Axial Skeleton

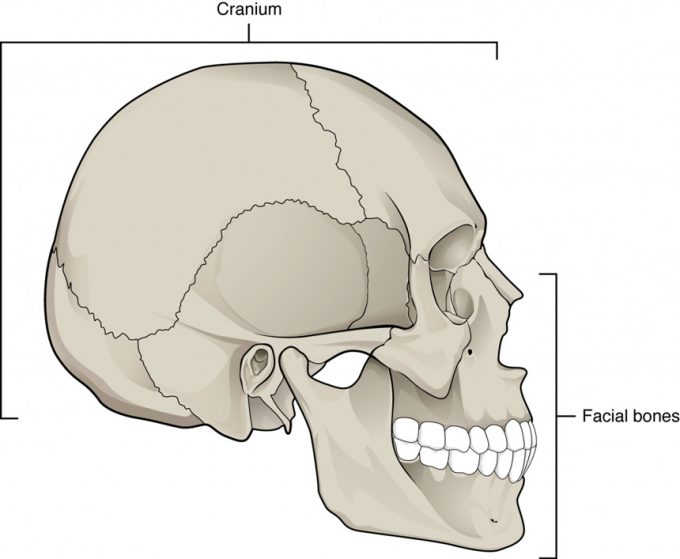
Bone Markings

| **Bone Markings (Table 2)** | | |
| --- | --- | --- |
| **Marking** | **Description** | **Example** |
| Articulations | Where two bones meet | Knee joint |
| Head | Prominent rounded surface | Head of femur |
| Facet | Flat surface | Vertebrae |
| Condyle | Rounded surface | Occipital condyles |
| Projections | Raised markings | Spinous process of the vertebrae |
| Protuberance | Protruding | Chin |
| Process | Prominence feature | Transverse process of vertebra |
| Spine | Sharp process | Ischial spine |
| Tubercle | Small, rounded process | Tubercle of humerus |
| Tuberosity | Rough surface | Deltoid tuberosity |
| Line | Slight, elongated ridge | Temporal lines of the parietal bones |
| Crest | Ridge | Iliac crest |
| Holes | Holes and depressions | Foramen (holes through which blood vessels can pass through) |
| Fossa | Elongated basin | Mandibular fossa |
| Fovea | Small pit | Fovea capitis on the head of the femur |
| Sulcus | Groove | Sigmoid sulcus of the temporal bones |
| Canal | Passage in bone | Auditory canal |
| Fissure | Slit through bone | Auricular fissure |
| Foramen | Hole through bone | Foramen magnum in the occipital bone |
| Meatus | Opening into canal | External auditory meatus |
| Sinus | Air-filled space in bone | Nasal sinus |

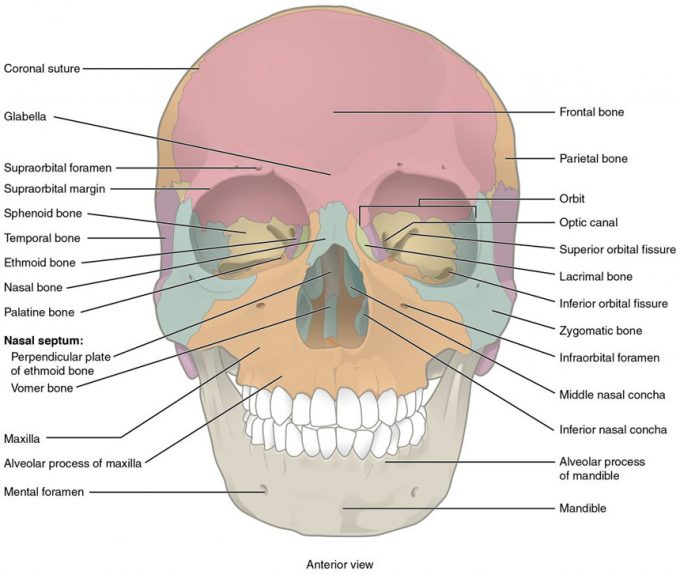
This illustration contains three diagrams. The left diagram is titled examples of processes formed where tendons or ligaments attach. The image shows an anterior view of the femur and an anterior view of the humerus. For the femur, the distal epiphysis contains a smaller lateral bulge and a larger medial bulge. These are examples of condyles. The inner halves of the two condyles as well as the groove between them compose a facet. An oval-shaped ridge on the medial surface of the distal metaphysis is an example of a tubercle. On the proximal epiphysis of the femur, the large knob that attaches to the hip socket is an example of a head. The tip of the head contains a small depression, an example of a fovea called the fovea capitis. On the humerus, the distal epiphysis contains a central depression that is an example of a fossa. Two condyles are located on the right and left sides of the fossa. The diaphysis of the humerus contains a small ridge running up the shaft that is an example of a tuberosity. The proximal epiphysis of the humerus contains a lateral and a medial bulge that are both examples of tubercles. Finally, a narrow groove runs from the center of the proximal metaphysis in between the medial and lateral condyles. This is an example of a sulcus. The middle image is entitled elevations or depressions. It shows an anterior view of the hip bones. The hip bones are shaped like two wings that join at the bottom. The crest along the upper edge of each hip bones, at the tip of each “wing” is an example of an elevation. A depression on the inner surface of both hip bones just under the crest is called out as a fossa. The right image is entitled examples of openings and shows an anterior view of the skull. The bone underlying the chin is an example of a protuberance while two small holes above each eye socket are examples of foramen. Five green sinuses surround the nose cavity are colored green. These are sinuses because they are hollowed out cavities within the skull bones. A small channel leads into the corner of each eye where the tear ducts occur. These two channels are both examples of a canal. Finally, the bones that form the posterior wall of the eye socket have a small crack running diagonally away from the nose. These are examples of fissures.

**Figure 7.21 – Bone Features:** The surface features of bones depend on their function, location, attachment of ligaments and tendons, or the penetration of blood vessels and nerves.

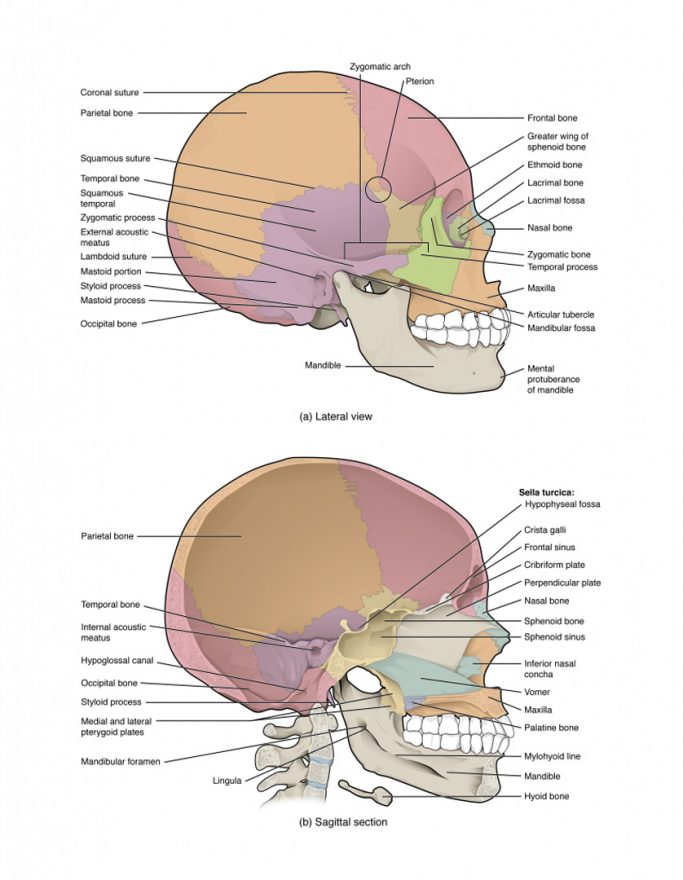
Skull



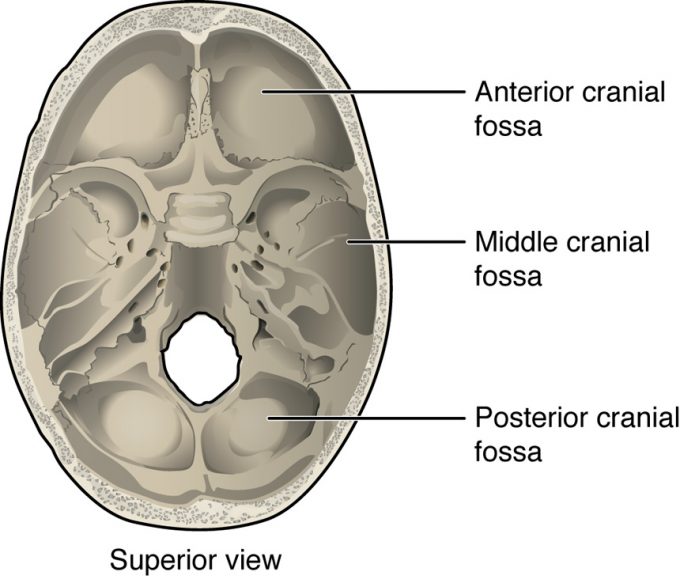
**Figure 7.31 – Parts of the Skull:** The skull consists of the rounded cranium that houses the brain and the facial bones that form the upper and lower jaws, nose, orbits, and other facial structures.



**Figure 7.32 – Anterior View of Skull:** An anterior view of the skull shows the bones that form the forehead, orbits (eye sockets), nasal cavity, nasal septum, and upper and lower jaws.



**Figure 7.33:** (a) Lateral View of Skull. The lateral skull shows the large rounded brain case, zygomatic arch, and the upper and lower jaws. The zygomatic arch is formed jointly by the zygomatic process of the temporal bone and the temporal process of the zygomatic bone. The shallow space above the zygomatic arch is the temporal fossa. (b) Sagittal Section of Skull. This midline view of the sagittally sectioned skull shows the nasal septum.



**Figure 7.34 – Cranial Fossae:** The bones of the brain case surround and protect the brain, which occupies the cranial cavity. The base of the brain case, which forms the floor of cranial cavity, is subdivided into the shallow anterior cranial fossa, the middle cranial fossa, and the deep posterior cranial fossa.

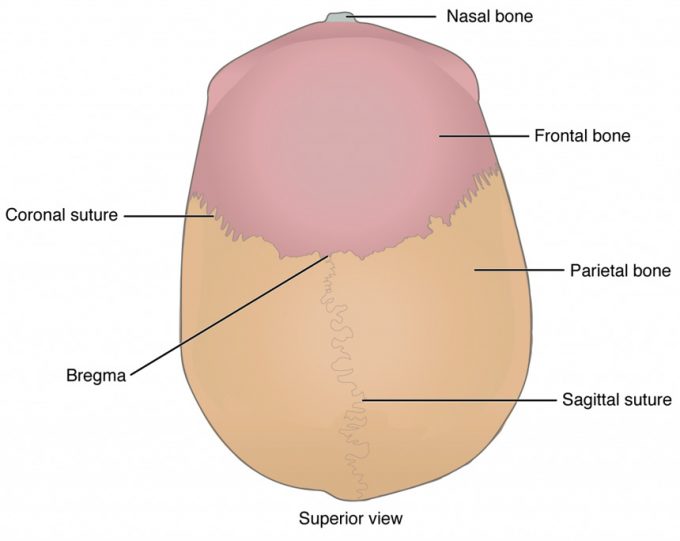
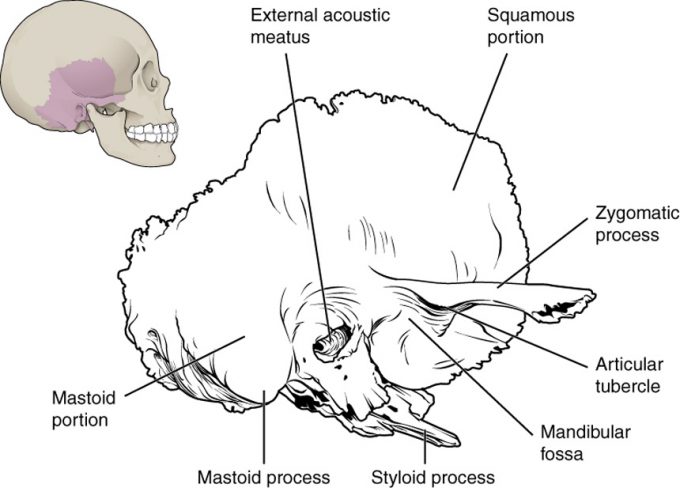
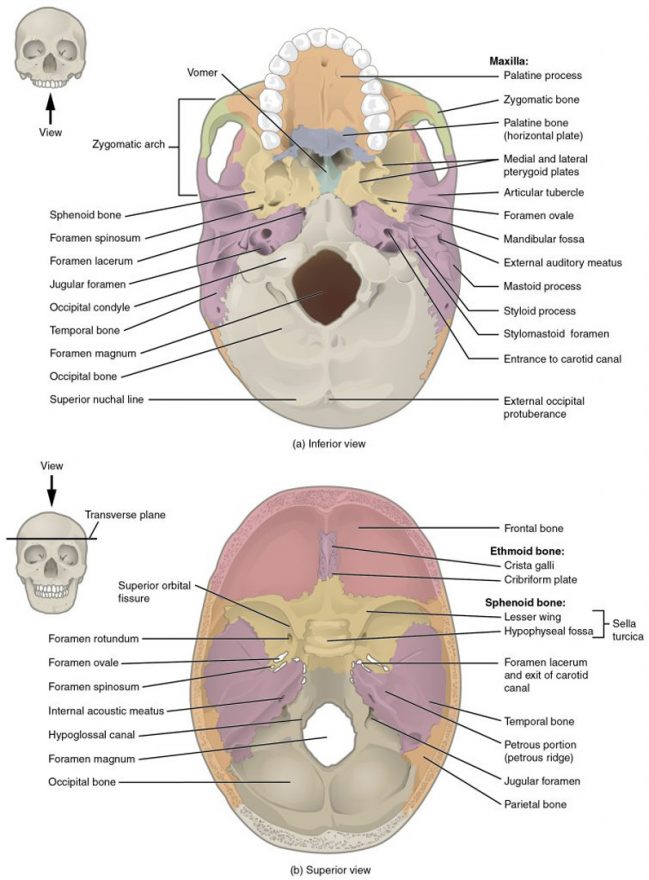


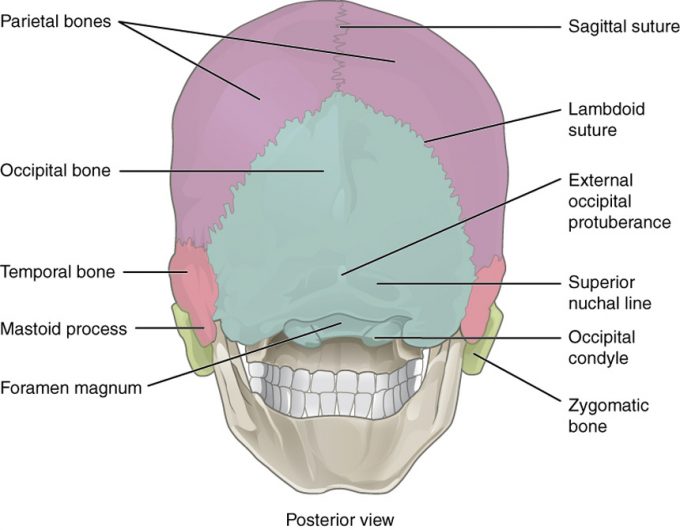
Figure 7.35. Superior view of the skull.



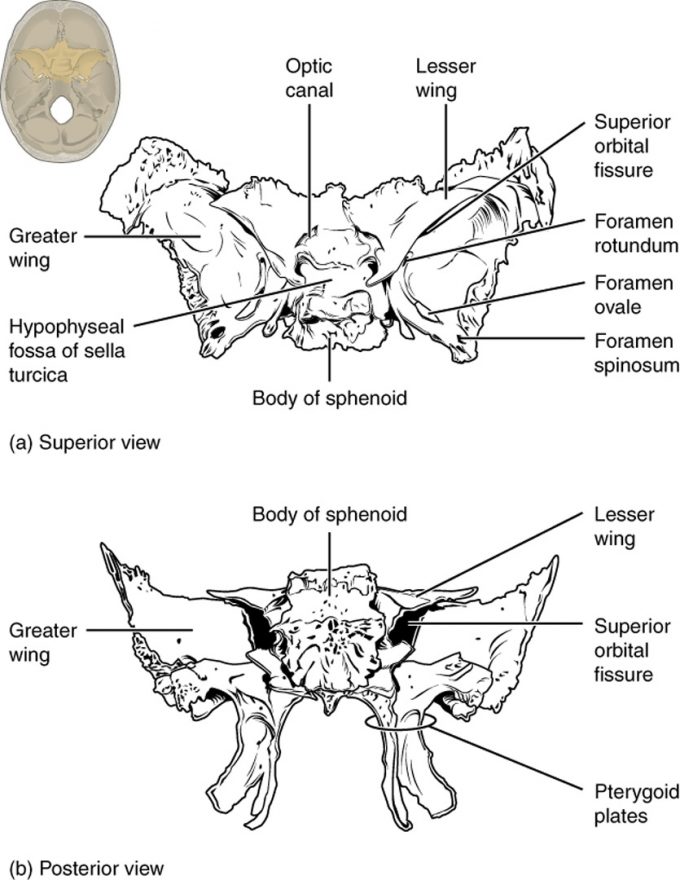
**Figure 7.36 – Temporal Bone:** A lateral view of the isolated temporal bone shows the squamous, mastoid, and zygomatic portions of the temporal bone.



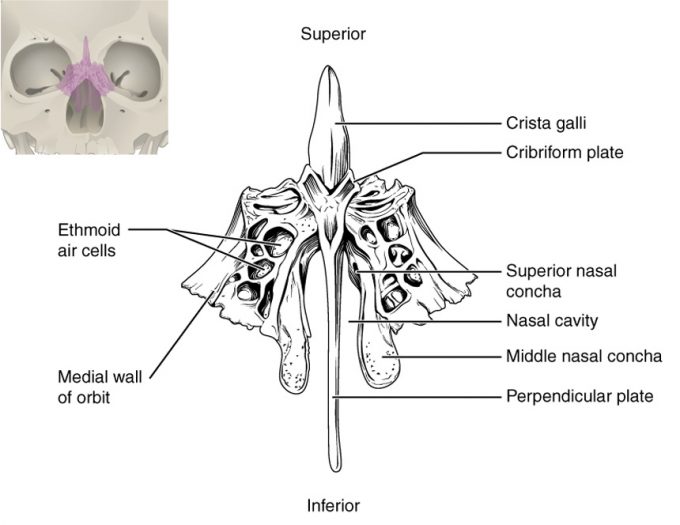
**Figure 7.37 – External and Internal Views of Base of Skull:** (a) The hard palate is formed anteriorly by the palatine processes of the maxilla bones and posteriorly by the horizontal plate of the palatine bones. (b) The complex floor of the cranial cavity is formed by the frontal, ethmoid, sphenoid, temporal, and occipital bones. The lesser wing of the sphenoid bone separates the anterior and middle cranial fossae. The petrous ridge (petrous portion of temporal bone) separates the middle and posterior cranial fossae.

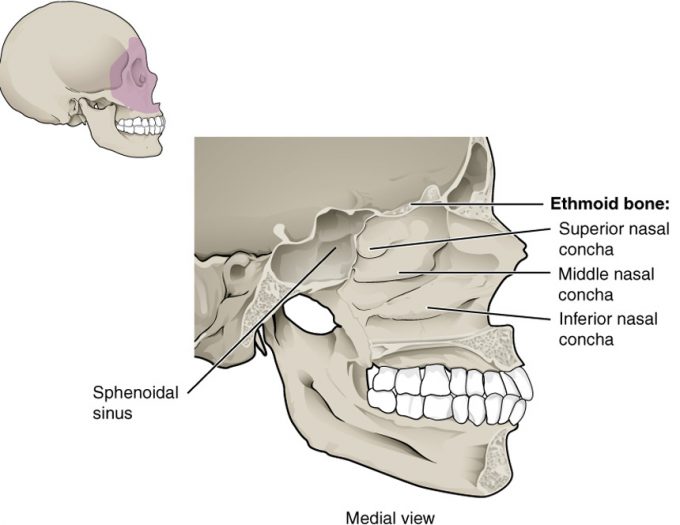


**Figure 7.38 – Posterior View of Skull:** This view of the posterior skull shows attachment sites for muscles and joints that support the skull.



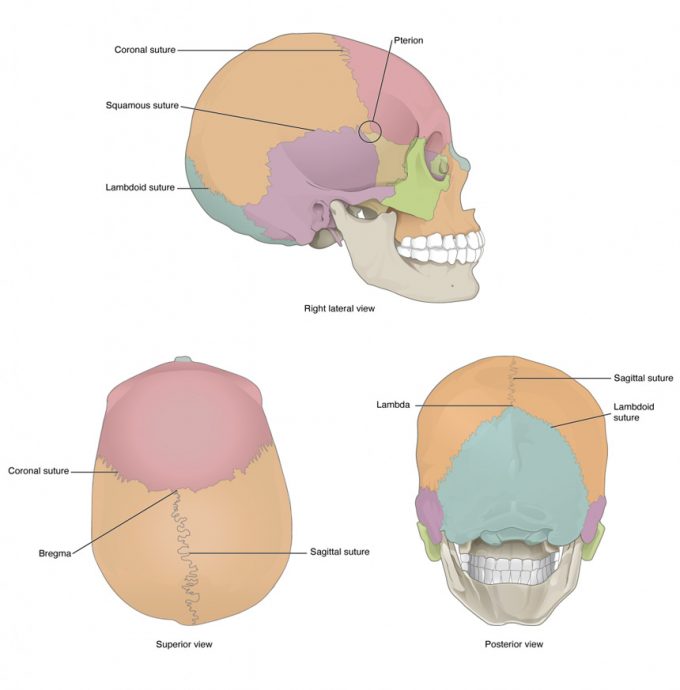
**Figure 7.39 – Sphenoid Bone:** Shown in isolation in (a) superior and (b) posterior views, the sphenoid bone is a single midline bone that forms the anterior walls and floor of the middle cranial fossa. It has a pair of lesser wings and a pair of greater wings. The sella turcica surrounds the hypophyseal fossa. Projecting downward are the medial and lateral pterygoid plates. The sphenoid has multiple openings for the passage of nerves and blood vessels, including the optic canal, superior orbital fissure, foramen rotundum, foramen ovale, and foramen spinosum.

**Figure 7.311 – Ethmoid Bone:** The unpaired ethmoid bone is located at the midline within the central skull. It has an upward projection, the crista galli, and a downward projection, the perpendicular plate, which forms the upper nasal septum. The cribriform plates form both the roof of the nasal cavity and a portion of the anterior cranial fossa floor. The lateral sides of the ethmoid bone form the lateral walls of the upper nasal cavity, part of the medial orbit wall, and give rise to the superior and middle nasal conchae. The ethmoid bone also contains the ethmoid air cells.

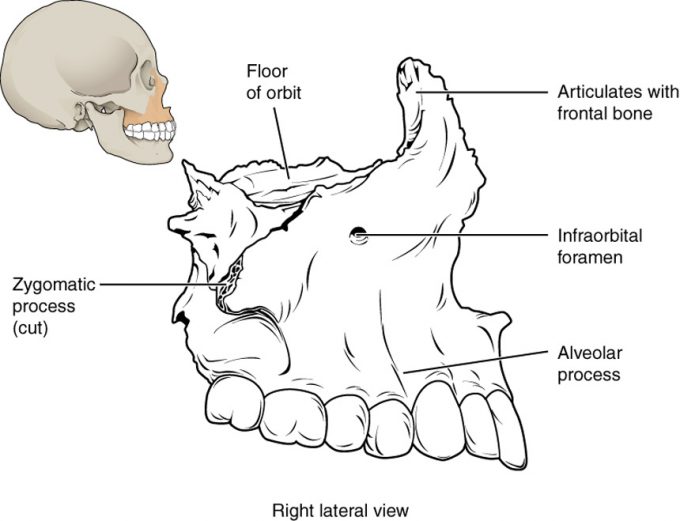


**Figure 7.312 – Lateral Wall of Nasal Cavity:** The three nasal conchae are curved bones that project from the lateral walls of the nasal cavity. The superior nasal concha and middle nasal concha are parts of the ethmoid bone. The inferior nasal concha is an independent bone of the skull.

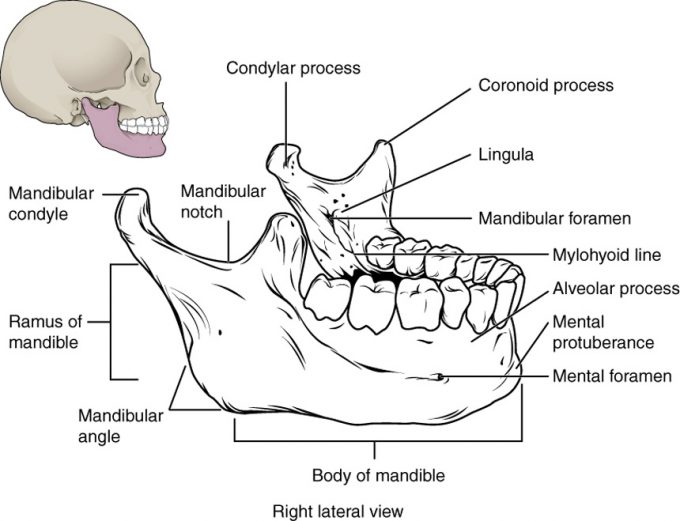
Sutures

**Figure 7.313 – Sutures of the skull**

Facial Bones

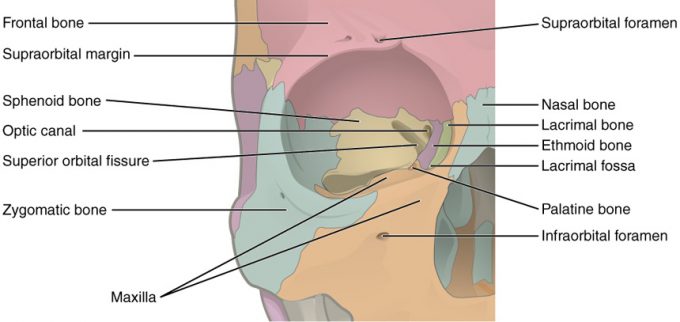


**Figure 7.312 – Maxillary Bone:** The maxillary bone forms the upper jaw and supports the upper teeth. Each maxilla also forms the lateral floor of each orbit and the majority of the hard palate.

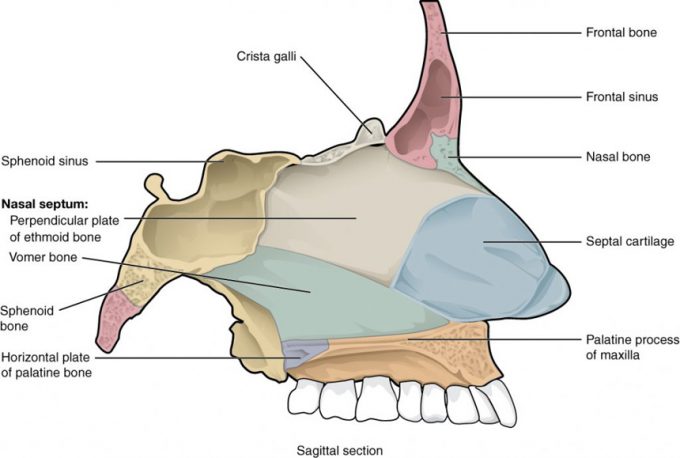


**Figure 7.314 – Isolated Mandible:** The mandible is the only moveable bone of the skull.

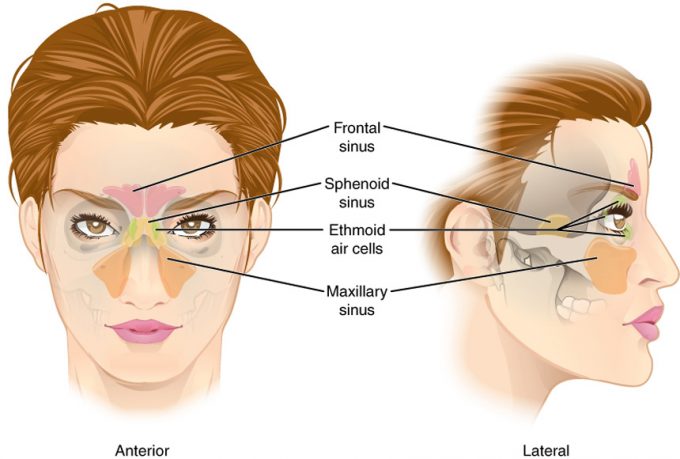
The Orbit



Nasal Septum and Sinuses

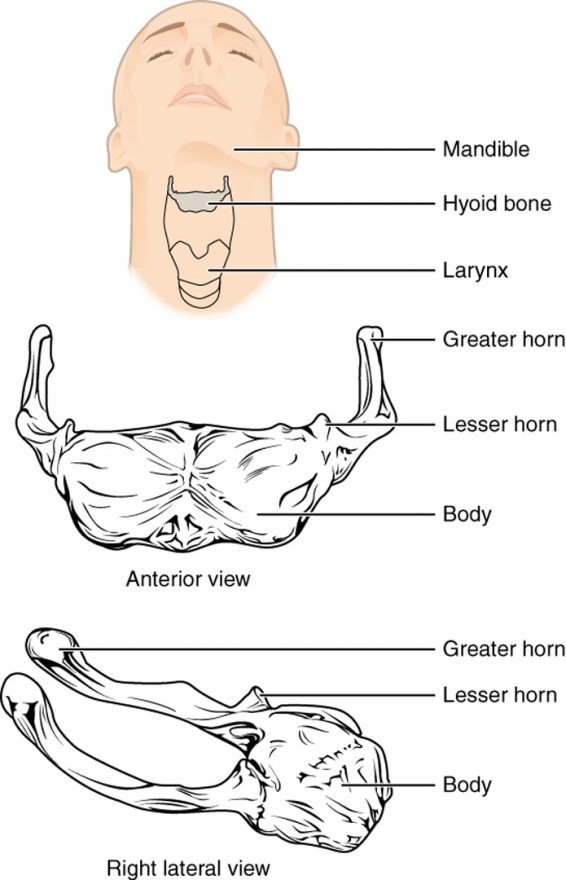


**Figure 7.316 – Nasal Septum:** The nasal septum is formed by the perpendicular plate of the ethmoid bone and the vomer bone. The septal cartilage fills the gap between these bones and extends into the nose.

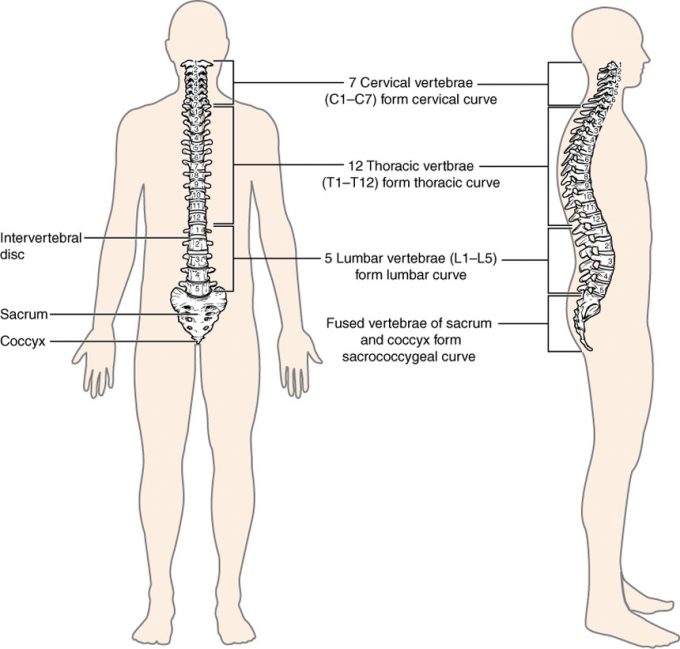


**Figure 7.317 – Paranasal Sinuses:** The air-filled paranasal sinuses, each named for the bone in which it is found, drain into the nasal cavity.

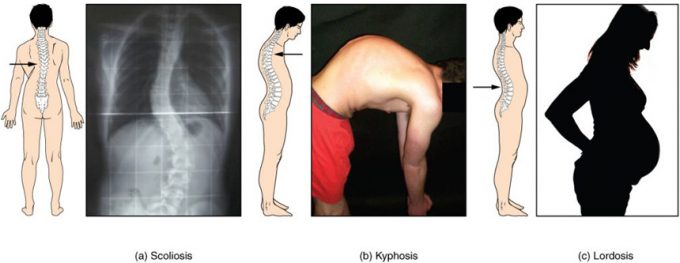
Hyoid Bone



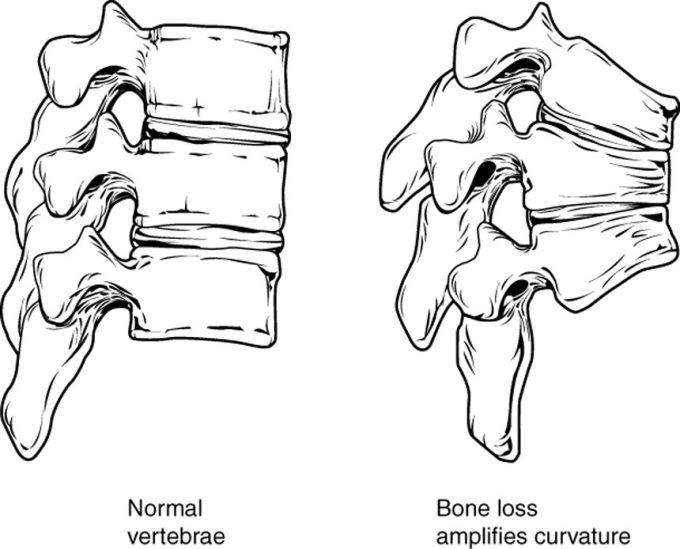
Vertebral Column



**Figure 7.41 – Vertebral Column:** The adult vertebral column consists of 24 vertebrae, plus the fused vertebrae of the sacrum and coccyx. The vertebrae are divided into three regions: cervical C1–C7 vertebrae, thoracic T1–T12 vertebrae, and lumbar L1–L5 vertebrae. The vertebral column is curved, with two primary curvatures (thoracic and sacrococcygeal curves) and two secondary curvatures (cervical and lumbar curves).

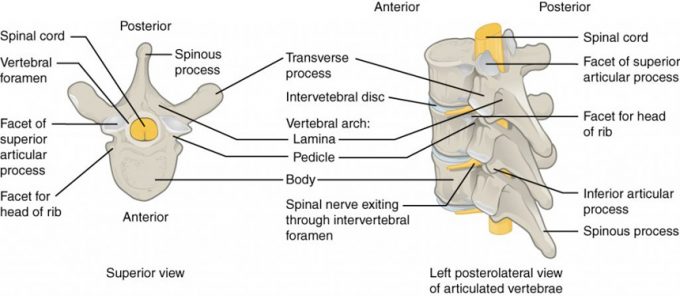


**igure 7.42 – Abnormal Curvatures of the Vertebral Column:** (a) Scoliosis is an abnormal lateral bending of the vertebral column. (b) An excessive curvature of the upper thoracic vertebral column is called kyphosis. (c) Lordosis is an excessive curvature in the lumbar region of the vertebral column.



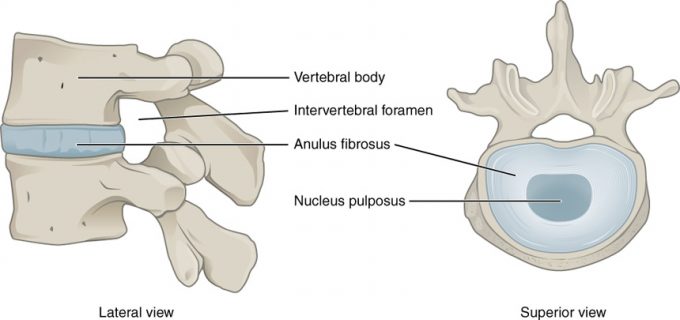
**Figure 7.43 – Osteoporosis:** Osteoporosis is an age-related disorder that causes the gradual loss of bone density and strength. When the thoracic vertebrae are affected, there can be a gradual collapse of the vertebrae. This results in kyphosis, an excessive curvature of the thoracic region.

General Structure of Vertebrae



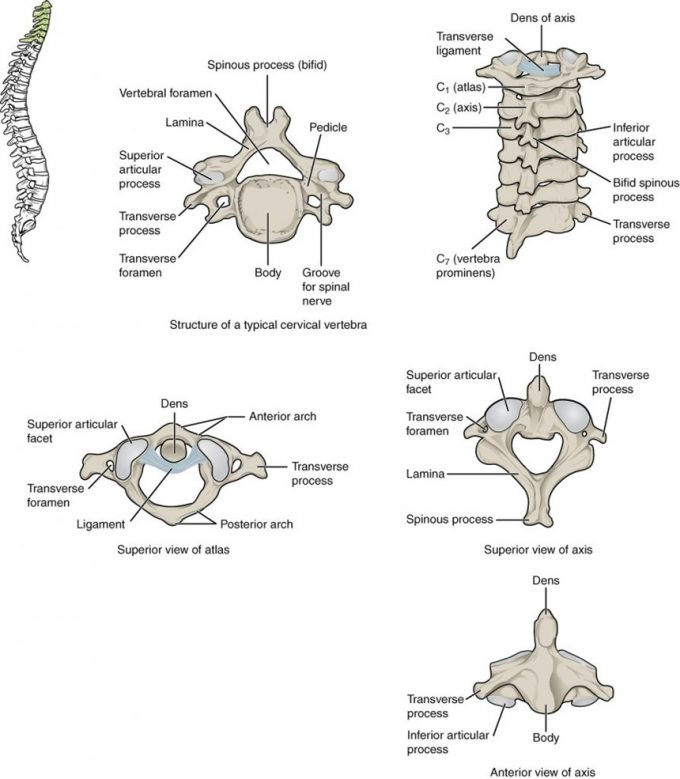
**Figure 7.44 – Parts of a Typical Vertebra:** A typical vertebra consists of a body and a vertebral arch. The arch is formed by the paired pedicles and paired laminae. Arising from the vertebral arch are the transverse, spinous, superior articular, and inferior articular processes. The vertebral foramen provides for passage of the spinal cord. Each spinal nerve exits through an intervertebral foramen, located between adjacent vertebrae. Intervertebral discs unite the bodies of adjacent vertebrae.

Intervertebral Disc



**Figure 7.45 – Intervertebral Disc:** The bodies of adjacent vertebrae are separated and united by an intervertebral disc, which provides padding and allows for movements between adjacent vertebrae. The disc consists of a fibrous outer layer called the anulus fibrosus and a gel-like center called the nucleus pulposus. The intervertebral foramen is the opening formed between adjacent vertebrae for the exit of a spinal nerve.

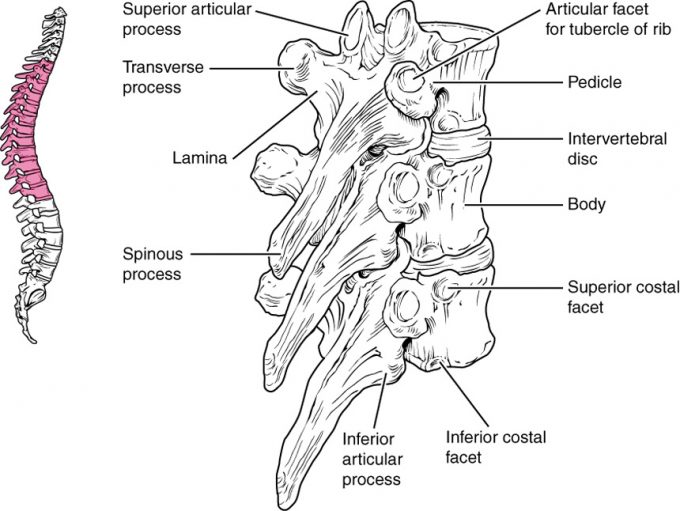
Cervical Vertebrae



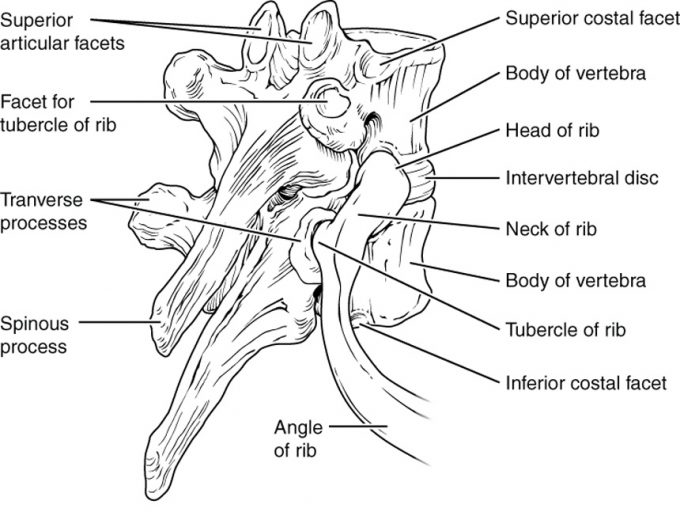
**Figure 7.46 – Cervical Vertebrae:** A typical cervical vertebra has a small body, a bifid spinous process, transverse processes that have a transverse foramen and are curved for spinal nerve passage. The atlas (C1 vertebra) does not have a body or spinous process. It consists of an anterior and a posterior arch and elongated transverse processes. The axis (C2 vertebra) has the upward projecting



Thoracic Vertebrae

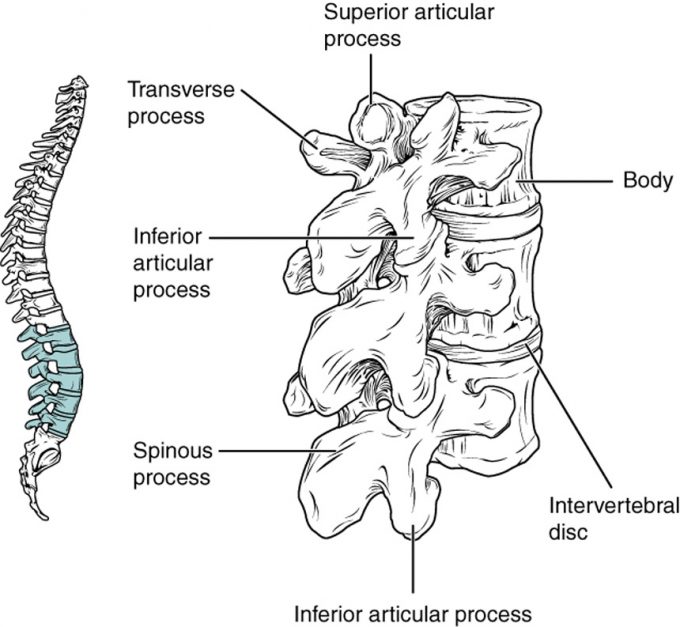


**Figure 7.47 – Thoracic Vertebrae:** A typical thoracic vertebra is distinguished by the spinous process, which is long and projects downward to overlap the next inferior vertebra. It also has articulation sites (facets) on the vertebral body and a transverse process for rib attachment. A posterior view of a midthoracic vertebra resembles a giraffe.

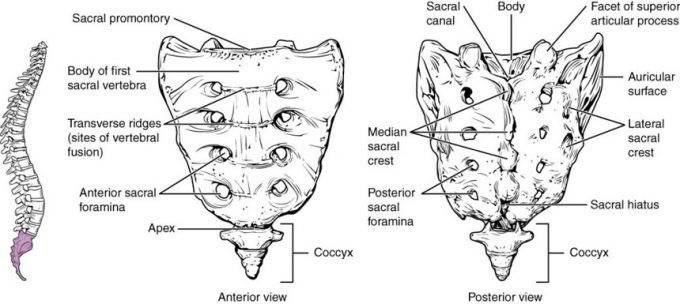


**Figure 7.48 – Rib Articulation in Thoracic Vertebrae:** Thoracic vertebrae have superior and inferior articular facets on the vertebral body for articulation with the head of a rib, and a transverse process facet for articulation with the rib tubercle.

Lumbar Vertebrae

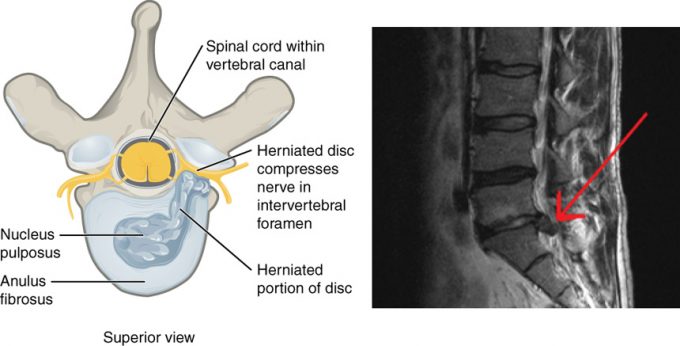


**Figure 7.49 – Lumbar Vertebrae:** Lumbar vertebrae are characterized by having a large, thick body and a short, rounded spinous process. A posterior view of a lumbar vertebra resembles a moose. Sacrum and Coccyx



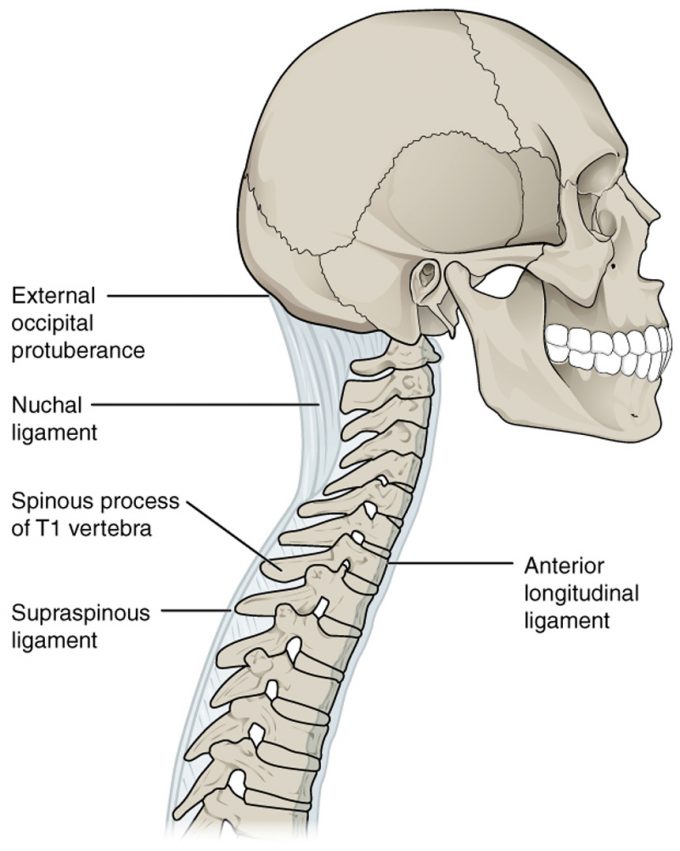
**Figure 7.410 – Sacrum and Coccyx:** The sacrum is formed from the fusion of five sacral vertebrae, whose lines of fusion are indicated by the transverse ridges. The fused spinous processes form the median sacral crest, while the lateral sacral crest arises from the fused transverse processes. The coccyx is formed by the fusion of four small coccygeal vertebrae.

Disc Herniation



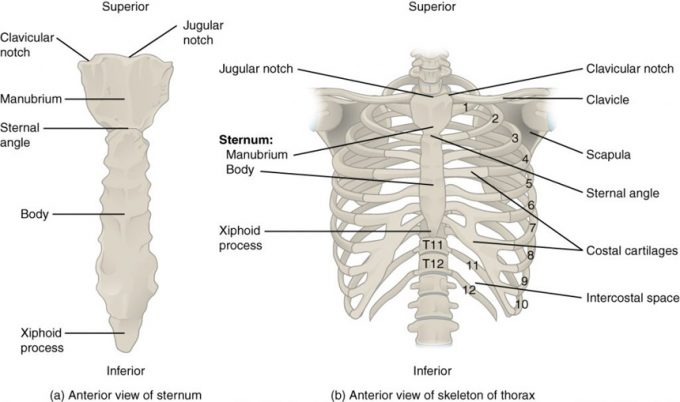
**Figure 7.411 – Herniated Intervertebral Disc:** Weakening of the anulus fibrosus can result in herniation (protrusion) of the nucleus pulposus and compression of a spinal nerve, resulting in pain and/or muscle weakness in the body regions supplied by that nerve.

Ligaments of Vertebral Column



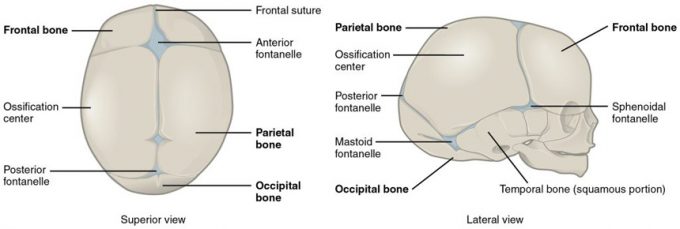
**Figure 7.412 – Ligaments of Vertebral Column:** The anterior longitudinal ligament runs the length of the vertebral column, uniting the anterior sides of the vertebral bodies. The supraspinous ligament connects the spinous processes of the thoracic and lumbar vertebrae. In the posterior neck, the supraspinous ligament enlarges to form the nuchal ligament, which attaches to the cervical spinous processes and to the base of the skull.

Thoracic Cage



**Figure 7.51 – Thoracic Cage:** The thoracic cage is formed by the (a) sternum and (b) 12 pairs of ribs with their costal cartilages. The ribs are anchored posteriorly to the 12 thoracic vertebrae. The sternum consists of the manubrium, body, and xiphoid process. The ribs are classified as true ribs (1–7) and false ribs (8–12). The last two pairs of false ribs are also known as floating ribs (11–12).

Embryonic Development



**Figure 7.61 – Newborn Skull:** The bones of the newborn skull are not fully ossified and are separated by large areas called fontanelles, which are filled with fibrous connective tissue. The fontanelles allow for continued growth of the brain and skull after birth. At the time of birth, the facial bones are small and underdeveloped, and the mastoid process has not yet formed.