Fish have a waterproof, therefore gas-tight outer covering. Being relatively large, they have a small surface area to volume ratio = body surface isn't suitable to supply and remove their respiratory gases so they evolved a specialised internal gas exchange surface: the gills.

## **Structure of the Gills:**

Located behind the head. Made up of <u>gill filaments</u>. These are **stacked up in a pile** (like book pages). At right angles to the filaments are <u>gill lamellae</u> = <u>increase surface area of gills</u>. Water is taken through the mouth and furter over gills and out through an opening on each if of the body. The flow of water

over the gill lange are ord the flow of blood witton mem are in opposite directions = <u>counter current flow</u>. Its important to ensure that maximum gas exchange is achieved, if water and blood flowed in the same direction, far less gas exchange would occur.



## Counter-Current exchange principle:

The flow of blood and water over the gill lamellae is in opposite directions. This means that:

Blood that is already well loaded with oxygen meets water, which has its maximum concentration of oxygen. Therefore diffusion of oxygen from the water to the blood takes place.

Blood with little oxygen in it meets water which has had most, but not all of the oxygen removed. Diffusion of the gen from water to blood takes place.

A Cesut, a diffusion gradient for oxygen uptake is maintained across the entire width of one gill lamellae. So about 80% of the oxygen available in the water is absorbed into the blood of the fish. If the flow was in the same direction (parallel flow) only 50% would be absorbed by blood.





There is a diffusion gradient favouring the diffusion of oxygen from water into the blood all the way across the gill lamellae. Almost all the oxygen from the water diffuses into the blood.





Numbers represent relative oxygen concentrations

Diffusion of oxygen There is a diffusion gradient favouring the diffusion of oxygen from water to blood for only part of the way across the gill lamellae. Only 50% of the oxygen from the water diffuses into the blood.