



Dr. Bbosa Science

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Based on, best for sciences

o-level Biology

### Coordination and control in animals

Coordination means to cause the part to function together or in proper order.

Coordination and control in animals is performed by the nervous system and endocrine system.

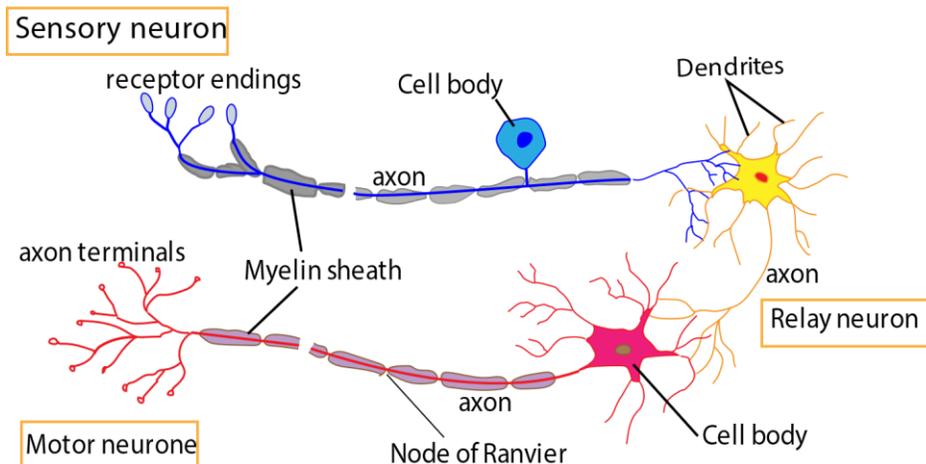
#### Difference between nervous and endocrine system

|    | Nervous system   | Endocrine system   |
|----|--|--|
| 1. | Fast acting  | slow acting  |
| 2. | It's effects are localized                                 | It's effects are diffuse                                   |
| 3. | Transmission are electrical and Chemical theory cell fibre | Relies on chemical transmission through circulatory system |
| 4. | Transmission occur in nerve                                | It occurs in blood   |

#### The nervous system.

The nervous system is composed of highly differentiated cells called **nerve cells** or **neurons**.

Those that carry impulses from receptors to the control nervous system are called **sensory neurons** while those that carry impulses from the CNS to effector are called **effector neurons**.



### Functions of parts of nerve cell

- Nerve fibre or axon transmits impulses
- The myelin sheath protects the axon; it also insulates the axon and speeds up transmission of impulse.
- Nucleus controls cellular activity
- Dendrites or make contacts with other nerve cells or effector
- Nodes of Ranvier are microscopic gaps found within myelinated axons. Their function is to speed up propagation of action potentials along the axon via saltatory conduction
- The cell body preserves the structural integrity of the neuron, houses the genetic material, and supplies energy to drive activities.

### Differences between effector and sensory neuron

|    | Effector neurons                                | Sensory neuron   |
|----|---|--|
| 1. | Transmit impulse from CNS to the effector       | Transmit impulse from sense organ or receptor to the CNS cell body in the middle of axon |
| 2. | Cell body at the end of the axon                | Cell body in the middle of axon  |
| 3. | Cell body located in grey matter of spinal cord | Cell body located in dorsal root ganglion of the spinal chord                            |

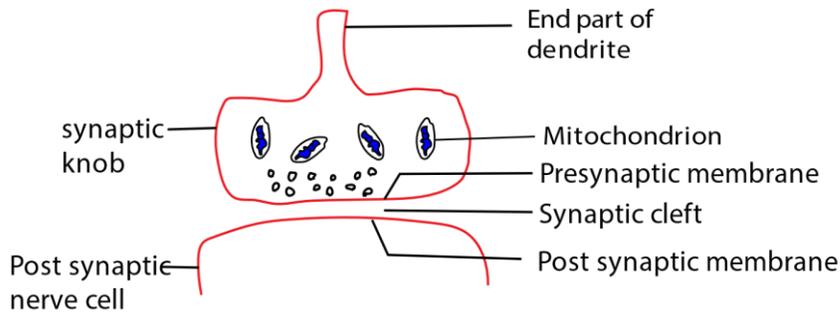
### Structure of the nerve cell

1. The cytoplasm contains the same organelles as the other body cell; mitochondria, nucleus cell membrane and ribosome grouped in Nissl's granules.
2. Along nerve fibre or axon extend from the cell body in effector neurons or either sides of the cell body in sensory neuron to transmits impulses. The axon enclosed within a fatty **myelin sheath** which is not part of the neuron but another cell Schwann cell which wraps itself repeatedly round the axon. The myelin sheath protects the axon, but also insulates the axon and speeds up transmission of impulse.

### The Synapse.

This a functional area, where an axon come into contact with another for the purpose of transferring information. These are two types of synapse, electrical and chemical, depending on the nature of transfer of information across the synapse, A structurally dissimilar but functionally similar synapse exists between the terminal of a motor neuron and the surface of a muscle fibre and this is called neuromuscular junction.

### Structure of the chemical synapse



## The vertebrate nervous system.

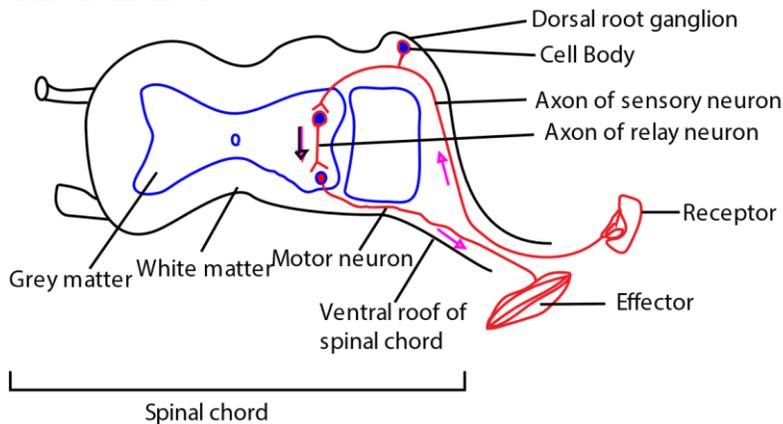
The nervous system of vertebrate is characterized by the structural and functional diversity of neurons and their complex organization with the body. The nervous system is subdivided into two main parts, the central nervous system [CNS] and peripheral nervous system.

The central nervous system consists of brain and spinal cord while peripheral nervous system consists of numerous nerves which link the CNS with the receptors and effectors.

## Reflex action and reflex arch.

The reflex action is a rapid, automatic stereotyped response to a stimulus which is not under the conscious control of the brain. It's also described as involuntary action. The neurons forming the pathway taken by the nerve impulse in reflex action is referred to as reflex arch. Illustrated below.

## The reflex arc



## The brain

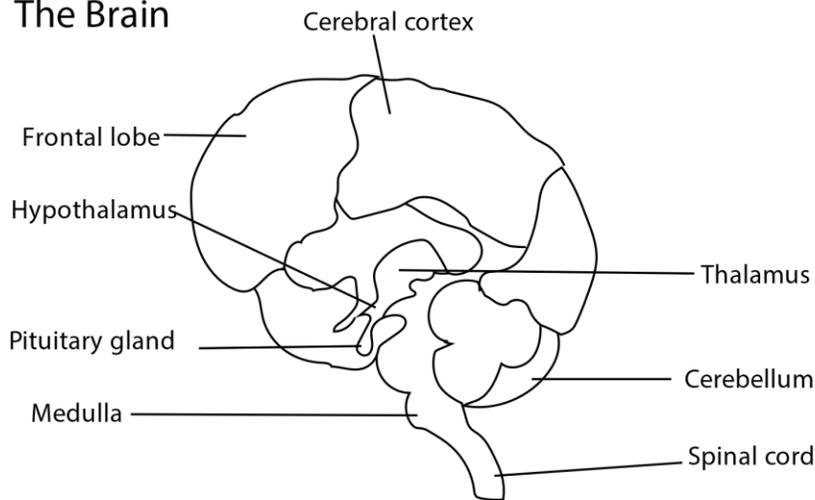
The brain is swollen anterior end of the vertebrate neural tube which has the over role of the coordination and control of the activities of the whole nervous system. To accomplish this there are special centers or nuclei in the different parts of the brain for dealing with specific functions such as locomotion, balancing and so on

Functions of the brain

1. Recieves impulses from receptors
2. Intergrates these impulses

3. sends out new impulses to the appropriate effect.

## The Brain



### **Function of the main parts of the brain the human brain.**

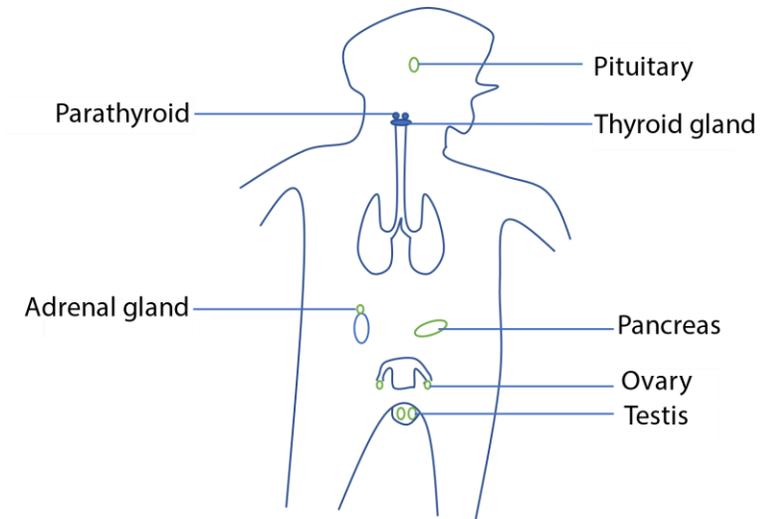
1. **Medulla oblongata** is the most posterior part of the brain. It contains centers controlling breathing, circulation, swallowing salivation and vomiting.
2. The **cerebellum** coordinates voluntary movements such as posture, balance, coordination, and speech, resulting in smooth and balanced muscular activity. It is also important for learning motor behaviors
3. **The thalamus and associated structures:** contain centers controlling such function as sleep, aggression, feeding, drinking, osmoregulation, temperature regulation, speech and sexual activity.
4. **Pituitary** is an endocrine gland that secretes a wide range of hormones controlling such function as water and salt balance, growth, metabolism and sexual development.
5. **The cerebral hemispheres** coordinate all voluntary response.

### **Hormonal communication.**

Hormones are organic compounds produced in one part of the body, from which is transported - usually in the blood stream – to another part when it evokes a response.

In the human and other vertebrate hormones are secreted into the blood stream by endocrine glands.

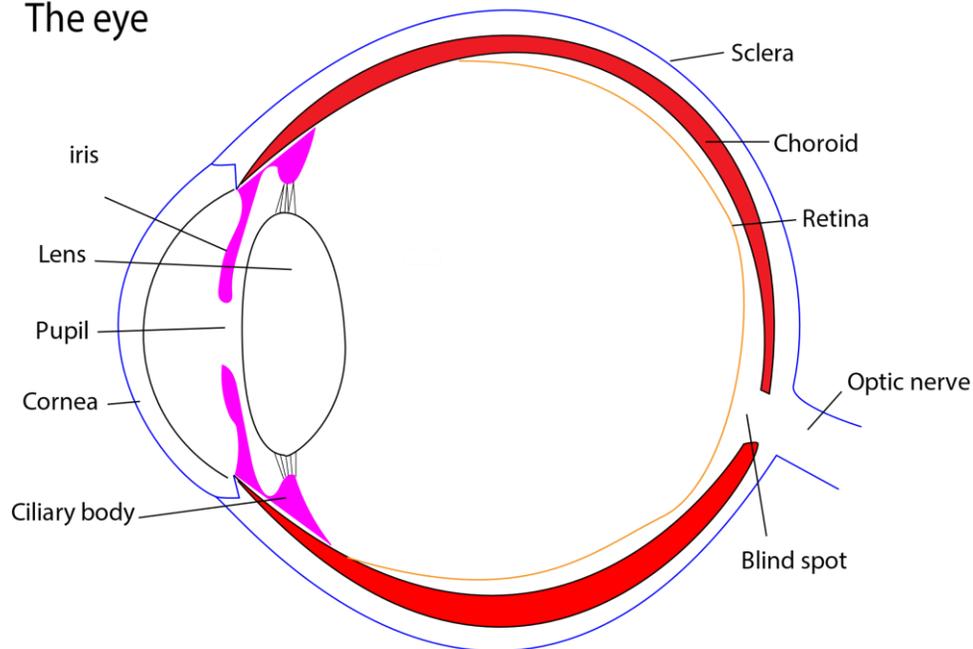
Position of the main endocrine gland in a human body



The principle endocrine glands of mammal, hormones and functions of the hormones

|    | Gland                      | Hormone                               | main function  |
|----|----------------------------|---------------------------------------|--|
| a. | Thyroid                    | Thyroxine                             | Raise basal metabolic rate   |
|    |                            | Calcitonin                            | Opposes action of parathormone   |
| b. | Parathyroid                | Parathormone                          | Controls concentration of calcium and phosphate ions in blood  |
| c. | Pancreas                   | insulin                               | lows blood sugar concentration   |
| d. | Adrenal medulla            | adrenaline                            | prepare body for emergency; metabolic rate increases,  |
| e. | Adrenal cortex             | Aldosterone                           | Controls concentration of $K^+$ and $Na^+$ in blood  |
|    |                            | Cortisol                              | Prevent excessive immune response  |
|    |                            | androgens                             | Promotes development of testes and secondary sexual characteristics  |
| F  | Pineal body                | melatonin                             | causes concentration of melanin in frog's skin; promote sexual development in mammal                             |
| g. | Testes                     | Androgens                             | Promotes development of testes and secondary sexual characteristics  |
| h. | Ovaries                    | Estrogens                             | promotes development of ovaries secondary sexual characteristic of female control menstrual cycle and pregnancy. |
| I  | Pituitary (anterior lobe)  | Thyroid stimulating hormone           | Causes the thyroid gland to secrete thyroxine  |
|    |                            | Adreno - corticotrophin (ACTH)        | Cause adrenal cortex to secrete adrenal cortical hormones  |
|    |                            | Growth hormones                       | Stimulate growth   |
|    |                            | prolactin                             | Causes mammary gland to secrete milk   |
|    |                            | Follicle stimulating hormone          | Controls testes and ovary  |
|    |                            | Luteinizing hormone                   | Controls testes and ovaries  |
|    | Pituitary (posterior lobe) | Antidiuretic hormone (ADH)            | Causes reabsorption of water in kidney   |
|    | oxytocin                   | Causes contraction of uterus at birth |  |

## The eye



### Functions of the parts of the eye

1. Lens refracts light to the retina
2. Iris adjust the size of the pupil
3. Retina is where the image forms
4. Pupil allows light to pass through into the eye.

### Controlling amount of light entering the eye

The amount of light entering the eye is controlled by the iris.

In bright light, the iris circular muscles to contract and pupil constricts.

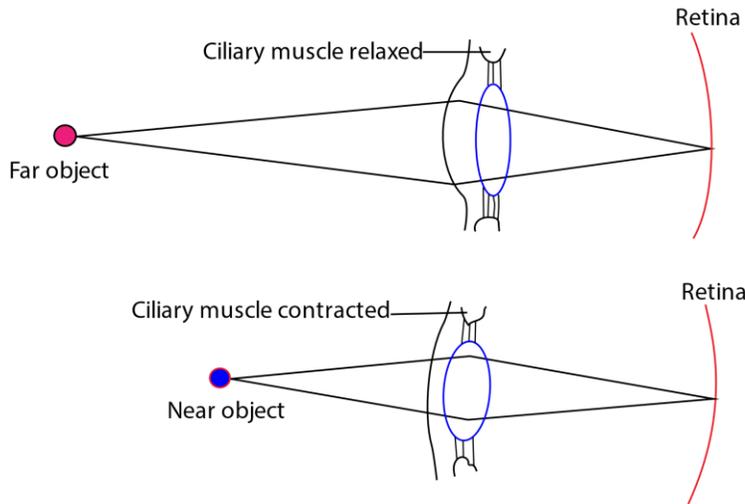
In dim light iris radial muscles contract and the pupil widens.

### Accommodation

Is the ability of the eye to see near and far objects

- (a) To see near objects, the ciliary muscle contract, releases the tension on the lens allowing it to adopt a more spherical shape. The lens then refracts light strongly.
- (b) To view distant objects, the ciliary muscles relax, the suspensory ligament exert a pull on the lens and it flattens.

The figure shows the lens shape changes depending on whether a distant or near object is being viewed



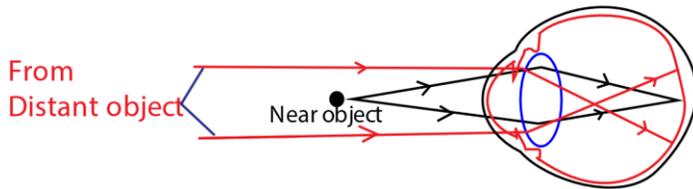
### Eye defects

Short sightedness is inability to see distant objects clearly because rays from a distant object are focus in front of the retina.

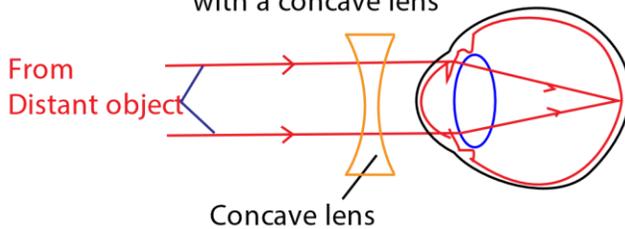
- Causes (i) Lens too strong  
(ii) eyeball too long

Correction: by use of a concave or diverging lens

In short sightedness (myopia) rays from distant object are focused in front of the retina



Short sightedness is corrected with a concave lens

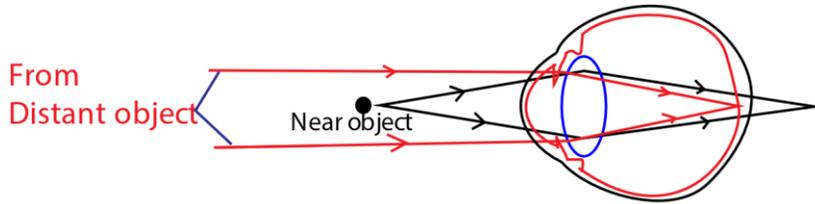


Long sightedness is inability to see near objects clearly because rays from a near object are focused behind the retina

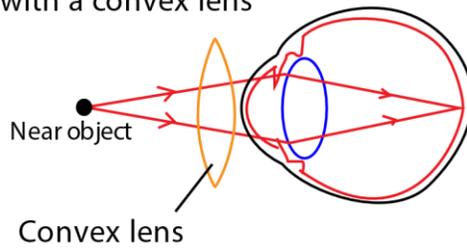
- Cause (i) lens too weak  
(ii) eyeball too short

Correction: by use of a convex lens

In long sightedness (hyper myopia) rays from near object are focused behind the retina



Long sightedness is corrected with a convex lens

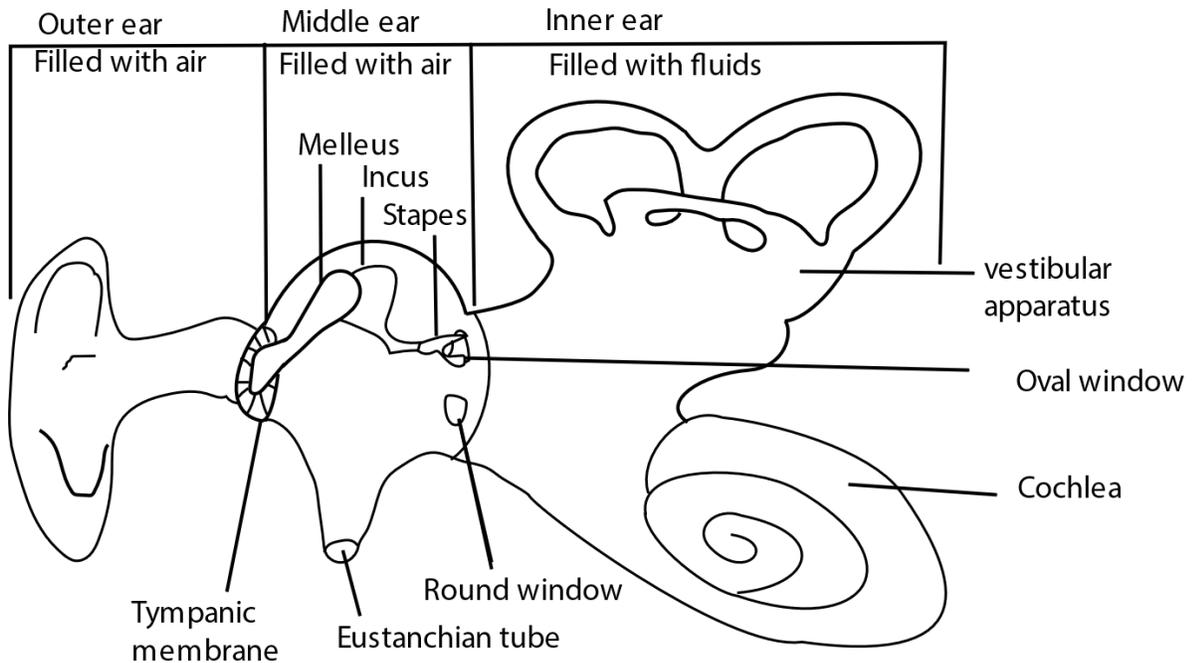


### The human Ear

The mammalian ear has two major functions

- (a) Detecting sound through the cochlea
- (b) Maintenance of body balance by the semicircular canal

### Structure of mammalian ear



The has three main parts

- (a) Outer ear
- (b) Middle ear
- (c) Inner ear

The middle ear is separated from the outer ear by **tympanic membrane, or ear drum**. The middle ear is separated from the inner ear by an **oval window (fenestra ovalis)** and **round window (fenestra rotunda)** both of which are covered by membranes.

Spanning the middle ear from the tympanic membrane to the oval window are three tiny bone called **ossicles** (the **malleus, incus** and **stapes**). The Eustachian tube, which connects the middle ear with the pharynx, ensures that the air pressure on the both side of the tympanic membrane are equal.

The Eustachian tube regulates pressure.

Hearing

1. Sound funnels into the ear canal and causes the eardrum to move.
2. The eardrum vibrates with sound.
3. Sound vibrations move through the ossicles to the cochlea.
4. Sound vibrations cause the fluid in the cochlea to move.
5. Fluid movement causes the hair cells in Organ of Corti to distort.
6. Distortion of hair cells causes firing of impulses through Auditory nerves to the brain that interprets the nature of sound.

### Exercise

1 Which one of the following is a result of increased levels of adrenaline in the body?

- A. increase uptake of glucose by the liver
- B. decreased rate of breathing
- C. reduction in metabolic rate
- D. increased rate of heart beat.

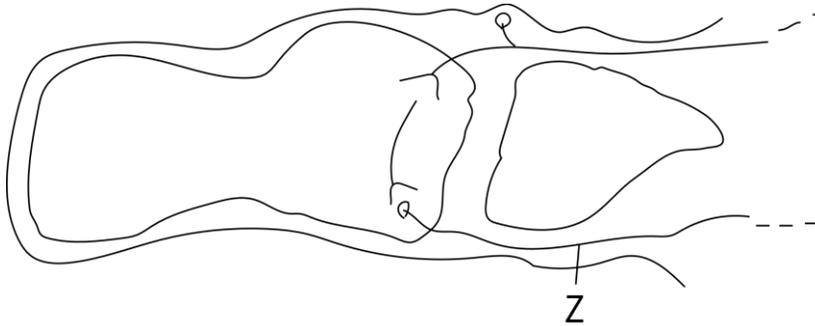
2. Which one of the following is a difference between nervous and endocrine coordination?

| Nervous                            | Endocrine                           |
|------------------------------------|-------------------------------------|
| A. messages are transmitted slowly | A. messages are rapidly transmitted |
| B. effects are localized           | B. effect wide spread               |
| C. produce long term effect        | C. produce short lived effect       |
| D. message chemical                | D. message electrical               |

3. Which of the following part of the rear, regulate air pressure?

- A. Eardrum
- B. oval window
- C. Round window
- D. Eustachian tube

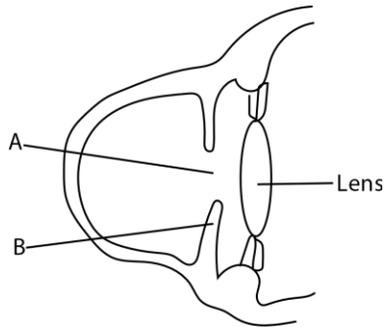
4. Which of the following controls the rate of heart beat in mammals?
  - A. cerebrum
  - B. pituitary
  - C. Medulla oblongata
  - D. cerebellum
5. What is the function for the choroid layer in human eye?
  - A. Focusing rays of light on the retina
  - B. supplying nutrients to the eye
  - C. Bringing about accommodation
  - D. Controlling amount of light entering the eye
6. What is the function of eustachian tube?
  - A. Detect body posture
  - B. transmission of sound waves to the middle ear
  - C. Equalizing pressure in the middle ear
  - D. transmission of sound waves to inner ear
7. What is the destination of impulse moving along the nerve fibre marked A in the figure below?



- A. the spinal chord
  - B. brain
  - C. receptor organ
  - D. effector organ
8. Which of the following controls the activities of other ductless gland?
  - A. thyroid gland
  - B. adrenal gland
  - C. Pituitary gland
  - D. Islets of Langerhans

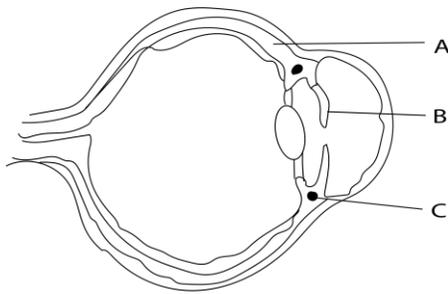
## Structured Questions

9. The figure below shows a section of human eye



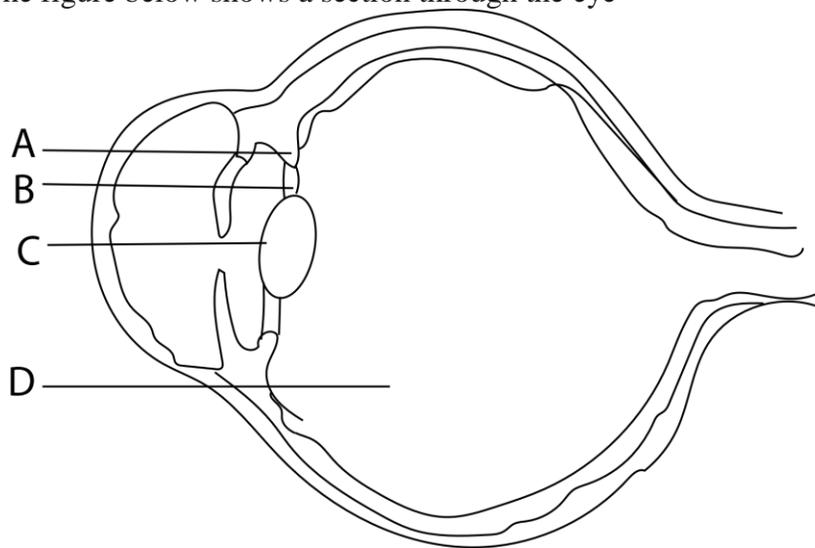
- Name the parts labeled A and B
- What is the function of part B?
- If a person entered a room with bright light, state the changes that would occur in each of the parts A and B of the eye.
- In the space below, draw the shape of the lens only, when the eye is focusing on a near and distant object respectively.
- Describe how the shape of the lens is brought about when the eye is focusing on a near object.

10. The figure below shows a section of human eye



- Give two functions of structure A (2marks)
- What stimulus does B responds to (i) (1mark)
  - How does structure B respond to stimulus stated in (b)(i)? (3marks)
- How is part C involved in the change of focus of the eye from distant object to a near object? (4marks)

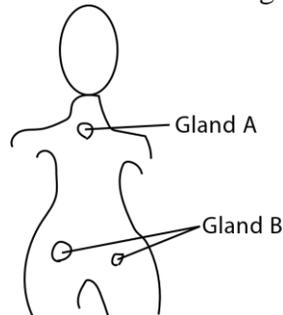
11. The figure below shows a section through the eye



- (a) Name parts labelled A, B, C and D (2marks)
- (b) What function is performed jointly by the parts A, B, C and D? (1mark)
- (c) Other than the joint function, state two other functions of the part labelled D (1mark)
- (d) Give the state of parts A, B, C when the eye is viewing
  - (i) near object
  - (ii) Distant object (6marks)

12. (a) What is long sightedness? (2marks)
- (b) State two causes of long sightedness (2marks)
- (c) in the space below, draw light rays from an object into the eye to show long-sightedness.
- (d) what is the effect of each of the following movements of different parts of the eye?
  - (i) contraction of the iris (1mark)
  - (ii) relaxation of the ciliary muscle (1mark)
  - (iii) shortening and thickening of the lens (1mark)

13. (a) Distinguish between endocrine and exocrine gland
- (b) Below is a diagram of human female showing the location of two endocrine gland



Name glands A and B and one hormone produced by each

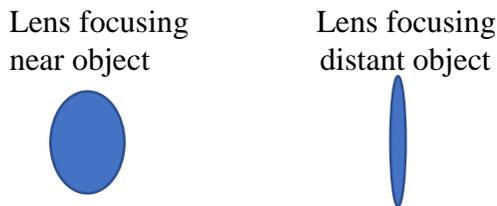
- (c) Give three effects of adrenaline in the body

14. (a) Describe the structure of motor neuron
  - (b) (i) what is meant by the reflex action?
  - (ii) By means of a diagram show the path followed by a nerve impulse during a reflex action
15. Describe how sound produced externally is heard by human ear (15 marks)

Marking guide

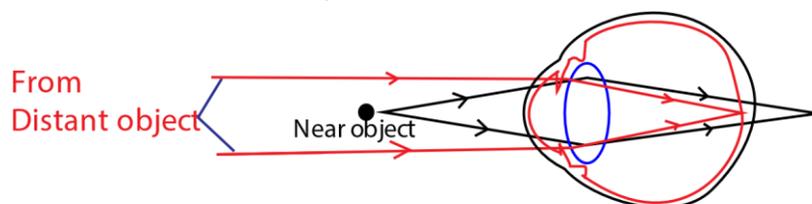
1. A 2. B 3. D 4. C 5. B 6. C 7. D 8. C

9. (a) A- pupil B. iris  
(b) Control the size of the pupil and thus amount of light that enters the eye  
(c) A- contracts  
B- widens  
(d)



- (e) When focusing a near object, the ciliary muscle contracts, the lens become fatter such that it refracts light strongly.
10. A supplies the eye with oxygen and nutrient  
makes the eye opaque  
(b)(i) Light intensity  
(ii) In strong light, it expands narrowing the pupil  
In dim light, it contracts widening the pupil  
(c) C contracts putting less stress on suspensory ligament; the lens become fatter and focus near objects.
11. (a) A -ciliary body  
B – suspensory ligament  
C – lens  
D – vitreous humor  
(b) refract light  
(c) maintain shape of eye ball  
(d) (i) Near object  
A – contract  
B – less stretched  
C - fatten  
(ii) A- relaxes  
B – strained  
C – thin
12. (a) Long sighted people do not see near objects clearly  
(b) short eyeball  
weak lens

- (c) In long sightedness (hyper myopia) rays from near object are focused behind the retina



- (d) (i) pupil widen more light enter the eye
- (ii) make lens thin to focus distant objects
- (iii) refracts light strongly to focus near objects

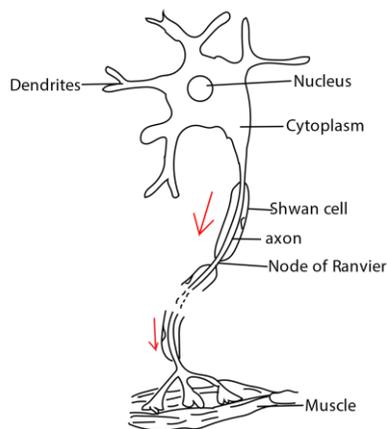
13. (a) Endocrine glands are ductless glands that release their contents into blood while exocrine glands are glands with ducts and release their contents through duct to lumen.

- (b) A – thyroid gland
- B – Ovaries (female)

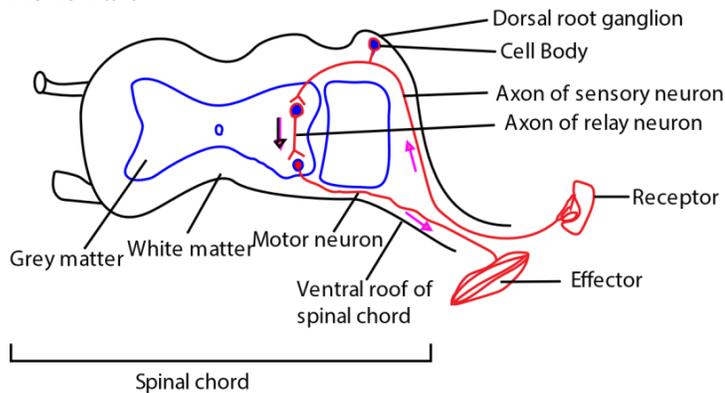
- (d) Effects of adrenaline
  - increase rate of heart beat
  - increases rate of breathing
  - increases metabolic rate
  - increase blood pressure
  - enlarges pupil
  - expand air way to the lungs

14. A motor neuron is a nerve cell that conducts impulses from central nervous system to the effector.

Motor neuron



(c) Reflex arc





## 15. Hearing

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