DEPARTMENT OF
BOTANY
Te Tari Huaota o Otago

ASK A BOTANIST

Why do some plants have furry leaves and stems?

Many leaves are furry or hairy. Even when a leaf looks smooth, a magnifying glass or microscope will often reveal tiny hairs, particularly on the back of the leaf. Botanists use a range of scientific terms to describe the different hairs on plants, including glandular (a stalk with a ‘pin head’ containing, for example, a chemical that deter bugs), stellate (branched like a snowflake), and arachnoid, meaning spidery. The type of hairs on a plant can be important in identification. For example, yellow-flowered daisies you probably have in your garden, like dandelion, cat’s ear, hawkbit, and hawksbeard differ in whether their leaf hairs are simple, segmented or stellate.

Dense white fur on the underside of a leaf, scientifically called tomentum, is particularly common in the daisy family. The tomentum of tikumu, large native mountain daisies (*Celmisia* spp.), is so dense it can be stripped off; it was used for clothing and insulation by southern Māori. White furry leaves are also seen on plants in cold, high light areas like high mountains or in dry areas, like deserts.

So why are leaves furry? It’s all to do with water. Leaves produce food for the plant via photosynthesis. In order to turn sunlight into carbohydrates, chloroplasts inside the leaf need carbon-dioxide and water. Pores in the leaf allow carbon dioxide in, but they also allow water to escape. When a plant has plenty of water this isn’t a problem; in fact, losing water through the pores can stop the leaf from overheating, just like your sweat cools you down. However, in cold or dry places where water can be limited, the plant needs to reduce water loss while avoiding overheating. Plants in these places often protect their pores in deep furrows under a layer of hairs, often on the underside of the leaf. This way the leaf can let in carbon dioxide and cool down without losing too much water to evaporation.

Plants that have white or silvery fur can even further limit water loss and overheating by reflecting back the high levels of light that are typical of high mountains and deserts.

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How long does it take a flower like flax to replenish its nectar after it is visited by a tui or bellbird?

Flowers produce nectar to attract animals such as insects and birds, which then transfer pollen to other flowers to achieve cross-fertilisation. Although nectar is costly to produce, the benefit of the plant is that pollen is likely to be transferred more directly to another flower.

In general, nectar-producing flowers will replenish their offerings over the lifetime of the flower. However, the rate at which replenishment occurs depends on plant health, microclimate and flower age. Large, healthy plants will not only produce more flowers, but each flower is more likely to have more nectar and replace it more readily. Hot, dry conditions will cause nectar to evaporate or not be replenished as readily.

Some species will respond to pollinator visits by producing greater amounts of nectar, but for many species, nectar production is fairly constant until the flower reaches a certain age. For plants with hermaphroditic flowers, like New Zealand flax, or harakeke, each flower can function both as a male, exporting pollen to other flowers, and as a female, receiving pollen and producing seeds. When harakeke flowers first open they are functionally male, releasing pollen which is initially orange but which fades to yellow after six to 12 hours. Nectar production is the greatest during the first day and is apparently replenished to some extent even if the flower has been visited. After 18-24 hours, the flower changes to the female phase and is ready to receive pollen from another plant. Nectar is still produced during this phase, but not in the same quantities as when the flower was releasing pollen.

This difference in nectar production between male and female phases is an efficient use of resources, as the amount of pollen exported to other flowers (success as a male parent) increases with the number of pollinator visits, hence it is worthwhile producing more nectar to attract more visitors. However, success as a female parent only requires one visit from a pollinator carrying enough pollen to fertilise all of the flower’s ovules. So there is usually little benefit in replenishing nectar in the female flower phase.

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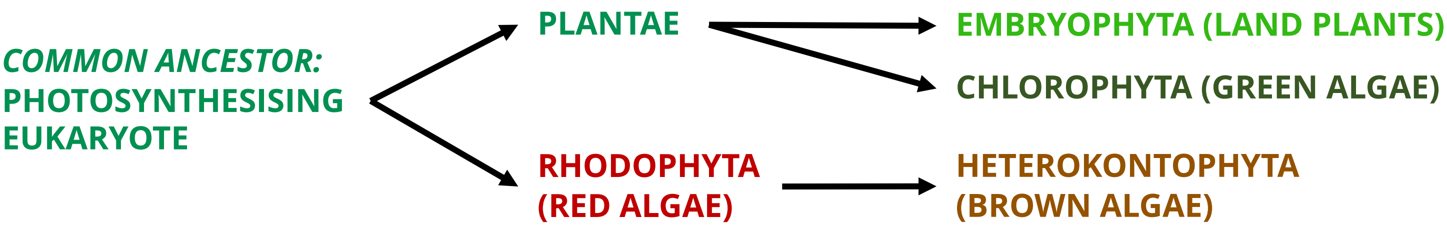
Are seaweeds plants?

Seaweeds are not plants, although they shared a common ancestor many hundreds of millions of years ago. The term seaweed refers to one of three kinds of algae, the red, brown and green algae, which each have a complicated relationship to each other, and to ‘true’ plants.

Around 1.5 billion years ago, the first multicellular photosynthetic organisms emerged. This followed an event called ‘primary endosymbiosis’ - a kind-of merger between a cyanobacterium cell (which produces its own energy via photosynthesis) and a bacterium that possessed a mitochondria (which metabolises sugars into ATP) into the first eukaryotic cell (which could use both photosynthesis and mitochondria). From this common ancestor, green algae (Chlorophyta) and red algae (Rhodophyta) evolved. Land plants (Embryophyta) branched off from the Chlorophyta, and brown algae (including the giant kelp and other large seaweeds) emerged as a result of a second endosymbiotic event to form their own group, the Heterokontophyta.

All three types of algae share common features with plants, including the production of chlorophyll to harvest light energy from the sun in order to fix carbon via photosynthesis. Some brown algae have independently evolved mechanisms for transporting sugars that are similar to the phloem of plant stems. However, unlike plants, seaweeds have very little differentiation of tissues - think of a relatively uniform sheet of sea lettuce, *Ulva*, compared to the big differences between roots, stems, leaves and flowers of plants.



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ASK A BOTANIST

Why do some flowers change colour as they develop?

Colour pigments in plants have a variety of functions and are not just adapted to attract pollinators. Flowering is an expensive and sometimes risky process for a plant, as a lot of resources are diverted from growth into structures that are vulnerable to damage and may not bear fruit. The flowers of most plants are surrounded and protected by a structure called a calyx when they are in bud. The calyx segments often look like petals but they are tougher and, in most plants, they are green.

The green colour is due to chlorophyll, which is the main light-harvesting pigment that plants use to convert sunlight into energy. So before the flower has opened, the plant is using chlorophyll to make energy to help pay for the flowers.

When the flower has fully opened the petals become conspicuous and the green calyx is hidden. Colourful flowers are attractive to a range of pollinating insects, such as flies and bees, so here colour is helping the flower to be pollinated and set seeds.

Damage from sunburn and attack from flower eating insects can trigger the production of another important plant pigment: anthocyanin. Anthocyanins are responsible for most of the red, purple and blue colours we see in plants; they have an important role as antioxidants, mopping up the effects of damage to plant tissues.

Some flowers, like those of the native tree fuchsia (kōtukutuku), change colour after they have been visited by a pollinator. In this case, colour change might be used to signal that the nectar has been depleted and that the flower is no longer worth visiting. But, this is just a guess, as no-one really knows! So the changing colours of flowers represent just some of the ways that pigments help plants harvest energy, attract pollinators and protect themselves from damage.

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ASK A BOTANIST

Why are there very few deciduous native plants in NZ?

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Autumn highlights one of the most profound differences between native New Zealand trees and trees from temperate northern hemisphere regions. While visitors and locals alike marvel at the glorious colours of poplars, maples and many other northern hemisphere deciduous trees, our native trees mostly don’t look that different at any particular time of year.

Leaf fall in winter-deciduous trees is generally triggered by a combination of colder temperatures and shorter day lengths. The colour change we love occurs as a result of pigments and other compounds being dismantled or transported back into the stem as the plant actively cuts off its leaves.

In regions where summers are predictably warm and suitable for growth and photosynthesis, but winters are predictably unsuitable for growth, leaf fall is thought to be economical as it reduces damage from frost, wind and snow, and also conserves water, as leaves lose water through their pores (stomata). Evergreen trees in cold climates, such as pines, have small leaves that are well protected with a thick waxy coating, and branching patterns that help shed snow.

Our oceanic climate means New Zealand summers are not always reliably warm and New Zealand winters are not always consistently too cold for growth. This is thought to be the main reason why so few native trees have evolved to drop all their leaves in autumn – they might miss a chance to grow!

However, New Zealand trees don’t keep their leaves forever; some species replace them more or less continuously, but other species, such as beech trees, have distinct spring or autumn periods of leaf fall. If you want to know when your favourite tree changes its leaves, mark some leaves with small dot of paint on the underside and watch them. You might be surprised to find our trees do drop leaves in autumn, just not all at the same time.