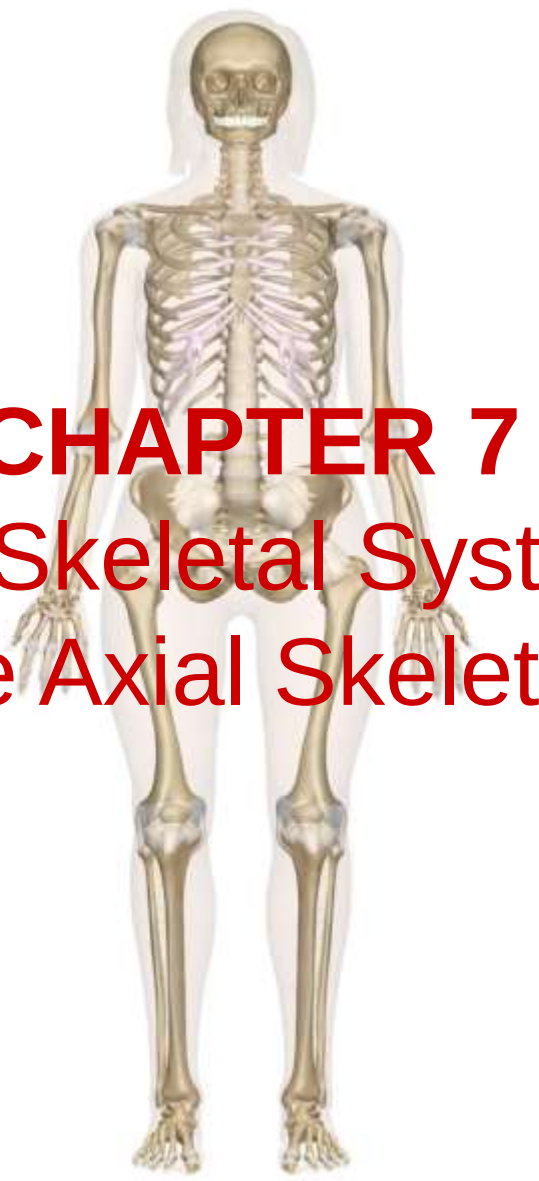




CHAPTER 7

The Skeletal System: The Axial Skeleton

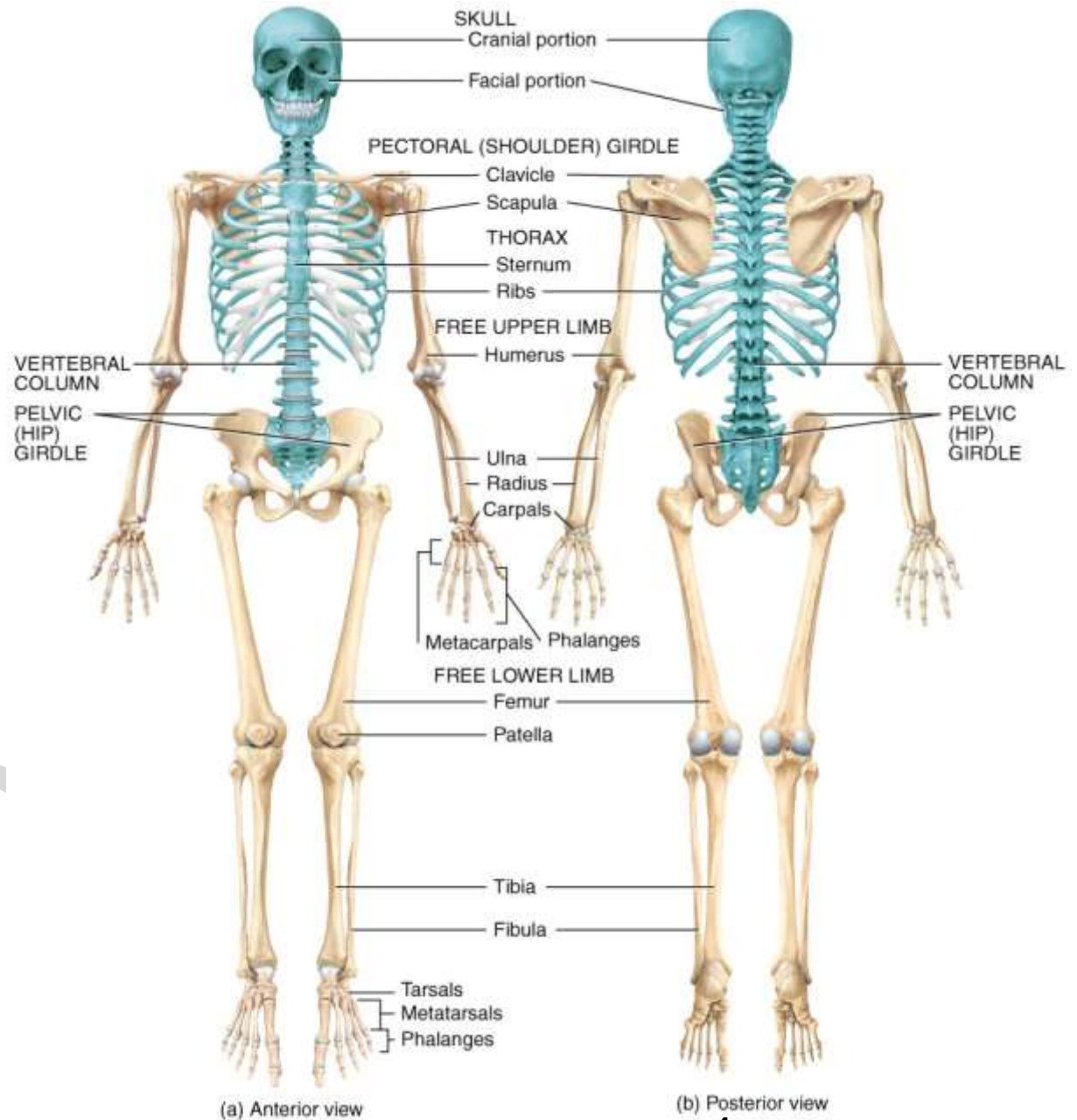
Orthopedics

Is the branch of medicine concerned with the musculoskeletal system and treating injuries to bones, joints, ligaments, or tendons.

Bones of the Adult Skeleton

- 206 named bones make up the adult skeleton.
- Bones are grouped into two divisions:
 - Axial skeleton - 80
 - Appendicular skeleton - 126

Divisions of the Skeletal System



The Skeletal System

Anatomy Overview

- The Skeletal System

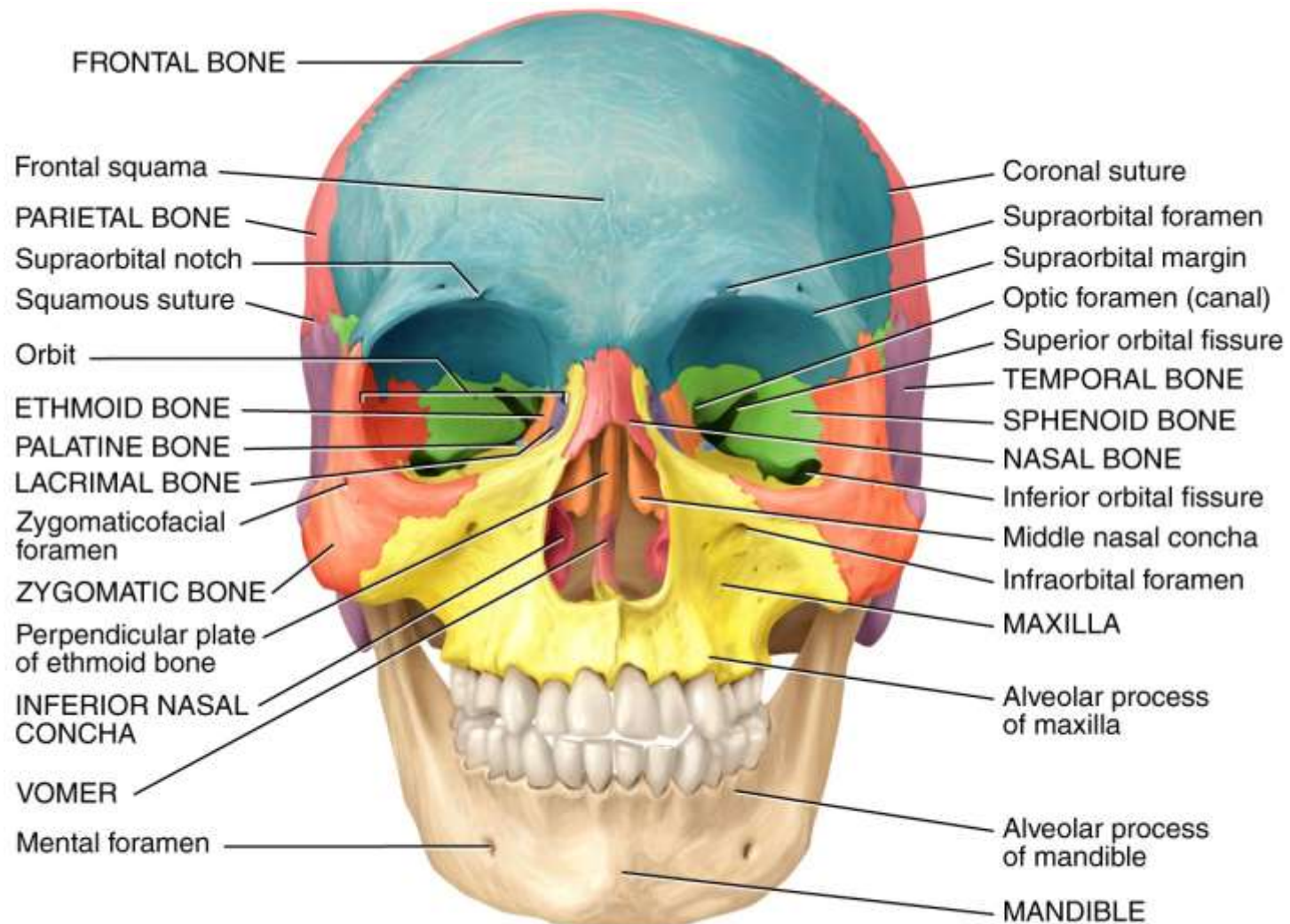
R.BISHAY

You must be connected to the internet to run this animation.

The Skull

- The skull contains two sets of bones:
 - Cranial bones (8) form the cranial cavity.
 - Facial bones (14) form the face.

Anterior View of Skull



(a) Anterior view

General Features of the Skull

- Bones of the skull have numerous surface markings that aid in their identification.
 - Holes through the bone (foramina)
 - Bony projections (e.g., a spine)

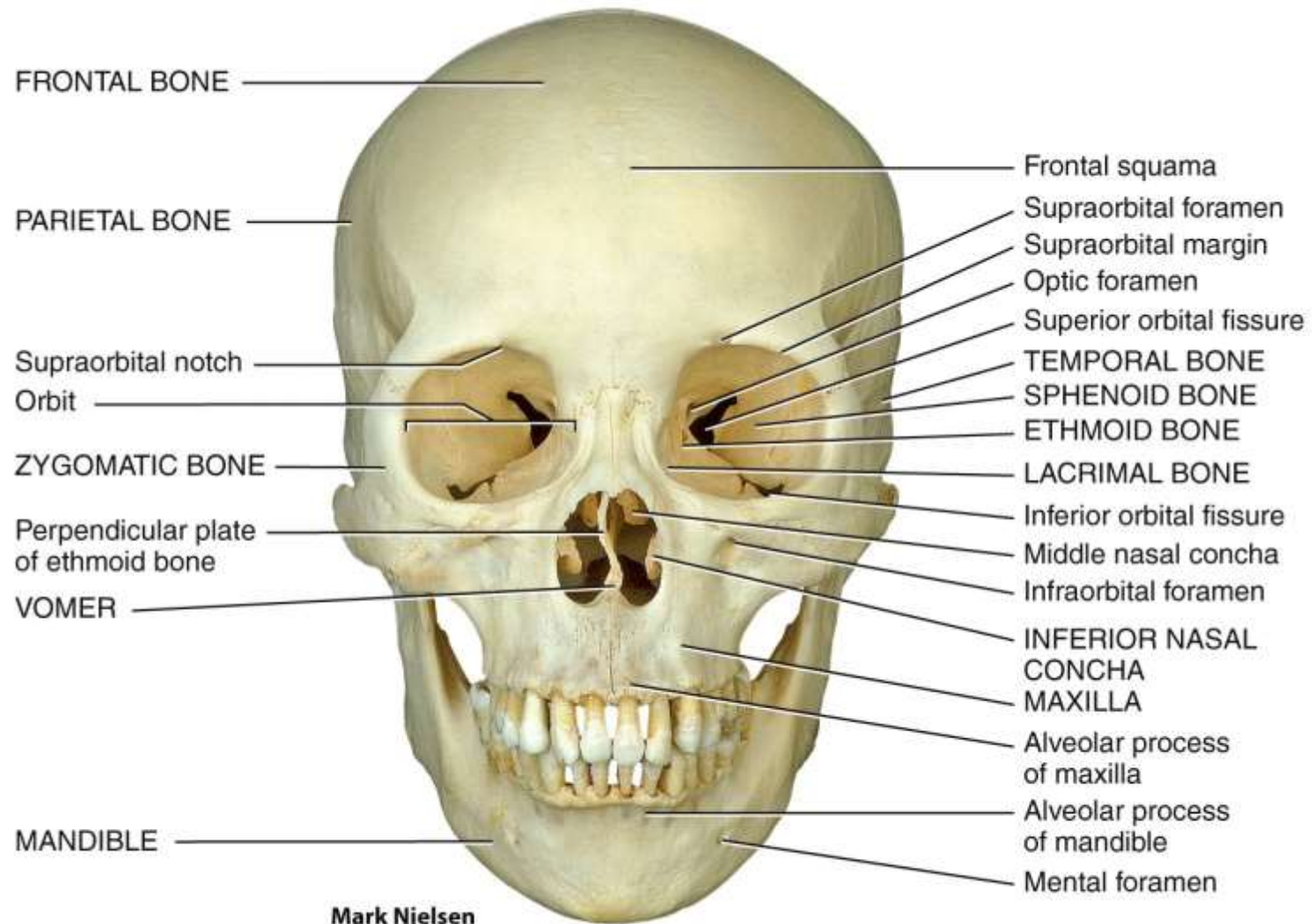
Frontal Bone Forms Facial 'Icons'

- Forehead
- Eye socket (superior part)
- Also forms much of the anterior part of the cranial floor

Surface Features of Frontal Bone

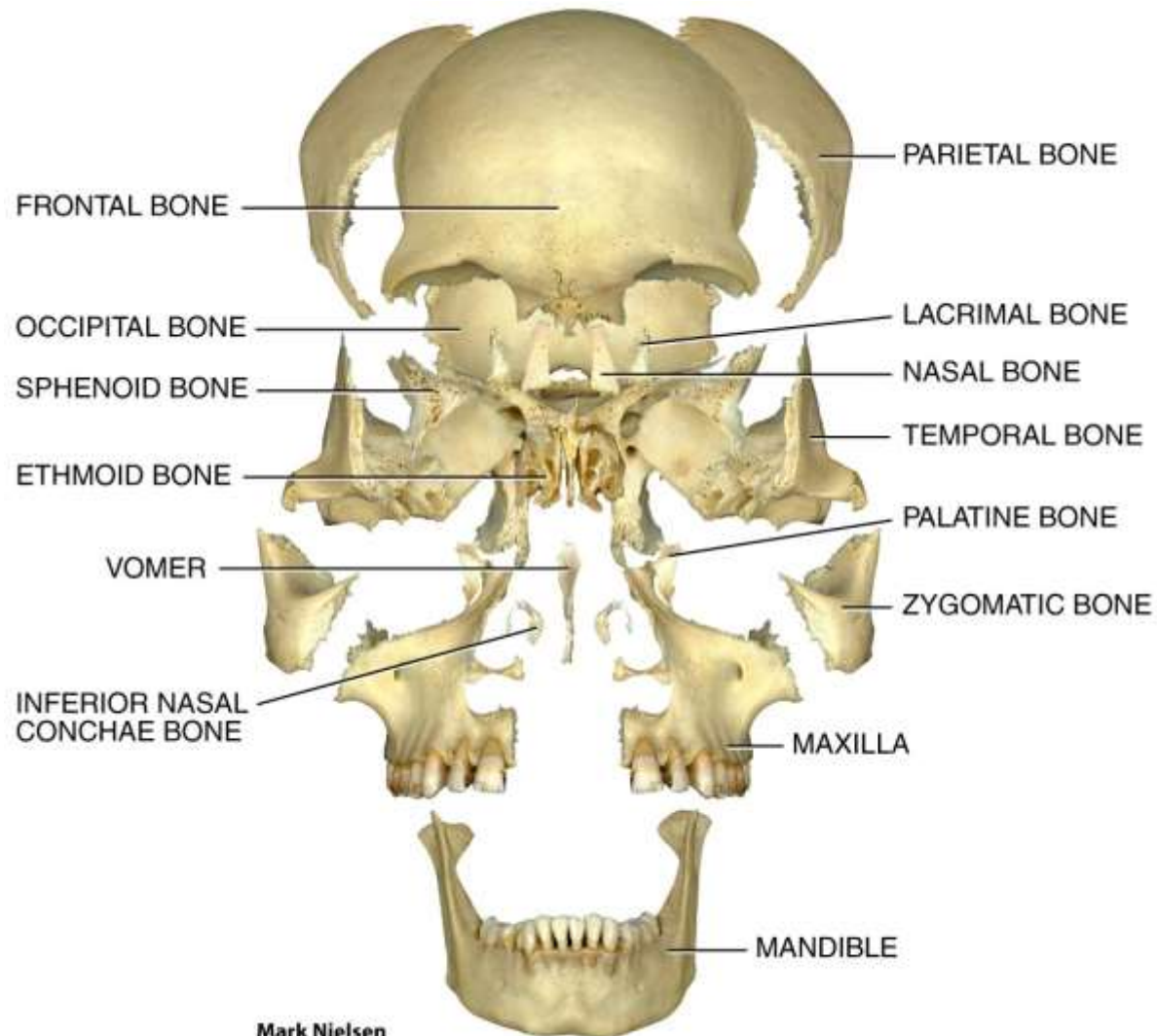
- Frontal squama
- Supraorbital margin
- Supraorbital foramen
- Supraorbital notch
- Frontal sinuses

Bones of the Skull



(b) Anterior view

Bones of the Skull

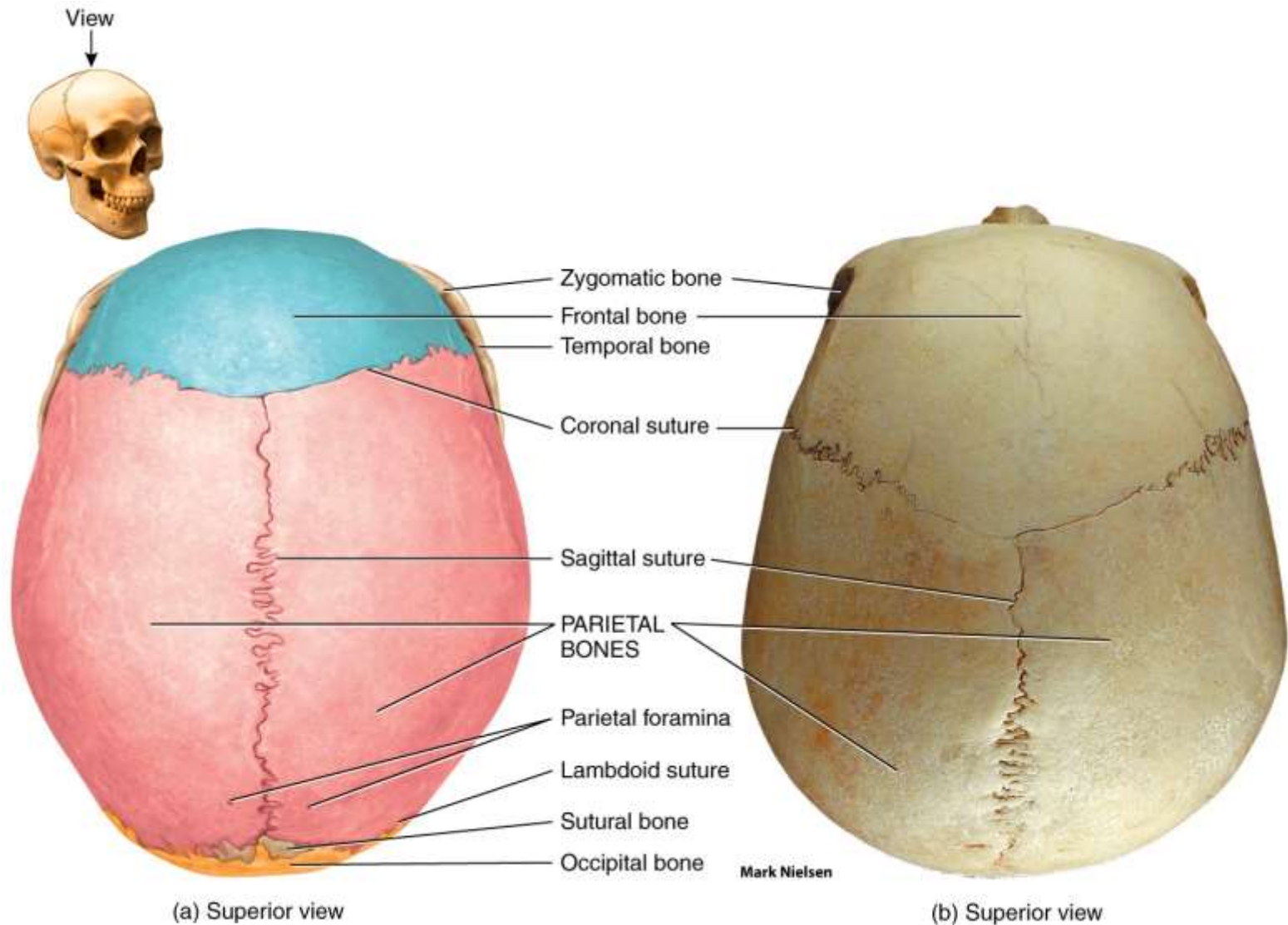


(c) Anterior view of disarticulated skull

Parietal Bones

- Form much of the sides and roof of the cranial cavity

Superior View of Skull



(a) Superior view

(b) Superior view

Surface Features of Parietal Bones

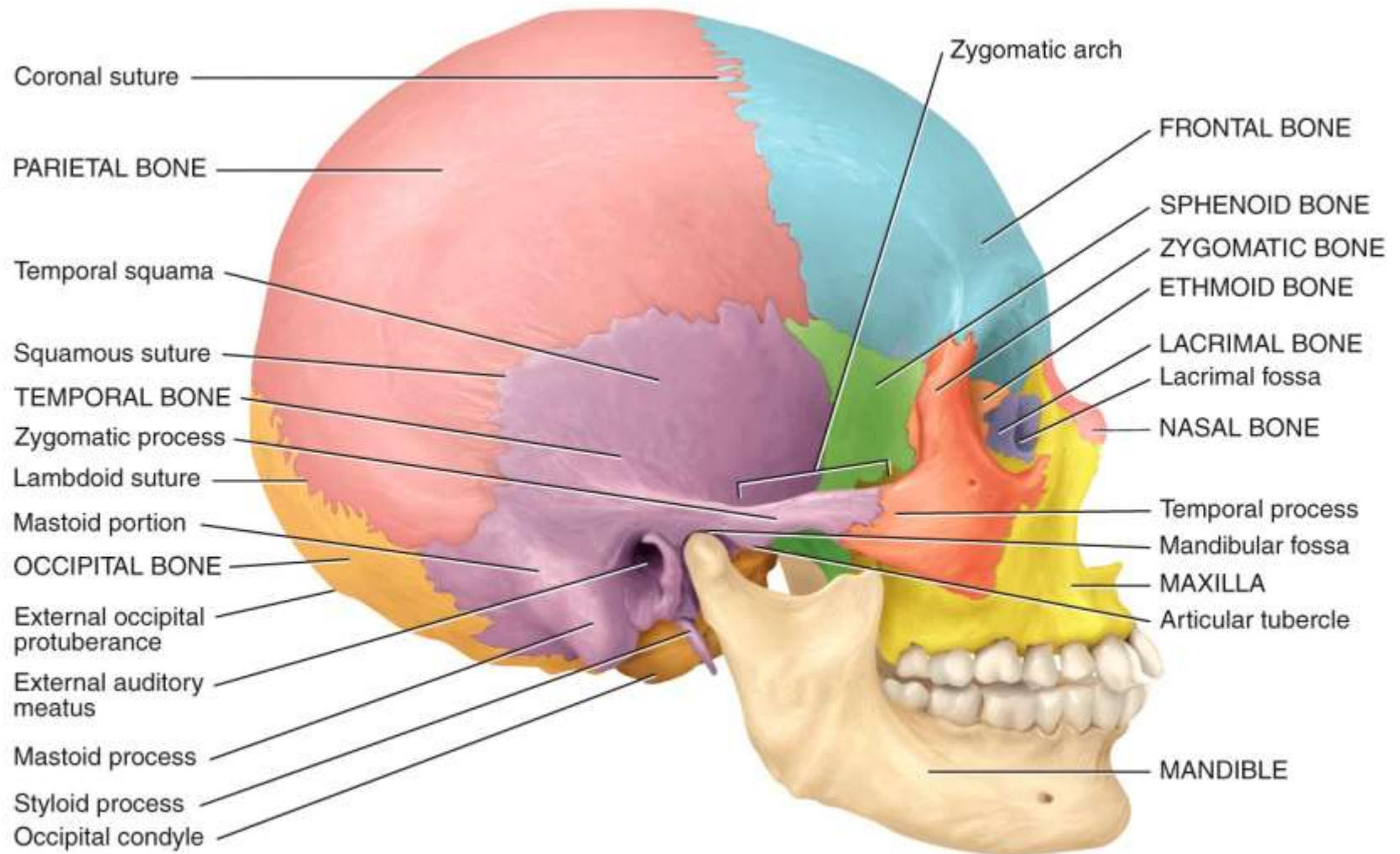
- External surfaces are convex.

R.BISHAY

Temporal Bones

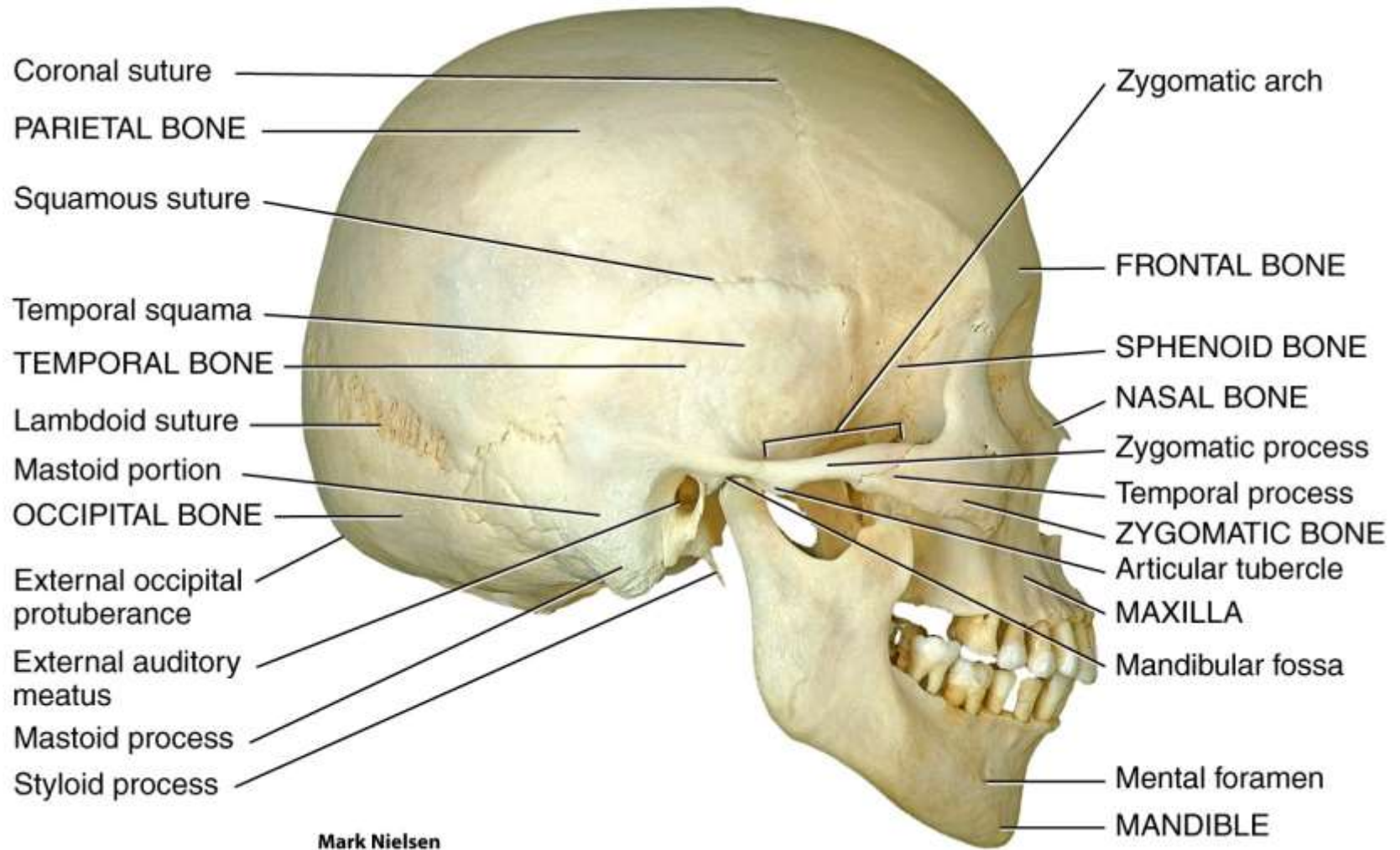
- Form the inferior lateral part of the cranial floor plus part of the lateral wall near the ear
- Surface features include
 - Zygomatic process
 - Zygomatic arch
 - Mandibular fossa
 - Mastoid process
 - Petrous portion
 - Auditory ossicles
 - Carotid foramen
 - Jugular foramen

Right Lateral View of Skull



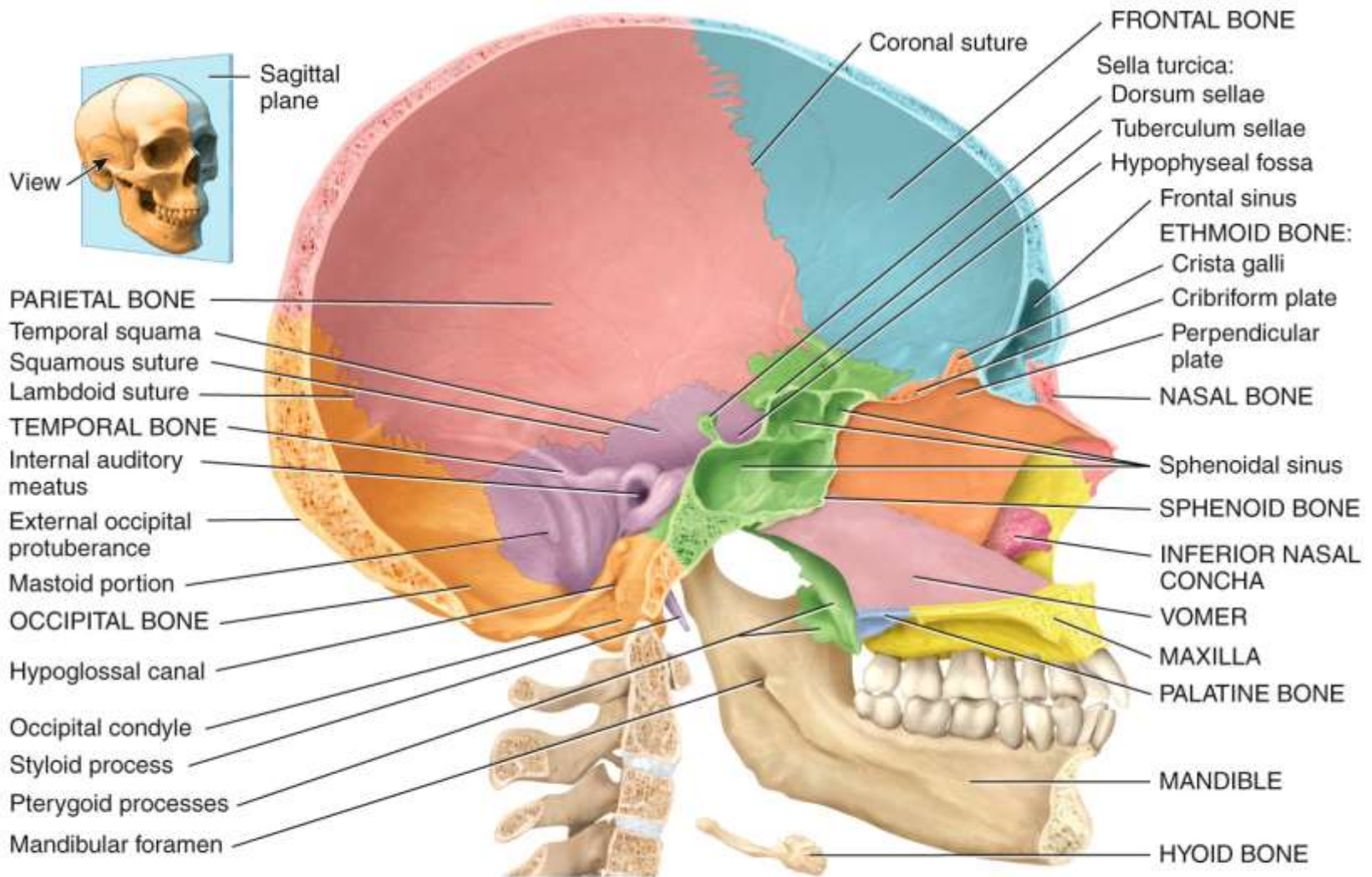
(c) Right lateral view

Right Lateral View of Skull



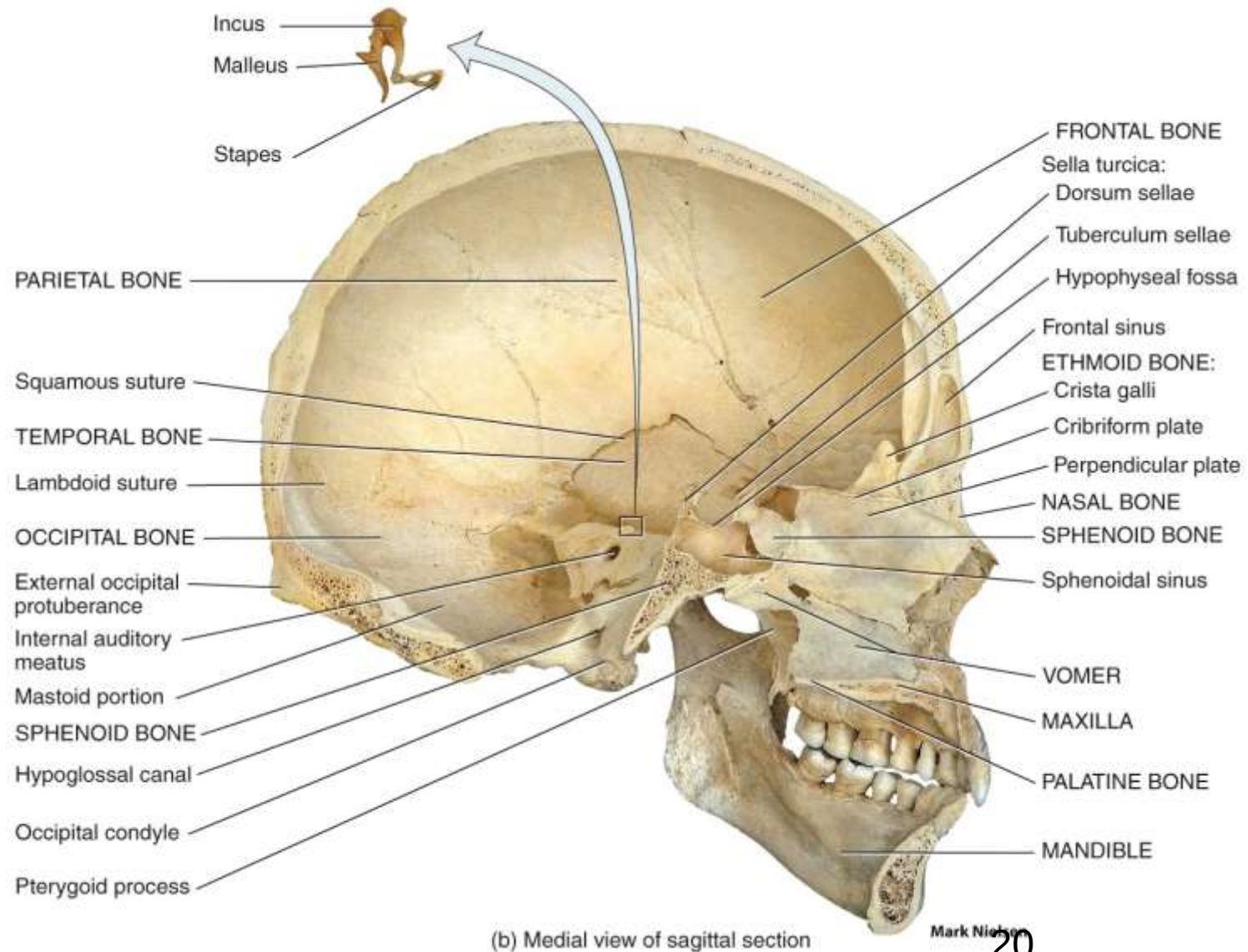
(d) Right lateral view

Medial View of Sagittal Section of Skull



(a) Medial view of sagittal section

Medial View of Sagittal Section of Skull

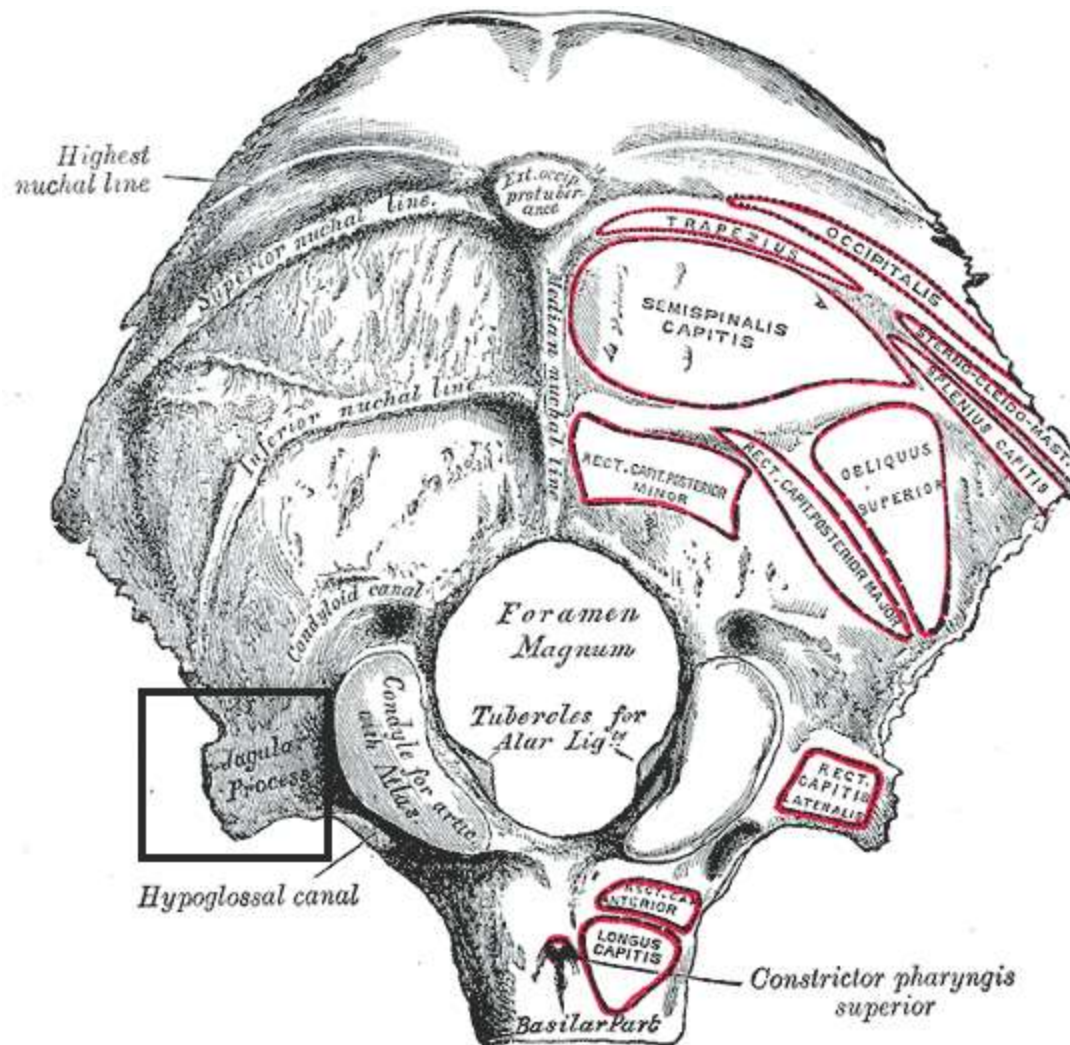


Occipital Bone

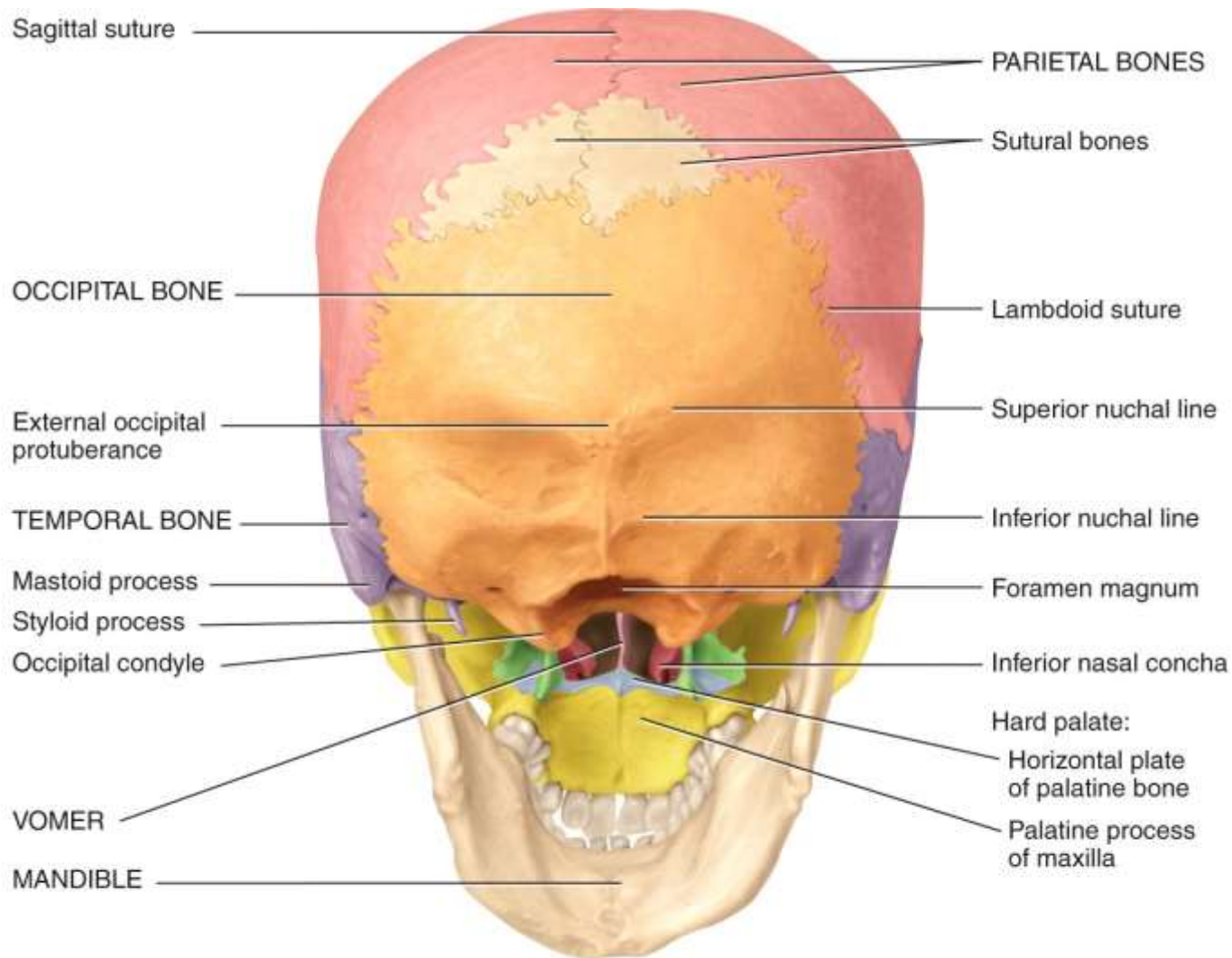
Forms much of the posterior wall and posterior floor of the cranial cavity

- Foramen magnum
 - transmits medulla oblongata and its membranes,
 - accessory (CN XI) nerves
 - vertebral arteries, the anterior and posterior spinal arteries
 - membrana tectoria and alar ligaments
- Occipital condyles
 - forms atlanto-occipital joint (with depressions on Atlas (C1))
- Hypoglossal canal
 - hypoglossal (CN XII) and branch of ascending pharyngeal artery
- External occipital protuberance
 - ligamentum nuchae
- Superior nuchal lines
 - trapezius, sternocleidomastoid, and splenius capitis muscles
- Inferior nuchal lines
 - rectus capitus posterior minor, major, obliquus superior

Occipital Bone https://en.wikipedia.org/wiki/Occipital_bone

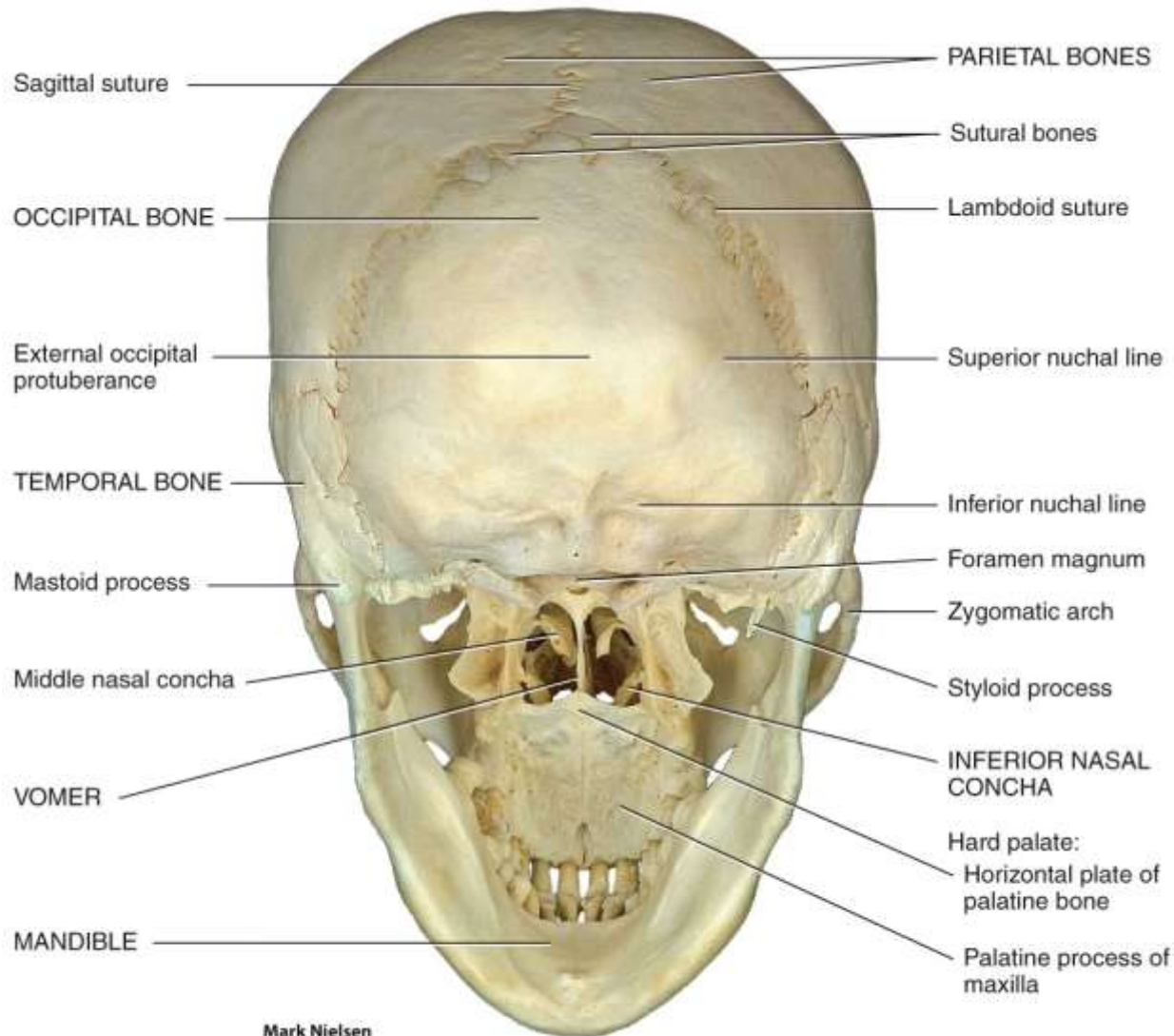


Occipital Bone



(a) Posteroinferior view

Occipital Bone



Mark Nielsen

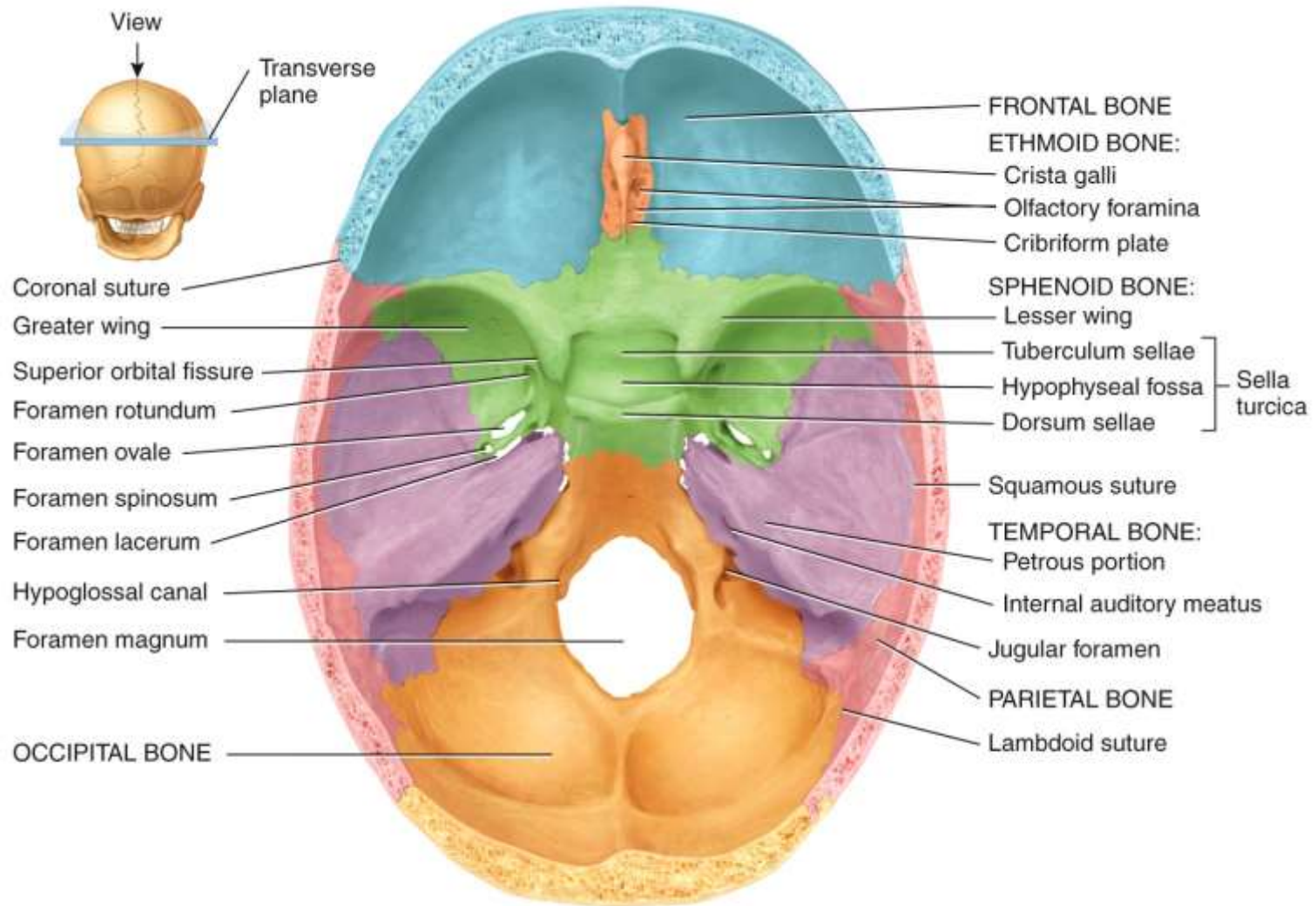
(b) Posteroinferior view

24

Sphenoid Bone

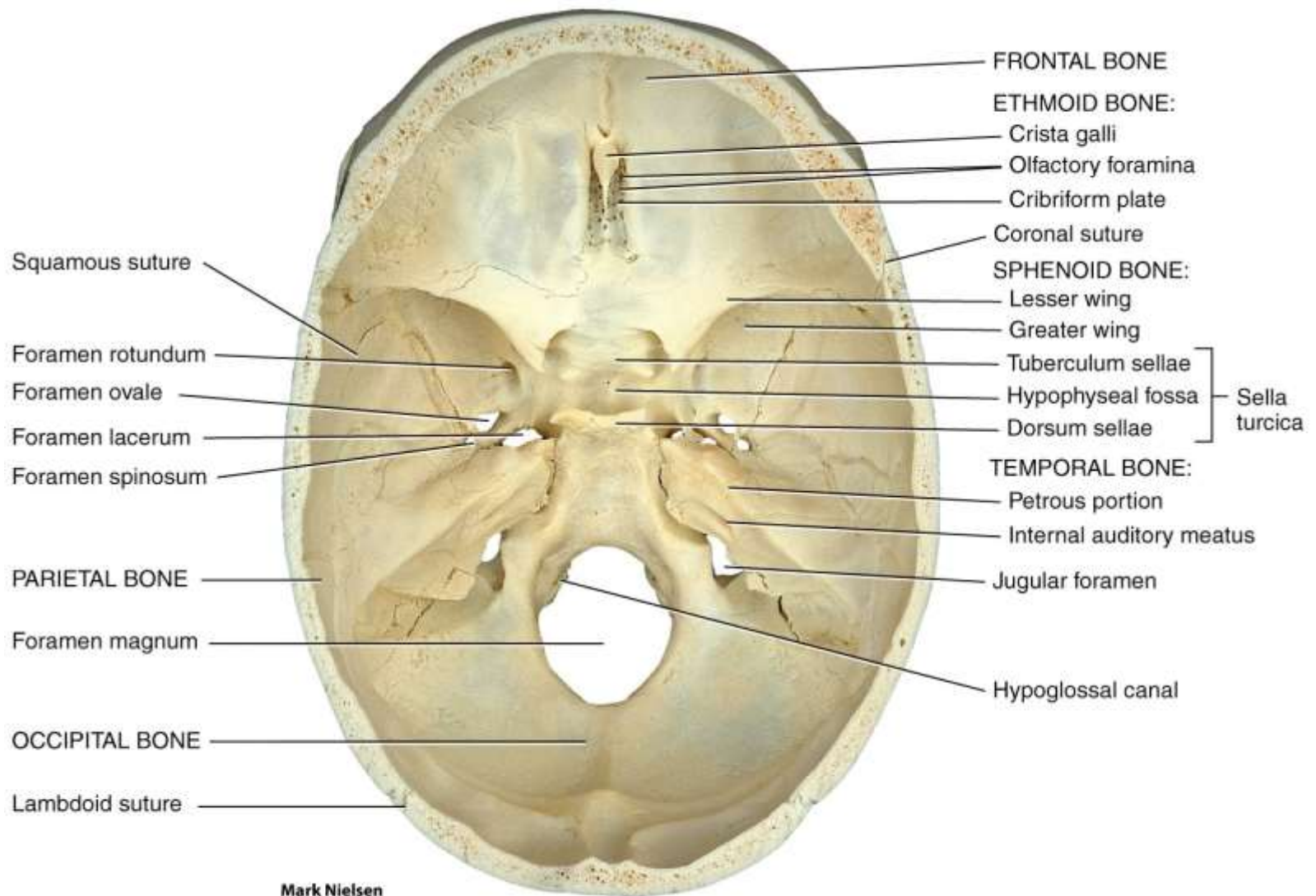
- Articulates with all other cranial bones, providing considerable stability to the skull
- Has a complex shape resembling a bat
- Greater wings and lesser wings

Sphenoid Bone



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

Sphenoid Bone



Mark Nielsen

(b) Superior view

Surface Features of Sphenoid Bone

Body

Sphenoid sinus

Sella turcica

Tuberculum sellae

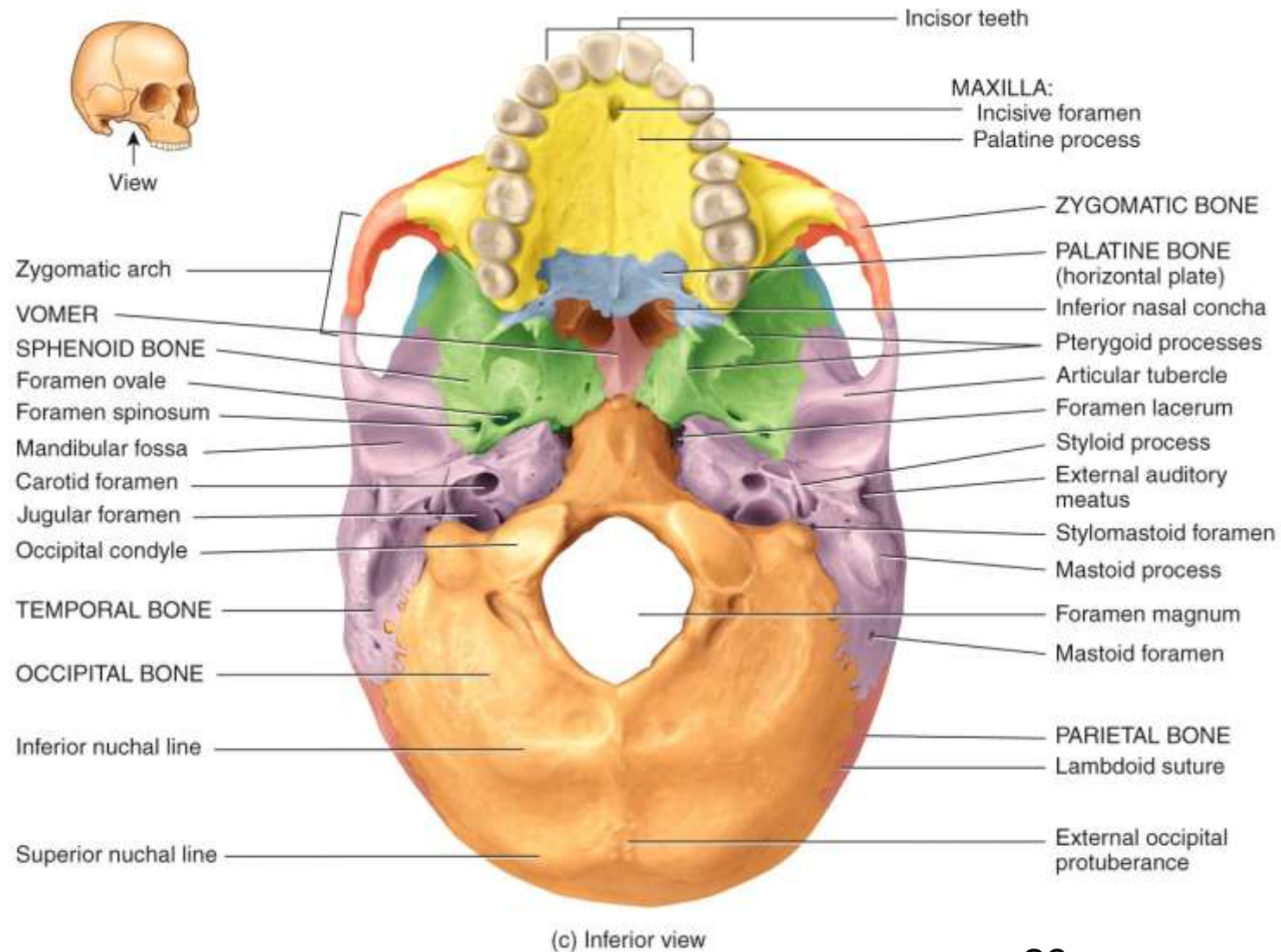
Hypophyseal fossa

Dorsum sellae

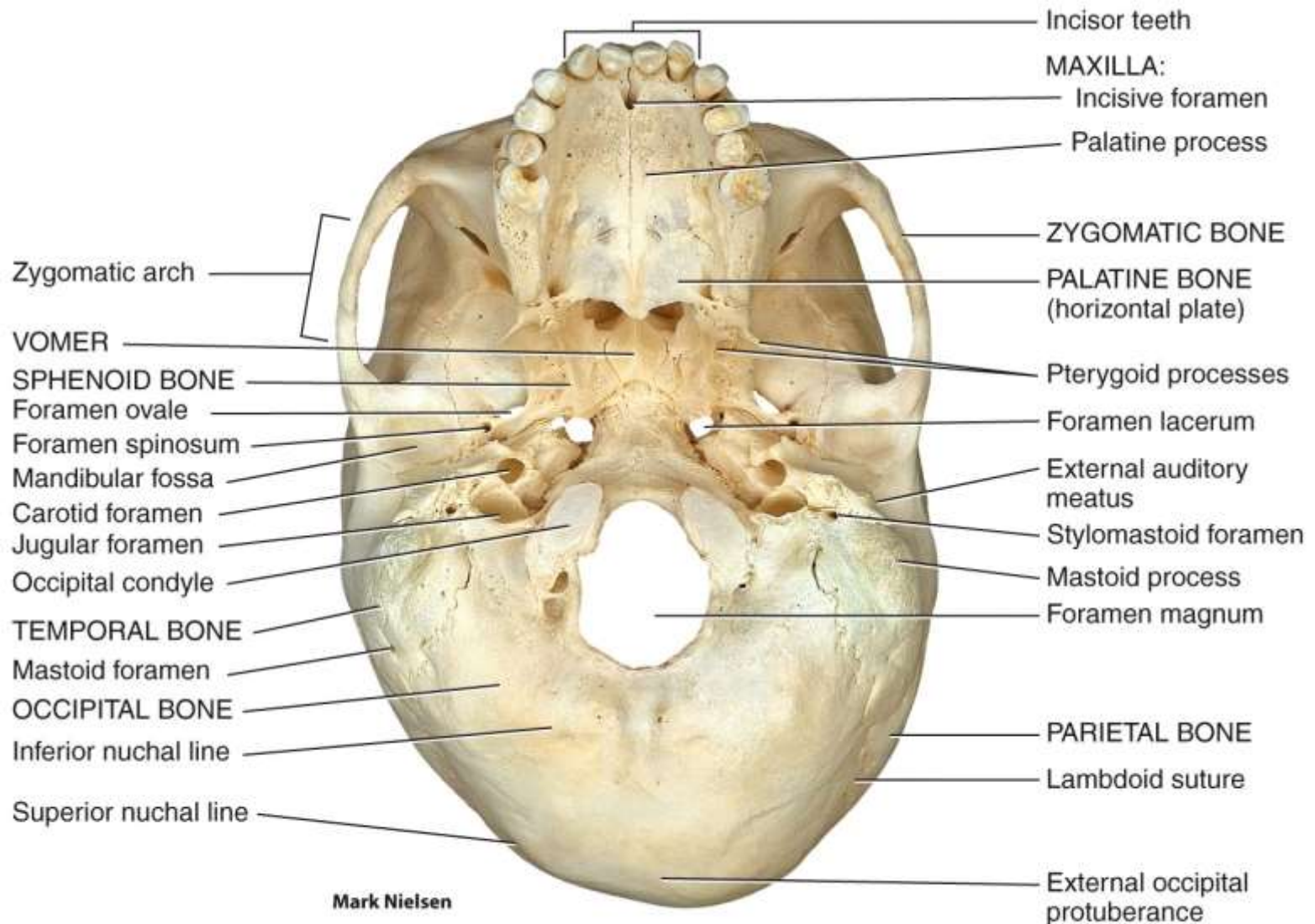
Sphenoid Bone Surface Features

- Greater and lesser wings
- Optic foramen
- Superior orbital fissure
- Pterygoid process
- Foramen ovale
- Foramen spinosum
- Foramen lacerum
- Foramen rotundum

Sphenoid Bone



Sphenoid Bone

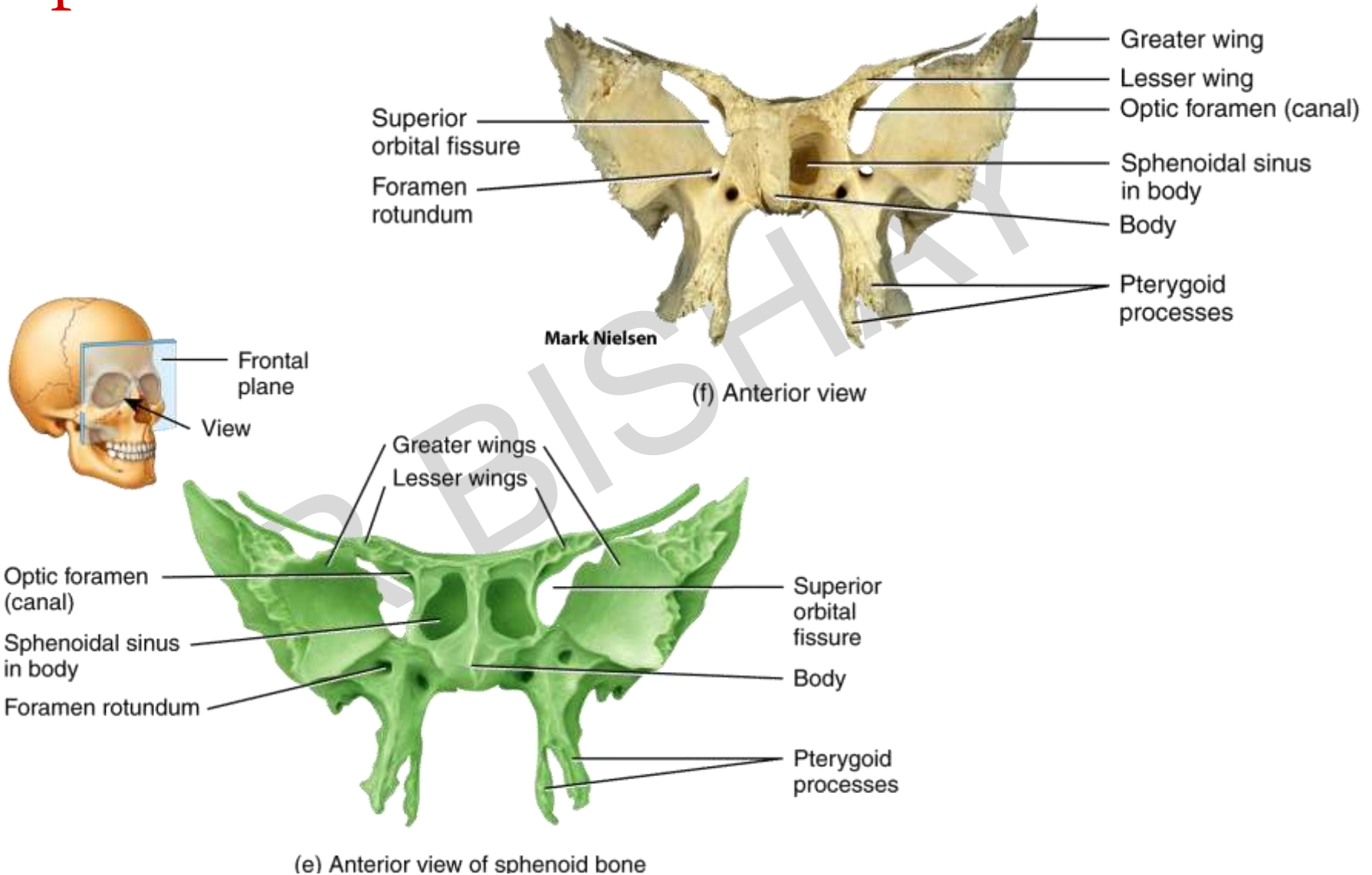


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(d) Inferior view

31

Sphenoid Bone



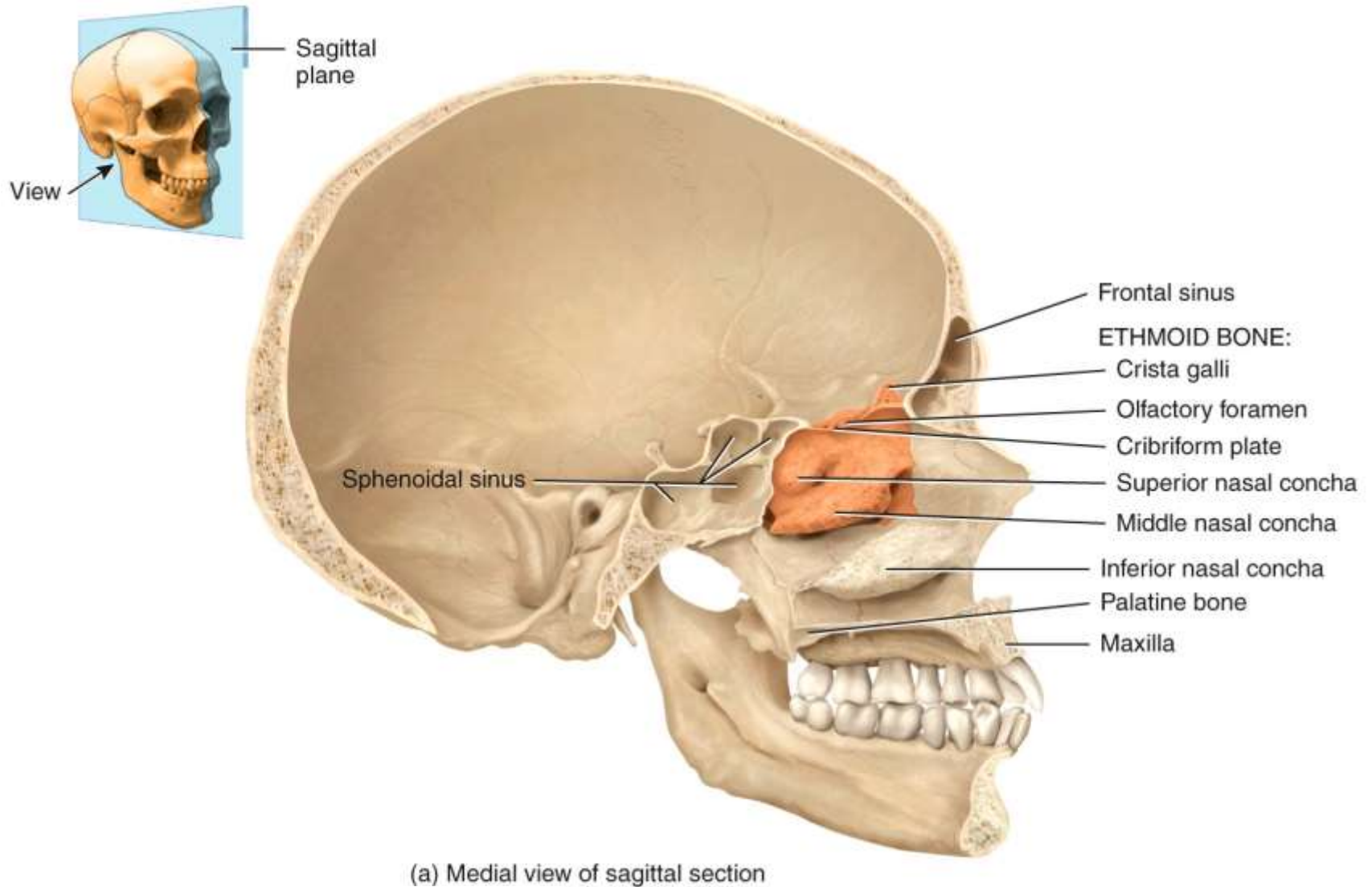
Ethmoid Bone Surface Features

- Lateral masses
- Ethmoidal cells
- Ethmoidal sinuses
- Perpendicular plate
- Cribriform plate
- Olfactory foramina
- Crista galli

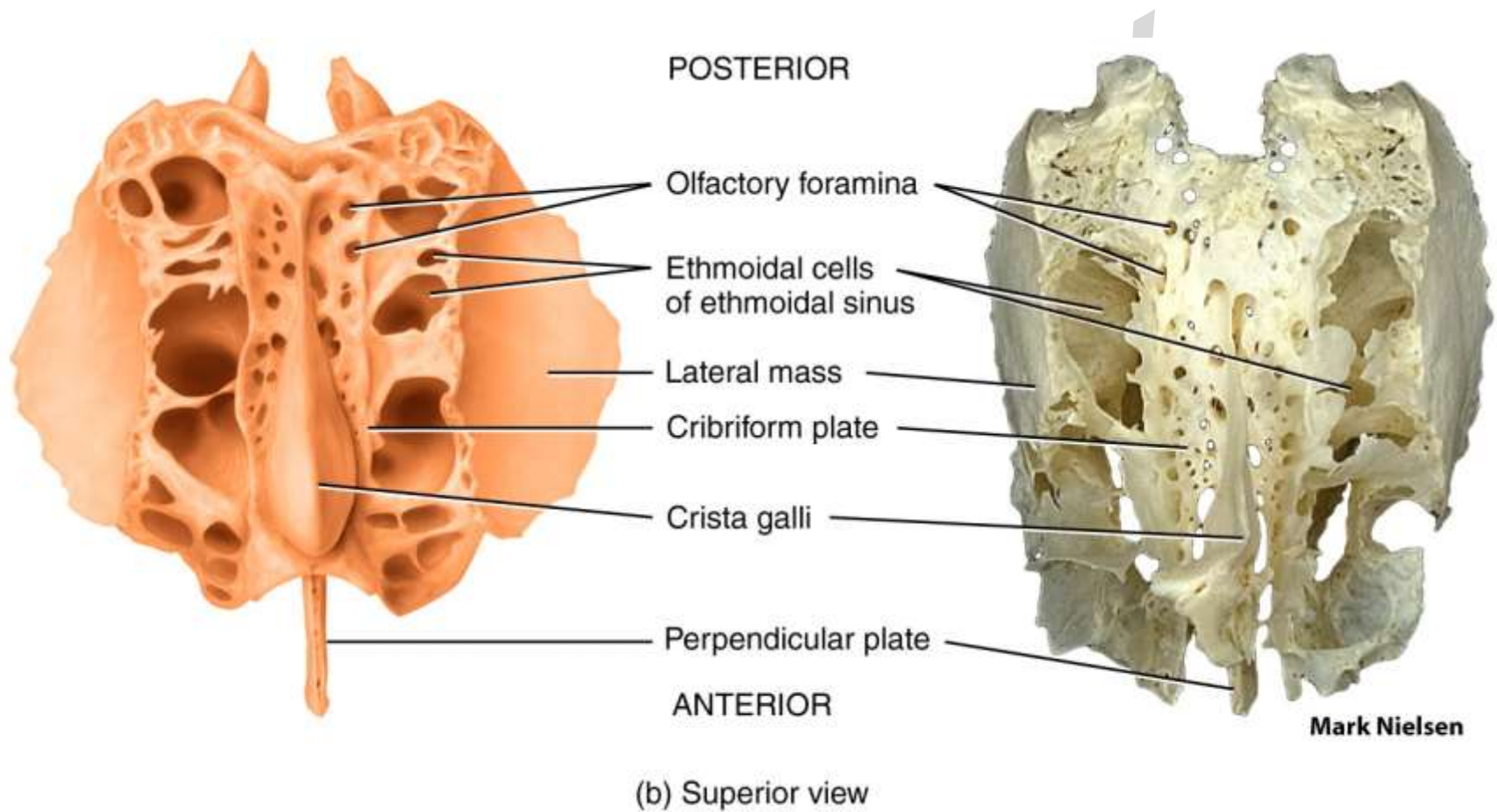
Ethmoid Bone Surface Features

- Superior nasal concha (or superior nasal turbinate)
- Middle nasal concha (or middle nasal turbinate)

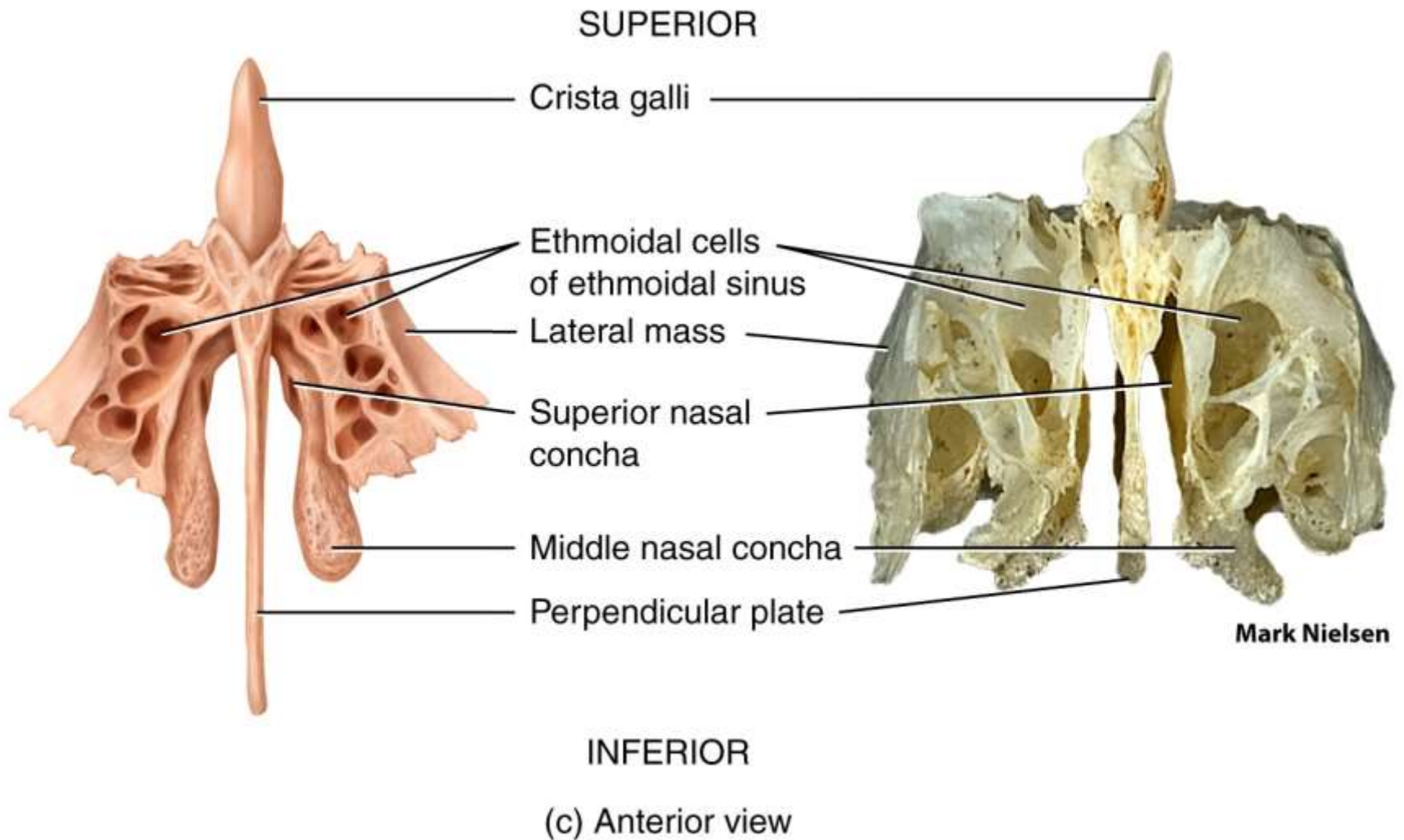
Ethmoid Bone



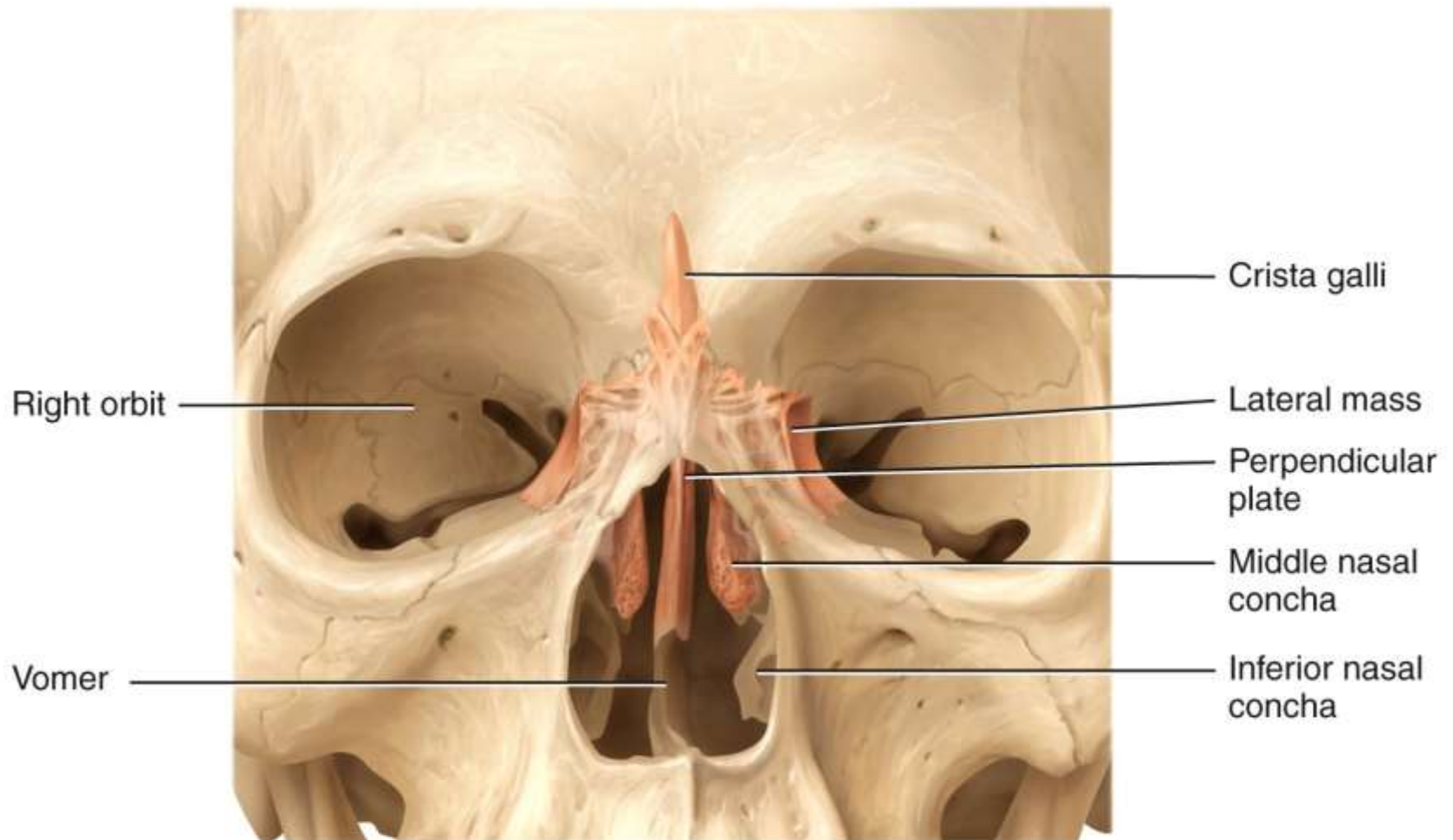
Ethmoid Bone



Ethmoid Bone



Ethmoid Bone



(d) Anterior view of position of ethmoid bone in skull
(projected to the surface)

Facial Bones

- Nasal
- Lacrimal
- Palatine
- Inferior nasal conchae
- Vomer
- Maxillae
- Zygoma
- Mandible

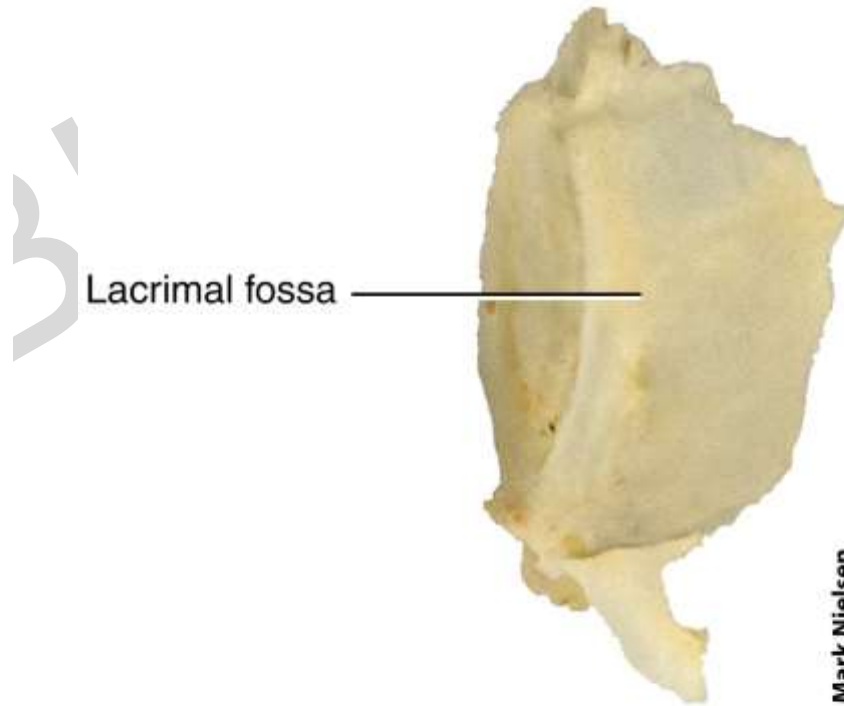
Facial Bones

- Nasal
 - These are paired bones that form the bridge of the nose.
- Lacrimal
 - These are paired bones that form the anterior portion of the medial wall of the eye socket.

Nasal, Lacrimal, and Palantine Bones, Inferior Nasal Conchae, and Vomer



(a) Right nasal bone, anterior view



(b) Right lacrimal bone, anterior view

Nasal, Lacrimal, and Palatine Bones, Inferior Nasal Conchae, and Vomer

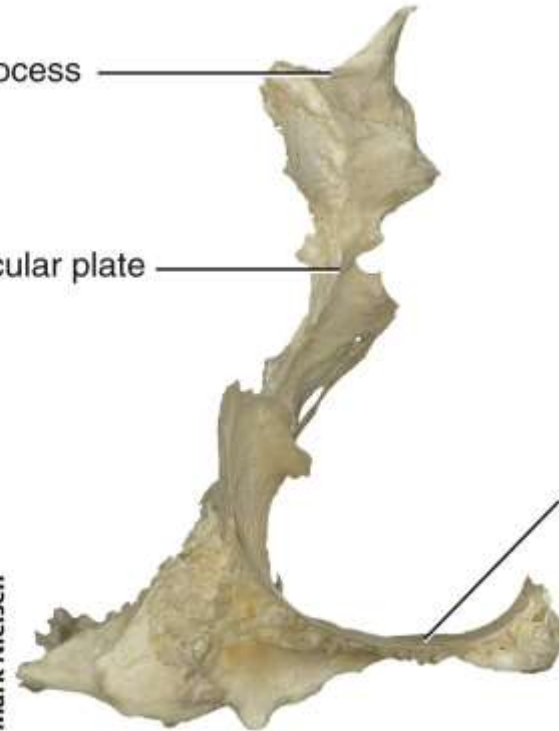


(c) Right inferior nasal conchae, medial view

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Orbital process

Perpendicular plate



Horizontal plate

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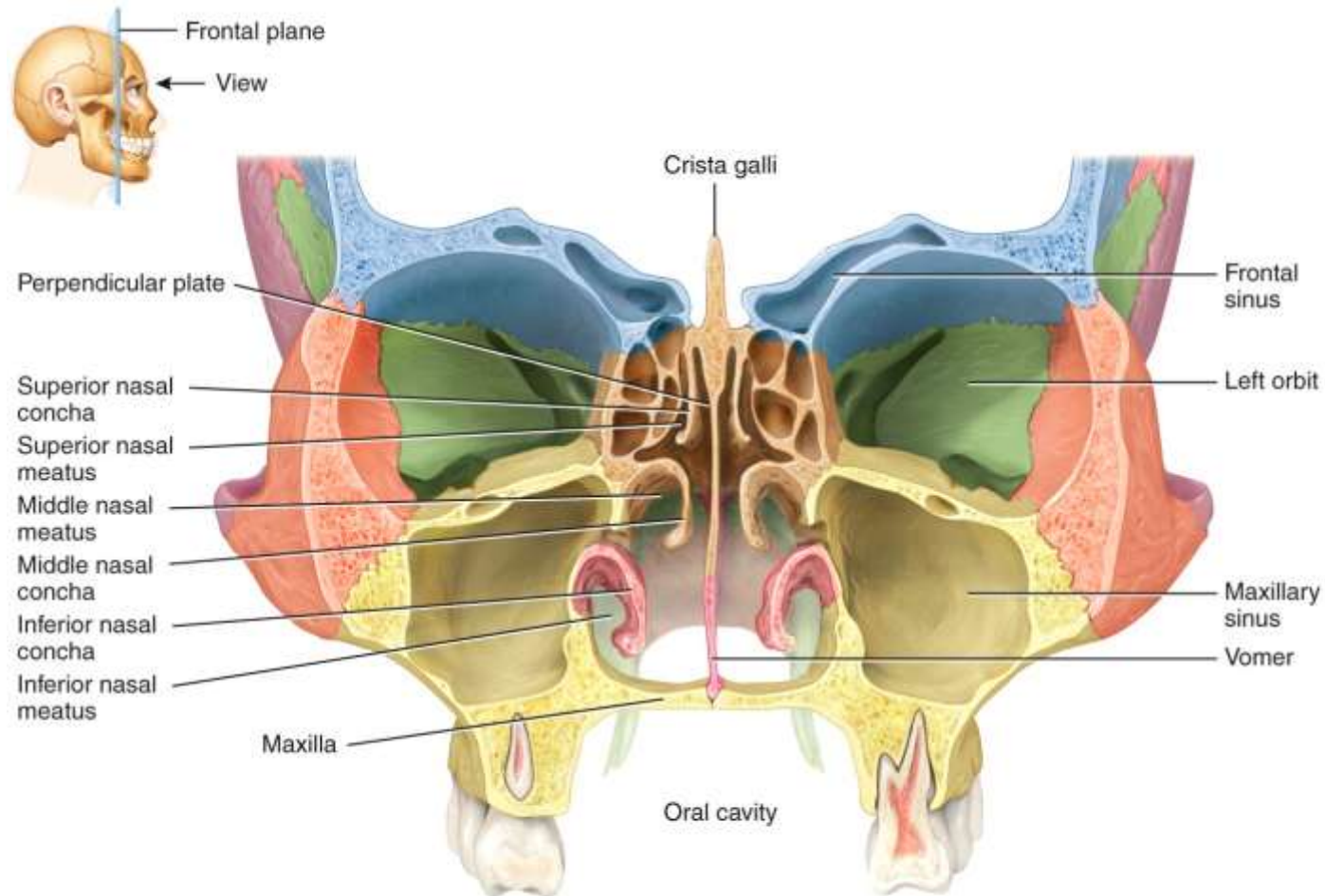
(d) Right palatine bone, anterior view



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(e) Vomer, lateral view

Nasal, Lacrimal, and Palatine Bones, Inferior Nasal Conchae, and Vomer



(f) Frontal section through ethmoid bone in skull

Facial Bones

■ Palatine

- These are paired bones that form the posterior edge of the hard palate, as well as portions of the eye socket and nasal cavity wall and floor.

■ Inferior nasal conchae

- All conchae help to swirl and filter air before it passes into the lungs.

Clinical Connection

- Black eye: is the appearance of bruising around the **eyes**. It's usually the result of trauma to the head or face, which causes bleeding beneath the skin. When the small blood vessels, or capillaries, beneath the skin break, blood leaks into the surrounding tissue. This is what causes the discoloration or bruising.



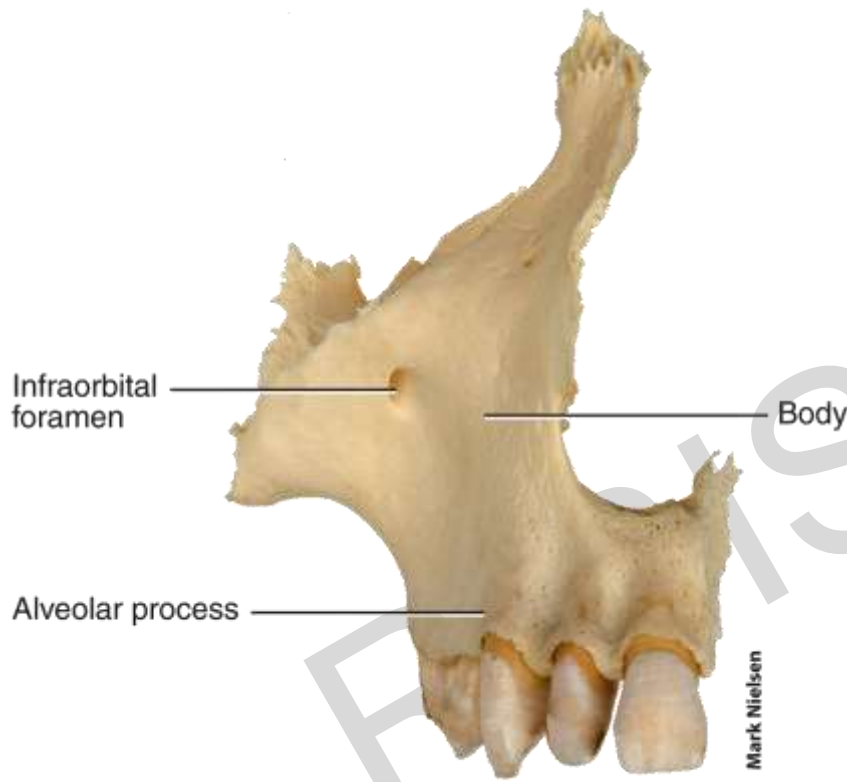
Maxillae Surface Features

- Maxillary sinus
- Alveolar process
- Palatine process
- Infraorbital foramen
- Incisive foramen

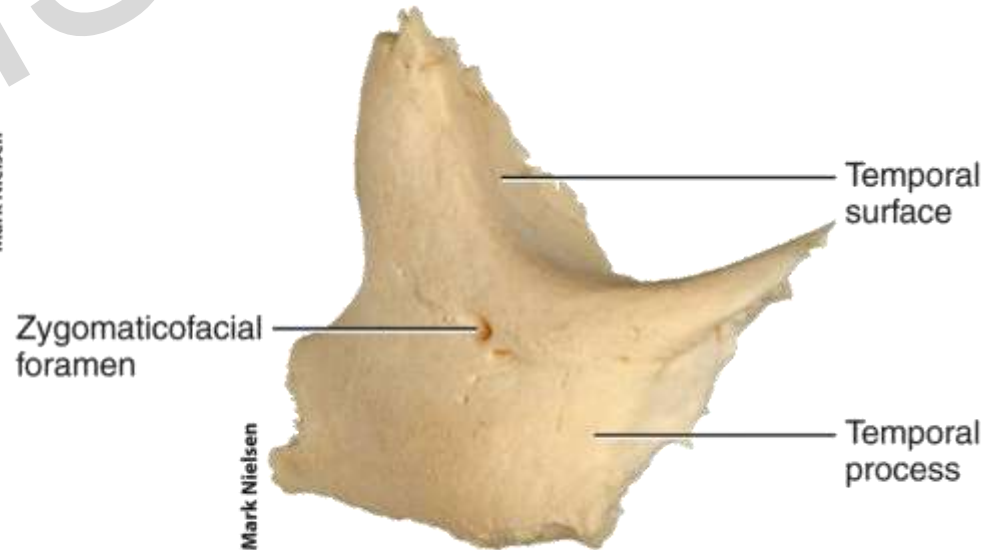
Surface Features of Zygomatic Bone

- Temporal process
- Zygomatic arch
- Zygomaticofacial foramen

Maxilla and Zygomatic Bone



(a) Right maxilla, anterior view



(b) Right zygomatic bone, lateral view

Clinical Connection

- **Cleft palate:** A cleft palate is an opening or split in the roof of the mouth that occurs when the tissue doesn't fuse together during development in the womb. A cleft palate often includes a split (cleft) in the upper lip (cleft lip) but can occur without affecting the lip
- **Cleft lip:** is an opening or split in the upper lip that occurs when developing facial structures in an unborn baby don't close completely. Cleft lip may be unilateral or bilateral. A baby with a cleft lip may also experience a cleft in the roof of the mouth (cleft palate)



Surface Features of Mandible

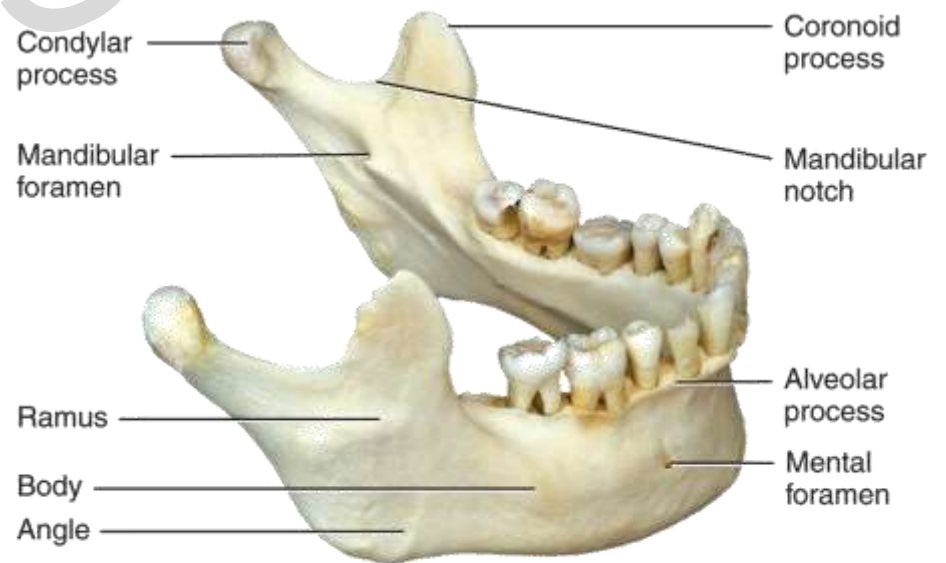
- Body
- Rami
- Angle
- Temporomandibular joint
- Mental foramen
- Mandibular canal

Mandible



(a) Right lateral view

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Mark Nielsen

(b) Right lateral view

Clinical Connection

- **Temporomandibular joint (TMJ) syndrome:** The temporomandibular joint (TMJ) acts like a sliding hinge, connecting your jawbone to your skull. You have one joint on each side of your jaw. TMJ disorders — a type of temporomandibular disorder or TMD — can cause pain in your jaw joint and in the muscles that control jaw movement.
- The exact cause of a person's TMJ disorder is often difficult to determine. Your pain may be due to a combination of factors, such as genetics, arthritis or jaw injury. Some people who have jaw pain also tend to clench or grind their teeth (bruxism), although many people habitually clench or grind their teeth and never develop TMJ disorders.
- In most cases, the pain and discomfort associated with TMJ disorders is temporary and can be relieved with self-managed care or nonsurgical treatments. Surgery is typically a last resort after conservative measures have failed, but some people with TMJ disorders may benefit from surgical treatments.

Nasal Septum

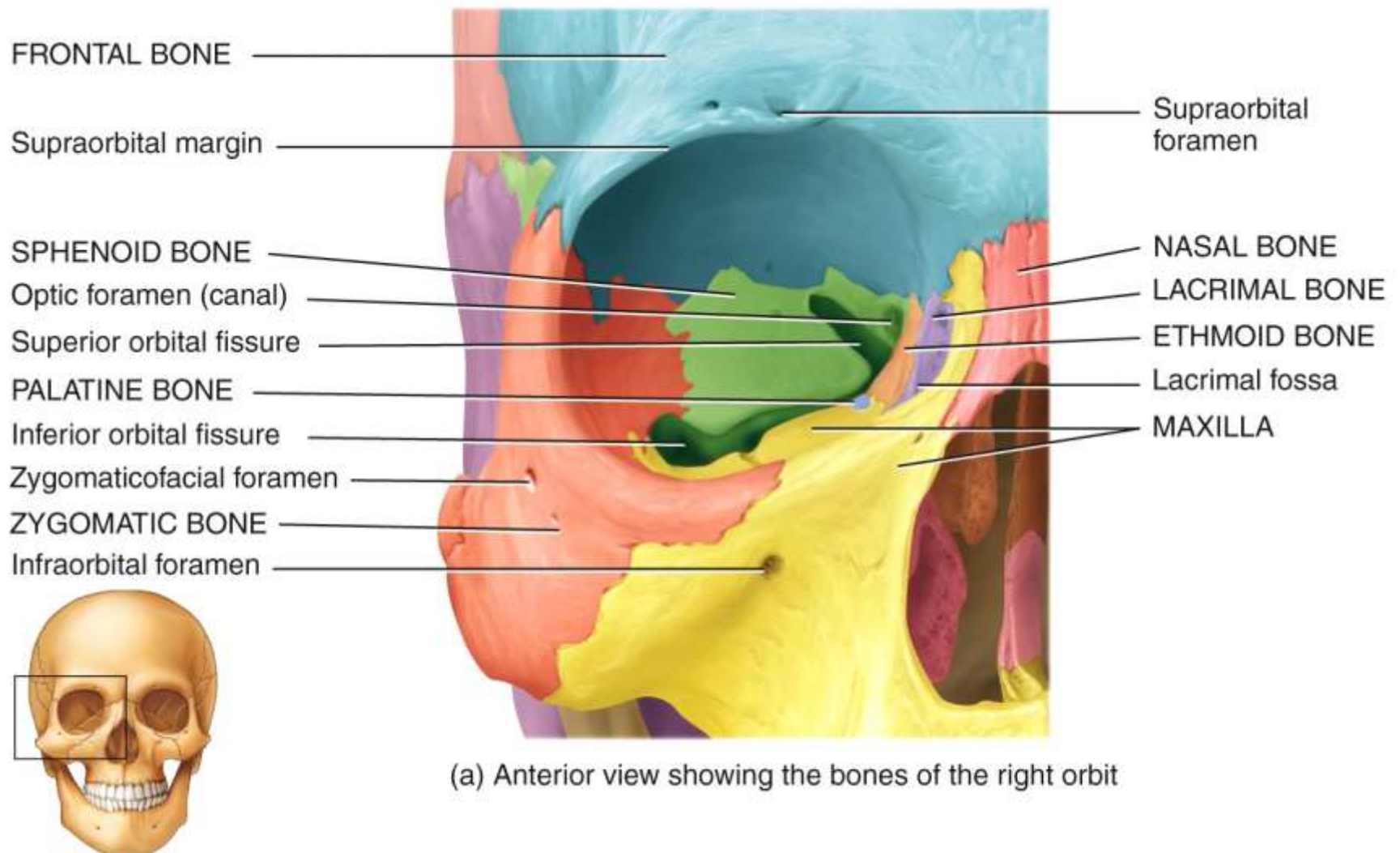
- Clinical Connection
- **Deviated nasal septum:** The septum is the cartilage in the nose that separates the nostrils. Typically, it sits at the center and divides the nostrils evenly. However, in some people, this isn't the case. Many people have an uneven septum, which makes one nostril larger than the other.
- Severe unevenness is known as a deviated septum. It can cause health complications such as a blocked nostril or difficulty breathing.
- An uneven septum is very common. According to the American Academy of Otolaryngology - Head and Neck Surgery, 80 percent of all septums are deviated to some degree. A deviated septum requires medical attention only if it causes other health issues or negatively impacts quality of life.



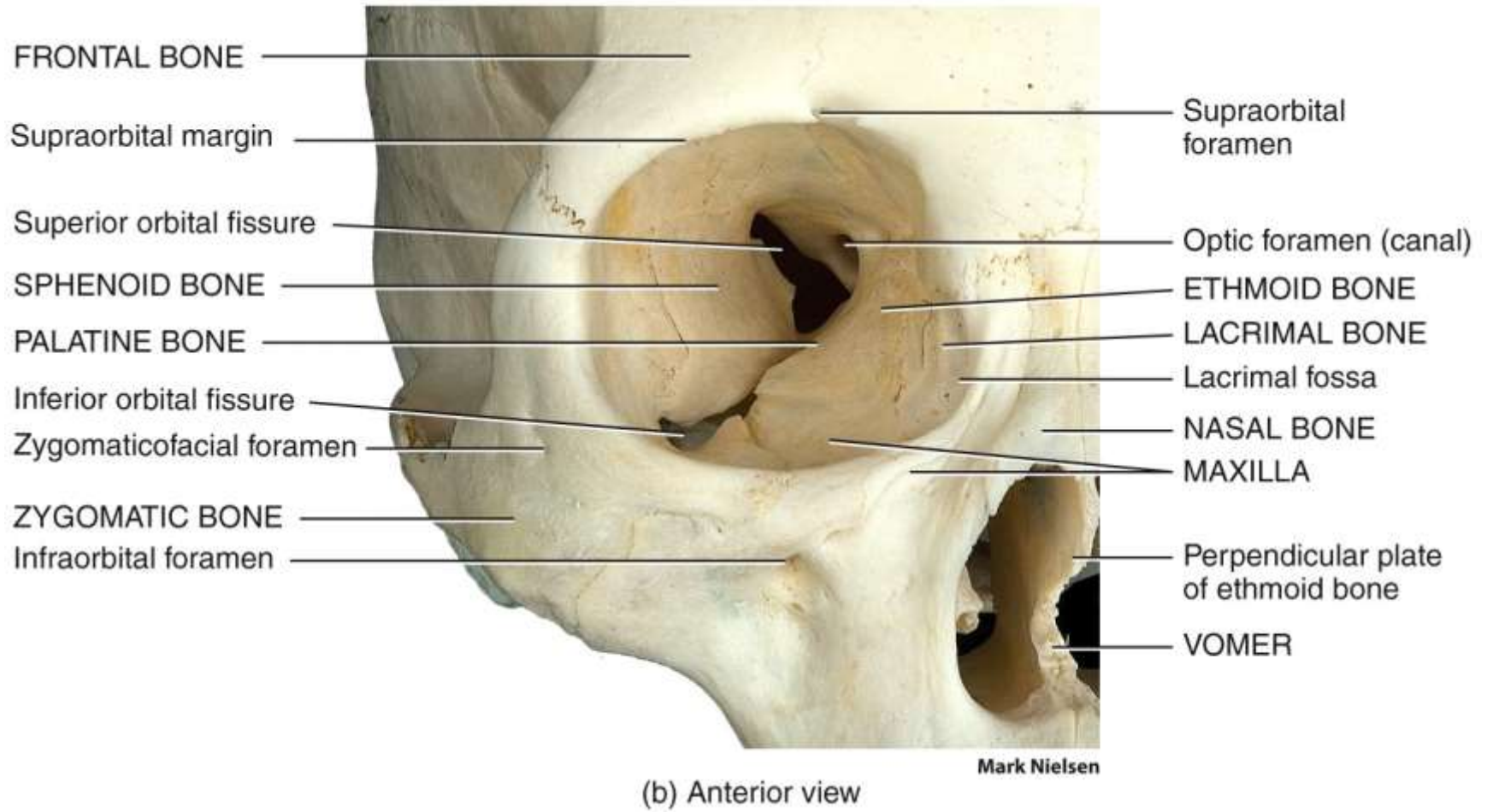
Orbits

- Three cranial bones and four facial bones form each orbit.
- Associated with each orbit are five openings:
 - ❑ *Optic foramen (canal)*
 - ❑ *Superior orbital fissure*
 - ❑ *Inferior orbital fissure*
 - ❑ *Supraorbital foramen*
 - ❑ *Lacrimonal fossa*

Details of the Orbit



Details of the Orbit



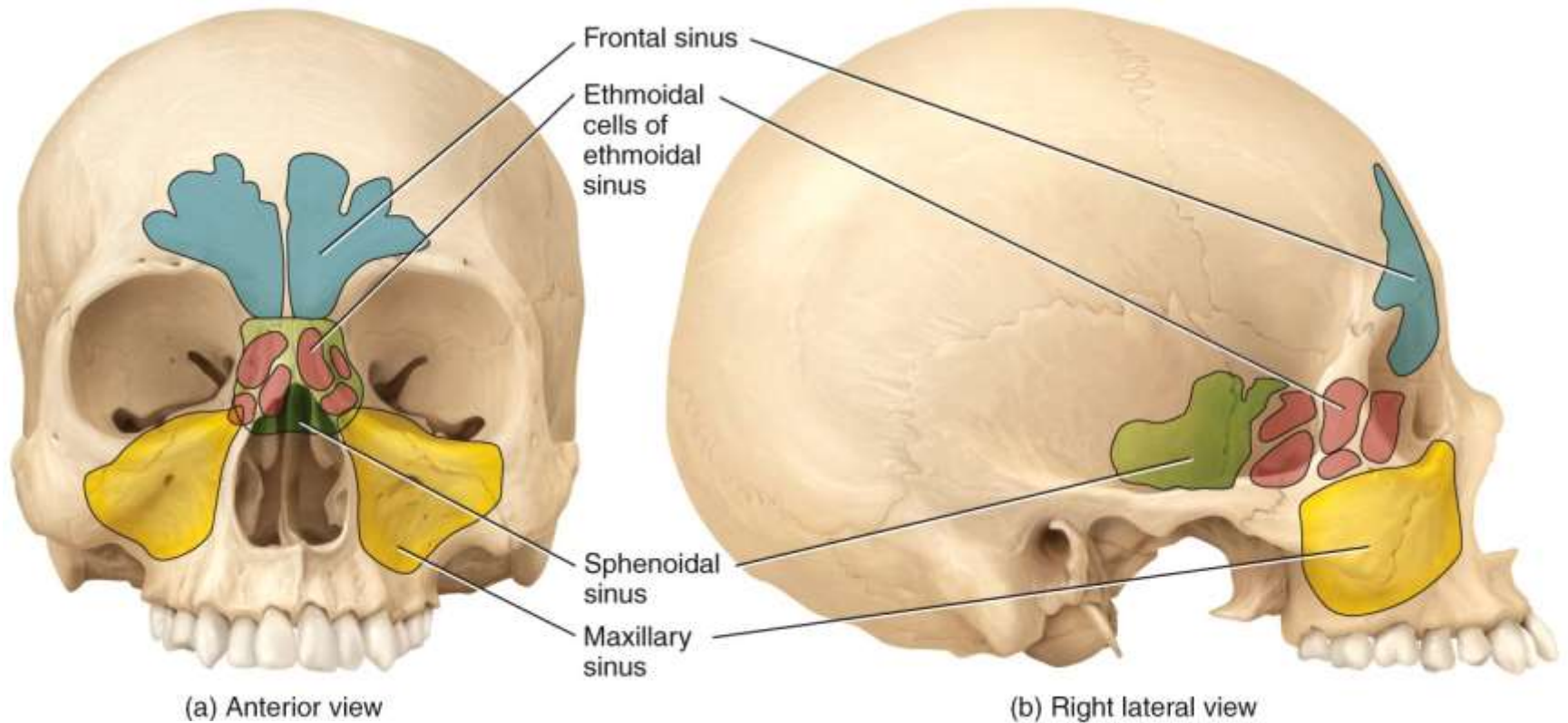
Unique Features of the Skull

- The skull exhibits the following unique features:
 - Sutures
 - Paranasal sinuses
 - Fontanelles

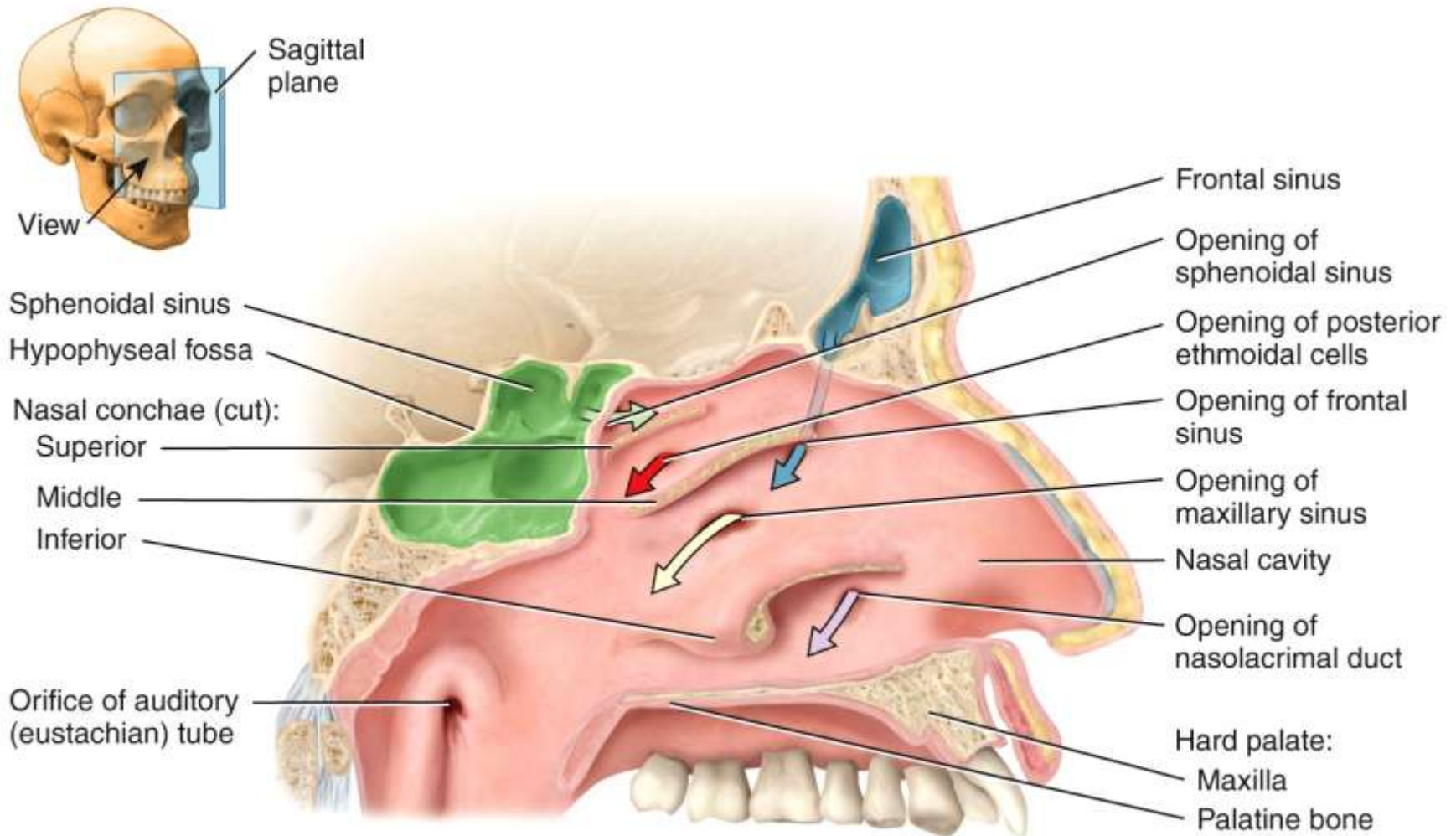
Paranasal Sinuses

- These are cavities within frontal, sphenoid, and ethmoid bones.
- The sinuses lighten the skull's mass and play a **role in resonance**.

Paranasal Sinuses

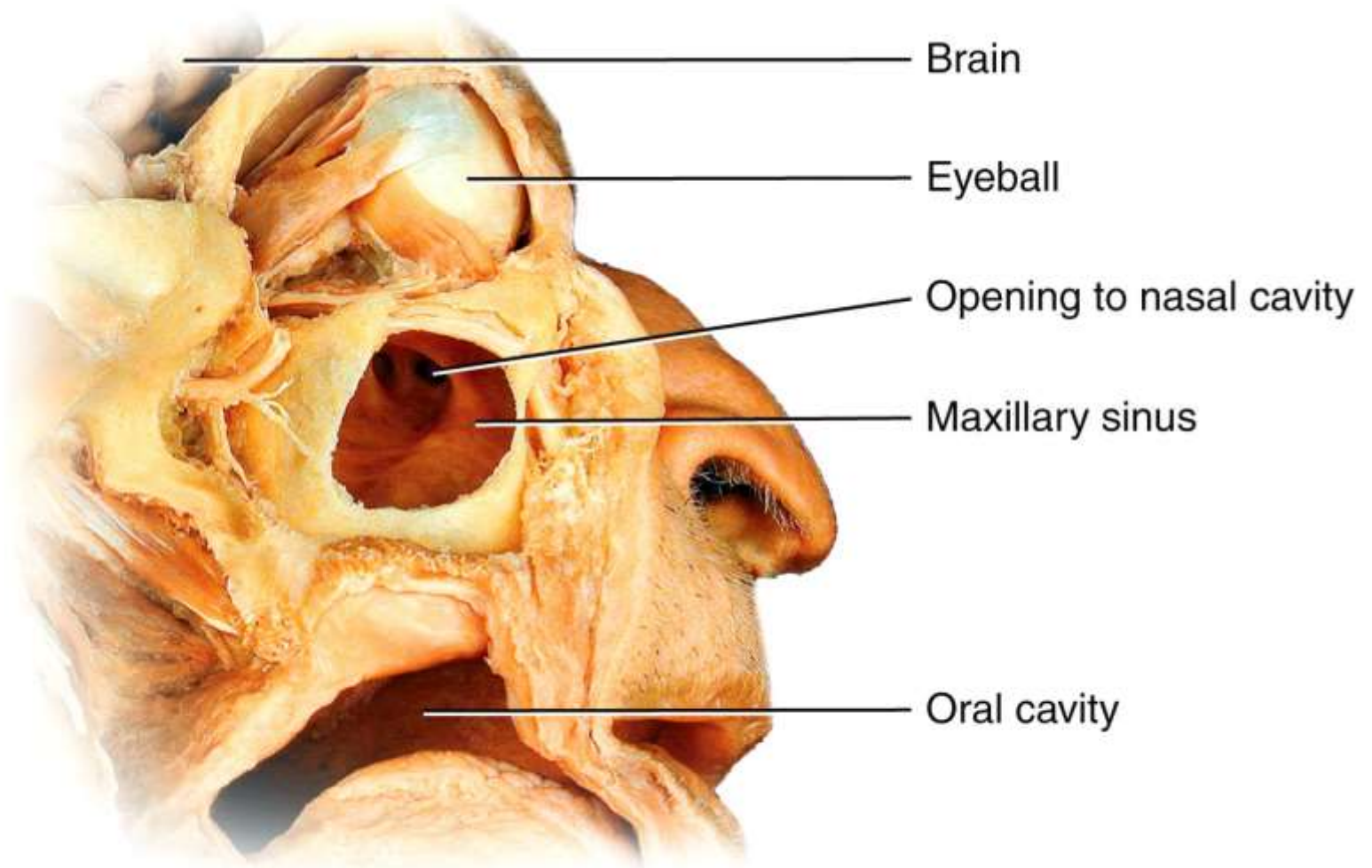


Paranasal Sinuses



(c) Sagittal section

Paranasal Sinuses



Dissection Shawn Miller, Photograph Mark Nielsen

(d) Dissection into maxillary sinus

Clinical Connection

- **Sinusitis:** is an inflammation or swelling of the tissue lining the sinuses. Healthy sinuses are filled with air. But when they become blocked and filled with fluid, germs can grow and cause an infection. Conditions that can cause sinus blockage include: The common cold.

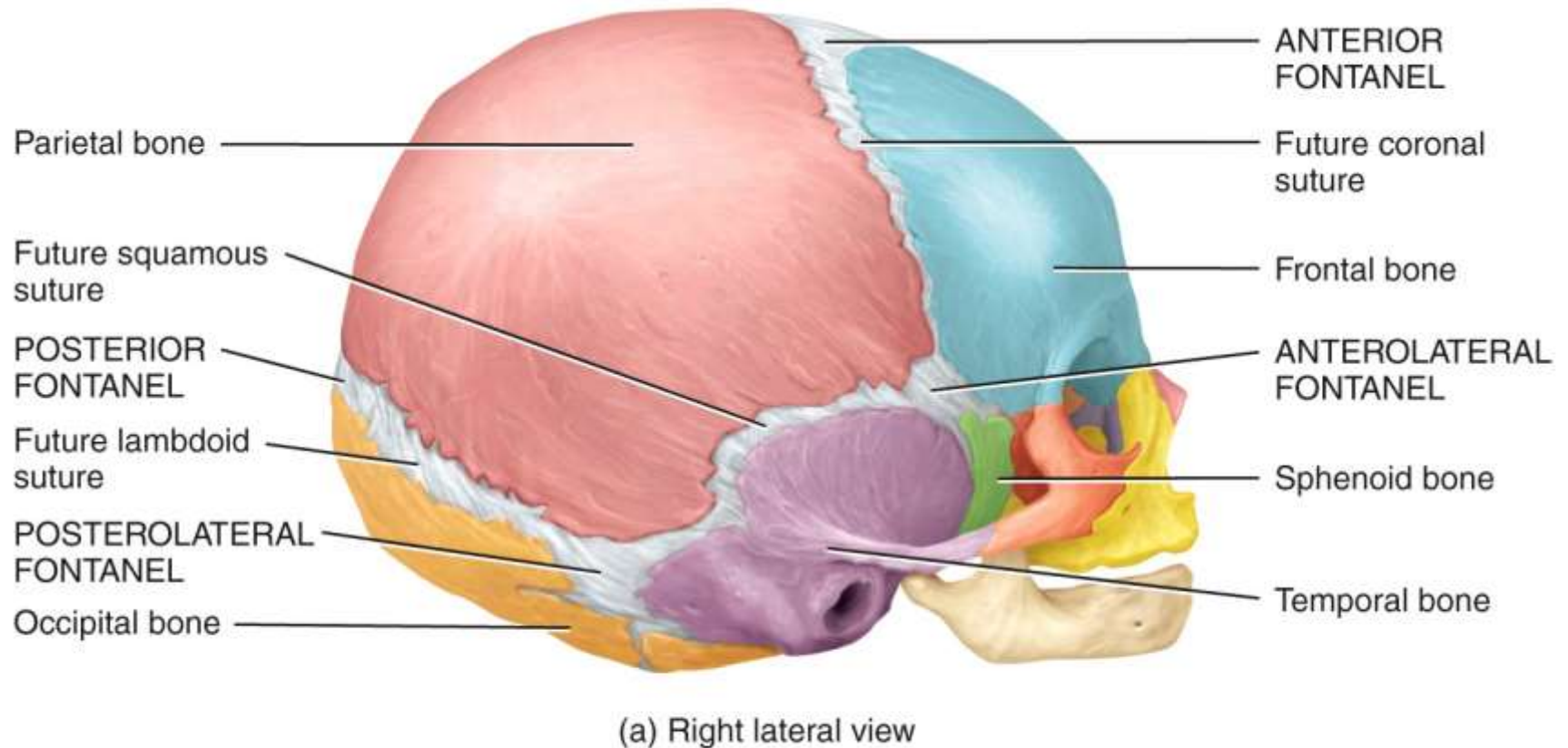


Sutures

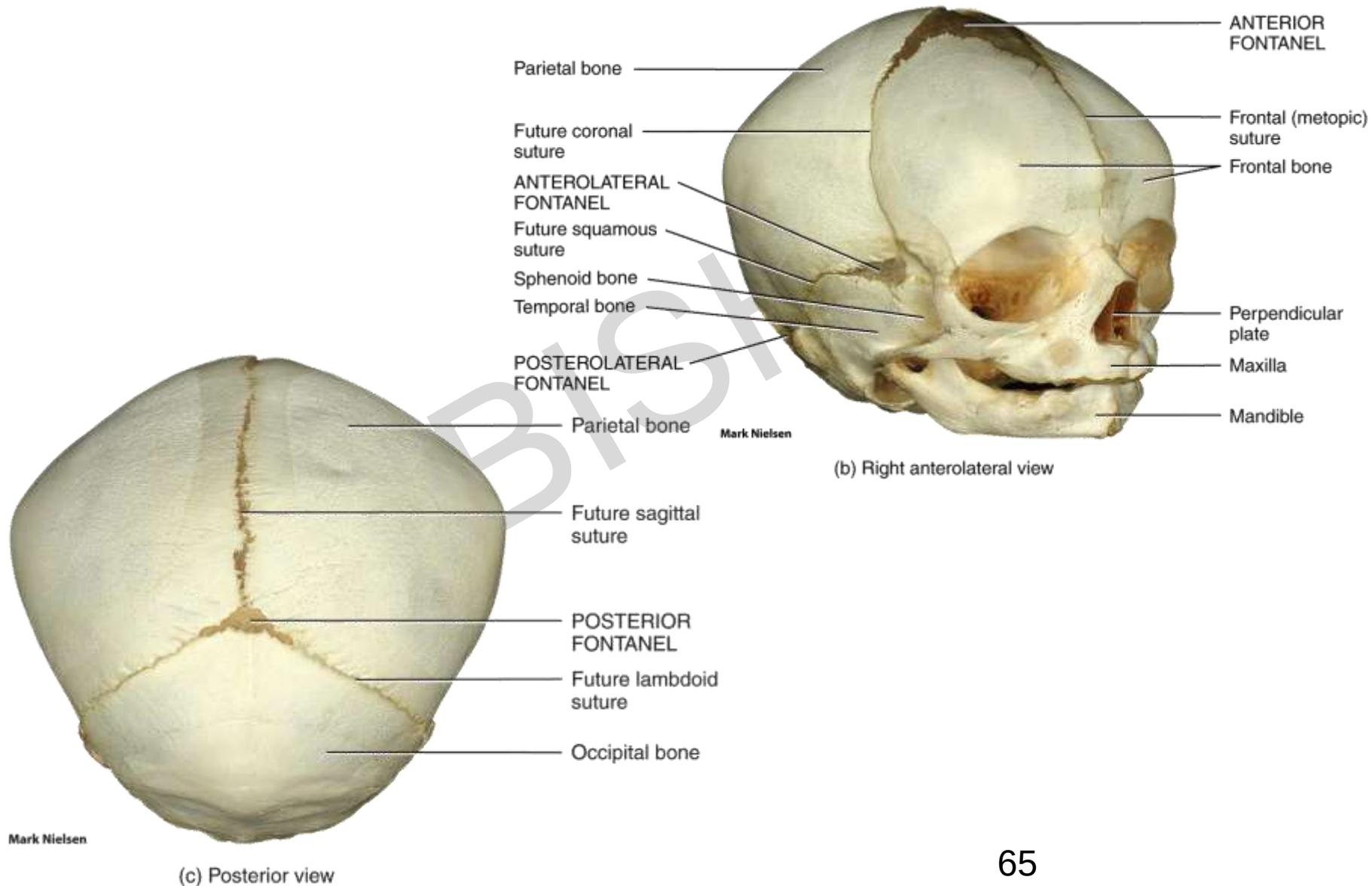
■ **An immovable joint in adults**

- ❑ Coronal
- ❑ Sagittal
- ❑ Lambdoid
- ❑ Squamous

Fontanels at Birth



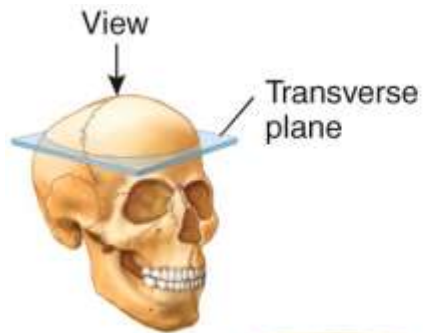
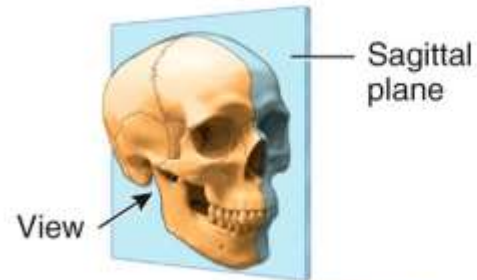
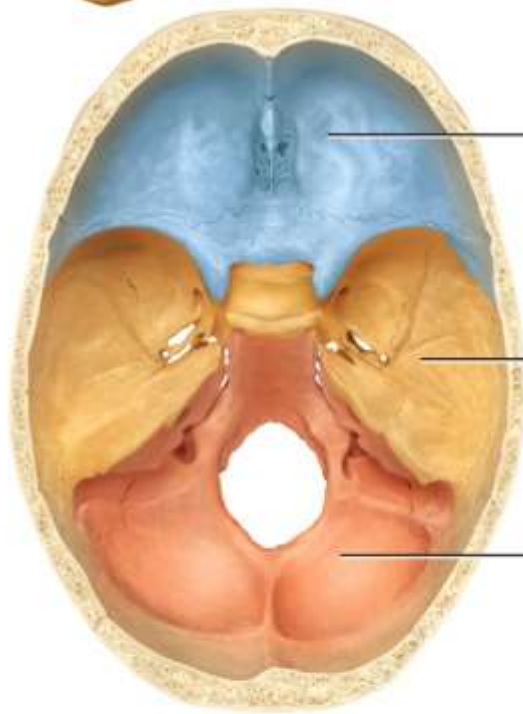
Fontanelles at Birth



Cranial Fossae

- The cranium has three distinct regions called *cranial fossae* that correspond to the major contours of the inferior surface of the brain.

Cranial Fossae

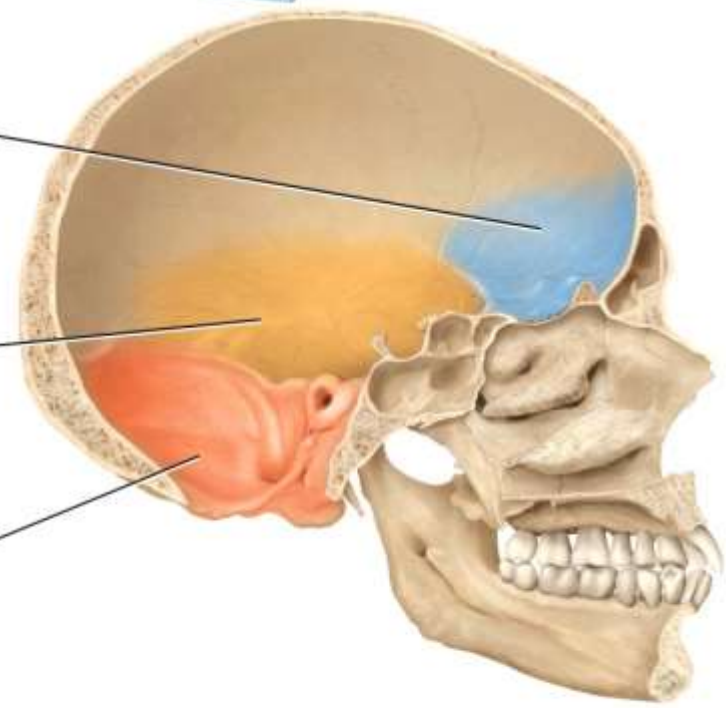


(a) Superior view of floor of cranium

ANTERIOR
CRANIAL
FOSSA

MIDDLE
CRANIAL
FOSSA

POSTERIOR
CRANIAL
FOSSA



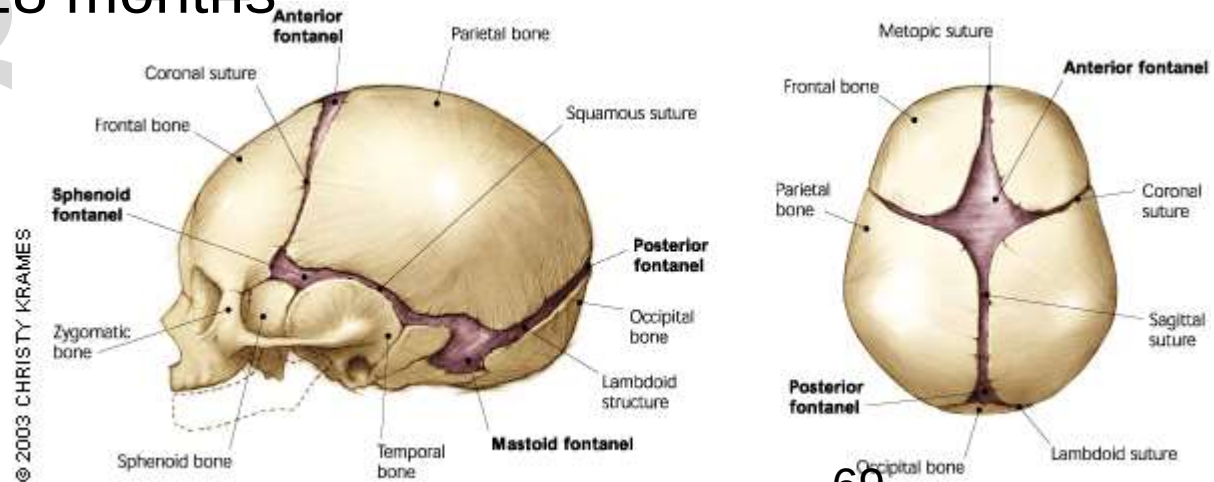
(b) Medial view of sagittal section

Age-related Changes in the Skull

- From fetus through adult, the five parts of the occipital bone increase in size to accommodate the growing brain and eventually fuse into a single bone.
- Other individual bones of the skull separated by fontanelles enlarge while the fontanelles shrink as the person grows.
- Paranasal sinuses and teeth emerge in a young skull. Later, bone loss of mandible and maxilla may cause tooth loss in an older adult.

Age-related Changes in the Skull

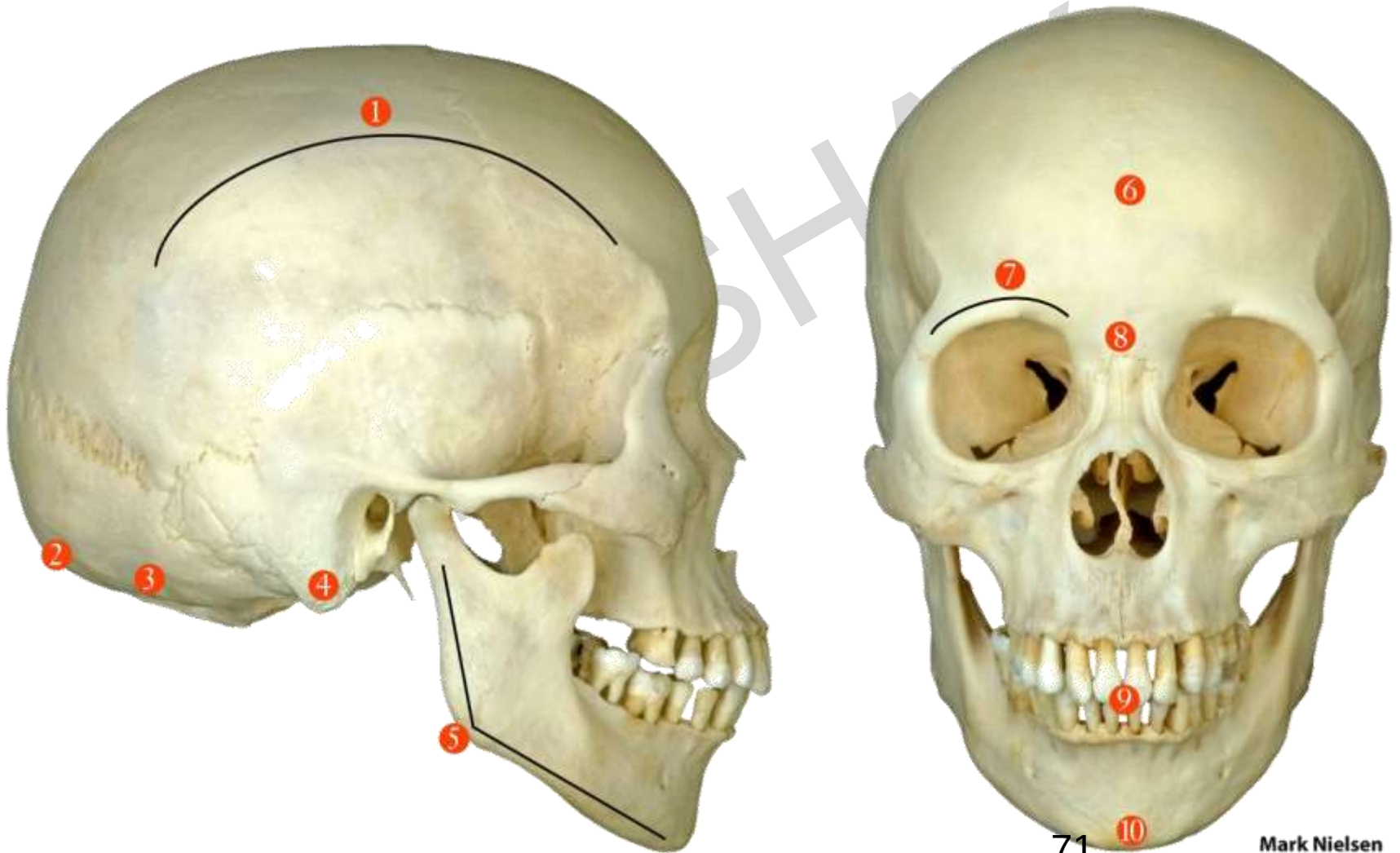
- The posterior fontanelle generally closes 2 to 3 months after birth.
- The sphenoidal fontanelle is the next to close around 6 months after birth.
- The mastoid fontanelle closes next from 6 to 18 months after birth.
- The anterior fontanelle is generally the last to close between 12-18 months



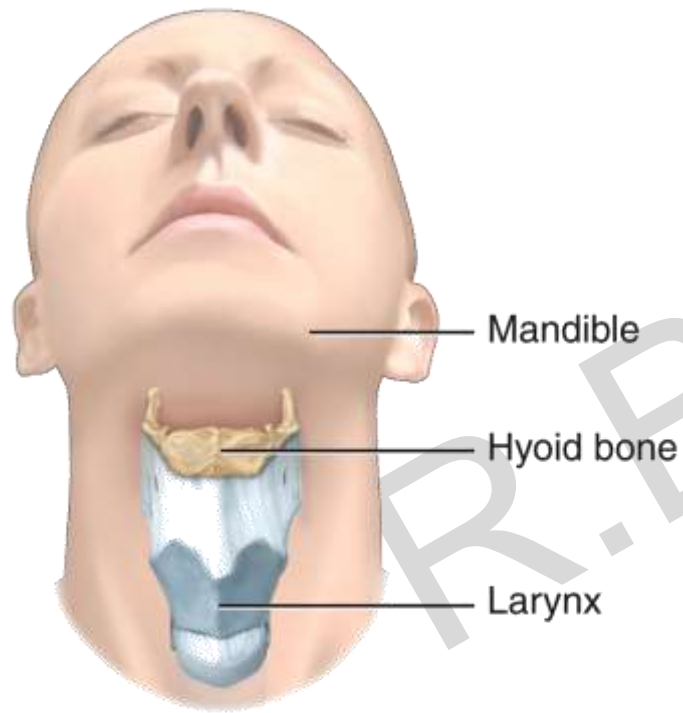
Sexual Differences in the Skull

- **Sexual dimorphism:** the differences in appearance between males and females of the same species, such as in colour, shape, size, and structure, that are caused by the inheritance of one or the other sexual pattern in the genetic material.

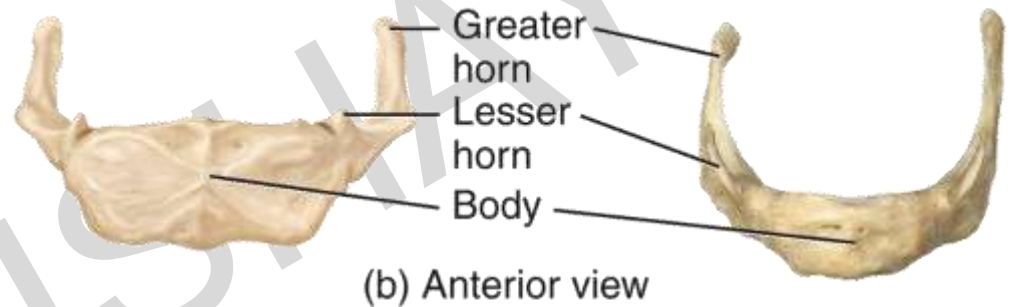
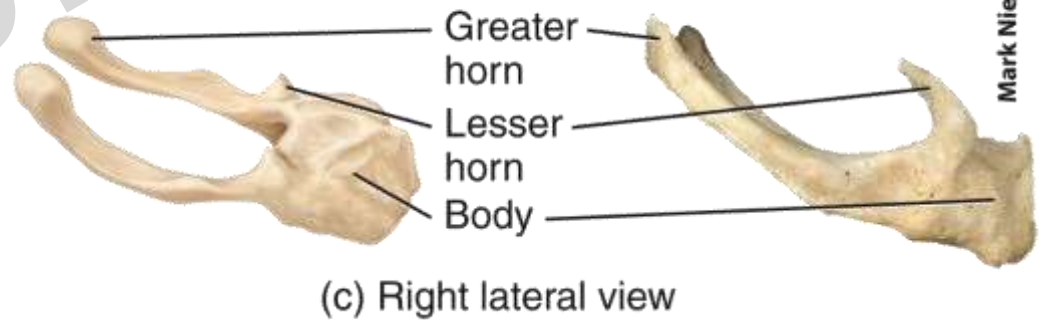
Key Visible Gender Differences in Skulls



Hyoid Bone



(a) Position of hyoid bone



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Vertebral Column

- Also known as the *spine* or backbone
 - Cervical vertebrae
 - Thoracic vertebrae
 - Lumbar vertebrae
 - Fused sacral vertebrae that form the sacrum
 - Fused coccygeal vertebrae that form the coccyx

Clinical Connection

- Scoliosis
- Kyphosis
- Lordosis
- Spina bifida
- Herniated disc

Abnormal Curves of Vertebral Column



Princess Margaret Rose Orthopaedic
Hospital/Photo Researchers, Inc.

(A) Scoliosis



Dr. P. Marazzi / Photo Researchers, Inc.

(B) Kyphosis



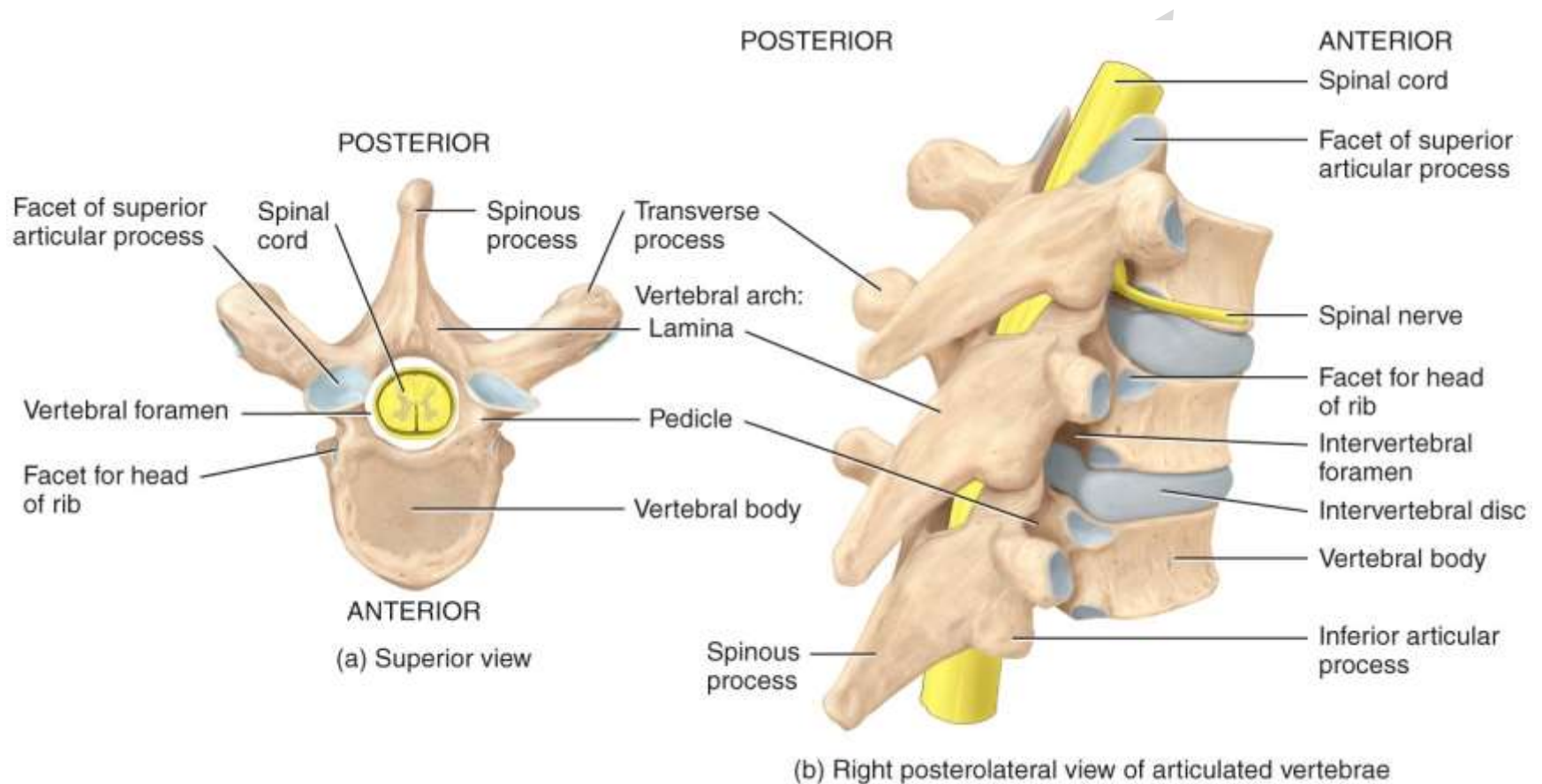
Custom Medical Stock Photo, Inc.

(C) Lordosis

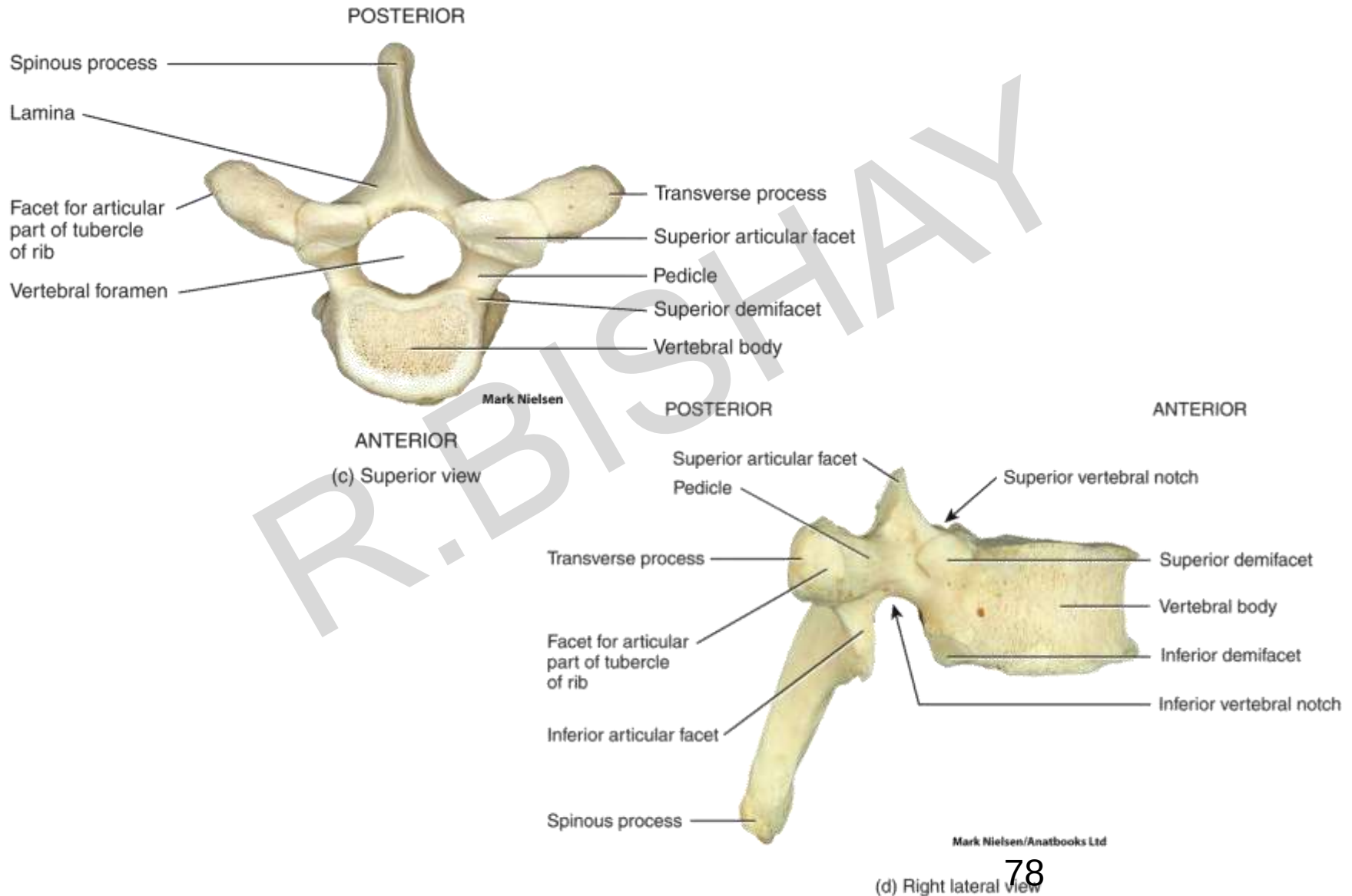
Parts of a Typical Vertebra

- Vertebrae typically consist of
 - Vertebral body
 - Vertebral arch
 - Processes

Structure of a Typical Vertebrae



Structure of a Typical Vertebrae



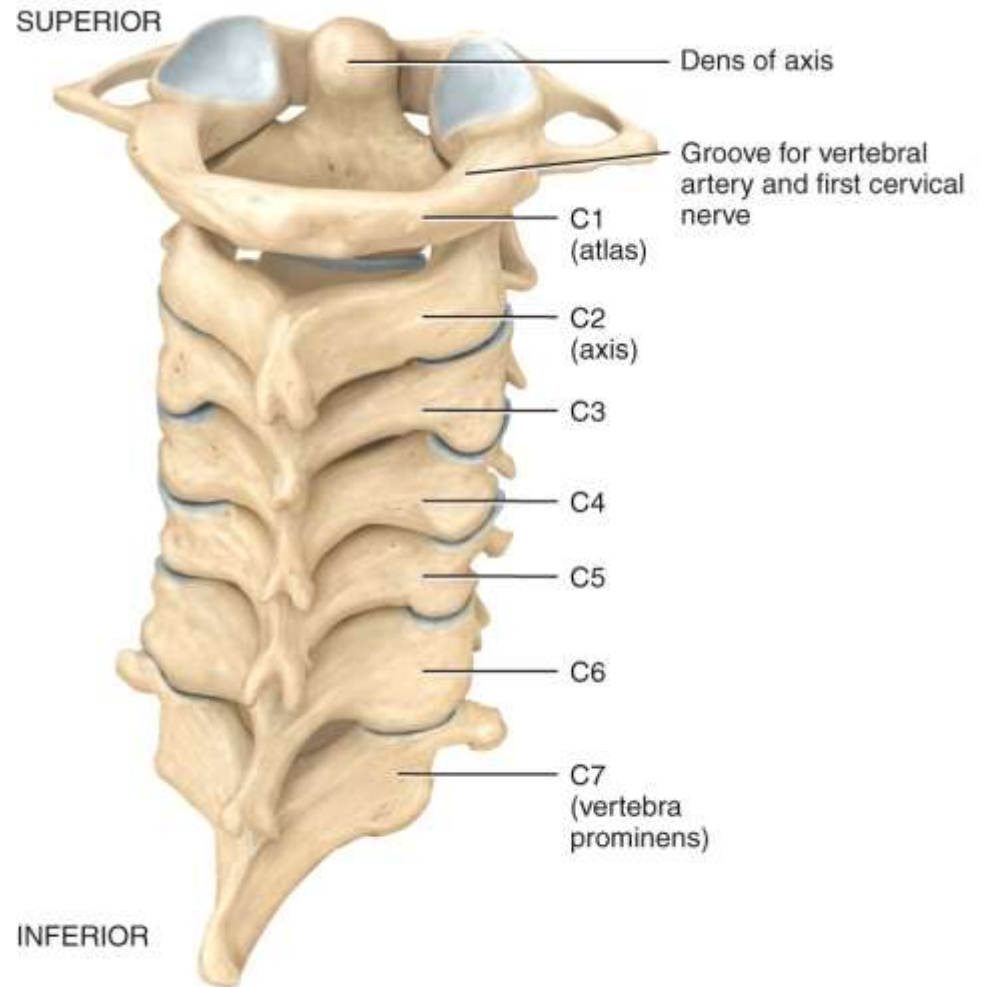
Cervical Vertebrae Surface Features

- ❑ Vertebral foramina
- ❑ Transverse foramen
- ❑ Bifid
- ❑ Atlas C1
- ❑ Axis C2

Cervical Vertebrae

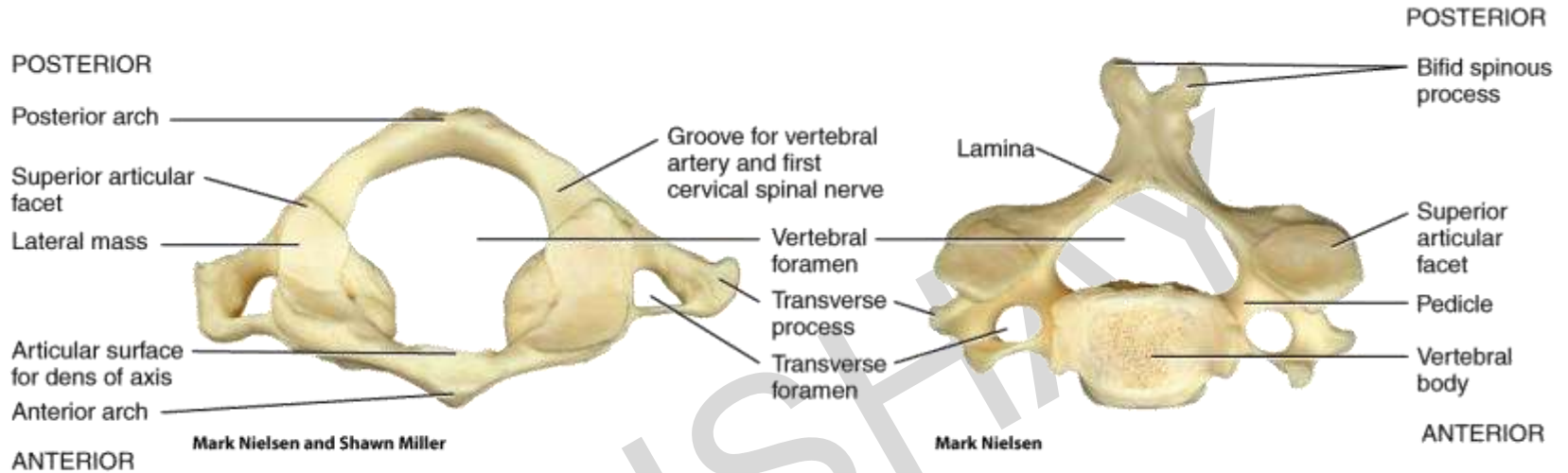


Location of cervical vertebrae



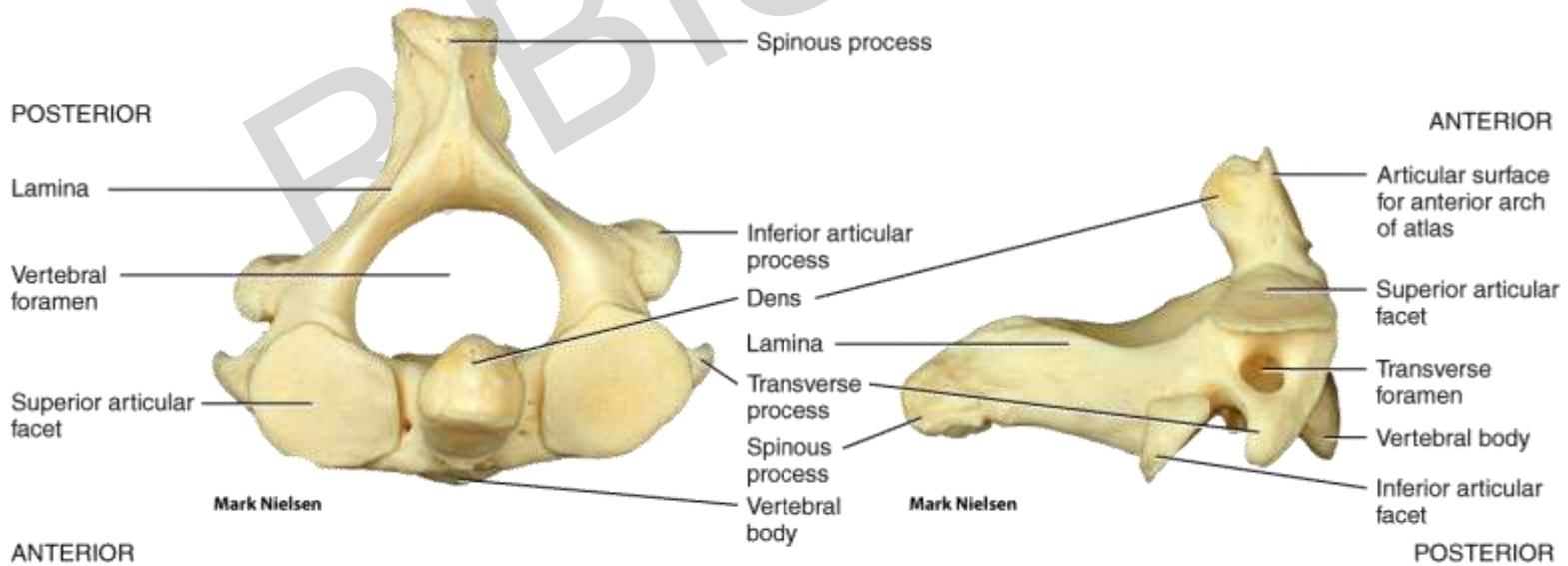
(a) Posterior view of articulated cervical vertebrae

Cervical Vertebrae



(b) Superior view of atlas (C1)

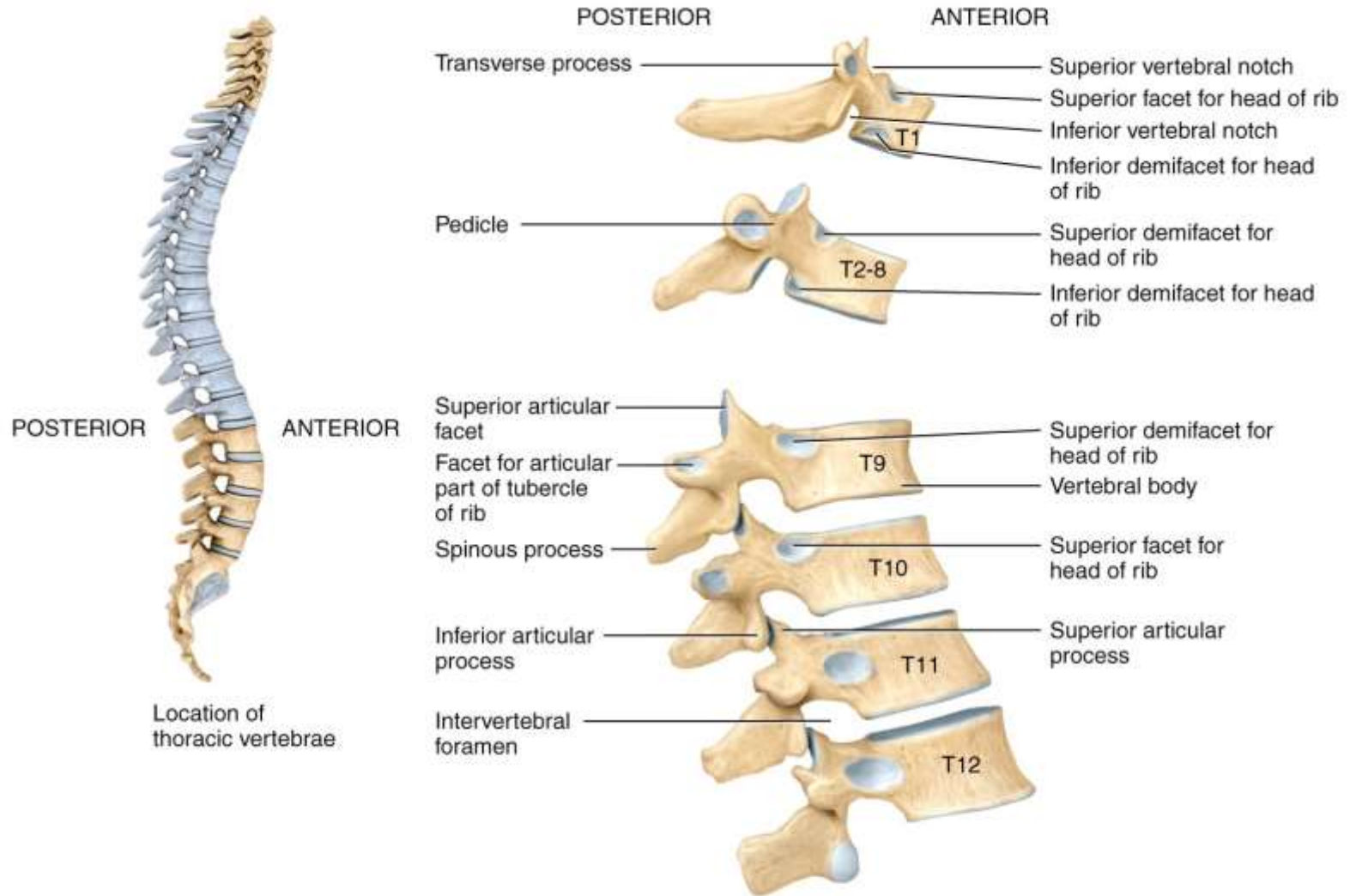
(c) Superior view of a typical cervical vertebra



(d) Superior view of axis (C2)

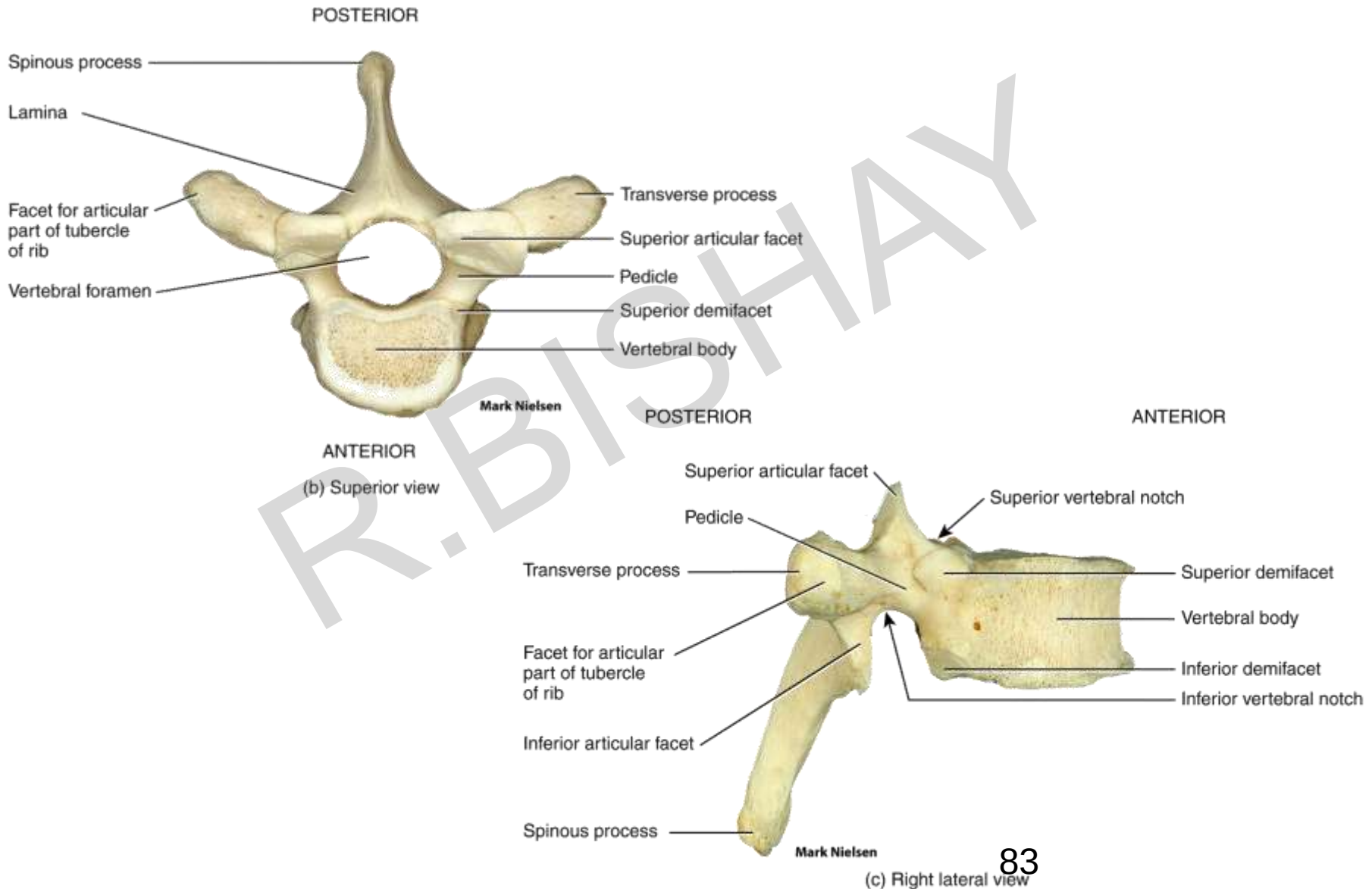
(e) Right lateral view of axis (C2)

Thoracic Vertebrae

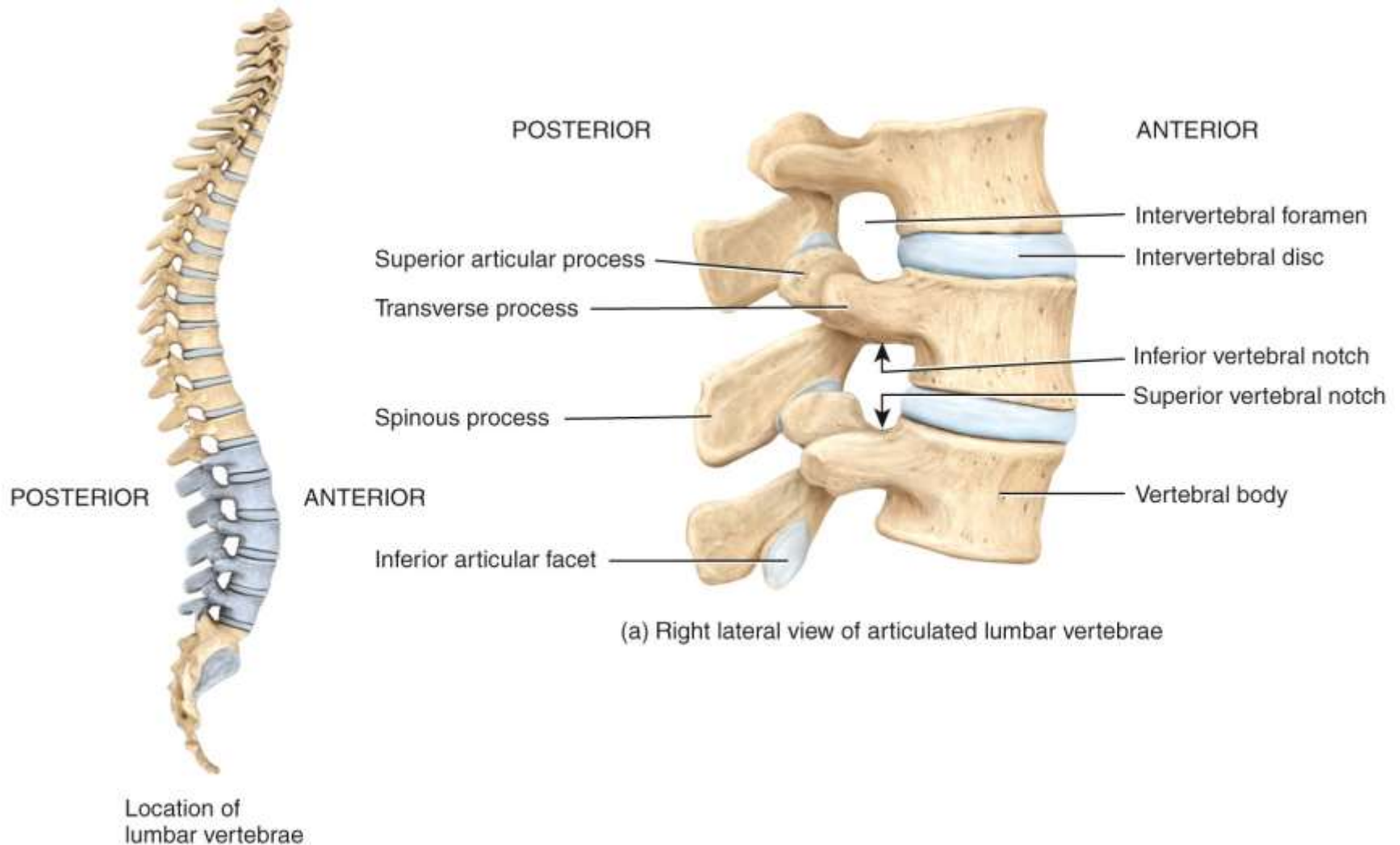


(a) Right lateral view of several articulated thoracic vertebrae

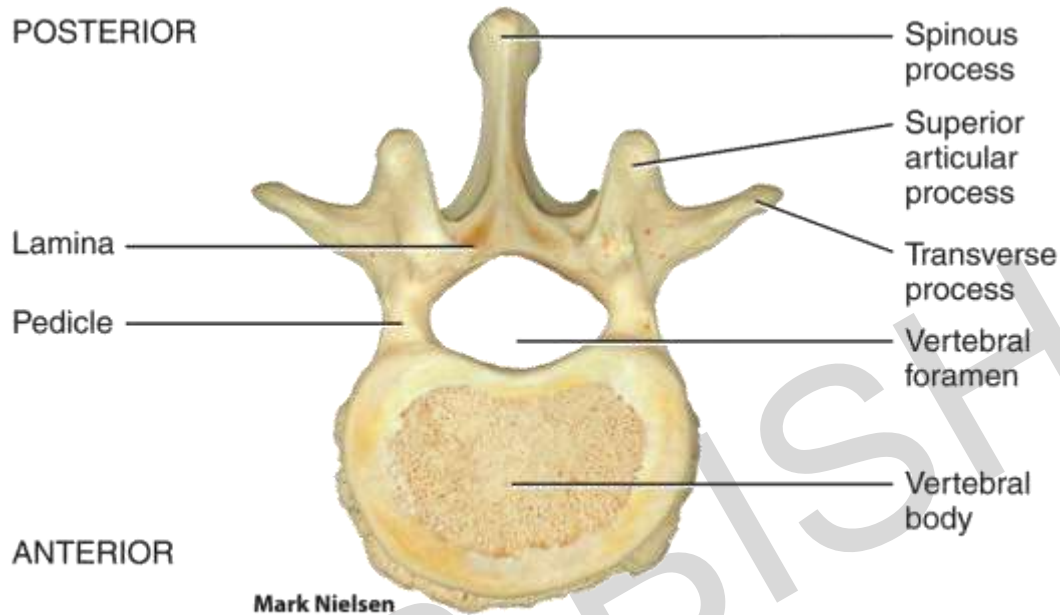
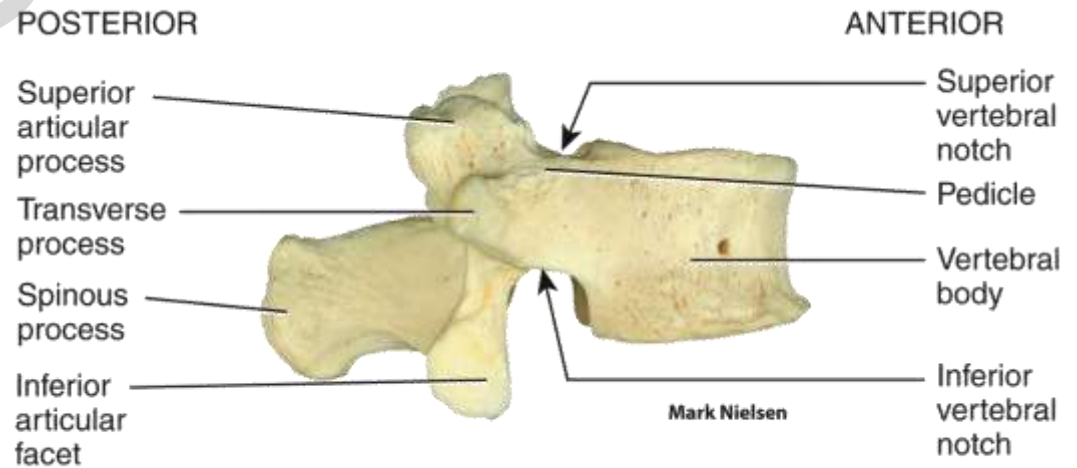
Thoracic Vertebrae



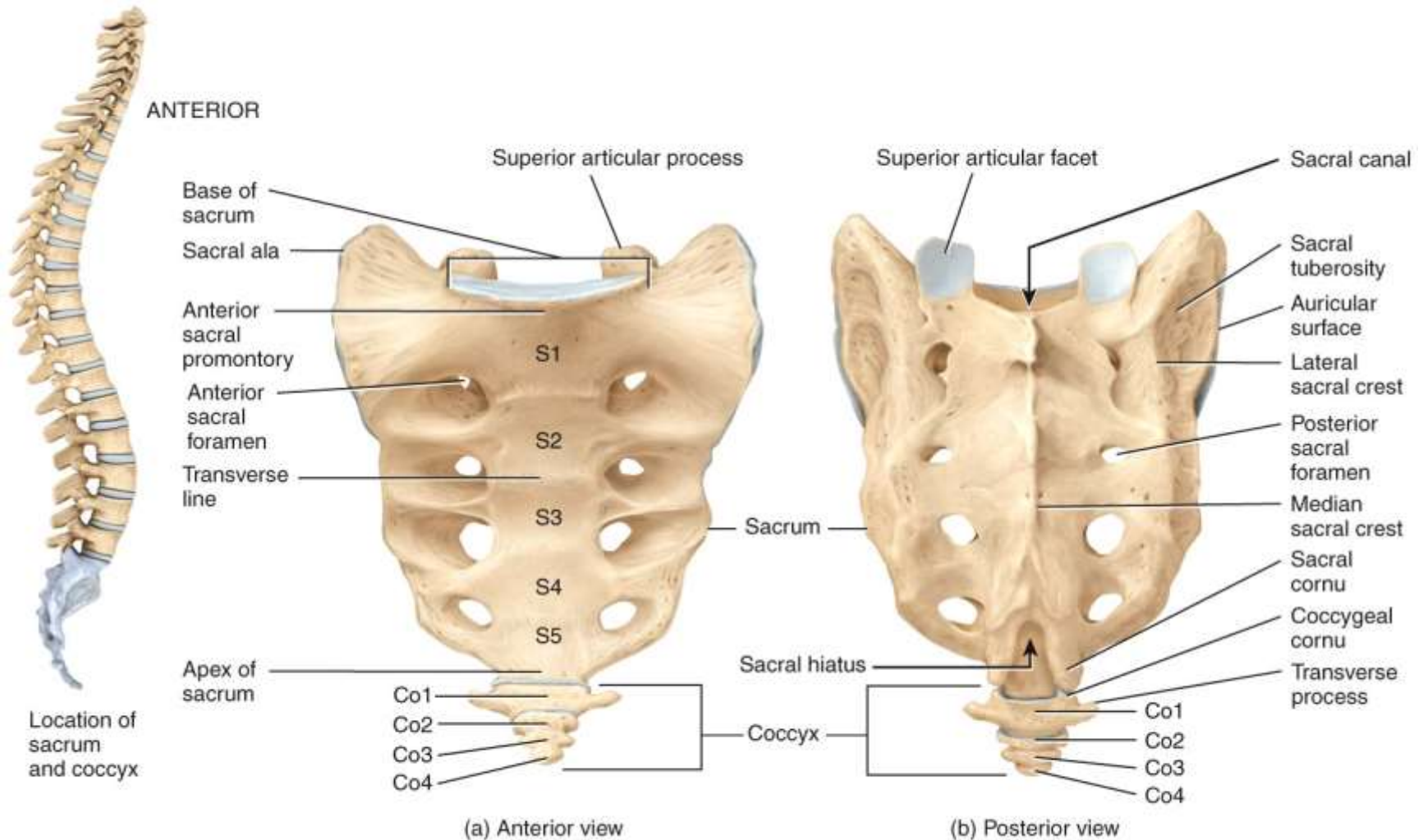
Lumbar Vertebrae



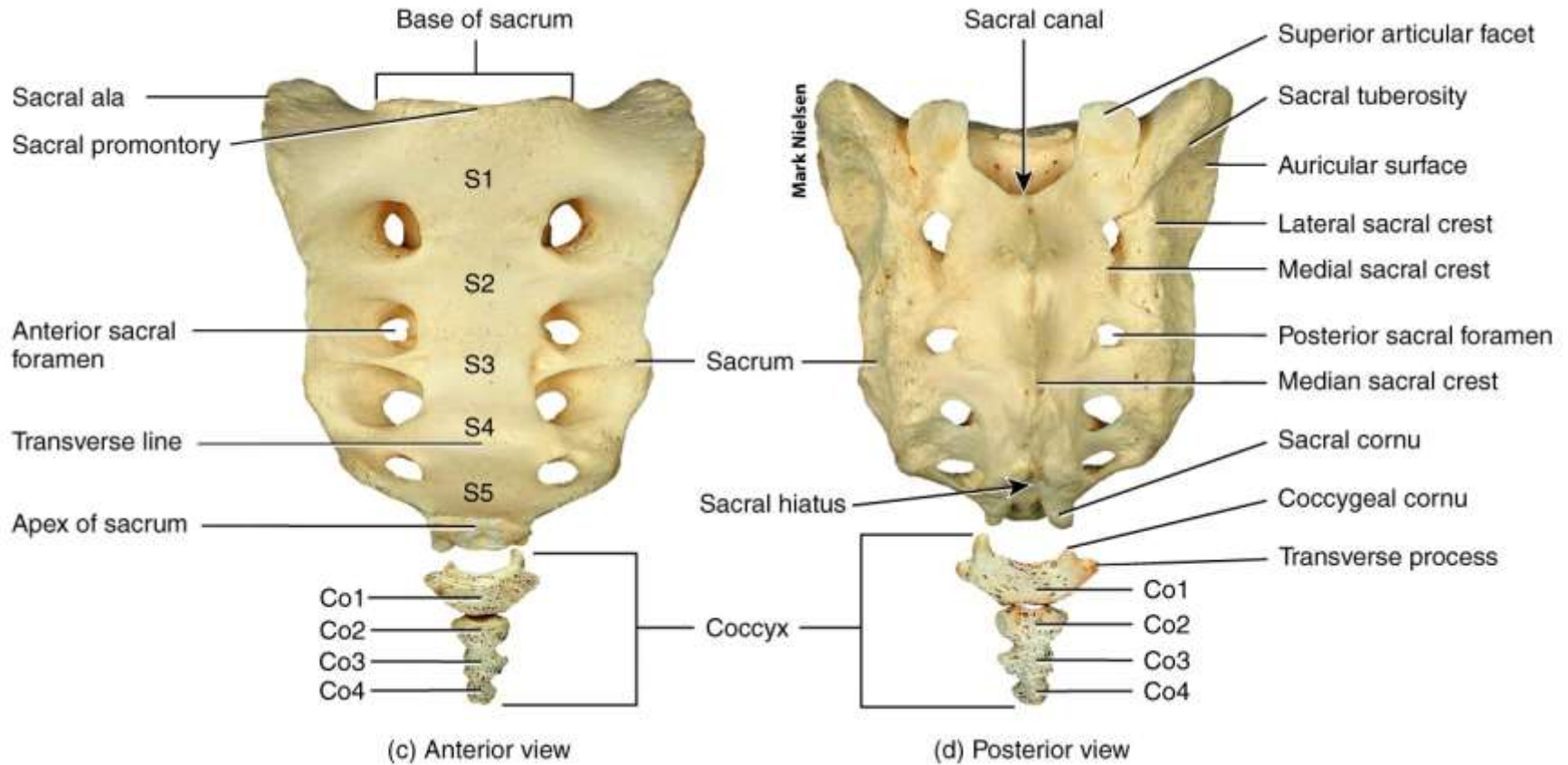
Lumbar Vertebrae



Sacrum and Coccyx



Sacrum and Coccyx



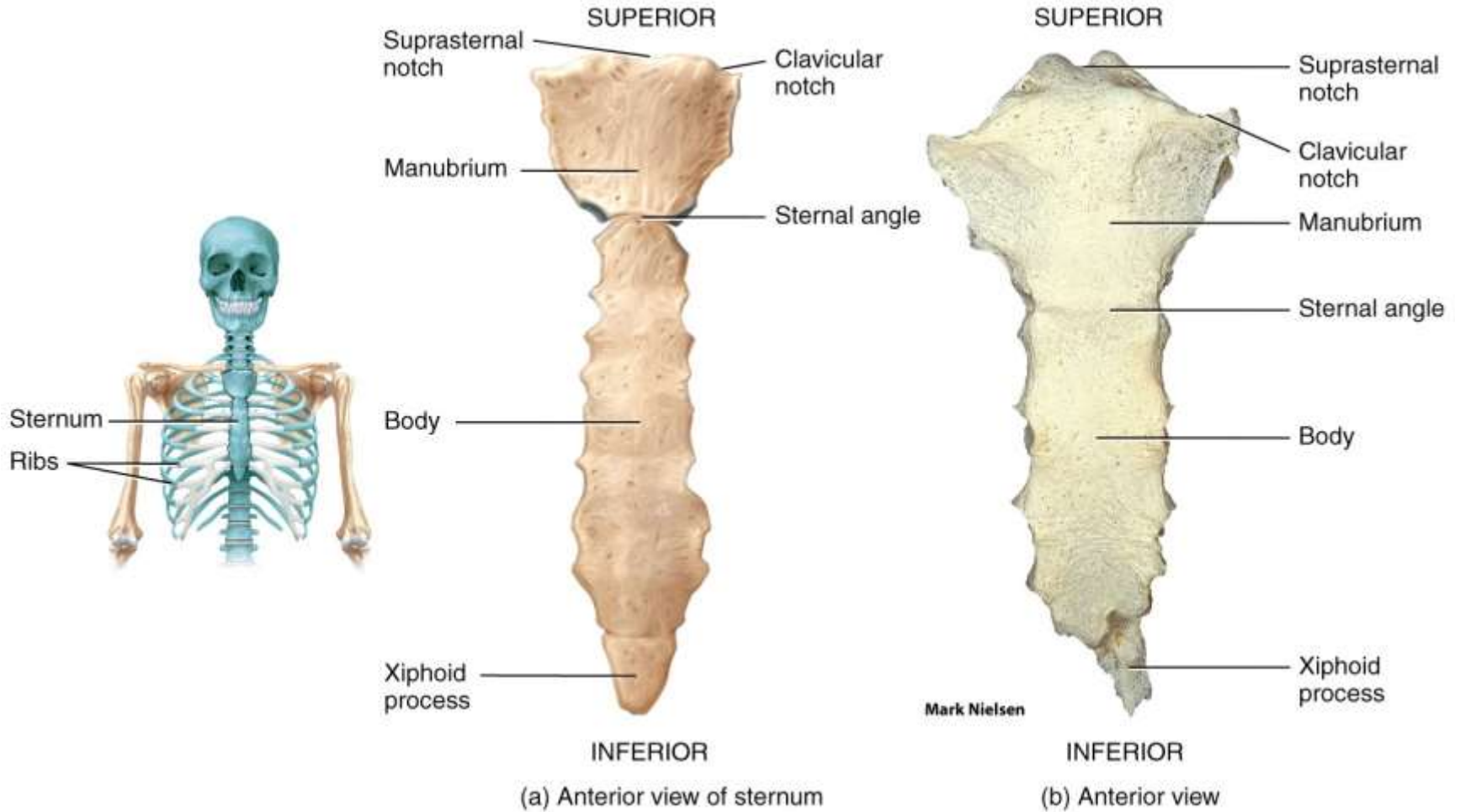
Clinical Connection

- **Caudal anesthesia:** Anesthesia produced by injection of a local anesthetic into the caudal canal, the sacral portion of the spinal canal. Caudal anesthesia is used to provide anesthesia and analgesia (pain relief) below the umbilicus. It may be the sole anesthetic or combined with general anesthesia. Also known as caudal epidural anesthesia or a caudal block.

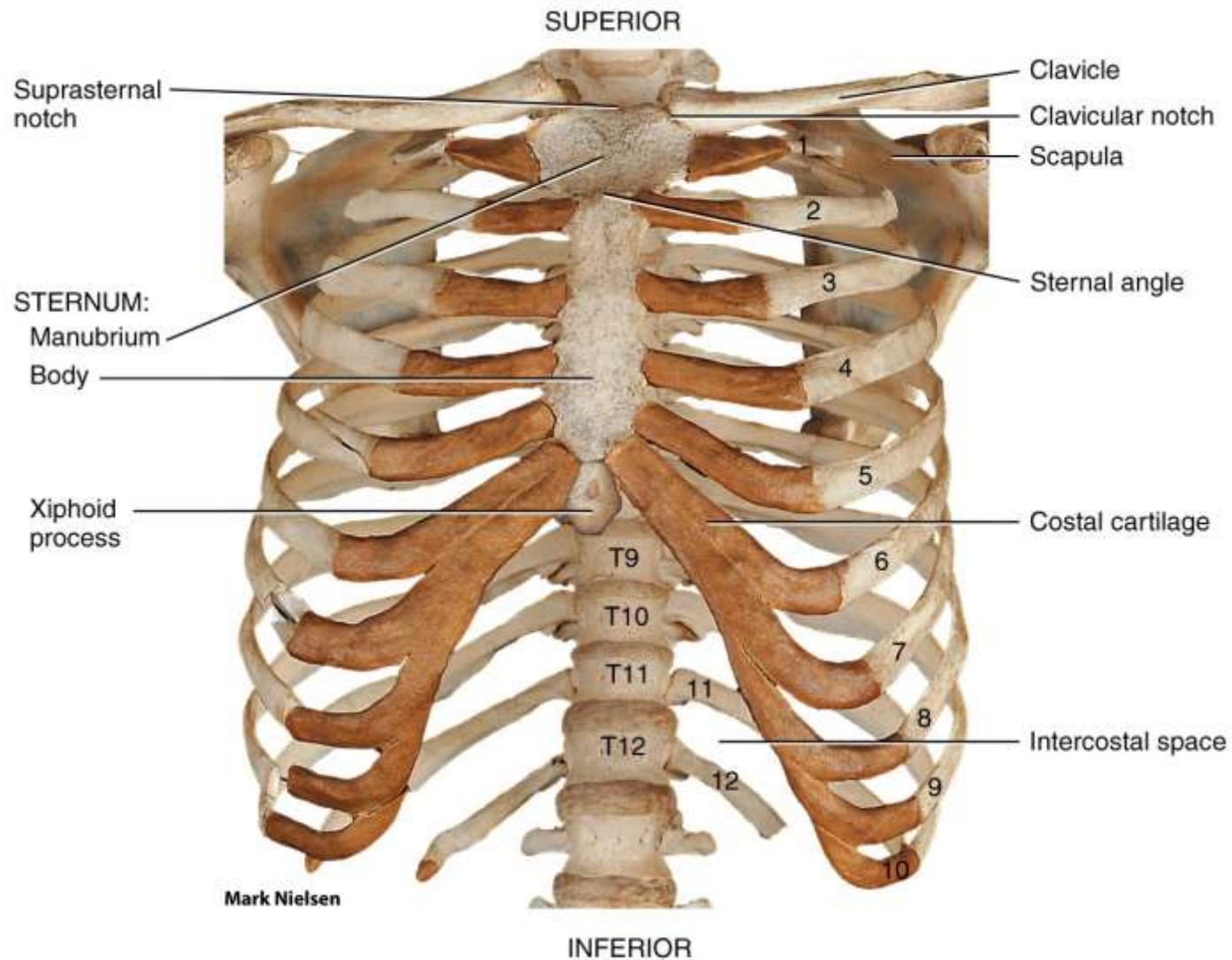
Thorax

- The skeletal part of the thorax is the thoracic cage.
 - Sternum
 - Ribs

Sternum



Sternum

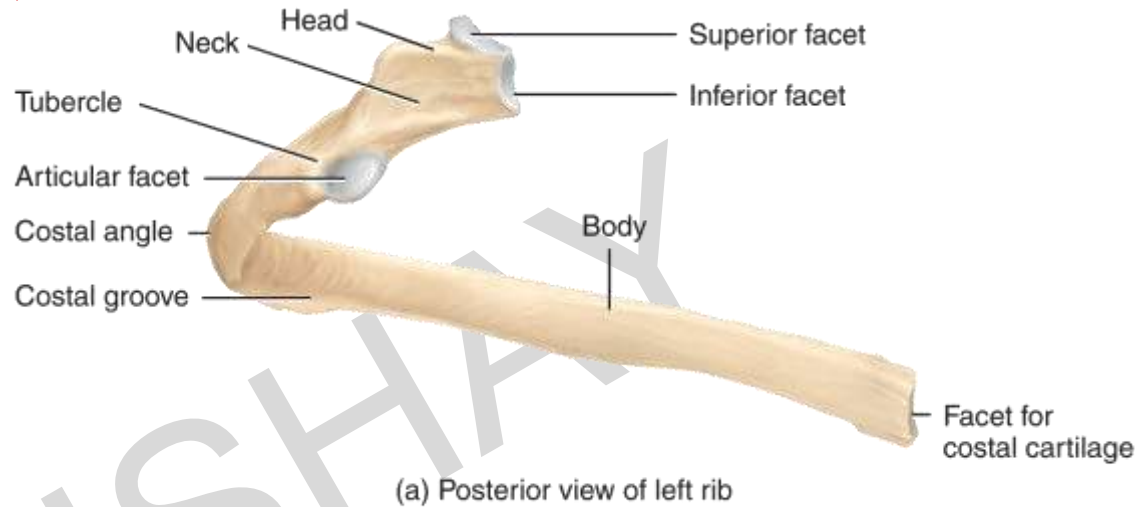


(c) Anterior view of skeleton of thorax

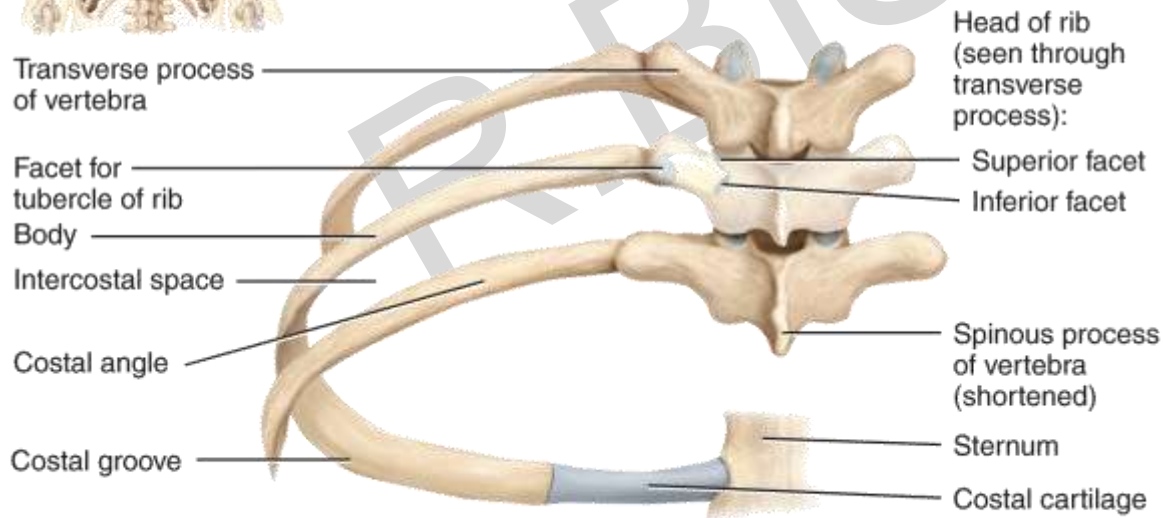
Surface Features of the Ribs

- Costal cartilage
- True ribs
- False ribs
- Floating ribs
- Head
- Facets
- Body

Structure of Ribs



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(b) Posterior view of left ribs articulated with thoracic vertebrae and sternum

Structure of Ribs

