CHAPTER
1

Introduction to the Human Body

SAQ: Short answer question: Marks: 2
BAQ: Brief answer question: Marks: 4 or 5
LAQ: Long answer question: Marks: 9 or 10

MCQs: Multiple choice questions: Marks: 0.5 each
Match the columns: Marks: 0.5 each
Draw a labelled diagram: Marks: 5

Objective: To describe the branches of academic study, "anatomy and physiology" and their relation.

INTRODUCTION

The anatomy and physiology subjects are very important to understand the basic framework of body parts, the location of various organs, knowledge regarding various body systems such as the skeletal system, circulatory system, respiratory system, digestive system, nervous system, reproductive system, etc., the location of cells, tissues, various bones, joints, and their related functions. Anatomy and physiology subjects help to get knowledge of human development and to understand how the body grows and changes during a lifetime.

Anatomy and physiology are the fundamental subjects to study in courses related to paramedical and medical subjects. The study of these subjects is important to get basic information on the health status of an individual body and is also extremely useful to pursue a career in the health professions. Mastery of anatomy and physiology subjects is necessary to understand and arrive at the right diagnosis; while examining a patient and also understanding related clinical reports and then taking appropriate action to treat the diseases. Good knowledge of anatomy and physiology is also useful for understanding the effects of nutrition, infections, genetic errors and effects of medicines on the human body and also for understanding the use of medical devices and procedures during the treatment of a disease.

Objective: To describe important terms related to anatomy and physiology.

IMPORTANT TERMS

SAQ: Define the following terms.

Ans: (Each term-related answer is equivalent to one SAQ.)

- ***Human anatomy:*** It is the study of body structure and its relationship with related body structures.
- ***Human physiology:*** It is the study of the functions of the body parts.
- ***Human anatomy branches:*** Include gross anatomy, microscopic anatomy, developmental anatomy and pathological anatomy.
- ***Gross anatomy:*** It is the observation of body structure with unaided eyes.
- ***Microscopic anatomy:*** It is the observation of the body structure using a microscope.
- ***Developmental anatomy:*** It is the study of the structure of the body from conception to birth.
- ***Pathological anatomy:*** It is the study of structural changes caused by a specific disease.
- ***Human physiology branches:*** Include cellular physiology, developmental physiology, and pathological physiology.
- ***Cellular physiology:*** It is the study of various components of cells.
- ***Developmental physiology:*** It is the study of cells as an organism grows.
- ***Pathological physiology:*** It is the study of functional changes that occur in an organism in a disease.
- ***Histology:*** It deals with the microscopic examination of a tissue.
- ***Histopathology:*** It deals with the study of diseased tissue.

ANATOMY AND PHYSIOLOGY SUBJECTS ARE STUDIED TOGETHER

LAQ: Why are anatomy and physiology subjects studied together?

Ans: Anatomy and physiology are subdivisions of biology. These subjects are always related together and studied together. The various parts of the human body form very well-organized units. Each of these body units functions to make the body operate as a complete unit. A specific structure of the body determines what specific functions could take place by that structural unit. Anatomy and physiology provide basic knowledge about the human body and various functions performed by the human body.

A normal person is usually good in health. Subclinical conditions do not show specific signs and symptoms. Adverse changes in the anatomy of the body affect the related physiology. The changes in anatomy and physiology lead to the presence of clinical conditions. A clinical condition means the presence of recognizable clinical signs and symptoms, due to a specific disorder or disease. A disorder leads to disturbed normal functioning of the body and its cause may not be known. When the cause of a disorder is determined, the diagnosis of a disease is confirmed.

The following are some examples of gross anatomical and physiological changes in a patient, which could be seen by eyes: A specific rash on the face and other parts of the body, swellings on the face and feet, excessive loss of hair, bleeding from any external parts of the body, difficulty in breathing, etc. Microanatomical changes caused by disorders and diseases could be seen by studying stained tissue sections, blood and other body fluid smears on glass slides, using a microscope. Good knowledge of anatomy and physiology helps to find out which part of the body is affected by a specific disease; and with proper identification and treatment, a patient can make full recovery.

A medical team is comprised of general physicians, specialists, surgeons, laboratory technicians, X-ray technicians, biochemists, microbiologists, pharmacists, nurses, dentists, physiotherapists, and nutritionists. Each category of this team requires good knowledge of anatomy and physiology subjects to perform individual duties very well.

Objective: To describe human beings concerning a classification scheme.

CLASSIFICATION OF HUMAN BEINGS

SAQ: Why classification of human beings is important?

Ans: The classification is useful to know the origin and evolution of human beings. The classification of human beings is important since it easily facilitates the study of a wide variety of organisms. The classification is useful to understand and study the similarities, features, and differences between different living organisms. The classification also helps to understand how organisms are grouped under different categories.

BAQ: Classify human beings using taxonomic classification.

Ans: The following is the classification of human beings based on taxonomic classification (Table 1.1).

Table 1.1: Classification of human beings

Taxon	*Grouping*	*Characteristics*
Kingdom	Animalia	Cells with defined internal components
Phylum	Chordata	Dorsal hollow nerve cord, pharyngeal pouches, and notochord (a cartilaginous skeletal rod supporting the body)
Subphylum	Vertebrata	Vertebral column, bony endoskeleton
Class	Mammalia	Mammary glands, three auditory ossicles, attached placenta, hair, muscular diaphragm
Order	Primates	Large brain, prehensile hands, modified digits for grasping
Family	Hominidae	Flattened face, well-developed vocal structure
Genus	Homo	Well-developed and large cerebellum, bipedal
Species	Sapiens	Posture and locomotion, opposable thumb

Note: Prehensile means part of an animal's body that can hold things.

Objective: To describe levels of the organization of the human body.

LEVELS OF BODY ORGANIZATION (Fig. 1.1)

SAQ: Describe the various levels of body organization.

Ans: The basic levels of organization in the body are:

1. Microscopic forms such as atoms, molecules and
2. Macroscopic forms such as cells, tissues, organs, organ systems, and the human organism.

LAQ: Describe the various levels of body macroscopic organization.

Ans: The macroscopic organization of the body is formed of cells, tissues, organs and organ systems (Fig. 1.1).

Cell

A cell is defined as the basic and the smallest functioning unit of the body.

Tissue

A tissue is formed when the cells are spaced uniformly and bind together.

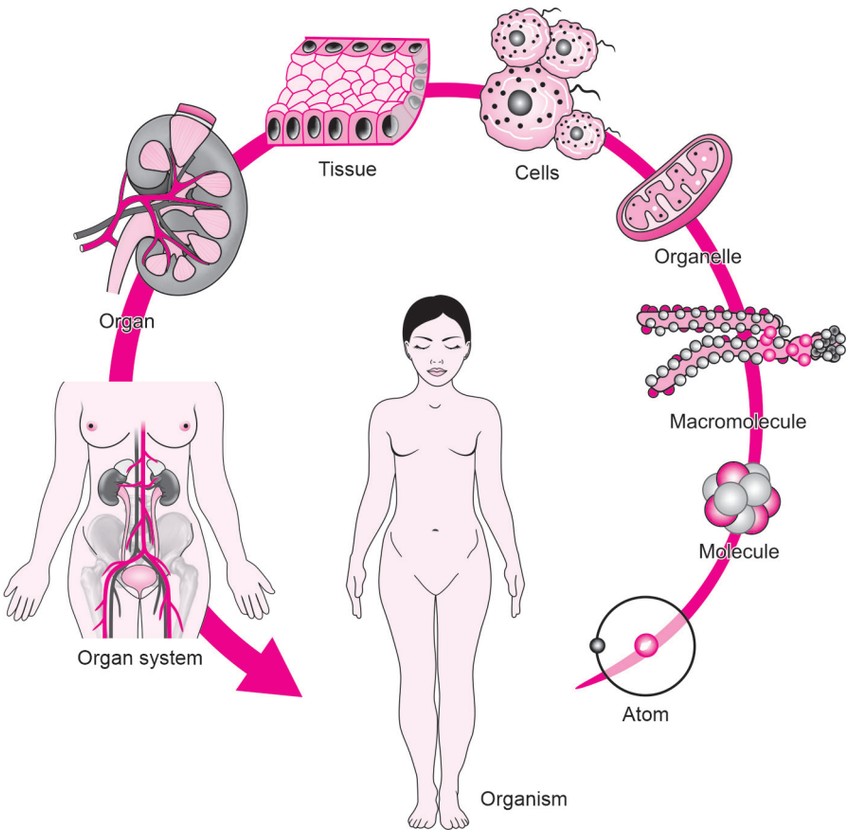


Fig. 1.1: Levels of the body organization

Matrix

The cells are bound together by a matrix, which is a non-living matter secreted by the cells. The matrix may be present in liquid, semisolid or solid form and may vary in composition from one tissue to another tissue. For example, blood tissue has a liquid matrix and bone tissues are bound by a solid matrix.

Organ

An organ is composed of several integrated tissue types that perform a specific function. For example, the femur is an organ. The components of the femur are bone tissue, nervous tissue, blood (vascular) tissue, and cartilaginous tissue. The femur helps to maintain body support and muscular support and helps the circulatory system by providing bone marrow cells (Fig. 1.2).

The organs are the functional elements in the body and often; they are physically distinct. The following are the various examples of organs: Kidneys, lungs, liver, heart, stomach, gastrointestinal tract, pancreas, blood, blood cells, hair, teeth, nerves, etc. All these organs are defined by a shape and a location in the body and they perform specific functions.

System (Fig. 1.2)

A system is an organization of two or more organs and structures associated with them, working as a unit to perform a common function or set of functions.

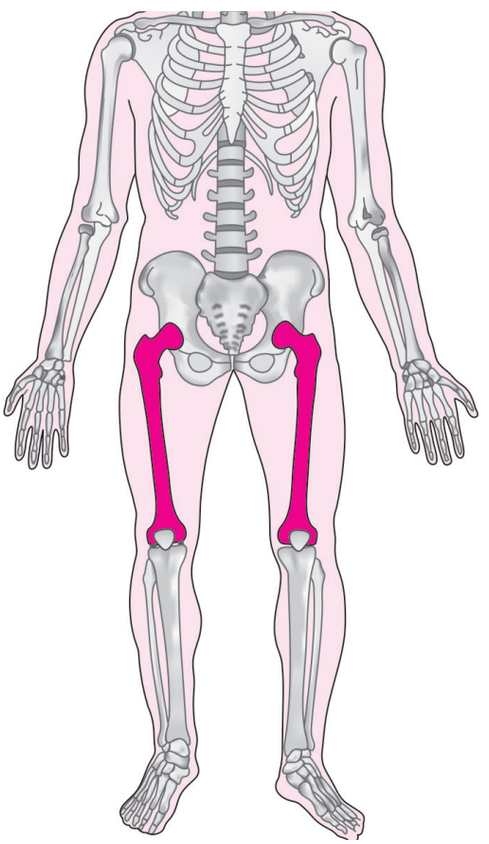


Fig. 1.2: An example of organ—femur

Organ Systems (Fig. 1.3)

Although each organ has its specific functions, these also function together in groups, called organ systems. Doctors categorize disorders and their own medical specialities according to the organ systems. The following are the various organ systems:

- Skeletal system
- Integumentary system
- Muscular system
- Nervous system
- Cardiovascular system
- Lymphatic system
- Respiratory system
- Digestive system
- Urinary system
- Endocrine system
- Reproductive system

Body (Fig. 1.3)

A body is the physical structure of a person that includes various organ systems.

Objective: To describe the various basic organ systems.

LAQ: Briefly describe the various organ systems and their respective functions.

Ans: The following are the various organ systems (Fig. 1.3):

Skeletal system, integumentary system, muscular system, nervous system, cardiovascular system, lymphatic system, respiratory system, digestive (gastrointestinal) system, urinary system, endocrine system, and reproductive system.

DESCRIPTION AND FUNCTIONS OF ORGAN SYSTEMS

Digestive (gastrointestinal) system (Fig. 1.3): It extends from the mouth to the anus. This system includes the mouth, the oesophagus, the stomach, the small intestine, and the large intestine. The digestive system also includes the associated organs such as the pancreas, the liver, and the gallbladder.

Functions: The digestive system produces digestive substances and enzymes for the breakdown of complex food components. It facilitates the digestion of food and absorption of digested microproducts, which can be used by the body cells for their metabolic reactions. The digestive system also facilitates the movement of food materials in the gastrointestinal tract.

Integumentary system (Fig. 1.3): Includes the epidermis, dermis, hypodermis, the glands associated with the integumentary system, hair, and nails.

Functions: The integumentary system forms a physical barrier between the external environment and the internal environment and plays a very important role in maintaining and protecting the body.

Nervous system (Fig. 1.3): It is comprised of the central nervous system, which is made up of the brain and the spinal cord and the peripheral nervous system, which is made up of the nerves that form branches from the spinal cord and spread to all the parts of the body.

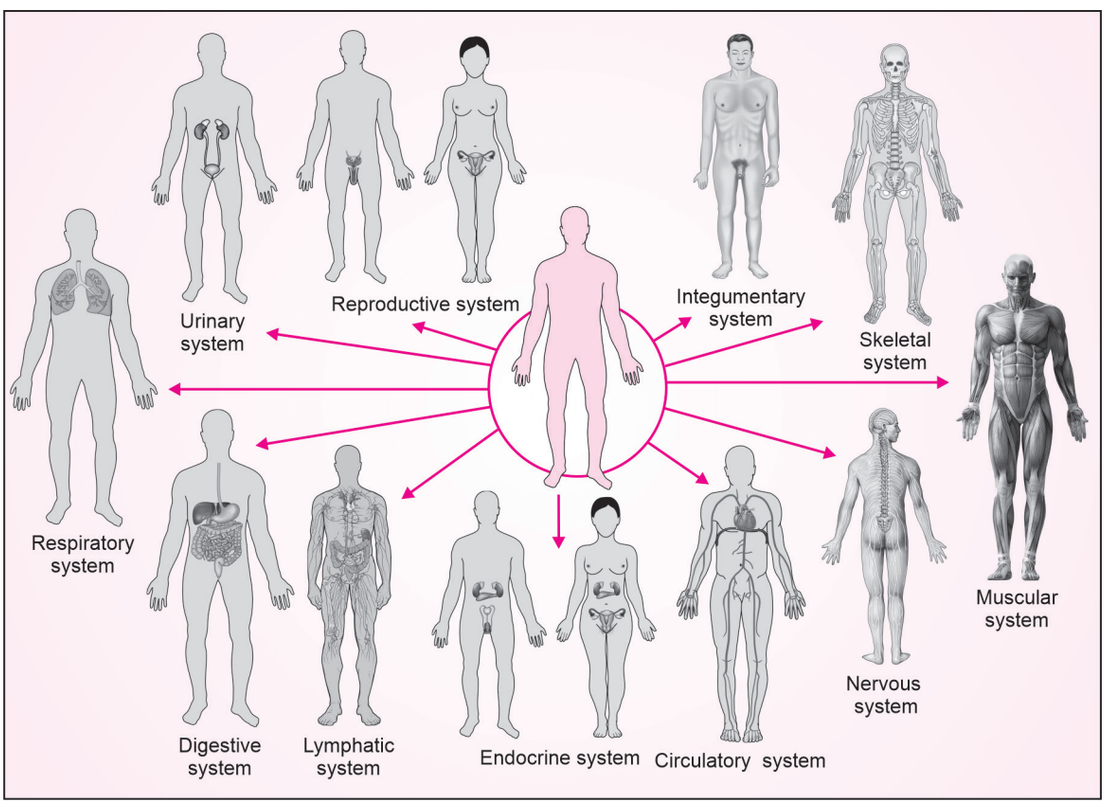


Fig. 1.3: Various organ systems

Functions: The main function of the nervous system is to send messages from the various parts of the body to the brain, and from the brain back to the body to perform related specific functions.

Circulatory system (Fig. 1.3): It is made up of blood vessels, such as arteries and veins.

Functions: The arteries carry pure, oxygenated blood away from the heart and the veins carry impure deoxygenated blood to the heart, and then to the lungs. The circulatory system carries oxygen, various nutrients, and hormones to the cells, and helps in the process of removal of waste products from the body; such as carbon dioxide, urea, creatinine, etc.

Cardiovascular system (Fig. 1.3): Includes the heart (cardio) and the blood vessels (vascular).

Functions: The cardiovascular system is responsible for pumping and circulating the blood to the various organs and the cells to provide oxygen and nutrients and back to the lungs to expel carbon dioxide and capture oxygen using the haemoglobin in the red blood cells.

Lymphatic system (Fig. 1.3): It is a part of the circulatory system and the immune system. It includes spleen, thymus gland, lymph nodes and lymph.

Functions: It protects body from the foreign invaders like microorganisms and maintains normal body fluid levels. It also plays an important role in the absorption of fats in the digestive tract and the removal of cellular waste products. The lymphatic system also plays an important role in controlling the number of blood cells in circulation and training the lymphocytes to perform normal functions.

Immune system (Fig. 1.3): Contains the important primary lymphoid organs that include the thymus and the bone marrow (which produce red and white blood cells) and secondary lymphoid tissue, which contains the spleen, tonsils, lymph nodes, lymph vessels, adenoids, the skin and the liver.

Function: The immune system provides the body with a defence system, which protects against microorganisms and other foreign substances.

Respiratory system (Fig. 1.3): Contains nostrils, pharynx, larynx, trachea and two lungs.

Functions: The respiratory system provides oxygen to the cells of the body for their normal functions; during the inspiration process and removes the carbon dioxide produced during the cellular activities, during the expiration process.

Musculoskeletal system (Fig. 1.3): Includes the bones, muscles, ligaments, tendons, and joints.

Functions: The musculoskeletal system supports the body and facilitates normal movements of the body parts and the body.

Endocrine system (Fig. 1.3): Includes various endocrine glands such as the hypothalamus, the pituitary, the thyroid, the pancreatic alpha and beta cells, the adrenal gland, etc.

Functions: The endocrine system secretes hormones, which are added directly to the general blood circulation. The hormones maintain the normal functioning of the body by controlling homeostasis.

Urinary system (Fig. 1.3): Contains two kidneys, the renal pelvis, ureters, the bladder and the urethra.

Functions: The urinary system plays an important role in the regulation of the composition of extracellular fluid by controlling the excretion of water, salts and waste products through the formation and excretion of urine. By performing these functions, the urinary system plays an important role in maintaining blood volume and blood pressure.

Reproductive system (Fig. 1.3): Includes the male reproductive system and the female reproductive system. The male reproductive system includes the external genitals (the penis, testes and scrotum) and the internal parts include the prostate gland, vas deferens and urethra. The female reproductive system includes the external part and the internal organs such as the uterus, ovaries, Fallopian tubes, cervix and vagina.

Functions: The parts of the male and female reproductive systems play important roles in processes such as reproduction (production of offspring), fertility (ability of a person to conceive children), and sex.

The male reproductive system produces the sperm, and the female reproductive system produces the egg cells. The reproductive system of the female protects and nourishes the fetus until birth.

Note:

1. All of the organs, except the reproductive system that are parts of the body system are formed within the six-week embryonic period of prenatal development. Many organs and body systems also become functional during this time.
2. Prenatal development is the process in which the development of a baby takes place from a single cell after conception and then into a zygote, an embryo and later on into a fetus (Fig. 1.4). A zygote is formed by a fertilization event between two gametes, one belonging to a male and another to a female.
3. The organs of the reproductive system are formed between 10 and 12 weeks of conception and become functional when a person attains puberty at the age of 12–13 years.
4. The process of prenatal development takes place in three main stages. The first two weeks after conception are known as the germinal stage (zygote formation). From the third week up to the eighth week is known as the embryonic period (embryo formation). The period from the ninth week up to birth is known as the fetal period (fetus formation) (Figs 1.4 and 1.5).

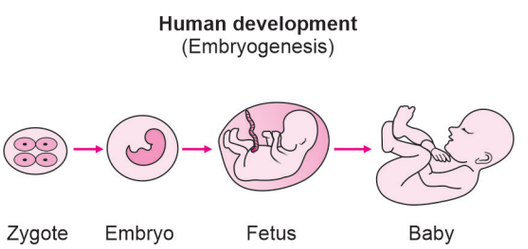


Fig. 1.4: Process of prenatal development

Objective: To describe the regional anatomy and anatomical positions.

REGIONAL ANATOMY AND ANATOMICAL POSITIONS

SAQ: What is the regional anatomy?

Ans: Regional anatomy is the study of the interrelationships of all of the structures in a specific body region. The human body can be roughly divided into the following five regions: Head, neck, torso or trunk (part of body except head, arms and legs), upper extremity and lower extremity (Fig. 1.5). Torso can be divided into thorax and abdomen (Fig. 1.6).

BODY PARTS

BAQ: Label the body parts of male and female.

Ans: Figure 1.7A indicates the main body parts of male and female:

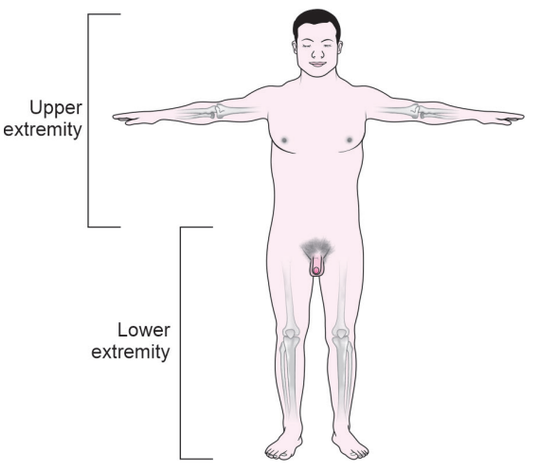


Fig. 1.5: Main human body divisions

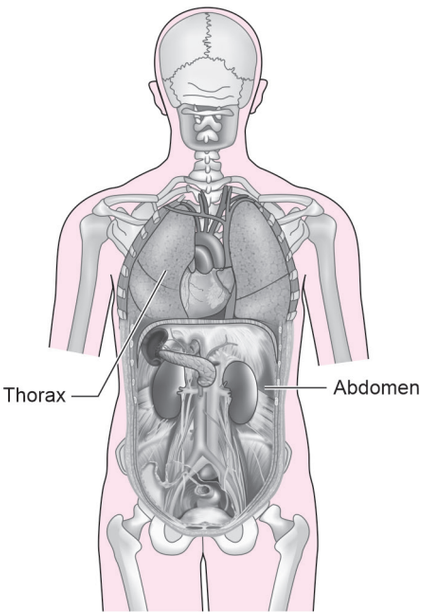


Fig. 1.6: Thorax and abdomen

Objective: To identify and locate principal body regions.

BODY REGIONS (Figs 1.7B and 1.8A–D)

BAQ: What are body regions? Give four examples.

Ans: Each main area of the body (such as the head, neck, thorax, abdomen, and upper, and lower extremities) area contains specific smaller regions (Fig. 1.8B). The following are some examples of the smaller regions of the body parts:

- The cubital fossa is an area of transition between the arm and the forearm. It is located in a depression on the anterior surface of the elbow joint (Fig. 1.8A).

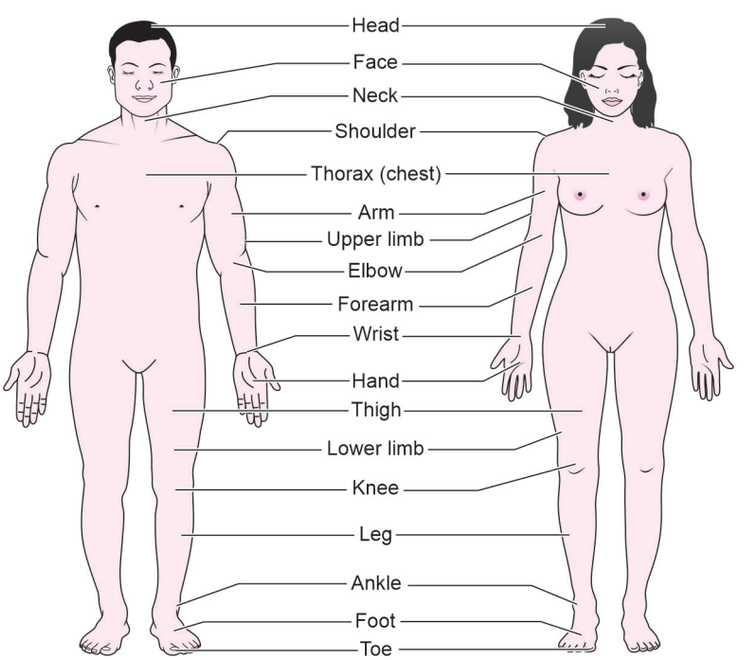


Fig. 1.7A: Male and female body parts

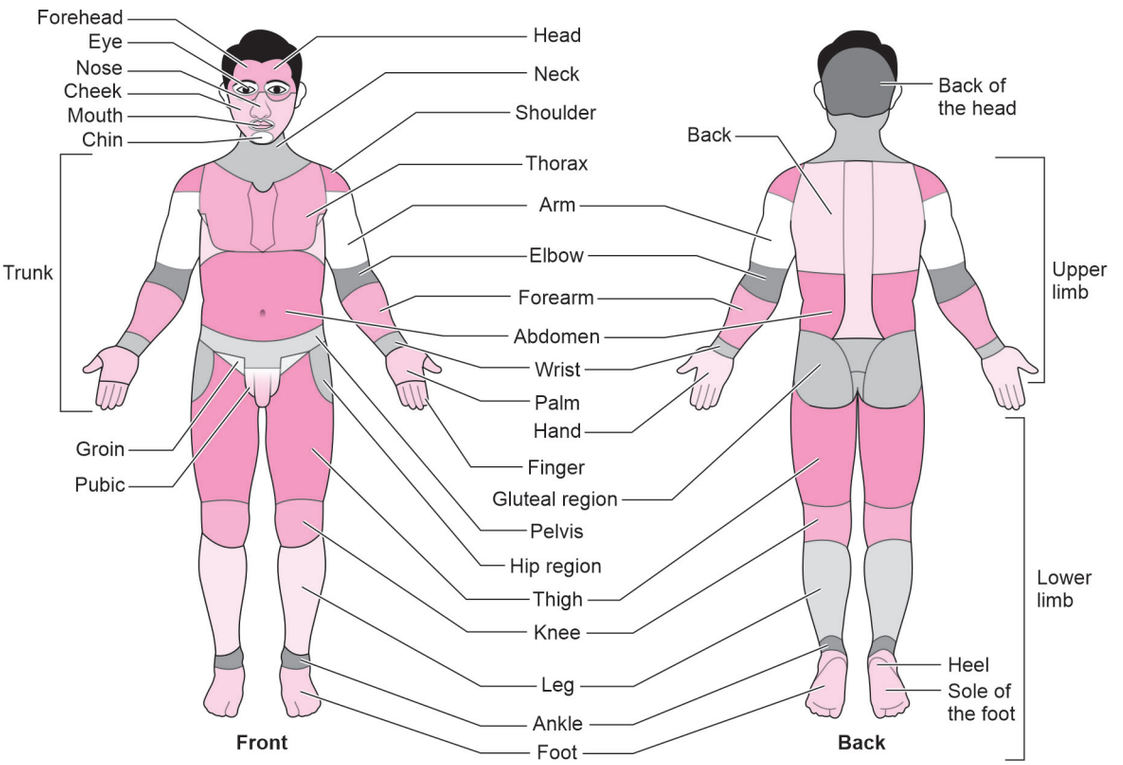


Fig. 1.7B: Various regions of the body

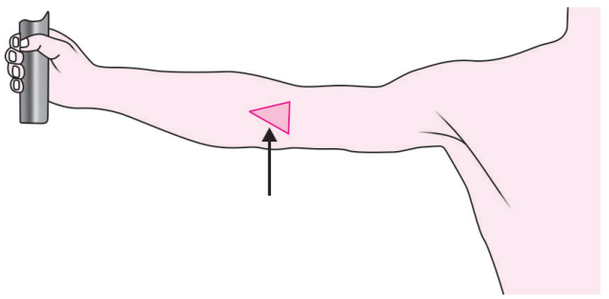


Fig. 1.8A: Cubital fossa region

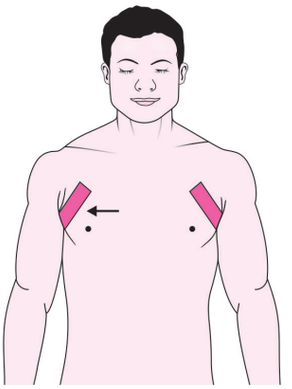


Fig. 1.8B: Axilla region

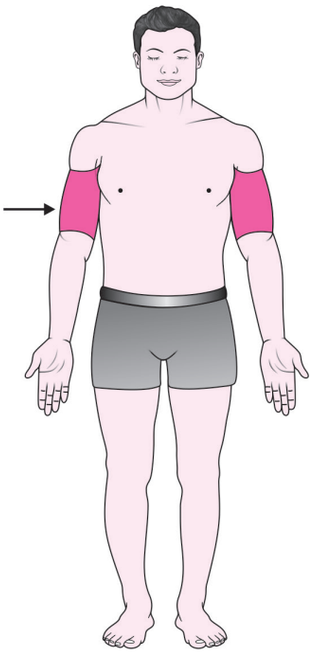


Fig. 1.8C: Brachium region

- The axilla is an anatomical region under the shoulder joint where the arm connects to the shoulder (Fig. 1.8B).
- The brachium is the part of the arm from the shoulder to the elbow (Fig. 1.8C).
- The popliteal fossa is a diamond-shaped space behind the knee joint (Fig. 1.8D).

SAQ: Why study of the regional anatomy is important?

Ans: Study of regional anatomy is useful for understanding the inter-relationships of body structures. The study of regional anatomy is useful to understand, how cells, muscles, nerves, blood vessels, and other parts of body structures work together to serve a particular body region.

BAQ: Draw labelled figures of the following parts:

(A) Cubital fossa

(B) Axilla

(C) Brachium

(D) Popliteal fossa

Ans: Refer to Figs 1.8A to D.

Objective: To describe the descriptive and directional terms related to the anatomical structures.

IMPORTANT DIRECTIONAL TERMS

SAQ: Define the following terms.

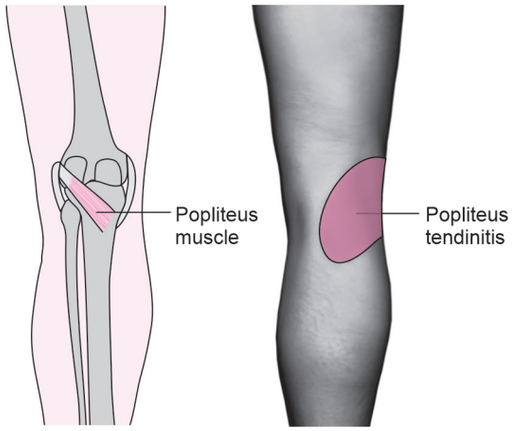


Fig. 1.8D: Popliteus region

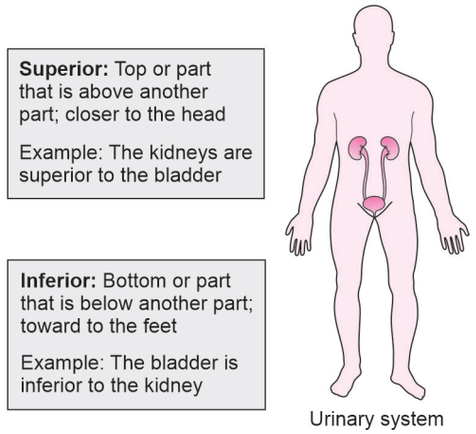


Fig. 1.9: Superior and inferior positions

Ans: (Each term-related answer is equivalent to one SAQ)

- ***Anterior or ventral:*** Towards the front.
  Example: The knee cap is located on the anterior side of the leg.
- ***Distal:*** Away from the main mass of the body.
  Example: The thumb is distal to the wrist.
- ***Proximal:*** Towards the main point of origin of a part or mass of the body.
  Examples: The knee is proximal to the foot. The proximal end of the femur joins with the pelvic bone.
- ***Posterior or dorsal:*** Towards the back.
  Example: The kidneys are posterior to the intestines.
- ***Medial:*** Towards the middle line of the body.
  Example: The chest is medial to the arms.
- ***Inferior or caudal:*** Away from the head and towards the bottom.
  Example: The legs are inferior to the trunk.
- ***Lateral:*** Towards the side of the body.
  Example: The arms are lateral to the chest.
- ***Internal:*** Away from the surface of the body.
  Examples: The brain is internal to the cranium.
- ***External:*** Towards the surface of the body.
  Examples: The skin is external to the muscles.
- ***Visceral:*** Related to internal organs.
  Examples: The visceral organs are wrapped in the peritoneum.
- ***Parietal:*** Related to the body walls.
  Examples: Parietal cells of the stomach secret hydrochloric acid.

SAQ: What are the anatomical positions? Give examples.

Ans: The anatomical position means the positioning of the body when the body is standing upright and facing forward with each arm hanging on either side of the body, and the palms facing forward. The legs are parallel, and the feet are flat on the floor and facing forward (Fig. 1.9).

The main directions for parts of the body are, superior, inferior, anterior, posterior, medial, and lateral. Figure 1.10 indicates, how the terms proximal and distal are used for describing positions of the limbs.

Objectives: To identify different body planes

BODY PLANES (Fig. 1.11)

BAQ: What are the important body planes? What is the importance of understanding the various body planes?

Ans: The body planes can be used to identify and locate the positions of the internal organs of a person. Individual body organs can also be divided by planes to identify smaller structures within that organ.

The following set of three flat surfaces passing through the body is used to project structural arrangement: Sagittal plane, coronal plane and transverse plane.

SAQ: What are the sagittal, parasagittal and midsagittal planes?

Ans: The sagittal plane, also referred to parasagittal plane; divides the body into unequal right and left portions. The midsagittal plane divides the body into equal right and left portions. Sagittal planes (parasagittal planes) run parallel to the midsagittal plane (Figs 1.11 and 1.12).

SAQ: What is the coronal plane?

Ans: The coronal plane divides the body into front and back portions (Fig. 1.12).

SAQ: What is the transverse plane?

Ans: The transverse plane divides the body into superior (upper) and inferior portions (Fig. 1.12).

BAQ: Draw labelled figures of various body planes.

Ans: Refer to Fig. 11.12.

SAQ: What are the advantages of computerized tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography imaging (PET) scans over X-ray examinations of body parts?

Ans: In X-ray examination, only vertical plane images could be studied. While by computerized tomography

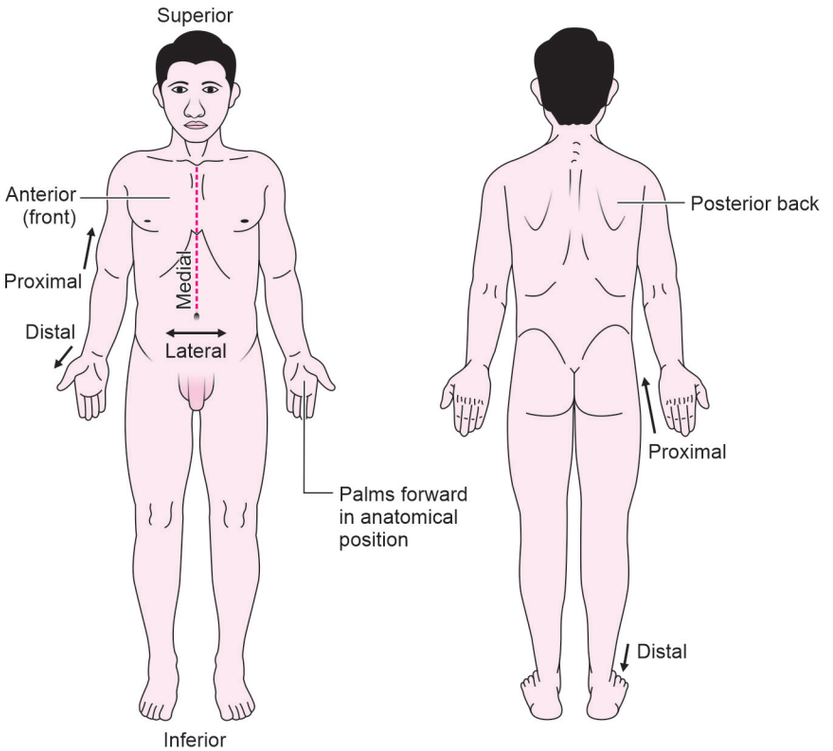


Fig. 1.10: Main anatomical positions

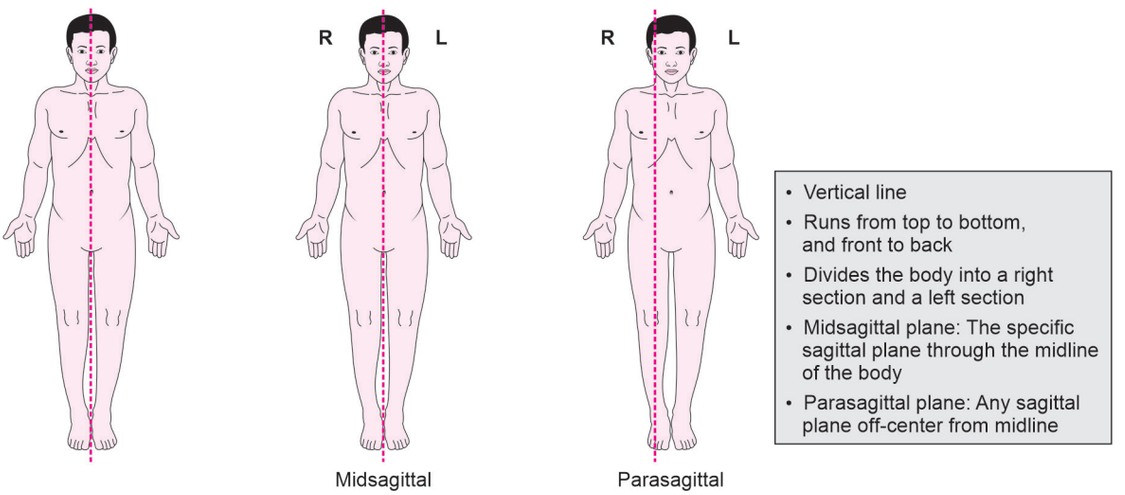


Fig. 1.11: Sagittal planes

(CT scan), magnetic resonance imaging (MRI), positron emission tomography imaging (PET scan) and ultrasound examination (sonography), along with vertical plane images of the body, transverse and sagittal plane images also could be seen and studied.

Objective: To identify the body cavities and the organs within them.

BODY CAVITIES (Table 1.2 and Fig. 1.13)

BAQ: What are various body cavities and their respective importance?

Ans: The body cavities contain delicate internal organs (Fig. 1.13). These protect delicate internal organs. A specific body cavity is useful for the internal organs to grow and move independently of the outer body wall.

The main prominent body cavities are: (1) Dorsal (posterior) cavity and (2) ventral (anterior) cavity.

The dorsal body cavity further contains the following cavities: (1) Cranial cavity, enclosed by the skull and

Table 1.2: Human body cavities and membranes

	Name of cavity	*Membranous lining*
Dorsal body cavity	Vertebral canal	Meninges
Ventral body cavity	Thoracic cavity	Pericardium pleural cavity
	Abdominopelvic cavity	Peritoneum

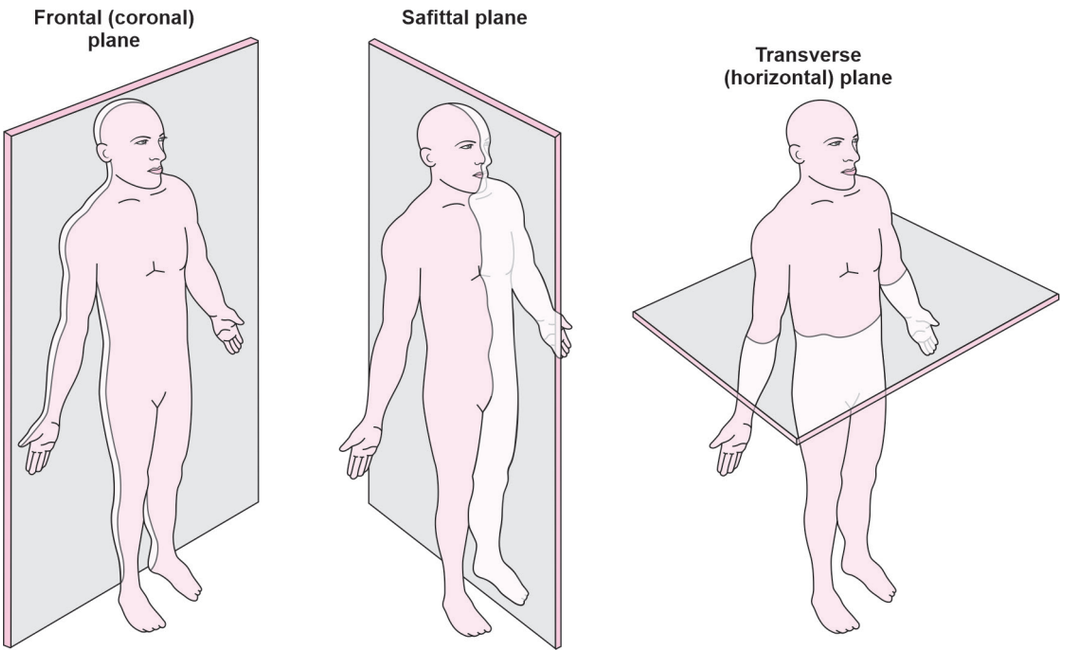


Fig. 1.12: Various body planes

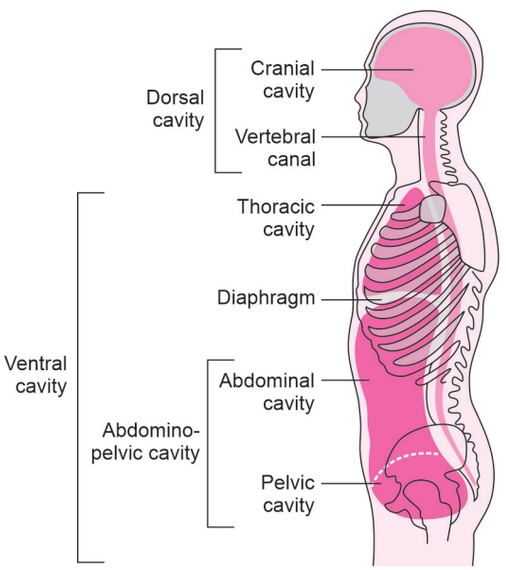


Fig. 1.13: Various body cavities (Lateral view)

contains the brain, and (2) Spinal cavity is enclosed by the spine and contains the spinal cord (Fig. 1.13).

The ventral body cavity further contains the following cavities: (1) Thoracic cavity, enclosed by the ribcage and contains the lungs and heart; and (2) abdominopelvic cavity. Abdominopelvic cavity can be further divided into A. Abdominal cavity is enclosed by the ribcage and pelvis and contains the kidneys, ureters, stomach, intestines, liver, gallbladder, and pancreas; and B. Pelvic cavity, which is enclosed by the pelvis and contains bladder, anus and reproductive system.

SAQ: What are the various regions of the abdominal cavity?

Ans: Various regions of the abdominal cavity are shown in Fig. 1.14.

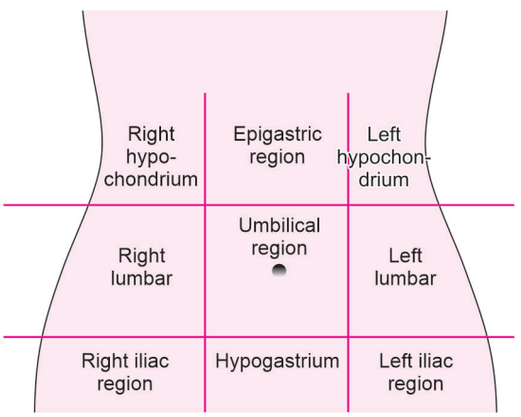


Fig. 1.14: Regions of the abdominal cavity

Objective: To describe the various body membranes and their functions.

BODY MEMBRANES (Figs 1.16–1.21)

SAQ: What are the various body membranes and their main functions?

Ans: Body membranes are thin layers of epithelial tissue (Fig 1.15). It is generally bound to an underlying layer of connective tissue. Following are the four types of membranes:

1. Cutaneous membranes
2. Serous membranes
3. Mucous membranes
4. Synovial membranes.

Main function: The main function of the body membranes is to cover, protect, and separate other structures or tissues in the body.

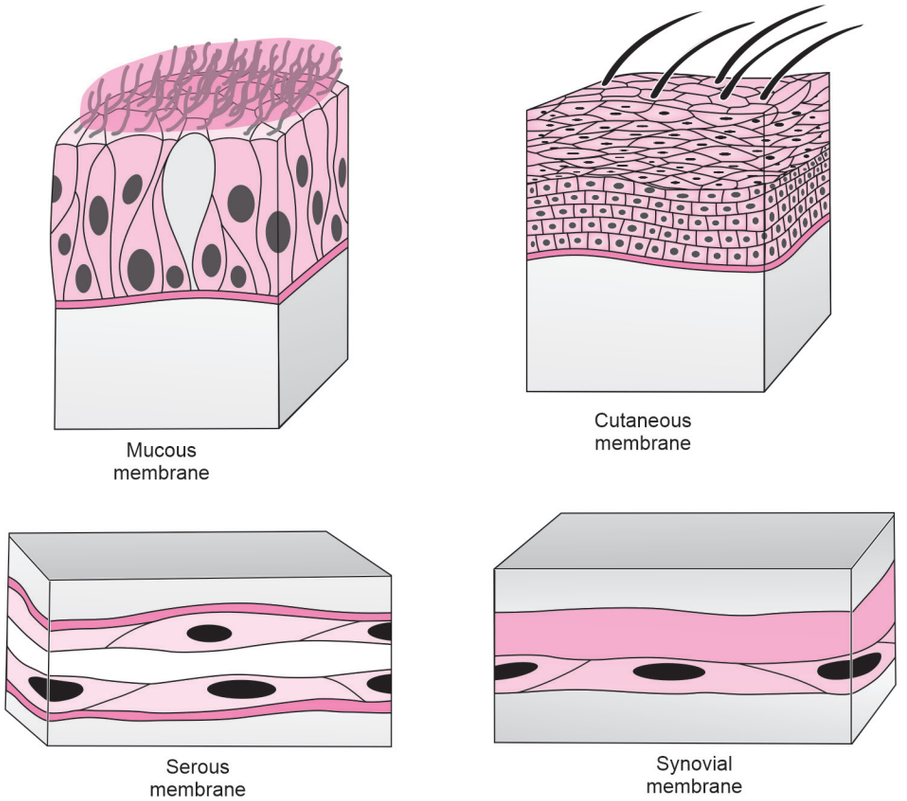


Fig. 1.15: Body membranes

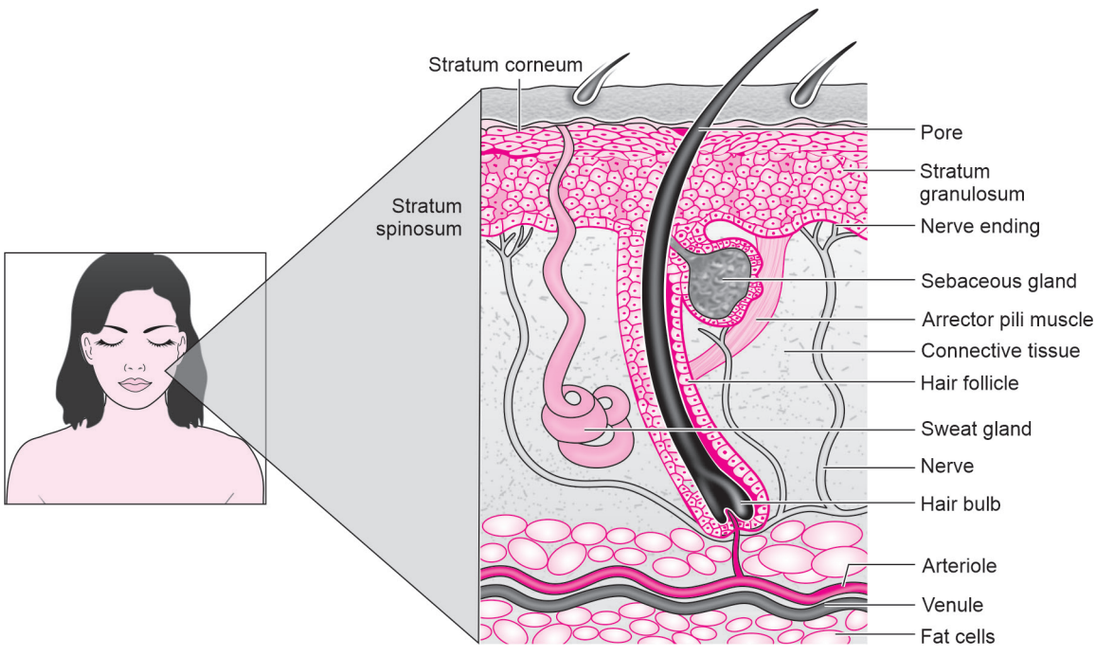


Fig. 1.16: Cutaneous membrane

Cutaneous Membrane (Fig. 1.16)

SAQ: Write a note on the cutaneous membrane.

Ans: The cutaneous membrane is the technical term for the skin. The primary role of the skin is to protect the rest of the tissues of the body and organs from physical damage such as abrasions, damage from chemicals, and microorganisms.

Serous Membrane (Figs 1.17 and 1.18)

SAQ: Write a note on the serous membrane.

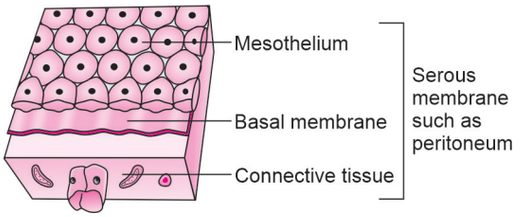


Fig. 1.17: Serous membrane

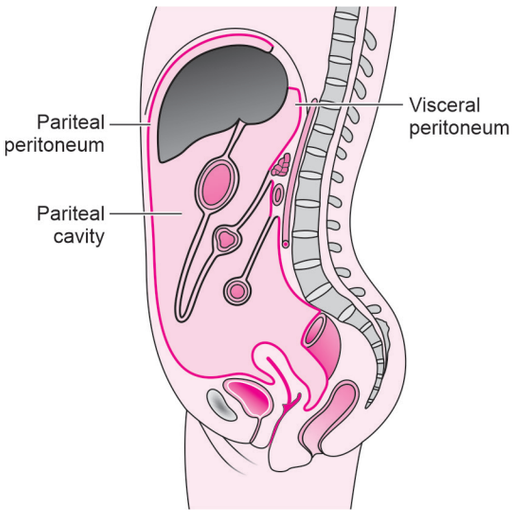


Fig. 1.18: Peritoneum

Ans: The serous membrane is a smooth tissue membrane that lines the contents and inner wall of body cavities. These body cavities secret serous fluid, which facilitates lubricated sliding movements between opposing surfaces. The pericardial cavity membrane (surrounding the heart), pleural cavity membrane (surrounding the lungs) and peritoneal cavity membrane (surrounding most organs of the abdomen) are the three serous cavities within the human body.

Mucous Membrane (Fig. 1.19)

SAQ: Write a note on the mucous membrane.

Ans: Mucous membranes line various structures of the body such as the mouth, nose, eyelids, trachea, lungs, stomach, intestines, ureters, urethra, urinary bladder, etc.

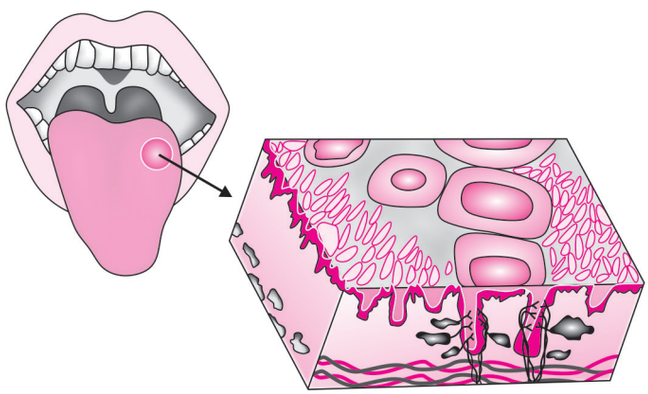


Fig. 1.19: Tongue—mucous membrane

Mucous membranes form a surface layer of epithelial cells over a deeper layer of connective tissue.

The epithelial layer of the membrane consists of either stratified squamous epithelium (multiple layers of epithelial cells), with the top flat layer or simple columnar epithelium (a layer of column-shaped epithelial cells).

Mucous membranes are tough. These are able to resist abrasion and other forms of wear associated with exposure to external substances like food particles. They contain cells specifically adapted for absorption and secretion. The main substance secreted from mucous membranes is mucus.

Synovial Membrane (Fig. 1.20)

SAQ: Write a note on the synovial membrane.

Ans: The synovial membrane is a specific connective tissue that lines the inner surface of capsules of synovial joints and tendon sheath.

The synovial membrane secretes synovial fluid which serves a lubricating function, that allows joint surfaces to smoothly move across each other.

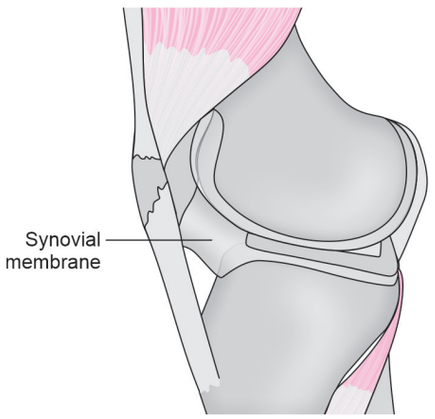


Fig. 1.20: Synovial membrane

Objective: To identify various visceral organs and study the composition and properties of various fluids within the visceral membranes.

VISCERAL ORGANS (VISCERA)

SAQ: What are visceral organs?

Ans: Visceral organs are located within the anterior body cavity. The viscera of the thoracic cavity contains the heart and lungs (Figs 1.22A and B) and the viscera of the abdominal cavity contains the stomach, small intestine, large intestine, liver, gallbladder and spleen (Fig. 1.21).

Organs in Thoracic Cavity and Pericardial Cavity

SAQ: What organs are present in the thoracic cavity and the pericardial cavity, respectively?

Ans: The thoracic cavity is divided into two pleural cavities, one each for lungs. The area between the two

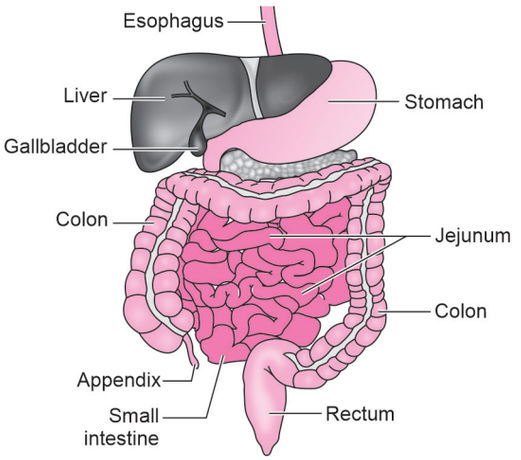


Fig. 1.21: Organs in the abdominal cavity

lungs is known as the mediastinum (Figs 1.22A and B). Pericardial cavity contains the heart.

SAQ: Why thoracic organs are placed in separate compartments?

Ans: Each thoracic organ is placed into separate compartments. In case of any traumatic situation, trauma is minimized and the risk of disease spreading from one organ to another organ is decreased. For example, if one lung collapses due to trauma, the other lung continues to function normally.

Pleural Fluid (Fig. 1.23)

SAQ: Write information on the plural fluid along with the functions and related clinical condition.

Ans: Pleural fluid is located between the layers of the pleura. The pleura is a two-layer membrane that covers the lungs and lines the chest cavity.

Functions: Pleural fluid keeps the pleura moist and reduces friction between the membranes during breathing.

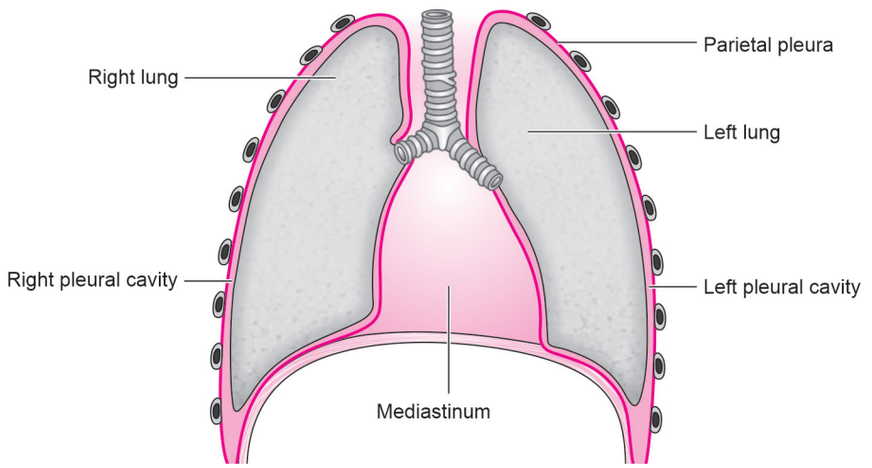


Fig. 1.22A: Mediastinum and pleural cavities containing lungs

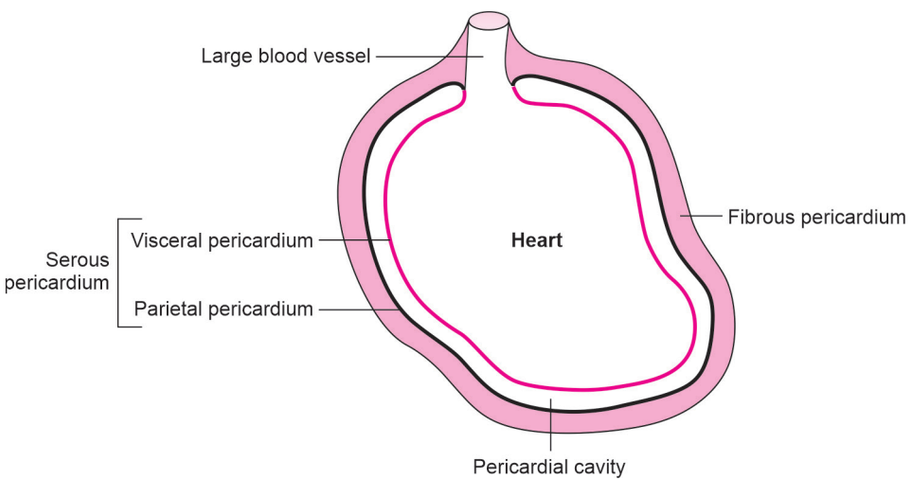


Fig. 1.22B: Pericardial cavity and pericardium

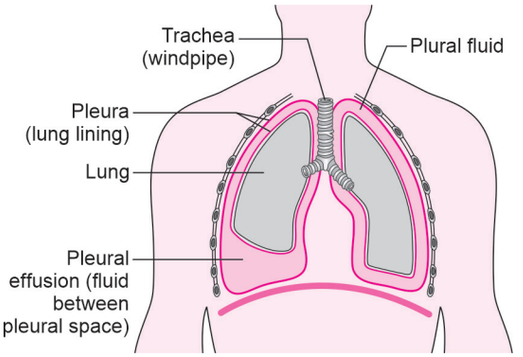


Fig. 1.23: Pleural fluid

Clinical condition: An increase in pleural fluid quantity (Fig. 1.23: Plural effusion) and change in normal composition indicates specific clinical conditions related to lungs.

Pericardial Fluid (Figs 1.24A and B)

SAQ: Write information on the pericardial fluid along with the functions and related clinical condition.

Ans: The inner layer of the pericardium is attached to heart muscle. Small amount of pericardial fluid is present in the pericardial sac (Fig. 1.24A).

Function: Pericardial fluid is used to decrease friction between the pericardial layers. It also facilitates smooth heart movements during the heartbeats.

Clinical condition: Increase in the pericardial fluid quantity and change in normal composition indicates specific clinical conditions related to the heart (Fig. 1.24 B).

Peritoneal Fluid (Figs 1.25 and 1.26)

SAQ: Write information on the peritoneal fluid along with the functions and related clinical condition.

Ans: Peritoneal fluid is a serous fluid made by the peritoneum in the abdominal cavity.

Functions: Peritoneal fluid lubricates the surface of tissue that lines the abdominal wall and pelvic cavity. Peritoneal fluid covers most of the organs in the abdomen.

Clinical condition: An increased volume of peritoneal fluid is called ascites. Increase in the pleural fluid quantity and change in normal composition indicates specific clinical conditions related to abdominal cavity (Fig. 1.26).

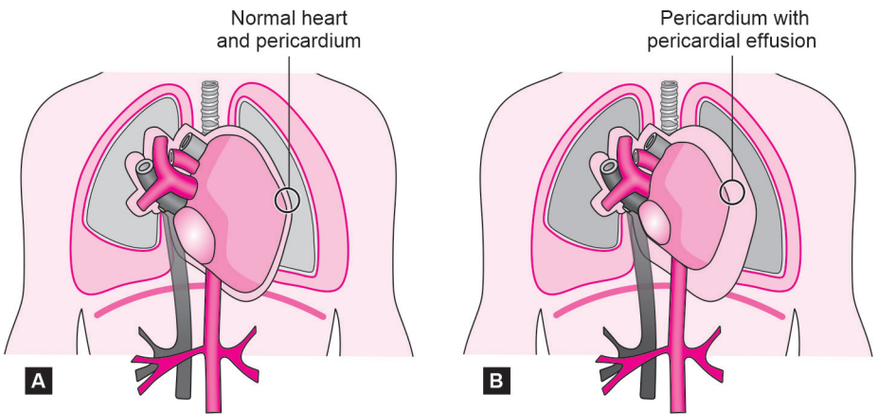


Fig. 1.24: Pericardial fluid: (A) normal and (B) increased

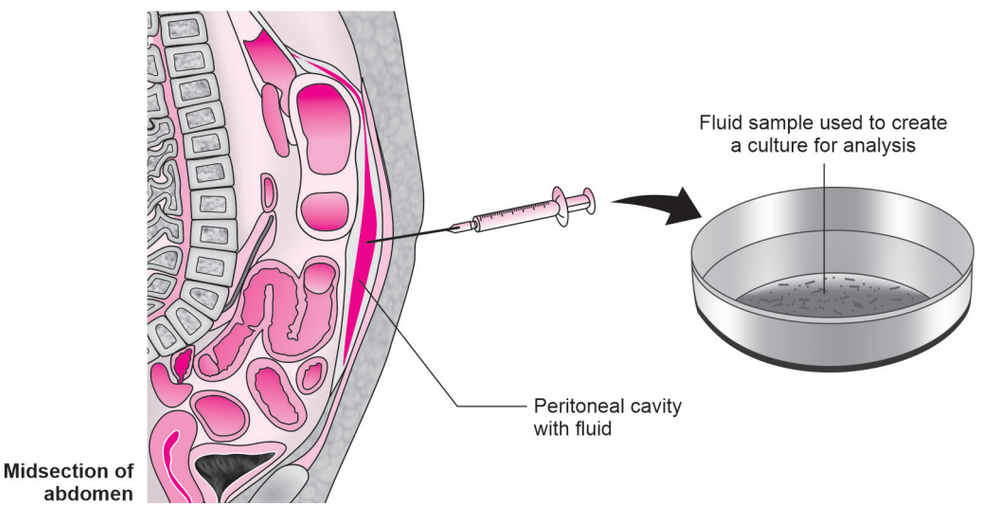


Fig. 1.25: Peritoneal fluid

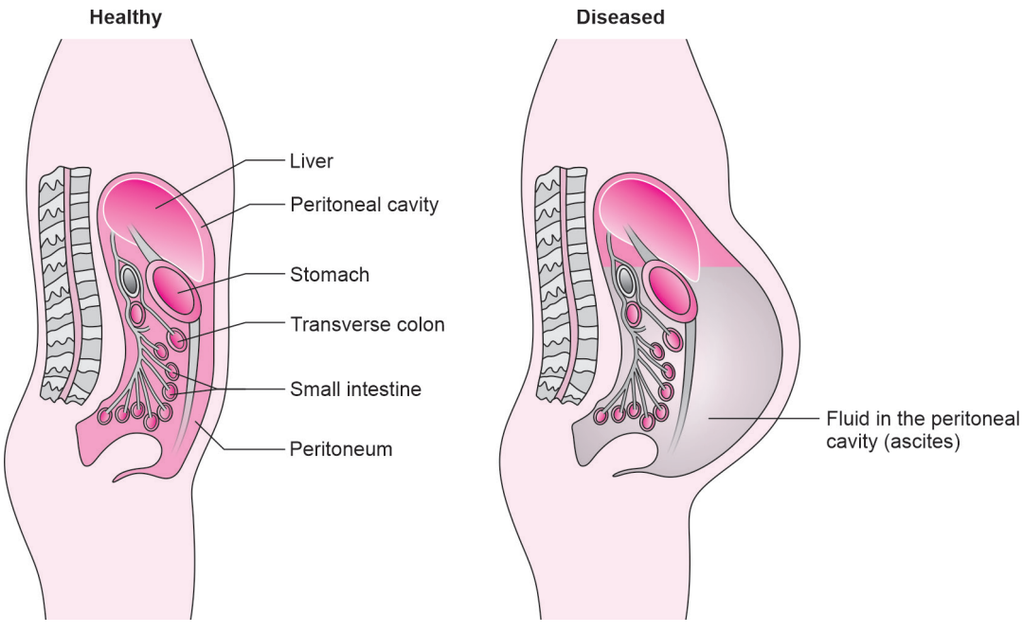


Fig. 1.26: Increased peritoneal fluid (ascites)

Cerebrospinal Fluid (CSF) (Figs 1.27A and B)

SAQ: Write information on the cerebrospinal fluid (CSF) along with the functions and related clinical conditions.

Ans: Cerebrospinal fluid (CSF) is a clear and colourless body fluid present within the tissue that surrounds the brain and spinal cord (Figs 1.27A and B).

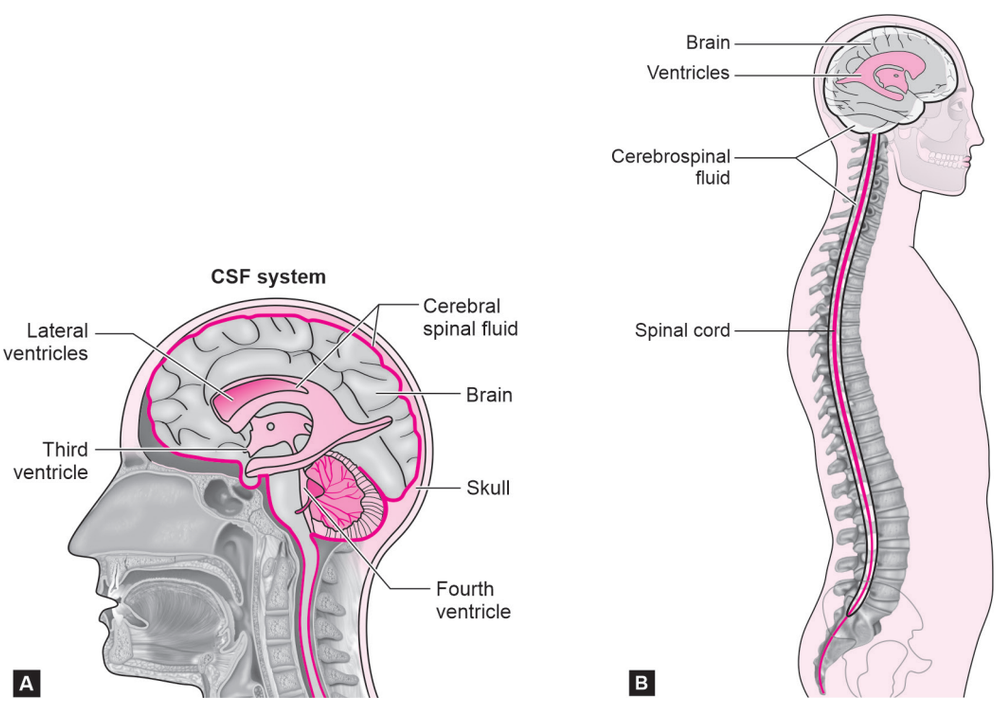
Function: CSF protects the brain and spinal cord by action like a cushion against sudden impact or injury. CSF also plays an important role in removing waste products produced in the central nervous system.

Clinical condition: Normal cerebrospinal fluid (CSF) composition changes in clinical conditions that affect the brain and the spinal cord.

MESENTERY (Fig. 1.28)

SAQ: What is the mesentery and its function?

Ans: Mesentery is a fold of membrane that attaches the intestine to the abdominal wall. It holds the intestine in a specific place.



Figs 1.27A and B: Cerebrospinal fluid

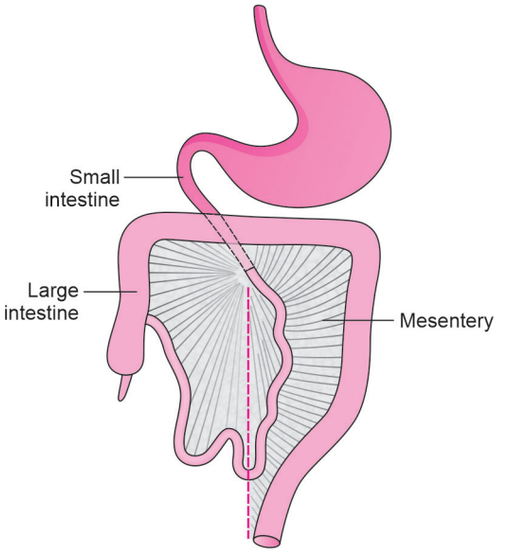


Fig. 1.28: Mesentery

Objective: To describe homeostasis and feedback mechanisms.

HOMEOSTASIS

BAQ: Write a note on homeostasis.

Ans: Homeostasis means the maintenance of a state of steady internal physical and chemical conditions in the case of a living person. Homeostasis includes maintenance of normal body temperature and body fluid balance. All the organs and tissues of the body perform various functions and maintain homeostasis by maintaining normal constituents of extracellular and intracellular fluids relatively constant.

The human body possesses many control systems to maintain homeostasis. Negative feedback systems and positive feedback systems work appropriately to maintain homeostasis.

BAQ: Write a note on the feedback mechanism.

Ans: The feedback mechanism is a physiological regulation system in a living body that works to return the body to homeostasis. A negative feedback loop and a positive feedback loop manage to maintain homeostasis.

When a person suffers from a disease or injury, homeostasis gets disturbed. For example, raised fever and disturbed internal body fluid balance in microbial infections is an indications of disturbed homeostasis. Similarly, excessive loss of blood by internal and external bleeding due to any accident will lead to disturbed homeostasis.

A negative feedback loop is a self-regulating type of system. In a negative feedback loop, increased output from the system inhibits future production of related products by the system. The body reduces its own manufacturing of certain proteins or hormones when their levels get too high. For example, when thyroid hormones are required, the body will stimulate thyroid stimulating hormone (THS), which stimulates the

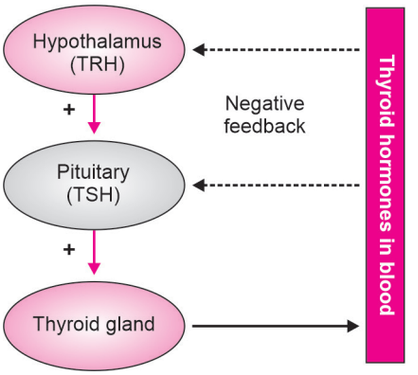


Fig.1.29A: Negative feedback mechanism

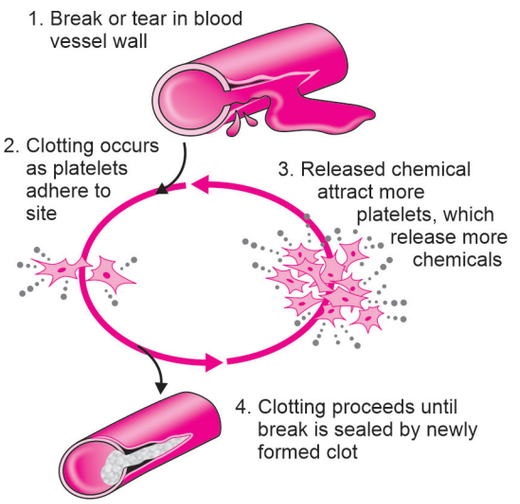


Fig. 1.29B: Positive feedback mechanism

thyroid gland to stimulate thyroid hormones. Once a normal level of thyroid hormone is reached, the blood levels of these hormones inhibit secretion of TSH and then no more increase in thyroid hormones takes place (Fig. 1.29A).

In a positive feedback system, the end-products formed in a chemical reaction increase the speed of that chemical reaction. For example, when bleeding takes place, a large number of platelets gather there and a fibrin clot forms at the site of bleeding. The clotting will continue till the damaged part of the body gets sealed (Fig. 1.29B).

Objective: To describe the clinical conditions related to the disturbed homeostasis and related terms.

SAQ: Write a note on the disturbed homeostasis.

Ans: When the cells in the body are not able to function normally, homeostatic balance is disrupted. Disturbed homeostatic imbalance leads to a state of disease.

BAQ: Define the following terms: Disease, illness, disorder, and syndrome.

Ans: Disease is a condition in which a disturbed structural and functional state of an organ system or

many organ systems is observed. A specific disease is associated with specific signs and symptoms. A disease is distinct and measurable using various diagnostic tests. For example, liver disease can be diagnosed by signs and symptoms of jaundice and also by correlating symptoms with laboratory tests.

Ill means a person is not in good health and illness is the state of being mentally and physically ill.

A disorder indicates that a specific disease may be present, however, sufficient evidence may not be there for diagnosis purposes. Examples of disorders are anxiety, depression, stress, etc. Diagnosis of these disorders may be nonconclusive by diagnostic tests.

A syndrome is a set of medical signs and symptoms of a specific disease or disorder, which are correlated with each other. Examples are nephrotic syndrome (related to kidney disease), acquired immunodeficiency syndrome (AIDS), Down syndrome, etc.

Note:
1. Morbidity means a diseased condition.
2. A medical condition or a health condition includes all diseases, disorders and also conditions like pregnancy and childbirth; that normally receive medical treatment.

Objective: To describe the major factors that cause diseases.

MAJOR FACTORS THAT CAUSE DISEASES

BAQ: What are the major factors that cause diseases?

Ans: According to the definition of the World Health Organization (WHO), health is a state of complete mental, physical, and social well-being. Abnormalities in the chemical constituents and with the rate of reactions in the living cells are exhibited by various diseases. The following are the major factors responsible for causing diseases in humans:

- Biological agents such as bacteria, fungi, viruses and other parasites
- Certain toxic chemicals and drugs
- Endocrine imbalance leading either to hormonal excesses or deficiencies
- Autoimmune diseases involving immunological reactions
- Nutritional imbalances caused by nutritional excess and deficiencies
- Genetic disorders
- Oxygen deficiency caused by loss of blood and by pathological conditions leading to a considerable decrease in circulating red blood cells which result in depletion of oxygen-carrying capacity.
- Physical agents such as radiation, atmospheric pressure, electric shock and sudden change in temperature.

Objective: To describe the terms—pathophysiology and pathology.

PATHOPHYSIOLOGY AND PATHOLOGY

SAQ: Write a brief note on pathophysiology and pathology.

Ans: Pathophysiology is the study of the disturbed physiological processes that are associated with a disease or injury.

Pathology is a branch of biological science that deals with the nature of a disease through a study of its causes, its process and its effects with associated structural and functional alterations. A clinical laboratory makes use of principles of pathology by using test reports of blood, urine, CSF, sputum, tissues, etc.

Objective: To describe the importance of radiology.

RADIOLOGY

BAQ: Write a note on radiology.

Ans: Radiology is a field of medicine that uses medical imaging to diagnose and treat diseases within the body of a person. Various imaging techniques such as X-ray radiography, computed tomography (CT), and nuclear medicine including positron emission tomography (PET), magnetic resonance imaging (MRI) and ultrasound tests are used to diagnose diseases.

Note: Clinical laboratory tests and radiology tests are useful to:
1. Reveal the causes of the diseases
2. Screen easy diagnosis
3. Suggest effective treatment
4. Assist in monitoring the progress of a pathological condition
5. Help in assessing response to therapy

Objective: To describe the terms horizontal and vertical integration of premedical subjects (anatomy, physiology and nutrition) paramedical subjects (microbiology and pharmacology) and medical subjects (paediatrics, orthopaedic, obstetrics and gynaecology) as a part of competency-based education.

HORIZONTAL INTEGRATION OF THE PREMEDICAL SUBJECTS

BAQ: What is the meaning of horizontal integration of a specific event related to "anatomy" with other pre-medical subjects such as physiology, biochemistry and nutrition? Give examples.

Ans: Horizontal integration of a specific event related to "anatomy" with other pre-medical subjects is useful to understand the effects of specific anatomical changes on physiologic and biochemical aspects of an individual and support nutrition to control and get rid of the anatomical change.

- For example, when a person suffers from severe kidney disease,

- The related anatomical change is a significant decrease in the functional micro units (nephrons).
- The related physiologic change is a decrease in the rate of blood filtration at the kidneys.
- The related biochemical change is an increase in the excretory substances such as urea, creatinine, uric acid, etc., in the blood circulation.
- The related nutritional support is: To keep moderate amounts of protein and salt in the diet to decrease the workload on the kidneys.

BAQ: What is the meaning of vertical integration of the above-mentioned case (patient suffering from kidney disease) with other paramedical subjects such as microbiology and pharmacology? Give examples.

Ans: The correlation of the paramedical subjects in this case is useful as follows:

Microbiology: To identify microorganisms, that may cause kidney disease.

Pharmacology: To select an effective drug to treat microbial infection.

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MULTIPLE CHOICE QUESTIONS (MCQs)

Q.A. Select the correct option.

1. The thyroid gland belongs to this body system:

(A) Skeletal
(B) Integumentary
(C) Lymphatic
(D) Endocrine system

2. The hair belongs to this body system:

(A) Skeletal
(B) Integumentary
(C) Lymphatic
(D) Endocrine system

3. The anatomical position of the ear is:

(A) Medial
(B) Lateral
(C) Superficial
(D) Proximal

4. The ventral body does not contain:

(A) The spinal cavity
(B) The thoracic cavity
(C) The abdominal cavity
(D) Both (A) and (B)

5. The axilla region is:

(A) The chest area
(B) The armpit
(C) The forearm
(D) The shoulder region

6. The popliteal fossa is:

(A) The chest area
(B) The armpit
(C) The forearm
(D) The area behind the knee joint

7. This term defines the position of the knee relative to the hip:

(A) Medial (B) Distal
(C) Lateral (D) Proximal

8. This part separates the thoracic cavity from the abdominal cavity:

(A) The abdominal septum
(B) The sternum
(C) The diaphragm
(D) The abdominal wall

9. This organ is present in the thoracic cavity:

(A) Heart (B) Stomach
(C) Liver (D) Pancreas

10. This plane divides the body into upper and lower portions:

(A) Midsagittal (B) Transverse
(C) Coronal (D) Sagittal

11. This plane divides the body into the left and right half of the body:

(A) Midsagittal (B) Transverse
(C) Coronal (D) Sagittal

12. This fluid is a serous fluid, which lubricates the surface of tissue that lines the abdominal wall and pelvic cavity:

(A) Pericardial fluid
(B) CSF
(C) Peritoneal fluid
(D) Synovial fluid

13. This fluid is a serous fluid, that lubricates the surface of the brain and spinal cord:

(A) Pericardial fluid
(B) CSF
(C) Peritoneal fluid
(D) Synovial fluid

14. The term parietal refers to:

(A) Forming part of cell wall
(B) Forming part of a cavity wall
(C) Internal body organ
(D) A and B

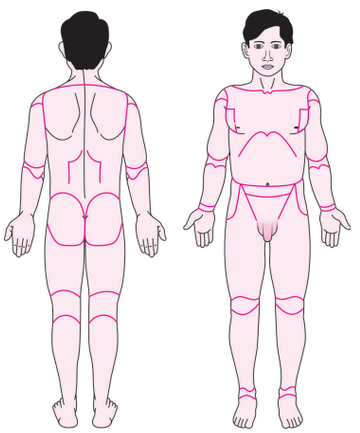
15. The term visceral refers to:

(A) Forming part of cell wall
(B) Forming part of a cavity wall
(C) Internal body organ
(D) Both (A) and (B)

ANSWERS

1. D 2. B 3. B 4. A 5. B 6. D 7. B
8. C 9. A 10. B 11. A 12. C 13. B 14. D
15. C

Q.B. Label the main anatomical positions.



ANSWER:

Refer to page 9, Fig. 1.10

Q.C. Write the principal organs and functions of the following systems:

1. Respiratory system
2. Urinary system
3. Nervous system
4. Reproductive system
5. Digestive system

MATCH THE COLUMNS

I	II
1. Epithelial tissue	A. Medial
2. Toward the feet	B. Posterior
3. Mesentery	C. Facilitate movements of body parts
4. Connective tissue	D. Covers organs and body surfaces
5. Toward the back	E. Nerve impulse transmission
6. Muscle tissue	F. Binds, supports and protects body parts
7. Toward the head	G. Supports abdominopelvic viscera
8. Nervous tissue	H. Inferior or caudal
9. Upper surface of the body	I. Superior
10. Toward the midsagittal plane	J. Dorsal

ANSWERS

1. D 2. H 3. G 4. F 5. B 6. C 7. I
8. E 9. J 10. A