Spermatophytes

- **General Characters:-**
- **The spermatophytes (also known as phanerogams) comprise those plants that produce seeds. They are a subset of the embryophytes or land plants. The living spermatophytes include five groups:**

1. Cycadophyta: a subtropical and tropical group of plants with a large crown of pinnate compound leaves and a stout trunk. They look like palms.

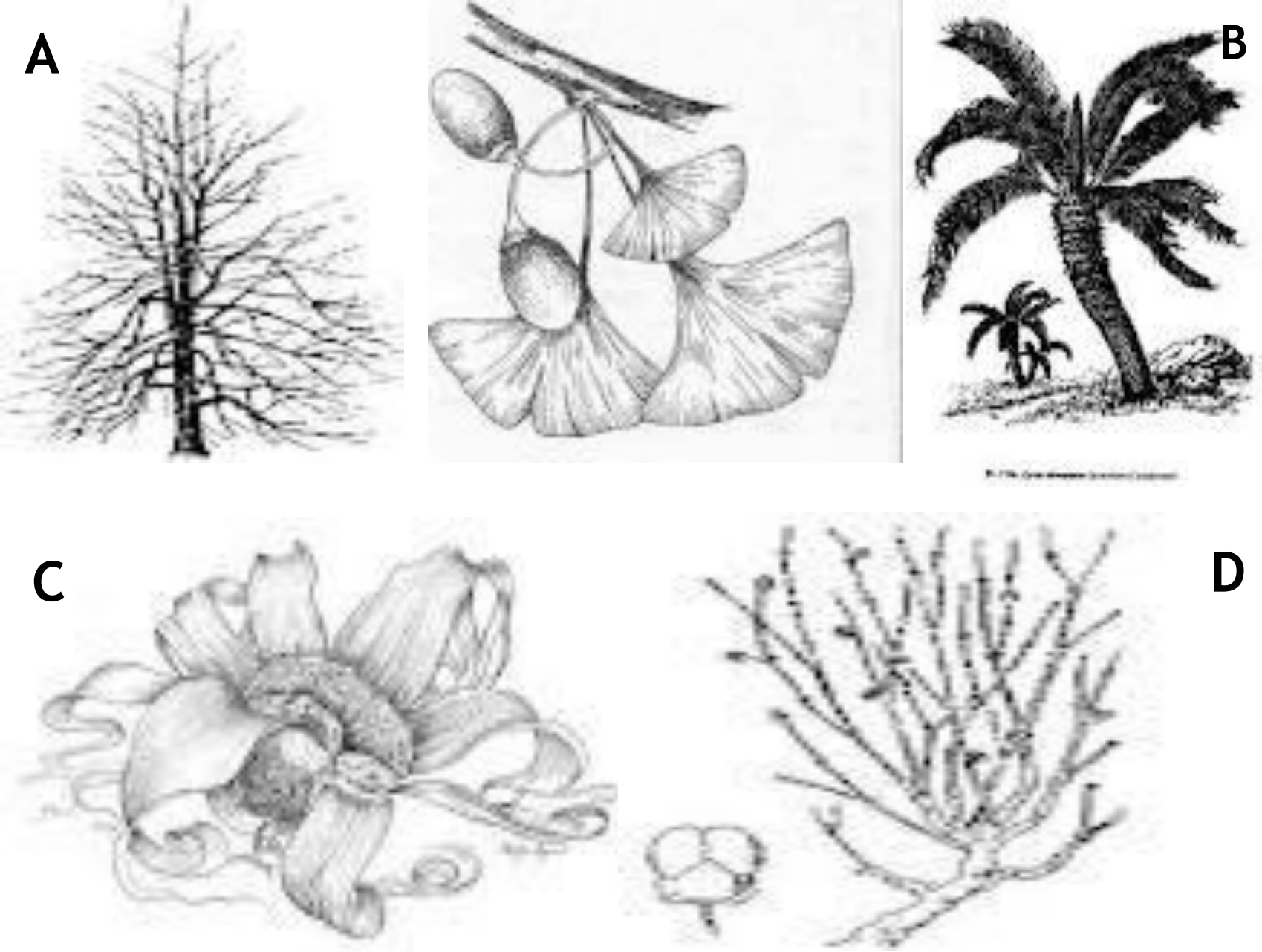
2. Ginkgophyta: represented by a single living species of trees (*Ginkgo biloba*).

3. Coniferophyta: cone-bearing trees and shrubs such as *Pinus*.

4. Gnetophyta: woody plants; represented by the genera *Gnetum*, *Welwitschia*, *and Ephedra*.

5. Angiosperms: the flowering plants, a large group including many familiar plants (both monocotyledons and dicotyledons) in a wide variety of habitats.

- The first four groups are collectively known as Gymnosperms (non-flowering seed plants, or naked-seed plants).
- In addition to the groups listed above, the fossil record contains evidence of many extinct species of seed plants. The so-called "seed ferns" (Pteridospermae) were one of the earliest successful groups of land plants; and forests dominated by seed ferns were prevalent in the ancient ages. In the recent ages, seed ferns had declined and representatives of modern gymnosperm groups were abundant and dominant.



Gymnosperms:(A) *Ginkgo biloba*, (B) *Cycas*, (C) *Welwtschia*, (D) *Ephedra*

- **Morphological studies** have shown a close relationship between the gnetophytes and the angiosperms; both groups contain xylem vessels and sieve tubes as the tracheary elements. In the lower vascular plants xylem is represented by tracheids and phloem by sieve cells.

Gymnosperms

- **General Characters:-**

1- Gymnosperms (Gymnospermae) are a group of spermatophytes (seed-bearing plants) with ovules being carried on the edge of open sporophylls, which are usually arranged in cone-like structures.

2- The other major group of seed-bearing plants, that is the angiosperms, have ovules enclosed in a carpel (a sporophyll with fused margins). The term gymnosperm means "naked seeds" and refers to the un-enclosed condition of the seeds, as they are found naked on the scales of a cone or similar structure.

3- There are between 700 and 900 species of Gymnosperm. Often they have many economical uses such as soap, varnish, wood, paint and perfumes; some are used in folk medicine and some are edible.

4- Gymnosperms are heterosporous, producing microspores (pollen grains) and megaspores (the ovules).

5- After fertilization, the resulting embryo, along with other cells comprising the ovule, develops into a seed. The seed is a sporophyte resting stage.

6- Reproduction in gymnosperms varies greatly. Cycads and Ginkgo have motile sperms that swim directly to the egg inside the ovule, while conifers and gnetophytes have sperms with no flagella that are conveyed to the egg along a pollen tube which grows through the ovule tissues.

Division: Coniferophyta

- **General Characters:-**

1- Coniferophyta or Pinophyta are cone-bearing seed plants.

2- All extant conifers are woody plants; the great majority being trees with just a few being shrubs. Typical examples of conifers include cedars, douglas-firs, cypresses, junipers, pines, redwoods and spruces.

3- Species of conifers grow naturally in almost all habitats, and are frequently the dominant plants in certain habitats for example in the taiga. Conifers are of immense economic value primarily for timber and paper production; the wood of conifers is known as softwood.

4- The conifers are an ancient group, with a fossil record extending back about 300 million years.

(A) Female cone of Norway spruce (*Picea abies*) and (B) male cone of (*Larix kaempferi*)

Reproduction

- Most conifers are monoecious, but some are dioecious; all are wind-pollinated.
- Conifer seeds develop inside a protective cone called a strobilus. The cones take from four months to three years to reach maturity, and vary in size from 2 mm to 60 cm long.
- In Pinaceae the cones are woody, and when mature the scales usually are spread open allowing the seeds to fall out and to be dispersed by wind.

- In some species (e.g. firs and cedars) the cones disintegrate to release the seeds and in others (e.g. the pines that produce pine nuts) the nut-like seeds are dispersed by birds.

- Ripe cones may remain on the plant for a long time before falling to the ground. In some fire-adapted pines the seeds may be stored in closed cones for up to 60-80 years; being released only when a fire kills the parent tree.

- The male cones have structures called microsporangia carried in pairs on the lower surface of staminate scales (microsporophylls).

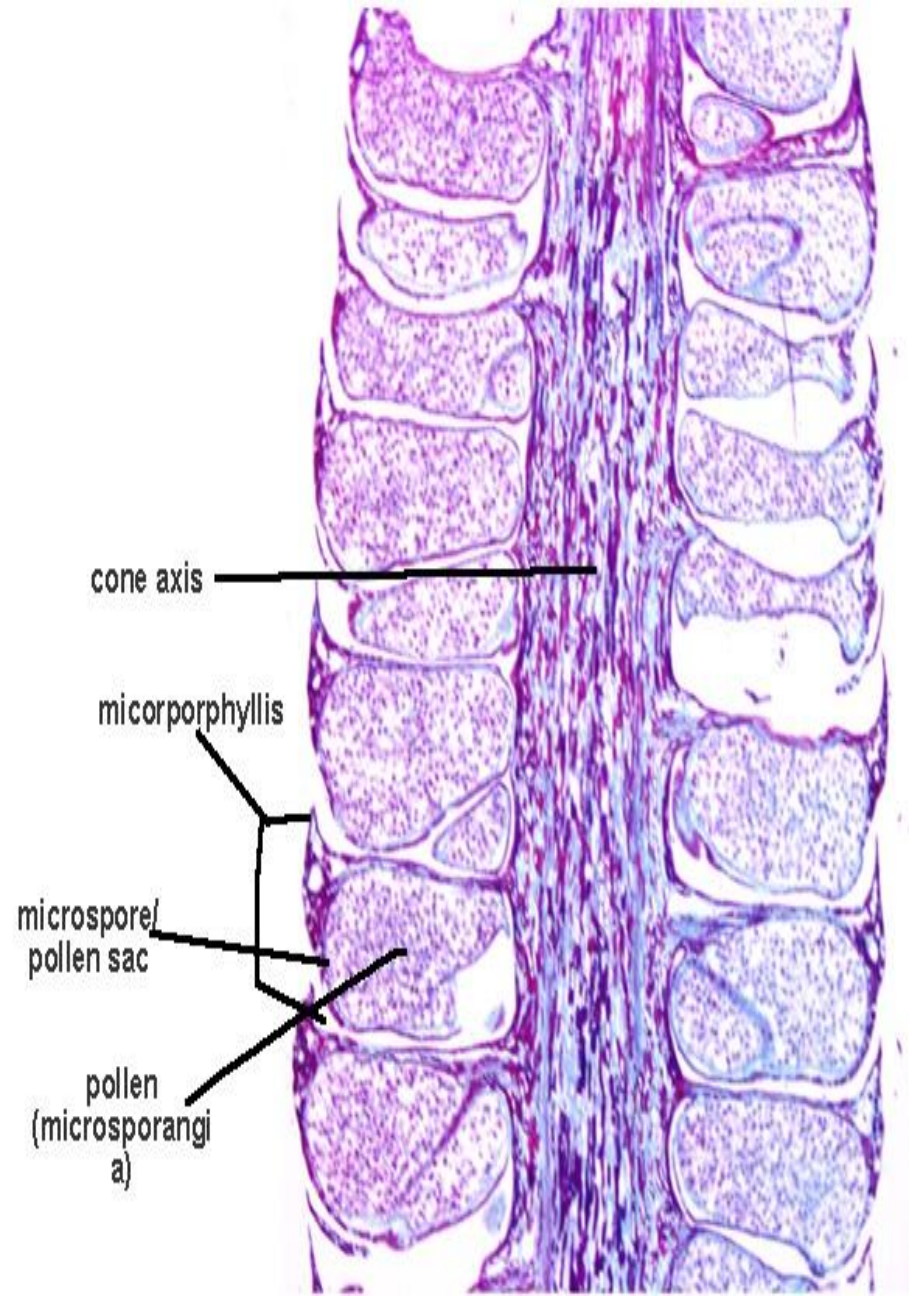
- Microsporangia produce yellowish pollen (microspores) through meiosis. Pollen is released and carried out by the wind to female cones.

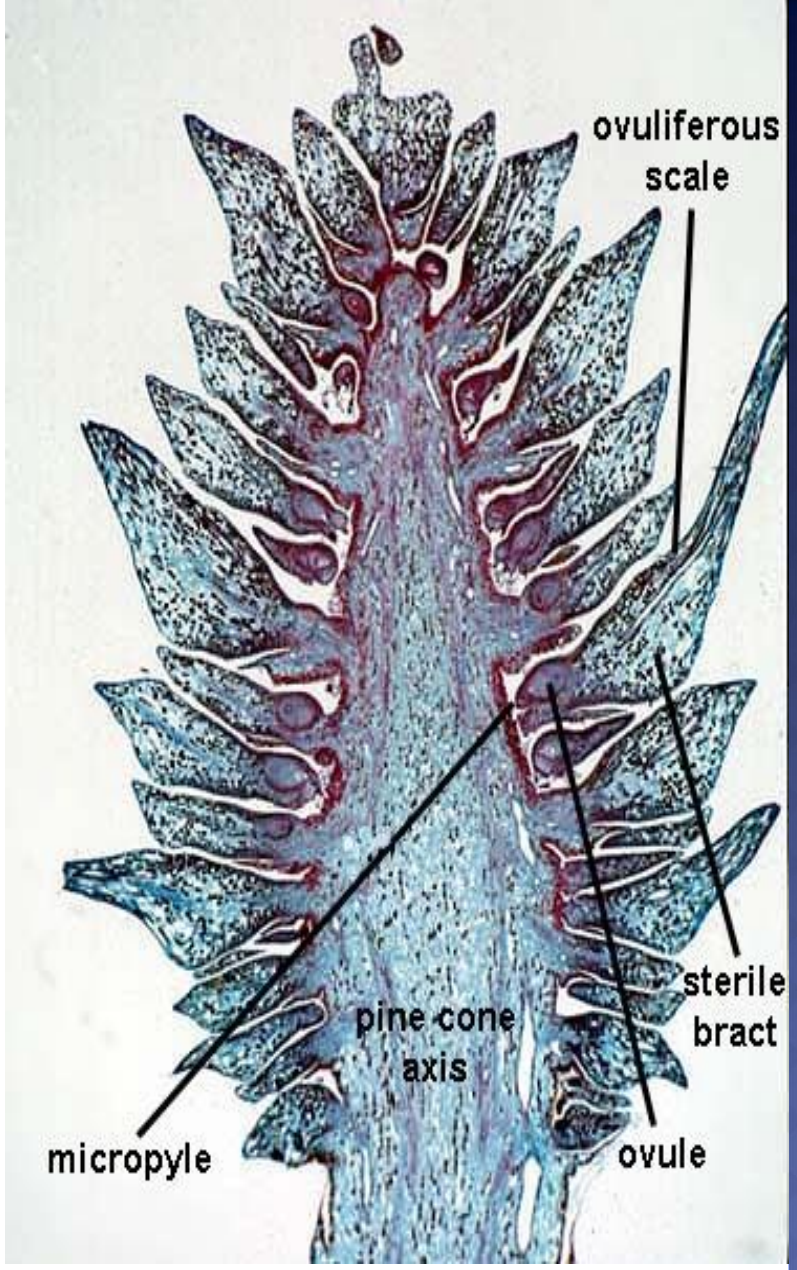
- Pollen grains produce pollen tubes, much like those of angiosperms. The female cone carries megasporangia (ovules) in pairs on the upper surface of megasporophylls (carpels or ovuliferous scales).

- Within the megasporangium meiosis occurs, leading to the formation of a single megaspore which on germination gives rise to the female gametophyte.

- The microspores or pollen grains are carried out by wind to the female cone and are drawn into a tiny opening on the ovule called the micropyle. It is within the ovule that germination occurs; a pollen tube seeks out the female gametophyte.

- Fertilization will occur. The resulting zygote develops into an embryo, which along with its surrounding integuments, becomes a seed. Eventually the seed may fall to the ground and, if conditions permit, grows into a new plant.





Structure of the male and female cones of *Pinus*

ANGIOSPERMS

- The flowering plants or angiosperms (Angiospermae) are the most widespread group of land plants.
- They are distinguished from other seed plants by distinct characteristics.
- According to the structure of the embryo, Angioserms are classified into two main groups:
  - Monocotyledons (with the embryo possesses a single embryonic leaf or cotyledon).
  - Dicotyledons, in which the embryo possesses two cotyledons.
- In addition to this major difference in embryo structure the two groups exhibit other differences regarding morphology and anatomy of plant organs and flower structure.