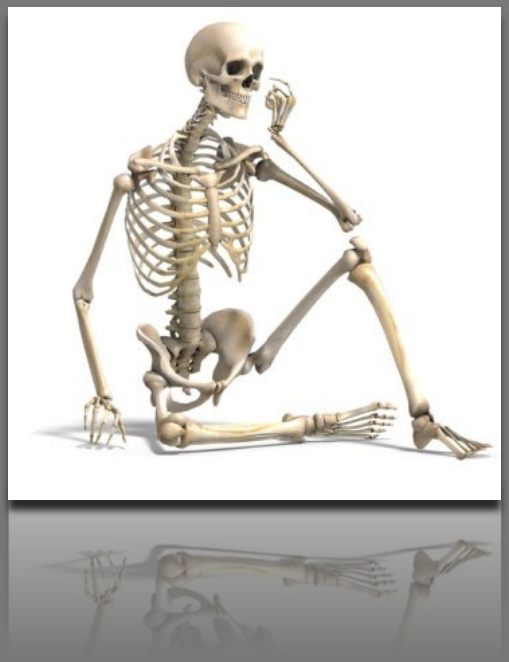
BALANCED BODY
ANATOMY IN THREE DIMENSIONS™



An Introduction to Anatomy for Movers and Movement Educators

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Introduction: Establishing Vocabulary

Anatomy vocabulary basics

- Joints
- Muscles
- Bones
- Systems of the body
- Planes of Motion

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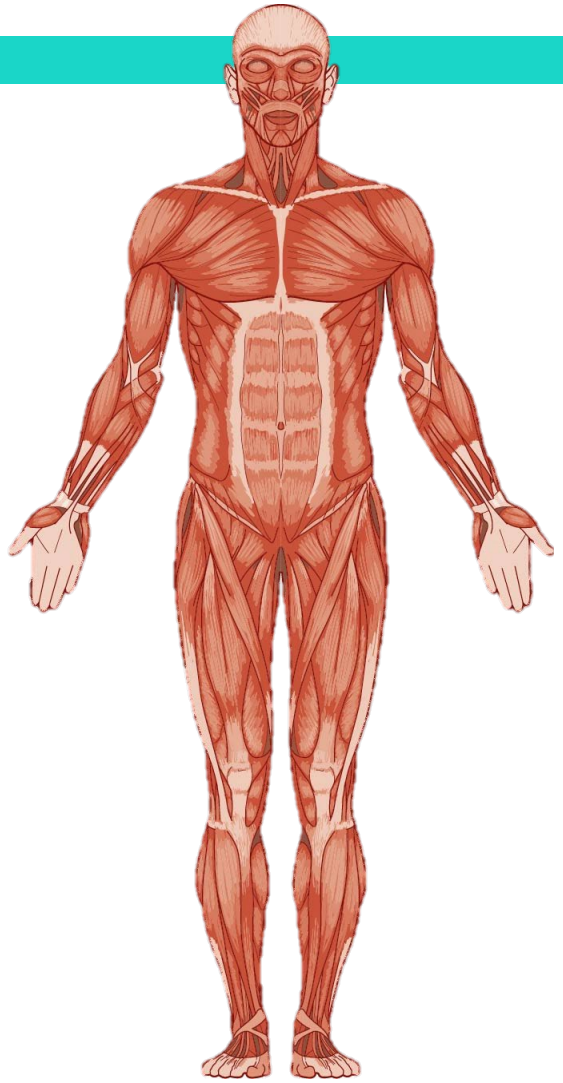
Anatomical Position

Western anatomical position is standing with the palms and feet facing forward.
As if lying face up on a dissecting table.



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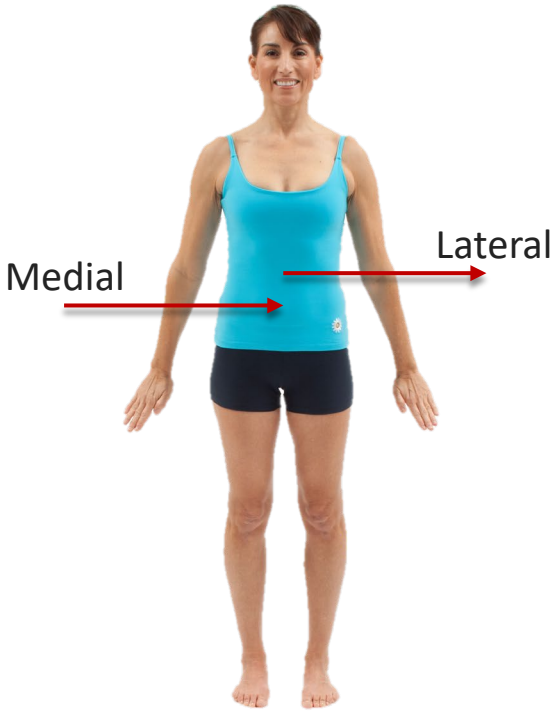
Anatomical Directions

Superior Above	**Inferior** Below
Anterior In the front	**Posterior** In the back
Superficial Closer to the surface of the body	**Deep** Further from the surface of the body
Cranial Toward the head	**Caudal** Toward the tail



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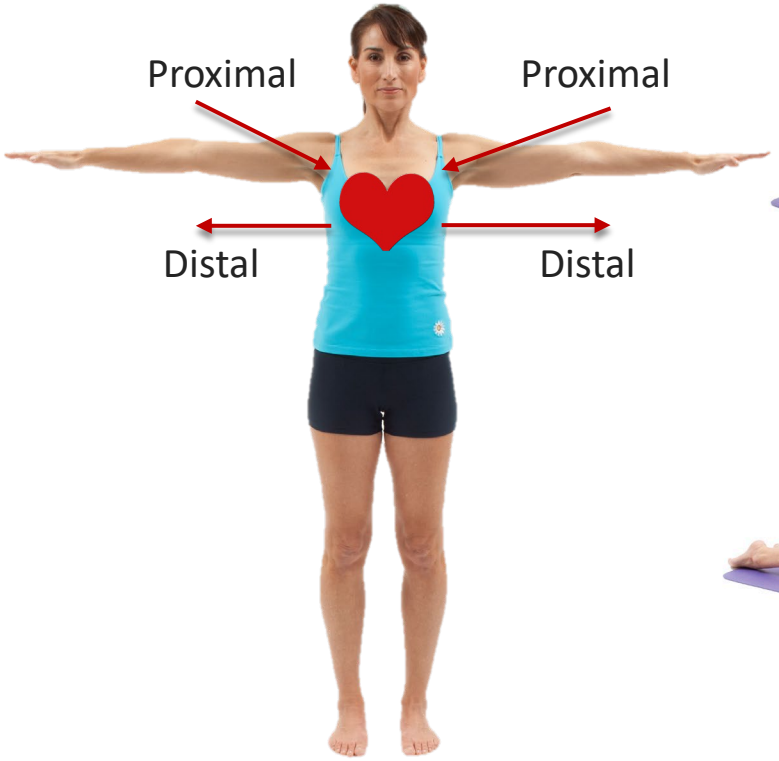
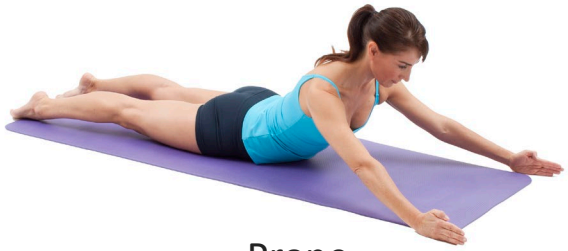
Anatomical Directions



Supine



Prone

Proximal
Closer to the heart

Distal
Farther from the heart

Supine
Lying on the back

Prone
Lying on the stomach

Ipsilateral
To the same side (usually referring to rotation)

Contralateral
To the opposite side (usually referring to rotation)

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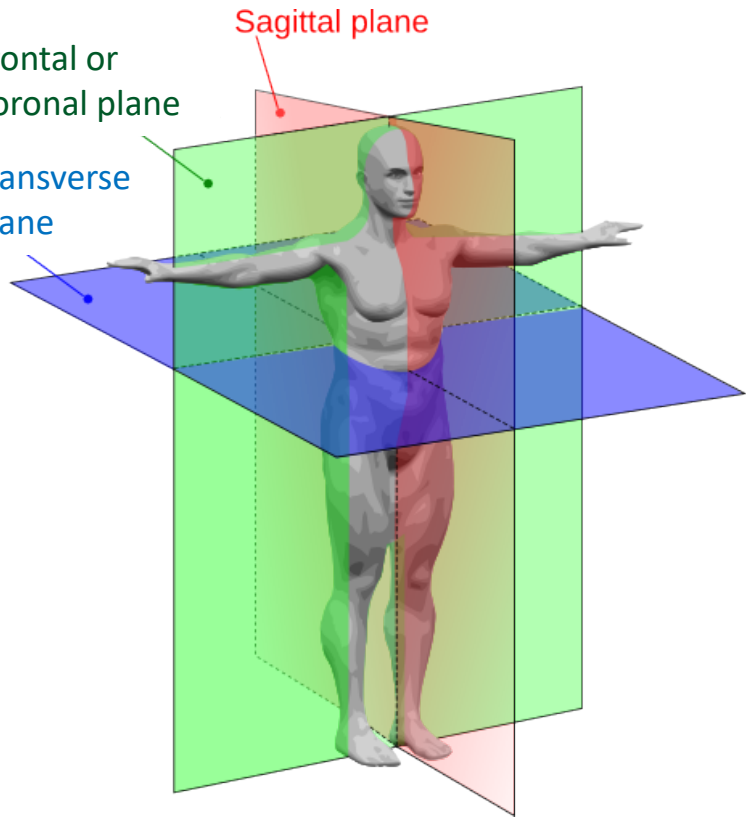
Planes of Motion



Sagittal or
Wheel plane

Coronal or
Frontal plane

Transverse,
Horizontal or
Rotational
plane

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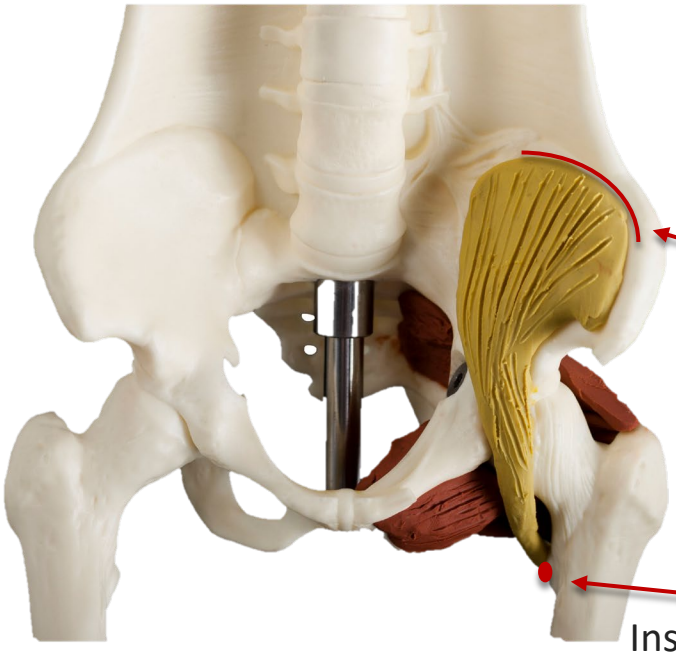
Origin and Insertion

Iliacus



Origin: Superior two thirds of iliac fossa

Insertion: Lesser trochanter

Origin
Refers to the relatively stationary or fixed end of a muscle (O)

Insertion
Refers to the relatively more mobile end of a muscle (I)

Since muscles can often move joints from both the insertion towards the origin and from the origin towards the insertion, the origin can more accurately be referred to as the proximal end and the insertion as the distal end of the muscle.

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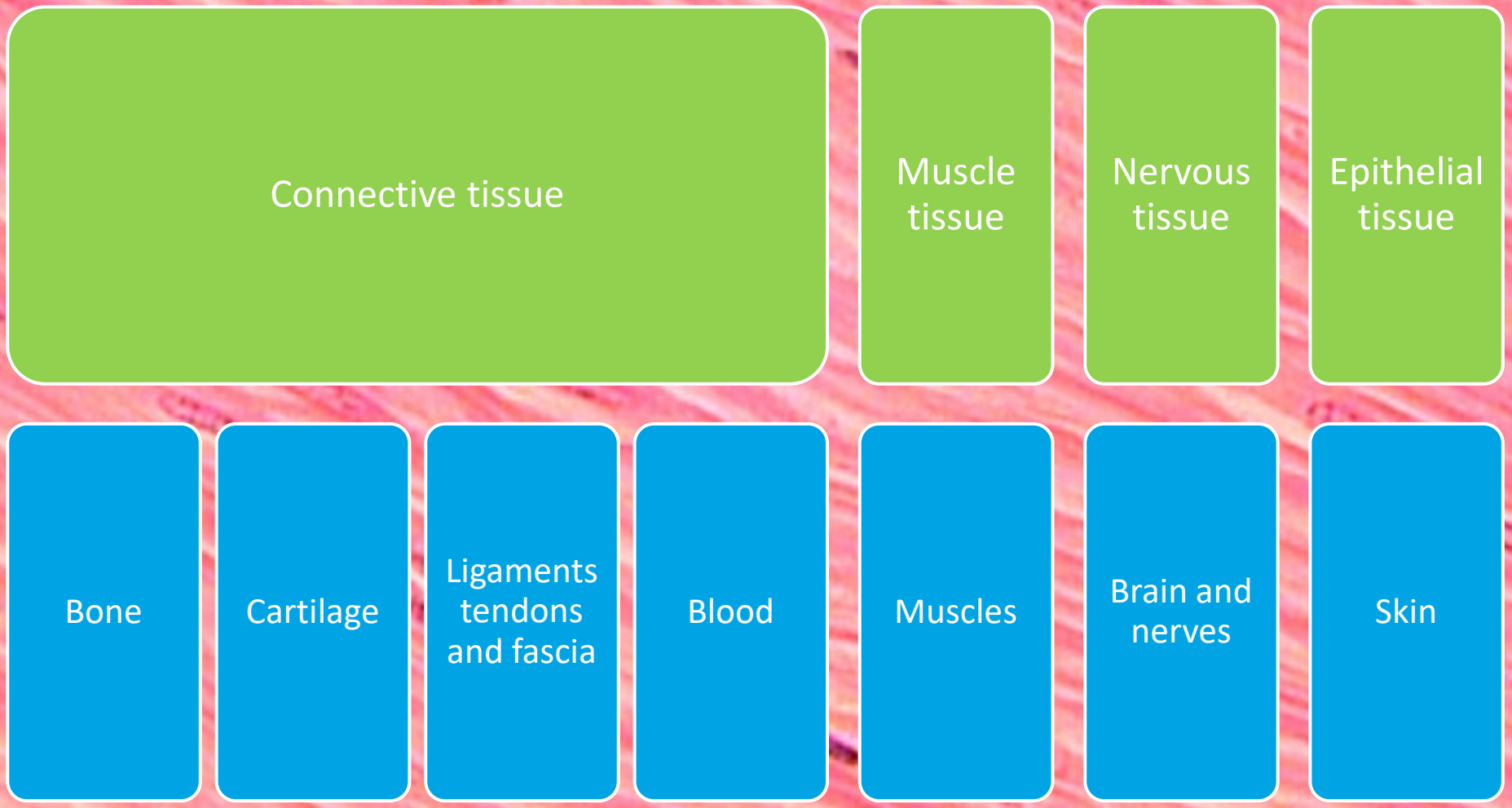
Tissues of the Body



Background is smooth muscle tissue

Bone

206 bones in the human body create structure, protect organs and anchor muscles.

Bones are the levers by which muscles create movement.

Bones are alive. Remodel in response to stress. Contain immune system components.

As strong as steel, but lightweight and flexible

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Bones

Function

- Protection
- Support
- Movement
- Red and white blood cell production
- Mineral storage

Common Pathologies

- Breaks
- Fractures
- Osteoporosis

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Bones

Periosteum

- Outer layer
- Creates new bone
- Blood and nerve supply

Cortical (or compact) bone

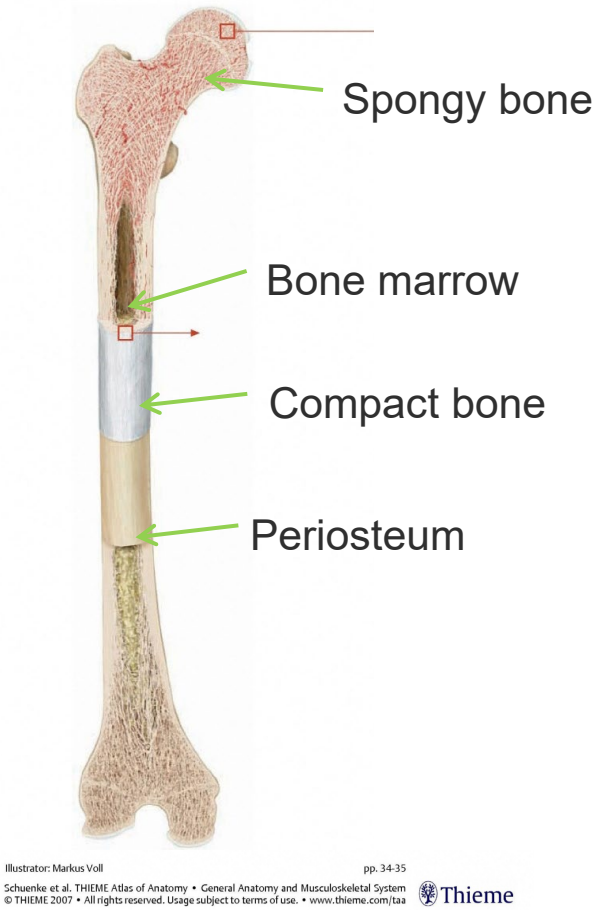
- Surface of the bone
- Tightly packed structure

Trabecular (cancellous or spongy) bone

- Inside the bones
- Composed of trabeculae, arches of bone formed in response to stress
- Trabeculae thin with osteoporosis

Bone marrow

- Inside the long bones and flat bones
- Produces red and white blood cells



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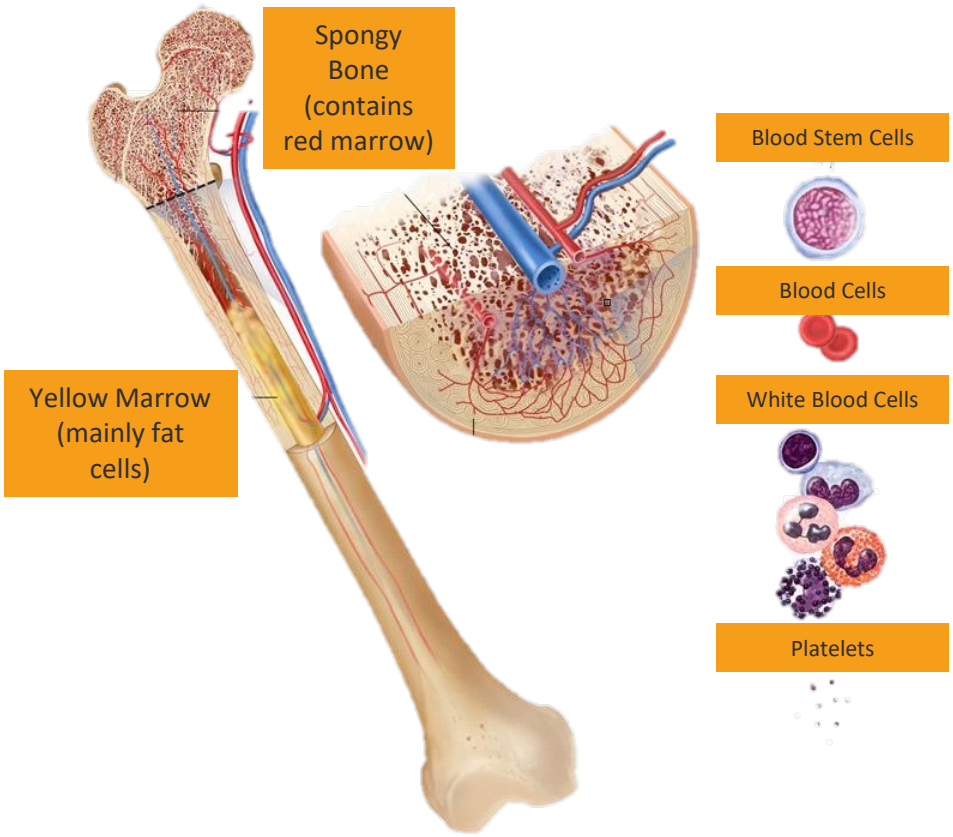
Bone Marrow

Bone marrow produces blood cells of all kinds including red blood cells and white or immune system cells.



In adults it is primarily found in the flat bones: sternum, ilium, vertebrae, scapulae and ribs.

Red blood cell production is a process known as hematopoiesis

The hematopoietic component of bone marrow produces 500 billion blood cells per day

Bone marrow is essential for good energy metabolism and a healthy immune system.

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Skeletal System

Axial Skeleton

Skull

Spine

Ribcage

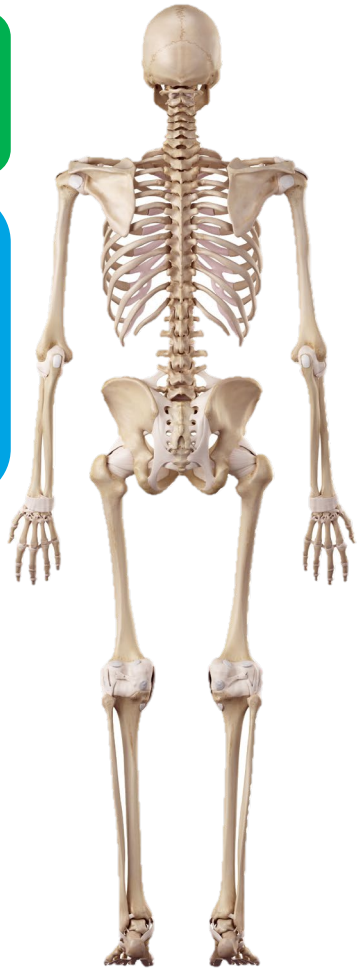
Appendicular Skeleton

Shoulder Girdle

Pelvic Girdle

Appendages

- Arms
- Legs



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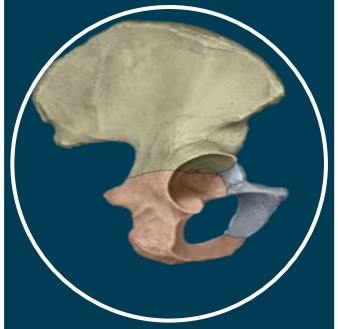
Types of Bones

Long Bone

has a shaft, mostly limb bones (humeral bone, femur bone)

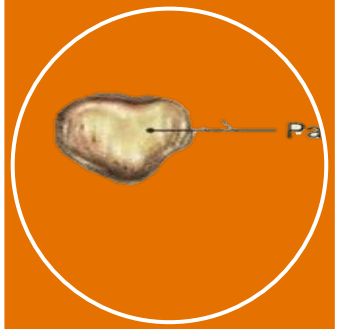
Short Bones

"cubed" most carpal (wrist) and tarsal (ankle) bones



Flat Bones

thin and generally curved, skull, hip bones, sternum, ribs and scapulae



Sesamoid Bones

Embedded in tendons, i.e. Patella

Irregular Bones

shapes are irregular, vertebrae, sacrum and coccyx

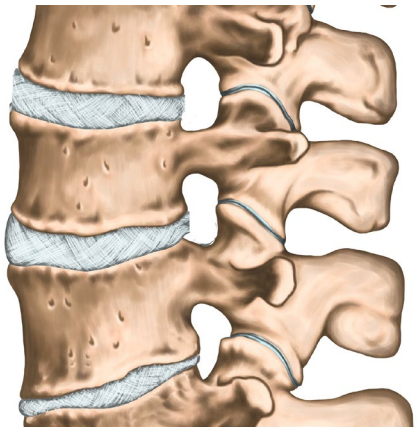
Joints: Classification

Fibrous Joints

- Bones held together by fibrous tissue
- Fibrous joints allow little or no movement.
- Examples: Joints of the skull, teeth in the jaw

Cartilaginous or Symphyseal Joints

- Bones held together by thickened discs of cartilage.
- Cartilaginous joints are strong and stable and allow a small amount of movement
- Examples: Symphysis pubis, joints between the bodies of the vertebrae, joint between the sternum and the manubrium



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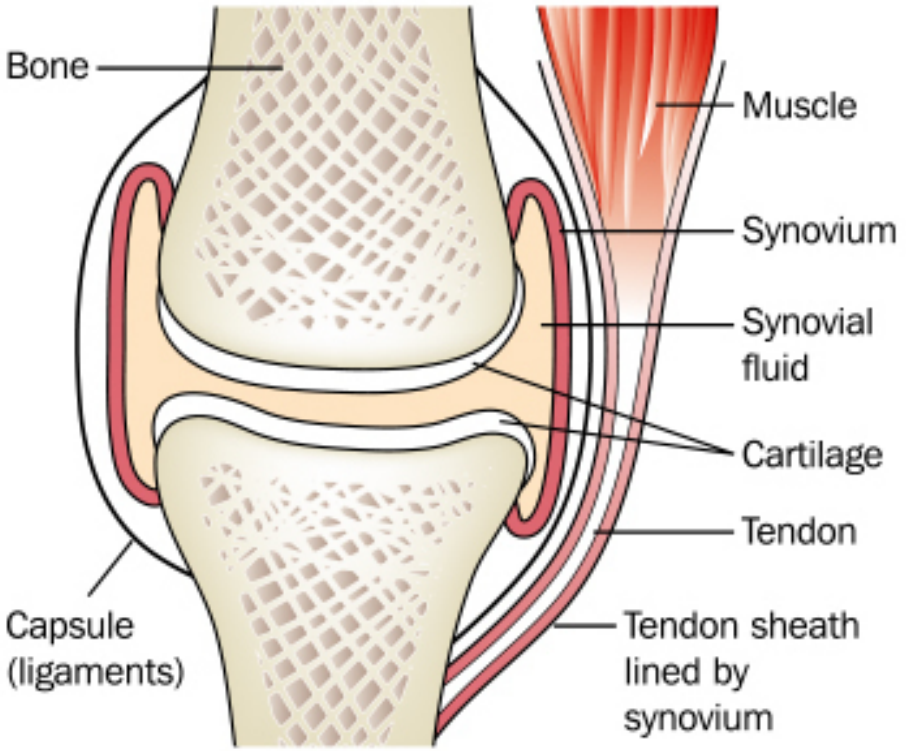
Synovial Joints

The bones are not joined directly together leaving space for the bones to move.

Allows maximum range of motion.

Example: Knee, elbow, hip, finger and toe joints



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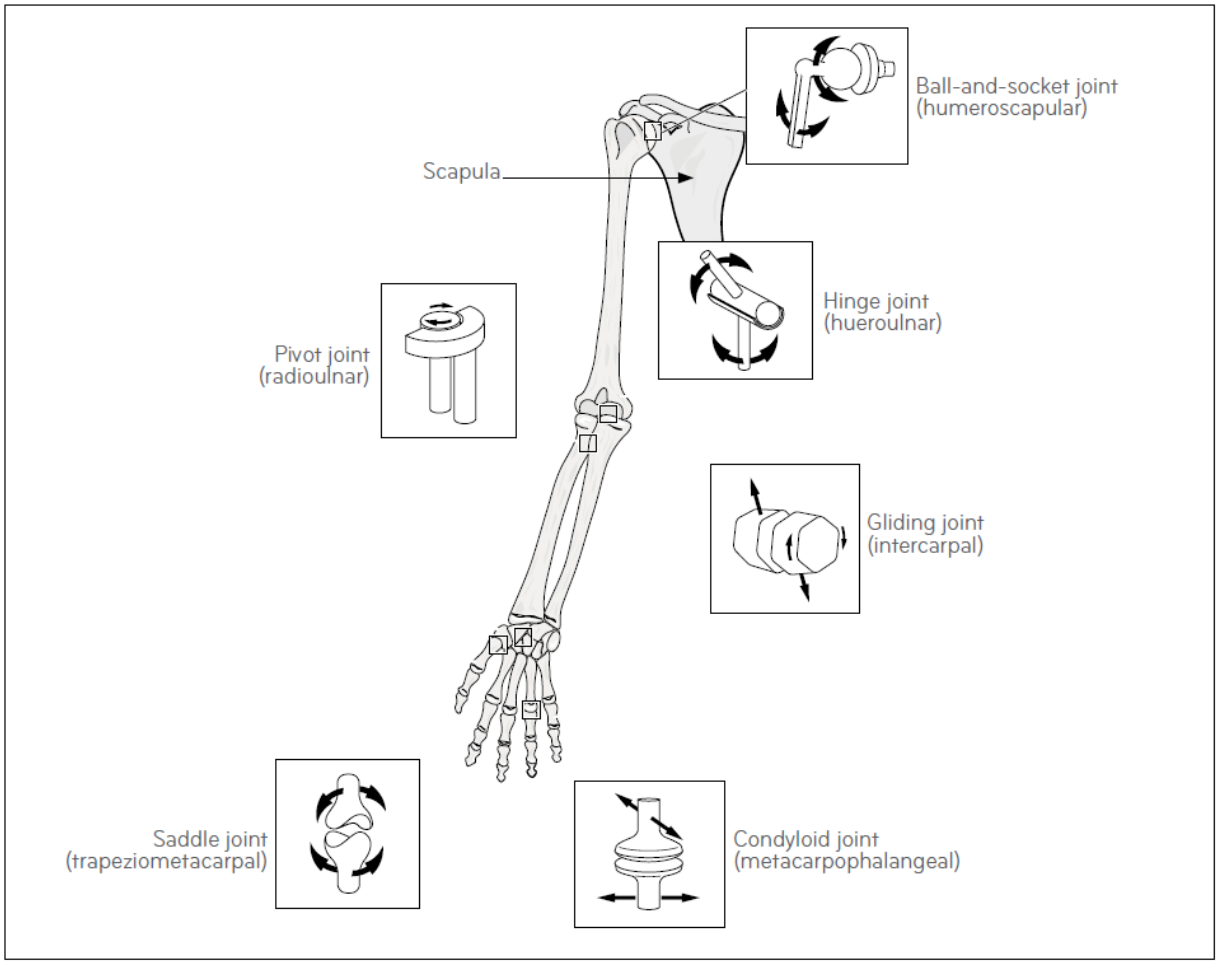
Types of Synovial Joints

Type of Joint	Example	Joint Shape	Joint Movement
Ball and Socket	Hip, Shoulder	Ball and Socket	Movement in all planes
Hinge	Elbow, Knee, Phalanges	Varies	Flexion and extension
Gliding	Carpals, Tarsals	2 flat surfaces meeting	Small amount of glide in one or several planes
Ellipsoid or Condyloid	Radiocarpal	Oval end articulates with elliptical basin	Flexion, extension, abduction, adduction
Saddle	Thumb, Sternoclavicular	2 nesting saddles	Flexion, extension, abduction, adduction
Pivot	Atlantoaxial or radioulnar	Axle and Wheel	Rotation

Types of Joints



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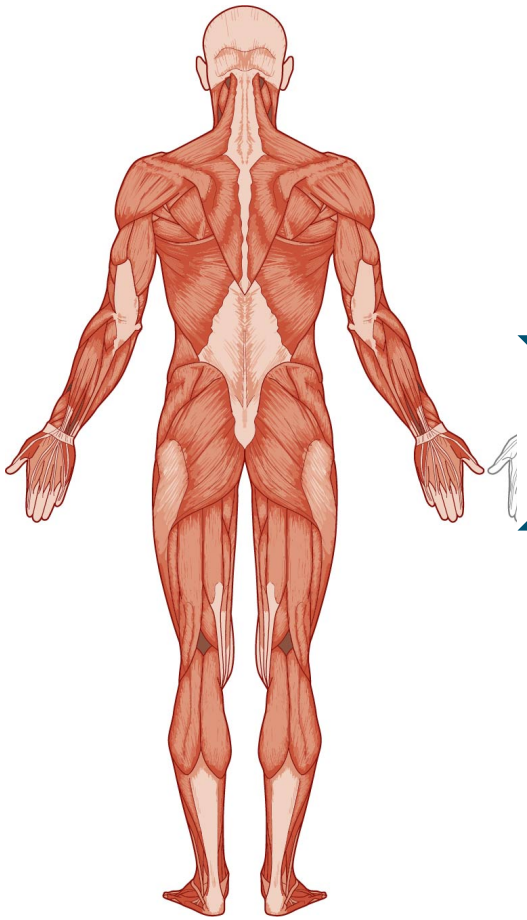
Muscular System

There are three categories of muscle:

- Skeletal
- Smooth
- Cardiac

The skeletal muscles consist of striped or striated fibers. They move the various parts of the body.

Skeletal muscles are considered "voluntary" muscles because the person controls their use.



The muscular system is made up of some six trillion muscle fibers.

Each fiber is thinner than a human hair, but can support up to 1,000x its own weight

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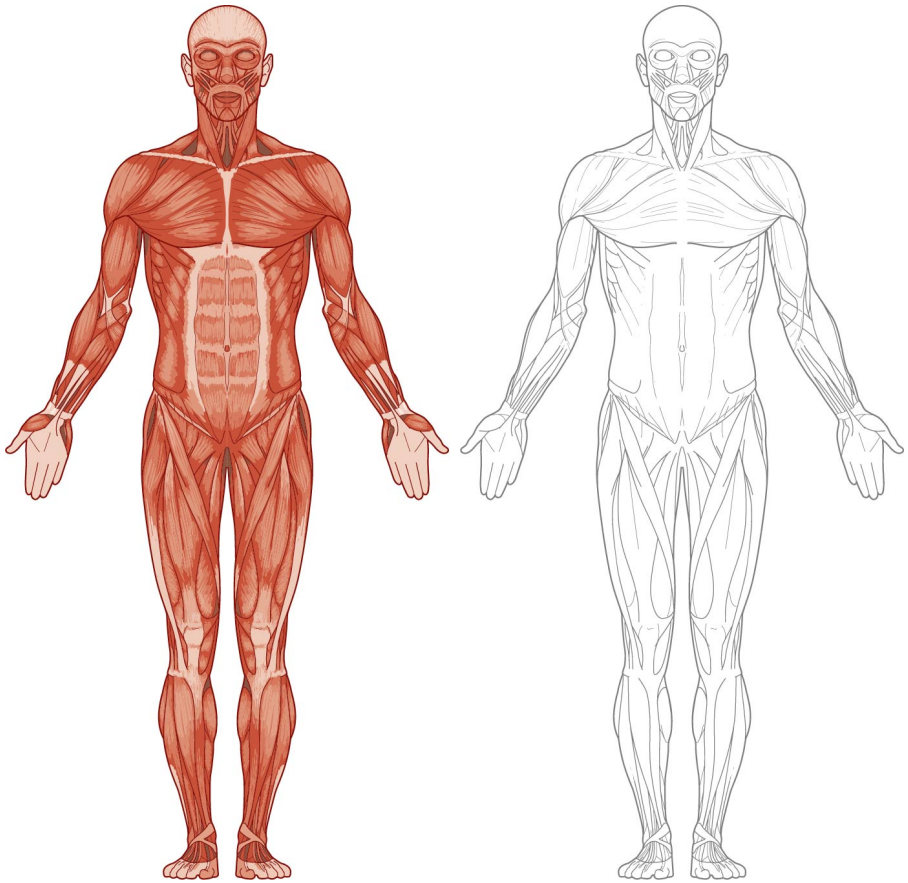
Muscular System



The number of muscles in the human body varies from about 656 to 850, depending on which expert you consult.

No exact figure is available because there are a variety of opinions about what constitutes a distinct muscle (versus part of a complex muscle).

There is also variability in muscular structure between individuals.

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Muscle Structure

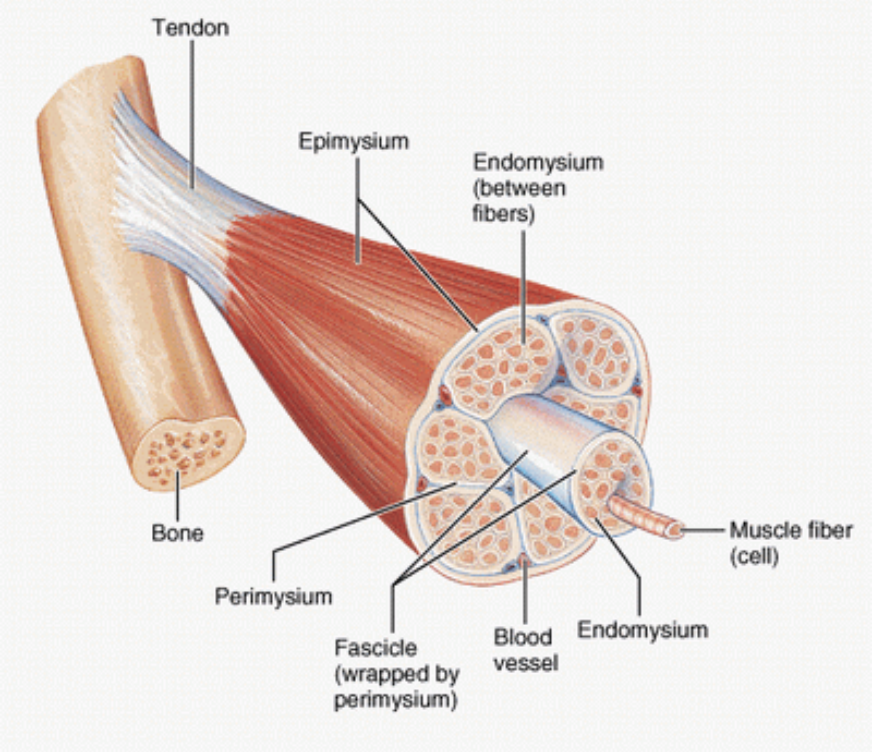
Typical Skeletal Muscle

Structure: Muscles are composed of a combination of muscle fibers and connective tissue.

Endomysium: Internal layer of connective tissue which encases individual muscle fibers.

Perimysium: Connective tissue that surrounds bundles of muscle fibers.

Epimysium: Connective tissue which encases entire muscle.



Tendon: Epimysium merges with the tendon which attaches to the bone. Creates a strong junction between muscle and tendon.

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Muscle Shapes

Parallel

Parallel to the force generating axis.

Strap

Strap or belt shape. Can shorten about 40-60% of resting length

Fusiform

Wider in the center and tapers at both ends. Force production is concentrated into a small area (i.e. Biceps)

Triangular or Fan shaped

Spread from broad area to converge at one end.

Flat

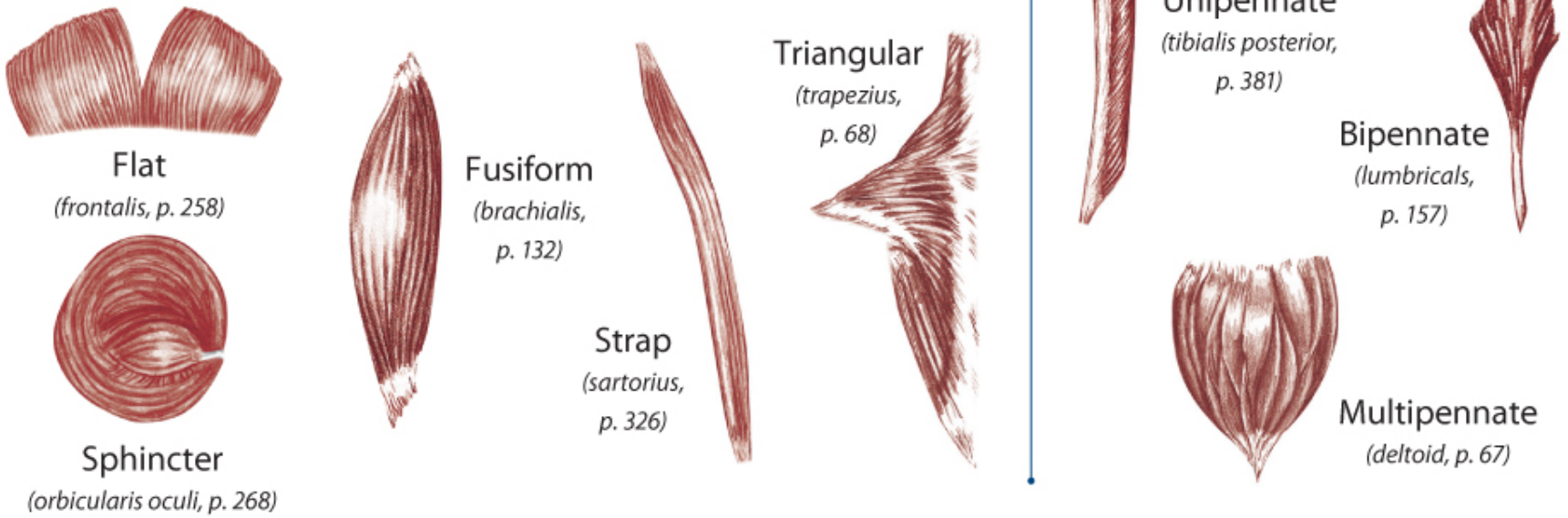
Broad, relatively thin, sheet-like muscle

Sphincter

Circular muscle controlling body passages or orifices. (i.e. urinary sphincter)

Pennate – uni, bi or multipennate

Feather shaped. Short fibers insert at an angle along a central tendon. Produce greater force then parallel muscles.



Build a Muscle!

Make 3 muscle fibers

Cover each muscle fiber with a layer of endomysium

Wrap all three muscle bundles together in a layer of perimysium

Wrap them all up in epimysium and make a tendon where they all attach.

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The Lower Body

Including the bones, muscles and actions of the hip and knee

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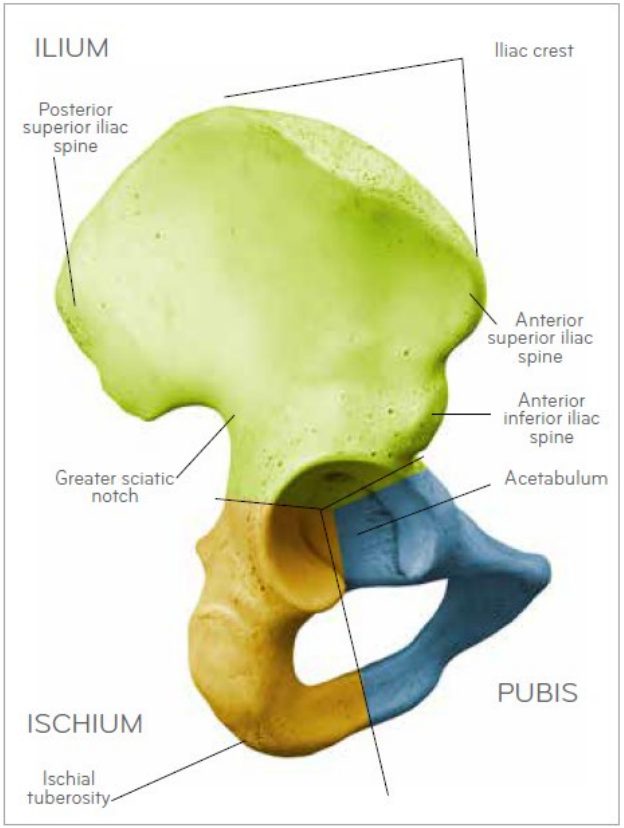
The Pelvic Half



The ilium, ischium and pubis, three island of bones which fuse together to form the hemi pelvis or hip bone.

The pelvic bone is also called

- Innominate
- Os coxa
- Hip Bone
- Hemi-pelvis

The pelvic half is made up of three fused bones

- Ilium
- Ischium
- Pubis

The acetabulum is the cup that holds the head of the femur forming the hip joint.

By the end of puberty these three bones fuse together and ossify by around 25 years of age.

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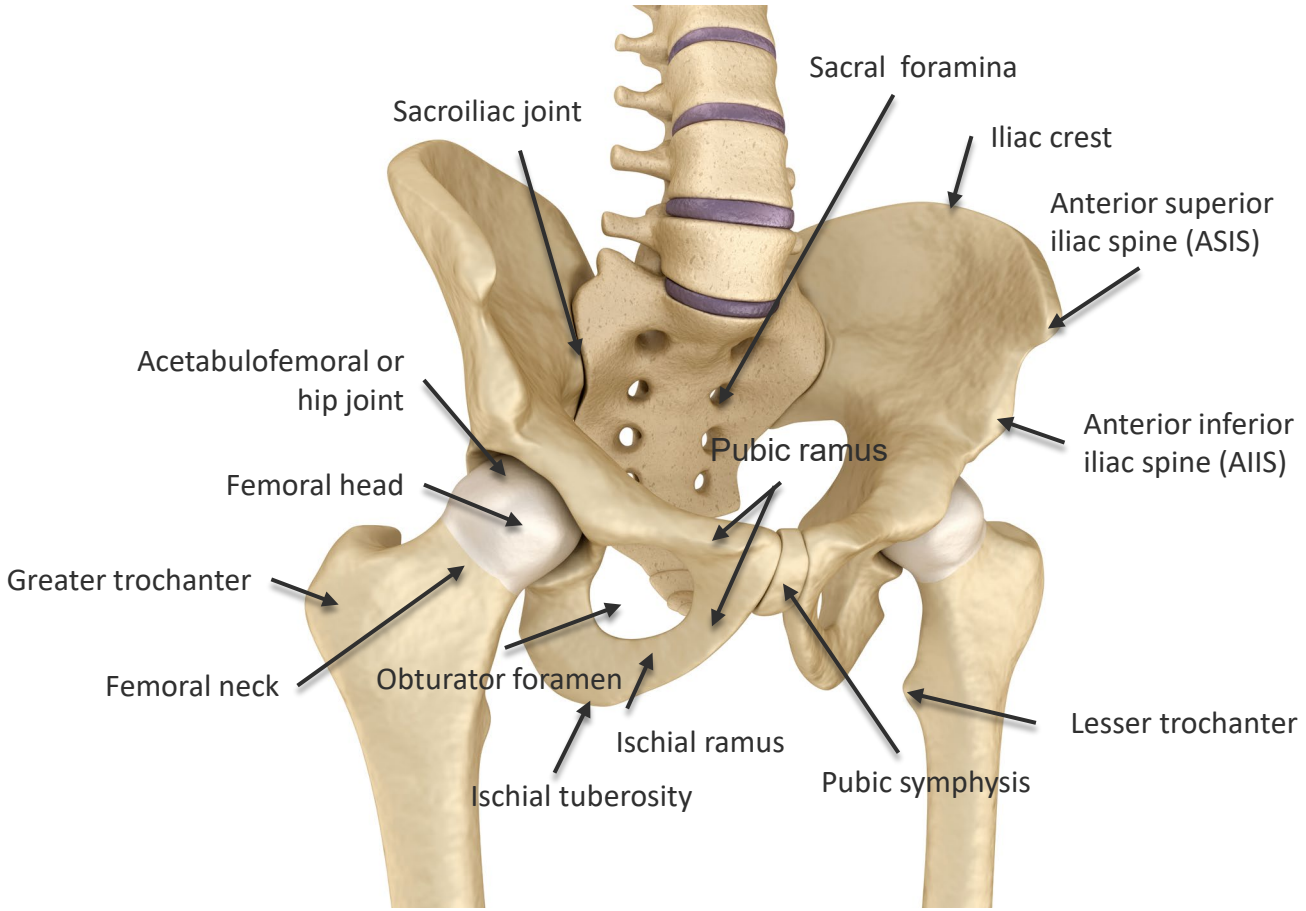
Bony Landmarks
Anterior Pelvis, Sacrum and Hip



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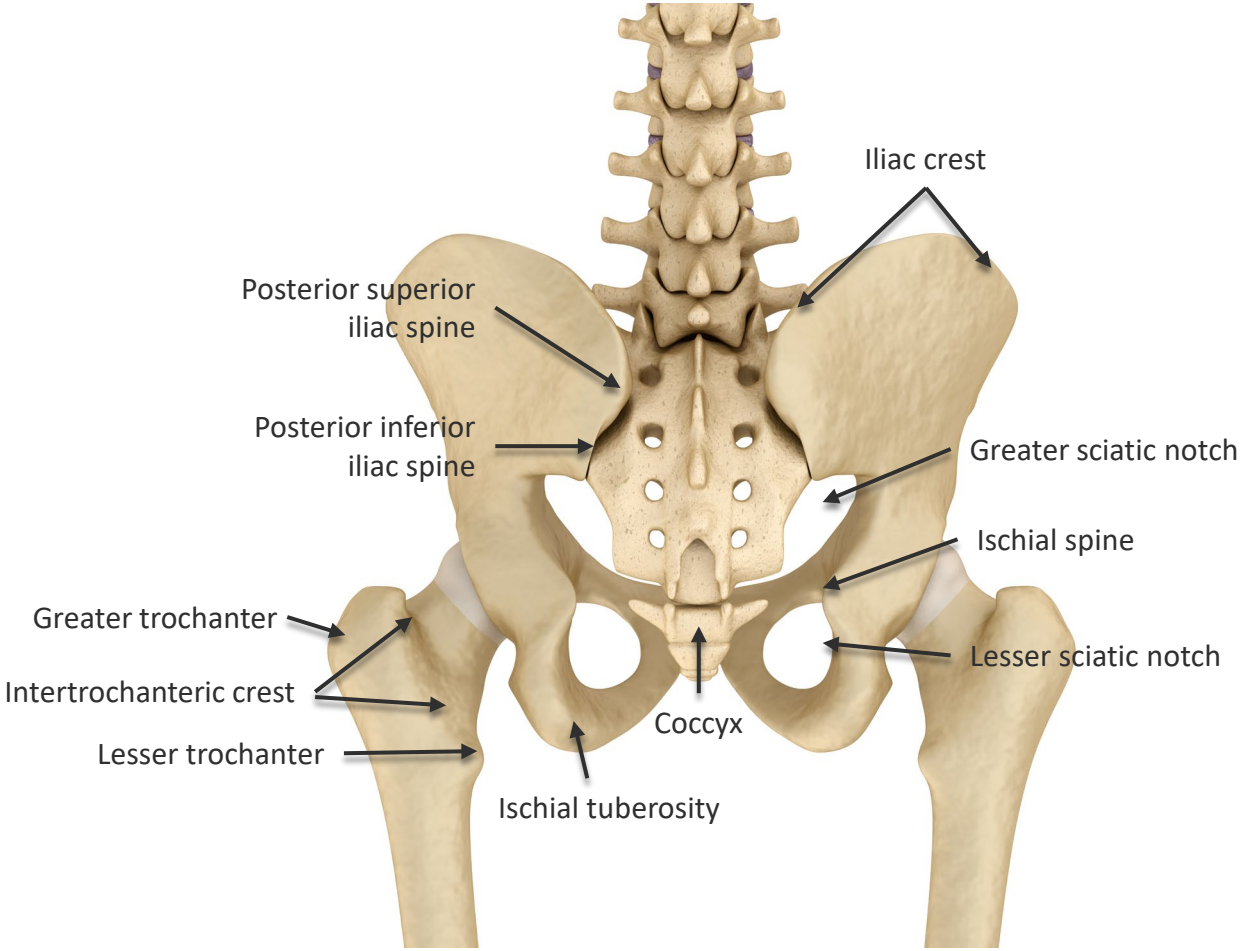
Bony Landmarks
Posterior Pelvis, Sacrum and Hip



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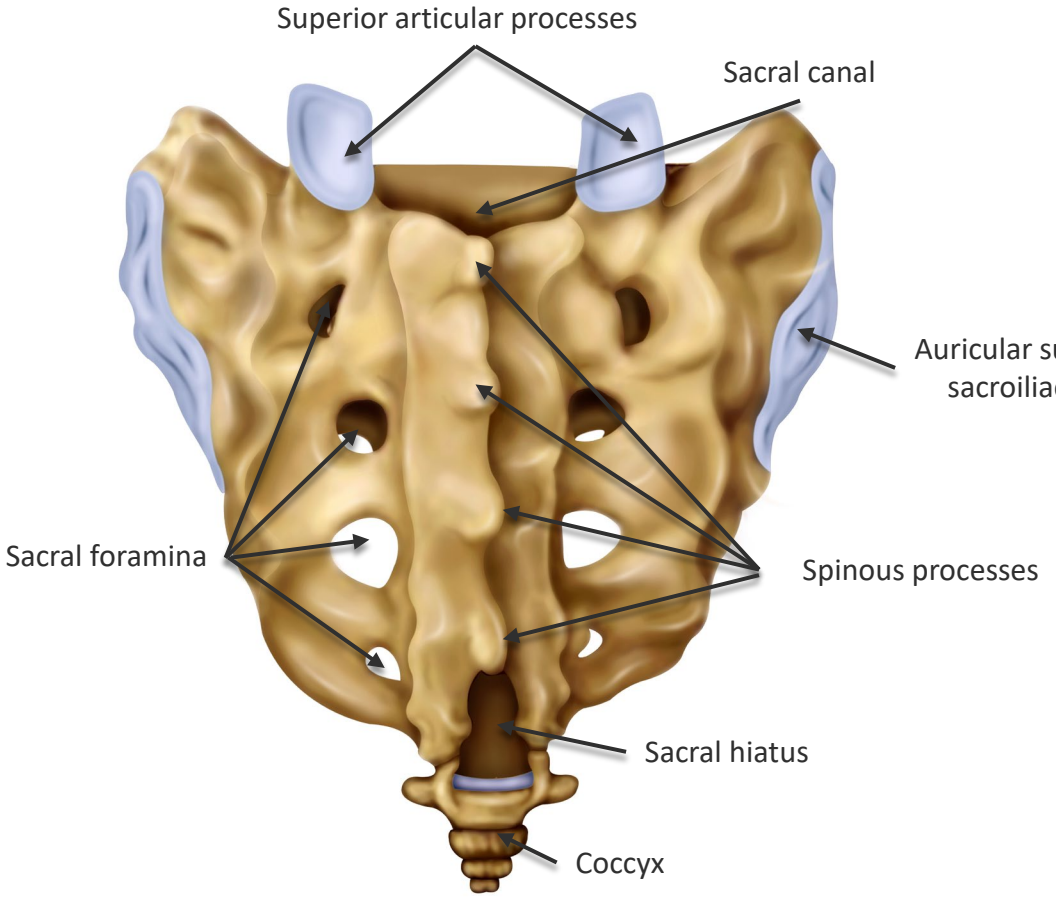
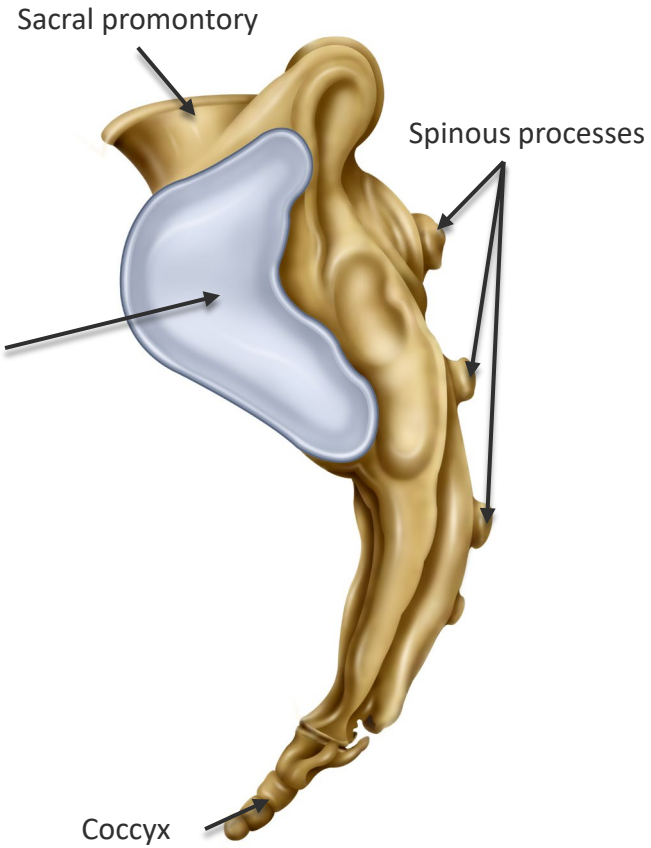
Bony Landmarks
Sacrum





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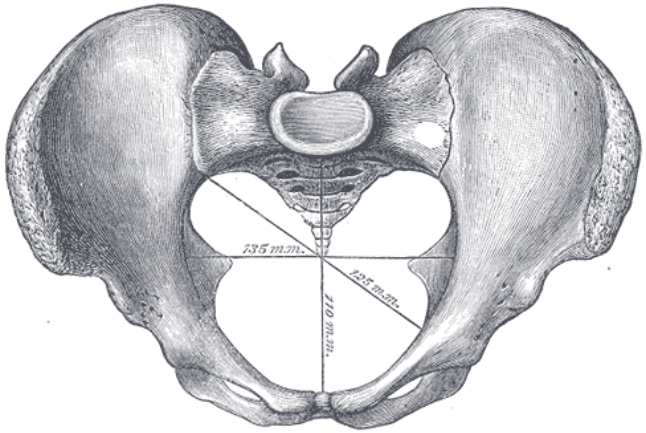
Sacrum as Keystone of the Pelvis

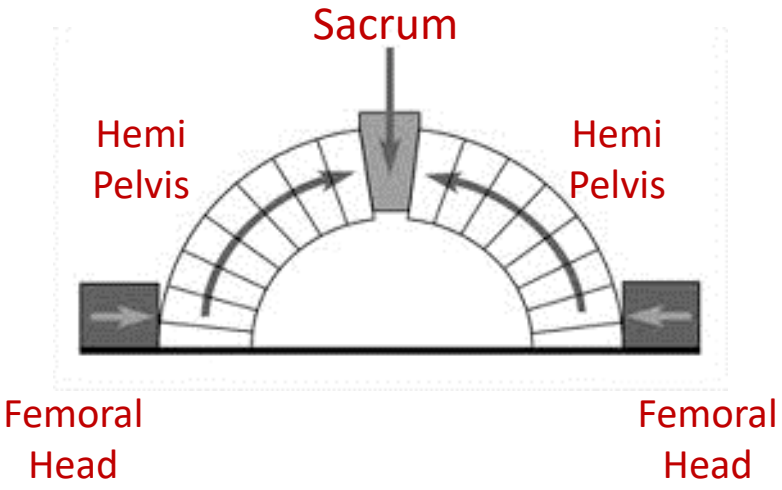
The sacrum has two roles, one is the keystone to pelvis, the other is the platform for the spine.

Keystone is a wedge between two arching columns.

A keystone prevents the columns from falling in on one another

The downward forces of the body fall onto the sacrum via the spine and are met by the ground forces pressing upward and inward through the femur heads and around the ilium.





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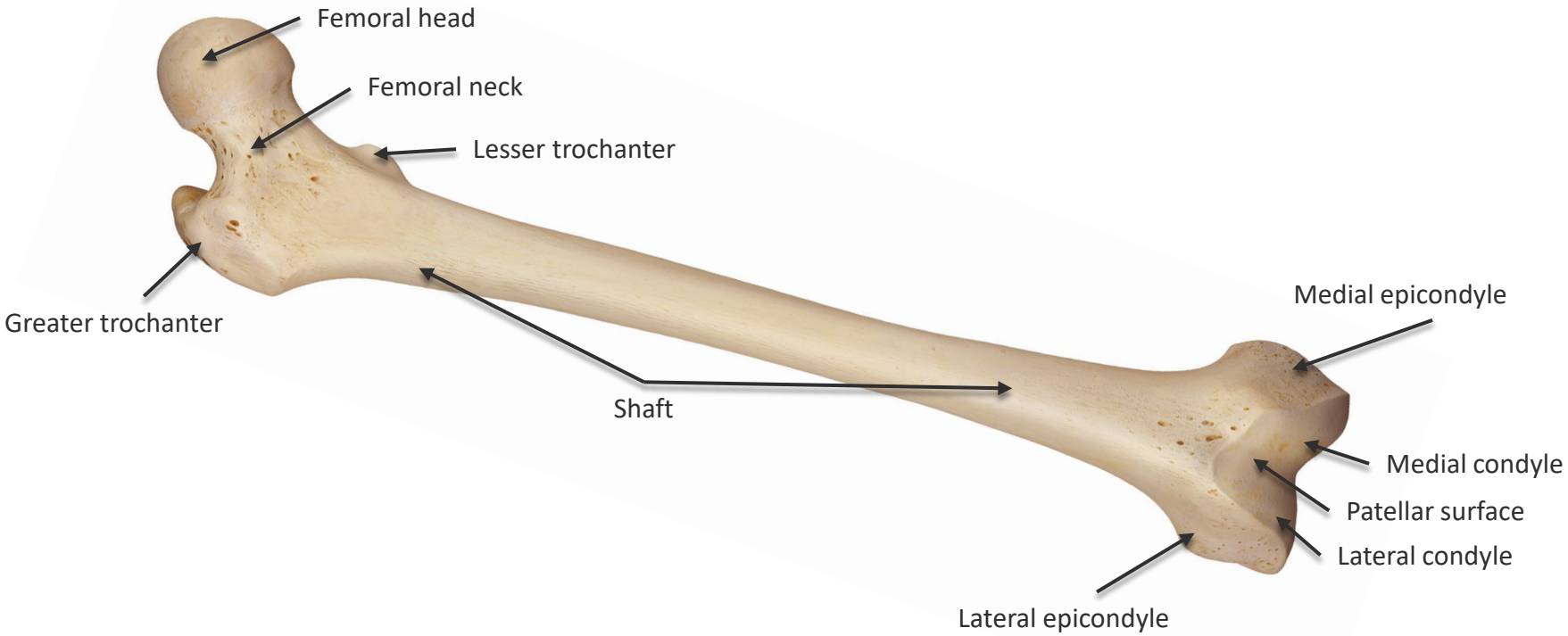
Bony Landmarks
Anterior Femur



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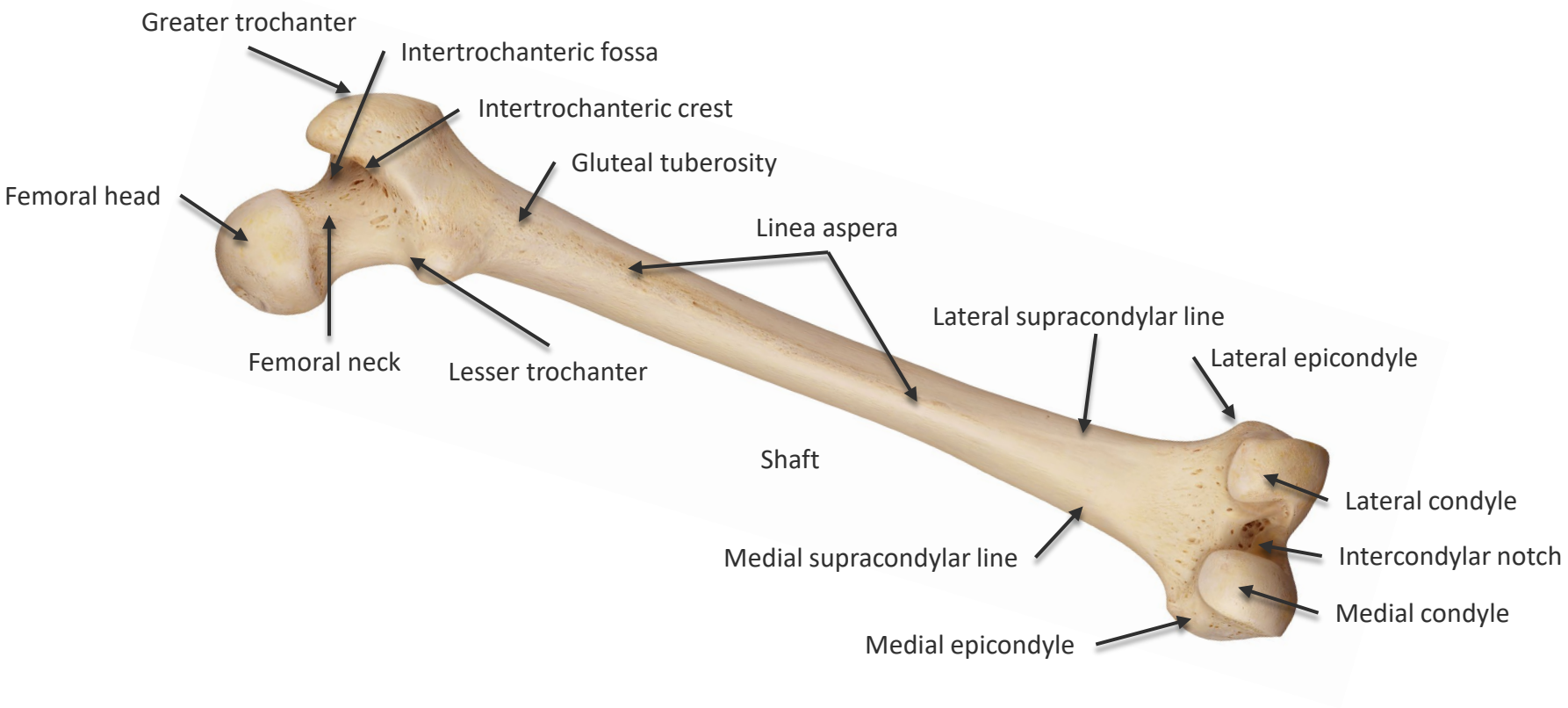
Bony Landmarks
Posterior Femur



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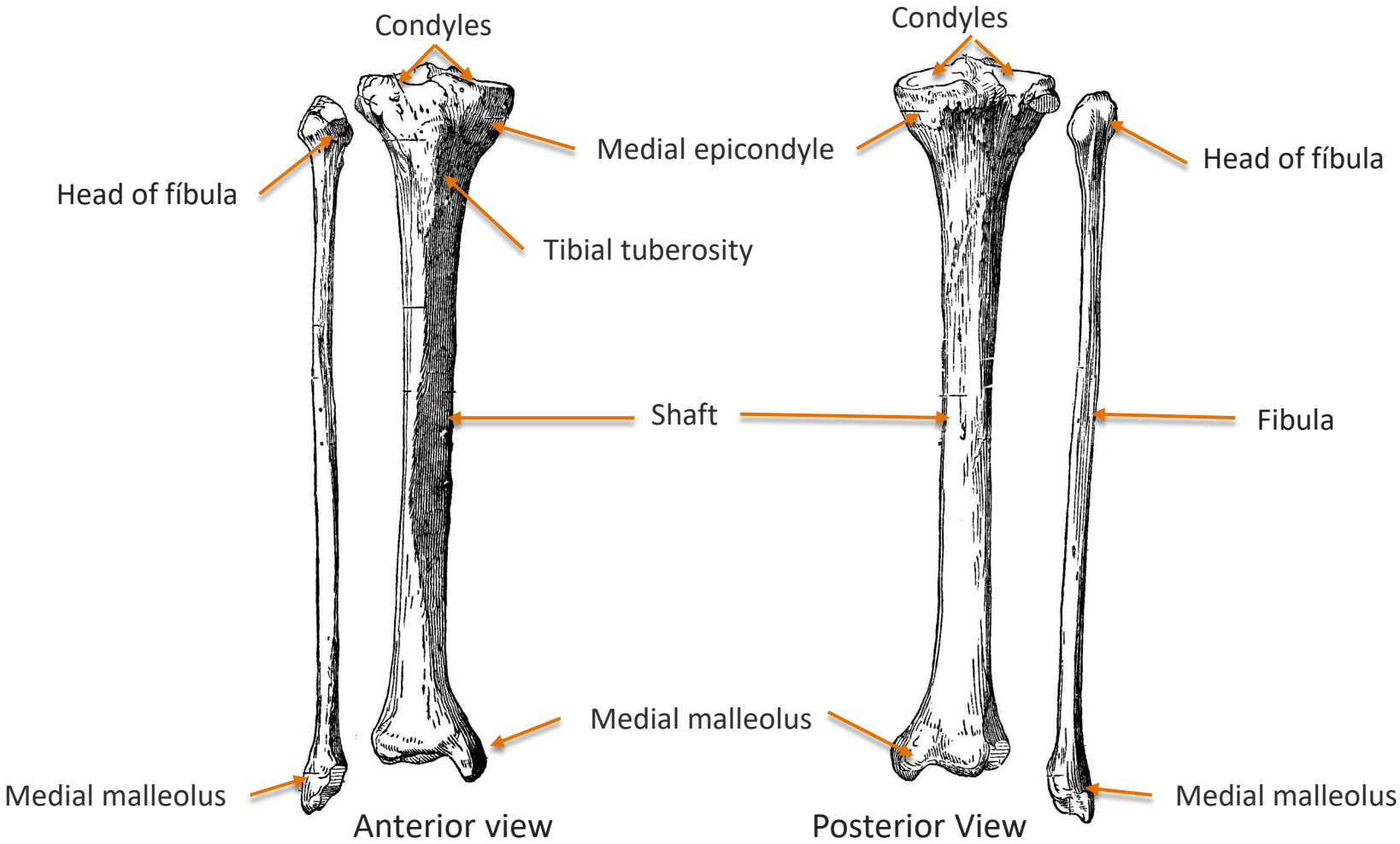
Tibia and Fibula: Anterior and Posterior View



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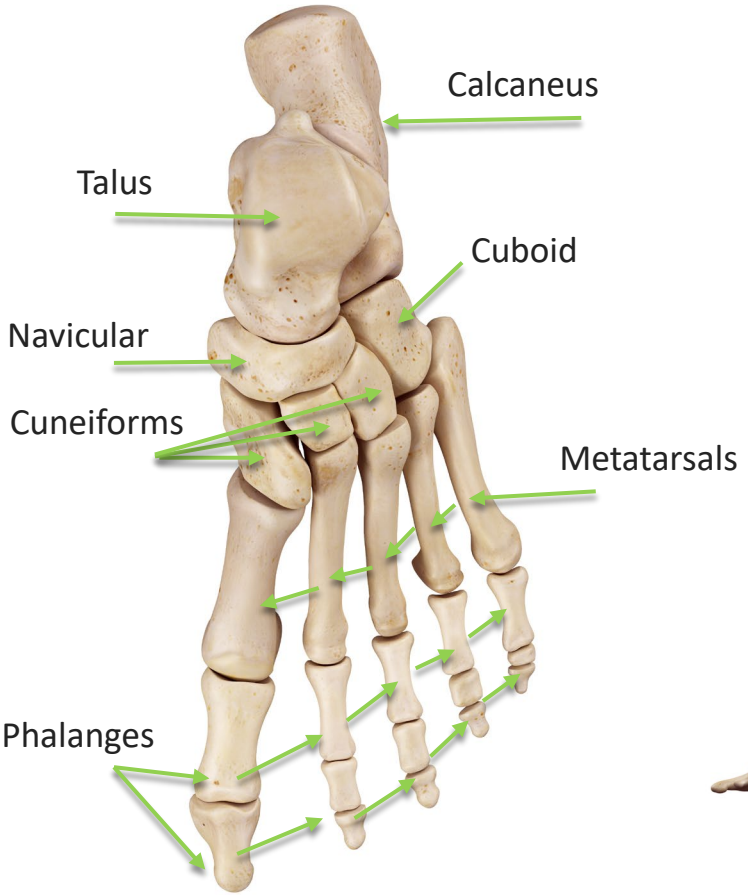
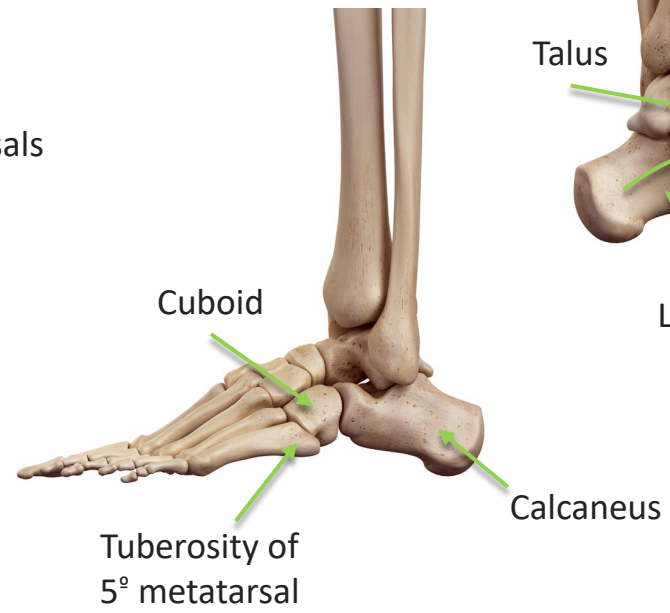
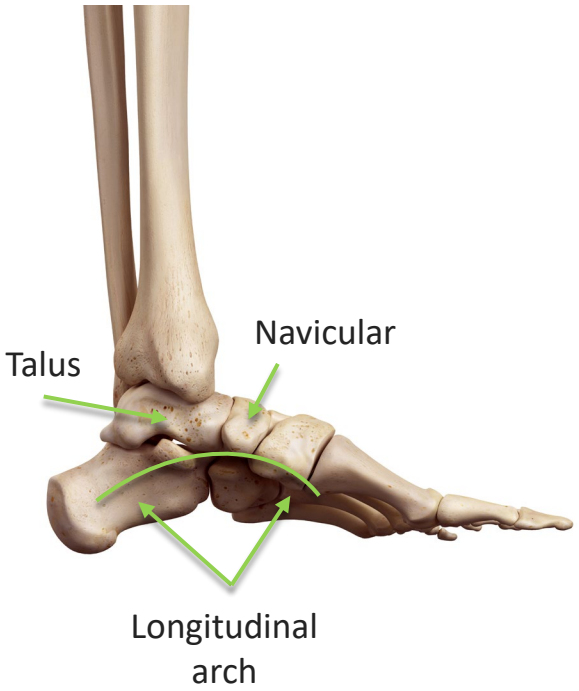
Foot







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Lower Body Build

Hip and Thigh

Deep Rotators

- Obturator Externus and Internus
- Gemellus Inferior and Superior
- Piriformis
- Quadratus Femoris

Psoas and Iliacus

Primary Hip Flexors and Knee Actors

- Quadriceps: Vastus Intermedius, Lateralis and Medialis, Rectus Femoris
- Sartorius

Abductors and lateral thigh

- Gluteus Minimus and Medius
- Iliotibial Band
- Tensor Fascia Lata

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Lower Body Build

Hip and Thigh

Adductors

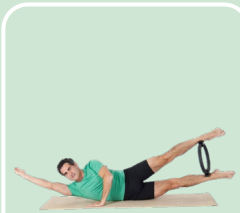
- Pectineus
- Adductor Longus
- Adductor Brevis
- Adductor Magnus
- Gracilis

Hip Extensors and Knee Actors

- Semimembranosus, Semitendinosus
- Biceps Femoris
- Gluteus Maximus

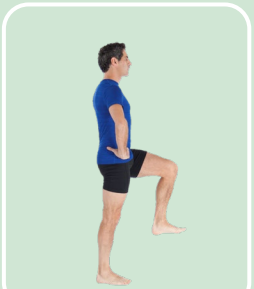
Lower Body Build

Movements of the Hip



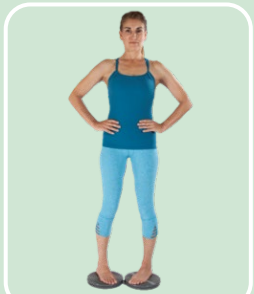
Adduction

Abduction



Flexion

Extension



Medial rotation

Lateral rotation

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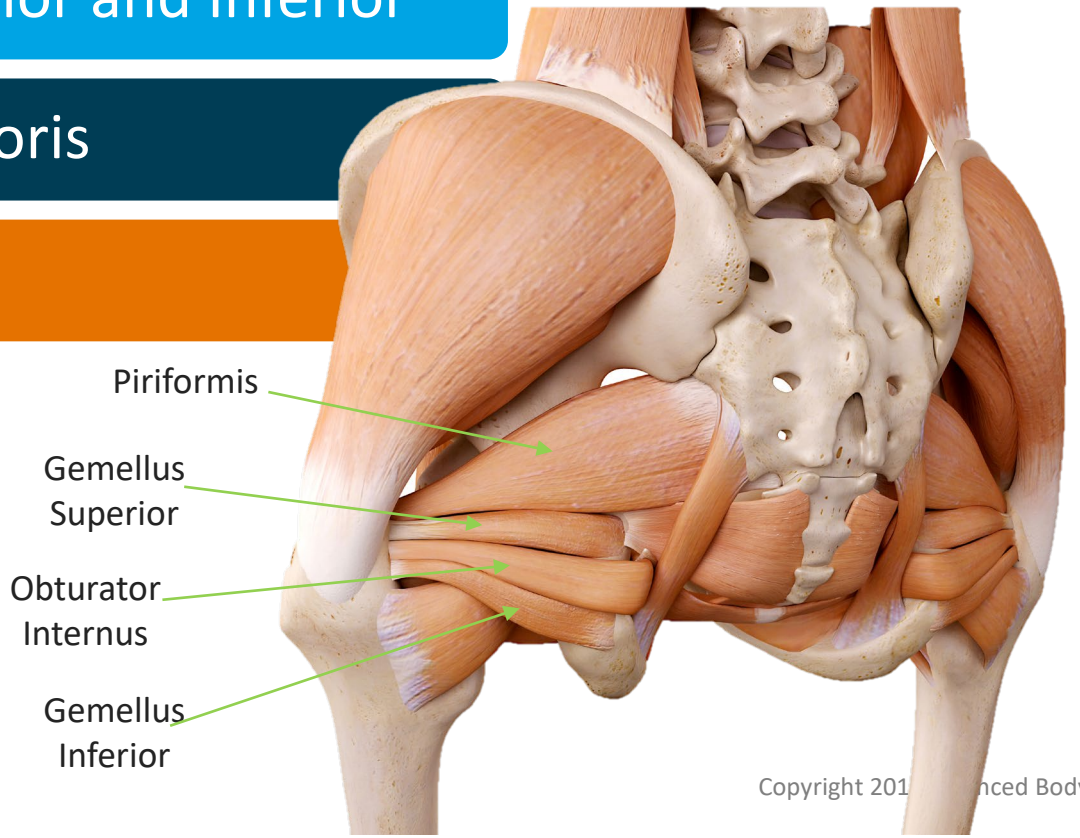
Deep Rotators

Ready, set, build!

- Obturator Externus and Internus
- Gemellus Superior and Inferior
- Quadratus Femoris
- Piriformis



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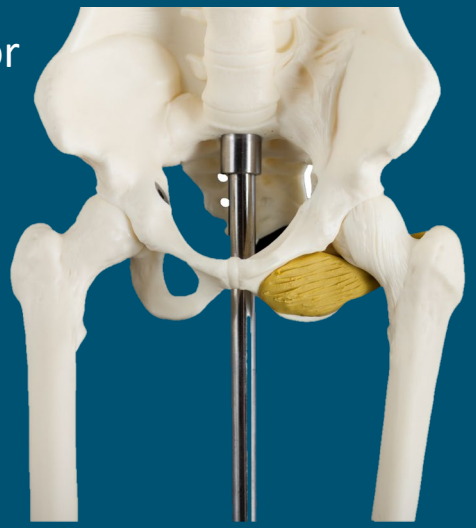
Obturator Externus

Anterior View



Posterior View

Origin:

- Rami of pubis
- Rami of the ischium
- External surface of obturator membrane

Insertion:

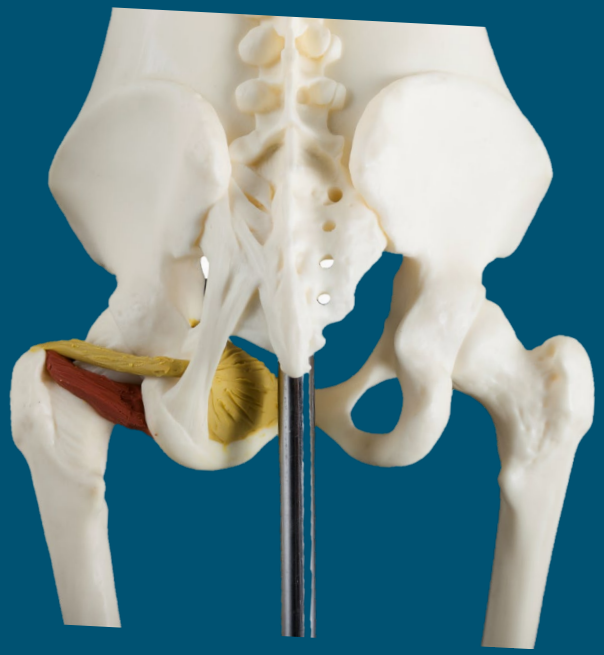
- Trochanteric fossa of the femur

Actions:

- Lateral rotation
- Adduction
- Supports the inferior surface of femoral neck and stabilizes the pelvis

Obturator Internus

Posterior View



Origin:

- Fills lesser pelvis covering inferior surface of obturator membrane

Insertion:

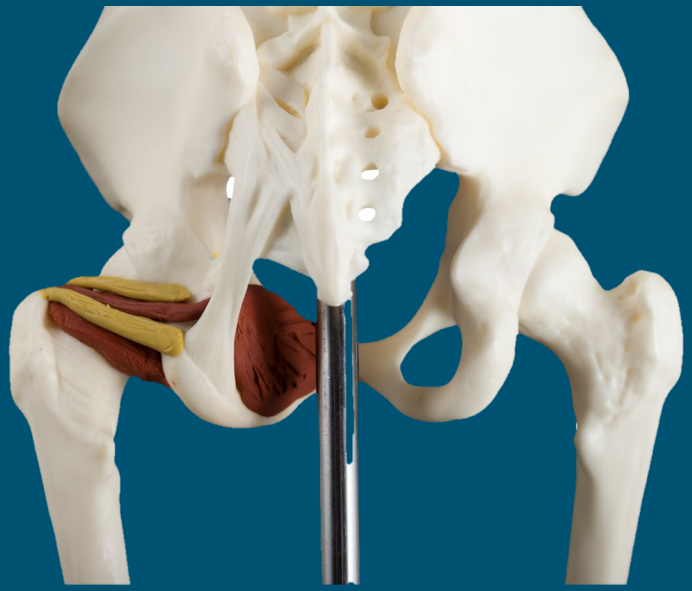
- Medial surface of greater trochanter of femur
- Proximal and superior to trochanteric fossa.

Actions:

- Laterally rotates
- Abducts and laterally rotates extended hip
- Abducts leg when hip is neutral, flexed or extended
- Stabilizes hip during walking
- Serves as attachment point for Levator Ani

Gemellus Superior and Inferior

Posterior View



Origin:

- *G. Superior:* External surface of ischial spine superior to obturator internus.
- *G. Inferior:* Superior ischial tuberosity just inferior to obturator internus.

Insertion:

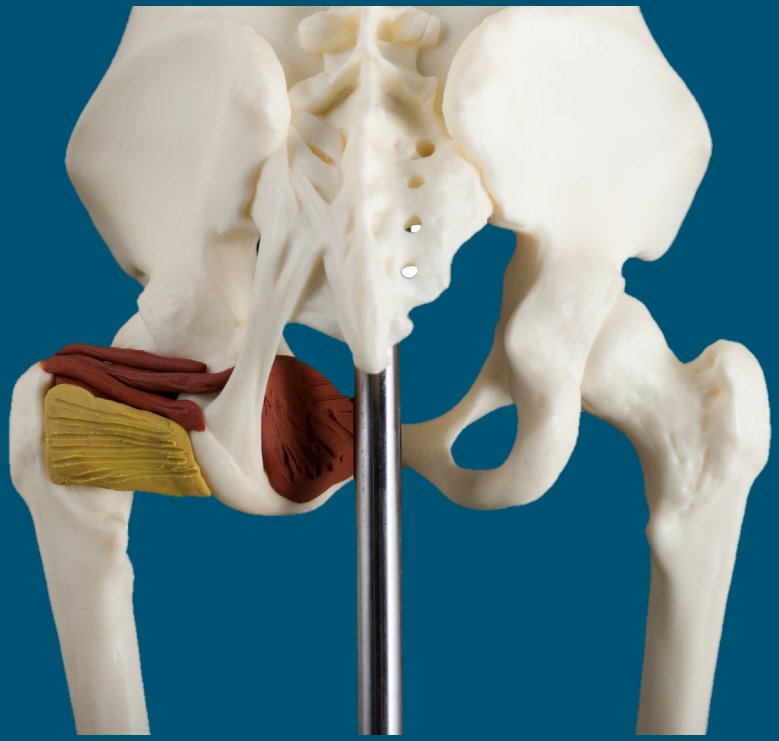
- With the tendon of the obturator internus onto medial surface of greater trochanter of femur

Actions:

- Lateral rotation on neutral or extended hip
- Abduction on neutral, flexed or extended hip
- Steadies head of the femur in acetabulum

Quadratus Femoris

Posterior
View



Origin:

- Proximal part of lateral border of ischial tuberosity

Insertion:

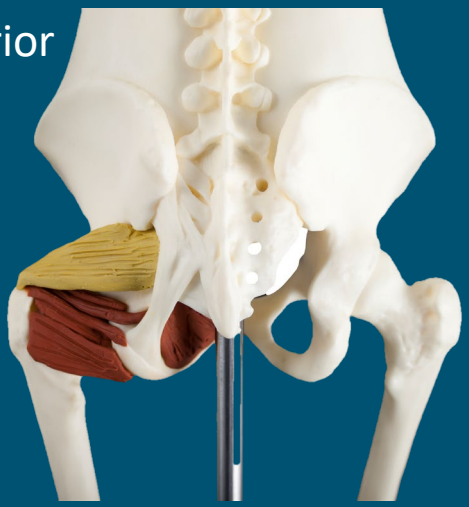
- Intertrochanteric crest between the greater and lesser trochanters

Actions:

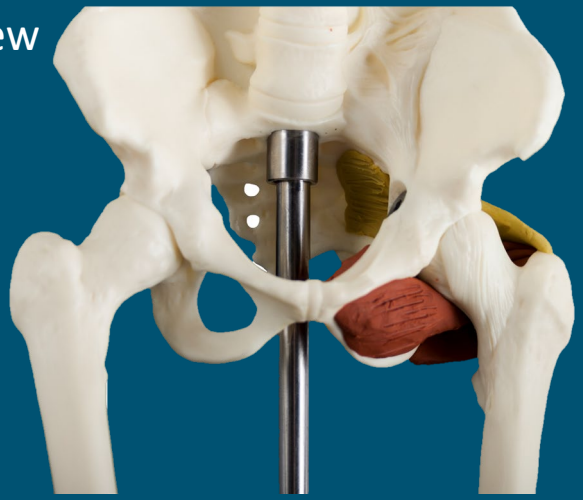
- Lateral rotation of the hip
- Adduction of the hip
- Stability of femur and acetabulum

Piriformis

Posterior View



Anterior View



Origin:

- Pelvic surface of sacrum between (and lateral to) pelvic sacral foramen 1-4
- Margin of greater sciatic foramen
- Pelvic surface of sacrotuberous ligament

Insertion:

- Superior border of the greater trochanter

Actions:

- Laterally rotates and abducts neutral or extended hip
- Medial rotation when hip flexed above 60^{o}
- Creates posterior wall of the pelvis and shares connective tissue with the Coccygeus of the pelvic floor

Deep Posterior Hip Muscle Movements

Muscle	Lateral rotation	Medial rotation	Adduction	Abduction	Extension	Stability
Quadratus femoris	X		X			X
Obturator externus	X		X			X
Obturator internus	X			X		X
Gemellus inferior and superior	X			X		X
Piriformis	X	X (above 60 degrees of flexion)		X	X	X

balanced body