

Role of the kidneys and liver in homeostasis



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What is homeostasis? Homeostasis is what gives the living organism (animal) the ability to keep their internal body at a balanced state. For example it will keep the amount of water that is in the animal's body at around the same level. If there was too much water in the body the kidneys will then excrete it as urine.

Negative feed back

In a living organism like the dog all of the mechanisms that help the homeostasis use negative feedback. This is what maintains the constant value which is needed in the animal's body; this is known as the set point. Negative feedback occurs whenever a change happens in the internal environment of the living organism. As soon as that particular change happens, like the temperature, the negative feedback will automatically cause the corrective mechanism to begin. This is what reverses the original change and begins the process of getting the internal environment back to the way that it was before the change occurred. This means that the bigger the change that has happened in the internal system, the more the corrective system is. This is what makes it easier for the corrective mechanism to correct the problem.

In the living organism, negative feedback is never maintained perfectly but it will be maintained to the best of the ability. It is constantly oscillating around the set point. This means that it will try to keep the balance around the same point. To keep the water balance at the same level, at around the same amount. If it is not at that amount, it will only be over or under by a few millilitres.

What factors must be kept constant?

There is a number of factors that must be kept constant in the animals body. These factors will be kept constant by homeostasis. The factors that must be kept are: chemical constituents for example glucose and ions etc, osmotic pressure, this is determined by the relative amounts of water.

Temperature homeostasis

Temperature homeostasis is one of the most important examples of homeostasis that there is in the living organism. Temperature homeostasis is keeping the animal's body temperature at a steady temperature which will mean it will help the animal from over heating or getting too cold. Animals that maintain a good balance of their body temperature (birds and mammals) are known as homeotherms. Other animals that have a temperature that varies is known as poikilotherms. Homeotherms will usually maintain their body temperature at around 37°C animals like this is sometimes known as warm blooded animals. Although the poikilotherms can also have very warm blood if they have been basking in the sun for a while.

Effectors

Response to low temperature

Response to high temperature

Smooth muscles in the peripheral arterioles which is in the skin.

As the muscles contract which causes vasoconstriction, less heat is carried from the core to the surface of the animal's body. If the animal gets too cold the extremities could turn blue can be damaged in worst cases

The muscles relax which causes vasodilatation more heat is then carried from the core to the animal's body surface. This is where it is lost by thier convection and the radiation, the skin can turn red.

Sweat glands

If the living animal is cold there is no sweat produced

When the living animal is warm sweat glands begin to produce sweat on the surface of the animal's skin. It will be evaporated here. This is an endothermic process and water has a high latent heat of evaporation. This means that the living animal takes the heat from the body

Erector pili muscle in the skin (attached to the skin)

As the muscles contracts, the hair rises which traps an insulating layer of still warm air which is next to the skin. This is not very effective in humans as it is what causes them to get goosebumps. In animals this process is useful.

As the muscles relaxes the hairs will lower which allows the air to circulate over the skin which is what encourages convection and evaporation

Skeletal muscles

As the muscles contracts and relax repeatedly heat is generated heat by the friction and forms metabolic reactions

If the animal needs to warm up the body up and won't be shivering

Adrenal and thyroid glands

The glands secrete adrenaline and thyroxin. This is what increases the metabolic rate in the different tissues. Especially in the liver.

The glands stop releasing the adrenaline and also stop releasing the thyroxin.

Behaviour

If the animal is cold the living animal can curl up, huddle, or find some sort of shelter to heat it up

If the animal is too warm the animal could find some sort of shade to cool it down, it could go in to water.

Blood glucose homeostasis

Glucose is what transports carbohydrates in the animal's body. The concentration in the blood affects all of the cells in the animal's body. It is controlled strictly within the range of 80-100mg. If the animal has a very low level or a very high level of this it could cause death in the worst cases.

The blood glucose concentration is controlled by an organ that is known as the pancreas. The pancreas contains a glucose receptor which is what allows it to monitor the concentration of the amount of glucose which is in the animal's blood. It also contains endocrine cells which is also known as the islets of Langerhans. This is what gives the animal the ability to secrete the hormones. The α cell is what secretes the hormone which is known as glucagon, whilst the β cell secretes the hormone insulin. These two

hormones are known as antagonistic, which have the opposite effect on the blood glucose.

Insulin- this is what stimulates the uptake of the glucose by the cells that is for respiration, and in the liver it stimulates the conversion of the glucose in to the glycogen. This means that it decreases the blood glucose.

Glucagon- this is what stimulates the breakdown of the glycogen to glucose. This is done in the liver. In the extreme cases it also has the ability to stimulate the synthesis of the glucose. This is what increases the blood glucose.

Once the animal has eaten, the glucose is then absorbed from the gut into the hepatic portal vein, increasing the blood glucose concentration that there is in the animals body. The pancreas detects this and when it detects this it secretes the insulin. Insulin causes the glucose to be taken up by the liver and then converted to glycogen. This is what reduces the blood glucose which means the pancreas stops to secrete the insulin. If the level of blood glucose was to fall to low the pancreas also detects this and starts to release glucagon. This is what causes the liver to break down an amount of glycogen so it can store it as glucose. This is then diffused in to the blood and carried around the body.

Blood Water homeostasis

There is a certain amount of water that is in the animals body which is needed. This amount of water must be regulated to prevent any loss or gain of water that is in the animals body cells. This type of homeostasis is known

as hypothalamus which contains osmosreceptor cells. This is what detects the changes that has occurred in the water potential of the blood that is passing through the brain. This control gives the sensation of thirst, and also secretes the hormone, which is known as ADH (antidiuretic hormones). This hormone is stored in a gland which is known as the pituitary gland. The target cells is the endothelial cells of the collecting ducts of the kidney nephrons. These cells is usually with in the water molecules which can only cross their membranes by going through the water channels which is known as the aquaporins, rather than going through the lipid bi-layer. The ADH hormones is what causes the water channels to open. If there was to much water in the animals body the excess water will be sent to the kidneys to be secreted as urine. This is the main function of the kidneys that aids homeostasis.

Advantages of homeostasis

There is a number of advantages that homeostasis has for an animal. These advantages are that it has a survival value, meaning that the animal has the ability to adapt to an environment that is changing. It is able to deal with all sorts of changes like a change in temperature, water balance changes, etc. All animals will attempt to keep the body at a level that is their desired factor so it can achieve the homeostasis that the animal needs to do to survive. This only works with in tolerable limits so if the internal environment changer to much it would cause complications and the body would find it difficult to change the environment back to the way it was before the change.

Liver and pancreas

As mentioned above the liver plays a part in homeostasis. The liver does not have the ability to perform the homeostatic function if it is not aided with the help of the pancreas. For the liver to perform in the correct way it has to receive information that is giving it instructions on what to do. This is provided by the hormone which is known as insulin, which is secreted into the blood stream from special groups of cells (islets of Langerhans) which is stored in the pancreas.

Kidneys

The kidneys have a number of functions that help the animal to survive. The main functions are filtering the blood, removing any waste products that is in the blood and it also helps the regulation of the pH levels. Three main functions of the kidney that aid homeostasis are maintaining the correct amount of blood volume, ion balance maintenance which is also known as the maintenance of the pH level and last of all the removal of any waste products that is in the blood. If the kidney detected that there was too much water in the animal body it will secrete it out of the animal's body by urinating.