HUMAN MUSCULOSKELETAL ANATOMY

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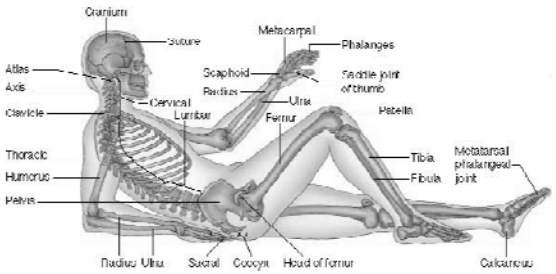
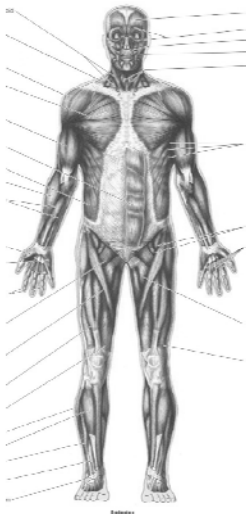
Objectives of this Course

- To understand the human gross musculoskeletal anatomy
  - A foundation of
    - Medicine
    - and related sciences
      - Physiology, Biomechanics, Motor learning & control…
- To learn the application of the anatomical knowledge
  - Human movement, sports, exercise, physical activity
  - Health care, Medicine

What we will study

- Osteology - bones
- Arthrology - joints
- Myology - muscles



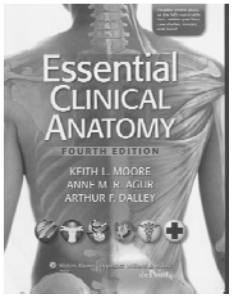


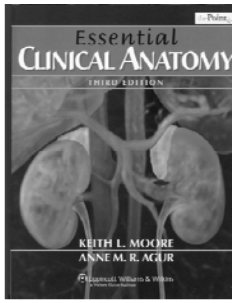
How important?

Master Course of all Human Related Subjects

Body, Degrees, Career

Teaching Materials





Text book: University book store

Teaching notes: **virtual campus**

APA1313 - Musculoskeletal Anatomy

Teaching approaches

Lectures

in- class practical exercises

lab exercise

Important date:

- 3rd Week : lab session starting
- Oct 22: mid-term exam
- Oct 20 – Oct 24: mid-term lab exam
- Dec 2 – Dec 22: final exam period

Evaluation

- Lab work …….. 40% of final mark
  - mid-term lab exam: 10%
  - lab exercises: 10%
  - final lab exam: 20%
- Mid-term exam……. 30% of final mark
- Final exam…… 30% of final mark
- Scores from in-class exercises will be a reference for your final grade

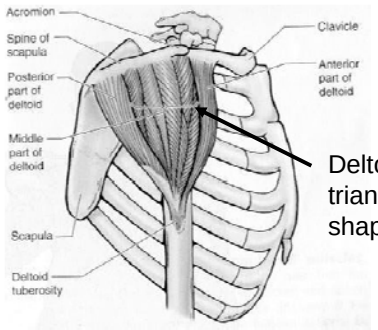
Tips for Studying Anatomy

- Before class: download teaching notes and know the lecture topics
- Attend class and lab exercise
- After class: read text book and notes
- visualize, palpate, and locate the structures as much as you can
- studying with a partner together to facilitate memorization

INTRODUCTION TO ANATOMY AND ANATOMICAL TERMINOLOGY

Anatomy

- Anatomy – the study of the structure and function of the body, and is one of the oldest basic medical sciences
- Anatomy is a descriptive science, studying shape, size, location, and function of the structures of human body



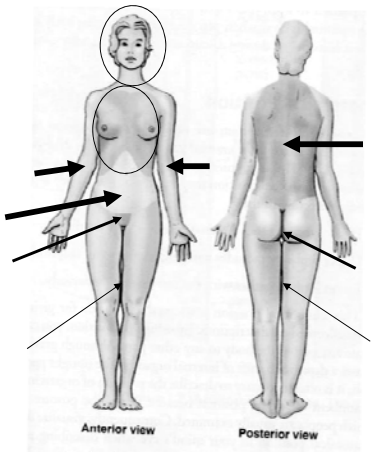
Deltoid muscle, triangular shaped muscle

Approaches to Studying Anatomy: Regional Anatomy

Studying the body by the regions

Human body can be divided into several regions

- Head/neck
- Upper limb
- Thorax
- Back
- Abdomen
- Pelvis/perineum
- Lower limb



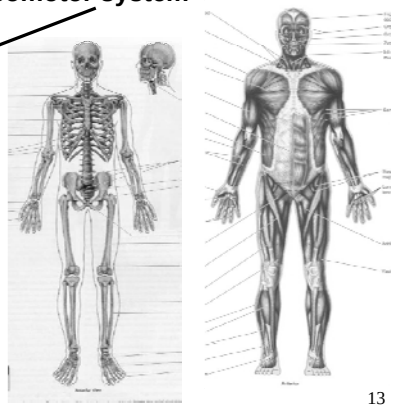
Approaches to Studying Anatomy: Systemic Anatomy

Studying the body by systems

Human body has

- integumentary system
- **skeletal system**
- **Articular system**
- **Muscular system**
- Nervous system
- Circulatory system
- Digestive system
- Respiratory system
- Urinary system
- Reproductive system
- Endocrine system

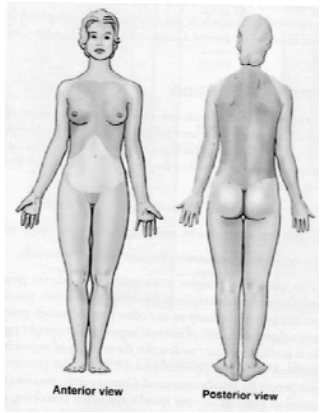
Locomotor system



Anatomicomedical Terminology

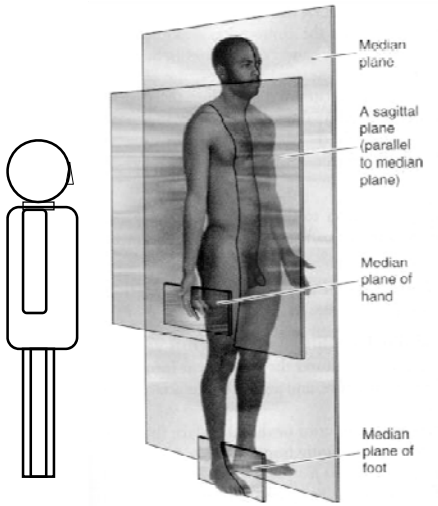
Anatomical Position

- The universally accepted **anatomical position**
  - Standing erect
  - Head, eyes, and toes directed anteriorly (forward)
  - Upper limbs by the side with the palms facing anteriorly
  - Lower limbs close together with the feet directed anteriorly
- All anatomical description are expressed in relation to the anatomical position



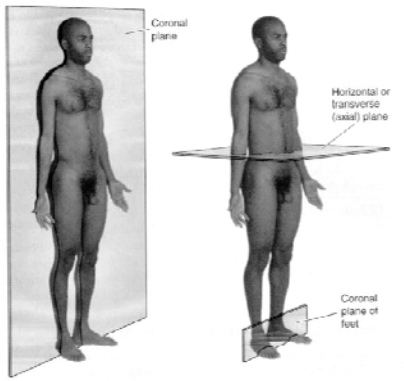
Anatomical Planes

- **Median plane** is the vertical plane passing longitudinally through the center of the body – dividing it into right and left halves
- **Sagittal planes** are vertical planes passing through the body parallel to the median plane



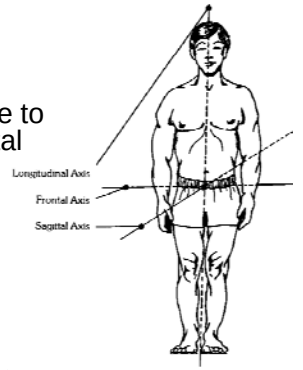
Anatomical Planes

- **Coronal planes (frontal planes)** are vertical planes passing through the body at right angles to the median plane, dividing it into anterior (front) and posterior (back) portions
- **Transverse planes** are planes passing through the body at right angles to the median and coronal planes. A transverse plane divides the body into superior (upper) and inferior (lower) parts



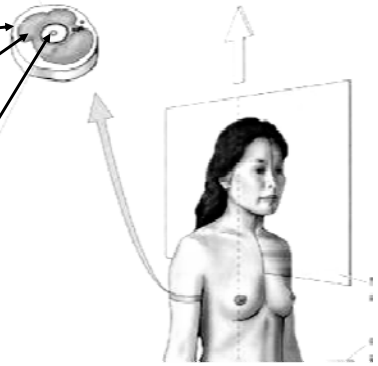
Axes of Motion

- **Sagittal Axis**
  - passes through body horizontally, front to back and is perpendicular to the frontal plane
  - Motion about it is within frontal plane
- **Frontal (transverse) Axis**
  - passes through body horizontally, side to side and is perpendicular to the sagittal plane
  - Motion about it is within sagittal plane
- **Longitudinal (vertical) Axis**
  - passes through body top to bottom
  - perpendicular to the ground and the transverse plane
  - Motion about it is within transverse plane



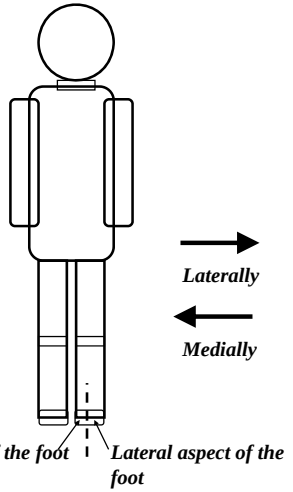
Terms of Relationship and Comparison

- **Superfical** is near to surface
- **Intermediate** between a superficial and a deep structure
- **deep** is farther from surface



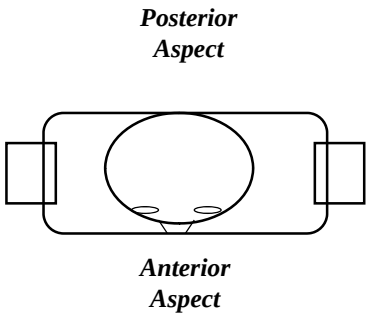
Terms of Relationship and Comparison

- **Medial** is used to indicate that a structure is near or nearer to the median plane of the body
- **Lateral** stipulates that a structure is farther away from the median plane



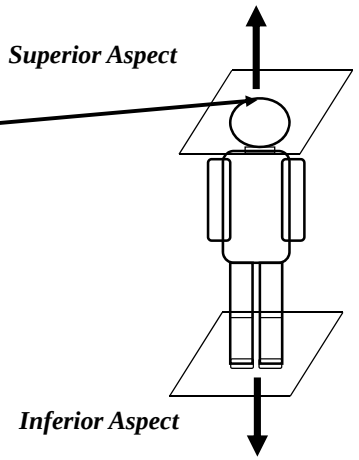
Terms of Relationship and Comparison

- **Anterior** (**ventral**) denotes the front surface of the body
- **Posterior** (**dorsal**) denotes the back surface of the body or nearer to the back



Terms of Relationship and Comparison

- **Superior** refers to a structure that is nearer the vertex
- **Inferior** refers to a structure that is situated nearer the soles of the feet



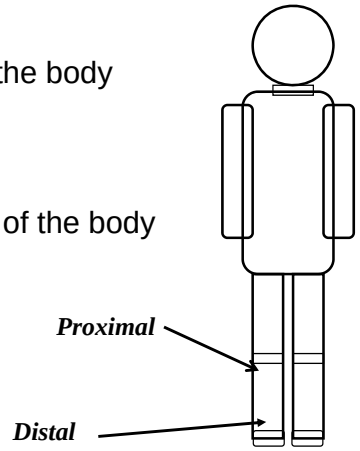
Terms of Relationship and Comparison

- **Proximal**

closer to the trunk of the body

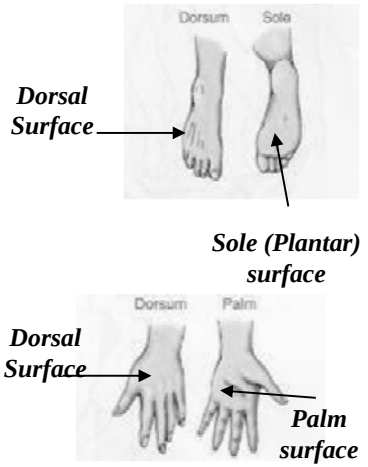
- **Distal**

further from the trunk of the body



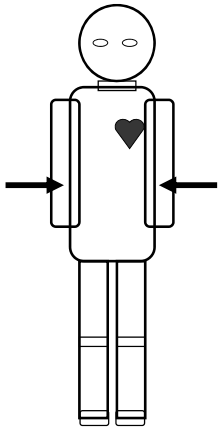
Terms of Relationship and Comparison

- **Dorsum** refers to the superior or dorsal surface (back) of foot and hand
- The **sole** (**plantar**) indicates the inferior aspect or bottom of the foot
- The **palm** refers to the flat of the hand, exclusive of the thumb and fingers, and is the opposite of the dorsum of the hand



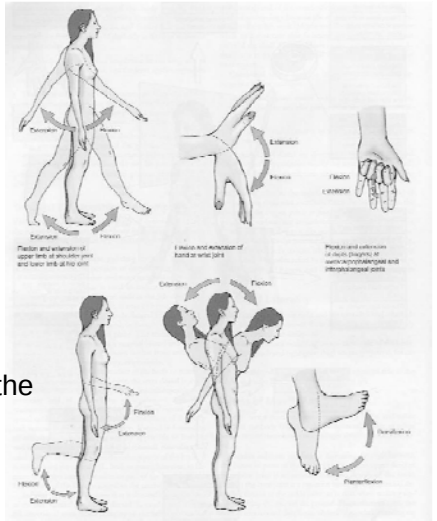
Terms of Laterality

- **Unilateral** is used to describe the structure occurring on one side
- **bilateral** is used to describe the paired structures having right and left members
- **Ipsilateral** means occurring on the same side of the body
- **Contralateral** means occurring on the opposite side of the body



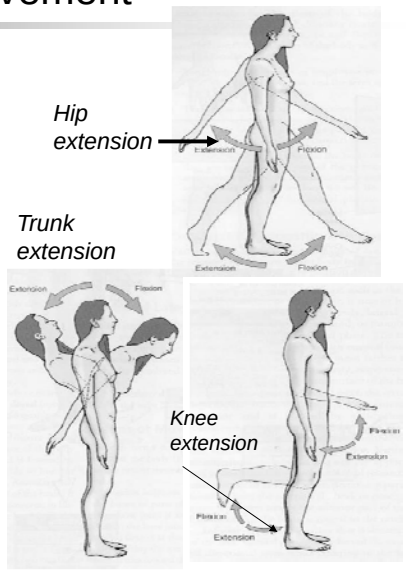
Terms of Movement

- **Flexion**
  - occurs in the sagittal plane about the frontal axis
  - angle formed at the joint decreases
- **Dorsiflexion**
  - occurs in the sagittal plane
  - flexion at the ankle joint
- **Plantarflexion**
  - occurs in the sagittal plane
  - turns the foot or toes toward the plantar surface



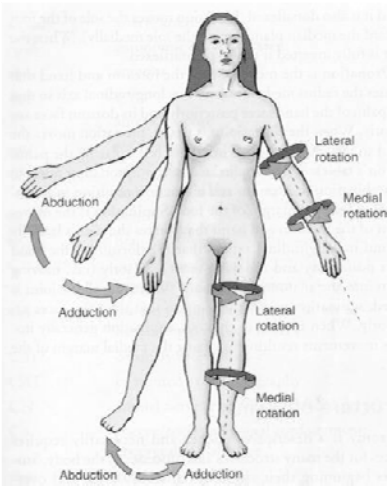
Terms of Movement

- **Extension**
  - occurs in the sagittal plane
  - angle formed at the joint increases
- **Hyperextensio**n (overextension)



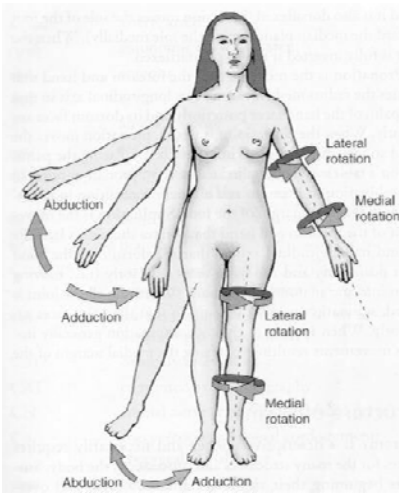
Terms of Movement

- **Abduction**
  - means moving away from the median plane
  - occurs in the coronal plane about the sagittal axis
- **Adduction**
  - means moving toward the median plane
  - occurs in the frontal plane about the sagittal axis



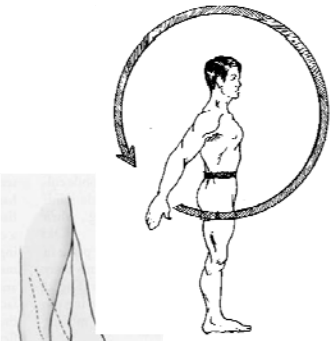
Terms of Movement

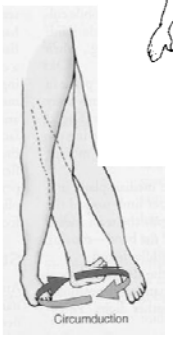
- **Rotation** involves turning a part of the body around its longitudinal axis
  - **Medial rotation (internal rotation)** brings the anterior surface of a limb closer to the median plane
  - **Lateral rotation (external rotation**) takes the anterior surface away from the median plane



Terms of Movement

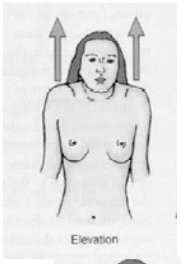
- **Circumduction**
  - Is a circular movement and a combination of flexion, extension, abduction, and adduction
  - occurs at any joint at which all the above-mentioned movements are possible (moving in 2 planes or more)

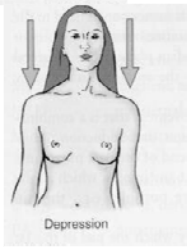




Terms of Movement

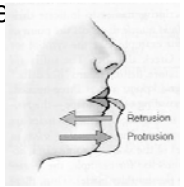
- **Elevation**
  - Is the movement in the frontal plane
  - Raises or moves a part of the body superiorly
- **Depression**
  - Is the movement in the frontal plane
  - Lowers or moves a part of the body inferiorly





Terms of Movement

- **Protrusion** means to move the jaw anteriorly
- **Retrusion** means to move the jaw posteriorly
- **Protraction** and **retraction** are used for anterior and posterior movement of the shoulder

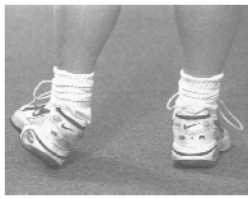


Protraction **Retraction**

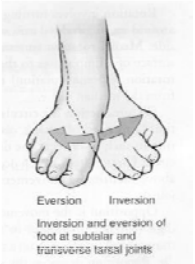
Terms of Movement

- **Eversion** means turning the sole of the foot outward
- **Inversion** means turning the sole of the foot inward

Inversion



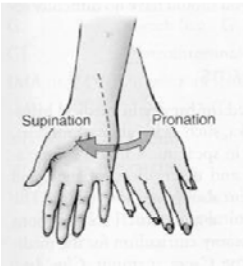
Eversion



Inversion and eversion of foot at subtalar and transverse tarsal joints

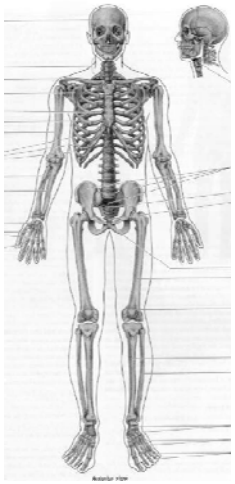
Terms of Movement

- **Pronation**
  - Is the movement of the forearm and hand (foot)
  - Is a medial rotation of the forearm and hand so that the palm faces posteriorly
- **Supination**
  - Is movement of the forearm and hand (foot)
  - Is a lateral rotation of the forearm and hand so that the palm faces anteriorly

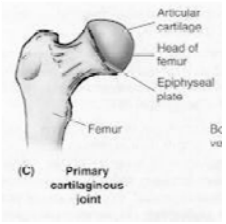


SKELETAL SYSTEM

- The **skeleton** is composed of **bones** and **cartilages**
- The skeletal system consists of two main parts, **axial skeleton**, and **appendicular skeleton**
- The skeleton of the head, neck, and trunk forms the **axial skeleton**
- The skeleton of the limbs forms the **appendicular skeleton**



- **Cartilage** is a resilient, semirigid form of connective tissue and forms parts of the skeleton where motion occurs. Most of them are
  - **Costal cartilages** attach the ribs to the sternum
  - **Articular cartilages** provide gliding surfaces for free movement of the articulating bone



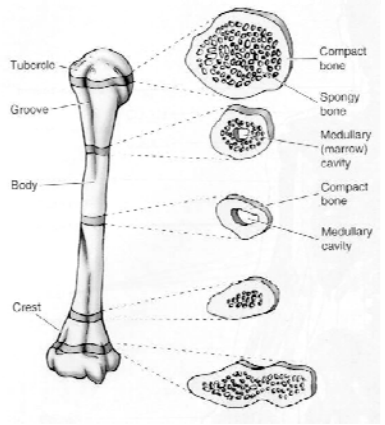
BONE

Function of the Bone

- **Bone** is a living tissue and highly specialized, hard form of connective tissue
- **Functions of bones** include
  - Protection for vital structures
  - Support for the body
  - The mechanical basis for movement
  - Storage for minerals, e.g. calcium
  - A continuous supply of new blood cells

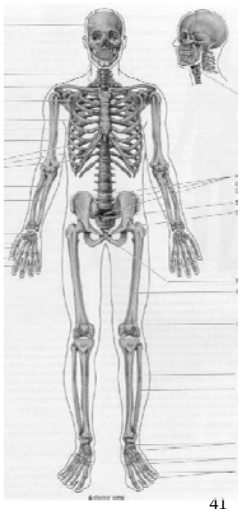
Types of the Bone

- two types
  - **Compact bone** is a superficial thin layer around a central mass of spongy bone
  - **Spongy/cancellous bone** is that type bone showing spongylike structure. Blood cells and platelets are formed in the spongy bone and in the marrow cavity



Classification of Bones

- *Long bones* are tubular
- *Short bones* are cuboidal and are found only in the ankle and wrist
- *Flat bones* usually serve protective functions
- *Irregular bones* have various shapes other than long, short, or flat
- *Sesamoid* bones develop in certain tendons and are found where tendons cross the ends of long bones in the limbs



The structure of a long bone

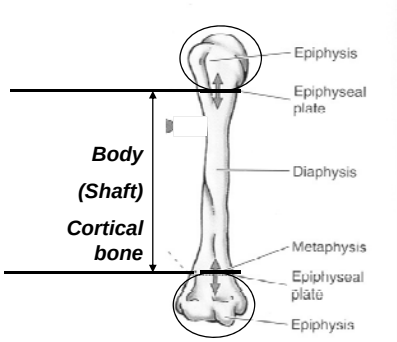
One body (shaft / diaphysis)

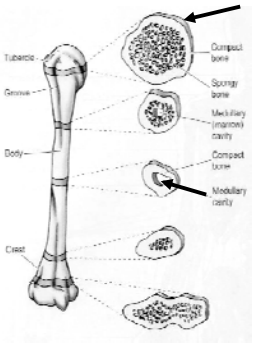
Two ends (epiphysis)

Two growth plates (epiphyseal plate)

Periosteum

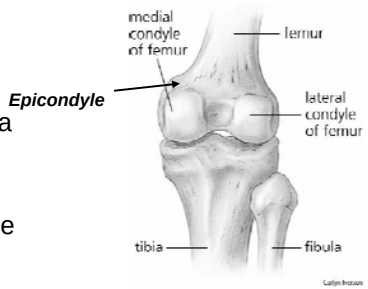
Medullary cavity

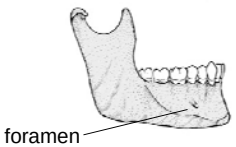


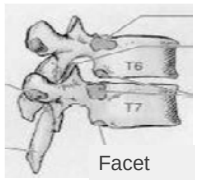


Bone Markings and Formations

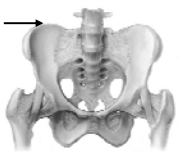
- **Condyle**: rounded articular area
- **Crest**: ridge of bone
- **Epicondyle**: Eminence superior to a condyle
- **Facet**: Smooth, flat area, usually covered with cartilage, where a bone articulates with another bone
- **Foramen**: passage through a bone





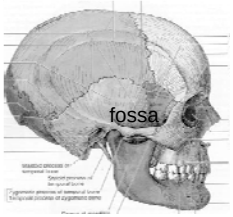


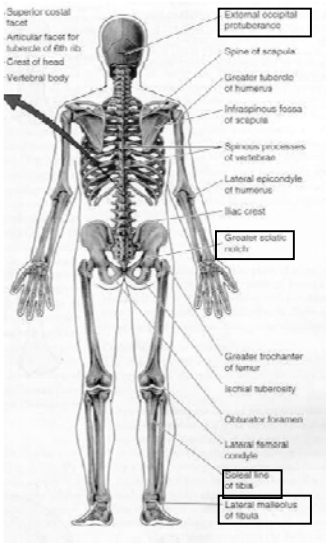
Iliac crest



Bone Markings and Formations

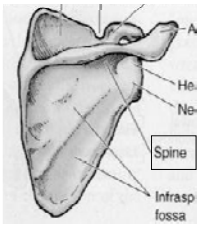
- **Fossa**: Hollow or depressed area
- **Line**: Linear elevation
- **Malleolus**: Rounded process
- **Notch**: Indentation at the edge of a bone
- **Process**: Projecting spine-like part
- **Protuberance**: Projection of bone

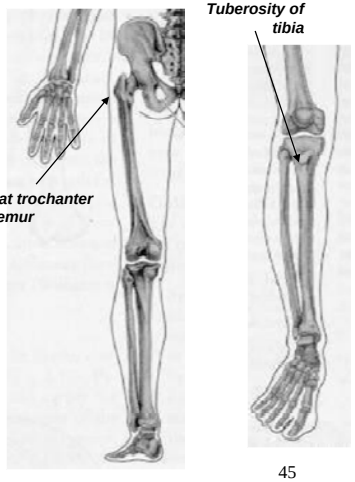




Bone Markings and Formations

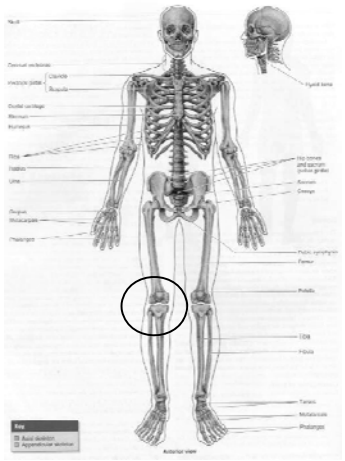
- **Spine**: Thornlike process
- **Trochanter**: Large blunt elevation
- **Tubercle**: Small raised eminence
- **Tuberosity**: Large round elevation





JOINTS

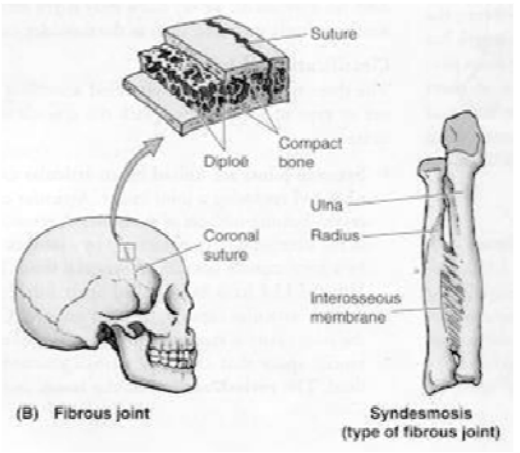
- A **joint** is an **articulation** – the place of union or junction between two or more bones or parts of bones of the skeleton



Classification of Joints

1. Fibrous joints are united by fibrous tissues, such as **sutures** of the skull.

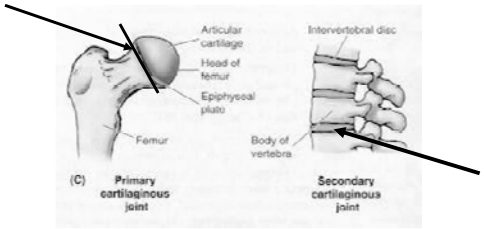
The **syndesmosis** type of fibrous joint unites the bones with a sheet of fibrous tissue, such as **interosseous membrane** in the forearm,….



Classification of Joints

2. Cartilaginous joints are united by cartilage

- *Primary cartilaginous joints* are usually united by hayling cartilage, which permit growth in the length of a bone and usually are temporary unions
- *Secondary cartilaginous joints* / ***symphyses*** are united by fibrocartilage and are strong, slightly movable joints

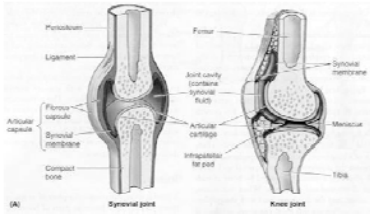


Classification of Joints

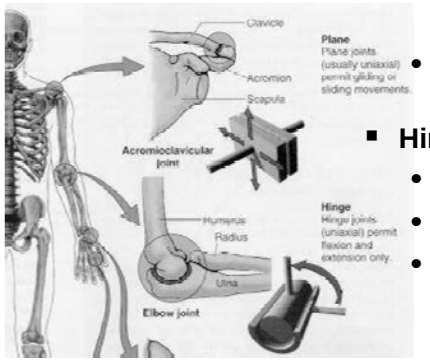
3. Synovial joints are united by an articular capsule spanning and enclosing a joint cavity

- The three distinguishing features of synovial joint are
  1) **A joint cavity** enclosed by a joint capsule containing synovial fluid
  2) Bone ends covered with **articular cartilage**
  3) An **articular capsule** – fibrous capsule lined with synovial membrane

- Synovial joints are usually reinforced by accessory ligaments

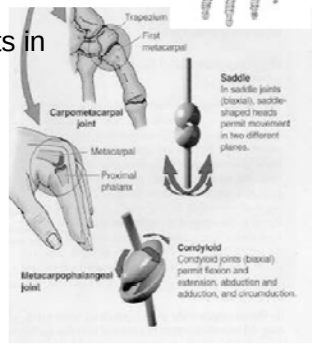


Six major types of synovial joint

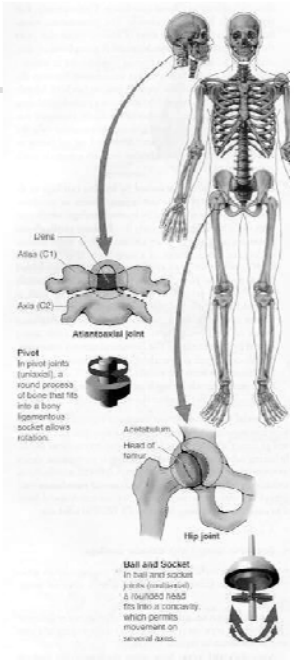


- **Plane joints**
  - The opposed surfaces of the bones are flat or almost flat
  - permit gliding or sliding movements
- **Hinge joints**
  - uniaxial joint
  - permit flexion and extension only
  - strong, laterally placed collateral ligaments enhance the joints

- **Saddle joints**
  - biaxial
  - opposing surfaces shaped like a saddle
  - Permit a wider range of movements in three different planes
- **Condyloid joints**
  - biaxial and allow movement in two planes, sagittal and coronal
  - permit flexion and extension, abduction and adduction, and circumduction.



- **Ball and socket joints**
  - multiaxial and highly movable joints
  - permit flexion and extension, abduction and adduction, medial and lateral rotation, and circumduction
- **Pivot joints**
  - A rounded process of bone rotates within a sleeve or ring
  - Uniaxial and allow rotation



Structures Associated with Joints

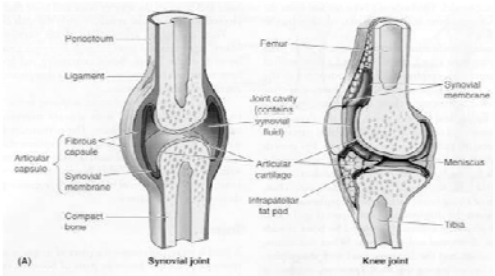
Ligament

- connects bone to bone
- is tough connective tissue
- helps maintaining joint stability

Structures Associated with Joints

Synovial Membrane

- is thin connective tissue
- surrounds most freely moving joints
- secretes synovial fluid providing nourishment for cartilaginous disks, lubrication and hydrostatic cushioning



SKELETAL MUSCLE

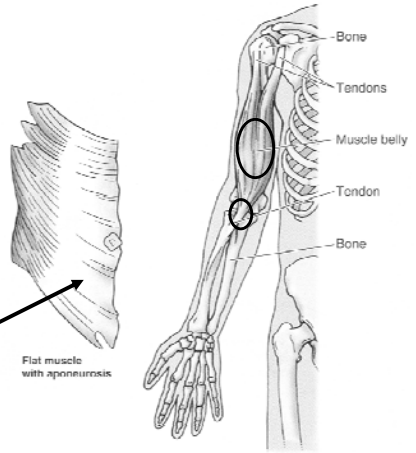
Function

Skeletal muscle/voluntary muscle/striated muscle:

- maintain body posture
- produce movement of the skeleton and other parts
- give the contour the body
- provide heat and energy

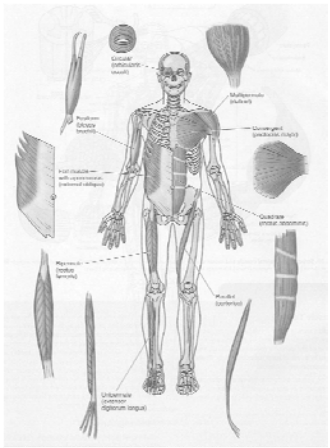
The Shape & Architecture

- Each of skeletal muscle has two parts
  - **Muscle belly** that is the fleshy part of the muscle
  - And **tendons** are the parts of the muscle that attach to bones.
  - Some tendons form flat sheet, or **aponeuroses**, that anchor one muscle to another



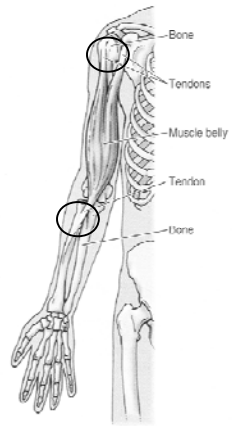
Classification of Skeletal Muscle

- **Flat muscle** with parallel fibers often having an aponeurosis
- **Pennate muscles** are featherlike in the arrangement of their fascicles, and may be uni-, bi-, or multipennate
- **Fusiform muscle** is spindle-shaped
- A **quadrate muscle** has four equal sides
- **Circular** or **sphincteral muscle** surrounds a body opening or orifice constricting it when contracted



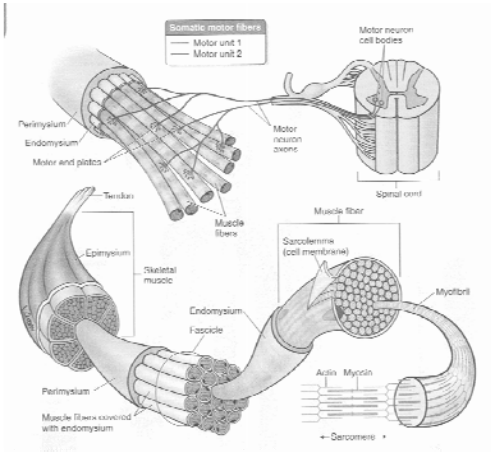
Attachments of Muscles

- Attachments of muscles are commonly described as the *origin* and *insertion*
- **Origin** is usually the proximal end of the muscle that remains fixed during muscular contraction
- **Insertion** is usually the distal end of the muscle that is movable
- The *terms,* ***proximal*****,** and ***distal*** or ***medial*** and ***lateral,*** are also used to describe the attachments of muscles



Structural Unit of a Muscle

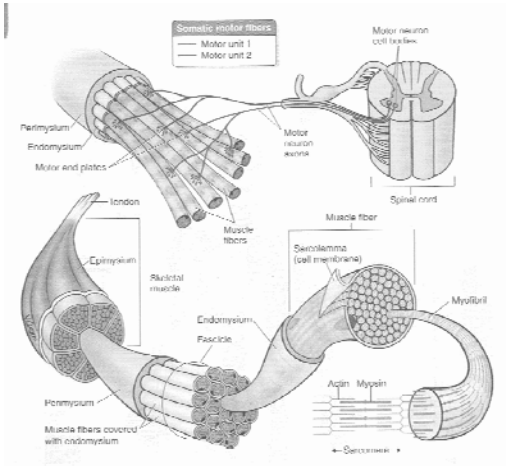
- The structural unit of a muscle is a **muscle fiber**
- **Endomysium** covers individual muscle fibers
- **Perimysium** encloses a group of fibers
- **Epimysium** surrounds a entire muscle



Schematic drawing of the structural organization of muscle

Functional Unit of a Muscle

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

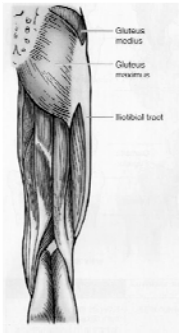


Roles of muscle playing in specific movements

- **Prime movers** or **agonists** are the main muscles that activate a specific movement of the body; they contract actively to produce the desired movement
- **Antagonists** are muscles that oppose the action of prime movers; as a prime mover contracts, the antagonist progressively relaxes, producing a smooth movement

Roles of muscle playing in specific movements

- **Synergist**
  - A muscle which aids the action of a prime mover.
  - The synergist may produce the same movement as the prime mover, or it may stabilize the joints across which the prime mover acts, preventing undesirable movements



Study Questions

1. Name the regions of the body.
2. Describe anatomical position, anatomical planes, and axes of motion.
3. Based on the anatomical position, describe the location of the left thumb with respect to the little finger of the left hand, elbow of the left arm, median axis of the body, right thumb, and first toe of the left foot
4. Describe flexion, extension, dorsiflesion, plantarflexion, abduction, adduction, rotation, circumduction, elevation, depression, protrusion, retrusion, protraction, retraction, eversion, inversion, pronation and supination.
5. Describe the functions of the skeleton, joint, and skeletal muscle.
6. Name the structures associated with joints and their functions.
7. Describe the classification of joints and characteristics of each type of joints.
8. Explain what is motor unit.
9. What is origin, insertion, agonists, antagonists, and synergists.