AGA 2110

THE SKELETAL SYSTEM 1

THE SKELETAL SYSTEM

- ❑ It is the framework of the body.
- ❑ Skeletal system is made up of bones & connective tissue
- ❑ Provides structural support for all of the other organ systems

ROLES OF THE SKELETAL SYTEM

1) The skeletal system protects the organs of the body.

- ✓ The skull protects the brain
- ✓ Ribs protect the lungs
- ✓ Vertebrae protect the spinal cord

2) The skeleton also works in conjunction with the muscles to allow movement of the different body parts

INTRODUCTION

TERMINOLOGY

- ❑ *Osteo* or *Os* – generally refer to bone
- ❑ Osteology - the study of the structure & function of the skeleton & bony structures.
- ❑ Cells that produce bones are called osteoblasts
- ❑ Suffix – 'blast' indicates a cell that produces something
- ❑ Development & growth of bone is referred to as osteogenesis or ossification
- ❑ Bone is a living tissue, a second hardest tissue after enamel

BONE & BONE CELLS

- Bones are cellular structures in which the extracellular fluid environment of the cell is surrounded by a rigid calcified frame called matrix

- Three types of cells that make up bone are;

a. **Osteoblasts** – bone forming cells (make new bone)
b. **Osteocytes** – mature bone cells
c. **Osteoclasts** – bone remodelling cells

BONE CELLS

OSTEOBLASTS

- ✓ Are cells that form new bone.
- ✓ They come from bone marrow and are related to structural cells.
- ✓ They have only one nucleus. Osteoblasts work in teams to build bone.
- ✓ They produce new bone or matrix called "osteoid"
- ✓ Osteoblasts secrete matrix composed of collagen fibers which is initially soft embedded in a gelatin-like ground substance.
- ✓ The osteoblasts then harden the matrix through a process called ossification. When ossification takes place, the matrix is infiltrated with calcium & phosphate
- ✓ Osteoid is made of bone collagen & other protein.
- ✓ Osteoblasts are found on the surface of new bone. They control calcium & mineral deposition.
- ✓ When the team of osteoblasts has finished filling in a cavity, the cells become flat and look like pancakes

BONE CELLS

OSTEOCYTES

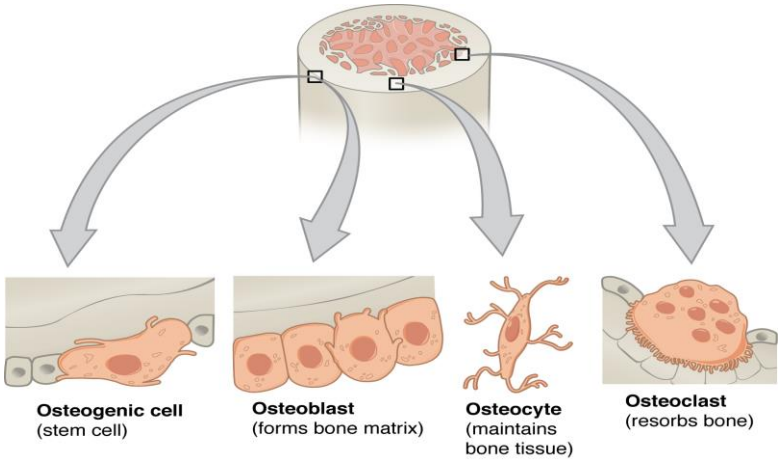
- Once the bone is completely surrounded by matrix at which point they become **osteocytes**.
- So osteocytes are mature bone cells found inside the bone, They come from osteoblasts
- Osteocytes live in their little cell-like lacunae.
- They are not isolated, however, because they send out long branches that connect to the other osteocytes. These cells can sense pressures or cracks in the bone & help to direct where osteoclasts will dissolve the bone.

BONE CELLS

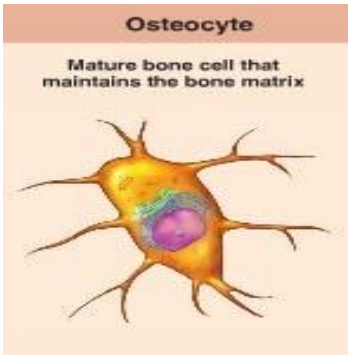
OSTEOCLASTS

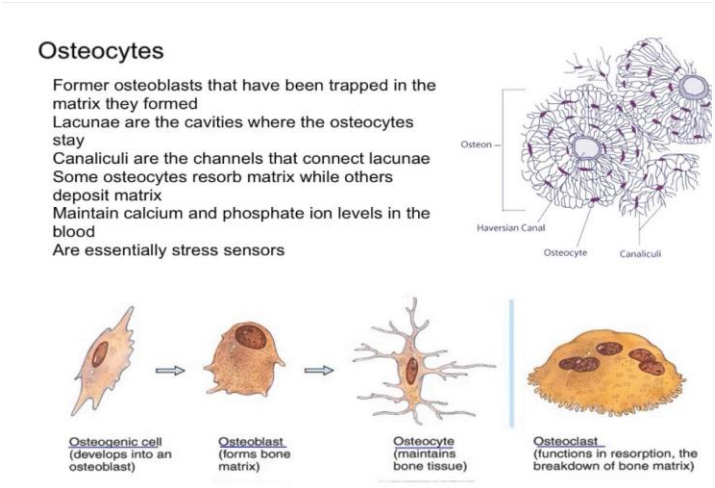
- Are large cells that dissolve the bone
- They come from the bone marrow & are related to white blood cells.
- They are formed from two or more cells that fuse together, so the osteoclasts usually have more than one nucleus. They are found on the surface of the bone mineral next to the dissolving bone.
- **Role of osteoclasts is to** break down & destroy old & damaged bone so that it can be repaired & replaced by osteoblasts.
- Repair & rebuilding cycle is constantly ongoing to keep bones strong & healthy.

BONE CELLS



OSTEOCYTES





BONE REMODELLING

- A lifelong process where mature bone tissue is removed from the skeleton & new bone is formed.
- the process also controls the reshaping or replacement of bone following injuries like fractures

TYPES OF BONE

- The 2 main types of bone are;

1. Cancellous bone – light & spongy
2. Compact bone – heavy & dense

CANCELLOUS BONE (SPONGY BONE)

- Very porous
- Also called spongy bone because it looks like a sponge or honey comb with many open spaces connected by flat planes or rods of bone known as trabeculae.
- Spongy bone is found at the ends of long bone
- Red bone marrow is found in the irregular cavities between the trabeculae
- **Canaliculi** connect to the adjacent cavities instead of the harversian canals to receive their blood supply.

CANCELLOUS BONE (SPONGY BONE)

- Inside the **trabeculae** are 3 types of bone cells;

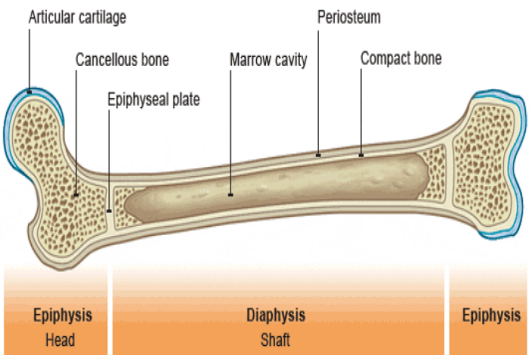
i. Osteoblasts

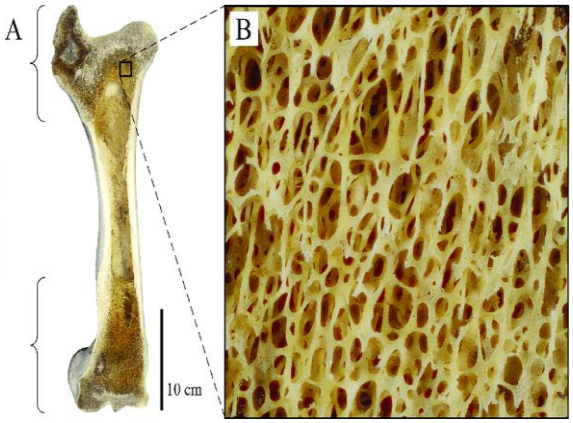
ii. Osteocytes

iii. Osteoclasts.

- Usually located at the ends of long bones (epiphyses) with the harder compact bone surrounding it.
- Spongy bone is weaker & easier to fracture that cortical bone

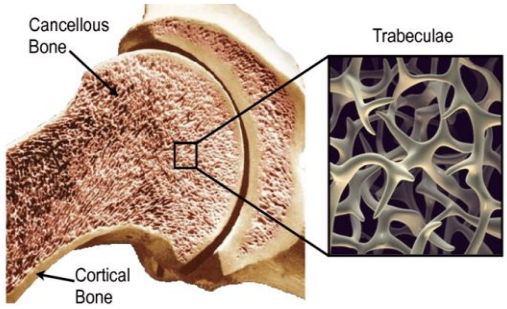
CANCELLOUS (SPONGY) BONE

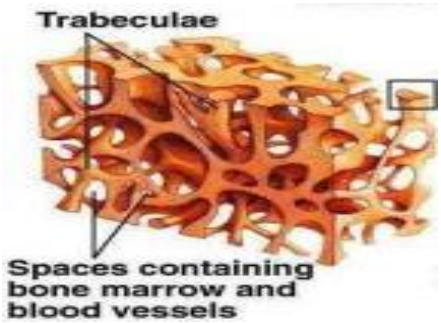




CANCELLOUS (SPONGY) BONE

ical bone and cancellous bone respectively [34].





CORTICAL BONE (COMPACT)

- Very dense & strong
- Difficult to fracture
- Found at the central parts of long bones
- Has a central canal where blood vessels, nerves & bone marrow are found.

CORTICAL BONE

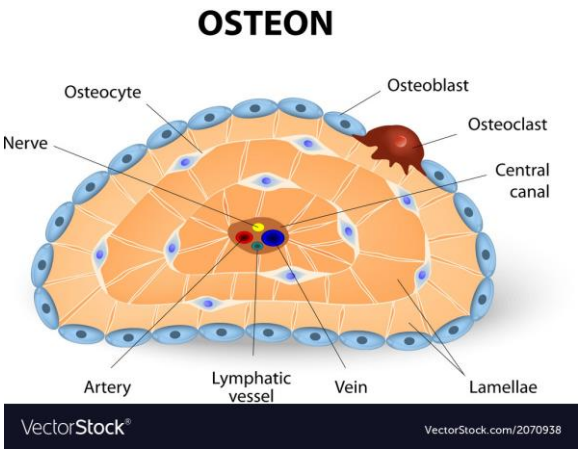
- The unit of structure of compact bone is the Haversian system or osteon
- Osteon consists of a central Haversian canal surrounded by concentric layers of bone**, the lamellae**.
- Bone cells, the osteocytes, are contained within small cavities known as lacunae. (Lacunae are cavities where osteocytes stay)
- The osteocytes communicate with each other & with the haversian canal through a branching network of canals, the canaliculi.
- Canaliculi are channels that connect lacunae

OSTEON (HAVERSIAN SYSTEM)

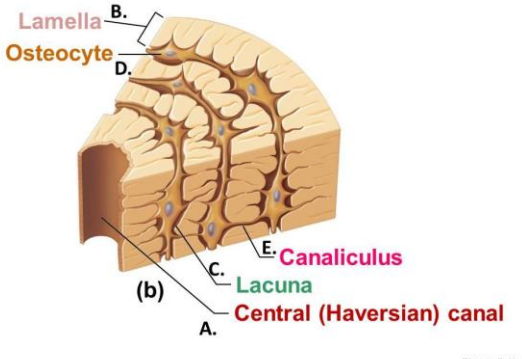
- Basic unit of structure of compact bone
- Osteocytes, are contained within small cavities known as lacunae
- Osteocytes communicate with each other & with the Haversian canal through a branching network of canals, the **canaliculi**
- Osteocytes extend their cytoplasmic processes through the canaliculi to contact, by means of gap junctions, similar processes of neighbouring cells

OSTEON STRUCTURE

- Comprises osteocytes in lacunae
- Cytoplasmic processes extend into canaliculi
- Lamellae is the hard matrix



CORTICAL (COMPACT) BONE



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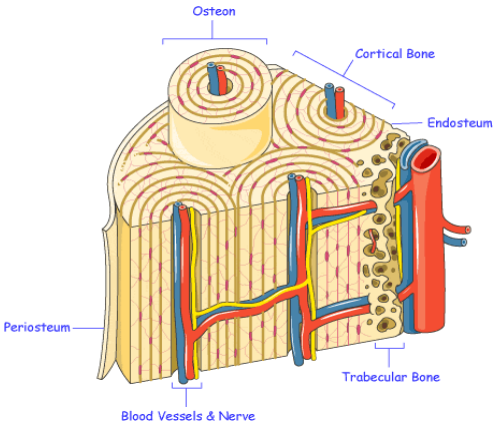
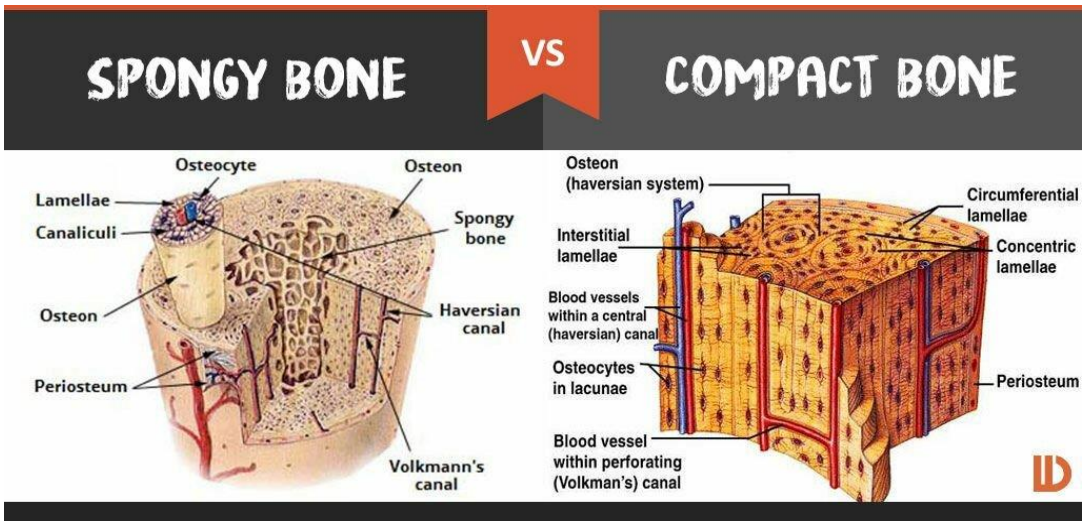


DIFFERENCES BETWEEN SPONGY & COMPACT BONE



DIFFERENCE BETWEEN SPONGY BONE & COMPACT BONE

- Haversian systems are absent in spongy bone, but concentric lamellae with enclosed lacunae & osteocytes with intercommunicating canaliculi are present

BONE MARROW

- Bone marrow fills the spaces within bones.
- This includes spaces between the spicules of cancellous bone & large spaces within the diaphyses of long bones
- comes in 2 basic types:

a) red bone marrow

b) yellow bone marrow

TYPES OF BONE MARROW

❑ **RED BONE MARROW**

✓ Is the hematopoietic tissue – bone forming

✓ Forms red blood cells

✓ Commonly found in bone marrow of young animals

✓ In older animals, found in few locations eg ends of long bones

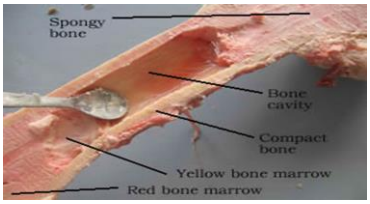
TYPES OF BONE MARROW

❑ **YELLOW BONE MARROW**

✓ Consists primarily of adipose connective tissue (fat)

✓ It is the most common type of marrow in adult animals

✓ Does not produce blood cells, but can revert to red bone marrow if the body needs to produce larger than normal numbers of blood cells.



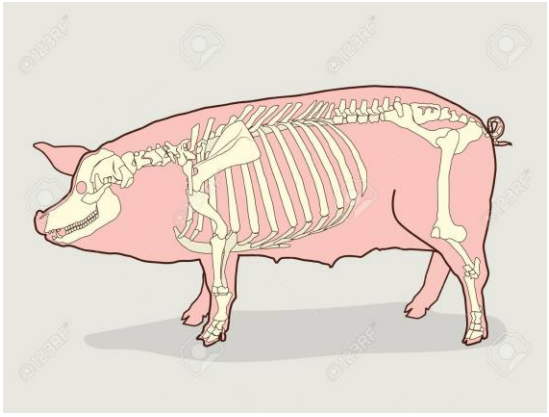
CLASSIFICATION OF BONES ACCORDING TO THE GROSS APPEARANCE

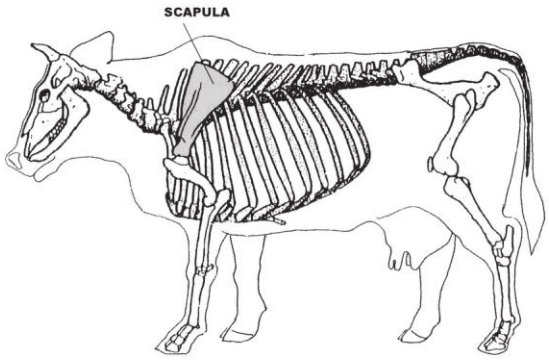
- ❑ Bones are divided into four classes;

1. Long bones
2. Flat bones
3. Short bones
4. Irregular bones

- ❑ The bones of the body are generally similar among animals but vary according to **size, shape**, and **number**

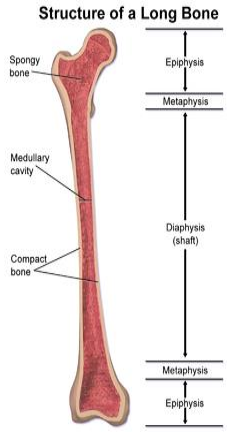
PIG & CATTLE SKELETON





1. LONG BONES

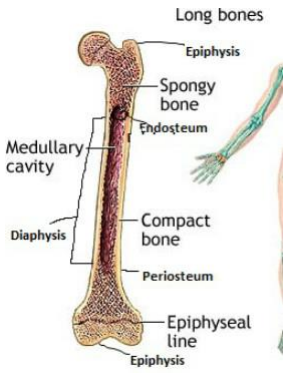
- ❑ Long bones, found in the limbs, are supporting columns & levers for the skeletal system & body.
- ❑ Are longer than they are wide
- ❑ Have a shaft with heads at both ends
- ❑ Contain mostly compact bone
- ❑ Examples ;
- **Thoracic limb** - humerus, radius, ulna, metacarpals & phalanges.
- **Pelvic limb** - femur, tibia, fibula, metatarsals & phalanges



PARTS OF A LONG BONE (PICTURE)

- ❑ Consists of 3 parts

I. Proximal epiphysis
II. Diaphysis – main part
III. Distal epiphysis



PARTS OF A LONG BONE

- **Epiphysis** - consists of light, cancellous bone covered by a thin layer of compact bone.
- **Diaphysis (shaft)** - has medullary cavity surrounded by compact bone
- **Epiphyseal plate (growth plates)** – cartilage found bt epiphyses & diaphysis because they are sites of bone growth that allow long bones to get longer.
- **Metaphysis** - expanded or flared part of the bone at the ends of the diaphysis.

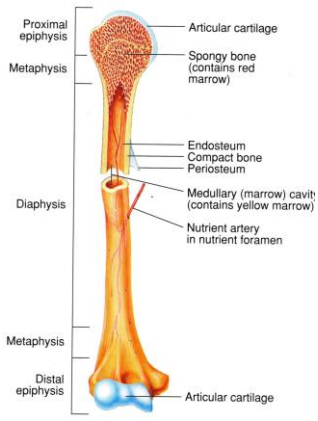
LONG BONE

- **Periosteum**

- outer fibrous membrane
- Contains blood vessels & nerves.
- The vessels enter a pinpoint opening into the diaphysis called a **nutrient foramen**

- **Endosteum** -

- A fibrous membrane that lines the medullary cavity
- Both periosteum and endosteum contain osteoblasts and osteoclasts.

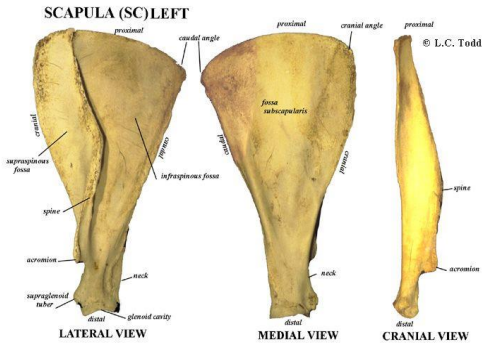


2. FLAT BONES

- ❑ As their name implies, are rel. thin & flattened.
- ❑ Their structure is like a cancellous bone sandwich that consists of two thin plates of compact bone separated by a layer of cancellous bone.
- ❑ Many of the skull bones are flat bones, as are the scapulae, the **pelvic bones**.

FLAT BONES

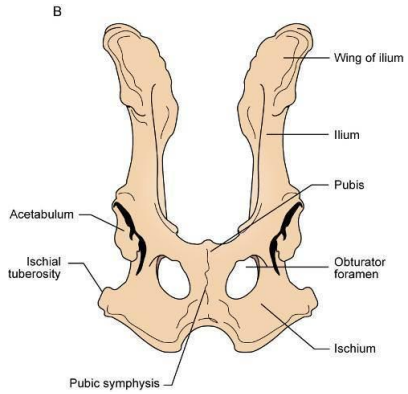
SCAPULA



BONE OF THE SKULL

FLAT BONES

Bones of the pelvis



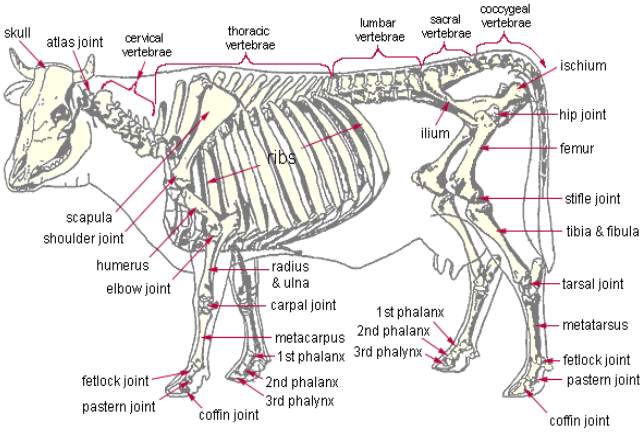
BONES OF THE PELVIS

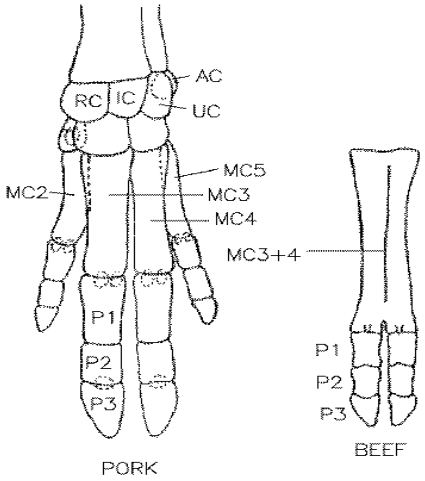
- Ilium
- Ischium
- pubis

3. SHORT BONES

- ❑ are shaped like small cubes or marshmallows.
- ❑ They consist mostly of a core of **spongy bone** layer of compact bone. Examples include the Carpal & tarsal bones
- ❑ Short bones, such as the bones in the knee hock joint, diffuse concussion, diminish friction, and change the direction of tendons

SHORT BONES – CARPAL BONES

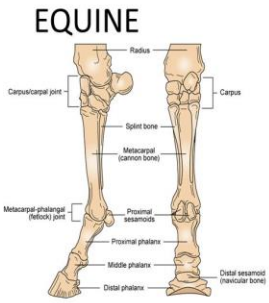


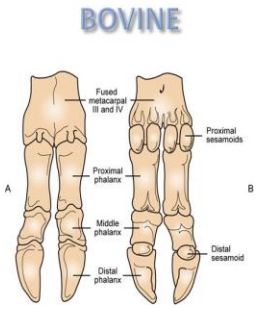


4. IRREGULAR BONES

- ❑ Irregular bones do not fit into the long, short, or flat categories.
- ❑ They either have characteristics of more than one of the other categories, or they have a truly irregular shape.
- ❑ Examples
- The vertebrae (vertebral column) – Bones of the spine
- Strangely shaped skull bones.
- **Sesamoid bones** (anatomists thought their shapes resembled sesame seeds.
- **Sesamoid bones** – present in some tendons (change direction markedly over the surfaces of joints. The kneecap (patella) is the largest sesamoid bone in the animal body.

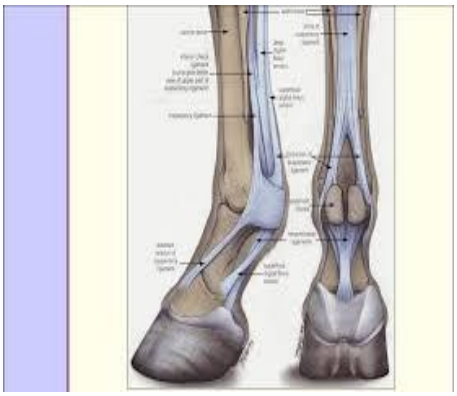
SESAMOID BONES





SESAMOID BONES

- Embedded within the tendon or muscle.



Irregular bones (vertebrae)