

## Lecture 17: The Respiratory System

### I. General Anatomy of Respiratory System

1. Upper Respiratory Tract : nose and throat
2. Lower Respiratory Tract :larynx, trachea, bronchi, lungs

#### A. Nose :

1. external portion
2. internal portion
  - a. internal nares
  - b. nasal septum
  - c. paranasal sinuses, frontal, sphenoidal, maxillary, ethmoidal
  - d. meatuses
  - e. olfactory region .

#### B. Pharynx (Throat)

1. nasopharynx -
  - a. auditory (Eustachian) tubes - open here
  - b. pharyngeal tonsil (adenoid)
2. oropharynx - posterior to oral cavity
  - a. fauces .
  - b. palantine and lingual tonsils
3. laryngopharynx - most inferior portion
  - a. larynx (voice box) located anteriorly
  - b. esophagus located inferiorly

#### C. Larynx (Voice Box)

1. 9 segments of cartilage
  - a. unpaired - thyroid, epiglottic, cricoid
  - b. paired - arytenoid, corniculate, cuneiform
2. thyroid cartilage (Adam's apple)
3. epiglottis - covers larynx to route food
  - a. glottis - vocal folds (cords) for sound
4. cricoid cartilage - attaches larynx to trachea
5. arytenoid cartilage - attached to vocal folds
6. Voice Production

#### D. Trachea (Wind Pipe)

1. larynx -> T5 ; anterior to the esophagus
2. C-shaped hyaline cartilage along the esophagus
3. carina - ridge at the bifurcation to the bronchi
  
4. intubation - tube down collapsed trachea
5. tracheostomy - hole in trachea; bypass obstructions

## **E. Bronchi**

1. primary bronchus -> secondary (lobar) bronchi
2. secondary bronchi -> tertiary (segmental) bronchi
3. tertiary bronchi -> bronchioles
4. bronchioles -> terminal bronchioles

## **F. Lungs**

1. outer pleural membranes (remember balloon analogy)
  - a. parietal pleura - on thoracic cavity wall
  - b. visceral pleura - covers the lungs
2. apex (cupula) - 1 inch superior to the clavicle
3. base - just above the diaphragm
4. costal surfaces - against the ribs
5. mediastinal surface - against the heart
6. hilus - bronchi, vessels, nerves enter and exit
7. cardiac notch - where heart lies near left lung
8. Right Lung
  - a. 3 lobes - superior, middle, inferior
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9. Left Lung
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  - a. lobule - own vessels & terminal bronchiole
  - b. terminal bronchioles -> respiratory bronchioles
  - c. respiratory bronchioles -> alveolar ducts
  - d. alveolar ducts -> alveoli & alveolar sacs
  - e. alveolar sacs - alveoli with common opening
11. Alveoli - site of gas exchange with capillaries
  - a. squamous pulmonary epithelial cells
  - b. septal cells - secrete SURFACTANT
12. Layers of Alveolar - Capillary Membrane
  - a. squamous pulmonary epithelium
  - b. pulmonary basement membrane
  - c. capillary basement membrane
  - d. lining endothelium of capillary

## Lecture 18 : The Digestive System

### A. Functions

1. ingestion
2. moving food along
3. digestion - breakdown of foodstuffs
  - a. chemical - breaking chemical bonds
  - b. mechanical - churning, breaking, tearing
4. absorption - passage from GI tract to blood
5. defecation - removal of waste from the body

II. General Histology : It consists of 4 layers (mucosa, submucosa, muscularis, serosa (adventitia)).

### III. Oral Cavity (Mouth)

#### A. Principle parts :

1. cheeks
2. lips (labia), labial frenulum (attach to gums)
3. hard palate - anterior part of roof of mouth
4. soft palate - posterior part of roof of mouth
5. uvula - hanging portion of soft palate

#### B. Tongue :

1. skeletal muscle covered with mucous membrane
2. extrinsic muscles & intrinsic muscles
3. papillae - projections of lamina propria (bumps)
  - a. filiform papillae - conical, no tastebuds
  - b. fungiform papillae - mushroom, tastebuds
  - c. circumvillate papillae - lined in V posterior

#### C. Salivary Glands

1. parotid - between skin and masseter muscle
2. submandibular - beneath the base of tongue
3. sublingual - below the tongue itself
4. saliva - lubricate, dissolve, begin digestion

#### D. Teeth

1. insert into alveolar processes of maxilla/mandible
2. gingivae (gums) - connective tissue for teeth/bone
3. periodontal ligaments - attach teeth to bone
4. tooth structure (crown, root, neck, dentin, pulp cavity, pulp, root canal, enamel, cementum).

### IV. Esophagus - long thin tube from pharynx to stomach

#### B. Function

1. secretes mucus and transports food to the stomach
2. NO absorption.

## **V. Stomach - directly under the diaphragm. J-shaped**

### **A. Anatomy**

1. cardia - upper portion, near esophageal sphincter
2. fundus - above and to left of cardia
3. body - central, major portion of the stomach
4. pylorus - junction with duodenum
5. pyloric sphincter - valve controls flow to duodenum
6. lesser curvature / greater curvature

### **B. Function - mechanically and chemically digest foodstuffs**

## **VI. Pancreas - posterior to great curvature of the stomach**

### **A. Anatomy**

1. head - enlarged portion in C-curve of the duodenum
2. body - tapers off beneath the stomach
3. tail - terminal part near the end
4. pancreatic duct - merges with bile duct to duodenum  
hepatopancreatic ampulla (merging of both)
5. accessory duct - empties into duodenum, smaller

## **VII. Liver - below diaphragm, most of Right Upper Quadrant**

### **A. Anatomy**

1. right lobe
2. left lobe
  - a. quadrate lobe - inferior
  - b. caudate lobe - posterior
3. falciform ligament - divides left and right lobes
4. ligamentum teres - derived from the umbilical vein
5. bile capillaries (canaliculi) --> ducts
6. ducts --> right & left hepatic ducts
7. --> common hepatic duct --> cystic duct (gall bladder)
8. --> common bile duct
9. joins pancreatic duct at hepatopancreatic ampulla
10. hepatic artery - oxygenated blood
11. hepatic portal vein - brings nutrient blood
12. hepatic vein - return of blood to the heart
13. Bile - molecules to help emulsify (digest) fats

## **VIII. Gall Bladder - pear-shaped sac on inferior liver surface**

**Function - store and concentrate bile.**

## **IX. Small Intestine - connects stomach & large intestine (21 ft)**

### **A. Anatomy**

- 1. duodenum - first ten inches after stomach**
- 2. jejunum - about next eight feet**
- 3. ileum - last twelve feet; to large intestine**
- 4. ileocecal sphincter - valve to large intestine**

### **B. Histology**

- 1. mucosa - pits lined with glandular epithelium**
  - a. intestinal glands - secrete intestinal juice**
  - b. goblet cells - secrete mucus**
  - c. duodenal glands - secretion protects wall**
  - d. microvilli - fingerlike projections of cells**
  - e. villi - fingerlike projections of mucosa itself**
- 2. circular folds - along length of entire tube**

## **X. Large Intestine - connects small intestine and anus (5 ft)**

### **A. Anatomy**

- 1. Cecum - small pouch at beginning of large intestine**
  - a. vermiform appendix - dangles from the cecum**
- 2. Colon - long tube (most of the large intestine)**
  - a. ascending colon - on right side**
  - b. transverse colon - across to the left side**
  - c. descending colon - on left side**
  - d. sigmoid colon - terminates at rectum (~S3)**
- 3. rectum - terminal eight inches of GI tract**
- 4. anus - opening to outside**
  - a. internal sphincter - smooth musc. (involuntary)**
  - b. external sphincter - skeletal musc. (voluntary)**

### **B. Histology**

- 1. Mucosa**
  - a. NO villi or circular folds**
  - b. simple columnar epithelium and goblet cells**
- 2. Sub mucosa - similar to rest of GI**
- 3. muscularis**
  - a. external layer - longitudinal smooth muscle**
  - b. internal layer - circular smooth muscle**

### **C. Function - water resorption/ electrolyte balance**

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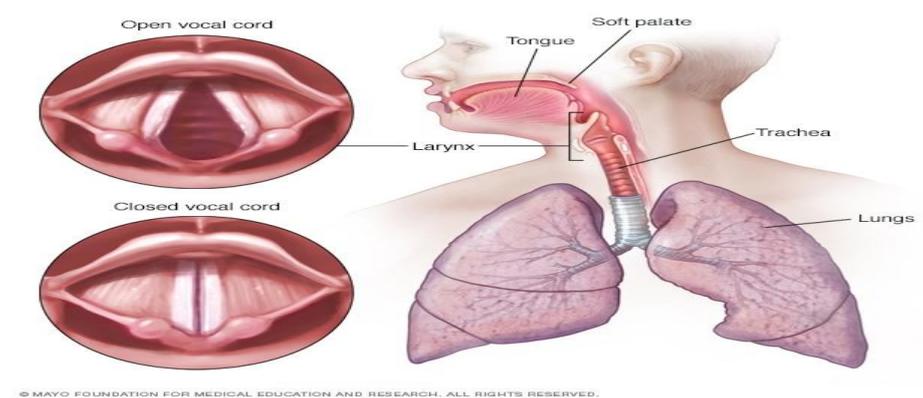
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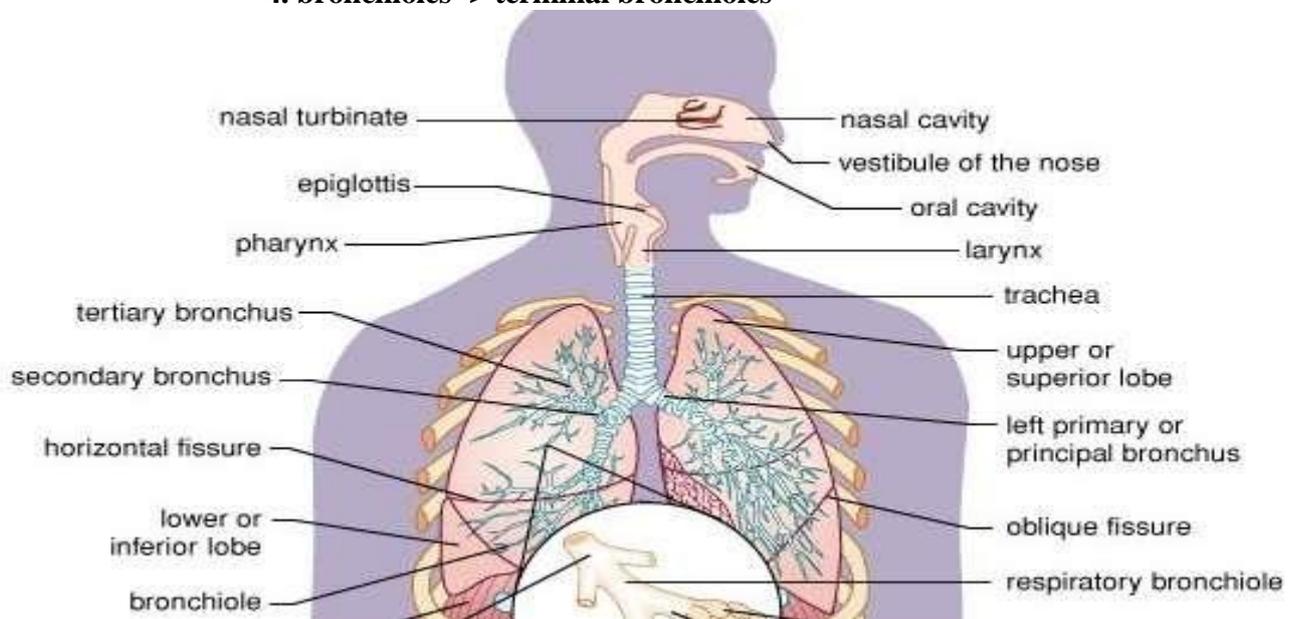
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## **The Upper Limbs**

## **Lec. 5**

**Bone Description and function:**

### **Shoulder (Pectoral) Girdle**

**Clavicle:** Collarbone; double-curved, long bone with rounded medial end and flattened lateral end; held in place by ligaments.

Holds shoulder joint and arm away from thorax so upper limb can swing freely.

**Scapula:** Shoulder blade; flat, triangular bone with horizontal spine separating fossae. Site of attachment for muscles of arm and chest.

**Humerus :** Longest, largest bone of upper limb; forms ball of ball and socket joint with glenoid fossa of scapula. Site of attachment for muscles of shoulder and arm, permitting arm to flex and extend at elbow.

### **Lower end of the humerus**

1-Articular parts (trochlea, capitulum).

Non-articular parts which include:

- a- Medial epicondyle.
- b- Lateral epicondyle.
- c- Radial fossa
- d- Coronoid fossa
- e- Olecranon fossa

### **Forearm (radius and ulna)**

**Radius:** Larger of two bones in forearm; large proximal end  
Consists of olecranon process (prominence of elbow).

**Ulna.**

### **Wrist**

**Carpals (16)** Small short bones; in each wrist, 8 carpals in 2 transverse rows of 4. With attached ligaments, allow slight gliding movement.

**The bones of the wrist are:**

Upper row (scaphoid, lunate, triquetral, pisiform).

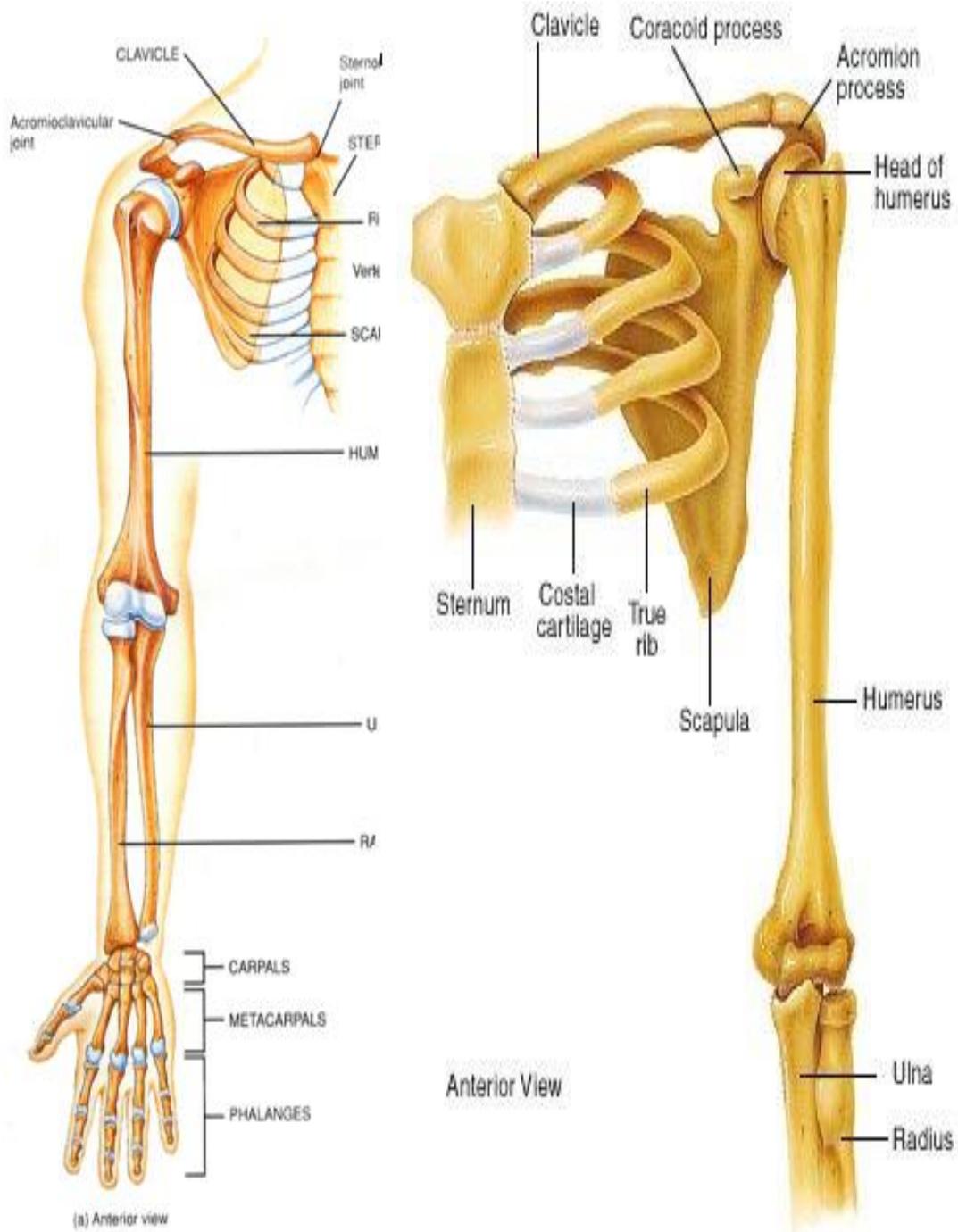
Lower rows (trapezium, trapezoid, capitate, hamate).

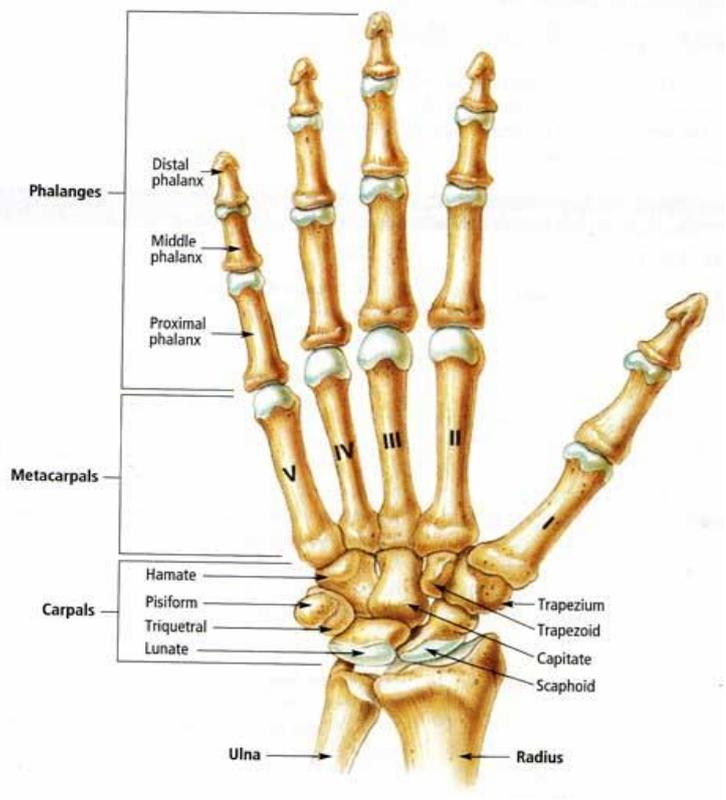
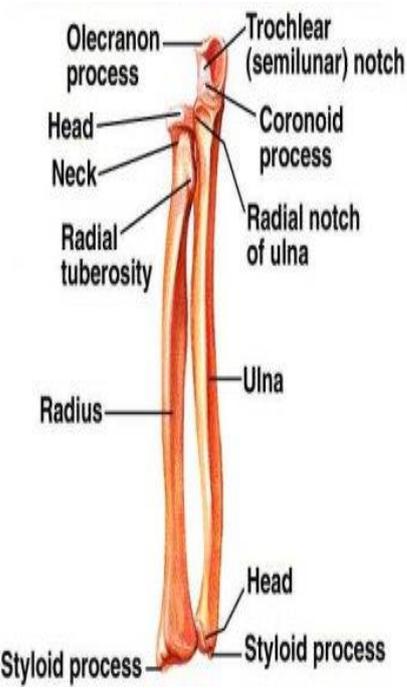
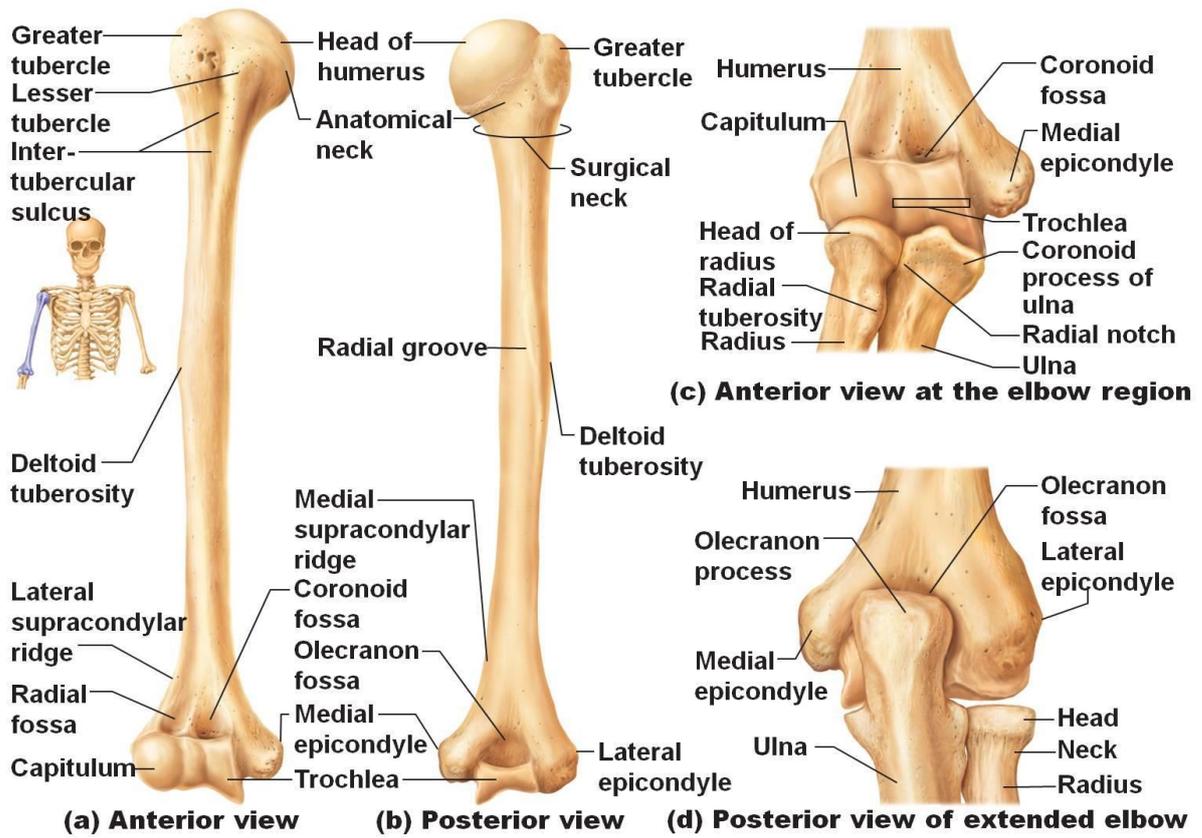
### **Hands and Fingers**

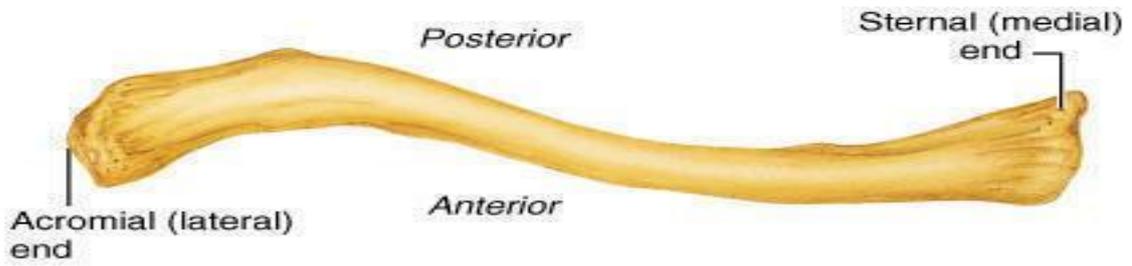
**Metacarpals (10)** Five miniature long bones in each hand in fanlike arrangement; articulate with fingers at metacarpal phalangeal

Joint (the Knuckle). Aid opposition movement of thumb; enable cupping of hand.

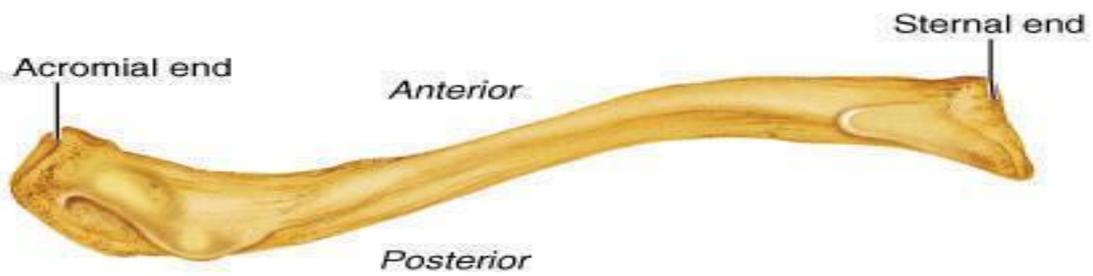
**Phalanges (28)** Miniature long bones, 2 in each thumb, 3 in each finger; articulate with each other at interphalangeal joint. Allow fingers to participate in stable grips.





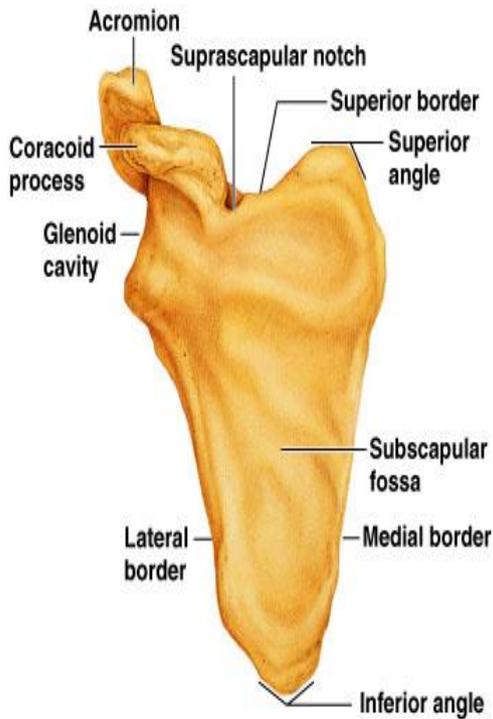


**(b) Right clavicle, superior view**

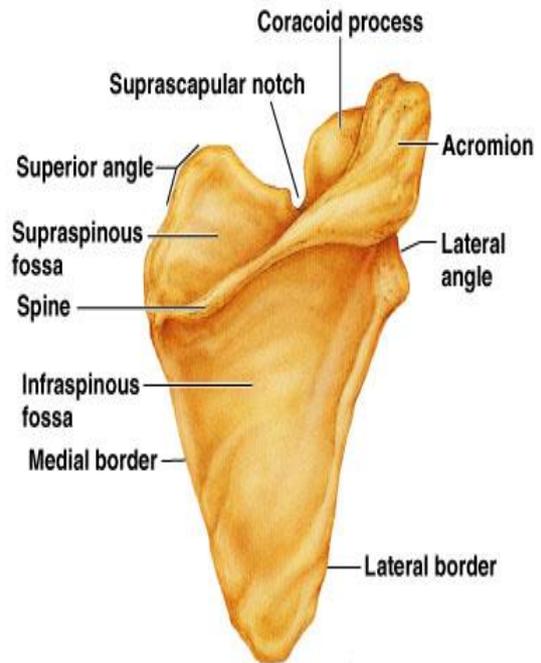


**(c) Right clavicle, inferior view**

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**(d) Right scapula, anterior aspect**



**(e) Right scapula, posterior aspect**

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## Bones of the Lower Limb LEC.6

### Function:

Locomotion

Carry weight of entire erect body

Support

Points for muscular attachments.

### Components:

1-Thigh (Femur) 2-Knee (Patella) 3-Leg A- Tibia (medial) B-Fibula (lateral)

6-Foot (7 Tarsals, 5Metatarsals, 14 Phalanges)

### Femur

- Largest, longest, strongest bone in the body.
- Receives a lot of stress
- Articulates with acetabulum proximally
- Articulates with tibia and patella distally.

### Knee

#### Patella

- Triangular sesamoid bone
- Protects knee joint
- Improves leverage of thigh muscles acting across the knee
- Contained within patellar ligament.

### Leg

#### ■ Tibia

- Receives the weight of body from femur and transmits to foot
- Second to femur in size and weight
- Articulates with fibula proximally and distally

#### ■ Fibula

- Does NOT bear weight
- Muscle attachment
- Not part of knee joint
- Stabilize ankle joint

### Foot

#### ■ Function:

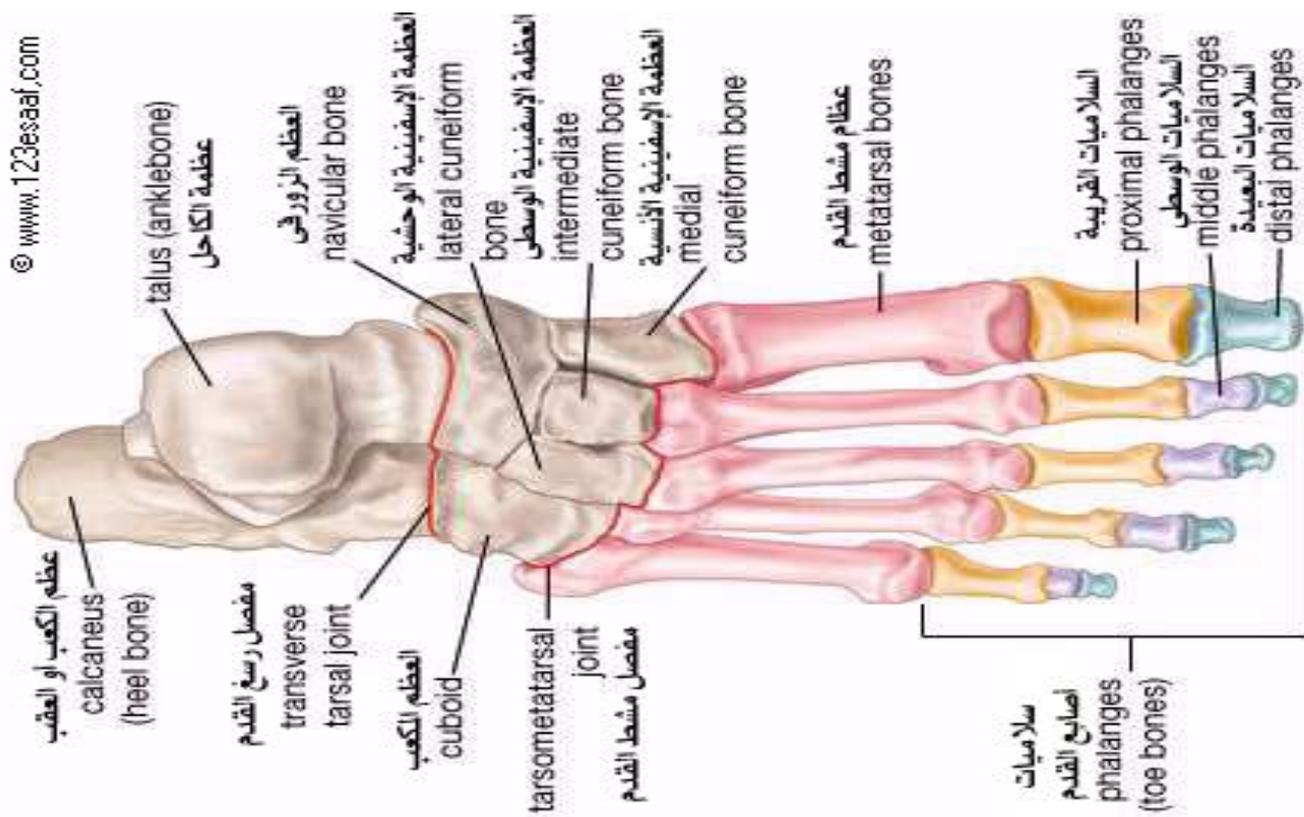
- Supports the weight of the body
- Act as a lever to propel the body forward

#### ■ Parts:

- Tarsals
- Talus = ankle
- Between tibia and fibula ,articulates with both
- Calcaneus = heel
- Attachment for Calcaneal tendon , Carries talus
- Navicular
- Cuboid

- **Medial, lateral and intermediate cuneiforms**
- **Metatarsals**
- **Phalanges**
- **3 arches**
- **Medial**
- **Lateral**
- **Transverse**
- **Has tendons that run inferior to foot bones**
- **Help support arches of foot**
  - **Function**
  - **Recoil after stepping**





عظم الكعب أو العقب  
calcaneus  
(heel bone)

talus (anklebone)  
عظمة الكاحل

مفصل رسي القدم  
transverse  
tarsal joint

العظم الزورقي  
navicular bone

العظم الكعب  
cuboid

العظمة الإسفينية الوحشية  
lateral cuneiform  
bone

العظمة الإسفينية الوسطى  
intermediate  
cuneiform bone

العظمة الإسفينية الأنسية  
medial  
cuneiform bone

tarsometatarsal  
joint  
مفصل مشط القدم

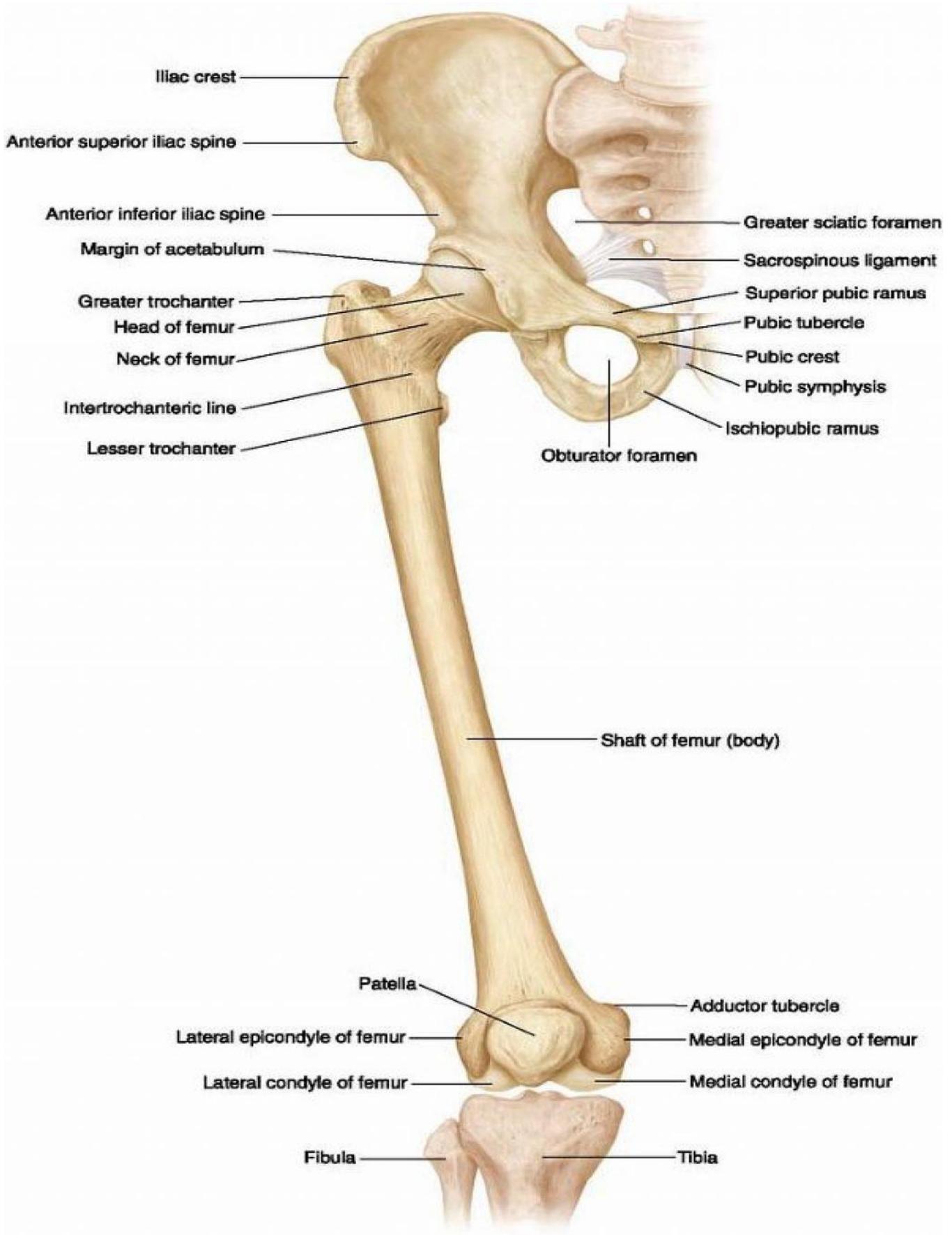
عظام مشط القدم  
metatarsal bones

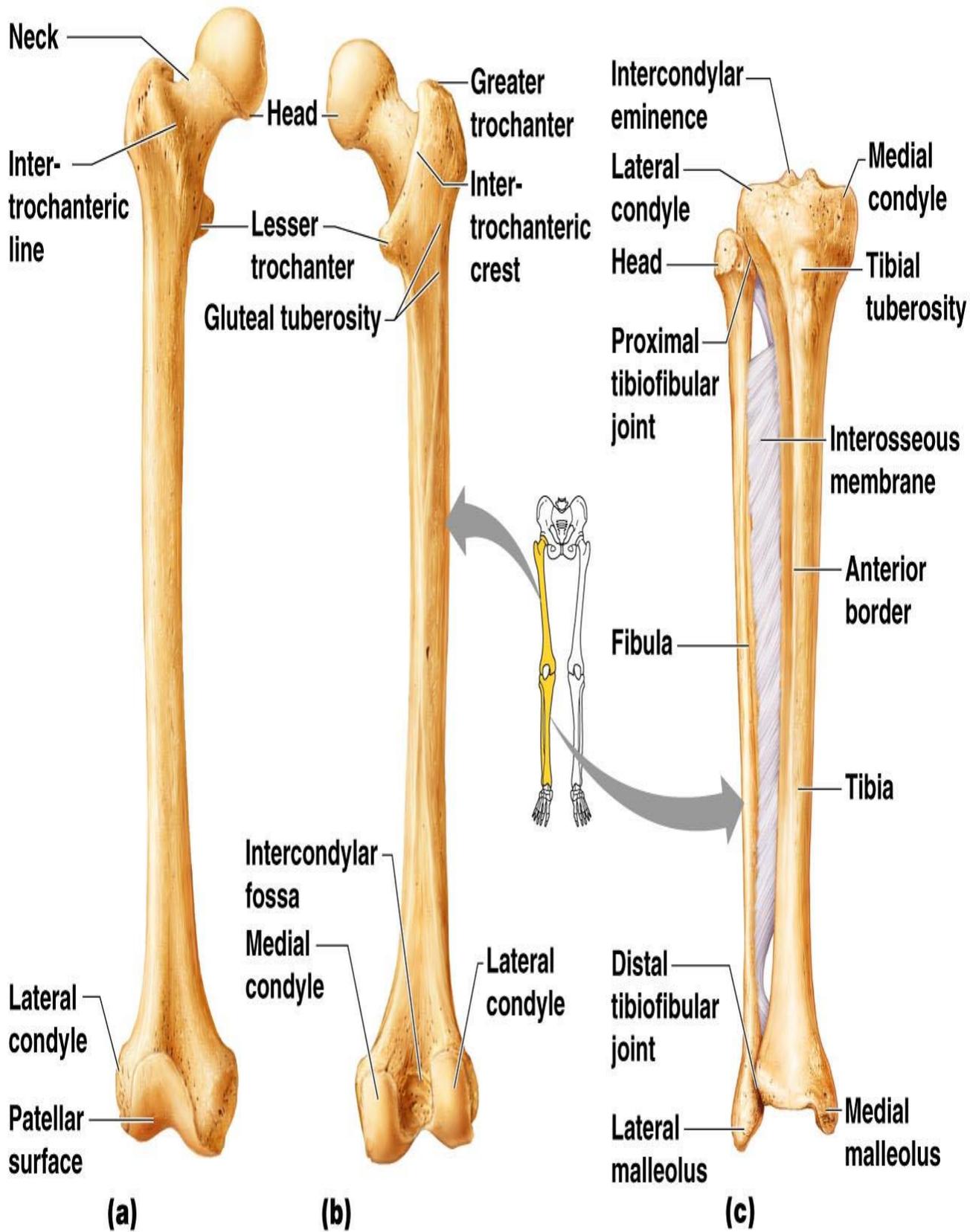
سلا ميات  
أصابع القدم  
phalanges  
(toe bones)

السلا ميات القريبة  
proximal phalanges

السلا ميات الوسطى  
middle phalanges

السلا ميات البعيدة  
distal phalanges





## I. Major Organ Systems

There are 12 major organ systems of the body:

1. Integumentary (skin)
2. Skeletal (bone)
3. Muscular (muscles)
4. Nervous (CNS and PNS)
5. Endocrine (hormones/regulation)
6. Cardiovascular (heart and blood vessels)
7. Lymphatic (lymph fluid)
8. Respiratory (lungs)
9. Digestive (stomach, intestine)
10. Urinary (kidneys, bladder)
11. Reproductive (male and female genitalia)
12. Immune (cells in the blood/body)

## II. Skin:

Major Components

1. Skin (epidermis, dermis, etc.)
2. Hair
3. Sweat and fat glands
4. Sensory organs and glands

## III. Skeletal System:

Major Components

1. Bone
2. Cartilages
3. Tendons
4. Ligaments
5. Joints

## IV. Muscular System:

A. Major Components:

- a. striated muscle (voluntary)
- b. smooth muscle (involuntary)
- c. cardiac muscle (heart)

## **V. Nervous System:**

### **Major Components:**

- 1. Brain and spinal cord (Central Nervous System)**
- 2. Nerves and sensory organs (Peripheral N S)**

## **VI. Endocrine System**

### **Major Components:**

- 1. Pituitary, thyroid, parathyroid, adrenal, pineal glands.**
- 2. Ovaries, testes, pancreas**

## **VII. Cardiovascular System**

### **Major Components**

- 1. Heart**
- 2. Blood vessels (arteries, veins, capillaries)**
- 3. Blood (serum, proteins, red & white cells)**

## **VIII. Lymphatic System**

### **Major Components:**

- 1. Lymph nodes and vessels**
- 2. Spleen**
- 3. Thymus**
- 4. Other scattered lymph tissue.**

## **XI. Respiratory System**

### **Major Components:**

- 1. Nasal passages**
- 2. Pharynx, larynx, trachea, bronchi**
- 3. Lungs**

## **X. Digestive System:**

### **Major Components:**

- 1. Oral cavity, esophagus**
- 2. Stomach**
- 3. Small and large intestine**
- 4. Rectum**
- 5. Other: teeth, salivary glands, liver, pancreas**

## **XI. Urinary System**

### **Major Components:**

- 1. Kidneys**
- 2. Ureters**
- 3. Bladder**
- 4. Urethra**

## **XII. Reproductive System**

### **Major Components:**

**Male: testes, scrotum, penis, and duct system for sperm**

**Female: ovaries, uterine tubes, uterus, vagina**

## Muscles (12)

There are 3 Types: Skeletal, Cardiac, Smooth

**Function:**

- 1) Movement
- 2) Maintain posture
- 3) Joint stability
- 4) Generate heat

**Naming of Muscles:** The muscles are named according to :

- 1- Location: (eg) brachialis = arm
- 2- Shape: (eg) deltoid = triangle
- 3- Relative Size: (eg) minimus, maximus, longus
- 4- Direction of Fascicles: (eg) oblique, rectus
- 5- Location of Attachment: (eg) brachioradialis
- 6- Number of Origins: (eg) biceps, quadriceps
- 7- Action: (eg) flexor, adductor, extensor.

### **Muscles Of Mastication**

- 1- Masseter
- 2- Temporalis
- 3- Digastric
- 4- Mylohyoid.

**Muscles That Move The Head :** Sternocleidomastoid.

### **Muscles That Attach Pectoral Appendages To Vertebral Column**

- 1- Trapezius
- 2- Latissimus dorsi.
- 3- Rhomboidus Major.
- 4- Rhomboidus Minor.
- 5- Levator Scapulae.

### **Muscles of The Shoulder**

- 1- Deltoid
- 2- Supraspinatus
- 3- Infraspinatus
- 4- Teres Major
- 5- Subscapularis

### **Muscles of The Upper Arm**

- 1- Triceps
- 2- Biceps
- 3- Brachialis

### **Chest Muscles**

- 1- Pectoralis Major
- 2- Pectoralis Minor
- 3- Serratus Anterior.

## **Muscles of The Trunk /Thoracic and abdominal Regions**

- 1- Intercostal muscles.
- 2- Rectus Abdominis
- 3- External abdominal oblique.
- 4- Transversus Abdominis.

## **Muscles of The Hip**

- 1- Gluteus Maximus.
- 2- Gluteus Medius.

## **Muscles of the back of the thigh**

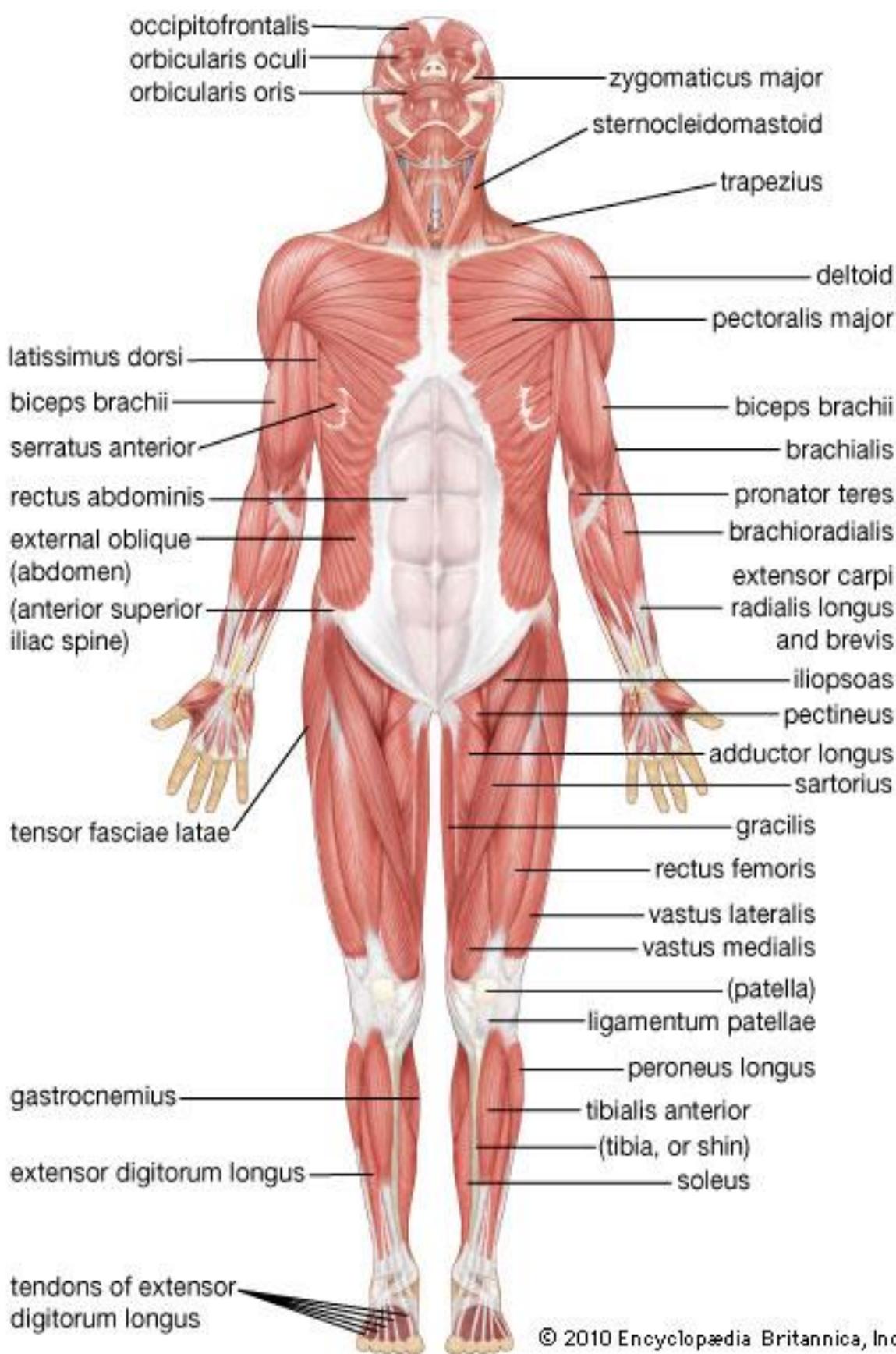
- 1- Biceps femoris
- 2- Semimembranosus
- 3- Semitendinosus

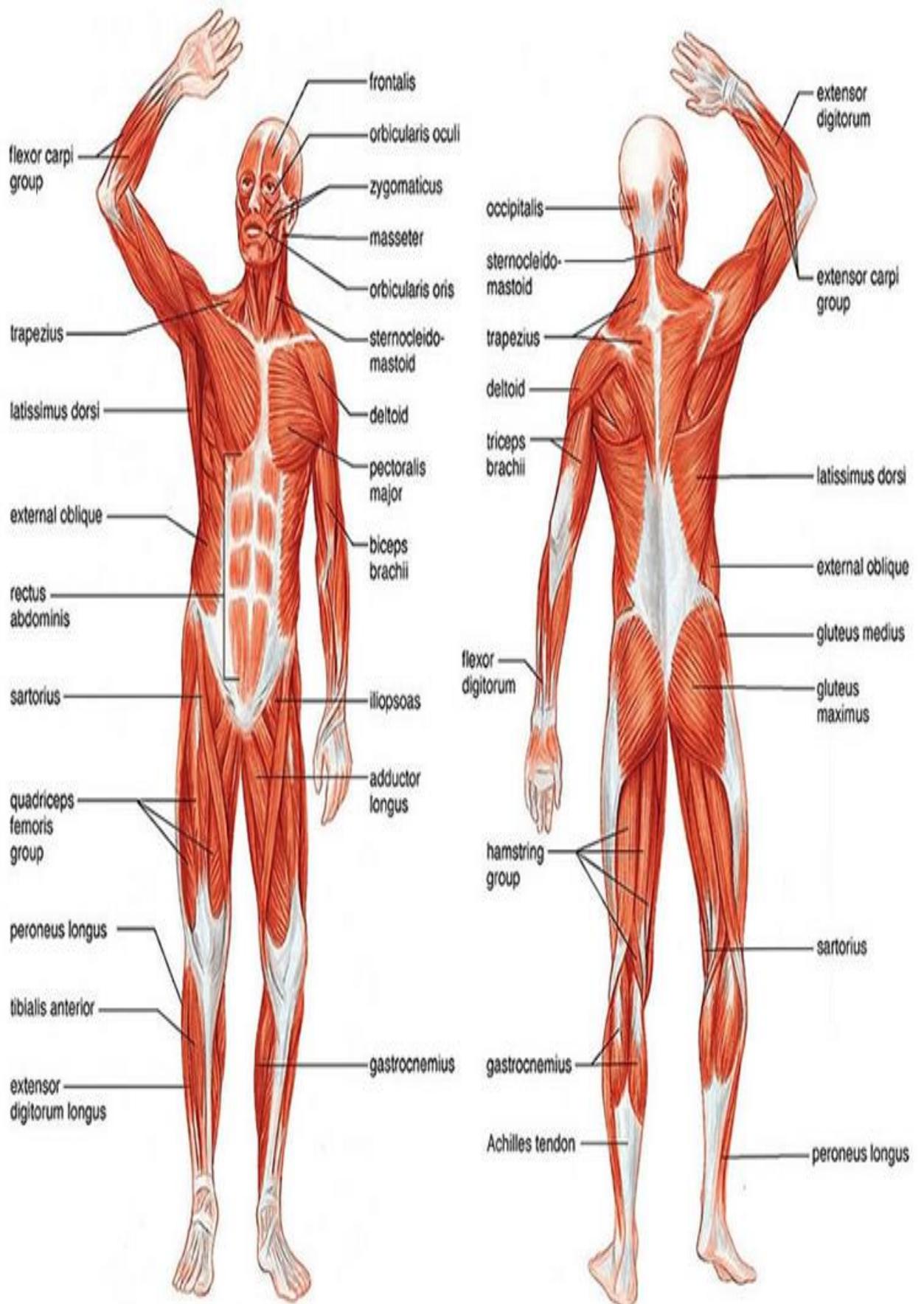
## **Muscles of the front of the thigh**

- 1-Rectus femoris
- 2-Vastus lateralis
- 3-Vastus medialis

## **Muscles of The Lower Leg**

- 1- Gastrocnemius
- 2- Soleus
- 3- Tibialis anterior.





a. Anterior view

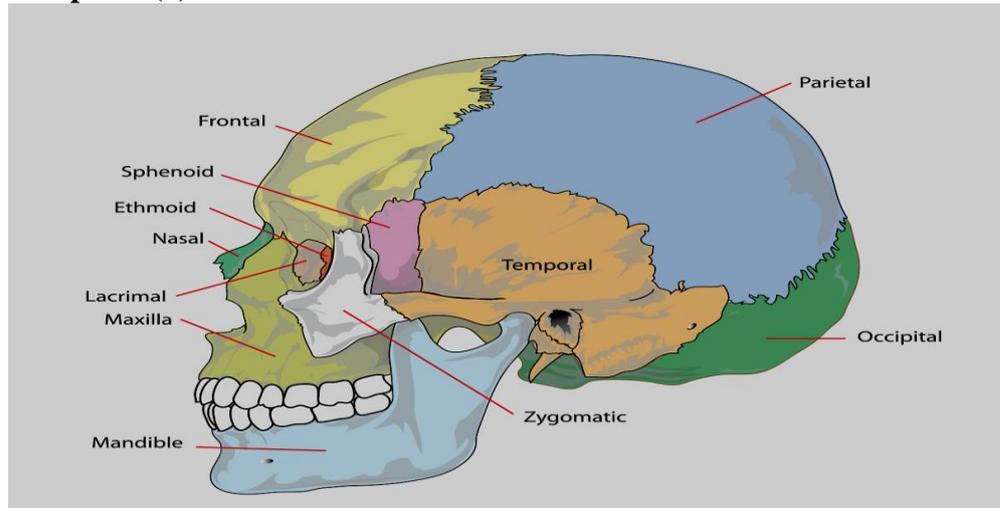
b. Posterior view

## The skull (12)

It is a part of Axial Skeleton. Cranial bones enclose and protect brain and they are sites for attachment for head and neck muscles.

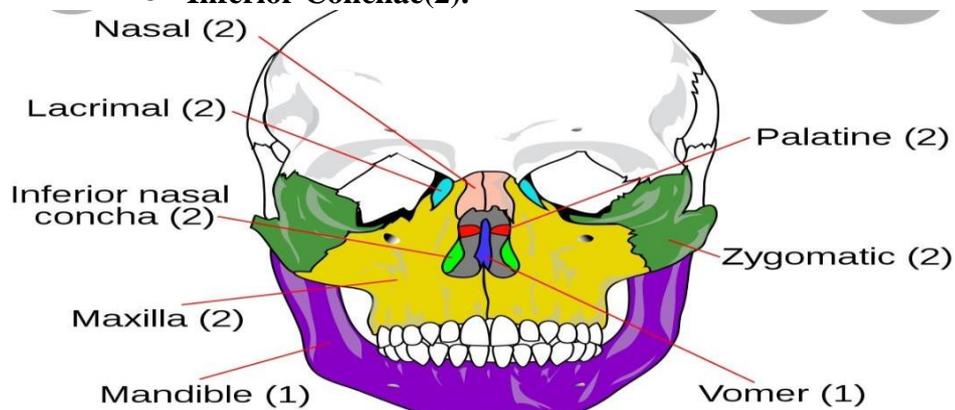
### Cranial bones include

- Frontal
- Occipital
- Sphenoid
- Ethmoid
- Parietal (2)
- Temporal (2)

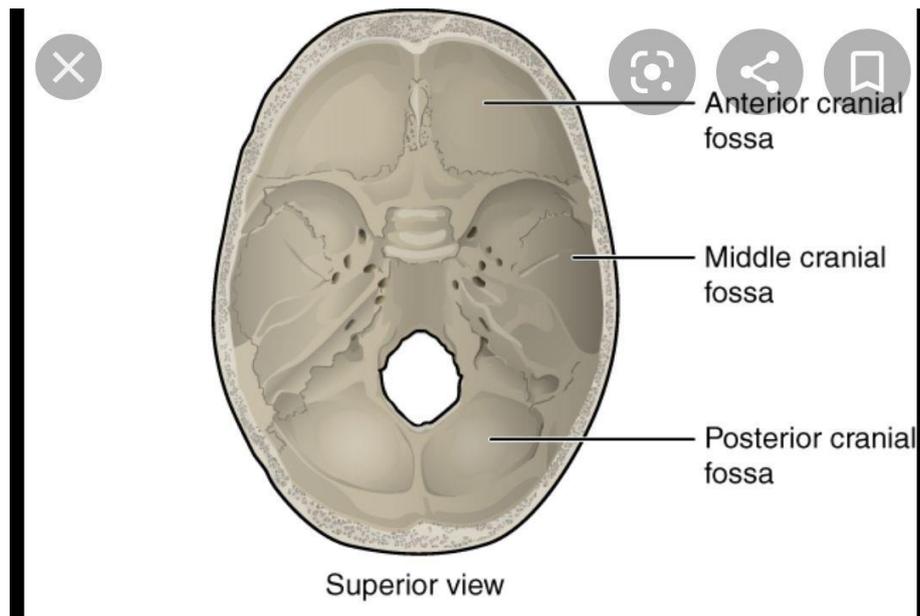


### Facial bones include

- Mandible
- Maxilla (2)
- Zygomatic (2)
- Nasal (2)
- Lacrimal (2)
- Palatine (2)
- Vomer
- Inferior Conchae(2).



**14 facial bones**



## **Cranial fossa**

### **Bones of anterior cranial fossa**

- 1- cribriform plate of ethmoid bone.
- 2- Orbital plate of the frontal bone.
- 3- Lesser wing of sphenoid bone.

### **Bones of middle cranial fossa**

- 1- body of sphenoid
- 2- greater wing of sphenoid.
- 3- Temporal bone.

### **Foramena in middle cranial fossa**

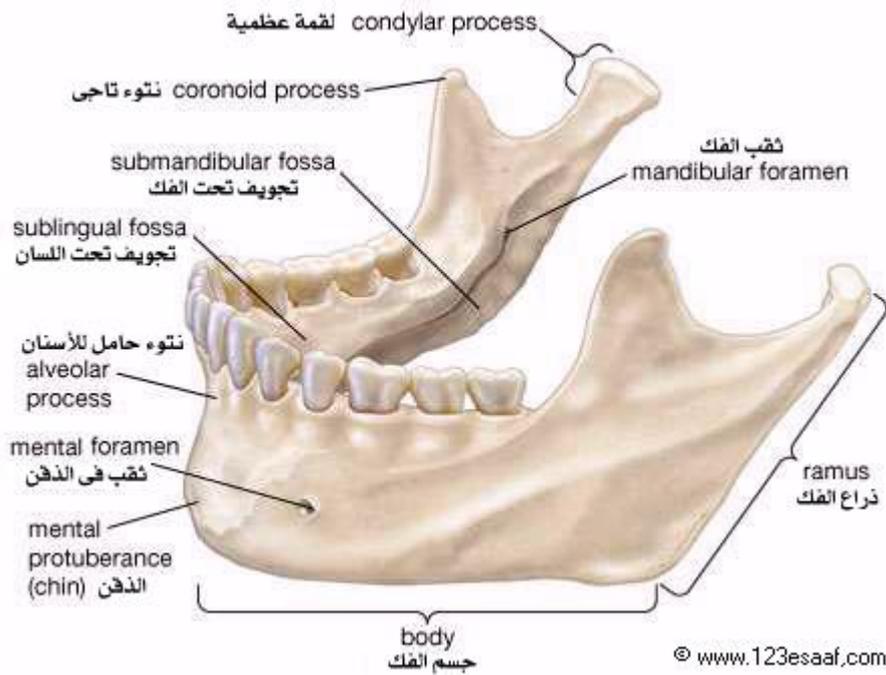
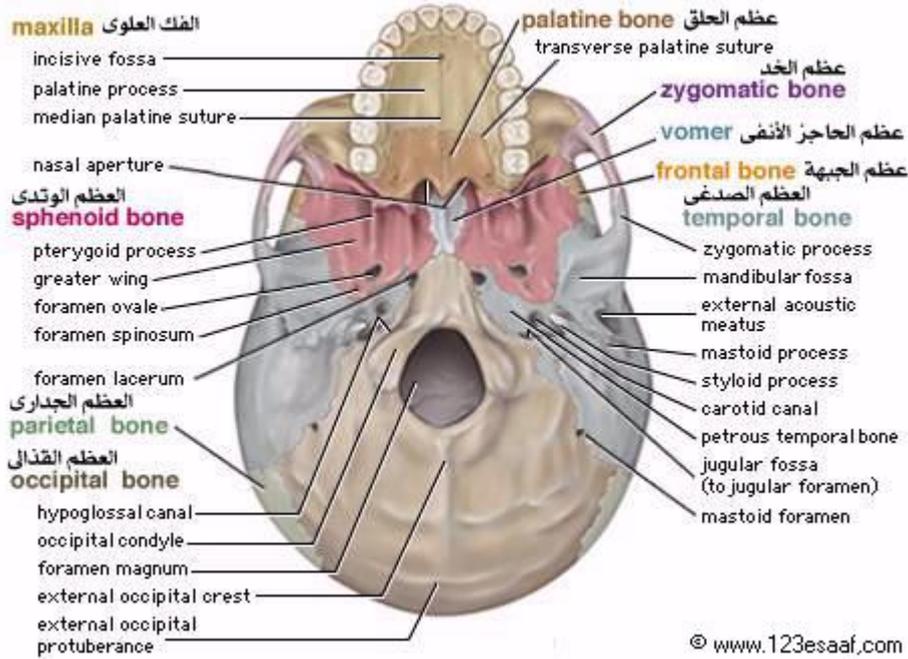
- 1- foramen rotundum
- 2- foramen ovale
- 3- foramen spinosum
- 4- Carotid canal foramina.

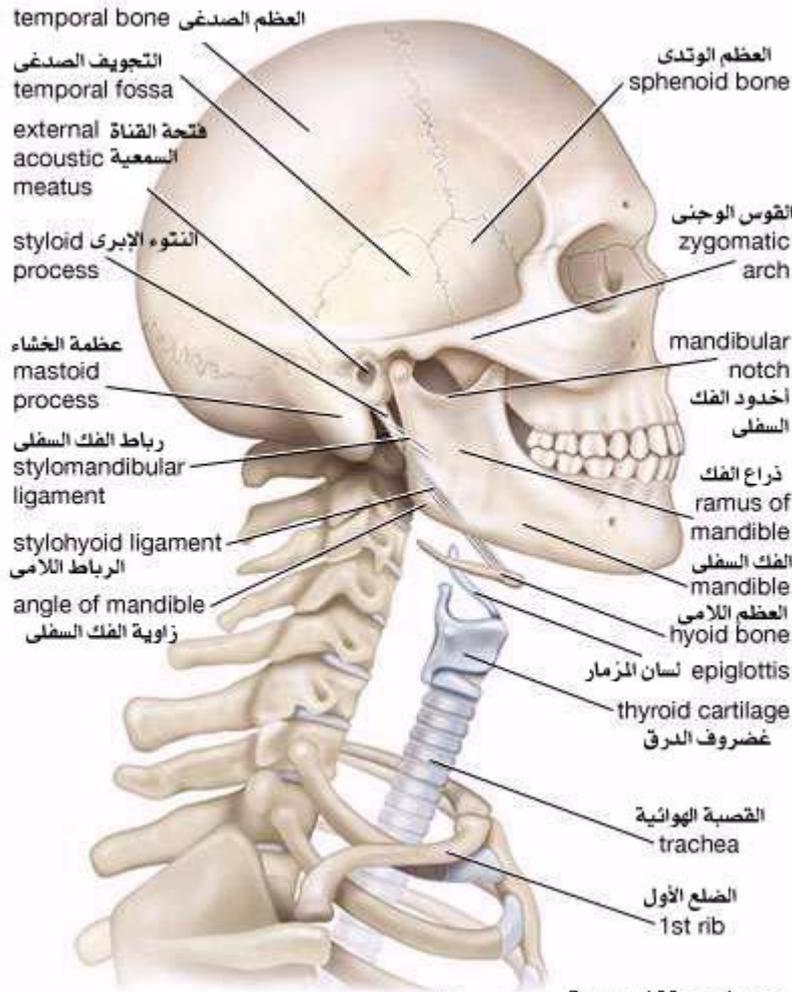
### **Bones of the posterior cranial fossa**

- 1- Occipital bone.
- 2- Body of the sphenoid.
- 3- Temporal bone.

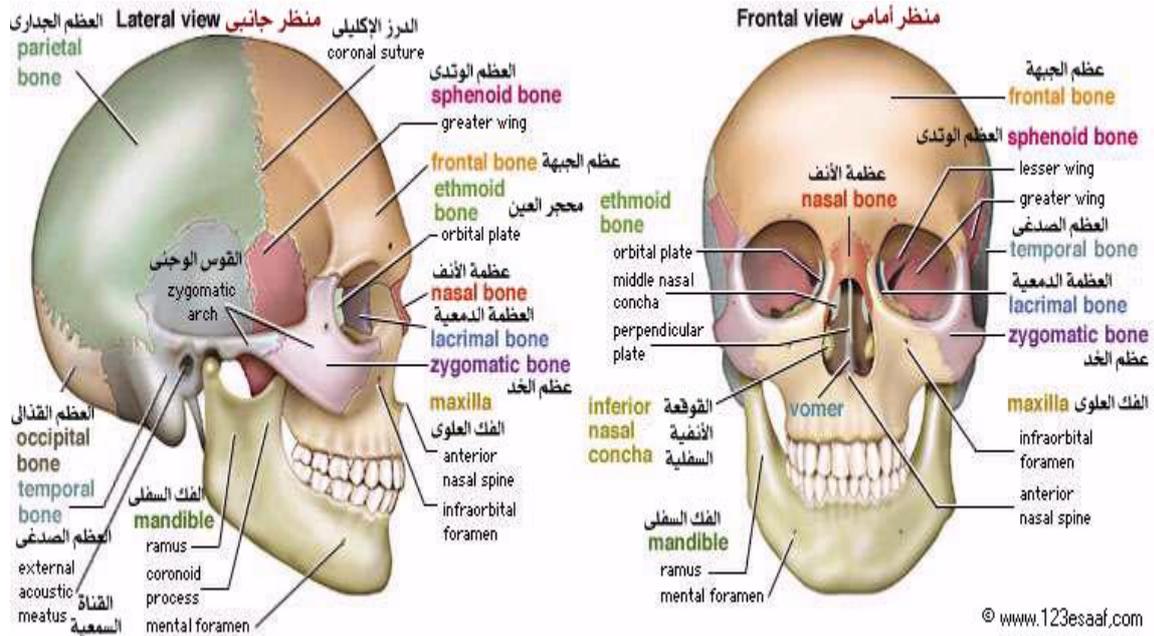
### **Foramena of the posterior cranial fossa**

- 1- Internal acoustic meatus
- 2- Jugular foramen
- 3- Hypoglossal canal
- 4- Foramen magnum.





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## Lecture 13: Lymphatic System

### I. General Anatomy of Lymphatic System

#### A. Diffuse Lymphatic Tissue - not enclosed in capsule

1. mucous membranes of GI, respiratory, urogenital

#### B. Lymphatic Nodules - not enclosed, oval shaped regions

1. germinal center - site of large lymphocytes
2. cortex - peripheral, smaller lymphocytes
3. mucous membranes of GI, respiratory, urogenital
4. tonsils, Peyer's patches of ileum, appendix

#### C. Lymphatic Organs - encapsulated by connective tissue

1. lymph nodes, spleen, thymus

### II. General Functions of Lymphatic System

#### A. Drainage - returns interstitial fluid to circulation

#### B. Transport - move fats from GI to the blood

#### C. Immunity - lymphocytes and macrophages ward off microbes

### III. Lymph Organization

#### A. Lymph Capillaries --> Lymph Vessels

#### B. Lymph Nodes - bean-shaped structures along lymph vessels

1. hilum - depression where efferent vessels emerge
2. capsule - dense connective tissue around node
3. cortex - outer region with many lymphocytes
4. medulla - inner region, less densely packed
5. afferent lymph vessels - toward the node
6. efferent lymph vessels - away from the node

7. **FUNCTION:** filter lymph fluid returning to blood

#### C. Tonsils - ring of nodules at start of pharynx

1. pharyngeal tonsil (adenoid) - posterior nasopharynx

2. palatine tonsils - at palatine arches
3. lingual tonsils - at base of the tongue
4. **FUNCTION:** defense against infection

**D. Spleen - lymph tissue between stomach and diaphragm**

1. visceral surface - to stomach, left kidney, colon
2. diaphragmatic surface
3. white pulp - dense lymphocytes around arteries
  - a. splenic nodules - dense lymph nodules
4. red pulp - venous sinuses filled with blood
5. **FUNCTION:** phagocytizes bacteria and old blood cells

**E. Thymus Gland - posterior to sternum and between lungs**

1. thymic lobes - two halves of thymus
2. epithelioreticular tissue - produces T cells
3. **FUNCTION:** release hormones and T cells for immunity

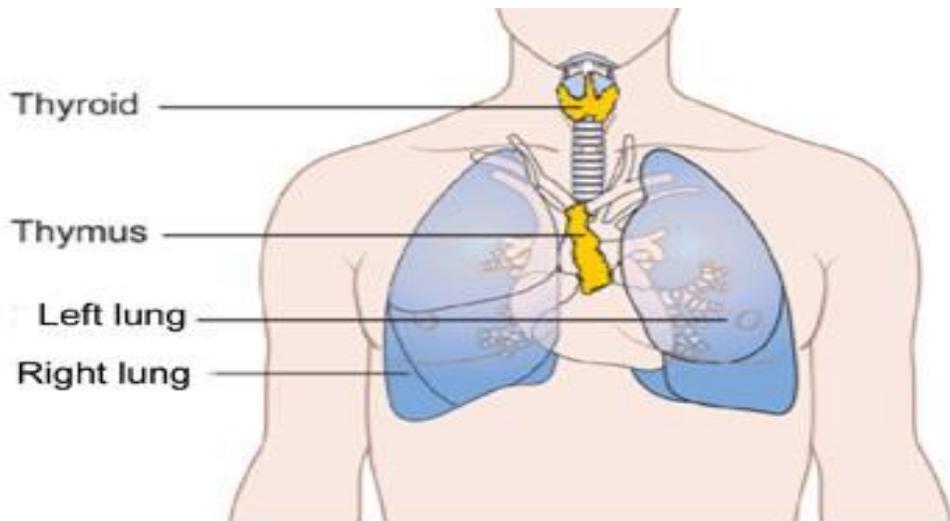
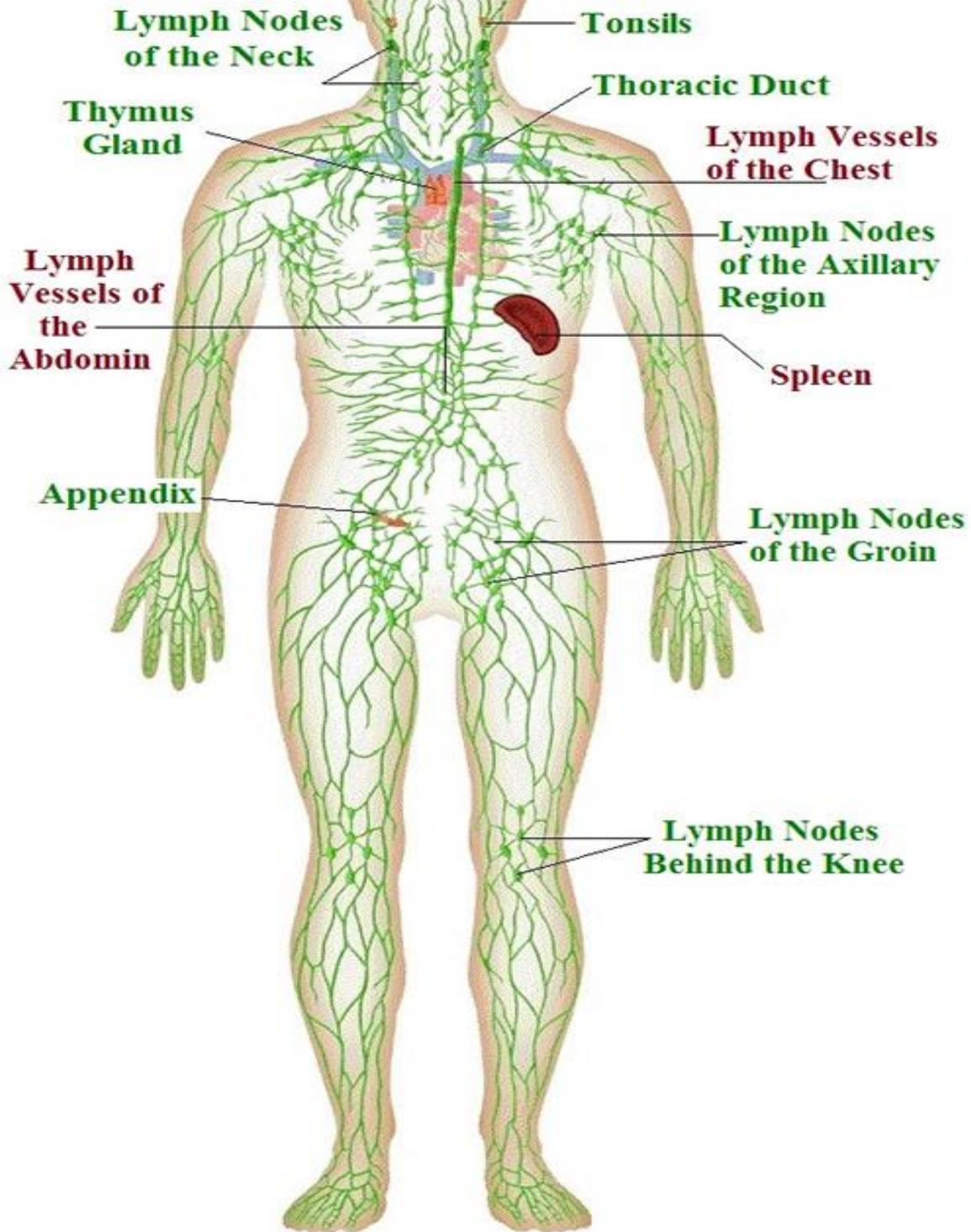
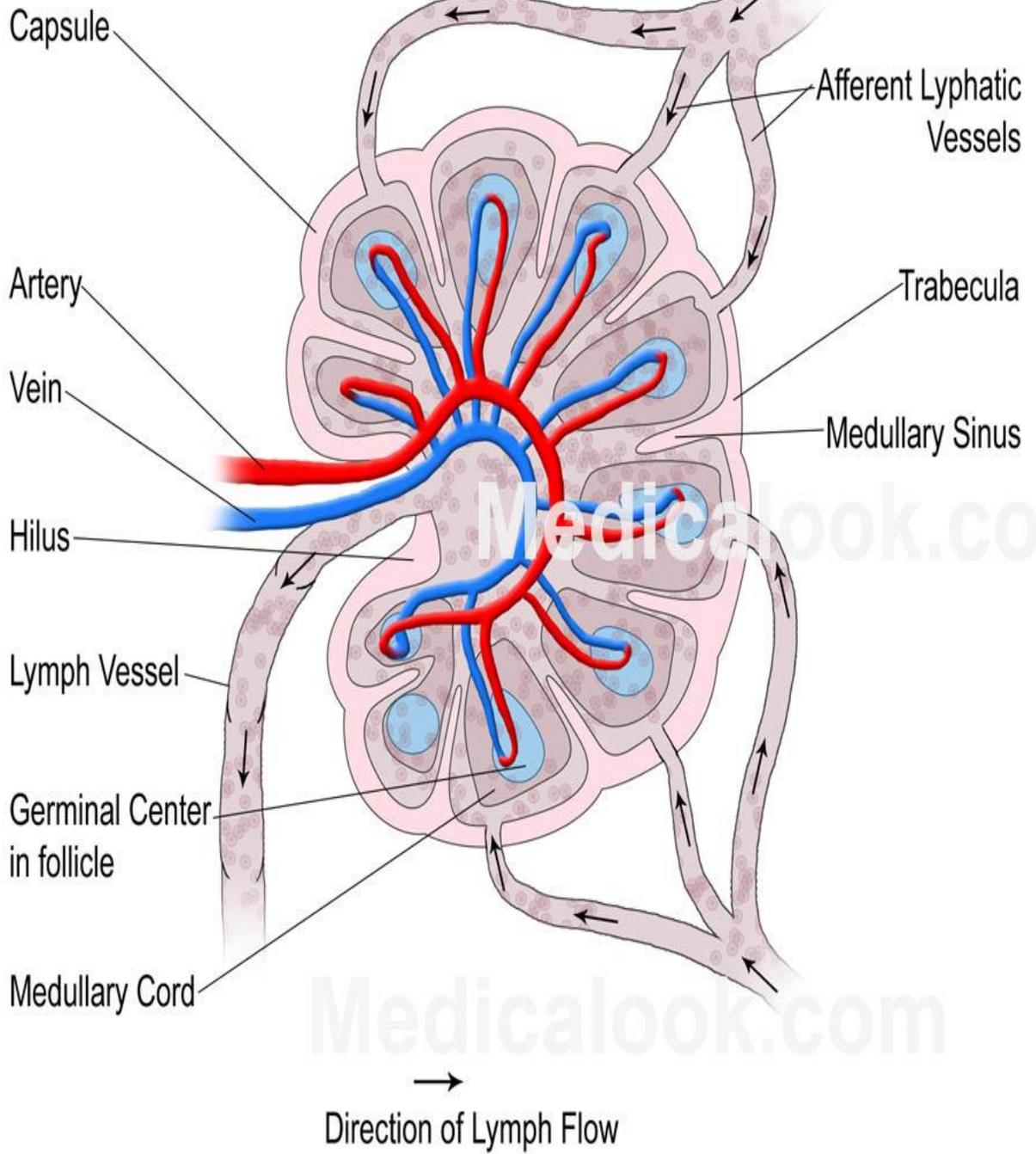


Diagram showing the position  
of the thymus gland  
Copyright © CancerHelp UK

# The Lymph & Immune System





## **Lecture 15: The Brain and Cranial Nerves:**

### **I. General Organization of Brain**

#### **A. Brain Stem**

- 1. Medulla oblongata**
- 2. Pons**
- 3. Midbrain (mesencephalon)**

#### **B. Diencephalon**

- 1. Thalamus**
- 2. Hypothalamus**

#### **C. Cerebrum**

#### **D. Cerebellum**

### **II. Specialized Parts of the Brain**

#### **A. Meninges**

- 1. Dura mater - outer layer, very tough**
- 2. Arachnoid - middle layer**
- 3. Pie mater - innermost layer, adheres to brain itself**

#### **B. Ventricles - Cavities in the Brain**

- 1. Lateral - (2) in each hemisphere**
- 2. Third - in slit between thalamic halves**
- 3. Fourth - between brain stem and cerebellum**

#### **C. Cerebrospinal Fluid**

- 1. Liquid of about 80-150 ml**
- 2. Flows around brain and through the ventricles**
- 3. Choroid plexuses - formation of CSF**

### **III. Brain Stem**

#### **A. Medulla Oblongata - just above for. magnum to the pons**

- 1. Pyramids - carry motor tracts from cerebrum**
- 2. Decussation of pyramids - where tracts cross sides**
- 3. Reticular formation - arousal and sleep (Quinley)**
- 4. Cardiac center - heart rhythm**
- 5. Rhythmicity area - breathing rate**
- 6. Vasomotor area - dilation of blood vessels**
- 7. Olive - (inferior and accessory nuclei)
  - i. projects motor fibers to cerebellum**
  - ii. Allows for coordinated motion****
- 8. Vestibular nuclear complex - from inner ear, balance**

- B. Pons - above medulla, anterior to cerebellum
  1. middle cerebellar peduncles - connect to cerebellum
  2. pneumotaxic/apneustic areas - breathing
- C. **Midbrain - above pons to diencephalon**
  1. cerebral peduncles - motor/sensory tracts (ventral)
  2. superior colliculi - visual stimuli -> motion
  3. inferior colliculi - auditory stimuli -> motion
  4. substantia nigra - motor coordination (Parkinsons)
  5. red nucleus - joining of cerebral/cerebellar tracts
  6. medial lemniscus - touch, pressure, vibration tracts

#### IV. Diencephalon - thalamus and hypothalamus

- A. Thalamus - relay station between cerebrum and midbrain
  1. medial geniculate n. - auditory
  2. lateral geniculate n. - visual
  3. ventral posterior n. - taste & general sensation
  4. ventral anterior n. - motor actions
  5. ventral lateral n. - motor actions and arousal
  6. anterior n. - emotion and memory
  7. reticular nucleus - regulates thalamic action
- B. Hypothalamus - tiny area below thalamus (sella turcica)
  5. Chief functions of Hypothalamus
    - a. regulates most organs through autonomics
    - b. integrates sensory information from organs
    - c. relay between Nervous <-> Endocrine Systems
      - i. antidiuretic hormone - urination
      - ii. oxytocin - uterine contraction/mammary
    - d. relays thoughts <-> emotions via autonomics
    - e. rage, aggression, passivity (rat studies)
    - f. temperature control/regulation via autonomics
    - g. feeding/satiety center
    - h. thirst center
    - i. sleep/arousal state with reticular formation
    - j. helps control body rhythms (circadian)

#### V. Cerebellum - posterior to midbrain, inferior to occipital

- A. Structure :
  1. transverse fissure - separates from occipital lobe
  2. tentorium cerebelli - dura mater around cerebellum
  3. anterior/posterior lobes - subconscious motion
  4. flocularnodular lobe - balance/equilibrium
  5. falx cerebelli - dura mater between hemispheres
  6. inf. cereb. peduncles - afferents from medulla
  7. mid. cereb. peduncles - afferents from pons

**8. sup. cereb. peduncles - efferents to midbrain**

**B. Functions :**

- 1. maintains equilibrium and posture**
- 2. fine tunes voluntary movement ordered by cerebrum**

**VI. Cerebrum - two hemispheres containing 5 different lobes**

**A. General Features**

- 1. cerebral cortex - (gray matter) surface, cell bodies**
- 2. cerebral tracts - (white matter) beneath, axons**
- 3. gyri/convolutions - ridges of cortex**
- 4. fissures - deep grooves/valleys between gyri**
- 5. sulci - shallow grooves/valleys between gyri**
- 6. longitudinal fissure - divide right/left hemispheres**
- 7. corpus callosum - tracts connecting right/left**
- 8. falx cerebri - dura mater in long. fissure**

**C. Basal Ganglia - communication cerebrum <-> thalamus**

**D. Limbic System - learning, memory, and emotions**

**E. Functional Areas of Cortex**

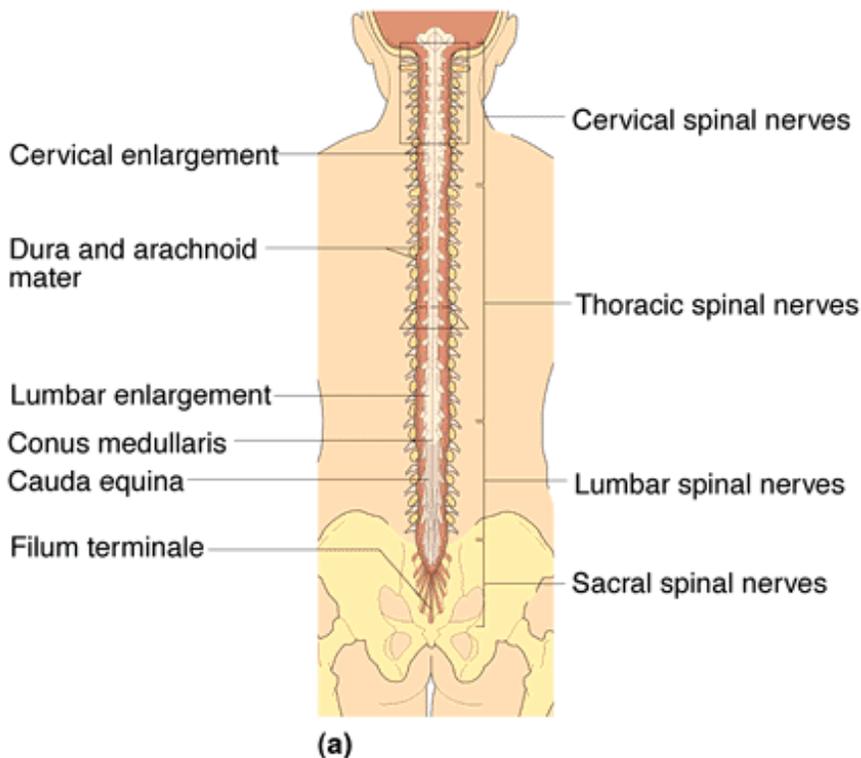
- 1. Motor area/ responsible for movement.**
- 2. Sensory area/ responsible for sensations.**
- 3. Visual area/ responsible for vision.**
- 4. Auditory area/ responsible for hearing.**
- 5. Other areas/ like speech area, taste area,... .**

## Lecture 16: Spinal Cord & Nerves, Autonomics

### I. General Structure of Spinal Cord

#### A. Principal Parts:

1. **42-45 cm in length; 2.5 cm wide**
2. **Cervical enlargement** - C4:T1 supply upper limbs
3. **Lumbar enlargement** - T9:T12 supply lower limbs
4. **conus medullaris** - tapers off to end at L1-L2
5. **filum terminale** - pia mater anchors cord to coccyx
6. **cauda equina** - (horse tail) nerves below L2



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### II. Spinal Cord Structure - Cross Section

#### A. Grey vs. White Matter

1. **grey matter** - nerve cell bodies motor & interneurons
2. **white matter** - myelinated axons of motor & sensory

## B. Different Reflexes

1. Spinal reflexes - spinal cord controlled (posture)
2. Somatic reflexes - skeletal muscles
3. Cranial reflexes - brain and cranial nerves
4. Visceral (autonomic) r. - smooth/cardiac/glands
5. stretch reflex
6. tendon reflex
7. flexor (withdrawal) reflex

## C. Major Clinical Reflexes :

1. Patellar reflex (knee jerk)
2. Achilles reflex (ankle jerk)
3. Babinski sign - positive (under 1 1/2 years old)  
negative (after 1 1/2 years old)
4. Abdominal reflex

## V. The Spinal Nerves

### Coverings:

1. endoneurium - around individual axon (myel. or not)
2. perineurium - around axon bundles (fascicles)
3. epineurium - around the entire nerve
4. Meninges of cord fuse with epineurium on exit

## D. The Four Nerve Plexuses

1. Cervical plexus - ventral rami of C1-C4 with some C5
  - a. muscles/skin of head, neck, some shoulder
  - b. phrenic nerve - diaphragm muscle (breathing)
2. Brachial plexus - ventral rami of C5-C8 and T1
  - a. nervous supply to entire arm and shoulder

Roots → Trunks → Divisions → Cords → Nerve → muscles

3. Lumbar plexus - ventral rami of L1-L4
  - a. abdominal wall, genitals, part of lower limb
  - b. femoral nerve
4. Sacral plexus - ventral rami of L4-L5 and S1-S4
  - a. buttocks, perineum, part of lower limb
  - b. sciatic nerve - largest nerve of body

## VI. Dermatomes

**A. Dermatome - skin innervated by dorsal root of a spinal n.**

## **VII. Overview of the Autonomic Nervous System (ANS)**

### **A. General Functions**

- 1. efferent control of everything except skeletal m.**
- 2. pupil size, accommodation for near/far vision**
- 3. dilation/constriction of blood vasculature**
- 4. rate and force of heart contractions**
- 5. gastrointestinal movements**
- 6. secretion of most glands**

### **B. General Differences from Somatic Nervous System**

- 1. All fibers are efferent (motor)**
- 2. Two different types of efferent fibers**
  - i. Two neurotransmitters (ACh and Norepinephrine)**
- 3. Must synapse on ganglion before effecting target**
- 4. Has two primary divisions**
  - a. sympathetic**
  - b. parasympathetic**
- 5. can act in both inhibitory and excitatory fashion**

## **VIII. Structure of Autonomic Pathway**

### **A. preganglionic neurons - spinal cord -> ganglion**

- 1. Sympathetic (thoracolumbar)**
- 2. Parasympathetic (lateral grey horn of S2-S4)**

### **B. autonomic ganglia - house cell bodies of effector n.**

- 1. Sympathetic**
  - a. vertebral ganglia - along the spine**
  - b. prevertebral ganglia - near arteries**
- 2. parasympathetic**
  - a. terminal ganglion - near effected organ**

### **C. postganglionic neurons - motor to effected organ**

## **Sternum** LUC7

The sternum is a long, flat bone, forming the middle portion of the front of the chest. The top of the sternum supports the clavicles (collarbones) and its edges join with the costal cartilages of the first seven pairs of ribs. The inner surface of the sternum is also the attachment of the sternopericardial ligaments. Its top is also connected to the sternocleidomastoid muscle. The sternum consists of three main parts, listed from the top:

- \_ Manubrium
- \_ Body
- \_ Xiphoid process

### Ribs

In humans, the rib cage, also known as the thoracic cage, is a bony and cartilaginous structure which surrounds the thoracic cavity and supports the (shoulder girdle), forming a core portion of the human skeleton. A typical human rib cage consists of 24 ribs, the sternum (with xiphoid process), costal cartilages, and the 12 thoracic vertebrae. Together with the skin and associated fascia and muscles, the rib cage makes up the thoracic wall and provides attachments for the muscles of the neck, thorax, upper abdomen, and back.

#### Types of ribs

- 1- True ribs ( first 7 ribs)
- 2- False ribs ( 5 ribs) : which include :
  - A- False floating: (11, 12).
  - B- False non floating: (8, 9, 10) attach to the 7<sup>th</sup> rib.

#### Each rib consists of:

- 1- Head
- 2- Neck
- 3- Tubercle

### Vertebrae

Each vertebra is an irregular bone with a complex structure composed of bone and some hyaline cartilage.

- 1-The large part is the body, and the central part is the centrum.
- 2-The upper and lower surfaces of the vertebra body give attachment to the intervertebral discs.
- 3-The posterior part of a vertebra forms a vertebral arch, in eleven parts, consisting of two pedicles, two laminae, and seven processes.
- 4-The laminae give attachment to the ligamenta flava (ligaments of the spine). There are vertebral notches formed from the shape of the pedicles, which form the intervertebral foramina when the vertebrae articulate.
- 5- These foramina are the entry and exit conducts for the spinal nerves.
- 6- The body of the vertebra and the vertebral arch form the vertebral foramen, the larger, central opening that accommodates the spinal canal, which encloses and protects the spinal cord.

**Vertebra is composed of:**

- 1- **Body.**
- 2- **Vertebral arch**
- 3- **Pedicles and laminae.**
- 4- **Vertebral notch**
- 5- **Transverse process**
- 6- **Spinous process (spine).**

**Types of vertebra**

- 1- **cervical vertebra (7)**
- 2- **Thoracic vertebra (12)**
- 3- **Lumber vertebra(5)**
- 4- **Sacral vertebra (5)**
- 5- **Coccygeal vertebra (4) which form the coccyx.**

**Features of cervical vertebra:**

- 1- **Small body and elongated.**
- 2- **Vertebral opening is triangular in shape.**
- 3- **Spinal process is divided in its posterior end.**
- 4- **Recognized transverse process that has opening.**

**Features of thoracic vertebra:**

- 1- **The body is larger than cervical and smaller than lumber .**
- 2- **The body is pear shaped like the shape of the heart.**
- 3- **Spinal process is long, pointed and directed backwards.**
- 4- **It has 6 articular facets.**

**Features of lumber vertebra:**

- 1- **The largest vertebra in the body.**
- 2- **Kidney-like shape.**
- 3- **No articular surface with ribs.**
- 4- **Short spinal process but strong and flat.**

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## **Anatomy/ Lecture 1**

**Anatomy** - the study of the structures of an organism. The branch of science concerned with the bodily structure of humans, animals, and other living organisms, especially as revealed by dissection and the separation of parts.

A. **Gross Anatomy** - structures as seen by eye.

B. **Developmental Anatomy** - study of the anatomy of the developing organism.

C. **Histology** ("tissues" "to study") - structures that can be seen with the microscope such as cells and tissues.

D. **Systemic Anatomy** - study of individual organ system

E. **Regional Anatomy** - study of structures in particular area

F. **Pathology** ("disease" "to study") - study of changes in structure due to disease/injury.

### **Anatomical Position:**

1. Subject stands erect
2. Upper limbs placed at sides with **palms forward**
3. Feet flat on floor in natural forward direction

### **Directional Terms:**

1. Superior (cephalic): inferior (caudal)
2. Anterior (ventral): posterior (dorsal)
3. Medial: lateral
4. ipsilateral (same side) : contralateral (opposite)
5. Proximal: distal
6. Superficial: deep
7. Parietal: visceral

### **Planes and Sections:**

1. **sagittal** - divides into right and left parts
  - a. midsagittal - right down the middle
  - b. parasagittal - away from the midline
2. **Frontal (coronal)** - divides anterior & posterior
3. **Horizontal (transverse)** - divide superior & inferior

**Body Cavities:**

**1. Dorsal Body Cavity:**

- a. cranial cavity (brain)
- b. vertebral cavity (spinal cord)

**2. Ventral Body Cavity (viscera - organs found here)**

**a. thoracic cavity:**

- i. pleural cavity (space separating the parietal pleura and visceral pleura of lungs ).
- ii. Mediastinum - all contents of thoracic cavity except the lungs (eg. heart)

**b. abdominopelvic cavity:**

- i. abdominal - stomach, spleen, liver, gallbladder, pancreas, small intestine.
- ii. Pelvic - urinary bladder, cecum, appendix, sigmoid colon, rectum, reproductive organs.

**3. Other Body Cavities:**

- a. oral cavity (mouth)
- b. nasal cavity (sinuses for air passage)
- c. orbital cavities (eyes)
- d. middle ear cavities (in temporal bone)
- e. synovial cavities (freely moveable joints)

**Regions (nine regions of the abdomen) :-**

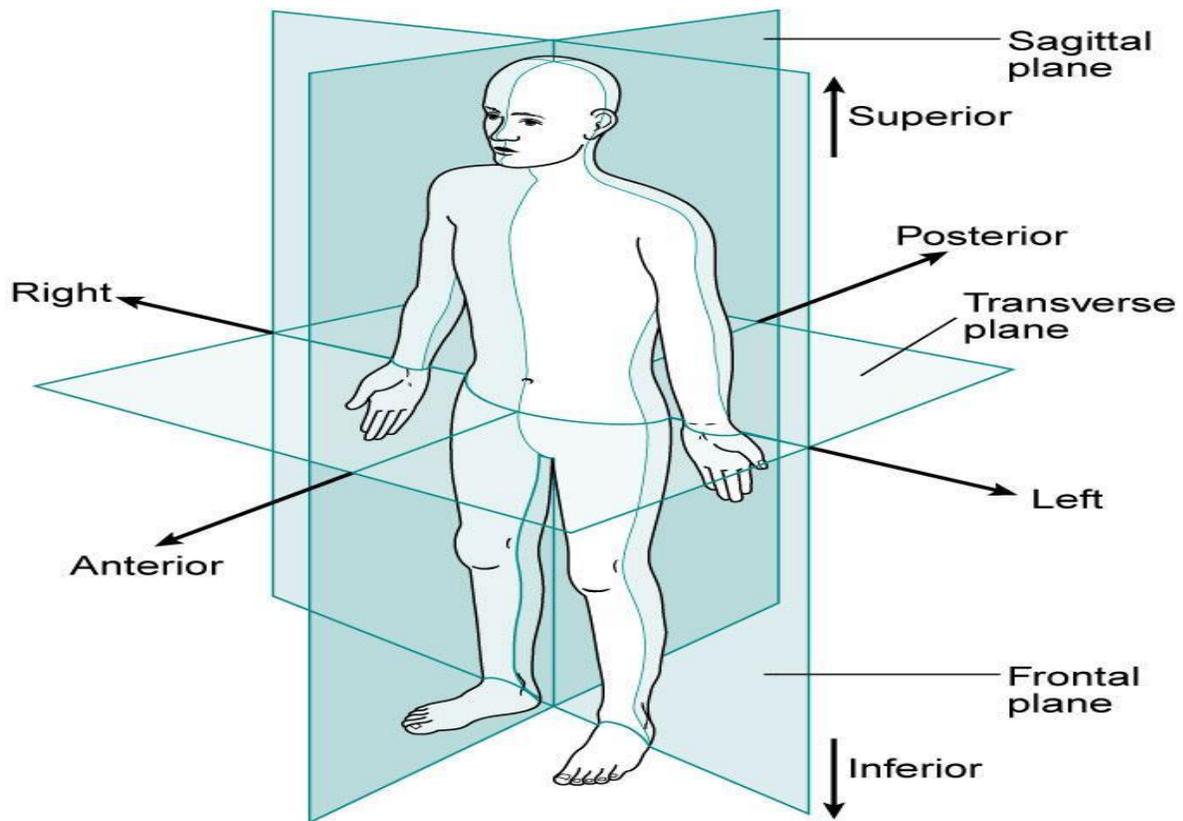
Right Hypochondriac  
Right Lumbar  
Right Iliac

Epigastric  
Umbilical  
Hypogastric(suprapubic)

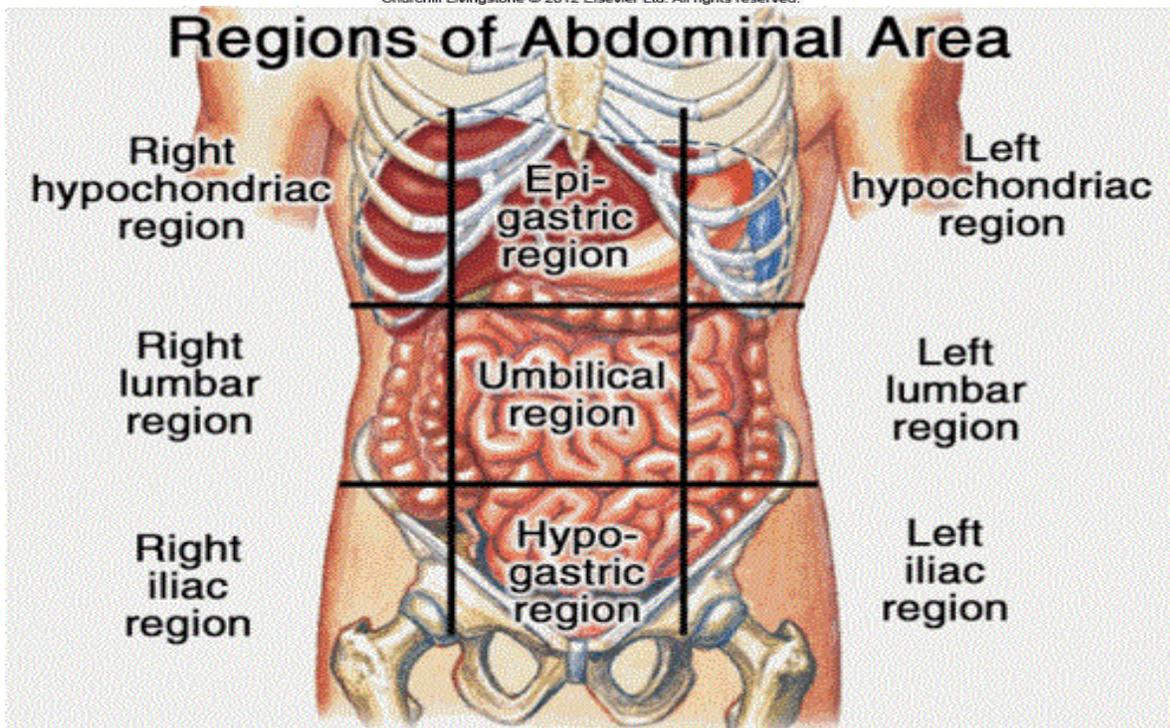
Left Hypochondriac  
Left Lumbar  
Left Iliac

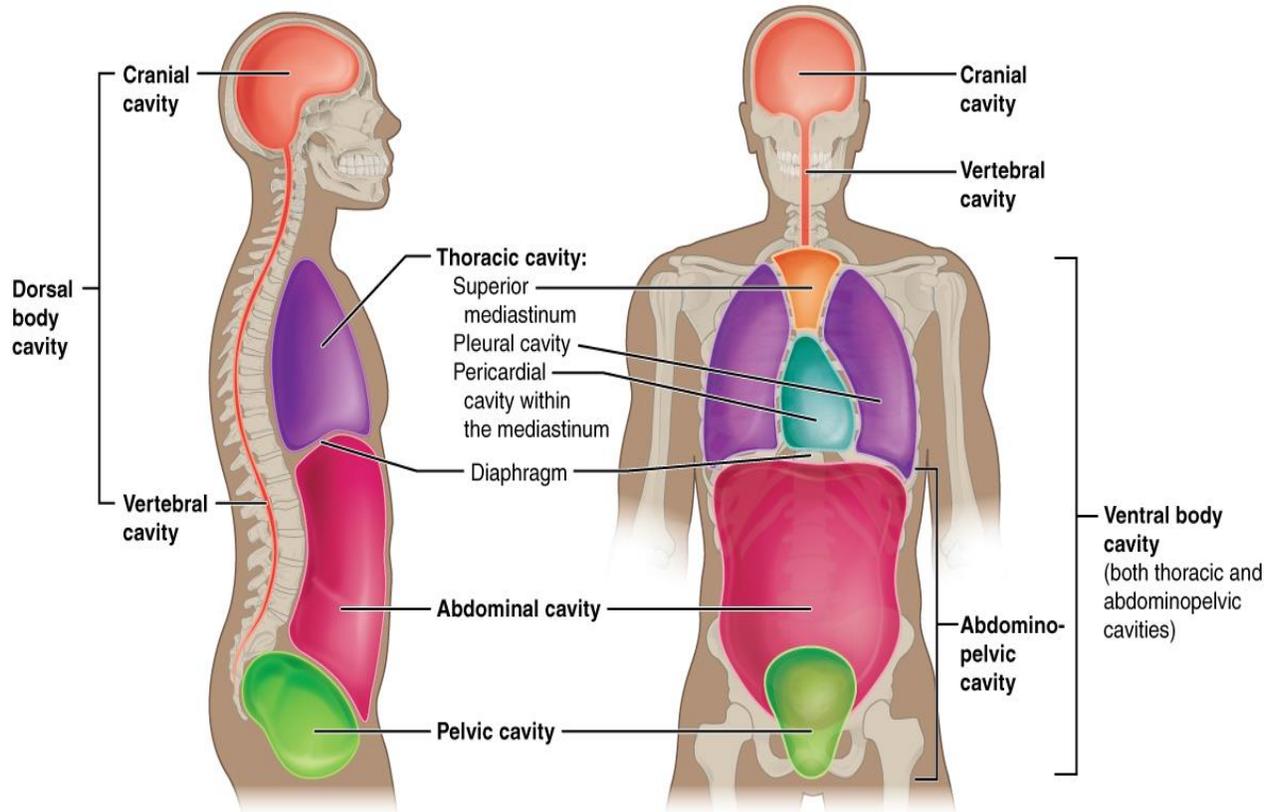
**Examples of Regional Terms**

- 1. axillary - armpit
- 2. Brachial - upper arm
- 3. pubic - around genitalia
- 4. Carpal - wrist
- 5. ante brachial - forearm
- 6. Acromial - point of shoulder



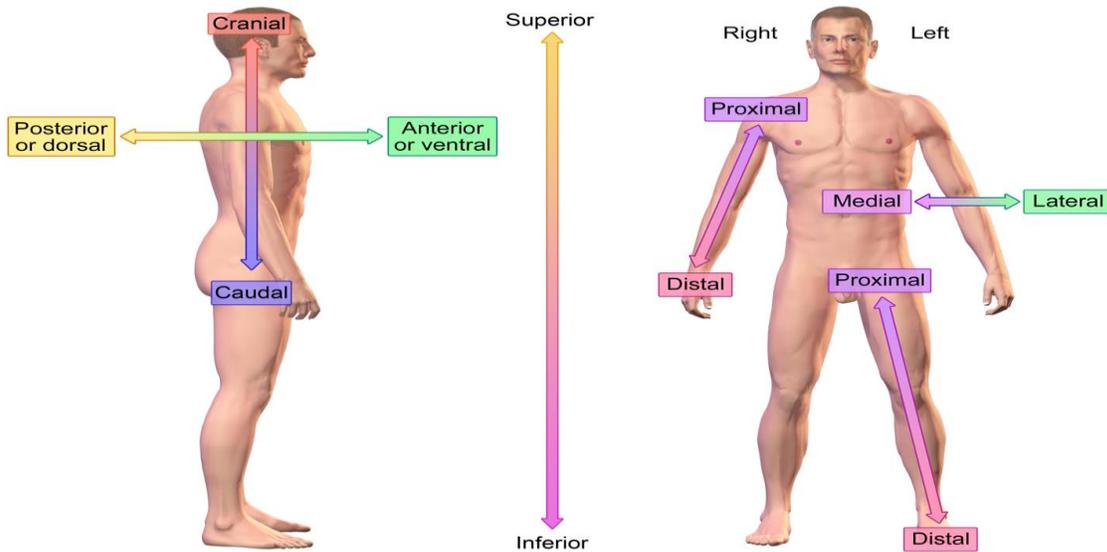
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Lateral view

Anterior view



Lateral view

Anterior view

## Directional References

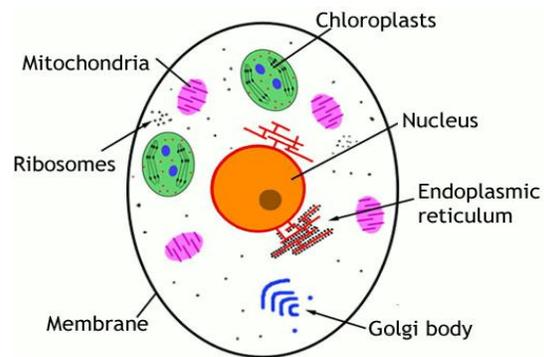
## Lecture 2: Structure of the Cell

### A. Plasma Membrane

### B. Cytoplasm

### C. Major Organelles:

1. Nucleus
2. Ribosomes
3. Endoplasmic reticulum (ER)
4. Golgi complex (apparatus)
5. Mitochondria
6. Lysosomes



### The Plasma Membrane

1. 80% phospholipids
2. 10% proteins - peripheral and integral
3. 10% cholesterol, glycolipids, carbohydrates

### Cytoplasm

#### Composition and Structure:

1. 90% water 10% protein, carbohydrate, lipid, salts
2. Colloids - collections of organic molecules
3. jelly-like fluid surrounding the nucleus

### Nucleus

#### Primary Functions

1. House and protect hereditary material (DNA)
2. Copy DNA to RNA so proteins can be manufactured
3. Produce ribosomal RNA (rRNA) to make ribosomes

### Ribosomes

#### Primary Functions

1. Only site of protein synthesis
2. "Read" the messenger RNA sent out from nucleus
3. Free ribosomes - scattered throughout cytoplasm
4. Attached ribosomes - found on endoplasmic reticulum

### Endoplasmic Reticulum (ER)

Granular (rough) ER - have ribosomes attached

A granular (smooth) ER - no ribosomes

### B. Primary Functions

Transport, storage, packaging of materials

### Golgi complex (Apparatus)

Primary Function

1. Process, sort, package, deliver proteins
2. Cis - closest to ER, receives new proteins
3. Medial - alters protein to functional form
4. Trans - forms secretory granules for protein release

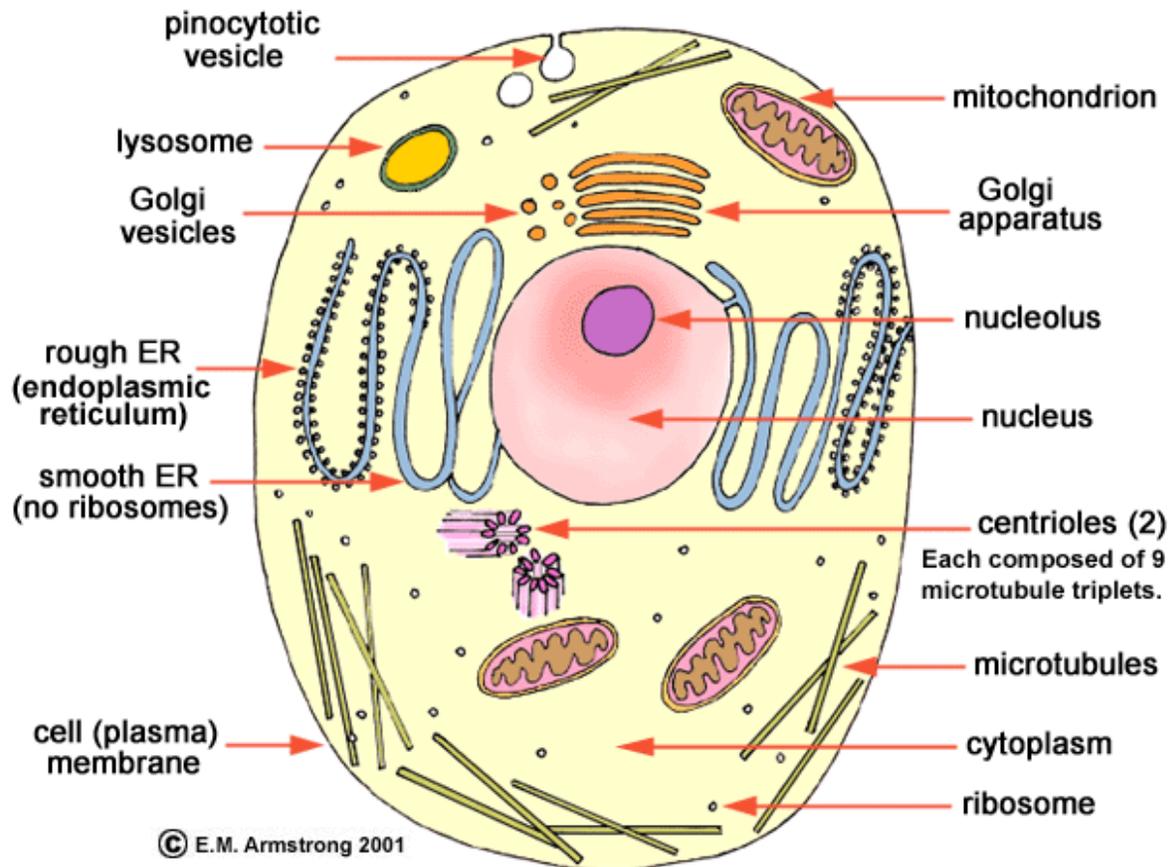
## VIII. Mitochondria

### A. Structure

1. two-membrane structure
  - a. outer mitochondrial membrane
  - b. inner mitochondrial membrane (cristae)
2. Matrix - within the inner membrane

## IX. Lysosomes:

1. Single membrane enclosed spheres
2. Primary lysosome - bud-off from Golgi complex
3. Secondary lysosome - when fused with a vacuole



## Lecture 3- Overview of Histology: Tissue Organization

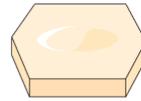
### A. Epithelial Tissue

#### 1. Simple Epithelium

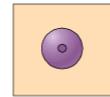
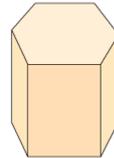
a. squamous (endothelium, mesothelium)

b. columnar (ciliated, nonciliated)

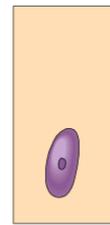
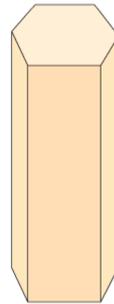
c. cuboidal



Squamous



Cuboidal



Columnar

(b)

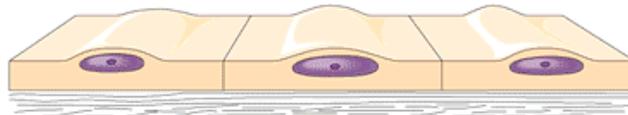
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#### 2. Stratified Epithelium

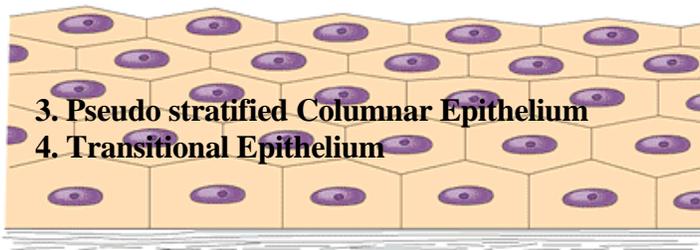
a. squamous (keratinized, nonkeratinized)

b. columnar

c. cuboidal



Simple



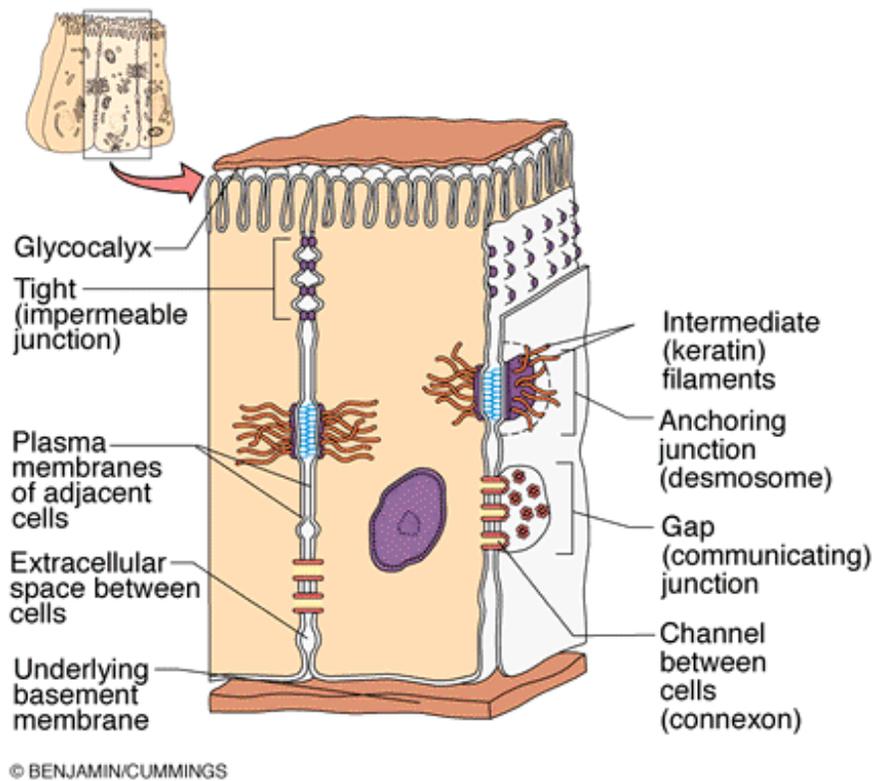
Stratified

(a)

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- 5. Glandular Epithelium
  - a. exocrine glands
  - b. endocrine glands

- 6. Cell Junctions in Epithelial Tissue
  - a. desmosome
  - b. tight junction
  - c. gap junction



**B. Connective Tissue:**

- 1. Embryonic Connective Tissue
  - a. mesenchymal.
  - b. mucous
- 2. Adult Connective Tissue
  - a. connective tissue proper
    - \* Loose (areolar, ordinary)
    - \* Adipose (fat)
    - \* Dense (collagenous)

- \* elastic
- \* reticular
- b. cartilage tissue
  - \* hyaline cartilage
  - \* fibrocartilage
  - \* elastic cartilage
- c. osseous tissue (bone)
- d. vascular tissue (blood).

### C. Muscle Tissue

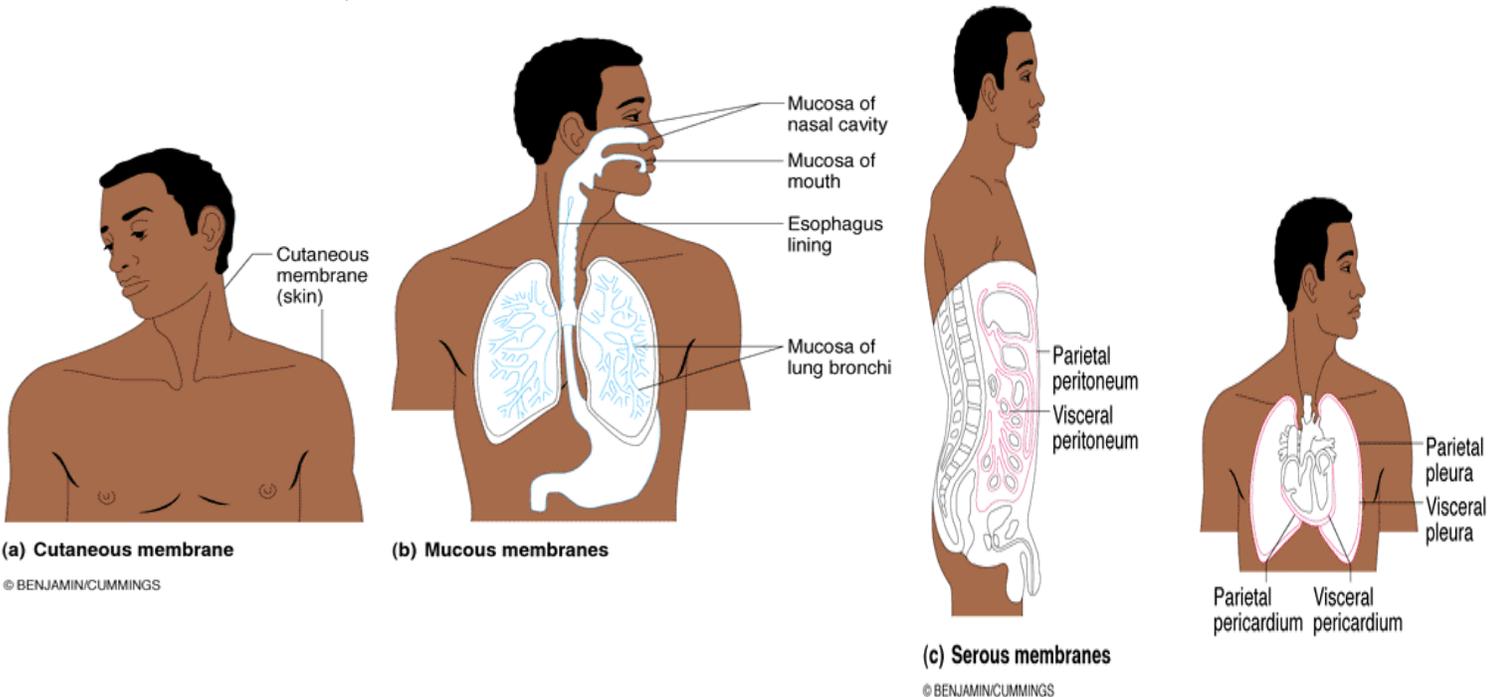
1. Skeletal Muscle (voluntary)
2. Smooth Muscle (involuntary, visceral)
3. Cardiac Muscle (heart)

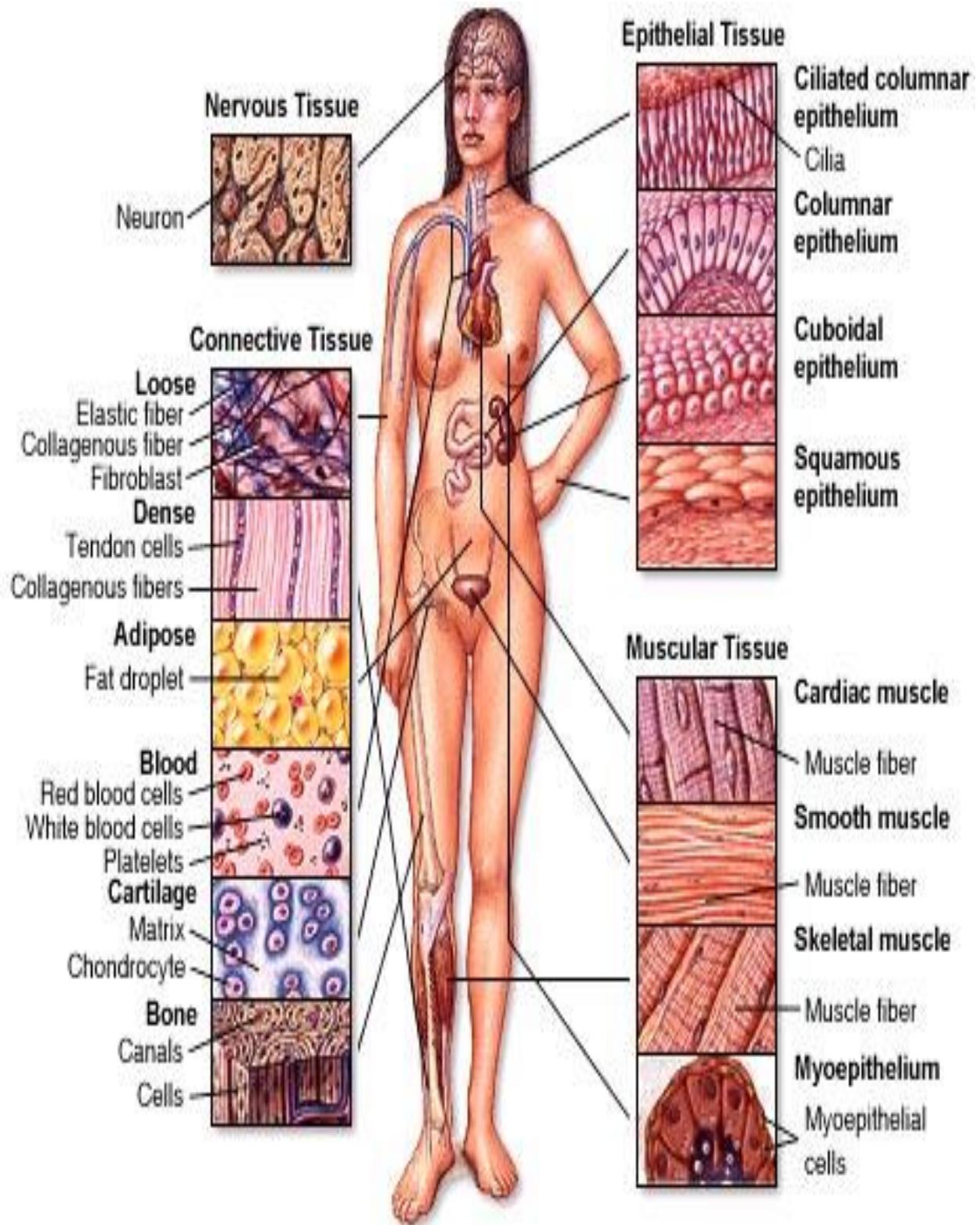
### D. Nervous Tissue

1. Neurons (nerve cells)
2. Neuroglia (supporting cells)

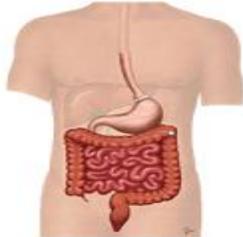
### E. Organismal Membranes

1. Mucous Membranes (mucosa)
2. Serous Membranes (serosa)
3. Cutaneous Membranes (skin)
4. Synovial Membranes



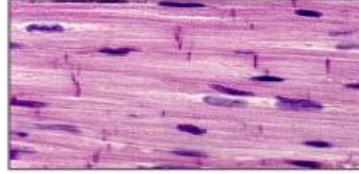


Smooth Muscle Tissue



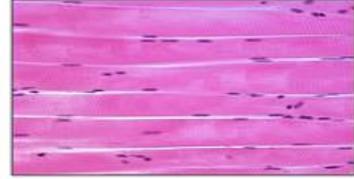
Involuntary Control

Cardiac Muscle Tissue



Involuntary Control

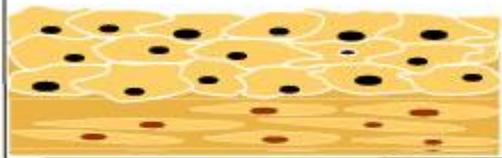
Skeletal Muscle Tissue



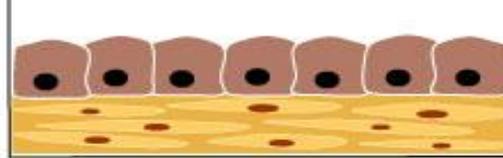
Voluntary Control

### Epithelial Types

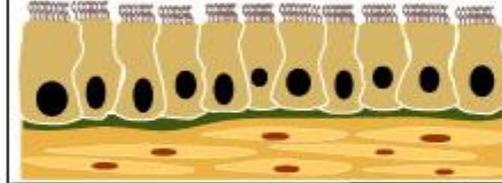
Simple Squamous



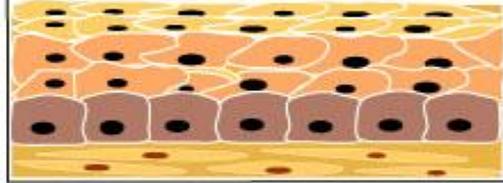
Simple Cuboidal



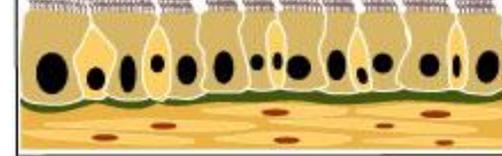
Simple Columnar



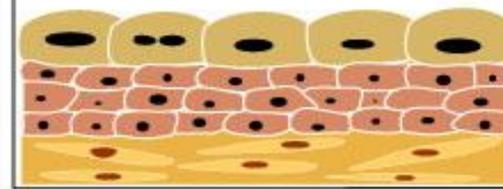
Stratified Squamous



Pseudostratified Columnar



Transitional



## Lecture 4: Skeletal System

### **I. Functions of Skeletal System**

- A. Support**
- B. Protection**
- C. Movement**
- D. Mineral Storage (Calcium + Phosphorus)**
- E. Hematopoiesis (blood cell formation in red marrow)**
- F. Energy Storage (lipids/fat stored in yellow marrow)**

### **II. Histology of Skeletal Tissue (Osseous Tissue):**

#### **A. Different Cell Types :**

- 1. osteoprogenitor cells give rise to osteoblasts**
- 2. osteoblasts secrete proteins, Ca, P**
- 3. osteocytes maintain bone integrity**
- 4. Osteoclasts degrade and absorb bone during growth**

#### **B. Chemical Composition :**

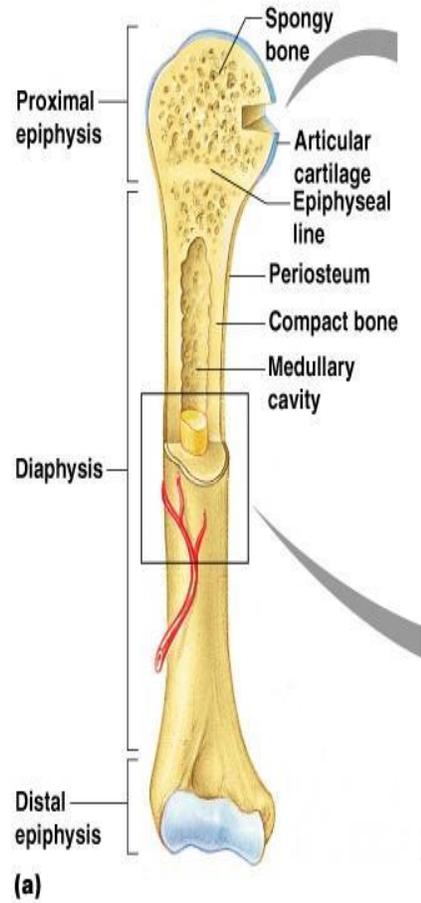
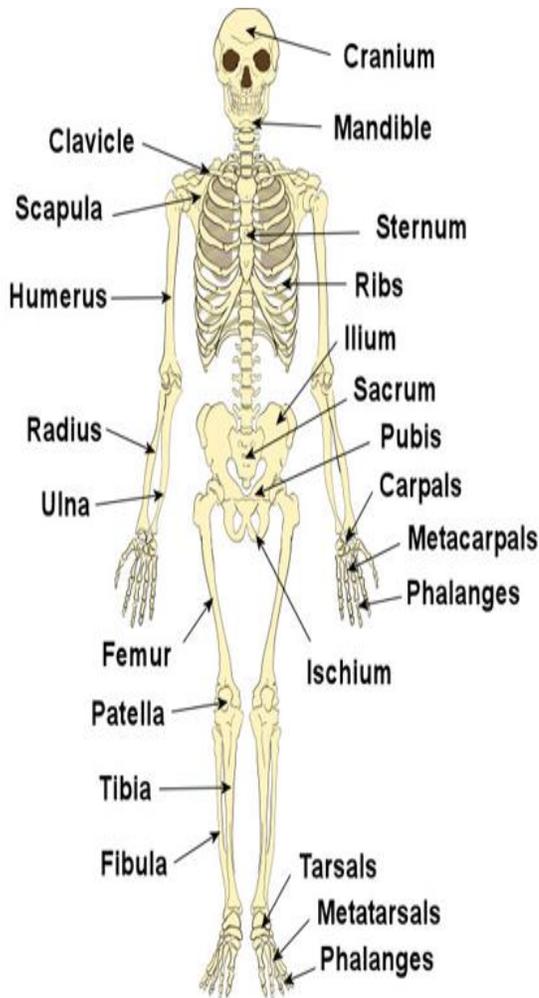
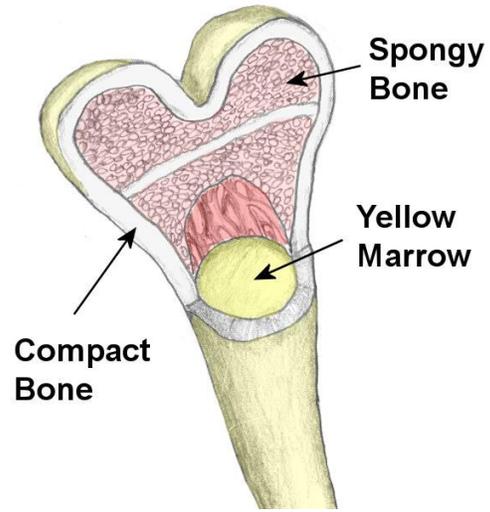
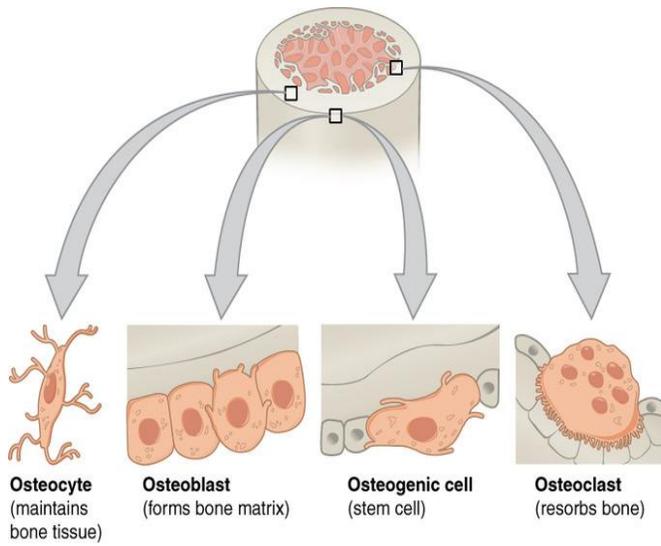
- 1. 33% collagenous fibers as in connective tissue**
- 2. 67% mineral salts - calcium phosphate + carbonate**
- 3. hardening depends on correct amount of each**

#### **C. Classification of Bones:**

- 1. Long Bones – most limb bones, finger bones**
- 2. Short Bones – wrist bones**
- 3. Flat bones – most cranial bones, ribs, sternum, and scapula**
- 4. Irregular bones – vertebrae, hip bones**
- 5. Pneumatic bones- sinuses in the skull.**

#### **General features of the bone**

- 1- all bones are covered with periosteum which is rich in blood vessels.**
- 2- Most of bones are covered in their end with cartilaginous layers.**
- 3- Bones contain marrow inside them which is red in young age and then filled with fat to be yellow in old age.**



## Lecture 14: The Axial Skeleton

A. **fissure**: cleft-like opening between adjacent parts of bones through which vessels & nerves pass

B. **foramen** : hole through which blood vessels, nerves, ligaments can pass

C. **meatus**: tunnel-like passageway through a bone

D. **sinus**: cavity within a bone with narrow opening

E. **sulcus** :groove or depression that accommodates a soft structure such as vessels, nerve, tendon

F. **fossa**: depression in/on a bone; generally at a joint

G. **process**: prominent projection or point of attachment

### \* Articular Processes (of the joints)

H. **condyle**: large, rounded articular (joint) prominence

I. **head**: rounded articular projection supported by a moreconstricted portion of a bone (neck)

J. **facet**: smooth, flat surface on a bone

### \* Processes for Attachment (tendons, ligaments, etc.)

K. **tubercle** small, rounded process

L. **tuberosity** large, rounded, usually rough process

M. **trochanter** large, blunt projection; only on the femur

N. **line** less prominent ridge than a crest

O. **spine** sharp, slender process.

## II. Curvature of the Vertebral Column

### A. Normal Curves in Vertebral Column:

1. Cervical curve - concave posteriorly
2. Thoracic curve - convex posteriorly
3. Lumbar curve - concave posteriorly
4. sacral-coccygeal curve - convex posteriorly

## B. Abnormal Curves of the Vertebral Column

1. Kyphosis - exaggerated thoracic curve (hunchback)
2. lordosis - exaggerated lumbar curve (slumping)
3. Scoliosis - **S-shaped deviation out of midsagittal plane.**

## III. Identifying Characteristics of Different Vertebrae

- A. cervical
- \* C1 (atlas) no body, no spine
  - \* C2 (axis) bifid spine, dens (head)
  - \* C3-6 bifid spine
  - \* C7 non-bifid spine, bulges from lower neck
  
  - \* Transverse foramen (vessel+nerve)
  - \* Largest vertebral foramen (down->smaller)
- B. thoracic
- \* T1 sup. Whole facet: inf. demi facet
  - \* T2-8 two demi facets; sup. Large/inf. small
  - \* T9 single superior demi facet
  - \* T10-12 whole facet for individual rib
  
  - \* long, inferior-directed spinous processes
  - \* transverse processes are long and heavy
- C. lumbar
- \* all have largest, thickest bodies
  - \* spinous processes are oblong and heavy
- D. sacral
- \* 5 bones fused at middle age to form sacrum
- E. coccygeal
- \* 3/5 bones fused to form coccyx

## IV. **Intervertebral Disc**

### A. Functions

1. absorb stress/shock on the vertebral column
2. provide surface for vertebra to twist

### B. Structure

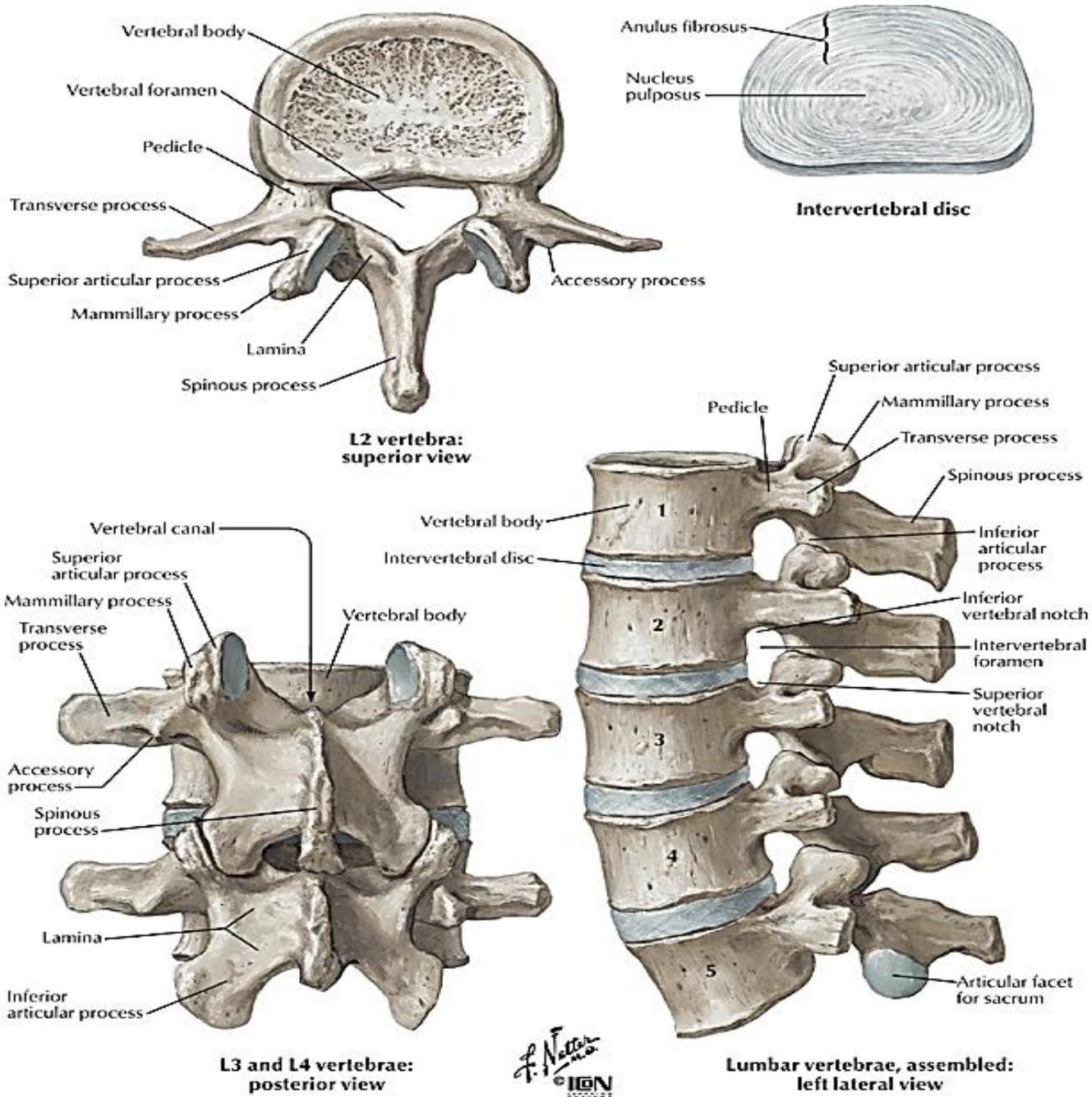
1. annulus fibrosus - outer ring of fibrocartilage
2. nucleus pulposus - inner structure, highly elastic

### C. **Herniated Disc**

1. nucleus pulposus ruptures through the fibrocartilage
2. generally ruptures at L3-5 (lower back slipped disc)
3. most often occurs in posterior direction
4. can compress spinal nerves and spinal cord.

## Vertebral Column (8)

Its length 70 cm in man and 60 cm in woman its composed of 33 vertebrae on five areas:



1-seven cervical vertebrae

2- Twelve thoracic vertebrae.

3- Five lumbar

4- five sacral

5- Four coccygeal

**On lateral looking of the column there are four curvatures:**

1-back ward thoracic

2- Fore ward cervical

3- for ward lumbar

4- Back ward sacrococcygeal

**These curvatures either primary ones from a bone or like thoracic and sacrococcygeal or secondary after walking like cervical and lumbar.**

**Anterior view of the column :**

-the bodies of vertebrae are different in size and become bigger down , the biggest one is at the lumbo-sacral angle then the size decreased gradually.

**-Posterior view of the column:**

See the spines of the cervical; it is bifid except at the cervical 7, in which the spines are big and not bifid.

**Functions of the vertebral column:**

1-gives the outlook of the skeleton of the body in erect posture.

2- Protect the spinal cord inside.

3- Bear the weight of the body.

**Characteristics feature of typical vertebrae:**

1-body: in which forms the anterior border of vertebral foramen.

2- Vertebral arch.

3- Vertebral processes: a- transverse process.

B-spine.

C-articular processes.

