

USBORNE DISCOVERY



Bugs

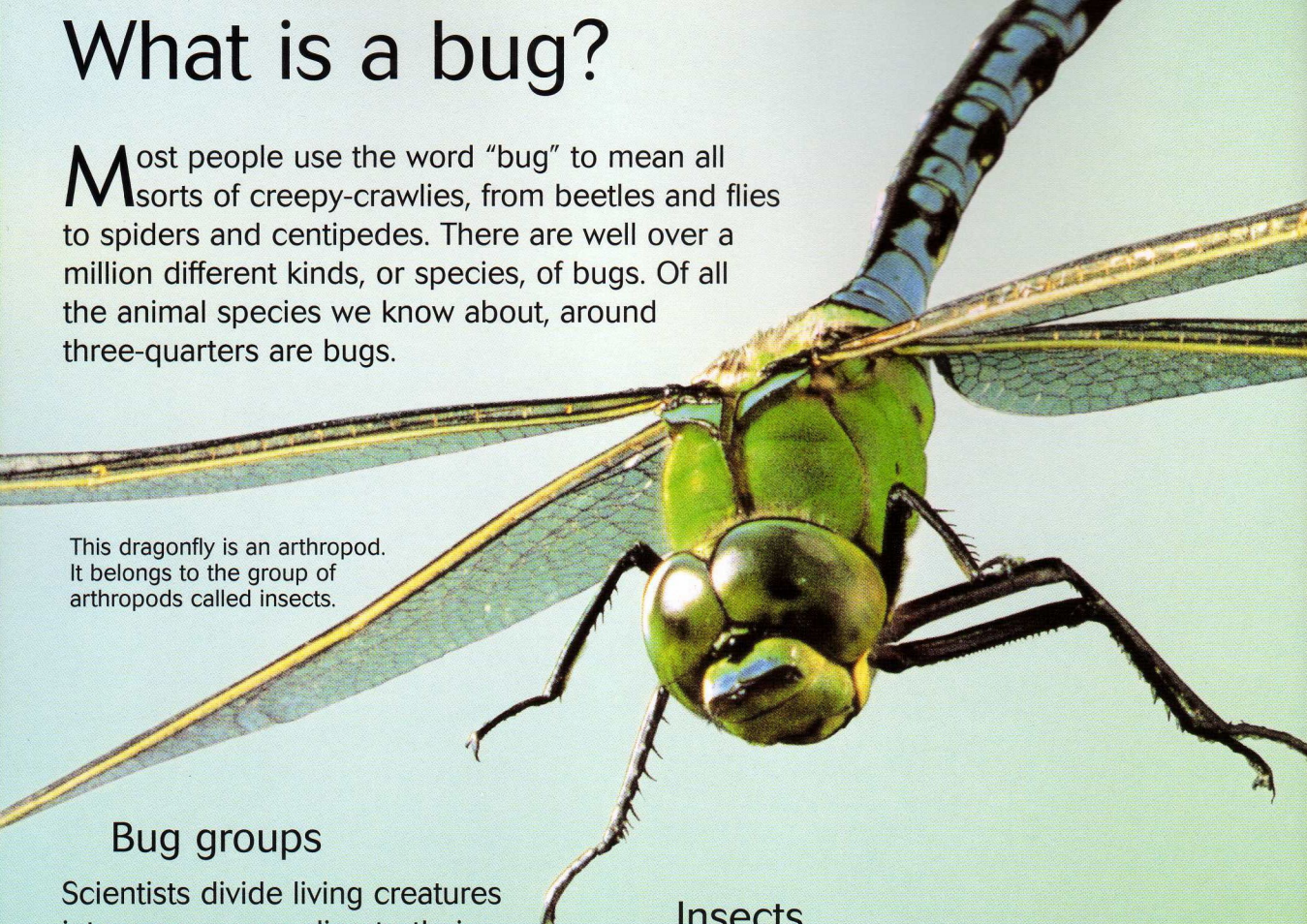


Internet-linked

What is a bug?

Most people use the word “bug” to mean all sorts of creepy-crawlies, from beetles and flies to spiders and centipedes. There are well over a million different kinds, or species, of bugs. Of all the animal species we know about, around three-quarters are bugs.

This dragonfly is an arthropod. It belongs to the group of arthropods called insects.



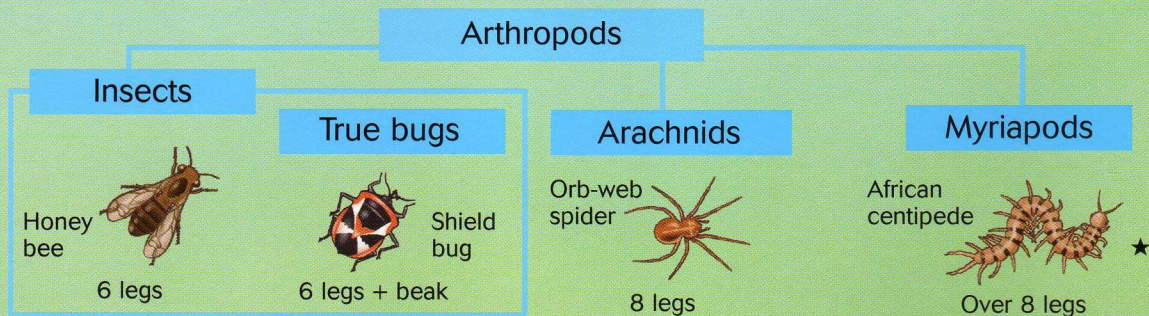
Bug groups

Scientists divide living creatures into groups according to their features. The creatures most people describe as “bugs” all belong to a group called arthropods. Arthropods have a hard covering on their bodies and have six or more legs. You can tell different kinds of bugs apart by counting their legs.

Insects

Bugs with six legs are called insects. For example, beetles, butterflies and bees are all insects. Scientists know of over a million insect species, but there are probably millions more that no one has discovered yet.

This diagram shows how scientists divide arthropods into smaller groups.



Fact: Bugs far outnumber people. For every person alive today, there are probably several billion bugs.

Myriapods

Bugs with lots of legs, such as centipedes and millipedes, are called myriapods. Centipede means "100 feet" and millipede means "1,000 feet". In fact, some centipedes may have over 300 legs, while some millipedes have as few as 80.



As well as many pairs of legs, this centipede has a pair of poisonous claws, and a pair of feelers on its head.

True bugs

Scientists use the word "bugs" to mean a particular group of insects, also known as true bugs. Like other insects, true bugs have six legs. Unlike other insects, however, they have beaks, which they use to feed. Some true bugs, such as aphids, feed on plants. Others, such as assassin bugs, feed on animals.

Internet links

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Arachnids

Bugs with eight legs, such as spiders, are called arachnids. Scorpions and mites are also arachnids. Arachnids can be deadly – a few spiders and scorpions can kill people by biting or stinging.



This garden spider is using its eight legs to help it spin a web to catch other bugs for food.

Tough bugs

All bugs have a tough outer covering on their bodies. The covering protects their body parts. It is made of a material called chitin, which is hard but light. Bugs don't have bones. This protective covering supports their bodies. It is called an external (outer) skeleton, or exoskeleton.

All the outer parts of this beetle are made of chitin, including its wings and wing cases.



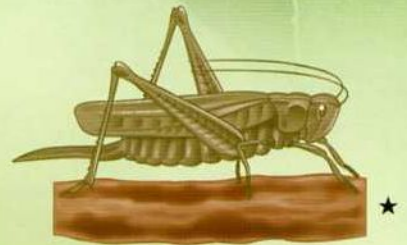
Getting bigger



A young cricket grows inside its exoskeleton until it gets too big. Then its exoskeleton starts to split.



The cricket struggles out of its old exoskeleton. Underneath, it has already grown a new one.



The new exoskeleton is soft at first, but it gradually hardens in the air.

Although bugs get bigger, their exoskeletons can't grow. This means that when a bug gets too big, its exoskeleton has to be replaced completely. The bug

develops a new, larger exoskeleton and sheds its old one. A bug may shed its exoskeleton several times before it is fully grown.



Fact: Bugs can't get as big as people because an exoskeleton could not support an animal that size. A person-sized bug would collapse under its own weight.

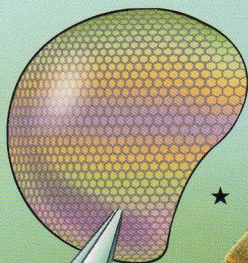
Senses

Like people, bugs can see, hear, feel, taste and smell what is around them. However, bug senses are quite different from people's senses in some ways – for instance, crickets have ears in their knees and flies taste through their feet.

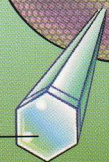
Bug-eyed

Most bugs have big eyes, called compound eyes, made up of small units called ommatidia. The ommatidia form separate, overlapping images, like a kaleidoscope. Compound eyes are not good at seeing details clearly, but are great at detecting movement. In addition, some bugs have extra eyes, called simple eyes, which can sense light and dark.

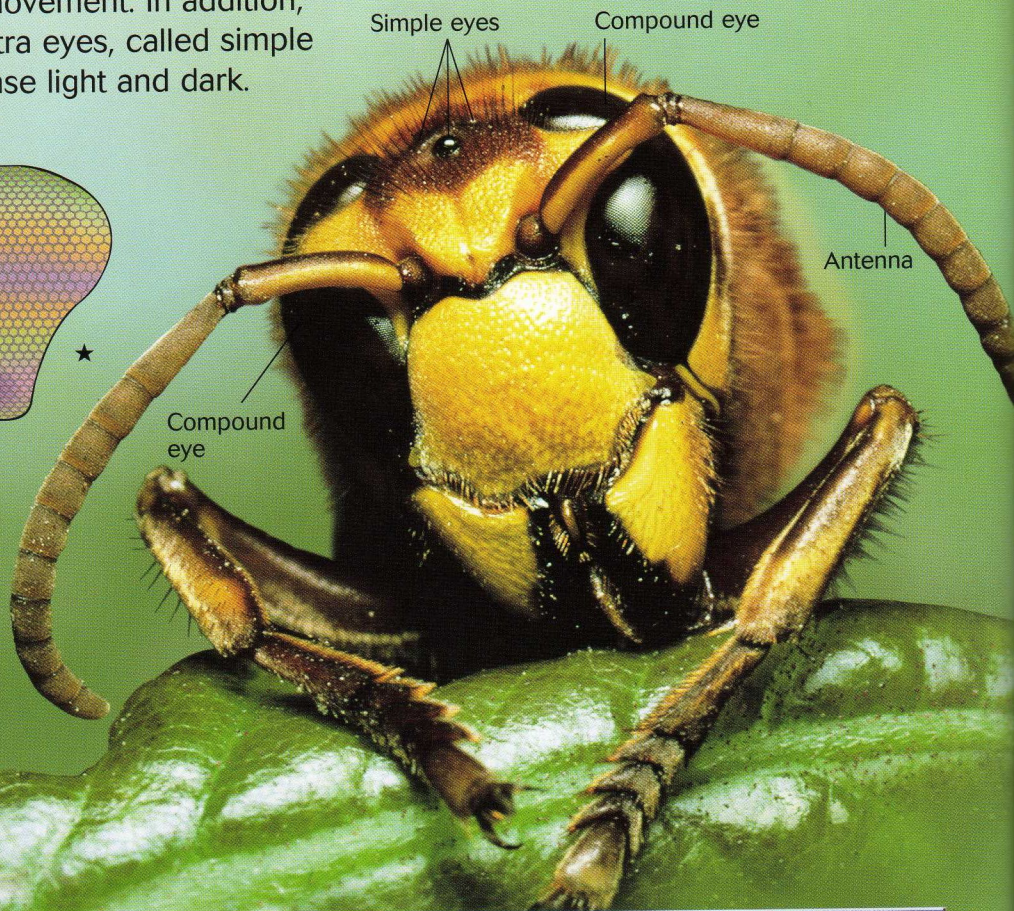
A compound eye is made up of lots of ommatidia packed together.



Single ommatidia, or "ommatidium"



This hornet has two compound eyes which wrap around the sides of its head. It also has three simple eyes on top of its head.



Internet links

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Antennae alert

A bug's feelers, or antennae, are covered in tiny sensitive hairs and bumps. These pick up smells in the air, alerting the bug to food or other bugs. The antennae are also sensitive to touch and can detect movements in the air, helping the bug to feel what is around it.



Hairy senses

Despite their hard exoskeletons, bugs have a good sense of touch. They have sensitive hairs growing out of their exoskeletons. Bugs can feel when something touches their hairs.

Bugs also have tiny hairs around their mouths which they use to taste things. Some bugs have the same kind of hairs on their feet. This is how flies and butterflies know when they have landed on something good to eat.

This butterfly can tell what kind of plant it has landed on by tasting the leaves with its feet.

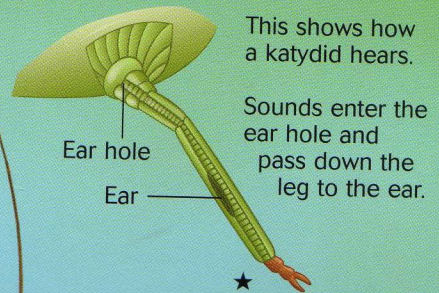


Hearing

Bugs can hear a much wider range of sounds than people. Most bugs have ears on their bodies or legs, not on their heads. For example, lacewings have ears

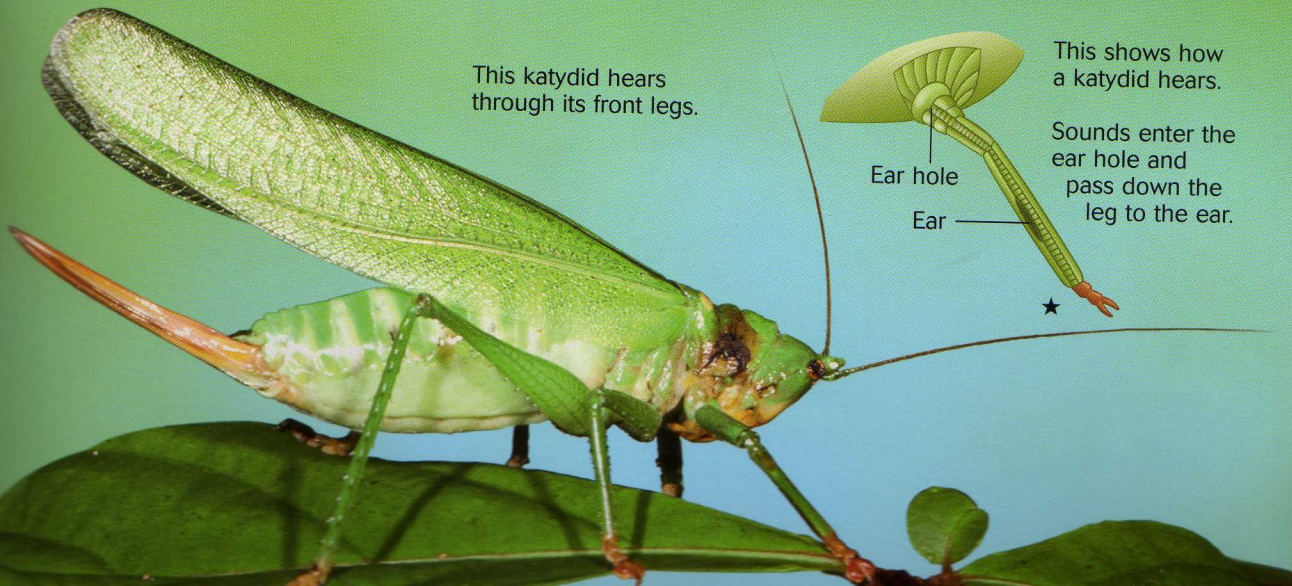
in their wings and katydids have ears in their legs. Some bugs also sense noises with their feet – their feet feel movements in the ground caused by noise.

This katydid hears through its front legs.



This shows how a katydid hears.

Sounds enter the ear hole and pass down the leg to the ear.



On the move

Bugs on the move can show amazing strength and speed. For their size, certain bugs can actually run faster and jump higher than people. Flying bugs are also incredible – weight for weight, they can be as powerful as aircraft engines.

Speedy sprinters



This tiger beetle's long legs make it a very fast runner, helping it to chase and catch its food.

Some bugs, such as sun spiders and house centipedes, have very long legs, which enable them to run fast. The fastest runners are long-legged tiger beetles, which can reach speeds of 9kph (6mph). If an Olympic sprinter and a tiger beetle were the same size, the beetle would easily win a race between them.

High jumps

A few bugs are good at jumping. Grasshoppers and fleas have extra-long hind legs, which they use to push themselves into the air. Cat fleas can jump 17 times their own height. To match that, a person would have to jump about as high as a building with nine floors.

To jump, a grasshopper first bends its hind legs.



When the legs straighten, the grasshopper is pushed upward.



On the wing

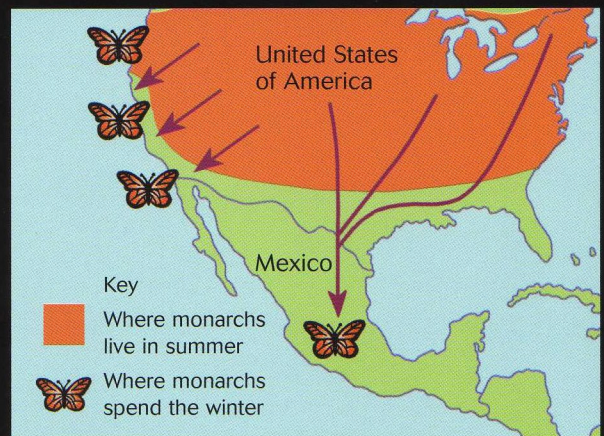
Many bugs can fly. These bugs have one or two pairs of wings. When a bug flies, muscles in its thorax pull its wings up and down, pushing it up into the air. Flies are some of the fastest fliers – a horsefly has been recorded flying at 145kph (90mph), which is faster than cars usually travel.



These pictures show how a lacewing moves its wings up, then down, and up again as it flies.

Migrating monarchs

Butterflies have very delicate wings, but they can fly huge distances. Each year, monarch butterflies travel, or migrate, across America, in order to escape harsh winter weather. They fly for days, or even weeks, stopping to rest at night. Some fly more than 3,200km (2,000 miles).



This map shows the journeys made by monarch butterflies to reach their winter resting places. ★

Internet links

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Fact: Flies beat their wings faster than bats or birds – some tiny flies called midges beat their wings up to 1,000 times a second.

Bugs and plants

Bugs and plants need each other to survive. Many bugs eat or live on plants, while most flowering plants depend on bugs to help them to make their seeds.

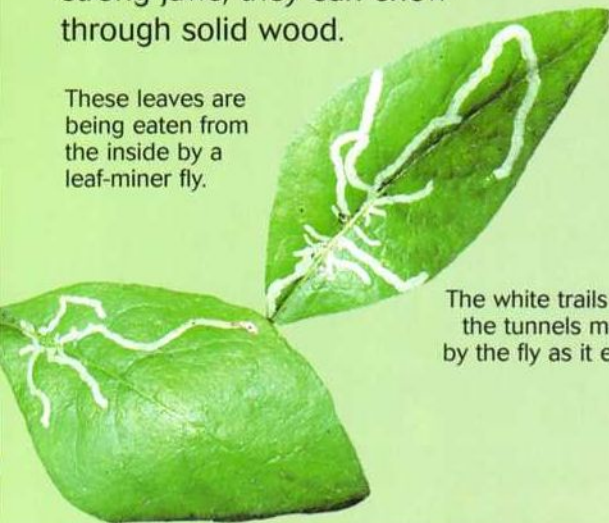


Caterpillars will hang upside down to eat leaves.

Eating plants

Different plant-eating bugs have different mouths, which are suited to the kinds of plants they eat. For example, caterpillars have jaws that are good for munching leaves, while honey bees have long tongues to drink nectar, a sweet liquid found in flowers. Termites have such strong jaws, they can chew through solid wood.

These leaves are being eaten from the inside by a leaf-miner fly.



The white trails are the tunnels made by the fly as it eats.

Pests and protectors

Certain bugs damage the plants they eat. These bugs are called pests. Some plants are protected by thorns, bristles or a waxy coating, which make them difficult to eat. Other plants have smells or tastes pests don't like. Some bugs help to protect plants by eating pests. For example, young lacewings eat aphids which feed on plant juices.

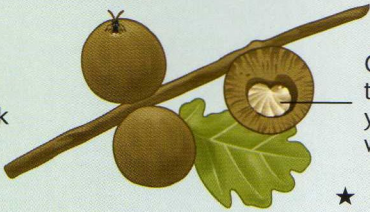


A young lacewing seizing an aphid in its strong, curved jaws. Young lacewings are so good at catching aphids, they are nicknamed "aphid lions".

Home, sweet home

Many bugs live on or around, or even inside, plants. Young gall wasps and borer beetles live and feed inside trees. The trees grow bumps, called galls, around the bugs. Scientists aren't sure what galls are for, but they may help to stop the bugs from spreading.

Oak tree galls like these are called oak apples.

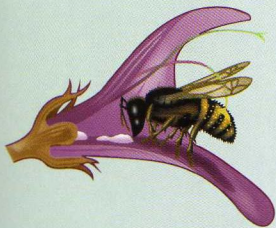


Gall cut away to show young gall wasp inside.



Flower power

Most flowers have markings and smells which attract bugs. They also make a sweet liquid, called nectar, and a powder, called pollen. Bugs visit flowers to drink nectar. At the same time, they pick up pollen and spread it to other flowers. When a flower receives pollen from another flower of the same kind, it can start to make seeds. The seeds will later grow into new flowers.



A bee pushes into a flower to drink nectar. Pollen rubs onto its body.



The bee visits a new flower, which picks up some of the pollen.



The yellow dust on this bee is pollen.

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Fact: Some plants have flowers which look and smell like rotting meat in order to attract bugs. These plants are called carrion flowers.



Hunting for food

Many bugs hunt small animals, often other bugs, for food. They have different ways of catching their prey (the animals they eat). Some rely on speed, while others set traps for their unlucky victims.



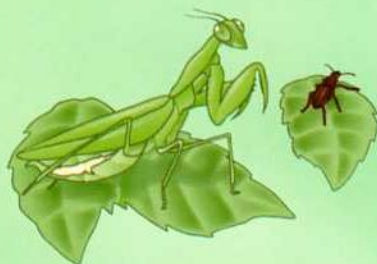
This beetle is such a fierce hunter, it is known as a tiger beetle.

Claws

Some bugs have sharp claws to help them catch their prey. Praying mantids have claws with jagged edges, to help grip their prey and stop it from slipping away. Centipedes have poisonous claws, which they use to stab and poison small animals.

Fast movers

Bugs that move quickly can catch their prey by chasing it. Wolf spiders and long-legged tiger beetles can run fast, chasing bugs on the ground. Dragonflies and robber flies chase bugs in the air. These flies are so quick, they can even catch fast-flying mosquitoes.



A praying mantis stays very still as it waits for its prey to come within reach of its claws.

This praying mantis has folded its jagged claws together. This position makes it look a bit like it is praying, which is how the mantis gets its name.



When the prey is close enough, the mantis strikes, seizing it in a twentieth of a second.

Trap door

Trap-door spiders make burrows in the ground to catch their prey. The entrance to a burrow is hidden by a trap door made of silk and mud. The spider waits behind the door. When an insect walks past, the spider darts out and catches it.

This is a trap-door spider. These spiders use their fangs to dig burrows.

Smelly beetle

One kind of beetle looks like a piece of dung, and can even make itself smell like dung. It sits very still and waits for the smell to attract a fly. When a fly lands, the beetle leaps on it and eats it.



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Antlion pit

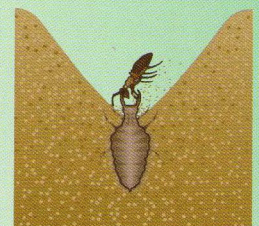
Antlions are a kind of baby insect. They trap ants and other small insects by digging pits in sandy soil. Then they hide in the sand at the bottom of the pit, with only their large, toothed jaws showing, and wait for their prey.



An ant falls into an antlion pit and slides down the side.



The antlion flicks sand at the ant, to make it slide faster.



At the bottom, the antlion seizes the ant and eats it. ★



Fact: Spitting spiders trap their prey by spitting poisonous glue at them.



In disguise

Some bugs have developed clever disguises to help them catch prey or avoid being caught. Most bugs use their disguises to hide, but some bugs disguise themselves by copying the eye-catching markings of poisonous bugs.



This leaf katydid has large wings that look just like leaves.

Hide-and-seek

Bugs that blend in with their background are less likely to be seen and eaten by other animals. For example, green grasshoppers are safest from birds when they are hidden among green grasses.



On a white and green leaf, a crab spider will be white and green.

When the spider moves to a yellow flower, it turns yellow.

Bugs that hunt can catch their prey more easily if they blend in. Crab spiders hide on plants to catch other bugs. The spiders can change their looks to match the plant where they are lying in wait.

Complete disguise

Some bugs don't just blend in, but are completely disguised as something else. Stick insects look like twigs, and leaf katydids are green and leaf-shaped. Pink orchid mantids have pink bodies and petal-shaped legs, making them look like pink orchid flowers.



The strange appearance of this pink orchid mantis fools insects into landing on it to look for nectar.

Warning markings

Poisonous bugs often have warning markings in orange or yellow and black. Most animals have learned to avoid eating bugs with these markings. Wasps and bees, which can sting, have black and yellow stripes. Orange and black monarch butterflies taste awful and, if eaten, usually make animals sick.



This is a monarch butterfly. Monarch butterflies are poisonous because they grow up feeding on milkweed, which makes most animals sick.

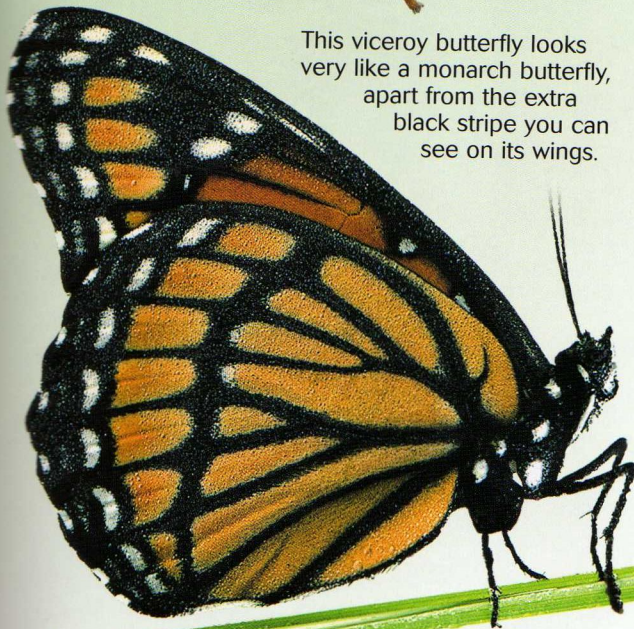
Wasps like this one have painful stings which they can use again and again.



Copycats

Some harmless bugs have the same markings as poisonous bugs. This is called mimicry. Although these bugs might be good to eat, most animals are put off by their copycat disguises. Hover flies can't sting, but are striped like wasps. Viceroy butterflies are harmless, but look like monarch butterflies.

This viceroy butterfly looks very like a monarch butterfly, apart from the extra black stripe you can see on its wings.



As well as looking like a wasp, this hover fly can buzz like a wasp.



Internet links

For links to exciting websites about this subject, go to www.usborne-quicklinks.com and enter the keywords "discovery bugs".

Fact: Elephant hawk moth caterpillars disguise themselves as snakes. If frightened, they puff themselves up and display markings that look like a snake's eyes.



Finding a mate

Most bugs have to find a mate (a bug of the opposite sex) before they can produce baby bugs. Different bugs have different ways of attracting a mate. Some dance or make noises, while others create light displays or smells.



Most female spiders are much larger than their mates.



The male spider attracts the female by plucking on her web with his legs.

Attention seekers

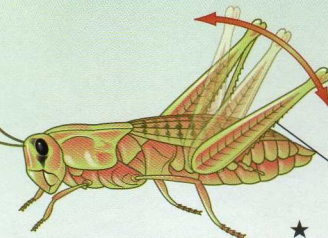
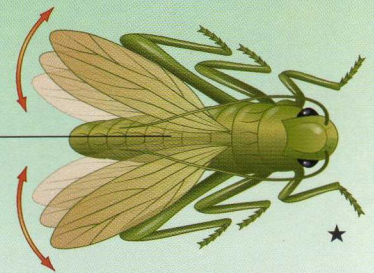
Male spiders have various ways of attracting a female's attention. Some dance or drum their legs on the ground. Others look for female spiders' webs. When a male finds a web, he plucks on it in a particular rhythm. This plucking lets the female know that a possible mate is nearby.

Big noises

Male grasshoppers, crickets and cicadas attract females by "singing". Grasshoppers and crickets make chirping noises by rubbing parts of their bodies together. Cicadas have a layer of chitin, called a tymbal, in their abdomens. They click their tymbals back and forth very fast, making a loud buzzing noise.

Crickets sing by moving their wings back and forth.

Rough parts on the wings rub against each other to make a noise.



Grasshoppers sing by moving their legs up and down.

Bumps on the legs rub against ridges on the wings to make a noise.

Internet links

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Smelly moths

Female moths attract mates by making smells called pheromones. Male moths have big, feathery feelers which can detect pheromones from a great distance. Each kind of moth has a different smell, so that the males can find the right females.

With its huge feelers, this male emperor moth can smell a female 10km (6 miles) away.



Bright lights



During the day, fireflies look like ordinary beetles.



At night, fireflies produce a bright light.

★

Glow-worms and fireflies are beetles that can make their own light. Chemicals in the beetles' abdomens produce red, green or orange light. Male and female beetles use flashes of light to signal to each other.

The mating game

Finding a mate can be a dangerous business. Female spiders and praying mantids will occasionally eat their mates. Some male spiders try to avoid this by giving their partners dead insects to eat instead.

This male spider is offering his partner a dead insect to eat, wrapped up in spider silk.



Baby bugs

Baby bugs usually start out in eggs. Parent bugs lay eggs in all sorts of places – on plants, in the ground, or even inside other animals – but nearly always somewhere where there will be food for their babies.



Caterpillars breaking out of their eggs



Growing up

Some baby bugs, such as baby silverfish and spiders, look exactly like tiny adults. The babies get bigger and bigger as they grow up, shedding their exoskeletons from time to time, until they are fully grown.

Hatching and after

Bugs' eggs have strong eggshells, made of chitin, which protect the babies inside as they develop. When the babies are big enough, they break out of their eggs, or hatch.

Outside the eggs, the babies continue to develop and start to look for food. Most have to find food and avoid enemies by themselves, as only a few bug parents look after their babies.

Unusually for bugs, tortoise beetles are good parents. This tortoise beetle mother is guarding her eggs from bugs which might eat them.



Internet links

For links to exciting websites about this subject, go to www.usborne-quicklinks.com and enter the keywords "discovery bugs".



Changing shape

Bugs that can fly have babies that don't look exactly like the adults. These bugs actually start out without wings. As they grow up, their shapes change and they develop wings. This is called metamorphosis, and there are two ways it can happen.



A mother cockroach and her babies. The mother has wings under her wing cases, but the babies don't and can't yet fly.

Budding wings

Baby cockroaches and grasshoppers look like small adults with no wings. Baby bugs like this are called nymphs. As the nymphs grow, they develop wing buds. Each time they shed their exoskeletons, their wing buds get bigger, until they have full-sized wings.

This diagram shows the stages a grasshopper goes through as it grows up.

1. An adult grasshopper lays lots of eggs.
2. A wingless nymph hatches out of each egg.



4. The grasshopper develops wings as it grows.
3. The nymph grows and sheds its exoskeleton.

Body changes

Baby beetles, butterflies and bees look very different from adults. Baby bugs like this are called larvae. The larvae grow for a few weeks, then turn into pupae. From outside, the pupae look lifeless. Inside, however, the bugs are becoming winged adults.

This diagram shows the stages a ladybird beetle (ladybug) goes through as it grows up.

1. An adult beetle lays lots of eggs.
2. A wingless larva hatches out of each egg.



4. The beetle emerges as a fully-grown adult.
3. The larva grows, then turns into a pupa.

Fact: It takes less than a week for a baby aphid to grow up and have babies of its own.



Living together

Some bugs live together in huge groups called colonies. Living together means the bugs can look after each other. Indeed, bugs from colonies can't survive on their own.

Different jobs

Termites and ants form vast colonies – one colony may contain several million termites or ants, ruled by a single queen. Colonies are organized so each bug does a particular job: gathering food, looking after young bugs or keeping guard. The queen lays all the eggs.

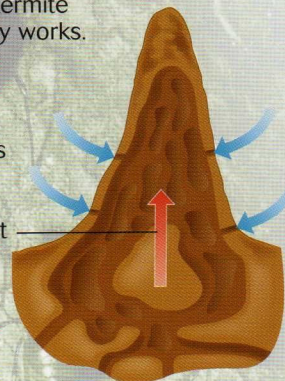
These termites are climbing up a tree trunk to look for food for their colony.

Nests and chimneys

Many ants and termites are skilled builders and make elaborate nests to house their colonies. Some termite nests even have air-conditioning – the termites build a chimney which helps fresh air flow around their nest.

This diagram shows how a termite chimney works.

Hot air rises from the nest and escapes out of the top.



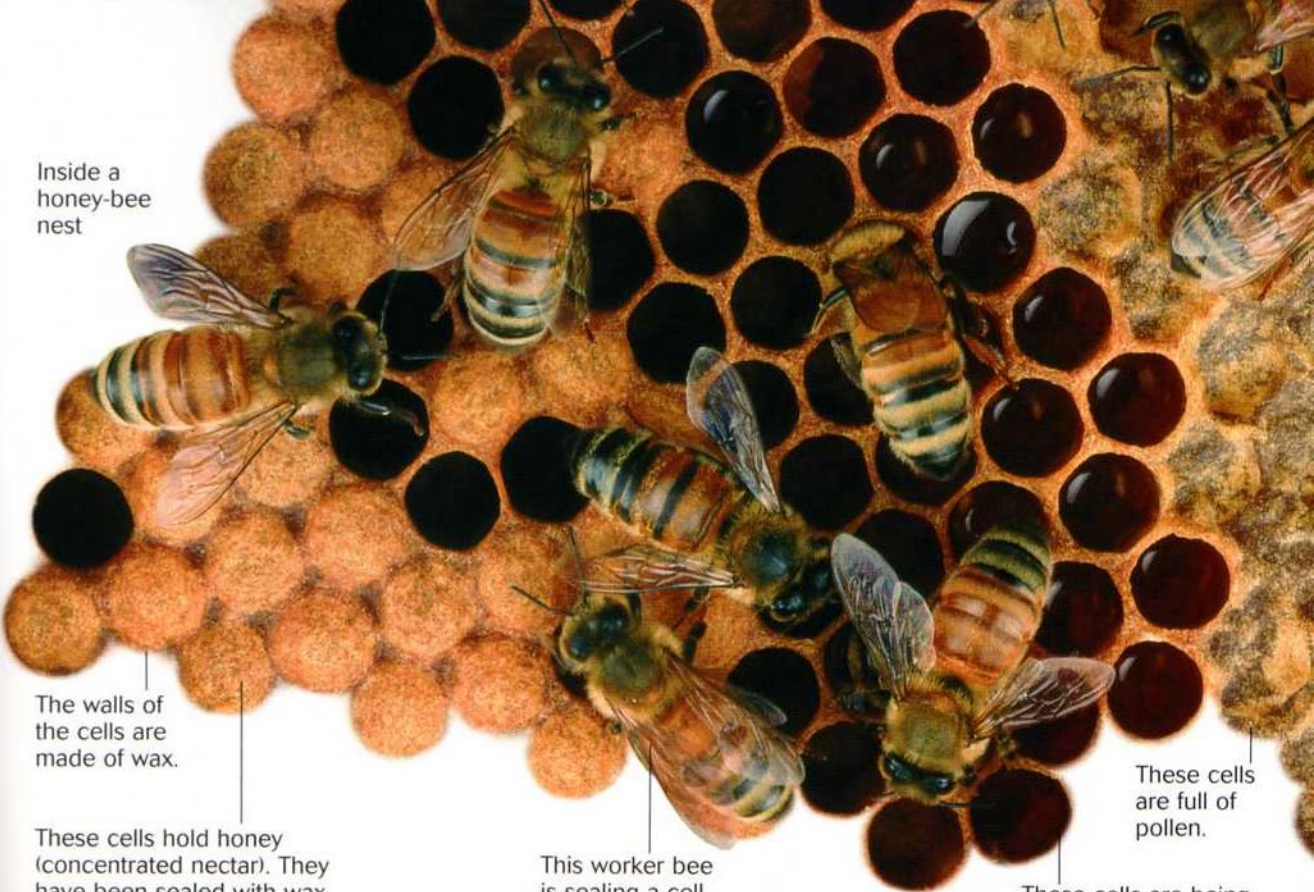
Cool air is drawn in at the sides.

Most of the nest is below the ground.



Fact: The tallest recorded termite mound was 12.8m (42ft) high, taller than a house with three floors.

Inside a honey-bee nest



The walls of the cells are made of wax.

These cells hold honey (concentrated nectar). They have been sealed with wax.

This worker bee is sealing a cell.

These cells are full of pollen.

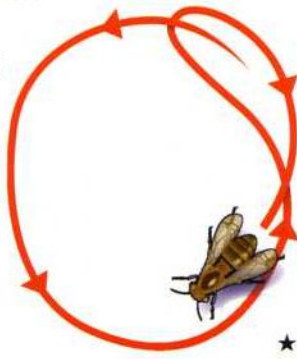
These cells are being filled with honey.

Busy bees

Honey bees live in some of the most highly-organized colonies. Each colony is made up of female workers, ruled by a queen who lays all the eggs. The workers build and defend the nest, look after larvae, gather food and make honey. Once a year, male drones are born. The drones mate with the queen, then die.

Dancing bees

When a worker bee returns to the nest from gathering food, it will dance in front of the other bees, moving around in circles and wagging its body. The dance shows the other bees how far away the food is, and in what direction, so they can find it too.



This diagram shows the "round dance", where a bee moves in a circle, first one way, then the other. This shows it has found food within 80m (260ft) of the nest.

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In the ground

Many different kinds of bugs live in the ground. Some live underground for just part of their lives, while others never leave the ground at all. Although well-hidden, underground bugs can have very visible effects, especially on plants.

Hidey-holes

A hole in the ground is a good hiding place for young bugs. There, they are protected from the weather and from animals which might eat them. Earwigs grow up in underground nests, where their mothers bring them food. Many caterpillars and beetles grow up underground too.

This earwig mother will look after her babies underground until they grow up.

Underground attack

Some bug pests damage plants by attacking them underground. For example, wireworms (young click beetles) and leatherjackets (crane fly larvae) feed on plants' roots. Cutworms (moth caterpillars) can be especially destructive because they eat all the way through plants' stems.




A cutworm feeds at night, chewing through plants' stems just below the ground's surface.



By day, the cutworm hides underground. The plants with cut stems wither and die.

Internet links

For links to exciting websites about bugs underground, go to www.usborne-quicklinks.com and enter the keywords "discovery bugs".



This green dung beetle feeds on dung and helps to enrich the soil.


Bugs and soil

Many bugs improve the soil for plants. To grow well, plants need soil containing plenty of air and nutrients (substances which plants feed on). Burrowing bugs mix up soil and mix in air. Other underground bugs feed on dung, or dead plants and animals, helping break them down into nutrients which can then be used by plants.


Diggers

Some underground bugs, such as mole crickets and burying beetles, are excellent diggers. Mole crickets have broad, strong front legs, to help them shift soil quickly.

They make tunnels to look for food, and dig burrows to live in. Burying beetles bury dead animals to eat. They dig holes to hide the bodies from other animals which might try to eat them.



Mole crickets like this one are very fast diggers and can make tunnels up to 6m (20ft) long.



Fact: Small insects called springtails are found in the soil in vast numbers; as many as 5,500 of them may live in an area the size of these two pages.

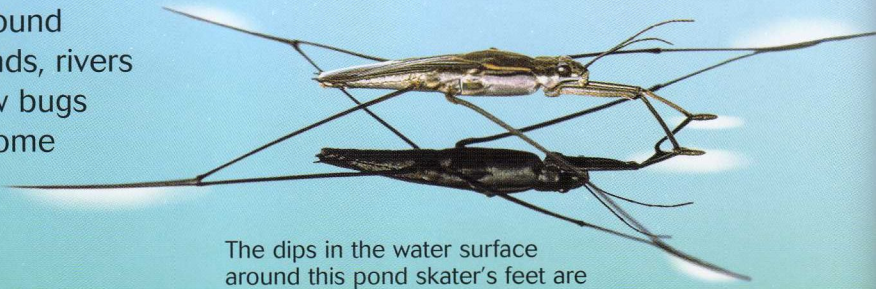
Underwater

Many bugs live in and around water – in streams, ponds, rivers and lakes. However, very few bugs live in the seas or oceans. Some bugs that live in water are very good swimmers, but not all of them can breathe underwater.

Swimming

Great diving beetles and water boatmen are excellent swimmers and divers. They can store bubbles of air, which they use to breathe while underwater. Diving beetles keep air under their wings, while water boatmen trap air under their bodies. To breathe, the bugs take in the stored air through holes in their exoskeletons called spiracles.

This water boatman is using its long, oar-like legs to push itself through the water.



The dips in the water surface around this pond skater's feet are caused by water-repelling hairs.

On the surface

Pond skaters and whirligig beetles live on the water surface, eating insects which fall in. Pond skaters walk on the water – they have long legs which spread out their weight, so they don't sink. Whirligig beetles swim around in circles looking for their prey.

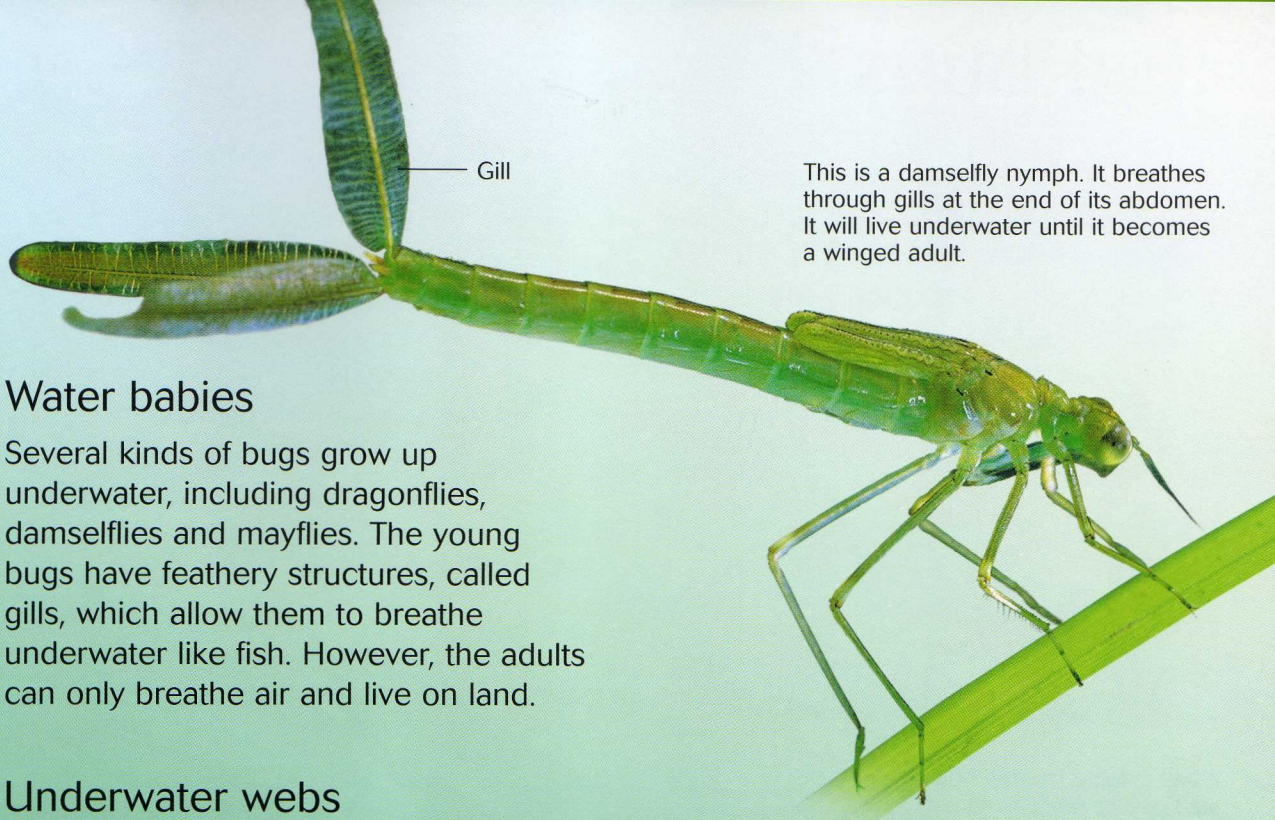
This diving beetle has caught a small fish to eat. Diving beetles also eat snails and tadpoles.

Internet links

For links to exciting websites about water bugs, go to www.usborne-quicklinks.com and enter the keywords "discovery bugs".

Fact: Whirligig beetles have four eyes, enabling them to see above and below the water at the same time.





Gill

This is a damselfly nymph. It breathes through gills at the end of its abdomen. It will live underwater until it becomes a winged adult.

Water babies

Several kinds of bugs grow up underwater, including dragonflies, damselflies and mayflies. The young bugs have feathery structures, called gills, which allow them to breathe underwater like fish. However, the adults can only breathe air and live on land.

Underwater webs

Water spiders live underwater, but need air to breathe. They make underwater air bubbles to live in, swimming out to catch passing water insects for food.



A water spider makes a dome-shaped web attached to water weeds.



The spider swims to the surface and traps a bubble of air with its legs.



The spider returns to its web and releases the bubble, filling the web with air. ★

At the bottom

Young caddisflies and drone flies live at the bottom of ponds and streams. Drone fly larvae live in the mud and breathe through long tubes, which look like tails. Caddisfly larvae live inside protective cases, which they make themselves out of bits of shells, stones or leaves.

See how this caddisfly larva is covered in a case of tiny stones.

