





BEETLES, BUGS AND BUTTERFLIES

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INTRODUCTION: WHAT THIS BOOK IS ABOUT

Do you think insects and bugs are cool – or a bit icky? Insects are all around you and that’s a good thing. They can be a bit of a nuisance sometimes but at the same time they’re really useful.

I study and work with insects. I like beetles, flies, wasps and other little critters. And there’s one thing I can say for sure: we couldn’t get by without bugs. They make soil out of dead animals and plants, they help plants make seeds and they are food for millions of birds and fish and bats. And that makes insects vital for many other species, both plants and animals. So they’re important for us humans too.

Since they are so useful, maybe it’s a good idea to find out a bit about them. In this book, you’ll find stories about common insects living around us – some below water in lakes and streams, some in forests, and some in your garden or your home.

You can read about mosquito larvae that breathe through a snorkel and ants that milk aphids for sugar water. You’ll learn how flies are able to walk upside down on the ceiling of your room, why mosquito bites itch and which insect was actually the very first animal in space. And although spiders aren’t insects, there are a couple of stories about them in here too.

I’ll also tell you about what I think are the world’s weirdest bugs. A little wasp that turns ladybirds into zombies. The larva that kills other insects by farting on them. One beetle that can flash and another that has a poison cannon in its bottom.

But first of all I’m going to tell you what insects actually are, as well as a bit about how they smell, hear and see. And where they hide away all winter.

**CAN YOU RECOGNIZE
AN INSECT?**



What is an insect? It doesn't look anything like you or me. Insects have six legs, four wings and two antennae. And they're also small, an awful lot smaller than a human. In fact some of them are so small that there's room for them to live inside the tiny little eggs of other insects! Yet they have everything they need to stay alive. They can eat, breathe, poo, move around and make babies. They just do it a bit differently from us humans.

SIX LEGS, FOUR WINGS, TWO ANTENNAE

One difference between insects and us is their skeleton. A skeleton is an important part of the body. If you didn't have bones, cartilage and a backbone to hold you up, you'd be nothing but a squishy blob of muscle on the ground. Insects don't have any bones or a backbone made up of vertebrae inside their bodies. That's why we say they belong to the invertebrate animals. That said, they do have a skeleton, but it's on the outside, like a shell or a solid suit of armour.

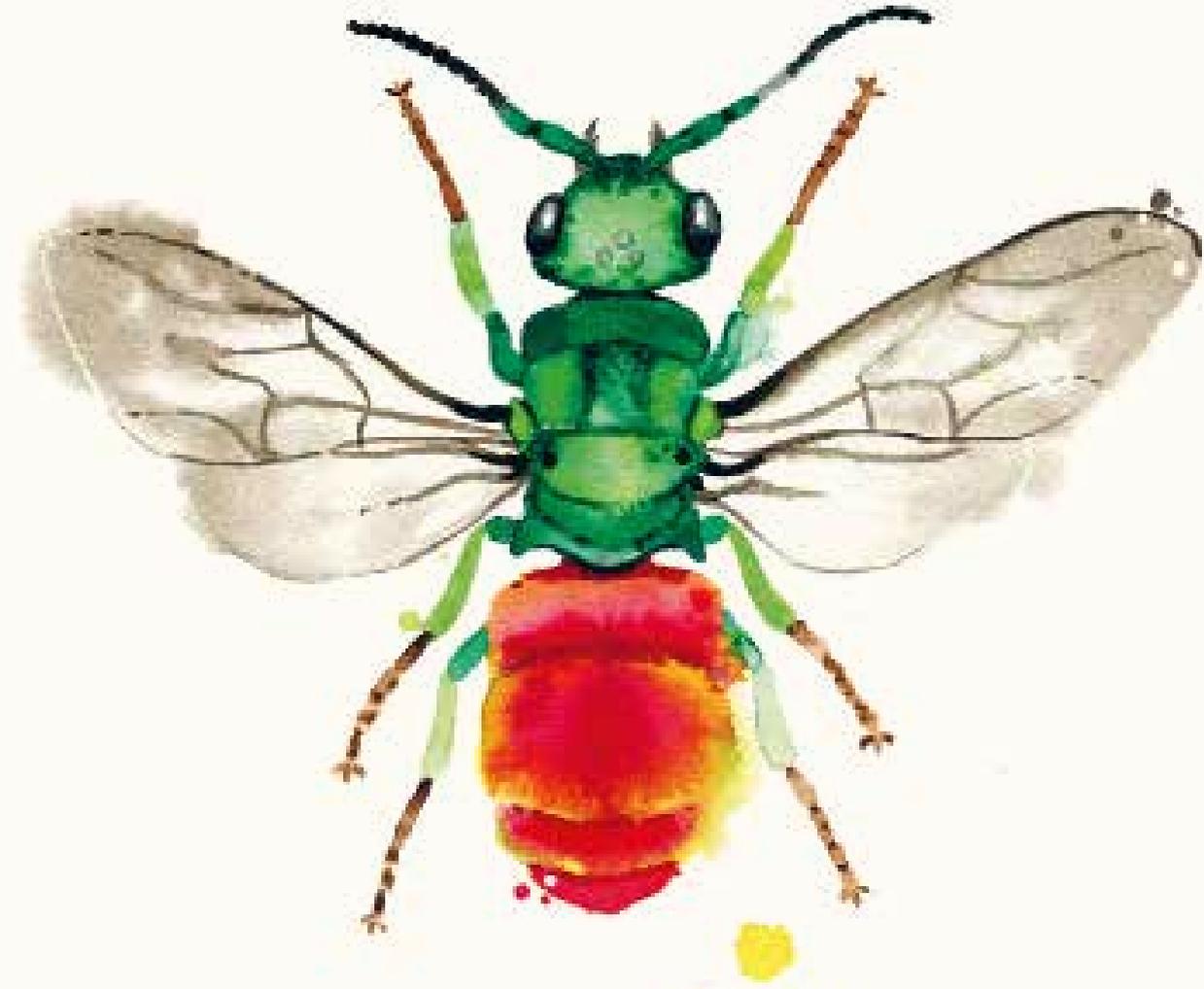
Although insects may look very different from each other, they have some important things in common. Where we humans have a body with a head on top and legs and arms sticking out, insects' bodies are divided into three: a head at the front, a middle part and a rear end. Each part has its own main job.

The head does the job of eating, so this is where you find the mouth. Just like us humans, insects have their eyes and nose on their head. But insect noses don't look like ours: the two antennae are the insect's nose.

The middle part of the body is in charge of movement. All insects have six legs and these are attached to the underside of the middle part. Most insects also have four wings, and these sit on top of their body.

Last of all we have the rear end, whose main task is to digest food, poo and make babies.

Next time you see a spider, count how many legs it has. That's how you can be sure that spiders aren't insects. Insects only have six legs. Spiders have eight whole legs to keep track of. By the way, most of them also have eight eyes, neatly arranged on their forehead.



CUCKOO WASPS LAY THEIR EGGS IN OTHER INSECTS' NESTS

Cuckoo wasps, also known as emerald wasps, are incredibly beautiful insects. They can be shimmering red, green or blue. But their way of life isn't quite as pretty. The cuckoo wasp mum sneaks into other insects' nests and lays her eggs there. When the cuckoo wasp larva hatches out of the egg, it starts off by eating up all the food in the nest. Then, for dessert, it gobbles up all the larvae who actually live there.



INSECTS HAVE BREATHING TUBES INSTEAD OF LUNGS

Insects don't breathe through their mouths the way you do. And they don't have lungs either. Instead, they have lots of tiny breathing holes along the sides of their body. They can be opened and closed. Tubes run inwards from these holes. They carry air into the body.

Inside, the breathing tubes split up into smaller tubes, like branches and twigs on a tree. In this way, the whole of the body gets fresh air with lots of oxygen, which the insect needs to survive.

If an insect was as big as you, it would need to have masses of these breathing tubes inside to get oxygen to all the nooks and crannies in its body. It would be so crammed with breathing tubes that there wouldn't be any room left over for all the other things a body needs to have! That is why there are no really big insects.

If you get a little cut, red blood oozes out. But do you know why your blood is red? The red colour comes from some stuff that contains iron. It carries the oxygen around in your blood. Normally, insects don't have this stuff. Since they use special tubes to carry oxygen to the whole of their body, they don't need blood to transport oxygen. That's why insect blood isn't red. Instead, it takes on the colour of other substances in the body, often green or yellowish-green. You can see that clearly when insects hit a car windscreen on a hot summer day. The window gets covered in yellowish-green splatters.

Insects don't have blood vessels either. Their blood just sloshes around in between all the other stuff inside their bodies, like gravy sloshing around meatballs inside a tin can. But they do have a kind of heart. A long sausage-shaped heart that keeps the blood moving. The blood is sucked in through tiny holes and pumped out of an opening at the front, inside the head.

DRAGONFLIES AS BIG AS MAGPIES

Several hundred million years ago, long before the dinosaurs appeared, there was more oxygen in the air than nowadays. That made it easier for insects to breathe, and they could be a lot bigger. In those days, there were gigantic dragonflies. Imagine your arms are wings and stretch them out as far as you can. That's how big these dragonflies could get!

FROM EGG TO ADULT

All insects start out on life by hatching from a tiny weeny egg. In order to get from that point to being a grown-up insect, the young insect has to change its skeleton several times. Remember that insects have their skeleton outside their body, not inside like us humans. When young insects grow, their skeletons eventually get so tight that they split open. Then they can wriggle out, a bit like the way you can peel off a tight bathing suit. They have a new, bigger skin skeleton ready and waiting underneath the old one.

There are two types of insect young. Some look pretty much the same the whole time, from the moment they hatch to the moment they become adults. Crickets and cockroaches are examples of these types of insects.

Other insects look totally different when they're young and when they're adults. A caterpillar doesn't look anything like a grown-up butterfly. To become adults, these insects have to switch from one type of body to another. This happens inside a hard shell known as a pupa or chrysalis. Inside the pupa shell, the whole insect is rebuilt. What started out as a larva ends up as a fully formed butterfly, wasp or beetle. With a totally different body – a body with long, thin legs, four beautiful wings and everything it takes to make new insect babies. It's pretty amazing really.





TONGUES BENEATH THEIR TOES AND EARS ON THEIR KNEES

Insects don't always have such good table manners. Houseflies, for example, tend to land right in the middle of the food they're about to eat and trample about in it. They do this because they use their feet to taste their food! Flies have a kind of tongue beneath their feet that lets them taste whether this is something they'll feel like eating. Imagine if your tongue was underneath your feet! You could go bare-

foot through the forest tasting the blueberries beneath your soles.

Insects have ears in all kinds of weird places. Some insects hear with their antennae or by the vibration of small hairs on their body or their bottom. Grasshoppers have their ears on their legs, while some butterflies have ears in their mouths! Around the only place you'll never find insect ears is on the side of the head, where you have your ears.

Why do insects need to hear? So they can listen out for hungry enemies, for example. At night, bats hunt moths. Some moths have learnt to listen out for the special sound signals bats send out when they fly. When the moth hears that the bat is nearby, it plays dead. It stops flying. It tumbles down to the ground and that way it doesn't end up as bat food.

■ Insects also need to be able to hear so that they can find their way to other tiny animals they want to eat – or look for a mate.



SINGING, BUZZING OR CHIRPING

Many insects aren't just good at hearing noises. They also make a lot of noise themselves. Each species often has its own special noise – in the same way as magpies and sparrows have different birdsong. That makes it easier for insects to recognize their own species when they're on the lookout for a mate.

Insects can make noises in lots of different ways. Some grasshoppers make noises by running a rough edge on one wing over the smooth edge on the other. It's a bit like the noise you get when you run your fingernail down a zip: it makes a rasping



sound. The rasping sound of the grasshoppers is loud and high, like the note of a violin. You can hear grasshoppers chirping in late summer. In China, people have long kept grasshoppers in cages instead of canaries because they think they sing so sweetly.

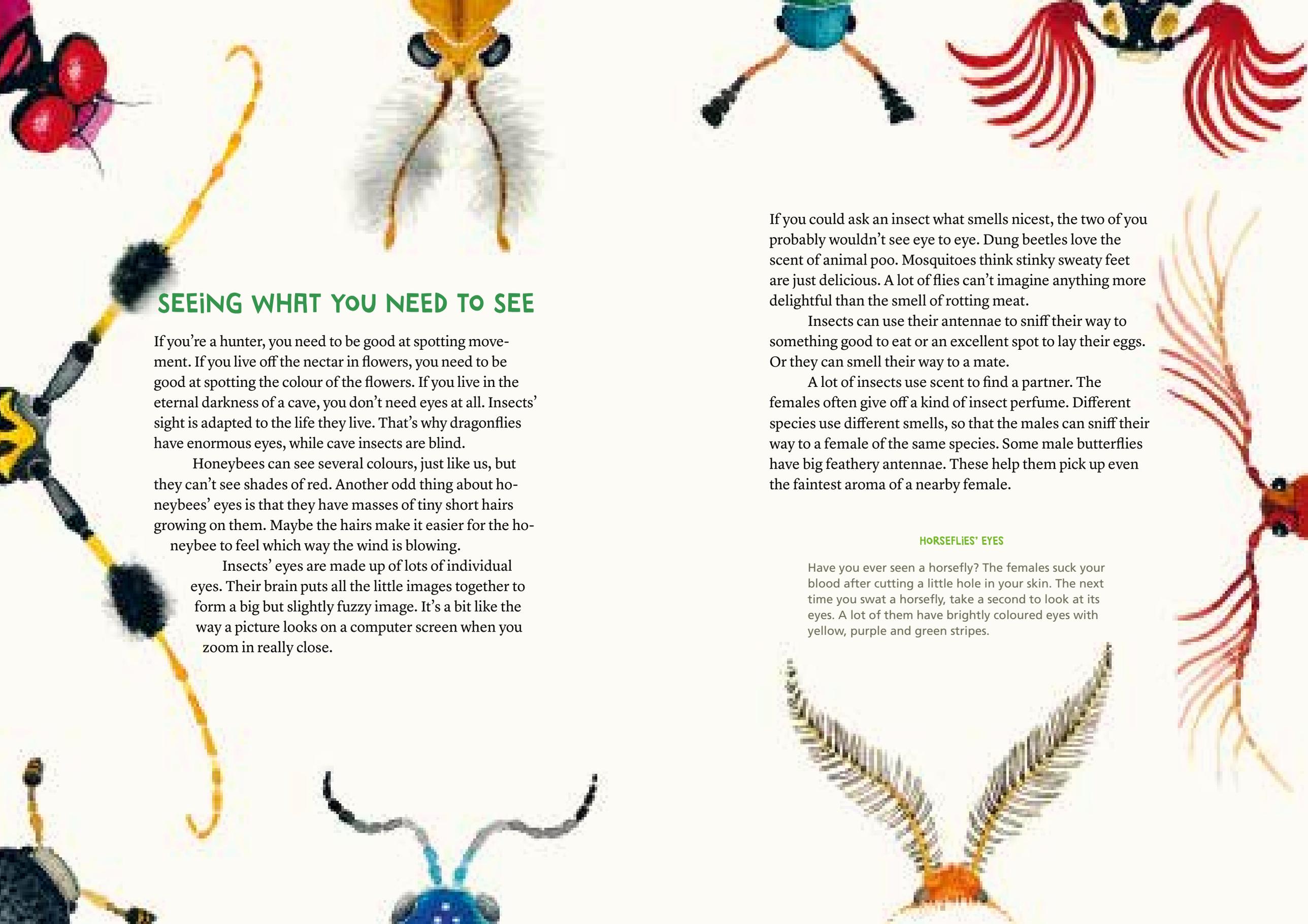
If you've ever been on holiday in southern Europe you may have heard cicadas. They sit hiding in trees and bushes, making a pretty intense chirping sound in the middle of hot summer days. Cicadas are among the very noisiest of insects. When there are an awful lot of them, the noise they make can be loud enough to damage your hearing if you spend too much time close to them.

Have you ever tried to make a clicking sound by squeezing the metal lid of a jam jar? Cicadas have two lids like that on the rear of their body, which they click really quickly, using special muscles. That's how they make that chirping noise.

THE MOSQUITO'S BUZZ

Did you know that male and female mosquitoes buzz slightly differently from one another? Or that the buzzing sound varies depending on how old the mosquito is?





SEEING WHAT YOU NEED TO SEE

If you're a hunter, you need to be good at spotting movement. If you live off the nectar in flowers, you need to be good at spotting the colour of the flowers. If you live in the eternal darkness of a cave, you don't need eyes at all. Insects' sight is adapted to the life they live. That's why dragonflies have enormous eyes, while cave insects are blind.

Honeybees can see several colours, just like us, but they can't see shades of red. Another odd thing about honeybees' eyes is that they have masses of tiny short hairs growing on them. Maybe the hairs make it easier for the honeybee to feel which way the wind is blowing.

Insects' eyes are made up of lots of individual eyes. Their brain puts all the little images together to form a big but slightly fuzzy image. It's a bit like the way a picture looks on a computer screen when you zoom in really close.

If you could ask an insect what smells nicest, the two of you probably wouldn't see eye to eye. Dung beetles love the scent of animal poo. Mosquitoes think stinky sweaty feet are just delicious. A lot of flies can't imagine anything more delightful than the smell of rotting meat.

Insects can use their antennae to sniff their way to something good to eat or an excellent spot to lay their eggs. Or they can smell their way to a mate.

A lot of insects use scent to find a partner. The females often give off a kind of insect perfume. Different species use different smells, so that the males can sniff their way to a female of the same species. Some male butterflies have big feathery antennae. These help them pick up even the faintest aroma of a nearby female.

HORSEFLIES' EYES

Have you ever seen a horsefly? The females suck your blood after cutting a little hole in your skin. The next time you swat a horsefly, take a second to look at its eyes. A lot of them have brightly coloured eyes with yellow, purple and green stripes.

WHERE ARE THE INSECTS IN WINTER?

Insects are easy to see in summer. But what happens when autumn and winter come? A lot of them die. They only live for one summer. But before they die, they make babies. That way, there will be insects next summer too.

If you are an insect that needs to live through the winter, you have three options when the cold sets in. You can head off to a hotter country. You can hide in a place where it doesn't get so cold. Or you can change things in your body so that you can cope with the cold without turning to ice.

Some butterflies flutter all the way to the Mediterranean every autumn. That way, they escape the cold Norwegian winters.

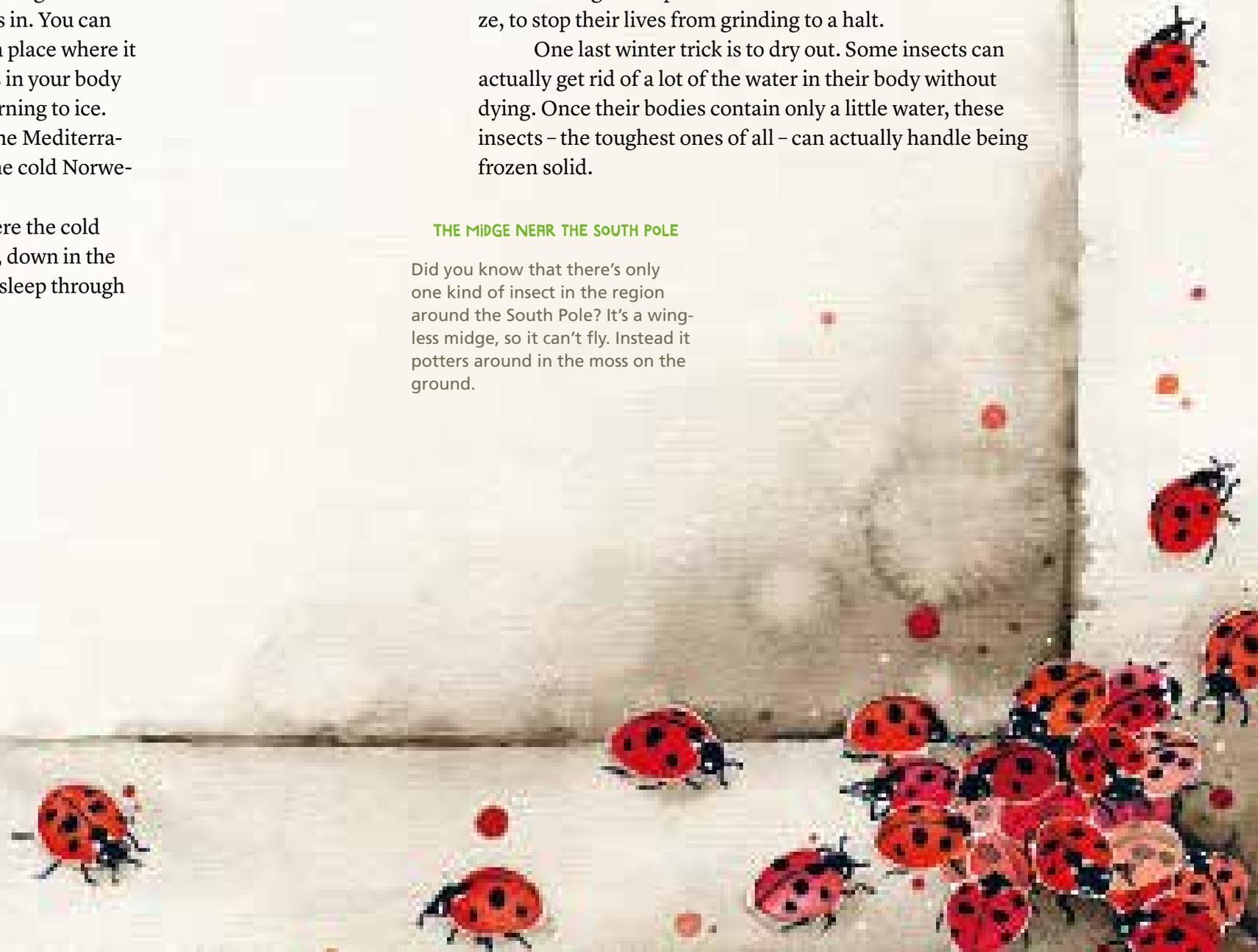
Other insects go to sleep in a place where the cold can't reach them. That may be inside houses, down in the earth or inside cracks in old trees. Ladybirds sleep through the winter in places like this, in big groups.

If you can't escape or hide away in the winter, you simply have to do something that helps you deal with the cold. We humans put antifreeze in our cars in winter. That stops the water in the engine from freezing, which would make the engine stop. Insects can make their own antifreeze, to stop their lives from grinding to a halt.

One last winter trick is to dry out. Some insects can actually get rid of a lot of the water in their body without dying. Once their bodies contain only a little water, these insects – the toughest ones of all – can actually handle being frozen solid.

THE MIDGE NEAR THE SOUTH POLE

Did you know that there's only one kind of insect in the region around the South Pole? It's a wingless midge, so it can't fly. Instead it potters around in the moss on the ground.



**INSECTS IN
THE WATER**

Maybe you think insects only live on land? Well, that isn't so. There are actually masses of insects living in water. Some spend their whole lives there. Others live in water when they are young but move to dry land as adults. That'd be like you living in a swimming pool right up until the time you became a grownup. But insects aren't keen on salt water. That's why you don't find them in the sea.



MAYFLIES

Imagine you've waited years to become an adult. At last the big day comes. Along with thousands of others, your body changes and you pass over into adult life. But whoops! What's happened to your mouth? It's gone, so you can't eat any more. And look! Your legs have become so feeble you're forced to fly almost all the time. That said, your adult life isn't especially long - anywhere from a few hours to one or two weeks. The sad record is held by an American mayfly, whose adult female lives for just five minutes.

Mayfly young, or nymphs, as they're known, live in water. When the time comes, they grow wings and fly up into the air. There, thousands of brand-new mayflies dance a beautiful aerial ballet as they look for a partner. The males have special extra eyes that help them spot a female mayfly. These are known as turban eyes, which is hardly surprising. They really do look like great big turbans perched on top of their heads.

Because adult mayflies live such a short time, it makes sense for all of the mayfly young to become adult at the same time. That way it's easier for them to find a partner and make new mayfly babies before starving to death. Because if you don't have a mouth to eat with you won't live all that long.

It actually ought to make us happy when we see masses of mayflies, because it's a sign that the water in a stream or river is clean and not polluted. But it can get to be too much of a good thing. In some countries, the police have sometimes had to close roads because millions of mayflies have turned into adults at the same time in the same place. There were so many mayflies that people couldn't see the road. Cars got stuck in piles of dead insects. In the end, the police had to fetch snowploughs to clear them away.



CADDISFLY LARVAE

Glue doesn't work very well in water. Think how easily a plaster unsticks and falls off if it gets wet! But one insect has found a solution. It makes a waterproof silken glue.

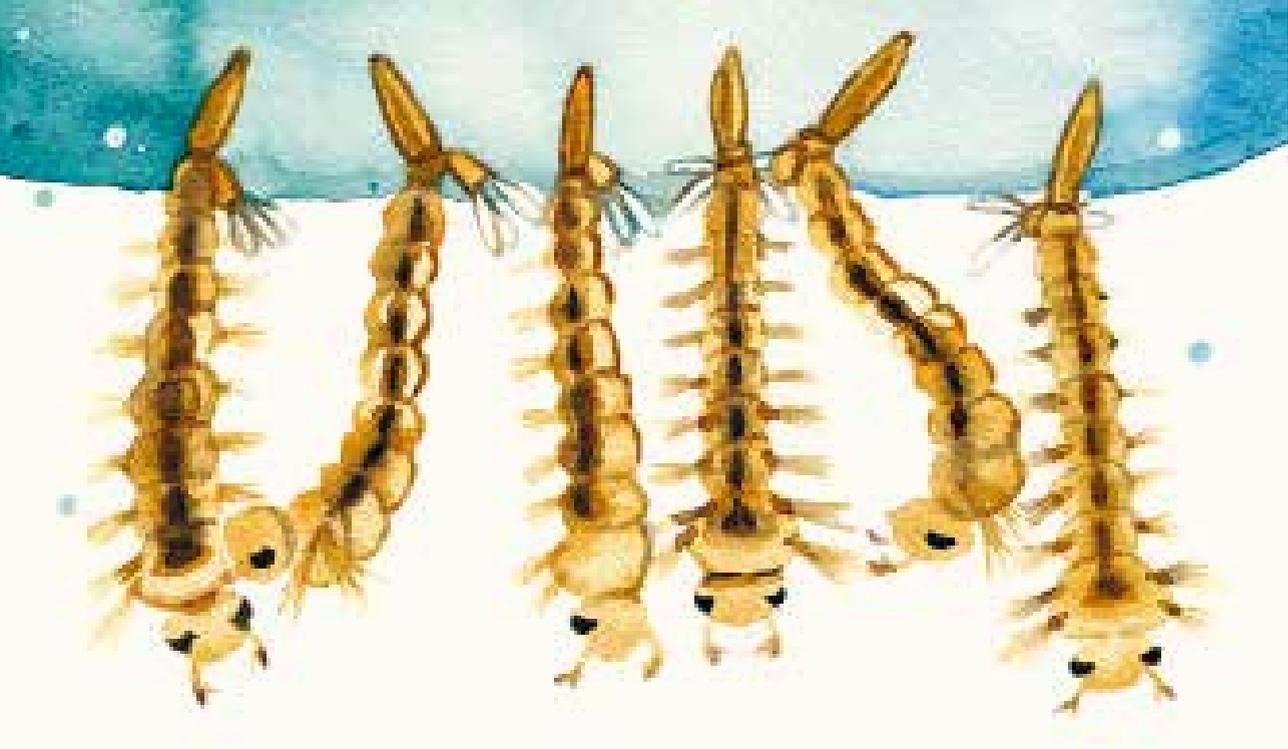
Caddisfly larvae live under water. Some of them spin a sticky silken thread around their body, like a sleeping bag. They attach tiny stones or twigs to this sleeping bag, which protects the soft rear part of their body. They can stick their head and legs out at the front, so they can eat and wander around on the riverbed. Since the larvae build their house out of whatever they find, we can trick them into building it out of particular materials. One artist got caddisfly larvae to build their sleeping-bag houses out of gold flakes, pearls and precious gems!

Adult caddisflies live on land and look a bit like small grey butterflies. But caddisflies have tiny hairs on their wings, unlike butterflies, which have teeny-weeny scales.

CADDISFLY GLUE

Scientists are excited about the caddisfly larvae's underwater glue. They want to use it to make a plaster that won't come unstuck so easily when you go swimming.





STINGING MOSQUITOES

Mosquitoes don't have very many friends. And that's hardly surprising when you think that in hot countries stinging mosquitoes can spread dangerous diseases. In cooler countries we don't need to worry about that. But their bites can still be irritating. Male mosquitoes never suck blood. They're happy to live on nectar from flowers. But the female mosquitoes need your nutritious blood to be able to lay mosquito eggs.

Somebody has worked out how much blood all the stinging mosquitoes in the world suck up in a year. Can you guess? If you took all that blood, it would be enough to fill up not just one but two big swimming pools!

Mosquito stings itch because the mosquito injects a little spit into your skin before it starts to suck your blood. The mosquito spit stops your blood from clotting too easily. It's no fun for the mosquito if its sucking snout gets blocked up! But your body doesn't like it when unknown substances get inside it. So it sends defensive stuff to the place where the sting is. This invisible war beneath your skin is what makes the sting swell up and itch.

The mosquitoes' young, mosquito larvae, live in small pools of water. They often hang out together right below the surface. They get the air they need through a kind of snorkel that they stick up out of the water. This snorkel grows out of the mosquito larva's bottom.

Mosquitoes aren't just a nuisance. The mosquito larvae's mouths are surrounded by loads of hairs and brushes that they use to sweep all sorts of bits and pieces into their mouths. In this way, the larvae clean the water. There are also a lot of other types of non-stinging mosquito-like insects. Many of them are important food for other animals. Fish, birds and bats love gobbling up different mosquitoes and midges.

DRAGONFLIES

We think babies are cute. But if you ever get a close look at a baby dragonfly in a pond, you may just change your mind.

Because the nymphs, as these insect young are actually known, look more like tiny monsters. Imagine if your mouth was on the end of your arm. Where your fingers are. And that your arm grew out of the place where your mouth normally is. That's roughly how it is with dragonfly nymphs. Normally they keep this arm bent – like when you bend your arm at the elbow so your fingers are touching your shoulder. But when some suitable prey comes close, the arm shoots out. The huge jaws at the end of the arm grab hold of the prey, which doesn't have a chance.

But these dragonfly nymphs have more tricks up their sleeve. They also have a jet engine in their bottom. If they get scared, they suck up water through their rear end. Then they squeeze it out again so fast that they shoot off at top speed!

Adult dragonflies are also pretty impressive. They can fly quicker than you can cycle on flat ground. They can also fly backwards, upside down or hover in the air without moving. That's something not many insects can do! So it's hardly surprising that we humans have copied dragonflies. They have helped us design light but solid mechanical wings – like the wings we use to make drones – those remotely controlled mini-helicopters.

Dragonflies often come in beautiful, shimmering colours. They can be blue, green or red, but the colours fade when the dragonflies die.

A lot of dragonflies also have enormous eyes. Pretty much the whole head is nothing but eyes.

Because they are quick and see so well, dragonflies almost always catch what they hunt. If we count how often dragonflies actually manage to capture their prey, they are better hunters than either lions or great white sharks.

In the olden days, people believed lots of strange things about dragonflies. Adults used to tell children that if they lied, a dragonfly would come and sew their mouths shut! That's just silly. Dragonflies can't sew – or breathe fire for that matter! But they still deserve their name because they are strange and fantastical, just like dragons, whether you find a monster nymph or an adult aerial acrobat.



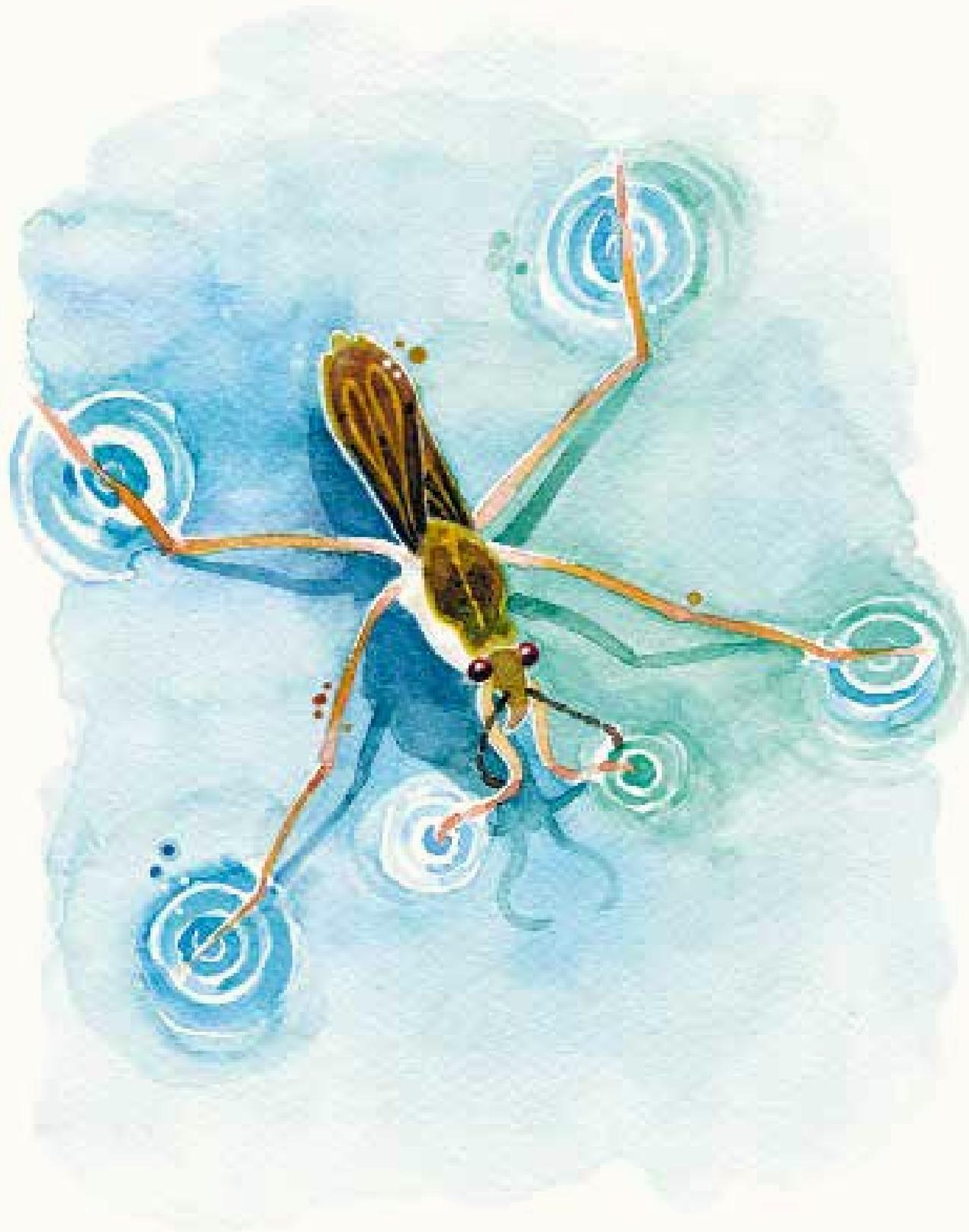
WATER STRIDERS

Did you know that some insects can walk on water? In the US, they're known as Jesus bugs, but they're also commonly called water striders. They are long, skinny insects that look a bit like big mosquitoes walking about on the surface of the water. You can often find them in ponds and tarns during the summer.

Their four hind legs are long and thin and are used for running on the water. The two front legs are short. They're used for catching food. Water striders feed on insects that have fallen into the water and can't fly out again. The water strider spears them with its powerful stabbing mouth and then sucks out the nutrition, as if the insect was a carton of chocolate milk.

Water striders also love to eat mosquito larvae. Although they hide under water, their little snorkels stick up. If it spots a mosquito larva, the water strider hauls it up by its snorkel and gobbles it up.

How do water striders manage to walk on water? The secret is hairs. Thousands of tiny hairs grow on the bottom of the water strider's long, thin legs. Air gets trapped between these hairs, so that the legs become like little rubber dinghies that keep the whole insect afloat. You can't see the hairs but you can see the little dents that form in the water around the water strider's feet.



WHIRLIGIG BEETLES

Wouldn't you love to have eyes on the back of your head too, so you could see what was happening behind your back? One insect, the whirligig beetle, has just that. Whirligig beetles are round and shiny, and look a bit like black plastic beads. They swim on the surface of ponds and lakes, and have four eyes. Two of them are on the underside of their head, beneath the water. These eyes let the whirligig beetle watch out for any fish that are approaching from below to eat it up. The beetle also has two eyes on the back of its head, pointing up in the air. It uses these to look out for enemies approaching from the air. It's also handy to have these eyes when the beetle is looking for food – usually dead insects floating on the water.

Whirligig beetles are incredibly speedy. It's far from easy to catch them because they use their four hind legs as oars. These legs are short and flat, and the beetle draws them back and forth through the water. This sends the beetle speeding off across the surface of the lake, travelling more than forty times its own body length in a second! Whirligig beetles can swim under water too, as well as having wings to fly with.

Whirligig beetles like being with other whirligig beetles. They dash round and round like bumper cars at a funfair. It makes sense for so many of them to stick together. That way, they have less chance of getting eaten. And these beetles have an extra trick up their sleeve: if they are disturbed, they can give off a substance that tastes disgusting. So fish often spit them out again.



BEAVER BEETLES AND HEAD LICE

It's possible to live in a pond without ever getting your feet wet. You can, for example, move into the pelt of a beaver. That, in fact, is where the beaver beetle lives. It's a really weird beetle that can't fly and can't see because it has neither wings nor eyes. It spends its entire life in the beaver's pelt. The beaver beetle isn't a bloodsucker but it eats dead skin and other little critters that live in the pelt. More than a hundred of these beetles can live on a single beaver. But the beaver doesn't seem to mind much.

We humans don't like it when insects move into our pelt – the hair on our heads. And that's where head lice love to be, sucking the blood from our scalp. Although head lice aren't dangerous, it isn't especially nice to have them there. It can get itchy after a while, too. That's because your body gets allergic to the head lice spit.

It's pretty common to get head lice and it has nothing to do with how often you wash your hair. Head lice can crawl from one head to another when we put our heads together, like when we take selfies.

Head lice are nothing new either. As far back as several thousand years ago, the Ancient Egyptians made special lice combs to get rid of these annoying bugs. Dead head lice can be found in the hair of mummies from those days.



DIVING-BELL SPIDERS

You've probably seen spiders in your garden. Maybe you've seen them inside your house too. But did you know you can also find some spiders under water? In fact, there's just one type of spider that spends its whole life under the water in streams and ponds.

The body and legs of the diving-bell spider, as it's called, are covered in masses of thin hairs. Once a day, the spider takes a little trip onto dry land to fetch the air it needs to breathe. The air gets trapped in between all its hairs. When the spider crawls back down into the water, it is covered in a thin layer of air. This layer of air makes it shine like silver when you see it below the water.

Down in the pond, the diving-bell spider has built itself a house of silk. The house is a curved roof that the spider fills with air. Here it can sit and chill inside its very own air bubble. Now and then the spider pops out to catch some food. It often holds onto silk threads that it has spun out from its house. The diving-bell spider is fond of mosquito larvae and other tiny bugs, which it traps with its legs. Then it kills them with a powerful bite.

With most other spider species, the female is bigger than the male. But the opposite is true for diving-bell spiders. Maybe that's because the female hunts less as she's looking after her eggs and her young. Or maybe it's easier to make sure there's room for the kids inside the silken house if Mum is small herself.

As the children grow, they travel out into the watery world. When they get to be teenagers, they often live in an abandoned snail's shell that they fill with air. Only when they are adult do they spin their own house beneath the water.



INSECTS IN THE FOREST

Insects in the forest are fond of lots of different types of food. Some eat leaves and needles from trees, while others gather pollen and nectar from flowers. Some are predators that eat other little bugs. A lot of them are tiny caretakers that help clear up and make soil out of dead plants and animals.



LEAF MINERS

Do you ever find yourself sitting scribbling with your pencil while your teacher's talking? Some insects do that kind of thing too, doodling on leaves.

Leaf miners are probably the easiest doodlers to spot. Mining means digging passageways. And that's exactly what the larvae of these moths do.

If you want to see one of these moths, you'll need to find an aspen. This tree is easy to recognize: its leaves quiver and shake at the slightest breath of wind. That's because the stalk the leaves are attached to is long and supple, while the leaf itself is heavy. If you see a tree like that, the chances are that its leaves won't be totally green. Instead they will be covered in white doodles. There may be so many leaf drawings that the leaves look more silvery-white than green!

This is the leaf miner's life. It starts with an egg that the mother has laid on an aspen leaf. A tiny little larva crawls out of it, straight down into the leaf. There isn't much headroom in this nursery, which is no thicker than a page of this book. The larva will spend its childhood inside there, chewing out intricate passageways.

If you look closely at one of these leaves, you'll see that the intricate line starts out narrow but gradually gets wider. That's because the larva gets wider as it eats and grows. The larva is flat and has no legs. There's so little space inside the leaf that legs would just get in the way.

In the middle of the passageway, you'll see a thin dark stripe. That's the larva's poo. Eventually, the passageway ends at the edge of the leaf. Here, the larva wraps the edge of the leaf around itself snugly, the way you wrap your duvet around you when you're going to sleep. Now the larva will lie under its leaf duvet and grow into an adult. In the end, it emerges as a fully-grown moth and flies away.





ERMINE MOTHS

Sometimes you'll see bushes or trees that are all wrapped up in white webbing. It looks as if somebody has decorated them for Halloween in the middle of the summer. Or perhaps it feels as if you've ended up in a spooky film. But maybe you've found the bird cherry ermine moth's kindergarten!

As adults, bird cherry ermines are pretty little moths.

White, with lots of tiny black dots, their wings lie across their back like a little roof. In autumn, ermine moths lay their eggs on a bird cherry tree. Lots of eggs. The following spring, masses of tiny yellowish-green larvae come crawling out. It's like a gigantic larva nursery. There may be hundreds of larvae in the same tree. But there's no time for playing here. All these larvae are interested in is eating. They're starving hungry all the time!

When so many larvae are gathered in one place they're easy prey for peckish birds. That's why it's important for them to hide. The larvae spin silk, making an enormous silk web that hides them. The silk web can cover the whole tree. Sometimes the larvae may carry on spinning until they cover fences, benches and bikes that happen to be leaning against the tree!

Beneath this web, the larvae can eat in peace. They may gobble up all the green leaves on the tree. When they're full up, they spin a little sleeping bag for themselves out of silk. Then they lie inside it to get their adult body. In late summer, the rebuild from larva to adult is finished. Out comes a pretty adult moth. It lays new eggs but it's unusual for there to be lots of larvae for several years in a row. That's why the bird cherry trees get by fine - although they may look spooky for a while.

A lot of moth larvae like eating leaves. Most of them don't spin webs, though. In Northern Norway, there are sometimes lots of leaf-eating autumn moth larvae. They may eat up all the green leaves on birches. Sometimes they eat blueberry bushes while they're at it.

A SWEETSHOP ON THE LEAVES

On the underside of the leaves of the bird cherry you'll find two little red lumps. It's kind of like a sweetshop for ants: this is where the bird cherry makes the sweet nectar the ants enjoy.

GALL LICE ON SPRUCE TREES

Did you know that pineapples grow on spruce trees? Not real pineapples but green or brown lumps at the very end of the branches. These lumps or balls are known as galls, and these galls look just like tiny pineapples. But they're not fruit or spruce cones. They're louse houses!

A female spruce gall louse lays her eggs where the needles are attached to the branch and when her young suck up the spruce sap, the needles swell up. The spruce tree is quite simply tricked into making a little apartment block for the louse babies. Every louse nymph gets its own little flat. It has only one room and there's no door for them to open, so all the louse nymphs have to stay inside their room nicely the whole summer. But they have plenty of food. All they have to do is stick their sucking snouts straight into the wall and they can suck out the most delicious spruce sap.

Only in summer does the door open. That's when the little pineapple-like lump splits open, and out crawl the adult spruce gall lice, complete with wings.

It's easy to find these galls that look like pineapples in spruce forests. Just take a close look at the end of the branches of young spruce tree. Early in summer, the pineapple galls are green and if you cut one of them open carefully, you'll see the grey nymphs living inside it. They look a bit like tiny sheep because they make thin curly threads of wax that they pack around themselves. During the autumn, the galls turn brown and dry, and you can see how all the little apartments have opened up. By that time, all the spruce gall lice have vanished.



STINKBUGS



Sometimes when you're out picking blueberries or raspberries, you'll suddenly get a whiff of a really yucky smell. It's like a mixture of farts and whiffy sweaty toes. Chances are you've disturbed a stinkbug. It's an insect of the kind known as true bugs. Some true bugs, including stinkbugs, are a bit like beetles except that they have a triangular mark on their back. What's more, all true bugs have a proboscis, which is like a long sucking snout that they poke into plants. And berries are what the stinkbug most likes to stick its sucking snout into.

There it sits, calmly sucking up the sap until you come along and disturb it. That gives it a scare because it thinks you're a hungry bird that wants it for breakfast. So to scare you off, the stinkbug makes a disgusting smell by squeezing nasty-smelling goop out of the small holes on the underside of its body. If you happen to squash one with your berry picker, it will stink even more.

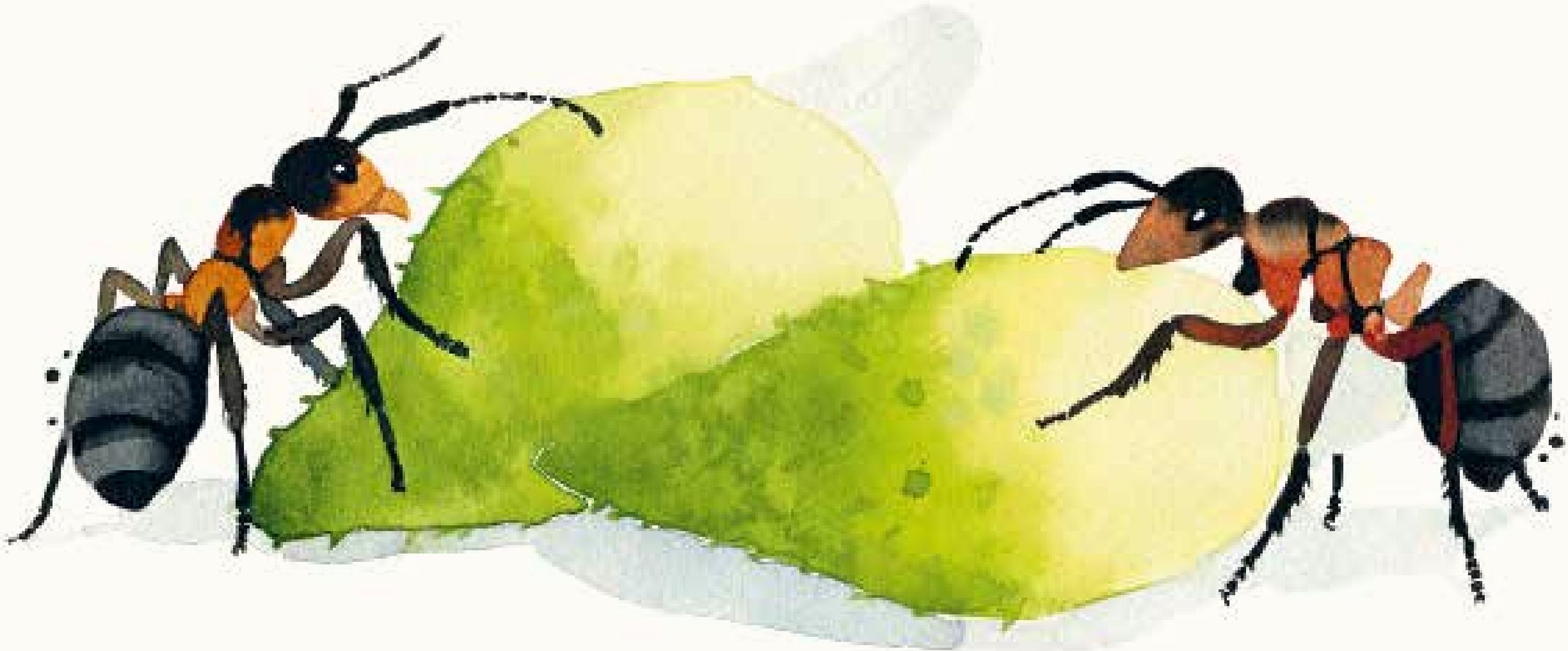
The stinky substance can give the berry an odd taste, but it isn't dangerous to eat it. In fact, people in some parts of the world think true bugs like these ones make excellent food.

ANTS AND PLANTS

Some plants and ants are sort of friends and help each other out. The plants help the ants with food while the ants help the plants by spreading their seeds.

The ant food is attached to the plants' seeds. If you take a close look at the seeds of, say, a wood anemone or liverwort, you'll easily spot this packed lunch fastened to each seed. When it takes away the packed lunch, the ant also takes the seed with it. Once it reaches the anthill, the ant bites the food off and feeds it to the ant larvae, setting the seed aside. That's just perfect for the plant. Its seeds get taken to new places. It's great for the ant too, because it gets extra food.

Some plants also use insects other than ants to spread their seeds. One South African plant is a real trickster: it makes seeds that look and smell just like antelope poo. That may not sound very tempting to you and me. But these seeds are very tempting for a dung beetle that buries real dung to lay its eggs in. The dung beetle thinks the seed is a ball of dung, so it trundles it off to a suitable spot. There it digs a neat hole for the seed in the soil. Only now does the beetle realize it's been tricked. We don't know quite how it realizes this. But we do know that the dung beetle heads off without trying to lay eggs on the seed.



EARTH-BORING DUNG BEETLE

Maybe you have a caretaker working at your school who cleans and tidies the classrooms and corridors. But have you ever thought about who takes care of the cleaning out in nature? How do elk poo, sheep droppings and cowpats all disappear?

Maybe you've seen the caretakers of the forest without knowing anything about the work they do. The big black dor beetle – a species of earth-boring dung beetle – is one of them. Earth-boring dung beetles are strong, hungry beetles. Their eating habits seem very peculiar to us because they eat animal poo. They can eat their own bodyweight

in poo in a single day! Adult earth-boring dung beetles dig long passageways under the earth beneath a dollop of animal dung. These passageways can be longer than your arm. Right at the end of the passage, they build a little nursery. They drag the poo down from the surface and into the nursery. Finally, the dung beetle mum lays an egg down there. That gives the larvae loads of food to eat in a safe, cosy room beneath the earth. At the same time, the poo gets cleared away from the surface and mixed in with the soil.

Next time you see a big black semi-circular beetle moving slowly across the path, pick it up gently and take a good look at it. If you've found a dor beetle, you'll see there's a blue or purple sheen to its underbelly. You'll also understand why this beetle moves so slowly: its legs are like elongated spades. They're great for digging soil but not much good at setting records in the 60 metres.

Maybe you'll also see some tiny reddish-brown creatures clinging to this dung beetle, often on its underbelly. These are mites. Mites aren't insects, but are related to spiders. They don't have wings and can't fly themselves. That's why it makes sense for them to hitch a ride with a dung beetle so they can make their way from one poo to the next. Although these passengers make it harder for the dung beetle to fly or walk, it's still worth the dung beetle's while to take them along because the mites eat up the larvae of other insects that also live in the poo. That way, there's more food for the earth-boring dung beetle's own children.



BARK BEETLES AND SHIP TIMBER BEETLES

There are other caretakers out in the forest. Because it's one thing cleaning up and clearing away dung. But think of all the big trees that die and need to be chewed up! It's a huge job for tiny insects. Fortunately there are a lot of them, and they're helped by fungi and bacteria.

The traces of insects' cleaning work are easy to spot. Next time you're out in the forest, loosen a bit of bark from a dead tree and take a close look at the surface beneath the bark. You'll almost certainly see intricate tunnels or passageways on the surface of the wood. Or else on the underside of the bark you've lifted off. This is the home of the beetles, the place where they live and eat.

One insect that's often found between the bark and the wood is the bark beetle. The bark beetle mum gnaws long passages beneath the bark, laying small eggs there. When the larvae hatch, they eat their way across the surface of the wood. If you look carefully at one of these passages and follow it a little way with your finger, you'll see how it gets wider and wider. That's because the insect is getting fatter and fatter as it eats. It takes up more and more space.

Sometimes these patterns can look like secret messages in some strange language. You can find patterns like this on birch trees that look a bit like old-fashioned letters, the kind the Vikings wrote. Viking letters were known as runes and that's why the insects that make these strange patterns are known as "rune beetles" in Norway, although their English name is ship timber beetles.

These beetles do something pretty smart: they send their larvae off with their own packed lunch. When the beetle mum lays her eggs, she covers them in a special kind of fun-



gus that the beetles like to eat. The larvae get covered in this fungus when they hatch and take it with them as they eat their way across the dead birch. In this way, they plant the fungus in the place where they live. The fungus grows into tasty food for the larvae. You can actually watch the beetles tending to the fungus in their passageways. You won't see the fungus itself, but you will see how it turns the wood around the passageways the larvae have made a blackish-blue colour.



MEADOW SPITTLEBUGS

Have you ever seen small blobs of foam in the grass in summertime? It looks as if somebody spat on the ground. A lot of people call this foam cuckoo spit. But it has nothing to do with cuckoos. The spit is made by a little baby insect, a spittlebug nymph. It sits still as a statue sipping plant sap through its long sucking snout. That's why it's a good idea for it to be able to hide away from enemies and sunlight.

The nymph does this by squeezing a special liquid from its bottom and then blowing air bubbles into it. This turns it into the very finest foam, like a long-lasting bubble bath!

When the spittlebug grows up, it moves out of its bubble bath and hops away to find a partner. And what a hopper it is! It can hop more than 400 times its own body length. That would be like you being able to jump higher than the Eiffel Tower. Imagine that!

IT'S RAINING SPIT!

In Africa, masses of spittlebugs live together in trees. They make so much foam that it drips down from the branches like rain!