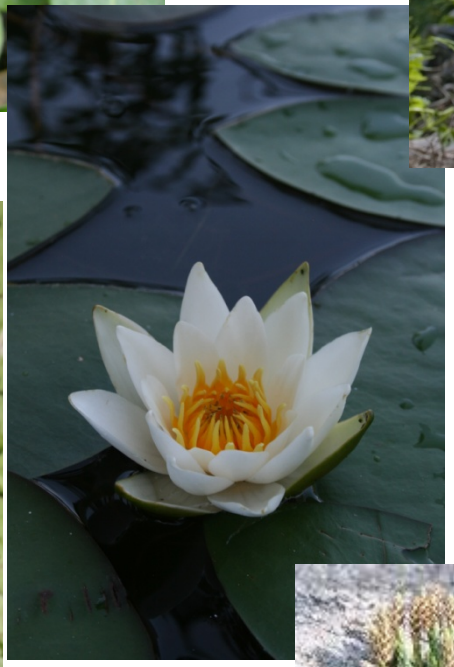
Higher plants (Embryophyta)

Higher spore plants



- Higher plants include all leafy plants which reproduce by spores or seeds. Most of them are terrestrial. The origin of higher plants is related to the entry into the land.
- Embryophytes are primarily adapted for life on land, although some are secondarily aquatic.
- It is believed that the ancestors of higher plants were green water plants of fresh or brackish-water bodies of water.

Peculiarities of air (terrestrial) habitat

- Parts of a plant are in two different environments (air and soil), which led to differentiation into two systems of organs - underground and above-ground with fundamentally different functions.

- In the air environment, unlike in the water environment, protection from moisture loss and appropriate adaptations are necessary.

- Transpiration, the most important mechanism of metabolism (water and gases), becomes possible and necessary in air environment; it allows the transfer of substances within a plant (upward flow).

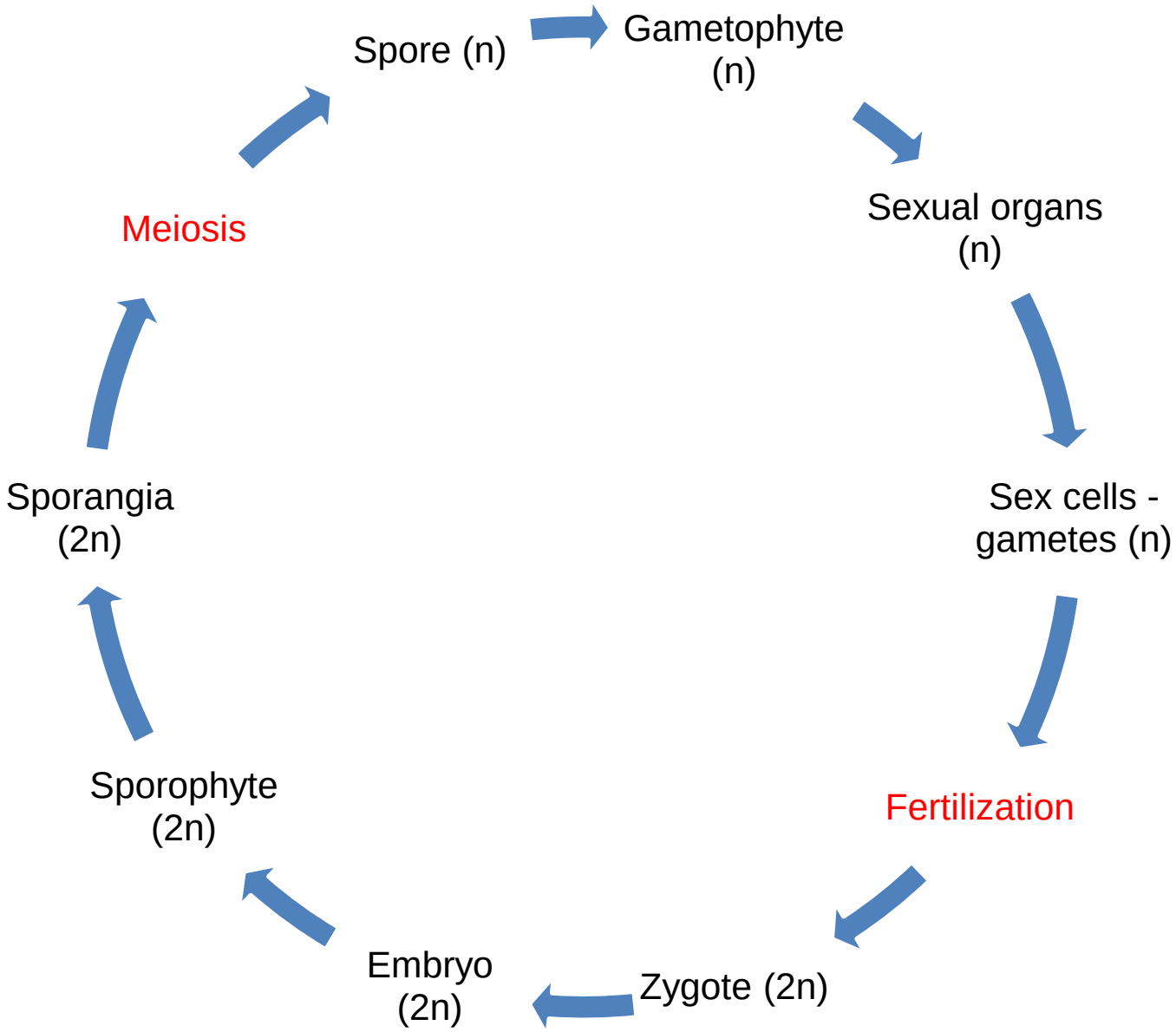
- Gravity is not compensated by Archimedes' force and the development of mechanical tissues becomes necessary.

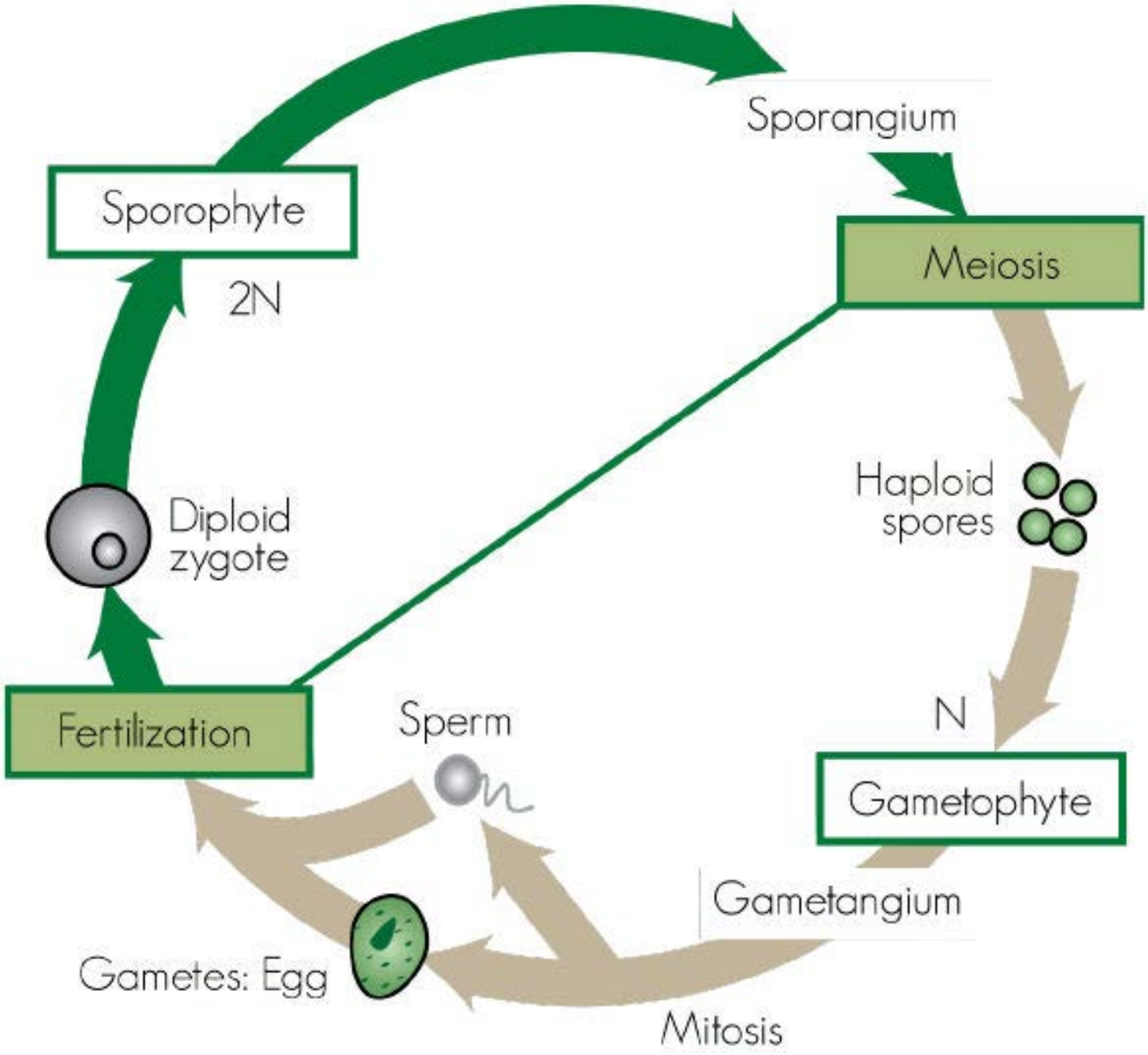
- The sexual process still requires water, and it requires the development of various adaptations, which further led to the formation of the flower.

Adaptations that emerged in higher plants in relation to their entry into the land:

- Tissue systems appear: covers, conductive, mechanical...
- Organs appear with different functions: root (or rhizoids), stem, leaf.
- Spore receptacles become multicellular.
- The reproductive organs also become multicellular. And protected by layers of sterile cells.

Life cycle of higher plants

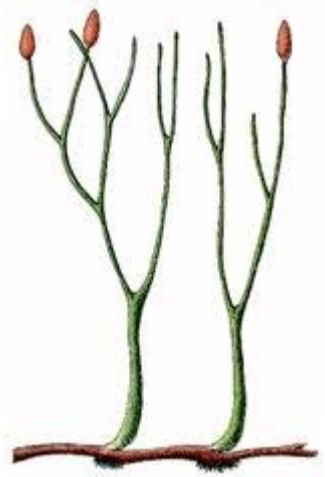


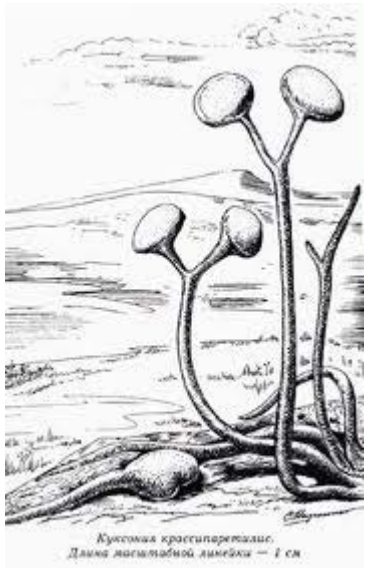

Sporangium
Sporophyte
Meiosis
2N
Haploid
spores
Diploid
zygote
N
Fertilization
Sperm
Gametophyte
Gametangium
Gametes: Egg
Mitosis

Higher plants - Embryophyta

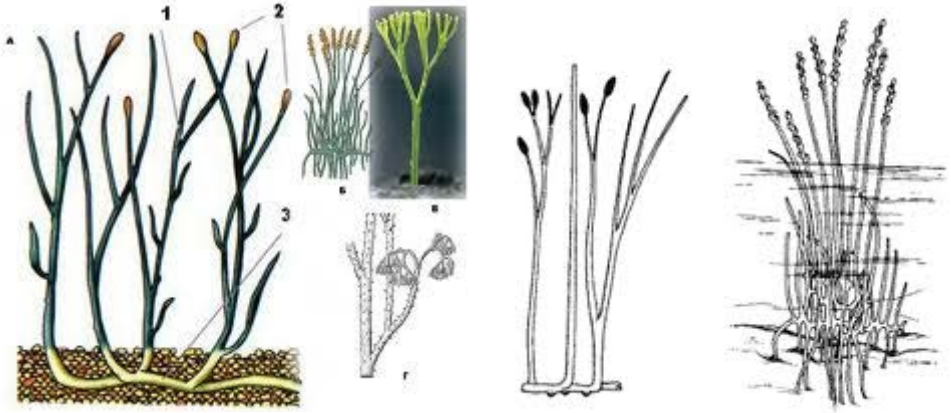
- **Rhinophytes – Rhyniopyta**
- **Bryophytes - Bryophyta**
- **Lycopods - Lycopodiophyta**
- **Horsetails - Equisetophyta**
- **Ferns - Polypodiophyta**
- **Gymnosperms - Pinophyta**
- **Angiosperms (flowering) - Magnoliophyta.**

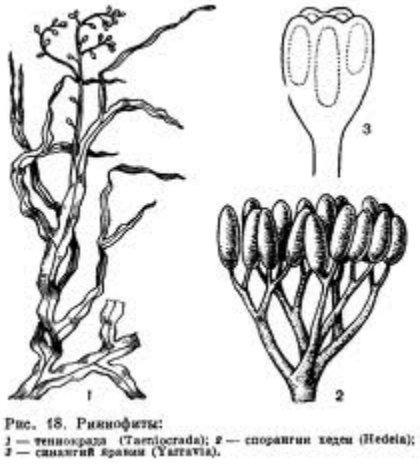
Rhinophytes - ***Rhyniophyta***





This is what the first plant communities looked like





Divisio Mosses – ***Bryophyta***

Печеночники

Листостебельные мхи

Антоцеротовые

The main feature of mosses is the predominance of the haploid stage, the gametophyte, in the development cycle

Class Marchantiopsida or Hepaticopsida)

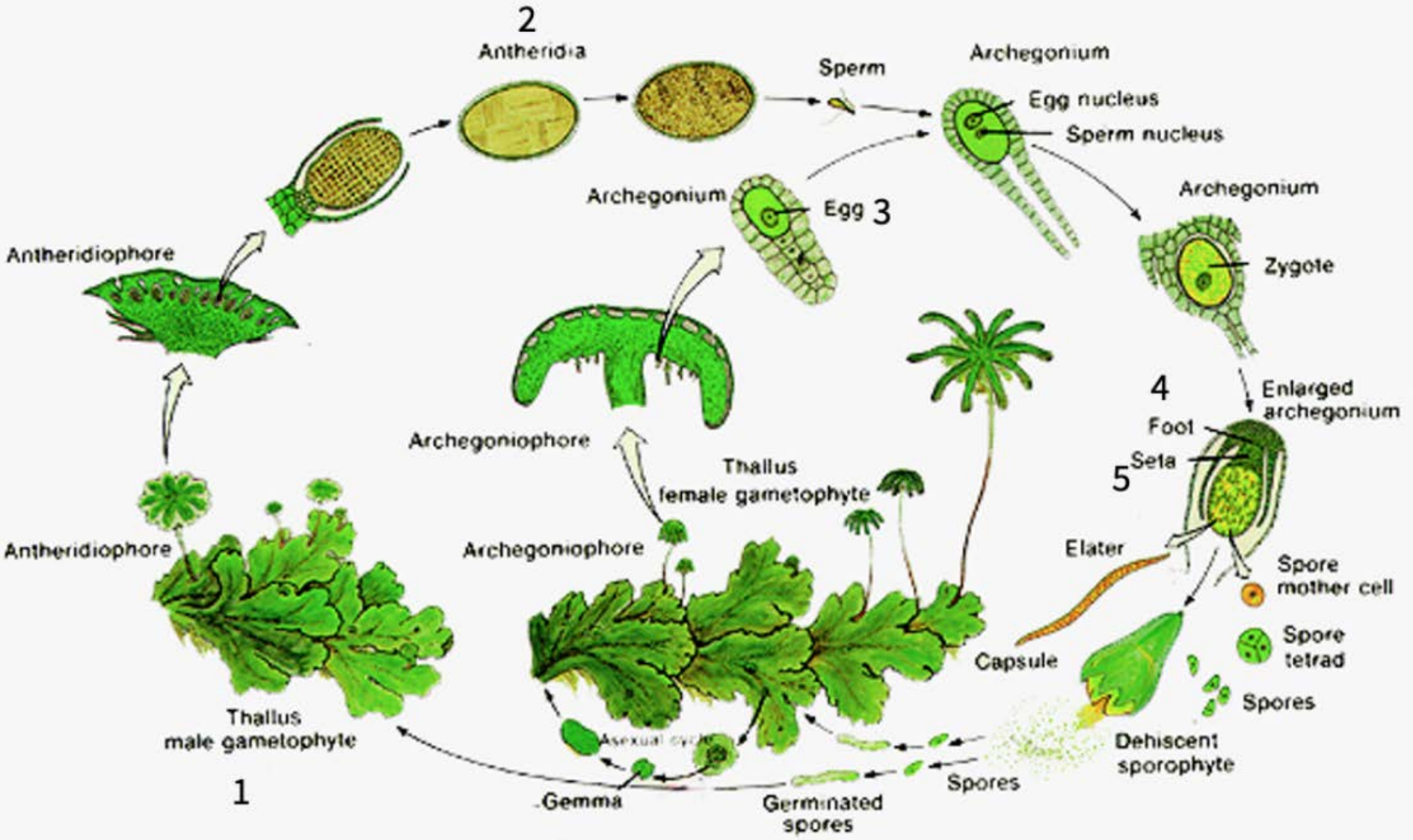
The thallus

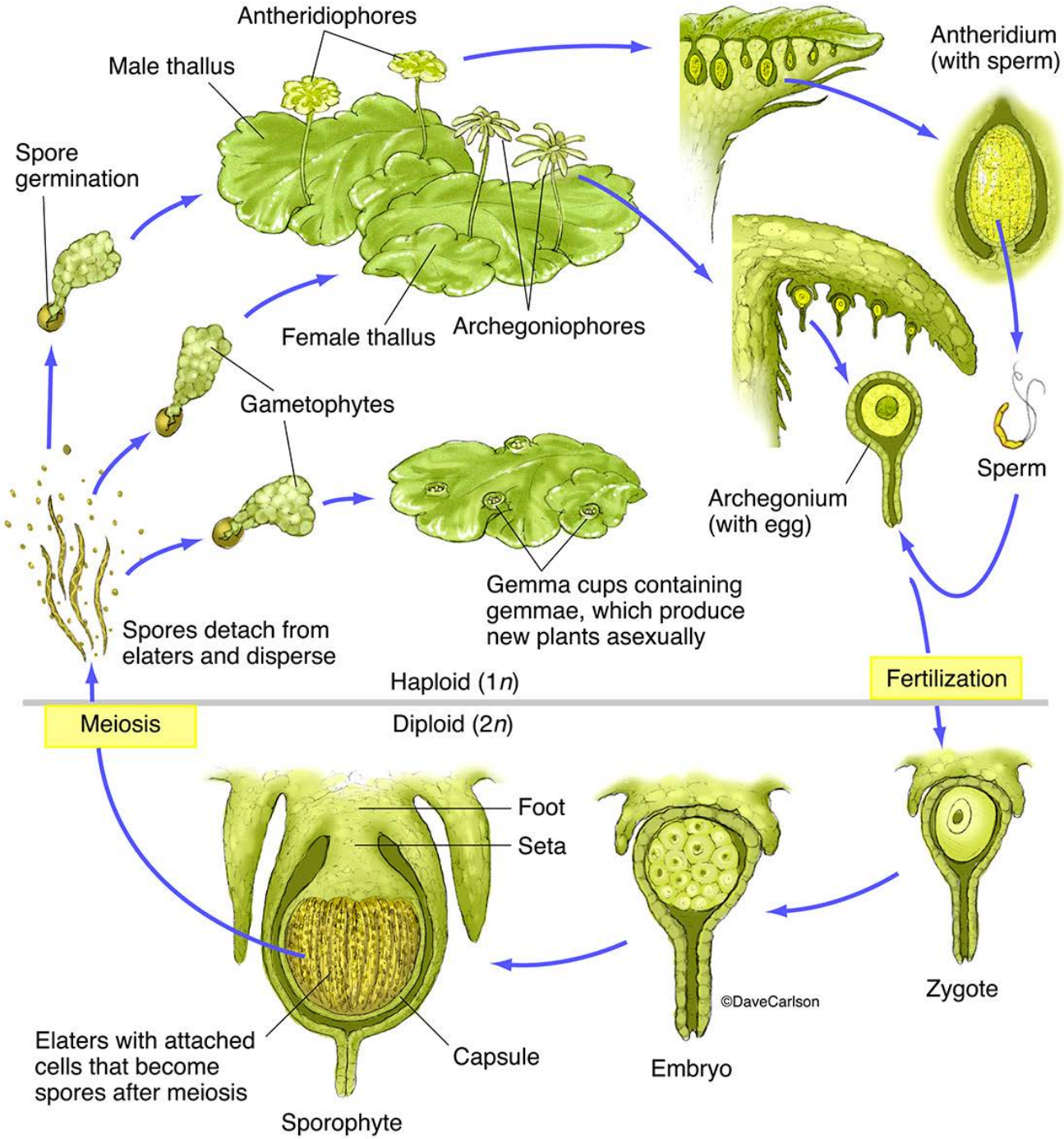
Gemma cups

Male gametangiophores

Female gametangiophores

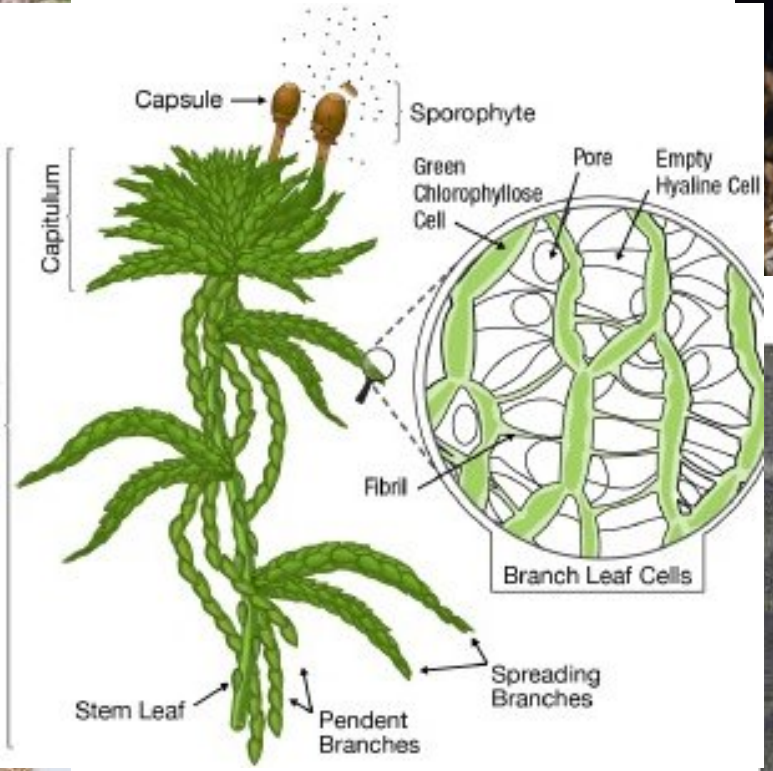
Marchantia Life Cycle




Antheridiophores
Male thallus
Antheridium
(with sperm)
Spore
germination
Female thallus
Archegoniophores
Gametophytes
Archegonium
(with egg)
Sperm
Gemma cups containing
gemmae, which produce
new plants asexually
Spores detach from
elaters and disperse
Haploid (1n)
Fertilization
Meiosis
Diploid (2n)
Foot
Seta
Zygote
©DaveCarlson
Embryo
Elaters with attached
cells that become
spores after meiosis
Capsule
Sporophyte

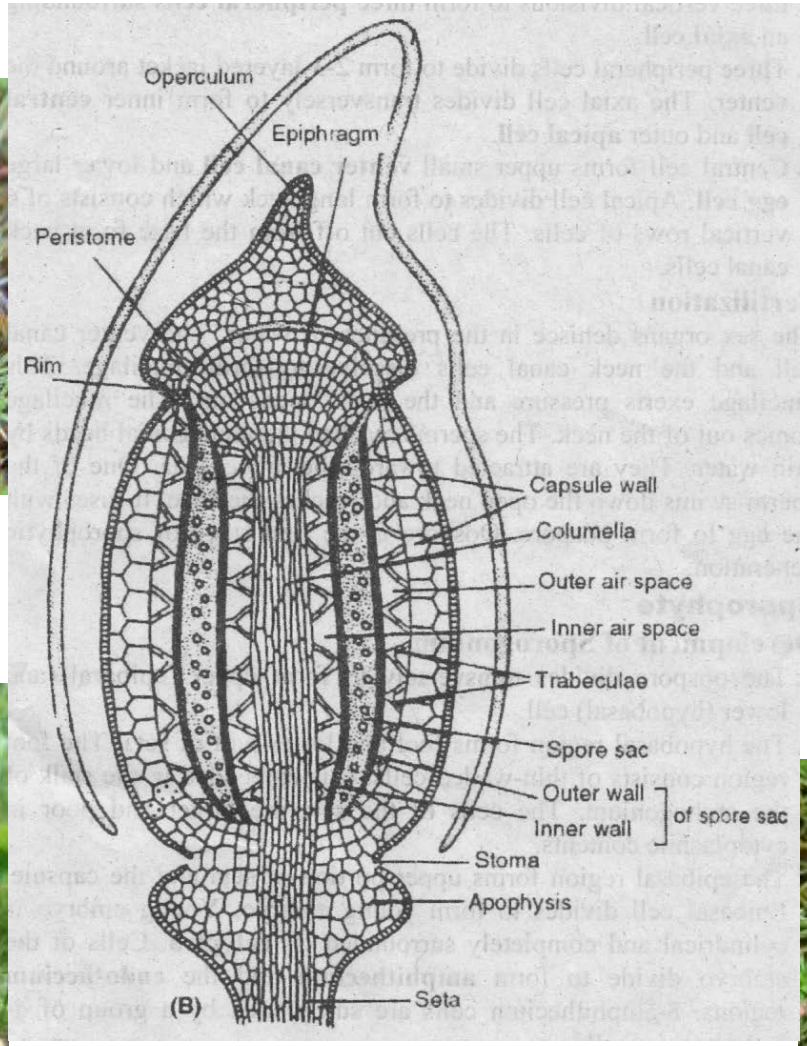
Classis True mosses - ***Bryopsida***

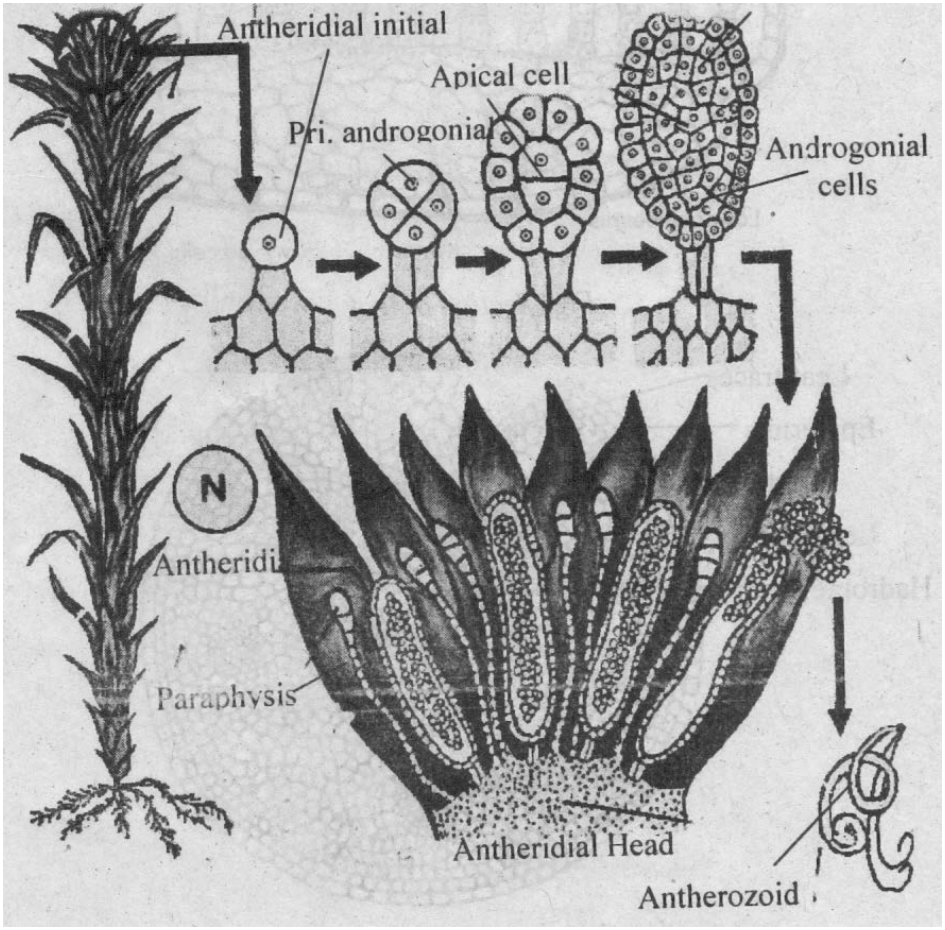
Subclass *Sphagnidae*



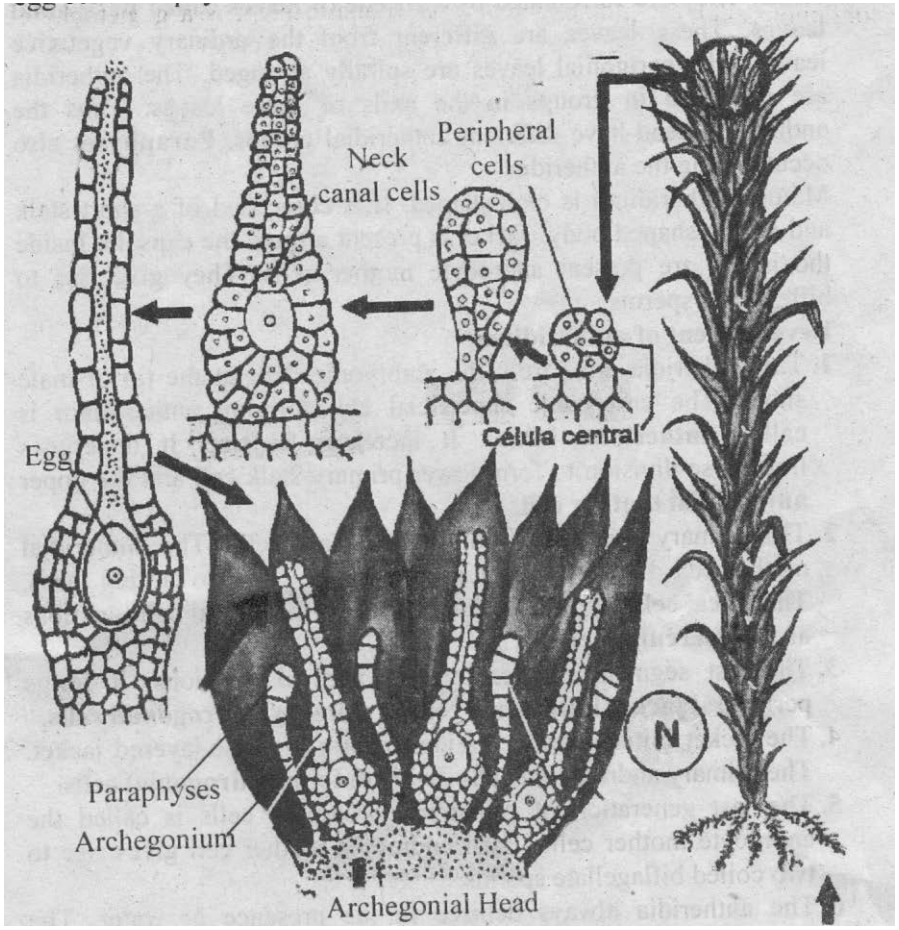
Subclass *Bryidae*

Кукушкин лен



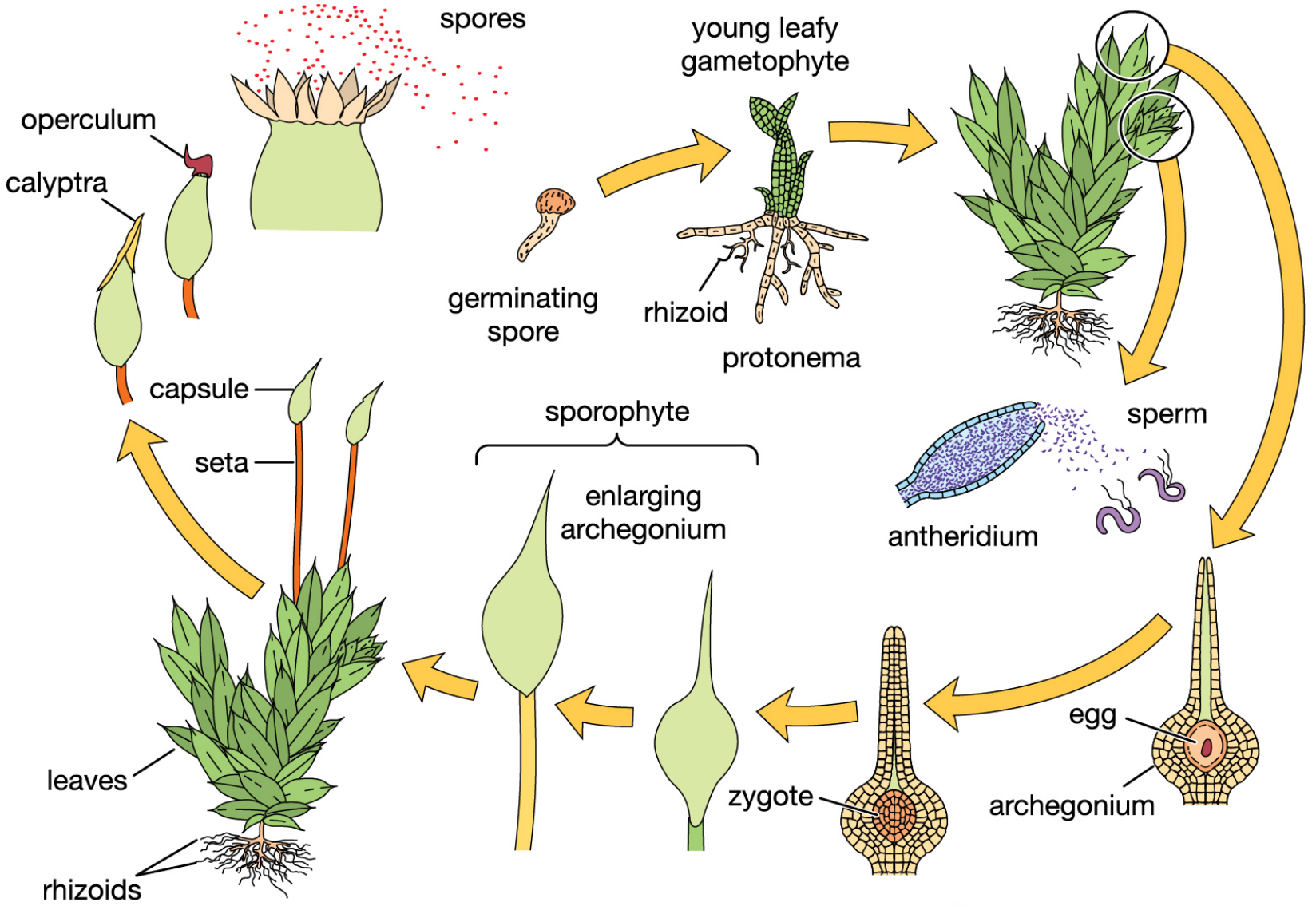


Male reproductive organs

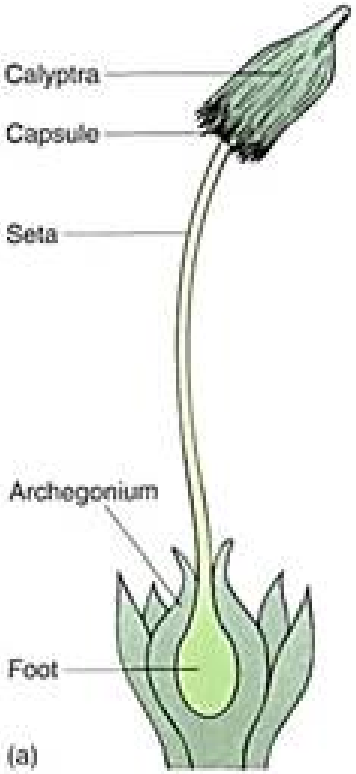


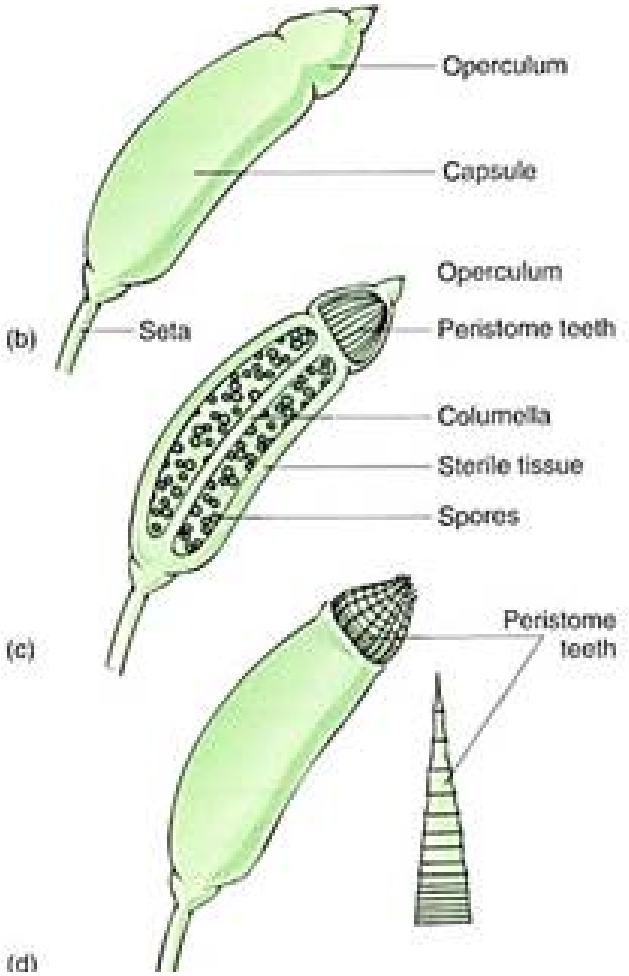
Female reproductive organs

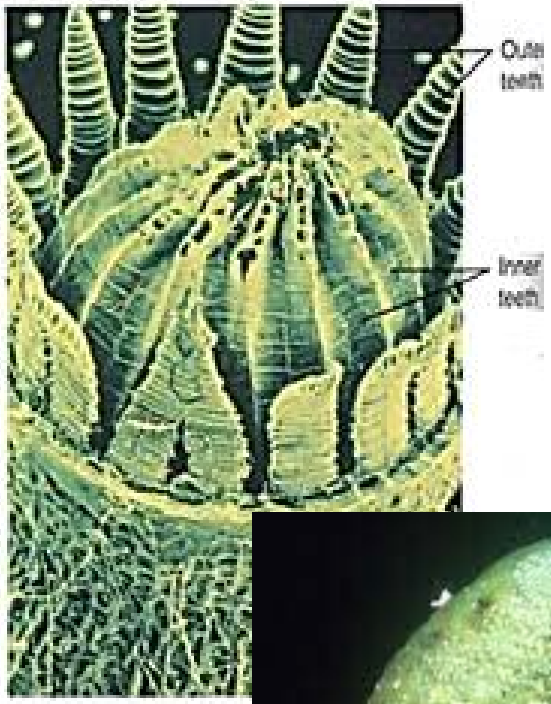
The life cycle of mosses by the example of cuckoo flax



https://www.youtube.com/watch?v=2kY7uzeYWFc


Calyptra
Capsule
Seta
Archegonium
Foot
(a)


Operculum
Capsule
(b)
Seta
Operculum
Peristome teeth
Columella
Sterile tissue
Spores
(c)
Peristome teeth
(d)


Outer teeth
Inner teeth
(e)

Habitats with mosses

Divisio - LYCOPODIOPHYTA

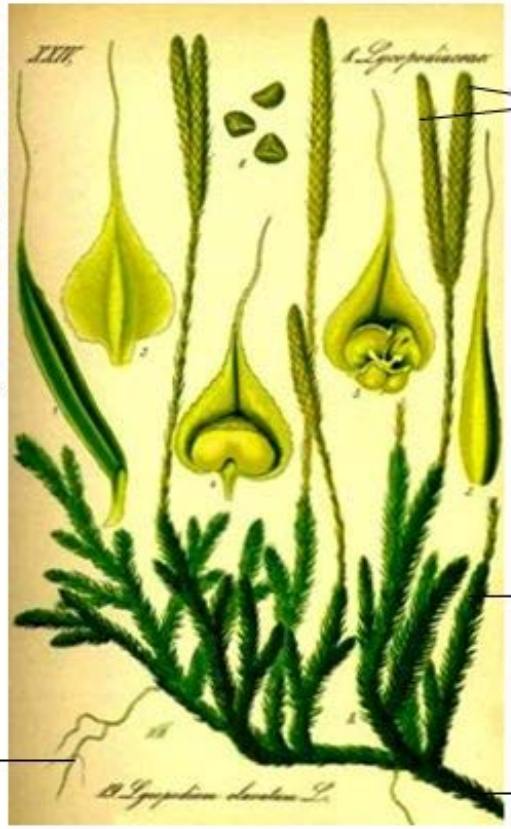
Phylum Lycopodiophyta

Genus *Lycopodium*

What is the name of the leaves on this plants?

Microphylls

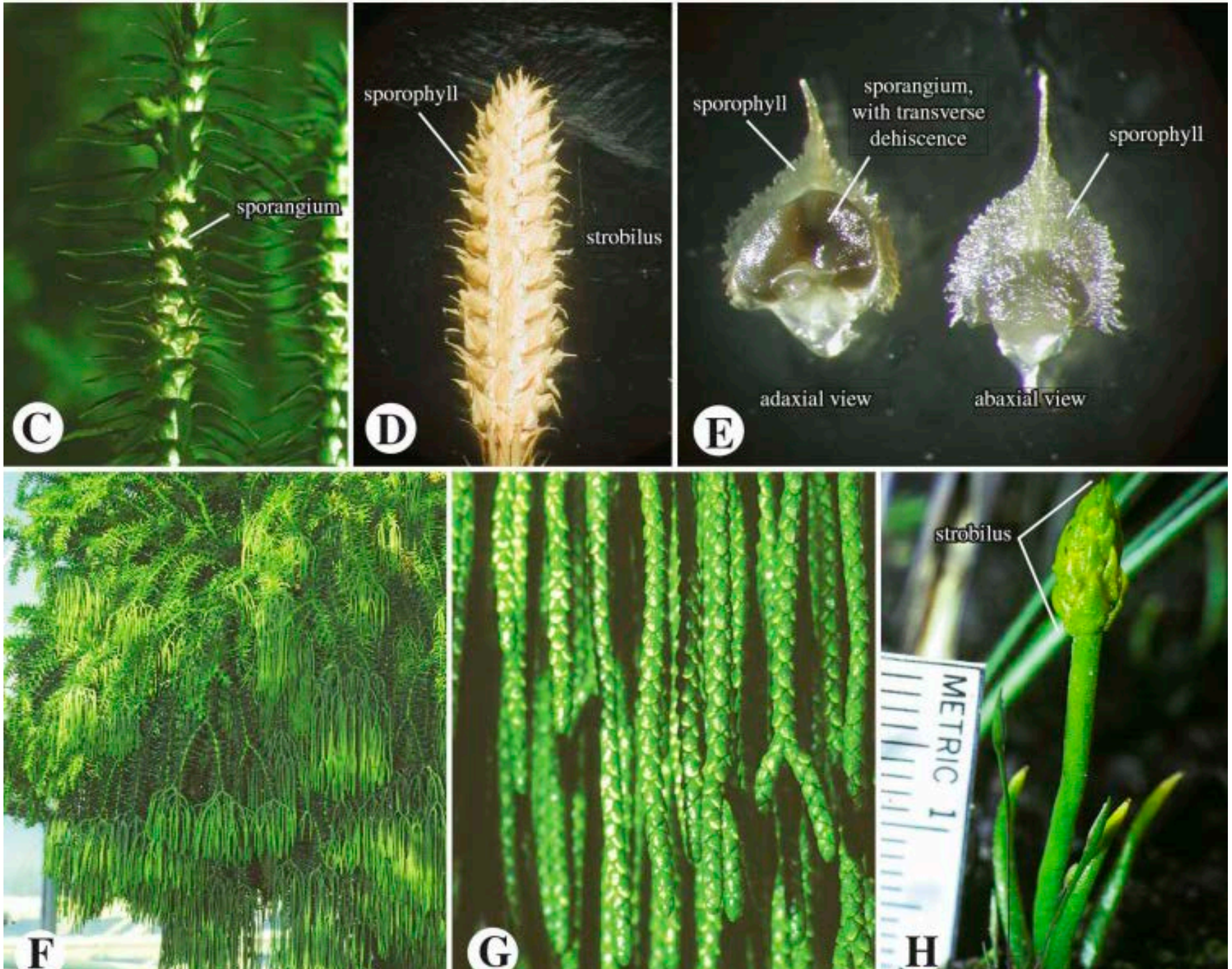
Label in the picture below.

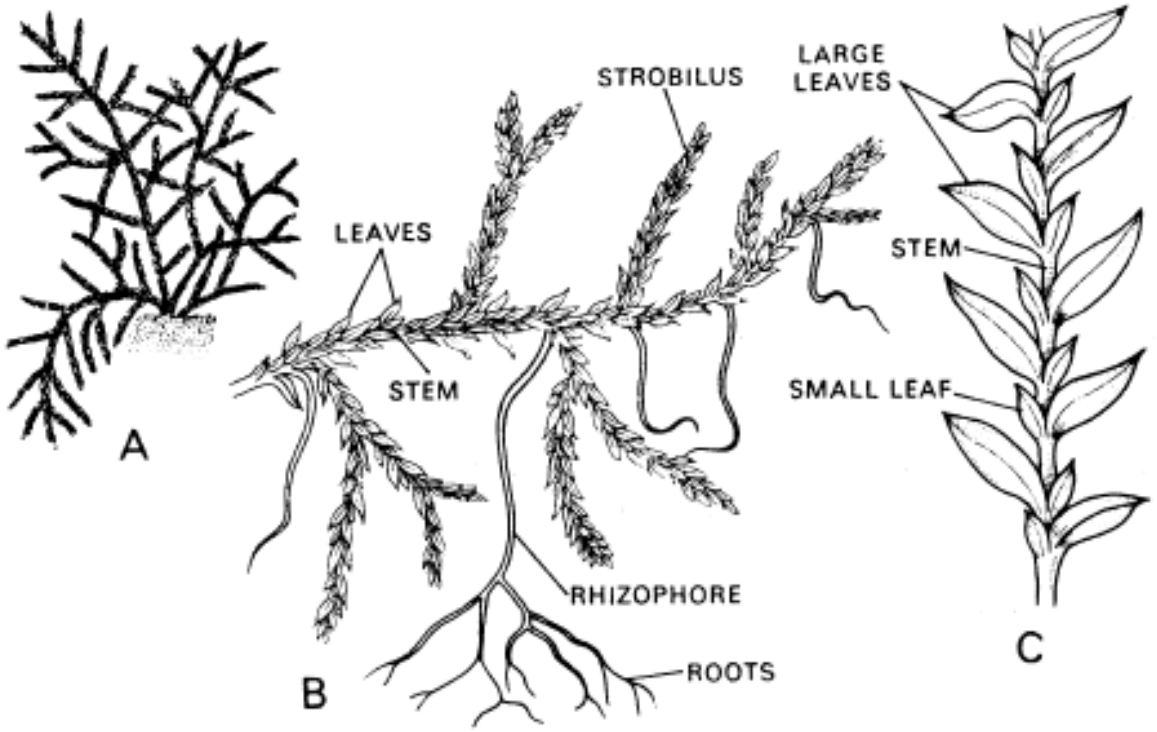


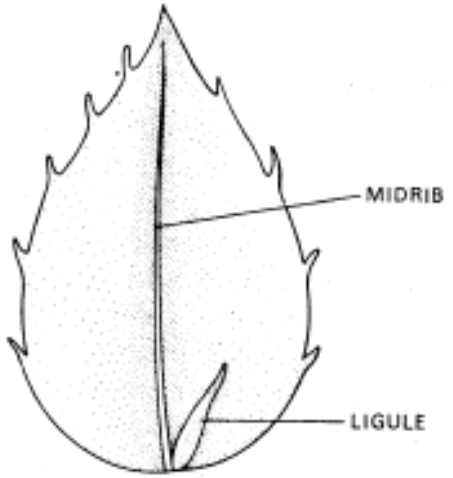
A) Strobili
B) Microphylls
C) Rhizome
D) Roots

In A),B),C)&D) Which structure is photosynthetic?

Microphylls


sporangium
C
sporophyll
strobilus
D
sporophyll
sporangium, with transverse dehiscence
sporophyll
adaxial view
abaxial view
E
F
G
strobilus
METRIC 1
H

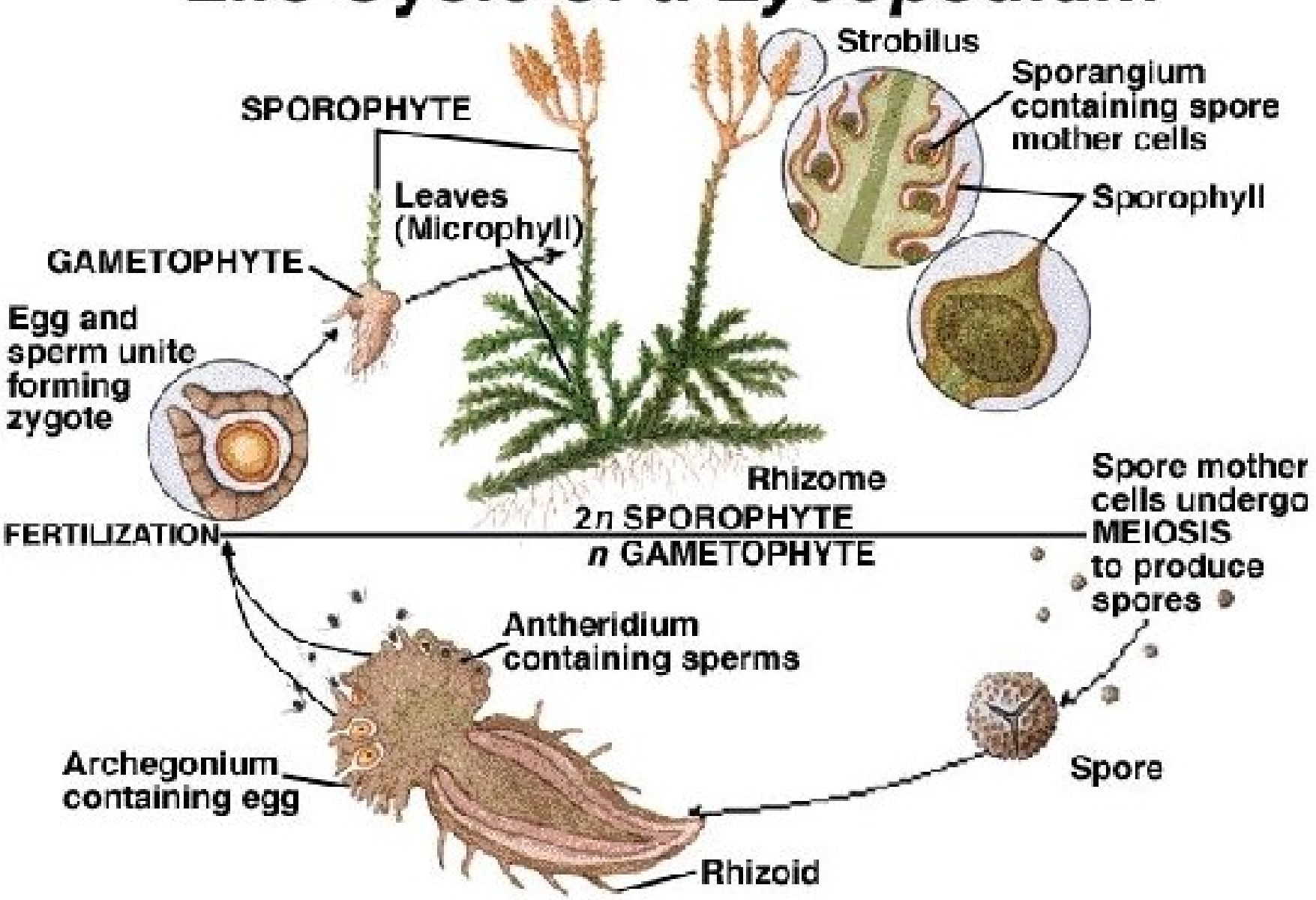




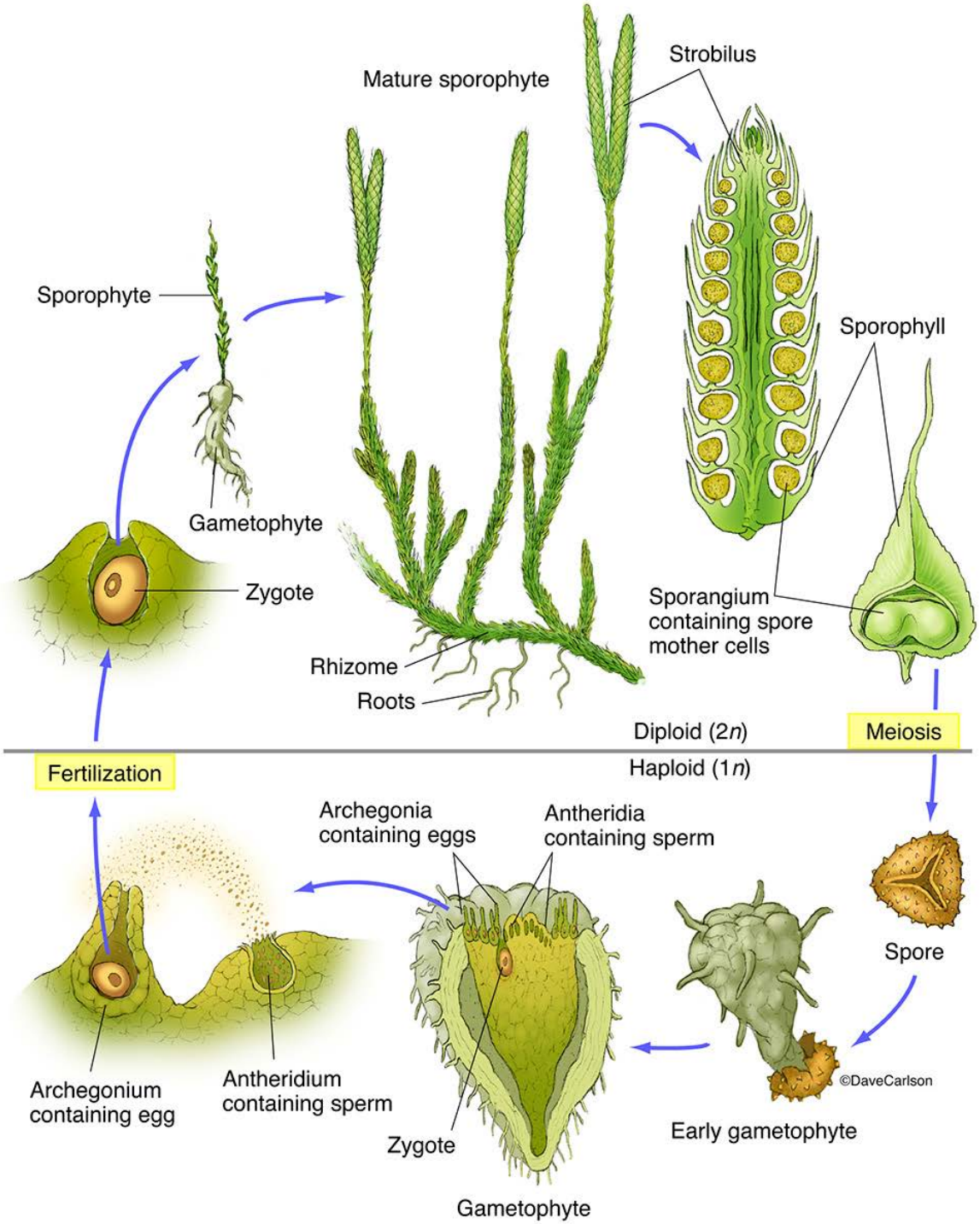
Selaginella—**Adaxial sur-**

Lycopodium clavatum

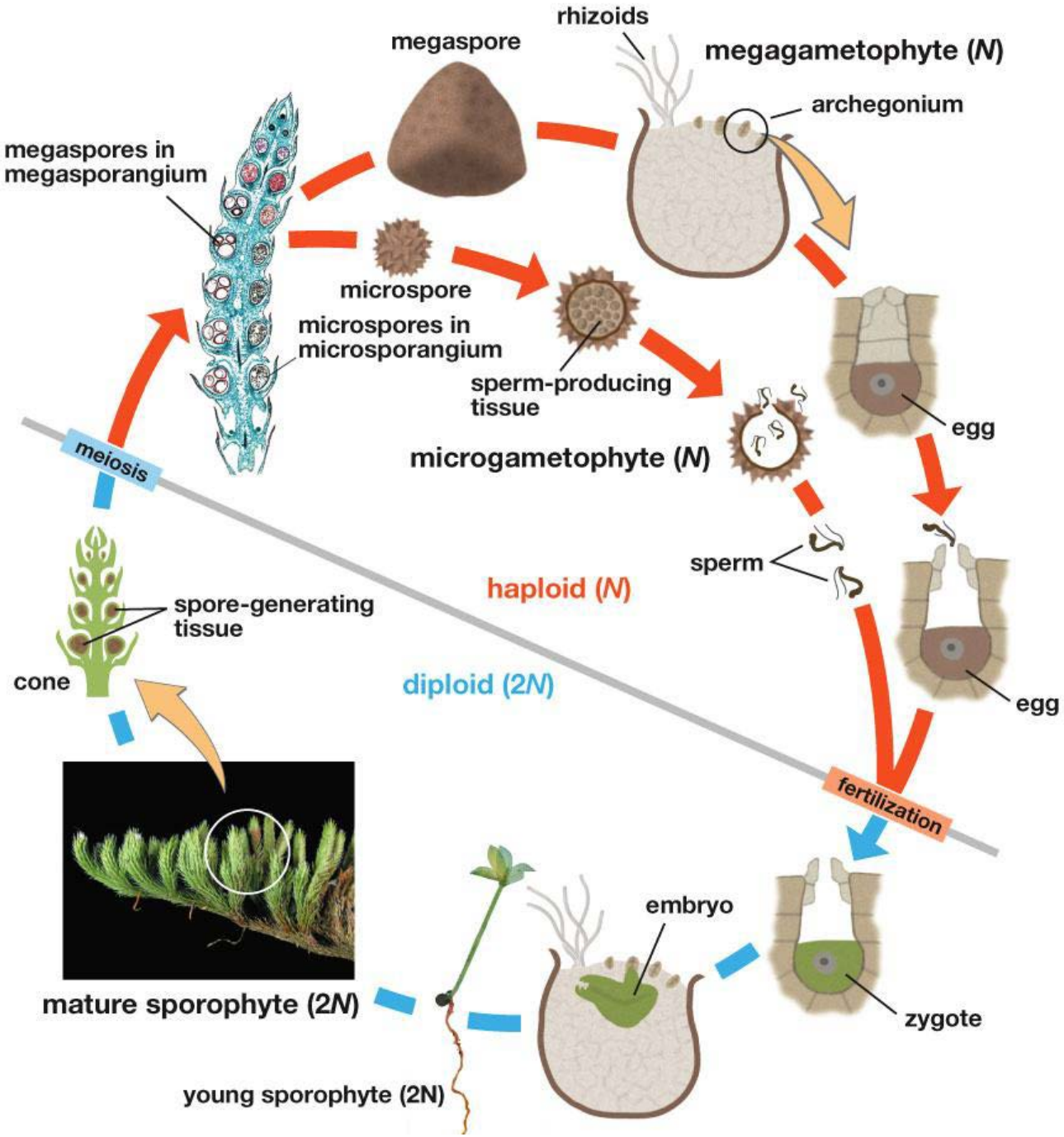
Life Cycle of a *Lycopodium*



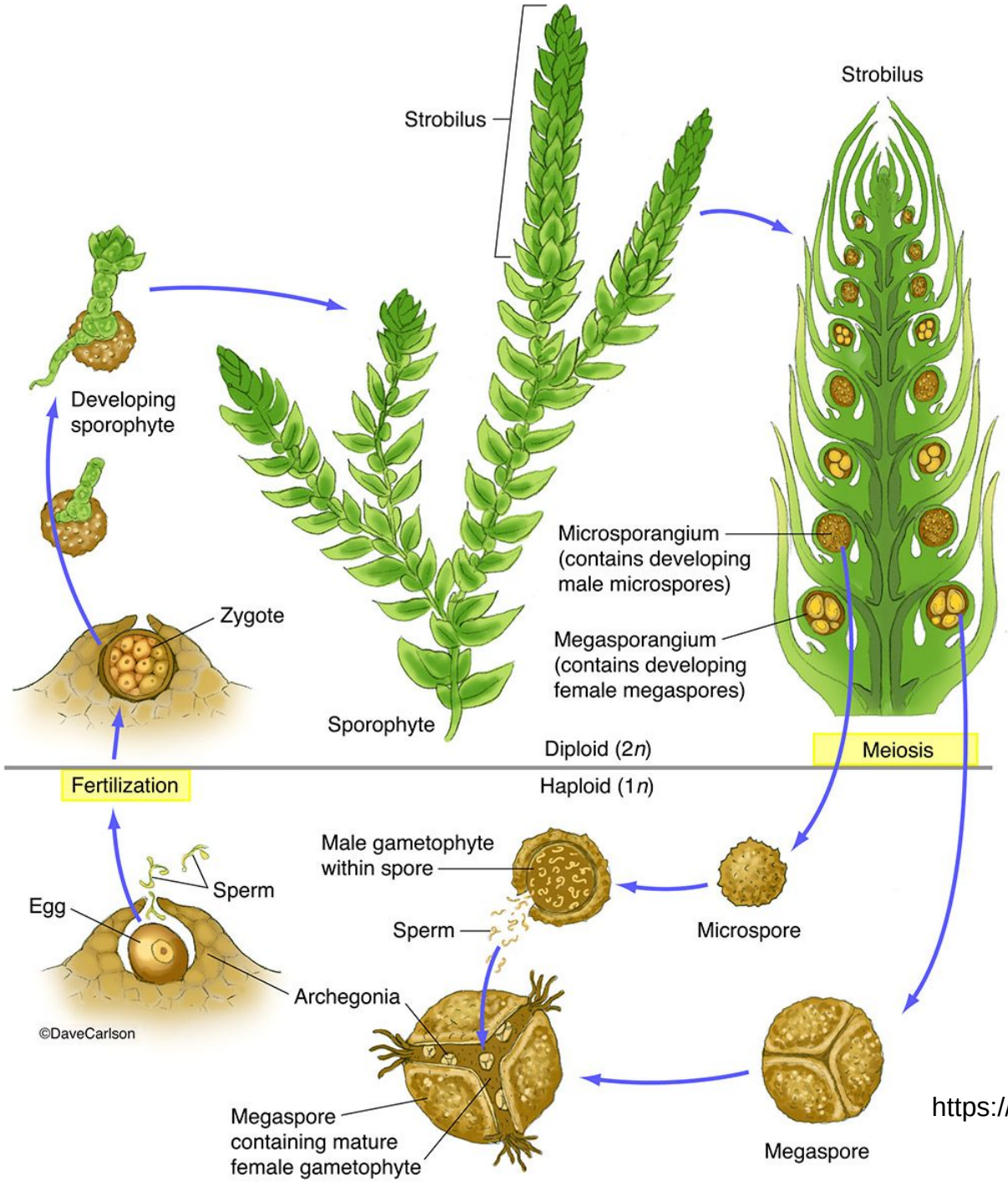
Life cycle of lycopodium



Life cycle of selaginella

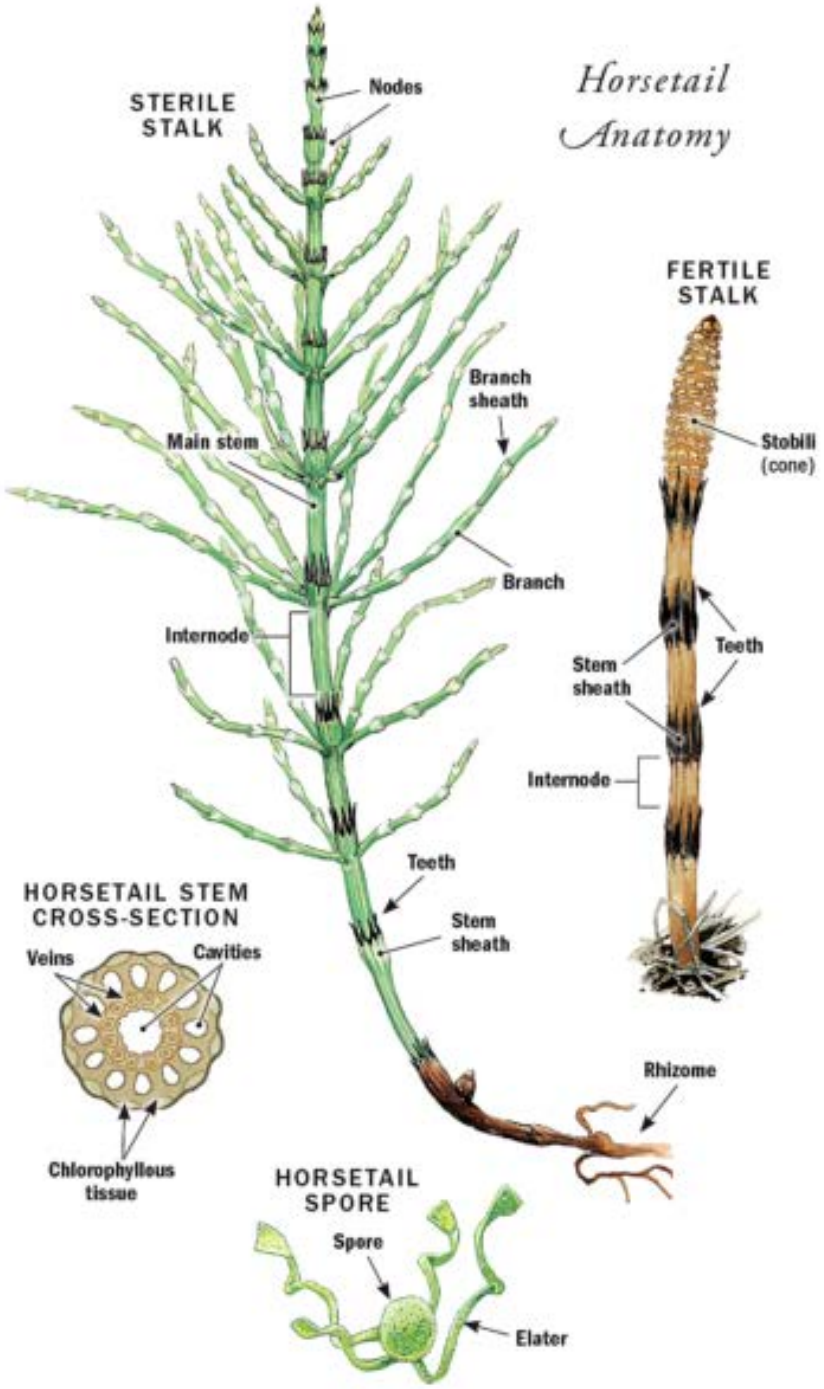


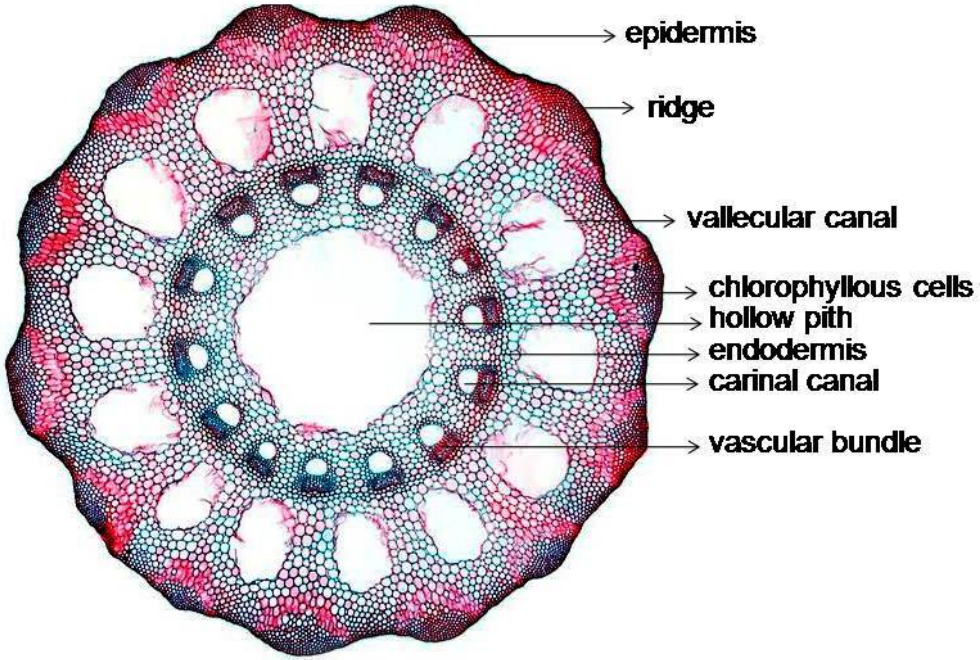
Life cycle of selaginella



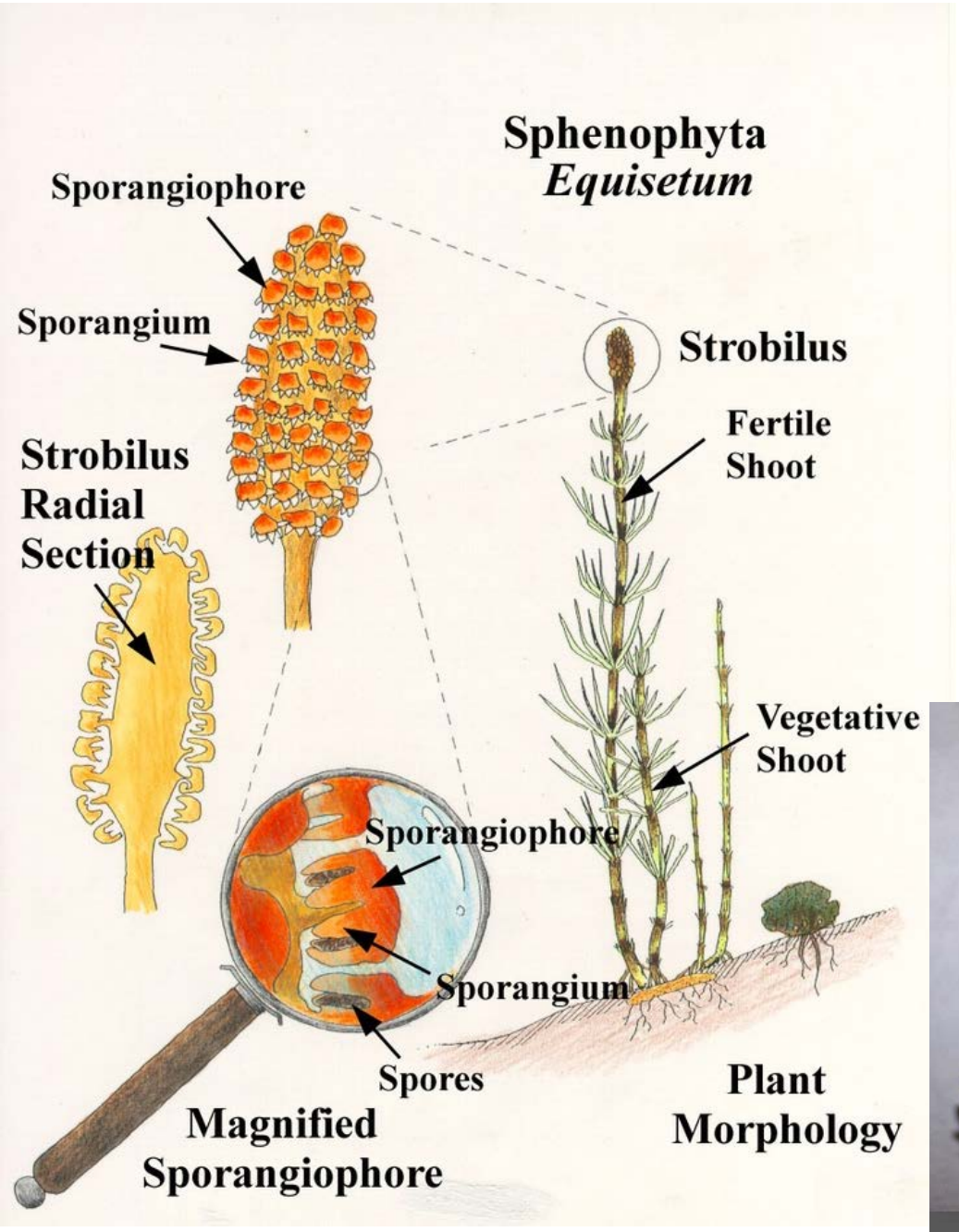
https://www.youtube.com/watch?v=BTXkh34BmZs

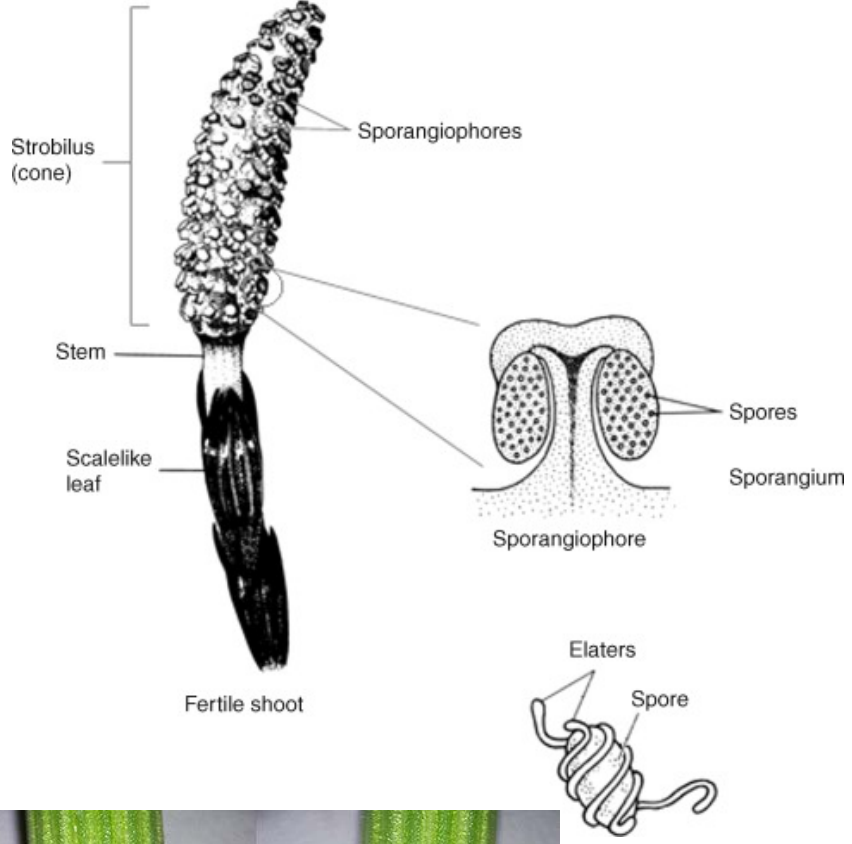
Divisio Equisetophyta

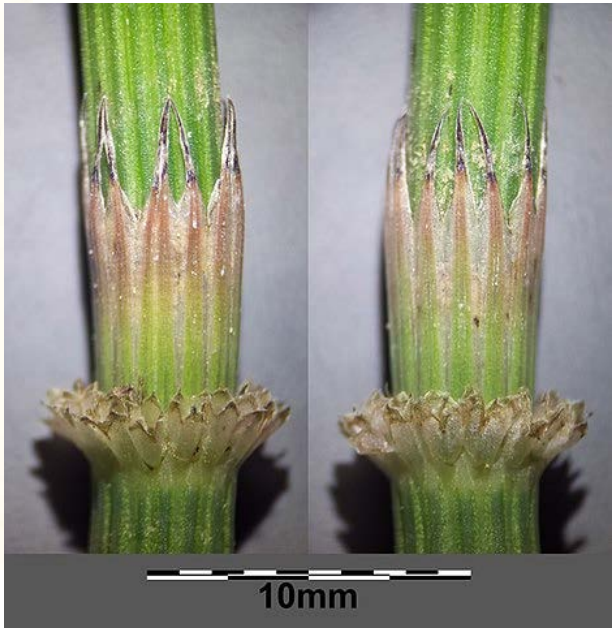


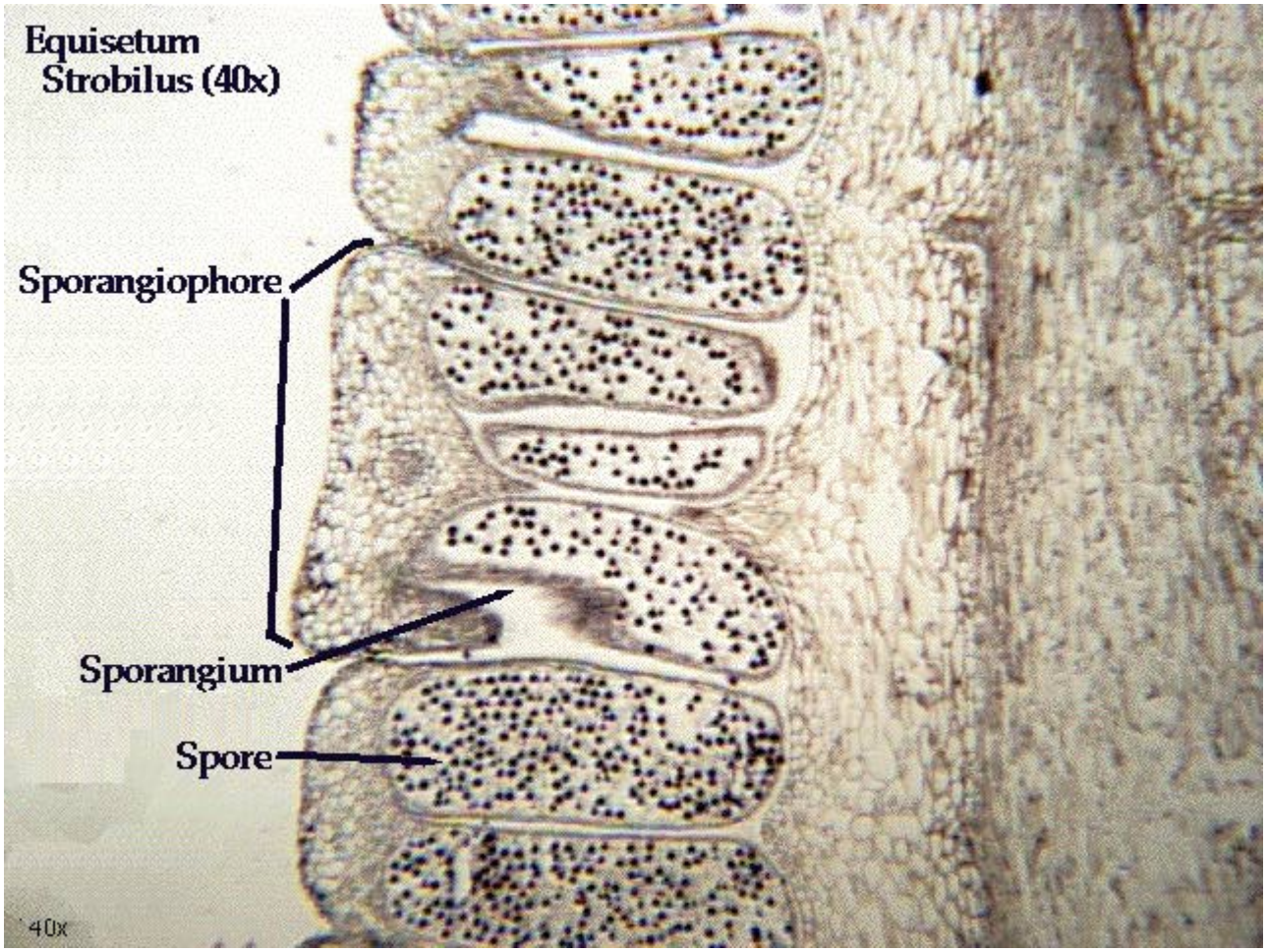


https://www.youtube.com/watch?v=Oj6SI_OT85A


Sphenophyta
Equisetum
Sporangiophore
Sporangium
Strobilus
Fertile
Shoot
Strobilus
Radial
Section
Vegetative
Shoot
Sporangiophore
Sporangium
Spores
Magnified
Sporangiophore
Plant
Morphology


Strobilus
(cone)
Sporangiophores
Stem
Scalelike
leaf
Spores
Sporangium
Sporangiophore
Fertile shoot
Elaters
Spore


10mm


Equisetum
Strobilus (40x)
Sporangiophore
Sporangium
Spore
40x

Life cycle of equisetum

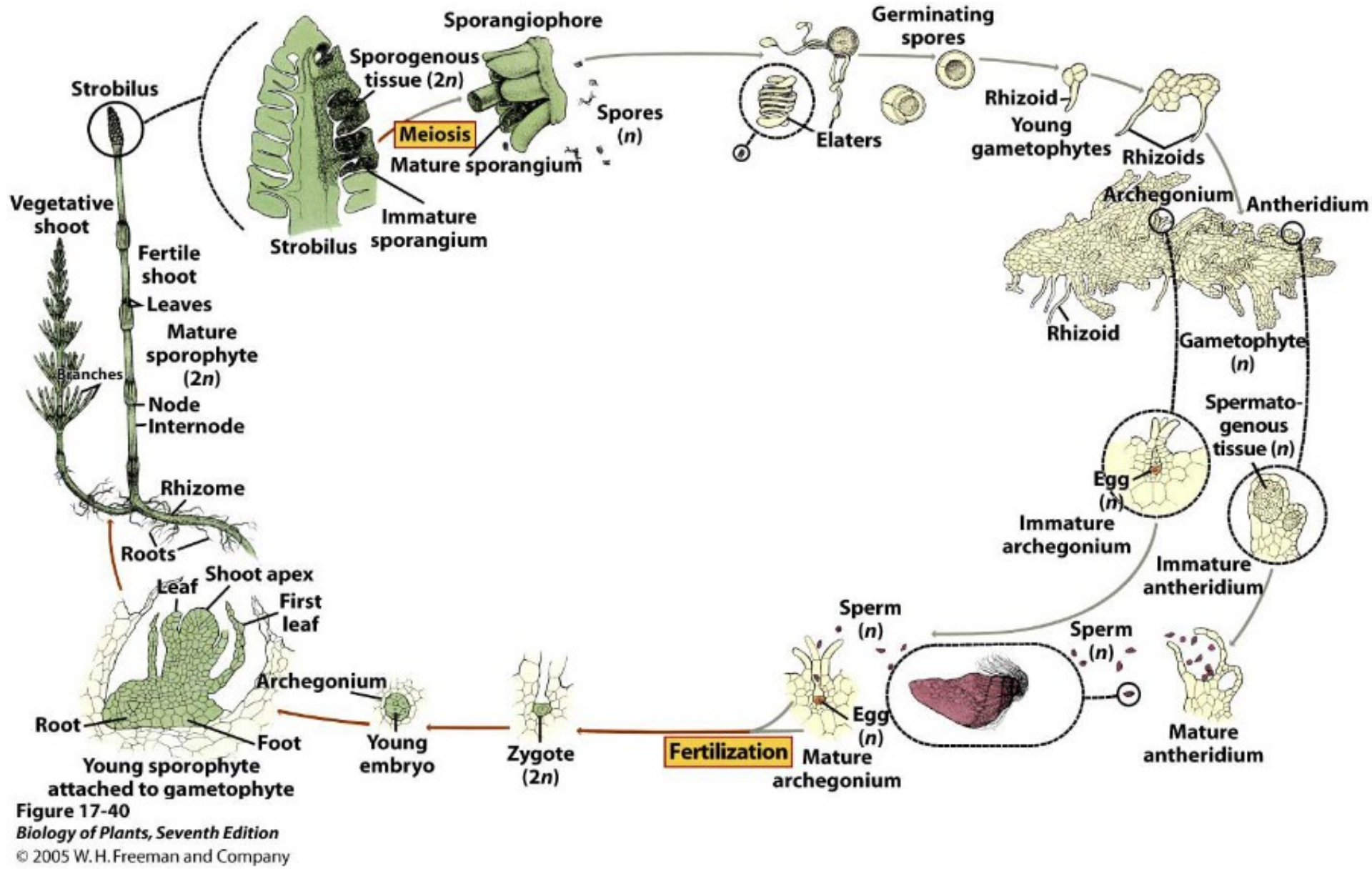
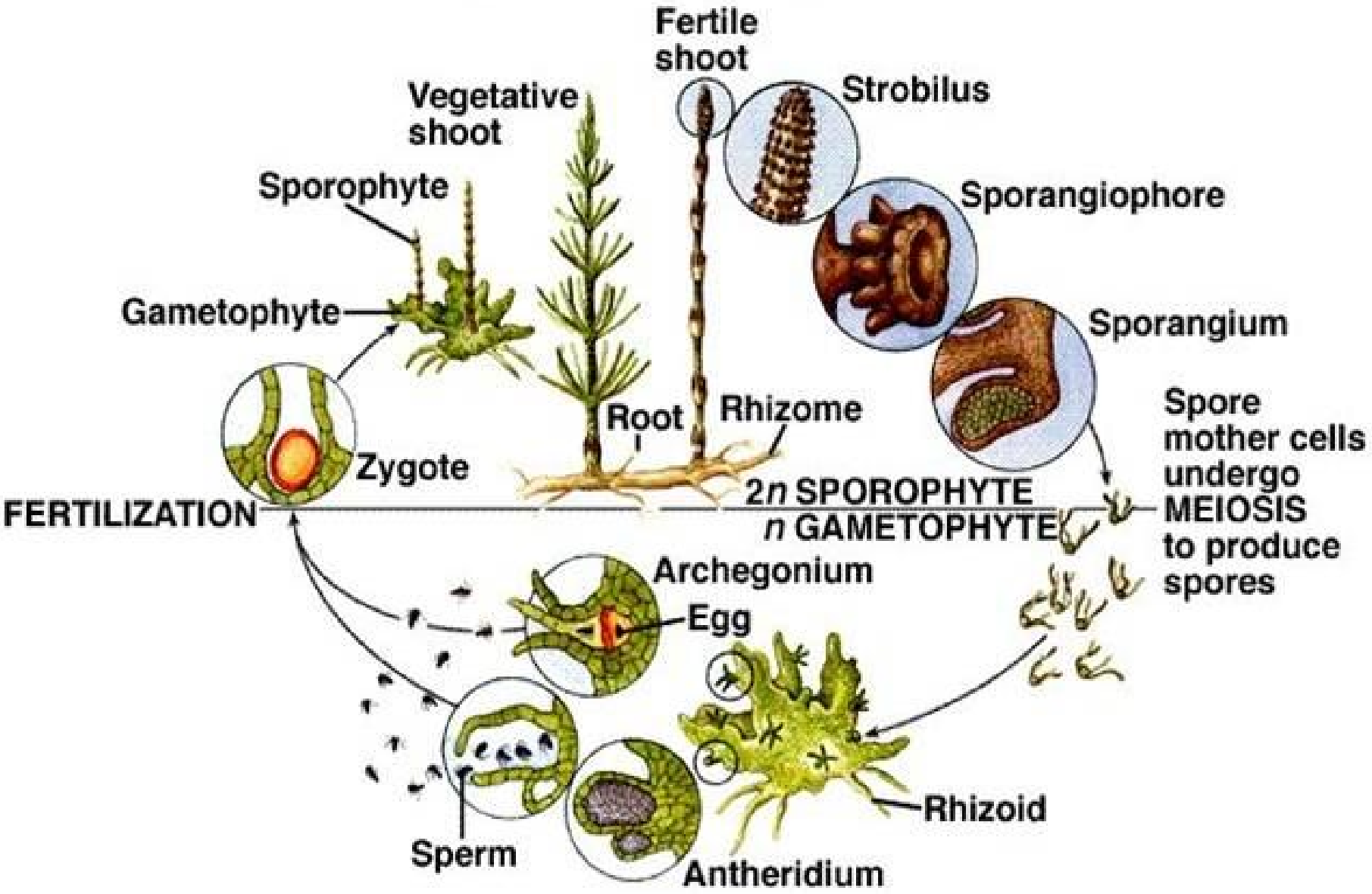


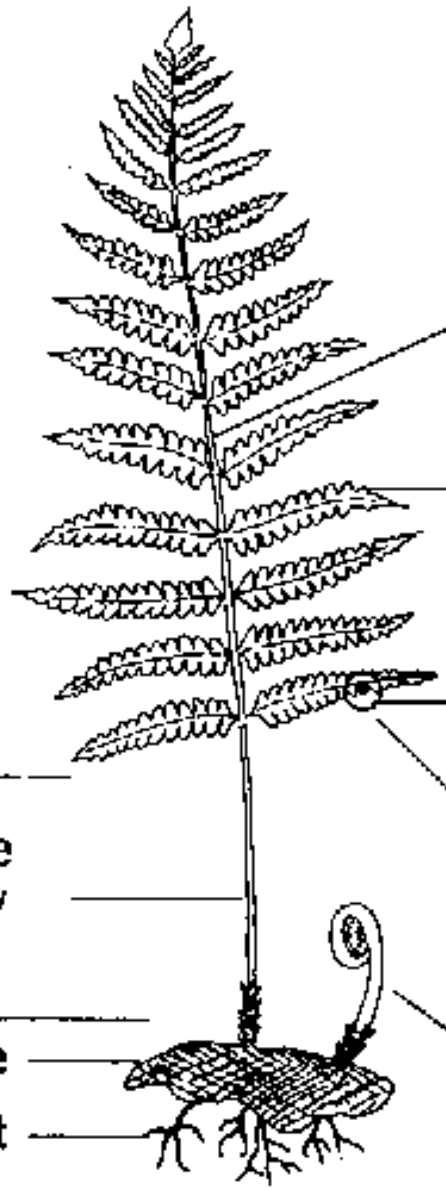
Figure 17-40
Biology of Plants, Seventh Edition

Life Cycle of *Equisetum*



Divisio Polypodiophyta

Parts of a Fern



Frond
The whole fern leaf; blade and stalk.

Blade
The expanded, leafy part of the frond.

Axis – rachis
The stalk within the blade.

Pinna – leaflet
A primary division of the blade.

Pinnule – subleaflet
A division of the pinna.

Pinnules can be divided into lobes.

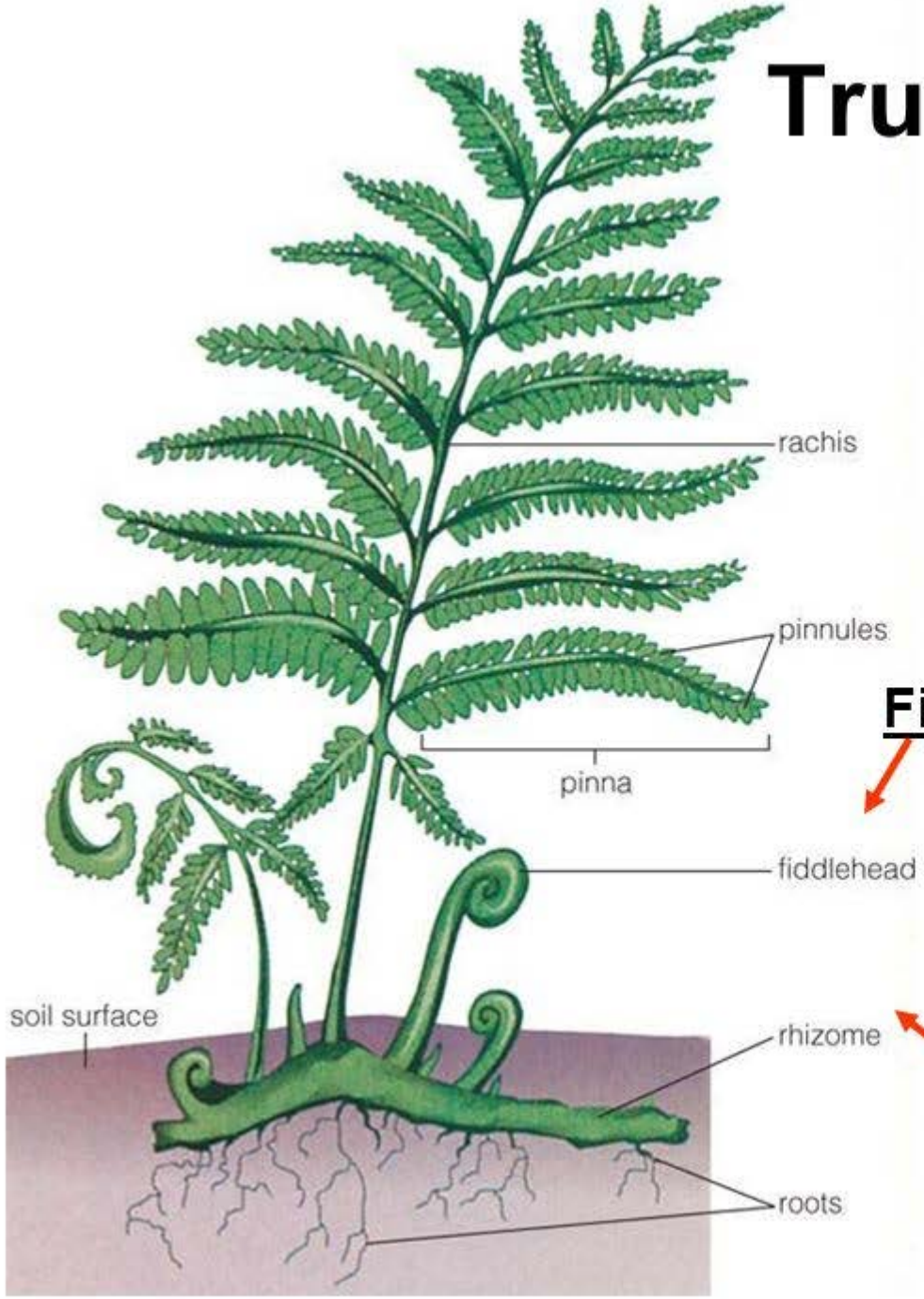
Stalk – Stipe
The stalk below the blade.

Rhizome

Root

Fiddlehead (Crozier)
An uncurling frond.

True Fern Structure

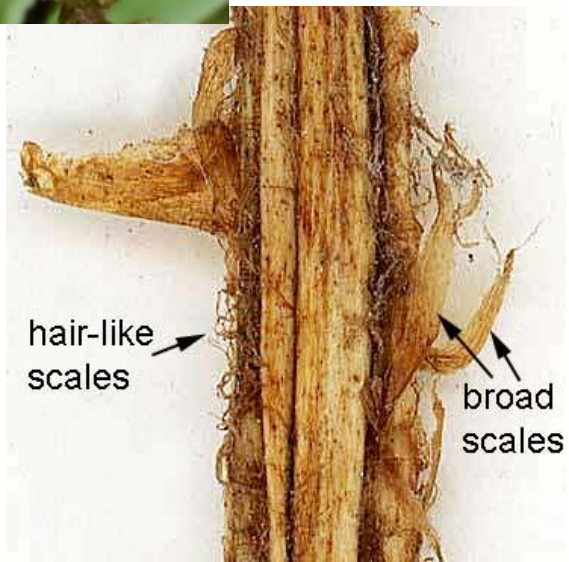


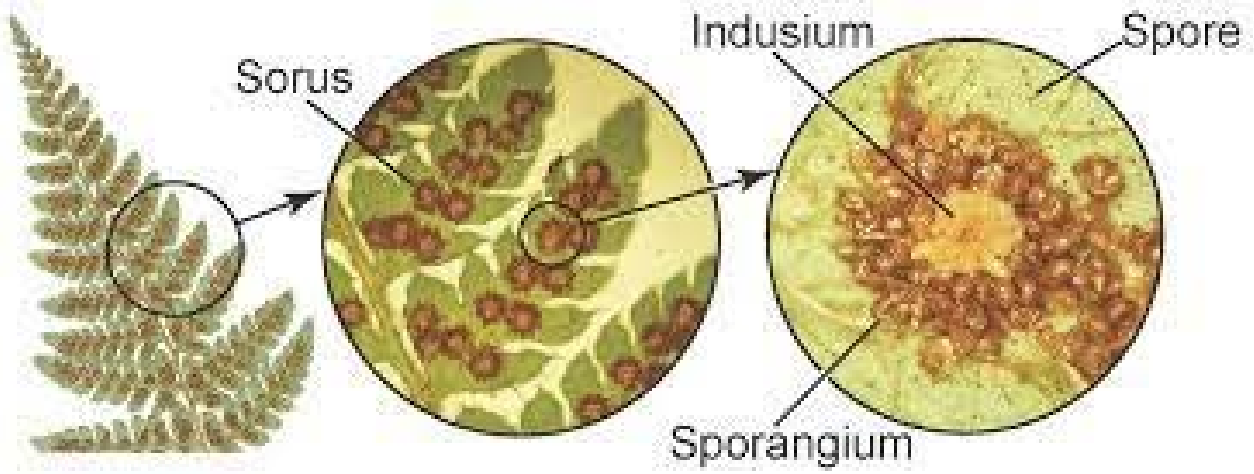
Know the parts of the frond (fern leaf) →rachis, pinna, pinnules.

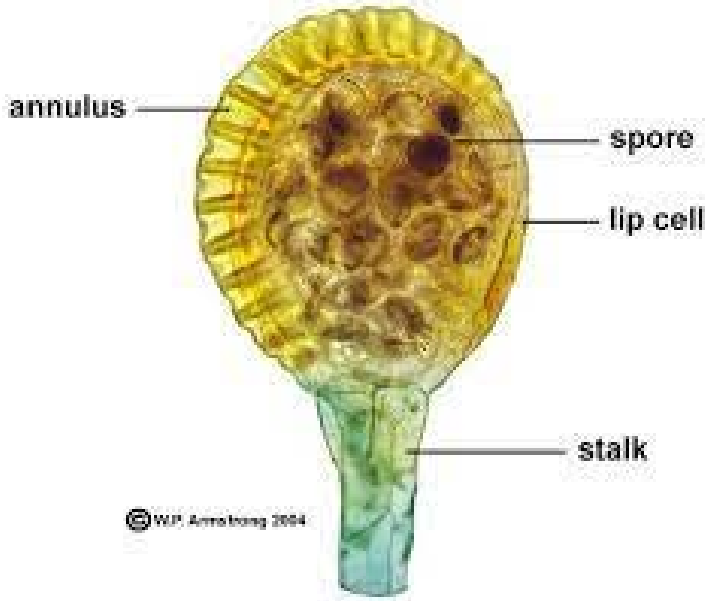
<u>Fiddlehead</u> - young tightly coiled fern fronds (leaves).

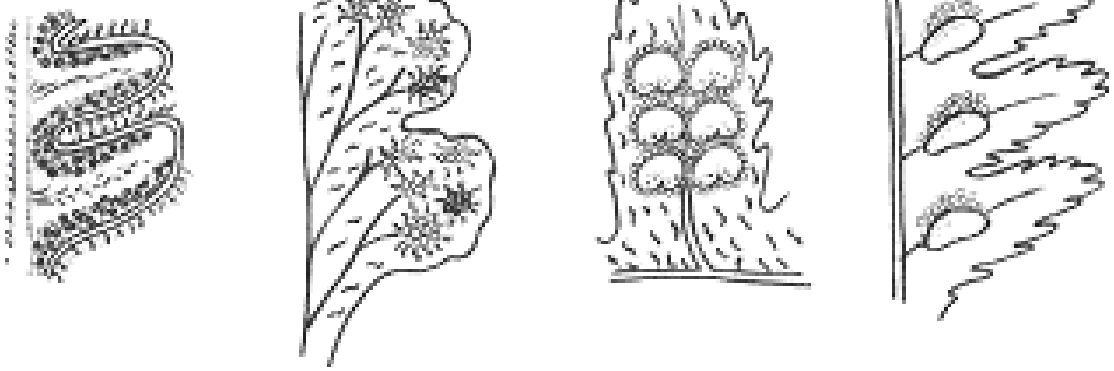
Stems are underground and fronds (leaves) are above ground. Remember, rhizomes are underground stems.

- **Fronds first tightly coiled (fiddleheads)**
  - **leaf development known as circinate vernation**
- **Uncoil due to differential growth on top and bottom.**

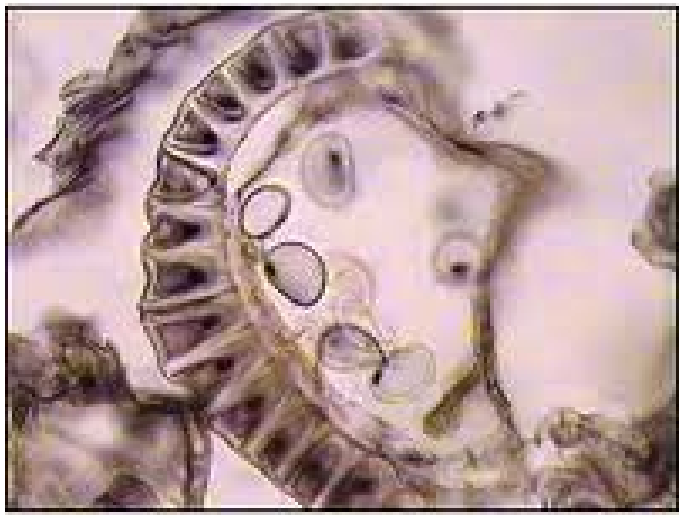

hair-like
scales
broad
scales

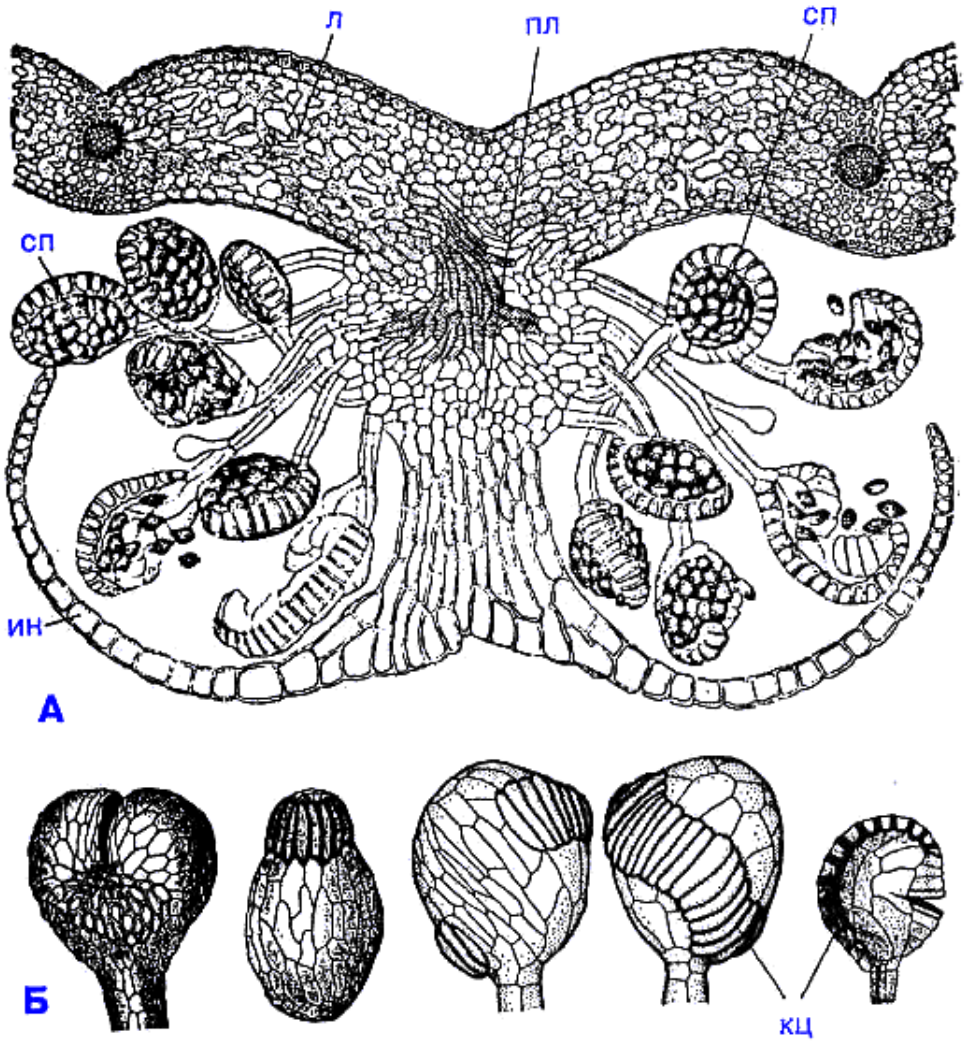

Sorus
Indusium
Spore
Sporangium

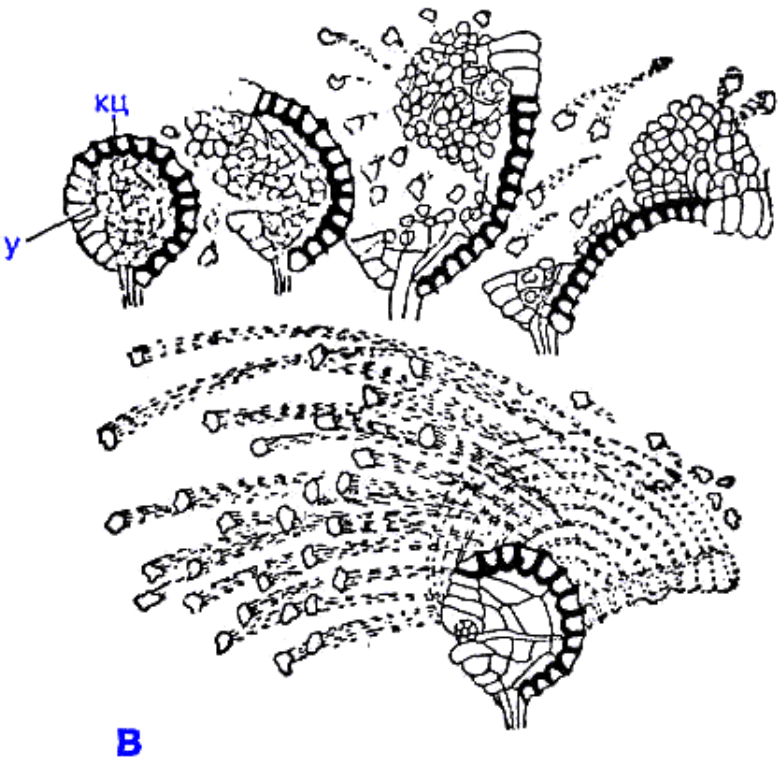

annulus
spore
lip cell
stalk
©W.P. Armstrong 2004



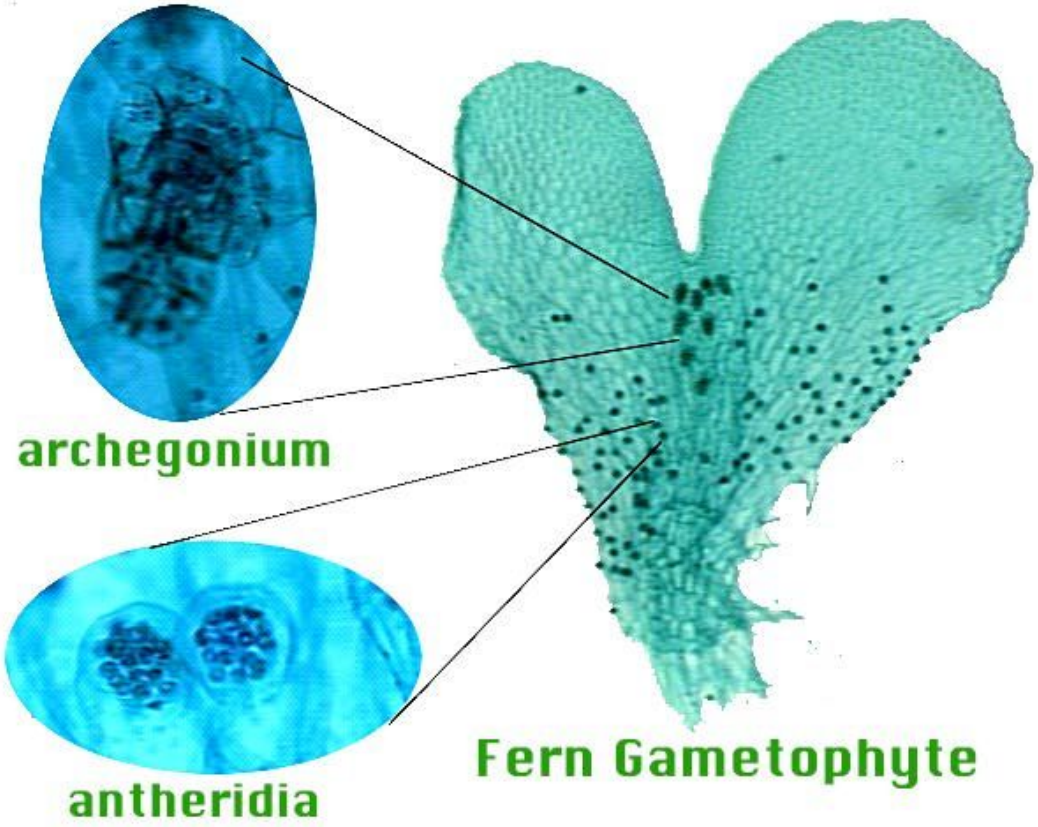
Arrangement of sporangia and sporules of ferns
1 - sporangia of Pteridium; 2 - sporangia of Woodsia; 3 - sporangia with a coverlet of Dryopteris; 4 - sporangia found in genera Asplenium, Athyrium, Polypodium.

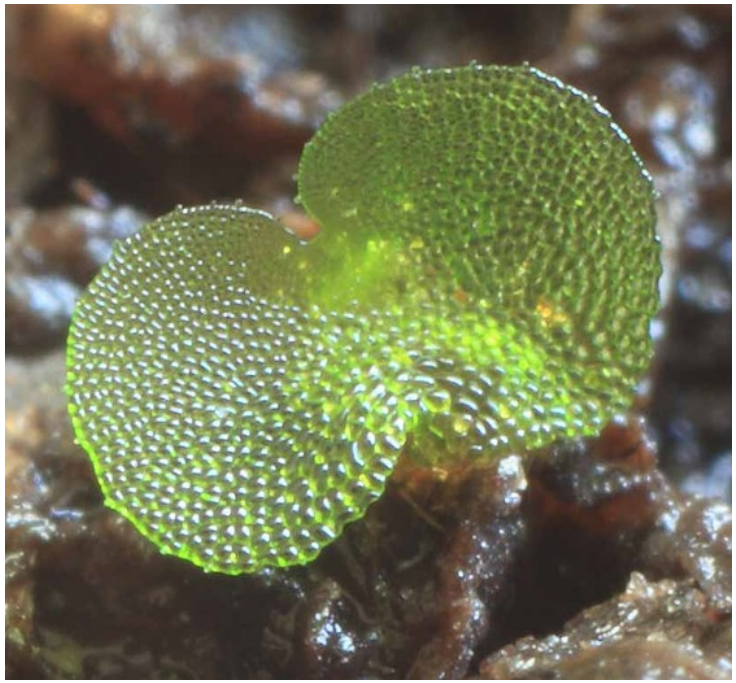






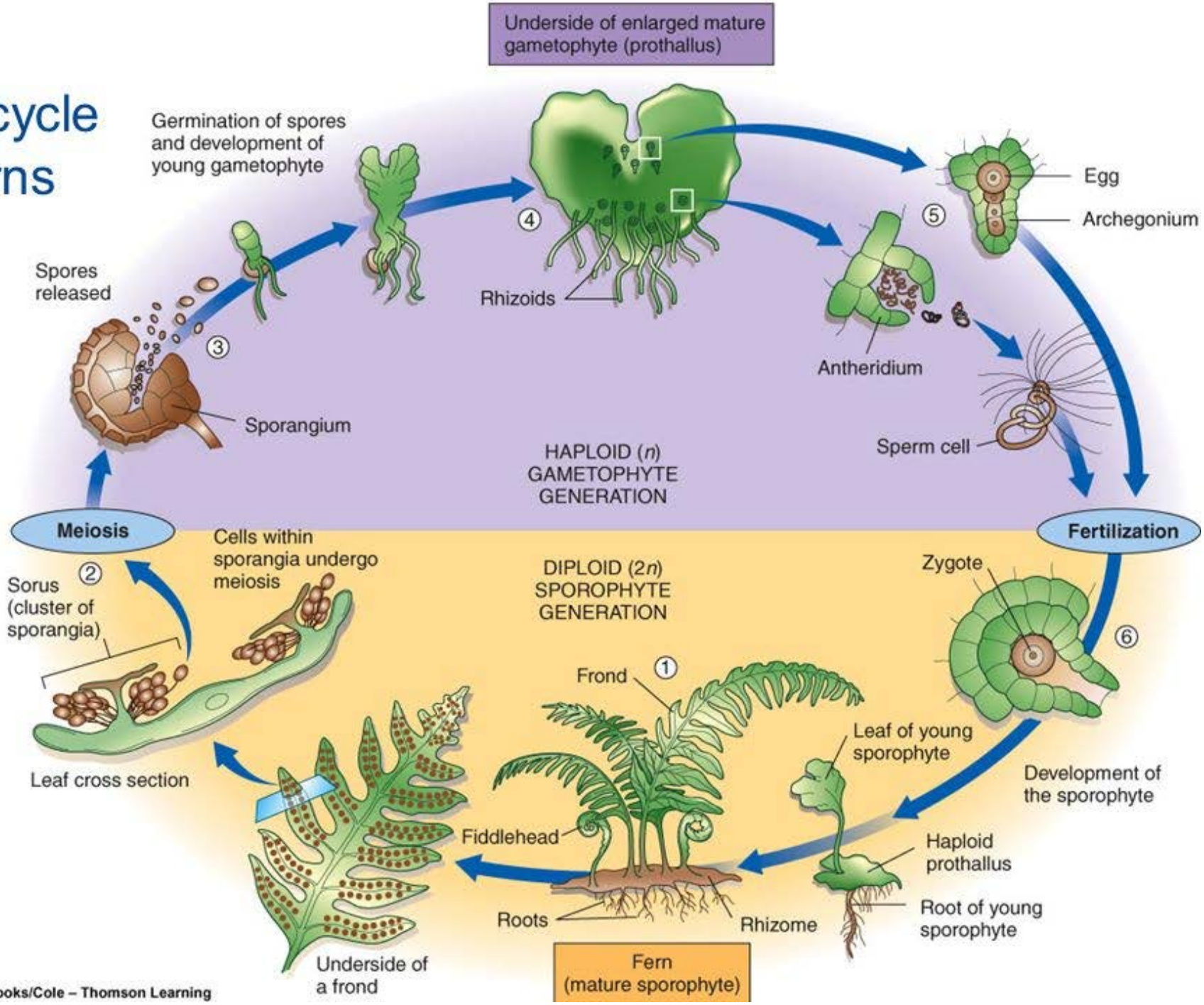
Structure of soruses and sporangia of ferns:
А - cross section of the sporus of the male fern (Dryopteris filix-mas) ;
Б - diversity of sporangia;
В - opening of sporangia; л - leaf; пл - placenta; сп - sporangium; лц - ring; у - mouth; ин - indusium.





https://www.youtube.com/watch?v=2_bLHzIbl6c

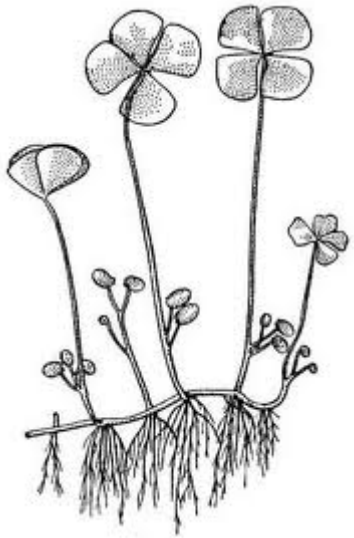
Life cycle of ferns



Разноспоровые папоротниковидные

Сальвиния
плавающая

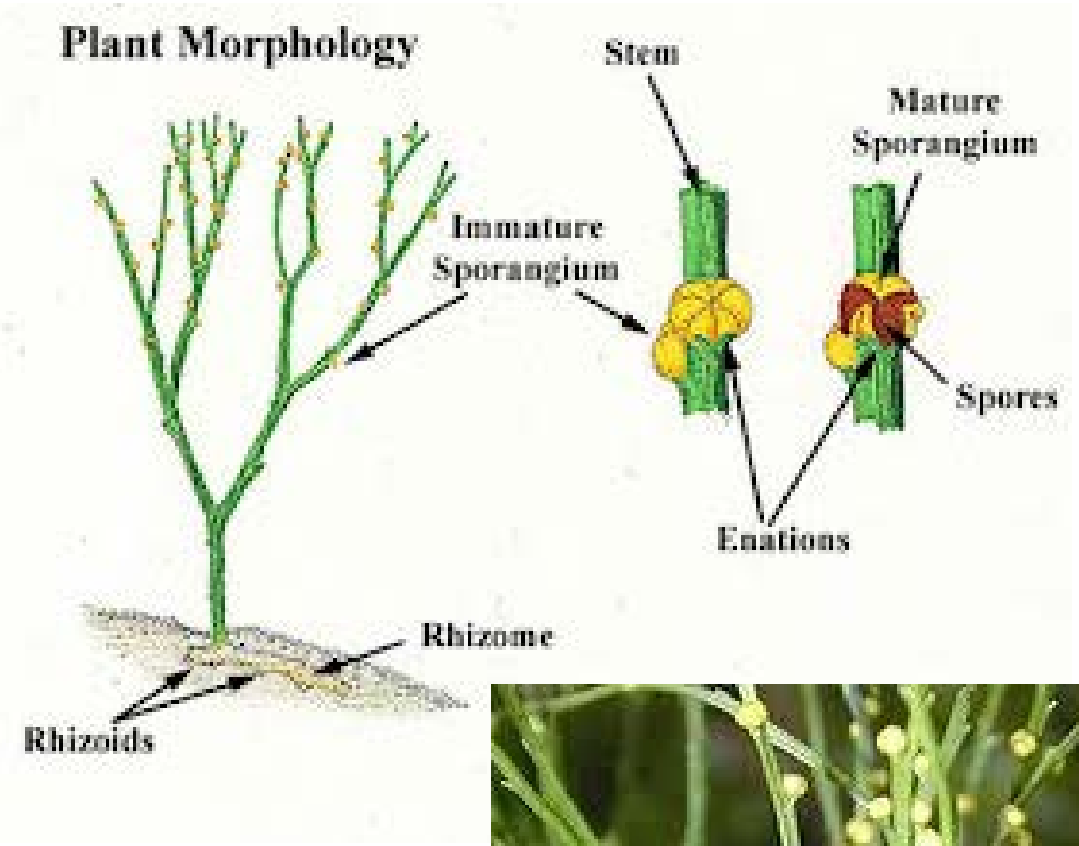
Марсилея
четырехлисточковая



LIFE CYCLE

1. Heterosporus
2. Keep sporangia in sporocarp→ covered by indusium
3. Sporocarp= 1.Megasporangia 2. Microsporangia
4. Megsporangia→ 8 microsporocytes--------$^{\text{meiosis}}$-32 megaspores→ only one matures and viable→enlarges,fills the whole megasporangia
5. Both types develops plasmodial tapetum—solidifies– lobed body massulae above spore
6. No annulus.. Sporocarp wall degenerate– spores germinates

Psilotum nudum



Psilotum reproduction

Homosporous life cycle