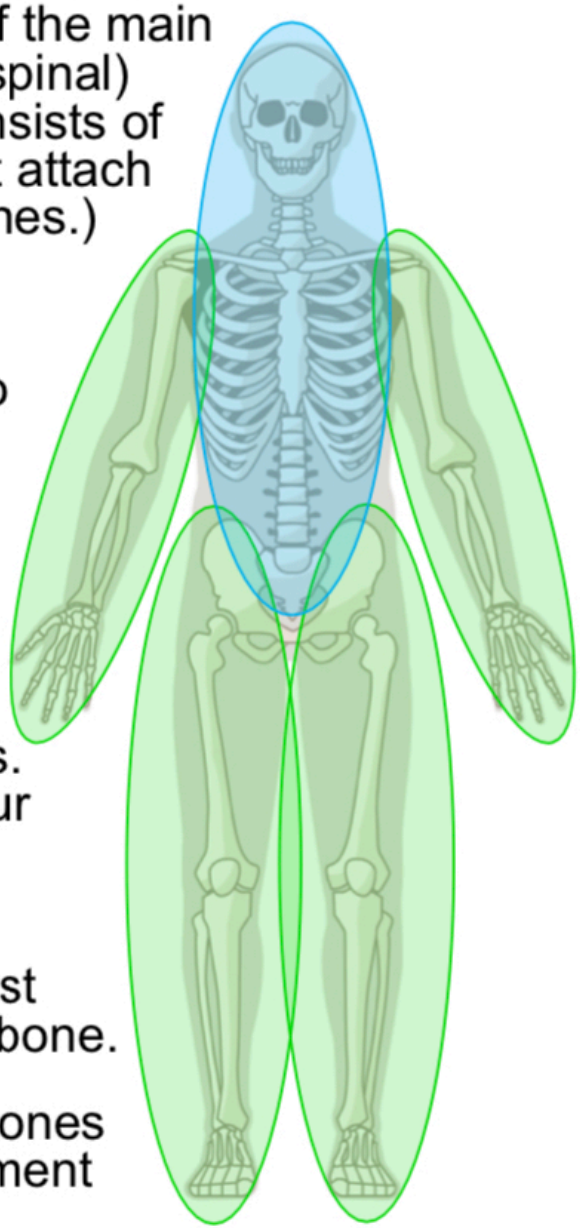
Station 1

Axial and Appendicular Skeletons

The 206 bones in the human skeletal system can be divided into two major groups. The **axial skeleton** consists of all the bones off the main axis/trunk of the body, including bones in the skull, vertebral (spinal) column, chest, and rib cage. The **appendicular skeleton** consists of the upper limbs (arms), lower limbs (legs), and the girdles that attach them to the axial skeleton (the shoulder bones and the hip bones.)



The skeletal system is not just made of bones though. It also includes the cartilage, ligaments, tendons, and joints that all work together to provide support, protection, and movement to the human body.

Remember, **cartilage** is a type of flexible connective tissue found all throughout the body (especially in infant skeletons!) You can easily feel the cartilage in your ear.

Ligaments are short bands of tough, yet flexible, dense connective tissue that can connect 2 bones and stabilize joints. An example is your ACL which connects your thighbone to your shinbone and provides stability to your knee joint.

Tendons are also cords of dense connective tissue but they connect muscles to bones, like your Achilles tendon (the largest one in your body!) that attaches your calf muscle to your heel bone.

Joints, or articulations, are the junctions between 2 or more bones and include all of the components listed above to aid in movement and flexibility of the body.

Station 2
Upper Limbs

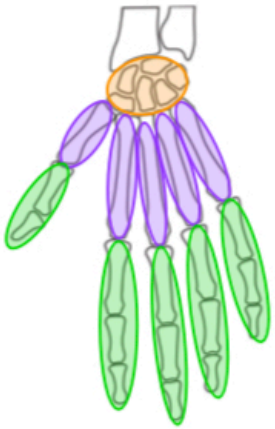
Each limb is composed of 3 major sections that are connected by joints that allow for mobility. In the upper limbs specifically, there are 30 bones divided into these 3 sections of the arm (the portion from the shoulder to the elbow), the forearm (the portion from the elbow to wrist), and the hand.

The clavicle and shoulder blade show where the humerus articulates (forms a joint) with the axial skeleton but are considered parts of the pectoral girdle, not the upper limb.

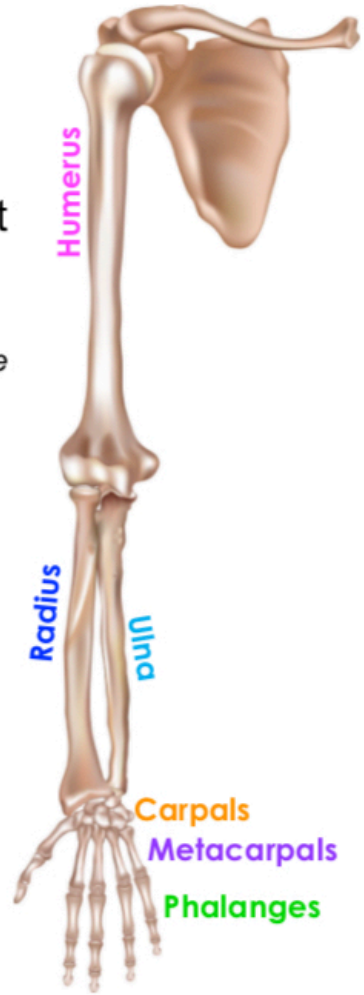
The Arm: only 1 bone = **humerus**.

The Forearm: 2 bones = **radius** and **ulna**, connected to each other by a flexible ligament called the interosseous membrane. The ulna forms the elbow joint with the humerus that acts as a hinge. The radius is the major forearm bone in the wrist joint.

Not sure how to tell the radius and ulna apart? The radius has a wider distal end and a thinner proximal end, while the ulna is the opposite (a thinner distal end and a wider proximal end.) Notice this difference on the picture to the right!



The Hand: the 8 wrist bones (**carpals**), 5 palm bones (**metacarpals**), and 14 finger bones (**phalanges**).
A wristwatch actually doesn't sit on your wrist bones at all, but instead on the distal end of your radius and ulna. Clench your fist and your knuckles will show the distal portion of each metacarpal. The most special metacarpal, Metacarpal I, is in your thumb. The joint it forms with the carpal bone allow for your thumb to be opposable. Touch your thumb to each fingertip to experience this opposition ability. Notice in the picture to the left how each finger/digit (other than your thumb) has 3 different phalange bones, referred to as the proximal, middle, and distal phalanges.

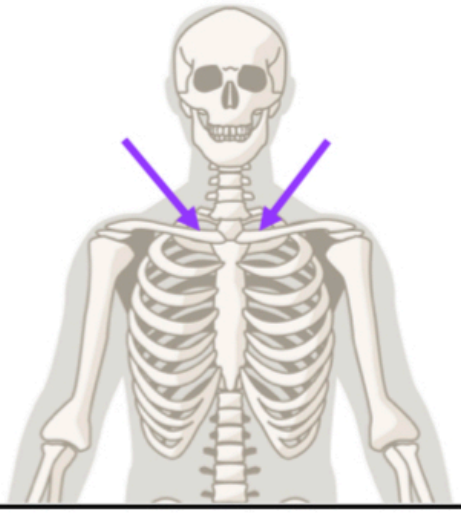


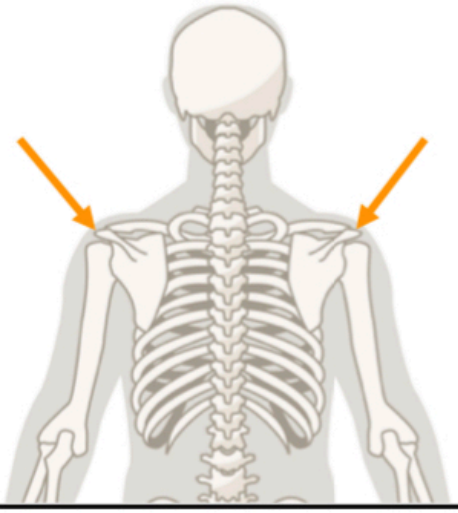
Station 3

Pectoral Girdle

Also known as the shoulder girdle, this region consists of the slender and curved **clavicles** (collarbones) on the anterior side and the **scapulae** (shoulder bones) on the posterior side. These bones attach the upper limbs to the body's trunk on both the right and left sides of the body. Each clavicle acts as a brace that holds the arms out laterally, while also anchoring many muscles. Each scapula is attached to the rib cage and the vertebral column only by the muscles on their surface, not by actual bone to bone contact. This allows for increased mobility and flexibility.

The medial end of each clavicle is attached to the sternum while the lateral ends attach to each scapula.



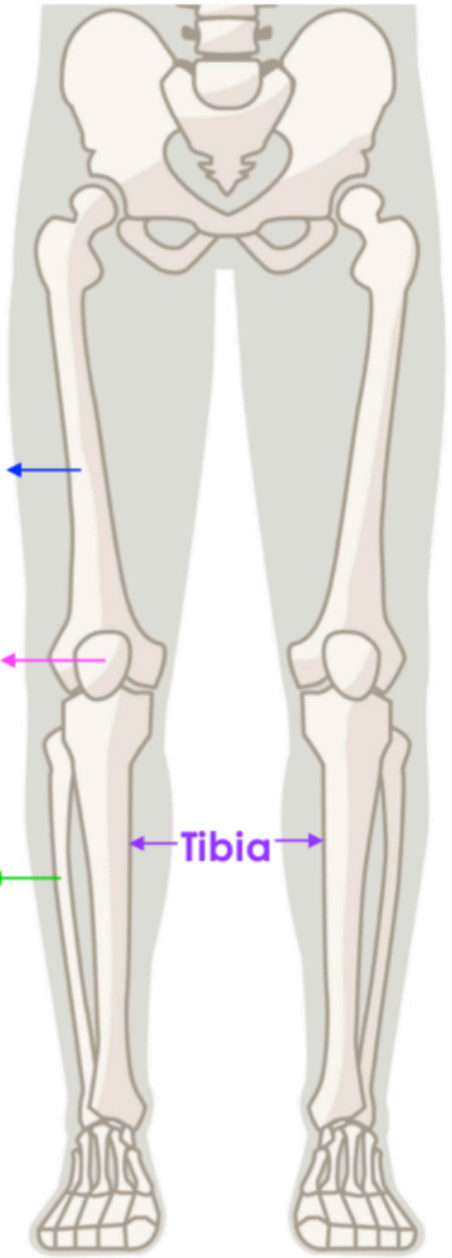


Each scapula connects the humerus arm bone to the clavicle.

Station 4
Lower Limbs

Each limb is composed of 3 major sections that are connected by joints that allow for mobility. In the lower limbs specifically, there are 30 bones divided into 3 sections: the thigh, the leg (the portion from the knee to the ankle), and the foot. The lower limbs carry the weight of the entire body when standing and endure great forces when we do activities like running and jumping, and therefore are much thicker in structure than the bones in the upper limbs.

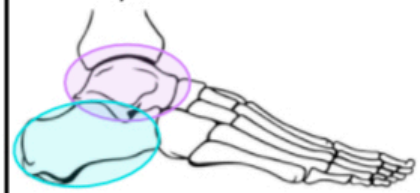
The pelvic girdle (see Station 5) connects the lower limbs to the rest of the body.

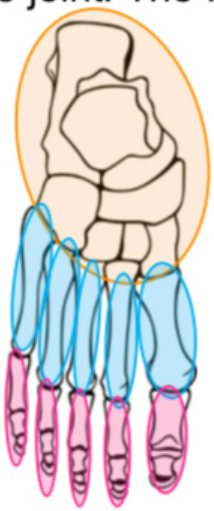


The Thigh: 2 bones = the **femur** and the **patella** (kneecap). The femur is the largest, longest and strongest bone in the entire human body! The patella connects the thigh muscles to the tibia and protects the knee joint.

The Leg: 2 bones = the **tibia** and the **fibula**, connected to each other by a flexible ligament called the interosseous membrane. They are less flexible but stronger bones than the bones of the forearm. The tibia (shinbone) is the 2nd strongest and longest bone and connects to the knee and ankle joints, while the fibula only contributes to stabilizing the ankle joint. The fibula doesn't bear any weight but does have several muscles attached to it.

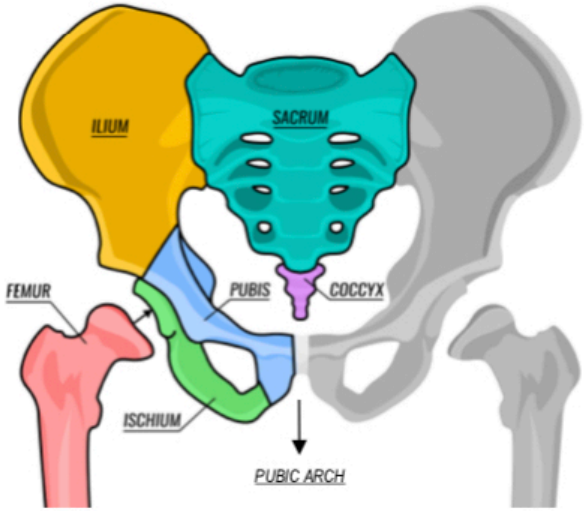
The Foot: the 7 **tarsals** in the ankle (tarsus), the 5 **metatarsals** in the metatarsus, and the 14 **phalanges** (toes). The two most notable tarsals are the **talus** (ankle bone) and the **calcaneus** (heel bone). The ball of the foot is formed at the head of the 1st metatarsal. Each toe is made up of 3 small phalange bones, except the big toe which has 2.





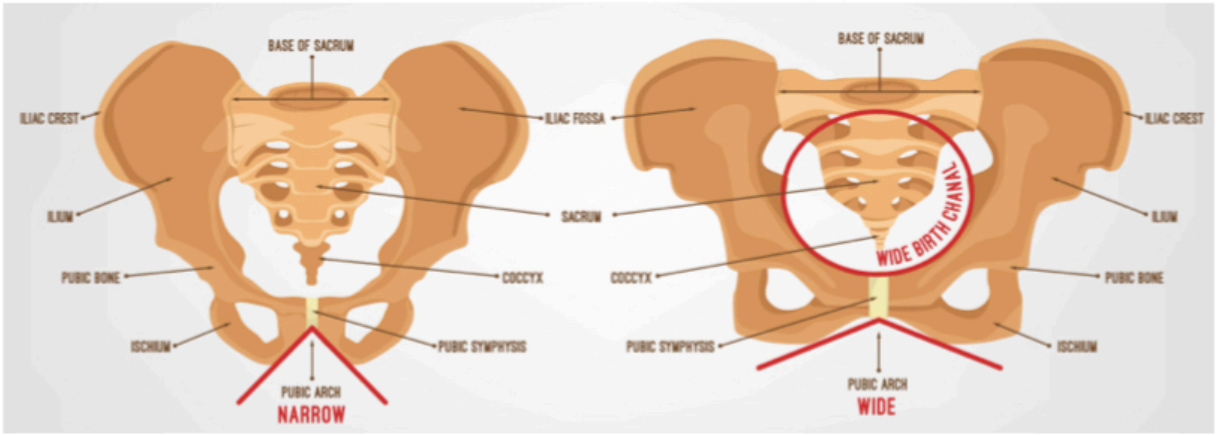
Station 5

Pelvic Girdle



Also known as the hip girdle, these bones attach the lower limbs to the axial skeleton, support the weight of the upper body, and protect the reproductive organs, bladder, and lower part of the digestive tract. It consists of the **sacrum** and the pair of **hip bones** (coxal bones). The hip bones are connected to each other anteriorly and to the sacrum posteriorly. Some of the strongest ligaments in the entire human body keep the hip bones secured to the axial skeleton. The pelvic girdle is much sturdier but provides far less mobility than the pectoral girdle. When born, the hip bone has 3 distinct parts: the **ilium**, **ischium**, and **pubis** (pubic bone). These bones seamlessly fuse together by adulthood. The ischium and pubis attach at the pubic arch.

Male **Female**

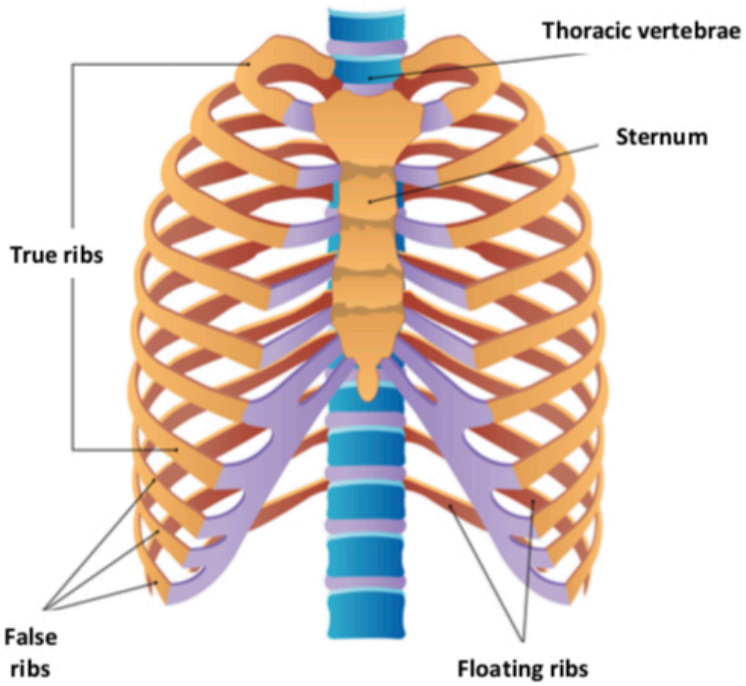


The female pelvis has major structural modifications, compared to the male pelvis, to allow for accommodating a growing fetus and the birth of the infant.

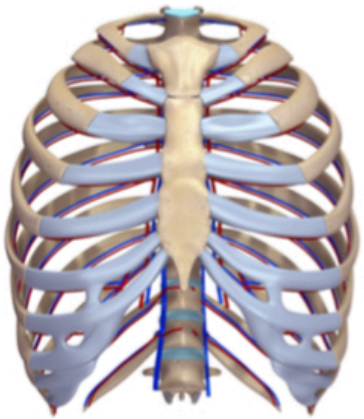
Station 6

Rib Cage

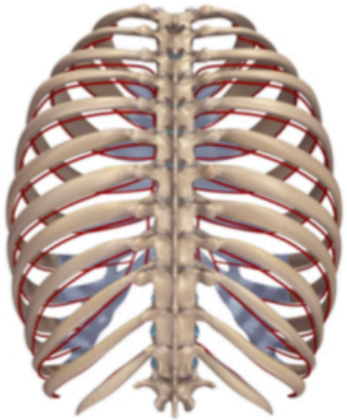
Also known as the thoracic cage, your rib cage consists of **12 pairs of ribs**, the **thoracic vertebrae** in the spinal cord, the **sternum** that the ribs attach to, and the **cartilage** that secures the ribs to the sternum. All of this encases the heart and lungs. The sternum, or breastbone, is actually 3 bones fused together. Slide your finger down your throat until you hit the beginning of your sternum and you will touch the jugular notch at the top. **True ribs** are the 7 pairs that are directly attached to the sternum. **False ribs** are the 5 pairs that are not.



Anterior View



Posterior View

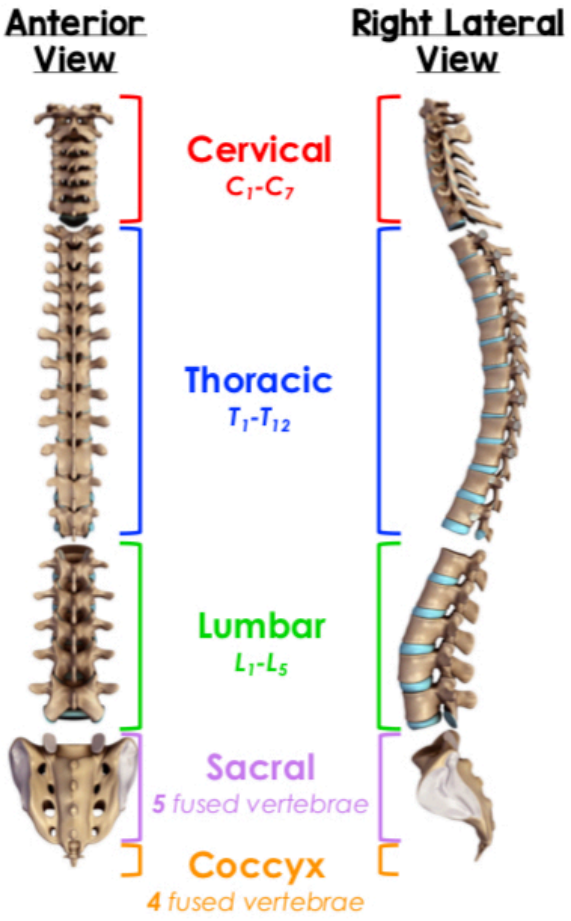


To the left you can compare the rib cage from the anterior and posterior view points. From the posterior view you can see the last two pairs of false ribs that are also considered to be **floating ribs** because they do not attach on the anterior side.

Station 7

Vertebral Column

Also known as the spine or spinal column, the vertebral column is made of 26 irregular bones, called **vertebrae**, in a curved and flexible formation that starts at the skull and extends all the way down to the pelvic girdle. Between the vertebrae are **intervertebral discs** that act as cushioning pads to absorb shock and protect against tension or torsion. The curvature of the spine allows the spine to act more like a spring than a rigid rod-like structure. A complex network of ligaments and muscles provide support to the column. While it does provide support for the axial skeleton, it also serves as a point of attachment for the ribs and many muscles, all while protecting the precious spinal cord, which is responsible for transmitting messages between the brain and the rest of the body.



The vertebral column is divided into 5 regions. The arrangement of the vertebrae makes it possible for us to bend forward, backward, and side to side (flexion and extension) as well as to twist (rotation). Each region also has additional unique functions due to their unique structures. In general, the vertebrae getting larger and thicker as you move down the column.

- The **cervical** region consists of 7 vertebrae that form a concave curvature. They are the smallest and lightest of all of the vertebrae, making up our neck and thus, supporting the skull.
- The **thoracic** region consists of 12 vertebrae that form a convex curvature. These connect to the thoracic region (rib cage).
- The **lumbar** region consists of 5 vertebrae that form a concave curvature. Located in our lower backs, they absorb the most stress of all the vertebrae, and thus are the sturdiest in structure in order to handle that stress.
- The **sacral** region consists of the sacrum, which is 5 fused vertebrae that articulate with the hip bones in the pelvic girdle.
- The final region is the **coccyx**, which consists of 4 fused vertebrae. This is our tailbone, and although it does provide a little support to our pelvic organs, it is a virtually useless bone.

Station 8

The Skull

The skull is the skeletal system's most unique and complicated bone structure. It consists of 8 cranial bones (cranium) that protect the delicate brain in the cranial cavity, and 14 facial bones that not only form the framework of our faces, but also have small yet distinct cavities for housing our special sense organs as well as openings for food and air to enter the body. All of the bones in the skull anchor many muscles that allow for us to make ridiculous faces when we take selfies. Only one bone in the skull, the **mandible**, is connected by a freely movable joint. All of the rest are united by interlocking joints called **sutures**.

Cranial Bones

The 8 cranial bones are the **frontal bone**, (2) **parietal bones**, (2) **temporal bones**, **occipital bone**, **sphenoid bone**, and the **ethmoid bone**. Some of the cranial bones house air-filled cavities lined with mucous membranes called **sinuses**.

Facial Bones

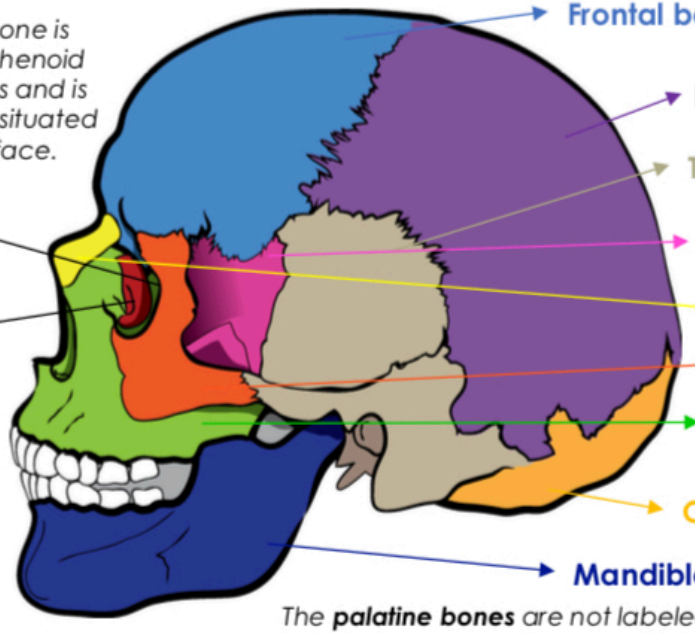
The 14 facial bones are the **mandible** (jaw bone), (2) **maxillary bones**, (2) **zygomatic bones** (cheek bones), (2) **nasal bones**, (2) **lacrimal bones**, (2) **palatine bones**, (2) **inferior nasal conchae**, and the **vomer**. The mandible is the strongest and largest bone of the face.

The ethmoid bone is between the sphenoid and nasal bones and is the most deeply situated bone on the face.

Ethmoid bone

Lacrimal bones

The lacrimal bones are part of the medial walls of each orbit (eye cavity).



Lateral View

Anterior View

The inferior nasal conchae form the lateral walls of the nasal cavity.

Inferior nasal conchae

Vomer

The vomer forms the inferior section of the nasal septum. Touch the skin between your nostrils (where people get septum piercings) and feel the hard bone behind it. That's the vomer!

*The **palatine bones** are not labeled because they can be seen best from a midsagittal cut of the skull, as they make up part of the palate (roof of the mouth) with the mandible.*