



Naturhistoriska
riksmuseet

Life in water

A guide to the exhibition

Swedish Museum of Natural History
Stockholm



This guide

is a short presentation of the exhibition *Life in water*. It focuses on some important and interesting parts of the exhibition and is not complete.

The Earth – a watery planet

Water in space?

Water exists in three different forms: as ice, liquid or steam. Temperatures and pressures determine the form that water takes. Where do we find water in our planetary system?

The Earth

70% of the earth's surface is covered by water. Huge areas of ice cover the poles and rain irrigates the continents. Water is part of a global hydrological cycle and is essential for life.

Other planets

Mars has lots of water on its surface, yet it is very cold, around -50 °C. Almost all of it is contained in huge layers of ice on its poles. But there are also ancient riverbeds, now completely dried up. This indicates that Mars once had large amounts of flowing water. On Uranus there is frozen water and ammonia. And on Pluto there is a layer of ice 200-300 kilometres thick. Other planets have very little water or none at all.

Without water – no life

Life in water

Life on earth began in the sea. Many plants and animals still live in water: in seas, lakes and rivers. Far fewer of them have adapted to the dangers of life on dry land.

Life on land

Plants and animals on land are also dependent on water without exception. Amphibians always live in moist environments so as not to dry out, and they lay their eggs in water. The embryos of reptiles and birds are surrounded by water inside the egg. And embryos of mammals are surrounded by water in the uterus.

Water in your body

There is water inside all living plants and animals, much more than you might think. How much? Press the button to find out the answer!

The aquarium

Have a look

at freshwater fish, for example roach and perch, and crayfish (but they often hide).

Never at rest:

The hydrological cycle

Where is there water?

Most of the water on land is trapped in the bed-rock. The rest of the water is part of the hydrological cycle.

Restless water

Most of the water in the cycle can be found in the sea, the ground water and the polar ice caps:

Seas	94 %
Ground water	4 %
Polar ice caps, glaciers	2 %
Soil water, lakes, rivers, the atmosphere	less than 1 %

All water on land and in the air comes originally from the sea. Sooner or later it returns there.

The calm bay in the lake

Teeming with life

Bays in lakes which are protected from strong winds are often home to many plants and animals which live both above and below the surface. Many lake fish like to live in the vegetation near the shore of the lake. Here they can find food, and also protection from animals which might prey on them. But in the reeds there are also fish which prey on smaller creatures, especially pike and large perch.

Plants in order

Close to the shore grow tall reeds and further out are plants with their leaves floating on the water, e.g. water lilies. Furthest out are short plants down on the bottom like algae and



mosses. They flourish in the dim light at a maximum depth of 10 metres. Outside this zone the bottom of the lake is without plant life. The light here is too weak for vegetation to grow.

Close neighbours

Among the vegetation at the edge of the lake there is a wide variety of animal life: leeches, worms, small crustaceans, insects, snails and mussels. There can be as many as 10,000 living creatures per square metre. They thrive because there are many microenvironments created around the various plants.

In the reeds, in the depths

Lack of oxygen

Bacteria absorb much of the oxygen in the water when they break down dead plants and animals. In the calm bays in lakes with their rich life, the oxygen level may drop and the animals here need to be capable of tolerating low levels of oxygen.

Darkness at the bottom of the lake

Deep down in the lake, at around ten metres, there is scarcely any vegetation at all. Here it is dark, the bottom of the lake is bare and the lack of oxygen can be a problem. However, these areas of mud and slime are often home to a wide variety of animal life.

Hunted mosquito larvae

Mosquitoes lay their eggs in water. The larvae, coloured red in some species, live down in the depths where they are hunted by fish. Another type of larvae are coloured white and can swim. During the day, when the fish can see them, they hide in the dark, oxygen-starved water near the bottom.

Worms eat the remains

There are also worms which live down in the mud at the bottom of the lake. They eat their way through the slime, living on the remains of dead plants, animals and bacteria.

The freshwater crayfish – A cannibal with claws

Selects its environment with care

The freshwater crayfish can be found at the edges of lakes, living at depths of between half a metre and 3 metres. The bottom must be firm so that it can dig the hole in which it lives. The crayfish needs water which is rich in oxygen. It is very sensitive to changes in the environment and water pollution.

Changing its shell

The shell of the crayfish does not grow and needs to be changed regularly. A new shell grows underneath the old one. The new shell is soft at first, making the crayfish vulnerable to attack. It remains hidden away from predators. It can also be attacked by other crayfish – the crayfish is undoubtedly a cannibal when it gets the chance. After a time, the shell hardens.

Who eats who?

Eat or be eaten

Animals have different diets: some are plant eaters, others are predators. In nature there are also animals which live on dead plants and animals, breaking them down. All species are part of a food web.

Press the button

The arrows in the diagram mean "eaten by". Press the button for the animal which you think eats planktonic algae. Keep going through the entire food web. If you guess correctly, all seven circles will light up at the same time.

Under the microscope

Look at the fantastic range of small creatures you can find in the lake.

From an invisible world

Plankton – life in motion

Plankton is made up of representatives from all the major groups of organisms: bacteria, fungi, plants and animals. Usually, they are microscopically small and no strong swimmers and follow passively with the currents in the water.



Plankton – swimming in food

Planktonic bacteria and plants live on nutrients which have been dissolved in the water.

Planktonic animals are often filter feeders: they create a flow of water which carries planktonic plant or bacteria to their mouths.

Video:

The tiny water flea, *Daphnia*, catches its food (planktonic algae and bacteria) with the help of the fine combs on its legs. This animal is about 2 millimetre long.

Wels catfish – a threatened fish

The biggest freshwater fish

The wels catfish may attain a length of more than four metres, weighing about 300 kilograms. The long barbels on its nose are equipped with sensitive taste receptors.

Calm waters

The wels catfish lives near the bottom in lakes and rivers with soft bottom sediments. During the night, the wels catfish hunts its prey by means of its barbels. Its food consists of roach, bream and burbot.

Sensitive reproduction

The wels catfish requires a high temperature to reproduce. Spawning takes place in July - August, but only if the temperature of the water is above 22 °C.

Threatened and protected

During the last hundred years, the wels catfish has disappeared from many Swedish lakes and rivers. The natural populations are small. Cultivated wels catfish is introduced in the natural populations to keep them productive.

Toxins in the environment and exploitation of natural waters have had negative consequences for the reproduction of the wels catfish. It is now protected in Sweden – it is prohibited to catch and kill this species.

The sounds of fish

Fish lack ears

Many species of fish produce various sounds caused by movements of the gill-lids or the sound.

Why sounds?

It is supposed that fish communicate by means of the sounds. In the case of Swedish species, the exact function is not known, however. Perhaps males and females "speak" to each other during mating or maybe a fish shoal is kept together by means of sound signals.

Running water

A difficult environment

Strongly flowing water usually lacks any tall vegetation. Moving water makes it hard for plant life to establish a hold. Instead, a covering of algae on the bottom is the most important vegetation, and this also provides a source of food for those creatures which eat plants.

Collects food

Fallen leaves end up in the water and provide food for bacteria. Many creatures in the stream eat these bacteria in turn, along with dead plants and animals. Many creatures come loose from the spot where they have fastened and float off with the current. They become an easy prey for hungry neighbours. What do they do to avoid losing their grip?

Gluing and burying

Many dragonfly larvae glue their pupae and houses to the stones on the bottom. Others live in the calm spaces under and between stones, or bury themselves into the bottom.

Flat against the bottom

Even though the water may be fast flowing near the surface, it is rather slow close to the bottom. A flattened body may be of assistance.

No air-breathing creatures

No creatures which breathe oxygen from the air live in fast flowing waters. They would be washed away by the current if they tried to gasp for air on the surface. Creatures here



breathe with gills or directly through their skin, taking oxygen from the water.

Salmon – the eternal wanderer

From river to sea to river

The life of the salmon is determined by its migrations. It lives in the North Atlantic and the Baltic Sea, yet finds its way into rivers to spawn. After some years, the young salmon find their way out to sea again.

Growing up in the sea

Young salmon grow quickly during their few years in the sea. Then the time comes round for them to spawn. With its fine sense of smell the salmon can find its way back to the river where it was once born, wandering upstream to the spawning sites. It is a strong swimmer and can jump three or four metres up rapid water flows.

Spawning

The fish spawn in shallow, fast flowing waters. The female digs in the coarse gravel, into which she lays her eggs. A salmon which has finished spawning is exhausted and may have lost up to half its body weight – during migration and spawning they do not eat at all. Most salmon die after spawning. Very few of them spawn more than once.

From parr to smolt

The eggs hatch during the spring. The salmon remains in freshwater for between one and five years, during which time it is known as a parr. When it starts to swim towards the sea it becomes known as a smolt. It then becomes able to live in salt water.

Eels

Adrift at sea

Eels reproduce in the Sargasso Sea. The tiny young eel larvae drift on the Gulf Stream for almost three years, and when they reach the coast they change into elvers.

Slippery as soap

Around our coasts the elvers seek out running water. They have a very strong instinct to migrate and are skilful at progressing on their journey. They crawl across land to bypass

difficult streams, and easily slide through narrow passageways.

Freshwater females – saltwater males

Eels which have migrated into freshwater develop into females, and those which remain in saltwater or brackish water develop into males.

Silver eels – towards the Sargasso Sea

At around ten years of age the appearance of the eel changes dramatically: its eyes become bigger, its back darkens and its belly becomes silvery. Its intestines shrivel up and it stops eating. This is when it starts its migration back towards the Atlantic.

Pearl mussel

No hurry

The freshwater pearl mussel likes to live in flowing forest streams. It grows slowly and can live for more than a hundred years.

Pearls, pearls...

The inside of the shell has a layer of mother-of-pearl which is formed by the mussel. Pearls can occasionally be formed when a grain of sand, trapped between the mussel and its shell, starts to pick up the mother-of-pearl. The pearl mussel has been plundered heavily for the sake of its pearls and is also sensitive to acidification. It is both a rare and protected species.

The Baltic Sea – freshwater or saltwater?

Neither one thing nor the other

The Baltic is an unusual sea in that its level of salt is very low. The water in the Baltic is brackish.

Unusual sea

The Baltic has a higher level of salt than inland lakes, but less salt than the North Sea. It contains a strange mixture of lake and sea plants and animals. Lake-side reeds grow alongside seaweed. Roach and perch share the same water as cod and herrings.



Rivers play their part

Many rivers and streams flow into the Baltic causing it to have a low level of salt. The extra flow of water is so great that the sea-level in the Baltic is higher than in the North Sea. This causes the water to flow out through the Danish sound. Heavier saltwater flows inwards along the bottom.

Why so few species?

On the west coast, you find about 1500 species of animals but in the Baltic only about 70! Why? The Baltic is a young sea, just 3,000 years old. During this short time no new species which are well-adapted to brackish water have managed to evolve. The organisms in the Baltic are therefore marine or freshwater species which can survive in brackish water. They live at the edge of what they can tolerate.

Life in the sea

Life everywhere

There is life everywhere in the sea, right down from the surface to the greatest depth of 11,000 metres. In clear sea water, light can penetrate down to a depth of 1,000 metres, but at depths of 100 metres it is so faint that no plants can survive. Below this level only animals can be found.

No insects

Of all known animal species around 15% live in the sea. All the major groups of organisms are well-represented in the oceans. However, there are scarcely any insects at all. This group has the greatest number of species on land.

Vegetation in the sea

On earth there are 30,000 species of algae. Most of them are microscopic. Almost all vegetation in the sea consists of algae, around 15,000 species.

Hard and soft bottom

Hard and soft bottoms have their own special animals and plants. Hard bottoms make up only 1% of the entire ocean floor, yet 80% of the species live there!

The diorama

The diorama shows a hard bottom on the west coast of Sweden at Bohuslän. A wide variety of plants and animals are situated directly on

the rock. You can also see the most common Swedish coastal fish. The depth of the water has been reduced to fit into the diorama. The lowest part represents a depth of 25 metres.

What you don't see

We cannot see most of earth's plants and animals with the naked eye. They are microscopic and they are not included in the diorama. But they exist in huge numbers, and they are just as important to nature as those plants and animals we can see.

The aquariums

In the three small aquariums you can see some common animals from the Swedish west coast: blue mussels, starfish, sea urchins, sea anemons and crabs.

Filter feeding – another way of eating

Are you a filterer?

A filterer is equipped with a sieve, a filter. A tea-strainer is a good example of a filter: the tea remains in the strainer and the water passes through.

What do they catch?

Filter feeders are common in aquatic environments. You never find them on land. The food of a filter feeder often consists of small plants and animals that live suspended in the water, so-called planktonic organisms.

Blue whales are strainers

The blue whale is a baleen whale. A great number of whale bones sit in rows in the upper jaw of the whale. When feeding, the whale takes a mouthful of water into its mouth and then presses the water back into the sea through the whale bones. Small crustacean animals, copepods and krill, are trapped on the whale bones and swallowed.

Blue mussels are gluers

Many filter feeders lack a filter but have instead a sticky mucus that catches the food particles. The blue mussel has two openings. In one of them water is sucked in and in the other it goes back to the environment. Inside the mussel, the water flows over its gills. Here, the



sticky mucus is produced and this is also where the food is captured.

The shallow sea bay

An important environment

The shallow sea bay is an important marine environment: many creatures live in the water as well as on and in the bottom and maybe it is here you take your summer baths.

Spring invasion

In spring many animals, shrimps and crabs for example, migrate into the bay from deeper waters, where they have spent the winter. Later on fish start to arrive. Here dinner is served up for them: worms, snails, mussels and small crustaceans in abundance. Can you see the flat-fish?

The big one, yes – but the small ones?

Hidden creatures

Polychaetes, such as lugworms with their u-shaped passages and sand worms, are anonymous creatures which are rarely seen but which leave a trail in the sand, e.g. a heap of faeces. Many mussels also live under the sand and mud.

Summer invasion

Mussels develop via a larval stage. They are microscopic and swim in the water. Around midsummer the bay is full of bathers and larvae.

Meadows of the sea

The kingdom of eel-grass

In the outer part of the shallow sea bay, at depths from 50 centimetres to 3 metres, eel-grass can often be found. This is one of the very few flowering plants which live in the sea.

Fish in the meadows

The bottom on which eel-grass grows is rich in nutrients. Many creatures live here, where they can get protection from the dense vegetation, for example the thin pipefish, related to sea horses, and the nest-building three-spined stickleback.

Life between the grains of sand

A handful of sand

Pick up a handful of sand from a typical beach. What do you see? Sand, yes, but you are actually holding much more than that. There may well be 10,000 microscopic creatures of 70 different species in your hand!

Who lives here?

Copepods (small crustaceans) and roundworms are the most common animals. But there are also many creatures which only have Latin names. All of them are small and have long bodies to fit into the spaces in the sand. The maze of sand is their universe.

From an invisible world

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Video:

What do planktonic plants look like?

Planktonic plants display fantastic variety. Many are surrounded by beautiful shells.

What do planktonic animals look like?

Some are covered with fine hairs, others have strange mouths. Some have tentacles to paralyse their prey. In fact, they come in all manner of shapes and forms.

Under the microscope

Look at all these creatures which live in the sea.



The North Sea, Skagerack and Kattegatt

Animal communities

Around Sweden you can find all kinds of animal communities depending on the depth of the water. Mussels and flat fish like sandy and muddy bottoms between 15 and 20 metres deep.

Brittle stars (ophiuroids) are the dominant species on muddy bottoms between 30 and 120 metres down. There are sometimes as many as 500 of them per square metre.

Deepest in Sweden

At a depth of between 150 and 800 metres, there are many North Sea prawns and squids on muddy sea beds and also brittle stars. On hard beds there are mainly sponges and mussels.

The hidden world of the deep oceans

The last wilderness

The bottom of the ocean, 1,000 metres down or more, is a pitch black world – no light reaches here. It is also a cold world. The few creatures which are found here live of the remains of dead plants and animals, which sink down from shallower waters.

Cracks in the ocean floor

But there are exceptions. There are long cracks across the ocean floor where the plates of earth's crust meet together edge to edge. These points are close to the hot core of the earth.

Warm oases

In certain places, the sea water flows through the sea bed, is heated up and enriched with sulphur. It then flows out from what are known as "black smokers". In this water live a wide variety of creatures, but only in a radius of a few metres from the "smokers". Distances between these communities are huge – hundreds or thousands of kilometres.

Unknown life

The first community was discovered in 1977 and caused a scientific sensation. Some 30 similar communities are now known to exist.

Creatures previously unknown to science have been found. There are undoubtedly more discoveries to be made.

Fish in the deep oceans

Lighting-up a dark world

Fish you have never seen before live down here. They have big eyes, big mouths with long teeth and are luminous!

Practical adaptation

The big eyes are an adaptation to the low level of light: the bigger the eyes, the more light they can absorb. There is a lack of prey in the deep oceans. A big mouth can take in both large and small creatures – they need to take advantage of any food which comes their way.

Finding a mate

In this vast, dark world there are long distances between the fish. The light is turned on an off rhythmically as a signal between the sexes, helping them to find each other. And with a real firework display of flashes, they can confuse a predator that came too close.

Architeuthis – giant from the deep

As yet unseen

Nobody has ever seen a living giant squid in its rightful environment. We therefore know very little about its habits and behaviour.

How many have been found?

Around one hundred. Most of them have been washed up on the coasts of the Atlantic and Pacific oceans. They are often half-rotten and in bad condition. The biggest one ever found was 18 metres long, including its arms, and was washed up in New Zealand at the end of the 19th century.

The giant squid at the Natural History Museum

The specimen you see here was caught on 16 July 1997 by Danish fishermen in the North Sea. It became trapped in their nets at a depth of 100 metres. The squid's eyes cannot be seen as they shrink and close up after death. Few



museums in the world can show a nearly complete specimen like the one you see here.

Squid and sperm whales

The giant sperm whale regards squid as a delicacy. Squid jaws can often be found in the stomachs of sperm whales.

Animals which catch fish

Many animals living on land catch fish in lakes and seas. Heron, osprey, otter and mink are just some of them, which you can see in the show case.