**How Things Live Underwater**

What an individual needs to survive. What a species needs to survive.

**Breathing Underwater**

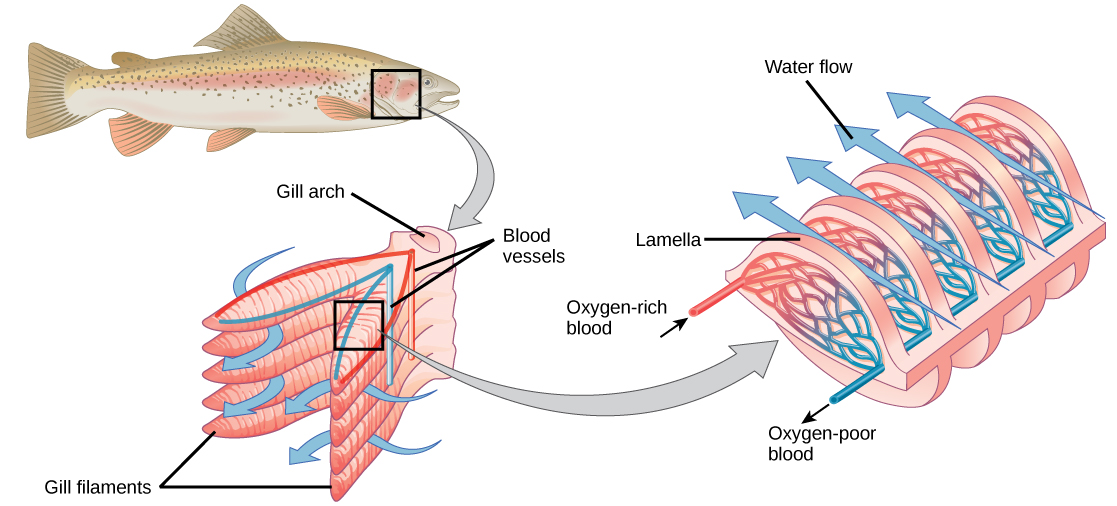
Fish are able to breathe underwater because of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Gills**

Gills function the same way as lungs do:

Lungs work by:

In fish the deoxygenated blood is sent directly to a group of specialized cells called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Seawater is forced across the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and dissolved oxygen in seawater is taken in by the blood vessels and CO2 is kicked out.



Gills are built like a car radiator, with a series of \_\_\_\_\_\_\_\_\_ that weave back and forth. This increases the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the gill that can be exposed to the water. This is needed in the ocean as there is about \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of dissolved oxygen in water (compared to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on land). This means the more surface area the better.

Fish also are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which helps reduce the amount of oxygen they require.

Fish in the ocean are also exposed not just to the oxygen in the water, but also the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* The ocean is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (saltier than the fish). Diffusion will make the fish absorb the salt.
  + In the gills are extra cells called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells. They allow the fish to expel excess salt.
* Fresh water is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (less salty than the fish). This means the salt will be dissolved out of the fish.
  + Freshwater fish have far fewer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells.
  + Freshwater fish also have the ability to make their \_\_\_\_\_\_\_\_\_\_ very dilute so they can still keep their salt levels high enough to live.

**How do mammals hold their breath for so long?**

**Imagine holding your breath while chasing down a giant squid (Architeuthis dux)—multi-tentacled monsters wielding suckers lined with tiny teeth—in freezing cold water, all in the dark. Sperm whales (Physeter macrocephalus) do this day in and day out.**

Many aquatic mammals that can dive have special mechanism that help them \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from their extremities to head to the brain, heart and muscles when starting a dive.

This doesn’t account entirely for their ability to hold their breath for so long.

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can hold their breath for \_\_\_\_\_\_\_\_\_\_\_\_. They have to rely on internal stores of oxygen.

It has recently been discovered that diving mammals have large quantities of a protein called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a protein that binds oxygen in the muscles. Diving animals can have up to ten times the amount of myoglobin in their muscles compared to land animals.

The downside packing too many proteins is dangerous because they can clump together if they get too close. This can cause \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.