

In order for movement and protection, bones must be linked together at **joints** or **articulations**.

Joints allow the skeleton to have motion and create the structural integrity necessary to support weight and protect vital internal organs.

Joints can be classified by function as **immoveable joints**, **slightly moveable joints**, and **freely moveable joints** (a.k.a. **synovial joints**).

An example of an immoveable joint is a **suture**. Sutures are only found in the skull. The edges of the articulating bone interlock, giving these joints tremendous strength – but no mobility.

An example of a slightly moveable joint is a **symphysis**. Symphyses are found in the joints between vertebrae and in the joint between the left and right pubic bones in the pelvis. In symphyses, articular cartilage covers the joint surfaces and there is a pad of **fibrocartilage** between the joint surfaces. Symphyses are very stable and only allow a small degree of motion.

Freely moveable (synovial) joints are numerous in the body. The knee, shoulder, and elbow joints are a few examples. Synovial joints have 6 major characteristics: **articular cartilage**, **joint cavity**, **articular capsule**, **synovial fluid**, **reinforcing ligaments**, and **nerves and blood vessels**.

Articular cartilage covers the ends of the adjoining bones. It is **hyaline cartilage** and provides cushioning between the bone surfaces.

The joint cavity is the space between the articulating bones. It is enclosed by the articular capsule and contains synovial fluid.

The articular capsule is a double layered membrane that is continuous with the periosteum of the articulating bones and surrounds the entire joint and unites the bones. The outer layer is the **fibrous capsule** which is composed of **dense irregular connective tissue**. The fibrous capsule helps to hold the 2 bones together. The inner layer is the **synovial membrane** which is composed of **areolar connective tissue** with abundant **fibroblasts** and **macrophages**. The synovial membrane produces the lubricating and nourishing synovial fluid. The synovial membrane is rather vascular and its blood vessels are the source of the synovial fluid.

Ligaments are bands of **dense regular connective tissue** that strengthen and support synovial joints. Ligaments may be **capsular**, i.e. they are thickened portions of the fibrous capsule. There are also **extracapsular ligaments** (which are distinct from and external to the fibrous capsule) and **intracapsular ligaments** (which are found between the 2 layers of the joint capsule).

Synovial joints are quite vascular (to produce the synovial fluid and nourish the joint structures) and innervated by nerves for pain reception and sensation of limb positions (**proprioception**).

Synovial joints allow 3 basic types of movement: **gliding**, **angular movement**, and **rotation**.

Gliding movements occur when flat bone surfaces slide upon one another. These movements occur at the **intercarpal joints**, **intertarsal joints**, and the **intervertebral joints**.

Angular movements change the angle that exists between 2 bones. Common angular movements include: **flexion**, **extension**, **hyperextension**, **abduction**, and **adduction**.

Flexion is often a bending movement that occurs in the sagittal plane. It decreases the angle of a joint.

Extension is the reverse of flexion. It typically occurs in the sagittal plane and increases the joint angle. Excessive extension beyond normal anatomical position is hyperextension.

Abduction is the movement of a limb away from the midline of the body in the frontal plane.

Adduction is the opposite of abduction. Note that *ab* means away while *ad* means towards.

Rotation turns a bone along its long axis. It occurs at the hip and shoulder joints and in the “no” motion of the cervical vertebrae.

There are 6 basic types of synovial joints: **plane joints**, **hinge joints**, **pivot joints**, **condyloid joints**, **saddle joints**, and **ball-and-socket joints**.

Plane joints involve a pair of flat articulating surfaces. Gliding joints are examples of plane joints.

Hinge joints involve a bony cylinder within a bony trough. The elbow joint and interphalangeal joints of the fingers and toes are examples. Hinge joints allow flexion and extension.

Pivot joints involve a bony head that can rotate within a bony or ligamentous ring. The joint between the first 2 cervical vertebrae as well as the proximal and distal joints between the radius and the ulna are examples. Pivot joints allow rotation.

Condyloid joints involve an oval bony projection resting in an oval bony depression. The radiocarpal and metacarpophalangeal joints are examples. Condyloid joints allow all angular movements.

Saddle joints involve 2 adjoining saddle-shaped projections. The carpometacarpal joints of the thumbs are examples.

Ball-and-socket joints involve a spherical bony projection joining a cup-like depression. All angular movements are allowed. The shoulder and hip joints are examples.