**SALIENT FEATURES OF GYMNOSPERMS**

The term ‘Gymnosperm’ is originated from two Greek words, ‘gymnos’ meaning naked and ‘sperma’ meaning seed. It is a smaller ancient group of plants that produce naked seeds because their seeds are not enclosed by a fruit. On earth, more than 1000 gymnospermic plants species are still found. The notable groups are cycads (Cycas, Lepidozamia, Macrozamia, Zamia, Microcycas, etc), conifers (cypresses, pines, cedars, firs, junipers, larches, redwoods, kauris, etc), gnetophytes (Ephedra, Gnetum, and Welwitschia) and Ginkgo (Ginkgo biloba). Among them, the largest group of living gymnosperms is Conifers while ginkgo is a single living plant species. Generally, gymnosperms are plentiful in the temperate forest zone and they can tolerate dry or moist conditions. They have needle-like leaves and most of them are evergreen. In the Himalayas of the Indian subcontinent, they are more abundant and form coniferous forests. ​Sequoiadendron giganteum (giant saquoia: family-Sequoioideae) is popularly known as a redwood which is the largest conifer species that can grow more than 100 meters in height.

Gymnosperms are the seed-producing plants, but unlike angiosperms, they produce seeds without fruits. These plants develop on the surface of scales or leaves, or at the end of stalks forming a cone-like structure. Gymnosperms belong to kingdom ‘Plantae‘ and sub-kingdom ‘Embryophyta’. The fossil evidence suggested that they originated during the Paleozoic era, about 390 million years ago. Basically, gymnosperms are plants in which the ovules are not enclosed within the ovary wall, unlike the angiosperms. It remains exposed before and after fertilisation and before developing into a seed. The stem of gymnosperms can be branched or unbranched. The thick cuticle, needle-like leaves, and sunken stomata reduce the rate of water loss in these plants.

The gymnosperms belong to six phyla:

1. Cycadophyta

2. Ginkgophyta

3. Gnetophyta

4. Pinophyta (Coniferophyta)

5. Pteridospermales and

6. Cordaitales

Among the above six phyla, Pteridospermales and Cordaitales have gone to extinct.

**Important characters of gymnosperms are as follows:**

1. The living gymnosperms are woody, evergreen (except Larix and a Taxodium) perennials grow as trees or shrubs. Tallest trees are Sequoia sempervirens (366ft) and S. gigantia (342ft). The gymnosperms are always green all year round and continue alive for a long period.

2. The living members are founding in colder regions of earth where snow (not rain) is the source of water. Only the members of cycadales and gnetales thrive in warm dry climate.

3. The dominant plant body is sporophyte (2n) which may be dioecious or monoecious. Gametophytes are inconspicuous and endosporic i.e. develop with the spores.

4. Sporophyte differentiated into — root, stem and leaves.

5. Tap root system is exarch and diarch to polyarch. Besides tap root, coralloid roots (in cycads) and mycorrhizal root (in coniferals) present.

6. Stem: Erect, generally branched (Cycas is un-branched)

7. Leaves are Dimorphic i.e. 2 types, foliage and scale leaves.

8. In many cases, transfusion tissue is present in the internal structure of a leaf. Sunken stomata are also present in the leaves.

9. Gymnosperms are xerophytes in nature due to presence of thick bark, thick hypodermis, thick cuticle, scales leaves, sunken stomata, transfusion tissue, etc. In some cases leaves modified into needle-like, scale like or small leathery. These are the adaptations to combat water stress in air and colder regions.

10. Xylem is Composed of xylem parenchyma and tracheids with bordered pits. Vessels are absent (exceptin Gnetales).

11. Pliloem is Composed of sieve cells and phloem parenchyma but companion cells absent.

12. The gymnosperms are heterosporous, means 2 types of spores produced i.e. haploid microspores and megaspores. Microspores produced within micro-sporangia while megaspores produce within megasporangia (nucellus) of ovules. Both types of sporangia are formed on special leaf-like structures called sporophylls (microsporophylls and megasporophylls).

13. Gymnosperms are flowerless plants which create seeds and cones. Seeds of all gymnosperms are enclosed in cones for protecting their seeds. In this case, male cones create pollen (male gametophyte) and female cone create eggs. Hence, the male is called pollen cone while the female is called a seed cone.

14. Presence of cones or Strobili. Sporophylls are spirally arranged along an axis to form compact cone or strobili i.e. male or pollen cones and female or seed cones but in Cycas female cone is loosely arranged called lax.

15. Ovules:Naked, sescile, geneiallyorthotropous, and unitegmic or bitegmic (in Gnetum).

16. All gymnosperms are anemophilous and pollen grains (microspores) are directly carried by wind to the micropyle of the ovule during pollination. In this case, the pollen grains fall directly on the pollen drop and then they are sucked into the nucleus.

17. Fertilization is siphonogamous i.e. male gametes carried to female gametes by means of a pollen tube. Double fertilization, a feature unique to angiosperms, is absent in gymnosperms, but found in Ephedra. After fertilization, Zygote develops into embryo and ovules become seed.

18. Endosperm or female gametophyte formed before fertilization and is always haploid. (But triploid in angiosperms.)

19. Embryo development is meroblastic i.e. develops from a small part of zygote.

20. Most members show polyembryony i.e. development of more than one embryo, but only one survives at the end.

21. Cotyledons 2 (in Cycas) or many (in Pinus 2-14).

22. Cambium form secondary wood which is monoxylic (soft and porous) or pycnoxylic (hard and compact)

23. Connecting Links:The lower gymnosperms like Cycadales resemble pteridophytesin absence of vessels and wood fibers whereas higher gymnosperms like Gnetales and Coniferales resemble angiosperms.