CHAPTER

1 Introduction to Human Body

Chapter Outline

- Definition and scope of anatomy and physiology
- Levels of structural organization of the human body
- Body systems
- Basic life processes
- Homeostasis
- Basic anatomical terminology
- Terms related to body movements
- Body cavities

DEFINITION AND SCOPE OF ANATOMY AND PHYSIOLOGY

Human body is unique, comprises various organs and systems, which work both independently and interdependently according to their needs. The human body has to be studied from both its normal structural and functional point of view. Once, the normal structure and functions are understood, it is easy to comprehend the diseased state and the necessary treatment to bring the status back to normal.

Anatomy is the science of learning the normal structure of the human. **Physiology** deals with learning and understanding the functions of the body. Physiology is focused on the body's functions at the level of cells in the organ systems. It describes how organ systems work together. Thus, anatomy and physiology are the two sides of the same coin. Physiology is the enacting of various scenes in anatomy hall/theatre. These two branches of medical science are intimately related.

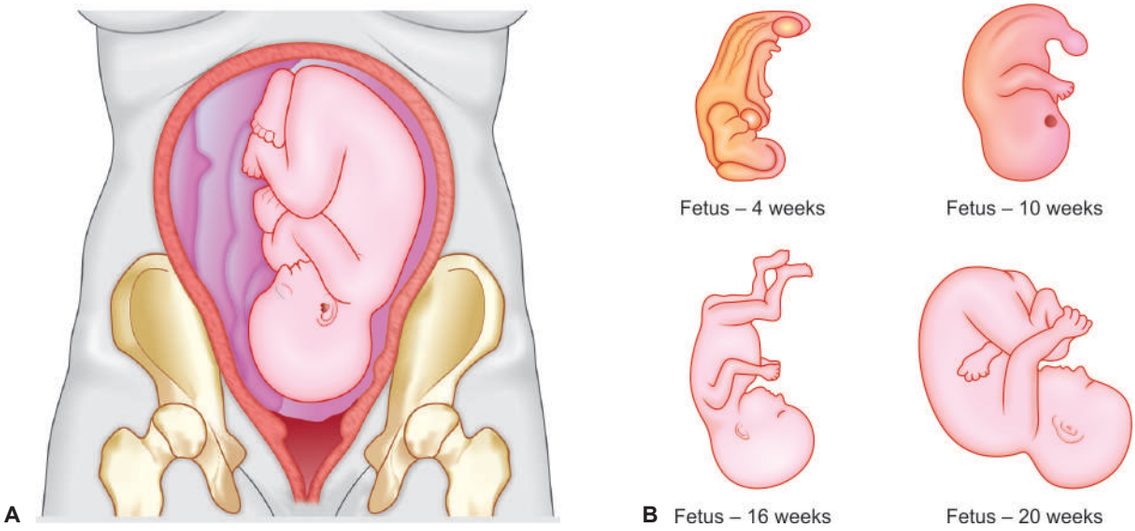
The main subdivisions of anatomy are:

- Cadaveric anatomy where study is done on dead, or embalmed (preserved) bodies. It is usually done with the naked eyes (macroscopic or gross anatomy). It is done by two methods.
  - *Regional anatomy* in which the body is studied in parts like the upper limb, lower limb, thorax, abdomen, head and neck and brain.
  - *Systemic anatomy* in which the body is studied in systems like the osteology (skeletalsystem), myology (muscular system), arthrology or syndesmology, angiology (vascular system), neurology, respiratory, digestive, urogenital systems (splanchnology). The locomotor system includes osteology, arthrology and myology.
- **Living anatomy** is studied by inspection, palpation, auscultation, percussion, endoscopy (bronchoscopy, gastroscopy), radiography, electromyography, etc.
- **Embryology (developmental anatomy)** (Figs 1.1A and B) is the study of the developmental stages/changes that occur in an individual while in mother's womb. The developmental history is called 'ontogeny'. On the other hand, the evolutionary history is called 'phylogeny'.
- **Microscopic anatomy (histology and cytology)** is the study of various structures of body, like tissues and organs with the help of a microscope.
- **Surface anatomy (topographic anatomy)** describes deeper parts of the body but in relation to the skin surface. It helps the healthcare teams in clinical practice and surgical operations.
- **Radiographic and imaging anatomy** is the study of the bones and deeper organs by plain and contrast radiography, by ultrasound and computerized tomographic (CT) scans (Fig. 1.2).
- **Clinical anatomy** correlates anatomy with signs and symptoms to reach a diagnosis.

Physiology refers to the study of normal functioning of the body. It helps the body in maintaining, adaptation and homeostatsis.

Various subdivisions of physiology are as follows:

- **Cell physiology:** It is the study of individual activities of the cell to maintain homeostasis.
- **General physiology:** It is the study of principles, which are basic to the functions of all systems of the body.
- **Systemic physiology:** Here, we study the functioning of all the diverse systems of the body.



Figs 1.1A and B: Human embryology

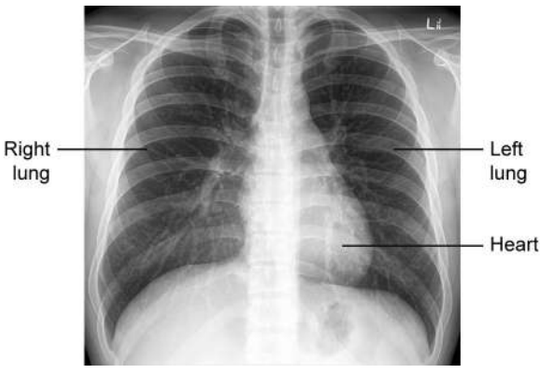


Fig. 1.2: Posteroanterior view of chest X-ray

- **Immunology:** It is the study of immune system in the body.

LEVELS OF STRUCTURAL ORGANIZATION OF THE HUMAN BODY

Before you begin to study the different structures and functions of the human body, it is helpful to consider its basic architecture; that is, how its smallest parts are assembled into larger structures. It is convenient to consider the structures of the body in terms of fundamental levels of organization that increase in complexity such as (from smallest to largest) chemicals, cells, tissues, organs, organ systems and an organism.

Levels of structural organization of the human body are shown in Fig. 1.3. The organization of the body often is discussed in terms of six distinct levels of increasing complexity, from the smallest chemical building blocks to a unique human organism.

Chemical Levels of Organization

To study the chemical level of organization, scientists consider the simplest building blocks of matter: Subatomic particles, atoms and molecules. All matter in the universe is composed of one or more unique pure substances called elements. Examples of these elements are hydrogen, oxygen, carbon, nitrogen, calcium and iron. The smallest unit of any of these pure substances (elements) is an atom. Atoms are made-up of subatomic particles such as the proton, electron and neutron. Two or more atoms combine to form a molecule such as the water molecules, proteins and sugars found in living things. **Molecules** are the chemical building blocks of all body structures.

Cellular Level

A **cell** is the smallest independently functioning unit of all living organisms. Single-celled organisms like bacteria, are extremely small, independently-living organisms with a cellular structure. Humans are multicellular organisms with independent cells working in concert together. Each bacterium is a single cell. All living structures of human anatomy contain cells and almost all functions in human physiology are performed in cells or are initiated by cells.

A human cell typically consists of flexible membranes that enclose cytoplasm, a water-based cellular fluid, with a variety of tiny functioning units called **organelles**. In humans, as in all organisms, cells perform all functions of life.

A **tissue** is a group of many similar cells (though sometimes composed of a few related types) that work together to perform a specific function.

Organ Level

An **organ** is an anatomically distinct structure of the body composed of two or more tissue types. Each organ performs one or more specific physiological functions. An **organ system** is a group of organs that work together to perform major functions or meet physiological needs of the body.

This book covers eleven distinct organ systems of the human body. Assigning organs to organ systems can be imprecise since organs that 'belong' to one system can also have functions integral to another system. In fact, most organs contribute to more than one system.

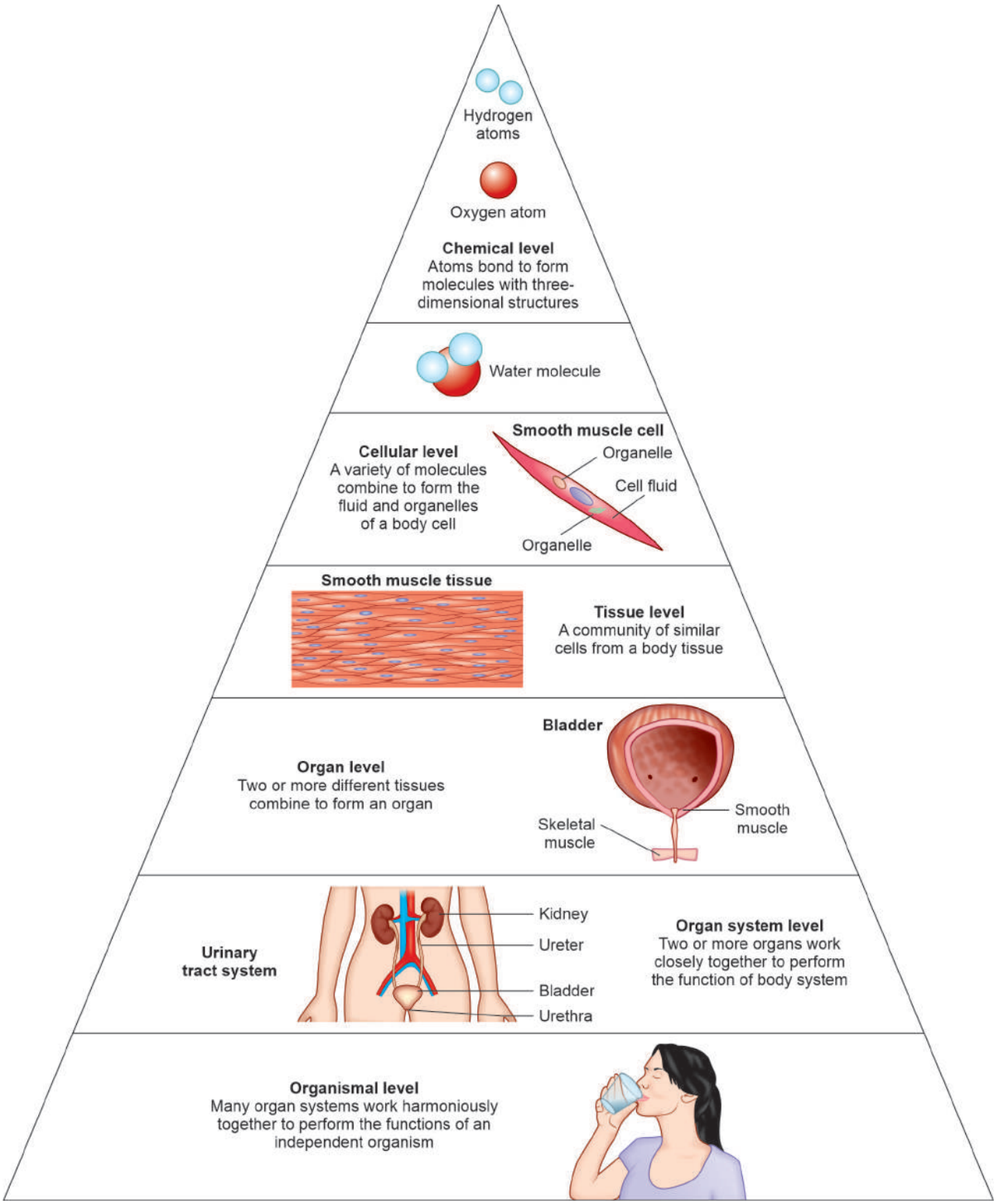


Fig. 1.3: Levels of structural organization

BODY SYSTEMS

Various systems are briefly outlined here as follows.

Skeletal System

The skeletal system (osteology) (Fig. 1.4) consists of numerous cartilages and bones, providing support and symmetry to the body. Cartilage keeps the respiratory pathway patent. Bone is composed of a hard outer shell called compact bone and an inner honeycomb type of bone called spongy bone. Inside the spongy bone is the softer core, the bone marrow. Blood cell production occurs within bone marrow.

Bones being the largest storehouse of calcium provide attachment to numerous skeletal muscles for locomotion. Bones also make cavities or cages for protection of organs like brain, heart, lungs and reproductive organs.

Bones give attachment to muscles and provide a means to counteract gravity. Bones provide area for muscle attachment via the tendons.

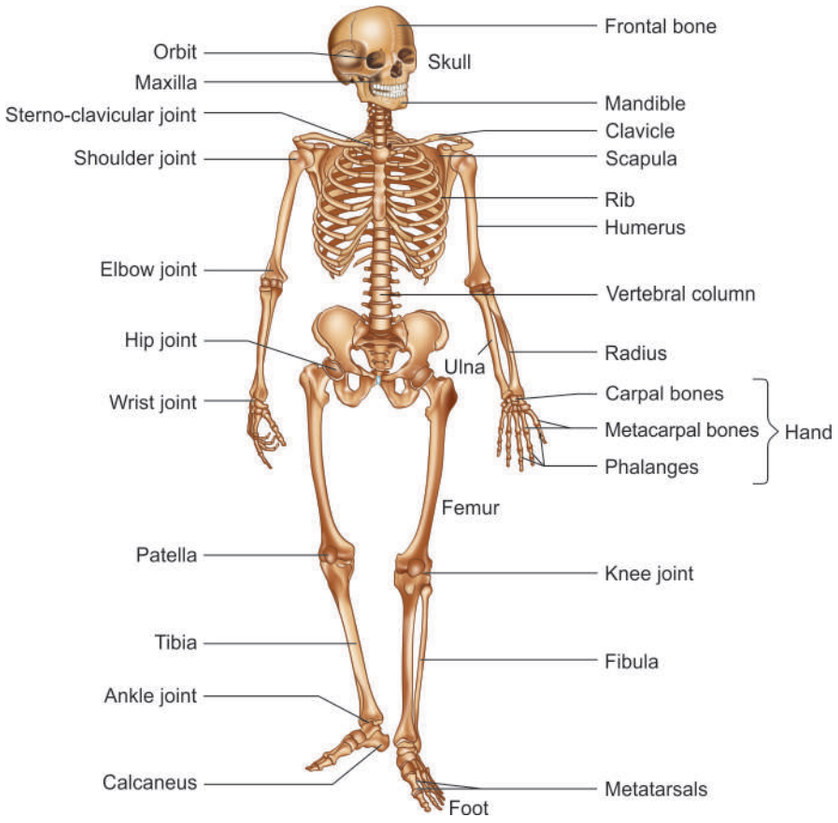


Fig. 1.4: Human skeletal system

Joints

Joints are areas of union of two or more bones or cartilage (Figs 1.5A and B). These allow growth in length of the bones; and joints diverse movements of the body for the purposes of speaking, eating, writing, walking, etc.

Muscular System

Skeletal muscles are attached to the bones and form the bulk of muscles. Smooth muscles are present in the viscera like stomach, intestines, uterus, urinary bladder, etc. Cardiac muscle is only confined to the heart. Different muscles are shown in Fig. 1.6.

Functions

There are three types of muscles—striated, smooth and cardiac. Striated muscles are maximum in body and they move the body externally from one place to other, besides causing movements at rest according to one's will.

Tendons attach muscle to the bone, allowing movement. Muscles and bones combine to form a protective covering for vital organs. Muscle contractions function to move blood up through the veins against the gravity. During normal walking, muscle contraction and relaxation occurs.

The smooth muscles of the digestive system move the food components from esophagus down to the stomach and intestines and eliminate the waste products.

The third type of muscle is cardiac muscle, which is rhythmically contracting and relaxing to help in the proper functioning of the heart.

Respiratory System

Air enters in the body via nose, travels through nasal cavity, nasopharynx, larynx and trachea and its divisions, the bronchi, bronchioles, alveolar ducts and reaches to alveoli. The exchange of gases (oxygen and carbon dioxide) occurs across the thin lining of the alveoli (Fig. 1.7).

The bulky lungs occupy most of the thoracic cage, leaving little space for the heart. Lung being enveloped in the double layered pleural sac consists of apex, base, large lateral, costal and small medial hilar surface. The lungs are separated from the abdominal cavity by a thin muscular diaphragm. Movements of diaphragm enable inspiration and expiration.

Functions

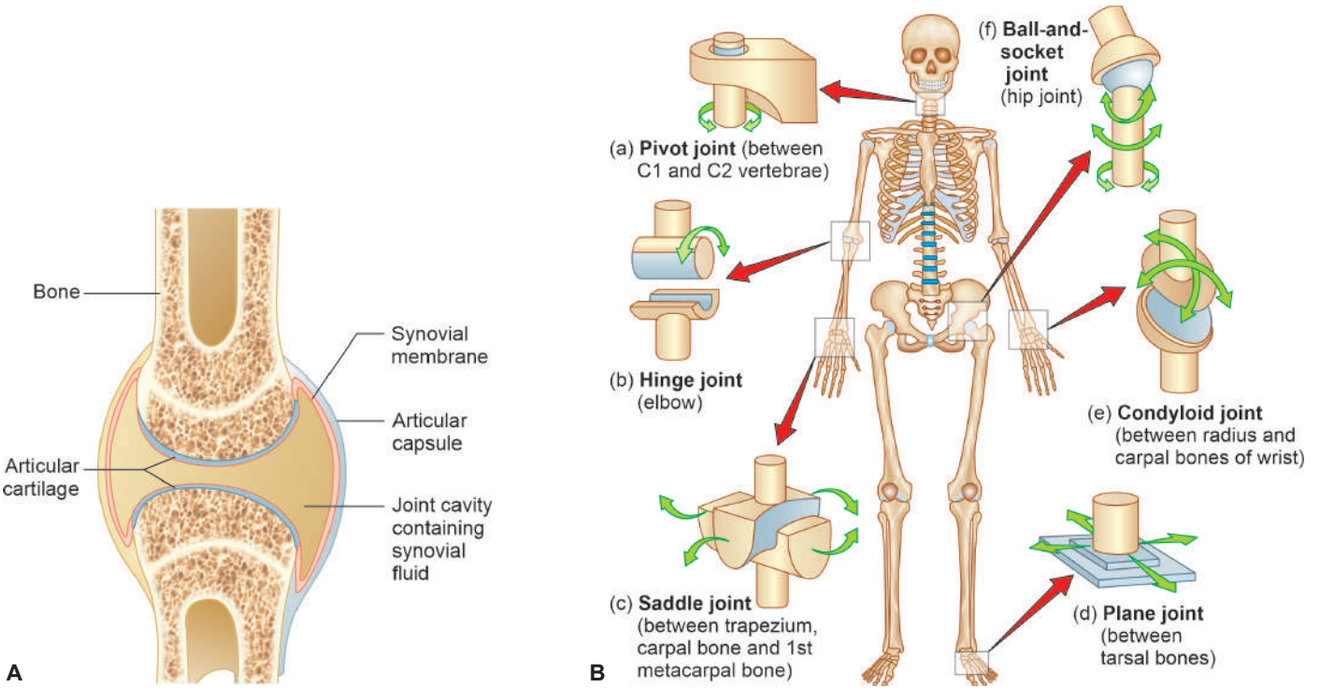
The respiratory system provides a means of supplying oxygen to the cells of the body and gets carbon dioxide, a product of cellular activity, eliminated.

Blood

Blood transports gases to and from the tissues, transfers nutrients absorbed from gastrointestinal tract, in addition to transporting metabolic waste of various organs. Blood provides buffers for maintenance of acid–base balance.

Cardiovascular System

The circulatory system and lymphatic system are two components of the cardiovascular system. Circulatory



Figs 1.5A and B: (A) Structure of a synovial joint; (B) various joints of a human body

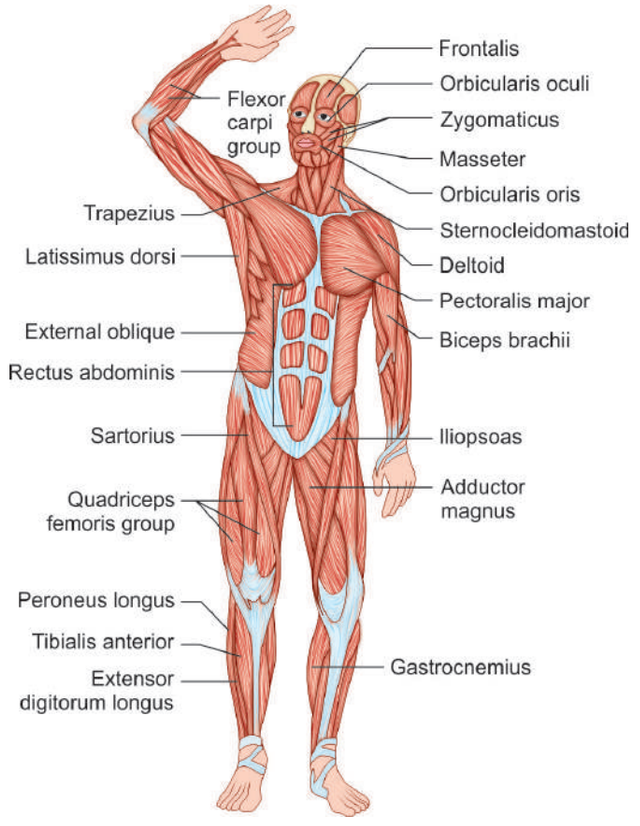


Fig. 1.6: Skeletal muscles of the human body

system is a network of tubes of various size and shapes for providing blood, oxygen and nutrients to the entire body and also removes the toxins. These functions depend upon the pumping action of heart (Figs 1.8A and B).

Functions

Arteries mostly carry oxygenated blood except pulmonary artery and umbilical arteries in fetus which carries deoxygenated blood.

Veins except pulmonary veins and umbilical vein carry deoxygenated blood to the heart. Veins, especially in lower limbs contain valves which provide unidirectional flow towards the heart. The valves located within the veins prevent downward return of blood.

Capillaries are thin-walled channels where exchange of oxygen and carbon dioxide takes place.

Lymphatic System

Lymph only travels in one direction, from the tissues towards the heart. This system is complementary to venous system. During exchange of gases and nutrients at the capillary level, some fluid remains within the tissues. This tissue fluid is transported through the lymph vessels and it gets filtered in the lymph nodes. These lymph nodes are situated in the groin, axilla, neck and posterior abdominal wall. In the root of the neck, the large lymph vessels open into the veins. Spleen is also a part of lymphatic system. Its function is to get rid of the old and worn out blood cells from the circulatory system (Fig. 1.9).

Functions

The lymphatic system transports excess tissue fluid from the tissues back to the bloodstream. This system has specialized cells which attack the harmful substances or bacteria with the help of phagocytes and lymphocytes.

Digestive System

The digestive system starts at mouth and ends at the lower opening, the anus. In between, it has tongue,

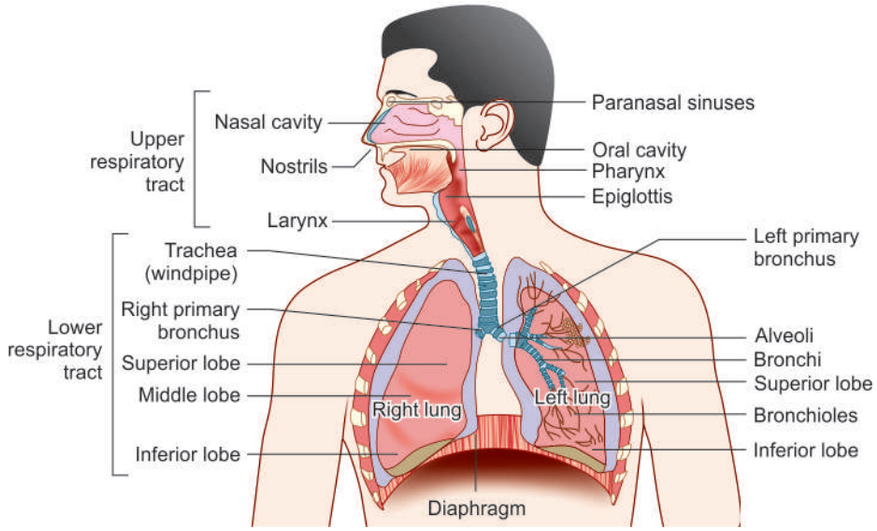
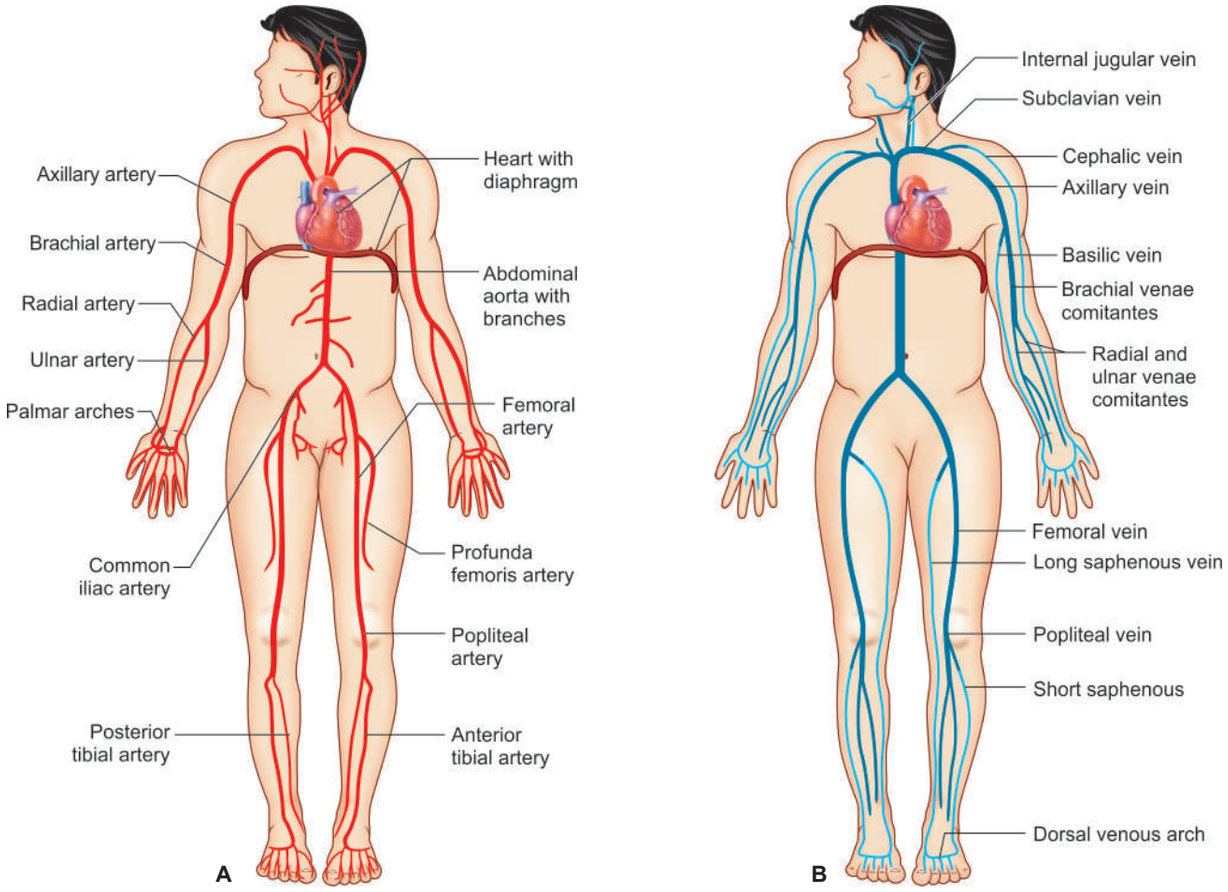


Fig. 1.7: Respiratory system



Figs 1.8A and B: (A) Arterial system; (B) venous system

pharynx, esophagus, stomach, small intestine (5 m long) and large intestine (1.5 m long). Associated with the long tube are three pairs of salivary glands, liver, gallbladder, pancreas besides the numerous glands situated in the wall of the long tube (Fig. 1.10).

Functions

The digestive system converts the eaten food into substances, which maintain metabolism. This system comprises various organs associated with ingestion, mastication, swallowing, digestion and absorption of

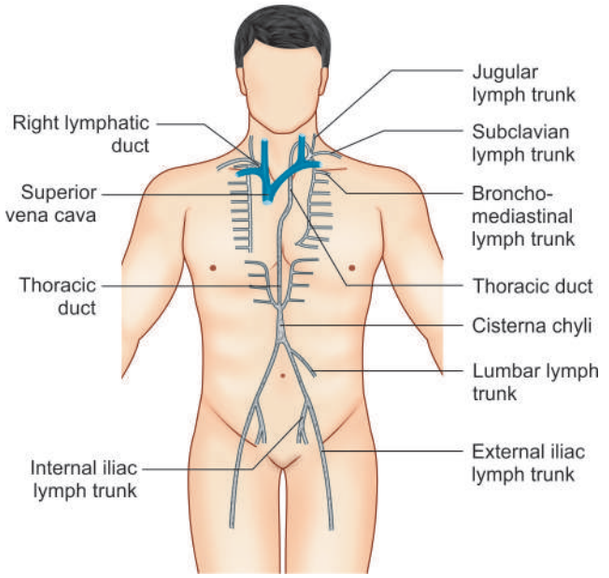


Fig. 1.9: Lymphatic system

useful components, while eliminating the solid waste from the body through the anal canal.

Urinary System

The urinary system comprises a pair of kidneys placed in the upper part of posterior abdominal wall, a pair of ureters, single urinary bladder placed behind pubic symphysis and a single urethra. Urethra is very short in females, whereas it is quite long (15–20 cm) in males and lies enveloped inside the penis (Fig. 1.11).

Functions

The urinary system filters the waste products like urea, uric acid to maintain water–electrolyte balance and pH of the blood. In addition, kidneys produce substances that influence blood pressure, production of red blood cells and maintain levels of serum calcium and phosphate.

Reproductive System

It comprises separate reproductive systems for males and females known as male and female reproductive systems, which are absolutely different. Male reproductive system comprises testis, epididymis, vas deferens, seminal vesicle, ejaculatory duct, prostate, urethra and penis. Female reproductive system comprises ovary, fallopian tube, uterus, vagina and external genital organs (Figs 1.12A and B).

Functions

The reproductive system provides a means for continuation of the species. The reproductive system provides the male gametes (spermatozoa) in case of male reproductive system and female gamete (ovum) in case of female reproductive system. These gametes on fertilization fuse to form a zygote. This zygote grows, differentiates and develops in the uterus to form embryo and this further develops into a fetus which gets delivered after a period of nine months as newborn baby.

Nervous System

The central nervous system comprises brain placed in bony skull and spinal cord enclosed in the vertebral

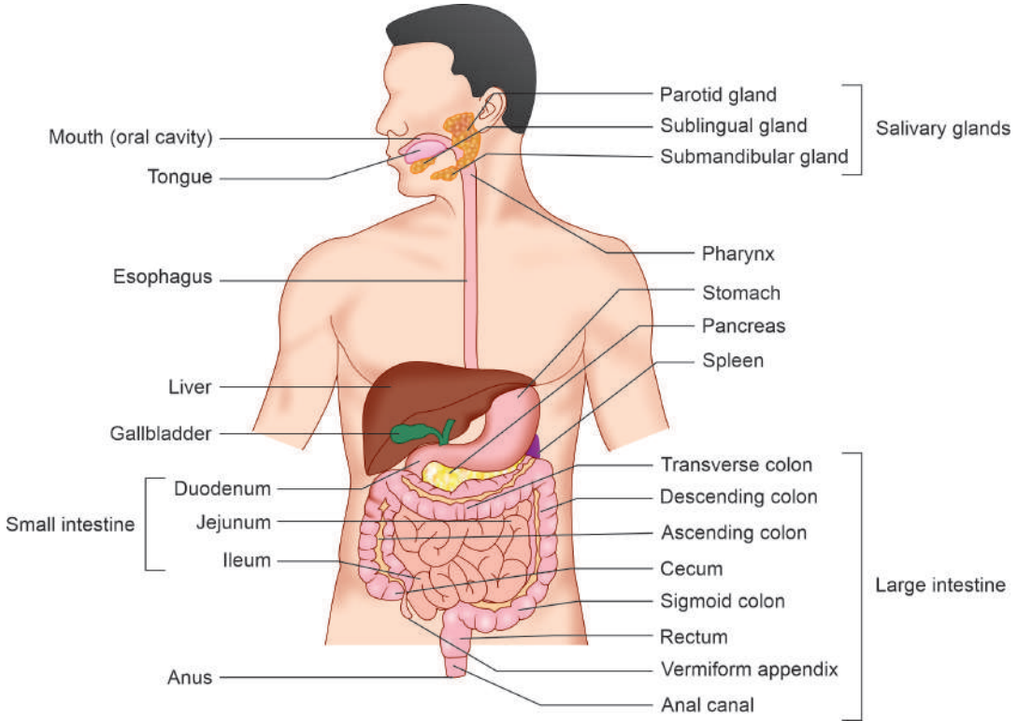


Fig. 1.10: Digestive system

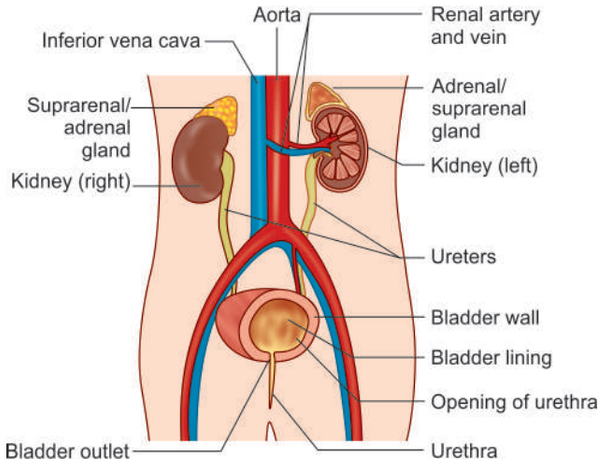


Fig. 1.11: Urinary system

canal. The autonomic nervous system regulates the functions of the various organs and blood vessels, etc. by means of its sympathetic and parasympathetic components. Neuron is the anatomical and functional unit of nervous system. There are billions of neurons in the brain which make trillions of synapses with other neurons to carry on the transfer of information (Fig. 1.13).

Functions

The central nervous system controls the whole body including its muscles. Autonomic nervous system controls both the voluntary and involuntary activities of an individual. It is body's 'computer', processing all the input data from the whole body and then transmitting messages to different parts of the body. 12 pairs of cranial nerves and 31 pairs of spinal nerves innervate all the skeletal muscles and carry impulses from skin, muscles, joints as the feedback.

Endocrine System

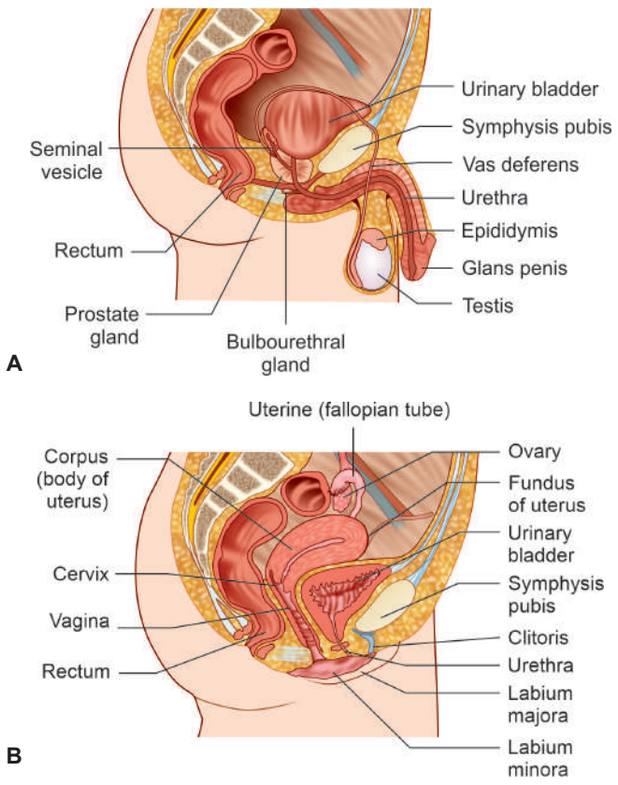
The endocrine glands are pineal, hypothalamus, pituitary in cranial cavity; thyroid, parathyroid situated in front of neck, suprarenal lying above the kidney, islets of Langerhans of pancreas and testes in male and ovaries in female. These endocrine glands produce their own hormones that control definite functions to help maintain homeostasis (Fig. 1.14).

Functions

The endocrine or neuroendocrine system regulates specific functions of various systems. The glands included in this system do not have ducts to carry off the secretions of their hormones. Thus, these are ductless glands, as these release the hormones directly into blood. The endocrine glands are controlled by the hypothalamus of the brain, which communicates with hypophysis cerebri or pituitary gland. Pituitary gland secretes various stimulating hormones, which act on endocrine glands to produce hormones.

Special Senses/Sensory Organs (Fig. 1.15)

Retina of the eyeball is the innermost nervous layer. The light impulse passes through the retina and is converted into electrical impulse which travels through optic nerve, optic chiasma, optic tract, lateral geniculate body to reach the occipital lobe of the brain. For more details see Chapter 11.



Figs 1.12A and B: Reproduction system: (A) Male; (B) female

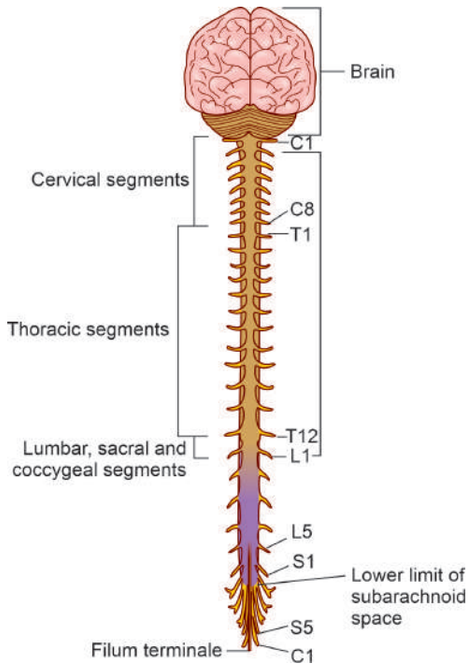


Fig. 1.13: Nervous system

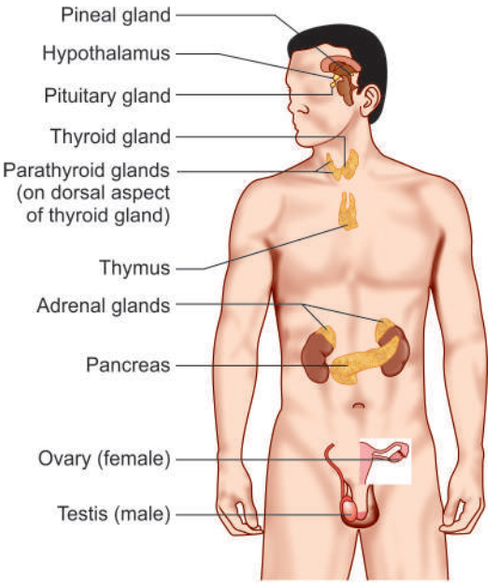


Fig. 1.14: Endocrine system

Hearing is appreciated by the membranous cochlea and impulses are sent to spiral ganglion, cochlear nerve, cochlear nuclei, medial geniculate body to reach the auditory area in temporal lobe of brain. Balance is appreciated by nerve endings in utricle, saccule and semicircular canals. The impulses reach the little brain or cerebellum.

Smell is recognized by specialized cells in the olfactory mucous membrane of the nasal cavity. It is carried by nerve rootlets to the uncus region of the temporal lobe.

Taste is recognized by taste buds which are specialized cells on the dorsum of tongue, epiglottis and soft palate. It is carried by VII, IX and X cranial nerves to nucleus of tractus solitarius and then to the lower part of postcentral gyrus of brain.

Touch is carried by numerous nerve fibers present in the skin of the whole body. Figures 1.15A to E show the different special sense organs.

Functions

The special senses function as sense of sight, hearing, balance, smell, taste and touch. These sensations are carried to the brain, where these are appreciated and action is taken, accordingly.

Integumentary System (Skin)

Skin is the outermost protective and sensitive covering of the body with its various appendages, i.e. hair, sweat glands, sebaceous glands and nails.

It contains melanin pigment which counteracts the effect of harmful ultraviolet rays.

Skin can be grafted from one part of the body to other with minimum problems.

Cosmetic industry has been flourishing due to its high claims on modifying the texture and colour of skin (Fig. 1.16).

BASIC LIFE PROCESSES

All living organisms have certain characteristics that distinguish them from non-living forms. The basic processes of life include organization, metabolism, responsiveness, movements and reproduction. In humans, who represent the most complex form of life, there are additional requirements such as growth, differentiation, respiration, digestion and excretion. All of these processes are inter-related. No part of the body, from the smallest cell to a complete body system, works in isolation. All function together, in fine-tuned balance, for the well being of the individual and to maintain life. Disease such as cancer and death represent a disruption of the balance in these processes.

The following is a brief description of the life processes:

Organization

At all levels of the organizational scheme, there is a division of labor. Each component has its own job to perform in cooperation with others. Even a single cell, if it loses its integrity or organization, will die.

Metabolism

Metabolism is a broad term that includes all the chemical reactions that occur in the body. One phase of metabolism is catabolism in which complex substances are broken down into simpler building blocks and energy is released.

Responsiveness

Responsiveness or irritability is concerned with detecting changes in the internal or external environments and reacting to that change. It is the act of sensing a stimulus and responding to it.

Movement

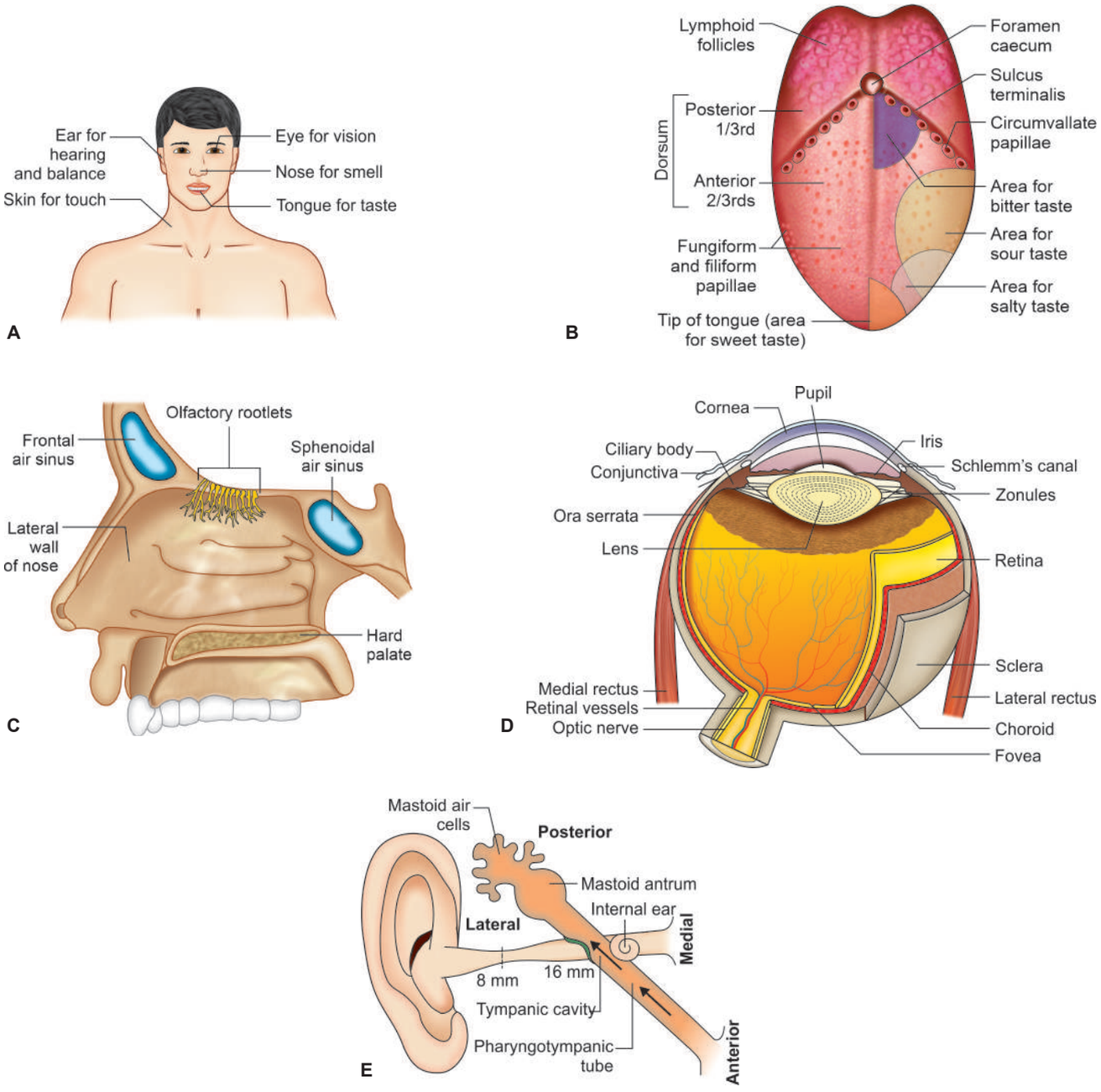
There are many types of movements within the body. On the cellular level, molecules move from one place to another. Blood moves from one part of the body to another. The diaphragm moves with every breath. The ability of muscle fibers to shorten and thus to produce movement is called contractility.

Reproduction

For most people, reproduction refers to the formation of a new person, the birth of a baby. In this way, life is transmitted from one generation to the next through reproduction of the organism. In a broader sense, reproduction also refers to the formation of new cells for the replacement and repair of old cells as well as for growth. This is cellular reproduction. Both are essential for the survival of the human race.

Growth

Growth refers to an increase in size either through an increase in the number of cells or through an increase in the size of each individual cell. In order for growth to occur, anabolic processes must occur at a faster rate than catabolic processes.



Figs 1.15A A to E: (A) Special sensory organs; (B) organ of taste; (C) organ to smell; (D) organ of vision; (E) organ to hear

Differentiation

Differentiation is a developmental process by which unspecialized cells change into specialized cells with distinctive structural and functional characteristics. Through differentiation, cells develop into tissues and organs.

HOMEOSTASIS

Most body systems contribute in some way to the maintenance of homeostasis. The endocrine and nervous systems are the main contributors to maintain a stable internal environment in body. The extracellular fluid contains more amount of nutrients such as glucose, fatty acid, amino acids and ions such as sodium, chloride, bicarbonate while intracellular fluid contains higher amount of potassium, phosphate and magnesium. Homeostasis is a state of dynamic equilibrium rather than constant, unchanging state.

Role of Endocrine and Nervous Systems in Maintaining Homeostasis

Endocrine system: It regulates the metabolism, growth and development, sleep, emotions, mood, sexual function, reproduction, stress response, tissue function among many other important body functions via feedback mechanisms. Most of the mechanisms of the endocrine system are negative feedback. For example,

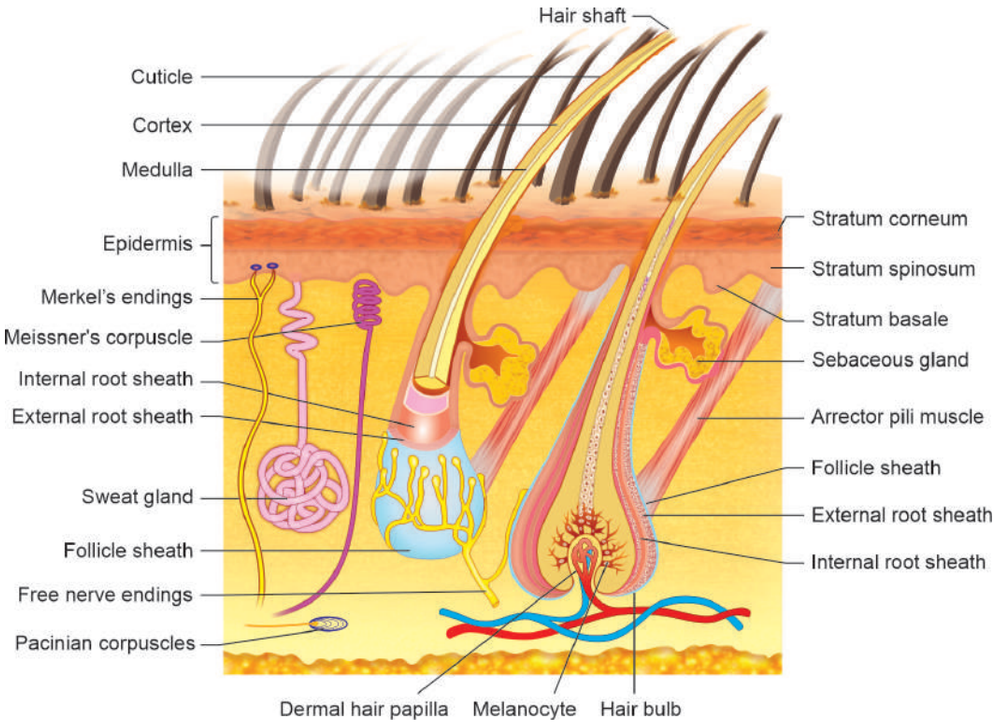


Fig. 1.16: Anatomy of skin

adrenocorticotropic releasing hormone (ACTH) and thyrotropin releasing hormone (TRH) are controlled by negative feedback mechanisms.

Nervous system: It consists of central or somatic nervous system and autonomic nervous system. Central nervous system controls important body functions such as regulation of muscle tone, maintenance of posture and equilibrium, planning and programming of movements, co-ordination for movements, expression of emotions, learning, memory, speech, etc. Central nervous system perceives sensory information and coordinates motor response. Autonomic nervous system controls sympathetic and parasympathetic functions.

BASIC ANATOMICAL TERMINOLOGY

Various positions, planes and terms used in relation to different regions and movements of a body are as follows:

Anatomical Positions

When a person is standing straight with eyes looking forward, both arms by the sides of body, palms facing forward and both feet together—the position is known as anatomical position (Fig. 1.17). This position is used to ensure consistency and accuracy in anatomical descriptions.

Supine position: When a person is lying on her/his back, arms by the side, palms facing upward and feet put together, the position is supine position. The arms are extended and secured on padded arm boards. Supine position is generally used for procedures such as cardiac, intracranial, abdominal, laparoscopic, endovascular, lower extremity procedures and ear, nose, throat, neck and face (Fig. 1.18).

Prone position: Person lying on his/her face, chest and abdomen, is said to be in prone position. This position is generally used for sedated patients who require a ventilator (Fig. 1.19).

Lithotomy position: It involves lying on one's back with legs flexed at 90° at hips. Person's knees are bent at 70° to 90° and padded feet rest attached to the table supports both the legs. This position is mostly used during childbirth and surgery in the pelvic area (Fig. 1.20).

Anatomical Planes

The planes divide the body into different sections and make it easy to describe or visualize the internal arrangement from different viewpoints. There are four body planes that lie at right angles to each other (Fig. 1.21). These are:

Midsagittal (median) and sagittal: A plane passing through the center of the body dividing it into two equal right and left halves, is the median or midsagittal plane. Plane parallel to median or midsagittal plane is the sagittal plane (Fig. 1.22). Sagittal plane shows the viscera anteroposteriorly.

Coronal or frontal plane: A plane at right angles to sagittal or median plane which divides the body into anterior and posterior halves is called a coronal or frontal plane (Figs 1.23 and 1.24). It shows the extent of a viscera anteroposteriorly.

Transverse or horizontal plane: A plane at right angles to both sagittal and coronal planes which divides the

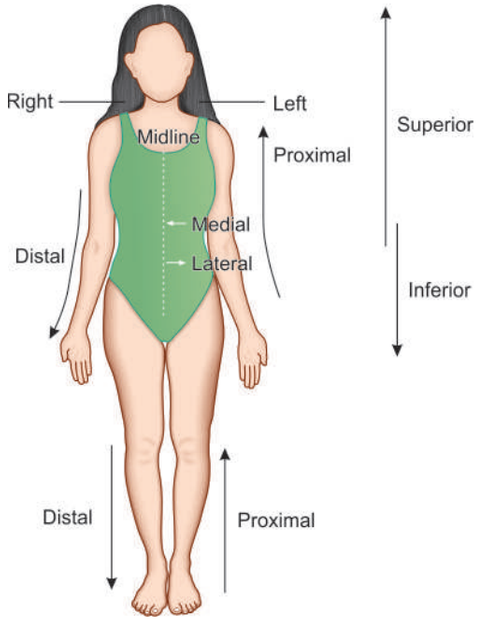


Fig. 1.17: Anatomical position

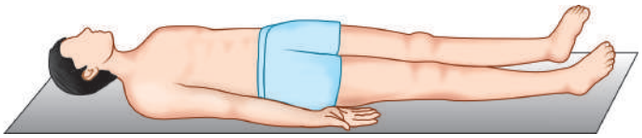


Fig. 1.18: Supine position

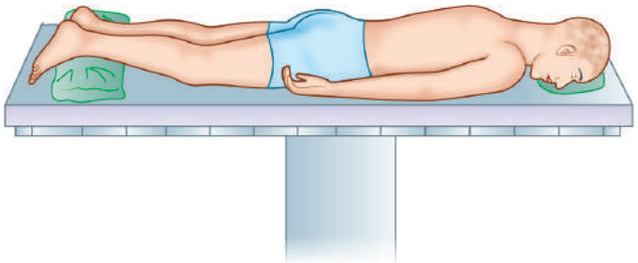


Fig. 1.19: Prone position

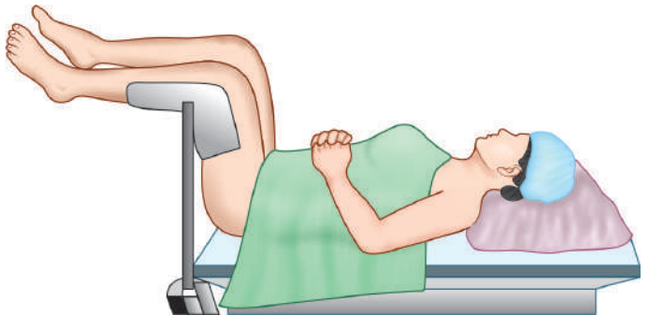


Fig. 1.20: Lithotomy position

body into upper and lower parts is called a transverse or horizontal plane (Figs 1.23 and 1.24). It shows the extent of a structure from proximal to distal parts.

TERMS RELATED TO BODY MOVEMENTS

Movements in general at synovial joints are divided into four main categories.

1. **Gliding movement:** Relatively flat surfaces move from side-to-side and back-and-forth with respect to one another. Whereas, the angle between articulating bones does not change significantly (Fig. 1.25).
2. **Angular movement:** Angle between articulating bones decreases or increases. During flexion, the angle between articulating bones decreases and in extension the angle between articulating bones increases (Fig. 1.26). When the trunk moves sideways to the right or left at the waist, it is known as lateral flexion. Adduction

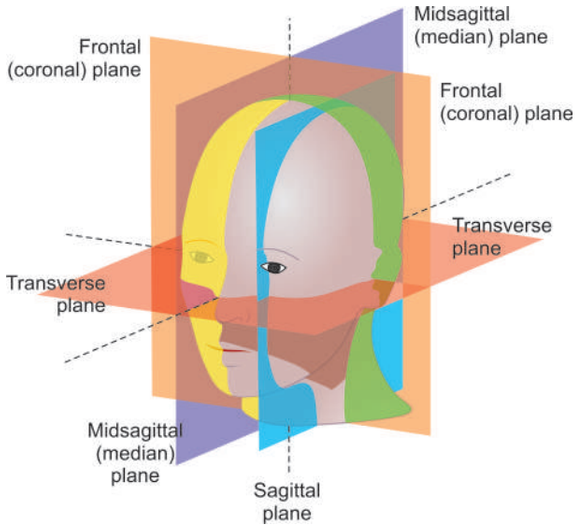


Fig. 1.21: Anatomical planes

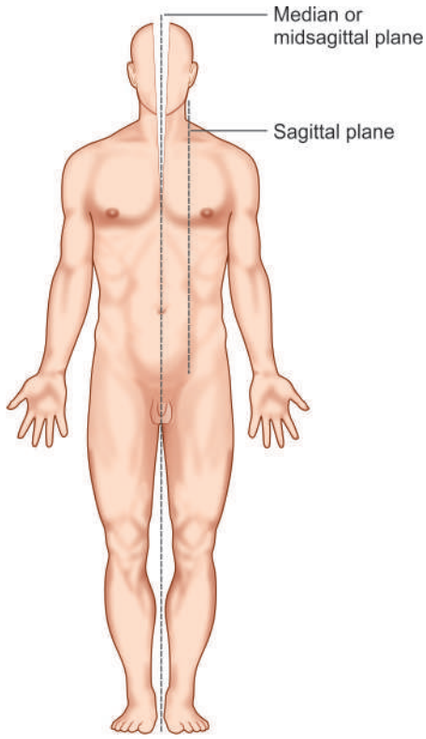


Fig. 1.22: Midsagittal (median) and sagittal planes

is movement of bone toward midline whereas when the bone moves away from midline, it is called abduction.

3. **Rotation:** When a bone revolves around its own longitudinal axis, it is known as rotation. During medial rotation, the anterior surface of a bone (of limb) turns toward the midline. In lateral rotation the anterior surface of bone (of limb) turns away from midline (Fig. 1.27).
4. **Special movements:** Such special movements occur only at certain joints, e.g. supination and pronation, at radioulnar joints (Fig. 1.28), retraction and protraction at temporo-mandibular joint.

Terms Used in Relation to the Neck Movements

- **Flexion and extension:** When face comes closer to chest, it is called flexion and when face is brought away from the chest, it is called extension (Fig. 1.29).

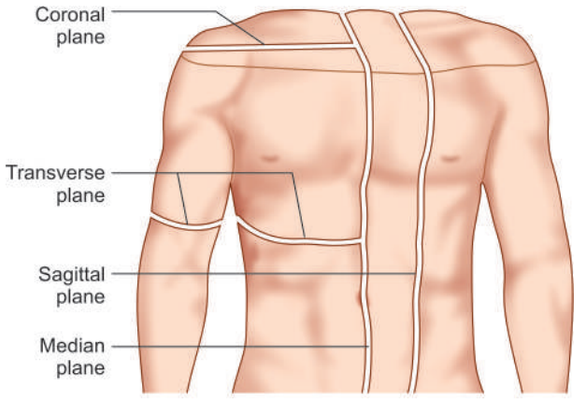


Fig. 1.23: Median, sagittal, coronal and transverse planes

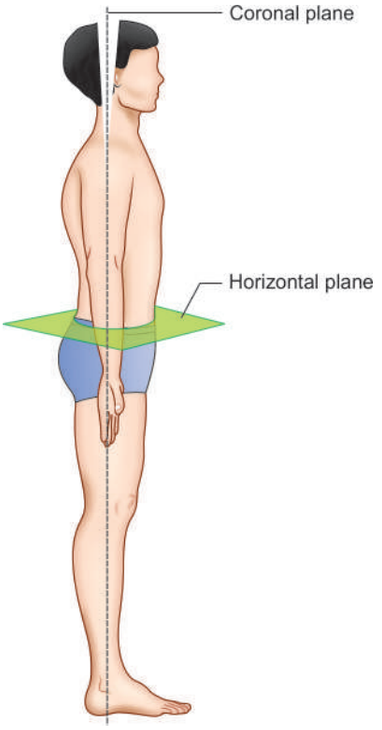


Fig. 1.24: Coronal and horizontal planes

- **Lateral flexion:** When ear is brought close to shoulder, it is called lateral flexion.
- **Opening the mouth and closure of mouth:** When lower jaw is lowered to open the mouth; it is called opening of mouth and when lower jaw is opposed to the upper jaw, it is called closing the mouth.
- **Protraction and retraction:** When lower jaw slides forward in its socket in the temporal bone of skull it is protraction and retraction is when lower jaw slides backward in its socket in the temporal bone of skull.

Terms Used in Relation to the Trunk Movements

- **Flexion and extension:** Forward bending is flexion and backward bending is called extension (Fig. 1.30).
- **Lateral flexion and lateral rotation:** Sideward movement is lateral flexion and sideward rotation are lateral rotations.

Terms Used in Relation to Upper Limb Movements

- **Flexion and extension:** When two flexor surfaces are brought close to each other, e.g. in elbow joint when front of arm and forearm is opposed to each other it is called flexion. Extension term is used when extensor or dorsal surfaces are brought in as much approximation as possible, e.g. straightening the arm and forearm at the elbow joint (Fig. 1.31).
- **Abduction and adduction:** When limb is taken away from the body, it is called abduction and adduction is when limb is brought close to the body (Fig. 1.32).

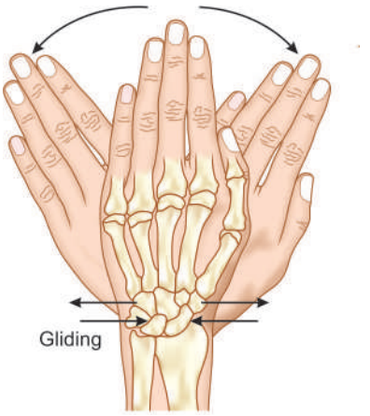


Fig. 1.25: Gliding movement

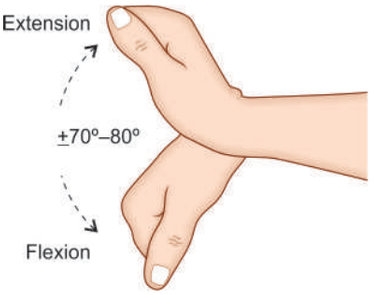


Fig. 1.26: Angular movement

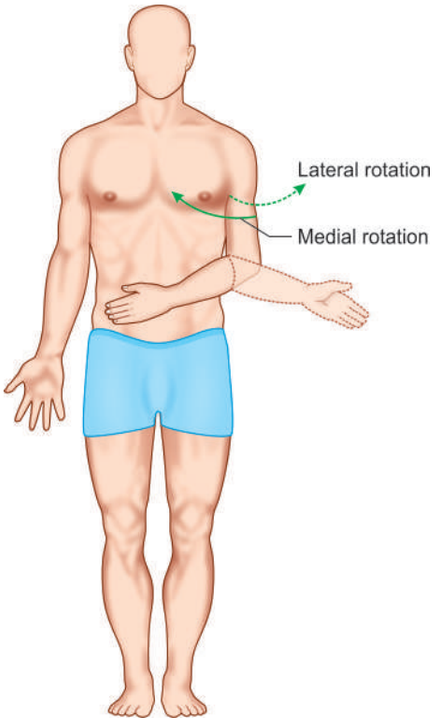


Fig. 1.27: Medial and lateral rotation

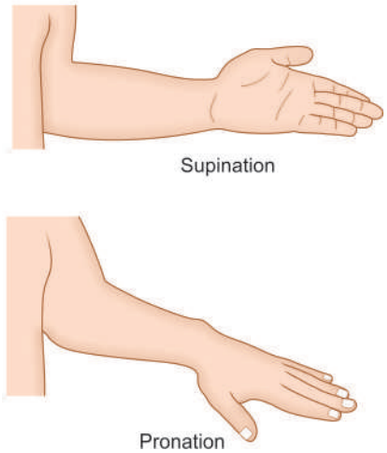


Fig. 1.28: Special movements

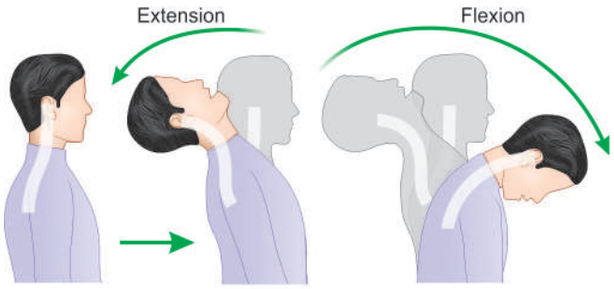


Fig. 1.29: Movements of neck

- **Circumduction:** It is movement of distal end of a part of the body in a circle. A combination of extension, abduction, flexion and adduction in a sequence is called circumduction, e.g. as in bowling.

- **Medial rotation and lateral rotation:** When the arm rotates medially bringing the flexed forearm across the chest, it is called medial rotation and lateral rotation is when arm rotates laterally taking the flexed forearm away from the body (Fig. 1.27).
- **Supination and pronation:** When the palm is facing forward or upward, e.g. putting food in the mouth, it is called supination and pronation is when the palm faces backward or downward, e.g. as is done in picking food with fingers from the plate.
- **Adduction of digits/fingers:** When all the fingers get together, it is known as adduction and abduction is when all fingers separate.
- The **axis of movement of fingers** is the line passing through the center of the middle finger.
- **Opposition of thumb:** When tip of thumb touches the tip of any of the fingers.
- **Circumduction of thumb:** Movement of thumb in extension, abduction, flexion and adduction in sequence.

Terms Used in Relation of Lower Limb Movements

- **Flexion and extension of thigh:** When front of thigh comes in contact with front of abdomen, it is called flexion and extension of thigh is when person stands erect.
- **Abduction and adduction:** When thigh is taken away from the median plane, it is abduction and adduction is when thigh is brought close to the median plane.
- **Medial rotation and lateral rotation:** When thigh is turned medially, it is called medial rotation, lateral rotation is when thigh is turned laterally (Fig. 1.33A).
- **Flexion and extension of knee:** When back of thigh and back of leg come opposite to each other, it is called flexion and extension of knee is when thigh and leg are in straight line as in standing.

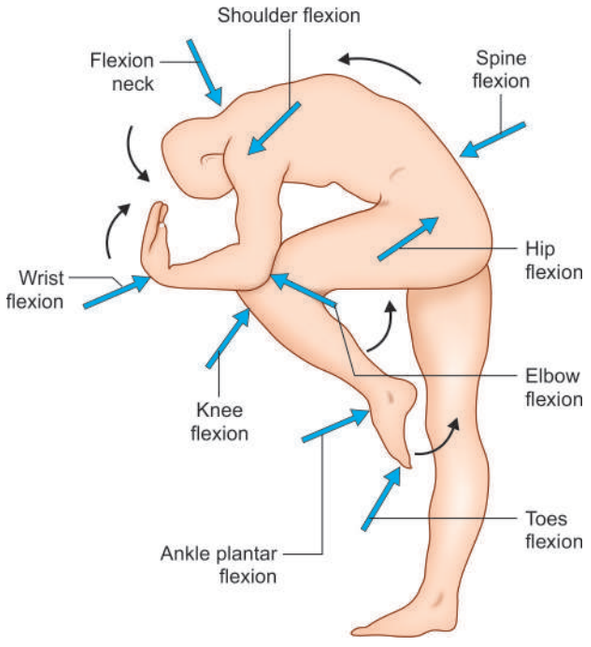


Fig. 1.30: Flexion movements

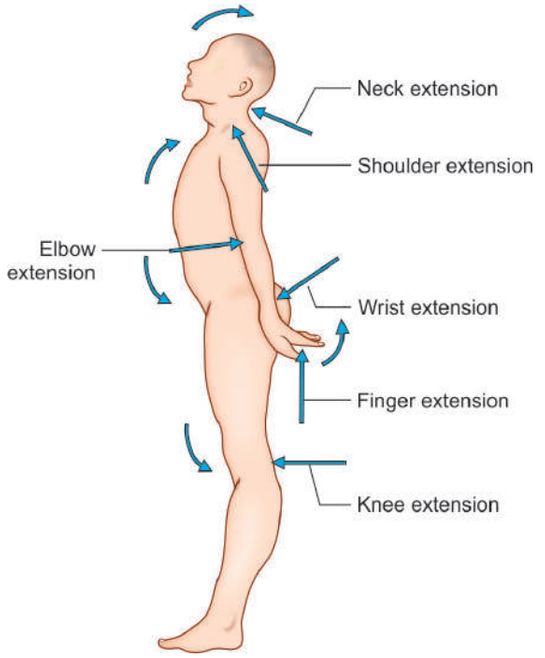


Fig. 1.31: Extension movements

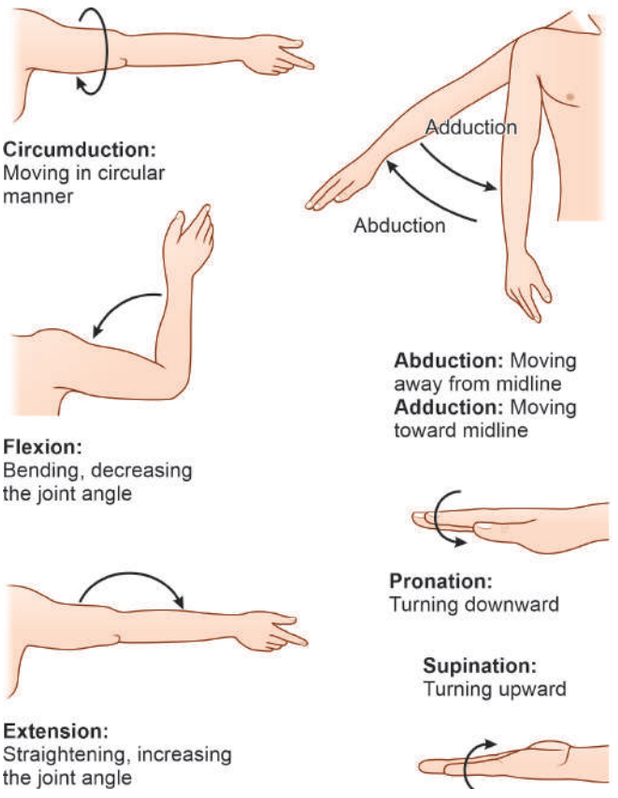


Fig. 1.32: Movements of upper limb

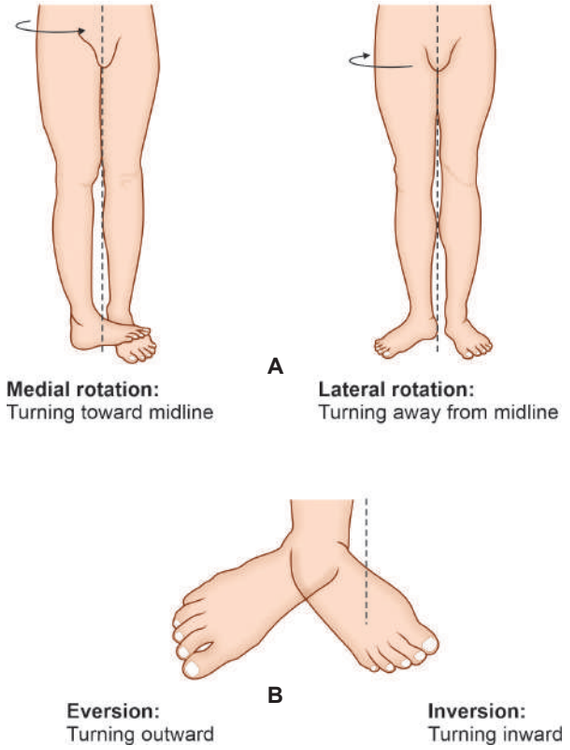
Terms Used in Relation of Foot Movements

- **Dorsiflexion of foot:** When dorsum of foot is brought close to front of leg and sole faces forward, it is called dorsiflexion of foot.
- **Plantar flexion of foot:** When sole of foot or plantar aspect of foot faces backward, it is plantar flexion of foot.
- **Inversion and eversion of foot:** When medial border of foot is raised from the ground, it is inversion and when lateral border of foot is raised from the ground, it is called eversion (Fig. 1.33B).

BODY CAVITIES

A cavity is a hollow place. It is usually filled with organs, nerves, vessels and muscles.

Cranial cavity contains the meninges, brain, venous sinuses, endocrine glands and CSF (Fig. 1.34).



Figs 1.33A and B: Movements of lower limb

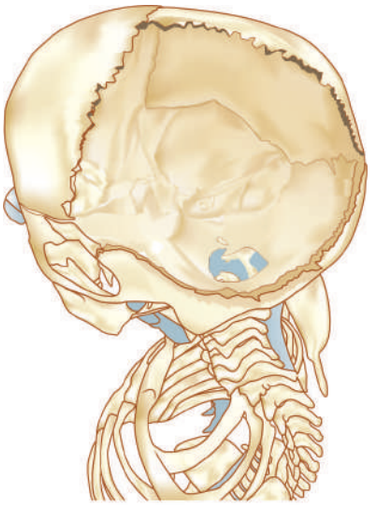


Fig. 1.34: Cranial cavity

Thoracic cavity contains organs and tissues that function in the respiratory (lungs, bronchi, trachea, pleura), cardiovascular (heart, pericardium, great vessels, lymphatics), nervous (vagus nerve, sympathetic chain, phrenic nerve, recurrent laryngeal nerve), immune (thymus) and digestive (esophagus) systems (Fig. 1.35).

Abdominal cavity contains vital organs—the stomach, the small intestine (jejunum and ileum), the large intestine (colon), the liver, the spleen, the gallbladder, the pancreas, the uterus, the fallopian tubes, the ovaries, the kidneys, the ureters, the bladder and many blood vessels (arteries and veins) (Fig. 1.36 and Table 1.1).

Pelvic cavity contains the reproductive organs, urinary bladder, distal ureters, proximal urethra, terminal sigmoid colon, rectum and anal canal (Fig. 1.37).

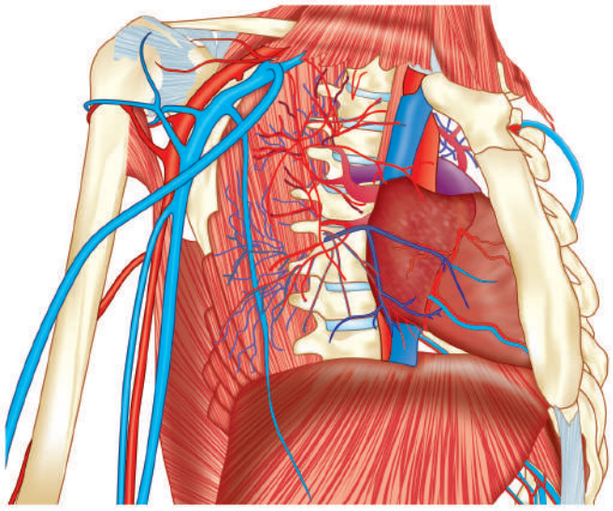


Fig. 1.35: Thoracic cavity

Table 1.1: Body cavities

Cranial cavity	Formed by the cranial bones and holds the brain
Vertebral canal	Formed by the vertebrae and contains the spinal cord
Thoracic cavity	Formed by the thoracic cage, muscles of the chest, sternum and the thoracic vertebrae; contains the pleural and pericardial cavities
Pleural cavity	Fluid-filled space that surrounds both lungs
Pericardial cavity	Fluid-filled space that surrounds the heart; the serous membrane of the pericardial cavity is the pericardium
Mediastinum	Central portion of the thoracic cavity; contains the heart, thymus, trachea, several major blood vessels and esophagus
Abdominal cavity	Contains liver, stomach, spleen, small intestine and most of the large intestine; the serous membrane of the abdominal cavity is the peritoneum
Pelvic cavity	Contains bladder, some part of the large intestine and reproductive organs (internal)

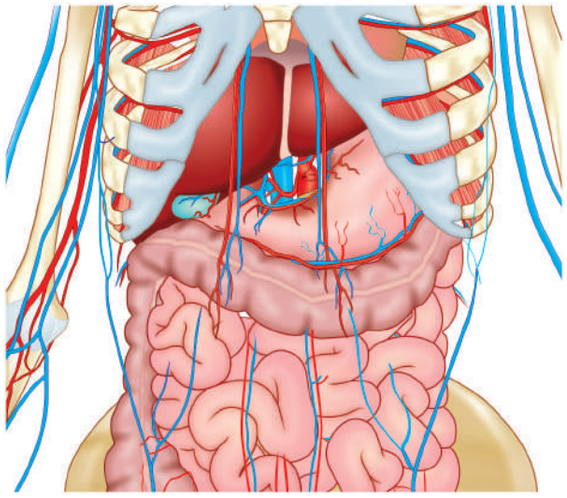


Fig. 1.36: Abdominal cavity

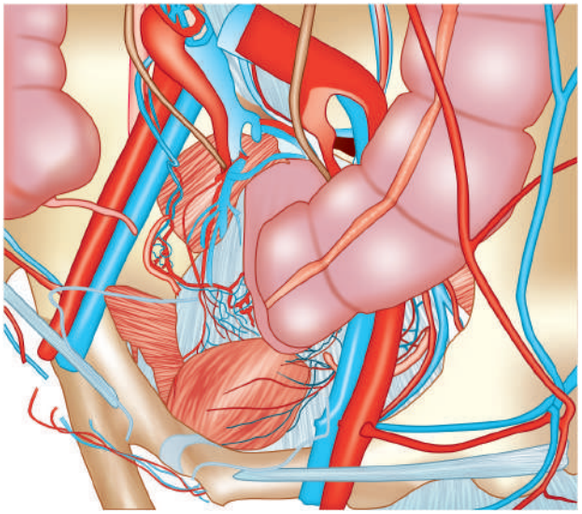


Fig. 1.37: Pelvic cavity

Golden Points

- Anatomy is the science of learning normal structure of the human body.
- Physiology deals with learning and understanding the functions of the body.
- Anatomical position: Person standing erect, eyes looking forwards, upper limbs by side of body, forearms supinated and palms facing forwards, lower limbs close to each other.
- Supine position: Person lying on back with hands on side of the body and feet together.
- Prone position: Person lying on abdomen and hands on sides and feet together.
- Lithotomy positon: Person lies on back, legs are strapped up so that perineal area is visualized. It is used during delivery of the baby.
- Median/midsagittal plane: Divides the body into right and left halves.
- Sagittal plane: Plane parallel to median plane.
- Coronal plane: Divides the body into anterior and posterior halves.
- Transverse plane: Divides the body or limb into proximal/upper or distal/lower parts.
- Parts of human body are:
  - Brain: Lies in cranial cavity.
  - Head: Contains eyes, ears, nose, tongue.
  - Upper limb region: Comprises pectoral region, scapular region, axilla, shoulder, arm, forearm and hand.
    - Deltoid muscle is used for giving intramuscular injection.
    - Brachial artery is auscultated for measuring blood pressure.
    - Median cubital vein is used for withdrawing samples of blood and for transfusion purposes.
    - The radial artery is used for counting pulse.
  - Thorax region encloses heart and two lungs besides some tubes, arteries, veins, etc.
  - Abdomen and pelvic region:
    - Abdomen is divided by few lines into 9 regions. These are:
      - Right and left hypochondrium and central epigastric regions.
      - Right and left lumbar regions and central umbilical region.
      - Right and left iliac regions and central suprapubic region.
      - Abdomen and pelvic cavity contain digestive system, various glands, genitourinary system, blood vessels, nerves, muscles and lymph nodes
  - Lower limb region:
    - This region comprises the gluteal region, thigh region, leg region and the foot including the sole.
    - Gluteal region is used for giving intramuscular injection.
    - Saphenons vein is used for transfusion purposes; femoral artery is used for catheterisation purposes.
  - Various organ systems in human body are: Skeletal system, joints, muscular system, respiratory system, blood, circulatory system, lymphatic system, digestive system, urinary system, reproductive system, nervous system, endocrine system, special sensory organs, skin/integumentary system and immunity.

Assess Yourself

Long Answer Questions

1. Describe the body cavities and their contents.
2. Discuss the importance of body planes.
3. Enumerate the subdivisions of anatomy and physiology.
4. Describe briefly parts of digestive system.

Short Answer Questions

1. Write a short note on anatomical position.
2. Write a note on body movements.
3. Define:
   a. Supine position
   b. Prone position
   c. Eversion of foot
   d. Inversion of foot
   e. Protraction of jaw

Multiple Choice Questions

Tick (✓) the correct option in the following:

1. Anatomical position has the following features, except:
   a. Person standing erect
   b. Forearms are pronated
   c. Feet together
   d. Eyes looking forward
2. Which statement about the coronal plane is incorrect?
   a. Divides the body into anterior half and posterior half
   b. Lies at right angle to sagittal plane
   c. Lies at right angle to transverse plane
   d. Divides the body into right half and left half
3. Define abduction:
   a. Movement away from central axis
   b. Movement toward central axis
   c. Approximation of the ventral surfaces
   d. Approximation of the dorsal surfaces
4. Plane at right angle to the long axis of body part is called:
   a. Sagittal
   b. Coronal
   c. Transverse/horizontal
   d. Oblique
5. Ulnar nerve lies:
   a. In front of medial epicondyle of humerus
   b. Behind medial epicondyle
   c. In front of lateral epicondyle
   d. Behind lateral epicondyle
6. Radial pulse is felt at:
   a. Front of wrist on medial side
   b. Back of wrist on medial side
   c. Back of wrist on lateral side
   d. Front of wrist on lateral side
7. Which organ is not a part of male reproductive system?
   a. Testis
   b. Ductus deferens
   c. Prostate
   d. Fallopian tube
8. Which are the stages of menstrual cycle?
   a. Proliferative phase
   b. Progestational phase
   c. Menstrual phase
   d. All of the above

Answer Key

1. b 2. d 3. a 4. c 5. b 6. d 7. d 8. d