Insect week | Royal Entomological Society

ISSUE 5

INSTAR

The Magazine for Young Entomologists, Age 7+

www.insectweek.org

Inside this edition

Lloyd of the Flies

Enchanting Earwigs

Insects of Antarctica

Discover the amazing lives of insects

...and lots more!

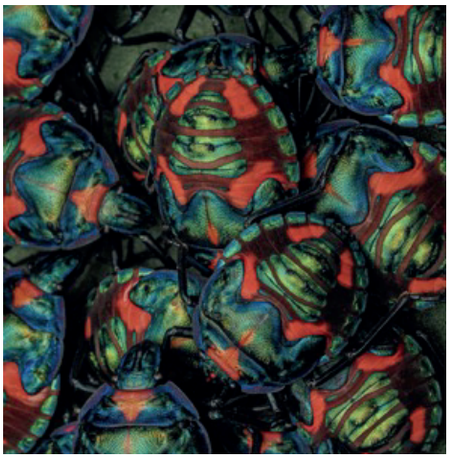
Praying mantis nymphs hatching

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 the insect world and our relationship with it!

Buzzword:

'INCOMPLETE METAMORPHOSIS'



Incomplete metamorphosis, also known as hemimetaboly, is when insects go through three distinct life stages: egg, nymph and adult. Nymphs usually hatch from their eggs looking quite similar to the adults, just smaller and lacking wings. This is different from insects, such as flies and butterflies, which hatch as maggots or caterpillars and go through a pupal stage.

Contents

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INSTAR would like to thank all the contributors for their wonderful articles and kindly donating their time to help share the wonder of insects with young people around the world.

Cover images:
Cover - Rosa Dunbar

Ento Info

Photo © Gustav Parenmark

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Banded demoiselle

Common name: Banded demoiselle

Scientific name: *Calopteryx splendens*

Order: Odonata

Where: Right across Eurasia from the Atlantic to central-eastern Russia.

Habitat: Likes slow-moving lowland streams and rivers.

Favourite food: Any insect or small invertebrate they can catch!

Giant water bug

Common name: Giant water bug

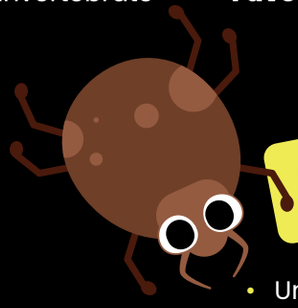
Scientific name: *Apassus japonicus*

Order: Hemiptera

Where: Japan and Korea.

Habitat: Lakes, ponds, rivers, streams and marshes but as these habitats decline, also commonly in rice paddies.

Favourite food: Aquatic insects and water snails



FACTS !!!

- The males are metallic blue with striking black marks on the wings (as above) and the females are metallic green or bronze with clear wings.
- The nymphs spend the winter buried in the mud at the bottom of streams.
- Males are very territorial and compete for females with an aerial dance.

FACTS !!!

- Unusually among insects, the male bug looks after the eggs until they hatch. Several different females will lay up to 150 eggs on his back!
- It takes between a week and a month for the eggs to hatch depending on temperature and he may care for up to four batches of eggs during one summer.
- They use a sharp pointy mouth called a proboscis to inject toxic saliva into their prey and suck out their liquid bodies.

Interview with Lloyd of the Flies

Can you introduce yourself?

I'm Lloyd, and I'm a FLY! You might recognise me because I feature in a documentary series all about my exciting life called Lloyd of the Flies. It's really good and all true! Except for the bits that make me look bad. Those bits are misrepresentions.

Where do you live?

I live in a rotting apple in a compost bin with my mum, dad, and 224 maggot siblings so it can get a bit crowded. Oh, and my little sister PB. She also wanted to be an insect ambassador but I told her she's too young for such an important role and now she's sulking.

Who are your friends?

My best friend is Abacus, he's a woodlouse. He's smart, but not as smart as me, and tough – too tough to eat so don't try – and slow because he can't fly but I don't hold that against him. I'm also friends with Cornea, she's a butterfly. She does this thing where you combine ingredients. She calls it 'cooking' but I'm not a fan. And there's Julie who is a spider! You'd think flies and spiders couldn't be friends and you'd be right, but Julie's different because she doesn't eat friends and I am definitely her friend and not scared of her at all – not a bit, ask anyone! I'd could say Berry too, but he's more of a nemesis than a friend, so I won't...

What things do you like to do?

Hanging out with Abacus. Reading comics with Abacus – mainly Adventures of Arachnofly, I have every issue. Talking about comics with Abacus. Arguing about comics with Abacus. Rereading comics with Abacus. Playing board games with Abacus – we're playing a campaign of Bluebottle Battle at the moment. Abacus thinks he is winning just because he has won every game so far but that is all part of my long term strategy.

What is your favourite food?

Yes. Food is my favourite! I mostly eat apple but only because I live in one. I much prefer a big pancake crumb or some baked bits – like bagel crumbs or crumpet crumbs. I also love a juicy raisin. I feel sick if I eat a whole one but it's worth it.

'My best friend is Abacus, he's a woodlouse'

Why do you think we need to talk more about insects?

If biggos – or 'humans' or whatever you call yourselves – want to survive, they need us insects! It is estimated there are some 10 quintillion insects alive at any one time, and they are all important, not just bees. Everyone always goes on about how great bees are, but I can pollinate too! So can lots of flies – and beetles and butterflies and moths. They're all pollinators. And we clean stuff too, for free! Where do you think all the poo goes? We eat it, that's where! Well not me personally, like I said I prefer pancake, but there's loads of insects who love eating poo and decaying matter. We're also important because there are animals who survive on a diet of insects but I don't like to think about that. Basically, insects are everywhere and we are essential to life on Earth but I've heard we're in trouble and our numbers are plummeting...
and I don't want that.

How can we help you and your friends from our own homes?

The world is a dangerous place for insects so you can help by not sucking us up into vacuum cleaners or trying to squish us or zapping us or swallowing us in your sleep. If you have a garden, leave it a bit messy and wild with lots of nooks and crannies for us to hide in. Personally I prefer the indoors where it's safer and there's no weather, but if I do go outdoors I love staying in bug hotels so please put some in your outdoor spaces. With room service if possible.

What will you be doing as an RES Ambassador?

I'm so excited to be the first ever Insect Ambassador for the RES. As an important insect I am well qualified for such an important role, and Cornea told me what an ambassador is and it didn't sound very difficult or dangerous so I said yes. I'm going to help you biggos see the world through the eyes of an insect and introduce you to lots of my friends so you can learn how amazing and important we are.

Where can we meet you?

I'll be bringing my Bug Hunt to the Royal Entomological Society's Garden at Stratford Cross from 22 July until December. I don't know what any of that means but that's where I will be. It would be really great to meet some biggos... not daunting at all. You will probably need to help me round up my friends and family and find the luxury bug hotel though because their sense of direction is terrible. The Bug Hunt will also be coming to other venues in the UK.

Find out more about the Bug Hunt at royensoc.co.uk/lloyd

Enchanting Earwigs!

Earwigs would much rather be snacking on flowers than bothering people!

By Dominique Vassie, artist, designer and biologist

Earwigs are among the most misunderstood and under-appreciated insects. People are immediately afraid of their pincers yet these insects pose no threat to us! Earwigs are insects in the order Dermaptera, which comes from the Greek words meaning 'skin-wing'. There are around 2000 different known species living on all the continents of the world (except for Antarctica), so nearly all of us have them as neighbours.

Antler earwig (Opisthocosmia sp.) from Malaysian Borneo.

What is an earwig?

CHEWING MOUTHPARTS

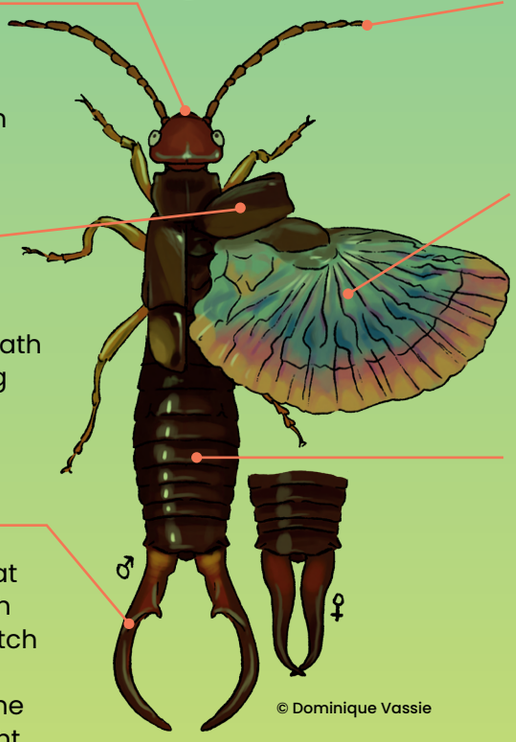
Most earwig species are omnivorous and have mouths that are good at eating up both plants and animal prey.

SHORT LEATHERY FOREWINGS

These soft little wings cover the beautiful folded wings underneath and protect them as the earwig rummages around in the undergrowth and tight spaces.

CERCI

Earwigs have a pair of pincers at the end of their abdomen which they can use for defence, to catch prey, groom themselves and fight for mates depending on the species. Usually they are straight in females and curved in males.



© Dominique Vassie

LONG THIN ANTENNAE

These help earwigs sense and smell their environment.

COMPACT ROUNDED WINGS

Most, but not all, species of earwig have wings they rarely use which fold to be much smaller than their open size.

LONG, FLATTENED BODY

The flat body of an earwig helps it to squeeze into cosy, damp places to sleep in during the day such as in tree bark, under rocks and inside flowers.

Amazing earwig wings

Did you know, earwigs can fly? Maybe not, as most species of earwigs have beautiful wings yet rarely fly. When they do, they are slow but manoeuvrable fliers. Earwigs spend a lot of time running around in tight spaces and need to have a flexible abdomen to make use of their cerci (pincers). Therefore, it's better if their wings are compact and protected. This means that earwigs have evolved wings which fold more times than any other insect. Their folded wings can be 10 to 18 times smaller in size than their open wings.

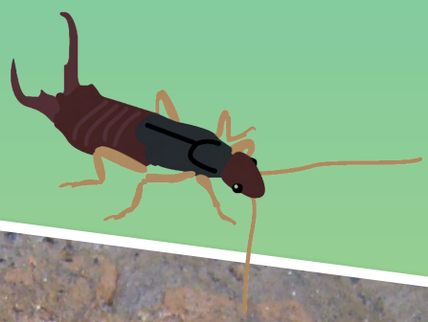
Earwig wings fold first in a fan shape and then in half to make them super small. The wings are stable in both their folded and unfolded shape, and special elastic **proteins** allow them to snap open and shut a bit like a slap-bracelet. This amazing folding ability is being studied by scientists to see if we can learn from earwigs to help us make better folding tents, solar panels and space equipment. These beautiful wings prove that delicate, flexible and lightweight materials can be incredibly strong if they have the right structure. If you see an earwig show its wings, you're very lucky!

A lesser earwig folding away its wings

© Cecil Smith (CC BY 4.0)

Buzzword: 'PROTEIN'

Proteins are big molecules which are found in all living things. They're made of chains of smaller molecules called amino acids which give them different shapes and functions. Proteins are important for building the bodies of living things and for running all sorts of processes which keep us alive.



An earwig nest in the soil.

Earwigs are good mums

Earwig mothers are very caring and look after their children for a long time, which is uncommon for insects. Most insects simply lay lots and lots of eggs somewhere, leave them and hope that a few survive but a mother earwig lays her eggs in a nest, often in soil. She stays close to clean them of harmful fungi and fiercely defend them from predators, not even leaving them to go and eat. After around a week, the earwig nymphs hatch. First, they eat their egg shells and then their mum feeds them with food from her own stomach which she regurgitates. Imagine having to eat your mum's sick! The mother earwig looks after her children until they have shed their skin twice then leaves them to look after themselves. However, in some species, the mother earwig lets herself be eaten by her nymphs as a final dinner to give them extra strength to survive in the big wide world - very dedicated!

A mother European earwig tends to her eggs and newly-hatched nymphs. Earwig nymphs hatch looking like tiny versions of the adults.

Hairy earwigs in Deer Cave, Malaysia. Look closely, can you see the bat fleas on them?

Hairless bulldog bat
© Tasnim Choudhury (CC BY-SA 4.0)

© Bernard Dupont (CC BY-SA 2.0)

Unusual earwigs

One of the strangest earwigs, the hairy earwig (*Arixenia esau*), lives on the bodies of the hairless bulldog bats of Borneo. Here, they eat the bats' dead skin and bodily fluids without causing them any problems. These blind, wingless earwigs have lots of sensitive hairs which help them sense where they're going in the dark caves in which they spend their lives. Hairy earwig mothers are also unusual in that they give birth to live young, not eggs, thanks to a special breathing system in their bodies which allows the nymphs to safely grow inside.

Unfortunately for the bats, these earwigs are used as taxis from the cave floor by bat fleas. Bat fleas are very weird small insects which drink the bats' blood but struggle to find the bats high on the cave ceiling. Therefore, they hop onto the bodies of the earwigs and hitch a ride to their hosts! These bulldog bats have special skin pockets which they use to keep their wing-tips safe while they walk around but these double up as a safe hideout for earwig and flea alike.

Striped earwig (*Labidura riparia*) which lives all over the world.
© Arnim Littek (CC BY 4.0)

Finally, earwigs do not live in ears!

Despite centuries of stories (particularly in Europe) convincing people that earwigs are dangerous and trying to enter human ears, there is no evidence to support this. They are no more likely to be found in your ear than any other insect. Earwigs come in a range of beautiful colours, shapes and sizes and hopefully next time you see one, you'll remember all their incredible superpowers instead of being afraid.

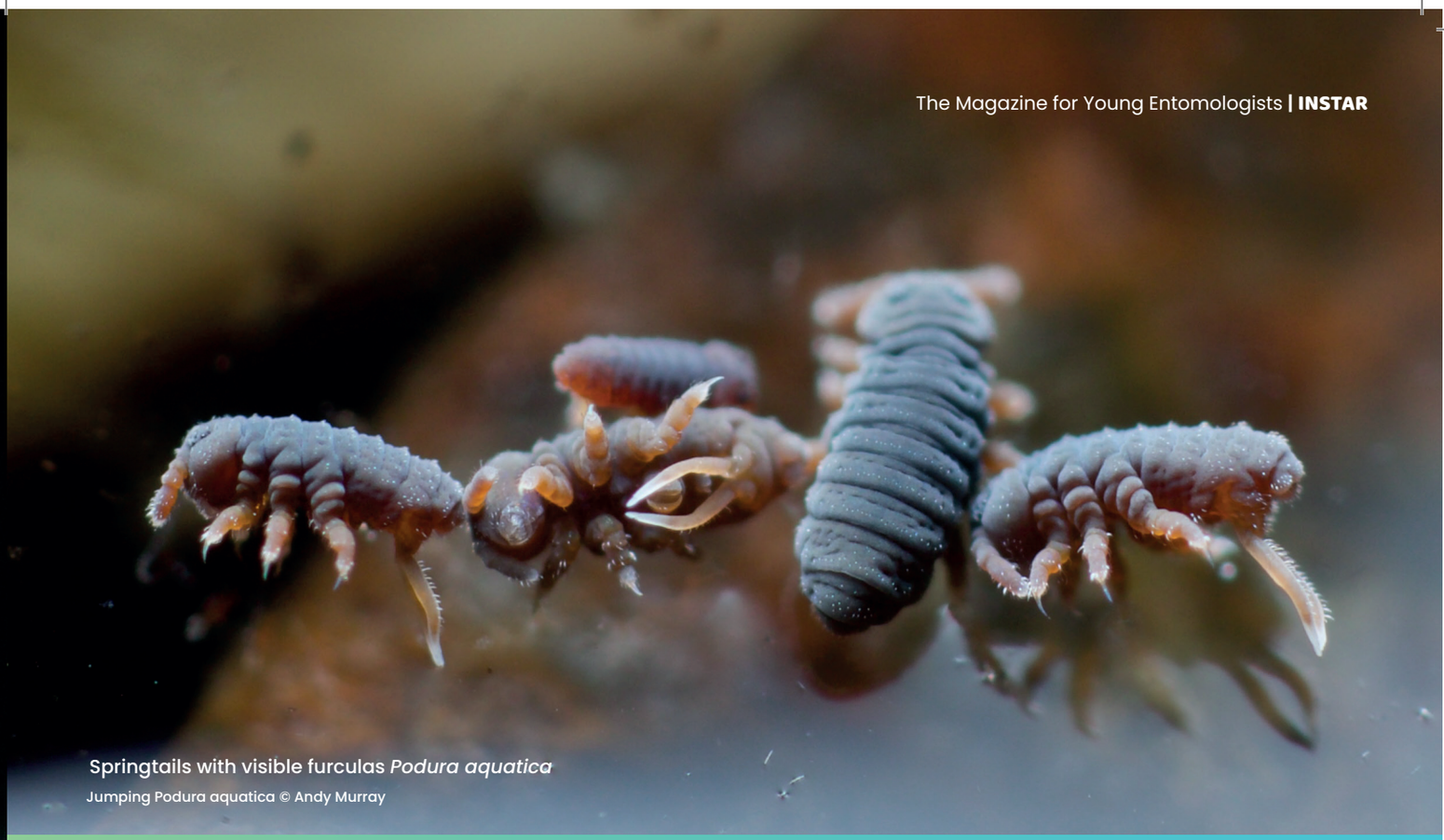
Springtail using its collophore to take in water
Sminthurus viridis

10 FACTS ABOUT SPRINGTAILS

Francisca Sconce, Senior Outreach & Learning Officer, Royal Entomological Society

1 They are like insects, but not quite the same.

Springtails have six legs, they are wingless and have simple eyes. They have a 'furcula', a two-pronged tail that they use to jump (spring) to escape from predators, and a 'collophore' which is a tube from their stomach area that can suck up or release fluid, and attach to things in their habitat.



Springtails with visible furculas *Podura aquatica*

Jumping Podura aquatica © Andy Murray

2 Scientifically speaking they are called 'Collembola'.

There are different subgroups that relate to their body shapes, some springtails are long and thing, others are like squishy teddy bears, and some are like two balls stuck together. Scientists have discovered over 9500 different springtail species, but some predict there could actually be over 500,000!

A 'giant' springtail from New Zealand, *Holacanthella paucispinosa*

© Frank Ashwood

3 They live nearly everywhere, even at the North and outh Poles.

Springtails have special structures on their skin to keep dry, and they can produce a natural antifreeze to prevent damage from ice.

4 They live mostly in soil and are important for soil health.

Springtails eat dead and decaying plant and animal matter, breaking it up and helping spread bacteria and fungi. This helps with the cycle of nutrients such as nitrogen and carbon, which are important for living things to survive in soil.

5 They are tiny animals.

Most springtails are a couple of millimetres in length, in soil they are actually the medium-sized animals or 'mesofauna', bigger than the 'microfauna' bacteria and fungi, but smaller than the 'macrofauna' such as spiders and beetles. There are however 'giant' springtails in New Zealand which can be over 10mm long.

One of the most beautiful springtails, *Dicyrtomina saundersi*

Springtail feeding in soil *Isotoma anglicana*

6 They have been around for a really long time.

Fossils of springtails have been discovered that date from 400 million years ago, making them one of the oldest groups of insect-related invertebrates.

7 Some of them live with ants.

Some springtail species from the Cyphoderinae group are present in ant colonies, they feed on the strands of fungi that some ant species can farm.

8 There are some springtails that like snow.

After snowfall you might see swarms of the springtail *Hypogastura nivicola*, sometimes it's called the 'Snow Flea'.

9 They dance!

Some species of springtail exhibit interesting courtship behaviours before mating, such as dancing and head banging!

10 They can be colourful.

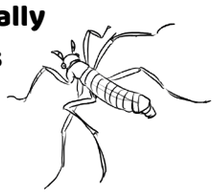
You can find springtails of all colours of the rainbow and some are multi-coloured, some species have scales that can give an metallic shine.

Antarctica's coolest critter

by Octavia Brayley, PhD Researcher in Antarctic Ecology

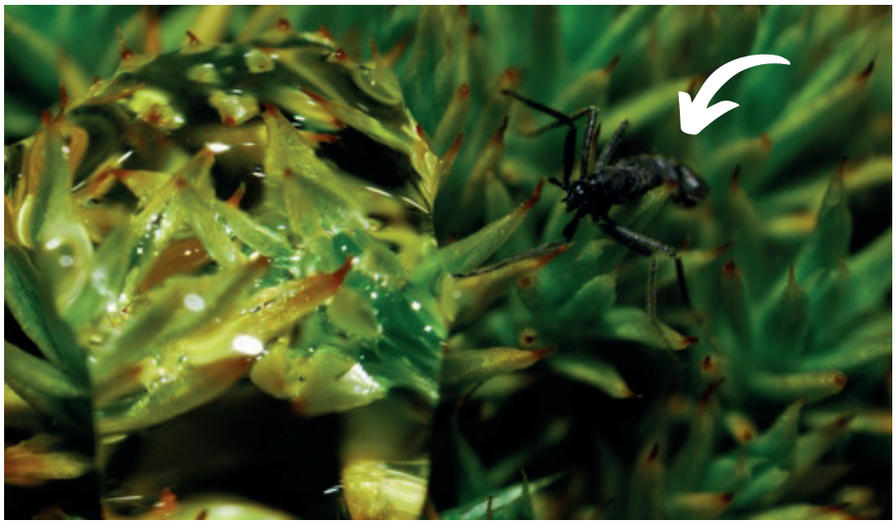
© Professor Pete Convey

Antarctica is cold. Really cold. The lowest ever temperature was recorded on the continent in 2010, which was a very chilly -93.2°C! You'd certainly need to put your hats and scarves on for that. You'd also imagine that nothing could survive there...especially not any bugs. But if you travel to the South Shetland Islands, and some other islands along the Antarctic Peninsula, you'll find one hardy and resilient insect called *Belgica antarctica*, the Antarctic midge.



Amazingly, this insect is the only one native to the continent and is actually the largest land animal found in Antarctica, measuring a very small 2-6mm in length! Now I know what you're thinking, how can *Belgica* be the largest animal when there are penguins and seals?! Well, although penguins and seals certainly spend some time on land to breed, they are actually classed as marine animals. Looking at the picture of *Belgica* below, I'm sure you agree that it doesn't look particularly beautiful or special...it can't even fly! But we really should give it a fair chance as it has spent 40 million years perfecting its adaptations to allow it to survive in some of the most extreme environments on Earth.

Scientists have spent a long time trying to work out how it survives in these inhospitable regions, and some of its amazing adaptations have now been discovered. To understand *Belgica's* impressive survival skills, we need to observe and study its tiny cells. Now that's a bit hard to do without a very high-powered microscope, so let me describe what we might see.



Belgica antarctica walking on some moss.

© Igor Gvozdovskyy (CC BY 4.0)

Every creature on Earth is made up of billions of cells, and they contain many structures that allow our bodies for function. For example, there are mitochondria where a chemical process called respiration occurs, allowing cells to produce lots and lots

© Professor Pete Convey

of energy to power really important processes like muscle contraction and digestion. There is also a structure called a nucleus and inside this, we find the DNA. This molecule is totally unique in every organism, and it provides the instructions for specialised proteins to be made, allowing animals to adapt to their environment.

Right now, in your **cells**, tiny structures called ribosomes are reading your DNA and building all kinds of proteins that allow you to survive. Pretty cool, right?! Anyway, back to Antarctica. *Belgica's* DNA is really unique, and it allows the insect to produce 'heat shock proteins', as well as lots of fats and sugars which prevents the insect from freezing and shrivelling up from water loss. These substances are called 'cryoprotective agents' and they work in a similar way to the antifreeze your mum and dad spray on the car windscreen in the winter. The production of these proteins means that ice crystals can't form inside the insect which would damage their body. In fact, to avoid the formation of ice even more, the larvae deliberately lose up to 70% of the water inside their bodies during the Antarctic winter! Humans can only lose about 10% of the water inside our bodies before we start to feel pretty unwell, so we'd turn into parched prunes pretty quickly if we lost as much as *Belgica* does!

So, there you have it.
A pretty remarkable story of the only insect found on the Antarctic continent. I hope you agree that when it comes to insects, we certainly shouldn't judge a bug by its cover, and that many of their incredible adaptations are found tucked away in their teeny tiny cells.

Buzzword: 'CELL'

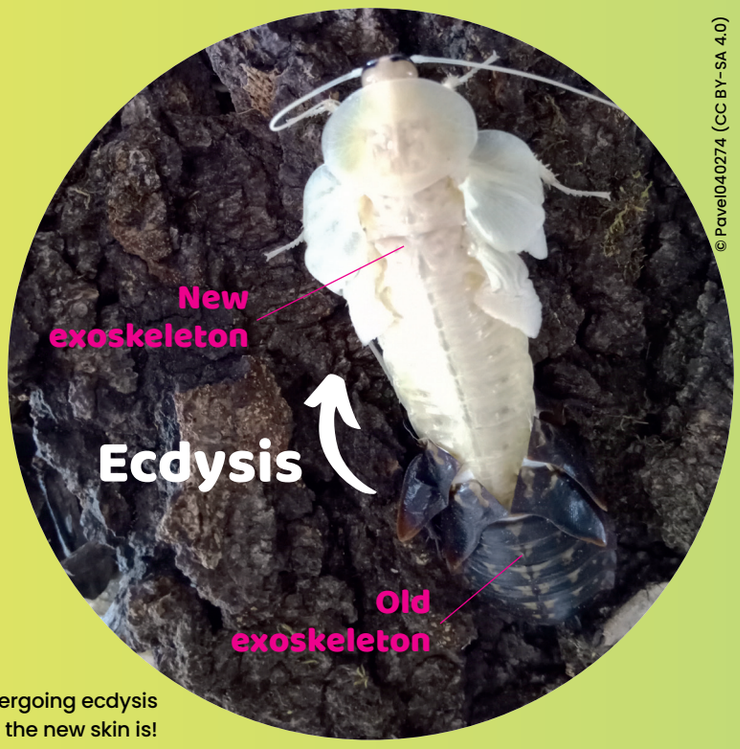
Cells are the basic building blocks of all living things, including us! They're like tiny bricks containing their own miniature organs and processes, working together to form our bodies and keep us alive. We have many cells but some living things are made of just one.

How to shed an exoskeleton

Insects have bodies which are supported by a tough shell called a cuticle or exoskeleton made from a material called chitin. We humans have an internal skeleton to give us structure but insects wear theirs on the outside. Exoskeletons give lots of benefits to insects as they protect their soft internal organs and fluids and help prevent them getting too dry or wet. Some insects can be very tough and armoured like beetles, whereas others have a much thinner, softer exoskeleton, such as caterpillars.

Citheronia splendens caterpillar soon after moulting its old exoskeleton.

However, there is a problem with having a skeleton on the outside: how do insects grow bigger? Our skin can grow with us, but exoskeletons cannot be stretched and this means all insects have to go through a process of shedding their old shell for a newer, bigger one in a process called **ecdysis**. It's like changing your clothes to a bigger size once you've outgrown them. To undergo this process, the insect must first find somewhere safe as they will stop moving for a while and don't want to be eaten or hurt.

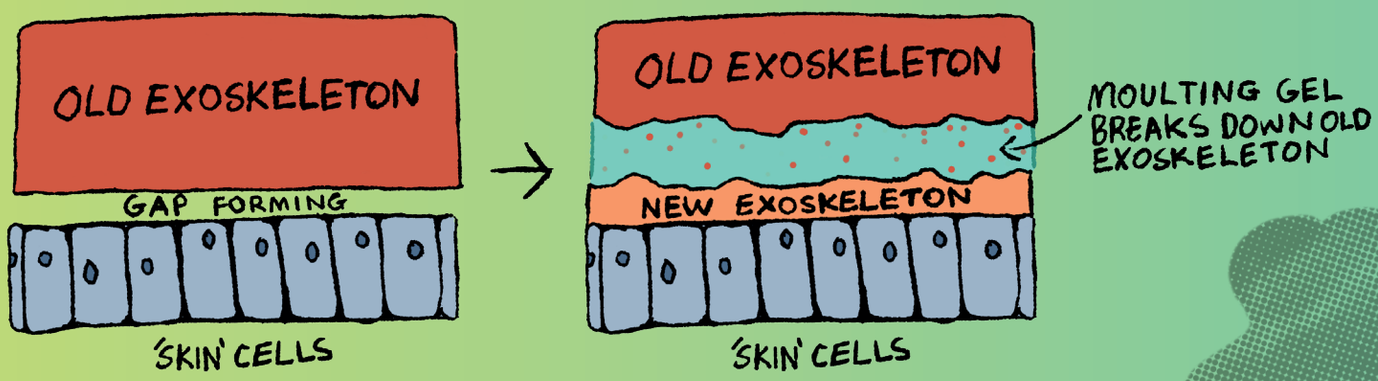


Cockroach undergoing ecdysis - note how pale the new skin is!

Step 1

APOLYSIS
- separating the old shell from the new

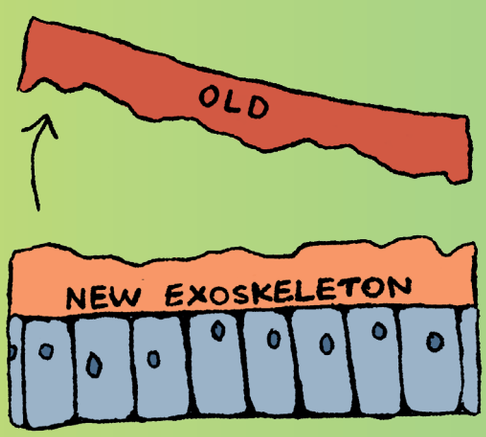
During this stage, the insect's inner 'skin' detaches from the inside layers of the old exoskeleton to make a gap. The outer layer of the new exoskeleton is formed in this gap from secretions of the inner skin cells. The skin cells also produce a special gel to fill the gap between old and new shells which contains substances that digest the inside of the old shell so it can be reabsorbed.



Step 2

ECDYSIS
- shedding the old shell

Once the outside of the new shell is formed, and the old shell is properly separated from the insect, it's time to moult. Usually by pushing forwards and breathing in air to make themselves bigger, the insect pushes strongly against the old shell until it splits down the back behind the head to form a crack. From here, the insect must steadily but quickly crawl free before their shell starts to harden.

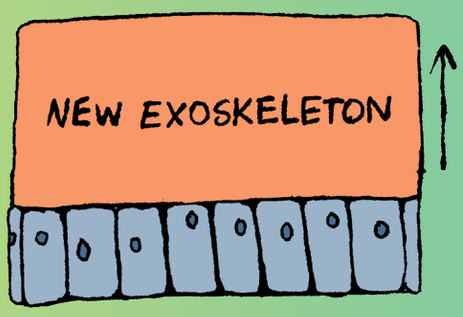


Cicada undergoing ecdysis and pushing out of its old exoskeleton

Step 3

EXPANSION
- growing bigger before the shell hardens

Now the insect is free from its old shell, it immediately needs to straighten out the remaining wrinkles in its soft new exoskeleton and grow. Some insects do this by sucking in lots of air to puff themselves up. When an insect is shedding into its final adult phase, their tiny new wings slowly expand into beautiful big ones as the insect pumps 'blood' into them which then dries.



Growth of a newly-emerged cicada's wings (photos taken 30 minutes apart)

Step 4

HARDENING
- new shell solidifies

An insect that has just shed its exoskeleton is very soft and vulnerable so must find somewhere safe to wait while their new shell hardens. During this time, the final parts of the new shell are formed and the colours of the insect's new life stage develop.

Stonefly skin
© Alex Zalenko (CC BY 2.0)

Even though ecdysis is quite risky for insects, it is an essential part of their life cycle. If they fail to shed their skin once they have outgrown it, they can die before reaching adulthood.

The old shell left behind by an insect is called an exuvia. If you look closely when out and about, you may be able to find these. Cicada shells are very easy to spot in summer in many parts of the world on tree trunks, fences and steps. Insects with aquatic nymphs, like stoneflies and dragonflies, leave their exuviae on plant stems and stones by the edge of rivers and ponds. Grasshoppers leave theirs on grass stems. See how many you can find!

LOOK CLOSELY: Do you see the little white strands coming out of the old exoskeletons? These are the insides of the insects' old tracheae, which act as their lungs. When they shed their exoskeleton it means all the outside surfaces of the body are ripped off, including the inside of their 'lungs'. This is another reason why an insect undergoing ecdysis is vulnerable because once they start moving out of the old skin whilst trapped inside it, they cannot breathe for a short time!

Discarded skin of a dragonfly nymph
© Peter Nijland (CC BY-SA 4.0)

Ocean Striders

The only Insect to Conquer the Seven Seas

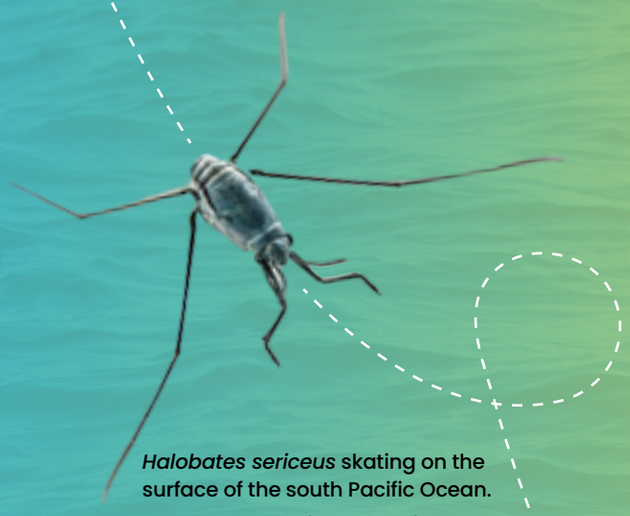
By Charlie Chen, marine biology enthusiast

Photo by Laurenz Kleinheider on Unsplash

What are Ocean Striders?

Of the 5.5 million species of insect that we think exist on Earth, only 5 of them live their entire lives in the ocean and they belong to a group called *Halobates*. Also known as sea skaters or ocean striders, these incredible insects are barely half a centimeter in length (about the size of a peppercorn), so small that you couldn't see them on the water surface from the deck of a boat. Even biologist Charles Darwin on his famous expedition on the HMS Beagle was unable to spot them on his travels. And yet despite their tiny numbers and size, they have conquered much of the world's oceans and are one of the most widespread insects on Earth!

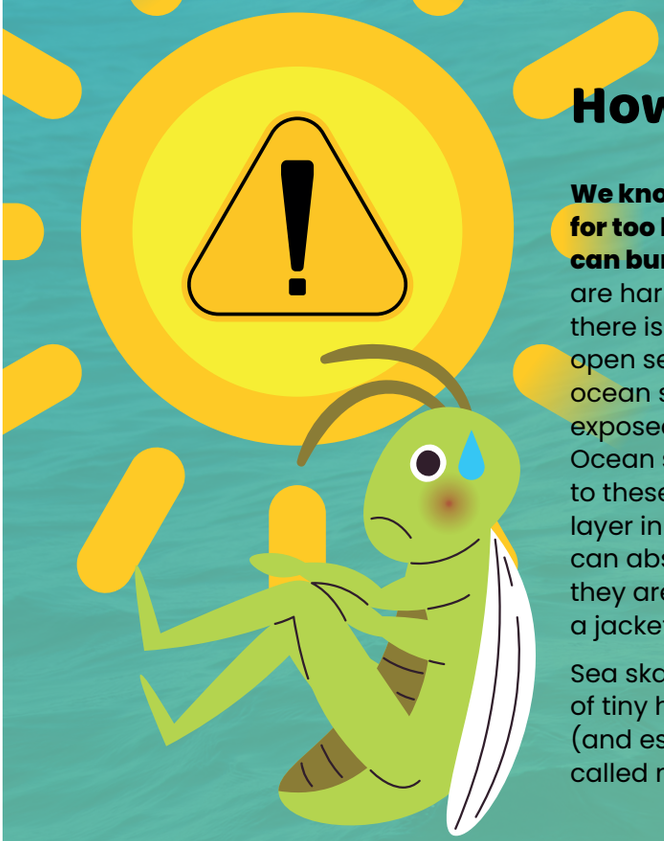
So who are these secret skaters of the seas? Ocean striders are closely related to the pond skaters that you see on your garden pond or on the surface of a lake or river. They have small round bodies and long thin legs which they use to gently spread their weight across the water's surface so that they are able to stand, move and live their lives on top of it. These ocean striders spend their entire lives at sea, eating **zooplankton** or other insects that get trapped on the surface. They lay their eggs on floating materials such as sea shells, bird feathers, tar lumps, fishing gear, and bits of plastic.



Halobates sericeus skating on the surface of the south Pacific Ocean.

Buzzword: 'ZOOPLANKTON'

Zooplankton are tiny little animals and microscopic organisms that live in water. Sometimes they spend their entire lives as zooplankton, and sometimes they are the babies of bigger sea animals like crabs, fish and shellfish. They're not strong swimmers and so float along in the currents, going wherever the ocean takes them.



How can they survive at sea?

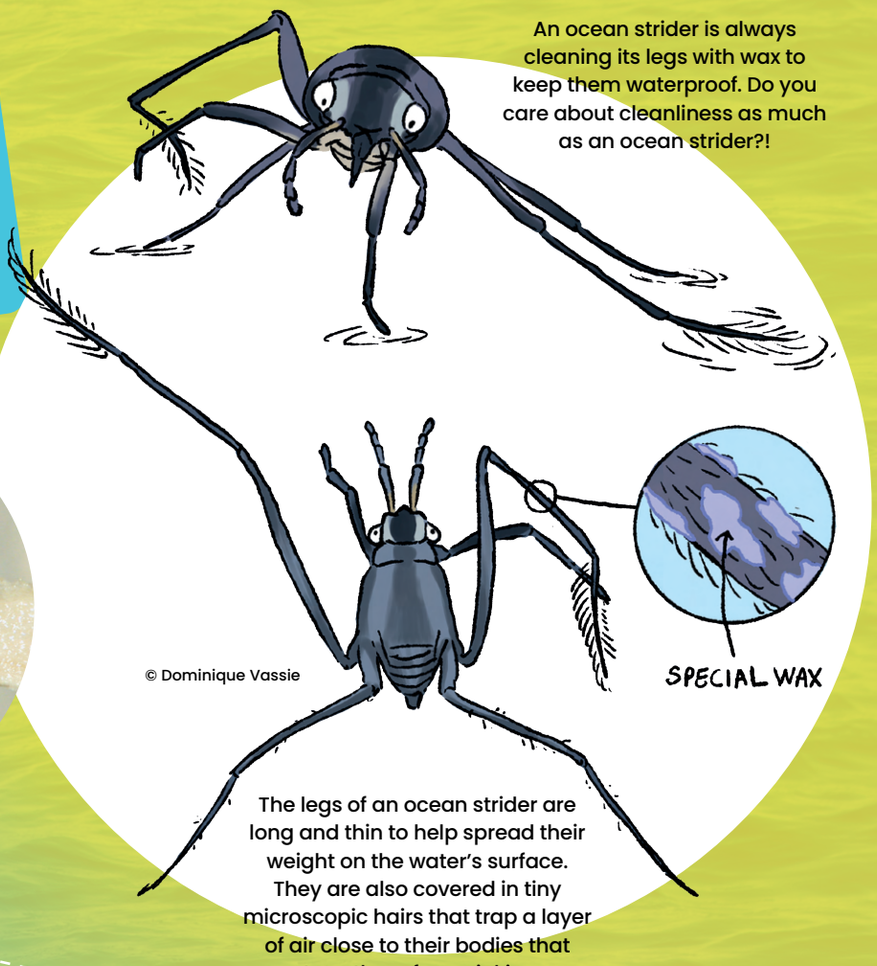
We know that being in the sun for too long is dangerous and can burn us. The sun's rays are harmful to insects too and there is little to no shade in the open sea which means that ocean skaters are constantly exposed to harsh sun rays. Ocean striders are very resistant to these sunrays, possessing a layer in their exoskeleton that can absorb any harmful sunlight they are exposed to - like having a jacket made out of suncream!

Sea skaters possess thousands of tiny hairs all over their body (and especially on their legs) called microtrichia. These special hairs trap a layer of air around the ocean striders which keeps them from sinking. When they are standing on the water's surface, they are practically floating on air as less than 5% of their total leg surface area is actually touching the water's surface. Sea skaters are constantly grooming themselves in order to reapply layers of hydrophobic wax to their legs to keep that layer of air working. This layer of air stays with the skater even if they sink below the surface, creating a coat made of air and allowing them to breathe and survive underwater! Rain and water splashes simply slide off the surface of their body.

Buzzword: 'HYDROPHOBIC'

Hydrophobic means something that is water-repellant. This means that water does not mix with that material and will roll right off it rather than making it wet. Many waterproof items are made from special materials designed to be hydrophobic, such as rain jackets and hiking shoes!

A close-up of the compact body of an ocean strider.



Why aren't there more insects at sea?

We don't really have a clear answer to why there aren't more marine insects. There are a few ideas floating around that may all be contributing to the truth. Firstly, once insects conquered the land and became the most successful land animal group, it was just too much effort to evolve back into life at sea. There are too many important adaptations for them to be able to survive. Another very likely reason is that the oceans were already so full of other animal groups that there wasn't any more room for insects in the ecosystem. Other marine invertebrates, like crabs, shrimp, octopus and squid evolved over 200 millions earlier, which is quite the head start in the evolutionary race! Halobates have been so successful because they've managed to develop all of the adaptations that they would need to survive at sea and they've managed to conquer a very specific niche in the marine habitat, the surface of the ocean.

Unanswered Questions!

There are many mysteries remaining about the world of ocean striders. Such as:

- ? What are the materials in their exoskeletons that protect them so well from the sun?
- ? How do they stop themselves from slipping and sliding all over the water's surface??
- ? What is the wax in their hair made out of?
- ? What do they see on the water's surface and how do they find food and mates?

Finding the answer to these questions could help scientists in so many ways. We could make new and exciting materials by learning how ocean striders deal with harmful sunlight, or how the wax that coats their legs works. Also, learning why ocean striders live in certain parts of the seas might help climate scientists discover new ways of monitoring the health of the world's oceans.

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To learn more about our amazing insect neighbours, please visit the Insect Week website at:

www.insectweek.org