

# Why leaves change colour



For many people autumn is a time of beauty, when the natural world treats us to a last burst of colour before the onset of winter.

The annual colour change and leaf shedding that is characteristic of broad-leaved trees is closely linked to the way they obtain food.

Trees, like the majority of plants, produce their own food by a process called photosynthesis...

## Photosynthesis

Photosynthesis, literally "putting together with light", is the process by which plants make the food they need to grow and reproduce. They convert inorganic substances (carbon dioxide and water) into organic substances (sugars) using the energy in sunlight to power the reaction.

The sunlight energy is captured by chlorophyll, a green chemical pigment found in leaves and other green parts of plants, and converted to chemical energy. The sugars produced by photosynthesis are either stored in the leaves or transported to other parts of the tree for growth and storage.

A by-product of photosynthesis is oxygen, which virtually all living things need for respiration, making photosynthesis essential for life.



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Photosynthesis takes place in the leaves which contain a chemical pigment called chlorophyll, which makes leaves look green.

It's produced in leaf cells throughout the growing season when it is warm and sunny and has an essential role in photosynthesis.



## Chlorophyll

Chlorophyll is a green pigment found in leaf cells. It is the reason why leaves look green.

Plants need sunlight and warmth to produce chlorophyll but bright sunlight destroys it, so in summer it must be continuously created in order to keep up the level of chlorophyll in the leaves. When there is little or no sunlight, chlorophyll is not produced (think of the yellowing of grass that has been growing under a stone, or where a tent has been).

Chlorophyll production ceases in winter when there is very little sunlight. Chlorophyll is essential for photosynthesis. It captures the sunlight energy needed to convert carbon dioxide and water into sugars and oxygen.



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Carotene is another chemical pigment found in leaf cells throughout the growing season and has a secondary role in photosynthesis.

The yellow colour of carotene isn't visible in spring and summer leaves because it is masked by the green of the chlorophyll.

As summer turns into autumn, the shorter days and cooler nights trigger two major changes in the leaf, both of which have consequences for its colour...



## Carotene

Carotene is a yellow chemical pigment found in leaf cells. It has a secondary role in photosynthesis absorbing sunlight energy and transferring this energy to the chlorophyll.

Unlike chlorophyll, it is not affected by sunlight and temperature so it remains in the leaves when the chlorophyll has disappeared making the leaf look yellow.

Carotene is the main pigment in carrots and also in the feathers, eyes and scales of some animals.



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- chlorophyll production slows down and eventually stops, the remaining chlorophyll breaks down and the green colouration fades to reveal the yellow carotene.



- a layer of corky cells forms across the base of leaf stalk, in preparation for leaf shedding, which restricts the movement of sugars back to the main part of the tree.

Sugars become concentrated in the leaf and are eventually converted to anthocyanin, a red/purple chemical pigment.

## Anthocyanin

Anthocyanin is a red/purple pigment only present in leaf cells when the concentration of sugars is high enough to trigger a reaction between sugars and proteins in the cell sap. Light is required for the reaction to occur.

Anthocyanin production is enhanced by sunlight, drought and temperature. It's responsible for the red skin of apples and the purple of black grapes. An apple that is red on one side and green on the other indicates that the red side has been in the sun and the green side in shade



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It's not only chemical changes in the leaves that affect their colour. Weather conditions also have an effect:

- cold nights - low temperatures destroy chlorophyll so the green leaf fades to yellow, but if temperatures stay above freezing anthocyanin production is enhanced and the leaves take on a red colour.
- dry weather - sugars become concentrated in the leaves, more anthocyanin is produced and consequently leaves are redder.
- bright sunny days - although the production of new chlorophyll stops in autumn, photosynthesis can still occur on sunny autumn days, using the remaining chlorophyll. Sugar concentration increases, more anthocyanin is produced and the leaves are redder.

So, for the greatest variety and intensity of autumn colours, sunny, dry autumn days with cold but not freezing nights are best, especially if preceded by a dry summer. Cloudy and rainy autumn days on the other hand, lead to muted autumn colours.

