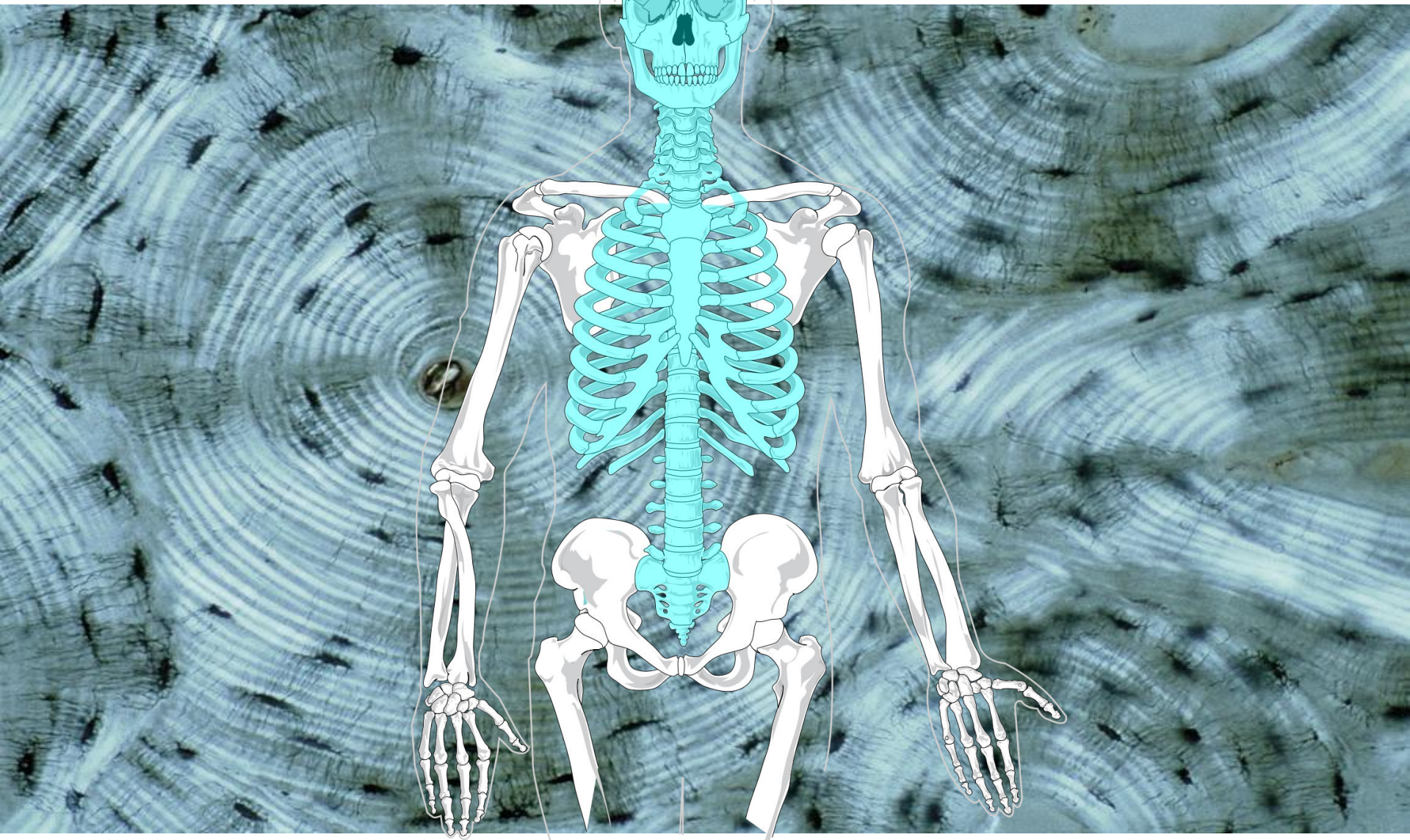
Chapter 7: Axial Skeleton



Dr. Paige Morgan
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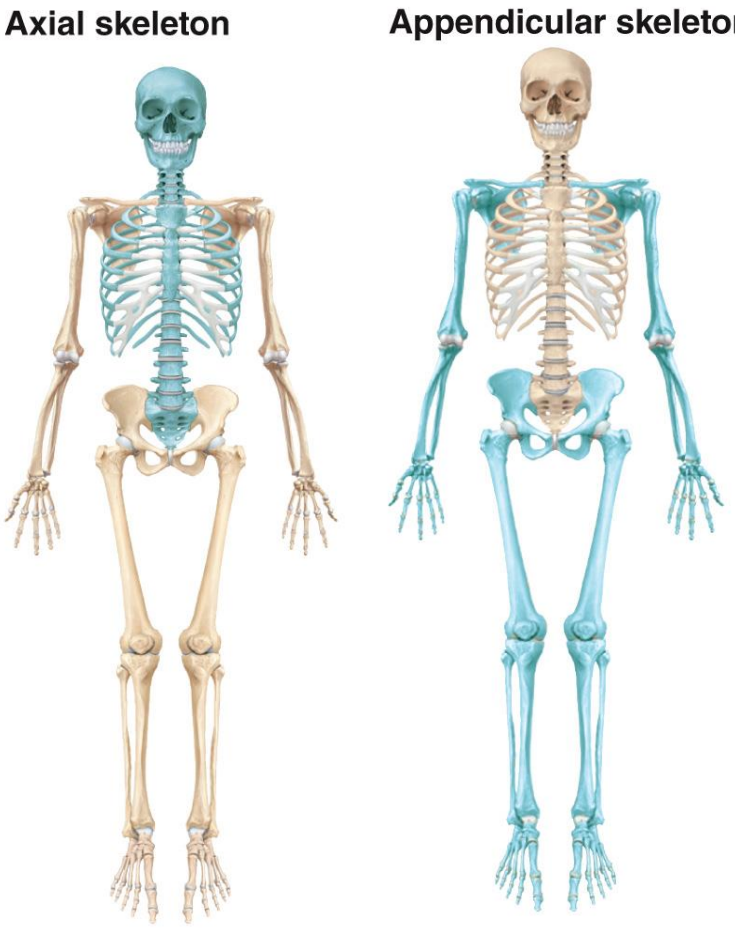
Axial vs. Appendicular Skeleton

- **axial skeleton:** consists of the bones that lie around the longitudinal axis of the body
- **appendicular skeleton:** consists of bones of the upper and lower limbs + the bones forming the girdles, connecting limbs to the axial skeleton

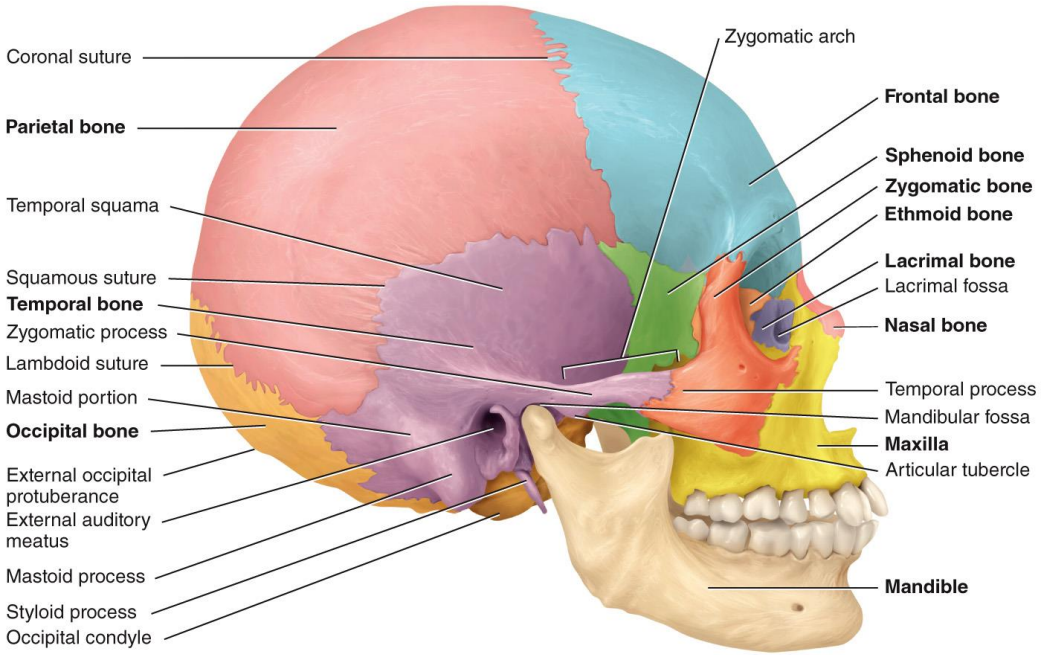


Cranial Bones

- **skull:** bony framework of the head, contains 22 bones
- bones of the skull are arranged into two categories:
  [1] **cranial bones:** those that form the cranial cavity (8)
  [2] **facial bones:** form the face (14)

cranial bones:

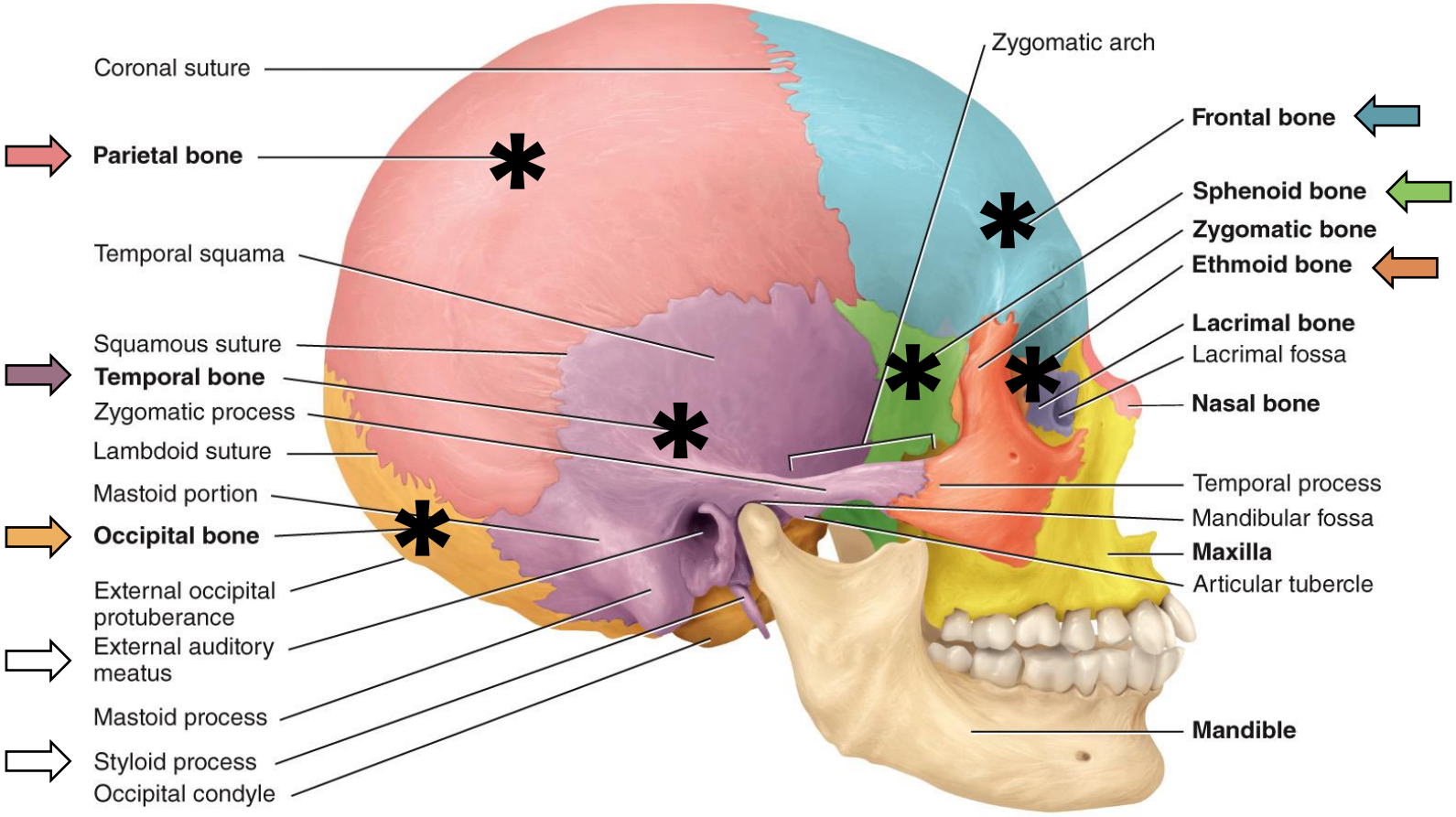
- occipital bone
- parietal bones (2)
- frontal bone
- temporal bones (2)
- ethmoid bone
- sphenoid bone



(a) Right lateral view

Old People From Texas Eat Spiders

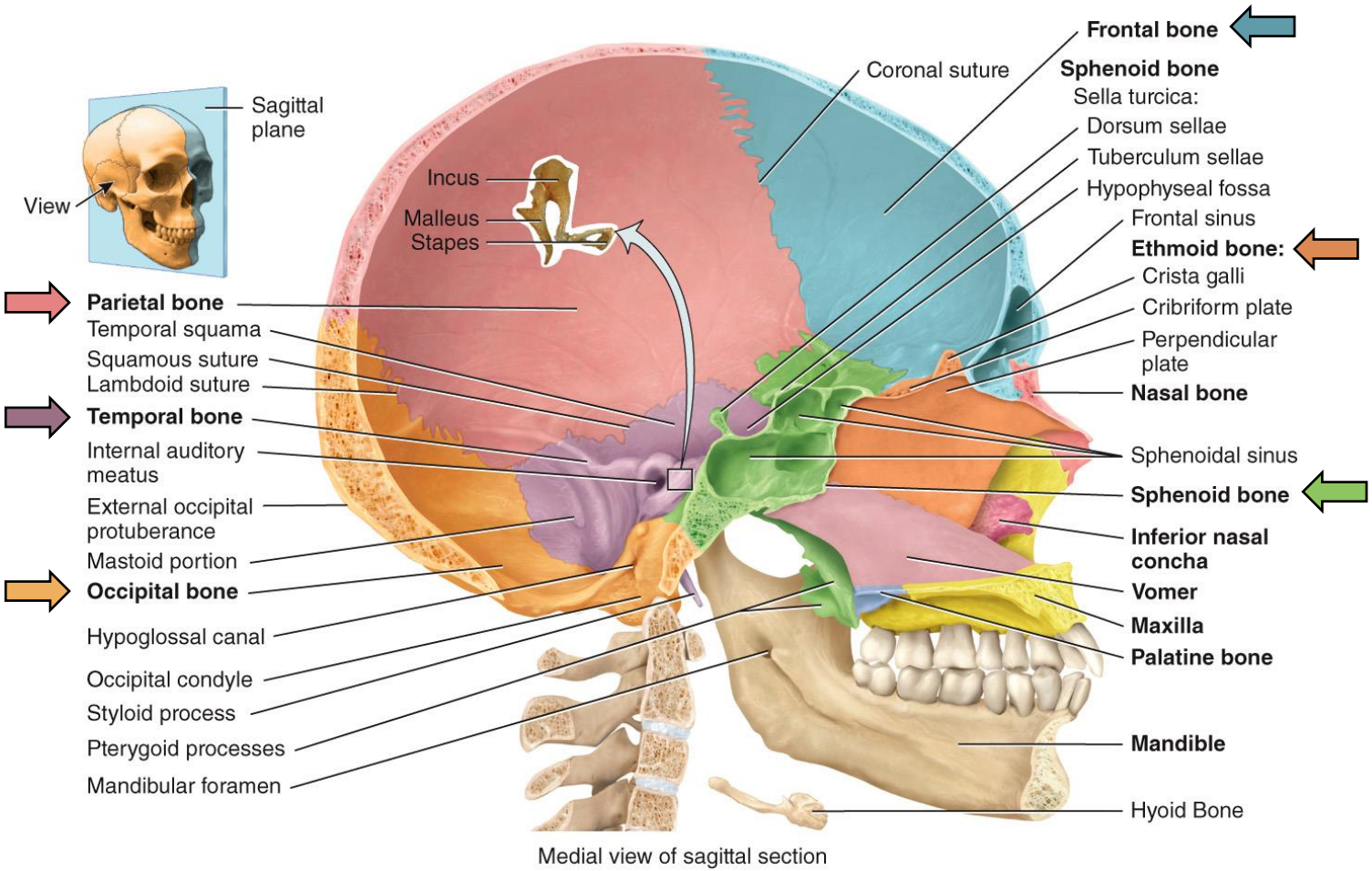
Cranial Bones – External View



(a) Right lateral view

Old People From Texas Eat Spiders

Cranial Bones – Midsagittal View



Medial view of sagittal section

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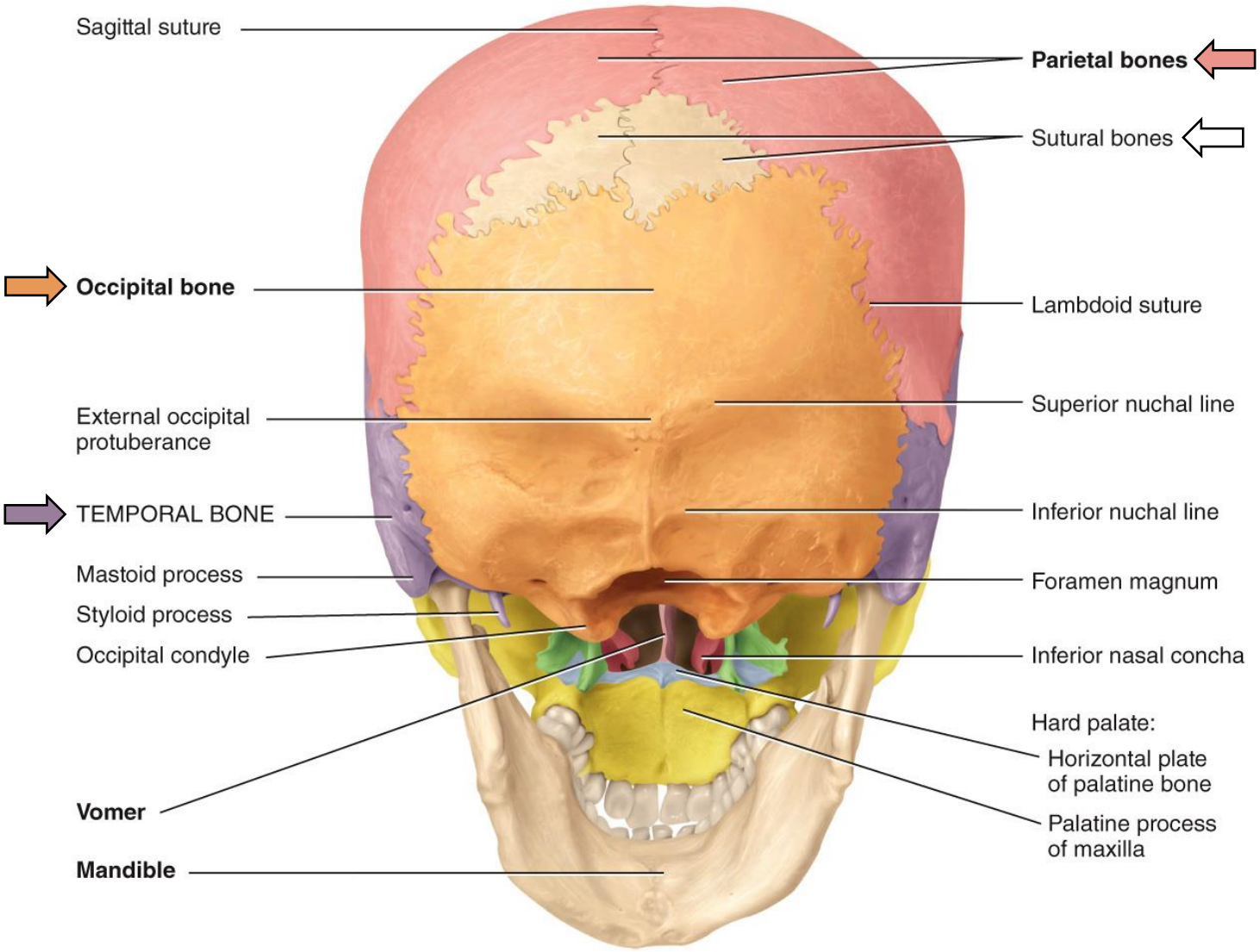
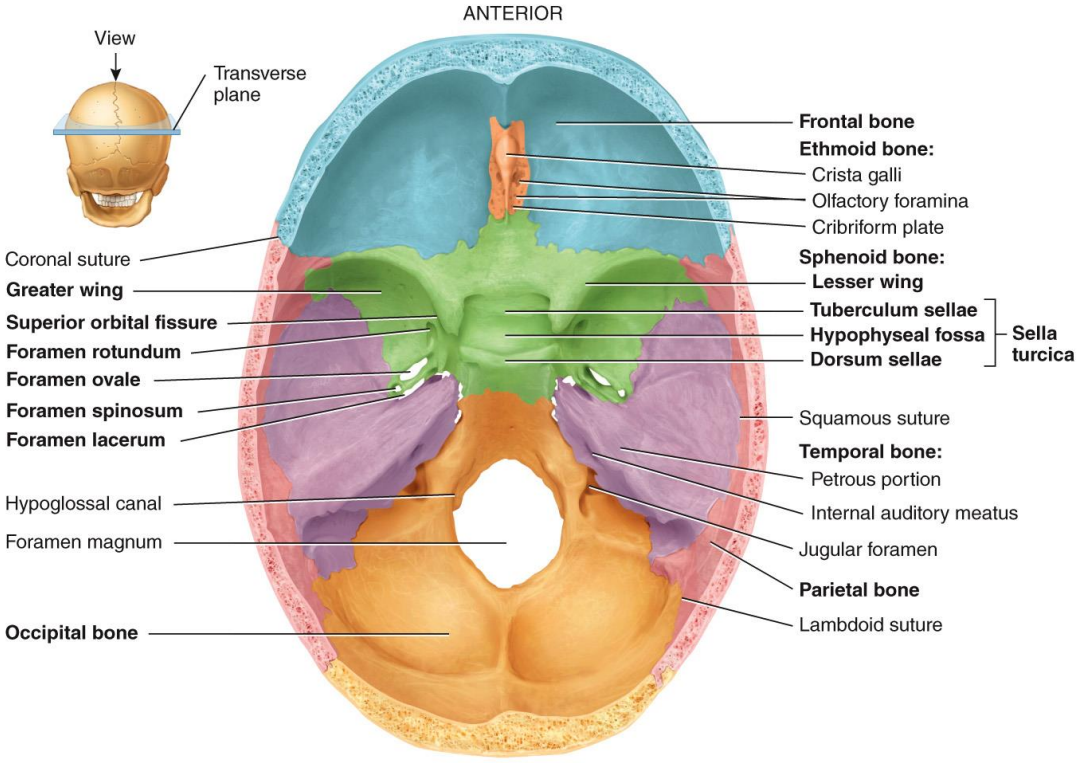
Cranial Bones – Posteroinferior View



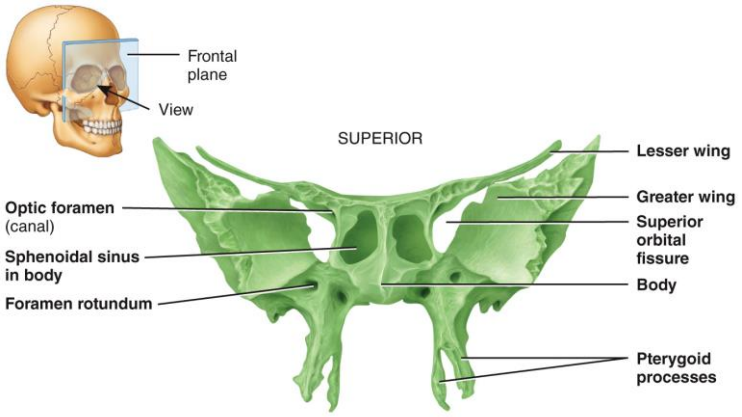
Posteroinferior view

Cranial Bones – Closer Look at the Sphenoid

- **sphenoid bone:** lies at the middle part of the base of the skull
  → "keystone" of the cranial floor b/c it articulates with all the other cranial bones
  → houses some notable foramen = openings thru which vessels, nerves, ligaments pass



(a) Superior view of sphenoid bone in floor of cranium

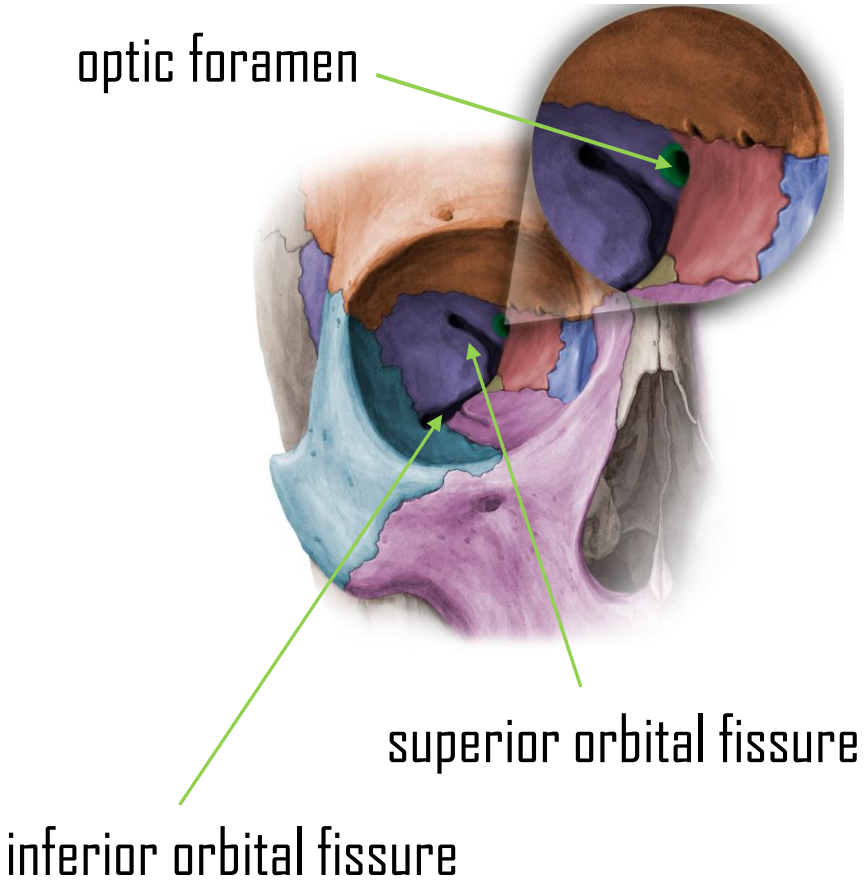


(b) Anterior view of sphenoid bone

check out this video: https://www.anatomystandard.com/Cranium/Neurocranium/Sphenoid.html

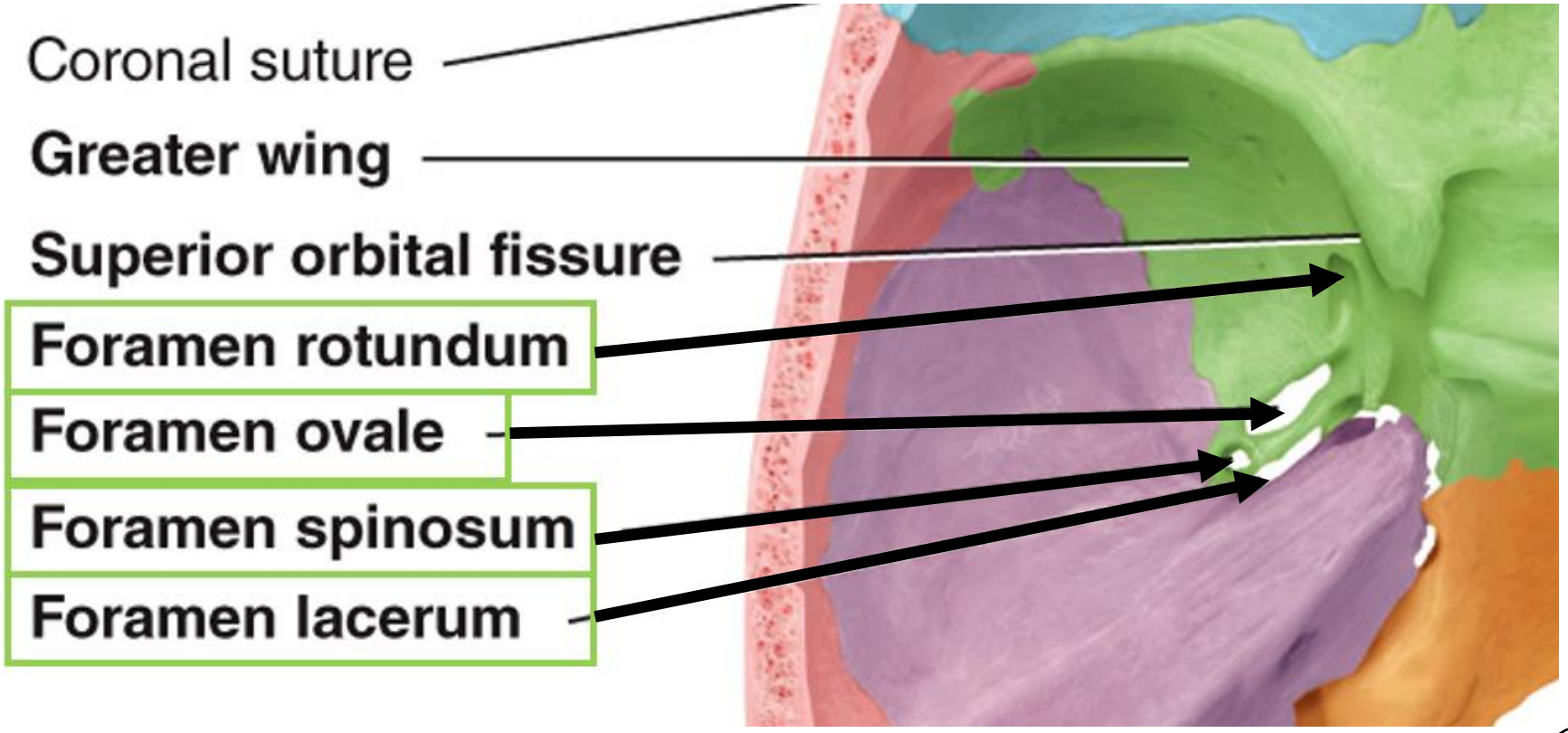
Cranial Bones – Closer Look at the Sphenoid

- **optic foramen (canal)**: transmits the optic nerve (CN II) and the ophthalmic artery
- **superior orbital fissure**: transmits the trigeminal (CN V), abducens (CN VI), trochlear (CN IV), and oculomotor nerve (CN III)
- **inferior orbital fissure**: transmits branches of the trigeminal (CN V)



Cranial Bones – Closer Look at the Sphenoid

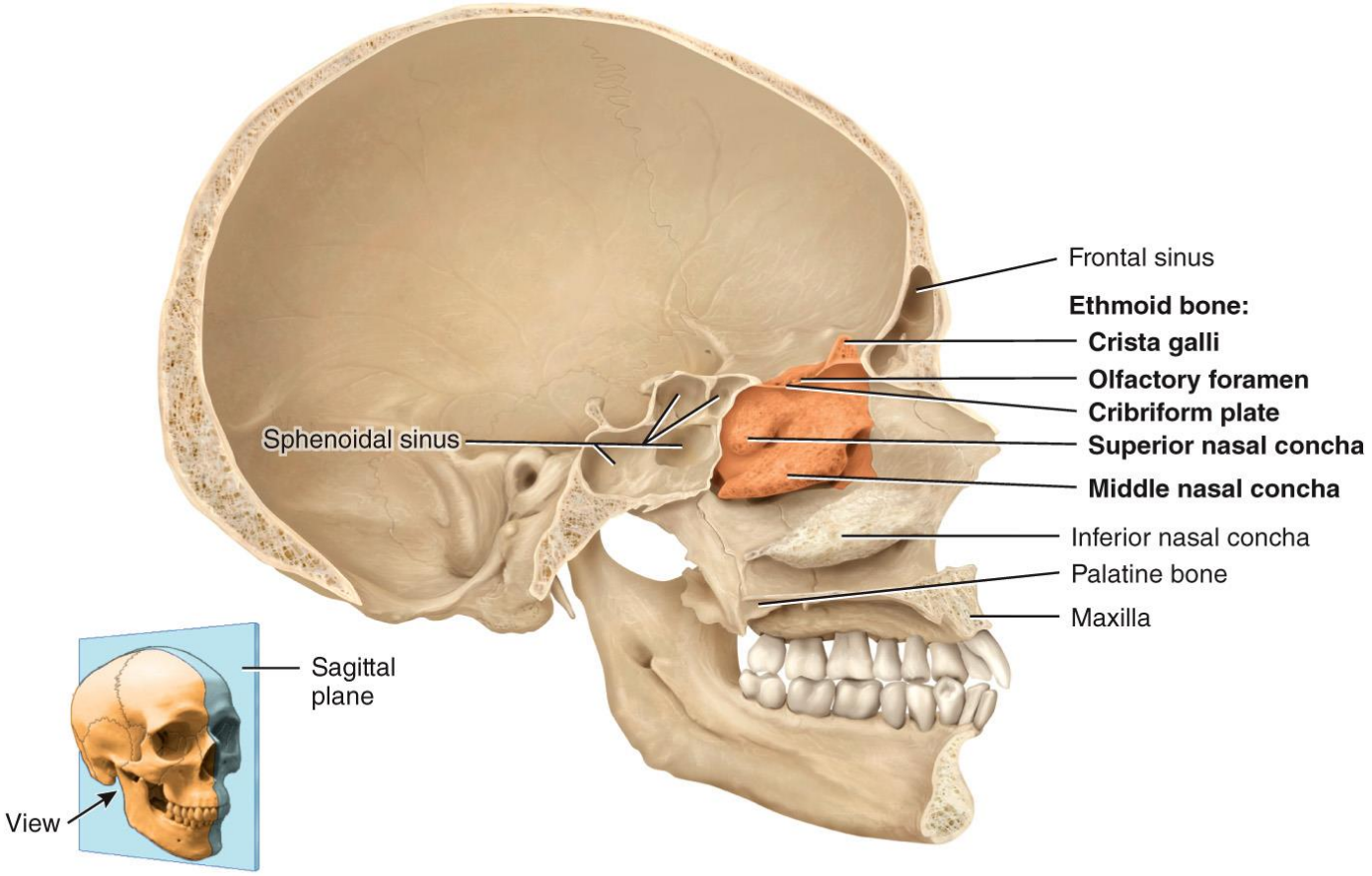
- **foramen rotundum**: transmits the maxillary (branch of CN V, trigeminal)
- **foramen ovale**: transmits mandibular nerve (branch of CN V, trigeminal)
- **foramen spinosum**: transmits the anterior branch of the middle meningeal artery
- **foramen lacerum**: transmits branch of ascending pharyngeal artery



Cranial Bones – Closer Look at the Ethmoid

- **ethmoid bone:** forms the…

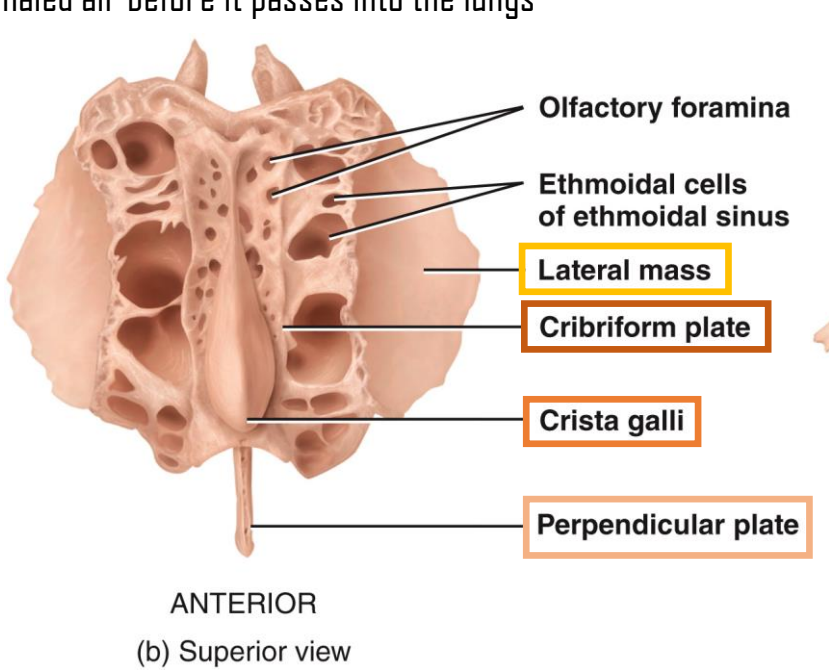
  [1] anterior part of the cranial floor
  [2] medial wall of the orbits
  [3] superior portion of the **nasal septum** = a partition that divides the nasal cavity into L/R sides
  [4] most superior supporting structure of the nasal cavity

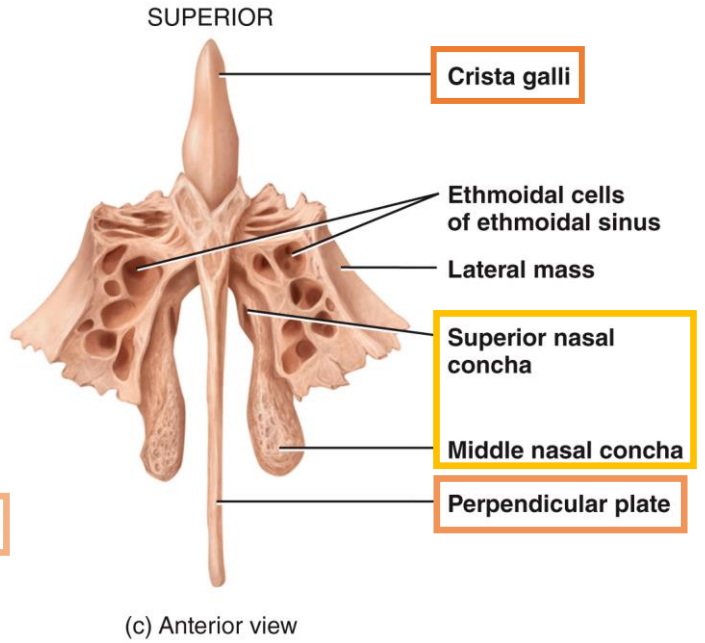


(a) Medial view of sagittal section

Cranial Bones – Closer Look at the Ethmoid

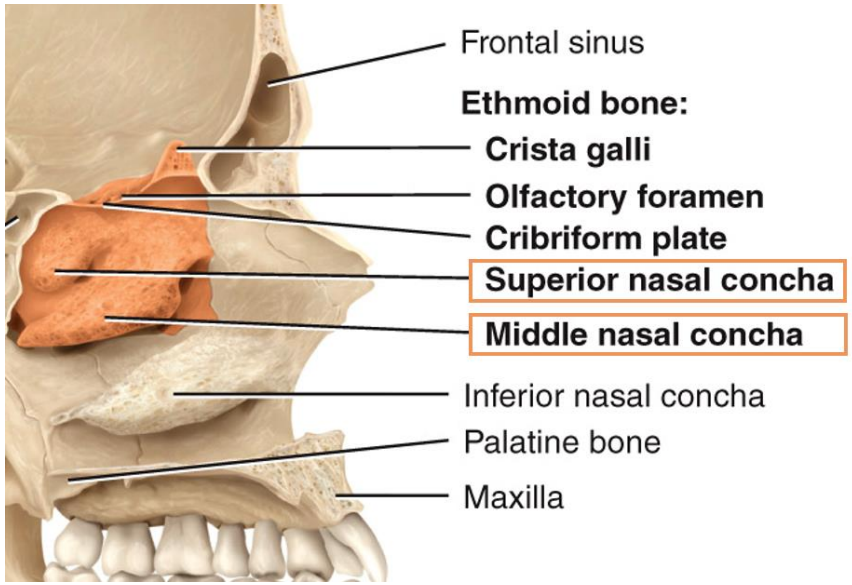
- **[1] cribriform plate**: lies in the anterior floor of the cranium and forms the roof of the nasal cavity
  → contains the olfactory foramina through which the olfactory nerves pass
- **[2] crista galli**: projects superiorly from the cribriform plate and serves as a point of attachment for the falx cerebri = membrane that separates the 2 hemispheres of the brain
- **[3] perpendicular plate**: projects inferiorly from the cribriform plate and forms the superior portion of the nasal septum
- **[4] lateral masses**: contain 3-18 air spaces called ethmoidal cells which together form the ethmoidal sinus
  → contain two thin projections called the superior nasal concha and middle nasal concha
  → conchae greatly increase vascular and mucus membrane surface area in nasal cavity which warms and moistens inhaled air before it passes into the lungs



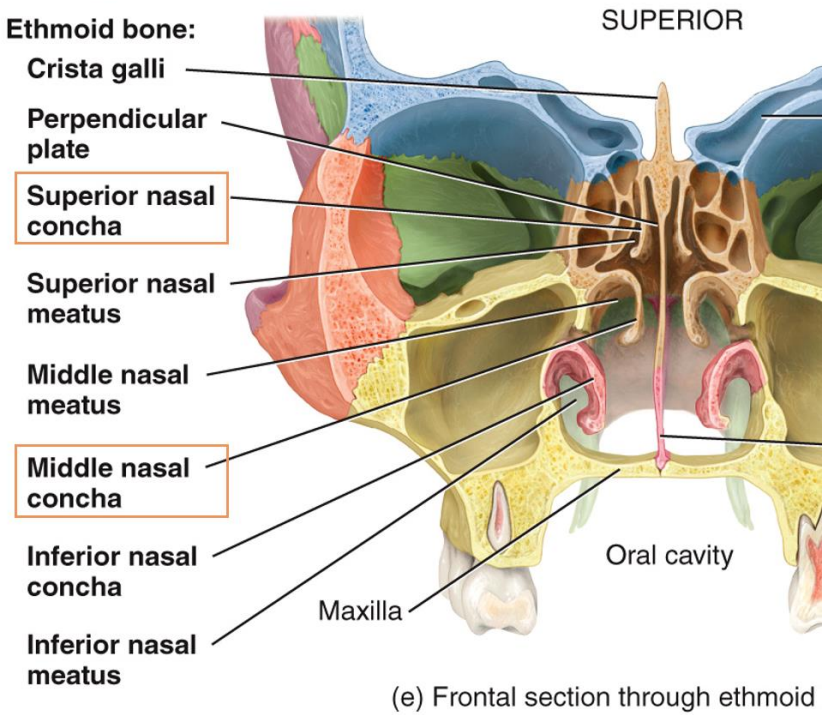


Cranial Bones – Closer Look at the Ethmoid

sagittal view:



frontal view:



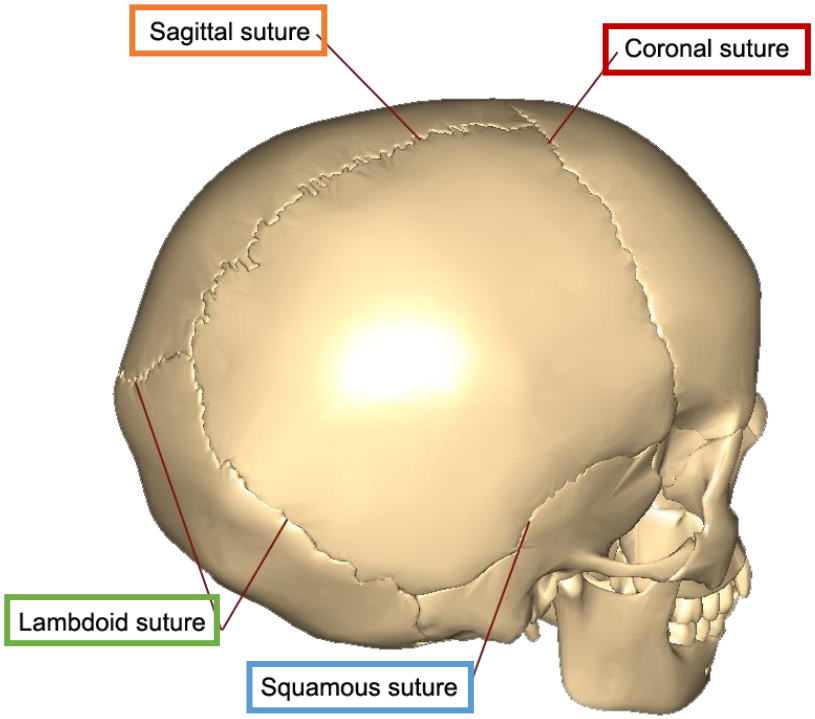
(e) Frontal section through ethmoid

check out this video: https://www.anatomystandard.com/Cranium/Neurocranium/Ethmoid.html

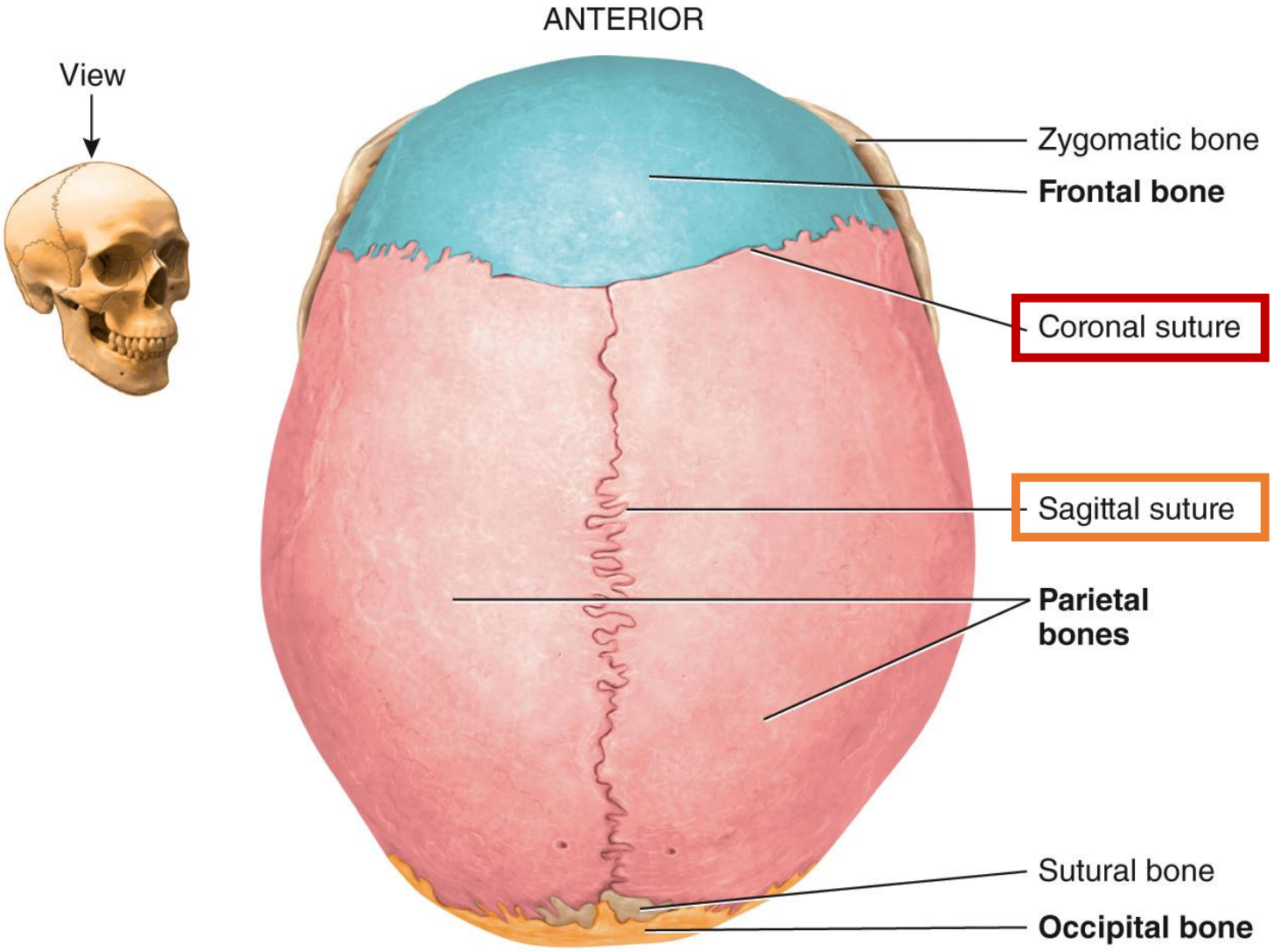
Cranial Bones – Sutures

- **suture**: an immovable joint (in adults) that holds most skull bones together
  → sutures in the skull of infants and children are often movable and function as growth centers
  → there are 4 prominent sutures:

[1] **coronal suture:** unites frontal bone with both parietal bones
[2] **sagittal suture:** unites the 2 parietal bones
[3] **lamboid suture:** unites the 2 parietal bones with the occipital bone
[4] **squamous sutures** (2): unites the parietal and temporal bones on the lateral aspects of the skull



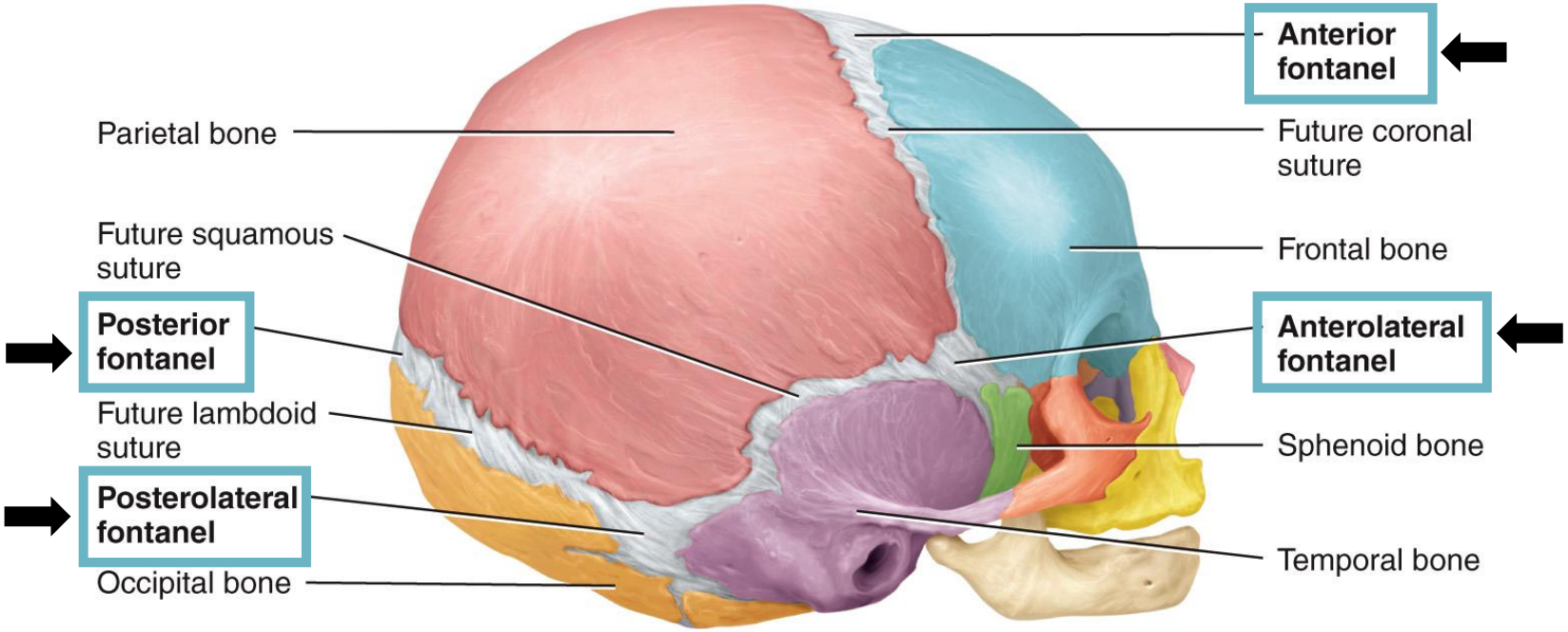
Cranial Bones – Sutures



(b) Superior view

Cranial Bones – Fontanels

- **fontanel** (aka "softspots"): areas where unossified mesenchyme develops into dense connective tissue of the skull
  → as bone formation continues after birth, the fontanels are eventually replaced with bone and the thin collagenous connective tissue junctions that remain between neighboring bones become the sutures



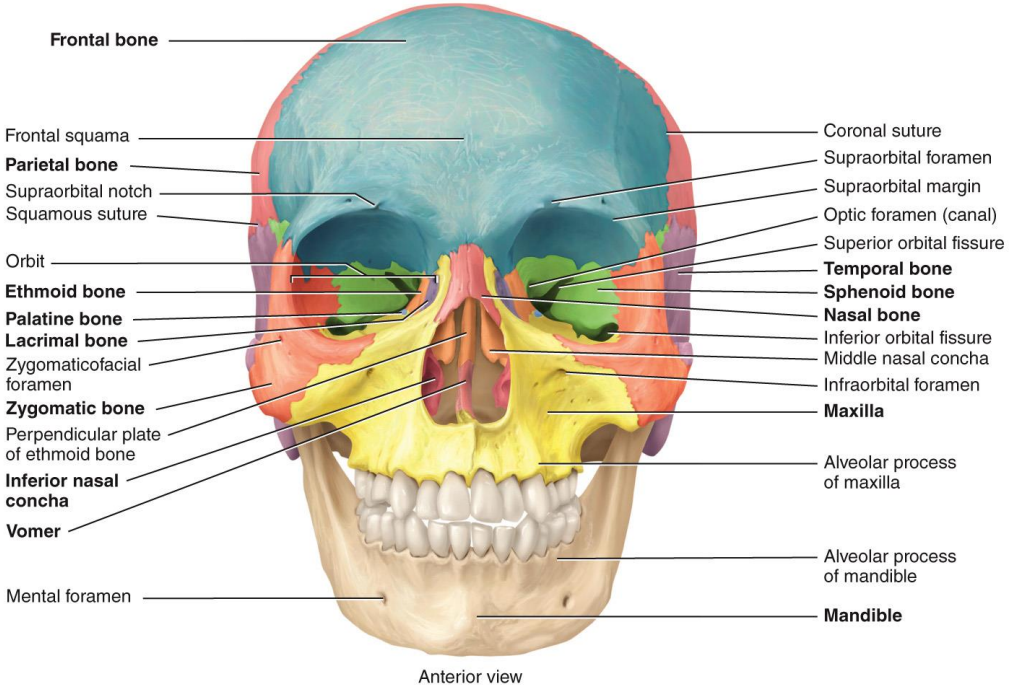
Right lateral view

Facial Bones

- **skull:** bony framework of the head, contains 22 bones
- bones of the skull are arranged into two categories:
  [1] **cranial bones:** those that form the cranial cavity (8)
  [2] **facial bones:** form the face (14)

facial bones:

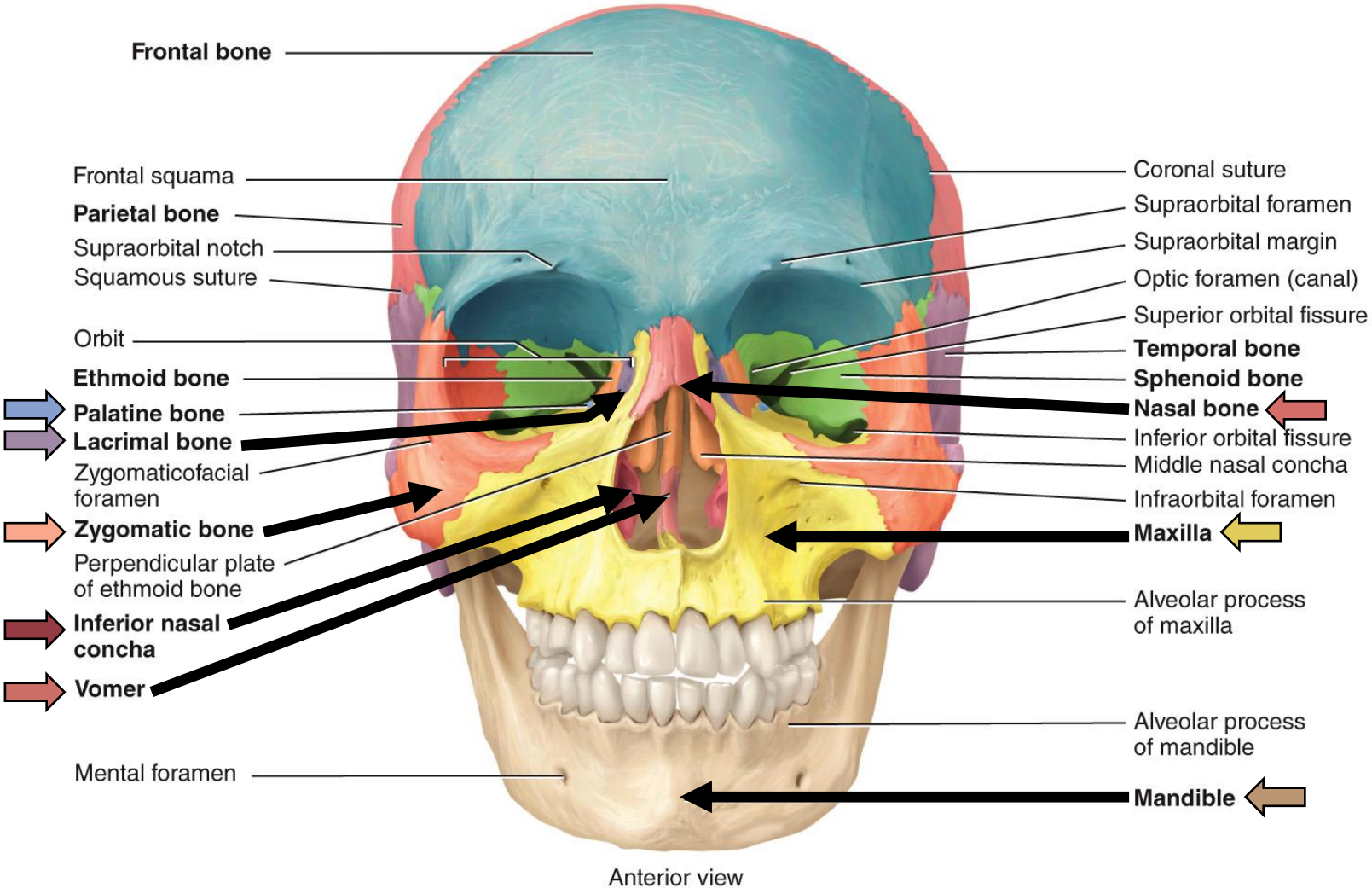
- maxillae bones (2)
- mandible
- chonchae (2)
- nasal (2)
- vomer
- lacrimal (2)
- zygomatic (2)
- palatine (2)



Anterior view

My Mandible Chews Nine Very Large Zucchini Pizzas

Facial Bones

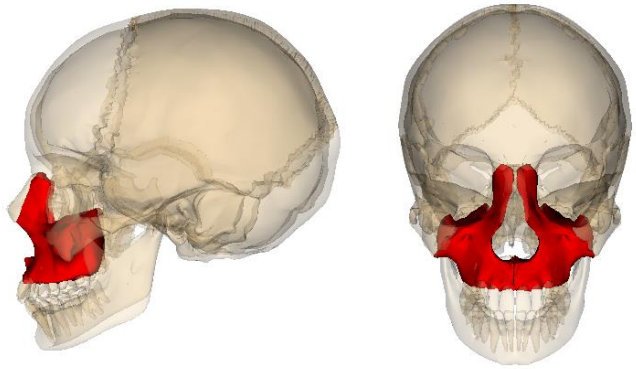


Anterior view

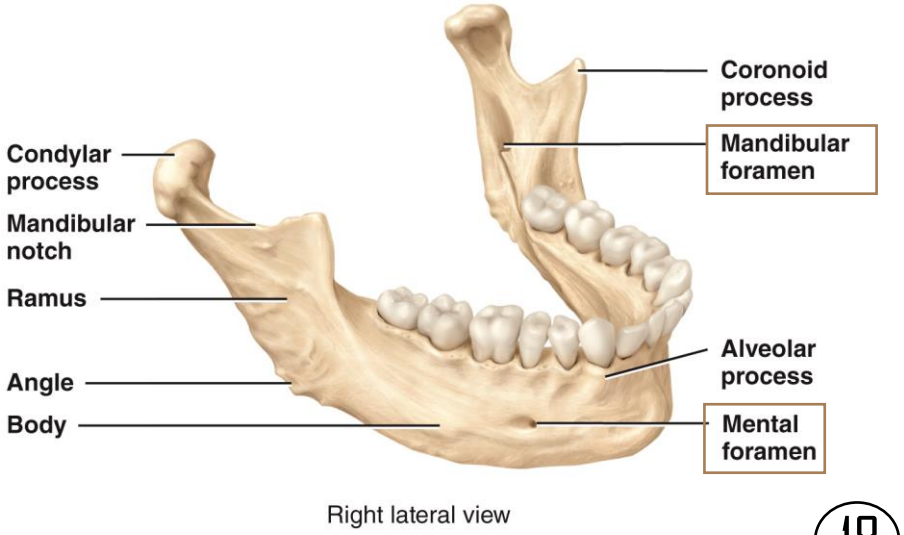
My Mandible Chews Nine Very Large Zucchini Pizzas

Facial Bones – Closer Looks

- **maxillae (2):** bones of the upper jaw
  → articulate with every bone of the face except the mandible (lower jaw)
  → forms part of the orbits, part of the nasal cavity, and most of the hard palate (bony roof of the mouth)
  → each maxilla contains a large maxillary sinus that empties into the nasal cavity
  → the alveolar processes of the maxilla are ridge-like arches that contain the alveoli (sockets) for the maxillary (upper) teeth



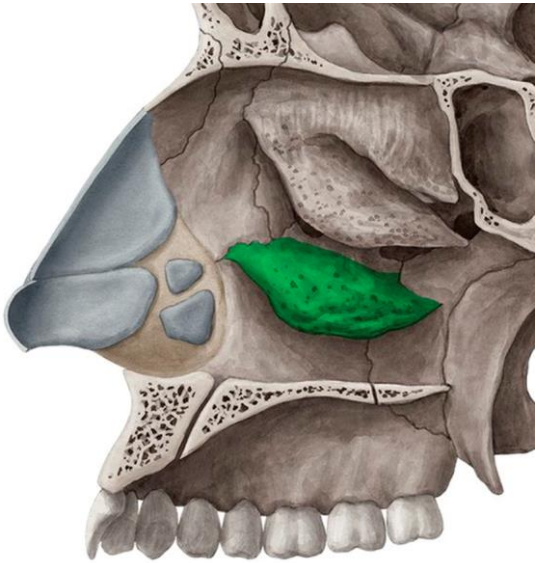
- **mandible:** largest, strongest facial bone that forms the lower jaw
  → mental foramen = transmits terminal branches of alveolar nerve and mental vessels
  → mandibular foramen = transmits mandibular nerve and blood vessels
  these foramina are where dentists inject anesthetics



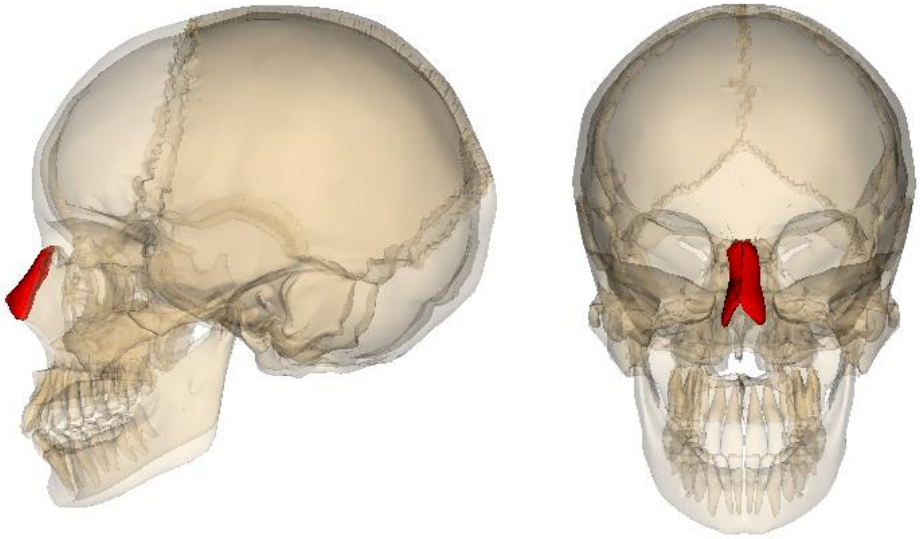
Right lateral view

Facial Bones – Closer Looks

- **inferior nasal conchae (2):** separate bones from nasal conchae of the ethmoid bone
  → form part of (and project into) the nasal cavity
  → all three pairs of nasal conchae (superior, middle, inferior) increase the surface area of the nasal cavity and help swirl and filter air before it passes into the lungs

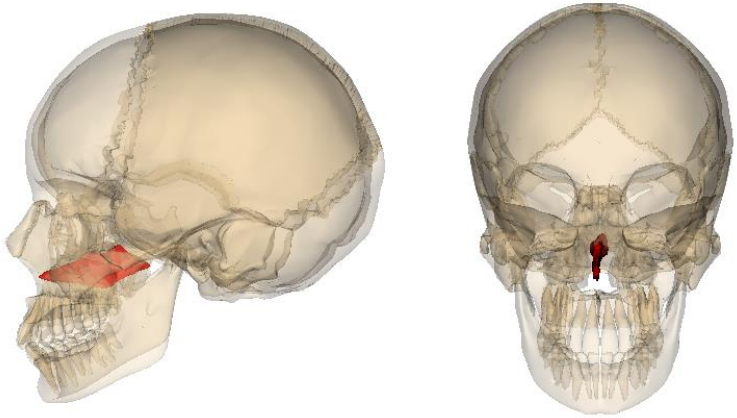


- **nasal bones (2):** small, flattened rectangular shaped bones that form the bridge of the nose

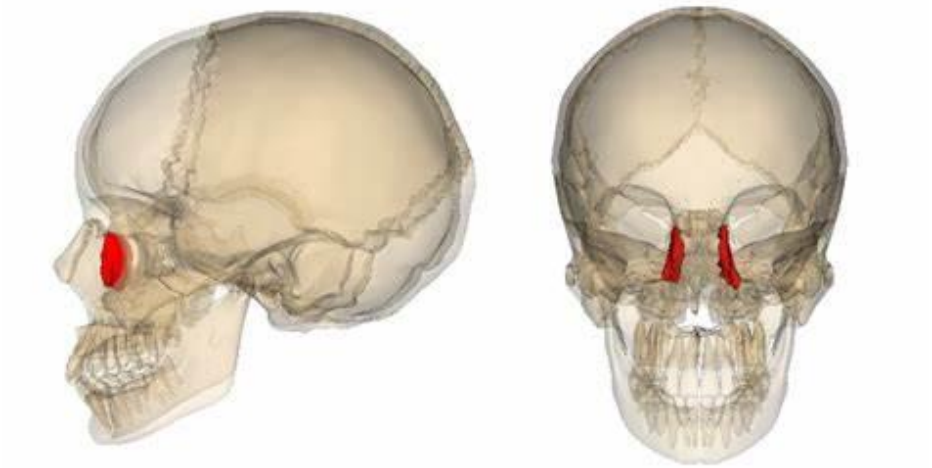


Facial Bones – Closer Looks

- **vomer:** triangular bone that forms the nasal septum (along with the ethmoid)
  → nasal septum = the partition that divides the nasal cavity into L/R sides

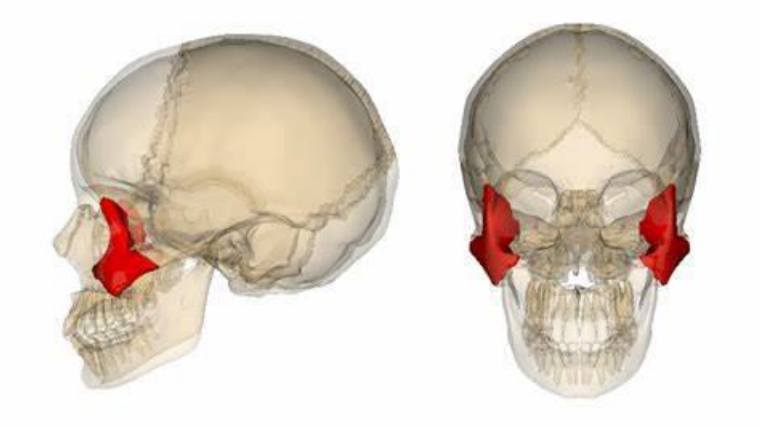


- **lacrimal bones (2):** smallest bones of the face
  → each contain a lacrimal fossa = vertical tunnel formed with the maxilla that houses the lacrimal sac which gathers tears

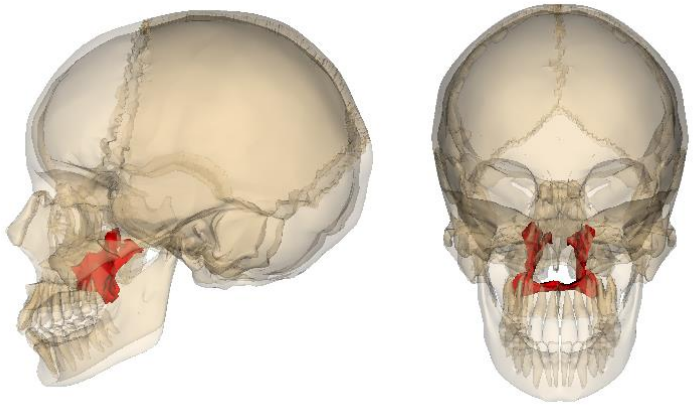


Facial Bones – Closer Looks

- **zygomatic bones (2):** (aka cheekbones) form the prominences of the cheeks and part of the orbit → the temporal process of the zygomatic bone projects posteriorly and articulates with the zygomatic process of the temporal bone to form the zygomatic arch

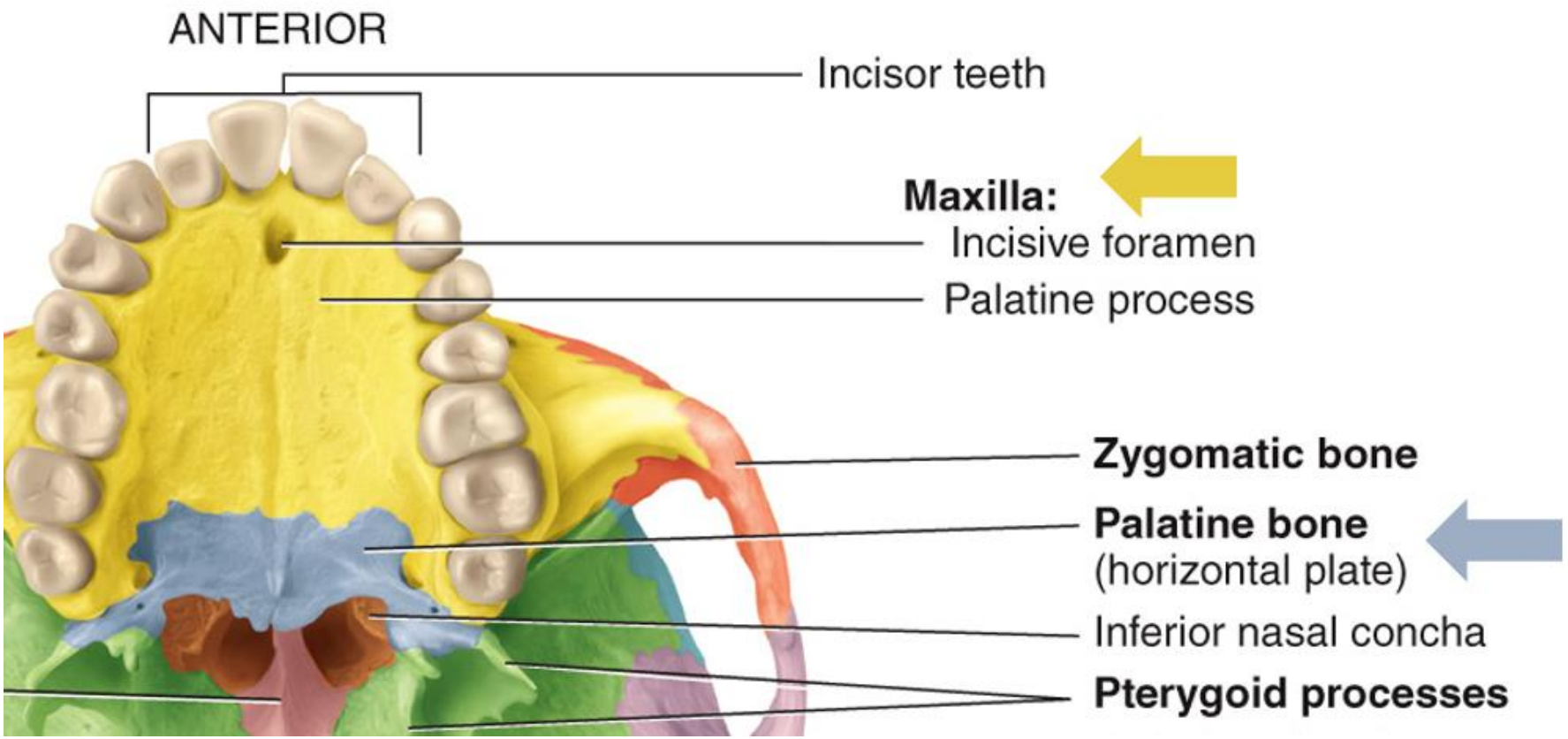


- **palatine bones (2):** form the posterior portion of the hard palate, part of the nasal cavity, and a small portion of the orbits



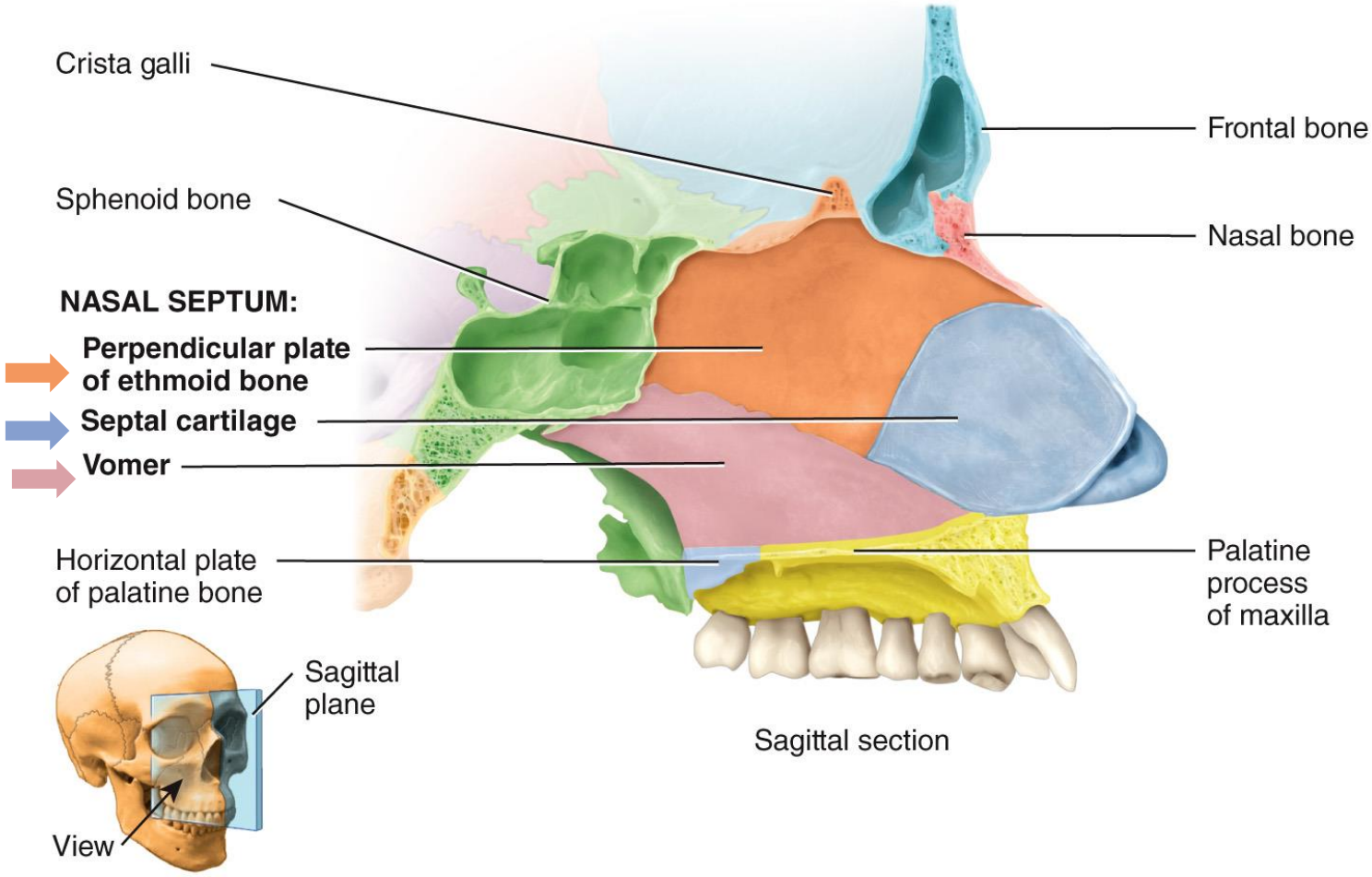
Special Structures – Hard Palate

- bones that form the **hard palate** (roof of the mouth) = **maxillae** + **palatine**



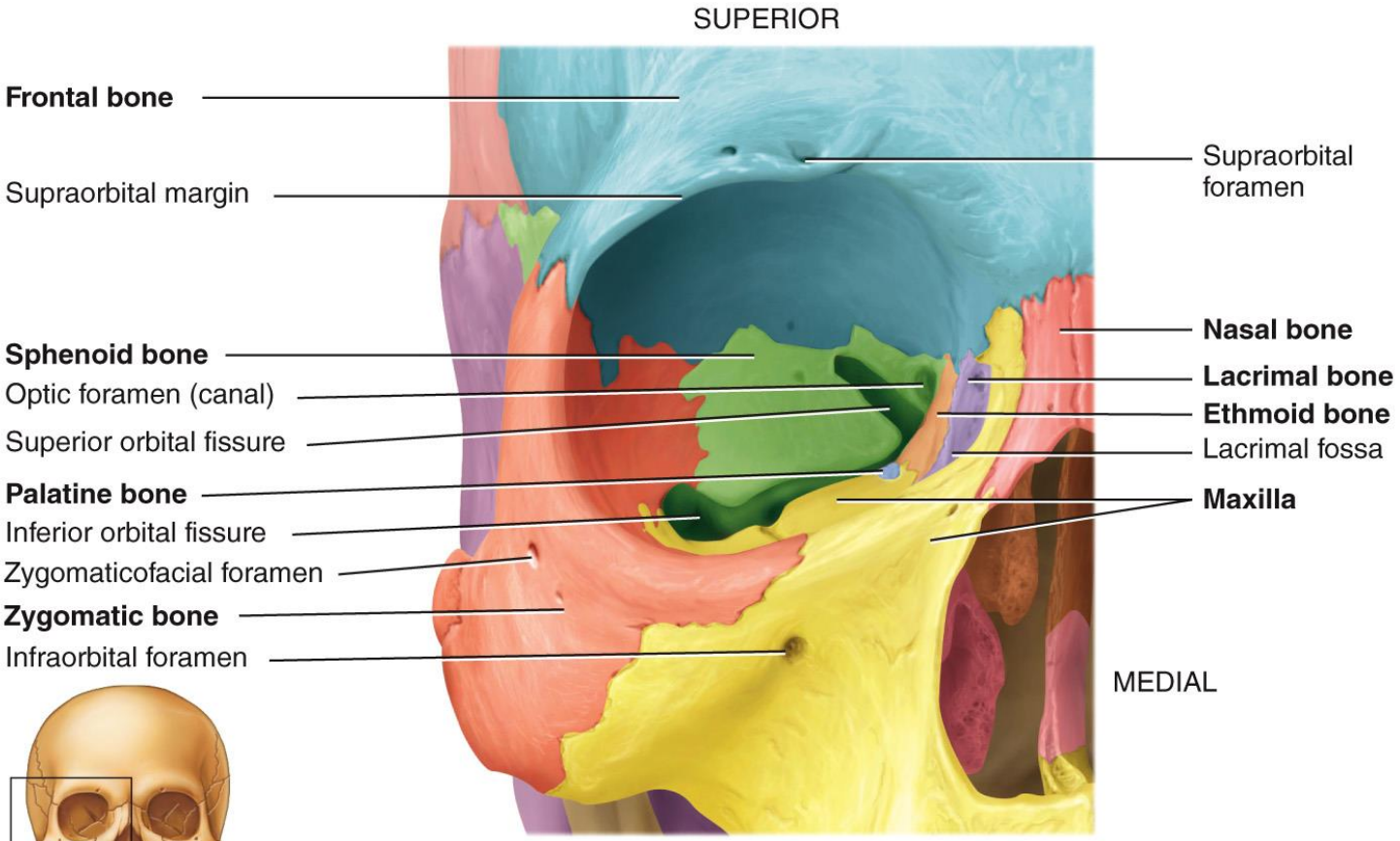
Special Structures – Nasal Septum

- bones that form the **nasal septum** = vomer
  ethmoid bone (perpendicular plate)
  + septal cartilage



Special Structures – Orbit

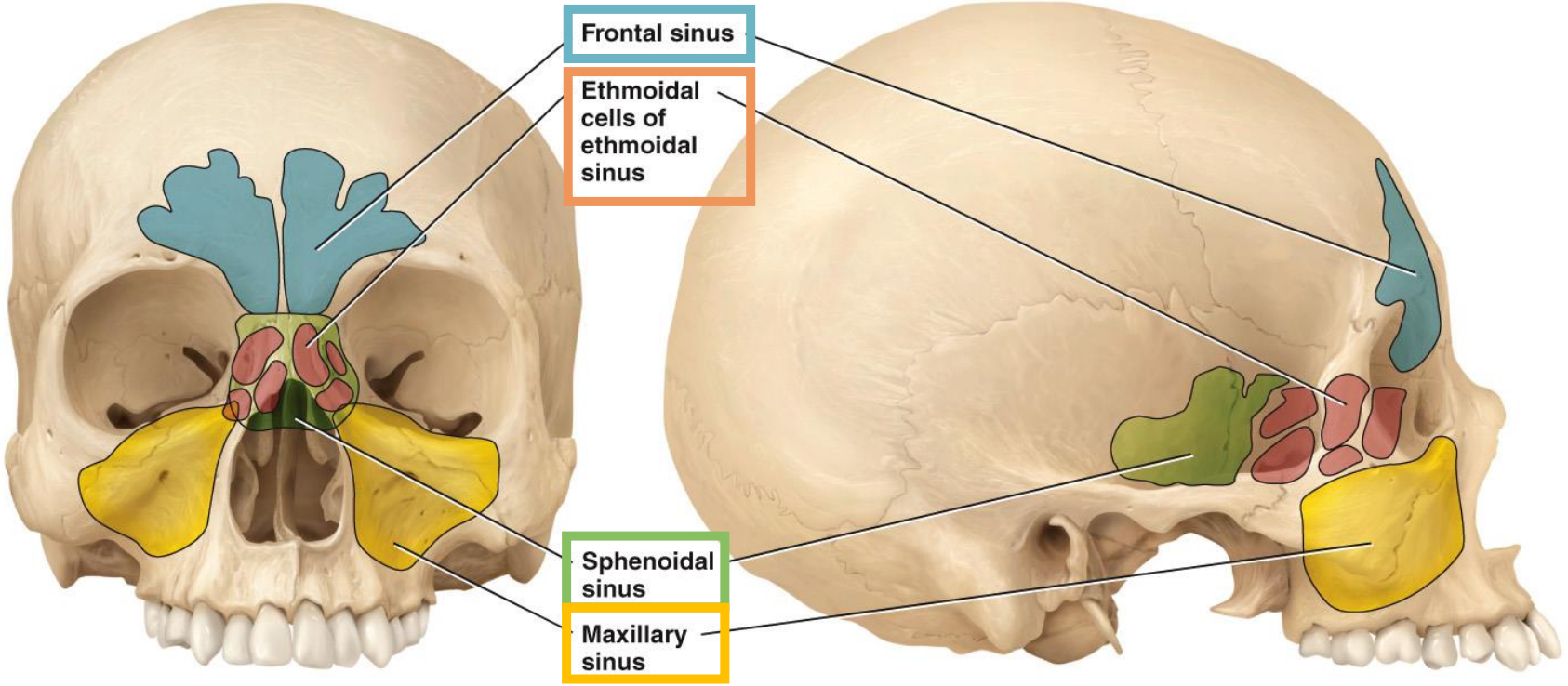
- **orbit:** (aka orbital cavity, eye socket) contains the eyeball and associated structures
  → comprised of 3 cranial bones = frontal, sphenoid, ethmoid
  and 4 facial bones = palatine, zygomatic, lacrimal, maxilla



Anterior view showing the bones of the right orbit

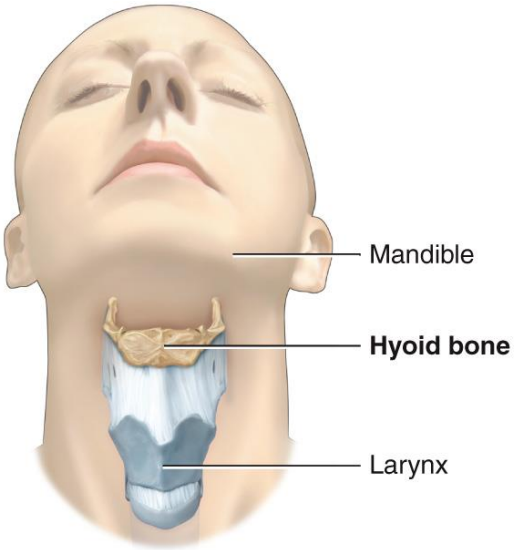
Special Structures – Sinuses

- **paranasal sinuses:** cavities within certain cranial and facial bones near the nasal cavity
  → lined with mucus membranes that are continuous with the lining of the nasal cavity
  → sinuses increase the surface area of the nasal mucosa, thus increasing the production of mucus to help moisten and cleanse inhaled air
  → small or nearly absent at birth, allow the skull to increase in size without a change in the mass of the bone

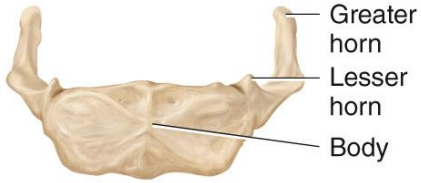


Hyoid Bone

- **hyoid bone**
  → does not articulate with ANY other bone
  → suspended from the styloid processes of the temporal bones by ligaments and muscles
  → supports the tongue, providing attachment sites for some tongue muscles and for muscles of the neck and pharynx



(a) Position of hyoid bone

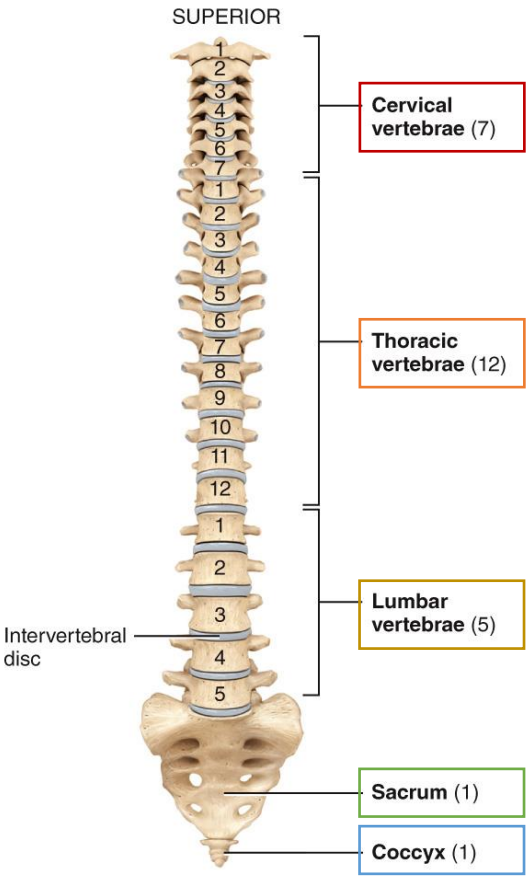


(b) Anterior view

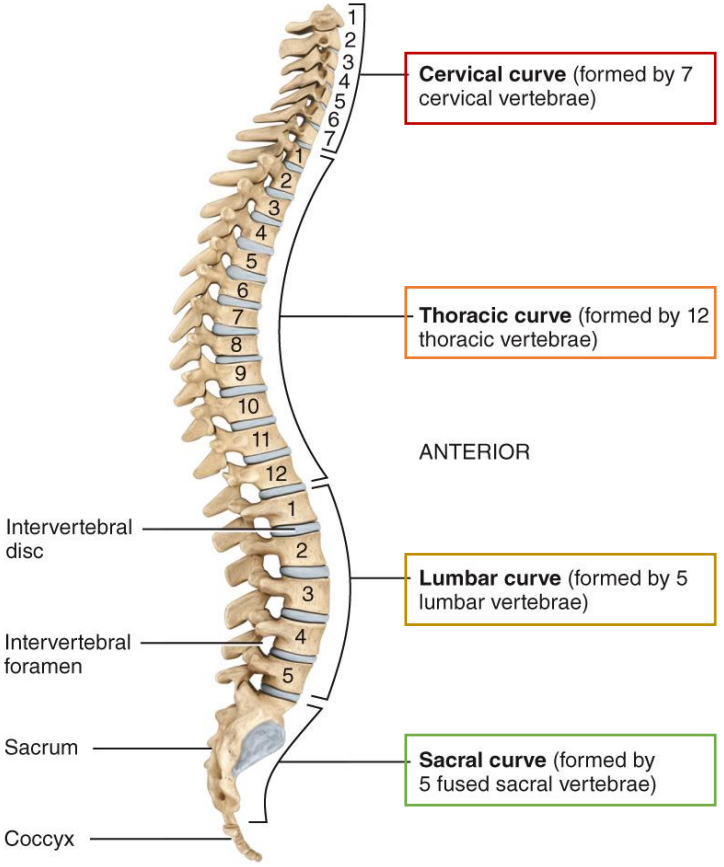
(c) Right lateral view

Vertebral Column

- **vertebral column** (aka "spine" "backbone" "spinal column")
  → makes up about 2/5 of your total height
  → contains a series of bones called **vertebrae** organized into 5 regions
  [1] cervical [2] thoracic [3] lumbar [4] sacral [5] coccygeal



(a) Anterior view showing regions of the vertebral column



(b) Right lateral view showing four normal curves

Vertebral Column – Vertebrae

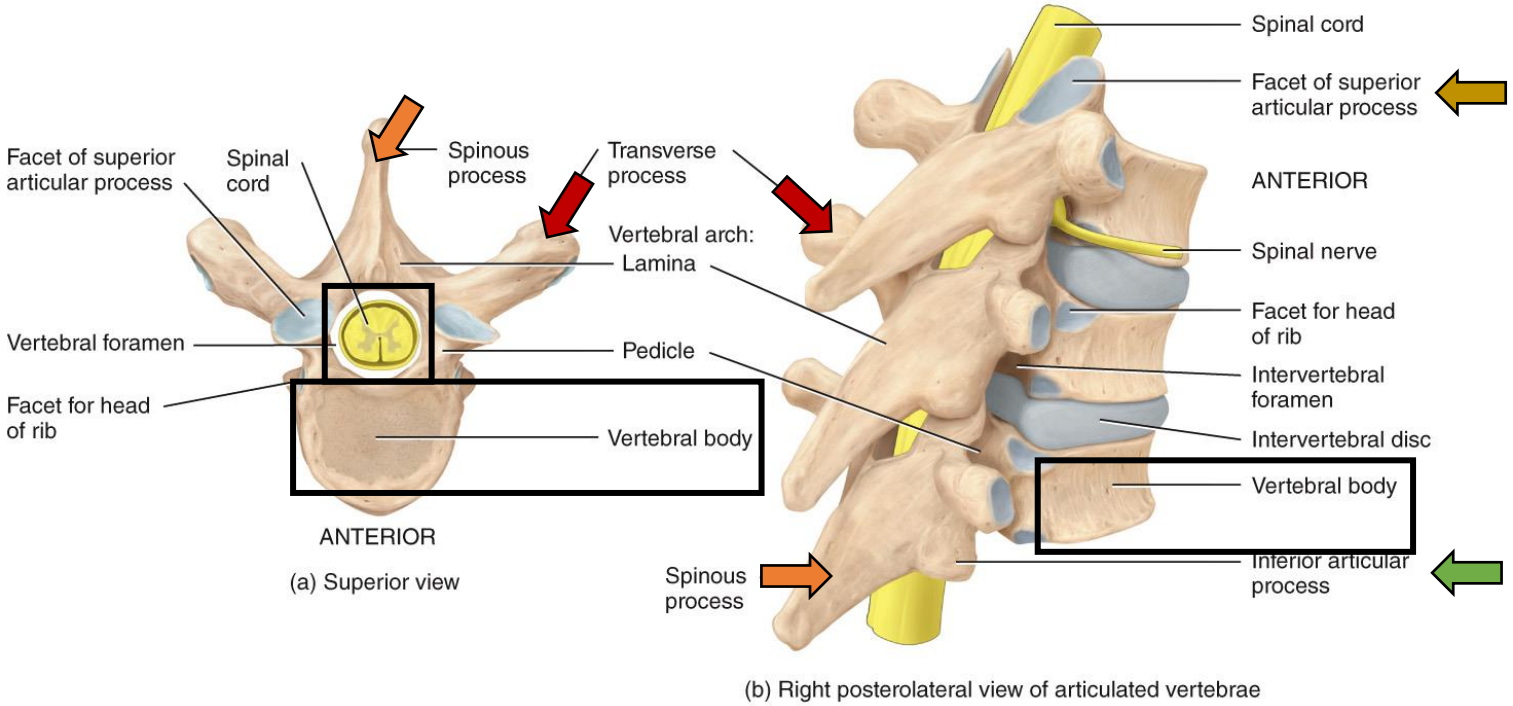
- **vertebral body:** the thick, disc-shaped anterior portion; the weight-bearing part of the vertebra
- **vertebral foramen:** accommodates the spinal cord
- **processes**: 7 processes arise from the vertebral arch

  [1] transverse process - (2) extends laterally on each side

  [2] spinous process – projects posteriorly from the junction of the laminae

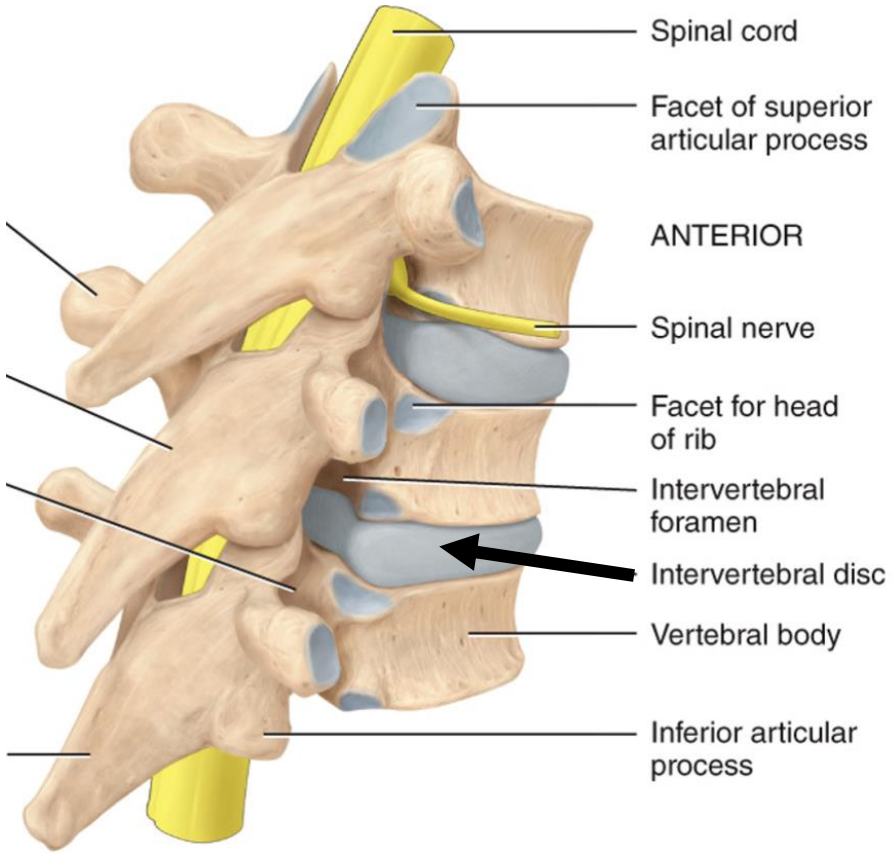
  [3] superior articular processes – (2) articulate with the 2 inferior articular processes above them

  [4] inferior articular processes – (2) articulate with the 2 superior articular processes below them



Vertebral Column – Intervertebral Discs

- **intervertebral discs:** found between the bodies of adjacent vertebrae from the 2nd cervical vertebra to the sacrum
  → made of fibrocartilage
  → fun fact: you are slightly shorter at night because over the course of the day, the discs compress and lose water

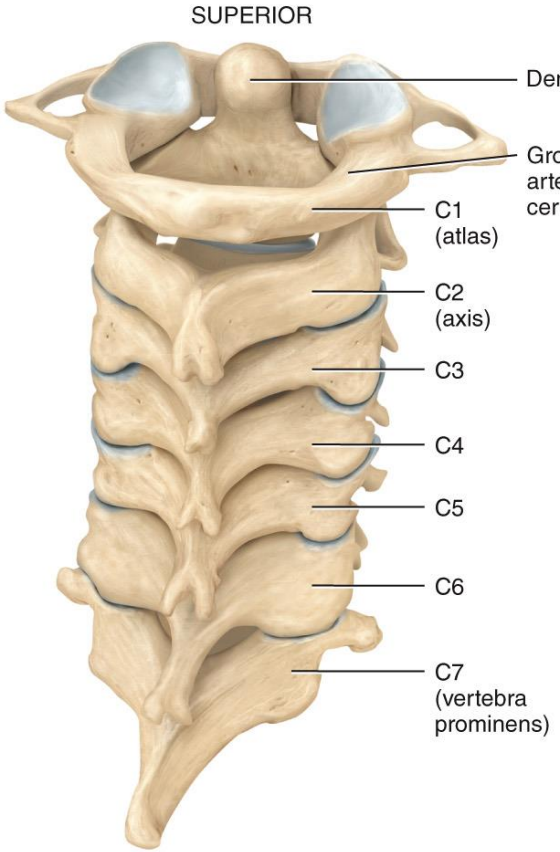


Vertebral Column – Cervical

- **cervical vertebrae:** C1-C7
  → smaller than all other vertebrae, except those that form the coccyx
  → have 3 foramina: 1 vertebral foramen and 2 transverse foramina (vertebral artery and vein)

  C1 = ATLAS
  C2 = AXIS

Location of cervical vertebrae

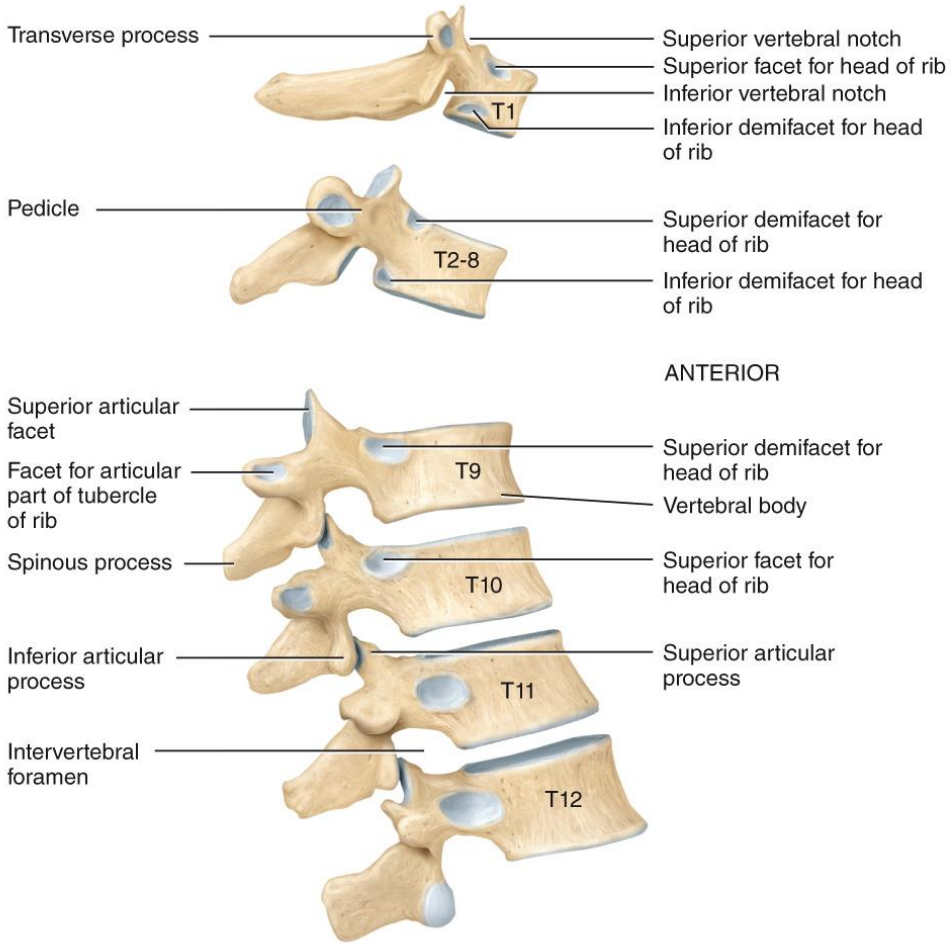


(a) Posterior view of articulated cervical vertebrae

Vertebral Column – Thoracic

- **thoracic vertebrae:** T1-T12
  - → considerably larger and stronger than cervical vertebrae
  - → articulate with the ribs

Location of thoracic vertebrae

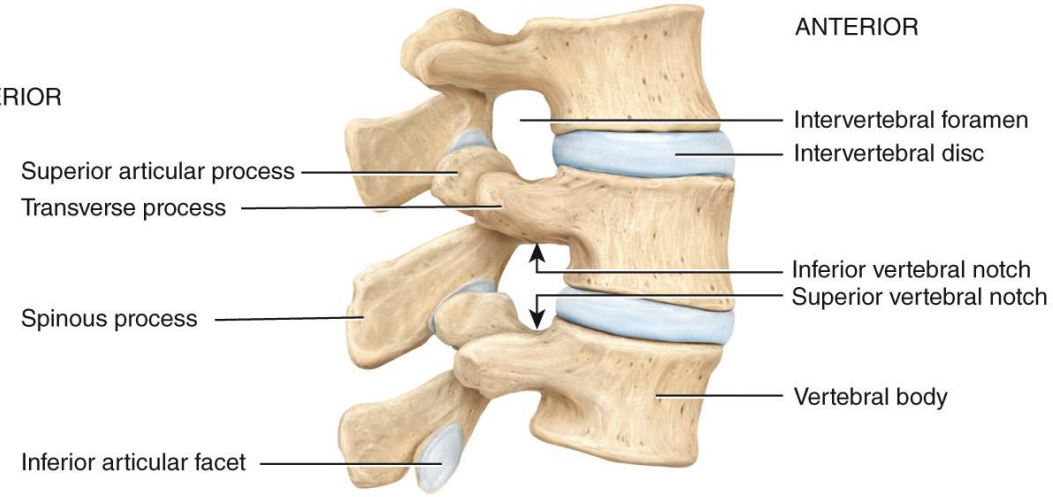


(a) Right lateral view of several articulated thoracic vertebrae

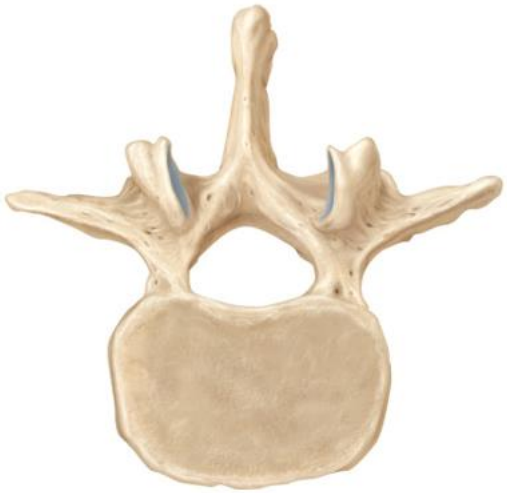
Vertebral Column – Lumbar

- **lumbar vertebrae:** L1-L5
  - → largest, strongest of the unfused bones in the vertebral column
  - → the spinous processes are well adapted for the attachment of the large back muscles

Location of lumbar vertebrae

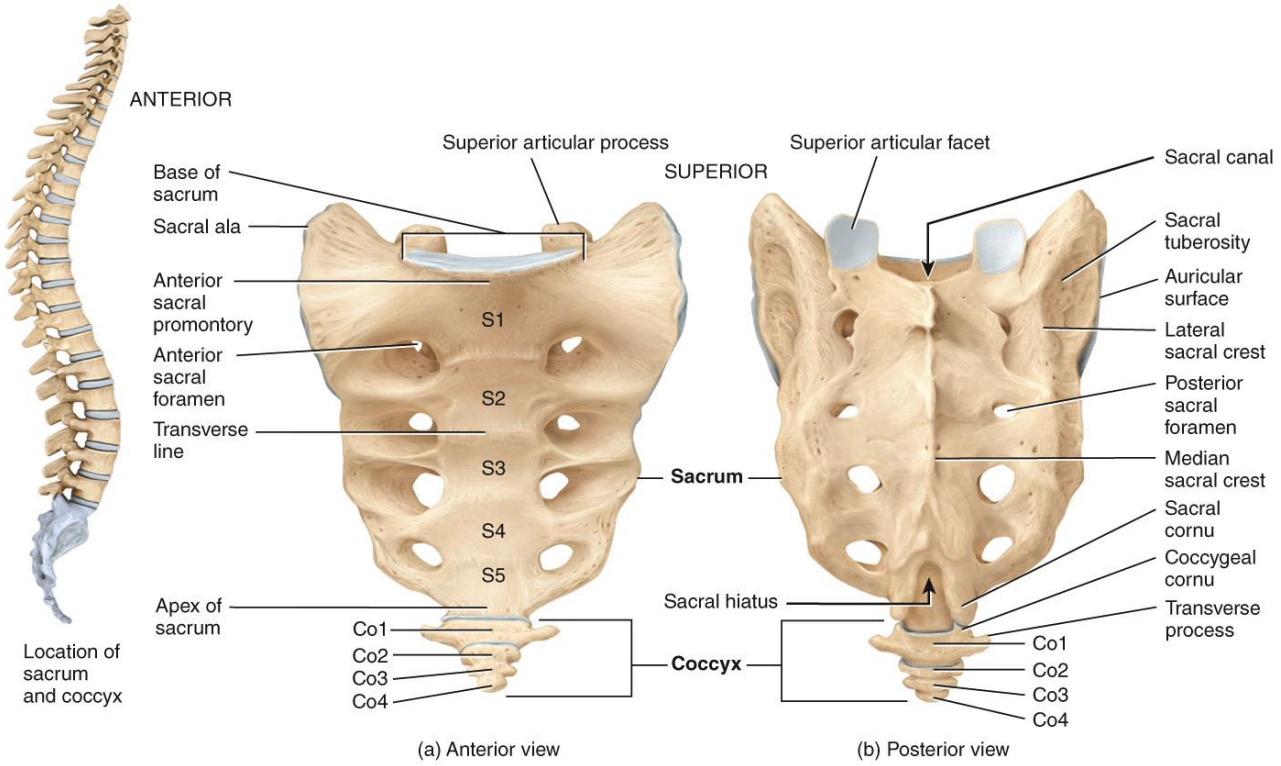


(a) Right lateral view of articulated lumbar vertebrae



Vertebral Column – Sacrum and Coccyx

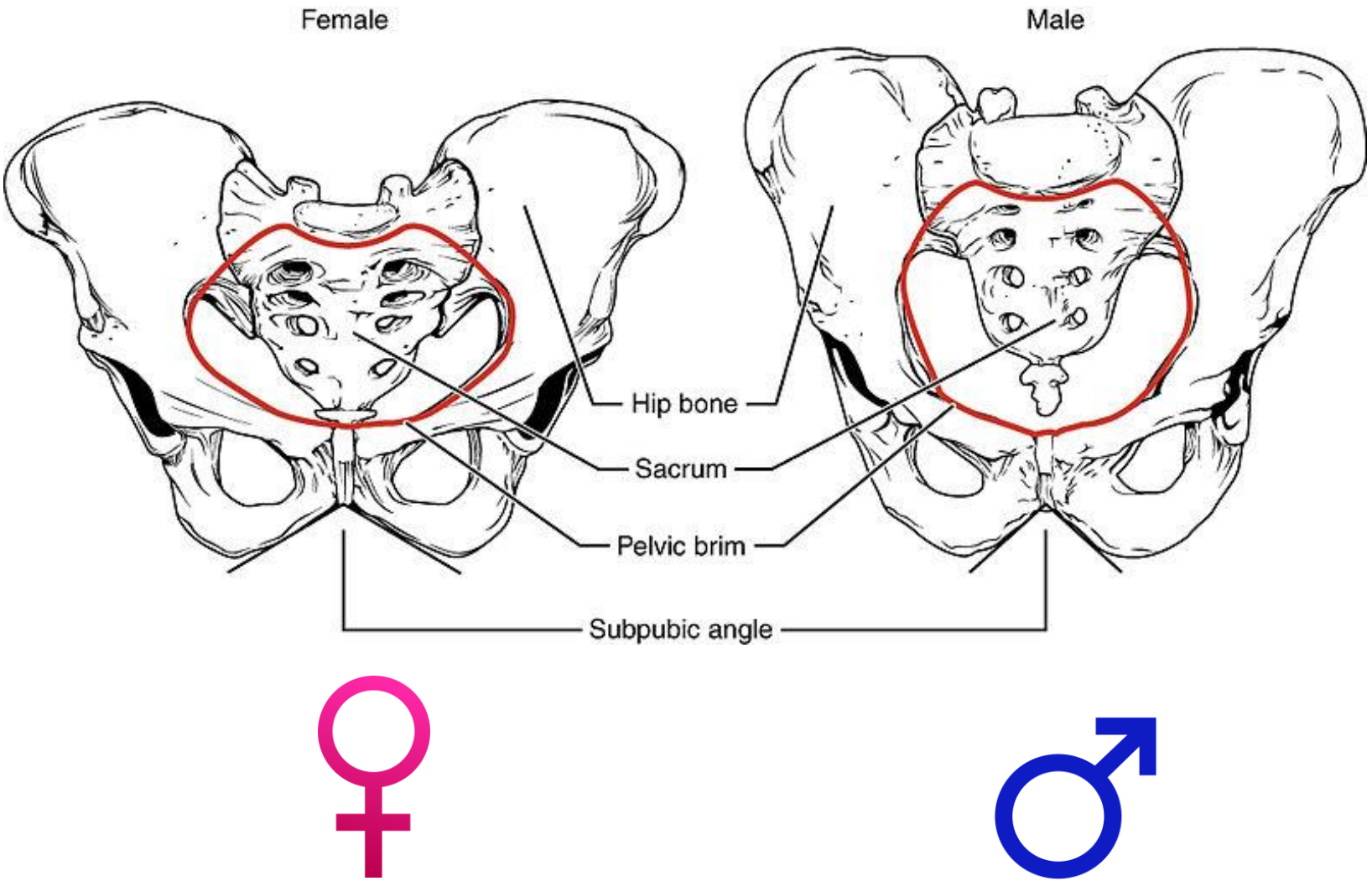
- **sacrum:** triangular bone formed by the union of 5 sacral vertebrae (S1-S5)
  → sacral vertebrae begin to fuse between 16-18 years of age (process completed by 30)
  → serves as foundation for the pelvic girdle



- **coccyx** (aka "tailbone"): triangular bone formed by the union of 4 coccygeal vertebrae (Co4-Co4)
  → fusion occurs between the age of 20-30

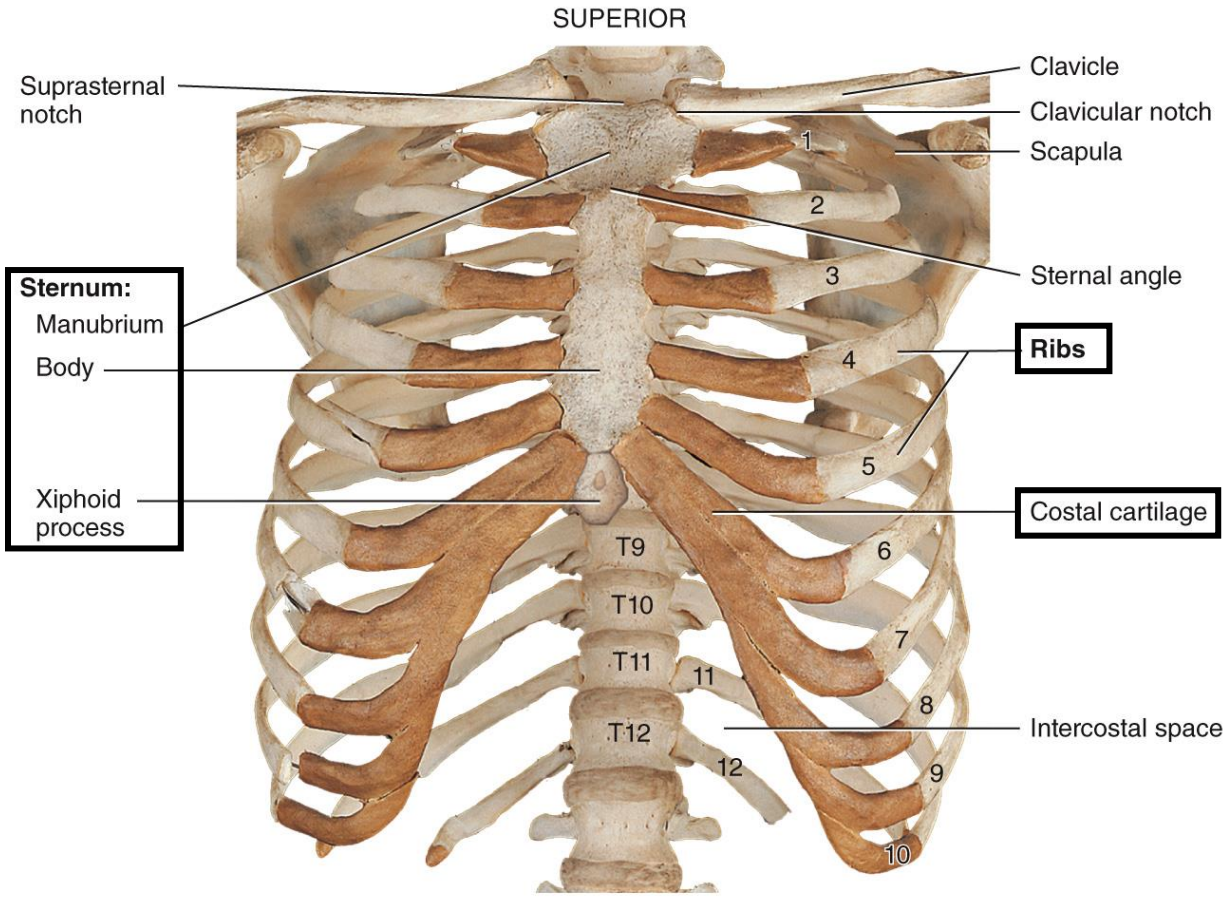
Vertebral Column – Sacrum and Coccyx

- the female sacrum is shorter, wider, and more curved between S2-S3



Thoracic Cage

- **thoracic cage:** bony enclosure formed by the [1] sternum, [2] ribs and their [3] costal cartilages, and the bodies of the thoracic vertebrae



(b) Anterior view of skeleton of thorax

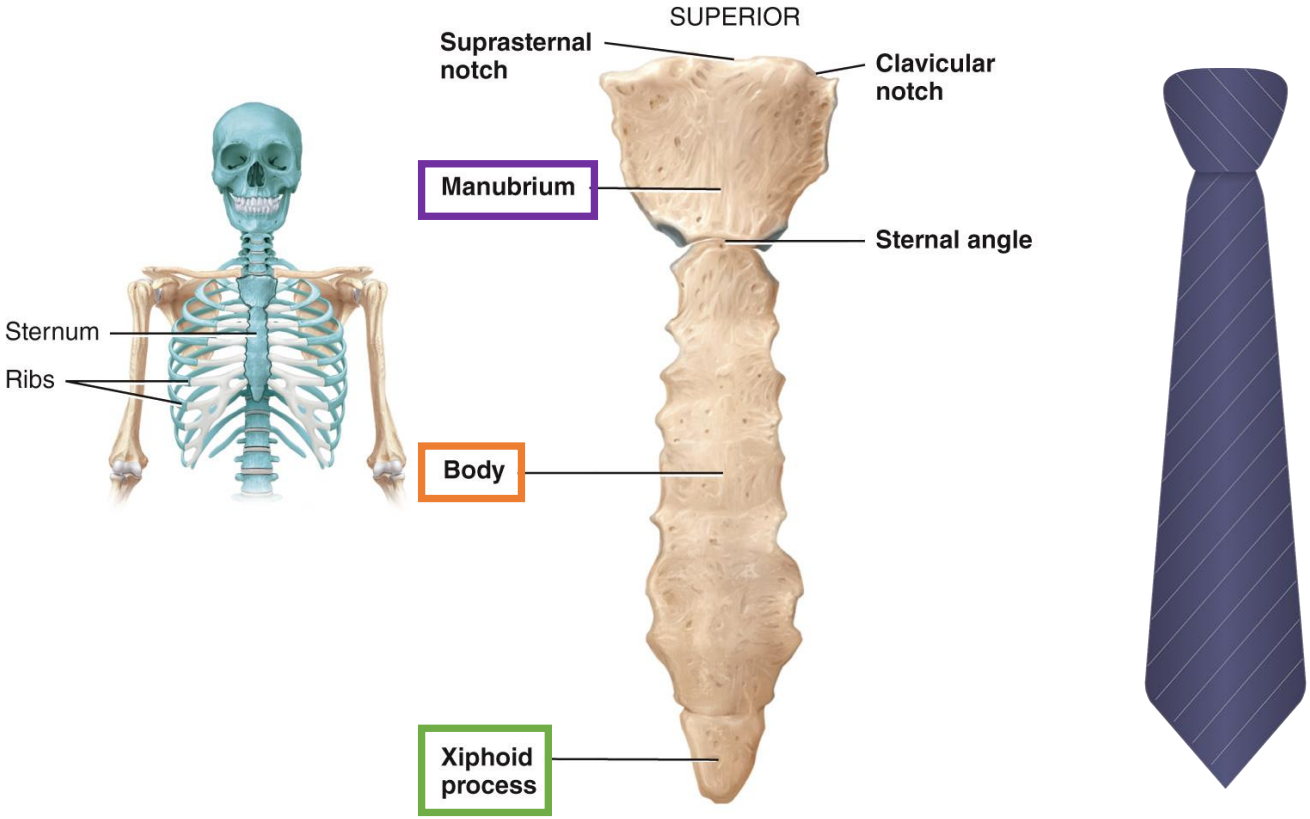
Thoracic Cage – Sternum

- **sternum** (aka breastbone): flat, narrow bone located in the center of the anterior thoracic wall

  [1] **manubrium:** the superior portion

  [2] **body:** the middle and largest part

  [3] **xiphoid process:** inferior and smallest part

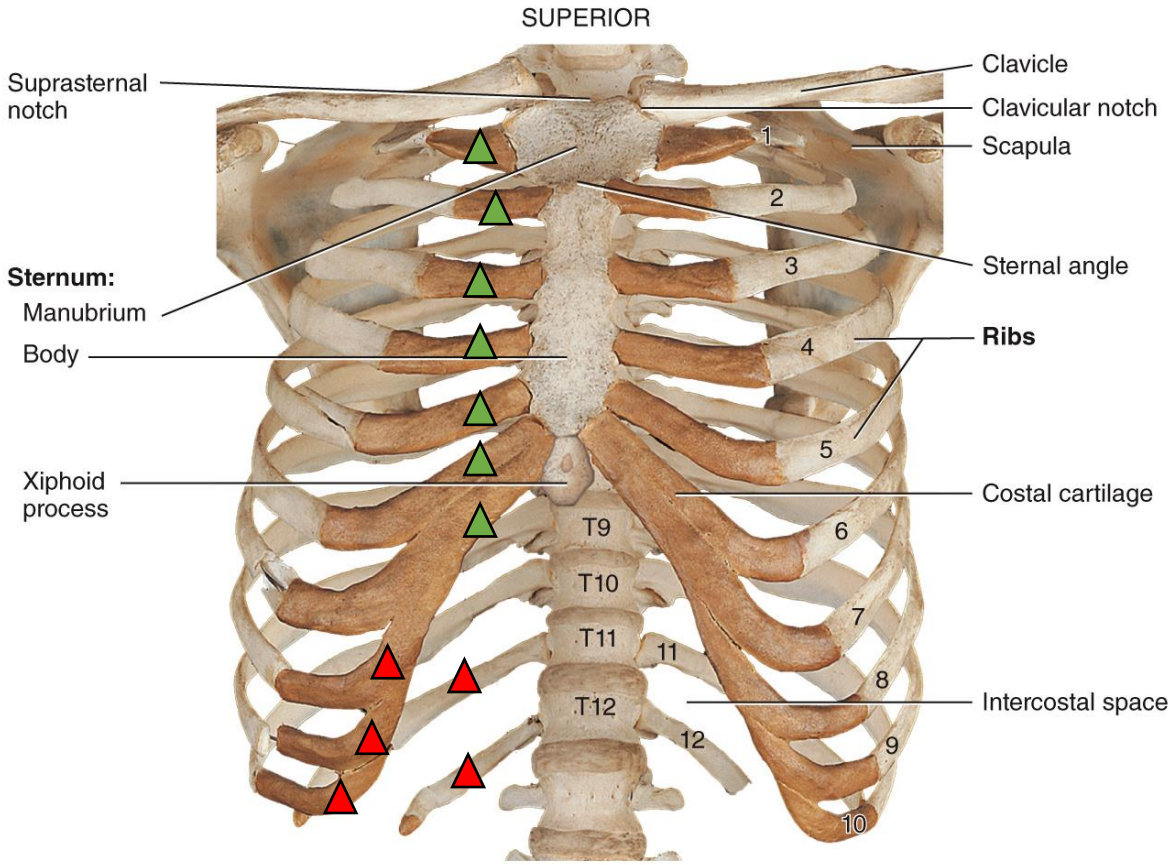


(a) Anterior view of sternum

Thoracic Cage – Ribs

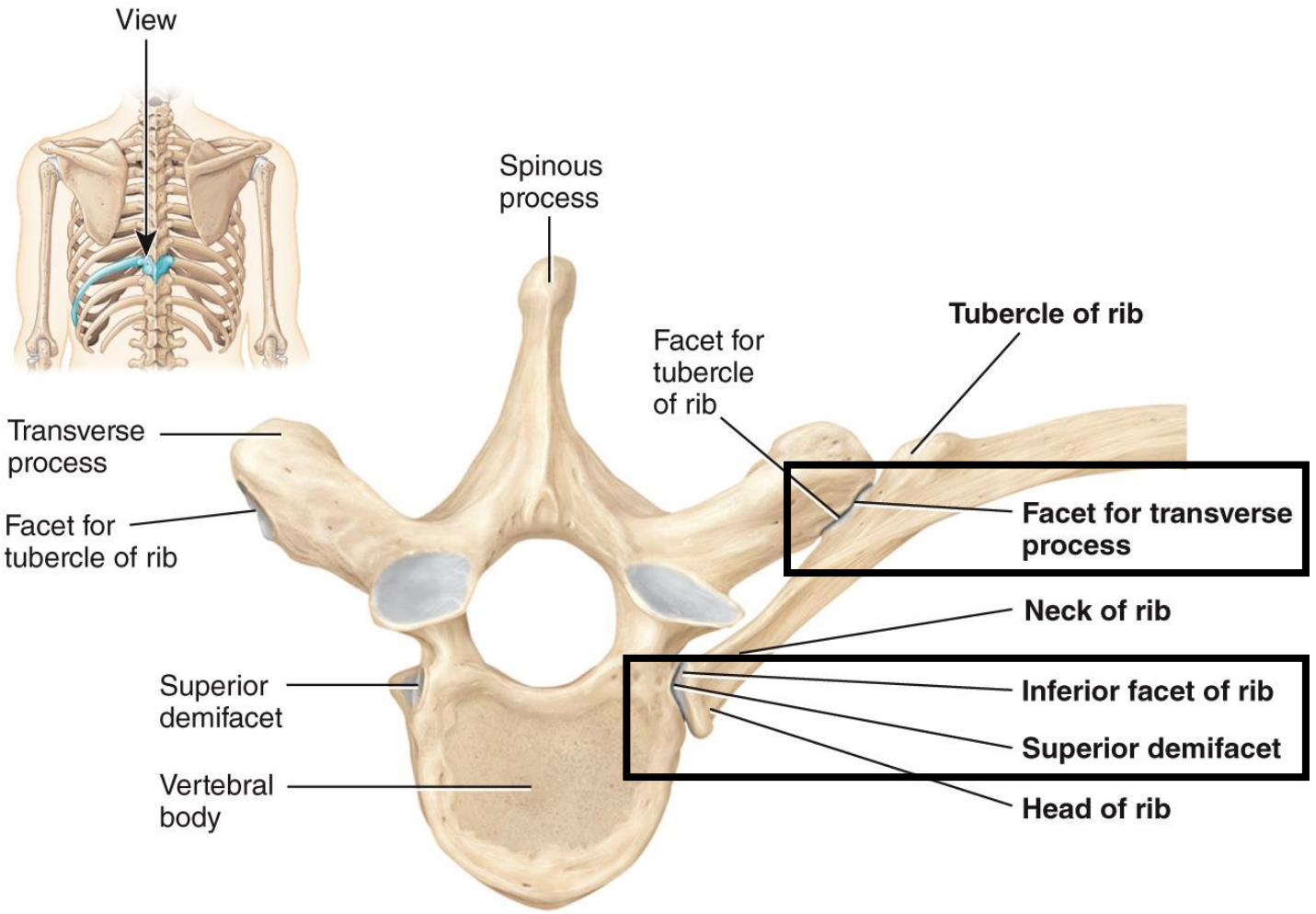
- **ribs:** 12 pairs, numbered 1-12 from superior to inferior
  → give structural support to the sides of the thoracic cavity
  → each rib articulates posteriorly with its corresponding thoracic vertebra

true ribs = those that have costal cartilages that attach *directly* to the sternum (1-7)
false ribs = costal cartilages either attach *indirectly* to the sternum or do not attach to the sternum at all (8-12)



(b) Anterior view of skeleton of thorax

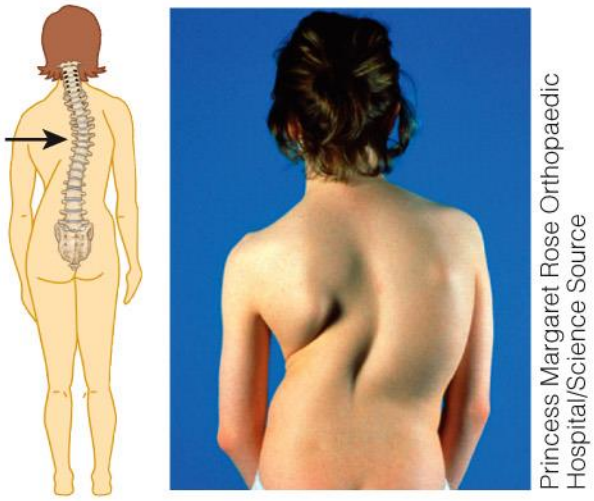
Thoracic Cage – Ribs



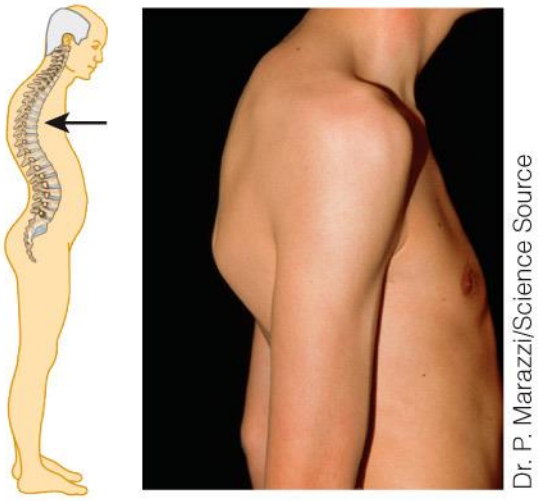
(c) Superior view of left rib articulated with thoracic vertebra

Clinical Connection – Spinal Curvature

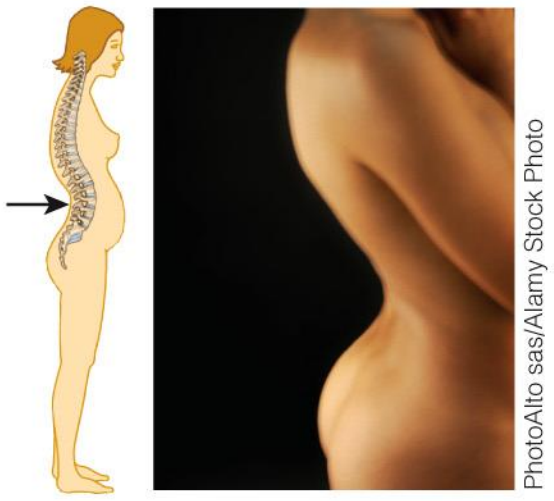
- **scoliosis:** increased lateral curvature
- **kyphosis:** increased thoracic curvature, bent forward
- **lordosis:** increased lumbar curvature, bent backwards



(a) Scoliosis



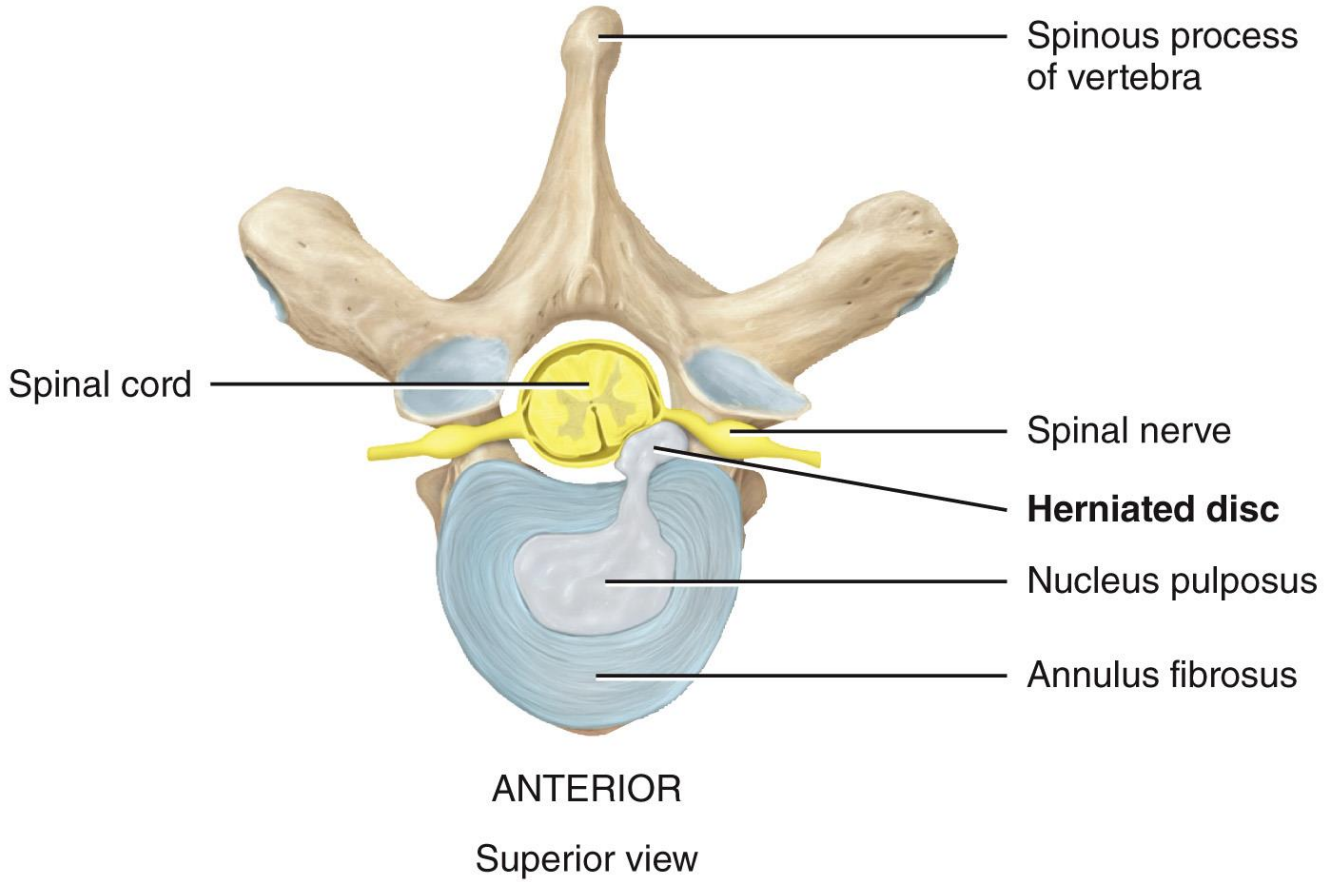
(b) Kyphosis



(c) Lordosis

Clinical Connection – Herniated Disc

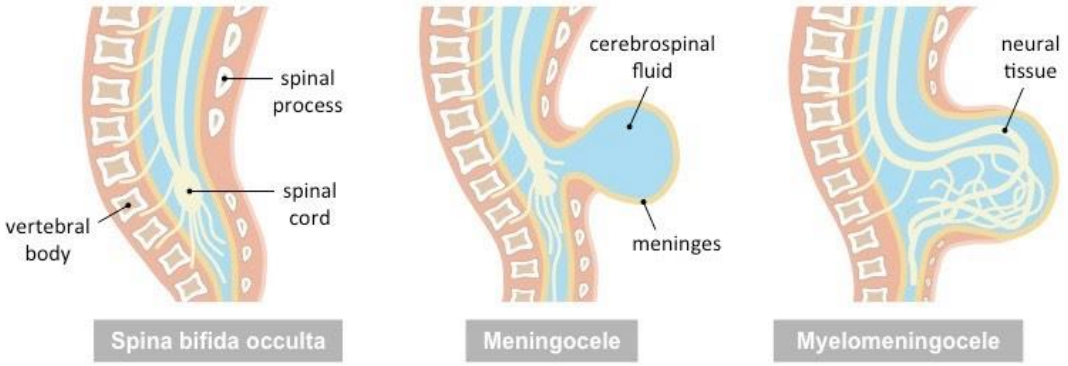
- **herniated disc:** results from rupture of an intervertebral disc
  → the soft inner portion of the disc (nucleus pulposus) protrudes outside through the hard outer ring (annulus fibrosus)
  → causes pain when a nerve is compressed
  → can be precipitated by strain, injury, and aging



Clinical Connection – Spina bifida

- **spina bifida:** is a congenital neural tube defect (NTD) in which the spinal column does not form properly and neural tissue protrudes from an opening in the back

  → the degrees of this deformity vary from minor (spina bifida occulta) to severe (spina bifida with meningomyelocele)



Center for Disease Control/Project Masters, Inc.

Watch These Videos:

Videos from the textbook:

Divisions of the Skeletal System

The Vertebral Column

The Thorax