

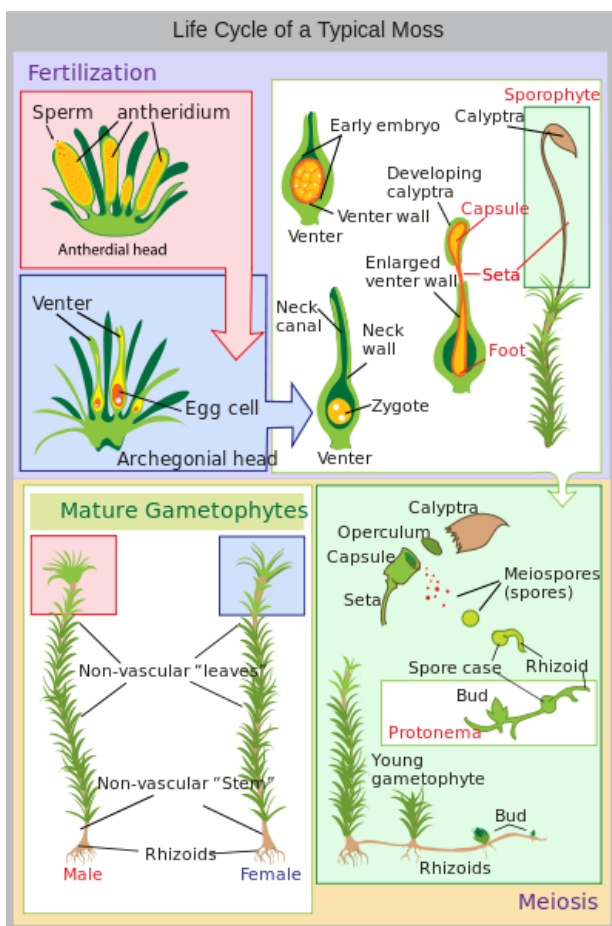


I'm Lichen the Mosses

Mosses and lichens are often confused and overlooked because they are small and not very showy, but they are quite different in that Mosses are plants and Lichens are not.

(Ferns,) Mosses and Lichens have neither seeds nor flowers but reproduce via spores, relying mainly on wind and rain for dispersal.

MOSESSES are delicate, non-vascular green plants in the land plant division Bryophyta. They are mostly small; 1/16 inch, with a few up to 20 inches. Having chlorophyll, they photosynthesis their own food and absorb water and nutrients mainly through their leaves, which are usually only a single cell in thickness.



Mosses have a gametophyte stage and a sporophyte stage. They propagate by spores or vegetatively through fragmentation and are dispersed by wind, rain, or animals. The spore capsule, often with a supporting stalk (called a seta), is the sporophyte and this grows from the gametophyte stage. Spores are fertilized when water droplets spread the motile sperm on the antheridium to the egg inside the archegonia.

There are essentially two growth forms for moss plants. In one, the stems are basically erect, with just one upright stem per plant or with the initial erect stem producing some branches, depending on the species, giving the individual plant a tufted or shrubby appearance. In the other growth form, the moss will have mostly trailing stems.

Mosses do not have proper roots, but have threadlike rhizoids that anchor them to their substrate and may grow on almost any reasonably stable surface. Rhizoids are anchoring structures; superficially root-like, but without the absorptive functions of true roots.

There are approximately 12,000 species, and grow throughout the world except within salt water environments. Mosses grow chiefly in moist, shaded areas, but are found anywhere in cool, humid, cloudy climates, and some species are adapted to sunny, seasonally dry areas like alpine rocks or stabilized sand

dunes. Mosses tend to grow close together in large numbers often forming soft, dense mats on rocks, at the base of trees, or on soil. Mosses are often early colonizers of bare areas, growing before other, more complex plants can move in.

Mosses are an indicator of natural conditions, as certain species grow on acid or alkaline soils. The identification of mosses often requires the use of a microscope, though; choice of substrate varies by species and as such can be useful in identification. Moss species growing on or under trees are often specific about the species of trees

they grow on. While mosses often grow on trees as epiphytes, they are never parasitic on the tree. Some species are aquatic or semi-aquatic. Wherever they occur, mosses require liquid water for at least part of the year to complete fertilization. Many mosses can survive desiccation, sometimes for months, returning to life within a few hours of rehydration.

Contrary to popular belief, moss growth on trees should not be used to determine north or south direction as moss will grow on the moister sides of trees and other surfaces, whichever direction that may be.

In boreal forests, some moss species are colonized by nitrogen fixing cyanobacteria. The moss, when disturbed, will release the fixed nitrogen, along with other nutrients, making it available throughout the ecosystem.

Ecologically, mosses are important for a number of reasons. At a larger scale, mosses perform a number of functions that help ecosystems perform effectively such as filtering and retaining water, stabilizing the ground and aiding against soil erosion, and removing CO₂ from the atmosphere. In addition, they break down exposed substrata, releasing nutrients for the use of more complex plants that succeed them. For both vertebrates and invertebrates, mosses can provide a great habitat and source of food. Certain mites and spiders live in mosses. Some birds use moss fibers to build or line their nests.

For humans, mosses are aesthetically beautiful, and are used for: green roofs, lawn, bedding, insulation, diapers, fuel, wound dressings, packing material, floral and garden trade, making biopharmaceuticals, and monitoring water and air quality.

It is interesting to note that there are several plant names in which the word “moss” is misused! Although certain seaweeds are called Sea Mosses, no mosses are found in salt water. Spanish Moss (*Tillandsia usneoides*) is not a moss but a flowering plant in the same family as the pineapple! Reindeer Moss (*Cladonia rangiferina*) is not a moss but a lichen found in the arctic tundra, Irish Moss (*Chondrus crispus*) is a red algae and Club Moss (*Lycopodium*) is a relative of ferns!

LICHENS are a complex life form that represents a symbiotic partnership of two separate organisms between a fungus and either [algae](#) or [cyanobacteria](#). Lichens form a fascinating example of cooperative relationships in nature, with the fungus using the algae or bacteria to produce energy, while the algae or bacteria enjoys the protection the fungus provides. Lichens are classified by the fungal component, as the dominant partner is the fungus, which gives the lichen the majority of its characteristics, from its thallus shape to its fruiting bodies. The fungal component of lichen is called the mycobiont. The [photosynthetic](#) partner in lichen is called a photobiont. Lichens do not have any roots, stems or leaves and their chloroplasts are contained only in the algae on the top surface of the lichen.

Lichens can be found growing in almost all parts of the terrestrial world, from the ice-free polar areas to the tropics, from tropical rainforests to those desert areas free of mobile sand dunes. While generally terrestrial, a few aquatic lichens are known.

While most lichens are some shade of green, colour can vary widely from black, brown, yellow and even bright orange—but internally all lichens contain algae or cyanobacteria. Colour is used in identification and is based on the colour that shows when the lichen is dry.

Lichens are frequently found on the bark of trees, doing no harm. Their growth forms may be classified as crustose, foliose, fruticose, and squamulose. Though, there are variations and overlapping in growth types in a single lichen species. Many lichen species and some lichen genera are only distinguishable from each other by means of chemical tests or light microscopy, especially crustose lichens.

1. Crustose - Growing like a crust or a stain/paint, attached so closely to its substrate that to remove it would destroy the lichen.
2. Foliose – Flat, leaf-like or widely strap-shaped growth form. Foliose lichens have a distinct upper and lower surface, distinguishable by colour, texture, or presence of unique structures.
3. Fruticose - Distinctly three dimensional in shape, like a shrub, upright or dangling network of threads or a pedestal.
4. Squamulose - Composed of small “foliose” thalli (squamules) but are much smaller and numerous, like little lichen “flakes” growing in patches or colonies.
5. Leprose – Powdery.
6. Gelatinous – Jelly-like.
7. Byssoid – Wispy, like teased wool.
8. **Filamentous** – Stringy or like matted hair.

Many lichens reproduce through tiny particles called soredia and are carried away by wind, water or animals to create new lichens. Others reproduce vegetatively when a piece breaks off. They grow on and in a wide range of substrates and habitats, including some of the most extreme environments on Earth. They are abundant growing on bark, leaves, and hanging from branches "living on thin air" (**epiphytes**) in **rain forests** and in **temperate woodland**. They grow on bare rock, walls, gravestones, roofs, and exposed soil surfaces. Some lichens do not grow on anything, living out their lives blowing about the environment.

Most lichens appear different from other fungi-like mushrooms, yeasts, or bread molds and when cut or broken, they usually reveal distinct layers: a dense cortex, a green or blue-green photobiont layer and spongy medulla. The texture of lichens is usually more fibrous and stiff, especially when dry, compared to non-lichenized fungi which are usually soft, fleshy and delicate to the touch.

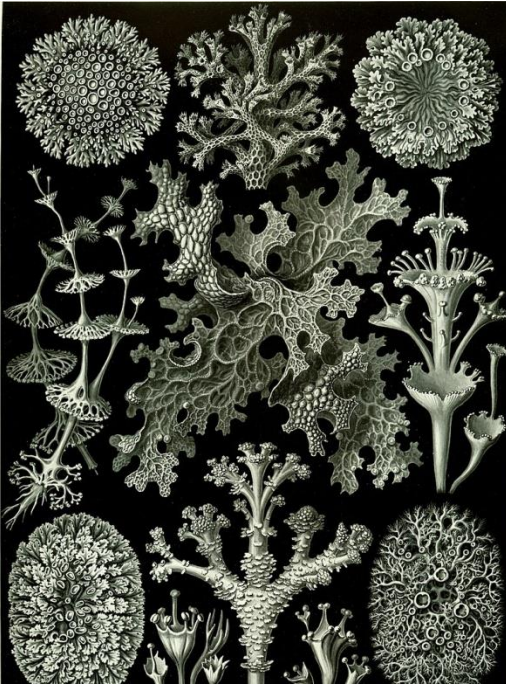
Lichen body parts

1. Thallus - The vegetative lichen body as a whole, excluding the sexually reproductive parts.
2. Cortex - The hardened outer layer of the lichen thallus, often some distinct colour like brown, yellow or orange from pigments. Under a dissecting scope, the fungal hyphae (fungal ‘cells’) in this layer are densely packed and often uniformly shaped.
3. Photobiont layer - The part of the lichen capable of photosynthesis and composed of an algal or cyanobacterial symbiont. Because the symbiont photosynthesizes, for brevity, it is called a ‘photobiont’. The chloroplasts of the photobiont give the lichen its green colour, brightest when the lichen is moist. There are two main types of photobionts. a) Algal - When the layer between the cortex and medulla is the colour of green grass, not at all bluish, the photobiont is an alga. b) Cyanobacterial - When the layer is some shade of dark blue green or grey or even black (but not the yellow green colour of grass!) the photobiont is a cyanobacteria.
4. Medulla - The white, fuzzy layer in the center of the lichen that often constitutes the majority of the volume of the lichen. The medulla is composed entirely of loosely-packed fungal hyphae. It is usually white.
5. Rhizine - Rhizines are root-like structures that lichens use to attach themselves to their substrates. They occur on the lower surface of many lichen thalli and look like small hairs.

Lichens are beautiful and are an important food source for many animals. Another important function of lichens is that they provide a mode of survival in harsh environments where algae cannot normally survive. Since the fungus can protect its algae, these normally water-requiring organisms can live in dry, sunny climates without dying, as long as there are occasional rain showers or flooding to let them recharge and store food for the next drought period. Because lichens enable algae to live all over the world in many different climates, they also provide a means to convert carbon dioxide in the atmosphere through photosynthesis into oxygen, which we all need to survive. Lichens are **pioneer species**, among the first living things to grow on bare rock or

areas denuded of life by a disaster. Lichens break down rocks, releasing minerals and over time, this activity creates new fertile soil from lifeless stone. They help to stabilize soils and provide shelter for microinvertebrate and macroinvertebrates. Some animals make use of them in nest or shelter building (hummingbirds).

Lichens absorb food from the atmosphere; fog, wind and rain and are extremely sensitive to changes in temperatures, gases from the burning of fossil fuels, and windblown fertilizers/herbicides, pollutants and other elements (heavy metals, ammonium nitrate, carbon, sulfur, nitrogen). Better air quality means higher lichen diversity. They are an indicator of air quality and health of their habitat and sentinels of climate change. The EPA and the U.S. Forest Service have been studying lichens for over 30 years in monitoring pollution levels from more than 6,000 sites nationwide. <http://gis.nacse.org/lichenair/>



Lichens may be very long lived, with *Rhizocarpon geographicum* having been dated at 8,600 years, apparently the world's oldest living organism. Lichens often have a regular but very slow growth rate of less than a millimeter to 2 millimeters per year. The long life-span and slow and regular growth rate of some lichens can be used to date events ([lichenometry](#)).

As well as having important ecological roles lichens have also been used by humans as food, medicine and for the dyeing of cloth. For example, traditionally, lichens were used to produce the colours of Harris Tweed.



WHAT IS A TARDIGRADE?

Tardigrades are microscopic eight-legged animals that have been to outer space and would likely survive the apocalypse. Bonus: they look like adorable miniature bears. Around 1,300 species of Tardigrades are found worldwide. Considered aquatic because they require a thin layer of water around their bodies to prevent dehydration, they've also been observed in all kinds of environments, from the deep sea to sand dunes. Freshwater mosses and lichens are their preferred habitat, hence their nickname, moss piglet.

Created in 2020 by Meg Scanlon from a variety of resources, including, but not limited to these internet links:

<https://en.wikipedia.org/wiki/Moss>

<https://basicbiology.net/plants/non-vascular/mosses>

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_069239.pdf

<https://www.plant-ark.com/index.php/about-plants/ferns-mosses/what-are-mosses.html>

http://gis.nacse.org/lichenair/doc/lesson_plans/LP1WhatIsALichen7Jul2009.pdf

<https://en.wikipedia.org/wiki/Lichen>

"Lichenes" fancifully drawn by [Ernst Haeckel](#) to emphasize his ideas of symmetry in his *Artforms of Nature*, 1904