

# 36. The Skeleton and Muscles

## Functions of the Skeleton

1. Support: forms the framework of the body.
2. Movement: the muscles pull on bones to allow movement.
3. Protection: protects vital organs, e.g. brain, lungs, heart etc.
4. Production: red bone marrow makes red blood cells, platelets and monocytes.

## Two Parts of the Skeleton

### 1. The Axial Skeleton

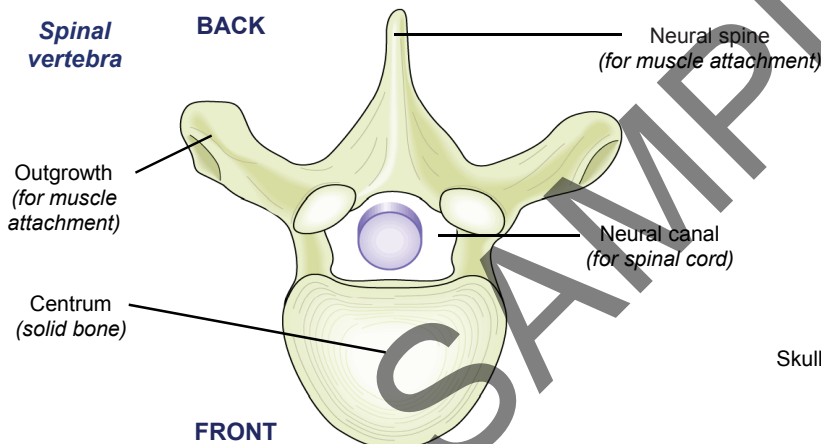
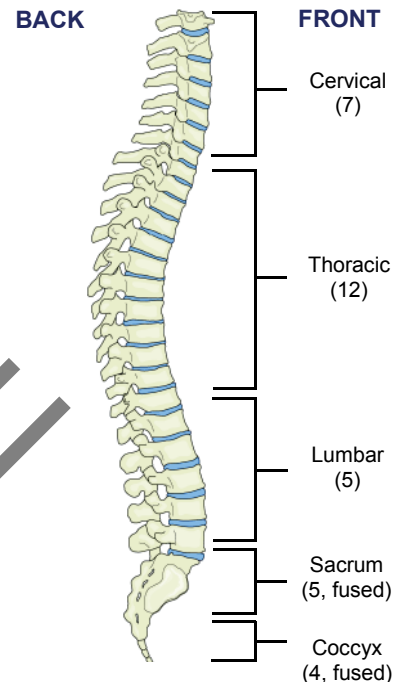
Consists of the **skull**, **vertebral column** (spine), **ribs** and **sternum**.

The vertebrae have a hollow central canal through which the **spinal cord** passes.

Between the vertebrae (except the fused vertebrae of the sacrum and coccyx) are spongy, fluid-filled discs of cartilage.

The discs are located in front of the spinal cord and absorb shocks.

The regions of vertebrae are as follows: **cervical** (7), **thoracic** (12), **lumbar** (5), **sacrum** (5 fused), **coccyx** (tailbone, 4 fused).



### 2. The Appendicular Skeleton

Consists of the **limbs** and the **girdles** that attach them to the spine.

The **pectoral girdle** (shoulder) and the **pelvic girdle** (hip) are the two girdles.

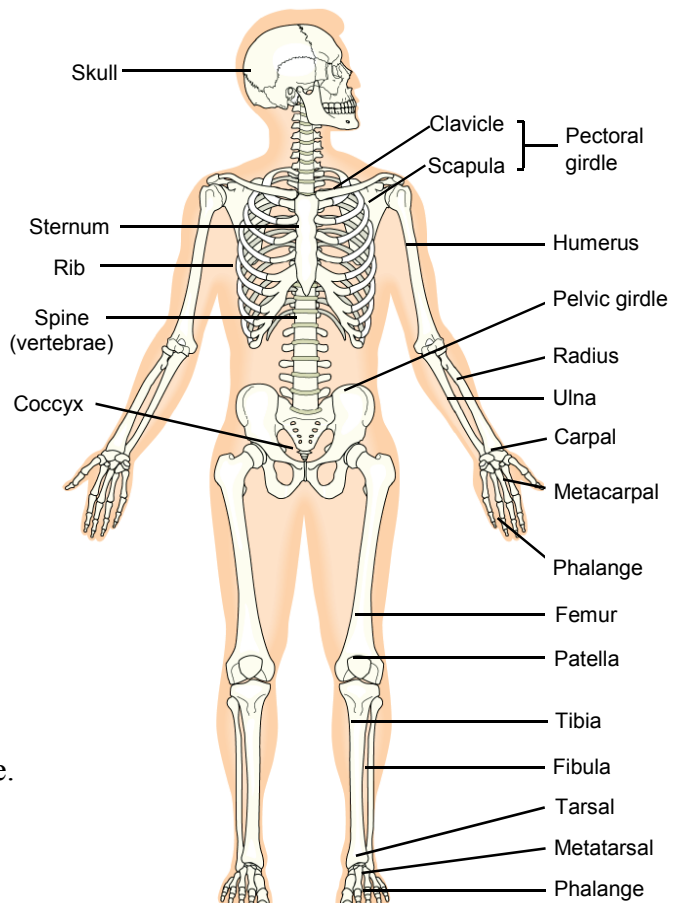
The pectoral girdle consists of the **clavicle** (collar bone) and **scapula** (shoulder blade). Attached to this are the bones of the arm, the **humerus**, **radius**, **ulna**, **carpals** (wrist), **metacarpals** (hand), and **phalanges** (fingers).

The pelvic girdle is made up of fused hip bones that surround a cavity.

It is attached to the sacrum of the vertebral column.

The bones of the leg are attached to the pelvic girdle.

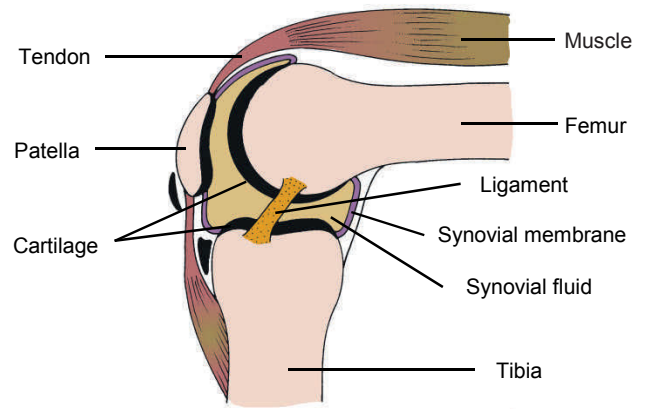
They are: the **femur**, **patella**, **tibia**, **fibula**, **tarsals** (ankle), **metatarsals** (feet) and **phalanges** (toes).



## Joints

A joint is where two bones meet. There are 3 types, depending on the amount of movement they allow:

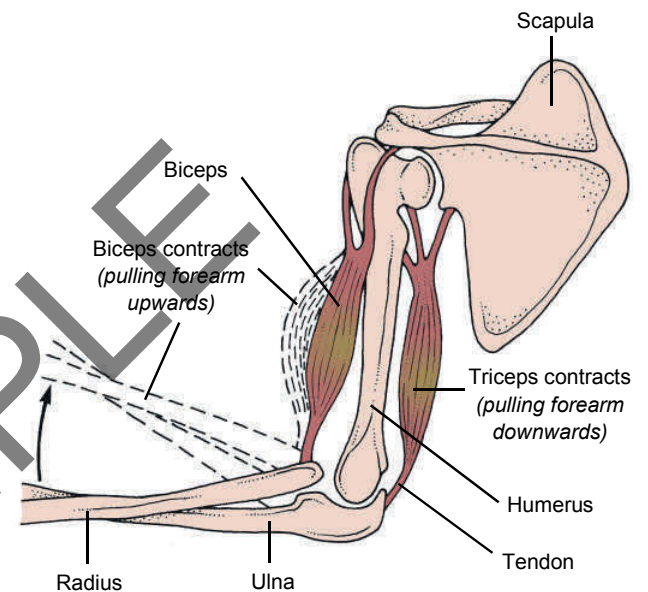
1. **Immovable:**  
allow **no movement**.  
e.g. between the skull bones.
2. **Slightly movable:**  
e.g. between the **vertebrae**.
3. **Free moving (synovial):**  
e.g. **hinge joint** – knee, elbow.  
**Ball and socket** – hip or shoulder.



Synovial joint

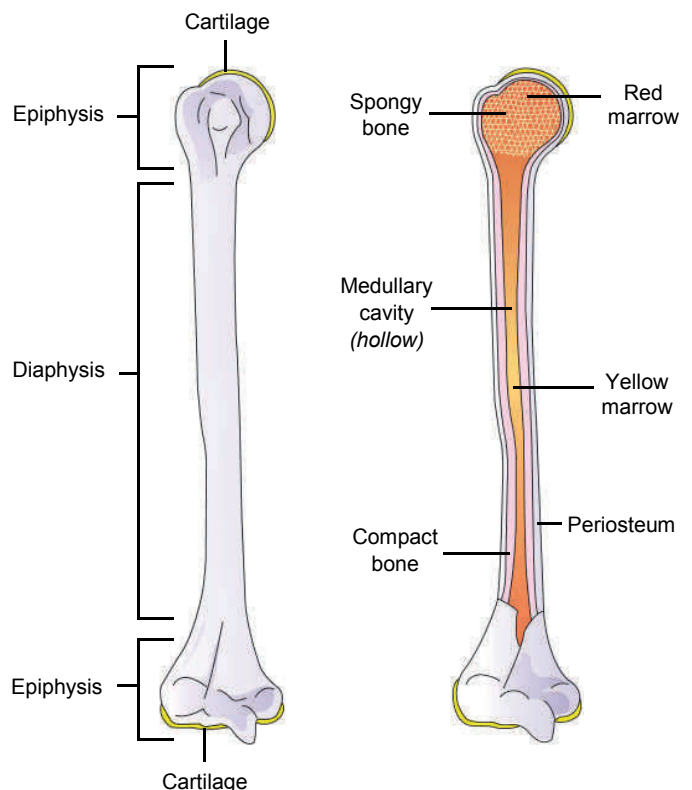
## Antagonistic Muscles

Muscles can only **contract**. Another muscle working **opposite** is needed to pull on the contracted muscle and thereby lengthen it again. Such pairs of muscles are called **antagonistic muscle pairs**, e.g. the **biceps** and **triceps** muscles of the upper arm.



## Structure of a Long Bone

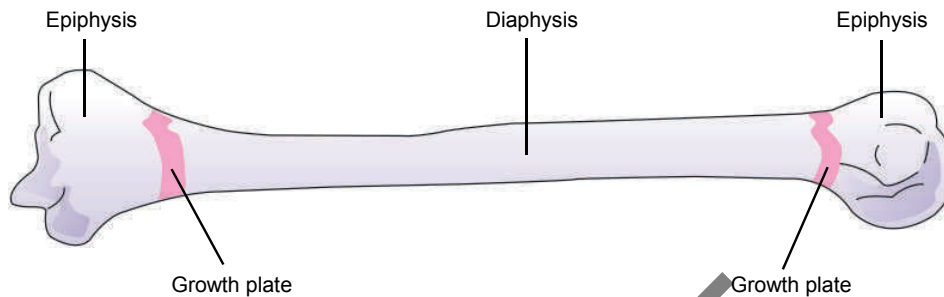
1. **Compact bone:**  
**Dense** outer layer of smooth, **solid** bone. It gives strength and rigidity and contains living cells which are supplied by blood vessels and nerves.
2. **Spongy bone:**  
Consists of bone rods forming a **honeycomb structure** with many **spaces** in between. It gives strength and rigidity and is **lighter** than compact bone. The spaces are filled with either red bone marrow that produces blood cells or yellow bone marrow that stores fats.
3. **Articular cartilage:**  
Surrounds the ends of the bone and **protects** it from **friction** and **shock** during movement at the joints.
4. **Medullary cavity:**  
**Central cavity** bounded by compact bone, tapering at the ends to spongy bone. It is filled with yellow bone marrow in adults, and red bone marrow in the long bones of children.



## Growth of Bones

The skeleton of the human embryo is made of **cartilage**. After week 8, the cartilage is gradually replaced by bone tissue. Bone-making cells, called **osteoblasts**, secrete a **protein matrix** and combine it with **calcium phosphate**. This **organic** and **inorganic component** of bone makes it very strong.

In young persons, the lengthening of long bones is centered at two **growth plates** at either end of the shaft. Growth plates are made of cartilage cells that divide to lengthen the bone, and then are changed to bone by the osteoblasts. When the bone is fully grown, the **growth plate fuses** and disappears – the person has reached their maximum height.



In adults, bone is continually being broken down by other cells called **osteoclasts** and being replaced again by the **osteoblasts**. As osteoclasts break down bone, osteoblasts build it up again.

Osteoclasts absorb broken-down bone cells and deposit their calcium into the blood.

This calcium, and calcium taken in the diet, is used by the osteoblasts to make the calcium phosphate for new bone.

**Hormones** – including thyroxine, growth hormone, oestrogen and testosterone – regulate bone growth.

**Exercise** is good for the skeleton as it responds to the stress by producing a greater bone mass.

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## Arthritis

Arthritis is a painful disorder where there is **inflammation** in one or more joints, resulting in swelling, warmth, pain and restricted movement. It is caused by the joint **cartilage degenerating** through wear and tear and old age.

Prevention can be through good diet, care in selection of footwear, and avoiding excessive stress on bones and joints during exercise.

It is treated with **aspirin** to reduce swelling, inflammation and pain or, in severe cases, by **replacement** of the joint (e.g. a new hip joint).