**Comparative account of gymnosperms and Angiosperms**

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| Sl. No. | Gymnosperms | Angiosperms |
| 1 | Plants are woody perennial trees or shrubs | Plants are annual, bi-annual or perennial hurbs, shrubs or trees- either woody or herbaceous |
| 2 | Xylem generally consists of tracheids and xylem parenchyma and phloem of sieve tubes and phloem parenchyma | Xylem generally consists of tracheids, tracheae and xylem parenchyma and phloem consists of sieve tubes, companion cells and phloem parenchyma |
| 3 | Leaves are two types i.e. green foliage and brown scale leaves | Only green foliage leaves present |
| 4 | Flowers are unisexual, simple and without perianth (except Gnetum) | Flowers are unisexual or bisexual with or without perianth |
| 5 | Carpels (megasporophylls) are not differentiated into stigma, style and ovary | Carpels are modified to form stigma, style and ovary |
| 6 | Ovules are freely exposed on carpels, hence seeds are remain naked  | carpels form an ovarian chamber in which ovules are enclosed, consequently seeds remain closed within fruit |
| 7 | At the time of pollination pollen grains are directly carried by wind to the micropyle of the ovule | Pollen grains are carried by various agents and are deposited on the stigma- not directly to micropyle, as ovules are enclosed within the ovary |
| 8 | Embryo consists of one or more cotyledons. Here several embryos develop in each ovule, although one embryo survive, thus they are polyembryonic | Embryo consists of 1 or 2 cotyledons. Here 1 embryo develop in each ovule, although one embryo survive, thus they are not polyembryonic |

**Phylogenetic relationship of the gymnosperms**

The gymonsperms are generally divided into two main groups, *viz*. *Cycadophyta* and *Coniferophyta*. Most of the authors suggest that both groups originated from the filicinae of the pteridophyta, but it is still an unsettled question as to whether the two groups had a common origin or whether the two groups arose independently from different groups of Filicinae. Of course the pteridospermae (Cycadofilicales) i.e. seed ferns possess numerous fern-like characters. It is also reasonable to suppose that the orders Bennettitales and the Cycadales were derived from the Pteridospermae. The Cordaitales either evolved independently or they had a common origin with the Pteridospermae, anyway the Cordaitales probably gave rise to the Coniferales and the ginkgoales. The order Gentales may represent an offshoot from the Coniferophyta.

**Affinities of Gymnosperms**

The gymnosperms have close affinities with pteridophytes on the one hand and the angiosperms on the other.

The sporophyte and gametophytic generations in both pteridohytes and gymnosperms alternate with each other, but gymnosperms have more reduced gametophytic generations, here the gametophyte is unlike that of ferns as it is totally dependent upon the sporophyte. The cycads shows affinity with ferns in the compound nature of their leaves and in circinate vernation- both are also alike in the absence of companion cells in phloem and tracheids in xylem (except *Gnetum*). In heterospory, gymnosperms resembles *Selaginella, Isoetes, marsilea* etc. members of Cycadales show affinity with pteridophytes in presence of multiflagellate motile sperms.

Gymnosperms resemble angiosperms in habit (shrubs or tree-like), in unisexual apetalous (**flower** having no petals) flowers represented by microsporophylls (stamens) and megasporophylls (carpels), in presence of pollen tube for carrying male gametes to the egg, retention of megaspore inside the megasporangium and its development into female gametophyte.

**Economical importance of gymnosperm**

The tuber and seeds of *Cycas circinalis* produced arrowroot (a starch obtained from the rhizomes), a type of sago. Sometimes the seeds and young shoots are also taken as food. The stem produces gum. The juice of the tender leaves is supposed to be helpful for reducing vomiting. *Cycas revolute* also recognised as an important plant in the decoration of the garden. It is also said to be a tonic, helps expectoration. The resin of *Cycas ramphii* is used for the treatment of ulcers.

The woods of Pinaceae are of great commercial importance. *Pinus* produces a good quality of timber, which is used as building material, fuel, in making furniture, poles, shingles, packing cases, match boxes, pencils etc. Several species of *Pinus*, of which, *Pinus roxburghii*, commonly called ‘chir’, is the principal source of methyl alcohol, turpentine and resin. The resin is also internally used in connection with stomach troubles and as a remedy for gonorrhoea. It is extremely applied as aplaster to inflamed swelling of the glands and for the collection of pus in the cavity. It is also used as timber. The seeds of *Pinus gerardiana*, commonly called chilgoza, are eaten after roasting. It is very nourishing. Oil is also obtained from the seeds, which is applied for dressing wounds and ulcers. Some *Pinus* species produces pulp for the paper industry. The woods of *Pinus wallichiana* is superior in quality to that of *Pinus roxburghii* and yields resin. An essential oil produced by the leaves and wood of *Pinus insularis* is used as fuel. The seeds of *Pinus edulis* are consumed by human beings. The fossilised resin of *Pinus succinifera* (now extinct) is known as amber (hard translucent fossilized resin), which is of great commercial value and even used in jewellery.

Ephedra produces a medicine called ephedrine, which is used against asthma and bronchial trobles.

The seeds of *Gnetum gnem*on and *G latifolia* are edible. The seeds are taken as food after roasting or boiling and rejecting the yellowish red outer coat of fruit. The seed-kernel is crushed, moulded to form cakes or biscuits. After drying in the sun it is fried in the boiling oil. The young leaves and inflorescences are eaten as vegetable. The bark of the plant produces a fibre, which is strong, durable in sea water and has a good tensile strength both in dry and wet condition. It is used for fishing nets and lines. Ropes prepared from it are strong, flexible and light. The wood is used for anchoring posts for rafts and junks (a Chinese vessel). Split branches can be used for basket. The seeds of *Gnetum ula* are also edible and produce a cooking oil, used for edible purposes. *Gnetum montanum* is able to kill fish i.e they poses pesticidal properties.