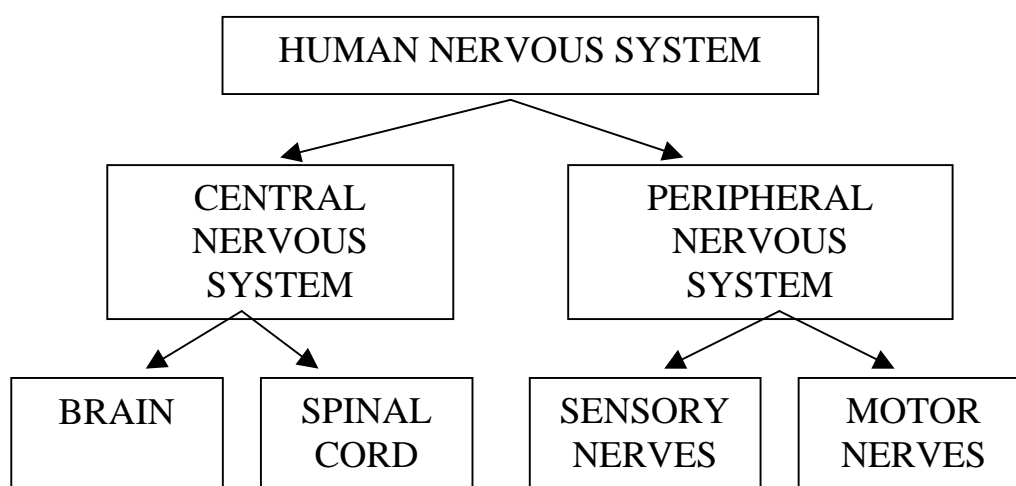


THE HUMAN NERVOUS SYSTEM



3 Main Parts of the Nervous System

1. Brain
2. Spinal Cord
3. Nerves – Sensory and Motor Nerves

The Neurone

Refer to the Neurone diagram in your textbook and identify the parts of the neuron as well as the synapse and the nerve impulse direction.

- ◆ Nerve cells are called neurones.
- ◆ A neurone consists of a cell body (with a nucleus and cytoplasm), dendrites which carry electrical impulses to the cell, and a long axon which carries the impulses away from the cell.
- ◆ The axon of one neurone and the dendrites of the next neurone do not actually touch. The gap between neurones is called the synapse.

Neuronal Function

- ◆ There are 3 processes involved in nerve transmission:
 1. Generation of a nerve impulse (action potential) of a sensory neurone occurs as a result of a stimulus such as light, a particular chemical or stretching of a cell membrane by sound.
 2. Conduction of an impulse along a neurone occurs from the dendrites to the cell body to the axon.
 3. Transmission of a signal to another neuron across a synapse - A chemical transmitter substance is released across the synapse to allow the electrical impulses to pass from one neurone to the next. This substance causes the next neurone to be electrically stimulated and keeps the signal going along a nerve.

The Central Nervous System

Refer to the diagram of a Human Brain in your textbook.

- ◆ The Central Nervous System comprises the parts that are enclosed and protected by bone - the Brain and the Spinal Cord.
- ◆ The Brain is composed of millions of interconnected neurones with short axons. It is protected within 3 membranes or meninges as well as the skull or cranium.
- ◆ The Spinal Cord is a bundle of nerve fibres made of many neurones. It is protected by the 3 meninges also as well as the vertebral column.
- ◆ Cerebro-spinal Fluid lies inside the meninges and acts as a buffer against hard knocks or jolts.
- ◆ 3 Parts of The Brain
 1. Cerebrum (Forebrain) – the largest section of the brain, which lets us think, interpret sensory messages, carry out voluntary muscle movements, remember and have consciousness
 2. Cerebellum (Midbrain) – helps us to keep our balance, and have repetitive muscle control
 3. Medulla Oblongata (Hindbrain or Brain Stem) – control the vital functions of heartbeat, breathing and blood pressure

The Hypothalamus

- ◆ The hypothalamus is a small cluster of neurones deep within the brain. It plays a central role by regulating many vital processes (e.g. regulating body temperature, heart rate, water balance and blood pressure, carbohydrate and fat metabolism, appetite, sleep and sex drive).
- ◆ It also links the nervous system with the endocrine system, because it controls the pituitary gland which is the master gland of the endocrine system.

The Peripheral Nervous System

- ◆ This is the part of the nervous system that does not include the brain and the spinal cord.
- ◆ There are 2 types of nerves – sensory and motor nerves.
- ◆ Sensory Nerves carry information about the surroundings from the sense receptors in the skin, eyes, ears, nose and tongue, along the spinal cord to the brain to be interpreted.
- ◆ Motor Nerves carry messages from the brain through the spinal cord to the muscles and other organs to produce an action.
- ◆ Some of the nerves of the peripheral nervous system are under voluntary control (e.g. controlling motor nerves and muscles when writing). Other nerves are involuntary or uncontrolled (e.g. regulating heartbeat).

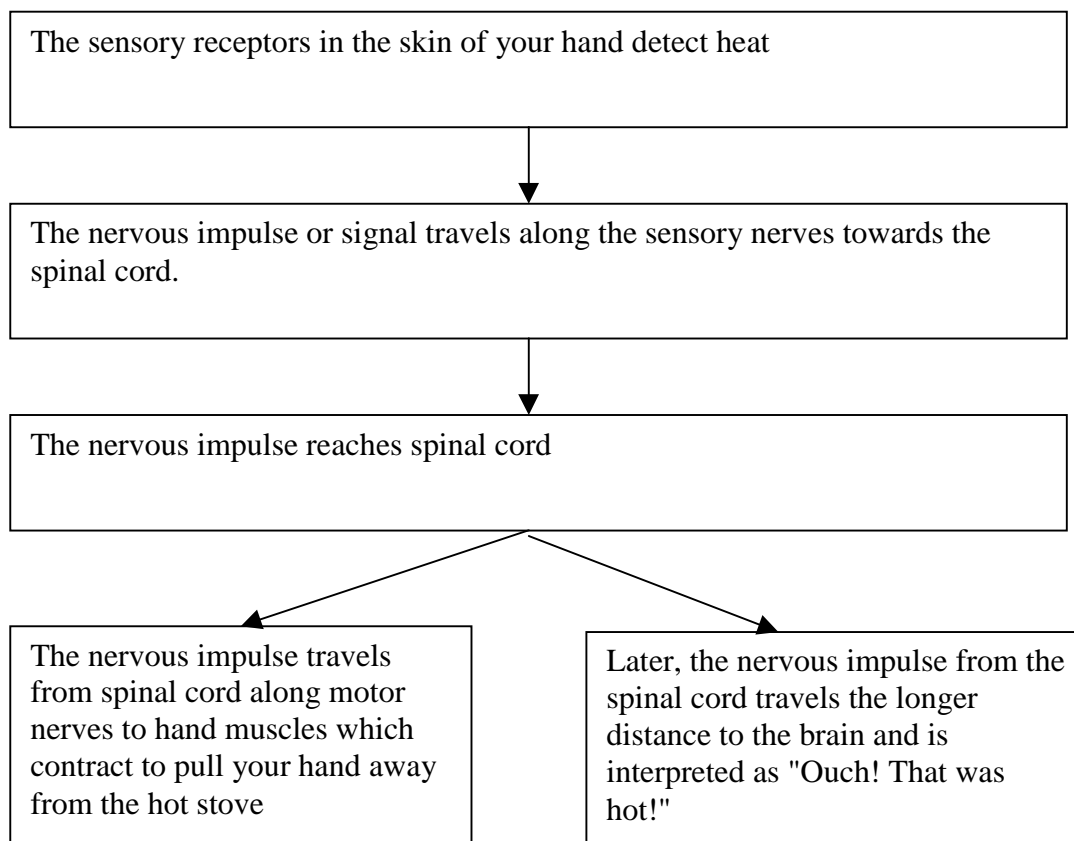
The Autonomic Nervous System

- ◆ The autonomic nervous system is not under voluntary control.
- ◆ It consists only of motor nerves transmitting to major organs such as the heart, lungs, digestive organs and skin.
- ◆ It is a double system with 2 parts that work together – Sympathetic Nervous System and Parasympathetic Nervous System.

ORGAN	ACTION OF SYMPATHETIC NERVES	ACTION OF PARA-SYMPATHETIC NERVES
Heart	Strengthens and speeds up heartbeat	Weakens and slows heartbeat
Arteries	Constricts arteries and raises blood pressure	Dilates arteries and lowers blood pressure
Digestive Tract	Slows peristalsis and decreases activity	Speeds up peristalsis and increase activity
Urinary Bladder	Relaxes bladder	Constricts bladder
Bronchi Muscles	Dilates passages, makes for easier breathing	Constricts passages
Iris Muscles	Dilates pupil	Constricts pupil
Hair Muscles	Causes erection of hair	Causes hair to lie flat
Sweat Glands	Increases secretion	Decreases secretion

A Reflex Arc

- ◆ A reflex arc involves transmission of a nervous impulse or message from sensory receptors to the spinal cord and back to muscles. Later, the message also reaches the brain for interpretation.
- ◆ Example: touching your hand on a hot stove



SENSES

♦ 5 main senses are:

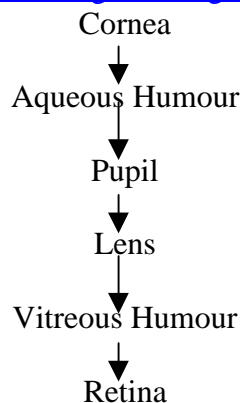
1. Touch
2. Smell
3. Taste
4. Sight
5. Hearing

- ♦ The sense of touch includes touch, pressure, heat, cold and pain.
- ♦ A stimulus is a factor in the surroundings that causes the sense receptors to function.

SENSE	SENSE ORGANS	STIMULUS
Touch, pressure, heat, cold, pain	Skin, joints, internal organs	Internal or external force or temperature
Smell	Nose	Airborne chemicals
Taste	Taste buds on tongue	Ingested chemicals
Sight	Eyes	Light
Hearing	Ears	Sound

THE EYE

The Path of Light through the Eye



Functions of the Parts of the Eye

- ♦ Cornea – thin transparent layer at the front of the eye
- ♦ Aqueous Humour – watery substance that fills the cavity between cornea and lens
- ♦ Pupil – a hole to allow to pass to the lens
- ♦ Iris – a coloured circular muscle that contracts or relaxes to dilate or constrict the pupil
- ♦ Lens – a transparent elastic ball that focuses light rays onto the retina
- ♦ Ciliary Ligament – attached to lens, and contracts or relaxes to adjust the lens
- ♦ Ciliary Body – attaches the ciliary ligament to the eyeball, and produces both aqueous and vitreous humours
- ♦ Vitreous Humour – a more viscous fluid that fills the cavity behind the lens
- ♦ Retina – a hemispherical layer of light-sensitive cells (rods and cones) at the back of the eye

- ◆ Fovea – a small area of the retina which is directly in line with the centre of the cornea and the lens, and is concentrated with the colour-sensitive cones
- ◆ Optic Nerve – the nerve which connects the retina with the vision area of the brain
- ◆ “Blind Spot” – the place on the retina where the optic nerve attaches; has no light-sensitive cones and rods
- ◆ Choroid Coat – sheet of cells next to the retina with a black pigment to absorb extra light, and blood vessels to nourish the retina
- ◆ Sclera – tough outer coat of the eyeball

Refer to the diagram of the Human Eye in your textbook.

Light-Sensitive Sense Receptors - Rods and Cones

- ◆ Rods are the more numerous cells that detect shades of black, grey and white light. They are more prevalent in the periphery of the eye.
- ◆ Cones are cells that detect coloured light. They are more prevalent in the centre of the retina, particularly the fovea.
- ◆ There are no rods nor cones in the ‘Blind Spot’ where the optic nerve meets the retina.

Vision

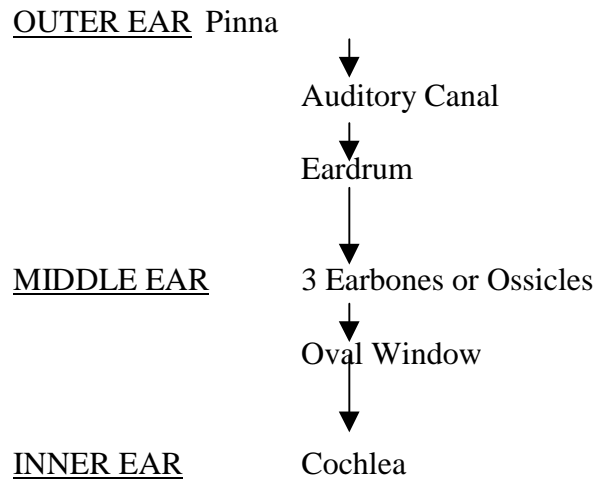
- ◆ Focus of the Lens – When looking at distant objects, the lens is long and thin in shape. When looking at close objects, the lens is short and wide.
- ◆ Binocular Vision – Two eyes are important in judging distance and depth.
- ◆ Pupil Size – In bright light, the iris muscle relaxes and the pupil decreases in size so that less light enters the eye.
In dim light, the iris muscle contracts and the pupil increase in size to allow more light to enter.
- ◆ Short-sightedness (Myopia) – This is a condition where the person can see close objects well, but not distant objects. Light focuses in front of the retina. It is corrected with concave lenses in spectacles.
- ◆ Long-sightedness (Hyperopia) – This is a condition where the person can see distant objects well, but not close objects. Light focuses behind the retina. It is corrected with convex lenses in spectacles.
- ◆ Astigmatism – This is a condition where the cornea is curved unevenly, so that different light rays focus in different places. It is corrected with spectacles.

Did You Know That...?

- ◆ The average person can see for a distance of 2 million light-years.
- ◆ When we look at something very colourful, we must look directly at it. This is because the colour-sensitive cones in our retinas are concentrated in the fovea which is directly in line with the front of the eye.
- ◆ When we are in the dark, we see shades of black white and grey but not colour. This is because our colour-sensitive cones require a higher stimulus of light to function than do rods.

THE EAR

Path of Sound through the Ear



Functions of the Parts of the Ear

OUTER EAR

- ◆ Pinna – funnel-shaped visible flap that directs sound waves into the auditory canal
- ◆ Auditory Canal – canal that carries the sound waves to the eardrum
- ◆ Eardrum – a thin membrane which is vibrated by sound waves

MIDDLE EAR

- ◆ 3 Earbones or Ossicles (Hammer, Anvil and Stirrup) – These are the smallest bones in the body. The eardrum vibrates, and this vibrates the hammer, the anvil and the stirrup one after another. The stirrup then vibrates the Oval Window.

INNER EAR

- ◆ Cochlea – This is a spirally coiled tube containing fluid and the actual organ of hearing, the Organ of Corti. Each Organ of Corti contains thousands of hairs that are vibrated by the sound waves. The hairs then initiate nervous impulses in the Auditory Nerve which is connected to the auditory areas on the sides of the brain.

Refer to the diagram of the Human Ear in your textbook.

Pitch and Amplitude of Sound

- ◆ High-pitched sounds causes intense stimulation of the hairs in the cochlea, whereas low-pitched sounds cause less stimulation.
- ◆ Loud sounds stimulate a greater number of hairs in the cochlea, than do quiet sounds.

Other Features of the Ear

- ◆ Semi-Circular Canals – These are 3 fluid-filled canals that detect the position of the head in 3 dimensions. Impulses are sent through via the auditory nerve to the brain.
- ◆ Eustachian Tube – There is a tube that connects each middle ear to the pharynx to equalise air pressure within the middle ear.