Bryophyte Divisions

- Three divisions
  - Hepatophyta (liverworts)
  - Anthocerophyta (hornworts)
  - Bryophyta (mosses)

Common Characteristics

- Motile sperm
- Gametophyte thallus most prominent generation, not sporophyte
  - Thallus = plant tissue undifferentiated into a leaf, stem or root
- Most leaves lack cuticle
  - For absorption
- No true leaves, stems or roots
  - General lack of vascular tissue
  - But see mosses, …

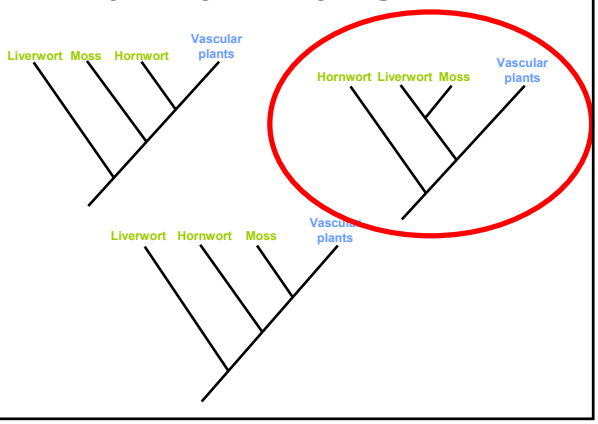
Homospory

- All bryophytes homosporous
- Produce 1 kind of spore
- Spore develops into gametophyte
- Gametophyte produces both antheridia (sperm) and archegonia (eggs)

But Not a Natural Group!

- **Paraphyletic**
  - Some, but not all, descendents of a common ancestor
  - In other words, what other people thought was correct was, in fact, wrong
  - Based on an old taxonomy

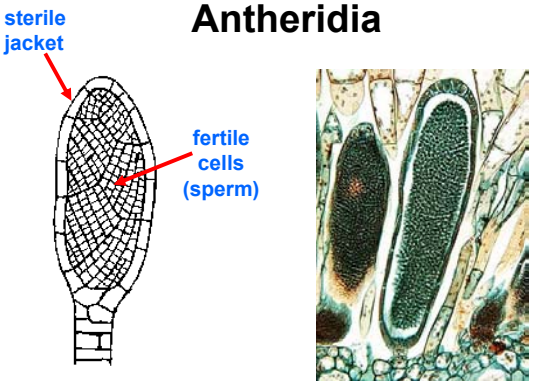
Bryophyte Phylogenies



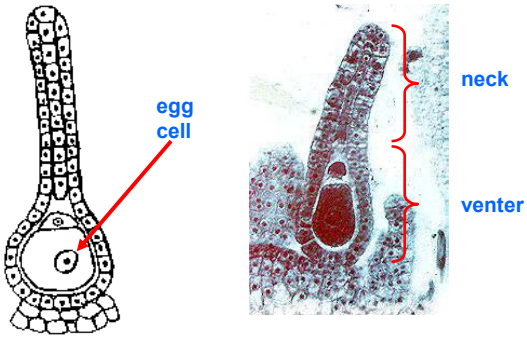
Rhizoids

- **Roots**
  - Absorption
  - Anchorage
  - Vascular tissue
- **Rhizoids**
  - Anchorage
  - Minimal or no absorption
  - *No* vascular tissue!
- **Rhizomes**
  - Underground stem
  - Vascularized, with stem (not root) pattern

Antheridia

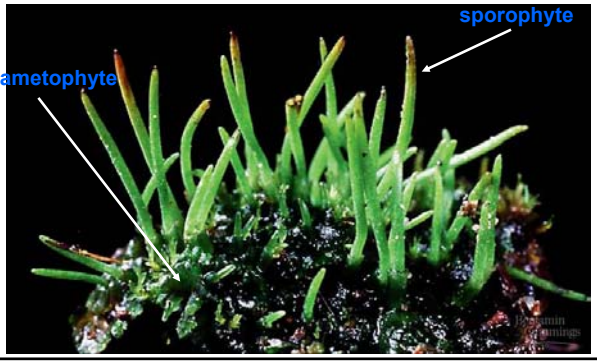


Archegonia

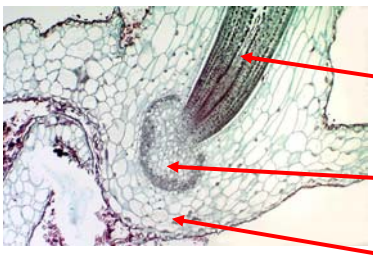


Hornworts

- Simplest gametophyte of all bryophytes
  - Small, flat thallus



Sporophyte

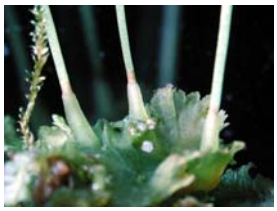


- Foot supplies nutrients via transfer cells
  - Embedded in gametophyte

Sporophyte

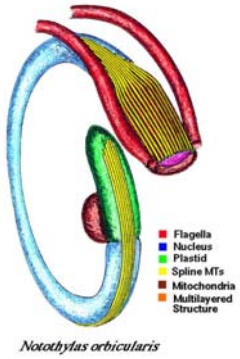
- Contains true stomata
  - Gas exchange
- Under favorable conditions may outlive gametophyte
  - Foot acts as root
  - Conducting tissue may develop at sporangium base
  - Unusual condition of free-living sporophyte!

Anthoceros



Capsule splits (sporangium)

Hornwort Spermatozoid



Notothylas orbicularis

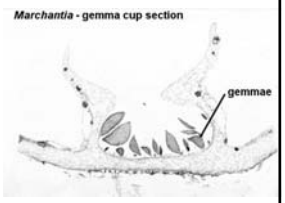
Liverworts

Using *Marchantia* as an example

Liverworts

- Gametophyte often ribbon-like
  - Thallose or leafy
- Rhizoids
- Sporangia with 4 valves
- Capsule with elaters
  - Specialized, thickened cells
  - Dispersal
- Examples: *Riccia* & *Marchantia*
- Gametangia buried in deep, lengthwise depressions on upper surface of thallus

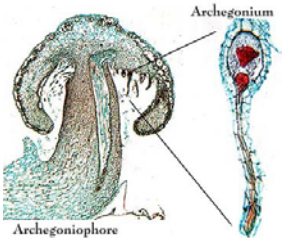
Asexual reproduction



•Form on upper surface.
•Contain gemmae (small green disks of tissue)
•Raindrops break them free of cup, & these can turn into gametophytes

Sexual reproduction: Archegoniophores

- ***Marchantia*** **is dioecious (separate male & female plants)**

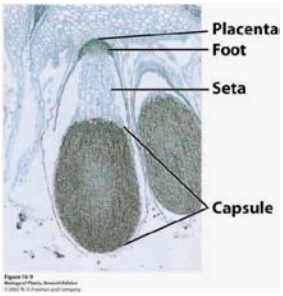


Archegoniophore: structure bearing archegonia NOT sporophyte tissue!!!!

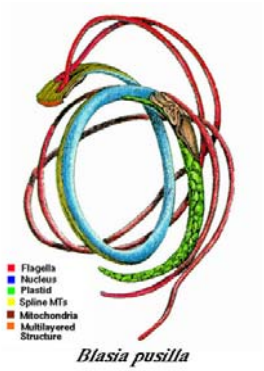
Marchantia Antheridiophores

Antheridiophore: structure bearing antheridia

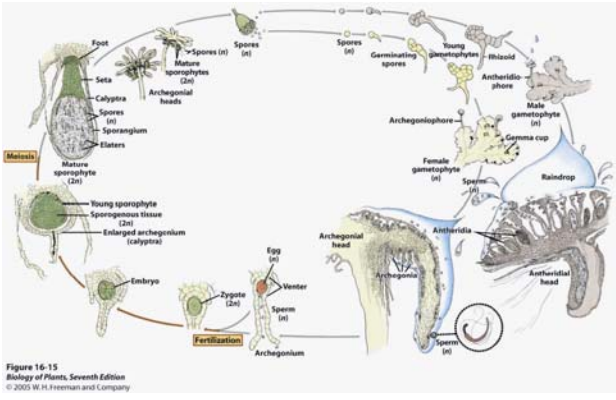
Marchantia Sporophyte



Spermatozoid



Marchantia Life Cycle



Mosses

Bryophyta: Mosses

3 classes

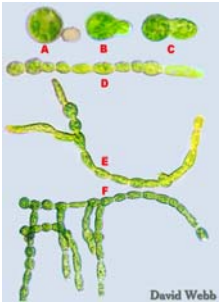
- Andreaeopsida
  - Lantern, Granite mosses
- Sphagnopsida
  - Peat mosses
- Bryopsida
  - True mosses

Gametophytes

- 3 Phases
  - Protonemal phase
  - Bud phase
  - Leafy phase (“phyllids”)



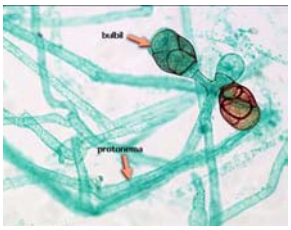
Protonemal Phase



- Creeping, filamentous phase
- Spores initially dormant
  - Water + light cause growth
  - Protonema comes out of spore
  - Growth is directed towards red light

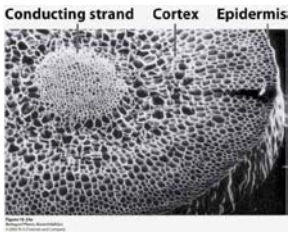
Bud Phase

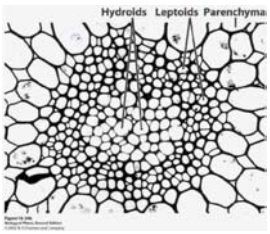
- Some protonemal cells develop into a mass of cells called a *bud*
- One bud cell functions as the tip of a caulid, controlling direction of further cell division
- Each bud develops into a mature gametophyte
- Rhizoids grow downward from bud



Vascular Plants?

- Some mosses have hydroids & leptoids
- Not the same as xylem & phloem





Hydroids

- Hydroids have no lignin
- Very slow translocation of water
- Limited distribution in plant
- Mosses can remain dry for a long time, yet come back to life when wetted
  - Up to 20 years in drought-tolerant species, yet come back to life within 4-24 hours!
  - Try it! Get some moss, let it dry for a few weeks or longer, then wet it

Leptoids

- Primitive sieve elements?
- Degenerate, inactive nuclei
- Many plasmodesmata in end walls
  - Plasmodesmata connect cells
- Nearby parenchyma tissue may act as companion cells
  - Details when we cover anatomy
  - Companion cells (higher plants) help load/unload sugars, etc.

Asexual reproduction

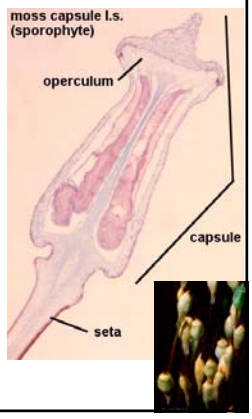
- Gemma cups (splash cups)
- Clonal
  - Protonema can produce more buds
- Phyllid tissue in wet soil may produce protonemal strands
- Rhizoids can produce buds (sometimes)

Sexual Reproduction

- Gametangia produced at main caulid apex
- Monoecious or dioecious
- Apparent independent of light
  - Soil pH, air temp., etc.
- Antheridial heads
  - Antheridia elongate
  - Outer sterile jacket usually contains chloroplasts
  - Sperm have 2 flagella
- Archegonial heads.
  - Often retain a layer of water (phyllids aid in this)
  - Any sperm that land can swim on in

Moss Sporophyte

- Foot, seta and capsule
- Old archegonium increases in size, becomes the calyptra
  - Acts as temporary protective covering over sporangium
- Operculum covers sporangium opening
- Up to 50 million spores per sporangium

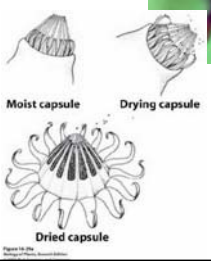


Moss Sporophyte

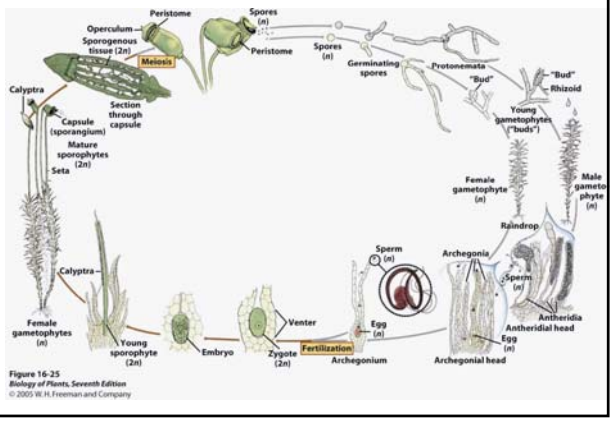
- Mature seta and capsules contain:
  - epidermis of cuticle
  - stomata
  - thick-walled steroids (small, thick-walled parenchyma cells)
  - a cortex region
  - central strand of conducting tissue
- Can produce 10-50% of photosynthesis needs
  - Rest from gametophyte

Dispersal: Peristome

- Calyptra falls off
- Operculum shed
- Peristome teeth attached to annulus



Moss Life Cycle



What good is it?

What about ecological indicators?

Sphagnum

- ***Sphagnum*** **have large, empty, clear cells in epidermis that fill with water (via a pore) & serve as reservoir**
- **Worldwide carbon dioxide buffer**
  - **High CO_2 levels, take in more**
  - **Low levels, take in less**
- **Environmental indicators**
- **WWI wound dressing**
  - **Antiseptic & absorbent**
- **Peat bogs cover ~ 1% earth's surface**
  - **Half size USA!**

Various Moss Structures