GROSS Anatomy

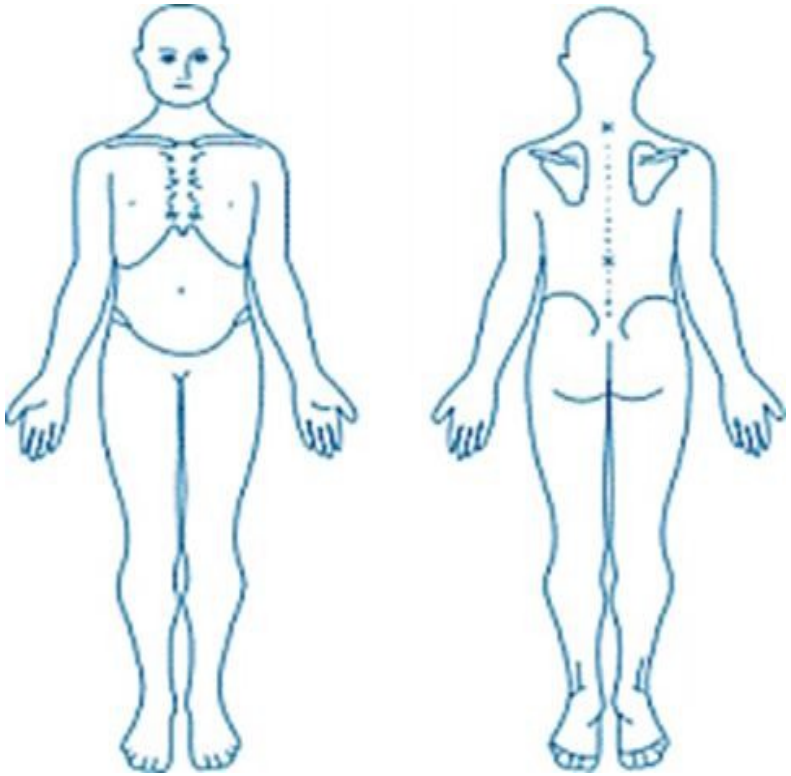
1. Introduction to Anatomy

Lecture Note for post basic nursing & midwifery

Dr. GENALE
(MD)

1. Introduction to ANATOMY

- Outline:
  1) Introduction to human body
  2) Integumentary system
  3) Skeletal System
  4) Muscular System
  5) Circulatory System
  6) Nervous System



1) INTRODUCTION TO HUMAN BODY

Definition of Anatomy

- The word Anatomy is derived from a Greek term **''Anatome''**

  (**ana** = apart & **tome** = cutting), meaning cutting apart.

- Present definition: the study of normal structures of the body and their relationships.

Anatomy

- is one of the oldest basic medical sciences
- first studied formally in Egypt (~500 B.C.) and Later taught in Greece.

Hippocrates (460-377 B.C)

- Considered as Father of the medicine and a founder of the science of anatomy

Aristotle (384-322 B.C)

- First person to use the term ‘’**Anatome**’’

Divisions of Anatomy

Gross (macroscopic) anatomy

- Studies the human body parts (structures) that are visible without microscope
- It is usually studied by means of **dissection** of the body (cadaver)

Surface anatomy

- Study of internal structures as they relate to the overlying skin (body surface)

Divisions of Anatomy

Microscopic anatomy= Histology

- Studies cells, tissues and organs by the help of a light microscope

Developmental anatomy= Embryology

- Studies structural changes of an individual from fertilization to adulthood

Divisions of Anatomy

Comparative anatomy

- Comparative study of the structures with regard to homologous organs or parts

Radiological anatomy

- Study of structures of the body by using radiographs

Approaches to study anatomy

Systemic anatomy

- Studies anatomy by organizing structures of related function in to d/t systems of the body

- About ~~ELEVEN~~ specific systems are functioning together in the human body.

  Eg. Urinary system

  Skeletal system

  Nervous system…

Approaches to study anatomy

Regional anatomy

- Studies anatomy by dividing the body into certain related parts.

- Deals several systems located in specific region of the body

Eg. Upper limb
Lower limb
Head & neck
Abdomen
Pelvis & perineum
Thorax
CNS

Approaches to study anatomy

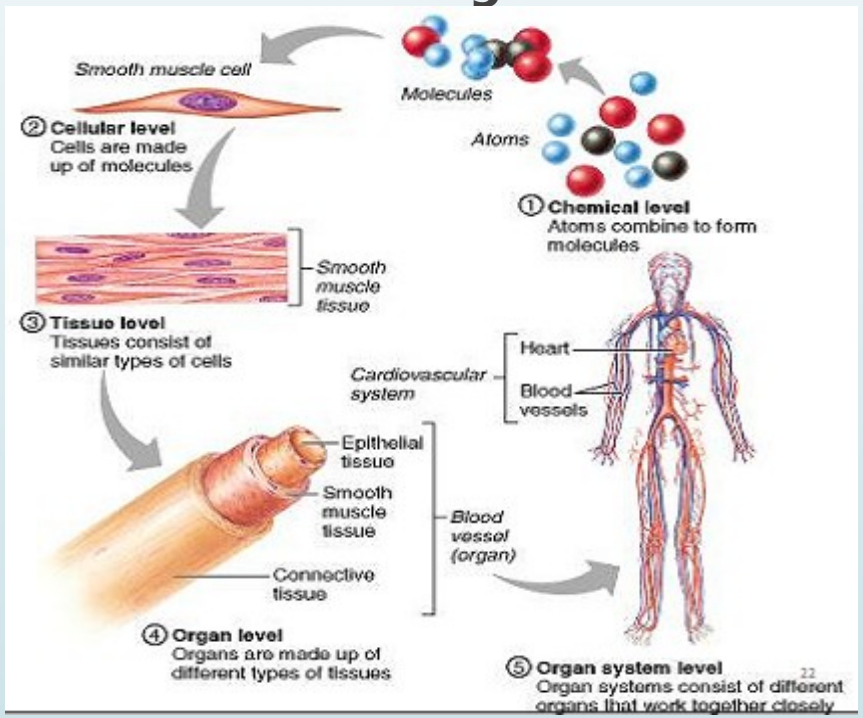
Applied (clinical) anatomy

- Correlation of anatomical knowledge to the diagnosis and treatment of diseases as in surgical procedure

- Emphasis is given to structures of clinical importance

Levels of Structural Organization of Human Body

Chemical level to **Organismic level**



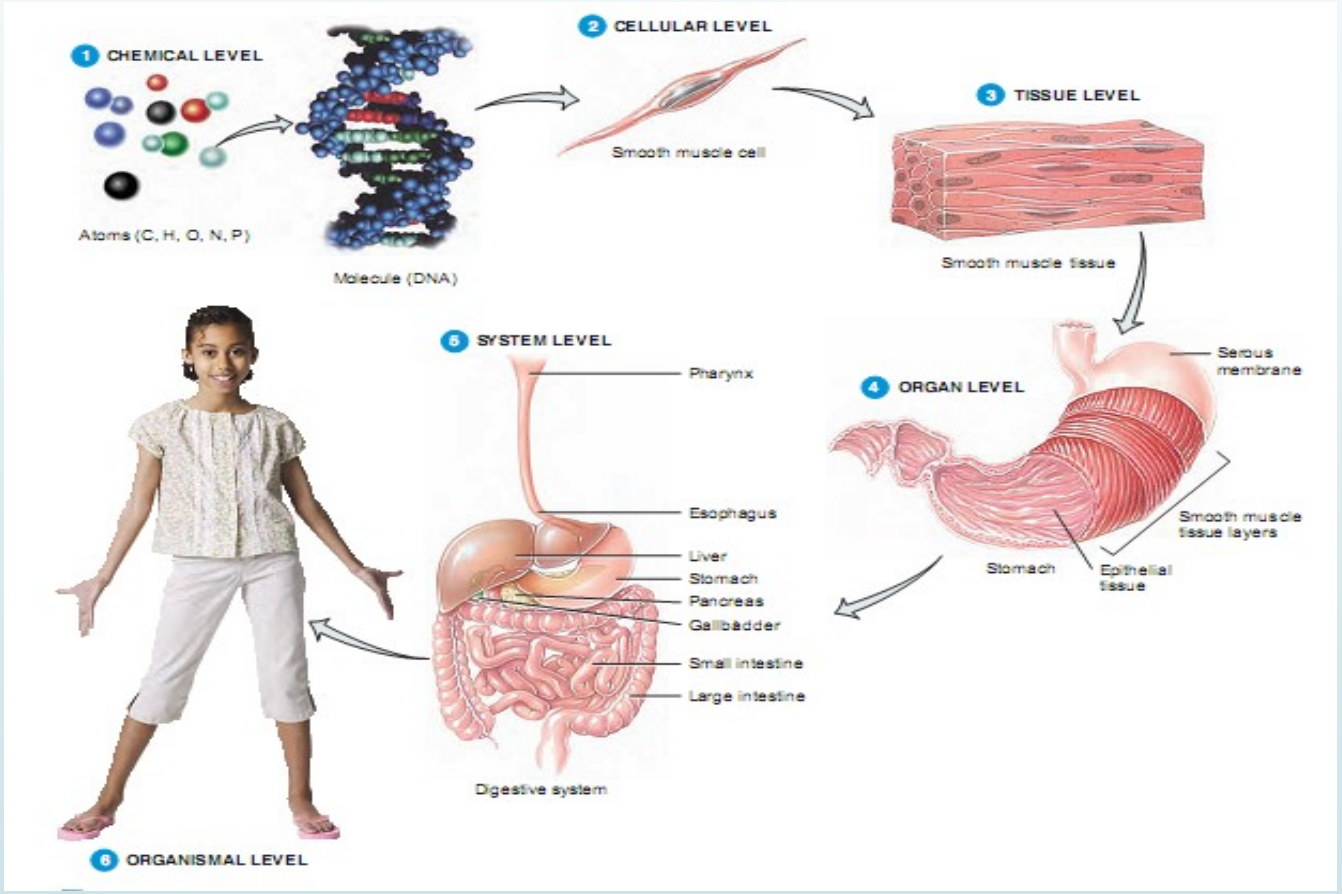
Read!

Levels of structural organization

- Atomic level
- Molecular Level
  - **(Atomic → Chemical → Molecules)**
- Organelle level

  - **Molecules → Organelle → Cell**
- Cellular level
- Tissue Level
- Organ Level
- Organ system Level
- Organism Level

Levels of organization



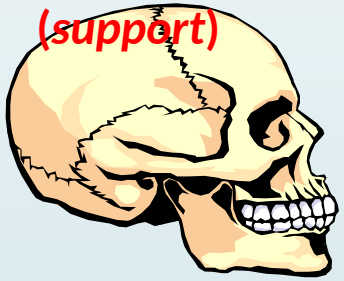
Cont…

- These tissues differ in the types and functions of their cells, and the products of those cells and the relative distribution of the two.

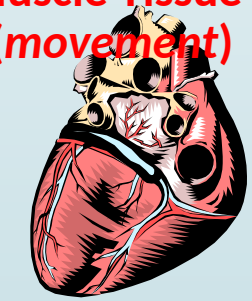
1. Epithelial Tissue
(covering/lining)



2. Connective Tissue
(support)



3. Muscle Tissue
(movement)



4. Nervous Tissue
(control)



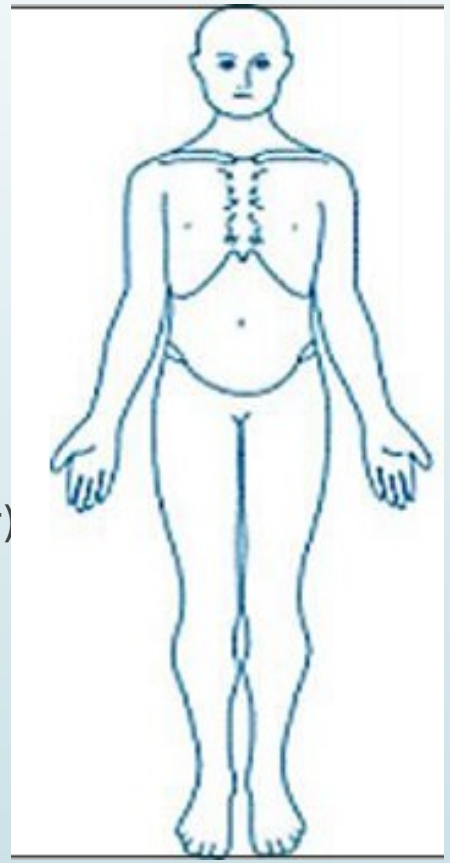
Anatomical Position

- is the **standard reference position of the body** used to describe the position & relations of various anatomical structures

- All descriptions in human anatomy are expressed in relation to the anatomical position

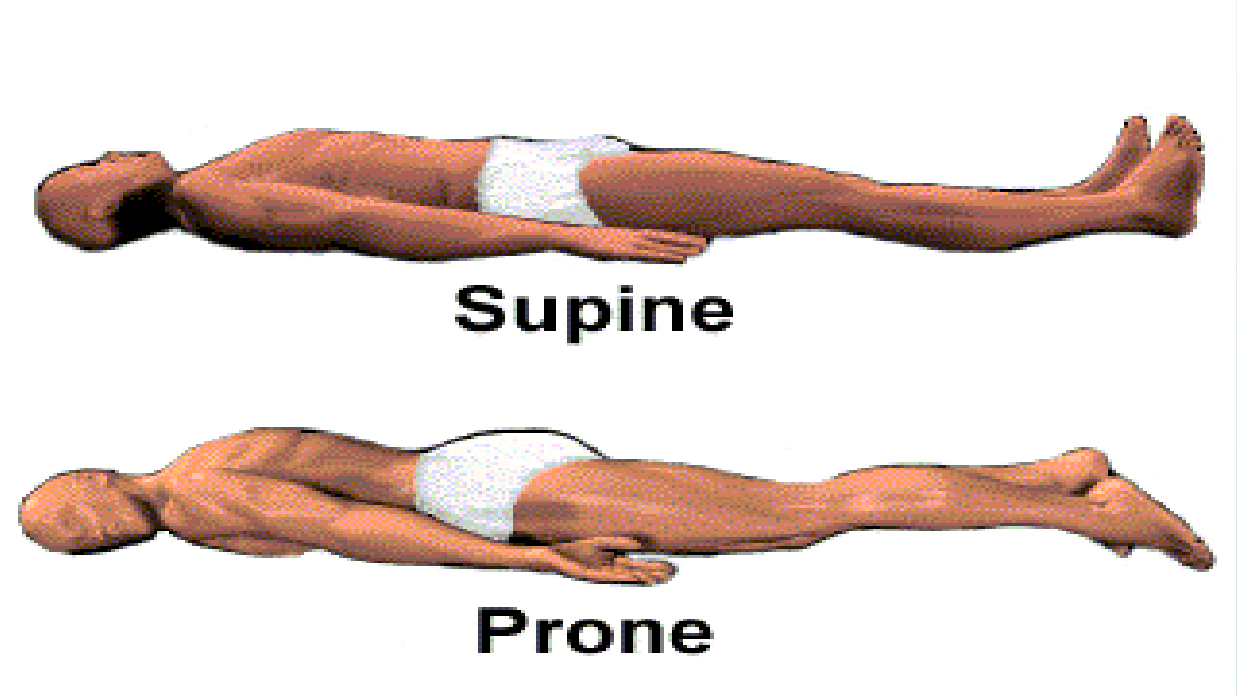
Anatomical Position…

- To be in Anatomical position, individuals (the body) should:
  - Stand erect
  - Eyes looking directly forward
  - Upper limb by the sides
  - Palms directed forward
  - Lower limbs lie parallel (together)
  - Feet directed anteriorly (the toes directed forward)



Supine position: face up & palm down when lying on back (dorsal surface of the body).

Prone position: face down & palm face up when lying on anterior (ventral) surface of body



Anatomical Planes and Sections

1. Sagittal Plane

- Directed from front to back dividing the body into right and left parts

A. Mid-sagittal or median plane

- divides the body or part of the body into **equal** right & left halves)

B. Para-sagittal planes

- divides the body (parts) into **unequal** right & left sides

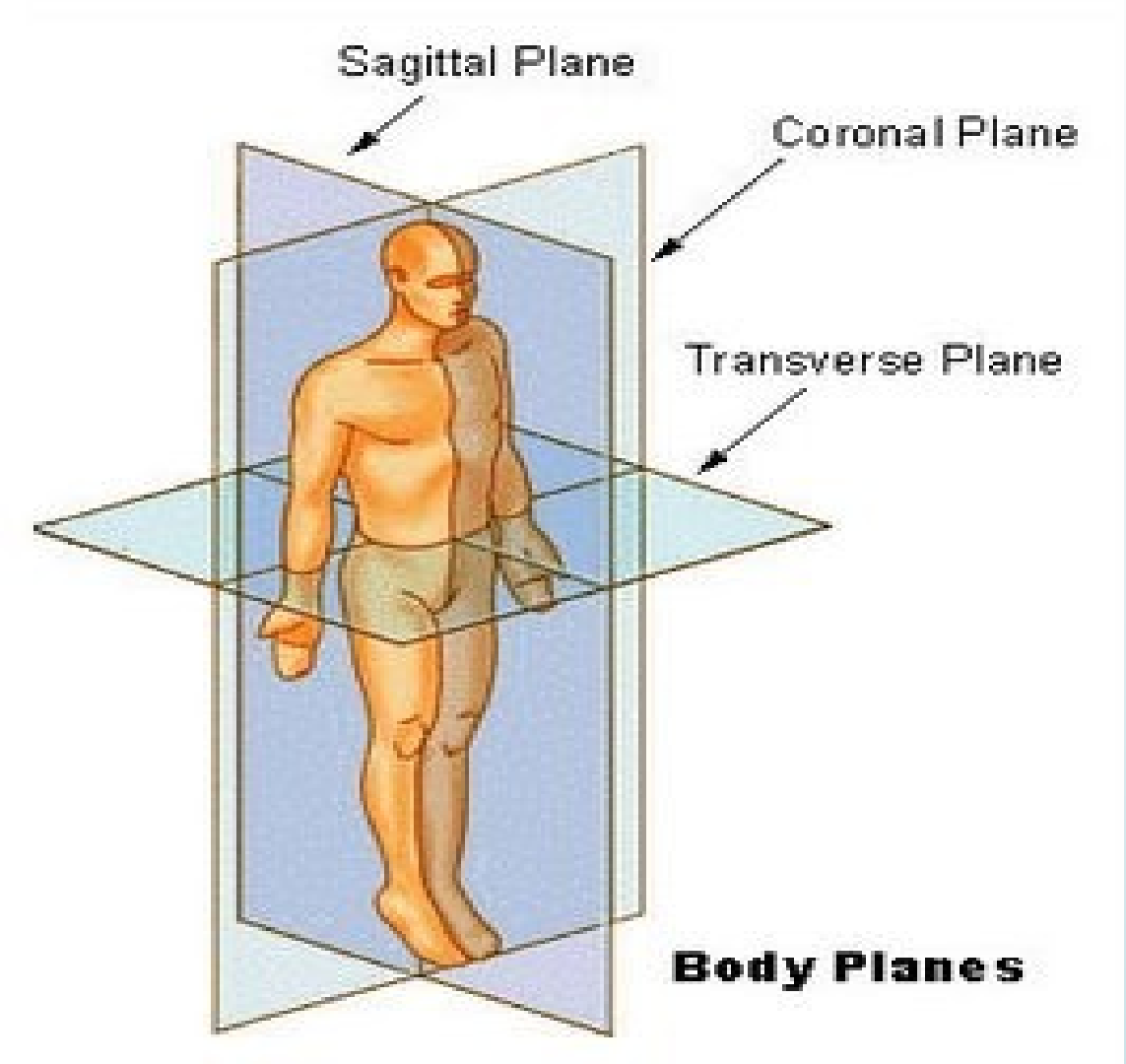
Anatomical Planes and Sections…

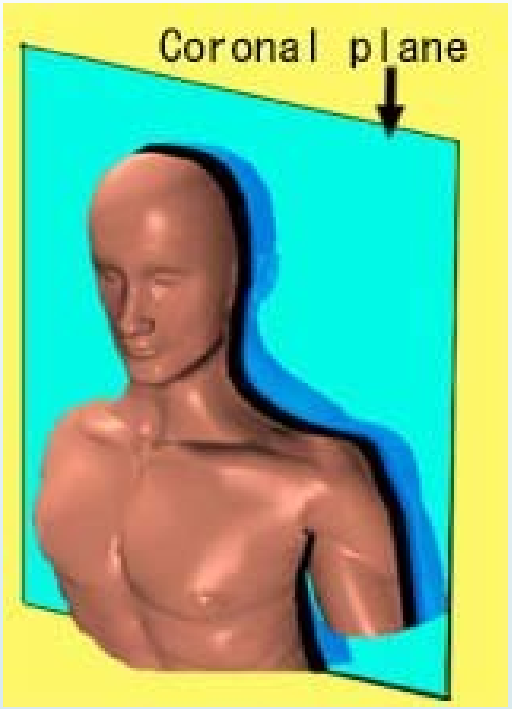
2. Coronal (Frontal) Plane

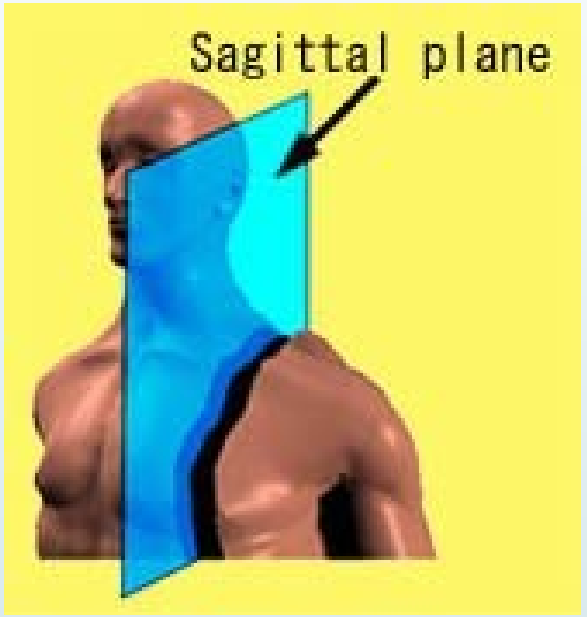
- It divides the body longitudinally into anterior & posterior parts

3. Horizontal Plane

- a transverse plane which runs horizontally at a right angle to the vertical plane
- It divides the body into upper & lower parts


Sagittal Plane
Coronal Plane
Transverse Plane
Body Planes





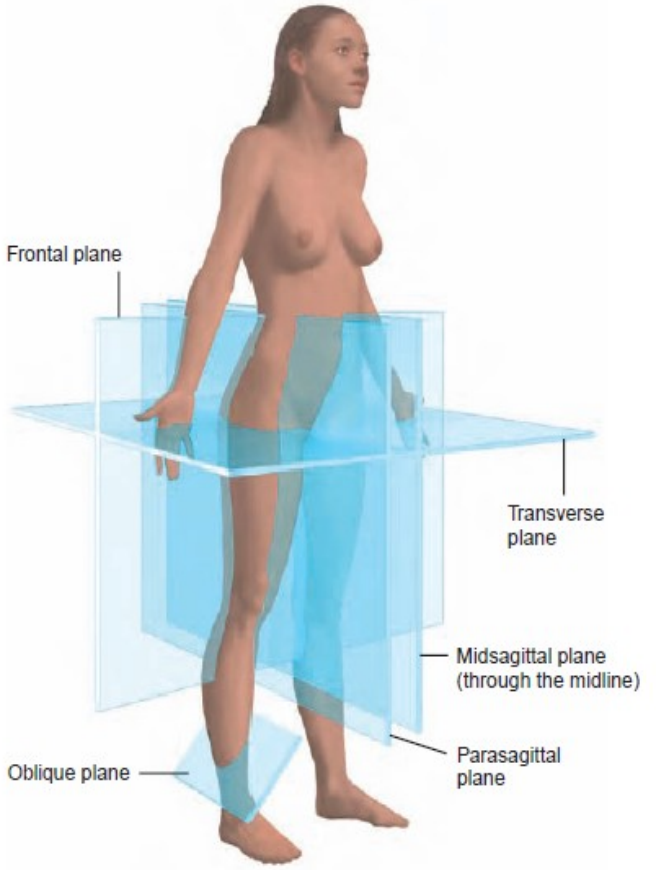
Body parts in front of the plane, or on the front of the body, are said to be ventral or anterior. Body parts on the back of the body or behind the plane are said to be dorsal or posterior.

Anatomical Planes and Sections…

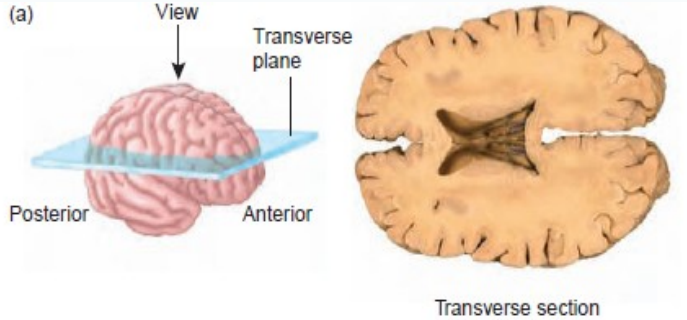
- Sections of the body parts correspondingly named as the planes:
  - Sagittal section
  - Median section
  - Frontal or coronal section
  - Horizontal, transverse or cross section
  - Oblique section

Planes through the human body.

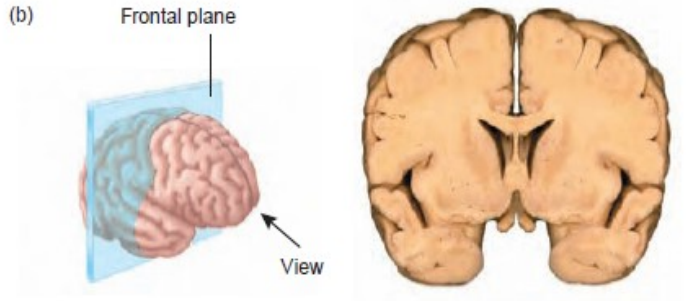
Frontal, transverse, sagittal, and oblique planes divide the body in specific ways.



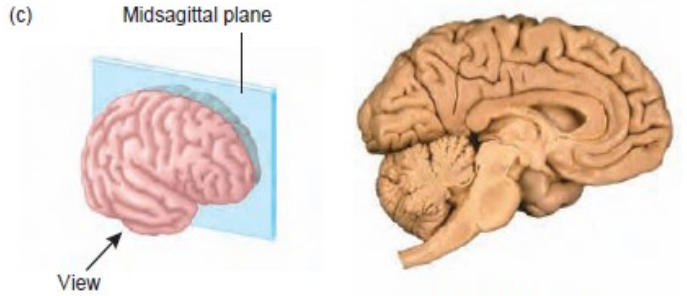
Right anterolateral view



Transverse section



Frontal section

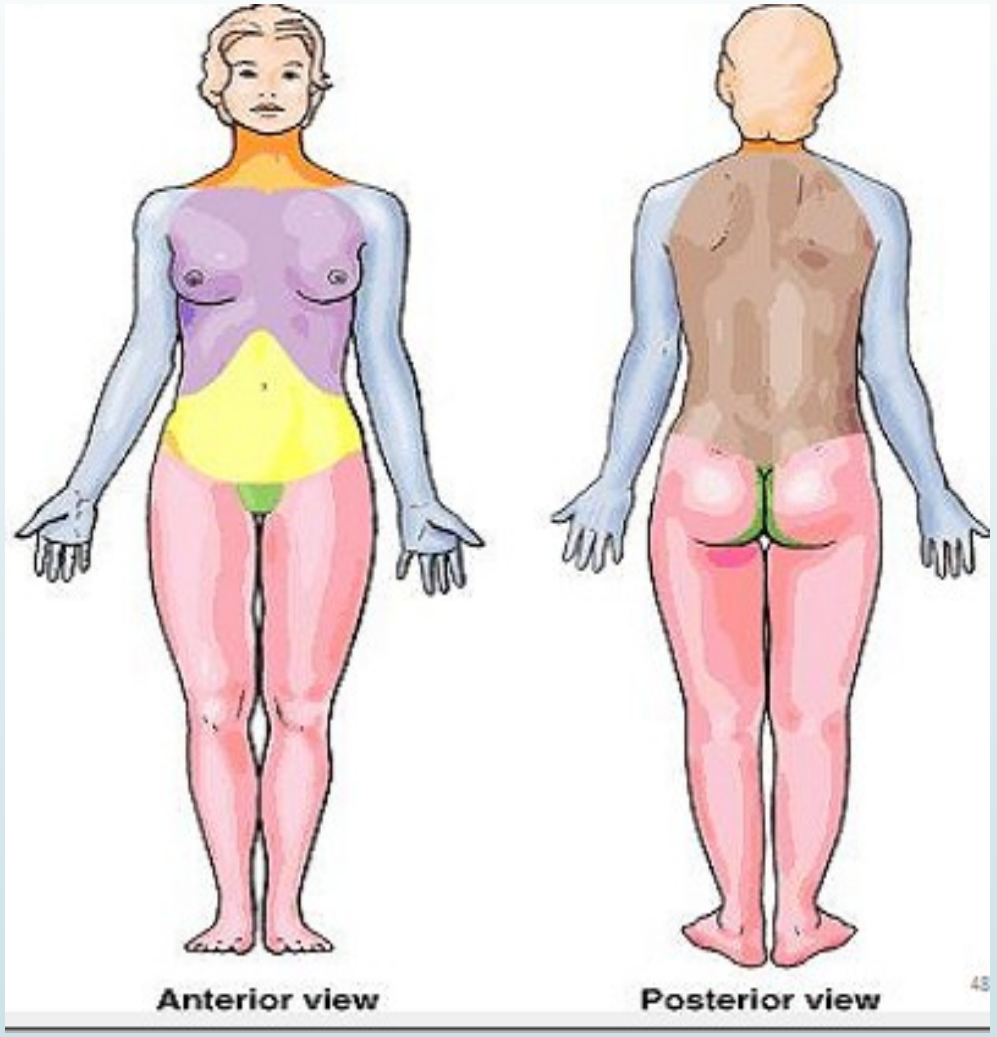


Midsagittal section

ANATOMICAL TERMS

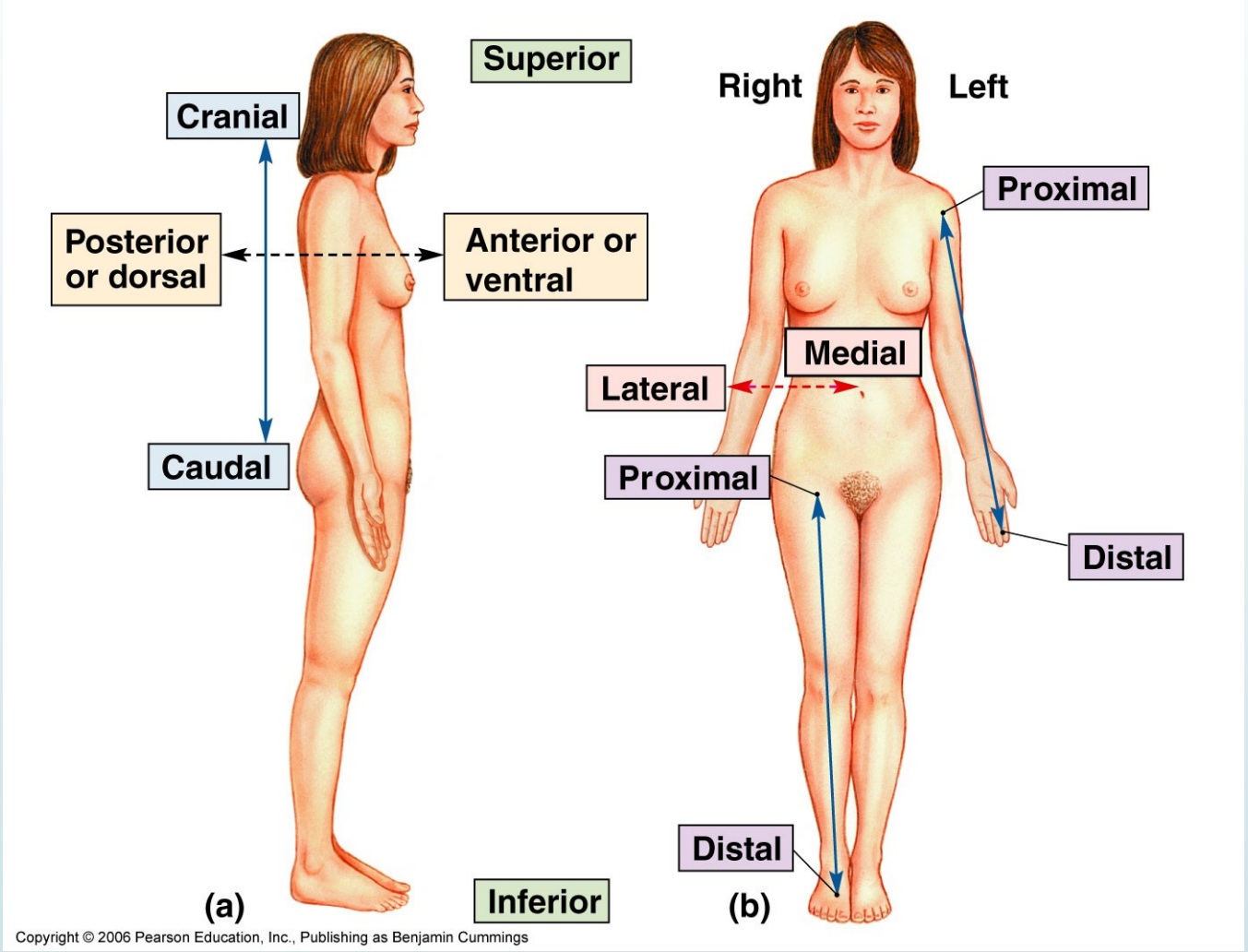
1. Terms of Position/Relationship

- **Anterior (ventral)**: a position on the front of the body or nearer to it.
- **Posterior (dorsal)**: a position on the back of the body or nearer to it
- **Medial**: nearer to the median plane
- **Lateral**: away form the median plane
- **Intermediate**: a position b/n medial point & lateral point


Anterior view
Posterior view

Terms of Position/Relationship…

- **Superior (cranial)**: a position relatively nearer towards the highest point in the body.
- **Inferior (caudal)**: a position relatively nearer to the lower end of the body.
- **Proximal**: a position relatively nearer to the point of origin.
- **Distal:** a position relatively away from the point of origin



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Fig. 1-8, p. 18

Terms of Position/Relationship…

- **Superficial**: a position relatively nearer to the surface of the body.
- **Deep**: a position relatively away from the surface of the body, i.e. towards the inside
- **Internal**: nearer to the cavity (Lumina) of the body
- **External**: away from cavity (Lumina) of the body

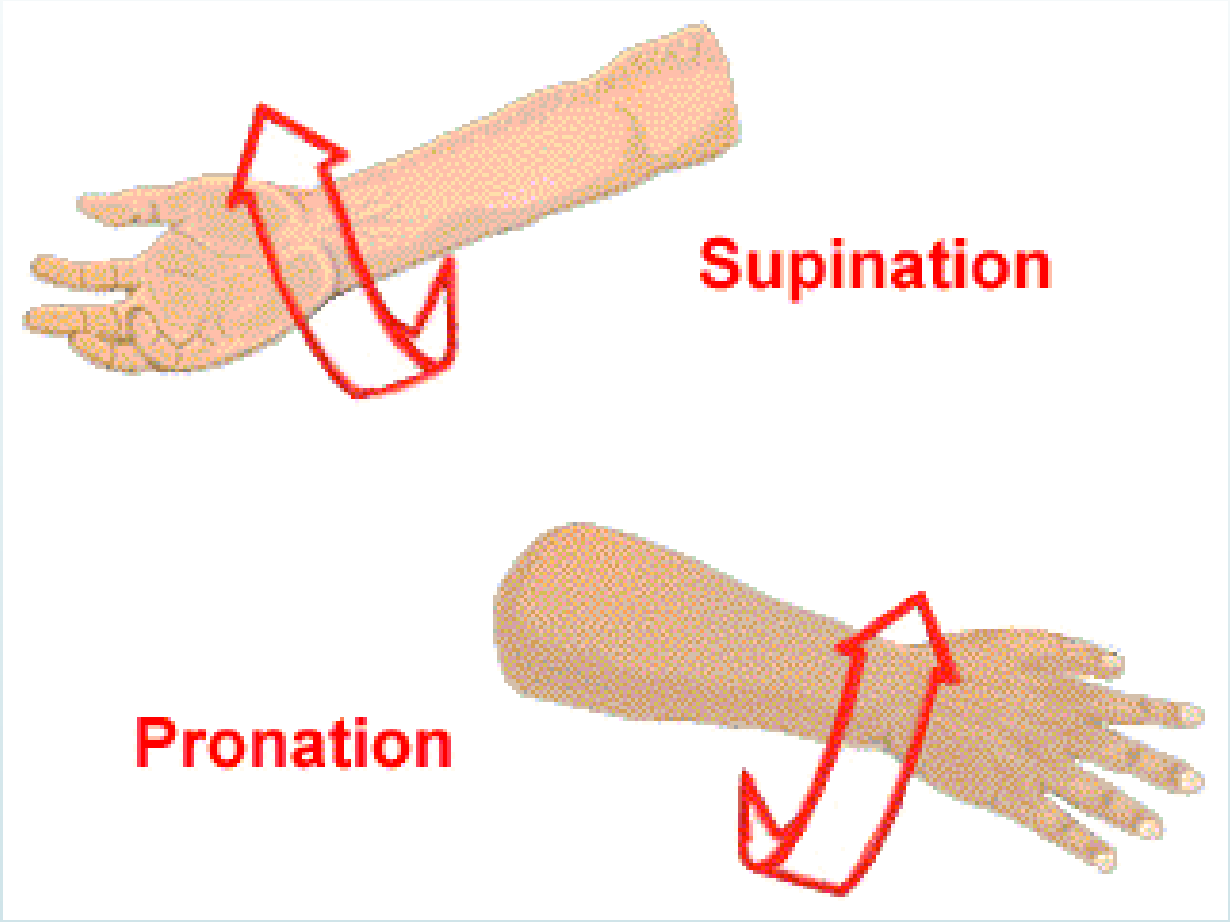
Terms of Position/Relationship…

- **Ipsilateral**: refers to same side of the body
- **Contralateral**: refers to the opposite side of the body
- **Bilateral**: paired structures having right & left members
- **Unilateral**: occurring on one side only (unpaired)

Anatomical terms of movement

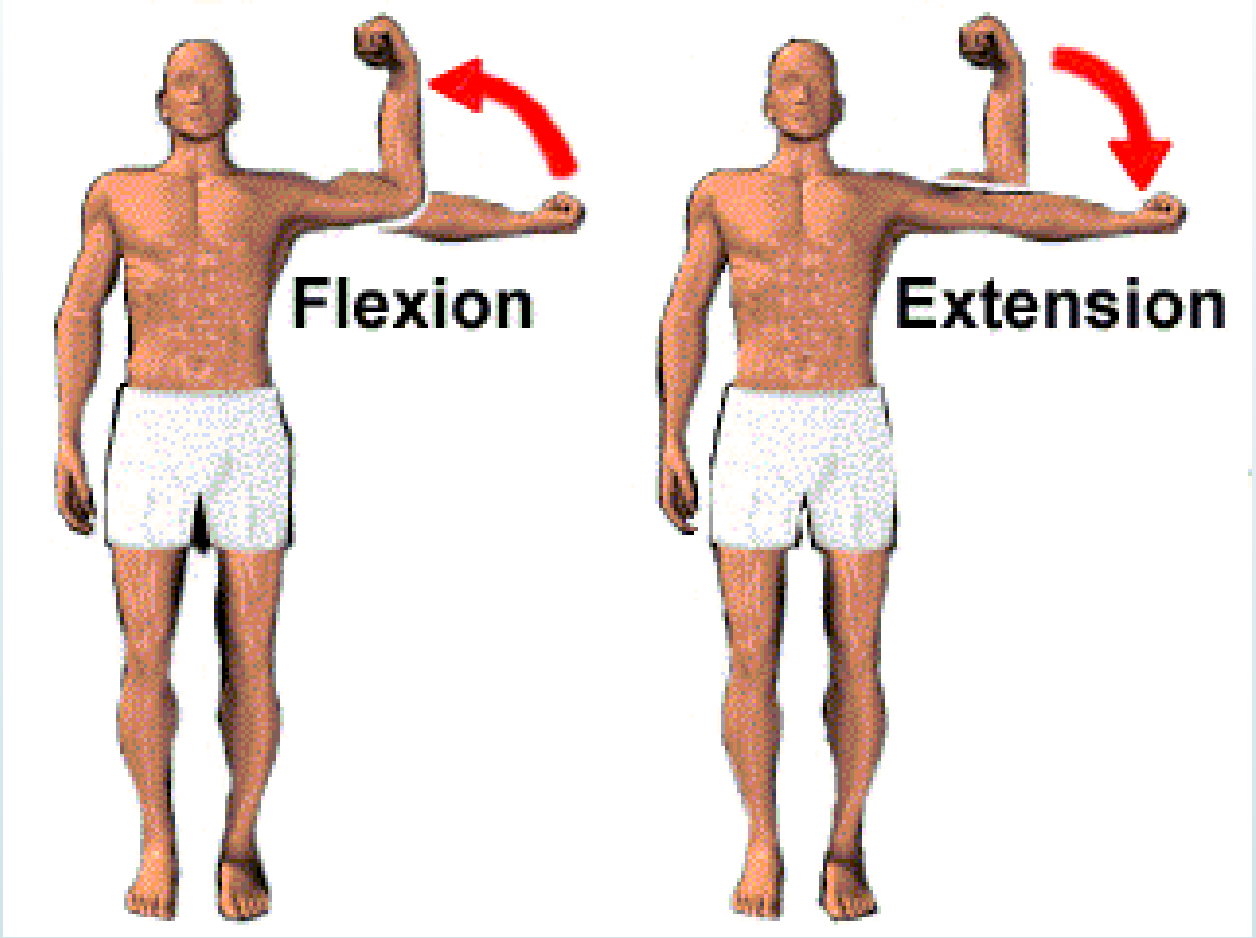
- Terms which describe the direction of movements that take place at joints

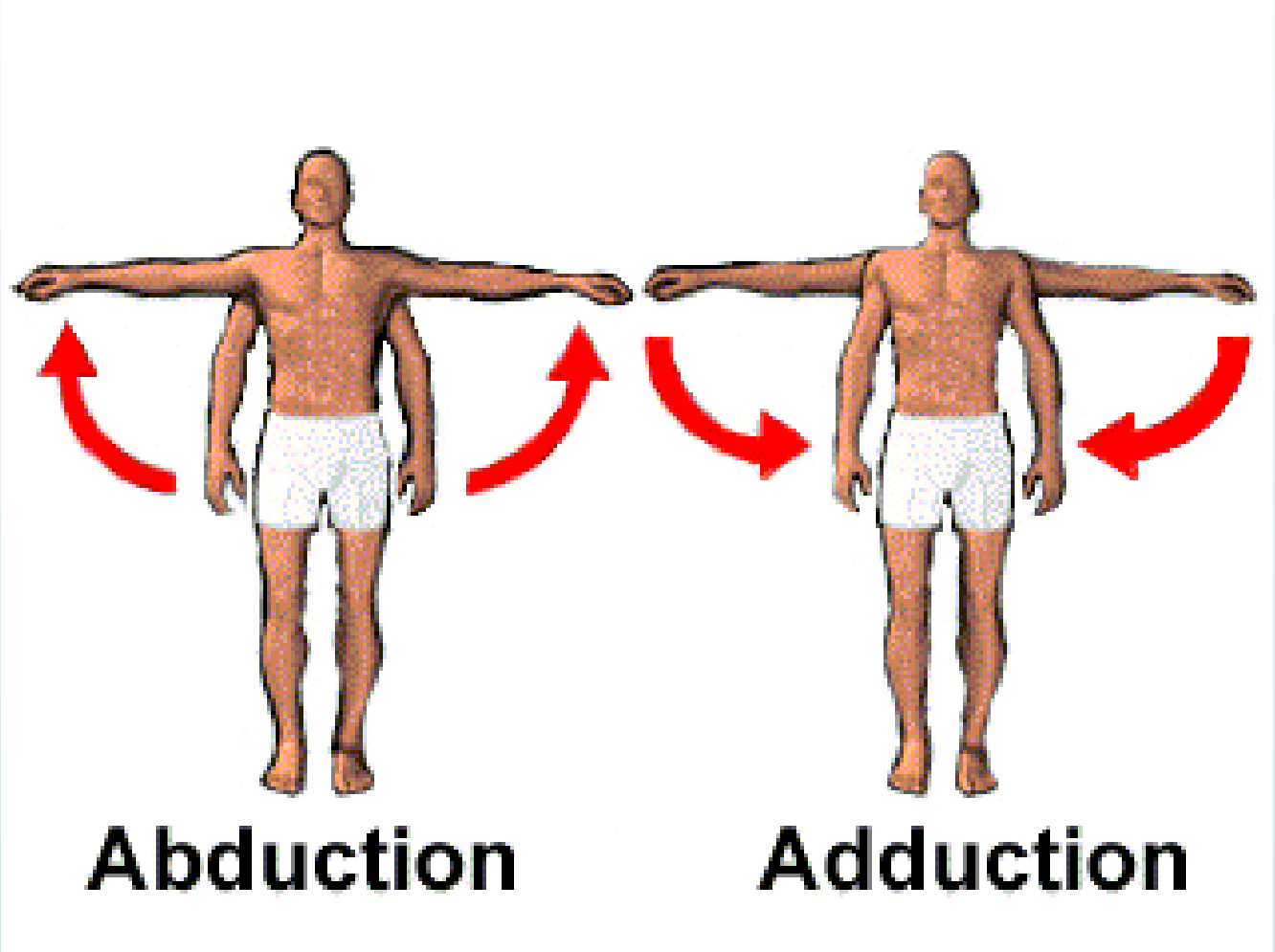
- **Supination**: mov’t of the forearm by facing palm of hand forward
- **Pronation**: mov’t of the forearm by turning palm of hand backward

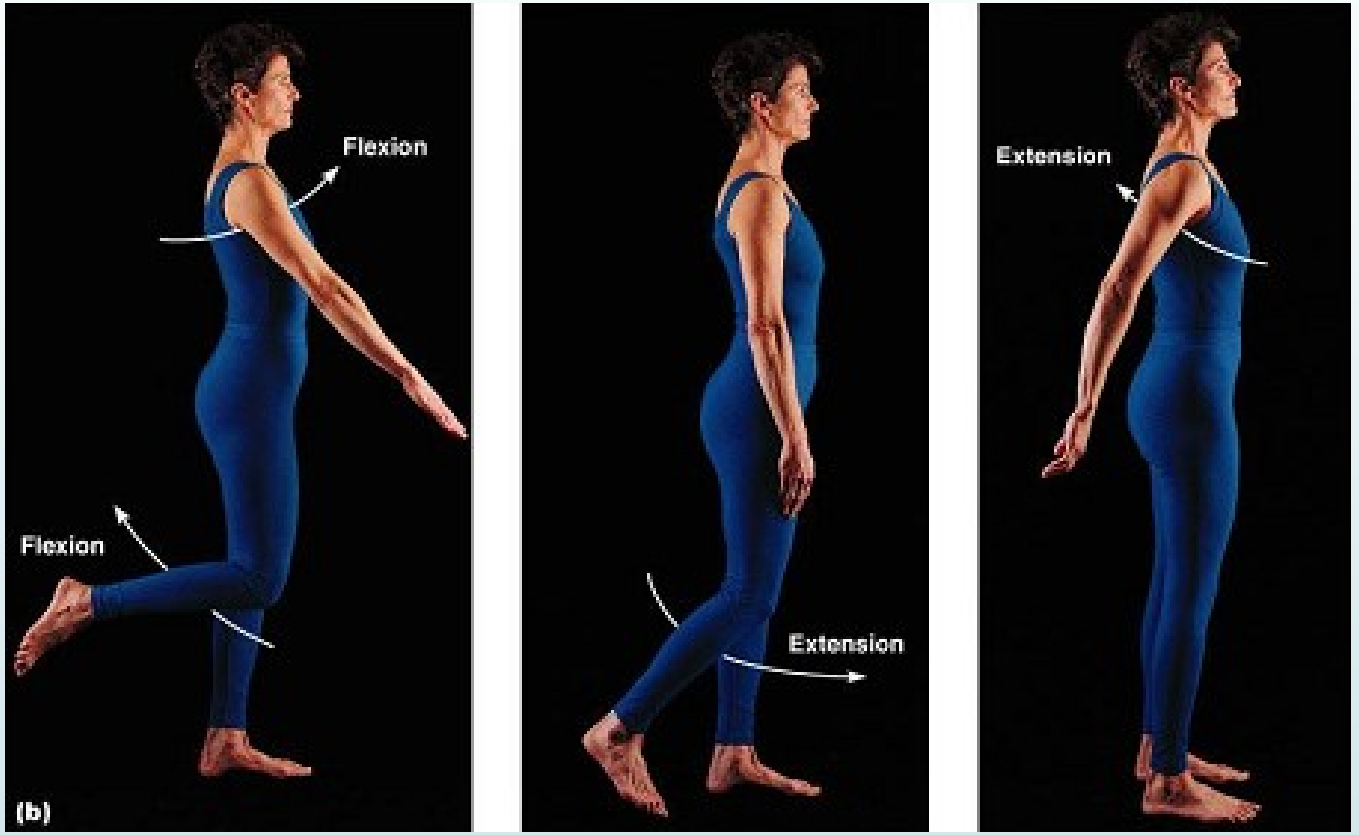

Supination
Pronation

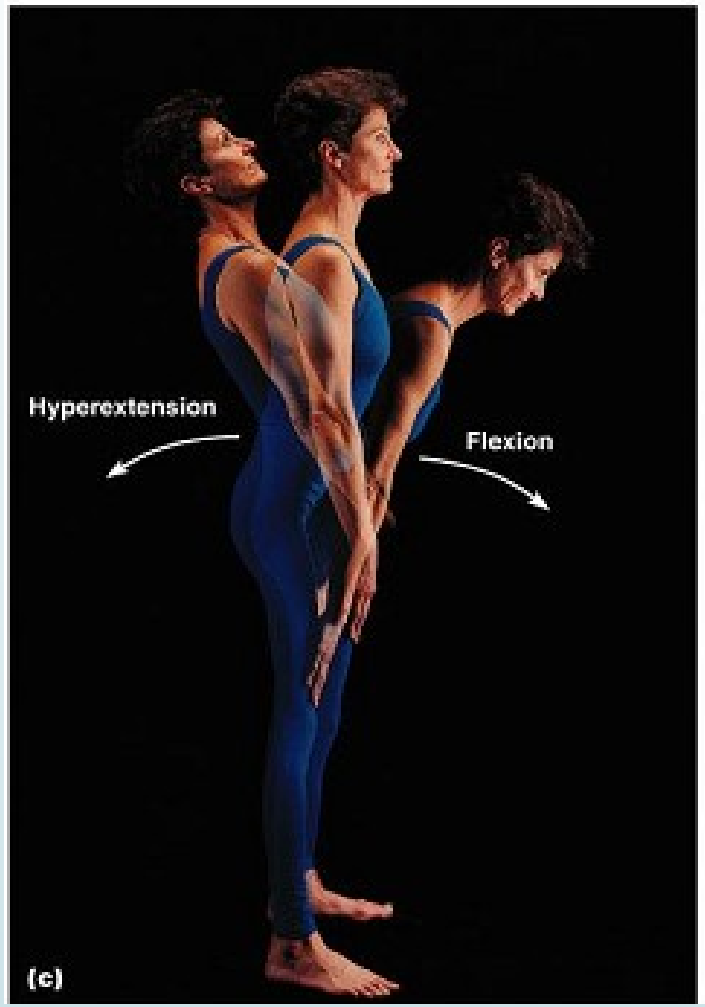
Anatomical terms of movement...

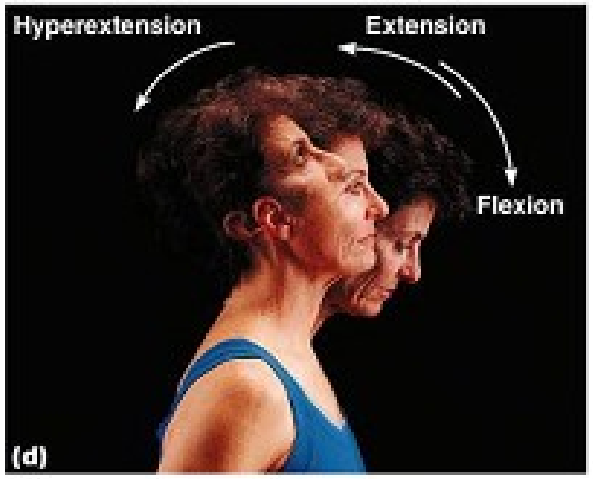
- **Flexion**: mov’t by decreasing angle b/n parts in the direction bending is possible
- **Extension**: straightening mov’t by increasing angle b/n parts
- **Hyperextension**: extension of a limb or part beyond the normal limit
- **Adduction**: movement toward median plane
- **Abduction**: movement away from median plane

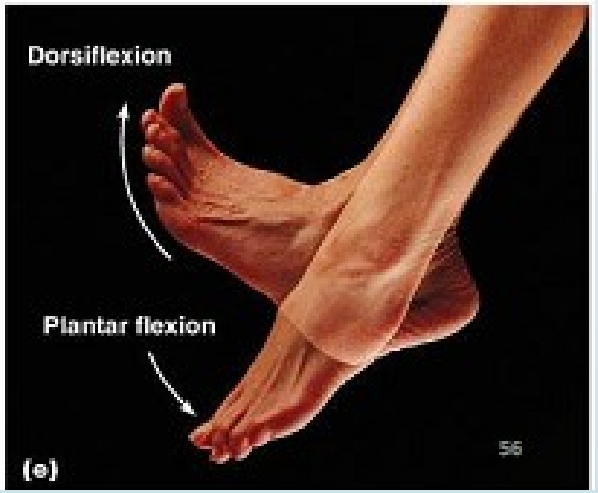

Flexion
Extension


Abduction
Adduction


Flexion
Flexion
(b)
Extension
Extension


Hyperextension
Flexion
(c)

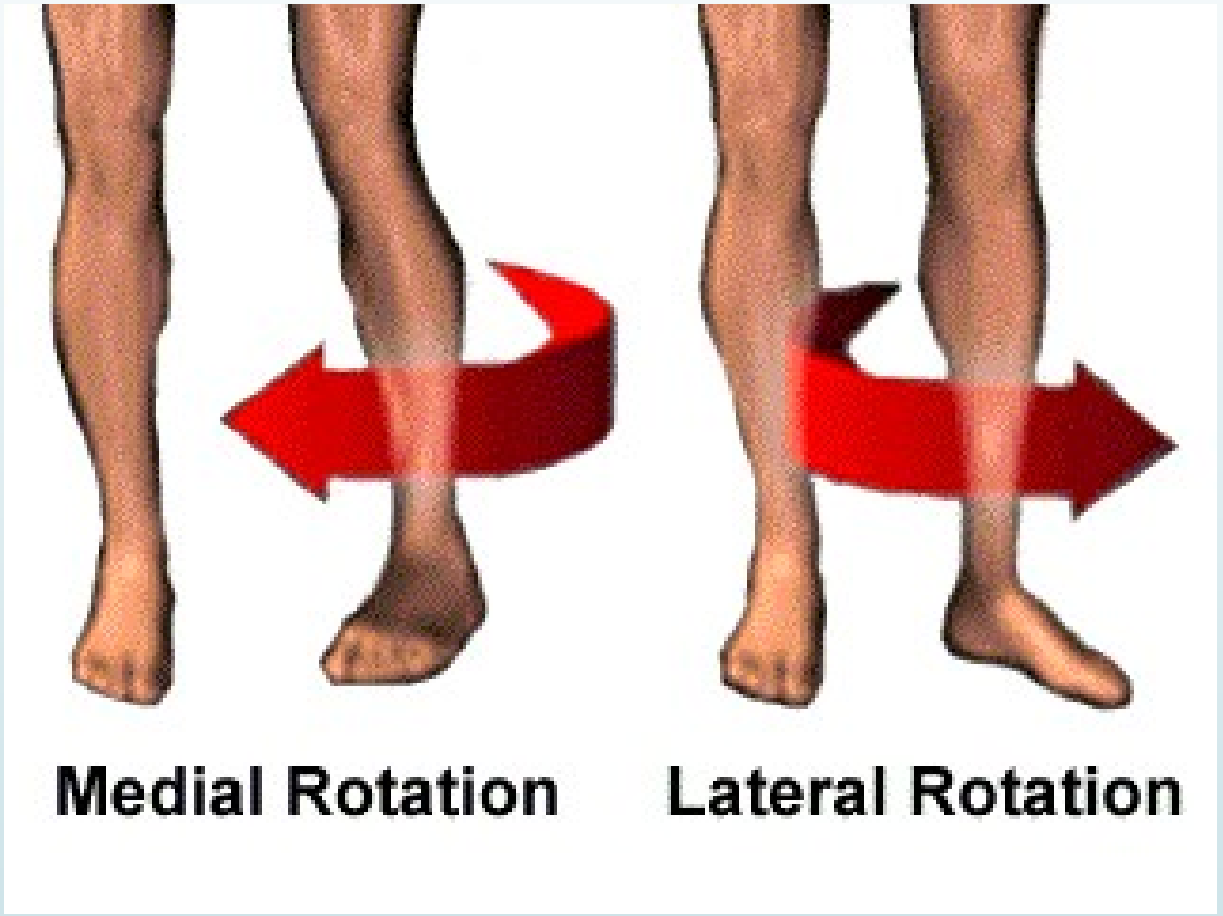

Hyperextension
Extension
Flexion
(d)

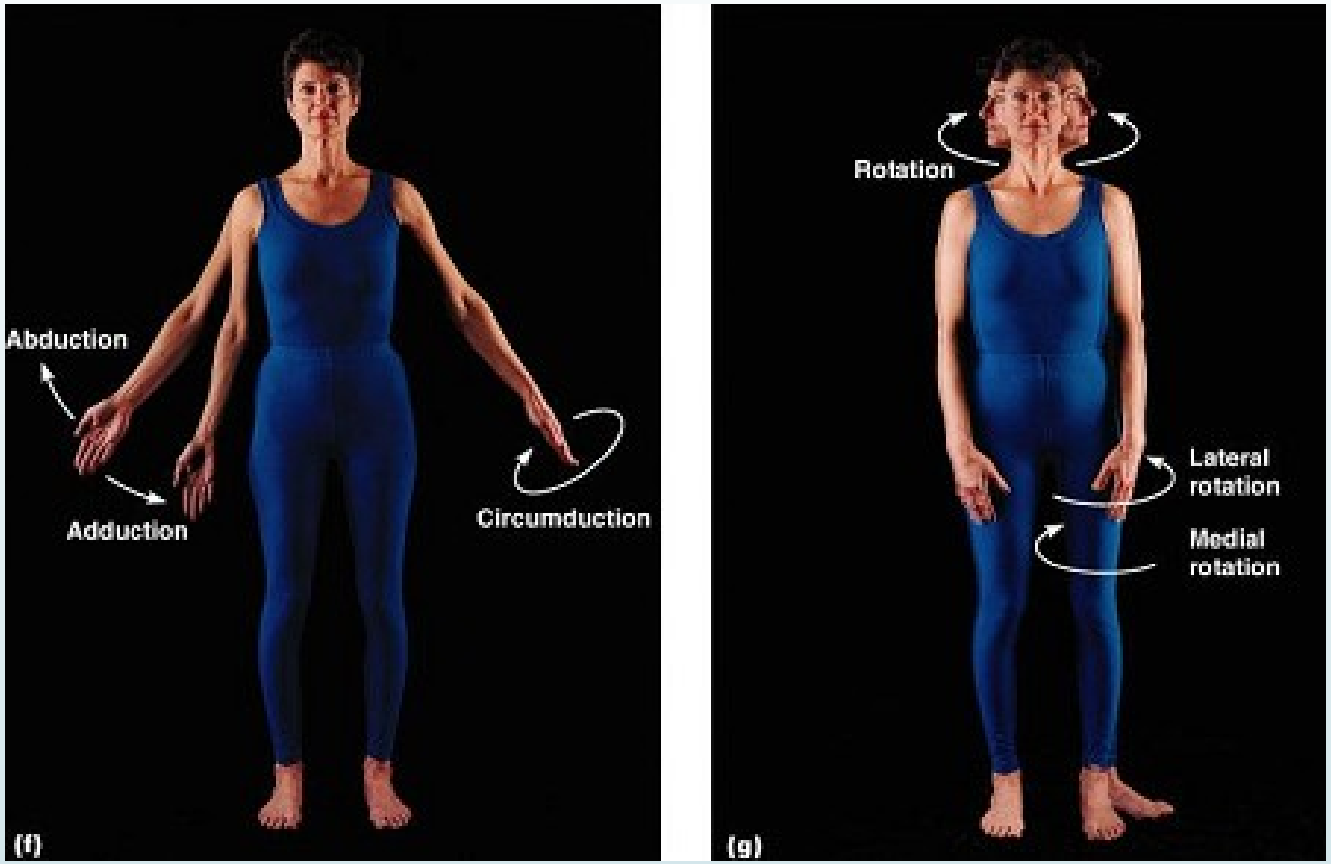

Dorsiflexion
Plantar flexion
(e)

Anatomical terms of movement…

- **Rotation:** rotary mov't of part of the body on fixed axis
  - **Medial rotation**: rotation toward median plane (inward)
  - **Lateral rotation**: rotation away from median plane (outward)

- **Circumduction**: is a circular movement of part of the body on fixed origin but changing axis
  - Is combination of flexion, extension, abduction, & adduction movements.


Medial Rotation
Lateral Rotation


Abduction
Adduction
Circumduction
(f)
Rotation
Lateral rotation
Medial rotation
(g)

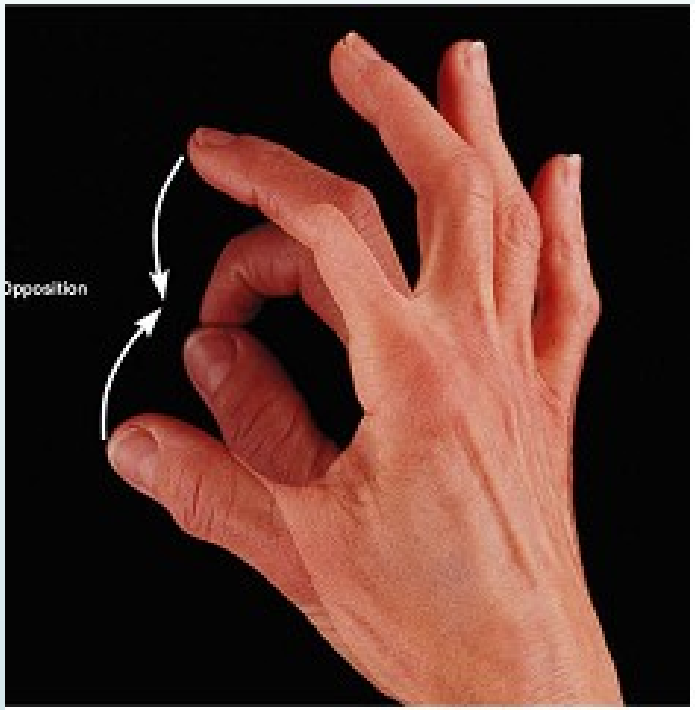
Anatomical terms of movement...

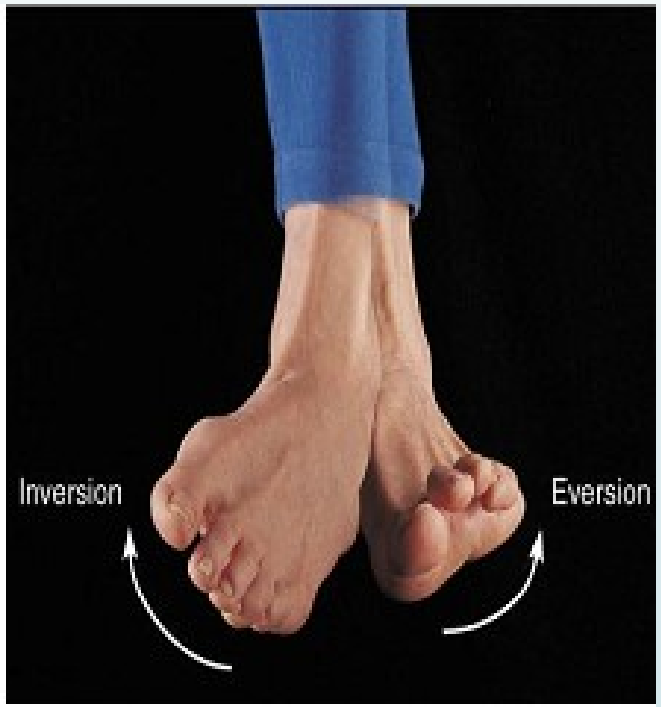
- **Opposition**: mov't of the thumb toward the other four digits as in holding an object
- **Reposition**: the movement of thumb from position of opposition back or away from other fingers as in releasing an object
- **Eversion**: mov't of the foot at an ankle joint by turning the sole away from the median plane
- **Inversion**: turns the sole of the foot toward the median plane (facing the sole medially)

Anatomical terms of movement...

- **(dorsiflexion)Dorsal flexion:** the up ward flexion mov't of foot at an ankle joint as in taking off foot from automobile pedal

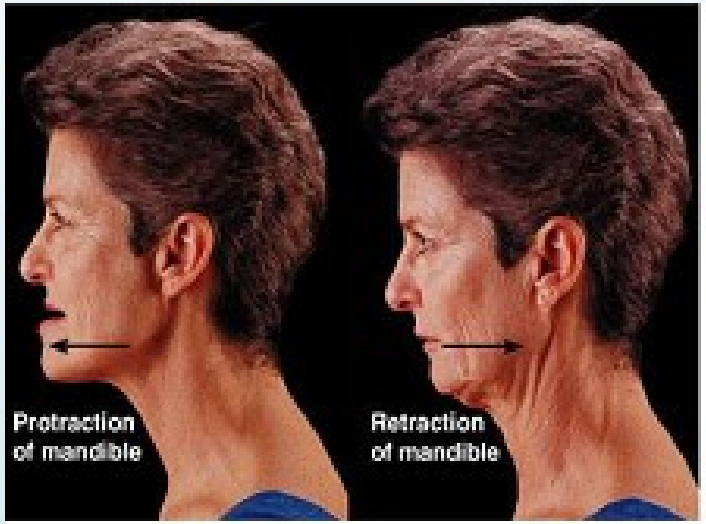
- **Plantar flexion:** the down ward flexion mov't of foot at an ankle joint


Opposition

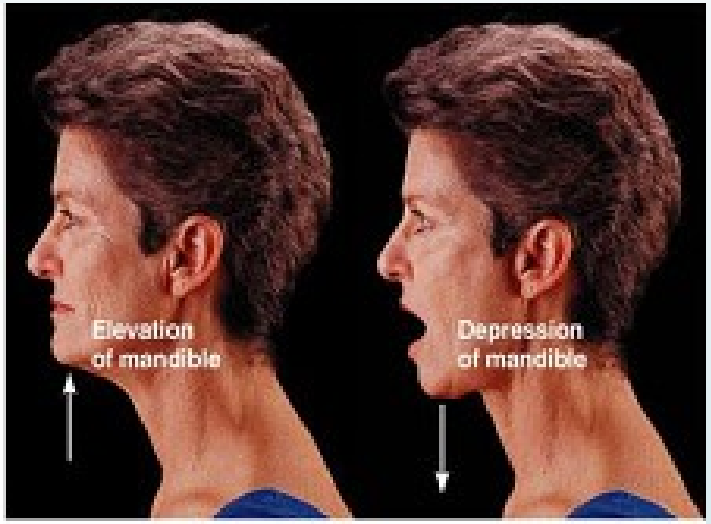

Inversion
Eversion

Anatomical terms of movement...

- **Protrusion (protraction):** is a movement anteriorly as in protruding the mandible, lips, or tongue
- **Retrusion (retraction):** is a movement posteriorly, as in retruding the mandible, lips,or tongue
- **Elevation**: raises or moves a part superiorly
- **Depression**: lowers or moves a part inferiorly



c) Protraction and retraction



(d) Elevation and depression

Anatomical Variations

- Human diversity is expressed in anatomical variations
- Books describe the most common patterns. However, occasionally a particular structure demonstrates so much variation within the normal range
  - ***Physical, sexual, racial, genetic….***
- A wide variation is found in the size, shape & form of attachments of ***muscles, bones*** & patterns of branching of ***veins, arteries & nerves***

✪ ***Individual variation must be considered in physical examination, diagnosis & treatment.***

Body Cavities

- Internal compartments of hollow spaces called body cavities
- Cavities protect internal organs, hold them in place, and allow them to change size and shape.
- All the internal organs found within these cavities are called viscera.

Body cavities

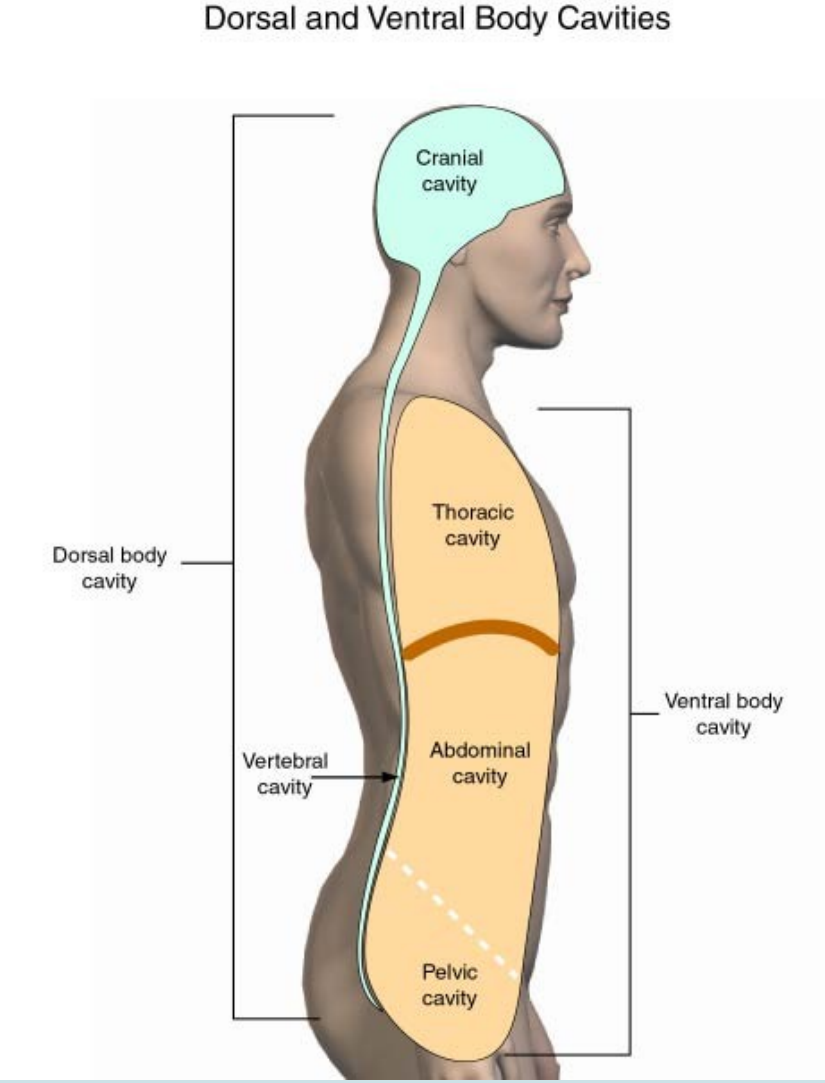
- Two main categories of body cavity are:
  - **Dorsal body cavities** (cranial cavity & vertebral canal)
  - **Ventral body cavities**

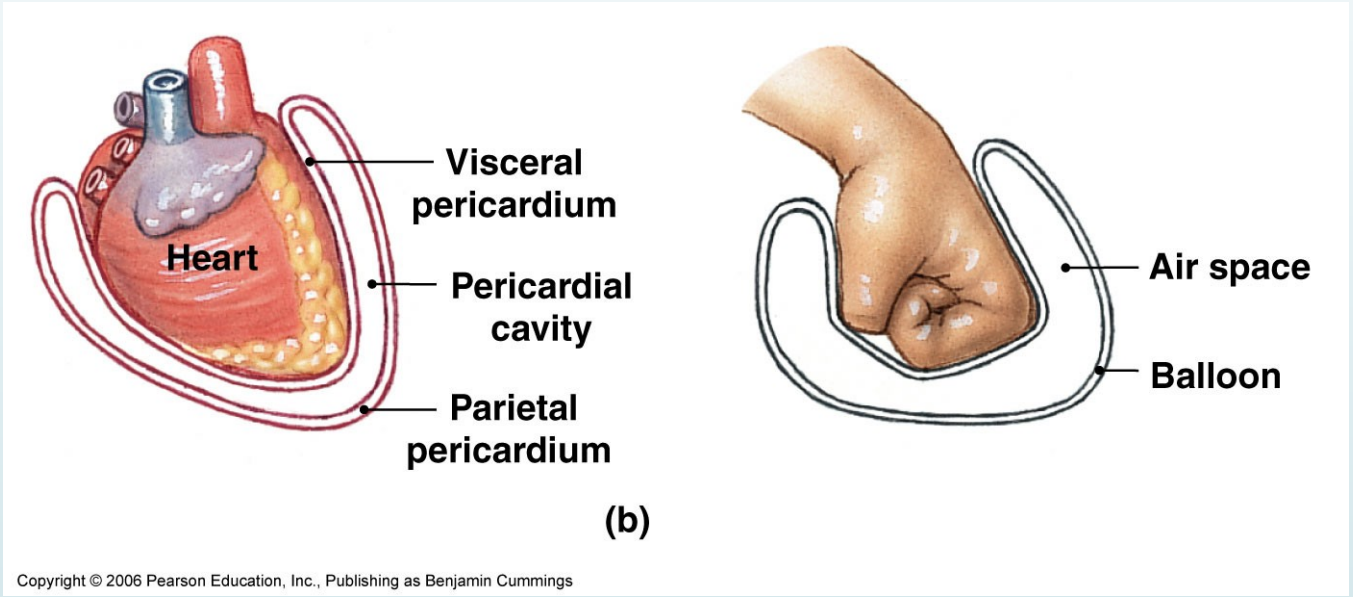
- The ventral body cavity (coelom) is divided by the diaphragm muscle into 2 parts:
  - 1. Superior thoracic cavity
  - 2. Inferior abdominopelvic cavity

Thoracic Cavity

Contains the:

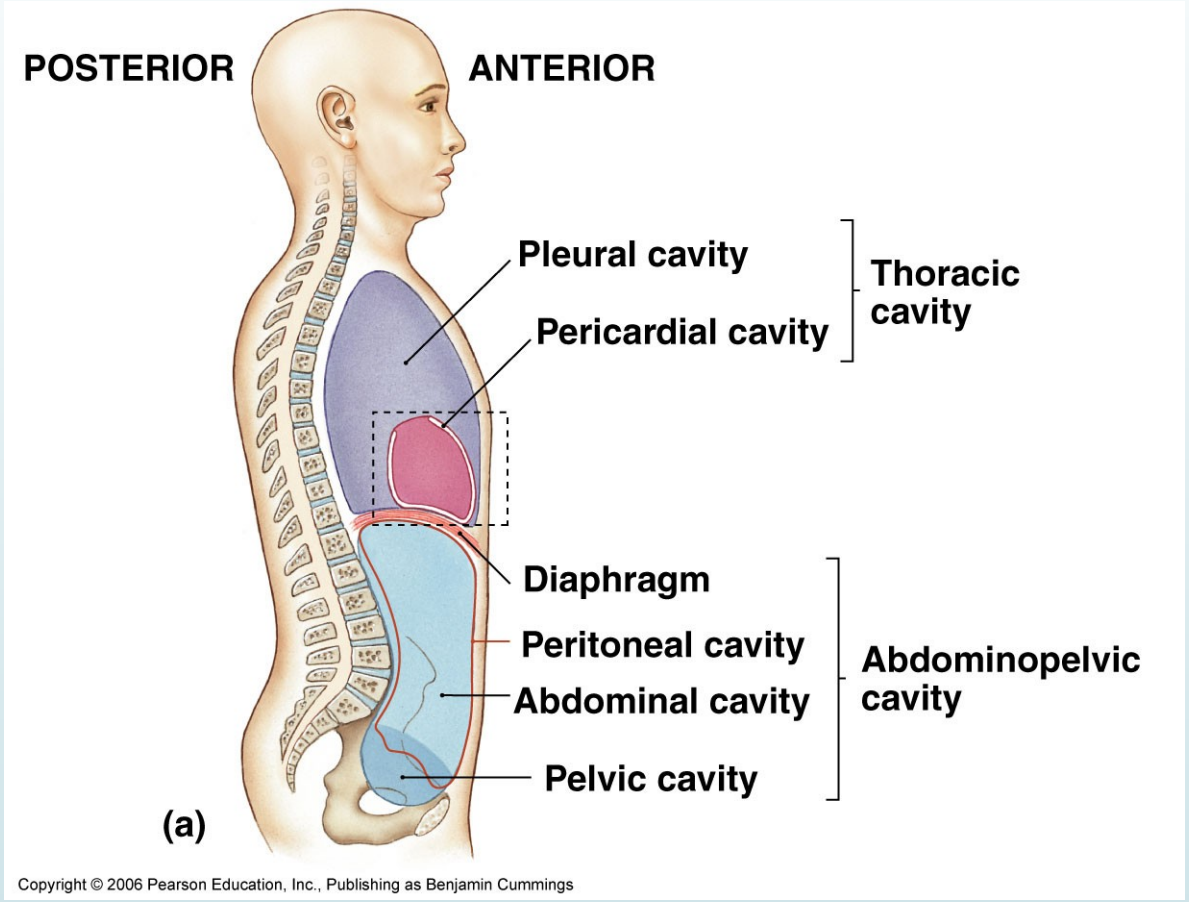
- (a) pleural cavity (left and right, divided by the mediastinum)
  - encloses: the lungs
  - the membranes: visceral and parietal **pleura**
- (b) pericardial cavity
  - encloses: the heart
  - The membranes: visceral and parietal **pericardium**


Dorsal and Ventral Body Cavities
Cranial cavity
Thoracic cavity
Abdominal cavity
Pelvic cavity
Dorsal body cavity
Vertebral cavity
Ventral body cavity



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Fig. 1-10b, p. 21



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Fig. 1-10a, p. 21

MEMBRANES -flat sheets of pliable tissue that cover or line the body or a parts of the body.

A. MUCOUS MEMBRANE (MUCOSA)-lines a body cavity that opens directly to the outside (digestive, respiratory etc.)

Functions:

- Protection-tight junctions between cells prevent leakage and is hard for microbes to penetrate
- Secrete mucus, which keeps the membrane moist and provides lubrication
- Cells secretes digestive enzymes and are the site of absorption of digested micronutrients.

B. SEROUS MEMBRANES (serosa)-lines a body cavity that does not open directly to the outside and covers organs in the cavity

- Cover both the walls of internal cavities (parietal layer) and the visceral organs themselves (visceral layer), and b/n the two layers is the **cavity**

- Serous membrane secrete a watery lubricant in to the cavity that reduces friction, allowing organs to expand and contract freely.

Serous membranes include:

1. **Pleura** is the serous membrane enclosing the lung
   a. Parietal pleura lines wall of the cavity
   b. Visceral pleura covers organs surface
2. **Peritoneum** is the serous membrane of the abdominal cavity
   a. Parietal peritoneum lines the abdominal wall internally
   b. Visceral peritoneum covers abdominal organs
3. **Pericardium** is the membrane that covers the heart

C. CUTANEOUS MEMBRANE- outer limiting membrane of the body, which is the **skin**

D. SYNOVIAL MEMBRANES -line the cavities of freely movable joints. They secrete synovial fluid which lubricates the joint and nourished the cartilage.

Synovial membranes also forms:

Bursa -cushioning fluid filled sacs outside but near the joint (b/n tendons, b/n tendons & bones or joints)

Tendon sheaths- envelope tendons as they cross joints so as to ease movement

Body parts (Regions)

The body can generally be described to have:

1. **Axial body part: -** It is the part of the body near the axis of the body.
   - This includes head, neck, and trunk

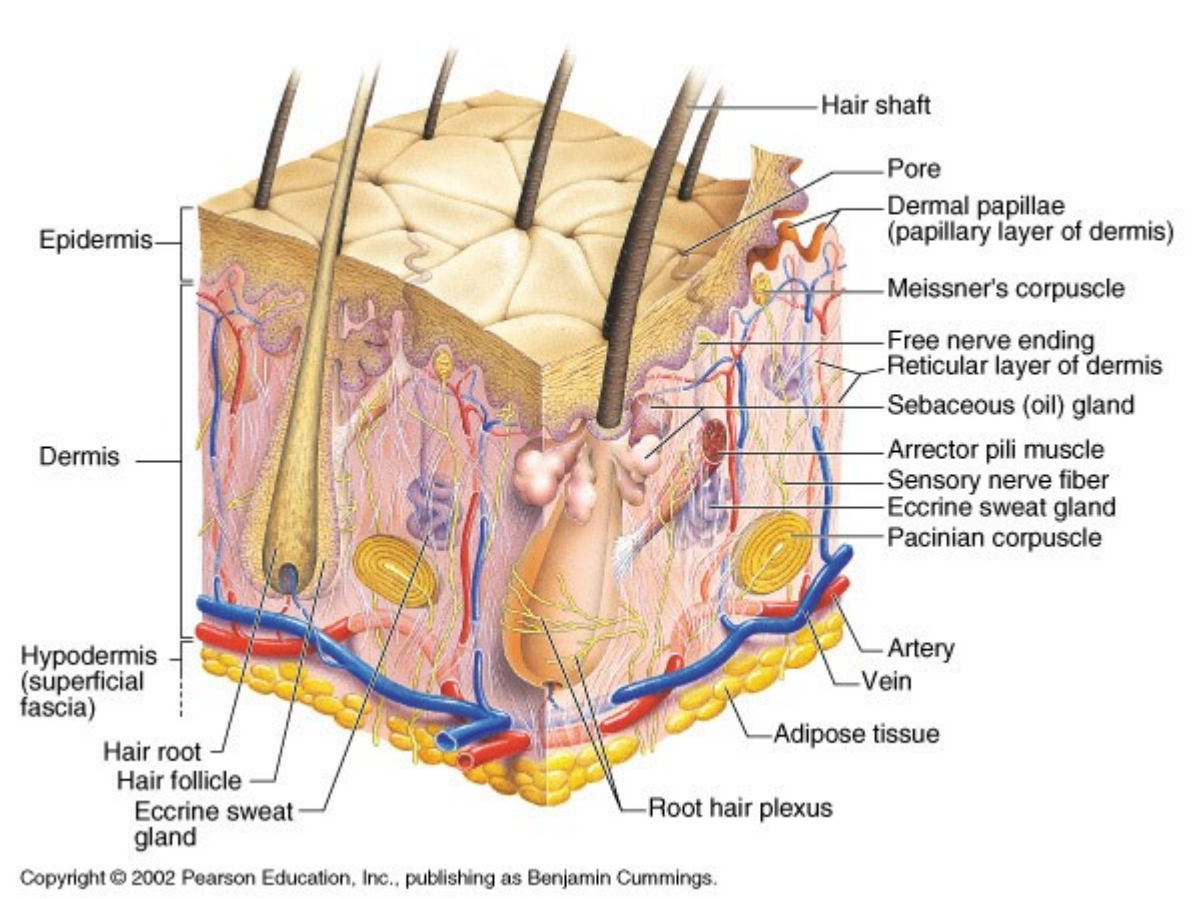
2. **Appendicular body part: -** It is the part of the body out of the axis line.
   - This includes the upper and lower limbs.

2) The integumentary system

- Composed of the skin, sweat and oil glands, hair, and nails.
- Varies in thickness from 1.5 to 4.0 mm.
- Composed of 2 distinct layers.
  - **Epidermis** and **Dermis**

The skin functions

- Temperature regulation and excretion = sweat
- Sensation (general sense organ)
- Synthesis **vitamin D** .
- is readily accessible, and is one of the best **indicators of general health** .
- Major role is **protection** from pathogens and **dehydration**.



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Epidermis

- Outermost layer.
- Composed mostly of keratinized stratified squamous epithelium.
- Contains 4 distinct cell types and 4 to 5 distinct layers.

Cell Types of the Epidermis

- **Keratinocytes**— produce keratin, a fibrous protein that give the epidermis its protective properties.
  - These cells are tightly connected by desmosomes.
  - Arise from the stratum basale and undergo continuous mitosis.
  - Are pushed upward and continuously become more **keratinized**. Those on the surface of the skin are dead. Millions rub off per day.
- Friction may lead to a protective thickening of the cells as wearing new shoes known as a **callus**.

Cell Types of the Epidermis

Melanocytes— synthesize melanin.

- Located at the deepest layer of the epidermis.
- The melanin is transferred to the keratocytes.
- Protects against UV damage.

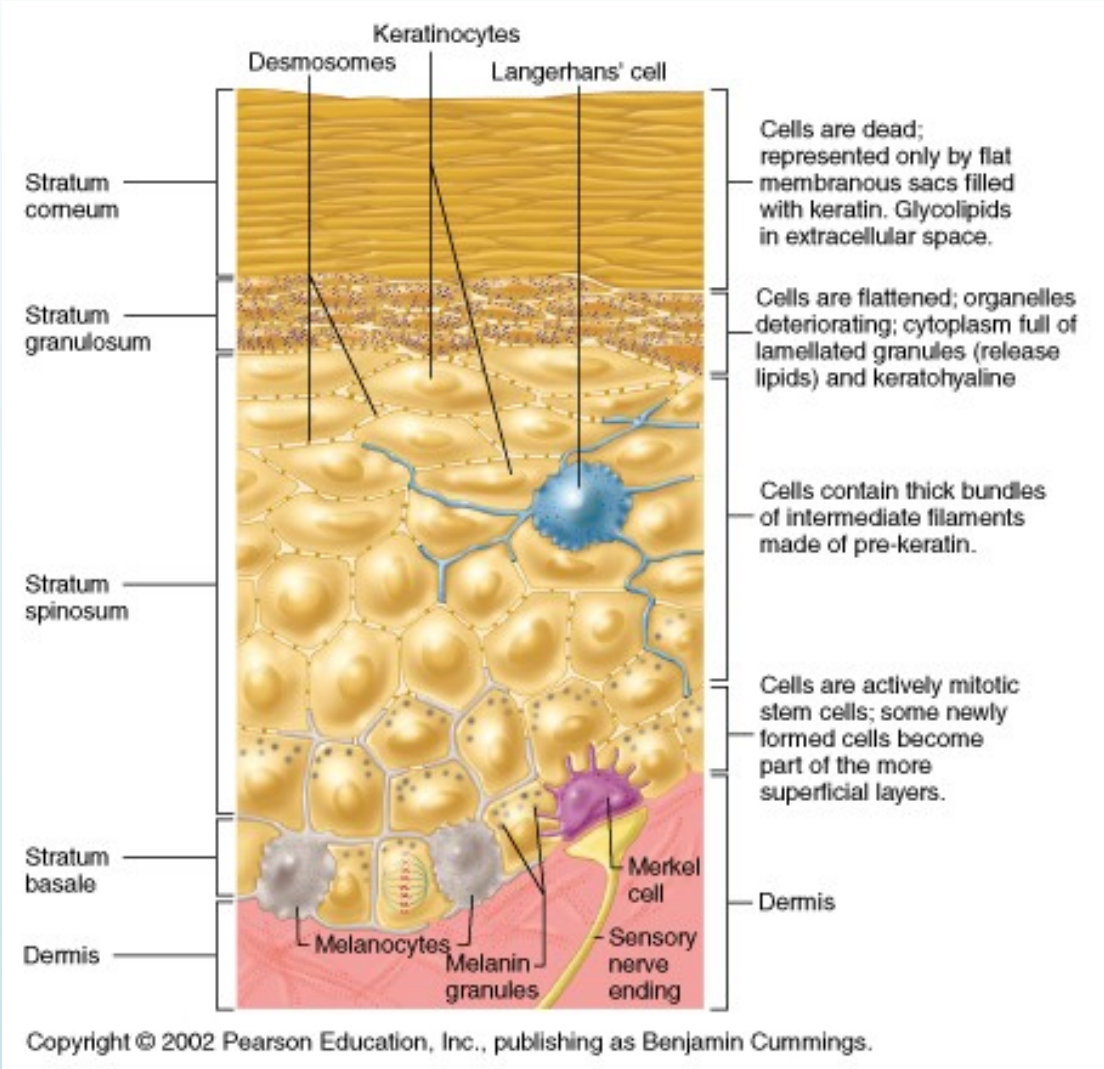

Albino

Cell Types of the Epidermis

Langerhans' cells— arise from the bone marrow.

- Act as macrophages that activate the immune system.

Merkel cells— present at the junction of the epidermis and dermis. Associated with sensory receptors.



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Layers of the Epidermis

- **Thick skin** (on palms, fingertips, soles) has 5 strata.
- **Thin skin** has only 4. The **stratum lucidum** is absent and the other layers are visibly thinner.

1. **Stratum Basale**— deepest layer.
   - Attached to the dermis.
   - Sometimes called the stratum germinativum because of the constant mitosis occurs there.
   - Made of a single row of keratinocytes.

Layers of the Epidermis

2. **Stratum Spinosum**— Several layers thick. Consist mainly of keratin like **filaments**
   - Melanin granules and Langerhan's cells are abundant in this layer.

3. **Stratum Granulosum—** 3-5 cell layers thick. Keratinocytes become more flattened and the cells contain more keratin and **lamellated granules**.

4. **Stratum Lucidum**— thin layer of dead keratinocytes. Present only in thick skin.

Layers of the Epidermis

5. **Stratum Corneum**— Outermost layer. 20-30 cell layers thick. Cells have thick cell membranes and a great deal of keratin. Cells are referred to as **cornified**.

- When first wearing new shoes, the skin of the foot may be subject to friction. This will separate layers of Epidermis, or separate the Epidermis from the Dermis, and tissue fluid may collect, causing a **BLISTER**.

- If the skin is subjected to pressure, the rate of mitosis will increase and create a thicker Epidermis; we call this a **CALLUS**

The Dermis

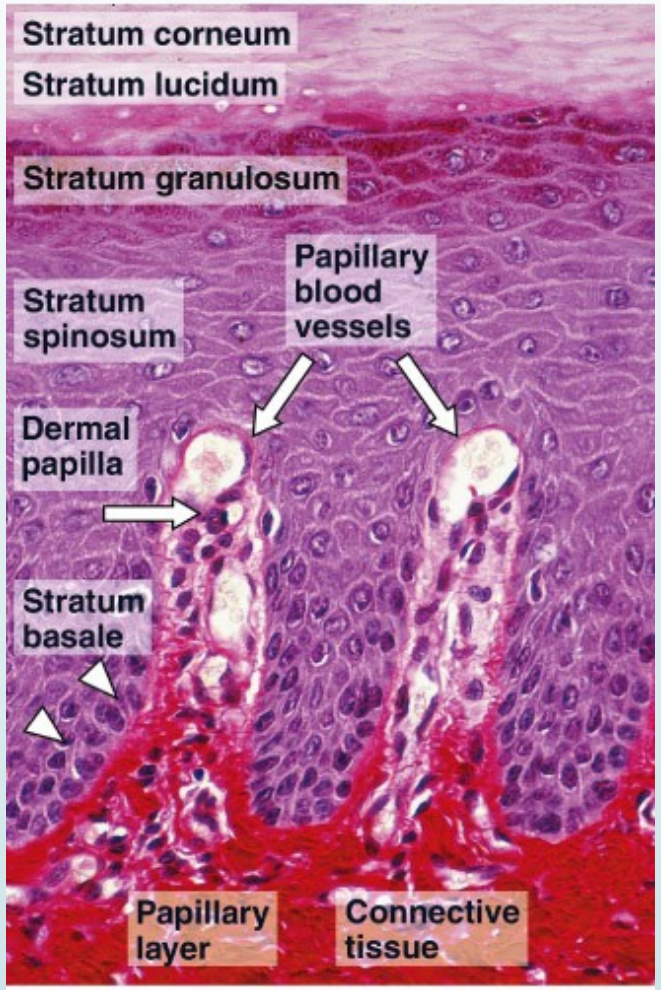
- Made mostly of connective tissue.
- Richly **innervated** and **vascularized**.
- Contains the hair follicles, sweat glands, oil glands, lymphatic vessels, arrector pili muscle and many sensory receptors.

The Dermis

- Consists of 2 layers.

1. Papillary layer

- Loose connective tissue, heavily vascularized. Contains the peg-like **dermal papillae**, capillary loops, and Meissner's corpuscles.
  - In palms and sole, contain the **dermal ridges**
  - interdigitations formed b/n dermal ridges and epidermal ridges or grooves cause formation of **fingerprints**.

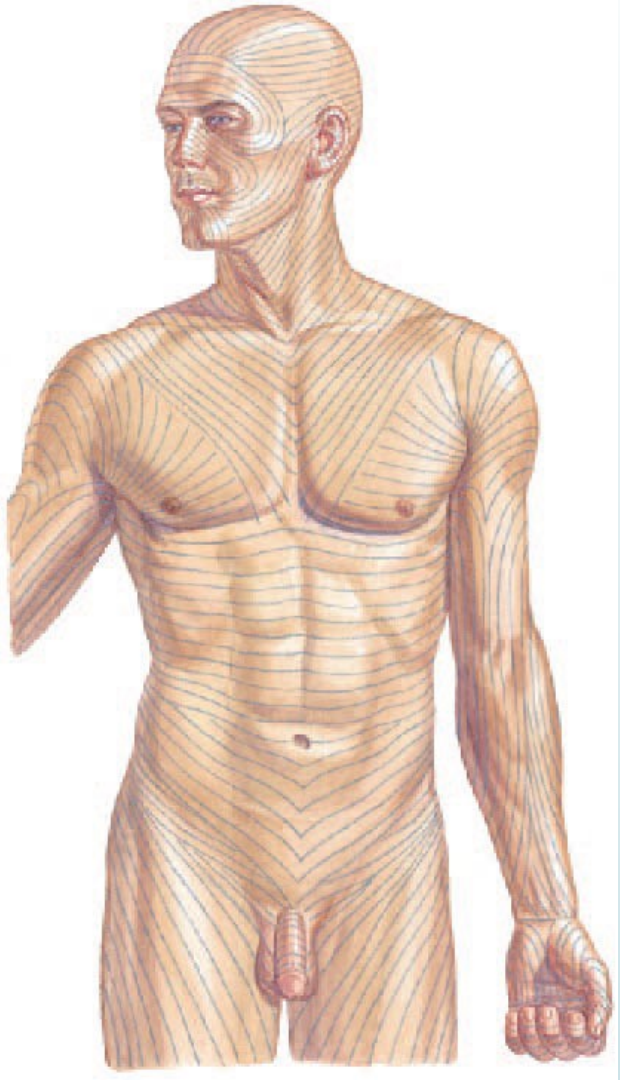


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Reticular layer

- Is formed by a dense layer of interlacing collagen and elastic fibers
- These fibers provide skin tone (elasticity) and account for the strength
- The pattern of collagen fibers in a particular region determines the characteristic tension lines (cleavage lines- for Skin Incisions) and wrinkle lines in the skin

Cleavage line
(tension line)



Stretch Marks in Skin

- The collagen and elastic fibers in the dermis form a tough, flexible meshwork of tissue
- Considerable distend (as in pregnancy) can result in damage to the collagen fibers in the dermis
- As a result Bands of thin wrinkled skin, initially red, become purple and later white is **Stretch marks.**
- Appear on the abdomen, buttocks, thighs, and breasts during pregnancy, and in obese

Stretch mark



Aging of the skin results in a loss of **elasticity** and the appearance of **wrinkles**



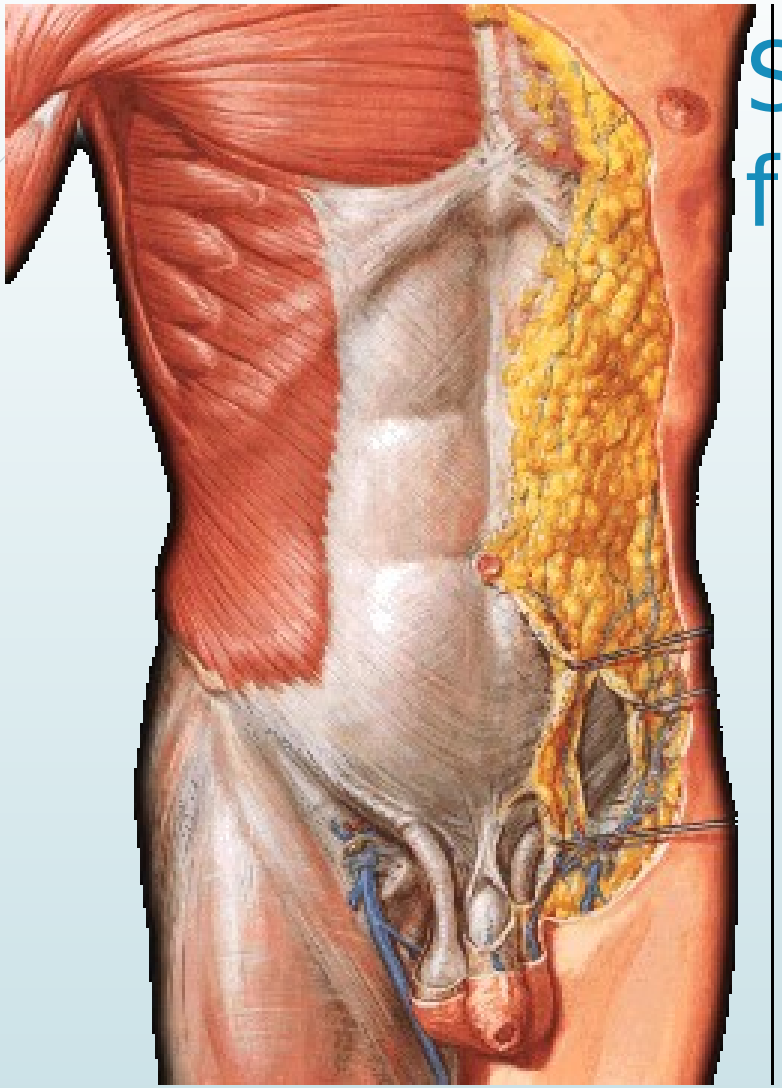
The subcutaneous tissue

(superficial fascia = **hypodermis**)

- Is **loose connective tissue** and **fatty** layer between the dermis and underlying deep fascia

- the subcutaneous tissue contains neurovascular structures distributed to the skin and **deepest part of sweat gland**

- It provides for most of the body's **fat storage**, so its thickness varies among individuals due to nutritional state .

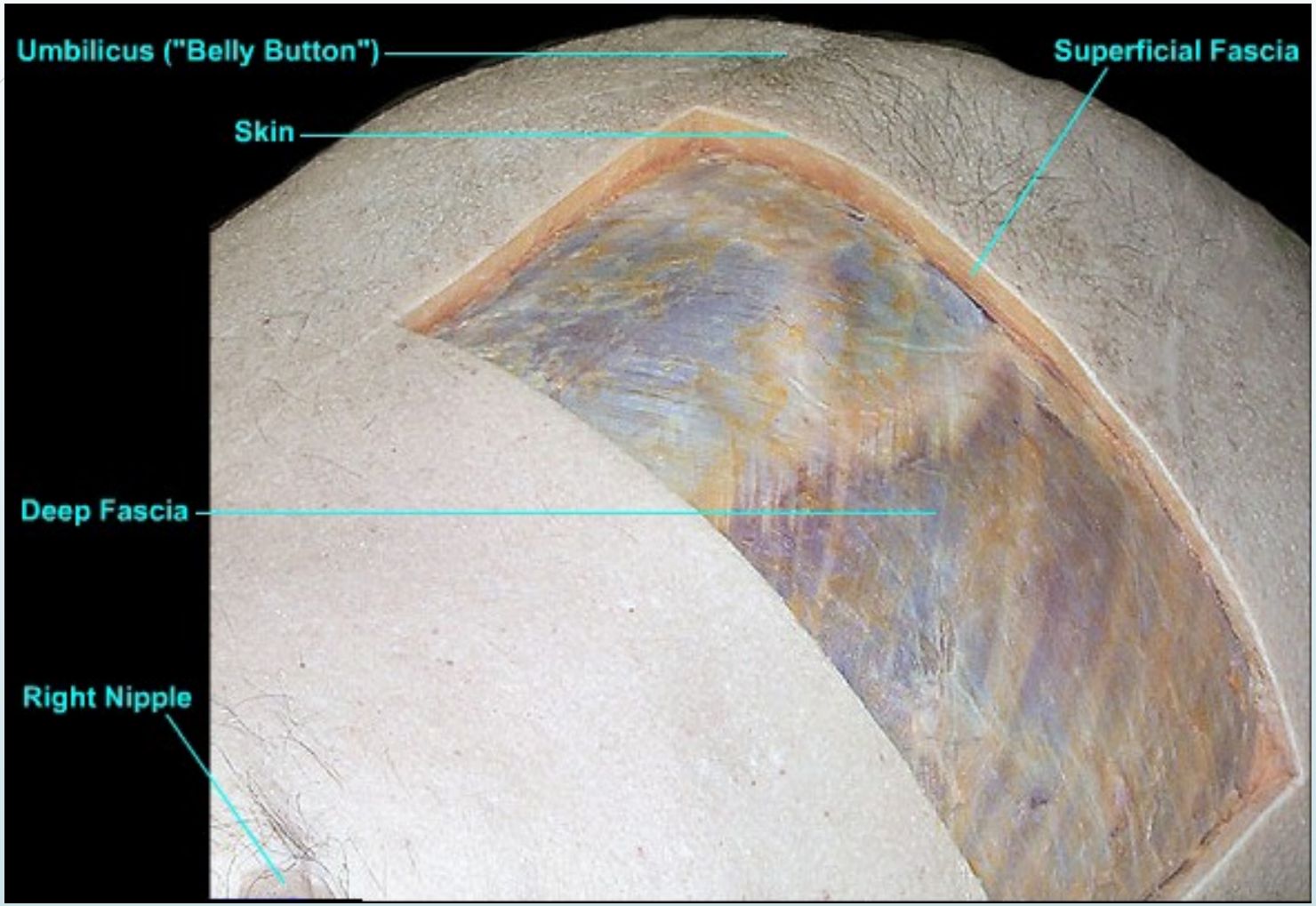


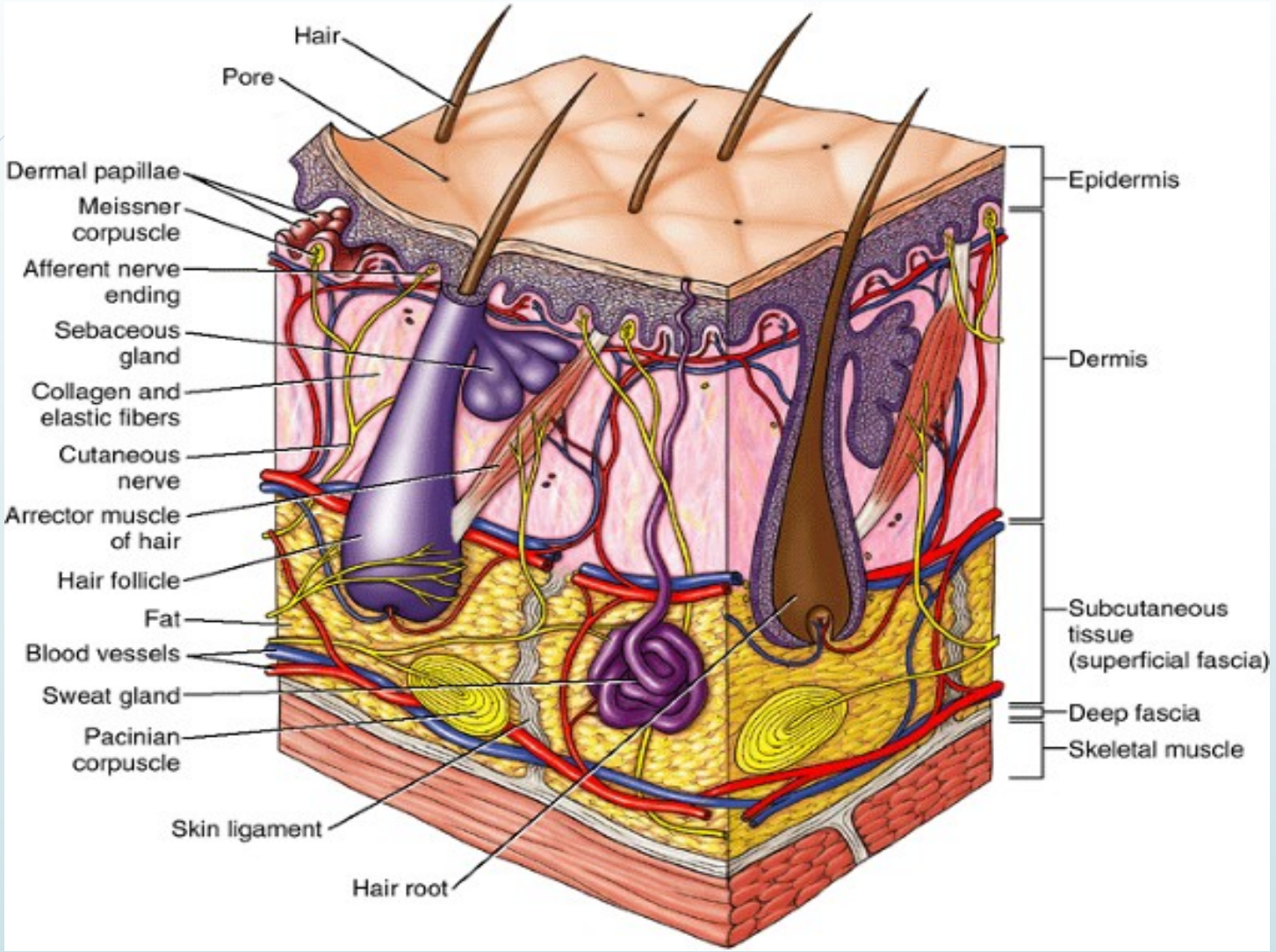
Superficial fascia

The deep fascia

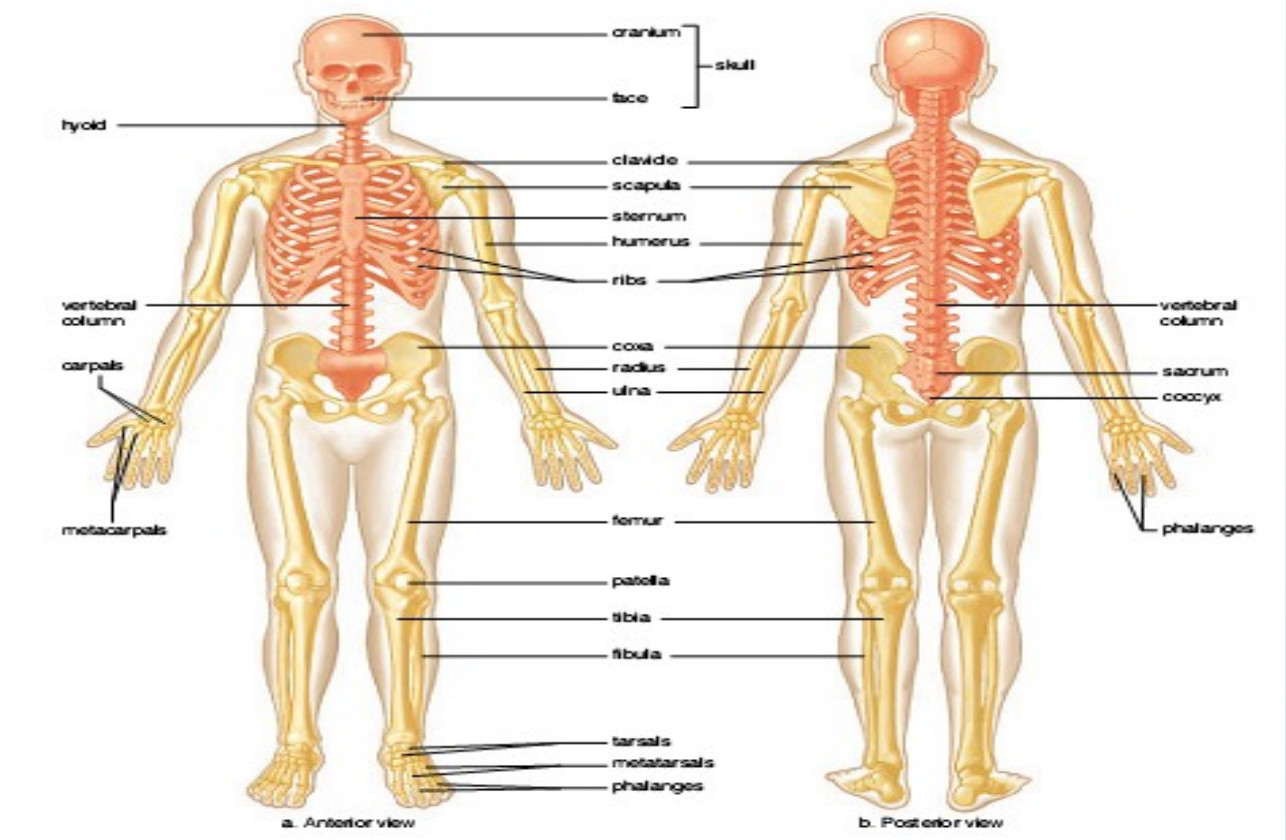
- Is a dense, organized connective tissue layer, **devoid of fat**

- that **envelopes** most of the body structures deep to the skin and subcutaneous tissue


Umbilicus ("Belly Button")
Skin
Superficial Fascia
Deep Fascia
Right Nipple


Hair
Pore
Dermal papillae
Meissner corpuscle
Afferent nerve ending
Sebaceous gland
Collagen and elastic fibers
Cutaneous nerve
Arrector muscle of hair
Hair follicle
Fat
Blood vessels
Sweat gland
Pacinian corpuscle
Skin ligament
Hair root
Epidermis
Dermis
Subcutaneous tissue (superficial fascia)
Deep fascia
Skeletal muscle

3) The SKELETAL system



- The skeleton of the body is composed of bones, cartilages and joints.

1. **Bone**, a living tissue, is a highly specialized, hard form of connective tissue that makes up most of the skeleton

  - **The number decreases with age**

2. Cartilage is a resilient, semirigid, avascular form of connective tissue that forms parts of the skeleton **where more flexibility is necessary**

– The proportion of cartilage to bone decreases with age due **ossification**

- **Articular cartilage** –caps the articulating surfaces of bones participating in a synovial joint

The Skeleton

Divided into two divisions

1. The **axial skeleton** consists of the bones of the **head** (cranium), **neck** (cervical vertebrae), and **trunk** (**ribs**, **sternum**, **vertebrae**, and **sacrum**).

2. The **appendicular skeleton** consists of the bones of the **limbs**, including those forming the **pectoral** (shoulder) and **pelvic girdles**.


Creek

AXIAL SKELETON		APPENDICULAR SKELETON	
Skull—22 bones	**Auditory ossicles**—6 bones	**Pectoral girdle**—4 bones	
14 facial bones	malleus (2)	scapula (2)	
maxilla (2)	incus (2)	clavicle (2)	
palatine bone (2)	stapes (2)		
zygomatic bone (2)		**Upper extremities**—60 bones	
lacrimal bone (2)	**Hyoid**—1 bone	humerus (2)	carpal bone (16)
nasal bone (2)		radius (2)	metacarpal bone (10)
vomer (1)	**Vertebral column**—26 bones	ulna (2)	phalanx (28)
inferior nasal	cervical vertebra (7)		
concha (2)	thoracic vertebra (12)	**Pelvic girdle**—2 bones	
mandible (1)	lumbar vertebra (5)	os coxae (2) (each contains 3 fused bones)	
	sacrum (1) (5 fused bones)		
8 cranial bones	coccyx (1) (3 to 5 fused bones)	**Lower extremities**—60 bones	
frontal bone (1)		femur (2)	tarsal bone (14)
parietal bone (2)	**Rib cage**—25 bones	tibia (2)	metatarsal bone (10)
occipital bone (1)	rib (24)	fibula (2)	phalanx (28)
temporal bone (2)	sternum (1)	patella (2)	
sphenoid bone (1)			
ethmoid bone (1)			

Classification of Bones

1. **Long Bones**
   - are tubular structures
   - Has a shaft and two ends
   - Named according to shape and not size
     - E.g. Femur, Humerus, Phalanges

2. **Short Bones**
   - Shaped like cubes
     - E.g. Carpals and Tarsals

Classification of Bones

- **Sesamoid <u>bone:</u>**
  - _is a special type of short bone
  - forms in a tendon where there is physical stress

    e.g. the patella

  - The function of sesamoid bones is to protect tendon from excessive wear and tear.

Classification of Bones

3. Flat Bones

- Thin, broad and a bit curved
- Serve for protection and provide an extensive surface for muscle attachment
  - Scapula, rib, sternum, skull bone

4. Irregular Bones

- Complex shape that do not fit any of the categories above
  - Vertebrae and hip bones and calcaneus

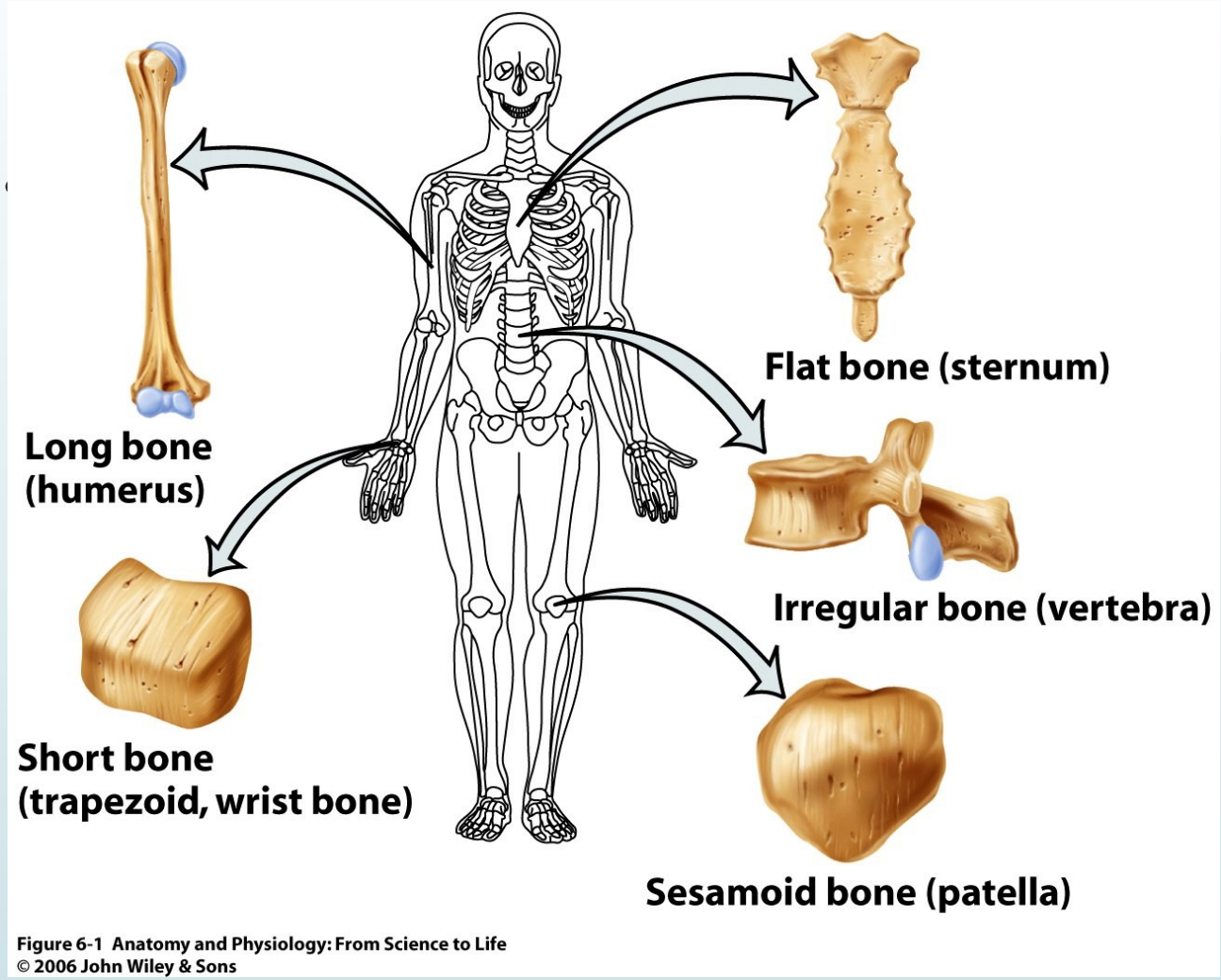


Figure 6-1 Anatomy and Physiology: From Science to Life
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Functions of Bone

- **Support**
  - Structural support for the whole body
- **Protection**
  - Vital organs like the brain and spinal cord
- **Movement**
  - Levers for muscle to provide movement
- **Storage**
  - Calcium and phosphates, lipids in yellow marrow
- **Hematopoiesis**
  - Blood cell production

Rickets develops from an improper diet and also from lack of the sunlight needed to synthesize vitamin D.





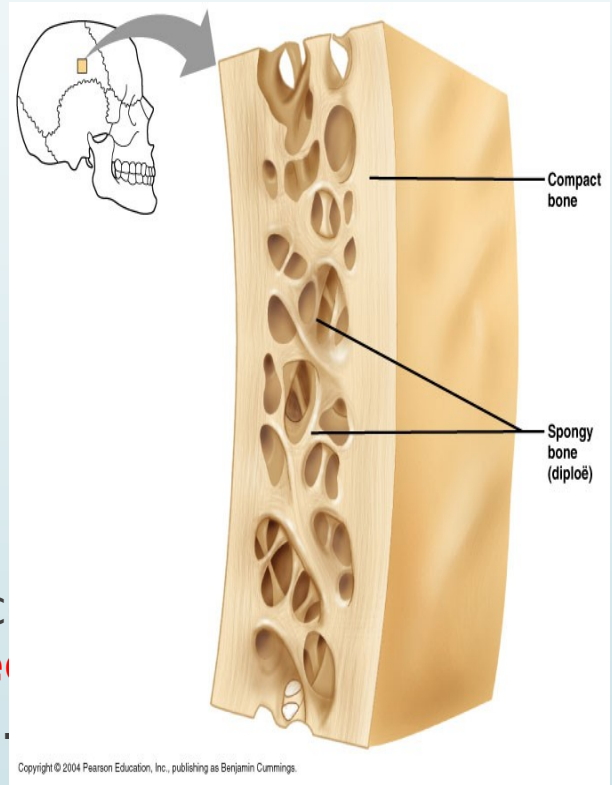
- There are two types of **bone tissues**:
  - **compact** and
  - **spongy** (**cancellous**).

- The differences between these types of bone depend on the relative amount of **solid matter** and the **number** and **size** of the **spaces** they contain.

Spongy Bone vs Compact Bone

Spongy Bone

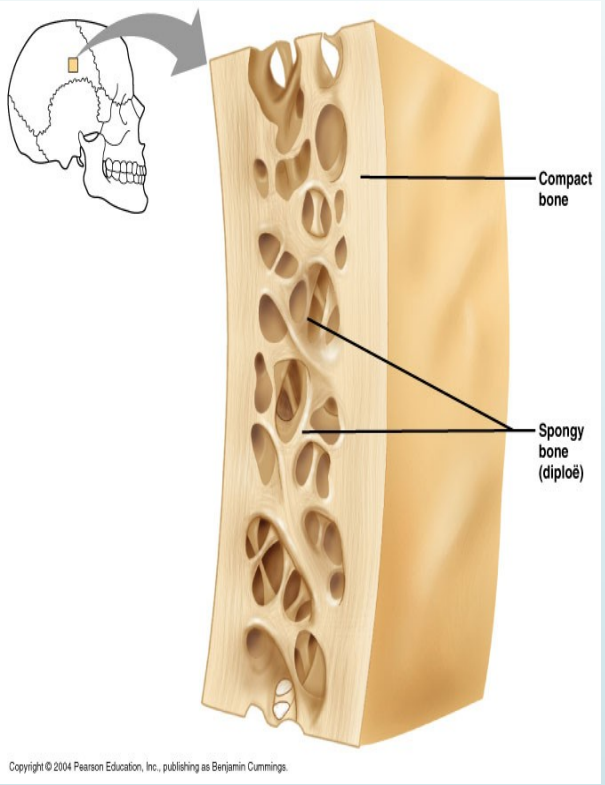
- Internal layer of bone
- Consists of interconnecting rods or spins of bone tissue called **trabeculae**.
- b/n the trabeculae are spac that in life are filled with **re bone marrow** and vessels.

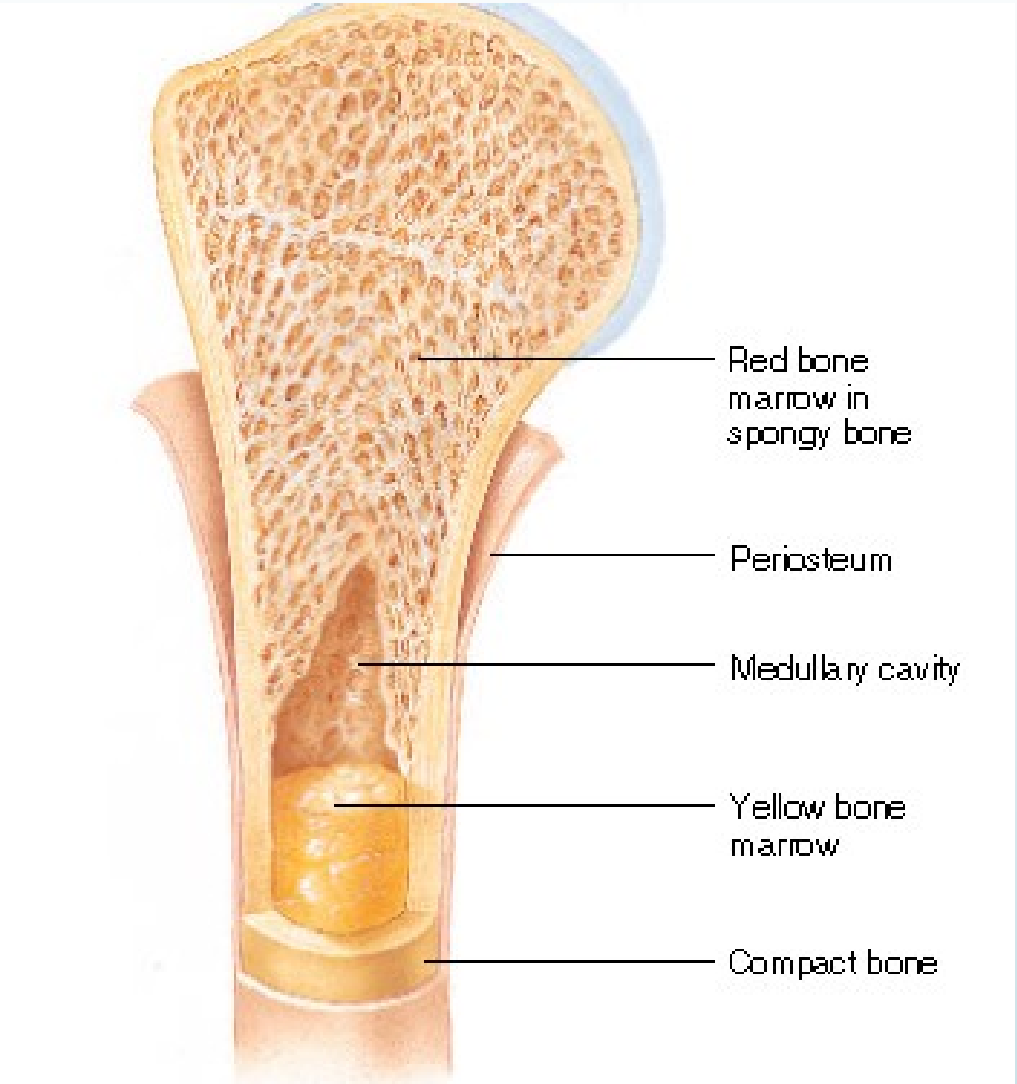


Spongy Bone vs Compact Bone

Compact bone

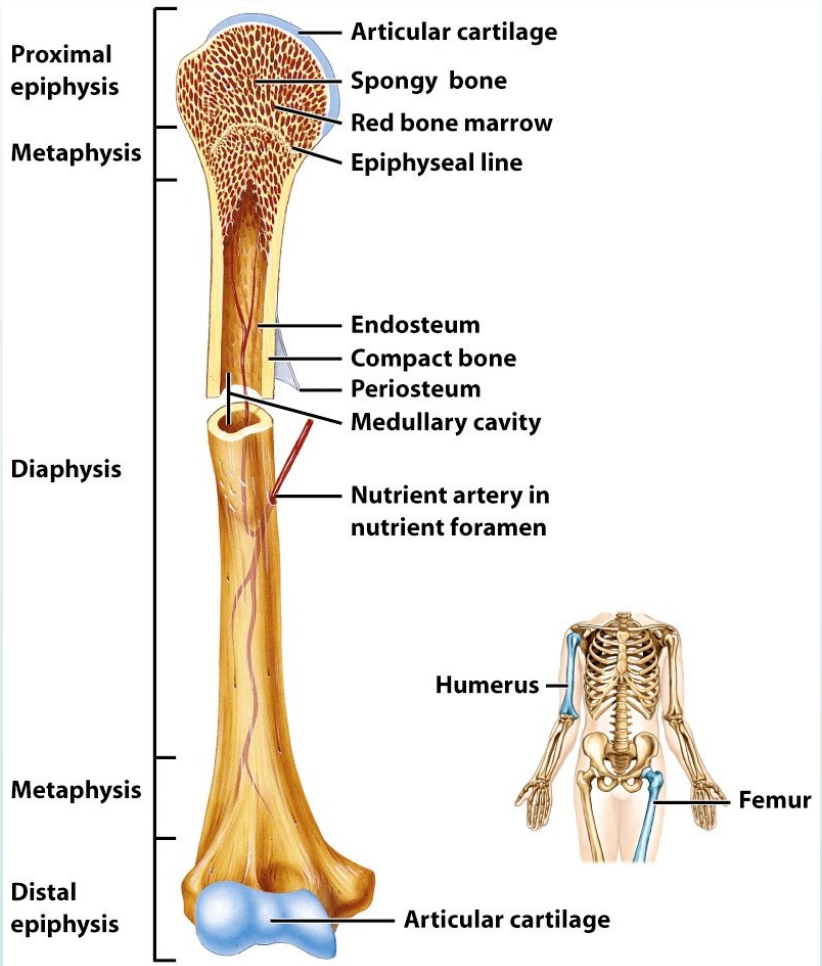
- External layer of bone
- contains many cylinder-shaped units called **osteons**.
- Provides protection and resists the stresses produce by weight and movement.




Red bone marrow in spongy bone
Periosteum
Medullary cavity
Yellow bone marrow
Compact bone

Structures of a Long Bone

- **Diaphysis**
  - a tubular bone shaft
  - consisting of a bone collar surrounding a hollow **medullary cavity**, which is filled with yellow bone marrow in adults.
- **Epiphyses**
  - are the ends of the long bone
  - consist of internal spongy bone covered by an outer layer of compact.
- **Epiphysial plates**
  - Cartilaginous intervene between the diaphysis and the epiphyses
  - **Growth occurs** here



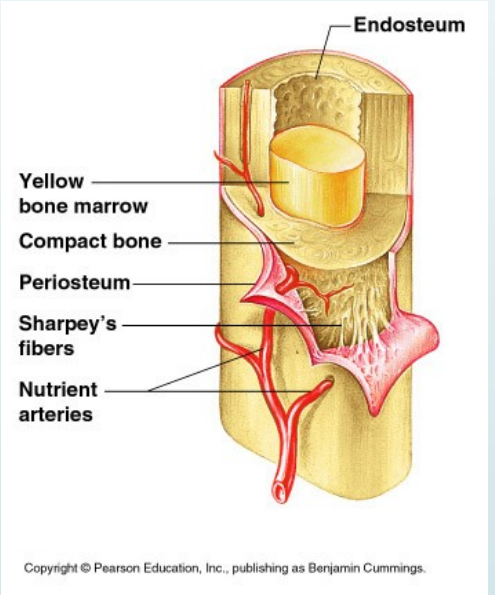
Partially sectioned humerus (arm bone)

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Structures of a Long Bone…

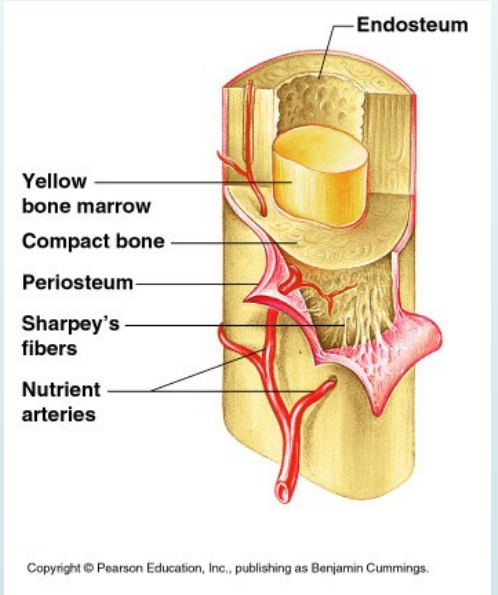
- **Periosteum**: A dense, white fibrous covering around the diaphysis

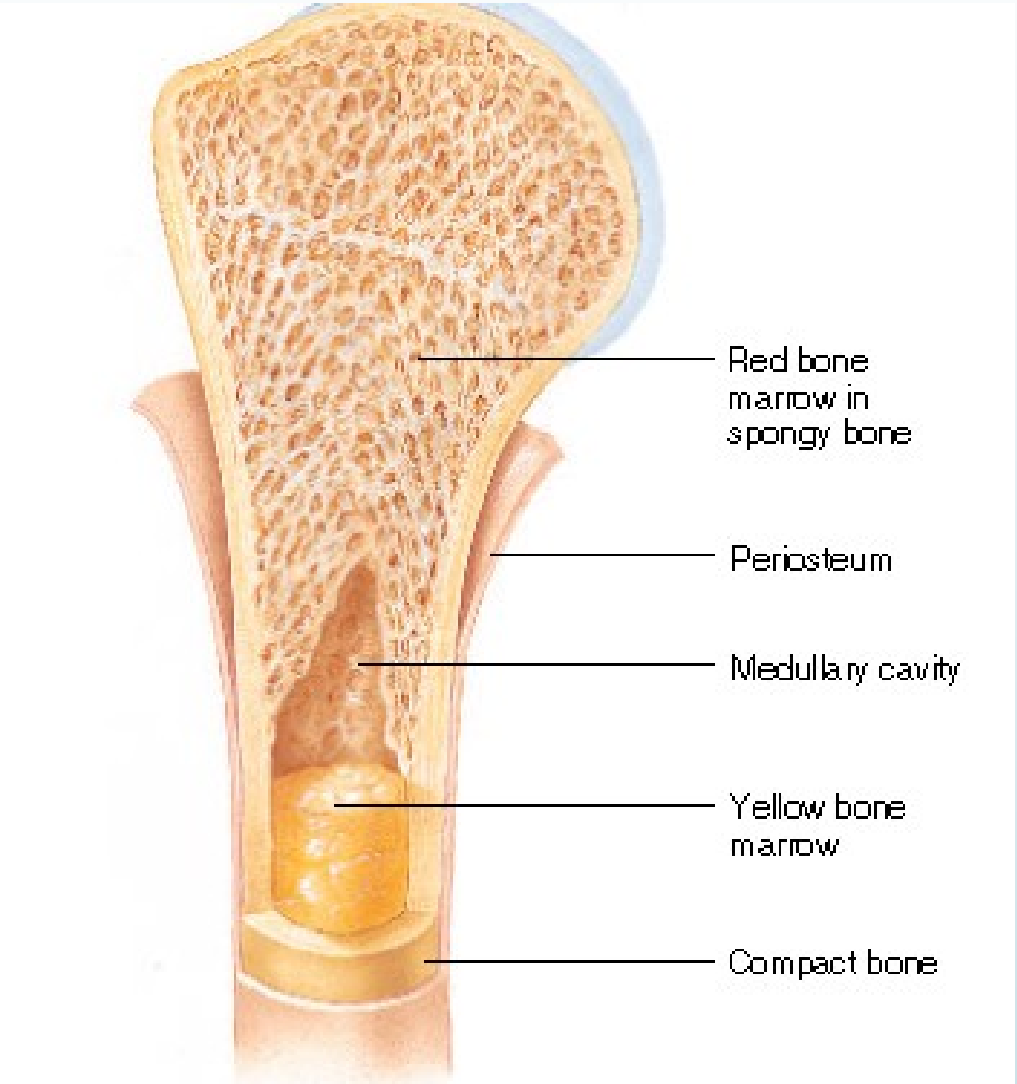
- Is essential for bone **growth**, **repair**, and **nutrition**; a point of **attachment** for ligaments and tendons



Structures of a Long Bone…

- **Endosteum**: Is a connective tissue membrane that lines the internal surfaces of all cavities within bone




Red bone marrow in spongy bone
Periosteum
Medullary cavity
Yellow bone marrow
Compact bone

Vasculature & Innervation of Bones

- Bones are richly supplied with blood vessels.

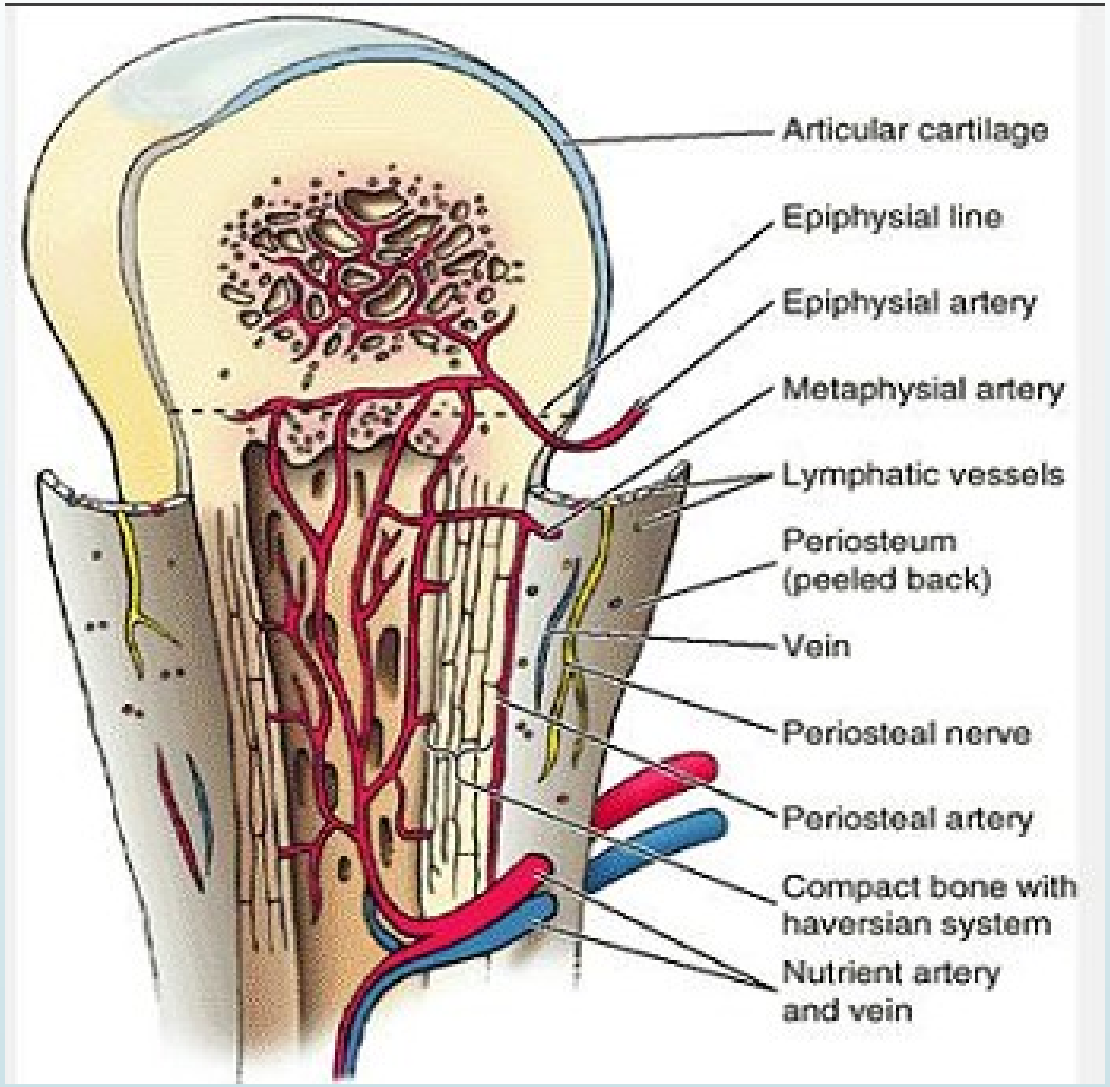
Nutrient arteries:- (one or more per bone)

- Pass obliquely through the compact bone of the shaft of a long bone via **nutrient foramina**.
- supply the bone marrow, spongy bone, & deeper portions of the compact bone

Vasculature & Innervation of Bones

Periosteal arteries:-

- small branches from periosteum, responsible for nourishment of most of the compact bone.
- a bone from which the periosteum has been removed dies


Articular cartilage
Epiphysial line
Epiphysial artery
Metaphysial artery
Lymphatic vessels
Periosteum (peeled back)
Vein
Periosteal nerve
Periosteal artery
Compact bone with haversian system
Nutrient artery and vein

- **Metaphysial & epiphysial arteries**
  - supply ends of bones & arise mainly from arteries that supply the joints

- **Veins** accompany arteries through nutrient foramina & some leave through foramina near the articular ends of the bones.

- **Lymphatic vessels** are abundant in the periosteum.

Nerves

- accompany blood vessels supplying bones.
- The periosteum is richly supplied with **sensory nerves** (**periosteal nerves)**
- Periosteal nerves carry pain fibers especially sensitive to tearing or tension i.e. why bone fractures are very painful
- Also supplied by **motor nerves- vasodialator** or **constrictor**

Bone Markings

Bone markings appear where:

- tendons, ligaments, & fascias are attached
- Arteries lie adjacent to or enter bones.
- In relation to the passage of a tendon (often to direct the tendon or improve its leverage)

There are two categories of bone markings

A. Projections/Processes

- elevations which grow out from surface of the bone
- Provides a site for the attachment of structures like muscles
- Help in the formation of joints

B. Depressions

- Which are indentations

Bone Markings

CANAL - A tube-like opening

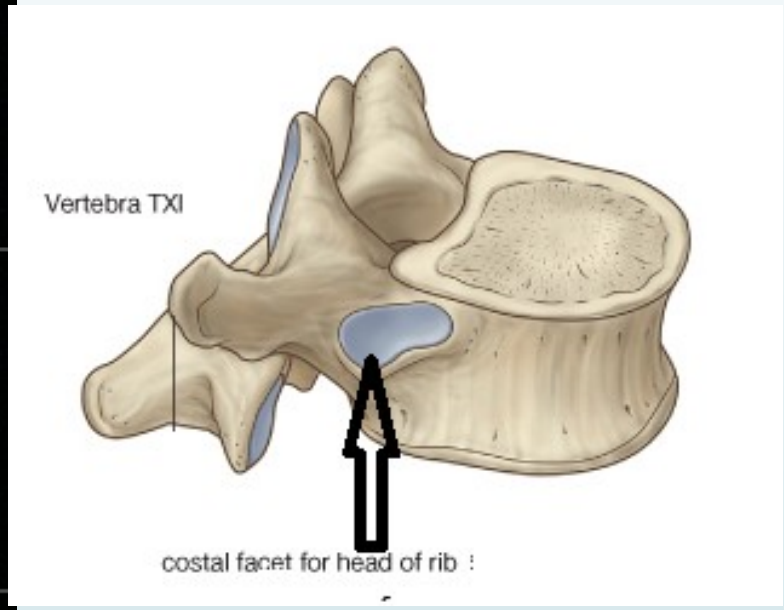
CONDYLE - A rounded projection for articulation

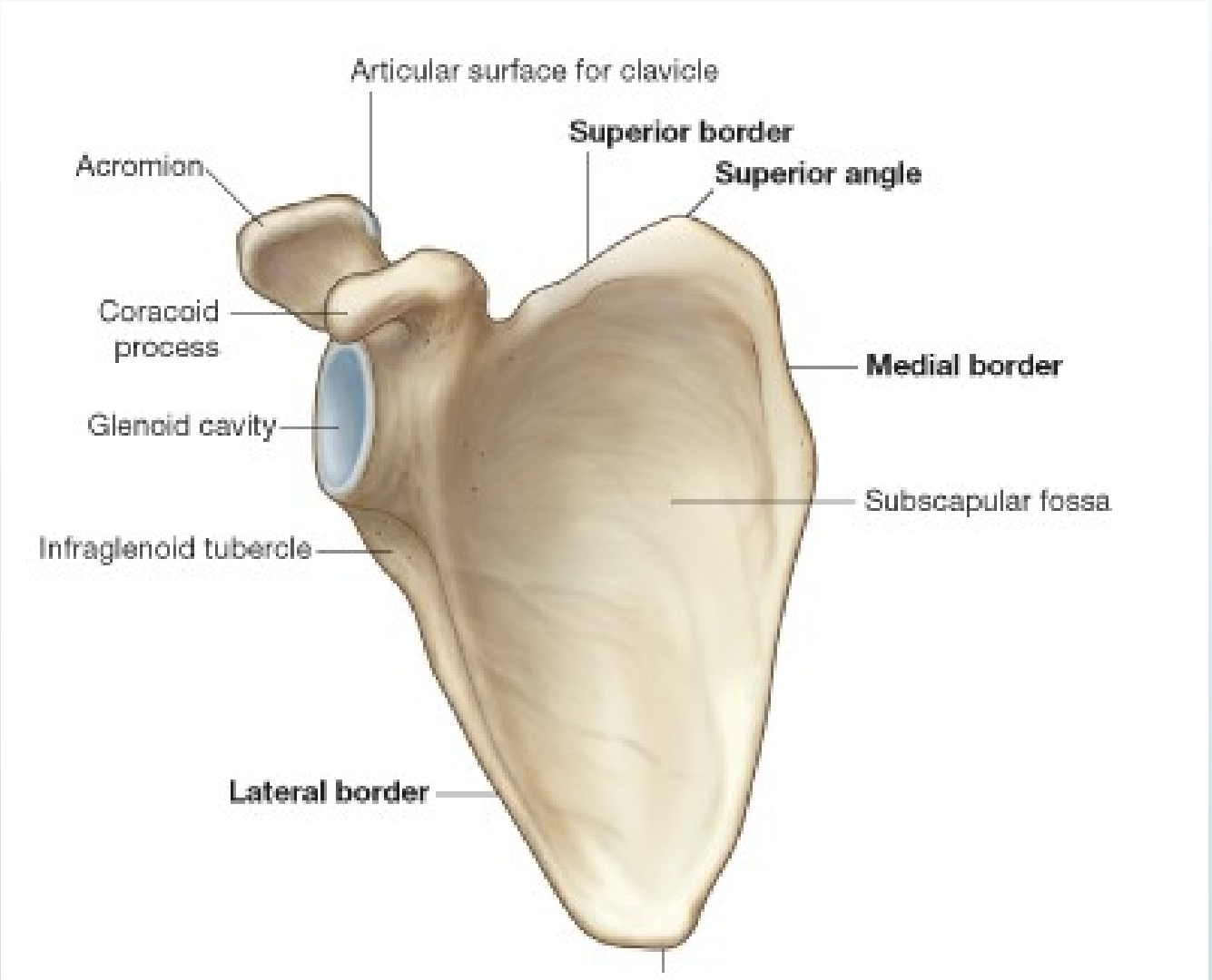
CREST - A narrow ridge

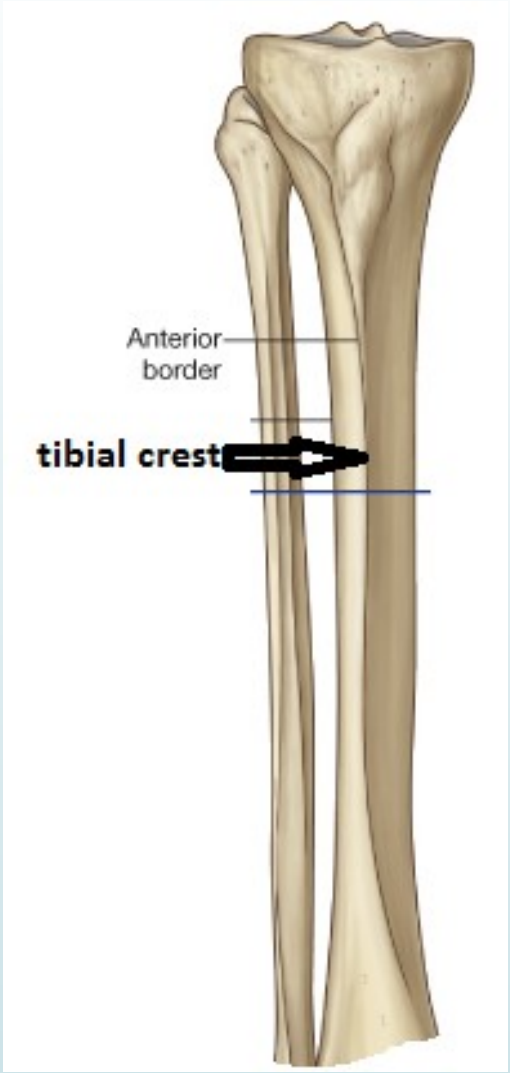
EPICONDYLE - A bump on or superior to a condyle, for the attachment of muscle or ligament

FACET - A smooth, flat area for articulation


epicondyle
condyle


Vertebra TXI
costal facet for head of rib


Articular surface for clavicle
Superior border
Acromion
Superior angle
Coracoid process
Medial border
Glenoid cavity
Subscapular fossa
Infraglenoid tubercle
Lateral border


Anterior
border
tibial crest

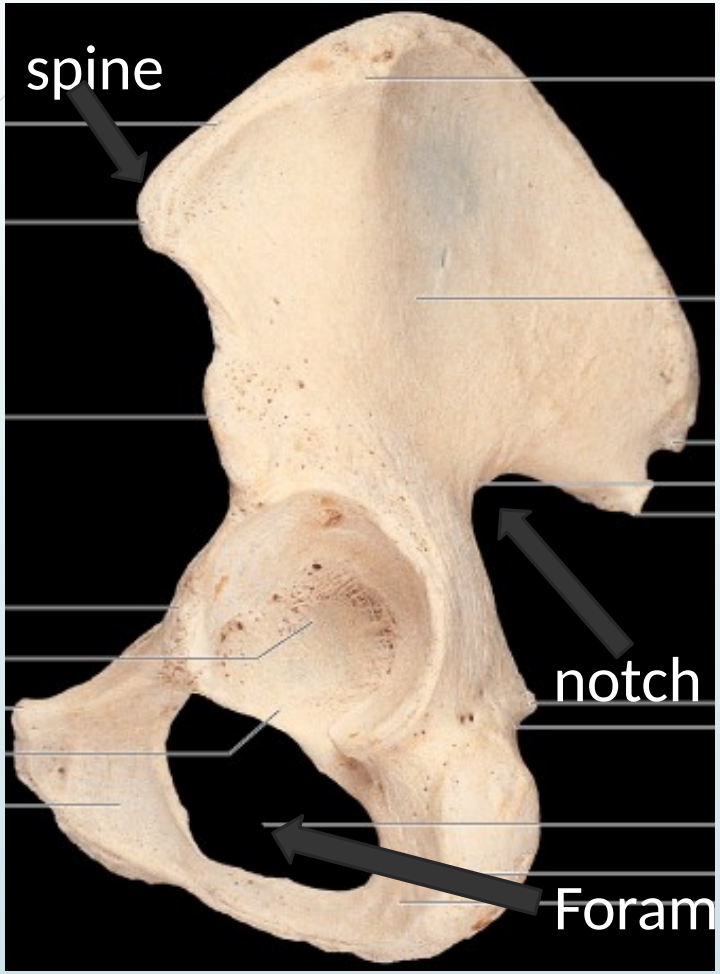
Bone Markings…

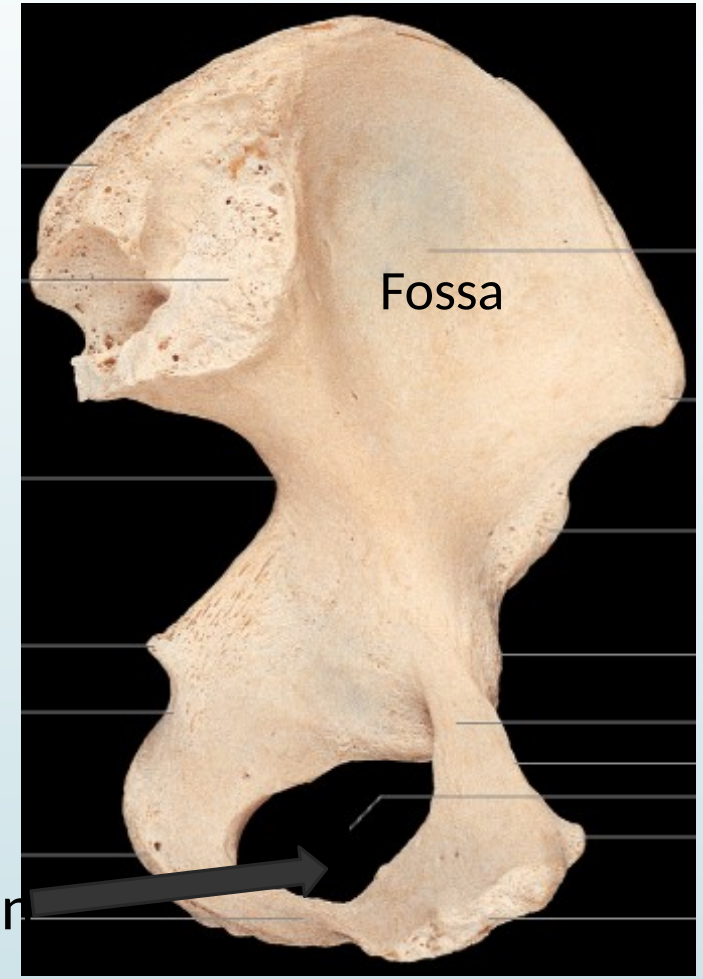
FISSURE - A narrow slit like opening, may be irregular in shape

FORAMEN - A round or oval hole, not as long as a canal or meatus

FOSSA - A large flat area, often shallowly depressed

GROOVE - A narrow depression through which some other structure runs


spine
notch
Foramen


Fossa

Bone Markings…

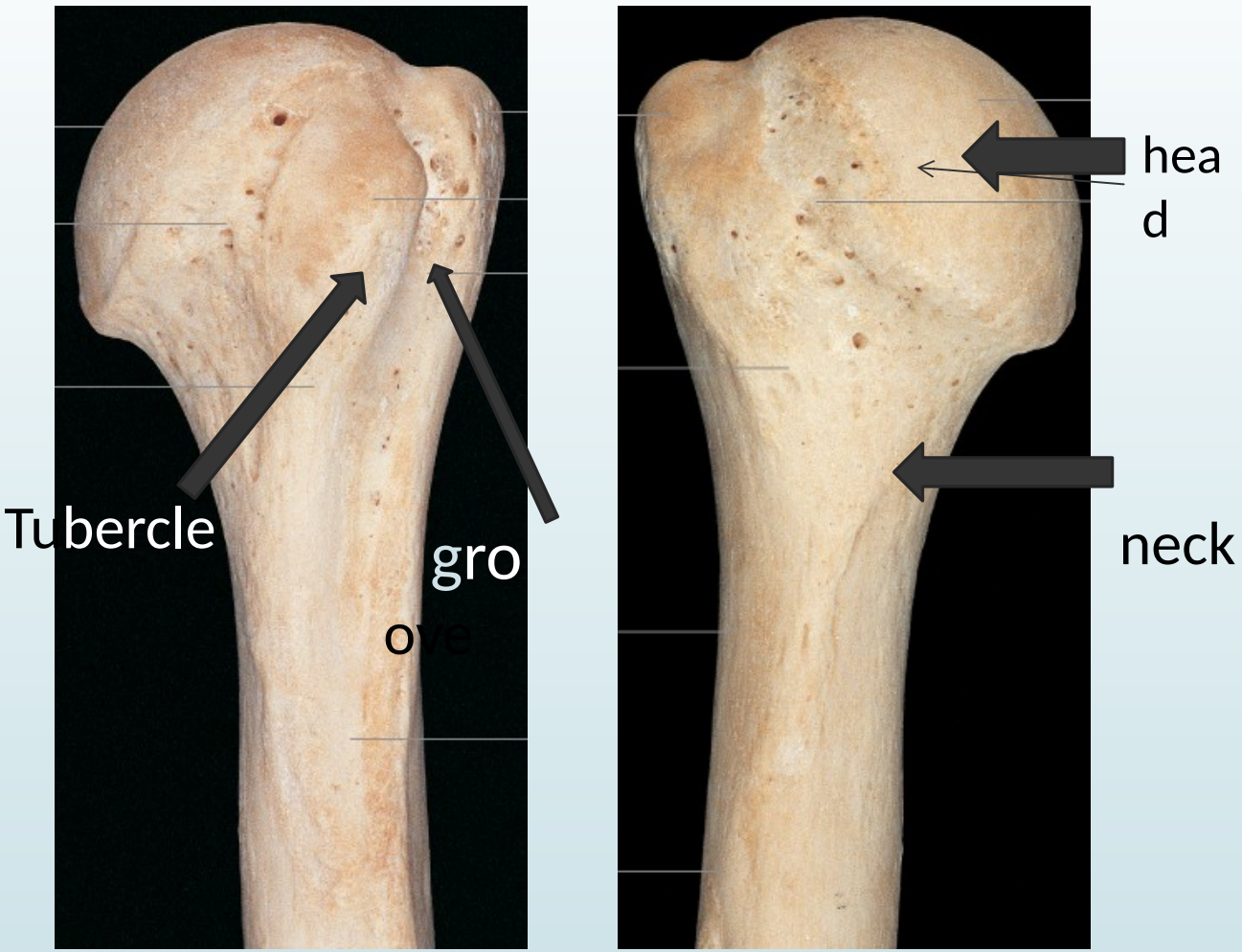
HEAD - An enlargement carried on a neck, takes part in forming a joint

LINE - A narrow ridge, smaller than a crest

MEATUS - A tube-like opening

NECK - A narrowed region at one end of a long bone, attached to head

PROCESS - The general term for a long projection from a bone

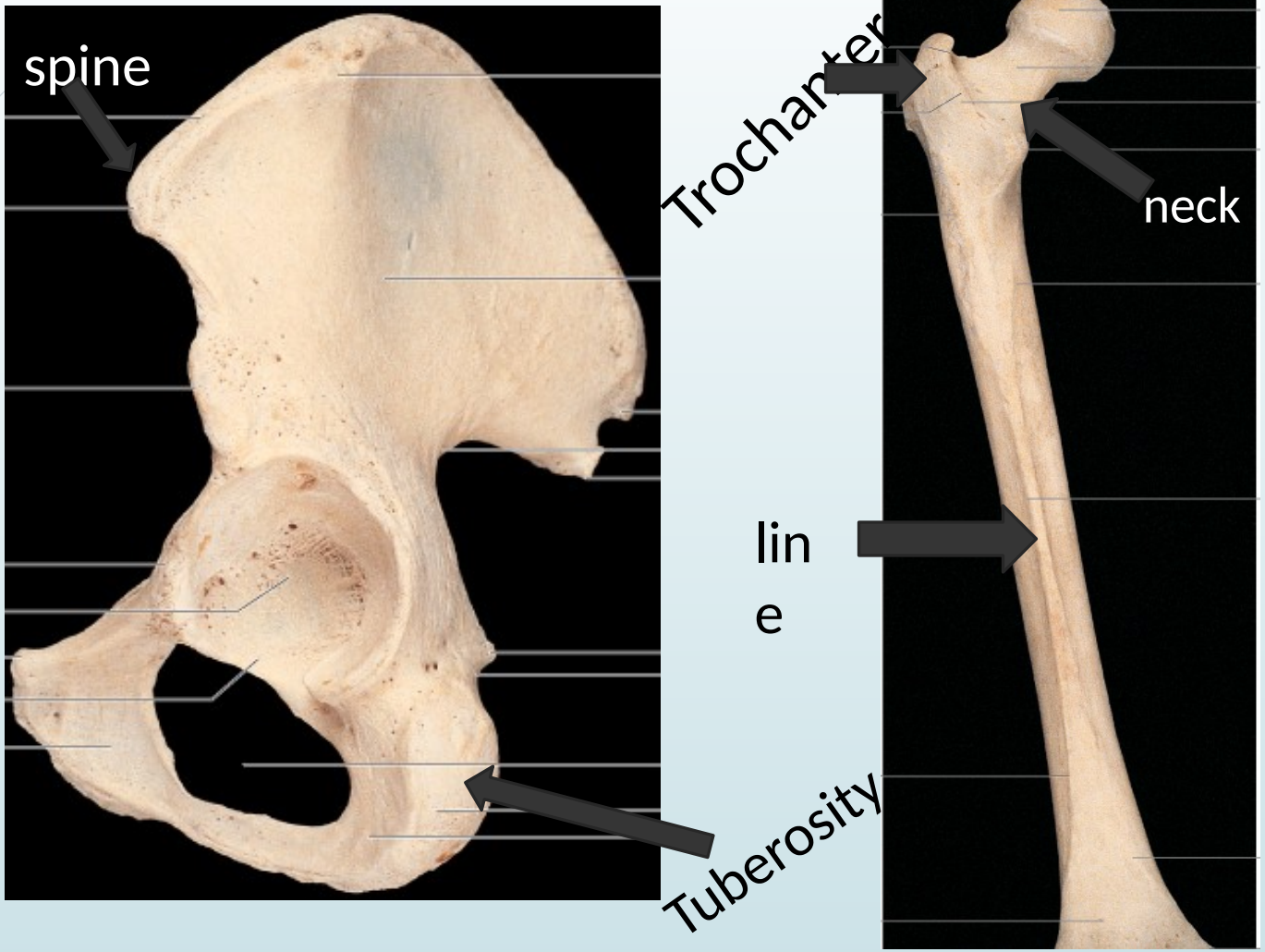

Tubercle
gro
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neck

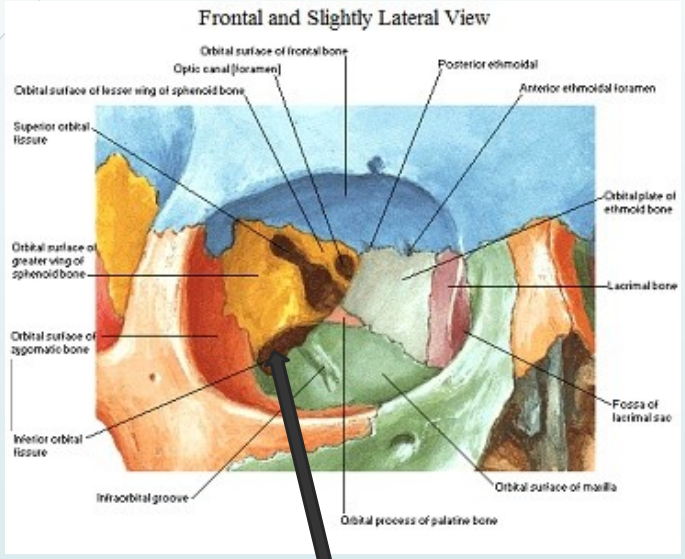
Bone Markings…

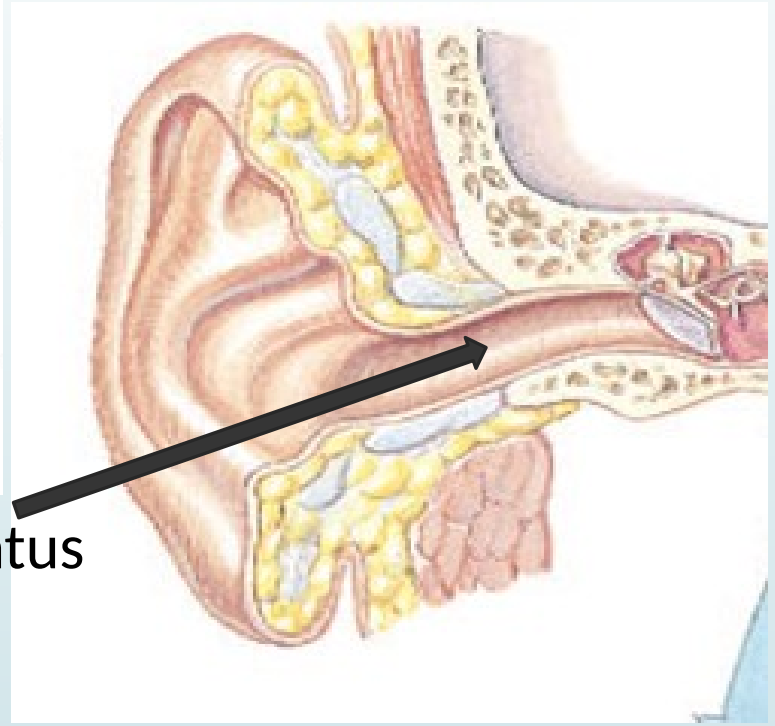
TUBERCLE - A small rounded projection

TUBEROSITY - A large, rounded projection for muscle attachment, usually rough

TROCHANTER - A large, irregularly shaped projection


spine
Trochanter
neck
lin
e
Tuberosity





Fissure

Meatus

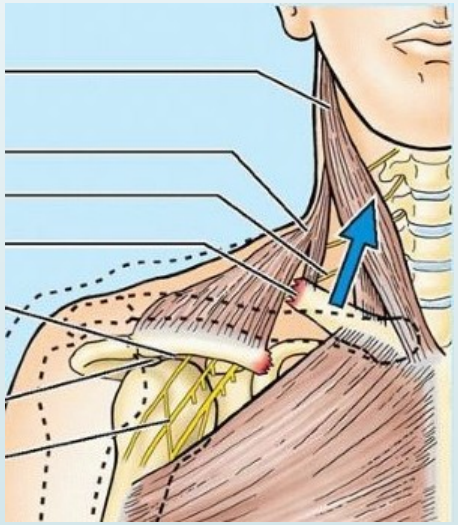
BONE FRACTURES

Partial (Incomplete): a fracture in which the break across the bone is incomplete.

Complete: a fracture in which the break across the bone is complete, so that the bone is broken into two or more pieces.

Closed (Simple): a fracture in which the bone does not open through the skin.

Complete fracture



BONE FRACTURES…

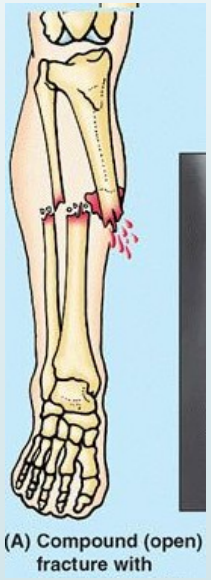
Open (Compound): a fracture in which the broken ends of the bone protrude through the skin.

Spiral:-fracture line is twisted as it is broken

Greenstick:- in this incomplete break one side of bone is broken & other side is bowed

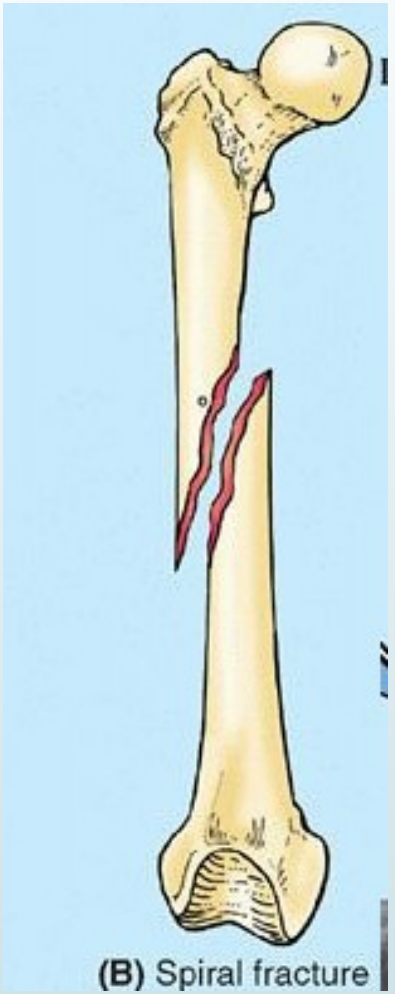
Comminuted:- the bone is splintered into small fragments

Open (Compound) fracture

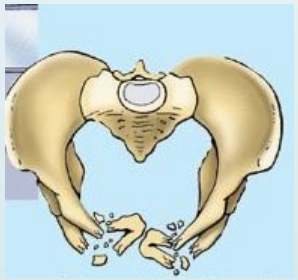


(A) Compound (open) fracture with

Spiral fracture



Comminuted fracture

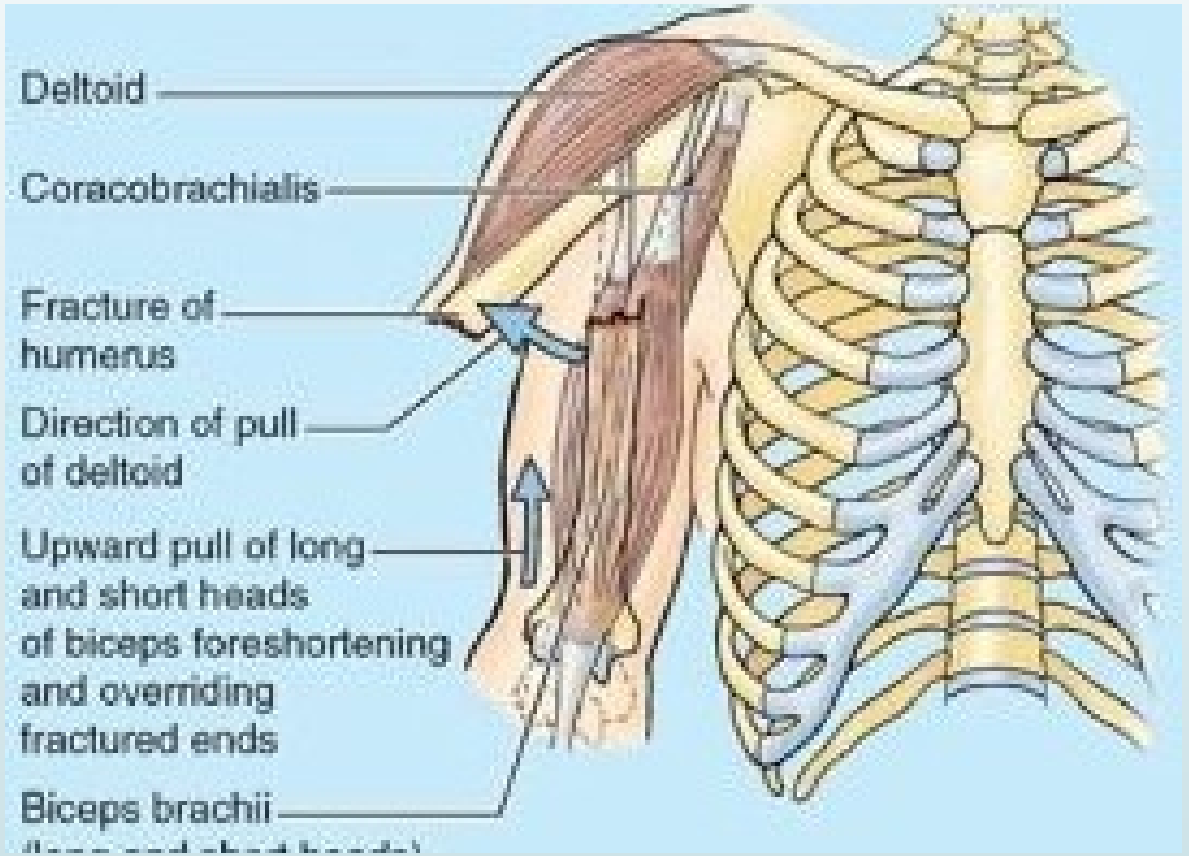


BONE FRACTURES…

Impacted:- one broken end of a bone is driven into the other

Transverse:- the fracture occurs across the bone at right angles to the shaft

Transverse fracture



Joints (articulations)

- Where parts of skeleton meet
- Allows varying amounts of mobility
- Classified by structure or function
- Arthrology: study of joints

Classification of Joints

- By Function/degree of movement:
  - **Synarthroses** (fibrous) = no/little movement
  - **Amphiarthroses** (cartilageous) = slight movement
  - **Diarthroses** (synovial)= great movement

Joints by Functional Classification

Type	Movement	Example	
Synarthroses	None (minimal)	Sutures, Teeth, Epiphyseal plates,	
Amphiarthroses	Slight	Intervertebral discs Pubic symphysis	
Diarthroses	Great	Glenohumeral joint Knee joint TMJ	

Joint Classification by Structure

- **Cartilagenous**
  - Synchondrosis: connected by **hyaline cartilage** (synarthrosis)
  - Symphysis: connected by **fibrocartilage** (amphiarthrosis)
- **Fibrous**
  - Sutures: connected by short strands of dense CT fibers (synarthrosis)
  - Gomphosis: peg like short ligament in socket (synarthroses)
  - Syndesmosis: connected by **ligaments**
- **Synovial** (diarthrosis)-with synovial membrane & cavity

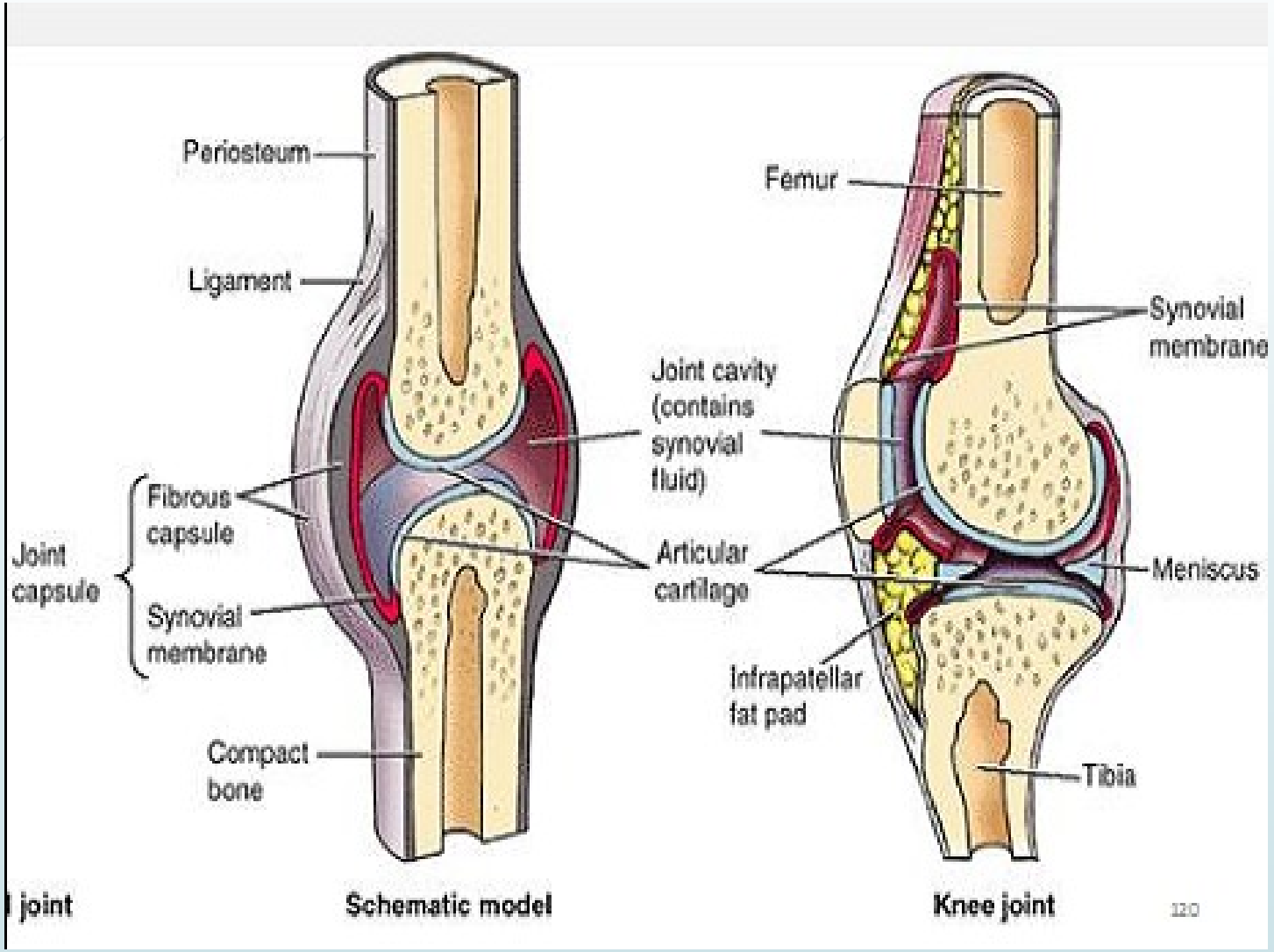
Joints by Structural Classification

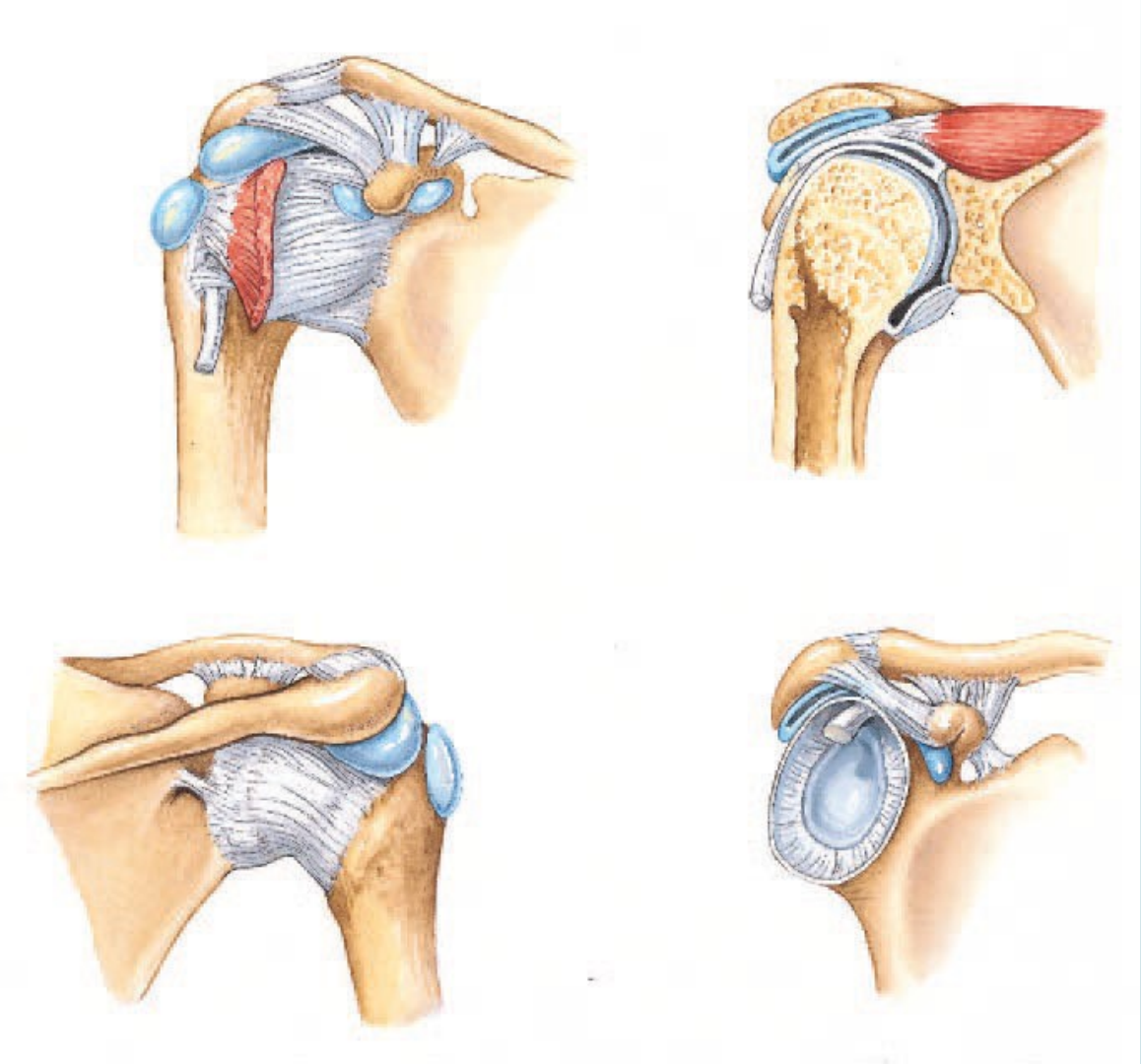
Structure	Type	Example
Cartilagenous	Synchondrosis Symphysis	Epiphyseal plates Intervertebral discs
Fibrous	Sutures Syndesmosis Gomphosis	Skull Distal Tibia/fibula Teeth in sockets
Synovial		Glenohumeral joint Knee joint TMJ

Components of SYNOVIAL JOINTS:

- **Articular cartilage**: covers ends of both bones
- **Synovial (joint) cavity**: space holding synovial fluid
- **Articular capsule**: Made of 2 layers
  - **Fibrous**: external, dense CT for strength
  - **Synovial membrane**: internal, produces synovial fluid

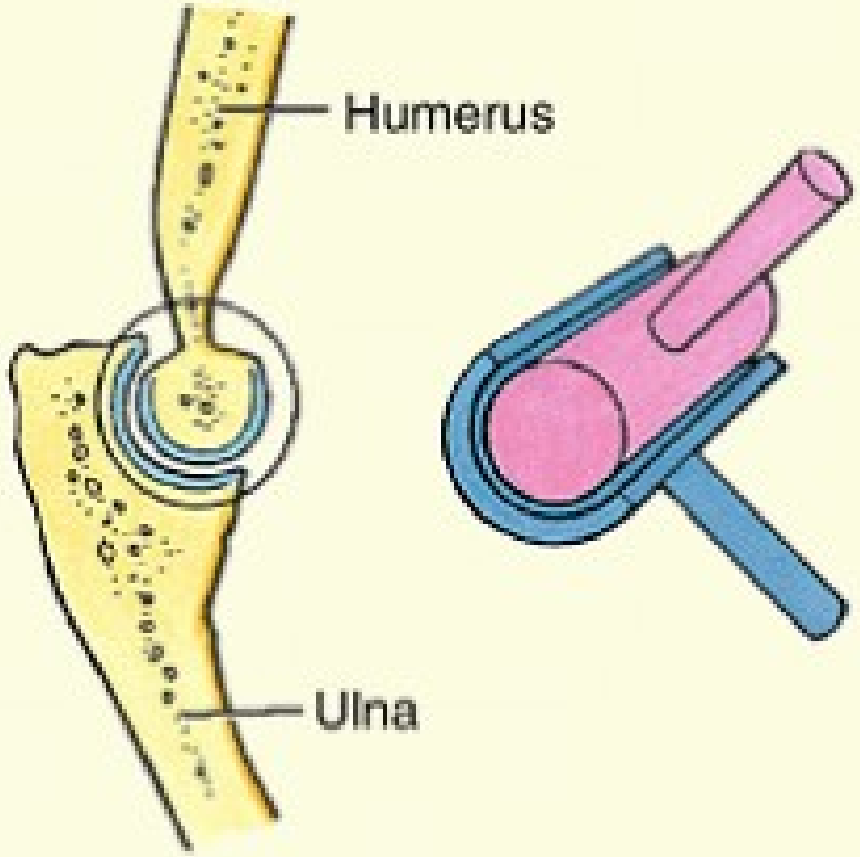
- **Reinforcing ligaments:** extracapsular/intracapsular
- **Nerves + vessels**: Highly innervated, Highly vascular
- **Meniscus** (in some): fibrocartilage; improves the fit of two bones to increase stability


Periosteum
Ligament
Joint capsule
Fibrous capsule
Synovial membrane
Compact bone
Joint cavity (contains synovial fluid)
Articular cartilage
Schematic model
Femur
Synovial membrane
Meniscus
Infrapatellar fat pad
Tibia
Knee joint



Types of synovial joint: by shape

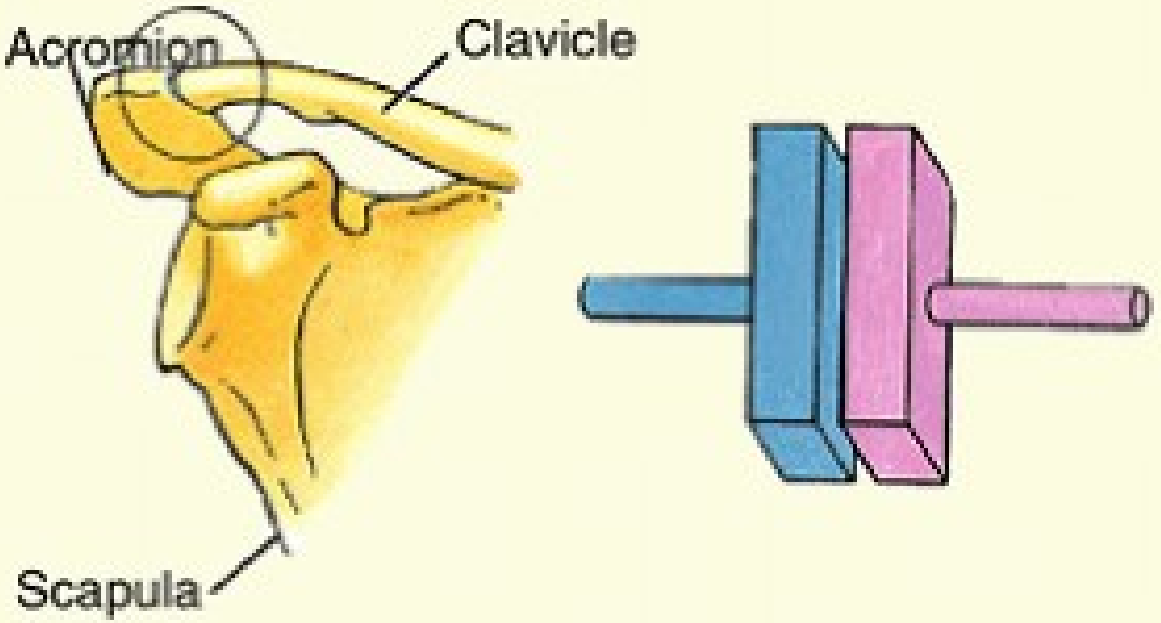
- **Hinge:** cylindrical end of one bone fits into **trough shape** of other end
  - angular movement-one plane (eg) elbow, ankle, interphalangal



Hinge joints (uniaxial) permit flexion and extension only (e.g., the elbow joint).

Joint Shapes: types of synovial joint

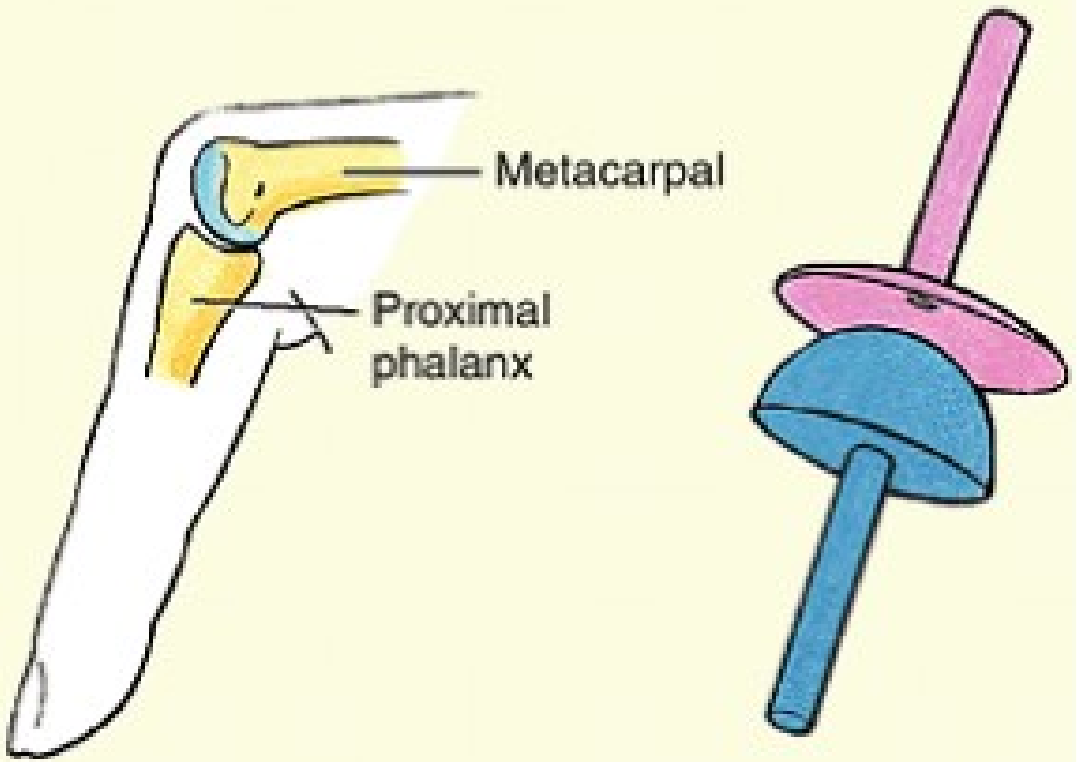
- **Plane**: articular surface in flat plane
  - Short gliding movement
  - (eg) intertarsal, articular processes of vertebrae



Plane joints permit gliding or sliding movements (e.g., the acromioclavicular joint).

Joint Shapes: types of synovial joint

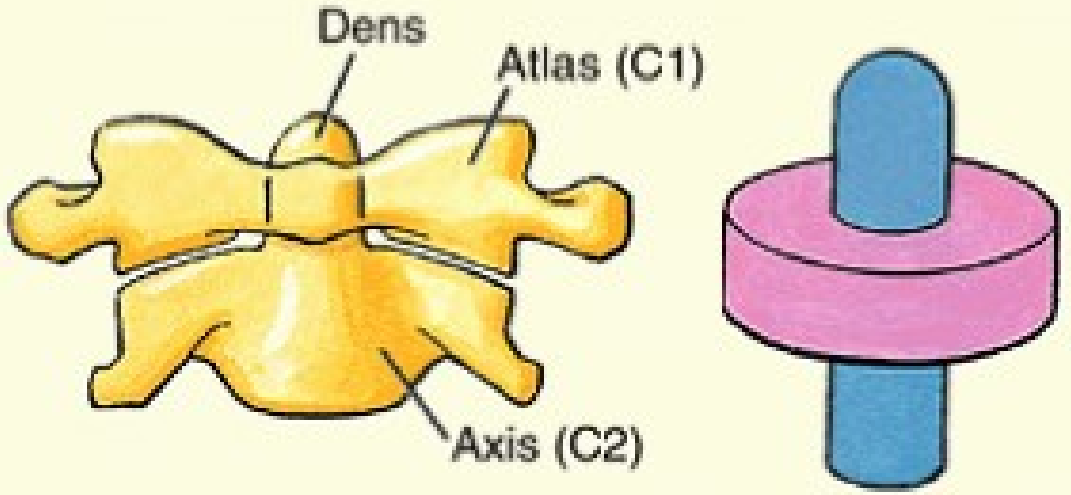
- **Condyloid**: egg-shape articular surface + oval concavity
  - side-to-side, back+forth movement
  - (eg) metacarpophalangeal (knuckle)



Condyloid joints (biaxial) permit flexion and extension, abduction and adduction, and circumduction (e.g., the metacarpophalangeal [knuckle] joints of fingers).

Joint Shapes: types of synovial joint

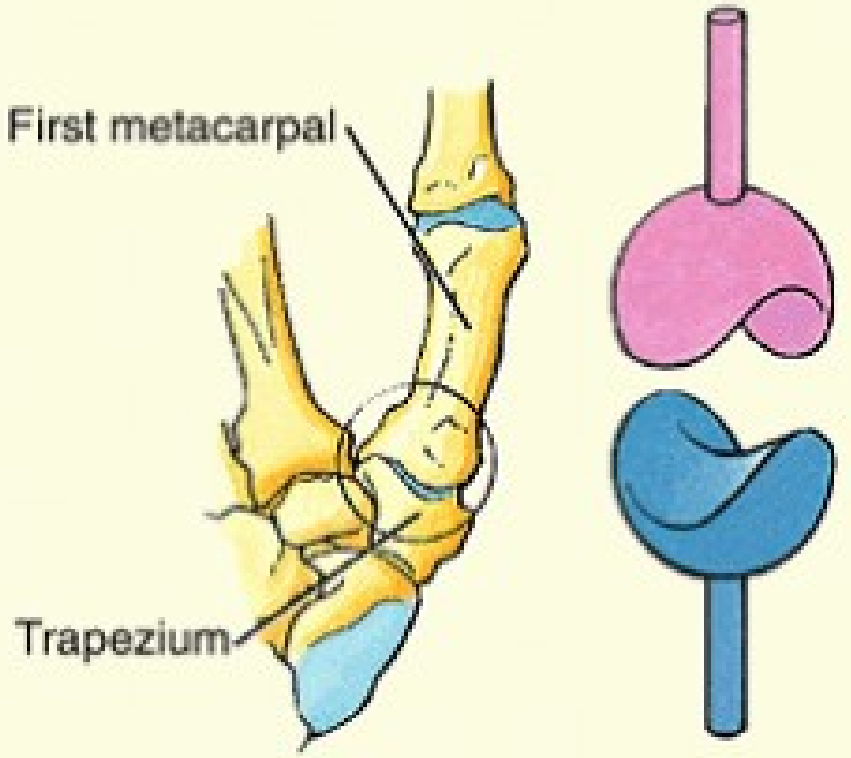
- **Pivot**: round end fits into ring of bone + ligament
  - rotation on long axis
  - (eg) proximal radio-ulna, atlanto-axial joint



Pivot joints (uniaxial) allow rotation. A round process of bone fits into a bony ligamentous socket (e.g., the atlantoaxial joint between the atlas [C1] and axis [C2]).

Joint Shapes: types of synovial joint

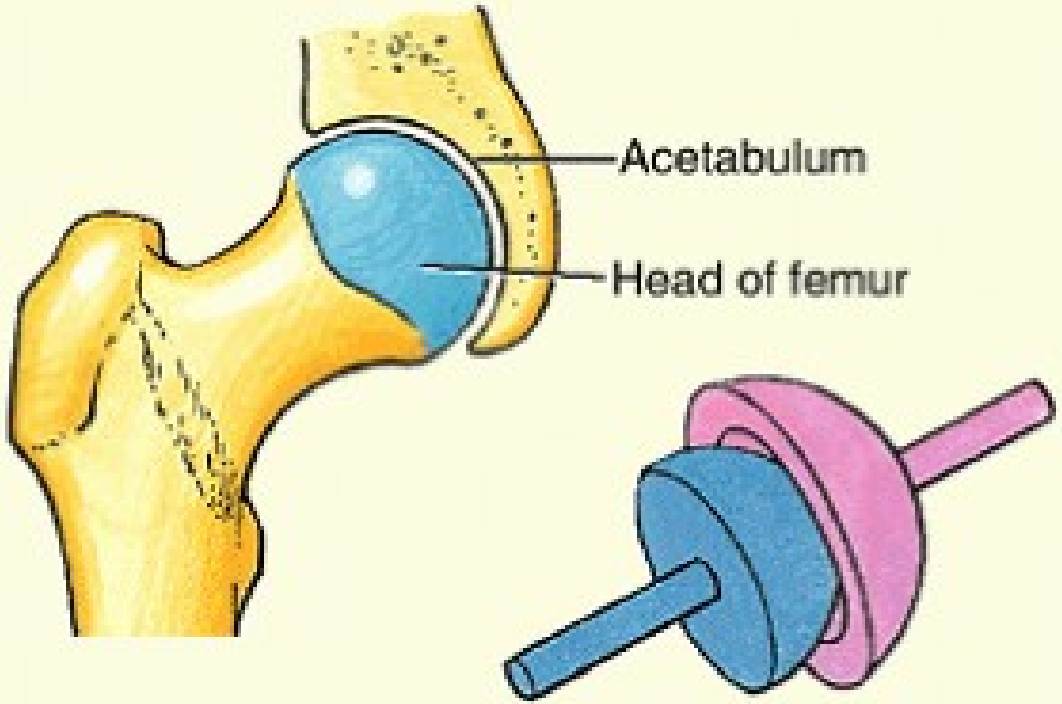
- **Saddle**: articular surface both concave + convex
  - side-to-side, back-forth movement
  - (eg) carpometacarpal joint of thumb



Saddle joints (biaxial) are shaped like a saddle—that is, they are concave and convex where the bones articulate (e.g., the joint between the metacarpal and the trapezium).

Joint Shapes: types of synovial joint

- **Ball + Socket**: spherical head + round socket
  - multiaxial movement
  - (eg) shoulder & hip joints



Ball and socket joints (multiaxial) permit movement in several axes (e.g., flexion-extension, abduction-adduction, medial and lateral rotation, and circumduction). A rounded head fits into a concavity (e.g., the hip joint).

4) The muscular system

- Comprises all muscles of the body
- Muscle comprises the largest group of tissues in the body
  - approximately constitutes half of the body’s weight
  - Skeletal muscle about **40%** of body weight in men & **32%** in women

Muscular System…

Muscle cells:

- often called **muscle fibers** because they are long and narrow when relaxed
- are specialized **contractile cells**, organized into tissues that move body parts
- The associated **connective tissue** conveys nerve fibers and capillaries to the muscle fibers as it binds them

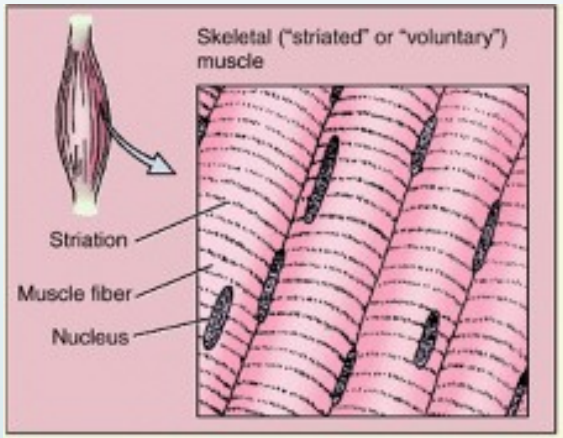
There are three types of muscles

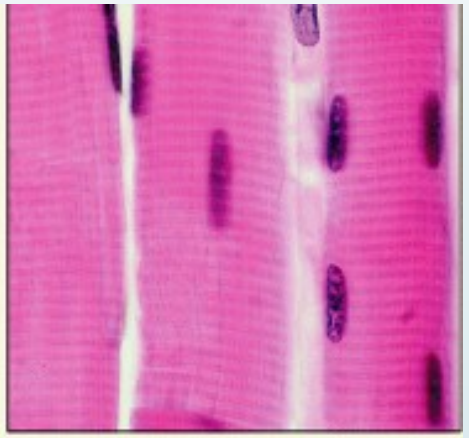
1:**skeletal muscle**, which moves bones and other structures = **somatic**

2:**cardiac muscle**, which forms most of the walls of the heart, and is **autonomic**

3:**smooth muscle**, which forms part of the walls of most vessels and hollow organs (viscera's) , and is **autonomic**

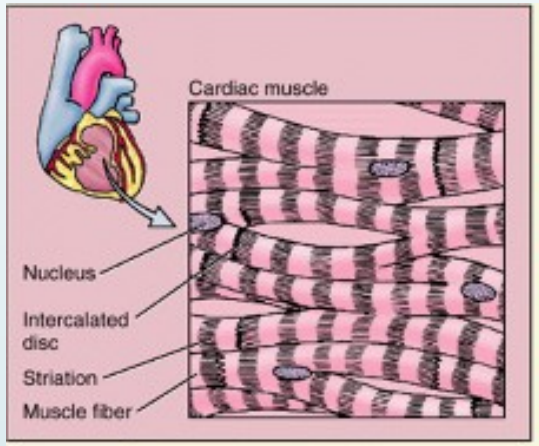
Skeletal muscle tissue

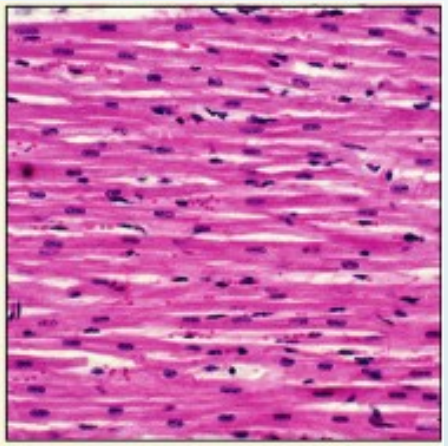




Location	Appearance	Type of Activity	Stimulation
Composes gross named muscles (e.g., the biceps of the arm) attached to the skeleton and/or fascia of limbs, body wall, and head/neck	Large, long, unbranched, cylindrical fibers with transverse striations (stripes) arranged in parallel bundles; multiple, peripherally located nuclei	Strong, quick intermittent (phasic) contraction above a baseline tonus; acts primarily to produce movement or resist gravity	Voluntary (or reflexive) by the somatic nervous system (SNS, p.34)

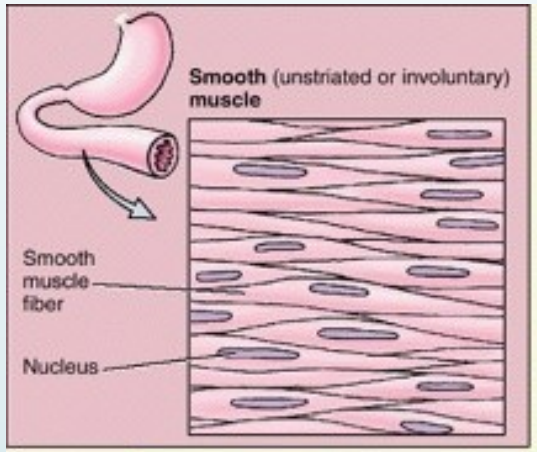
Cardiac muscle tissue

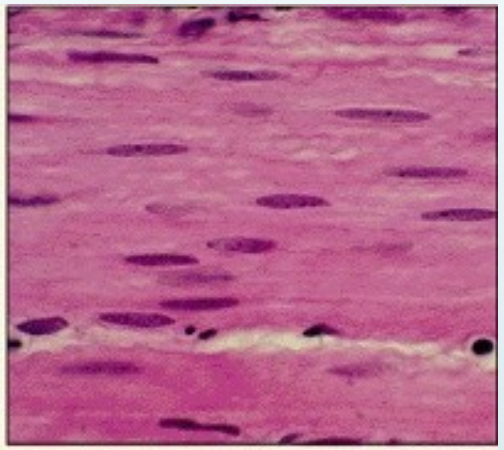




Location	Appearance	Type of Activity	Stimulation
Muscle of heart (myocardium) and adjacent portions of the great vessels (aorta, vena cava)	Branching and anastomosing shorter fibers with transverse striations (stripes) running parallel and connected end-to-end by complex junctions (intercalated discs); single, central nucleus	Strong, quick, continuous rhythmic contraction; acts to pump blood from heart	Involuntary; intrinsically (myogenically) stimulated and propagated; rate and strength of contraction modified by autonomic nervous system (ANS, p. 34)

Smooth muscle tissue

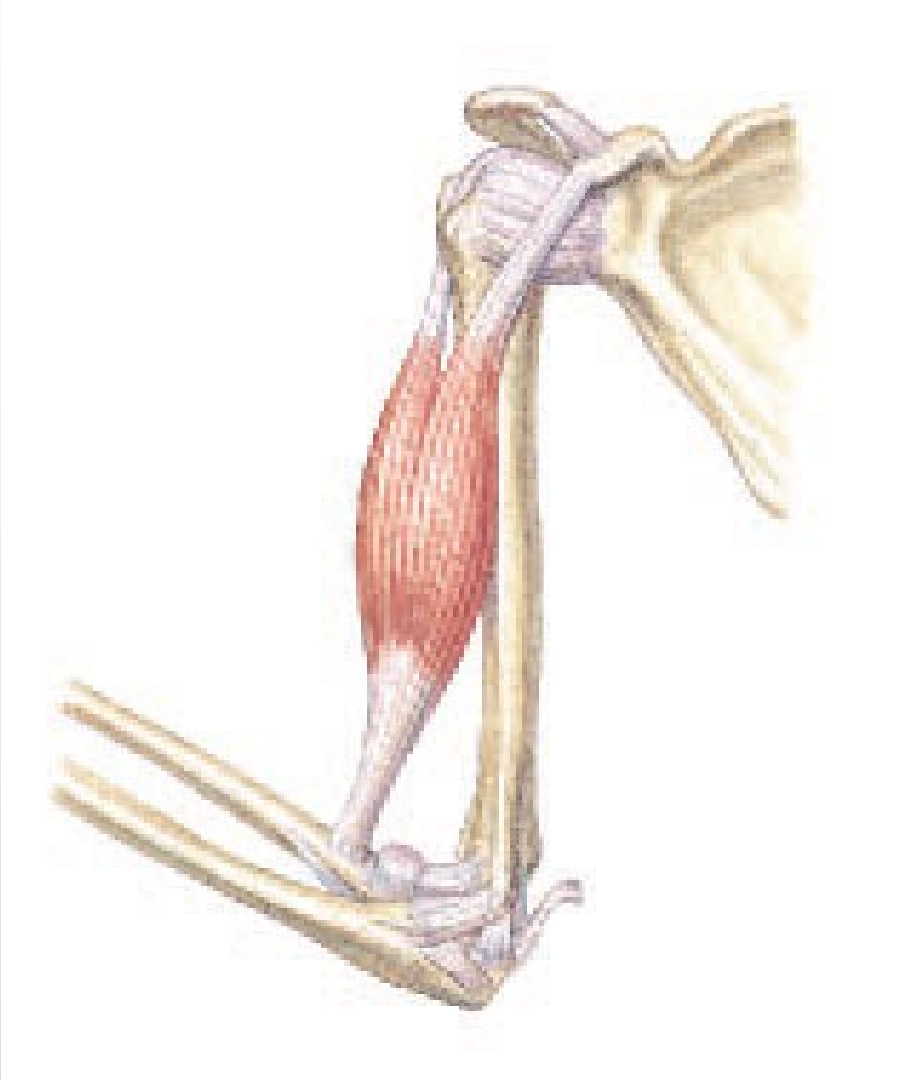


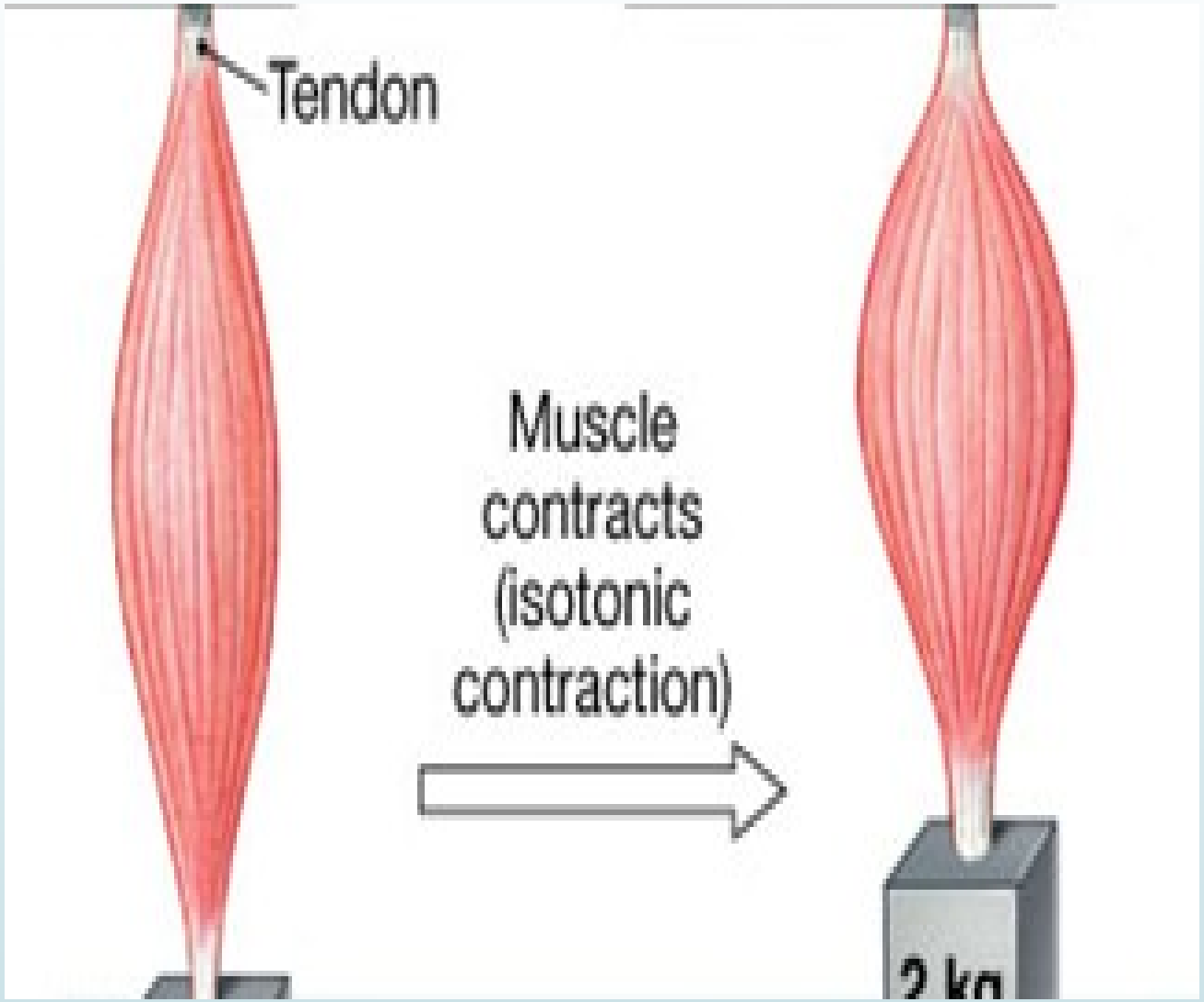


Location	Appearance	Type of Activity	Stimulation
Walls of hollow viscera and blood vessels, iris, and ciliary body of eye; attached to hair follicles of skin (arrector muscle of hair)	Single or agglomerated small, spindle-shaped fibers without striations; single, central nucleus	Weak, slow, rhythmic, or sustained tonic contraction; acts mainly to propel substances (peristalsis) and to restrict flow (vasoconstriction and sphincteric activity)	Involuntary by autonomic nervous system (ANS)

Skeletal Muscle structure

- **Bellies**: have a fleshy contractile portion composed of skeletal striated muscle
- **Tendons**: (rounded) and **aponeuroses** (flat sheets) :white non-contractile portion composed mainly of collagen bundles
- **Origin**: is usually the proximal end of the muscle, which remains fixed during muscular contraction
- **Insertion**: is usually the distal end of the muscle, which is movable



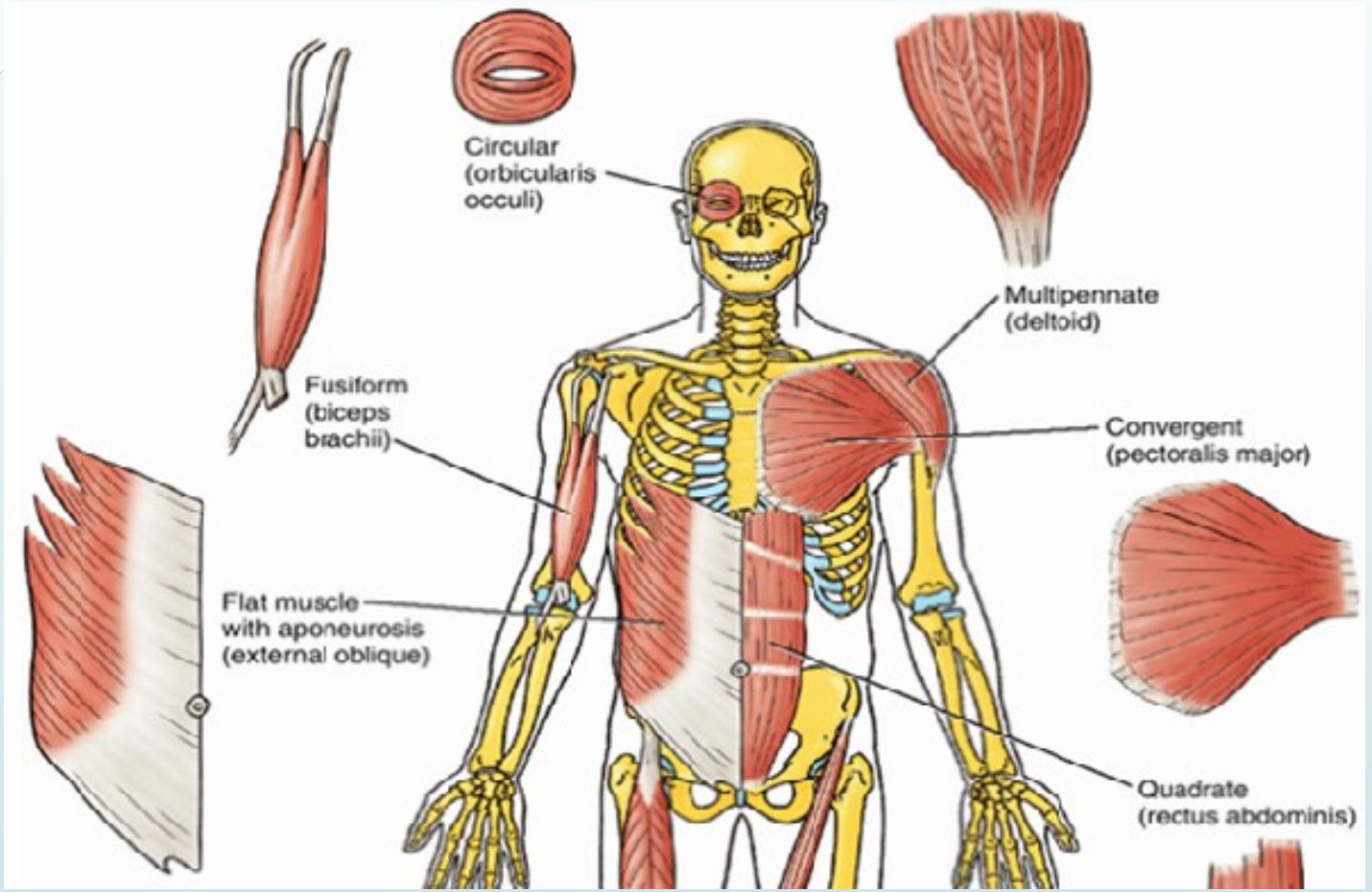

Tendon
Muscle
contracts
(isotonic
contraction)
2 kg

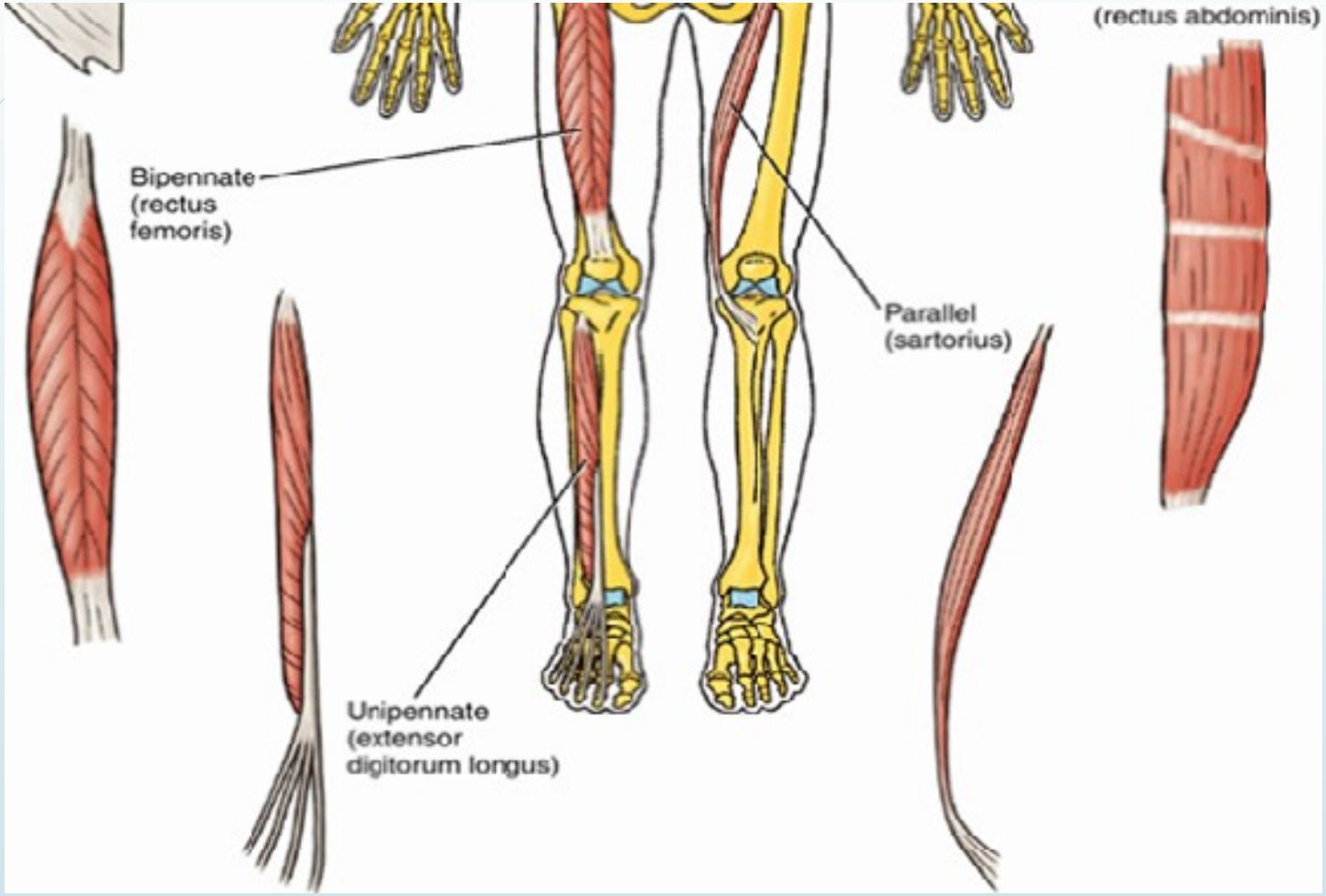
Naming of muscles

- Most muscles are named on the basis of their **function** or the bones to which they are attached (abductor digiti minimi)
- On the basis of their **shape** (G. deltoid, triangle)
- On the basis of their **position** (vastus lateralis)
- On the basis of their **length** (brevis, short; longus, long),
- On the basis of their **size** (maximus, minimus)
- on the basis of their **number of attachments** (biceps, triceps).

Muscle architecture

- **Pennate muscles** are feather-like in the arrangement of their fascicles (fiber bundles): unipennate, bipennate, or multipennate
- **Fusiform muscles** are spindle shaped (round, thick belly, and tapered ends).eg biceps brachi
- **In parallel muscles**, the fascicles lie parallel to the long axis of the muscle; flat muscles with parallel fibers often have aponeuroses.
- **Convergent muscles** have a broad attachment from which the fascicles converge to a single tendon.
- **Circular muscle** surrounds a body opening or orifice constricting it when contracted


Circular
(orbicularis
occuli)
Multipennate
(deltoid)
Fusiform
(biceps
brachii)
Convergent
(pectoralis major)
Flat muscle
with aponeurosis
(external oblique)
Quadrate
(rectus abdominis)

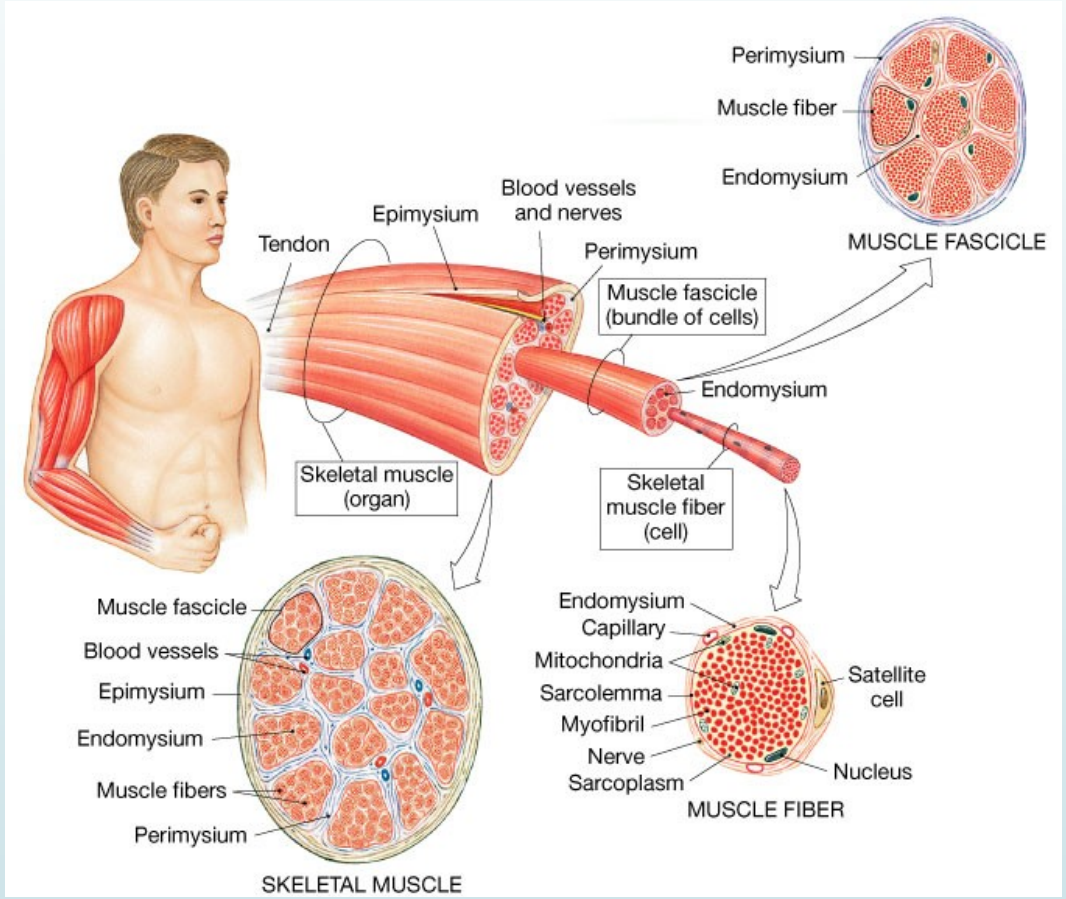

(rectus abdominis)
Bipennate
(rectus
femoris)
Parallel
(sartorius)
Unipennate
(extensor
digitorum longus)

- **Muscle fiber**: the structural unit of a muscle
- **Endomysium:** Connective tissue covering individual muscle fibers
- **Perimysium**: invests a group of fibers (fiber bundles)
- **Epimysium**: surround the entire muscle

- The functional unit of a muscle, consisting of a motor neuron and the muscle fibers it controls, is a **motor unit**.

NB:The number of muscle fibers in a motor unit varies from one to several hundred

The Organization of Skeletal Muscles



The functions catagories of skeletal muscles

- A **prime mover** or **agonist**: is the main muscle responsible for producing a specific movement
- A **synergist**: complements the action of prime movers
- An **antagonist:** is a muscle that opposes the action of a prime mover.
- **Fixators**: steady the proximal parts of a limb while movements are occurring in distal parts.

5) The CIRCULATORY system

- The circulatory system transports fluids throughout the body.

- It consists of:

➢ **Cardiovascular** (contains the heart ,blood and blood vessels) and

➢ **lymphatic systems** (contains lymph,lymph node,lymphatic vessels and lymphoid organs)

Cardiovascular System

- The transport network of blood which carries nutrients, oxygen, and waste products to and from cells
- There are three types of blood vessels:

  arteries, **veins**, and **capillaries**

- The wall of most vessels of the circulatory system have three tunics or coats:
  - **Tunica intima**, the thin endothelial lining of vessels;
  - **Tunica media**, the middle smooth muscle layer;
  - **Tunica adventitia**, the outer connective tissue coat.

Arteries

- Arteries carry blood away from the heart and distribute it to the body

- There are three types of arteries

➢ **Large (Elastic arteries)** **= conducting arteries**

-have many elastic layers in their walls; e.g. Aorta

➢ **Medium muscular arteries** **= distributing arteries**

-walls consist mainly of smooth muscle, e.g. Femoral a.

➢ **Small arteries and arterioles**

-have relatively narrow lumina and thick muscular walls

- **Degree of tonus (firmness):** contraction & relaxation of the smooth muscle of the arteriolar walls regulates the degree of arterial pressure within the vascular system

- If the tonus of muscle in the arterial wall is above normal, hypertension results

- **Anastomoses(CollateralCirculation**):

  -communications between the multiple branches of an artery that provides numerous potential detours for blood flow

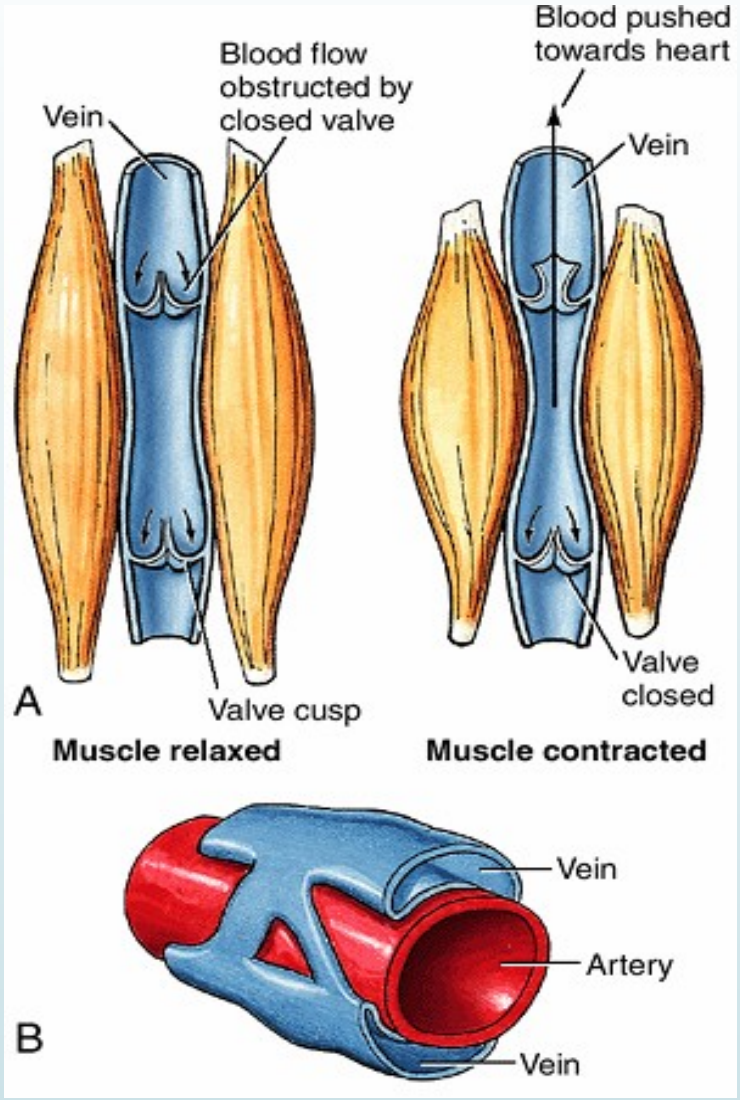
- **Arteriosclerosis** :thickening and loss of elasticity of arterial walls mainly due to the buildup of fat (mainly cholesterol) in the arterial walls

- **Ischemia** :reduction of blood supply to an organ or region due to thrombosis (local clottinga due to theromatous plaque), which may occlude the artery

- **Infarction** :local death of an organ or tissue due to Ischemia ex. gangrene , heart attack (myocardial infarction)

Veins

- Return poorly oxygenated blood to the heart from the capillary beds **except pulmonary veins**.
- Have **thinner walls** ,because of the lower blood pressure (skeletal muscle pump)
- Flow of blood is opposed by the pull of gravity ,so **have valves**
- Varicose Veins :When the walls of veins lose their elasticity, they become weak, tortious and dilated
- Venacomitants: veins accompanying deep arteries. Usually tend to be double or more


Blood flow
obstructed by
closed valve
Vein
Blood pushed
towards heart
Vein
Valve cusp
Valve
closed
A
Muscle relaxed
Muscle contracted
Vein
Artery
Vein
B

Capillaries

- Are **simple endothelial tubes** connecting the arterial and venous sides of the circulation.
- They are generally arranged in networks (**capillary beds**) between the arterioles and venules
- through the capillary bed, oxygen, nutrients, and other cellular materials are **exchanged** with the surrounding tissue
- **Arteriovenous anastomoses** (AV shunts) :permit blood to pass directly from the arterial to the venous side of the circulation without passing through capillary beds eg. in the fingers

Lymphatic System

- The lymphatic system provides for the drainage of surplus tissue fluid (**lymph**) to the bloodstream
- This is also important for the removal of cellular debris and infection
- Involved in **absorption** (**lacteals)** and transport of dietary **fat** =chyle from intestine to blood
- Lymph is usually clear and watery and is similar in composition to blood plasma

The lymphatic system consists of:

- Lymphatic plexuses
  - -networks of small lymphatic capillaries
  - -originate in the extracellular spaces of tissues
- Lymphatic vessels
  - -body wide network of thin-walled vessels
  - -originating from lymphatic plexuses
  - -have valves and are along with lymph nodes
- Lymph nodes
  - - small masses of lymphatic tissue
  - -lymph is **filtered** here on its way
- Lymphocytes– are immune cells
- Lymphoid tissue (organ)-sites that produce lymphocytes ,ex. spleen , walls of GIT, lymph nodes , myeloid tissue in red bone marrow .

lymphatic trunks(large l.ves’s ends at;

- The right lymphatic duct

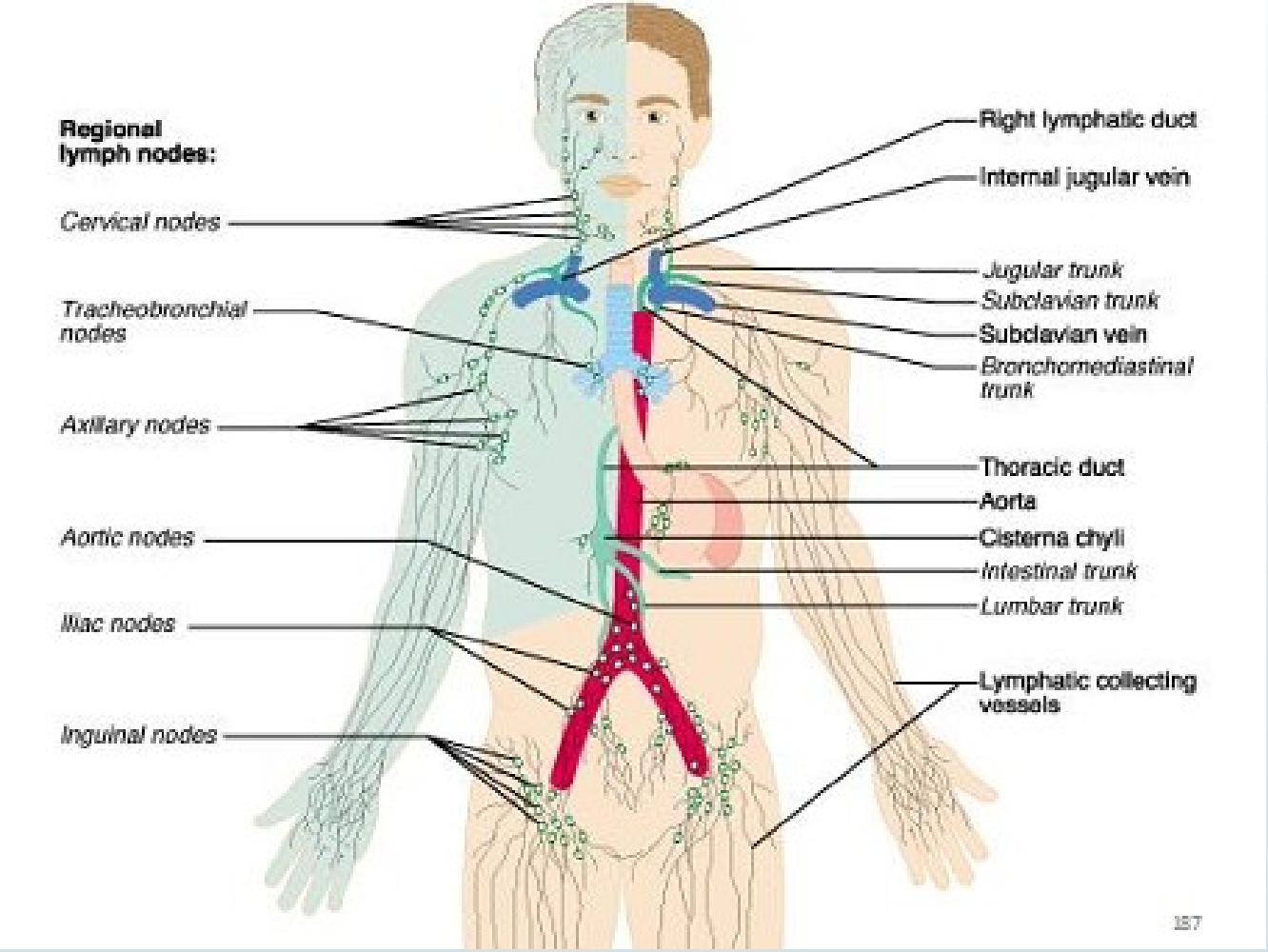
  -drains lymph from the body's **right upper quadrant**

  -The duct ends in the right subclavian vein at its angle

- The thoracic duct

  -drains lymph from the remainder of body

  -ends at left venous angle (internal jugular and left subclavian veins)


Regional lymph nodes:
Cervical nodes
Tracheobronchial nodes
Axillary nodes
Aortic nodes
Iliac nodes
Inguinal nodes
Right lymphatic duct
Internal jugular vein
Jugular trunk
Subclavian trunk
Subclavian vein
Bronchomediastinal trunk
Thoracic duct
Aorta
Cisterna chyli
Intestinal trunk
Lumbar trunk
Lymphatic collecting vessels
157

- **Lymphedema** (edema)=the accumulation of interstitial fluid occurs when lymph is not drained from an area of the body

- **lymphangitis** =secondary inflammation of lymphatic vessels

- **lymphadenitis** = secondary inflammation of lymph nodes.

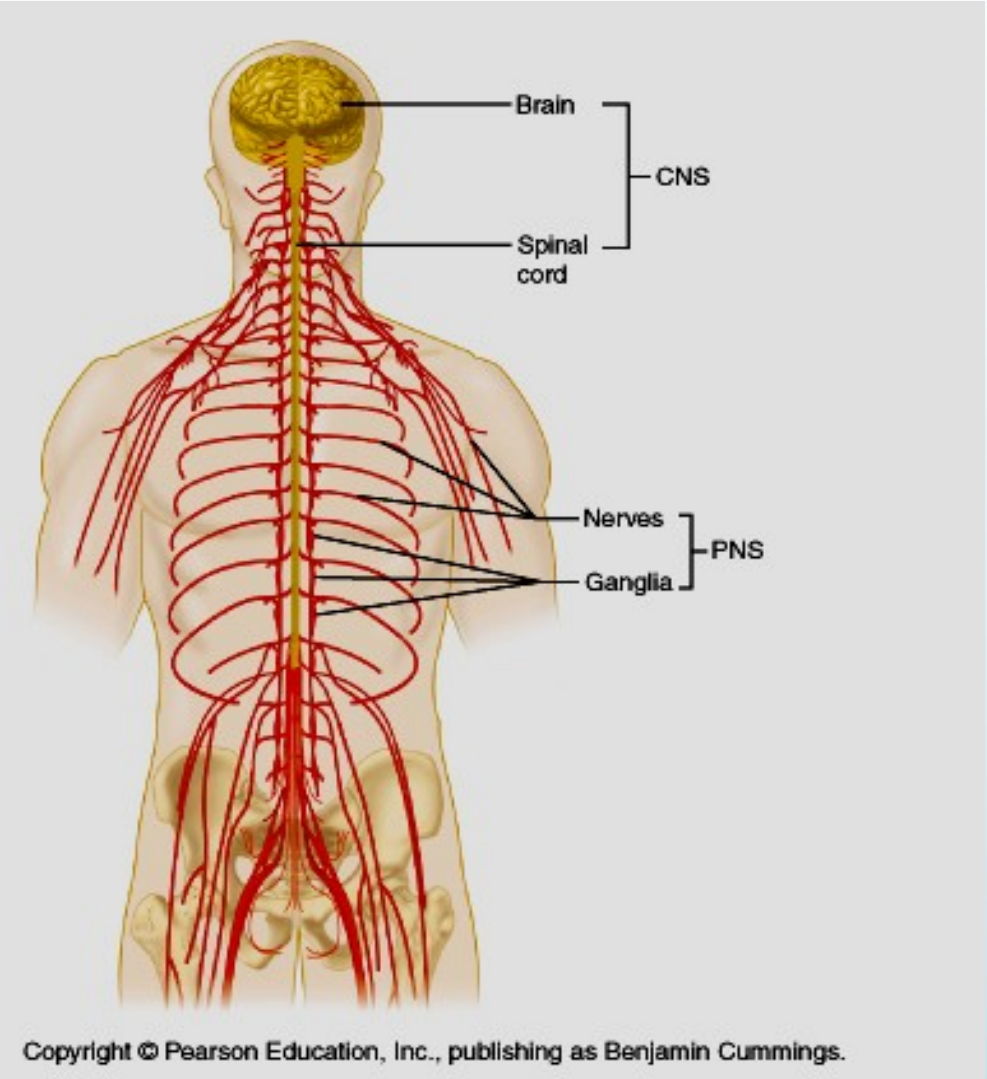
6) The NERVOUS system

- Enables the body to react to continuous changes in its external and internal environments
- It controls and integrates various activities of the body
- human nervous system is divided as :

❖ **Based on Structure**

➢ **CNS** :made up of the brain and spinal cord

➢ **PNS** : made up of nerves out side CNS (12 –pairs of cranial and 31 –pair spinal)


Brain
CNS
Spinal cord
Nerves
PNS
Ganglia
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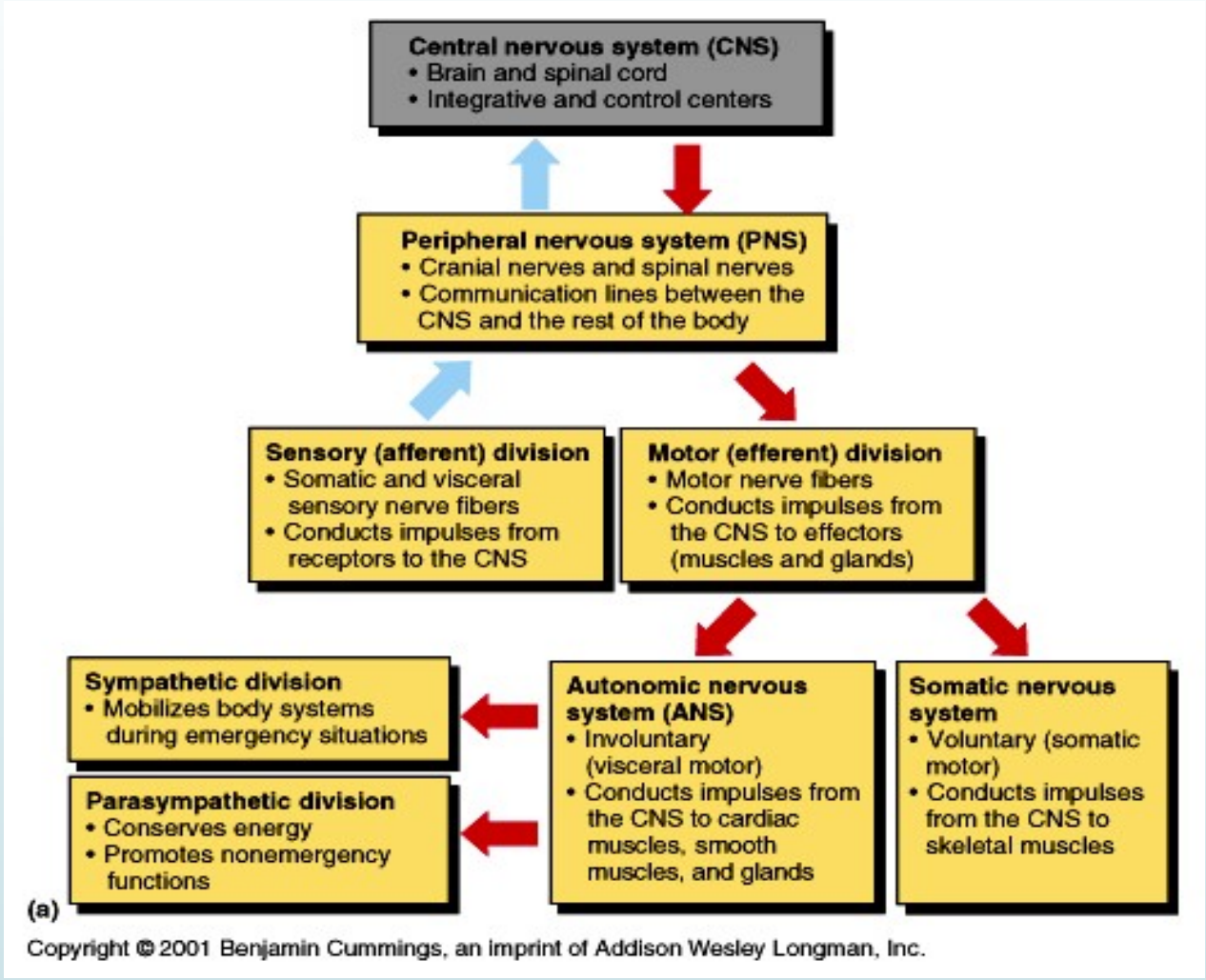
Nervous System

- **Based on Function**
  - somatic nervous system (SNS): the voluntary nervous system

    - supplies skeletal muscle

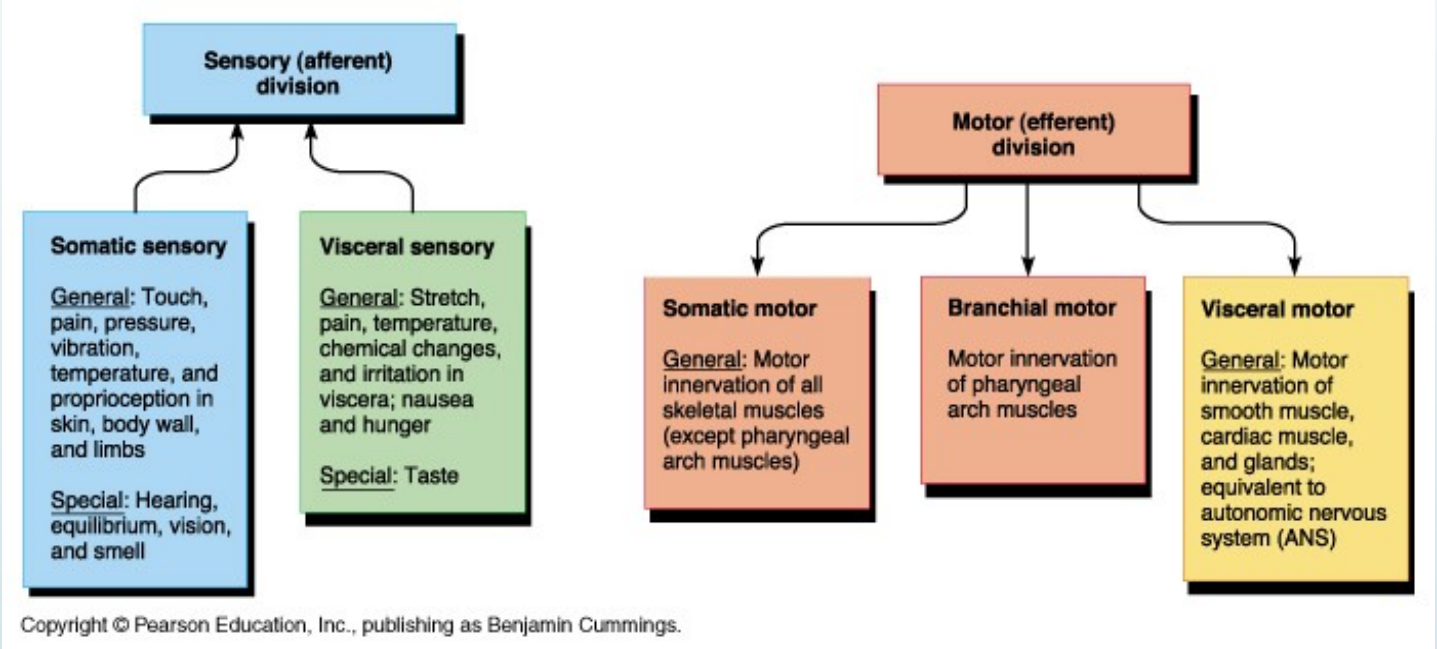
  - autonomic nervous system (ANS) :involuntary/visceral nervous system

    - supplies smooth muscle



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Subdivisions of peripheral nervous system



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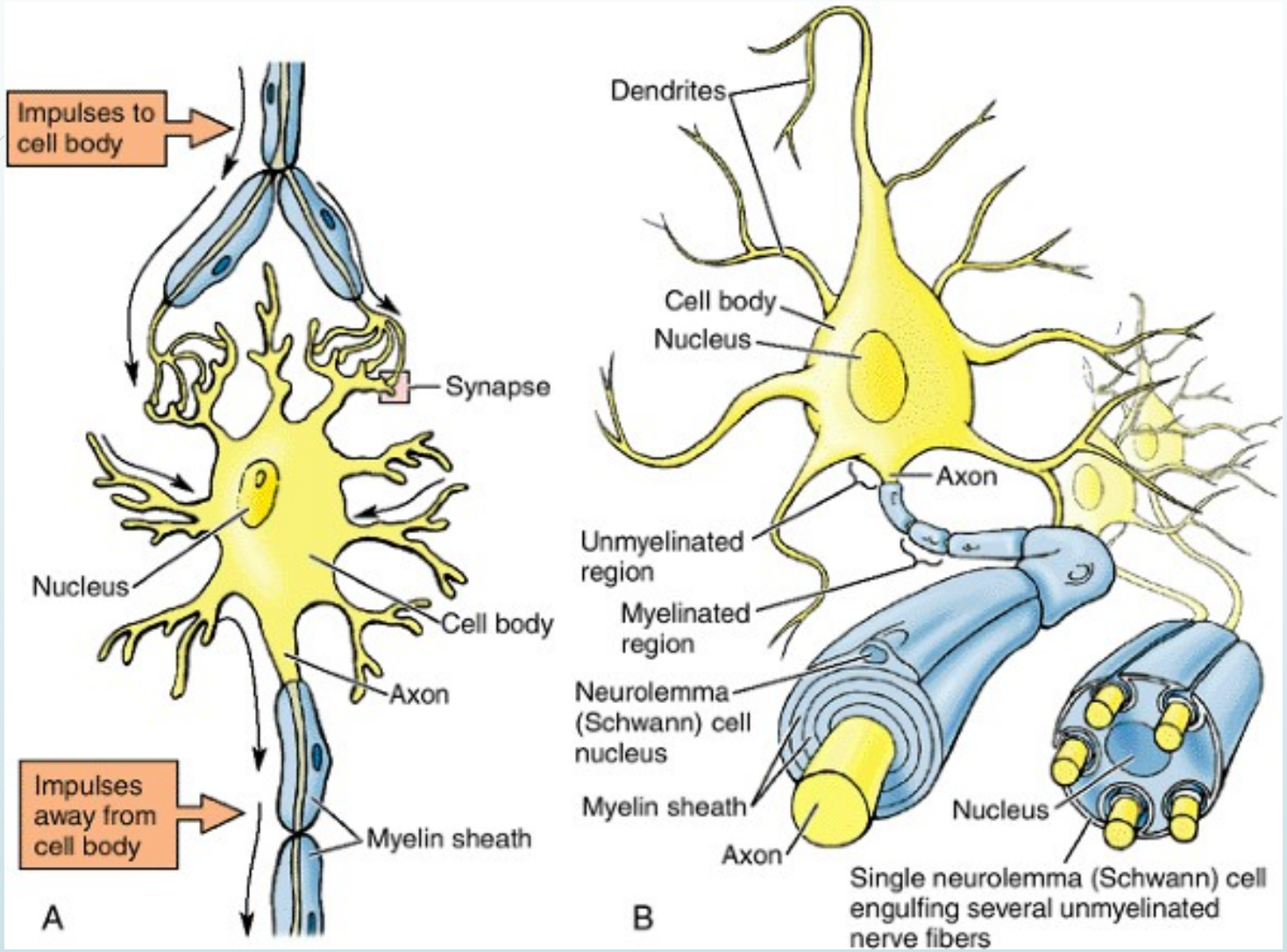
Nervous tissue consists of two main cell types

1.Neurons (nerve cells) :

- are the structural and functional units of the nervous system specialized for rapid communication

=Is composed of:

- **cell body** : contains cellular organelles &nucleus
- **dendrites** :short cytoplasmic extension of cell body
- **axon** :long cytoplasmic extension of cell body


Impulses to cell body
Synapse
Nucleus
Cell body
Axon
Impulses away from cell body
Myelin sheath
A
Dendrites
Cell body
Nucleus
Axon
Unmyelinated region
Myelinated region
Neurolemma (Schwann) cell nucleus
Myelin sheath
Axon
Nucleus
Single neurolemma (Schwann) cell engulfing several unmyelinated nerve fibers
B

Cotd..

And other features as:

- **myelin sheath** :layers of lipid and protein substances ,around some axons, greatly increasing the velocity of impulse conduction

- **neurotransmitters** :chemical agents released or secreted by one neuron, which may excite or inhibit another neuron

- **synapses** :points of contact between neurons where communication occurs by means of neurotransmitters

2.Neuroglia (non-neuronal ,glial cells)

- are non-neuronal, non-excitable cells that form a major component of nervous tissue
- Neuroglia support, insulate, and nourish the neurons.

Glial Cells & Neuronal Activity

- Glial cells are 10 times more abundant in the mammalian brain than neurons;
- they surround both cell bodies and their axonal and dendritic processes that occupy the interneuronal spaces.
- Nerve tissue has only a very small amount of extracellular matrix, and glial cells furnish a microenvironment suitable for neuronal activity.

Supporting Cells

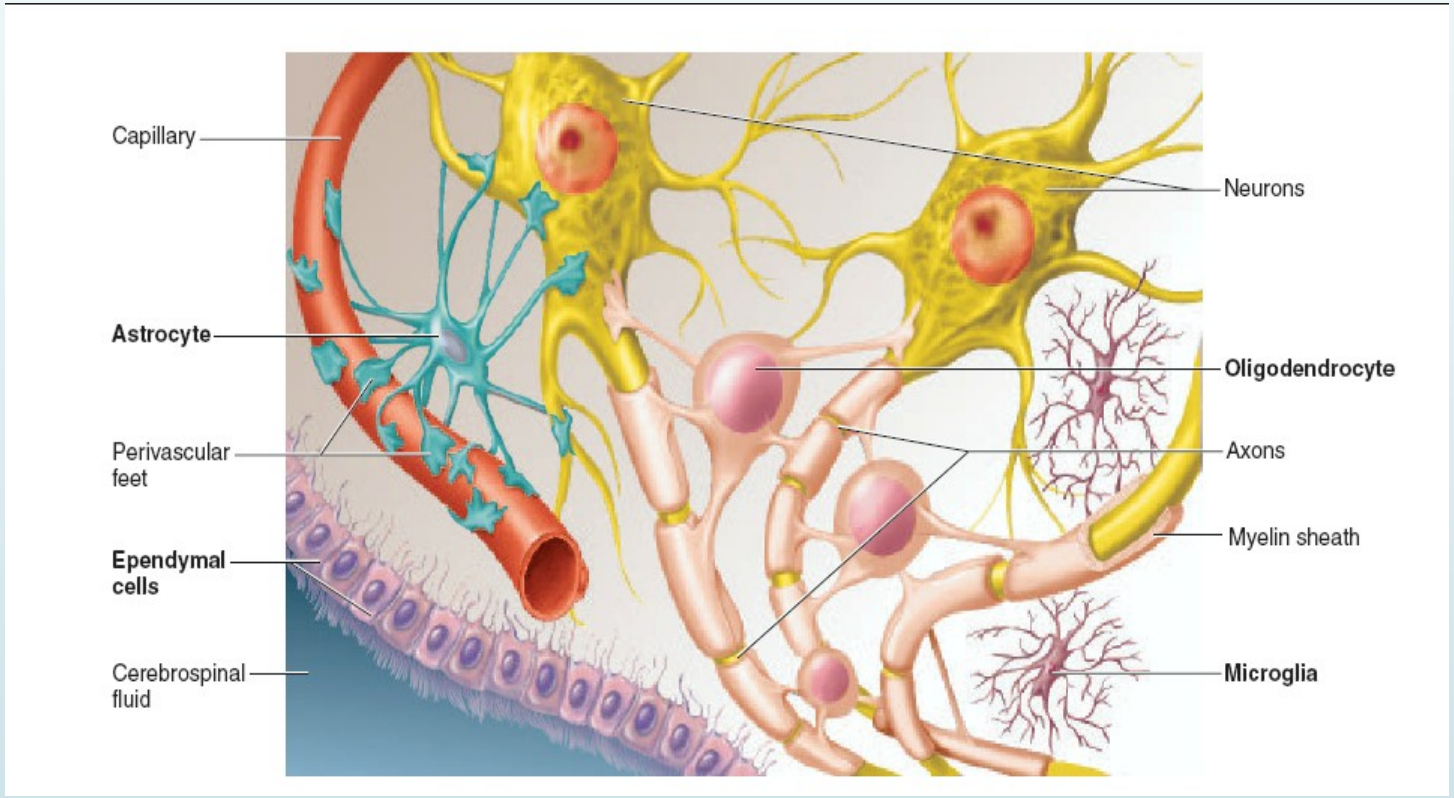


Table 9–1. Origin and Principal Functions of Neuroglial Cells.			
Glial Cell Type	**Origin**	**Location**	**Main Functions**
Oligodendrocyte	Neural tube	Central nervous system	Myelin production, electric insulation
Schwann cell	Neural tube	Peripheral nerves	Myelin production, electric insulation
Astrocyte	Neural tube	Central nervous system	Structural support, repair processes
			Blood–brain barrier, metabolic exchanges
Ependymal cell	Neural tube	Central nervous system	Lining cavities of central nervous system
Microglia	Bone marrow	Central nervous system	Macrophagic activity

A peripheral nerve consists of:

- A bundle of peripheral **nerve fibers** or fascicles
- **CT coverings** that surround & bind the nerve fibers & fascicles together
- Blood vessels (**vasa nervorum**) that nourish the nerve fibers & their coverings

Connective Tissue Coverings

- **Endoneurium**: surround neurolemma cells & axons
- **Perineurium**: a layer of dense CT that encloses a fascicle of peripheral nerve fibers
- **Epineurium**: a thick CT sheath that forms the outermost covering of the nerve

- A collection of nerve cell bodies outside the CNS is a **ganglion**.

Spinal Nerves

- arise from the spinal cord as **rootlets**, which converge to form two nerve **roots**:

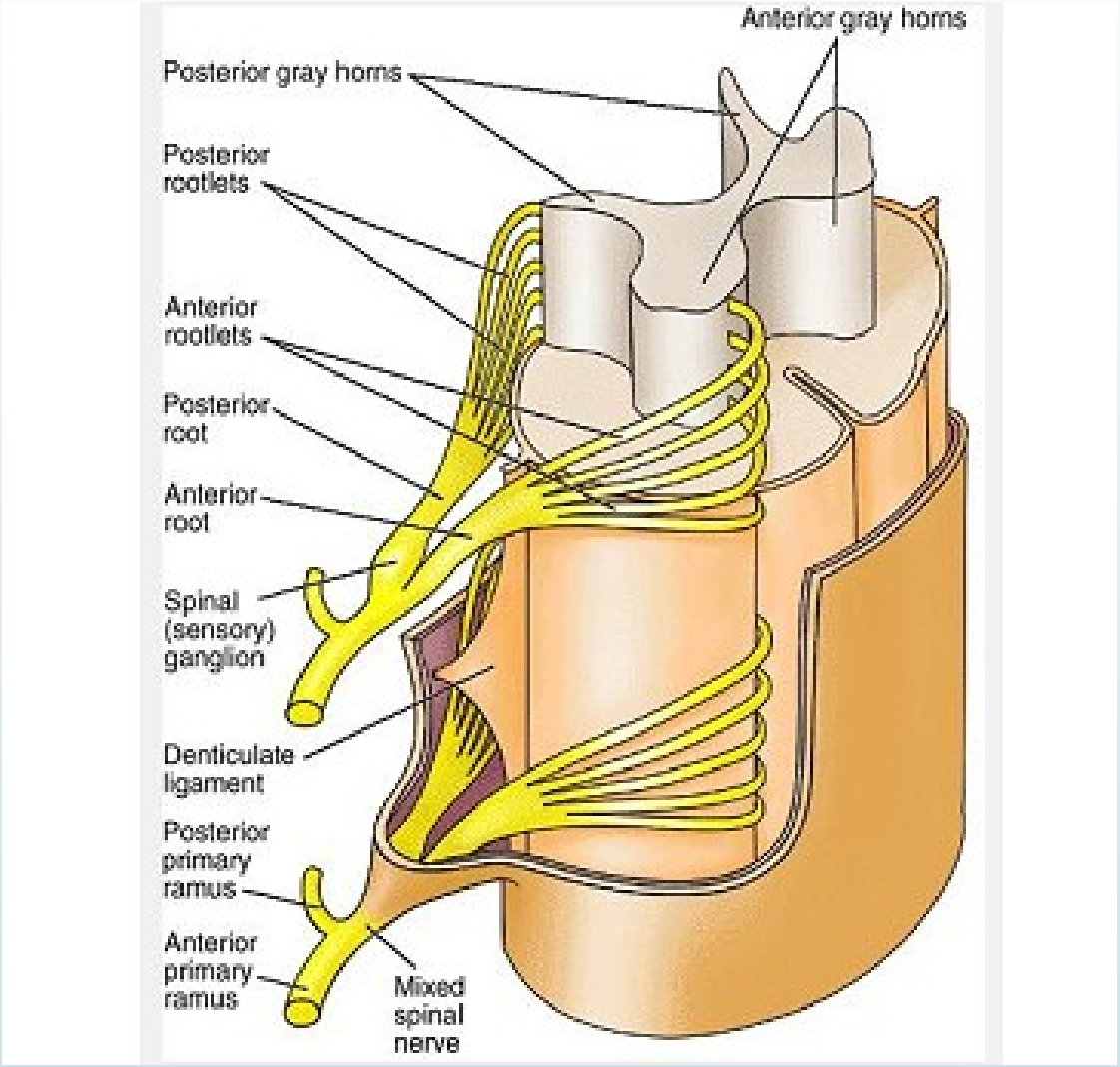
  - **An anterior (ventral) root**: consists of motor (efferent) fibers

  - **A posterior (dorsal) root**: consisting of sensory (afferent) fibers

- The posterior & anterior nerve roots unite to form a mixed **spinal nerve**
- This immediately divides into two **primary rami**:

  -- A posterior **(dorsal) ramus** &

  -- an anterior **(ventral) ramus**


Anterior gray horns
Posterior gray horns
Posterior rootlets
Anterior rootlets
Posterior root
Anterior root
Spinal (sensory) ganglion
Denticulate ligament
Posterior primary ramus
Anterior primary ramus
Mixed spinal nerve

THE END!