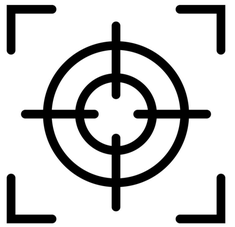
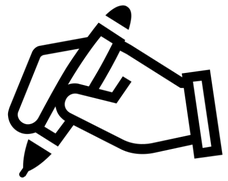
Topic 10: Homeostasis

Chapter Analysis



FOCUS

- straightforward chapter
- very much linked to hormones and excretion



EXAM

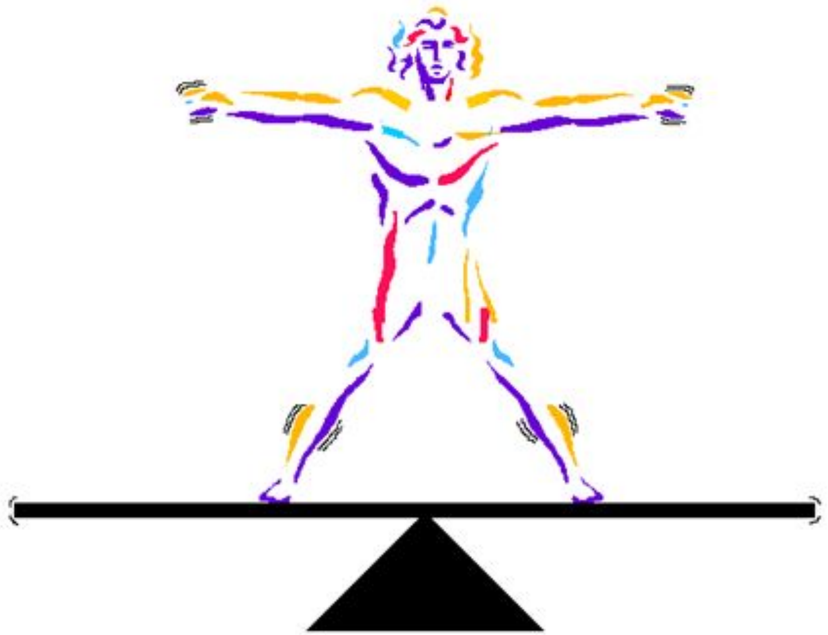
- commonly tested in MCQ and structured questions
- tested twice in section B in the past 5 years

WEIGHTAGE

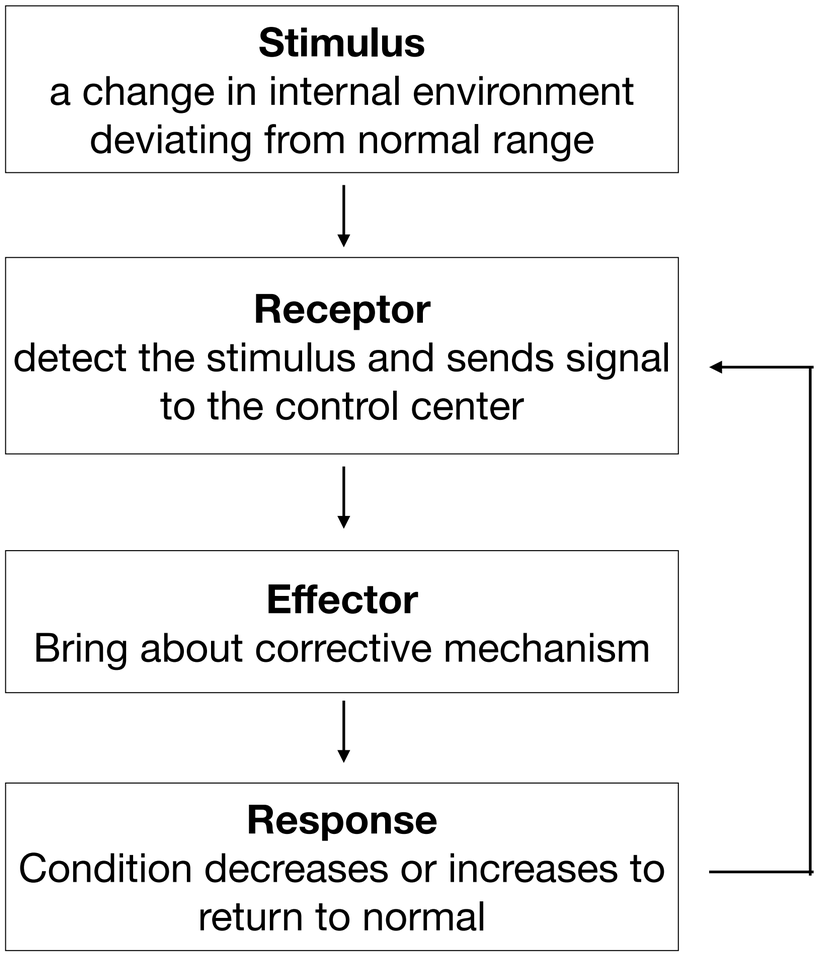
- Constitute to around 4% in Paper 2 in the past 5 years

Key Concept

homeostasis
negative feedback



homeostasis



Homeostasis is the **dynamic maintenance** of a **constant internal environment.**

- Internal Environment refers to conditions within the body of the organism such as **body temperature (this chapter), blood glucose level (hormone chapter), water potential of blood (excretion chapter)**
- Homeostasis allows an organism to be independent from changes in the external environment.

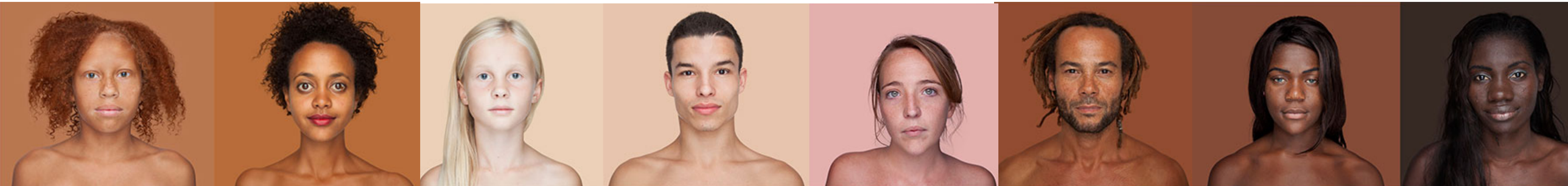
Negative feedback is the **corrective mechanism** where the body reacts to **bring about an opposite effect** to the changes detected and **restore the normal conditions** of the internal environment.

Negative feedback

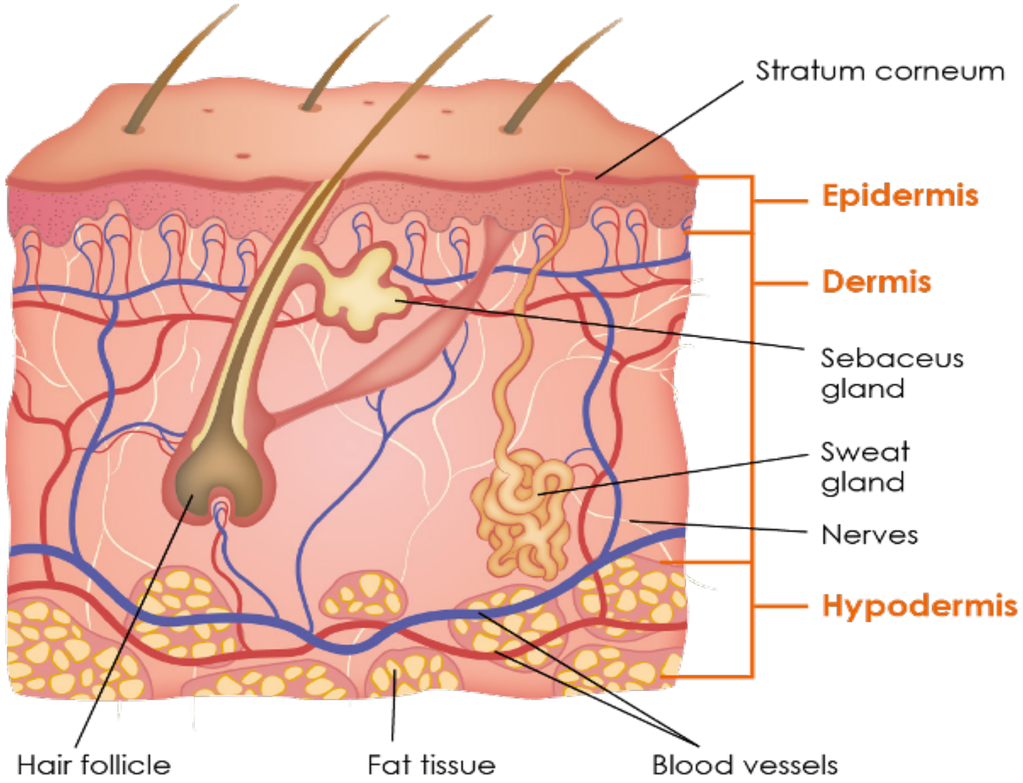
- stimulus: body temperature increases above normal
- receptor: thermoreceptor sensed the increase
- effector: body reacts to decrease body temperature
- response: body temperature successfully decrease and back to normal
- negative feedback: Thermoreceptor receives feedback that the temperature is back to normal. This causes the corrective mechanism to stop.

Key Concept

skin thermoregulation



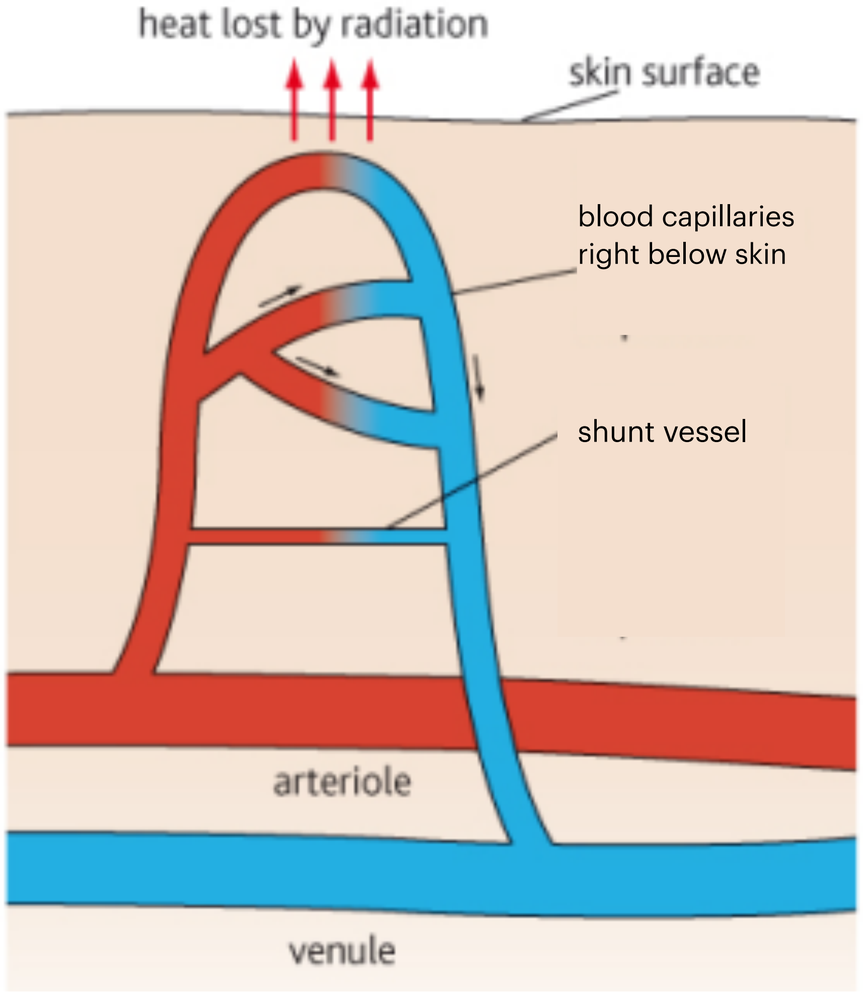
structure of skin



Epidermis	outermost layer which forms a waterproof and protective covering	
Dermis	Inner later containing hair follicles, sweat glands, sebaceous glands, blood vessels, sensory receptors	
	Sensory receptors	detect changes in the environment, eg enable us to sense pain (pain receptors), pressure (mechanorecptors) and **temperature changes (thermoreceptors)**
	Hair follicles	Each hair grows inside a hair follicle
	Hair erector muscles	When these muscles contract, the hairs are raised and when the skin around the hair is raised, “goose bumps” are produced
	Sebaceous glands	Produce Sebum
	Sweat glands	A coiled tube Secrete sweat through a sweat duct. sweat contains water, sodium chloride and small amounts of urea
Subcutaneous Tissue / Hypodermis	This layer consists of adipose tissue. Adipose cells store fat. This layer serves as insulation to reduce heat loss and padding.	

structure of skin

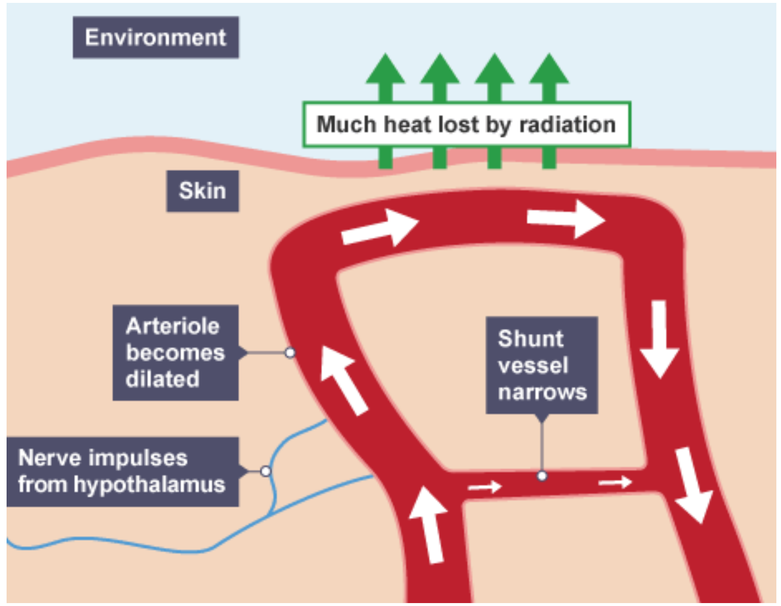
blood vessels in skins



Arterioles	The arterioles leading to the blood capillaries in the dermis are controlled by nerves. They respond to stimulation by undergoing vasoconstriction and vasodilation. • **Vasoconstriction** is the contraction of smooth muscles in the arteriole walls. It decreases the diameter of the blood vessels, reducing blood flow. • **Vasodilation** is the relaxation of smooth muscles in the arteriole walls. It increases the diameter of the blood vessels, increasing blood flow.
Shunt Vessel	• A blood vessel that **links an artery directly to a vein**, allowing the blood to bypass the blood capillaries. • Shunt vessels can control blood flow by **constriction and dilation.**

thermoregulation

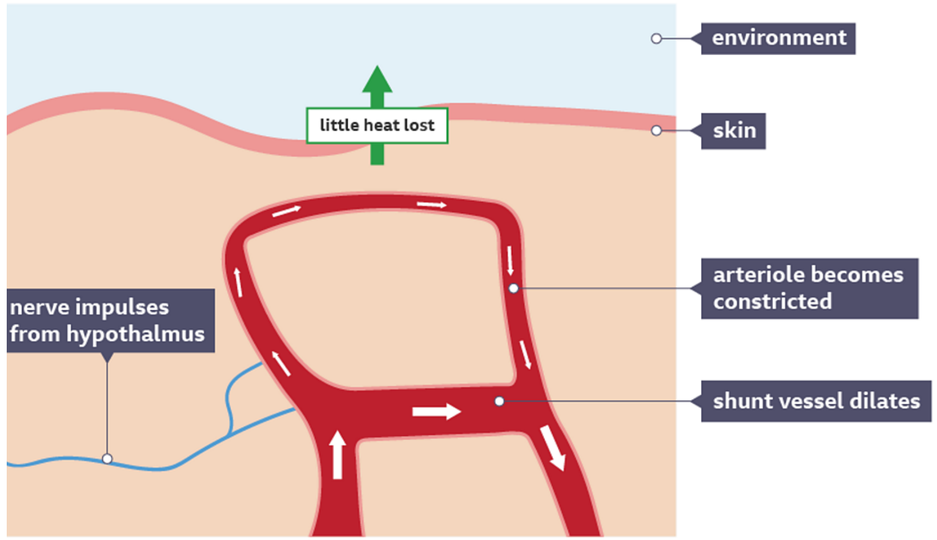
body temperature increases beyond normal



Stimulus	**Body temperature increases beyond normal** e.g. vigorous exercise, consumption of hot food, being in warm environment
Receptor	• **Thermoreceptors** in our skin which **detects increase in temperature** from the environment • Thermoreceptors in the hypothalamus which detect increase in temperature of the blood • They **send signals to** the control centre, **hypothalamus in brain**
Effector	Hypothalamus thus send signals to 1. **Stimulate vasodilation of arterioles** in our skin and constriction of shunt vessels. This **increases blood flow in capillaries in skin** so more **heat is lost through conduction, convection and radiation.** 2. Sweat glands become more active and increase **sweat production**. When **water in sweat evaporates**, it **removes latent heat of vaporisation** from the body 3. **Decreased in metabolic rate** to reduce amount of heat produced by our body
Response	Temperature decreases

thermoregulation

body temperature decreases beyond normal



Stimulus	**Body temperature decreases beyond normal** e.g. being in cold environment
Receptor	• **Thermoreceptors** in our skin which **detects decrease in temperature** from the environment • Thermoreceptors in the hypothalamus which detect decrease in temperature of the blood • They **send signals** to the control centre, **hypothalamus in brain**
Effector	Hypothalamus thus send signals to 1. Stimulate **vasoconstriction of arterioles** in our skin and **dilation of shunt vessels.** This **decreases blood flow in capillaries in skin** so **less heat is lost through conduction, convection and radiation.** 2. Sweat glands become less active and **decrease sweat production**. Less latent heat of vaporisation is removed 3. **Increased metabolic rate** to increase the amount of heat released by our bodies. 4. **Shivering** which is a i**nvoluntary contraction of muscles** will lead to cellular **respiration of muscle cells** thus **increase heat released**
Response	Temperature increases

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