LIFE-CYCLE OF *SELAGINELLA*

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PANIPAT

INTRODUCTION

- More than 700 Species worldwide.
- Nearly 70 reported from India.
- Tropical and subtropical regions
- Common in moist, shady localities
- Some spp. Xerophytic (*S. lepidophylla, S. pilifera*)-resurrection plants
- Some epiphytic (*S. oregana*)
- Common Indian spp.- *S. monospora, S. kraussiana, S. sanguinolenta, S. chrysocaulous, S. chrysorrhizos, S. exigua, S. rodrigaesiana etc.*

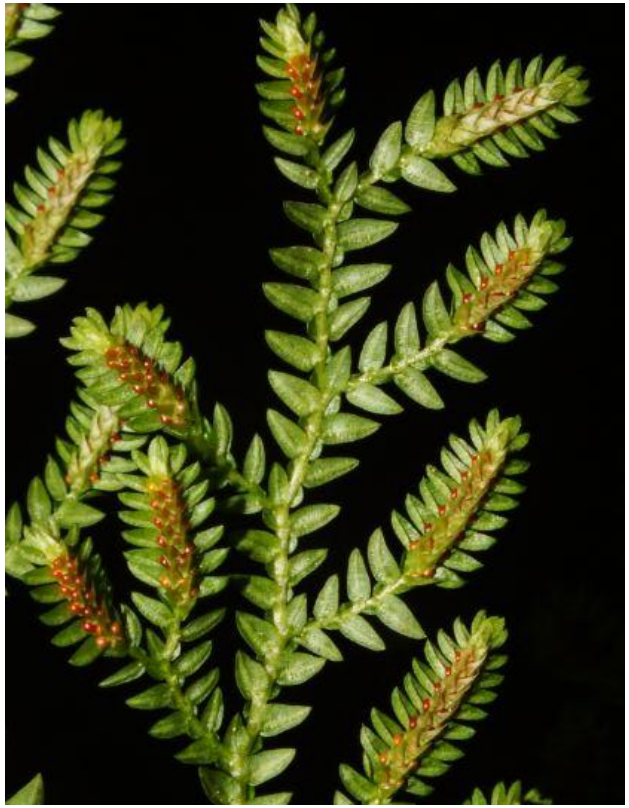
CLASSIFICATION

Division: Lycophyta

Class: Ligulopsida

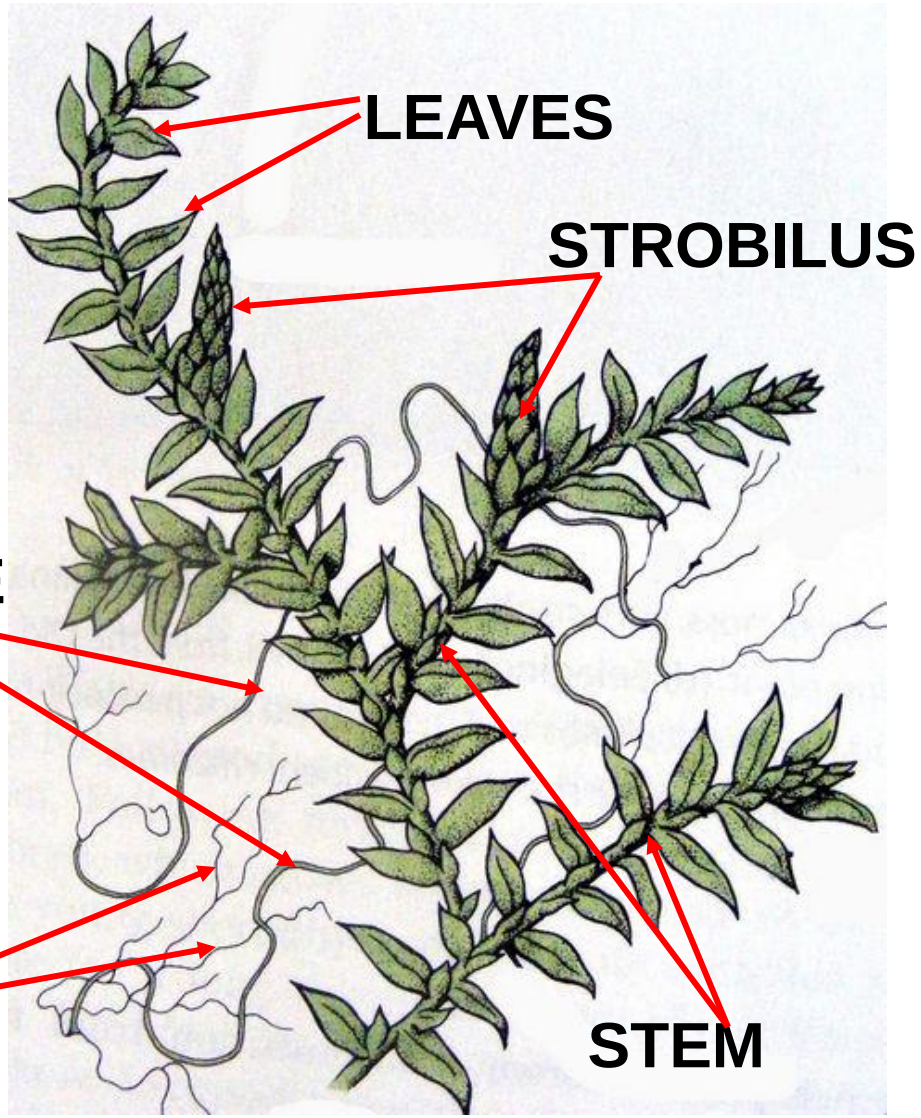
Order: Selaginellales

Family: Selaginellaceae



MORPHOLOGY

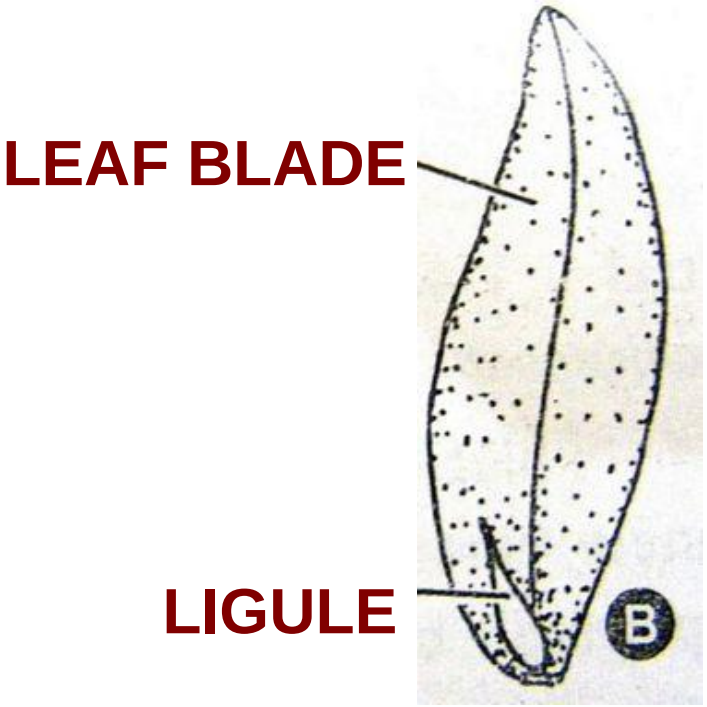
Sporophytic Plant body is well-differentiated into Root, Stem and Leaves



MORPHOLOGY

1. STEM & LEAVES

Stem bears two kinds of leaves Dorsal Smaller and Ventral Larger



Ligule is a special tongue-like structure on upper side of each large leaf

STEM

- **STEM MAY BE ERECT, DORSI-VENTRAL, SUB-ERECT SCANDENT or PENDANT**

- **MOSTLY MUCH BRANCHED, RARELY UN-BRANCHED**

LEAVES

- Very small (microphyllous), simple, sessile, with distinct midrib, apex acute.
- Two sections on the basis of leaves:
- (a) **Heterophyllum**-majority of spp., two kinds of leaves (different sizes)
- (b) **Homoeophyllum**- few spp., are isophyllous, have one kind of leaves
- All the species have Ligulate leaves

MORPHOLOGY

2. RHIZOPHORE & ROOTS

RHIZOPHORE: In dorsiventral spp., long, colorless prop-like structures, supportive in function, present on dichotomy of stem

ROOTS: Adventitious, dichotomously branched, primary root short-lived

REPRODUCTION

VEGETATIVE-

- Fragmentation- *S. rupestris*
- Small tubers-

S. chrysocaulos, *S. chrysorrhizos*

↓ Surface tubers

↓ Underground tubers

SEXUAL REPRODUCTION

Occurs through Spores, two types are produced in Selaginella, Microspores and Megaspores

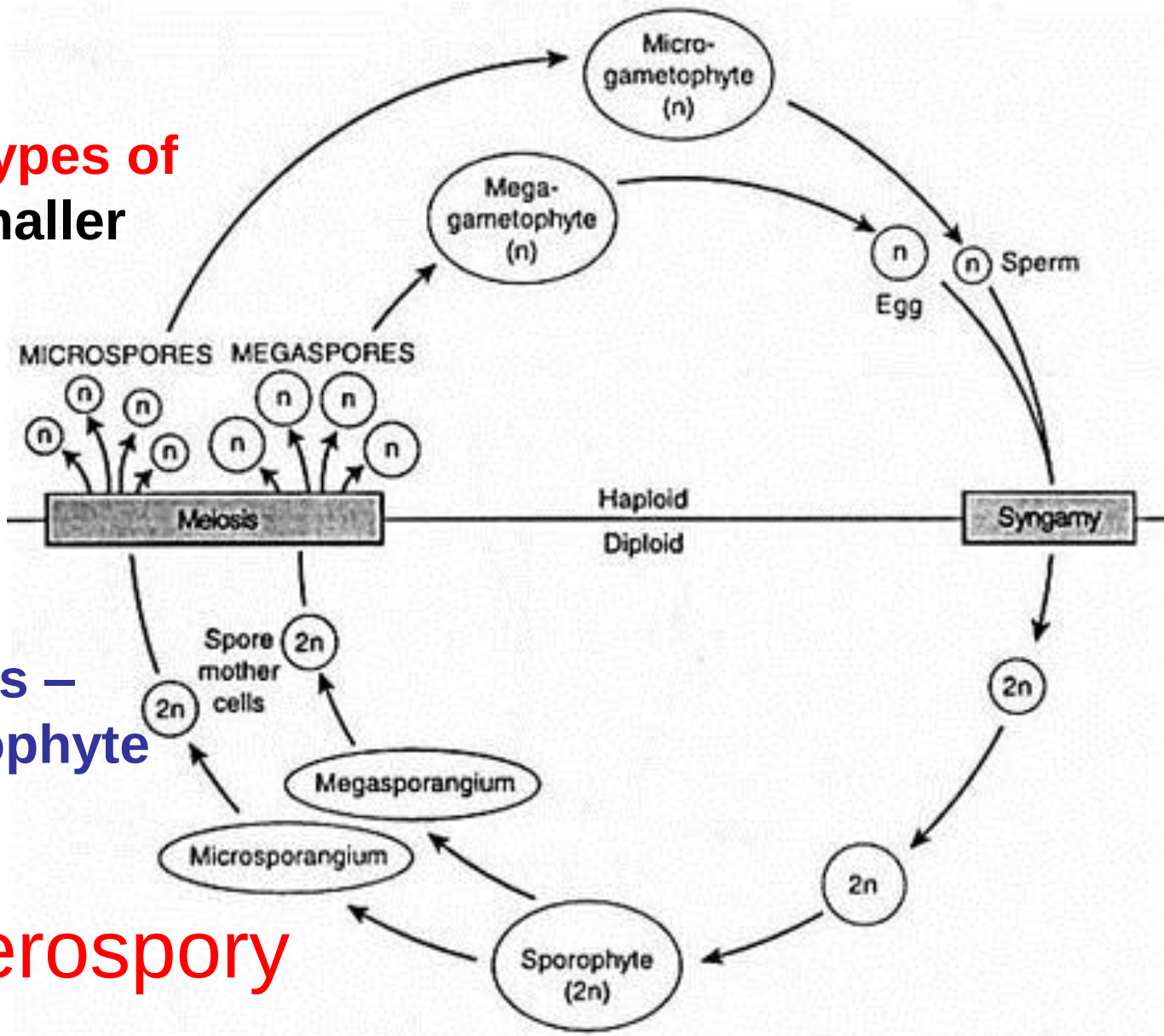
HETEROSPORY- Production of two different kinds of spores having distinct structure and functions.

Characteristic of Genus *Selaginella* and many other Pteridophytes like *Isoetes*, *Marsilea* etc., thus these are called HETEROSPOROUS

Selaginella Produces..

Two Different Types of Spores: **The Smaller Microspores and the larger Megaspores**

Microspores produce male Gametophyte and Megaspores – Female Gametophyte



This is Heterospory

SPORE BEARING ORGANS

Known as STROBILI (Singular STROBILUS)

Strobili bear two kinds of leaves in *Selaginella:*

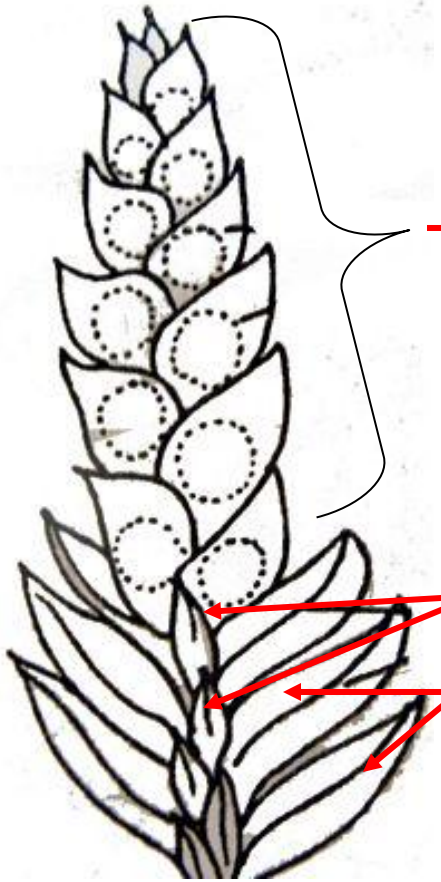
Microsporophylls and Megasporophylls

Usually borne at the apices of growing stem,

The stem stops growing in most of the cases,

Sometimes, as in *S. grandis* and *S. patula* the axis continues its growth after producing the strobilus.

STROBILUS



STROBILUS

DORSAL LEAVES

VENTRAL LEAVES

MEGASPOROPHYLL

MEGASPORANGIUM

MICROSPORANGIUM

MICROSPOROPHYLL

SPORE BEARING ORGANS

- The Megasporophylls have in their axis Megasporangia producing Megaspores
- The Microsporophylls have Microsporangia giving rise to numerous Microspores.

THE MOST IMPORTANT POINT TO NOTE IS THAT *SELAGINELLA* SHOWS A VERY ADVANCED PHENOMENON OF HETEROSPORY FOR THE FIRST TIME IN LIFE OF PLANTS, ULTIMATELY LEADING TO "SEED-HABIT"

Micro- and Megasporophylls

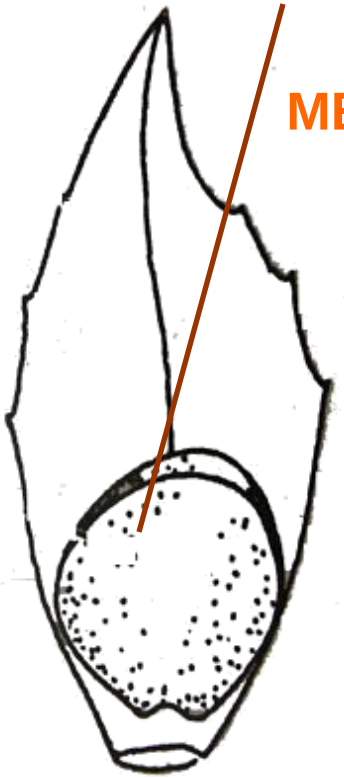
T.S. STROBILUS

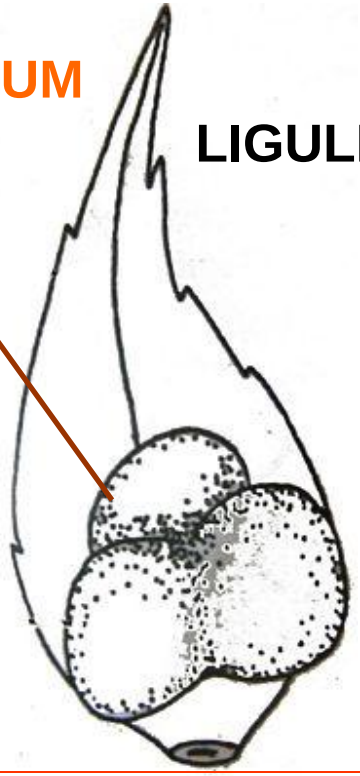
MICROSPORANGIUM

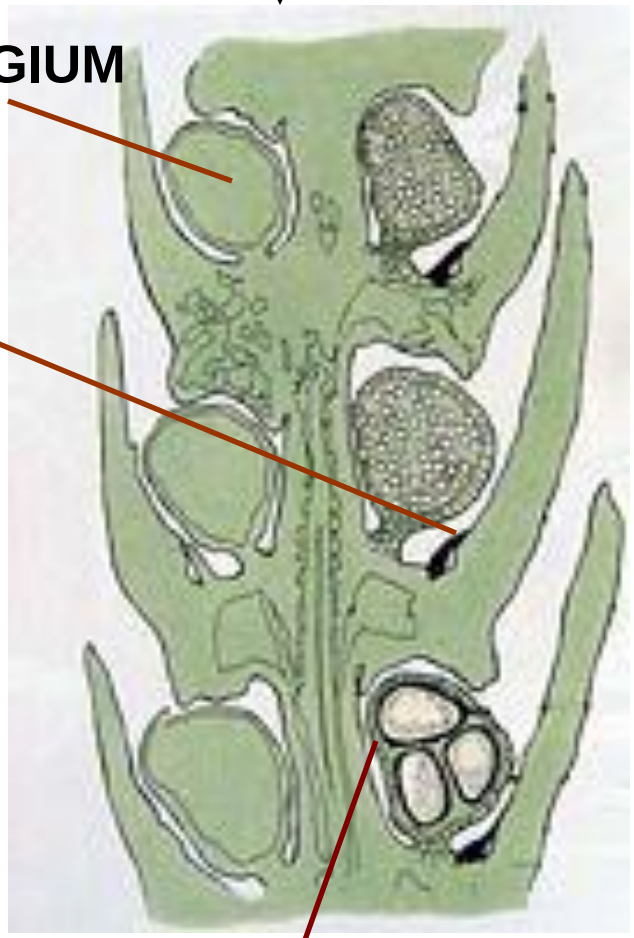
MICROSPORANGIUM

MEGASPORANGIUM

LIGULE







MEGASPORANGIUM

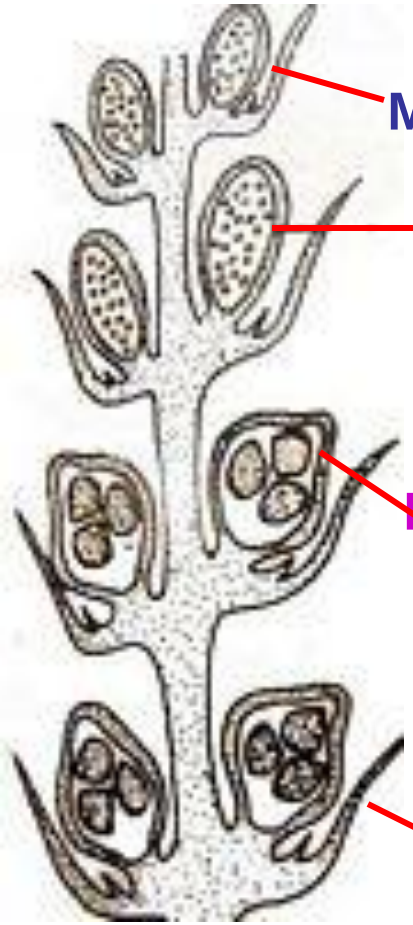
MICROPOROPHYLL

MEGASPOROPHYLL

STROBILUS

FIVE CATEGORIES ON THE BASIS OF DISTRIBUTION OF MICRO- AND MEGASPORANGIA (MICROSPOROPHYLLS AND MEGASPOROPHYLLS) ON THE AXIS (STEM)

CATEGORY-I



Megasporangia on Lower Side and Microsporangia on Upper Side of the Strobilus e.g. *S. chrysocaulos*, *S. selaginoides*

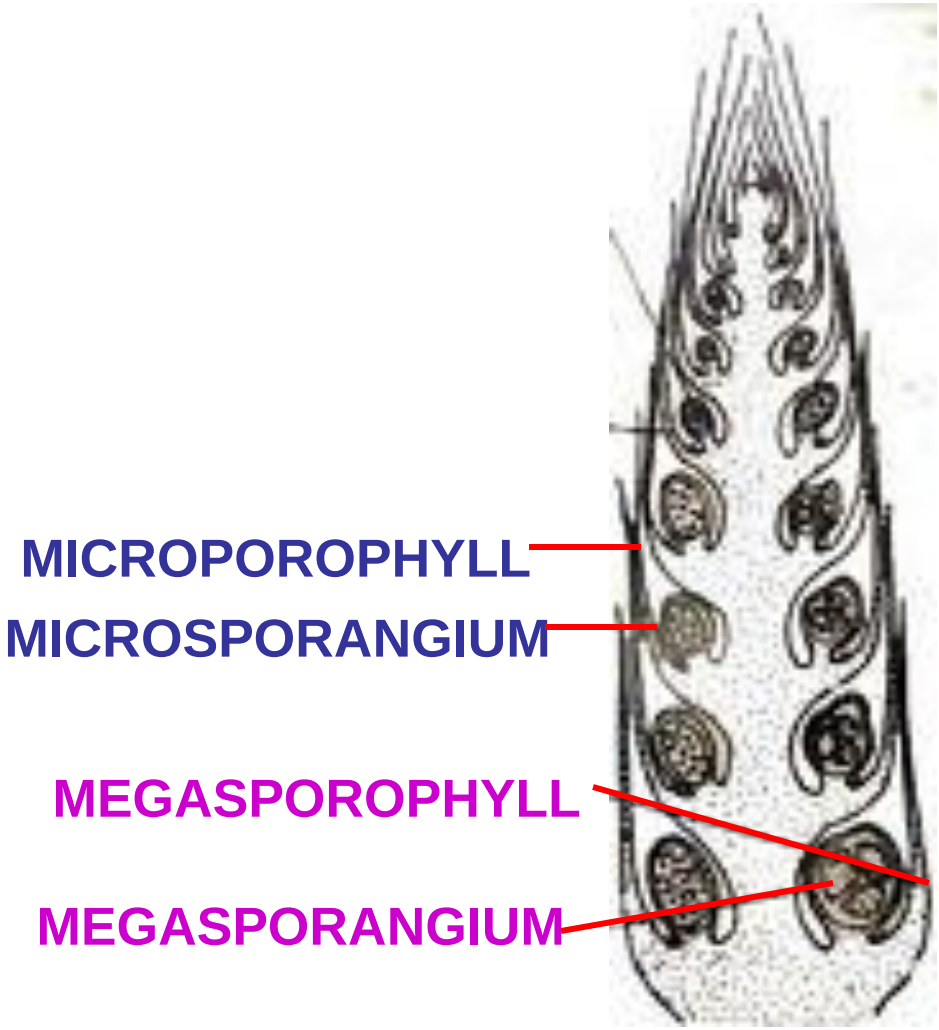
CATEGORY-II

Megasporangia on One Side and Microsporangia on Other Side of the Strobilus e.g.

S. oregana,

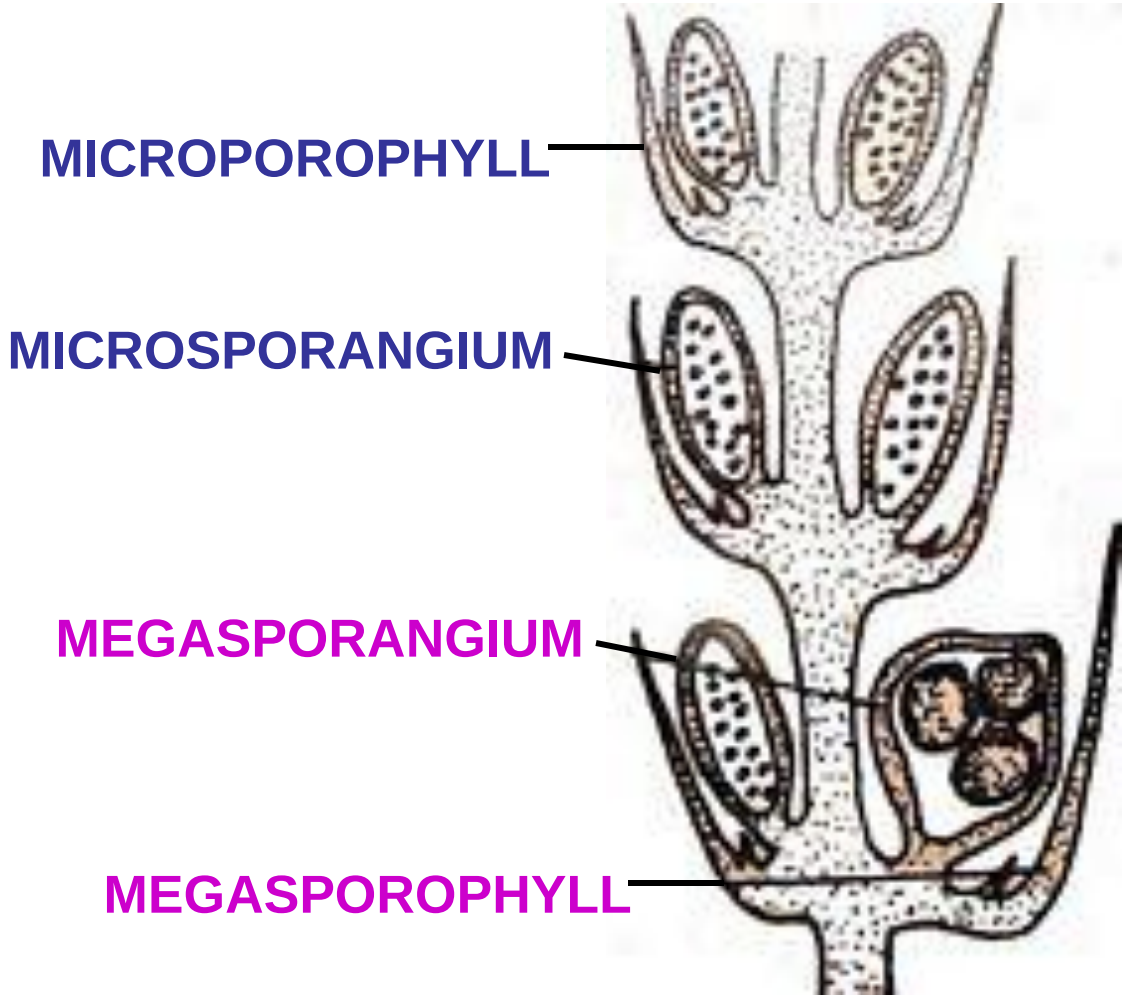
S. inaequalifolia

S.pilifera



CATEGORY-III

Only one Megasporangium at the base and rest all Microsporangia e.g. *S. kraussiana*



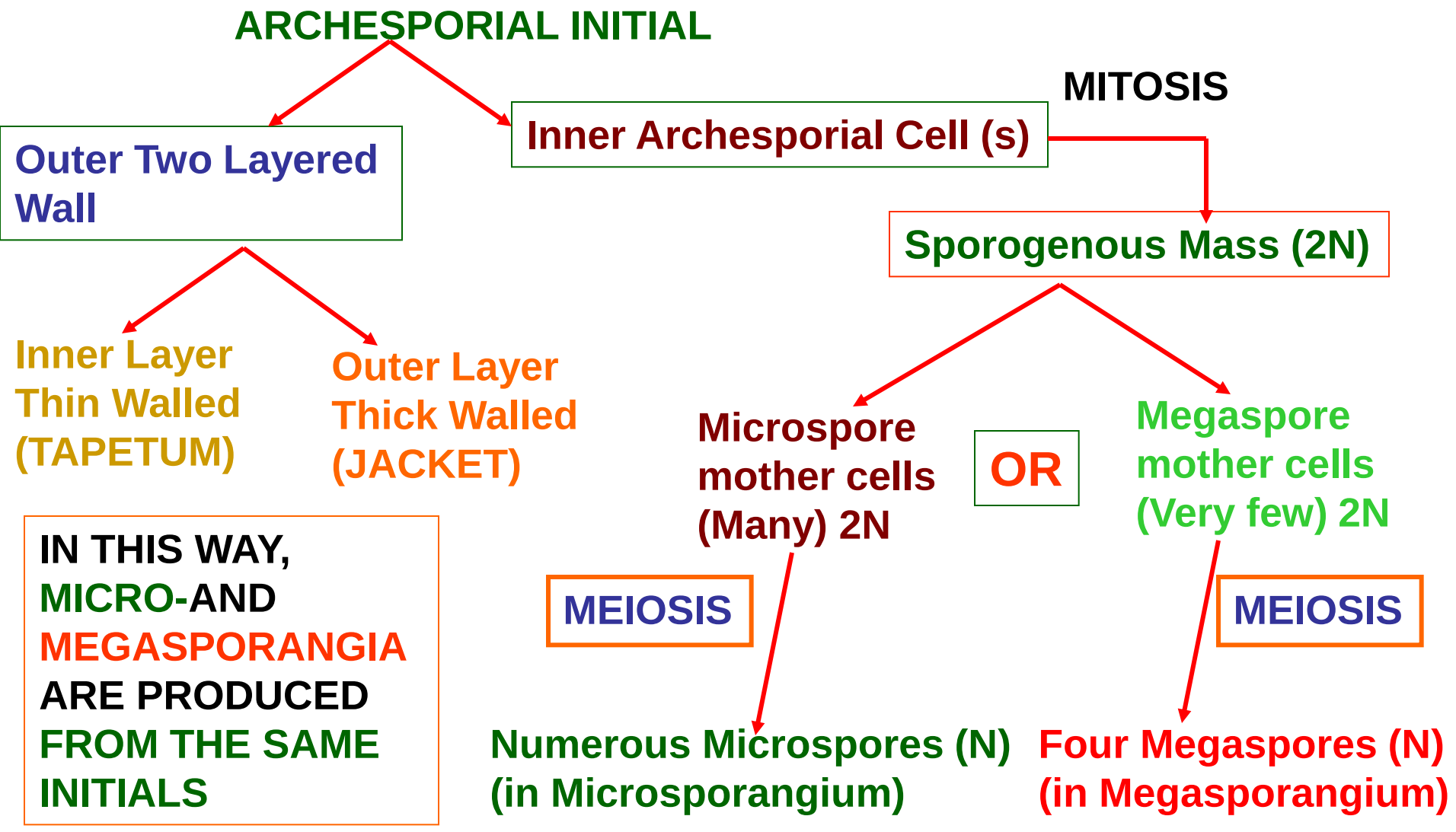
CATEGORY-IV

Microsporangia and Megasporangia irregularly located along entire length of the Strobilus e.g. *S. martensii*

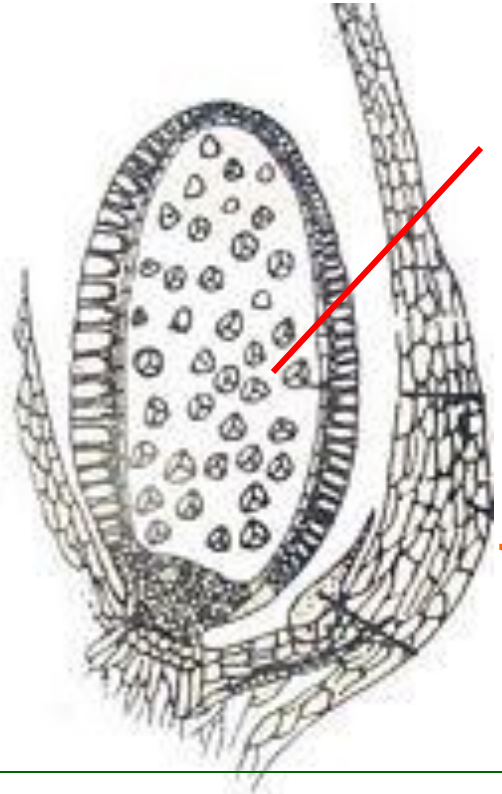
CATEGORY-V

Microsporangia and Megasporangia borne on different Strobili but on the same plant e.g. *S. gracilis*

DEVELOPMENT OF SPORANGIA (MICRO- OR MEGASPORANGIUM)



Microsporangium and Microspore



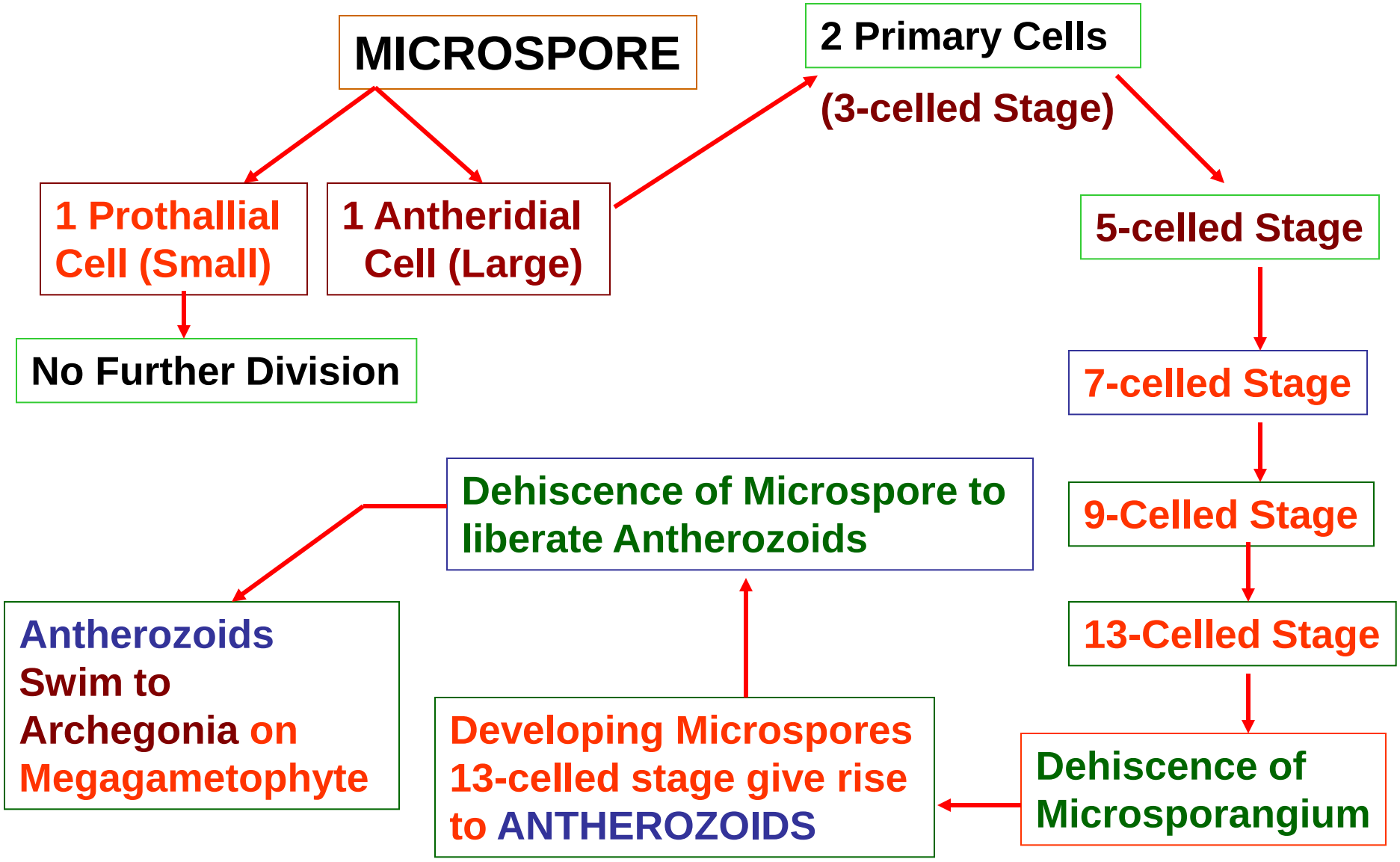
Cavity filled with 600-2000 microspores, dehisce by vertical splitting of apical part of sporangial jacket

Microspores very small, have outer hard exine (exosporium) and inner delicate intine (endosporium)

Microspores, start germinating inside before dehiscence

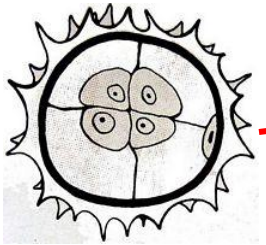
Before being released they reach to 13-celled stage

Microspore to Microgametes
(Dev. of Male Gametophyte)



Microspore to Microgametes
(Dev. of Male Gametophyte)-Contd.

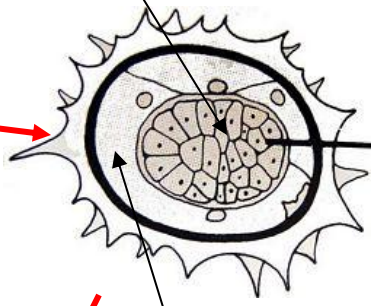
Microspore



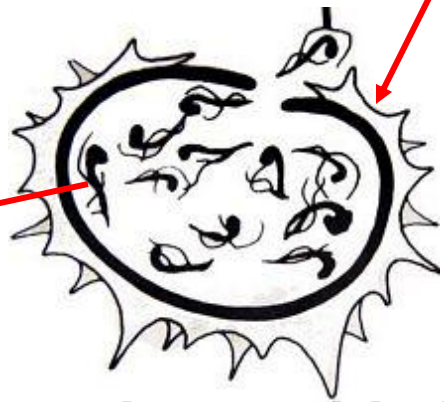
9-Celled Stage

13-Celled Stage

Antherozoid Mother Cells

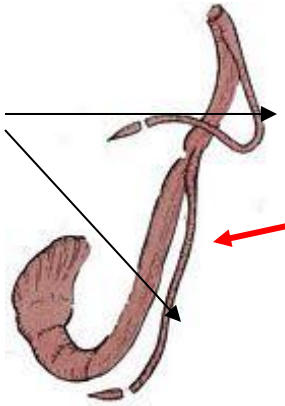


Jacket Cells



Antherozoids in Microgametophyte

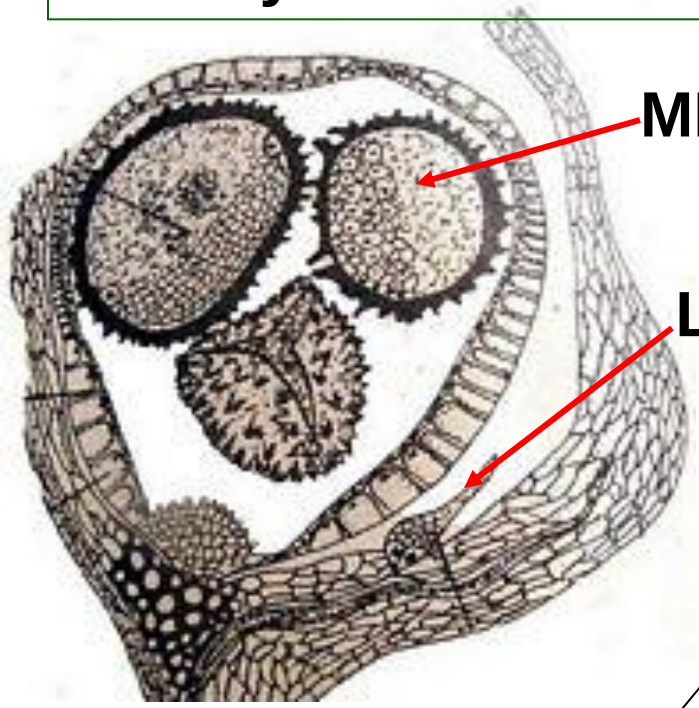
Flagella



Liberated Antherozoids

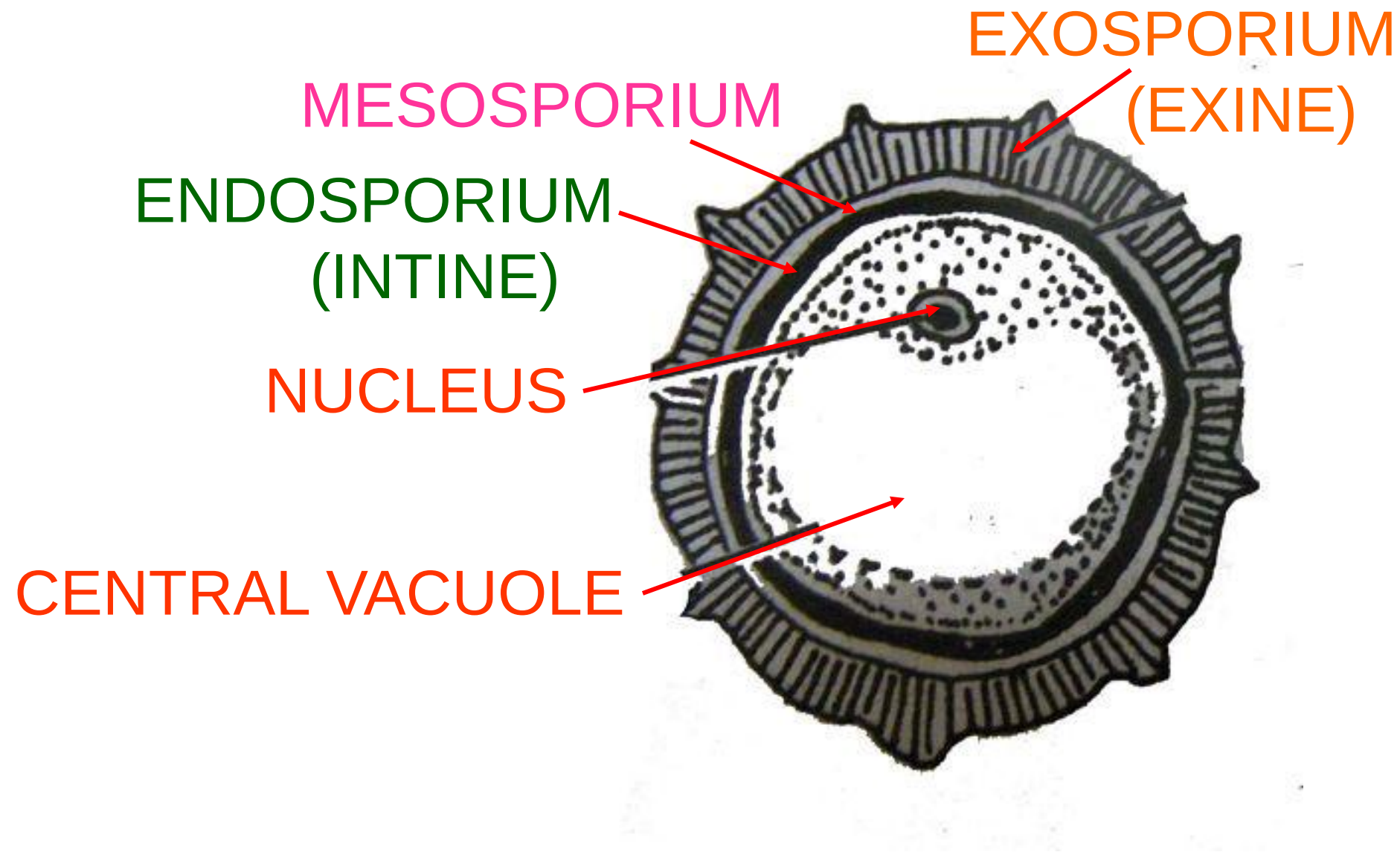
Megaporangium and Megaspore

Each Megasporangium has only 4 Megaspores which fill the cavity entirely.



Megaspores are large and tetrahedral in shape, with a heavy wall- three layers outermost Exosporium, middle Mesosporium and inner Endosporium

MEGASPORE STRUCTURE



Megaspore to Megagametes
(Dev. of Female Gametophyte)

Megagametophyte development starts *in situ* and different species show different stages of development of Megaspore before its release from Megasporangium

Megaspore is shed after 1st Archegonium is formed as in S. kraussiana

Megaspore is retained up to fertilization and even embryo development *S. rupestris, S. apus*

Megagametophyte starts development only after megaspore is liberated from Megasporangium *S. spinulosa, S. helvetica*

Development of Female Gametophyte-I

Megaspore Germinates inside the Megasporangium.

In due course, the apical layers form a dome shaped cushion near the apex which is three-celled thick near middle, only single cell thick towards margins.

Development of Female Gametophyte-iii

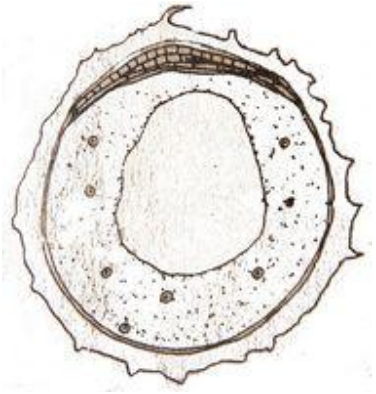
This cushion is known as Diaphragm, with cellular part above this, known as "Generative Region"

The part below this diaphragm is not cellular in the beginning, known as "Nutritive Region", later becoming cellular.

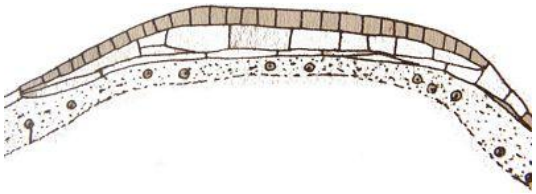
Rhizoids are produced in Generative Region for water absorption.

Archegonia develop from many superficial cells in this region.

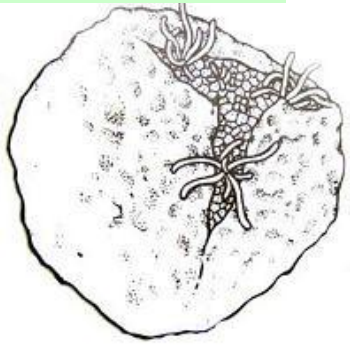
Development of Female Gametophyte-iv



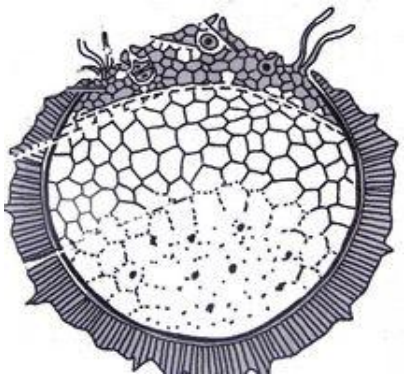
GERMINATING MEGASPORE



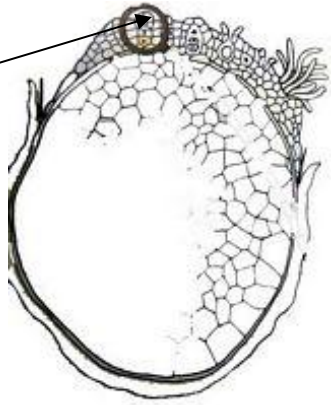
DIAPHRAGM ENLARGED



RHIZOIDS APPEARING



ARCHEGONIA DEVELOPING



DEVELOPED ARCHEGONIUM

DEVELOPMENT OF ARCHEGONIA

Any Superficial cell of Generative Region acts as Archegonial initial

Periclinal Division

Central Cell

Periclinal Division

Primary Canal Cell

Primary Ventral Cell

No Division

Ventral Canal Cell

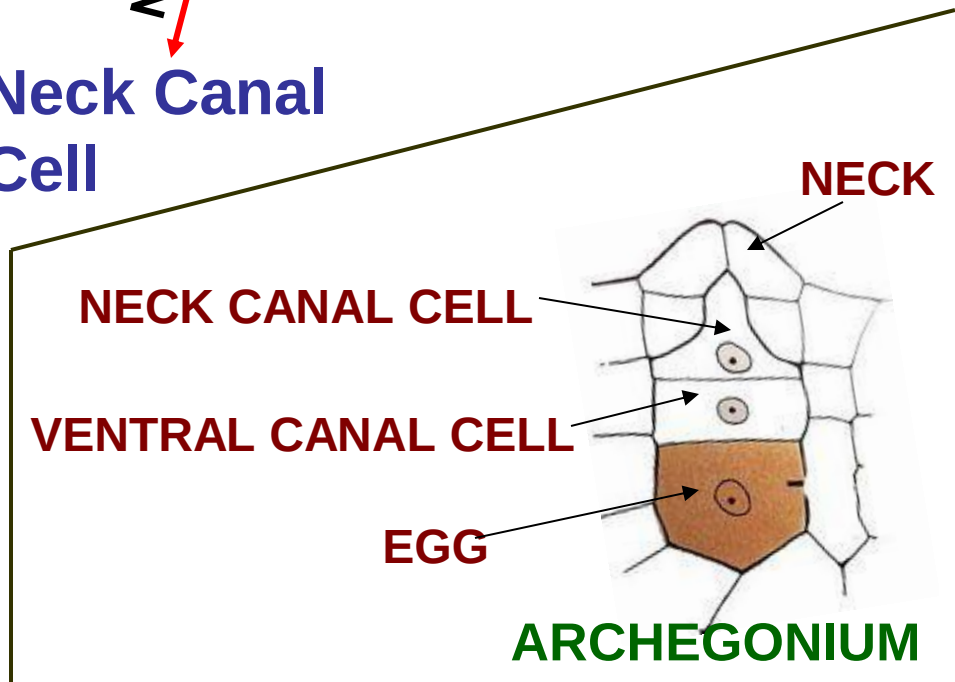
Egg

Neck Canal Cell

Primary Cover Cell

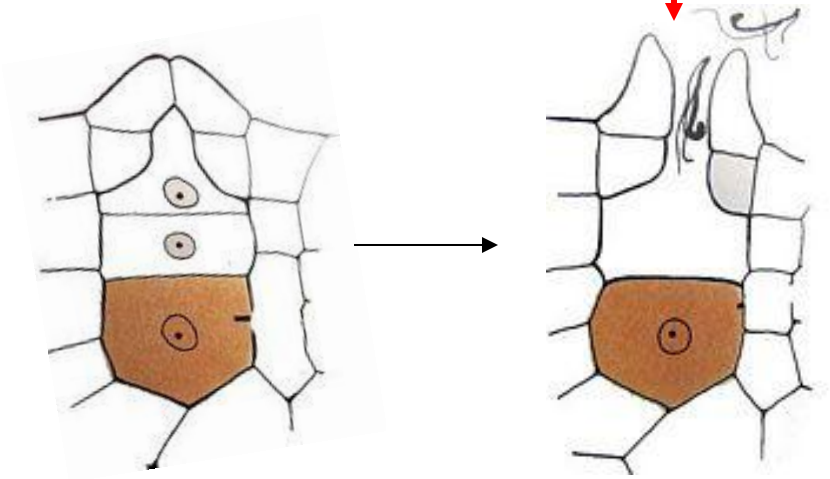
4 Neck Initials

8-celled Neck (2 tiers of 4 cells each)



FERTILIZATION

After maturity, Neck Canal Cells and Ventral Canal Cells disintegrate, neck spreads apart so that Antherozoids may enter the Egg

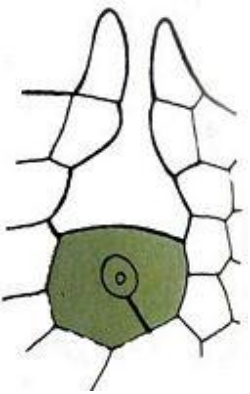


Mature Archegonium

Spermatozoid reaching the egg Neck Opens

The remarkable feature is that fertilization and even embryo development in some species occurs while Megagametophyte is still within Megasporangium, attached to the strobilus i.e. old Sporophyte

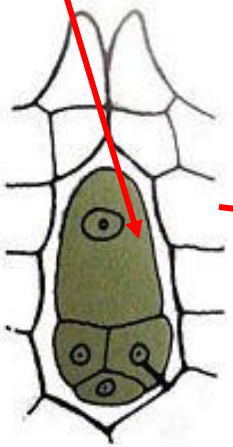
POST-FERTILIZATION DEVELOPMENT



Fertilized Archegonium (ZYGOTE) 2N

2-Celled Embryo

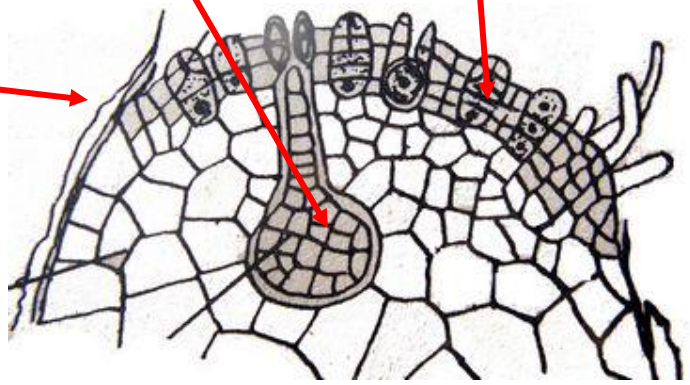
Suspensor



4-Celled Embryo

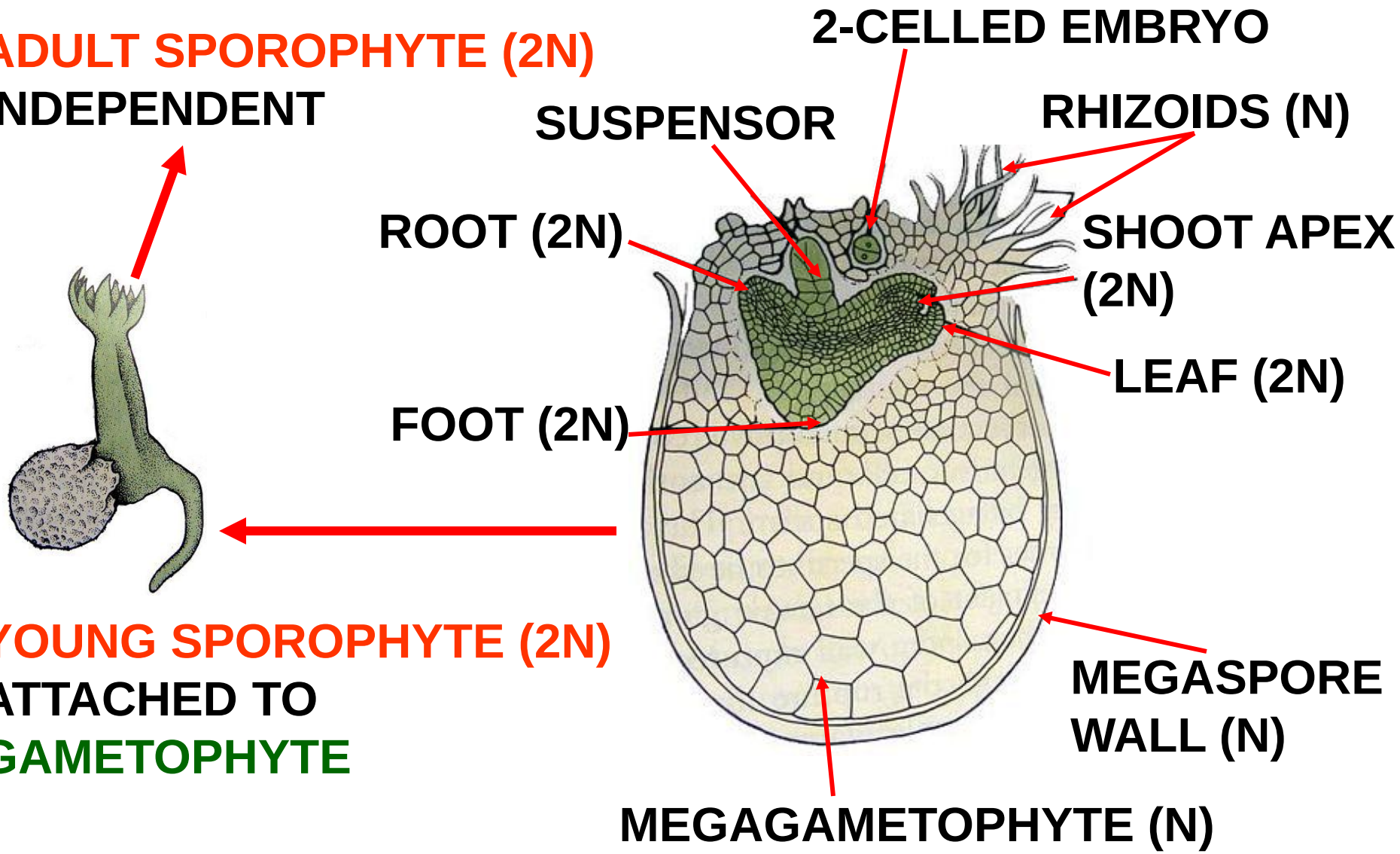
Advanced Embryo

Developing Archegonia

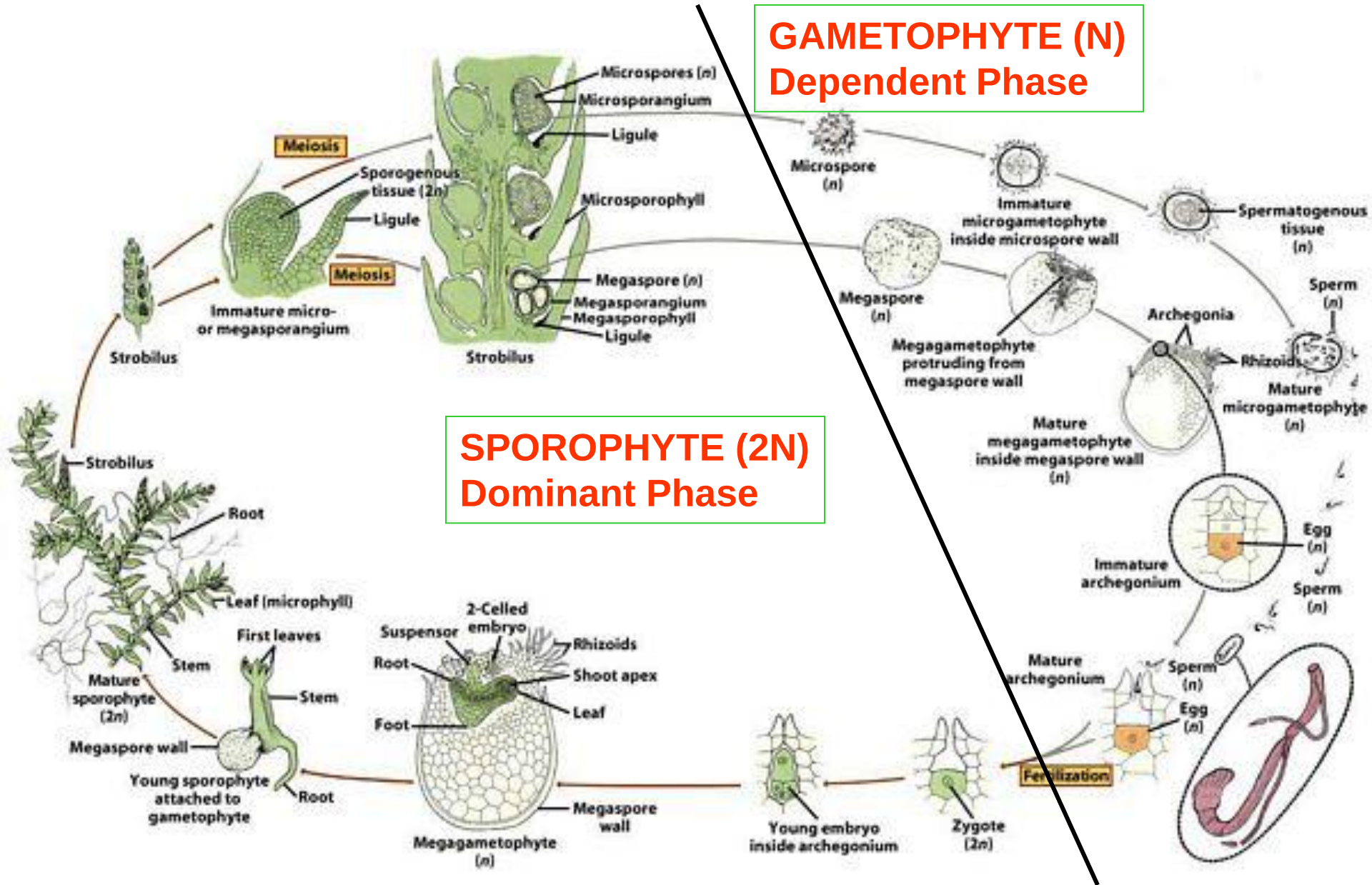


Megagametophyte with Advanced Stage of Embryo And Still Developing Archegonia

EMBRYO DEVELOPMENT- FINAL STAGES



PICTORIAL LIFE-CYCLE




Thank You