Student 5: Low Achieved

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Homeostasis is the way animals maintain a stable internal balance in their body. It allows animals to function in the changing external conditions surrounding their body. Homeostasis is important to Chinook salmon because they depend on the functioning of its cells to help its survival and ability to reproduce. Osmoregulation is an example of homeostasis. It is way osmosis is controlled by salmon to maintain a water balance. Osmosis is the net movement of water molecules from an area of high concentration to an area of low concentration. 1

Salmon live in both fresh water and salt water during their lives. They are born in in fresh water and migrate out to marine waters for most of their life. They return to the place they were born in fresh water to spawn. Changing between fresh water and salt water changes the balance of water in their body. Salmon need to maintain the balance of water and salts in their bodies. They are adapted to the changes they face in their lifetime through the control system called osmoregulation. 1

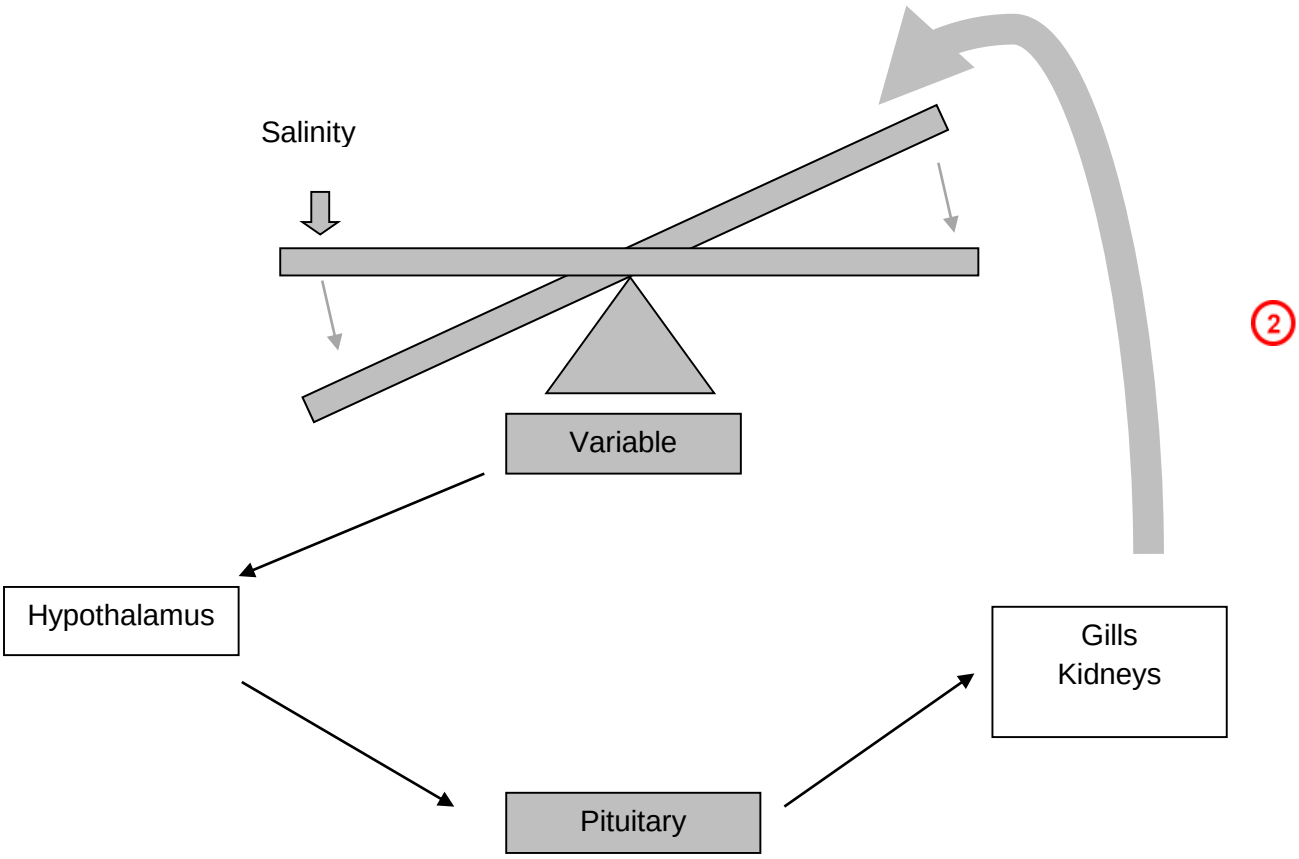
Whenever an imbalance occurs, osmoregulation restores the balance by negative feedback. This control system detects the changes and initiates changes to maintain a constant concentration of water in the body. Osmoregulation is an example of a negative feedback, control system. This system detects changes in the salt concentration of the water Chinook salmon live in. The feedback mechanism works differently when they are in fresh water and salt water environments. 3

Like all negative feedback systems it is made up of components which detect the change, followed by a process to reverse the change. The components in the negative feedback system include (see diagram below): the **stimulus**, the **receptor**, the **control centre** and the **effector**. The stimulus is the thing which causes the fish's response. In this case it is the change in water salinity or salt level within the body. The receptor senses and detects the stimulus and sends information to the control centre. In salmon the receptor is the hypothalamus, part of the brain. The hypothalamus detects how concentrated the blood is inside the fish. The hypothalamus stimulates the pituitary gland, which is the control centre. The control centre determines the appropriate response to the stimulus. The effector includes the kidneys and gills, which respond to the commands set by the pituitary gland. 2

When salmon are in salt water there are more water molecules inside the body cells than outside the body cells. Water molecules move out of the body cells. Receptors in the hypothalamus detect that there is a high concentration of salts in the blood, and stimulate the pituitary glands to release a hormone into the bloodstream. This causes the transport of ions to take place in the gill membrane - the main site for the transport of sodium and chloride ions. The high salt concentration in the ocean means that salt will be constantly diffusing into the salmon's body, which means that salmon suffer from dehydration and salt loading. To prevent dehydration salmon drink several litres of water a day. Water and salts can move through the gill membrane to maintain the balance. 3
The kidneys are used to remove excess salts through their urine, which is quite concentrated. The concentrated urine is also due to the increase in a hormone (ADH) which causes more water to be reabsorbed by the kidneys.

When salmon are in fresh water, there are more water molecules and low levels of salt outside their body cells than inside their body cells, so water molecules move inside the body cells. In fresh water salmon suffer from salt loss and water loading. Receptors in the 3

hypothalamus detect the high concentration of water within the blood to stimulate the pituitary glands to release a hormone into the bloodstream. The hormone causes the transport of ions to take place within the gill membrane. The salmon will not drink much and a large quantity of water is expelled.



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A number of environmental factors can lead to disruptions in the control system, such as toxicants and micro-organisms which fish gills are sensitive to. It is also possible that pollutants clog the gills directly. Excessive loss of water molecules can cause dehydration which can ultimately result in death. Damage to the kidney through bacterial infection can also be lethal. When the control system breaks down, salmon are under stress and may not be able to break down food or carry out essential life processes. For example, the excretion of waste products which can then build up and cause further harm to the fish.

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