



How do fish breathe underwater?

KS2 KS3 Ages 7-14 ⌚ 3 min read

Water contains dissolved oxygen — not the oxygen that makes up the water molecule itself (H₂O), but separate O₂ molecules that have dissolved in from the air. Fish extract this dissolved oxygen using **gills** — organs that function like underwater lungs, but far more efficient.

How gills work

Gills are made of thin, folded filaments with an enormous surface area, richly supplied with blood vessels. As water flows over them, oxygen passes directly from the water into the bloodstream — across a membrane just a few cells thick. At the same time, carbon dioxide passes the other way, from blood into the water. The exchange happens entirely through diffusion — molecules moving from where they're concentrated to where they're less concentrated.

Your lungs and fish gills are doing the same job (gas exchange) with the same mechanism (diffusion across thin membranes), but with different mediums. You pull oxygen-rich air over the membrane; fish push oxygen-dissolved water over theirs. The elegant part is that neither system needs to actively move the molecules — they move themselves, from high concentration to low, like perfume spreading through a room. The membrane just gives them somewhere to cross into the bloodstream.

The counter-current trick

Fish gills use an ingenious trick called counter-current exchange. Blood flows through the gills in the *opposite* direction to the water flow. This means blood is always meeting water that's slightly more oxygenated than itself, maintaining a concentration gradient that drives oxygen transfer along the full length of the gill. By the time water exits, fish have extracted up to 80–90% of the available oxygen. Human lungs, by comparison, extract about 25% of the oxygen in each breath.

Can fish breathe air?

Some can. Lungfish have primitive lungs and can breathe air in addition to using gills. Mudskippers can absorb oxygen through their moist skin and the lining of their

mouth. Certain catfish can gulp air at the surface. The evolutionary path from fish to land animals 375 million years ago likely involved fish that could already extract oxygen from both air and water — fins that could prop them up, and primitive lungs that became more capable over millions of generations.