★ VEGETATIVE REPRODUCTION: FRAGMENTATION.
★ ASEXUAL REPRODUCTION: ZOOSPORE (COMMON).
MOTILE (FLAGELLATED), ENDOGENOUS FORMED IN ZOOSPORANGIUM.

★ HALF OF CO_2: FIX: PHOTOSYNTHESIS, INCREASE O_2 CONTENT, PRODUCER, SYNTHESIS FOOD UPON AQUATIC ANIMAL DEPEND.

★ PORPHYRA (RED), LAMINARIA & SARGASSUM (BROWN ALGAE) AMONG 70 MARINE SPECIES, USED (FOOD)

★ CHLORELLA (PROTISTA), SPACE FOOD, PROTEIN
UNICELLULAR

★ SOME GA → PYRENOID PRESENT IN CHLOROPLAST
→ CENTRE: PROTEIN
→ PERIPHERY: STARCH.

SEXUAL REPRODUCTION

ISOGAMOUS: FUSING GAMETE MORPHOLOGICALLY SIMILAR (FLAGELLATED, ULOTHRIX)
NON FLAGELLATED, SPIROGYRA), GA

ANISOGAMOUS: MORPHOLOGICALLY DISIMILAR.
EUDORINA, GA

Thalloid (ROOT, STEM, LEAF) ABSENT, AUTOTROPH, CHLOROPHYL, AQUATIC (FRESH H_2O, MARINE H_2O) WOOD, SOIL, MOIST STONE

★ ALGAE + FUNGUS: LICHEN ON SLOTH BEAR
★ FRUIT, FLOWER, SEED, EMBRYO, VASCULAR TISSUE: ABSENT

★ SIZE, FORM: HIGHLY VARIABLE EG: VOLVOX (COLONIAL) AND ULOTHRIX, SPIROGYRA (FILAMENTOUS) AND SOME MARINE ALGAE ARE MASSIVE/BIG (KELPS) → BROWN ALGAE

HYDROCOLLOID

SUBSTANCE: H_2O ABSORBING CAPACITY.
AIGIN: BA AND CARRAGEEN: RA

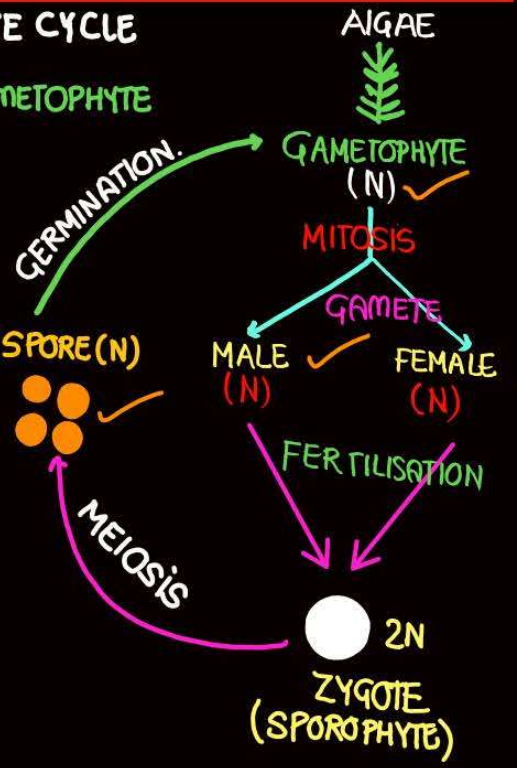
AGAR-AGAR: RA (GRACILARIA, GELIDIUM), USED TO GROW MICROBE IN LAB, PREPARATION OF ICE CREAM, JELLIES

OOGAMOUS:
MALE GAMETE: USUALLY MOTILE, SMALL
FEMALE GAMETE: NON MOTILE, LARGE
eg VOLVOX, FUCUS, RED ALGAE
(GA) (BA)
→ MALE GAMETE (NON MOTILE)

LIFE CYCLE

MAIN BODY: GAMETOPHYTE

HAPLONTIC LIFE CYCLE,
HAPLOID ALGAE



CHLOROPHYCEAE

- GREEN ALGAE (GA), Chla,b Carotene, xanthophyll.
- CELL WALL: RIGID (HARD), DOUBLE LAYER, OUTER (PECTIN), INNER (CELLULOSE)
- PYRENOIDS PRESENT
- VEGETATIVE: FRAGMENTATION
- ASEXUAL: ZOOSPORE
- SEXUAL: ISOGAMOUS, ANISOGAMOUS, OOGAMOUS.
- CHLOROPLAST: DISC, PLATE, RETICULATE, CUP, SPIRAL/RIBBON SHAPE
- UNICELLULAR: CHLAMYDOMONAS
- COLONIAL: VOLVOX
- FILAMENTOUS: ULOTHRIX, SPIROGYRA.
- STORED FOOD: STARCH & OILDROPLETS (IN FEW)

PHAEOPHYCEAE

- BROWN ALGAE (OLIVE GREEN TO DIFFERENT SHADES OF BROWN COLOUR, DEPEND UPON XANTHOPHYLL.
- Chlg, C carotene, FUCOXANTHIN ↑

- MOSTLY MARINE, MULTICELLULAR,
- FOOD: LAMINARIN & MANNITOL (COMPLEX, CARBOHYDRATE).
- PROTOPLASM: NUCLEUS, PLASTID, VACUOLE PRESENT
- BODY: SIMPLE BRANCHED, FILAMENTOUS ECTOCARPUS OR PROFUSELY (BUSHY) BRANCHED: MASSIVE/GIANT ⟶ KELPS, 100m (LAMINARIA)
- BODY: ① HOLDFAST: ATTACHMENT ② STIPE: FOOD CONDUCTION ③ FROND/LEAF LIKE. PHOTOSYNTHESIS
- VEGETATIVE: FRAGMENTATION. & ASEXUAL: ZOOSPORE PEAR/PYRIFORM SHAPE, FLAGELLA UNEQUAL, AT LATERAL END.
- SEXUAL: ISOGAMOUS, ANISOGAMOUS, OOGAMOUS. PEAR/PYRIFORM SHAPE: GAMETES, FLAGELLA AT LATERAL END.
- FERTILISATION: H_2O (EXTERNAL) & OOGONIUM (INTERNAL) (OOGAMOUS TYPE)

RHODOPHYCEAE

- RED ALGAE (Chlg,d, phycoerythrin), MOSTLY MARINE, MULTICELLULAR,
- VEGETATIVE: FRAGMENTATION. AND ASEXUAL: NON MOTILE SPORE
- SEXUAL: ONY OOGAMOUS (MALE, FEMALE GAMETE: NON MOTILE)
- MORE: WARMER REGION (HIGH TEMP).
- CELL LIGHTER REGION & BOTTOM OF SEA.
- FOOD: FLORIDEAN STARCH. (SIMILAR TO GLYCOGEN & AMYLOPECTIN)
- COMPLEX POST FERTILISATION STRUCTURE FORMED.

eg: GRACILARIA, GELIDIUM, POLYSIPHONIA, PORPYRA.

BRYOPHYTE

LIVERWORTS

'G'	'S'
⇒ GAMETOPHYTE +	SPOROPHYTE
★ (GREEN, PROSTRATE)	(ERECT)
★ HAPLOID FORMED GAMETE (MITOSIS)	★ DIPLOID FORMED SPORE (MEIOSIS)
★ PHOTOSYNTHETIC	★ NON-PHOTOSYNT.
★ INDEPENDENT, FREE LIVING, DOMINANT/MAIN BODY.	★ DEPENDENT ON 'G'
★ MULTICELLULAR	★ MULTICELLULAR.
★ MALE & FEMALE SEX ORGAN (ANTHERIDIA & ARCHEGONIA (FLASKSHAPE).	★ ROOT, STEM, LEAF, XYLEM, PHLOEM, SEED, FRUIT ABSENT.
	★ RHIZOIDS: ONICELLULAR, UNBRANCHED.

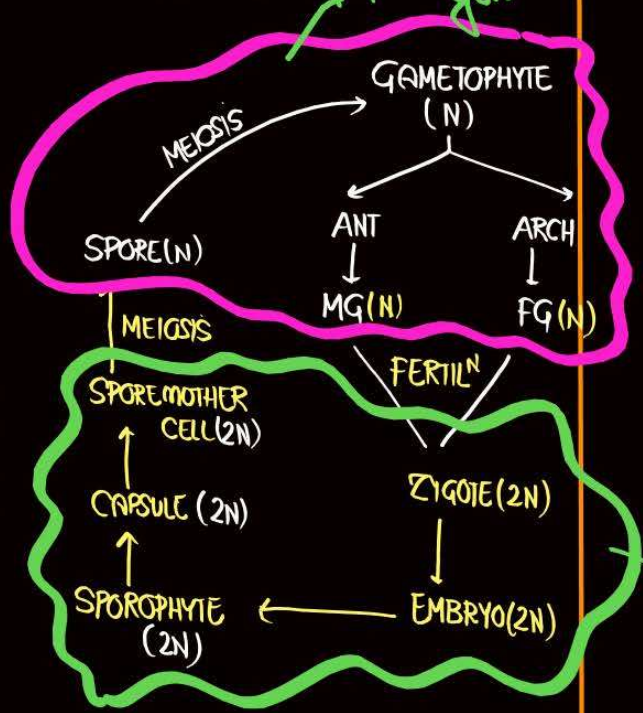
★ MALE GAMETE TRANSFER INTO ARCHEGONIUM WITH HELP OF H_2O, DEPEND UPON H_2O FOR FERTILISATION (AMPHIBIAN OF PLANT KINGDOM)

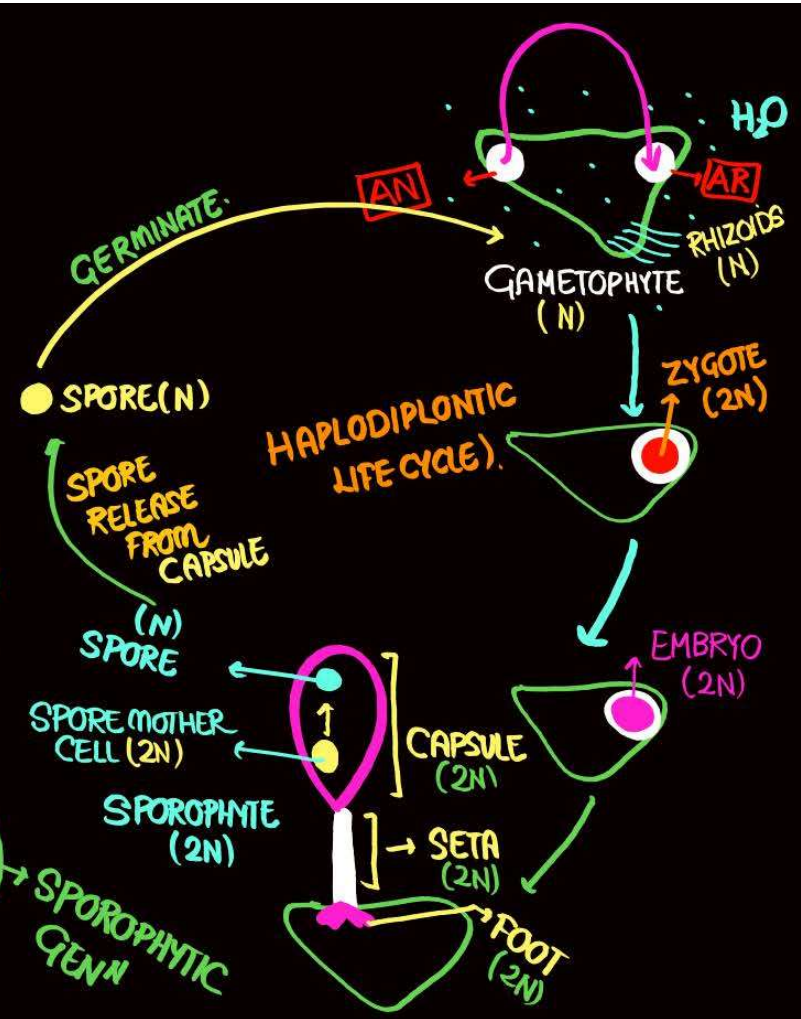
LIFE CYCLE

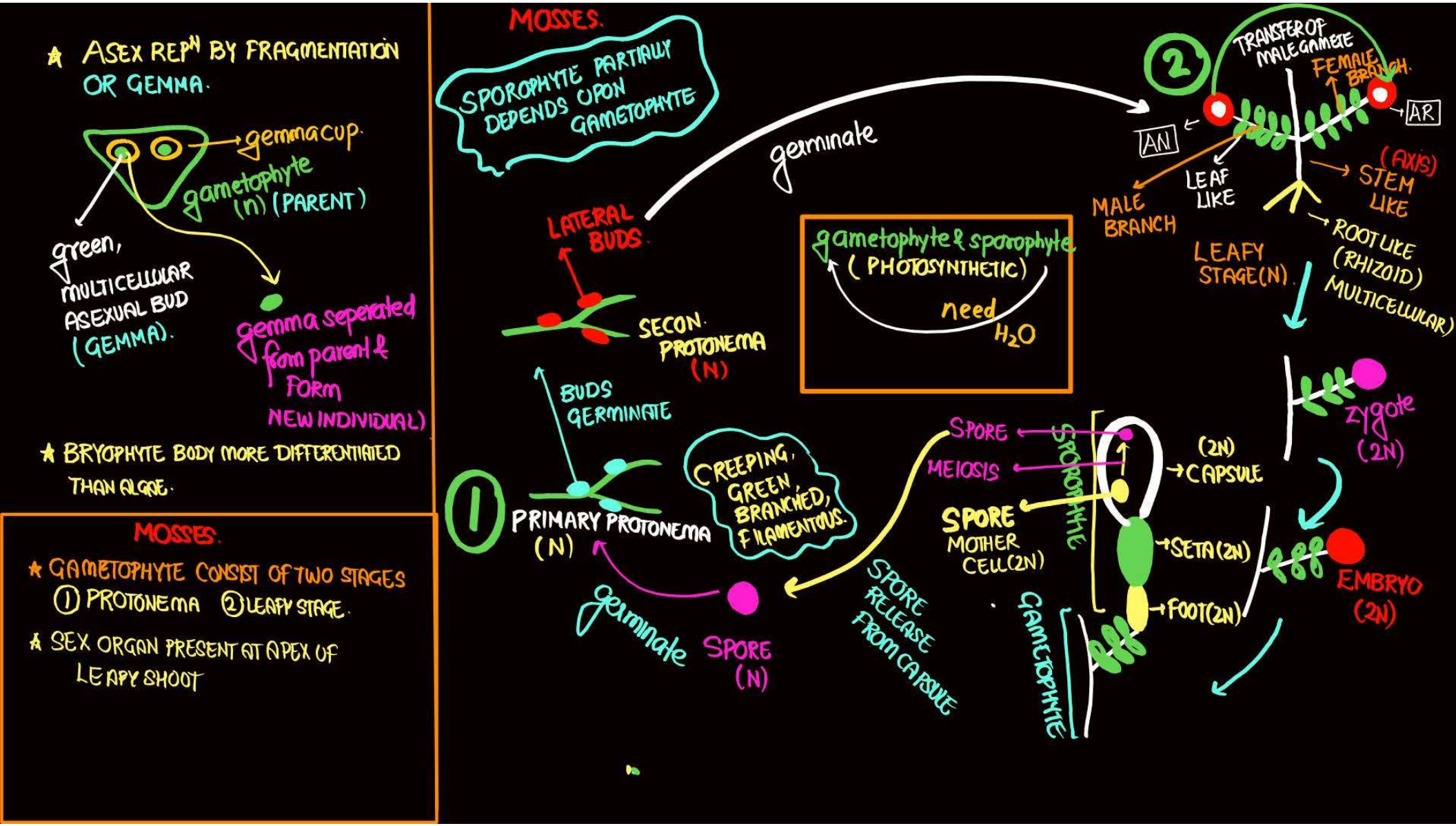
★ SOME CELLS IN CAPSULE OF SPOROPHYTE PRESENT: SMC (2N)

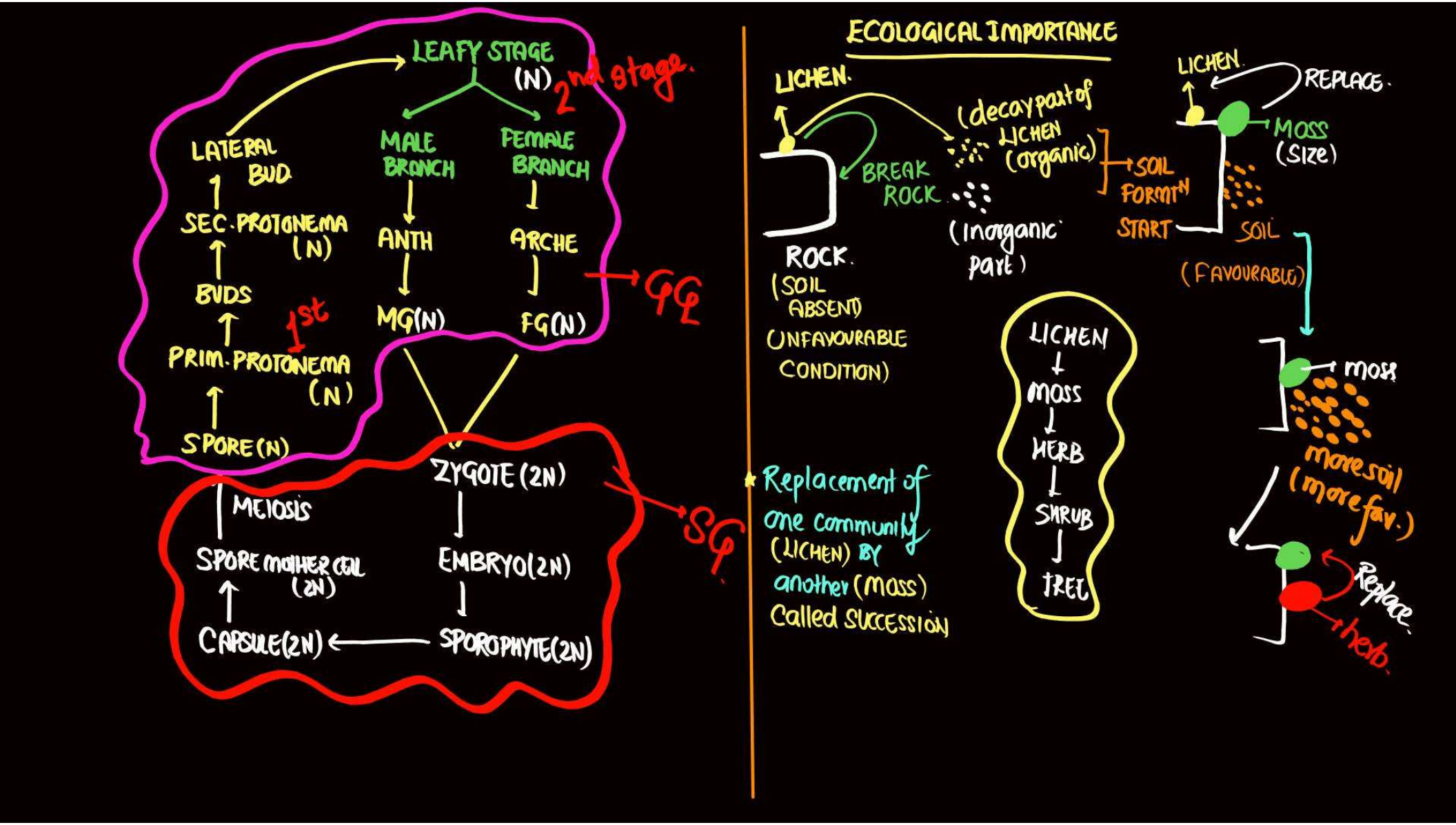
↓ MEIOSIS

SPORE (N)






★ ASEX REPN BY FRAGMENTATION OR GEMMA.
gemma cup.
gametophyte (n) (PARENT)
green, MULTICELLULAR ASEXUAL BUD (GEMMA).
gemma seperated from parent & FORM NEW INDIVIDUAL)
★ BRYOPHYTE BODY MORE DIFFERENTIATED THAN ALGAE.
MOSSES.
★ GAMETOPHYTE CONSIST OF TWO STAGES
① PROTONEMA ② LEAFY STAGE.
★ SEX ORGAN PRESENT AT APEX OF LEAFY SHOOT
MOSSES.
SPOROPHYTE PARTIALLY DEPENDS UPON GAMETOPHYTE
germinate
LATERAL BUDS.
SECON. PROTONEMA (N)
BUDS GERMINATE
PRIMARY PROTONEMA (N)
CREEPING, GREEN, BRANCHED, FILAMENTOUS.
germinate
SPORE (N)
gametophyte & sporophyte
(PHOTOSYNTHETIC)
need H_2O
TRANSFER OF MALE GAMETE
FEMALE BRANCH.
AN
AR
MALE BRANCH
LEAF LIKE
(AXIS) STEM LIKE
ROOT LIKE (RHIZOID) MULTICELLULAR)
LEAFY STAGE(N).
ZYGOTE (2N)
SPORE
MEIOSIS
SPORE MOTHER CELL(2N)
SPOROPHYTE
(2N) → CAPSULE
→ SETA (2N)
→ FOOT (2N)
EMBRYO (2N)
SPORE RELEASE FROM CAPSULE
GAMETOPHYTE


LEAFY STAGE (N)
2nd stage.
LATERAL BUD
SEC. PROTONEMA (N)
BUDS
PRIM. PROTONEMA (N)
1st
SPORE (N)
MALE BRANCH
FEMALE BRANCH
ANTH
ARCHE
MG(N)
FG(N)
GG
ZYGOTE (2N)
SG
MEIOSIS
SPORE MOTHER CELL (2N)
EMBRYO(2N)
CAPSULE(2N)
SPOROPHYTE(2N)
ECOLOGICAL IMPORTANCE
LICHEN.
BREAK ROCK
(decay part of LICHEN (organic)
(inorganic part)
SOIL FORMTN START
ROCK.
(SOIL ABSENT)
UNFAVOURABLE CONDITION)
LICHEN
REPLACE.
MOSS (SIZE)
SOIL
(FAVOURABLE)
LICHEN
MOSS
HERB
SHRUB
TREE
MOSS
more soil (more fav.)
Replace.
herb.
Replacement of one community (LICHEN) BY another (MOSS) Called SUCCESSION

★ 1st Time: ROOT, STEM, LEAF, XYLEM PHOLEM APPEAR.

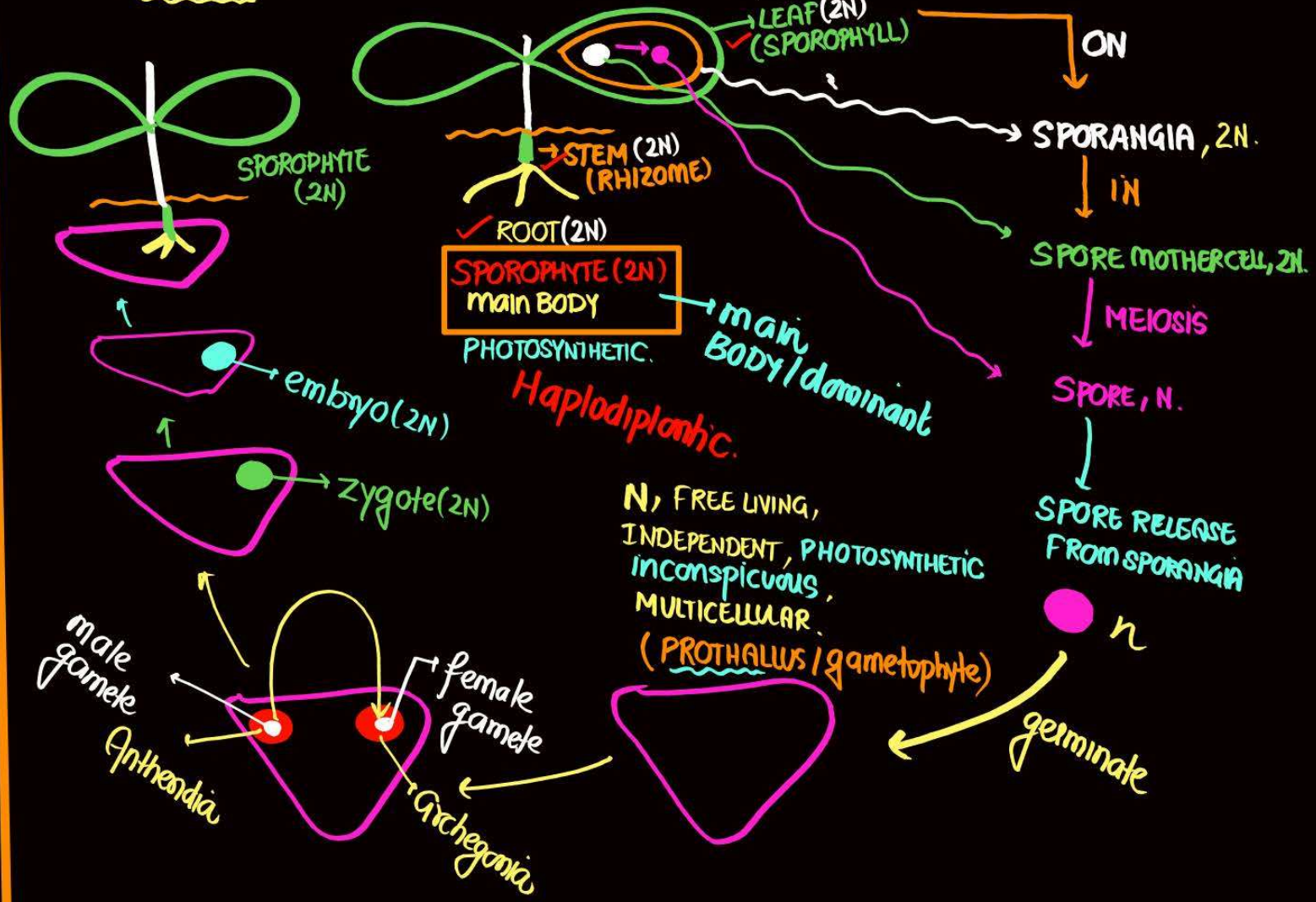
LEAF

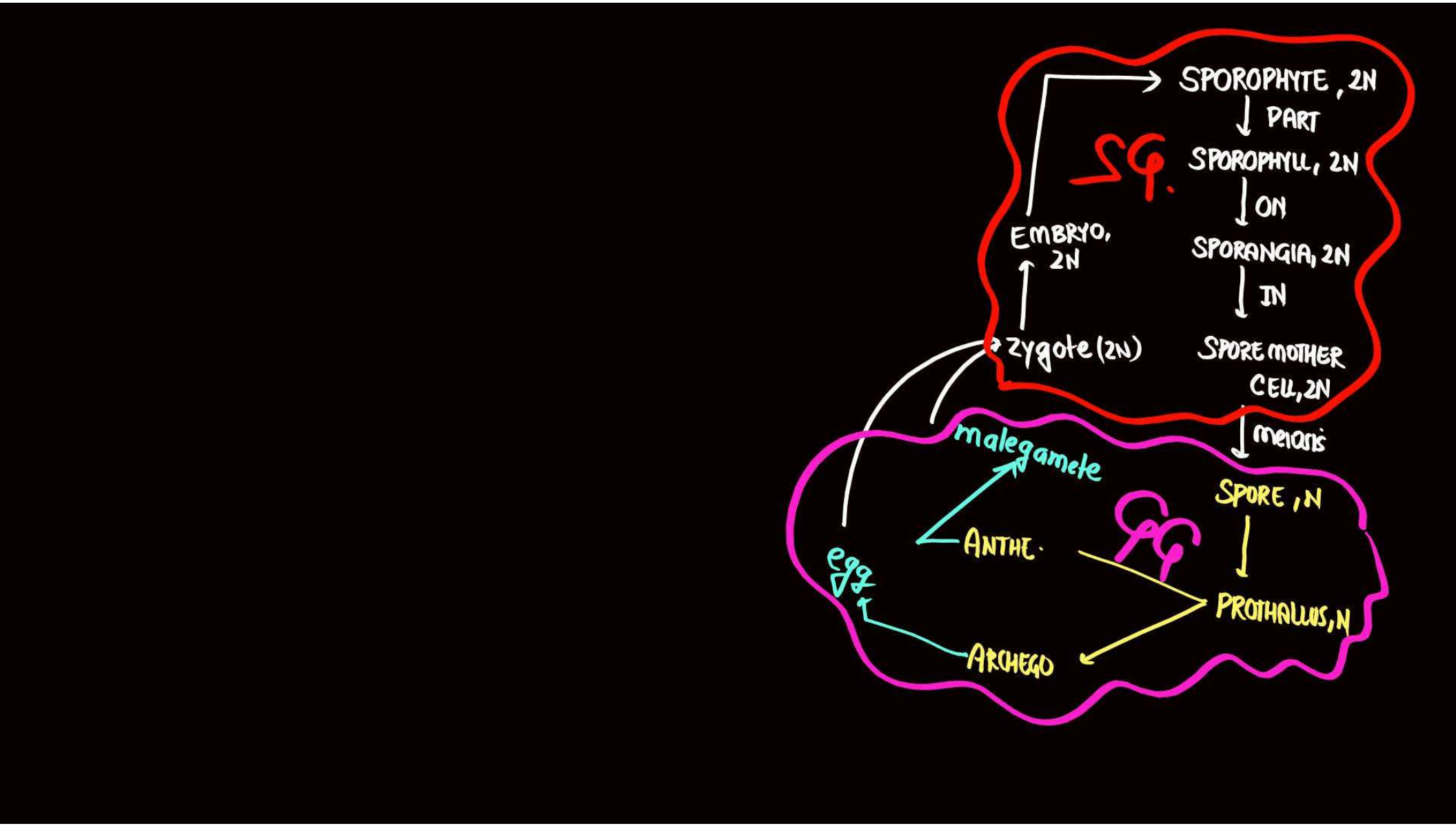
small (microphyll) — eg Selaginella, equisetum

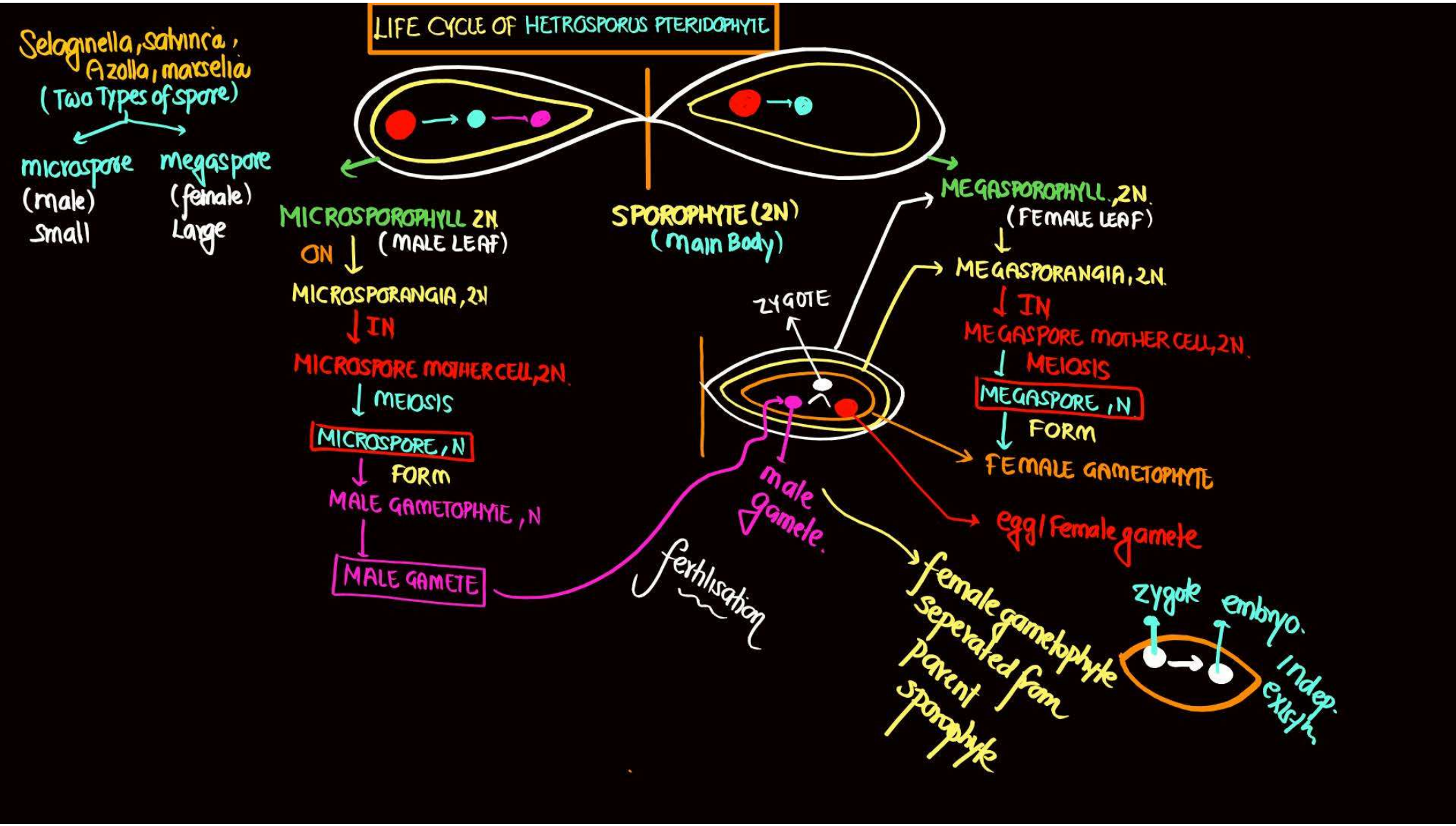
large (megaphyll/ Macrophyll) — eg: ferns

★ Sporophyll aggregate to form Strobilus/CONE

PTERIDOPHYTE (LIFE CYCLE OF HOMOSPOROS PTERIDOPHYTE (MOSTLY).



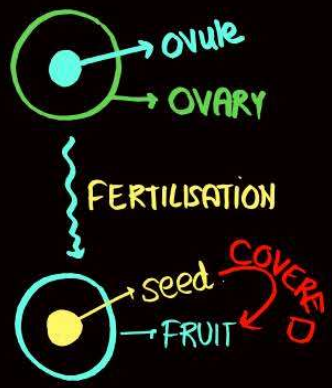

SPOROPHYTE, 2N
PART
SPOROPHYLL, 2N
ON
SPORANGIA, 2N
IN
SPORE MOTHER CELL, 2N
meiosis
SPORE, N
PROTHALLUS, N
ANTHE.
malegamete
egg
ARCHEGO
zygote (2N)
EMBRYO, 2N
SG.
GG


LIFE CYCLE OF HETROSPORUS PTERIDOPHYTE
Selaginella, Salvinia, Azolla, marsilia
(Two Types of spore)
microspore (male) small
megaspore (female) Large
SPOROPHYTE (2N) (main Body)
MICROSPOROPHYLL 2N (MALE LEAF)
ON
MICROSPORANGIA, 2N
IN
MICROSPORE MOTHER CELL, 2N.
MEIOSIS
MICROSPORE, N
FORM
MALE GAMETOPHYTE, N
MALE GAMETE
MEGASPOROPHYLL, 2N. (FEMALE LEAF)
MEGASPORANGIA, 2N.
IN
MEGASPORE MOTHER CELL, 2N.
MEIOSIS
MEGASPORE, N
FORM
FEMALE GAMETOPHYTE
egg/Female gamete
ZYGOTE
male gamete.
fertilisation
female gametophyte seperated from parent sporophyte
zygote
embryo.
indep. existn.

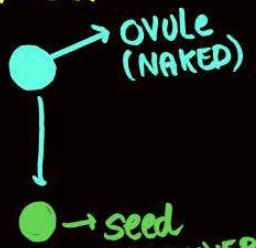
GYMNOSPERM.

	A	B	P	G	A.
Gam	M·B	M·B	Indep.	Dep	Dep
Spora		Dep^{n}	M·B	M·B	M·B
			Inde	Inde	Inde

Angiosperm.



Gymnosperm



⇒ Medium size TREE, (CYCAS)
SHRUB, (EPHEDRA)
TALL TREE. (PINUS)

⇒ Tallest: Red wood TREE (SEQUOIA).

⇒ PINUS ROOT + FUNGUS: SYMBIOTIC RELATION (MYCORRHIZA).

⇒ CYCAS: COROLLOID ROOT, NEGATIVELY GEOTROPHIC (BLUE GREEN AIGAE, ANABAENA, N_2 FIX^{n}).

⇒ CYCAS: STEM: UNBRANCHED
PINUS: STEM: BRANCHED.
& CEDRUS

⇒ ROOT USUALLY: TAPROOT (formed from (RADICLE)

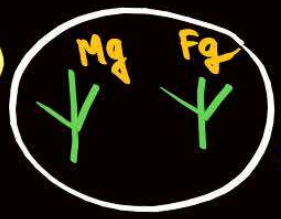
⇒ SIMPLE & COMPOUND LEAF (PINNATE LEAF).

★ All Heterosporus.

★ main Body: sporophyte, 2N. (dominant).

★ gametophyte: NOT FREE LIVING, NOT INDEPENDENT.

★ mostly dioecious (cycas)
BUT PINUS MONOECIOUS



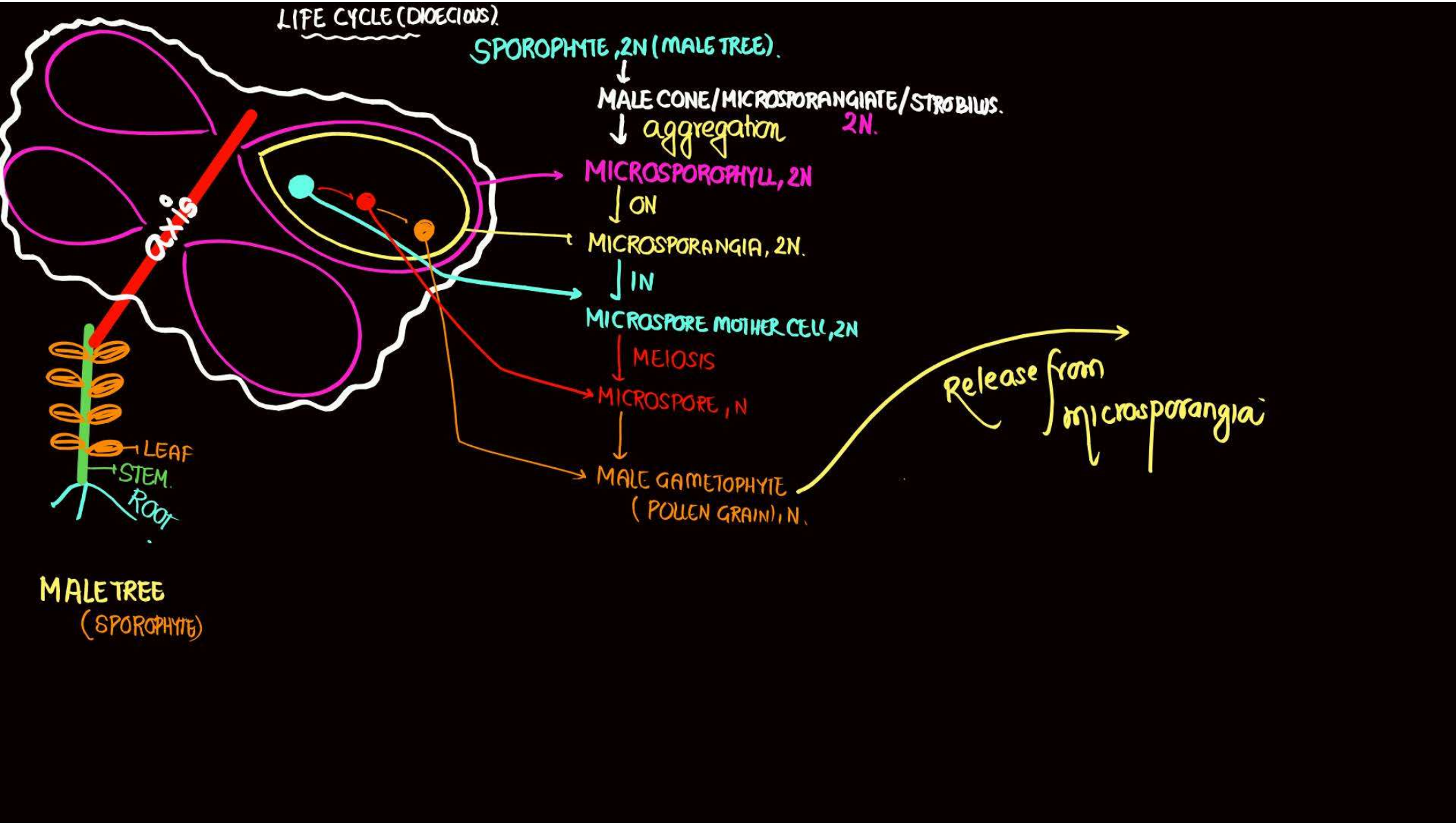
diff TREE

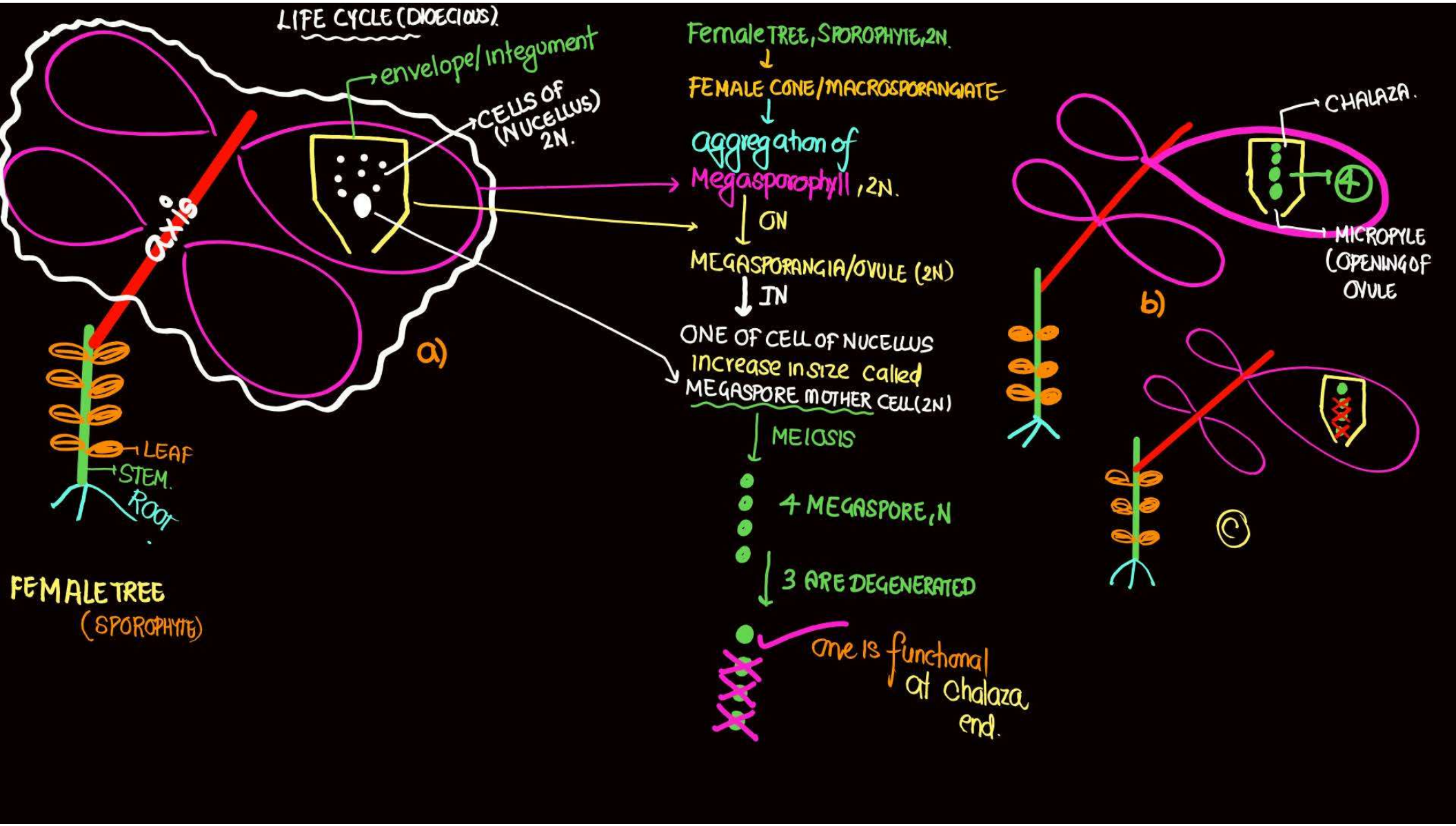
same TREE.

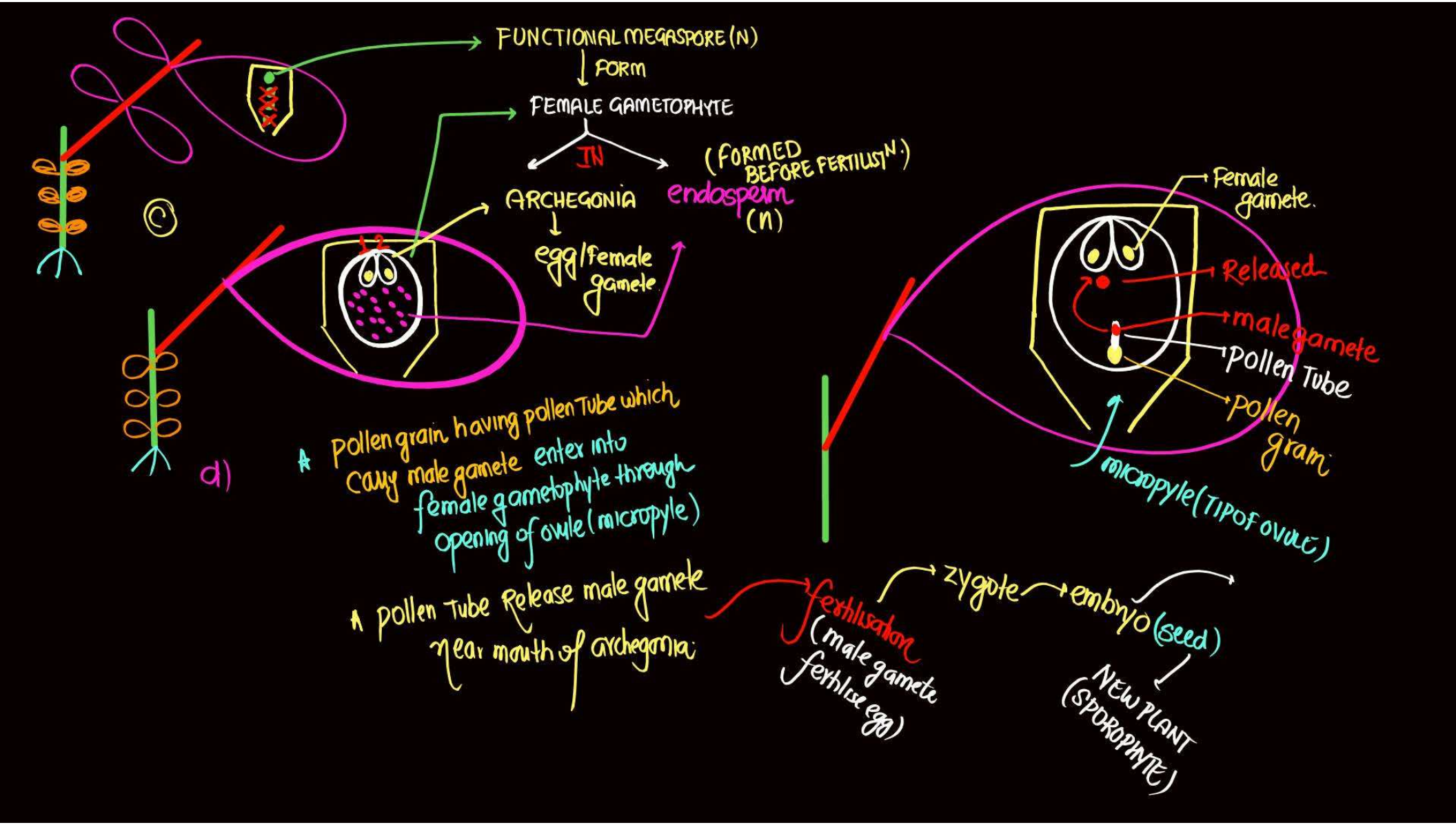
⇒ Seed (1st Time)

⇒ FRUIT absent

⇒ Vascular Tissue


LIFE CYCLE (DIOECIOUS)
SPOROPHYTE, 2N (MALE TREE).
MALE CONE/MICROSPORANGIATE/STROBILUS.
aggregation
2N.
MICROSPOROPHYLL, 2N
ON
MICROSPORANGIA, 2N.
IN
MICROSPORE MOTHER CELL, 2N
MEIOSIS
MICROSPORE, N
MALE GAMETOPHYTE
(POLLEN GRAIN), N.
Release from microsporangia
AXIS
LEAF
STEM
ROOT
MALE TREE
(SPOROPHYTE)


LIFE CYCLE (DIOECIOUS)
envelope/integument
CELLS OF (NUCELLUS) 2N.
axis
a)
LEAF
STEM.
ROOT
FEMALE TREE (SPOROPHYTE)
Female TREE, SPOROPHYTE, 2N.
FEMALE CONE/MACROSPORANGIATE
aggregation of Megasporophyll, 2N.
ON
MEGASPORANGIA/OVULE (2N)
IN
ONE OF CELL OF NUCELLUS increase in size called MEGASPORE MOTHER CELL (2N)
MEIOSIS
4 MEGASPORE, N
3 ARE DEGENERATED
one is functional at chalaza end.
CHALAZA.
4
MICROPYLE (OPENING OF OVULE
b)
c)


FUNCTIONAL MEGASPORE (N)
FORM
FEMALE GAMETOPHYTE
IN
ARCHEGONIA
(FORMED BEFORE FERTILISTN.)
endosperm (n)
egg/female gamete
c)
d)
Female gamete.
Released
male gamete
Pollen Tube
Pollen gram
micropyle (TIP OF OVULE)
* Pollen grain having pollen Tube which carry male gamete enter into female gametophyte through opening of ovule (micropyle)
* Pollen Tube Release male gamete near mouth of archegonia
fertilisation (male gamete fertilise egg)
zygote
embryo (seed)
NEW PLANT (SPOROPHYTE)

ARTIFICAL C

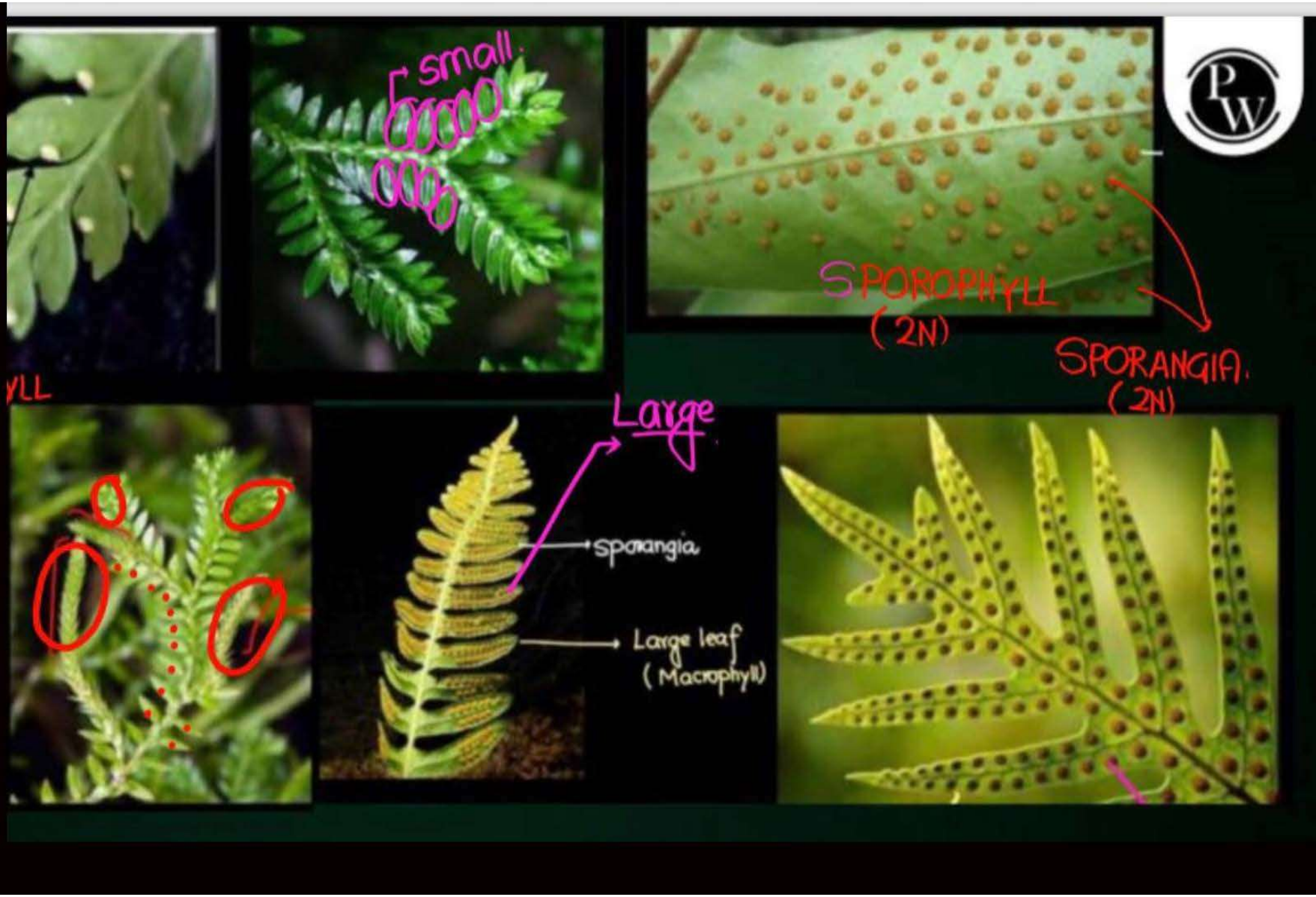
- ARISTOTLE, LINNAEUS.
- ONE OR FEW CRITERIA (MORPHOLOGICAL CHARACTER/EXTERNAL)

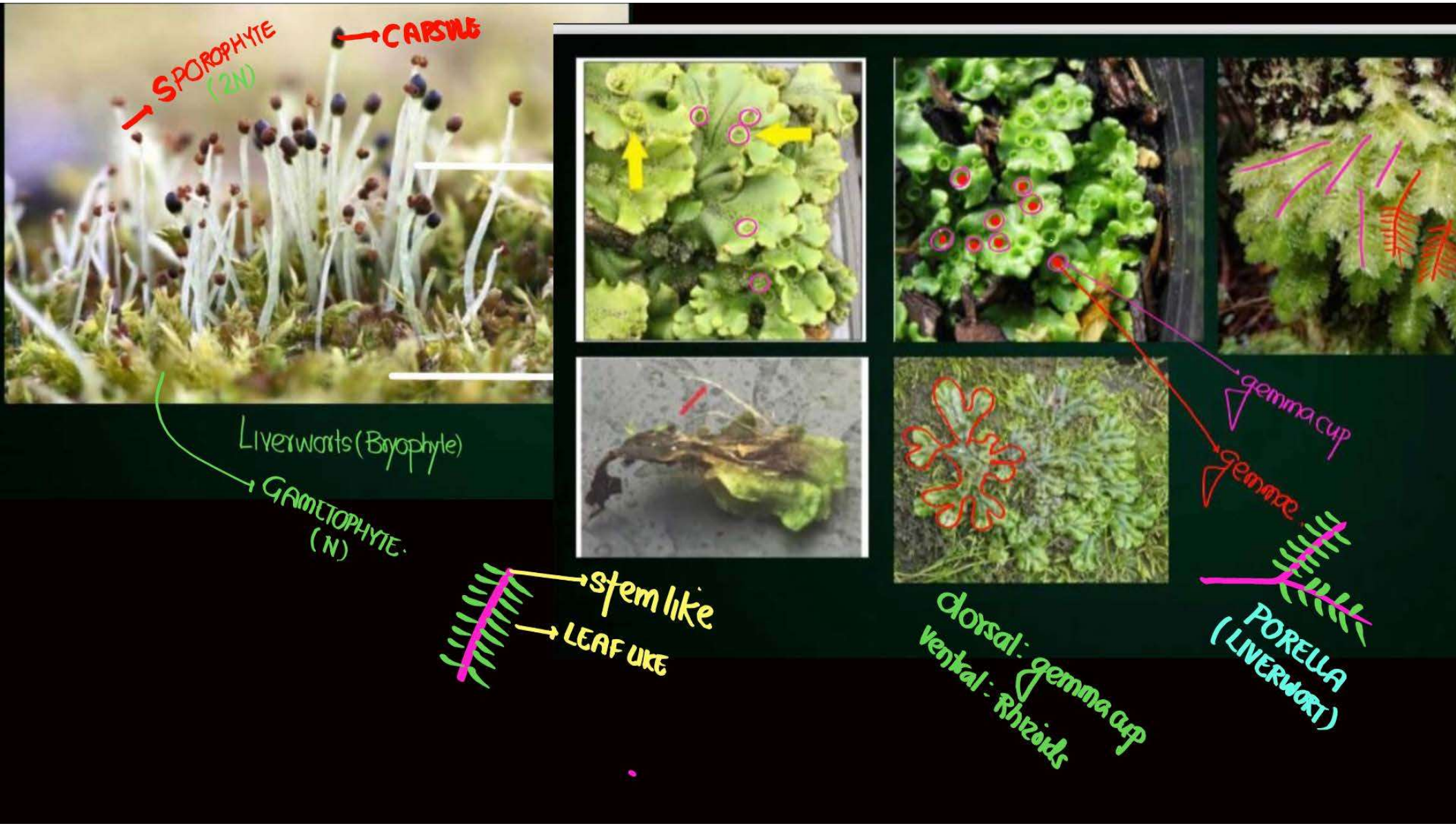
  number, colour, shape, HABIT of LEAVES. (VEGETATIVE CHARACTER)
- LINNAEUS : CRITERIA : (ANDROECIUM. STRUCTURE)

DRAWBACK

- equal importance to vegetative & Reproductive character. BUT Rep. character is more Conservative Because least affected By environment.
- They seperated closely Related. Species on Basis of few characters.


Tall (Pinus)
Stem (Branched)
medium size
(Cycas)
Stem (Unbranched)
Sequoia (Red wood Tree)
Coralloid Root
Ephedra (Shrubs)
ROOTS WITH MYCORRHIZAL FUNGI


small
SPOROPHYLL
(2N)
SPORANGIA.
(2N)
Large
Sporangia
Large leaf
(Macrophyll)


SPOROPHYTE
(2N)
CAPSULE
Liverworts (Bryophyte)
GAMETOPHYTE
(N)
stem like
LEAF LIKE
gemma cup
gemma
dorsal: gemma cup
ventral: Rhizoids
PORELLA
(LIVERWORT)

Archegonia

Archegoniophore

Antheridium

Anthendiophore

gametophyte (n)

gametophyte (n)

Male Marchantia

female marchantia

Let us also look at classification within angiosperms to understand some of the concerns that influenced the classification systems. The earliest systems of classification used only gross superficial morphological characters such as habit, colour, number and shape of leaves, etc. They were based mainly on vegetative characters or on the androecium structure (system given by Linnaeus). Such systems were **artificial**; they separated the closely related species since they were based on a few characteristics. Also, the artificial systems gave equal weightage to vegetative and sexual characteristics; this is not acceptable since we know that often the vegetative characters are more easily affected by environment.

Similar character Between organism

no. of criteria : more.

As against this, **natural classification systems** developed, which were based on natural affinities among the organisms and consider, not only the external features, but also internal features, like ultrastructure (Cell structure), anatomy, embryology and phytochemistry. Such a classification for flowering plants was given by George Bentham and Joseph Dalton Hooker. (Terpene, alkaloids, crystal ($CaCO_3$))

At present **phylogenetic classification systems** based on evolutionary relationships between the various organisms are acceptable. This assumes that organisms belonging to the same taxa have a common ancestor. We now use information from many other sources too to help resolve difficulties in classification. These become more important when there is no supporting fossil evidence.

Same class

Ancestel evolution study

Same

Similarity more

Same class

Numerical Taxonomy which is now easily carried out using computers is based on all observable characteristics. Number and codes are assigned to all the characters and the data are then processed. In this way each character is given equal importance and at the same time hundreds of characters can be considered. **Cytotaxonomy** that is based on cytological information like chromosome number, structure, behaviour and **chemotaxonomy** that uses the chemical constituents of the plant to resolve confusions, are also used by taxonomists these days.

DNA

TABLE 3.1 Divisions of Algae and their Main Characteristics

Classes	Common Name	Major Pigments	Stored Food	Cell Wall	Flagellar Number and Position of Insertions	Habitat
Chlorophyceae	Green algae	Chlorophyll *a*, *b*	Starch	Cellulose	2-8 equal, apical	Fresh water, brackish water, salt water (MARINE)
Phaeophyceae	Brown algae	Chlorophyll *a*, *c*, fucoxanthin	Mannitol, laminarin	Cellulose and algin (Cellulose cell wall covered by algin)	2 unequal, lateral	Fresh water (rare) brackish water, salt water
Rhodophyceae	Red algae	Chlorophyll *a*, *d*, phycoerythrin	Floridean starch	Cellulose, pectin and poly sulphate esters	Absent	Fresh water (some), brackish water, salt water (most)

MAIN PIGMENT

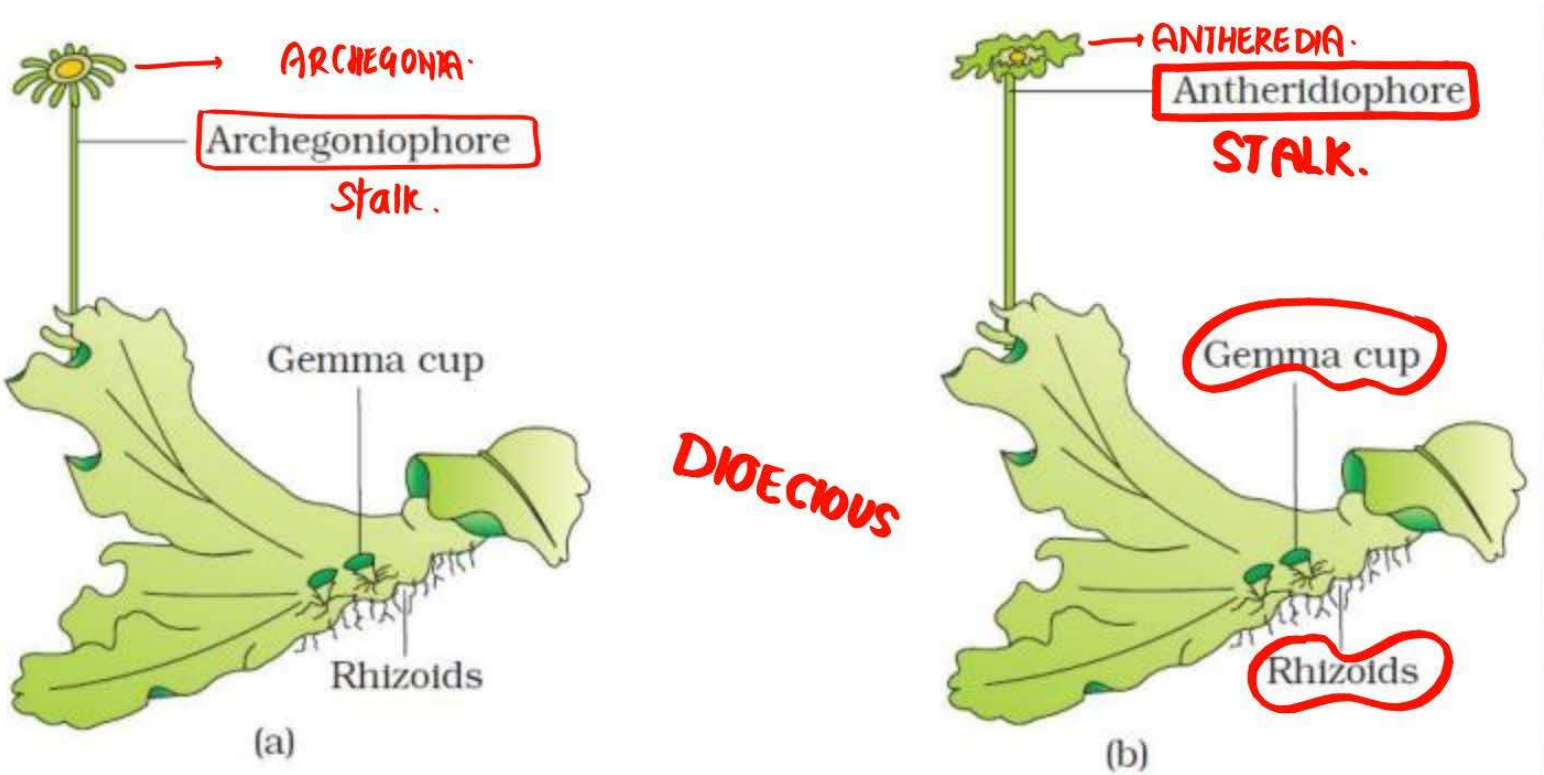
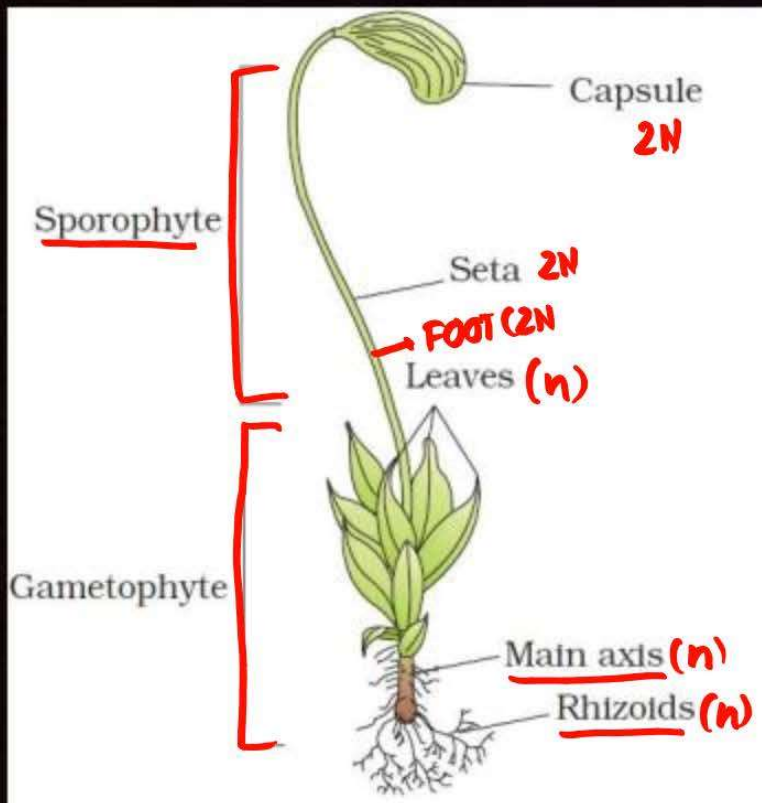


Figure 3.2 Bryophytes: A liverwort – *Marchantia* (a) Female thallus (b) Male thallus Mosses – (c) *Funaria*, gametophyte and sporophyte (d) *Sphagnum* gametophyte



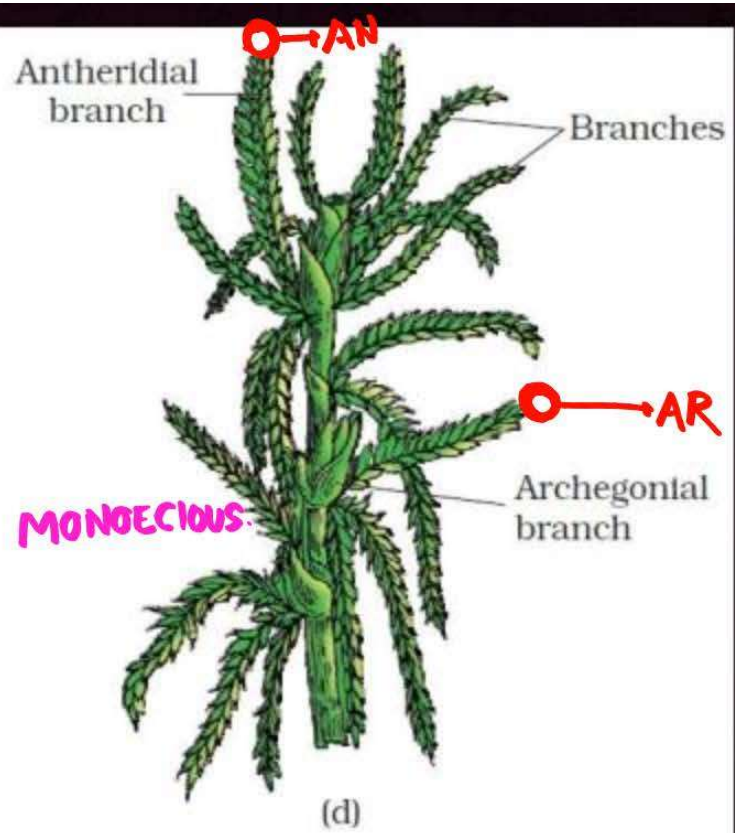


Figure 3.2 Bryophytes: A liverwort – *Marchantia* (a) Female thallus (b) Male thallus Mosses – (c) *Funaria*, gametophyte and sporophyte (d) *Sphagnum* gametophyte

The plant body of bryophytes is more differentiated than that of algae. It is thallus-like and prostrate or erect, and attached to the substratum by unicellular or multicellular rhizoids. They lack true roots, stem or leaves. They may possess root-like, leaf-like or stem-like structures. The main plant body of the bryophyte is haploid. It produces gametes, hence is called a **gametophyte**. The sex organs in bryophytes are multicellular. The male sex organ is called **antheridium**. They produce biflagellate **antherozoids**. The female sex organ called **archegonium** is flask-shaped and produces a single egg.

male gamete (motile)

female gamete

Male gamete

The antherozoids are released into water where they come in contact with archegonium. An antherozoid fuses with the egg to produce the zygote. Zygotes do not undergo reduction division immediately. They produce a multicellular body called a **sporophyte**. The sporophyte is not free-living but attached to the photosynthetic gametophyte and derives nourishment from it. Some cells of the sporophyte undergo reduction division (meiosis) to produce haploid spores. These spores germinate to produce gametophyte.

meiosis

SMC ← SPOROPHYTE ← embryo

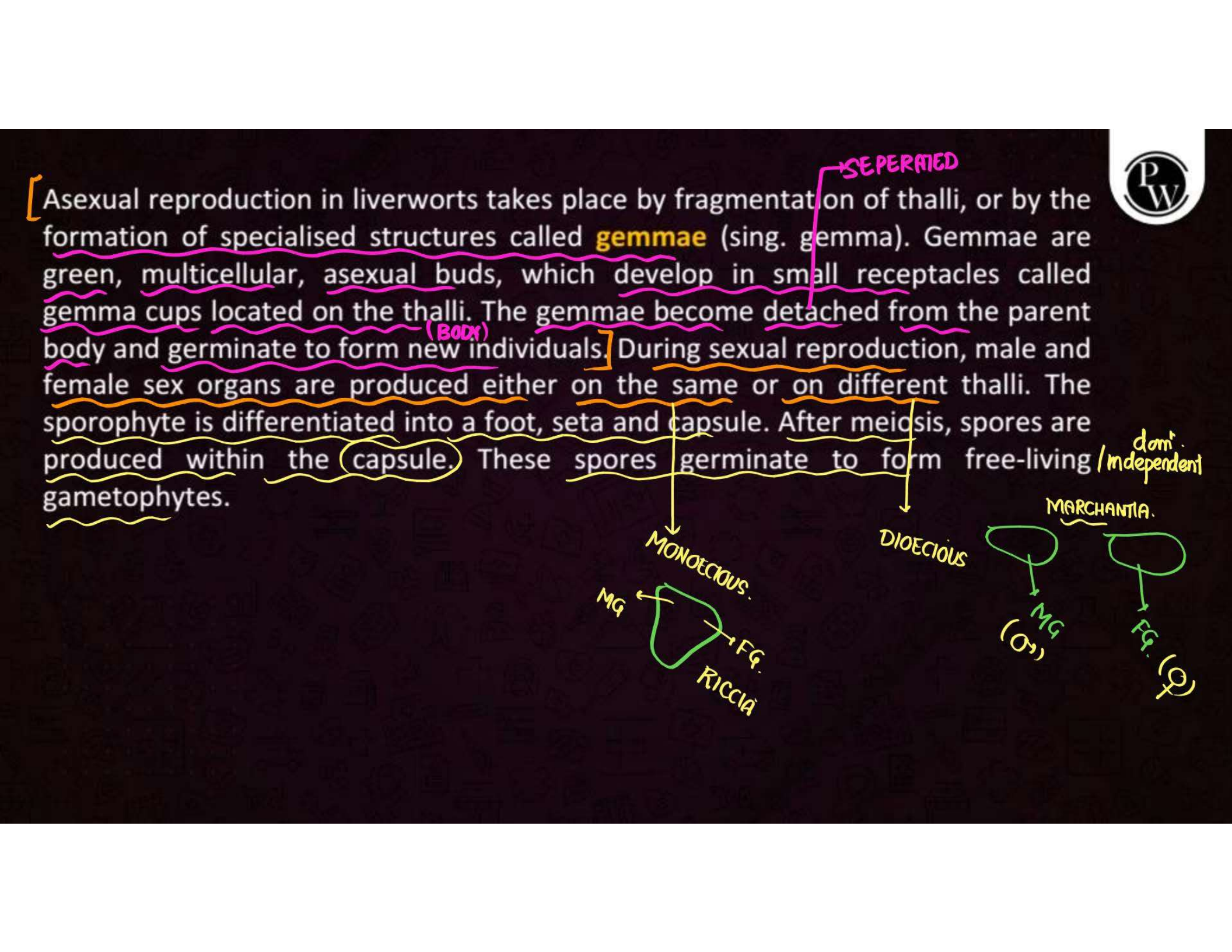
MEIOSIS

Bryophytes in general are of little economic importance but some mosses provide food for herbaceous mammals, birds and other animals. Species of *Sphagnum*, a moss, provide peat that have long been used as fuel, and as packing material for trans-shipment of living material because of their capacity to hold water. Mosses along with lichens are the first organisms to colonise rocks and hence, are of great ecological importance. They decompose rocks making the substrate suitable for the growth of higher plants. Since mosses form dense mats on the soil, they reduce the impact of falling rain and prevent soil erosion. The bryophytes are divided into **liverworts** and **mosses**.

2.1 Liverworts

The liverworts grow usually in moist, shady habitats such as banks of streams, marshy ground, damp soil, bark of trees and deep in the woods. The plant body of a liverwort is thalloid, e.g., *Marchantia*. The thallus is dorsiventral and closely appressed to the substrate. The leafy members have tiny leaf-like appendages in two rows on the stem-like structures.

Asexual reproduction in liverworts takes place by fragmentation of thalli, or by the formation of specialised structures called **gemmae** (sing. gemma). Gemmae are green, multicellular, asexual buds, which develop in small receptacles called gemma cups located on the thalli. The gemmae become detached from the parent body and germinate to form new individuals. During sexual reproduction, male and female sex organs are produced either on the same or on different thalli. The sporophyte is differentiated into a foot, seta and capsule. After meiosis, spores are produced within the capsule. These spores germinate to form free-living gametophytes.



2.2. Mosses

The predominant stage of the life cycle of a moss is the gametophyte which consists of two stages. The first stage is the **protonema** stage, which develops directly from a spore. It is a creeping, green, branched and frequently filamentous stage. The second stage is the **leafy stage**, which develops from the secondary protonema as a lateral bud. They consist of upright, slender axes bearing spirally arranged leaves. They are attached to the soil through multicellular and branched rhizoids. This stage bears the sex organs.

FALSE

→ BUDS → LEAFY GAMETOPHYTE.

Vegetative reproduction in mosses is by fragmentation and budding in the secondary protonema. In sexual reproduction, the sex organs antheridia and archegonia are produced at the apex of the leafy shoots. After fertilisation, the zygote develops into a sporophyte, consisting of a foot, seta and capsule. The sporophyte in mosses is more elaborate than that in liverworts. The capsule contains spores. Spores are formed after meiosis. The mosses have an elaborate mechanism of spore dispersal. Common examples of mosses are *Funaria*, *Polytrichum* and *Sphagnum* (Figure 3.2).

COMPLEX.

SPOROPHYTE

CAPSULE
SETA
FOOT

OPERCULUM
THECA
APOPHYSIS

COMPLEX.

Release of spore from capsule is complex process

COMPLEX.

3. Pteridophytes

The Pteridophytes include horsetails and ferns. Pteridophytes are used for medicinal purposes and as soil-binders. They are also frequently grown as ornamentals. Evolutionarily, they are the first terrestrial plants to possess vascular tissues – xylem and phloem. You shall study more about these tissues in Chapter 6. The pteridophytes are found in cool, damp, shady places though some may flourish well in sandy-soil conditions.

You may recall that in bryophytes the dominant phase in the life cycle is the gametophytic plant body. However, in pteridophytes, the main plant body is a sporophyte which is differentiated into true root, stem and leaves (Figure 3.3). These organs possess well-differentiated vascular tissues. The leaves in pteridophyta are small (microphylls) as in *Selaginella* or large (macrophylls) as in ferns. The sporophytes bear sporangia that are subtended by leaf-like appendages called **sporophylls**. In some cases sporophylls may form distinct compact structures called strobili or cones (*Selaginella*, *Equisetum*). The sporangia produce spores by meiosis in spore mother cells. The spores germinate to give rise to inconspicuous, small but multicellular, free-living, mostly photosynthetic thalloid gametophytes called **prothallus**.

PROTHALLUS

These gametophytes require cool, damp, shady places to grow. Because of this specific restricted requirement and the need for water for fertilisation, the spread of living pteridophytes is limited and restricted to narrow geographical regions. The gametophytes bear male and female sex organs called antheridia and archegonia, respectively. Water is required for transfer of antherozoids – the male gametes released from the antheridia, to the mouth of archegonium.Fusion of male gamete with the egg present in the archegonium result in the formation of zygote. Zygote thereafter produces a multicellular well-differentiated sporophyte which is the dominant phase of the pteridophytes. In majority of the pteridophytes all the spores are of similar kinds; such plants are called **homosporous**.

Genera like *Selaginella* and *Salvinia* which produce two kinds of spores, macro (large) and micro (small) spores, are known as **heterosporous**. The megaspores and microspores germinate and give rise to female and male gametophytes, respectively. The female gametophytes in these plants are retained on the parent sporophytes for variable periods. The development of the zygotes into young embryos take place within the female gametophytes. This event is a precursor to the **seed habit** considered an important step in evolution.

The pteridophytes are further classified into four classes: Psilopsida (*Psilotum*); Lycopsida (*Selaginella, Lycopodium*), Sphenopsida (*Equisetum*) and Pteropsida (*Dryopteris, Pteris, Adiantum*).

Figure 3.3 Pteridophytes : (a) *Selaginella* (b) *Equisetum* (c) Fern (d) *Salvinia*

4. Gymnosperms

The gymnosperms (*gymnos* : naked, *sperma* : seeds) are plants in which the ovules are not enclosed by any ovary wall and remain exposed, both before and after fertilisation. The seeds that develop post-fertilisation, are not covered, i.e., are naked. Gymnosperms include medium-sized trees or tall trees and shrubs (Figure 3.4). One of the gymnosperms, the giant redwood tree Sequoia is one of the tallest tree species. The roots are generally tap roots. Roots in some genera have fungal association in the form of **mycorrhiza** (*Pinus*), while in some others (*Cycas*) small specialised roots called coralloid roots are associated with N_2- fixing cyanobacteria.

Anabaena

The stems are unbranched (*Cycas*) or branched (*Pinus, Cedrus*). The leaves may be simple or compound. In *Cycas* the pinnate leaves persist for a few years. The leaves in gymnosperms are well-adapted to withstand extremes of temperature, humidity and wind. In conifers, the needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss.

TRANSPIRATION ↓

Pinus.

impermeable to H_2O

deeply seated.

The gymnosperms are heterosporous; they produce haploid microspores and megaspores. The two kinds of spores are produced within sporangia that are borne on sporophylls which are arranged spirally along an axis to form lax or compact strobili or **cones**. The strobili bearing **microsporophylls** and **microsporangia** are called microsporangiate or **male strobili**. The microspores develop into a male gametophytic generation which is highly reduced and is confined to only a limited number of cells. This reduced gametophyte is called a **pollen grain**. The development of pollen grains take place within the microsporangia. The cones bearing megasporophylls with ovules or **megasporangia** are called macrosporangiate or **female strobili**.

megasporangia female cone absent not aggregate to form female cone. MONOECIOUS.

The male or female cones or strobili may be borne on the same tree (*Pinus*). However, in *cycas* male cones and megasporophylls are borne on different trees. dioecious

The megaspore mother cell is differentiated from one of the cells of the nucellus. The nucellus is protected by envelopes and the composite structure is called an **ovule**. The ovules are borne on megasporophylls which may be clustered to form the female cones. The megaspore mother cell divides meiotically to form four megaspores. One of the megaspores enclosed within the **megasporangium** develops into a multicellular female gametophyte that bears two or more **archegonia** or female sex organs. The multicellular female gametophyte is also retained within megasporangium.

(Integument)

3 degenerated.

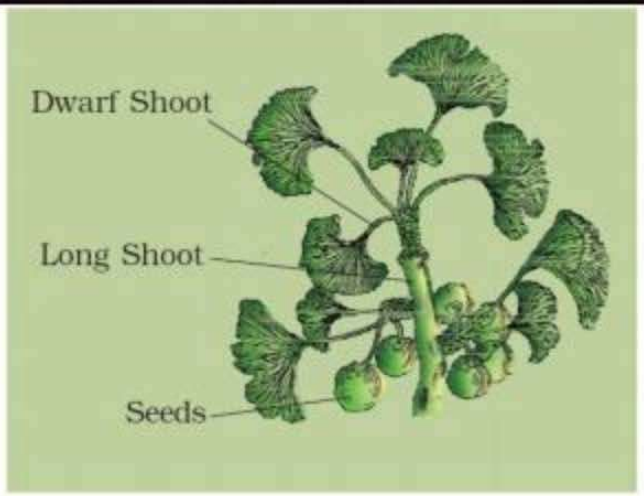
permanently

micropyle

Unlike bryophytes and pteridophytes, in gymnosperms the male and the female gametophytes do not have an independent free-living existence. They remain within the sporangia retained on the sporophytes. The pollen grain is released from the microsporangium. They are carried in air currents and come in contact with the opening of the ovules borne on megasporophylls. The pollen tube carrying the male gametes grows towards archegonia in the ovules and discharge their contents near the mouth of the archegonia. Following fertilisation, zygote develops into an embryo and the ovules into seeds. These seeds are not covered.

(a)

(b)



(c)

Figure 3.4 Gymnosperms: (a) *Cycas* (b) *Pinus* (c) *Ginkgo*

5. Angiosperms

Unlike the gymnosperms where the ovules are naked, in the angiosperms or flowering plants, the pollen grains and ovules are developed in specialised structures called **flowers**. In angiosperms, the seeds are enclosed in fruits. The angiosperms are an exceptionally large group of plants occurring in wide range of habitats. They range in size from the smallest *Wolffia* to tall trees of *Eucalyptus* (over 100 metres). They provide us with food, fodder, fuel, medicines and several other commercially important products. They are divided into two classes : the **dicotyledons** and the **monocotyledons** (Figure 3.5).

(a) (b)

Figure 3.5 Angiosperms : (a) A dicotyledon (b) A monocotyledon

141. Read the following statements and choose the set of correct statements:

In the members of Phaeophyceae,

NEET 2024.

A. Asexual reproduction occurs usually by biflagellate zoospores.

B. Sexual reproduction is by oogamous method only. ISO, anISO, OO

C. Stored food is in the form of carbohydrates which is either mannitol or laminarin.

D. The major pigments found are chlorophyll a, c and carotenoids and xanthophyll.

E. Vegetative cells have a cellulosic wall, usually covered on the outside by gelatinous coating of algi

Choose the correct answer from the options given below:

(1) A, B, C and D only

(2) B, C, D and E only

(3) A, C, D and E only

(4) A, B, C and E only

QUESTION

A : In gymnosperms, the pollen grains are released from the microsporangium and carried by air currents.

R : Air currents carry the pollen grains to the mouth of archegonia where male gamete is discharged and pollen tube is not formed. (2023)

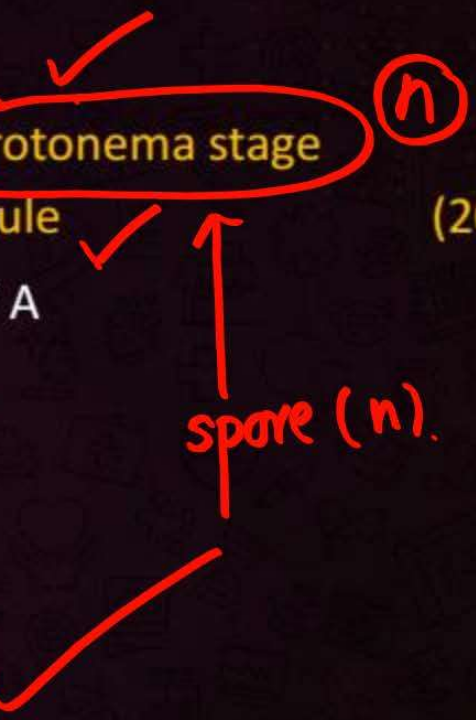
1. Both A and R are true but R is not correct explanation of A
2. A is true but R is false
3. A is false but R is true
4. Both A and R are true and R is correct explanation of A

QUESTION

A : The first stage of gametophyte in the life cycle of moss is protonema stage

R : Protonema develops directly from spores produced in capsule (2023)

1. Both A and R are true but R is not correct explanation of A
2. A is true but R is false
3. A is false but R is true
4. Both A and R are true and R is correct explanation of A



QUESTION

Identify the pair of heterosporous pteridophytes (2023)

1. Selaginella and Salvinia
2. Psilotum* and Salvinia
3. Equisetum and Salvinia
4. Lycopodium and Selaginella

QUESTION

Which of the following is incorrectly matched? (2022)

1. *Volvox* - Starch
2. *Ectocarpus* - Fucoxanthin
3. *Ulothrix* - ~~Mannitol~~ Starch
4. *Porphyra* - Floridean Starch

QUESTION

Hydrocolloid carrageen is obtained from: (2022)

1. Phaeophycea only
2. Chlorophyceae and Phaeophyceae
3. Phaeophyceae and Rhodophyceae
4. Rhodophyceae only (Red algae)

QUESTION

Match the plant with the kind of life cycle it exhibits:

Choose the correct answer from the options given below. (2022)

1	A-ii	B-iv	C-i	D-iii
2	A-iv	B-i	C-ii	D-iii
3	A-ii	B-iii	C-iv	D-i
4	A-iii	B-iv	C-i	D-ii

List-I		List-II	
(A)	*Spirogyra*	(i)	Dominant diploid sporophyte vascular plant, with highly reduced male or female gametophyte
(B)	Fern	(ii)	Dominant haploid free-living gametophyte
(C)	*Funaria*	(iii)	Dominant diploid sporophyte alternating with reduced gametophyte called prothallus
(D)	*Cycas*	(iv)	Dominant haploid leafy gametophyte alternating with partially dependent multicellular sporophyte

QUESTION

Which of the following algae produce Carrageen? (2021)

1. Brown algae
2. Red algae
3. Blue-green algae
4. Green algae

QUESTION

Which of the following algae contains mannitol as reserve food material? (2021)

(BA)

1. *Gracilaria* (R)
2. *Volvox* (G)
3. *Ulothrix* (G)
4. *Ectocarpus* (B)

QUESTION

Gemmae are present in: (2021)

1. Pteriodophytes
2. Some Gymnosperms
3. Some Liverworts
4. Mosses

QUESTION

Genera like *Selaginella* and *Salvinia* produce two kinds of spores. Such plants are known as: (2021)

1. Heterosorus
2. Homosporous
3. Heterosporous
4. Homosorus

QUESTION

Which of the following pairs is of unicellular algae? (2020)

1. *Gelidium* and *Gracilaria*
2. *Anabaena* and *Volvox*
3. *Chlorella* and *Spirulina*
4. *Laminaria* and *Sargassum*

QUESTION

Floridean starch has structure similar to: (2020)

1. Amylopectin and glycogen
2. Mannitol and algin
3. Laminarin and cellulose
4. Starch and cellulose

QUESTION

Phycoerythrin is the major pigment in: (2020-Covid)

1. Blue green algae
2. Green algae
3. Brown algae
4. Red algae

QUESTION

Strobili or cones are found in: (2020)

1. *Pteris*
2. *Marchantia*
3. *Equisetum* & selaginella
4. *Salvinia*

QUESTION

Which of the following statements is incorrect about gymnosperms? (2020-Covid)

1. Male and female gametophytes are not free living
2. Most of them have narrow leaves with thick cuticle
3. Their seeds are not covered
4. They are heterosporous

QUESTION

Male and female gametophytes do not have an independent free living existence in:

(2020-Covid)

gym & angio

1. Algae
2. Angiosperms
3. Bryophytes
4. Pteridophytes

QUESTION

From evolutionary point of view, retention of the female gametophyte with developing young embryo on the parent sporophyte for some time, is first observed in (2019)

variable period.

1. Liverworts
2. Mosses
3. Pteridophytes
4. Gymnosperms

QUESTION

Pinus seed cannot germinate and established without fungal association. This is because : (2019)

1. Its embryo is immature.
2. It has obligate association with mycorrhizae.
3. It has very hard seed coat.
4. Its seeds contain inhibitors that prevent germination.

QUESTION

Which one is wrongly matched? (2018)

1. Uniflagellate gametes - *Polysiphonia*
2. Biflagellate zoospores - Brown algae
3. Gemma cups - *Marchantia*
4. Unicellular organism - *Chlorella*

QUESTION

Which of the following statement is correct? (2018)

1. Ovules are not enclosed by ovary wall in gymnosperms
2. *Selaginella* is heterosporous, while *Salvinia* is homosporous
3. Horsetails are gymnosperms
4. Stems are usually unbranched in both Cycas and Cedrus

QUESTION

An example of colonial alga is (2017-Delhi)

1. *Chlorella*
2. *Volvox*
3. *Ulothrix*
4. *Spirogyra*

QUESTION

Select the mismatch: (2017-Delhi)

1. *Pinus* – Dioecious
2. *Cycas* – Dioecious
3. *Salvinia* – Heterosporous
4. *Equisetum* – Homosporous

QUESTION

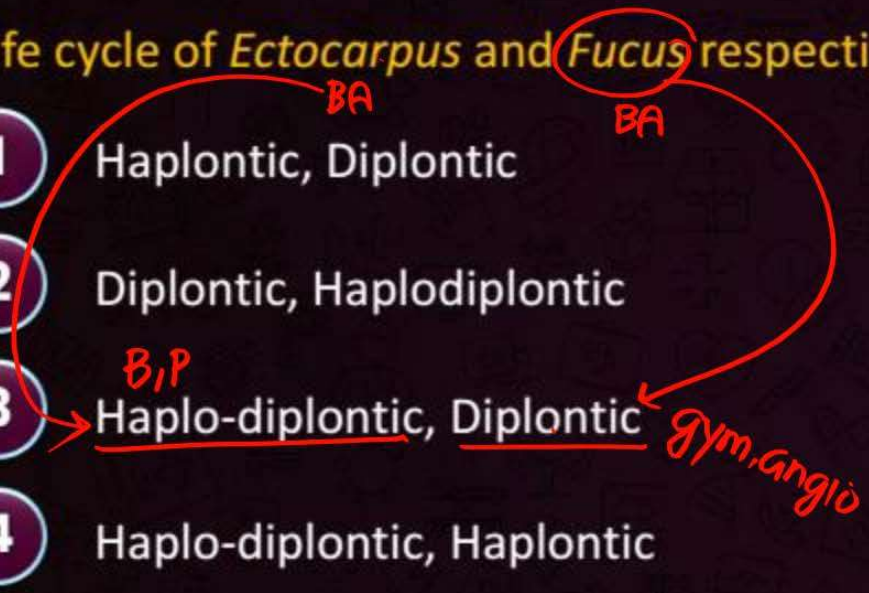
Double fertilisation is exhibited by (2017-Delhi)

1. Gymnosperms
2. Algae
3. Fungi
4. Angiosperms

QUESTION

Life cycle of *Ectocarpus* and *Fucus* respectively are: (2017-Delhi)

1. Haplontic, Diplontic
2. Diplontic, Haplodiplontic
3. Haplo-diplontic, Diplontic
4. Haplo-diplontic, Haplontic



QUESTION

Zygotic meiosis is characteristic of: [OS] (2017-Delhi)

1. *Marchantia* (BRYOP)
2. *Fucus* (DIPLONTIC)
3. *Funaria* (Bryop)
4. *Chlamydomonas* (Haplontic). Haploid

QUESTION

Conifers are adapted to tolerate extreme environmental conditions because of: (2016 - II)

1. Thick cuticle
2. Presence of vessels
3. Broad hardy leaves
4. Superficial stomata

SUNKEN.

QUESTION

Select the correct statement. (2016 - I)

1. Gymnosperms are both ~~homosporous~~ and heterosporous
2. *Salvinia*, *Ginkgo* and *Pinus* all are gymnosperms
3. *Sequoia* is one of the tallest trees
4. The leaves of gymnosperms are ~~not~~ well adapted to extremes of climate

QUESTION

Which one of the following statements is wrong? (2016 - II)

1. Agar-agar is obtained from *Gelidium* and *Gracilaria*.
2. *Laminaria* and *Sargassum* are used as food.
3. Algae increase the level of dissolved oxygen in the immediate environment.
4. Algin is obtained from red algae, and carrageen from brown algae.

QUESTION

In bryophytes and pteridophytes, transport of male gametes requires: (2016 - I)

1. Wind
2. Insects
3. Birds
4. Water