Main Menu

1 Introduction to Kinesiology

click here

Kinesiology The scientific study of muscular activity and the anatomy, physiology, and mechanics of movement.

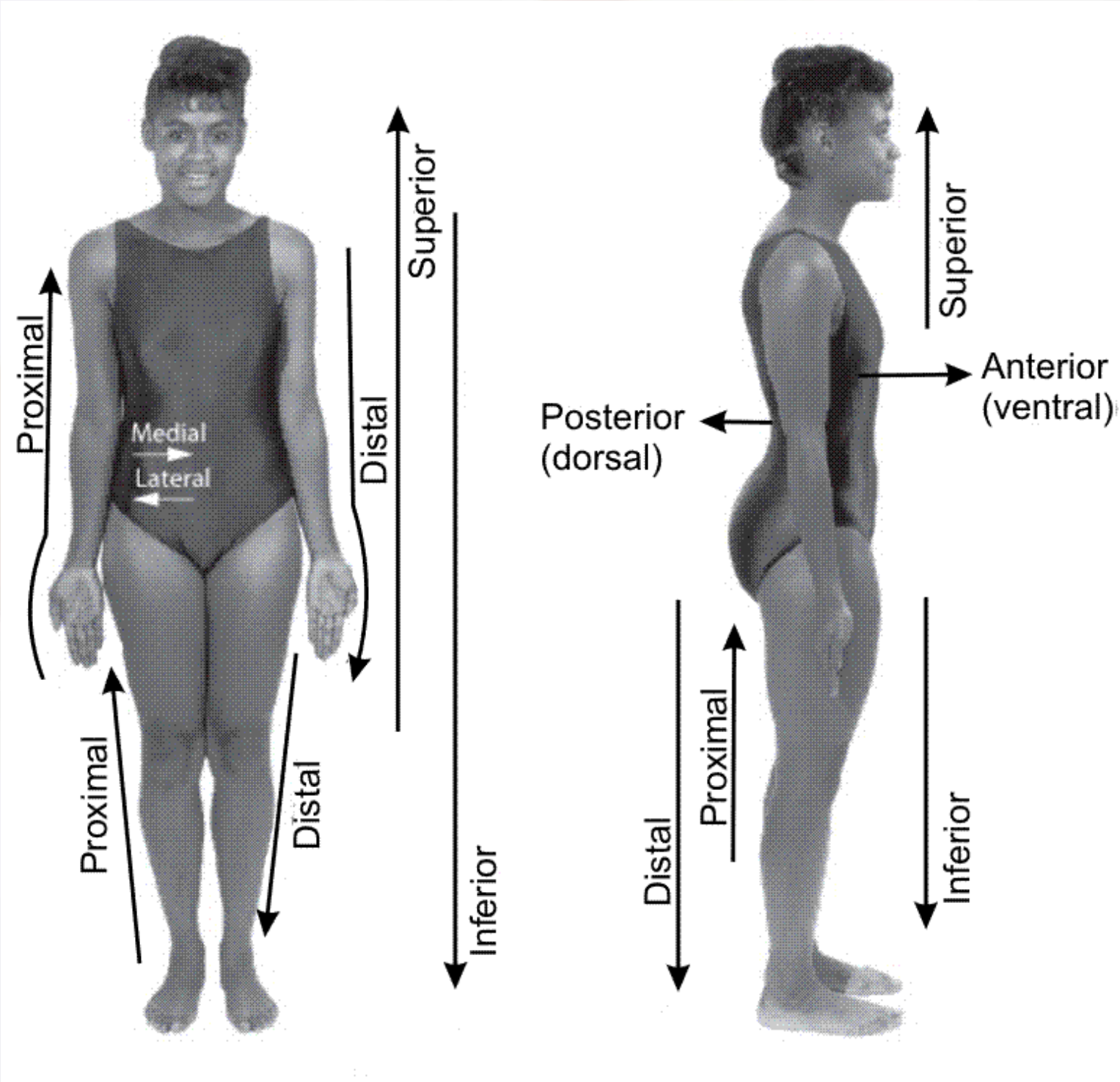
Anatomic Kinesiology the study of human musculoskeletal system and musculotendinous system

Biomechanics the mechanical physics to human motion

Structural Kinesiology the study of muscles as they are involved in science of movement

Back Next

Reference Position basis from which to describe joint movements

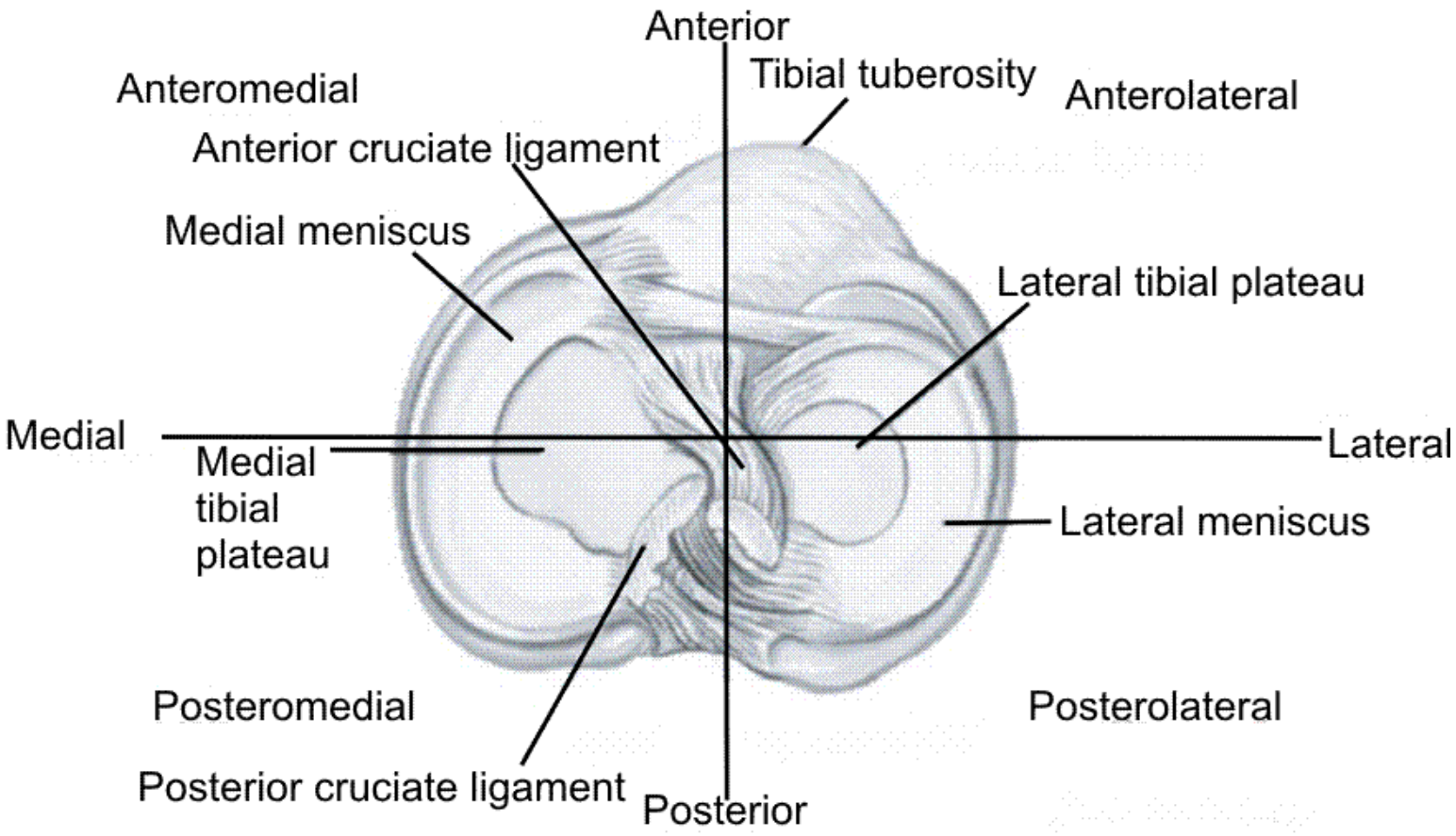


Anatomical Directional Terminology

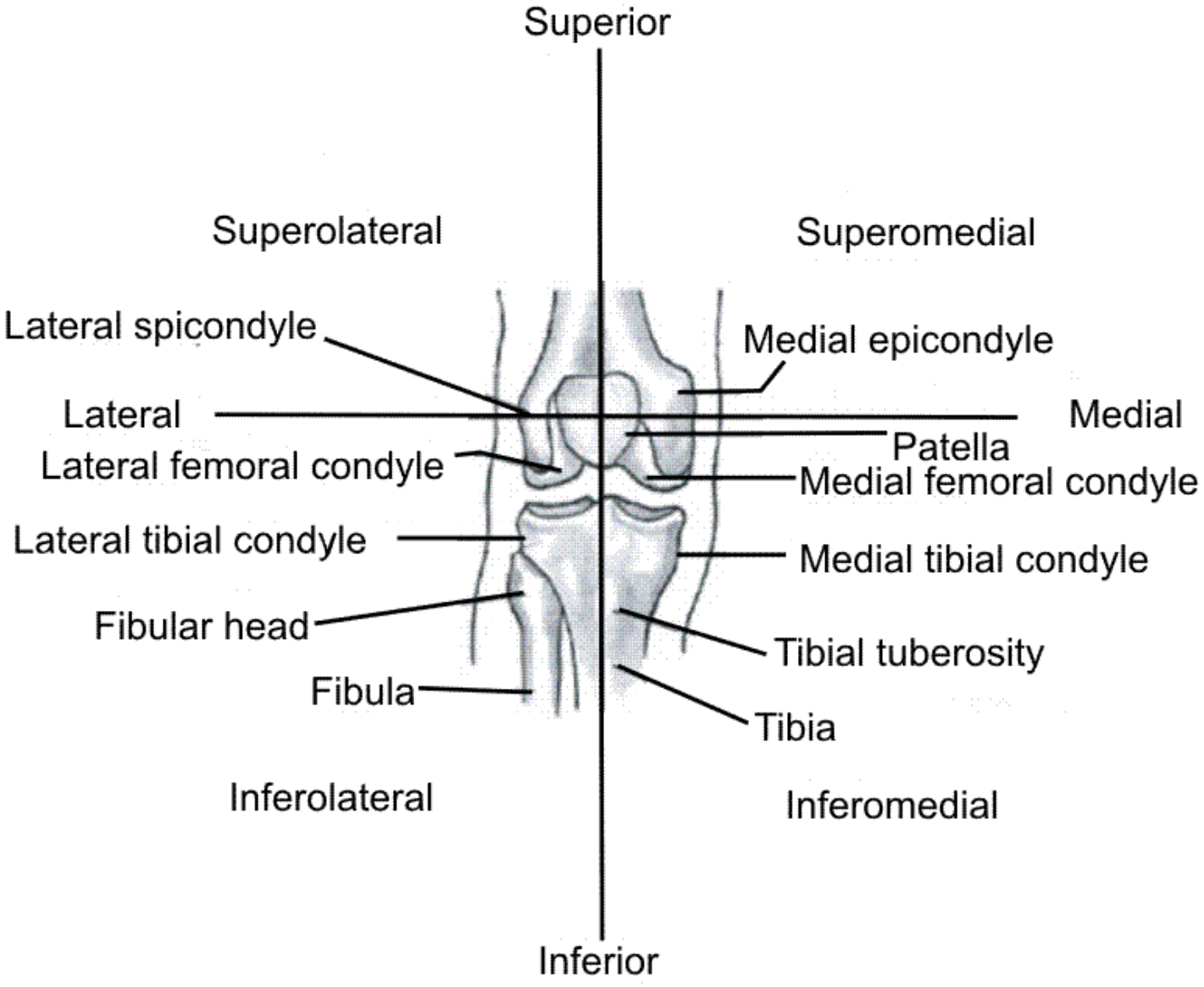
Anterolateral	in front and to the side, especially the outside
Anteromedial	in front and toward the inner side or midline
Anteroposterior	relating to both front and rear
Posteromedial	behind and to the inner side
Posterosuperior	behind and at the upper part
Contralateral	pertaining or relating to the opposite side
Ipsilateral	on the same side
Bilateral	relating to the right and left sides of the body or of a body structure such as the right and left extremities
Inferior (infra)	below in relation to another structure; caudal
Superior (supra)	above in relation to another structure; higher, cephalic
Distal	situated away from the center or midline of the body, or away from the point of origin
Proximal	nearest the trunk or the point of origin
Lateral	on or to the side; outside, farther from the median or midsagittal plane
Medial	relating to the middle or center; nearer to the media or midsagittal plane
Median	relating to the middle or center; nearer to the median or midsagittal plane
Inferolateral	below and to the outside
Inferomedial	below and toward the midline or inside
Superolateral	above and to the outside
Superomedial	above and toward the midline or inside
Caudal	below in relation to another structure; inferior
Cephalic	above in relation to another structure; higher, superior
Deep	beneath or below the surface; used to describe relative depth or location of muscles or tissue
Superficial	near the surface; used to describe relative depth or location of muscles or tissue
Prone	the body lying face downward; stomach lying

Supine	lying on the back; face upward position of the body
Dorsal	relating to the back; being or located near, on or toward the back, osterior part or upper surface of
Ventral	relating to the belly or abdomen, on or toward the front, anterior part of
Volar	relating to palm of the hand or sole of the foot
Plantar	relating to the sole or undersurface of the foot

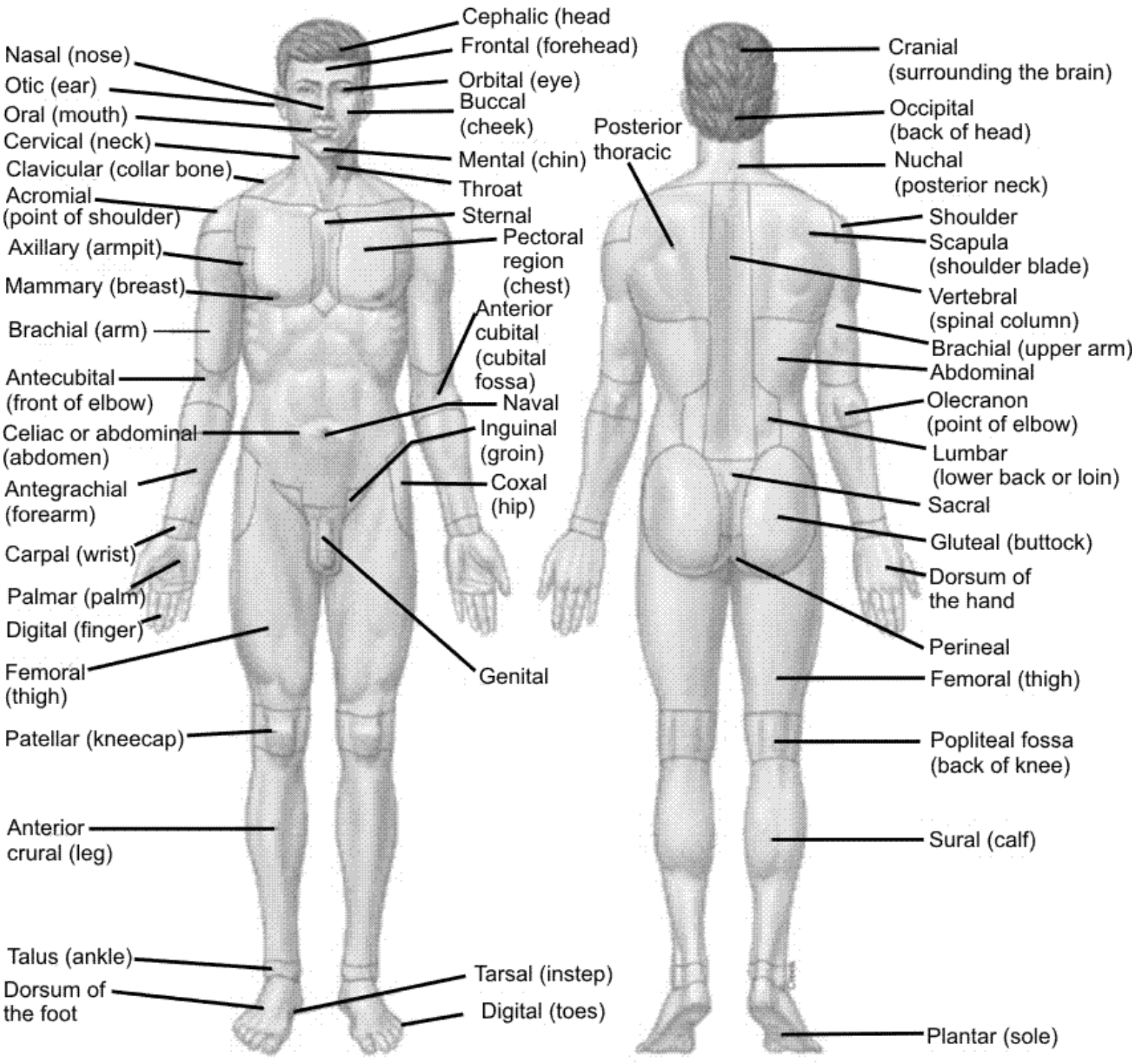
Back Next



Right knee, superior view with femur removed



Body Regions



Body Regions

Axial	Cephalic (Head)	Cranium and Face
	Cervical (Neck)	
	Trunk	Thoracic (Thorax), Dorsal (Back), Abdominal (Abdomen), and Pelvic (Pelvis)
Appendicular	Upper linbs	Shoulder, arm, forearm and manual
	Lower Limbs	Thigh, leg and pedal

Back Next

Planes of Motion are imaginary two-dimensional surfaces through which a limb or body segment is moved

Motion through a plane revolves around an axis

There is a ninety-degree relationship between a plane of motion and its axis

Back Next

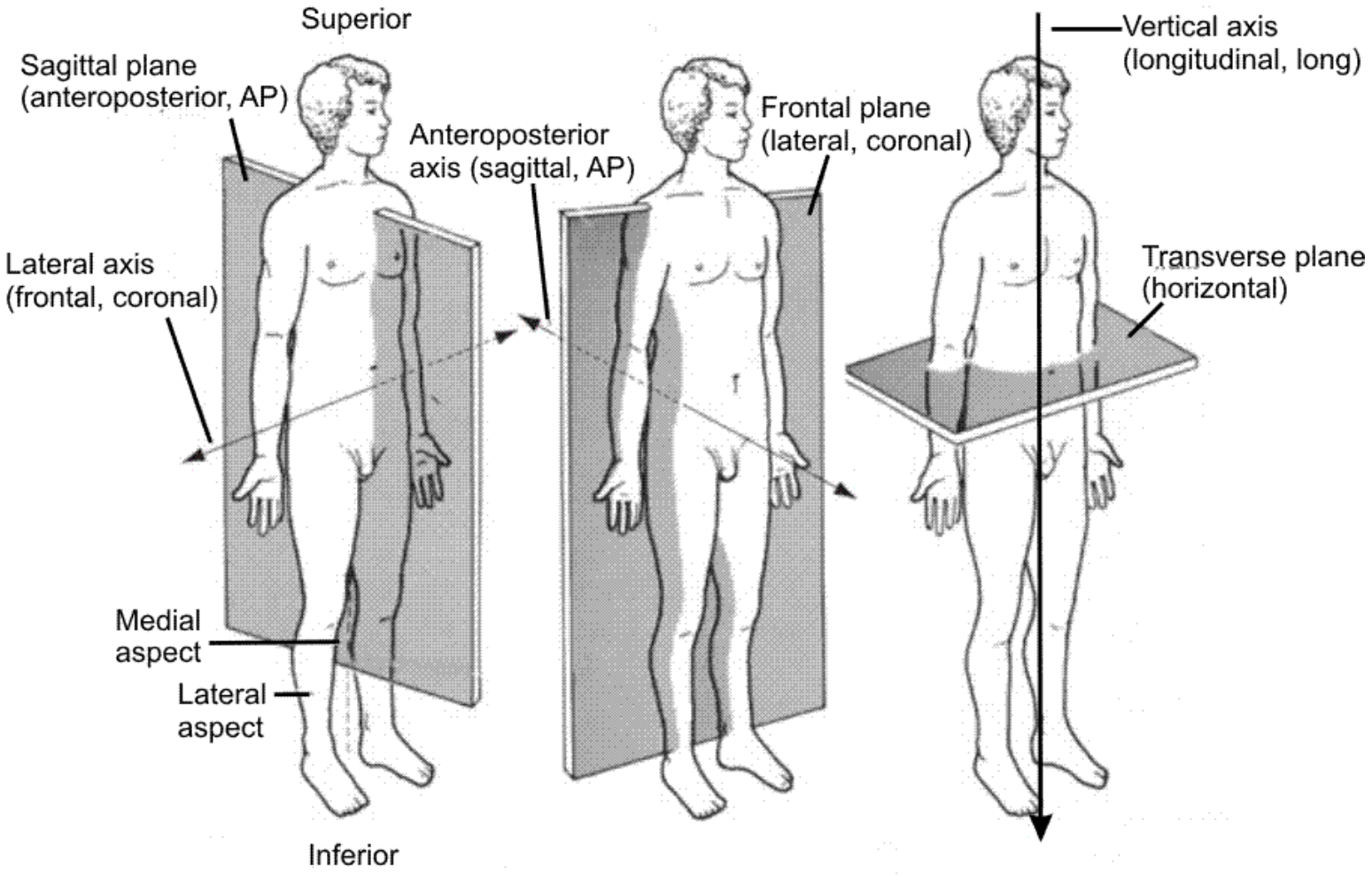
Cardinal Planes of Motion

There are 3 basic or traditional Cardinal Planes of Motion; in relation to the body, not in relation to the earth

Cardinal Plane	Description	Example
Anteroposterior or Sagittal Plane	divides body into equal, bilateral segments	Sit-up
	bisects body into two equal symmetrical halves or a right and left half	
Lateral or Frontal Plane	divides the body into (front) anterior and (back posterior halves	Jumping Jacks
Transverse or Horizontal Plane	divides body into (top) superior and (bottom) inferior halves when the individual is in anatomic position	Spinal rotation to left or right

Back Next

Planes of the Body



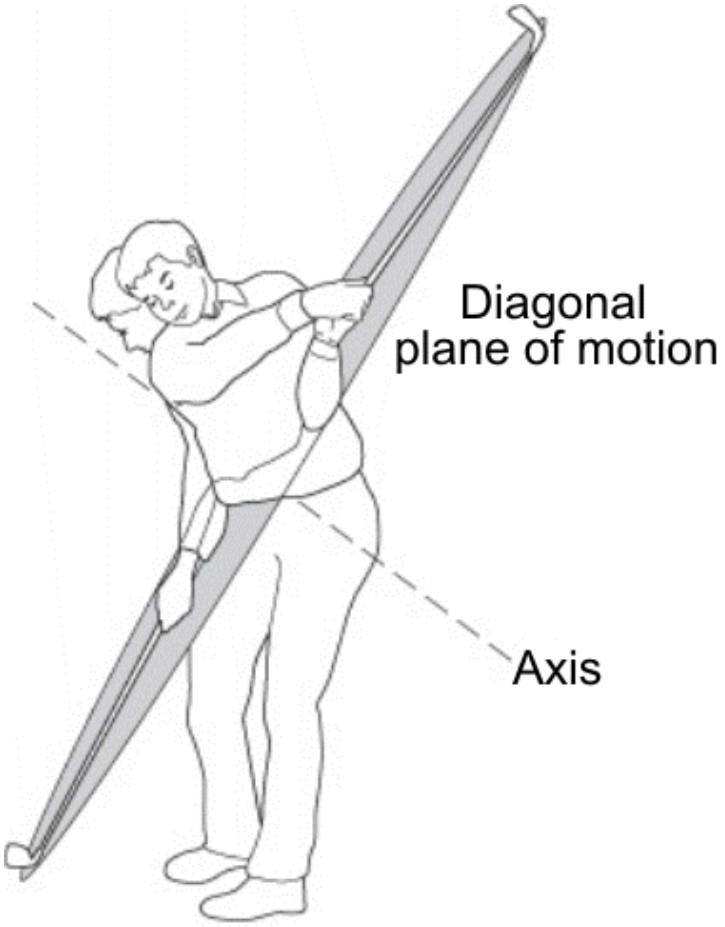
Diagonal Planes of Motion

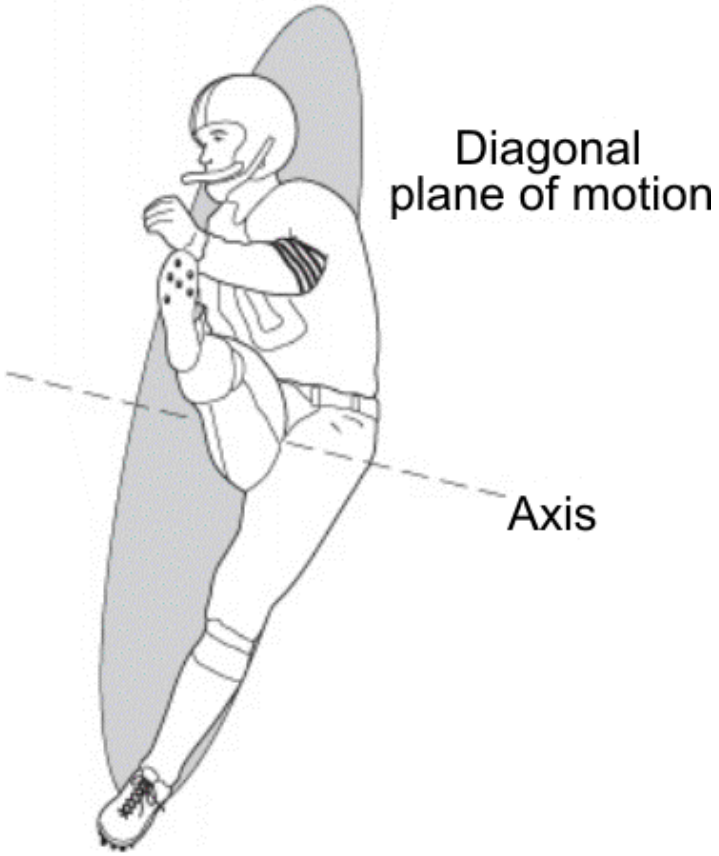
There are 3 Diagonal Planes of Motion; in relation to the body, not in relation to the earth

Diagonal Plane	Description	Example
High Diagonal	upper limbs at shoulder joints overhand skills	Baseball Pitch
Low Diagonal	upper limbs at shoulder joints underhand skills	Discus Thrower
Low Diagonal	lower limbs at the hip joints	Kickers and Punters

Back Next

Diagonal Planes of Motion





Axes of Rotation

For movement to occur in a plane, it must turn or rotate about an axis; the axes are named in relation to their orientation

Axis	Description	Includes
Frontal, lateral or coronal	has same orientation as frontal plane of motion and runs from side to side at a right angle to sagittal plane of motion runs medial/lateral	flexion, extension movements
Sagittal or anteroposterior	has same orientation as sagittal plane of otion and runs from front to back at a right angle to frontal plane of motion runs anterior/posterior	abduction, adduction movements
Long or vertical	runs straight down through top of head and is at a right angle to transverse plane of motion runs superior/inferior	internal rotation, external rotation movements
Diagonal or oblique	also known as the oblique axis runs at a right angle to the diagonal plane	

Back Next

Classification of Joints

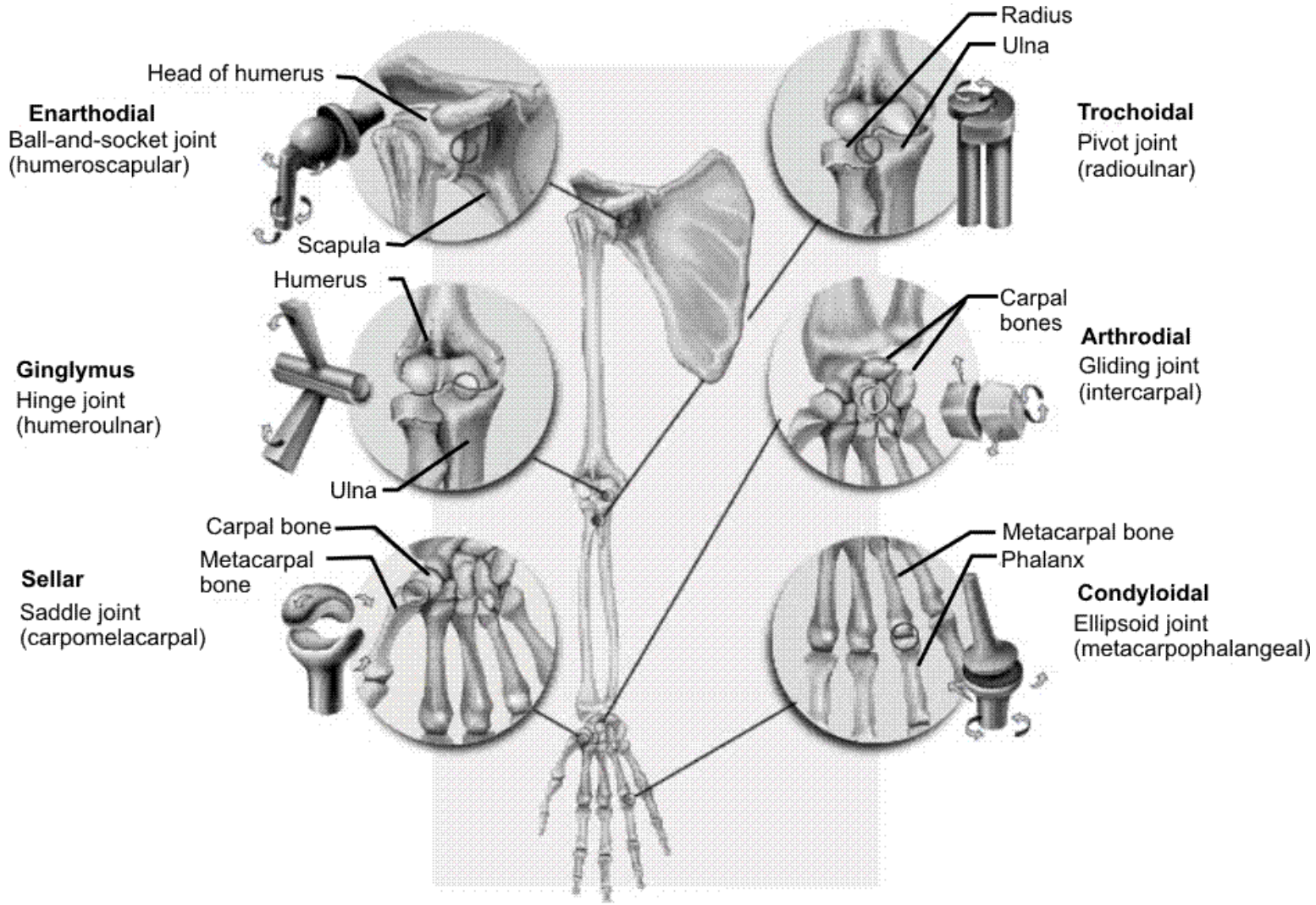
Articulation: connection of bones at a joint usually to allow movement between surfaces of bones; three major classifications according to structure and movement characteristics

Synarthrodial	immovable joints
	suture such as skull sutures
	gomphosis such as teeth fitting into mandible or maxilla
Amphiarthorodial	slightly movable joints
	allow a slight amount of motion to occur
	Synchondrosis: type of joint separated by hyaline cartilage that allows very slight movement between bones; ex. costochondral joints of the ribs with the sternum
	Symphysis: joint separated by a fibrocartilage pad that allows very slight movement between bones; ex. symphysis pubis and interverteral discs Syndesmosis: two bones joined together by a strong ligament or an interosseus membrane that allows minimal movement between bones; bones may or may not touch each other at the actual joint; ex. coracoclavicular joint, distal tibiofibular joint
	known as synovial joints; freely movable; composed of sleevelike joint capsule; secretes synovial fluid to lubricate joint cavity
	capsule thickenings form tough, nonelastic ligaments that provide additional support against abnormal movement or joint opening
	articular or hyaline cartilage covers the articular surface ends of bones inside joint cavity to absorb shock and protect bone
	slowly absorbs synovial fluid during joint unloading or distraction; secretes synovial fluid during subsequent weight bearing and compression
	some have specialized fibrocartilage disks
	have motion possible in one or more planes
	six type with each having a different type of bony arrangement
	Arthrodial (Gliding): 2 plane or flat bony surfaces which butt against each

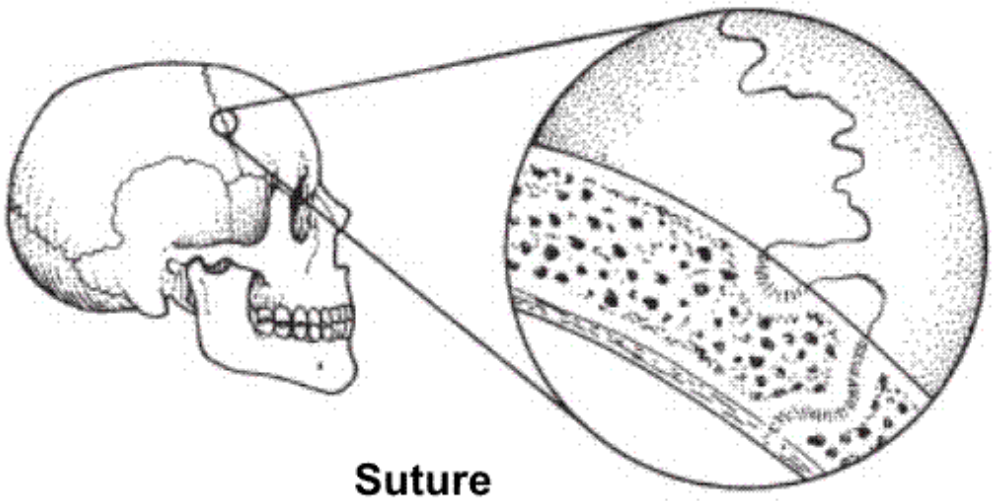
Diathrodial	other; lottle motion possible in any 1 joint articulation; usually work together in series of articulations; ex. vertebral facets in spinal column, intercarpal and intertarsal joints; motions are flexion, extension, abduction, adduction, diagonal abduction and adduction and rotation
	Ginglymus (Hinge); a uniaxial articulation; articular surfaces allow motion inonly one plane; ex. elbow, know and ankle
	Condyloid (Knuckle): biaxial ball and socket joint; one bone with an oval concave surface received by another bone with an oval convex surface; ex. 2nd, 3rd, 4th and 5th metacarpophalangeal or knuckles joints, wrist articulation between carpals and radius; flexion, extension, abduction and adduction
	Enarthrodial: multiaxial or triaxial ball and socket joint; boney rounded head fitting into a concave articular surface; ex. hip and should joint; motions are flexion, extension, abduction, adduction, diagonal abduction and adduction, rotation and circumduction
	Sellar (Saddle): unique triaxial joint; two reciprocally concave and convex articular surfaces; ex. carpometacarpal joint at thumb; movement includes flexion, extension, adduction and abduction, circumduction and slight rotation

Back Next

Joint Classifications

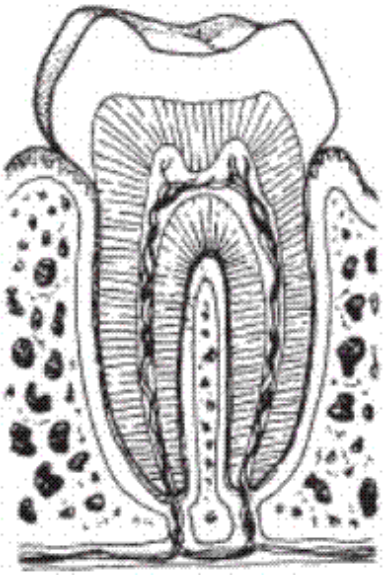


Synarthrodial Joint

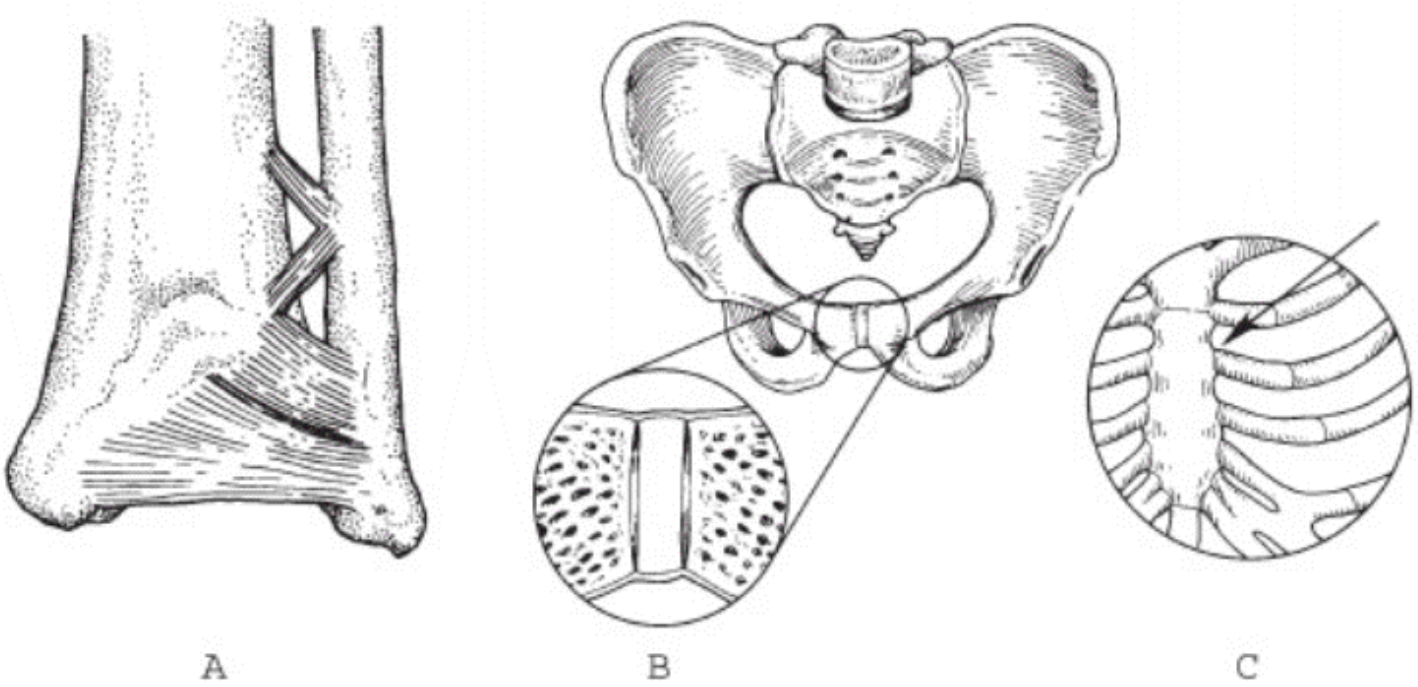


Suture

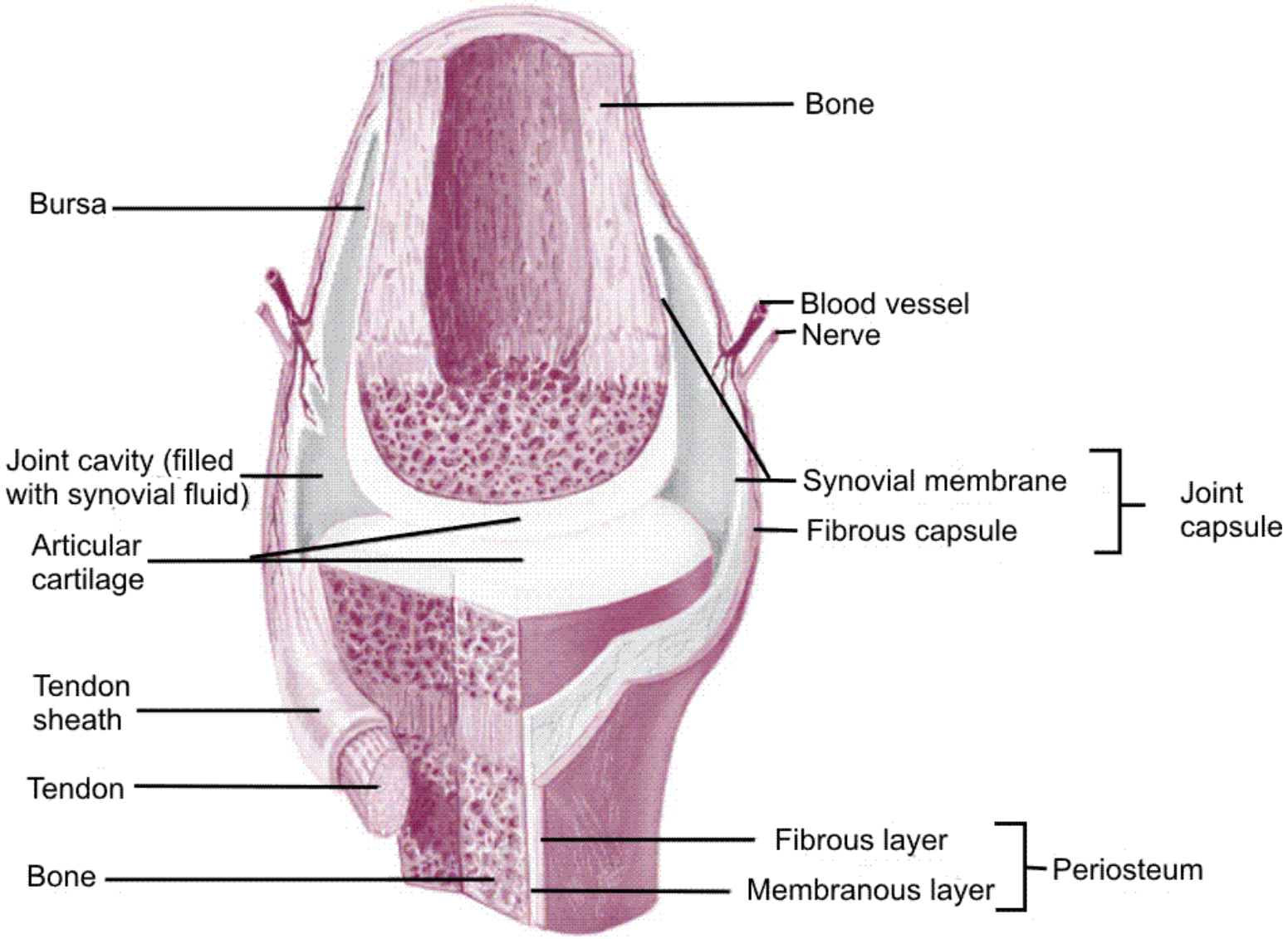
Gomphosis



Amphiarthrodial Joint



Diarthrodial Joint



Range of Motion

area through which a joint may normally be freely and painlessly moved

measurable degree of movement potential in a joint or joints
measured with a *goniometer* in degrees 0^0 to 360^0

Back Next

Movement Terms

Describes movement occurring throughout the full range of motion or through a very small range

Some movement terms describe motion at several joints throughout body ; some terms are relatively specific to a joint or group of joints

Abduction	Lateral movement away from midline of trunk in lateral plane raising arms or legs to side horizontally
Adduction	Movement medially toward midline of trunk in lateral plane ; lowering arm to side or thigh back to anatomical position
Flexion	Bending movement that results in a ▼ of angle in joint by bringing bones together, usually in sagittal plane ; elbow joint when hand is drawn to shoulder
Extension	Straightening movement that results in an ▲ of angle in joint by moving bones apart, usually in sagittal plane ; elbow joint when hand moves away from shoulder
Circumduction	Circular movement of a limb that delineates an arc or describes a cone ; combination of flexion, extension, abduction, & adduction ; when shoulder joint & hip joint move in a circular fashion around a fixed point ; also referred to as circumflexion
Diagonal abduction	Movement by a limb through a diagonal plane away from midline of body
Diagonal adduction	Movement by a limb through a diagonal plane toward & across midline of body
External rotation	Rotary movement around longitudinal axis of a bone away from midline of body Occurs in transverse plane ; a.k.a. rotation laterally, outward rotation, & lateral rotation
Internal rotation	Rotary movement around longitudinal axis of a bone toward midline of body ; Occurs in transverse plane ; a.k.a. rotation medially, inward rotation, & medial rotation

Back Next

Movement Terms - Ankle and Foot

Eversion	Turning sole of foot outward or laterally ; standing with weight on inner edge of foot
Inversion	Turning sole of foot inward or medially ; standing with weight on outer edge of foot
Dorsal flexion	Flexion movement of ankle that results in top of foot moving toward anterior tibia bone
Plantar flexion	Extension movement of ankle that results in foot moving away from body
Pronation	A combination of ankle dorsiflexion, subtalar eversion, and forefoot abduction (toe-out)
Supination	A combination of ankle plantar flexion, subtalar inversion, and forefoot adduction (toe-in)

Back Next

Movement Terms - Radioulnar Joint

Pronation	Internally rotating radius where it lies diagonally across ulna, resulting in palm-down position of forearm
Supination	Externally rotating radius where it lies parallel to ulna, resulting in palm-up position of forearm

Back Next

Movement Terms - Shoulder Girdle

Protraction	Forward movement of shoulder girdle away from spine ; Abduction of the scapula
Retraction	Backward movement of shoulder girdle toward spine ; Adduction of the scapula
Rotation downward	Rotary movement of scapula with inferior angle of scapula moving medially & downward
Rotation upward	Rotary movement of scapula with inferior angle of scapula moving laterally & upward
Horizontal abduction	Movement of humerus in horizontal plane away from midline of body ; also known as horizontal extension or transverse abduction
Horizontal adduction	Movement of humerus in horizontal plane toward midline of body ; also known as horizontal flexion or transverse adduction

Back Next

Movement Terms - Spine

Lateral flexion (side bending)	Movement of head and / or trunk laterally away from midline ; Abduction of spine
Reduction	Return of spinal column to anatomic position from lateral flexion ; Adduction of spine

Back Next

Physiological Movements vs Accessory Motions

Physiological movements (flexion, extension, abduction, adduction, & rotation) occur by bones moving through planes of motion about an axis of rotation at joint

Osteokinematic motion - resulting motion of bones relative to 3 cardinal planes from these physiological ; for osteokinematic motions to occur there must be movement between the joint articular surfaces

Arthrokinematics - motion between articular surfaces

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3 specific types of *accessory motion : Spin, Roll and Glide*

If accessory motion is prevented from occurring, then physiological motion cannot occur to any substantial degree other than by joint compression or distraction

Due to most diarthrodial joints being composed of a concave surface articulating with a convex surface roll and glide must occur together to some degree

Ex. 1 as a person stands from a squatted position the femur must roll forward and simultaneously slide backward on the tibia for the knee to extend

If not for the slide the femur would roll off the front of the tibia

If not for the roll, the femur would slide off the back of the tibia

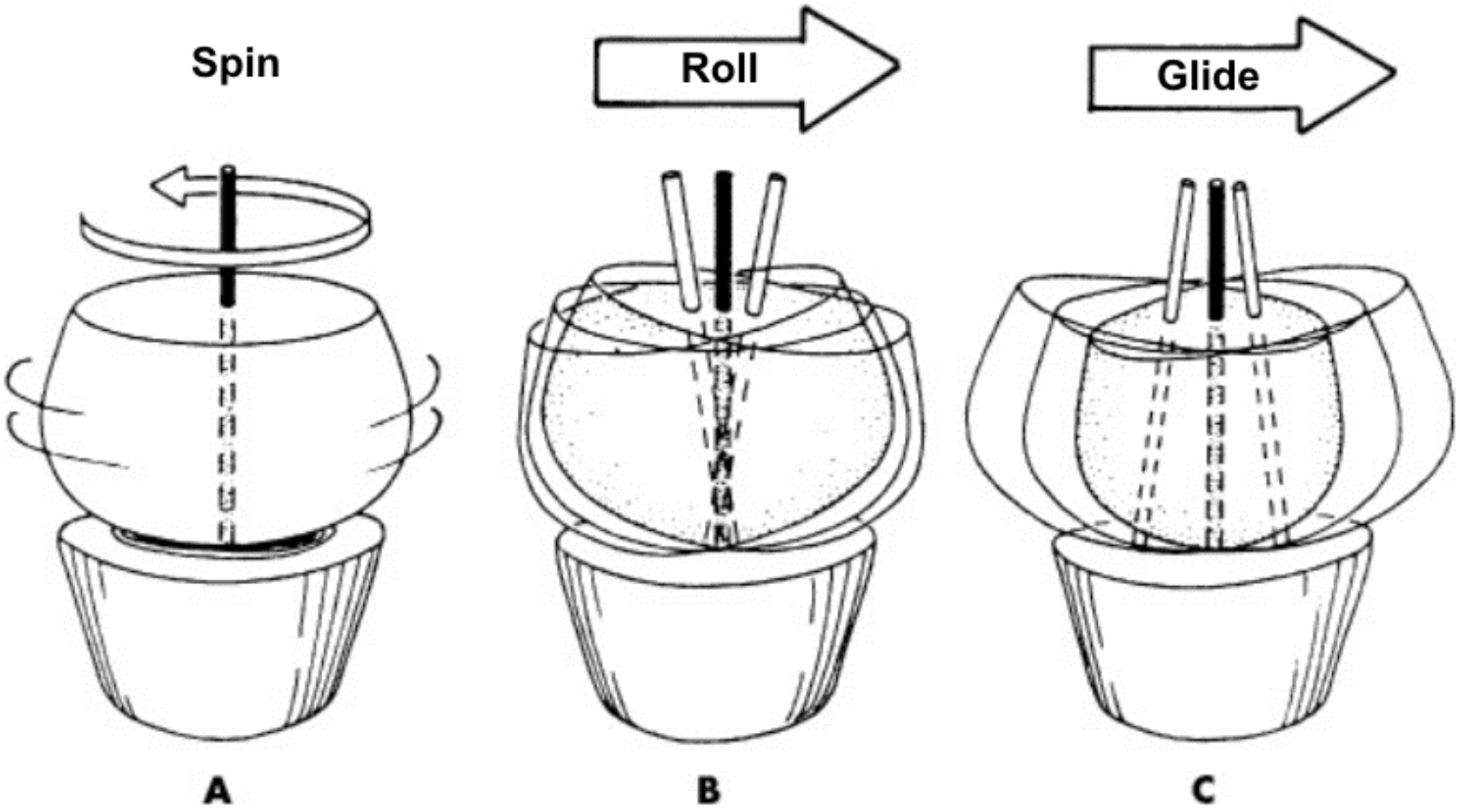
Spin may occur in isolation or in combination with roll & glide. As the knee flexes & extends spin occurs to some degree. In Ex. 1, the femur spins medially or internally rotates as the knee reaches full extension

Roll (rock) - a series of points on one articular surface contacts with a series of points on another articular surface

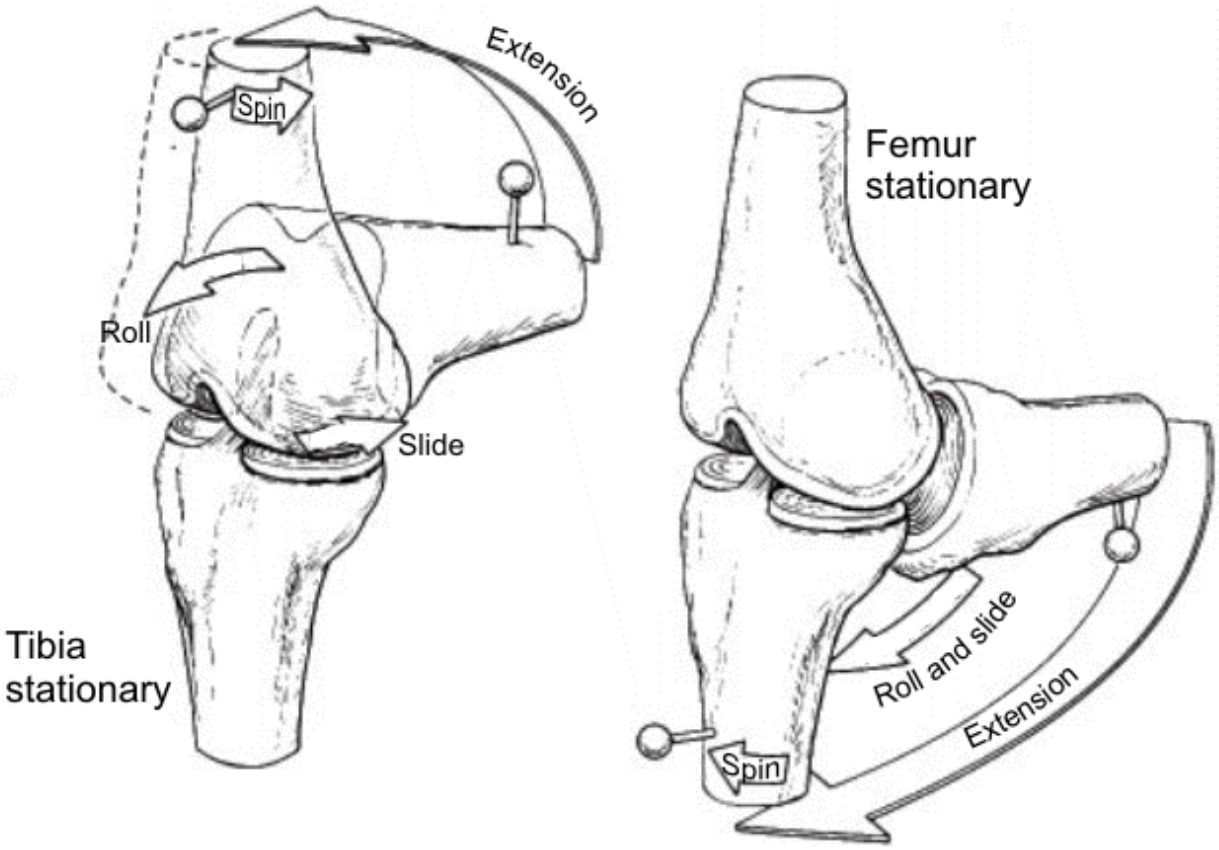
Glide (slide) (translation) - a specific point on one articulating surface comes in contact with a series of points on another surface

Spin - A single point on one articular surface rotates about a single point on another articular surface ; Motion occurs around some stationary longitudinal mechanical axis in either a clockwise or counterclockwise direction

Accessory Movement



Accessory Movement



Back

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