

Monday January 14th
 Thursday January 17th

2.4 Anatomy of the skeleton:

2.4.1 Axial skeleton

Skull:

Identify and describe the cranial and facial bones

Describe the sutures and paranasal sinuses

Vertebral column:

Identify the regions of the vertebral column

Describe the ligaments and intervertebral discs associated with the vertebral column

Describe the general structure of vertebrae and compare their regional differences

Describe the structure of the sacrum and coccyx.

Thorax:

Describe the anatomy of the sternum and ribs

Table 6.1 Bone Markings		
NAME OF BONE MARKING	DESCRIPTION	ILLUSTRATIONS
Projections That Are Sites of Muscle and Ligament Attachment		
Tuberosity (too'bē-ros'i-te)	Large rounded projection; may be roughened	
Crest	Narrow ridge of bone; usually prominent	
Trochanter (tro-kan'ter)	Very large, blunt, irregularly shaped process (the only examples are on the femur)	
Line	Narrow ridge of bone; less prominent than a crest	
Tubercle (too'ber-kl)	Small rounded projection or process	
Epicondyle (ep'i-kon'dil)	Raised area on or above a condyle	
Spine	Sharp, slender, often pointed projection	
Process	Any bony prominence	

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Throughout this section, refer to table 6.2: Bone Markings – you are responsible for being able to define all of these bone markings

tuberosity : ischial spine = hamstring muscles

Table 6.1 Bone Markings (*continued*)

NAME OF BONE MARKING	DESCRIPTION	ILLUSTRATIONS
Projections That Help to Form Joints		
Head	Bony expansion carried on a narrow neck	
Facet	Smooth, nearly flat articular surface	
Condyle (kon'dil)	Rounded articular projection	
Ramus (ra'mus)	Armlike bar of bone	
Depressions and Openings		
For Passage of Blood Vessels and Nerves		
Groove	Furrow	
Fissure	Narrow, slitlike opening	
Foramen (fo-ra'men)	Round or oval opening through a bone	
Notch	Indentation at the edge of a structure	
Others		
Meatus (me-a'tus)	Canal-like passageway	
Sinus	Cavity within a bone, filled with air and lined with mucous membrane	
Fossa (fos'ah)	Shallow, basinlike depression in a bone, often serving as an articular surface	

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Read and understand.

THE SKELETON (Chapter 7)

- **206** bones in human skeleton - make up about 20% of body weight
- grouped into **axial** and **appendicular** skeletons

axial skeleton = bones of skull, vertebral column, rib cage

appendicular skeleton = bones of upper & lower limbs + pectoral/pelvic girdles (attach limbs to axial skeleton)

Consists of 80 bones

Three major regions:

Skull

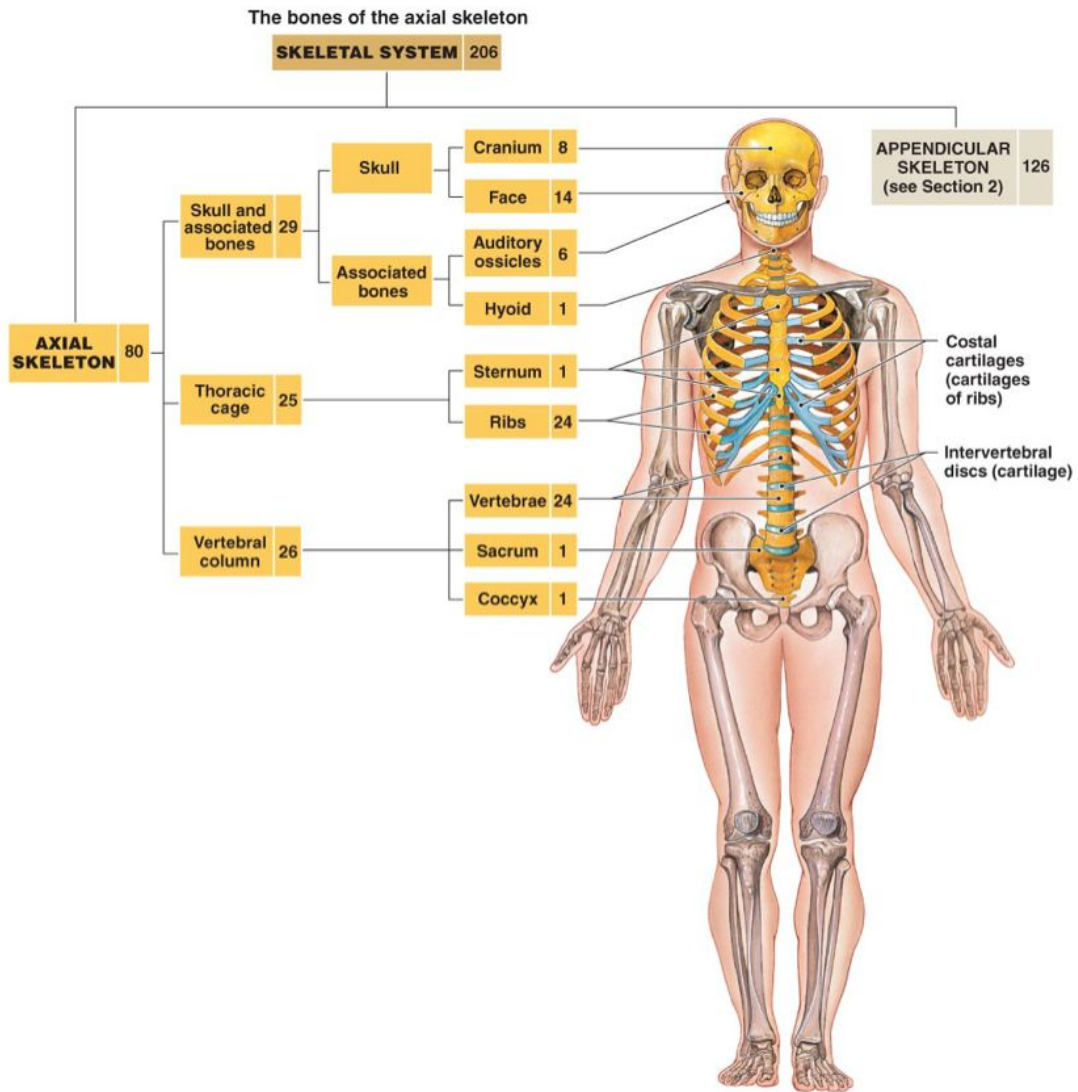
- Cranial bones
- Facial bones

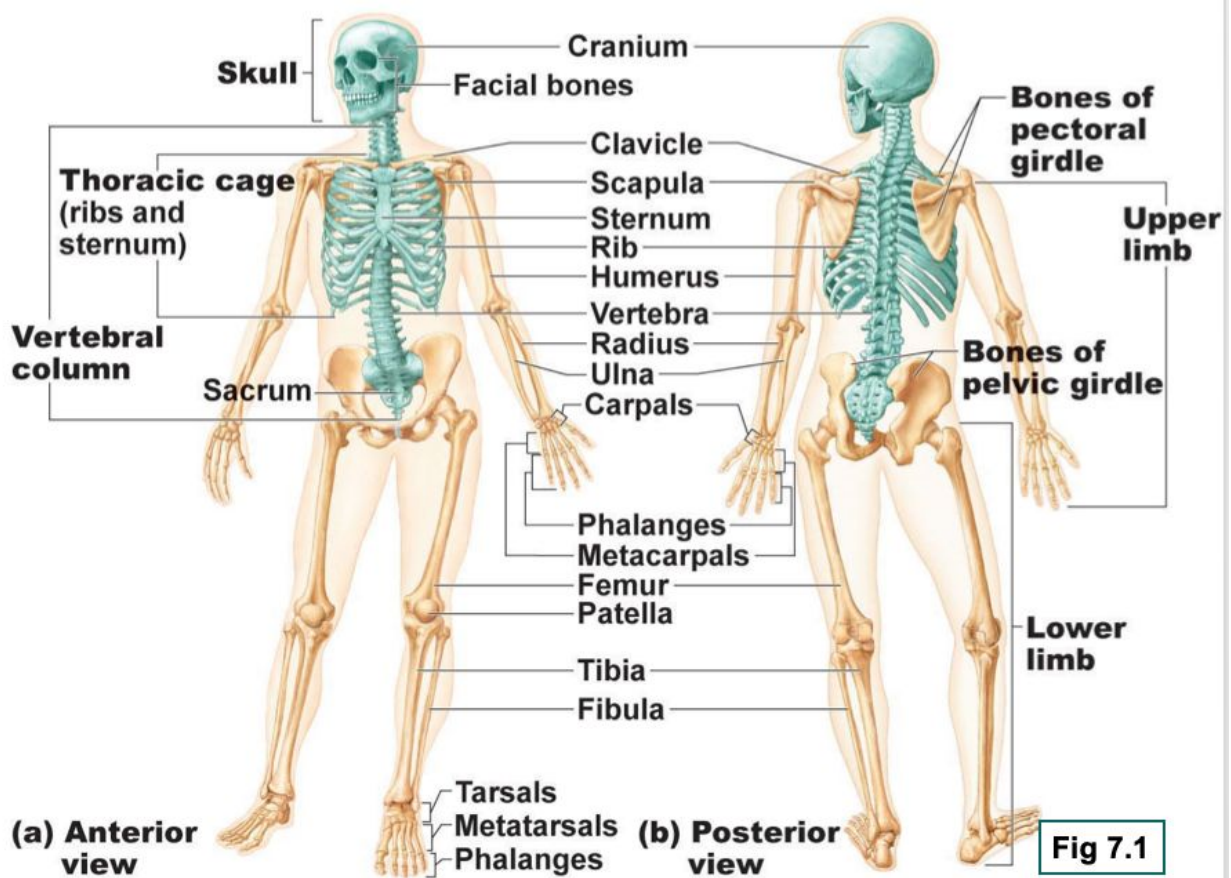
Thoracic cage

- Sternum
- Ribs

Vertebral Column

- Vertebrae
- Sacrum
- Coccyx





SKULL

Names of the muscles: second midterm exam

Cranial only in posterior

most complex

2 sets of bones: **cranial** + **facial** = 22 bones

Cranial Bones

- most skull bones are flat bones
- united by [sutures](#)

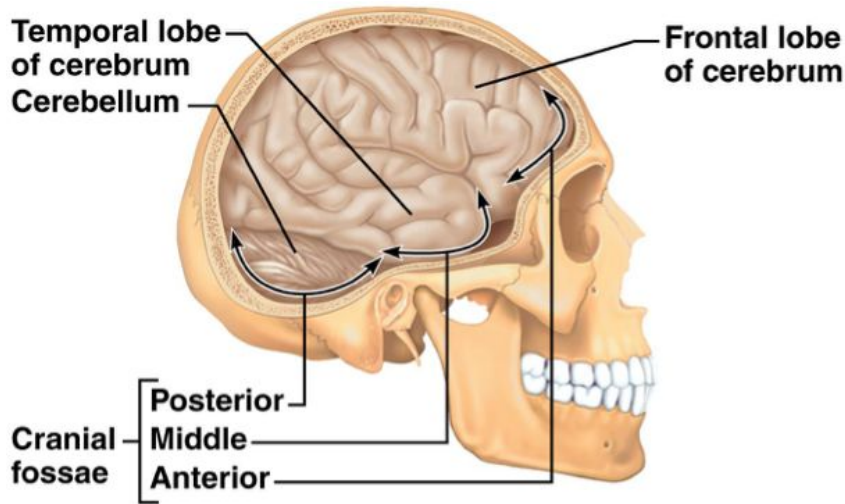
o Cranial vault (calvaria) superior, lateral & posterior aspects of the skull + forehead

o Cranial base: anterior, middle, and posterior cranial fossae

o surrounds & protects brain & organs of hearing & balance

o Provide sites of attachment for head and neck muscles

Cranial bones stabilize the position of the brain, blood vessels, lymphatic vessels and nerves through the attachment of their inner surfaces to the meninges



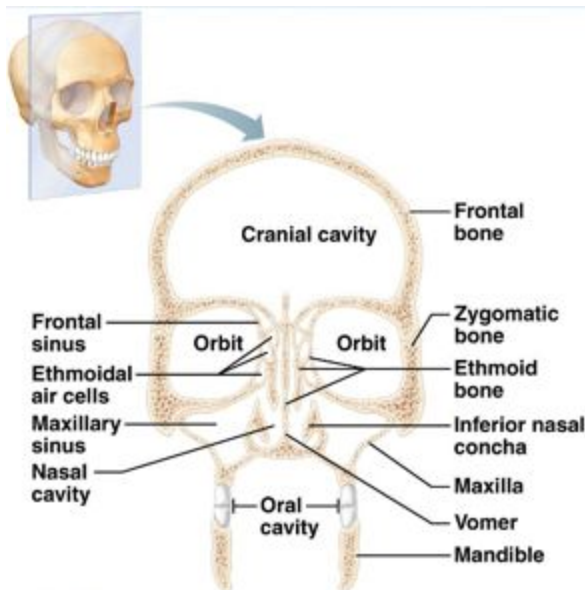
(c) Lateral view of cranial fossae showing the contained brain regions

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Facial bones

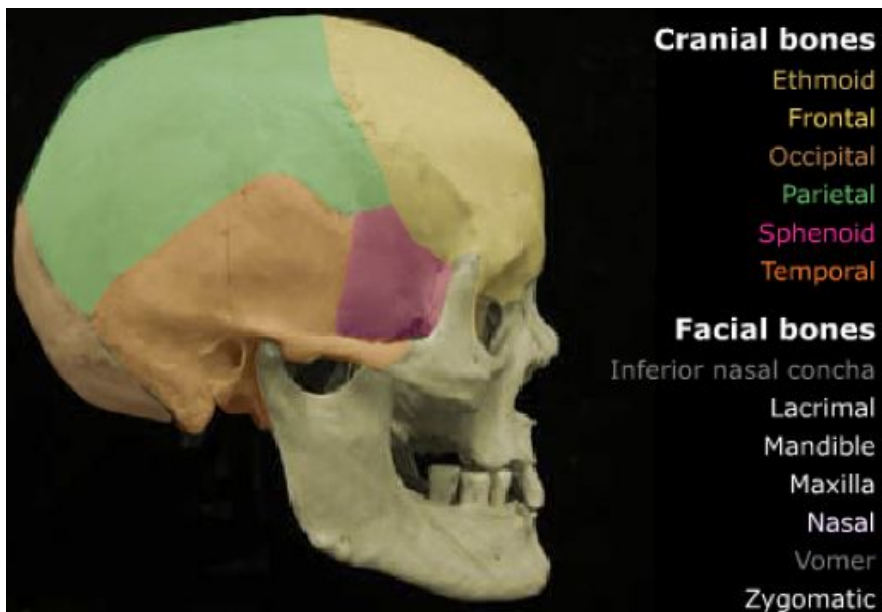
facial bones form anterior part of skull & cranial bones form the rest

skull has eye orbits & paranasal sinuses, houses organs of hearing, has 85 openings for nerves, blood vessels & spinal cord



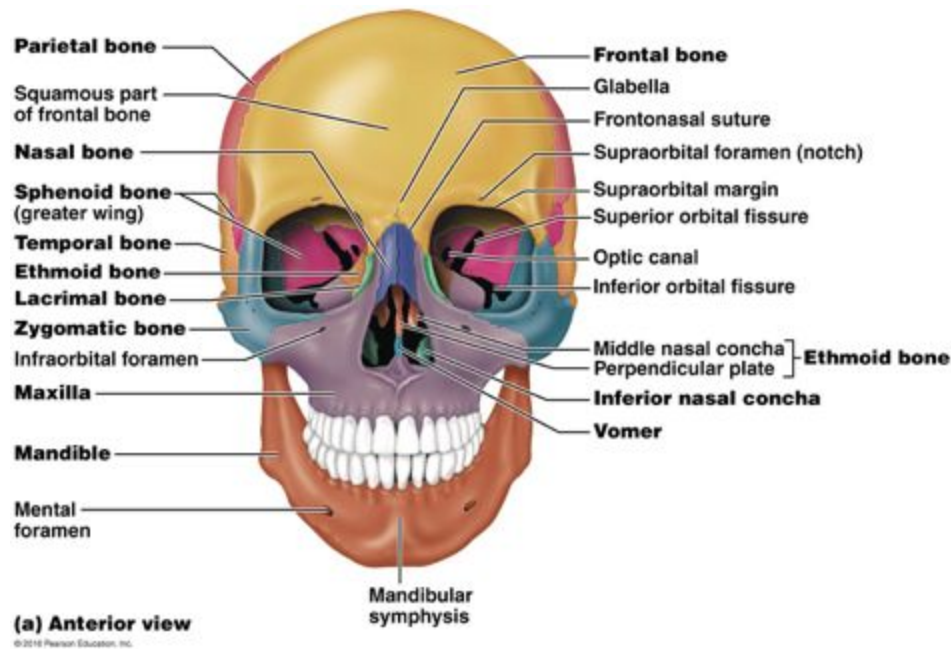
A) Cranium:

- cranium can be divided into a **vault** & a **base**
- **vault**: forms superior, lateral & posterior aspects of the skull + forehead
- **base**: inferior aspect of skull
- cranium surrounds & protects brain & organs of hearing & balance
- internally, 3 bony ridges divide the cranial base into 3 distinct areas: anterior (highest) fossa, middle fossa & posterior (lowest) fossa



Lacrimal: name comes from gland.

B) Facial bones or Face



know!

Facial bones of face:

- form framework of the face
- contain the cavities for the sensory organs of sight, smell & taste
- provide openings for passage of air & food
- secure the teeth
- anchor the facial muscles that we use to show our feelings

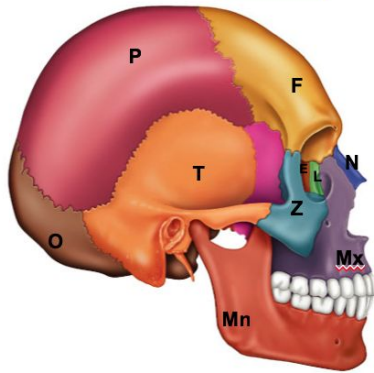
Dont write the names just what wing it belongs too ex sphenoid bone: (greater wing)

Cranium

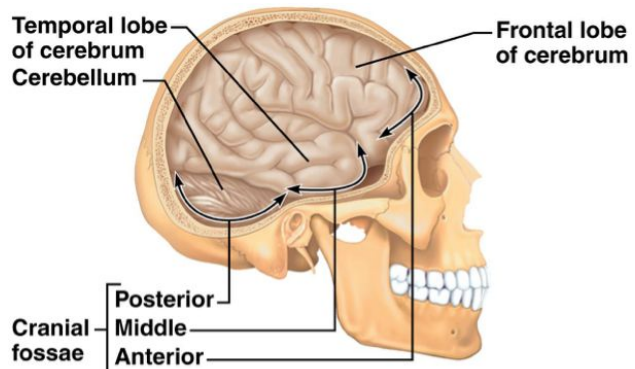
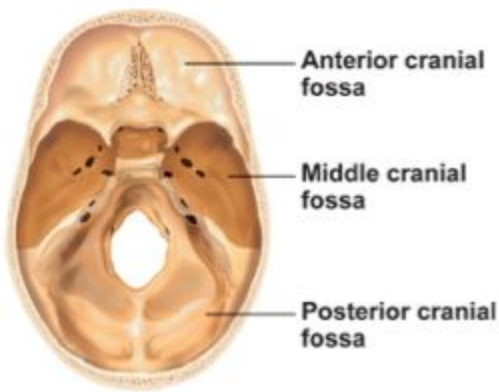
8 cranial bones are the **paired parietal & temporal** bones & the **unpaired frontal, occipital, sphenoid & ethmoid** bones

curvature allows them to be self-bracing; can be strong while being quite thin

Fig. 7.5a



Cranial bones stabilize the position of the brain, blood vessels, lymphatic vessels and nerves through the attachment of their inner surfaces to the meninges



(c) Lateral view of cranial fossae showing the contained brain regions

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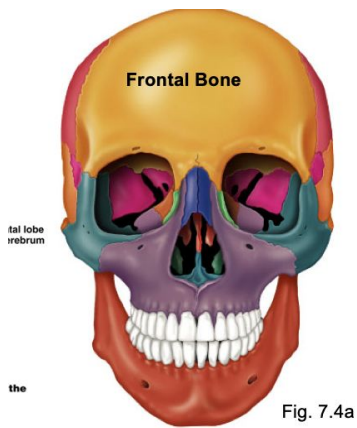


Fig. 7.4a

Frontal Bone:

dome-shaped bone; also forms the roof of the orbits & anterior cranial fossa articulates with paired parietal bones posteriorly

note supraorbital margin, supraorbital foramen, and glabella

area lateral to glabella has left & right frontal sinus within bone

40.00 Sensation is in the meninges

Yellow = squamous part of the frontal bone

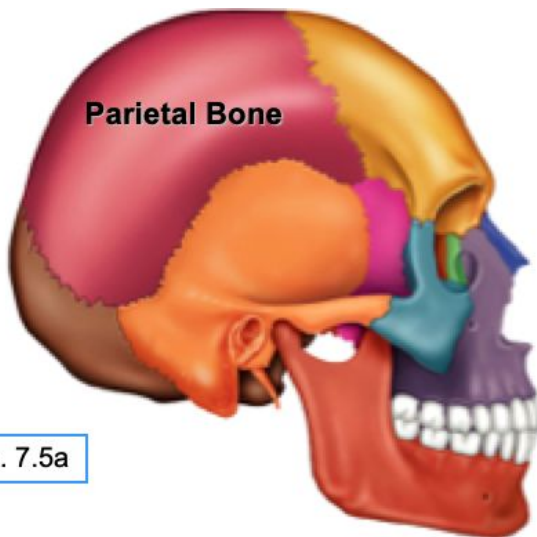


Fig. 7.5a

Occipital Bone:

single bone at base of skull; helps form post aspect of skull

also forms walls of the post cranial fossa

attaches anteriorly to the 2 parietals & 2 temporals & attaches to sphenoid

(ii) Parietal Bones

paired - form superior & lateral aspects of skull

therefore form bulk of **cranial vault**

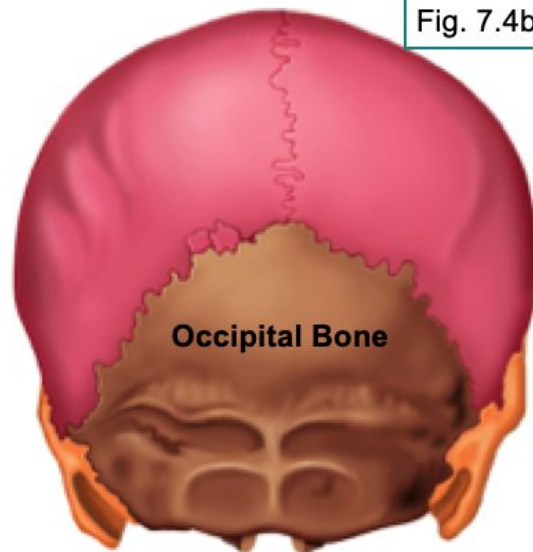
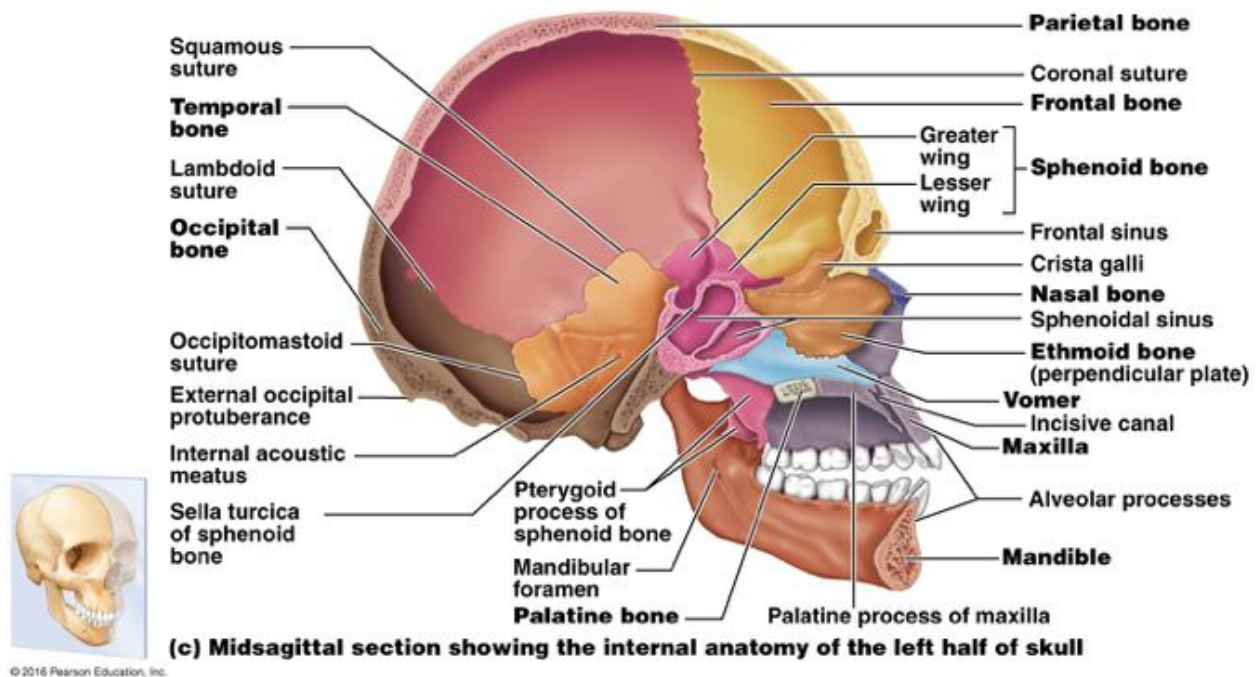


Fig. 7.4b



Cavity in frontal bone = frontal sinus



Fig. 7.6a

Occipital Bone (cont.)

large hole at base = **foramen magnum**
(through which the inferior part of the Brain connects with the spinal cord)

occipital condyles on each side of foramen magnum = site of articulation with first cervical vertebra

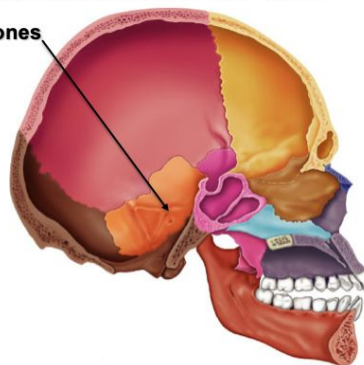
external occipital protuberance = projection at back of skull - more

Temporal Bones

paired; form inferior & lateral aspects of skull and parts of the cranial floor

located just below the 2 parietal bones; have 3 very different areas or regions

Fig. 7.5c



Occipital bone = large

50.00

1) **Squamous region:** flattened zygomatic process to cheekbone (**zygomatic bone**)

mandibular fossa receives condyle of mandible

2) **Tympanic region:** surrounds external acoustic meatus

3) **Petrous region** is on internal aspect of temporal bone
contributes to cranial base; houses middle and inner ear cavities

mastoid process is attachment site for some neck muscles

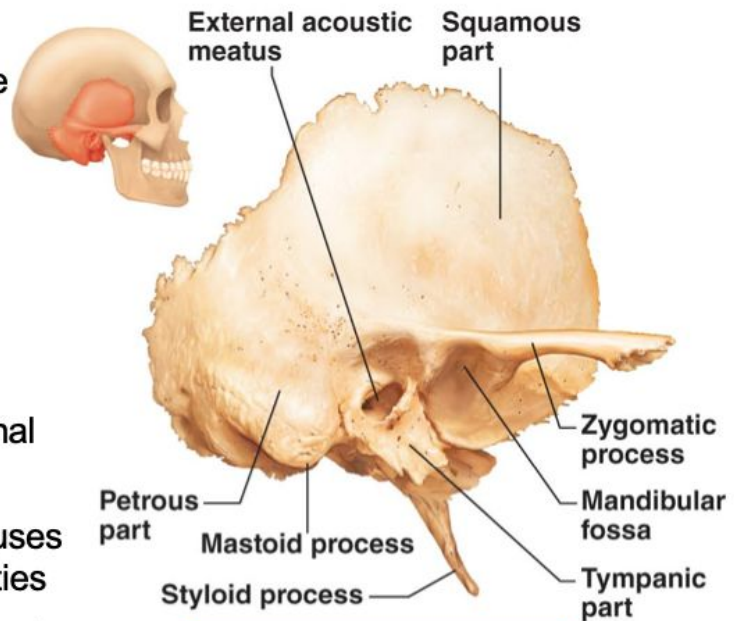


Fig. 7.8: Temporal Bone

styloid process is attachment area for muscles of the tongue

several important foramina associated with this part of the temporal bone: **jugular foramen, carotid canal, internal acoustic meatus**

May give diagram label technicalities

Frontal bone / temporal bone

Zygomatic process: expansion, called this because the zygomatic process is attached directly to the zygomatic bone.

Mastoid process: Part of the bone that you can easily feel

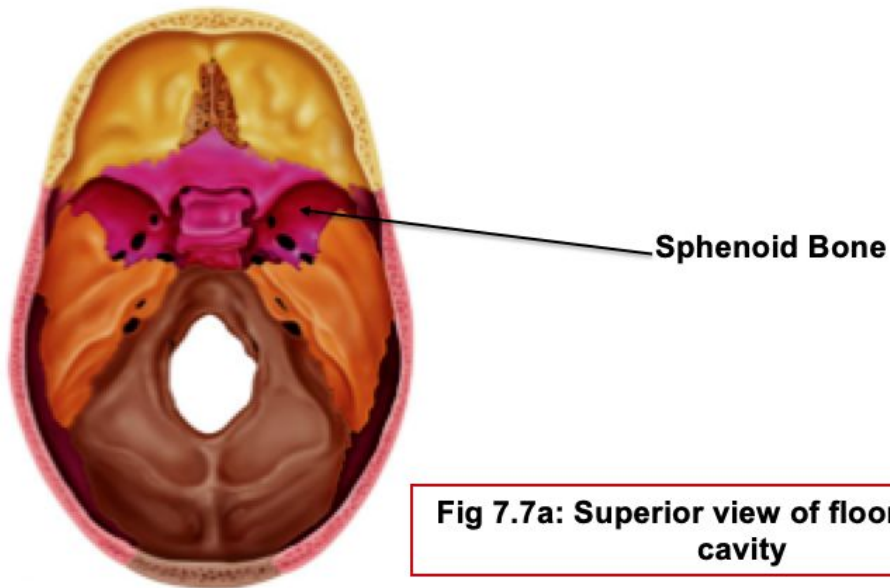
Different part of the bones

Not the names of the nerves / arteries

Everything in bold red = part of temporal role and not apart of any other one.

Sphenoid Bone:

complex bone; difficult to visualize; articulates with **all** other cranial bones.
forms base of middle cranial fossa; contributes to base of anterior cranial fossa



In the middle so it is in contact with all of the bones (articulates with all of the bones we have in the cranium)

central body which contains **sphenoid sinuses**

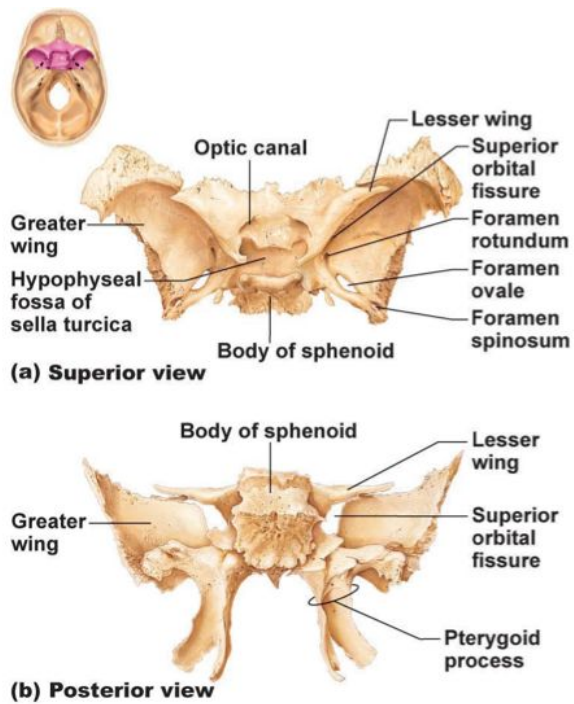
3 projections:

greater & lesser wings (orbits, MCF & ACF)

pterygoid processes (muscles for ?)

optic foramina (canals): for optic nerves

superior orbital fissure between greater & lesser wings (cranial nerves for eye movement)



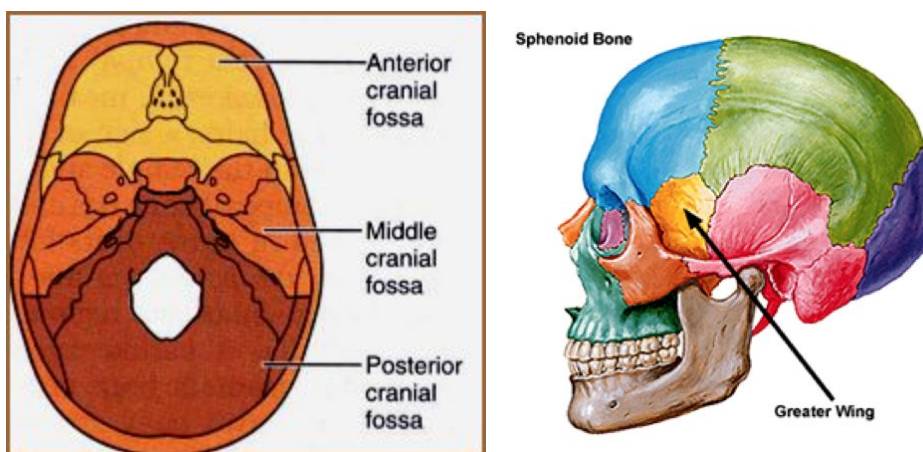
1hr 4 minutes

Pterygoid processes: muscles for medial and lateral

Both views are responsible for both

Optic canal is part of the sphenoid bone

Fig. 7.7a Cranial cavity floor showing major fossae



Ethmoid bone: approximates a cube that lies deep between orbits & nasal cavities

cribriform plate forms roof of nasal cavity & floor of anterior cranial fossa; tiny holes (**olfactory foramina**) transmit olfactory nerves

perpendicular plate projects inferiorly to contribute to nasal septum

crista galli projects superiorly to attach to dura mater of brain

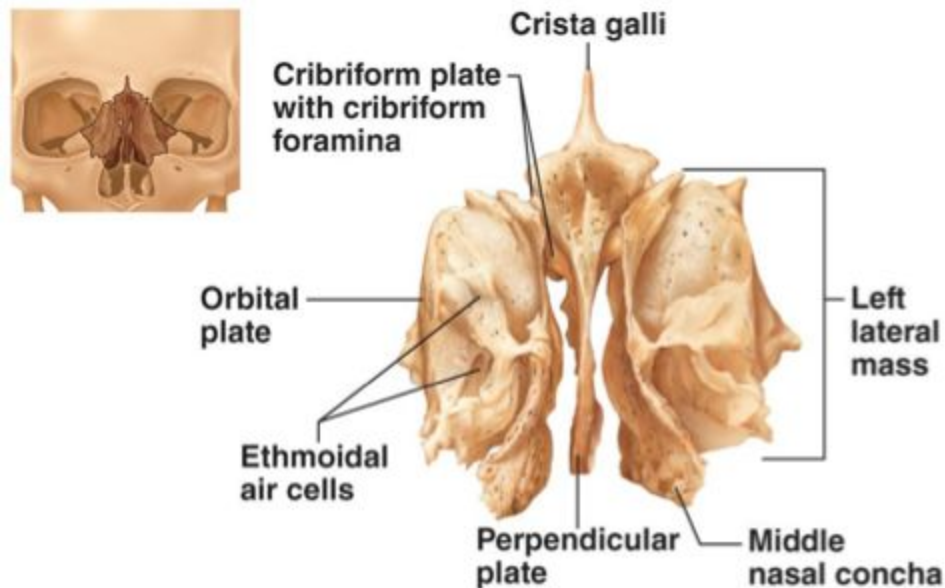


Fig 7.10

lateral masses contain **ethmoid sinuses**

medially are superior & middle **nasal conchae**

laterally are **orbital plates** - contribute to medial walls of orbits

Nasal cavity = large cavity in the middle that is divided into 2

Crista galli = dura matter which separates 2 hemispheres

Ethmoidal air cell: same meaning and function as sinuses

Major Cranial Sutures:

- bones of the adult skull are firmly united by **sutures**
- 4 main sutures that connect the cranial bones
- **Coronal suture:** frontal bone & 2 parietal bones
- **Squamous suture:** parietal bone & temporal bone
- **Lambdoid suture:** occipital bone & 2 parietal bones
- **Sagittal suture:** 2 parietal bones

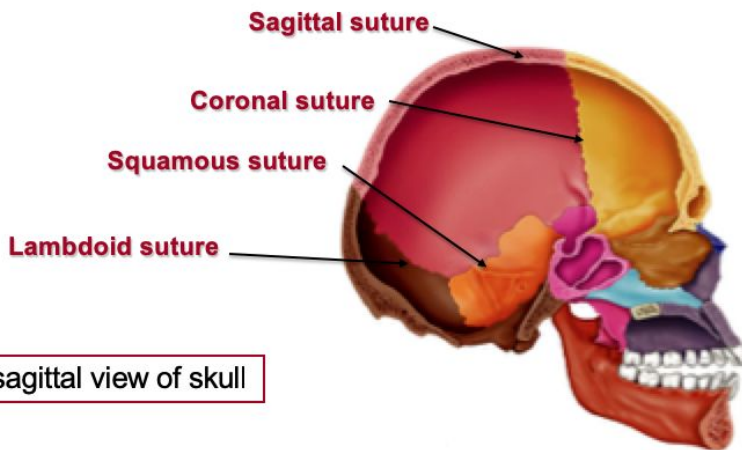
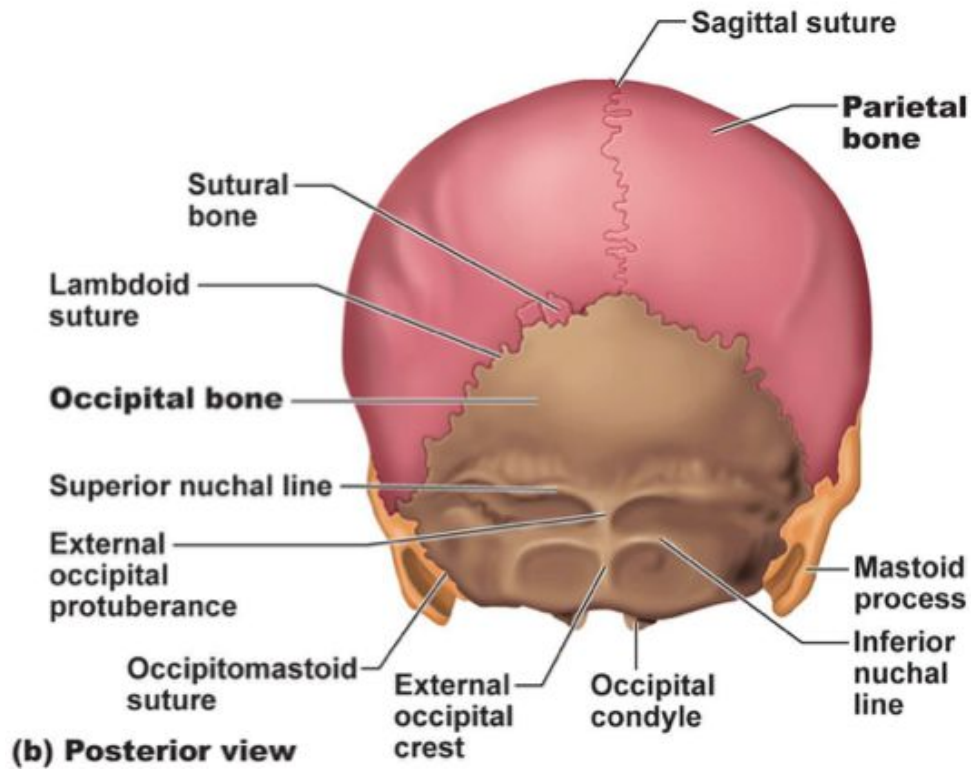


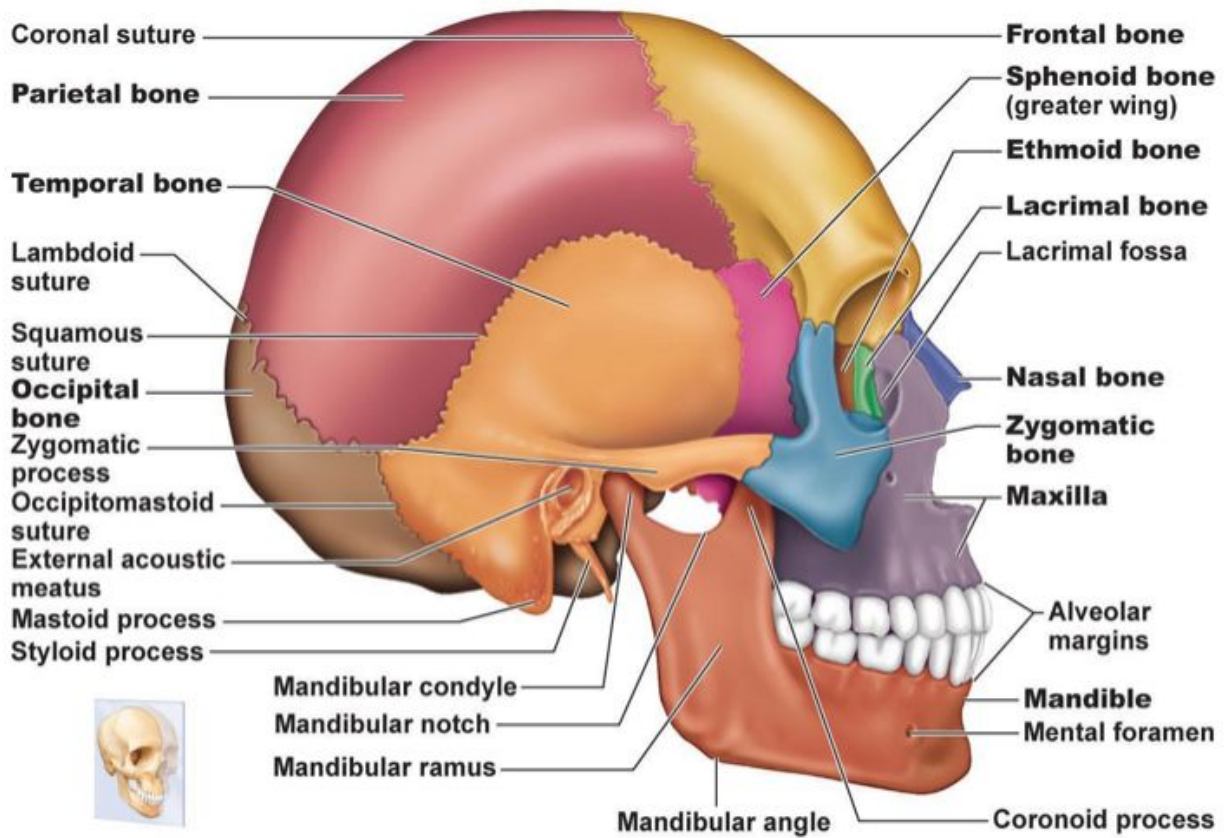
Fig. 7.5c: Midsagittal view of skull

KNOW !!!!!!!Everything !!!

Sutural bones: tiny irregular bones; can occur within cranial suture
 additional ossification centres that appeared rapidly during fetal development



Irregular bones: vertebrates * *



(a) External anatomy of the right side of the skull

Facial Bones

• 14 bones of which **mandible** & **vomer** are **unpaired**

• **paired** bones are: **maxillae, zygomatic, nasal, lacrimal, palatine & inferior conchae**

• **Mandible:** lower jaw bone - strongest & largest bone of the face

body is horizontal part & contains chin; left & right rami join body at mandibular angle

note: **mandibular notch**, **coronoid process** (insertion of temporalis muscle), **mandibular condyle**, **alveolar margin** (contains tooth sockets), **mandibular foramina** (nerves to teeth in lower jaw) & **mental foramina** (blood vessels & nerves to chin & lower lip)

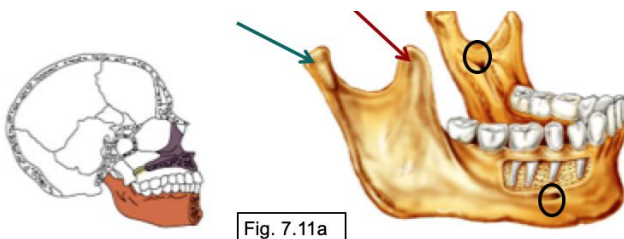
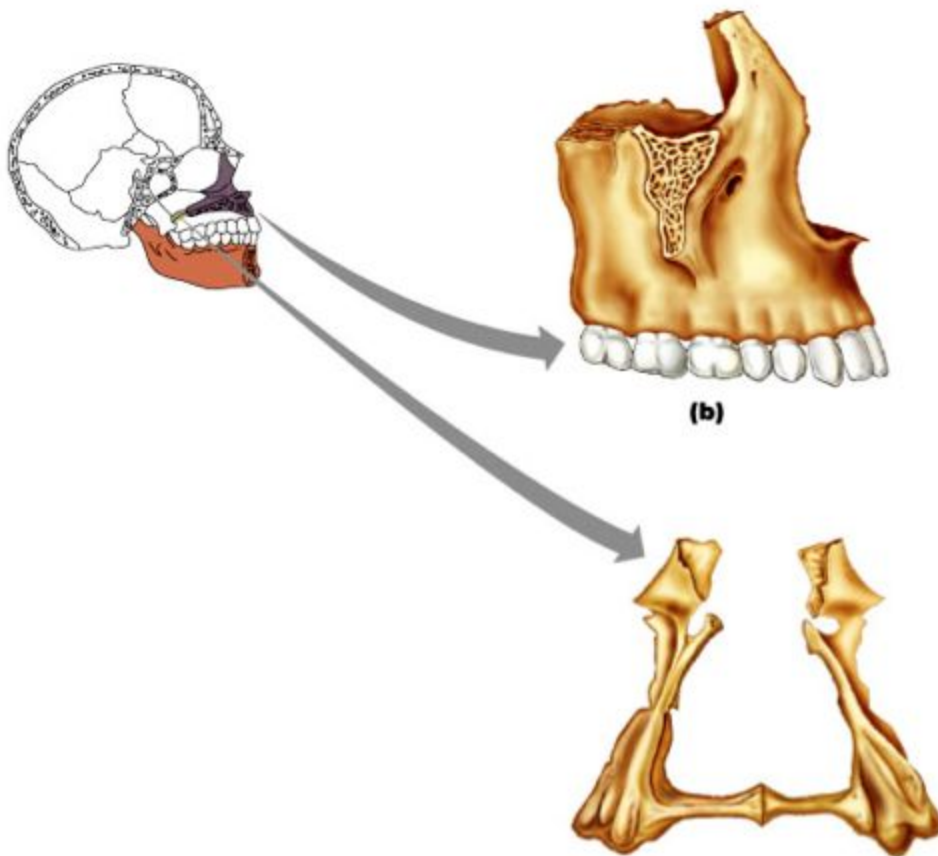


Fig. 7.11a



Maxillary bones:

- fused medially
- alveolar margins hold teeth of upper jaw
- palatine processes project posteriorly forming anterior 2/3 of hard palate

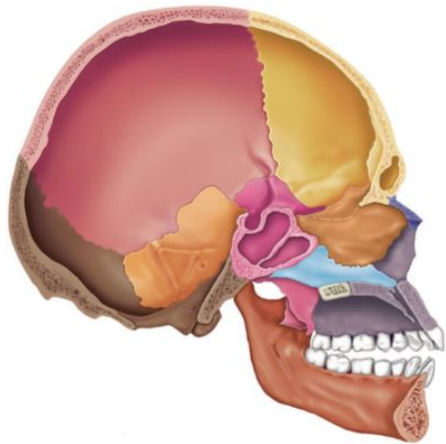
note: (incisive fossa) (passage of blood vessels & nerves), frontal processes & zygomatic processes

main portion of bone on each side has maxillary sinus - these are the sinuses that get infected

Soft bone can change placement.

Try labelling diagram





Zygomatic bones: = cheekbones

- articulate with **zygomatic processes** of maxilla, frontal & temporal bones
- contribute to inferolateral margins of orbit

Nasal bones:

- 2 tiny, rectangular bones that fuse medially to form bridge of nose
- articulate with **frontal** bone superiorly & **maxillary** bones laterally

Lacrimal bones:

- 2 fingernail-shaped bones in anterior, medial portion of orbit –

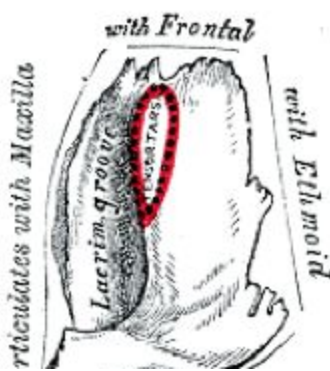
articulate with:

frontal bone

ethmoid bone

maxillae

each has a depression (**lacrimal fossa**) for *lacrimal sac*



Orbits:

zygomatic

frontal

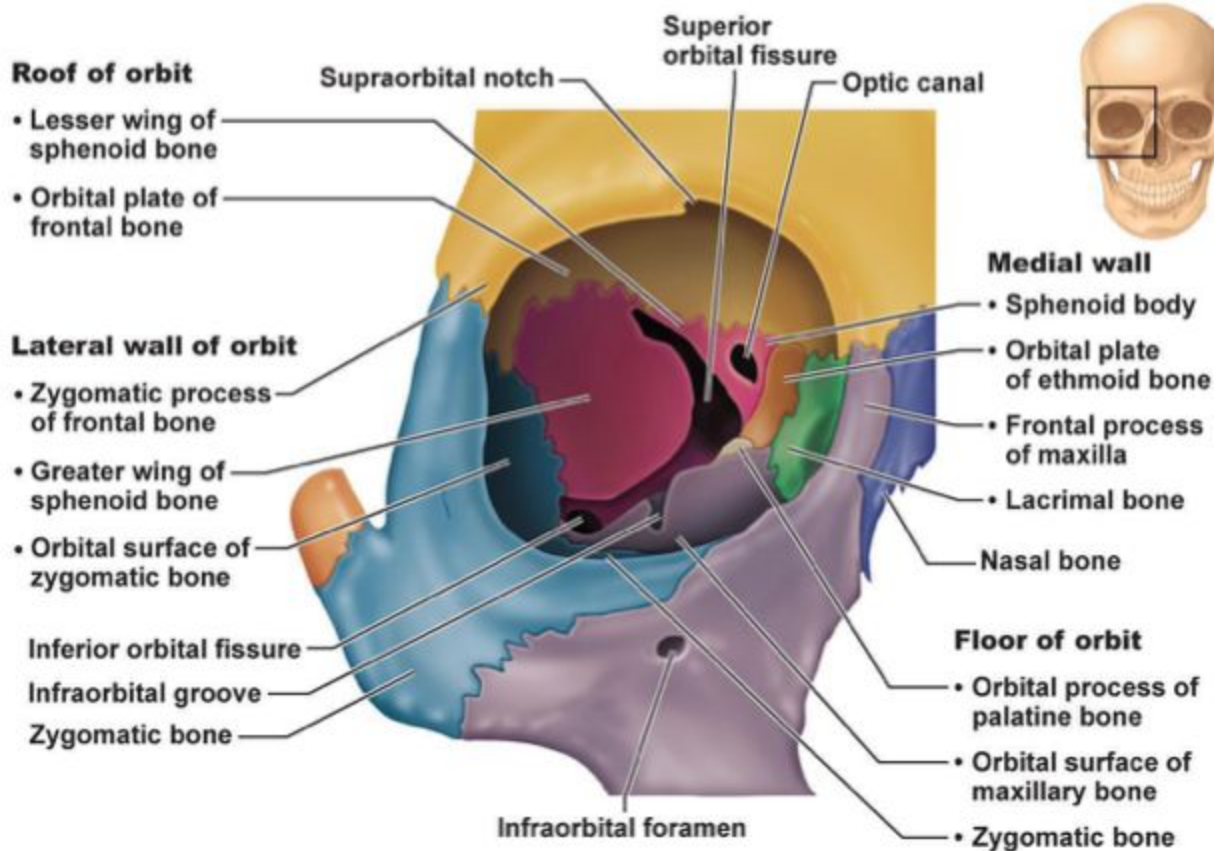
maxilla

ethmoid

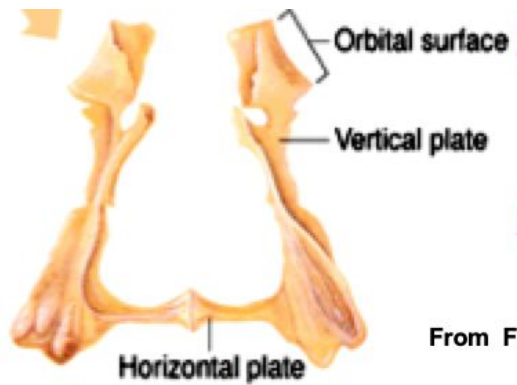
lacrima

sphenoid

palatine (orbital process)



(b) Contribution of each of the seven bones forming the right orbit



(c) Palatine bones (posterior aspect)

From Fig. 7.8

Palatine bones:

2 L-shaped bones

horizontal plates form part of **hard palate**
vertical plates - nasal cavity & orbit

Vomer:

single thin bone forms nasal septum
 (see **Fig. 7.4a**)

Inferior nasal conchae:

[superior and middle nasal conchae from ethmoid bone]
 thin, curved bones - project medially
 largest of 3 pairs of conchae

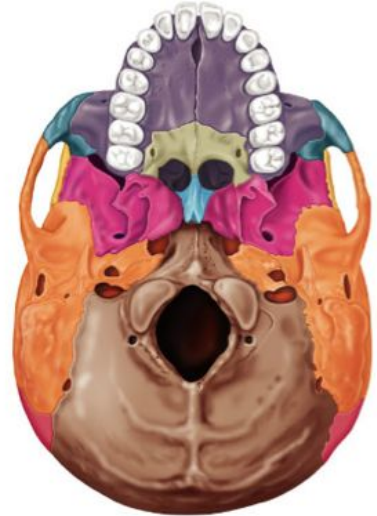


Fig.7.6a
 Inferior view of the skull

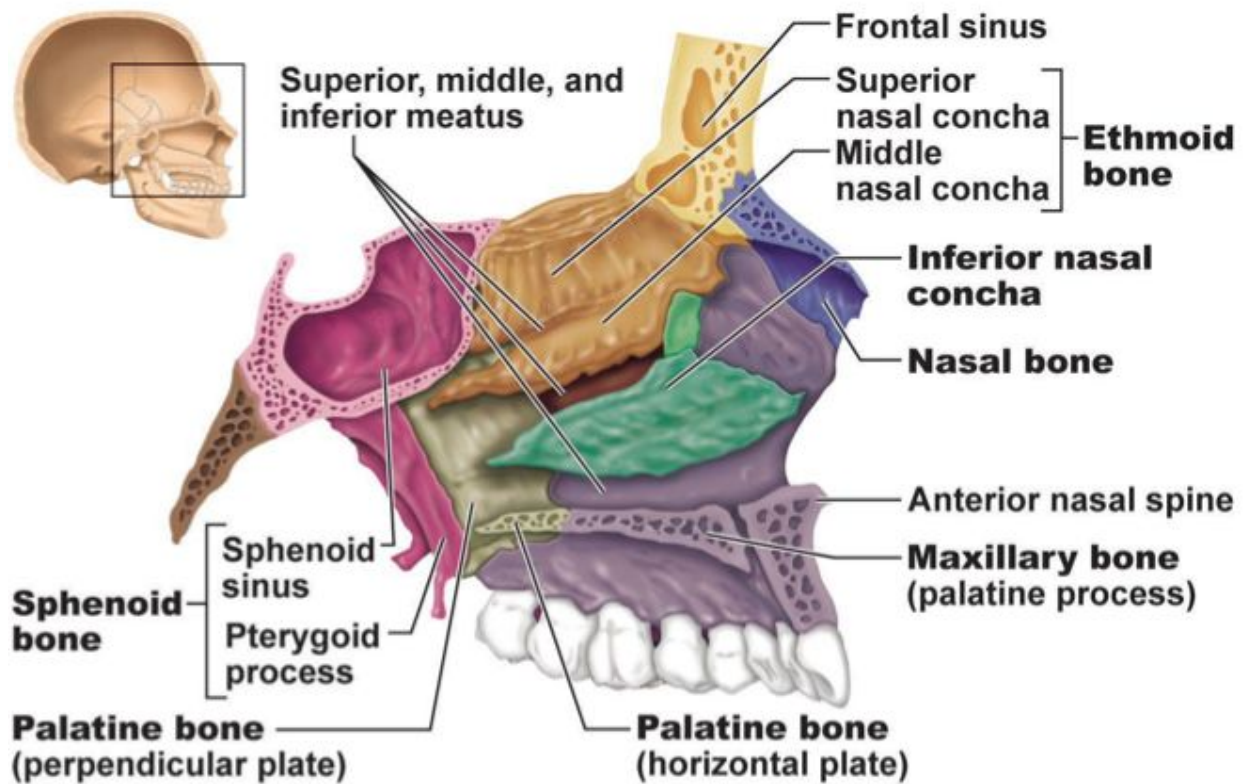
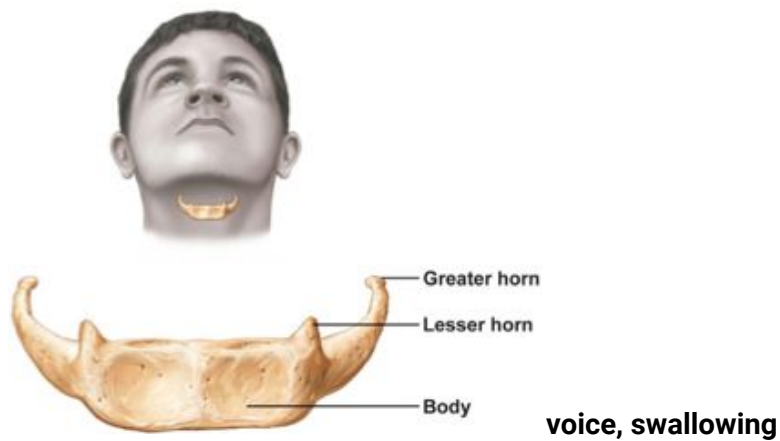
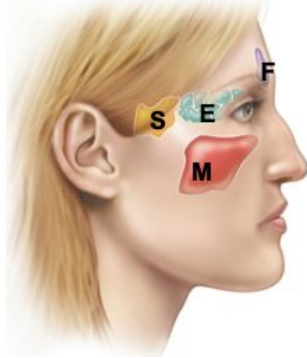
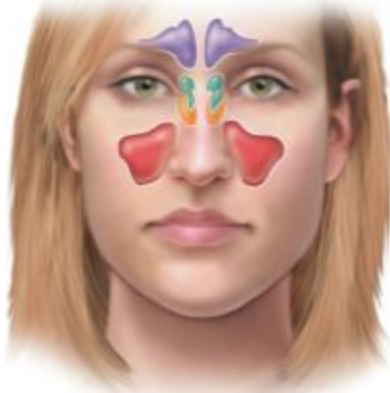


Fig. 7.14a: Bones forming the *left lateral* wall of the nasal cavity:

Hyoid bone:

- only bone of the body that does not articulate with any other bone
- supports tongue & gives attachment to muscles for swallowing & speech
- horseshoe-shaped with a body + 2 pairs of horns





Paranasal Sinuses:

Frontal (purple never equal one is bigger than the other one)

maxillary

Sphenoidal (orange)

Ethmoidal (green)

mucosa-lined, air-filled

lighten skull and enhance resonance of voice; connect to nasal cavity so also help to warm & humidify incoming air

All of the sinuses communicate with the nasal cavity

Vertebral Column

33 bones of which 24 remain separate (flexibility) and the remaining 9 fuse to form 2 composite bones (**sacrum** & **coccyx**) - 70 cm long

7 cervical, 12 thoracic, 5 lumbar, 5 sacral, 3/4 coccyx

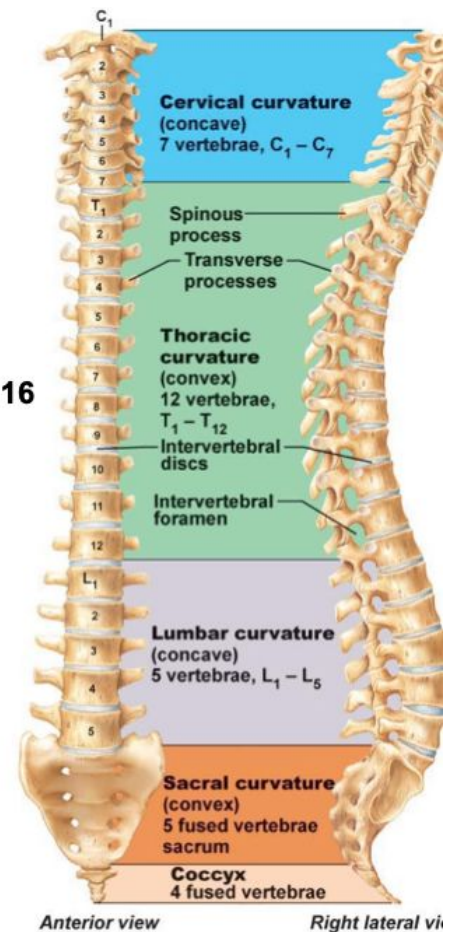
3 main functions:

- (1) **weight-bearing**
- (2) **anchor** for muscles & ligaments
- (3) **protection** of spinal cord

Curvatures

- **resilience & flexibility**
- cervical & lumbar: concave**
- thoracic & sacral: convex**

Fig. 7.16



55.00 Normal spine curvatures

Primary curves: Developed before birth

○ Thoracic curve

○ Sacral curve

- **Secondary curves** Developed after birth

○ Cervical curve (wide, bc all of the bones are fragile)

○ Lumbar curve

Abnormal spine curvatures

• **Scoliosis** - abnormal lateral curve

• **Kyphosis** (hunchback) – exaggerated thoracic curvature

• **Lordosis** (swayback) – accentuated lumbar curvature

Just understand don't need to know diagrams

The spinal curves and vertebral regions in the adult vertebral column

Spinal Curves

Primary curves develop before birth, and secondary curves after birth.

Cervical curve
(a secondary curve)

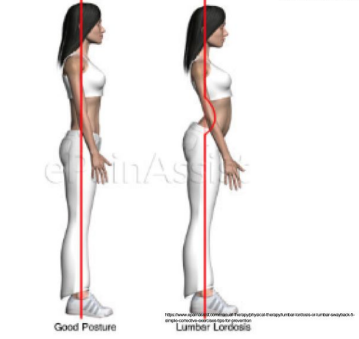
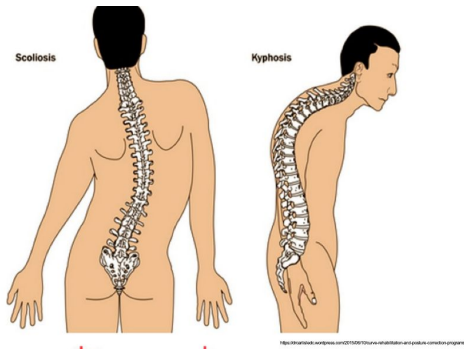
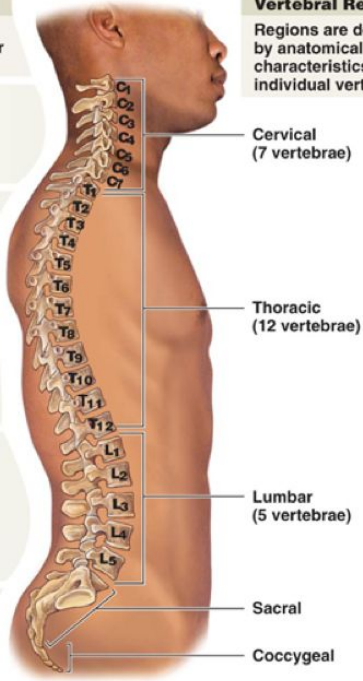
Thoracic curve
(a primary curve)

Lumbar curve
(a secondary curve)

Sacral curve
(a primary curve)

Vertebral Regions

Regions are defined by anatomical characteristics of individual vertebrae.

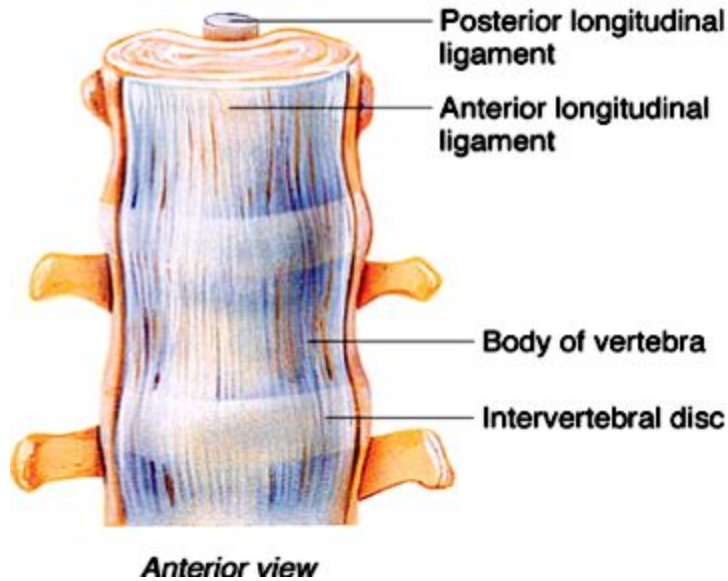


erlinAssist

Supporting Elements of Vertebral Column

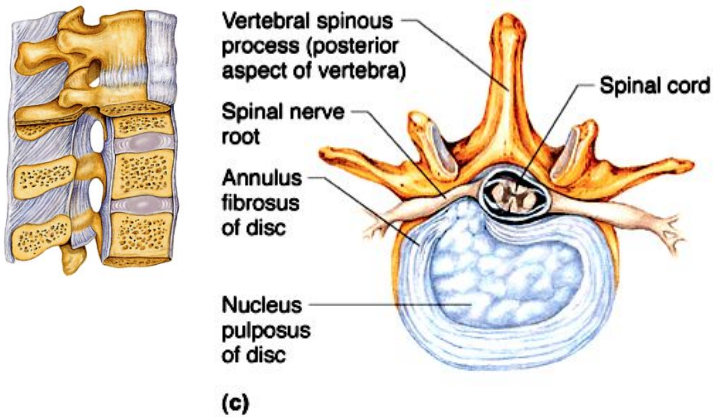
1. Ligaments:

- strap-like; support column of bones so stay upright
- major supporting ligaments are **anterior** & **posterior longitudinal**
- continuous bands down front & back of vertebral bodies from neck to sacrum
- broad **anterior** is strongly attached to bony vertebrae & the discs; prevents **hyperextension** of spine
- **posterior** is narrow, weaker & attached only to discs; prevents **hyperflexion** of spine



1 hr 2. Intervertebral Discs:

- cushioning between bony vertebral bodies - shock absorbers - 25% length of vertebral column
- each is circular with **nucleus pulposus** in centre & **annulus fibrosus** around periphery
- **nucleus pulposus** is like a rubber ball »» elasticity & compressibility
- **annulus fibrosus** holds together successive vertebrae & resists tension in spine
- discs thickest in **lumbar/cervical** regions » flexibility



A Typical Vertebra:

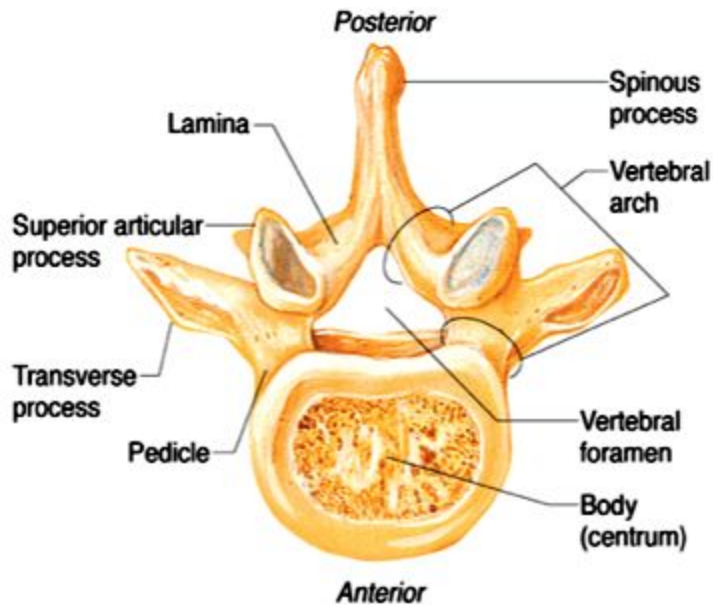
get larger as one descends column

weight-bearing **body** + **vertebral arch**

arch + body enclose **vertebral foramen** (What passes through here? What forms the **vertebral canal**?)

- 2 **pedicles** + 2 **laminae** make up each **vertebral arch**

pedicles have notches on superior & inferior surfaces » lateral openings between adjacent vertebrae called **intervertebral foramina** (what passes through these?)



7 processes from each vertebral arch:

- 1 **spinous process** ∅ muscle & ligament attachment

- **2 transverse processes** - 1 per side for muscle attachment
- **paired superior & inferior articular processes** - link vertebrae above & below; smooth, collagen-coated facets for articulation

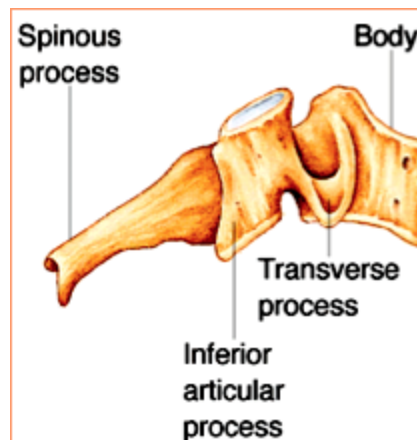
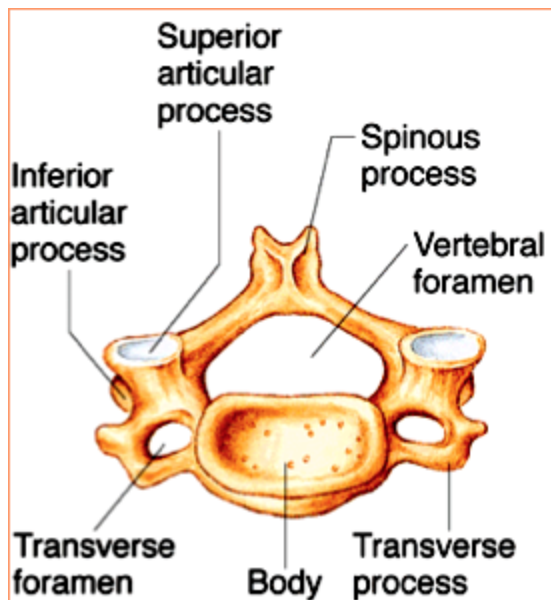
Cervical Vertebrae

7 total; #1 & 2 have unusual structure &

no intervertebral disc

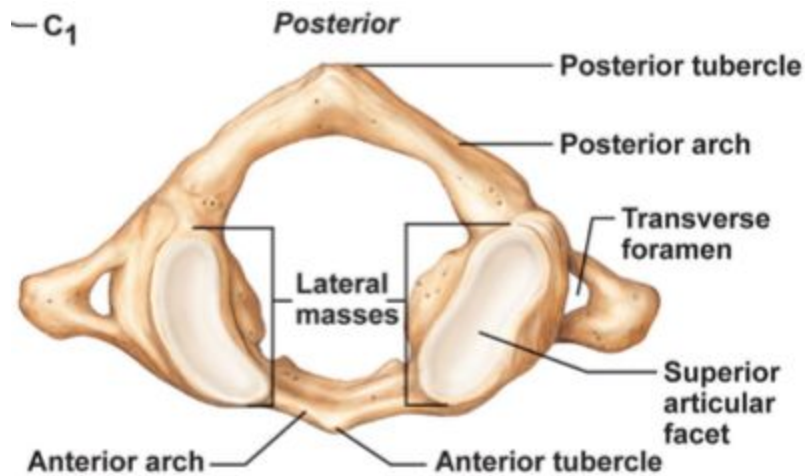
C3- C7 considered typical:

- (1) body oval, broader side-to-side than front-to-back
- (2) spinous process short & split at end (except #7 - sticks out/not split)
- (3) vertebral foramen large Why??
- (4) each transverse process contains transverse foramen for passage of vertebral artery to brain



Typical Cervical Vertebrae (C3-C7)

End!!



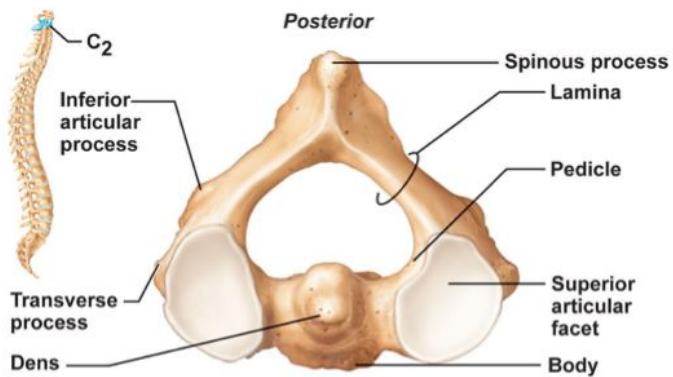
(a) Superior view of atlas (C₁)

Atlas C1:

- no body & no spinous process
- posterior & anterior **neural arches**
- lateral masses with **superior & inferior articular facets** – articulation with brain and with C2 [allows ???]

Axis C2:

- more like others, except for **dens or odontoid process** = pivot [allows ?]

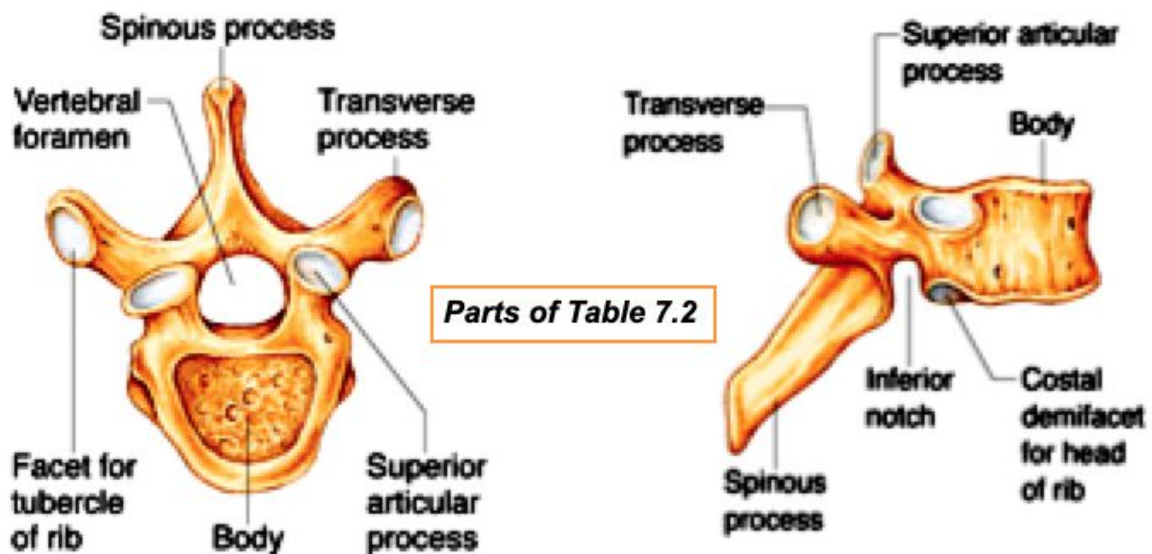


(c) Superior view of axis (C₂)



Thoracic Vertebrae

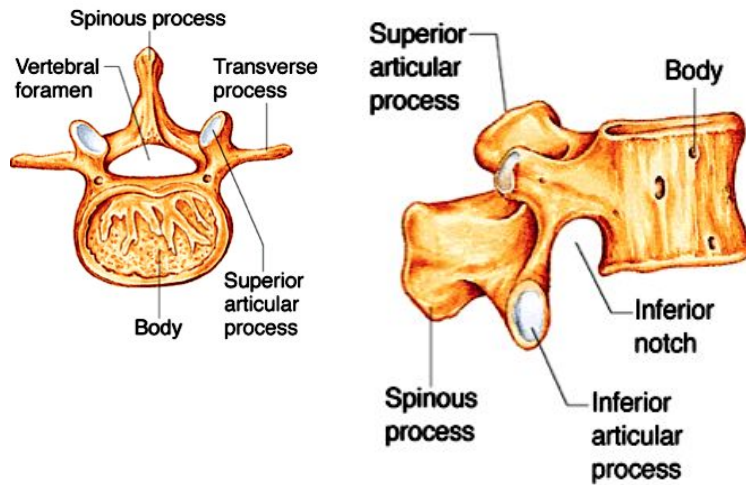
- **12** in all; all have ribs attached; increase in size from first to last
- (1) body roughly heart-shaped & bears facets for ribs (paired **demifacets**)
- (2) **vertebral foramen** is circular
- (3) **spinous process** long, points ↓
- (4) transverse processes have facets for articulation with **tubercles** of ribs (except nos. 11 & 12)



Lumbar Vertebrae

lower back » major weight-bearing function

- bodies are kidney-shaped & increase in size from top to bottom
- (1) **pedicles** & **laminae** shorter & thicker than those of other vertebrae
- (2) **spinous processes** are flat & short - project directly back
- (3) **vertebral foramen** is triangular
- (4) orientation of inferior & superior facets unique - curved; **sup** faces **in** & **inf** faces **out**



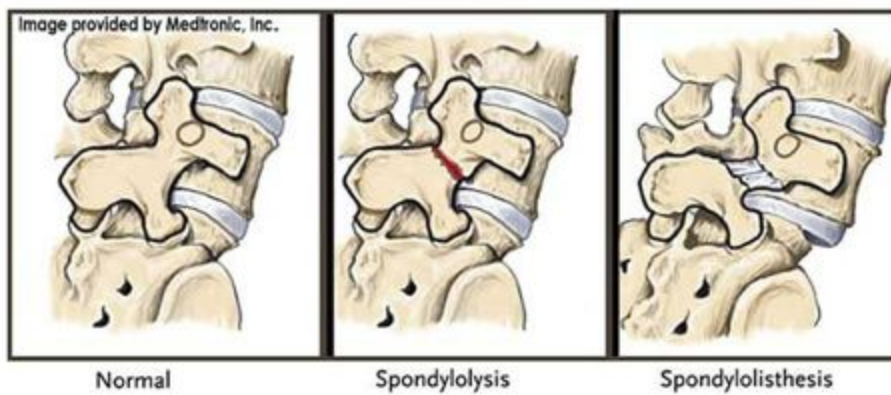
Clinical note: Spondylolysis and Spondylolisthesis

•**Spondylolysis:**

Is a fracture across the interarticular part of the lamina, usually at L5.

•**Spondylolisthesis:**

When the defect is bilateral, the vertebral body may separate from its vertebral arch and shift anteriorly relative to the vertebra below it



Sacral Vertebrae

anterior view



Fig. 7.22

(b)

posterior view

starts as 5 separate vertebrae »» fuse in adolescents = **sacrum**

articulates with 5th lumbar & laterally with hip bones (**sacroiliac joint**)

- note: **sacral promontory, transverse lines & sacral foramina**
- note: median **sacral crest, sacral canal, sacral hiatus**

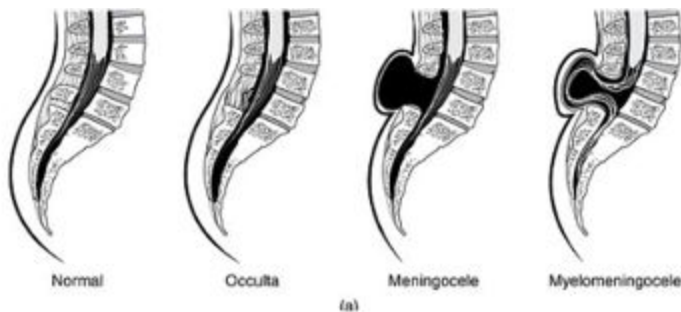
Coccygeal Vertebrae

- tailbone = 3 or 4 fused coccygeal vertebrae
- attachment area for some pelvic ligaments, but otherwise quite useless

Clinical note: spina bifida

Spina bifida is a congenital defect associated with:
the incomplete fusion of the vertebral arches (usually L5& S1)

- Incomplete closure of the embryonic neural tube

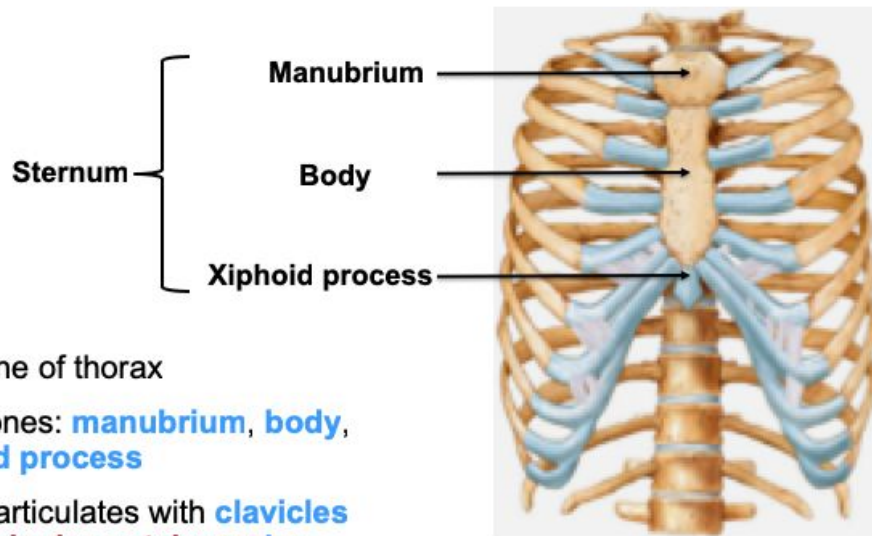


Thoracic cage

Thoracic vertebrae + ribs + costal cartilage + sternum

Function

- o protective cage around heart, lungs & major blood vessels
- o supports shoulder girdle & upper limbs
- o provides area of muscle attachment for back, chest & shoulders



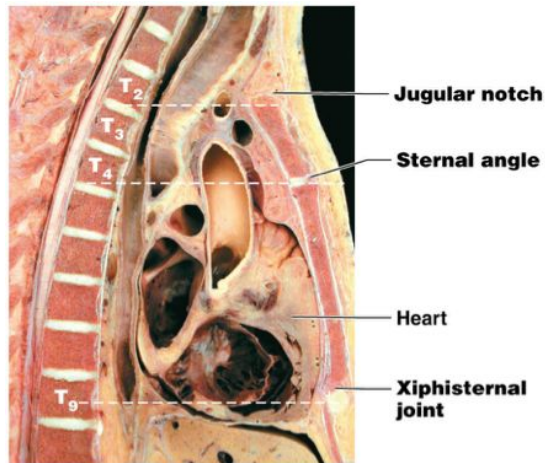
Sternum

- anterior midline of thorax
- fusion of 3 bones: **manubrium**, **body**, **xiphoid process**
- **manubrium** articulates with **clavicles** via **clavicular notches**; also with **1st pr of ribs**
- **body** has notches for articulation with 2nd to 7th ribs
- attachment of some abdominal muscles to **xiphoid process**

Fig. 7.23

3 important anatomical landmarks:

- (1) **Jugular notch**: indentation you can palpate; in line with disc between T₂ & T₃; It common carotid artery from aorta
- (2) **Sternal angle**: cartilagenous hinge between manubrium & body of sternum
- (3) **Xiphisternal joint**: fusion of sternal body & xiphoid process - opposite T₉

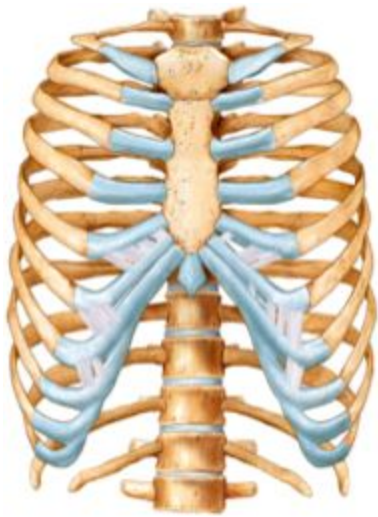


(b) Midsagittal section through the thorax, showing the relationship of surface anatomical landmarks of the thorax to the vertebral column

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Ribs

- 12/side; all attach at back to vertebral column
- curve inferiorly & anteriorly
- **True ribs** : pairs 1-7 (vertebrosternal ribs)
attach to sternum directly; by individual costal cartilages
- **False ribs**: pairs 8-10 (vertebrochondral ribs)
attach to sternum indirectly via costal cartilages & rib 7
- **Floating ribs: ribs 11 & 12**
are not attached anteriorly (sternum)



RIBS (cont.)

typical rib is a bowed, flat bone

shaft, head, neck, tubercle

- main portion is **shaft** – what is the **costal groove**?

note head with **2 facets** - one articulates with the demi-facet on the body of the **same-numbered** thoracic vertebra, other with that on the body of **superior** vertebra

tubercle articulates with **transverse process** of **same-numbered** thoracic vertebra

