COORDINATION

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Dfn:

is the ability of an organism to detect and respond to changes in their internal and external environment.

Definitions of important terms

1. ***Irritability/Sensitivity;*** this is the ability of an organism to detect and responds to a stimulus in the environment.
2. ***Stimulus;*** this is a change in the external or internal environment to which an organism responds.
   For example;
   a) External stimuli; temperature, light, humidity, sound, touch, smell.
   b) Internal stimuli; body temperature, blood sugar, carbon dioxide, salt concentration.
3. ***Response;*** this is a change in activity of an organism in reaction to a stimulus

4. Impulse; this is an electrical message transmitted along nerves in a nervous system.

5. Effectors; these are cells or organs in an organism that carry out a response to a stimulus.

6. Receptors; these are cells or organs that receive or detect a stimulus.

7. Internal environment; this is the immediate surroundings of cells. In animals the internal environment is the blood and tissue fluid.

8. External environment; this is the surrounding of the entire organism.

9. Sense organ; Is a group of sensitive cells/receptors that detect a given stimulus

10. Central nervous system; is the central part of the nervous system consisting of brain and spinal cord.

11. Hormone; is a chemical messenger, protein in nature that regulates body physiological processes. Like ***auxins, insulin, adrenaline, glucagon and ADH***

12. Neurone; is the basic structural and functional unit of a nervous system along which impulses are transmitted.

It is also called ***nerve cell/nerve fibre***

COORDINATION SYSTEMS IN ANIMALS

There are two main distinct coordination systems in mammals

1. ***The nervous system;*** which is a network of message conducting cells called neuron cells connected to all body parts.
2. ***The endocrine system;*** which is made up of a system of glands that produce chemical substances (hormones) for coordination.

Chemical coordination in mammals

This is the endocrine system of glands that secrete chemical substances called ***hormones***.

A hormone is a specific chemical substance produced by glands and is transported to a target organ to regulate physiological activities in the body.

Characteristics of hormones

- They are protein or steroid in nature.
- They are produced and work best in small quantities.
- Their site of action is far from where they are produced.
- They are secreted by glands.
- Their effect on the target organ is either by stimulation or inhibition i.e. they regulate the activities of the target organs

GLANDS

These are tissues or organs that secrete chemical substances.

There are 2 types of glands i.e. ***endocrine and exocrine***.

EXOCRINE GLANDS

These are glands that secrete their substances to their target organs through **ducts** i.e. these glands have ducts that connect and carry their chemical substances to their target organs hence they are called **duct glands.**

Examples:

1) Pancreas releases pancreatic juice.
2) Salivary gland has salivary duct that carries saliva into the mouth cavity.
3) Sweat glands
4) Tear glands

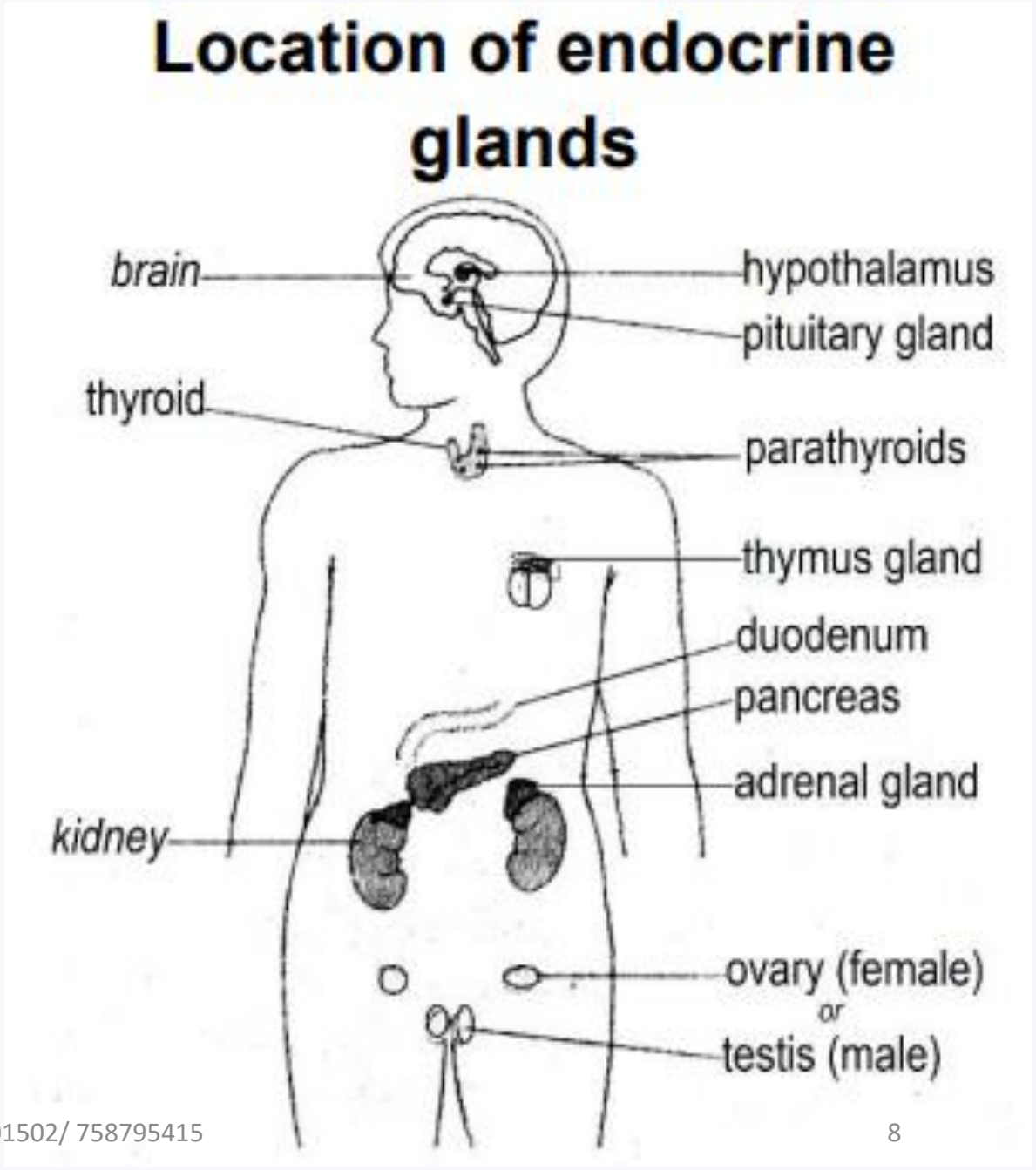
NOTE: The focus of this topic however are the endocrine glands

ENDOCRINE GLANDS

These are **ductless glands** that secret their hormones directly into the blood stream.

The blood carries the hormones from the glands to their target organs hence endocrine glands are called ductless glands i.e. **have no ducts** e.g. **pituitary gland, thyroid gland, islets of Langerhans in pancreas**, etc.

NB: The pituitary gland controls most though not all endocrine glands and is therefore known as the **MASTER GLAND**



HORMONES OF THE ENDOCRINE GLANDS AND THEIR FUNCTIONS

1. Pituitary gland

Found at the base of the brain immediately above roof of mouth.

It's mainly controlled by the **hypothalamus.**

- ✓Controls activities of other glands thus called master gland.
- ✓Consists of two parts; **anterior pituitary** and **posterior pituitary**
- ✓Secretes two types of hormones i.e. **trophic hormones** and **non-trophic hormones**
- ✓Trophic hormones **control secretion of other hormones** by endocrine glands e.g. **thyroid stimulating hormone, follicle stimulating hormone** etc.
- ✓Non trophic hormones **affect activity of non-endocrine tissues**.

Table showing effects of hormones produced by the pituitary gland

HORMONE	Abbreviation	FUNCTION
Thyroid stimulating hormone	TSH	✓ Stimulates thyroid gland to produce thyroxinee hormone
Follicle stimulating hormone	FSH	✓ Stimulates sperm formation in testis ✓ Stimulates formation and development of Graafian follicle in females
Interstitial cell stimulating hormone	ICSH	✓ Stimulates secretion of testosterone from testis
Luteinizing hormone	LH	✓ Causes ovulation ✓ Stimulates development of corpus luteum from Graafian follicle
Antidiuretic hormone	ADH	✓ Controls water reabsorption in kidney tubules
Growth hormone	GH	✓ Controls growth of bones and muscles ✓ Controls general body metabolism. Over secretion leads to ***gigantism.*** Under secretion leads to ***dwarfism***
Prolactin		✓ Induces production of milk in pregnant/lactating females
Oxytocin		✓ Induces uterine contraction to cause birth (parturition) ✓ Induces lactation. Release of milk from nipple

2. The thyroid gland.

Found in the neck close to the larynx (voice box). This produces a hormone ***thyroxine***.

FUNCTION

- ✓Control growth and development in young ones e.g. metamorphosis in tadpoles
- ✓Controls cellular respiration in organisms, being high when secreted and low when little quantity of hormone is present

NB: among adults, **too little secretion** of thyroxine leads to **overweight** and **sluggishness** and **too much of it** causes **thinness** and **over activity**.

Deficiency of thyroxine in infancy cause a type of mental deficiency known as **cretinism** which can be cured if identified early by administering thyroxine in the body.

Thyroxine contains iodine. Lack of iodine results into little or no production of thyroxine and causes the thyroid gland to increase in size a deficiency disease called **goiter**.

3. Adrenal gland.

There are two adrenal glands, each situated above each kidney.

The gland is made up of two parts.

a) **Cortex;** this is the outer region of the adrenal gland.

The adrenal cortex produces a hormone cortisone

Function:

- ✓Cortisone stimulates conversion of fats into glucose for cell respiration
- ✓Cortisone stimulates conversion of amino acids into glucose for cell respiration

b) Medulla; this is the inner region of the adrenal gland.

The adrenal medulla is stimulated by nervous impulses to produce a hormone known as **adrenaline**.

Adrenaline is produced in situations of **anxiety, excitement, feeling or when facing of danger.**

Adrenaline when secreted has the following **effects**;

i) It increases the rate of heartbeat.

ii) It increases the breathing rate.

iii) It widens the pupils of the eyes.

iv) It brings about conversion of glycogen to glucose in the liver.

v) It increases the rate of respiration in order to ensure adequate supply of energy to body muscles.

vi) Reduces blood supply to the skin and alimentary canal with more blood channeled to the muscles.

NB: Due to effects above, adrenaline is referred to as "**freight or fight**" hormone.

4. The pancreas.

This consists of a tissue **Islets of Langerhans** consisting of two groups of cells; **α cells** and **β cells**.

The **α cells secrete Glucagon hormone while the β cells secrete Insulin hormone which hormones regulate the levels of Glucose in the body.**

The normal level of Glucose in the body is about 90mg/100cm3.

When Glucose levels rise beyond normal e.g. after a meal:

✓β cells secrete **insulin** hormone which stimulates the liver cells to; convert excess glucose into glycogen for storage, excess glucose to fats, increase metabolic rate

When Glucose levels in the body decrease below the normal e.g. during starvation:

✓ α Cells secrete **glucagon** hormone which stimulates the liver cells to; convert glycogen to glucose, fats to glucose, decrease metabolic rate

The glucose may be used during cell respiration to produce energy.

Diabetes Melitus

Type 1 (juvenile/ insulin-dependent diabetes)

A chronic condition in which the pancreas **produces little or no insulin** because the body's immune system attacks the islet cells in the pancreas that make insulin

Type 2

Occurs **when the cells in the body don't respond properly to the insulin** that is produced (insulin resistance). This means your blood glucose levels may become very high and this is known as ***Hyper glycaemia***.

Symptoms

1. Feeling more thirsty than usual
2. Urinating often
3. Losing weight
4. Presence of ketones in urine
5. Feeling tired and weak
6. Having blurry vision

Prevention and treatment

1. Cut sugar and refined carbohydrates from the diet
2. Quit smoking (causes insulin resistance)
3. Drink a lot of water
4. Taking insulin
5. Monitoring blood sugar often
6. Exercising regularly
7. Eating healthy foods

5. The duodenum

The presence of food in the duodenum stimulates the lining of the duodenum to produce a hormone called ***secretin***.

Secretin moves in blood to the pancreas and stimulates it to produce pancreatic enzymes.

This ensures that the enzymes are produced when food is present.

6. The reproductive organs/ Gonads (testes and ovaries)

The ovary in females produces two major hormones.

These are **oestrogen** and **progesterone**.

Oestrogen controls **secondary sexual characteristics in females such as;**

- ✓Development of breasts.
- ✓Growth of pubic hairs.
- ✓Widening of hips.
- ✓Enlargement of reproductive organs.
- ✓Softening of muscles.
- ✓Softening of the voice.

Oestrogen also causes **repair of the uterine lining after menstruation**.

Progesterone produced by the corpus luteum after ovulation and is responsible for;

- ✓Thickening the endometrium for implantation
- ✓vascularization the endometrium for implantation
- ✓maintaining the endometrium for implantation
- ✓Prevents constriction of uterus until baby is due to be born.

In males the testes produce a hormone known as **testosterone**.

This hormone **controls male sex characteristics**, which include;

i) Deepening of the voice.
ii) Growth of beards.
iii) Toughening of muscles.
iv) Widening of the chest.
v) Enlargement of reproductive organs.
vi) Growth of pubic hairs.
vii) Sperm production.

7. Parathyroid gland

It secretes parathormone which has the following functions:

✓Raises blood calcium levels.

✓Lowers blood phosphate levels.

Common hormonal disorders/diseases

These include**: osteoporosis, diabetes and goiter**

1. Osteoporosis

is a condition in which bones become weak and brittle.

Osteoporosis is more likely to occur in people who have **low calcium intake.**

Low calcium intake contributes to diminished bone density, early bone loss and increased risk of fractures

Signs and symptoms

1. Losing an inch or more of your height
2. Changes in ones natural posture (bending forward more)
3. Shortness of breath (if disks in the spine are compressed to reduce lung capacity)
4. Lower back pain

Prevention

1. Eat foods that support bone health (containing calcium, vitamin D and protein)
2. Get active i.e. do exercised e.g. hiking, jogging, tennis, dancing
3. Avoid smoking
4. Limit alcohol consumption

8. Thymus gland

This gland is close to the heart and well developed in young mammal but greatly reduced in adults.

It’s responsible for formation of lymphocytes which defend body against pathogens

Comparison between hormones and enzyme

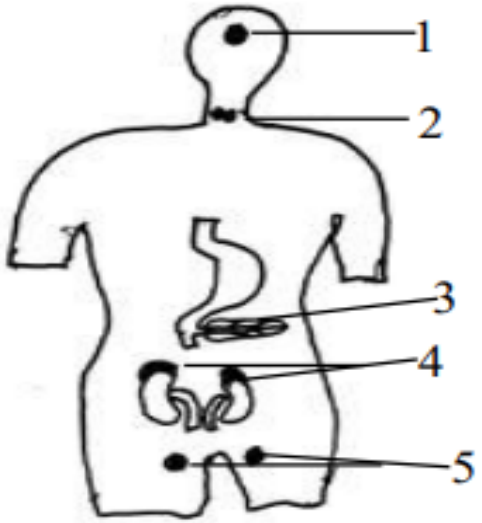
Similarities

- ✓Both are required in minute concentrations for action
- ✓Both are specific in action; enzymes work on specific substrate while hormones affect only target organs and tissues
- ✓ Both affect body metabolism

Differences

HORMONES	ENZYMES
✓ May be proteins or steroids	✓ Are protein in nature
✓ Site of action different from site of production	✓ Site of action either at or away from site of production
✓ Transported through blood to target organ	✓ Not transported through blood but in ducts
✓ Secreted only by endocrine glands	✓ Secreted by all body cells

9. The figure below shows the location of some major glands in man



(a) What general name is given to the glands labeled 1 to 5. (01 mark)

.....

(b) In the table below state one hormone secreted by the gland stated and in each case state one effect of the hormone secreted. (06 marks)

Gland	Hormone	Effect
1		
2		
3		
4		
5		

Assignment

Using the internet or Biology reference material from the library, Appreciate and explain the role of diet in managing hormonal disorders or diseases in humans.

NERVOUS COORDINATION IN A MAMMAL

The nervous system is composed of;

- ✓ Nerve cells/neurons/neurons
- ✓ Receptors
- ✓ Effectors

Definitions

i) ***A nerve cell;*** is the basic structural and functional unit of a nervous system along which nerve impulses are transmitted.

ii) ***A receptor;*** is a sensitive cell, tissue or organ that receives a stimulus; converts it into nerve impulse and sends it to the central nervous system (brain or spinal cord).

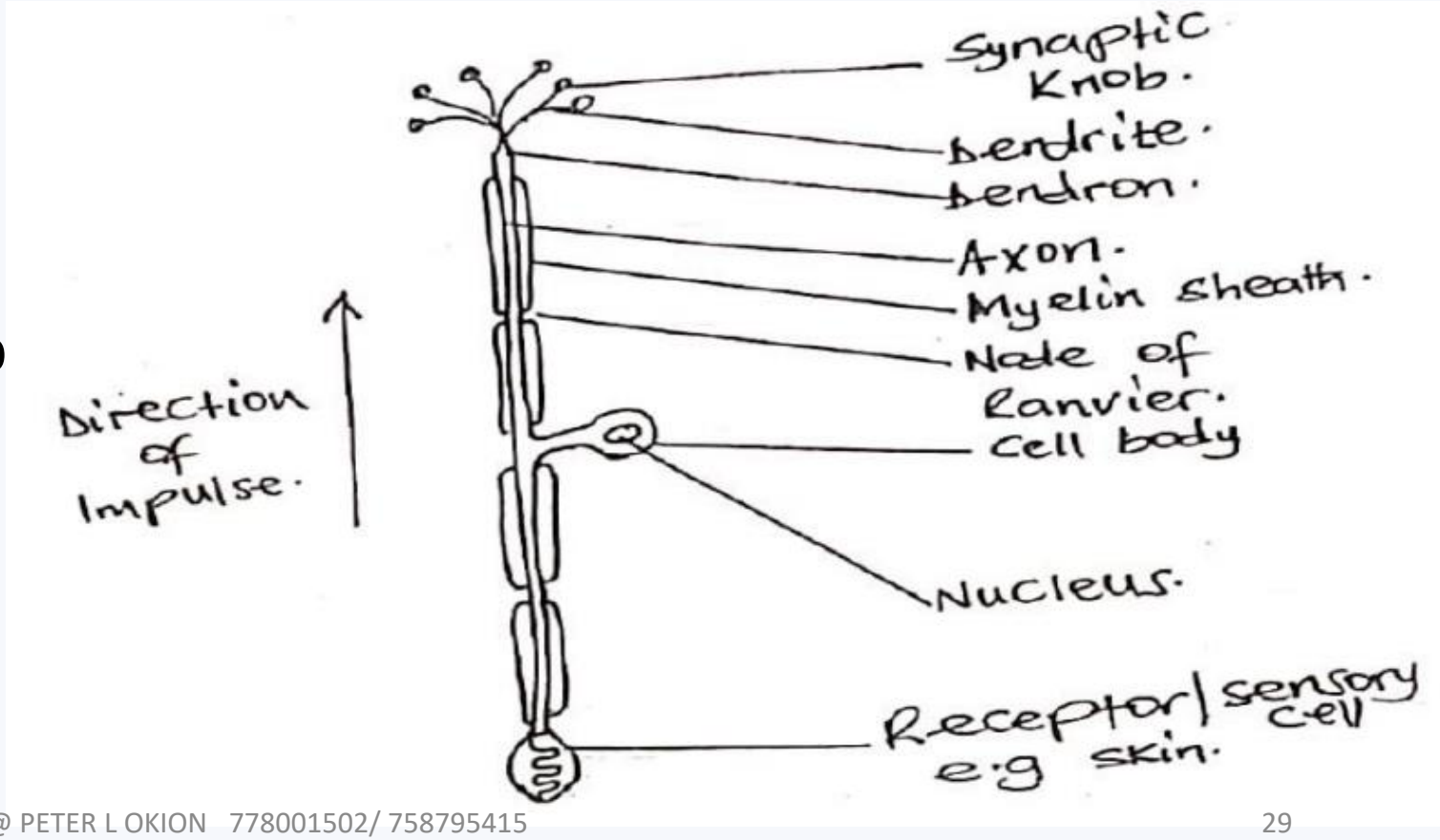
iii) ***An effector;*** is a cell, tissue, organ/structure that receives impulses from the central nervous system and makes the necessary reaction/response like muscles and glands.

Types of nerve cells

1. Sensory/afferent neurones;

These receive impulses from receptors and transmit them to the central nervous system

Structure of a sensory neurone

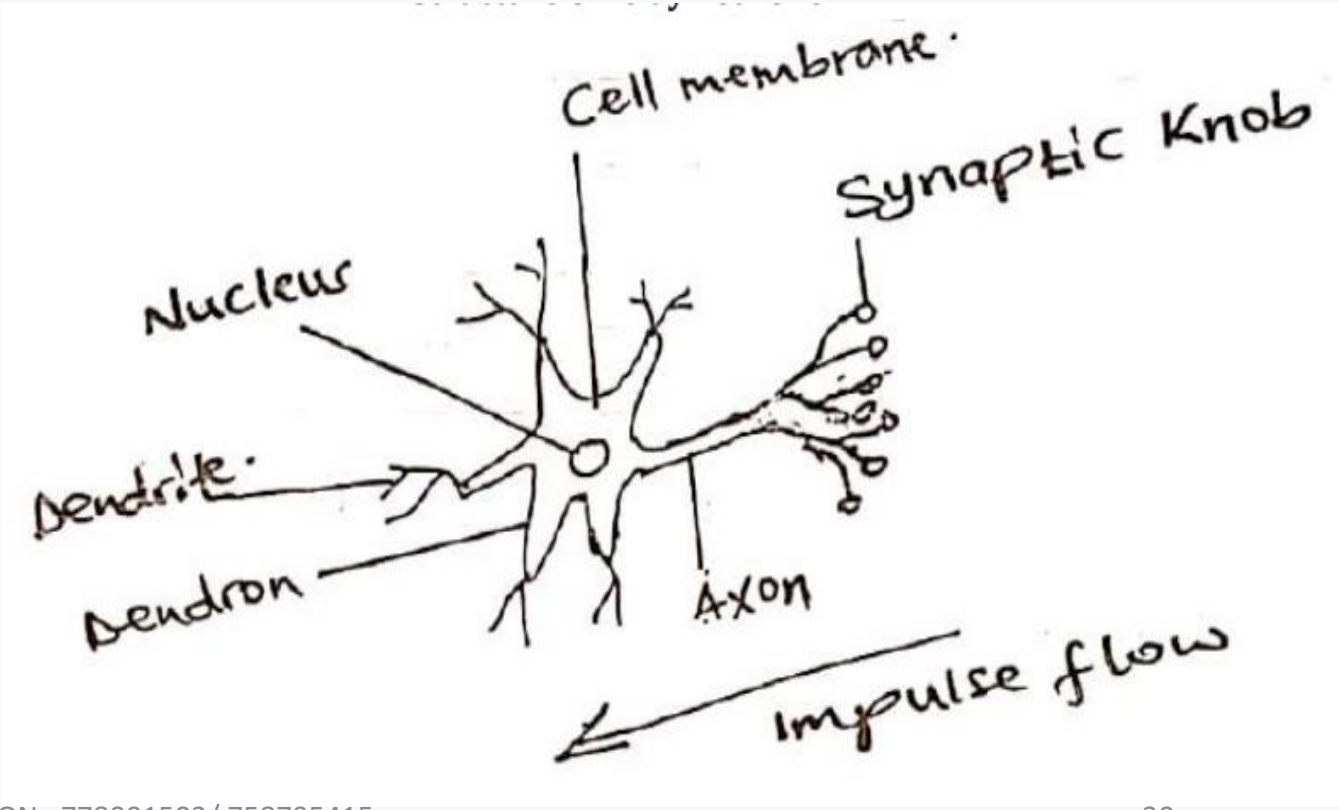


2. Relay/intermediate/associative/intercalary neurones;

These conduct impulses within the central nervous system linking sensory neurons to the motor neurons.

Are located in the central nervous system between sensory and motor neurons

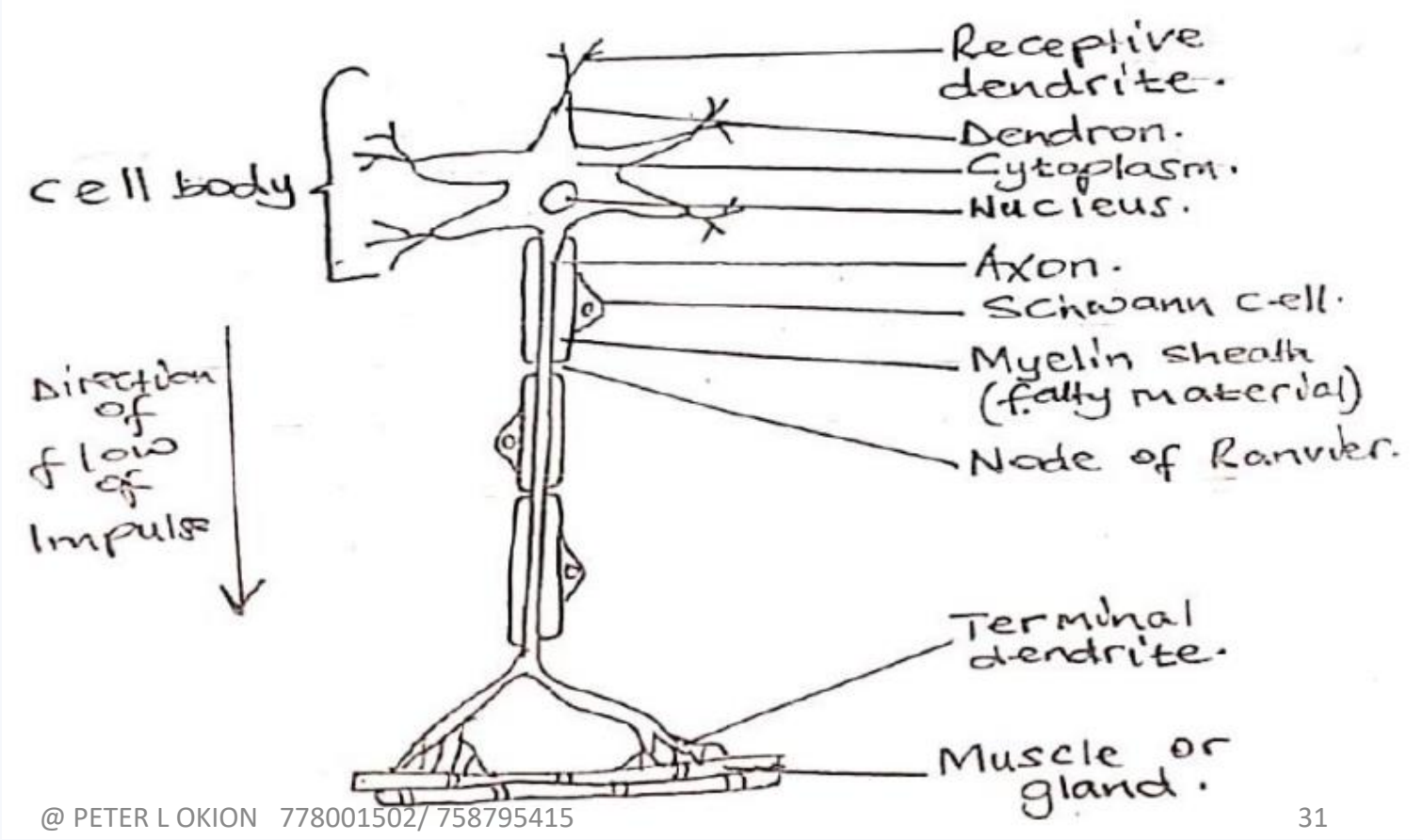
Structure of a relay Neurone



3. Motor (efferent) neurones.

These receive impulses from the central nervous system and transmit them to the effectors

Structure of motor Neurone



Functions of different parts of neurons

(i) Dendrites and dendrones;

- ✓Are extensions of the cell body.
- ✓They link one nerve cell to another via small gaps called **synapses**.
- ✓Receptive dendrites of a motor neurone receive impulses from relay neurone and send them to the cell body
- ✓The terminal dendrites of motor nerve send impulses to the effector(muscle)

(ii) Cell body

Contains cytoplasm in which cell reactions occur like respiration that releases energy used to transmit impulses.

Has nucleus that controls cell activities.

(iii) Axon

- Is a long thread-like part of a nerve cell.
- It carries impulses from the cell body to an effector/brain.
- Contains axoplasm.

(iv) Schwann cell;

Produces myelin sheath.

(v) Myelin sheath; fatty material.

- Made of fats
- It speeds up transmission of impulses.
- Protects and insulates the axon.

(vii) Synaptic knob

- Contains chemicals called **neurotransmitter substances**; which when released are used to transmit a nerve impulse across a synapse from one nerve cell to another.
- A synapse is a microscopic gap between 2 nerve cells or between a nerve cell and an effector; through which transmission of an impulse occurs neurotransmitter substance released from the synaptic knob.
- Thus, the dendrite endings of one nerve cell don't touch those of another but there is a gap called **synapse**.
- Synapse ensures that impulses flow in only one direction.

(viii) Node of Ranvier

- Is a small gap between adjacent myelin sheaths.
- It also speeds up transmission of nerve impulses.

Comparison between sensory neurone and motor neurone

Question:

Compare;

(a) Motor with relay neurones

(b) Sensory and relay neurones.

(c) Sensory and motor neurones.

Comparison between motor and sensory neurones

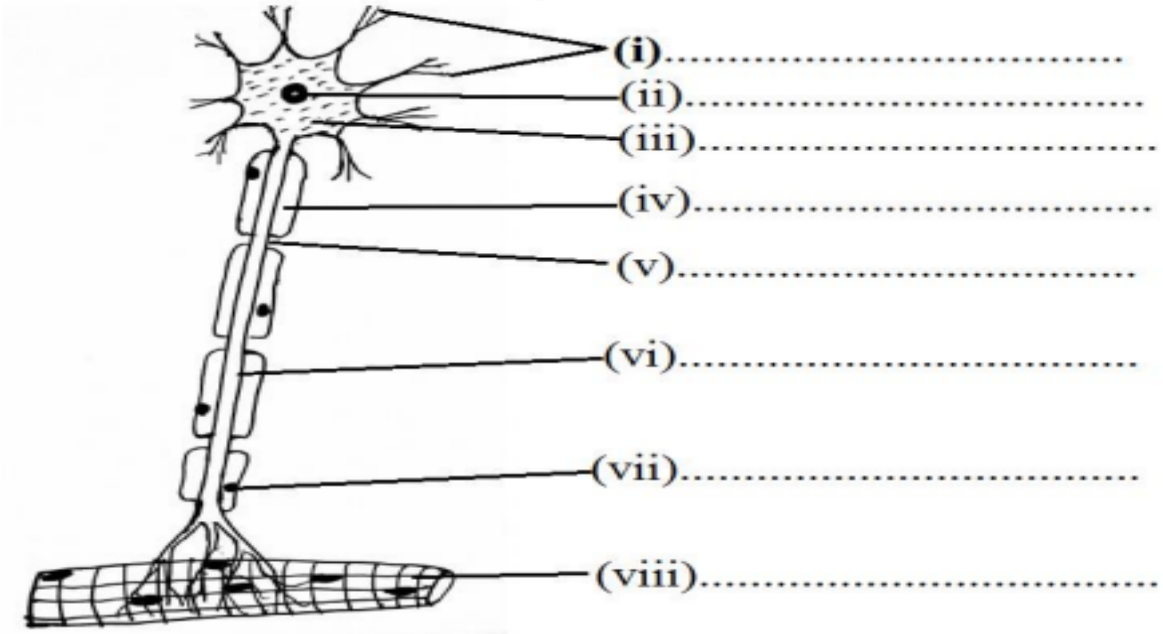
Similarities:

1. They both transmit impulses.
2. They both have a nucleus.
3. They both have an axon,
4. Both have dendrites
5. Both have cytoplasm in their cell bodies.
6. In both impulses move in one direction.

Differences:

Motor neurone	Sensory neurone
i) Has a longer axon	Has a shorter axon
ii) It has a cell body at the terminal end of the axon	Has a cell body located on the axon branch.
iii) It has a short dendrite	It has a long Dendron
iv) It carries impulses from the central nervous system to the effectors	It carries impulses from the receptors to the central nervous system.
v) It has several dendrites	It has one Dendron

1. Study figure 6 below and answer the questions that follow.



DO NOT COPY THIS

(a). Name the parts labelled (i) to (vi) on the diagram. ***(04 marks)***

(b) By means of an arrow show the direction of impulses propagation in the diagram above. ***(01 mark)***

(c) ***(i)*** What type of neurone is this? ***(01 mark)***

.....

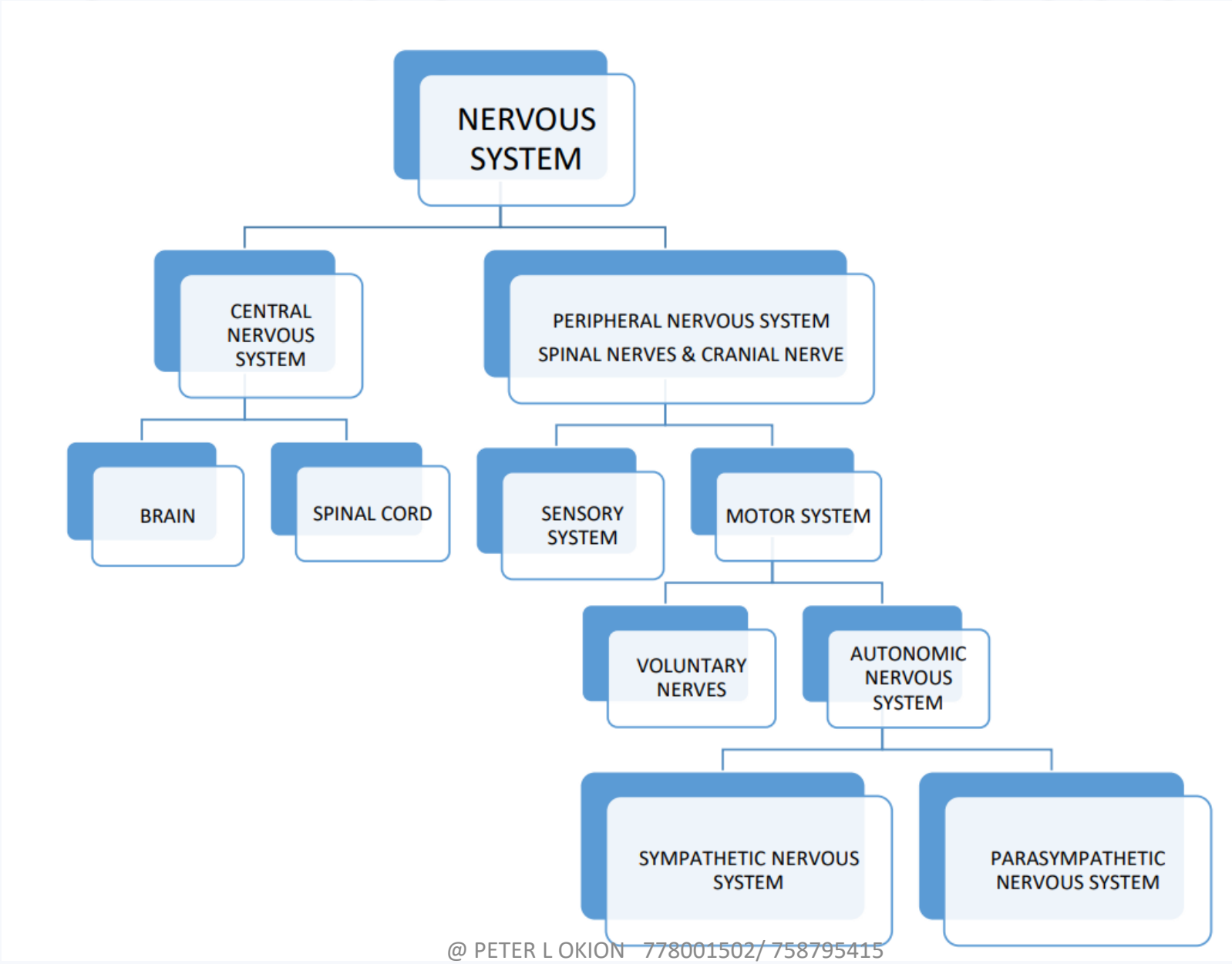
(ii) What action does it induce in the body? ***(01 mark)***

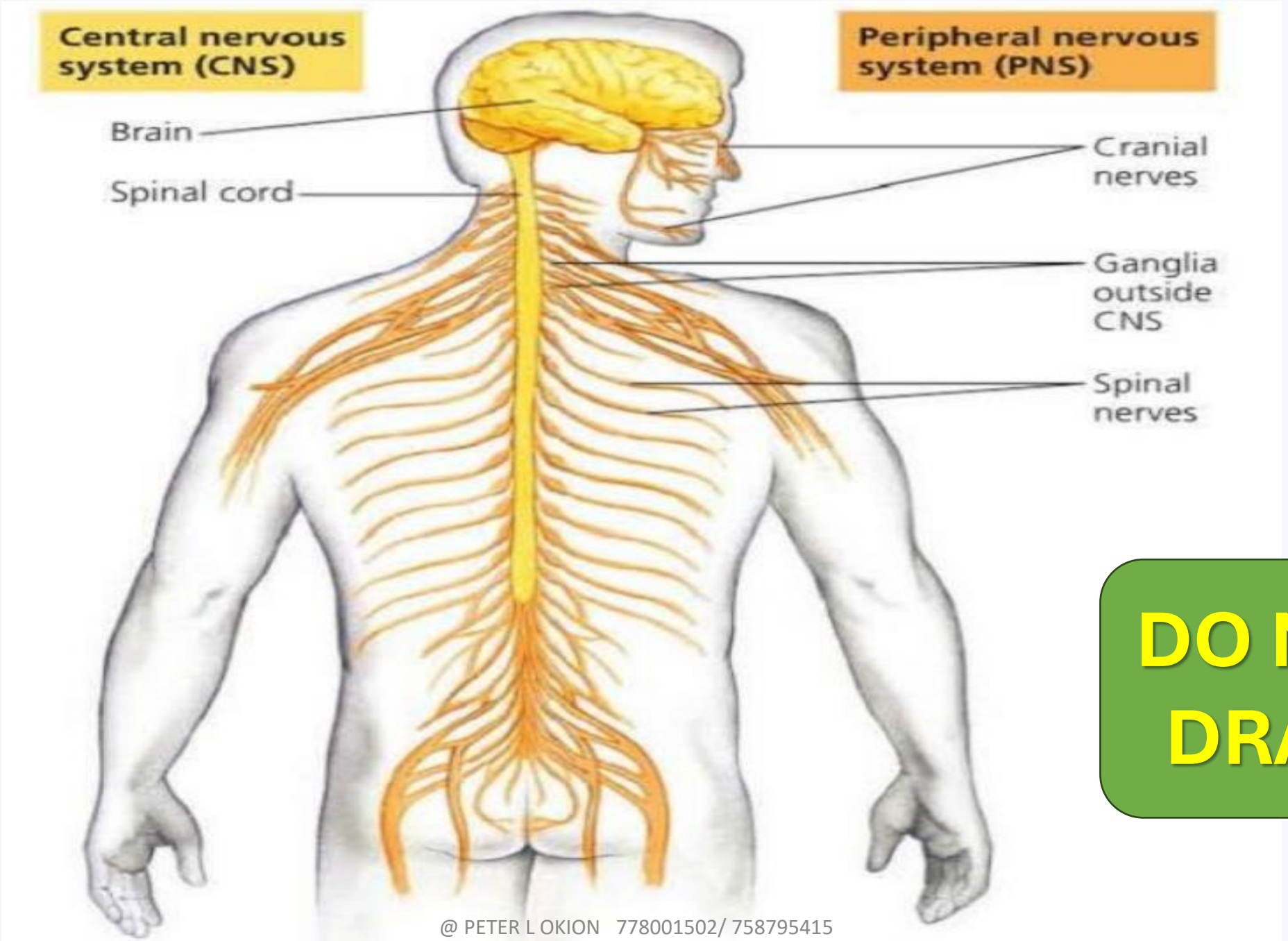
.....

(d) What is the function of structure labelled (iv)? ***(01 mark)***

.....

COMPONENTS OF THE NERVOUS SYSTEM




Central nervous system (CNS)
Peripheral nervous system (PNS)
Brain
Spinal cord
Cranial nerves
Ganglia outside CNS
Spinal nerves

DO NOT DRAW

The nervous system consists of;

i) **Receptors:** These detect the stimuli e.g. sensory endings in the skin, rods and cones

ii) **The central nervous system (CNS)**
This interprets and determines the nature of the response. The CNS consists of the brain and spinal cord.

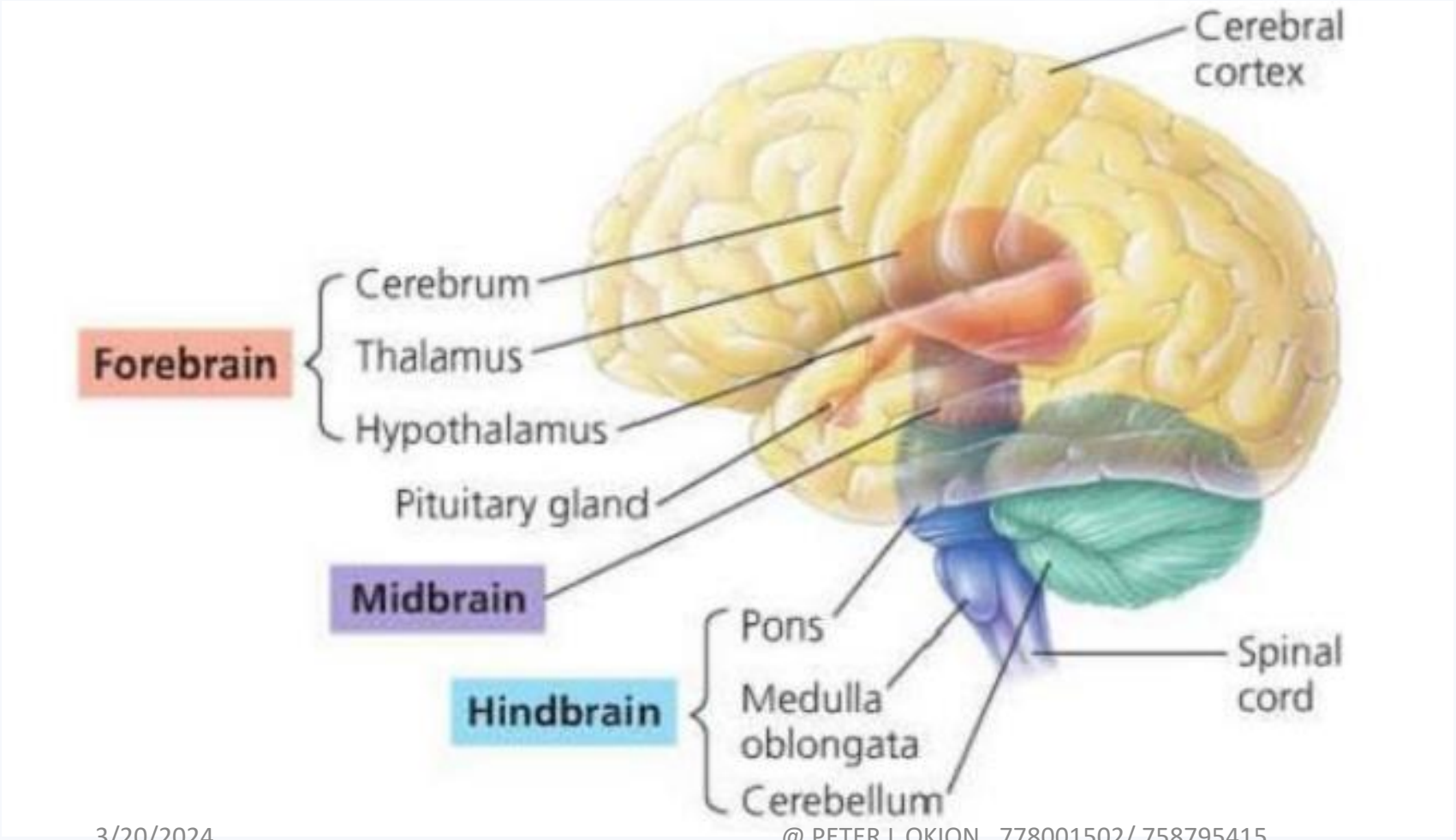
iii) **Peripheral nervous system**
This consists of spinal and cranial nerves which are either voluntary or involuntary nerves. The involuntary nerves form the autonomic nervous system

iv) **autonomic nervous system**
This consists of the sympathetic and parasympathetic nerves.

THE CENTRAL NERVOUS SYSTEM

This is made up of the brain and spinal cord.

THE BRAIN



MAKE THE DRAWING ON CLASS CHART

The brain is covered and protected externally by the **skull (cranium)** and internally by membranes called **meninges**.

It is made up of three distinct areas namely the **forebrain, midbrain** and **hindbrain**.

Functions of the parts of the brain

1. The fore brain It consists of:

i) The cerebrum (cerebral hemisphere):

It consists of right and left cerebral hemispheres which are interconnected by the corpus callosum.
It is covered by a thin layer of cerebral cortex.
The right hemisphere sends and receives impulses from the left side of the body while the left hemisphere receives impulses from the right side of the body.

It coordinates **learning, memory, reasoning, conscience and personality**.

It is responsible for intelligence. (Sensing, thinking and imagining).

ii) Thalamus:

It transmits impulses of sensations received from sense organs to the cerebral cortex.

iii) Hypothalamus:

- ✓It controls activities of the pituitary gland
- ✓It also coordinates and controls the autonomous nervous system.

The autonomic nervous system is a control system that acts largely **unconsciously** and **regulates bodily functions**, such as the **heart rate, digestion, respiratory rate, pupillary response, urination, and sexual arousal**.

This system is the primary mechanism in control of the **fight-or-flight** response.

2. The mid brain

- ✓It relays audio and visual information.
- ✓It is also responsible for movement of the head and the trunk.

3. Hind brain:

It is made up of:

i) ***Cerebellum:*** It is responsible for balance, muscular coordination (motion). It is the one affected in drunkards.

ii) ***Medulla oblongata:*** It controls automatic functions in the body like heartbeat, blood pressure, breathing rate, coughing and sneezing.

Functions of the brain

✓• It receives impulses from all receptors and sends back impulses to the effectors.

✓• It integrates and coordinates all activities in the body such that the body works efficiently.

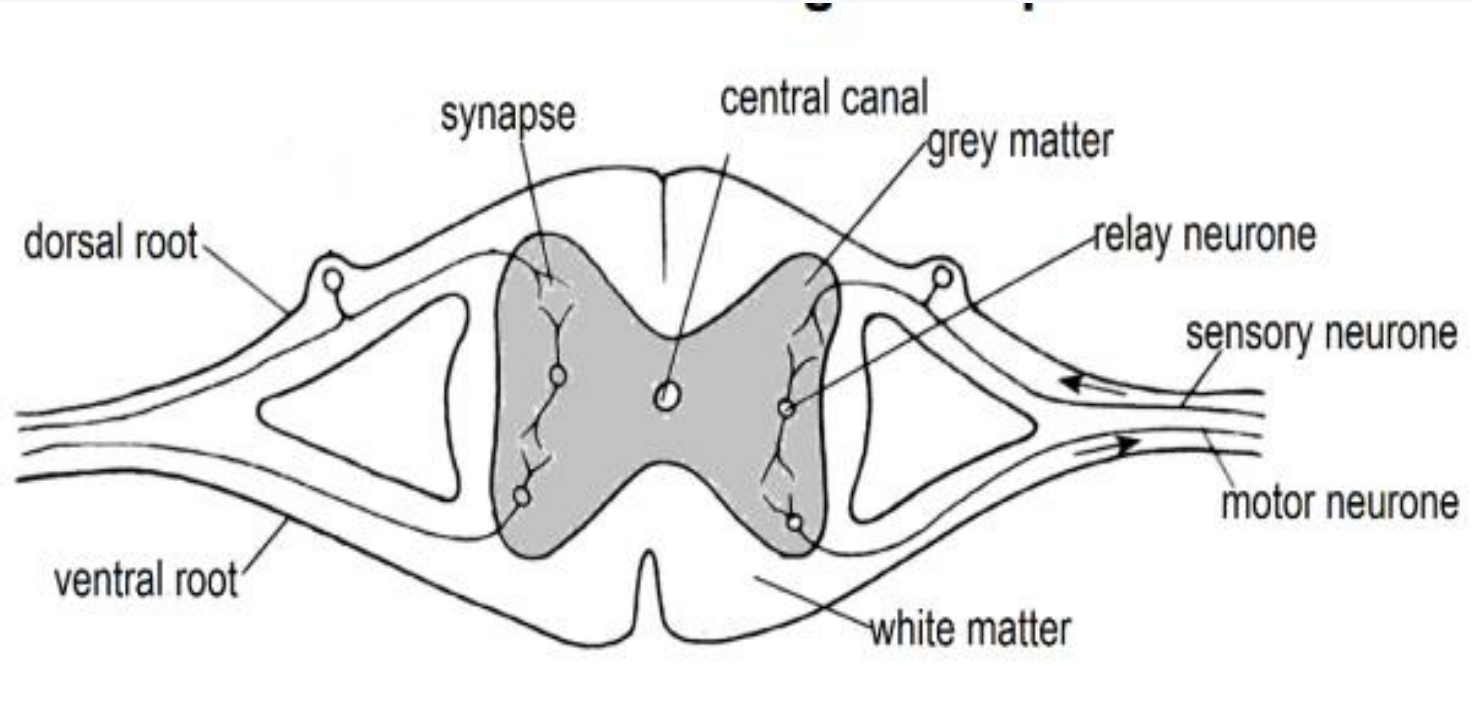
✓• It stores information.

✓• It is involved in cranial reflex actions but it does not initiate them.

The spinal cord

This is part of the central nervous system that runs from the brain through to the tail and protected by the vertebral column.

Transverse section through the spinal cord



Functions of the spinal cord

- ✓• It connects the peripheral nervous system to the brain.
- ✓• It is a center for simple spinal reflex actions.
- ✓• Receives impulses from receptors.
- ✓• Interprets messages especially in reflex arc.
- ✓• Sends impulses to the effectors.

The peripheral nervous system

- ✓It is made up of ***neurones*** that link the **brain** and **spinal** cord to **muscles** and **organs such as the eyes and ears**.
- ✓It is divided into **autonomic nervous system** and **somatic nervous system.**
- ✓The autonomic nervous system is responsible for the ***involuntary*** control of internal organs, blood vessels, smooth muscles and cardiac muscles.
- ✓The somatic nervous system is responsible for the ***voluntary*** control of skin, bones, joints and skeletal muscles.

Voluntary and involuntary actions

A voluntary action

is one initiated consciously under the direct control of the brain i.e. they are actions one does at will e.g. **dancing, laughing, stealing**, etc.

These actions are performed consciously by an animal.

In such actions the animal chooses to do or not to do something.

Involuntary actions

are the ones that occur without conscious thoughts e.g. **breathing**, etc.

The reflex action

A reflex action is an automatic (involuntary) response to a particular stimulus.

Reflex actions take place without the awareness of the individual.

A reflex action occurs as a result of impulses travelling along neurons in a path called a **reflex arc**.

A reflex action can either be **simple or conditioned reflex**

Simple reflex action

This is an involuntary quick response to a stimulus without conscious thought.

It is also known as an **instinctive reflex** which does not have to be learnt.

They include **sneezing, coughing, salivating, the knee jerk and removal of a hand from a hot flame.**

For instance,

when one steps on a sharp object, the knee jerk enables the removal of the foot thus avoiding further injury.

Characteristics of a simple reflex action

✓ It occurs rapidly i.e. the action occurs very fast.

✓ It is inborn (innate) but not learnt.

✓ It is coordinated by either the brain or spinal cord but usually initiated by spinal cord.

✓ It occurs without one's will.

✓ It is a repeated response to a similar stimulus.

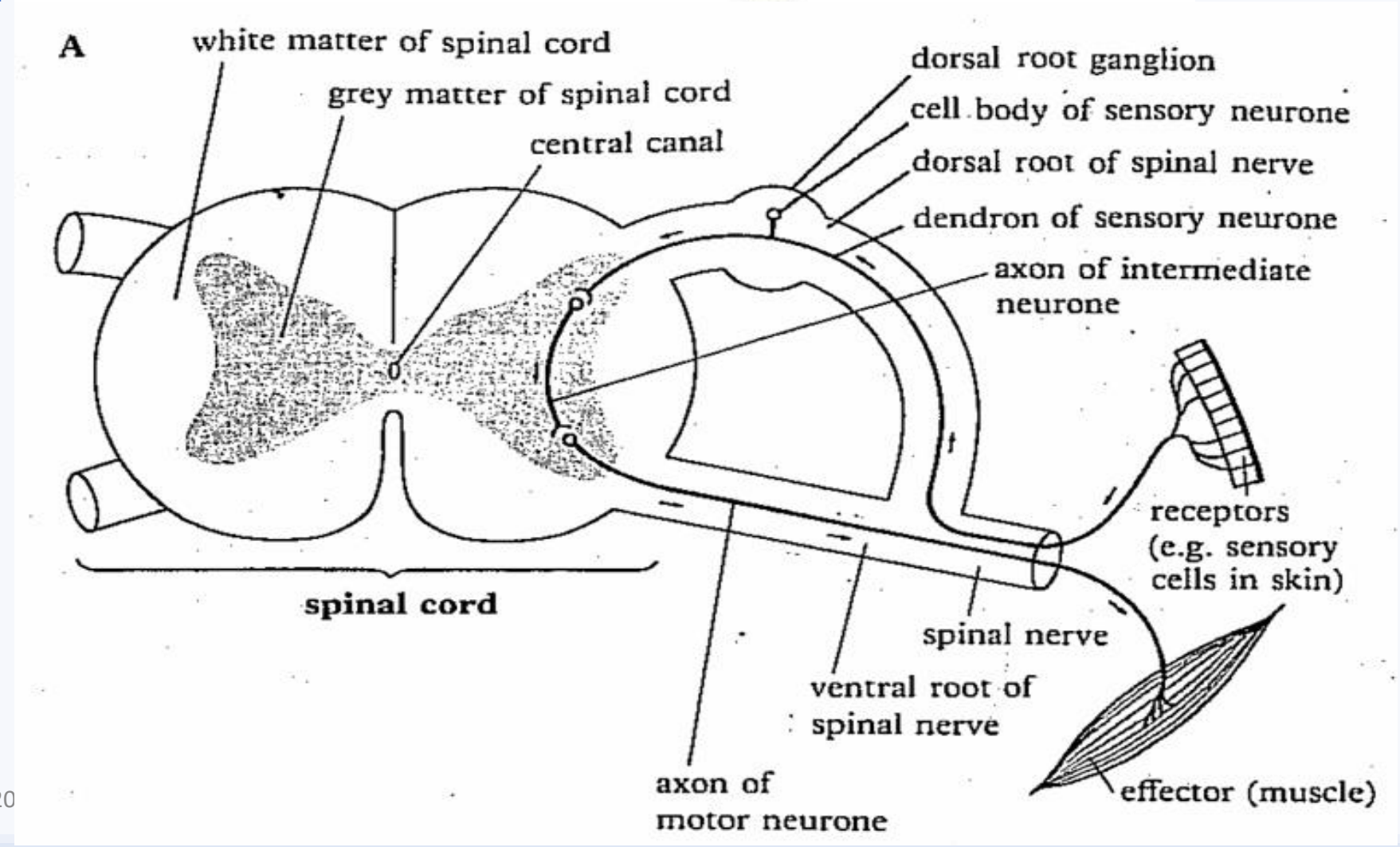
✓ Three neurons are involved.

Examples of simple reflex actions

Simple reflex action	stimulus	Importance
Knee jerk	Touch on tendon of the knee	Prevents damage of the lower leg
Withdrawal of hand	Hot objects	Prevents burning of hand
Blinking	Foreign particles on the cornea	Protects the eye from physical injury
salivation	Sight or sight of food	Prepares the individual for softening and lubrication of food, easing swallowing.
Constriction of the pupil of eye.	Bright light	Prevents excess entry of light into the eye, which can damage the cells in the retina.
Sneezing	Dust getting into nose	Releases and expels dust containing germs e.g bacteria
Secretion of tears	Onion peels	Irritating chemicals that can damage the eyes are washed away by tears.

DESCRIPTION OF A REFLEX ARC

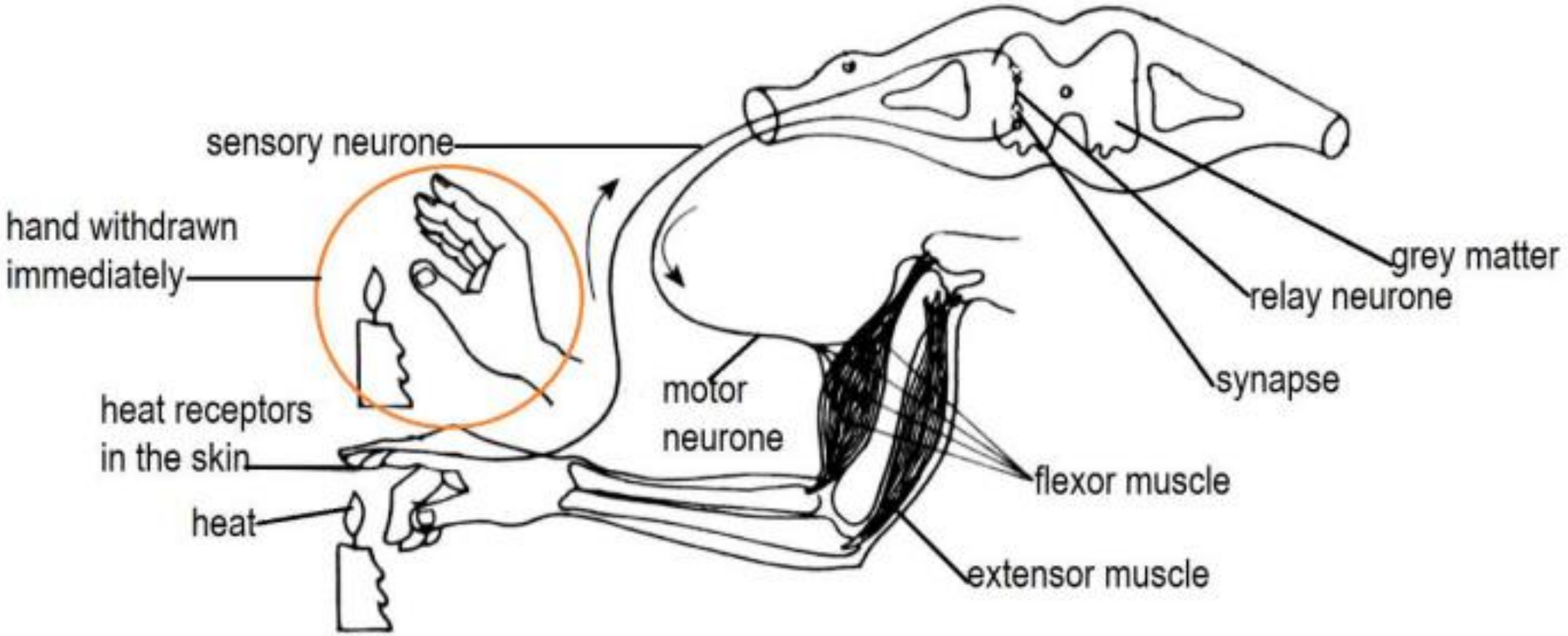
Reflex arc Is a route or nervous pathway taken by the nerve impulses in a reflex action.



- ✓The stimulus is perceived by the **receptors**, which change it into nervous impulse (**transduction**).
- ✓The impulse travels along the sensory neurone to the spinal cord.
- ✓In the **grey matter** of the spinal cord, the sensory neurone makes synaptic connections to the relay neurone and impulses move from the sensory neurone to the relay neurone across synapses.
- ✓The relay neurone in turn transmits the impulse to the motor neurone across a synapse.
- ✓The impulse then moves from the spinal cord to the effector muscles through the motor neurone.
- ✓The impulse causes the muscles to contract or relax depending on the stimulus.

Receptors sensory neurone ➡ relay neurone ➡ motor neurone ➡ effectors

Reflex arc of a hand being withdrawn from a hot flame



How a hand is withdrawn from a hot object (an example of a simple reflex action)

- ✓When one accidentally touches a hot body using a finger, the receptors in the finger receive the stimulus and change it into nervous impulses that travel along the sensory neurone to the spinal cord and then cross the synapse.
- ✓The impulse is then handed over to the relay neurone in the spinal cord (gray matter) and then cross another synapse.
- ✓The relay neurone in turn hands over the impulse to the motor neuron.
- ✓The motor neuron then carries the impulse from the spinal cord to the effector muscles of the hand.
- ✓This causes the muscles to contract and the hand is removed from the hot body.
- ✓At the same time, the original message is sent to the brain which then interprets it as pain or heat.

Note; these processes occur rapidly in the body without the awareness of the individual

Occurrence of the Knee jerk reflex

- ✓When the knee is tapped, the receptors in the knee detect the stimulus.
- ✓The impulse is converted into electrical messages (impulses).
- ✓These impulses are transmitted by the sensory neurone to the spinal cord.
- ✓In the spinal cord the sensory neurone transmits the impulses to the relay neurone.
- ✓The relay neurone relays the impulses to the motor neurone.
- ✓The motor neurone transmits the impulses to the effectors.
- ✓The effectors bring about the response. `

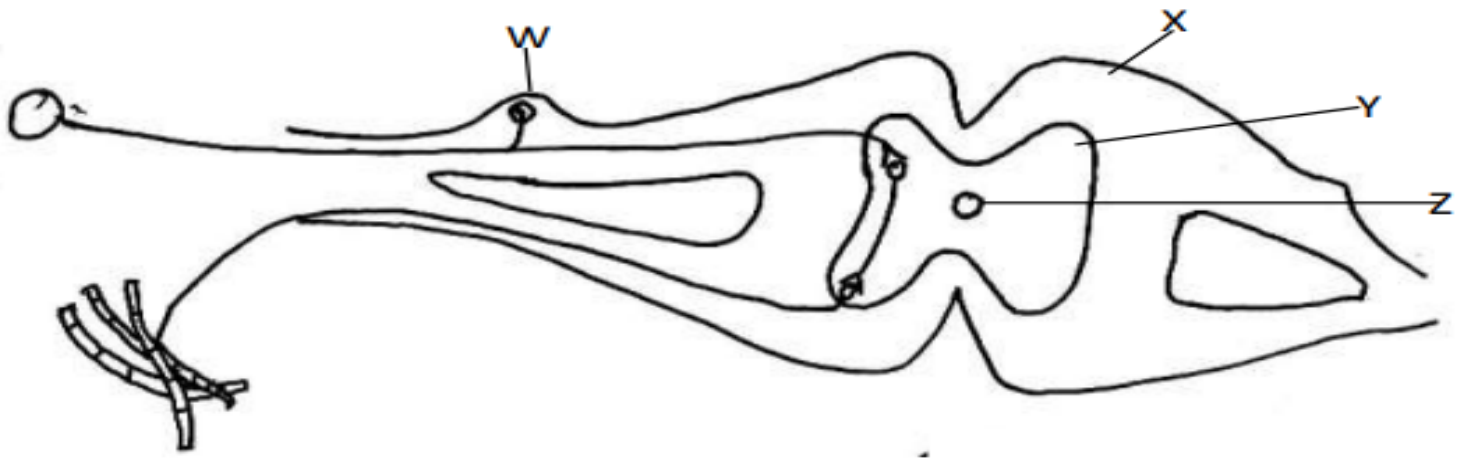
Importance of simple reflex actions to animals

- ✓They help animals to avoid danger
- ✓They control activities in the body, which we do not have conscious control over.
- ✓They form a basis of some animals' behaviour, e.g. amoeba.

assignment

Using Biology reference material, research and read about conditioned reflex actions e.g. Ivan Pavlov's experiment on the dog

12. The figure below shows the cross section of the spinal cord.



(a) (i) Name the parts labeled W to Z(02 marks)

W; ..... Y: .....

X: ..... Z: .....

(ii) What is the importance of parts W and Z to the spinal cord? (02 marks)

.....

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(b) By use of arrows, show the direction of flow of nerve impulses along the neurons in the spinal cord (01 mark)

(c) Of what importance is the spinal cord to the body of an organism? (04 marks)

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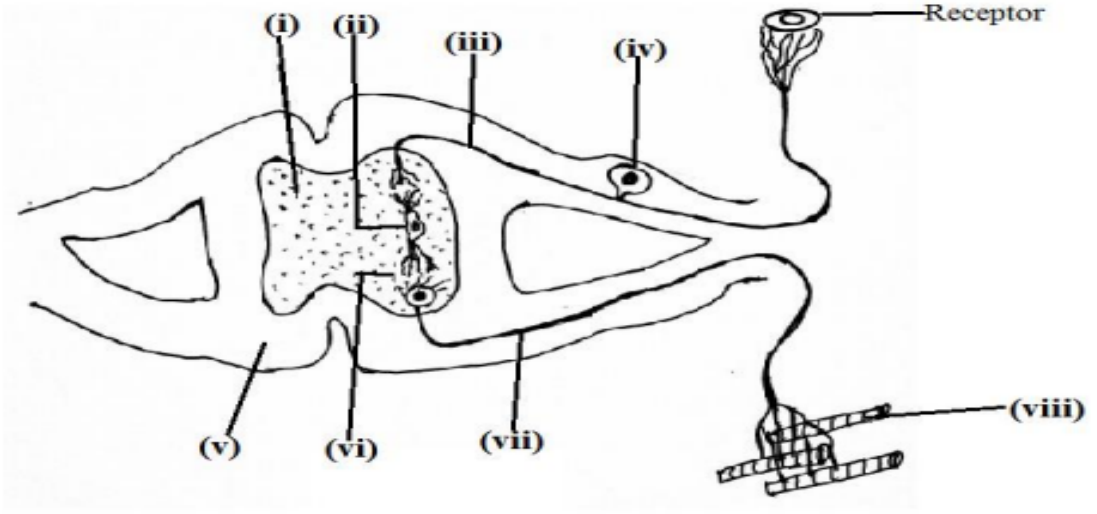
3. The figure below shows part of the central nervous system and reflex arc.



(a) Name the labeled parts. ***(04 marks)***

(i)..... (ii)..... (iii).....

(iv)..... (v)..... (vi).....

(vii)..... (viii).....

(b) Draw arrows on the above diagram to show the direction of impulse flow. ***(01 mark)***

(c) Briefly describe how impulses are transmitted across part (vi). ***(03 marks)***

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(d) Give one example of a simple reflex action and its signature. ***(02 marks)***

.....

Similarities between the nervous and endocrine system

- ✓ Both affected by nature of stimulus
- ✓ Both cause a response
- ✓ Both result co-ordination in the body
- ✓ Both involve chemical transmission of messages
- ✓ Responses in both are both physiological and physical

Nervous system	Endocrine system
Nerve impulses are both electrical and chemical	Messages are only chemical
Responses are fast.	Responses are slow
Responses are shorter lived	Most responses occur over a longer time
Impulses are transmitted along nerve fibres	Hormones are carried in blood
This effect is more localized (specific)	Effect is wide spread in the whole body
Stimulus arises from any part of the body where sensory receptors are located.	Stimulus arises from specific organs and tissues only e.g. endocrine glands.

Drug/substance use and drug abuse

Drug use is a single episode of use of a substance both for medicinal or recreational purposes. The substance of choice can vary from person to person

Drug abuse or substance abuse refers to the use of certain chemicals for the purpose of creating pleasurable effects on the brain. This is mainly among young adults below the age of 30

Common drugs include; ***alcohol, cigarettes, marijuana, kuber, khat, shisha, and petrol/glue, cocaine/coke, heroin***

Physiological effects of drug abuse

1. Nausea and abdominal pain, which can also lead to changes in appetite and weight loss
2. Increased strain on the liver, which puts the person at risk of significant liver damage or liver failure
3. Seizures
4. Stroke
5. Mental confusion
6. Brain damage
7. Lung disease
8. Weakened immune system increasing risk of illness and infection
9. Heart conditions

Social and economic effects of drug abuse

1. Users become paranoid about their relationships e.g. thinking their friend are turning against them
2. Become aggressive and violent toward people
3. Family conflict that might include physical, mental abuse and neglect
4. Unemployment
5. Increased likelihood of emotional and mental disorders (like anxiety and depression)
6. Sexually transmitted diseases, due to unprotected sex
7. Unplanned pregnancies

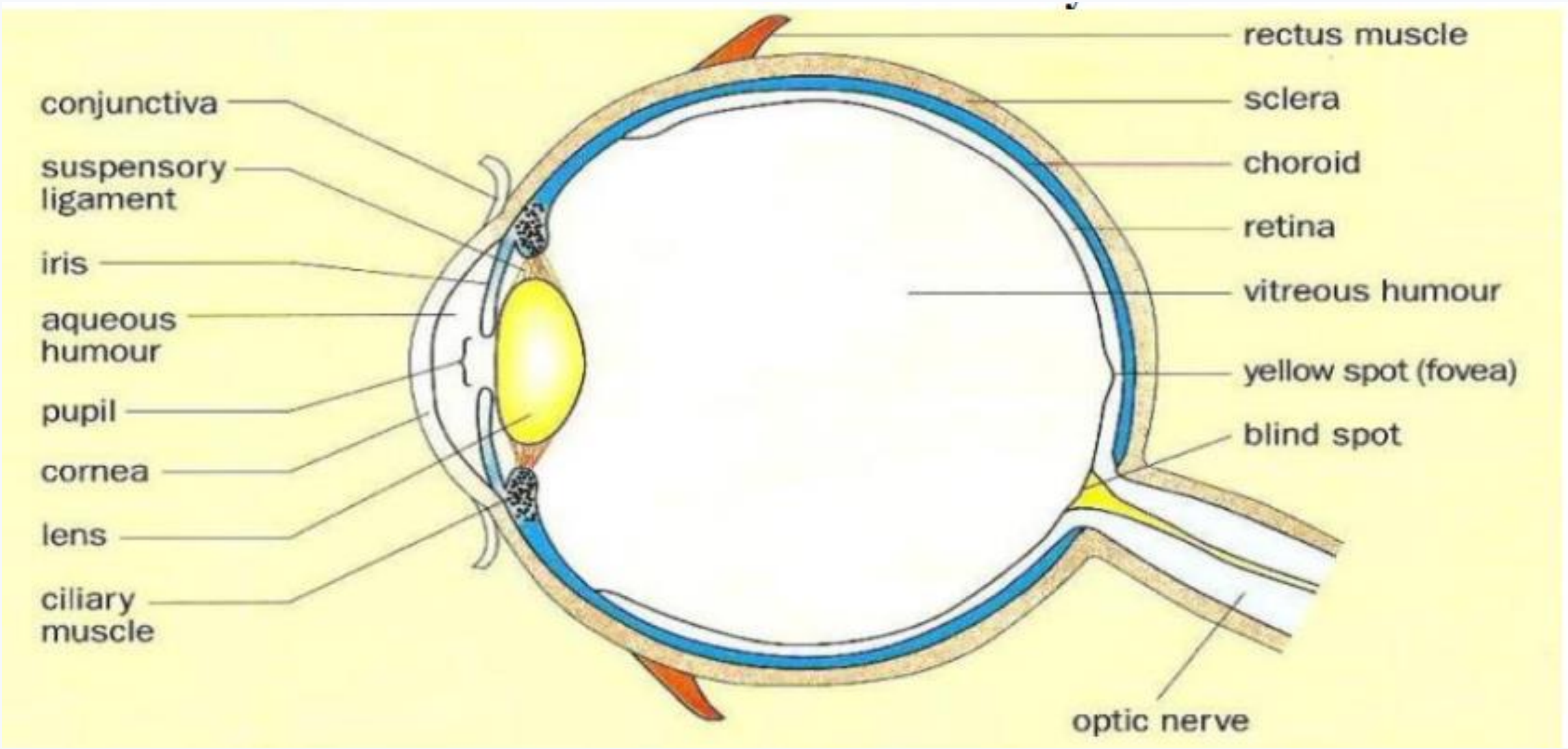
Prevention, control of substance and drug abuse

1. Providing moral support and counselling
2. Effectively deal with any kind of temptations and peer pressure
3. Create awareness about the side effects and consequences of the addiction
4. Avoid addiction to all these drugs
5. Treatment of the people who are already addicted
6. Build habits to stay busy
7. Cut out toxic relationships
8. Practice positive self-talk
9. Adopt a pet

RECEPTOR ORGANS IN MAMMALS/MAN

Examples of receptor organs

Receptor organ	Function	Stimulus
Eye	Sight	Light
Ear	Hearing and body balance	Sound
Skin	Temperature regulation	Heat, touch, pressure
Nose	Smell	Chemicals
Tongue	Taste	Chemicals

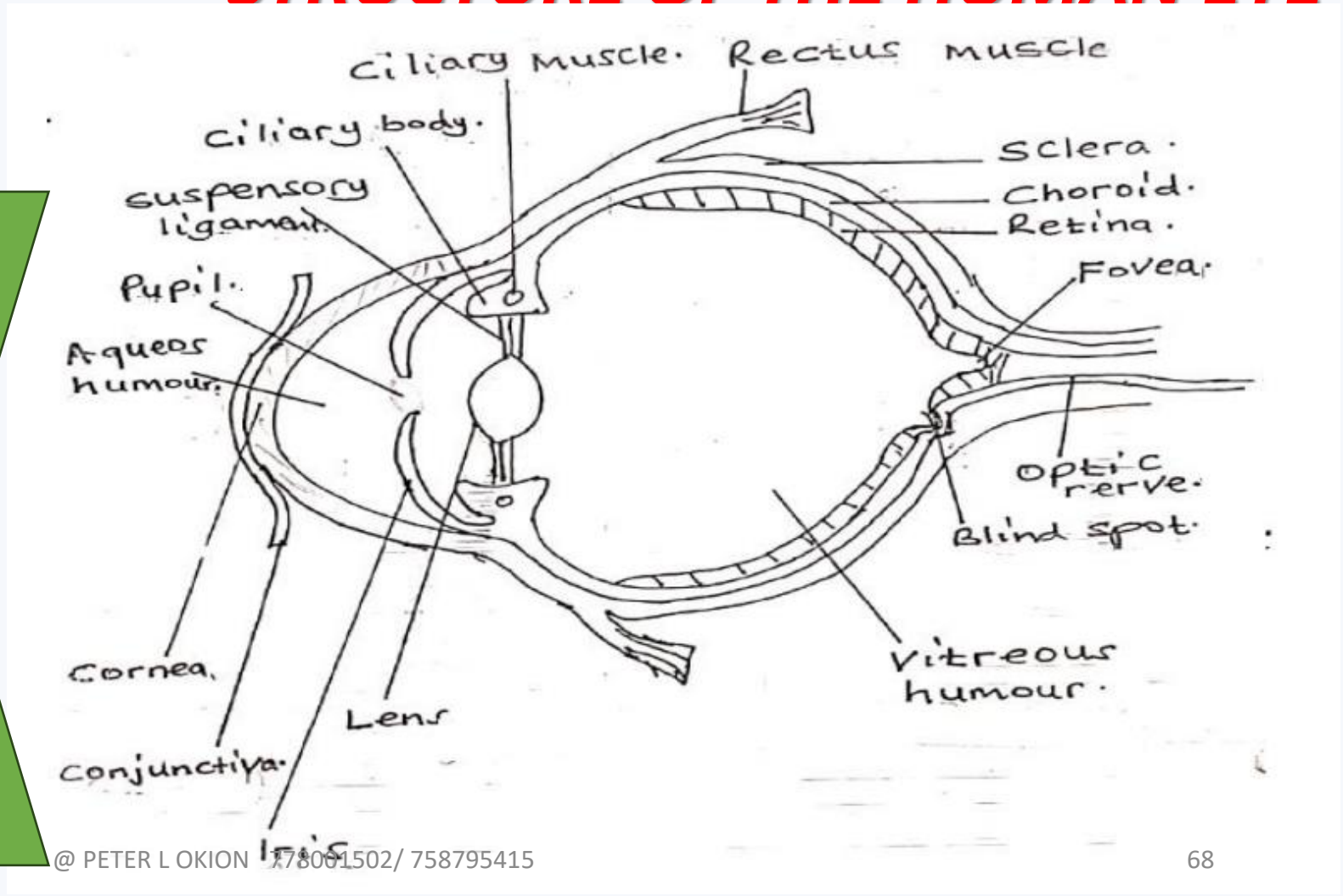

conjunctiva
suspensory ligament
iris
aqueous humour
pupil
cornea
lens
ciliary muscle
rectus muscle
sclera
choroid
retina
vitreous humour
yellow spot (fovea)
blind spot
optic nerve

THE HUMAN EYE

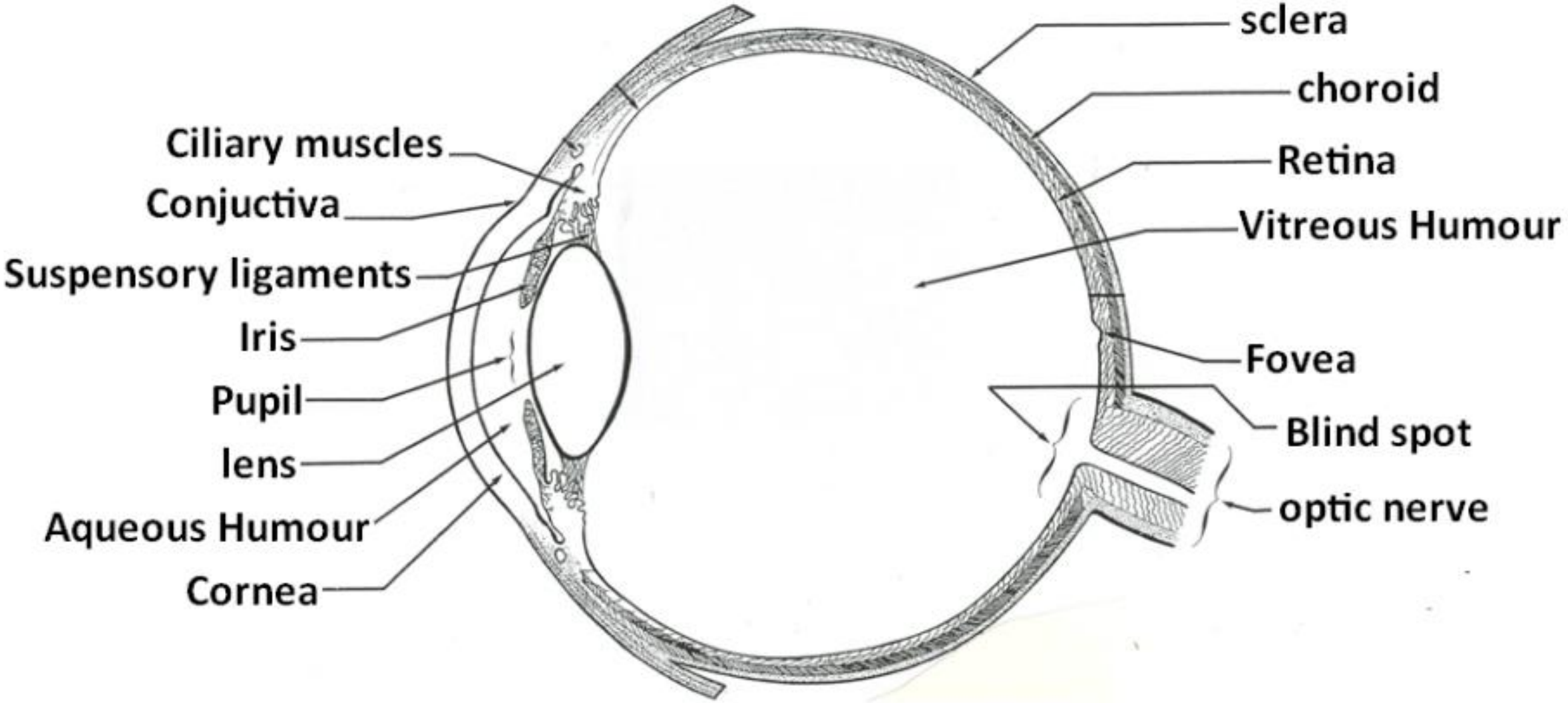
This is a receptor organ for vision/sight.

STRUCTURE OF THE HUMAN EYE

ACTIVITY:
Obtain a fresh eyeball from a slaughtered sheep, cow or goat; dissect it and study the above structural features.



THE HUMAN EYE



A table showing structure, function(s) and adaptations of parts of the human eye

Part	Descriptive features	functions
sclera	• Tough , non elastic, fibrous coat round the eye ball • Forms a transparent part, cornea	✓ Protection of the eye ball. ✓ Maintains shape of the eye ball ✓ Provides surfaces for attachment of the muscles.
Eye lid	Cover , so protecting the eye ball Regularly blinks so distributing fluid round the surface of the eye and thus preventing drying the eye Protects the retina from bright light by reflex action	
Eye lashes	Trap dust particles preventing them from entering the eye	
Tear glands	Open under the top of the eyelids	Secrete tears that ✓ keeps the surface of the eye moist ✓ kills any bacteria which be present ✓ Wash away dust and other particles.
cornea	Curved transparent disc in the front part of the sclera	✓ Allows light into the eye ✓ Refracts light rays focusing them onto the retina

conjuctiva	Thin transparent layer of tissue lining the inside of the eyelids, front of the sclera, and continuous with the epithelium of the cornea.	✓ Protects the cornea
Choroid layer	Layer of tissue lining the inside of the sclera, its deeply pigmented with melanin & richly supplied with blood vessels	✓ Blood vessels supply the retina and rest of the eye with nutrients and oxygen ✓ Blood vessels also remove carbon dioxide and other metabolic wastes ✓ Melanin prevents reflection of light within the eye.
Ciliary body	Located at the junction between the sclera and cornea & contains blood vessels and ciliary muscles	✓ Produces aqueous humour
Ciliary muscles	Circular sheets of muscles forming bundles of radial and circular muscles.	✓ On contraction and relaxation, alter the shape of the lens during accommodation.
Suspensory ligament	✓ Attach ciliary body to the lens	

lens	Transparent, elastic, biconvex, in structure	✓ Separates the aqueous and vitreous humour ✓ Refracts light on to the retina
Vitreous humour	Semi solid, colourless, transparent, jelly like substance containing water, salts and proteins	✓ Refracts light rays onto the retina ✓ maintains the shape of the eye ✓ equalize pressure on both sides of the lens
Aqueous humour	Clear/colourless watery fluid of salts, secreted by the ciliary body	✓ supplies nutrients and removes wastes from the cornea and lens. ✓ Refracts light rays onto the retina ✓ Equalize pressure on both sides of the lens ✓ Maintains shape of the eyeball
Iris	Circular, muscular diaphragm containing the pigment that gives the eye its colour.	✓ Controls the amount of light entering the eye by adjusting the size of the pupil
pupil	An opening/hole at the centre of the iris	✓ Allows light to enter into the eye

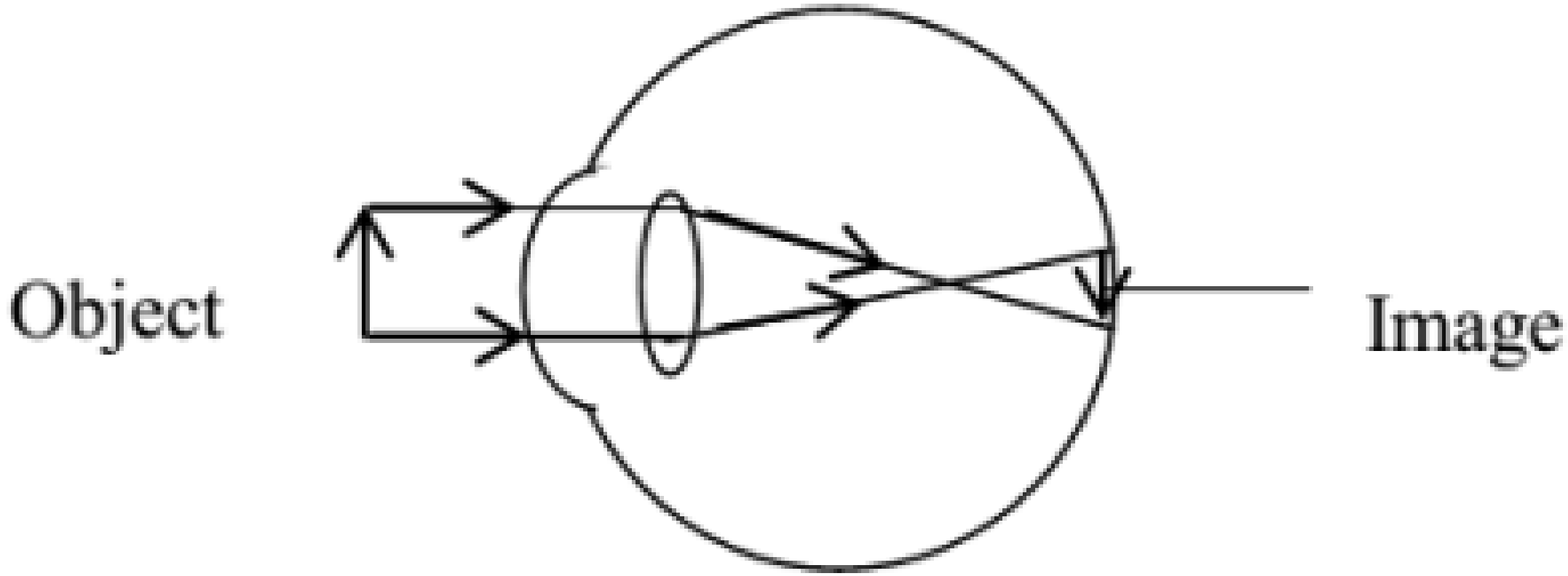
retina	Innermost layer of the eye, containing light sensitive cells, photoreceptor cells(cones and rods), cellbodies, and axons of neurones supplying the optic nerve	✓ Contain photoreceptor cells that are sensitive to light of different intensity i.e cones(high light intensity) and rods (low light intensity)
Optic nerve	✓ Bundle of nerve fibres carrying impulses from the retina to the brain	
Fovea(yellow spot)	Most sensitive part of the retina, containing cones only	✓ Sensitive to colour ✓ Gives clear images
Blind spot	Has no rods and cones, thus not light sensitive ✓ Has only blood vessels	

IMAGE FORMATION AND VISION

- ✓ Light rays from an external object are reflected to the cornea of eye
- ✓ Cornea refracts these light rays to the pupil, which are then passed through the aqueous humour, lens, and vitreous humour reaching the retina by refraction.
- ✓ Image of the object, real, upside down/inverted, and smaller than the object is formed on the retina,
- ✓ Image on the retina stimulates light sensitive cells, impulses are fired off in the nerve fibres, passed along the optic nerve to the brain, upside down image is interpreted and right size , color and distance of object determined.

Illustration (**long horn** biology book 3 page **93**, **DG MacKean** , page **131**)

Illustration



ACCOMMODATION OF THE EYE

Is the ability of the eye to focus both distant and near objects .

Occurs as a result of adjustments in the shape of the lens, brought by contraction and relaxation of the ciliary muscles.

(a).During focusing of close objects e.g letters in a book being read.

- ✓ Diverging light rays from a close object reach cornea where they are refracted
- ✓ Circular ciliary muscles contract.
- ✓ Suspensory ligament relax hence slacken/become loose(tension is reduced).
- ✓ Lens becomes thicker/more convex/more curved/assume a round shape.
- ✓ Degree of refraction of light rays increases, & are focused onto the retina where image is formed.

OR (see page 95, long horn book 3)

(b) During focusing of distant objects e.g. a plane high in the sky.

- ✓ Parallel rays from a distant object reach the cornea where they are refracted.
- ✓ Circular ciliary muscles are relaxed
- ✓ Suspensory ligaments are stretched outwards, making them tight
- ✓ Lens is pulled outward, making it flat and thin/ less convex
- ✓ Degree of refraction of light rays decreases, & are focused onto the retina where image is formed

OR (see DG mackean , page 132)

EYE DEFECTS

An eye defect is a condition in which eyes fail to focus certain objects well unless aided by spectacles.

There are 2 major common eye defects i.e;

i. Short sightedness (***myopia***)

ii. Long sightedness (***hypermetropia***)

NB: Eye defects differ from eye diseases because eye diseases are due to infections, genetic defects or deficiencies.

Short sightedness (myopia)

Is the ability of the eye to see clearly only near objects but not far objects.

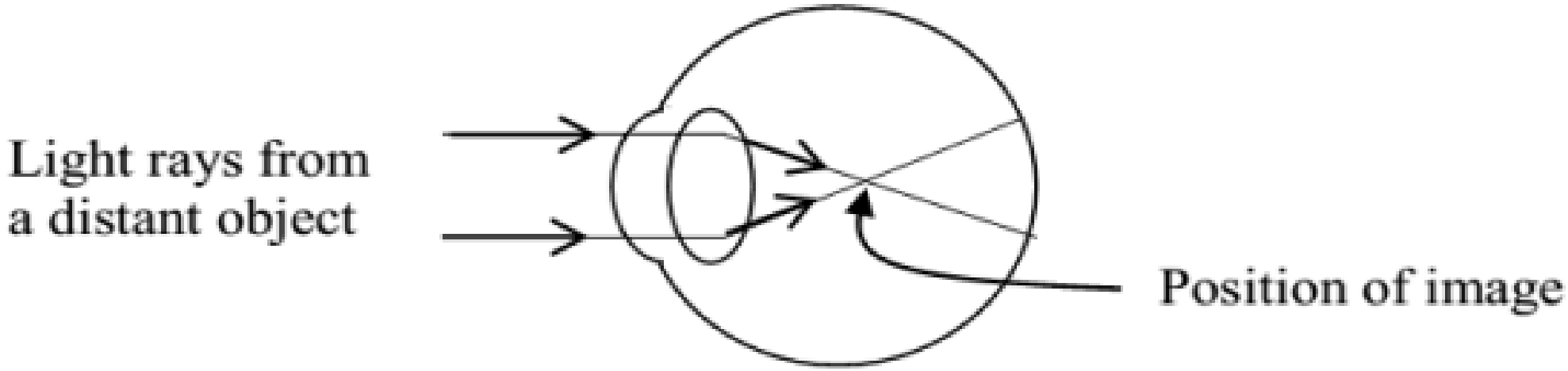
Light from a distant object is focused in front of the retina.

Causes of short sightedness

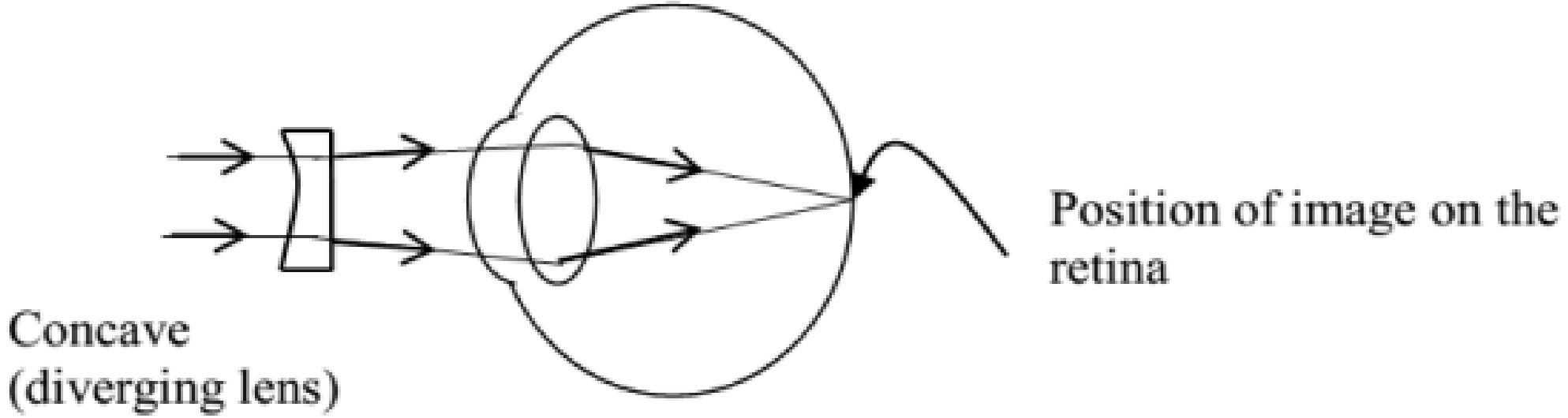
i. Large eye balls/abnormally long eye balls so that only light rays from a near object can be focused on the retina, those from the far are focused in front of the retina.

ii. Lens is too curved/more convex causing too much refraction of light.

Illustration



This can be corrected by putting on diverging (concave) lenses.



Correction of short sightedness:

Wear spectacles with **concave /diverging lens;**

The concave lens **reduces the refractive power** of the eye and diverges the light rays from the far object before entering the eye farther onto the retina.

Long sightedness (Hypermetropia)

Is the ability to see clearly only distant objects but not near ones.

Light from a near object is focused behind the retina.

Causes of long sightedness

i. Small/short eye balls; so that only rays from far object can be focused onto the retina; those from a near object are focused behind the retina.

ii. Non-elastic lens/permanently too flat/thin/low convexity thus weak lens.

Illustration

Rays from a nearby object

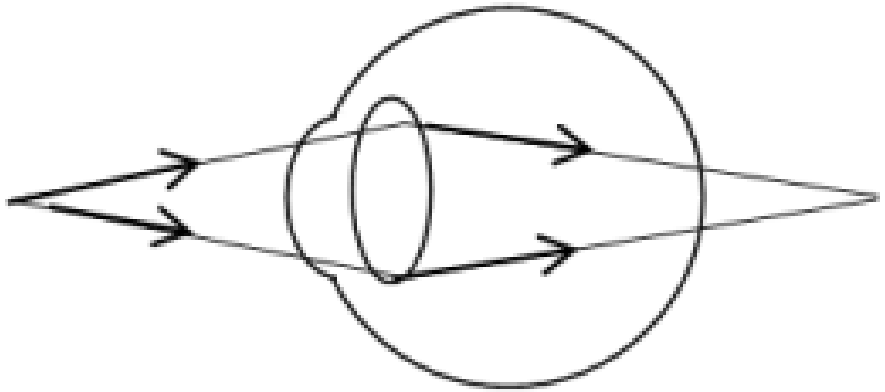
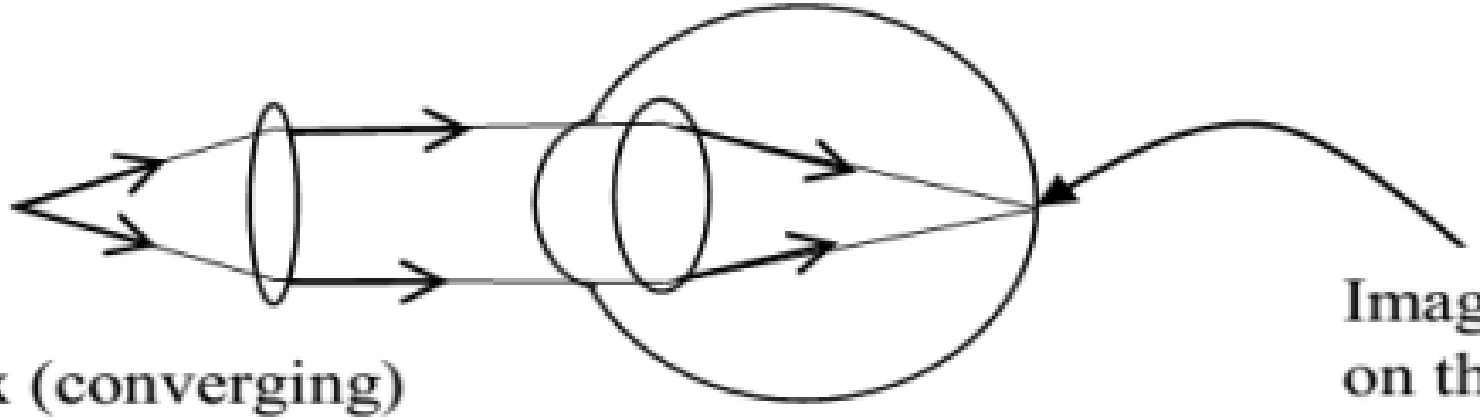


Image formed outside the retina

Long sightedness can be corrected by wearing converging (convex) lenses.



Convex (converging) lens

Image formed on the retina

Correction of long sightedness

Wear spectacles with **convex lens/converging lens.**

The convex lens converges the light rays from a near object before entering the eye so that the image is focused nearer onto the retina.

Question:

a) State the causes of long sightedness and short sightedness.

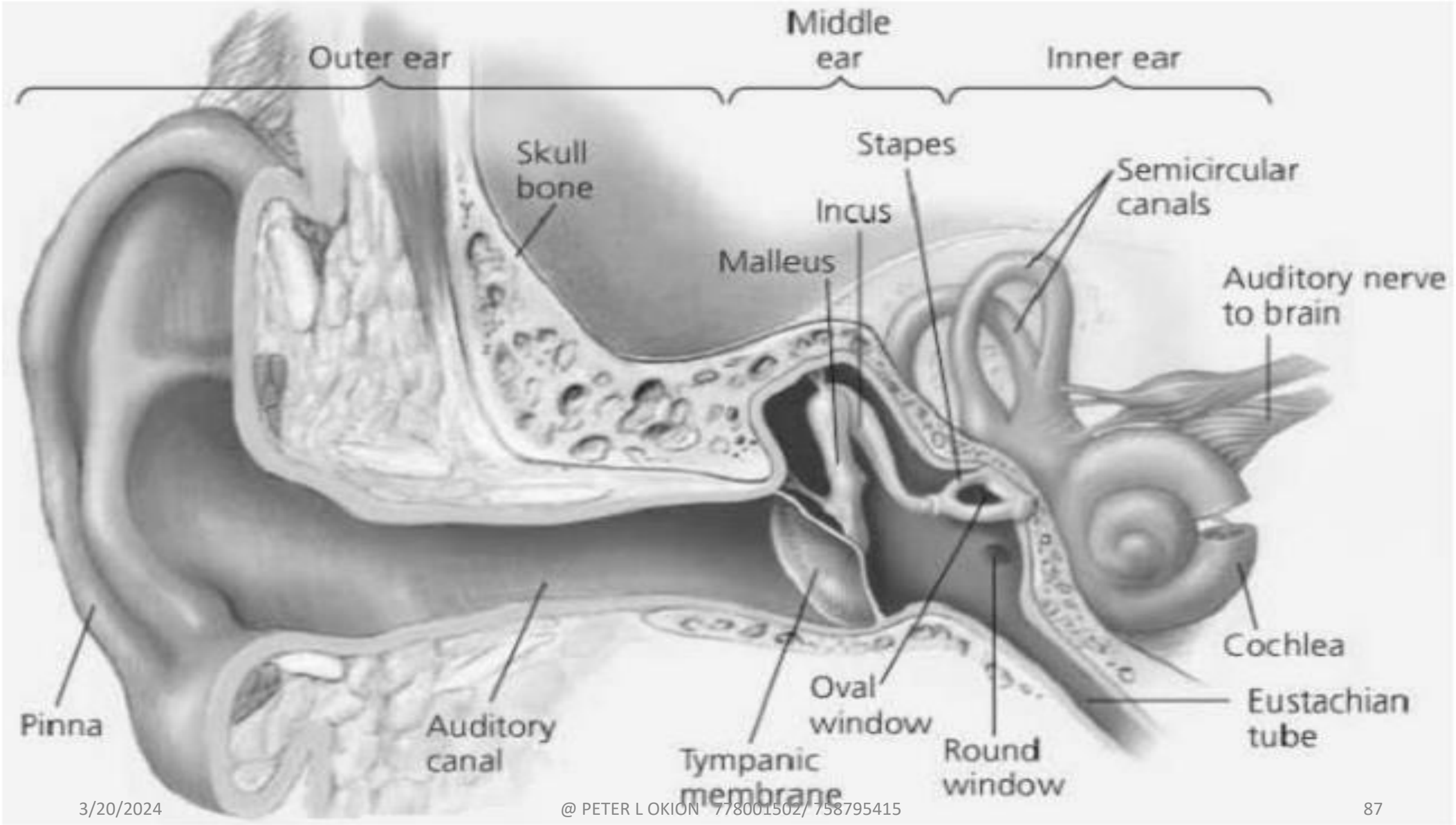
b) Draw a diagram illustrating a person suffering from;
   i. Short sightedness
   ii. Long sightedness

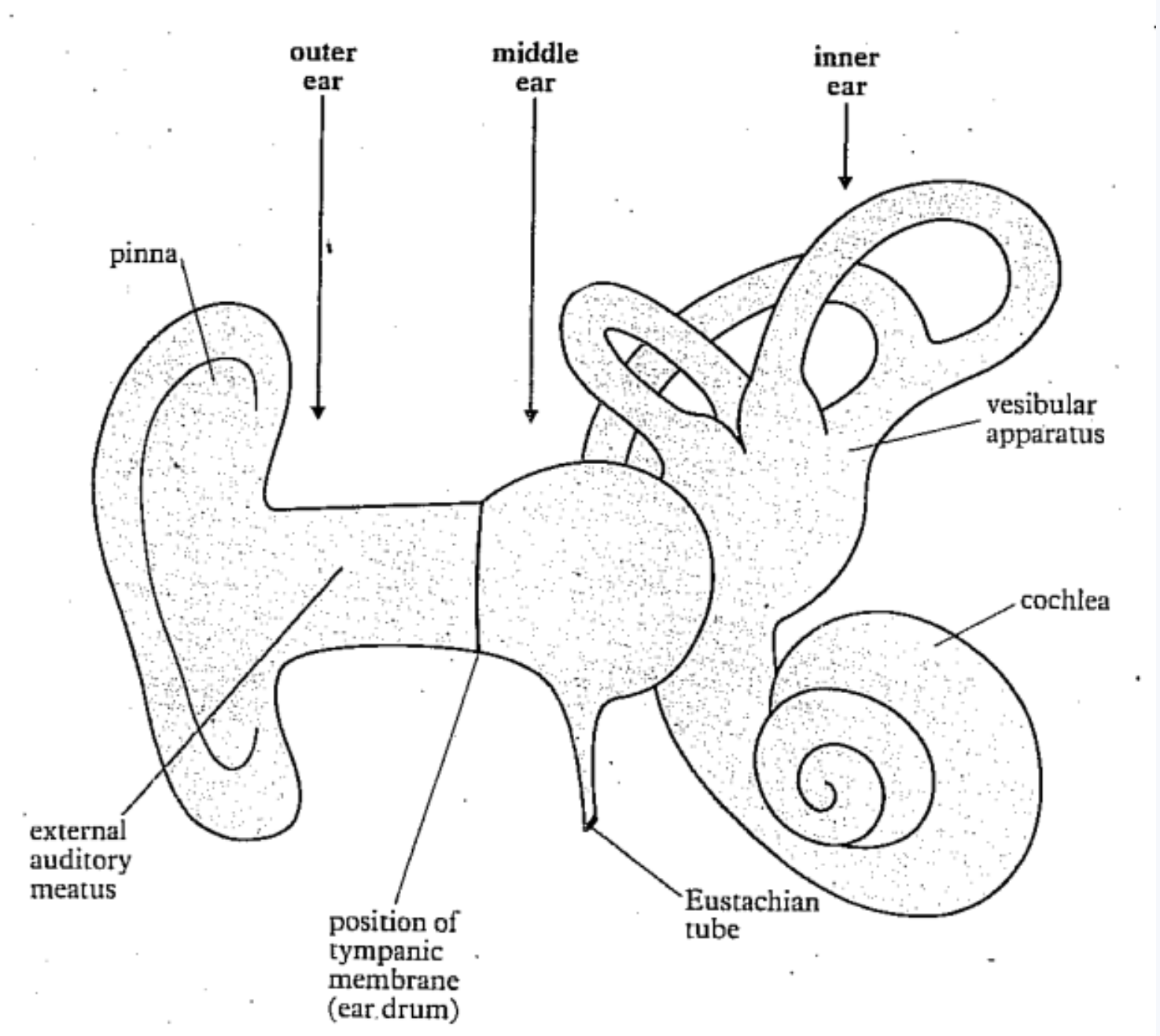
c) Draw diagrams to show how the eye defects in (b) above can be corrected

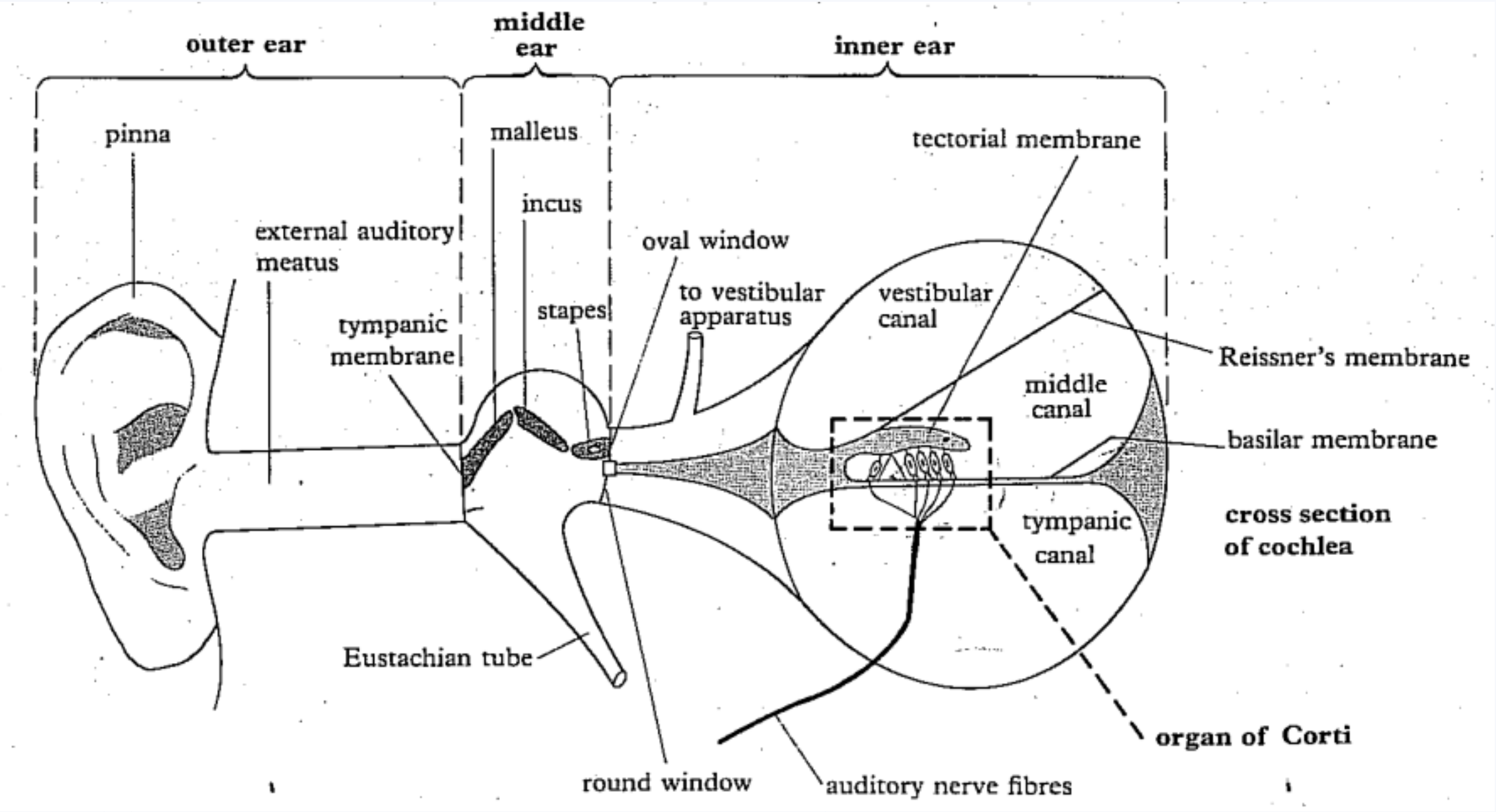
THE MAMMALIAN EAR

Functions

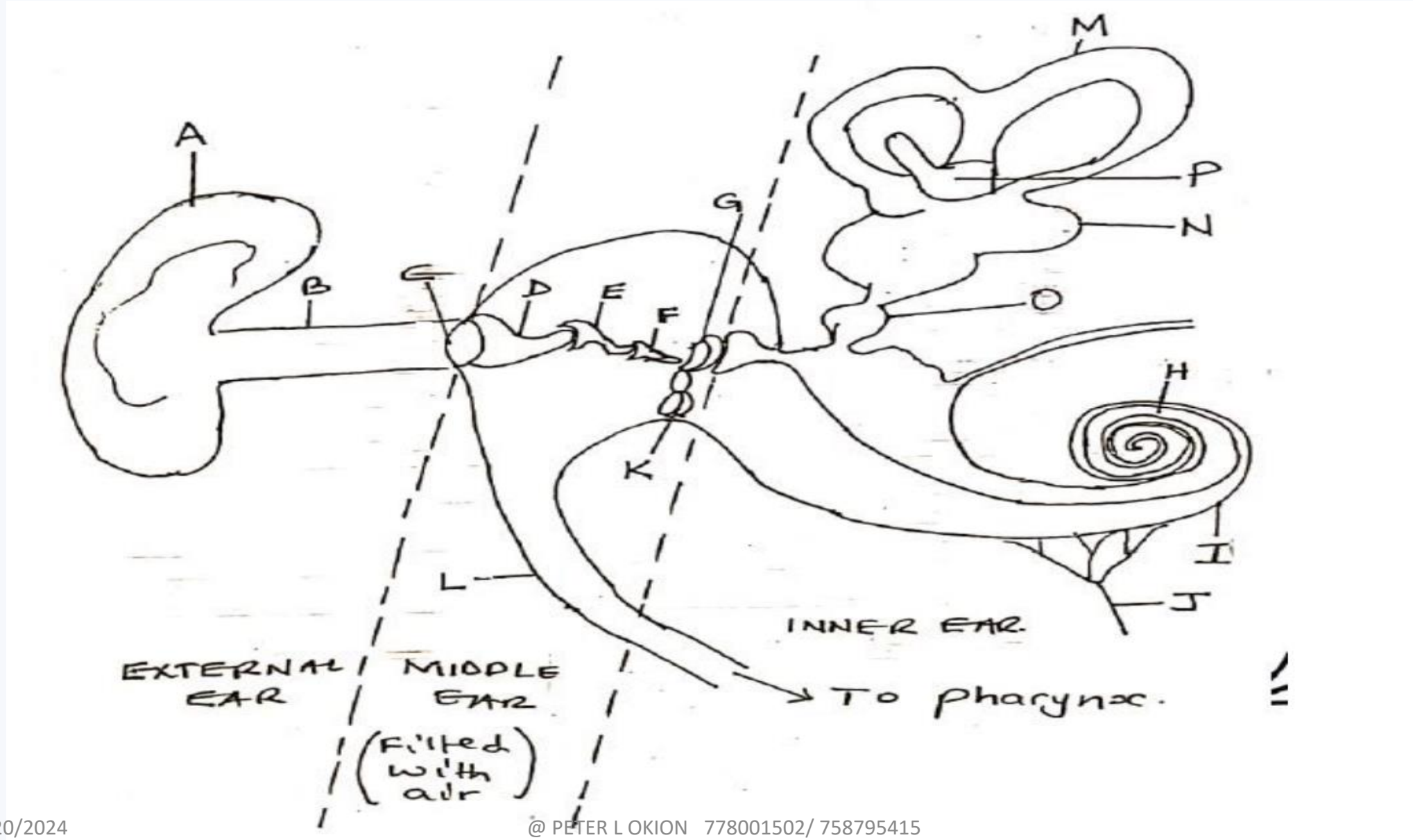
- ✓Is a sense organ containing special cells that detect sound waves for hearing.
- ✓Has sensory cells for determining posture and balancing/equilibrium of the body.


Outer ear
Middle ear
Inner ear
Skull bone
Stapes
Semicircular canals
Incus
Malleus
Auditory nerve to brain
Pinna
Auditory canal
Tympanic membrane
Oval window
Round window
Cochlea
Eustachian tube


outer ear
middle ear
inner ear
pinna
vesibular apparatus
cochlea
external auditory meatus
position of tympanic membrane (ear drum)
Eustachian tube


outer ear
middle ear
inner ear
pinna
malleus
incus
external auditory meatus
oval window
to vestibular apparatus
tectorial membrane
vestibular canal
stapes
tympanic membrane
Reissner's membrane
middle canal
basilar membrane
cross section of cochlea
tympanic canal
Eustachian tube
organ of Corti
round window
auditory nerve fibres

Structure of the human ear



KEY:

A. Pinna.
B. External auditory canal/external auditory meatus.
C. Ear drum/tympanic membrane.
D. Malleus/hammer.
E. Incus/anvil
F. Stapes/stirrup
G. Oval window/fenestra ovalis.
H. Endolymph fluid in cochlea.
I. Cochlea
J. Auditory nerve
K. Round window/fenestra rotunda.
L. Eustachian tube
M. Semicircular canals
N. Utriculus
O. Sacculus
P. Ampulla

The ear is divided into 3 main parts;

i. Outer ear; pinna, auditory canal and ear drum.
ii. Middle ear.
iii. Inner ear

Functions of the parts of the ear

- The outer projecting portion of the outer ear is known as the ***pinna***. Its function is to receive and concentrate sound waves.
- ***The auditory canal*** has hairs and wax that trap foreign bodies. It transmits sound waves to the eardrum (tympanum).
- ***The ear drum*** is a thin membrane; the eardrum transmits sound waves to the middle ear.
- The three small bones i.e. ***hammer (malleus), anvil (incus) and stapes (stirrup)*** are known as ***ear ossicles***. They transmit acoustic vibrations from the eardrum to the inner ear.
- ***The Eustachian tube*** is a slender canal that connects the middle ear to the pharynx. It equalizes the air pressure on the two sides of the eardrum.

- ***The oval window*** transmits sound vibrations to the inner ear.
- The ***semi-circular canals, utriculus and sacculus*** form the ***vestibular apparatus***, which controls body balance and posture. The canals are filled with fluid which moves as the body moves or when the head changes position.

- The ***cochlea*** facilitates hearing.

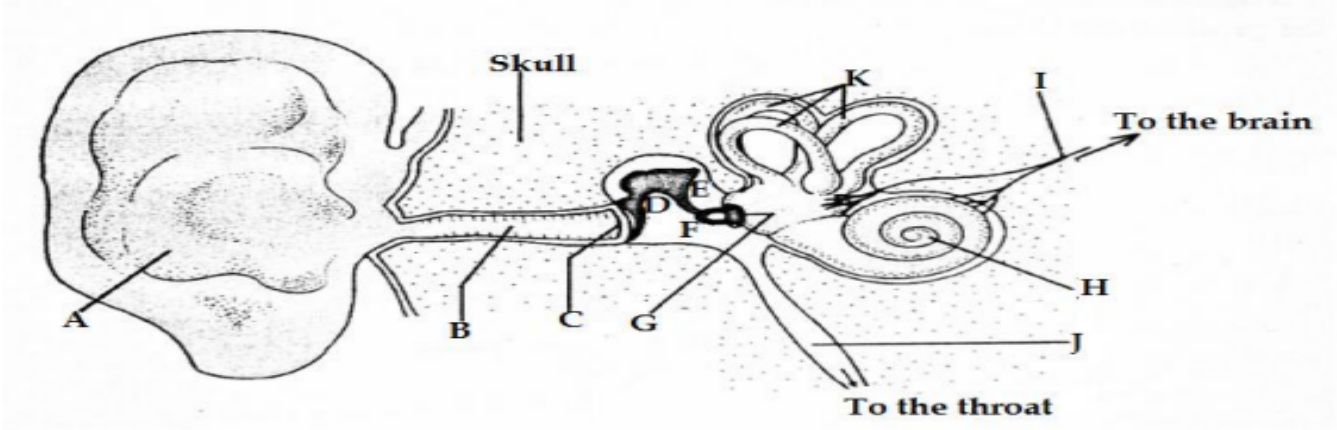
- The ***round window*** equalizes pressure in the cochlea.

- The ***auditory nerve*** transmits impulses to the brain

Question: Describe the mechanism of hearing in man

Solution

- ✓Soundwaves from the source (object) are trapped and concentrated by the pinna and are directed to the ear drum via auditory canal.
- ✓Ear drum vibrates and the vibrations are transmitted to three ear osscicles; hammer, anvil, stirrup which vibrate and amplify vibrations, causing the oval window to vibrate which displaces the lymph fluid (perilymph and endolymph) in the cochlea of the inner ear.
- ✓This distorts the sensory cells in the cochlea which are stimulated to trigger auditory impulses to the brain for interpretation via auditory neurons.



(a) (i) Name the parts labelled ***(02 marks)***

A ..... C .....

B ..... G.....

(ii) State the general name for structures D, E and F ***(01 mark)***

.....

(iii). State the function of the following structures: ***(02 marks)***

J

.....

K

.....

(b) Describe how the structures labelled A to I are involved in the hearing process. ***(05 marks)***

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END

BIOLOGY IS LIFE

SLIDES PREPARED BY TR. PETER L OKION