

Key Stage 5 Worksheet

Earth LIVE Lessons: Nature in Your Garden



What is it about?

In this video Abi March, Learning and Engagement Manager for **London Wildlife Trust**, talks about the behaviour and physiology of invertebrates that can be found in the smallest gardens, yards and even plant pots on balconies.

Watch video here:
youtu.be/GGQ_02LdibM

Open file in your web browser to click on the links.

Invertebrates

Invertebrates make up around 97% of the animal kingdom, and many different species can be easily observed in UK gardens. Unlike vertebrates, invertebrates do not possess a vertebral column (backbone). They are hugely variable in size and form, including those with hard protective exoskeletons such as insects and crabs, and those with soft bodies, like earthworms and octopuses. Invertebrates that tend to be found in UK gardens include slugs, snails, earthworms, centipedes, millipedes, spiders, woodlice, ants, beetles, bees and wasps.

Slugs

There are around 40 different species of slug in the UK. Along with land snails, slugs possess two sets of **tentacles**. The top pair are for seeing and smelling and the bottom pair for tasting and feeling. In each of the lower tentacles there are two nostrils.

Some slugs have 27,000 teeth and are often considered a gardener's enemy, as they particularly enjoy eating new leaves of young plants. However, this isn't the case for all species. The leopard slug (*Limax maximus*) is a large slug that doesn't eat fresh leaves, but instead eats rotting leaves and other slugs!

Slugs continued

If you observe a slug closely, you will see a pore opening and closing on the right-hand side of its body. This is the pneumostome, or breathing pore, allowing the slug to take air into its body. On top of a slug's body, where a snail's shell would be, there is a mantle shield, which is a thick, tough area which helps to protect the slug from damage.

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Photo by H. Krisp, Creative Commons.

Leopard slugs have a distinctive spotted pattern and eat a varied diet including other slugs.

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Snails

The difference between slugs and snails is that snails have a shell that they can fully retract into. Some slugs do, in fact, possess a partial shell and are known as semi-slugs. This partial shell is a **vestigial** feature, as slugs evolved from snails. Snails can seal themselves inside their shells to keep moisture in to prevent them from drying out, for example during hot, dry weather and hibernation.

Snails have around 14,000 teeth, and like most slugs they are herbivores. Both slugs and snails can eat around 40 times their own body weight every day.

Snails continued

Snails have a reputation for moving slowly, but they do move faster than many people think, at around 0.05kph, and research suggests **they may even use each other's slime trails** to help them move faster! Snails can secrete different types of **slime**, which is actually a type of mucus, for different purposes, for example, to move, to adhere to surfaces, and in response to feeling threatened.

Both slugs and snails belong to the Class Gastropoda in the phylum Mollusca, and are therefore known as gastropod molluscs. "Gastropod" literally means "stomach foot", and refers to the fact that slugs and snails move around on a large foot, which makes up most of their body. Gastropods move by rhythmically contracting muscles in this foot.

There are around 100 types of snail in the UK, some of which are relatively easy to identify. The glass snail (*Zonitoides nitidus*), has a translucent shell, so it is possible to see its heart beating, and the girdled snail (*Hygromia cinctella*) has a distinctive ridge on its shell.

Brown-lipped snails (*Cepaea nemoralis*) have extensive shell pattern and colour **polymorphism**, meaning they can look very different from each other even though they are members of the same species. If one of the colour forms was advantageous, for example in helping to conceal the snail from predators through camouflage, then this variant would be selected for by natural selection and over evolutionary time all of the snails in the population would be this colour. Snails of different colours are probably better adapted to certain parts of their habitat, or the variation might help to hide them from predators that aren't used to looking for snails of a particular colour! This means that natural selection can actually maintain the variation in the population, instead of one "best adapted" form.



Photos by Chiswick Chap, Creative Commons.

Examples of shell colour and pattern polymorphism in brown-lipped snails. All of these snails possess a brown lip to the shell where it joins with the body. Colour variations include brown, pink and yellow, and the shells can have no bands, a single band or multiple bands.



Photo by Andrew Dunn, Creative Commons

The Glass Snail



Photo by Africa Gomez, Creative Commons

Girdled snail

Woodlice

Woodlice are easy to find under flowerpots and logs. There are around 30 different species in the UK, including the **pill woodlouse** (*Armadillidium vulgare*), which is able to roll into a ball to protect itself, only exposing its hard outer shell to a potential predator.

Woodlice possess 7 pairs of jointed legs and belong to the invertebrate phylum Arthropoda, in the subphylum Crustacea, along with animals like crabs, lobsters and shrimps. Woodlice belong to the order Isopoda, along with species like *Bathynomus giganteus*, a woodlouse-like deep-sea creature that can grow up to 36cm long!



Photo by Katja Schulz, Creative Commons.

Woodlouse

The Isopoda also includes the species **Eurythenes plasticus**, newly discovered by researchers at Newcastle University in 2020. This new species was found 7km below sea level and was named after the fact that it contained PET plastic fibres inside its body, an indication of how extensive plastic pollution has become. PET fibres from clothes are common in the ocean, as the microplastic fibres are shed from clothes during washing, and are difficult to filter out in water treatment facilities. Research suggests around **800,000 microplastic fibres** may be released from a washing machine during every wash. Manufacturers are now starting to develop washing machines with **microplastic filters**, and there is increasing consumer demand for this technology, with a **petition** to the UK Government in 2019 with 17,500 signatures calling for all new washing machines to have filters fitted as standard.

Woodlice play an important role in the garden, as they are **detritivores**, breaking down dead, decaying matter like leaf litter, helping to return nutrients to the ecosystem in a useable form.

Woodlice use a protein called haemocyanin, rather than haemoglobin, to transport oxygen around their body. Haemocyanin is copper-based, and when the blood is carrying oxygen it turns blue because it contains Cu(II), just like copper (II) sulphate solutions in Chemistry! Haemocyanin is able to bind with oxygen even when oxygen concentrations are low, which helps woodlice and their relatives to survive in low oxygen environments.

Earthworms

Earthworms belong to the invertebrate phylum Annelida, and there are 27 species in the UK with considerable variation in size between them. When you find an earthworm, its size is not a reliable indication of whether or not it is an adult or juvenile. Instead, adults can be identified by their possession of a bulge known as a saddle (clitellum), which plays a role in **earthworm reproduction**.

Earthworms possess 5 pairs of “hearts”, which are actually enlarged blood vessels known as pseudohearts, which pump blood around the body. The blood is oxygenated via gas exchange across the surface of the earthworm. Air dissolves in the mucus covering the earthworm, with oxygen then drawn into the circulatory system. This mucus is essential for gas exchange, such that if an earthworm dries out it will suffocate.

The largest earthworm in the world lives on the mudflats of the Mekong River in Asia, and can grow to be 3m long!

Earthworms are very valuable in the garden as they eat rotting material and produce soil. They also help to aerate the soil through their vertical burrowing action, providing oxygen for other organisms living in the soil. Like many invertebrates, earthworms are not the target species of pesticides but are adversely affected by them, which decreases their populations and therefore impairs the health of the soil.

Excessive pesticide application has had an adverse effect on many species of invertebrates, including beneficial insects such as **bees**. Some pesticides are particularly harmful in the environment as they are persistent organic pollutants, which means they do not break down in the environment, and they **bioaccumulate** up the food web. This means that although they are found in low concentrations in the environment, they are stored in the body tissues of animals and not excreted, so each time a predator feeds on a prey animal contaminated with the pesticide, the levels of pesticides in the predator’s body increased. Some pesticides and therefore found in high concentrations in top predators like birds of prey.



Photo by Magnus Manske, Creative Commons.

This photo shows an adult earthworm, identifiable by the saddle towards the end of the body.

Find out more about it

- If you're interested in snail behaviour and research that has been undertaken to investigate it, Abi recommends the book "**A Slow Passion: Snails, My Garden and Me**" by **Ruth Brooks**. Ruth conducted scientific research with the snails in her garden, investigating factors such as how far they could travel and how far they can be taken away from the garden and still find their way back.
- Polymorphism maintained by apostatic selection is found in many other invertebrate species, but some research suggests it is also found in predators, such as birds of prey, to help disguise them from prey. Find out more **here**.
- Semi-slugs possess a vestigial partial shell, a feature inherited from their snail ancestors that no longer performs a function. Discover examples of vestigial organs found in the human body **here**.
- If you'd like to try identifying some invertebrates in your own garden, you can find identification keys on **iSpot**, and a simple guide for common **slugs and snails**.
- Discover more about the haemocyanin blood of woodlice and how this compound can also be used in human medicine **here**, and more about its structure **here**.
- The widespread use of pesticides is contributing to what some people are calling an "insect apocalypse", find out more **here**.
- Find out about the other **threats to invertebrates** and steps being taken to try to conserve them in Wales.

Questions

Interactive: Click on box to start typing

Describe two adaptations that enable different species of invertebrates to protect themselves from predators.



How has natural selection maintained shell colour variation in brown-lipped snails?

How do earthworms help to maintain the health and structure of the soil?

What enables woodlice to survive in low oxygen environments?

How does gas exchange occur in earthworms?

Try an exercise!



Woodlice belong to the phylum Arthropoda, along with invertebrates such as spiders, insects and centipedes. Create a diagram to illustrate the classification of the arthropods, and label with the features which define both the Arthropoda as a whole and the classes and orders you choose to include in your diagram.

For teachers and home schoolers

Links to Science in the National curriculum for Wales (KS4)

<https://www.wjec.co.uk/media/gcgjtvqj/wjec-gce-biology-spec-from-2015.pdf>

AS Biology: Basic Biochemistry and Cell Organisation – Chemical elements are joined together to form biological compounds [(i) the primary, secondary, tertiary and quaternary structure of proteins] – the quaternary structure of haemocyanin, as compared with haemoglobin, and the incorporation of copper to enable oxygen binding.

AS Biology: Biodiversity and Physiology of Body Systems – All organisms are related through their evolutionary history [(a) (a) the classification of organisms into groups based on their evolutionary relationships and that classification places organisms into discrete and hierarchical groups with other closely related species] – the classification of invertebrates into phyla including the annelids, molluscs and crustaceans.

AS Biology: Biodiversity and Physiology of Body Systems - All organisms are related through their evolutionary history [(m) biodiversity has been generated through natural selection] – the example of *Cepaea nemoralis* as a species with colour and pattern polymorphism maintained by natural selection.

AS Biology: Biodiversity and Physiology of Body Systems - All organisms are related through their evolutionary history [(n) the different types of adaptations of organisms to their environment including anatomical, physiological and behavioural adaptations] – the adaptations of invertebrates to their environments, including to protect or disguise themselves from predators.

AS Biology: Biodiversity and Physiology of Body Systems – Adaptations for gas exchange [(c) the comparison of gas exchange mechanisms in *Amoeba*, flatworm and earthworm] – gas exchange in earthworms and gastropod molluscs.

A2 Biology: Energy, Homeostasis and the Environment – Human impact on the environment [(a) the reasons for species becoming endangered and causes of extinction, (d) the increased human pressures on the environment including the need to achieve sustainability by changes in human attitudes and making informed choices] – the threats to invertebrates, such as excessive pesticide use, and the wider implications of decreases in invertebrate populations on humans and other species.

A2 Biology: Variation and Inheritance – Inheritance [(a) alleles as different forms of the same gene] – colour morph polymorphism in *Cepaea nemoralis* caused by multiple alleles of different genes.

A2 Biology: Variation and Inheritance – Variation and evolution [(d) the impact of selective agencies (e.g. supply of food, breeding sites, climate, human impact) on the survival of organisms, (k) Darwin's theory of evolution that existing species have arisen through modification of ancestral species by natural selection] – the influence of predation on shaping morphology, including crypsis and the maintenance of polymorphism through apostatic selection, and then evolution of slugs from snails, including the possession of vestigial shells by semi-slugs.



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