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B9 COORDINATION AND RESPONSE

B9.1 Nervous control in humans

A nerve impulse is an electrical signal that passes along nerve cells called neurones.

The human nervous system consists of:

- the central nervous system.

The CNS is made up of the brain and the spinal cord

The CNS is connected to different parts of the body by nerves that make up the peripheral nervous system (PNS).

- the peripheral nervous system.

The PNS is made up of nerves that arise from the brain and spinal cord, and go to all the organs of the body.

- coordination and regulation of body functions

Distinguishing between voluntary and involuntary actions

Voluntary action

an action that we decide to make.

Involuntary action

an action that we do not have to think about.

receptor: cells that detect stimuli.

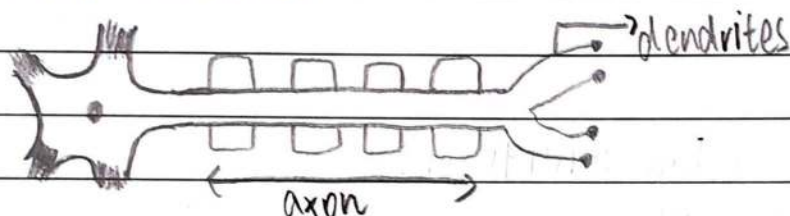
motor/effector: neurones that transmit impulses away from the brain and spinal cord to muscles and glands - effector organs.

relay/connector: neurones that transmit impulses from sensory neurones to motor neurones inside the CNS.

Sensory neurones: transmit impulses from receptors/sense organs to the brain and spinal cord.

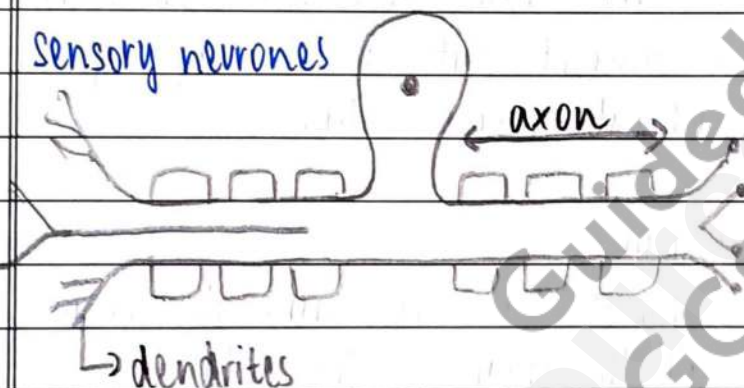
Diagrams of neurones

Motor neurones



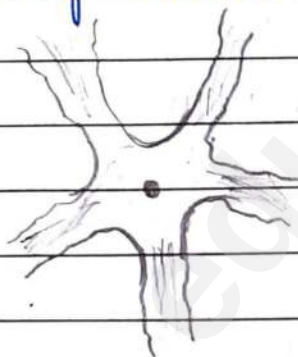
small/short dendrites
comparitively long axon

Sensory neurones



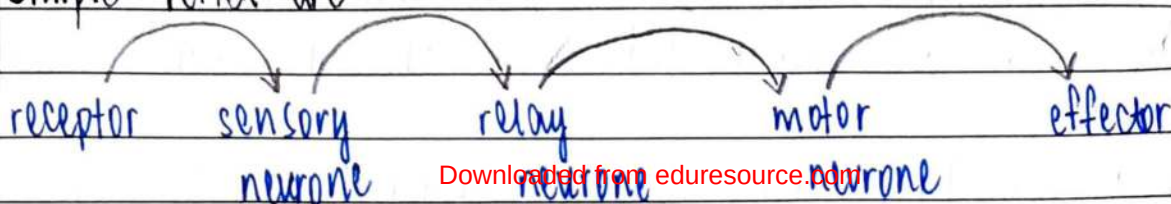
long dendrites
comparitively small axon

Relay neurones



interconnects sensory and
motor neurones

Simple reflex arc

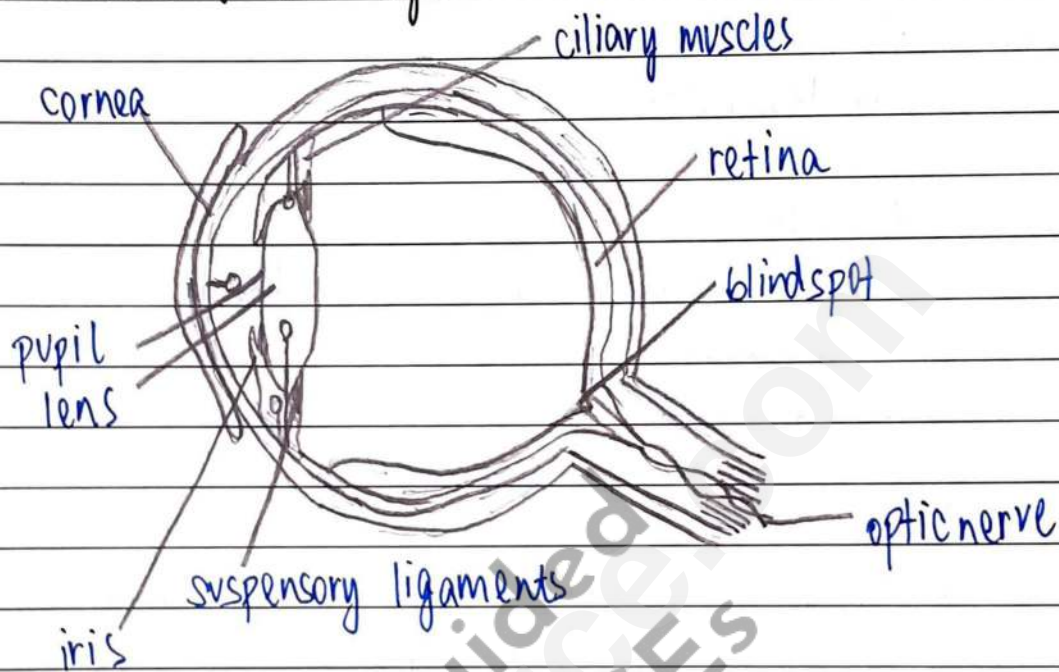


Reflex action

- an automatic and rapid response to a stimulus.
- spinal cord makes decisions without involving the brain.
- brain is informed about action after action is completed.

Sense Organs

The structure of the eye:



Functions :

- The Cornea refracts light.
- The iris controls how much light enters the pupil
- The lens focuses light onto the retina
- The retina transform light impulses to electric signals. It contains light receptors. It contains cones - sensitive to different colours of light - and rods - sensitive to black and white lights.
- optic nerve carries impulses to the brain.

The Pupil Reflex

- controlled by a pair of antagonistic muscles.
- circular muscles are arranged around the pupil and radial muscles run outwards from the pupil like spokes in a wheel.
- radial muscles contract to increase size of pupil.
- circular muscles contract to reduce size of pupil.

- In dim light,
- radial muscles contract
- pupil dilates/expands
- circular muscles relax

- In bright light,
- circular muscles contract — bright light has the potential to damage the retina.
- pupil constricts/contracts
- radial muscles relax

Accommodation

- the term used to describe changes that occur in the eye when focusing on far and near objects.

When looking at a distant object: distant object is in focus:

- ciliary muscles relax.
- pressure in the eye pulls suspensory ligaments tight. Lens is pulled into an elliptical shape.
- light rays are refracted as they pass through the lens, and are focused on the retina.

When looking at a near object: near object is in focus:

- ciliary muscles contract to counteract pressure inside the eye.
- suspensory ligaments are not pulled. Lens is spherical.
- light rays are refracted more than for a distant object.

B9.3 Hormones

Hormones are chemical substances produced by glands and carried by the blood, which alter the activity of one or more specific target organs.

Target organs are the organs that recognise and respond to hormone

Adrenaline :

- the hormone secreted by adrenal glands
- secreted in 'fight' or 'flight' situations.

Effects of adrenaline :

- increased breathing rate
- increased pulse rate
- widened pupils

Situations :

- when someone is frightened
- excited

Adrenaline increases the rate of chemical reactions within the body.

- Adrenaline stimulates cells in the liver to convert glycogen to glucose. The glucose diffuses into the blood, increasing its concentration.
- There is more glucose for muscles if sudden action is needed.
- Adrenaline changes distribution of blood so that glucose and oxygen reaches muscles that are needed for sudden action.
- Blood is diverted at muscles and a hollow feeling is felt in the stomach.

Nervous system and Endocrine system

- In the nervous system, speed of action is fast. The longevity of action is short-lived.
- In the endocrine system, speed of action is slow. The longevity of action is long-lasting.

B9.4 Homeostasis

Homeostasis is the maintenance of constant internal environment.

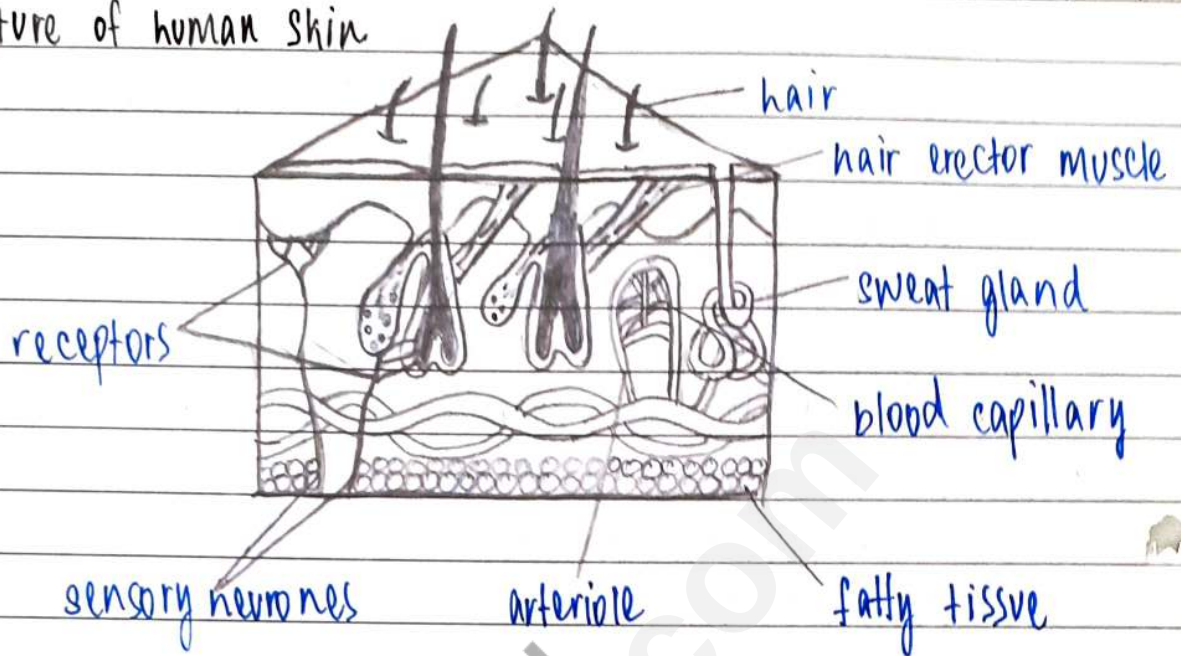
- Homeostasis is the control of internal conditions within set limits. The brain has overall control of body processes.
- If the temperature falls below 37°C , the brain will stimulate heat in muscles by shivering, increase rate of respiration in the liver, and decrease production of sweat by sweat glands.
- If the temperature goes above 37°C , the brain sends impulses to promote heat loss.

Negative feedback is the mechanism used in homeostasis for maintaining near constant conditions in the body.

Control of blood glucose

- Pancreas detects high glucose concentration in the blood.
- The cells in the pancreas secrete a hormone called insulin.
- Insulin stimulates liver cells to convert glucose to glycogen.
- The glucose concentration in the blood is decreased to normal.
- Pancreas detects low glucose concentration in the blood.
- These cells secrete a hormone called glucagon.
- Glucagon stimulates liver cells to break down glycogen to glucose.
- The glucose concentration in the blood is increased to normal.
- Blood glucose concentration is monitored by the pancreas, which releases hormones and instructs liver cells for action.

Structure of human skin



In the heat,

- brain detects an increase in blood temperature.
- brain sends impulses to skin to increase rate of sweating.
- heat is lost by evaporation from surface of skin.

In the cold,

- brain detects a decrease in blood temperature.
- brain sends impulses to skin to decrease rate of sweating.
- sweat glands stop sweat production.
- hair erector muscles contract to raise hairs. This causes a thick layer of air to be trapped → reduced heat loss
- body starts to shiver as body muscles contract to release heat from respiration.

Vasodilation - does not need energy from respiration

- muscles in the arterioles dilate (relax).
- vessels widen.
- increase in blood flow through capillaries.
- more heat is lost to the surroundings by convection and radiation.

Vasoconstriction

- muscles of the arterioles contract (constrict).
- vessels narrow.
- reduced blood flow through capillaries.
- blood is diverted to stay beneath fat layer in the skin.
- little heat is lost by radiation.

- The control of body temperature is by negative feedback.
- Brain coordinates responses by effector organs to lose, conserve or gain heat in order to maintain a body temperature that stays within limits.

B9.5 Tropic Responses

- Gravitropism is the response by plants in which parts of a plant grow towards or away from gravity.
- Phototropism is the response by plants in which parts of a plant grow towards or away from the direction from which light is coming.
- Roots are positively gravitropic as they respond to gravity by growing in the downward direction; whereas, shoots are negatively gravitropic as they respond to gravity by growing in the upward direction.
- Roots are not sensitive to light. Shoots are positively phototropic as they grow towards the light.

The growth responses are chemical controls of plant growth.

Auxin, a plant hormone, controls growth.

Auxin

- auxin stimulates growth by causing cells to elongate.
- in roots, auxin inhibits growth.
- auxin is made in shoot tip and spreads through the plant
- auxin is unevenly distributed.

