



Learning Objectives: At the end of the session, you will be able to:

- ✓ Compare between Cryptogams and Phanerogams.
- ✓ Differentiate between Gymnosperms and Angiosperms
- ✓ Explain the modes of reproduction in Gymnosperms and Angiosperms.
- ✓ Explain economic importance of Gymnosperms and Angiosperms.
- ✓ Elucidate the life cycle pattern of Gymnosperms and Angiosperms.

DISCUSSION:

GYMNOSPERMS : (Gk. Gymnos = naked ; sperma = seed)
Gymnosperms originated much before Flowering plant and is represented by shrubs, medium to tall sized trees including Tallest Tree (Giant Redwood Sequoia). In older classification such plants have been generally placed in the division spermatophyta (seed bearing plants) along with angiosperms. It was Robert Brown (1827) that separated them from angiosperms and placed under a distinct group Gymnosperm due to presence of unprotected ovules in them.

GYMNOSPERM

GENERAL FEATURES OF GYMNASPERMS

Habitat:

Found in Hilly areas, generally at high altitude. It forms coniferous forests

Structure:

- ✓ **Stem:** It can unbranched (Cycas) or branched (Pinus, Cedrus).
- ✓ **Leaves:** Leaves may be simple or compound. In Cycas the pinnate leaves persist for a few years.
(The leaves in gymnosperms are well- **adapted to withstand extremes of temperature, humidity and wind**. In conifers, the **needle-like leaves** reduce the surface area. Their **thick cuticle** and **sunken stomata** also help to **reduce water loss**.)
- ✓ **Roots:** The roots are generally tap roots.
(Roots in some genera have **fungal association** in the form of **mycorrhiza** (Pinus), while in some others (Cycas) small specialized roots called **coralloid roots** are **associated with N₂- fixing cyanobacteria**.)
- ✓ **Seeds:** Gymnosperm have naked seeds as the ovules are not enclosed by any ovary wall and remain exposed.



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- ✓ Gymnosperms are Heterosporous and produces haploid microspores and megaspores. The two kinds of spores are produced within sporangia that are borne on sporophylls which are arranged spirally along an axis to form lax or compact strobili or cones.
- ✓ **The male or female cones or strobili may be borne on the same tree (Pinus) or on different trees (Cycas).**
- ✓ Male cone has microsporophylls which bear microsporangia having microspores which develop into reduced gametophyte called pollen grain.
- ✓ Female cone has megasporophylls which bear megasporangia having megaspores which are enclosed within the mega sporangium (Nucellus). One megaspore develops into female gametophyte bearing two or more archegonia.

*Zamia**Thuja**Podocarpus**Ginkgo biloba**Araucaria**Pinus*

REPRODUCTION:

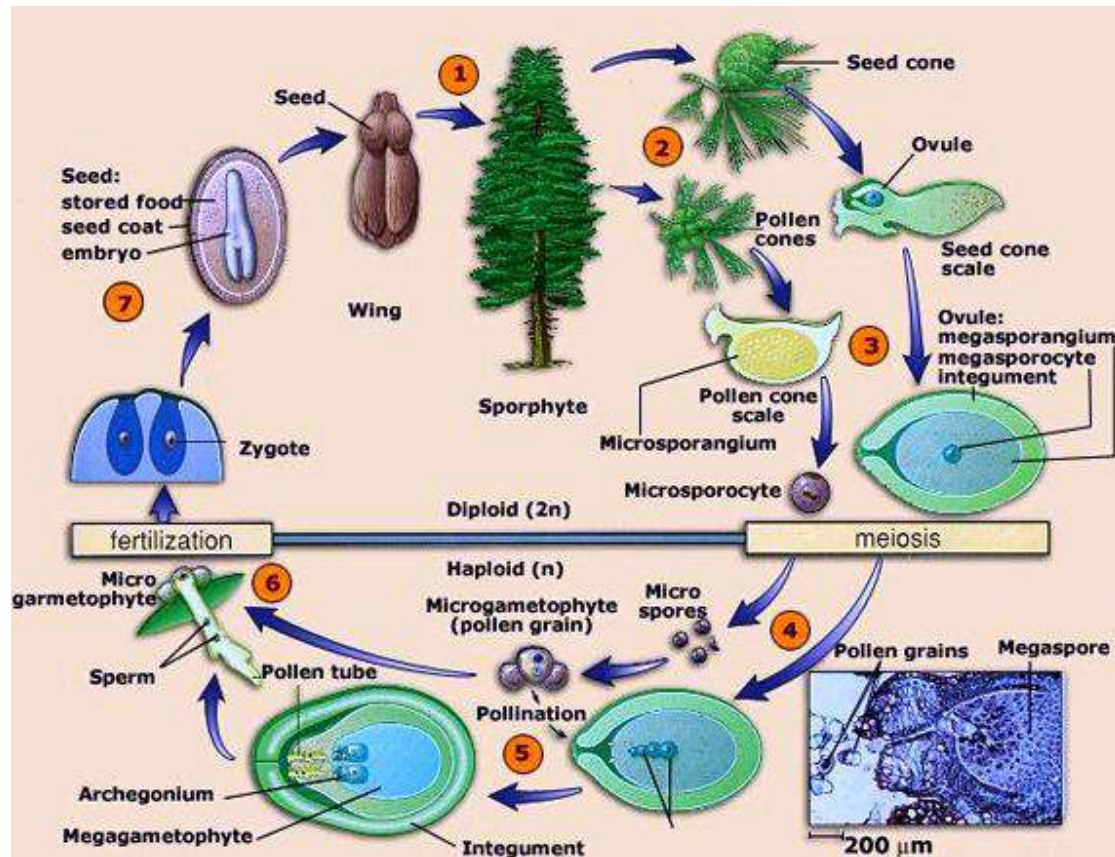
- ✓ Microspore produces pollen grain whereas megaspore forms female gametophyte. The megaspore mother cell is differentiated from one of the cells of the nucellus.
- ✓ The nucellus is protected by envelopes and the composite structure is called an ovule. The ovules are borne on megasporophylls which may be clustered to form the female cones.
- ✓ The megaspore mother cell divides meiotically to form four megaspores.
- ✓ One of the megaspores enclosed within the megasporangium (nucellus) develops into a multicellular female gametophyte that bears two or more archegonia or female sex organs.
- ✓ The multicellular female gametophyte is also retained within megasporangium.
- ✓ Unlike bryophytes and pteridophytes, in gymnosperms the male and the female gametophytes do not have an independent free-living existence. They remain within the sporangia retained on the sporophytes.



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Fertilization:

- ✓ The **pollen grain** is released from the microsporangium. They are **carried in air currents** and come in **contact with the opening of the ovules** borne on megasporophylls.
- ✓ The **pollen tube carrying the male gametes** grow towards **archegonia** in the ovules and discharge their contents near the mouth of the archegonia.
- ✓ Following fertilization, zygote develops into an embryo and the ovules .into seeds. These seeds are not covered.

**Economic importance of Gymnosperm:**

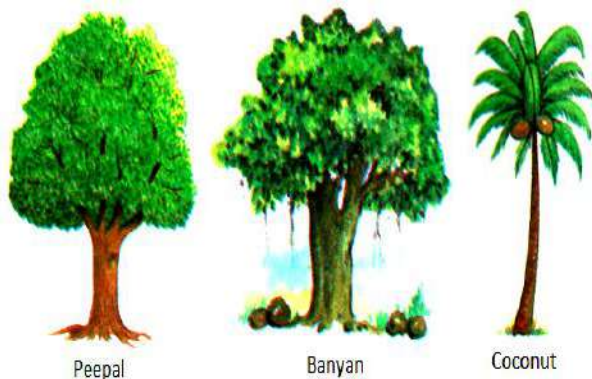
- ✓ Sago is obtained from pith cortex of *Cycas revolute*. Seeds of *Pinus* is eaten as Chilgoza.
- ✓ Ephedrine obtained from *Ephedra* is used in cough and Asthma.
- ✓ Gymnosperm wood are softwood used to make furnitures.
- ✓ Tannins from *Pinus* is used in tannery.

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ANGIOSPERMS:

Angiosperms are called flowering plants as, the pollen grains and ovules are developed in specialized structures called flowers and have seeds enclosed in fruits. They range in size from tiny, almost microscopic *Wolffia* to tall trees of *Eucalyptus* (over 100 meters).

They are Divided into two classes – Dicotyledons (have two cotyledons) and Monocotyledons (have one cotyledon).



Peepal

Banyan

Coconut

Habitat: Cosmopolitan , Found in most habitat.

STRUCTURE:

Stem	: Soft or woody, erect, branched
Leaves	: Simple as well as compound with lots of modification.
Roots	: Tap(Dicot) and Fibrous(Monocot)

REPRODUCTION

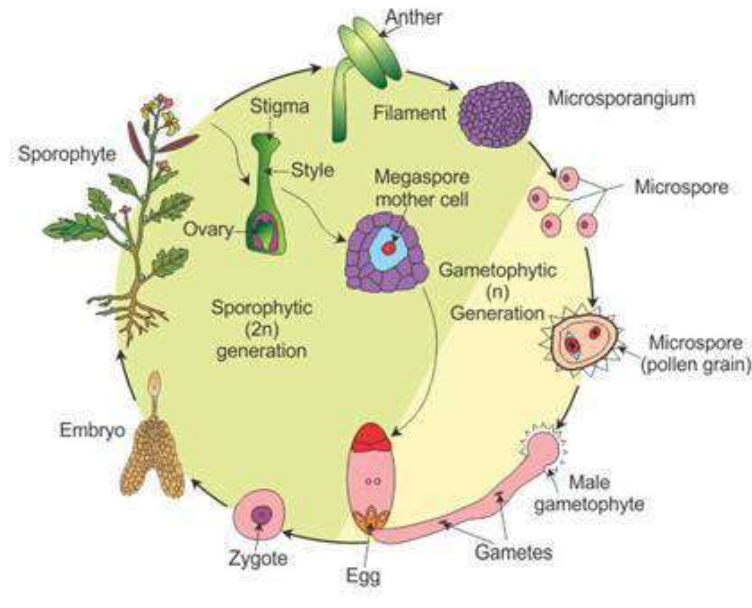
- ✓ The **male sex** organ in a **flower** is the **stamen**. Each stamen consists of a **filament with an anther** at the tip. The anthers following **meiosis** produce pollen grains.
- ✓ The **female sex** organ in a **flower** is the **pistil or the carpel**. Pistil consists of an ovary enclosing one to many ovules.
- ✓ Within ovules are present highly reduced female gametophytes termed **embryo sacs**. The female gametophyte is formed by meiosis. It is called Embryo sac. Hence, each of the cells of an embryo-sac is haploid.
- ✓ Each embryo-sac has a **three-celled egg apparatus(one egg cell and two synergids)**, **three antipodal cells and two polar nuclei**(7 cells and 8 nuclei stage). The polar nuclei eventually fuse to produce a **diploid secondary nucleus**.



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POLLINATION AND FERTILIZATION:

- ✓ Pollen grains, after dispersal from the anthers, are carried by wind or various other agencies to the stigma of a pistil. This is termed as pollination.
- ✓ The pollen grains germinate on the stigma and the resulting pollen tubes grow through the tissues of stigma and style and reach the ovule.
- ✓ The pollen tubes enter the embryo-sac where two male gametes are discharged.
- ✓ An unique phenomenon of Double Fertilization is seen in Angiosperms.
One of the male gametes fuses with the egg cell to form a zygote (syngamy).
The other male gamete fuses with the diploid secondary nucleus to produce the triploid primary endosperm nucleus (PEN).

**Post Fertilization Development:**

The zygote develops into an embryo (with one-or two cotyledons) and the PEN develops into endosperm which provides nourishment to the developing embryo. The synergids and antipodal degenerate after fertilization. During these events the ovules develop into seeds and the ovaries develop into fruit.

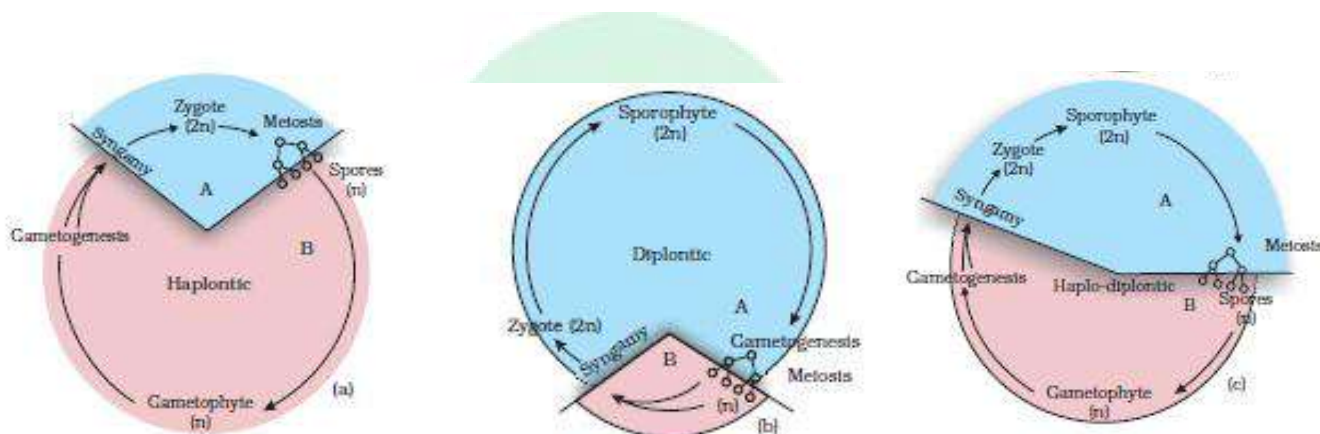


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LIFE CYCLES IN GYMNOSPERM AND ANGIOSPERM (DIPLONTIC TYPE)

	GYMNOSPERM	ANGIOSPERM
SPOROPHYTE	Multicellular, Photosynthetic, Persistent, Vascular Sporophyte which is Totally independent .	Multicellular, Photosynthetic, Persistent, Vascular and Flowering Sporophyte which is Totally independent
GAMETOPHYTE	Represented by the single to few-celled Haploid gametophyte dependent on Sporophyte .	Represented by the single to few-celled Haploid gametophyte dependent on Sporophyte .
Example	Pinus , Cycas, Gingko etc.	Rose, Mango, Bamboo etc.

Life Cycle Pattern at a Glance



Haplontic

: **Gametophytic phase dominant.** e.g., Chlamydomonas

Diplontic

: **Sporophytic phase dominant.** e.g., Angiosperms and Gymnosperms

Haplo-Diplontic

: **Intermediate** like stage where **gametophytic and sporophytic** stage **partially dominate** at different stages. e.g., Bryophytes and Pteridophytes.

Exceptions: Ectocarpus, Polysiphonia are Haplo-diplontic algae. **Fucus** is **diplontic** alga.

Images taken from :

<https://www.quora.com/What-are-some-examples-of-gymnosperms>

<https://www.easybiologyclass.com/economic-importance-of-gymnosperms-short-notes/>

<https://www.sciencephoto.com/media/17722/view/male-and-female-pine-cones>

<https://www.ncert.nic.in>

<https://acadhelp.com/work/>

