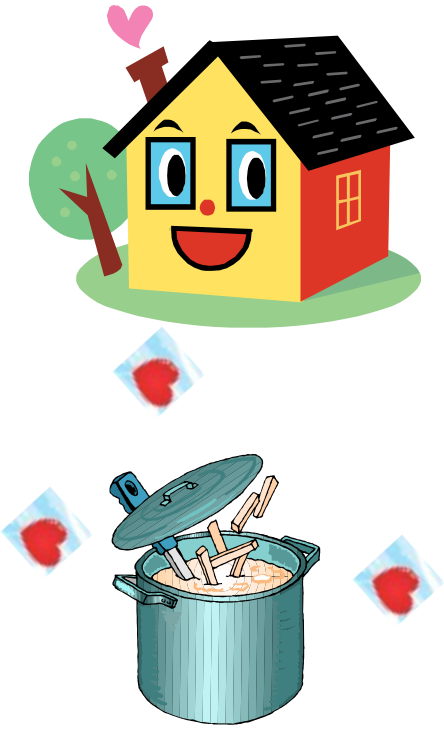
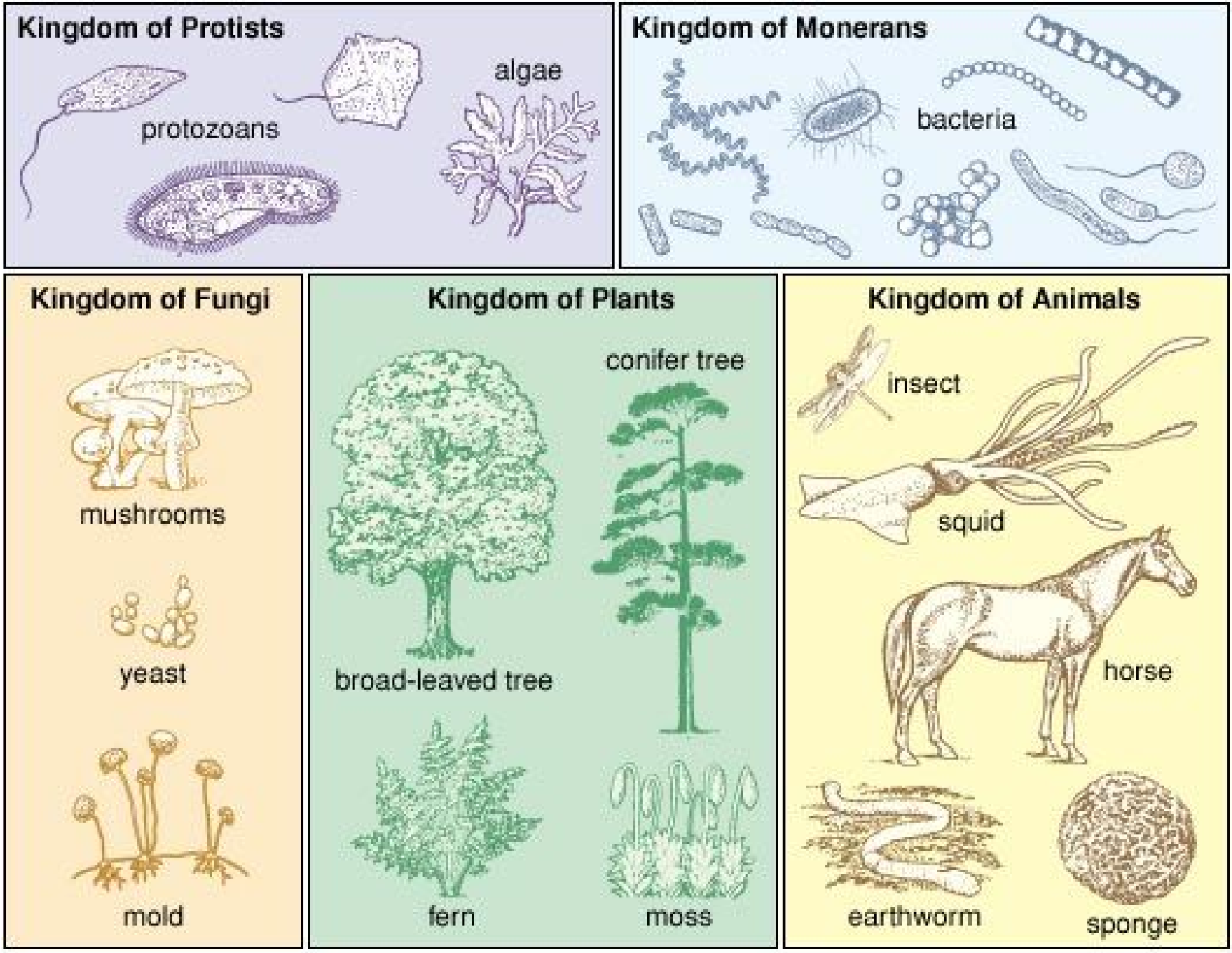
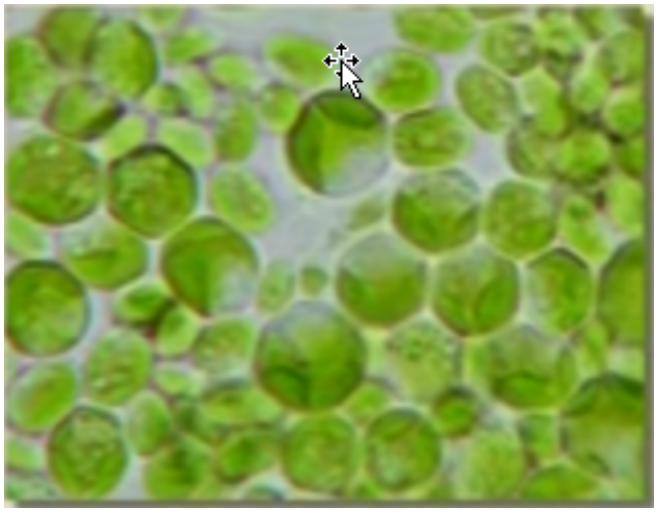
What are Lichens?

- The fungus (Freddie Fungus) provides a cozy, sheltered environment and some nutrients to the algae (Amy Algae). The algae makes its food from sunlight (photosynthesis) and shares it with the fungus.
- They join in order to help each other survive (a **mutualistic** or **symbiotic** relationship).



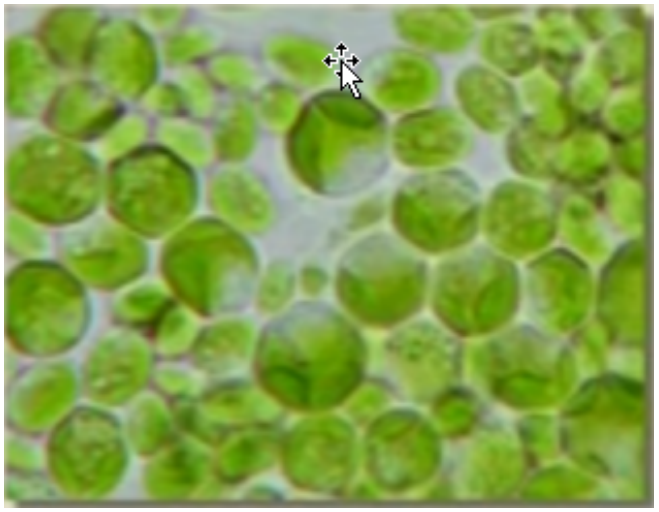


Mycobiont	Photobionts	
Kingdom: Fungi	**Kingdom: Plantae**	**Kingdom: Monera**
(A mushroom)	(Single cell algae)	(Cyanobacteria)



Most common

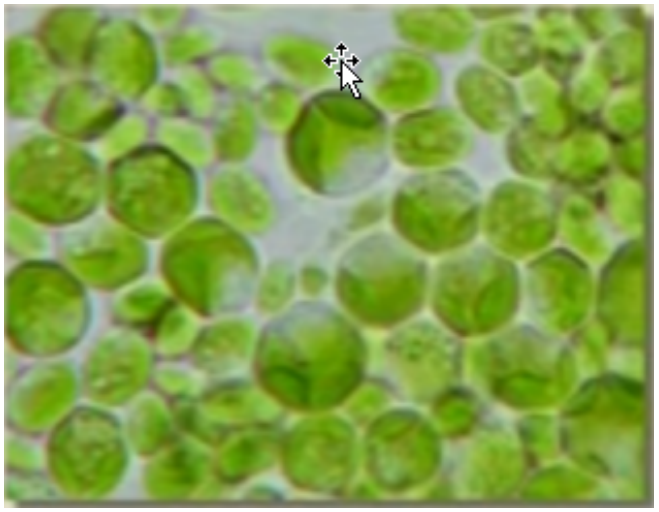
Mycobiont	Photobionts	
Kingdom: Fungi	**Kingdom: Plantae**	**Kingdom: Monera**
(A mushroom)	(Single cell algae)	(Cyanobacteria)



Note dark color due to cyanobacteria

15% of time

Mycobiont	Photobionts	
Kingdom: Fungi	**Kingdom: Plantae**	**Kingdom: Monera**
(A mushroom)	(Single cell algae)	(Cyanobacteria)



Small number of lichens

???
Which lichens

What are Lichens?

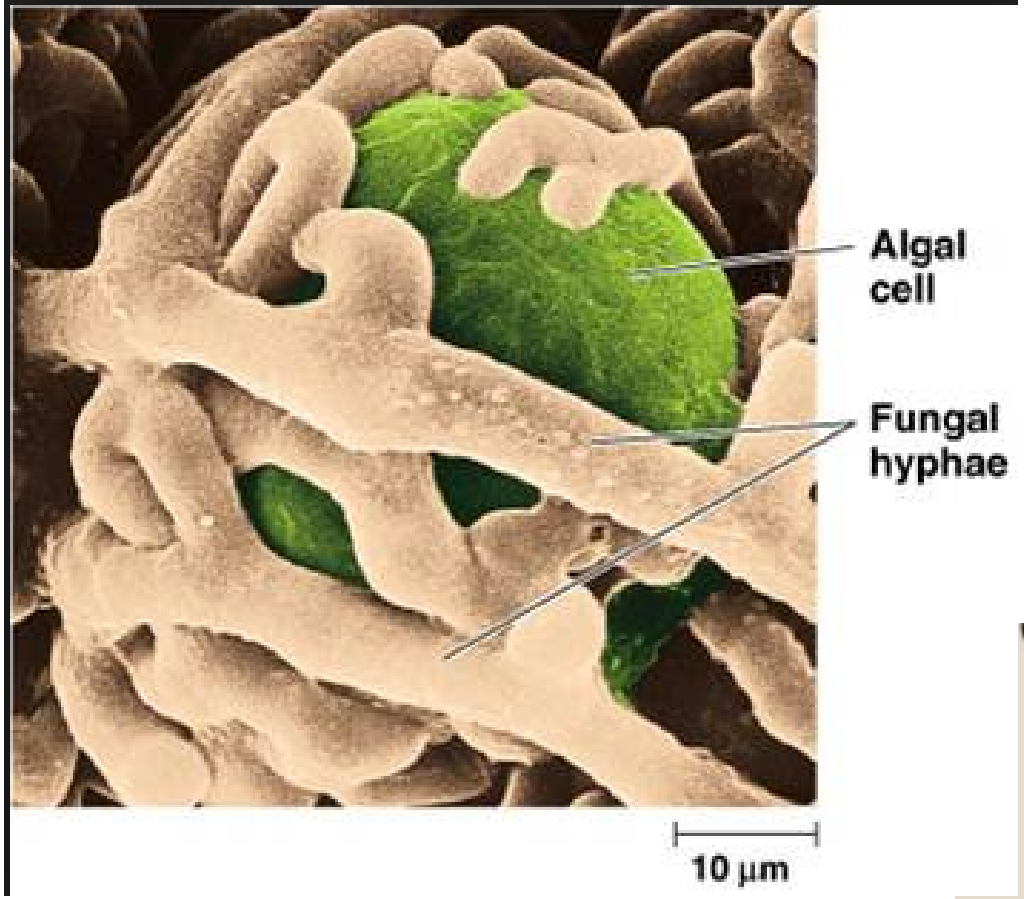
- When a fungus (**mycobiont**), algae, and/or cyanobacteia (**photobionts**) join to form lichen it is called ***lichenization.***

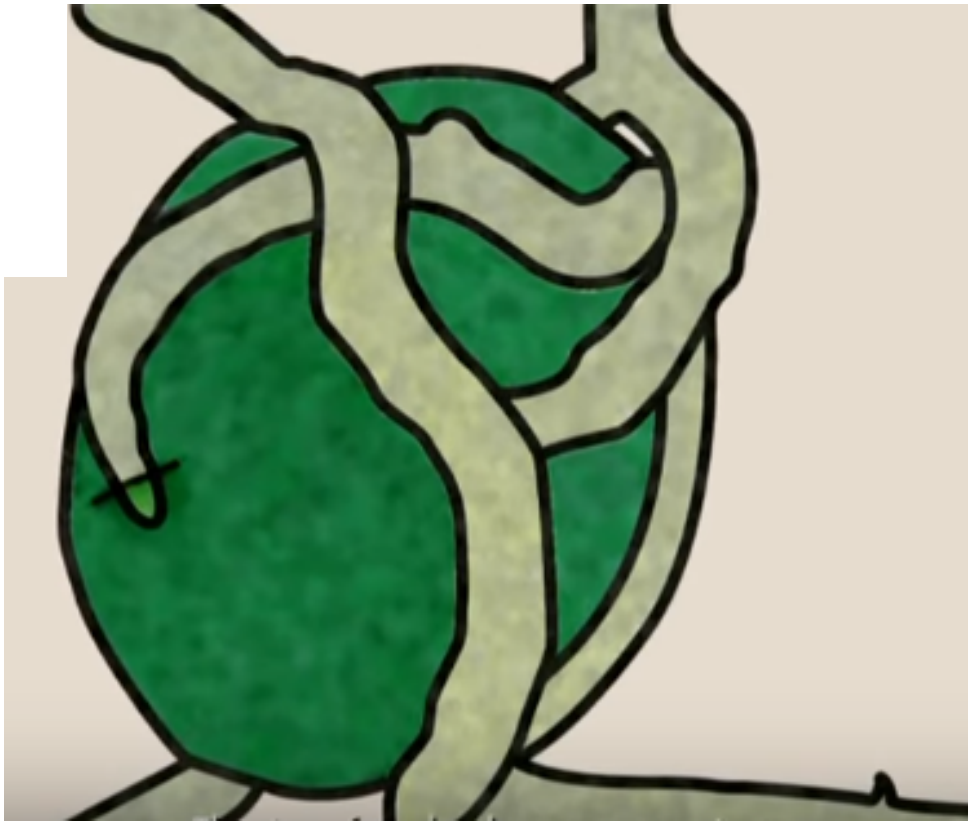
Fungal threads wrapped around alga

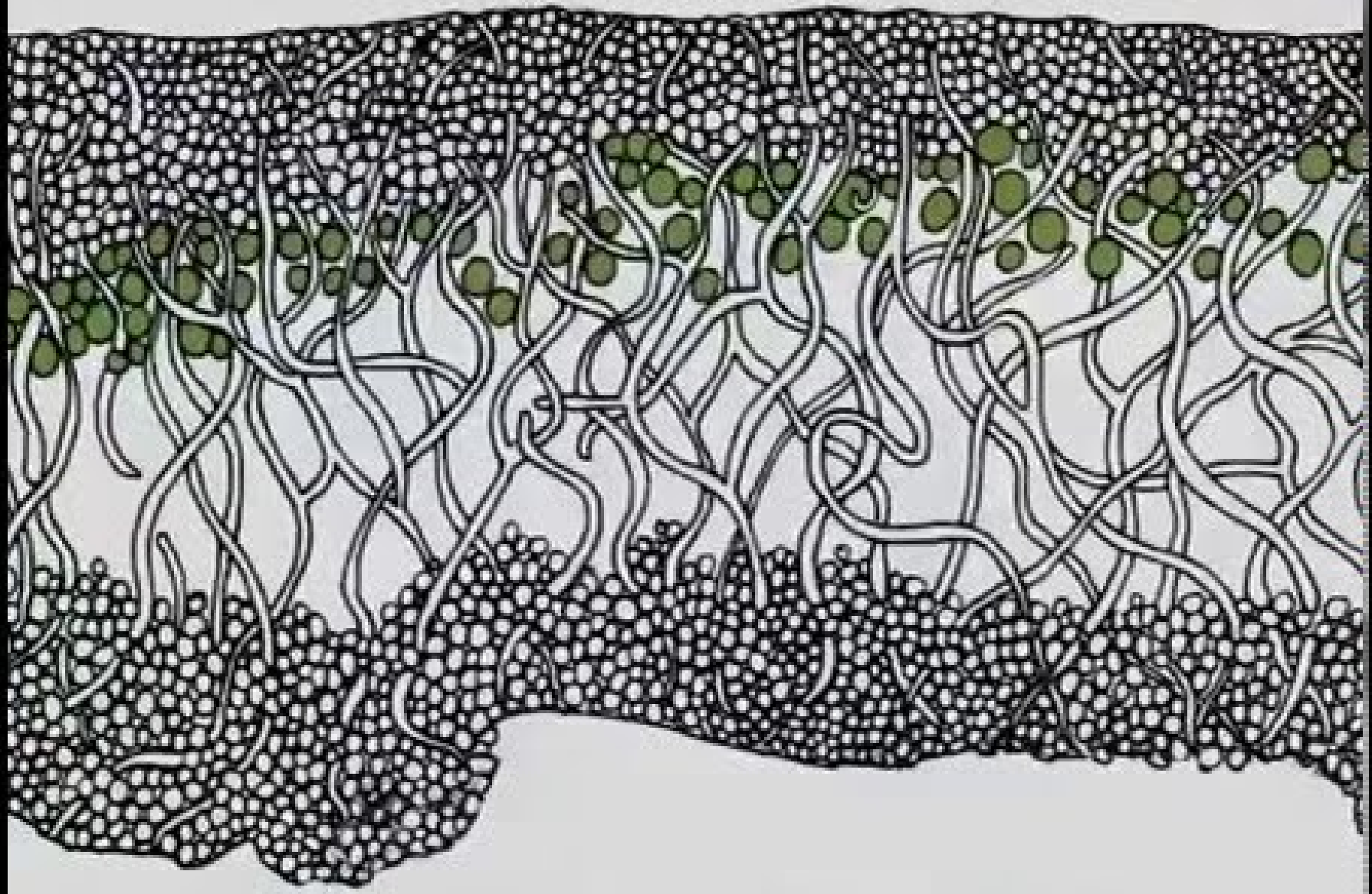
- The composite form is strongly altered in appearance, physiology, reproduction, and chemistry, compared to free-living fungi, algae, or bacteria.

- This allows lichen to live in some inhospitable places that neither of the partners could without the other. They can dry out completely when moisture is unavailable (*poikilohydry*), and their complex chemistry serve to reduce attacks by predators.


Mycelia


Algal cell
Fungal hyphae
10 µm





Together, the fungal hyphae and photosynthetic cells form a stable vegetative body or thallus.

Conceptual to Structure

Basic Forms of Lichens

- **Foliose** (Leafy)

Rag Lichen
Parmelia

- **Fruticose** (Shrubby, branched, beard-like or strap-shaped)

Beard Lichen
Usnea

- **Crustose** (Flaky or crust-like)

Dust Lichen
Leptraria

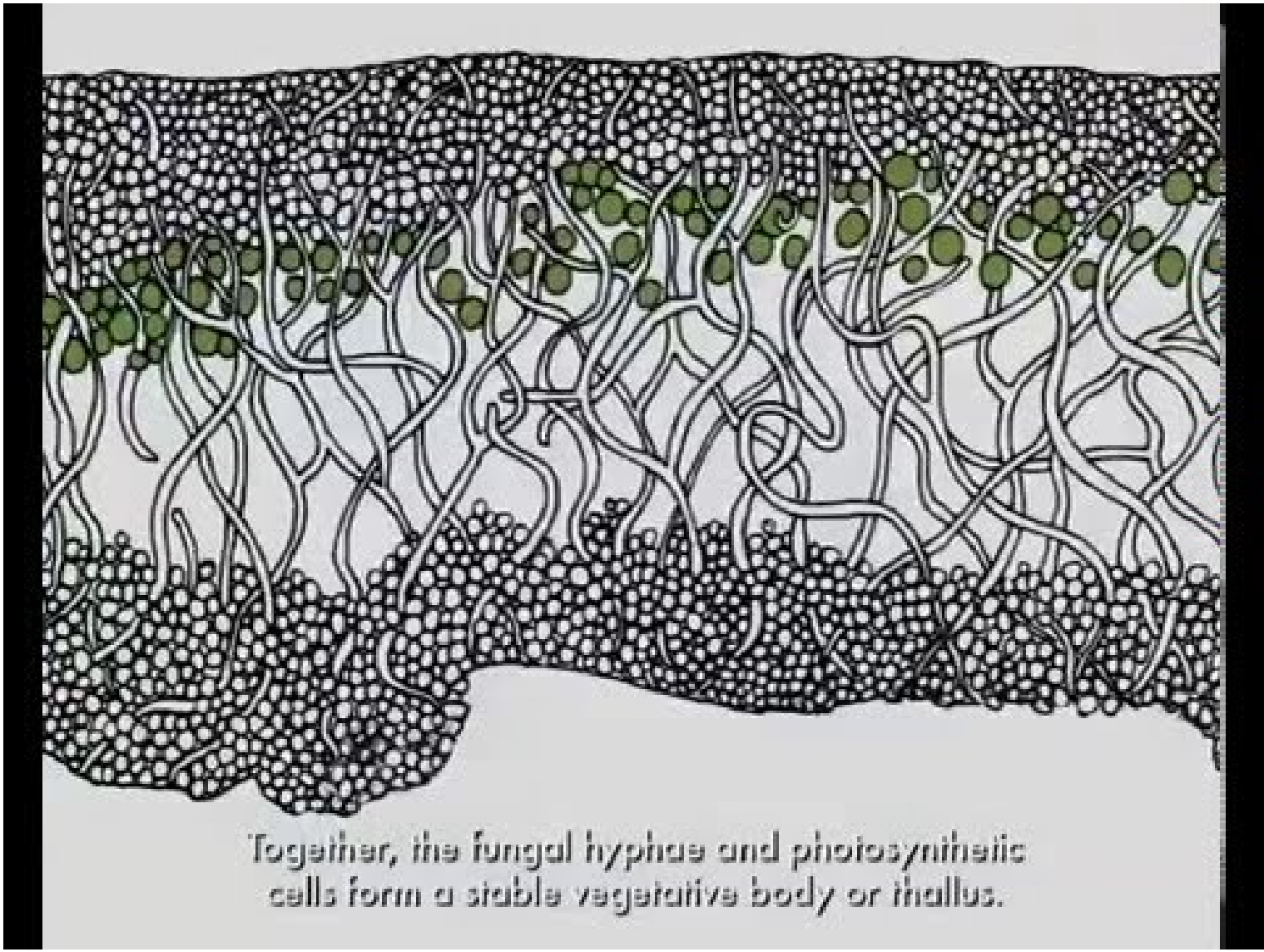
Structure of Lichens

For foliose & fruticose forms

Cortex
(protective layer)

Algae

Medulla
(fungal hyphae)



Lichen Reproduction

Sexual reproduction Structures

- Apothecia – cup-like structures with fungal spores on upper surface.
- Fungus – spores – germinate –

  capture algae -- new individual.

Asexual reproduction

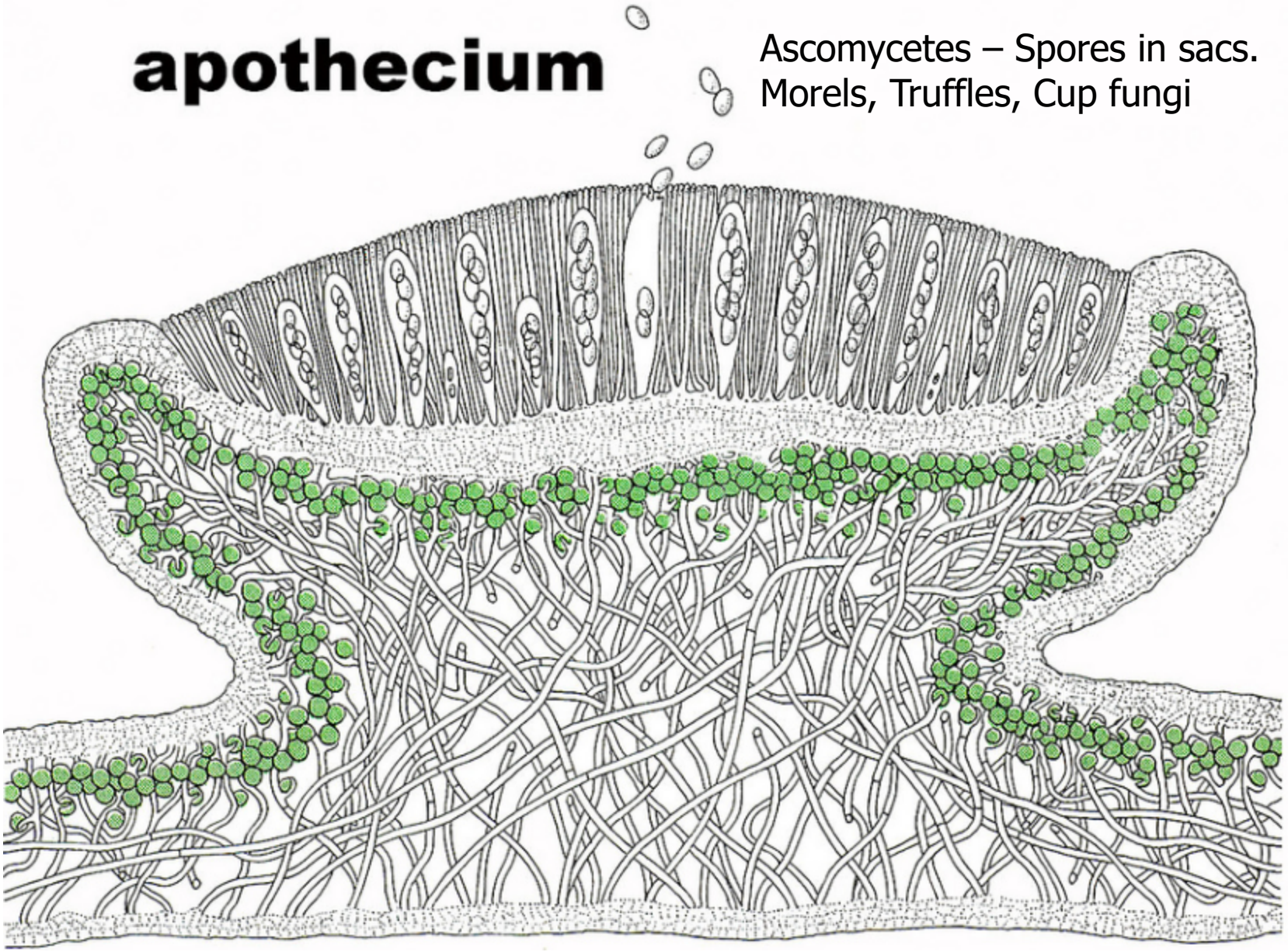
- Soredia and Isidia – balls or finger-like projections of fungi and algae (photobiont)

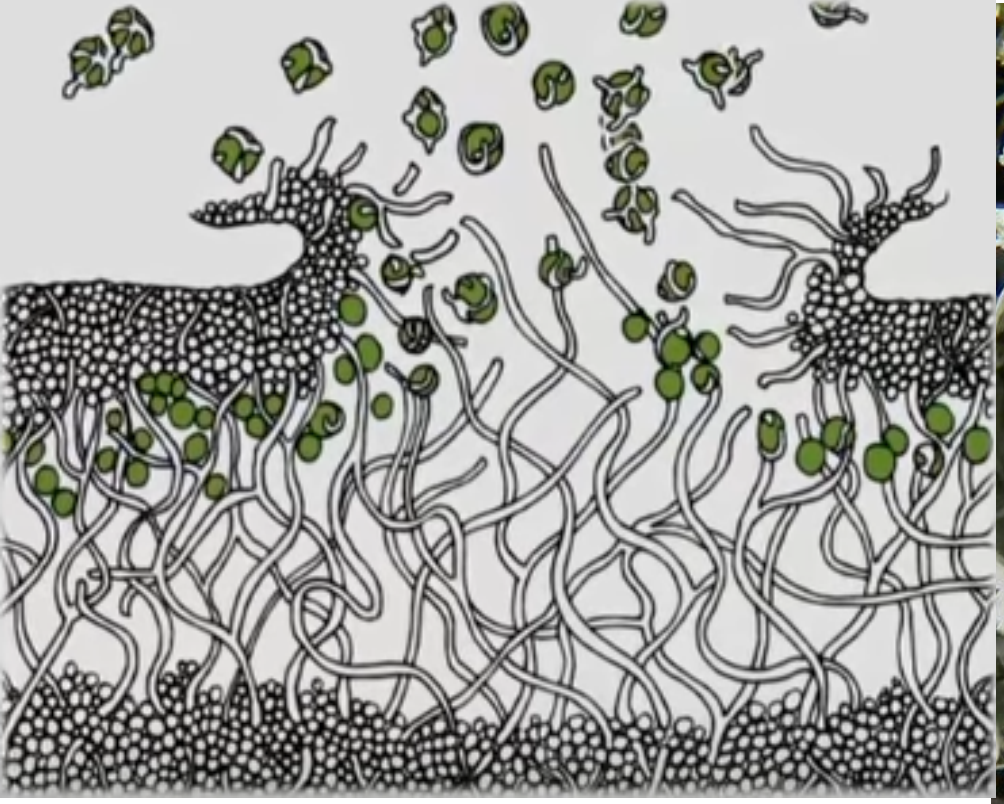
Apothicia

Sexual: Spores (think seeds) are produced in **apothecia** (a disk- or cup-shaped structure). However spores only contain the fungus component and have to find the algae component.

apothecium

Ascomycetes – Spores in sacs.
Morels, Truffles, Cup fungi

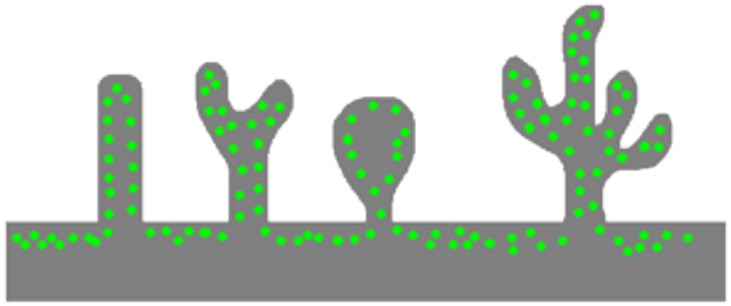




Soredia

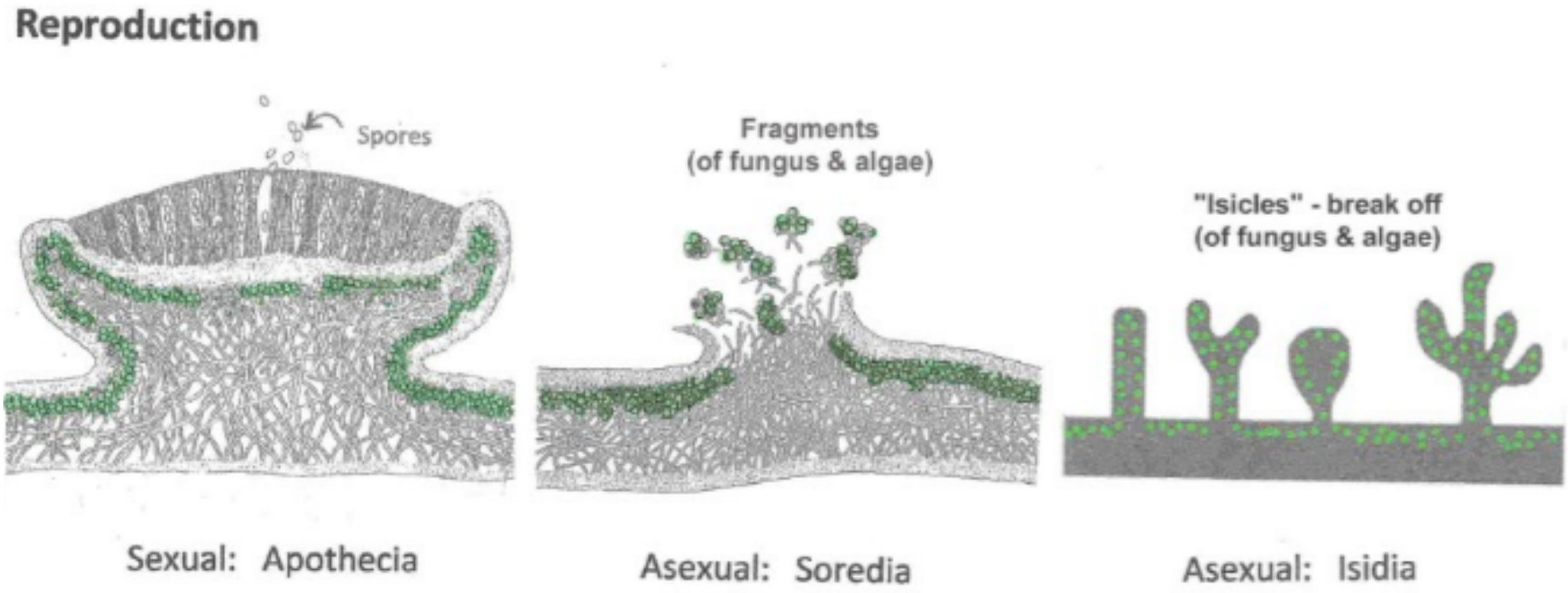
Asexual: Sometimes there are openings here and there in the cortex (think “open sores”) and the inner “stuffing” of the lichen become exposed at the surface. These “stuffings” are little roundish packages made up of fungus & algae called **soredia** that look like clusters of tiny, powdery or granular balls. When released soredia can grow into new lichen.

Isidia



Asexual: **<u>Isidia</u>** are wart like or “icicle-like” growths that contain both fungus and algae cells that can break off to start a new lichen just like soredia can.

Summary



<u>Fragmentation:</u> when pieces of lichen break off they may travel short distances by the wind or animals & they may establish new individuals. Some lichen rely largely on this strategy.

Where are Lichens Found?

- Ground, glass, metal
- Tree bark and other wood
- Rocks
- Leaves
- Other lichens

They can be found in our forests, deserts, tundra, the highest mountains of the world, and rocks in Antarctica.

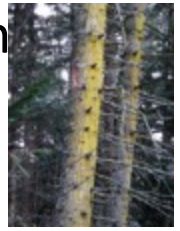
Lichen Characteristics

- Lichens are <u>non-vascular</u>. This makes them very dependent on the water and nutrients located directly on the surface or provided in the air.

- Many lichens show a marked <u>preference to substrate</u>---rock, bark of trees, wood, soil. They are very <u>sensitive to the amount of nutrients available</u> on any given growing site (calcium-loving, acid-loving, base-rich).

- The are **not** <u>parasitic</u> on what they attach themselves to (substrate)---except maybe other lichens.

- Lichens <u>grow & disperse slowly</u> compared to vascular plants.

- In PNW li  ty is high in coas  rian areas & in rainfall, lo  evation forests

How to talk like a lichenologist:

Few lichens have common names that are in widespread use. Wolf lichen and reindeer lichen are two examples. But Ramalina doesn't even have a common name. So don't be afraid to use scientific names for lichen genera.

There are approx 14,000 species of described lichens in all life zones.
There are more than a 1000 in the PNW.

The Lichen Chart:

- The first page of the lichen chart shows 10 of the most common lichens in western Washington lowland forests.

- The second page shows 5 other common lichens of western & eastern Wa. It also shows 5 common crustose lichens.

10 common lichens  **80%**

Lichen ID --- presented in the same order as they are on the lichen chart

Lichen ID

Lichens on branch

Lichen Chart -- page 1


Frog Pelt Lichen-
Peltigera
Large lobes
Large apothecia


Lung Lichen
Lobaria
Large lobes
Deaply indented


Shield or Waxpaper Lichen
Parmelia
Appressed small lobes


Rag Lichen
Platismatia
Loose large lobes


Tube Lichen
Hypogymnia
Hollow tube-like lobes
"Dripped wax" look


Antler Lichen
Evernia
Strap-like
Divide regularly

Top
Gray-green

Bottom
White

Evernia

Pixie Cups and British Soldiers - Cladonia sp – Fruticose/Squamulose

Clusters of tiny basal scales (spaumules)

Clubs (podetia)

Photo taken by Gini Tripp

Dragon Cladonia


Ramalina
Lobes divide (forks) unevenly

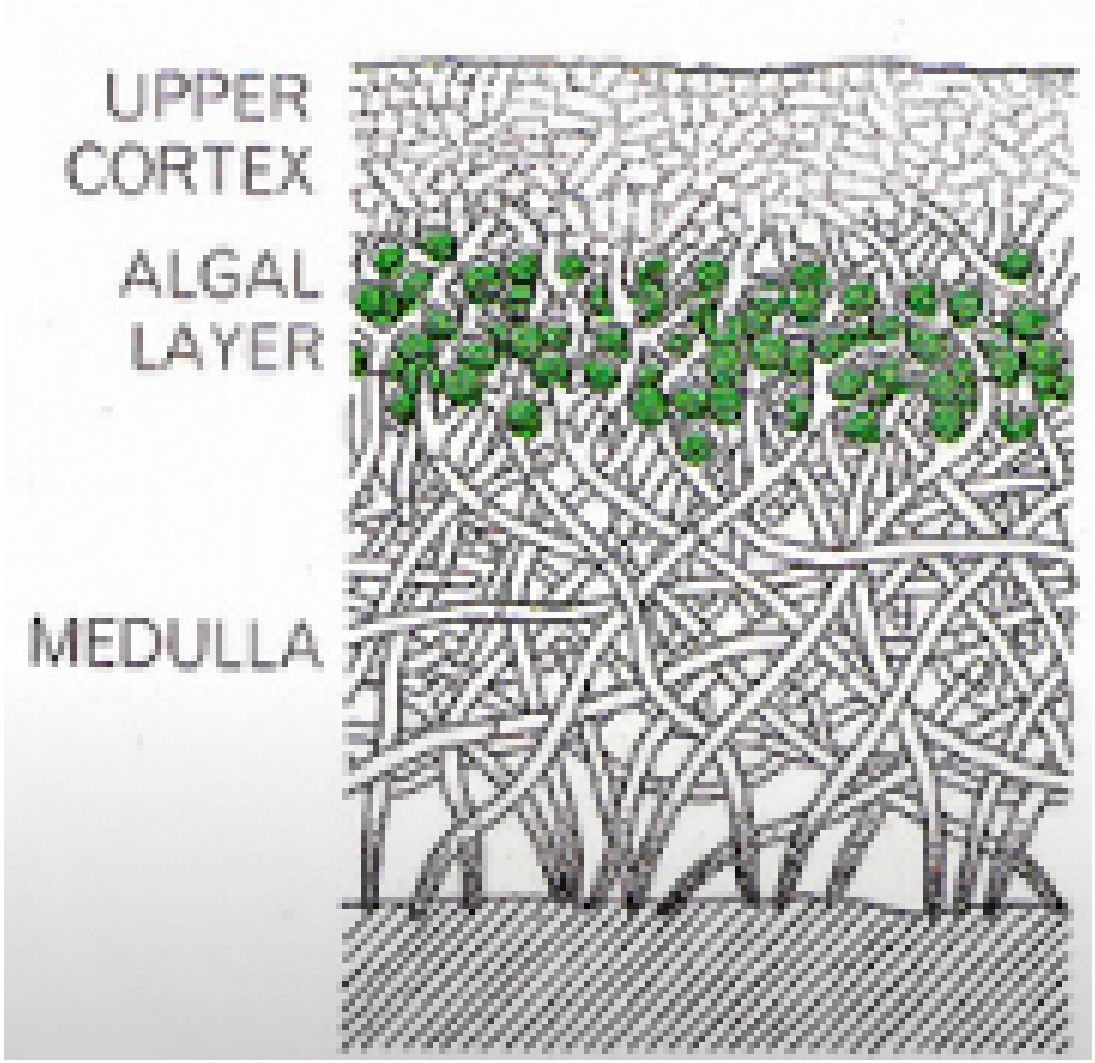
Fishnet Lichen
Ramalina menziesii


Beard Lichen
Usnea
Hairlike or long & pendulous
Central cord

Pendulous (no central cord)

Witch's Hair – Alectoria sp. - Fruticose

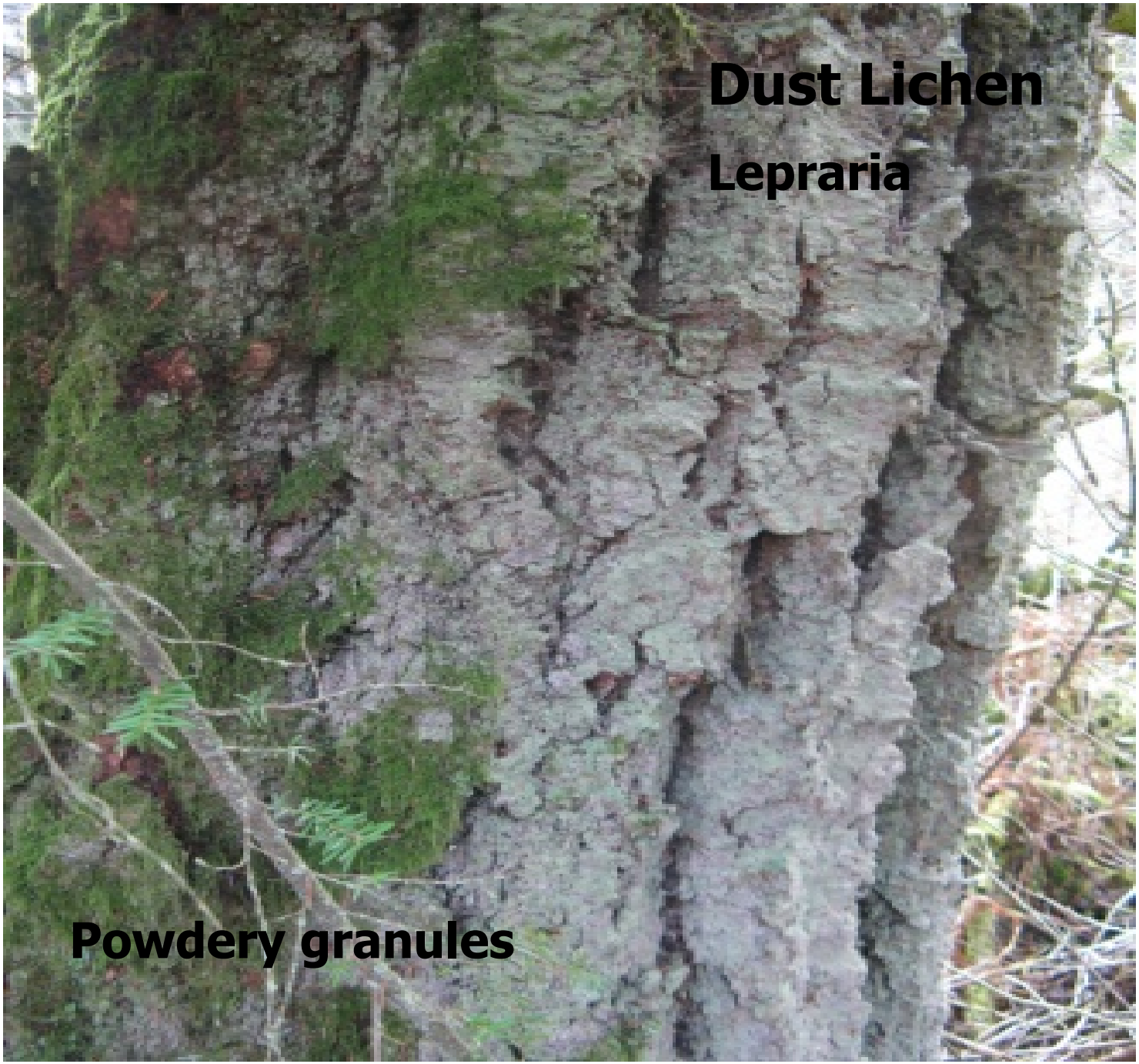
Lichen Chart -- page 2
Crustose lichens


UPPER
CORTEX
ALGAL
LAYER
MEDULLA


©Rainyside.com


Lichen covered
alder trees
©Rainyside.com


Bark Barnacle
Thelotrema
Alai
Continuous smooth crust
Barnacle-like apothecia
Alder


Dust Lichen
Lepraria
Powdery granules

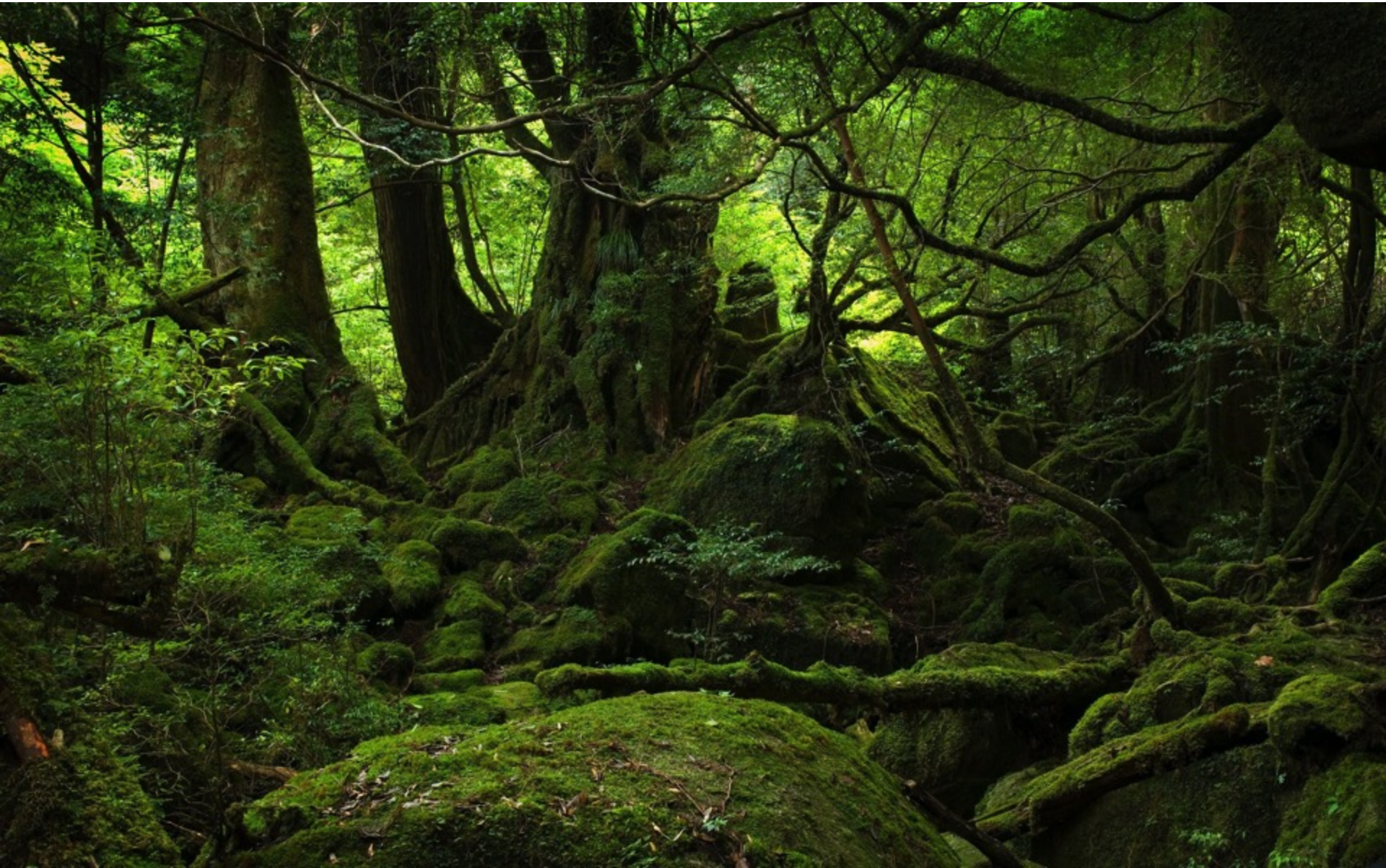
Introduction to Mosses and Liverworts

Appreciation of the Little Things in Life

Photographs by Gary Brill & several other sources

By Stewart Hougen, Cindy Luksus and Lynn Graf

Identification of some common mosses & liverworts found in our lowland (<3000') west side PNW forests.



Identifying mosses – the Yin & Yang

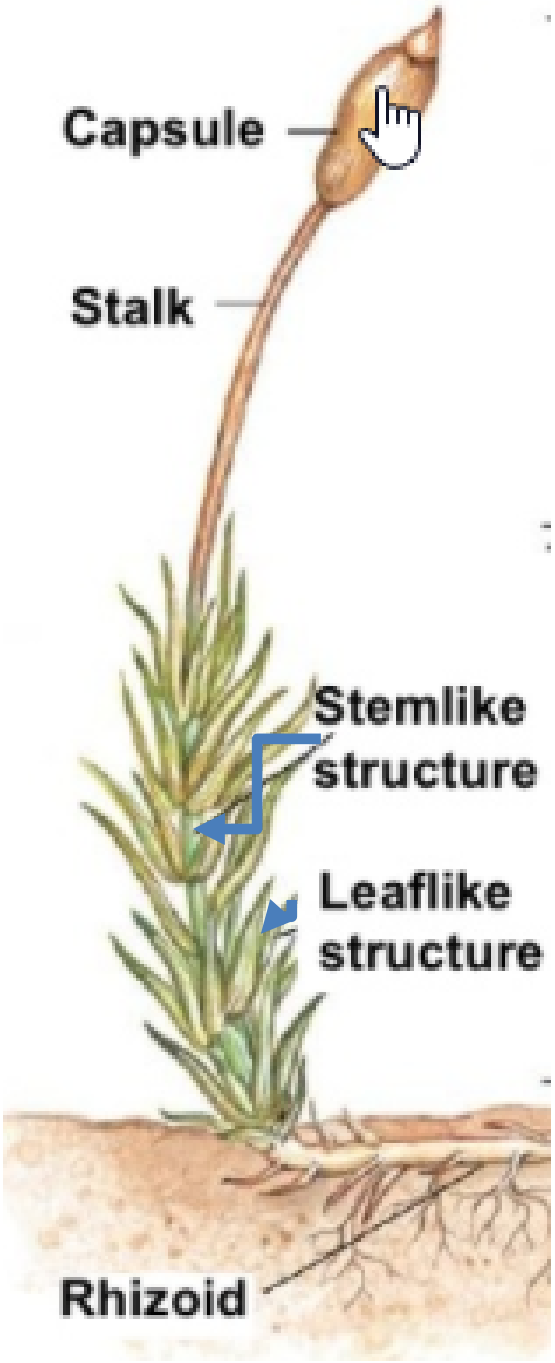
1. Summer is for plants, birds & butterflies. They like warm sun
   But…… Winter is for mosses, ducks & lichen. They like rain.
   and….. embarrasing to see moss everywhere & know nothing about them.

2. They are small
   But…….. If you look closely, they are amazing & form miniature landscapes

3. Many species (597 in our area)
   But…… If you know about 24 mosses & 5 liverworts, you will know 80%

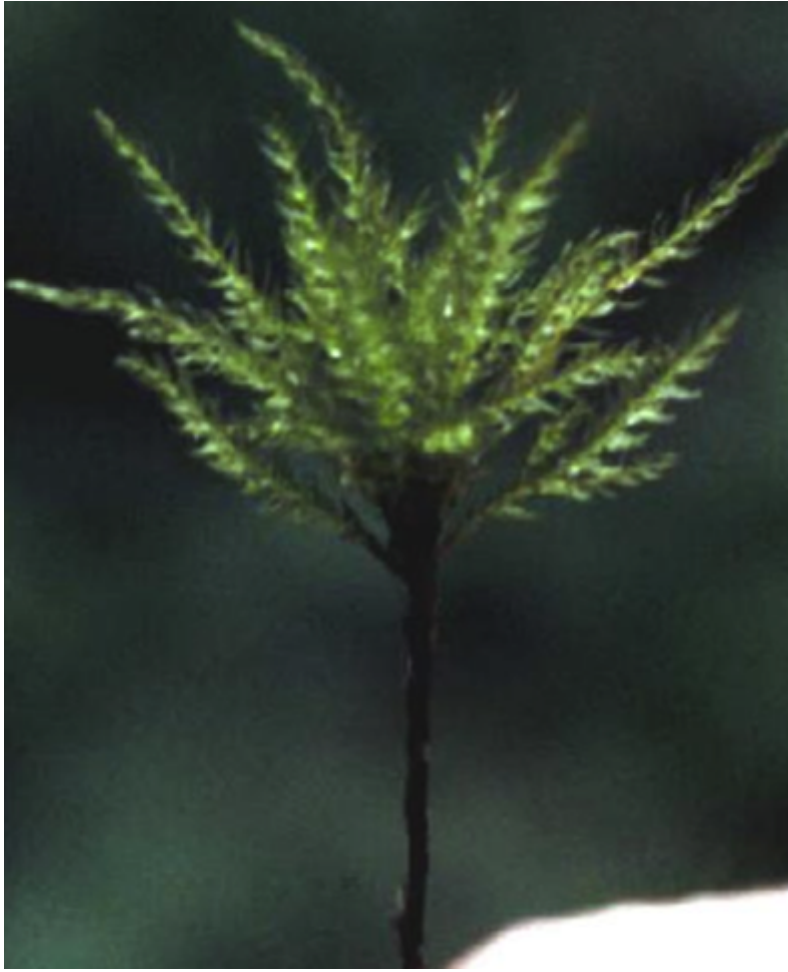
4. Lack of easy groupings with shared characteristics.
   But…….We have created a sense of groupings in the Moss Chart.
   This will help you get started on identification

Basic Structure Of Moss



Some common growth patterns

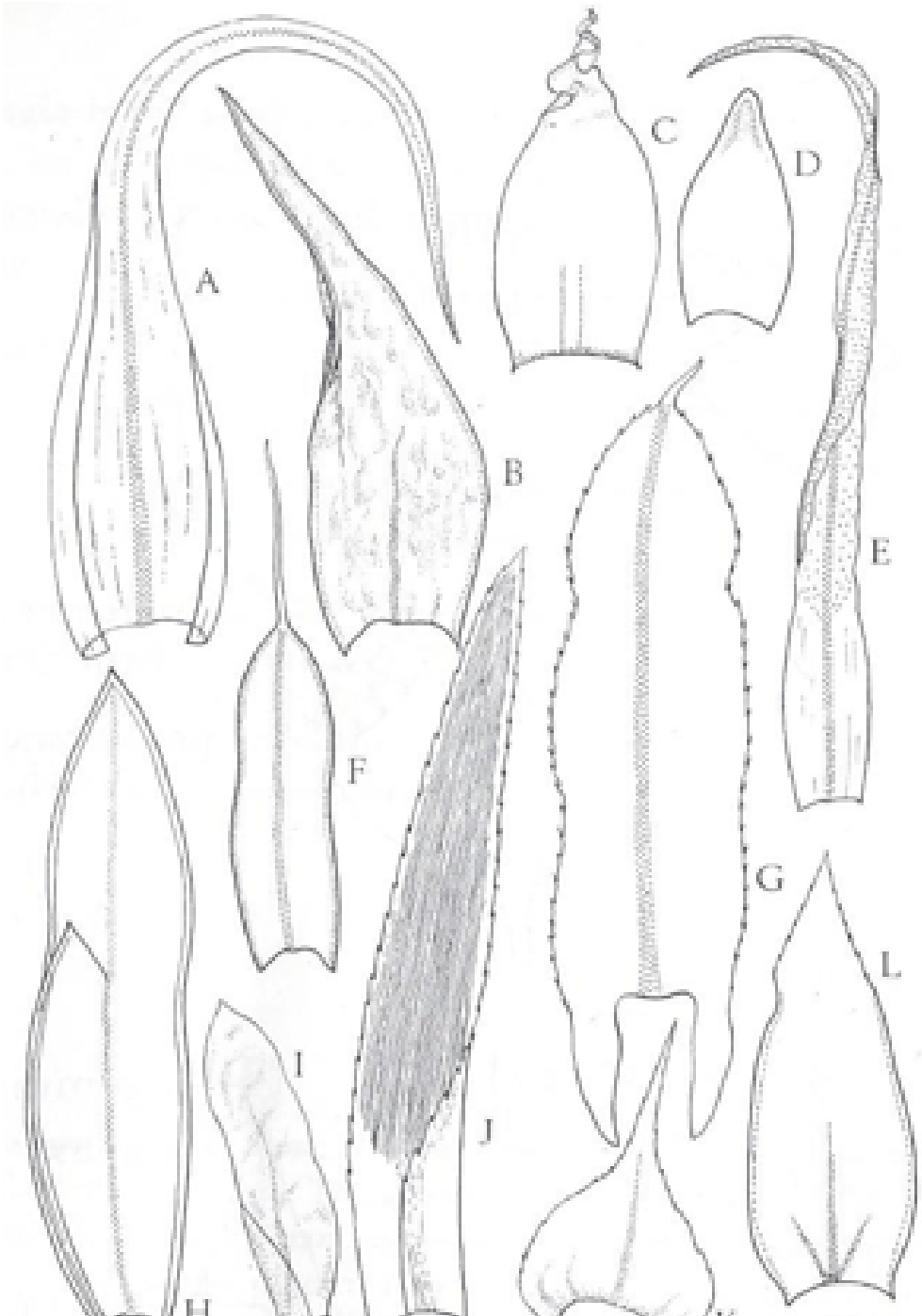
Sort of feather-like
or irregular branching



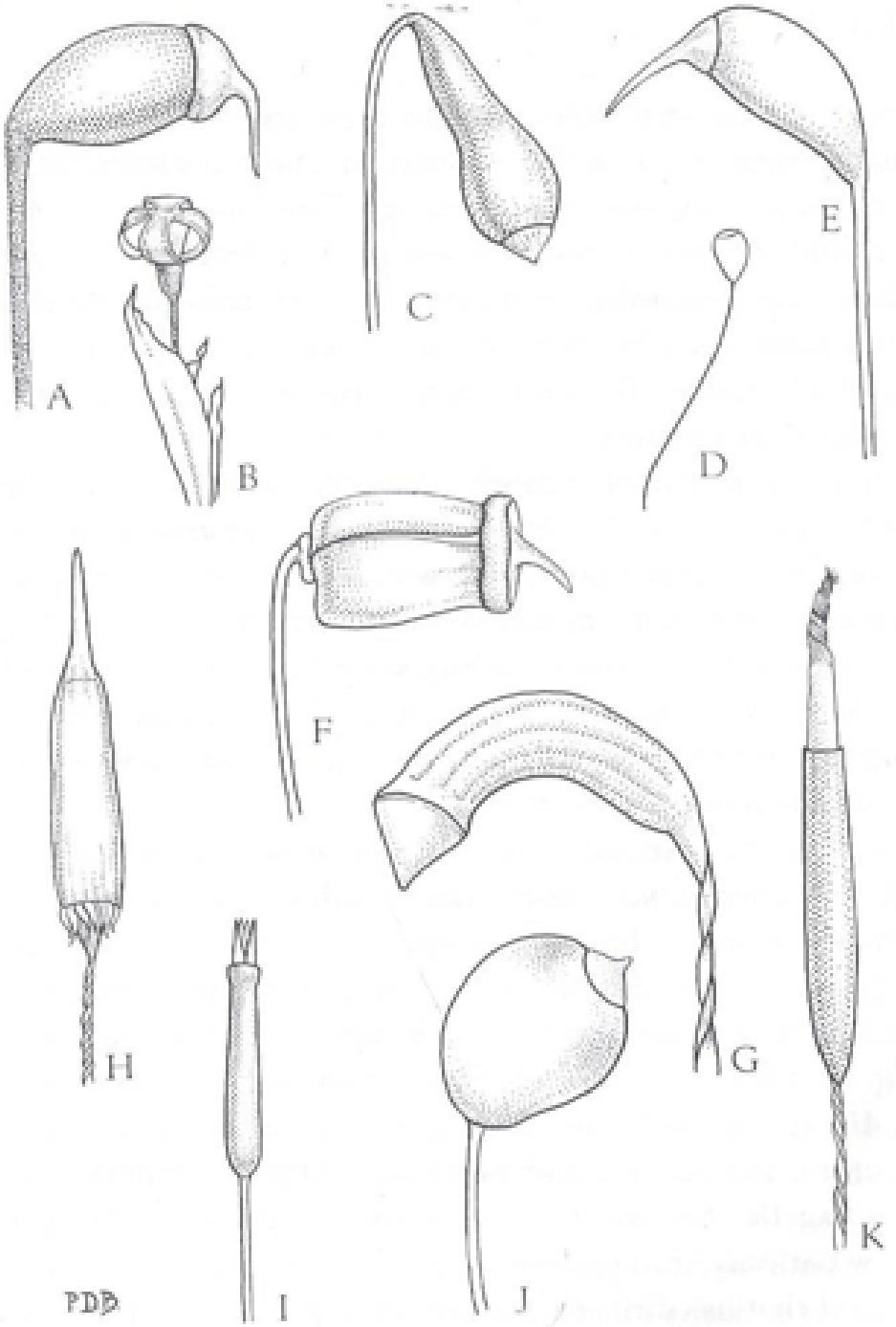
Sort of shrub-like
or grass-like

SPOROPHYTES

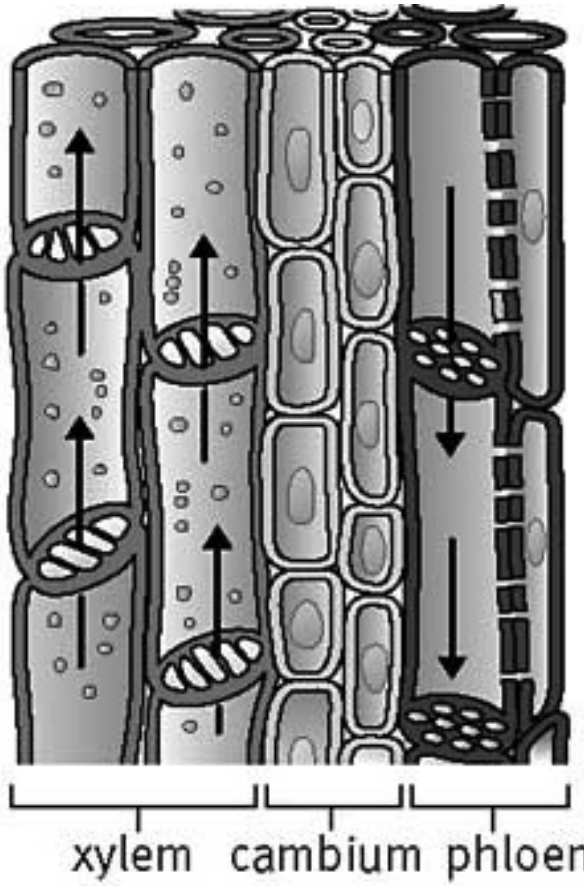
Leaves

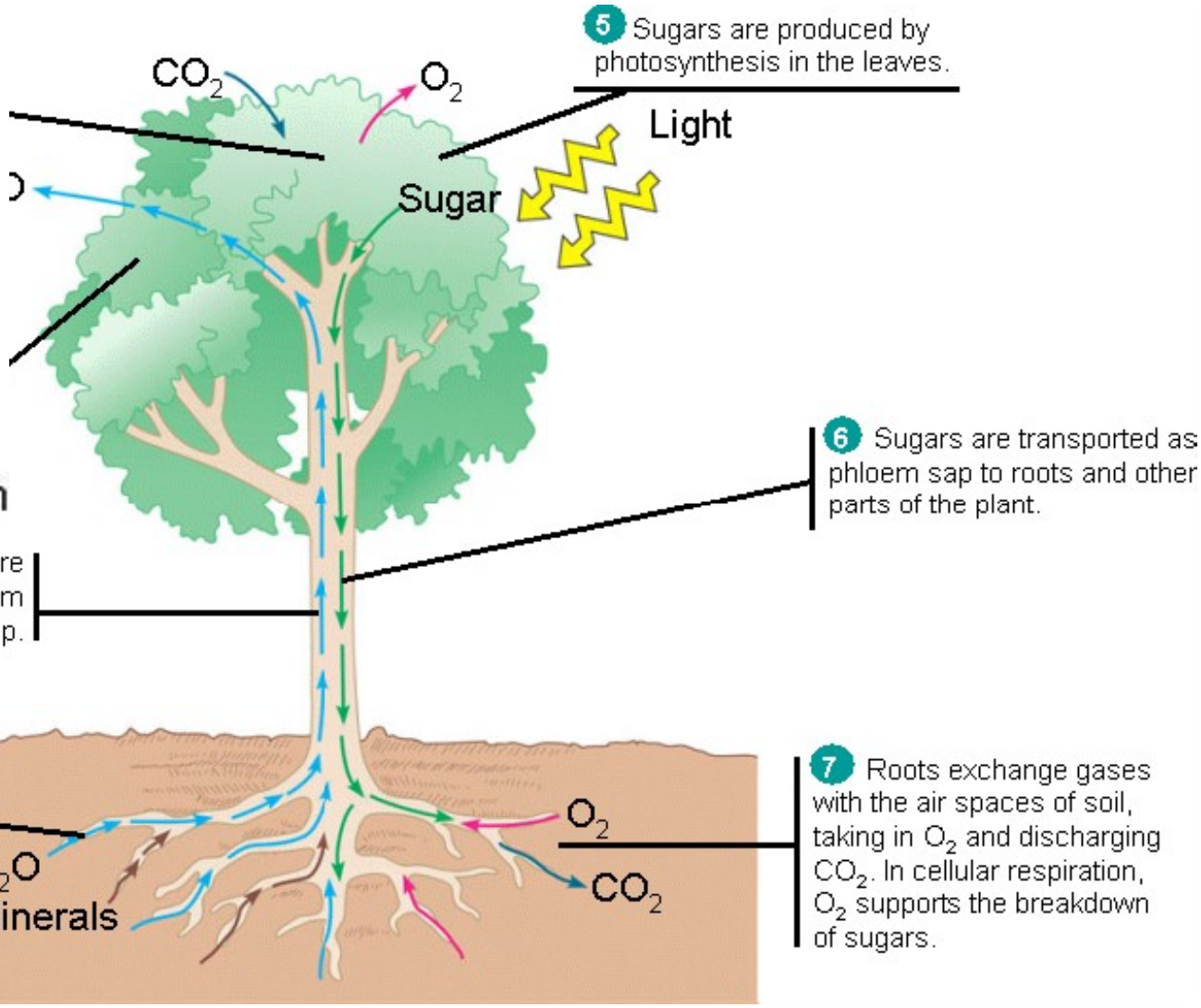


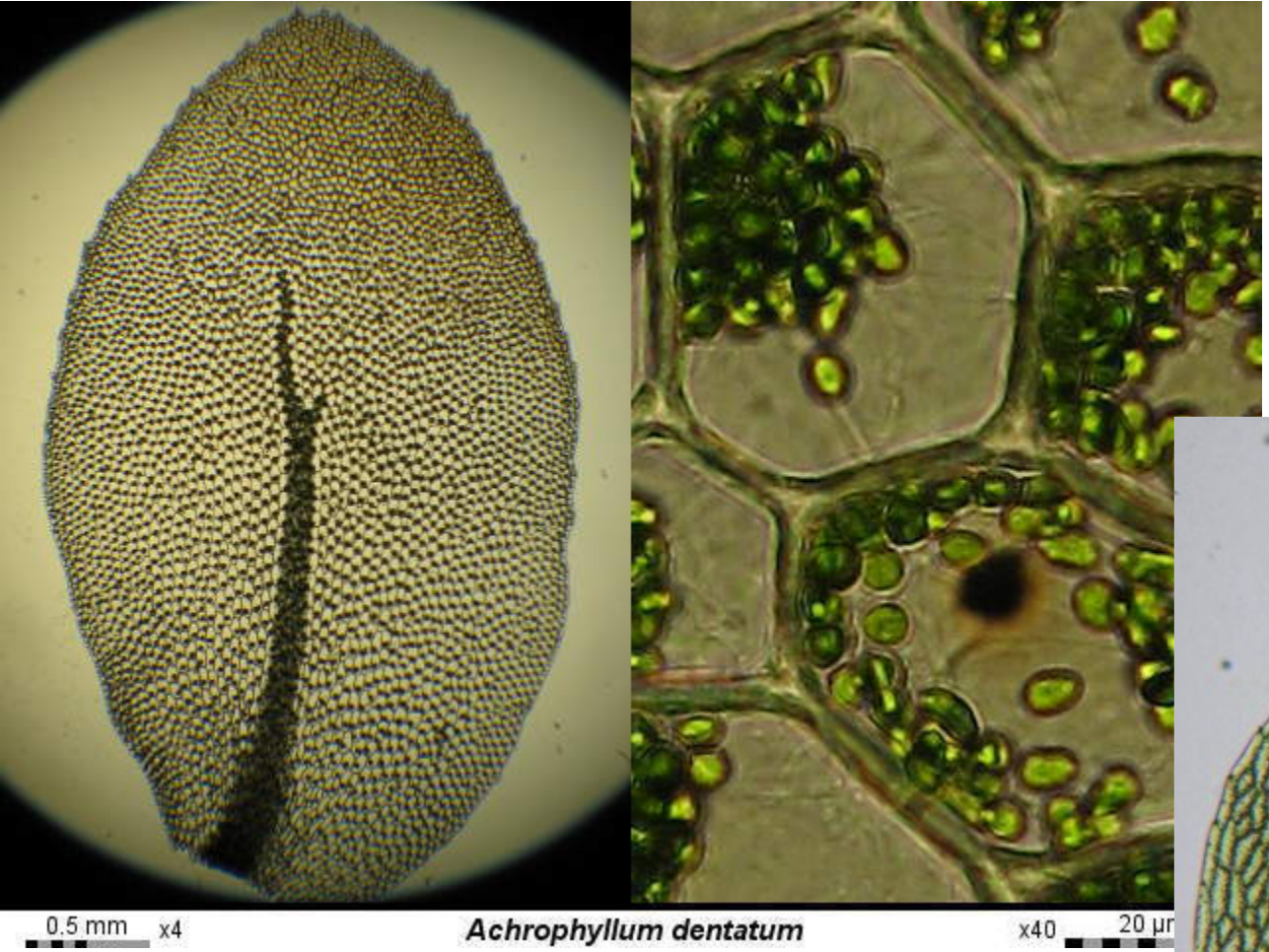
Sporophytes



Vascular system







No vascular system
Single cell thick

Do have chloroplasts.
They are a plant after all.

MOSSES ARE PLANTS

Like the seed plants:

1. Multicellular
2. Photosynthesize

AMPHIBIANS OF THE PLANT WORLD.

Unlike seed plants:

No conducting tissues for moving things around. They depend on diffusion.

Lack cuticle impervious to water.

--Rely on the ambient environment for moisture thus they live close to the substrate

--Dehydrate, but can revive quickly & absorb water & minerals when air is humid again.

No supporting tissue: no strong tissue to enable them to resist gravity. Therefore, they are short & grow close to whatever they attach to.

Identifying Mosses -- Macroscopic

- **Growth form:** feather-like, irregular branching, shrub-like, grass-like, string-like mats, draping or hanging.
- **Habitat**: trees, terrestrial, (ground, logs, rotten logs, rocks, etc.)
- **Color**: "50 shades of green" but note the obvious.
- **Wet or dry:** some are more common in dry or wet areas.

Identifying Mosses -- "Microscopic"

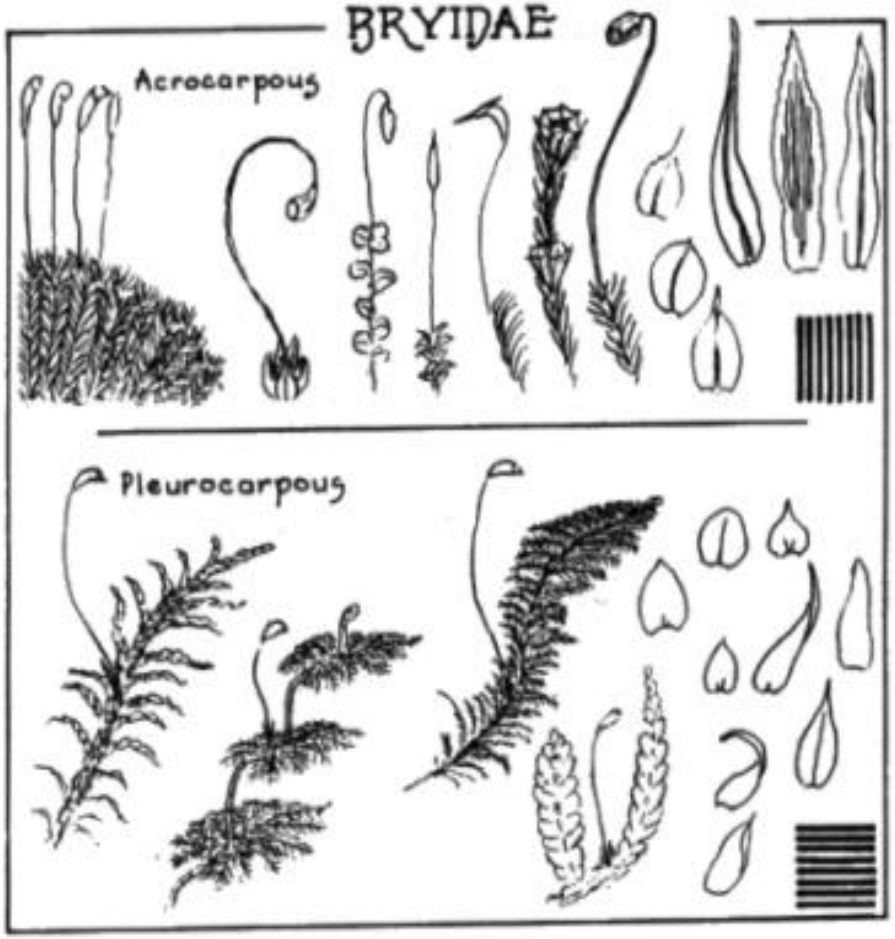
Grab Your Hand Lens

- **Shape of leaf:** overall shape, curls and pleat - horizontal and vertical
- **Midrib of leaf:** present or absent, how prominent
- **Leaf edge:** smooth or serrated
- **Sporophytes:** length, size, angle of capsule, how frequent, stalk, peristome .

Many of these vary when wet versus dry and you can watch the change in real-time!

GROWTH FORMS

A classic way to group mosses for identification



Guide to Ontario Mosses

- **Acrocarps** - ”upright”
  - sporophyte at tip
  - usually unbranched
  - often in tufts
- **Pleurocarps** - ”feather”
  - sporophyte along branches
  - creeping, prostrate
  - often pinnate (branched, fern-like)

FEATHER-LIKE (4)

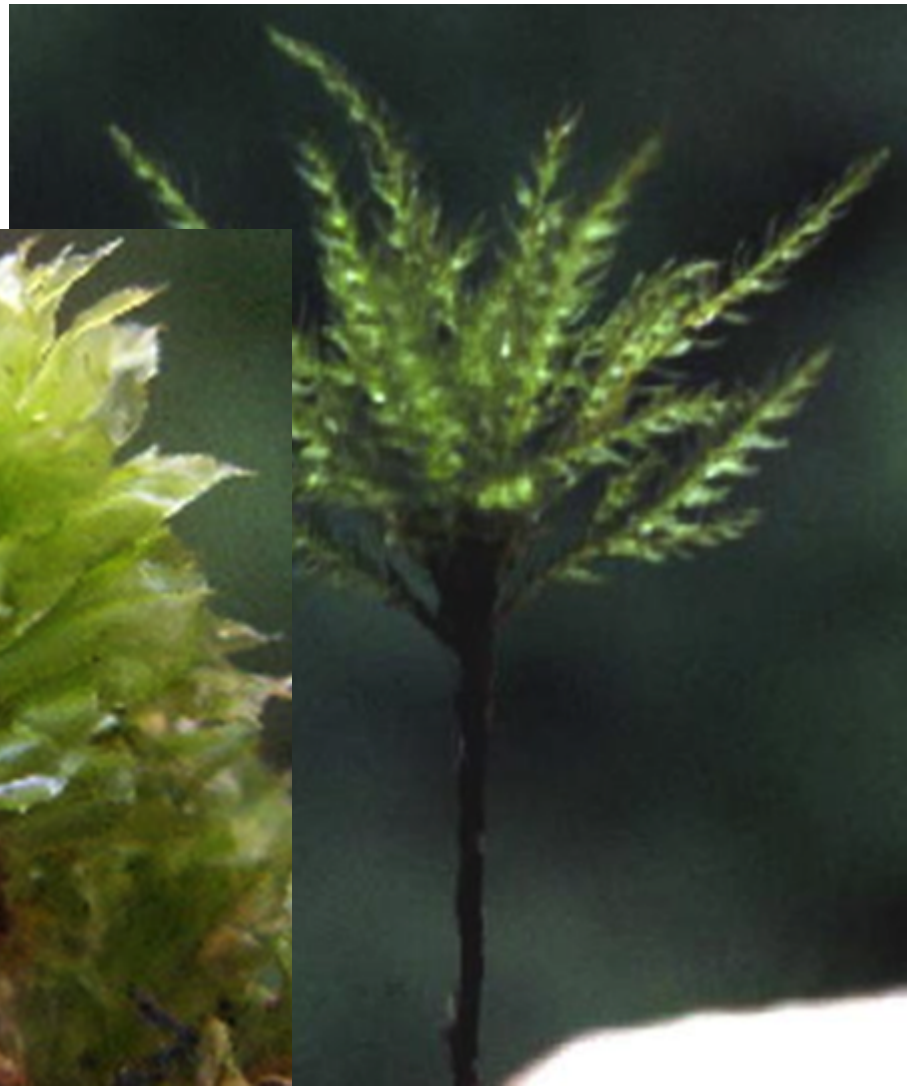
Regularly Pinnate Branching

IRREGULAR BRANCHING (6) Difficult

Varied length of successively branching shoots & meandering shoot form, contribute to the somewhat untidy tangled appearance of many mosses.

TREE OR SHRUB-LIKE (7)

Some mosses have a distinct main shoot and a crown of smaller shoots, producing a tree or shrub-like form.



GRASS-LIKE (3)

STRING-LIKE MATS (1)

Long, thin, unbranched shoots.

Draping or Hanging (2)

Some mosses have a stringy & elongated appearance.

Bit tricky at times

Distribution of mosses we are covering

Western Washington forests below 3000’

HABITATS OF MOSSES

Tree Trunks

1. Tree trunks
   Some terrestrial mosses creep up the lower base of trees.

Terrestrial

2. Rotten stumps & logs
   Many mosses persist on the fallen logs but other mosses replace them as the wood decomposes.
3. Ground
   a. Shaded forest floor
   b. Dry, sun exposed sites
   c. Disturbed sites
   d. Banks

4. Rocks, wet & dry
   Ignore rocks for now. Too difficult.

Comparing & Contrasting Mosses

Follow along on your chart.

Same order as on your chart

FEATHER-LIKE (3)


Stair Step Moss
Big
Ground

Oregon Beaked Moss

or, creeping up the bases of trees.

Slender Beaked Moss

Ground **or, rotten logs.**
Not tree bases.

IRREGULAR BRANCHING (2)


Douglas' Neckera
Stick out


Douglas’ Neckera


Douglas’ Neckera


Douglas’ Neckera


Douglas’ Neckera

Lyall's Bristle Moss


Lyall’s Bristle Moss

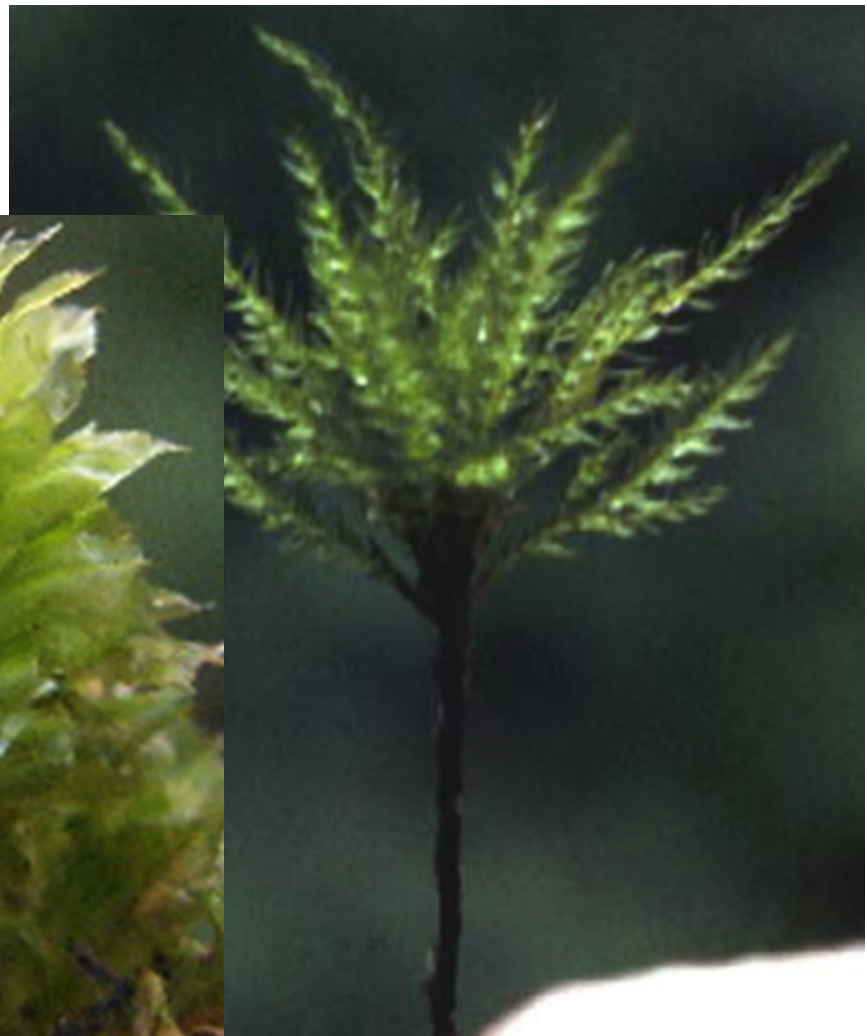

Douglas' Neckera


Lyall's Bristle Moss

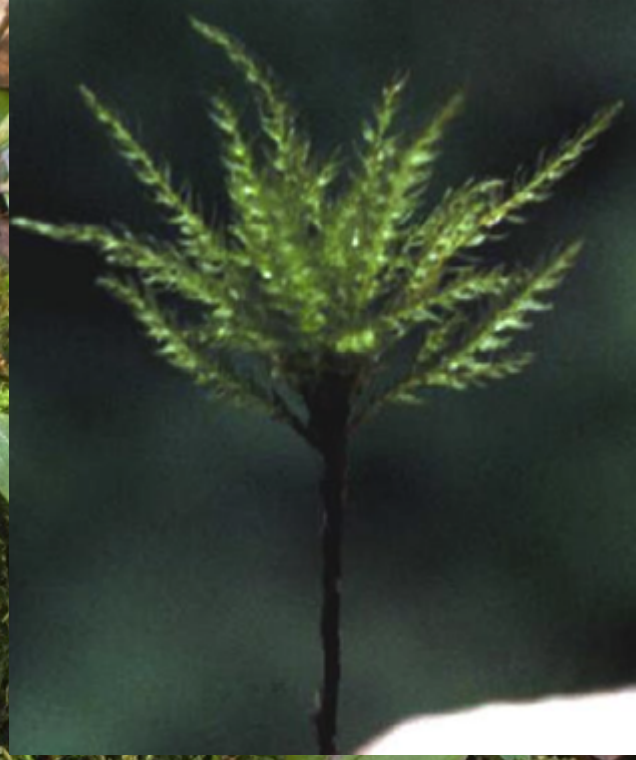
TREE OR SHRUB-LIKE (3)

Tree -- 0

Terrestrial -- 3



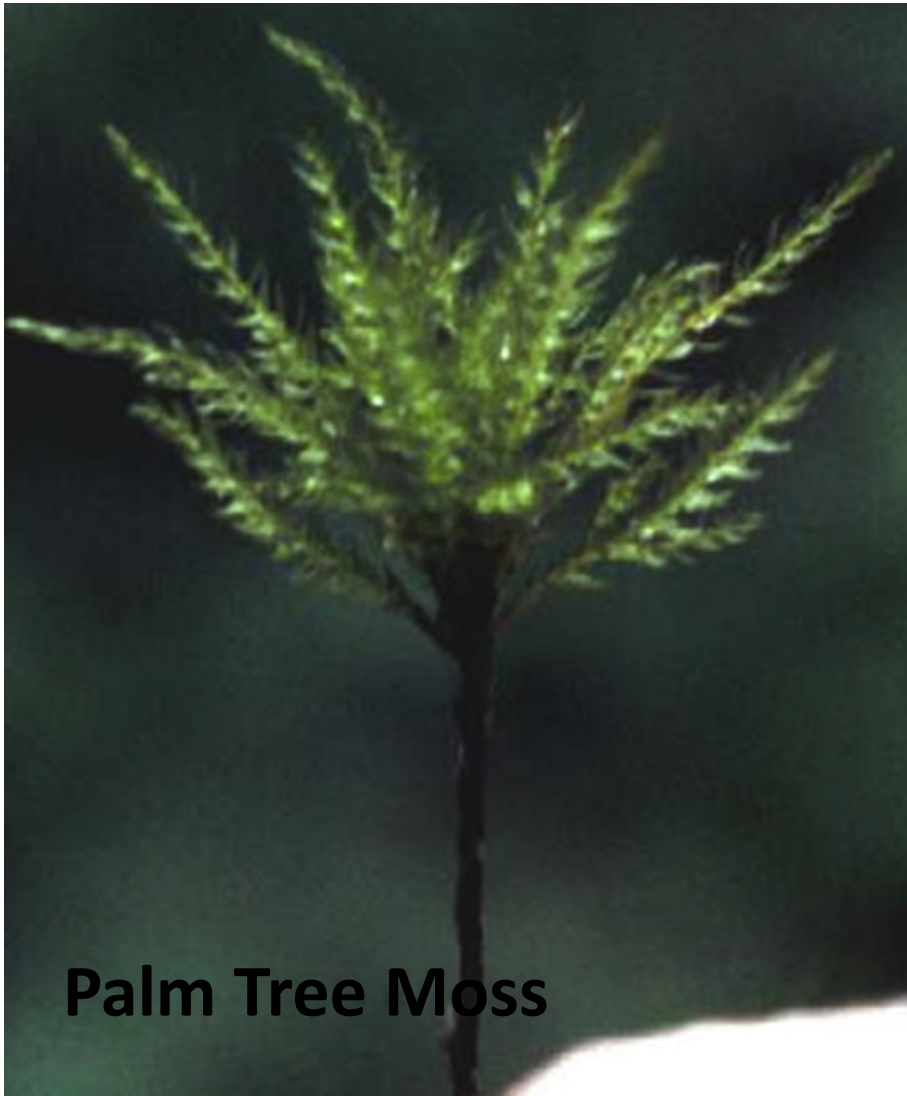
Juniper Haircap Moss



N.C.

Palm tree Moss

Palm tree Moss



White-toothed Peat Moss

Sphagnum

New leaves

GRASS-LIKE (2)


Broom Moss
Terrestrial & rotting logs


Broken-leaf Moss
Rotting logs & trees
© Michael Lüth


Broom Moss


Broken-leaf Moss

STRING-LIKE MATS (1)

Long, thin, unbranched shoots.


Wavy-leaved Cotton Moss
Terrestrial


Wavy-leaved Cotton Moss

Draping or Hanging (1)

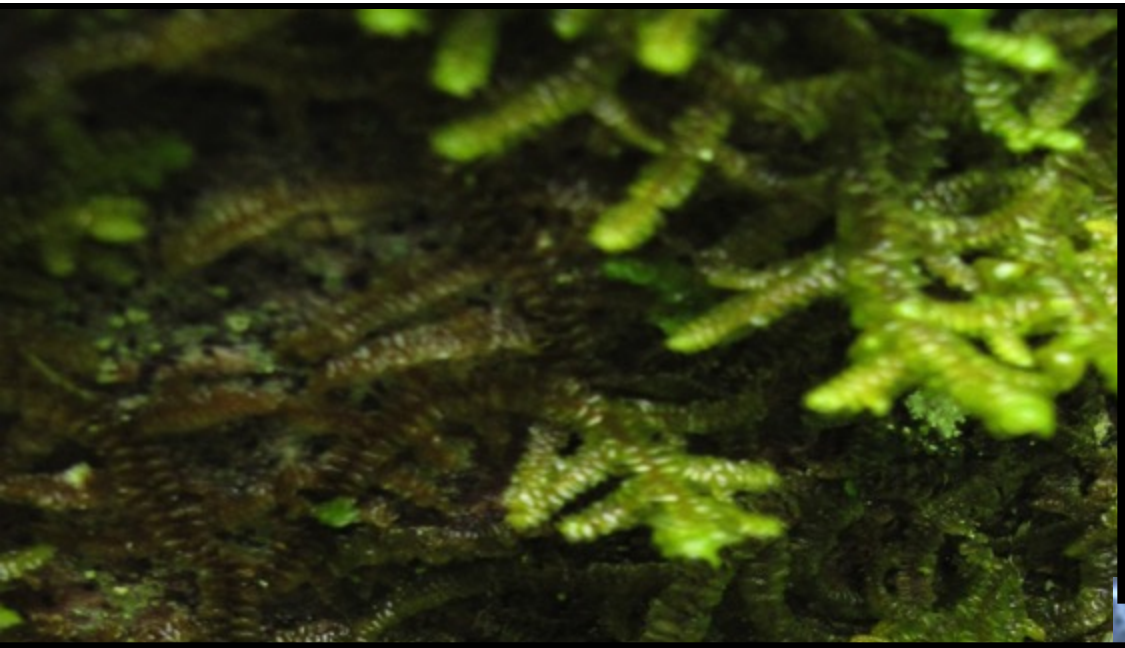
Some mosses have a stringy & elongated appearance.

Cat-tail Moss

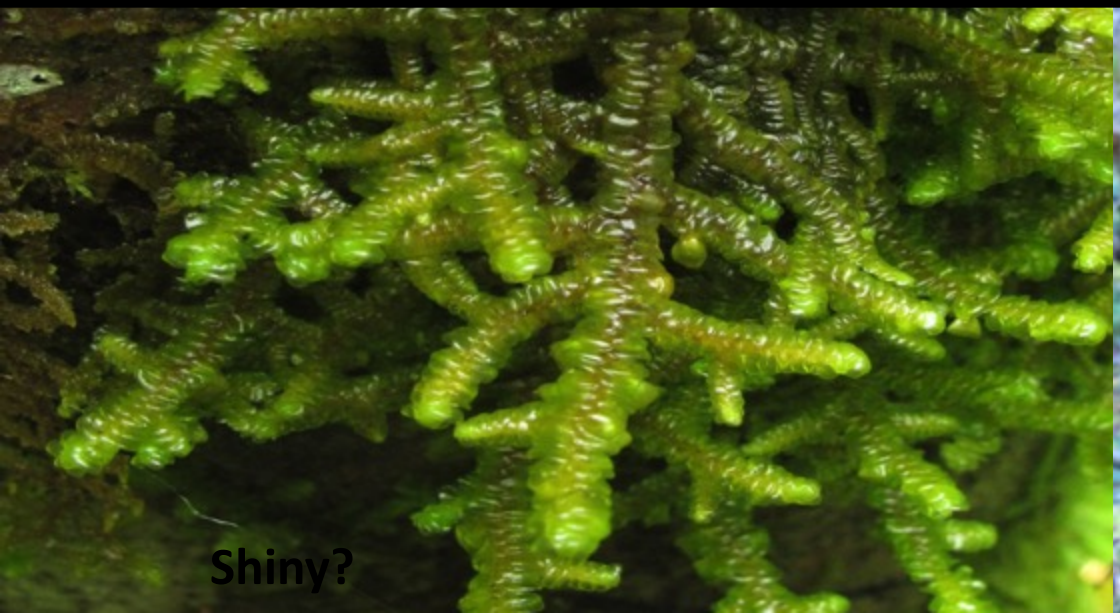
AND NOW SOME LIVERWORTS!

More common in the southern hemisphere. Much less important in our region

Can you start to see how they are different from mosses?




Two flat ranks
No midrib


Shiny?

Leafy Liverworts

- Leafy or leaf-like, but leaves never have a mid-rib. The leafy liverworts have **two rows of opposite leaves, flattened in the same plane**.

- Leafy liverworts can be various colors of green, some are yellow to golden, rich orange, red, dark purple, black or brown.

- Look shiny?

- Unlike mosses, leafy liverworts grow the **capsule first (black egg-shaped**), and then sends it up on a translucent to white stem. Disappear quickly so rarely see.

And now a look at a couple of Thallose Liverworts

Thallose Liverworts

- Though most liverworts are leafy, the can also be “thallose”---**green, strap-like bodies** with scales on the undersurface, often with a purplish pigment.

- Thallose liverworts have a **receptacle** that, as it ages, bears the **sporophyte** on its underside.

- Can be fairly large, are usually terrestrial, and like to be in damp places like seeps and streams. Some folks might confuse them with thallose lichen---remember they are plants!.