1. Details of Module and its structure

Module Detail	
Subject Name	Psychology
Course Name	Psychology 01 (Class XI, Semester - 1)
Module Name/Title	Nervous System Overview, Peripheral Nervous System and Endocrine System – Part 3
Module Id	kepy_10303
Pre-requisites	To understand the nervous system, peripheral nervous system and endocrine system
Objectives	After going through this lesson, the learners will be able to understand the following: • The Human Nervous System - an overview • Prenatal and Postnatal development of the Nervous system • Peripheral nervous system • The Somatic nervous system • Reflex Arcs and the Somatic Nervous System
Keywords	Nervous System, Peripheral Nervous System, Autonomic Nervous System, Somatic Nervous System, Sympathetic Nervous System, Parasympathetic Nervous System, Cranial Nerves, Spinal Nerves, Endocrine System Pituitary, Growth Hormone, Thyroid, Hypothyroidism, Hyperthyroidism, Pancreas, Insulin, Adrenal Medulla, Adrenal Cortex, Acth (Adrenocorticotrophic Hormone), Epinephrine, Norepinephrine, Gonads, Testosterone, Estrogen, Progesterone, Testes, Ovary, Gth (Gonadotropic Hormone)

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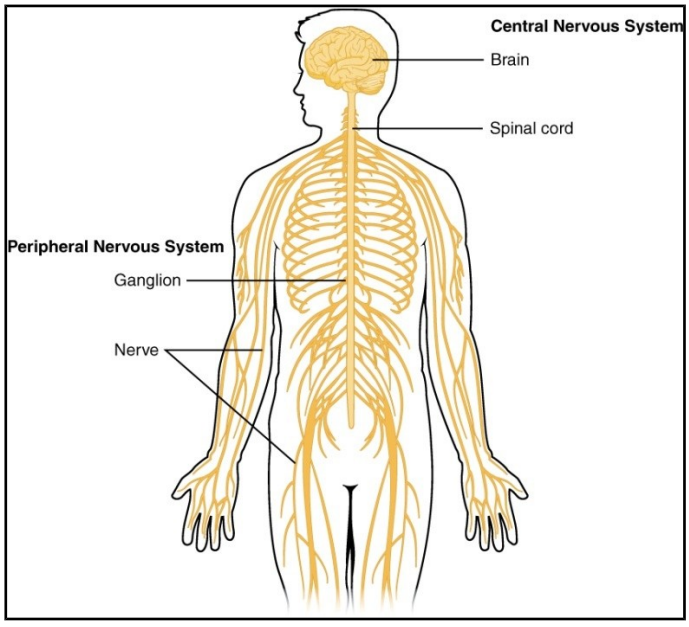
The Nervous System; An Overview, The Peripheral Nervous System

Since our biological structures play an important role in organisation and execution of behaviour, we shall look at these structures in some detail. In particular, you will read about the nervous system and the endocrine system, which work together in giving a shape to human behaviour and experience.

The Nervous System



Source-
https://upload.wikimedia.org/wikipedia/commons/d/d3/1201_Overview_of_Nervous_System.jpg

Human nervous system is the most complex and most developed of all living creatures.

Based on its location, the nervous system can be divided into two parts: Central Nervous System (CNS) and Peripheral Nervous System (PNS). The part of the nervous system found inside the hard bony cases (cranium and backbone) is classified as CNS. The brain and spinal cord are the organs of this system. The parts of the nervous system other than central nervous system are placed in the PNS.

Peripheral Nervous System

PNS can be further classified. Here, we will look at Somatic and Autonomic nervous system. Somatic nervous system is concerned with voluntary actions, while the autonomic nervous system performs functions on which we have no voluntary control.

The PNS is composed of all the neurons and nerve fibres that connect the CNS to the rest of the body. The PNS is divided into Somatic Nervous System and Autonomic Nervous System. The autonomic nervous system is further divided into Sympathetic and Parasympathetic systems. The PNS provides information to the CNS from sensory receptors (eyes, ears, skin, etc.) and relays back motor commands from the brain to the muscles and glands.

The Somatic Nervous System

This system consists of two types of nerves, called **cranial nerves** and **spinal nerves**.

There are **twelve sets of cranial nerves** which either emanate from or reach different locations of the brain. There are **three types of cranial nerves - sensory, motor, and mixed**. **Sensory nerves** collect sensory information from receptors of the head region (vision, audition, smell, taste, touch, etc.) and carry them to the brain.

The **motor nerves** carry motor impulses originating from the brain to muscles of the head region. For example, movements of the eyeballs are controlled by motor cranial nerves. **Mixed nerves** have both sensory and motor fibres, which conduct sensory and motor information to and from the brain.

There are **thirty one sets of spinal nerves** coming out of or reaching to the spinal cord. Each set has **sensory** and **motor** nerves. Spinal nerves have two functions.

The sensory fibres of the spinal nerves collect sensory information from all over the body (except the head region) and send them to the spinal cord from where they are then carried out to the brain.

In addition, motor impulses coming down from the brain are sent to the muscles by the motor fibres of the spinal nerves.

The Somatic Nervous System

The primary function of the somatic nervous system is to connect the central nervous system to the body's muscles and control voluntary movements and reflex arcs.

Information taken in by sensory systems is transmitted to the central nervous system. The CNS then sends signals via the nerve networks of the somatic system to the muscles and organs.

An Example of the Somatic Nervous System in Action

Source- http://maxpixel.freegreatpicture.com/static/photo/1x/Accident-Risk-Banana-Peel-Banana-Slip-Injury-994009.jpg

For example, imagine that you are out for a jog in the park one morning. As you run, you spot a banana peel on the path ahead. Your visual system perceives the banana peel and relays this information to your brain. Your brain then sends signals to engage your muscles to take action. Thanks to your somatic system, you are able to turn your body and move to a different part of the path, successfully avoid the banana peel and prevent a possibly dangerous fall on the hard pavement.

Reflex Actions

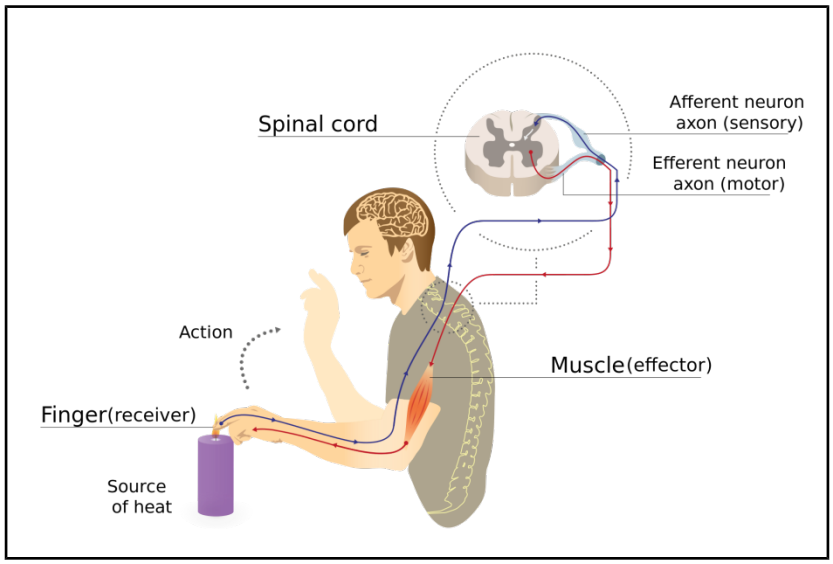
In addition to controlling voluntary muscles movements, the somatic nervous system is also associated with involuntary movements known as the reflex action which takes place automatically without conscious decision of the brain. Reflex actions are inherited in our nervous system through evolutionary processes, for example, the eye-blinking reflex. Whenever any object suddenly comes near our eyes, our eyelids blink. During this, muscles move involuntarily

without input from the brain. Though several reflex actions are performed by our nervous system, the familiar reflexes are the knee jerk, pupil constriction, pulling away from very hot or cold objects, breathing and stretching. Most reflex actions are carried out by the spinal cord and do not involve the brain. This occurs when a nerve pathway connects directly to the spinal cord. Some other examples of reflex actions include jerking your hand back after accidentally touching a hot pan or an involuntary knee jerk when your doctor taps on your knee.

You don't have to think about doing these things.

Reflex actions that impact the organs are called autonomic reflex arcs while those that affect the muscles are referred to as somatic reflex arcs.

A pictorial depiction of the reflex arc:



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The Autonomic Nervous System

This system governs activities which are normally not under direct control of individuals. It controls such internal functions as breathing, blood circulation, salivation, stomach contraction, and emotional reactions. These activities of the autonomic system are under the control of different structures of the brain. The Autonomic Nervous System has two main divisions:

Sympathetic division and Parasympathetic division. Although the effect of one division is opposite to the effect of the other, both work together to maintain a state of equilibrium.

Sympathetic Nervous System

The sympathetic division deals with emergencies when the action must be quick and powerful, such as in situations of fight or flight. During this period, the digestion stops, blood flows from internal organs to the muscles, and breathing rate, oxygen supply, heart rate, and blood sugar level increases.

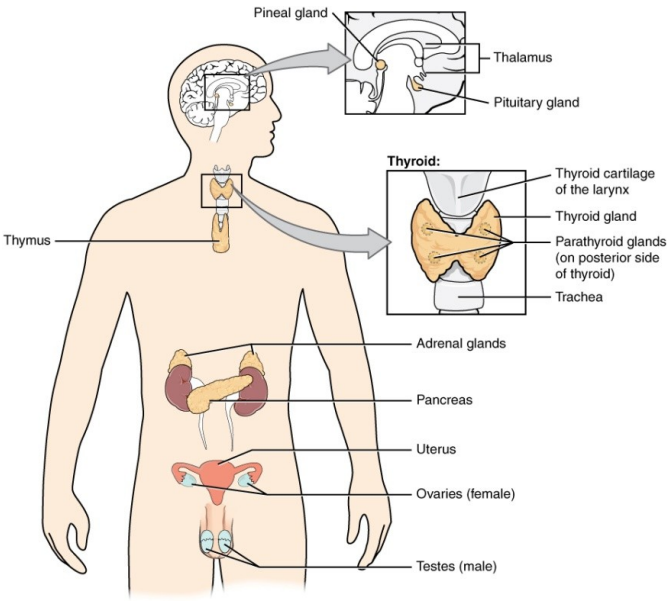
Parasympathetic Nervous System

The Parasympathetic division is mainly concerned with conservation of energy. It monitors the routine functions of the internal system of the body. When the emergency is over, the parasympathetic division takes over; it decelerates the sympathetic activation and calms down the individual to a normal condition. As a result all body functions like heart beat, breathing, and blood flow return to their normal levels.

In the picture above, that the cell bodies of the parasympathetic nervous system are located in the spinal cord and in the **medulla**. It should be noted that the autonomic nervous system is always working. It is NOT only active during "fight or flight" situations. Rather, the autonomic nervous system acts to maintain normal internal functions and works with the somatic nervous system.

The Endocrine System

The Endocrine System



Source:https://upload.wikimedia.org/wikipedia/commons/1/15/1801_The_Endocrine_System.jpg
The endocrine glands play a crucial role in our development and behaviour. They secrete specific chemical substances, called hormones, which control some of our behaviours. These glands are called ductless glands or endocrine glands, because they do not have any duct (unlike other glands) to send their secretions to specific places. Hormones are circulated by the bloodstream. The endocrine glands form the endocrine system of the body. This system works in conjunction with different parts of the nervous system. The whole system is thus known as neuroendocrine system.

Pituitary Gland - This gland is situated within the cranium just below the hypothalamus. The pituitary gland is divided into anterior pituitary and posterior pituitary.

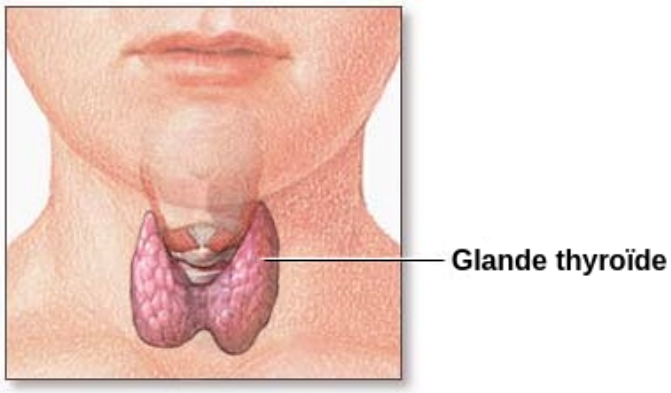
The pituitary gland is about the size of a pea and is situated in a bony hollow, just behind the bridge of our nose. It is attached to the base of our brain by a thin stalk.

If our pituitary gland is not producing sufficient amounts of one or more hormones this is called hypopituitarism. If on the other hand we are over producing certain hormones, then we would have features due to the over production of the specific hormone concerned.

The anterior pituitary is directly connected with hypothalamus, which regulates its hormonal secretions. The pituitary gland secretes the **growth hormone** and many other hormones, which direct and regulate the secretions of many other endocrine glands found in our body. This is why the pituitary gland is known as the **“master gland”.**

Some hormones are secreted at a steady rate throughout life, while others are secreted at an appropriate time in life. For example, the **growth hormone** is released steadily through childhood, with some spurt during adolescence, but **gonadotropic hormones (GTH)** are secreted at the age of puberty, which stimulates the secretion of appropriate sex hormones among boys and girls. As a result, primary and secondary sexual changes take place.

Thyroid Gland



Source:https://upload.wikimedia.org/wikipedia/commons/thumb/4/46/Thyroid_gland-fr.svg/2000px-Thyroid_gland-fr.svg.png

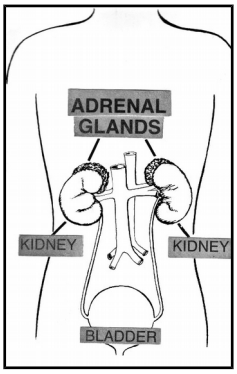
This is a butterfly-shaped gland in the front of the neck. The thyroid has important roles to regulate numerous metabolic processes throughout the body. Different types of thyroid disorders affect either its structure or function.

The thyroid uses iodine to produce vital hormones. Thyroxine, also known as T4, is the primary hormone produced by the gland.

The steady secretion of this hormone maintains the production of energy, consumption of oxygen and elimination of wastes in body cells. On the other hand, underproduction of thyroxin leads to physical and psychological lethargy.

If thyroid gland is removed in young animals, their growth gets stunted and they fail to develop sexually.

Adrenal Gland



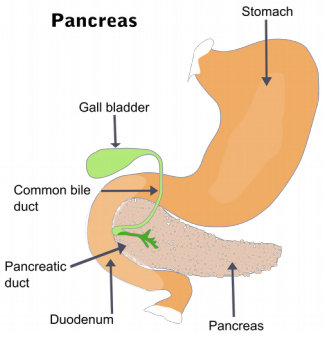
Source:https://upload.wikimedia.org/wikipedia/commons/b/b3/Adrenal_gland_%28PSF%29.png

This gland is located above each kidney. It has two parts, **adrenal cortex** and **adrenal medulla**, each secreting different hormones. The secretion of adrenal cortex is controlled and regulated by Adrenocorticotrophic Hormone (ACTH) secreted by anterior pituitary gland.

When the secretion of adrenal cortex goes down, anterior pituitary gets the message and increases the secretion of ACTH, which stimulates the adrenal cortex to secrete more hormones. The adrenal cortex secretes a group of hormones, called corticoids, which are utilised by the body for a number of physiological purposes, e.g., regulation of minerals in the body, particularly sodium, potassium, and chlorides. Any disturbance in its function seriously affects the functions of the nervous system.

Adrenal medulla secretes two hormones, namely **epinephrine** and **norepinephrine** (also known as adrenaline and noradrenaline, respectively). Sympathetic activation, such as increased heart rate, oxygen consumption, metabolic rate, muscle tone, etc., take place through the secretion of these two hormones. Epinephrine and norepinephrine stimulate the hypothalamus, which prolongs emotions in an individual even when the stressor has been removed.

Pancreas



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The pancreas, lying near the stomach, has a primary role in digestion of food, but it also secretes a hormone known as insulin. Insulin helps the liver to break down glucose for use by the body or for storage as glycogen by the liver. When insulin is not secreted in proper amount, people develop a disease, called diabetic mellitus or simply diabetes.

Gonads

Gonads refer to testes in males and ovaries in females. The hormones secreted by these glands control and regulate sexual behaviours and reproductive functions of males and females.

Gonads: *Secretion of hormones of these glands is initiated, maintained and regulated by a hormone, called gonadotrophic hormone (GTH) secreted by the anterior pituitary. The secretion of GTH starts at the age of puberty (10 to 14 years in human beings) and stimulates gonads to secrete hormones, which in turn stimulates development of primary and secondary sexual characteristics.*

The ovaries in females produce estrogen and progesterone.

Estrogen guides the sexual development of the female body. Primary sexual characteristics related with reproduction, such as development of ovum or egg cell, appear on every 28 days or so in the ovary of a sexually mature female. Secondary sexual characteristics, such as breast development, rounded body contours, widened pelvis, etc., also depend on this hormone.

Progesterone has no role in sexual development. Its function is related with preparation of uterus for the possible reception of fertilised ovum.

The hormonal system for reproductive behaviour is much simpler in the male because there is no cyclic pattern. Testes in males produce sperm continuously and secrete male sex hormones called **androgens**.

The major androgen is **testosterone**. Testosterone prompts secondary sexual changes such as physical changes, growth of facial and body hairs, deepening of voice, and increase in sexually oriented behaviour. Increased aggression and other behaviours are also linked with testosterone production.

The normal functioning of all hormones is crucial to our behavioural well-being. Without a balanced secretion of hormones, the body would be unable to maintain the state of internal equilibrium. Without the increased secretion of hormones during the times of stress, we would not be able to react effectively to potential dangers in our environment. Finally, without the secretion of hormones at specific times in our lives, we would not be able to grow, mature and reproduce.