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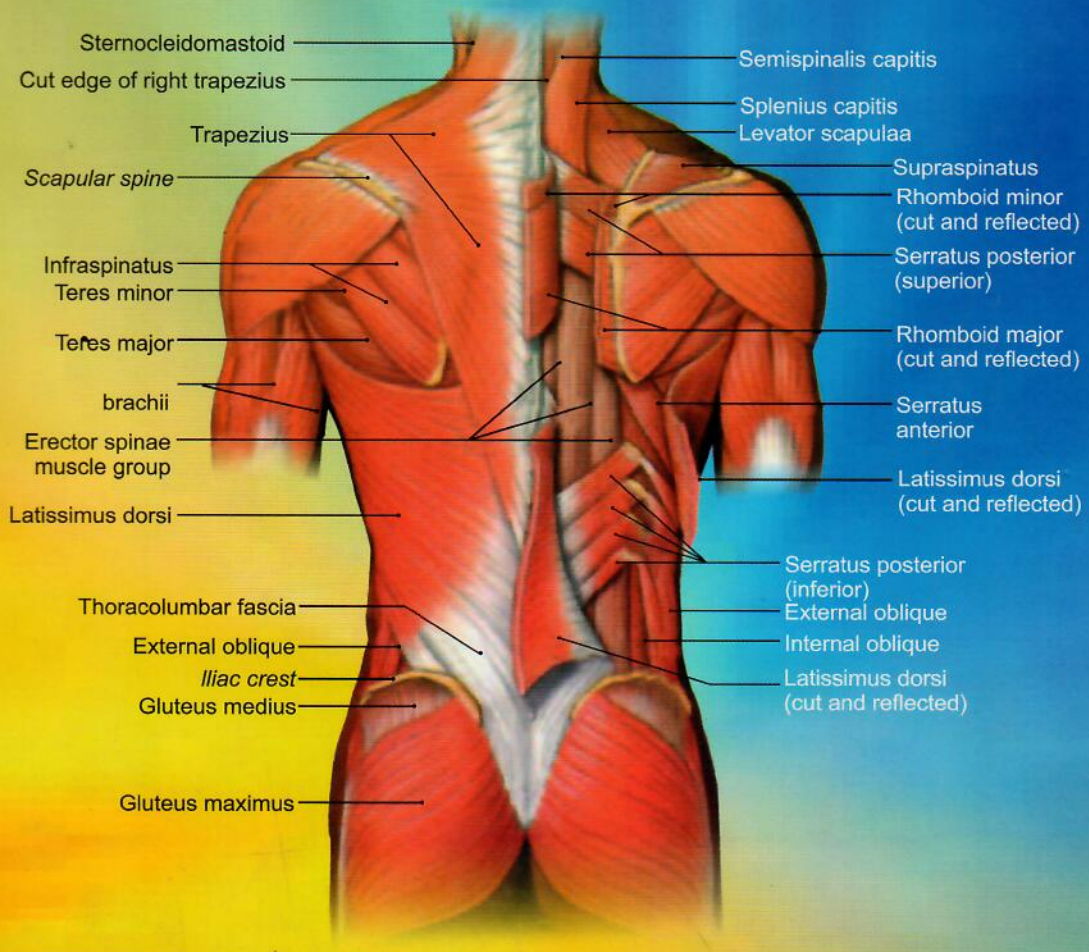

OLUCHI ANN OLOFIN

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Dedication

This book is dedicated to God Almighty; and our Lord Jesus Christ,

the Author and Finisher of my faith.

Acknowledgements

First and foremost, I express my greatest gratitude to the Almighty God for the successful completion of this text. The way you get good ideas is by working with talented people who are also fun to be with. The Department of Dental Therapy, Federal College of Dental Technology & Therapy, Enugu is a wonderful place to work, and my colleagues gave me all the support I needed while working on this book. I would like to thank my Rector, Dr. (Mrs) K. B. Sofoluwe, the Deputy Rector, Dr. J. J. Omale, the Registrar, Sir P. O. Anigbo, and the entire management staff, who gave me the privilege to impart the knowledge to students.

My hearty gratitude goes to my husband, Dr. Babatunde Olofin, who repeatedly endured and understood my busy schedules and appointments. I appreciate your care, prayers and love. Finally, the author will not forget the labour of love that the Managing Director of Immaculate Publications Limited, Mr. Ezeh Emmanuel Ezeh and his staff, Chioma Ugwu, Ugochukwu Ani and Ikechukwu Azuruonye, towards the successful printing of this book, despite the lean financial resources. The God of heaven and earth will bless you all.

Olofin, Oluchi, A. RDTh, FIIA
July, 2016

Preface

Human anatomy and physiology courses present exciting and tremendous challenges to both students and teachers. The acquisition of basic anatomical and physiological facts is essential to the study of anatomy and physiology, but it is also important for students to develop ability to solve practical, real-life problems related to the knowledge they have acquired. It is not possible for students to learn all of the details of anatomy and physiology that are known. Selecting the most important information to provide a solid understanding of anatomy and physiology and to prepare students to solve problems effectively are major challenges for teachers and for authors. Anatomy is the science of the structure of the body. When used without qualification, the term is applied usually to human anatomy. The word is derived indirectly from the Greek anatome, a term built from ana, meaning "up," and tome, meaning "a cutting" (compare the words tome, microtome, and epitome). From an etymological point of view, the term" dissection" (dis-, meaning" asunder, " and section, meaning "to cut") is the Latin equivalent of the Greek anatome. Anatomy, wrote Vesalius in the preface to his De Fabrica (1543), "should rightly be regarded as the firm foundation of the whole art of medicine and its essential preliminary." Moreover, the study of anatomy introduces the student to the greater part of medical terminology. Anatomy "is to physiology as geography is to history" (Femel); that is, it provides the setting for the events. Although the primary concern of anatomy is with structure, structure and function should be considered together. Moreover, by means of surface and radiological anatomy, emphasis should be placed on the anatomy of the living body. As Whitnall expressed it, "I cannot put before you too strongly the value and interest of this rather neglected [surface] aspect of anatomy. Many a student first realizes its importance only when brought to the bedside or the operating table of his patient, when the first thing he is faced with is the last and least he has considered." The classical methods of physical examination of the body and the use of some of the various "-scopes," e.g., the stethoscope and the ophthalmoscope, should be included. Radiological studies facilitate achievement of "an understanding of the fluid character of anatomy and physiology of the living" (A.E. Barclay), and the importance of variation should be kept in mind. In relation to the size of the parts studied, anatomy is

usually divided into (1) macroscopic or gross anatomy, and (2) microscopic anatomy or histology (now used synonymously). In addition, embryology is the study of the embryo and the foetus, that is, the study of prenatal development, whereas the study of congenital malformations is known as teratology.

In general, works dealing with human anatomy are arranged either (1) systemically, that is, according to the various systems of the body (skeletal, muscular, digestive, etc.) or (2) regionally, that is, according to the natural, main subdivisions of the body (head and neck, upper limb, thorax, etc.). In this book, after the general features of certain systems have been discussed in introductory chapters, the remainder of the work will general follow a regional approach. The regional plan has been adopted chiefly because the vast majority of laboratory courses in human anatomy are based on regional dissection.

Organization and Scope

This new text elaborately outlines the fundamental concepts of human anatomy and physiology, with the explanation of the Introductory Concept of Human Anatomy and Physiology, Human Cell Structure, Human Tissues, Body System Structures, Body Fluids and Composition, Respiratory System, Digestive System, Reproductive System, Endocrine System, and Nervous System. To buttress the vivid explanation of the author, this book is reinforced with review questions at the end of each chapter. For clarity and understanding, this text is divided into ten distinct chapters.

Chapter 1: Introductory Concept of Human Anatomy and Physiology – This chapter begins with an overview of anatomy and physiology and a preview of the body regions and functions. It then covers the characteristics of life and how the body works to maintain stable conditions. It introduces a set of standard terms for body structures and for planes and positions in the body that will serve as a foundation for more comprehensive information covered later in the text. It ends with examples of medical imaging used to see inside the living body.

Chapter 2: Human Cell Structure – explains the structure and function of the cell membrane, including its regulation of materials into and out of the cell; describe the functions of the various cytoplasmic organelles; explain the structure and contents of the nucleus, as well as the process of DNA replication; explain the process by which a cell builds proteins using the DNA code; list the stages of the cell cycle in order, including the steps of cell division in somatic cells; discuss how a cell differentiates and becomes more specialized; and lists the morphological and physiological characteristics of some representative cell types in the human body.

Chapter 3: Human Tissues – Identify the main tissue types and discuss their roles in the human body; identify the four types of tissue membranes and the characteristics of each that make them functional; explain the functions of various epithelial tissues and how their

forms enable their functions; explain the functions of various connective tissues and how their forms enable their functions' describe the characteristics of muscle tissue and how these enable function; discuss the characteristics of nervous tissue and how these enable information processing and control of muscular and glandular activities.

Chapter 4: **Body System Structures** – Discuss the bones of the pectoral and pelvic girdles, and describe how these unite the limbs with the axial skeleton; describe the bones of the upper limb, including the bones of the arm, forearm, wrist, and hand; Identify the features of the pelvis and explain how these differ between the adult male and female pelvis; Describe the bones of the lower limb, including the bones of the thigh, leg, ankle, and foot; Describe the embryonic formation and growth of the limb bones; Discuss both functional and structural classifications for body joints; Describe the characteristic features for fibrous, cartilaginous, and synovial joints and give examples of each; Define and identify the different body movements; Discuss the structure of specific body joints and the movements allowed by each; Explain the development of body joints; Explain the organization of muscle tissue; Describe the function and structure of skeletal, cardiac muscle, and smooth muscle; Explain how muscles work with tendons to move the body; Describe how muscles contract and relax; Define the process of muscle metabolism; Explain how the nervous system controls muscle tension; Relate the connections between exercise and muscle performance; Explain the development and regeneration of muscle tissue; Explain the structure and organization of muscle fascicles and their role in generating force; Explain the criteria used to name skeletal muscles; and Identify the skeletal muscles and their actions on the skeleton and soft tissues of the body.

Chapter 5: **Body Fluids and Composition** – Identify the body's main fluid compartments; Define plasma osmolality and identify two ways in which plasma osmolality is maintained; Identify the six ions most important to the function of the body; Define buffer and discuss the role of buffers in the body; Explain why bicarbonate must be conserved rather than reabsorbed in the kidney; and Identify the normal range of blood pH and name the conditions where one has a blood pH that is either too high or too low.

Chapter 6: Respiratory System – -Describe the purpose of the respiratory system; Differentiate between external and internal respiration; Name all of the structures of the respiratory system; Explain how food and foreign materials are kept out of the respiratory tract; Explain the mechanism for the pulmonary ventilation; List and define five breathing volumes; and Describe in which respiration is regulated.

Chapter 7: Digestive System- List and describe the functional anatomy of the organs and accessory organs of the digestive system; Discuss the processes and control of ingestion, propulsion, mechanical digestion, chemical digestion, absorption, and defecation; Discuss the roles of the liver, pancreas, and gallbladder in digestion; and Compare and contrast the digestion of the three macronutrients.

Chapter 8: Reproductive System– treats extensively the following: the anatomy of the male and female reproductive systems, including their accessory structures; the role of

hypothalamic and pituitary hormones in male and female reproductive function; trace the path of a sperm cell from its initial production through fertilization of an oocyte; the events in the ovary prior to ovulation; and the development and maturation of the sex organs and the emergence of secondary sex characteristics during puberty.

Chapter 9: Endocrine System– ensures that at the end of the chapter, the learners should be able to learn about: compare the effects of the nervous system and the endocrine system in controlling the body; compare protein and steroid hormones with respect to position and method of action and give examples of each type; describe three methods for regulating the release of hormone; identify the glands of the endocrine system on a diagram; list the hormones produced by each endocrine gland and describe the effects of each on the body; describe how the hypothalamus controls the anterior and posterior pituitary; explain why the anterior pituitary is called the master gland; and explain how the endocrine system responds to stress.

Chapter 10: Nervous System– enables the learners should be able to learn about: the generalized functions of the system as a whole; the organisation of the nervous tissue; the major types of cells in the nervous system and discuss the function of each; types of neurons; brief description of the mechanisms of transmission of a nerve impulse; transmission at a synapse; neurotransmitter and give several examples of them; components of a reflex arc; the divisions of the nervous system; the major anatomical components of the brain and spinal cord and briefly comment in the function of each; coverings and fluid spaces of the brain and spinal cord; spinal and cranial nerves; the anatomical and functional characteristics of the two divisions of the autonomic nervous system ; classify sense organs as special or general and explain the basic differences between the two groups; chemical receptors and their functions; and general sense organs and their functions.

Olofin, Oluchi A. RDTh, FIIA
July, 2016

Brief Contents

Detailed Table of Contents

Chapter 1

Introductory Concepts

1.1 Definitions of Anatomy and Physiology

The term "**anatomy**" derives from the ancient Greek meaning "to dissect". Anatomy is the study of structures that make up the body and how those structures relate with each other. As in veterinary anatomy human anatomy is subdivided into macroscopic (or gross) and microscopic anatomy. Macroscopic anatomy describes structures, organs, muscles, and bones, which are visible to the naked eye that is macroscopic. In order to establish a certain order they are divided topographically and systematically. Microscopic human anatomy is the study of "tissues", that is histology. It may be further separated into cytology, the pure study of cells. In contrast to macroscopic anatomy you require – as the name suggests - an optical magnification in order to evaluate microscopic (e.g. cellular) structures. Embryology needs to be considered as part of human anatomy as well. It is the study of the development of the human body beginning from fertilization of the ovum until birth.

Much like anatomy, physiology is concerned with the principal organ systems, such as the musculoskeletal and nervous systems. The word "physiology" derived from a Greek word for study of nature. It is the study of how the body and its part work or function. However, when studying physiology, you will be looking at the functions of cells and organs within their biological systems, rather than their structures. You could study physiology on a broad level, such as the physiology of mammals, during which you would study the manner in which organs function in the body of a mammal as a whole. You might also study with a narrower focus, such as the physiology of the cardiovascular system. For example, during this course, you might take a look at how the heart performs its particular function. Hence, Anatomy and physiology are studied together to give students a full appreciation and understanding of human body.

Human anatomy has a very old and vast history; it is an about 2000 year old scientific discipline. Historically seen since the first dissection of the human body in the third century B.C. in the old Egypt there has been no rapid development - at least not in the beginning. Some of the most intelligent people the world has ever seen had been the part of this history. The overall history of human anatomy can be divided into the following periods:

1. **Greek period**: Greek period in the history of human anatomy started somewhere near 400 BC. The most famous anatomists of this period were Hippocrates and Herophilus. Hippocrates was regarded as the father of medicine and he was one of the founders of anatomy. Herophilus is known as father of anatomy and he was one of the first very few people to dissect human body. Herophilus did some great differentiations in the field of

anatomy for example he differentiated cerebrum from cerebellum, nerves from tendons, arteries from veins etc.

2. **Roman period**: The most prominent anatomist of this period was Galen. He is known as the "Prince of Physicians" because he was the first experimental physiologist. His teachings were followed for nearly 15 centuries considering them as infallible authorities of anatomy.
3. **Fourteenth century**: The most prominent scientist of this period was Mondino de Liuzzi. He was an Italian and had the post of professor of anatomy in Balogna. His famous book "Anthomia" was treated as the authorized anatomical text for over a century. The reason his book became so famous was that he taught anatomy by dissection for which his book was a guide. Before the famous Vesalius, he was the most renowned anatomist.
4. **Fifteenth century**: This century is the time when one of the greatest geniuses of all times Leonardo da Vinci lived. Da Vinci was the originator of cross sectional anatomy. The most admirable and important work done by him in the field of anatomy was the collection of drawings of the things he observed. These drawings were made with extreme perfection. He made a total of 500 diagrams in his 60 notebooks.
5. **Sixteenth century**: This is the century of the greatest anatomist of all times, the famous Vesalius. He is regarded as the "Founder of Modern Anatomy" because he made the world realize that anatomy can only be taught through dissection. He corrected the erroneous concepts of Galen and fought against his authority thus he corrected the concepts which were continuously taught wrong for about 15 centuries.
6. **Seventeenth century**: In this century lived the famous English anatomist William Harvey. He discovered the circulation of blood through human body and published in the book titled "Anatomical exercise on the motion of blood and heart in animals:" He also published a book on embryology.
7. **Eighteenth and Nineteenth century**: In these two centuries major steps were taken in learning procedure for anatomy. Dissection was made compulsory for medical students. Warburton Anatomy Act was passed in England under which the unclaimed bodies were made available for dissection. The use of formalin as a fixative started in this period and techniques of endoscopy were also discovered. Prominent anatomists of this century included Cuvier, Meckel and Henry

1.2 Branches of Human Anatomy

Human anatomy is divided into following important branches:

1. **Gross anatomy**: Gross anatomy is the study of macroscopic details of human body structure. Because gross anatomy is concerned only with macroscopic details, therefore it does not require the aid of any instrument. Generally gross anatomy is studied on dead bodies because you cannot dissect a living human just to study anatomy; therefore gross anatomy is also known as cadaveric anatomy. There are two approaches to study gross anatomy: Systemic Approach and Regional Approach. In systemic approach, human body is studied in different systems and in regional approach, human body is studied in different regions. The end result of both approaches is the same but generally for students of surgery, regional approach is preferred.

2. **Living anatomy**: In contrast to the cadaveric anatomy, in living anatomy deals with the study of live human beings and not dead bodies, therefore methods like dissection cannot be applied. Techniques to study living anatomy include palpation, percussion, auscultation etc.
3. **Embryology**: Embryology is also known as developmental anatomy. It is concerned with the study of development of an embryo from a single cell to a complete human being. Embryology provides details of the prenatal and postnatal developmental changes in the body and the mechanisms by which these changes occur.
4. **Histology**: Histology is also known as microscopic anatomy. It deals with the study of microscopic details of tissues that make human body.
5. **Surface anatomy**: Surface anatomy, as the named indicates, is anatomy of the surface of human body structures. It is also known as topographic anatomy. Surface anatomy establishes a relation between the internal structures of human body with its surface. It enables a medical professional to locate the position of internal organs from surface of the body and therefore it is very important for surgical operations. Sometimes surface anatomy is described as a sub-branch of gross anatomy but it is better to write it separately to highlight its importance.
6. **Clinical anatomy**: Clinical anatomy is the application of anatomical knowledge to clinical practice. This branch is a more practical aspect of human anatomy and is of supreme importance for medical professionals.

1.3 Level of Structural Organization of the Body

The human body has different structural levels of organization, starting with atoms molecules and compounds and increasing in size and complexity to cells, tissues, organs and the systems that make up the complete organism.

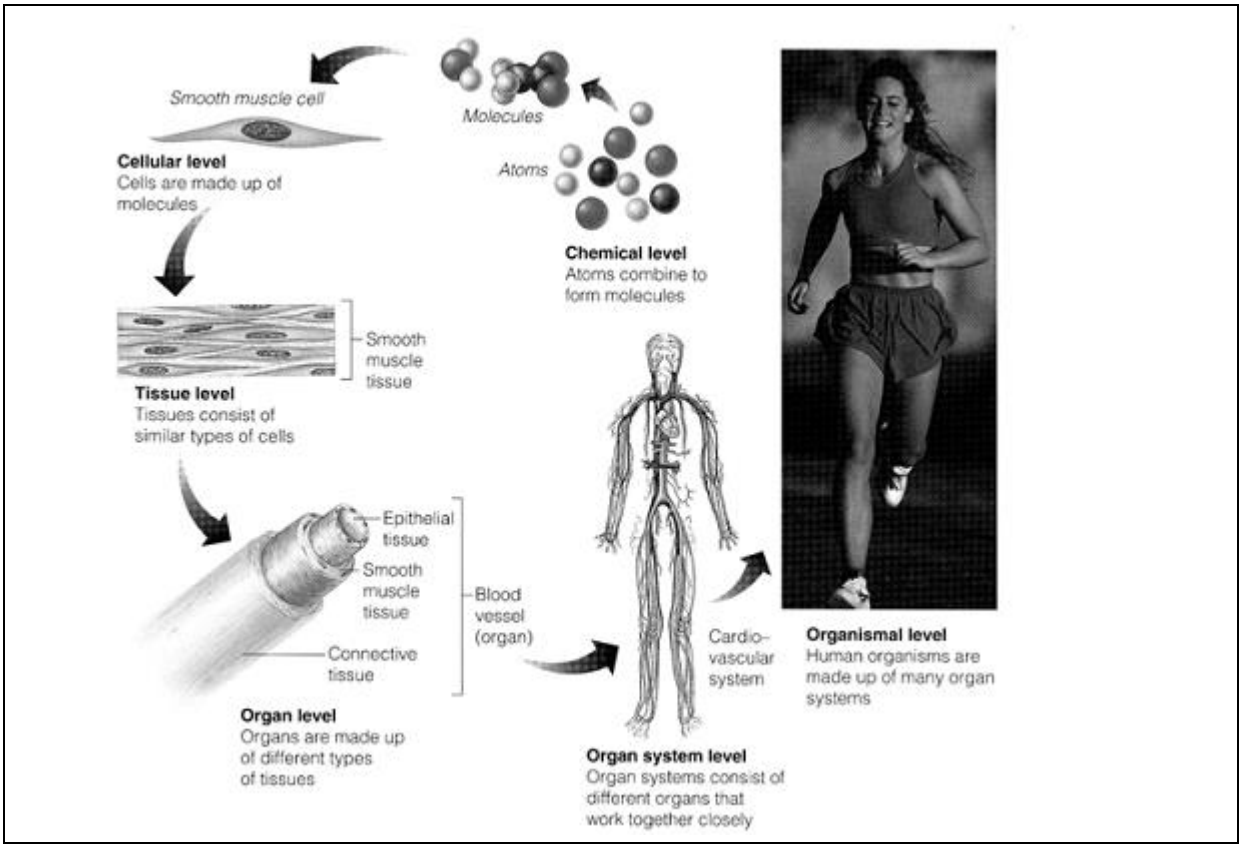

Figure: 1.1: Levels of structural organization of the body (Source: Elaine MARIEB, (2000), Essentials of human anatomy and physiology, Addison Wesley Longman Inc., San Francisco, 6th Ed.)

1. **Atoms molecules and compounds**: At its simplest level, the body is composed of atoms. The most common elements in living organisms are carbon, hydrogen, oxygen, nitrogen phosphorus and sulphur.

Atoms → Molecule → Compounds

2. **Cell**: The smallest independent units of life. All life depends on the many chemical activities of cells. Some of the basic functions of cell are: growth, metabolism, irritability and reproduction.
3. **Tissue**: tissue is made up of many similar cells that perform a specific function. The various tissues of the body are divided in to four groups. These are epithelial, connective, nervous and muscle tissues. Epithelial tissue is found in the outer layer of skin, lining of organs, blood and lymph vessels and body cavities. Connective tissue connects and supports most part of the body, they constitute most part of skin, bone and tendons. Muscle tissue produces movement through its ability to contract; this constitutes skeletal, smooth and cardiac muscles. Nerve tissue is found in the brain, spinal cord and nerves; it responds to various types of stimuli and transmits nerve impulses.
4. **Organ**: - Is an integrated collection of two or more kinds of tissue that works together to perform specific function. For example: Stomach is made of all type of tissues.
5. **System**: Is a group of organs that work together to perform major function. For example: Respiratory system contains several organs.
6. **Organism** level: - The various organs of the body form the entire organism.

1.4 Basic Anatomical Terms

Anatomical terms are made up of roots, prefixes, and suffixes. The root of a term often refers to an organ, tissue, or condition, whereas the prefix or suffix often describes the root. For example, in the disorder hypertension, the prefix "hyper-" means "high" or "over," and the root word "tension" refers to pressure, so the word "hypertension" refers to abnormally high blood pressure. The roots, prefixes and suffixes are often derived from Greek or Latin, and often quite dissimilar from their English-language variants. Latin names of structures such as musculus biceps brachii can be split up and refer to, musculus for muscle, biceps for "two-headed", brachii as in the brachial region of the arm. The first word tells us what we are speaking about, the second describes it, and the third points to location.

When describing the position of anatomical structures, structures may be described according to the anatomical landmark they are near. These landmarks may include structures, such as the umbilicus or sternum, or anatomical lines, such as the midclavicular line from the centre of the clavicle. The cephalon or cephalic region refers to the head. This area is further differentiated into the cranium (skull), facies (face), frons (forehead), oculus (eye area), auris (ear), bucca (cheek), nausus (nose), oris (mouth), and mentis (chin). The neck area is called the cervicis or cervical region. Examples of structures named according to this include the frontalis muscle, submental lymph nodes, buccal membrane and orbicularis oculi muscle.

Sometimes, unique terminology is used to reduce confusion in different parts of the body. For example, different terms are used when it comes to the skull in compliance with its embryonic origin and its tilted position compared to in other animals. Here, Rostral refers to proximity to the front of the nose, and is particularly used when describing the skull. Similarly, in the arms, different terminology is often used in the arms, in part to reduce ambiguity as what is the "front", "back", "inner" and "outer" surfaces. For this reason, the terms below are used:

- **Radial** referring to the radius bone, seen laterally in the anatomical position.
- **Ulnar** referring to the ulna bone, medially positioned when in the anatomical position.

When anatomists refer to the right and left of the body, it is in reference to the right and left of the subject, not the right and left of the observer. When observing a body in the anatomical position, the left of the body is on the observer’s right, and vice versa. It is really important to understand the basic terms, which would be used again and again throughout the course of learning anatomy. Therefore, it is highly recommended that you try to learn the following terms. These standardized terms avoid confusion. Examples of terms include:

- **Anterior** and **posterior**, which describe structures at the front (anterior) and back (posterior) of the body. For example, the toes are anterior to the heel, and the popliteus is posterior to the patella.
- **Superior** and **inferior**, which describe a position above (superior) or below (inferior) another part of the body. For example, the orbits are superior to the oris, and the pelvis is inferior to the abdomen.
- **Proximal** and **distal**, which describe a position that is closer (proximal) or further (distal) from the trunk of the body. For example, the shoulder is proximal to the arm, and the foot is distal to the knee.

- **Superficial** and **deep**, which describe structures that are closer to (superficial) or further from (deep) the surface of the body. For example, the skin is superficial to the bones, and the brain is deep to the skull. Sometimes profound is used synonymously with deep.
- **Medial** and **lateral**, which describe a position that is closer to (medial) or further from (lateral) the midline of the body. For example, the nose is medial to the eyes, and the thumb is lateral to the other fingers.
- **Ventral** and **Dorsal**, which describe structures derived from the front (ventral) and back (dorsal) of the embryo, before limb rotation.
- **Cranial** and **caudal**, which describe structures close to the top of the skull (cranial), and towards the bottom of the body (caudal).
- Occasionally, **sinister** for left, and **dexter** for right are used.
- **Paired**, referring to a structure that is present on both sides of the body. For example, the hands are paired structures.

1.4.1 Anatomical terms for describing positions:

Anatomical position: In this position the body is straight in standing position with eyes also looking straight. The palms are hanging by the sides close to the body and are facing forwards. The feet also point forwards and the legs are fully extended. Anatomical position is very important because the relations of all structures are described as presumed to be in anatomical position. In standard anatomical position, the human body is standing erect and at rest. Unlike the situation in other vertebrates, the limbs are placed in positions reminiscent of the supine position imposed on cadavers during autopsy. Therefore, the body has its feet together (or slightly separated), and its arms are rotated outward so that the palms are forward, and the thumbs are pointed away from the body (forearms supine). As well, the arms are usually moved slightly out from the body, so that the hands do not touch the sides. The positions of the limbs (and the arms in particular) have important implications for directional terms in those appendages. The penis in the anatomical position lies against the abdomen, hence the dorsal surface of the penis is actually anterior when the penis is pointing down between the legs.

In humans, the anatomical position of the skull has been agreed by international convention to be the Frankfurt plane or Frankfort plane, a position in which the lower margins of the orbits, the orbitales, and the upper margins of the ear canals, the poria, all lie in the same horizontal plane. This is a good approximation to the position in which the skull would be if the subject were standing upright and facing forward normally.

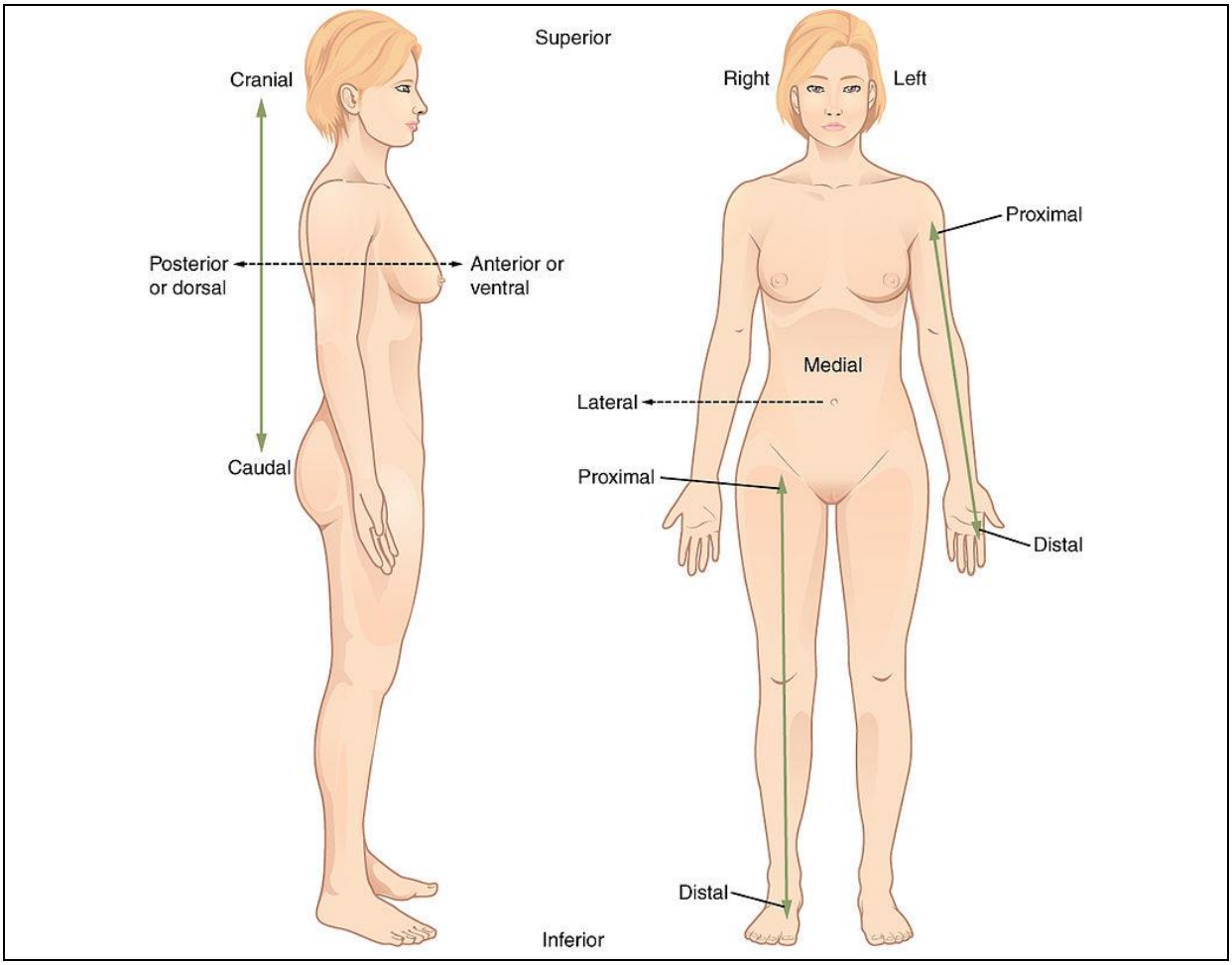

Fig. 1.2: Anatomical Position – Superior and Inferior

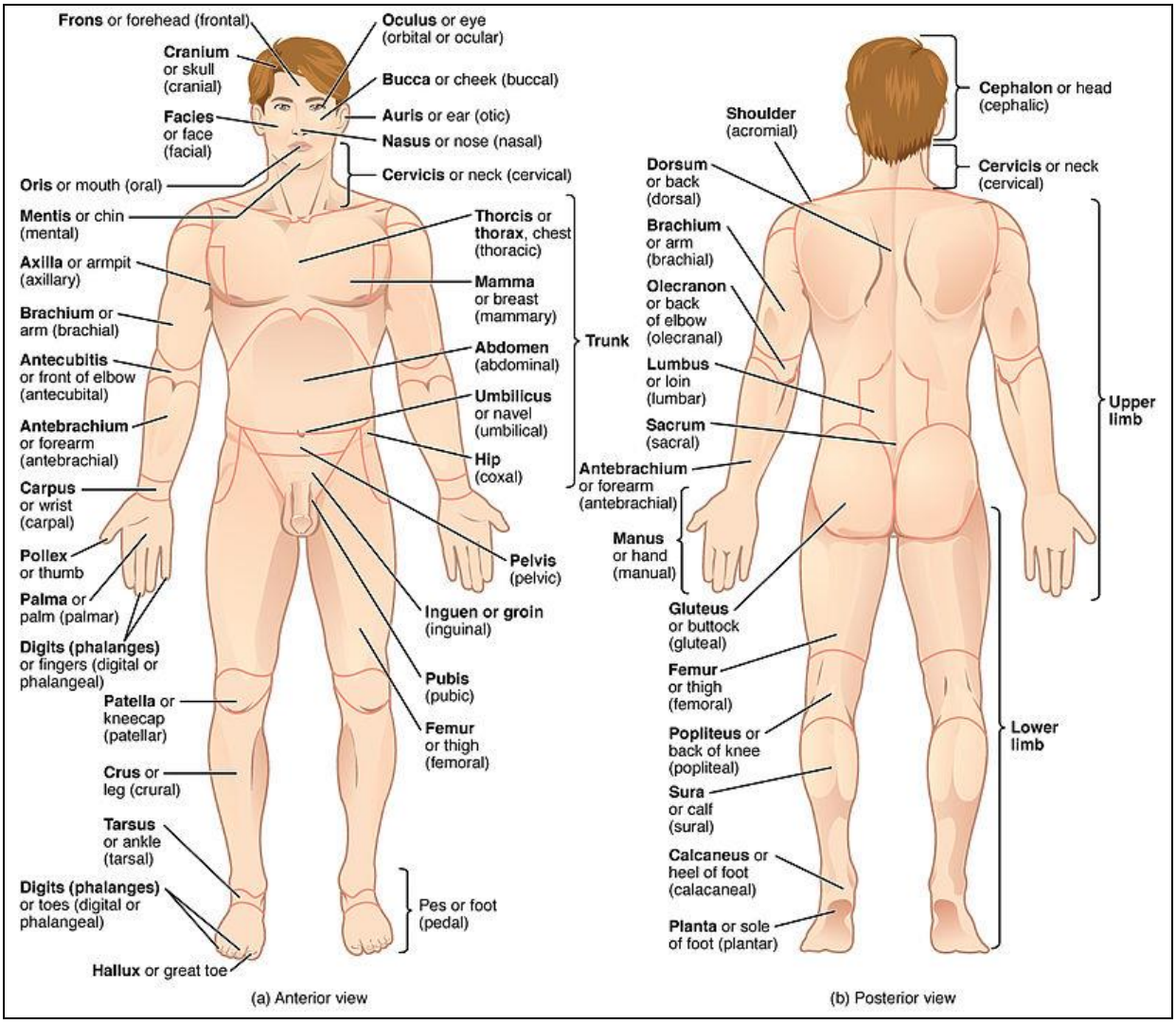

Fig. 1.3: Anatomical Position – Anterior and Posterior

Supine position: In this position, the body is lying down with face pointing upwards. All the remaining positions are similar to anatomical position with the only difference of being in a horizontal plane rather than a vertical plane.

Fig. 1.4: Supine Position

Prone position: This is the position in which the back of the body is directed upwards. The body lies in a horizontal plane with face directed downwards.

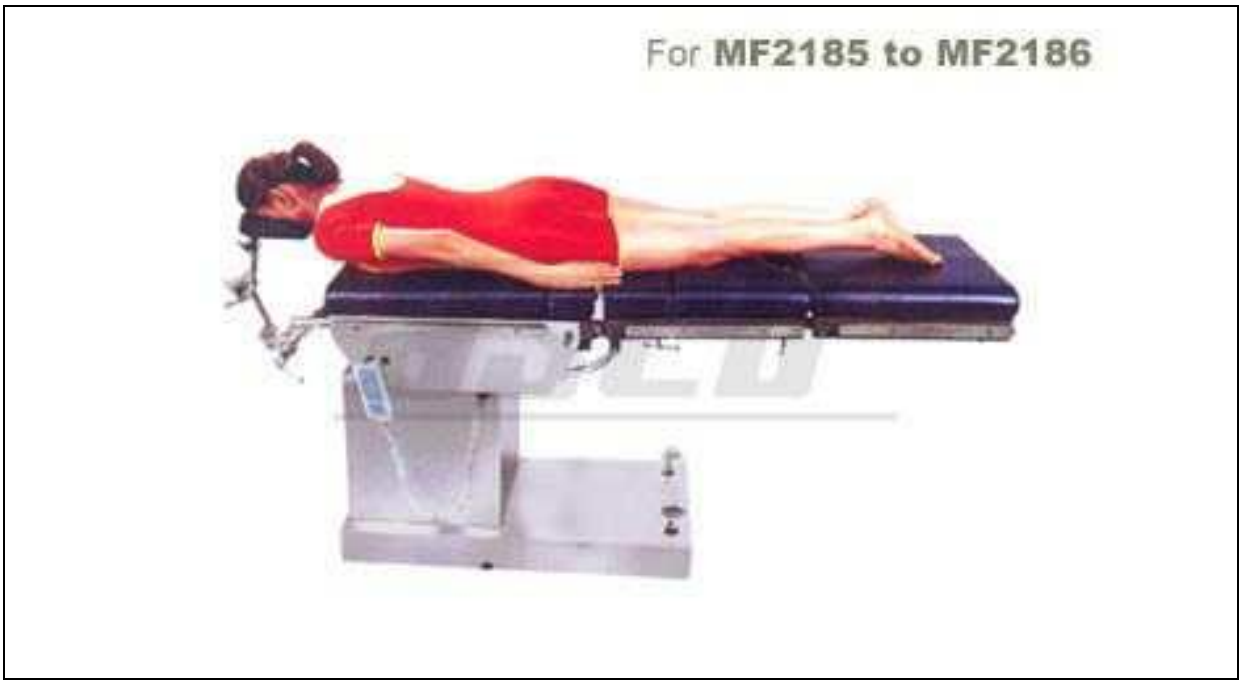

Fig. 1.5: Prone Position

Lithotomy position: In this position the body is lying in a supine with hips and knees fully extended. The feet are strapped in position to support the flexed knees and hips.

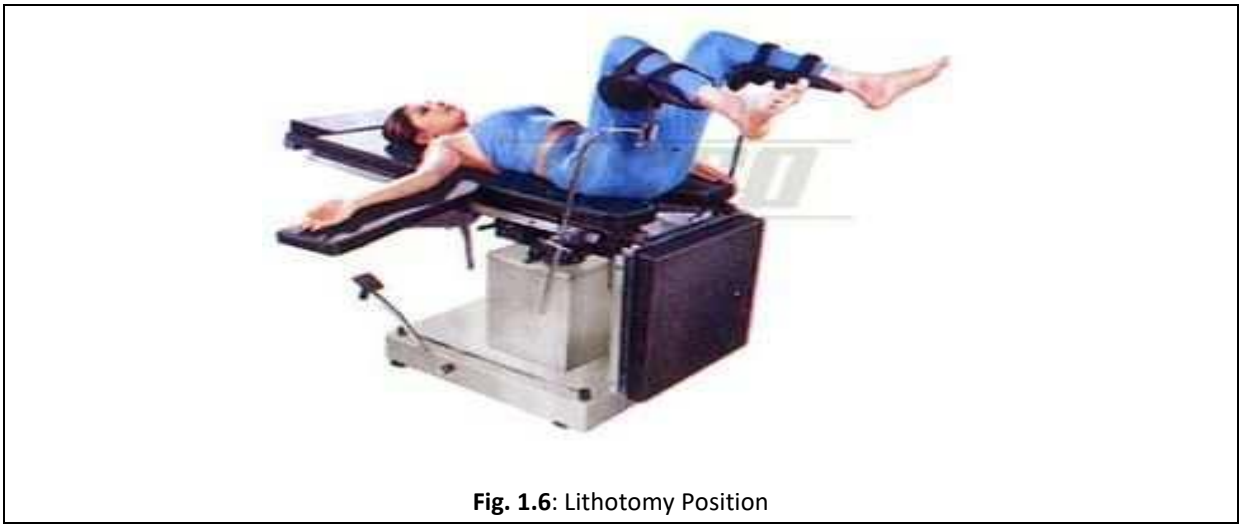

Fig. 1.6: Lithotomy Position

1.4.2 Anatomical terms for describing planes:

Anatomy is often described in planes, referring to two-dimensional sections of the body. A section is a two-dimensional surface of a three-dimensional structure that has been cut. A plane is an imaginary two-dimensional surface that passes through the body. Three planes are commonly referred to in anatomy and medicine:

1. The **sagittal plane** is the plane that divides the body or an organ vertically into right and left sides. If this vertical plane runs directly down the middle of the body, it is called the **midsagittal** or **median plane**. If it divides the body into unequal right and left sides, it is called a parasagittal plane, or less commonly a longitudinal section.
2. The **frontal plane** is the plane that divides the body or an organ into an anterior (front) portion and a posterior (rear) portion. The frontal plane is often referred to as a coronal plane, following Latin corona, which means "crown".
3. The **transverse plane** is the plane that divides the body or organ horizontally into upper and lower portions. Transverse planes produce images referred to as cross sections.

Any plane other than the above described planes will be oblique plane.

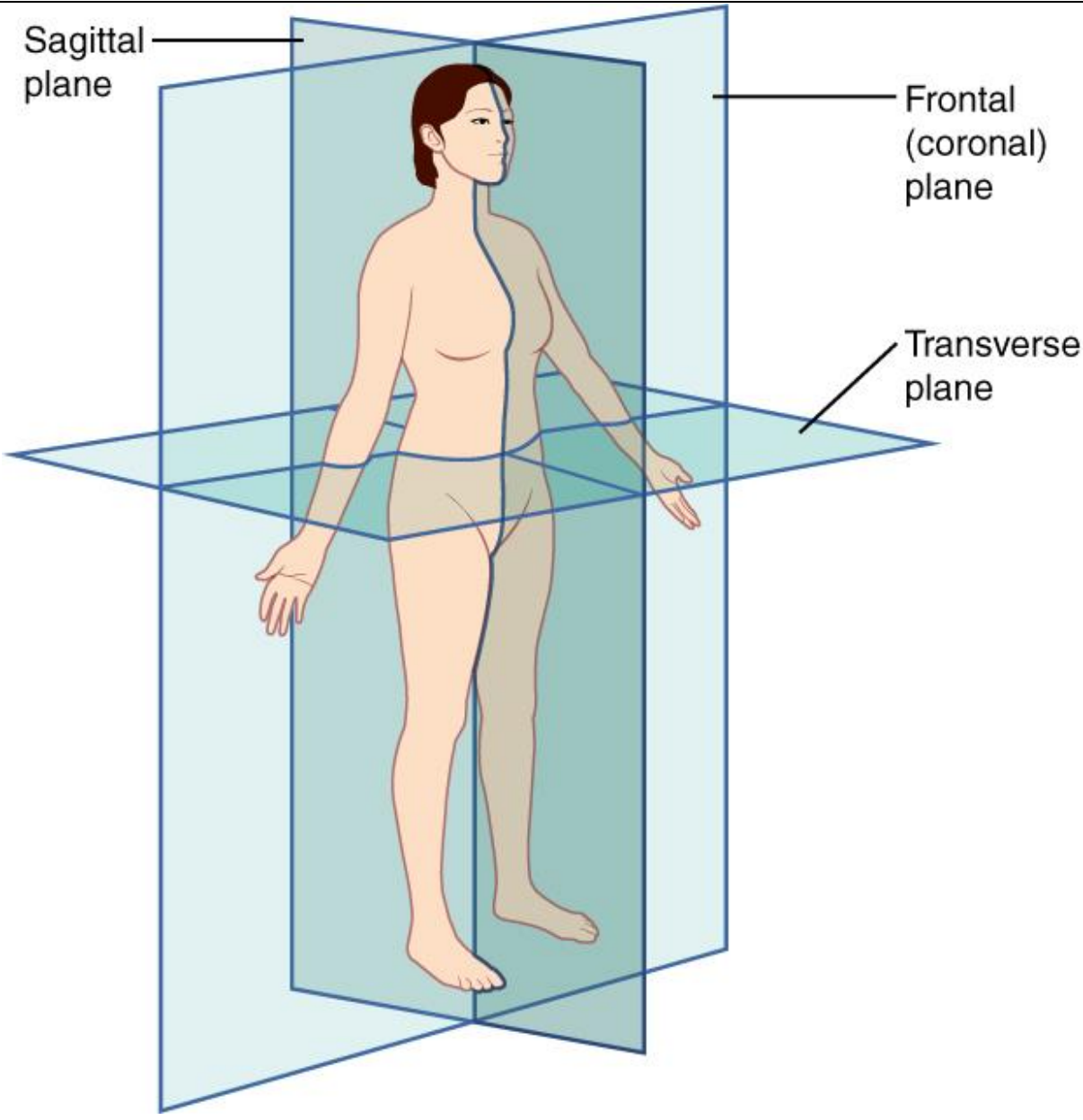

Fig. 1.7: The three anatomical planes of the body: the sagittal, transverse (or horizontal), frontal planes.

1.4.3 Anatomical terms for describing movements:

Joints, especially synovial joints allow the body a tremendous range of movements. Each movement at a synovial joint results from the contraction or relaxation of the muscles that are attached to the bones on either side of the articulation. The type of movement that can be produced at a synovial joint is determined by its structural type.

Movement types are generally paired, with one being the opposite of the other. Body movements are always described in relation to the anatomical position of the body: upright stance, with upper limbs to the side of body and palms facing forward.

Terms describing motion in general include:

1. **Flexion and Extension**, which refer to a movement that decreases (flexion) or increases (extension) the angle between body parts. For example, when standing up, the knees are extended.
2. **Abduction and adduction** refers to a motion that pulls a structure away from (abduction) or towards (adduction) the midline of the body or limb. For example, a star jump requires the legs to be abducted.
3. **Internal rotation** (or medial rotation) and External rotation (or lateral rotation) refers to rotation towards (internal) or away from (external) the center of the body. For example, the asana posture in yoga requires the legs to be externally rotated.[citation needed]
4. **Elevation and Depression** refer to movement in a superior (elevation) or inferior (depression) direction. Primarily refers to movements involving the scapula and mandible.[citation needed]

Special motions of the hands and feet

These terms refer to movements that are regarded as unique to the hands and feet:

1. **Dorsiflexion and Plantarflexion** refers to flexion (dorsiflexion) or extension of the foot at the ankle. For example, plantarflexion occurs when pressing the brake pedal of a car.
2. **Palmarflexion and dorsiflexion** refer to movement of the flexion (palmarflexion) or extension (dorsiflexion) of the hand at the wrist. For example, prayer is often conducted with the hands dorsiflexed.
3. **Pronation and Supination** refer to rotation of the forearm or foot so that in the anatomical position the palm or sole is facing anteriorly (supination) or posteriorly (pronation) rotation of the forearm. For example, a person skiing must pronate their arms in order to grasp the skis.
4. **Eversion and Inversion** refer to movements that tilt the sole of the foot away from (eversion) or towards (inversion) the midline of the body.

1.4.4 Anatomical terms for describing muscles:

Muscle action that moves the axial skeleton work over a joint with an origin and insertion of the muscle on respective side. The insertion is on the bone deemed to move towards the origin during muscle contraction. Muscles are often present that engage in several actions of the joint; able to perform for example both flexion and extension of the forearm as in the biceps and triceps respectively. This is not only to be able to revert actions of muscles, but also brings on stability of the actions though muscle co-activation.

1. **Origin**: The relatively fixed end of muscle during natural movements of the muscle
2. **Insertion**: The relatively mobile end of the muscle during natural movements of the muscle
3. **Belly**: The fat fleshy part of the muscle which is contractile in function
4. **Tendon**: The fibrous and non-contractile part of the muscle which attaches muscle to the bone.
5. **Aponeurosis**: It is a flattened tendon arising from the connective tissues around the muscle.

The muscle performing an action is the agonist, while the muscle which contraction brings about an opposite action is the antagonist. For example, an extension of the lower arm is performed by the triceps as the agonist and the biceps as the antagonist (which contraction will perform flexion over the same joint). Muscles that work together to perform the same action are called synergists. In the above example synergists to the biceps can be the brachioradialis and the brachialis muscle.

The gross anatomy of a muscle is the most important indicator of its role in the body. One particularly important aspect of gross anatomy of muscles is pennation or lack thereof. In most muscles, all the fibres are oriented in the same direction, running in a line from the origin to the insertion. In pennate muscles, the individual fibres are oriented at an angle relative to the line of action, attaching to the origin and insertion tendons at each end. Because the contracting fibres are pulling at an angle to the overall action of the muscle, the change in length is smaller, but this same orientation allows for more fibres (thus more force) in a muscle of a given size. Pennate muscles are usually found where their length change is less important than maximum force, such as the rectus femoris.

Skeletal muscle is arranged in discrete muscles, an example of which is the biceps brachii. The tough, fibrous epimysium of skeletal muscle is both connected to and continuous with the tendons. In turn, the tendons connect to the periosteum layer surrounding the bones, permitting the transfer of force from the muscles to the skeleton. Together, these fibrous layers, along with tendons and ligaments, constitute the deep fascia of the body.

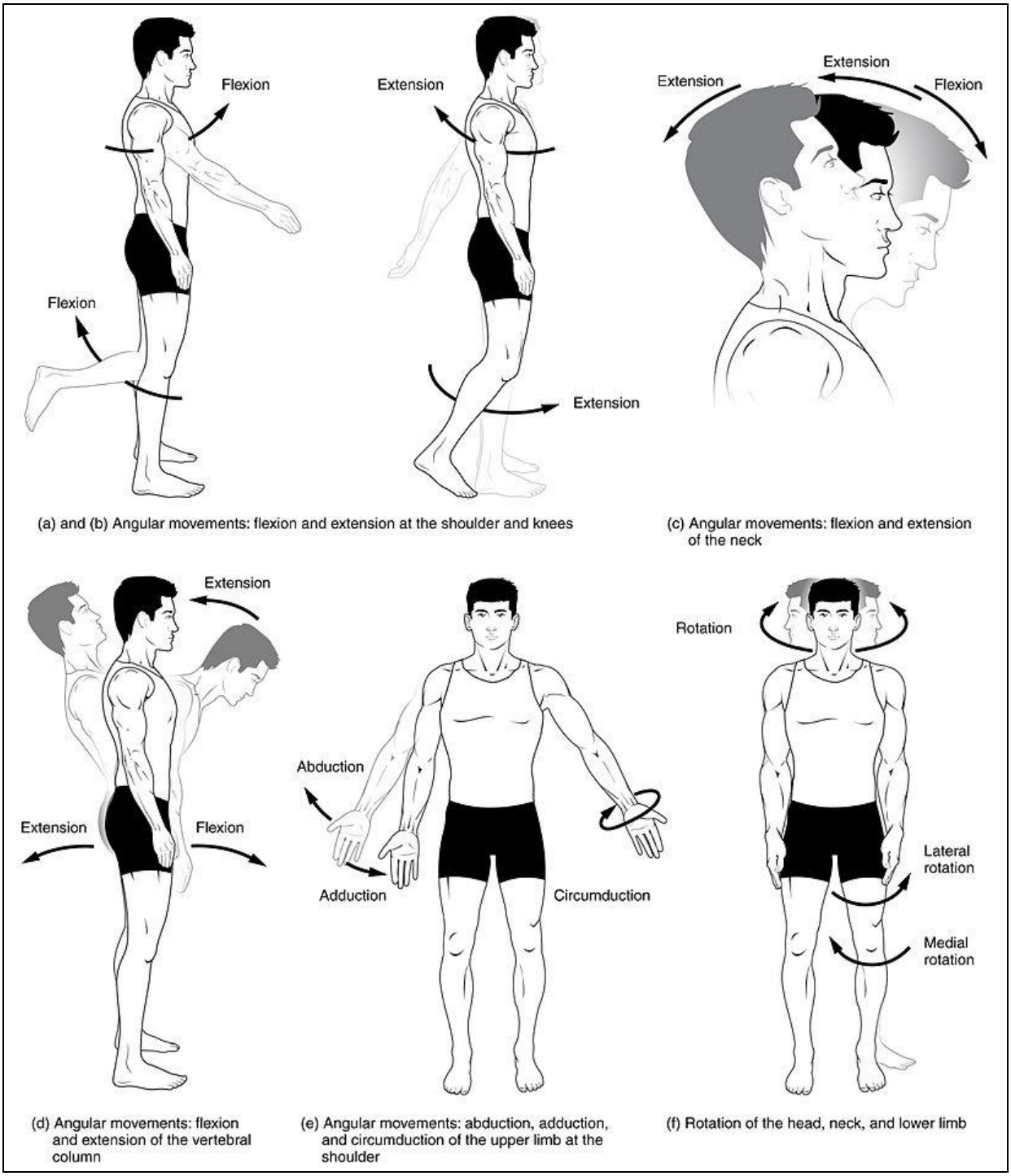

Fig. 1.8: Anatomy Diagrams for General Motion

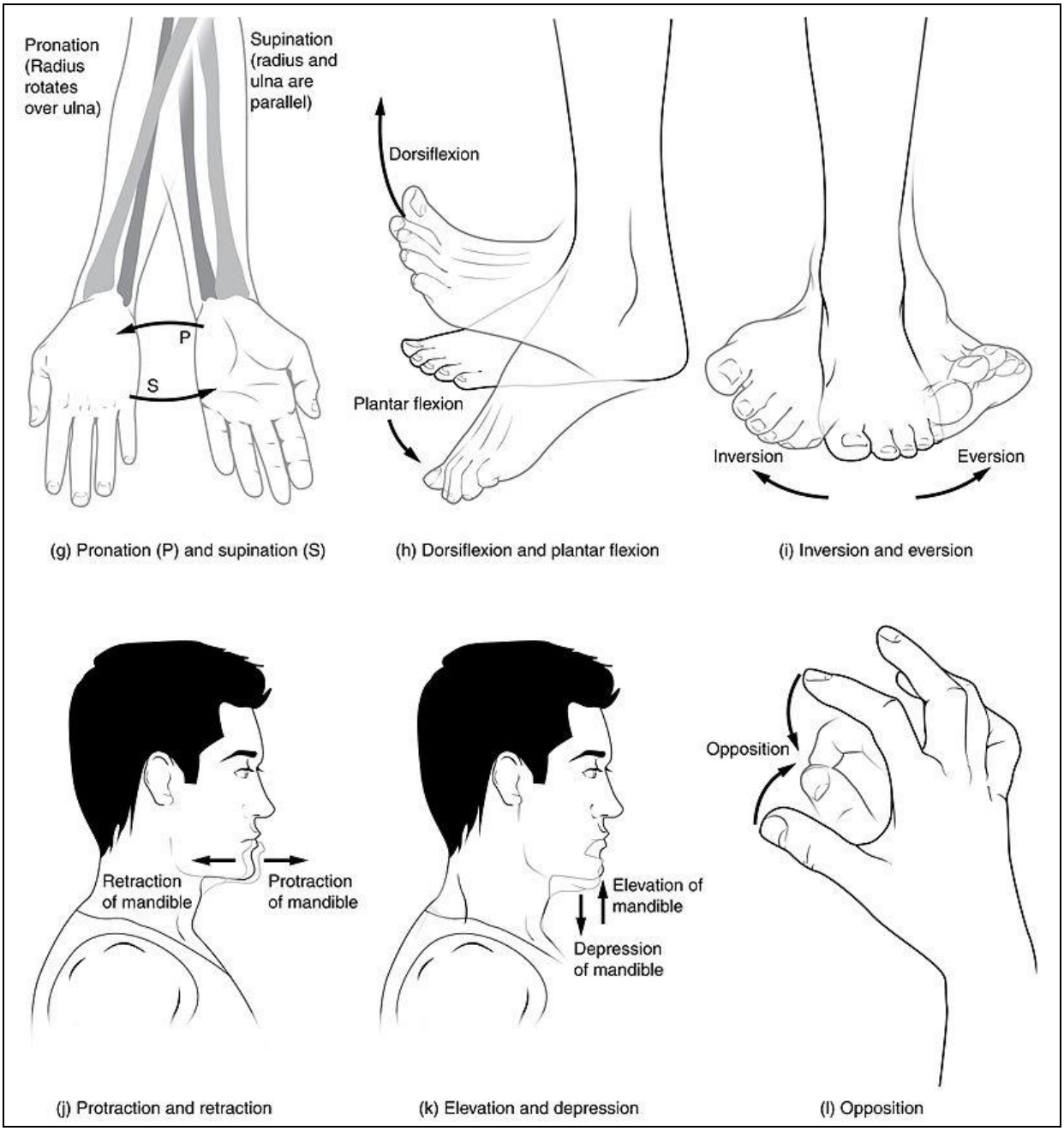

Fig. 1.8: Anatomy Diagrams for Special motions of the hands and feet

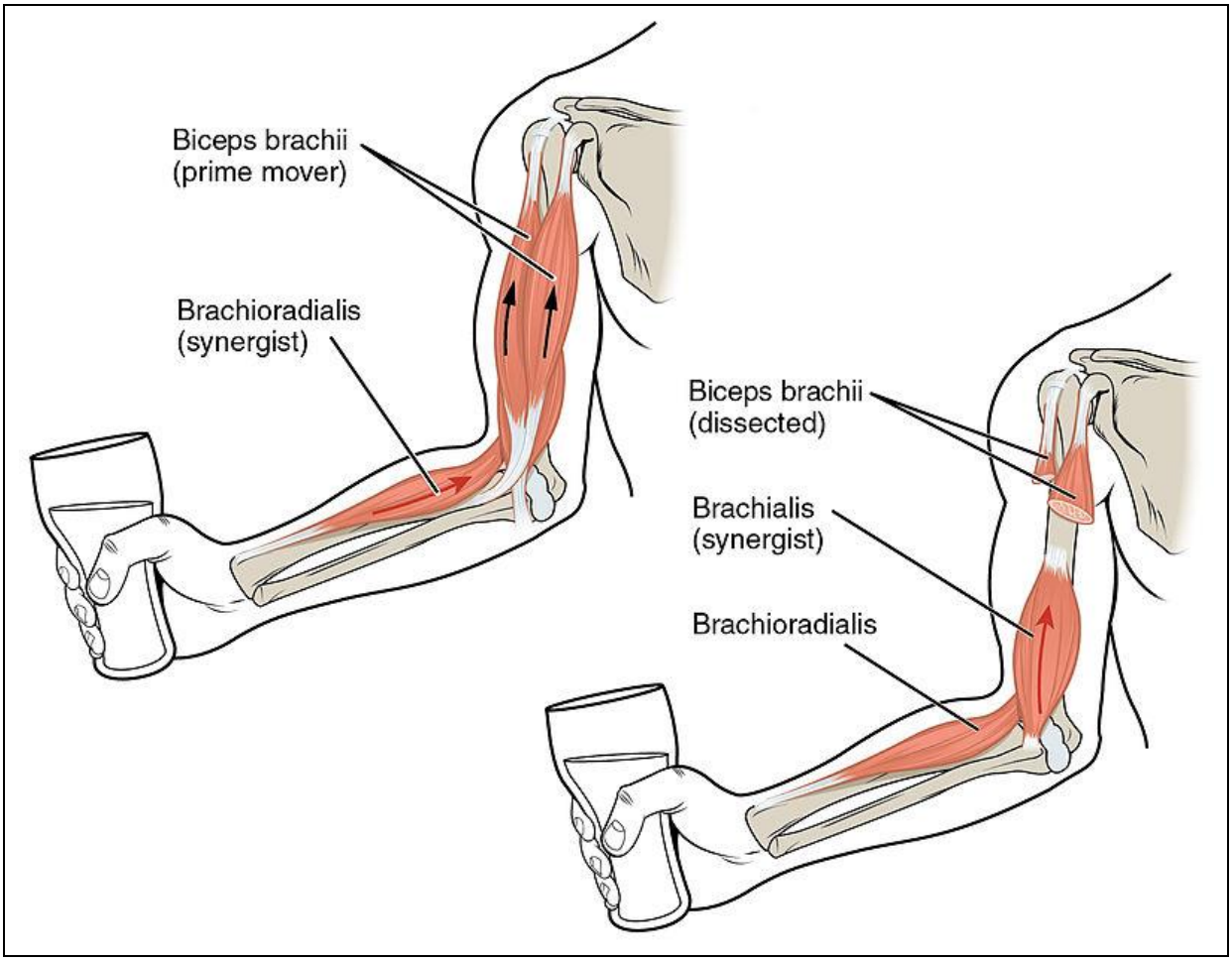

Fig. 1.9: The biceps brachii flex the lower arm. The brachioradialis, in the forearm, and brachialis, located deep to the biceps in the upper arm, are both synergists that aid in this motion.

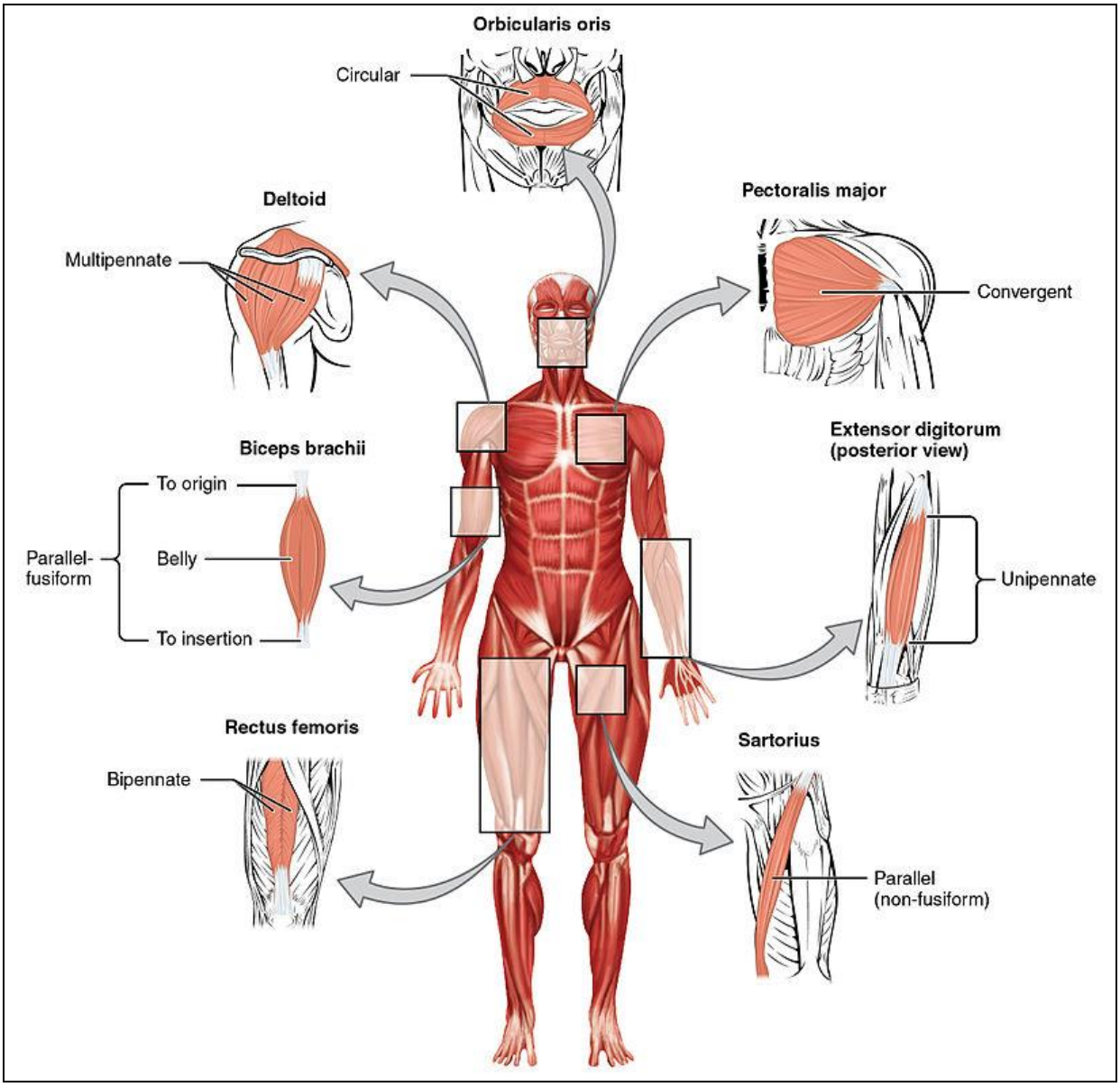

Fig. 1.10: The skeletal muscles of the human body with the major muscle groups labelled.

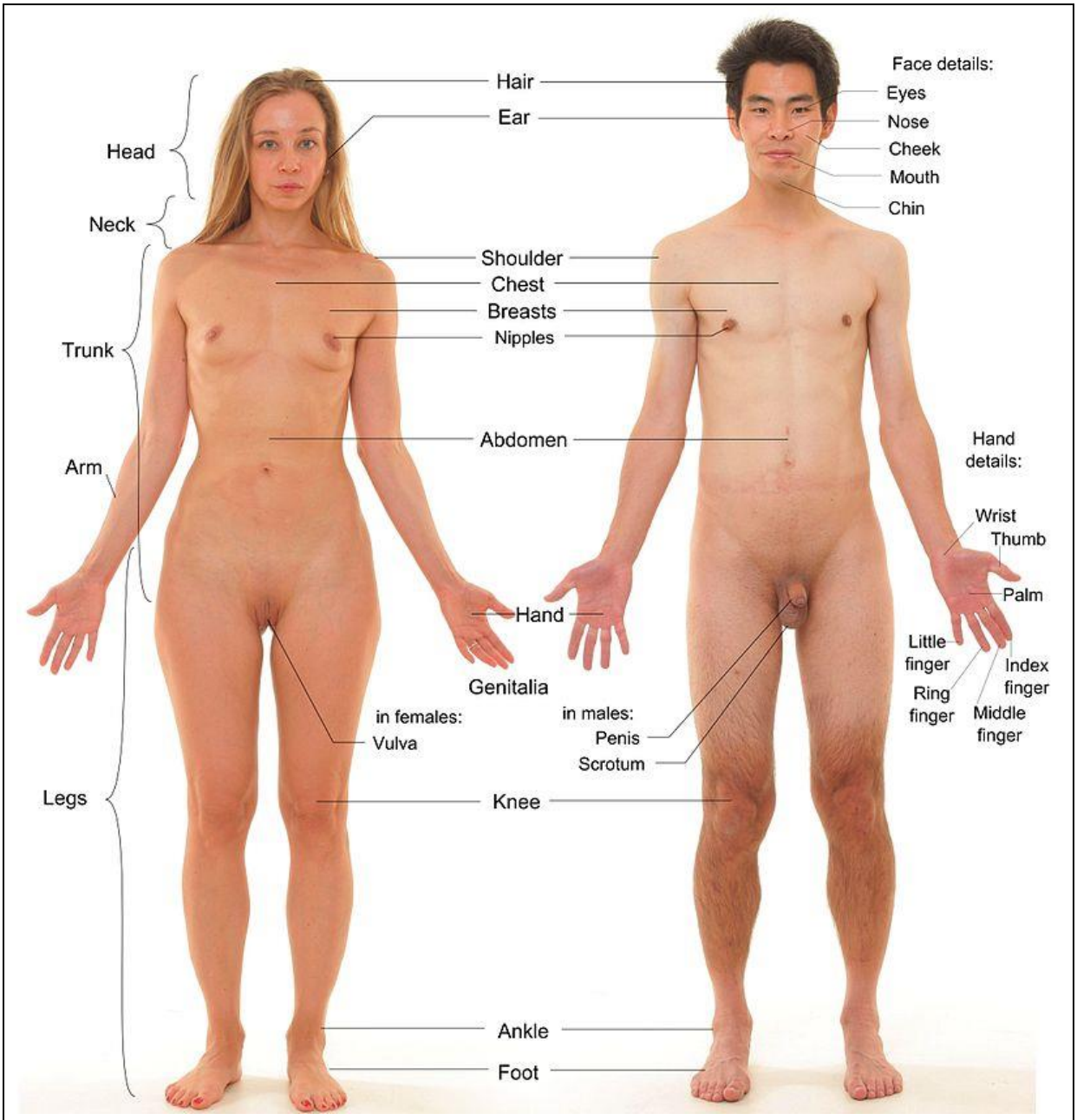

Fig. 1.11: Labels of human body features displayed on images of actual human bodies, from which body hair and male facial hair has been removed. (Source: City Studios in Stockholm (www.stockholmsfotografen.se), September 29, 2011, with assistance from KYO (The organisation of life models) in Stockholm.

1.5 Body Cavities

The cavities of the body house the internal organs, which commonly referred to as the viscera. The two main body cavities are the larger ventral (anterior) and the smaller, dorsal (posterior) body cavity.

1. The **ventral body cavity** constitutes the thoracic cavity and the abdomino-pelvic body cavity.
2. The **Thoracic cavity** houses lung and heart. It is protected by the rib cage & associated musculature and the sternum anteriorly. It consists of the right and left pleural cavities and mediastinum (the portion of tissues and organs that separates the left and right lung).

3. **Abdomino-pelvic Cavity** extends from the diaphragm inferior to the floor of the pelvis. It is divided into superior abdominal and inferior pelvic cavity by imaginary line passing at upper pelvis.
4. **Abdominal cavity** contains the stomach, intestine, liver, spleen and gallbladder.
5. The **pelvic cavity** contains urinary bladder, rectum, and portions of the reproductive organs
6. The **dorsal body cavity** constitutes the cephalic cavity containing brain and the vertebral canal containing the spinal cord.

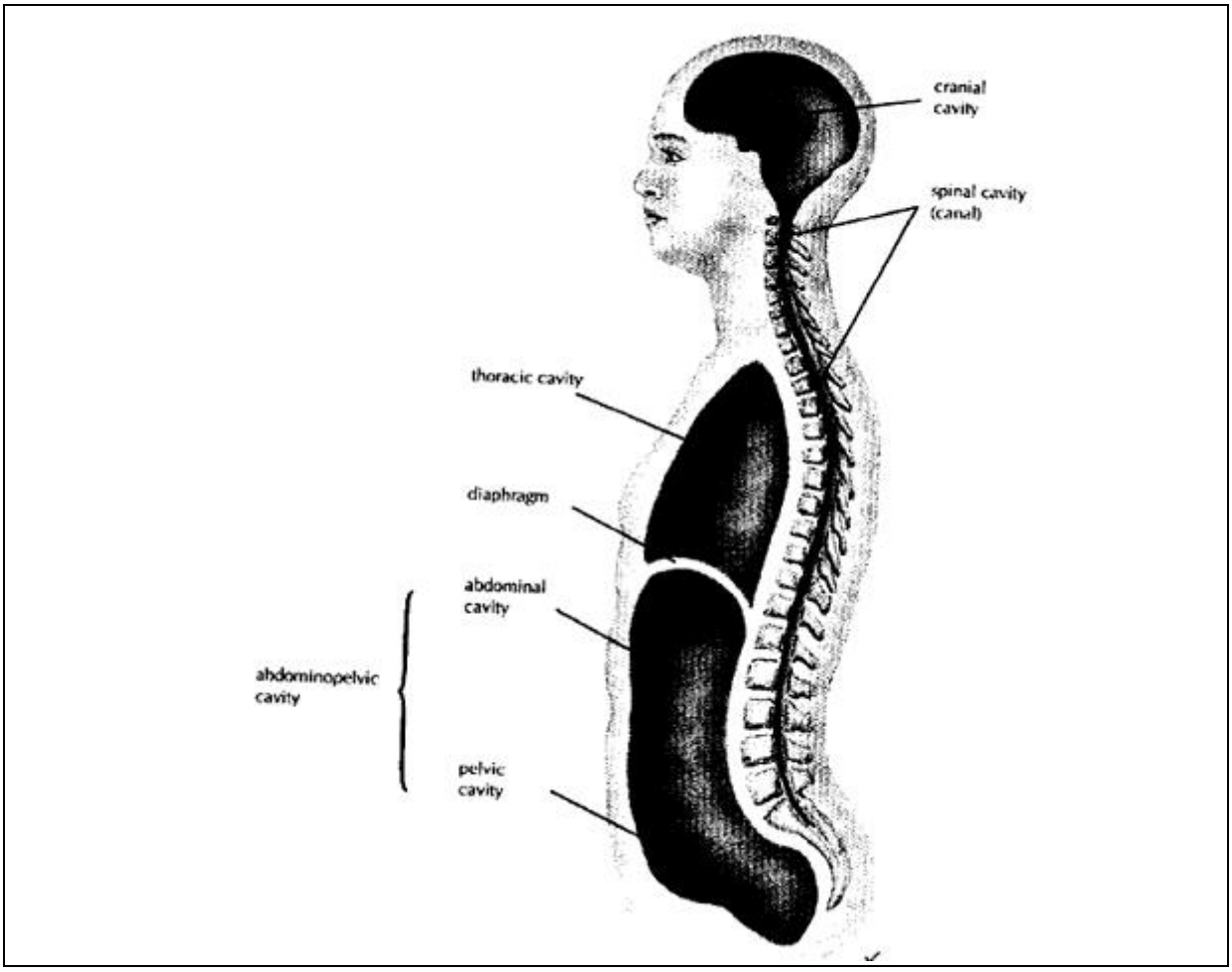

Fig. 1.11: Body cavities (Source: Memmler, Ruth Lundeen, Barbara Jansen Cohen and Dena Lin Wood (1996), The Human Body in Health and Disease, 8th Ed, pp 9).

REFERENCES

12cranialnerves.net. (2012). Functions and placements of 12 cranial nerves. Retrieved July 17, 2016, from http://12cranialnerves.net/functions-and-placements-of-12-cranial-nerves/

Anatomical terminology. (2013). In Wikipedia. Retrieved May 30, 2016, from https://en.wikipedia.org/wiki/Anatomical_terminology

Boundless. (26 May, 2016). Movement of Fluid among Compartments. Retrieved 18 Jul. 2016 from https://www.boundless.com/physiology/textbooks/boundless-anatomy-and-physiology-textbook/body-fluids-and-acid-base-balance-26/body-fluids-246/movement-of-fluid-among-compartments-1210-7139/

Boundless. (26 May. 2016). Classification of Receptors by Stimulus. Boundless Anatomy and Physiology. Retrieved 17 Jul. 2016 from https://www.boundless.com/physiology/textbooks/boundless-anatomy-and-physiology-textbook/peripheral-nervous-system-13/sensory-receptors-128/classification-of-receptors-by-stimulus-687-8532/

Drake, Richard L.; Vogl, Wayne; Tibbitts, Adam W.M. Mitchell; illustrations by Richard; Richardson, Paul (2005). Gray's anatomy for students (Pbk. Ed.). Philadelphia: Elsevier/Churchill Livingstone.

Engelbrecht, Rolf. (2005). Connecting Medical Informatics and Bio-informatics: Proceedings of MIE2005 : the XIXth International Congress of the European Federation for Medical Informatics. Volume 116 of Studies in health technology and informatics.

Federative Committee on Anatomical Terminology (1998). Terminologia Anatomica – International Anatomical Terminology. Stuttgart: Thieme.

Federative Committee on Anatomical Terminology (2008). Terminologia Histologica – International Terms for Human Cytology and Histology. Cardiff: Lippincott Williams & Wilkins.

http://www.sciencemuseum.org.uk/WhoAmI/FindOutMore/Yourbrain/Howdoesyourbrainwork/Howdoesyournervoussystemwork/Whatarenerveimpulses

HubPages Inc. (2016). The Differences between Skeletal, Smooth & Cardiac Muscles. Retrieved July 7, 2016, from https://healdove.com/misc/The-function-of-Muscles-and-th e-3-main-types

Human Anatomy. (2010a). History of Human Anatomy. Retrieved May 30, 2016, from http://www.mananatomy.com/basic-anatomy/history-human-anatomy

Human Anatomy. (2010b). Branches of Human Anatomy. Retrieved May 30, 2016, from http://www.mananatomy.com/basic-anatomy/branches-human-anatomy

Indiana University. (2016). Integration. Retrieved July 17, 2016, from http://www.indiana.edu/~p1013447/dictionary/integr.htm

IvyRose Holistic. (2016). Structure and Functions of Muscular Tissue. Retrieved July 7, 2016, from http://www.ivyroses.com/HumanBody/Tissue/Tissue_Muscular-Tissue.php

John Wiley & Sons, Inc. (2016). Understanding the Transmission of Nerve Impulses. Retrieved July 17, 2016 from http://www.dummies.com/how-to/content/understanding-the-transmission-of-nerve-impulses.html

Kenhub. (2016). Human Anatomy. Retrieved May 30, 2016, from https://www.kenhub.com/en/library/anatomy/the-human-anatomy

Larsson, L; Edström, L; Lindegren, B; Gorza, L; Schiaffino, S (July 1991). "MHC composition and enzyme-histochemical and physiological properties of a novel fast-twitch motor unit type". The American Journal of Physiology 261 (1 pt 1): C93–101. PMID 1858863. Retrieved July 6, 2016, from http://ajpcell.physiology.org/content/261/1/C93

Learn.org. (2016). What Is Anatomy and Physiology? Retrieved May 30, 2016, from http://learn.org/articles/What_is_Anatomy_and_Physiology.html

Losardo, Ricardo J. (2009). "Pan American Association of Anatomy: history and relevant regulations". Int J Morphol 27 (4): 1345–52.

Marieb, Elaine; Hoehn, Katja (2007). Human Anatomy & Physiology (7th Ed.). Pearson Benjamin Cummings.

McCloud, Aaron (2014). "Build Fast Twitch Muscle Fibers". Complete Strength Training. Retrieved July 6, 2016, from http://www.complete-strength-training.com/fast-twitch-muscle-fibers.html

Ming GL, Song H. (2005). Adult neurogenesis in the mammalian central nervous system. Annu. Rev. Neurosci., 28:223–250.

Moore, Keith L., Dalley, Arthur F., Agur Anne M. R. (2010). Moore's Clinically Oriented Anatomy. Phildadelphia: Lippincott Williams & Wilkins. pp. 29–35.

Morrissey, S. (2016). Base in Chemistry: Definition & Example. Retrieved 18 Jul. 2016 from http://study.com/academy/lesson/base-in-chemistry-definition-example-quiz.html

Motor nerve. (2016, June 2). In Wikipedia, The Free Encyclopedia. Retrieved 07:17, July 17, 2016, from https://en.wikipedia.org/w/index.php?title=Motor_nerve&oldid=723311993

NCS Pearson. (2016). Nerve Cell Structure and Function. Retrieved July 17, 2016, from http://www.tutorvista.com/science/nerve-cell-structure-and-function

Neural facilitation. (2016, June 13). In Wikipedia, The Free Encyclopedia. Retrieved 14:24, July 17, 2016, from https://en.wikipedia.org/w/index.php?title=Neural_facilitation&oldid=725138782

Newhealthadvisor.com. (2014). Anatomy of Respiratory System. Retrieved July 7, 2016, from http://www.newhealthadvisor.com/Anatomy-of-Respiratory-System.html

Nicholls, J. G. and Purves, D. (1972). A comparison of chemical and electrical synaptic transmission between single sensory cells and a motoneurone in the central nervous system of the leech. J Physiol. 1972 Sep; 225(3): 637–656.1. Retrieved July 17, 2016, from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1331135/

O'Rahilly, R. (2008). Basic Human Anatomy: A Regional Study of Human Structure. Retrieved July 16, 2016, from https://www.dartmouth.edu/~humananatomy/part_1/chapter_3.html#chpt_3_questions

Reference. (2016). What are phasic and tonic receptors?. Retrieved July 17, 2016 from https://www.reference.com/science/phasic-tonic-receptors-a925812b072ba489#

Rice University. (2016). Anatomy & Physiology. Openstax college at Connexions. Retrieved May 31, 2016, from http://cnx.org/contents/FPtK1zmh@8.25:zMTtFGyH@4/Introduction

Roberson, S. (2014). What is Grey Matter? Retrieved July 6, 2016, from http://www.news-medical.net/health/What-is-Grey-Matter.aspx

Sensory nerve. (2016, July 5). In Wikipedia, The Free Encyclopedia. Retrieved 07:16, July 17, 2016, from https://en.wikipedia.org/w/index.php?title=Sensory_nerve&oldid=728496517

Sensory receptor. (2016, May 16). In Wikipedia, The Free Encyclopedia. Retrieved 09:27, July 17, 2016, from https://en.wikipedia.org/w/index.php?title=Sensory_receptor&oldid=720604462

Sinauer Associates, Inc. (2001). Chemical Synapses. Retrieved July 17, 2016, from http://www.ncbi.nlm.nih.gov/books/NBK11009/

Singh, A. P. (2015). Types of Muscles and their Functions. Retrieved July 7, 2016, from http://boneandspine.com/types-of-muscles-and-there-functions/

State of Victoria. (2016). Hormonal (endocrine) system. Department of Health & Human Services. Retrieved July 16, 2016, from https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/hormonal-endocrine-system

Stern, P. (2010). Focus issue: getting excited about glia, 3(147):330-773. Retrieved July 6, 2016, from http://stke.sciencemag.org/content/3/147/eg11.abstract

Summation (neurophysiology). (2016, June 23). In Wikipedia, The Free Encyclopedia. Retrieved 14:14, July 17, 2016, from https://en.wikipedia.org/w/index.php?title=Summation_(neurophysiology)&oldid=726687075

Swartz, Mark H. (2010). Textbook of physical diagnosis: history and examination (6th Ed.). Philadelphia, PA: Saunders/Elsevier.

Synapse. (2016, July 14). In Wikipedia, The Free Encyclopedia. Retrieved 10:05, July 17, 2016, from https://en.wikipedia.org/w/index.php?title=Synapse&oldid=729778739

Terminologia Anatomica: International Anatomical Terminology. New York: Thieme Medical Publishers. 1998.

The Anatomical Travelogue. (2014). Muscle Tissue. Retrieved July 6, 2016, from http://www.thevisualmd.com/searchimg/?idu=1033608173&q=%2520muscle%2520fibers&p=0

The Science Museum. (n.d.). What are impulses? Retrieved July 17, 2016 from

TheyDifer.com. (July 6, 2015). Difference between Skeletal, Smooth and Cardiac Muscles. Retrieved July 9, 2016, from http://theydiffer.com/difference-between-skeletal-smooth-and-cardiac-muscles/#

Tonic (physiology). (2015, August 4). In Wikipedia, The Free Encyclopedia. Retrieved 09:28, July 17, 2016, from https://en.wikipedia.org/w/index.php?title=Tonic_(physiology)&oldid=674454889

U.S. Department of Health and Human Services National Institutes of Health. (2016). Types of Muscle Tissue. Retrieved July 7, 2016, from https://www.nlm.nih.gov/medlineplus/ency/imagepages/19841.htm

University of Iowa Department of Pathology (2016). Neurons and Support Cells. Retrieved July 6, 2016, from http://www.siumed.edu/~dking2/ssb/neuron.htm#3

Williams, J. (2016). What is Acid in Chemistry? - Definition & Overview. Retrieved 18 Jul. 2016 from http://study.com/academy/lesson/what-is-acid-in-chemistry-definition-lesson-quiz.html

Zimmermann, K. A. (March 11, 2016). Reproductive System: Facts, Functions & Diseases. Retrieved July 10, 2016, from http://www.livescience.com/26741-reproductive-system.html

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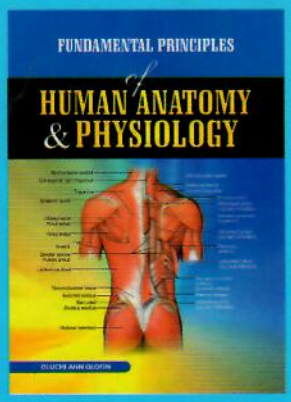
Olofin Oluchi Ann is a registered and licensed Dental Therapist (**RDTh**) and an erudite scholar in the field of Dental Therapy and Public Health. She is a graduate of Dental Therapy; obtained her Post-Graduate Diploma in Education (PGDE) and MSc Degree in Physical & Health Education from Enugu State University of Science and Technology (ESUT) in 2002 and 2006 respectively. She has concluded her coursework, and at the concluding stage of her dissertation in her doctorate degree in Public Health at the Walden University, Baltimore, USA. She specializes in Community Health Promotion and Education, with the aim of promoting oral health care delivery, especially among the illiterates and literates who are totally ignorant of the need to visit dental clinic centres, and to be aware of the various diseases caused by lack of oral health care. She is a member of notable professional bodies including: National Association of Dental Therapists of Nigeria (NADTH); Foundation for African Development through International Bio-Technology; and American Public Health Association (APHA). She is also a research member with the Research and Development Network (RDN) of the International Research and Development Institute (IRDI). In recognition of her numerous contributions to the Dental Therapy education and dedication to duty, she was recommended and thereafter appointed by the Federal Minister of Health as a Board Member of the Dental Therapists Registration Board of Nigeria. She was also conferred with the Fellowship Award for Distinguished Professional contribution to Industrial Administration by the Institute of Industrial Administration. This offer qualifies her as a senior member of the institute, and entitles him to append the designator letters, **FIIA**, after her name. The author has presented academic and professional papers at national and international conferences and workshops, and has to her credit papers published in reputable local and international journals. Oluchi Olofin is the author of her first book, "***Fundamental Concepts of Primary Health Care Delivery System***". She was the head of department for two terms, 2006-2008 and 2008-2010. She is the Chairman of Examinations Committee of the Federal College of Dental Technology and Therapy. She has been a member of accreditation visitation team to polytechnics and monotechnics organized by the National Board for Technical Education (NBTE). She is happily married and blessed with godly children.

ABOUT THE BOOK



This book, **FUNDAMENTAL PRINCIPLES OF HUMAN ANATOMY & PHYSIOLOGY**, is written so as stress the fact that all allied health careers is aware that a relationship exists between the health care providers and his or her patients. Unless your patients are coming for annual exams, they come to you because an organ or organ system is not functioning properly in their body. In order to treat them well, you must first understand how the body functions when it is healthy. This is the purpose of your pre-requisite anatomy and physiology course. Much attention was paid to include chapters that are required by the students studying different health-based programmes such as Nursing, Community Health, Dental Technology, Dental Therapy, Community Medicine, Health and Physical Education, etc. The book deals with the theoretical concepts and selected case studies. The unique features and the style of writing this book are as follows:

- **The language used in the book is lucid, and facilitates easy grasping of concepts.**
- **The chapters have been logically arranged in sequence.**
- **The book is written in a reader-friendly manner both for students and teachers.**
- **Most of the contents in this book were presented using bullets, which are sequentially-organized to facilitate the reader view, understand and remember the points better.**
- **The explanations, especially are supported by diagrams, pictures and images.**
- **Sufficient references to best practices in the field of Public Health were made.**
- **The chapter review questions at the end of each chapter are given section-wise, easier for the reader to remember the answers.**
- **This book is written keeping in mind the readers may be familiar and not-so familiar with the Human Anatomy.**
- **Several chapters included in this book cover the syllabi of different institutions - Universities, Polytechnics, Monotechnics, Colleges of Education, Schools of Health Technology, School of Nursing, etc., in Nigeria, West Africa, and beyond.**

This book, therefore, prepares the student to have a solid foundation on the organisation, structure and functions of the systems of the human body. Equipping the student with the knowledge of anatomy and physiology will further assist the student in understanding what happens and what to do when the body is injured, diseased or placed under stress. Moreover, understanding the parts of the human body and how they work will promote your own personal health and those of your family members. Finally, the book provides a background medical knowledge - when studying to become a doctor, nurse or therapist, or even a dentist, advanced training and learning in those fields require a basic working knowledge of anatomy and physiology. Lecturers, teachers and instructors will assume that you know the normal functioning of a particular organ system. You will then learn all of what can go wrong within that particular organ system.

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