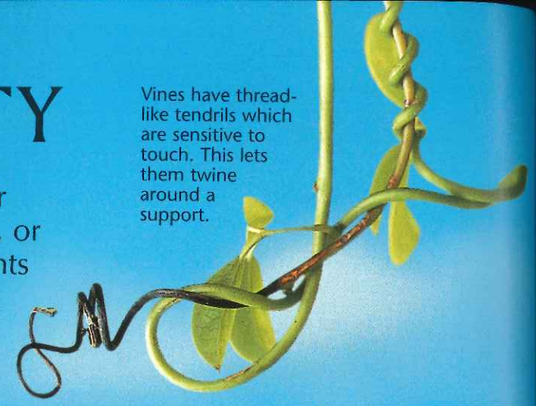
PLANT SENSITIVITY

All living things can react to changes in their environment. This is known as **sensitivity**, or responding to a **stimulus**. Unlike animals, plants do not have a specialized nervous system, but they are still able to react slowly to stimuli such as light, touch and temperature.



Vines have thread-like tendrils which are sensitive to touch. This lets them twine around a support.

PLANT RESPONSE

Most plants respond to a stimulus by growing toward or away from it. This response is called a **tropism**. Growing toward a stimulus is known as a **positive tropism**, and growing away from it is known as a **negative tropism**.

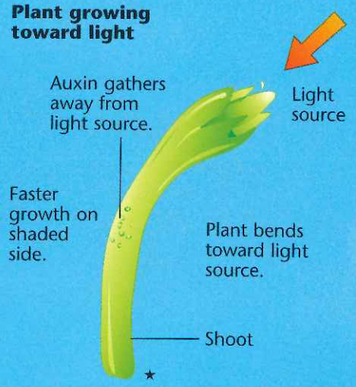
Tropisms are controlled by **auxins**. These are growth hormones (chemicals) made in the plant's cells. Plant stems contain an auxin which collects in cells furthest from the light, causing these areas to grow more quickly. This makes the plant grow toward the light.

RESPONDING TO LIGHT

Almost all plants react to the amount of light available and the direction from which it is coming. This response is called **phototropism**. For instance, the leaves of most plants turn to face the Sun. This helps them to absorb as much light as possible for photosynthesis*.

The sunflowers below respond to light by turning to face the Sun.

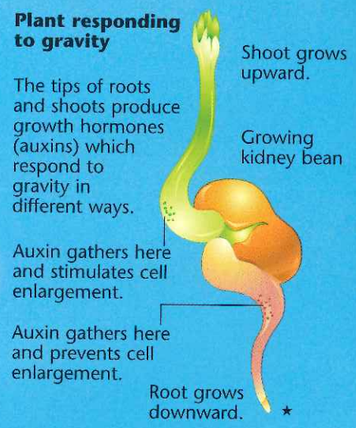
Plant growing toward light



GRAVITY AND WATER

All roots respond to the pull of gravity. This is **geotropism**. The roots grow down into the soil to obtain water and minerals. Some roots also show a response to water, called **hydrotropism**. They may grow out sideways if more water lies in that direction.

Plant responding to gravity



* *Photosynthesis, 22.*

RESPONDING TO TOUCH

Some plants are sensitive to touch. This response, which is known as **haptotropism** or **thigmotropism**, can help a plant in different ways. For example, meat-eating plants trap their food when it touches sensitive parts on their surface (see page 25).

Being able to respond to touch is also important to climbing plants, such as vines. When their thread-like tendrils touch something, it triggers a climbing and twining response.

This sweet pea's touch-sensitive tendrils help it to climb.

In some plants, touch causes a reaction which acts as a defense. For instance, the leaves of a mimosa (nicknamed the "sensitive plant") instantly close and droop when touched. This is because touch causes the pressure of water in its leaf cells to drop.

The leaves of this mimosa close up like fans when they are touched.

DAY AND NIGHT

Many plants will only grow during periods when light is available for a certain length of time. These periods are called **photoperiods**, and the plant's response is **photoperiodism**.

Long-night plants, such as chrysanthemums, only produce flowers at times of the year when the night is longer than a certain length, called its **critical length**. (These plants are also known as short-day plants.)

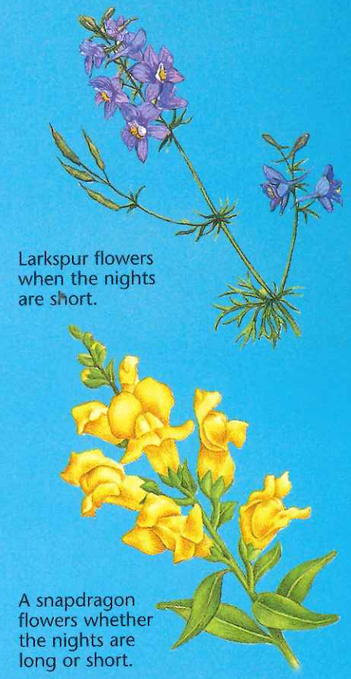
Short-night plants, such as larkspur, only produce flowers if the night is shorter than the critical length. (These plants are also known as long-day plants.)

It is thought that there is a growth hormone called **florigen** produced in the leaves, which makes a plant behave like this. When the correct amount of light is available, the florigen sends a "message" telling the plant to produce flowers.

Some plants, such as snapdragons, are described as **night-neutral** or **day-neutral**. Their flowering does not depend on the night's length.

Photoperiodism may be affected by the age of the plant, or the temperature of its surroundings.

Chrysanthemums flower when the nights are long.



Larkspur flowers when the nights are short.

A snapdragon flowers whether the nights are long or short.

See for yourself

Leave a potted plant in a room with one window. Place it a little way from the window and water it as usual. After a few days, you will see that the plant's leaves are leaning toward the window. If you turn the plant around, after a few more days the same thing will have happened. This is because leaves always grow toward the nearest source of light.

Internet links

Go to **www.usborne-quicklinks.com** for links to the following Web sites:

Web site 1 See if time of day has an effect on plant movement.

Web site 2 Detailed information about the history, discovery and function of plant hormones.

Web site 3 An advanced look at various tropisms, with many helpful images.

Web site 4 In-depth information about plant hormones and plant sensitivity.

FLOWERING PLANTS

There are over 250,000 different kinds of flowering plants, including grasses, wild flowers, shrubs and trees. Plants which produce flowers are known as **angiosperms**. All flowering plants have certain features in common. For example, they all produce seeds and contain tissue which transports fluid around the plant.

FLOWERS

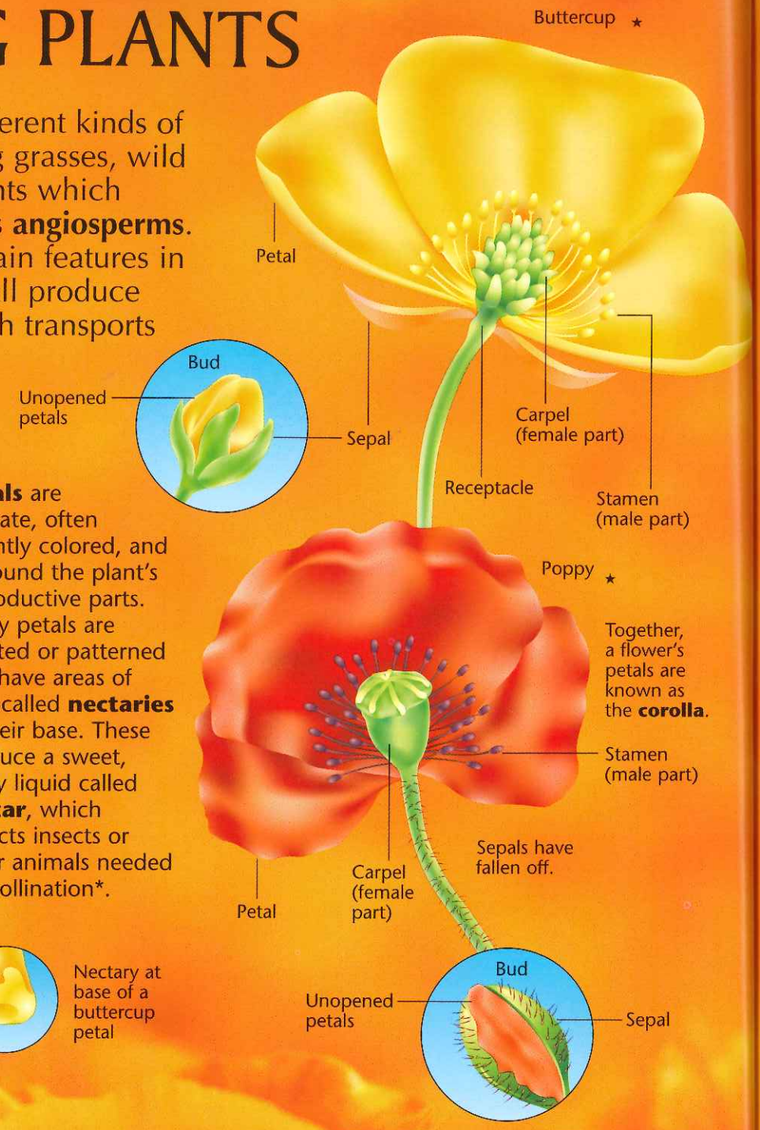
Reproduction is the creation of new life. Flowers contain the parts of plants needed for reproduction. These produce male and female sex cells, called **gametes**, which join together to create new plants of the same kind. This type of reproduction is called **sexual reproduction**.

Flowers are made up of many specialized parts. These include petals, stamens (the male parts), and one or more carpels (the female parts). In most plants, the petals are arranged in a circle, around the male and female parts.

Just before a plant blooms, it produces a **bud**, which will eventually develop into a flower. It grows from the expanded tip of a stalk, called the **receptacle**. Buds are surrounded and protected by small, leaf-like **sepals**.

In some plants, such as buttercups, the sepals remain as a ring around the flower after the bud has opened. In others, such as poppies, they wither and fall off.

Petals are delicate, often brightly colored, and surround the plant's reproductive parts. Many petals are scented or patterned and have areas of cells called **nectaries** at their base. These produce a sweet, sticky liquid called **nectar**, which attracts insects or other animals needed for pollination*.



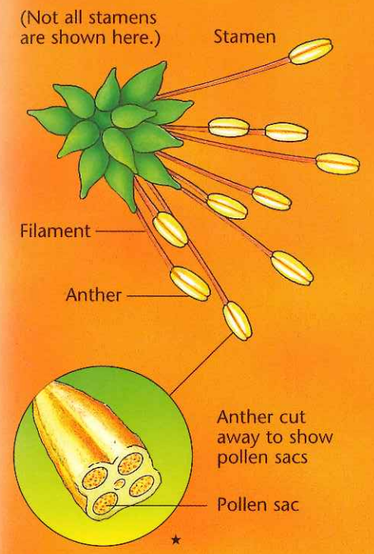
The petals of these Californian poppies surround their reproductive parts. Their sepals have fallen off.

* *Pollination, 30.*

MALE PARTS

A flower's male reproductive parts are called **stamens**. Each stamen is made up of a pod-like **anther**, at the end of a long stalk called a **filament**. Anthers contain **pollen sacs**, which split open to release grains of **pollen**, the male reproductive cells.

Male parts of a buttercup



Pollen grains from different plants may be different sizes and shapes, but they do share some features. For instance, when they are mature, all pollen grains have a hard outer wall, making them very tough.

See for yourself

Look at different types of flowers and, using the pictures on these pages, try to identify their male and female parts.

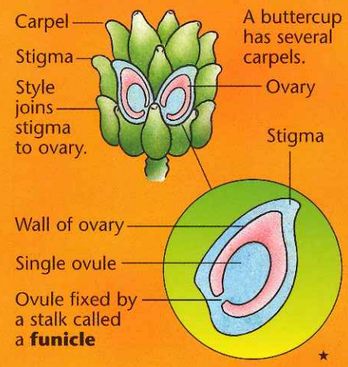
You may find that not every plant has both parts together in the same flower. They may be on separate flowers or on separate plants.

FEMALE PARTS

A flower's female reproductive part is known as the **carpel** or **pistil**. It is made up of the stigma, style and ovary.

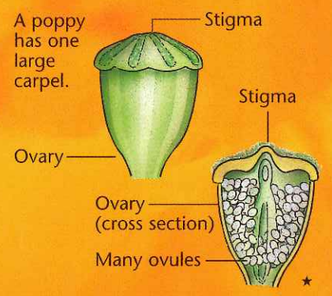
The **stigma** is the top part of a carpel. It has a sticky surface which traps grains of pollen that touch it. The stigma is joined to the ovary by a part of the carpel called the **style**. Each **ovary** holds one or more tiny eggs called **ovules**, which are the female reproductive cells. These develop into seeds after fertilization (see next page).

Female parts of a buttercup



Some flowers, like the buttercup above, have several carpels clustered together. Others, such as the poppy below, have only one.

Female parts of a poppy



The styles of many flowers, such as daffodils, are easy to see. In others, such as poppies, the style is very short and almost impossible to see.

MALE AND FEMALE

Buttercups and tulips are examples of **hermaphrodite** plants. This means each flower has both male and female parts.

You can see the female carpel and the male stamens in the center of this tulip.

Some plants, such as corn, have two types of flowers on one plant: **staminate** flowers, which have only male parts, and **pistillate** flowers, which have only female parts. Plants with flowers of this kind are described as **monoecious**. Other plants, such as holly, have staminate and pistillate flowers on separate plants. They are described as **dioecious**.

Holly has its male and female parts on separate plants. Berries develop from the ovaries of the female plant.

Internet links

Go to **www.usborne-quicklinks.com** for links to the following Web sites:

Web site 1 Learn about different types of pollen dispersal.

Web site 2 An introduction to diversity in flowering plants.

Web site 3 Take a detailed look at flowering plants, with helpful diagrams.

Web site 4 Browse an online illustrated plant encyclopedia.

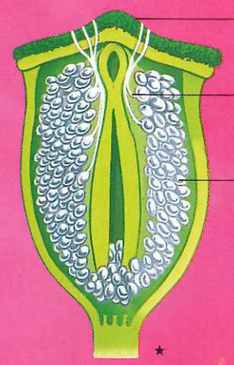
Thousands of tiny pollen grains are being shed from stamens in the middle of this flower.

FERTILIZATION

In order for a flowering plant to reproduce, the male cell (pollen) and the female cell (ovule) need to join together. This is called **fertilization**.

When a pollen grain lands on the stigma of a plant of the same type, it forms a **pollen tube**. This grows down into the ovary and enters an ovule through a tiny hole called a **micropyle**. This process is called **pollination**.

Cross section of poppy ovary



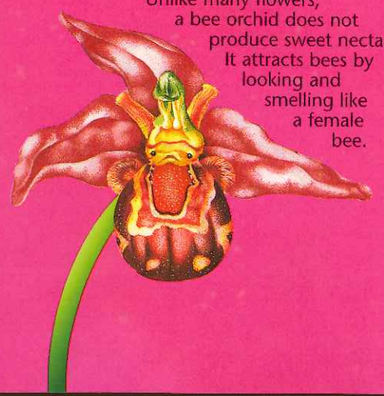
A pollen grain contains two male nuclei*. These travel down the pollen tube and join with the contents of the ovule. One forms a **zygote** – the first cell of a new organism. The other forms a layer of protective, nourishing tissue called the **endosperm**. Together these make a seed, and the ovary grows to become a fruit. After fertilization, the plant no longer needs the rest of its flower parts, so they wither and die.

* *Nucleus, 8.*

POLLINATION METHODS

Pollen may be carried from plant to plant by wind, water or animals. When pollen from one plant pollinates another plant of the same kind, it is described as **cross-pollination**. If the grains land on a different type of plant, they don't produce pollen tubes, so pollination can't take place.

Some types of plants are able to pollinate themselves. This is called **self-pollination**. For instance, a bee orchid tries to attract a certain type of bee, by looking and smelling like the female of its species. But if no bees come, the plant's stamens bend over and transfer pollen to its own stigma.



Unlike many flowers, a bee orchid does not produce sweet nectar. It attracts bees by looking and smelling like a female bee.

ANIMAL POLLINATION

Flowers have various ways of attracting animals to carry their pollen. Most have brightly colored petals or sweet scents which attract insects, birds or bats. Many also produce a sweet liquid called nectar, or extra pollen, on which the animals feed. Some have patterns on the petals called **nectar guides**. These lead the insect into the middle of the flower, where the pollen or nectar can be found.

Nectar guides in the middle of these pansies lead insects to the nectar.

Plants pollinated by animals tend to produce spiky pollen grains. When an animal visits a plant, pollen grains stick to its body. The animal may then transfer these to another flower.

WIND POLLINATION

Wind-pollinated plants rely on the wind to scatter their pollen. They do not need to attract animals, so their flowers are usually unscented, with very small petals and sepals. Some have their male and female parts on separate plants. The male parts hang outside the flowers, allowing their pollen to be scattered more easily.

Pollen from these birch tree catkins is scattered by the wind.

Plants which are pollinated by the wind produce huge amounts of pollen. This increases the chances of some landing on female flowers nearby. The pollen grains are usually smooth and light, allowing them to glide easily through the air.

See for yourself

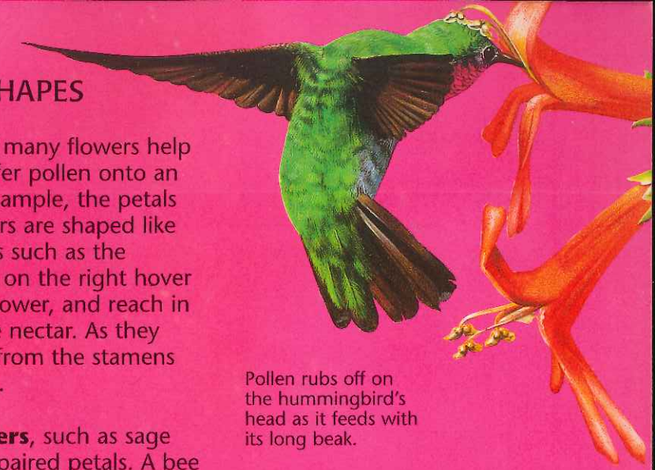
If you have a garden, you can plant flowers to attract certain types of animals. For instance, butterflies tend to visit plants with purple or yellow flowers, such as buddleia or sedum. Bees are attracted to flowers with a strong scent, such as lavender.

FLOWER SHAPES

The shapes of many flowers help them to transfer pollen onto an animal. For example, the petals of some flowers are shaped like a bell. Animals such as the hummingbird on the right hover beneath the flower, and reach in to feed on the nectar. As they do so, pollen from the stamens sticks to them.

Lipped flowers, such as sage flowers, have paired petals. A bee lands on the lower petal to drink nectar from within the flower. As it does so, the stamens, which hang down from the top lip, transfer pollen onto its body.

As the bee lands on this sage flower's lower "lip" to drink nectar, pollen is brushed onto its body.



Pollen rubs off on the hummingbird's head as it feeds with its long beak.

Most flowers have ways of keeping their pollen safe until they are visited by a certain kind of animal. For instance, evening primrose flowers remain closed all day. They open up at night, when the moths which pollinate them become active. Many flowers close up when it begins to rain, to keep their pollen dry.

Pollen sticks to this butterfly's body as it feeds from a daisy.

Internet links

Go to **www.usborne-quicklinks.com** for links to the following Web sites:

Web site 1 Find out which plants to grow in order to attract butterflies into your garden.

Web site 2 Take a close-up look at a dandelion.

Web site 3 A short animated movie about pollination.

Web site 4 A useful essay on pollination.

Web site 5 Discover lots of useful flowering plant information and try a quiz.