

Textbook of Blood Banking and Transfusion Technology

for Blood Bank and Transfusion Technicians Year I

The chapters in this first volume have taken the reader from the basic structure and function of the human body to the microscopic details of blood cells, their disorders and core hematology procedures. For a blood bank technician, this knowledge shapes every decision about sample integrity, result reliability and the interpretation of laboratory findings that influence transfusion choices.

As training progresses, readers will notice that these principles recur in many situations. Understanding erythropoiesis clarifies why some donors should be deferred; recognizing hemolysis helps in investigating transfusion reactions; knowing coagulation pathways makes PT/INR results meaningful when plasma or cryoprecipitate is prescribed. Referring to these pages during practical postings will reinforce that connection between basic science and safe transfusion practice.

Volume 1 is best viewed as a foundation. New guidelines, instruments and reagents will continue to evolve, but careful history taking, meticulous sample collection, correct use of anticoagulants, proper smear preparation and thoughtful interpretation will remain the bedrock of every technician. The second volume will carry this foundation into the blood bank itself—into donor chairs, processing rooms, refrigerators, quality records and, ultimately, the bedside of the patient who receives the blood that has been so carefully handled.

Ramnik Sood MBBS, PGEn&OH, MD (Pathology) Gold Medallist is a medical author known worldover. His books are prescribed and read in the West as much as they are preferred in the East; having written scores of books for technologists, and undergraduate, postgraduate and PhD students belonging to pathology stream or allied health sciences. He started with *Textbook of Haematology*, followed by *Laboratory Technology* and went onto *Immunohistochemistry*, *MCQs in MLT*, *MCQs in Pathology*, *Textbook of Clinical Pathology for MLT Students*, *Parasitology*, *Clinical Biochemistry*, *Haematology*, *Phlebotomy*, *Laboratory Biosafety and Security*, *Molecular Pathology* and so on.

He has worked as a Consultant "A" at the UAE and was invited to work in several other countries too. So having an international perspective has come in very handy in creation of this book. His books are treated as must read texts the worldover. Surely, his effort would assist the students of paramedical and allied health sciences for years to come!

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Vol 1
Textbook of Blood Banking and
Transfusion Technology

Sood | Sabharwal

Volume 1

Textbook of Blood Banking and Transfusion Technology

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As per the latest Syllabus and Guidelines

Ramnik Sood
Anil Sabharwal



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for Blood Bank and Transfusion Technicians **Year I**
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Disclaimer

Science and technology are constantly changing fields. New research and experience broaden the scope of information and knowledge. The authors have tried their best in giving information available to them while preparing the material for this book. Although all efforts have been made to ensure optimum accuracy of the material, yet it is quite possible some errors might have been left uncorrected. The publisher, printer and the authors will not be held responsible for any inadvertent errors or inaccuracies.

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Preface

Blood bank technicians are trusted with the collection, processing and safe use of human blood and its components, and their work directly affects patient survival. Volume 1 of this series is designed to give future blood bank technicians the essential scientific foundation in anatomy, physiology and clinical hematology on which all safe transfusion practice ultimately rests.

The early chapters introduce basic anatomy and physiology relevant to the cardiovascular, respiratory, renal, endocrine and immune systems, helping the reader understand how blood is formed, how it circulates, and how it responds to disease and therapy. The subsequent chapters on clinical hematology explain in a stepwise manner the morphology, counting and interpretation of red cells, white cells and platelets; the laboratory diagnosis of anemias, hemolytic disorders, leukemias and coagulation abnormalities; and the correct use of anticoagulants, sampling techniques and blood collection systems that a technician will handle every day.

Throughout this volume, emphasis is placed on practical laboratory skills. Standard procedures for hemoglobin estimation, hematocrit, cell counts, ESR, peripheral smear preparation and staining, reticulocyte counts, platelet counts and basic coagulation tests are described in sufficient detail to be converted into bench-side checklists. Common pitfalls in specimen collection, storage and processing are highlighted so that the learner acquires habits of accuracy, safety and quality that are now expected under modern regulatory and accreditation frameworks like NABH.

Textbook of Blood Banking and Transfusion Technology (Volume 1) is not intended to replace institutional standard operating procedures, nor does it cover the full breadth of immunohematology, donor management, compatibility testing or component therapy. Those aspects are developed systematically in Volume 2, which builds on the principles laid here and takes the reader into the core of blood bank technology, transfusion practice, quality systems and basic clinical nursing relevant to transfusion medicine. Together, the two volumes aim to accompany the technician from classroom and skills lab to blood center and ward, as a concise yet comprehensive reference through training and early professional life. Master Volume 1 to excel in Volume 2.

Ramnik Sood
Anil Sabharwal

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Human Body

Our body is comprised of multiple organs which work in tandem. Any problem in one part of the body has an impact on the rest of its functions. Therefore, a working knowledge of anatomy and physiology is mandatory before proceeding further. **Anatomy** deals with the structure of the human body while **Physiology** deals with its functions.

The fundamental structural and functional unit of our body is the **cell**. Groups of cells performing similar functions are called **tissues**. Tissues performing similar functions make up **organs**, which further group to form **organ systems**. The digestive system is one such organ system. It is made up of various organs like the esophagus, stomach, small intestine, large intestine, liver, gallbladder, pancreas, etc. Our body is a coordinated arrangement of these organ systems. In a healthy body, all our organ systems work harmoniously.

The human life starts with a single cell that is formed by the fusion of a sperm with an ovum. It further divides and specialises to form tissues, organs and ultimately the whole body. These embryonic cells which develop into different cell types to perform different functions are called **totipotent cells**.

Each cell is comprised of **organelles** and each organelle performs different functions. We have nearly 200 varieties of cells in our body, yet each cell has the same genetic material.

ORGAN SYSTEMS

- *Integumentary system:* Consists of skin, hair, sweat glands, oil glands and nails. It is the largest organ system of the body (**Fig. 1.1**).

Functions: Protects body from injury, bacteria and sunlight. Regulates body temperature, manufactures vitamin D and is an important sensory organ.

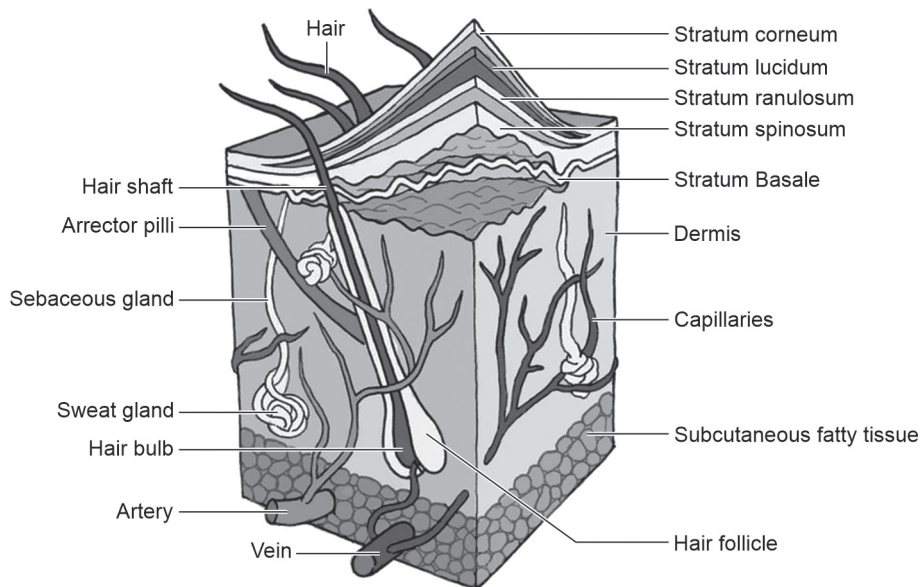


Fig. 1.1: Structure of skin

- **Skeletal system:** Comprises bones, cartilage, ligaments and tendons.
Functions: Provides support to organs, protects internal organs, movement of body, stores calcium and phosphorus (**Fig. 1.2**).

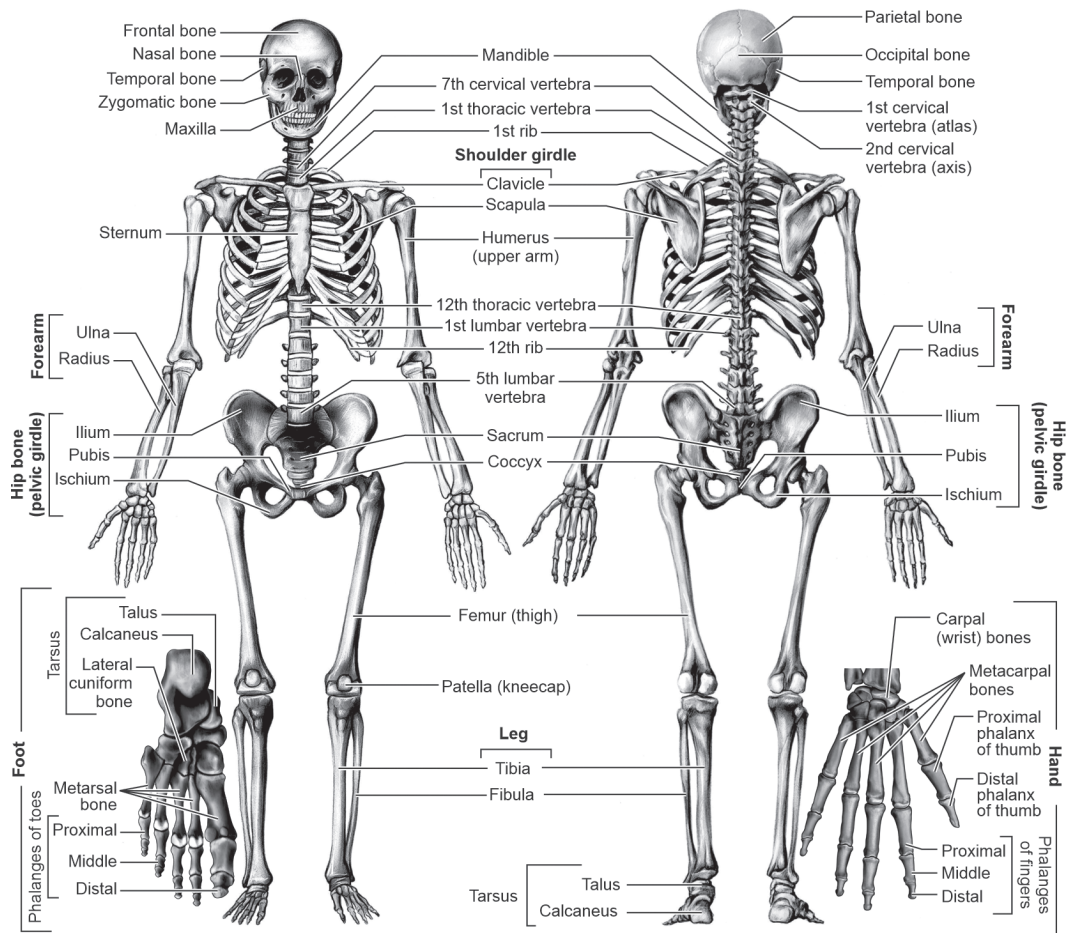


Fig. 1.2: Skeletal system

- **Cardiovascular system:** Consists of heart, blood vessels and blood (**Fig. 1.3**).
Functions: Transports oxygen, nutrients, hormones and waste products. Regulation of body temperature, pH and electrolytes. Functioning of the immune system.

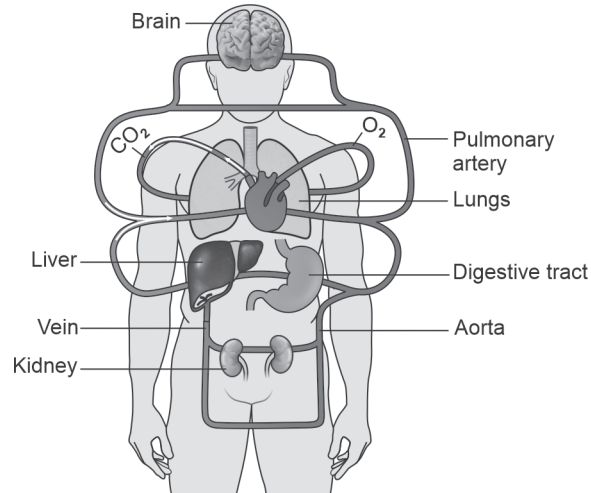


Fig. 1.3: Cardiovascular system

- **Lymphatic system and immune system:** Comprises lymph vessels, lymph nodes, spleen and thymus (**Fig. 1.4**).
Functions: Transport of white blood cells and immunoglobulins, transfer of interstitial fluid into blood stream and transporting fats from the digestive system into bloodstream.

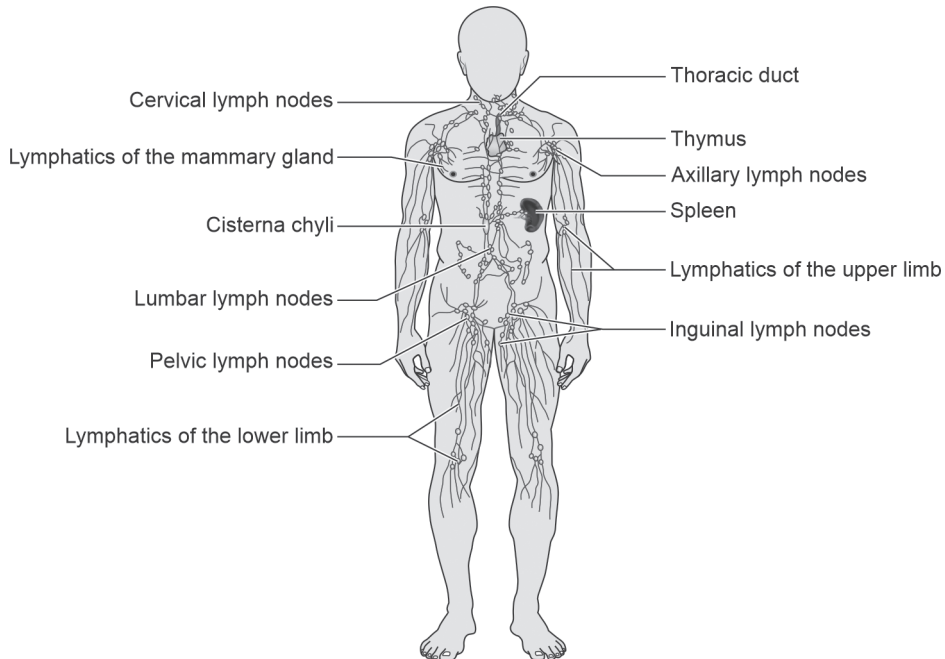


Fig. 1.4: Lymphatic system

- *Respiratory system:* Comprises lungs, trachea, bronchi and diaphragm (**Fig. 1.5**).
Functions: Exchange of oxygen and carbon dioxide between the body and air.

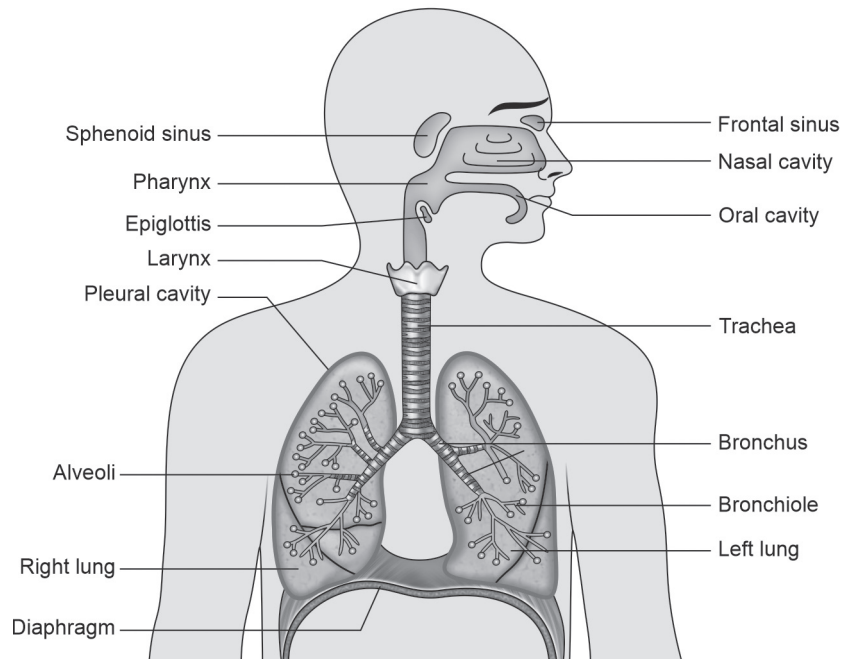


Fig. 1.5: Respiratory system

- *Nervous system:* Comprises brain, spinal cord and nerves (**Fig. 1.6**).
Functions: Controls all functions of the body by relaying messages through electric impulses, sensory perception, motor control and higher functions like thinking, memory and emotions.

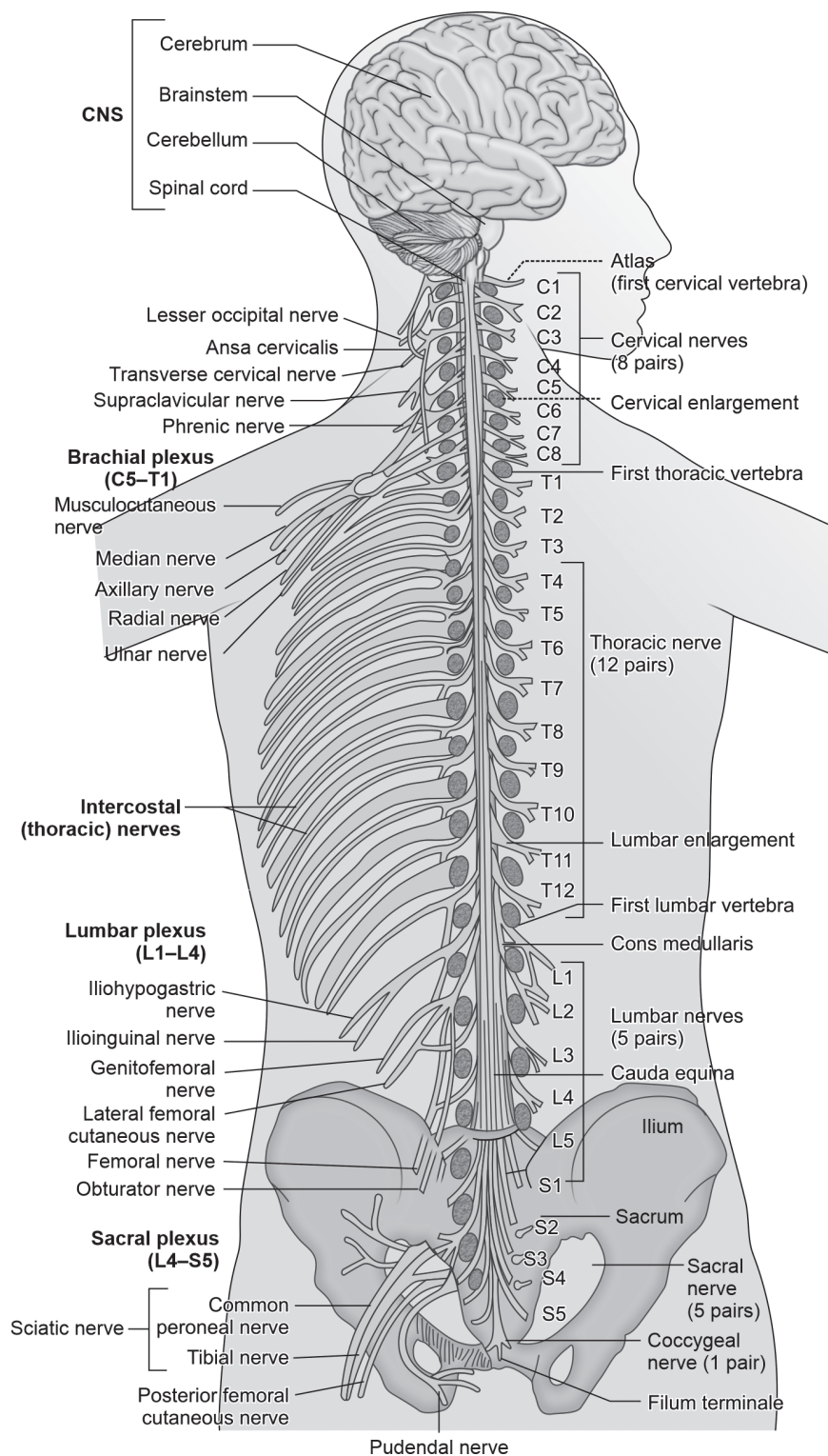


Fig. 1.6: Nervous system

- *Digestive system:* Comprises mouth, esophagus, stomach, small intestine, large intestine, liver and pancreas (**Fig. 1.7**).
Functions: Breakdown of food taken by mouth into small absorbable nutrients in the intestines. Excretion of waste products in the form of stools.

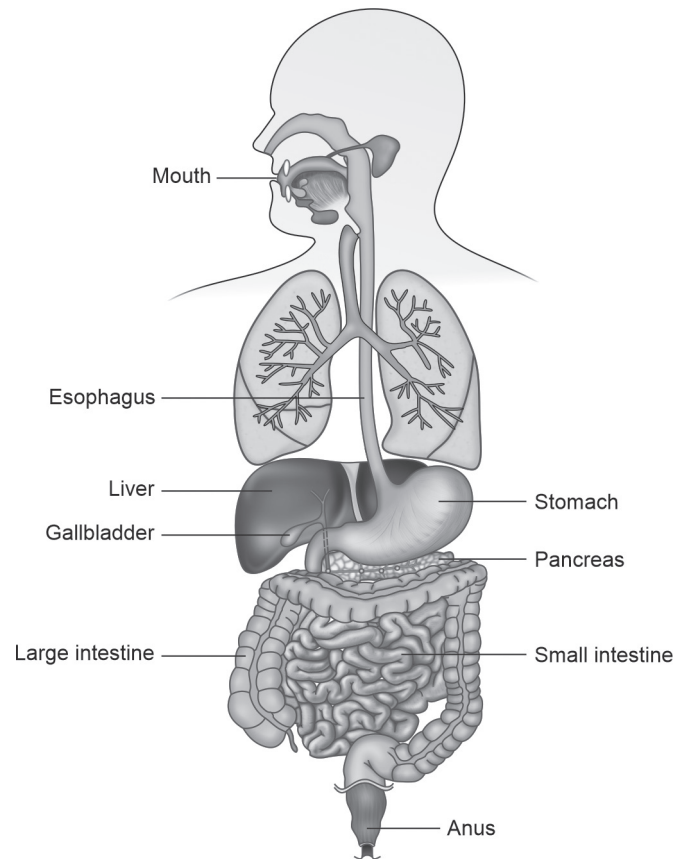


Fig. 1.7: Digestive system

- **Muscular system:** Comprises skeletal, smooth and cardiac muscles (**Fig. 1.8**).
Functions: Voluntary and involuntary movements, posture and generation of heat.

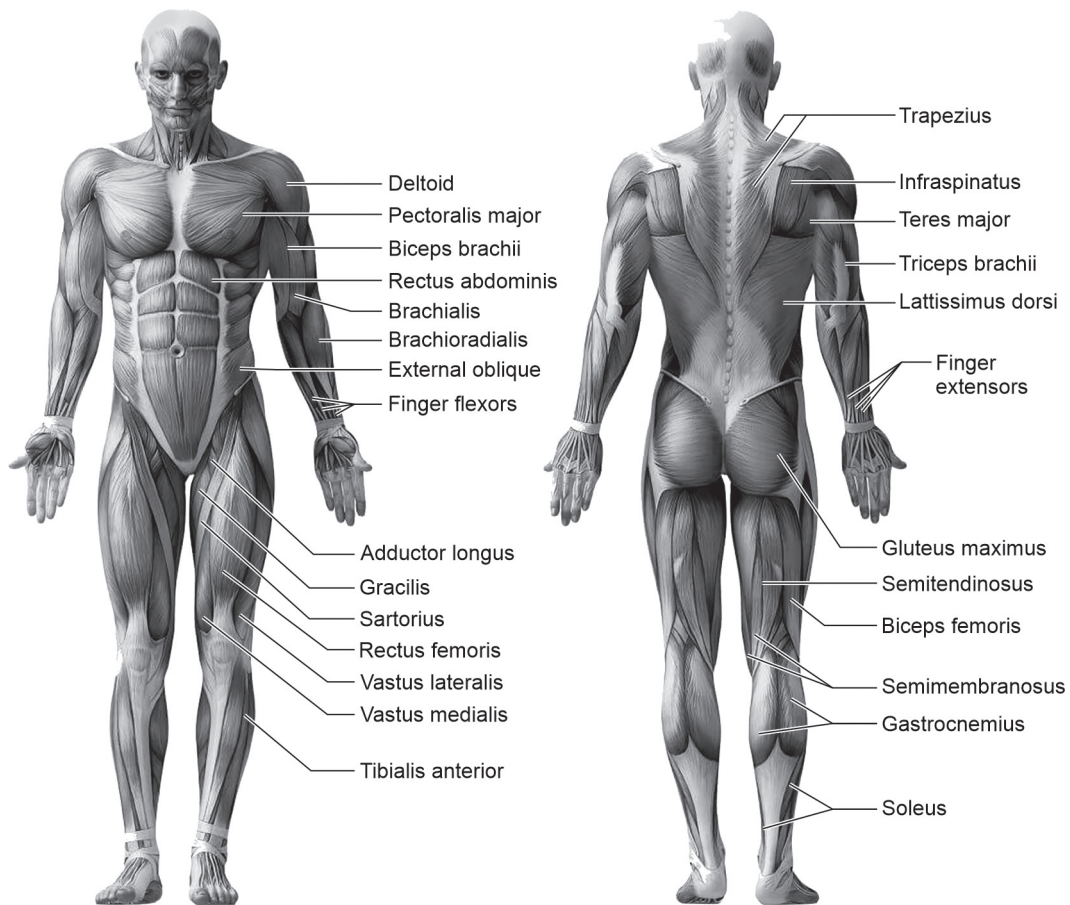


Fig. 1.8: Muscular system

- Urinary system:** Comprises kidneys, ureters, bladder and urethra (**Fig. 1.9**).
Functions: Filters blood and removes waste products, fluid and electrolyte balance, blood pressure regulation, producing erythropoietin, converting inactive vitamin D into active form.

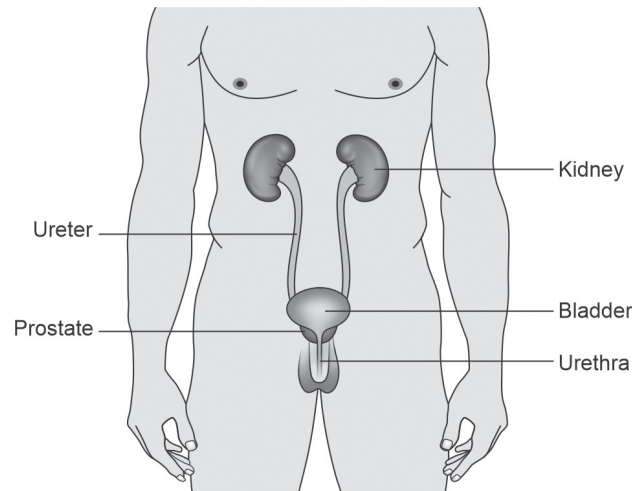


Fig. 1.9: Urinary system

- Reproductive system:** The reproductive system is different in males and females. In males it comprises testes, seminal vesicles, prostate, and penis. In females it comprises ovaries, uterus, fallopian tubes and vagina (**Fig. 1.10**).
Functions: Production of gametes (spermatozoa and ova) for reproduction.

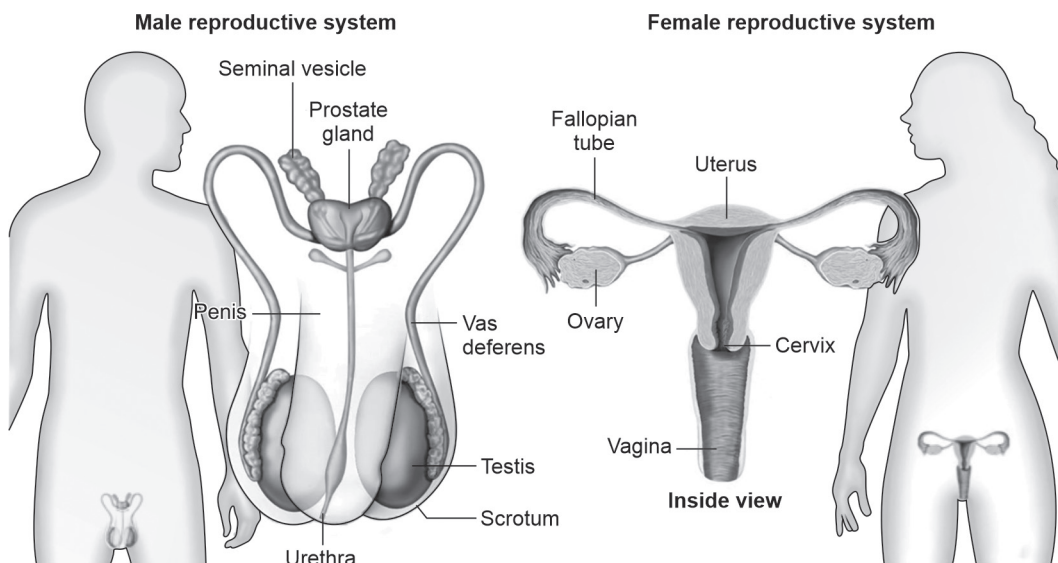


Fig. 1.10: Reproductive system

- **Endocrine system:** Comprises ductless glands like pituitary, thyroid, adrenal and reproductive glands (**Fig. 1.11**).

Functions: These glands produce hormones which regulate various functions like growth, development, metabolism and reproduction.

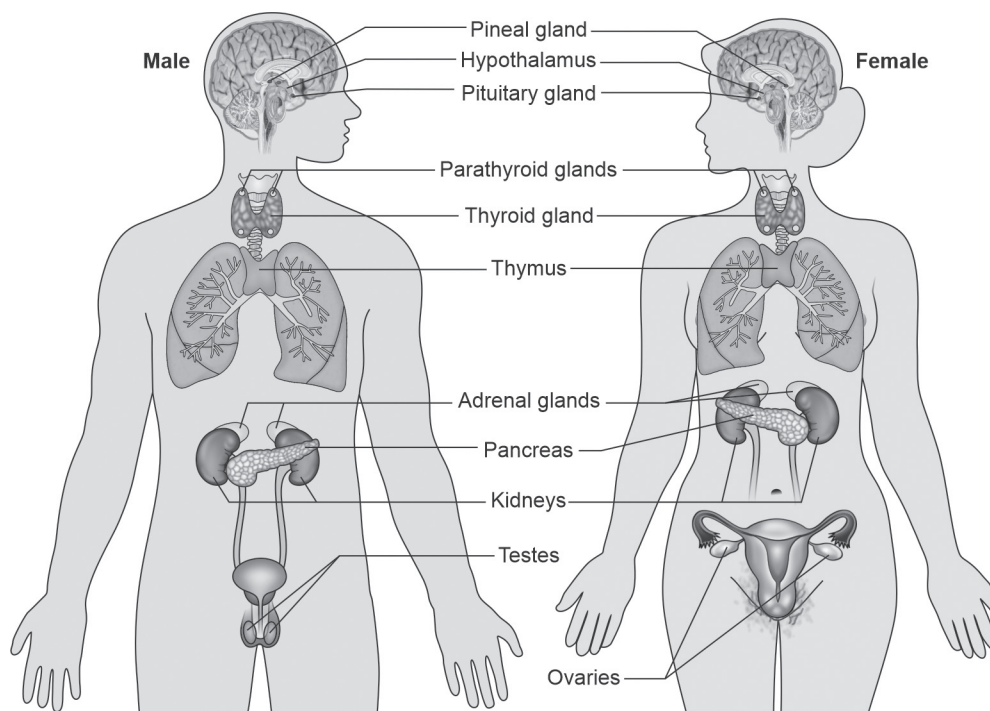


Fig. 1.11: Endocrine system

COMMONLY USED MEDICAL TERMS IN DESCRIBING ANATOMY (**Fig. 1.12**)

- **Coronal plane:** Frontal plane. This plane runs from the head to feet dividing the body into a front (anterior) and a back (posterior) portion.
- **Sagittal plane:** Lateral plane. This plane runs from front to back dividing the body into a left and a right half.
- **Axial plane:** Transverse plane. This plane runs horizontally dividing the body into upper and lower parts.
- **Superior (cranial):** Any structure that is directed towards the head.

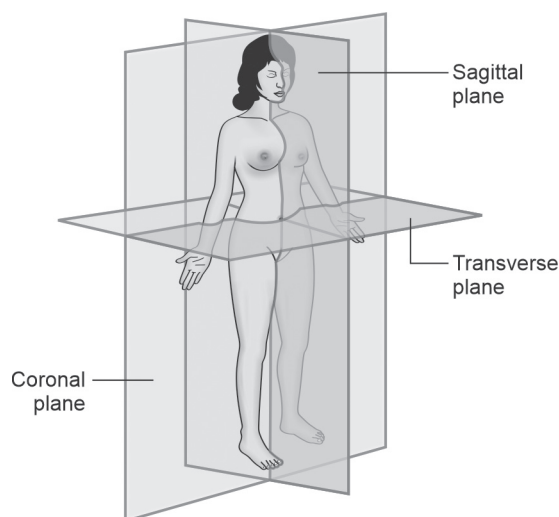


Fig. 1.12: Planes of the body

- *Inferior (caudal)*: Any structure that is directed towards the feet.
- *Anterior (ventral)*: Structures located towards the front.
- *Posterior (dorsal)*: Structures located towards the back.
- *Medial*: Structures directed towards the midline of the body.
- *Lateral*: Structures directed towards the sides of the body.
- *Intermediate*: Structures in between a medial and a lateral structure.
- *Proximal*: Structures close to the body.
- *Distal*: Structures away from the body.
- *Superficial*: Structures close to the surface.
- *Deep*: Structures inner to the surface.
- *Afferent*: Coming towards. For example, sensory nerves carrying sensations from skin to the brain.
- *Efferent*: Going away. For example, motor nerves carrying messages from the brain to the muscle.

IMPORTANT CAVITIES OF THE BODY

- *Thoracic cavity*: It is the cavity in the chest that houses the heart and its major blood vessels, the trachea and lungs, the esophagus and many nerves. It is surrounded by the pleura (**Fig. 1.13**).

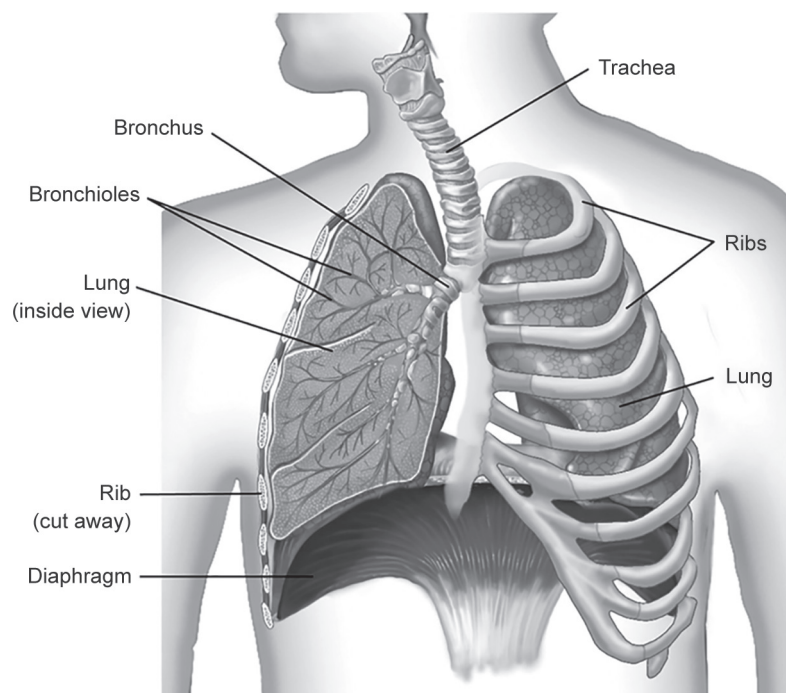


Fig. 1.13: Thoracic cavity

- *Abdominal cavity:* Its upper part is called the abdomen and the lower part is called the pelvis. It is separated from the thoracic cavity by diaphragms. The abdomen houses the major part of the gastrointestinal tract, kidneys adrenal glands, large blood vessels, nerves and lymph nodes. The pelvis contains the rectum and the urogenital system (**Fig. 1.14**).

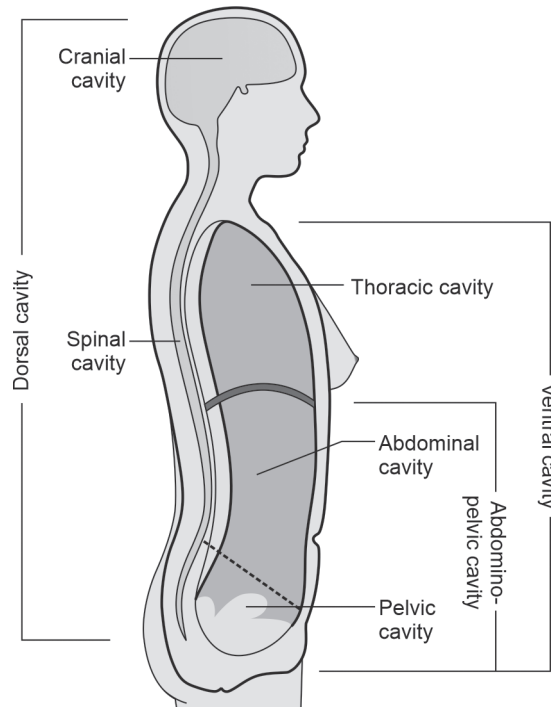


Fig. 1.14: Sagittal section showing body cavities

- *Cranial cavity:* It contains the brain and its blood vessels.
- *Vertebral canal:* It houses the spinal cord.