

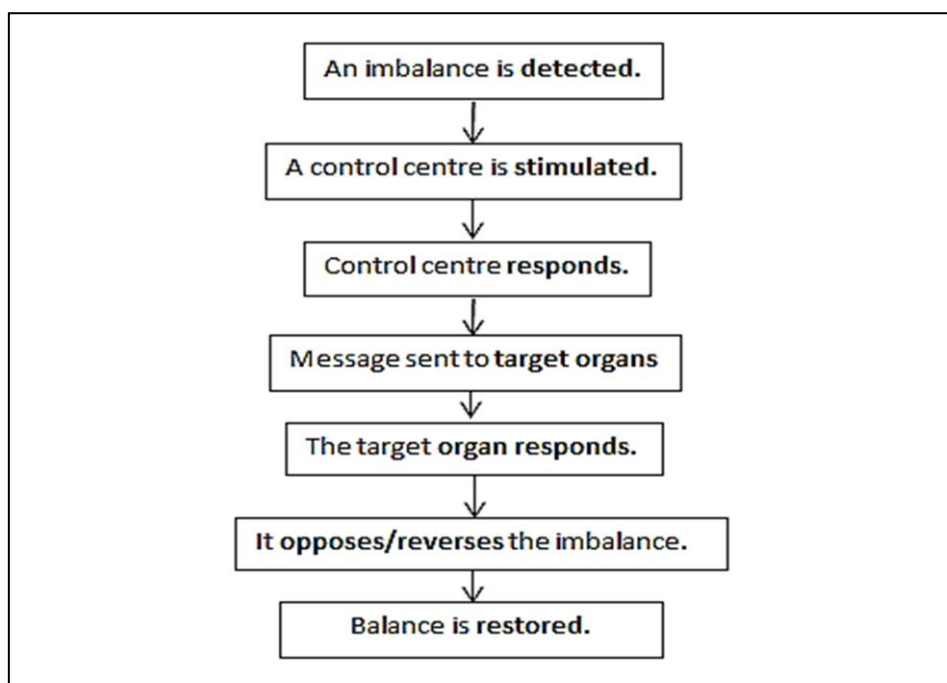
HOMEOSTASIS IN HUMANS

1. Introduction

- **Homeostasis** is the process of maintaining a constant, internal environment within narrow limits, despite changes that take place internally and externally
- The internal environment refers to the **blood and tissue fluid** that surrounds the cells of the body
- Homeostasis enables the body to function efficiently, despite changes that might occur in the external or internal environment.
- **Negative feedback mechanism:** when there is an increase from normal, a corrective mechanism causes a decrease and vice versa to maintain a balanced system.
- The conditions within cells depend on the conditions within the internal environment (the tissue fluid)
- Factors such as carbon dioxide, glucose, salt and water concentration, temperature and pH must be kept constant in the internal environment (tissue fluid)

2. Negative Feedback Mechanisms

- When there is an increase from normal, a corrective mechanism will cause it to decrease and vice versa. This ensures that a balance is maintained within the body.



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A. Negative feedback mechanism controlling the concentration of Glucose

+ Increase in Glucose above normal	Detected by	Secretes	Target	Action	- Blood glucose level decrease back to normal
	The pancreas	the Islets of Langerhans secretes (Beta cells) Insulin	Cells	Stimulates cells to absorb excess glucose	
			Liver	Stimulate the liver to convert glucose into glycogen	

Negative feedback

- Decrease in Glucose below normal	Detected by	Secretes	Target	Action	+ Blood glucose level increase back to normal
	The pancreas	the Islets of Langerhans secretes (Alpha cells) Glucagon	Liver	Stimulate the liver to convert glycogen into glucose	

Negative feedback

Diabetes mellitus

Causes	Symptoms	Management of diabetes mellitus
- Inadequate secretion insulin - Non-secretion of insulin - Production of defective insulin - Body cells resistant to the action of insulin - Inability of the cells to use glucose efficiently	- Glucose in the urine - Frequent urination - Extreme thirst - Fatigue - Weight loss - Blurred vision - Non-healing of wounds	- Exercise - Eating diet suitable for diabetic person - Using prescribed medication/drugs

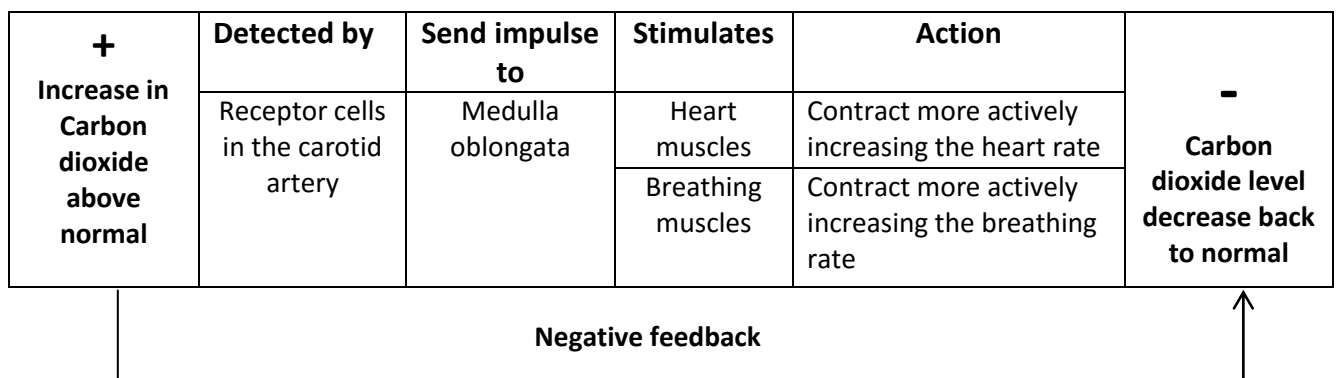
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B. Negative feedback mechanism controlling the concentration of Carbon dioxide

- Cells need a constant supply of oxygen for cellular respiration and the carbon dioxide formed is toxic.
- It must be removed from the body in order to have a stable internal environment.
- Normal breathing can be voluntary for short periods e.g. for speech, holding one's breath under water etc.
- Normal respiration is however controlled by the medulla oblongata of the brain.
- Yawning is stimulated by excess carbon dioxide in the blood and results in prolonged inspiration/inhalation (a long breath).

CO₂ negative feedback mechanism

- CO₂ levels in the blood increase **above** normal levels
- **Receptor** cells
- in the **carotid artery/aorta** are stimulated
- to send impulses to the **medulla oblongata** in the brain
- which then **stimulates** the heart to beat **faster**
- and the breathing muscles /example
- to contract **more** actively
- This **increases** the rate/ depth of breathing
- **More** CO₂ is taken to and exhaled from the lungs returning the CO₂ level in the blood to **normal**



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C. Negative feedback mechanism controlling the concentration of Water

- Cells function best under the correct **pH** and **osmotic pressure**
- Water, mineral salts and metabolic wastes affect the pH and osmotic pressure if they are not kept at a constant level
- **Osmoregulation**: maintaining the water and salt (ion) balance
- If tissue fluid is **HYPERTONIC** (less water), cells lose water and shrink.
- If tissue fluid is **HYPOTONIC** (more water) then the cells gain water and will burst.
- **Hormones** control the amount of water and salts that are reabsorbed.

I, L, L, L, L

+ Increase in water level	Detected by	Stimulates	- Secretes	Target	-	-	-	- Water level decrease s back to normal
	Osmoreceptors in the hypothalamus	Pituitary gland	Less ADH	Renal tubules	Less permeable (renal tubules)	Less water is re- absorbed	Less concentrated urine is produced	

Negative feedback

D, M, M, M, M

- Decrease in water level	Detected by	Stimulates	+ Secretes	Target	+	+	+	+ Water level increases back to normal
	Osmoreceptors in the hypothalamus	Pituitary gland	More ADH	Renal tubules	More permeable (renal tubules)	More water is re- absorbed	More concentrated urine is produced	

Negative feedback

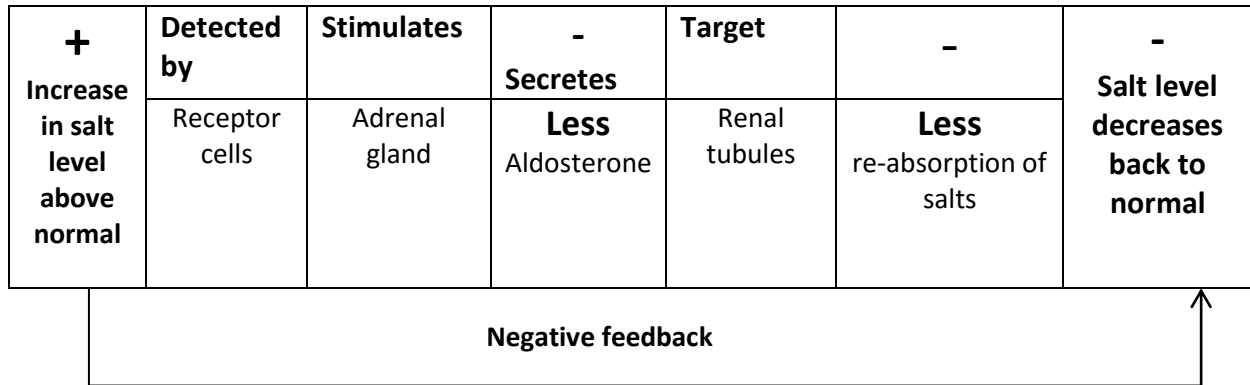
Effect of alcohol/Frequent urination after drinking alcohol

- Alcohol inhibits/reduces the secretion of ADH causing renal tubules to become less permeable to water and therefore less water is reabsorbed back into the blood and more urine is produced.

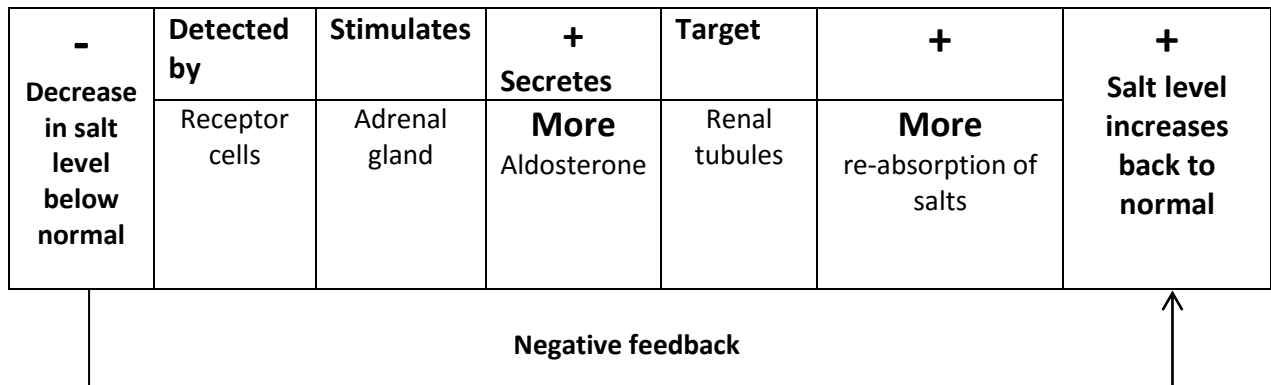
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D. Negative feedback mechanism controlling the concentration of Salt

I, L, L



D, M, M



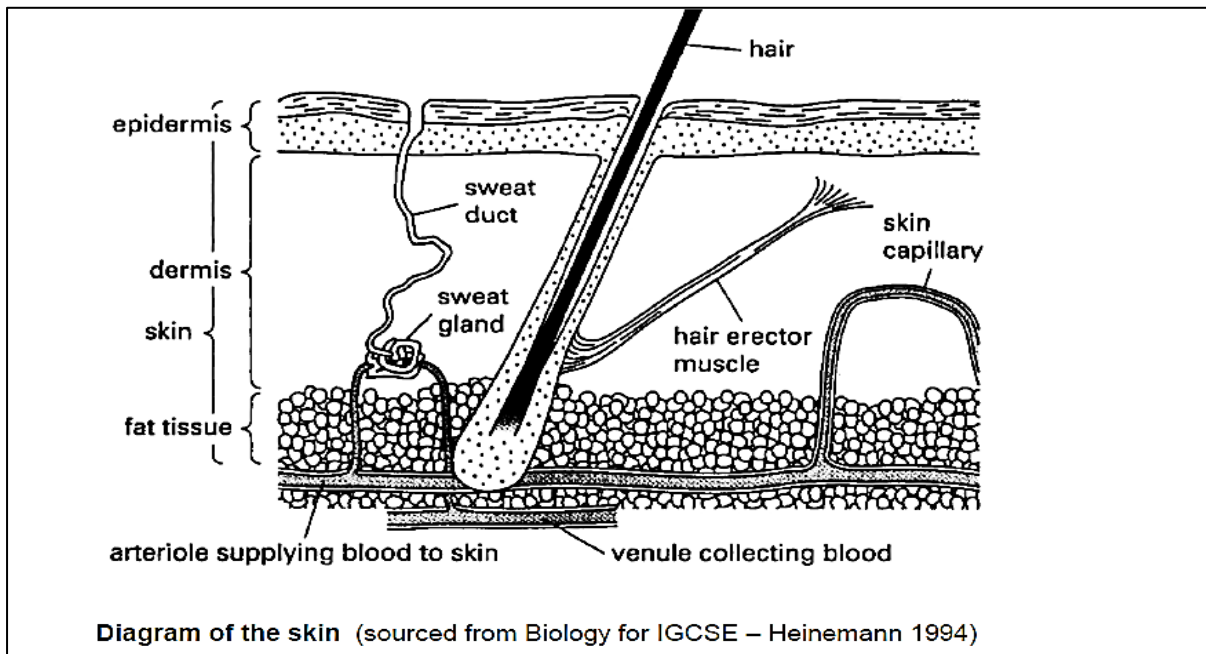
3. Thermoregulation

- **Thermoregulation:** a regulatory process to keep a constant body temperature.
- Optimal body temperature in humans is between 36,6 °C and 37 °C
- If the temperature is too high, the proteins will **denature** and be **unable to function**
- If the temperature is too low, the proteins will become **inactive** – the body temperature must be kept constant
- The hypothalamus stimulates various systems to regulate the body temperature. When the body is hot, the hypothalamus will stimulate the pituitary to **release more ADH** and **less thyroxin**. When the body is cold, the opposite will take place.
- **Sweating:** the secretion of water and dissolved waste substances from the sweat glands through ducts, onto the skin surface to cool the body down by evaporation.
- **Vasodilation:** is the widening of blood vessels by relaxing the smooth muscle cells in the walls of the arteries, veins and capillaries to decrease the pressure of the flow of blood
- **Vasoconstriction:** is the narrowing of blood vessels by contracting the smooth muscle cells in the walls of the arteries, veins and capillaries to increase the pressure of the flow of blood.

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Structure of the skin

- The skin is well adapted to aid in temperature regulation:
 - a large surface area
 - many blood vessels and capillaries
 - numerous sweat glands
 - hairs with erector muscles and adipose tissue (fat deposits)
 - thermoreceptors (receptors that are sensitive to changes in temperature)



Hot day	Cold day
On a hot day body temperature increases above normal - Heat receptors in the skin are stimulated by high temperature - Impulse is sent to the hypothalamus - Impulses is sent to the blood vessels - Impulse is sent to the erector muscle - Vasodilation occurs - More blood flows to the skin - Sweat glands are activated - More sweat is released - More heat is lost through evaporation of sweat - The erector muscle relaxes - To lie flat on the skin - Trapping very little air between the hair - Insulation is thus reduced - Causing cooling The body temperature decreases back to normal	On a cold day body temperature decreases above normal - Heat receptors in the skin are stimulated by low temperature - Impulse is sent to the hypothalamus - Impulses is sent to the blood vessels - Impulse is sent to the erector muscle - Vasoconstriction occurs - less blood flows to the skin - Sweat glands less active - less sweat is released - less heat is lost through evaporation of sweat - The erector muscle contracts - To lie flat on the skin - Trapping air between the hair - Insulation is thus increased - Causing less cooling/body heat is conserved The body temperature increases back to normal

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Negative feedback mechanism for controlling temperature/thermoregulation

I, M, M, M

+	Detected by	Stimulates	Target	+	+	+	+
Increase in body temp. (hot day)	Thermoreceptors in the skin	hypothalamus	Blood vessels of the skin	vasodilation occurs the blood vessels	More blood flows to the surface of the skin	More sweat is lost as sweat gland is activated	More heat is lost by evaporation

D, L, L, L

-	Detected by	Stimulates	Target	-	-	-	-
Decrease in body temp. (cold day)	Thermoreceptors in the skin	hypothalamus	Blood vessels of the skin	Vasoconstriction occurs in the blood vessels	Less blood flows to the surface of the skin	less sweat is lost as sweat gland not is activated	Less heat is lost by evaporation

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