

Part 2: Skeletomuscular system

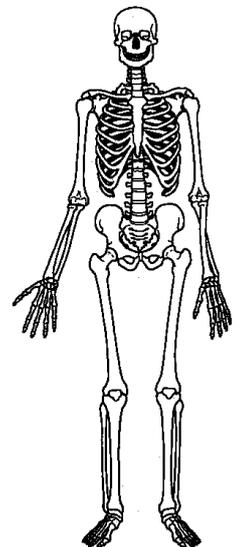
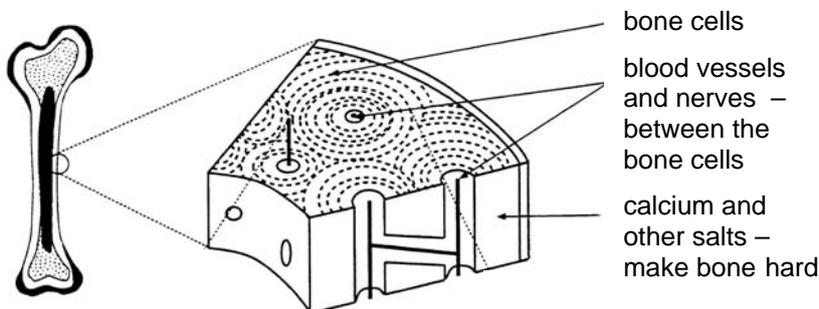
The skeleton is divided into: **Axial skeleton** (bones of the head, neck, trunk skull, vertebral column, rib cage (sternum and 12 pairs of ribs). **Appendicular skeleton** (bones of the limbs and hip/shoulder blades, scapula and clavicle, arm, pelvic girdle and leg).

Functions of Skeleton.

- **Support** - for the body's organs, & enabling body to stand upright.
- **Movement** - anchorage for muscles to pull against. Bones act as levers.
- **Protection** - protect delicate organs underneath - skull (brain), ribs & sternum (heart & lungs), spinal cord (vertebral column).
- **Mineral storage** - bones store minerals calcium (needed for ossification / hardening bone) and phosphate.
- **Blood manufacture** - bone marrow (particularly pelvic girdle, ribs, sternum and vertebrae) makes blood cells. Red bone marrow produces blood, yellow bone marrow stores fat.

The human skeleton has 206 bones. We are born with about 300 but many fuse together as a child grows up.

- Bone is a very hard living tissue with a blood supply and nerves, and able to heal itself if broken.
- Bone cells – **osteocytes** – are arranged in circles around central tubes – Haversian canals - that contain blood vessels and nerves to make a “web”. Space between cells and channels is a hard matrix of collagen (protein), calcium carbonate and calcium phosphate.



- In an embryo the skeleton is originally made of cartilage. As the foetus grows and the infant develops it changes from cartilage to bone.
- A long bone, such as your femur (thigh bone), grows in length at either end in regions called growth plates. Growth occurs when cartilage cells divide and increase in number in these growth plates. These new cartilage cells push older, larger cartilage cells towards the middle of a bone. Eventually, these older cartilage cells die and the space they occupied is replaced with bone. When a bone has reached its full size, its growth plates are converted into bone (ossified) and can't grow any more but can still be repaired.

Bones of the skeleton are linked to each other by **ligaments**. **Muscles** are attached to bones by **tendons**, and contractions of the muscles bring about movement of limbs and body. Muscles are attached to bones on either side of a joint. Muscles can only contract. They work in **antagonistic pairs** to produce a full range of movements, one contracting (shortening) as the other is relaxing. Eg. **biceps and triceps muscles**. When the biceps muscle contracts, the lower arm flexes (bends) at the elbow joint and the triceps muscle is stretched. When the triceps muscle contracts, the lower



arm extend (straightens) and the biceps muscle is stretched. **Extensors** muscles straighten a limb and **flexors** muscles bend a limb.

Tendons join voluntary muscles to bones. They grow into the periosteum (outer bone covering). When the muscle contracts, the tendon pulls on the bone and moves it. A muscle has an **origin** (where the tendon of the muscle is anchored to a fixed point on the skeleton) and an **insertion** (where the tendon is attached to the bone that will move). The origins of the triceps are in the shoulder, and two places on the humerus, and the insertion is in the ulna. Another eg of antagonistic muscles are **quadriceps** and **hamstring muscles** in the leg.

Classifying Muscles

The muscles in the body can be divided into three distinct groups:

- **Voluntary** - brain sends messages to muscle through nerves when we decide we want the muscle to contract. Voluntary muscles also contract to keep the body stable when sitting and standing (known as muscle tone).
- **Involuntary** (smooth) - found in the walls of internal organs, contraction not under conscious control (eyes, diaphragm, intestines, blood vessels, bladder, stomach).
- **Cardiac** - involuntary muscle found only in the walls of the heart that contracts rhythmically

Classification of Bones. The bones can be divided into four different groups:

- **long** bones eg femur, humerus, metacarpals, phalanges, ulna - long and cylindrical in shape and associated with movement
- **short** bones eg wrist carpals and foot tarsals – usually squarish bones for strength with limited movement
- **flat** bones eg ribs, sternum, scapula, skull – enclose & protect our vital organs
- **irregular** bones eg vertebrae - having no definite geometrical shape

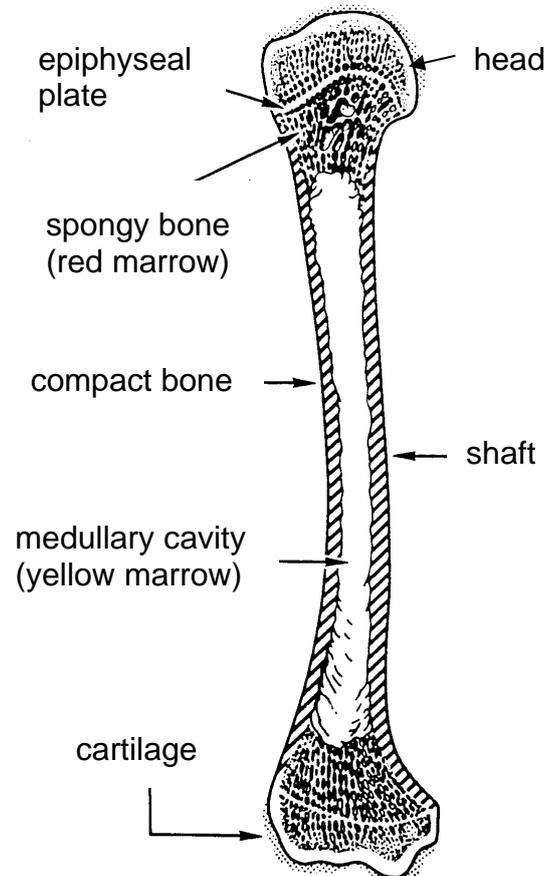
Parts of a bone

- epiphysis – ends (head) of the bone
- diaphysis - shaft of the bone made of compact bone
- compact bone - solid bone
- spongy bone - bone that is spongy; contains red marrow
- epiphyseal plate - separates the spongy bone of the epiphysis and the compact bone of the diaphysis
- periosteum - tough, outer covering of bone
- medullary cavity - contains yellow marrow
- cartilage - smooth slippery surface to protect the ends of the bones from jarring and scraping

Joints. A joint is simply where two or more bones meet. There are fixed joints, slightly movable joints & synovial joints. **Ligaments** are tough straps of connecting tissue keeps the joint together, by connecting bone to bone. They are flexible, very strong bundles of fibres. They stop the bones dislocating by restricting their movement.

Synovial joint

A synovial joint is lubricated with **synovial fluid**. It reduces friction as the bones move. The membrane which contains and produces it is called a synovial membrane. The ends of the bones are covered with a layer of smooth hyaline **cartilage**, called articular cartilage in the joint regions. This reduces friction at the point.



Ball and socket joints - most flexible and strongest joints eg hip and shoulder joints, allowing you to swing your legs and arms in many different directions.

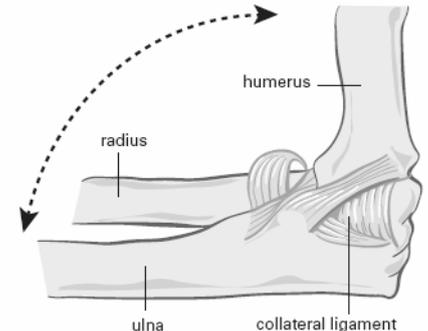
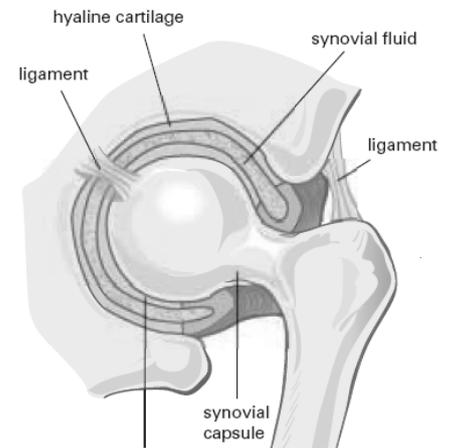
Hinge joints – eg knee and elbow, enabling movement similar to the opening/closing of a door.

Gliding joints – eg some of bones in your wrists and ankles. Occur between the surfaces of two flat bones that are held together by ligaments.

Pivot - joint allowing rotation in the socket. The atlas and axis (first and second vertebrae under the head) allow you head to turn from side to side. The forearm twists and untwists (flip your hand back and forth) because of a pivot joint between the radius and ulna.

Ellipsoidal joints eg joint at the base of your index finger, bending and extending, rocking from side to side, but limited rotation.

Saddle joints - in your thumbs, can rock back and forth and from side to side, but have limited rotation.



Functions and processes carried out

Bone is a living tissue. It has to be constantly renewed to keep it strong. Old bone is being broken down and replaced by new stronger bone all the time, a process called bone remodeling. There are two main types of cell in bone: osteoclasts which destroy bone and osteoblasts which make new bone. A long bone, such as your femur (thigh bone), grows in length at either end in regions called growth plates. Growth occurs when cartilage cells divide and increase in number in these growth plates. These new cartilage cells push older, larger cartilage cells towards the middle of a bone. Eventually, these older cartilage cells die and the space they occupied is replaced with bone. When a bone has reached its full size, its growth plates are converted into bone.

Broken bones - different types of fracture

- simple fracture - bone breaks cleanly.
- impacted fracture - ends of two bones are forced into one another
- spiral fracture – jagged bones caused by twisting
- compound fractures - bone breaks into fragments
- compression fractures - bone is crushed.
- greenstick – incomplete fracture, usually in young flexible bones
- open – broken bone penetrates the skin – risk of infection

Realignment & Repair

The bones are realigned to stop them from healing in the wrong shape, and held in place using: Plaster or fiberglass casts; Pins and wires; Plates, wires, screws, and rods (if severely fractured). Simple fractures take about 6-8 weeks to heal, although larger or older bones take longer. Four main steps in bone repair are:

- A blood filled swelling - haematoma – forms where blood vessels ruptured (site of fracture)
- A callus (of cartilage) replaces the haematoma and splints the broken bone
- A bony callus (spongy bone) forms and replaces the cartilage
- The bony callus remodels making a strong, permanent patch where the bone broke.

Injuries to muscles and tendons

Strain - muscles and tendons damaged by being suddenly pulled hard (common if a person does not 'warm up' before exercise). Tendons often injured are the hamstring (connects

large muscles in thigh to leg bones) and Achilles tendon (back of your ankle). A strong force on a tendon can sometimes cause it to break right through (rupture). Overused tendons can get inflamed eg “tennis elbow” affects the tendons attaching lower arm muscles to the elbow making the joint feels sore even when it isn’t being used. Strained muscles and tendons usually get better by themselves if you rest while the body gets on with mending the damage.

Sprains – Caused when the joint is moved beyond its normal limits of movement, sprains are partly torn ligaments. A person may sprain an ankle by falling awkwardly onto it, twisting it, damaging the ligaments holding the ankle bones together. Putting out a hand to break a fall can sprain a wrist. The joint often swells up. Something cold, such as ice, held against the damaged area will help to ease the pain. Sometimes when the tear is complete, surgery is needed to re-attach the ligament

Treatment for both includes **RICE**: R – **rest** (prevent more damage and reduce bleeding). I – **ice** (reduce blood flow, pain and to prevent swelling). C – **compression** (reduce bleeding and prevent swelling). E – **elevation** (prevent excess fluid accumulating around injury – raise injury above heart level)

Arthritis

Joints become inflamed and can be painful, hot and swollen. There are two types of arthritis **Osteoarthritis** – “*wear and tear*” arthritis, restricted to the joints and caused by cartilage being worn away from the ends of bones. The joint (usually weight bearing ones like hips, knees and spine) becomes stiff and painful when moved. It is common in previously damaged joints. It worsens with age. Badly affected joints can be replaced by artificial ones eg knee or hip replacement.

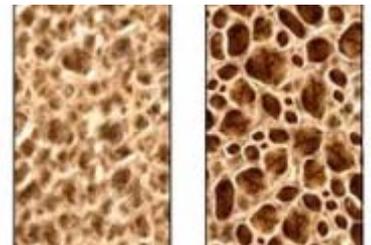
Rheumatoid Arthritis – this is an auto-immune disease and it affects more than just the joints. Fibrous tissue around the joints becomes inflamed, smaller joints eg the fingers are affected first. It generally affects younger people, and sufferers can have periods with mild symptoms are followed by periods where the symptoms are very bad. Joint replacement, especially of the fingers, may be used in severe cases.

Osteoporosis

In osteoporosis, the amount of both compact and spongy bone is reduced, both of these increasing the likelihood of fracture. Men begin to lose calcium from the skeleton from about age 40 and women from age 30. The body cannot absorb calcium as effectively and so the bones begin to thin leading to **osteoporosis**. The hormonal changes in **menopausal women** speed up bone thinning. Oestrogen deficiency is known to be mainly responsible for menopausal bone

normal

osteoporosis



loss in women. The risk of developing osteoporosis depends on how much bone a person has as a young adult and how quickly she or he loses bone in later life. The characteristic rounded shoulders of a person with osteoporosis are caused by tiny fractures in the vertebrae, causing the back to bend under its own weight. Osteoporosis can be combated with calcium supplements, regular exercise and a healthy diet.

MY EXTRA NOTES