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

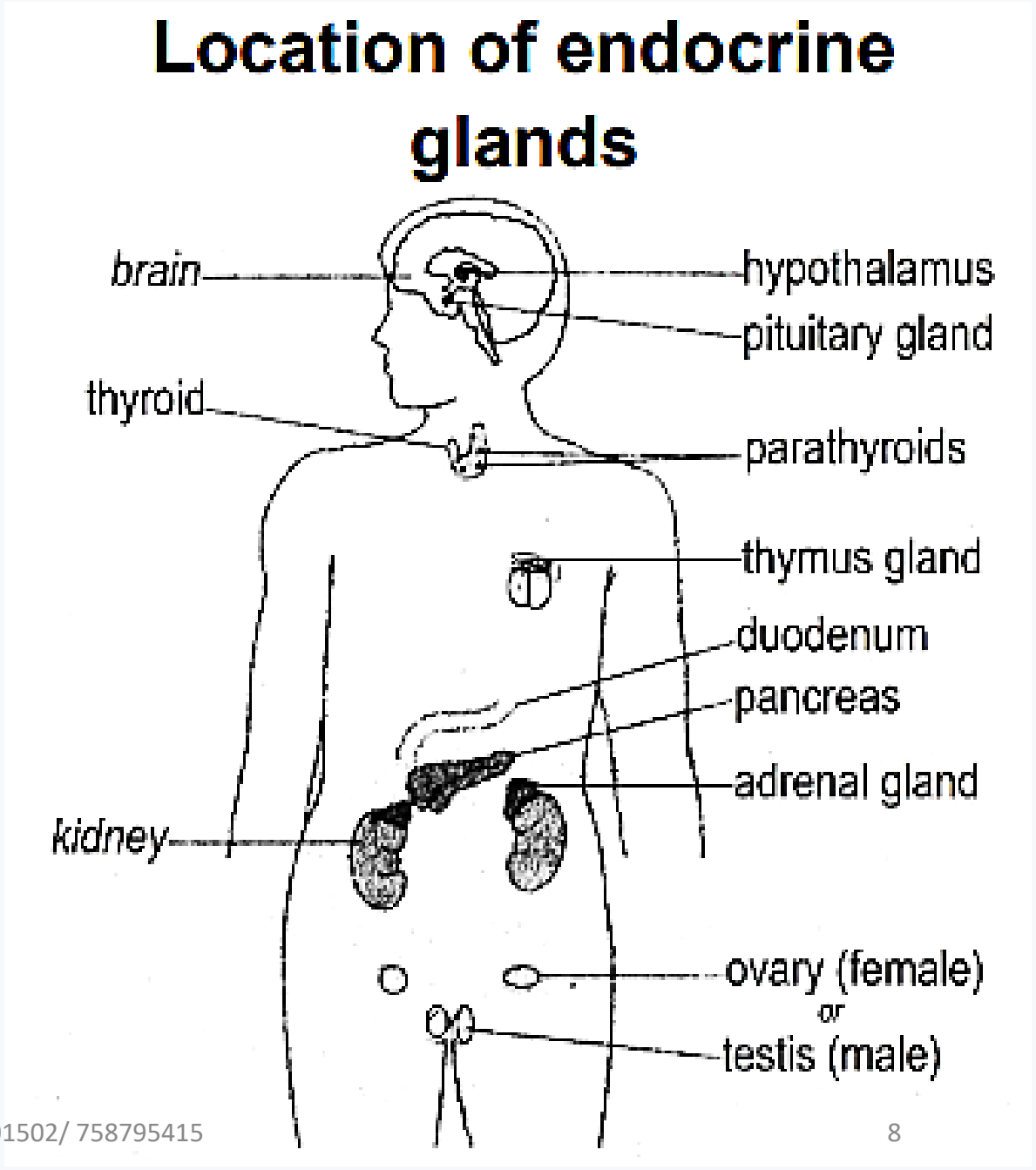
NOTE: The focus of this topic however are the endocrine glands

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.

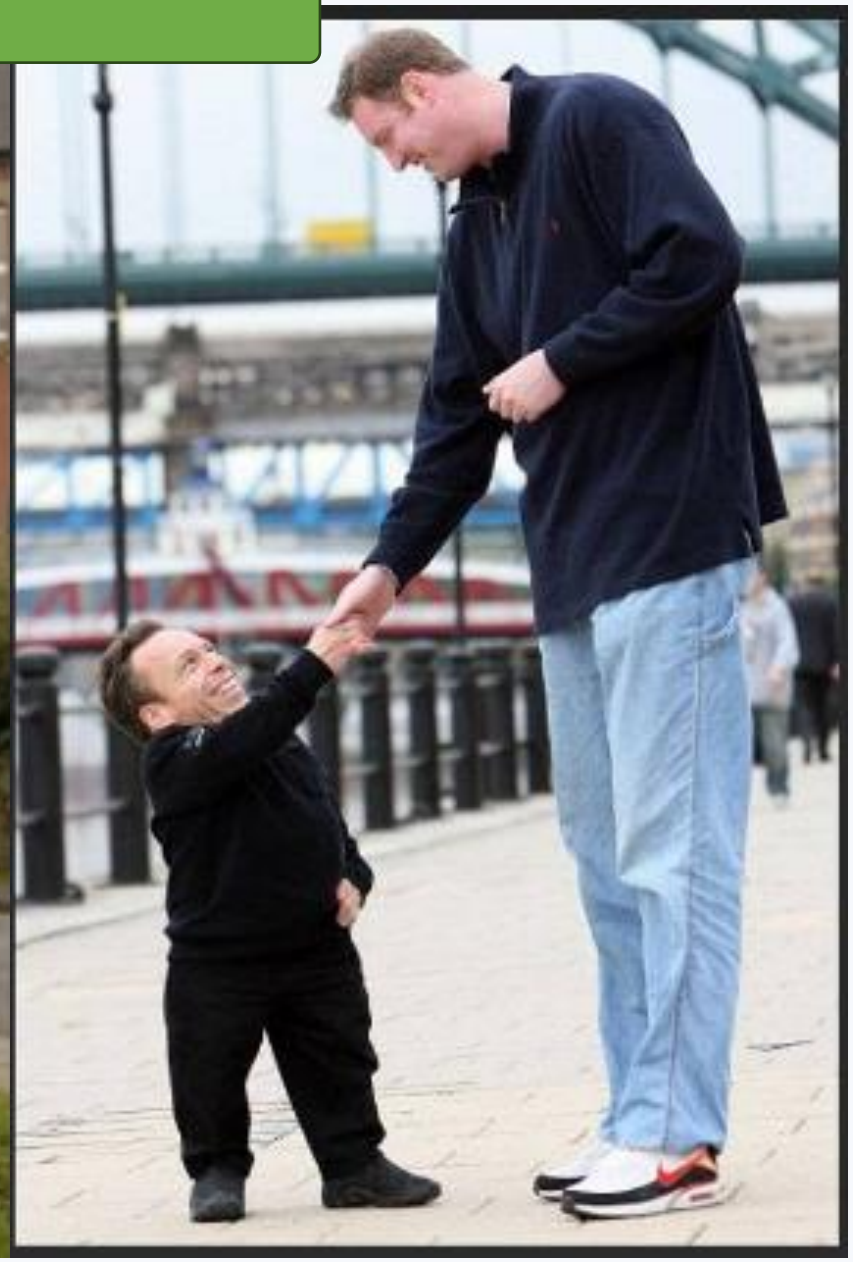
It's mainly controlled by the **hypothalamus.**

- ✓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 Pituitary gland

Hormone	*Abbreviation*	*Function*
Thyroid Stimulating Hormone	**TSH**	○ Stimulates Thyroid gland to produce Thyroxine Hormone
Follicle Stimulating hormone	**FSH**	• Stimulates sperm formation in testis • Stimulates formation and development of Graafian follicles 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

GIGANTISM



DWARFISM

2. The thyroid gland.

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

FUNCTION

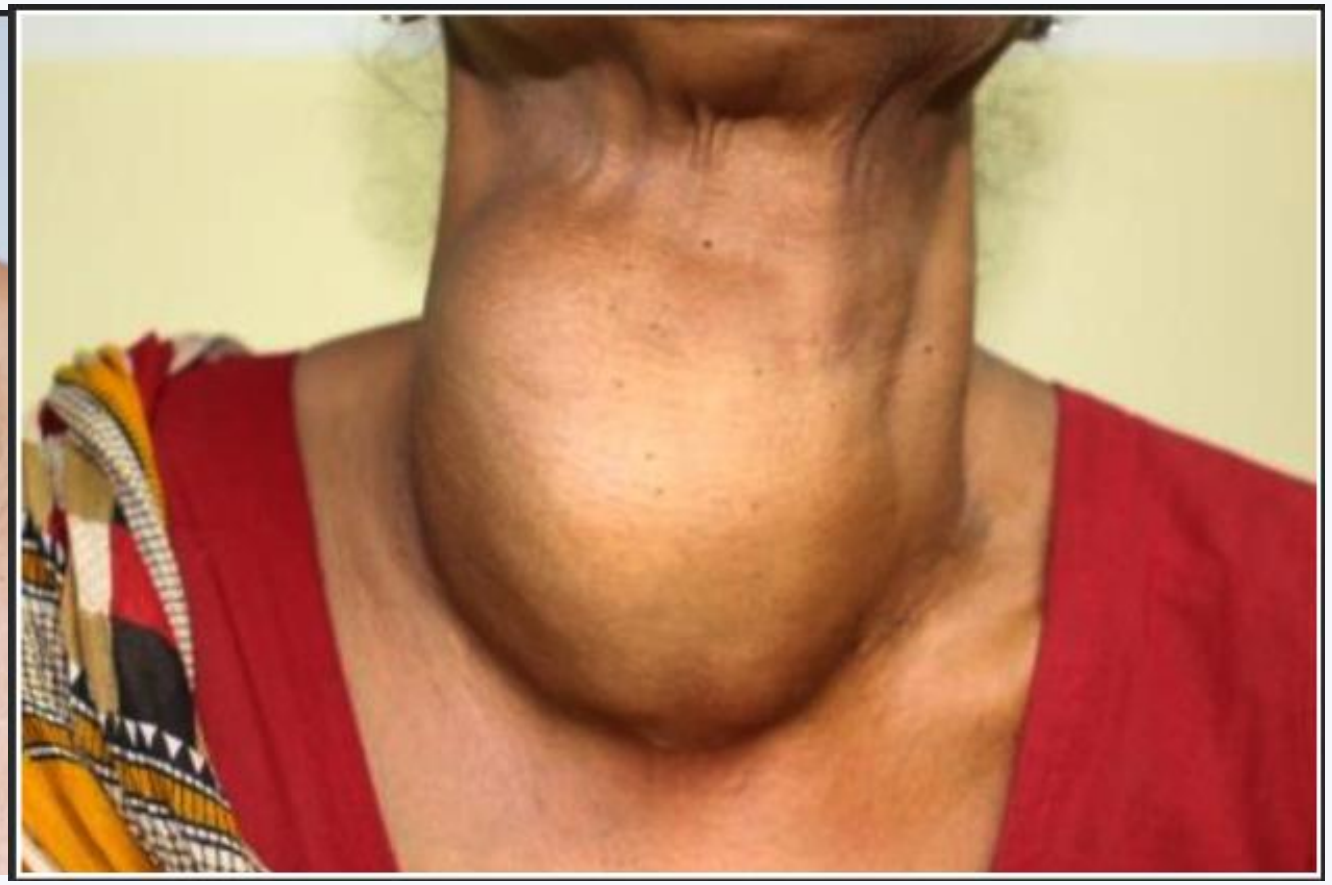
- ✓Control growth and development in young ones e.g. metamorphosis in tadpoles
- ✓Controls cellular respiration in organisms, being high when secreted and low when little quantity of hormone is present

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**.

Deficiency 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.

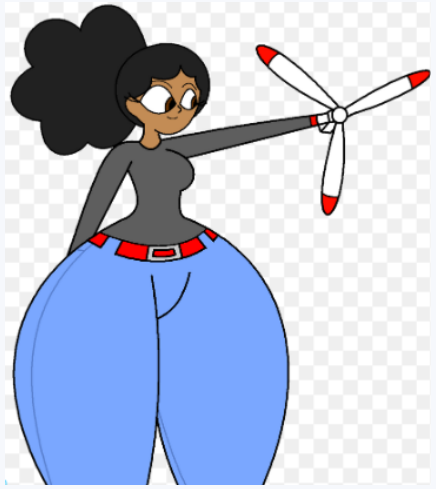
6. The reproductive organs/ Gonads (testes and ovaries)

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, goiter, gigantism, dwarfism, cretinism**

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	Transported in ducts
Secreted by only endocrine glands	Secreted by all body cells

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).

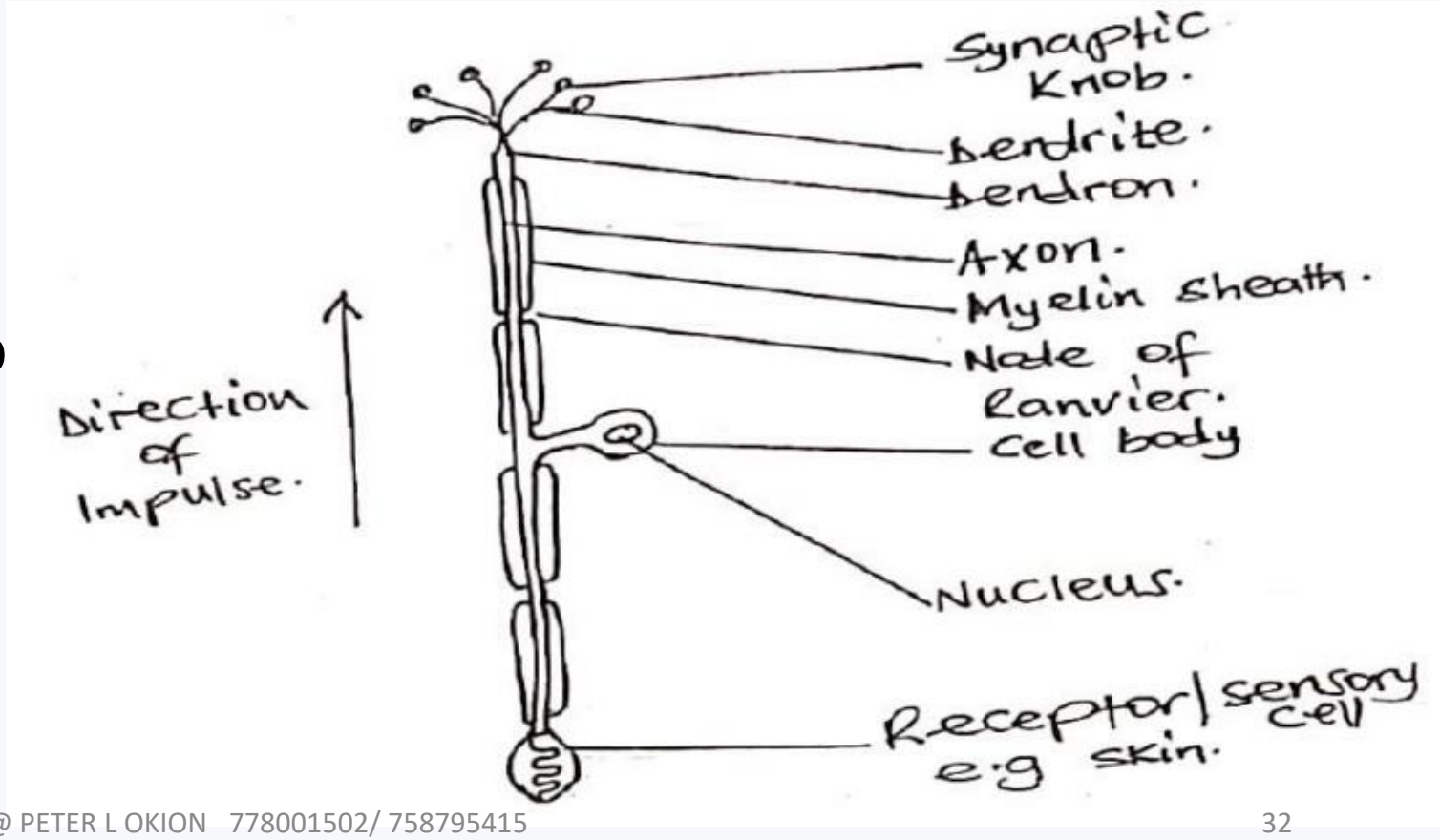
iii) ***An effector;*** is a cell, tissue, organ/structure that receives impulses from the central nervous system and makes the necessary reaction/response like muscles and glands.

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

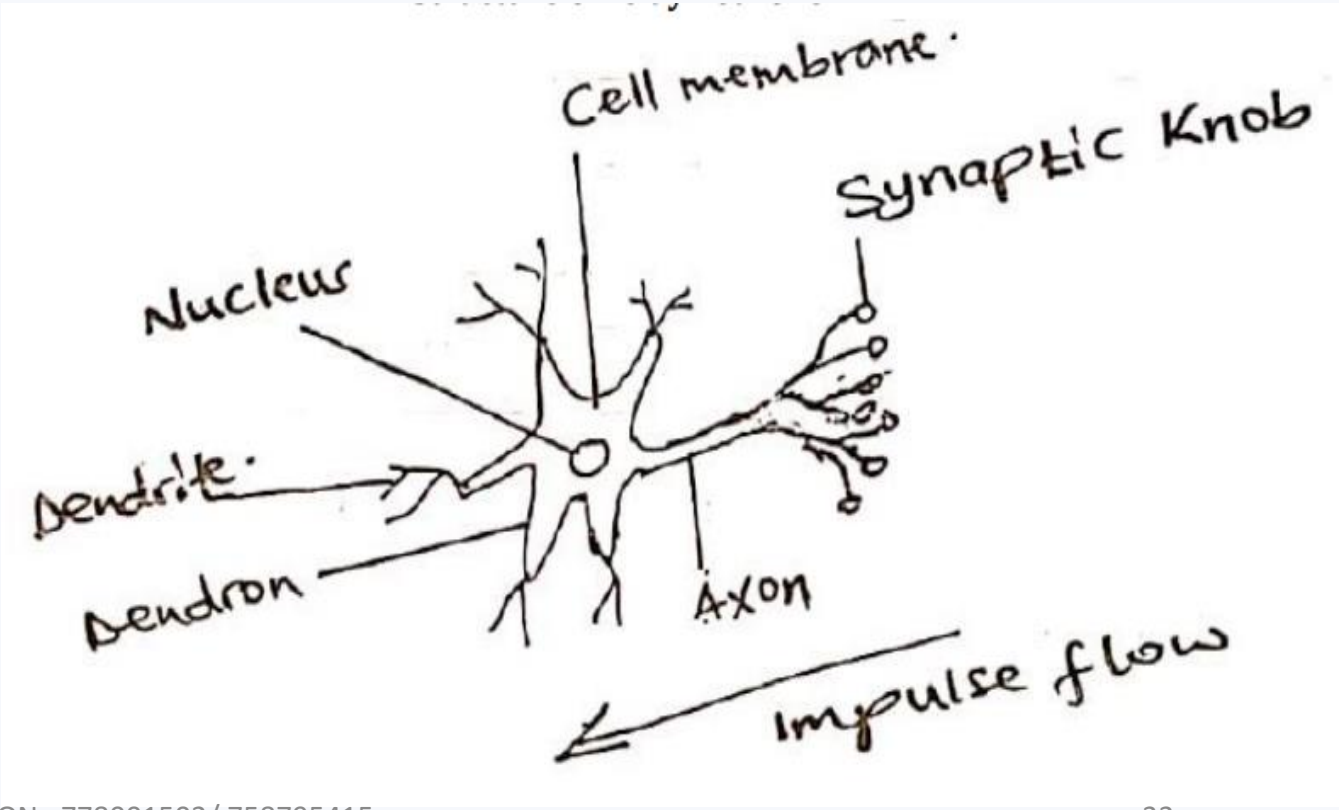


2. Relay/intermediate/associative/intercalary neurones;

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

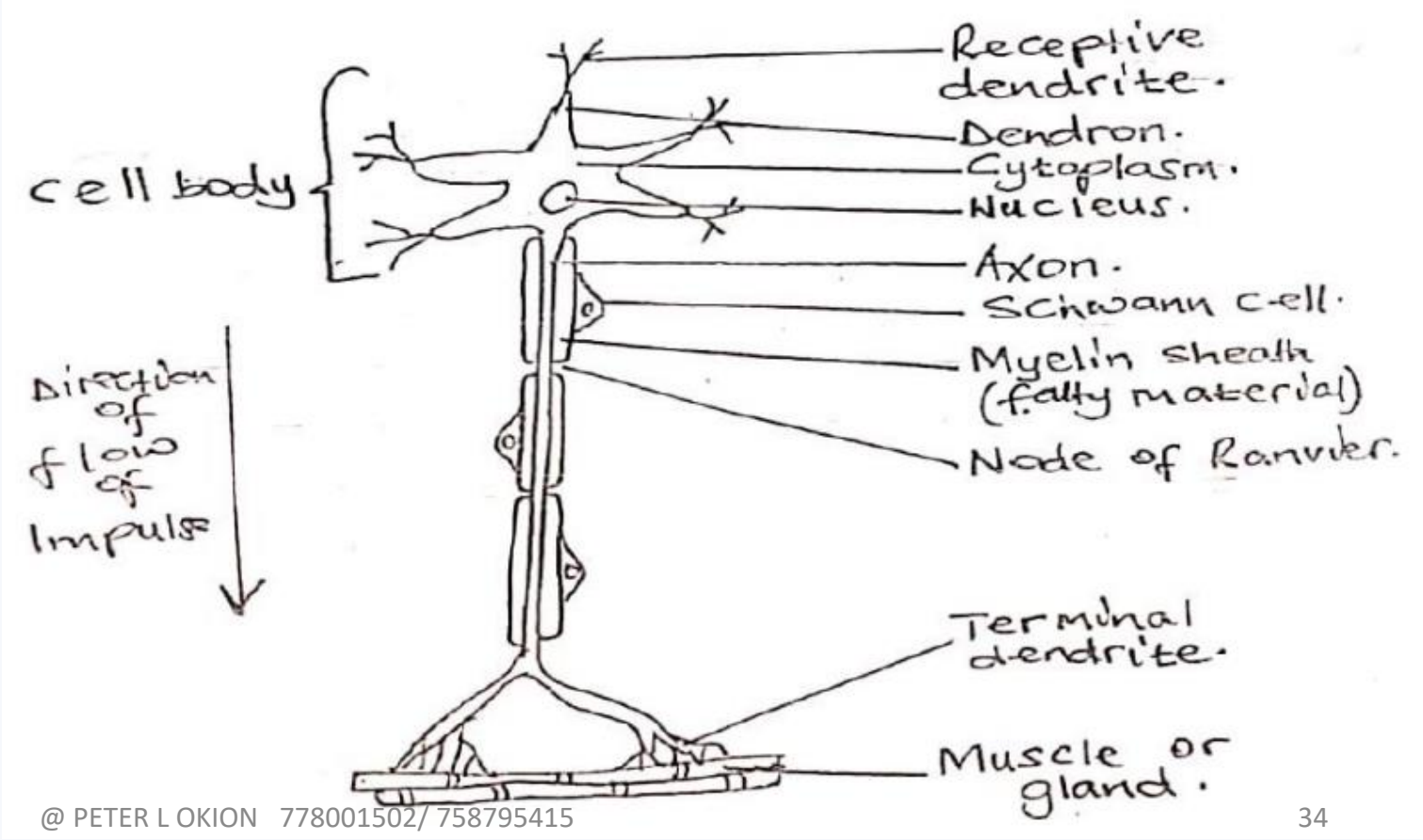
Structure of a relay Neurone



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

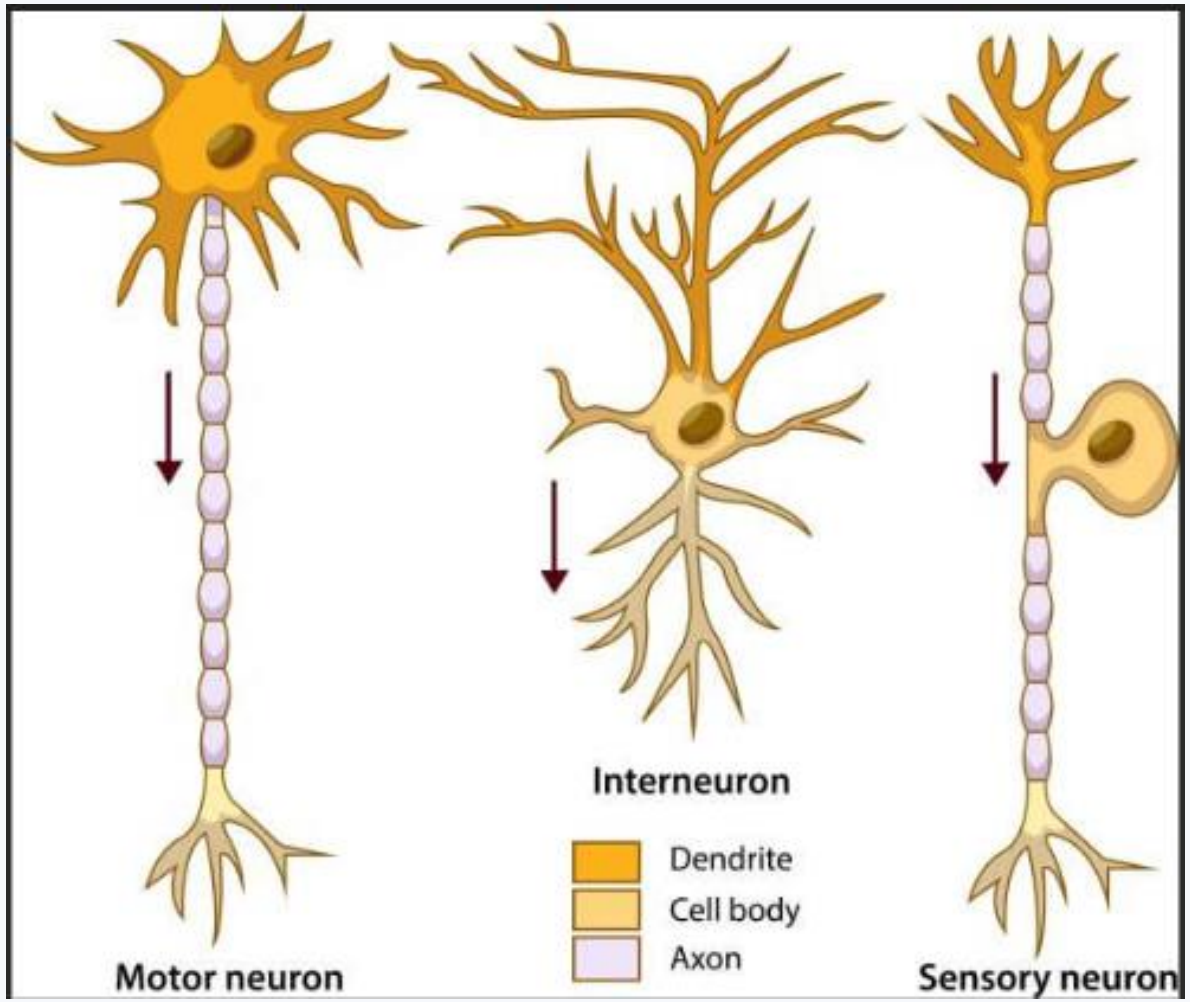
Question:

Compare;

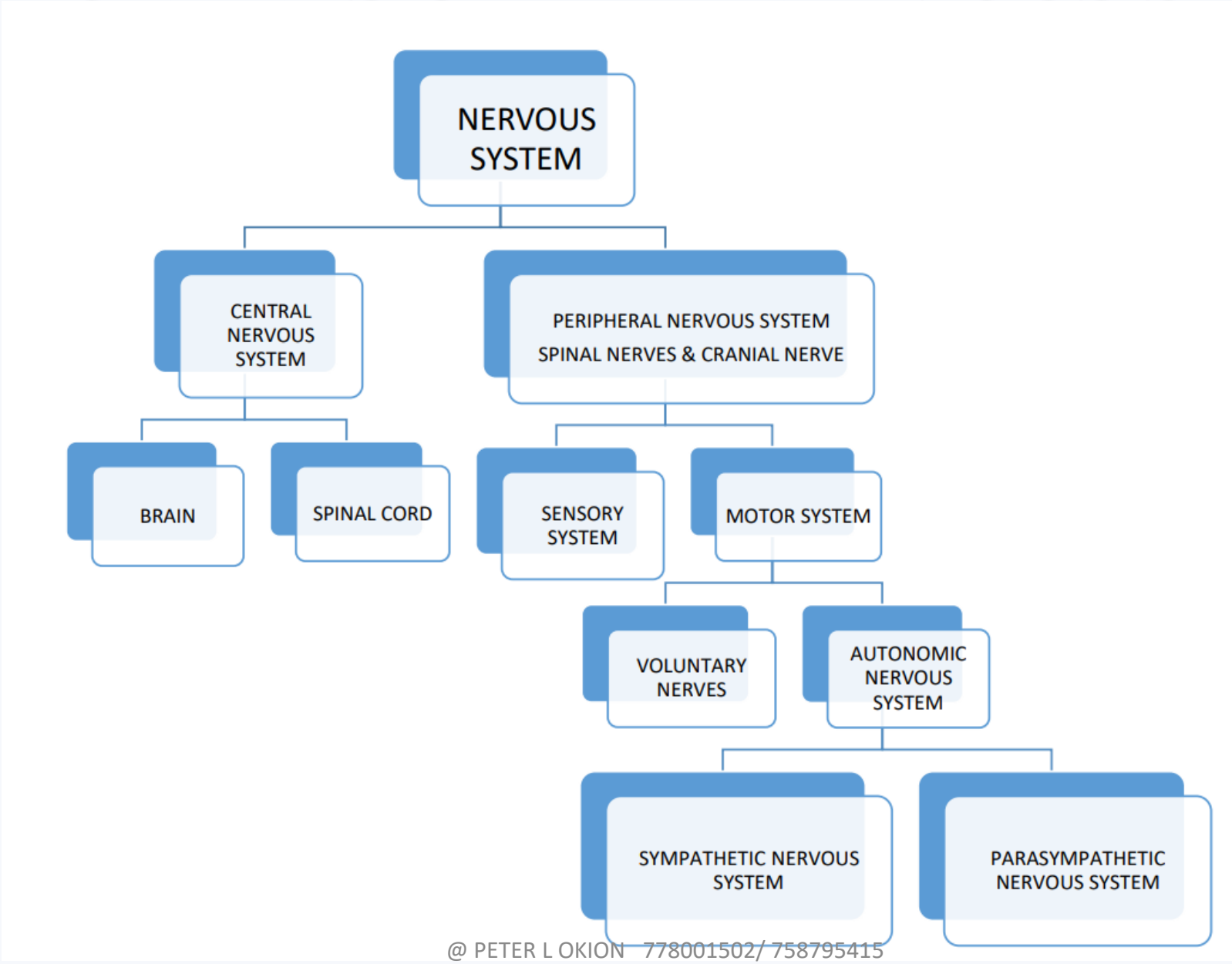
(a) Motor with relay neurones

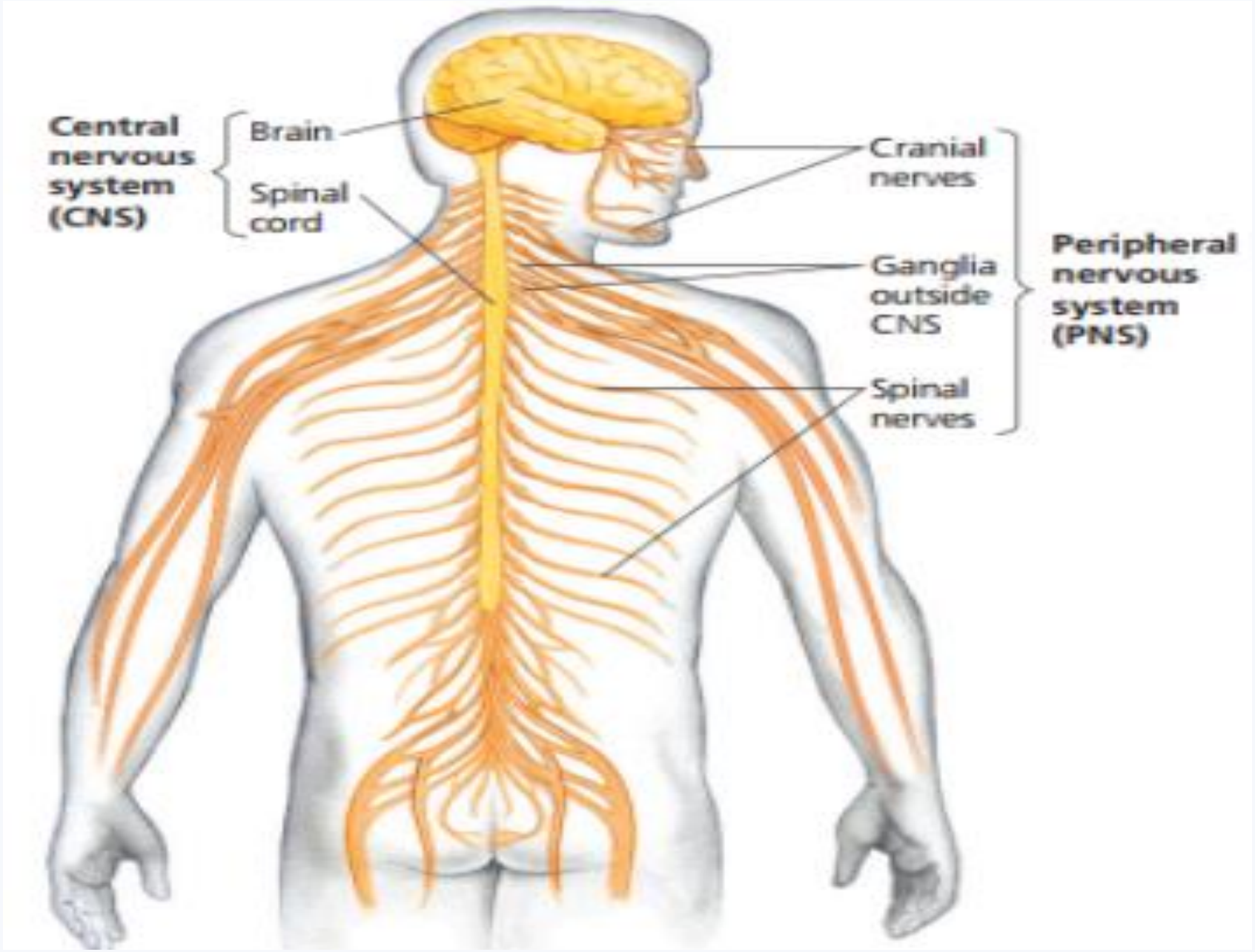
(b) Sensory and relay neurones.

(c) Sensory and motor neurones.



COMPONENTS OF THE NERVOUS SYSTEM




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

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.

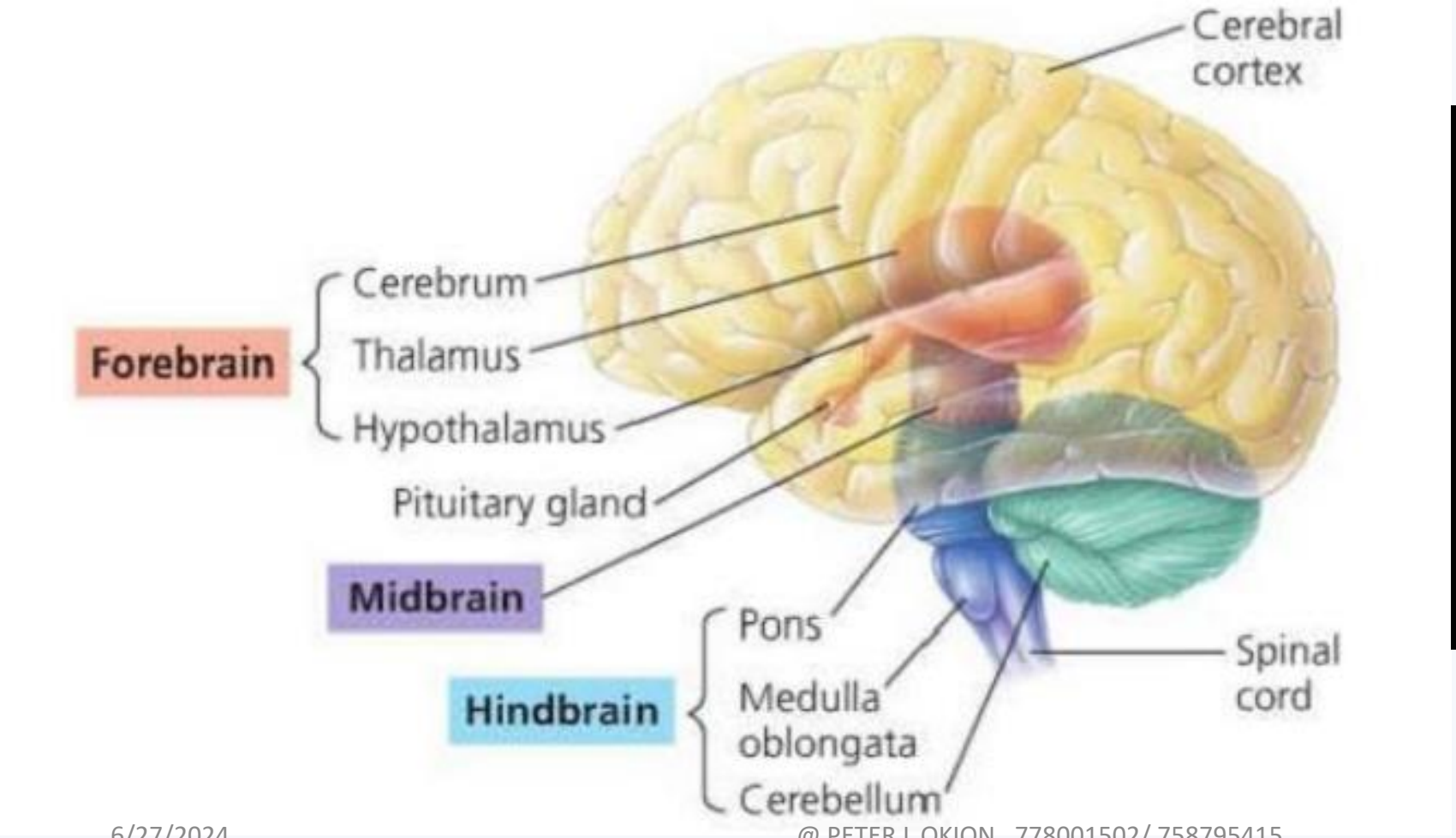
iii) **Peripheral nervous system**
This consists of spinal and cranial nerves which are either voluntary or involuntary nerves. The involuntary nerves form the autonomic nervous system

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



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.

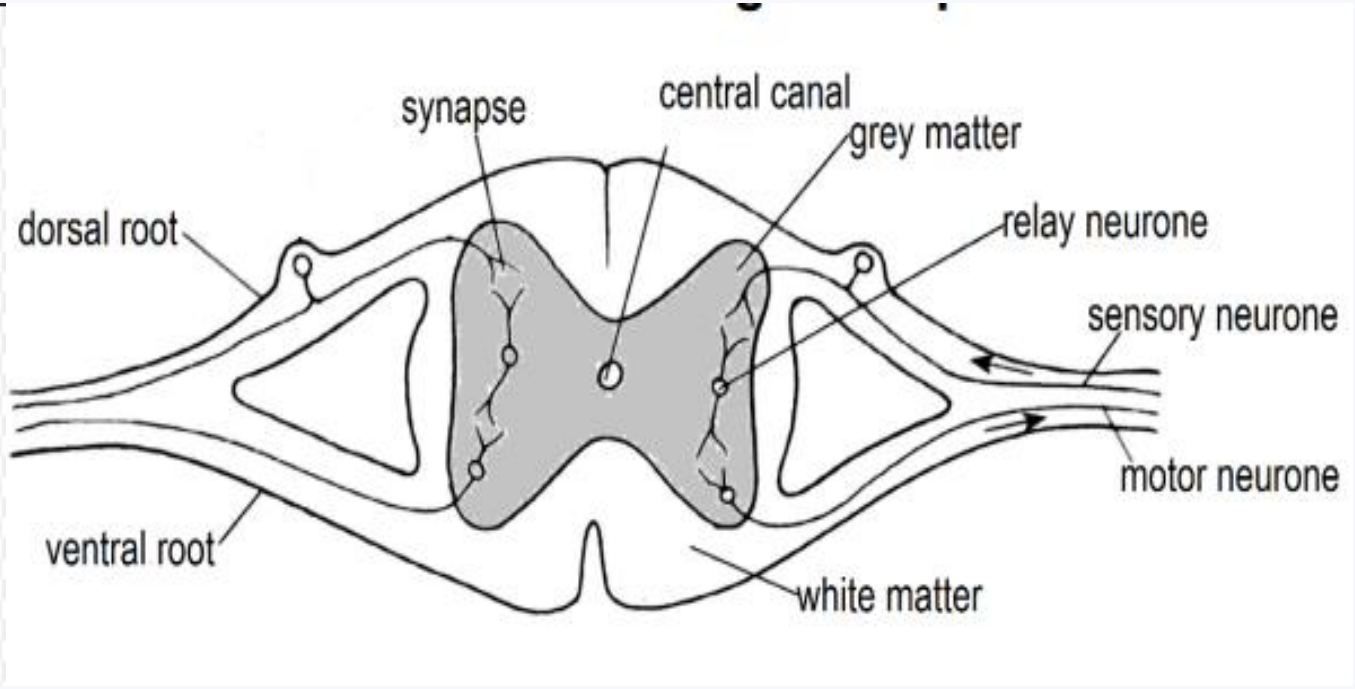
✓• It stores information.

✓• 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.

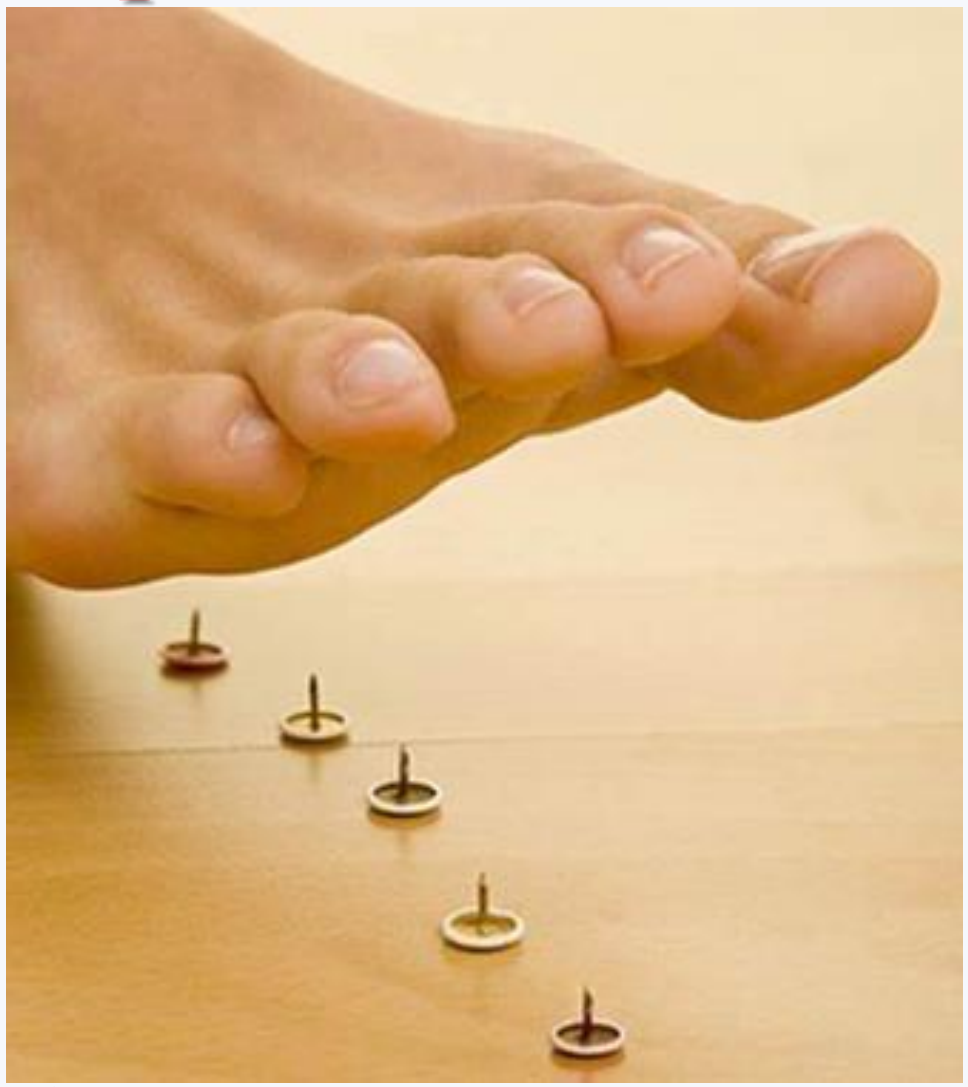
They include **sneezing, coughing, salivating, the knee jerk and removal of a hand from a hot flame.**

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.

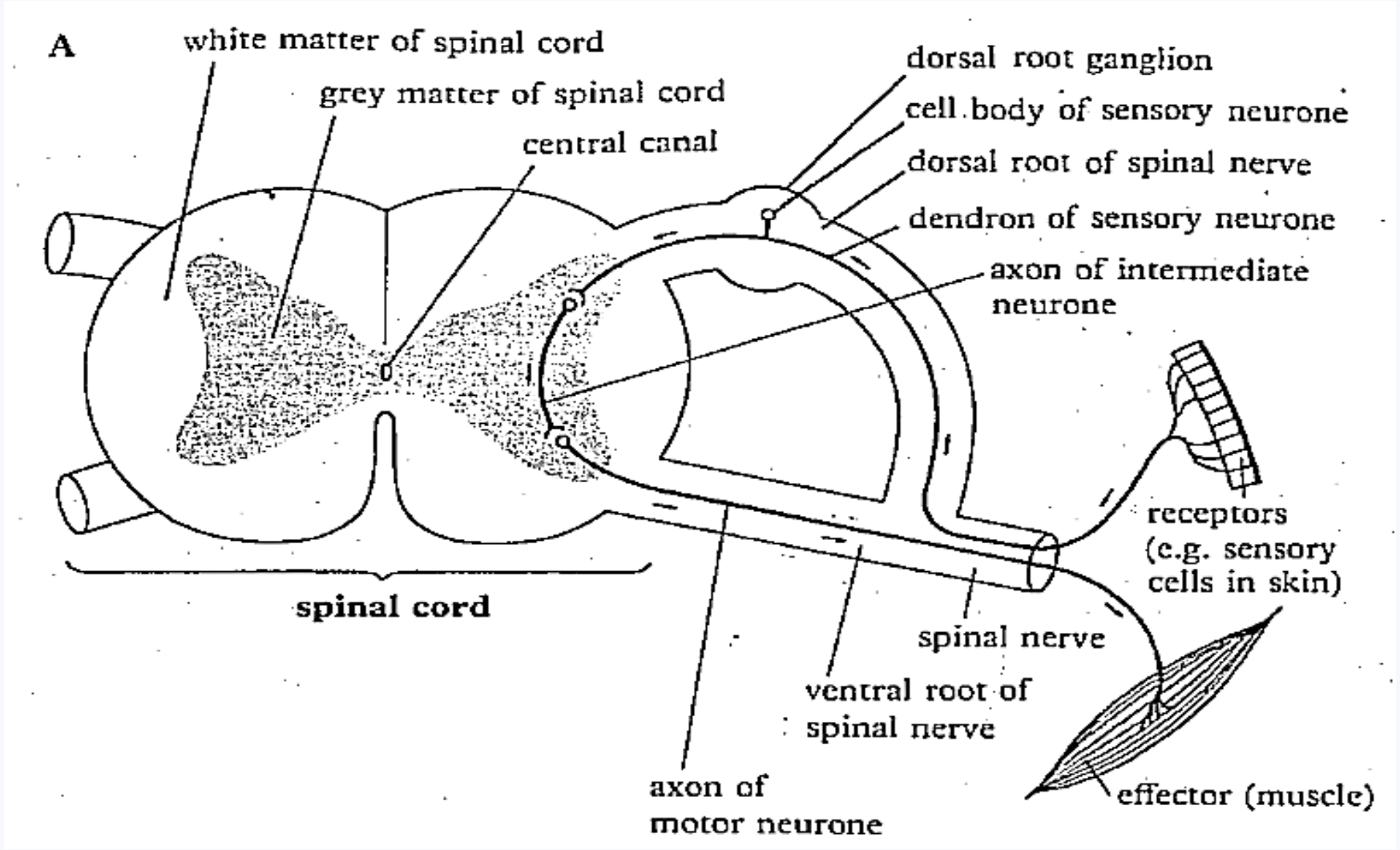


Examples of simple reflex actions

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 the hand
Blinking	Foreign particles on the cornea	✓ Protects the eye from physical injury
Salivation	Sight of food	✓ Prepares the individual for softening and lubrication of food, easing swallowing
Constriction of the pupil of the 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

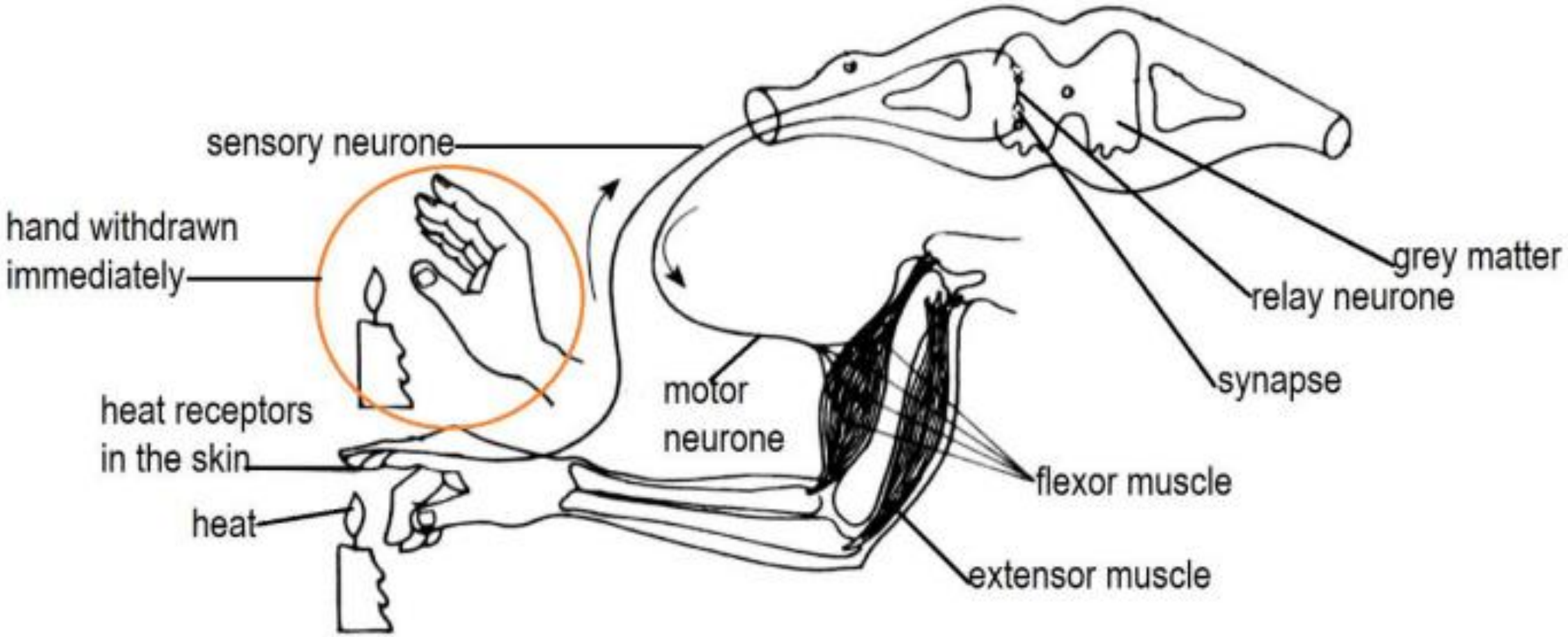
Reflex arc Is a route or nervous pathway taken by the nerve impulses in a reflex action.



- ✓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



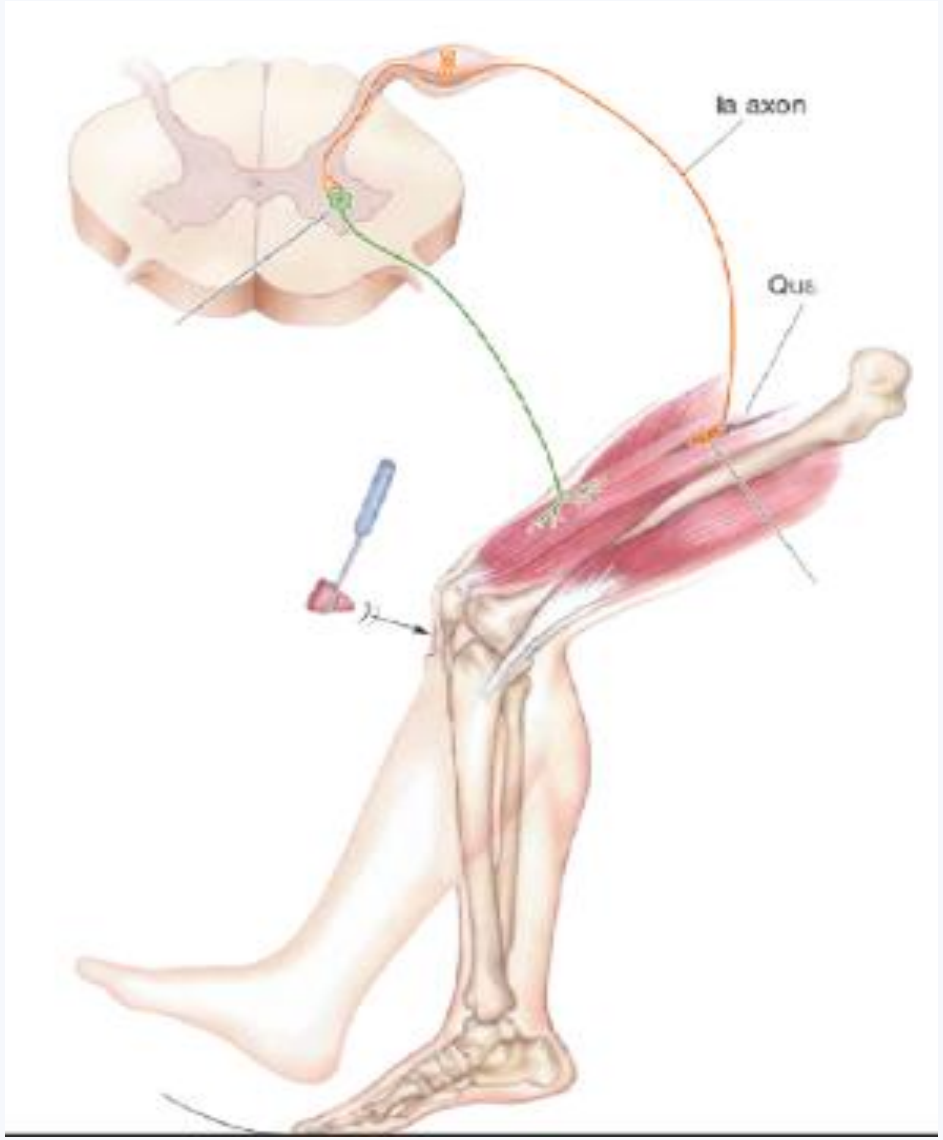
How a hand is withdrawn from a hot object (an example of a simple reflex action)

- ✓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' behavior, e.g. amoeba.

assignment

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

Drug/substance use and drug abuse

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

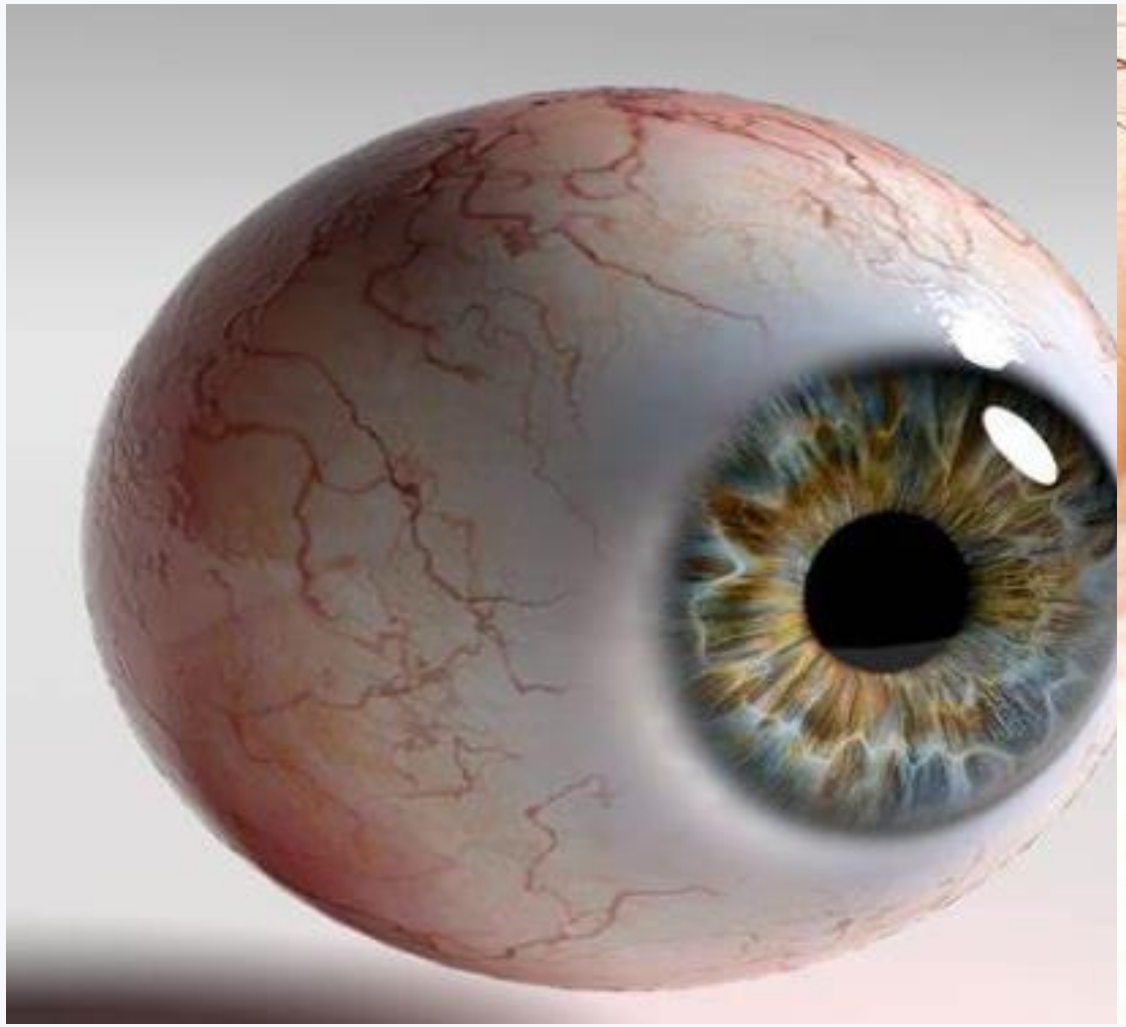
RECEPTOR ORGANS IN MAMMALS/MAN

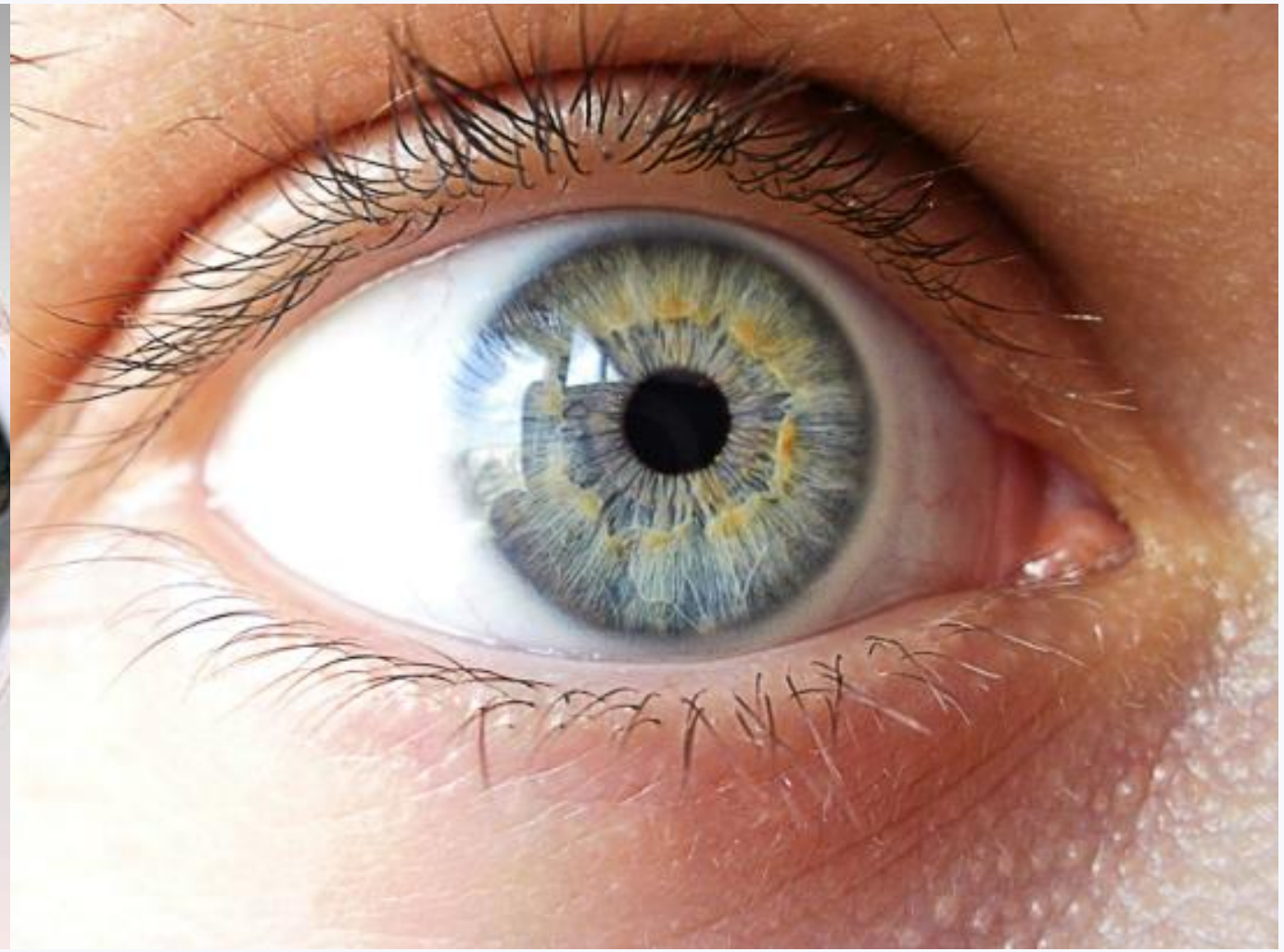
Examples of receptor organs

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

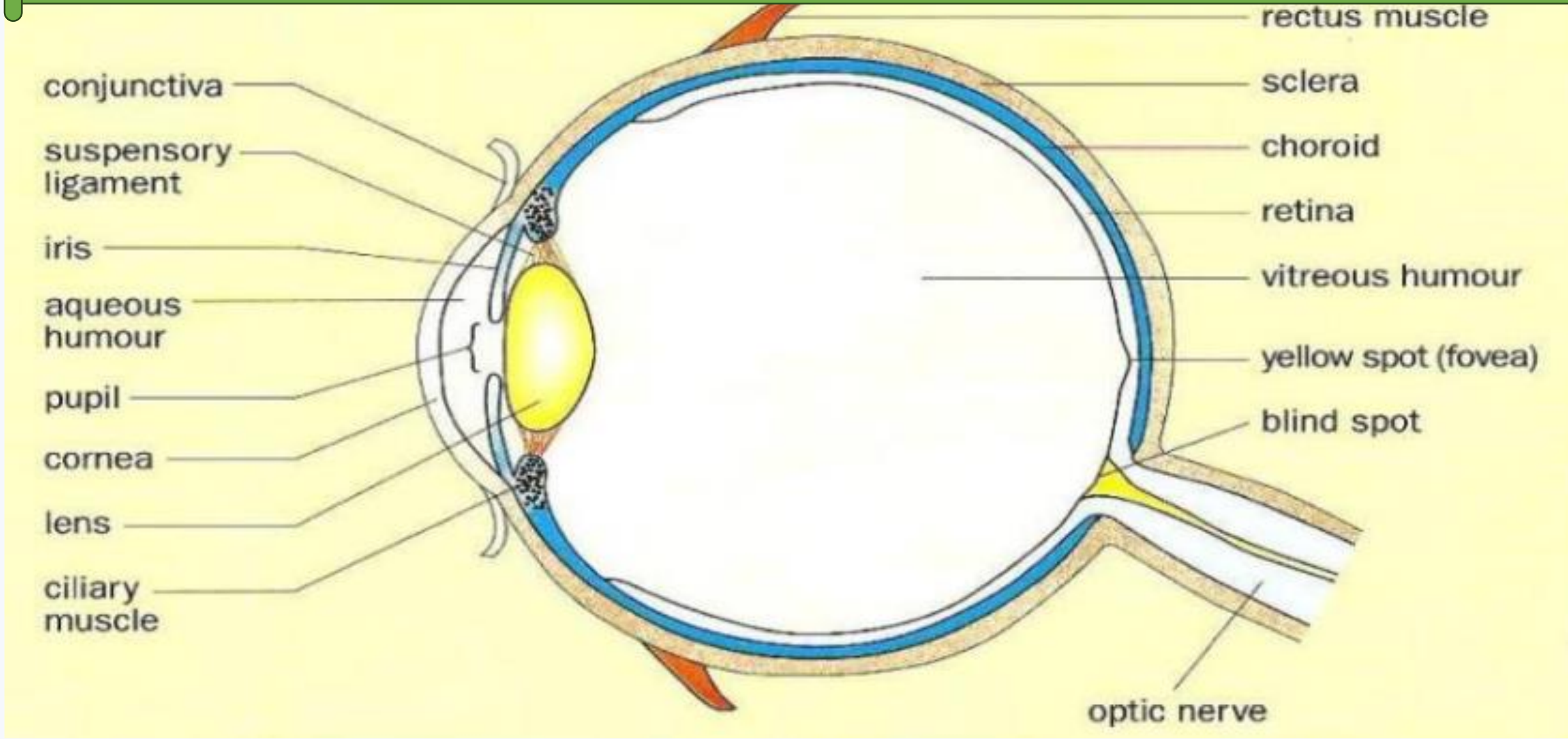
THE HUMAN EYE

This is a receptor organ for vision/sight.





STRUCTURE OF THE HUMAN EYE



PARTS OF THE HUMAN EYE

Part	Description	Function
The conjunctiva	This is a thin transparent layer lining the inside of the eyelid.	✓ • It protects the eye and holds it in position. ✓ • It enables the eye ball to move easily by secreting mucus.
The sclera	This is a tough inelastic layer that gives shape to the eye.	✓ • It protects the inner most delicate parts. ✓ • It provides attachment for the muscles of the eye.
The cornea	This is a transparent layer in front of the eye.	✓ • It refracts (bends) light into the eye.
The choroid layer	It is pigmented and mainly contains black pigment.	✓ • It prevents internal reflection of light. ✓ • This contains a network of blood vessels supplying oxygen and nutrients to the eye.

Part	Description	Function
The aqueous humour	It is a solution of sugar, salts and proteins.	✓ • The aqueous humor is a watery fluid which maintains the shape of the eye. ✓ • It also refracts light into the pupil and the lens.
The vitreous humour	It is a jelly-like substance that fills the inner cavity of the eye.	✓ • It is transparent and maintains the shape of the eye. ✓ • It refracts light to the retina.
The ciliary body		✓ This contains ciliary muscles which control the size of the lens during viewing nearby or distant objects.
The lens:		✓ It refracts light to make an image on the retina.
The iris:		✓ It is responsible for controlling the amount of light entering the eye.

Part	Description	Function
The retina	This layer contains photoreceptor cells (light sensitive cells) the rods and the cones.	✓ The retina is where the image is formed in the eye.
Pupil	This is a round black hole in the center of the eye lying behind the cornea.	✓ It allows light to pass into the eye to the lens
Suspensory ligaments	These are inelastic fibers	✓ Hold the lens in position.
The blind spot	This is a region where the nerve fibers leave the eye to enter the optic nerve.	✓ It has no light sensitive cells. When an image falls on this point, it is not taken to the brain thus blind spot.
The fovea	This is a small depression in the center of the retina. It has only cones in a high concentration.	✓ It is therefore a region on the retina that contains the largest number of sensory cells. Due to this, it produces the most accurate images in the eye.
Eye lids		✓ These protect the eye and remove any foreign bodies that enter it.
Eye lashes		✓ They prevent dust particles and other objects from entering the eye

IMAGE FORMATION AND VISION

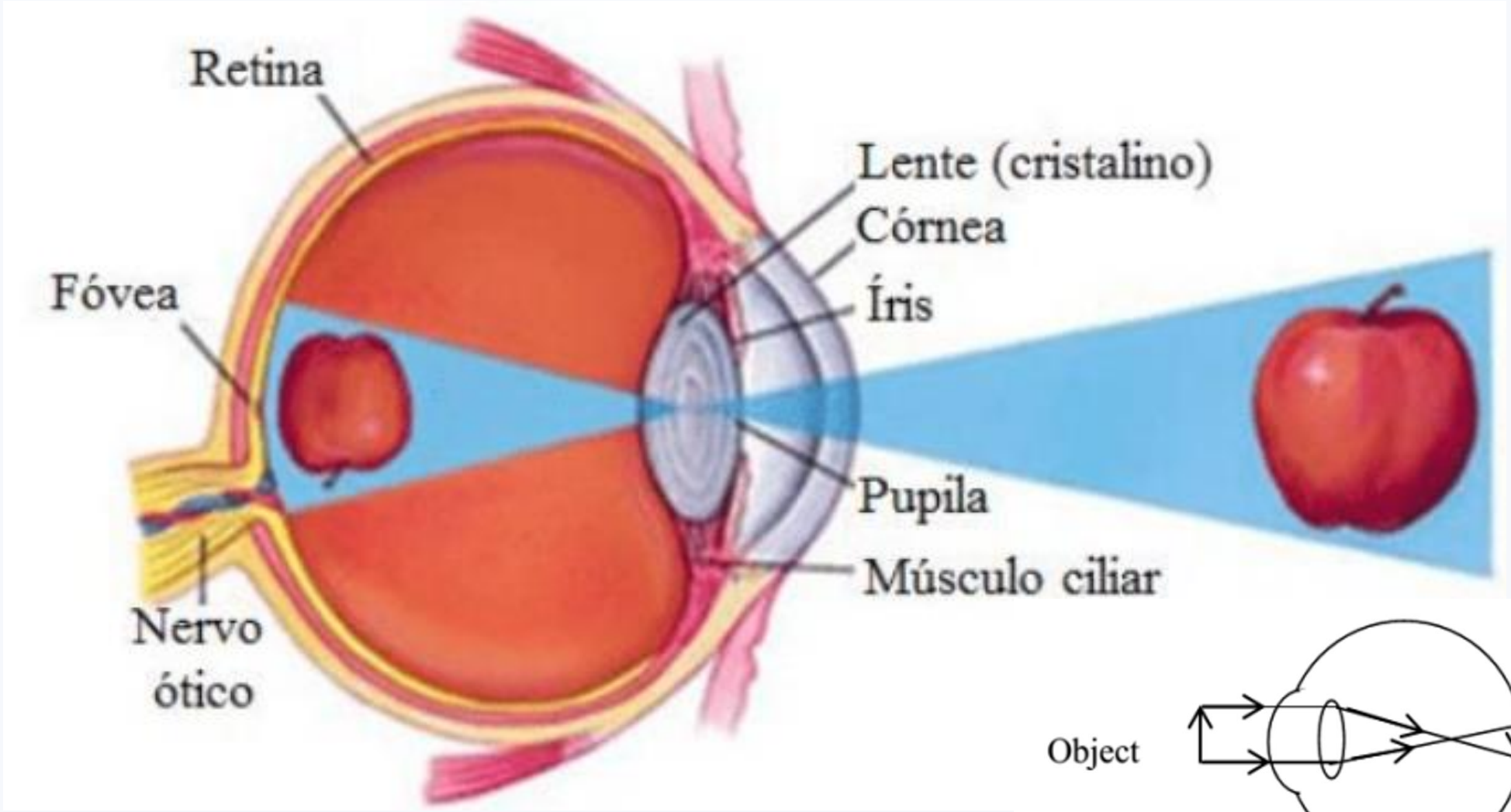


IMAGE FORMATION AND VISION

- ✓ 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.

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.

(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

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***)

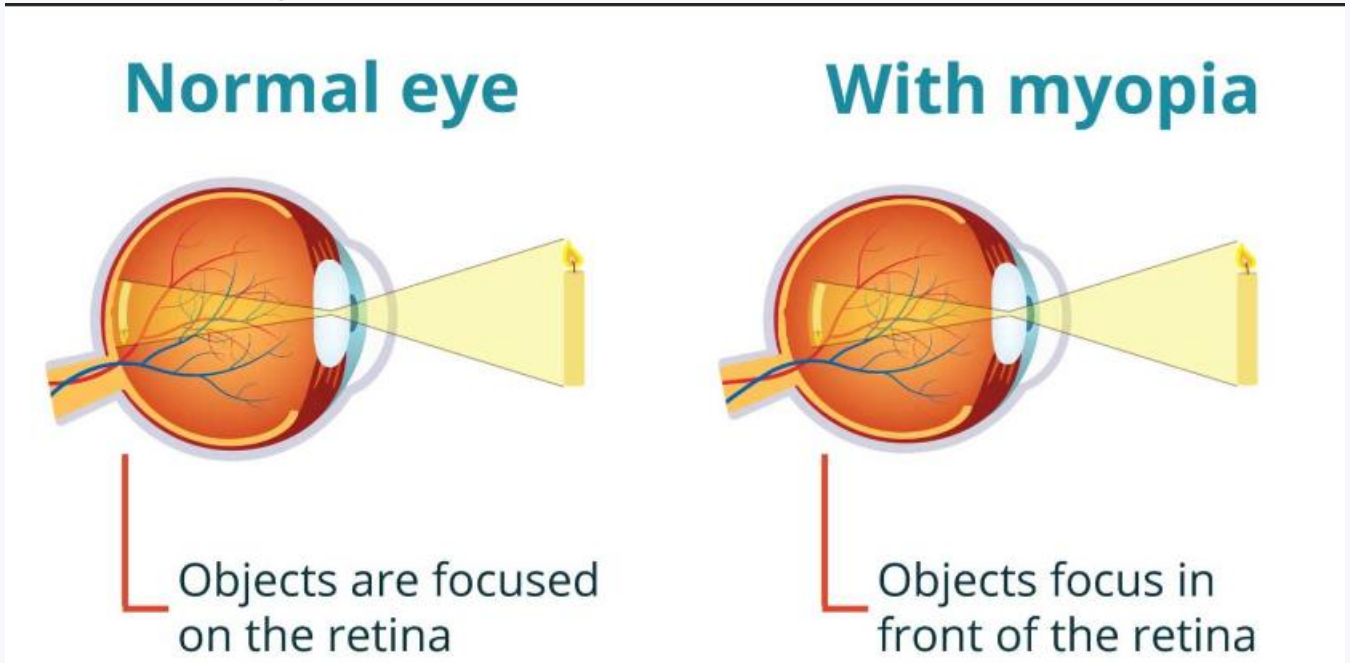
ii. Long sightedness (***hypermetropia***)

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.

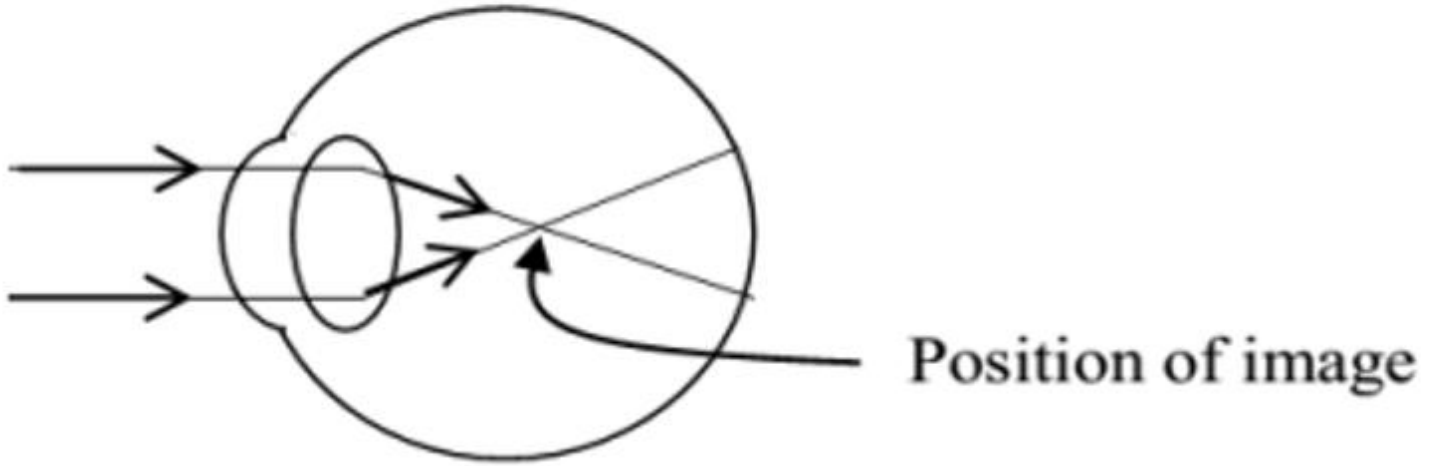


Causes of short sightedness

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.

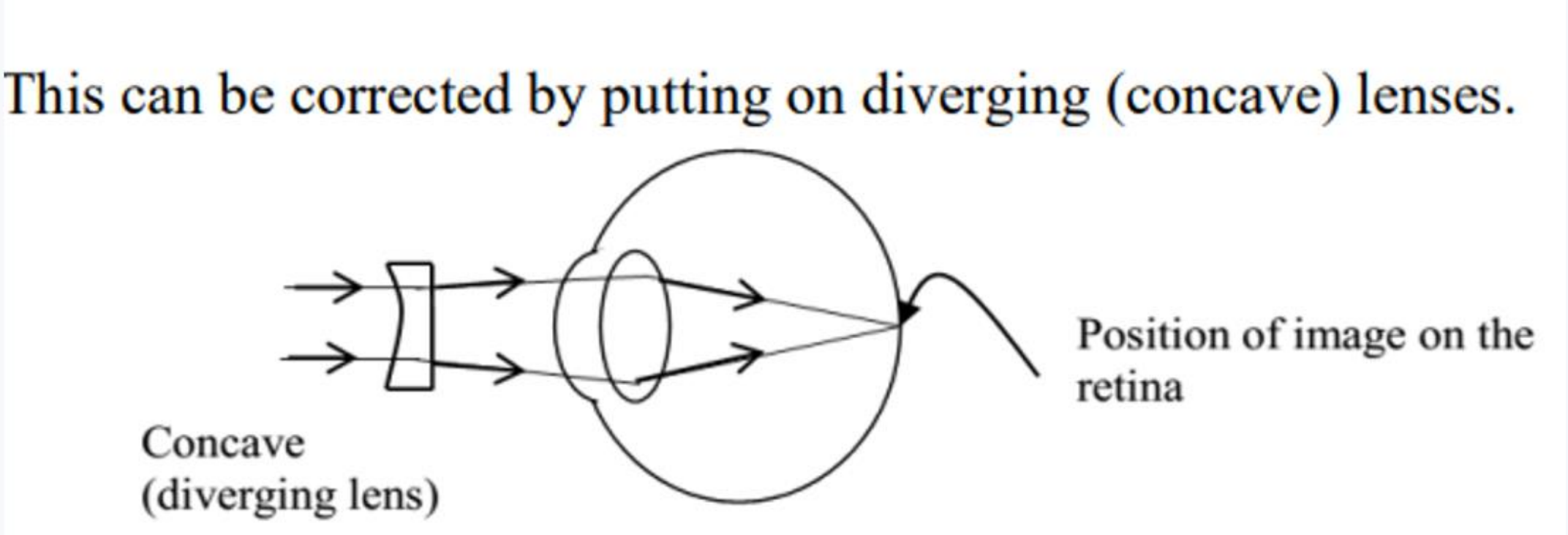
Illustration



Correction of short sightedness:

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

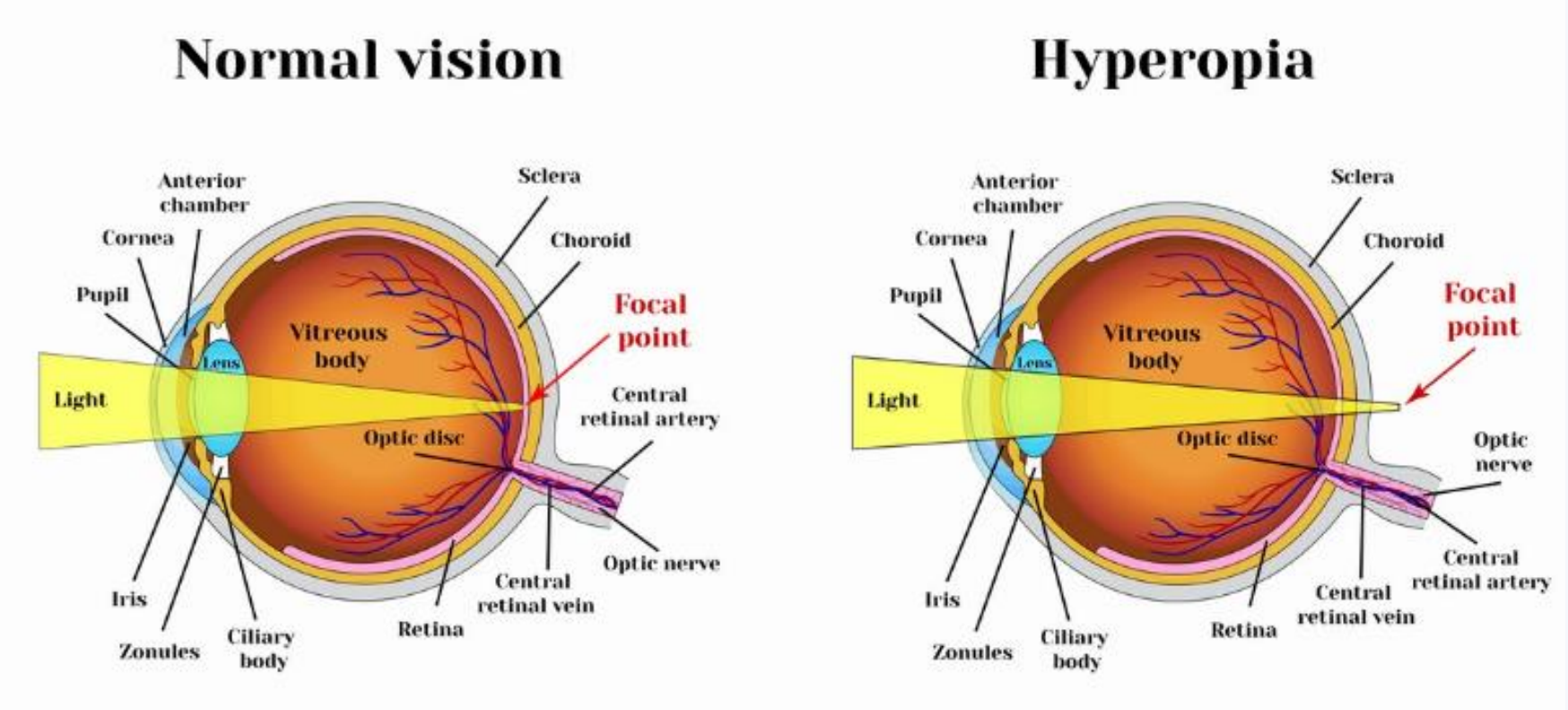
The concave lens **reduces the refractive power** of the eye and diverges the light rays from the far object before entering the eye farther onto the retina.



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.

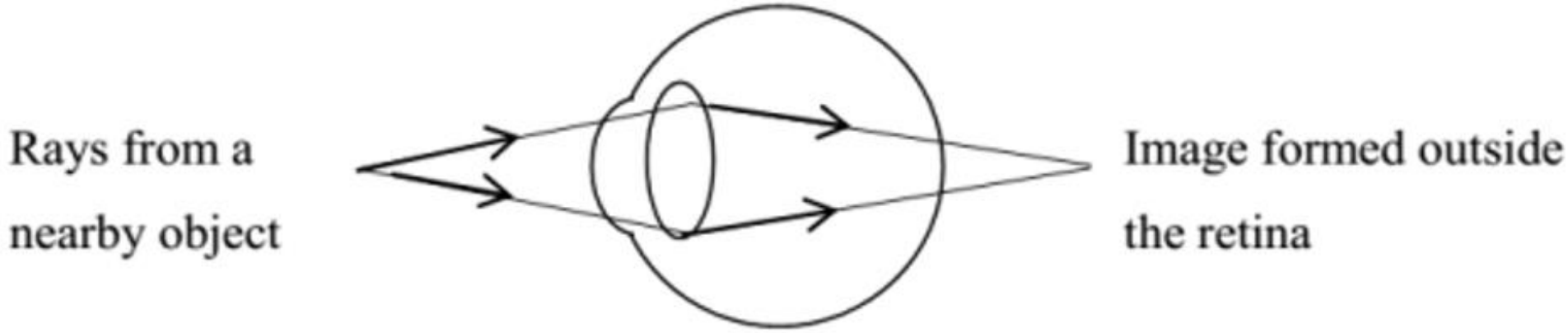


Causes of long sightedness

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.

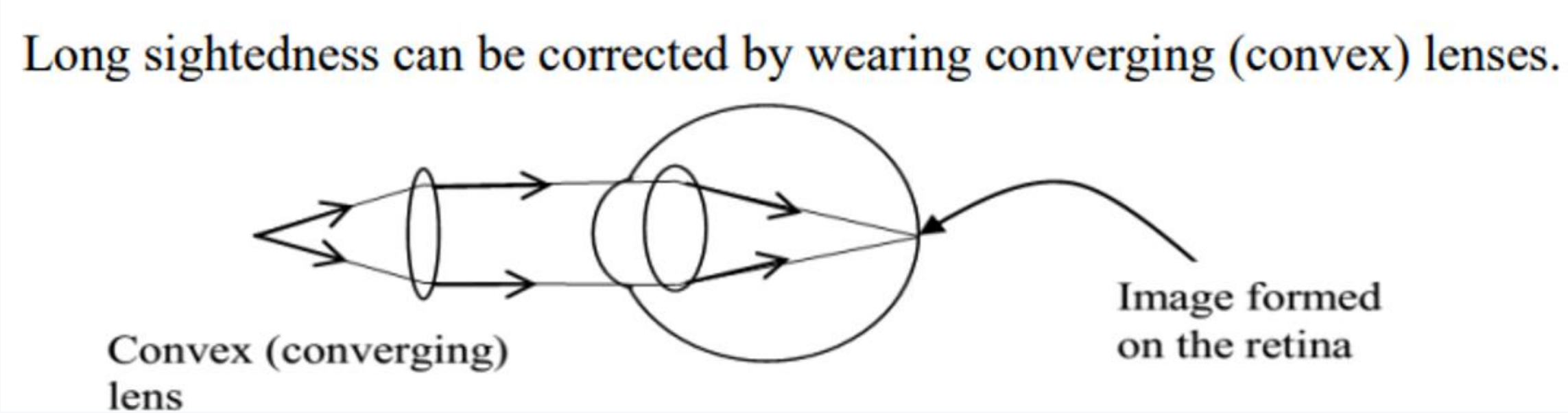
Illustration



Correction of long sightedness

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

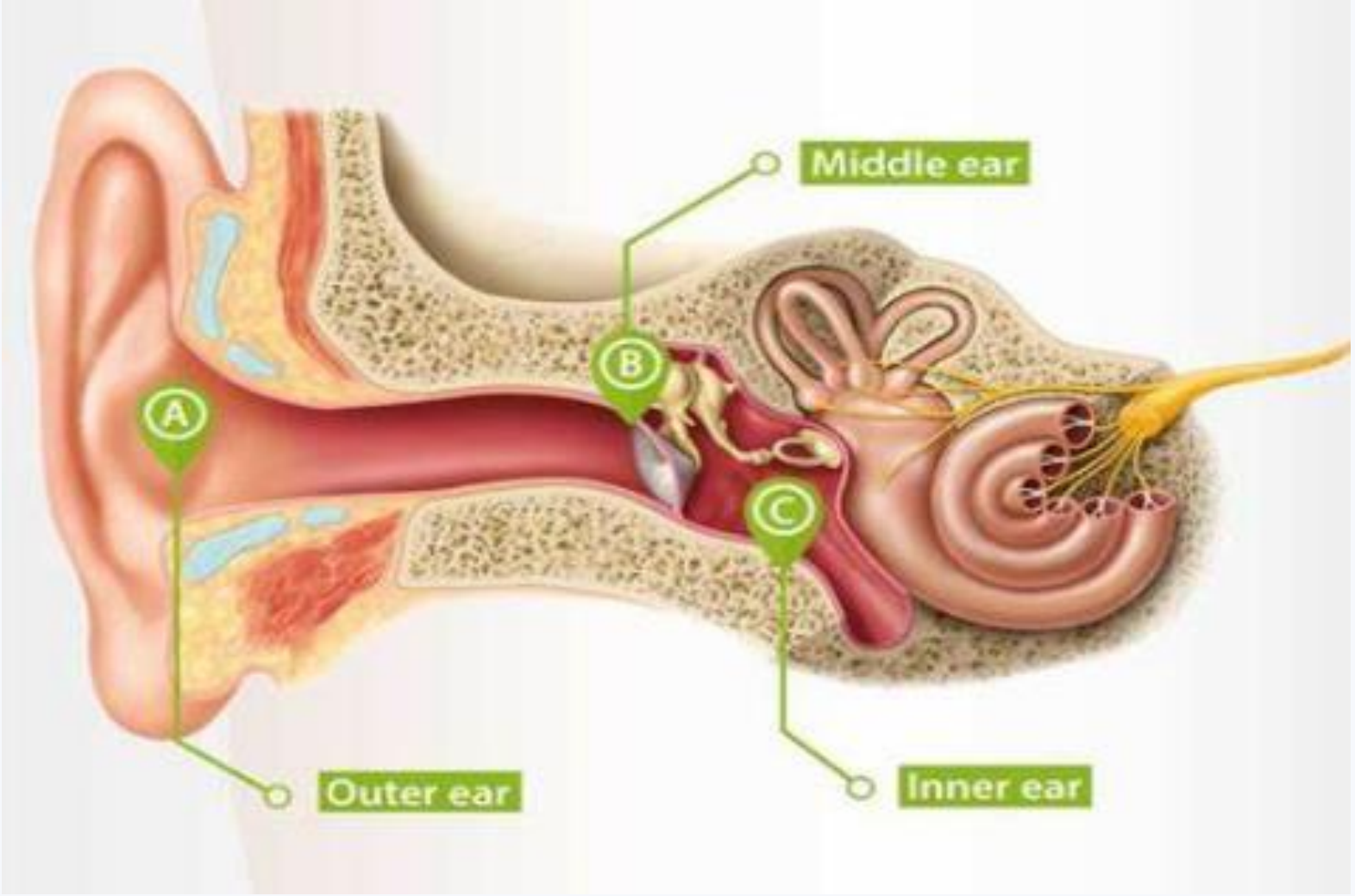
The convex lens converges the light rays from a near object before entering the eye so that the image is focused nearer onto the retina.

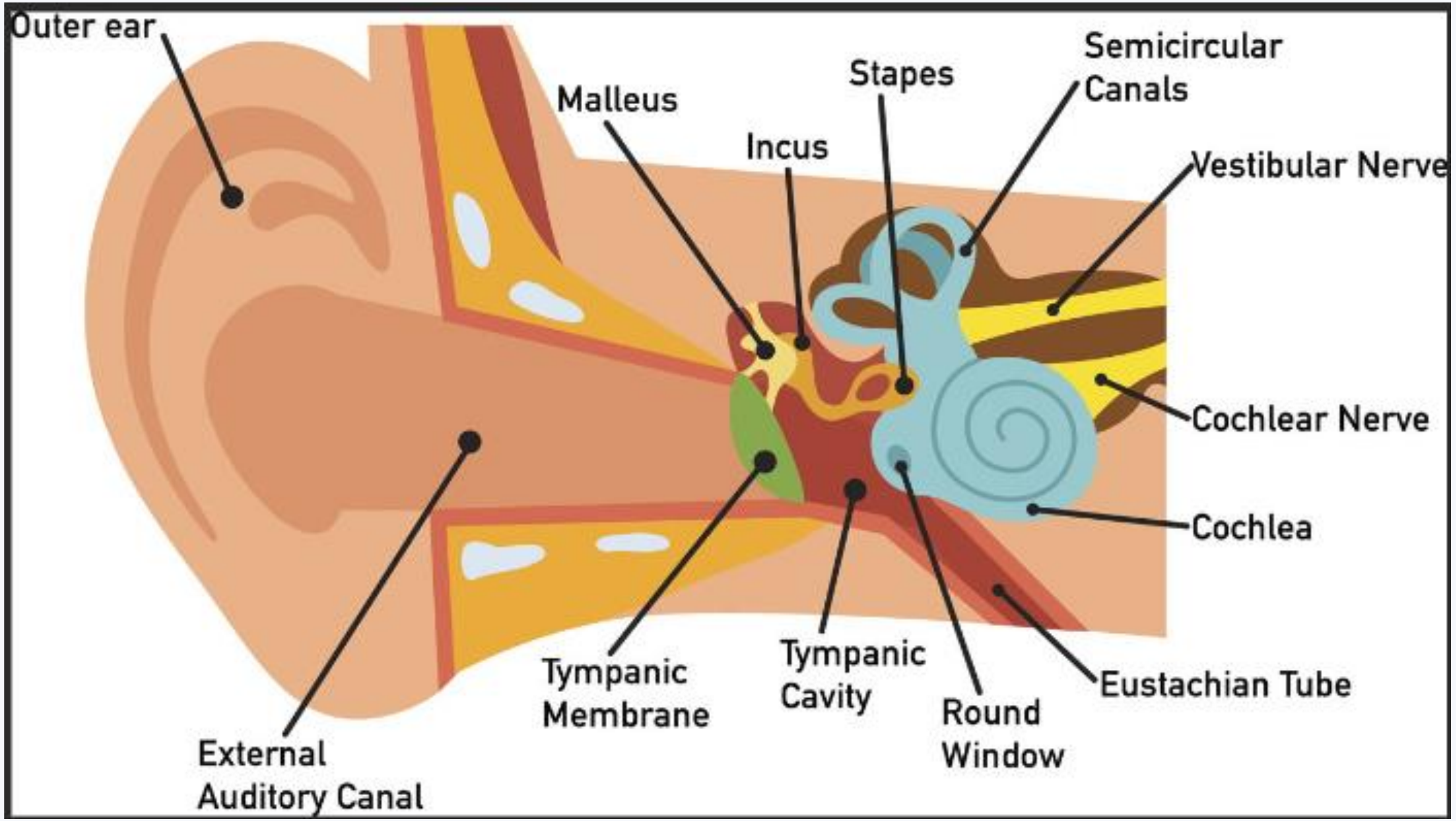


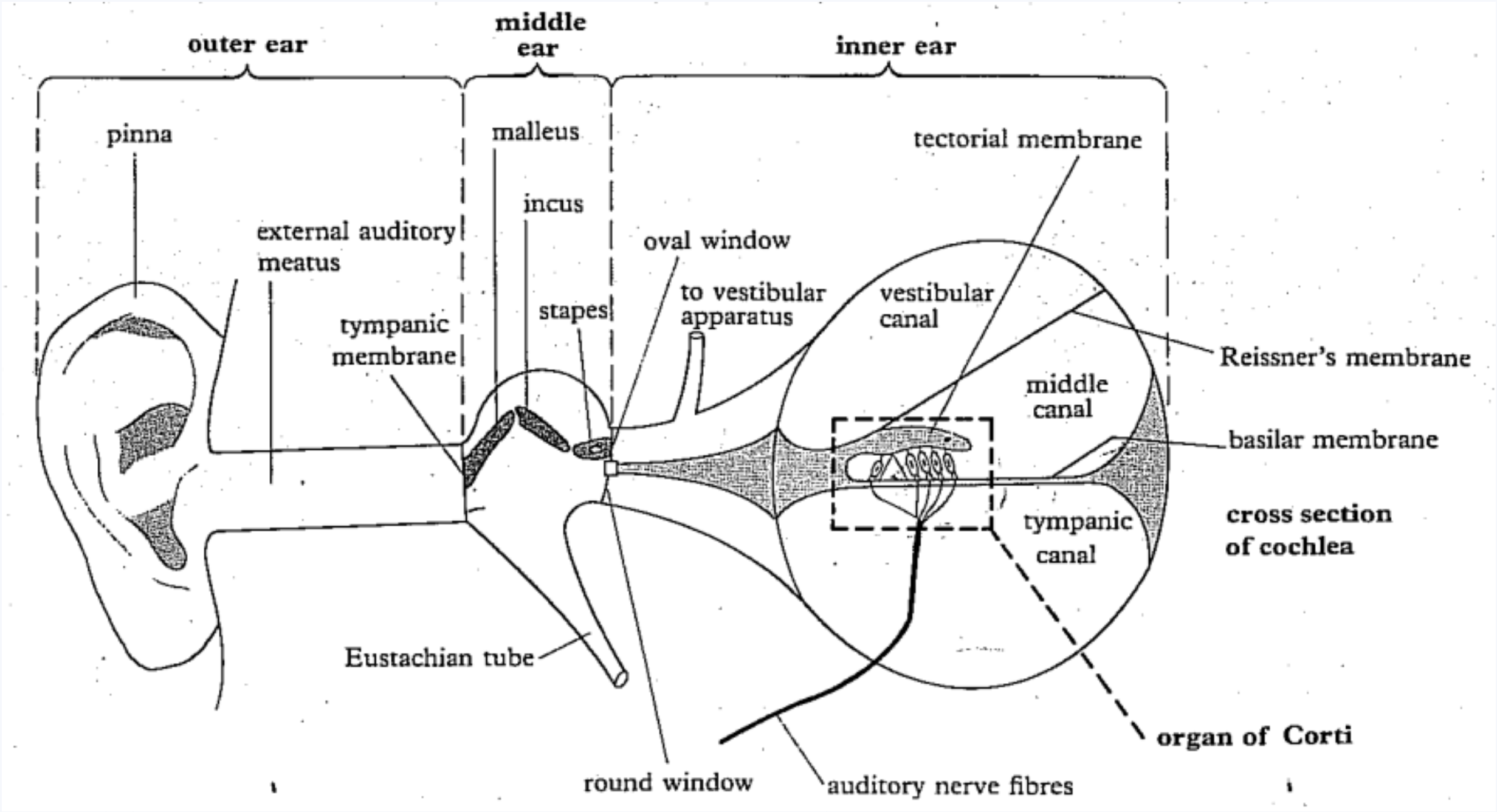
THE MAMMALIAN EAR

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
Malleus
Incus
Stapes
Semicircular Canals
Vestibular Nerve
Cochlear Nerve
Cochlea
Eustachian Tube
Round Window
Tympanic Cavity
Tympanic Membrane
External Auditory Canal


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

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.

END

BIOLOGY IS LIFE

SLIDES PREPARED

BY TR. PETER L OKION