

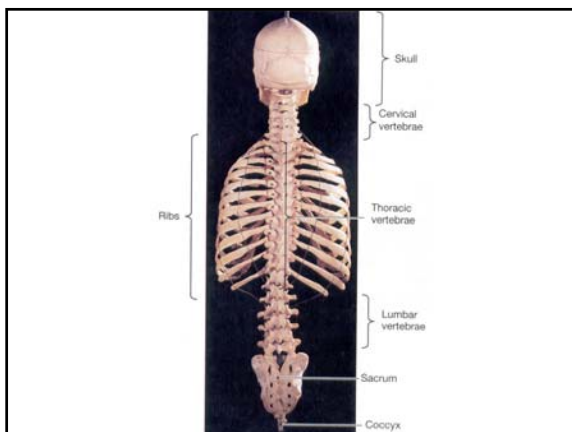
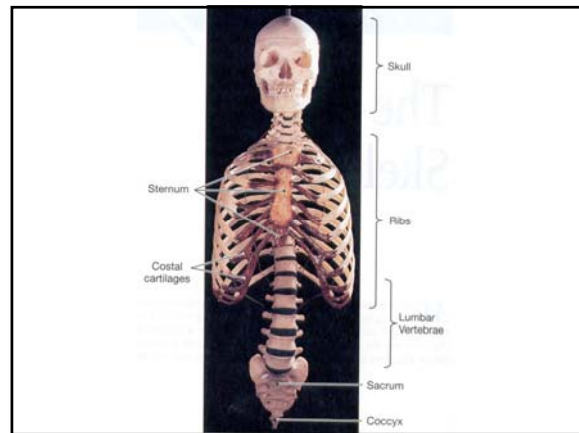
The Axial Skeleton

The Axial Skeleton

•The basic features of the human skeleton have been shaped by evolution, but the detailed characteristics of each bone reflect the stresses put on it. As a result, the skeleton changes during its lifetime.

The skeletal system is divided into:

1. **Axial Division:** bones of the body's axis (skull, ribs, vertebrae)
2. **Appendicular Division:** bones appended to the axial bones of the body (arms, legs, shoulders, hands, feet, etc.)



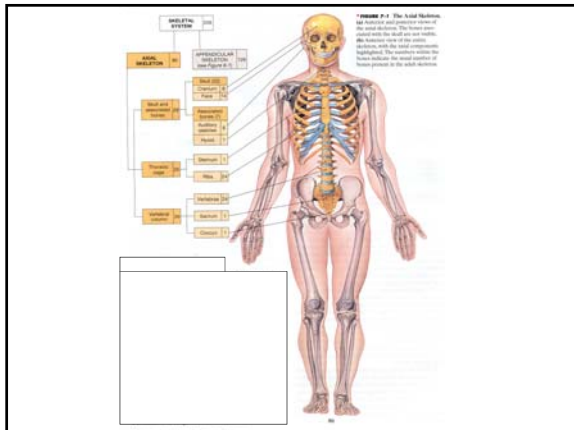
There are roughly 80 bones in the Axial skeleton, and they form the bones of the longitudinal axis of the body (roughly 40% of the bones in the human body)

Skull Bones: 8 cranial, 18 facial

Associated Skull Bones: 6 auditory ossicles, 1 hyoid bone

Thoracic Bones: 1 sternum, 24 ribs

Vertebral Bones: 24 vertebrae, 1 sacrum, 1 coccyx



The functions of the axial skeleton are:

1. Create a framework to support and protect organs in the dorsal and ventral cavities
 2. Provide extensive surface area for the attachment of muscles that:
 - a. adjust the position of the head, neck and trunk
 - b. perform respiratory movement
 - c. stabilize or position the appendicular skeleton
- The joints of the axial skeleton are limiting in terms of movement, but are VERY strong and heavily reinforced with ligaments.

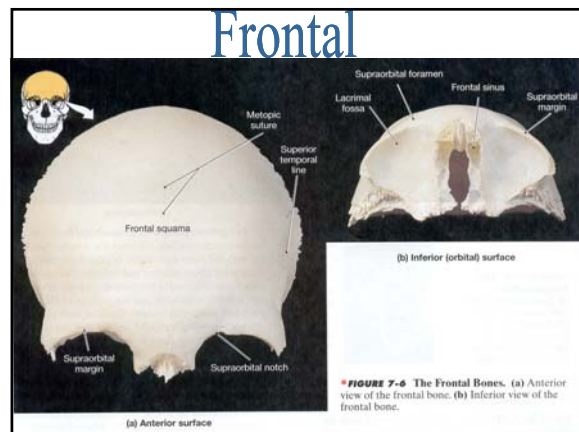
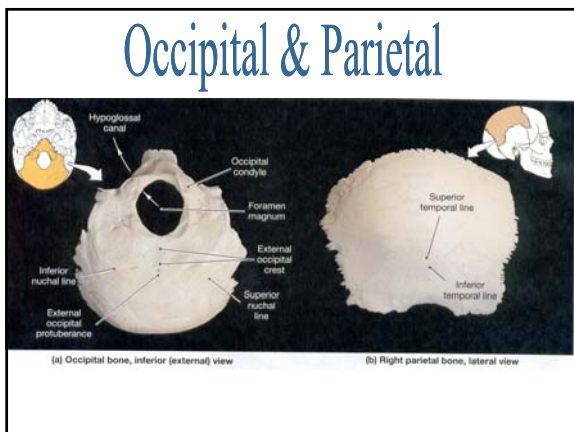
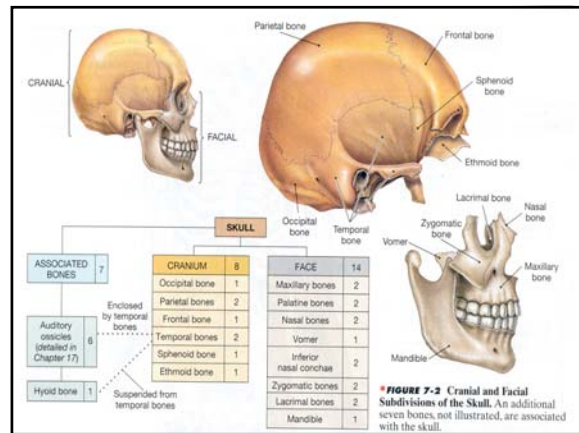
The Skull

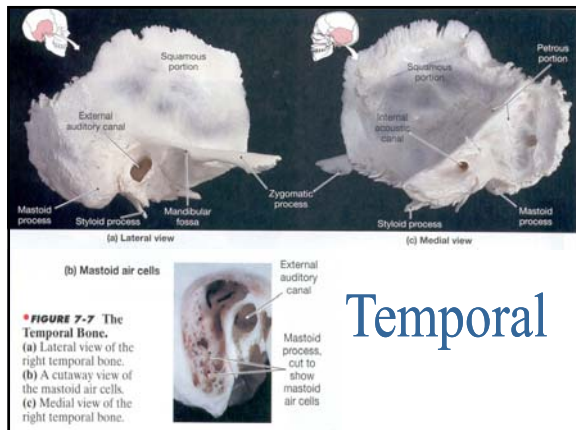
•The bones of the skull protect the brain and guard the entrances to the digestive and respiratory systems. The skull contains 22 bones.

Eight bones form the majority of the cranium or braincase:

- a. occipital
- b. parietal (L-R)
- c. frontal
- d. temporal (L- R)
- e. sphenoid (L-R)

•These bones along with the ethmoid (a facial bone) completely enclose the brain case.

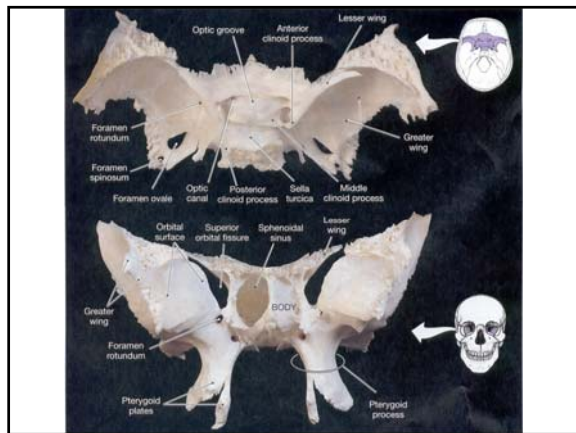




Temporal

Sphenoid

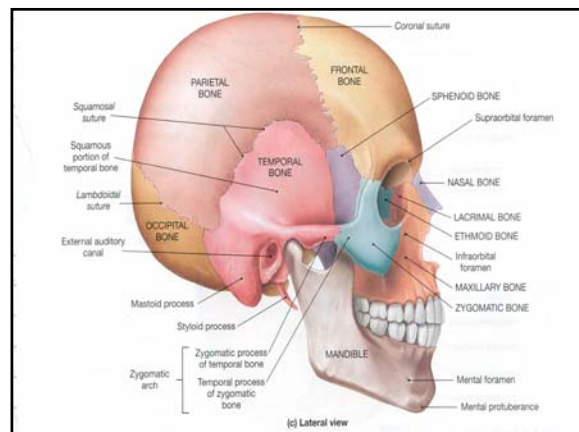
- The **sphenoid bone** is a bone situated at the base of the skull in front of the temporals and basilar part of the occipital.
- The sphenoid bone somewhat resembles a butterfly or bat with its wings extended.

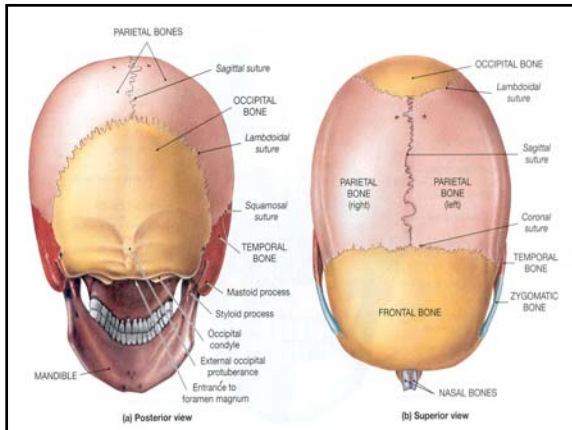


Except at the mandibular joints, the articulations of the skull are immovable joints called sutures

- At a suture the bones are tied firmly together with dense fibrous CT.
- Of course each suture of the skull has a name but there are 4 you need to know:

- Lambdoidal sutures:** on posterior surface of the skull (looks like λ) separates occipital bone from two parietal bones.
- Coronal suture:** separates the frontal bone from the two parietal bones.
- Sagittal suture:** extends between the lambdoidal and coronal sutures, separates the two parietal bones.
- Squamosal suture:** on either side of the skull, separates the temporal bone from the parietal bone on each side of the skull.





Seven additional bones are associated with the skull:

- The six auditory ossicles; **a. Malleus** (L-R), **b. Incus** (L-R), **c. Stapes** (L-R), are enclosed by the temporal bones by a pair of ligaments.
- The cranial cavity (brain case) is a fluid filled space that cushions and supports the brain.
- Vessels and nerves, that supply the brain, are attached to the inside of the cranium.

- The outside of the cranium serves as a site of attachment for the muscles of the eyes and jaw.
- The base of the cranium has a specialized joint that stabilizes the spinal cord, but allows for tremendous gross movements of the head.

Facial Complex

- Facial bones protect and support entrances to the digestive and respiratory tracts.
- Superficial facial bones; **maxillary**, **lacrimal**, **nasal**, **mandible**, and **zygomatic** bones provide areas of attachment of muscles that control facial expression, and assist in manipulation of food.
- The **palatine bone** (deep facial) helps separate the oral and nasal cavities
- The **vomer** (deep facial) contributes to the nasal septum (the wall that subdivides the nasal cavity).

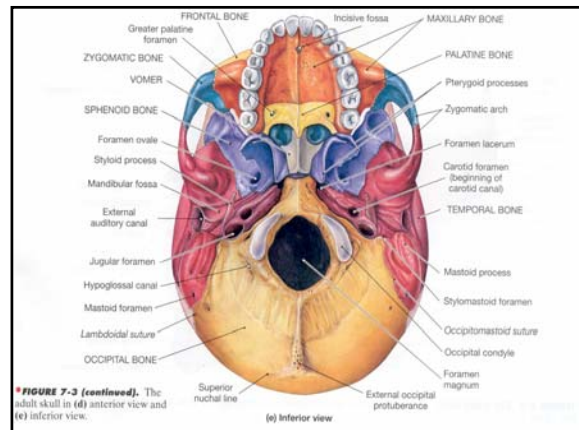
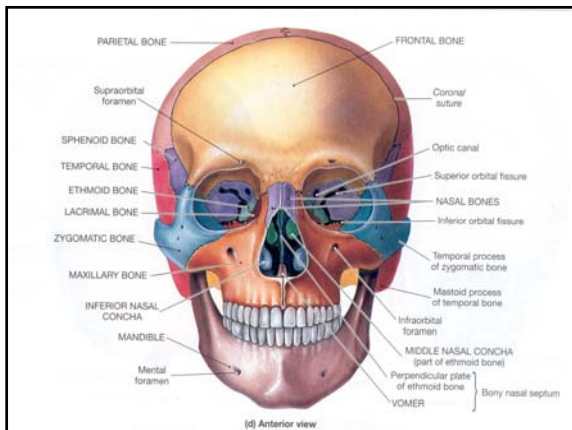
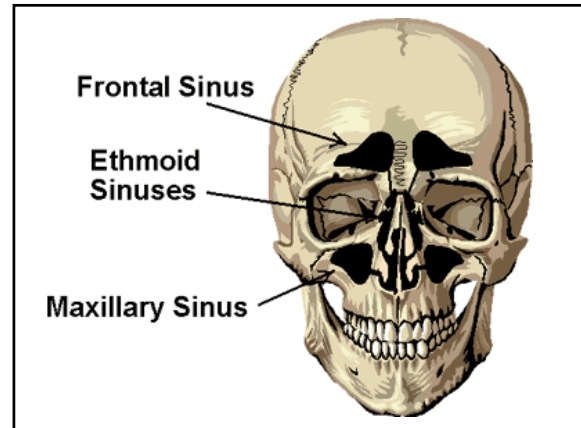


FIGURE 7-3 (continued). The adult skull in (d) anterior view and (e) inferior view.

- Several bones of the face contain air filled spaces called sinuses.

The sinuses have two main functions:

1. The presence of the sinus makes bones much lighter than it normally would be.
2. The mucous created by the lining of the sinus makes inhaled air moist and warm

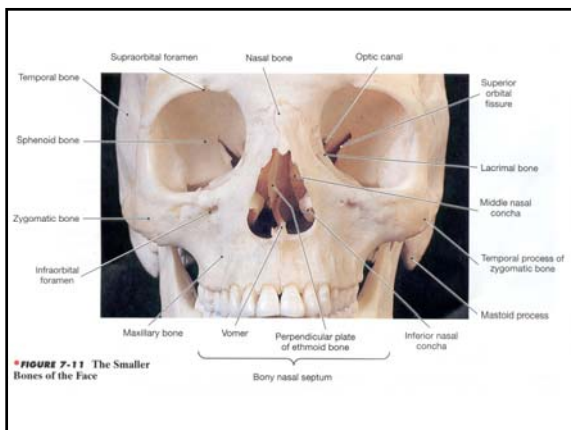


Sinusitis:

- Viral or bacterial infection of the sinuses tends to narrow the already small passages into and out of the sinuses, causing a backup of mucous and pressure which often cause a headache.
- Chronic sinusitis can be caused or aggravated by a deviated septum. If the nasal septum has a bend in it, it may cause a continuing cycle of infection. This can be caused naturally or by injury, and can be cured easily through surgery.

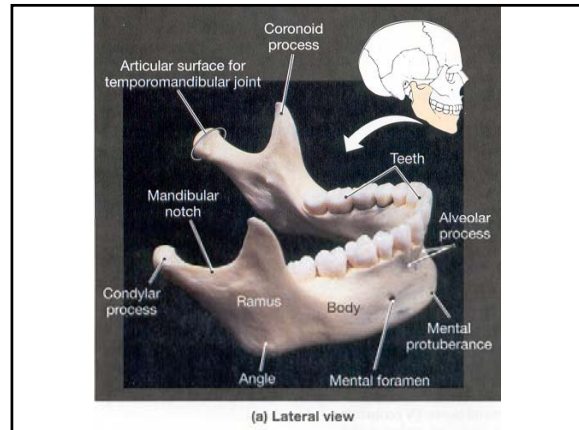
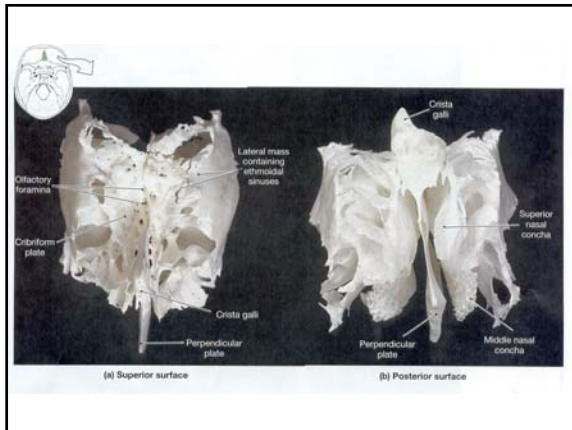
Turbinate (or nasal conchae)

- A **turbinate** (or **nasal conchae**) is a long, narrow and curled bone shelf (shaped like an elongated sea-shell) which protrudes into the breathing passage of the nose. Turbinate bone refers to any of the scrolled spongy bones of the nasal passage.
- The turbinates divide the nasal airway into three groove-like air passages—and are responsible for forcing inhaled air to flow in a steady, regular pattern around the largest possible surface of cilia and climate controlling tissue.



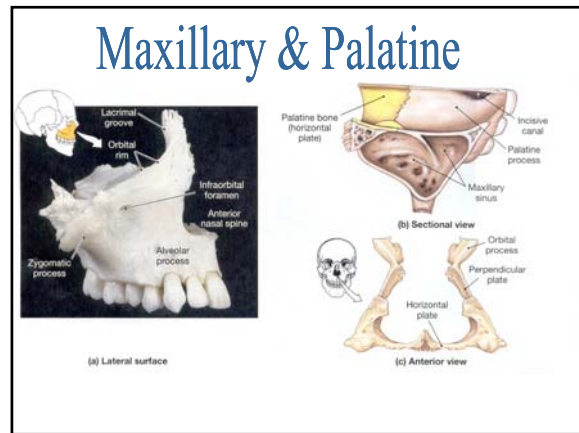
Ethmoid

- The **ethmoid bone** is a bone in the skull that separates the nasal cavity from the brain. As such, it is located at the roof of the nose, between the two orbits. The cubical bone is lightweight due to a spongy construction.



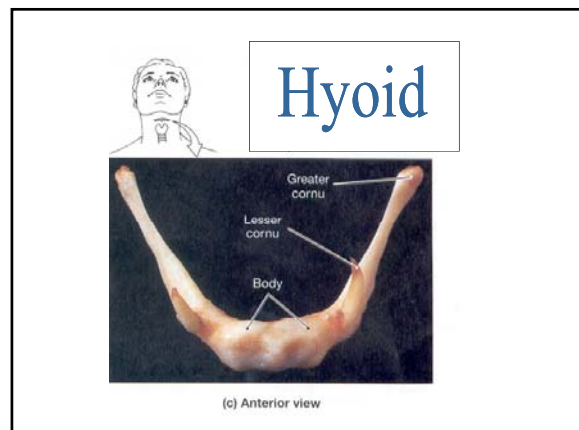
TMJ-Syndrome...

•The temporomandibular joint is relatively weak, and is easily dislocated by a forward or lateral force. Unfortunately this original dislocation may be the causative agent in TMJ-Syndrome (or TMJD). In TMJ-syndrome the TMJ keeps becoming dislocated (usually by muscle spasms) in a repeating cycle (muscle spasm → misalignment → pain → muscle spasm, etc). This may cause facial pain, and an inability to open the mouth fully. It also may cause people with this disorder to grind their teeth during sleep, or to experience emotional stress. This disorder is generally treated with application of heat, anti-inflammatory drugs, and/or local anesthetic. If teeth grinding is suspected, special mouth guards may be worn at night.



Hyoid

- This bone is shaped like a horseshoe.
- It lies behind the mandible and is positioned just superior to the larynx.
- It serves as an attachment point for several muscles that move the tongue and larynx.

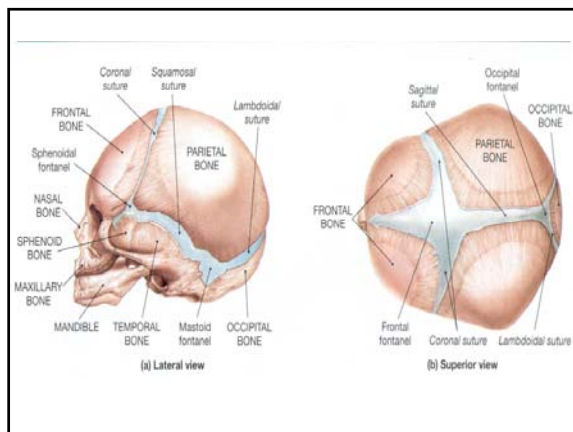


The Skulls of infants and children

- At the time of birth, the cranial bones are connected by areas of fibrous CT.
- These connections are quite flexible and the skull can be distorted without damage.
- Such distortion usually occurs during child birth and helps ease the baby out of the birth canal.

The fibrous areas between the cranial bones are called fontanels:

- a. frontal fontanel:** the largest, lies on top of the baby's head.
- b. occipital fontanel:** at the top of the lambdoidal suture.
- c. Sphenoid fontanel:** in tempal area.
- d. Mastoid fontanel:** near junction of temporal and occipital bone.



•The occipital, sphenoid, and mastoid fontanels disappear within a month or two after birth.

•The frontal fontanel persists until the child is about 2 years old.

•The most significant growth of the skull occurs before the age of 5 years old, at which time the brain stops growing and cranial sutures begin to develop.

The Vertebral Column

- The adult vertebral column consists of 26 bones : the vertebrae (24), the sacrum, and the coccyx.

The functions of the vertebrae include:

- providing a column of support, bearing the weight of the head neck and trunk, and ultimately transferring the weight to the appendicular skeleton.
- Protecting the spinal cord
- Helping maintain an upright body position

The vertebral column is divided into 5 regions:

Cervical (7): constitutes the neck and is extended inferiorly to the trunk

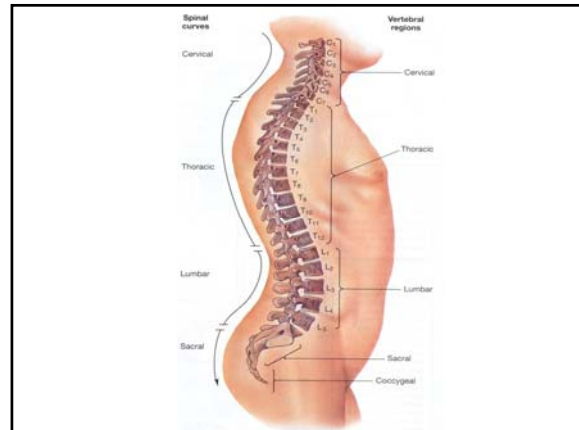
Thoracic (12): forms the upper back each articulated with one or more pairs of ribs

Lumbar (5): form the lower back, L5 articulates with sacrum

Sacral (1): starts in a fetus as 5 separate vertebrae, completely fused by age 25

Coccygeal (1): starts in a fetus as 3-5 tiny vertebrae that are not fused by puberty, but become fused at a variable rate after that.

- The total length of the adult spine averages 71 cm (28 in).



Spinal Curvature

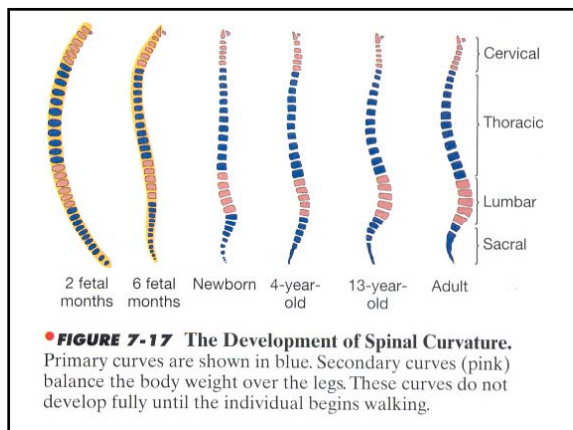
• The lateral view of the adult spine shows 4 curvatures: cervical, thoracic, lumbar, sacral

The thoracic and sacral curves are called primary curves or accommodation curves because they:

- are present at birth
- accommodate the developing thoracic and abdominopelvic viscera

The lumbar and cervical curves are called secondary curves or compensation curves because they:

- are not present till several months after birth
 - help shift the trunk weight over the lower limbs
- All curves are fully developed by age 10



Several abnormal distortions of spinal curvature may appear during childhood and adolescence, examples of these include:

Kyphosis: exaggerated thoracic curvature

Lordosis: exaggerated lumbar curvature

Scoliosis: abnormal lateral curvature

- Most of the body weight is in front of the spine, yet the spine must transfer the weight to the rest of the body evenly. The curvature helps the body do this

Vertebral Anatomy

•Each vertebrae consists of 3 basic parts:

- 1) a **body**
- 2) a **vertebral arch**
- 3) **articular processes**

The Vertebral Body

- The body (or centrum) is the main part of the vertebra. It is the part that transfers the weight through the spine.
- Adjacent vertebrae are interconnected by ligaments, but separated by intervertebral disks (pads of elastic CT).

The Vertebral Arch

•The vertebral arch (also called the neural arch) forms the posterior margin of each vertebral foramen. The vertebral foramina together form the spinal canal (collectively known as the vertebral canal) which contains the spinal cord.

The “roof” of the vertebral arch is called the lamina, and the walls of the arch are known as pedicles.

•In the condition called **Spina Bifida**, the lamina in the fetus fail to unite and fuse. The neural arch is then incomplete, and the tissues that line the vertebral canal bulge outward.

•A spinous process projects posteriorly from the fusion point of the lamina.

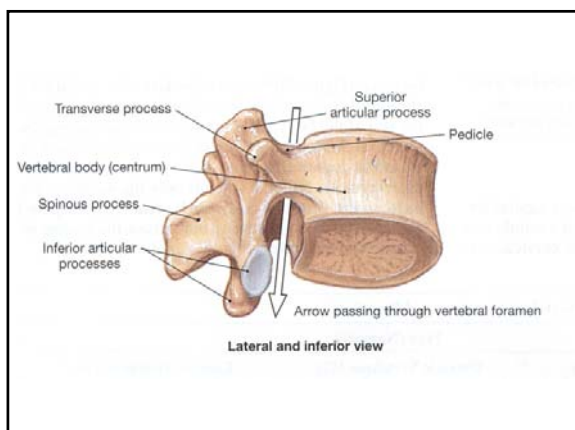
• Transverse processes project laterally or dorsolaterally on both sides from where the lamina fuse with the pedicles.

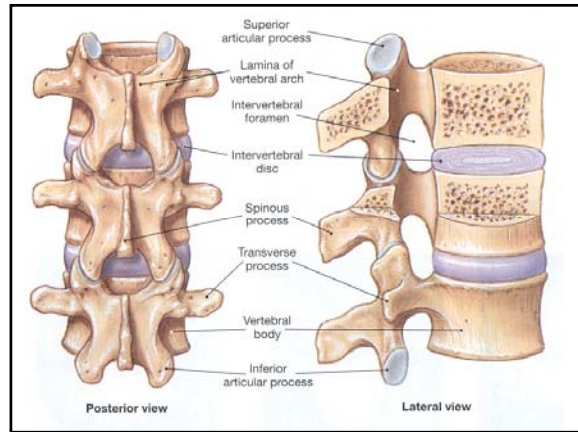
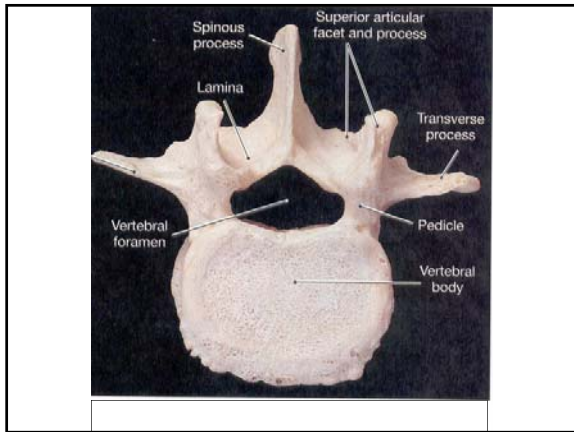
•These are sites muscle attachment, and may serve as articulation points for ribs

The Vertebral Articular Processes

•The articular processes lie superior and inferior on the near roof of the transverse processes. The inferior articular process of one vertebra articulate with the superior articular processes of the vertebra below it.

•Gaps exist between the vertebrae where spinal nerves can enter and exit the spine to access the spinal cord. These are known as intervertebral foramina.





Feature	Type (Number)		
	Cervical Vertebrae (7)	Thoracic Vertebrae (12)	Lumbar Vertebrae (5)
Location	Neck	Chest	Lower back
Body	Small, oval, curved faces	Medium, heart-shaped, flat faces; facets for rib articulations	Massive, oval, flat faces
Vertebral foramen	Large	Smaller	Smallest
Spinous process	Long; split tip; points inferiorly	Long, slender; not split; points inferiorly	Blunt, broad; points posteriorly
Transverse process	Has transverse foramen	All but two (T ₁₁ , T ₁₂) have facets for rib articulations	Short; no articular facets or transverse foramen
Functions	Support skull, stabilize relative positions of brain and spinal cord, and allow controlled head movement	Support weight of head, neck, upper limbs, chest; articulate with ribs to allow changes in volume of thoracic cage	Support weight of head, neck, upper limbs, and trunk

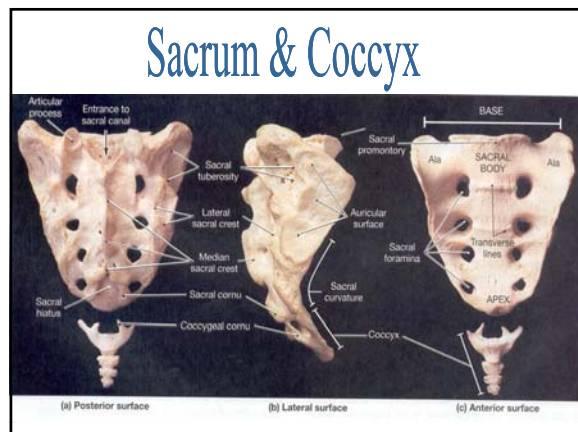
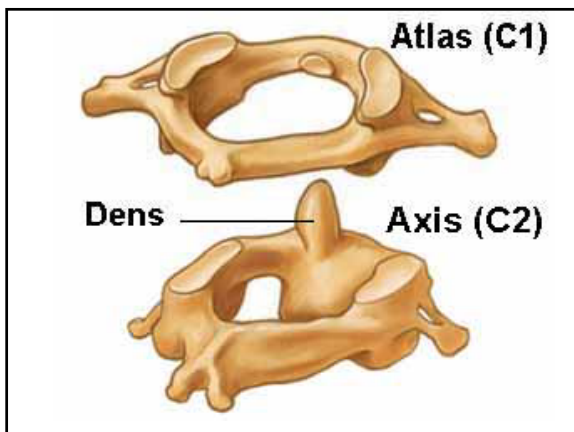


Atlas & Axis

•The **Atlas** (C1) is the topmost (first) cervical vertebrae of the spine. It is named for the Atlas of mythology, because it supports the globe of the head.

•The **Atlas** is the topmost vertebra, and – along with the **Axis** (C2) – forms the joint connecting the skull and spine.

•The **Atlas** and **Axis** are specialized to allow a greater range of motion than normal vertebrae.



Sacrum

- Provides protection for reproductive, digestive, an urinary organ.
- Via paired articulations, attaches the axial skeleton to the pelvic girdle of the appendicular skeleton.
- The broad surface area of the sacrum provides an extensive area for the attachment of muscles, especially those used for movement of the thigh.

Coccyx

- Provides an attachment site for a number of ligaments and for muscles that constrict the anal opening.

The Thoracic Cage

- The thoracic cage is formed by the thoracic vertebrae, the ribs, and the sternum. The functions of the thoracic cage include:
1. It protects the heart, lungs, thymus, and other structures of the thoracic cavity
 2. It serves as an attachment point for muscles involved in (a) respiration (b) the position of the vertebral column, and (c) movements of the pectoral girdle and upper extremity

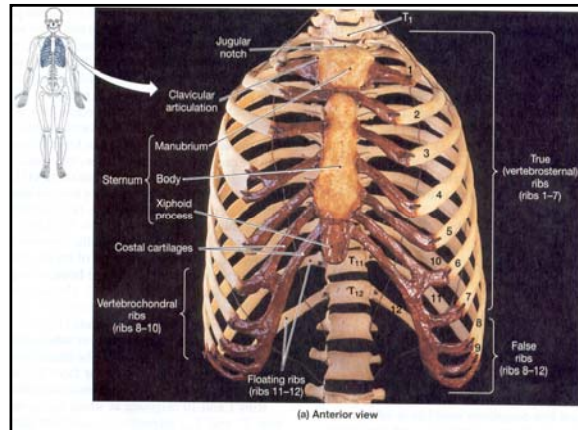
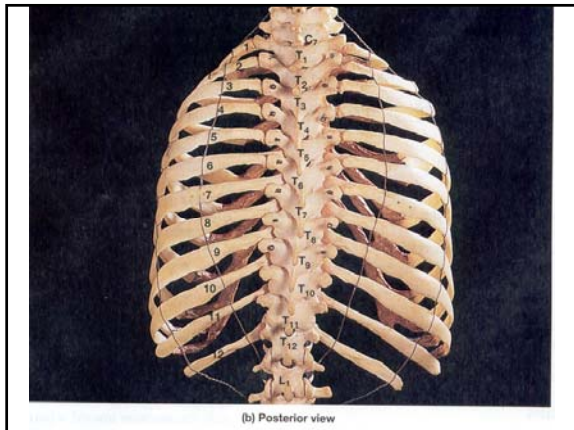
The Ribs

- The ribs (or coste) are elongate, curved, flattened bones that:
- 1) originate on or between the thoracic vertebrae
 - 2) end in the wall of the thoracic cavity

There are 12 pairs of ribs:

- Pairs 1-7 are called true ribs, or vertebrosteral ribs.
- They reach the anterior body wall and are connected to the sternum by separate "costal cartilages"
- They gradually increase in length and radius of curvature

- Ribs 8-12 are called false ribs because they don't attach directly to the sternum.
- The costal cartilage of ribs 8-10 (vertebrochondral ribs) fuse together with the costal cartilage of rib pair 7 before connecting to the sternum.
- The last two pairs of ribs 11-12 are called floating ribs because they have no connection to the sternum (they are also called vertebral ribs because they are only attached to the vertebrae)



The Sternum

•The adult sternum or breastbone is a flat bone that forms the anterior midline of the thoracic wall.

The Sternum has three components:

1. **The Manubrium:** widest and most superior part of the sternum. It articulates with the clavicle (collar bone) and has a shallow indentation that is superior and medial, called the jugular notch.
2. **The Body:** a tongue shaped bone that extends down the midline of the anterior thorax, and attaches to costal cartilages 2-7.
3. **The Xiphoid Process:** smallest part of the sternum. The respiratory diaphragm and the rectus abdominus muscles attach to the xiphoid process.
 - Prior to age 25 the sternum exists as 4 separate bones.