The Skeletal System

Joints

- In the skeleton a joint is the area where two or more bones meet.
- The skeleton consists of over one hundred joints.
- Joints allow our muscles to move our bones so that we can move.
- Joints are put into groups based on the amount of movement they allow.
- There are three types (groups) of joints:
  1. Immovable joints
  2. Slightly movable joints
  3. Freely movable joints

**Note:** Freely movable joints predominate in the limbs, whereas immovable and slightly movable joints are largely restricted to the axial skeleton, where firm bony attachments and protection of enclosed organs are priorities.

1. **Immovable joints** also called fibrous joints or fixed joints.
   - These joints are fixed
   - There is no movement between the bones because they interlock or overlap and are held together by tough fibre.
   - These joints are found between the flat bones of the skull and between the bones of the pelvic girdle.

(a) Suture

- Dense fibrous connective tissue
- Suture line
2. **Slightly movable joints** also called **cartilaginous joints**
   - This joint allows a slight amount of movement
   - The bones of this type of joint are held together by ligaments
   - Cartilage lies between the adjoining bones to prevent them from rubbing or knocking together.
   - This type of joint is found between the bones of the vertebral column and in the places where the ribs meet the sternum
3. **Freely movable joints** also called **synovial joints**

- There are six types of freely movable joints
- These joints contain similar features such as, articular cartilage, synovial fluid, a synovial membrane and surrounding ligaments
- A wide variety of movement is possible, although this may be restricted by the shape of the connecting bones, ligaments and tendons
- These joints are located at the hips, knees, ankles, feet, shoulders, elbows, wrist and hands

Types of Synovial Joints: Bones that are referred to are yellow. Non-involved bones are white.
Types of Freely Movable Joints

Note: The range of a joint is determined by the shape of the bones at the joint and/or its strong ligaments.

a) Gliding or plane joint allows a little movement in all directions.
   - The flat surfaces of the bones glide or slide across the top of another.
   - Ligaments limit the movement.
   - The carpals of the wrist and the tarsals of the feet are examples of gliding joints.

b) Hinge joint allows movement in one direction (or plane) only.
   - It widens or reduces the angle between two long bones.
   - A less rounded head of one bone fits into a cavity on another bone.
   - Movement is limited by the shape of the bones and position of the ligaments.
   - Examples are the elbow and fingers.

c) Pivot Joint allows a rotation movement only.
   - One bone has a bit that sticks like a peg or a ridge which fits into a ring or notch in the other bone.
   - Examples are in the neck where the atlas and the axis meet and in the upper forearm where the radius and ulna meet.

d) Condyloid joint is a mixture of a hinge and a ball and socket joint which allow movement in two planes (forward and backward and from side to side).
   - The ends of the bones in this joint are curved instead of round. The rounded end of one bone fits into the hollow of another.
   - Ligaments prevent rotation.
   - The wrist is an example.

e) Saddle joint allows movement in two planes at right angles to each other (backward and forward and side to side).
   - The connecting bones have a similar saddle shape and fit neatly together.
   - The shape of the bones limits the movement.
   - An example is the joint formed by the metacarpal of the thumb and a carpal of the hand.

f) Ball and socket joint allows movement in all directions.
   - The rounded head of a bone fits into a cup-like socket on another bone.
   - Ligaments keep the joint stable.
   - Examples are the hip and shoulder joint.
Structure of a Freely Movable Joint

A freely movable joint consist of the following parts:

Ligaments
- Bands of tough fibrous tissue which come in different shapes and sizes.
- They hold bones together and limit the range of movement in the joint.
- Prevent dislocation
- Will stretch to a limited amount

Joint capsule
- This is an outer sleeve of the joint which holds the bones together and protects the joint. It is an extension of the skin or periosteum (a fibrous tissue) that covers each bone.

A Synovial Membrane
- This lines the capsule and discharges a fluid called synovial fluid

Synovial Fluid
- Lubricates the joints to allow friction-free movement.

A Joint Cavity
- A small gap where the bones meet. It is filled with synovial fluid.

Hyaline Cartilage
- A tough, hard, smooth tissue that covers the ends of bones at a joint
- Prevents bones from knocking together and reduces friction during movement
**CONNECTIVE TISSUE**

**Cartilage, Ligaments and Tendons** are associated with the skeleton and play an important role in movement.

**Cartilage** is a glassy, smooth tissue that is tough but flexible. It protects the bones and stops them from knocking together. There are three types of cartilage: hyaline, elastic and fibrocartilage.

- **Hyaline cartilage** is found covering the ends of the bones in all synovial joints and at the ends of the ribs that meet the sternum. It provides smooth surfaces, enabling tissues to move/slide easily over each other, e.g. facilitating smooth movements at joints. It also provides flexibility and support.

- **Fibrocartilage** forms the discs between the vertebrae of the spine and the cartilage pads of the knee joint. It absorbs shocks to prevent damage to bones, enhances the sturdiness of joints while still allowing movement. It is the **strongest** of the three types of cartilage.

- **Elastic Cartilage** is found in the external ear and the epiglottis. It provides support to surrounding structures and helps to define and maintain the shape of the area in which it is present.

**Ligaments** are bands of slightly stretchy, fibrous tissue that hold one bone to another to form a joint. Ligaments control the range of motion of a joint, e.g. preventing the elbow from bending backwards, and stabilizing the joint so that the bones move in the proper alignment. The more ligaments a joint has, the stronger it is. Stretched ligaments stay stretched and can stretch only about 6% of its length before it snaps.

**Tendons** are strong, non-elastic cords that join muscles to bones, and therefore, allow movement to take place.

**Note:** Stretching exercises increase the length of the muscles allowing the joint to move farther than before. The ligaments themselves are not stretched, as they provide support for the joint.
MOVEMENT

The different joints of the skeleton allow a variety of movements. The type of movement at a joint depends on the shape of the bones at the joint and/or its ligaments. The movement occur when a muscle contracts to pull on a bone and another muscle relaxes to allow that bone to move.

Types of Movement

**Flexion** is a movement which **bends**, thereby decreasing the angle at the joint between the bones. Flexion is nearly always forward. E.g. bending the arm at the elbow and bending the leg at the knee.

**Extension** is a movement which **straightens**, thereby increasing the angle at the joint between the bones. It is the opposite of flexion. E.g. straightening the arm at the elbow and straightening the leg at the knee.

**Abduction** is a sideways movement of a bone/limb **away from the centre line** of the body. E.g. Raising the arm out to the side.

**Adduction** is a sideways movement **towards the centre line** of the body. It is the opposite of abduction.

**Rotation** is a turning movement around an imaginary line or central axis. E.g. Turning the head and turning the palm facing up to facing down.

**Circumduction** is a movement where the end of the bone makes a circle. A cone shape is formed.

Types of joints, their location and the movements they allow

<table>
<thead>
<tr>
<th>Type of joint</th>
<th>Location</th>
<th>Movement allowed</th>
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<tbody>
<tr>
<td>Ball and socket</td>
<td>Shoulder and Hip</td>
<td>Flexion and extension, Abduction and adduction, Rotation and Circumduction</td>
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<tr>
<td>Hinge</td>
<td>Elbow, knee, finger</td>
<td>Flexion and extension</td>
</tr>
<tr>
<td>Pivot</td>
<td>Head on spine, elbow</td>
<td>Rotation only</td>
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<tr>
<td>Saddle</td>
<td>Base of thumb</td>
<td>Flexion and extension, Abduction and adduction</td>
</tr>
<tr>
<td>Condyloid</td>
<td>Wrist</td>
<td>Flexion and extension, Abduction and adduction</td>
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<tr>
<td>Gliding</td>
<td>Carpal bones in wrist; Tarsal bones in ankle</td>
<td>Some gliding in all directions (no bending or circular movements.</td>
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FIGURE 6.6 Movements allowed by synovial joints. (a) Gliding movements. (b–g) Angular movements. (h,j) Rotation.
**FIGURE 8.6**
(continued), (f,g) Angular movements, (h,i) Rotation.

**FIGURE 8.7**
Special body movements.
THE EFFECTS OF EXERCISE ON THE SKELETAL SYSTEM

Regular exercise can improve the Skeletal System in the following ways;

1. Bones become stronger in order to deal with the stress that exercise places on them.

2. The cartilage at the ends of bones becomes thicker and better at shock absorption.

3. Ligaments will stretch slightly to enable greater flexibility at the joint.