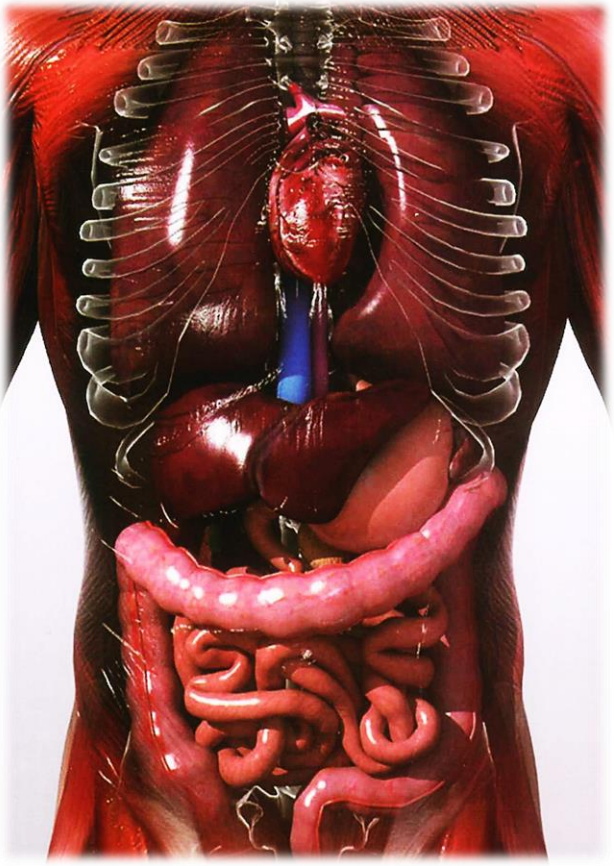
Faculty of Medicine
Menoufia University

INTRODUCTION TO

Human anatomy



For

First Year Pharmacy Students

Second Semester

By

Staff Members of Anatomy and Embryology

MFM hand book of
(Introduction of Human Anatomy)

Acknowledgment

We wish to express my sincere thanks to all members of the Anatomy and Embryology Department, Faculty of Medicine, Menoufia University and also to our students for their great help and support in the preparation of this edition.

Staff Members of Anatomy and Embryology Department.

Preface

This edition of the MFM Handbook of introduction of human anatomy was written with the aim to convey the basic information that serve the study of the human anatomy and other medical branches.

I hope you find this handbook helpful and easy to learn from. Feedback on errors and omissions would be much appreciated. Please send your comments through "Anatomy MNF" group on Facebook.

Intended Learning outcomes (ILOS)

N	Topic	ILOS
1	Overview and Introduction to Anatomy	1. Describe in simple terms the normal structure of the tissues, organs and systems individually and collectively. 2. Define level of body organisation
2	Anatomical position and Body planes	1. Describe the normal anatomical position. 2. Identify the different anatomical planes. 3. Define the different anatomical lines. 4. Know the different terms of the positions of human body.
3	Movements and position terminology	1. Describe the different movements of the limbs. 2. Define the different movements of the head. 3. Identify the different movements of the trunk.
4	Skeletal system (Overview and types of bone and cartilage)	1. Know the growth and ossification of bones. 2. Describe the different of types of bones. 3. Identify the surface features of bones. 4. Define the different bones of axial skeleton. 5. Identify the different bones of appendicular skeleton. 6. Outlines the function of bones.
5	Muscle and Fascia	1. Differentiate between different types of muscle. 2. Understand different types of muscle actions. 3. Identify different shape of muscle attachment. 4. Identify different type of fascia. 5. Describe the functions of fascia.
6	Joints (General)	1. Know the definition and structure of the joints. 2. Define the different divisions of the joints. 3. Describe the fibrous joints. 4. Identify the cartilaginous joints. 5. Describe the synovial joints.

7	Body parts and cavities	1. Know the definition and function of body cavities. 2. Know the division of the body cavities: 3. Dorsal cavities and Ventral cavities: 4. Know the contents of the thoracic cavity. 5. Know the contents of the abdominal cavity. 6. Know the contents of the pelvic cavity. 7. Know the serous membranes. 8. Know the inflammatory conditions and fluid collection of the body cavities.

Content

Detailed content

List of Abbreviations

Abbreviation	Word
UV	Ultraviolet
CNS	Central nervous system
PNS	Peripheral nervous system
ANS	Autonomic nervous system
IM	Intermuscular

Chapter I

OVERVIEW OF ANATOMY

OVERVIEW OF ANATOMY

What is anatomy?

□ Anatomy is a branch of medical science that deals with understanding the structural organization of the human body. So that the doctor knows which structure is affected in the disease, which structure is examined by him and which structure is being cut during surgery?

□ The term anatomy is a *Greek* word meaning to *cut up*. Here, ***anatomy means gross or macroscopic anatomy,*** which deals with study of structures of the human body that can be seen without using a microscope.

□ In older time anatomy and dissection were synonymous, so to do anatomy was considered to do dissection. Now, dissection is one of the techniques to learn gross anatomy.

Other subdivisions of anatomy:

Microscopic anatomy: (histology) is the study of cells and tissues using a microscope.

Developmental anatomy: traces structural changes that occur in the body throughout the life span.

Embryology, a subdivision of developmental anatomy, concerns with developmental changes that occur before birth.

Surface anatomy: it is the study of internal structures as they relate to the overlying skin surface. The clinicians use it to locate appropriate blood vessels to feel pulses.

Clinical anatomy: it is the practical application of anatomical knowledge for the solution of clinical problems.

Radiographic anatomy: it is the study of the internal structures as visualized by X-ray images or specialized scanning procedures.

Pathological anatomy: deals with the structural changes in cells, tissues, and organs caused by a disease.

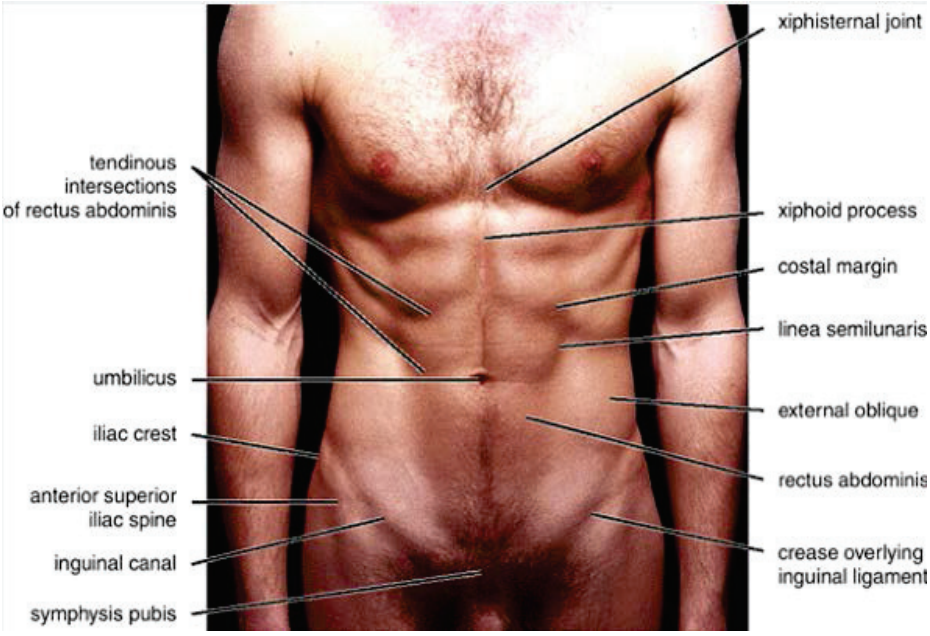


Figure (1): Surface anatomy, study of the internal structures as they relate to the overlying skin surface.

HOW CAN GROSS ANATOMY BE STUDIED?

■ ***By Dissection,*** which is the most important technique to learn gross anatomy and sometimes dissection of cadavers by students, is replaced by:

- Viewing previously dissected material and plastic models.
- Using computer teaching modules.

■ ***By knowledge of anatomical terminology,*** is an essential tool for studying anatomy.

■ ***Anatomy can be studied following a regional or a systemic approach.***

□ **Regional approach**: in a particular region of the body, such as the abdomen or leg, all the structures (muscles, bones, blood vessels, nerves, etc.) are examined at the same time.

□ **Systemic approach:** body structure is studied system by system. For example, when studying the cardiovascular system, you would examine the heart and the blood vessels of the entire body.

ORGANIZATION OF THE HUMAN BODY

I. The human body is organized into major parts.

II. The human body is organized also, by layers.

III. The human body is organized from four main basic tissues.

IV. The human body is organized from systems.

►The human body is organized into major parts which further subdivided into regions and zones.

Axial parts: the head, neck, and trunk (subdivided into thorax, abdomen, back, and pelvis/perineum).

Appendicular parts: paired upper limbs and lower limbs.

► From superficial to deep the human body is organized also, by layers as follows:

Skin (the most superficial structure) → **subcutaneous tissue** → **deep fascia** covering → **muscles** → **skeleton**, and **cavities**, which contain ***viscera*** (internal organs).

Levels of Structural Organization of human body:

►From the simplest structure, the atom to the most complex structure, the organism or the human body is organized as follow:

Chemical level:

Atoms → Molecule → Macromolecules → Organelles → the cell

Cellular level:

Cells →tissues → organ → Organ system→ organism (human body)

Cells, are the basic living unit.

Tissues: are groups of cells functioning together.

►The human body is organized from four main basic tissues:

i. Epithelial tissue, **ii. Connective tissue,**

iii. Muscular tissue, **iv. Nervous tissue.**

Organ: is formed of groups of tissues. ***Examples***: liver, lungs and stomach.

Organ system: groups of organs function together as organ systems.

► ***The human body is organized from the following systems:***

integumentary system, muscular system, skeletal system, respiratory system, cardiovascular system, immune/Lymphatic system, digestive system, endocrine system, urinary system, reproductive system, nervous system and system of special sense.

The organism: all the above mentioned body systems functioning together to make up ***an organism,*** which is the highest level of organization of the living human being.

N.B.: ***The anatomy of the body systems will be studied in the following chapters.***

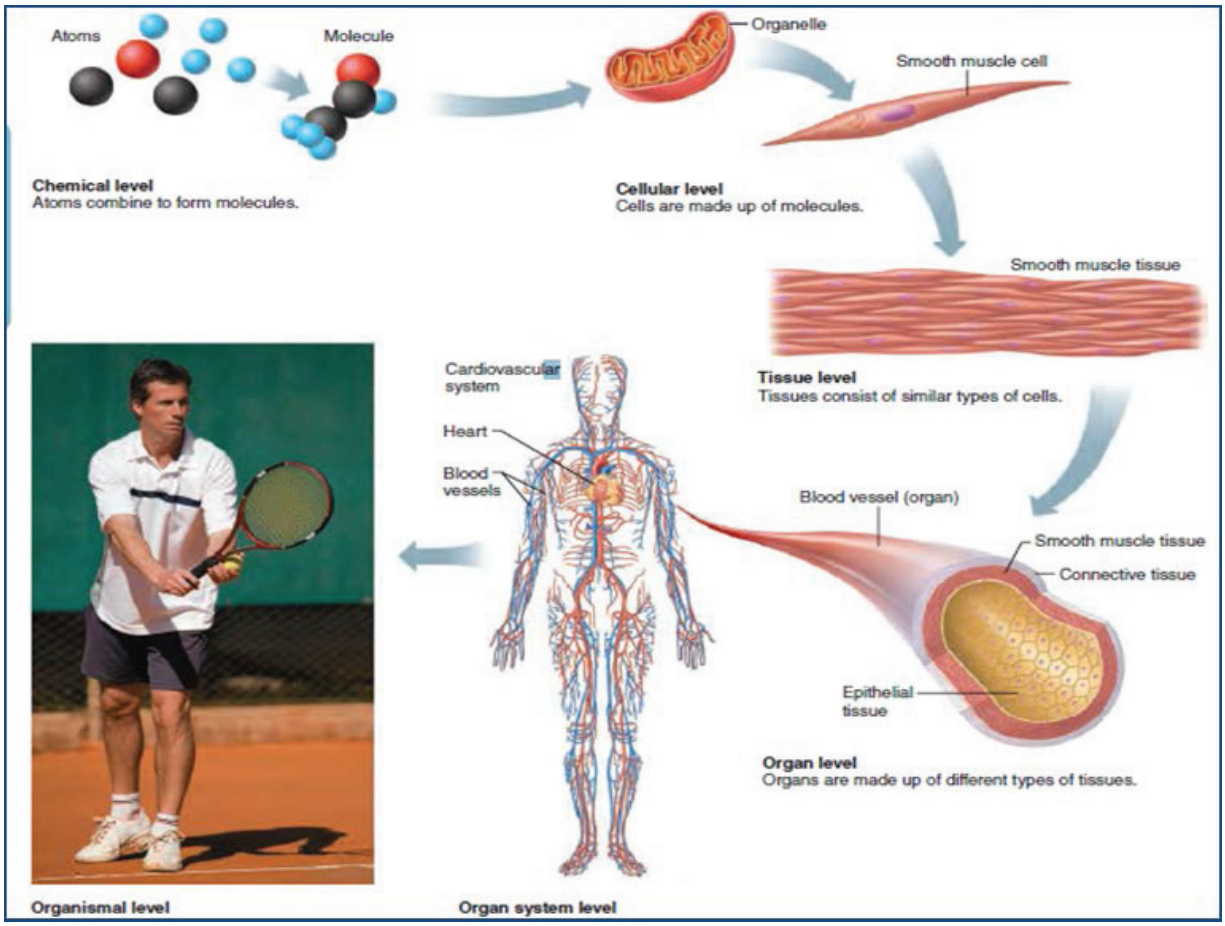


Figure (2): Levels of structural organization. Components of the cardiovascular system are used to illustrate the levels of structural organization in a human being.

THE LANGUAGE OF ANATOMY

A mastery of anatomical terminology is one of the essential tools for studying anatomy.

DESCRIPTIVE ANATOMICAL TERMS:

Anatomical position:

□ Anatomical position is the position of a person when:

- Standing erect with his eyes looking forwards and the mouth is closed.
- Arms resting by the side of the body and palms are facing forwards
- Feet are close together with toes pointing forwards.

□ The anatomical position is a standard reference position of the body used to describe the location and the relationship of anatomical structures.

Directional anatomical planes of human body:

Directional planes are imaginary flat surfaces pass through the body dividing it into sections, to understand relations of internal structures (organs inside the body).

Vertical planes:-

i. The median plane or mid-sagittal plane*:** is a vertical plane that divides the body lengthwise into ***two equal halves. It is called midsagittal because it passes along the length of sagittal suture of the skull.

ii. The para-median or para sagittal plane*:** is a vertical plane that passes parallel to the median plane for dividing the body into two ***unequal longitudinal halves.

***iii. The coronal or frontal plane*:** divides the body into **anterior and posterior parts.** It is so called because it passes through or is parallel to the coronal suture of the skull. The coronal plane is at right angles to the mid-sagittal plane.

The transverse or horizontal plane: it divides the body or organs into ***superior and inferior sections***. It is at right angles to both mid-sagittal and coronal planes.

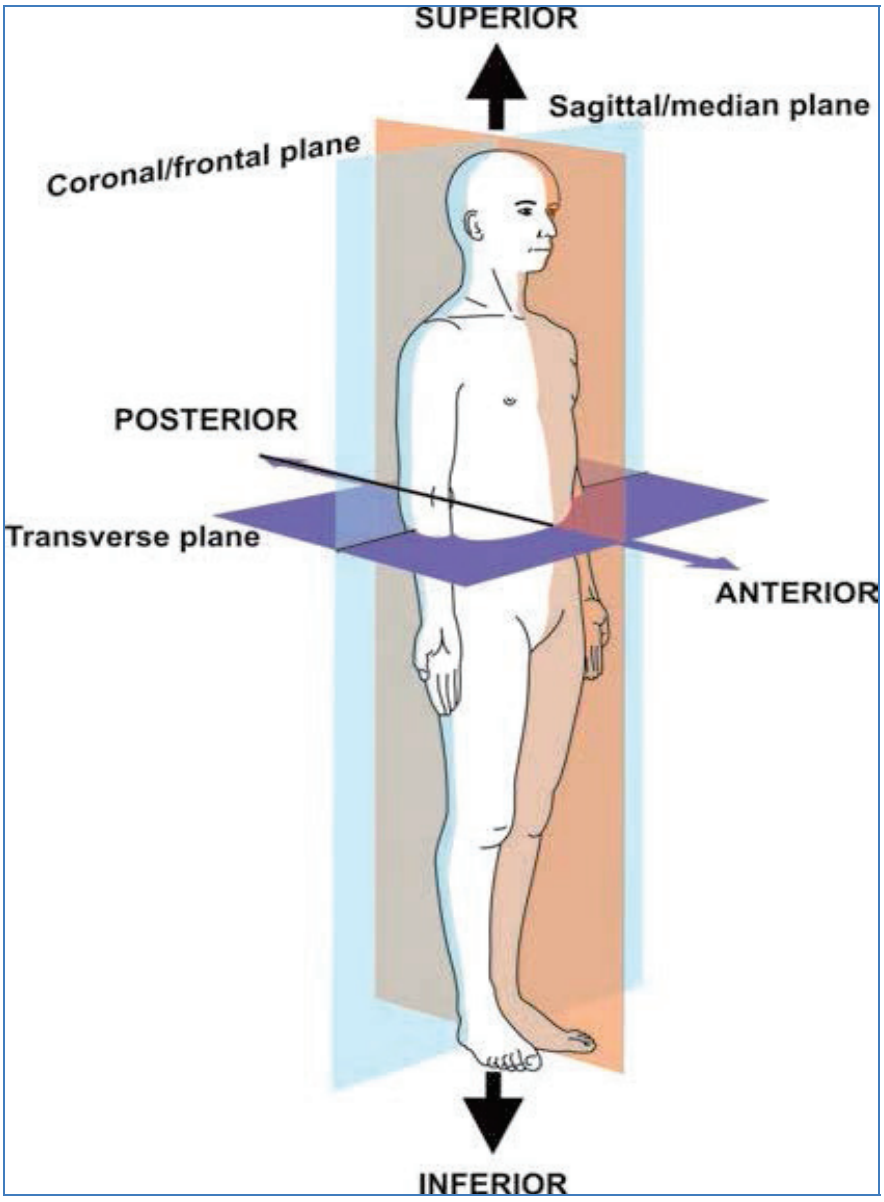


Figure (3): The anatomical position and planes.

Directional anatomical terms:

■ Terms of location and position:

□ These are terms used to describe the relationship of one part of the body to another.

□ It can be grouped into pairs that have opposite meanings. ***See table below***

Anatomical term	definition	Example
●Superior and Inferior: **▪Superior** **▪Inferior:**	▪Above or higher in position; toward the head. ▪Below or lower in position; toward the feet	▪The heart is superior to the liver. ▪The stomach is inferior to the lungs.
●Cranial and Caudal: **▪Cranial or cephalic** **▪Caudal:**	▪Toward the head. ▪Near the tail or posterior part of the body.	▪ The stomach is more cranial than the urinary bladder. ▪ The lumbar vertebrae are caudal to the cervical vertebrae.
●Anterior and posterior: **▪Anterior:** **▪Posterior:**	▪Nearer to or at the front of the body. ▪Nearer to or at the back of the body.	▪ The sternum is anterior to the heart. ▪ The oesophagus is posterior to the trachea.
●Ventral and dorsal: **▪Ventral:** **▪ Dorsal:**	▪Used synonymously with anterior in human anatomy. ▪Used synonymously with posterior in human anatomy.	▪The intestines are ventral to the vertebral column. ▪The kidneys are dorsal to the stomach.
● Medial, lateral and Intermediate: **▪ Medial:** **▪Lateral:** **▪Intermediate:**	▪ Nearer to the midline. ▪Farther from the midline. ▪ Between two structures.	▪ The ulna is medial to the radius. ▪ The lungs are lateral to the heart. ▪ The transverse colon is intermediate to the ascending colon and descending colon.
●Ipsilateral and contralateral: **▪ Ipsilateral:**	▪Two structures lie on the same side of the body's midline.	▪The gallbladder and ascending colon are ipsilateral.

▪ **contralateral**	▪One structure lies on the opposite side of the midline from another structure.	▪ The ascending and descending colons are contralateral.
●**Proximal and distal:** ▪**Proximal:** ▪**Distal:**	▪ Nearer to the attachment of a limb to the trunk; nearer to the origination of a structure. ▪ Farther from the attachment of a limb to the trunk; farther from the origination of a structure.	▪ The humerus (arm bone) is proximal to the radius. ▪ The phalanges (finger bones) are distal to the carpals (wrist bones).
Superficial and deep: ▪ **Superficial:** ▪ **Deep:**	▪ Toward or on the surface of the body. ▪ Away from the surface of the body.	▪ The ribs are superficial to the lungs. ▪ The ribs are deep to the skin of the chest and back.
● **External and Internal:** ▪**External:** ▪**Internal:**	▪Toward the outside of a structure. (it is typically used when describing relationships of individual organs. ▪ Toward the inside of a structure. (It is typically used when describing relationships of individual organs.)	▪The visceral pleura is on the external surface of the lungs. ▪ The mucosa forms the internal lining of the stomach.

Table (1): Terms of location and position.

■ Terms of movements:

These are terms used to describe the movements which occur at joints where two or more bones or cartilages articulate with one another. ***See table and figs below.***

Anatomical term	Definition
●Flexion and extension: **▪Flexion:** **▪Extension:**	 ▪Indicates bending or decreasing the angle between the bones or parts of the body. ▪Indicates straightening or increasing the angle between the bones or parts of the body.
●Abduction and adduction: **▪Abduction:** **▪Adduction:** **▪Circumduction:**	 ▪Means moving the part away from the median plane. ▪Means moving the part toward the median plane. ▪Is a circular movement that is a combination of flexion, abduction, extension, and adduction.
● Medial rotation and Lateral rotation: **▪Medial rotation (internal rotation)** **▪Lateral rotation(external rotation)**	 ▪This movement brings the anterior surface of a limb closer to the median plane. ▪This movement takes the anterior surface of a limb away from the median plane.
● Pronation and Supination: **▪Pronation:** **▪Supination:**	 ▪It is a rotational movement of the forearm and hand that swings the radius (the lateral long bone of the forearm) medially around its longitudinal axis so that the palm of the hand faces posteriorly and its dorsum faces anteriorly. ▪It is a rotational movement of the forearm and hand that swings the radius laterally around its longitudinal axis so that the dorsum of the hand faces posteriorly and the palm faces anteriorly.
● Eversion and Inversion: **▪Eversion:** **▪Inversion:**	 ▪It is the movement of the sole of the foot away from the median plane. ▪It is the movement of the sole of the foot toward the median plane.
● Opposition and Reposition: **▪Opposition:**	 ▪It is the movement by which the pad of the thumb, (1st digit) is brought to another digit pad.

▪Reposition:	▪It is the movement of the thumb (1st digit) from the position of opposition back to its anatomical position.
● Protrusion and Retrusion: **▪Protrusion:** **▪Retrusion:**	 ▪It is a movement of a part or a bone anteriorly (forward) as in protruding the mandible (chin), lips, or tongue. ▪It is a movement of a part or a bone posteriorly (backward), as in retruding the mandible, lips, or tongue.
● Protraction and retraction: **▪Protraction:** **▪Retraction:**	 ▪Anterior movements of the shoulder ▪Posterior movements of the shoulder.
● Elevation and Depression: **▪Elevation:** **▪Depression:**	 ▪It is the movement which moves or raises a part superiorly. ▪It is the movement which moves or lowers a part inferiorly,

Table (2): Terms of movement

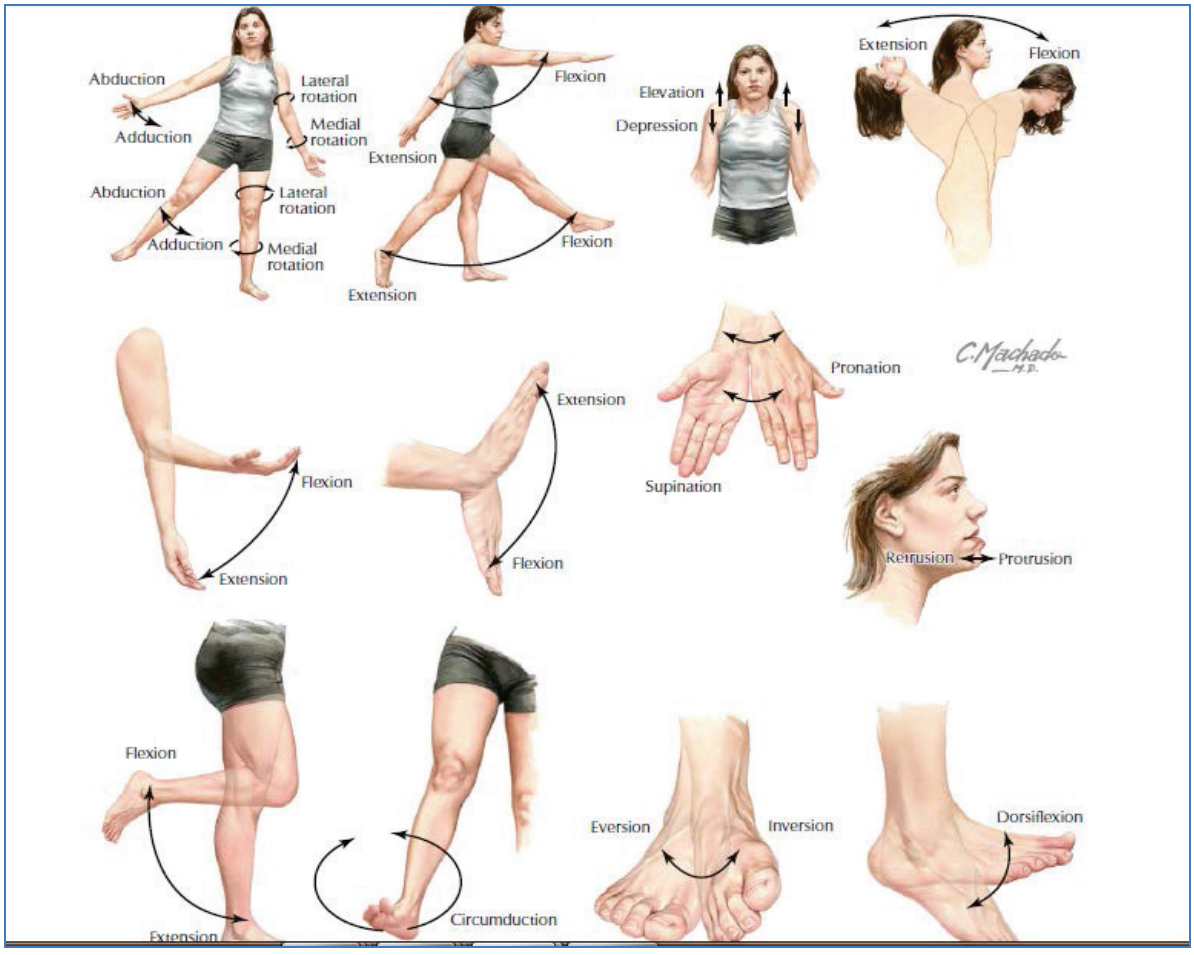


Figure (4): Terms of movement.

Figure (5): Movements of the thumb

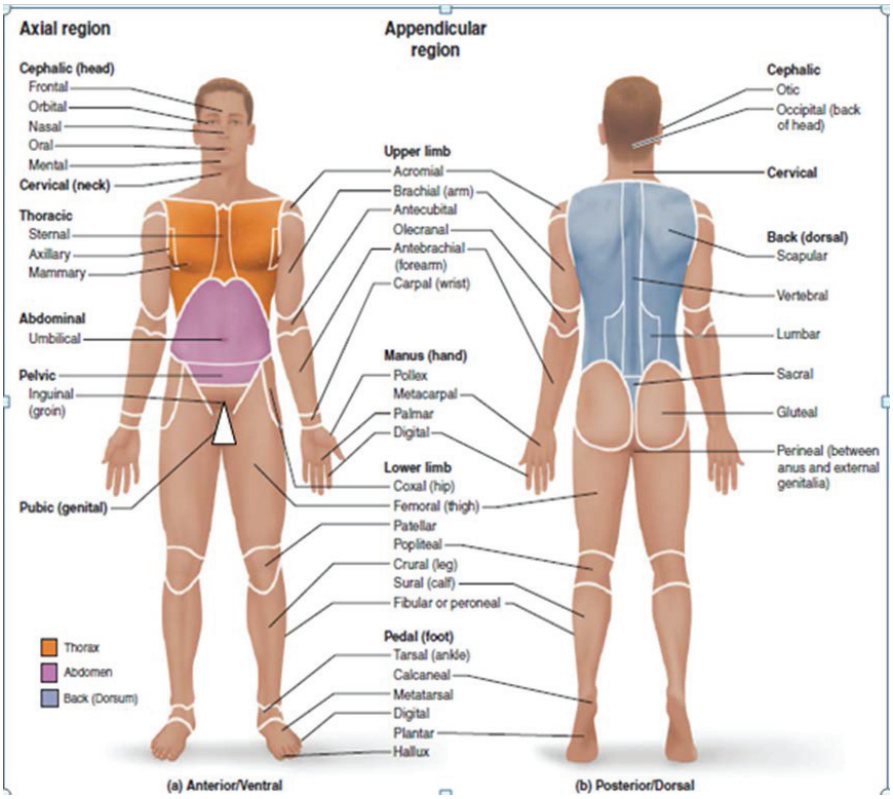


Figure (6): Body parts and areas. The body is shown in anatomic position.

■ Regional Terms

□These are terms related to body parts and areas. There are two fundamental divisions of our body, ***the axial and appendicular parts.***

□The regional terms are used to designate specific areas or related to an organ within these two major body divisions.

□ Example of specific Terms:

▪ **In the upper limb,** The term ***brachial*** always refers to **the arm**. The brachial artery is a blood vessel that passes through the arm.

▪ **In the lower limb,** The term ***femoral*** always refers to **the thigh.** The femoral artery is a blood vessel that passes through the **thigh.**

▪ The term ***cerebral*****,** always refers to ***the brain*****,** as in ***cerebral veins***

▪ The term ***gastric*****,** always refers to **the stomach,** as in ***gastric arteries***.

▪ The term ***pulmonary*****,** always refers to ***the lungs***, as in ***pulmonary artery***.

▪ The term ***cardiac***, always refers to ***the heart***, as in ***cardiac plexuses***.

Abdominal Regions and Quadrants:

Because the abdomen is a large area, if a patient reported abdominal pain, the physician would want to know where the pain was. To determine this, the abdomen may be divided into smaller regions or areas.

■ Four quadrants of the abdomen:

□ The abdomen is divided into four quadrants by a transverse plane and a vertical mid-sagittal plane at the umbilicus.

□ ***Clinically,*** this is probably the division used more frequently. The pain of gallstones might then be described as in the right upper quadrant.

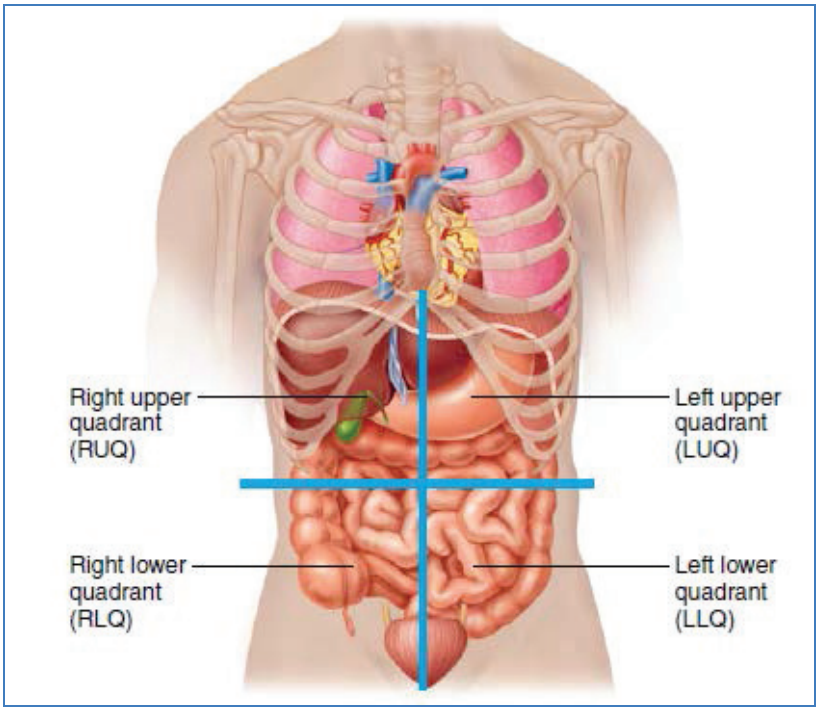


Figure (7): Anterior view showing division of the abdomen into four quadrants.

■ Nine regions of the abdomen:

□ Two transverse planes and two sagittal planes are used to divide the abdomen into nine areas:

- **Upper areas:** the right hypochondriac, epigastric, and left hypochondriac.
- **Middle areas:** the right lumbar, umbilical, and left lumbar.
- **Lower areas**: the right iliac, hypogastric, and left iliac.

□ **The nine-region division** is more widely used for ***anatomical studies*** to determine organ location. The liver, for example, is located in the epigastric and right hypochondriac areas.

□ **quadrants** are more commonly used by ***clinicians*** for describing the site of abdominopelvic pain, tumour, injury, or other abnormality.

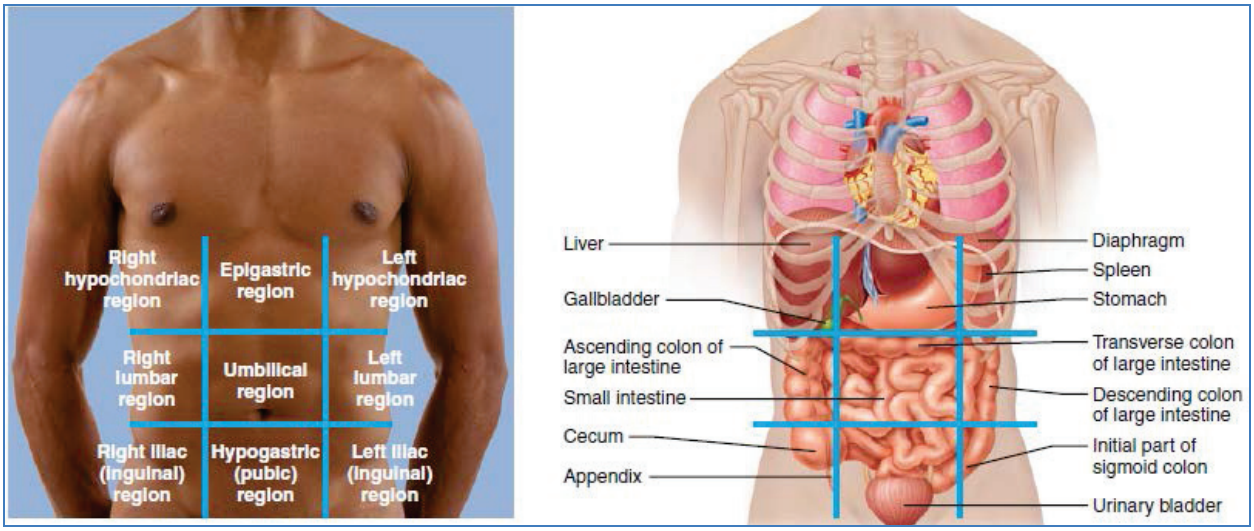


Figure (8): Anterior view showing nine regions of the abdomen

BODY CAVITIES

□ The body has two major cavities: the dorsal cavity and the ventral cavity. Each of these cavities has further subdivisions. (See table below)

□The ventral cavity lies in the trunk and consists of two compartments, ***the thoracic cavity*** and the ***abdominal cavity*** which are separated by the ***diaphragm.***

Name	Site	Contents	Lining membrane
●Dorsal cavities:			
▪Vertebral canal	▪Vertebral column	▪Spinal cord	▪Meninges
▪Cranial cavity	▪skull	▪Brain	▪Meninges
●Ventral cavities:			
▪Thoracic cavity	▪Trunk	▪Lungs ▪Heart	▪Pleura ▪Pericardium
▪Abdominopelvic cavity	▪Trunk	▪Viscera	▪peritoneum
●Other cavities:			
▪Mouth cavity	▪Skull	▪Tongue and teeth	▪Mucous membrane
▪Nasal cavity	▪Skull	▪Opening of paranasal sinuses	▪Mucous membrane
▪Orbit	▪Skull	▪The eyeballs	▪Endosteum
▪The middle ear cavities	▪Skull	▪Small bones and muscles	▪Mucous membrane
▪synovial cavities:	▪Synovial joints	▪Synovial fluid	▪Synovial membrane

Table (3): body cavities and their subdivisions.

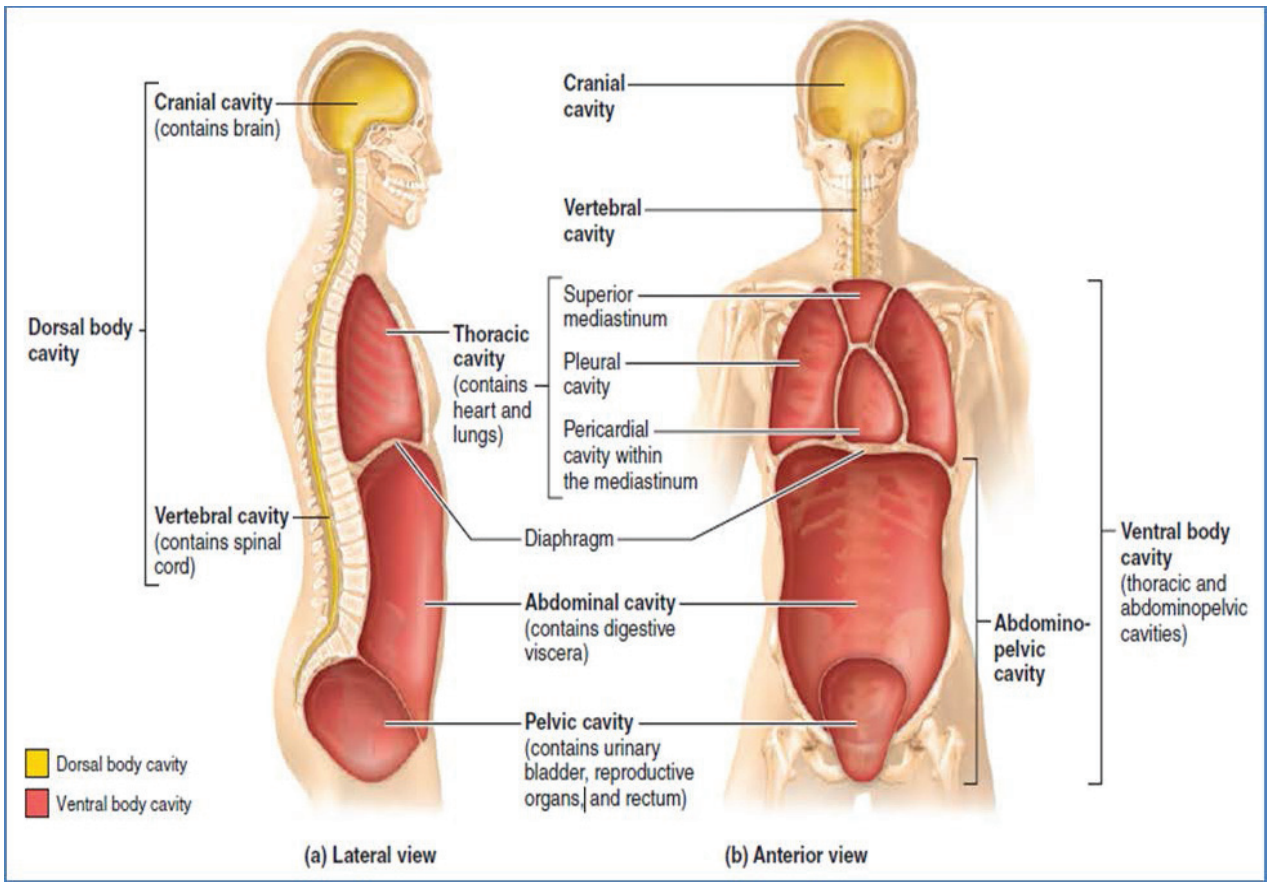


Figure (9): Dorsal and ventral body cavities and their subdivisions.

Key words

1- What is anatomy?

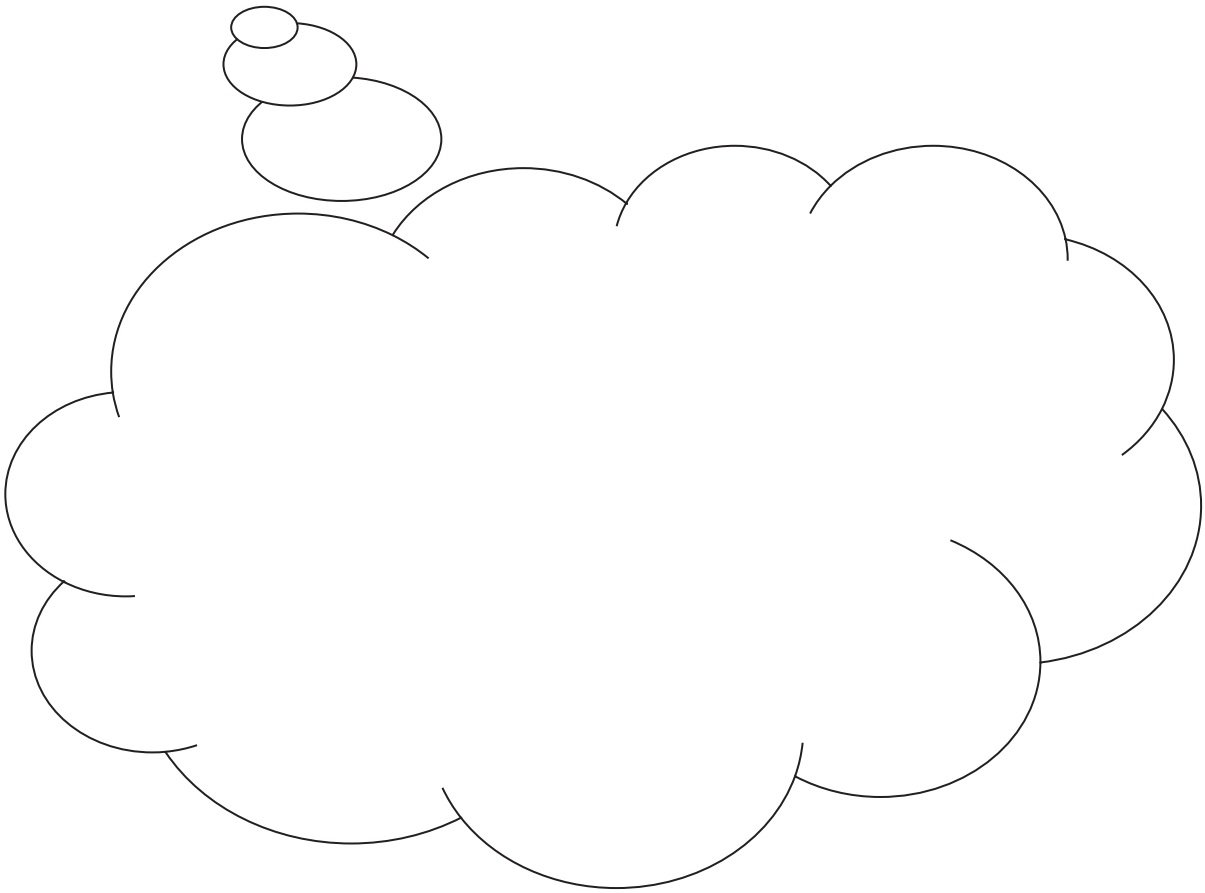
2- Subdivisions of anatomy

3- Organization of the human body

4- The language of anatomy

5- Bodv cavities

Write your note



Check your understanding

1. What is the difference between microanatomy and gross anatomy?

2. Define a tissue. List the four types of tissues in the body, and briefly state the function of each.

3. Follow up organization of human body from atom to organism.

4. Arrange the layers of organization of human body from superficial to deep.

5. Describe the anatomical position and explain why it is important.

6. List the planes that divide the body vertically.

7. What is the difference between a plane and a section?

8- Which directional terms can be used to specify the relationships between

(1) the elbow and the shoulder, (2) the left and right shoulders

(3) the sternum and the humerus, (4) the heart and the diaphragm?

9- Is the radius proximal to the humerus? Is the esophagus anterior to the trachea? Are the ribs superficial to the lungs? Is the urinary bladder medial to the ascending colon? Is the sternum lateral to the descending colon?

10- Use the directional terms to describe the location of the liver in reference to the heart.

11- In which quadrant would the pain from appendicitis (inflammation of the appendix) be felt?

12- In which abdominopelvic region is each of the following found:

1- Most of the liver. 2- Transverse colon.

3- Urinary bladder. 4- Spleen.

Chapter II

BASIC COVERING ANATOMIC STRUCTURES

BASIC COVERING ANATOMIC STRUCTURES

□ The superficial region of the skin is a thick epithelial tissue, called ***epidermis.***

□ The deep region of the skin is ***a*** fibrous connective tissue, called ***dermis.***

□ Just deep to the skin lies a fatty layer called ***the hypodermis,*** composed of loose areolar connective tissue and adipose tissue which attaches the dermis to the deep fascia of the body.

N.B.: The integumentary system consists of the skin with its appendages (hair, nails, and sweat glands) and the hypodermis.

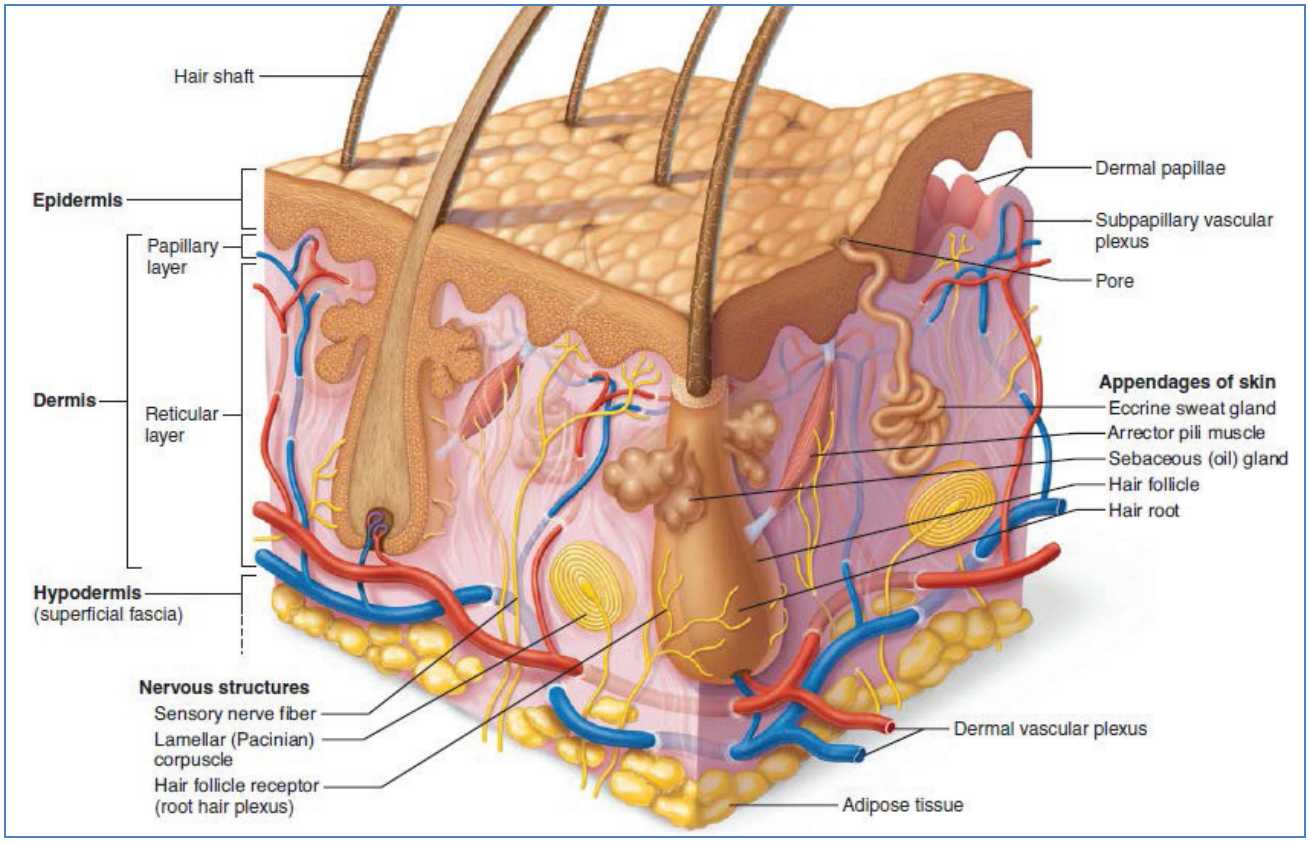


Figure (10): Skin structure.

THE SKIN

□ Description:

- It is the largest organ of the body in weight.
- The skin over joints always folds to form the skin creases. At these sites, the skin is thinner than elsewhere and is firmly attached to underlying structures by strong bands of fibrous tissue.

□ Functions:

- **Protection:** it protects the body from chemicals and invading micro-organisms.
- **Body temperature regulation:** this because the skin is rich in capillary networks and sweat glands which regulate the loss of heat from the body.
- **Sensory reception:** the skin contains sense organs called *sensory receptors* that are associated with nerve endings.
- **Excretion:** the skin acts as a miniature excretory system where urea, salts, and water are lost through sweat.
- **Production of vitamin D:** the epidermal cells use UV radiation to synthesize vitamin D, a molecule necessary for absorbing calcium from the digestive tract.

□ Structure:

►Structurally, the skin consists of two main parts:

	Epidermis	Dermis
Description	▪It is the superficial and the thinner portion of the skin. ▪Thick over the heel. ▪Thin over eye lid.	It is the deeper and the thicker portion of the skin. ▪Thick in the palm and sole. ▪Thin over joints.
Structure	Composed of many layers of epithelial tissue.	Composed of dense connective tissue containing collagen and elastic fibers.
Vascularity	It is ***avascular***	It is ***vascular***
Subdivision:	▪It is composed of four to five layers.	▪It is divided into two layers: **i.** a thin, superficial papillary region. **ii.** a thick, deeper reticular region.
developmentally	Ectodermal in origin.	Mesodermal in origin.

Table (4): The two regions of the skin.

Vascularity of the skin:

□ The epidermis is ***avascular*** so, there is no bleeding if the skin is scratched.

□ The dermis is ***vascular,*** so a cut that penetrates to the dermis produces bleeding.

□ Nutrients and oxygen diffuse to the avascular epidermis from blood vessels in the dermal papillae.

□ The two layers of the dermis contain dense networks of small blood vessels, arise from vessels supplying the underlying skeletal muscles.

▪ ***The cutaneous arterial plexus,*** is located at the junction of the dermis and subcutaneous layer and sends branches that supply the sebaceous (oil) and sweat glands, the deep portions of hair follicles, and adipose tissue.

▪ ***The papillary arterial plexus,*** formed at the level of the papillary region, sends branches that supply the capillary loops in the dermal papillae, sebaceous (oil) glands, and the superficial portion of hair follicles.

■ Skin markings:

►Dermal modifications result in characteristic skin markings.

a) Friction ridges and finger prints:

These are epidermal ridges topping the deeper dermal papillary projections.

Importance:

Because the ducts of sweat glands open on the tops of the epidermal ridges as sweat pores, the sweat and ridges form finger-prints (or foot-prints) when a smooth object is touched, which has a medico- logical importance.

(b) Cleavage (tension) lines:

It represents separations between underlying collagen fiber bundles in the reticular region of the dermis and indicates the predominant direction of these fibers. They tend to run circularly around the trunk and longitudinally in the limbs.

Importance:

Knowledge of tension lines is especially important to plastic surgeons, a surgical incision running parallel to the collagen fibers will heal with only a fine scar. A surgical incision made across the rows of fibers disrupts the collagen, and the wound tends to gap open and heal in a broad, thick scar.

(c) Flexure lines form mainly in front of the joints where the dermis is thin and closely attached to the underlying fascia.

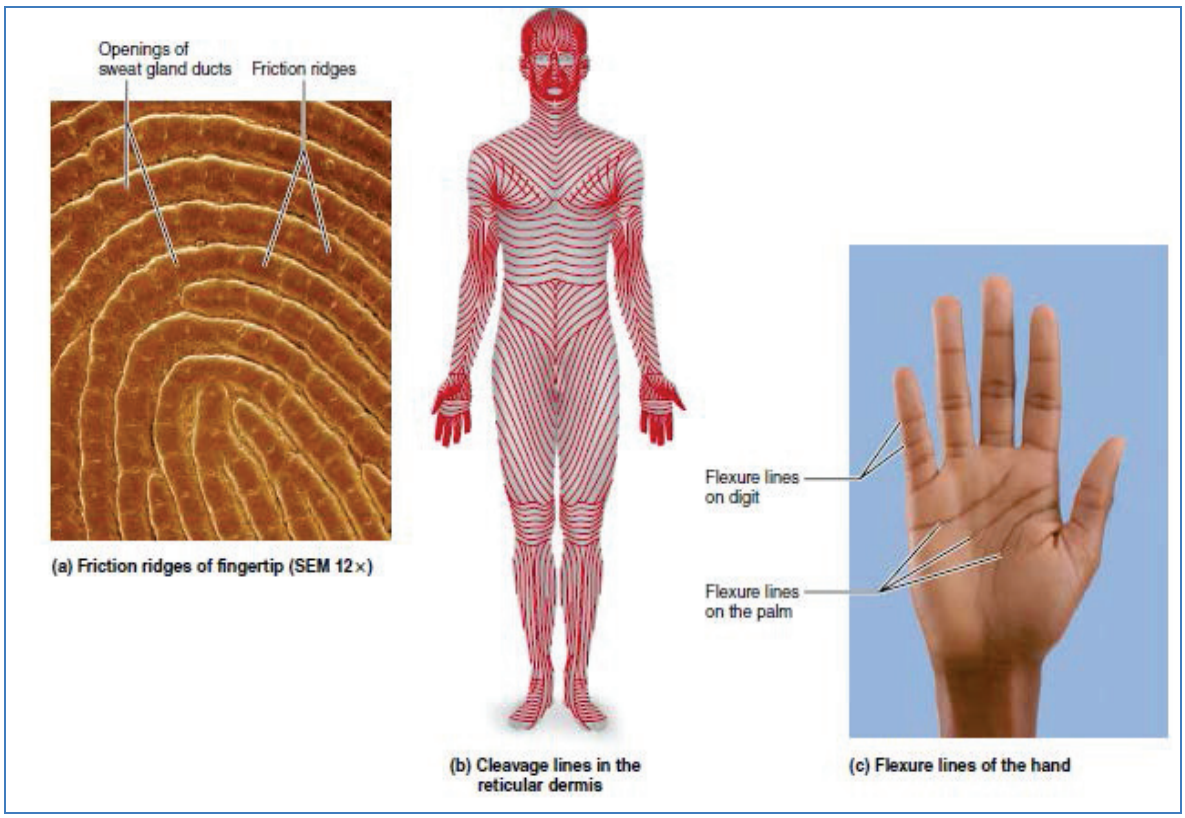


Figure (11): Dermal modifications result in characteristic skin markings.

N.B:

- If the skin becomes stretched as in pregnancy or by rapidly growing tumours or excessive deposition of fat, the fibers of the reticular layer become partially ruptured with scar formations which appear on the surface of skin as white lines as in the " Linea gravidara " of pregnancy.
- In old age the elastic fibers of the reticular layer become degenrated and atrophic, hence the skin loses its elasticity and become wrinkled.

■ Skin appendages:

□ ***The skin appendages include:***

- Hair and hair follicles.
- Nails.
- Sweat glands.
- Sebaceous (oil) glands.

Hairs:

□ Hairs grow out of follicles, which are invaginations of the epidermis into the dermis.

□ A band of smooth muscle, ***the arrector pili,*** connects the undersurface of the follicle to the superficial part of the dermis. The muscle is innervated by sympathetic nerve fibers, and its contraction causes the hair to move into a more vertical position.

□ **Distribution:**

Hairs are distributed over the whole surface of the body **except:** palms, soles, lips, nipples, and parts of the external genitalia.

Sweat Glands:

□ **Distribution:**

Sweat glands are distributed over the entire skin surface **except:** the nipples and parts of the external genitalia.

□ **Modified sweat glands:**

i. Ceruminous glands are modified sweat glands found in the lining of the external ear canal. Their secretion mixes with sebum produced by nearby sebaceous glands to form a sticky, bitter substance called ***cerumen*.**

ii. Mammary glands, another variety of specialized sweat glands, secrete milk.

Sebaceous (Oil) Glands

□The sebaceous glands, or oil glands are found all over the body, **except** in the thick skin of the palms and soles.

□ Sebaceous glands are developed as outgrowths of hair follicles and secrete ***sebum*** into a hair follicle, or occasionally to a pore on the skin surface.

□ Arrector pili contractions force ***sebum*** out of the ***hair follicles*** to the skin surface.

Nails

□ A nail is a scale like modification of the epidermis that forms protective covering on the dorsal surface of the distal part of a finger or toe.

□ Structure of a nail, each nail has:

- **Free edge.**
- **Nail plate or body,** (visible attached portion).
- **proximal *root*** (embedded in the skin).
- **Nail bed,** is the deeper layers of the epidermis which extend beneath the nail. Nails normally appear pink because of the rich bed of capillaries in the underlying dermis.
- **Nail folds,** are the proximal and lateral borders of the nail are overlapped by skin folds.

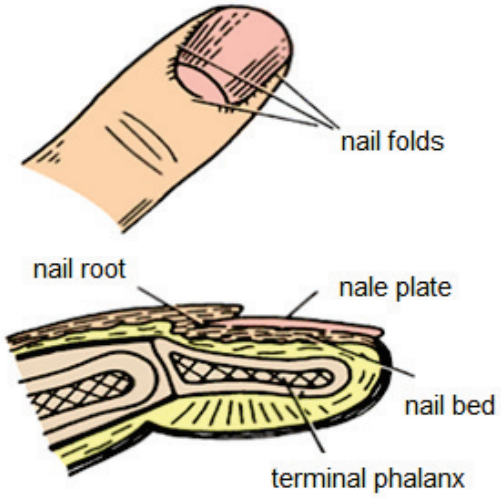


Figure (12): Structure of a nail.

THE FASCIA

□ Fascia is connective tissue containing varying amounts of fat that separate, support, and interconnect organs and enable movement of one structure relative to another.

► ***There are two types of fascia: Superficial fascia and deep fascia.***

I. Superficial fascia or subcutaneous tissue:

□ It is composed of loose connective tissue and adipose tissue that unites the dermis of the skin to the underlying deep fascia.

□ It holds the skin firmly to the deeper structures in the following sites:

▪ In the scalp. ▪ The back of the neck.

▪ The palms of the hands. ▪ The soles of the feet.

□ It is devoid of adipose tissue in the following sites:

▪ The eyelids, ▪ Auricle of the ear,

▪ Some of external genitalia (penis and scrotum, and clitoris).

Functions of superficial fascia:

1- Allows movement of the skin over deeper areas of the body.

2- It conducts vessels and nerves to and from the skin.

3- Due to its high fat content, it **serves as:**

- Heat insulator. - Energy store.
- Factor which gives the body its rounded contours.

II. Deep fascia:

□ It is a membranous layer of connective tissue that invests the muscles and other deep structures and attached to the deep surface of the superficial fascia.

□ It is **absent** in the face, scalp and anterior abdominal wall.

► **Forms and functions of deep fascia:**

▪ **In the neck,** it forms well-defined layers that invest the deep structures and play an important role in determining the path taken by pathogenic

organisms during the spread of infection.

▪ **In the limbs,** it forms a definite sheath around the muscles and other structures, holding them in place, from it fibrous ***intermuscular septa*** extend between the groups of muscles, to divide the interior of the limbs into compartments.

▪**In the region of joints,** the deep fascia may be thickened to form bands called ***retinacula***, their function is to hold underlying tendons in position.

▪In certain sites, the deep fascia is thickened for protection, e.g., palmer aponeurosis in the palm of the hand and planter aponeurosis in the sole of foot

▪ It forms a definite ***sheath*** around the neurovascular structures, such as axillary sheath, femoral sheath and carotid sheath.

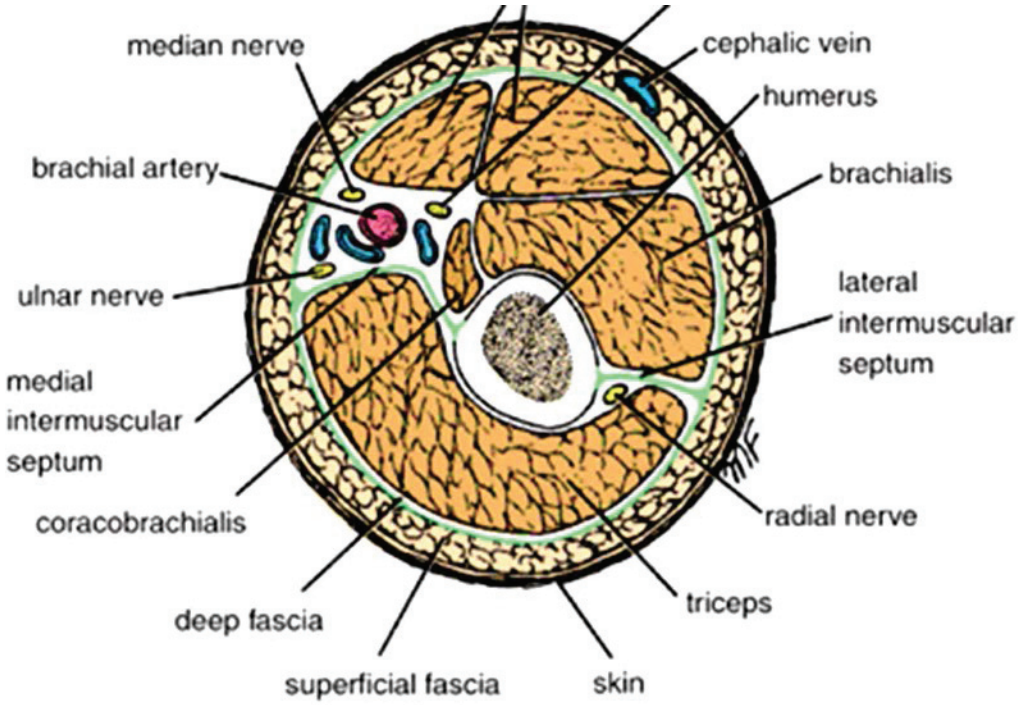


Figure (13): Section through the middle of the right arm showing the arrangement of the superficial and deep fascia. Note how the fibrous septa extend between groups of muscles, dividing the arm into fascial compartments.

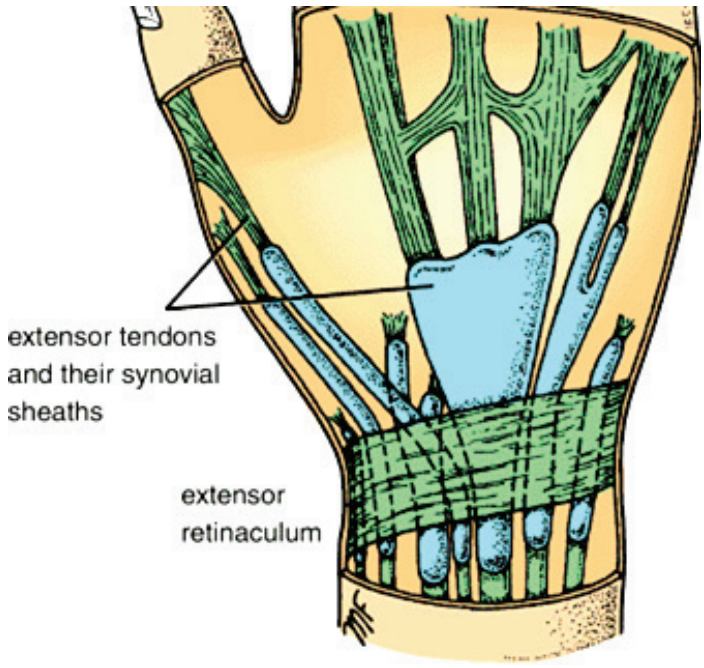


Figure (14): Extensor retinaculum on the posterior surface of the wrist holding the underlying tendons of the extensor muscles in position

Keywords

Skin:

1- Description.

2- Function.

3- Structure

4- Vascularity

5- Skin color

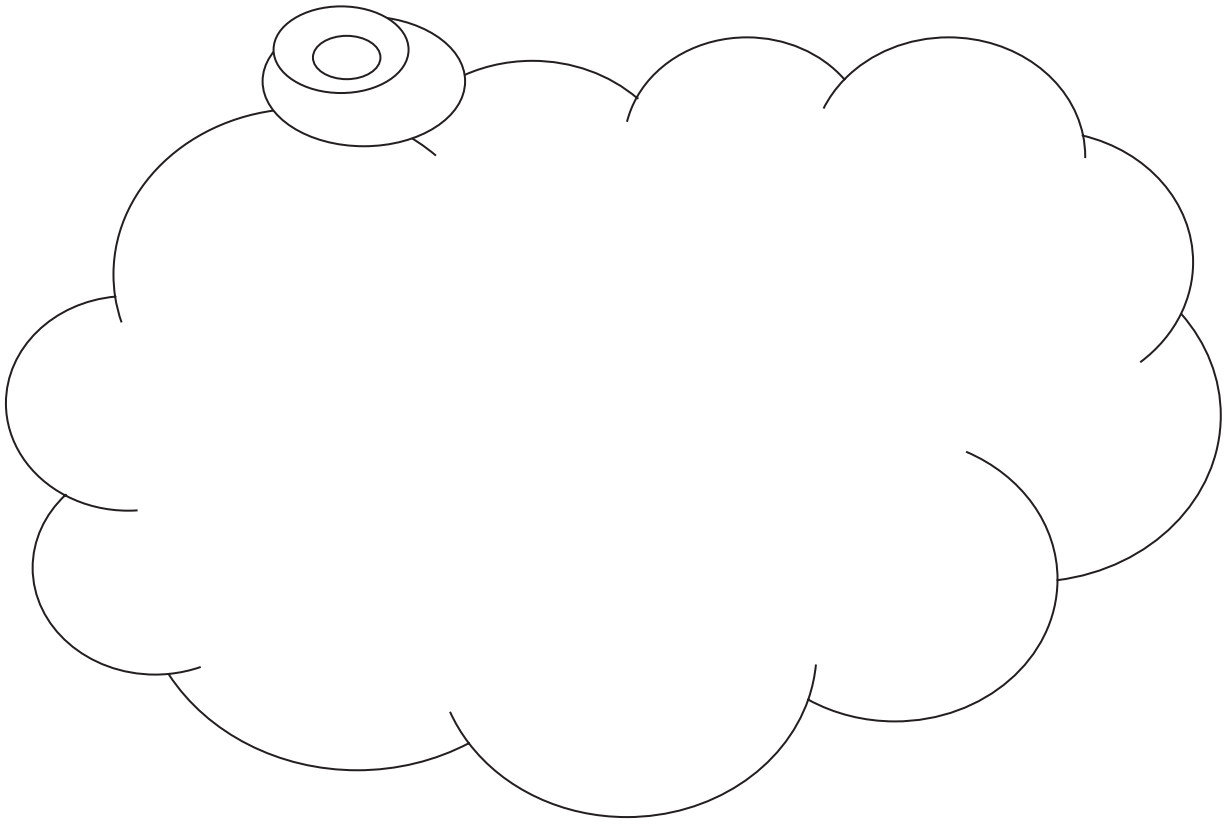
6- Skin appendages (Hair and hair follicles, Nails, Sweat glands and Oil (Sebaceous) glands).

Fascia:

1- Superficial fascia, sites and its function.

2- Deep fascia, sites and its function.

Write your note



Check points

1- Name the two major layers of skin, the location of each, and the tissue of which each is made.

2- How does the skin contribute to regulation of body temperature, blood reservoir and protection?

3- Which cutaneous glands are associated with hair follicles?

4- Sebaceous glands are not found in thick skin. Why is their absence in those body regions?

5- Name the sits of secretions of sebum and cerumen and give the function of each

6- Name three structures in the skin have sympathetic innervation.

7- The nail bed is which part of the skin?

8- Name the tissues of which the superficial fascia is made. Describe the functions of these tissues.

9- Describe the vascularity of the skin.

10- Give reason: a) Nails normally appear pink

b) Superficial fascia serves as energy store.

11- Name the skin marking. Give reason for the occurrence of each.

Chapter III

BASIC SKELETAL ANATOMIC STRUCTURES

BASIC SKELETAL ANATOMIC STRUCTURES

♦ The skeletal system is composed of the cartilages, bones, and joints

CARTILAGE

♦ Cartilage is a semi-rigid form of connective tissue that forms parts of the skeleton where more flexibility is required:

• At the sites of attachments of the ribs to the sternum.

• Covering the articulating surfaces of bones in the synovial joints, that provides smooth, gliding surfaces for free movement.

♦ It is avascular tissue and its cells obtain oxygen and nutrients by diffusion.

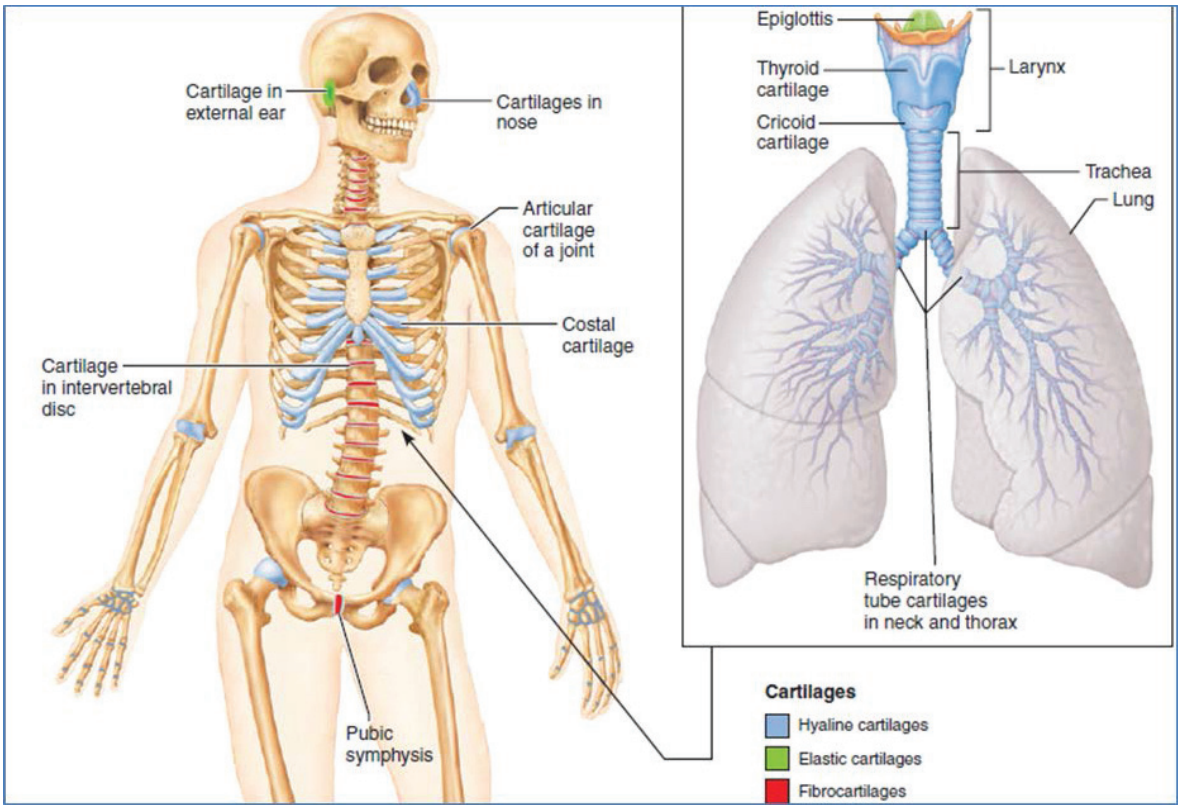


Figure (15): Cartilages in the body.

► ***According to the type of the fibres contents of the matrix, there are three types of cartilage tissue in the body:***

Hyaline cartilage	White fibrocartilage	Elastic cartilage
■ It appears translucent due to its very fine collagen fibres. ■ **Sites:** • Developing bones of the embryo. • Epiphyseal plates of cartilage. • Articular cartilages. • Costal cartilages.	■ It appears white due to its high content of collagen fibres. ■ **Sites:** •Symphysis pubis. •Intervertebral discs. •Menisci of the knee joint. •Articular cartilage in the tempro-mandibular joint, sterno-clavicular and acromio-clavicular joints.	■It is rich in elastic fibres. ■**Sites:** •Auricle and external auditory meatus of external ear. •Eustachian tube. •Epiglottis of the larynx.

Table (5): Types of cartilages.

BONE

The bone is the hardest connective tissue in the body. It is a highly vascular and dynamic tissue which shows a continuous turn over throughout life.

FUNCTIONS OF BONE

- **Support:** for the body and its vital cavities.
- **Protection:** for vital structures.
- **Assistance for movement:** The mechanical basis for movement (leverage).
- **Storage for minerals:** e.g., calcium and phosphorus.
- **Storage for triglyceride:** Yellow bone marrow, are a potential chemical energy reserve.
- **Blood cell production**: a continuous supply of new blood cells (produced by the marrow contained within many bones).

THE BONY SKELETON

CLASSIFICATION OF BONES:

► ***Bones are classified according to their position into***

■ **Axial skeleton:**

■ **Skull:**

□ **Bones of the skull are 22 in number classified into:**

▪ **Cranial Bones (8 bones): Frontal** (1), **Parietal** (2), occipital (1) **Temporal** (2) **Sphenoid** (1) **Ethmoid** (1)

▪ **Facial Bones (14 bones): Mandible** (1) **Maxilla** (2) **Zygomatic** (2) **Nasal** (2) **Lacrimal** (2) **Palatine** (2), inferior conchae (2) and vomer (1)

■ **Vertebral column:**

□ The adult vertebral column typically contains 26 vertebrae. These are distributed as follows:

♦ 7 **cervical vertebrae,** in the neck region.

♦ 12 **thoracic vertebrae,** posterior to the thoracic cavity.

♦ 5 **lumbar vertebrae,** supporting the lower back.

♦ 1 **sacrum,** consisting of five fused **sacral vertebrae.**

♦ 1 **coccyx**, consisting of four fused **coccygeal Vertebrae.**

■ Bones of the thorax:

♦ **Anteriorly:** sternum.

♦ **On each sides:** twelve ribs

♦ **Posteriorly:** 12 thoracic vertebrae

■ Appendicular skeleton:

►Bones of upper limb:

□ The skeleton of the upper limb formed of two distinct regions:

(1) The pectoral girdle or **shoulder girdle**: consists of the ***clavicle*** anteriorly and the ***scapula*** posteriorly

(2) The free upper limb: The three segments of the upper limb are the arm, the forearm, and the hand.

♦ The **humerus, is the only** bone of the **arm**

♦ The **radius** and the **ulna**, form the skeleton of the **forearm,**

♦ The **skeleton of the hand** includes:

▪ **Carpal** bones, bones of the **wrist**;

▪ **Metacarpa**l bones, the bones of the **palm.**

▪ **Phalanges**, bones of the **fingers**.

►Bones of lower limb:

□ The skeleton of the upper limb formed of two distinct regions:

(1) The pelvic girdle: consists of the tow hip bones.

(2) The free lower limb: The three segments of the lower limb are the thigh, the leg, and the foot.

♦ The **femur:** is the single bone of the thigh.

♦ The tibia and fibula, form the skeleton of the leg.

♦**The skeleton of the foot includes:**

▪ The bones of the ***tarsus.***

▪ The bones of the ***metatarsus.***

▪ The ***phalanges,*** or toe bones.

DIVISION OF THE SKELETON	STRUCTURE	NUMBER OF BONES
Axial skeleton	Skull	
	Cranium	8
	Face	14
	Hyoid bone	1
	Auditory ossicles	6
	Vertebral column	26
	Thorax	
	Sternum	1
	Ribs	24
	Number of bones =	80

DIVISION OF THE SKELETON	STRUCTURE	NUMBER OF BONES
Appendicular skeleton	Upper limbs	
	Pectoral (shoulder) girdles	
	Clavicle	2
	Scapula	2
	Free upper limbs	
	Humerus	2
	Ulna	2
	Radius	2
	Carpals	16
	Metacarpals	10
	Phalanges	28
	Lower limb	
	Pelvic (hip) girdle	
	Hip, pelvic, or coxal bone	2
	Free lower limbs	
	Femur	2
	Patella	2
	Fibula	2
	Tibia	2
	Tarsals	14
	Metatarsals	10
	Phalanges	28
	Number of bones =	126
	Total in adult skeleton =	206

Figure (16): The bones of the human skeleton are grouped into the axial and appendicular skeletons.

► *Bones are classified according to their shape into:*

Long bones:

i. Typical long bone: Each has a long tubular shaft, with a central medullary cavity and expanded articular ends.

▪ **Examples:** The humerus (arm bone), ulna and radius (forearm bones), femur (thigh bone), tibia and fibula (leg bones).

ii. Short long bones (Miniature long bone): each has a single epiphysis.

▪ **Examples:** Metacarpals (hand bones), metatarsals (foot bones), and phalanges (finger and toe bones).

iii. Modified long bone: is the only long bone without marrow cavity, is a membrane bone and ossifies from two primary centres.

▪ **Examples:** The clavicle.

Short bones:

▪ They are cube-shaped and nearly equal in length, width, and depth. These bones are subjected to pressure.

▪ Examples: carpal (wrist) bones and tarsal (ankle) bones.

Flat bones:

▪ It provides protection for the vital organs and gives attachment for muscles.

▪ **Examples:**

- The cranial (skull) bones, which protect the brain.
- The sternum (breastbone) and ribs, which protect organs in the thorax.
- The scapulae (shoulder blades).

Irregular bones:

▪They have complex shapes and cannot be grouped into any of the three mentioned categories.

▪ **Examples:** The vertebrae (backbones), certain facial bones, and the calcaneus (heel bone).

Pneumatic bones:

These are the bones containing air spaces (sinuses).

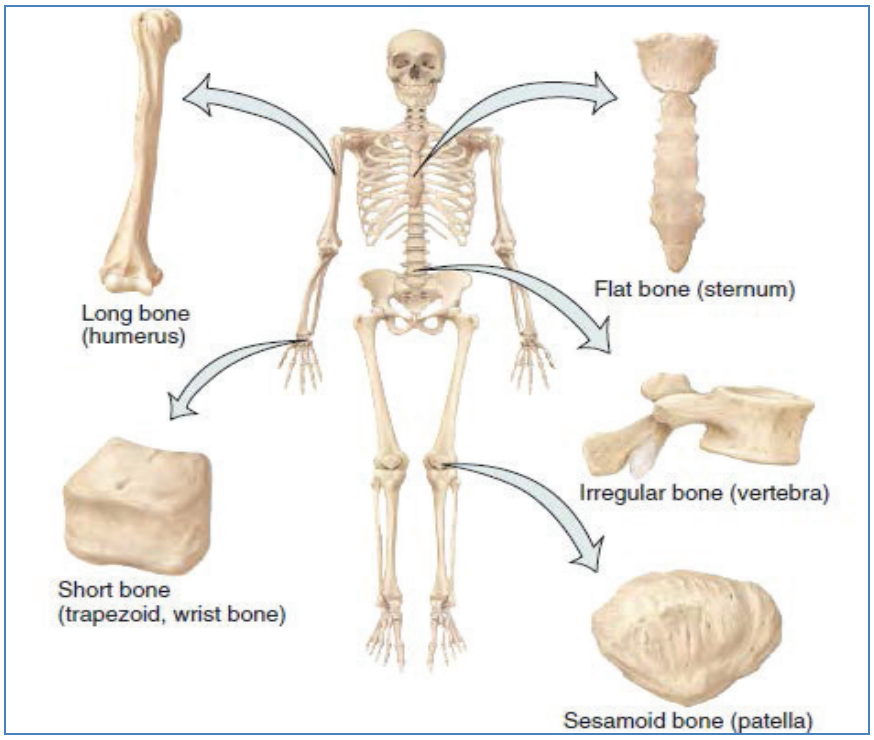
▪ Examples: Certain cranial bones (maxilla, sphenoid, frontal bones and the mastoid part of the temporal bone).

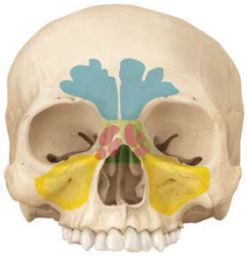
Sesamoid bones:

▪They are small bones shaped like a sesame seed and develop in certain tendons where there is considerable friction, compression, and physical stress.

▪ Example: The patella (knee cap) in the quadriceps tendon.

● **Sutural bones:** are small bones located within the sutures (joints) of certain cranial bones.





Pneumatic bone (some of facial bones)

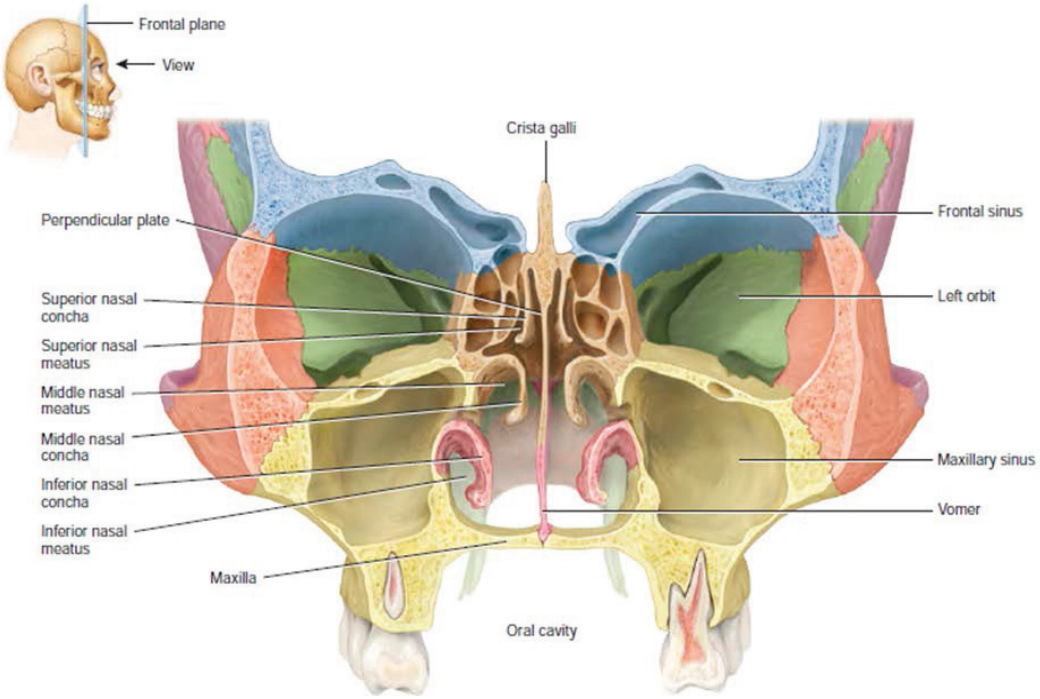


Figure (17): Types of bones based on shape.

► ***Bones are classified according to structure into:***

- **Compact bones,** makes up the diaphysis of long bones.
- **Spongy bone,** located in the *interior* of a bone, protected by a covering of compact bone.

Gross Anatomy of the bone: By the naked eye, every bone has:

□ **An outer layer**, that looks smooth and solid this is **compact bone.**

□ **An inner layer**, a honey comb of small needle-like pieces, this is **spongy bone**.

■ Structure of Short, Irregular, and Flat Bones

♦They all consist of thin plates of spongy bone covered by compact bone.

♦These plates are covered outside and inside by connective tissue membranes, respectively the periosteum and endosteum.

♦ **Example:** the flat bone of the skull is formed of two thin layers of compact bone and spongy bone lies in between. The spongy bone here called the **diploe.**

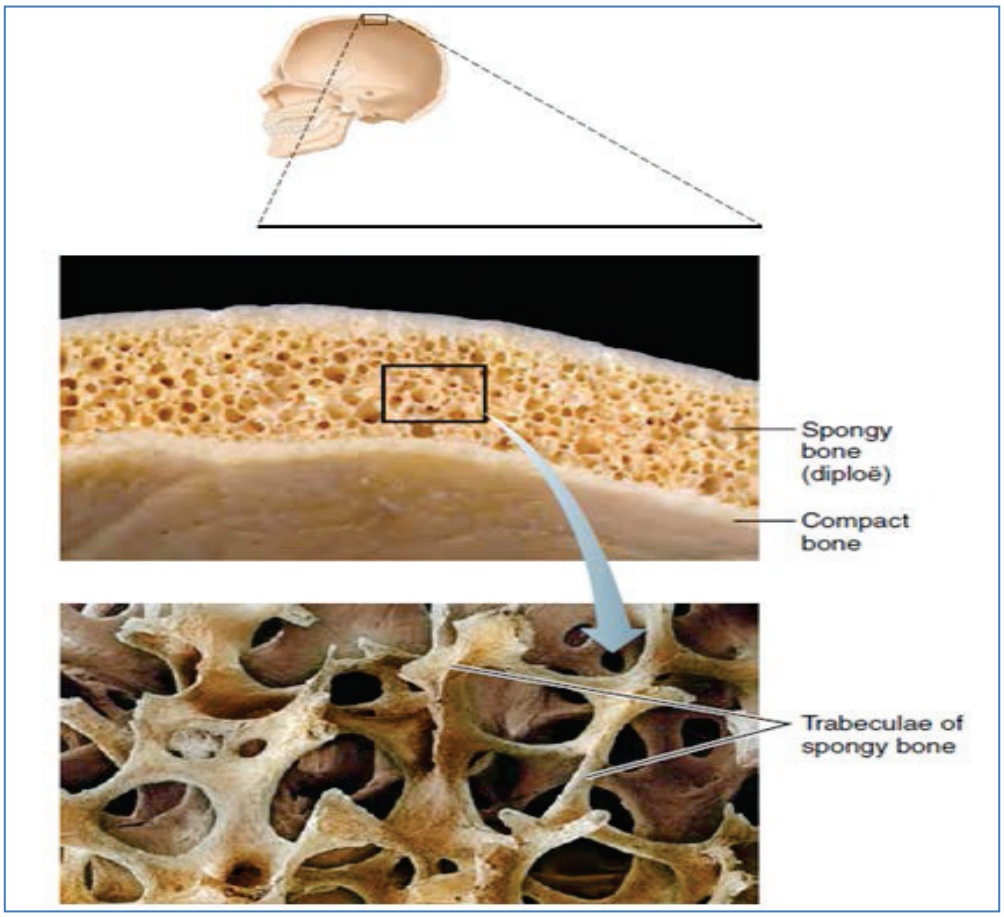


Figure (18): Flat bones consist of a layer of spongy bone between two thin layers of compact bone.

Structure of long bone

With few exceptions, all long bones have the same general structure: ***a shaft (Diaphysis), bone ends (Epiphyses), and membranes.***

Parts of a growing long bone:

1. The **diaphysis**, is the bone's shaft, the long and cylindrical.

2. The **epiphyses,** are the proximal and distal ends of the bone. It is covered by thin layer of hyaline cartilage called articular cartilage at the site of articulation with another bone.

3. The **metaphyses,** are the regions between the diaphysis and the epiphyses. It is highly vascular and it is the area of active growth.

□ **In the growing bone: (before complete ossification),** each metaphysis contains a layer of hyaline cartilage that allows the diaphysis of the bone to grow in length, called an **epiphyseal plate or (growth cartilage)**.

□ **When full height is achieved (after complete ossification),** the cartilaginous epiphyseal plate turns into bone and indicated by ***the epiphyseal line.***

4. The medullary cavity, or **marrow cavity**, is a hollow, cylindrical space within the diaphysis that contains fatty yellow bone marrow and numerous blood vessels in adults.

5. The endosteum, is a thin membrane that lines the medullary cavity

6. The **periosteum,** is a tough of connective tissue sheath that surrounds the bone surface except parts covered by articular cartilage.

Function of periosteum:

1. Some of its cells enable bone to grow in thickness.

2. The periosteum also protects the bone.

3. Assists in fracture repair.

4. Helps nourish bone tissue.

5. Serves as an attachment point for ligaments and tendons.

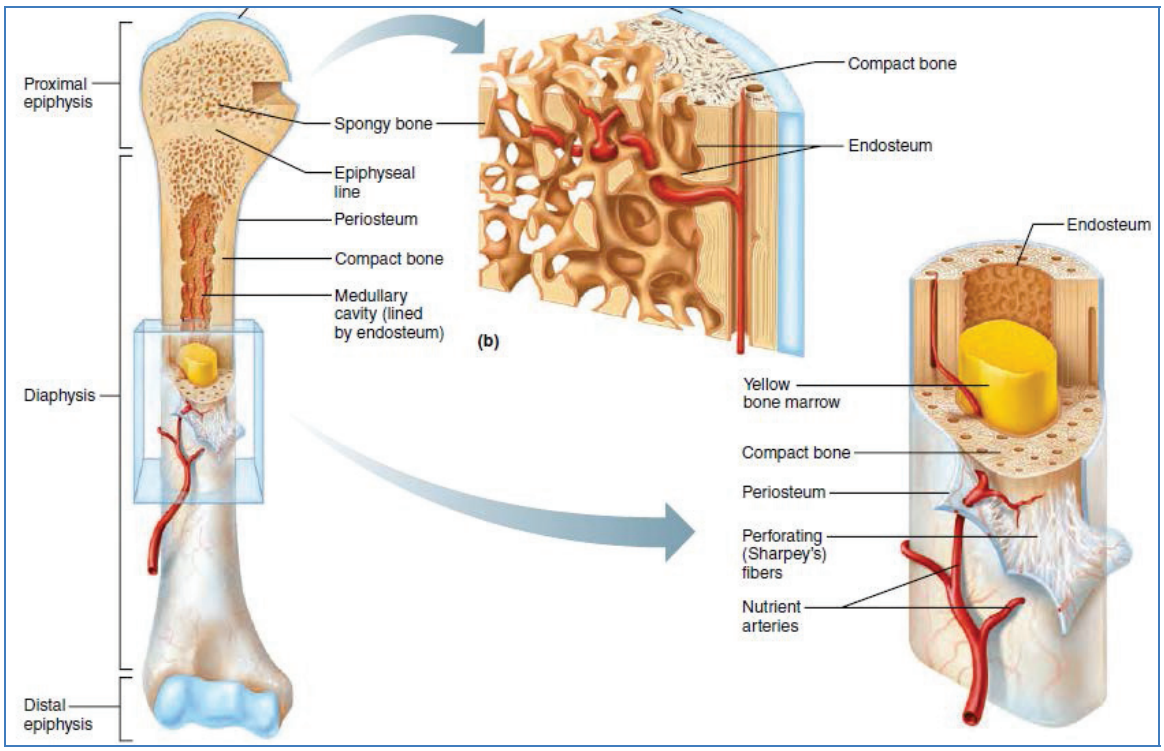


Figure (19): The structure of a long bone (humerus).

BLOOD SUPPLY OF BONE

1-Periosteal arteries: arises from the arteries which supply the muscle attached to the periosteum. They supply **the periosteum and outer part of the compact bone of the shaft.**

2-Nutrient artery:

□ It enters the compact bone of the shaft at an oblique angle through a hole called the **nutrient foramen** to supply **the inner part of the compact bone of the shaft, the spongy bone tissue and red bone marrow** as far as the epiphyseal plates.

□ The direction of nutrient foramen and the path of the nutrient artery through the bone, help in identifying the growing end of the long bone according to **low of all '*Towards the elbow I run and away from the knee I flee*'.**

3-The metaphyseal arteries: Arise from the adjacent large arteries.

4-The epiphyseal arteries: Arise from arteries around the associated joint.

N.B.:

□ ***The shaft*** of the long bone is supplied by ***the nutrient artery and the periosteal*** arteries and ***both ends*** are supplied by the ***metaphyseal and epiphyseal arteries***.

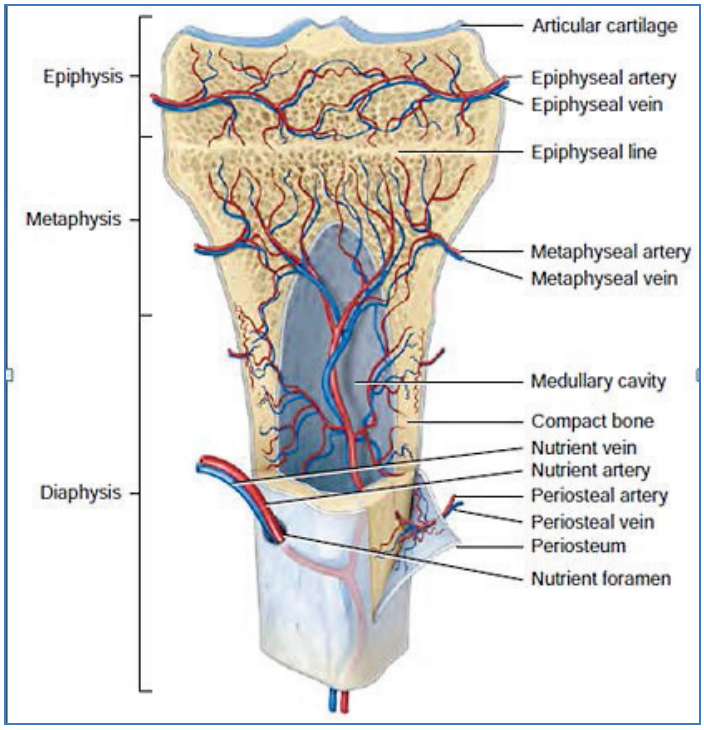


Figure (20): Blood supply of a mature long bone,

BONE FORMATION

The process by which bone forms is called **ossification**

►***According to development, there are two types of bones:***

■ Membrane bones:

□ Develop from a mesenchymal membrane through a process called **intramembranous ossification.**

□The examples: bones of face including mandible and bones of the vault of skull and clavicle.

■ Endochondral bones or **cartilage replacement bones:**

□ The bone ossifies in a preformed model of hyaline cartilage, through a process called endochondral ossification.

The examples: ear ossicles, hyoid bone, long bones of limbs and bones of cranial base.

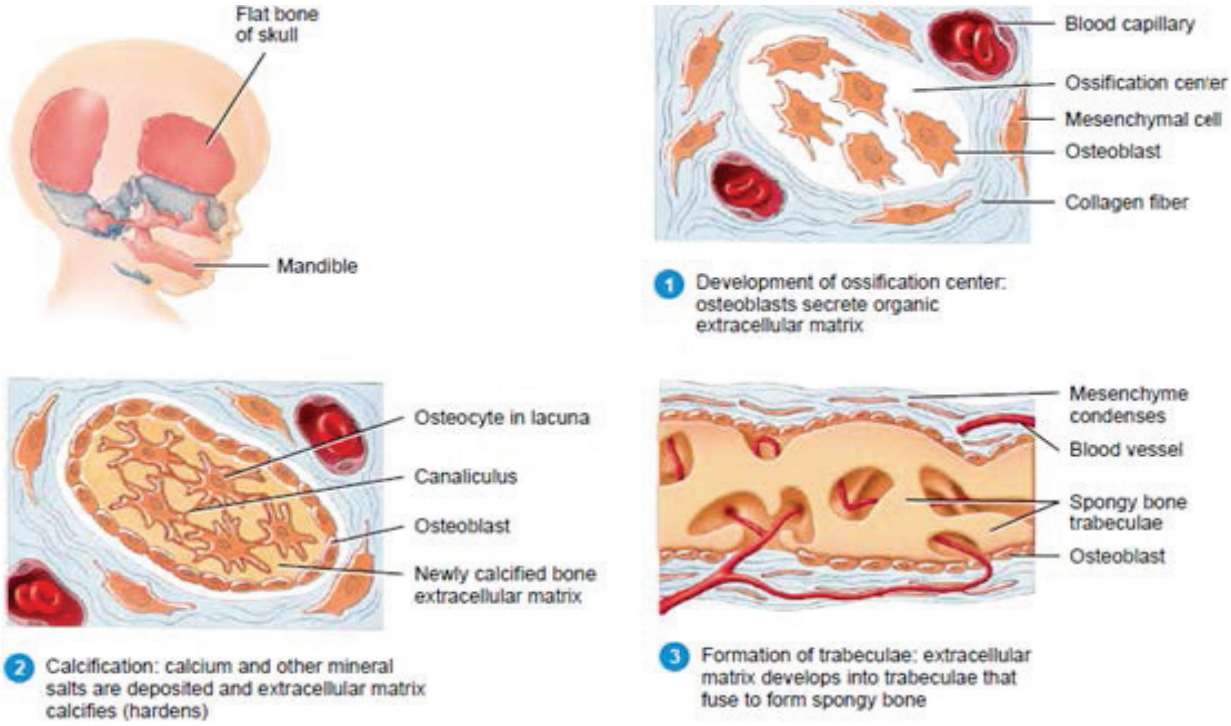
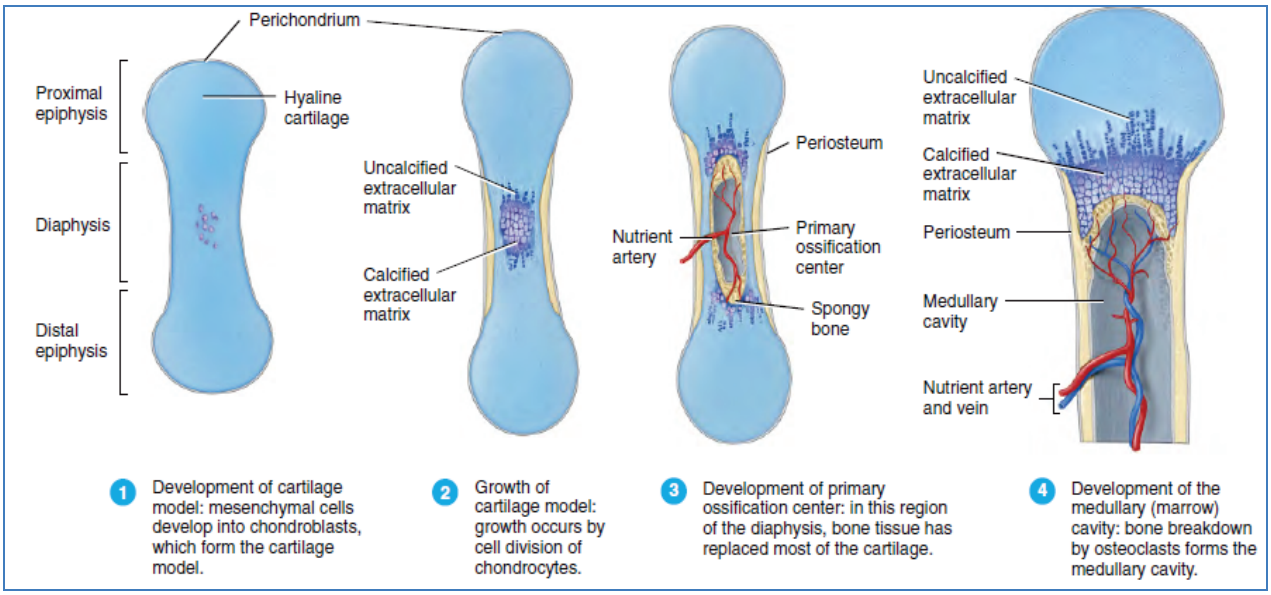


Figure (21): Intramembranous ossification.



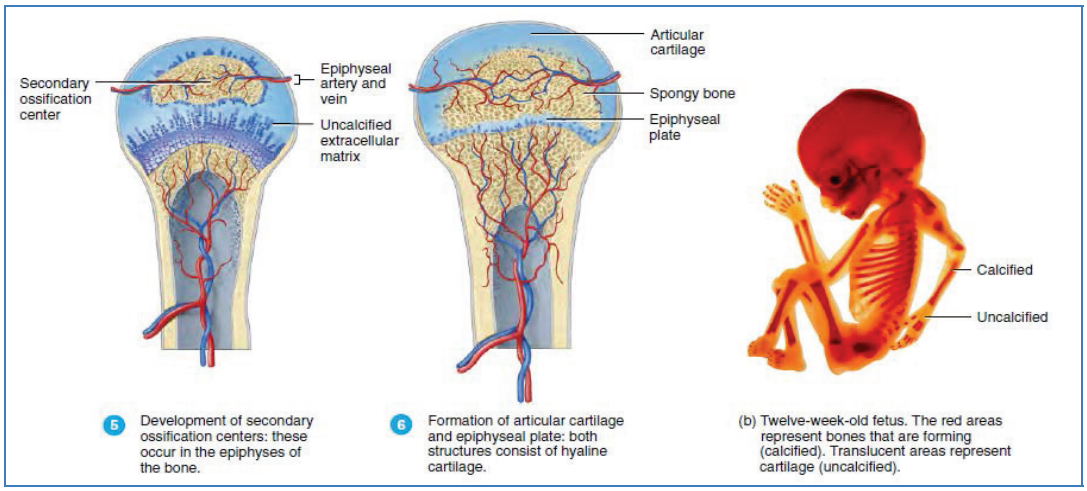


Figure (22): Endochondrial ossification.

Growth of long bone:

■ *Growth of bone in length*

The activity of the epiphyseal plate is the only way that the diaphysis can increase in length.

▪***The growth in length of a long bone involves two main stages:***

1- ***Interstitial growth of cartilage,*** on the epiphyseal side of the epiphyseal plate.

2- ***Replacement of cartilage with bone,*** by endochondral ossification on the diaphyseal side of the epiphyseal plate.

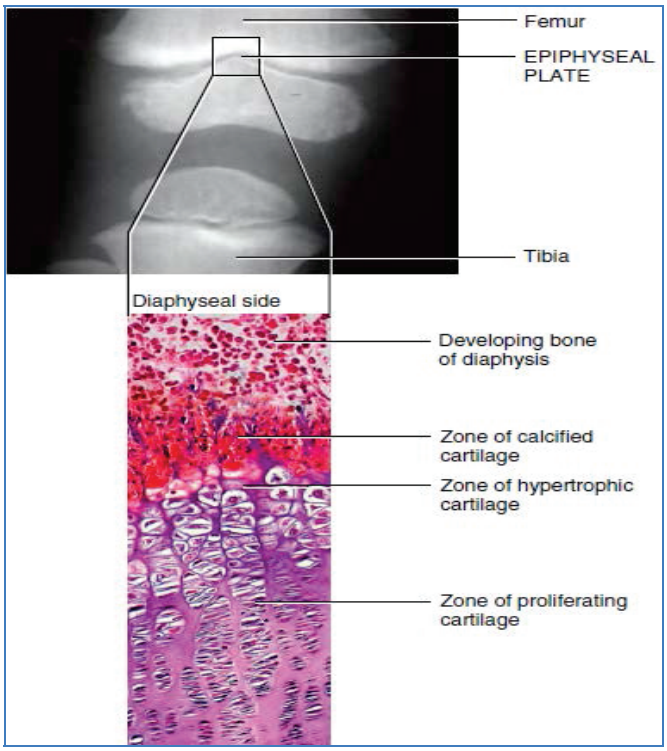


Figure (23): Growth of bone in length.

■ *Growth of bone in thickness*

▪The bone grows in thickness by subperiosteal deposition of bone tissue by osteoblasts from cellular layer of periosteum. This process is known as **appositional growth**.

▪In a long bone, there are corresponding resorption of bone from endosteal side by the osteoclasts. The net result of these two diametrically opposite processes is increase in diameter without increase in width of compact bone.

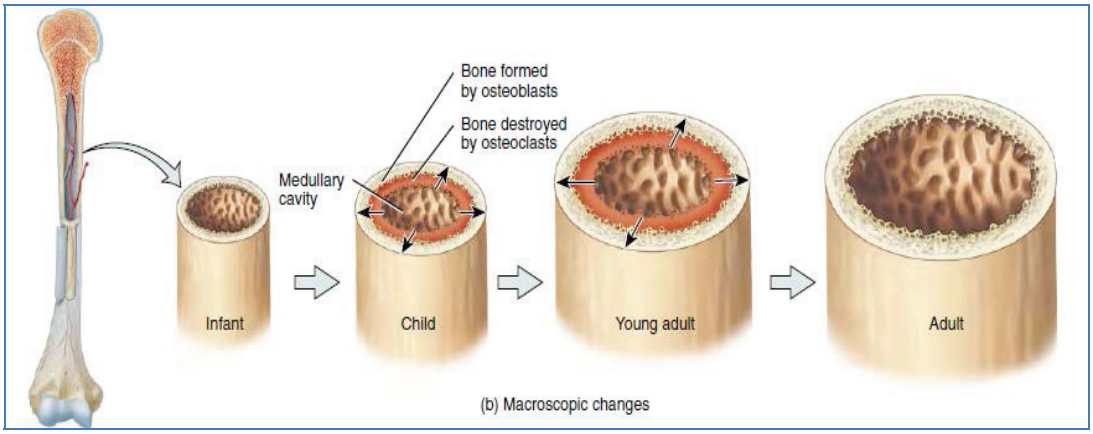


Figure (24): Growth of bone in width.

Clinical correlation:

Fracture of bone: ***Steps involved in repair of a bone fracture:***

□ **Reactive phase:**

Formation of fracture hematoma

□ **Reparative phase:**

- Fibro-cartilaginous callus formation, soft callus.
- Bony callus formation, hard callus.

□ **Bony remodelling phase**

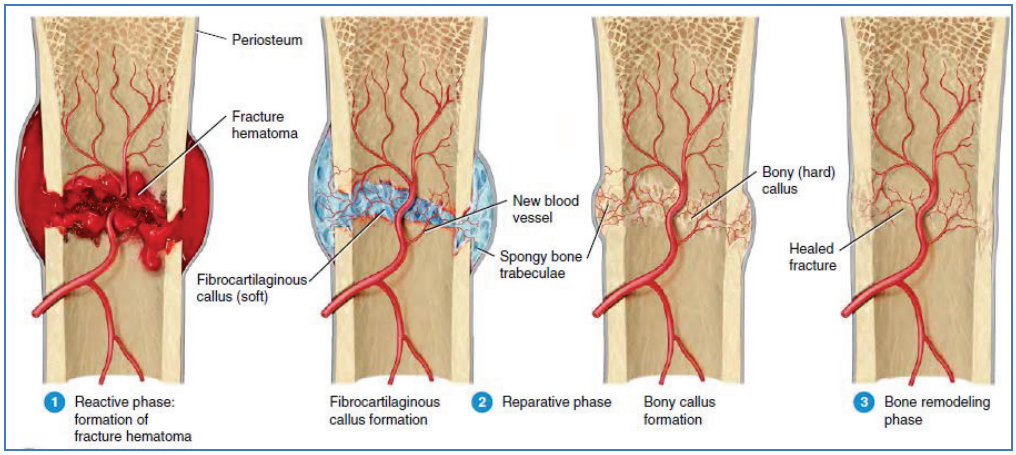


Figure (25): Steps involved in repair of a bone fracture.

BONE SURFACE MARKINGS

□ They are structural features adapted for specific functions. Most are not present at birth but develop and become most prominent during adult life in response to certain forces.

□ ***There are two major types of surface markings:***

- **Depressions and openings:** help to form joints or allow the passage of soft tissues (such as blood vessels and nerves)
- **Processes, projections, or outgrowths:** help to form joints or serve as attachment points for connective tissue (such as ligaments and tendons).

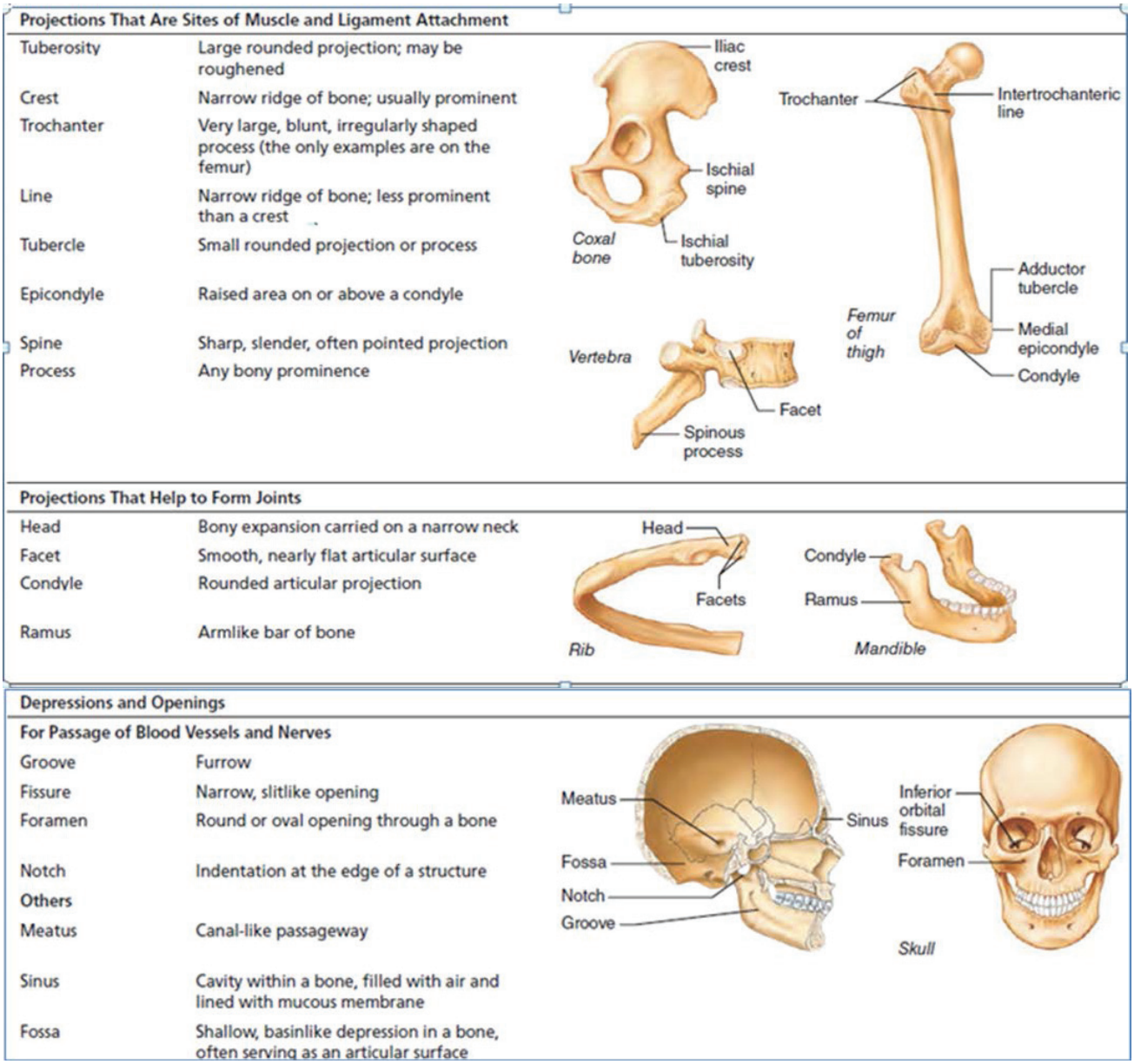


Figure (26): Bone Surface Markings

JOINTS

♦The sites where two skeletal elements come together are termed joints.

♦The two general categories of joints are:

►**Synovial joints**: the skeletal elements are separated by a cavity.

►**Solid joints**: there is no cavity and the components are held together by connective tissue.

♦Blood vessels that cross a joint and nerves that innervate muscles acting on a joint usually contribute articular branches to that joint.

CLASSIFICATION OF JOINT

Joints are classified by structure and by function:

►**The functional classification:** is based on the amount of movement allowed at the joint. ***Functionally, joints are classified into:***

●**Synarthroses:** are immovable joints.

●**Amphiarthroses:** slightly movable joints.

●**Diarthroses:** freely movable joints.

►**The structural classification**: focuses on the material binding the bones together and whether or not a joint cavity is present. **Structurally, joints are classified into:**

■**Solid joints**: there is no cavity and the components are held together by connective tissue. It is subdivided into:

●**Fibrous joints:** the bones are joined by fibrous tissue and this type is immovable.

●**Cartilaginous joints:** the articulating bones are united by cartilage and these joints *have both rigid and slightly movable examples.*

■**Synovial joints:** the articulating bones are separated by a fluid-containing joint cavity and this allows freedom of movement (diarthroses).

In general:

▪*Immovable and slightly movable joints are largely restricted to the axial skeleton.*

▪*Freely movable joints predominate in the limbs.*

▪*Fibrous joints are immovable, synovial joints are freely movable and cartilaginous joints have both rigid and slightly movable examples.*

▪*A freely movable joint; these come in a variety of shapes and permit several different types of movements.*

►Fibrous Joints:

♦ The bones are joined by fibrous tissue with no joint cavity and no movement is allowed.

♦ The three types of fibrous joints are: sutures, syndesmoses, and gomphoses.

●Sutures:

♦They are fibrous joints composed of a thin layer of dense irregular connective tissue called ***the sutural ligament***.

♦Sutures are found only between bones of the skull.

♦Some sutures are replaced by bone in the adult so that it is a temporary joint; such suture is called a **synostosis.**

● Gomphosis:

♦The term *gomphosis* refers to the way where teeth are embedded in their sockets. The fibrous connection in this case is the short **periodontal ligament**.

♦The only example is the articulation of a tooth with its bony alveolar socket.

●Syndesmoses:

♦In this type, the bones are connected by bands of fibrous tissue.

♦The amount of movement allowed at a syndesmosis depends on the length of the connecting fibres.

♦If the fibres are short (as in the ligament connecting the distal ends of the tibia and fibula, ***inferior tibio-fibular joint),*** little or no movement is allowed.

♦If the fibres are long (as in the ligament-like interosseous membrane connecting the radius and ulna, ***middle radio-ulnar joint),*** a large amount of movement is possible.

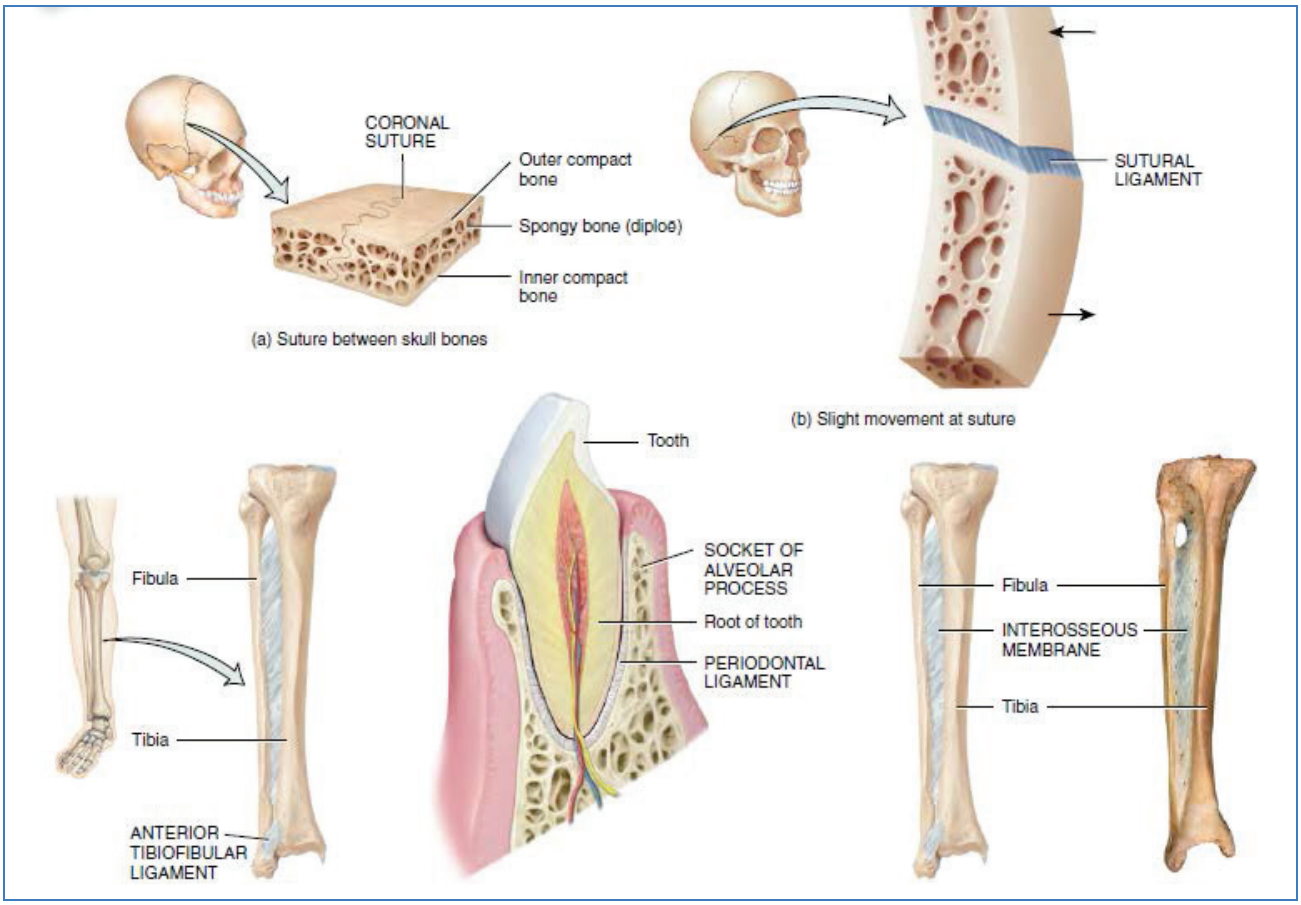


Figure (27): Types of Fibrous joints.

►Cartilaginous Joints:

▪The articulating bones are united by cartilage.

▪They lack a joint cavity and are not highly movable.

▪The two types of cartilaginous joints are *synchondroses* and *symphyses*.

● **Synchondroses: (primary cartilaginous joint):**

It is an immovable, cartilaginous joint in which the connecting material is hyaline cartilage.

Example:

▪ The epiphyseal (growth) plate that connects the epiphysis and diaphysis of a growing bone. Epiphyseal plates are temporary joints and eventually become synostoses.

▪ The immovable joint between the costal cartilage of the first rib and the manubrium of the sternum.

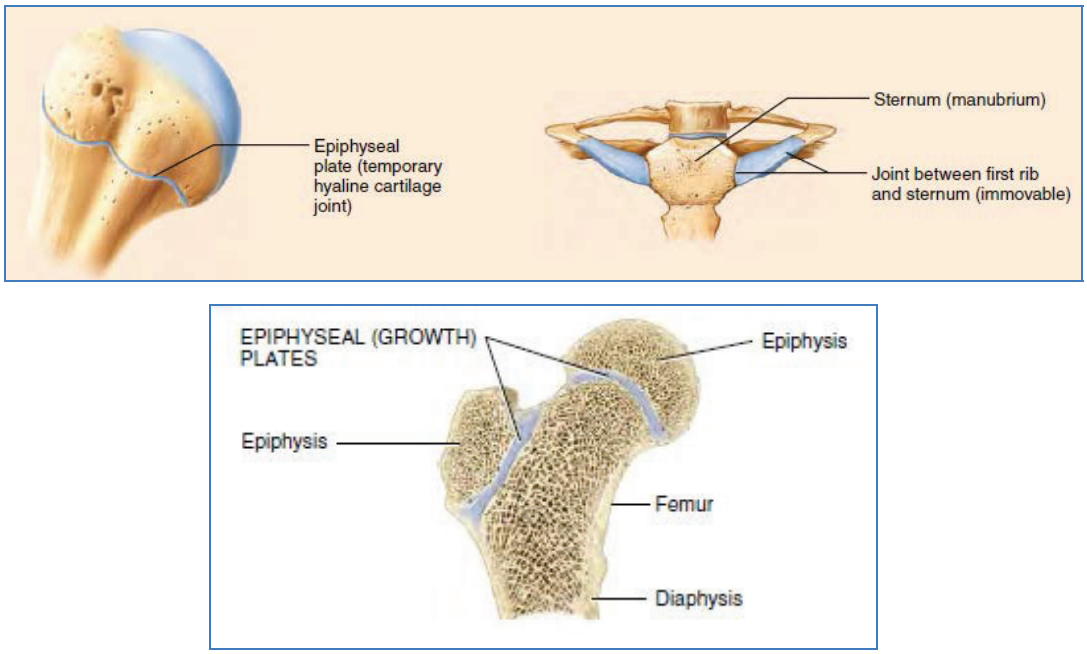


Figure (28): Cartilaginous joints (Synchondroses type).

●A symphysis: (secondary cartilaginous joint):

It is a cartilaginous joint in which the ends of the articulating bones are covered by hyaline cartilage, but the bones are connected by a broad, flat disc of fibrocartilage.

All symphyses occur in the midline of the body.

Example:

▪The pubic symphysis (between the anterior surfaces of the hip bones) is slightly movable.

▪At the junction of the manubrium and body of the sternum

▪At the intervertebral joints between the bodies of vertebrae.

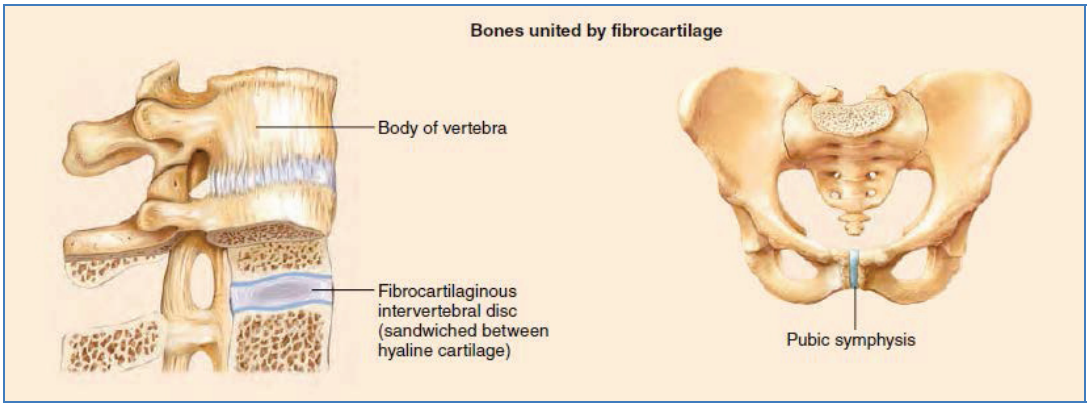


Figure (29): Cartilaginous joints (symphisis type).

► Synovial joints:

In this type, the articulating bones are separated by a fluid containing joint cavity and this allows freedom of movement (diarthroses).

General Structure for all synovial joints:

■ The articulating bony surfaces are covered by **articular hyaline cartilage** and separated by **joint cavity**.

■ **Joint (articular) cavity:** is a potential space that contains a small amount of synovial fluid and is surrounded by joint capsule.

■ **Joint capsule:** it is a two-layered **articular capsule**:

▪The tough external **fibrous layer** that is continuous with the periostea of the articulating bones.

▪The inner layer of the joint capsule is a **synovial membrane** lines the fibrous layer internally and covers all internal joint surfaces except the hyaline cartilage which covers the articulating surfaces. The synovial membrane's function is to make synovial fluid.

■ **Reinforcing ligaments:** Synovial joints are reinforced and strengthened by a number of **capsular ligaments**, which are found outside the capsule (as **extracapsular ligaments**) or deep to it (as **intracapsular ligaments**).

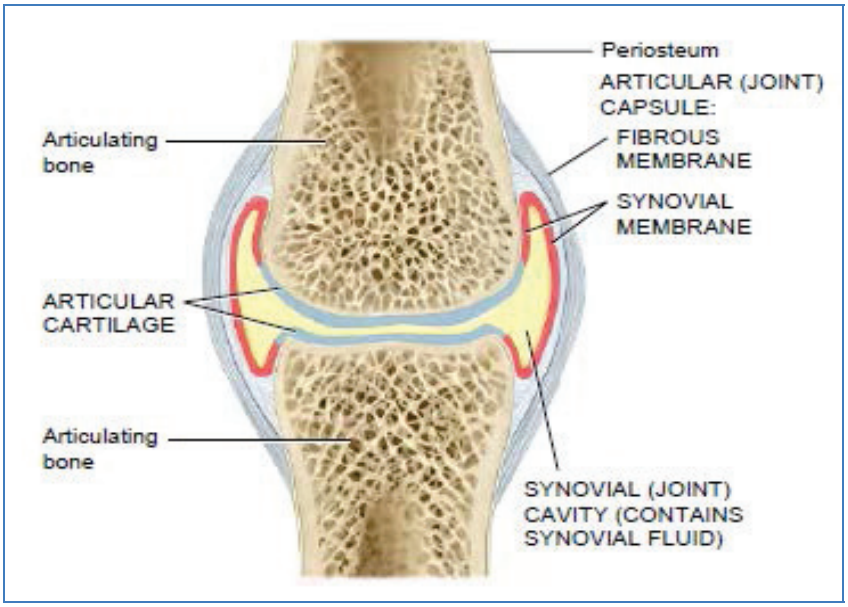


Figure (30): Structure of a typical synovial joint.

Some synovial joints contain intracapsular structures such as:

● Intracapsular ligaments: are found deep to the capsule**.** Since these ligaments are covered with synovial membrane, they do not actually lie *within* the joint cavity (extrasynovial), such as: the anterior and posterior cruciate ligaments of the knee joint are intracapsular ligaments.

● Tendons of muscles:

▪Tendon of the long head of biceps (inside the shoulder joint).

▪Tendon of popliteus (inside the knee joint).

●Fatty pads, act as cushion between the fibrous layer and the synovial membrane or bone, such as the hip and knee joints.

●Articular discs, or menisci of fibrocartilage separating the articular surfaces, extend inward from the articular capsule and partially or completely divide the synovial cavity.

Importance:

▪Articular discs improve the fit between articulating bone ends making the joint more stable.

Examples:

▪Intra articular disc inside tempromandibular joint and sternoclavicular joints.

▪Intra articular menisci inside the knee joint.

● Labrum: is the fibrocartilaginous lip that extends from the edge of the joint socket. It helps deepen the joint socket and increases the area of contact between the socket and the ball-like surface of the head of the humerus or the femur in **shoulder and hip joints.**

● Bursa and Tendon Sheaths

They are closely associated with synovial joints to reduce friction between adjacent structures during joint activity.

Bursae are flattened fibrous sacs lined with synovial membrane and containing a thin film of synovial fluid. They occur where ligaments, muscles, skin, tendons, or bones rub together.

A **tendon sheath** is essentially an elongated bursa that wraps completely around a tendon subjected to friction. They are common where several tendons are crowded together within narrow canals as in wrist region. For example:

▪The tendon of the biceps brachii muscle at the shoulder joint.

▪The tendons of wrist, ankle, fingers, and toes.

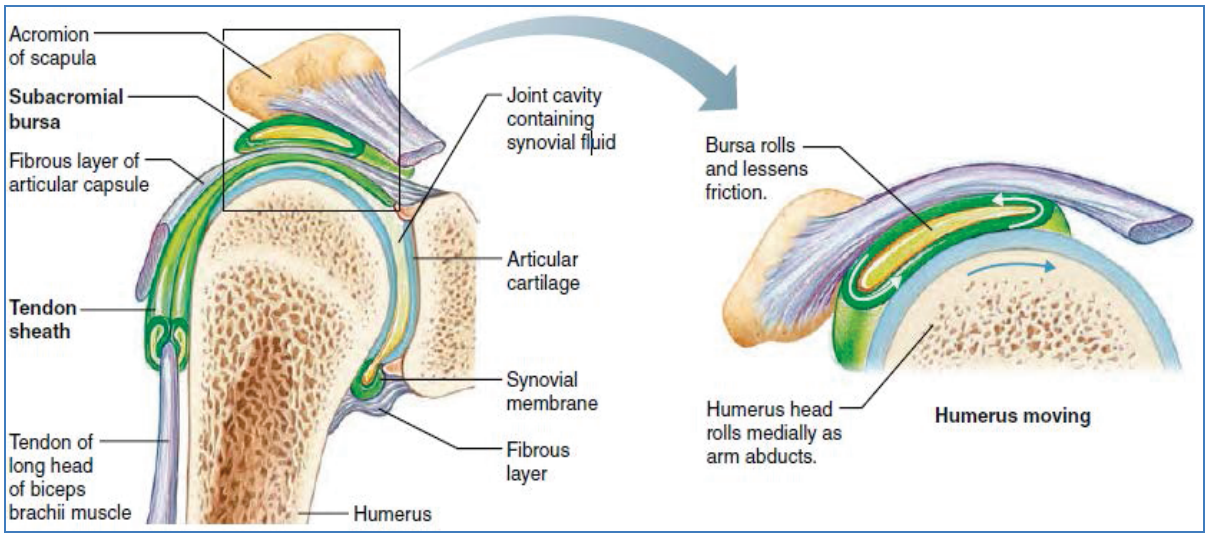


Figure (31): Bursae and tendon sheaths.

Factors Influencing the Stability of Synovial Joints:

▪ **Shape of the articulating bones**: determines how closely they can fit together.

▪ **Strength and tension of the joint ligaments:** Tense ligaments restrict the range of motion and direct the movement of the articulating bones with respect to each other.

Example, in the knee joint, the anterior cruciate ligament is taut and the posterior cruciate ligament is loose when the knee is straightened, and the reverse occurs when the knee is bent.

▪**Arrangement and tension of the muscles,** the muscle tendons that cross the joint are kept taut at all times by the tone of their muscles. Muscle tone is extremely important in reinforcing the shoulder and knee joints and the arches of the foot.

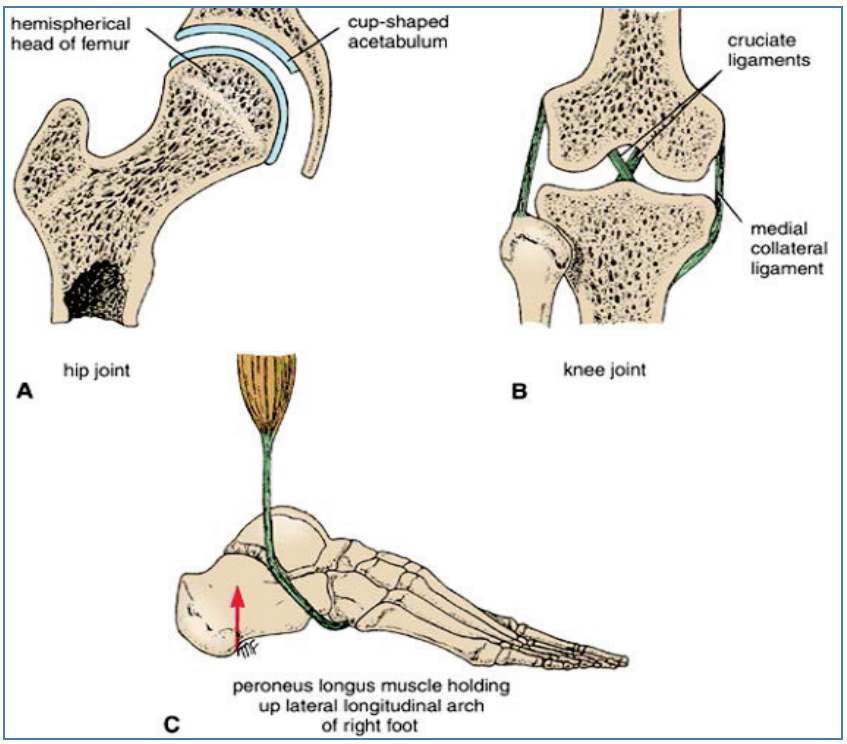


Figure (32): The three main factors responsible for stabilizing a joint. A. Shape of articular surfaces. B. Ligaments. C. Muscle tone.

Nerve supply:

The capsule and ligaments receive an abundant sensory nerve supply.

Hilton's law: A sensory nerve supplying a joint also supplies the muscles moving the joint and the skin overlying the insertions of these muscles.

Blood supply:

The blood supply of the synovial joints is derived from the **arterial anastomosis** around the joint. Articular branches arise from the anastomoses which pierce the capsule forming plexus within the synovial membrane giving arterial supply to all intra-articular structures except the articular cartilages.

Classification of synovial joints:

►Based on the **shape** of their articular surfaces, synovial joints are described as:

Plane (flat), hinge, pivot, condylar (ellipsoid), saddle, and ball and socket.

►Based on **movement,** synovial joints are described as:

●uniaxial (movement around one axis).

●biaxial (movement around two axes).

●multiaxial (movement around three axes).

►Non axial joints:

●Plane joints:

▪**Articular surfaces** are flat.

▪**Movement:** gliding

▪**Examples:** intercarpal, intertarsal, acromioclvicular.

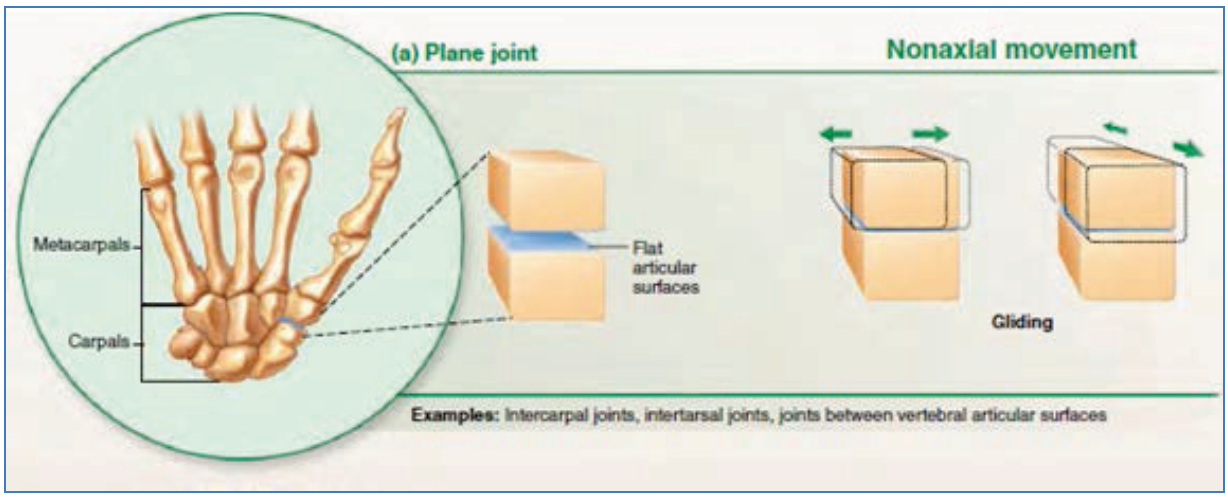


Figure (33): Non axial synovial joints (plane type).

► Uniaxial joints:

● Hinge joints:

▪**The articulating surfaces:** resemble the hinge of the door

▪ **Movement:** flexion and extension at a single horizontal axis.

▪ **Examples:** elbow, ankle, and interphalangeal joints (between the phalanges of the fingers and toes).

●Pivot joint:

▪**The articular surfaces:** consist of bony pivot surrounded by a ring which is partly bony and partly ligamentous.

▪ **Movement:** it allows rotation only around its own longitudinal axis.

▪ **Examples**: atlanto-axial and superior and inferior radioulnar joints.

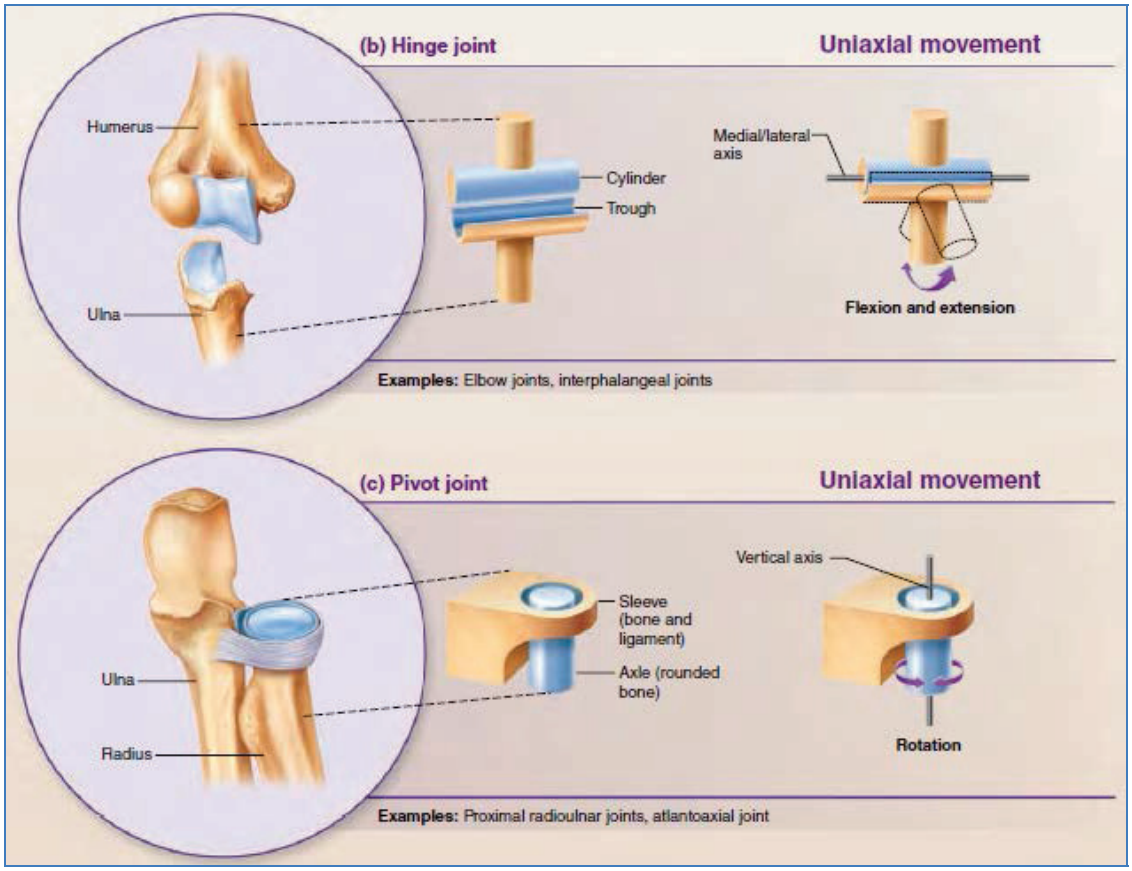


Figure (34): Uniaxial synovial joints.

► Biaxial joints:

● condyloid joints or ellipsoid joints:

▪**The articular surfaces:** consist of one convex and one concave.

▪**Movement:** (flexion-extension and abduction–adduction), plus limited circumduction around two axes, transverse and anterior posterior axes.

▪ **Examples:** radiocarpal (wrist) and metacarpophalangeal joints (between the metacarpals and proximal phalanges) of the second through fifth digits.

● Saddle joint:

▪**The articular surfaces**: are shaped like a saddle (i.e., they are reciprocally concave and convex).

▪**Movement:** flexion–extension and abduction–adduction plus limited circumduction around two axes, transverse and anterior posterior axes.

▪ **Examples:** carpometacarpal joint between the trapezium of the carpus and metacarpal of the thumb.

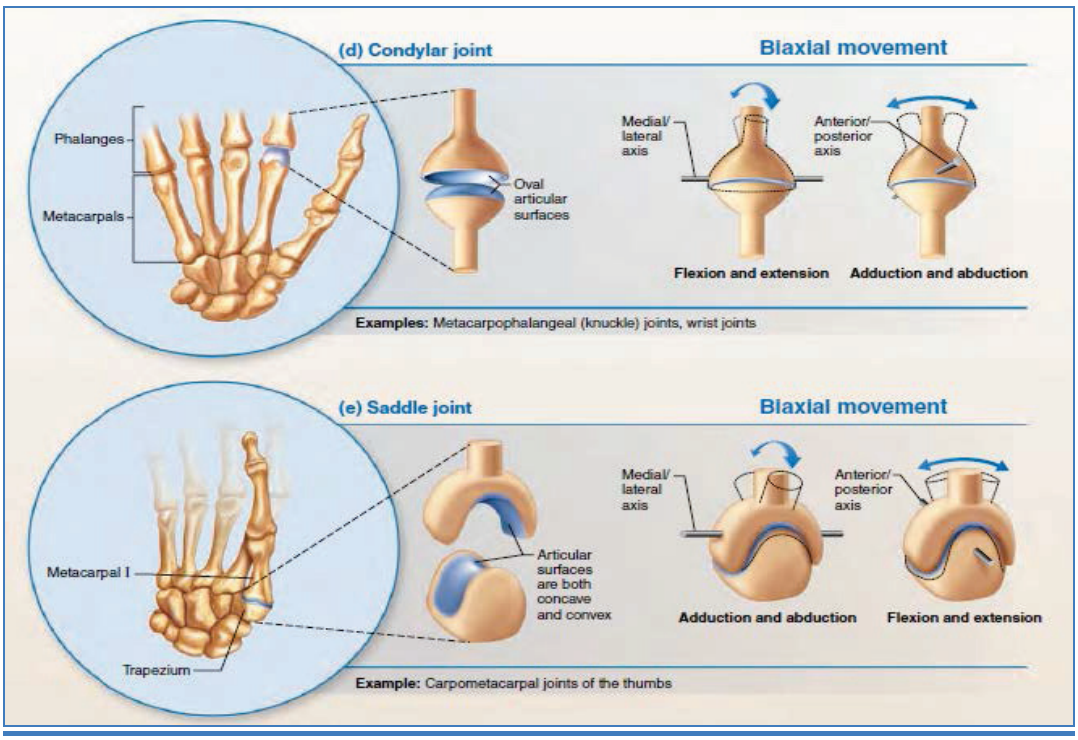


Figure (35): Biaxial synovial joints.

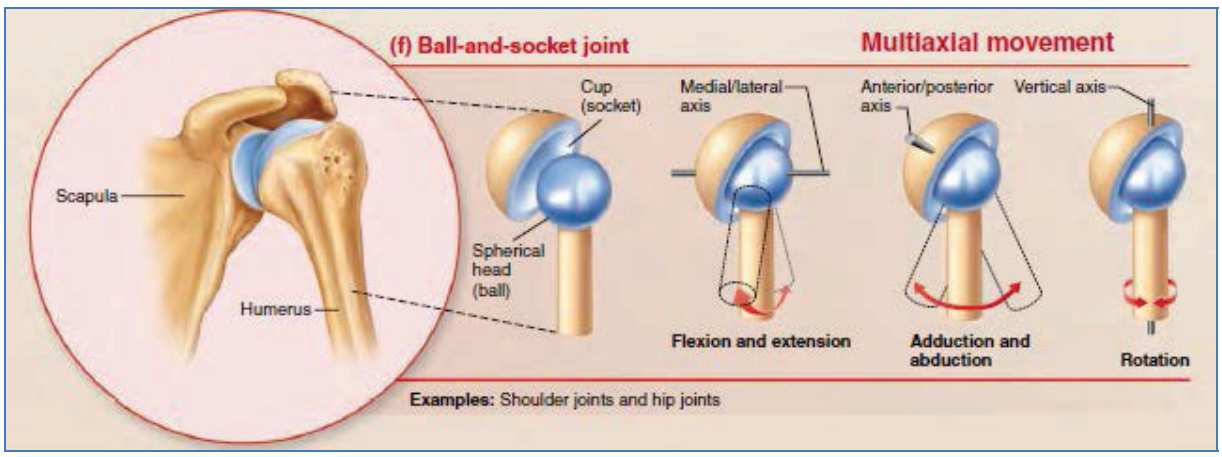
► Multiaxial joints:

- **Ball-and-Socket joints:**

▪**The articulating surfaces** consist of a round head (the ball) and cup-shaped concavity (the socket).

▪ **Movement:** (flexion–extension, abduction–adduction, and rotation) around three axes,(transverse ,anterior posterior and vertical axes).

▪ **Examples:** shoulder and hip joints.



MUSCULAR SYSTEM

Types of Muscular Tissue

□There are three types of muscular tissue: skeletal, cardiac, and smooth.

□They differ from one another in their microscopic anatomy, location, and how they are controlled by the nervous system.

Skeletal muscle

The skeletal muscle is the most abundant in the body. It produces movement of the skeleton, innervated by somatic nerve supply, so it acts voluntary.

Cardiac muscle

It forms the myocardium of the heart. It is innervated by autonomic nerve supply so it acts involuntary.

Smooth muscle

Surrounds the viscera, innervated by autonomic nerves, so it acts involuntary.

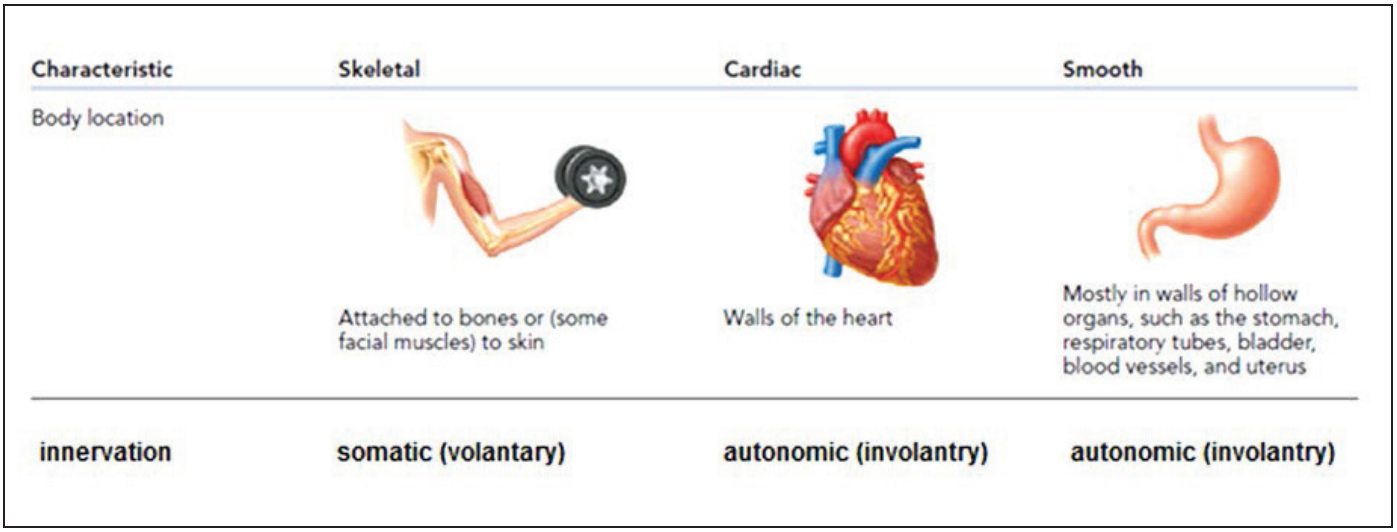


Figure (37): Types of Muscular Tissue

Skeletal muscle:

Relationship of skeletal muscles to bones:

►*muscle attachment sites: Origin and insertion*

□ A typical skeletal muscle consists of : a muscle belly connected by tendons to the skeleton.

□ Attachment of a muscle's tendon to the stationary bone is called the ***origin***.

□ The attachment of the muscle's other tendon to the movable bone is called the ***insertion.***

□The fleshy portion of the muscle between the tendons is called the ***belly.***

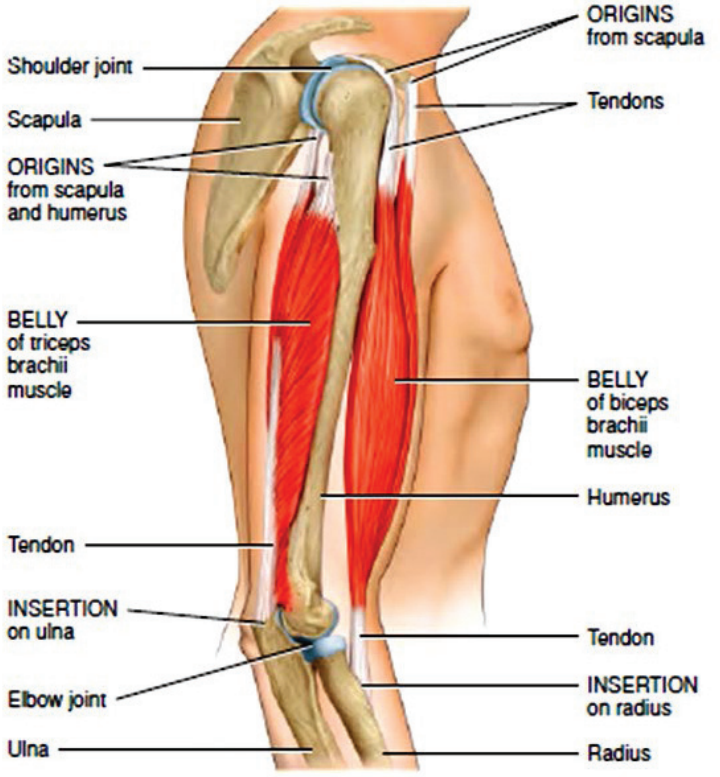


Figure (38): Origin and insertion of a skeletal muscle. Not, biceps brachii muscle here is an example of polyarticular muscle.

► ***Most muscles cross at least one joint to produce movement:***

□ The muscles that cross two joints or more, the ***polyarticular muscles such as biceps brachii ,*** have more complex actions than muscles that cross only one joint, **uniarticular muscles such as brachialis .**

► ***The two articulating bones usually do not move equally in response to contraction:***

□The bone which gives origin remains stationary.

□The other bone which gives insertion is more movable.

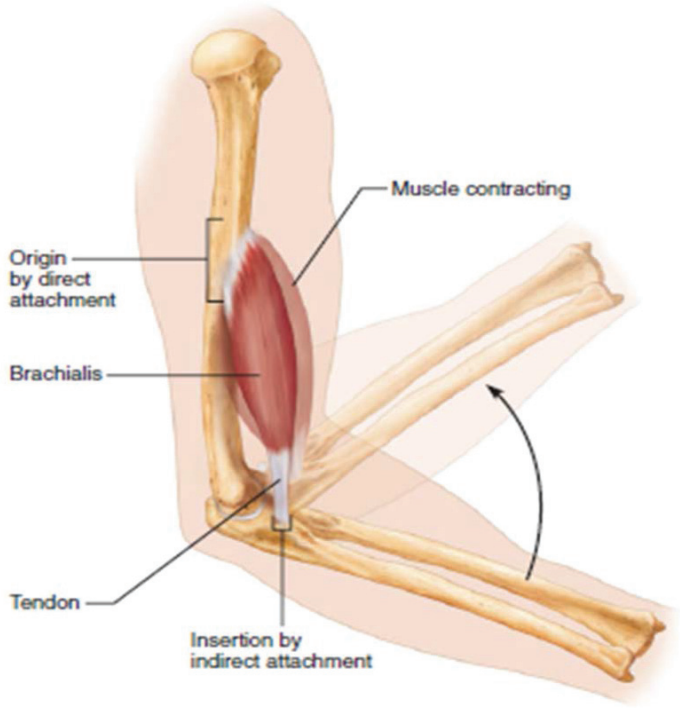


Figure (39): Movement of the two articulating bones in response to contraction

Types of muscle attachments:

- Tendon.
- Aponeurosis.
- Raphe
- Fleshy

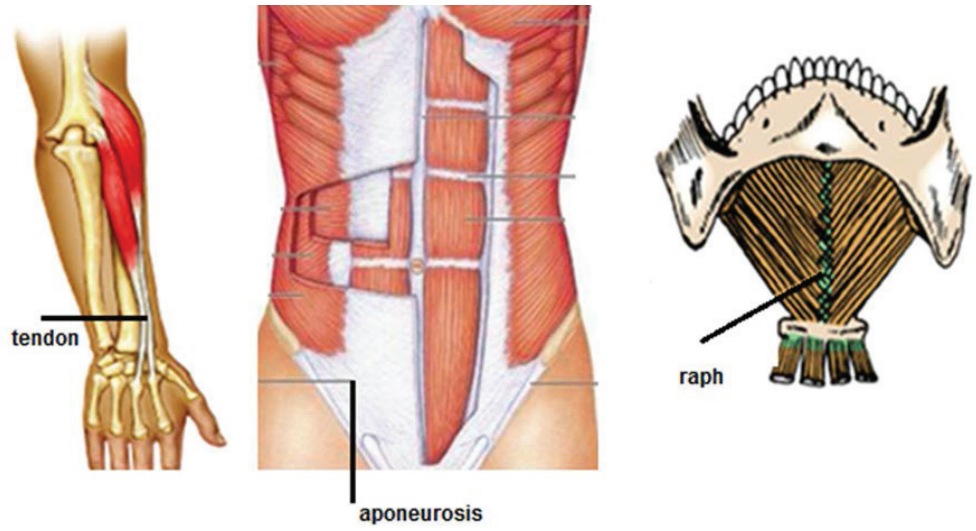


Figure (40): Types of muscle attachments

Arrangement of muscle fibers in skeletal muscles:

►Arrangement of fibers in the skeletal muscle →has an effect on the shape of the muscle → and in turn, an effect on the action of the muscle.

Types of arrangement of muscle fibers:

- **Parallel,** Sartorius, sternocledomastoid muscle.
- **Fusiform,** biceps brachii.
- **Circular,** orbicularis oris.
- **Triangular:** pectoralis major.
- **Pinnate:**
  - **Unipinnate:** extensor digitorum longus.
  - **Bipinnate:** rectus femoris.
  - **Multipinnate:** deltoid
  - **Circumpinnate:** tibialis anterior muscle.

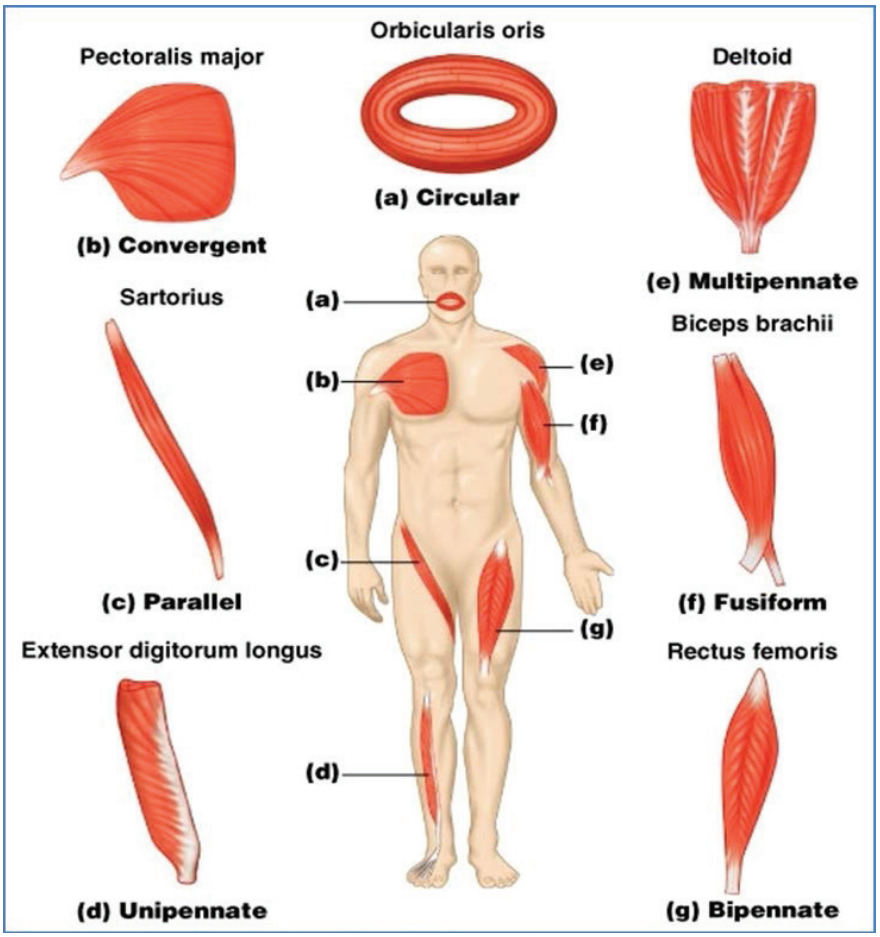


Figure (41): Types of arrangement of muscle fibers

Motor units:

□ Muscle is a contractile tissue responsible for movements and controlled by nervous stimuli.

□ Each motor unit consists of: one motor neuron + all the muscle fibers innervated by it.

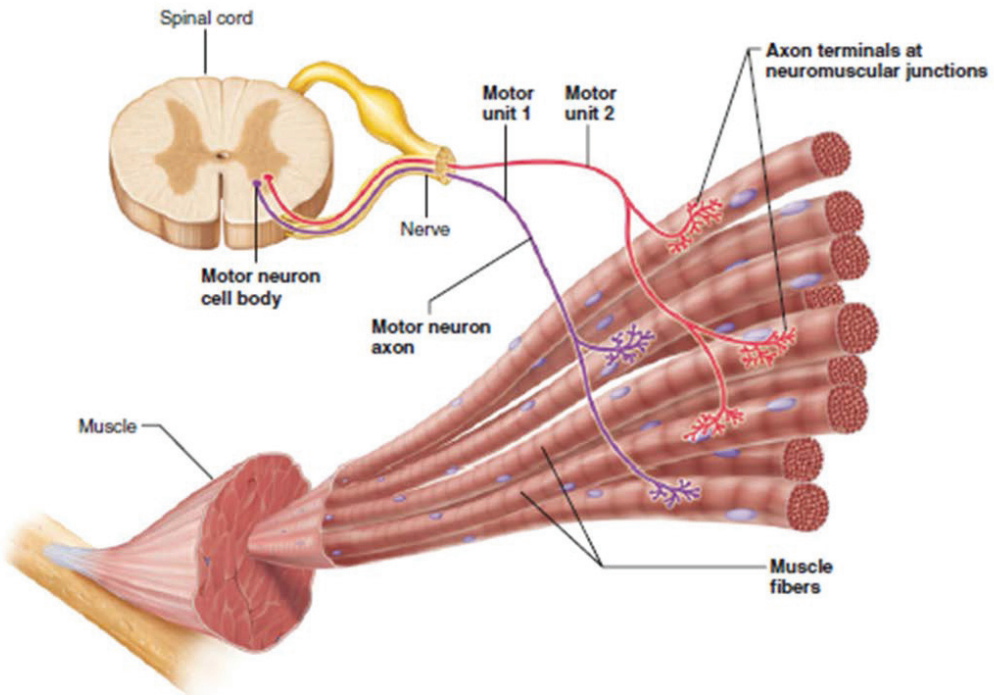


Figure (42): Motor unit consists of: one motor neuron and all the muscle fibers it innervates

Examples of the Important Groups of Muscles in the Body

Muscles of the head and neck:

These muscles can be divided into:

-Muscles of the scalp: Occipito-frontalis.

-Muscles of facial expression: Are thin and small muscles lying directly beneath the skin of the face surrounding the openings in the face as eye (orbicularis oculi) and mouth (orbicularis oris). They act as sphincters and are responsible for the movements of the facial skin in different expressions.

-Muscles of mastication: Are four muscles which move the mandible. termporalis, masseter and medial & lateral pterygoids.

Muscles of the tongue:

They form the bulk and move the tongue.

Sterno-mastoid: Is strong and prominent muscle on the sides of the neck. It is the main flexor of the neck.

Trapezius: Large triangular muscle at the back of the neck and all length of the thorax. It moves the shoulder and extends the head backwards.

Muscles of the upper limb:

-Trapezius.

-Pectoralis major: lies deep to breast.

-Latissmus dorsi: is the main climbing muscle.

-Deltoid: It is a flexor, extensor and adductor to shoulder. It is a flexor, extensor and adductor to the shoulder joint.

-Muscles of the arm:

Anterior group: Are the main flexors of the elbow joint (Biceps & Brachialis).

Posterior group: One muscle with three heads (Triceps) which is the main extensor of the elbow.

-Muscles of the forearm:

Anterior group: They are the main flexors of the wrist joint and fingers.

Posterior group: They are the main extensors of the wrist joint and fingers.

-Muscles of the hand:

Are the short muscles that have their attachments into the bones of the hand only. They are the thenar hypothenar, lumbricals and interossei.

Muscles of the lower limb:

-Muscles of the buttock: The rounded eminence of the buttock is formed by the gluteal muscles, the biggest of which is the fluteus maximus. The sciatic nerve lies deep to the medial and lower parts of

the muscle and so, the upper and lateral quadrant of the buttock is the safest place for intr5amusclar (I.M) injections

-Muscles of the thigh:

Anteriorly: Only one muscle with four heads; the quadriceps muscle which is the main extensor of the knee joint .

Posteriorly: Are called the hamstring group. This group flexes the knee and consists of three muscles

Medially: Lie the adductors of the thigh.

Muscles of the leg:

-Anterior group: Are the main dorsiflexors and help in invertion of the foot.

-Lateral (fibular) group: Are the main evertors and help in plantar flexion of the foot.

-Posterior group: Are the main plantar flexors of the foot. The most important of this group is the gastrocnemius muscle that tapers downwards into tendoachilis.

Muscles of the trunk :

Muscles of the thoracic wall:

-Pectoralis major.

-Serratus anterior.

-Intercostal muscles : They are eleven pairs. They pass from the lower border of one rib to the upper border of the rib below.

-They are formed of 3 layers; external intercostals, internal intercostals and transversus thoracis.

-Diaphragm: Is a large dome –shaped partition separating the thoracic from the abdominal cavity.

It is arises from the outlet of the thoracis cage and upper lumbar vertebrae by muscle fibres which converge into a central tendon.

It is important muscle of respiration.

It has a number of openings:

Inferior vena cave: at the level of 8th thoracic vert.

Oesophagus: at the level of 10th thoracic vert.

Aorta: at the level of 12th thoracic vert.

Muscles of the abdomen:

Anterior abdominal wall:

-Rectus abdominis: is a straight muscle which runs parallel to its fellow of the opposite side.

-Anterolaterally: there are three muscular sheets which run in different directions.

External oblique muscle, passing downward and medially.

Internal oblique muscle , lassing upwards and medially.

The transversus abdominis passing transversly.

-Medially: the abdominal aponeurosis which enclose the rectus abdominis muscle and then become atteched to a median band; the linea alba. The lower edge of the aponeurosis is rolled inwards to form the inguinal ligament & canal.

Posterior abdominal wall:

-The back of the abdomen is supported by vertebrae with several groups of muscles on either side of the spine as the erector spinae muscle.

-Inferior muscle group: These muscles form the pelvic floor. The most important of which is the levator ani. This muscle is concerned with supporting the pelvic viscera and in controlling defecation and micturition.

Action of Skeletal Muscles:

►*A muscle may work in the following four ways:*

1- Prime mover, it is the chief muscle or member of a chief group of muscles responsible for a particular movement.

For example, the quadriceps femoris is a prime mover in the movement of extending the knee joint.

2- Antagonist: Any muscle that opposes the action of the prime mover is an antagonist.

For example, the biceps femoris opposes the action of the quadriceps femoris when the knee joint is extended.

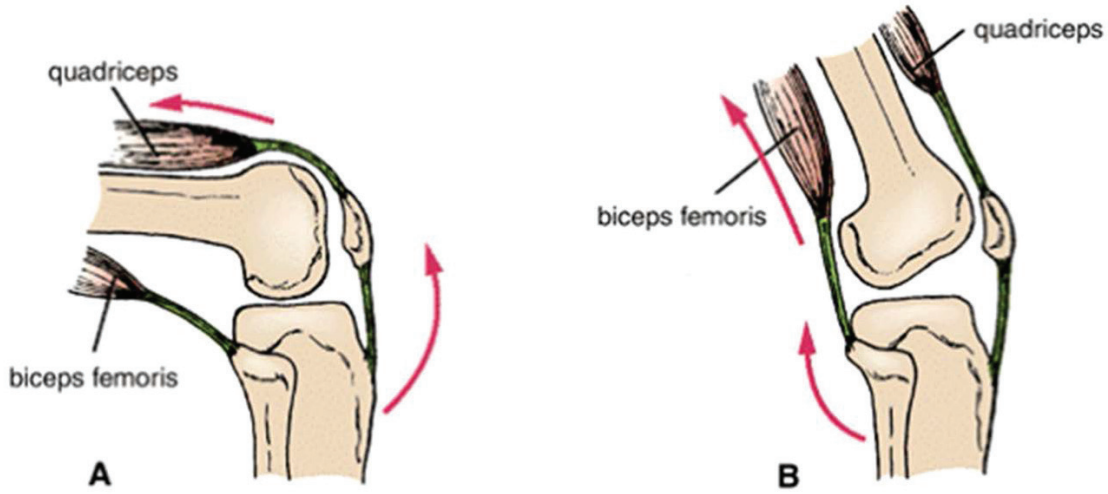


Figure (43): prime mover and antagonist. Here, the quadriceps femoris is a prime mover in the movement that extends the knee joint, and the biceps femoris is the antagonist.

3- Fixator: muscle contracts isometrically to increase the tone but not produce movement. This stabilizes the origin of the prime mover to act efficiently.

For example, In abduction of the arm, the deltoid muscle serves as the prime mover, and the fixators are (pectoralis minor, trapezius, subclavius,

serratus anterior muscles, and others), which hold the scapula firmly against the back of the chest.

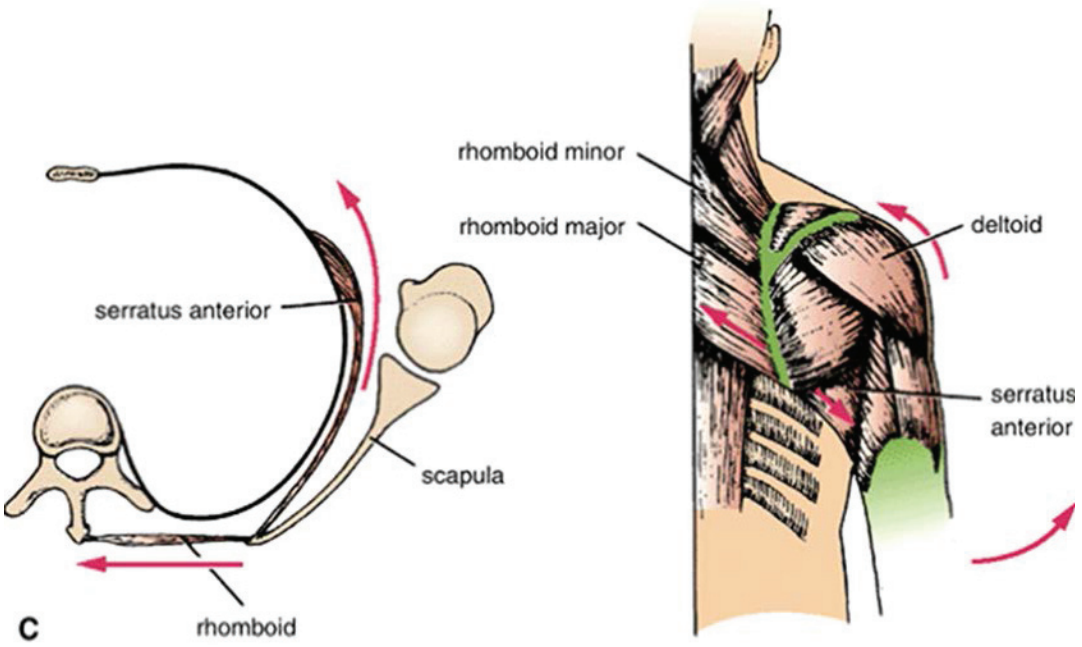


Figure (44): Fixators stabilize the origin of the prime mover to act efficiently.

4- Synergists: muscles contract and stabilize the intermediate joints to prevent the unwanted movements during action of the prime mover muscle, before it reaches the joint at which its main action takes place.

For example, the flexor and extensor muscles in the forearm which act on the fingers.

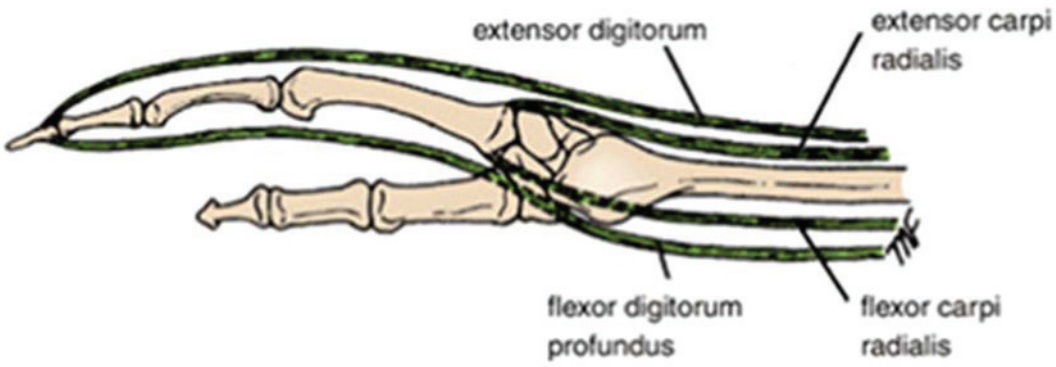


Figure (45): Synergists, muscles prevent unwanted movements at intermediate joints during movements of prime mover muscles.

* ***Action of paradox:*** Muscles opposing the movement aided by gravity (paying out a rope) against the force of gravity. Example: contraction of biceps to control the passive extension of the elbow by gravity.

* ***Maintaining the posture:*** By the muscle tone, state of partial contraction to prepar the muscle for immediate action.

Nerve and Blood Supply

□ Nerves enter the muscle along with the main blood vessels of the muscle as a unit called ***a neurovascular bundle.***

□These neurovascular bundles enter the muscle body near the stable tendon attachment, tendon of origin, then spread through the muscle via the connective tissue channels formed by perimysium and endomysium.

Keywords

Cartilage: (structure, different type).

Bone:

1- Function. 2- Classification

3- Gross of anatomy 4- Structure of bone

5- Blood supply of bone 6- Growth of bone

7- Surface marking.

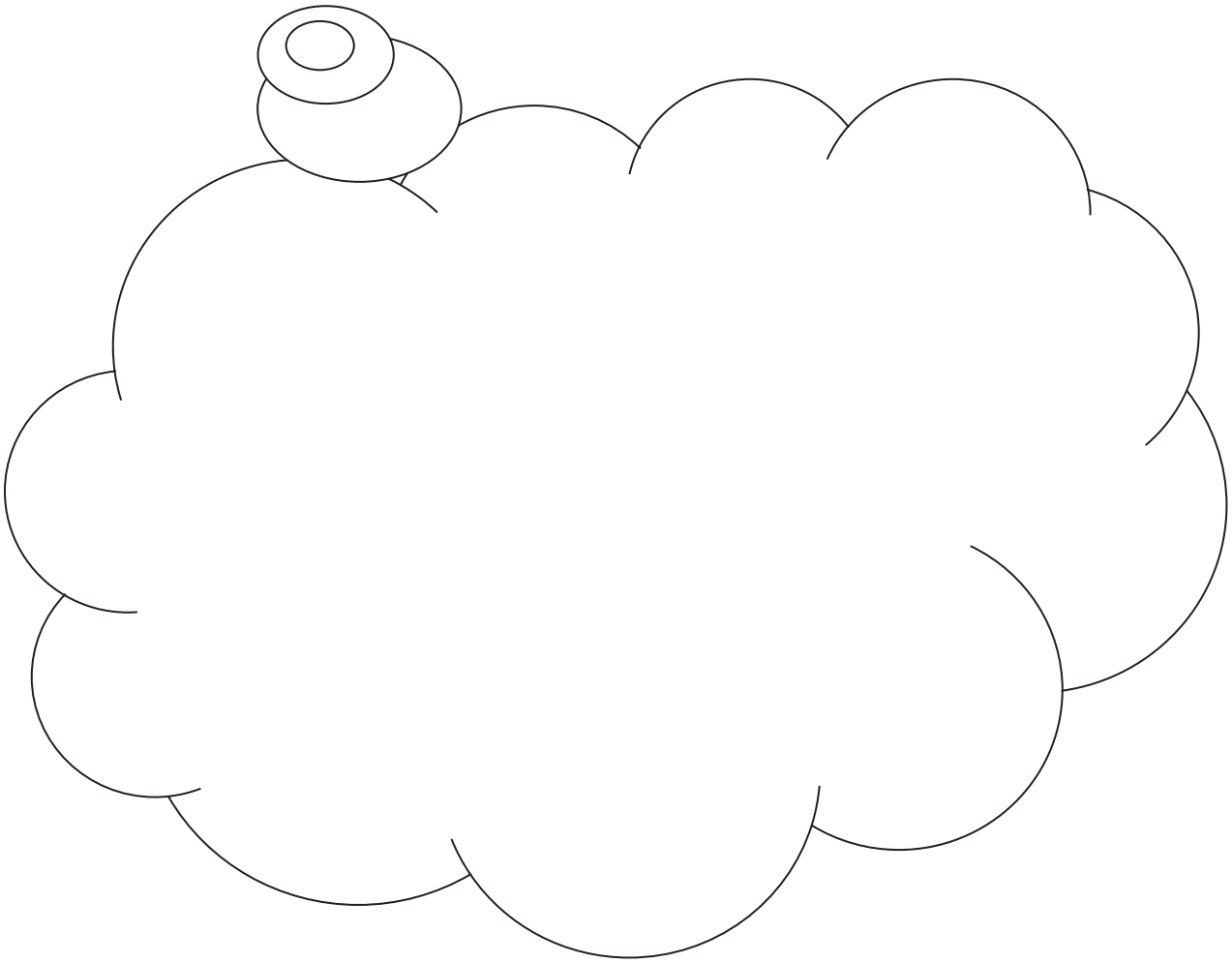
Joints: (Classification and study of different types).

Muscle:

1- Types of muscle tissue.

2- Arrangement of muscle fibers in skeletal muscle.

Write your note



Check your understand

1- How does the matrix differ in each of the three types of cartilage?

2- Which type of cartilage is most abundant? List three locations where this type of cartilage is found

3- Describe the functions of the bony skeleton. Which of the bones of the skeleton would be classified as irregular bones?

4- Describe the structural components of bone?

5- Describe the gross anatomy of a typical long bone and a typical flat bone?

6- Describe the types of markings found on bones?

7- What is the function of each of the following bone markings—condyle, tubercle, foramen?

8- What are the two osteogenic membranes found in a bone, where is each located,

9- In a flat bone, where is compact bone located? Where is spongy bone located?

10- Compare and contrast the two types of bone formation: intramembranous and endochondral ossification.

11- Describe how endochondral bones grow at their epiphyseal plates?

12- Which bones of the skeleton are membrane bones? As a bone grows in length during childhood, does the thickness of the epiphyseal plate change? In which region of the epiphyseal plate is bone tissue added: the epiphyseal end or the diaphyseal end?

13- If the epiphyseal discs of the bone are closed. What does that mean?

14- Divide and name the bone of the skull. Name the joints between it?

15- Divide and give the number of vertebrae in each region of vertebral column?

16- With what bones do all of the ribs articulate?

17- Name the bones that make up the rib cage?

18- Name the bones forming the shoulder girdle, the arm and forearm?

19- Differentiate between the bones forming the shoulder girdle in (site, shape, development)?

20- Divide the lower limb and name the bones forming each part.

21- Describe cartilaginous joints, and give examples of the two main types?

22- Define each of the following terms: synarthrosis, syndesmosis, synchondrosis. Which of these terms is a functional classification of joints?

23- What types of cartilage are found in a symphysis joint? Name one location of this type of joint?

24- Describe the structural characteristics shared by all synovial joints?

25- Define bursa and tendon sheath?

26- Explain how synovial joints function?

27- List three factors that influence the stability of synovial joints.

28- List the six basic features of synovial joints?

29- How does an articular disc differ from articular cartilage?

30- What are the functions of synovial fluid?

31- Classify synovial joints into six categories according to the shapes

of their joint surfaces and the types of movement they allow. Give examples of joints in each class?

32- Name all the movements that occur at these joints:

(a) elbow, (b) hip, (c) ankle, (d) atlantoaxial joint, (e) metacarpophalangeal joint.

33- Classify each of the joints according to joint shape. For each joint, indicate whether it is uniaxial, biaxial, or multiaxial?

34- Define pronation and supination. At what joint do these movements occur? Of the shoulder, elbow, or wrist, which joint is the most stable? Which is the least stable?

35- What structures contribute most to stability of the shoulder joint?

36- Which forearm bone forms part of the elbow joint?

37-Which forms part of the wrist joint?

38- Compare and contrast the three kinds of skeletal muscle fibers?

39- Name some muscles in which the fascicle arrangement:

(a) parallel, (b) convergent, (c) pennate, and (d) circular.

40- Describe the functional implications of fascicle arrangement?

Chapter IV

Structures for maintenance of the body

Cardiovascular structures

CARDIOVASCULAR STRUCTURES

►**The cardiovascular structures include three items:**

1. The blood, which is the fluid circulates through the arteries to reach the body's tissues and then returns to the heart through the veins.

2. The heart, which is the muscular pump which propels the blood into the blood vessels (arteries).

3. The blood vessels, the routes by which the blood travels to the tissues and back to the heart.

THE HEART

Structure of the heart

□ The heart has two sides***: right and left,*** each side comprises ***two chambers*** and **two valves.**

□ The right side is venous, receives the non-oxygenated blood; and the left is arterial pumping oxygenated blood.

□ The **two chambers** are:

- **An atrium,** a receiving chamber.
- **A ventricle,** a pumping chamber**.**

□ **Valves**, allow passage of the blood in one direction, located at the entrance and the exit of each ventricle. Each valve has a specific name, as follows:

- The right atrioventricular valve also is known as the tricuspid valve
- The left atrioventricular valve is the bicuspid valve, but it is usually referred to as the mitral valve.

- The pulmonary (semilunar) valve is located between the right ventricle and the pulmonary artery that leads to the lungs.
- The aortic (semilunar) valve is located between the left ventricle and the aorta.

Heart valves: lie along an ablique line as follows:

1- Pulmonary: Sternal end of the left 3rd costal cartilage.
2- Aortic: Left margin of sternum at the level of 3rd intercostal space.
3- Mitral: Left half of sternum at the level of 4th costal cartilage.
4- Tricuspid: Middle of the sternum at level of 4th intercostal space.

□ The cardiac muscle is supplied by right and left coronary arteries which arise from the aorta, and drained by the coronary sinus which ends in the right atrium.

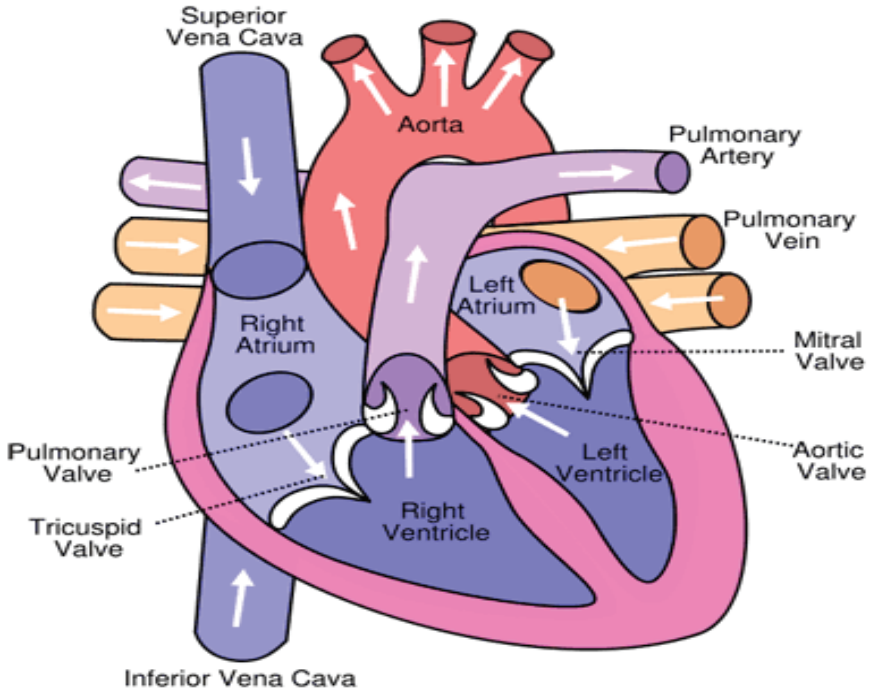


Figure (46): Chambers & Valves of the heart

BLOOD VESSELS

On the basis of function, blood vessels may be classified into three groups:

1. Arteries: carry blood from the ventricles (pumping chambers) of the heart out to the capillaries in organs and tissue. The smallest arteries are called arterioles.

2. Veins: drain capillaries in the tissues and organs and return the blood to the heart. The smallest veins are the venules.

3. Capillaries: allow for exchanges between the blood and body cells, or between the blood and air in the lung tissues. The capillaries connect the arterioles and venules.

	Arteries	Veins	Capillaries
Function	Carry blood away from the heart.	Return blood to the heart.	Carry blood between artery and vein. - Supply all cells with their requirements and take away waste products.
Wall	Thick, strong.	Thin.	Very thin.
Lumen	Narrow	Wide	Very narrow
Blood pressure	High	Low	Lowest
Blood content	Oxygenated blood except pulmonary artery.	Deoxygenated blood except pulmonary veins.	Oxygenated blood at the arteriole end. Deoxegenated blood at the venule end.
Blood flow	Blood flows in spurts or pulses	Blood flows smoothly not in pulses	Blood flows smoothly not in pulses
Valves	Absent	Present	Absent
Permeability	Walls are not permeable	Walls are not permeable	Walls are permeable

Table (6): Comparison between arteries, veins and capillaries

N.B.

- Veins have a unique structural feature not present in arteries. They are equipped with one-way valves that prevent the backflow of blood.
- The most important structural feature of capillaries is their extreme thinness. So, Substances such as glucose, oxygen, and wastes can quickly pass through it on their way to or from the cells.

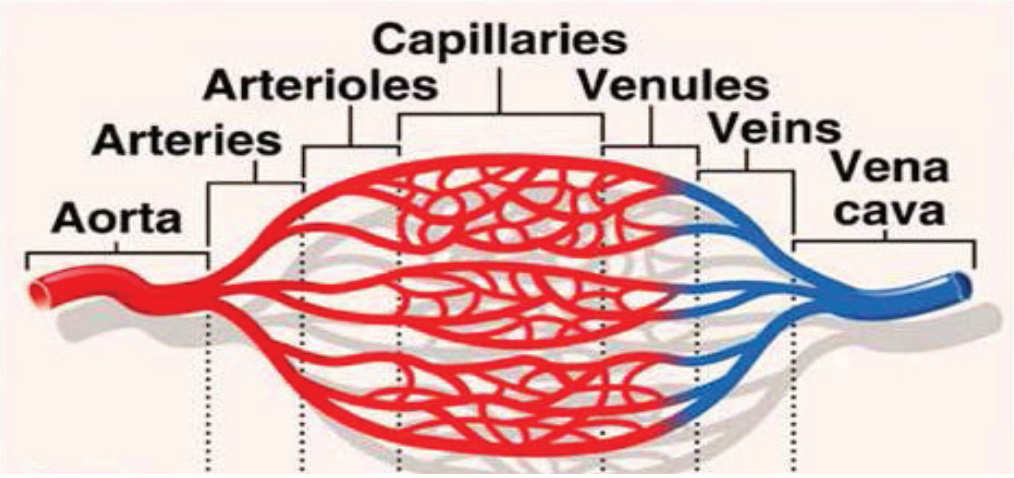


Figure (47): Constituent of blood vessels.

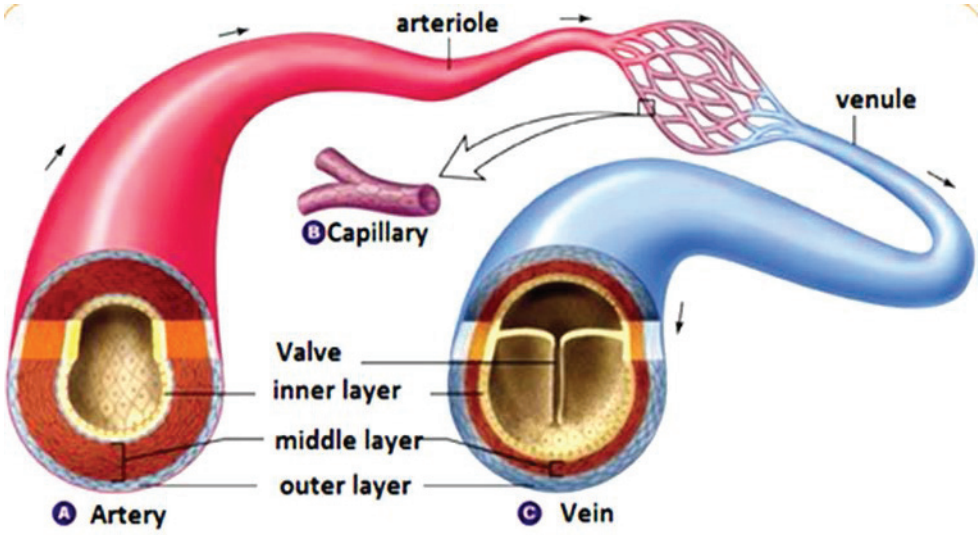


Figure (48): Structure of the blood vessels.

Arterio- venous junction:

1-Capillaries:

---Capillaries are the most common communication between the artery and the veins, present mainly in the tissues.

2-Sinusoids:

---Another type of communication, resemble capillaries in that they are thin-walled blood vessels, but they have an irregular cross diameter and are wider than capillaries.

---They are found in the bone marrow, spleen, liver, and some endocrine glands.

3-Arterio –venous anastomoses:

---It is a type of connection that occurs in some areas of the body, principally the tips of the fingers and toes, where direct connections occur between the arteries and veins without the intervention of capillaries.

4-Cavernous tissue:

---Another type of communication like that present in the penis .This tissue consists of many small spaces lined with endothelium and separated from each other by fibrous septa.

Anastomoses (communications):

- A communication between two arteries is called an anastomosis. If a main channel is occluded, a series of smaller vessels (collateral vessels) can usually increase in size in a relatively short time, providing a collateral circulation that ensures the blood supply to structures distal to the blockage.
- There are areas, however, where collateral circulation does not exist, or is inadequate to replace the main channel. Arteries that do not anastomose with adjacent arteries are **anatomical or true terminal or end arteries**. Occlusion of an end artery interrupts the blood supply

to the structure or segment of an organ it supplies. An example is the retinal artery the occlusion of which will result in blindness.

- **Not true terminal arteries, functional terminal arteries** (arteries with ineffectual anastomoses) supply segments of the brain, liver, kidneys, spleen, and intestines; they may also exist in the heart.

►Systemic Arteries and Veins: Differences in Pathways and Courses:

1- The heart pumps all of its blood into a single systemic artery—the aorta.

In contrast, blood returning to the heart is delivered largely by two terminal systemic veins, the superior and inferior venae cavae.

2- Arteries run deep while veins are both deep and superficial.

3- Venous pathways are more interconnected, unlike the fairly distinct arterial pathways. As a result, venous pathways are more difficult to follow.

4- Most body regions have a similar pattern for their arterial supply and venous drainage. However, the venous drainage pattern in at least two important body areas is unique.

a) First, venous blood draining from the brain enters large *dural venous sinuses* rather than typical veins.

b) Second, blood draining from the digestive organs enters a special subcirculation, the *hepatic portal system*, and perfuses through the liver before it reenters the general systemic circulation.

Principal Vessels of the Systemic Circulation:

□ **The aorta,** the largest artery in the body, is divided into the following three parts:

● **The ascending aorta,** The only branches of the ascending aorta are the two *coronary arteries* that supply the wall of the heart

● **Aortic Arch:** Three arteries branch from the aortic arch: the **brachiocephalic trunk,** the **left common carotid** and **left subclavian arteries.** These three branches of the aorta supply the head and neck, upper limbs, and the superior part of the thoracic wall.

● **Descending Aorta,** It has two parts:

▪ **The *thoracic aorta*,** it sends many small branches to the thoracic organs and body wall.

▪ **The *abdominal aorta,*** ends at the level of vertebra L4, where it divides into the right and left *common iliac arteries,* which supply the pelvis and lower limbs

□ **Branches of abdominal part:**

▪ **Celiac Trunk**, supplies the viscera in the superior part of the abdominal cavity, it sends branches to the stomach, liver, gallbladder, pancreas, spleen, and a part of the small intestine (duodenum). It divides almost immediately into three branches: the *left gastric, splenic,* and *common hepatic arteries*.

▪ **Superior Mesenteric Artery**, serves most of the intestines.

▪ **Inferior Mesenteric Artery,** It serves the distal half of the large intestine.

▪ **Inferior phrenic Arteries,** supply diaphragm.

▪ **Suprarenal Arteries**, supply blood to the adrenal (suprarenal) glands.

▪ **Renal Arteries,** to the kidneys.

▪ **Gonadal Arteries** The paired arteries to the gonads are more specifically called **testicular arteries** in males and **ovarian arteries** in females.

■ Major veins of systemic circulation:

□ **Superior vena cava.** This great vein receives systemic blood draining from all areas superior to the diaphragm, except the heart wall. It is formed by the union of the **right** and **left brachiocephalic veins** and empties into the right atrium.

□ **Inferior vena cava.** The widest blood vessel in the body, this vein returns blood to the heart from all body regions below the diaphragm. The abdominal aorta lies directly to its left. It is formed by the union of the **right** and **left common iliac veins.**

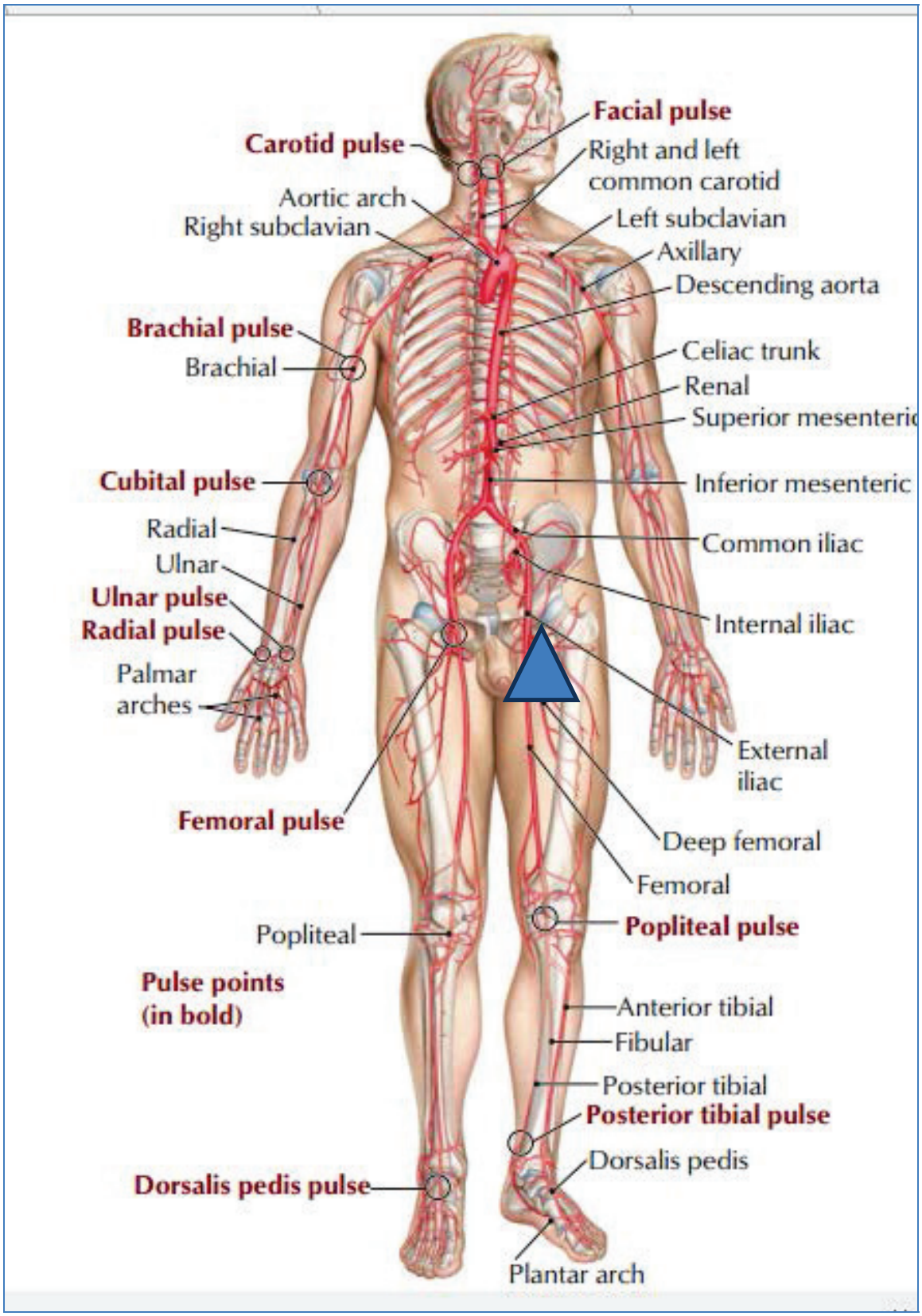


Figure (49): Main arteries in the body.

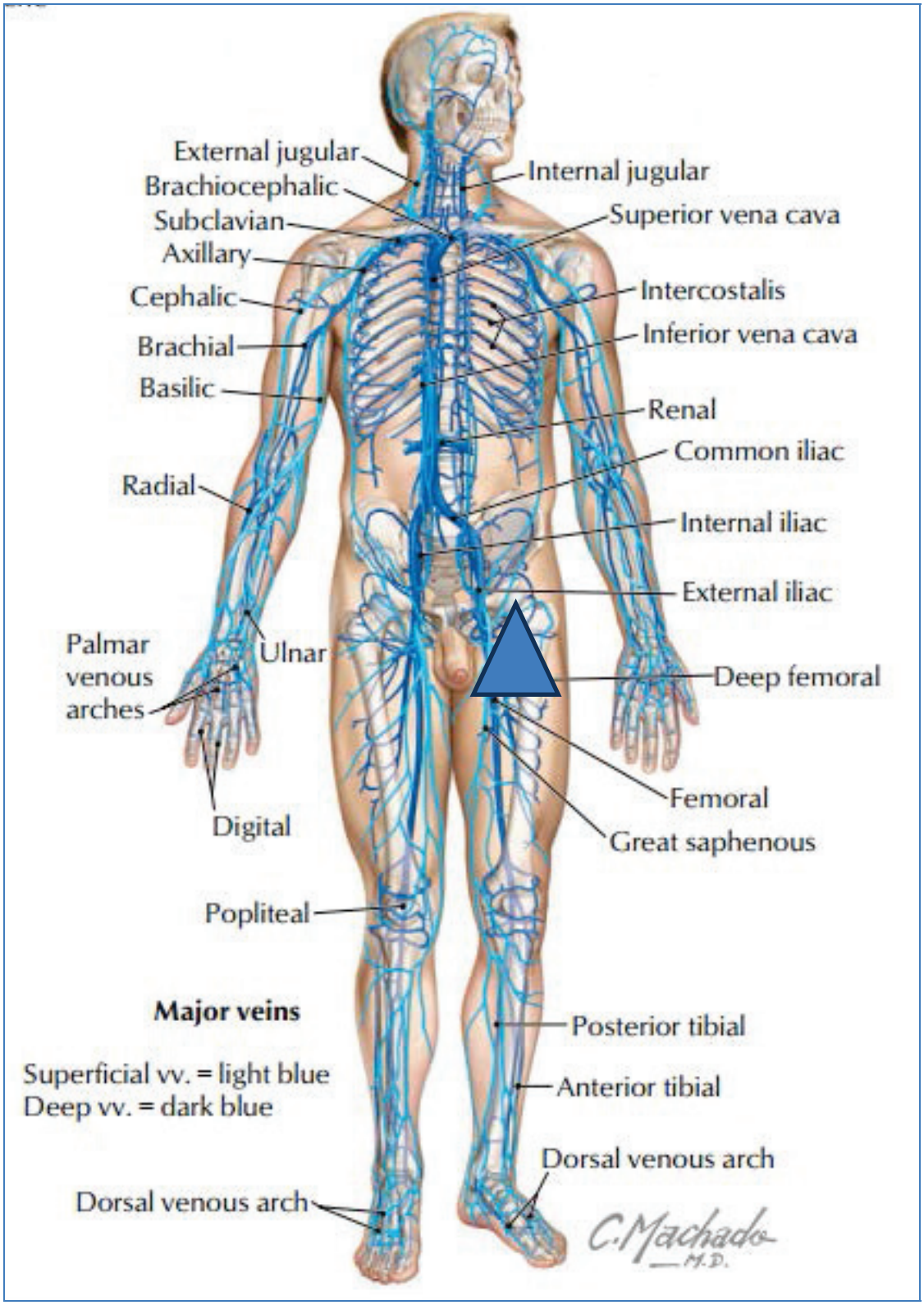


Figure (50): Main veins in the body.

Circulatory Routes or Circuits

- **Pulmonary circulation:**

♦ Carry blood to and from the lungs.

♦ The pulmonary arteries carry blood low in oxygen from the right ventricle and reach to the lung. In the lung, eliminate carbon dioxide from the blood and replenish its supply of oxygen then the pulmonary veins carry the blood high in oxygen from the lungs into the left atrium.

- **Systemic circulation:**

♦ It is the largest circulatory route.

♦ It takes oxygenated blood from the left ventricle through the aorta to all parts of the body, including some lung tissue (not air sac or alveolus) and returns the deoxygenated blood to the right atrium, through the systemic veins; the superior vena cava, the inferior vena cava, and the coronary sinus.

- **Hepatic portal circulation:**

♦ The **hepatic portal system** is a specialized part of the vascular circuit that serves a function unique to digestion: It picks up digested nutrients from the stomach and intestines and delivers these nutrients to the liver for processing and storage.

♦ Like all portal systems, the hepatic portal system is a series of vessels in which two separate capillary beds lie between the arterial supply and the final venous drainage.

♦In this case, capillaries in the stomach and intestines receive the digested nutrients and then drain into the tributaries of the **hepatic portal vein.** This vein then delivers the nutrient-rich blood to a second capillary bed—the *liver sinusoids*—through which nutrients reach liver cells for processing.

♦After passing through the liver sinusoids, the blood enters the hepatic veins and inferior vena cava, thereby re-entering the general systemic circulation.

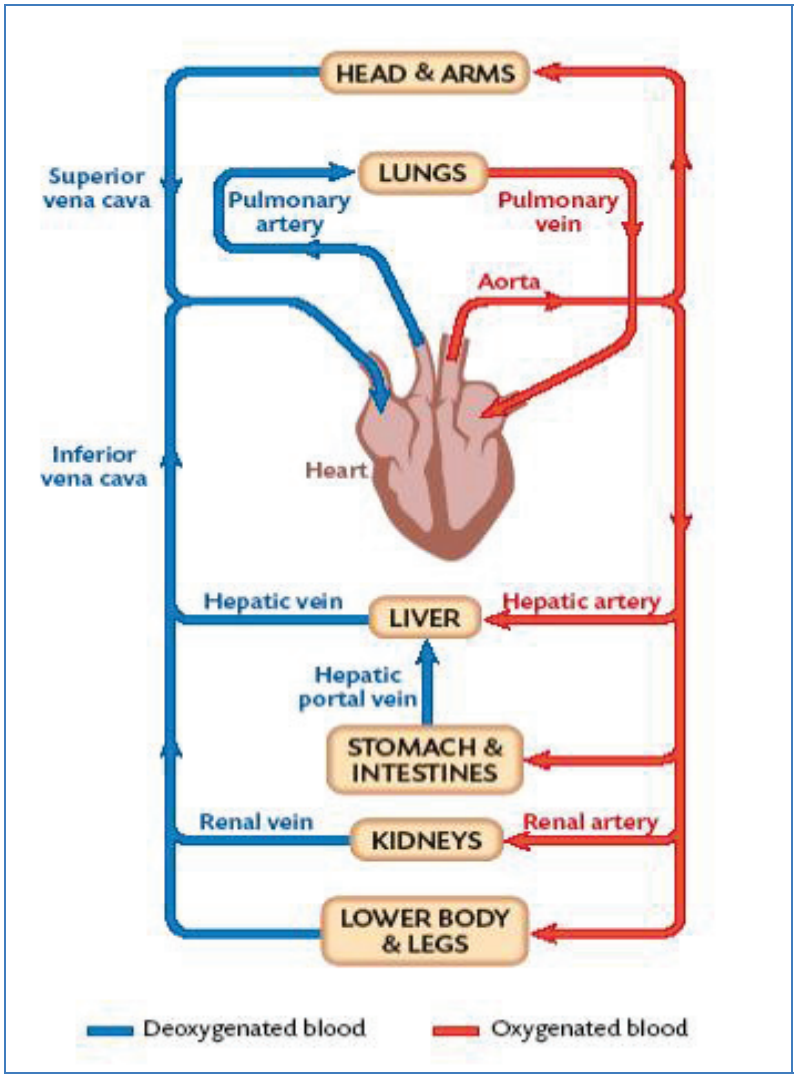


Figure (51): Blood circulation.

Lymphatic system

It includes lymph vessels & aggregations of lymphatic tissues: lymph nodes, thymus spleen, mucosa of respiratory and digestive tract.

Definition of lymph: clear colourless fluid which escapes from capillaries by filtration into tissue spaces as it becomes tissue fluid. It returns back to blood stream through lymph vessels.

Composition:

a- Plasma

b- Proteins

c- Lymphocytes

d- Others as waste products and micro-organisms.

(A) Lymph Vessels

- The lymphatic vessels drain the excess interstitial fluid containing the protein "***lymph***" into the blood stream. Thus, the lymph vessels are accessory to veins.
- The lymph vessels start as network of capillaries. The lymphatic capillaries join each other to form larger vessels which run along the blood vessels and interrupted by lymph nodes.
- The vessels end in collecting ducts at the root of the neck:
  - *On the left side,* there is the thoracic duct.
  - *On the right side,* there is the right lymphatic duct.
- These ducts open into the angle between the internal jugular and subclavian veins. Thus, ***in the end all the lymph pours into the blood stream.***

Characteristics of lymph vessels:

1-Lymph capillaries are wider than blood capillaries .Their endothelium is thin and permits passage of water, crystalloids and protein.

2- Pressure will allow larger particles as blood cells to enter lymph capillaries.

3-The tissue fluid once enter the vessels is named, ***the lymph.***

4-Larger lymph vessels have numerous valves.

5- Lymph vessels pass through at least one lymph node and often through several stations of lymph nodes. The vessels that enter the lymph node are named ***afferent vessels***, and those carry filtered lymph from the lymph nodes called ***efferent vessels***.

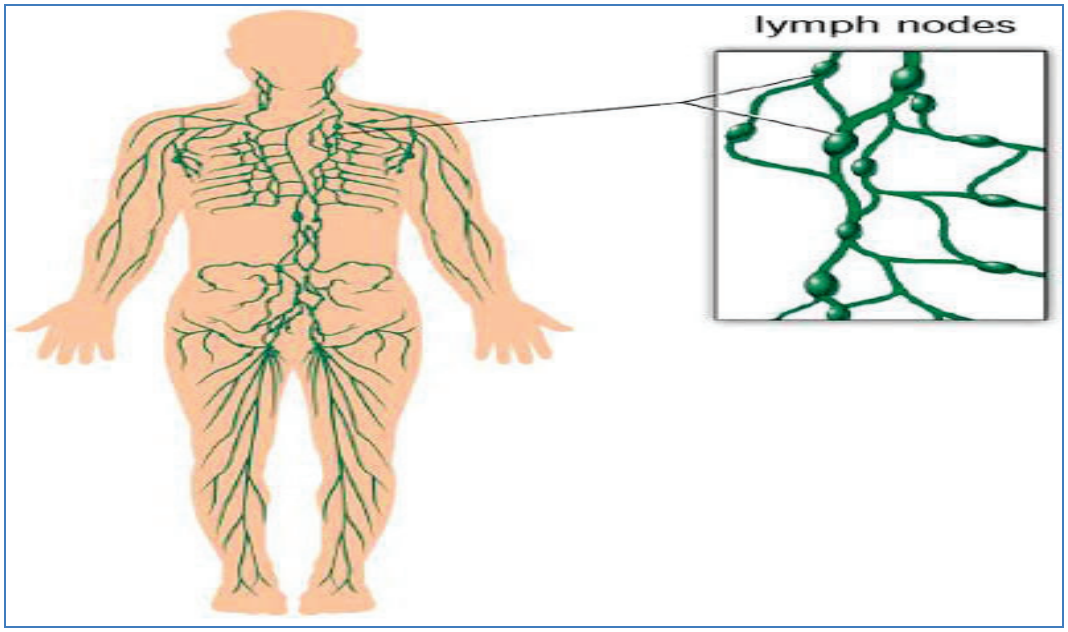


Figure (52): Lymphatic system.

Arrangement of lymph vessels:

All the body sites possess lymphatic, however there are:

1- ***Sites with no lymphatic*;** central nervous system, cornea, the internal ear, the epidermis of the skin, the cartilage and the bone marrow.

2- ***Sites have a rich network of lymphatic*;** dermis of skin, mucous and serous membranes and glands.

Blood capillaries	Lymphatic capillaries
Present superficial in position under the skin and mucous membrane.	Present more deep in position than blood capillaries.
They are the branching vessels of arterioles and are connected with venules at the other side.	They start as blind ended channels and are connected to lymph vessels at one side only.
They have uniform diameters.	Their diameters are irregular.
The endothelium is fenestrated.	Non – fenestrated endothelium.
The lumen is usually patent.	The lumen may be collapsed.
They carry blood.	They carry lymph.

Table (7): Comparison between blood and lymphatic capillaries

(B) Lymphatic aggregations

Lymph nodes:

Bean shaped glands presents along the course of lymphatic vessels. (at birth there are between 600-700 lymph)and tend to be grouped together. They are aggregated in particular sites such as the neck, axillae, groins and para-aortic region.

Function:

a) Filter the blood from bacteria, and particulate solid matter, and phagocyte them by its phagocytic cells.

b) Proliferation of lymphocytes.

The Spleen

- It lies in the upper left quadrant of the abdomen under the diaphragm.
- It is oval shaped measures (1×3×5inches).
- It has upper and lower borders, anterior broad and posterior tapering ends, in the upper border near the anterior end there is a notch that consider an important point in clinical examination.
- It has outer convex and inner concave surface, in the middle of medial surface there is a hilum where the blood vessels and nerves enter and leave the spleen.

Function:

a) Filter out old red blood cells.

b) Harbors phagocytes, which engulf bacteria and other foreign particles

c) Serves as a reservoir of blood in cases of emergency.

The Thymus

It is a flattened, pink bilobed structure present behind the sternum. In the newborn infant, it reaches its largest size relative to the size of the body, and then it continues to grow until puberty but thereafter undergoes involution.

Function:

a- It is the site in which T-lymphocytes develop and mature before birth and is most active prior to puberty.

b-The thymus secretes the hormone thymosin, which promotes the growth of lymphocytes and lymphoid tissue throughout the body.

Mucosa associated lymphoid tissue

They are embedded in the mucous membranes of the respiratory and digestive systems as adenoid, palatine tonsils, lingual tonsil, and payer's patches in the wall of the ileum.

Keywords

The heart:

1- Location.

2- Orientation and structure of the heart.

3- Covering of the heart and Layers of heart wall.

Blood vessels:

1- Structure of blood vessels wall.

2- Arteries (Different types and size).

3- Veins (Different types and size).

4- Capillaries (Types).

5- Arterio-venous shunt.

6- Circulatory pathways.

Lymphatic structure:

1- Definition of lymph.

2- Parts (Lymph node, lymph vessels and lymphatic aggregation) and function of each.

Write your note

Check your understand

1- Describe the layers of the pericardium and the tissue layers of the heart wall.

2- Name the heart valves, and describe their locations and functions. Indicate where on the chest wall each of the valves is heard.

3- Describe the path of a drop of blood through the four chambers of the heart and the systemic and pulmonary circuits

4- Where does blood travel after passing through the aortic semilunar valve? Is this blood oxygenated or deoxygenated?

5- Describe the three layers that typically form the wall of a blood vessel, and state the function of each?

6- Define vasoconstriction and vasodilation.

7- Which branch of the autonomic nervous system innervates blood vessels? Which layer of the blood vessel wall do these nerves innervate?

8- When vascular smooth muscle contracts, what happens to the diameter of the blood vessel? What is this called?

9- Describe the types of capillaries and their functions?

10- Describe the structure and function of capillaries, sinusoids, and capillary beds,

11- Define vascular anastomoses and explain their functions?

12- Compare and contrast the structure and function of the three types of arteries

13- Describe the structure and function of veins, and explain how veins differ from arteries.

14- What is the function of venous valves?

15- In the systemic circuit, which contains more blood—arteries or veins—or is it the same?

16- Name the major vessels of the pulmonary circuit.

17- Name the three vessels that branch off the aortic arch and the body region each serves.

18- What vessel is palpated to feel a pulse in each of the following locations: (a) thigh, (b) arm, (c) wrist, (d) foot, (e) neck?

19- Name the vessels that branch off the abdominal aorta to supply blood to the digestive organs

20- Consider the hepatic veins and the hepatic portal vein. What organ or organs does each vein drain? Into what vessel does each vein empty?

21- Name the three branches of arch of aorta

22- Name the four unpaired arteries that emerge from the abdominal aorta.

23- You are assessing the circulation in the leg of a diabetic patient at the clinic. Name the artery you palpate in each of these three locations:

a) behind the knee,

b) behind the medial malleolus of the tibia,

c) the dorsum of the foot

24- What is lymph? Where does it come from?

25- Name two lymphatic ducts and indicate the body regions usually drained by each.

26- To which large veins is lymph returned, and why is this return important?

27- Describe the relationship of lymphatic vessels to the cardiovascular system.

28- Where are the major paired groups of lymph nodes located?

29- List sites with no lymphatic.

Chapter V

Regulating and integrating structures of the body

Nervous structures

THE NERVOUS SYSTEM

The nervous system is divided into two main parts:

The central nervous system (C.N.S.), which is formed of ***brain*** and ***spinal cord***:

□ ***The brain is further subdivided into:***

- ***Two cerebral hemisphere.***
- ***Two cerebellar hemispheres.***
- ***Brain stem,*** which is subdivided into**: mid brain**, **pons**, **medulla oblongata**.

□ ***The spinal cord is further subdivided into 31 segments***: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and one coccygeal segments. It ends at the level of the lower border of the 1st lumbar vertebra.

►***Both of the brain and spinal cord lie inside bony cavities:***

- **The brain** lies inside the ***cranial cavity*** of the skull.
- **The spinal** cord lies inside the ***central canal*** of the vertebral column.

►***Both are continuous together through the foramen magnum of the skull.***

►***Both are covered by three membranes called meninges:*** Dura matter, arachnoid

matter, and pia matter , that allow support, protection and nutrition functions.

►***Both are surrounded by circulating fluid called cerebrospinal fluid.***

► ***Structurally, Both are formed of grey matter and white matter.***

- ***In the brain,*** the grey matter lies on the surface and the white matter lies inside.
- ***In spinal cord,*** the grey matter forms butterfly central form that is traversed by central canal, and the white matter lies externally.

The peripheral nervous system (P.N.S.):

- ***Anatomically,*** it is formed of 12 pairs of cranial nerves and 31 pairs of spinal nerves and related ganglia.
- ***Functionally,*** it is differentiated into:

• ***Somatic nervous system,*** which controls voluntary activities.

• ***Autonomic nervous system,*** formed of sympathetic &parasympathetic divisions which controls involuntary activities.

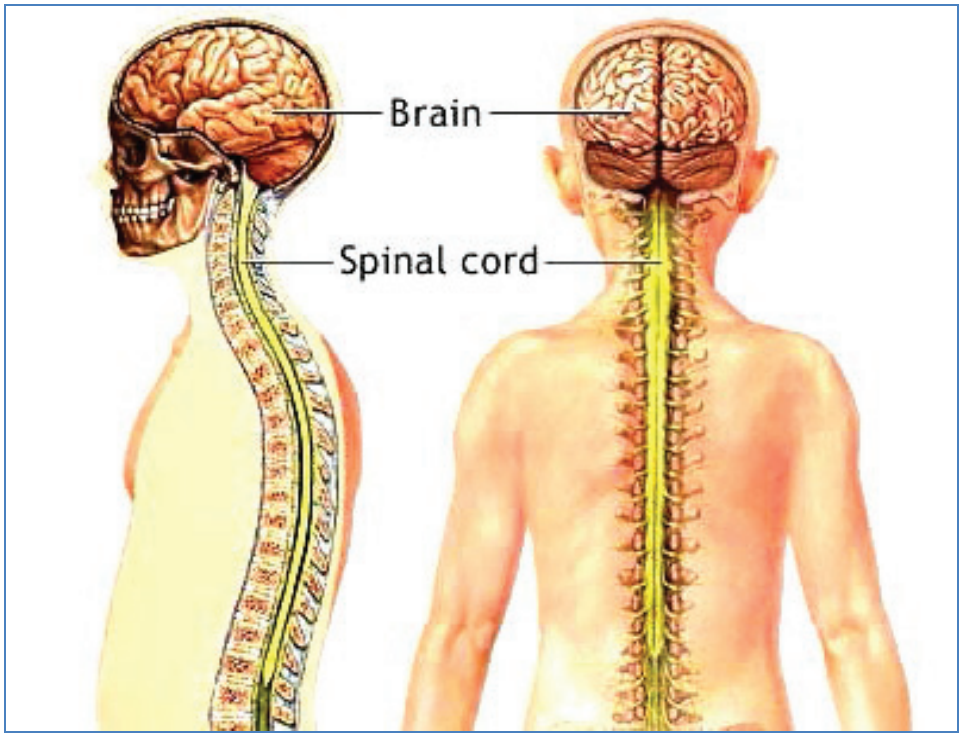


Figure (53): Components of the central nervous system.

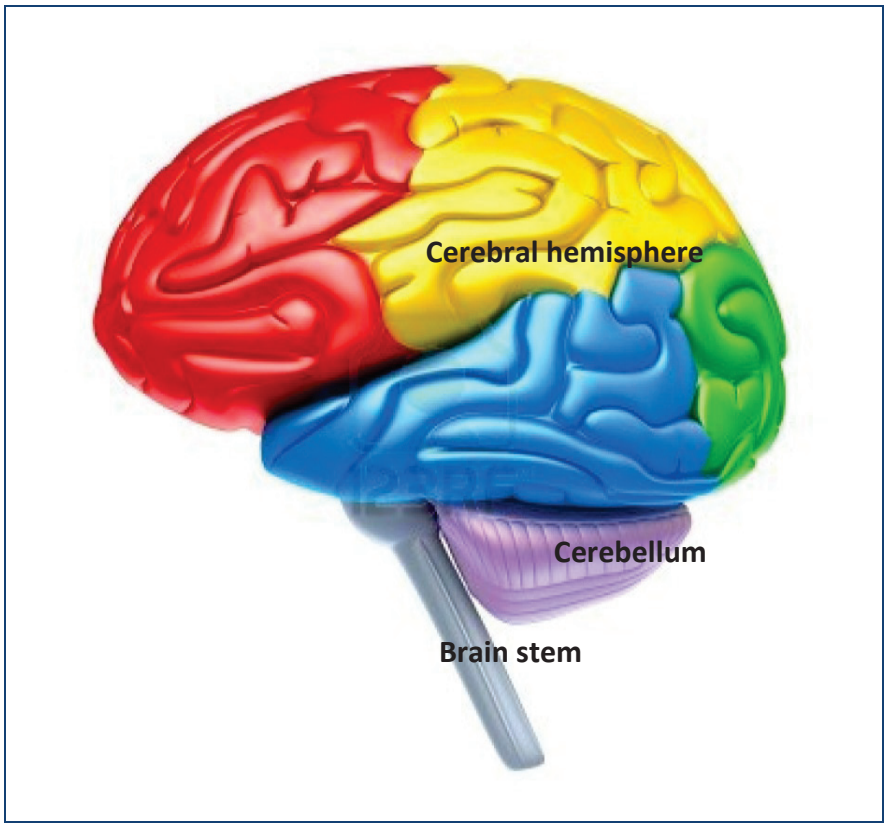


Figure (54): parts of the brain.

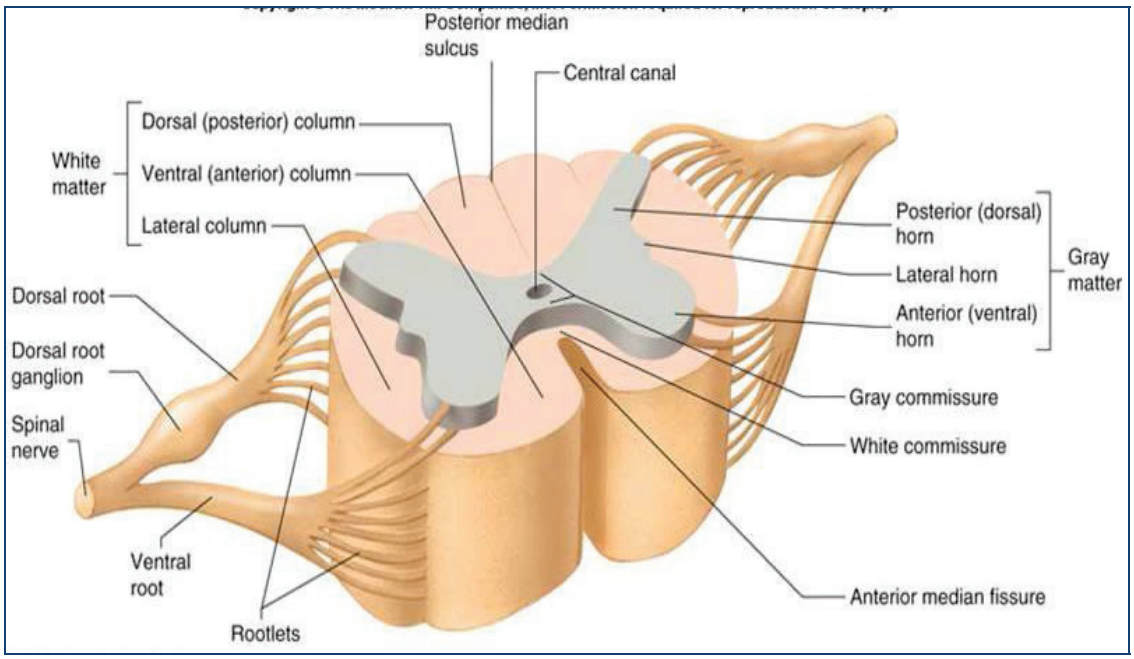


Figure (55): Cross section in the spinal cord showing formation of the spinal nerve.

	Brain	Spinal cord
Site	Cranial cavity of the skull.	Vertebral canal of vertebral column.
Cavities	Ventricles.	Central canal.
Parts	Three parts: cerebrum, cerebellum and brain stem (mid brain, pons, medulla oblongata).	31 segments: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and 1 coccygeal.
Structure	Grey matter on the surface and the white matter internally	The grey matter internally and the white matter externally.
Attached nerves	12 pairs of cranial nerves	31 pairs of spinal nerves

Table (8): Difference between the brain and spinal cord.

I. the somatic part of peripheral nervous system:

►Spinal Nerves:

□ They are the nerves which arise from the spinal cord inside vertebral canal and get out through intervertebral foramina.

□ They are 31 pairs arranged as following: (8) Cervical nerves,(12) Thoracic nerves, (5) Lumbar nerves (5) Sacral nerves and (1) Coccygeal nerve.

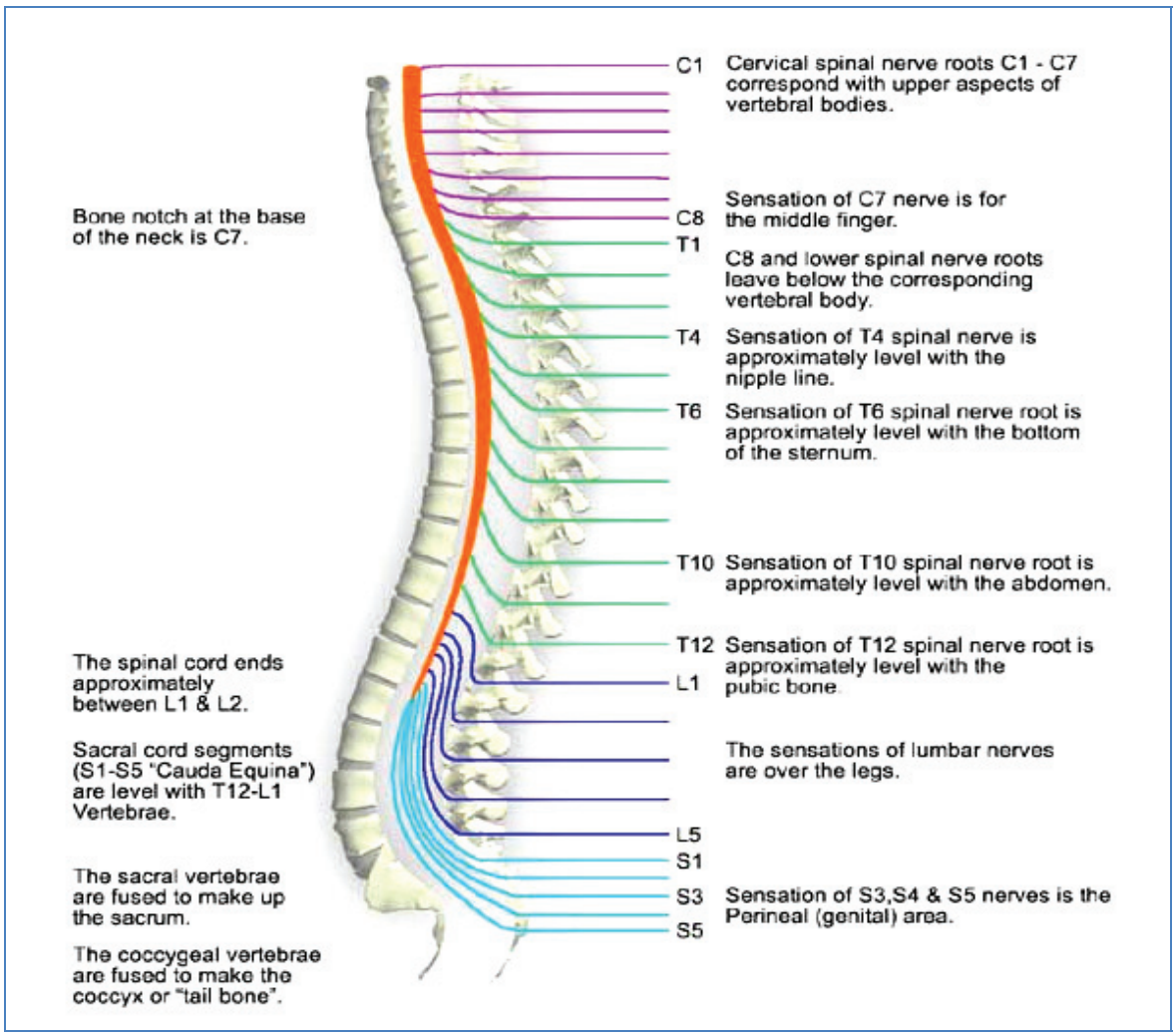


Figure (56): Spinal nerves.

Formation of the typical spinal nerve:

□ Each spinal nerve is formed of two roots:

▪**Dorsal root**: is purely sensory (afferent) and ends in the dorsal horn of spinal grey matter. It carries a dorsal root ganglion, formed of sensory nerve cells.

▪**Ventral root:** is purely motor (efferent) and arise from the ventral horn of the spinal cord grey matter.

□The two roots unite to form a spinal nerve trunk, which is mixed, contains sensory and motor nerve fibres.

□The spinal nerve then escapes through the intervertebral foramen of the vertebral column and divides into two rami:

▪**Dorsal ramus (mixed)**, small and innervates the skin and muscles of the back of the trunk and never forms a plexus.

▪**Ventral ramus (mixed),** large and innervates the skin and muscles of the rest of the body except the head. It tends to form nerve plexuses except in thoracic region.

Nerve plexuses:

- At the root of the limbs, the anterior rami join one another to form complicated ***nerve plexuses***.
- **At the root of the upper limbs,** the cervical and brachial plexuses are found.
- **At the root of the lower limbs,** the lumbar and sacral plexuses are found.

►Cranial Nerves

□They are 12 pairs of cranial nerves that arise from the brain inside the cranial cavity and leave the brain by passing through the foramina in the skull.

□ All cranial nerves are distributed in the head and neck except the 10th (vagus) which also supplies structures in the thorax and abdomen.

□ The cranial nerves are divided according to function into:

▪ Three sensory nerves, four mixed nerves and five motor nerves.

▪ The parasympathetic autonomic function is distributed through four nerves: oculomotor n. (III), Facial n. (VII), glossopharyngeal n. (IX) and vagus n. (X).

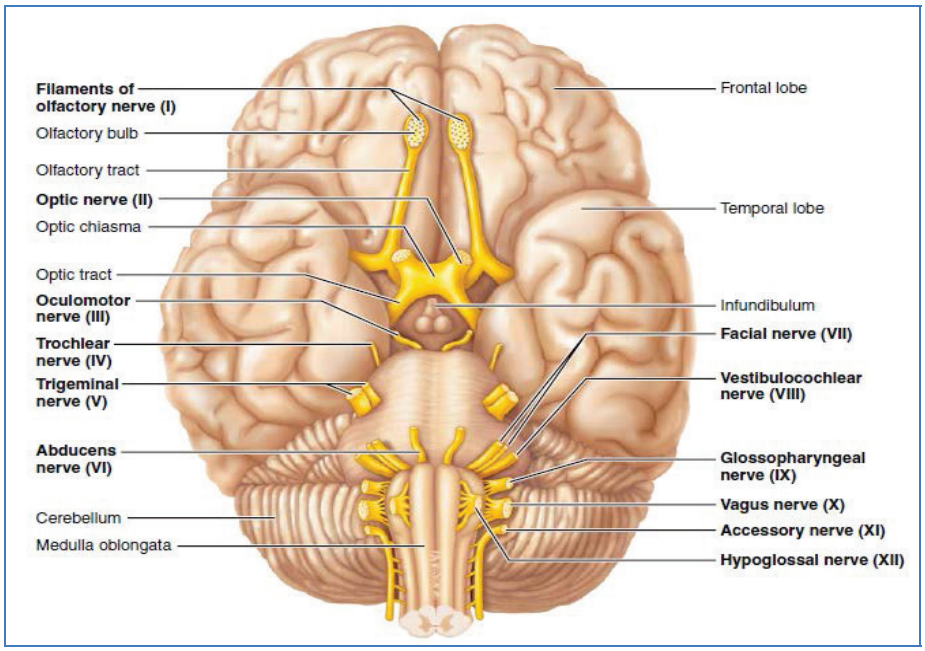


Figure (57): Attachment of the cranial nerves.

Cranial nerve	Function
I. Olfactory nerve (sensory).	- Smell sensation.
II .Optic nerve (sensory).	-Visual sensation.
III. Oculomotor nerve (motor).	-Motor to most of the muscles of the eye.
IV. Trochlear (motor).	-Motor to superior oblique muscle of the eye.
V. Trigeminal (mixed).	-Sensory to most of the head.
VI. Abducent (motor).	-Motor to lateral rectus muscle of the eye.
VII. Facial (mixed).	-Motor to the muscle of the face &participate in taste sensation.
VIII. Vestibulocochlear(sensory)	- Equilibrium and hearing sensation
IX. Glossopharyngeal(mixed).	-General and taste sensation of tongue & pharynx and motor to one muscle of the pharynx.
X. Vagus (mixed).	-Sensory and motor to respiratory, gastrointestinal and cardiovascular system and participates in taste sensation.
XI. Accessory (mixed).	-Assists the vagus nerve and motor to two muscles in the neck.
XII. Hypoglossal(motor)	-Motor to the muscles of the tongue

Table (9): Cranial nerves: names & functions

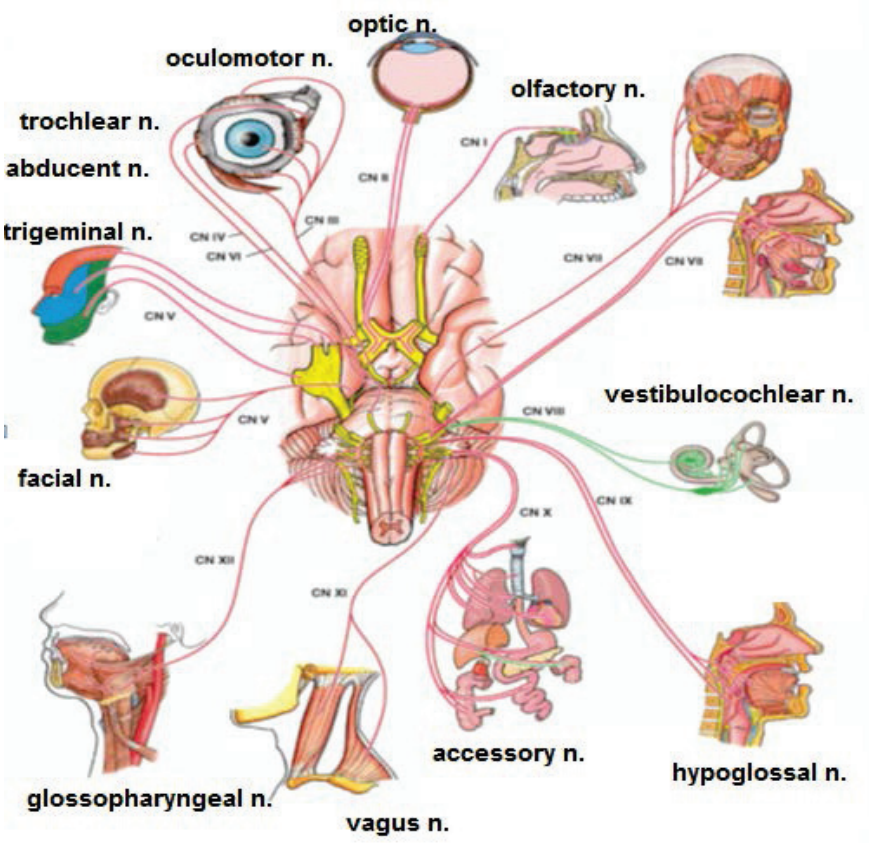


Figure (58): Distribution of the cranial nerves.

	Cranial nerves	Spinal nerves
Number	▪**12 pairs,** designated as Romans numbers (I-XII)	31 pairs: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and 1 coccygeal
Origin	▪10 pairs from the brain stem and two pairs from the cerebrum.	▪All arise from Spinal cord segments.
Number of roots	▪ Single roots (sensory or motor), or two roots (mixed).	▪ Each arises by 2 roots (ventral & dorsal roots).
Divisions	Not divided into rami and has no rami communicants	▪ Divided into ventral and dorsal rami and has rami communicants

Plexuses	It is formed away near the effector organs, e.g. Pharyngeal plexus.	Plexuses are formed just after its exit from spinal cord, e.g. brachial plexus.
Types of fibers	3 are sensory, 4 are motor and 5 are mixed.	All are mixed.
Related ganglia	▪Sensory, motor and parasympathetic.	▪Sensory, dorsal root ganglia.
Targets	▪Head & neck except vagus nerve extend its action into thorax and abdomen.	▪Limbs & trunk.

Table (10): Cranial & spinal nerves.

II. The autonomic part of peripheral nervous system:

□ Consists of motor fibres that stimulate smooth (involuntary) muscle, modified cardiac muscle (the intrinsic stimulating and conducting tissue of heart), and glandular (secretory) cells.

►The autonomic nervous system has two-neurons in its motor pathway: preganglionic and postganglionic neurons.

▪ the preganglionic neuron, its cell body is located in the grey matter of the CNS.

▪ the postganglionic neuron, its cell body is located in a peripheral autonomic ganglion.

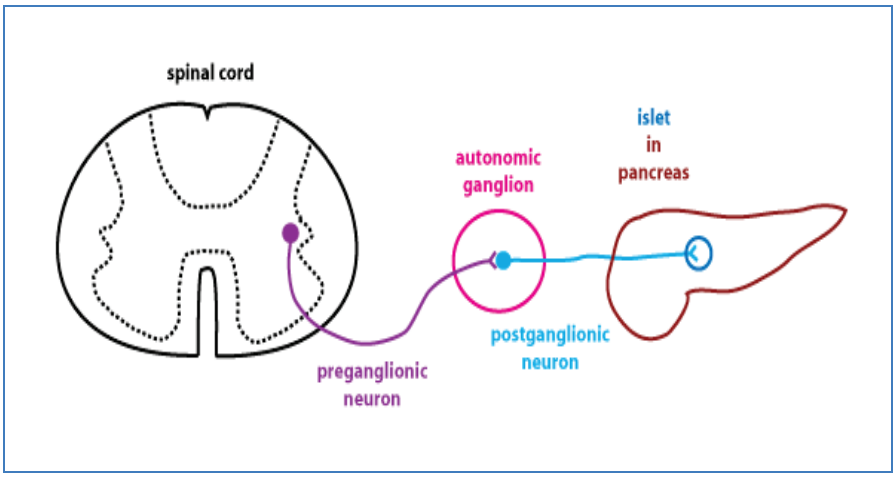


Figure (59): The two neuron systems of ANS (Preganglionic and postganglionic neurons)

Subdivisions:

A. Sympathetic division of the ANS:

□ **The preganglionic neurons,** are found in the lateral grey columns (horns) of the spinal cord from T1-L2 or L3 segments.

□ **The postganglionic neurons,** occur in two locations:

- **Paravertebral ganglia** of the sympathetic trunks (chains) which lies on each side of the vertebral column, from the base of the skull to the coccyx.
- **Prevertebral ganglia** which lies near the origins of the main branches of the abdominal aorta e.g. celiac, superior mesenteric and inferior mesenteric ganglia.

□ From lateral horn cells of the grey matter of spinal cord → preganglionic neurons → anterior roots of spinal nerve → anterior rami→ white rami communicants (white because the fibres are covered with white myelin) → sympathetic trunks.

►***Within the sympathetic chains, preganglionic fibres follow one of the following possible courses:***

1- ***Synapse on a sympathetic chain postganglionic neuron at the T1-L2 level:***

From sympathetic trunk, postganglionic fibres → grey rami communicants (grey because the fibres are devoid of myelin) → join the spinal nerves at the T1-L2 level.

2- ***Ascend in the sympathetic trunk to synapse in ganglia in level above,*** the cervical region and the postganglionic grey rami communicants join the cervical spinal nerves.

3- ***Descend in the sympathetic trunk to synapse in ganglia in level below,*** the lower lumbar and sacral regions and the postganglionic grey rami communicants join the lumbar, sacral and coccygeal spinal nerves.

4- Pass through the sympathetic trunk and leave it without synapsing as splanchnic nerves.

►***The splanchnic nerves therefore are,*** preganglionic fibres pass through the sympathetic chain without relay and leave it as greater, lesser, least and lumbar splanchnic nerves to relay in the prevertebral ganglia.

N.B:

▪ The postsynaptic sympathetic fibres are **components of all branches of all spinal nerves**. By this means they extend to and innervate all the body's **blood vessels as well as sweat glands, erector muscles of hairs, and visceral structures.**

▪ The ratio of preganglionic to postganglionic sympathetic fibres is about 1:10 **allowing wide control of involuntary structures.**

▪The presynpatic sympathetic fibres are ***short***, extending from the spinal cord to the peripheral ganglion located near to the vertebral column, whereas the postsynaptic fibres are ***long.***

(B) Parasympathetic division of the ANS:

►The preganglionic parasympathetic neurons arise from two sites:

▪ ***The brainstem***, the fibres exit the CNS within cranial nerves (CN) III, VII, IX, and X → ***cranial parasympathetic outflow*** → pass to synapse a peripheral ganglion in the head (ciliary, ptyergopalatine, submandibular, and otic ganglia) except CN X (vagus nerve), synapse on terminal ganglia in or near the targets in the neck, thorax and abdomen.

▪ ***The sacral segments of the spinal cord*** (S2—4) → the ***sacral parasympathetic outflow*** → via a ventral root of spinal nerve → pelvic splanchnic nerves → synapse on postganglionic neurons in terminal ganglia located in or near the viscera to be innervated.

N.B.:

▪The ratio of preganglionic to postganglionic parasympathetic fibres is about **1: 3** which is **much more restricted** than the sympathetic part.

▪Most presynpatic parasympathetic fibres are ***very long***, extending from the CNS to the effector organ, whereas the postsynaptic fibres are ***very short***, running from a ganglion located near or embedded in the effector organ.

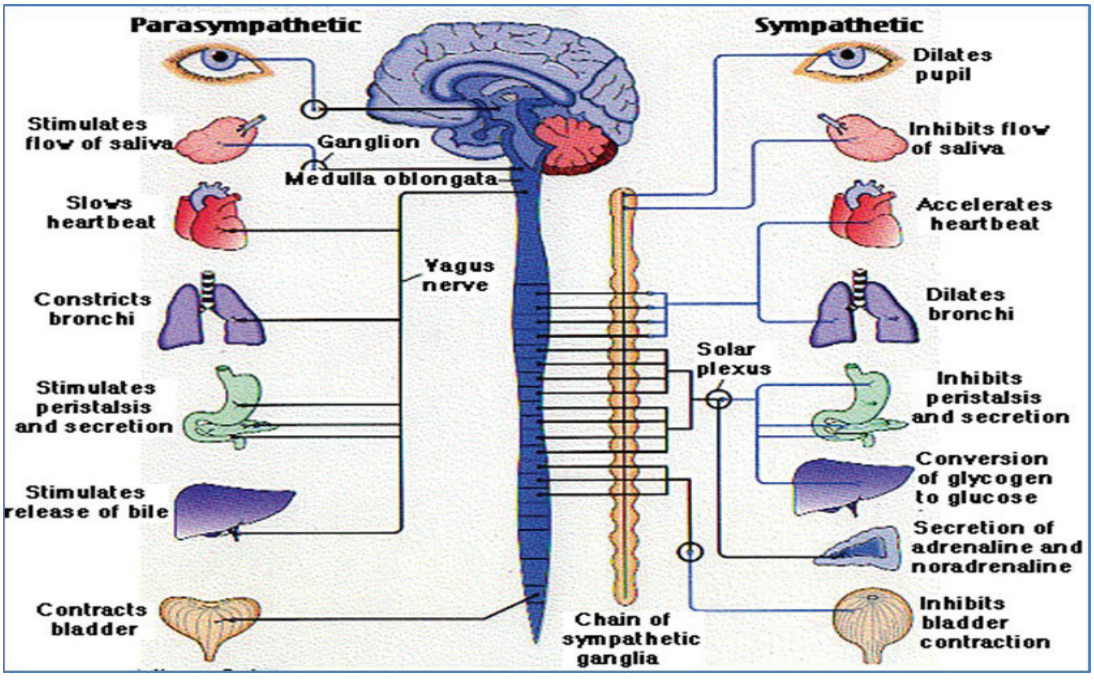


Figure (60): Distribution of autonomic nervous system.

	Sympathetic	Parasympathetic
Origin	Thoraco-lumber, the cell bodies of the preganglionic neurons are found in the lateral grey columns (horns) of the spinal cord segments from T1-L2	Craino- sacral, the cell bodies of the preganglionic neurons are found in ▪ the grey matter of the S2-S4 segments of spinal cord ▪ in the brain stem nuclei, the fibers exit within cranial nerves III, VII, IX, and X.
Length of neurons	Short preganglionic – long postganglionic neurons	Very long preganglionic – very short postganglionic neurons
Location of the ganglia	Nearer to spinal cord , in two locations: i. Paravertebral ganglia (sympathetic chain). ii. Prevertebral ganglia, with plexuses surrounding the origin of the main branches of aorta.	Terminal, near the viscera to be innervated (Paravertebral ganglia).
Distribution	Wide control, the ratio of preganglionic to postganglionic sympathetic fibers is about 1:10.	More restricted, the ratio of preganglionic to postganglionic parasympathetic fibers is about 1:3.
Function	It acts in stress & emergency, so it is a catabolic system (energy-expending).	It acts during rest e.g. assimilation of food. So it is anabolic system (energy - conserving).

Table (11): Sympathetic & parasympathetic divisions of autonomic nervous system.

	Motor neurons of somatic spinal nerves	Motor neurons of autonomic nerves
Origin	Anterior horn cells of all spinal cord segments.	Lateral horn cells of TI-L2 (sympathetic) and S2-S4 (parasympathetic).
Function	Regulate voluntary movement.	Regulate the function of internal organs (involuntary).
Terminal ganglia	There is no synapse in terminal ganglia after leave the spinal cord, so there are no pre and post ganglionic fibers.	There are synapse in the terminal ganglia, so there are pre and post ganglionic fibers.
Neurotransmitter	Acetylcholine.	Acetylcholine, adrenaline and noradrenalin.

Table (12): Comparison between somatic and autonomic motor nerves.

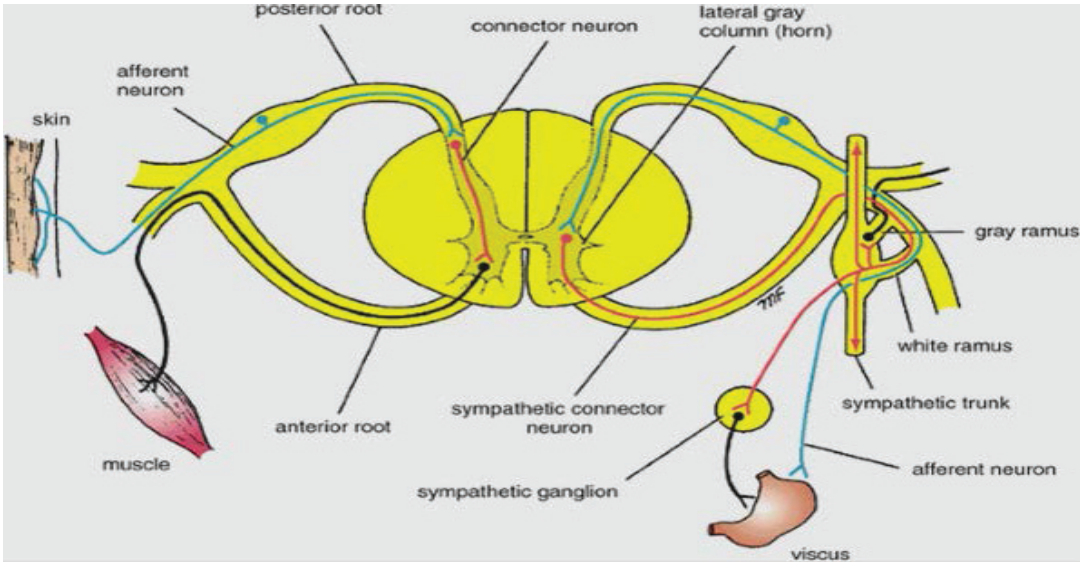


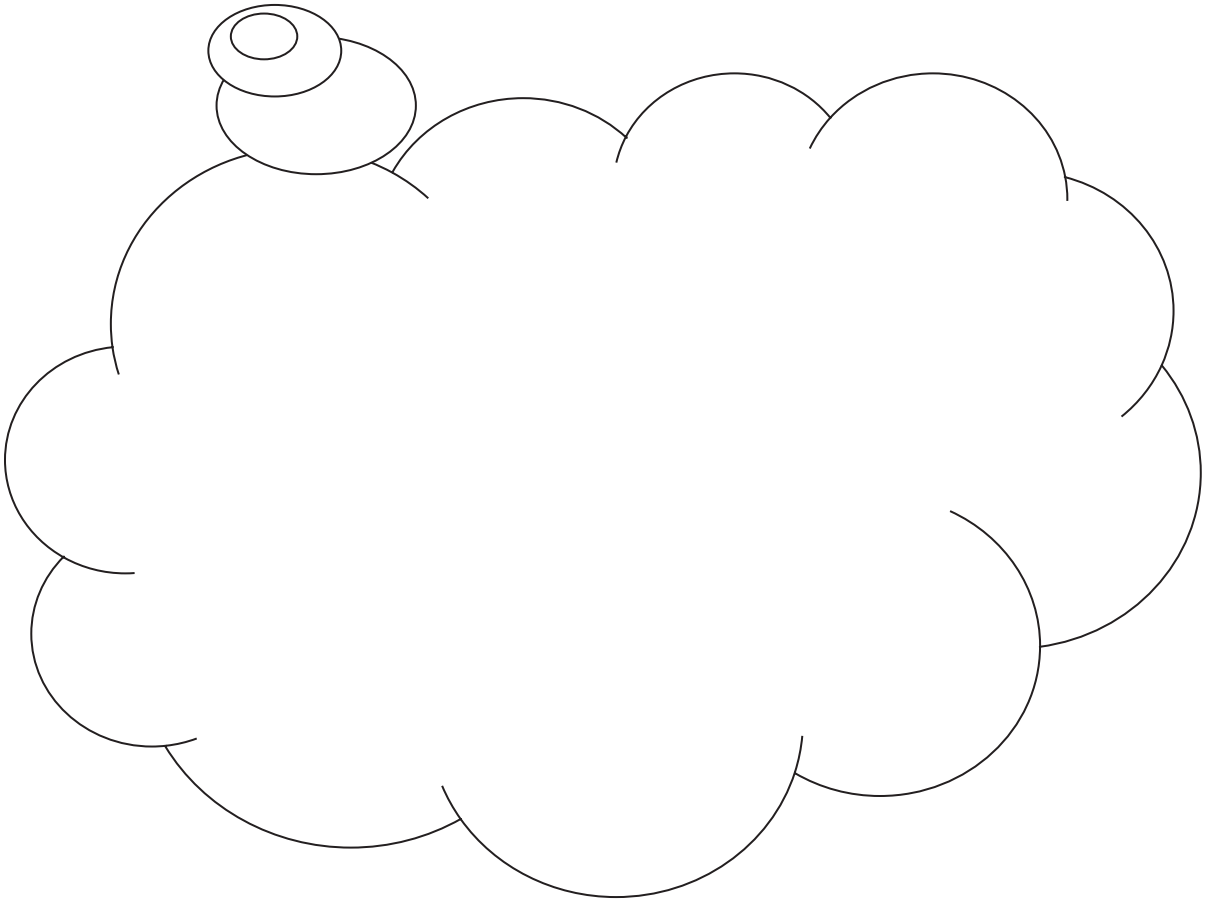
Figure (61): Somatic part of nervous system (left) compared to autonomic part of nervous system (right).

Keyword

Central nervous system (Subdivisions and study cranial and spinal nerves).

Peripheral nervous system (Subdivisions and study the autonomic parts of peripheral nervous system).

Write your note



Check your understanding

1- Differentiate between (1) a nerve and a tract, and (2) a nucleus and a ganglion.

2- How is the nervous system organized anatomically?

3- What are the structural components of the CNS and PNS?

4- Name and locate the meningeal coverings of the spinal cord?

5- Describe the protective structures of the spinal cord?

6- Describe the formation of the typical spinal nerve?

7- Divide the cranial nerves according to function and name the nerves that carry parasympathetic fibres?

8- Compare preganglionic and postganglionic neurons of the autonomic nervous system.

9- Describe the anatomy of the autonomic ganglia

10- Explain the central nervous system origin of the sympathetic and parasympathetic divisions.

11- Describe the location of the sympathetic ganglia.

12- List the synapses between the preganglionic and postganglionic motor neurons of the sympathetic division and the different pathways of the postganglionic neurons to their effector organs.

13- Define the splanchnic nerves and name its fibers preganglionic or post ganglionic.

Chapter VI

Regulating and integrating structures of the body

Endocrine glands

THE ENDOCRINE SYSTEM

The endocrine system is composed of a group of anatomically independent ductless glands that regulates body processes slowly by the use of chemical messengers called HORMONES. Hormones reach through the bloodstream to distant target organs.

The major glands of this body system are the following:

- **Hypothalamus:** regulates hunger, thirst, sleep and wakefulness in addition to most of the involuntary mechanisms including body temperature.
- **Pituitary gland:** controls all other endocrine glands; influence growth, metabolism and regeneration**.**
- **Pineal body:** controls the timing of reproduction.
- **Thyroid gland:** regulates the metabolism and blood calcium level.
- **Parathyroids:** regulates the blood calcium level with the thyroid gland.
- **Thymus:** controls functional maturation of lymphocytes. Undergoes atrophy during adulthood.
- **Adrenals:** secretes hormones which help the body react to emergencies, regulates metabolic processes, water balance, blood pressure.
- **Reproductive organs**: ovaries in females and testes in males: responsible for sexual characters and functions.
- **Pancreas:** produces insulin that regulates blood sugar level.

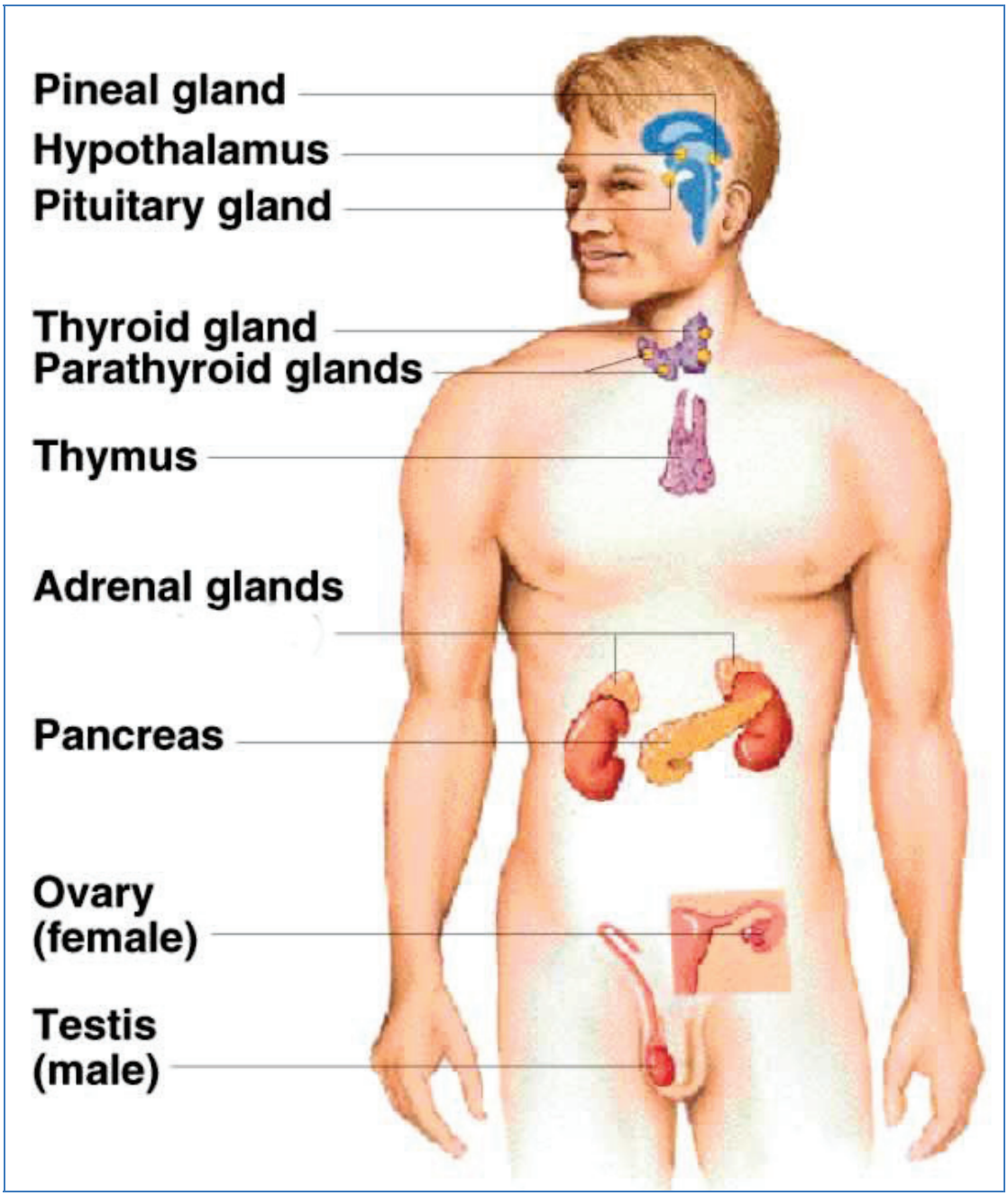


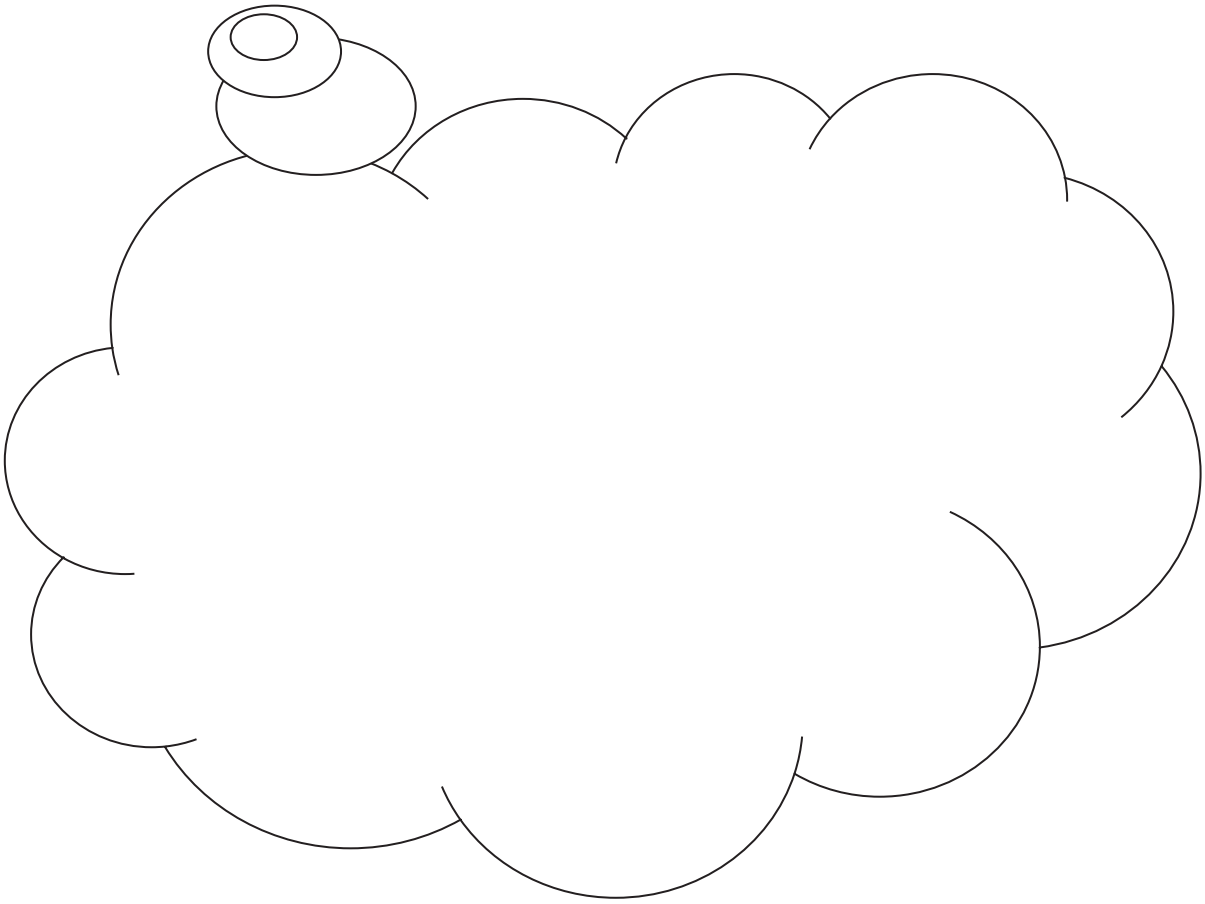
Figure (62): Endocrine system.

Keyword

The major endocrine glands in human body and function of each.

1- Hypothalamus
2- Pituitary gland
3- Thyroid gland
5- Adrenals.
6- Pineal body
7- Parathyroids
8- Reproductive organs
9- Pancreas
10- Thymus.

Write your note



Check your understanding

1- Define endocrine gland.

2- List different endocrine glands in human body?

3- Name and locate each endocrine gland in human body?

4- Describe the function of different endocrine glands in human body?

Chapter VII

Digestive system

THE DIGESTIVE SYSTEM

It has two main parts:

1- Gastro-intestinal tube.

2- Accessory organs.

Gastro-intestinal tube

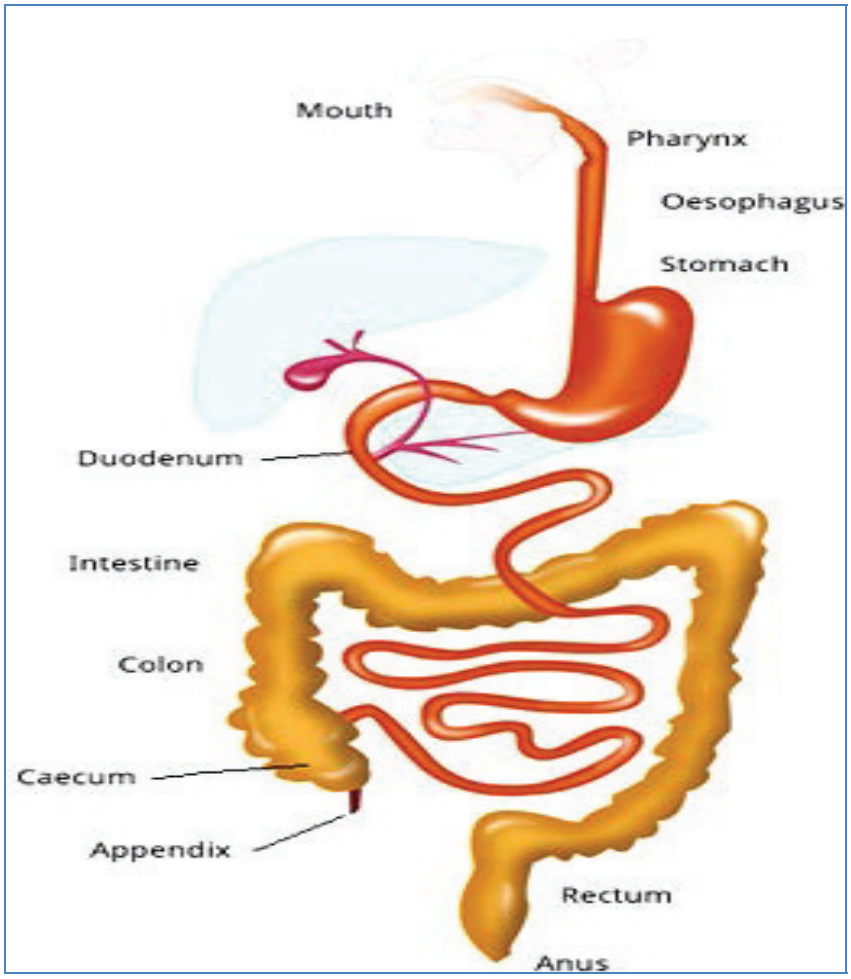


Figure (63): Digestive system.

It extends from the mouth to the anus.

1-Mouth:

It extends from the lips to oropharyngeal opening & contains:

a) **Gum & Teeth**: There are 32 permanent teeth in the adults**.**

b**) Tongue,** it is a muscular organ covered by mucous membrane for speech, taste and deglutition.

c) **Vestibule**, it is a cleft which lies between the teeth and the check externally and the teeth and the gums internally.

d) **Mouth cavity proper** between the upper jaw and the lower jaw,

e) **Palate**, It forms the roof of the mouth, and divided into two parts: hard palate in front and soft palate behind.

2-Pharynx:

It is a tube behind the nose, then mouth, and the larynx and according to that it's divided into three main parts as follows:

- **Nasopharynx:** It is that part behind the nose. It contains the pharyngeal opening of Eustachian tube & the nasopharyngeal tonsil.
- **Oropharynx:** It is that part behind the mouth.
- **Laryngopharynx:** It is that part behind the larynx and continues with the oesophagus.

3-Oesophagus:

The oesophagus is a muscular tube that joins the stomach at gastro-esophageal junction.

4-Stomach:

It is a widest part of the digestive tube between the oesophagus and the small intestine.

- It has:

Two opening:

a) Cardiac opening, between it and the oesophagus.

b) Pyloric opening, between it and the duodenum

Two borders:

-Lesser curvature. -Greater curvature.

Two surfaces:

-Anterior surface. -Posterior surface.

Two sphincters:

-Cardiac -Pyloric

Parts of the stomach:

a) Fundus. b) Body. c) Pyloric antrum. d) Pylorus.

5-Small intestine:

It extends from the pylorus of the stomach to the ileocecal junction (**6.25** m).

- ***It has three parts:***

***a) Duodenum*:** 25cm, c-shaped around the head of the pancreas, it receives the openings of bile duct and pancreatic duct.

b) Jejunum: 2.5m long

c) Ileum: 3.5 m long, thinner walled, and paler than jejunum.

6-Large intestine:

It is 1.5m long, It has the following parts:

a) *Caecum*: A blind –ended pouch, connected to the ileum by the ileocecal valve and to the vermiform appendix.

b) *Ascending colon:* It is about (5 inches) long, and extend from the caecum below to the right colic flexure above.

c) *Transverse colon*: It is about (15 inches) long, and extend across the abdomen from the right colic flexure to the left colic flexure.

d) *Descending colon:* It is about (10 inches) long, and extend downward from the left colic flexure to the pelvic brim, where it becomes continuous with the sigmoid colon.

e) *Sigmoid (pelvic) colon:* It is (10-15 inches) long, S -shaped, and begins as a continuation of descending colon above to the rectum below.

f) *Rectum:* It is about (5 inches) long, it extends from the sigmoid colon & ends in front of the tip of the coccyx**.**

f) *Anal canal:* It is about (1.5 inches) long and passes downward and backward from the rectum to the anus.

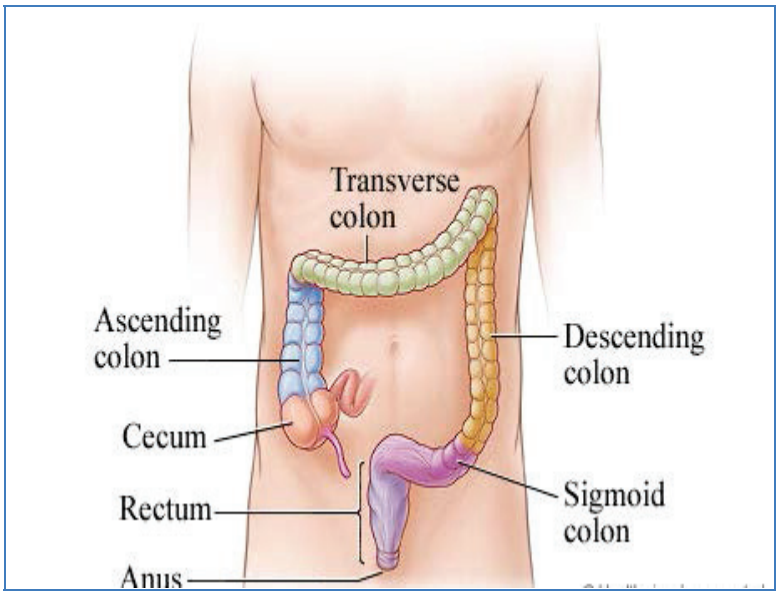


Figure (64): Parts of large intestine.

Accessory Organs

Liver:

- It is the ***largest gland*** in the body presents in the upper part of the abdominal cavity under the diaphragm. It is wedge-shaped and weights 1.5 kg.
- The liver has five surfaces (anterior, posterior, inferior, superior, and right).
- The inferior surface contains fossa for gall bladder, and the porta hepatis, which allow entrance and exit of structures into and out of the liver.

Gall bladder &Biliary System:

Gall bladder

- It is a pear-shaped sac lying on the inferior- surface of the liver.

- Its function is to store and concentrates bile by absorption of water.
- For descriptive purpose the gallbladder is divided into the **fundus**, **body**, and the **neck**, from it the cystic duct arises

Biliary system

It is formed of:

1- Two hepatic ducts from the right and the left lobes of the liver unite to form common hepatic duct.

2-The common hepatic duct unites with the cystic duct to form the bile duct which opens into the second part of the duodenum.

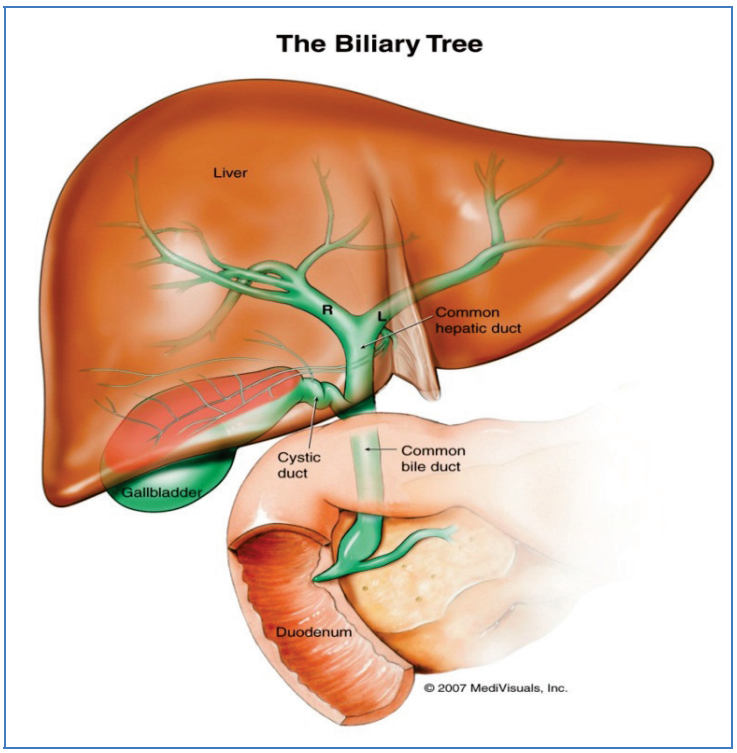


Figure (65): Liver and biliary system.

Pancreas:

- The pancreas is divided into a head, neck, body and tail.
- It has 2 ducts:-main &accessory ducts

---Pancreas is mixed gland that has exocrine and endocrine functions. The exocrine part produces an alkaline juice that contains enzymes capable of

hydrolysing protein, fats, and carbohydrates. The endocrine part produces insulin and glucagon, which play a key role in carbohydrate metabolism.

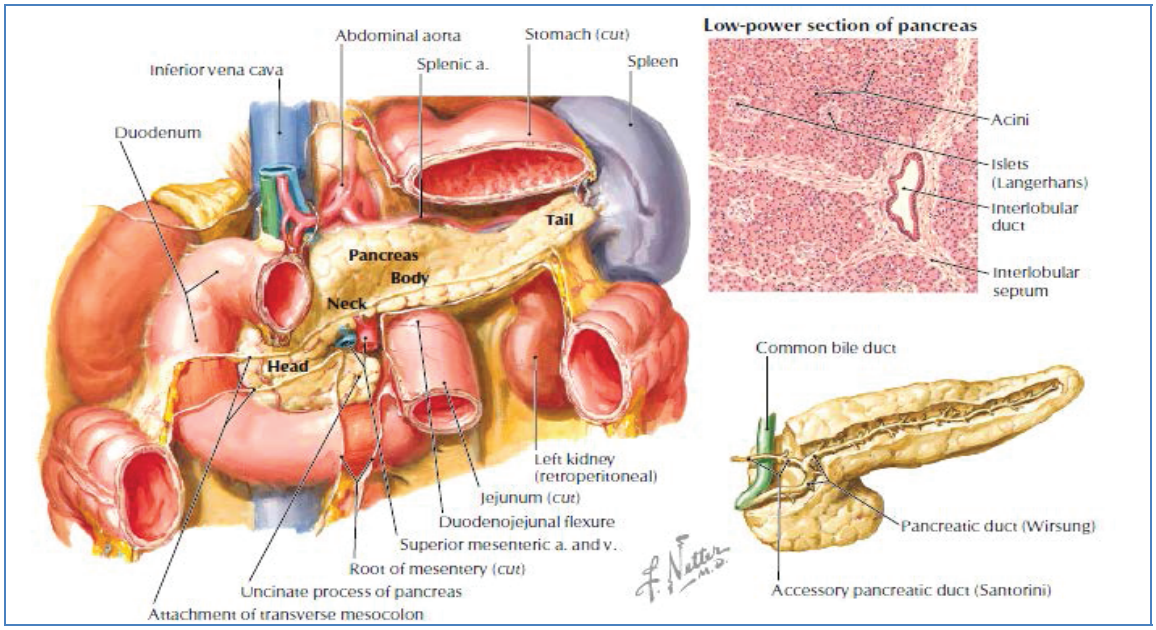


Figure (66): Position and parts of the pancreas.

Salivary glands:

They are 3 pairs: parotid, submandibular, and sublingual.

Function

- It has a cleansing action on the teeth.
- It moistens and lubricates food during mastication and swallowing.
- It dissolves certain molecules so that food can be tasted.
- It begins the chemical digestion of starches through the action of amylase, which breaks down polysaccharides into disaccharides.

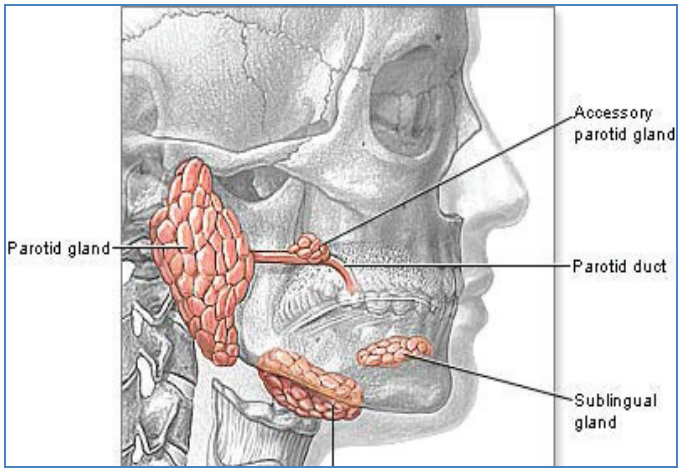


Figure (67): Salivary glands.

Keyword

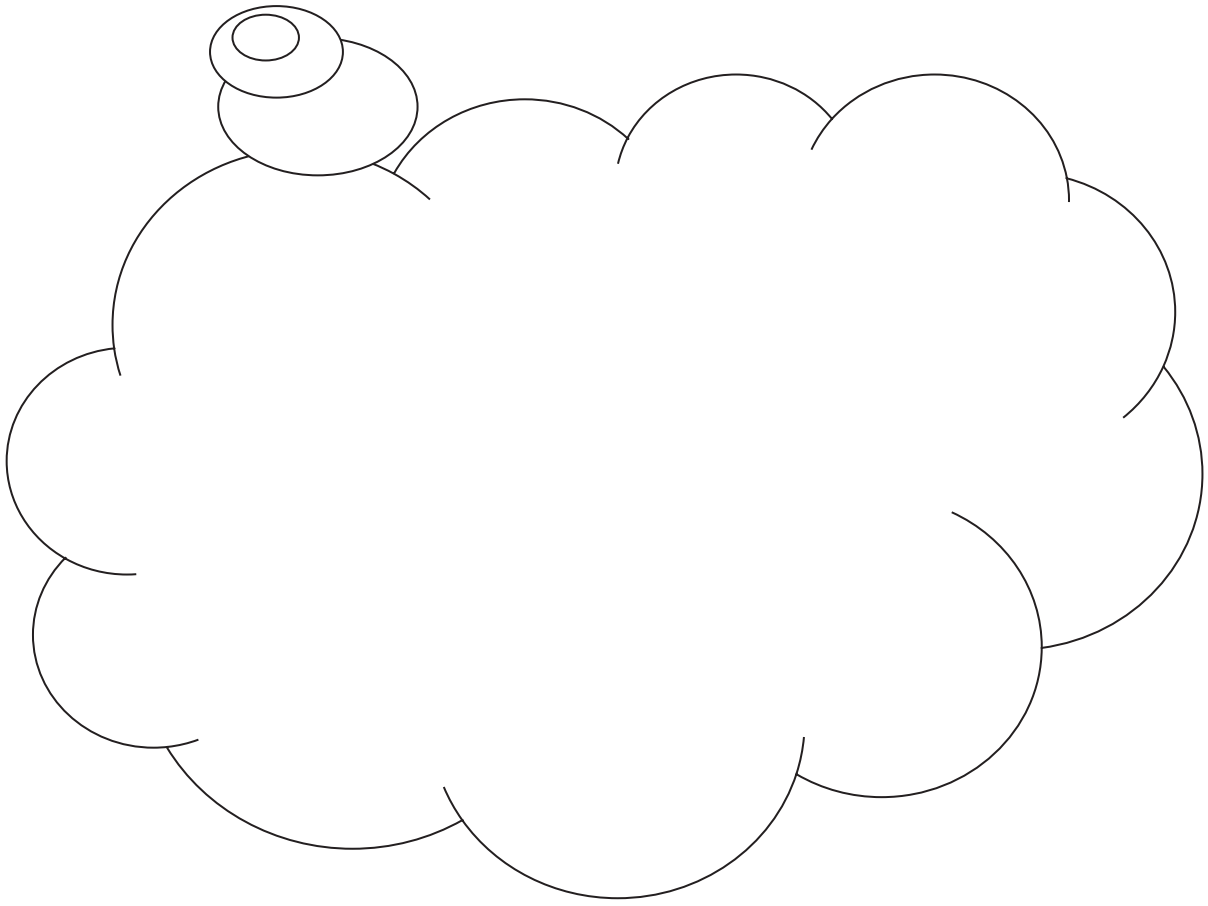
- The Main parts of digestive system

1- Mouth cavity
2- Pharynx
3- Oesophagus
4- Stomach
5- Small intestine
6- Large intestine

- Accessory glands.

1- Liver
2- gall bladder and biliary system
3- Pancreases
4- Salivary glands

Write your note



Check your understanding

1- Define Vestibule of mouth.

2- List two parts of palate?

3- List parts of pharynx?

4- Define esophagus?

5- Describe stomach?

6- List parts of stomach?

7- Describe parts of small intestine and mention length of each part?

8- Describe parts of large intestine and mention length of each part?

9- Define porta hepatis?

10- Describe function of gall bladder?

11- List parts of gall bladder?

12- Outline the biliary system ducts?

13- Mention position of gall bladder?

14- Describe position and parts of pancreases?

15- Mention function of salivary gland?

Chapter VIII

Respiratory system

THE RESPIRATORY SYSTEM

It includes the following parts.

1-Nose:

- It is formed of two nasal cavities which are separated by nasal septum.
- The nose opens to the outside by two nasal opening and to the inside into the nasopharynx.
- Through the cavities the nasal sinuses and nasolacrimal ducts are opening.
- It is provided with hairs to remove dust from the air entering it.

2-Pharynx:

The pharynx (discussed before), as it is common passage for the food and air.

3-Larynx:

- It is a specialised organ that provides a protective sphincter at the inlet of the air passage and is responsible for voice production.
- The framework of the larynx is made up of cartilages which are connected by membranes and ligaments and moved by muscles.
- The entrance of the larynx is guarded by leaflet -like cartilage named ***epiglottis***

4-Trachea:

- It is a tube, 13 cm long.
- Its wall consists of incomplete cartilages that keep the lumen patent.
- It is present in the anterior part of the neck in front of the oesophagus.
- The trachea begin in the neck from the end of the larynx at the level of the body of sixth cervical vertebra ,and ends in the thorax at the lower border of fourth thoracic vertebra by dividing into right and left principal bronchi.

5-Bronchi:

The right and left bronchi

	Right bronchus	Left bronchus
Length:	Short.	Long.
Lumen:	Wide.	Narrow.
Direction:	Vertical.	Oblique.

- Foreign bodies are more likely to enter the right bronchus to reach lower lobe of right lung.
- Each bronchi enter the hilum of the corresponding lung and divides into several generations of branching like a tree as follows/

1- Principal bronchus
2- Lobar bronchi (one for each lobe).
3- Segmental bronchi (one for each broncho pulmonary segment)
4- bronchioles
5- alveolar ducts & alveolas sacs. Alveolar sacs are thin walled and constitute the barrier between air inside and capillaries outside where the gaseous exchanges take place.

6-Lungs:

- They are two conical organs.
- Each has apex, base, lateral and medial surfaces.
- In the centre of the medial surface it has a hilum through which pulmonary vessels & bronchi enter.

- The two lungs are present in the thorax separated by a large space named ***mediastinum***, which contains mainly the heart and the great vessels.

Mediastinum

- Is a thick massive median septum between the 2 lungs .
- It is a movable septum but is kept in its median position by the equal intrathoracic pressure on either sides.
- Contents:

Heart & big vessels, trachea, oesophagus, thoracic duct and some important nerves.

- Subdivisions:

It is subdivided by a horizontal plane passing between the angle of Louis till the lower border of the 4^{th} thoracic vertebra into:

- Superior mediastinum, behind the manubrium.
- Inferior mediastinum, which is further subdivided into: Middle mediastinum which contains the heart.
- Anterior mediastinum infront of the heart.
- Posterior mediastinum behind the heart.

Pleura:

- Is a closed sac of serous membrane which is invaginated from the medial side by the lung. So it has 2 layers, viscerel which covers the lung and lines its fissures and parietal which lines the chest wall.
- Between the 2 layers is a thin film of fluid which makes them slippery and moist to allow easy mobility of lung.
- The 2 layers are continuous at the root of lung where it extends downwards as the pulmonary ligament.

- Inside the lungs the two bronchi divide repeatedly into smaller branches which end lastly with numerous thin- walled pouches called alveoli.

Broncho – pulmonary segments:

- A broncho-pulmonary segment is a functionally independent unit of lung tissue.
- Each unit is supplied by a segmental bronchus, a branch of the pumonary artery and anther from the pulmonary vein.

	Right lung	**Left lung**
Lobes:	Three lobes.	Two lobes.
Fissures:	Two, one is oblique& the other is transverse.	One oblique fissure.
Shape:	Short with broad base.	Long with narrow base.
Anterior border:	Straight	Presents cardiac notch

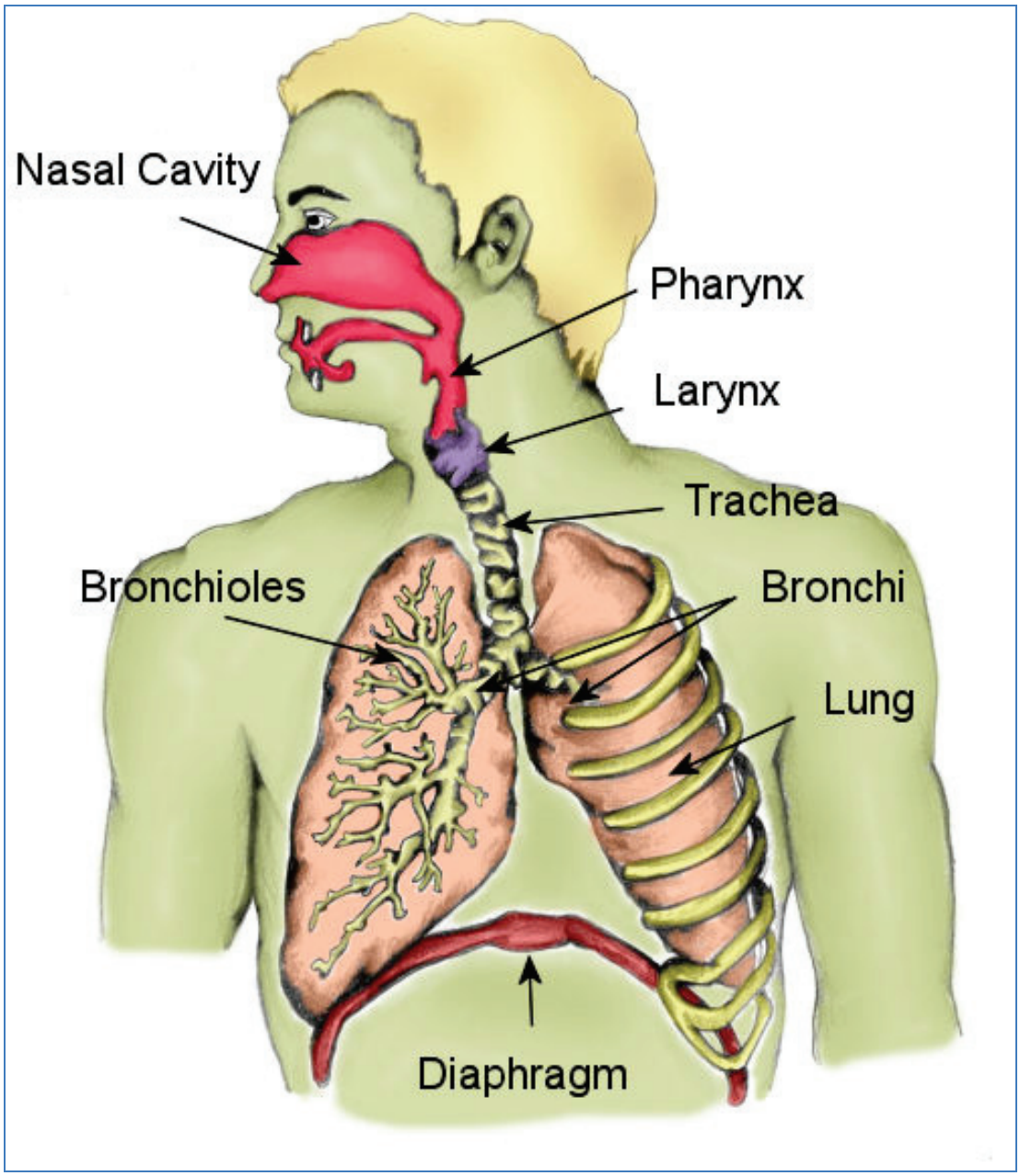


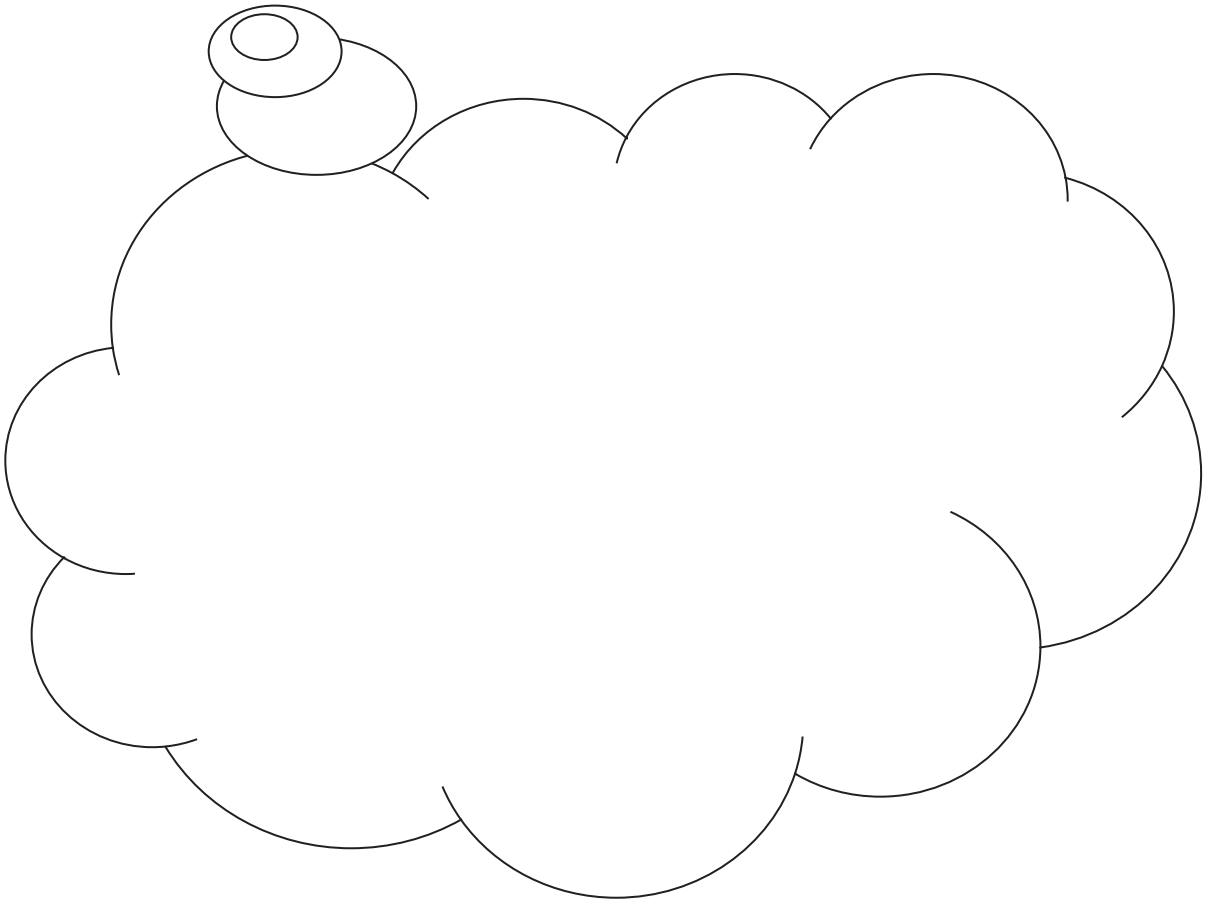
Figure (68): Respiratory system.

Keyword

- The Main parts of Respiratory system

1- Nose
2- Pharynx
3- Larynx
4- Trachea
5- Bronchi
6- Lung

Write your note



Check your understanding

1- List components of larynx?

3- Identify length of trachea and mention its beginning and termination?

4- Compare between right and left bronchi?

5- Name the membrane which covering the lung?

6- Describe partition between the lung?

7- Describe the lung?

8- Compare between right and left lung?

9- Describe broncho-vascular markings?

Chapter IX

Urinary system

THE URINARY SYSTEM

It includes kidney, ureter, urinary bladder and urethra.

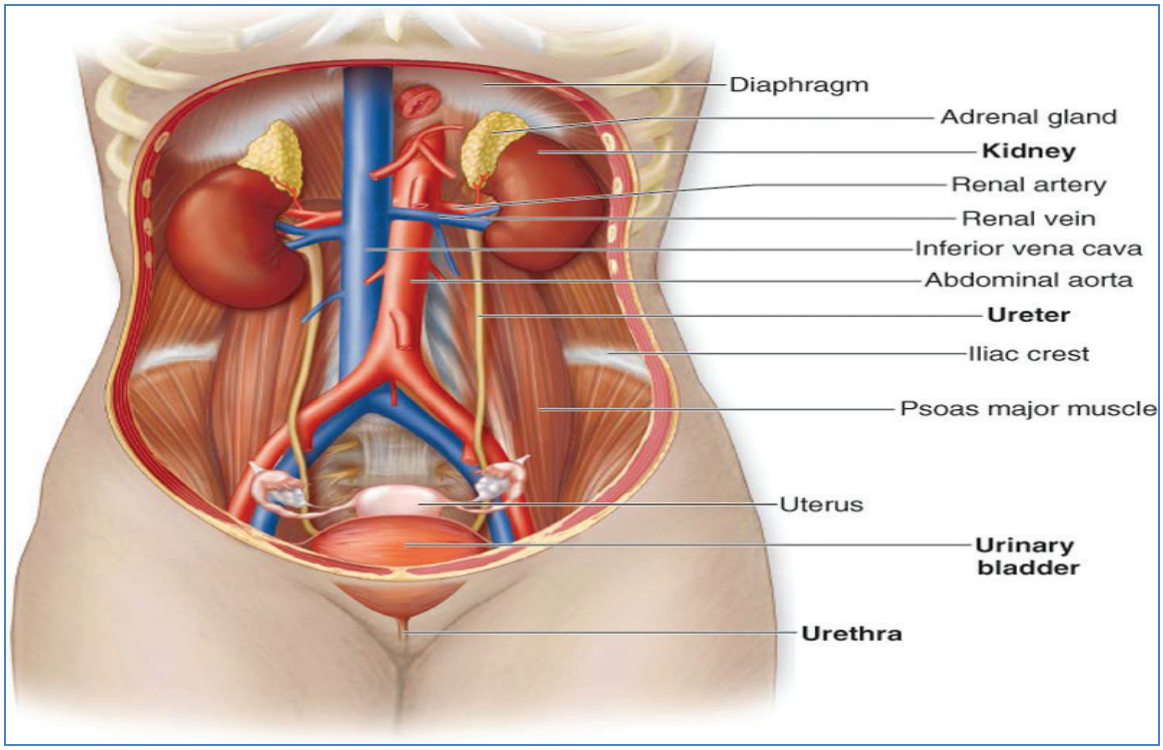


Figure (69): Urinary system.

1-Kidneys:

- They are lying on the posterior abdominal wall; one on either side of the vertebral column behind the peritoneum, the right kidney is lower than the left one.
- The kidney has anterior and posterior surfaces, medial concave and lateral convex borders.
- The depressed area on the medial concave border is called the **hilum**, through which the renal vessels enter and the ureter comes out.

2-Ureter:

- The two ureters are muscular tubes that extend from the hilum of the kidney above to the urinary bladder below.
- Each ureter measures about 25cm long and having three constrictions along its course (the most vulnerable site of stone formation): at the

beginning, at crossing the pelvic brim, and at the end where the ureter pierces the bladder**.**

3-Urinary bladder:

- It is a hollow muscular organ, which present in the pelvis behind the pubic bone and is considered as a reservoir of the urine.
- It has a base directed posterior and apex directed anterior behind the symphysis pubis.
- It has superior and two inferolateral surfaces.
- The bladder is lying anterior to the rectum in male and the uterus in female.
- It receives the opening of both ureters; the neck of the bladder is continuous below with the urethra.

4-Urethra:

A. Male urethra

- It is 20 cm long.
- It has 3 parts

Prostatic: 3cm long, traverse the prostate and surrounded by the internal urethral sphincter.

Membranous: 2cm long, traverse the perineum and surrounded by the external urethral sphincter.

Penile: 15cm long, traverse the corpus spongiosum of the penis and end at the external urethral meatus.

B. Female urethra

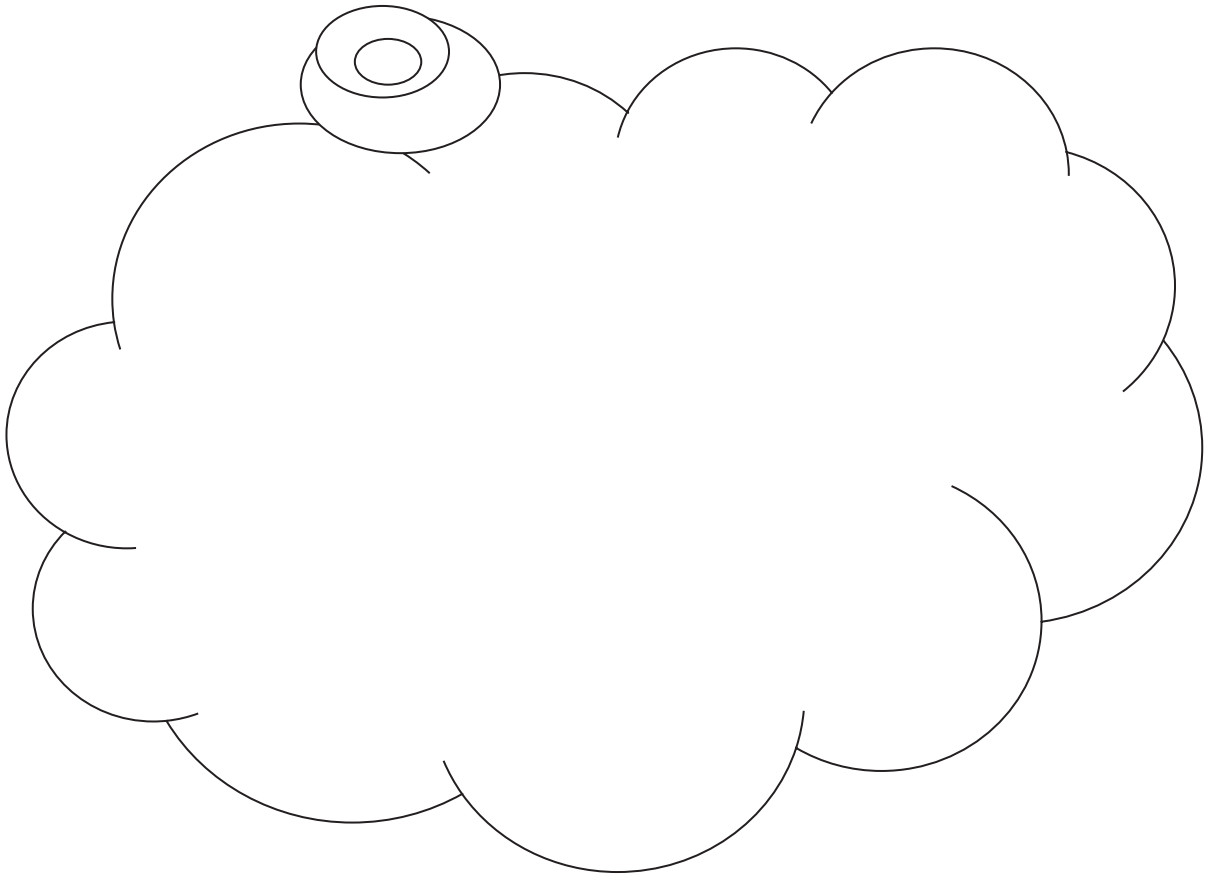
- It is 4 cm long.
- It is embedded in the anterior wall of the vagina.
- It begins at the neck of the urinary bladder and open in the vestibule anterior to the vaginal orifice.

Keyword

- The Main parts of Urinary system

1- Kidney
2- Ureter
3- Urinary bladder
4- Urethra

Write your note



Check your understanding

1- Describe position of kidney?

2- Define hilum of kidney?

4- Describe shape and length of ureter?

5- List 3 constrictions of the ureter and their clinical importance?

6- Describe anatomy of urinary bladder?

7- Describe Length and parts of male urethra?

8- Describe length and position of female urethra?

Chapter X

Genital system

THE GENITAL SYSTEM

It is the system which is concerned with reproduction.

This system is concerned with the production of germ cells: the sperm in males and the ovum in females based on the different pattern of sex chromosome: X Y in male and XX in female. The Y chromosome is responsible for all of the male characters.

MALE GENITAL SYSTEM

The male reproductive system includes the **scrotum**, **testes**, **genital ducts, accessory glands, and penis**. These organs work together to produce sperm and the other components of semen. These organs also work together to deliver semen out of the body and into the vagina where it can fertilize the ovum to produce offspring.

1- **Scrotum**

The scrotum is a sac-like organ made of skin and muscles that houses the testes. It is located inferior to the penis in the pubic region.

2- **Testes**: ***are the male gonads***. They are situated in the scrotum. The cells of the testis produce ***sperms*** and the male sex hormone, ***testosterone***.

3- **The genital ducts**

These ducts conduct sperms from testis to the urethra and include:

a) The epididymis, b) The vas deferens, c) Ejaculatory duct and d) Urethra.

a) **The Epididymis**: Epididymis is a tube-like structure which connects the testis and the vas deferens. The sperms are stored and matured in the epididymis.

b) **The Vas deferens**: The two vas deferens are thin tubes which carry sperms to the urethra. Each vas deferens is about 45 cms long.

c) **The ejaculatory duct:** The vas deferens passes through the prostate and joins with the urethra at a structure known as the ejaculatory duct. The **ejaculatory duct** contains the ducts from the seminal vesicles as well. During ejaculation, the ejaculatory duct opens and expels sperm and the secretions from the seminal vesicles into the urethra.

d) **Urethra**: Urethra is the tube in the penis that passes urine and semen out of the body.

4- Accessory glands:

a) **Seminal vesicles**: Seminal vesicles are glands that produce seminal fluid which is rich in fructose. This fructose provides nutrition to the sperms.

b) **Prostate**: Prostate is a gland that lies just below the urinary bladder and surrounds the upper part of the urethra. It produces a milky white fluid that forms a part of the semen.

c) **Bulbo-urethral glands:** a pair of pea-sized exocrine glands located inferior to the prostate. They secrete a thin alkaline fluid into the urethra.

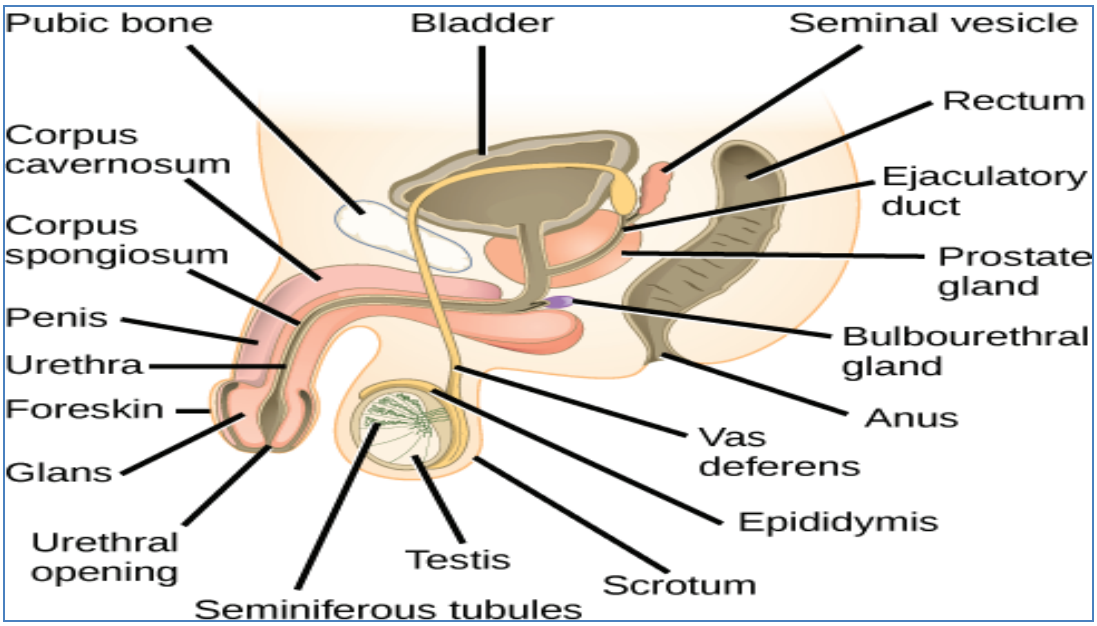


Figure (70): Male genital system.

FEMALE GENITAL SYSTEM

The main female organs of reproduction are: 1) **The** 2 **ovaries, 2) The female genital ducts** and **3) The vulva.** These organs are involved in the production and transportation of gametes and the production of sex hormones.

1- Ovaries:

The ovaries are the ***female gonads***. They are a pair of almond shaped glands, located in the pelvic cavity close to the side wall of the pelvis. Ovaries produce female sex hormones such as ***estrogen*** and ***progesterone*** as well as ***ova***; the female gametes. Each month during ovulation, a mature ovum is released. The ovum travels from the ovary to the fallopian tube, where it may be fertilized before reaching the uterus.

2- Female genital ducts:

a) ***Fallopian tubes****:*

The fallopian tubes are a pair of muscular tubes that extend from the superior corners of the uterus to the edge of the ovaries. The fallopian tubes end in a funnel-shaped structure called the infundibulum, which is covered with small finger-like projections called fimbriae. The fimbriae swipe over the outside of the ovaries to pick up released ova and carry them into the infundibulum for transport to the uterus.

b) ***Uterus***:

The uterus is a hollow, muscular, pear-shaped organ, located in the middle of the pelvic cavity, posterior to the urinary bladder. Connected to the two fallopian tubes on its superior end and to the vagina (via the cervix) on its inferior end. The inner lining of the uterus, known as

the endometrium, provides support to the embryo during early development.

The uterus consists of 3 parts; the **fundus,** the **body** and the **cervix.**

- **The fundus:** is the upper part which lies above the level of uterine tube.
- **The body**: is the main part which has a flat triangular cavity.
- **The cervix**: is the lower part which has a narrow canal. The upper end of this canal is called the internal os while the lower end is called the external os.

c) **Vagina**

The vagina is the female organ of copulation receiving the penis during coitus. It forms the lower end of the birth canal.

3- Vulva:

The **vulva** is the collective name for the external female genitalia located in the pubic region of the body.

4- External genitalia of female :

It consists of the external orifices of the vagina and urethera, with the surrounding structures.

- **Vestibule:** shows vaginal orifice, orifices of bartholine glands ,urethral orifice and the vaginal orifice .

- Labia minora: A pair of skin folds which encloses the vestibule and lie medial to labia majora.

- Clitoris: It is formed of spongy erectile tissue.

- Labia majora; A pair of thick fatty hairy skin folds. Anteriorly they join the mons pubis which is situated infront of the symphysis.

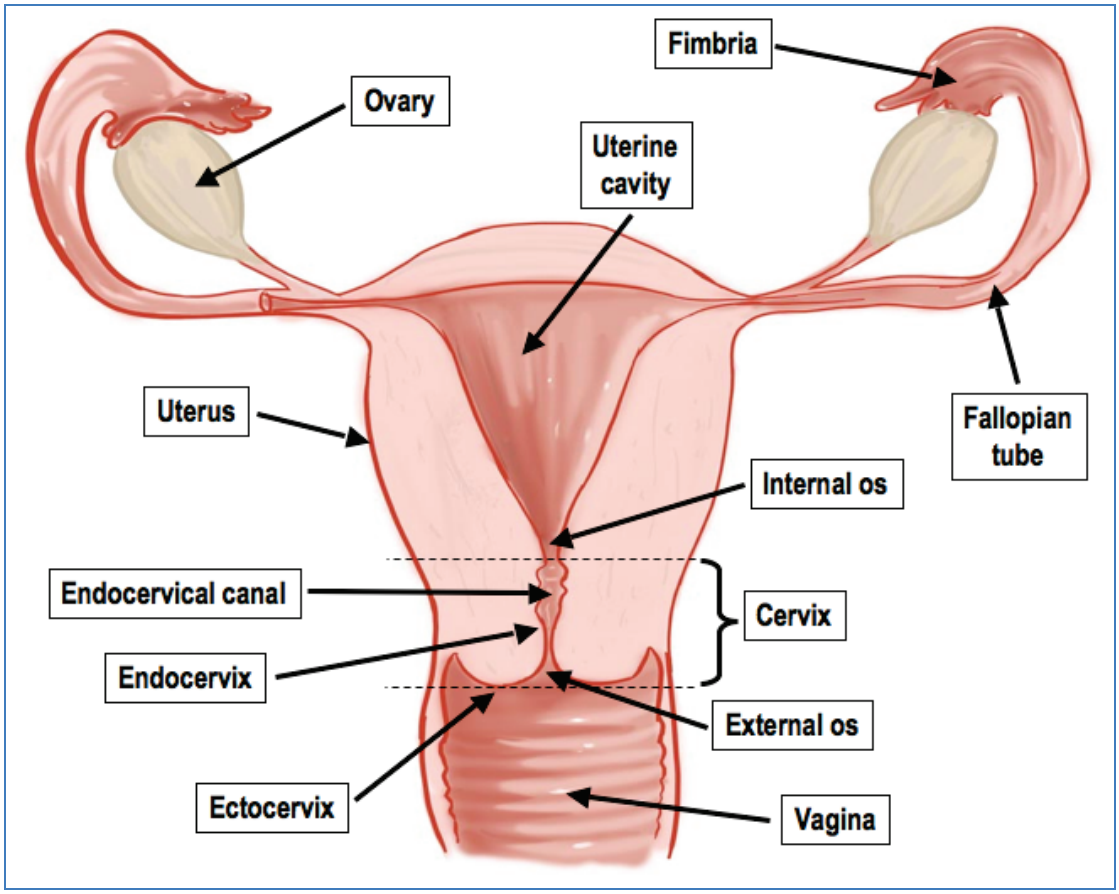


Figure (71): Female genital system.

Keyword

- Male genital system

1- Scrotum

2- Testis

3- Genital ducts

4- Accessory glands

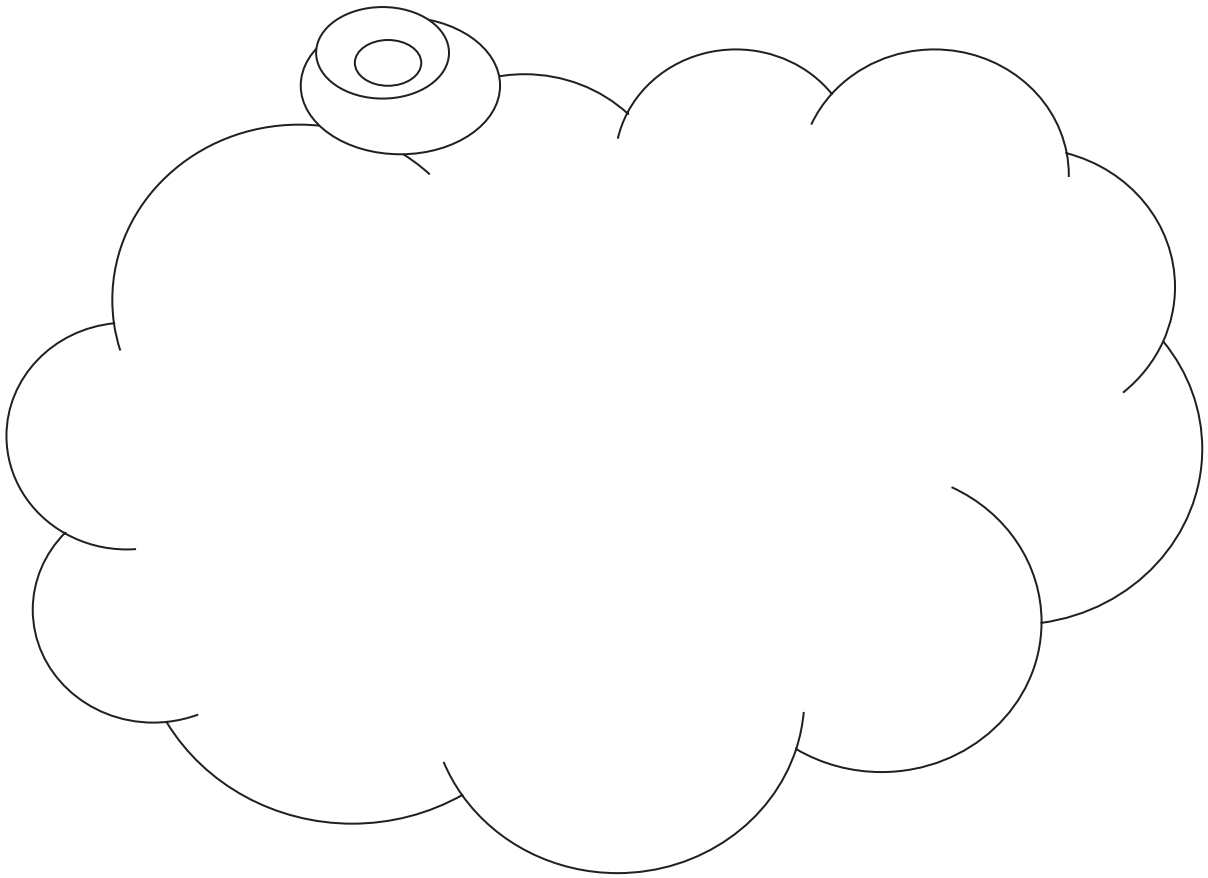
- Female genital system

1- Ovary

2- Female genital ducts

3- Vulva.

Write your note



Check your understanding

1- Define scrotum?

2- Male gonad is named……..and its function…… and ……..

3- Identify length and function of vas deference?

4- List main accessory glands in male genital system and mention their function?

5- List 3 constrictions of the ureter and their clinical importance?

6- Describe anatomy of fallopian tube?

7- Describe anatomy of ovary?

8- Describe parts of uterus?

Chapter XI

SYSTEMS OF SPECIAL SENSATIONS

THE SPECIAL SENSATIONS

VISUAL SYSTEM

The visual system consists of: The two eyes with associated structures, the optic nerves, and the visual areas in the brain.

THE EYE

---The eye **(eye ball)** is the organ of vision and the principal component of visual system.

--- Both eyes are present in pyramidal bony cavities (**the orbit)** in front of the skull, which also include accessory ocular structures (the extraocular muscles, nerves, vessels, fat, fascia and lacrimal gland).

---The orbital opening is guarded by the upper and lower eye lids which are lined by the conjunctiva that is reflected to the sclera to form a complete closed sac.

---Skeletal (voluntary) extraocular muscles (6) move the eye in different directions, but the smooth (involuntary) intraocular muscles (3) control the size of the pupil and increase the refractive index of the lens.

Structure Of The Eye Ball

The eye consists of three coats arranged from outside to inside as: the fibrous coat, the vascular pigmented coat, and the nervous coat.

1-The fibrous coat:

The fibrous coat is made of a posterior opaque, **the sclera**, and an anterior transparent part**, the cornea.**

2-The vascular pigmented coat:

The vascular coat consists of; from behind forward, **the choroid**, **the ciliary body** and **the iris** (coloured &perforated centrally by the pupil).

3-The nervous coat :the retina:

---The retina consists of an outer pigmented layer-one layer- (rods& cons) and inner nervous layers (nine layers).

---The centre of the posterior part of the retina is an oval, yellowish area; **the macula lutea** which is the area of the retina for the most distinct vision (contains cones only).

---The optic nerve leaves the retina about 3mm to the medial side of the macula lutea by the optic disc, which is completely devoid of the rods and cones so that, it is insensitive to light and is referred to as, **the blind spot.**

Contents Of The Eye Ball

The contents of the eyeball consist of:

- **Lens:** Is a transparent, biconvex structure enclosed in a transparent capsule, and attached at its periphery to a ciliary body through a suspensory ligament**.**
- **Aqueous Humor:** Is a clear fluid which fills the region in front of the lens that is divided by the iris into anterior &posterior chambers.
- **Vitreous body:** Is a colourless ,jelly –like mass which fills the space behind the lens

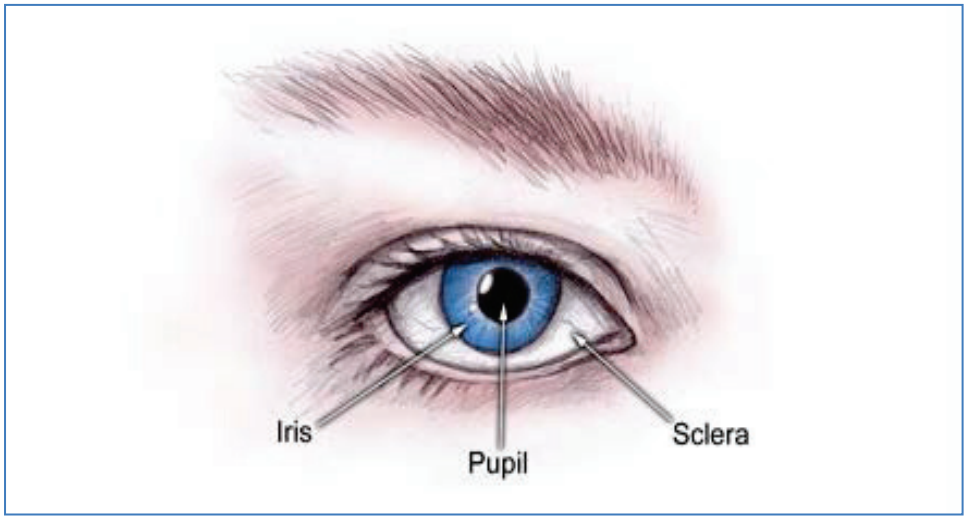


Figure (72): Gross structure of the eye.

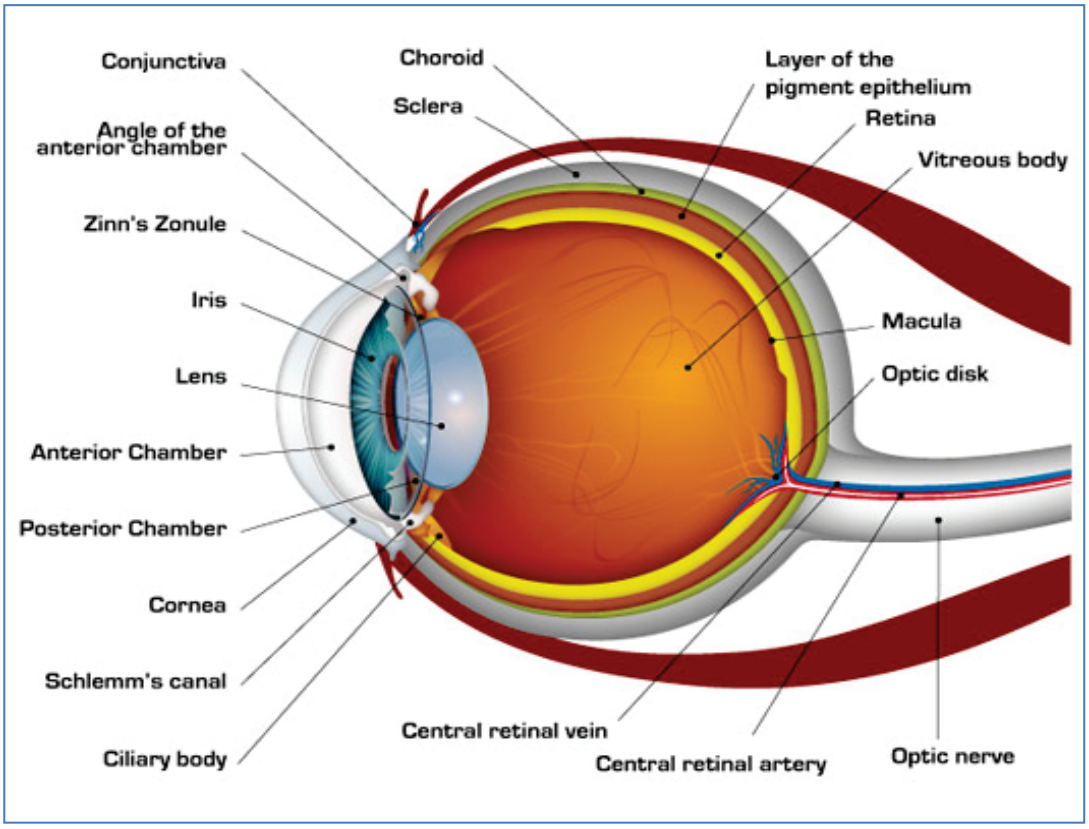


Figure (73): The eye ball.

HEARING AND VESTIBUAR SYSTEMS

The hearing and vestibular system consists of the two ears, two vestibulocochlear nerves (cranial VIII), and hearing &vestibular centers in the brain.

THE EAR

The ear, which houses the peripheral parts of the auditory and vestibular system, is descriptively divided into external, middle, and internal ear.

External ear:

The external ear has an **auricle (**elastic cartilage), that collects the sound vibrations to end in **external auditor meatus** (S- shaped tube 2.5cm), which conducts the vibrations to the **tympanic membrane (ear drum).**

Middle ear (Tympanic cavity):

The middle ear is an air –containing cavity within the bone of the skull, that connects with the pharynx by Eustachian tube (why?), and contains the ear ossicles (malleus, incus, stapes) whose function is to transmit the vibrations of the tympanic membrane to the inner ear.

Internal ear:

The internal ear is present in the inner side of middle ear, it has **a cochlea**, that receives hearing impulses, and **three semicircular canals**, that receive vestibular (equilibrium) impulses. From both of them the vestibulocochlear nerves emerge to the hearing area of the brain.

THE VESTIBULAR SYSTEM

It is the part of the ear that helps equilibrium. It is located in the inner ear.

It consists of:

-Saccule and utricle for linear motion (acceleration, movement).

-Semicircular canals for angular motion.

-Vestibular portion of vestibulocochlear nerve.

-Vestibular areas in the brain and brain stem

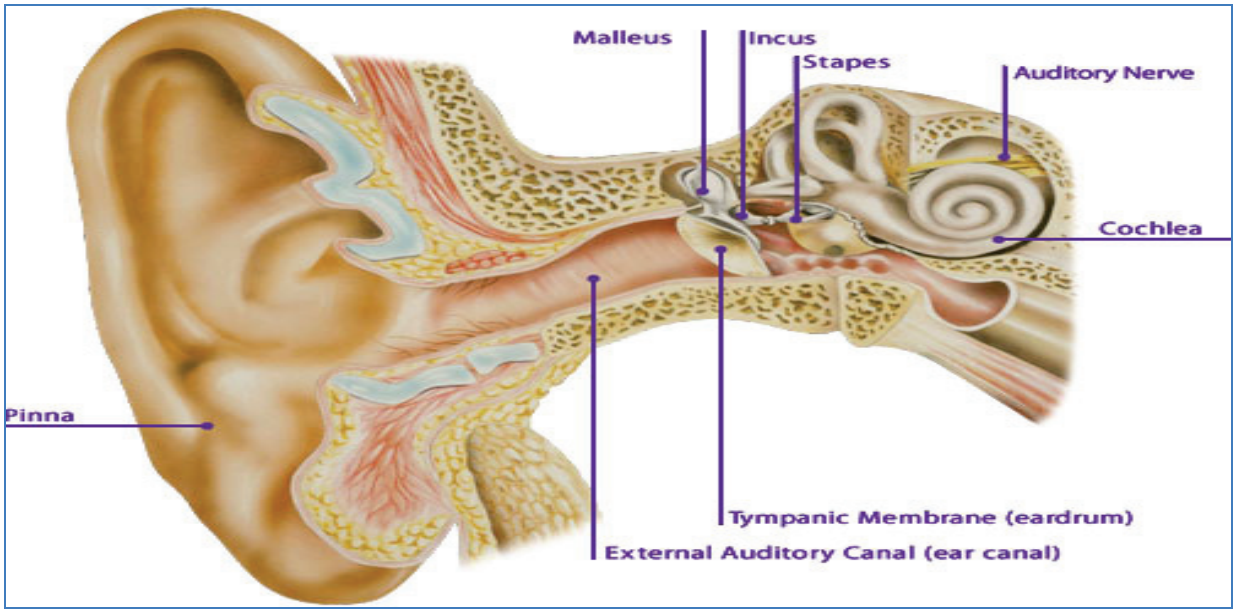


Figure (74): The ear.

OLFACTORY SYSTEMS

The olfactory system consists of: The nose, olfactory nerve, olfactory bulb, olfactory tract and olfactory cortex.

The nose: It has two parts; the outer nose positioned in the middle of the face and is shaped like a pyramid. The inner nose or nasal cavities, contained in the skull, are lined by olfactory mucous and separated by a septum.

The function of the nose is to receive air, to warm and filter it prior to entering the lungs and to give us the sense of smell.

The Olfactory nerve:

It starts as hair cells from olfactory epithelium that respond to particular chemicals. These cells have small hairs called cilia on one side and an axon on the other side.

Olfactory bulb: The electrical activity produced in the hair cells is transmitted to the olfactory bulb.

The olfactory tract: transmits the signals to the brain.

The olfactory cortex: Is that area of the brain that responds to smell stimuli

THE GUSTATORY SYSTEM

It is the system that concerns of taste sensation. It consists of ***taste receptors in the tongue (taste buds), taste fibers in cranial nerves VII, IX and X, and taste centers in the brain.***

The taste buds:

They are the receptors of taste sensation.

Present in the dorsum of the tongue and epiglottis in groups.

Present in three types: Filiform, fungiform and circumvallate.

Taste modalities:

Sweet → tip of the tongue.

Salty → over the dorsum of the tongue.

Sour → sides of the tongue.

Bitter → back of the tongue.

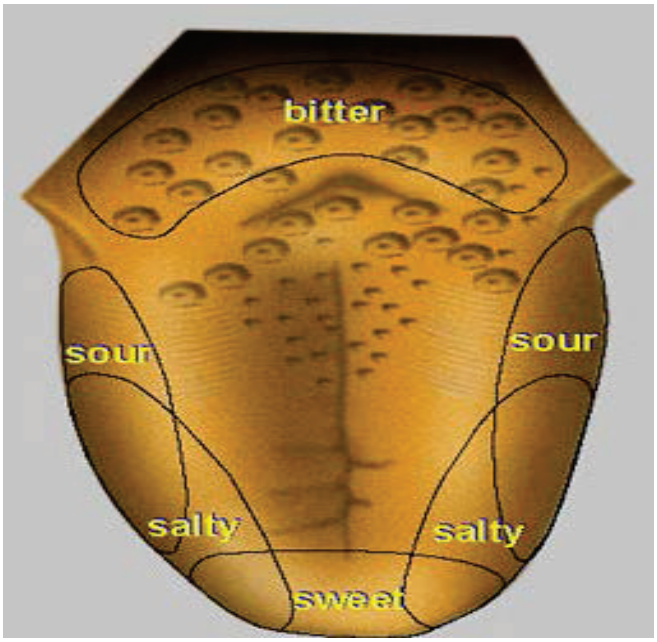
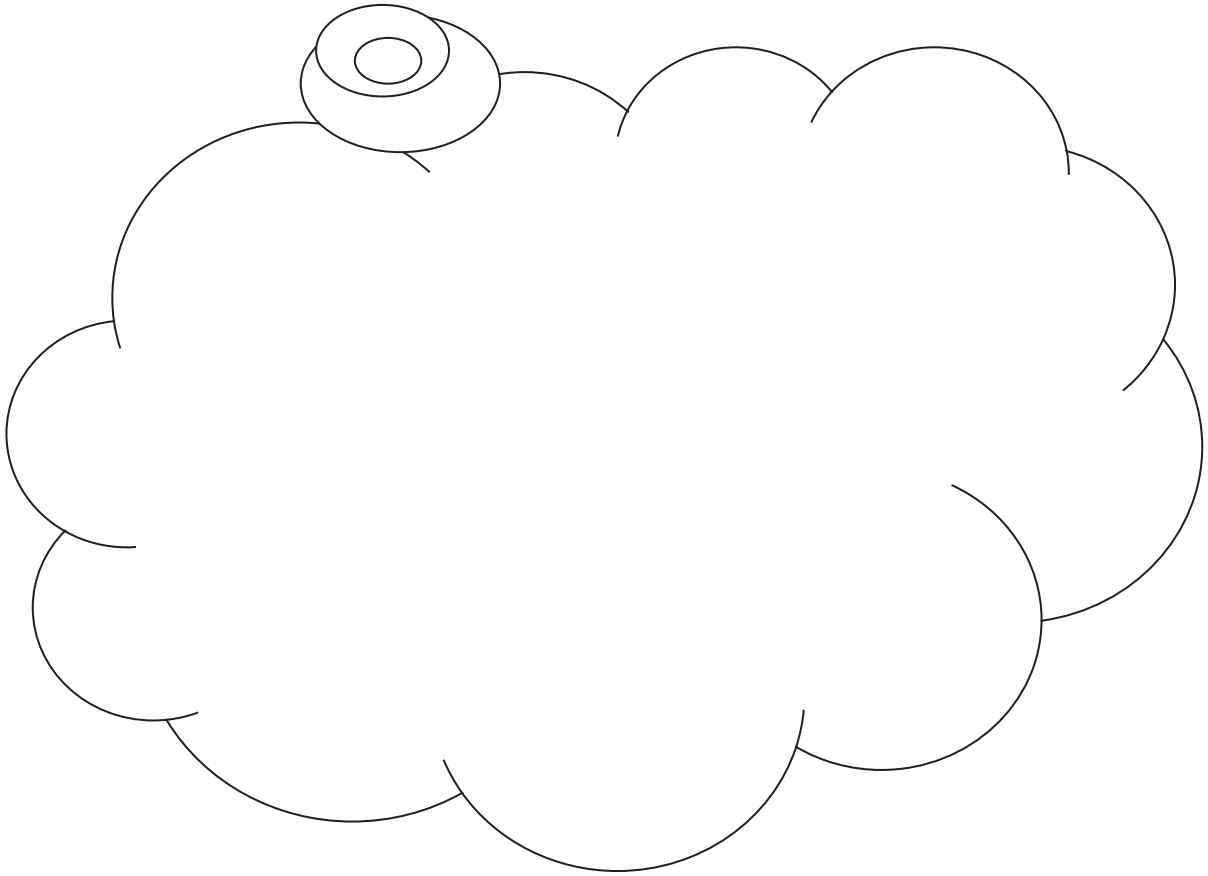


Figure (75): Dorsum of the tongue and taste modalities.

Keyword

- Visual system
- Auditory and vestibular systems
- Gustatory system.
- Olfactory system.

Write your note



Check your understanding

1- Describe function of intraocular and extraoccular muscle?

2- Describe contents of eyeball?

3- Define the macula lutea?

4- Define the blind spot?

5- Describe function of auditory tube?

6- List main contents of middle ear?

7- Identify length of external auditory tube?

8- List components of vestibular system and function of each?

9- List components of olfactory system and functions of each?

10- Describe taste modalities?

Reference:

1- Gray's Anatomy for student.

1-Basic Gray's Anatomy.

2-Atlas of Human Anatomy, 6th Edition.

3- Clinically Oriented Anatomy 7th Edition.