

Biology Notes

Topic: Nervous Control in Humans

Objectives: At the end of this topic, the students should be able to:

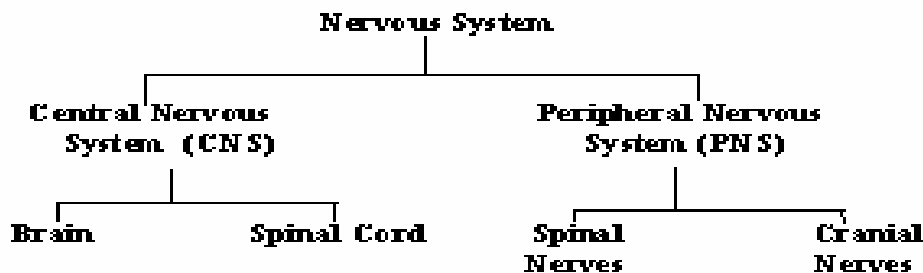
1. State the importance of having a nervous system.
2. Name the two main divisions of the human nervous system and state their role in the functioning of the nervous system.
3. Describe the structure and function of the human brain.
4. Name the three types of nerve cells and describe their structure and function.
5. Differentiate between voluntary and involuntary actions giving examples in each case.
6. Describe reflex actions and the simple reflex arc.
7. Recall the comparison between nervous control systems and hormonal control systems.

The human nervous system

The human nervous system is a network of millions of interconnecting nerve cells called **neurons**. Its function is to carry messages (impulses) rapidly from one part of the body to the next.

The nervous system is important for communication within the body and with the environment.

Divisions of the nervous system



Central nervous system – consists of the brain and the spinal cord

Brain – co-ordinates all activities of the body and specific activities such as memory, reasoning, intelligence, vision, speech, hearing etc

- located in the cranial cavity which protects it.

- **grey on the outside (grey matter) and white on the inside (white matter)**

Spinal cord - main pathway for information connecting the brain and the peripheral nervous system

- located in the spinal canal which protects it.

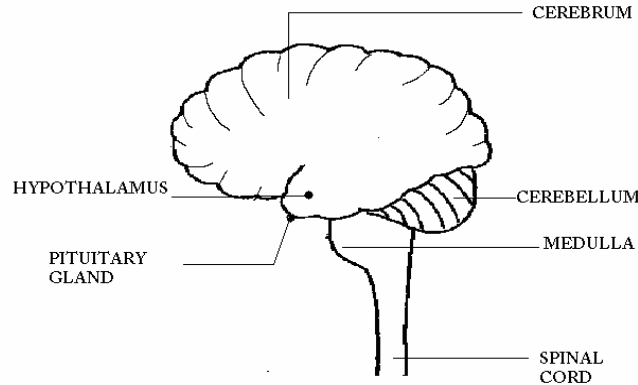
- **white on the outside (white matter) and grey on the inside (grey matter)**

Peripheral nervous system- consists of the **cranial nerves** (out of the brain) and the **spinal nerves** (out of the spinal cord).

The PNS sends to and carries information from all areas of the body outside of the CNS.

The cranial and spinal nerves are also responsible for carrying out reflex actions.

The Brain



The brain weighs about 3 1/2 pounds in an adult and sits within the cranial cavity of the skull in a bath of fluid which both supports it and acts as a shock absorber. It is shaped like a large mushroom with many ridges and folds and **appears grey on the outside (grey matter) and white on the inside (white matter)**. It is very soft and delicate and if damaged, cannot be replaced.

The main parts of the brain are the **cerebrum, cerebellum, medulla, hypothalamus and pituitary gland**.

Cerebrum- the largest part of the brain; the seat of intelligence, controls memory, reasoning, consciousness and thought

Cerebellum – co-ordinate and control the skeletal muscles to give smoothness of action, balance and muscle tone.

If the cerebellum is damaged, movements are clumsy, and the control of balance may be lost.

Medulla – controls the vital reflexes of the body such as breathing, heart rate, blood pressure

Hypothalamus – links the nervous system with the endocrine system; helps in the regulation of the body temperature.

Pituitary gland –the master gland; controls all other endocrine glands of the body.

Nerve Cells (neurons)

The cells of the nervous system are called neurons. They are unusual cells in that they can be extremely long. Each neuron has a cell body with granular cytoplasm and a large centrally located nucleus. The cell body gives rise to thin threads called nerve fibres. The nerve fibres are of two kinds- dendrites and axons:

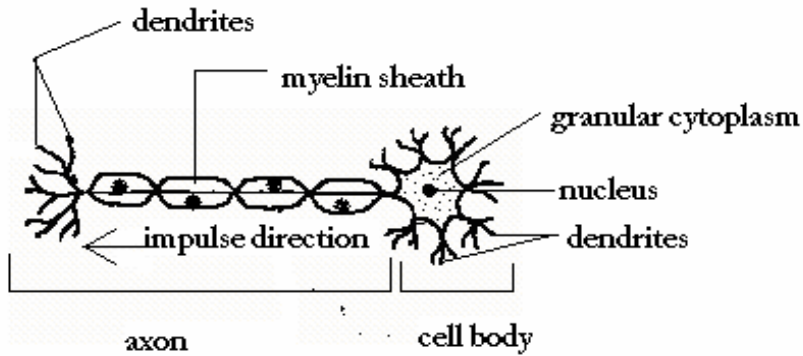
>**dendrites** – thread-like extensions which conduct impulses towards the cell body

The dendrites are in close contact with sense cells (receptors) from which impulses originate.




>**axons** – fibres covered and insulated by a layer of fat which conduct impulses away from the cell body

*The layer of fat which covers the axon is called the **myelin sheath**. It insulates the nerve fibre and allows impulses to be conducted along it more quickly.*

Diagram of a typical nerve cell



Types of nerve cells

<p>1. sensory neuron</p> 	<p>structure -cell body located in a ganglion* between the axon and the dendrite</p> <p>function - transmit impulses from a sense organ to the CNS</p>
<p>2. motor neuron</p> 	<p>structure - has a long axon with the cell body on one end</p> <p>function - transmit impulses from the CNS to an effector organ such as a muscle or gland</p>
<p>3. relay neuron/interneuron</p> 	<p>structure -has branching nerve fibres that allow one neuron to connect to many others</p> <p>function - forms link between sensory and motor neurons</p>

* a ganglion is a cluster of nerve cell bodies outside the CNS

Voluntary and involuntary actions

Voluntary actions are actions which the brain decides to carry out; they are under the control of our will.

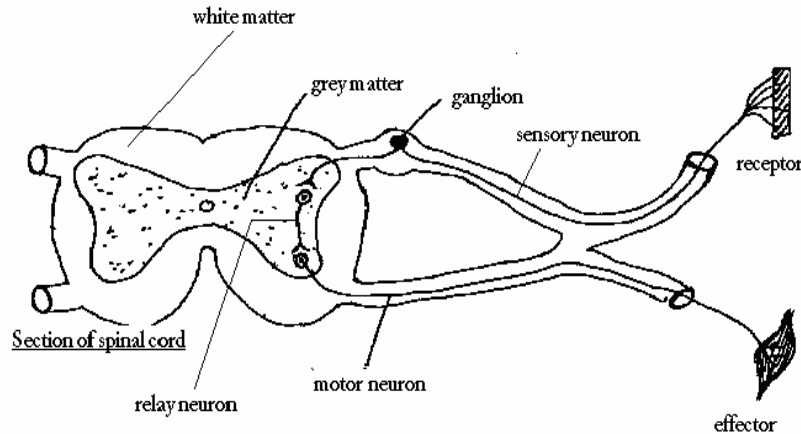
We choose these actions and are aware of them, and they can be altered, stopped or repeated. *e.g. when to get out of bed, when to eat, behavior, talking, reading etc*

Involuntary actions are actions that occur without our deciding the action. These actions are constantly taking place in our bodies and we have no voluntary control over them. *e.g. beating of the heart, peristaltic movements, blinking of the eye, digestion of food etc.*

Reflex actions

A reflex action is an automatic response to a stimulus. It is an involuntary response. It is usually carried out quickly and without thinking, and often has a protective function. *e.g. knee jerk, pupil reflex, withdrawal of hand from cause of pain, sneezing, coughing, blinking when something gets close to the eyes, producing saliva when food enters the mouth etc.*

The pathway of a reflex action is called a **reflex arc**.



The following are the components of a typical reflex arc:

Receptor or sense organ – receives the stimulus and converts it into an impulse

Sensory neuron – transmit the impulse to the CNS.

Relay neuron – links the sensory neuron with various parts of the brain and with the motor neuron.

Motor neuron – transmit messages from the CNS to an effector organ

Effector – carries out the instructions received in response to the stimulus e.g muscle or gland

NOTE

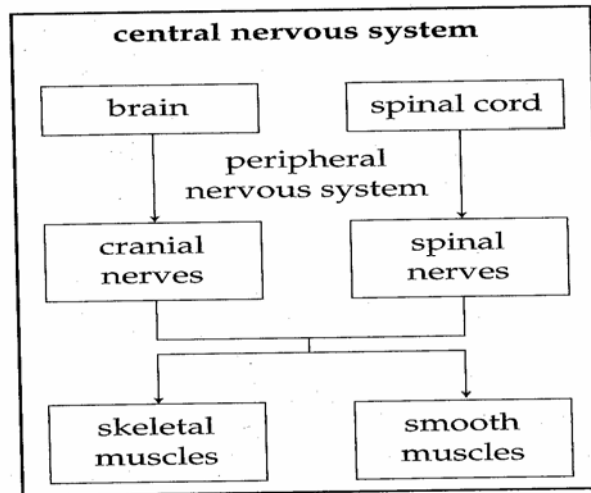
1. Impulse is a short burst of electrical current which passes along a neurone.
2. An impulse travels from one neuron to the next via a **synapse** (a junction between two neurons containing chemicals called neuro-transmitters).

Comparison of nervous and hormonal control systems (recall)

FEATURE	NERVOUS SYSTEM	ENDOCRINE SYSTEM
<i>Nature of message</i>	electrical impulses	chemicals
<i>Transmission of message</i>	along nerves	in the bloodstream
<i>Speed</i>	rapid	slow
<i>Destination</i>	specific regions of the body	all parts of the body but only produce a reaction in target cells
<i>Effect on the body</i>	immediate and short lasting	slower effect and long lasting

Questions

1. The diagram shows the Central Nervous System and the Peripheral Nervous System.



- (a) State TWO differences between the brain and the spinal cord. (2)
- (b) State the TWO main functions of the Central Nervous System. (2)
- (c) State ONE similarity and ONE difference between the cranial nerves and the spinal nerves. (2)
- (d) Name the type of cell that is found in all parts of the nervous system. (1)
- (e) Name the types of nerves found between the spinal cord and the smooth muscles. (3)

- 2.(a) (i) Differentiate between flexor and extensor muscles. (3)
- (ii) Identify by name, the flexor and the extensor muscles in the arm of a human. (2)
- (b) Describe the pathway (reflex arc) involved in removing your hand from a hot object (stimulus to response).
- (c) (i) State the differences between sneezing (reflex action) and speaking.
- (ii) List TWO differences between nervous and endocrine control. (2)