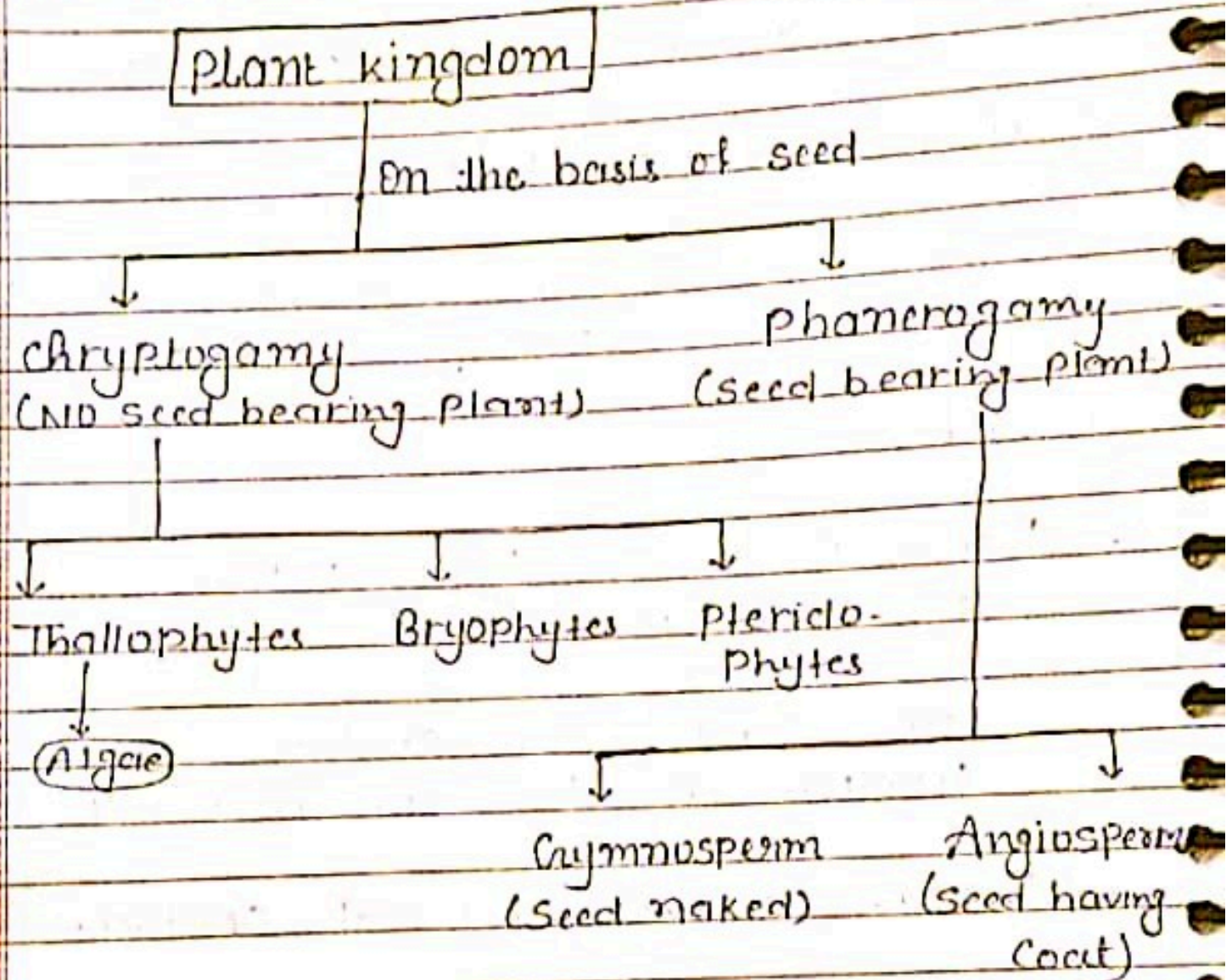


Plant Kingdom



* Thallophytes :-

- In thallophytes Algae, fungi, bacteria and lichens was included.
- Later on after modern classification by R.H. Whittaker (1969) all these are included into separate kingdom.
- Thallophytes are Simple, Seedless, Flowerless, & Nonvascular System (xylem or phloem).

- Plant is formed by thallus (group of cell / tissue)
- Thallus is a haploid cell that is n and it is called gametophytic.
- Thallophytes are not differentiated into root, stem, leaves.
- The sex organ are unicellular & it is called gametangia and it is not jacketed or covered by sterile cell.

* Algae :-

- Study of Algae is called Algology or Phycology.
- Term Algae was given by Linnaeus.
- Father of Algology or Phycology E. E. Eritsch.
- Father of Indian Phycology M. N. P. Iyengar.
- Algae are classified under plant kingdom but some of the Algae are included in monera also.
- BGA (Blue green Algae) are included into monera kingdom & These are photosynthetic.
- Green, red & Brown are included into plant kingdom.

→ Algae are haploid gametophyte, Eukaryotic, Autotrophic, chlorophyllous and Aquatic plants.

→ Algae consist of thallus like plant body that is no differentiation of root, stem or leaf.

→ That is only algae are true thallophytes.

→ Algae are considered plant since they have chlorophyll a, cellulosic cell wall, starch as reserve food material and absorption of food in the form of liquid.

→ Other than chlorophyll a, carotenes and xanthophyll are also present in algae.

→ Every algae group has additional photosynthesis pigment like:-
 (i) fucoxanthine and chlorophyll c → brown

Algae

(ii) phycoerythrin in → red Algae

(iii) β carotenes and chlorophyll b occur in green Algae.

→ Every Algae group has a specific reserve food material like:-

(i) red Algae (Rhodophyceae) → Floridean Starch.

(ii) Mannitol & laminaria → Brown Algae (Phaeophyceae)

(iii) Starch in green algae → Chlorophyceae.

- Asexual reproduction occurs by unicellular microspore (mitospore).
- Sex organs are unicellular, non-jacketed and are called gametangia.
- In multicellular reproductive organs found in brown algae.
- All the cells are fertile and take part in reproduction but are non-jacketed.
- Fertilization occurs by the help of water (pollination).
- Zygote never develops into embryo.
- Zygote said to develop into thick-walled zygospore.
- True alternation of generation is absent except eutocarpous since they show isomorphic (same type) alternation of generation.
- Mostly haplontic life-cycle occurs.
- Algae does not require mechanical tissue because buoyancy holds them upright.

→ Algae are found in different size.

→ They occur from microscopic unicellular form like *Chlamydomonas* to colonial form *Volvox* and filamentous forms like *Ulothrix* and *Spirgyra*.

* Reproduction :-

- Vegetative Reproduction:- In which they follow fragmentation and each fragment develop into thallus.

- Asexual Reproduction:- Spores like zoospore, aplanospore, autospore, Endospore & akinete.

The most common is zoospore & they have flagellated.

- Sexual Reproduction:-

→ Isogamous fusion -

gametes can be flagellated or non-flagellated but similar in size.

Ex:- *Chlamydomonas*, *Ulothrix*, *Debaryana*

→ Anisogamous fusion -

disimilar type of gamete size

Ex:- *Chlamydomonas*, *Braunii*

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→ Oogamous Fussion-

Fussion between a large & non-motile female gametes with motile & small gametes of male.

Ex: Volvox, Fucus, Chlamydomonas.

* Economic Importance of Algae :-

Half of the total carbon dioxide fixation individually by algae on this earth through their photosynthetic activity.

They are primary producers of energy rich compounds which forms the basis of the food cycle of all aquatic animal.

Some of the marine brown and red algae produce large amount of hydrochlorides (water holding substance) like algin (brown algae) carrageenan (red Algae) having commercial use.

Agar is one of the commercial production that is obtain from gelidium and gracilaria that is used to grow microbes as well as in the production of ice cream and Jelly.

Chlorella and Spirulina are the unicellular algae which having more protein contain that is why these are used as food materials for space travelles or it is also called space food.

	Common name	Pigment	Special Pigment	Storage food
Chlorophyceae	Green Algae	chl-a, b	β -Carotene	Starch
Phaeophyceae	Brown Algae	chl-a, c	Fucoxanthin	Mannitol and laminaria
Rhodophyceae	Red Algae	chl-a, d	Phycobillins	Floridean Starch

	Cell Wall	Flagella & Orientation	Habitat
	Cellulose with algin	2-8 equal apical	Fresh water, Brackish water & Salt water
	Cellulose, Pectine	2 and unequal laterally	Fresh, Brackish and Salt water
	Polysulphate esters	Absent	excessive in Salt Concentration

Bryophyta:-

Bryophyta is also called amphibian of Plant kingdom.

Study of Bryophyta is called Bryology.

Father of Bryology Hedwig.

Father of Indian Bryology S.R. Kashyap
(Shiv Ram Kashyap).

Bryophyta are originated in about 420 to 500 million year ago.

Age of bryophyta from

- Bryophyta usually occur in damp, humid and shaded localities.
- The plant body of bryophyta is more differentiated compare to algae.
- Their body is like thallus.
- They have prostrate or erect & attached to substratum by unicellular Rhizoids or multicellular Rhizoids.
- Bryophyta don't have true roots, stems or leaves.
- Bryophyta are adapted to grow under land conditions and having rhizoids for fixation.
- A waxy layer or epidermis to reduce water loss and protect from desiccation (Cuticle).
- Stomata or airpore is use for gaseous exchange.
- Sex organs are Jacketed or cover in multicellular structure to protect gamete against drying effect of air and retention of zygote inside archegonium to provide nourishment and developing of an embryo.

- Bryophyta are fundamentally terrestrial plant but they require water for dehiscence of Antheridium to liberate and swimming of antherozoids by which fertilization can take place.
- Due to this behaviour of Bryophyta these are called Amphibians of plant kingdom.
- Bryophyta are completely lack of vascular system and they absorb water through their body surface.
- The main body part of bryophyta is haploid.
- it produces gametes so it is called gametophyte.
- gametophytes are dominant over sporophyte.
- gametophyte is green, branched, haploid, long lived and independent while sporophytes are diploid short lived and depend upon gametophytes.
- The sex organs in bryophyta are multicellular.
- Male sex organ is called Antheridium and Female sex organ is called Archegonium.

- * Antheridium :- Antheridium are by flagellated and motile.
- * Archegonium :- Archegonium is by flask shape and produce a single non motile egg.
- Antherozoids are released into water where they come in contact with archegonium and than fuse each and produce zygote.
- Zygote do not undergo meiosis division immediately and produce a multicellular body that is called sporophytes.
- Sporophytes are not free living but attached to the photosynthetic gametophyte and derives nourishment from it.
- All spores are like same that is homospore.
- Sporangium is short-lived and differentiated into either foot than seta and capsule.
- These spores germinate to produce gametophytes.
- * Reproduction :-
 - Asexual Reproduction -
Asexual Reproduction is absent.

→ Vegetative reproduction is takes place by Fragmentation.

→ Through vegetative reproduction mosses converted into protonema while liverworts consistly growing from apical portion

• Sexual Reproduction-

→ They follow oogamous in which male gamete is motile where as female gamete is non motile.

→ Archegonia attract sperm by secreting sucrose or protein or potassium salt from mucilage.

x Bryophyta is classified into two class:-
a) liverworts
a) Mosses.

x Economic importance of bryophyta:-

→ Sub mosses provide food for herbaceous, Mamelons, birds and other animals.

→ Species of sphagnum having peat, that have long and it is used as fuel.

→ because of their capacity to hold water it is also used as packing material of transshipment of living material.

* Liver Worts :-

Liver Worts is also called Marchantia

Liver Worts are grow in moist shady habitats such as bank of streams marche area, damp soil and book of trees.

Plant body is haploid, gametophytic small dorsoventral, flattened thallus

These are unicellular and unbranched rhizoids.

All the dorsal side gemma cup is present through which Asexual bud gemma are produced.

On the ventral side scale are found for absorb in moisture and protecting growing appex.

Internal thallus is differenciated into Photosynthetic (upper position)

And lower thallus is used for storage of material

Chlorophyllous cells of thallus are without Pyrenoid (storing structure)

Asexual Reproduction in liver Worts in takes place by Fragmentation.

- Unit Fragmented structure is called thalli.
- During Sexual Reproduction male and female sex organs are produced either on the same or different thalli.
- Sporophytes are differentiated into Foot, Seta and capsule.
- After meiosis spores are produced inside the capsule. and spores form free living gametophyte.

* Mosses :-

- Mosses are either Monoecious, Dioecious
- Most common Indian species of Mosses are Funaria.
- Funaria is Monoecious.
- Mosses are found in damp, shady, moist soil, it also occur on moist rocks, bird, humid soil, damps wall and on the tree-trunk.
- The main body part of Funaria is gametophytes.

- x It consist of two stages:-
 - a) Juvenile stage or creeping protonema.
 - ii) Adult form or leafy gametophore.

x Juvenile stage or creeping protonema:-

→ Protonema is a green filamentous, branched, structure.

→ Protonema having some branches that grow below to the substratum are produced.

→ These branches are without chloroplast and it is called rhizoid branches.

→ Rhizoid fixed the protonema into the soil and help in absorption of water and minerals.

x Adult stage form or leafy gametophore:-

→ This is the main plant body of mosses containing a small erect axis that is called stem surrounded by spirally arranged leaf.

→ Numerous rhizoids are present at the base.

* Reproduction :-

• Vegetative Reproduction :-

They produce through fragmentation and form Primary Protonema, Secondary Protonema, gammae and bulbil.

• Sexual Reproduction :- There, male part is called antheridia and female part is Archegonia.

* Protandrous :-

if male part is develop first compare to female part that is called protandrous.

if female part get mature before male part than it is called gynandrous.

* Sporophytes :-

The diploid zygote develop into spore producing plant than it is called sporophytes.

mature Sporophytes differentiated into Foot, Seta and capsule.

* Foot :-

It is embedded in the epical tissue of the archegonial head.

* Seta :-

Seta is long cylinder, stalk like structure having capsule at the top.

* Capsule :-

Capsule is pear shaped green, yellow or orange structure.

its shape look like pendant structure.

Capsule main function is production & dispersal of spore.

* It consisting of three parts :-

(i) Apophysis

(ii) Theca

(iii) operculum.

* Apophysis :-

it is basal part and sterile region.

* Theca :-

it is central fertile region.

it consist of spore sac.

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Contain newly diploid spore mother cell.

From this spore mother cell large number of haploid spores are formed.

* Operculum :-

It is upper reason of capsule enclosing unit peristoma.

Operculum having two rings of long colonial teeth like structure.

There arrangement are one teeth upon another teeth and it is called 16 teeth.

* dehiscence of capsule :-

Breakout of capsule due to hygroscopic movement of peristomial teeth or 16 teeth.

* germination of spore :-

Getting favourable condition spore germinates to produced a young filamentous stage of gametophyte is called protonema.

Ex:- Funaria, Polytrichum and sphagnum.

x- Pteridophyta :-

- Pteridophyta are cool, damp, shady places through so many flourish well in sandy soil condition.
- As to Evolutionary Pteridophyta are the first terrestrial plants. that have vascular tissue or xylem or Phloem. so it is also called vascular Cryptogams.
- In Pteridophyta flower and seed are not occur.
- Their main plant body is Saprophytes and they have well develop vascular system.
- Their body part is well differentiated into true root, stem and leaves.
- These plants are a Cambium system but not together.
- In xylem trachea are present while Phloem companion cell is absent.
- Primary root is short leaved it is replaced by adventitious root.
- leaves in Pteridophyta are small that is called microphylls while in some Pteridophyta large leaves are found there is called macrophylls.

- Macrophylls found in ferns.
- Pteridophyta shows origin and evolution of stele.
- Stele means vascular tissue Pericycle Pith.
- Stem is usually underground Rhizoid rhizome or erect trunk as in tree ferns
- leaves are large that is megaphyllous and of various shape.
- Sporophytes bear sporangia that are subtended by leaf like structure that is called sporophylls
- In some cases sporophylls may form distinct compact structure that is called strobili or cones.
- Sporangia produce spore by meiosis.
- Sporangia produced on axial part of fertile leaf.
- Sporangia maybe either single or in group that is called sori
- Spores that are photosynthetic, free living multicellular and small gametophytes are called prothallus.

- The gametophyte require full damp shady places to grow.
- These are requireds water (H_2O) for their fertilization.
- Pteridophyta are limited and restricted to ~~spit~~ speed in narrow geographical reason.
- Male gametophytes (Male sex organ) are called antheridia and motile sperms (By biflagellated in Selaginella and multiflagellates in ferns).
- Female sex organ is archegonia, These are sessile, flask shape having neck and swollen venter.
- Venter having imbibed structure of wall and included a nonmotile ventral canal cell and egg cell (oosphere).
- Sexual reproduction is oogamous.
- Water is require for transfer of antherozoids to antheridia to form.
- Fusion of male gamete with egg present inside archegonia due to this formation of zygote occur which represent the first cell of sporophyte.

→ Their life cycle is Diplontic.

→ Alternation of generation is heteromorphic type.

→ Selaginella and Salvinia produces two kind of spore that is first one is macro or large and second one is micro or small and it is known as heterospores.

→ The megaspore and microspore germinate and give rise to female and male gametophyte.

→ Female gametophyte depended on parent sporophyte for variable periods.

→ The development of zygote into young embryo takes place within female gametophyte. These event is precursor to the seed habit and it considered evolutionary except.

* Classification of Pteridophyta:-

- ① Psilophyta or Psilopsida
- ② Lycophyta or Lycopsidea
- ③ Arthrophyta or Sphenopsida
- ④ Filicophyta or Pteropsida

① Psilophyta or psilopsida :-

- These plants are root less sporophytes.
- These are mainly constitute fossils
Ex:- Psilotum are the example of living form.
- vascular tissue only present in stem
- Rhizoids are present to use for absorption of water and minerals.

② Lycophyta or Lycopside :-

- These are clubbed or accumulated mosses.
- These are differentiated into root, stem and leaves.
- vascular tissue are found in all organs of plant.

* Arthophyta or sphenopsida :-

- Horse tail or Scouring rushes present to this group.
- Silica are present in their stem.
Ex:- Equisetum (Horsetail)

* Filicophyta or pteropsida :-

- Fan shape leaf
- Stem usually having rhizome.

→ These are homosporous
Ex:- dryopteris, Marsilea, Pteris or
heterosporous and adiantum.

* Gymnosperm:-

Term gymnosperm was given by Theophrastus

gymno(naked) sperm(seed), That is plant
having seed without seed coat or seed cover.

Gymnospermic plants are link between
pteridophytes and angiosperms.

Gymnosperm represent only 900 species
in which 500 species are conifers.

Gymnosperm include medium size and
tall tree as well as shrubs.

Most ^{very large} giant (firam) gymnospermic plant
are red wood tree and Sequoia (tallest tree)

Most of the gymnospermic plants are
perennial, woody having well develop
type root system.

Gymnospermic plant shows mycorrhiza
i.e. mutual relation between fungus and
root of plant

ex:- Pinus and Cycas

Gymnospermic plant also carry small special seed root i.e. called coralloid root.

These roots having N_2 (Nitrogen) Fixating bacteria or Cyanobacteria.

Vascular tissue are arranged in vascular bundle.

In most of the gymnospermic plant secondary growth occur and annual rings are disting.

xylem is without vessels and phloem lacks companion cell.

Stems are unbranched.

Ex:- Cycas

Stems are branched

Ex:- Pinus and Cedrus

Their leaf may be simple or compound.

In cycas pinnate leaves persist for few years.

leaves in gymnosperms are well adapted to with stand extremes of temperature humidity and wind.

In Callyphers needle like leaves are present due to which surface area get reduced.

These leaves having thick cuticle and sunken stomata and it helpful for to reduced water loss.

Gymnosperms are heterosporous, that is they produced haploid microspore and megaspore.

These spores are produced with in sporangia and these are arranged spirally along and axis to form lax or strobili or cone.

* Strobili are differentiated into two type :-

- u Male Strobili
- u Female strobili

u * Male Strobili :-

Strobili having micro sporophyll having microsporangia is called male Strobili.

Male strobili are develop into a male-gametophytes

These gametophytes are reduced and form pollen grains and it is develop into microsporangia.

*Female strobili:-

- The cones bearing megasporophyll with ovules or megasporangia are called female strobili or macrosporangia.
- Male or female may be developed in same tree.
Ex:- Pinus
- While on different plant cycas.
- * → There is no female strobili or female cone occur in cycas.
- Megaspore mother cell (M.M.C) differentiated and form nucleus and through this nucleus a covered structure is present that is called ovule and then through ovules group of megasporophyll develop and form female cones.

Megaspore mother cell (M.M.C) divide meiotically to form four megaspore, out of four three get gene degenerated and from one it start developing.

Female sex organ of gymnosperm are called archegonia.

In gymnosperm male and female donot have an independent free living existence. They remain with in the sporangia.

Female and male are both differentiated from new nucellus cell

Nucellus cell is protected by envelop and Composite structure is called ovule

Ovule are mainly occur through megasporophyll.

Male unit structure is Pollengrain. That is released from microsporangium.

In gymnosperm male and female gametes donot have and independent free living existence.

The remain with in the sporangia.

usually Pollengrain shows multiple numbers.

After fertilization with female gametophyte they form zygote. zygote further develop into embryo and ovules and than ultimately seed. and seed are not covered.

Polyembryony stage are found in seed and ultimately only one embryo survives.

Embryo having two in number is Cycas while 10 to 11 in Pinus.

Classification of gymnosperms:-

- (i) Progymnospermitophyta (Extinct)
- (ii) Pteridospermitophyta (Extinct)
- (iii) Cycadophyta (Cycads)
- (iv) Cycadiophyta (Extinct)
- (v) Ginkgophyta (Extinct except - Ginkgo biloba)
- (vi) Coniferophyta (Extinct) - One living plant is conifers
- (vii) Gnecidophyta.

* Angiosperm:-

Angiosperms are flowering plant

Angiosperms bear seed and their seed is covered by fruit wall.

Angiosperms are the most dominant plant

* Angiospermic flowers are a two type:-

(i) Bi-Sexual flower (male & female both)

(ii) Uni-Sexual flower

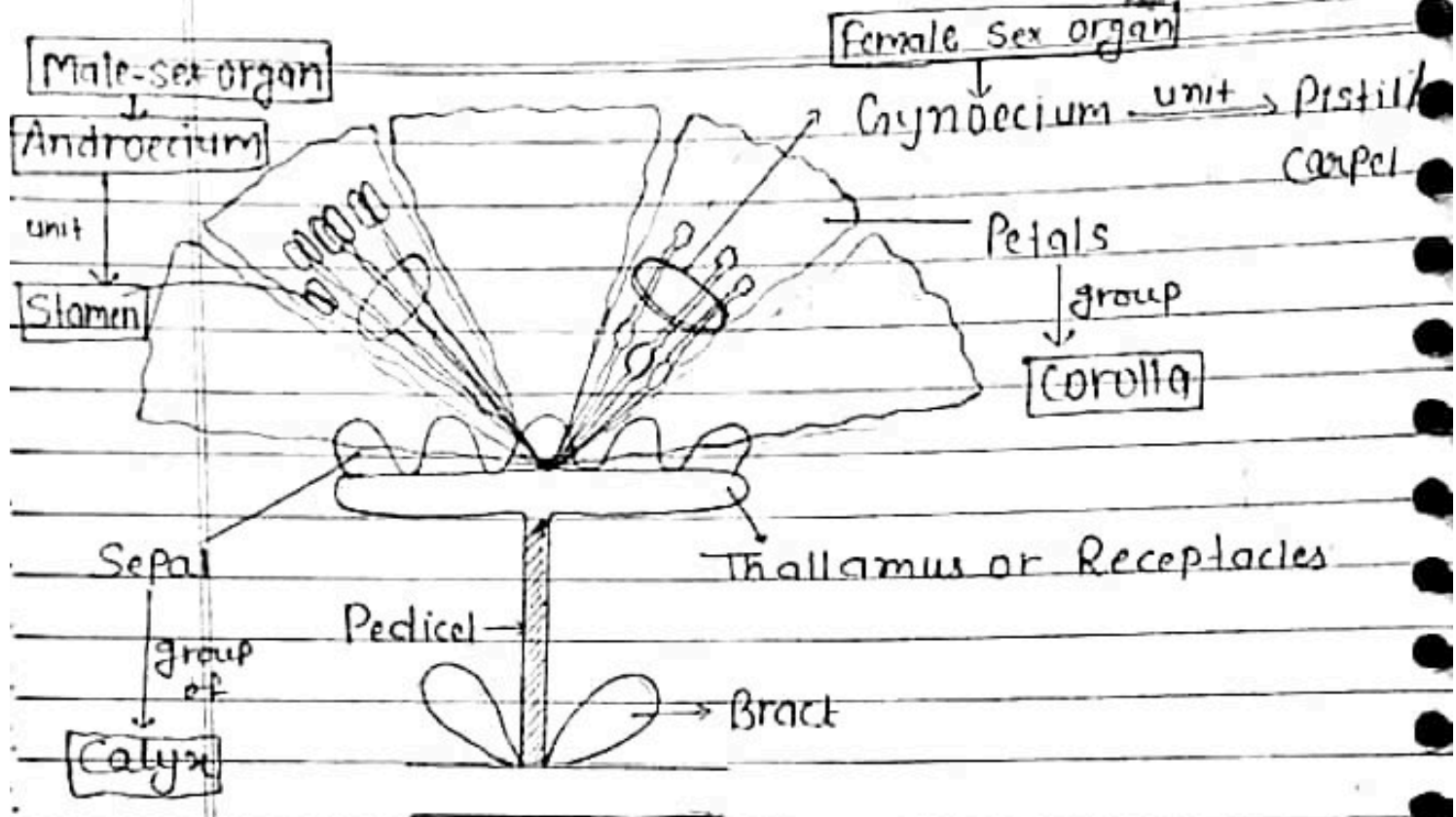
Either → Male

Staminate flower

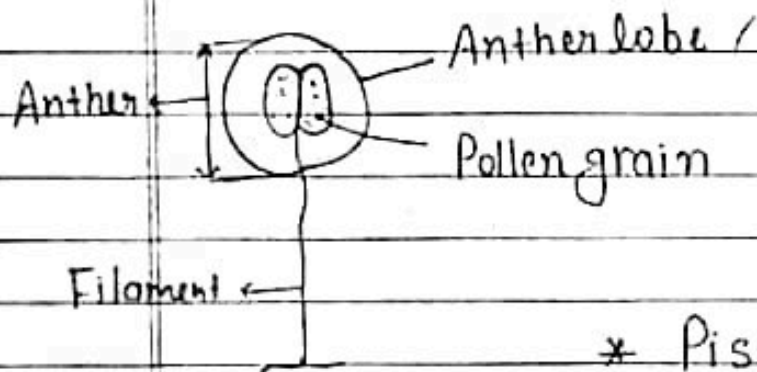
or

→ Female

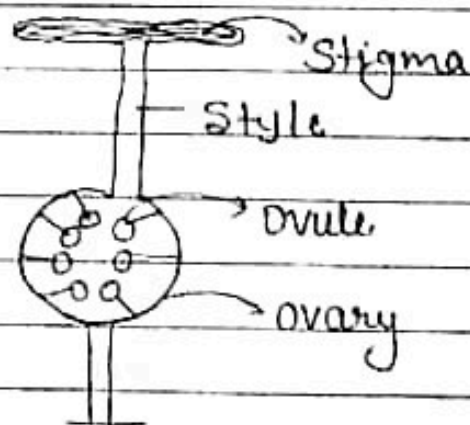
Pistillate flower



- * Stamen (male unit)



* Pistil (female unit):



Angiospermic plants are occur in every habitat and they are more than 50% of total plants on this earth.

Angiospermic plants having flower insided of cone and flower consist of male and female part or either male or female.

Angiospermic plants are flowering plant and it is the most characteristic structure of the Angiosperm.

Flower is defined as a modified shoot that means this is attential for the reproduction of plant.

Flower are usually develop from a branch of bud that are growing in the axil of a small leaf like structure that is called Bract.

A stalk like structure is present that is called pedicel that support the flower in the axil of the bract.

The upper swollen in of the Paddy cell is called thalamus or receptacles that carry all the floral parts.

A typical angiospermic flower consist of four whorl / cover.

(i) Calyx → group of sepal

(ii) Corolla → group of petals

(iii) Gynoecium → group of pistil / carpel.

(iv) Androecium → group of stamen.

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→ Female Sex organ is called Gynoecium and their unit is called Pistil or carpel.

* Pistil or carpel is differentiated into three part :-
(i) Stigma
(ii) Style
(iii) ovary

→ At stigma pollengrain lands and through style is reaches to ovule inside ovary for fertilization.

→ Ovule having nucellus cell in which megaspore mother cell (M.M.C) differentiated.

→ From megaspore mother cell (M.M.C) it reduced through meiosis and form four haploid structure.

→ Out of four, three get degenerated and only one get survive. This is called monosporic condition.

→ Through one cell it further differentiated through mitosis and form eight (8) cell structure.

→ These eight (8) haploid cell arranged at form embryo sac.

3n from Antipodal cell

2n from central cell or polar nuclei and next 3 cell in which 1 is egg cell and another two form synergids.

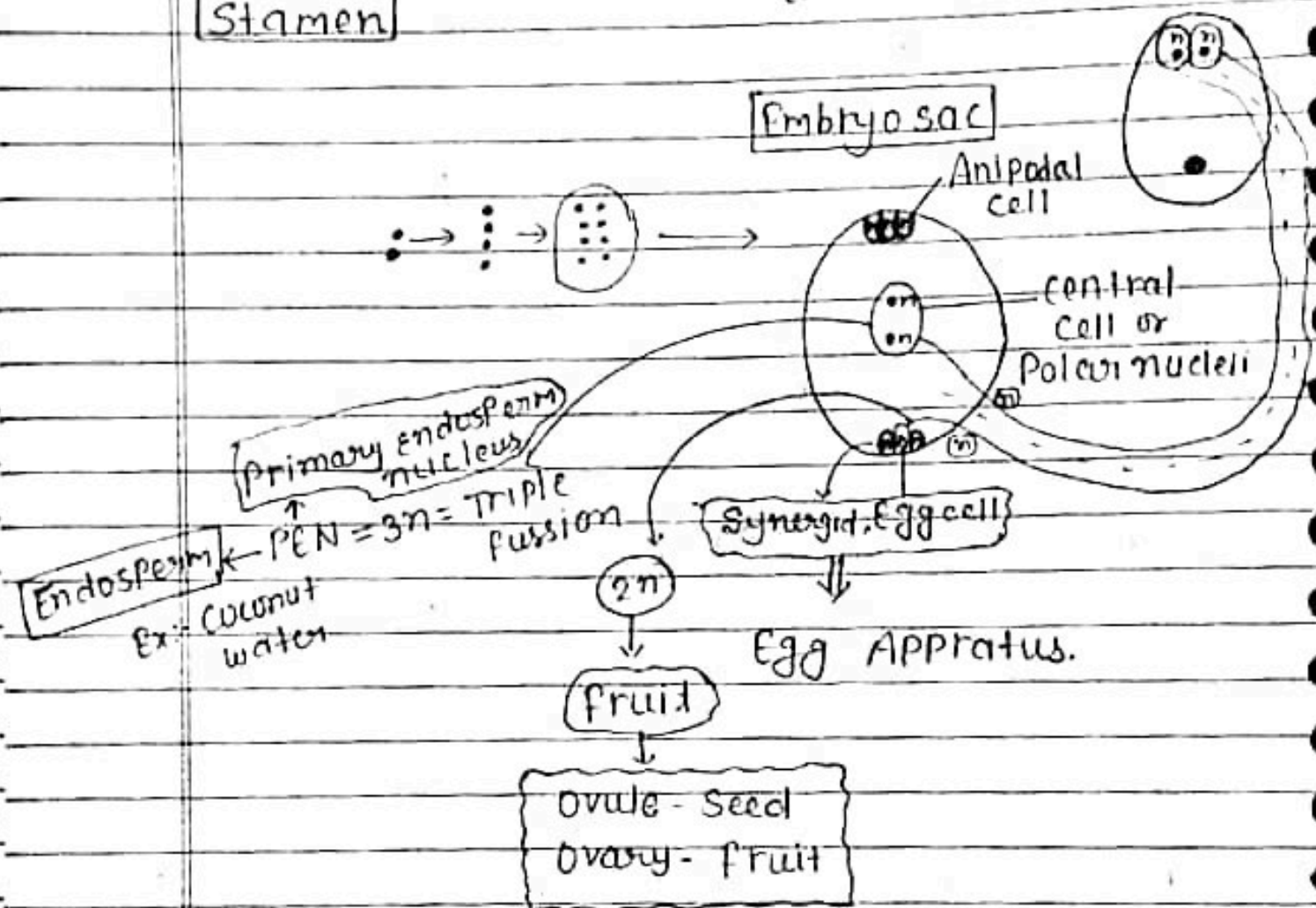
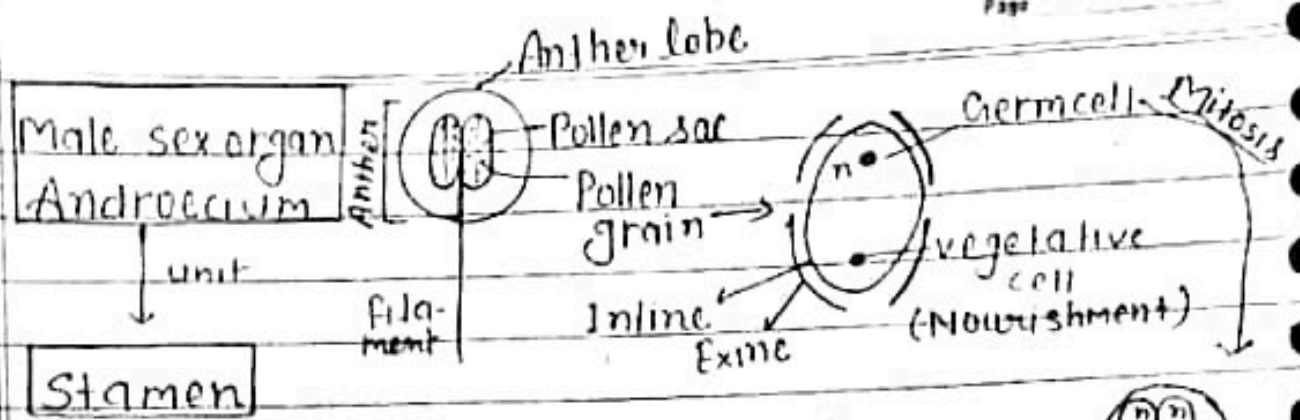
* $\text{Egg cell} + \text{Synergid} = \text{Egg Apparatus}$

→ When two male haploid cell enter into embryo sac and perform double fertilization and triple fusion.

* Double fertilization:-

Polar nuclei + Male Germ cell I and form 3n that is called triple fusion (3n) which further develop into PEN (Primary Endosperm nucleus). and it further get mature and form Endosperm.

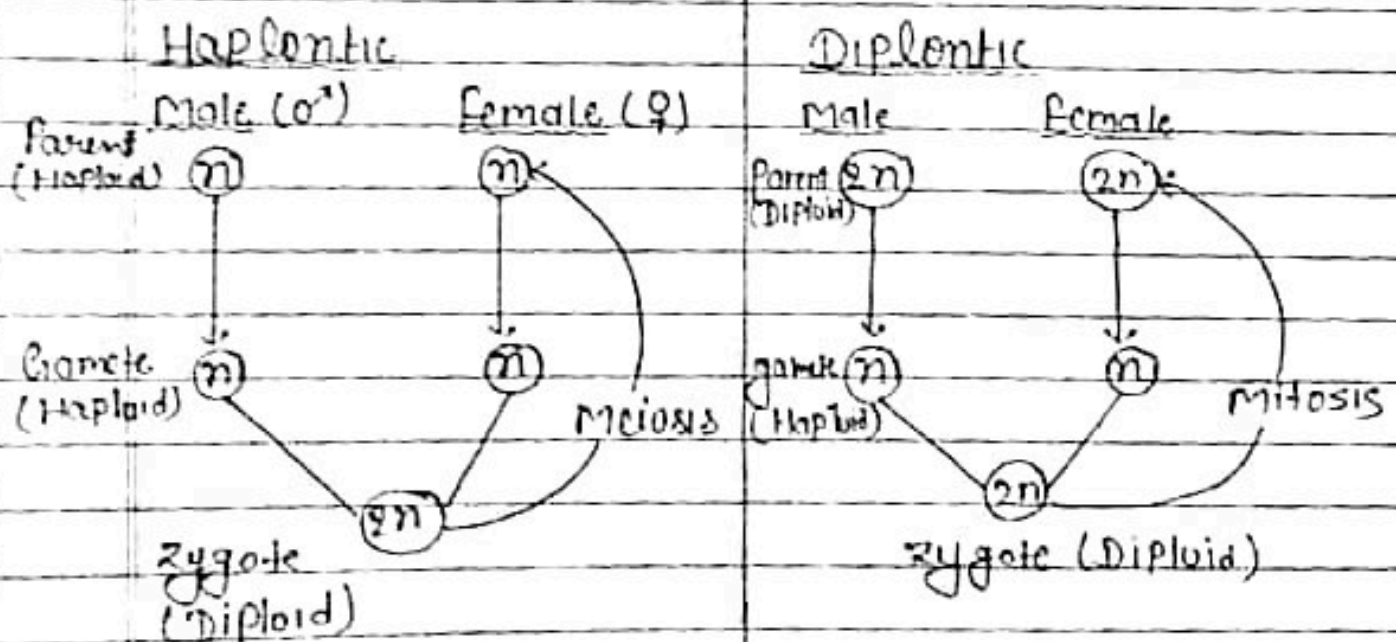
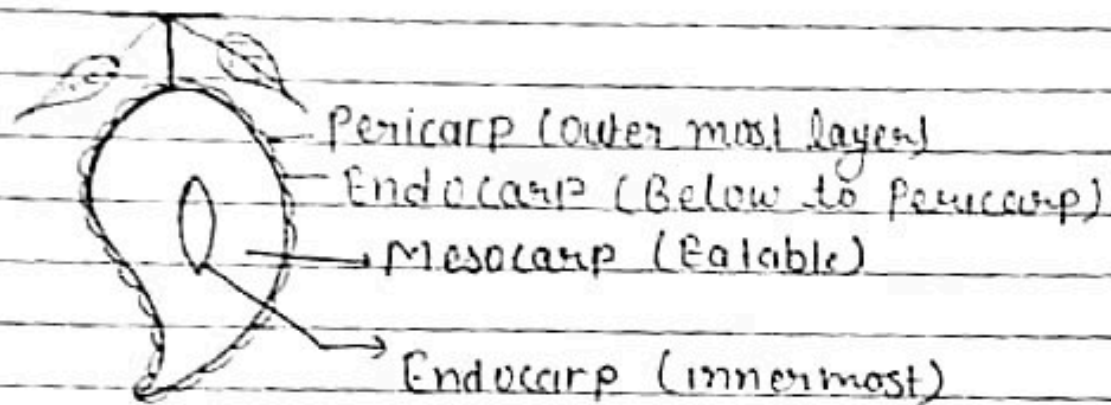
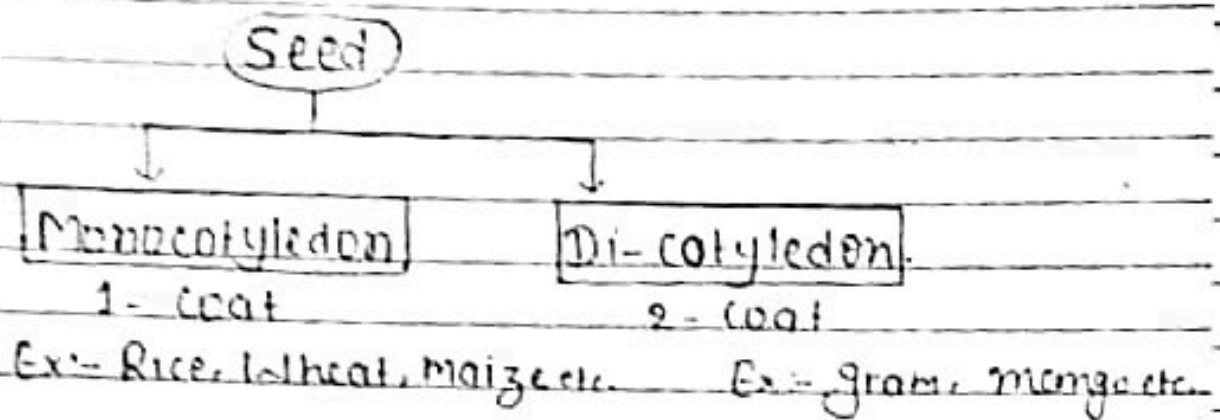
Ex:- Coconut water, corn endosperm.



Double Fertilization

- (i) Polar nuclei + Male germ cell I
- (ii) Egg cell + Male Germ cell II

→ Egg cell with male germ cell it fuse and form fruit in which their ovule converted into seed and ovary converted into seed and ovary converted into fruit.



Haplo-Diplontic

