Life under Water

Teacher Resource Guide

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Objective

The object of this presentation is to create an understanding of the function and purpose of adaptations, while applying this concept to life under water. Content will be focused around fish, amphibians, reptiles and aquatic insects found locally. The overall purpose of the talk is to inspire curiosity among students about backyard ecology, and promote them as young scientist through inquiry.

What is an Adaptation?

An adaptation is a term that refers to a feature that is especially important to an organism's survival. These features develop over many generations in a population, because the organisms with these features are best suited to survive and reproduce; a process known as *natural selection*.

There are many different adaptations to living under water. Like you and I, organisms that live underwater must fulfill some basic needs in order to survive.

What are some common things that all organisms need?

Energy, food, water, oxygen, space, the ability to maintain homeostasis and reproduce

Every organism needs **food** to survive. This food provides an organism with **energy**. In addition, food contains the resources and raw materials it needs to grow and survive such as **nutrients**. Living things need **water** to survive. But why is water so important? Every organism on Earth is made up of mostly water, in fact, a Human's body is about 66% water! This water in your body is used in blood that transports important nutrients and chemicals to your cells. Water is also used to remove waste from the body, and carry out chemical reactions that allow an organism to move and grow.

Organisms get oxygen from their environment in a variety of ways. Many land animals breathe oxygen directly from the air, while animals that spend their time under water often use the oxygen dissolved in the water to survive. No matter how they get it, oxygen is an important need for almost all forms of life.

Homeostasis is a big word that scientists use to explain that organisms need to keep the conditions inside their body relatively constant, even though conditions outside of their body are constantly changing. An example of homeostasis is how an organism who regulates its body temperature.

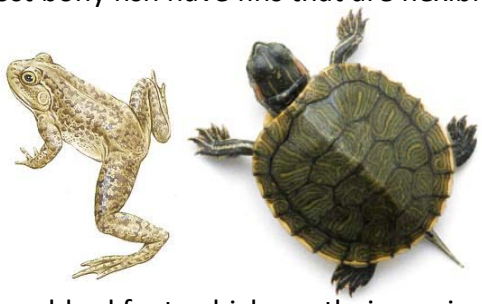
Adaptations of Local Aquatic Organisms

MOVEMENT

Fins

Example: Fish

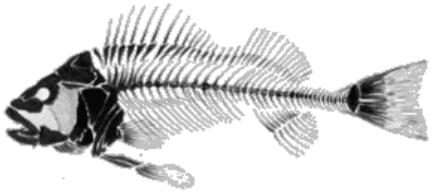
Different group of fish use their fins in different ways. The location, shape and size of a fin is closely related to the way it lives. Primarily, tail fins are used for propulsion and the other fins are used to steer the fish through the water. Most bony fish have fins that are flexible, with rays that provide support and structure.



Webbed Feet

Example: Amphibians (frogs) Reptiles (turtles)

Amphibians that spend their time in water have webbed feet, which are their version of fins. When swimming through water, folds of skin between their toes and fingers are stretched out and aid in movement because there is more surface area to propel their bodies through the water with.



Skeletons

Example: Fish, frogs, amphibians

Most fish are active swimmers and the shape of their skeleton reflects their need to move in water. Thus the skeleton of an average bony fish looks like an arrow where the skull represents the arrows head, the backbone or spine the arrows shaft and the tail represents the feathers. These skeletons have lots of cartilage that make them flexible, and strong muscles are attached to the bones. A fish moves by making an 'S' motion with its spine by flexing its spine left and right. Amphibians on the other hand, move through the water with less of an 'S' motion and alternately are propelled using their limbs and webbed feet. It's important to think about the evolution would have caused these differences in skeleton function. For example, a dolphin uses similar movements as a fish in the water, but instead of flexing its spine back and forth it moves up and down. This is because dolphins' ancestors were land mammals that adapted to living in water.

BREATHING

Internal Gills

When a fish breathes, it draws in a mouthful of water at regular intervals. Then it draws the sides of its throat together, forcing the water through the gill openings, so that it passes over the gills to the outside.

External Gills

Instead of internal gills, they develop three feathery external gills that grow from the outer surface of the gill arches. Sometimes adults retain these, but they usually disappear during metamorphosis, which is the development of the organism from juvenile to adult life

Insects

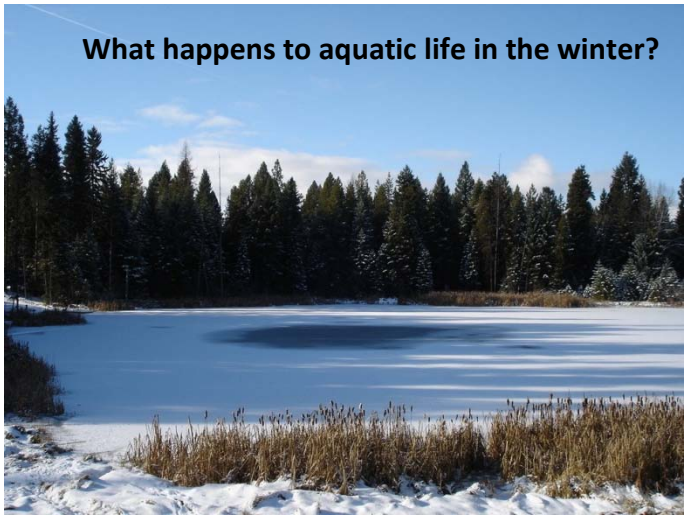
Aquatic insects have a number of different physical adaptation for breathing under water

Mosquito larva with air siphon to the surface

Backswimmers have tiny bristles called setae on their underside that trap oxygen

Maintaining Internal and Ecosystem Balance

Cool adaptations for maintaining **HOMEOSTASIS**



ECOSYSTEM STABILITY AND INVASIVE SPECIES

<u>What are invasive species?</u>

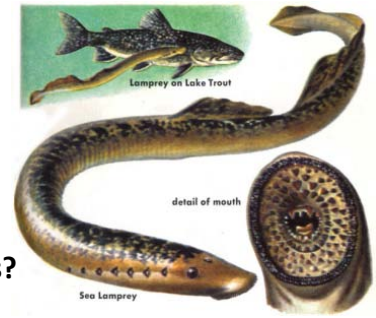
A species that is not native to the ecosystem, and whose introduction may cause significantly greater economic, environmental or harm to human health than benefits. Invasive species compete so well in new ecosystems that they displace native species and disrupt important ecosystem processes. Plants, fish, insects, mammals, birds, and diseases all can be invasive.

<u>What kind of adaptations might make a species good at invading?</u>

They tolerate a variety of habitat conditions
They grow and reproduce rapidly
They compete aggressively for resources (like food, water, and nesting sites)
They lack natural enemies or pests in the new ecosystem

Invasive species of the Finger Lakes:

The sea lamprey and zebra mussel



So, why learn about aquatic adaptations?

We live in a time of environmental changes, with ecological threats such as climate change, loss of habitat and pollution, it is important for people to develop knowledge about how and what organisms need to survive. Organisms have particular roles in their communities and if those communities are destabilized then we risk losing both the services and inherent value that they provide us. Studying how organisms interact with their surroundings allows us to better understand how ecosystems are built and how to best protect and manage them for future generations.