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LESSON NOTES
WEEK 22

Year/Level: 13A/B **Subject:** BIOLOGY

Strand	3 Biodiversity Change & Sustainability
Sub Strand	3.2.5 Kingdom Plantae (Gymnosperms)
Content Learning Outcome	• Describe the general characteristics of gymnosperms • Explain the reproductive cycle of gymnosperms and adaptation to life on land

VASCULAR SEED PLANTS (Spermatophyta)

GYMNOSPERMS AND ANGIOSPERMS

General Characteristics of Seed Plants

- Have vascular tissue.
- Use seeds to reproduce.
- Gametophyte is reduced and cannot photosynthesise.
- Sperms are non-flagellated.
- The sporophyte embryo is contained within a seed coat. (Protects embryo from desiccation). It retains embryo till conditions become favourable.
- Seed plants produce **heterospores** that have different looking spores usually a male and a female where one grows into **male called microspore** and the **female megaspore**
- Each microspore develops into pollen grains
- The pollen grain in seed plants develops a pollen tube which carries the sperm to the egg. Hence there is no need for external water

PHYLUM: CONIFEROPHYTA

GYMNOSPERMS (NON FLOWERING PLANTS)

Division : conifers/ coniferophyta

Characteristics of Gymnosperms

- They do not have an outer covering around their seeds.
- They do not produce flowers.
- They do not produce fruits.

- They are pollinated by the wind.
- Have powerful tap roots, aided by lateral roots.
- Have evergreen needle like leaves which helps to withstand heat, cold and high winds.
- Reproductive structures are cones.
- Most are evergreens: pines, spruces, jews, junipers, cedars, redwoods etc
- Includes some of the tallest (red woods and some eucalyptus) ; largest (gaint sequoias) and oldest (bristle cone pine) living organisms
- Most lumber and paper pulp is from conifer wood
- Needle shaped conifer leaves are adapted to dry conditions
- Thick cuticle covers the leaf
- Stomata are in pits reducing water loss
- Have tracheids

LIFE CYCLE OF PINE

Gymnosperms produce two types of cones:

- Pollen Cones and Seed Cones
- Pollen cones are found at the lower branches of the trees, are small in size and produce microspores
- Seed cones are found at the top branches of the trees, are larger in size and produce megaspores

The life cycle of a pine demonstrates the key reproductive adaptations of seed plants

- The multicellular sporophyte is the most conspicuous stage: the pine tree is a sporophyte, with its sporangia located on cones

- The multicellular gametophyte generation is reduced and develops from haploid spores that are retained within sporangia

- The male gametophyte is the pollen grain: there is no antheridium

- The female gametophyte consists of multicellular nutritive tissue and an archegonium that develops within an ovule

- Conifer life cycles are heterosporous: male and female gametophytes develop from different types of spores produced by separate cones

- Trees of most pine species bear both pollen cones and ovulate cones which develop on different branches

- Pollen cones have microsporangia; cells in these sporangia undergo meiosis producing haploid microspores, small spores that develop into pollen grains- the male gametophytes

- Ovulate cones have megasporangia; cells in these sporangia undergo meiosis producing large megaspores that develop into the female gametophyte. Each ovule initially includes a mega sporangium (nucleus) enclose in protective integuments with a single opening, the microphyle

- it takes nearly 3 years to complete the pine life cycle, which progresses through a complicated series of events to produce mature seeds

- wind blown pollen falls onto the ovulate cone and is drawn into the ovule through the microphyle

- the pollen grain germinates in the ovule, forming a pollen tube that begins to digest its way through the nucleus

- a megaspore mother cell in the nucleus undergoes meiosis producing four haploid megaspores, one of which will survive: it grows and divides repeatedly by mitosis producing the immature female gametophyte

- 2/3 archegonia, each with an egg, then develop within the multicellular gametophyte

- More than a year after pollination, the eggs are ready to be fertilized, two sperm cells have developed and the pollen tube has grown through the nucleus to the female gametophyte

- Fertilization occurs when one of the sperm nuclei unites with the egg nucleus

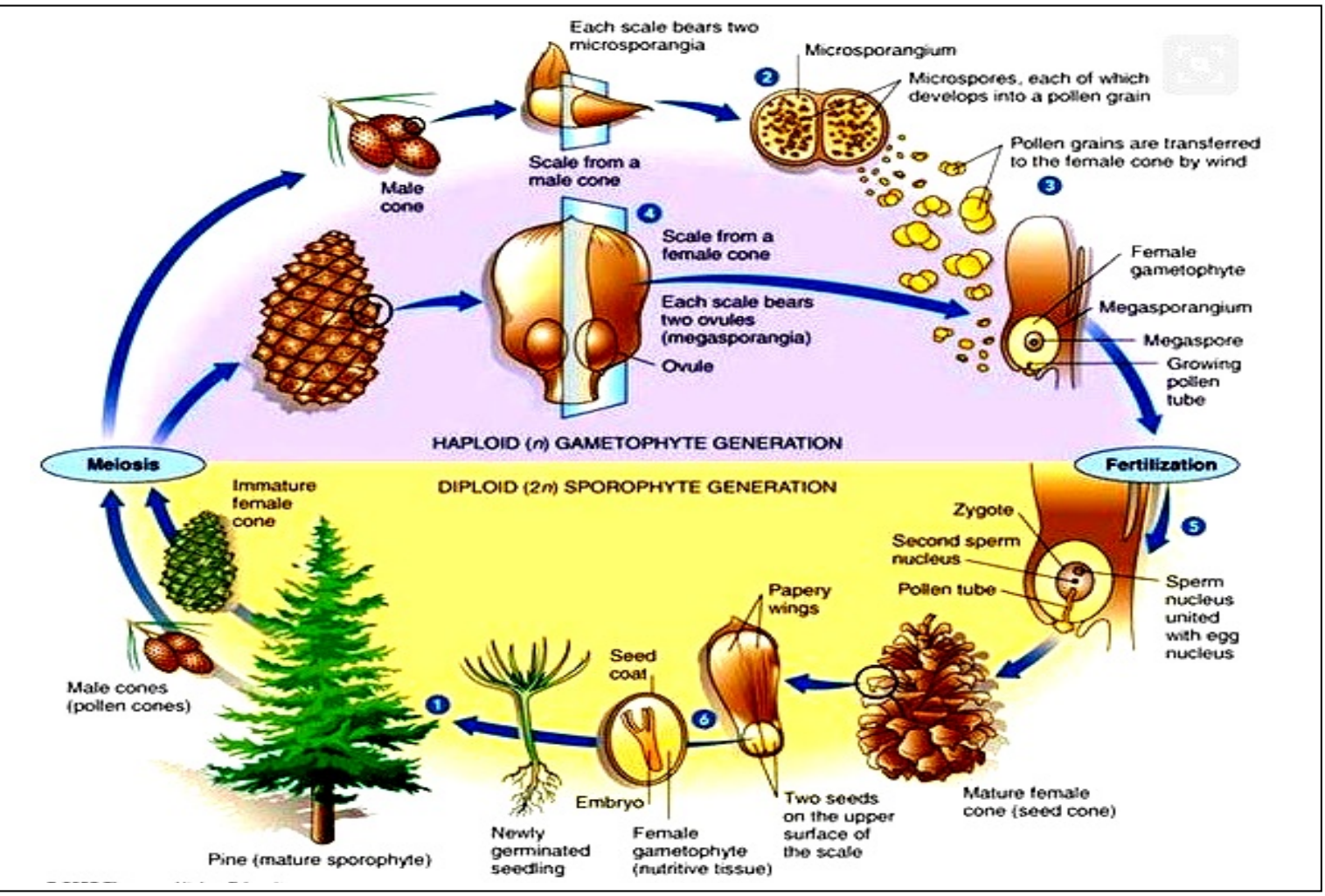
- All eggs in an ovule maybe fertilized , but usually only one zygote develops into an embryo

- The pine embryo, or new sporophyle, has a rudimentary root and several embryonic leaves. It is embedded in the female gametophyte, which nourishes the embryo unti it is capable of photosynthesis. The ovule has developed into a pine seed, which consists of an embryo(2n), its food source (n) and a surrounding seed coat (2n) derived from the integuments of the parent tree

- Scales of the ovulate cone separate, and the winged seeds are carried by the wind to new locations

- A seed that lands in a habitable place germinates, its embryos emerging as a pine seedling

DIAGRAM OF LIFE CYCLE OF PINE



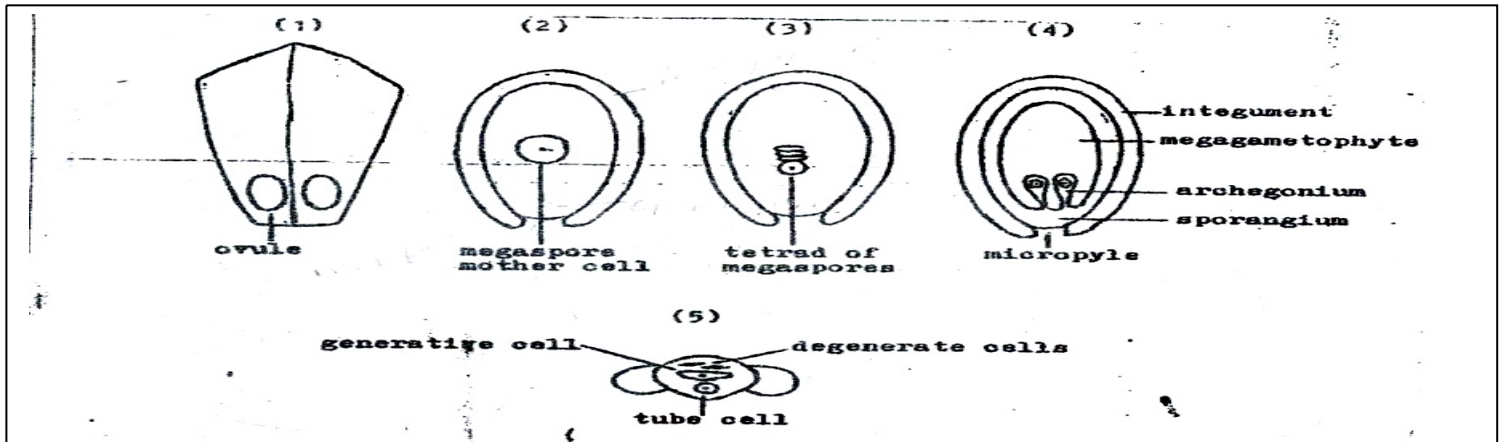


FIGURE: *The life cycle of a pine tree (above left). Pine cones (above right). Ovules and pollen grain of pi (below) — (1) A scale from a female cone; (2) section of an ovule, showing megaspore mother ce (3) section of an ovule at a later stage, showing three degenerate megaspores and a fourth megaspo which will survive; (4) section of an ovule at a still later stage, showing the megagametophyte, deriv from the surviving megaspore; (5) pollen grain.*

SUMMARY OF GYMNOSPERM LIFECYCLE

Sporophyte

Female cone – 1 scale/sporophylls

Diagram 1

2ovules ; consists of 1. Integument

2. sporangium

3.micropyle

4. megaspore mother cell (diagram 2)

Meiosis

4 haploid cells

3 disintegrate, 1 remains- megaspore(diagram 3)

Mitosis

Forms female gametophyte- mega gametophyte

Which is a multicellular mass when matures forms

2 – 5 archegonia (contains egg) (diagram 4)

Mature ovule contains integument, sporangium and

male cone

microspore

meiosis

haploid microspores

Known as pollen grains
(diagram 5 describe it)

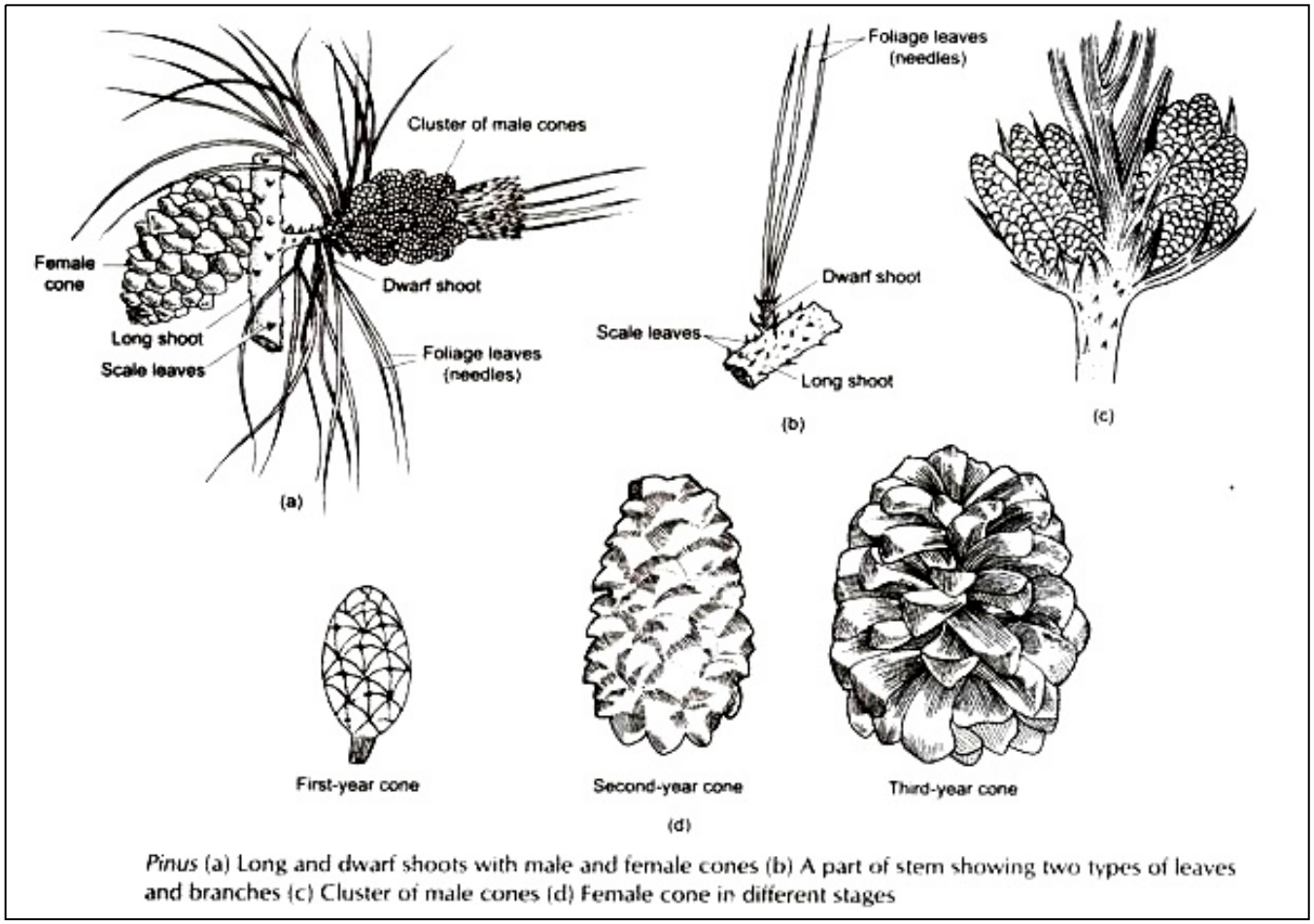
Mega gametophyte

pollinatio

- Land near micropyle
- Goes inside and grows a pollen tube, penetrates archegonia
- Generative cell and tube cell enter , generative cell releases 2 sperm nuclei, tube ruptures
- 1 sperm and egg → fertilization → zygote → mitosis → embryo (within mega gametophyte) → whole ovule is shed as seed
- Seed consists of – 1. Seed coat from integument
  2. food – endosperm – tissue of megagametophyte
  3. embryo

- 3 years 1.pollination 2.fertilisation 3.shedding

PINE CONE IN VARIOUS STAGES



Pinus (a) Long and dwarf shoots with male and female cones (b) A part of stem showing two types of leaves and branches (c) Cluster of male cones (d) Female cone in different stages

MALE AND FEMALE PINE CONE

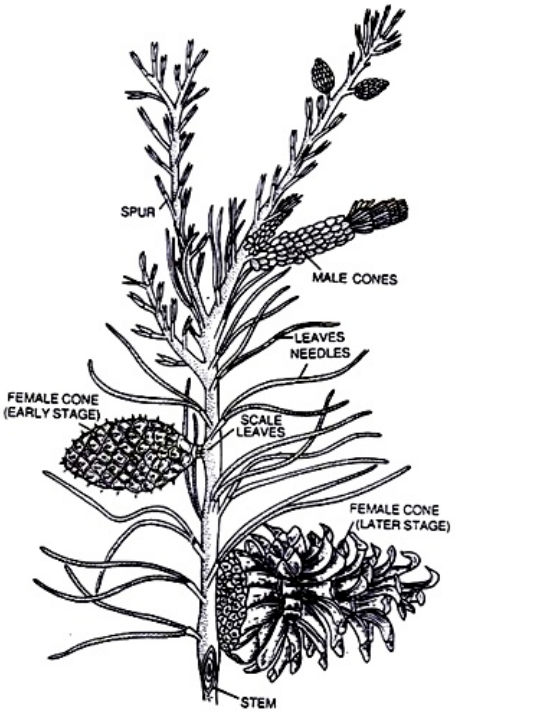


Fig. 4.12. *Pinus* sp. A twig showing male and female cones, spurs, scale leaves and foliage leaves

• Smaller in size. • Located on the top of lower branches. • 2ormoremicrosporangiaonthe underside. • 4 microspores produced. • Two of the four microspores develop into pollen grain. Contain the pollen	• Much larger in size. • Located on the tips of upper branch. • 2 ovules are produced on the upper side. • 4 megaspores produced. • Only onedevelopsintothefemale gamete. Holds the seeds

Adaptations to life on land

♦ Embryo well protected within the seed.

- ♦ Seed can remain dormant for a long period of time.
- ♦ **Heterospory**–produces 2 kinds of spores: female megaspores and male microspores.
- ♦ Gametophyte is much reduced and dependent on the sporophyte which is highly modified.
- ♦ Have true roots, stems and leaves suitable for terrestrial habitat.
- ♦ Sperms do not require water for fertilization.

ACTIVITY QUESTIONS:

1. Sate the importance of seeds in the plant kingdom?

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2. How are the male gamete of gymnosperm formed?

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3. How are the female gamete of gymnosperm formed?

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4. How are gymnosperm seeds formed?

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