

Skeletal System

Student Learning Objectives:

- Identify the major bones of the skeleton
- Identify the major landmark structures found on bones of the skeleton
- Identify the major types of articulations of the skeleton

Structures to be identified:

Axial Skeleton:

Frontal bone
Parietal bone
Temporal bone
 External auditory meatus
 Mastoid process
 Zygomatic arch
Occipital bone
 Foramen magnum
Sphenoid bone
 Sella turcica
Ethmoid bone
 Perpendicular plate
 Cribriform plate
 Crista gali
Vomer
Zygomatic bone
 Zygomatic arch
Maxilla
 Anterior hard palate
Palatine bone
Lacrimal bone
Nasal bone
Mandible
 Angle
 Body
 Ramus
 Temporomandibular joint
Hyoid bone
Vertebra
 Body
 Dorsal process
 Transverse process
 Intervertebral disc
 Cervical
 Thoracic
 Lumbar
 Sacrum
 Coccyx
Sternum
 Body
 Xiphoid
Ribs
Costal cartilages

Appendicular Skeleton:

Clavicle
Scapula
 Acromion process
 Coracoid process
 Glenoid fossa
 Scapular spine
Humerus
 Greater tubercle
 Head
Radius
Ulna
 Olecranon process
Carpals
Metacarpals
Phalanges
Ilium
 Iliac crest
Pubis
 Pubic symphysis
Ischium
Acetabulum
Femur
 Head
 Neck
 Greater trochanter
Tibia
 Medial malleolus
Fibula
 Lateral malleolus
Tarsals
 Talus
 Calcaneus
Metatarsals
Phalanges

Articulations:

Immoveable
Partially moveable
Ball and socket
Pivot
Hinge
Gliding

Introduction

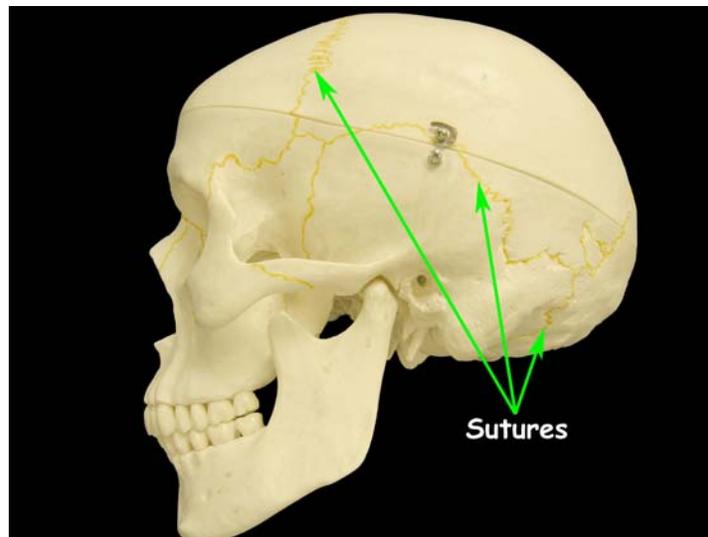
The human body is designed in a particular shape because of the skeletal system. The bones and associated cartilages of the skeleton create a supportive framework for the muscles and organs of the body. The bones are rigid while the cartilage components of the skeleton are flexible. The joints, or **articulations**, form the junctions between individual bones. The muscles pull against the bone levers to cause movement.

The **axial skeleton** consists of the skull, vertebral column, and ribcage. The **appendicular skeleton** consists of the arms, legs, and supporting structures in the shoulders and pelvis.

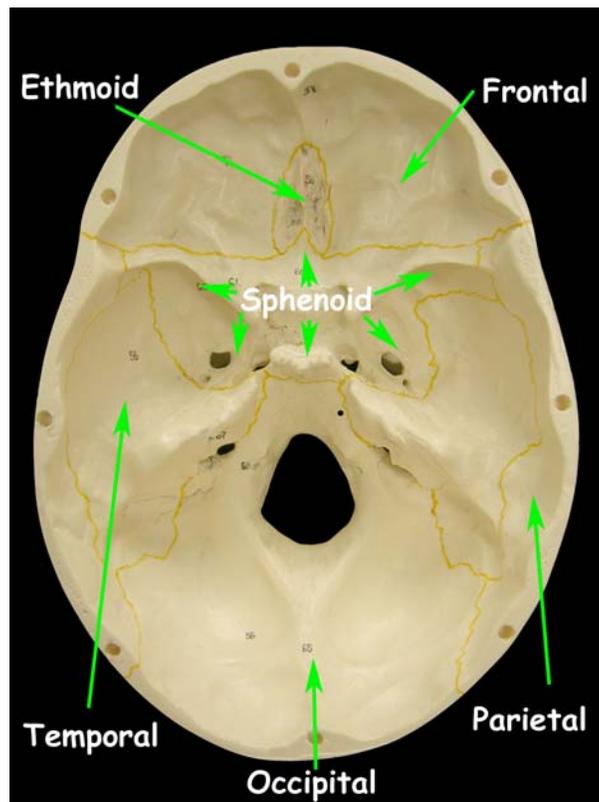
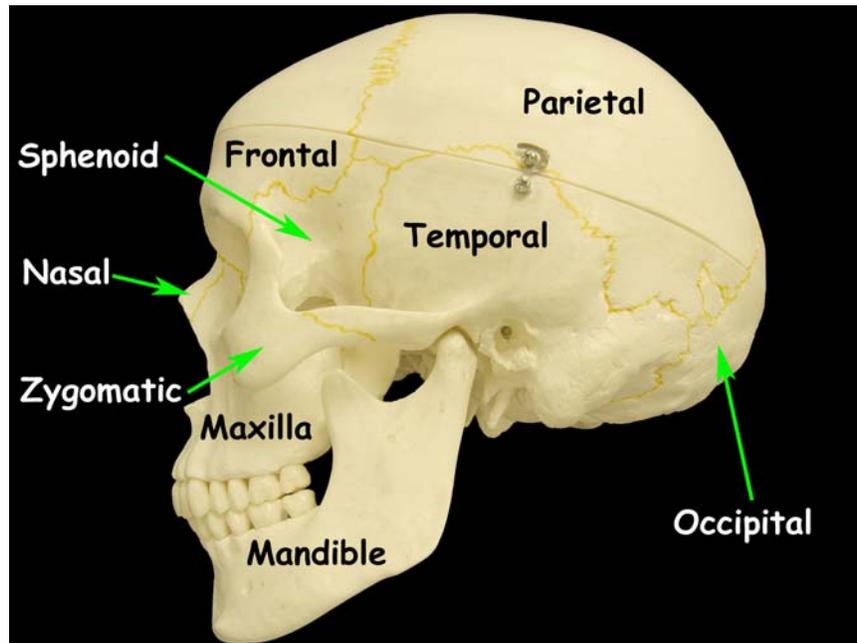
Many of the bones have a number of important landmarks that will be used to guide medical personnel who are administering treatments. Some of these landmarks are “bumps”, or **processes** or **crests**, that extend above the surface of the bone, most serving as muscle attachments. Others are “holes”, or **foramen**, through which nerves and blood vessels pass. A few are “depressions”, or **fossa**, that can hold another bone as part of a joint or muscles. The medical professional might *palpate* (feel) these structures to determine where to give an injection, place a stethoscope, or apply pressure to control bleeding.

Axial Skeleton

The **skull** is composed of over two dozen bones, most of which are fused together to form a single, solid unit surrounding the brain and special sense organs. The **suture lines** that can be seen on the *cranial (dorsal) surface* represent some of the immovable joints that have formed between various bones of the skull.



Eight bones form most of the *cranial vault* that surrounds the brain. The **frontal bone** forms the anterior part of the cranial vault and the forehead. The two **parietal bones** form the upper lateral wall, and the two **temporal bones** form the lower lateral wall of the cranial vault. The bottom (ventral) portion of the cranium consists primarily of the **occipital bone** at the back and the **sphenoid bone** in the middle and extending up the sides. All of these bones can be seen from a lateral view of the skull. The final piece, the small **ethmoid bone**, fills in the remaining square of the floor near the front of the cranial vault and can only be seen from the inside of the skull.

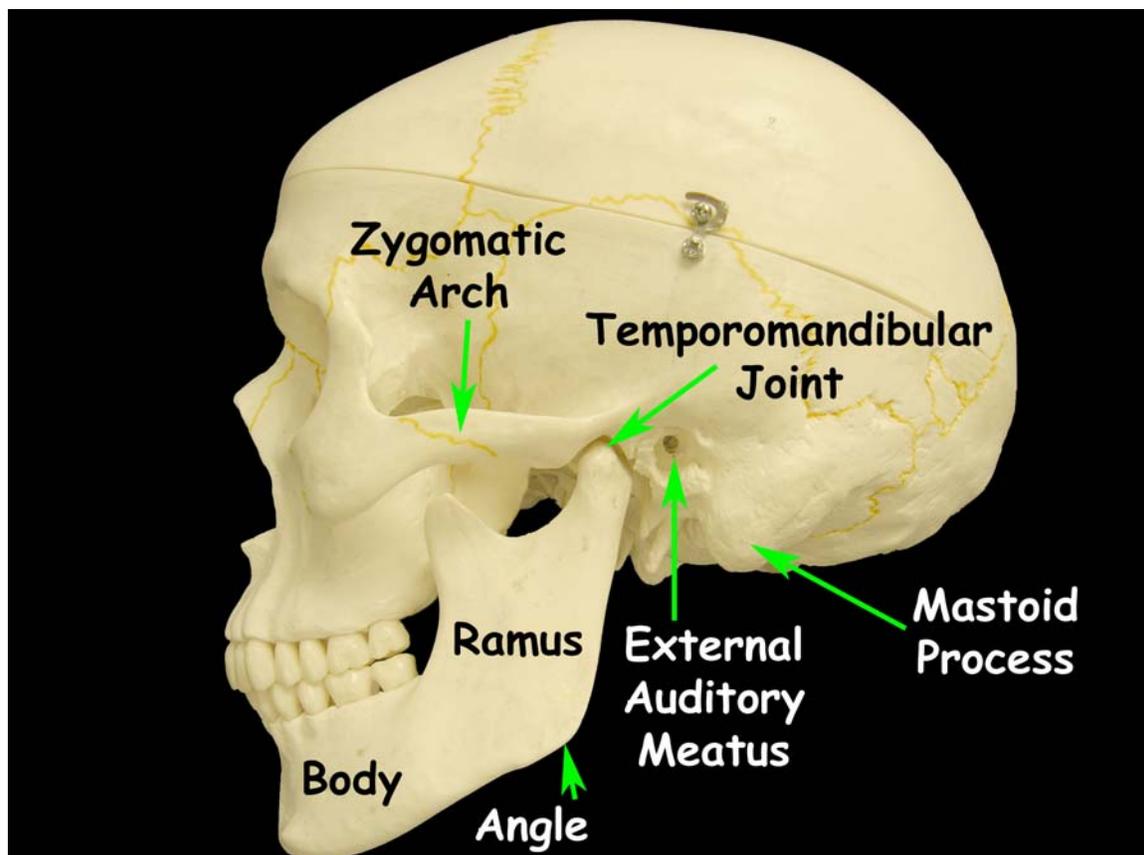


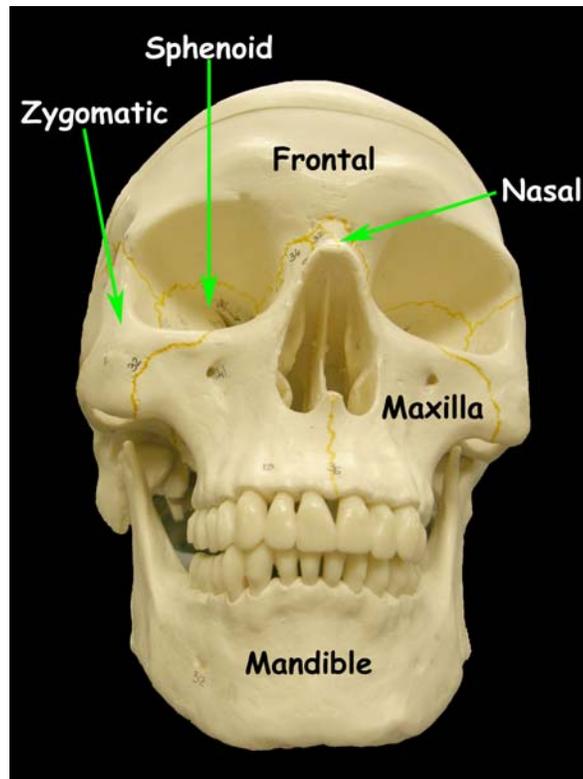
The remaining skull bones form the framework for the structures of the face. The upper portion of the face, between the eyes and the upper teeth is composed of the two **maxillae**. The maxilla on each side has “sockets” that hold the **maxillary teeth** (i.e. the upper row of teeth). In addition, the maxilla extends behind the maxillary teeth to form most of the roof of the mouth and the hard palate.

The **zygomatic bone** lies lateral to the maxilla and forms the upper portion of the cheek. The **zygomatic arch** forms between the zygomatic bone and the temporal bone on the side of the head. The paired **nasal bones** form the “bridge” of the nose between the eyes.

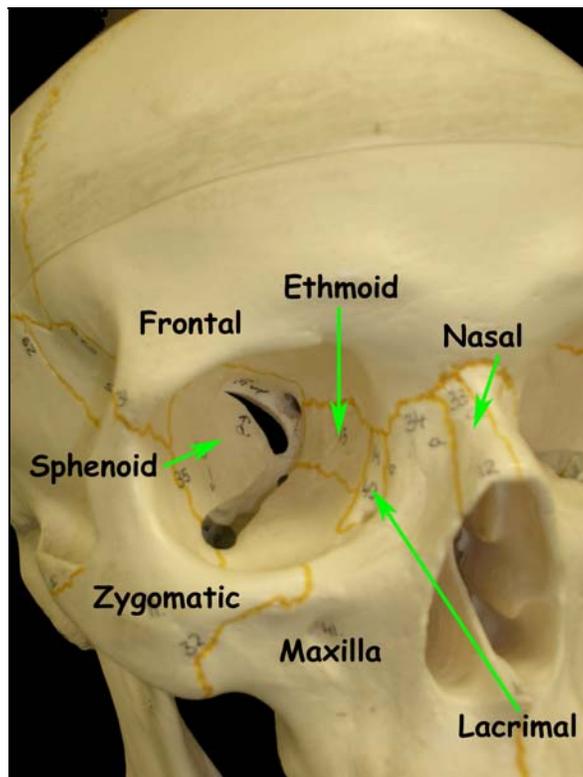
The lower teeth, or **mandibular teeth**, are mounted into “sockets” in the **mandible**. The mandible is one of the few moveable bones of the skull (the others are found in the inner ear). The **body** portion of the mandible lies inferior to the teeth. Below the ear, the mandible turns, at the **angle** of the mandible, and extends up to the base of the ear as the **ramus**. An important blood vessel for structures of the face curves around the bone near the angle of the mandible. The **temporomandibular joint** is the articulation between the mandible and the temporal bone.

The temporomandibular joint lies just anterior to the **mastoid process** of the temporal bone. This large “bump” can be felt just posterior to the ear. A large hole, the **external auditory meatus**, serves as the entry into the internal structures of the ear and is located in this same area.

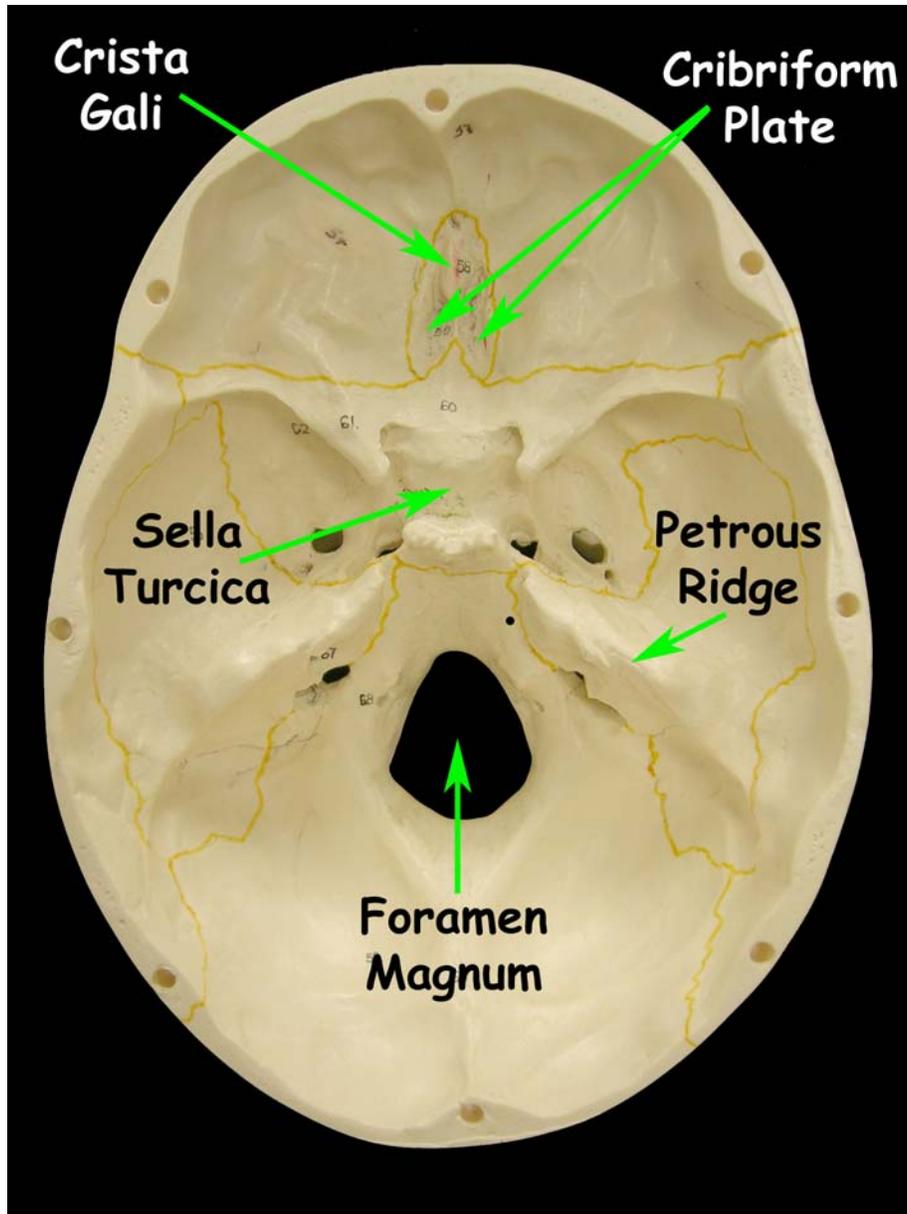




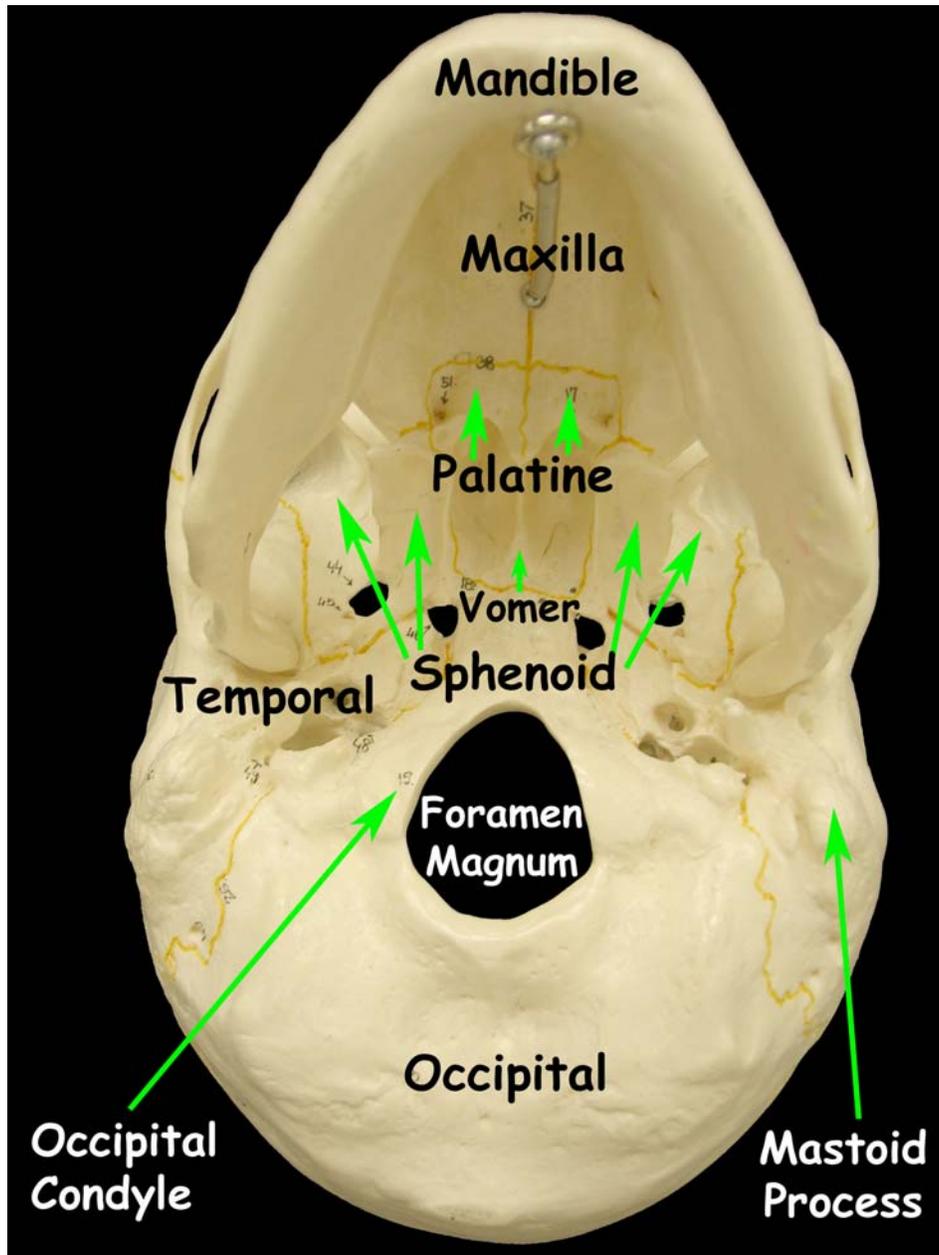
Six different bones form the **orbit**, the “socket” for the eye. The frontal bone forms the superior socket and the maxilla forms the inferior socket. The ethmoid bone forms most of the medial socket and the zygomatic bone forms the lateral socket. The sphenoid bone forms the posterior socket. The final bone of the orbit, the **lacrimal bone**, is a tiny bone near the nose that has a hole in it for the lacrimal (tear) duct.



Inside the skull, you can see several landmarks associated with the floor of the cranial vault. The **crista gali** is a ridge at the front of the skull to which the membranes surrounding the brain (i.e. the meninges) attach. The **cribriform plate**, a perforated bone through which the nerves from the nose enter the skull, surrounds the crista gali. The cribriform plate and the crista gali are parts of the ethmoid bone.

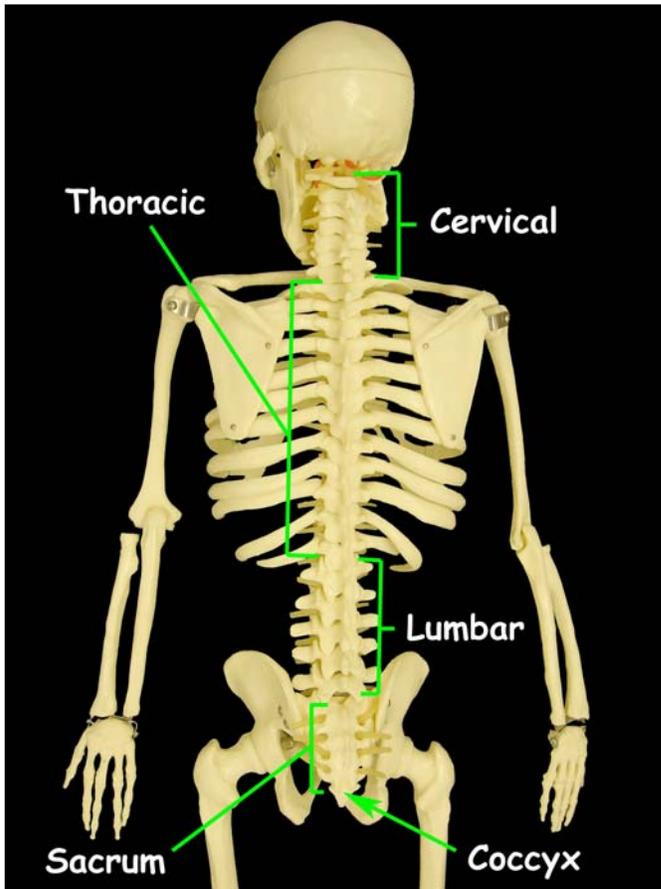


Also inside the skull you can see the **sella turcica**, a trough-like depression, which shelters the pituitary gland. This structure is part of the sphenoid bone. Two large **petrous ridges** extend through the central floor of the cranial vault. These ridges are part of the temporal bones and house the inner ear structures. The final landmark of the cranial vault is the **foramen magnum**, a large hole through which the spinal cord exits the skull.



When viewed from the underside (i.e. ventral surface), several bones are visible. You can again view the occipital, temporal, and sphenoid bones, as well as the mandible and maxilla. Two additional bones are also seen from this view. The **palatine bones** attach to the maxilla and form the back of the hard palate. The **vomer** is a plow-shaped bone that along with the **perpendicular plate** of the ethmoid bone forms the *nasal septum*, the wall between the nasal cavities.

From this view, you can once again see the foramen magnum and the mastoid process. Lateral to the foramen magnum are two smooth elevations known as the **occipital condyles**. These smooth surfaces are the place where the vertebral column articulates with the skull.

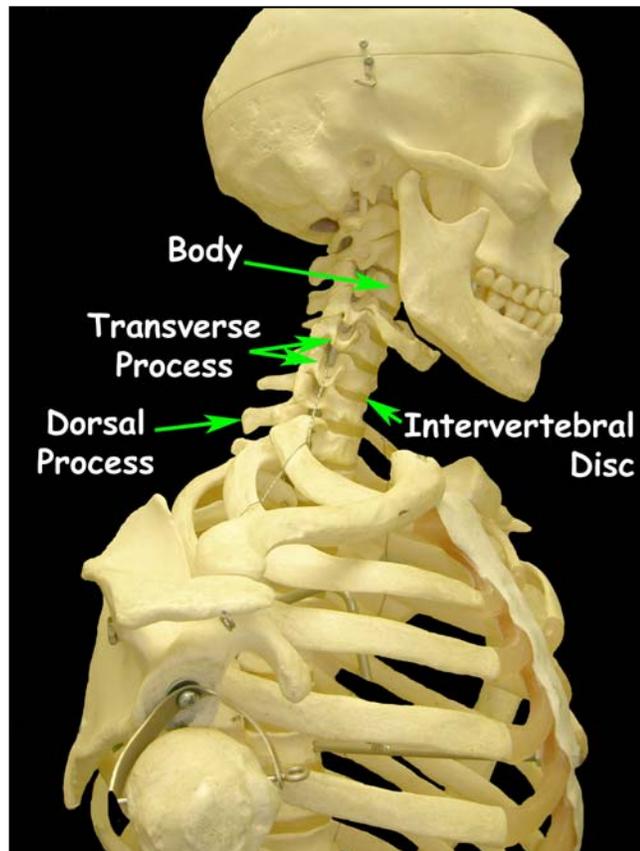


The **vertebral column** extends inferiorly from the skull and forms the rigid backbone. The vertebra are named according to body region and vertebra structure. The eight **cervical vertebra** form the neck. The first of these, the *atlas*, articulates with the occipital condyles of the skull. The twelve **thoracic vertebra** are associated with the ribs and upper back. The lower back is formed by the five **lumbar vertebra**. The five **sacral vertebra** are fused together forming a solid piece known as the **sacrum** which forms the back of the pelvis. Extending from the inferior sacrum is the **coccyx**, or tailbone, formed by the fusion of one or more **coccygeal vertebra**.

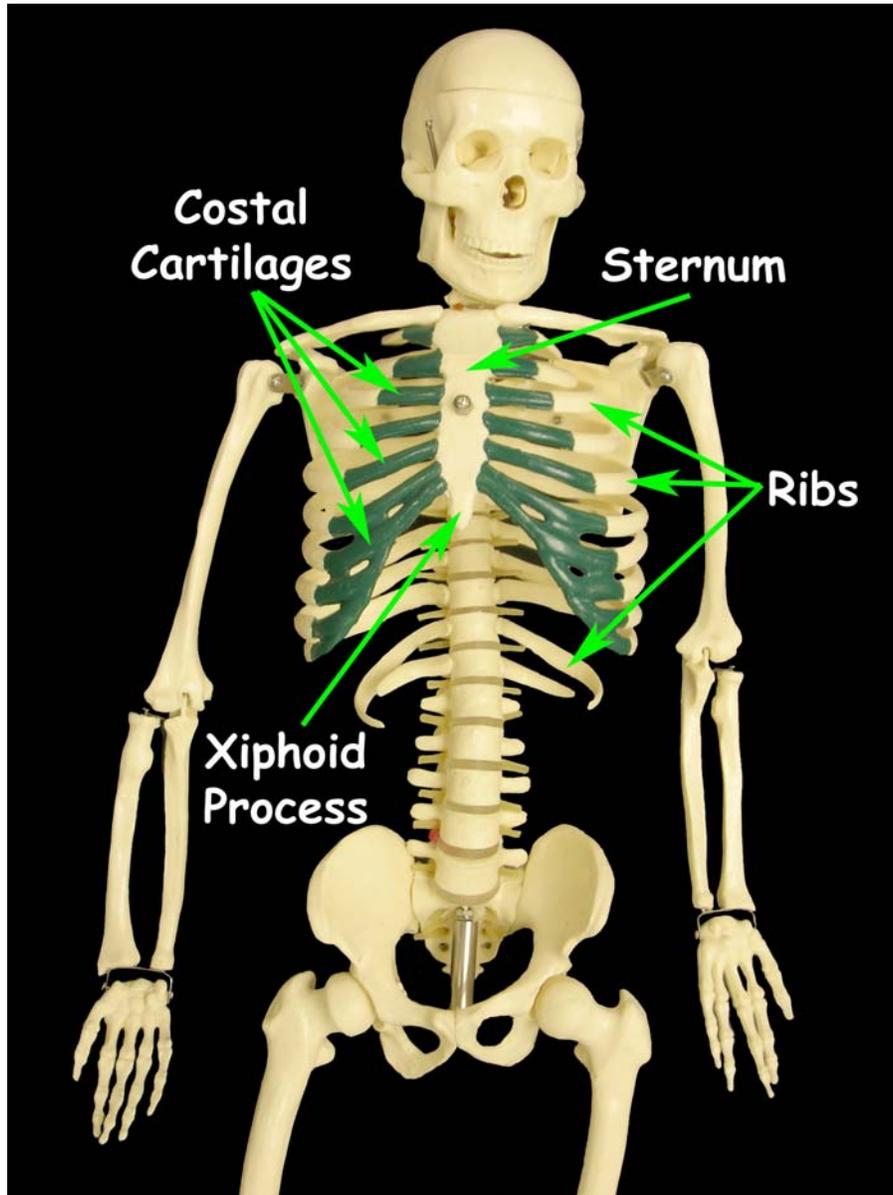
The vertebra consist of a large round or oval **body**. This is the weight-bearing part of the vertebra. The **intervertebral discs** are firm cartilage pads that sit between the bodies of the adjacent vertebra.

Several projections extend out from the sides and back of each vertebra. The **dorsal process** can be felt as the bumps that run down the back when you feel along the spine. The **transverse processes** extend laterally from each side of the vertebra. These projections serve primarily as muscle attachment points.

The *spinal cord*, part of the nervous system, runs through a tunnel that is formed at the center of the vertebra.



The ribs and sternum form the wall of the *thorax*, or chest. The **sternum**, or breast bone, lies at the front and covers over the heart and important blood vessels and airways. At the inferior end of the sternum is the **xiphoid process**, a small triangle of cartilage that is an important landmark for doing CPR. During CPR chest compressions, the rescuer will place his/her hands about mid-way up the sternum, being careful to avoid the xiphoid process which could poke into the liver if pressed on, causing severe hemorrhaging.

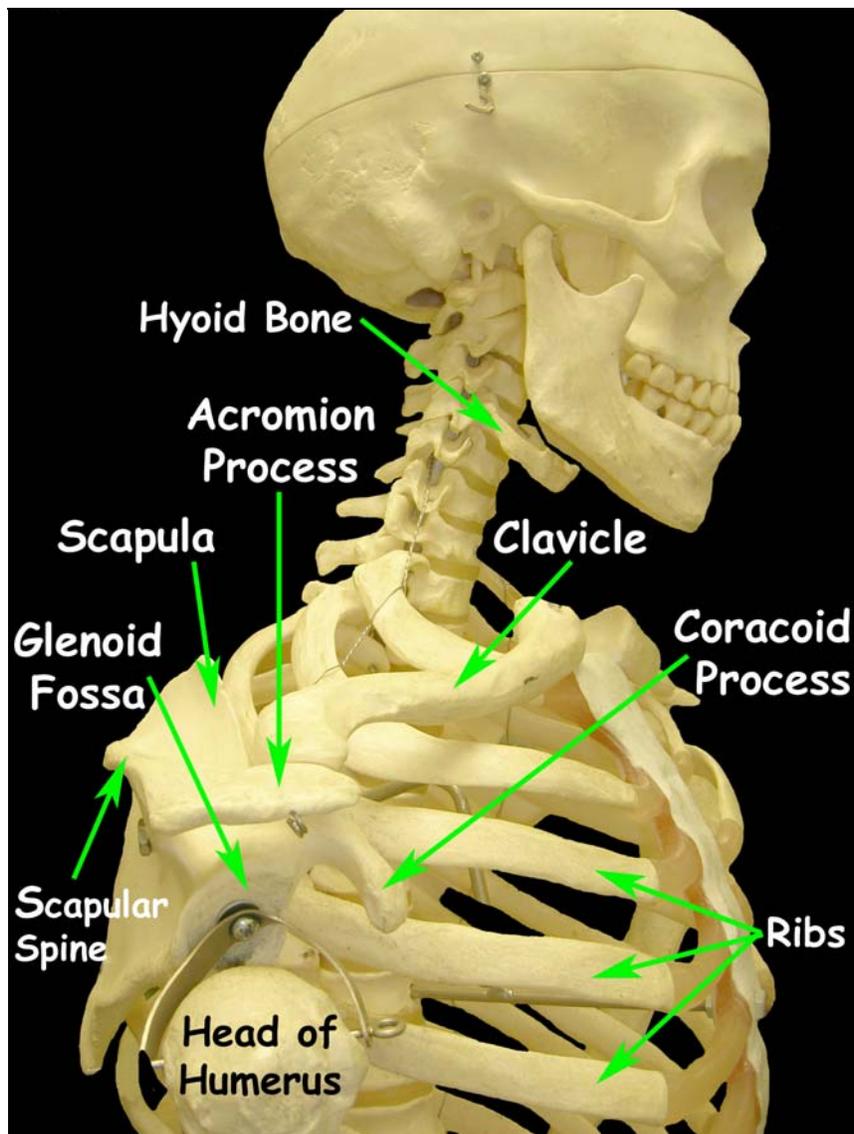


There are twelve pairs of **ribs** that attach to the thoracic vertebra posteriorly and arc around to the front of the thorax. The first seven pair of ribs attach to the sternum directly via the **costal cartilages**. These are referred to as “true ribs”. The remaining ribs are referred to as “false ribs”. Ribs eight, nine, and ten link their costal cartilage attachments together before attaching to the sternum. The liver and the spleen lie medial to these ribs. The final two pairs, sometimes referred to as “floating ribs”, have no attachment to the sternum at all. These form a protective cover for the kidneys.

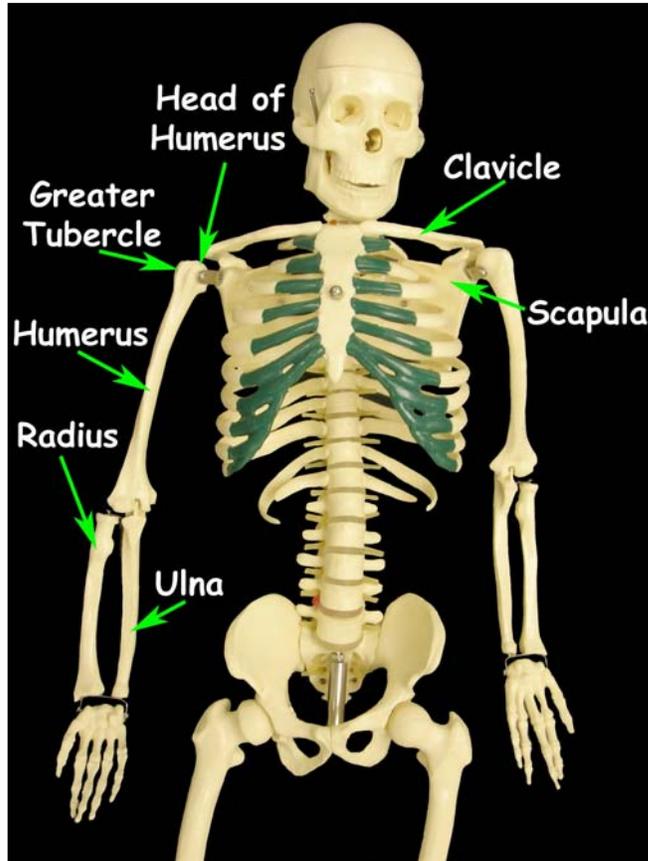
The final bone of the axial skeleton is the **hyoid bone**. This bone is suspended in the area beneath the skull and is not attached to any other bones of the skeleton. The hyoid bone is secured in place by the airways and tongue muscles. The hyoid bone serves as an anchor for these structures. You can view this bone in the picture of the shoulder structures below.

Appendicular Skeleton

The upper limbs are attached to the trunk via the **shoulder girdle**. This part of the appendicular skeleton is composed for the clavicle and the scapula. The **clavicle**, commonly known as the “collarbone”, attaches medially to the top of the sternum and laterally to the scapula at the front of the shoulder.

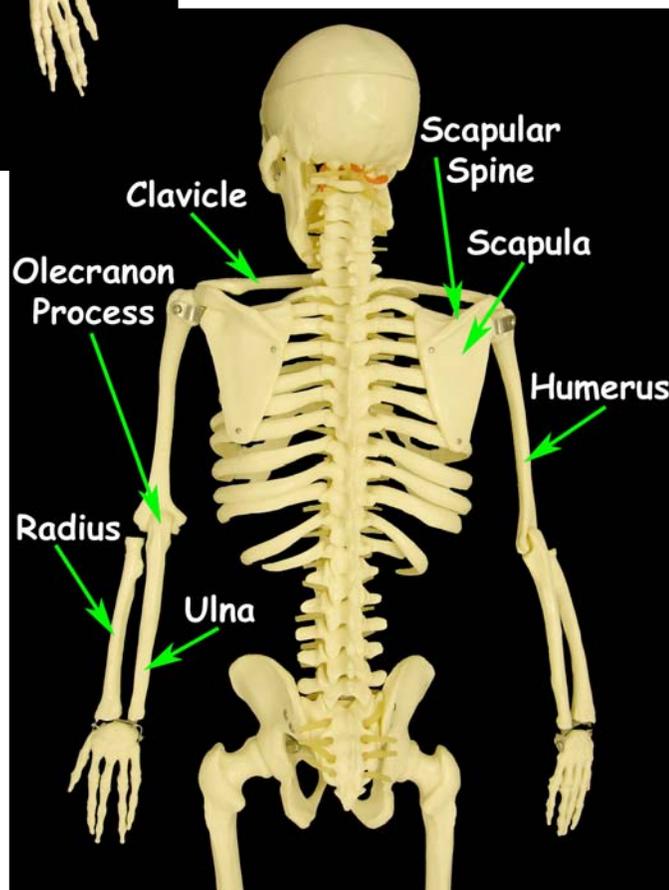


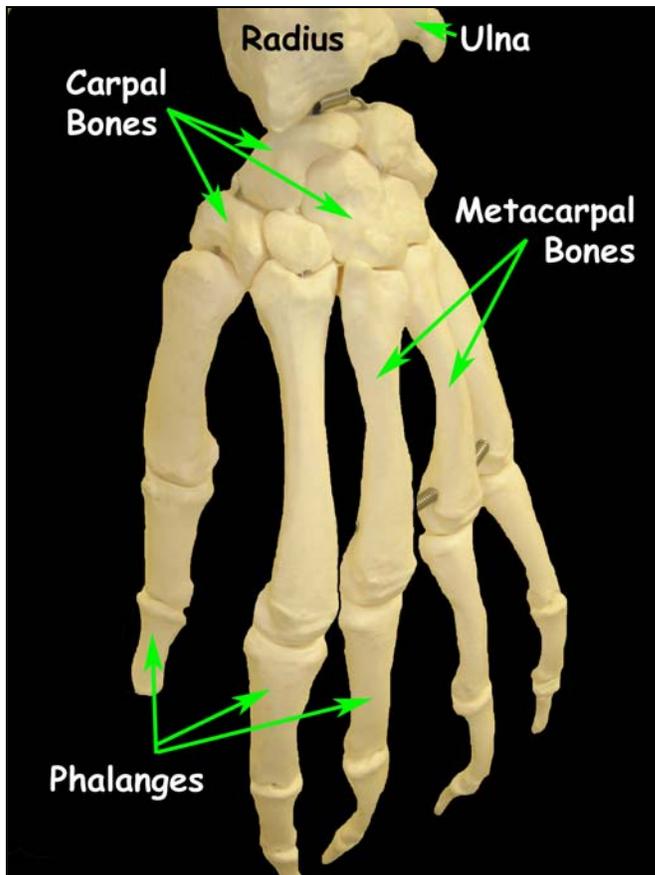
The **scapula** lies at the back of the shoulder and can be felt as the “wing” in the superior portion of the back. A ridge, the **scapular spine**, runs along the posterior portion of the scapula. There are two lateral projections from the scapula. The **acromion process**, the larger of the two, and articulates with the clavicle. The **coracoid process** lies below and is an important muscle attachment point for some of the shoulder muscles. The **glenoid fossa**, a lateral depression, articulates with the humerus, the bone of the upper arm.



The arm is constructed of multiple bones. The **humerus** is the most proximal of the arm bones and attaches to the scapula at the glenoid fossa. Lateral to this articulation is a large “bump” called the **greater tubercle**. This structure serves as an attachment point for some of the shoulder muscles and is an important landmark used when giving injections in the muscle of the arm.

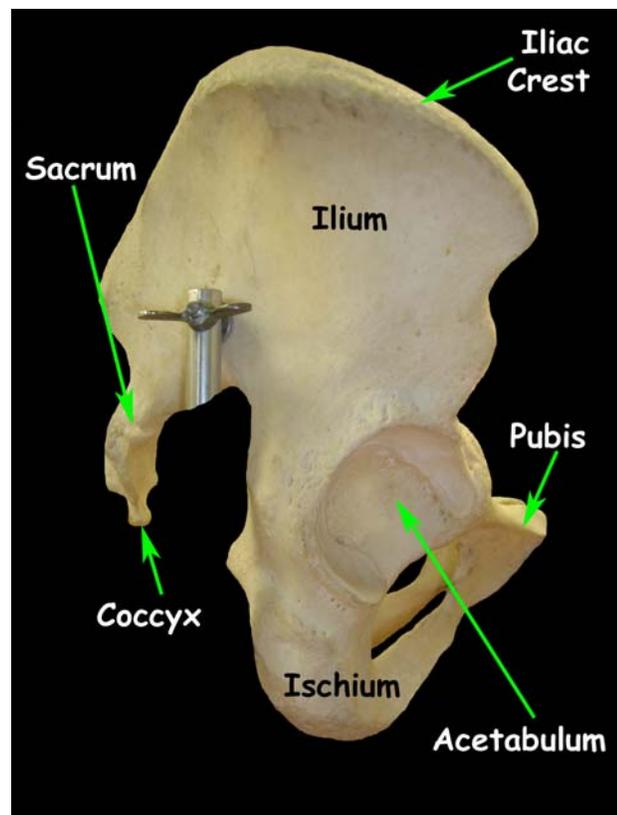
Distal to the humerus are two bones. The **radius** runs laterally down the lower arm and the **ulna** runs medially next to it. The radius has a flat head on it that pivots on the surface of the humerus to allow the hand to be turned over. The ulna hooks onto the end of the humerus and allows the lower arm to move up and down. The **olecranon process**, located at the proximal end of the ulna, can be felt at the large posterior “bump” of the elbow.

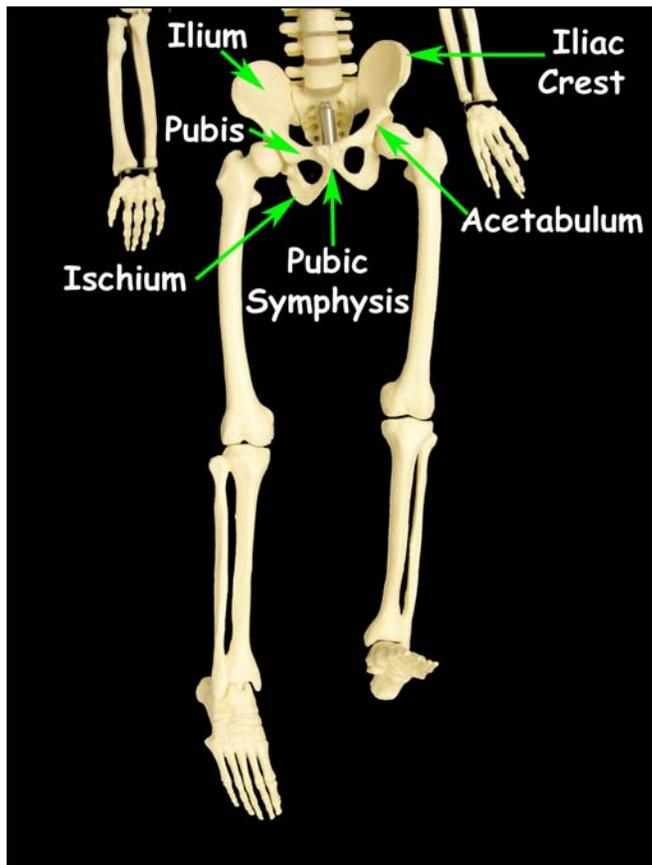




The hand and wrist are composed of numerous bones. The eight **carpal bones** form the wrist. This group of irregularly-shaped bones are held together by a band of connective tissue. The hand is made up of five **metacarpal bones** and each finger contains three **phalanges** (two for the thumb).

The **pelvic girdle** forms the supportive framework for the lower limbs. Three bones have fused together on each side of the pelvis forming an *os coxa*. The two *os coxa* join with the sacrum then to form the pelvis. Each *os coxa* consists of an ilium, pubis, and ischium. The **ilium** is a large, fan-shaped bone that forms the upper portion of the pelvis. The superior surface is called the **iliac crest**. When you “put your hands on your hips”, you are resting them on the iliac crest. The iliac crest serves as an important landmark for giving injections into the muscles of the buttocks region.

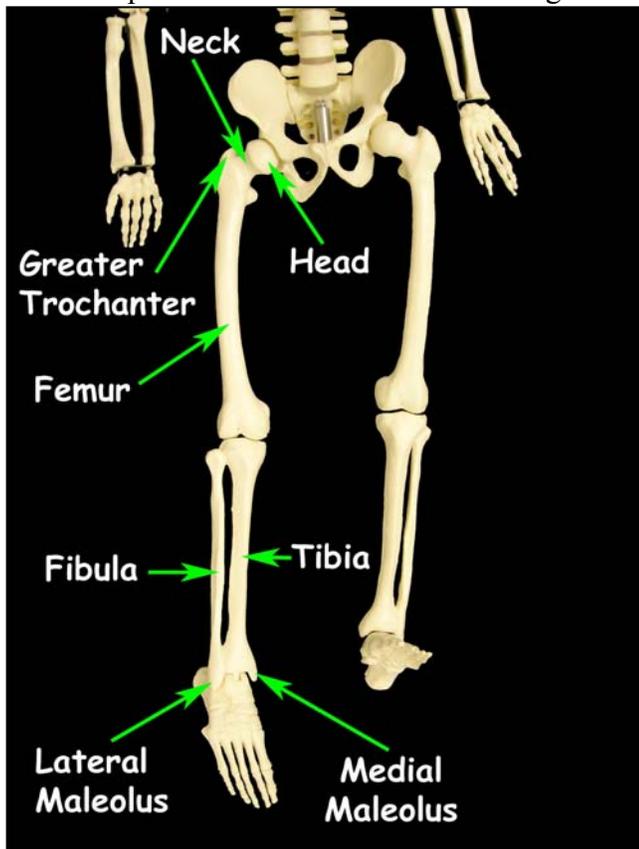




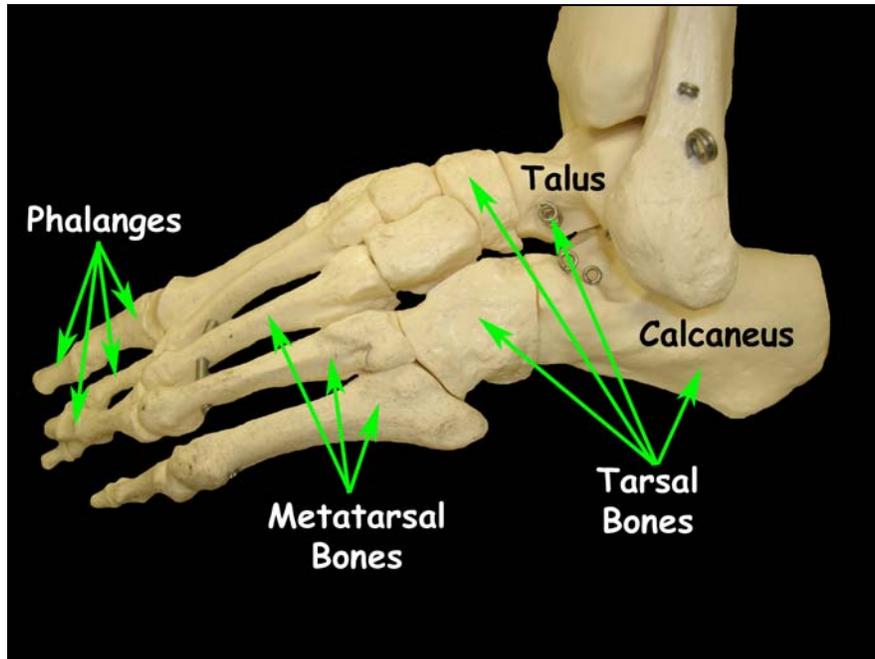
The **pubic bone**, or **pubis**, forms the upper part of the front of the pelvis. The pubic bones from each of the os coxa join at the front of the pelvis in an area called the **pubic symphysis**. Cartilage holds these two bones together. The **ischium** is located towards the back of the lower pelvis. These bones form the part of the pelvis that you sit on. At the center of the junction between these three bones of the os coxa there is a deep depression, the **acetabulum**, that articulates with the femur to form the joint of the hip.

The lower extremities are composed similarly to the upper extremities. The **femur** lies in the thigh region. This is the largest bone of the body, but is somewhat poorly designed. The **head** of the femur articulates with the acetabulum of the os coxa.

A narrow **neck** connects the head to the main portion of the femur. Fracturing of the neck of the femur is common, especially in older females. The **greater trochanter**, an important muscle attachment site, lies lateral to the head/neck of the femur.



As with the arm, the lower leg contains two bones. The larger, medial bone is the **tibia**. This bone articulates with the femur and most of the weight is directed to this bone in the lower leg. The lateral **fibula** is much smaller and acts to stabilize the leg. Articulation with the tarsal bones occurs at the distal end of the tibia and fibula. The **medial malleolus** of the tibia can be felt as the large bump on the medial ankle. The **lateral malleolus** of the fibula can be felt as the large bump on the lateral ankle. These structures secure the leg to the ankle and resist movements of the ankle side-to-side.



The seven **tarsal bones** form the ankle. The **talus** is the tarsal bone that articulates with the tibia and fibula in the ankle joint. The **calcaneus** is the tarsal bone that forms the heel of the foot and supports most of the body weight. The remaining five bones are smaller, irregular bones that resemble the carpal bones found in the wrist. As with the wrist, a band of connective tissue helps hold these bones in place. The **metatarsals** of the foot and the **phalanges** of the toes have the same design as the metacarpal and phalanges noted in the hands.

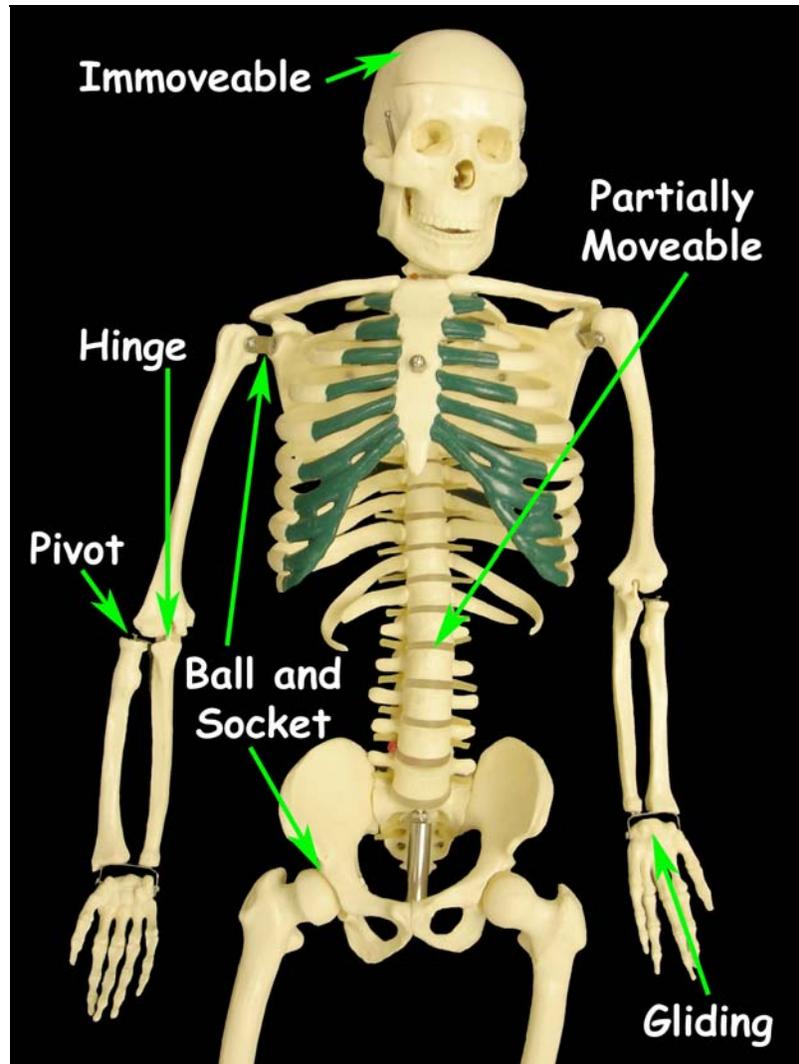
Articulations

Articulations, or joints, are the junctions between two bones. Some are designed for movement; while others are merely connections between the bones. The suture lines of the skull are an example of **immoveable joints**. This type of joint is found in places in which bones need to be connected to form a larger unit (e.g. the skull) and where movement could prove harmful to other tissues in the area (i.e. the brain).

The joints between the vertebrae are examples of **partially moveable joints**. The movement here is restricted because of large piece of cartilage (i.e. the intervertebral disc) is obstructing the movement of the bones. The pubic symphysis is another example of this type of joint.

Most of the other joints in the body are **freely moveable joints** in which there is a wide range of motion. The types of motion that can occur in these joints is determined by the shape of the bone surfaces and the placement of the ligaments (fibrous bands that connect bones together) within the joint. Some examples of the freely moveable joints would include:

- Ball and socket: shoulder and hip (round head moves within a cup) – this type of joint has the greatest freedom of motion (i.e. up/down, side-to-side, front-to-back, and circular)
- Hinge: humerus to ulna articulation (trough and cylinder) – this is much like the movement of a door, rotation back-and-forth
- Pivot: humerus to radius articulation (flat head of radius spins on the humerus) – this allows the turning of the hand over.
- Gliding: carpal bones (flat surfaces slide across one another) – the sliding of these bones is restricted by the connective tissue band surrounding the bones



Check yourself to see if you can identify other examples of these types of joints.