

Chapter # 13

Support & Movement

→ **Support**: It is the ability of organisms to bear its own mass/weight and maintain its body form.

→ **Movement**: It is the process by which an organism displaces parts of its body or the whole of its body from one place to another.

→ **Locomotion**: Ability to move from one place to another.

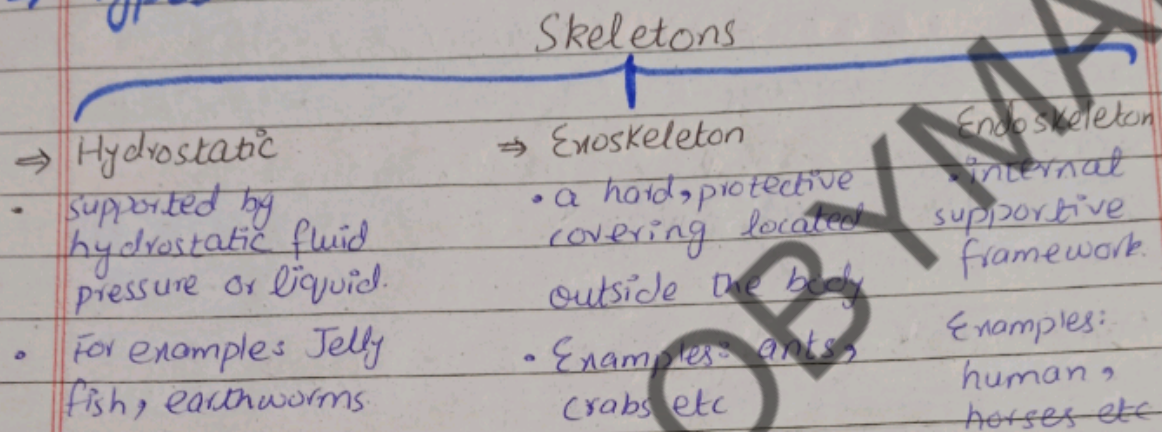
→ Difference between movement & locomotion.

Movement	Locomotion
Definition:	Definition:
⇒ Moving away from the original position of an organism or without moving away from original position are movement .	Moving away from the original position of an organism is called locomotion .
Action:	Action:
⇒ It can either be voluntary or involuntary.	It is always voluntary.
Level:	Level:
⇒ Movement takes place at biological level.	Locomotion takes place at organism level.
Energy: It requires energy.	It doesnot requirves energy
⇒ Examples: Breathing, walking etc.	Examples: Walking, Running, swimming etc.

→ Human Skeletal:

- Skeletal: What is skeletal? or skeleton.
- ⇒ a usually rigid supportive or protective structure or framework of an organism.

→ Types:



→ Human Skeleton:

- ⇒ Endoskeleton.
- ⇒ grow, repair & made of living cells.

• Role of Skeleton System:

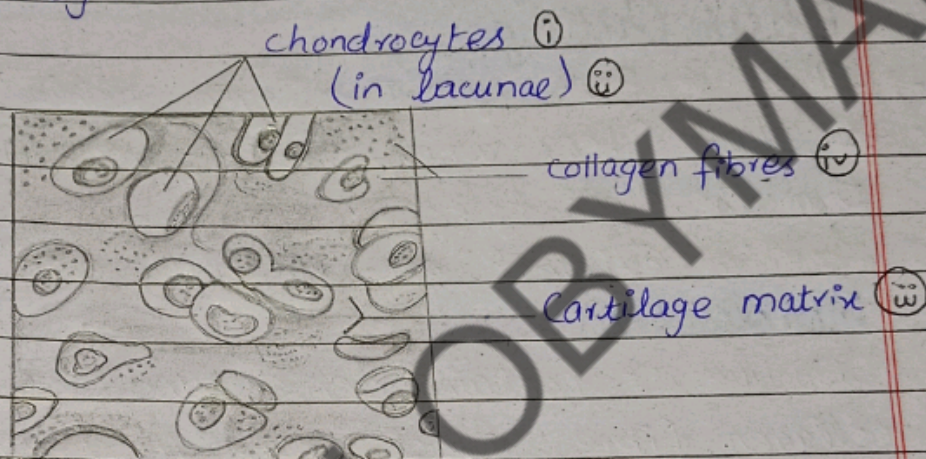
- Supports the body.
- facilitate movement.
- protect internal organs. (e.g: heart, lungs)
- produces blood cells
- store & release minerals and fats.
- Main support to body mass

Bone and Cartilage:

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→ @ Cartilage:

- Cartilage is a strong, flexible connective tissue that protects joint and bone.
- Cartilage is a dense, clear blue-white firm connective tissue (but less strong than bone).
- It acts as shock absorber throughout your body.



Chondrocytes in cartilage matrix

- Cells of cartilage are called **chondrocytes** (i)
 - Each chondrocyte lies in a fluid space called **lacuna** present in the matrix of cartilage (ii) & (iii).
 - The matrix of cartilage also contains collagen fibres (iv)
- ⇒ Blood vessels do not enter cartilage.

• There are three types of **Cartilage**:

(a) Hyaline Cartilage

(b) Elastic Cartilage

(c) Fibrous Cartilage

→ Hyaline Cartilage:

- Structure: Hyaline cartilage has a smooth, glassy structure appearance and is primarily composed of type II collagen fibers.
- It also contains proteoglycans that help retain water.

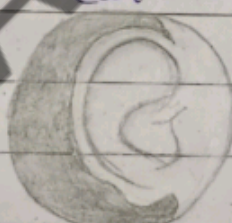
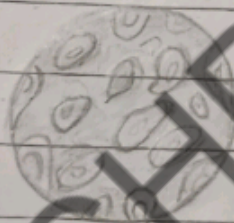
- Location: Found in the articular surfaces of joints, rib cage, trachea, bronchi, nose etc.

→ Elastic Cartilage:

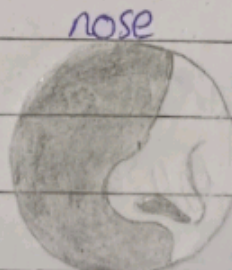
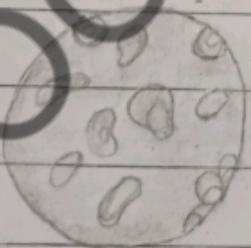
- Structure: Both type II collagen, highly density of elastic fibers which gives it more flexibility than the other types.
- Location: External ear, epiglottis etc.

→ Fibrous Cartilage:

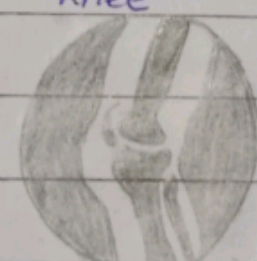
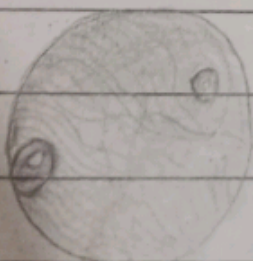
- Structure: It contains dense bundle of collagen fibre which make it tougher and more flexible.
- Location: Found in intervertebral disc, knee etc.



Elastic Cartilage
is the most flexible



Hyaline Cartilage
is the 2nd most flexible



Fibro Cartilage
is the least flexible

→ Main Function of Cartilage:

- ⇒ Support & Structure: Cartilage provides structure and shape to various body parts e.g.: ear, nose, trachea etc. It helps maintain the shape of these structures while being flexible and resilient.
- ⇒ Shock Absorption: Cartilage acts as cushion between bones at Joints. It helps absorb the impact and reduce friction during movement, preventing the bones from rubbing against each other. This is especially important in weight-bearing Joints like knee, hips and spine.
- ⇒ Facilitating Smooth Movement: Cartilage provides a smooth surface for bones to glide over one another at the Joints, reducing friction and making movement easier and less painful.
- ⇒ Growth and Development: During childhood and adolescence, cartilage is involved in the growth and development of bones. The growth plates at the ends of long bones (called epiphyseal plates) are made of cartilage, which gradually turns into bone as a person matures. This process helps the bone elongate.
- ⇒ Flexibility and Elasticity: Certain types of cartilage like elastic cartilage (found in the ear) provide both flexibility and support.

→ Bones:-

- **structure** { A hard, dense connective tissue that form the structural framework of the body in vertebrates.
- **function** { It provides support, protection for internal organs, facilitate movement, stores minerals (like calcium and phosphorus) and is involved in the production of blood cells through the bone marrow.

→ Bone structure:

- ① • Outer Layer (Periosteum): A dense, fibrous membrane that covers the bone surface.
- ⇒ It contains blood vessels and nerves and is essential for bone growth, repair and nourishment.

- Compact Bone (cortex) Dense & hard this form the outer layer of bone. It provides strength and rigidity and is organized in concentric layers around the central canal.

Spongy Bone (Cancellous Bone) Found inside the bone, particularly at the end of long bones and in the interior of flat bones.

It has a porous, honey-comb like structure that makes it lighter but still strong, providing structural support while reducing bone weight.

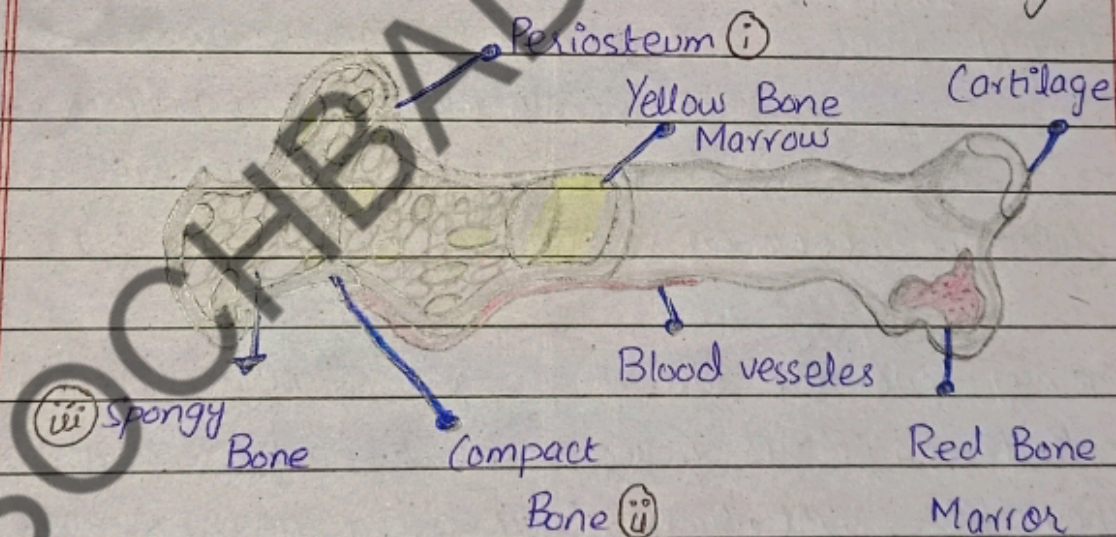
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- **Bone Marrow:** It is the soft tissue inside the bones.

→ Two Types:

- a) **Red Bone Marrow:** Produces blood cells (Red blood cells, White blood cells and platelets)
- b) **Yellow Bone Marrow:** Primarily composed of fat cells, and in emergencies (like severe blood loss) it can convert to produce red marrow to produce blood cells.

- Matrix of bone contain collagen.
- Bones contain different types of cells.
- Mature bone cells are called osteocytes.



Structure Of Bone

Q: Difference between Bone and Cartilage:

Bone

Cartilage

- | | |
|---|---|
| <p>→ Bone is a hard and inelastic connective tissue</p> <p>→ Bones are tough.</p> <p>→ Mature bone cells are called osteocytes (mature)</p> <p>→ Blood vessels are present in bones.</p> <p>→ Bones are of two types</p> <p>(a) compact bone</p> <p>(b) spongy bone</p> | <p>Cartilage is a soft and elastic connective tissue.</p> <p>→ Cartilage is flexible.</p> <p>Cells of cartilage are called chondrocytes</p> <p>Blood vessels are absent in bones cartilage.</p> <p>Cartilage are of three types</p> <p>(a) Hyaline cartilage</p> <p>(b) Elastic cartilage</p> <p>(c) Fibrous cartilage.</p> |
|---|---|

Q: Difference between Spongy and compact bone

Spongy

Compact

- | | |
|--|--|
| <p>→ Spongy bones are also called cancellous bones</p> <p>→ They are light, spongy and soft in nature</p> <p>→ They are made up of trabeculae</p> <p>→ Contains Yellow bone marrow</p> | <p>Compact bones are also called cortical bones.</p> <p>They are heavy, tough and compact in nature.</p> <p>They are made up of osteons.</p> <p>Contains Red bone marrow</p> |
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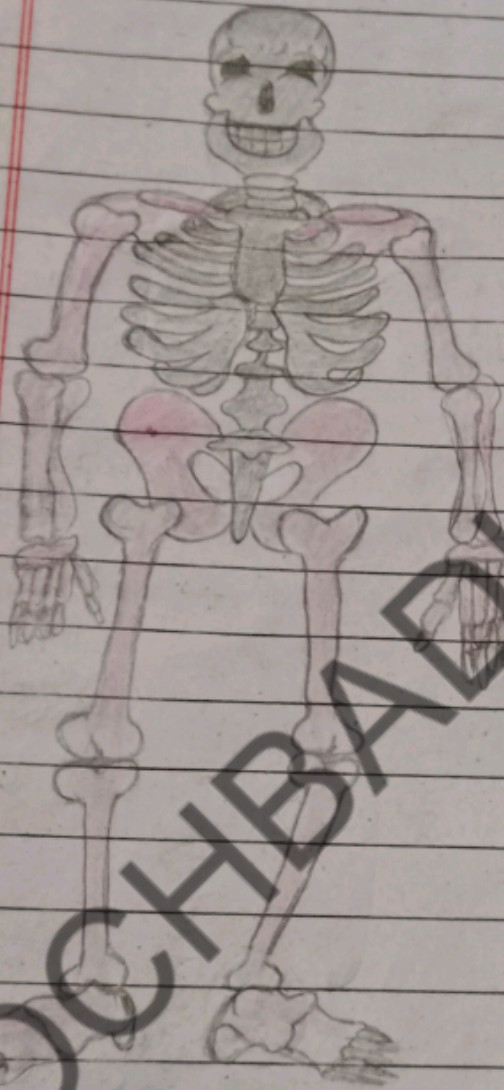
→ Components Of Human Skeleton:

The adult human skeleton usually consists of 206 named bones.

⇒ 206 bones are divided into two parts

a Axial Skeleton

b Appendicular Skeleton:



■ Axial Skeleton

■ Appendicular Skeleton

Human
Skeleton
System

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Human Skeleton

206 bones

* Axial Skeleton

80 bones

skull 1

sternum 1

ribs 24

vertebral column 26

head 9

3

14

6

17

hyoid bone

cartilage

condyles

• Appendicular skeleton

126 bones

upper limbs

pectoral girdle

4 bones

6 arms

54 hands

lower limbs

pelvic girdle

2 bones

6 legs

54 feet

(1) Difference between axial & appendicular

Axial Skeleton

Appendicular Skeleton

⇒ Part of the skeleton that consist of the bones of the head & trunk of the vertebrate

Portion of the skeleton of vertebrates consisting of the bones that support the appendages

⇒ Central axis of the human skeleton

Consist of the appendages connected to the axial skeleton

⇒ Make-up of 80 bones

Make up of 126 bones

⇒ supports the upright position & protects the internal organs.

Aid in the movement of the body

→ Types of Joints:

→ **Joint:** A location where two or more bones make contact

- **Function:** They allow movement & provide mechanical support.

- **Classification:** They can be classified on the basis of degree of movement they allow.

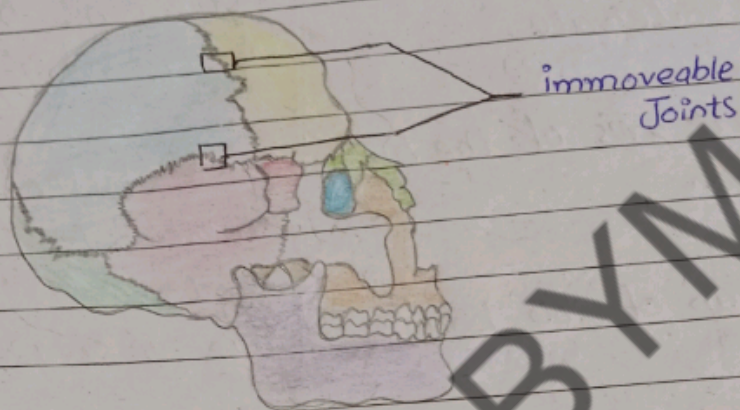
- **Composition:** They are complex structure made up of bones, muscles, synovium membrane, cartilage and ligaments.

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⇒ Joints:

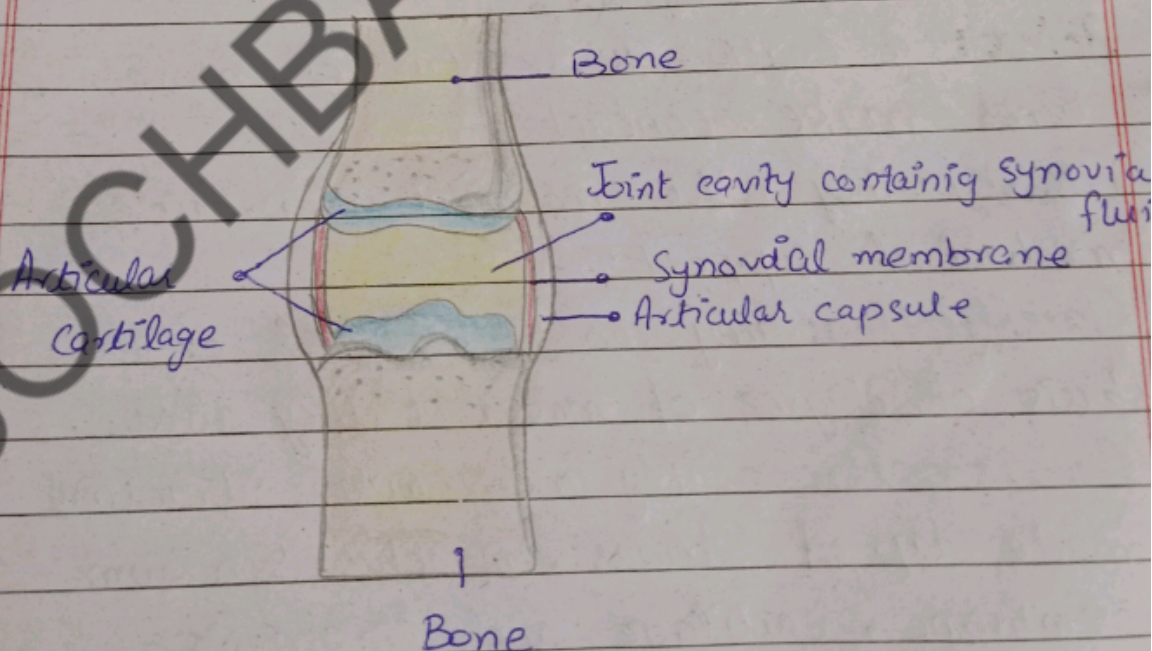
① **Immoveable Joint:** Two or more bones are in close contact, but no movement can occur.

Examples: Joints between the skull bones.



② **Slightly moveable Joints:** In this type of Joints, bones are connected by hyaline or fibro cartilage. Such Joints allow slight movement.

Examples: Joints between the vertebrae



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③ **Moveable Joint:** They allow variety of movement.

For Example: shoulder Joint, hip Joint, elbow Joint etc.

→ There are many types of moveable Joints. The main types are

→ ① **Hinge Joints:** Move back and forth like hinge on a door. Allow movement in one plane only. e.g. knee

→ ② **Ball & Socket Joints:** Allow movement in all direction. For Example: Hip & (Shoulder) Joints are ball & socket Joints.

Hinge Joints
&

Ball &
Socket
Joint

Moveable Joints



Ball & Socket



Hinge Joint

→ **Role of Tendons & Ligaments:**

Tendons are bands of fibrous connective tissue (made of collagen)

⇒ **Function:** Tendons are tough bands and attach muscles to bones.

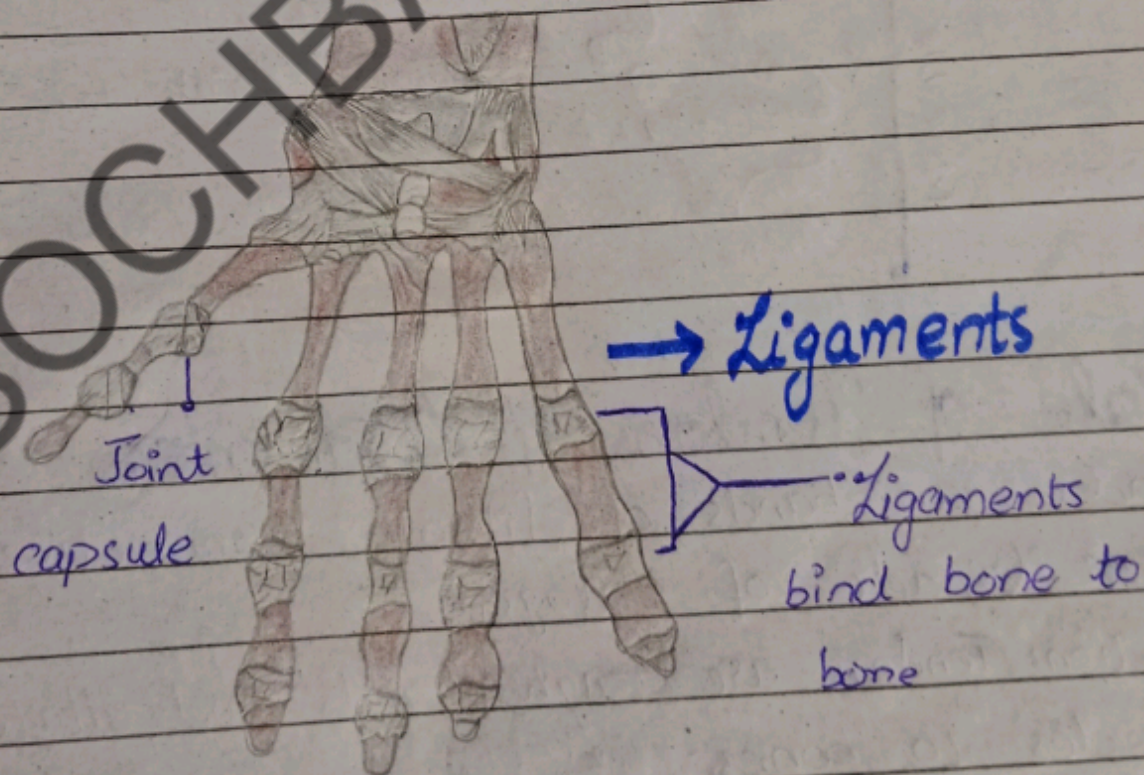
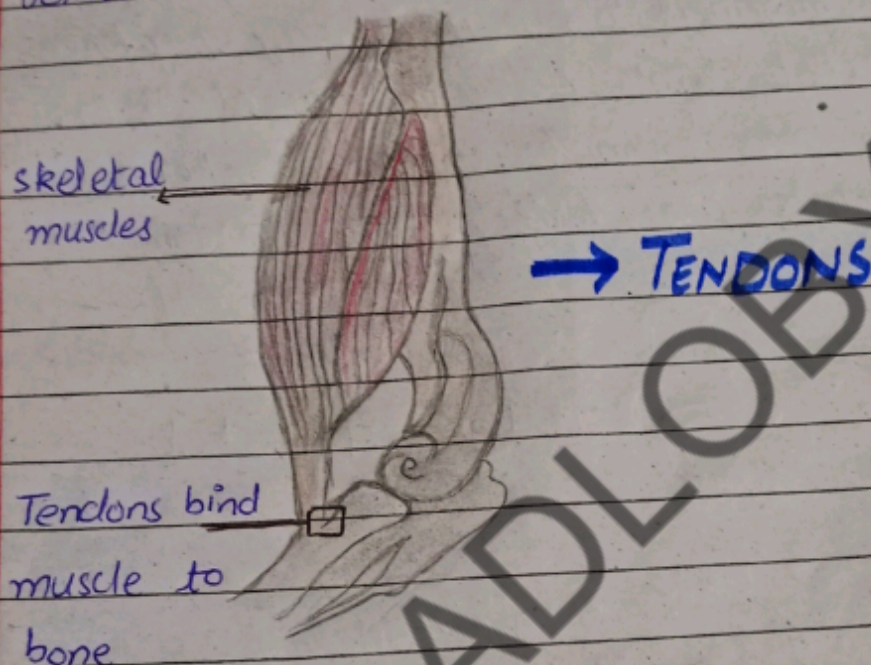
• When a muscle contracts tendons exert

a pulling force on the attached bones,
which moves as a result.

→ Ligaments:

- Ligaments are strong but flexible bands and join one bone to another at joints.

Function: They prevent dislocation of bones at joints.



→ Q: Difference between tendons and Ligaments.

→ Tendons:

- Tendon Join skeletal muscles to bones.
- Tendons are tough and inelastic.
- Tendons are modification of white fibrous tissue.
- Tendons have more collagen.

Ligaments:

Ligament Join bone to bone.

Ligaments are strong and elastic.

Ligaments are modification of Yellow elastic tissue.

Ligaments have less collagen as compared to tendons.

→ Muscle and Movement:

- When bones move at Joint, they produce movements.
- Movement in bones are brought about by the contraction of skeletal muscles, which are attached to them by tendons.

Structure of Muscles:

- **Origin:** End attached with immovable bone.
- **Insertion:** End attached with a moveable bone.

→ Role of Skeletal Muscles:

→ Antagonism: Phenomena in which pair of muscles perform opposite jobs means when one muscle will contract other will relax and vice versa and muscles pair is known as antagonistic muscles.

→ Example: movement of arm.

→ Antagonistic Pair: → Biceps and Triceps.

→ Biceps: In front of upper arm.

→ Triceps: On back of arm.

→ Origin: of both muscles is at pectoral girdle.

→ Insertion: at one of the two bones of forearm.

→ Flexor: Contract and bend the joint.

→ Extensor: contract and straighten the joint.

→ Disorders Of Skeletal System:

→ Osteoporosis:

- | | |
|----------|--|
| found in | <ul style="list-style-type: none"> • It is a bone disease in adults especially in old people. • It is more common in old women. |
| | <ul style="list-style-type: none"> • There is a decrease in density of bones due to loss of calcium & phosphorus. |
| causes | <ul style="list-style-type: none"> • It may be due to malnutrition (lack of proteins and vitamin C), lack of physical activities or estrogen hormones deficiency. |
| | <ul style="list-style-type: none"> • In old age there is decreased secretion of growth hormones and it also leads to decreased deposition of minerals in bone matrix. |

→ Arthritis:

- It means "Inflammation in Joints"
- Common in old age and in women.
- It is characterised by pain and stiffness in Joints (particularly in weight bearing Joints e.g: hip Joint, ankle Joint etc)

- **Treatment:** Treatment of arthritis includes pain killer and anti-inflammatory medicines

There are many types of arthritis:

(i) Osteo-arthritis:

→ **Causes:** due to degeneration in the cartilage present at Joints or due to decreased lubricant production at Joints.

- In this arthritis, fusion of the bones at Joint may occur and Joints may become totally immovable.

(2) Rheumatoid arthritis: It involves the inflammation of the membranes at Joints.

→ **Symptoms:** Fatigue, low grade fever, pain and stiffness in Joints.

(3) Gout: It is characterised by the accumulation of uric acid crystals in moveable Joints. It generally attacks the toe Joints.

Q: Difference between osteoporosis and arthritis:

→ Osteoporosis

- It is related to bones
- It means porous bones

→ In osteoporosis, there is decrease in density of bones so, bones become fragile

→ This can be prevented by taking proper diet in young age.

→ It can be treated by taking good amount of calcium, vitamin C and D

Arthritis

It is related to Joints

It means inflammation of Joints.

In arthritis, joints become stiff and it results in Pain.

This can be prevented by avoiding alcohol and stress

It can be treated by taking pain killers and anti-inflammatory medicines