EVOLUTION, VARIATION AND SYSTEMATICS (PART 1): PLANT ORIGIN




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Reference Simpson, M.G. 2006. Plant systematics.
Chapter 1 and 3

What is a plant?

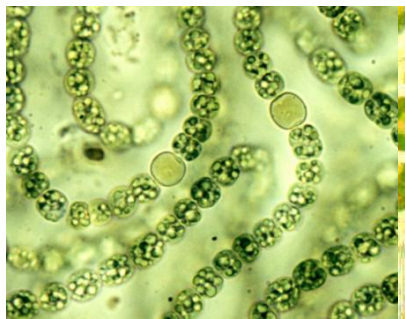
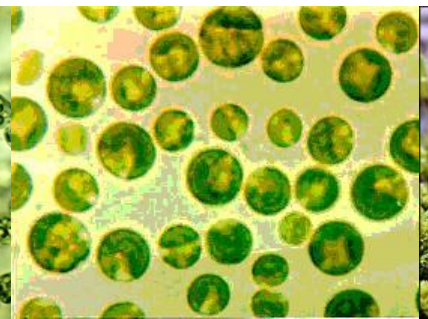
Two conceptual ways to define a plant:

Traditional way:

- Organism that posses **photosynthesis, cell walls, spores**, and more or less sedentary behavior
- Contain variety of **microscopic organism all of the algae**, and the more familiar plants that **live on land**.

Modern way:

- Delimiting **organismal groups** based on **evolutionary history**.
- Some of the photosynthetic organisms evolved independently of one another and are not closely related.



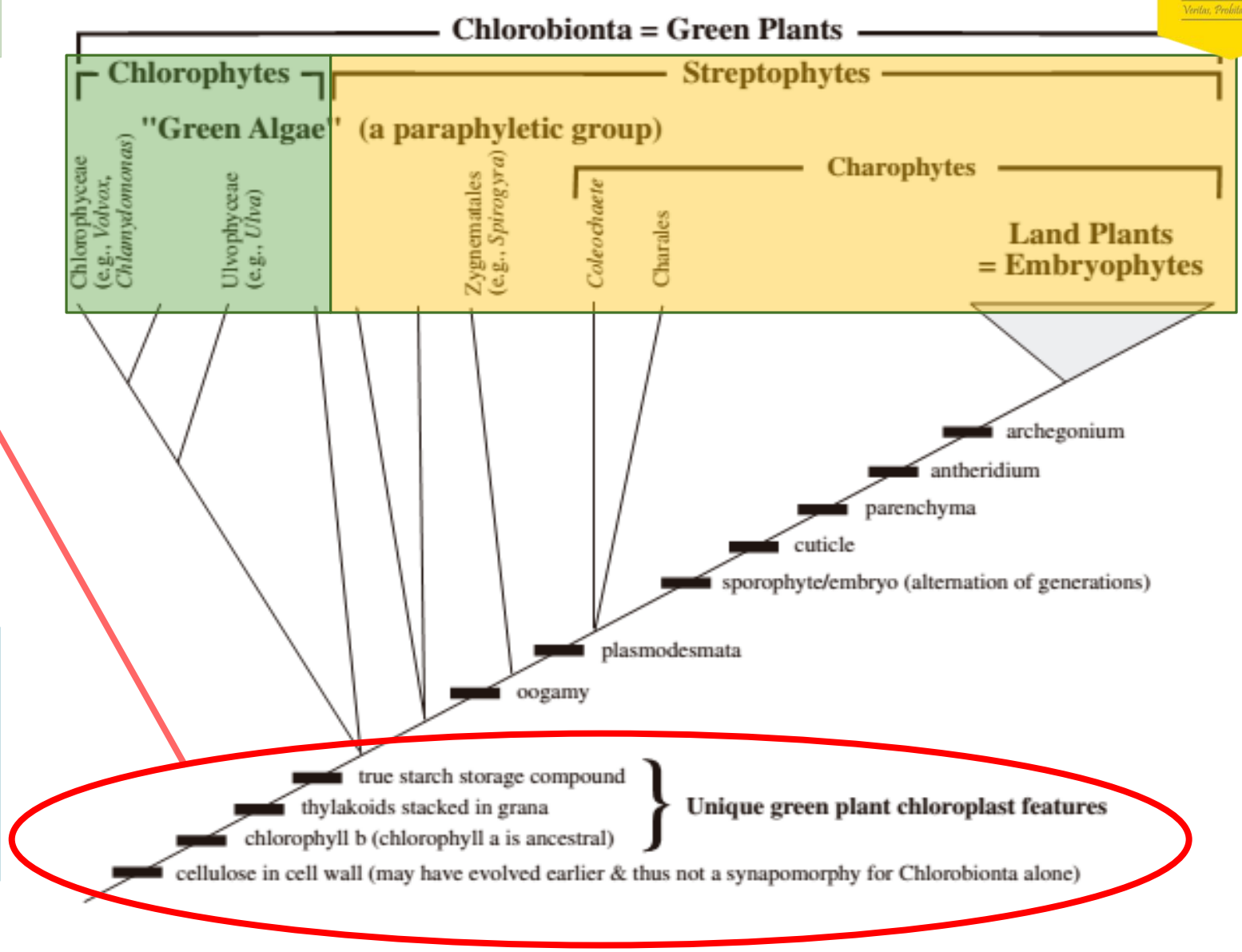
Chlorobionta = Green plants are monophyletic group of **eukaryotic organisms**

The apomorphy of Chlorobionta

1. Celluse in cell wall
2. Chlorophyll b
3. Thylakoids stacked in grana
4. True starch storage compound

Classified as **two sister groups**:

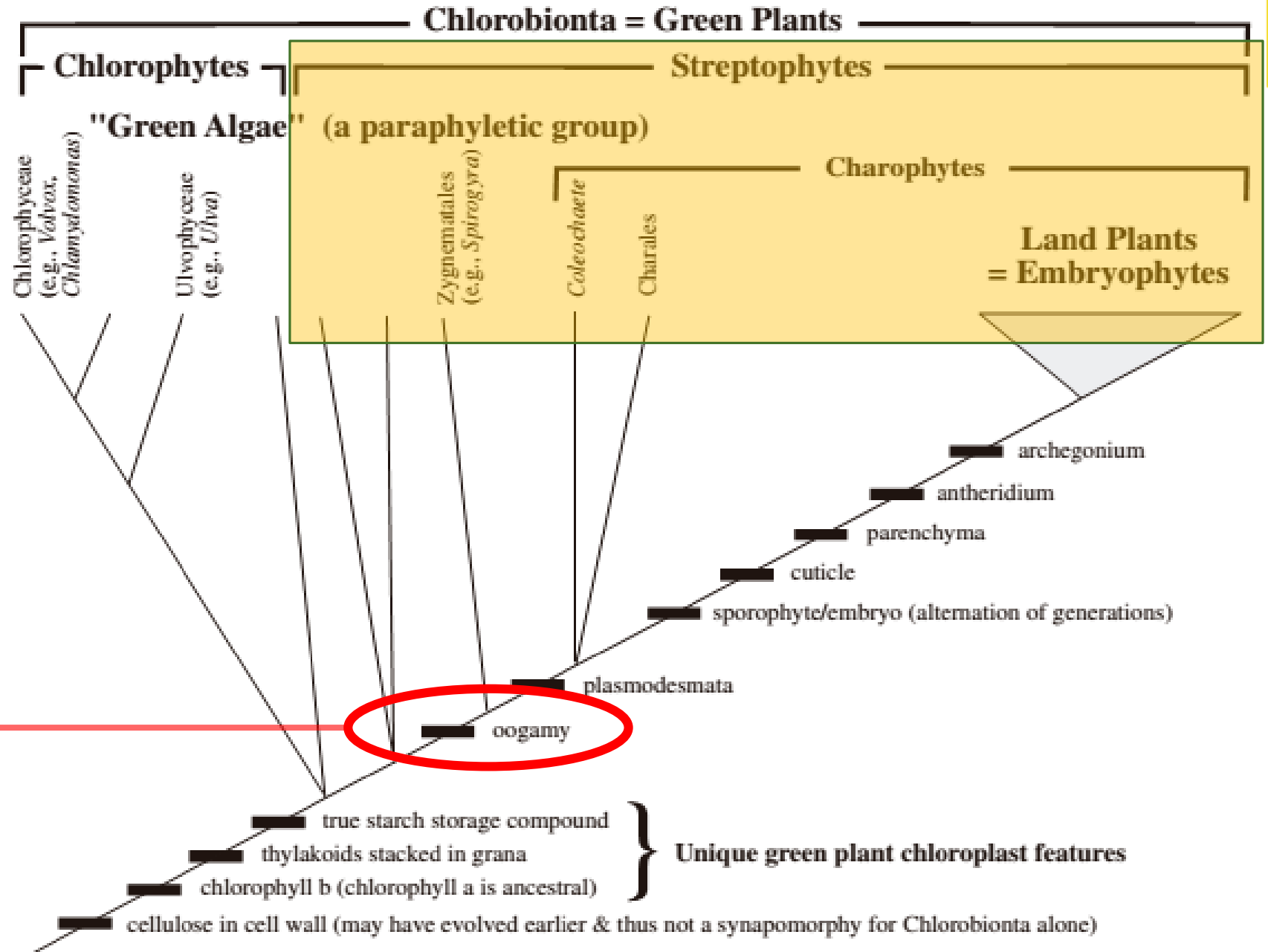
1. **Chlorophytes/Chlorophyceae**
2. Streptophytes/Streptophyceae



Streptophytes:

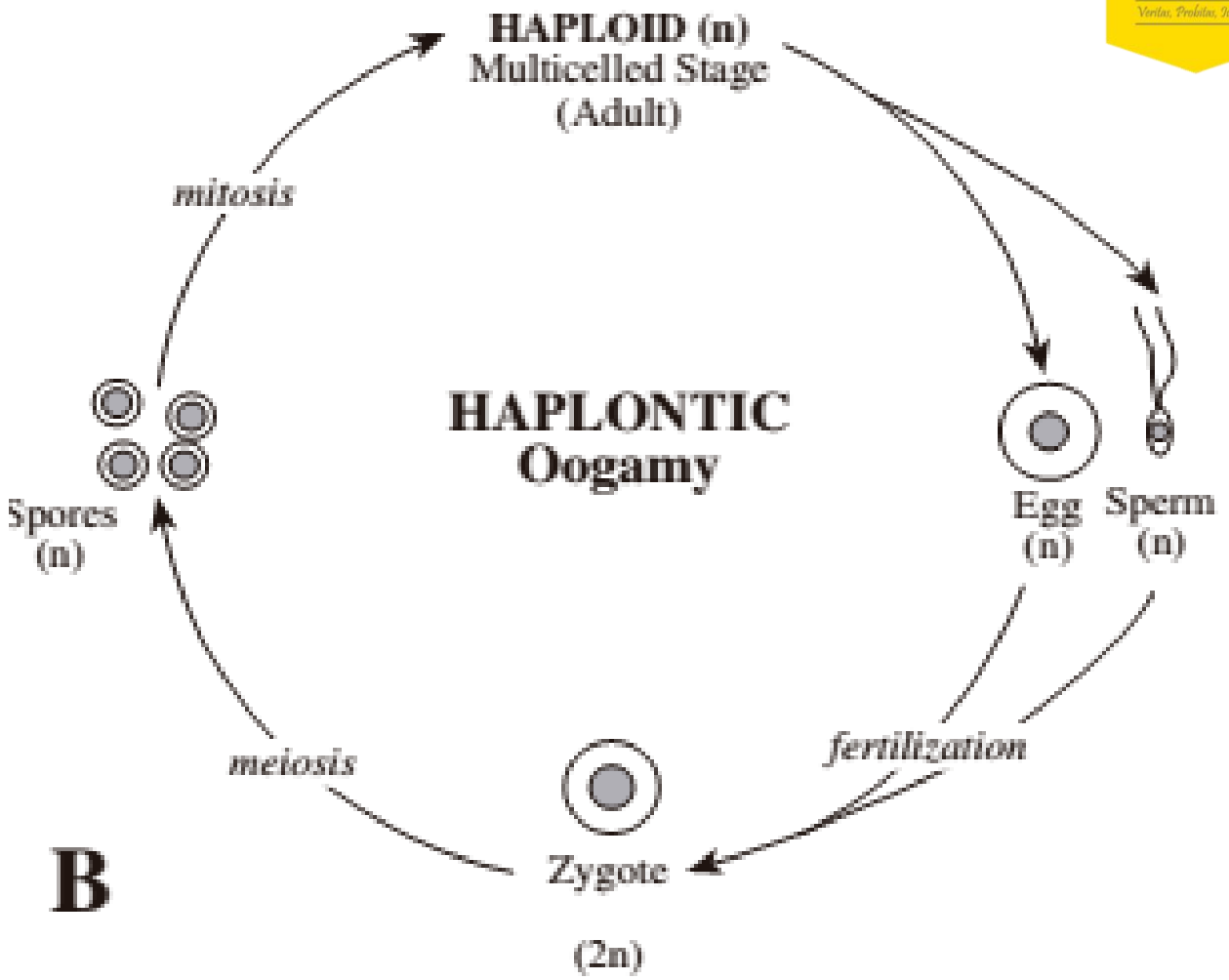
Consist of:
1. Zygnematales
2. Charophytes

Apomorphy:
Oogamy



Streptophyte sexual reproduction:

- Found in all land plants and independently evolved algae and in the animals
- **Gamets:** an egg and a sperm cell.
- The egg becomes larger and non flagellate,
- **Retention** of the egg, and **retention** of the zygote on the parent body
- Adaptive → by making possible the future nutritional dependence of the zygote upon the haploid plant, ultimately leading to the sporophyte

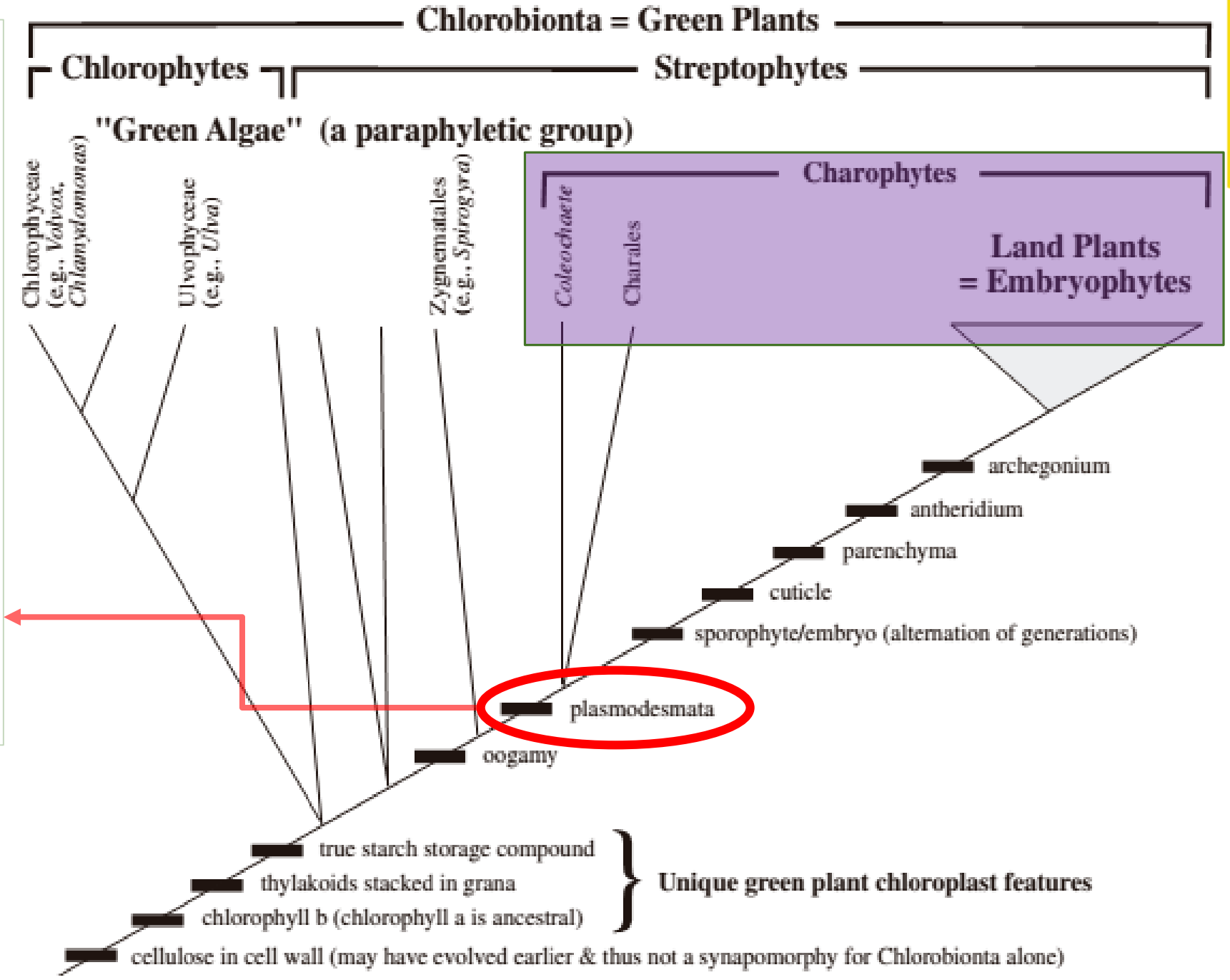


Charophytes:

A clade of Streptophytes, consisting of:

1. Coleochaete
2. Charales
3. Embryophytes (land plants)

Apomorphy:
Plasmodesmata



Land plants (Embryophytes)

Shared character of land plants:
Major adaptations that enabled formerly aquatic green plants to **survive** and **reproduce** in the **absence** of a **surrounding water** medium.

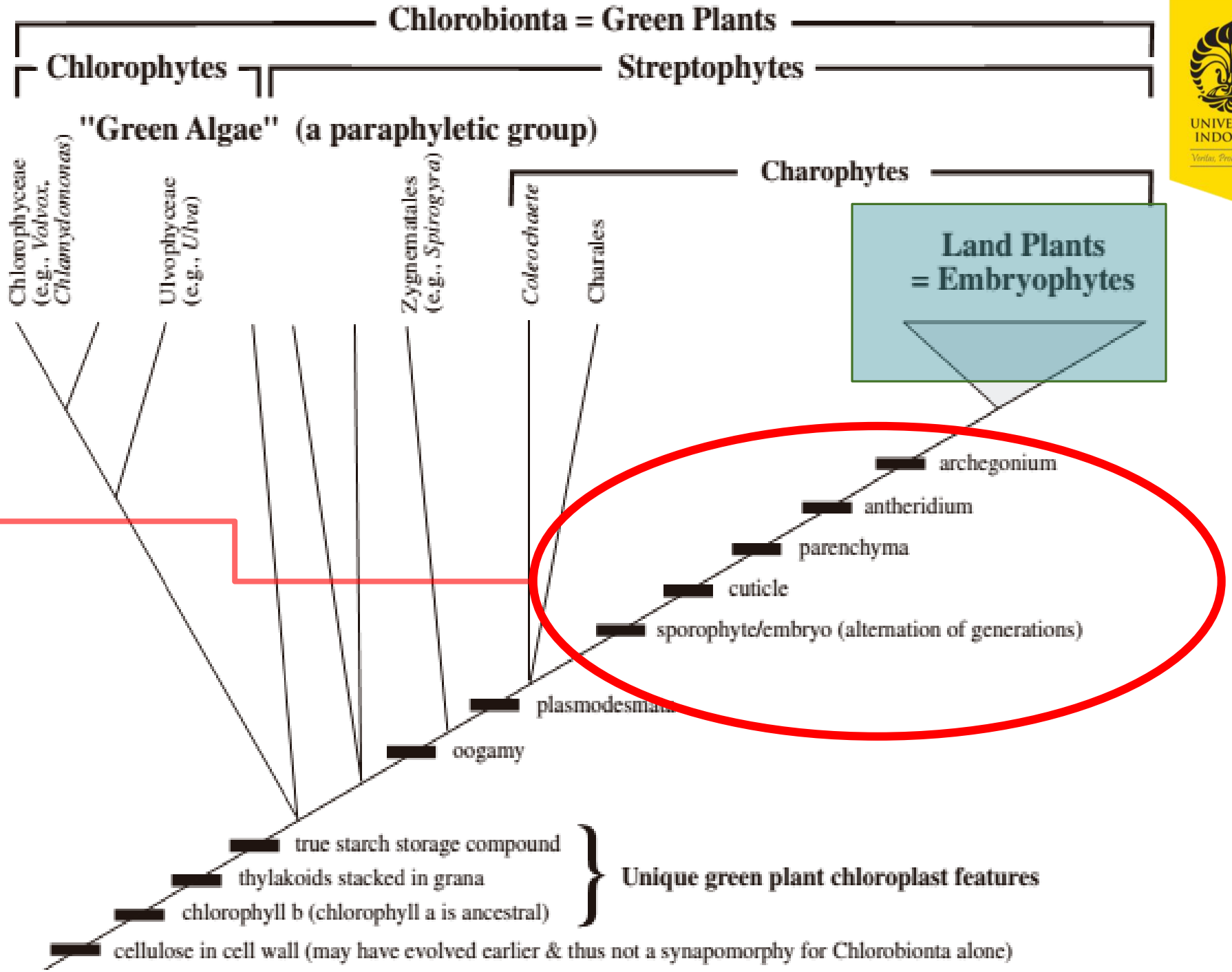
Embryophytes:

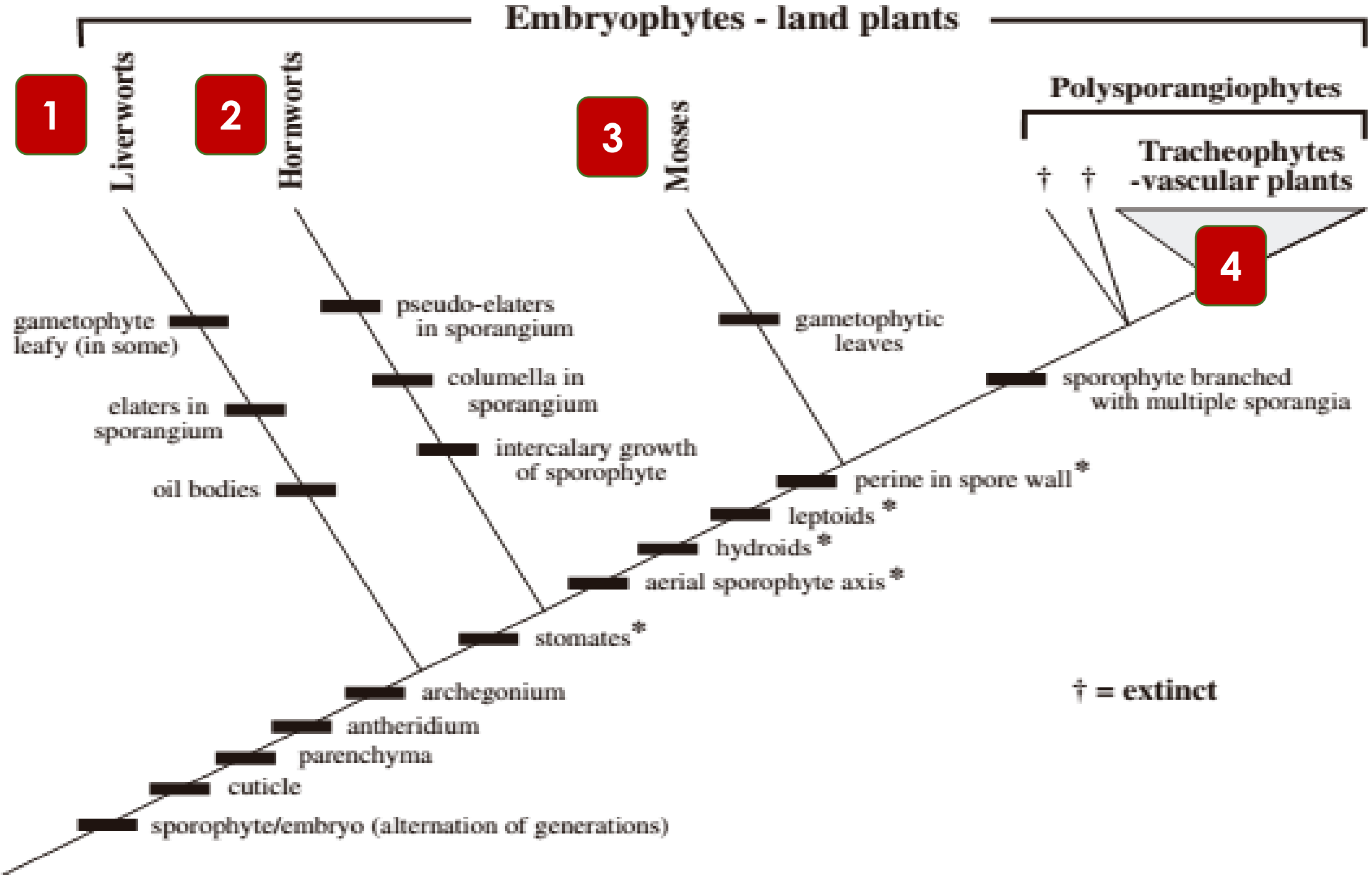
Apomorphy:

1. Sporophyte/ embryo

Alternation of generation

2. Cuticle
3. Parenchyma
4. Antheridium
5. Archegonium

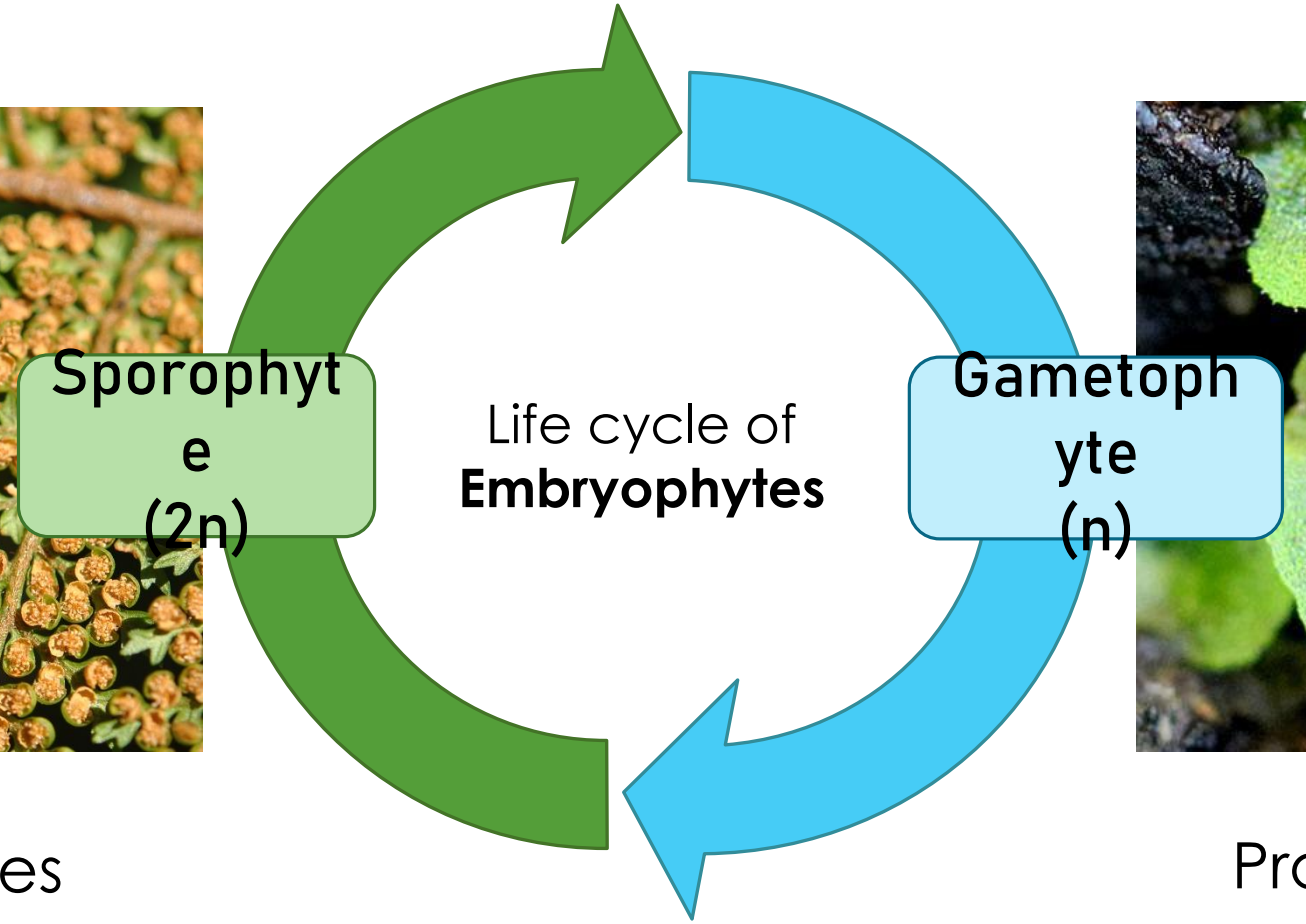



Embryophytes - land plants
1
2
3
4
Liverworts
Hornworts
Mosses
Polysporangiophytes
Tracheophytes
-vascular plants
† †
gametophyte
leafy (in some)
elaters in
sporangium
oil bodies
pseudo-elaters
in sporangium
columella in
sporangium
intercalary growth
of sporophyte
gametophytic
leaves
sporophyte branched
with multiple sporangia
perine in spore wall *
leptoids *
hydroids *
aerial sporophyte axis *
stomates *
archegonium
antheridium
parenchyma
cuticle
sporophyte/embryo (alternation of generations)
† = extinct

Embryophytes Apomorphy #1:

Sporophyte/Embryo (alternation of generation)

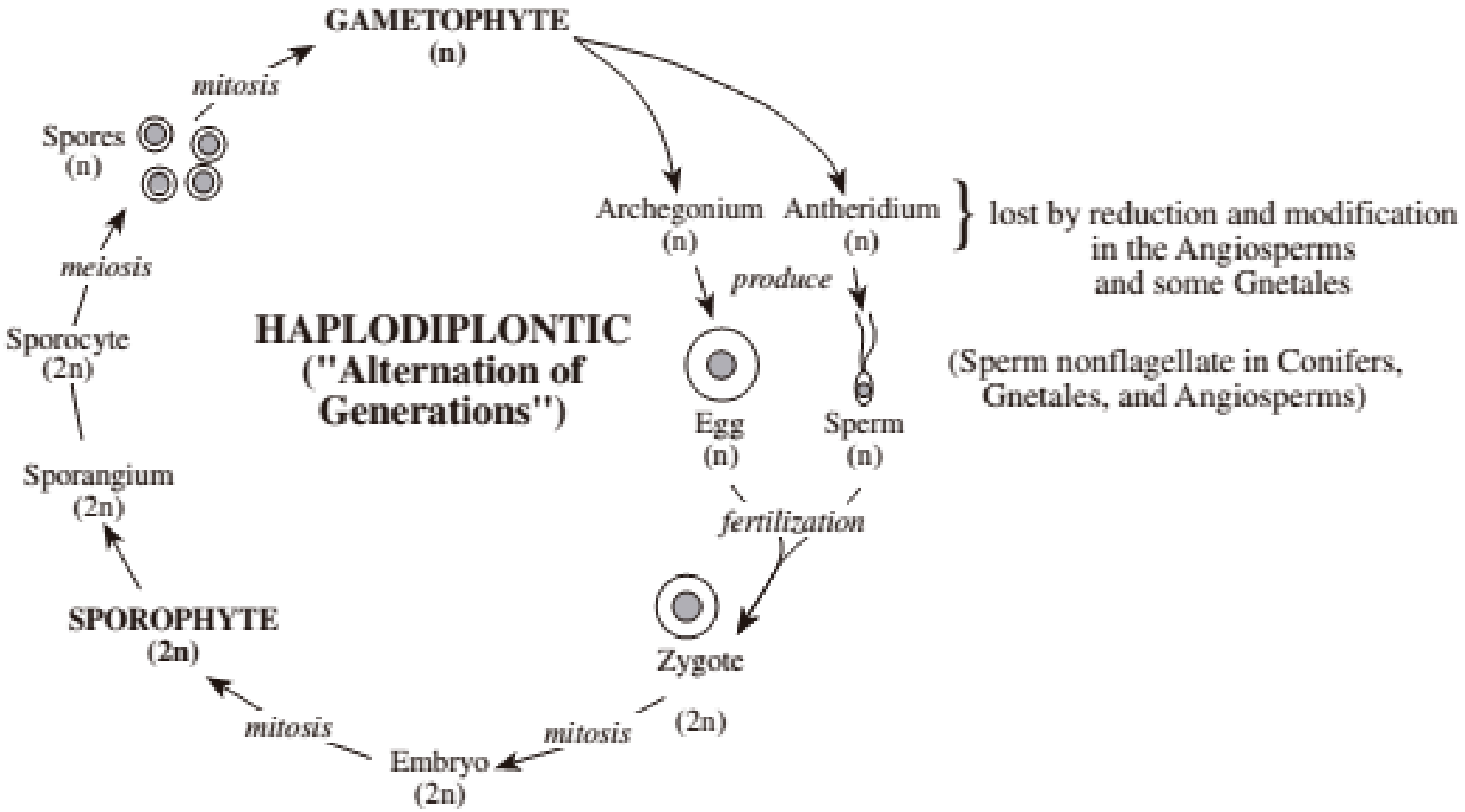
The **embryo** → an immature sporophyte that is attached to or surrounded by the gametophyte



Produces spores

Produces gamets

Embryo development is the key



Delayed meiosis produce **embryo**, which later develops as a **sporophyte**.

However, in Embryophytes

↓

Haplodiplontic

↓

Zygote undergoes mitosis to develop **Embryo**

↓

Embryo → **sporophyte**

↓

Undergoes meiosis to produce **spores**

Embryophytes Apomorphy #2:

Cutin & cuticle

A cuticle:

- a protective layer → secreted to the outside of the cells of the epidermis,
- the outermost layer of land plant organs.
- Consist of a thin, homogeneous transparent layer of cutin

Cutin → a polymer of fatty acids, and functions as a sealant, preventing excess water loss

The adaptive advantage of cutin and the cuticle:

- Prevention of desiccation outside the ancestral water medium.
- Plants that are adapted to very dry environments will often have a particularly thick cuticle to inhibit water loss.

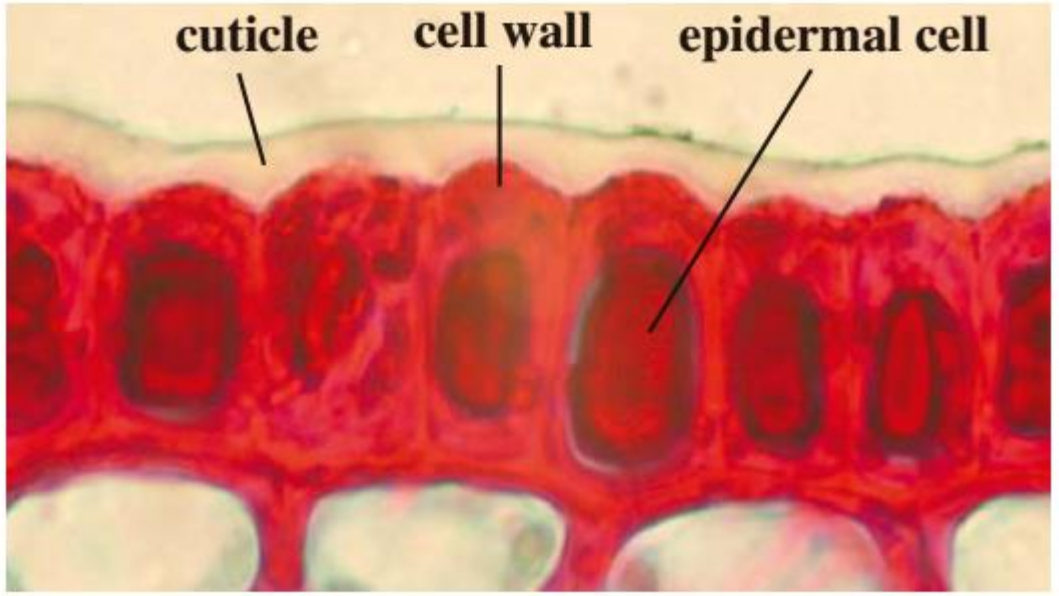


FIGURE 3.9 The cuticle, an apomorphy for the land plants.

Embryophytes Apomorphy #3:

Evolution of parenchyma tissue

All land plants grow by means of rapid cell divisions at the apical meristem.

Cells derived from apical meristem are called parenchyma tissue

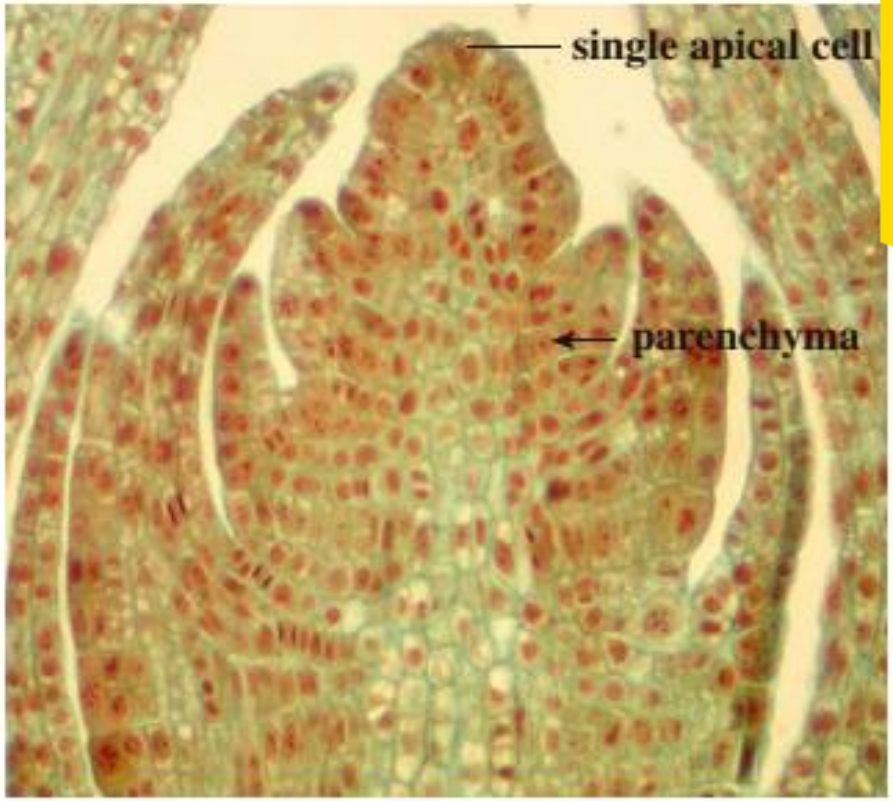


FIGURE 3.10 *Equisetum* shoot apex, showing parenchymatous growth form, from an apical meristem.

Structurally, parenchyma cells:

1. are elongate to isodiametric;
2. have a primary (1°) cell wall only;
3. are living at maturity and potentially capable of continued cell divisions.

Charales dan Coleochaete posses only **parenchymatous** tissue, **analogous** to parenchyma tissue of higher plants.

Embryophytes Apomorphy #4 & #5:

The antheridium & archegonium

Antheridium

a type of specialized gametangium containing the sperm-producing cells

Archegonium

a specialized female gametangium consisting of an outer layer of sterile cells, termed the **venter**, that immediately surround the **egg**, plus others that extend outward as a tube-like **neck**.

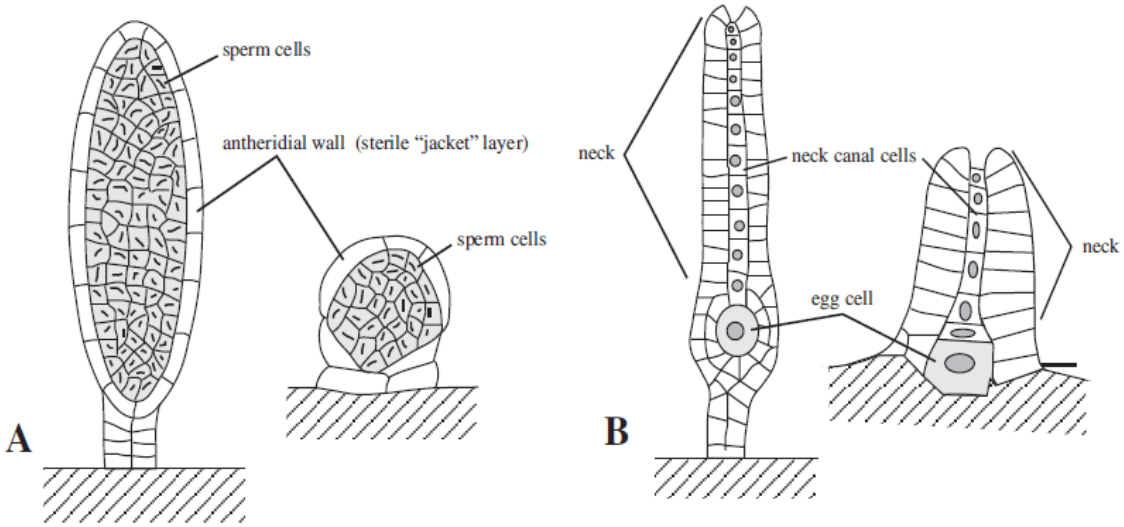
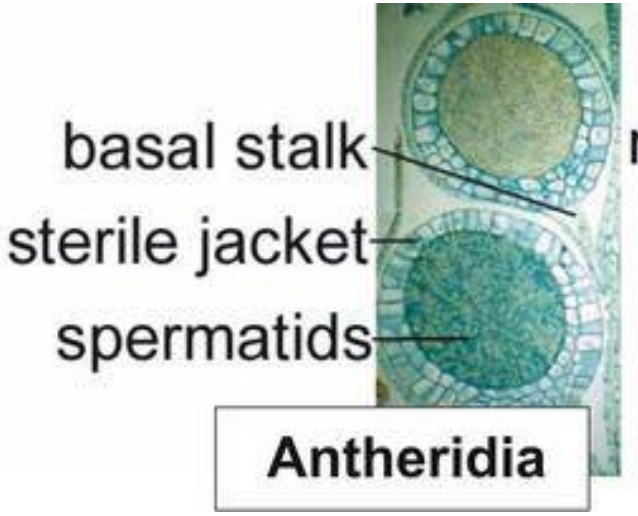
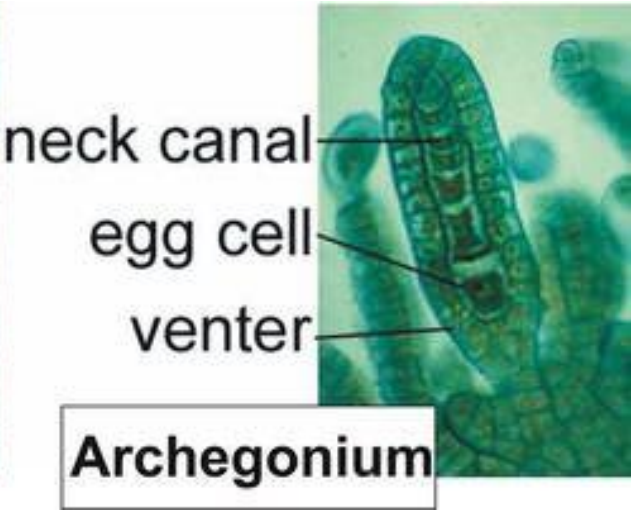


FIGURE 3.10 **A.** Antheridia. **B.** Archegonia. Both are apomorphies of land plants.





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