

Kingdom Plantae: Bryophytes

non-vascular land plants · moss · liverwort · hornwort

Big idea

Bryophytes = land plants with a **dominant haploid gametophyte**, **no vascular tissue**, and **swimming sperm**. The last two keep them small, low, and in **moist** places.

3 phyla

Phylum	Common name	Lab example
Bryophyta	moss (most prevalent)	moss (common name only)
Hepatophyta	liverwort (hepat = liver)	<u>Marchantia</u>
Anthocerophyta	hornwort (horn-shaped sporophyte)	<u>Anthoceros</u>

Plants vs algae

Shared: eukaryotic cells · chlorophyll *a* · alternation of generations · cellulose walls. Algae are **polyphyletic** (different origins), so they are not plants.

Class rules

- Moss: **common name only**. Moss slides: **4X objective only, write 40X total**.
- Marchantia: low power then high dry; draw at **400X total** in most cases.
- Genus = italic + underlined. Always the **TOTAL** magnification. Label **all** parts. Typed answers not in black. No blanks.



Fig 1. Green carpet = gametophytes (n). Thin stalks + capsules = sporophytes (2n).



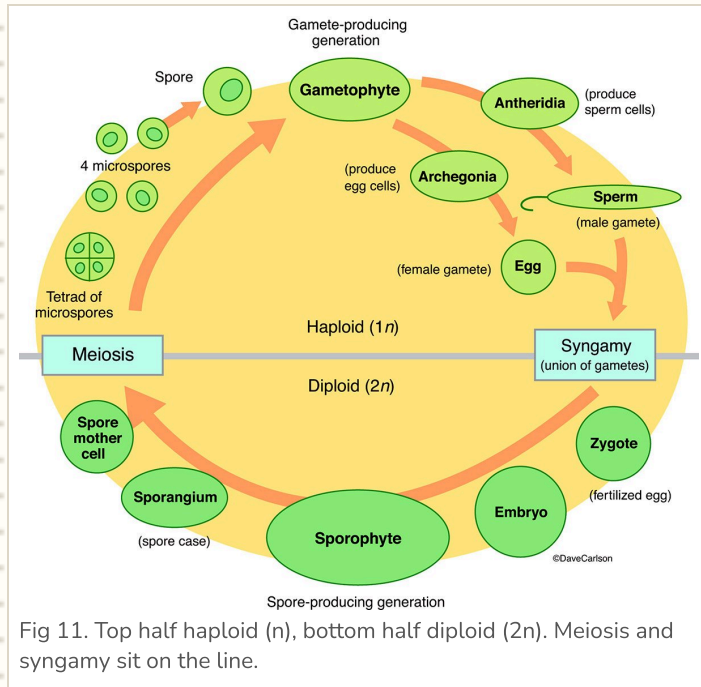
Fig 28. Hornwort: flat thallus, horn-like sporophytes.

My notes

Concept

Alternation of generations

the cycle every plant life cycle is built on



sporophyte $2n$ **MEIOSIS** spores n **mitosis**
 gametophyte n **mitosis** gametes n
FERTILIZATION (syngamy) zygote $2n$ **mitosis**
 sporophyte $2n$

- **Haploid (n)**: one copy of each chromosome. **Diploid ($2n$)**: two, one from each parent.
- **Mitosis** keeps ploidy ($n \rightarrow n$, $2n \rightarrow 2n$). **Meiosis** halves it ($2n \rightarrow$ four n).
- **Gametophyte**: haploid, makes gametes by mitosis.
- **Sporophyte**: diploid, makes spores by meiosis in a sporangium.
- **Spores**: always haploid. **Zygote**: first diploid cell.
- **Spore mother cell**: diploid cell in the sporangium $\rightarrow$ meiosis $\rightarrow$ tetrad of 4 spores.

Trap

Bryophyte gametes come from **mitosis**, not meiosis: the plant is already haploid. The Crash Course video says "diploid spores"; that's wrong.

My notes

Moss body + life cycle

gametophyte dominant · sporophyte attached and dependent

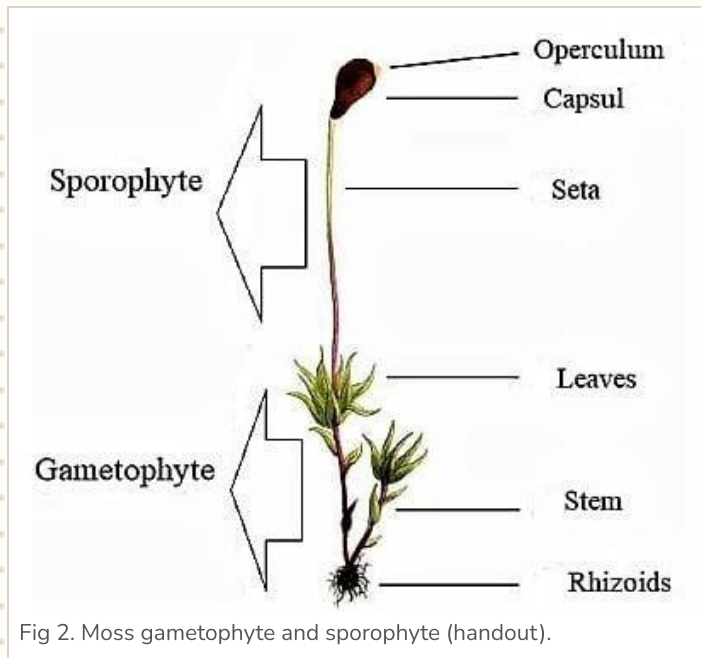


Fig 2. Moss gametophyte and sporophyte (handout).

- **Operculum:** lid of the capsule; pops off to release spores.
- **Capsule (sporangium):** spore case; meiosis happens here.
- **Seta:** the long stalk of the sporophyte.
- **"Leaves" / "stem":** leaf-like and stem-like, not true (no vascular tissue).
- **Rhizoids:** root-like anchors, not true roots.
- **Calyptra:** cap on the young capsule, torn from the archegonium (haploid).

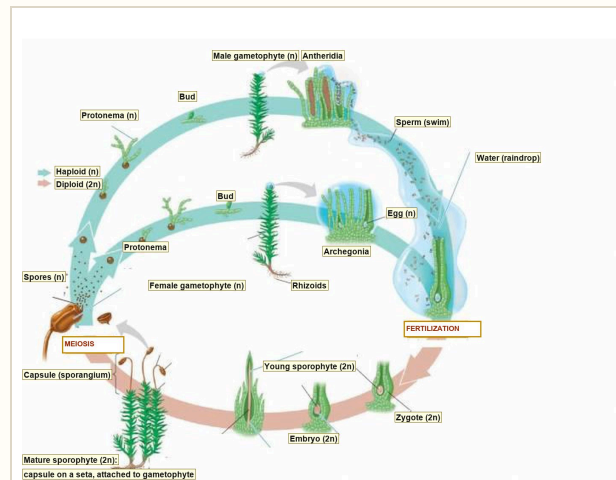


Fig 3. Figure 8.1 moss life cycle, stages labeled.

1. Spore (n) → **protonema** (green threads) → bud → leafy gametophyte.
2. Male shoot: **antheridia** → sperm. Female shoot: **archegonia** → egg.
3. Water: sperm **swim** to the archegonium → **zygote (2n)** stays inside.
4. Zygote → mitosis → **sporophyte**: seta + capsule.
5. Capsule: **meiosis** → spores (n) released. Repeat.

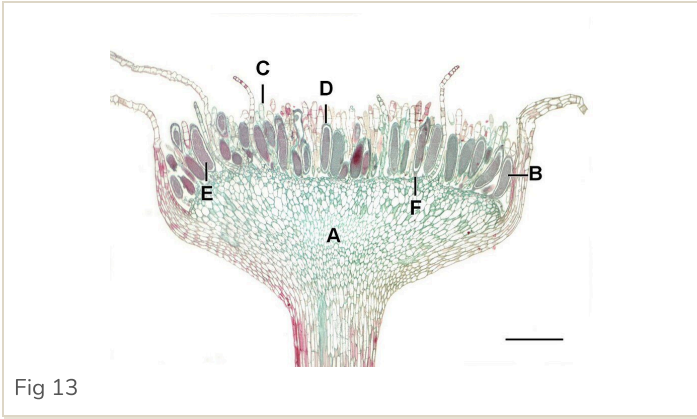
Practice: cover the labels on Fig 3, or use the blank Fig 4, and name every stage.

My notes

What you draw: moss

all at 4X objective → write **40X** total · title with the common name

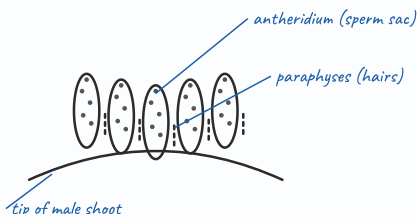
Moss antheridia



4X objective · 40X total

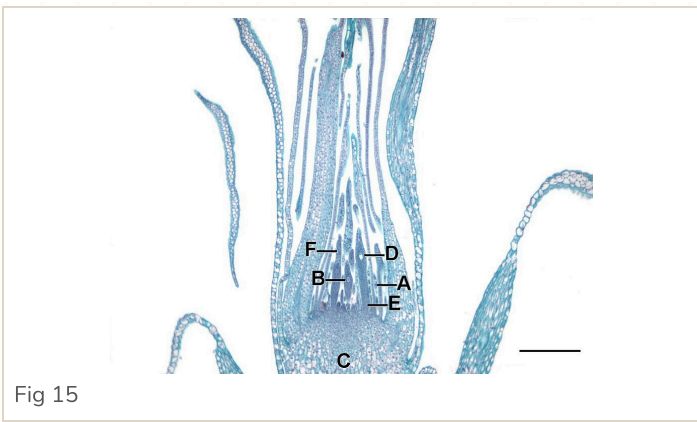
- **Antheridium:** elongated sac full of dark sperm-forming cells (makes sperm)
- **Paraphyses:** sterile hairs between the sacs
- **Male shoot tip:** cup-shaped tip of the male gametophyte

How to draw it



1. Draw a shallow cup line for the shoot tip.
2. Stand 4 or 5 long ovals on it.
3. Stipple dots inside each oval (sperm cells).
4. Thin lines between them = paraphyses.
5. Label: antheridium, paraphyses, male gametophyte.

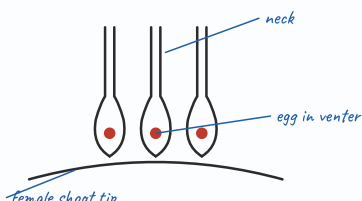
Moss archegonia



4X objective · 40X total

- **Archegonium:** flask shape: long neck + swollen venter
- **Venter:** swollen base holding ONE egg
- **Neck:** long tube the sperm swims down
- **Paraphyses:** hairs between archegonia

How to draw it

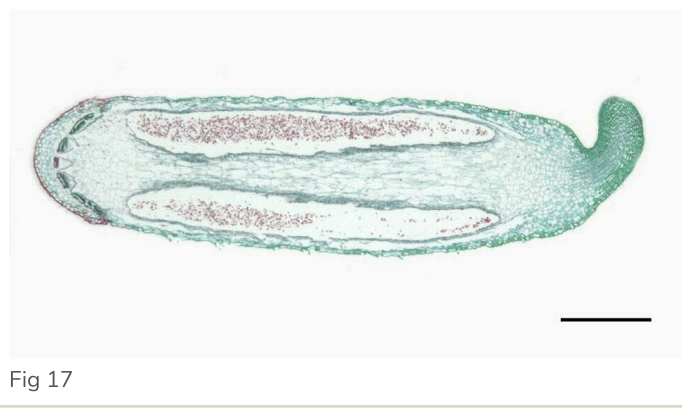


1. Curve for the female shoot tip.
2. Draw 2 or 3 tall flasks: wide base, long thin neck.
3. One dot in each base = egg.
4. Label: archegonium, neck, venter, egg, female gametophyte.

What you draw: moss (cont.)

4X objective → 40X total

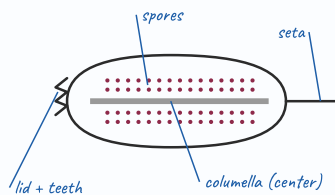
Moss capsule



4X objective · 40X total

- **Capsule (sporangium):** spore case on the sporophyte; meiosis → haploid spores
- **Spores:** dots packed around the center
- **Columella:** central column of tissue
- **Operculum + peristome:** lid and ring of teeth at the open end
- **Seta:** stalk at the other end

How to draw it



1. Long oval for the capsule.
2. Line down the middle = columella.
3. Dots on both sides = spores.
4. Zig-zag teeth at one end (lid end); short stalk at the other.
5. Label all five parts.

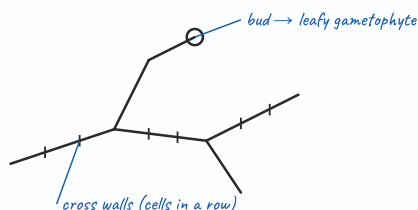
Moss protonema



4X objective · 40X total

- **Protonema:** branching green threads of haploid cells grown from a spore
- **Cross walls:** cells in a single row
- **Bud:** swelling that becomes a leafy gametophyte

How to draw it



1. Draw a few branching lines.
2. Short ticks across them = cell walls.
3. Small circle at a tip = bud.
4. Label: protonema, cell, bud.

Marchantia: the liverwort

Phylum Hepatophyta · body = thallus · water needed for sex

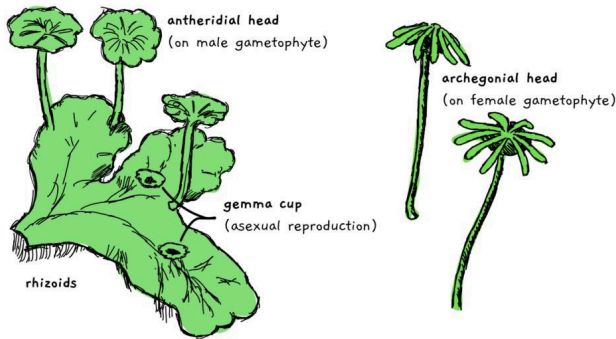


Fig 9. Male and female gametophytes (handout drawing).



Fig 6. Archegonial heads (female)



Fig 8. Antheridial heads (male)



Fig 10. Gemma cups

- **Thallus:** flat, lobed green body of the gametophyte (n), close to the ground.
- **Rhizoids:** on the underside; anchor, not roots.
- **Antheridial head:** flat disc on a stalk, male. Antheridia sit in its top surface.
- **Archegonial head:** finger-like rays (star umbrella), female. Archegonia hang underneath.
- **Gemma cup:** cup on the thallus holding **gemmae**, the asexual clones splashed out by rain.
- **Sporophyte:** tiny, hangs under the female head: foot, short seta, capsule with spores + **elaters**.

Why the capsule looks different

Moss capsule: held up on a long seta. Marchantia capsule: small, hangs down under the archegonial head, very short stalk, spores mixed with spiral elaters.

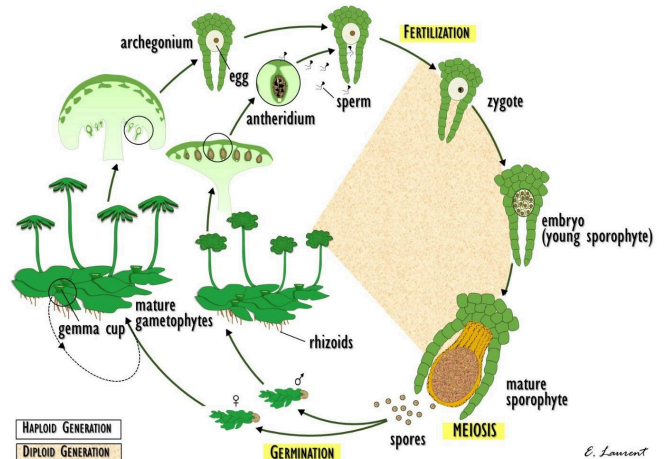
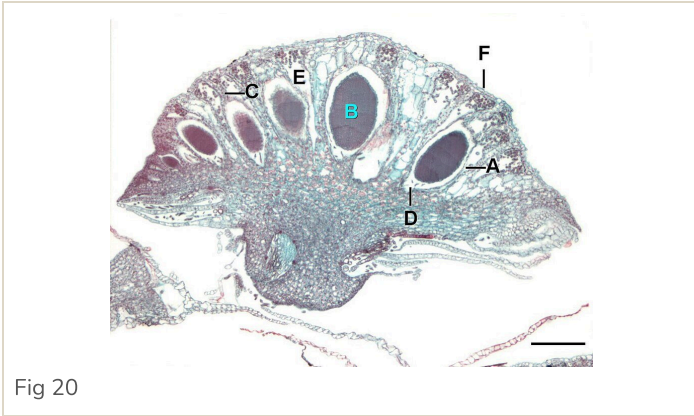


Fig 5. Figure 8.2 Marchantia life cycle. The gemma-cup loop is asexual.

What you draw: liverwort

low power then high dry · draw at **400X** total (100X if it won't fit)

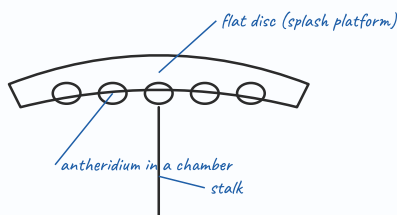
Marchantia antheridia



40X objective · 400X total

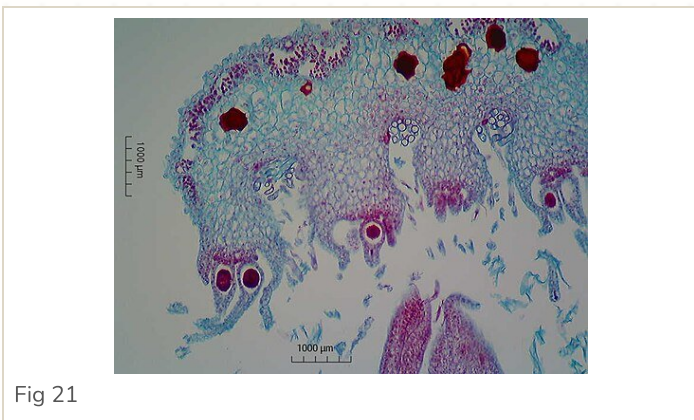
- **Antheridial head:** flat disc = splash platform
- **Antheridium:** oval sac sunk in a chamber, full of sperm-forming tissue
- **Stalk:** holds the disc up
- **Air chambers:** spaces under the top surface

How to draw it



1. Draw a flat, slightly domed disc on a stalk.
2. Row of ovals just under the top surface.
3. Label: antheridial head, antheridium, stalk.

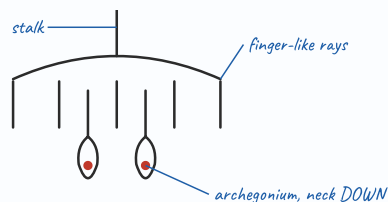
Marchantia archegonia



40X objective · 400X total

- **Archegonial head:** umbrella with finger-like rays
- **Archegonium:** flask hanging NECK-DOWN under the head
- **Egg:** in the swollen venter

How to draw it



1. Umbrella curve with rays.
2. Flasks hanging down underneath, neck pointing down.
3. Dot = egg. Label: archegonial head, archegonium, egg.

What you draw: liverwort (cont.)

400X total in most cases

Marchantia capsule (sporophyte)

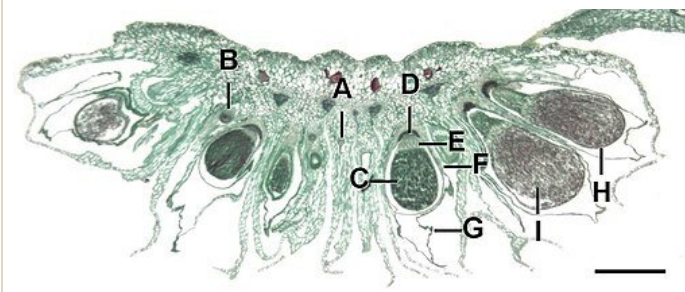


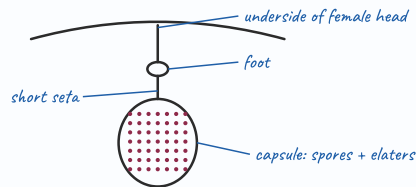
Fig 22

40X objective · 400X total

- **Foot:** anchors the sporophyte in the gametophyte; absorbs food
- **Seta:** very short stalk
- **Capsule:** round case of spores + elaters
- **Elaters:** spiral cells that scatter spores

Fig 23 shows a younger sporophyte still inside the archegonium.

How to draw it



1. Curve for the underside of the female head.
2. Small knob = foot, then a short stalk.
3. Round capsule full of dots.
4. Label: foot, seta, capsule, spores, elaters.

Marchantia gemma cup

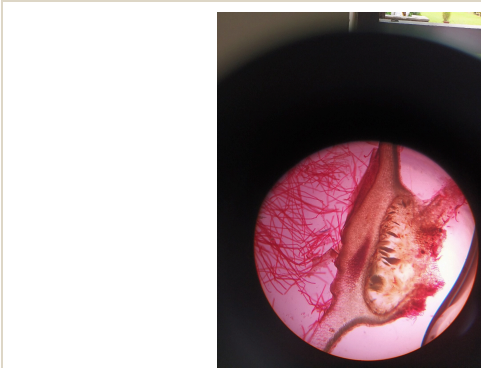
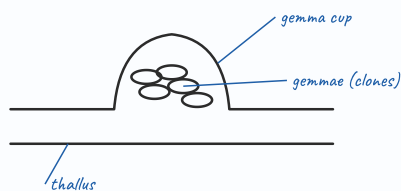


Fig 24

40X objective · 400X total (100X for a whole cup)

- **Gemma cup:** cup-shaped rim on the thallus surface
- **Gemmae:** small flat discs, clones made by mitosis
- **Thallus:** flat body tissue under the cup

How to draw it



1. Flat line for the thallus.
2. U-shaped cup rising from it.
3. Lens-shaped discs inside = gemmae.
4. Label: gemma cup, gemmae, thallus.

Compare + traps

one page to look at before the quiz

	Moss	Liverwort (<i>Marchantia</i>)
Phylum	Bryophyta	Hepatophyta
Body	leafy shoot	flat thallus
Male	antheridia at the shoot tip	antheridia in a flat disc head
Female	archegonia at the shoot tip	archegonia under a finger-rayed head
Sporophyte	long seta, capsule on top	hangs under the female head; foot, short seta, capsule
In capsule	spores; lid + peristome teeth	spores + elaters
Asexual	(not in the handout)	gemmae in gemma cups
Draw at	4X obj · 40X total	400X total

Traps

- Antheridia = sperm (male). Archegonia = egg (female).
- Green plant = gametophyte (n). Brown stalk + capsule = sporophyte (2n).
- Spores are haploid. Zygote, seta, capsule, foot are diploid. Calyptra is haploid.
- Gametes by mitosis; spores by meiosis.
- Rhizoids are not roots. No true leaves or stems.

Every drawing

- Title (moss = common name; *Marchantia* italic + underlined).
- Magnification: **total** (40X moss, 400X liverwort).
- Description: shape, color, what's inside.
- Label **all** parts. Typed answers not in black.

My notes