

## 1. Details of Module and its structure

Module Detail	
Subject Name	Biology
Course Name	Biology 02 (Class XI, Semester - 2)
Module Name/Title	Locomotion and Movement: Part – 4
Module Id	Kebo_22004
Pre-requisites	Characteristics of living of living organism?
Objectives	After going through this lesson, the learners will be able to understand the following: <ul style="list-style-type: none"><li>• What are joints?</li><li>• Classification of joints</li><li>• Functions of joints</li><li>• Muscular Disorders</li><li>• Skeletal Disorders</li></ul>
Keywords	Joints, Cartilage, Synovial, Ligament, Tendons, Femur, Tibia, Fibrous, Immovable, Ball and Socket, Hinge, Pivot, Disorders, Axial

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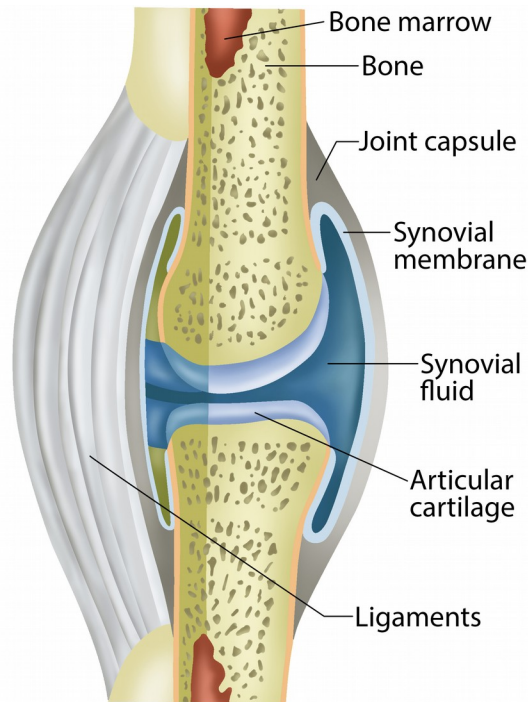
### **1. Introduction**

Just observe every gesture you do with your body. What do you find ? Every time you try to move your body you are moving one or the other part of the body. Every time you walk, run, sit down, eat or hug someone you are using your bones, voluntary muscles and joints. We have already discussed bones and muscles, so in this module we would be discussing joints.

A joint is a place where two or more bones meet. It is a structure in the body at which two parts of the skeleton are fitted together. Joints are the junctions where two or more bones articulate with each other. These joints allow the movement of bones in different ways. Most joints are mobile, allowing the bones to move.

Joints hold your bones together. For this joints contain a variety of fibrous connective tissue. Ligaments connect the bones to each other, tendons connect muscle to bone and cartilage covers the ends of bones and provides cushioning.

In human anatomy, a joint is the physical point of connection between two bones. For example, the knee joint is the point of connection between the femur, or thigh bone, and the tibia, or shin bone. The hip is the point of connection for femur and pelvis, the wrist is the connection point of Radius, Ulna and Carpels, and so on.



## 2. Joints

The area where two bones are attached for the purpose of permitting body parts to move is a joint. The anatomy of a joint consist of the following parts:

- **Cartilage** - A type of tissue that covers the surface of a bone at a joint. Cartilage helps reduce the friction of movement within a joint.
- **Synovial membrane** - A tissue called the synovial membrane lines the joint and seals it into a joint capsule.
- **Ligaments** - Strong ligaments which are tough, elastic bands of connective tissue surround the joint to give support and limit the joint's movement.
- **Tendons** - Tendons are also tough connective tissue on each side of a joint which attach to muscles that control movement of the joint.
- **Bursas** - Fluid-filled sacs are called bursas. They are present between bones, ligaments, or other adjacent structures and help cushion the friction in a joint.
- **Synovial fluid** - The synovial membrane secretes synovial fluid which is a clear and sticky fluid around the joint to lubricate it.
- **Femur** - This is the thighbone.
- **Tibia** - This is the shin bone.
- **Patella** - This is the kneecap.
- **Meniscus** - This is a curved part of cartilage in the knees and other joints.

## 2. Structural Classification of Joints

Till now you have understood the definition and constitution of joints. Now, let's try to classify joints based on the articulating surface of the adjacent bones, whether they are directly connected by fibrous connective tissue or cartilage or whether the articulating surface contact each other within a fluid-filled joint cavity.

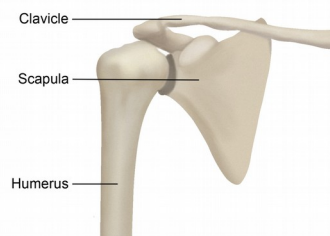
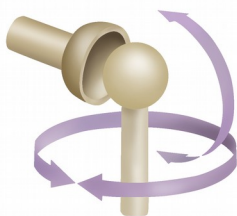
**(a) Fibrous or Fixed or Immovable joints** - As the name suggests, in this type of joint, the bones are held firmly together and movements are not allowed in between them. At these joints a dense and tough inextensible white fibrous tissue is present. For example, sutures that join the various bones of the skull.

**(b) Cartilaginous or Slightly movable joints** - As we have discussed that joints are the places where two bones meet. So, at the Cartilaginous joints a dense disc of white fibrocartilage is present that joins the opposite surfaces of the articulating bones. It allows only a little movement like bending and rotation. These joints are seen in between the vertebrae.

**(c) Synovial or Freely movable joints** - In this type of joint there is a fluid filled synovial cavity in between the movably articulated bones. This cavity is filled with a fluid called synovial fluid. The cavity is even protected by a synovial membrane which covers this fluid filled synovial cavity forming the capsule. The articulating bones are provided with cartilage caps. Ligaments are also present to hold the bones.

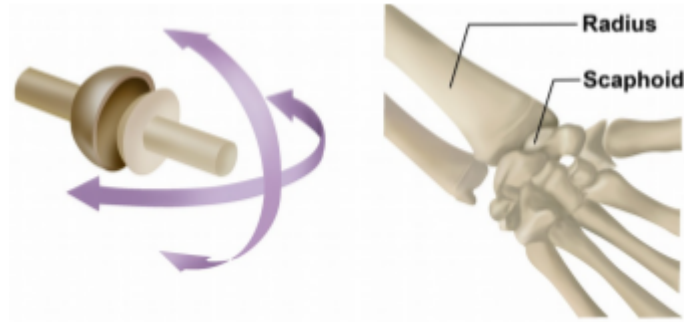
The Synovial joints are further classified as:

**i) Ball and socket joint** - This kind of joint involves two bones. One of the bones forms a glob-

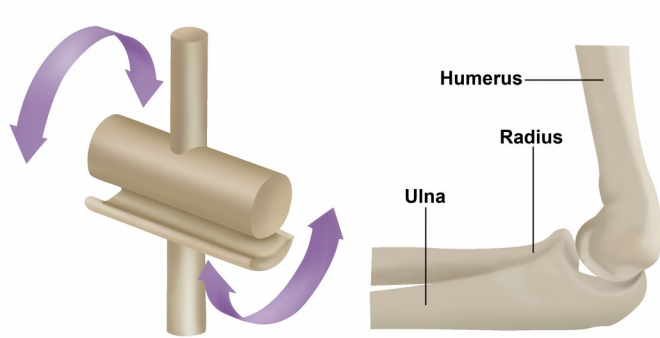
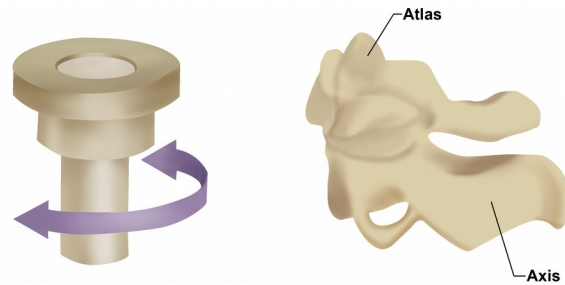


ular head while the other forms a cup-like socket into which head fits in. It allows a free movement in all directions. A ball and socket joint provides the greatest degree of movement among different kinds of joints. Such joints may stretch, fold and rotate the limb of the body. This

may allow the movement of the limb towards the body or away from the body. For example - shoulder girdle and hip girdle joints.

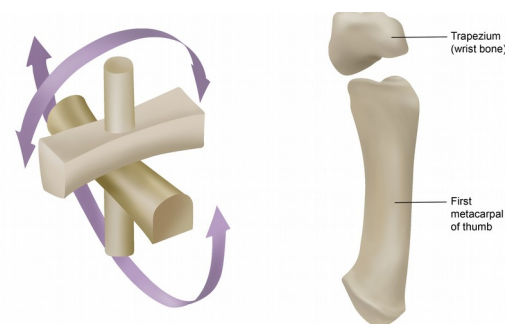


**(ii) Hinge joint** - This joint is said to be a very simple joint that allows movement only in one



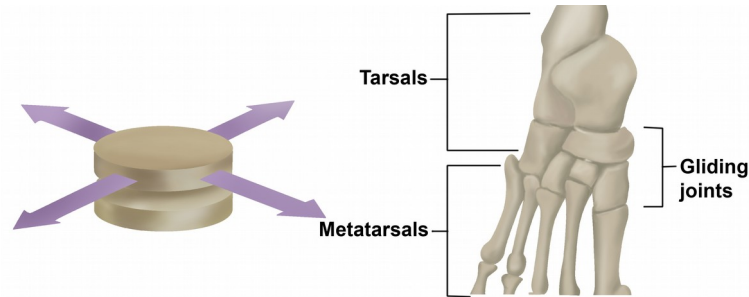
axis. Here the two bones are fitted like the hinge of a door so as to allow to and fro movements in one direction only. It allows only two kinds of movements - flexion and extension. These joints are provided with strong ligaments. It is seen in elbow joint, knee joint and joints between phalanges of fingers and toes.

**(iii) Pivot joint** - In this type of joint, one bone is fixed while the other moves freely over it. It



consist of the rounded end of one bone fitting into a ring formed by the other bone. This structure allows rotational movement, as the rounded bone moves around its own axis. Example : Joint of the first and second vertebrae of the neck that allows the head to move back and forth. Also the joint of the wrist that allows the palm of the hand to be turned up and down.

**(iv) Gliding joint** - It is a biaxial joint, the articulating bones of which can glide one above the other. It is seen in wrist bones that can glide over forearm bones. For example some of the bones in the palm or in the sole of foot.



(v) **Ellipsoid joints** - They permit movements of articulating bones around two axes. Such joints are formed between the toe bones and some bones in the sole of foot.

### 3. Functional Classification of Joints

The functional classification of joints is determined by the amount of mobility found between the adjacent bones. Joints are functionally classified as :

**4.1 Synarthrosis:** A joint that is unable to move i.e. immobile or nearly immobile is called a synarthrosis. It is found in places where internal organs need protection. For example the sutures, the fibrous joints between the bones of the skull that surround and protect the brain. Also, the manubriosternal joint, the cartilaginous joint that unites the manubrium and body of the sternum for protection of the heart and Gomphosis joints found between teeth and sockets of the maxilla and mandible are also synarthrosis joints.

**4.2 Amphiarthrosis:** It is a type of continuous, slightly movable joint. It is a joint permitting limited mobility, as that between the vertebrae. It also implies the bones involved are joined together with the help of cartilages or the cartilaginous joint that unites the bodies of adjacent vertebrae. They are the Shock absorbers. Filling the gap between the vertebrae is a thick pad of fibrocartilage called an intervertebral disc. Each intervertebral disc strongly unites the vertebrae but still allows for a limited amount of movement between them. However, the small movements available between adjacent vertebrae can sum together along the length of the vertebral column to provide for large ranges of body movements. Another example is the pubic symphysis of the pelvis. This is a cartilaginous joint in which the pubic regions of the right and left hip bones are strongly anchored to each other by fibrocartilage. This joint normally has very little mobility. The strength of the pubic symphysis is important in conferring weight-bearing stability to the pelvis.

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**4.3 Diarthrosis:** This is an articulation that permits free movement. It is a condition of freely movable joints. These types of joints include all synovial joints of the body, which provide the majority of body movements. These joints are found in the appendicular skeleton and thus give the limbs a wide range of motion. These joints are further divided into three categories, based on the number of axes of motion provided by each. *An axis in anatomy is described as the movements in reference to the three anatomical planes : transverse, frontal, and sagittal.* Thus, diarthroses are classified as:

**4.3.1 Uniaxial joints-** for movement in one plane, only allows for a motion in a single plane, around a single axis. For example - The elbow joint, which only allows for bending or straightening.

**4.3.2 Biaxial joints-** for movement in two planes. For example - Metacarpophalangeal joint (knuckle joint) of the hand. The joint allows for movement along one axis to produce bending or straightening of the finger, and movement along a second axis, which allows for spreading of the fingers away from each other and bringing them together.

**4.3.3 Multi axial joints-** for movement in all three anatomical planes. It is also called polyaxial or triaxial joint. For example - The shoulder and hip joints. They allow the upper or lower limb to move in an anterior-posterior direction and a medial-lateral direction. In addition, the limb can also be rotated around its long axis. This third movement results in rotation of the limb so that its anterior surface is moved either toward or away from the midline of the body.

#### **4. Functions of joints**

- Joints connect the bones within your body.
- They help the body to bear weight.
- They are essential for all types of movement.
- Some of them do not allow motion, like knee and ankle have predetermined range of motion.
- The joints make body flexible.
- Some joints allow growth of the structures to which they are connected to.
- The range of motion of a joint is usually measured in degrees. A joint can be opened until it is straight.
- Stretching is another function of the joint. It helps in bending of a joint so that the bones forming the joint are moved farther apart, or straightened.

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- Joints even help in flexion. This is a condition where the bones that form a joint are pulled closer together.

## 5. Disorders of Muscular system

**Myasthenia gravis:** This is an autoimmune disease where the antibodies affect the nerves and they lose their ability to generate muscular contractions. Muscles of the face and neck are most affected. This leads to fatigue, drooping eyelids, difficulty and in some cases inability to swallow, weakening and paralysis of skeletal muscles are some of the examples.

**Muscular dystrophy:** In this there is progressive degradation of skeletal muscles of the body due to genetic disorder. They continue to lose their ability to walk, make movements with their hands etc. as they grow old.

**Tetany:** Uncontrolled twitching of muscles is known as tetany. It is a condition when there are rapid spasms in muscles due to low calcium in the body fluid. There can be many causes such as nutritional deficiencies, infections or other nervous system disorders that can cause tetany in muscles.

**Sprain and strain:** The most common muscular disorders are sprains and strains. They are two different disorders often confused with one another.

- A sprain occurs due to injury to the ligament and the joint is twisted but there is no dislocation of the bones. They can be mild to severe and can be accompanied by inflammation and pain. Severe cases also cause immobility of the body part.
- Strain is less severe than a sprain. It is an injury to a muscle or a tear in tendon due to over-stretching. A strain is caused by twisting or pulling a muscle or tendon. Strains can be acute or chronic. An acute strain is caused by trauma or an injury such as a blow to the body. It can also be caused by improperly lifting heavy objects or over-stressing the muscles.

## 6. Disorders of Skeletal System

The primary skeletal conditions are metabolic bone diseases such as osteoporosis, osteomalacia, and a few other rarer conditions.

**Osteoporosis:** A very commonly occurring disease that is characterized by reduced mineral density in bones. In osteoporosis, bone loses calcium, becomes thinner and may disappear com-



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pletely. It is more common in women as compared to men. Due to the decreased density of the bones, they are highly susceptible to fractures. Having calcium supplements helps to protect the bones and restore the bone density.

**Osteomalacia:** It is the softening of the bones. It is often caused by a vitamin D deficiency and results from a defect in the bone-building process.

**Arthritis:** It is found mainly in elderly population. It is a group of more than 100 inflammatory diseases that damage joints and their surrounding structures. Arthritis can attack joints, joint capsules, the surrounding tissue or parts throughout the body. It usually affects the joints of the neck, shoulders, hands, lower back, hips or knees.

- Rheumatoid arthritis is a type of arthritis that is autoimmune in nature because the body's cells destroy the cells in the joints.
- Osteoarthritis is a degenerative disease.
- Infectious arthritis is a type of arthritis that is caused by bacteria or virus that are present in the blood and attack the joints.
- Gouty arthritis is a type of arthritis where uric acid is deposited in the joints making it a painful condition. Usually only one or a few joints are affected, such as the big toe, knee, or ankle. The attack may only last a few days, but may return to the same or another joint. Gout occurs when the body makes too much uric acid or the kidneys do not properly excrete it.

**Spondylitis:** Spondylitis is an inflammation of the vertebra. In many cases spondylitis involves one or more vertebral joints as well, which itself is called spondylarthritis. Like arthritis, spondylitis is also a group of disorders that primarily affect the spine.

One of the much rarer diseases of the skeletal system is bone cancer. It may originate in the bones or spread there from another part of the body.

Bursitis is a disorder that most commonly affects the shoulder and hip joints. It is caused by an inflammation of the bursa, small fluid-filled bags that act as lubricating surfaces for muscles to move over bones.

The skeletal system is also susceptible to breaks, strains and fractures. Fractures are a break in the bones due to an injury. There can be many types of fractures depending upon the impact force, the kind of bone and location of the bones.

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Dislocations are the unnatural position of bones due to injury or impact of any kind. Due to this, the bones move from their original position to a slightly different one or change angulation.

While bones are meant to protect the body's vital organs, it takes about 10 to 16 pounds of pressure to break an average bone. Bones such as the skull and femur are much tougher to break.

## **7. Summary**

Movement, seems to be simple but is an extremely complex process that requires activities of several different parts of the brain working in tandem with muscles, nerves, bones and joints.

The thought areas of the brain trigger or stimulate the motor area to send signals to the muscles which with the help of the bones attached to them through the ligaments and tendons, then with the support of the joints, finally carry out the action.

Throughout the action there is a constant to and from of information between the brain and the muscles via nerves of the spinal cord. This regulates the power, speed, coordination and balance necessary for a smooth action.

Our bones provide support and give our bodies shape, but cannot move on their own. The muscles provide the movement. The joints help attach bones to one another to provide flexibility and allow the muscles to help give the bones a way to move.

There are many different type of bones like long, short, irregular and flat bones also hard bones. The bones are here to get you to stand up straight and walk . Joints are where the bones meet. There are three parts to this. A) The fixed joint, which cannot move. B) The partly moveable Joint that can move about in certain criteria. C) The freely moveable joints that can move in any direction.

The saddle Joint allows movement into two directions just like the thumb. The Pivot joint is a special joint that has a ring, which fits into axis vertebra. An example of this joint is the top of the neck to the head. The ball and socket joint is the most movable joint. It comprises of a ball that fits into a socket. The hip joint is a good example. The disadvantage to this joint is that the movement is limited. The gliding joint can be found in the spine where small sliding movements can take place. The joints are nearly flat. The condyloid joint is a joint found on the wrist. This joint also allows movement back and forward and side-to-side. The radius and the ulna have ends, which are hollow and can fit into bones of the wrist.

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It could mean that his shoulder has come out of socket, being a ball-and-socket joint. The bones and tendons could be potentially injured. Gait or normal locomotion or walking, running etc. is another complex area of movement that in addition requires maintenance of posture and balance.