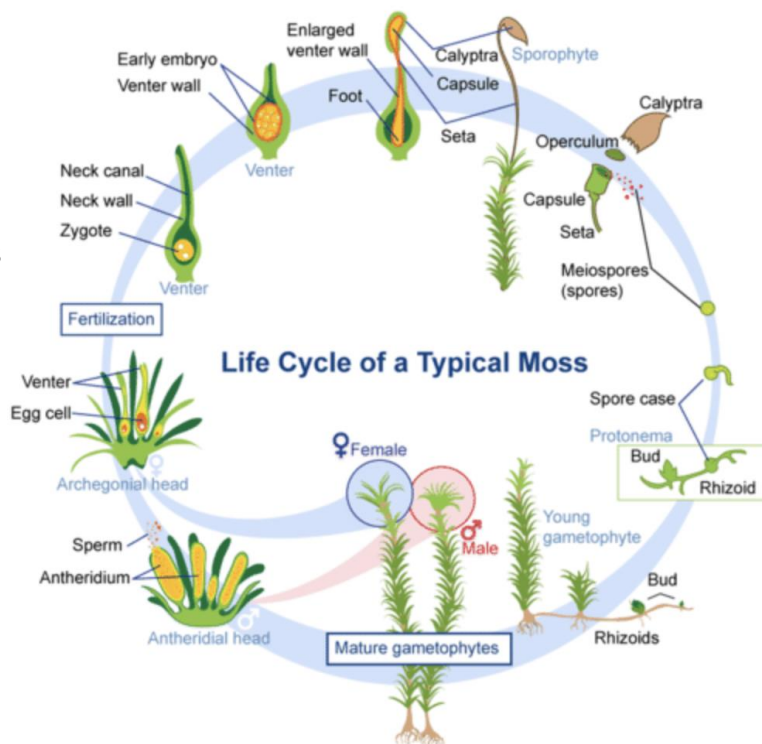


# BRYOPHYTES

Bryophytes were the first plants to colonise the land back in the Palaeozoic era about 450 million years ago, long before ferns, conifers and flowering plants appeared. They are still with us today representing the most ancient plants on the Earth. Current estimates suggest there are about 25,000 species of bryophytes in the world with the greatest diversity found in tropical, mountain forests. Britain and Ireland have over 1000 species, which is greater than half of the total number found in all of Europe and almost three-quarters of those are found in Wales. So Wales is a great place to look for and learn about these fascinating plants.

The diagram below shows the sexual life cycle of a typical moss which differs only in minor details from that of liverworts (e.g. liverwort spores don't germinate to produce a protonema). It involves the alternation of a dominant, haploid gametophyte with a diploid sporophyte (a capsule on a stalk) which remains attached to the gametophyte.

DIPLOID SPOROPHYTE  
(2 sets of chromosomes  
in each cell)



HAPLOID GAMETOPHYTE  
(1 set of chromosomes in each  
cell)

## Some important facts about bryophytes

1. Bryophytes are made up of 3 different groups; liverworts, hornworts and mosses.
2. They are found throughout the world in all the important ecosystems except for the marine environment.
3. Mosses make up the largest group of bryophytes, but there are also lots of different liverworts. The hornworts are a relatively small group of Bryophytes.
4. Mosses can be divided up into 3 groups, bog mosses, cushion mosses and feather mosses.
5. There are 2 types of liverworts, thallose liverworts and leafy liverworts. Thallose liverworts are very distinctive, but some resemble hornworts. Leafy Liverworts resemble mosses.
6. Bryophytes don't produce flowers or seeds. Instead, sexual reproduction involves the production of spores in a capsule. Asexual reproduction is also possible by the production of small propagating structures called gemmae (see the thallose liverworts in the demonstration). Many bryophytes also reproduce vegetatively, simply by detaching leaves or small bits of their shoots.
7. Those bryophytes that reproduce by means of spores have a life cycle where a dominant haploid plant (the gametophyte) gives rise to a diploid structure (the sporophyte) after the fusion of a sperm cell with an egg cell. The sporophyte is made up of a capsule held on a stalk (the seta) and it is largely, if not completely dependent on the dominant gametophyte. The capsule produces haploid spores which germinate and give rise, eventually, to the haploid gametophyte.
8. Bryophytes are unique among plants and most other terrestrial organisms in having a dominant phase in their life cycle that is haploid (see diagram of the life cycle).
9. Most Bryophytes are small and the majority of them can't transport water much higher than a few centimetres. So, unlike vascular plants, they can't grow tall. However some mosses, e.g. Common Hair-cap, have a primitive conducting system that allows them to grow up to 40 cm tall. The tallest moss in the world, *Dawsonia superba*, is able to grow up to 60cm (2 foot) tall in the mountain forests of Borneo, thanks to a simple conducting system.
10. Most bryophytes get much if not all of their nutrients from rain-wash or rain-splash, which they absorb all over their bodies. Bog Mosses (*Sphagnum*) can absorb up to 20 times their own weight in water and they perform a crucial ecosystem service in holding water in upland bogs and mires that would otherwise flood lowland areas.

11. *Sphagnum* mosses acidify their water-logged environment and decay slowly to form peat, which accumulates in bogs. This process provides a sink for atmospheric carbon, mitigating the effects of increased emissions of CO<sub>2</sub> and it is another example of a crucial ecosystem service provided by bryophytes.
12. It is easy to underestimate the important role bryophytes play as primary producers. In some ecosystems, (e.g. the northern boreal forests), the collective biomass of bog mosses and feather mosses is enormous and their contribution to ecosystem stability is very significant.
13. Bryophytes are pre-eminent pioneers able to grow on bare ground, sand, rock and bark as well as all sorts of man made structures. Bryophytes that grow on trees are called epiphytes.
14. Many bryophytes are sensitive to atmospheric pollution from sulphur-based and nitrogen-based pollutants. They are also responding to climate change and carbon dioxide fertilisation. The interactions of these factors is complex but we are seeing some spectacular changes in the abundance and distribution of many bryophytes, especially epiphytes. You will see some examples of this on the Moss Trail.

## **Notes on species in the demonstration:**

### **THALLOSE LIVERWORTS**

#### **Great Scented Liverwort**

A large thallose liverwort with a pleasant, sweet scent. This is one of the biggest liverwort in Britain. It grows in wet places e.g. near streams and rivers, often in very shaded locations. Plants growing in very shaded areas are a darker green than those found in more exposed sites because they produce more chlorophyll to compensate for the lower levels of light.

#### **Overleaf Pellia**

Probably the most common thallose liverwort in Britain and the one often used in school lessons about liverworts. It likes wet areas.

#### **Crescent-cup Liverwort**

A common thallose liverwort, found in drier places than the 2 species above. Note the crescent shaped cups which contain gemmae.

#### **Common Liverwort**

There are 2 subspecies, one grows on the banks of rivers and streams (you'll see this on the Nature Trail) and the other (in this demonstration) which is found commonly in disturbed, urban habitats. Note the little cups that are found all over the surface which contain gemmae. Individual plants are either males or females. The plants in the demonstration are males (look for the flat-topped receptacles held on a little stalk).

#### **Common Crystalwort**

Crystalworts are fabulous thallose liverworts which grow as rosettes in arable fields and on paths and tracks, sometimes forming colonies containing hundreds of individual plants.

## **LEAFY LIVERWORTS**

### **Greater Featherwort**

One of the largest leafy liverworts found in ancient woodlands. Note that the leaves are produced in 2 ranks, a structural feature that distinguishes leafy liverworts from mosses.

### **White Earwort**

One of the most common leafy liverworts found on acidic, heathy banks.

### **Grove Earwort.**

An attractive leafy liverwort with prominently toothed leaves. Look for the brown gemmae that are dotted on the surface of the apical leaves.

### **Stragglng Pouchwort**

A leafy liverwort found in upland areas, particularly in humid ravines where it can form large, impressive mats on vertical banks and rock faces. The 2 ranked leaves are arranged in neat opposite pairs.

### **Notched Rustwort**

Another upland species usually found on rocks in streams. It is the most common *Marsupella* species. Under the microscope the cells show very conspicuous triangular thickenings in the corners of the cells, which are called trigones. Other leafy liverworts also have trigones but they are not found in mosses.

### **Rustwort**

A small leafy liverwort which grows on the rotting, decorticated trunks of fallen trees. It is a characteristic species of upland oak woodland and conifer plantations in Wales. The dark red, sometimes crimson, colour of the shoots is a good identification feature. It's also worth looking at the amazing leaves with their pincer-shaped lobes (use a hand lens).

## **Bog Mosses**

There are more than 30 different species of *Sphagnum* found in Britain and Ireland. They are species of wet (or very humid) places and many of them are characteristic species of bogs and mires. However several common species, such as the 2 in the demonstration, are also found in woodlands and on wet banks along forest tracks.

### **Fringed Bog-moss**

A very common bog-moss which is almost ubiquitous on wet banks and in wet woodland. It is rather slender with long, slender branches and often forms extensive, loose colonies. The individual shoots have a very prominent apical 'bud' at the top (the capitulum), but one of its most useful identification features is the shape of stem leaves (use a hand lens), which are fan-shaped and ragged (fimbriate) along the upper margin. It usually produces abundant black capsules.

### **Blunt-leaved Bog-moss**

A chunky bog-moss which often grows in large, untidy colonies. It is one of the most shade tolerant species of *Sphagnum* and is found in both deciduous woodland and conifer plantations. It can be quite striking in appearance with contrasting colours of pink, orange, green and brown, but equally it can look rather sombre. The extent of pigmentation may be a response to the amount of exposure to daylight.

## **CUSHION MOSSES**

### **Mougeot's Yoke-moss**

This is an upland moss which grows in large colonies of dark green cushions on vertical, rock faces. It prefers siliceous rocks such as sandstones.

### **Broom-Fork-moss**

A very common moss in heathland, moorland and woodland, sometimes growing on wood. It forms very attractive spiky cushions.

### **Golden-head Moss**

A beautiful moss of base-rich flushes in the uplands. It sometimes forms huge colonies in banks along forestry roads. The golden-yellow colour of the leaves, especially at the tips, contrasts with the dark brown, hairy stems giving the appearance of a bottle-brush. Large colonies are so conspicuous that they can be identified at a distance.

### **Urn Hair-cap**

Another upland species and a pioneer of heathy banks, gravel tracks and quarries. The plants in the demonstration are producing sporophyte capsules. The thick, blue-green rosettes of spiky leaves and the hairy, pale-coloured 'hats' on the capsules make the colonies quite conspicuous.

### **Bank Hair-cap**

A common moss of heathland and acidic woodland. It bears a superficial resemblance to Urn Hair-cap, to which it is related, but it is bigger and the leaves are a rich green colour. It is closely related to Common Hair-cap (*Polytrichum commune*) which is much taller. All hair-caps are dioecious, i.e. individual plants are either male or female. The female plants produce capsules on tall stalks.

### **Sand-hill Screw-moss**

This is a characteristic pioneer species of sand dunes where it can be extremely abundant and it is one of the most desiccation-tolerant plants on the planet. When dry, the colonies curl up into formless, crispy brown structures that are able to remain dormant in a desiccated, metabolically inactive form for months. Then, if they are wetted, they become transformed into green, healthy-looking cushions almost immediately and their metabolism is activated in seconds. In this way they resemble the 'resurrection plants' that are found in deserts. The leaves have a long white hair-point at their tips which might help to reflect harmful solar radiation during hot, dry periods.

### **Bog Bead-moss**

An attractive, loosely-tufted moss found in acidic wet flushes and bogs. The bright yellow-green leaves contrast with the stems which are clothed in dark coloured hairs. In their *Field Guide to Bryophytes*, Dominic Price and Clive Bealey describe this as 'chocolate and lime bottle brushes'.

### **Shining Hookeria**

Another beautiful moss, so characteristic of Welsh woodlands. The shoot structure is markedly compressed to the extent that it could be mistaken for a large leafy liverwort, but the translucent leaves are spirally arranged and not organised into opposite pairs. It has enormous leaf cells that can be seen clearly with a hand lens.

### **Maidenhair Pocket-moss**

This is one of the largest pocket mosses and one that is commonly found in base-rich flushes and on wet rock faces. With their flattened shoots made up of a 2-ranked leaf structure and a clasping portion that resembles a 'pocket', *Fissidens* species are unique among mosses.



## **FEATHER MOSSES**

### **Flagellate Feather-moss**

A characteristic feather moss of shaded streams in the uplands, frequently growing in large groups. The golden-green tips to the shoots are often very conspicuous.

### **Little-Shaggy-moss**

This robust (not so little) feather moss is a characteristic species of upland Sessile Oak Woodland and humid conifer forests. It can form enormous colonies of loose mats in mature spruce forests. The leaves tend to be curved, but not as much as in the closely related Springy Turf-moss (*Rhytidiadelphus squarrosus*) which can be seen on the Moss Trail.

### **Glittering Wood-moss**

An abundant feather moss of acid grassland, woodland edges and forests that are not too shaded. The 2-pinnate, feathery structure of the shoots and the red stems make it fairly easy to identify. It can resemble Common Tamarisk-moss, but that species doesn't have a red stem. Glittering Wood-moss is one of the most abundant bryophytes in the northern hemisphere where it occupies vast areas of ground in the open forest of the northern boreal ecosystem.

### **Red-stemmed Feather Moss**

Another abundant moss of heathland, moorland and open woodland on acidic soils. Although it has red stems like Glittering Wood-moss, it is much less feathery than that species. In fact it is more likely to be confused with Neat Feather-moss, which is usually more chunky and doesn't have red stems. Like Glittering Wood-moss, Red-stemmed Feather Moss is abundant in northern boreal forests where it contributes significantly to the photosynthetic biomass of the ground flora.

### **Neat Feather-moss**

A very common feather moss in lots of different habitats including grasslands and woodlands. It is fairly robust with rather rounded or blunt shoot tips which give it a distinctive 'look'.

### **Heath Plait-moss**

A common moss of heathlands and woodlands and particularly common in some damp spruce forests. It can form extensive, pale-green mats of rather neat, pinnately branched shoots. Although it can be found as an epiphyte, or sometimes on rock, it is most commonly found growing on the ground. There are other very similar plait-mosses, but none of these occur so abundantly on the ground in heathland.

### **Waved-Silk-moss**

A very distinctive feather moss with pale green (almost white when dry), flattened shoots. It is a characteristic species of upland Sessile Oak Woodland and heathland, but it grows in super abundance in damp spruce forests.

### **Common Tamarisk-moss**

Because of the superficial resemblance to Tamarisk leaves, the common name of this attractive, yellow-green feather moss is very descriptive. Like Glittering Wood-moss, the shoots are very feathery, but unlike that species it doesn't have red stems. It also has rather small leaves on wiry shoots that tend to grow upright like a miniature tree. It is a very common moss found in all types of woodland.