Getting oxygen

Pond organisms are adapted to their habitats in a number of ways. Invertebrates need to be able to move around so that they can hunt or avoid being hunted. They must be able to gather enough oxygen for their needs and they must be able to reproduce.

The key to identifying any adaptation is by observation of behaviour, movements and lifecycles.

Movement

Organisms living in water are usually streamlined to reduce water friction and the amount of energy required to swim quickly. This is especially true for predators such as the Great Diving Beetle.

Others, like the Water Hoglouse, use their streamlining to help them stay on the bottom of the pond amid the detritus.

Pond skaters can walk on the water surface because they have tiny hairs on their feet which trap air.

Removing organisms to a clear collection jar will allow students to observe the various adaptations organisms have developed for moving through water.

Reproduction

Many pond organisms have adult stages which are not aquatic, for example the damselfly, dragonfly, mayfly and caddisfly. The adults are free to travel further in search of mates and lay their eggs in different ponds.

It is a useful activity to follow any pond dipping activity with some tree beating in the adjacent bushes and shrubs to find adult stages, in particular of caddisflies and mayflies.

Oxygen

Oxygen levels in water are significantly lower than in the air we breathe. Ponds which warm up through the day or have variable temperatures will also have varying levels of oxygen dissolved in the water. This can be an added problem for aquatic organisms and affects their behaviour.

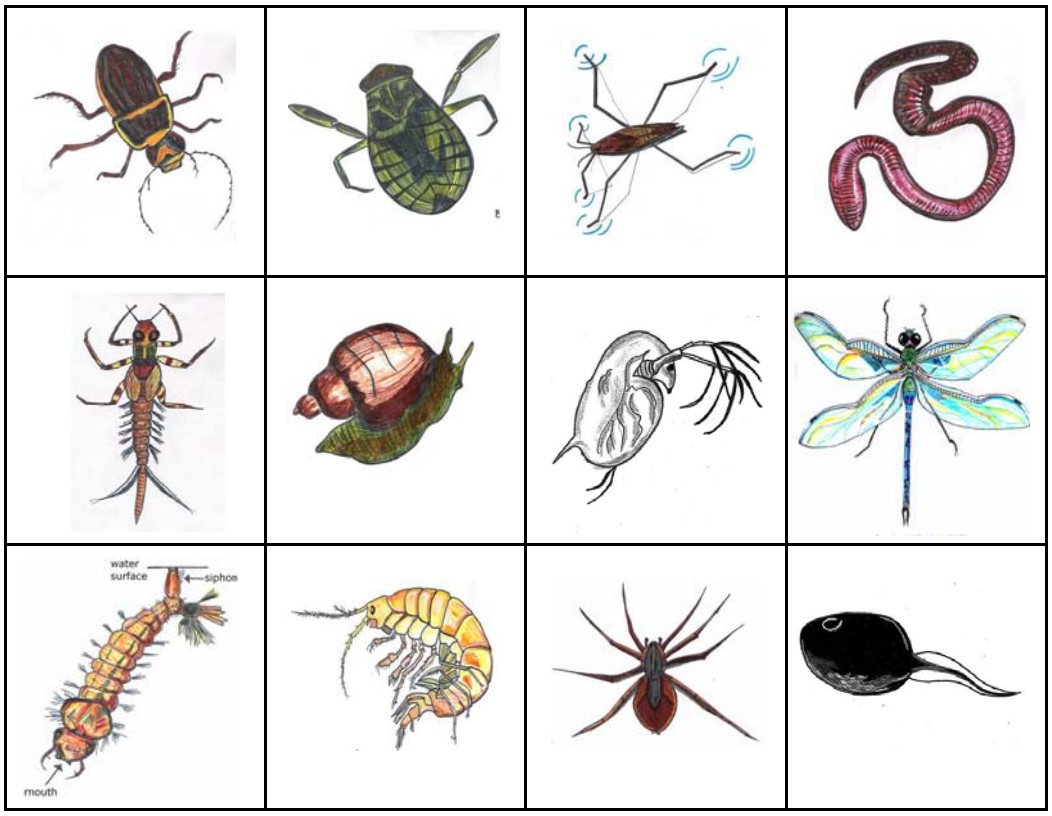
As in terrestrial habitats, the smallest organisms rely on diffusion across surface membranes for their oxygen supply. Larger organisms must find alternative strategies to gather the oxygen they need.

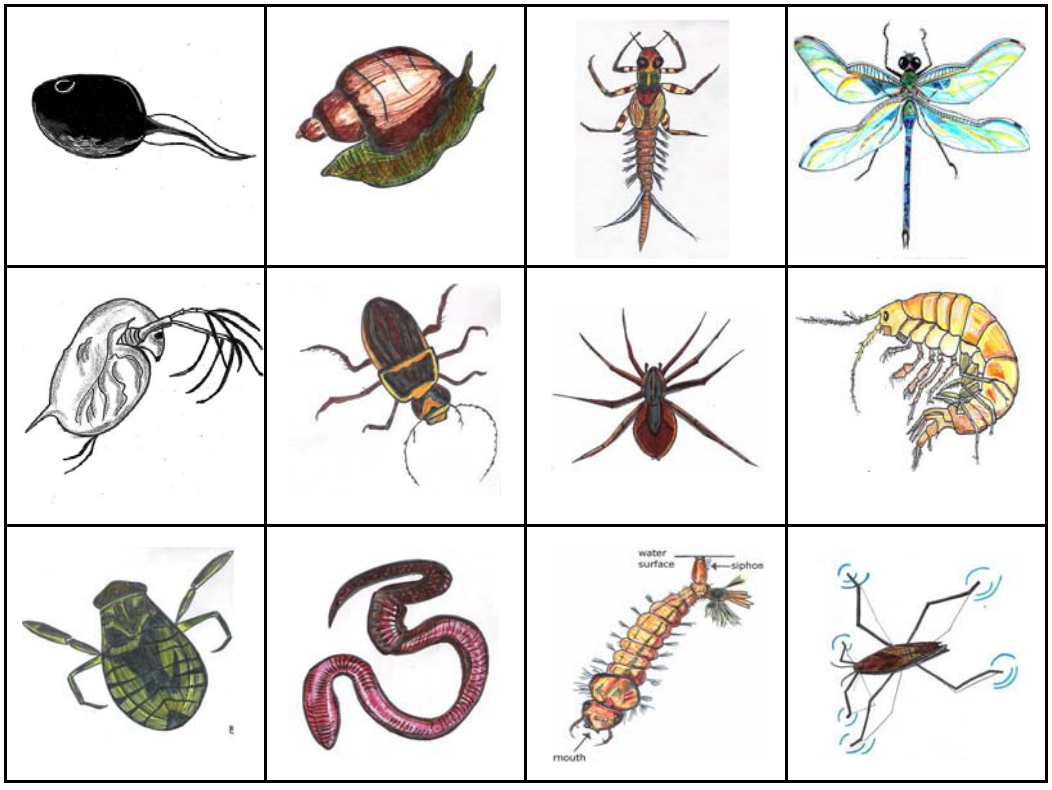
Students should be able to observe gills of various designs, seen in the mayfly and the freshwater shrimp, air sacs carried by the water boatman and the water spider, and physical adaptations similar to breathing tubes in mosquito larvae. These allow invertebrates to respire underwater. Smaller organisms such as the freshwater worms might not show visually obvious adaptations to gathering oxygen but their red colour can act as a trigger for looking at oxygen carrying chemicals.

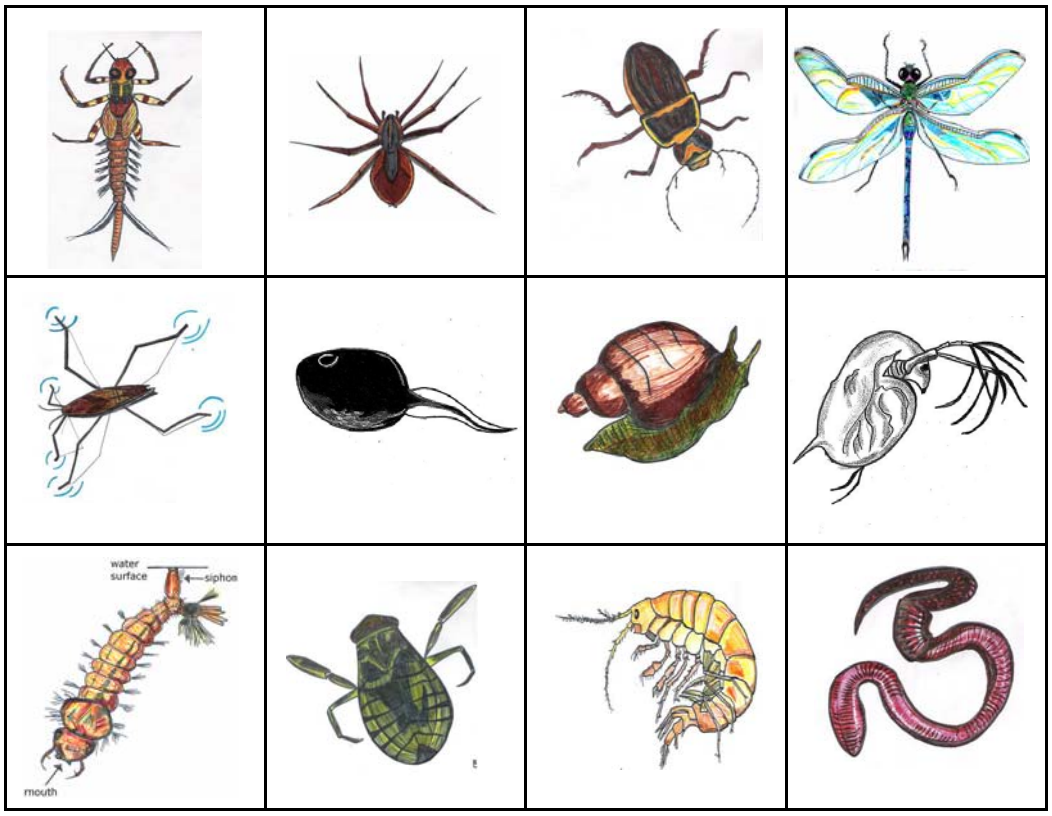
Lesson Plans to download

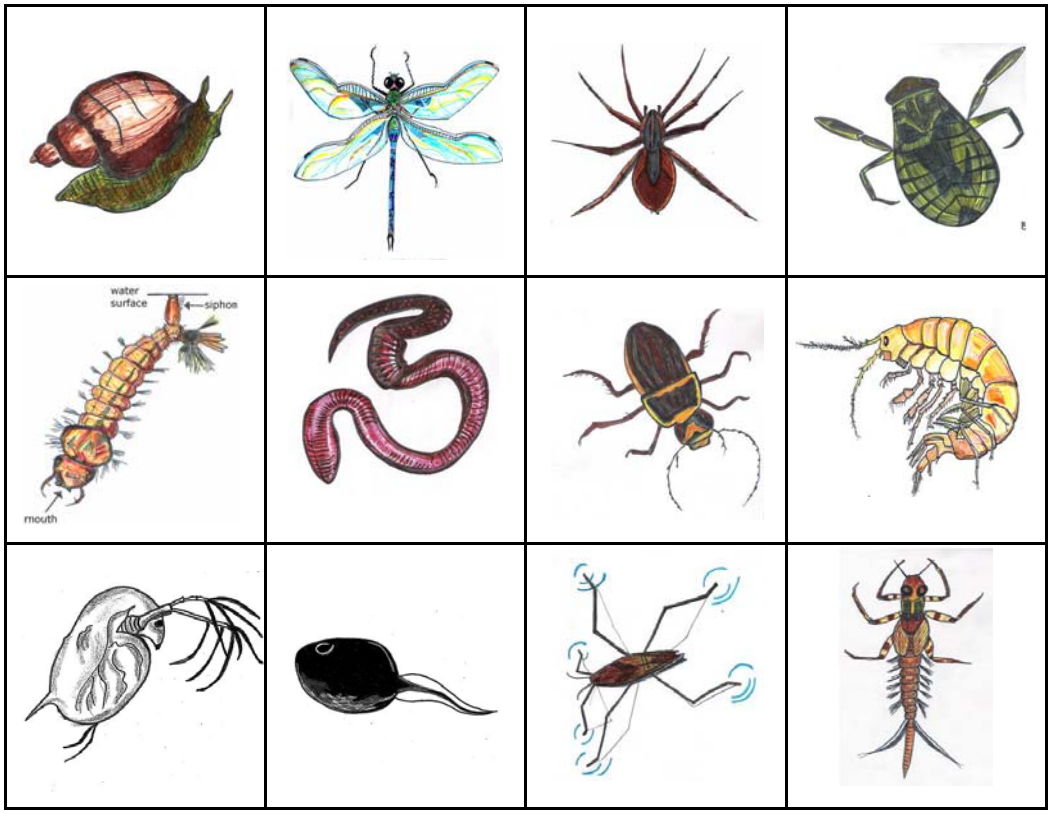
- Pond bingo (see end of pdf)

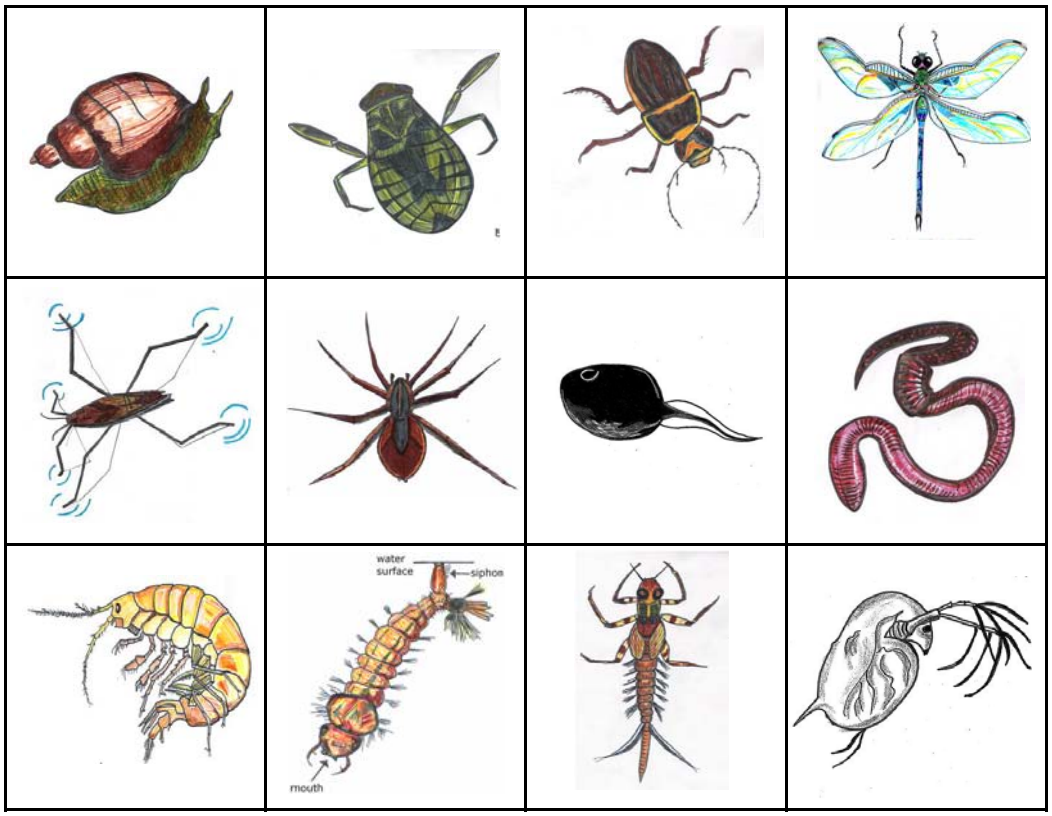
Pond adaptations (see end of pdf)

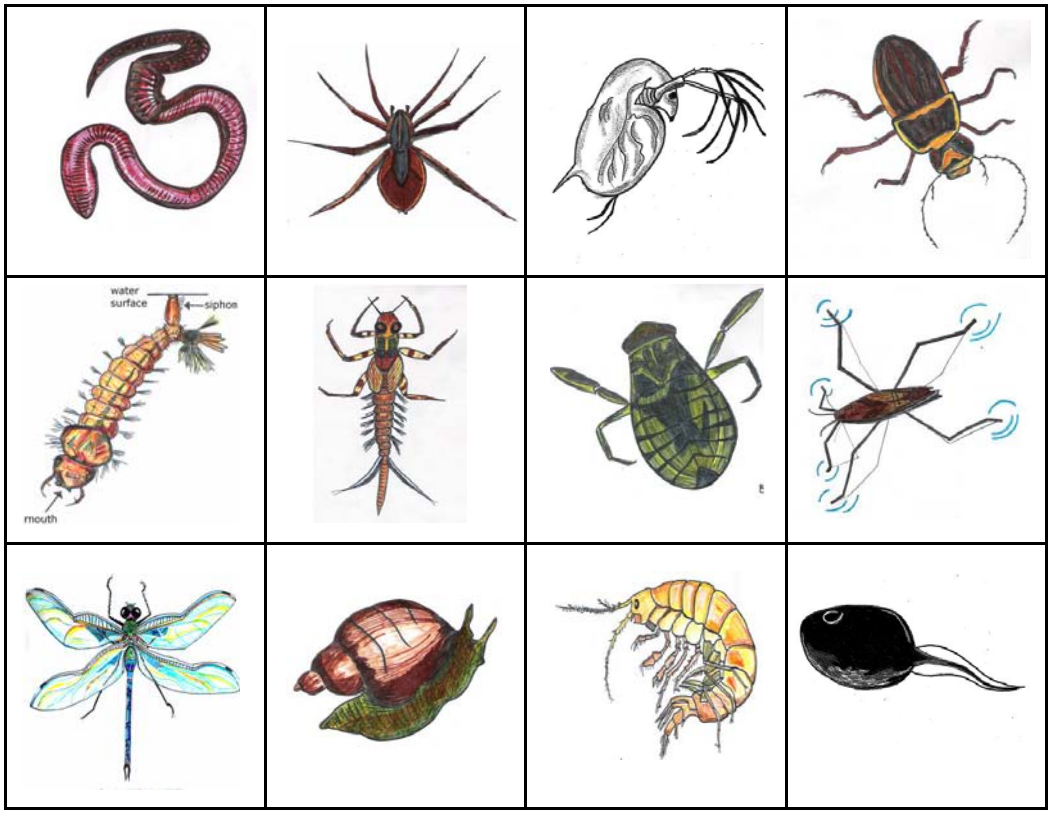


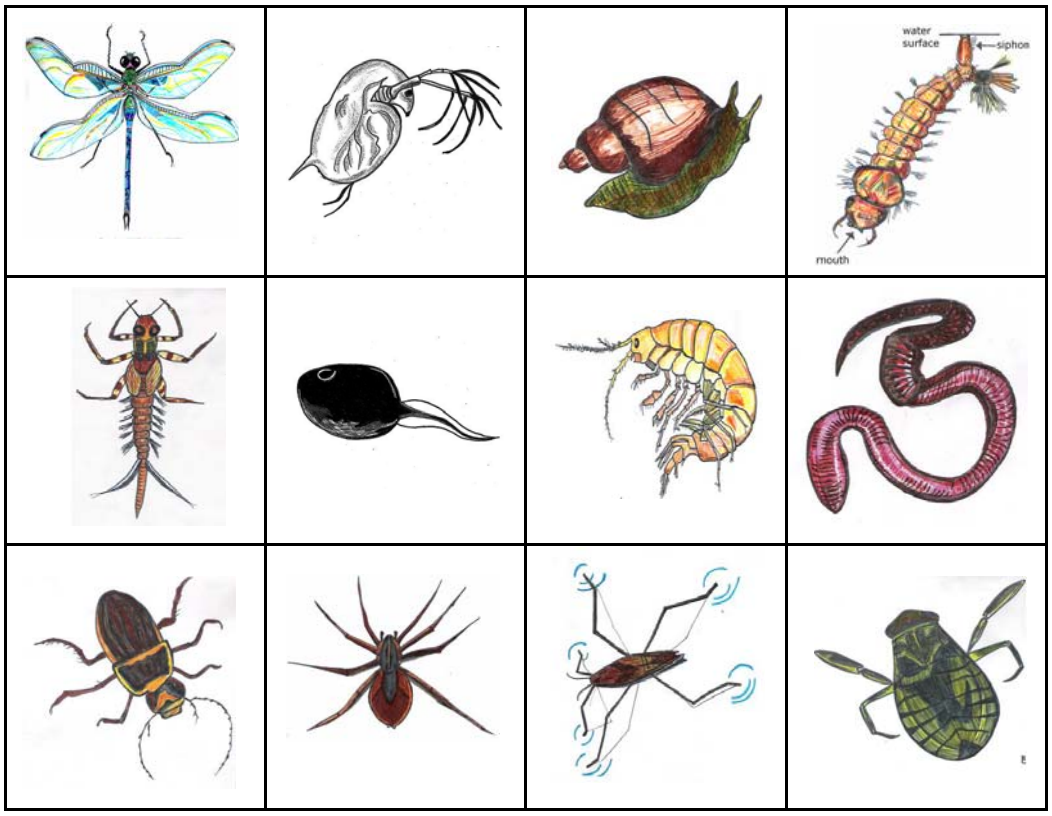


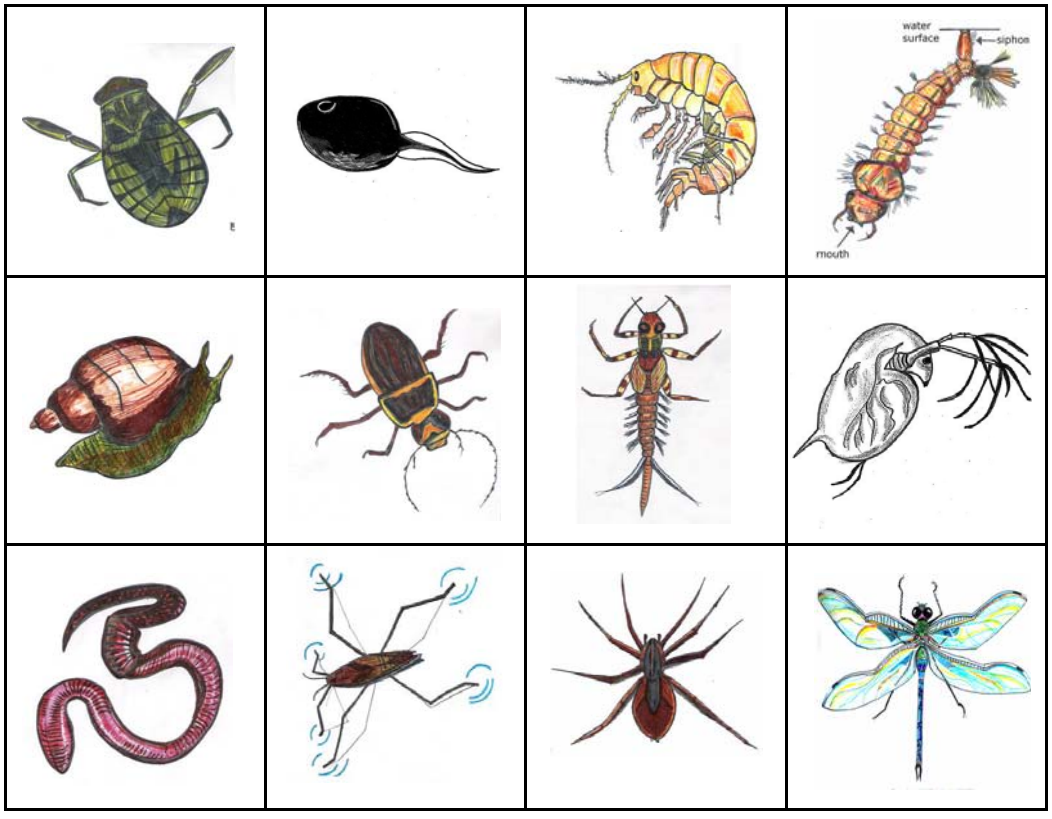












Lesson Plan: Adaptations to Aquatic Habitats

Curriculum links

Science	Key Stage 3/4	Unit 2.5:	Adaptations
		Unit 7C:	Environment and feeding relationships
		Unit 8D:	Ecological relationships

LESSON STRUCTURE

What do animals need to survive in their environment and how they are adapted to achieve this?

All animals are **physiologically adapted** to their particular environments and therefore pond organisms have developed specialised structures to enable them to breathe, move, obtain food and otherwise survive in an aquatic habitat. Adaptations can be identified by observation of behaviours, movement and lifecycles.

Starter Activity

Moving in Water: How do animals living in water move around?

Main Lesson Plan

Obtaining oxygen in water: There isn't much oxygen in water so how to animals respire?

Plenary Activity

Pond Bingo! a quick activity to recall which animals have developed specific adaptations

STARTER:

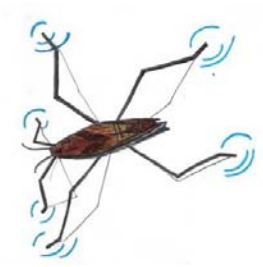
Moving in Water

Aquatic organisms move in and through the water in a number of ways. Begin by asking the class to list the pond animals they are familiar with and record suggestions on the board. Using the table below prompt students to think about how some organisms move in the water highlighting the links between habitat, diet and movement. [10 mins]

Organism	Where it lives	What it eats	How it moves	Adaptation
Duck	Above surface	Pondweed, insects, snails, larvae, tadpoles, small fish	Flies, dives, paddles.	Wings, waterproof feathers, webbed feet
Adult dragonfly		Insects	Flies, hovers	Two paired-wings, streamlined shape
Adult mayfly		Insects	Flies, hovers	
Frogs	Pond edge	Insects, snails, slugs, worms	Hops, swims	Amphibious, moist skin, webbed feet, long, strong hind legs, sticky tongue.
Newts		Water fleas, snails, worms	Walks, Swims	Amphibious, moist skin, long muscular tail.
Water vole		Insects, worms, grasses	Walks, swims,	Oily coat, sharp teeth,
Pond snail	Pond surface	Plants, algae, dead matter	Muscle contraction	Shell, muscular foot
Pond skater		Dead plants and animals	Skates across water surface	Long splayed legs, water-repellent hairs
Mosquito larvae		Micro-organisms, detritus	Swims	Breathing tube
Fish	Mid-water	Water fleas, tadpoles, shrimp	Swims	Gills, fins, streamlined body
Tadpole		Insects, plants, dead matter	Swims	Streamlined body, tail
Great diving beetle		Water fleas, snails, water boatmen, larvae, leeches,	Walks, dives, swims	Streamlined body, fringed jointed legs
Water boatman		Shrimp, worms, tadpoles	Rows using legs	Paddling legs, hair-lined body traps air
Leech		Snails, larvae, tadpoles	Swims	Sucker, flattened body
Insect larval stages (Dragonfly/Mayfly)		Fish, water fleas, shrimp, tadpoles, micro-organisms	Swims, crawls	Gills on abdomen,
Freshwater worm	Pond Bottom	Micro-organisms, dead and decaying matter 'detritus'	Swims	Haemoglobin, thin body wall, segmented body
Water Flea			Rows using antennae	Antennae, flattened body
Freshwater shrimp			Swims	Side-flattened body, swimming legs, gills
Water hog louse			Walks	Gills, six paired legs

Finally, use the following three examples to further explain how different physiological adaptations enable these invertebrates to move in an aquatic environment, prompting the class to suggest the unique characteristics that make that organism capable of their particular movement and lifestyle. [15 mins]

1) Pond Skaters



Pond skaters walk on the surface of the water. They have adapted **long, splayed, paddle-like legs** which allow them to spread their weight over a large surface area, their feet are covered with **tiny hairs** which trap air and enable the insect to 'skate' on the surface of the water taking advantage of the **surface tension** that lies between the water and the air. The pond skater's stomach is covered with **water-repellent hairs** to prevent direct contact between their body and the water.

2) Freshwater Shrimp

Freshwater shrimp have a body that is **flattened sideways**. They use their front legs to crawl along the bottom of the pond and swim sideways by moving five pairs of **segmented swimming legs** which propel a stream of water over their gills as they move, allowing them to obtain a constant supply of oxygen.

3) Great Diving Beetle

The great diving beetle is an aggressive predator, it has a **streamlined body** reducing water friction and **fringed jointed legs** allowing it to move very fast through the water to hunt and catch it's prey.

***** EXTENSION:** Discuss how moving in water differs to moving on land? ***

MAIN:

Obtaining Oxygen in Water

Objective:

I. *To understand that even animals in water must find oxygen.*
II. *To know the main adaptations that pond organisms have evolved to get oxygen.*

The levels of oxygen in water are significantly lower than in the air we breathe and are affected by changes in temperature. Pond organisms exhibit a variety of adaptations which enable them to obtain oxygen from the water and to cope with a variable oxygen supply. [20 mins]

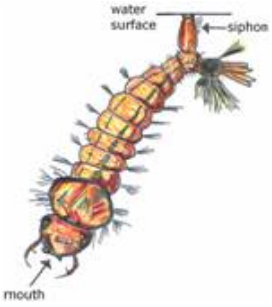
1) Mayfly Nymph

Mayfly nymphs have **gills** on the sides of their abdomen which **vibrate rapidly** to help keep a flow of water over their surface. **Gaseous exchange** takes place between the water and the many small blood vessels in the gills allowing the mayfly nymph to obtain oxygen from the water.

2) Water Boatman

Water boatman **breathe air** when at the surface of the water and are able to breathe under water by **carrying an air bubble** trapped by **hairs** that line their body.

3) Mosquito Larvae



The larvae of mosquito have **feather like structures on their tails** which allow them to hang onto the surface using the **water surface tension**. Mosquito larvae obtain oxygen from the air using a specially adapted **breathing tube** which reaches from the larvae's tail to the water surface and acts like a snorkel.

4) Freshwater Worms

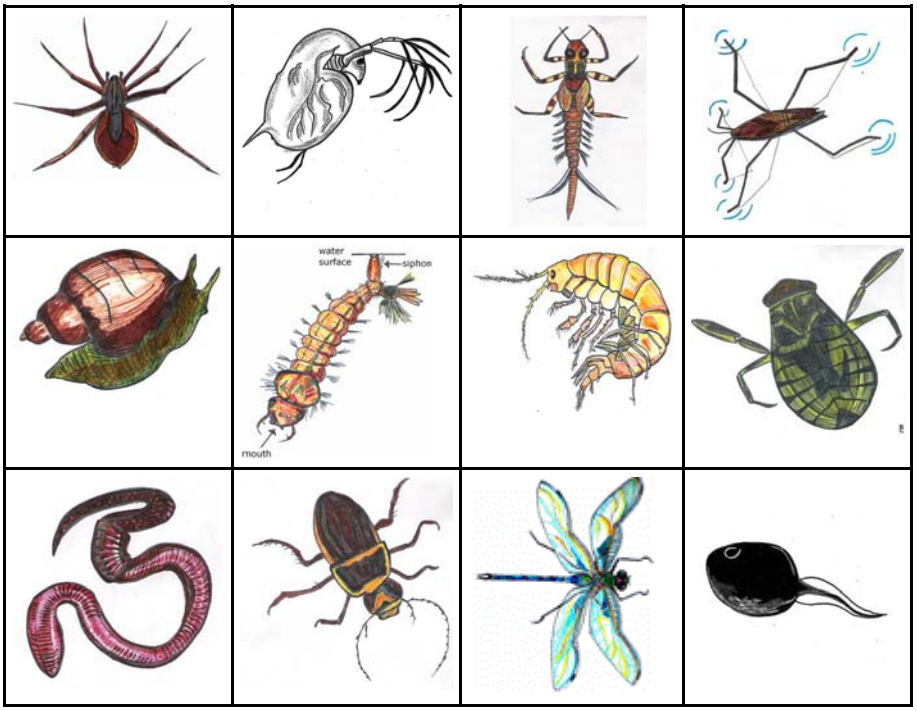
Freshwater worms are bright red due to the **haemoglobin** in their blood which carries oxygen obtained from the water via **diffusion** through their body wall.

PLENARY:

Pond Bingo!

Hand out the bingo cards to students and explain the rules of the game as follows:
The teacher will describe an adaptation of a particular pond animal and how this unique characteristic helps it to survive in an aquatic habitat. Students must cross off the animal described from their card. The first student to get a full row (horizontal *not vertical*) of correctly identified organisms wins. The winner must call out the organisms that make up the winning row to ensure species were matched to their adaptations correctly. [15 mins]

Example of bingo card (please find templates in supporting document, you will need to print and cut out cards prior to the lesson):



Adaptation clues:

- This organism is able to breathe air through a breathing tube attached to it's tail which punctures the water surface acting like a snorkel **:** **Mosquito larvae**
- This organism has long, thin, splayed legs allowing it to walk upon the surface of the water taking advantage of the water surface tension: **Pond skater**
- This organism is red due to the haemoglobin in it's blood which carries oxygen transferred across the skin through diffusion: **Freshwater worm**
- This organism has oar-like side swimming legs and breathes underwater by carrying an air bubble trapped by the hairs that line it's body: **Water boatman**
- This organism has a side-flattened body and swims on its side using five pairs of swimming legs which propel water across it's gills: **Freshwater shrimp**
- This organism has a streamlined body and fringed jointed legs allowing it to move very fast as it dives through the water to hunt its prey: **Great diving beetle**