Plants: Mosses & Allies
(Phylum: Bryophyta)

~15,000 species

include mosses, sphagnum, peat, liverworts, hornworts

***some other species have the word “moss” in their common names but they are NOT really mosses; they just resemble them in some way)

eg. ball moss, spanish moss  → types of flowering plants
eg. reindeer moss  → a kind of lichen
eg. clubmoss  → relative of ferns

General Characteristics of Mosses

1. mosses are the most ancient plants

   oldest plant fossils; over 400 MY old

   plants that were first able to leave aquatic environment and move onto land

   mosses apparently developed from a green alga as a “dead end” group

   not in direct path of evolution (ie. vascular plants did not have moss ancestors)

   but vascular plants probably also evolved from a green algal ancestor

2. mosses are the simplest of plants

   most are small (<20 cm) and inconspicuous

   eg. smallest are “pygmy mosses”: 1-2mm (.04-.08”)

   complete entire life cycle in a few weeks

   mosses have no vascular tissue

   → therefore they have no true roots stems or leaves

   no water distribution system: no vascular tissue

   → absorb water & nutrients through epidermis (like sponge)

   → water doesn't circulate through plant

   internal flow by osmosis and cytoplasmic streaming

   cells hydrate when water is around and dehydrate when water is scarce

   some have slender stem-like structure bearing leaf-like blades

   most only a single cell layer thick

   can grow upright or along ground

   in others most of the body is a thin sheetlike thallus that lays on the ground

3. generally poorly adapted to land

   → tend to live in moist places

   live in dense beds on moist soil, rocks or bark

   cuticle is very thin or completely lacking

   most species are tropical, but many also found in temperate areas and also found in the arctic tundra

4. all are still tied to water for sexual reproduction

   produce flagellated sperm cells that must swim to the egg

   only need a film of water for sexual reproduction

The Life of a Moss

since mosses lack vascular tissue they have no true roots stems or leaves

photosynthesis is done by

   → leaflike blades that are usually a single cell layer thick

   → or sheet-like thallus that sits on ground

some bryophytes have stomata for gas exchange

each individual plant has tiny root-like rhizoids for attachment

   (not to absorb nutrients for the plant)

   mosses do not require good soil since they have no vascular tissue

   mosses get all the nutrients and water they need by absorption across the whole plant

mosses are pioneer plants:

   often first to colonize bare rock

   often found on bare rock, tree trunks, frozen tundra, deserts, etc

   the plant also traps dust particles to help create soil

   hold soil in place and help prevent erosion along streams

   also thick growths help to retain moisture and minerals that might otherwise be lost

   mosses can actually accumulate some minerals from rainfall

   eg. calcium, potassium, and magnesium

   produce acids that help in soil formation

   a few mosses are restricted to very specific habitats:

   eg. antlers and bones of dead reindeer

   eg. dung of mammals

   eg. surface of dead insects
although generally poorly adapted to land
many mosses can withstand long periods of freezing or drought:

→ they can be very tolerant to desiccation
   they are not damaged as are all other plants
→ many mosses thrive at low temperatures;
   near or even below 0°C

some mosses have symbiotic nitrogen fixing blue green bacteria which can also add nitrogen to the soil
most of the nitrogen in arctic and sub-arctic ecosystems comes from this symbiosis

mosses also produce toxins that protect them from bacteria and fungi and prevent them from being eaten by insects and slugs

Reproduction and Life Cycle:
mosses show basic alternation of generations

**gametophyte** is the dominant form:

- It is larger
- It is often perennial while the sporophyte is temporary
- It provides nutrition for sporophyte

leafy green

feet

flagellated sperm are released from antheridia during rainy weather and transported by splashing of raindrops
sperm can also hitch a ride to the archegonium on tiny insects and mites that live in the moss
once at female plant, sperm swims down neck of archegonium and fuses with egg = zygote

**sporophyte**

the zygote grows into a sporophyte
it remains attached to the gametophyte for nutrition

the sporophyte consists of a:

- foot = embedded in tip of gametophyte
- seta = stalk
- capsule = sporangium

asexual spores develop in the capsule
may contain up to 50M spores
when spores are mature, capsule bursts open as it dries out

wind or rain carry spores to new areas where they germinate

Ecological Significance of Mosses

**Pioneer Plants**

often first to colonize bare rock
produce acids that help in soil formation
the plant also traps dust particles to help create soil

**Stabilize & enhance soil fertility**

hold soil in place and help prevent erosion along streams
also thick growths help to retain moisture and minerals that might otherwise be lost

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Nesting Material

many birds (eg. waxwings) use moss as nesting material

Habitats

small aquatic invertebrates (incl water bears & soil mites) live in and eat some mosses
mosses are not generally edible yet an important food source for a few arctic animals such as caribou

**Acid Bogs**

acid bogs are formed, typically in cooler areas of the world, when sphagnum (peat moss) begins growing on a lake or pond
as it grows it changes its environment to become less hospitable to other species by secreting acids and can lower the pH of the pond to ~3.5
acid inhibits the growth of most other plants
but a few plants have adapted to the acid environment
eg. pitcher plants, blueberries, cranberries
peat bog soils are especially low in Nitrogen
  ➔ also limits the number of other plant species that can live there
  insectivorous plants are well adapted since they can get nitrogen from eating insects
acids also inhibit the growth of bacteria and fungi
  ➔ slows decomposition of organic matter
  ➔ preserves animal and plant remains
  eventually the moss forms a thick mat over most or all of the pond and may look like forest floor but “quakes” when you walk on it
peat bogs: major carbon reserves eg. Sphagnum
  ➔ help to absorb CO₂ and stabilize climate

Human Impacts of Mosses

1. as fuel:
   for 100's of years moss was used as fuel in Finland, Sweden, England, Ireland, West Germany, Poland and Russia
   ➔ dried and burned
   today it can be used produce natural gas, methanol, ethylene, hydrogen
   peat is likely to become an important source of methane production and therefore electricity in the future
   ➔ has rapid regeneration time
   ➔ is easily harvested
   ➔ has low sulfur content
   ➔ heating value is superior to wood

2. medicinal uses:
   through WW I mosses were used extensively as wound dressing
   ➔ 3-4 x's more absorbant than cotton
   ➔ has antiseptic properties
   even today used to treat burns and wounds in the Himalayan region
   extracts are used as germicides, astringents and antiseptics
   used to treat a variety of skin diseases including; eczema, psoriasis, hemorrhoids, scabies, acne
   also seems to help in treating insect bites
   moss compounds have also been found to have anticancer properties

3. as construction materials:
   In parts of the world where woody plants are not available mosses are used in house construction
   when mixed with binders it becomes "peatcrete" & "peatwood"
   ➔ low cost, easily molded, easy to saw and nail

4. as bioindicators:
   a. mosses are sensitive indicators of air pollution
   b. mosses are good indicators of acid rain since they are less protected and therefore much more sensitive the acids
   c. some mosses grow on substrates in only a narrow and specific pH ranges
   ➔ their presence can be used as an indicator of soil pH
   d. some have been associated with mineral deposits
      eg. “copper mosses” (Mielichhoferia spp.) grow only in copper rich soil

5. horticultural uses:
   used as soil additives for ornamental and cultivated plants
   used as soil conditioners and potting mixes
   also used in air layering to propagate woody plants

6. water filtration and treatment:
   sphagnum is used for filtration in waste water treatment
   it tends to remove and concentrate toxins and heavy metals (eg. Ag, Cu, Cd, Hg, Fe, Sb & Pb) and
organic substances such as oils, detergents, dyes and microorganisms

7. collected and sold for crafts

eg. some species used to make baskets and other weavings

commercial moss collecting:

*est $8.4 – $33.7 M/yr business

sell est 4.2 – 17 M lbs/yr based on interviews and dept of commerce data

is an unregulated industry

→ many places ban moss collecting but poorly policed

→ often taken from private or protected land

in US, esp in Appalachia and the Pacific NW