GYMNO SPERM

1. Term Gymnosperm given by Theophrastus.

2. Study of Gymnosperm known as Gymnospermlogy.

3. Gymnosperm & Angiosperm are collectively included under spermatophyta i.e. seed bearing plants.

4. Gymnosperm are naked seeds plant i.e. no fruit formation takes place in these plant i.e. in gymnosperm embryo & seed formation takes place but no fruit formation occur.

5. Gymnosperm are very limited in distribution. They are mainly found in cold regions. In India Gymnosperm are found on Himalayan mountains **. Xerophyte** founds on slopes of mountain & cold region therefore gymnosperm are **xerophyte.**

6. All gymnosperm are vascular plants. Therefore vascular tissue present i.e. xylem & phloem. Xylem lack **vessels** & phloem lack **companion cells.**

Note -

- Exceptionally in xylem of ***Gnetum, Epheddra, Welwitschia*** true vessels are present.
- In gymnosperm vascular bundle is **Conjoint - Collarateral - Endarch - Open.**
- In the vascular bundle cambium is present therefore secondary growth takes place in gymnosperms, so that Gymnospoerms are woody plants.

7. Most of the gymnospoerms are occur at tree form - but some are present as shrub.
eg. Ephedra
Some Gymnospoerms are liana wood climbers.
eg. *Gnetum ula*

LIFE CYCLE OF GYMNOSPERM -

1. In Gymnospoerms main plant body is **sporophyte** (diploid). Gymnospoerms are **dioecious.** i.e. male & female plants are separate.

2. All Gymnospoerms are **heterosporus.** At the time of reproduction two types of spores are formed.
   - Microspores - Male
   - Megaspores - Female

3. These two types of spores are formed in different sporangia.
   - Microspores are formed in Microsporangia, Microsporangia also term as pollen sac.
   - Megaspores are formed in Magasporangia. megasporangia also term as ovule.

4. Both type of sporangia re formed on different sporophylls.
   - Microsporangia are formed on Microsporophyll. It is known as stamen.
   - Megasporangia are formed on Megasporophylls. It is known a carpel.

5. Both types of sprophylls are found in groups & form male cone (strobilus) & female cone.
   - **Gymnosperm's cone are just like flower of angiosperm.**
   - **Carpels of Angiosperm & Gymnosperm are different to each other.**

Carpel of Gymnosperm –

- Carpel of gymnosperm is les modified leaf it keeps its identity.
- Ovule of gymnosperm develops openly on carpel ovule doesnot enclose in any structure.

  Therefore carpel of gymnosperm is termed as **open carpel.**

Carpels of Angiosperm –

- Angiosperm's carpel divide into three part ovary, style stigma.
- Ovule enclosed in ovary. Therefore angiosperm's carpel termed as **closed carpel.** i.e. angiosperm carpel is well modified leaf. Sprophyll lost its identity.

6. Meisis takes place in cells of microsporangium & megasporangium and form microspore & meagaspore respectively.

7. In Gymnosperm (included angiosperm) germination of spores is **endosporic** i.e. germination of spore akes place with is sporangia.

8. Male gametophyte form after germination of microspore. Male gametophyte is also known as pollen grain. Male gametophyte forms male gamete.

9. In **lower gymnosperm,** male gametes are **motile** & **multiciliate** but in **higher gymnosperm** are angiosperm male gametes are **non motile** due to the absence of cilia and flagella. They (higher gymnosperm) do not require water for fertilization.

10. Female gametophyte form after germination of megaspore.

Female gametophyte of gymnosperm contains two type structures.

- Archegonia - If form egg.
- Endosperm - It provides nutrition for the development of embryo.

11. Pollen grain (male gametophyte) reach at the ovule by pollination. Pollen grains reach at the micropyle (ovule) by wind. **Anemophilly** occur in gymnosperm.

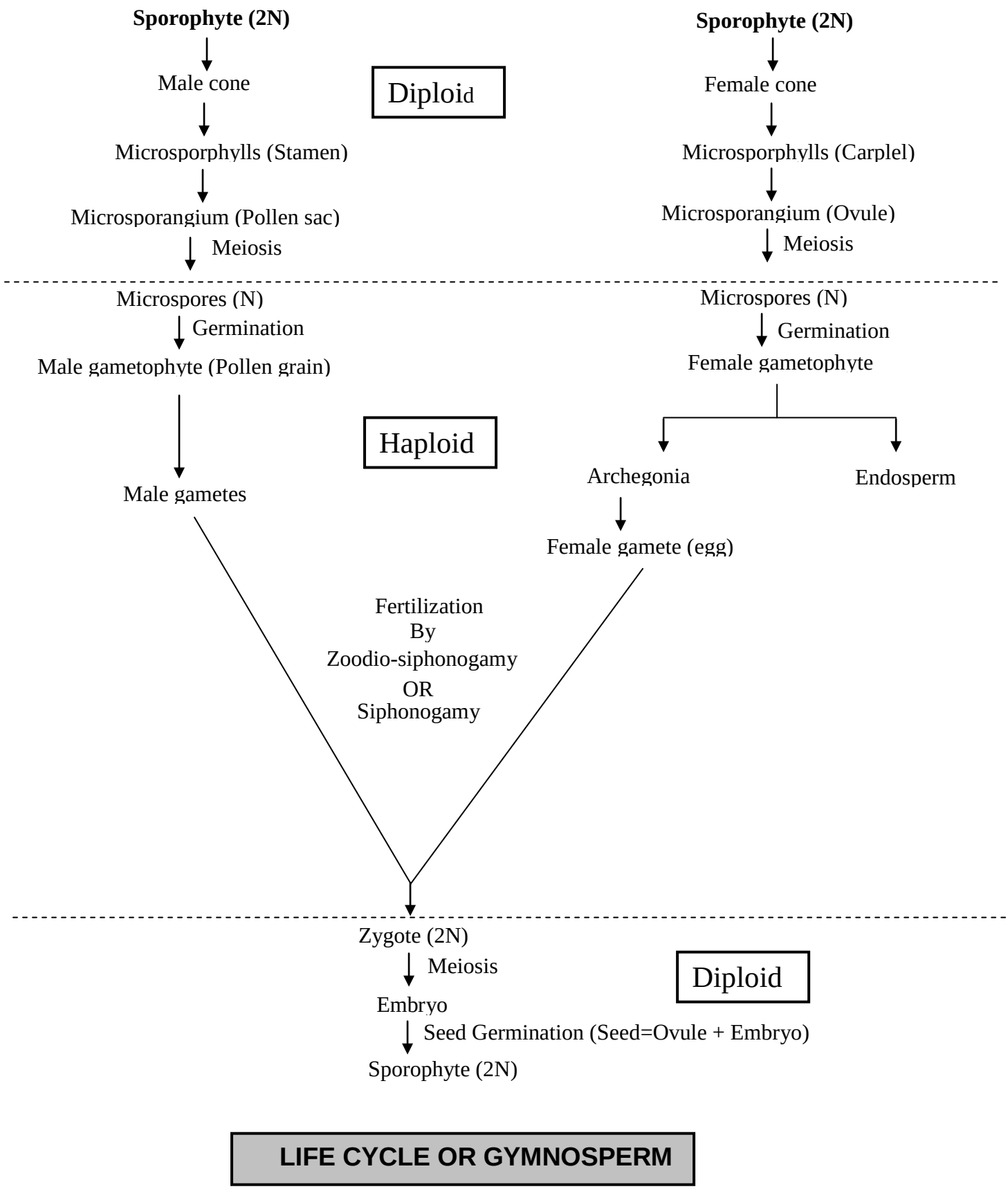
FERTILIZATION -

Two types of fertilization take place in gymnosperm

(1) Zoodio - siphonogamy - This type fertilization occurs in lower gymnosperm. Male gamete is motile and contained in pollen tube.

(2) Siphonogamy - This type of fertilization occur in higher gymnosperm. Male gamete is non motile and transferred to female gamete (egg) by pollen tube. After Pollination male & female gametes are fused & form a diploid zygote.

- In gymnosperm single fertilization takes place so that single zygote form through fertilization. In Angiosperm double fertilization takes places so that two product are formed are formed after it (i) Zygote (ii) Endosperm.
- In gymnosperm **endosperm** form before fertilization so it is **haploid** but in angiosperm endosperm are formed after fertilization so endosperm of angiosperm is **triploid.**



LIFE CYCLE OR GYMNOSPERM

DEVELOPMENT OF ZYGOTE -

1. Embryo formed by the development of diploid zygote. After embryo formation ovule term as **seed. (Seed** → Ovule + Embryo)

   - Ovule is a sporangia. Embryo enclosed ovule because development of spore is **endosporic.**
   - Seeds are not formed in pteridophyta because germination of spore is **exosporic** i.e. embryo develops outside the sporangia.

Note :- Polymbryony occurs in gymnosperm i.e. a single seed develops many embryo.

There is two type Polyembryony

(1) Potential polyembryony - Many embryo form by fertilization of many archegonia.
eg. Cycas - Single ovule of Cycas contains two archegonia. Fertilization occurs in both archegonia so two zygote form in a ovule. So two embryo form. Potential polyembryony is not true polyembryony because a zygote form only one embryo.

(2) Cleavage polyembryony - Many embryo are formed by the cleavable in zygote so it is true polyembryony.

eg. ***Pinus***

2. Embryo enclosed is seed. Seed absorbs water & bursts. Now embryo germinate and form a new diploid plant.

LIFE CYCLE :

Life cycle of Gymnosperm & angiosperm is diplontic because gametophytic generation is short lived. Gametophyte is very reduced & depend on its sporophyte.

SOME IMPORTANT POINTS :

1. **Antheridia** is absent in gymnosperm & angiosperm i.e. pteridophyte is last group of antheridia. But **Archegonia** is also absent in angiosperm. So gymnosperm is last group of archegonia.

Evolution of archegonia starts form liverworts. It is well develops in moss. Gymnosperm is last group of it. So in this group it is very reduced.

Archegonia of liver worts	-	NCC = 4 - 6 VCC = 1	Egg cell = 1
Archegonia of Moss	-	NCC = 6 - 18 VCC = 1	Egg cell = 1
Archegonia of Pteridophyta	-	NCC = 1 - 2 VCC = 1	Egg cell = 1
Archegonia of Gymnosperm	-	NCC = Absent VCC = 1 (Short lived)	Egg cell = 1

Note : neck of archegonia of **Ephedra** is longest.

2. During evolution Gametophyte becomes reduced & sporophyte becomes well-develop.

Gametophyte	Very reduced	-	In Angiosperm
	Well developed	-	In Moss
Sporophyte	Very reduced	-	In Thallophyta (Only zygote)
	Well developed	-	In Angiosperm

Gymnosperms are divided into two groups
(1) Cycadophyta (Lower Gymnosperm) (2) Coniferophyta (Higher Gymnosperm)

CYCADOPHYTA

Many characters of this group resemble to **fern.**

(A) The plants of this group are megaphyllous or macrophyllous.

(B) Presence of Ramenta.

(C) Male gamete is motile.

(D) Vascular bundle are hadrocentri.

Cycadophyta is divided into three orders.

(i) Cycadofillicales or Pteridospermae :
(a) This group includes seed fern.
(b) Now this group is completely extinct.
eg. Lyginopteris - Fossil Plant

(ii) Benettiatales :
(a) It is also **a completely extinct** group.

eg. Williamsonia -fossil plant

Note : Its fossils were discovered by **Prof. Birbal sahani**

(iii) Cycadales -
(a) Presently **living Gymnosperms** are included in this order.

(b) All the plants of this group are living fossils.

- ***Zamia pygmea*** **-** *Smallest Gymnosperm*
- ***Cycas*** **-** Fern palm or Sago palm
  Sago is obtained form its stem.

- ***Cycas thouarsii*** **-** The diameter of its ovules is 7 cm. Its ovules, male gametes and egg are largest in plant kingdom.

CONIFEROPHYTA

Four orders are included in this group

(i) Ginkgoales :

(a) It is the oldest order of coniferophyta. Maximum plants of this group are extinct.

(b) Only one plant of Ginkgo biloba is present in India (In Manali). Some plants are also present in China.

***Ginkgo biloba* -** living fossil - it is also known as “Maiden hair tree”.

Note : Exceptionally *Ginkgo biloba* belongs to higher gymnosperm but its male gametes are motile and fertiliztiion by zoodiosiophonogamy.

(ii) Cordiatales :

(a) It is completely extinct group

eg. *Cordaites*

(iii) Coniferales :

(a) Conifers re included in this group. (b) It is the largest group of gymnosperm

e.g. of Coniferales -

(a) *Pinus* (Pines) :

- *Pinus species* - A resin "turpentine" is obtained from it. Turpentine is used in varnish.
- *Pinus gerardiana* - It is known as "chilgoza pine"
- *Pinus roxyburghii* - It is known as "chirprine".

(b) *Cedrus* - It is known as deodar.

(c) *Taxus* - It is known as Yew tree An anticancer medicine "Taxol" is obtained from its bark.

(d) *Taxodium maxicanus* - The stem of this plant is thickest in the plant kingdom.

(e) *Abies balsamea* - A resin "Canada balsam" is obtained from it. It is used to manufacture permanenet slides in biology laboratory.

(f) *Juniperus virginiana* - An oil is obtained from this tree - "Cedar wood oil". It is used as cleansing fluid is biology laboratory. This oil is also used in microscope to increase the resolving power. This oil is used as nail polish remover.

(g) *Araucaria species*

- ***Araucaria excelsa*** - Christmas tree
- ***Aruacaria araucana*** - Monkey puzzle tree

} Ornamental plants

(h) *Sequoia species* - The plants in this genus are heavy. Therefore they are called as father of forest.

Sequoia giganteum - It is called Red wood tree or Sherman tree. It is the largest gymnosperm. There is only one tree of this species and that is in California (America)

(i) *Metasequoia* - It is a living fossil. This plant is present in china valley.

(iv) Gnetales -

(a) They are the most advanced gymnosperm.

(b) Exceptionally members of this group have vessels in xylem.

(c) Ovule of this group is bitegmic.

(D) Archegonia is absent in the members of this group.

eg. *(1) Gnetum* ***(2) Welwitschia***

(3) Ephedra - ***Exceptionally*** **archegonia is present in Ephedra.**

Epheddra - This gymnosperm is commonly found in Rajasthan. Ephedra is a medicinal plant. *Ephedrine* (Medicine) is obtained form it. It is an effective medicine in asthma. Athletes misuse it, so ephedrine is restricted for them.

Cycadofillicales was first seeds plant. First time seed habit established in this group. In general way seed habit was originated from those pteridophytes which are now extinct. These pteridophytes were ancestor of cycadofillicales.

Seed habit originated from those pteridophyte which were jut like **Selaginella.** Because **Selaginella** show origin of seed habit.

There is mainly two requirements for seed formation

(1) Plant should be heterosporus (2) Germination of mega spores should be endosporic