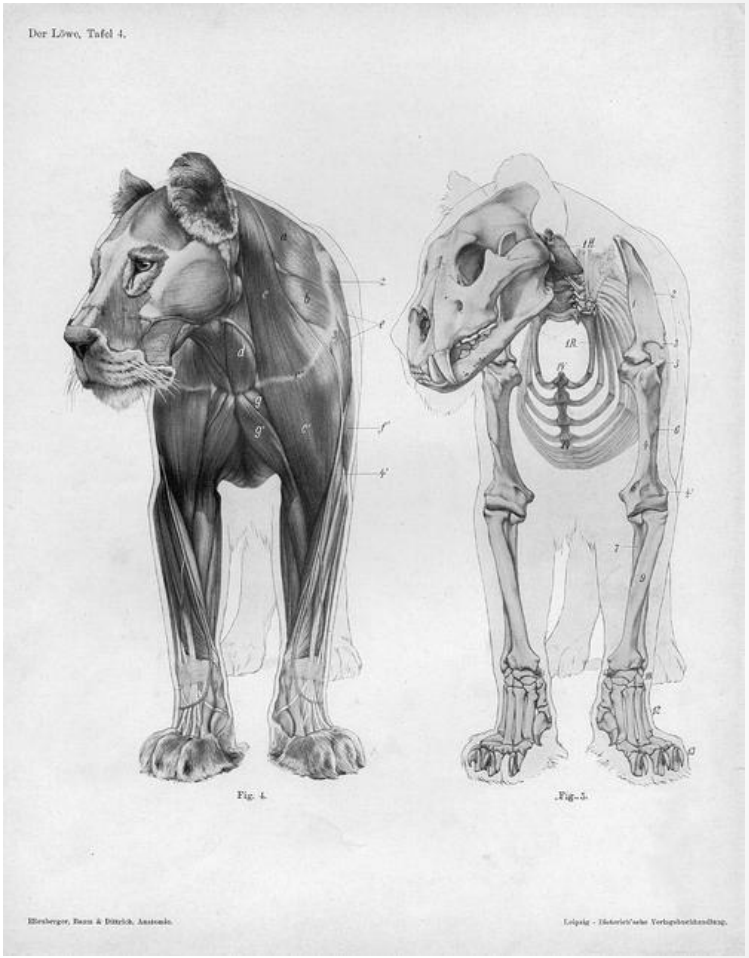
Skeletal and Muscular Systems



Asst. Prof. Dr. Wayne J. Fuller

Functions of the Skeletal System

- The musculoskeletal system consists of two systems that work together to support the body and allow the animal to move.
- Skeletal system – consists of bones, joints and cartilage
- The bones form a framework that supports and protects an animals body.

Connective Tissues

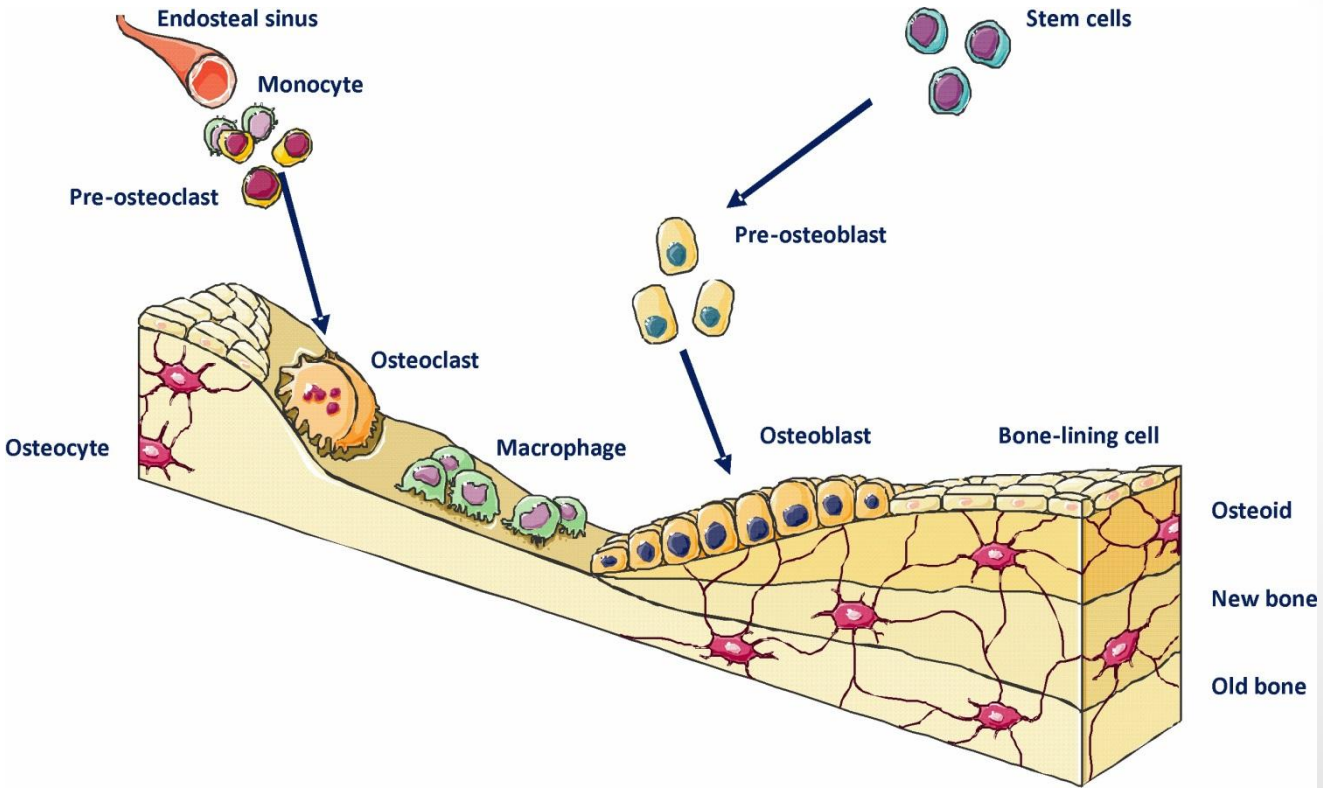
- The skeleton is formed from various types of connective tissue.
- Connective tissue binds together and supports various structures of the body.
- Connective tissue types:-
  - Bone
  - Tendons
  - Ligaments
  - Cartilage

Bone

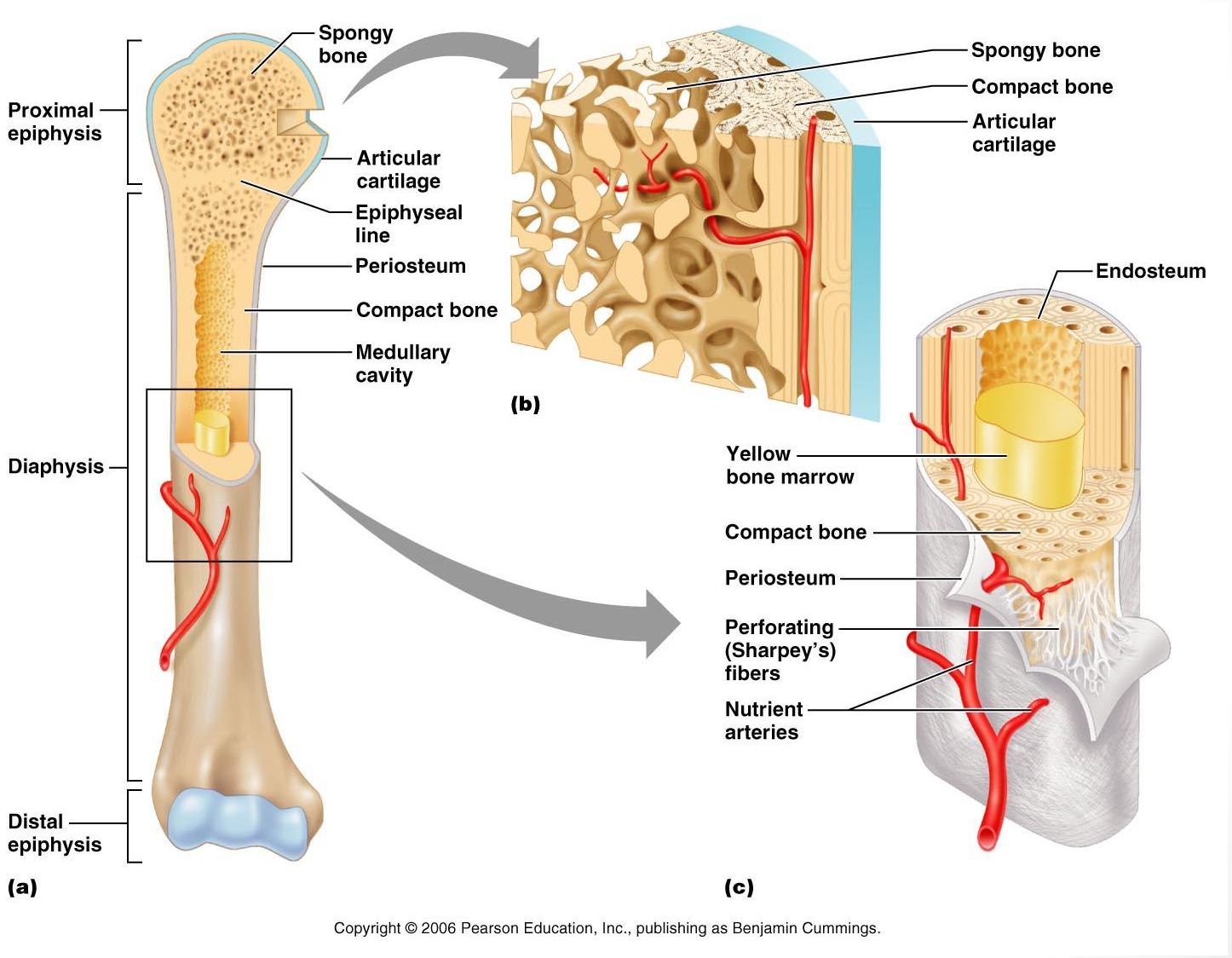
- A form of connective tissue and is one of the hardest tissues of the body.
- Embryonically, the skeleton is made of cartilage and fibrous membranes which harden before birth.
- After birth **ossification** (formation of bone from fibrous tissues) occurs until maturity.
- Normal bone undergoes a continuous process of deposition and breakdown.
- This allows bones to repair and heal themselves.

Bones Growth

- Osteoblasts – formation of new bone
- Osteoclasts – eat away bony tissue from the Medullary cavity

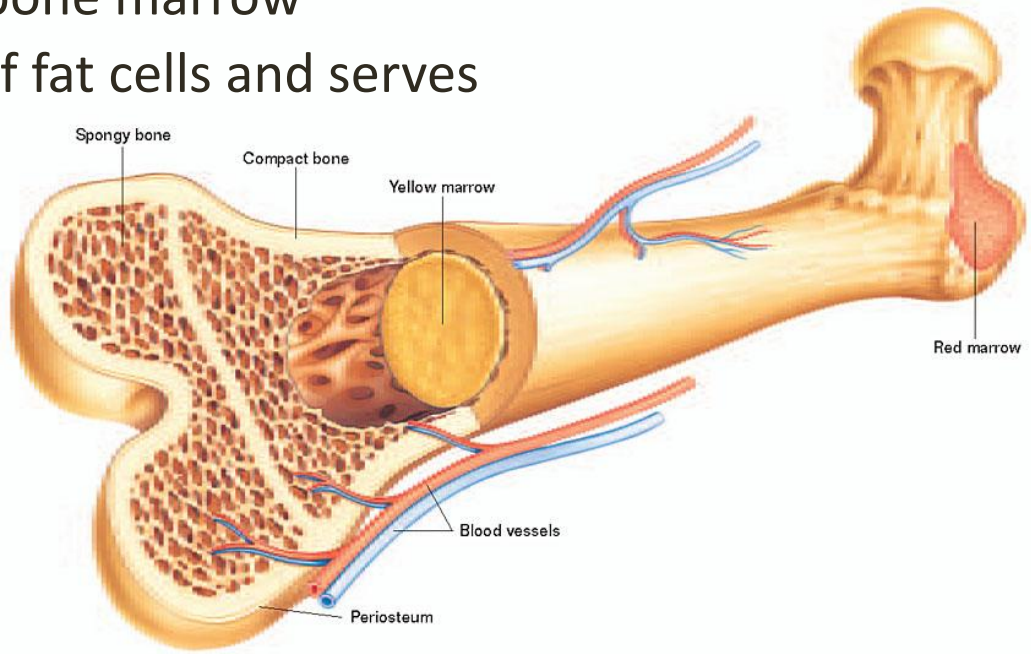


Bone Anatomy



Bone Marrow

- Red Bone Marrow
  - Located in the cancellous bone
  - Hematopoietic (Produces Red, White and Clotting cells)
- Yellow Bone Marrow
  - Located in the medullary cavity
  - Contains Yellow bone marrow
  - Mainly consists of fat cells and serves as a fat storage

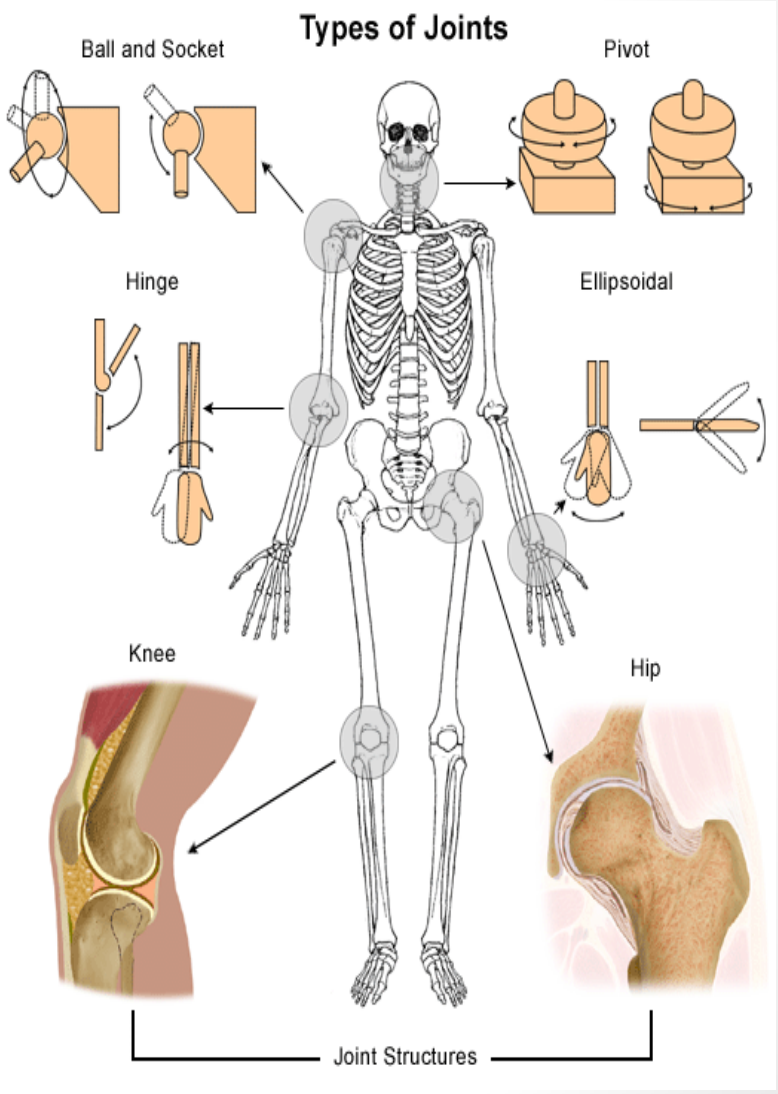


Cartilage

- More elastic than bone
- Useful in the more flexible portions of the skeleton
- **Articular cartilage** covers the joint surfaces of bone
- **Meniscus** a curved fibrous cartilage found in some joints such as the **canine stifle** where crush forces are applied to the joint
- Combining form **chondr/o**

Joints (or articulations)

- These are connections between bones
- Articulate means to join in a way that allows motion between the parts
- Combining form **arthr/o**

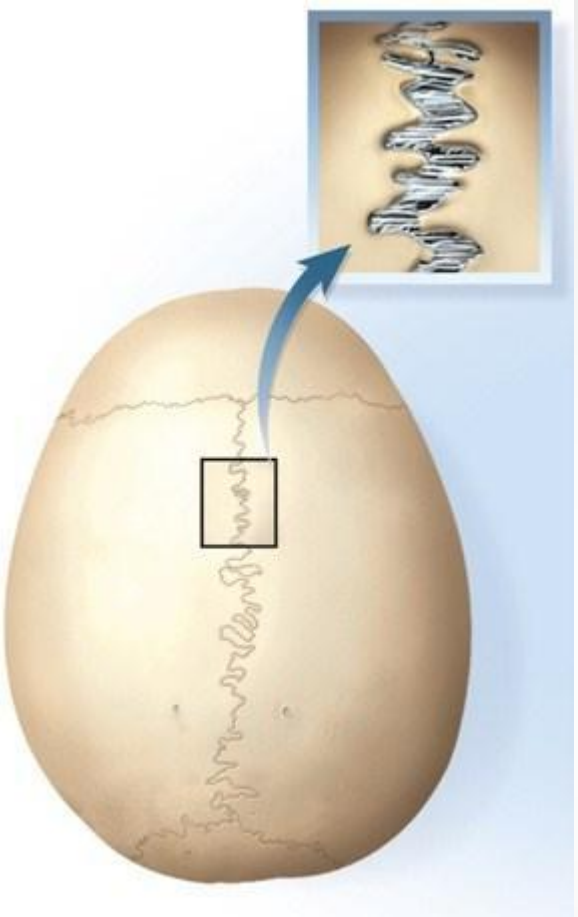


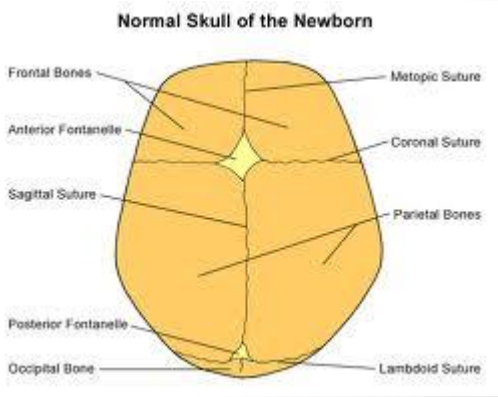
Joint Classification

- Joints are classified according to their degree of movement.
  - **Synarthoses** – allow no movement
  - **Amphiarthroses** – allow slight movement
  - **Diarthoses** – allow free movement

Synarthrosis Joints

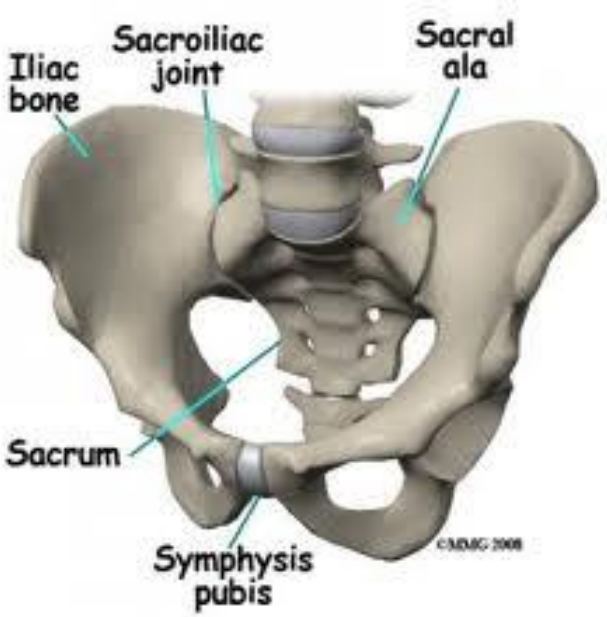
- These joints are immovable and are usually united with fibrous connective tissue. An example is a suture.
- A **suture** is a jagged line where bones join to form an immovable joint.
- These joints are typically found in the skull.
- A **fontanelle** is a soft spot remaining at the junction of sutures that normally closes after birth.

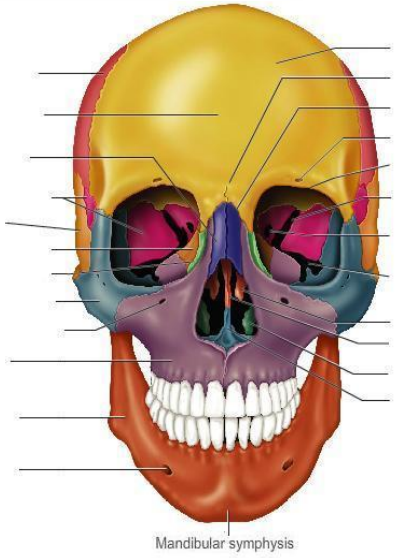




Amphiarthrosis Joints

- Semi-movable joints.
- An example of Amphiarthrosis is a **symphysis**.
- This type of joint is where two bones join and are held firmly together so they function as one bone.
- Another term for this type of joint is a **cartilaginous joint**.
- Examples of this type of joint are the **mandibular and pubic symphysis**

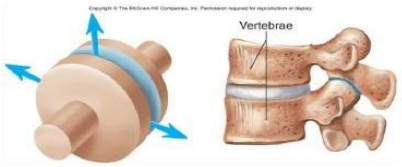


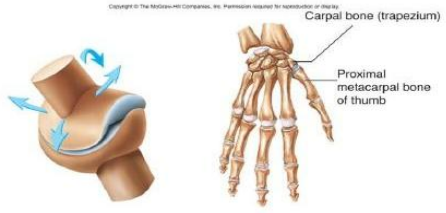


Diarthosis Joints

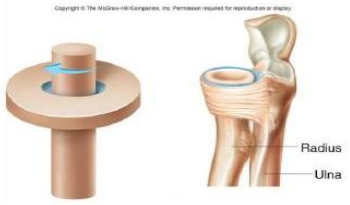
- Freely movable joints.
- An example of these joint is the **synovial joints.**
- These are also know as **ball and socket** joints.
- **Ball and Socket** joints allow a wide range of movement in many directions such as the **hip and shoulder joints.**

Plane / Gliding
Saddle

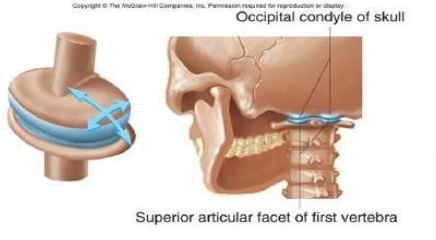




Hinge
Pivot

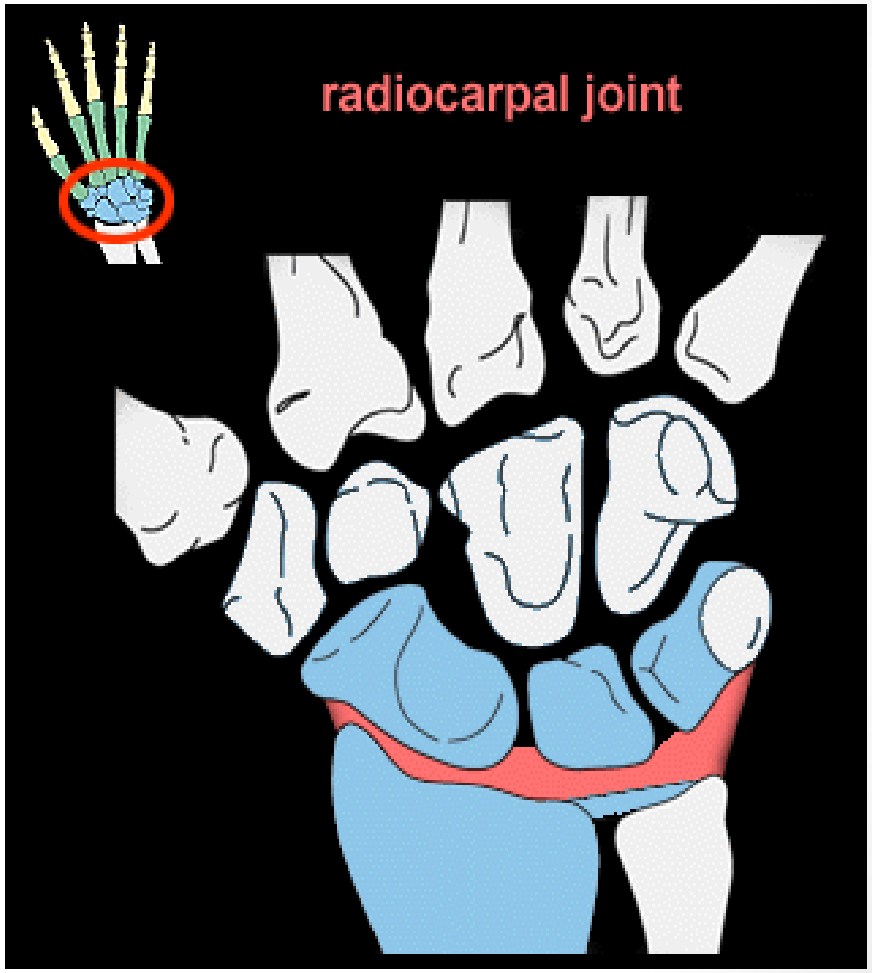


Ball-and-Socket
Ellipsoid



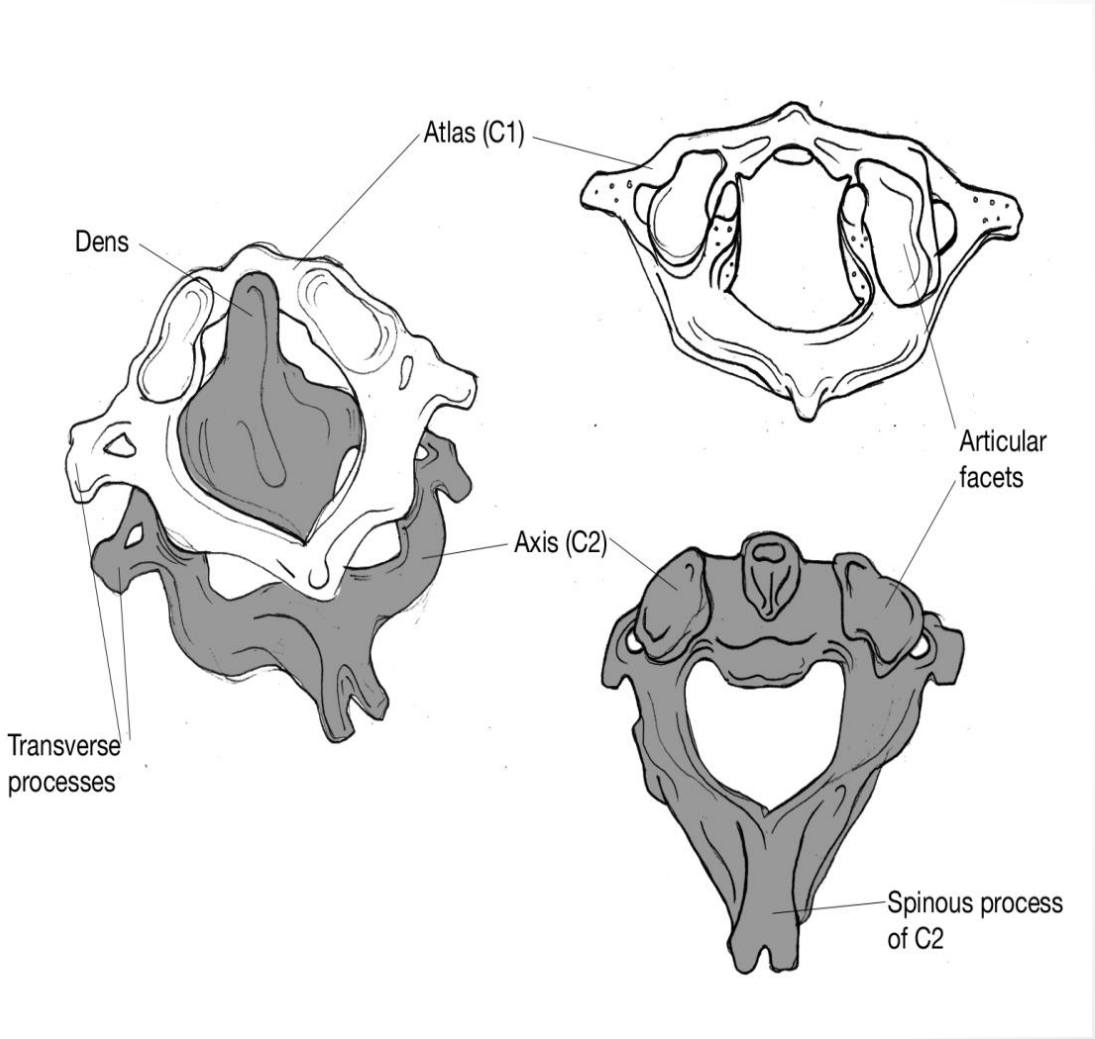
Diarthrosis Joints (cont.)

- **Arthrodial or Condyloid joints.** These type of joints have oval projections that fit into a socket.
- Example of this type of joint are found in carpal joints where the radius meets the carpus.



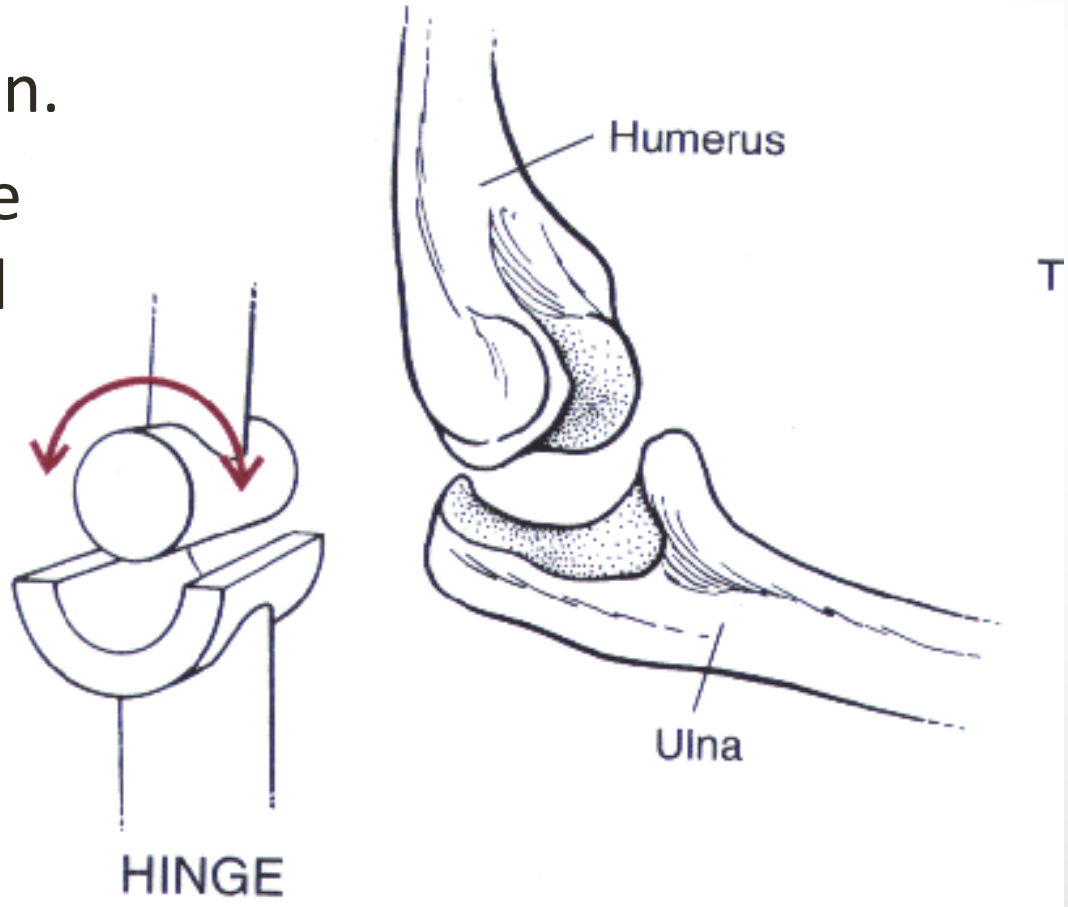
Diarthrosis Joints (cont.)

- **Trochoid Joints** (pivot joints) .
- An example of this type joint is found between the atlas and axis



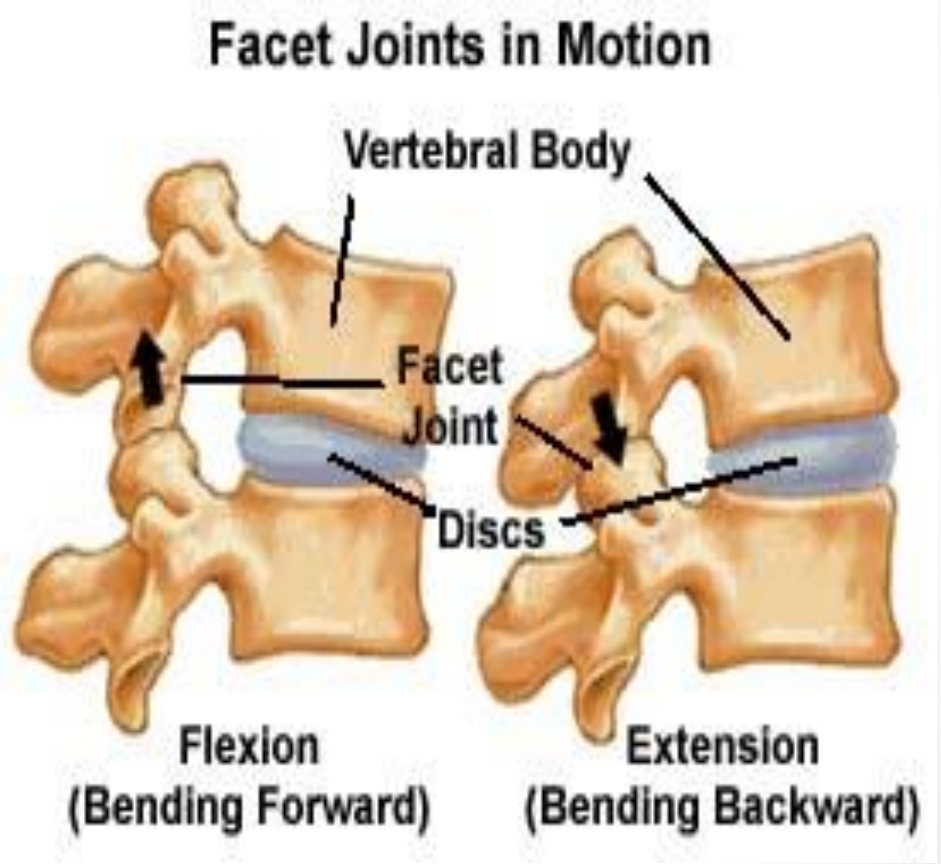
Diarthrosis Joints (cont.)

- **Hinge joints** allow motion in one plane or direction.
- Examples are the **canine stifle** and **elbow joints**.



Diarthrosis Joints (cont.)

- **Gliding joints** move or glide over each other.
- Examples of this joint type are found in **radioulnar** joint and between **adjoining vertebrae**.

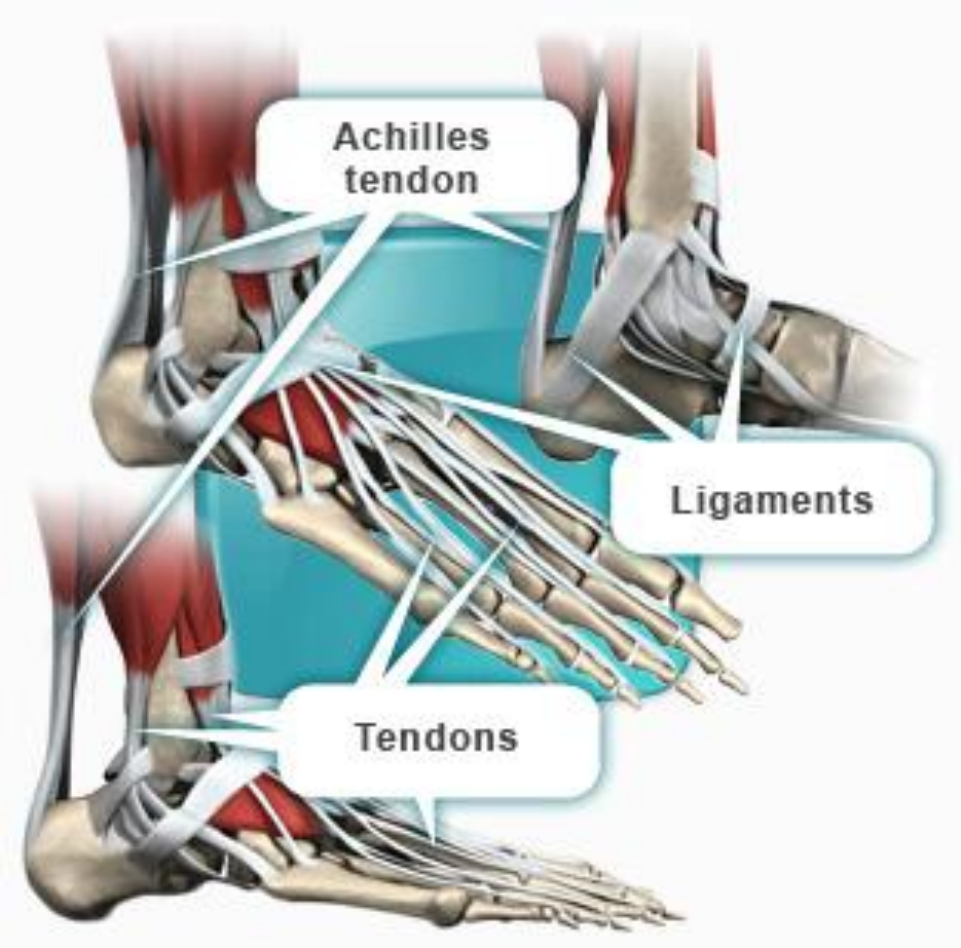


Diarthrosis Joints (cont.)

- **Saddle Joint** this joint is only found in primates (**Opposable thumb**)
- It is found in the **carpometacarpal joint.**
- It allows primates to flex, extend, adduct, abduct and circumduct the thumb.

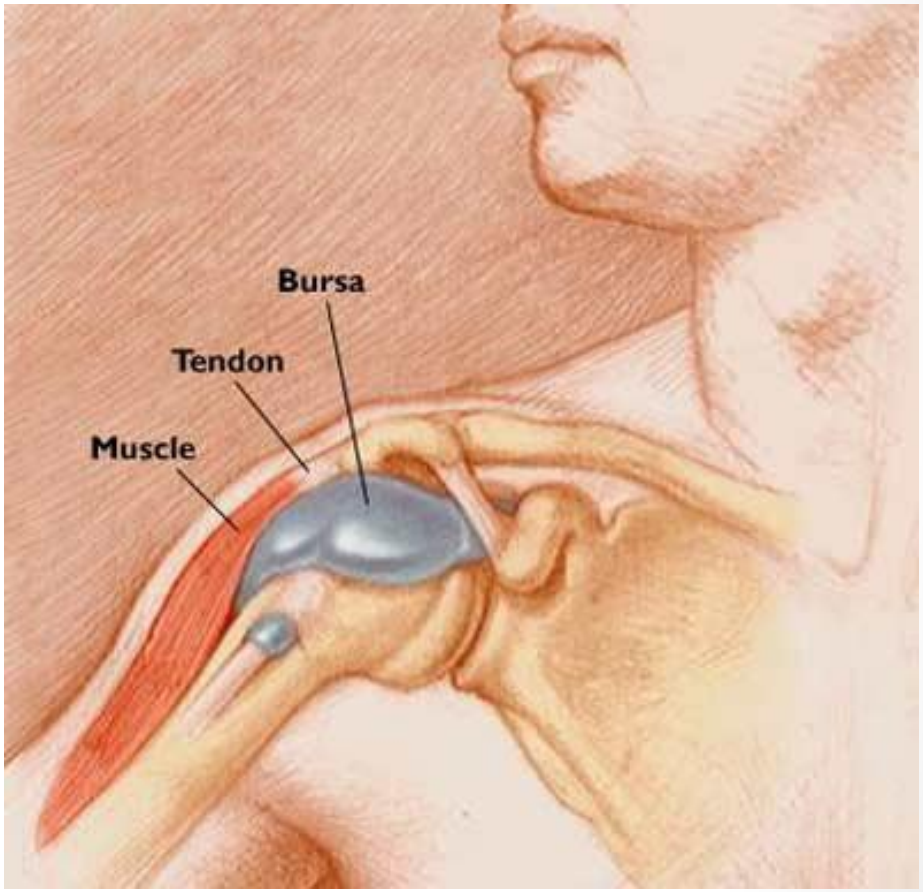
Ligaments & Tendons

- A ligament is a band of fibrous connective tissue that connects one bone to another.
- The combing form is **Ligament/o.**
- **Tendons** connect muscle to bone.
- Combining form is **ten/o, tend/o and tendin/o.**



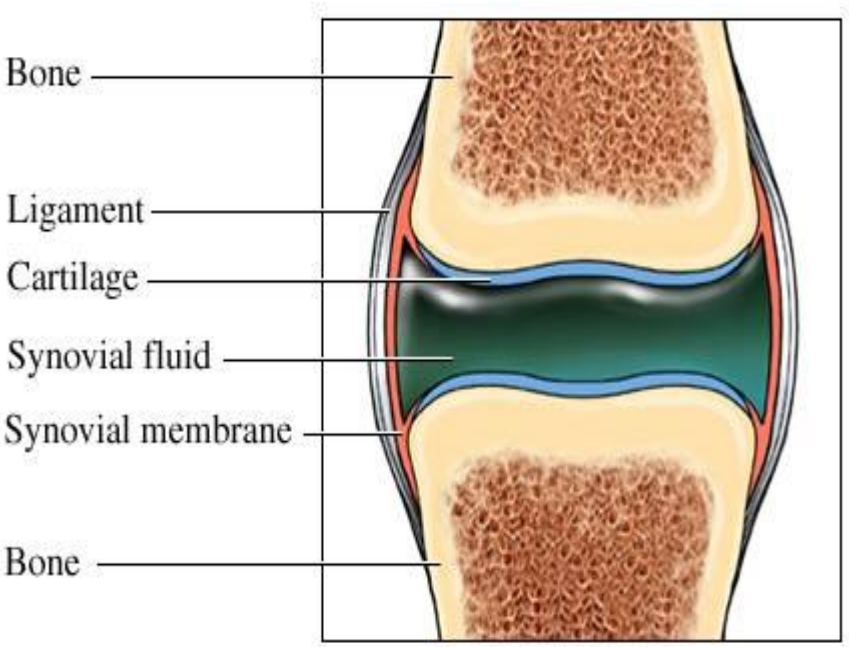
Bursa

- A **Bursa** is a fibrous sac that acts as a cushion to ease movement in areas of friction.
- Example in the shoulder joint where a tendon passes over the bone.
- The combing form is **burs/o** or plural is **bursae.**



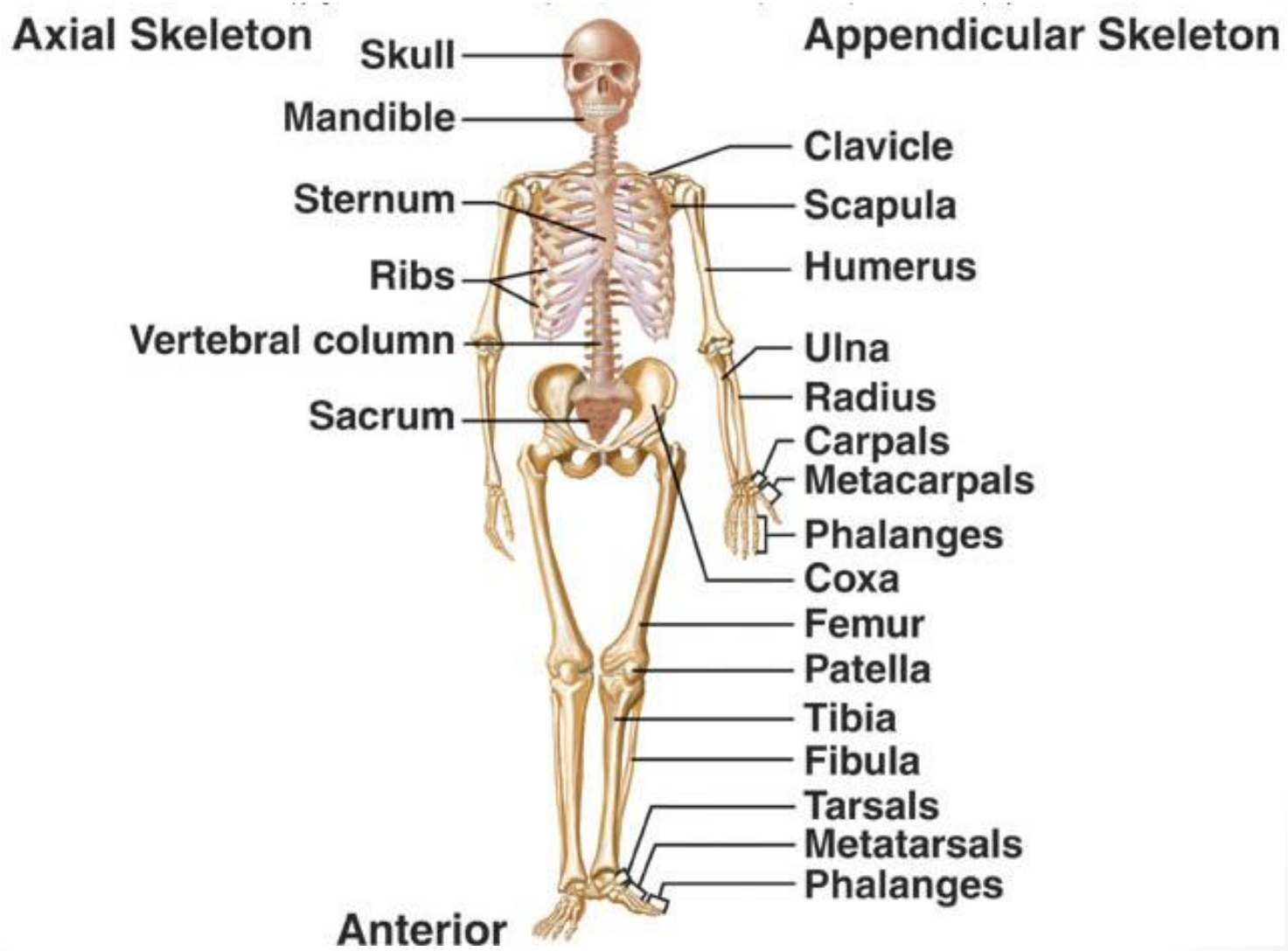
Synovial Membrane and Fluid

- **Bursae and Synovial joints** have an inner membrane called the **synovial membrane.**
- This membrane secretes the **synovial fluid**, which acts as a lubricant to enable smooth movement of the joint.
- The combining form is **Synovi/o.**



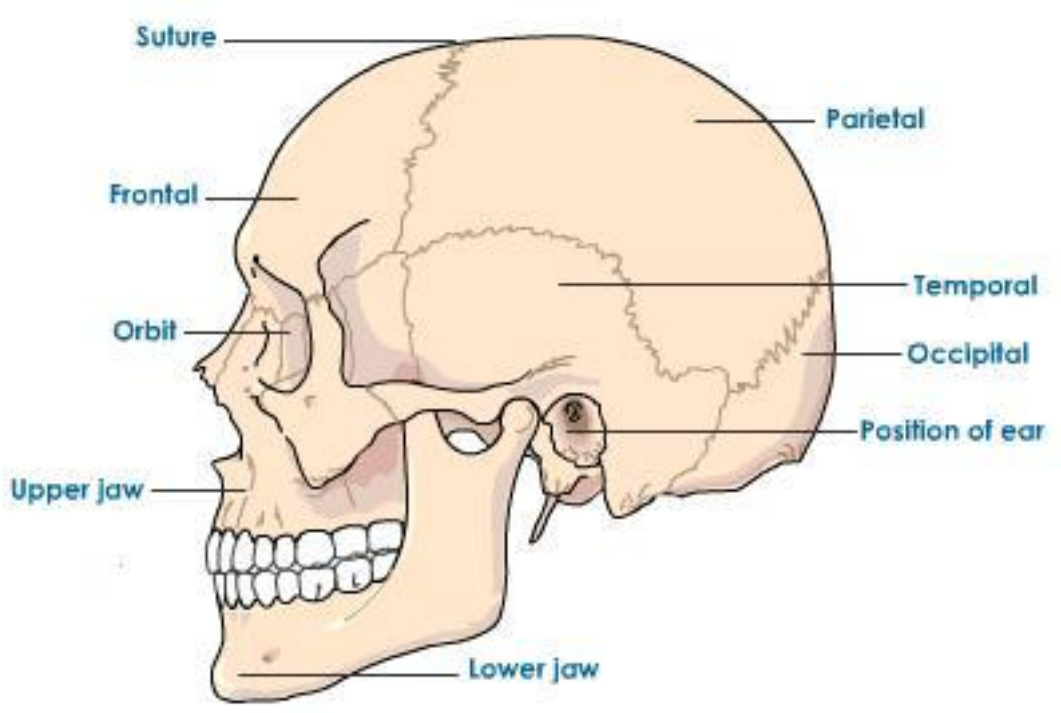
Cross section of a healthy joint

Skeleton


Axial Skeleton
Appendicular Skeleton
Skull
Mandible
Sternum
Ribs
Vertebral column
Sacrum
Clavicle
Scapula
Humerus
Ulna
Radius
Carpals
Metacarpals
Phalanges
Coxa
Femur
Patella
Tibia
Fibula
Tarsals
Metatarsals
Phalanges
Anterior

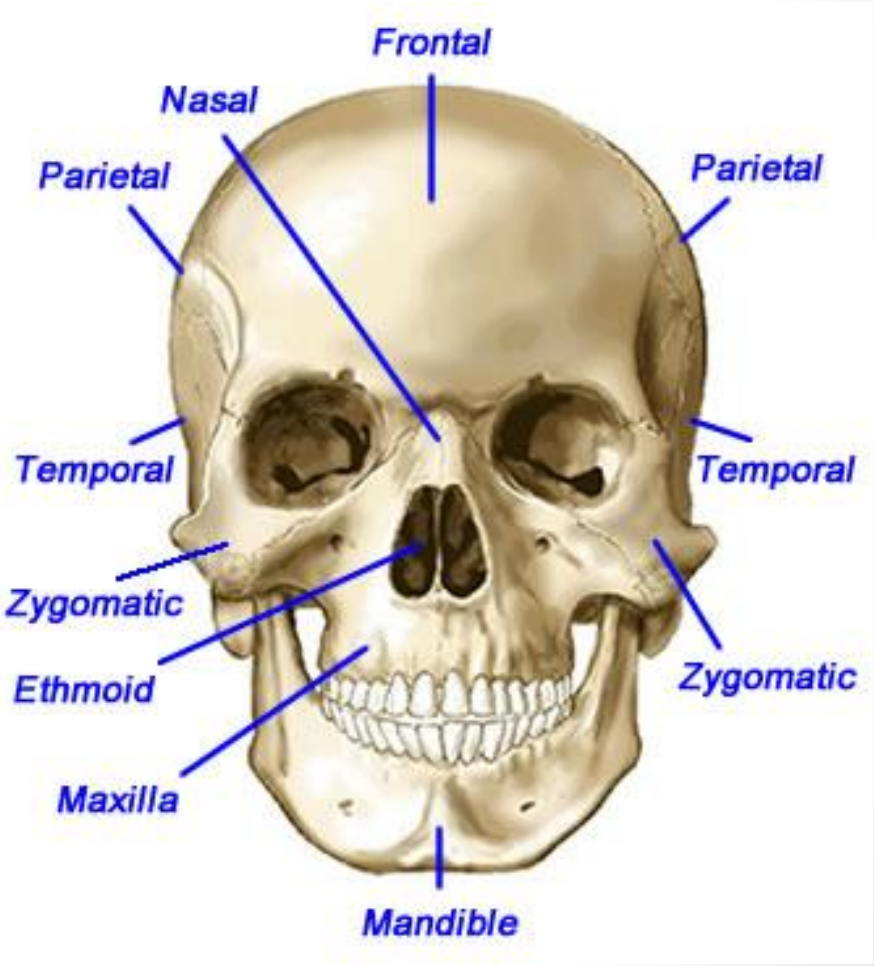
Axial Skeleton

- Lets start at the top.
- **Skull**
- **Cranium** is the part of the skull that encloses the brain and consists of the following bones.
  - **Frontal**
  - **Parietal**
  - **Occipital**
  - **Temporal**



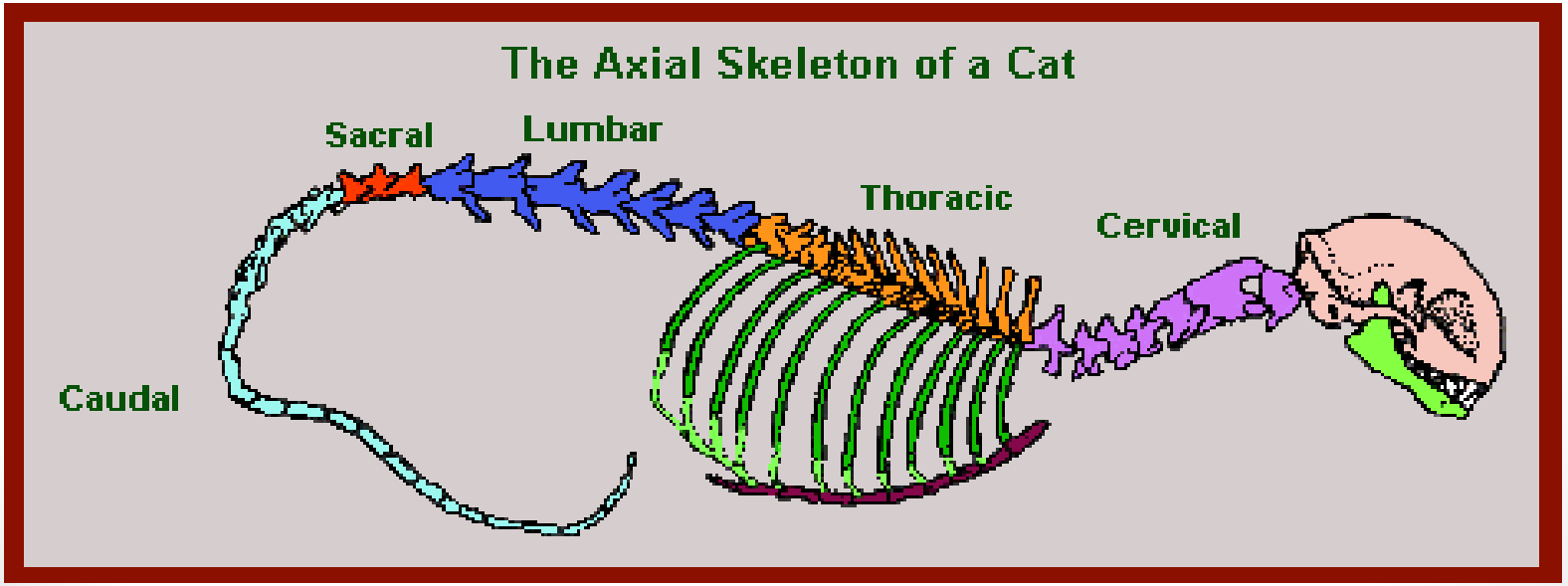
Axial Skeleton (cont.)

- Skull (face)
- Consists of some of the following bones:
  - Zygomatic
  - Maxilla
  - Mandible
  - Palatine
  - Nasal
  - Incisive



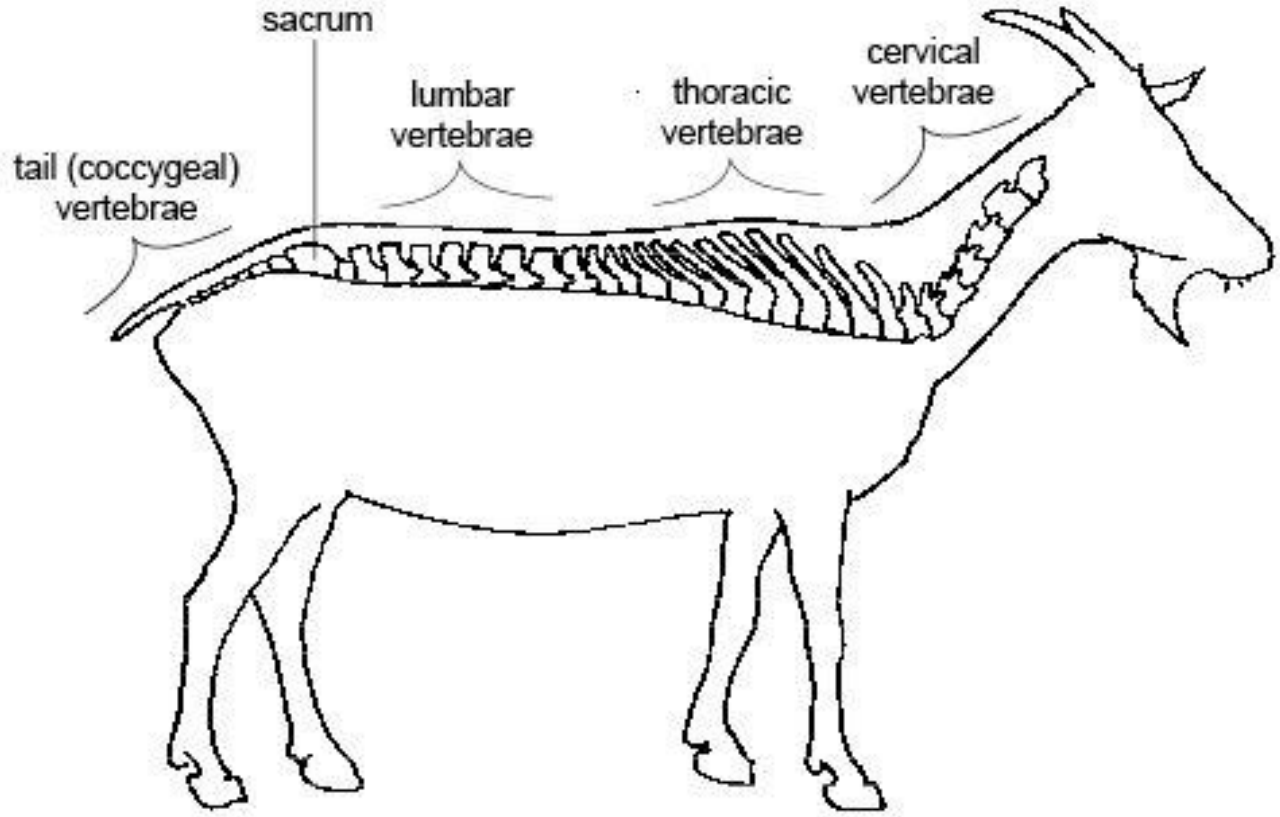
Back

- Vertebral Column (Spinal column or backbone).
- Supports the head and body.
- Protects the spinal cord.



Spinal Column

- The spinal column is made up of different groups of vertebrae.

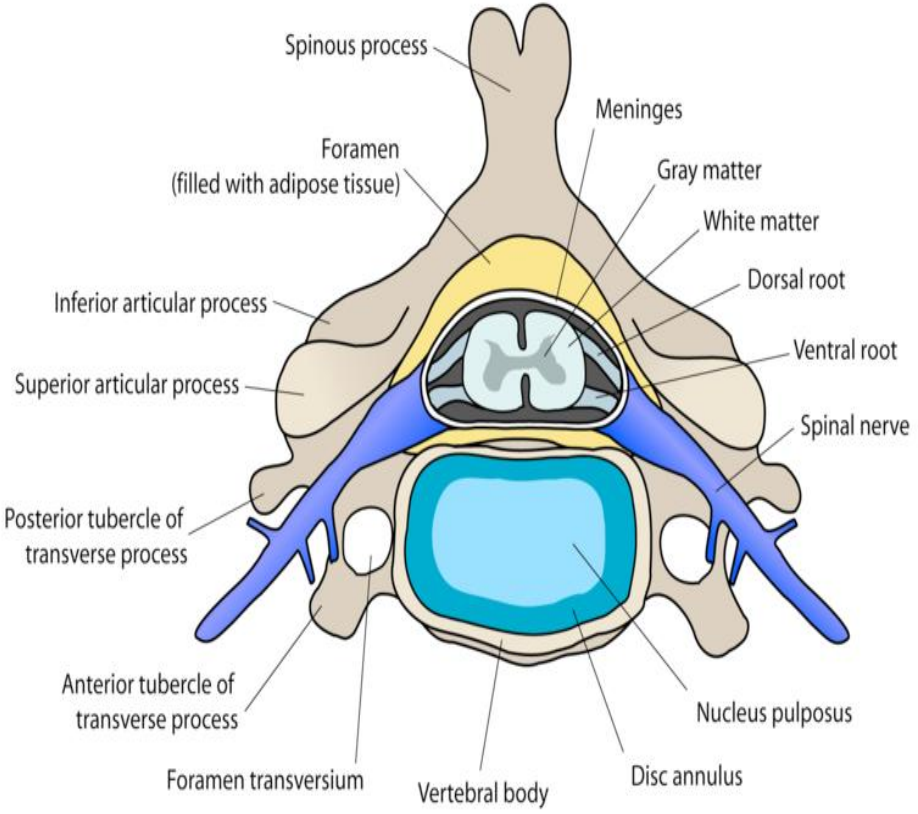


Vertebral Formulas

Species	C	T	L	S	CY
Cats & Dogs	7	13	7	3	6-23
Equine	7	18	6 (5 in some Arabians)	5	15-21
Bovine	7	13	6	5	18-20
Porcine	7	15	6	4	20-23
Sheep & Goats	7	13	6-7	4	16-18

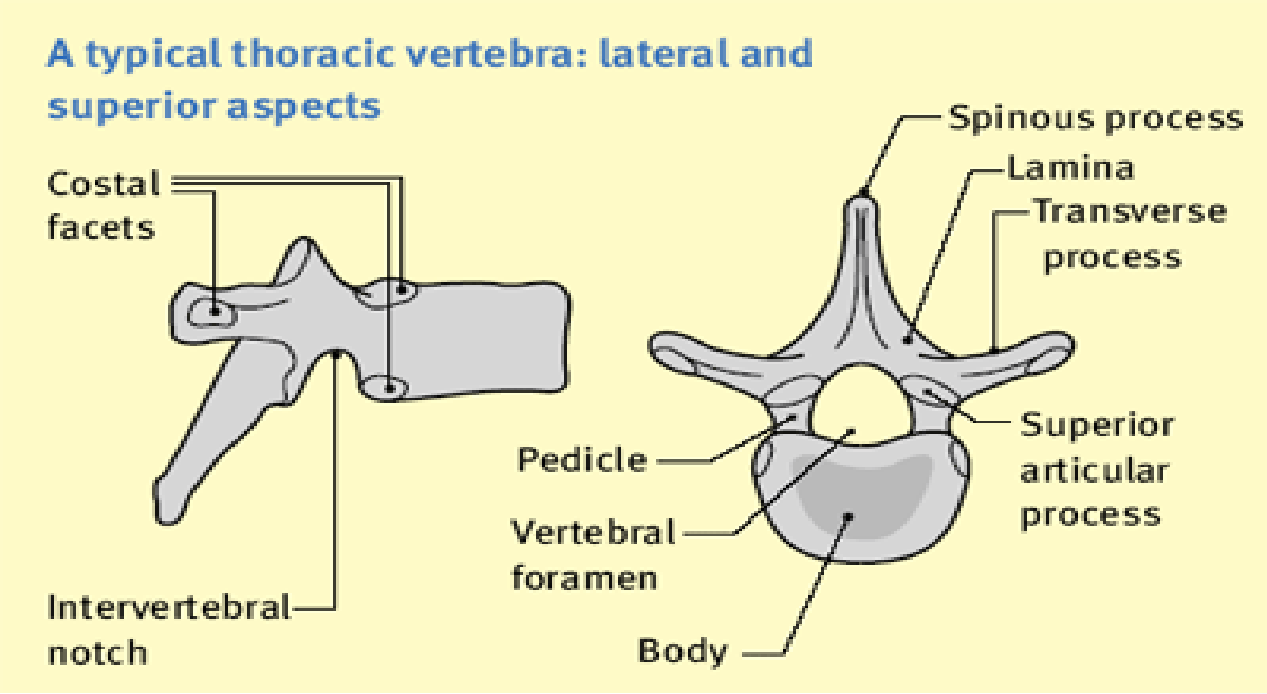
Cervical Vertebrae

- The first two cervical vertebrae are known as the **atlas** and the **axis** respectively, and are modified to allow movement of the head. The last (C7) cervical vertebra has a taller spinous process than those preceding it, and articulates with the first pair of ribs.



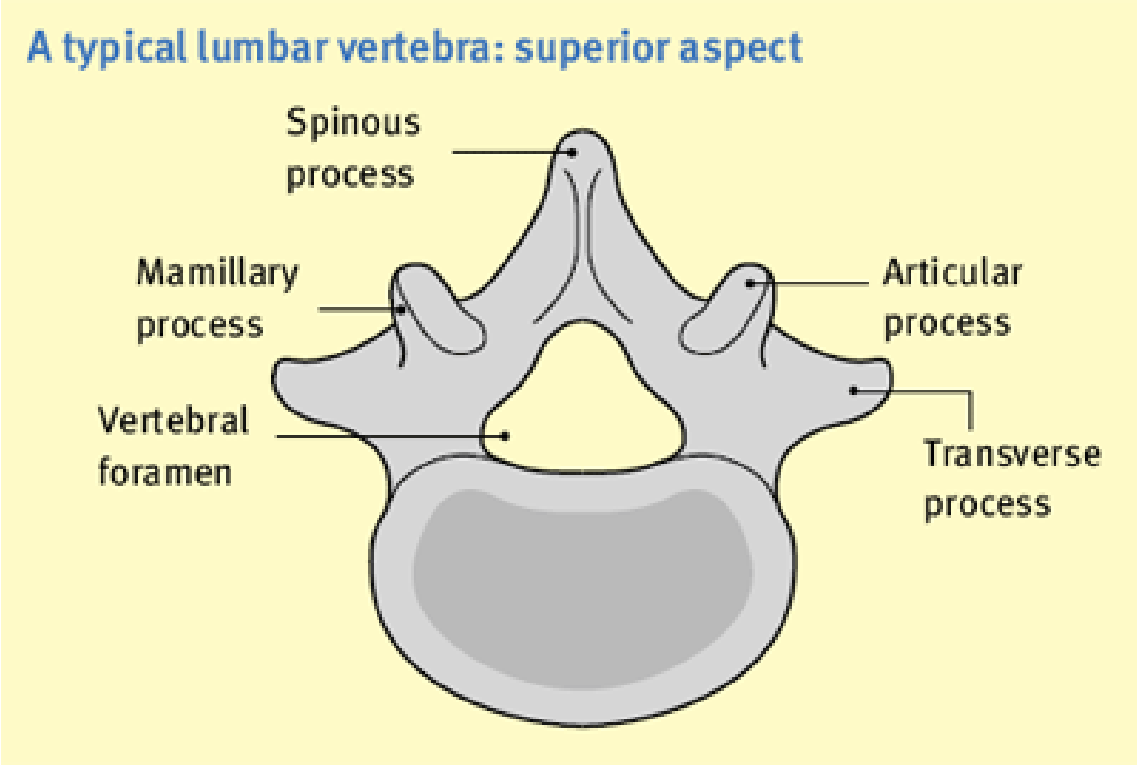
Thoracic Vertebrae

- Thoracic vertebrae articulate with the ribs. They are distinguished by short bodies with flattened extremities, costal facets, short transverse processes and prominent spinous processes.



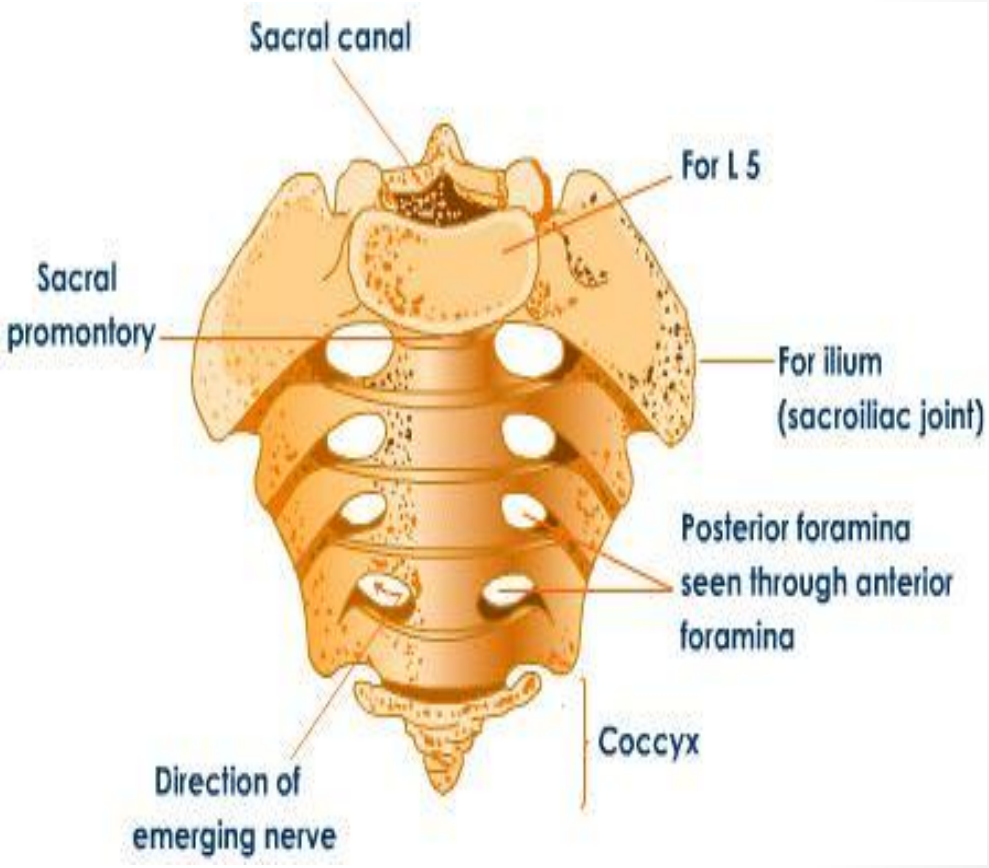
Lumbar Vertebrae

- The lumbar vertebrae are longer and more uniform in shape than the thoracic vertebrae. They are also shorter in height, with long, flattened transverse processes that project laterally.



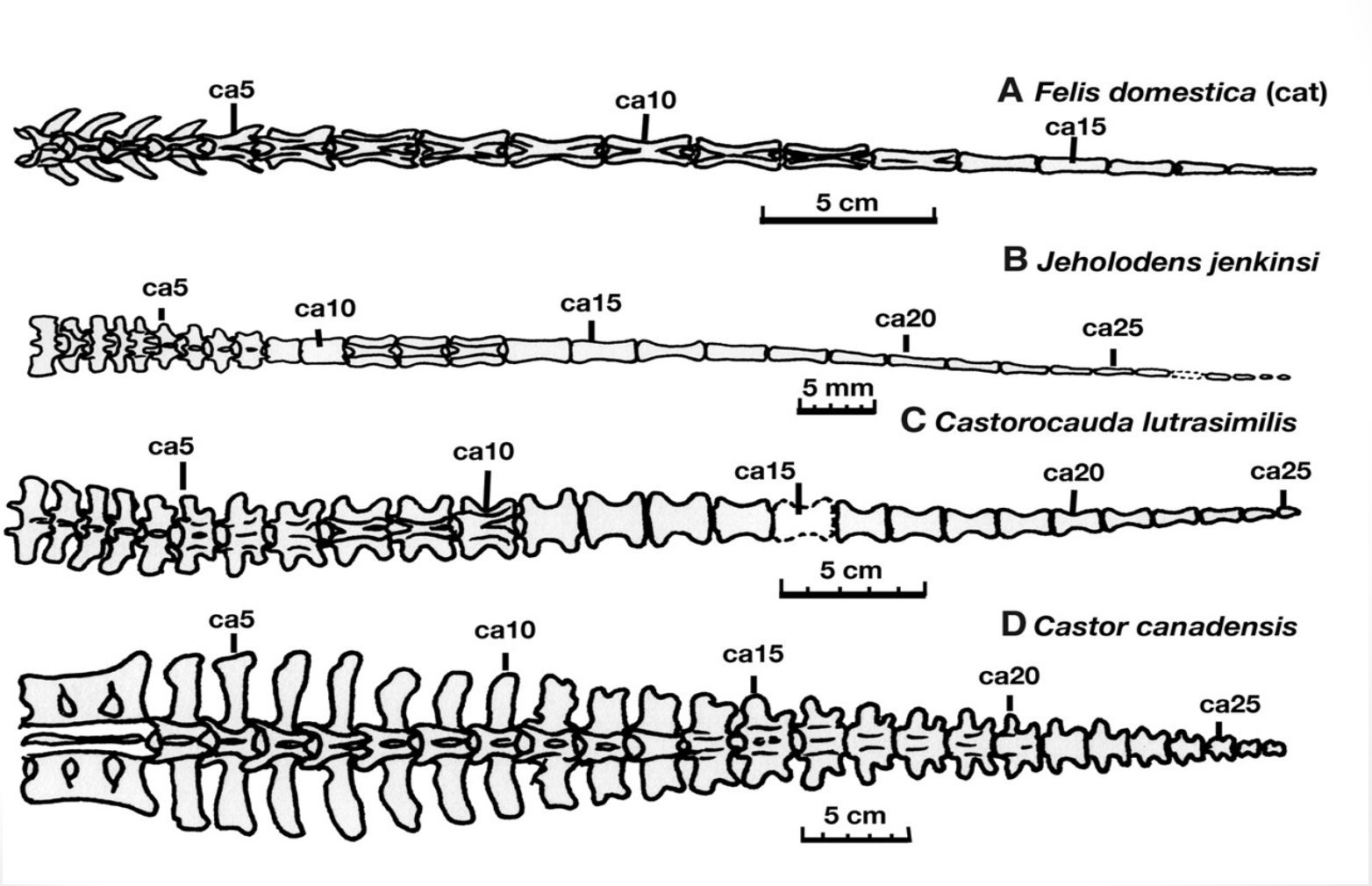
Sacral Vertebrae

- The **sacrum** is a single bone formed by the fusion of several vertebrae that articulates with the pelvic girdle. It allows the thrust of the hind limbs to be transmitted to the trunk. The sacrum narrows caudally and is curved to present a concave surface to the pelvic cavity.

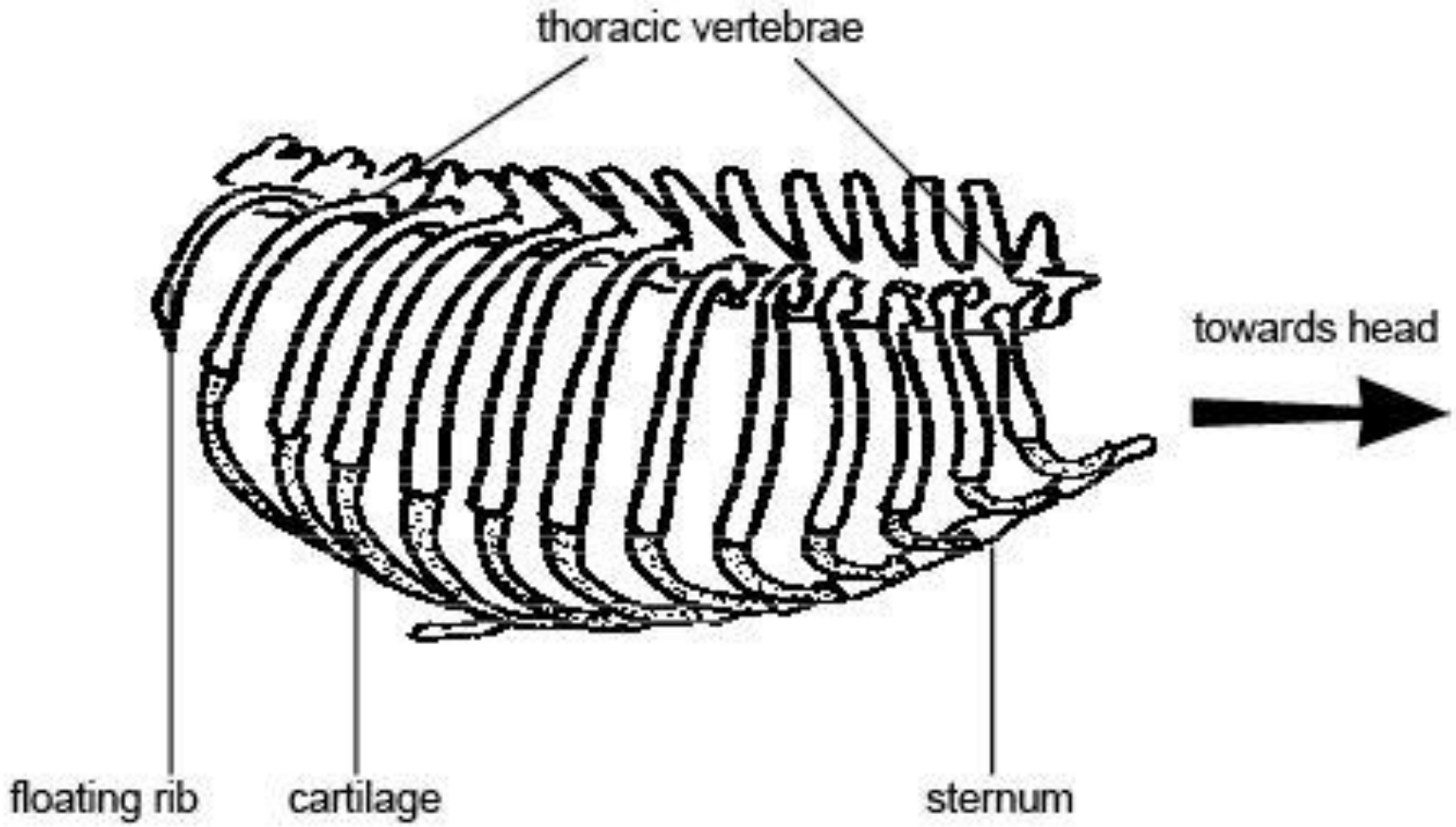


Coccygeal (Caudal) or Tail Vertebrae

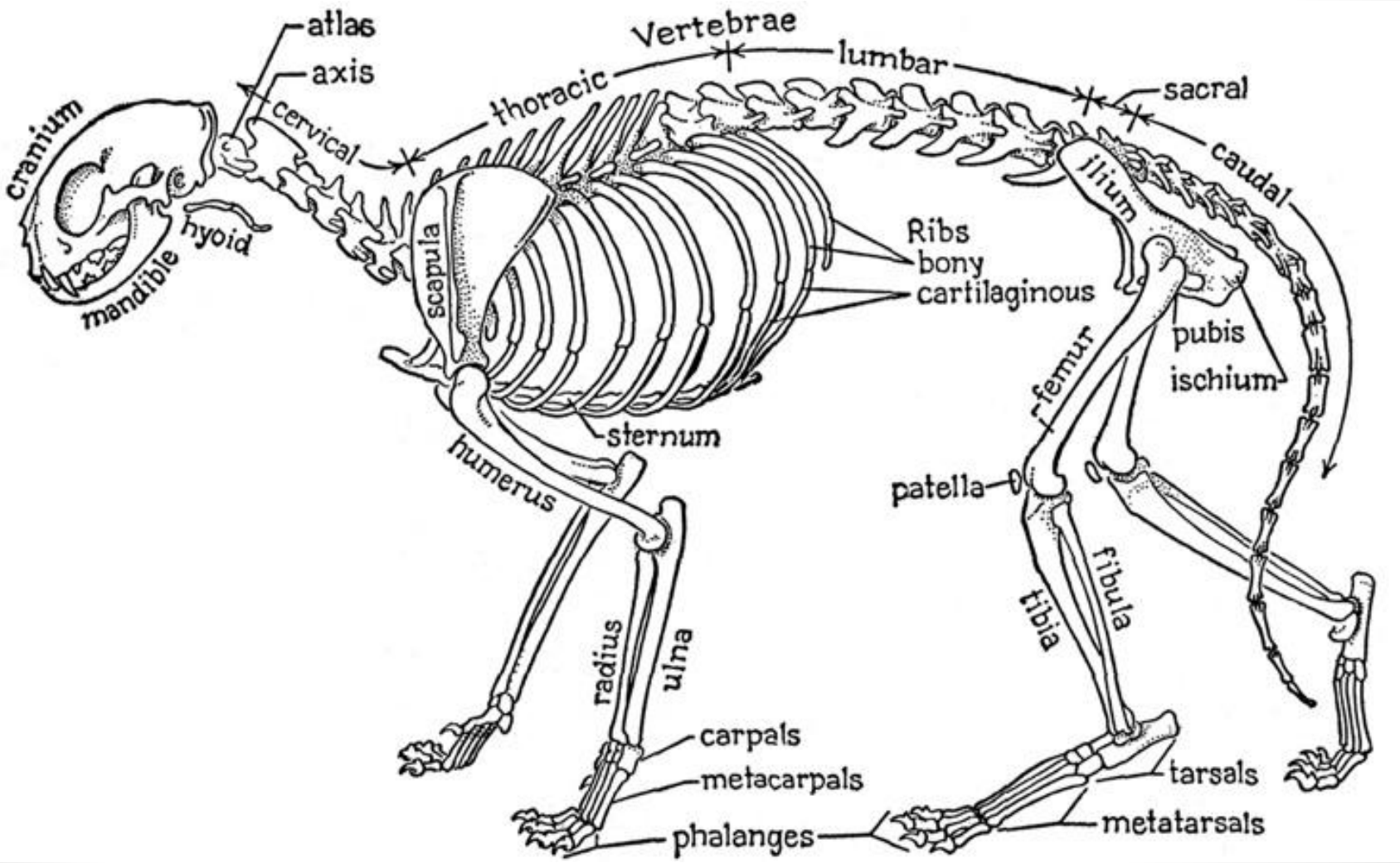
- The number varies greatly even within species. There is a progressive simplification of their form.



Ribs & Sternum

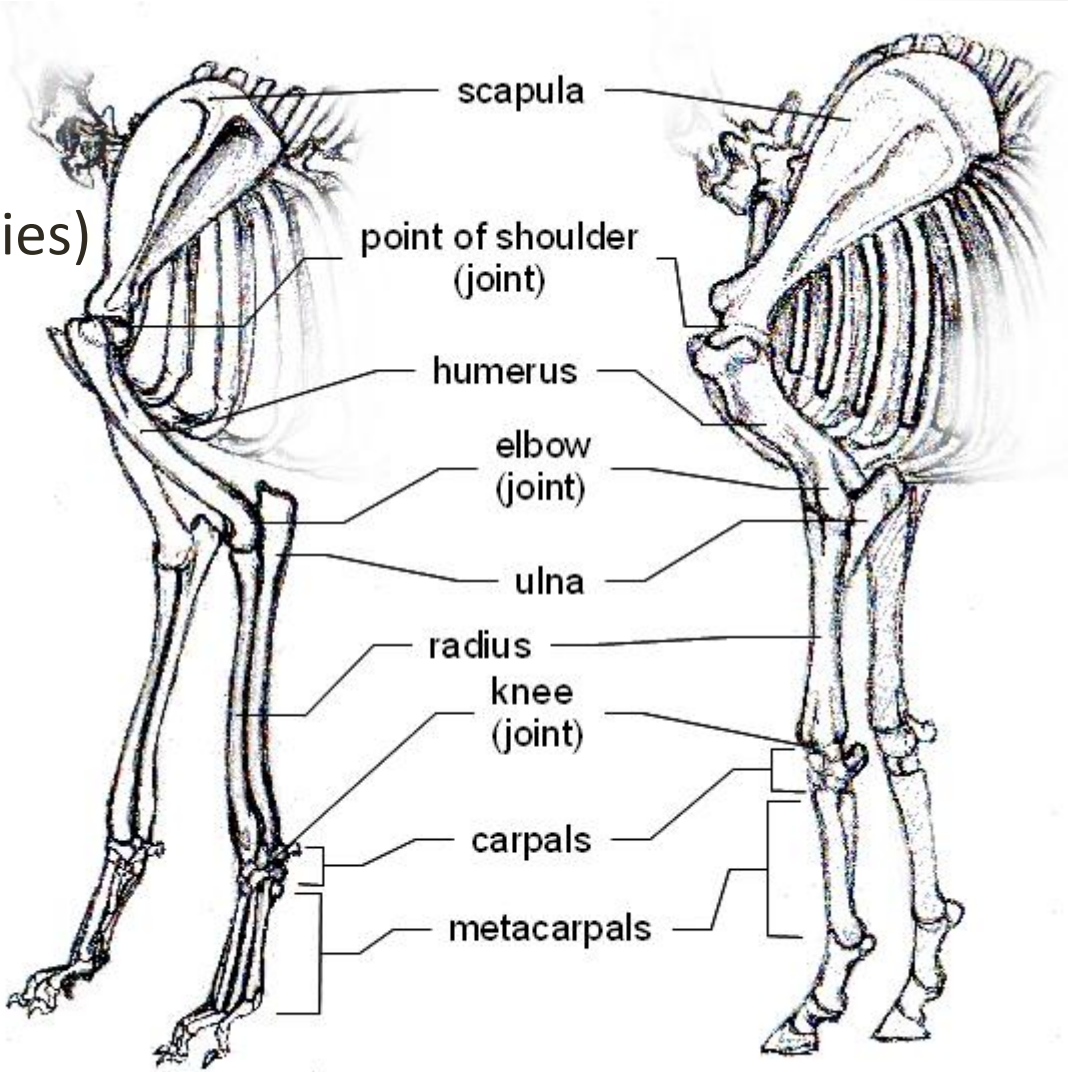


Appendicular Skeleton



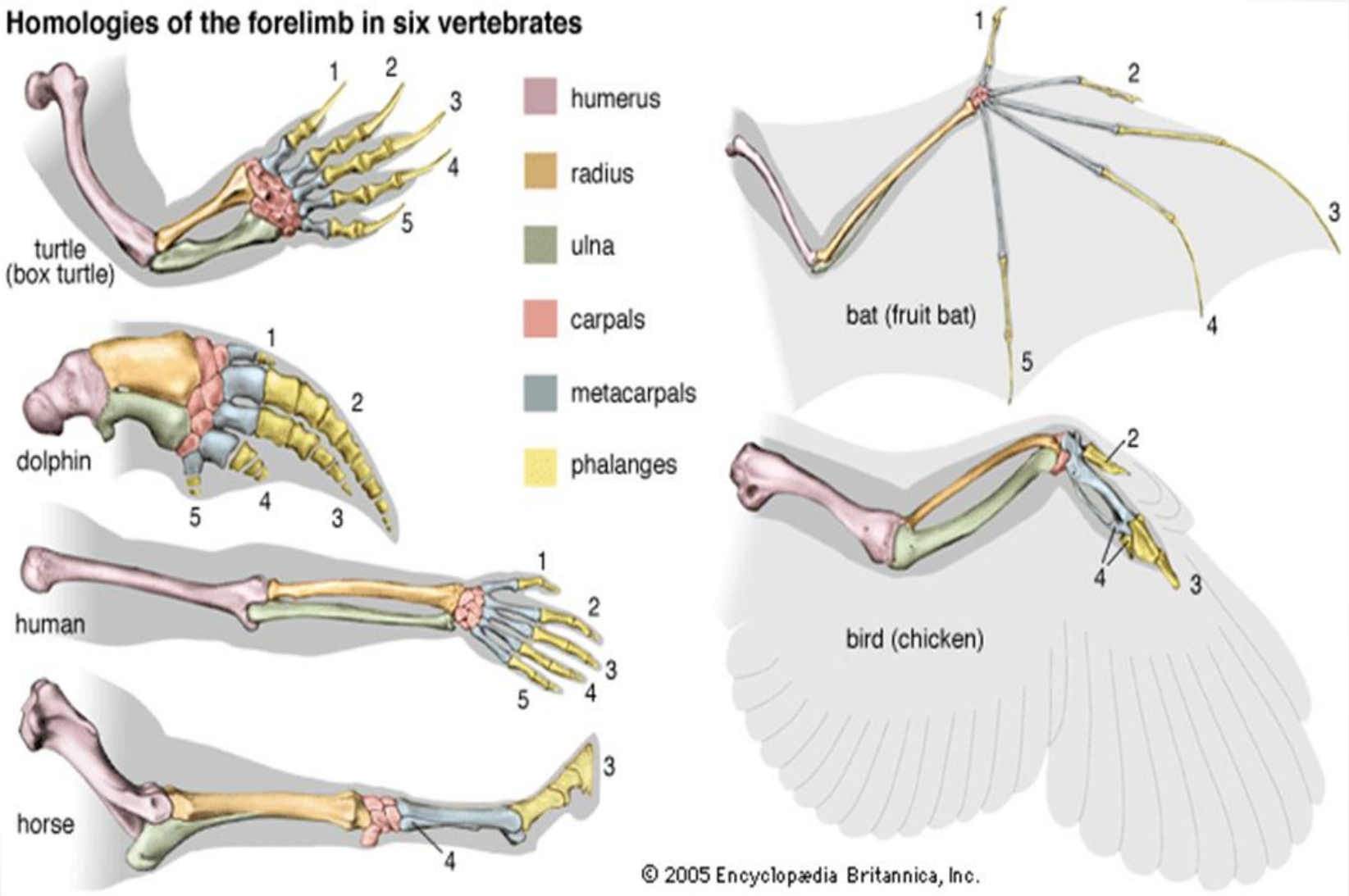
Bones of the Front Limb

- From Proximal to Distal:
  - Scapular
  - Clavical (some species)
  - Humerus
  - Radius
  - Ulna
  - Carpus
  - Metacarpals
  - Phalanges



Dog and Horse Fore Limbs (after Ellenberger)

Homologies


Homologies of the forelimb in six vertebrates
humerus
radius
ulna
carpals
metacarpals
phalanges
turtle (box turtle)
dolphin
human
horse
bat (fruit bat)
bird (chicken)
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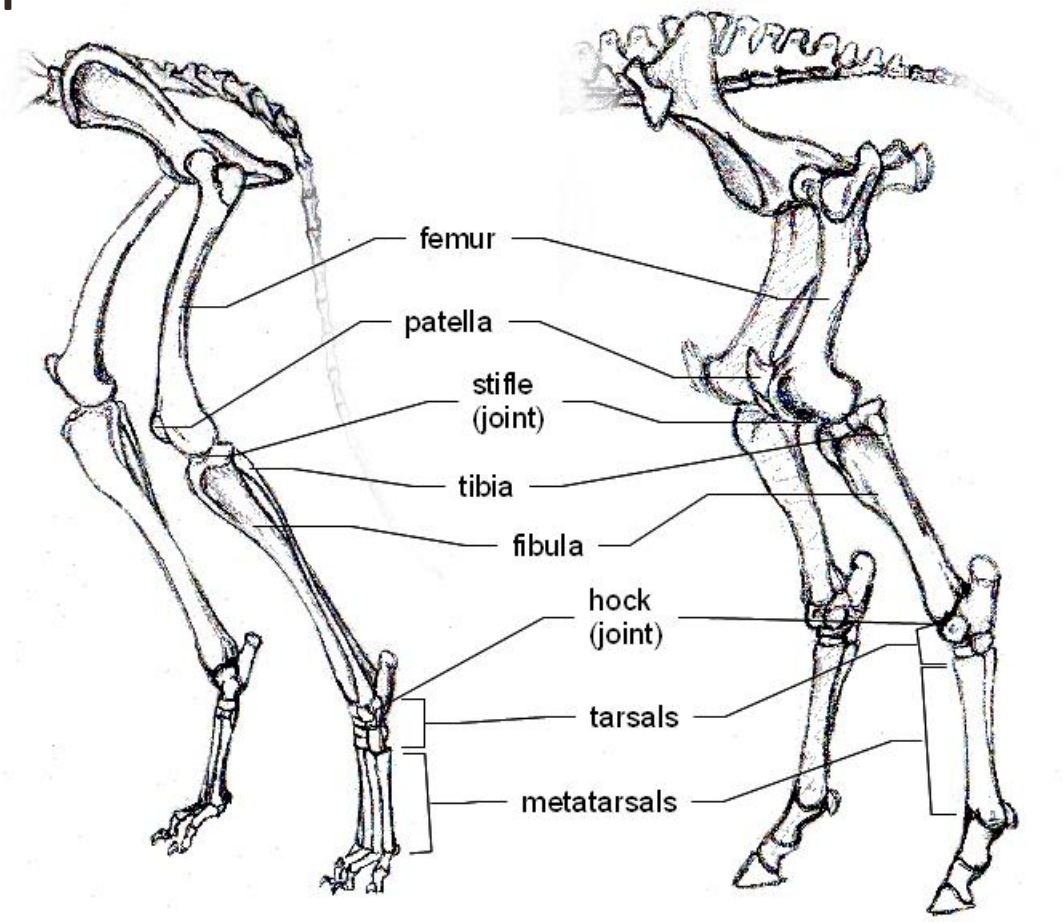
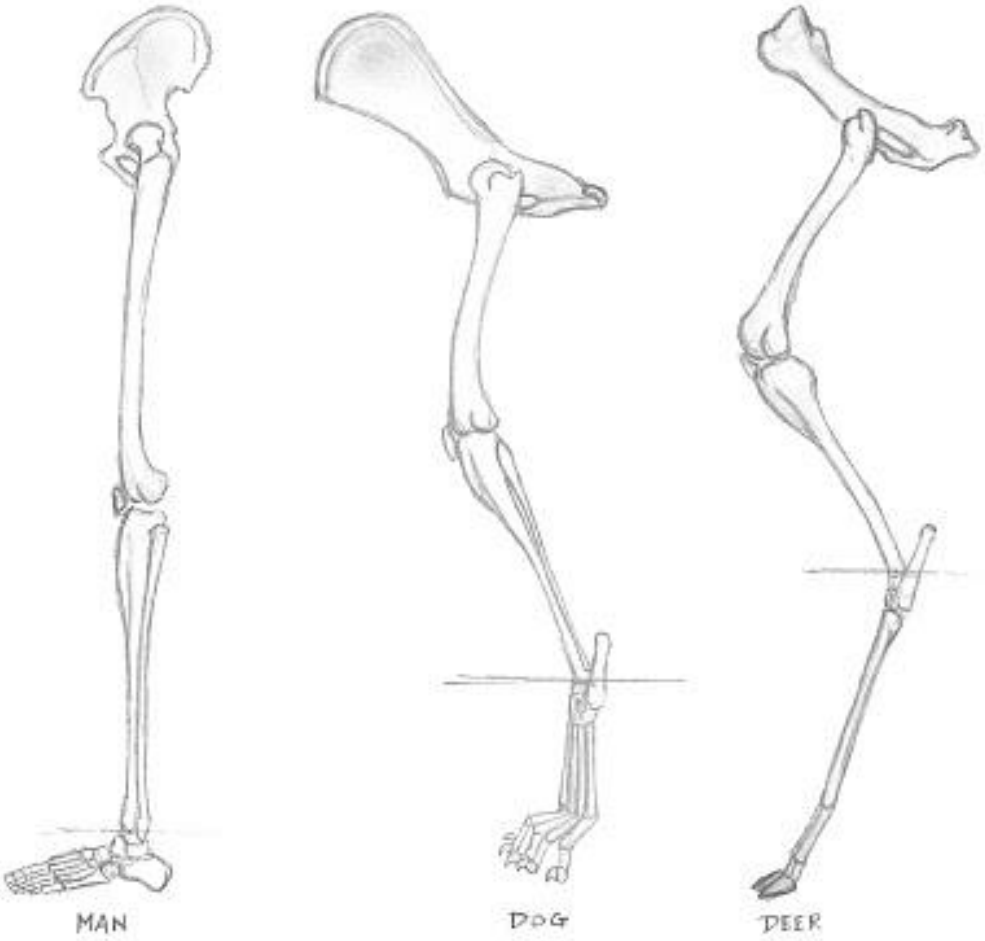
Bones of the Rear Limb

- Proximal to Distal
  - Pelvis
  - Femur
  - Tibia
  - Fibular
  - Tarsals
  - Metatarsals
  - Phalanges



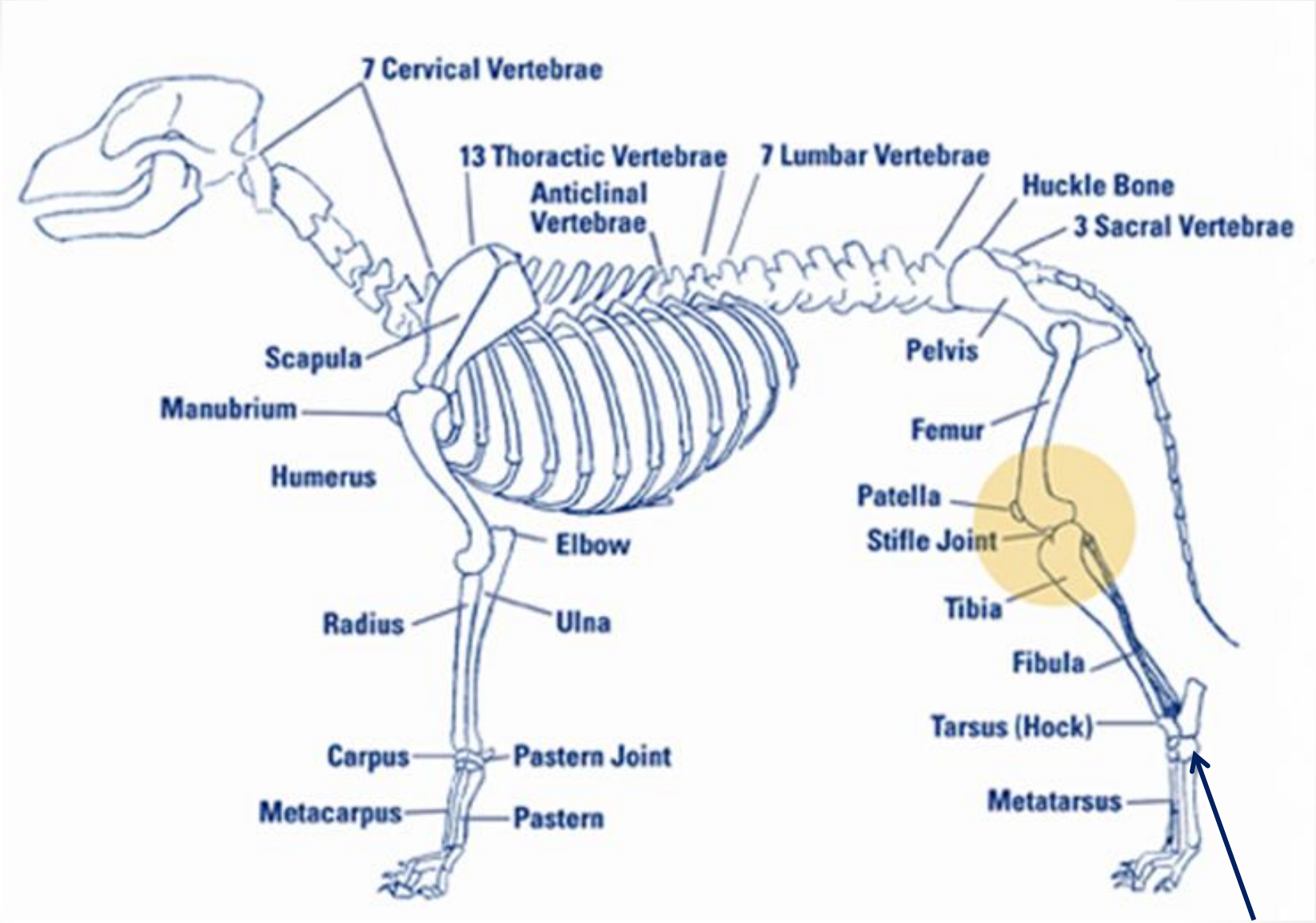
Dog and Horse Hind Limbs (after Ellenberger)

Homologies

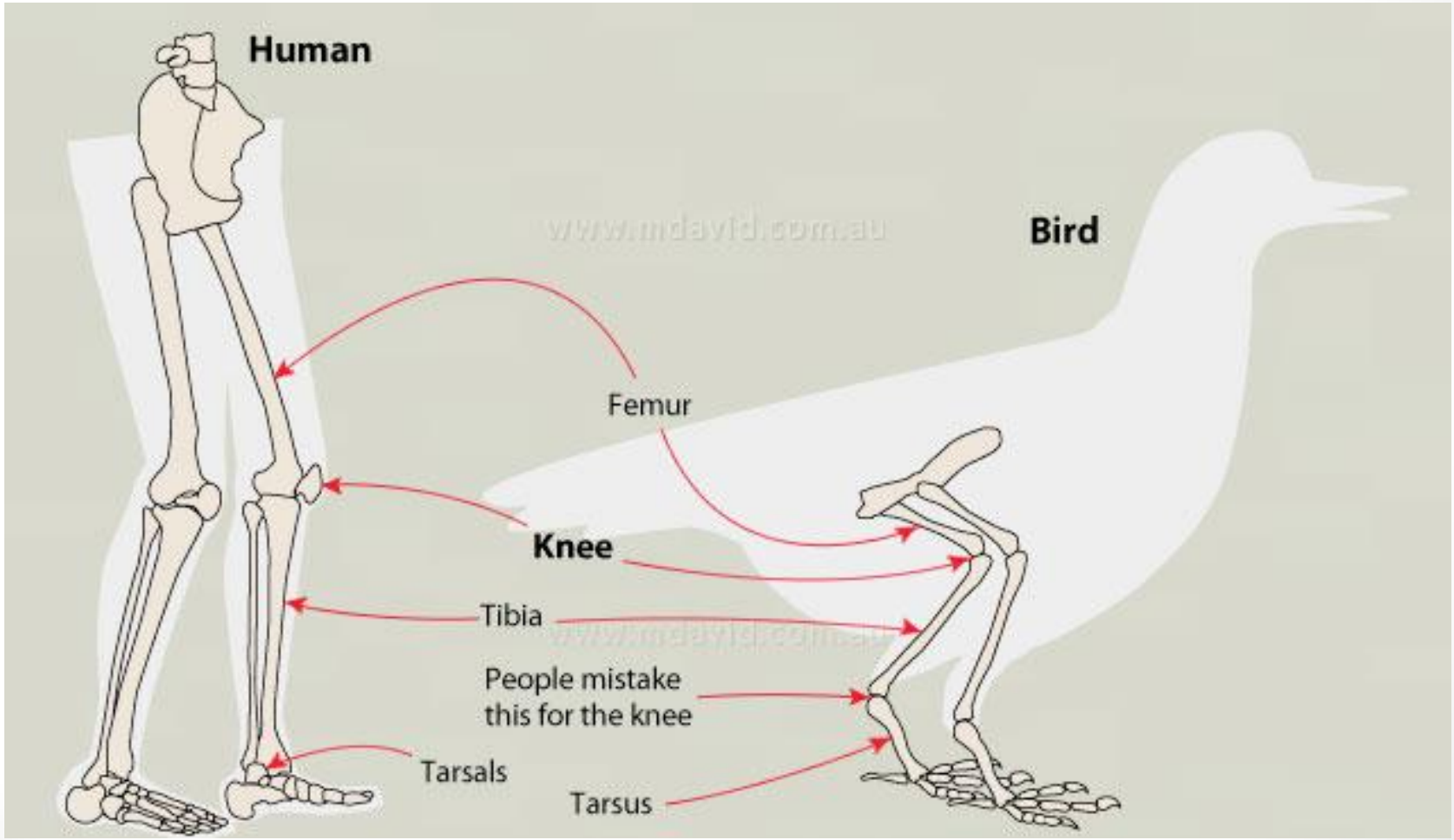


When is knee not a knee

- The term knee can be a confusing term in veterinary medicine.
- Lay people may use the term knee to refer the stifle joint of dogs and cats.
- However, in veterinary medicine the knee in large animals is used to describe the carple joint.


7 Cervical Vertebrae
13 Thoractic Vertebrae
Anticlinal Vertebrae
7 Lumbar Vertebrae
Huckle Bone
3 Sacral Vertebrae
Scapula
Manubrium
Humerus
Pelvis
Femur
Patella
Stifle Joint
Tibia
Fibula
Tarsus (Hock)
Metatarsus
Elbow
Radius
Ulna
Carpus
Pastern Joint
Metacarpus
Pastern
Knee joint

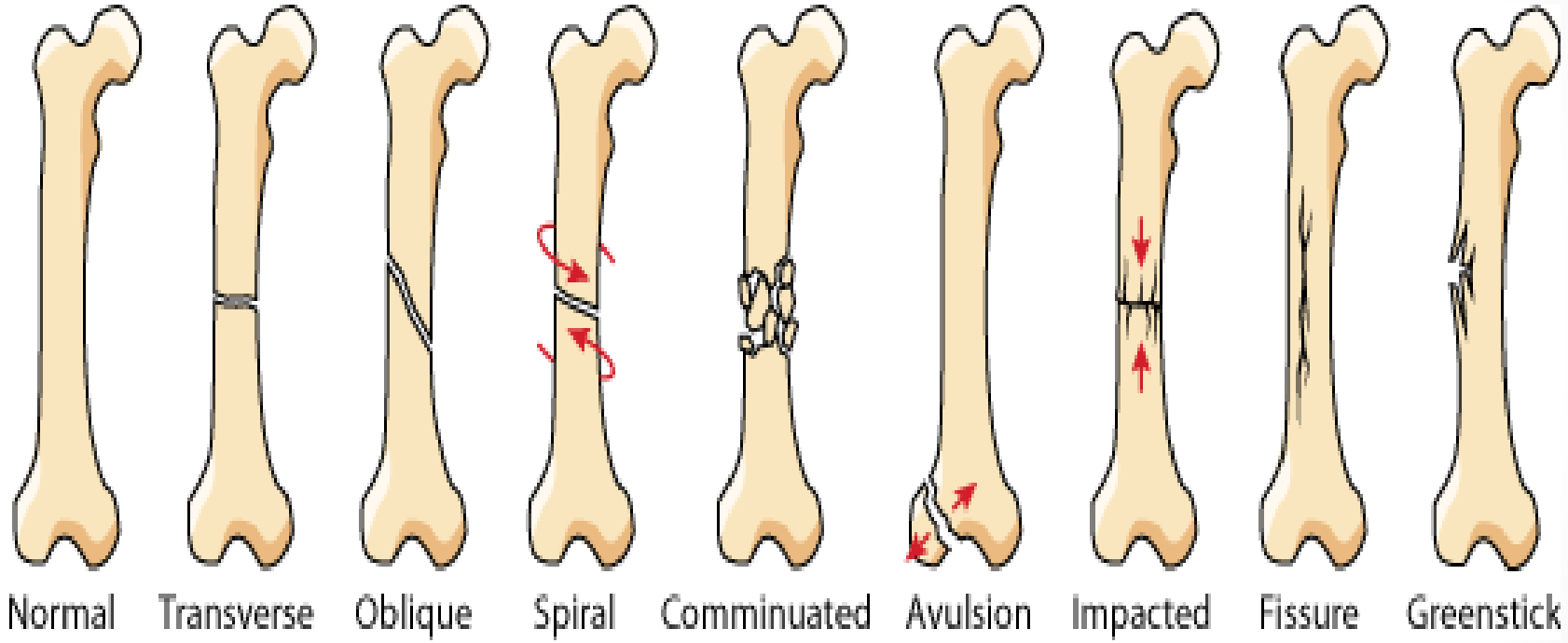
Birds Knee Joint



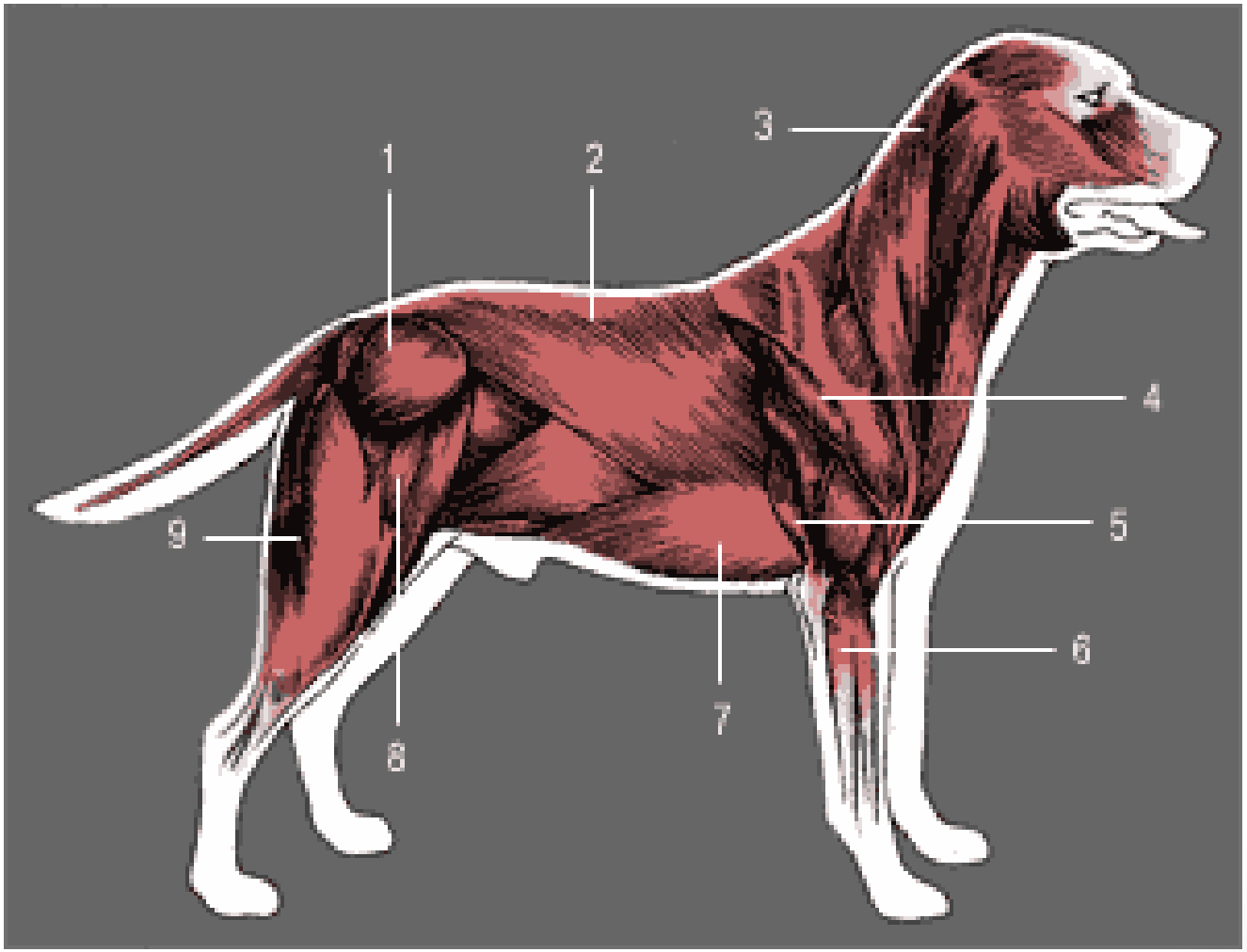
Fracture Terminology

- **Fracture** = broken bone
- **Crepitation** = cracking sensation that is felt and heard when broken bones move together.
- **Manipulation (reduction)** = realignment of fractured or dislocated bones
- **Immobilisation** = keeping the bone in a fixed position usually using a bandage or cast
- **Callus** = bulging deposit around and area of fractured bone that may eventually become bone
- **Closed fracture (simple facture)** = fracture with no open wound
- **Open fracture (compound fracture)** = open wound associated with the fracture

Fracture Types



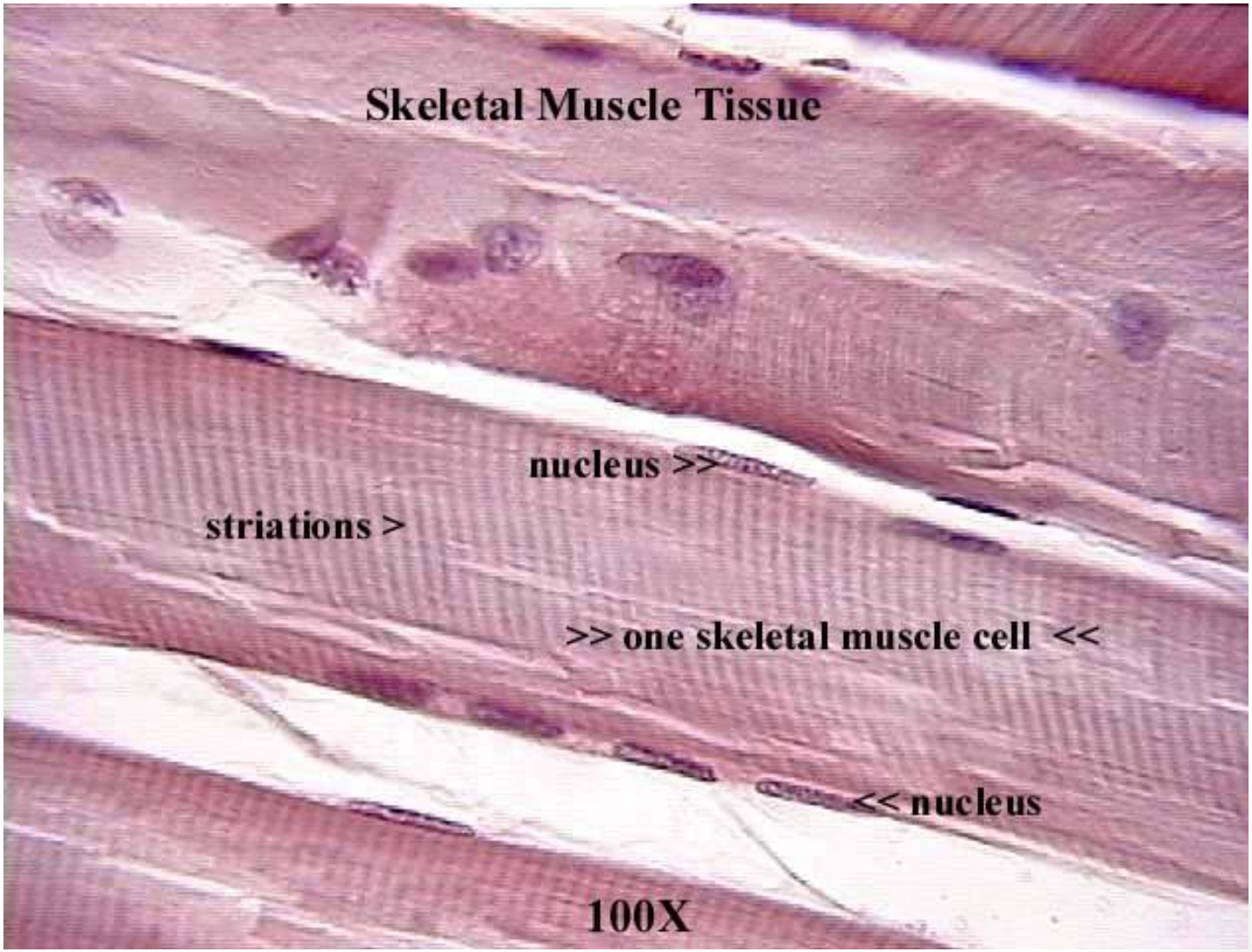
Structures of the Muscular System



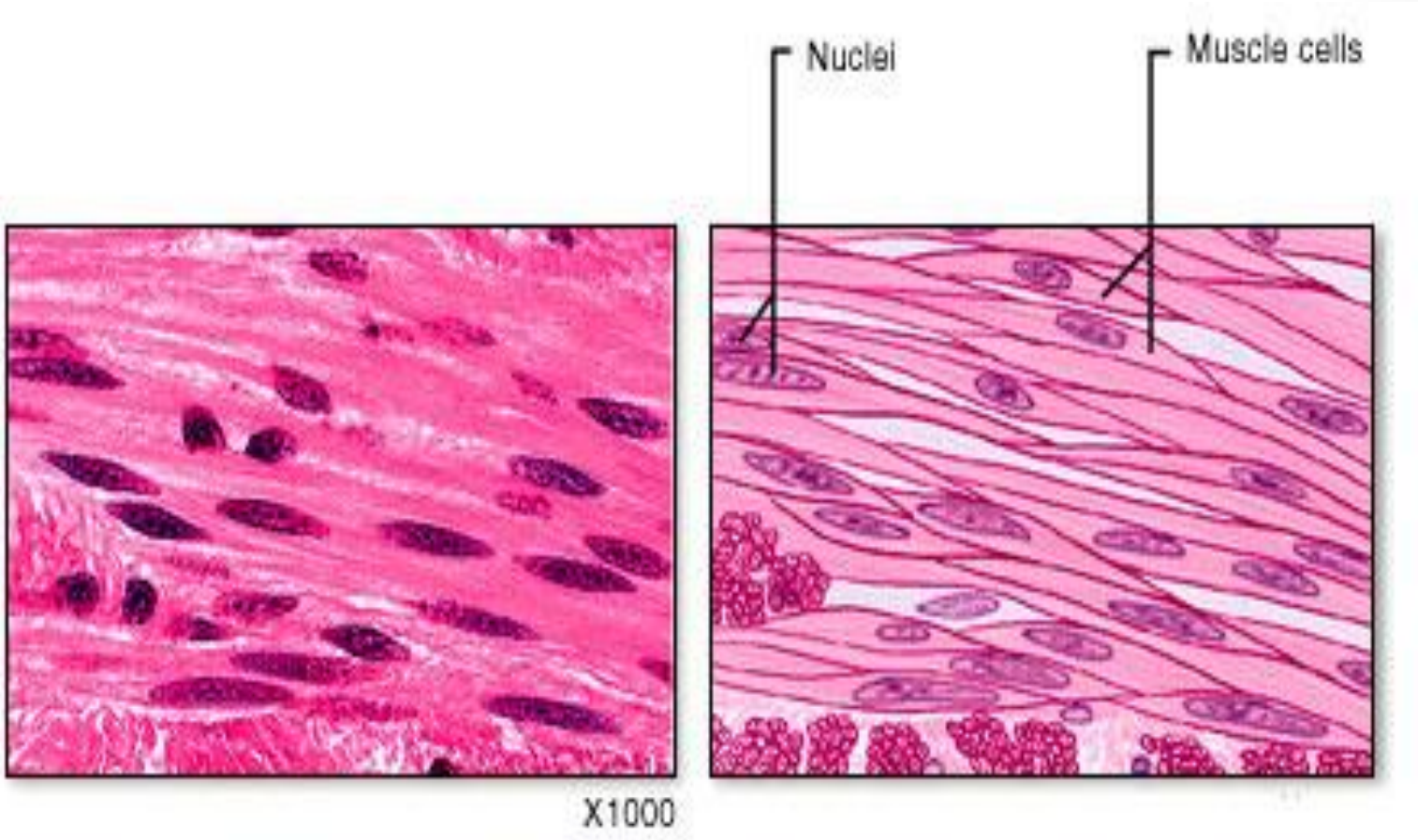
Muscle Fibres

- Muscle are made from long, slender cells called **muscle fibres.**
- The combing form from muscle is **my/o** and fibrous tissue is **fibr/o and fibros/o**.
- There are **three** types of muscle cell
  1. Skeletal
  2. Smooth
  3. Cardiac

Skeletal Muscle Fibres

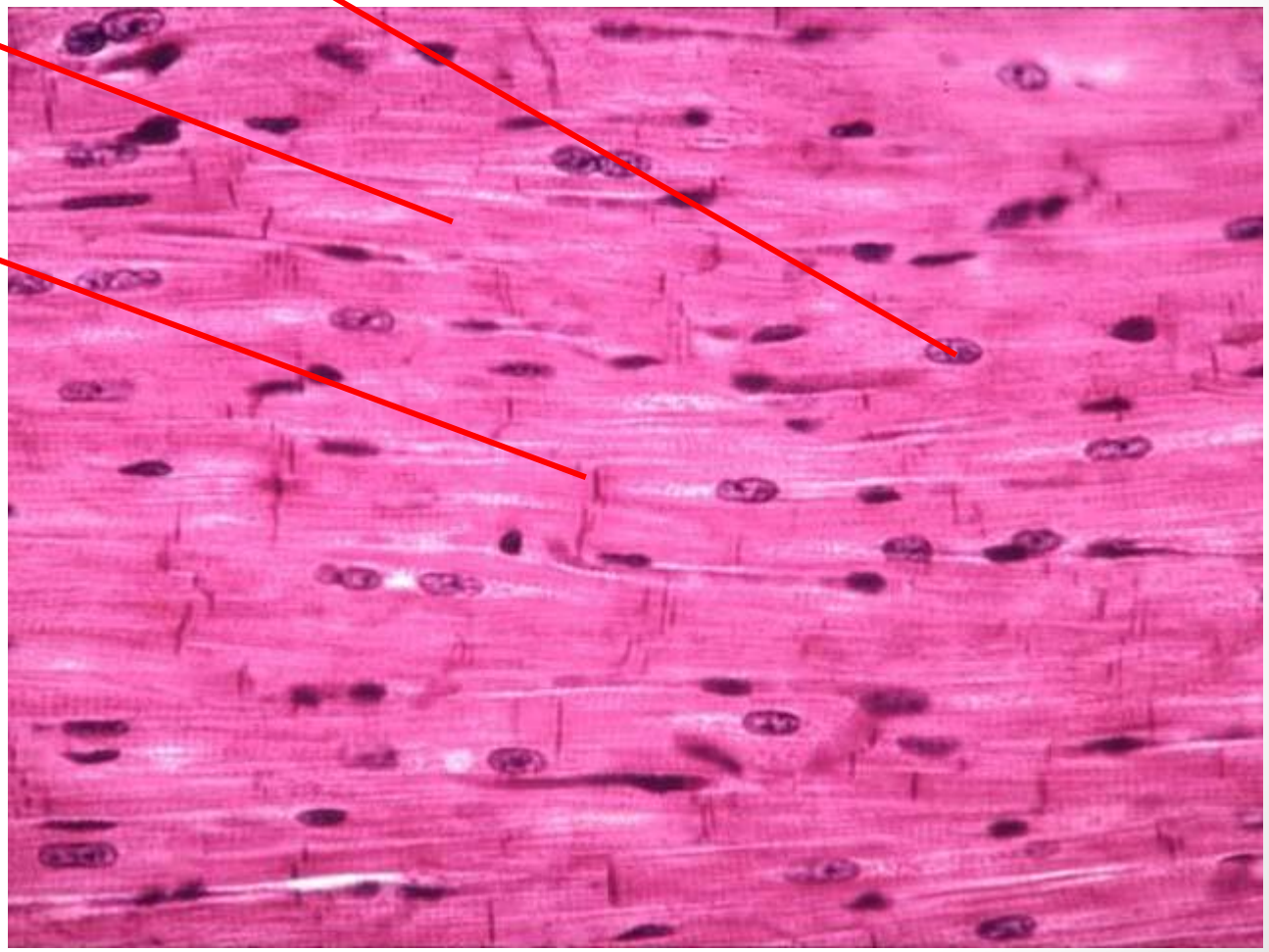


Smooth Muscle Fibres



Cardiac Muscle Fibres

- Centrally located nuclei
- Striations
- Intercalated Disks

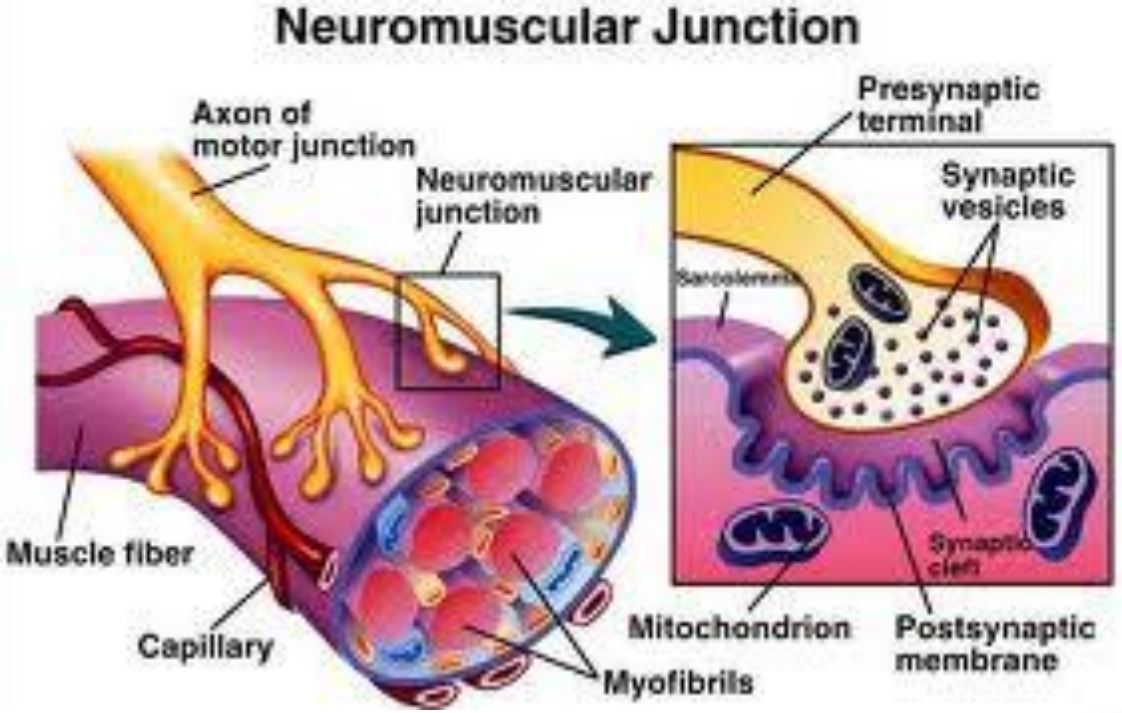


Function of Muscle

- One of the main functions of muscle is to allow movement.
- Combining form **kinesi/o** and the suffix **–kinesis** means movement.
- Some muscle are arranged in pairs and work opposite or against each other = **Antagonistic.**
- Other muscles are arranged to work with one another.
- **Synergists** are muscles that contract at the same time
- **Contraction** means tightening and the muscle becomes shorter and thicker.
- **Relaxation** means lessening of tension and returning to its normal shape.

Muscle Movement

- Muscles are signalled to contract or relax by nerve impulses.
- A neuromuscular junction is the point at which nerve endings come in contact with muscle cells



Muscle Names

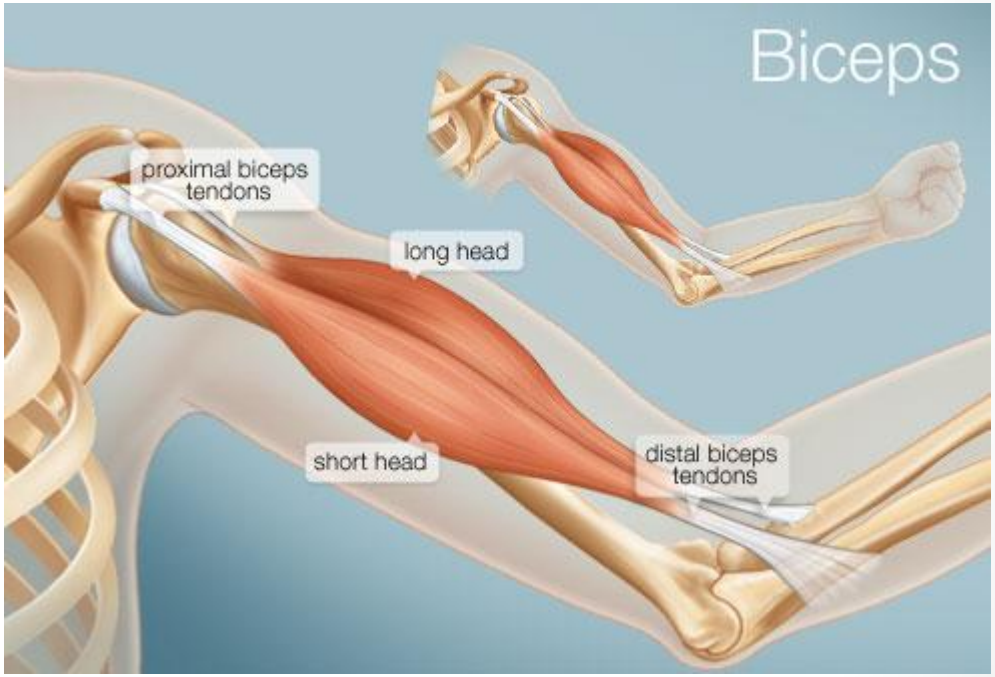
Muscles may be named due to the way they move.

- **Abductor** = muscle that moves part away from the midline
- **Adductor** = muscle that moves part toward the midline
- **Flexor** = muscle that reduces the joint angle
- **Extensor** = muscle that increases the joint angle
- **Levator** = muscle that raises or elevates a part
- **Depressor** = muscle that lowers or depresses a part
- **Rotator** = muscle that turns a body part on its axis
- **Supinator** = muscle that rotates the palmer or planter surface upwards
- **Pronator** = muscle that rotates the palmer or planter surface downwards

Muscle Names

Muscle can be named due to their location

- **Pectoral muscles** are located on the chest (pector=chest)
- **Intercostal muscles** found between the ribs (inter=between and costa = rib)



How many parts they have

- **Biceps** = two divisions (heads)
- **Triceps** = three divisions (heads)
- **Quadriceps** = four divisions (heads)

Muscle Names (cont.)

Also named in relation to their size

- **Small** = minimis
- **Large** = maximus or vastus
- **Broad** = latissimis
- **Narrow** = longissimis

Also major and minor are terms used to describe larger and smaller parts

Diagnostic Procedures

- **Electromyography** = records electrical activity of the muscle cells near recording electrodes
- **Electromyogram** = is the record of muscle contraction caused by electrical stimulus

Muscle Pathology

- **Home Work**

Next week bring a list of 10 muscular pathological conditions, causes and symptoms