

The Skeletal System

Skeletal System

- Bony framework of our body

Functions of Skeletal System

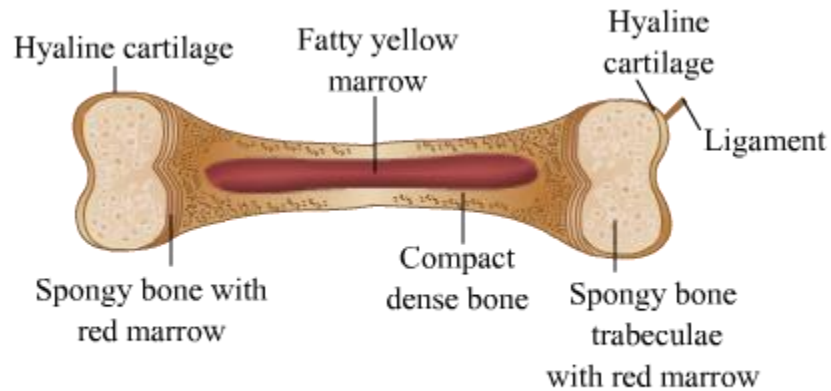
- Provides framework to all the body parts, thus giving our body a definite shape
- Maintains erect posture
- Helps in locomotion
- Protects internal soft organs
- Plays a major role in formation of blood cells
- Acts as storehouse of calcium and phosphorus for the body

Skeletal system = 206 bones + A few cartilages

- Bones are connective tissues, which are hard due to calcium salts
- Cartilages are connective tissues. They have a pliable matrix due to chondroitin salts.

Bones

- Bones are the chief constituents of the skeletal system.
- They consist of organic and inorganic parts (compounds of calcium and phosphorus).
- As we grow old, the organic part gets on reducing, making bones fragile.
- On the basis of shape, bones can be classified as:
- **Long bones:** Have a thick-walled shaft with a knob at each end. Examples, bones of arms, legs and chest
- **Short bones:** Box-like, spongy bones that show little movement. Examples, ankle, wrist, etc
- **Flat bones:** Made up of two or more parallel plates of compact bones. Examples, shoulder blade, skull, etc
- **Irregular bones:** Have complex shape. Examples, vertebral bones

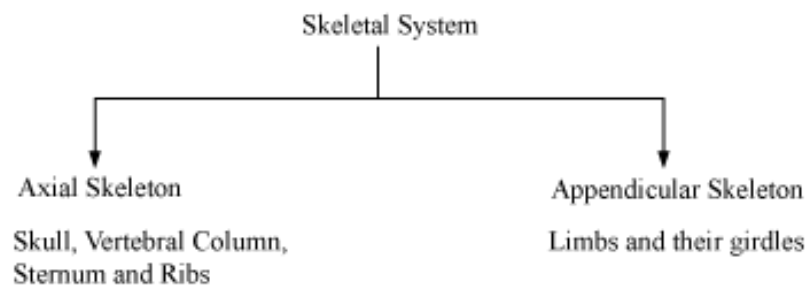


Structure of a long bone

A typical bone consists of osteocytes or bone cells that are embedded in a ground matrix made up of collagen fibres and calcium and phosphorus salts. The external surface of the bone is covered by a membrane called periosteum. Its outer layer is fibrous while inner layer is cellular.

The hollow cavity in the middle of the bone is filled with bone marrow. The yellow marrow is made up of adipose tissue (fat storing cells) and gives rise to white blood cells. The red marrow, which is present at the ends gives rise to red blood cells.

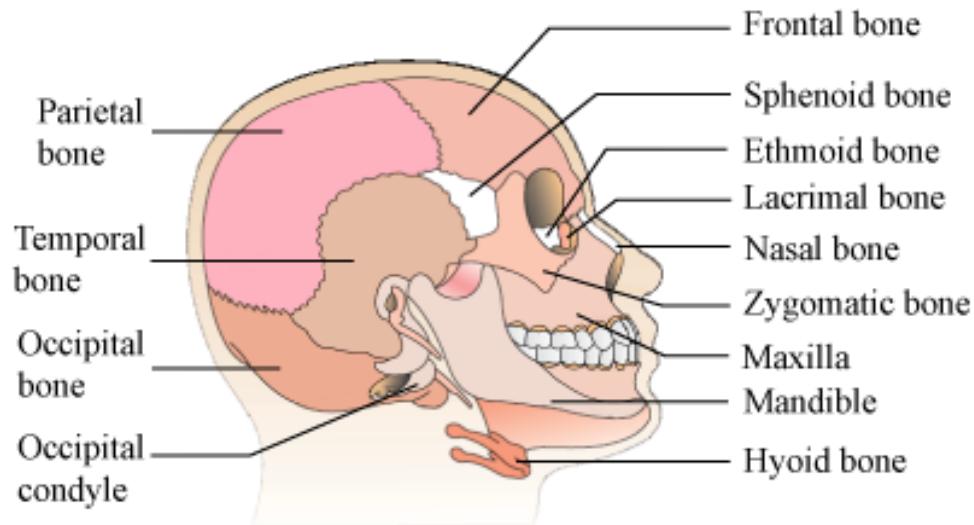
Major divisions of the skeletal system



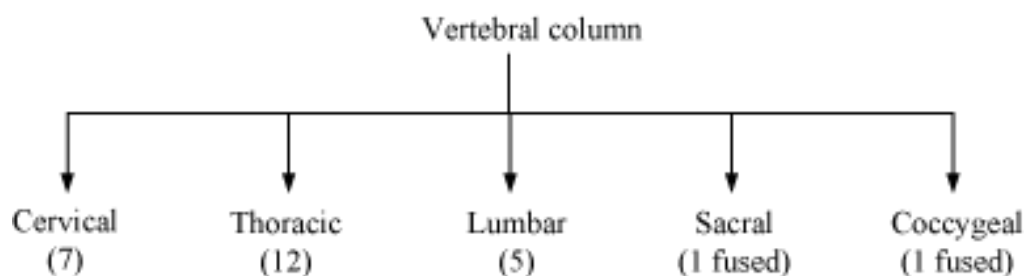
Axial Skeleton (80 bones)

- Skull – 22 bones
- Has two sets of bones – Cranial (8) and Facial (14)
- Skull also includes a U-shaped bone called *hyoid*, present at the base of the buccal cavity
- Ear Bones (ear ossicles) – Malleus, Incus, Stapes

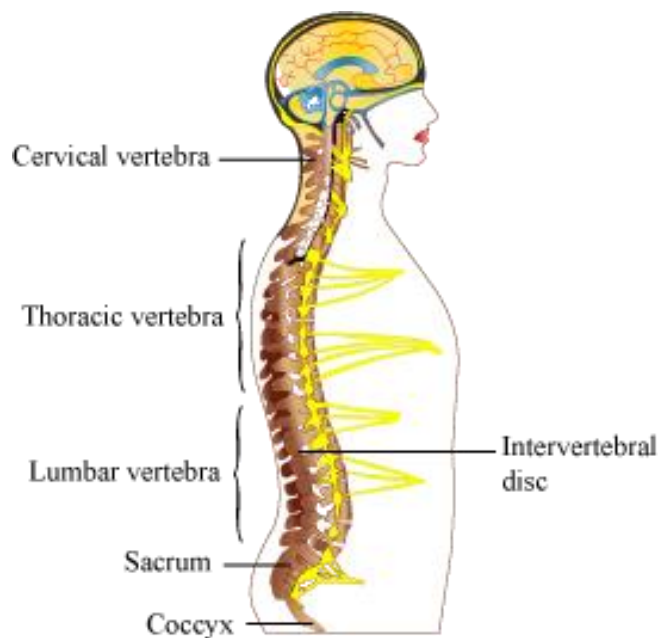
- Skull articulates with the vertebral column via two occipital condyles.



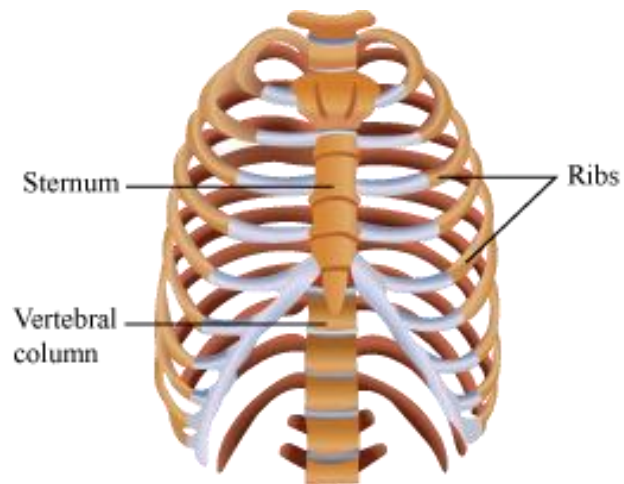
- Vertebral Column – 26 vertebra
- Each vertebra has a central hollow portion through which the spinal cord passes. This hollow portion is called the neural canal.
- Functions: Protects the spinal cord; supports the head; serves as the point of attachment of the ribs and the musculature of the back
- First vertebra: Atlas – it articulates with the occipital condyles



- Formula for vertebral column in man is $C_7 T_{12} L_5 S_1 Co_1$

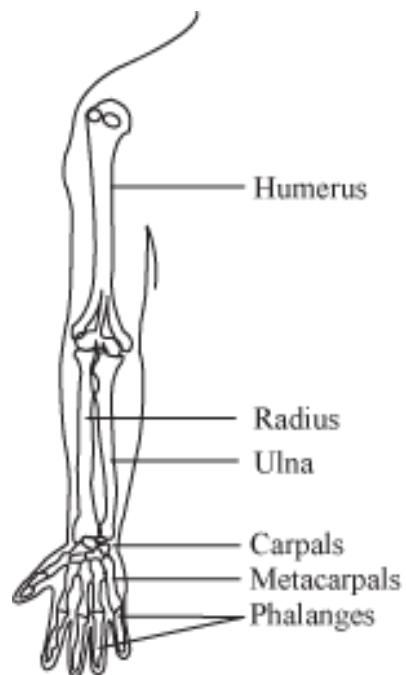
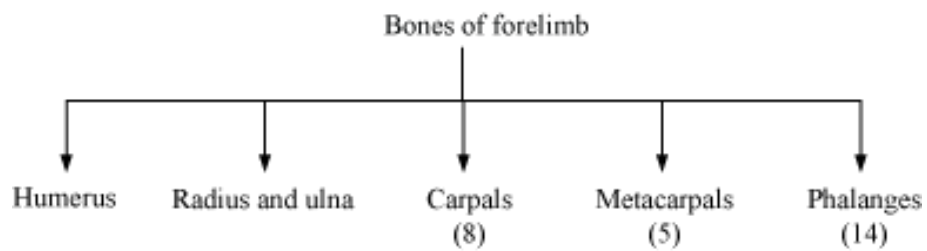


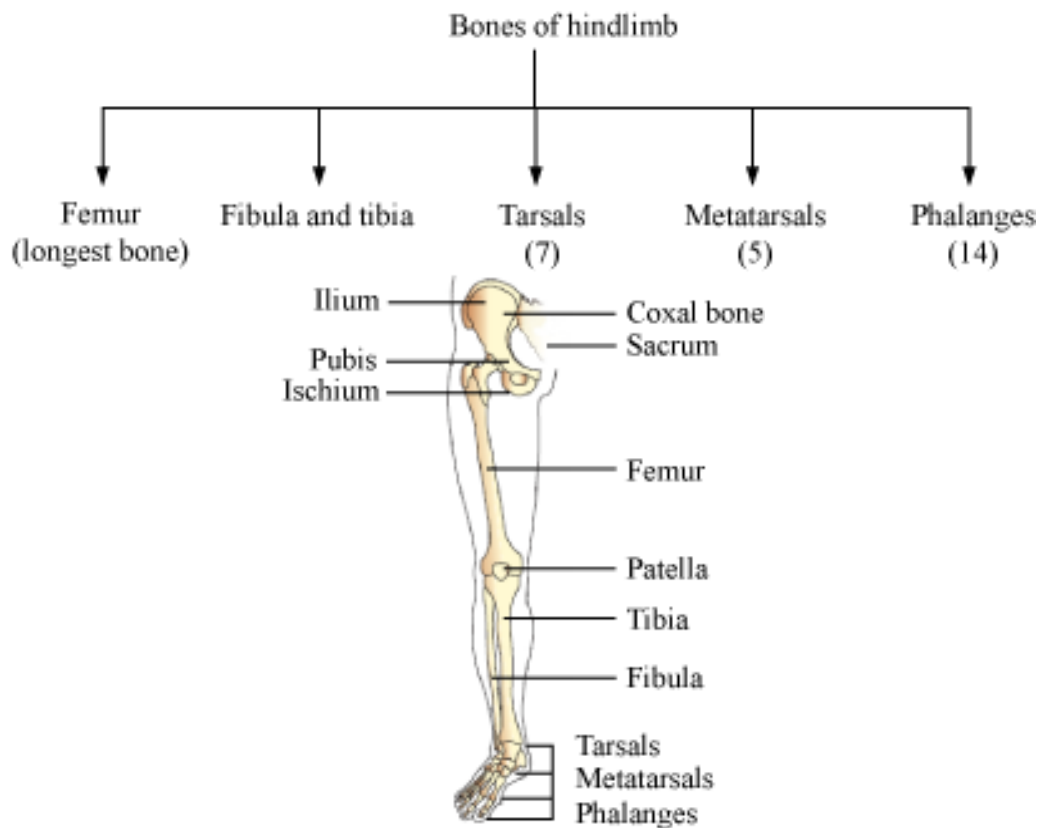
- Sternum – 1
- Flat bone on the ventral midline of the thorax, to which the ribs are attached ventrally
- Ribs – 12 pairs
- Connects dorsally to the vertebral column
Connects ventrally to the sternum
- True Ribs: First 7 pairs; they connect both dorsally and ventrally to the vertebrae and the sternum respectively via the hyaline cartilage
- False (vertebrochondral) Ribs: 8th, 9th and 10th pairs; do not connect to the sternum directly, but connect indirectly through the seventh rib
- Floating Ribs: 11th and 12th pairs; do not connect ventrally
- Rib cage = Thoracic vertebra + Ribs + Sternum



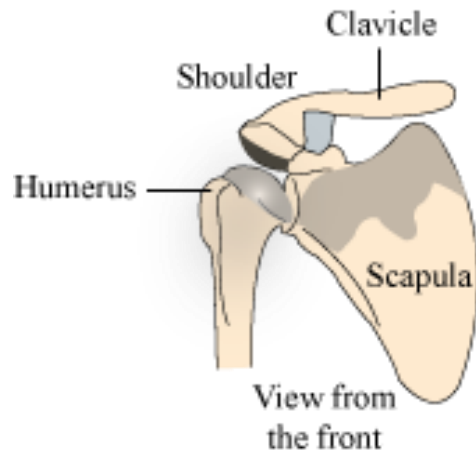
Appendicular Skeleton

- Limbs (each limb has 30 bones)

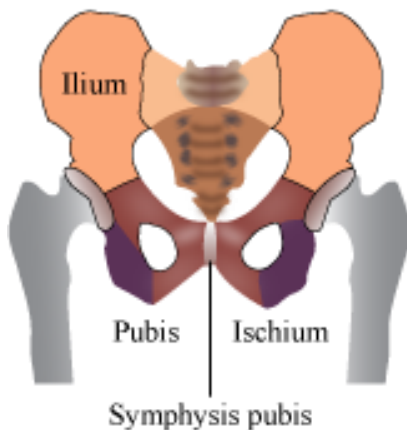




- Knee cap – Patella
- Girdles (Pectoral and Pelvic)
- Articulates the limbs with the axial skeleton
- Each girdle is composed of two halves.
- Pectoral girdle:
 - Consists of clavicle (collar bone) and scapula
 - Scapula is a triangular flat bone with a slightly elevated ridge called the spine, projecting as a flat, expanded process called acromion.
 - Clavicle articulates with acromion.
 - Below acromion, a depression called glenoid cavity is present. Here, humerus articulates to form the shoulder joint.



- Pelvic girdle:
- Has 2 coxal bones formed by the fusion of ilium, ischium and pubis
- Acetabulum is a cavity formed at the point of fusion of these three bones where the thigh bone articulates
- Two halves of the pelvic girdle meet ventrally to form Pubic Symphysis (contains fibrous cartilage)



Joints & Disorders of Musculo-Skeletal System

Joints

- Points of contact between bones or between bones and cartilages
- Joints act as fulcrum used to carry out movement by force generated through muscles.
- Classification of joints depending upon structure:

Fibrous joints	Cartilaginous joints	Synovial joints
Bones fuse end to end with the help of dense fibrous connective tissues.	Bones are joined together with the help of cartilages.	Bones are not joined together directly, but fluid-filled synovial cavity is present between articulating surfaces of two bones.
Do not allow any movement	Permit limited movement	Show maximum movement
Example – Skull bones fuse end to end with the help of dense fibrous connective tissues called sutures to form cranium.	Example – Joints between adjacent vertebrae	Example – Ball and socket joint

Types of Synovial joints

- Synovial joint – five types:
 - Ball and socket joint
 - Allows free movement
 - Found between humerus and pectoral girdle, femur and acetabulum
 - Hinge joint
 - Allows movement in one plane
 - Example: knee joint, elbow joint
 - Pivot joint
 - One bone rotates over other.
 - Found between atlas and axis
 - Gliding joint
 - Allows only gliding and sliding movement
 - Found between carpals and wrist
 - Saddle joint
 - This type of joints allows back and forth and side to side motion, but only limited

rotation.

Found between carpal and metacarpal of thumb

Muscles

Bones provide a framework to our body and joints help in the movements of our body. **How do bones move?**

Bones move with the help of muscles present in our body. Let us find out what muscles are and how they help in the movements of the body.

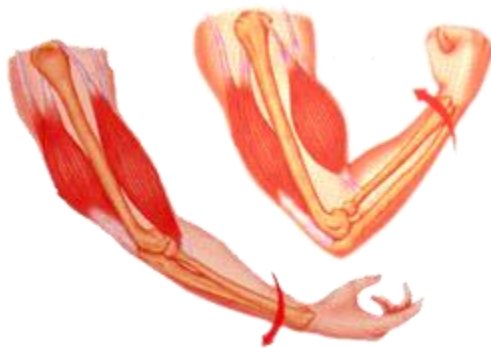
Muscles are one of the contractile organs of our body. They are the fleshy parts of our body, which help in the movement of different body parts. Each muscle has a fixed end (where it originates) and a movable end which is attached to the bone with help of tendon. Tendon helps in the movement of bone by pulling it.

Do you know how muscles move?

Muscles move by contracting and relaxing. Here, contracting means becoming shorter, while relaxing means becoming longer and thinner.

Let us explore how muscles move with the help of a small activity.

Make a fist with one hand and bend the arm at the elbow level. Then, touch your shoulder with your thumb.



You will feel a swollen region inside your upper arm. This swollen region is a muscle. Contraction makes it swollen.

When you bring your arm back to its normal position, you will observe that the muscle is no longer contracted.

What changes are observed in muscles when they contract?

When muscles contract, they become shorter, thicker, and stiffer.

Functioning of muscles

Muscles work in pairs to pull a bone. If one muscle contracts, then its partner (the other muscle of the pair) relaxes. This pulls the bone towards the contracted muscle. Such pairs of muscles that cause opposing movements are called antagonistic muscles.

Can you tell how muscles come back to their original position?

When the relaxed muscles contract and the contracted muscles relax, muscles are pulled back to their original position.

Kind of muscles

- **Voluntary muscles:** Muscles that can be controlled by our will. Example, muscles of hands and legs.
- **Involuntary muscles:** Muscles that are not under our control. Examples, muscles found in stomach, intestines, etc.
- **Cardiac muscles:** Muscles found in our heart walls; these are special kind of involuntary muscles that are capable of rapid movement and do not get tired.

Can muscles of the same group contract and relax at the same time?

When some muscles undergoes contraction, at the same time there are some muscles of the same group that relax. This functioning of muscles help in the performance of various operations in our body.

People go to the gym to maximize muscle building. On which muscles do they work?



Biceps are present on the front part of our upper arm while **triceps** are at the back. **Abdominal muscles** (abs) are pair of muscles present in the front of abdomen. Find out yourself about the other muscles.

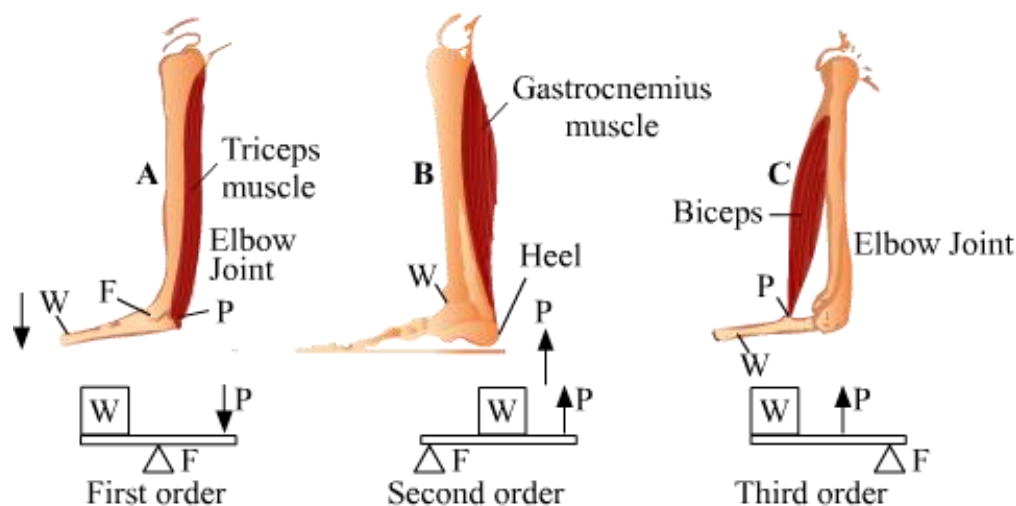
Some Interesting Facts:

- Did you know that there are more than 650 muscles in the human body?
- Sartorius is the longest muscle in the human body. It runs from the hip to the knee.

Lever Mechanisms in Human Skeleton

There exists some lever actions in our skeletal systems, that make the movement of different body parts easier.

- **First Order Lever:** Fulcrum (F) is in between Power (P) and Weight (W). Example, extension of arm at the elbow by the action of triceps muscles, and resting of skull on first and second neck vertebrae.
- **Second Order Lever:** Fulcrum and power are at the two ends with the weight in between. Example, gastrocnemius muscle raising weight of the body on the toes.
- **Third Order Lever:** Fulcrum and weight are at the two ends with the power in between. Example, biceps muscles flexing the arms.



Simple levers in human skeleton

- A. Elbow (extension of arm)
- B. Toes and heel (lifting up of heel)
- C. Elbow (Flexion of arm)