

CLASS II:

GYMNOSPERMAE

The word gymnosperm is derived from two words, gymnos means naked and sperma means seeds.

SEED PLANTS

Gymnosperms are successful group of seed plants, Gymnospermae are shrubs or trees, usually resinous producing seeds but no fruits. They bear their ovules exposed on open carpels. The seed are borne on the surface of the scales which form a cone.

CHARACTERISTICS

Gymnosperms are group of plants with the following unique characters:

1. They don't have an outer covering or shell around their seeds.

They don't produce flowers.

They don't produce fruits.

They are pollinated by wind.

PLANT BODY

The plant body is a sporophyte, the form of tall woody perennial trees or shrubs.

STEM

The stem is invariably branched with the exception of cycads which is rarely branched.

ROOTS

The root is well developed and persistent.

LEAVES

Leaves may be ^(two types of leaves) dimorphic i.e. foliage leaves and scale leaves. The leaves are evergreen with thick cuticle. Stomata are sunken in pits.

SECONDARY GROWTH

Secondary growth or increase in thickness occurs by the activity of cambium. Cambium is a cylinder of undifferentiated embryonic tissue (meristem) that allows the stem of the plant to grow in diameter.

MONOECIOUS PLANTS

The reproductive structures or cones are unisexual. Both the male cones and the female cones lie on the same plant (monoecious plants).

HETEROSPOROUS

The plants are heterosporous i.e. producing microspores or pollen grains and megaspores or embryo sacs.

[Heterosporous meaning - plants having a sporophyte that produces two types of gametophytes of different sexes]

LIGNIFIED VASCULAR TISSUES

Gymnosperms are able to grow larger than seedless vascular plants bcz of their woody stems. The vascular tissue in most members is highly lignified (make rigid and woody by deposition of lignin in cell walls), which add strength to their cell walls. The strengthened wood allows them to achieve great heights.

FERTILIZATION

Fertilization is single and development of embryo is partial bcz $\frac{1}{4}$ th of oospore is concerned with the development of embryo.

POLYEMBRYONY

Polyembryony (the production of many embryos simultaneously) is of common occurrence but finally a single embryo matures.

WIND POLLINATION: They have non-flagellated sperm; male gametes (carried inside pollen grains) are moved by wind instead of water.

COTYLEDONS

The number of cotyledons in the seed is variable from one to many.

Cotyledon is an embryonic leaf of a seed plant that provides food for the young plant.

ALTERNATION OF GENERATIONS

There is a clear alternation of sporophytic and gametophytic generation.

ADVANCEMENT OVER PTERIDOPHYTES

The character showing advancement over the pteridophytes (vascular plants lacking both seeds and flowers) is the permanent retention of the megaspore (haploid cell giving rise to female gametophyte) in the megasporangium (female reproductive structure of conifers that produces haploid megaspores) fertilization and development of embryo inside it. This feature has given rise to seed habit.

REPRODUCTION AND LIFE CYCLE OF GYMNOSPERMS

The life cycle of gymnosperms is explained, using pines as an example.

1. MICROGAMETOPHYTES

The male cones produce haploid pollen grains by meiosis. The pollen grains are immature microgametophytes (male gametophytes).

2. MEGAGAMETOPHYTES

The female cones have scales that each contain two ovules. Each ovule has one opening called the micropyle. When the ovule is ready to accept pollen, it secretes a liquid to which the pollen grains can adhere. As the liquid dries, the pollen is pulled into the ovule through the micropyle. At this point, a megaspore within the ovule goes through meiosis to produce four haploid cells. Only one cell survives, growing and dividing to produce immature megagametophyte (female gametophyte). Several eggs can develop within the megagametophyte.

3. FERTILIZATION

As the eggs are developing, two sperm cells are developing within the pollen grain. A third cell in the pollen grain begins to grow as the pollen tube moves towards the megagametophyte. Once the pollen tube reaches the megagametophyte, the sperm cells fertilize the egg cells. Note that pollination

occurred when the pollen grain reached the ovule but fertilization did not occur until the sperm reached the egg. In most cases, fertilization does not happen until at least one year after pollination.

4. FORMATION OF EMBRYO

Only one fertilized egg will survive and develop into an embryo. The embryo is diploid, therefore, it becomes the sporophyte of the next generation. ~~The~~ The embryo is made up of a rudimentary root and several embryonic leaves.

5. SEED

The seed consists of three types of tissues:

1. the new generation sporophyte and diploid embryo.
2. the haploid female gametophytic tissue that stores nutrients.
3. the parent sporophytic tissues of the seed coat.

The process of gamete formation, pollination, fertilization, and germination are often very slow, and the life cycle can take two to three years from beginning to end.

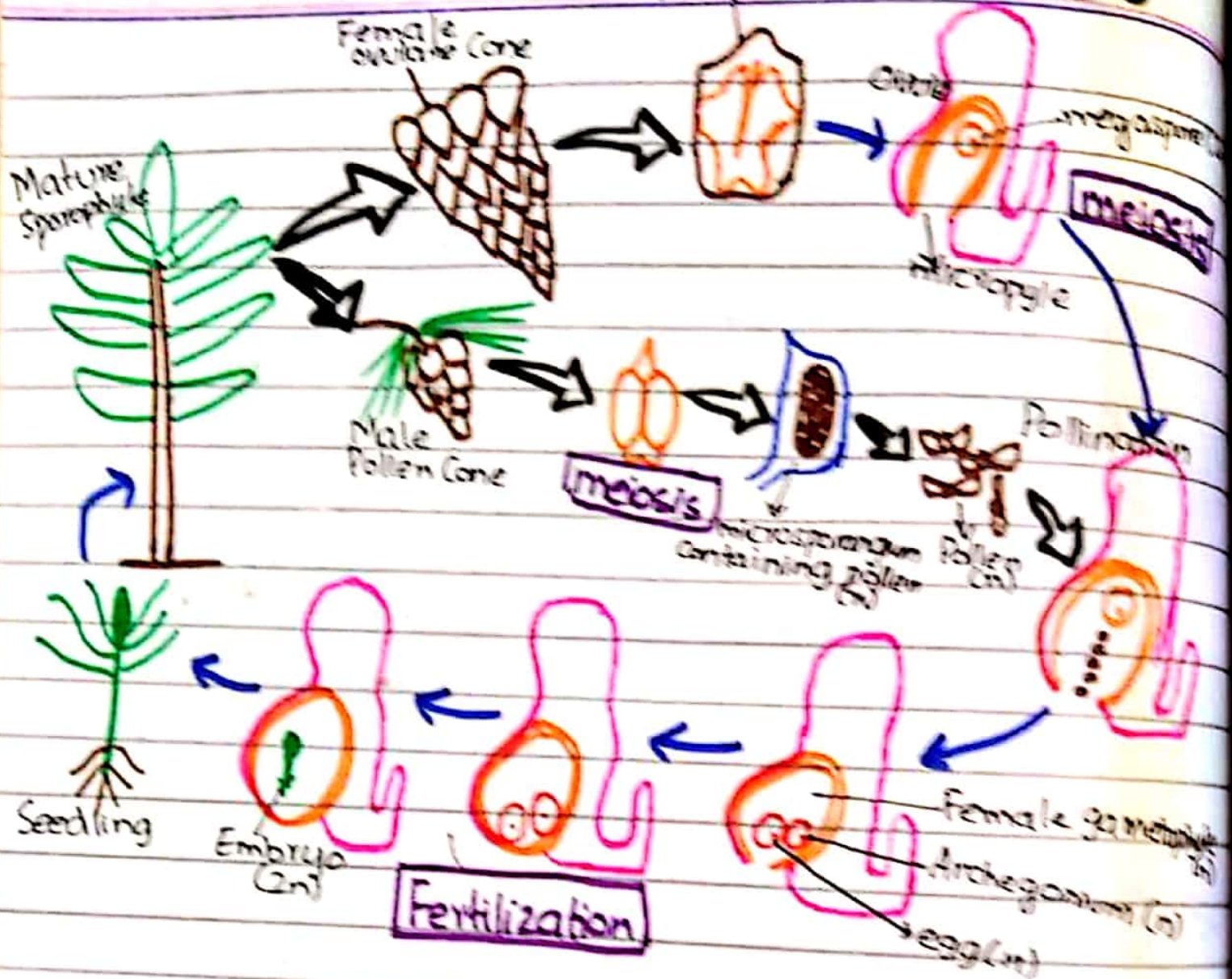


Fig: Gymnosperms. Life Cycle of Pinus

GROUPS OF GYMNASPERMS

Currently, the gymnosperms are comprised of four major groups:

1. Cycads
2. Ginkgos
3. Gnetophytes
4. Conifers

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1. CYCADS

The cycads are tropical and sub-tropical plants showing many fern like characters. Cycads are slow-growing and long-lived perennials. They are considered woody, even though their wood does not look like that of a pine or oak tree.

Cycads are dioecious plants; that is, their male and female reproductive structures reside on separate plants. One feature retained in cycads is motile sperm.

Examples are *Cycas circinalis* and *C. revoluta*.

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2. CONIFERS

The conifers constitute the largest and most important group of gymnosperms. They are mainly the natives of temperate regions, well represented in the hills where they form big forests. Most of these are evergreen, however, there^{are} a few deciduous (trees that drop their leaves each fall). The name conifer comes from cone bearing. Conifers can be either monoecious or dioecious.

The conifers of Pakistan include Pines, firs, cedars, spruce, yews, junipers etc.

USES OF GYMNOSPERMS

1. CONSTRUCTION PURPOSES

Many conifers such as pine, cedar etc are sources of the soft wood used in construction and packing. They are the best wood source utilized in the construction of boats, railway lines etc e.g *Cedrus deodara*.

2. MEDICINAL USES

* An anti-cancer drug Taxol is obtained from *Taxus*.

* Many species of *Ephedra* produce ephedrine, which can be used in treatment of asthma and bronchitis.

* Pollen grains of some *Cycas* have narcotic effect.

3. FOOD SOURCE

The seeds of *Pinus gerardiana* known as chilghoza are edible. Seeds and stem of *Cycas revoluta* used for making wine. *Zamia* is a rich source of starch.

4. AS ORNAMENTS / DECORATION

* Species of *Cycas* are used for decoration purposes.

* *Ginkgo biloba*, possess beautiful ornamental leaves.

* *Pinus*, *Taxus* etc are grown in parks.

5. INDUSTRIAL USES

- * Spruce or Picea is an important source of pulp wood.
- * Wood of Juniperus is used in making pencils, scales and holders.
- * Turpentine is obtained from Abies balsamea.

6. SOURCE OF RESINS

Resins are used commercially for manufacturing sealing waxes and water-proof paints. A type of resin known as turpentine is obtained from various species of Pinus.

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