



Royal
Entomological
Society



www.insectweek.co.uk

DISCOVER THE
AMAZING LIVES
OF INSECTS!

Issue No. 3

INSTAR

THE MAGAZINE FOR YOUNG ENTOMOLOGISTS

INSIDE...

A Royal Entomological Society
magazine for age 7+

**INSECT
MOUTHPARTS
METAMORPHOSIS
GUIDE TO
INSECT LARVAE**

**...AND LOTS,
LOTS MORE!!**

HOW DO INSECTS HEAR?

**PAGE 12:
HOW TO
DRAW
INSECTS**



Welcome to INSTAR!

INSTAR is a magazine full of amazing information about insects for young people interested in the natural world.

Read along to explore what life is like as an insect...

Contents

Amazing insect ears	4
Caterpillar soup: what's going on inside a butterfly's chrysalis?	6
You won't bee-lieve it!	9
How to draw an insect	12
Small but mighty: a guide to insect mouths!	17
Say it with smells!	21
Whose baby is this?	23
Insect larvae quiz	27
Secrets of silk	28
Game: Dragonfly Drive	31

If you find a word that you don't understand then have a look at the **BUZZ WORDS** in issues 1 and 2 of INSTAR too – read it online for free at www.insectweek.co.uk/news/instar-magazine

BUZZ WORD

LARVA

A larva is the young form of an insect which undergoes complete metamorphosis and so larvae must spend time as a pupa to grow into an adult. Insect larvae are usually adapted to different diets and habitats to their parents and look nothing like the adult insects they will become.



What's inside...

Page 4



© CHARLIE WOODROW

Page 6



BANKIM DESAI



Page 9

ANNIE SPRATT

Page 12



© DOMINIQUE VASSIE

Page 17



© DOMINIQUE VASSIE

Page 21



© KARUNAKARAN PARAMESWARAN

Page 23



JAY STURNER

Page 28



© DOMINIQUE VASSIE

BUZZ WORD

NYMPH

A nymph is the young form of an insect which undergoes incomplete metamorphosis. They hatch from their eggs as tiny versions of their parents and shed their skin several times to grow into an adult without forming a pupa.



© DOMINIQUE VASSIE



© DOMINIQUE VASSIE

ENTO INFO: RHINOCEROS BEETLE

COMMON NAME: Japanese Rhinoceros Beetle

SCIENTIFIC NAME: *Allomyrina dichotoma*

ORDER: Coleoptera (beetles)

WHERE: East Asia

HABITAT: Mountainous broad-leaved forests

FAVOURITE FOOD: Adults love sap, fruits and sugary things

FACTS

- ▶ In Japanese, this beetle is called 'kabuto-mushi' (カブトムシ) which translates as 'helmet-bug', because the heads of the males resemble the traditional helmets worn by samurai warriors.
- ▶ These beetles are a popular pet for children to raise in Japan.



HAA900, CC0 1.0 LICENSE

ENTO INFO: BIRDWING

COMMON NAME: Rajah Brooke birdwing

SCIENTIFIC NAME: *Trogonoptera brookiana*

ORDER: Lepidoptera

WHERE: Borneo, Sumatra and Thai-Malay peninsula

HABITAT: Along tropical rainforest streams

FAVOURITE FOOD: Adults like nectar

FACTS

- ▶ It is the national butterfly of Malaysia.
- ▶ They have an average wingspan of 15-17cm wide!
- ▶ The males and females look different.

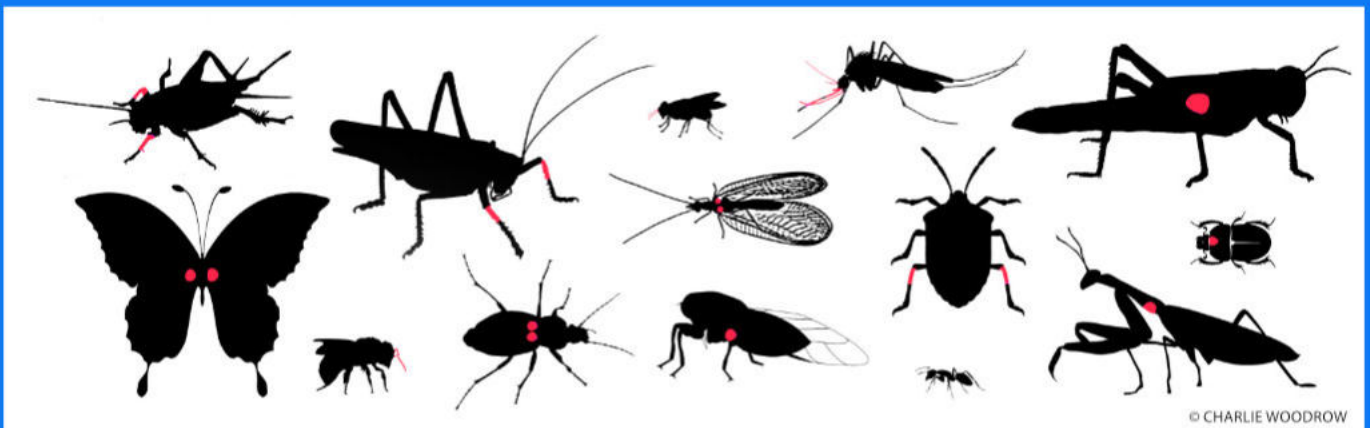


© DOMINIQUE VASSIE

Amazing Insect Ears

By Charlie Woodrow,
PhD student at University of Lincoln, UK

Nature is the ultimate problem solver, and across the natural world we see examples of animals finding their own unique solutions to problems. When unrelated animals evolve similar adaptations to solve a shared problem, we can call the adaptations 'convergent'. In most cases, convergent adaptations evolve only a couple of times, like the similar body shapes of sharks and dolphins, which have evolved to solve the problem of efficient swimming. In the odd case of insect hearing however, it is estimated that ears have evolved up to 20 times convergently!

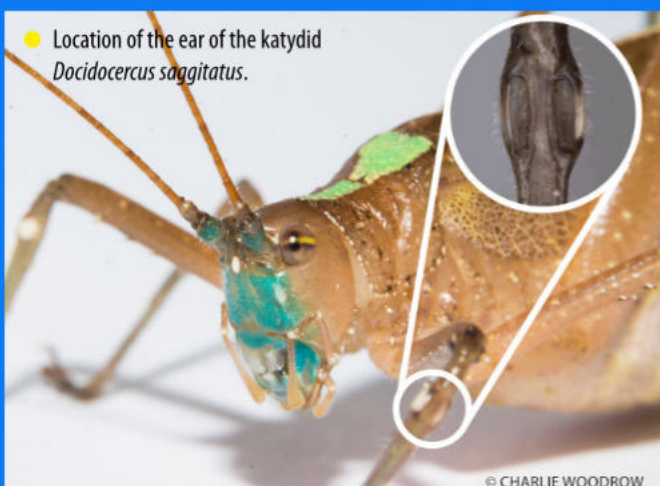


© CHARLIE WOODROW

▲ Figure 1 – Where insect ears are in their bodies.

Insects use their ears for the same reasons as all other animals – to detect mates and rivals, and to listen out for predators. Unlike vertebrates however, insects have ears in many locations on the body (Figure 1), that work in many ways. They are categorised into two types of ears: antennal ears, which respond to velocity (the speed of a sound), and tympanal ears, which respond to pressure (the loudness of a sound).

As the name may suggest, antennal ears are found in insect antennae, and are best studied in mosquitoes and fruit flies. The base of the antenna has a group of sensory cells (scolopidia) in a circle that form the Johnston's organ. When sound moves the antennae, this organ detects the movements to give the insect an idea of the location and pitch of the sound.



● Location of the ear of the katydid *Docidocercus saggitatus*.

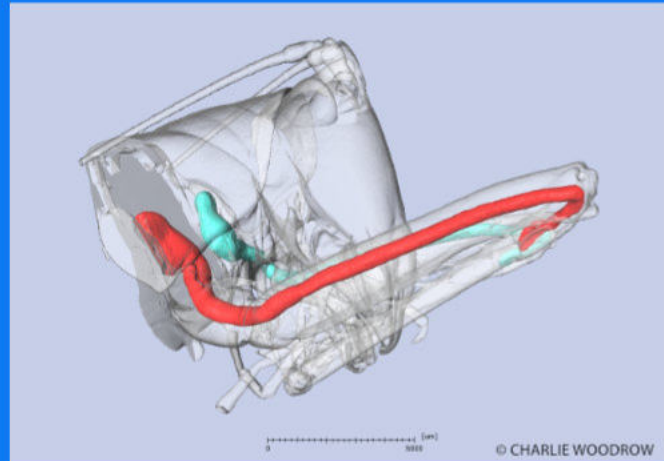
© CHARLIE WOODROW



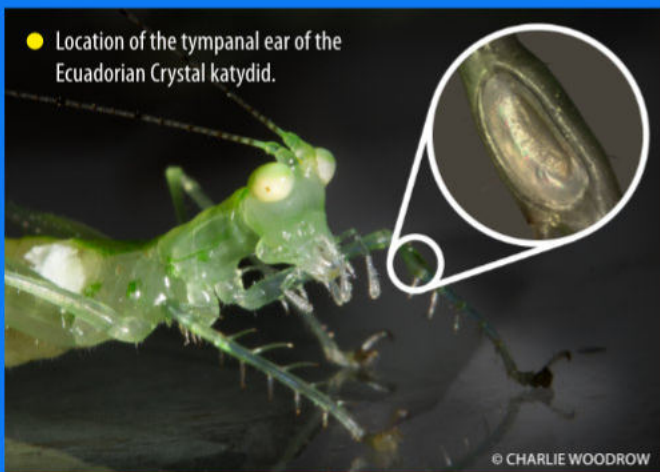
● Location of the ear canal in a live katydid species *Eopiphora gorgonensis*.

© CHARLIE WOODROW

Tympanal ears are different and have an eardrum like our own. In insects, tympanal ears have evolved in many locations, from the front legs (in crickets and bushcrickets), the abdomen (cicadas, grasshoppers), to wings (lacewing) and even the mouthparts (some moths)! These ears consist of an eardrum, which is backed by a pocket of air, and associated nerve cells for converting the movement of the eardrum into a nerve response. This nerve response can tell the brain where the sound came from, and whether it is a good or bad sound, so the insect can make a behavioral decision.



▲ Figure 2 – Bushcricket ear canal in front legs.



- Location of the tympanal ear of the Ecuadorian Crystal katydid.



- The katydid *Mecopoda elongata* is often kept as a pet in many parts of the world!

BUZZ WORD

ANTENNA

Antennae (more than one antenna) are segmented sensory organs that come in pairs on an insect's head. They can help insects smell, hear and feel and come in all sorts of shapes and sizes.

I study bushcrickets, which have even more advanced tympanal ears, because the movement of their eardrum is connected to a special organ called the *crista acustica*, which works just like the cochlea in the human inner ear. As sounds enter the *crista acustica*, it moves to a different part of the organ depending on the pitch of the sound, like a miniature piano! Many bushcrickets also have an ear canal. However, unlike the human ear canal, their ear canal is in their front legs (Figure 2). It helps guide sound to the eardrums and comes in all sorts of shapes and sizes. In some species, this ear canal is even tuned to the species-specific song, allowing them to hear potential mates even in the noisiest environments!



ENTO INFO: KATYDID

COMMON NAME: Supersonic Katydid
SCIENTIFIC NAME: <i>Supersonus aequoreus</i>
ORDER: Orthoptera
WHERE: Colombia, South America
HABITAT: Dense tropical rainforest (mid-high canopy)
FAVOURITE FOOD: Small flies and other small katydids

FACTS

- ▶ They produce the highest pitch sound of any katydid.
- ▶ They use spines on their front legs to catch their prey.

Caterpillar soup –

what's going on inside a butterfly's chrysalis?

By Liv Shovlin

You probably already know a lot about the life cycle of a butterfly. They hatch out of their eggs as caterpillars, which stuff themselves with leaves and grow bigger over time. When they are finished growing, the caterpillars stop eating, hang themselves upside down from a leaf or twig and form a protective casing. Weeks later, the caterpillar emerges as a butterfly.

But have you ever wondered what goes on inside to turn a squishy, stubby-limbed caterpillar into its colourful adult form?

Cocoons vs chrysalises



▲ Monarch butterflies hatch as tiny caterpillars (left) and grow through several instars into big eating machines (centre & right).

To get bigger, caterpillars have to shed their skin because their exoskeletons cannot grow. Each time a growing caterpillar changes its skin, it marks the start of a new stage called an **instar** and they must go through a certain number of instars before being ready to change into an adult insect.

When a butterfly caterpillar has eaten enough and is ready to transform, it makes a button of silk to attach its body somewhere safe and sheds its skin for a final time. This new skin is different and hardens into a protective case called a **chrysalis** if it is a butterfly and a **pupa** if it is a moth. This process is called **pupation** and it is in this stage that the caterpillars will transform.

Pupae (more than one pupa) can't run away or defend themselves so this is a vulnerable time for an insect! Moths usually feel less safe forming a pupa out in the open like butterflies do, so they often bury themselves in the soil or

make themselves a protective **cocoon**. Cocoons are spun out of silk which the moth caterpillars make with their mouthparts, and it is safely inside the cocoon that the caterpillars shed their skin and begin their transformation.



▲ Silkworm pupa inside a cut cocoon.

What happens in a chrysalis?

After the caterpillar hardens its exoskeleton into a chrysalis, it begins to digest itself from the inside out. The same juices that it once used to break down its food now turn the inside of the chrysalis into caterpillar soup. If you were to cut the chrysalis open at this stage, this goo would ooze out.

The only things that survive this process are structures called **imaginal discs**. These discs are part of the caterpillar from the time it hatches from its egg, but once the caterpillar is liquified inside the chrysalis, they spring into action to rebuild it in the shape of a butterfly. Different

imaginal discs have different jobs – there is a disk for the butterfly's eyes, one for the legs, one for the wings and so on. They use the materials in the caterpillar soup to build these new body parts in a process that can take as long as a month, or as little as five days.



▲ Gradually the butterfly inside the pupa becomes visible.

How do butterflies get out of the chrysalis?

When the imaginal discs have finished building all the butterfly's new body parts, it is ready to emerge. This process is called **eclosion**. The butterfly releases chemicals which tell the chrysalis to soften, making it easier for it to push its way out. As the chrysalis softens, it often becomes transparent, allowing you to see the butterfly inside. The butterfly uses its legs to open the part of the chrysalis covering its head, and then wriggles its way out. Often a reddish liquid drips out of the chrysalis. This is called **meconium**, and it is the leftover part of the caterpillar which was not needed to make the butterfly.



Getting pumped up

Once the butterfly has emerged, it is not ready to fly right away. Because they were tightly folded to fit inside the chrysalis, the butterfly's wings need to be

"pumped up" like bicycle tyres before they can work. Newly emerged butterflies hang upside down from their chrysalises for up to two hours to do this, pumping

haemolymph (insect blood) into their wings and drying them out in the air. Once this is done, the butterfly is ready to take flight.



"...the butterfly's wings need to be "pumped up" like bicycle tyres before they can work."



So next time you see a caterpillar or chrysalis, look closely and think about the amazing transformation it is soon to make. But be careful handling caterpillars as some are covered in fine hairs that can hurt you.

BUZZ WORD

COMPLETE METAMORPHOSIS

Complete metamorphosis is when insects go through 4 distinct stages: egg, larva, pupa and adult. Larvae and adults usually look very different to each other. Around 60% of all animal species are insects that undergo complete metamorphosis!

You won't Bee-lieve it!

By Adam Hart

Everybody loves honeybees as providers of honey and important pollinators. But how much do you really know about this popular, and fascinating, insect?

The first thing to realise is that a lot of insects you might think are honeybees, or see being called honeybees, actually aren't! Many people confuse all kinds of insects for honeybees, including wasps, hoverflies and bumblebees. We often think of honeybees as having yellow and black stripes but their stripes are often a brown or orange colour and some honeybees can be almost entirely black. These different forms of the honeybee are still the same species, but the darker bees are better adapted to colder places, where dark colours let them warm up more quickly in the sun.

If you see a honeybee on a flower then the chances are that it is a female worker bee from a nest that could be several kilometres or more away. The worker bee is out foraging on flowers, collecting nectar and pollen that will be used to feed hungry larvae back at the nest and to make honey. To transport it back to the nest, she stores the nectar in a special part of her



DAVID CLODE

gut, just before her stomach, called the crop. The pollen she collects will get transported by "sticking" it to special hairs in a little dip in the exoskeleton of each of her back legs. This structure is called a pollen basket and you can often see the colourful pollen "trousers" on honeybees (and bumblebees) as they fly around in the late spring and summer.

BEES:



Honeybee

© ROXANNE VASSIE



Bumblebee

© ROXANNE VASSIE

NOT BEES:



Hoverfly

© DOMINIQUE VASSIE



Greater bee fly

RICHARD BARTZ, CC BY-SA 2.5



Potter wasp

© WEN-CHI YEH



ANNIE SPRATT

Once she has collected all the nectar or pollen she needs, the forager bee flies straight back to her nest. Honeybees are excellent navigators and can use the sun and Earth's magnetic field, as well as landmarks like trees, to find their way around.

Back at the nest, or "hive" if it is a nest in a wooden box belonging to a beekeeper, the forager bee unloads

her pollen by kicking it off her legs into one of the waiting wax "cells" in the honeycomb. Honeycomb is made from wax that the bees produce using special glands under their abdomen. They can use their legs and mouthparts to work and shape the wax into the familiar hexagonal honeycomb. The nectar that worker bees collect is also stored in these versatile wax "buckets".



BEEING



WAUGSBERG, DISTRIBUTED UNDER CC BY-SA 2.5 LICENCE

▲ Bee larvae and eggs inside their cells.



CRISTINA MARIN

Most of the bees in the nest are female workers. At some times of the year there may be a few male bees (called drones) in the nest and these are a bit “fatter” in shape and have very large eyes. The other type of bee in the nest is the queen bee. The queen is the mother of all the bees in the nest, meaning that all the workers are actually sisters. The honeybee nest is a one big family all working together.

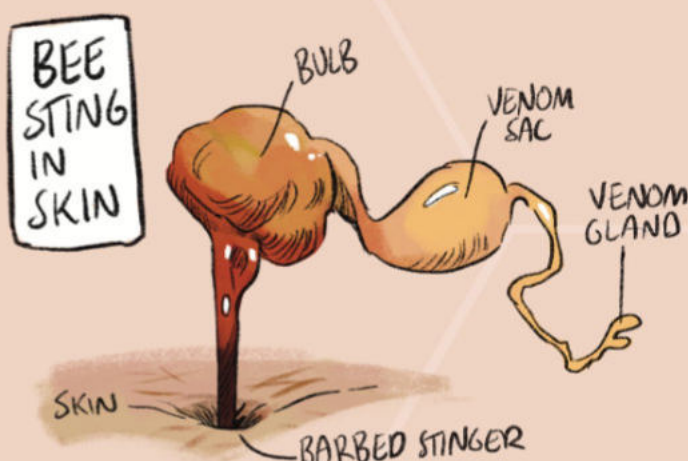
The queen doesn’t order the worker bees around – she isn’t in charge! Instead the workers decide what to do amongst themselves. They can communicate with each other by “dancing” (moving around in a way that tells other bees where food is), producing different sounds and by producing special chemicals called pheromones that they can “smell” with their antennae.

The only job the queen has to do is lay the eggs that will hatch into larvae. Eggs are laid in the honeycomb cells and the larvae that hatch from them are fed by worker bees. Once the larvae are big enough they pupate, undergoing metamorphosis (just like a butterfly caterpillar) to form the adult bees.

Of course, honeybees are most famous for making honey. Honey is an amazing substance that allows the

honeybee family in the hive to feed themselves over winter when there are no flowers. It is a very neat way for them to store the nectar they gather in the summer. Honey means that honeybees can really get going as soon as Spring starts and flowers start blooming. Honeybees make honey by evaporating some of the water from nectar and mixing the nectar with enzymes. These substances help to change the types of sugar found in nectar into the sugars that produce honey – that rich and long-lasting substance we love to spread on toast.

Honeybees are also well-known for their sting. The sting helps them to defend the nest against animals



that would love to steal their honey, including us! Honeybee stings stick in our skin and as the bee moves off it is quite common for the sting to pull away the bee. Once honeybees lose their sting they die.

A honeybee sting is painful and can cause swelling and itching. In some people, bee stings can produce a serious allergic reaction called anaphylaxis that can in some cases even be fatal. However, for most people a bee sting is just a painful reminder that honeybees will defend their nest come what may, even sacrificing their own lives to do so.

Honeybees are incredible insects. Like ants, termites, some wasps and some other bees, they are “social insects”. They live in close family groups and have a whole host of different ways to work together, communicate with each other and keep their family unit safe from harm. Honeybees also pollinate flowers as they collect nectar and pollen. This pollination is very important for nature and for us. Honeybees are not the only pollinators though. Keep a close eye out this summer to make sure that you aren’t mistaking other really important pollinators, like hoverflies, for honeybees!

HOW TO DRAW AN INSECT

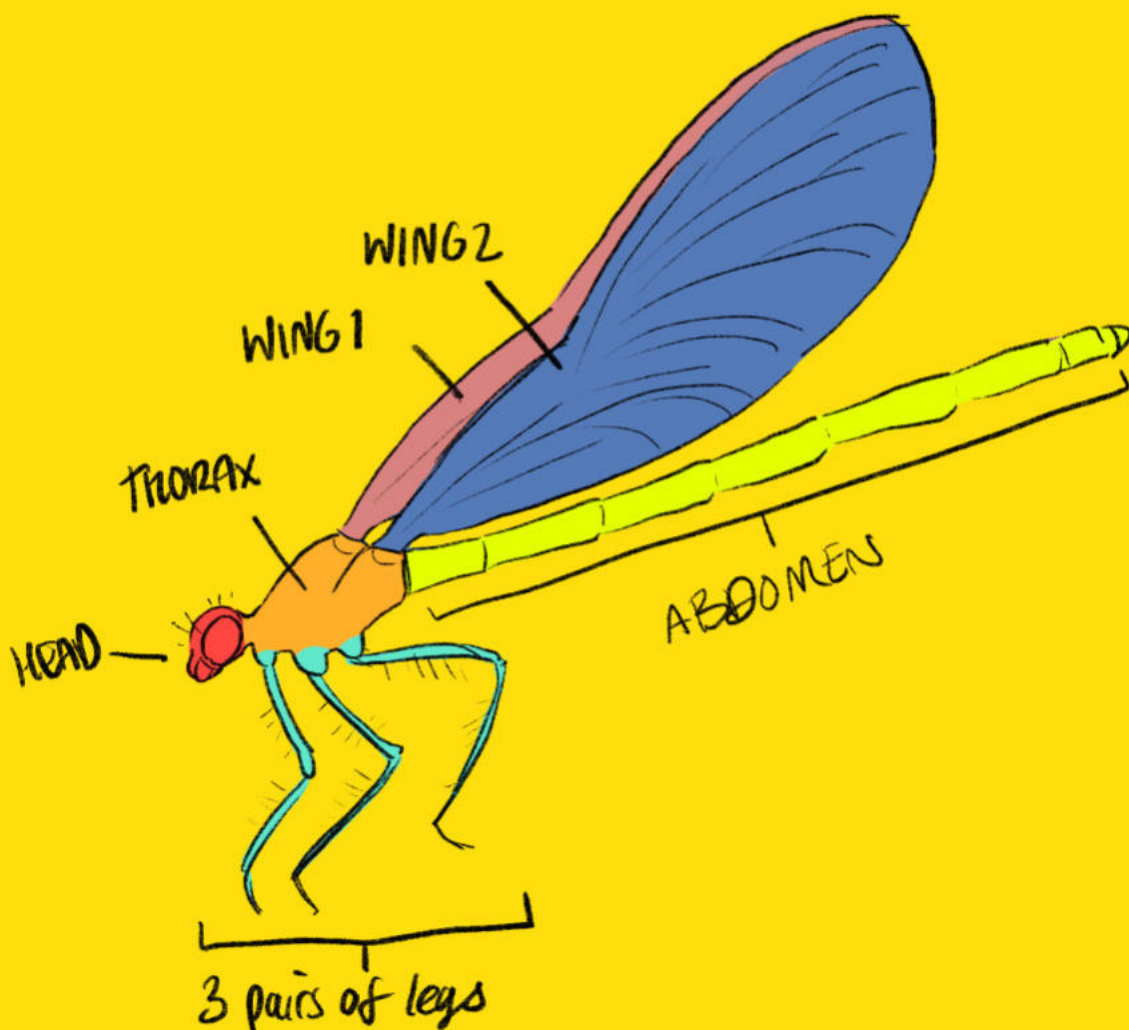
There are so many beautiful and interesting insects in the world to inspire you to draw! Let's learn the basics of drawing these wonderful animals.

What you will need:

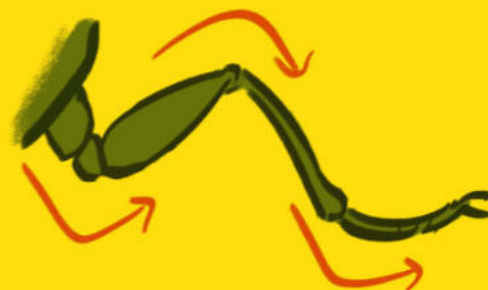
- Paper
- Something to draw with! You could use a normal pencil, a coloured pencil or even a ballpoint pen.

Before we start drawing, we need to remember some important facts about insect bodies to make sure we know what to look for when we draw from a photo, from life or from our imagination.

- Insect bodies have three main sections: the head, the thorax (chest) and the abdomen (belly).
- remember that the wings and legs are always attached to the thorax
- Antennae come in lots of different shapes and sizes



- Insects legs also have a slightly different structure to our legs.
- It helps to learn this basic shape to help bring life to your insect drawings.



Let's draw an ant!

The first insect we will draw is an ant. Ants have clear body sections and worker ants have no wings which makes them easier to draw. Take a look at this photo of a black garden ant (*Lasius niger*) and get to know her basic shapes and details!

- A** Long antennae
- B** Six long legs
- C** Curved abdomen ending in a point
- D** Long, thin thorax
- E** Triangle shaped head with small eyes



1. Sketch out the rough body shapes

Use a coloured pencil or a normal pencil to draw in the rough body shapes. Make sure you press lightly so that it's easy to change your shapes until you're happy! This is just a guide, not the final drawing.



The head of an ant is roughly a triangle and the body is made up of ovals. The middle oval is going to be the thorax, so this is where the legs will attach. Draw three small ovals to become the base of the three legs on this side of the body.

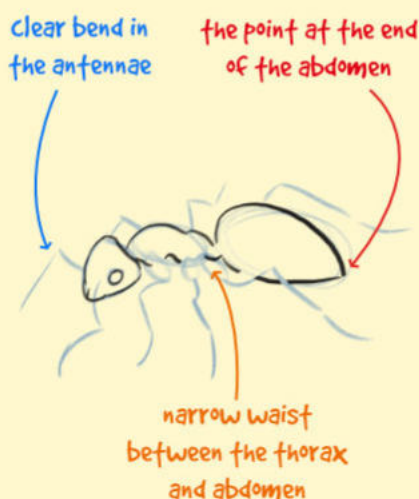
2. Sketch in the legs

From the bottom of each of these small ovals, draw some light stick legs so we know where the joints and feet will be. We can also lightly sketch the eye and antennae.



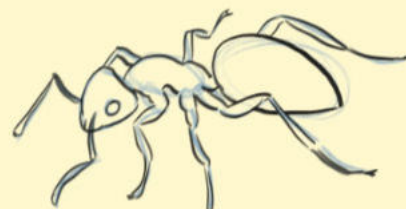
3. Start drawing in the body

Now we have a lightly drawn plan, we can start on a more solid drawing over the top. It's easiest to start with the head, thorax and abdomen before drawing the legs. Look carefully at the photo and think about what features make an ant look like an ant.



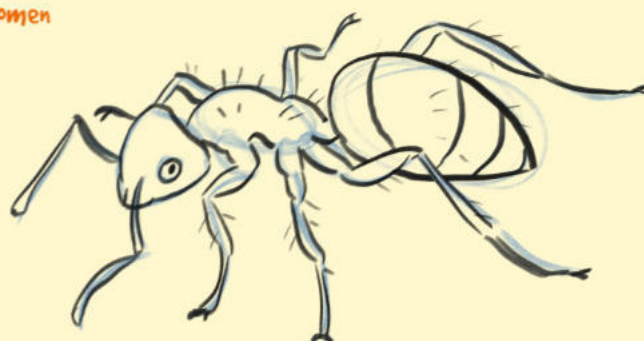
4. Draw in the legs and antennae

Next, using the light sketch, start drawing in the legs on the near side and the antennae. The legs are wider near where they connect to the body and thinner nearer the feet.



5. Add details!

Now we can add in the final details to our ant such as hairs, segments of the abdomen and the other legs. Such a cute ant!



Let's draw a stag beetle!

Now, let's try drawing a different insect! Here is a giant stag beetle (*Lucanus elaphus*). In beetles, the first pair of wings has evolved into tough cases called elytra which protect their actual wings underneath and hide part of their thorax and their abdomen.

Look carefully at the shapes of the body because now we have to simplify what we're seeing again to help lay out our drawing. It's much easier to change light basic shapes on your page than it is to redraw a detailed stag-beetle head.



- A** 6 long legs
- B** Small eyes
- C** Long antennae
- D** Big head with huge curved jaws for fighting other males!

E Pronotum between the head and wings

F Hard wing cases covering the back

1. Sketch out the rough body shapes

Like before, start by lightly drawing the basic shapes. Start with a rough rectangle for the head, circle for the pronotum (bit behind the head of a beetle) and an oval for the back end.

- Don't worry if you have to rub them out a few times, getting these shapes correct now is important!
- Make sure you've left enough room on your page for the legs and jaws



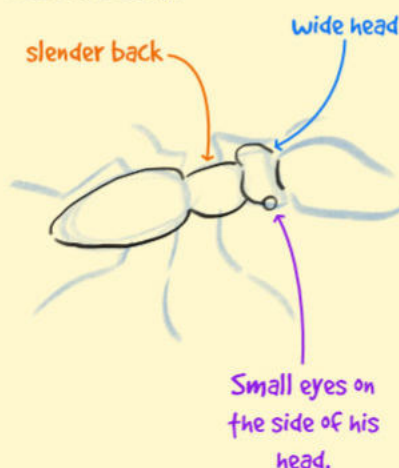
2. Sketch in the legs and jaws

Next, lightly draw where the legs and jaws will go. Pay attention to the bends in the legs and the curve of the jaws.



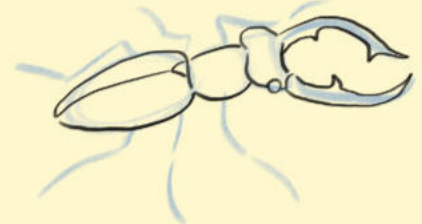
3. Start drawing in the body

Now we can begin our final drawing! Using darker lines or a different darker pen or pencil, start by drawing in the head and body.



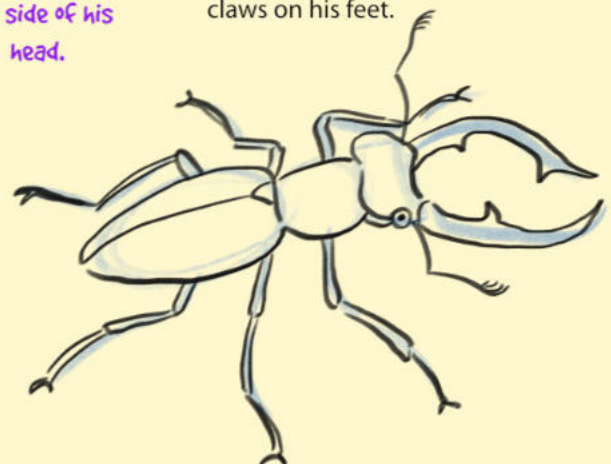
4. Draw in his big jaws!

Next, use the photo to help you draw in the stag beetle's big jaws! They curve outwards then back towards each other. You can also add a line down his back where his wings split.



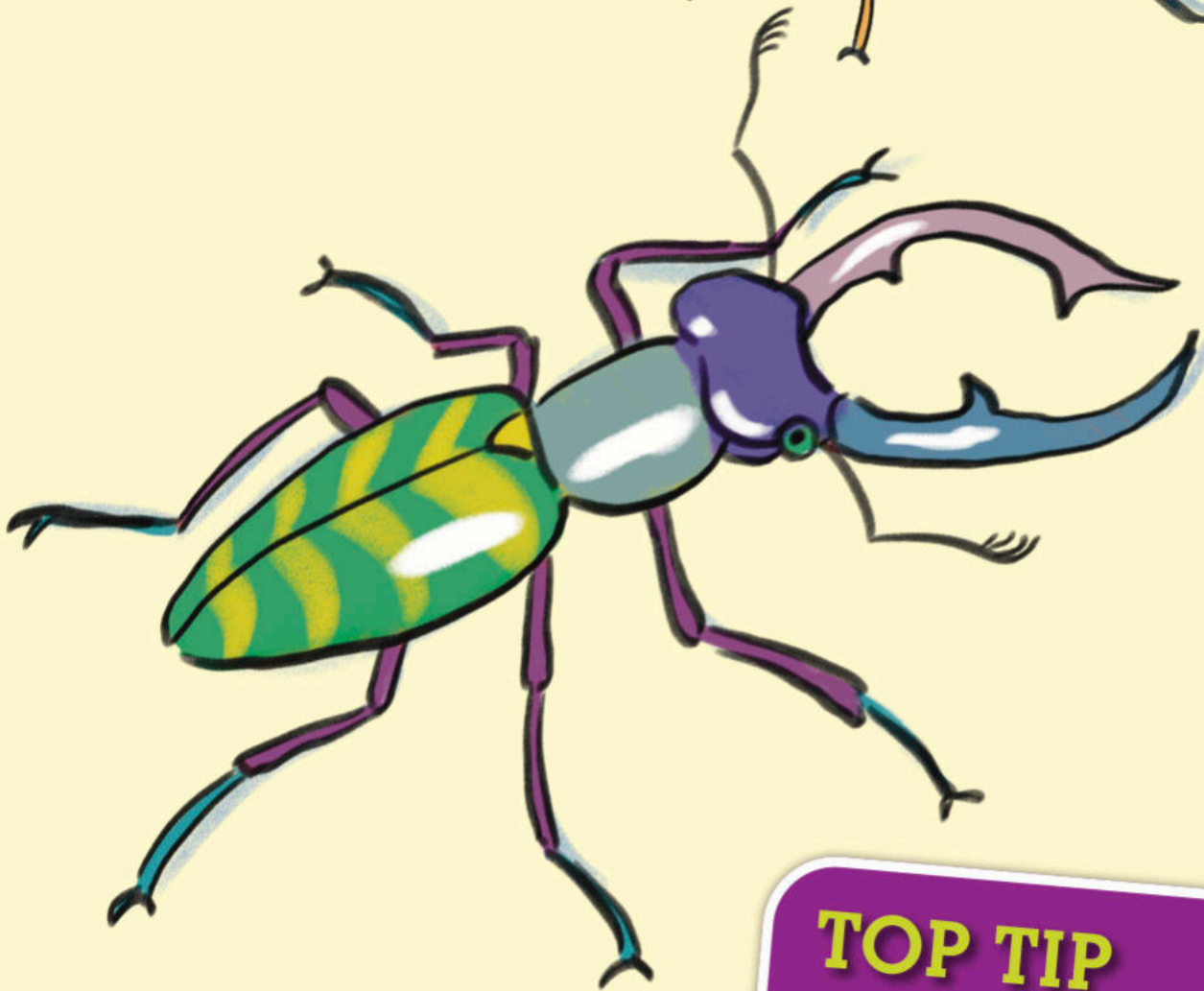
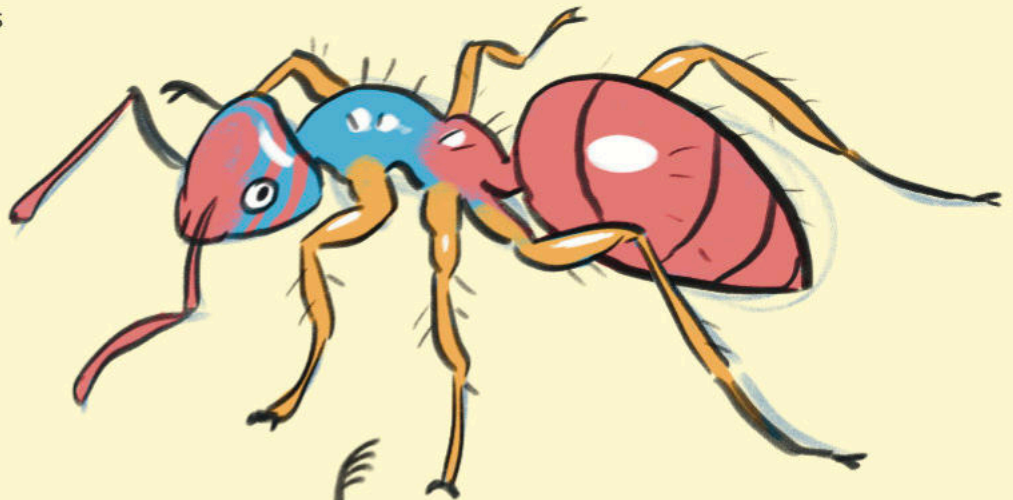
5. Draw the legs and details

Finally, finish up the legs! Add details such as antennae and little pairs of claws on his feet.



Colour in your insects!

Now you can colour in your insects – they can be any colour you like because they're works of art, not photos. Get creative and well done on your drawings!



BUZZ WORD

ABDOMEN

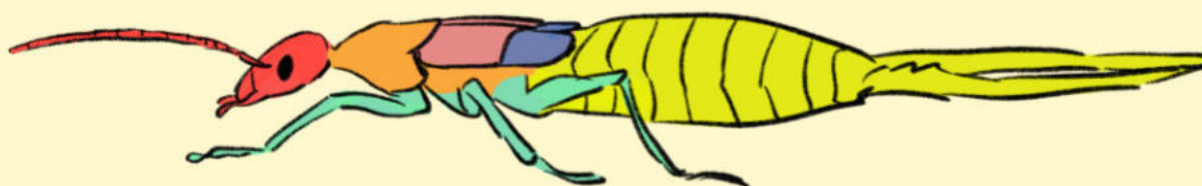
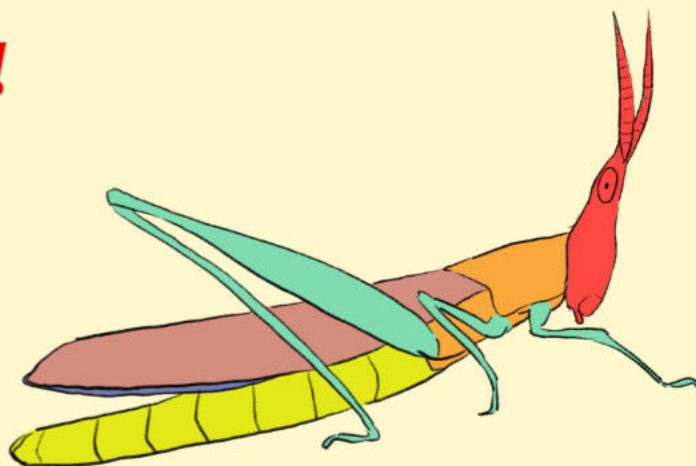
The abdomen is an insect's belly and is the third major part of their body. Think of it as the bum or tail.

TOP TIP

When you're learning to draw anything, don't be afraid to use photos to help! You have to draw something many times to understand it and looking at the real thing will help you a lot.

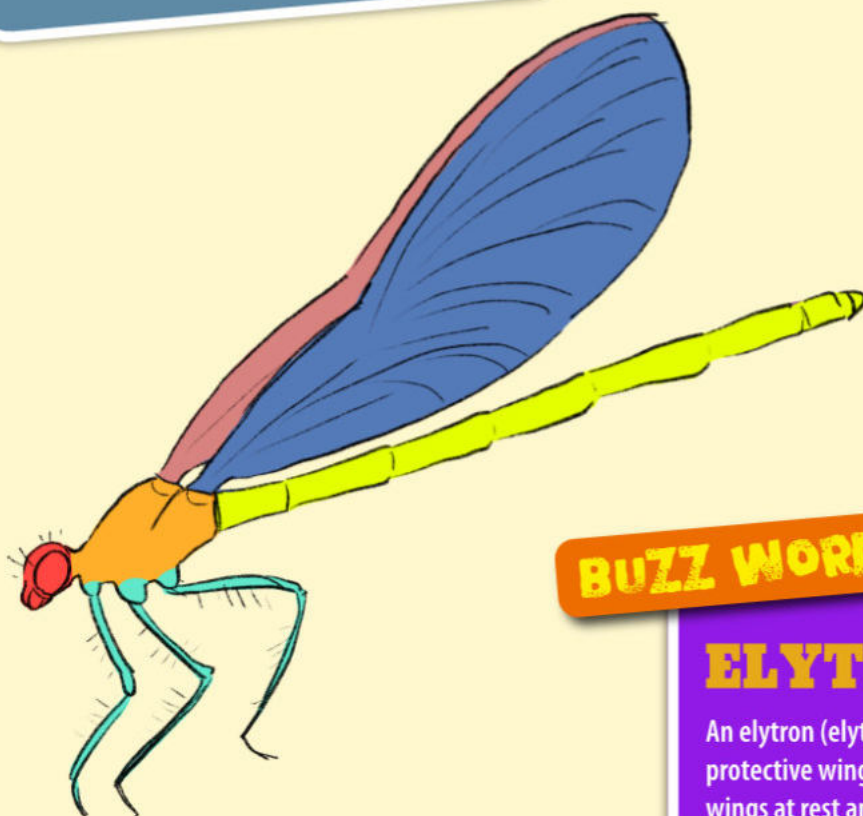
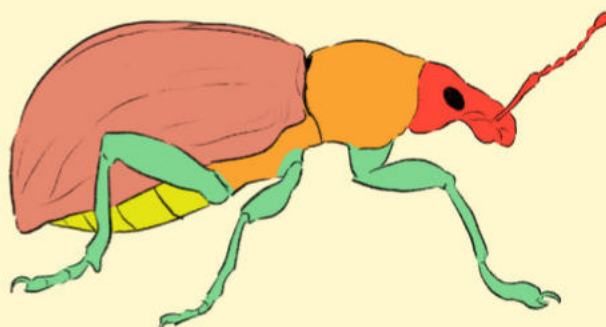
Draw some more!

Now, you can try using similar steps to draw from some of the other beautiful insect photos in this magazine!



TOP TIP

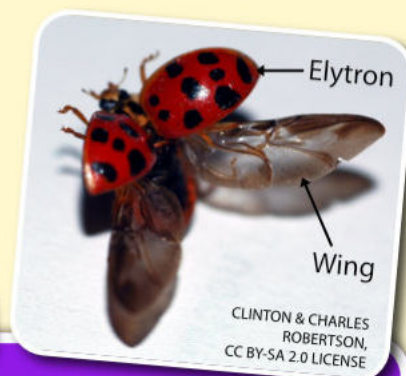
If you are having trouble drawing a particular part of an insect, look up photos of the insect from lots of different angles to give you a better sense of its 3D shape!



BUZZ WORD

ELYTRA

An elytron (elytra for more than one) is one of the hard protective wing cases of a beetle. These lie on top of their wings at rest and are lifted out of the way for flight.



Small but mighty: a guide to insect mouths

Written and illustrated by Dominique Vassie

Although insect mouths are small, they are complicated and made up of lots of different parts. These main parts come in all shapes and sizes to give each type of insect the best tools possible to help them eat their favourite foods.

Chewing insects

Lots of different types of insect have mouths designed to help them chew through tough materials like leaves, wood and even other insects! Beetles, grasshoppers, crickets, mantises, ants, cockroaches and caterpillars all have chewing mouthparts.

These insects have strong jaws which help slice through their food. Feelers around their mouths called palps help them check if their food is good to eat and feed it into their mouths without hands!

All the different parts of the mouth are clear on a chewing insect so let's look at them more closely.

The labrum (pink)

The **labrum** is the 'upper lip' of an insect found at the bottom of its face. It often covers the other mouthparts a bit and in some insects it helps hold food in place while eating.

The mandibles (purple)

Many insects have two **mandibles** which act like sharp teeth to cut from side-to-side through meat or plants.

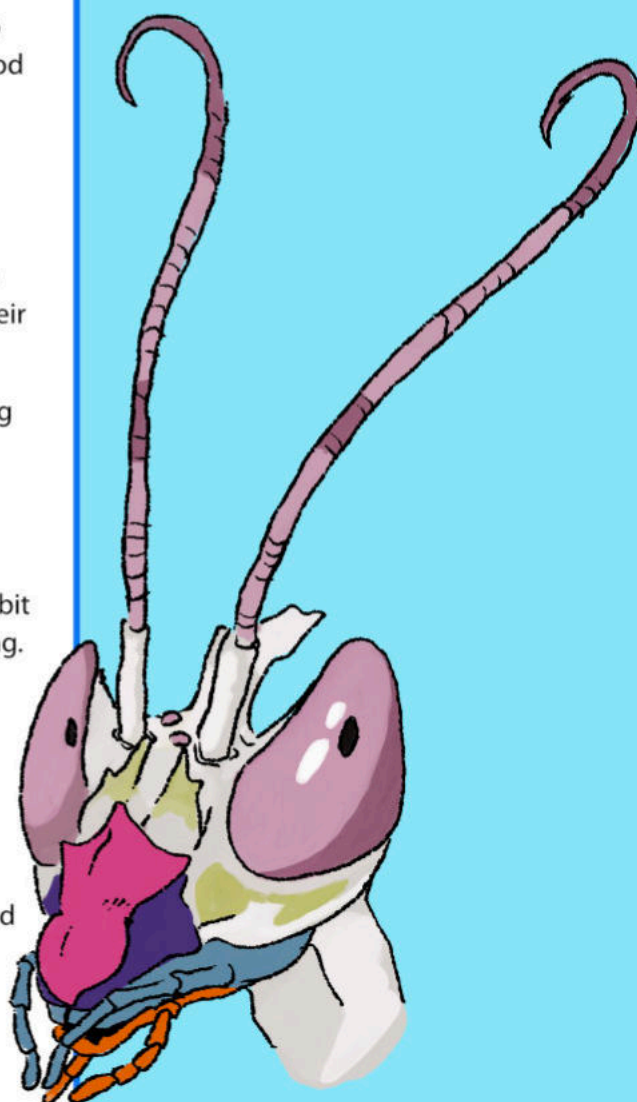
The maxilla (blue)

Two **maxillae** (the word for more than one **maxilla**) behind the mandibles usually help insects chew. They often have small palps which are used by the insect to examine and taste possible foods.

The labium (orange)

The **labium** usually forms the bottom of the mouth in insects with two palps to help handle food.

Now we know what the mouthparts look like in a typical chewing insect, let's see how these parts look in insects that eat different kinds of food!



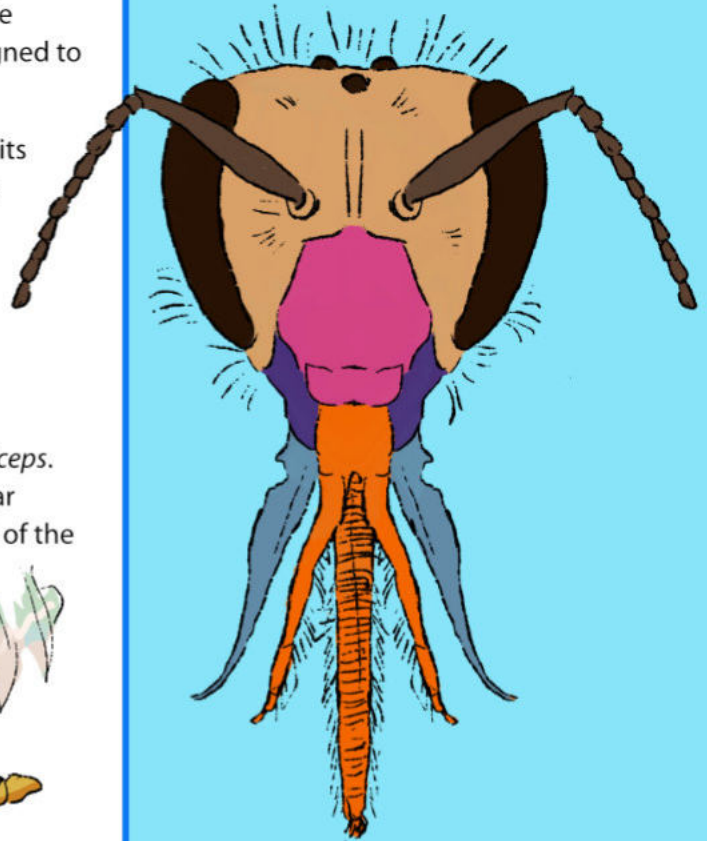
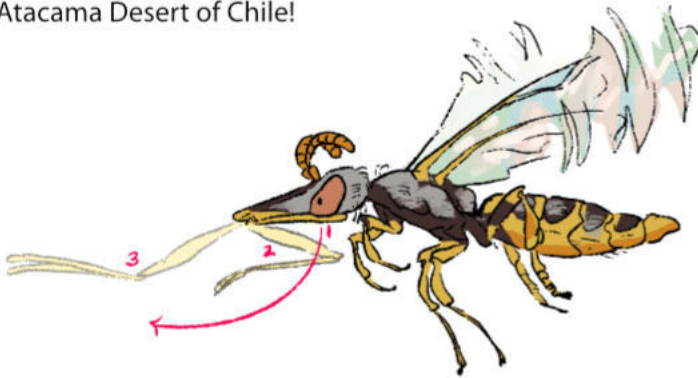
Bees

A honeybee's favourite food is the nectar found inside flowers and to reach it, they have a long mouth designed to eat liquids.

Their **labium** has evolved into a long tongue which sits inside a special tube formed by the **maxilla**. This lets them lick and suck nectar up into their mouths.

The **mandibles** protect the mouthparts when they are folded safely into the head but also have other functions such as helping bees build and maintain their nests and helping them feed their young.

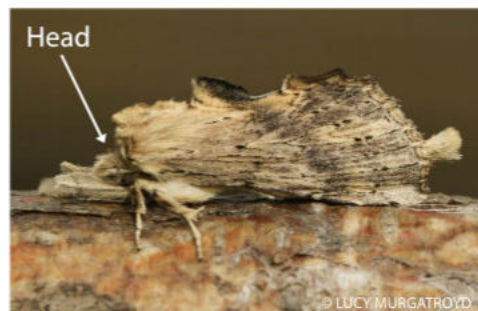
One unusual species of bee is called *Geodiscelis longiceps*. It has a very long face and mouthparts to reach nectar hidden deeply inside flowers away from the dry heat of the Atacama Desert of Chile!



Butterflies and moths

Adult butterflies and moths have mouthparts designed to siphon fluids. Usually, this is used to drink sugary nectar from flowers but some also drink animal's tears, fruit juice and even the liquid in poo!

Nearly all adult butterflies and moths lack **mandibles** because they don't need to chew anything. Their mouth is almost completely made up of the two **maxillae** which are very long and zip together to form a tube through which the insects can drink like a straw.



▲ Pale prominent moth using its mouthparts as part of its disguise as a piece of wood.

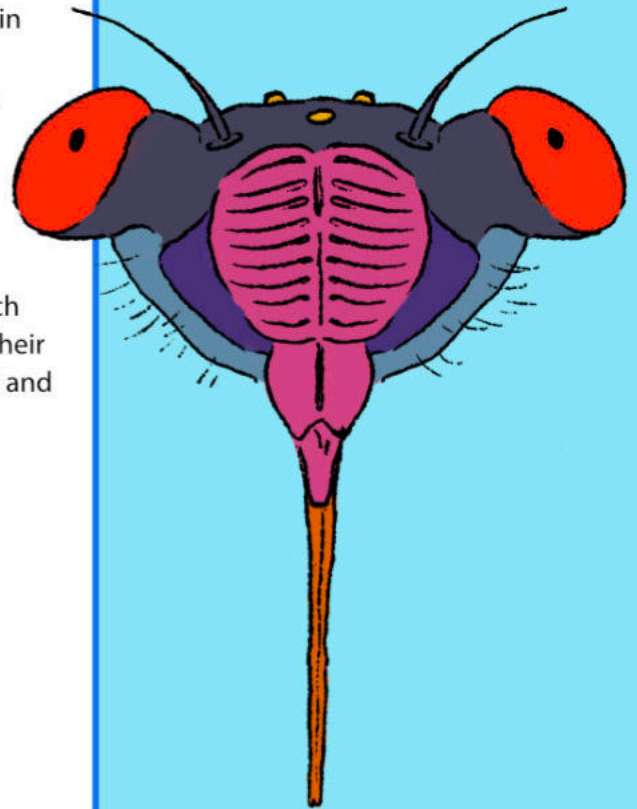
The palps of the **labium** are often hairy and usually fold over the face or stick out like a pointy nose.

True bugs

We often use the word 'bug' to mean many insects, but in insect science the true bugs are a special group with a beak adapted for piercing and sucking fluids. These are insects such as cicadas, aphids, shield bugs, hoppers, pond skaters and water bugs. Most prefer to drink the sap inside plants but some, such as water bugs, are predators of other animals!

The two **mandibles** and two **maxilla** form 4 tubes which are supported by the **labium** to help them pierce into their food. Each tube has two channels, one for injecting spit and the other for drinking up food.

True bugs always have a straw with them!

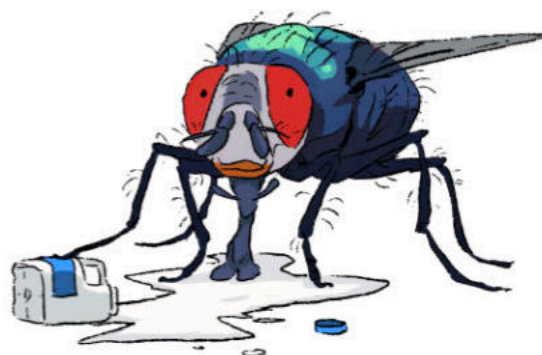
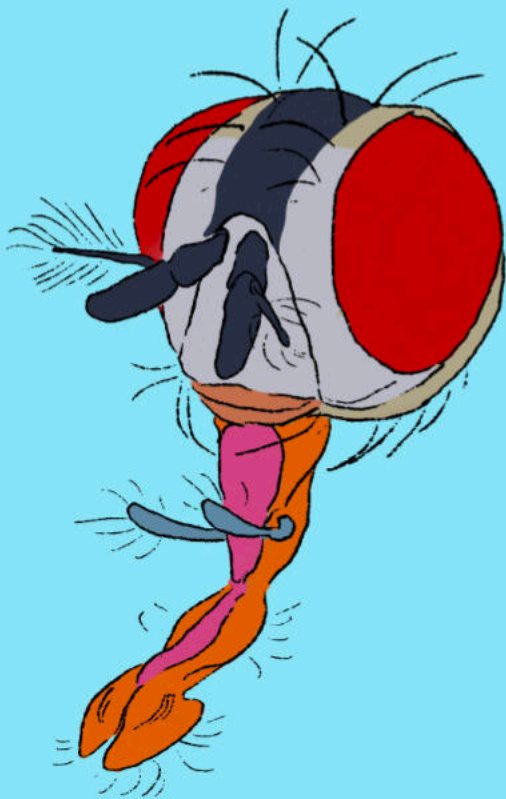


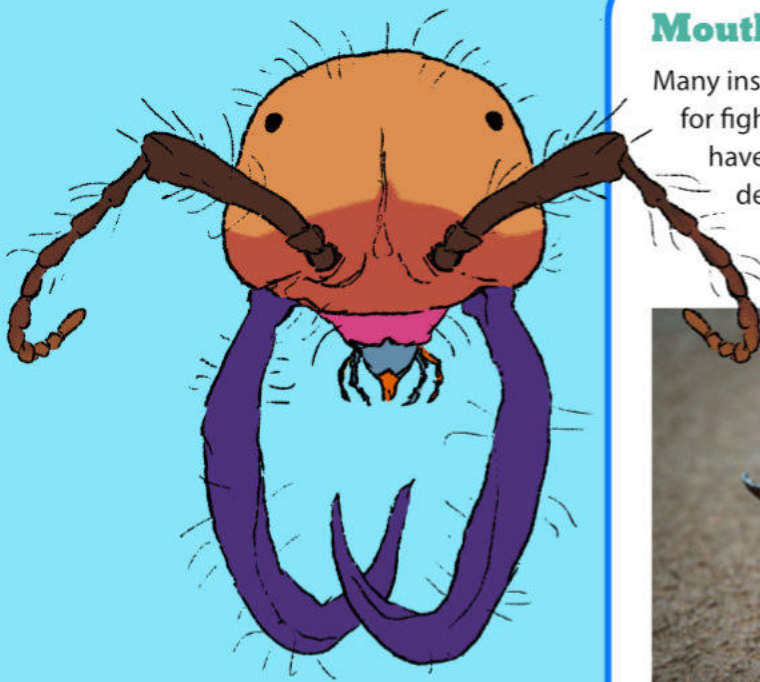
Flies

True flies feed in many different ways. Some, like mosquitos and horseflies, are able to bite skin and drink up blood but many others, like house flies, simply sponge up their food.

Their **labrum** and **labium** form a long foldable and flexible mouth with a sponge on the end which sucks up their food. They have no **mandibles** and cannot chew so must eat liquid food. If they find a solid food they want to eat, they have to spit all over it to start breaking it down so it can be slurped up.

Houseflies never cry over spilt milk, they just sponge it up!





Mouths for fighting

Many insects have mouth parts which are designed more for fighting and not eating. The soldiers of army ants have **mandibles** which are huge and sharp for defending their family and male stag beetles use their big **mandibles** to attract a female and fight other males!



ZU PHOTOGRAPHY

Hold on tight!

Some bee species use their jaws to attach themselves to a plant while they sleep!

There are many more weird and wonderful insect mouths out there. Next time you find an insect, look closely and see if you can work out what it eats.



© ZOLTAN GYORI

BUZZ WORD

PALP

Palps are jointed finger-like organs that can be found at the bottom of an insect's head on the maxilla or labium. They help insects taste and put food in their mouths!



ZDENEK MACHACEK

Did You Know...

Adults of the emperor moth family Saturniidae cannot eat as they do not have a working mouth. Therefore they must do all the eating of their life whilst still a caterpillar and live off fat reserves for their short adult life.

SAY IT WITH SMELLS!

By Adam Hart

Humans are very good at communicating. We can speak to each other (in many different languages), use telephones and radios, write words down, use flag and sign language, read maps, interpret drawings, send morse code and more besides. When it comes to getting our message across, no other animal even comes close to our complicated communications. But most of our communication is limited to sights and sounds. One thing we aren't that good at is communicating with smells!

What we think of as our sense of smell is actually our "sense of chemicals". When we "smell" something we are detecting chemicals in the air that go up our nose as we breathe in. We have a special place high in our nose that can detect these chemicals and send signals to our brain. These signals from our nose are interpreted in our brain into a "smell".

Insects are not that different but instead of noses they detect chemicals in the air with their antennae. Many insects are able to detect all kinds of chemicals, often at very low levels. They are often very much better at smelling than us and this is one of the features

that lets them communicate using smells.

The chemicals that insects can use to communicate with each other are called pheromones. A pheromone is a chemical produced by an animal that can carry a message to another animal of the same species. This message is as complicated as a sentence that we might say though. Think of pheromones more like a few words, or even just a single word.

Lots of insects use a pheromone to say "I'm over here and I'd like you to find me". Female moths for example that want to mate with males might produce a pheromone that the male can



▲ Clearwing moths can be lured with a pheromone trap.

detect in the air and follow back to the waiting female. We can make use of these pheromones to trap moths, wasps and other insects. By putting the chemical used as the pheromone in a trap we can send out a fake message and lure insects to the trap, perhaps to remove them from crops or to collect them to study.



▲ Male drinker moth with feathery antennae.

"Many insects are able to detect all kinds of chemicals."



▲ Termites in Borneo.



Some insects live together in large groups or colonies, like honeybees, termites and ants. Some of these insect colonies, like leaf-cutting ants, can contain millions of individuals. Trying to organise all of these insects would be very difficult without being able to communicate. It isn't surprising then that we find lots of different pheromones in these "social insects".

One way that ants use pheromones is to find food. When ants find food, they can lay a "trail" of pheromone back to the nest. This trail pheromone says "follow me and find food". Other ants can pick up the pheromone using their antennae and follow the trail. If these other ants also find **food** they can lay more trail, making a really strong "smell" that is very

attractive to yet more ants! One of the substances that army ants of South America use in their trail pheromones is the exact same chemical that gives some green grapes their distinctive smell.

We can smell other social insect pheromones. For example, bumblebees that have left the nest and found food can produce a pheromone when they return to the nest that tells other bees to "get out and look for food". One of the chemicals they produce to "say" this is eucalyptol, which smells like Olbas Oil or Vicks Vaporub.

When honeybees **sting** they often leave the sting behind in the skin. The "blob" on top of the sting produces an "alarm pheromone". This pheromone carries a more complicated message that says "be **more angry** than you would normally be" and "attack this person!" This is why you should move away from bees as soon as you can if you are unlucky enough to be stung. The alarm pheromone contains lots of different chemicals and some of them are very familiar to us. The chemical that gives banana sweets their distinctive banana-taste and that makes pear-drop sweets taste the way they do are both found in the honeybee alarm pheromone.

When we study **animals** we are often interested in how they see or hear because we have well-developed senses of vision and hearing. We also tend to think about animals seeing or hearing the world. Some animals though have all kinds of other sense and when it comes to **insects** we really have to turn on our "smelly-vision" to get the full picture of their world.



▲ Weaver ants bridging.

WHOSE BABY IS THIS?

A guide to insect larvae

Written & illustrated by Dominique Vassie

Most, but not all, insects spend the start of their life as a larva. These baby insects are mostly soft-bodied munching machines working hard to eat lots, but not get eaten themselves, in order to grow up into big, strong adult insects.

Larvae often look completely different to their adult forms as they are adapted to live in a different niche within their habitat. For example, a caterpillar spends all its time eating leaves whereas butterflies and moths can only drink a liquid diet. This helps them live side-by-side without fighting for the same resources.

There are so many different grubs, caterpillars and maggots in the world so how can we tell them apart?



Step 1: is it an insect larva?

There are a few other minibeasts that can be confused with insect larvae. So double check that the invertebrate you have found isn't one of these:

WORMS:

- ▶ There are lots of types of worm such as earthworms, leeches and flatworms.



- ▶ Worms are usually much longer and thinner than most insect larvae.

NYMPHS:

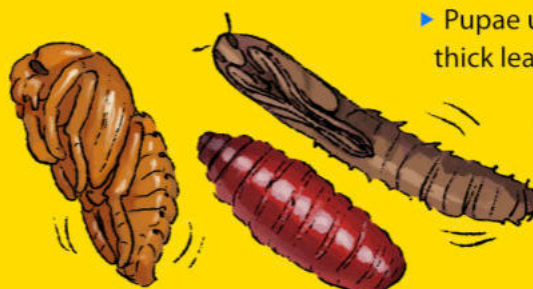
- ▶ Some insects hatch from their eggs as nymphs, not larvae. Some, like this aquatic dragonfly nymph, could be confused for a larva.



- ▶ Nymphs usually have longer limbs and tougher exoskeletons, looking much like the adult insect they will become.

INSECT PUPAE:

- ▶ They don't move much but sometimes wiggle when disturbed!

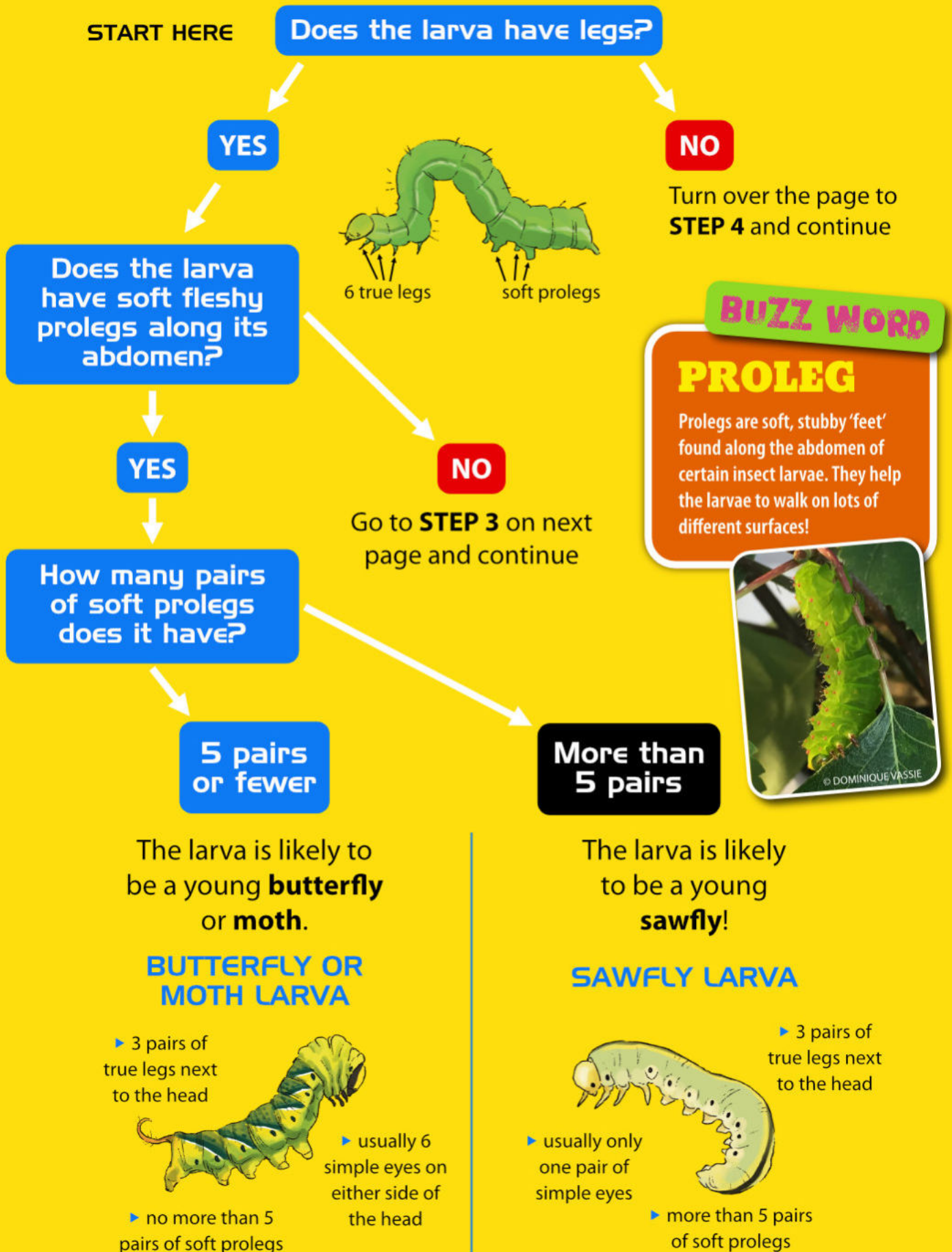


- ▶ Pupae usually have thick leathery skin.

- ▶ Sometimes the wings and legs of the insect that will emerge are visible, other times they are just smooth and cylindrical.

Step 2: Does it have legs?

Now we are more confident that our young animal is an insect larva, we can start trying to find out who they are! We can't fit all different types of insect larvae on just a few pages, but this key should help you narrow it down.



Step 3: Larvae with legs

Compared to its body,
how long are its legs?

Its legs are
quite long

Ladybird larva – they are usually spiky and slowly crawl all over plants and trees looking for aphids to eat.



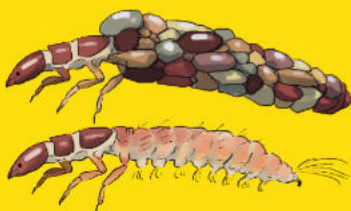
Ground beetle larva – fast moving predators that can be found in soil and leaf litter.



Lacewing larva – predatory larvae with large mandibles. Some species disguise themselves by carrying rubbish on their backs!



Diving beetle larva – these larvae are aquatic and are excellent predators!



Caddis fly larva – these larvae are aquatic and typically make a little home out of tiny pieces of rock or plants.

Its legs are
quite short



White grub – the baby of a beetle in the Scarab family. They like being underground or under rotting leaves and plants.

Carpet beetle larva – they are small, slow and hairy and likely to be seen in houses.



Leaf beetle larva – these larvae eat leaves and some species disguise themselves with poo!



Wireworm – these are the larvae of click beetles and can be found in soil.



TOP TIP!

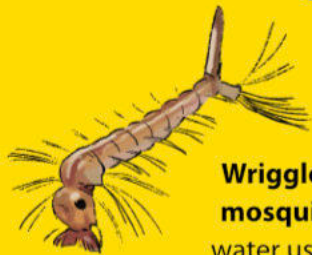
Most larvae are small and identifying them needs you to see tiny details. So try looking through a magnifying glass!



Step 3: Larvae without legs

Does the larva have a distinct and solid head capsule?

YES



Wiggler – the aquatic larva of a **mosquito**. They are found in still water usually at the surface where they breathe using a special tube.

Grub – the larva of a **weevil** beetle. They are found in many habitats such as in soil, plants, trees and seeds.



Midge larva – these larvae are aquatic and have very tiny soft prolegs at the front and back of the body.



Soldier fly larva – these larvae have tiny heads and can be found in compost heaps.



Fungus gnat larva – these larvae are commonly found in the damp compost of plants in pots and greenhouses.

NO

Larva has no clear head or only jaws are showing.

The larva is likely to be one of the following:



Roundhead borer – the larva of a **longhorn beetle** usually found under tree bark or in wood.



Flathead borer – the larva of a **jewel beetle** also usually found under tree bark or in wood.



Leatherjacket – the larva of a **crane fly**, usually found in soil.



Rat-tailed maggot – the larva of a **hoverfly** found in stagnant water, poo and dead animals!



Maggot – likely the larva of a **housefly** or **blowfly** usually found on dead animals and rotten food.
Bee, wasp and **ant** larvae can look similar to maggots, but are found in their nests.

QUIZ!

Now you have learned a bit about how to identify different insect larvae, have a go at using the key to find out who these baby insects are!



A: This insect was found munching on some leaves.

Answer:



B: This little insect was found running across leaves hiding beneath a pile of rubbish on its back.

Answer:



C: These larvae were found just under the surface of some still water. They all swam down and away when approached!

Answer:



D: These larvae were found eating together at the edge of a leaf.

Answer:



E: This larva was wandering slowly over a plant covered in aphids.

Answer:

Did You Know...

Most larval lacewing flies cannot poo as their gut is a dead end! They have to wait until they are adults to let it all out.

The answers can be found on the inside back cover. Check how many you got right!

Secrets of Silk!

What is silk?

Silk is a lightweight and shimmering fabric used around the world to make beautiful clothes such as saris, kimonos and scarves. But did you know, silk can only be made with the help of insects called silkworms?

Silkworms are not actually worms, but are the caterpillars of the domestic silk moth. These moths were first domesticated for their silk production over 4000 years ago in China and are related to a wild silk moth which is found across East Asia. Silk is made from the cocoons the caterpillars make to protect themselves whilst they transform into a moth!



▲ Silkworm cocoons.

Lifecycle of a silk moth

To grow big enough to make a cocoon, silkworms need to eat a lot of food but they are very fussy eaters and can only eat the leaves of the white mulberry tree. When the caterpillars are ready to become moths, they begin to produce silk from special glands near their mouth. This means that pretty silk clothes are actually made of caterpillar spit!

They spend 2 or 3 days moving their heads in a figure-of-eight slowly building the silk cocoon around their body and trapping themselves inside. Once they have finished, they shed their skin and form a pupa so that they can undergo metamorphosis. A few weeks later, the moth breaks out of its pupa skin and makes a special liquid to help them cut through the cocoon and emerge into the world again.

Adult silk moths have been cared for by humans for so long that they cannot fly anymore because people help provide everything they need, no need to fly anywhere! Despite eating non-stop as caterpillars, they do not have mouths as adults and cannot eat meaning that they only survive for around a week as moths, just enough time to find a partner and lay their eggs.



▲ Formal Japanese kimonos are traditionally woven from silk.



Look closely,
can you see the
silk strand
coming from
its mouth?

© DOMINIQUE VASSIE

▲ Fully grown silkworm ready to spin a cocoon.



© DOMINIQUE VASSIE

▲ Female silk moths usually lay around 300 eggs each!



LICHENG SHIH
DISTRIBUTED UNDER A CC
BY 2.0 LICENSE.

ENTO INFO: WILD SILK MOTH

COMMON NAME: Wild Silk Moth

SCIENTIFIC NAME: *Bombyx mandarina*

ORDER: Lepidoptera

WHERE: Across East Asia

FAVOURITE FOOD: Mulberry leaves

FACTS

- ▶ This silk moth is likely the wild ancestor of the domestic silkworm we use to make silk fabrics
- ▶ Females release pheromones to attract the males straight to them without having to move.

Making silk

A silkworm's cocoon is made from two types of material, the tough shiny silk thread and a sticky glue to hold it all together. Cocoons are made of a **single** thread of this silk that can be up to 900m in length! That's about 12,000 times longer than the caterpillar's



▲ Silk threads being reeled off cocoons in Thailand.

History of Silk

According to Chinese legend, the discovery of silk happened when the princess Xi Lingshi was sitting beneath a mulberry tree and suddenly a cocoon fell into her cup of tea. The heat from the tea began to unravel the silk cocoon inspiring her to explore it further as a material. China guarded the secret of silk fiercely for over 2000 years with silkworm farming not spreading abroad to Korea and Japan until after the year 200 CE.

Silk fabric was an important item traded along the Silk Road that connected East Asia with European civilisations for around 1500 years providing luxurious silk fabrics to be worn by royalty and the rich. Eventually, silkworm eggs were smuggled out of China to Europe where new centres of silk production were started.

body! To get this single silk thread for making clothes, the cocoons are boiled to soften the glue and allow the cocoons to be unravelled into long fibres that can be woven into soft, shiny fabrics. Over 5000 silk cocoons are needed to make just 1kg of silk fabric: that's over 300 cocoons to make a single scarf.

When a silk moth hatches from its cocoon, it breaks up the single silk thread into lots of tiny pieces which are difficult to weave into silk fabric. This means that the silkworm pupae have to be killed inside the cocoons in order to get silk threads. Therefore, although insects likely do not feel pain in the same way as we do, the process is considered by some to be unnecessarily cruel. Therefore some people prefer to let the moths emerge from the cocoons first and make a different kind of fabric with the silk.



▲ Traditional straw supports for silkworm cocoons in Hokkaido, Japan.

"Silk fabric was an important item traded along the Silk Road that connected East Asia with European civilisations for around 1500 years providing luxurious silk fabrics to be worn by royalty and the rich."

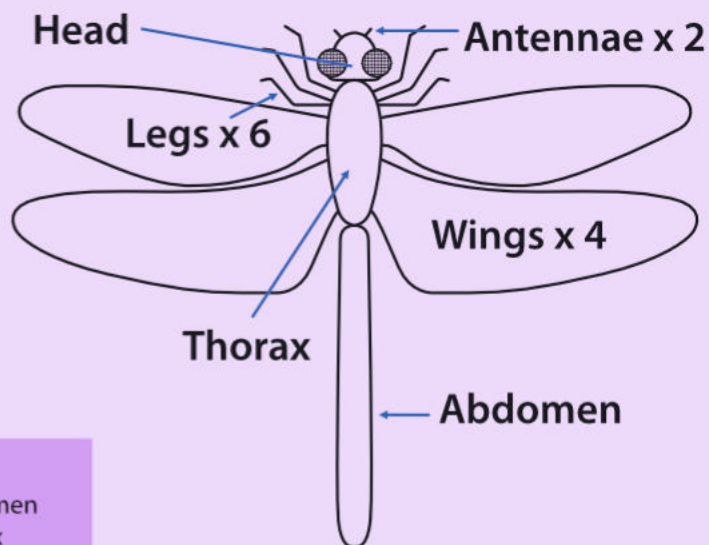
GAME: DRAGONFLY DRIVE

Take it in turns to roll a dice and draw the body part matching the dice number until a whole dragonfly has been drawn. You must draw the thorax before anything else, so you can't start until you throw a six. You must draw a head (four) before you can draw the antennae.

The first player to draw a complete dragonfly shouts DRAGONFLY! and scores the maximum 15 points for that round. Everyone else counts up how many body parts they have drawn, and scores one point per body part. Move to the next box to play another round. At the end the winner is the person who has scored the most points over all the games added together.

DICE ROLL:

- | | | |
|-------------------|----------------------|------------|
| 1. Legs (need 6) | 3. Antennae (need 2) | 5. Abdomen |
| 2. Wings (need 4) | 4. Head | 6. Thorax |



Game 1:	Game 2:	Score 1
		Score 2
Game 3:	Game 4:	Score 3
		Score 4
Game 5:	Game 6:	Score 5
		Score 6
TOTAL SCORE:		



These activities are taken from the 'Incredible Insects' activity pack of Girlguiding Surrey West County, UK.
Find more activities on their website!
www.ggsww.org.uk/incredible-insects

INSECT LARVAE QUIZ ANSWERS

- How many did you get right?
- ☐ a) Moth or butterfly larva – has fewer than 5 pairs of soft prolegs.
 - ☐ b) Lacewing larva – has long legs, big mandibles and is carrying trash on its back.
 - ☐ c) Mosquito larvae – they are aquatic, have no legs but do have proper heads!
 - ☐ d) Sawfly larvae – they have more than 5 pairs of soft prolegs.
 - ☐ e) Ladybird larva – long legs, spiky and walking on plants.

MINIBEAST magic



How to catch invertebrates with tricks and treats

Roma Oxford

Illustrations by
Anna Sutton



If you would like to learn more about how to catch invertebrates then
look for 'Minibeast Magic' by Roma Oxford and Anna Sutton –
available from the Field Studies Council
(www.field-studies-council.org)

INSTAR

A Royal Entomological Society magazine



**Royal
Entomological
Society**

Registered Charity 213620



www.insectweek.co.uk

Editor Dominique Vassie would like to thank Dr Luke Tilley, Prof Adam Hart, Charlie Woodrow, Liv Shovlin, Dr Hayley Jones, Fran Sconce, Lucy Murgatroyd, Nick Carter, Roxanne Vassie for their help and contributions. Thank you also to the past RES photography competition winners for use of their photos and to Andrew Griffiths for the design and compilation of the magazine.