

Excretion and Osmoregulation in Fish

Because of their environment, osmoregulation in fish presents specific problems.

Fish have adaptations that enable them to deal with these problems.

Those which live in fresh water or sea water have different problems.

Role of Kidneys and Gills

- The continual uptake of water in freshwater species is regulated by the kidneys which continually produce large amounts of dilute urine.
- Despite the importance of healthy kidneys to help counteract the problem of taking on water, some salts are also lost in the large amounts of urine as well as through the membrane of the gills.
- Fortunately, the gills are also a site of ion uptake. Special cells in gill contain sodium and chloride "pumps". These pumps are special enzymes that use energy to move the ions up their concentration gradient (remember that moving down a concentration gradient is spontaneous, as in diffusion, and requires no input of energy) to maintain their higher concentration in the body.

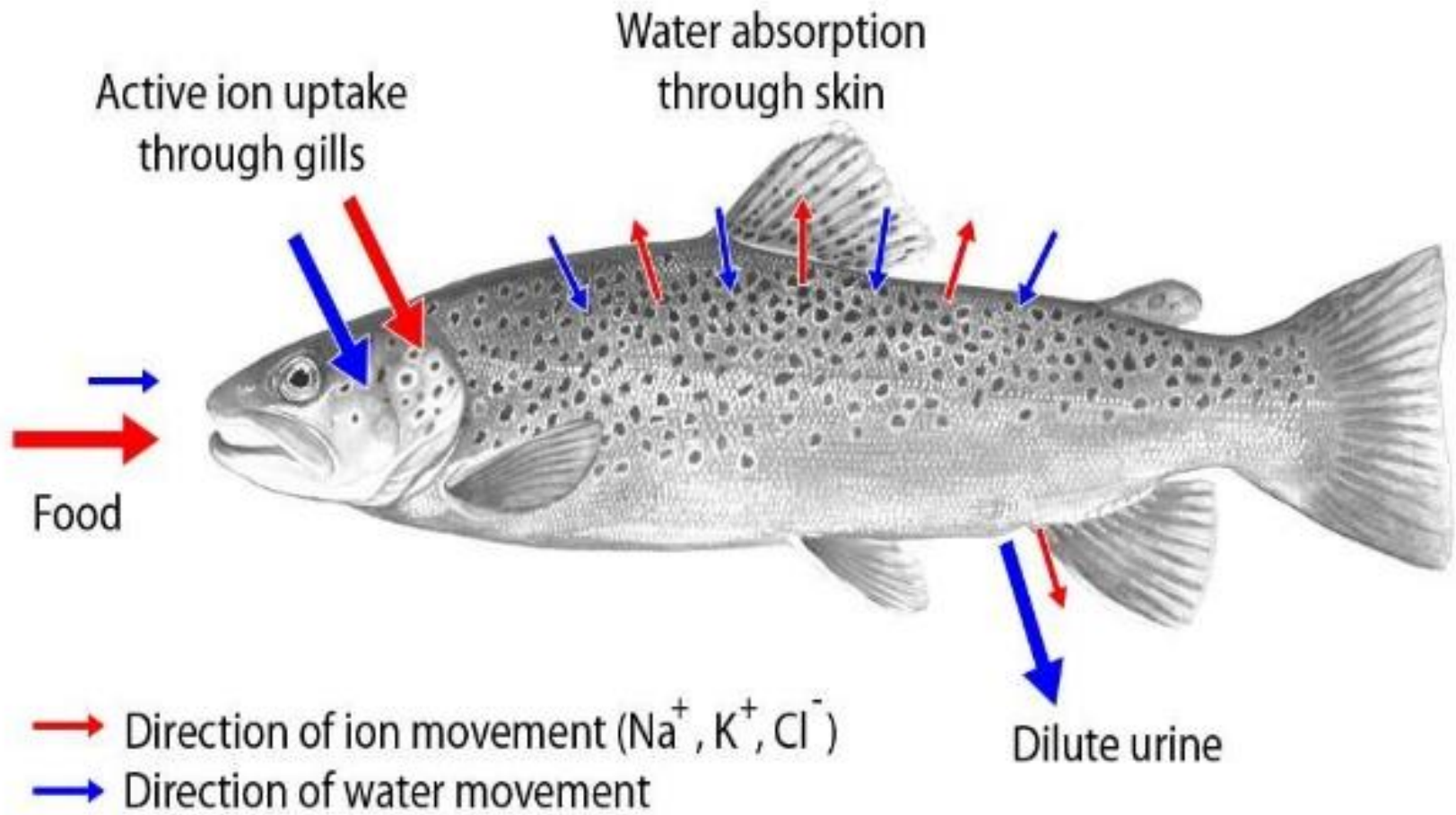
1. FRESHWATER FISH

Problems:

- These fish are *hypertonic* to their surroundings. This means their blood has a lower water concentration than the surrounding fresh water.
- As fresh water passes through the mouth and over the gill membranes, water molecules diffuse from the fresh water into the blood by osmosis.
- These fish must produce a very large volume of urine to balance this large intake of water.
- This large volume of urine carries salt with it, and the salt has to be replaced.

Solutions by fresh water fish:

- To produce a large volume of urine the fish must remove a large volume of water from the blood by having a high rate of filtration into the kidney tubules.
- This is done by having a kidney with many large glomeruli - capillary networks from which fluid is filtered at the start of the kidney tubules.
- Salt replacement is solved by chloride secretory cells in the gills, which actively transport salts from the surrounding water into the blood.

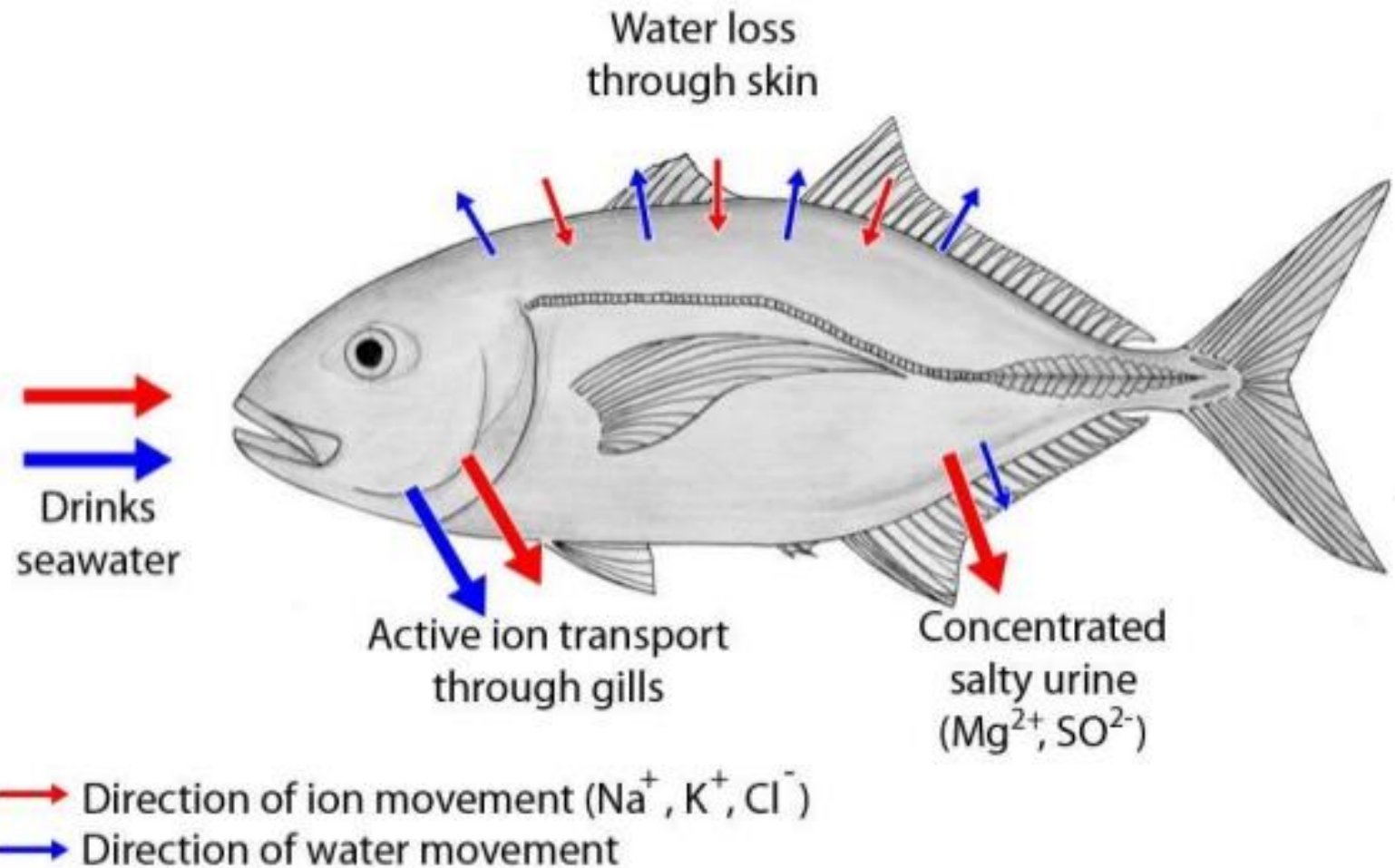


Movement of water and ions in freshwater fish

2. SALTWATER FISH

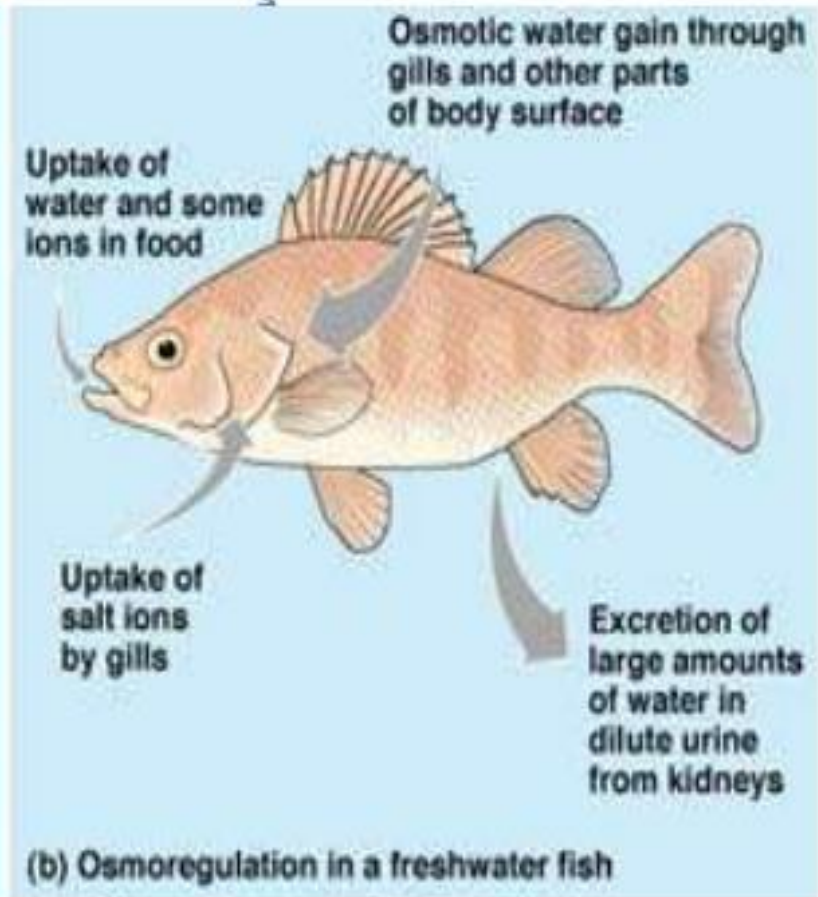
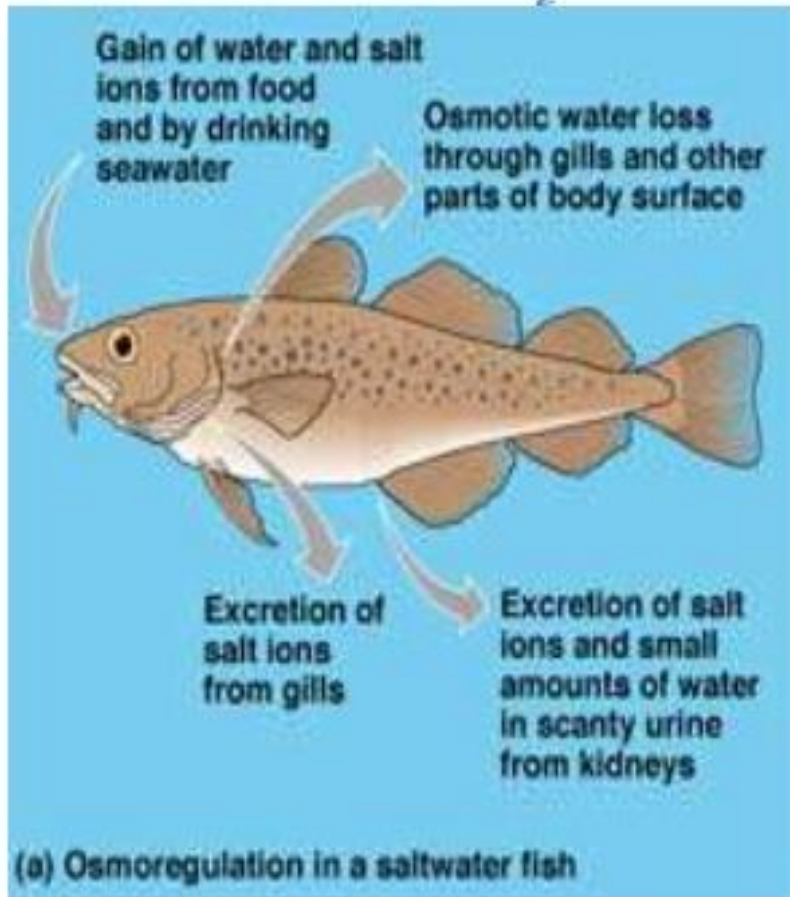
Problems:

- These fish are *hypotonic* to their surroundings. This means their blood has a higher water concentration than the surrounding sea water.
- As sea water passes through the mouth and over the gill membranes, water molecules diffuse out of the blood into the sea water by osmosis.
- These fish must replace the water which they constantly lose by osmosis
- They can also only afford to produce a very small volume of urine.
- Drinking sea water brings a large quantity of salt into the blood and this has to be removed.



Movement of water and ions in sea water fish

Let's explain it little more



Osmoregulation in fish (freshwater)

- Fish do not always find themselves in isotonic environments.
- Thus, their body cells must have a means by which to adapt to changing salt concentrations in their bodies and environments.
- Osmoregulation controls this balance of water/salt concentrations.
- Freshwater fish are hypertonic to their water environment and therefore, water is continually diffusing into the fish through the gill membranes into the blood.
- The gills are also permeable to respiratory gases, ammonia waste products, and ions.

References

www.slideshare.net