The Nature and Science of LEAVES

叶子的奥秘

Jane Burton and Kim Taylor 著　王冰欣 译

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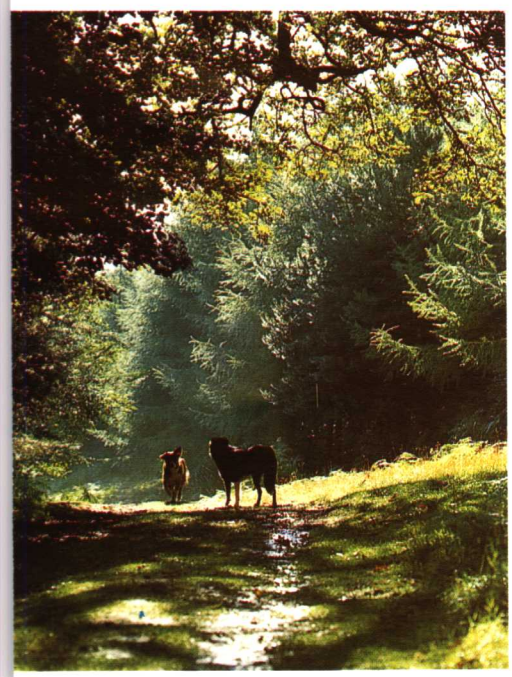
Contents 目录

The Life of a Leaf
一片叶子的生命



When you go into a forest, it is dark under the trees. The tree leaves have collected most of the light on its way down from the sky. Green leaves are a plant's own food factory. They produce the food that the plant needs for growing, and for making flowers, fruit and seeds—and new leaves. Light energy from the sun is used by the leaves to turn **carbon dioxide** and water into **oxygen** and **sugar.** This process is called **photosynthesis.** All green plants use sugar as a basic food for growing.

Leaves come in an amazing variety of shapes and sizes, but nearly all leaves do the same main job. They spread out so that they catch sunlight and use it to make plant food. When leaves get old, they fall off. Trees that lose all their leaves during the winter stop growing because their food factories have gone.

森林中的光线阴暗，这是因为从天空照射下来的光大部分被树叶采集。绿叶是植物自己的食物加工厂，生产植物生长、开花、结果、结籽以及长出新叶所需要的食物。叶子利用光能将二氧化碳和水转化为氧和碳水化合物。这一过程叫做光合作用。碳水化合物是所有绿色植物生长所需的基本食物。

叶子的形状和大小各异，但几乎所有的叶子都有相同的作用。叶子舒展开来以吸收阳光，然后利用阳光为植物制造食物。叶子衰老以后便会落下。在冬天落叶树会因为失去了食物工厂而停止生长。

The leaves of many Eucalyptus trees in Australia do not spread out to catch the maximum sunlight but hang down vertically. This stops the leaves getting burned in the very strong sun and dry air—yet they still get plenty of light for photosynthesis.
在澳大利亚，许多桉树的叶子并不是舒展开来最大限度地吸收阳光，而是笔直地垂下，以免被灼热的阳光和干燥的空气烤焦。即使这样，这些树叶仍能获得足够的阳光进行光合作用。

Each kind of plant has its own special shape of leaf, and you can tell which plant a leaf belongs to just from its shape. Some are short and round, others are long and thin like needles. These are **simple leaves**, but others are **compound leaves**—made up of lots of smaller **leaflets** arranged in rows or spread out like your hand. Leaves may be smooth, curly or hairy or have saw-like edges or prickles.

每种植物的叶子都有其特殊的形状。根据叶子的形状我们可以判断它是哪一种植物。有些叶子短而圆，有些叶子细而长，形状像针。有些是单叶，有些是复叶。复叶由许多小片叶子组成。这些小叶或排成几排，或像手一样伸展开来。叶子可能是平滑的，卷曲的，或是毛绒绒的。还有的叶子有锯齿状边缘或针刺。

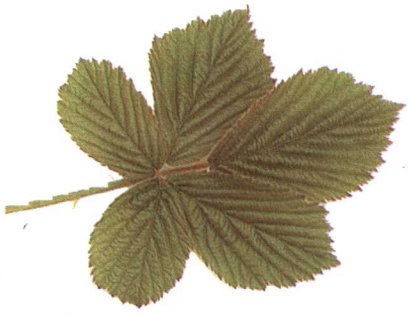
Most tree leaves spread out to catch the sun, so it is shady and dark underneath the trees. Grass and bracken can only grow in glades or open spaces where the sunlight can reach the ground.
大多数树叶舒展开来吸收阳光，因此树下阴暗。草和欧洲蕨只能在能见到阳光的林间空地或开阔地带生长。

Cotoneaster has a simple oval leaf, pointed at the tip.
栒子属灌木的叶子是椭圆形的单叶，叶梢尖。

Nettles have simple oval leaves tapering to a point, with saw- tooth edges. They are covered with stinging hairs.
荨麻的叶子也是椭圆形的单叶，叶梢逐渐变细，形成尖端，有锯齿形边缘。叶子表面覆盖着蜇毛。

Lawson Cypress leaves are just tiny overlapping scales covering the twigs.
美洲花柏的叶子只是一些覆盖在枝杈上面的相互叠盖的微小鳞苞。

Norway Maple has a simple leaf spread out like a hand.
挪威槭的叶子是单叶，像手一样展开。



Blackberry leaves are compound with usually three or sometimes five leaflets.
黑莓的叶子是由三片或五片小叶组成的复叶。

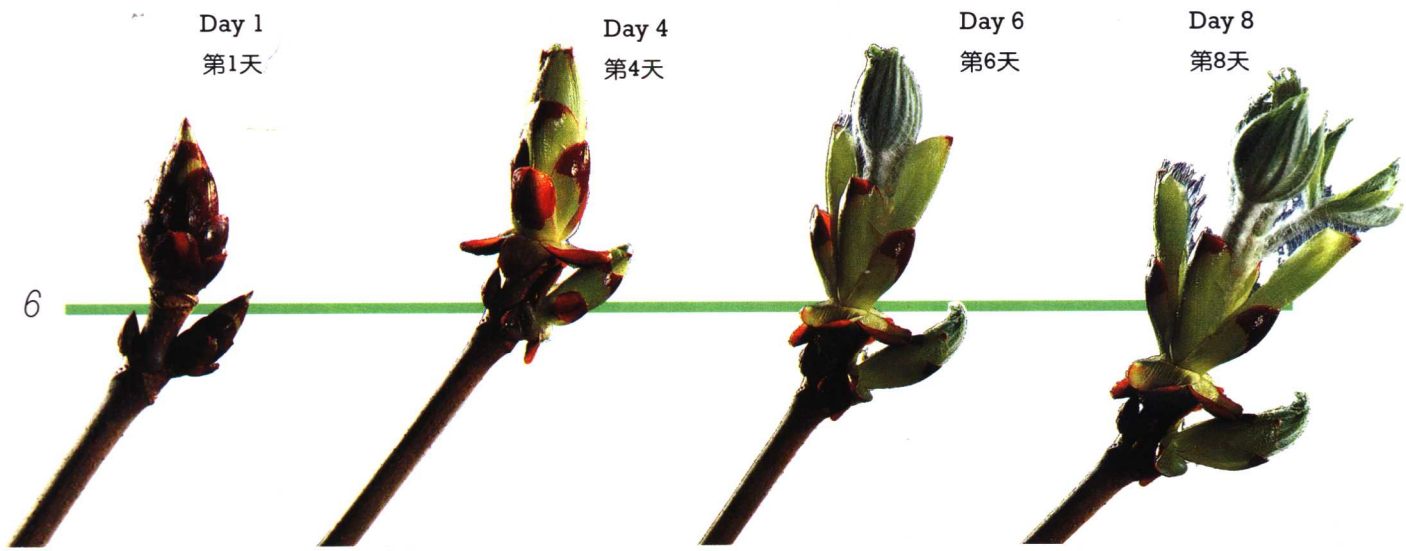
Rowan leaves are compound with the leaflets arranged in rows on each side of the leaf stalk.
欧洲花楸的叶子由许多片小叶组成。这些叶子在叶茎的两侧分成几排排列。

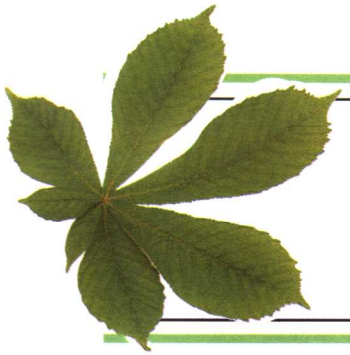
The scales are forced open . . .
鳞苞裂开……

the shoot lengthens . . .
树芽变长……

and the pale, crinkly leaves unfold.
苍白多皱的树叶展开

Water from the twigs pumps the soft, new leaves into shape.
来自枝杈的水分使柔软的新叶成形





Growing Leaves
生长着的叶子

Leaves cover a tree rather like clothes. Over a million leaves are needed to clothe a big tree. Without them, the tree is a bare skeleton. Many trees lose all of their leaves in winter (or during the **dry season**) but the bare twigs carry hundreds of **buds** containing tiny new leaves ready to burst forth when the weather improves. The buds are covered by hard scales which protect the tightly folded leaves inside. In spring, the tree's **sap** starts to rise. Sap is made from water that is drawn up through tiny tubes in the trunk of the tree, and then travels out along the branches to the twigs.

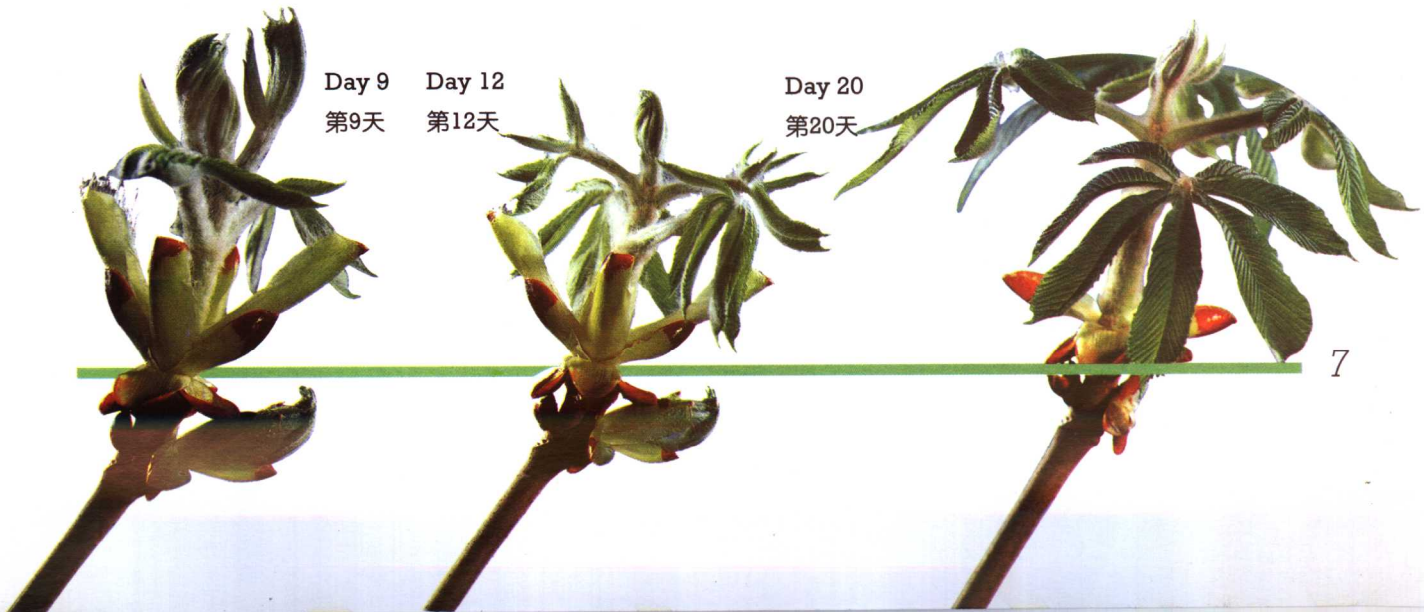
When the rising sap reaches the beech buds, they start to swell. The brown scales are forced apart. The sap pumps up the soft green stems and the bright crinkly leaves, which have been held firmly inside the buds. The stems lengthen and the new leaves unfold, together with the flowers.

叶子像衣服一样覆盖着树。覆盖一棵大树需要一百多万片叶子。没有树叶的树只是光秃秃的骨架。许多树的树叶在冬天(或在旱季)全部落光，但裸露的嫩枝上有几百个树芽，一旦天气转暖，树芽里孕育着的微小的新叶就会绽开。树芽上面有一层硬硬的鳞苞，保护紧包在里面的叶子。春天降临时，树液开始上升。树干上的微小细管抽取水分形成树液，树液又沿着树枝遍布桠杈。

当树液升至山毛榉树芽时，树芽就开始膨胀，棕色的鳞苞被胀裂，树液涌到柔软的绿茎和嫩亮多皱的叶子上，而这些叶子还紧紧包在树芽里。随后绿茎伸长，新叶与花一起展开。

Leaves come from buds which grow on twigs or stems. Inside a bud, all the tiny leaves are perfectly formed and folded up tight into a package. When everything is ready inside–and the weather is right outside–the whole bud starts to swell.This sticky bud of Horse Chestnut burst and the leaves expanded in just three weeks of warm spring weather. In one more week the first leaf was fully spread (*above*).

树叶从桠杈或梗上的树芽中长出。在树芽里面，所有的嫩叶都已完全成形并被紧紧包在一起。当树芽里面万事俱备而外部天气适宜时，整个树芽就开始膨胀。图中的七叶树的粘性树芽已经绽放，在温暖的春天仅三周时间就已伸展。再过一周第一片树叶就会完全展开。



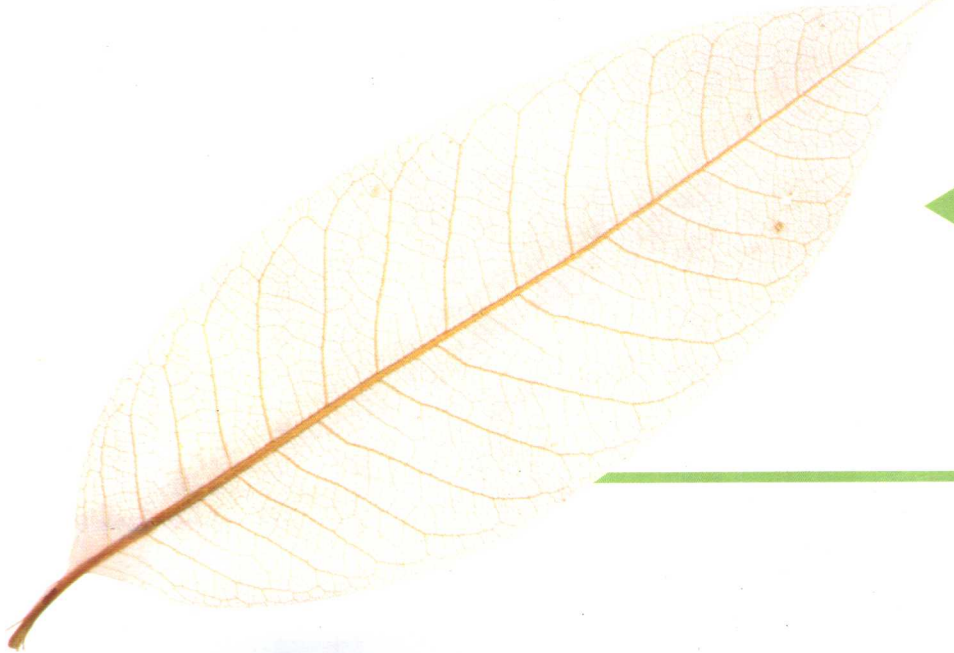
Leaves Need Water
叶子需要水

Leaves need a lot of water. The water flows up through the stem of the plant as sap and into the **veins** of its leaves. The big veins are rigid like a skeleton; they keep the leaf from flopping over. Little veins, like wire netting, fill in the spaces between the big veins. The **network** of veins stiffens the whole leaf and stops the wind from tearing it, as well as bringing water to all the **cells**.

Leaves use some of their water for making food, but much of it goes out into the air through thousands of tiny holes, called **stomata.** As the leaves give off **water vapour** into the air through their stomata, more sap is drawn up the stem of the plant. The sap is helped on its way by the plant's **roots** which draw water from the soil and pump it up the stem. A big tree draws up several tonnes of water in order to open out its leaves in spring.

叶子需要大量的水。水即汁液通过植物的茎部流向叶脉。大的叶脉坚硬得如同骨架，支撑着叶子，使之不会随便飘荡。小的叶脉像丝网一样填满大叶脉之间的空间。叶脉形成的网使整片叶子坚挺起来，抵挡风雨的袭击，同时这张网还将水分输送到各个细胞。

叶子用一部分水生产食物，但大量水分通过成千上万个微小的气孔蒸发到了空气中。当叶子透过气孔将水蒸气散发到空气中时，更多的汁液被吸入植物的茎部。植物的根部从土壤中吸取水分，以推动汁液到达茎部。在春天，一棵大树需要几吨水才能将全部树叶张开。



The light shining through this young oak leaf shows up its veins clearly. The Speckled Bush- cricket spends its life among the leaves, which keep the air moist and cool.
在光线的照射下，这片幼嫩的橡树叶的叶脉清晰可见。树叶使得这里的空气湿润凉爽，金蛀蛉就生活在这些 叶子中间。

The veins of this Begonia leaf are red and show up clearly. They support the leaf and carry water to it.
这片秋海棠叶子的叶脉是红色的。叶脉支撑着叶子，并将水分输送到这里。

When an old leaf falls to the ground, its softer parts rot away, leaving only its dry and delicate skeleton.
枯零的树叶落到地面后，它的柔软部分首先烂掉，只剩干燥纤细的骨架。

No Leaves, No Rain
没有叶子就没有雨

Most of the time you cannot see the water that is being given off by leaves because it appears as vapour. But sometimes a plant, such as water milfoil, draws up so much water during the night that the tips of its leaves are covered with water drops. While the air is cool and damp, the drops do not **evaporate.** When the morning sun touches them, they glisten for a moment like dew. But as the air warms, the drops rapidly shrink and disappear.

Wherever there are a lot of plants, the air is **moist** and moist air makes rain. Where people cut down forest trees and destroy the natural plant cover, the land often turns to desert because the air becomes dry. Only a few special kinds of plants can survive in deserts.

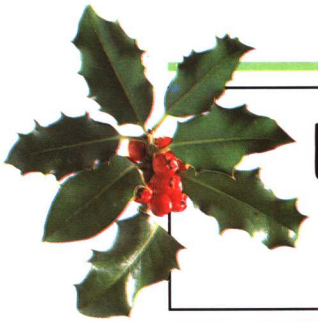
The leaves of cactus plants are sharp dry spines which give off no water and protect the plant from being eaten by animals. The outsides of the tough green stems do the work of leaves.

Cacti live in very dry desert country in North and South America. Their fat stems are used to store water and their green skins photosynthesise, just like leaves.
仙人掌生长在北美和南美一些气候异常干燥的沙漠地区。它的肥厚的茎用于储存水分，绿色的表层像叶子一样进行光合作用。

多数时候叶子散发的水分是看不见的，因为水分是以水汽的形式散发的。有时一棵植物，如狐尾藻，在夜间吸入很多水分，早上叶梢上挂满了水珠。空气凉爽湿润时，水珠不会蒸发。清晨，在阳光的照耀下，这些水珠像露珠一样在片刻间晶莹闪烁。随着气温的升高，水珠迅速缩小、消失。

植物多的地方空气就会湿润，空气湿润就会下雨。砍伐森林、破坏自然植被，会使空气变得干燥，从而导致土地沙漠化。只有几种特殊的植物能够在沙漠中生存。

仙人掌的叶子是干燥坚硬的刺。它不散发水分，同时保护仙人掌免遭动物袭击。坚硬的绿茎表层起着叶子的作用。



How Leaves Breathe
叶子怎样呼吸

Plants not only give off water through the stomata, they also breathe through them. A medium-sized tree leaf, such as Holly (*above*), may have more than 100,000 stomata on its underside, although they are so tiny you need a **microscope** to see them. Plants do not breathe in and out the way animals do. Air moves gradually of its own accord through the stomata.

All animals breathe in oxygen and breathe out carbon dioxide. During the daytime, plants do the opposite. They breathe in carbon dioxide and give out oxygen. At the same time, they also give out water vapour—making country air fresher than city air. At nighttime, or during very dry weather, stomata close to tiny cracks and a plant's breathing slows down.

All the oxygen in the air today has been made over millions of years by plants breathing. Cutting down forests and burning the wood reduces the amount of oxygen and increases the carbon dioxide in the atmosphere.

Leaves cannot photosynthesise at night because there is no light. The stomata in these Quiver Tree leaves in southern Africa are closed to prevent water being lost during the night.
由于夜间没有光，叶子不能进行光合作用。生长在南部非洲的二歧芦荟的叶子在夜间关闭了所有气孔，以免水分流失。

植物不仅通过气孔散发水分，而且还通过气孔呼吸。一片中等大小的叶子，例如冬青的叶子，可能在背面有十万个气孔，尽管这些气孔微小得只有在显微镜下才看得见。植物不像动物那样吸进呼出，空气通过气孔可以缓缓地自动进出叶子。

所有动物都吸进氧气，呼出二氧化碳。在白天，植物与动物相反，吸进二氧化碳，释放出氧气，同时也散发水汽——这就使得乡村的空气比城市的空气更清新。在夜间或是在非常干燥的天气里，气孔关闭，只剩小小的缝隙，植物呼吸放慢。

今天空气中的所有氧气都是由千百万年来植物呼吸制造出来的。砍伐森林、燃烧木材会使大气中的氧含量减少，二氧化碳含量增加。

Each leaf of this Wayfaring Bush has thousands of stomata on its underside. Throughout the day, the leaves are using light to make sugar, and releasing oxygen into the air. The red berries will turn black when they are ripe.

这片绵毛荚蒾的每一片叶子的背面都有成千上万个气孔。整个白天，叶子都在用光制造碳水化合物，并向空气中释放氧气。红莓成熟时颜色变黑。

Why Leaves Are Green
为什么叶子是绿色的

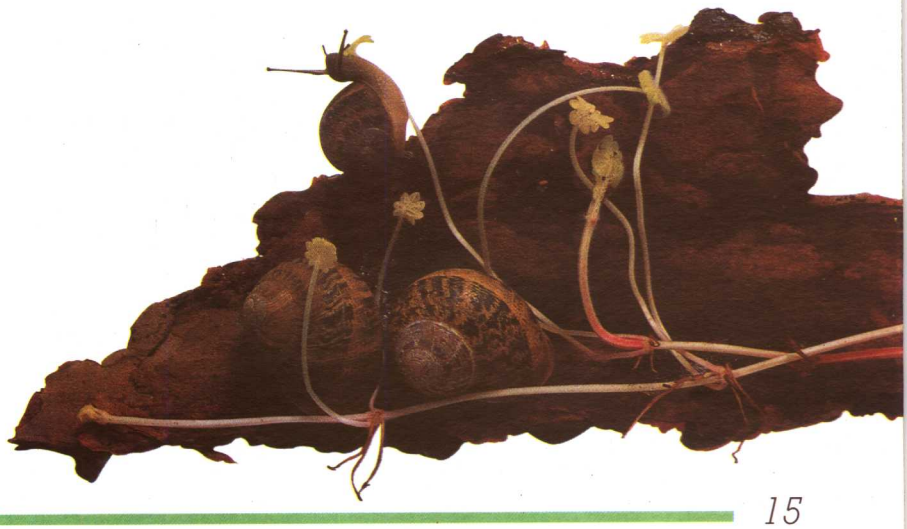
Most leaves are green, and this is because they have **chlorophyll** in their cells. Chlorophyll is a green **pigment** that absorbs energy from the sun. This energy is used to **combine** the water in the leaf with the carbon dioxide gas that is taken into the leaf through its stomata. When carbon dioxide and water are combined, they make sugar and oxygen. The process of making sugar using energy from sunlight is called photosynthesis. Plants that are kept in the dark do not make chlorophyll which is why their leaves are yellow, not green.

But plants need more than just sugar to grow. They get more food from the water that they suck up from the soil. **Minerals** dissolved in it are carried in the sap to the leaves. These minerals help to build the millions of cells in each leaf.

大多数叶子是绿色的，这是因为它们的细胞中含有叶绿素。叶绿素是一种从阳光中吸收能量的色素。它所吸收的能量使叶子中的水分和从气孔吸入的二氧化碳化合，产生碳水化合物和氧气。利用阳光生产碳水化合物的过程叫做光合作用。放在暗处的植物不能制造叶绿素，所以叶子的颜色就会发黄，而不是变绿。

但是植物生长不仅仅需要碳水化合物。从土壤中吸收的水分为它们提供了更多的食物。土壤中的矿物质由汁液带到叶子，帮助叶子中数以百万计的细胞生长。

The leaves of all the different trees and plants in this woodland are spreading out to catch the light so that they can use it to make plant food. Plants on the ground can only grow well where there are gaps in the trees, letting some light through.
这片林地中所有树木和植物的叶子都伸展开来吸收阳光，进而生产食物。只有当树木间有空地，阳光能从空隙透过时，林中的植物才能健康成长。



A chunk of dead bark fell off a tree onto this Ground Ivy. Its stems grew longer in the dark under the bark as they tried to reach the light. Its leaves are yellow because they have no chlorophyll.
一块树皮落到了这根欧亚活血丹上。长在树皮下面暗处的藤茎向着有阳光的地方生长，藤茎因此变长了。叶子由于缺乏叶绿素而变黄。

Most flowers are not green. Flowers do not photosynthesise; their job is to make seeds. They attract butterflies and other insects that will carry **pollen** from one flower to **fertilise** another. So flowers usually have bright-coloured petals which show up clearly among the green leaves.

The wings of this Green Hairstreak Butterfly look very like the young Honeysuckle leaves. But the green colour of the butterfly's wings does not come from chlorophyll, and the butterfly cannot make its own food by absorbing sunlight. No animal can do that—only green plants are able to make food directly from sunlight.

大多数的花并不是绿色的。花不进行光合作用；它们的作用是结籽。花将蝴蝶和其它昆虫吸引过来，这些蝴蝶和昆虫再将花粉带到另一朵花进行授粉。因此，花通常有鲜艳的花瓣，在绿叶的衬托下异常夺目。

这只绿色窄尾小灰蝶很像忍冬的幼叶，但是蝴蝶翅膀的绿颜色并非来自叶绿素，而且蝴蝶不能利用阳光生产自己的食物。所有的动物都不能——只有绿色植物才能直接用阳光生产食物。

Lesser Celandines,Forget-me-nots and Primroses advertise their presence to insects with their fresh spring colours.
小白屈菜、勿忘我和报春花各以其鲜艳的春装招徕昆虫。

The light pink petals of this Ivy-leafed Geranium flower stand out clearly against its green leaves.
这朵蔓生天竺葵花在绿叶的衬托下格外醒目。