm and an angiosperm?

2. What are the main characteristics of seed plants?

3. Pollination is a process that occurs only in seed plants. What process in seedless plants is analogous to pollination?

4. What adaptations allow conifers to live in dry habitats?

5. What are the reproductive structures of gymnosperms?

6. In what generation, gametophyte or sporophyte, do gymnosperms spend the majority of their life?

7. Are gymnosperms typically wind pollinated or animal pollinated? How does this process take place?

Seed Plants – Angiosperms
Notes

Name ____ Hour ____________

1. What are monocots and dicots?

2. How do annuals, biennials, and perennials differ?

3. Compare the growth forms of plants with woody stems and those with herbaceous stems.

4. What reproductive structures are unique to angiosperms? Briefly describe the function of each.

5. Describe the flower and how it is involved in reproduction.

6. Are angiosperms typically wind pollinated or animal pollinated? How does this process take place?

7. Many flowers have bright patterns of coloration that directly surround the reproductive structures. How might this type of coloration be an advantage to the plant?