GENERAL PHYSIOLOGY

1ST SEMESTER

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Survival Needs of the Body

- **Communication**
  Intake of raw materials and elimination of waste
  Protection and survival
- Transport systems: blood, circulatory system, lymphatic system
  Internal communication: nervous system, endocrine system
  External communication: special senses, verbal and non-verbal communication
- Intake of oxygen
  Dietary intake
  Elimination of waste: carbon dioxide, urine, faeces
- Protection against the external environment: skin
  Resistance and immunity: non-specific and specific defence mechanisms
  Body movement
  Reproduction.

Communication Overview

- Transport systems ensure that all cells have access to the internal and external environments; the blood, the circulatory system and lymphatic system are involved.
- All communication systems involve receiving, collating and responding to appropriate information.
- There are different systems for communicating with the internal and external environments. Internal communication involves mainly the nervous and endocrine systems; these are important in the maintenance of homeostasis and regulation of vital body functions.
- Communication with the external environment involves the special senses, and verbal and non-verbal activities, and all of these also depend on the nervous system.

Transport Systems

- **Blood**
  The blood transports substances around the body through a large network of blood vessels.
  In adults the body contains 5 to 6 l of blood (Ch. 4).
  It consists of two parts — a sticky fluid called plasma and cells which are suspended in the plasma.

Plasma

- **Plasma.** This is mainly water with a wide range of substances dissolved or suspended in it.
  These include:
  • nutrients absorbed from the alimentary canal
  • oxygen absorbed from the lungs
  • chemical substances synthesised by body cells, e.g. hormones
  • waste materials produced by body cells to be eliminated from the body by excretion.

Blood Cells

- **Blood cells.** There are three distinct groups, classified according to their functions (Fig. 1.5).
- **Erythrocytes (red blood cells)** are concerned with the transport of oxygen and, to a lesser extent, carbon dioxide between the lungs and all body cells.
- **Leukocytes (white blood cells)** are mainly concerned with protection of the body against microbes and other potentially damaging substances that gain entry to the body.
  There are several types of leukocytes which carry out their protective functions in different ways.
  These cells are larger than erythrocytes and are less numerous.
- **Thrombocytes (platelets)** are tiny cell fragments which play an essential part in the very complex process of blood clotting.

Circulatory System

- **Circulatory system (Ch. 5)**
  This consists of a network of blood vessels and the heart (Fig. 1.6).
- **Blood vessels.** There are three types:
  • arteries, which carry blood away from the heart
  • veins, which return blood to the heart
  • capillaries, which link the arteries and veins.
- Capillaries are tiny blood vessels with very thin walls consisting of only one layer of cells.
  They are the site of exchange of substances between the blood and body tissues, e.g. nutrients, oxygen and cellular waste products.

Circulation Pathways

- Blood vessels form a network that transports blood to:
  - the lungs (**pulmonary circulation**) where oxygen is absorbed from the air in the lungs and at the same time carbon dioxide is excreted from the blood into the air
  - cells in all parts of the body (**general or systemic circulation**).

The Heart

- **Heart.** The heart is a muscular sac.
  It pumps the blood round the body and maintains the blood pressure in the lungs and general circulation.
  This is essential for life.
- The heart muscle is not under conscious (voluntary) control.
  At rest, the heart contracts between 65 and 75 times per minute.
  The rate may be greatly increased during physical exercise, when the oxygen and nutritional needs of the muscles moving the limbs are increased, and in some emotional states.
- The rate at which the heart beats can be counted by taking the pulse.
  The pulse can be felt most easily where an artery lies close to the surface of the body and can be pressed gently against a bone.
  The wrist is the site most commonly used for this purpose.

Lymphatic System

- Consists of a series of lymph vessels, which begin as blind-ended tubes in the spaces between the blood capillaries and tissue cells
- Structurally they are similar to veins and blood capillaries but the pores in the walls of the lymph capillaries are larger than those of the blood capillaries.Lymph is tissue fluid containing large molecules, e.g. proteins, fragments of damaged tissue cells and microbes.
  It is transported along lymph vessels and is returned to the bloodstream.
- There are collections of lymph nodes situated at various points along the length of the lymph vessels. Lymph is filtered as it passes through the lymph nodes, and microbes, noxious substances and some waste materials are removed.
- The lymphatic system provides the sites for formation and maturation of lymphocytes, the white blood cells involved in immunity.

Internal Communication

- **Communication and the nervous system**
  The nervous system is a rapid communication system (Ch. 7).
  The main components are shown in Figure 1.8.
- The **central nervous system** consists of:
  • the brain, situated inside the skull
  • the spinal cord, which extends from the base of the skull to the lumbar region and is protected from injury by the bones of the spinal column.

Peripheral Nervous System

- The **peripheral nervous system** is a network of nerve fibres, which are:
  • **sensory or afferent**, providing the brain with 'input' from organs and tissues, or
  • **motor or efferent**, which convey nerve impulses carrying 'output' from the brain to effector organs: the muscles and glands.

The Somatic (Common) Senses

- The somatic (common) senses are pain, touch, heat and cold, and they arise following stimulation of specialised sensory receptors at nerve endings found throughout the skin.
- There are different receptors in muscles and joints that respond to changes in the position and orientation of the body, maintaining posture and balance.
- Yet other receptors are activated by stimuli in internal organs and maintain control of vital body functions, e.g. heart rate, respiratory rate and blood pressure.

Sensory Receptors and Impulses

- Stimulation of any of these receptors sets up impulses that are conducted to the brain in sensory (afferent) nerves.
- Communication along nerve fibres (cells) is by electrical impulses that are generated when nerve endings are stimulated.
- Communication between nerve cells is also required, since more than one nerve is involved in the chain of events occurring between the initial stimulus and the physiological reaction to it.

Nerve-to-Nerve Communication

- Nerves communicate with each other by releasing a chemical (the neurotransmitter) into tiny gaps between them.
- The neurotransmitter quickly travels across the gap and either stimulates or inhibits the next nerve cell, thus ensuring the message is transmitted.

Brain's Role in Processing

- Sensory nerves and chemical substances circulating in the blood provide information to appropriate parts of the brain, which collates it and then responds via motor nerves to effector organs, often through a negative feedback mechanism (Fig. 1.3).
- Some of these activities are understood and perceived, e.g. pain, whereas others take place subconsciously, e.g. changes in blood pressure.

Speed of Nervous Communication

- Nerve impulses travel at great speed along nerve fibres leading to rapid responses; adjustments to many body functions occur within a few seconds.

Communication and the Endocrine System

- The endocrine system consists of a number of endocrine glands situated in different parts of the body.
- They synthesise and secrete chemical messengers called hormones that circulate round the body in the blood.
- Hormones stimulate target glands or tissues, influencing metabolic and other cellular activities and regulating body growth and maturation.

Hormonal Control

- Endocrine glands detect and respond to levels of particular substances in the blood, including specific hormones.
- Changes in blood hormone levels are controlled by negative feedback mechanisms
- The endocrine system provides slower and more precise control of body functions than the nervous system.

Communication with the External Environment

- **Special senses**
  These senses arise following stimulation of specialised sensory receptor cells located in sensory organs or tissues in the head.

Coordination Between Senses

- Although these senses are usually considered separate and different from each other, one sense is rarely used alone.
- For example, when the smell of smoke is perceived then other senses such as sight and sound are used to try and locate the source of a fire.
- Similarly, taste and smell are closely associated in the enjoyment, or otherwise, of food.

Brain Integration of Senses

- The brain collates incoming information with information from the memory and initiates a response by setting up electrical impulses in motor (efferent) nerves to effector organs, muscles and glands.
- Such responses enable the individual to escape from the fire, or to prepare the digestive system for eating.

Verbal Communication

- Sound is a means of communication and is produced in the larynx as a result of blowing air through the space between the vocal cords during expiration.
- Speech is the manipulation of sound by contraction of the muscles of the throat and cheeks, and movements of the tongue and lower jaw.

Non-Verbal Communication

- Posture and movements are associated with non-verbal communication, e.g. nodding the head and shrugging the shoulders.
- The skeletal system provides the bony framework of the body, and movement takes place at joints between bones.
- Skeletal muscles which move the bones lie between them and the skin. They are stimulated by the part of the nervous system under conscious (voluntary) control.
- Some non-verbal communication, e.g. changes in facial expression, may not involve the movement of bones.

The Respiratory System

- The respiratory system carries air between the nose and the lungs during breathing
- Air passes through a system of passages consisting of the pharynx (also part of the alimentary canal), the larynx (voice box), the trachea, two bronchi (one bronchus to each lung) and a large number of bronchial passages
- These end in alveoli, millions of tiny air sacs in each lung.
  They are surrounded by a network of tiny capillaries and are the sites where the vital process of gas exchange between the lungs and the blood takes place

Dietary Intake

- A balanced diet is important for health and provides nutrients, substances that are absorbed, often following digestion, and promote body function.
- Nutrients include water, carbohydrates, proteins, fats, vitamins and mineral salts.
- They are required for:
  - maintaining water balance within the body
  - energy production, mainly carbohydrates and fats
  - synthesis of large and complex molecules, using mineral salts, proteins, fats, carbohydrates and vitamins
  - cell building, growth and repair, especially proteins.

Digestion

- The digestive system has developed because the food eaten is chemically complex and seldom in a form the body cells can use.
- Its function is to break down or digest food so that it can be absorbed into the circulation and then used by body cells.
- The digestive system consists of the alimentary tract and accessory glands

Alimentary Canal and Glands

- The **alimentary canal** is a tube that begins at the mouth and continues through the pharynx, oesophagus, stomach, small and large intestines, rectum and anus.
- The accessory organs situated outside the alimentary canal with ducts leading into it are the salivary gland


ANY
QUESTIONS?


THANK YOU