UNIT 4

Invertebrates

What do you remember?

- What characteristics make the giant squid an invertebrate?
- Do you know any invertebrates with …
  – a soft, porous body?
  – an elongated body with rings?
  – a soft body covered by a shell?
  – an external skeleton?

Did you know that...?

The giant squid is the largest known invertebrate: 20 m long, 1,000 kg. Its tentacles are more than 15 m long. It lives deep in the ocean: 400 to 1,500 m below the surface.

Content objectives

In this unit, you will ...

- Recognise the main characteristics of invertebrates
- Classify invertebrates into groups
- Describe invertebrate life functions
- Make a model of an invertebrate that can float
- Differentiate between bilateral and radial symmetry

Key language

Making generalisations
Most sponges live in the sea.
Some molluscs have no shell.

Making impersonal statements
Their bodies are divided into segments.
They are made up of one or two valves.

Expressing contrast
Some are carnivores, but others are herbivores.

1. What makes up the animal kingdom?

The animal kingdom is made up of multicellular, eukaryotic organisms. They are heterotrophic and sensitive to their environment.

How are animals classified?

Animals are classified in two groups:

- **Invertebrates.** Animals with no backbone. Some, like worms or jellyfish, have no skeleton. Others, like insects or spiders, have an external skeleton or **exoskeleton**.
- **Vertebrates.** Animals with a backbone which is part of their internal skeleton or **endoskeleton**.

The simplest invertebrates

The simplest invertebrate animals are classified into two groups: **porifera** and **cnidaria**. Porifera and cnidaria have no organs.

Porifera

Sponges belong to this group. Most live in the sea. Their bodies are full of **pores** and **channels**, so water circulates in and out of them. They feed by filtration. Water enters though the **central cavity**, deposits nutrients, and leaves through a hole called the **osculum**. Sponges do not move around; they are attached to rocks or coral.

Cnidaria

There are three different groups of cnidaria: jellyfish, corals and sea anemones. Their main characteristics are:

- **radial symmetry**.
- a soft body, with only one opening, the mouth, which is surrounded by **tentacles**.
- a **gastrovascular cavity**, something like a stomach, connected to the mouth.
- **Nutrition.** Cnidaria are carnivorous: they use their tentacles to capture prey.
- **Interaction.** Most cnidaria live in the sea. Jellyfish can float; corals and sea anemones live fixed to the sea bed.
- **Reproduction.** In their lifetime, cnidaria usually pass through both the polyp and the medusa stages:

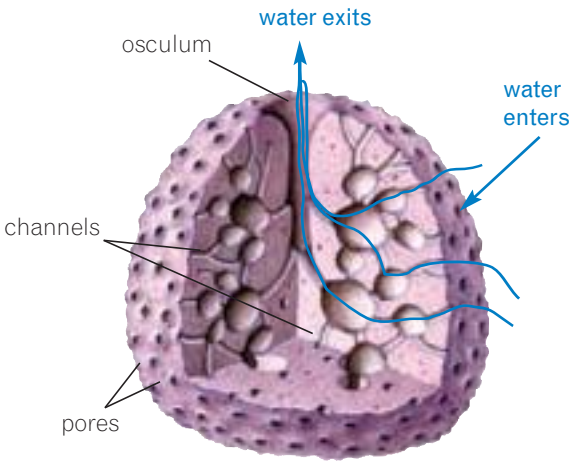
  Polyps reproduce asexually by budding.

  Jellyfish (medusae) reproduce sexually: there are male and female specimens.

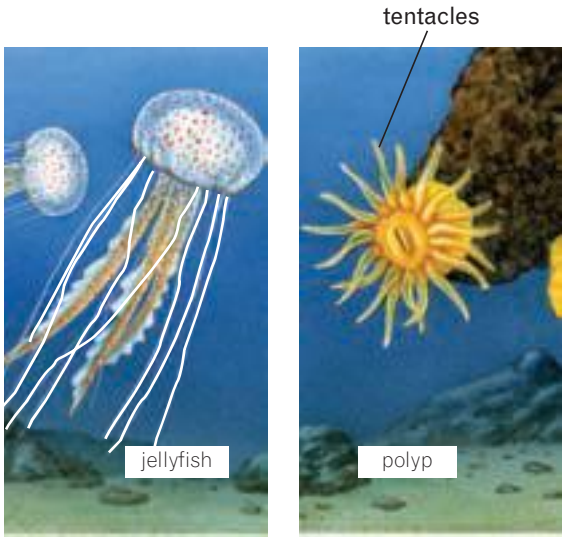
Activities

1. What part of a sponge body does the name *porifera* refer to?
2. Copy the drawing of the sponge. Use arrows to label the flow of water. Show the entry points and the exit point.
3. Talk about cnidaria.

Which	*are* *have* *can*	*tentacles?* *carnivorous?* *radial symmetry?* *an opening at the top?* *a body like a tube?* *float?*



Cross-section of a porifera



Cnidaria

2. How do these worms differ?

These worms have **bilateral symmetry**, a soft body, and no skeleton.
Annelid bodies are divided into segments. Each segment has a cavity called a **coelom**.
Nematodes have no segments.
The most common types of worms are:

NEMATODES

BODY
Soft, **cylindrical** bodies.
No segments or rings.
No respiratory system.

HABITAT
Water or soil.
Some are parasites.

REPRODUCTION
Heterosexual:
There are male and females specimens.

PLATYHELMINTHES

BODY
Long, **flat**, soft. In **tapeworms** the body is divided into **rings**. No legs.
No respiratory or digestive system.

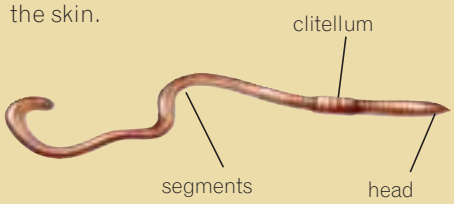
The *Taenia* tapeworm is a parasite that lives in human intestines. It absorbs nutrients directly from its host. Some *Taenia* species are more than ten metres long.

HABITAT
Water or damp places.
Many are parasites.

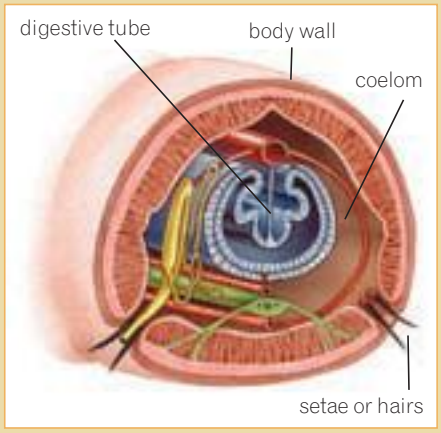
REPRODUCTION
Hermaphrodites: They have both male and female sex organs.
Platyhelminthes can fertilise themselves.

ANNELIDS

BODY
Soft, cylindrical body divided into **segments**. Each segment is similar and has the same organs. These repeated segments are called **metameres**. Tiny appendages on each segment enable movement.
Annelids breathe through gills.
Exception: earthworms breathe through the skin.



Earthworm



Cross-section of segment with coelom cavity

HABITAT
Water. Some are parasites, for example, **leeches**.

REPRODUCTION
Some annelids are **hermaphrodites**. **Earthworms** have larger segments called **clitellum** where the eggs are deposited.

Activities

4. Make your own table.

	Annelids
Main characteristics	
Habitat	
Example	

5. Which groups do the animals in the photos belong to?

6. Talk about these worms.

Which	*are* *breathe* *live*	*in water?* *hermaphrodites?* *through gills?* *parasites?*

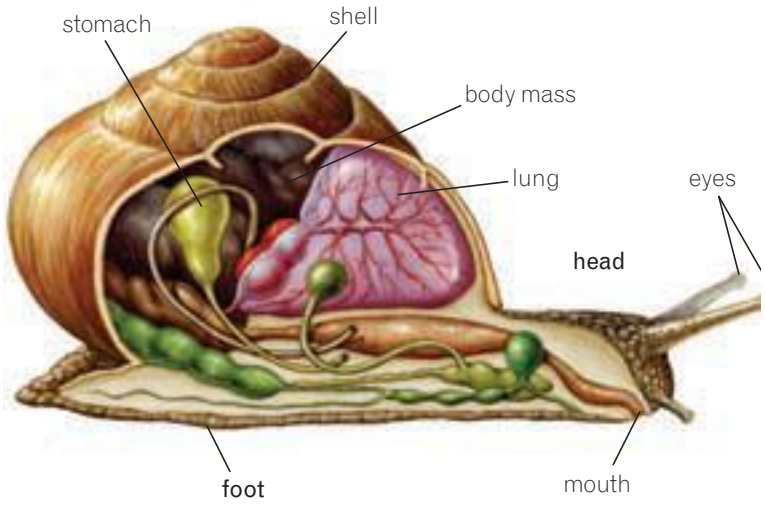
3. What are molluscs?

Squid, mussels, oysters, slugs and snails are all common molluscs. Most are aquatic: they live in the sea or in fresh water. Garden snails, however, live in damp soil.

What is a mollusc body like?

Molluscs have these main characteristics:

- **bilateral symmetry**
- a soft body divided into three parts:
  – **head** which contains sensorial organs and the mouth
  – **body mass** with the main organs
  – **muscular foot** to move about
- The body is covered by a fine membrane, the **mantle**. This produces a protective **shell**. The shell is made up of one or two **valves**. Some species, such as octopi and slugs, have no shell. Others, such as cuttlefish and squid, have an internal shell.



Garden snail

Mollusc functions

- **Respiration.** Aquatic molluscs breathe through gills. Terrestrial molluscs breathe through lungs.
- **Nutrition.** Some are carnivores. Others are herbivores.
- **Reproduction.** Most are hermaphrodite and oviparous. The larva hatches, goes through **metamorphosis** and produces an adult individual.

How many groups are there?

There are three main groups:

- **Gastropods:** snails, sea snails and slugs. They have a spiral-shaped shell with a single valve. Exception: slugs have no shell.
- **Bivalves:** clams, cockles and mussels. Their shells have two valves.
- **Cephalopods:** squid, cuttlefish and octopi. They have tentacles, but no shell.

Activities

7. Make your own table for molluscs. Use page 44 as a model.
8. Match the photos to the words.

no shell – eyes – foot – garden snail – bivalve – mouth – spiral shell

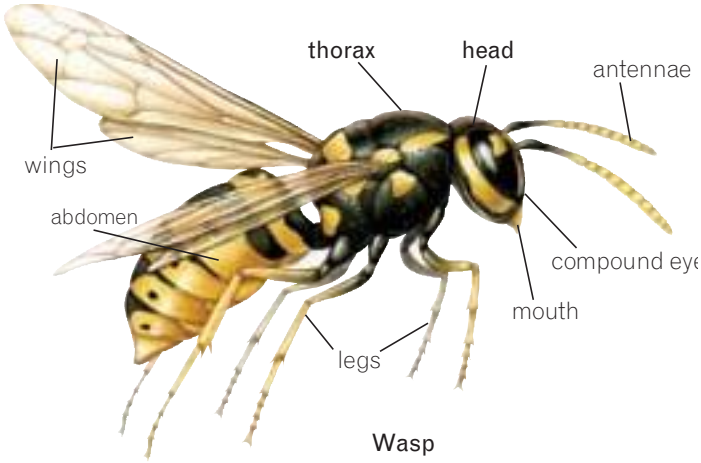

Gastropods: slug


Bivalves: mussel


Cephalopods: squid

4. What are arthropods?

Arthropods are the largest, most varied group of living things: more than one million species. They live in sea water, fresh water and on land.



Wasp

What is an arthropod body like?

The main characteristics of arthropod bodies are:

- a segmented body covered by a thick **cuticle** that acts like an external skeleton or **exoskeleton**.
- a body divided into three parts: **head**, **thorax** and **abdomen**.
  In some arthropods, the head and thorax are joined to form a **cephalothorax**. The antennae, eyes and mouth are in the head. The sensorial organs are well-developed. The eyes can be simple: **ocelli,** or **compound**.
- **bilateral symmetry**
- **jointed appendages:** legs, antennae, wings in insects. The number of legs varies.

Arthropod functions

- **Nutrition.** Arthropods can be carnivorous, herbivorous or scavengers.
- **Respiration.** They breathe through trachea (terrestrial arthropods) or gills (aquatic arthropods).
- **Reproduction.** Most have male and female sexes which are distinguishable. They are **oviparous**. Fertilisation is internal. Some hatch as larvae and undergo **metamorphosis**.

As they grow, arthropods shed the old exoskeleton and grow a new one. This is called **moulting**. Moulting takes place various times throughout an arthropod's lifetime. In other words, arthropod growth is discontinuous.

Activities

9. Make your own table for arthropods: see page 44.

10. Make generalisations about arthropods. Use pages 46 - 7.

Some are ... . Most are ... .

Some have ... , but others ... .

METAMORPHOSIS OF A MONARCH BUTTERFLY

① The female lays eggs. A larva, called a caterpillar, hatches. ② After a short period of development, the caterpillar changes into a pupa (chrysalis stage). ③ After more changes, the chrysalis breaks open and the butterfly comes out.

How many groups are there?

Groups	Examples	Body / Appendages	Habitat
Crustaceans	lobster, crab	usually 10 legs	aquatic
Myriapods	centipede, scolopendra	worm-like body, many legs	terrestrial
Arachnids	spider, scorpion	8 legs	terrestrial
Insects	butterfly, ant, bee, wasp	6 legs, 2 antennae, 2 or 4 or no wings	terrestrial, some aquatic

Crustacean. Lobster. The front legs have claws for defence.

Myriapod. Scolopendras are fast-moving, venomous and predatory.

Arachnid. Spider. The cephalothorax has two chelicerae which help the spider eat, and two pedipalps for defence. Spiders have four pairs of legs: eight in all.

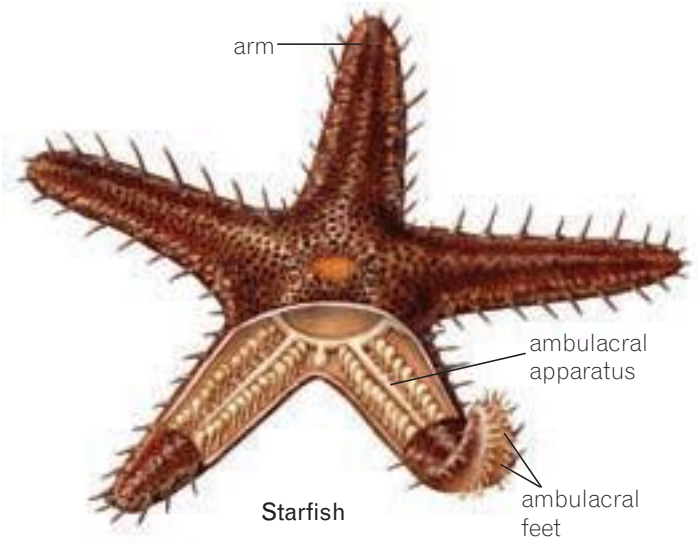
Insect. Ants have a strong mouth for chewing and six legs.

Did you know that...?

In some cultures, insects are food. You might find these insects in an Indonesian restaurant: fried dragonflies.

5. What are echinoderms?

Echinoderms live on the sea bed. Some live fixed to a surface, but others move slowly about. Examples: sea urchins, starfish and sea cucumbers.



Starfish

What is the body like?

The main characteristics of echinoderms are:

- **radial symmetry** in adults, **bilateral symmetry** in larvae.
- body shape: rounded (sea urchin), cylindrical (sea cucumber) or like a star (starfish).
- an **internal skeleton** made up of plaques.
- no separate head, but there is a mouth on the underside.

Echinoderm functions

- **Movement.** The **ambulacral apparatus**, a series of internal tubes filled with water, enables movement. The tubes form **ambulacral feet** with suckers.
- **Respiration.** Most echinoderms breathe through their skin, using the ambulacral apparatus. Some have simple gills.
- **Nutrition.** They are carnivorous and feed mainly on small crustaceans and molluscs.
- **Reproduction.** Most echinoderms have male and female sexes, but some are hermaphrodite. Fertilisation is external. The larvae can swim and undergo metamorphosis to change into adults.

Did you know that...?

Starfish can regenerate body parts or a whole body. All they need is a single leg with part of the central disc.

Activities

11. Can you trace the radial symmetry on the photos?

12. Make your own table for echinoderms: see page 44.

13. How does a starfish feel? And a sea urchin?

How many groups are there?


Echinoedea: sea urchins


Stelleroidea: starfish


Crinoidea: sea lilies


Holothuroidea: sea cucumbers


Ophiuroidea: ophiura

Hands on

Carrying out an experiment

The **exoskeleton** of an insect is covered with a fine layer of grease or wax. This makes it impermeable. The wax protects insects which live in water, such as the skater (*Gerris lacustris*). The skater floats on the water surface. If its legs get wet, it cannot take off.

Skaters can walk on water without sinking.

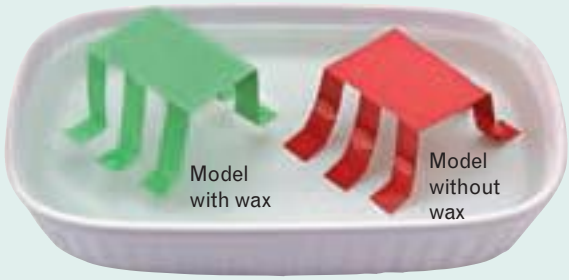
Compare the performance of insects with or without impermeable legs

1. Make two identical insect models from card as in the photograph.
   Body: a rectangle 4 x 6 cm Legs: 5 cm long
   Fold the ends of the legs so the insects can stand.

2. Melt wax from a candle. Cover the bottom of the legs of only one insect with the wax.

Observe and record the data

3. Place both insects on the surface of the water. Observe carefully, and record your data on a chart like this one. Initially, after two minutes, then after 10 minutes.



	It stands on its legs.	It floats initially.	It floats after 2 minutes.	It floats after 10 minutes.
Insect without waxed legs				
Insect with waxed legs				

Interpret the results

4. Does the wax make the paper model impermeable?

Activities

14. What would happen to an insect with no wax on its legs? *It would float | sink.*

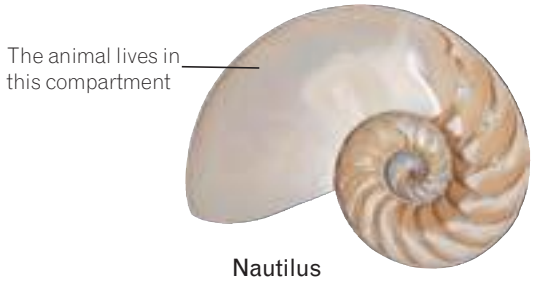
15. **RESEARCH:** Spiders can walk on their webs without sticking. Can you explain this? Think about the experiment above.

Activities

16. The nautilus lives in a spiral-shaped shell. Inside, the shell is divided into compartments. The animal lives in the largest one. The other compartments are filled with gas, so the shell floats.

a. What group of molluscs does the nautilus belong to? Explain.

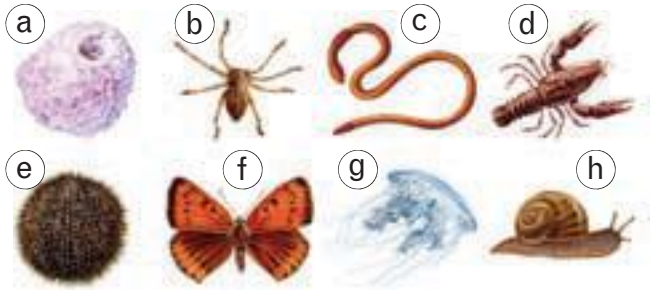
b. What is the main difference between a nautilus and an octopus?



Nautilus

17. Copy and label the cnidaria: *tentacles, opening, can float, live fixed*.

18. Which group of invertebrates does each animal belong to?



19. Study the drawing of the starfish.

a. Copy, then label the following parts: *arms, ambulacral apparatus, ambulacral feet.*

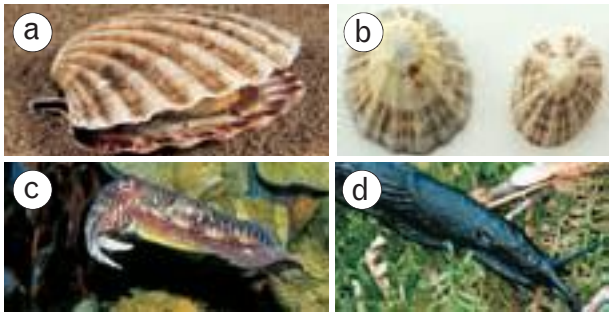
b. What do starfish eat? What body mechanisms do they use to eat?

20. Identify the photos: *annelid* or *caterpillar*. Compare them. *The... has, but the... has...*

21. Read and label: Tapeworms can be 4 metres long. The bulge in the front of the body is called the head or scolex. It has four suckers and *pointed hooks.* The thin part below it is called the *neck*. There are many *rings* which get bigger as they get older and move farther from the head.

Label the drawing: *head, suckers, hooks, neck, rings.*

22. Name each group of molluscs.



What should you know? 4

INVERTEBRATES

Porifera
- The body resembles a sack full of pores and channels. Water circulates through it.
- Porifera live attached to a surface. They feed by filtration.

Cnidaria
- They have a soft body and a mouth surrounded by tentacles. There are two body types: polyps which live attached to a surface, alone or in colonies, and jellyfish which float in the sea.
- They are carnivorous.

Worms
- They have a soft body and no skeleton.
- The main groups are:
  - Platyhelminthes: long, flat, soft bodies.
  - Nematodes: soft, cylindrical bodies, *not* divided into segments
  - Annelids: soft, cylindrical body divided into segments

Molluscs
- They have a soft body divided into three parts: head, body mass and foot. Many have a shell.
- They breathe through gills (aquatic species) or through lungs (terrestrial species).
- They go through metamorphosis.

Arthropods
- They have jointed legs and an external skeleton. Their bodies are divided into three parts: head, thorax and abdomen.
- They breathe through trachea (terrestrial arthropods) or gills (aquatic arthropods).
- They change their outer covering (moult), and some undergo metamorphosis.

Echinoderms
- They have an internal skeleton made up of plaques under their skin.
- They breathe through their skin, using the ambulacral apparatus. Some echinoderms have simple gills. All are carnivorous.
- They undergo metamorphosis.

Projects

RESEARCH: Find out what crustaceans local fish markets sell. Make a list.

WEB TASK: Find out what some spiders eat.