Chapter 5
The Skeletal System

HUMAN PHYSIOLOGY

Loulousis

Applied Learning Outcomes

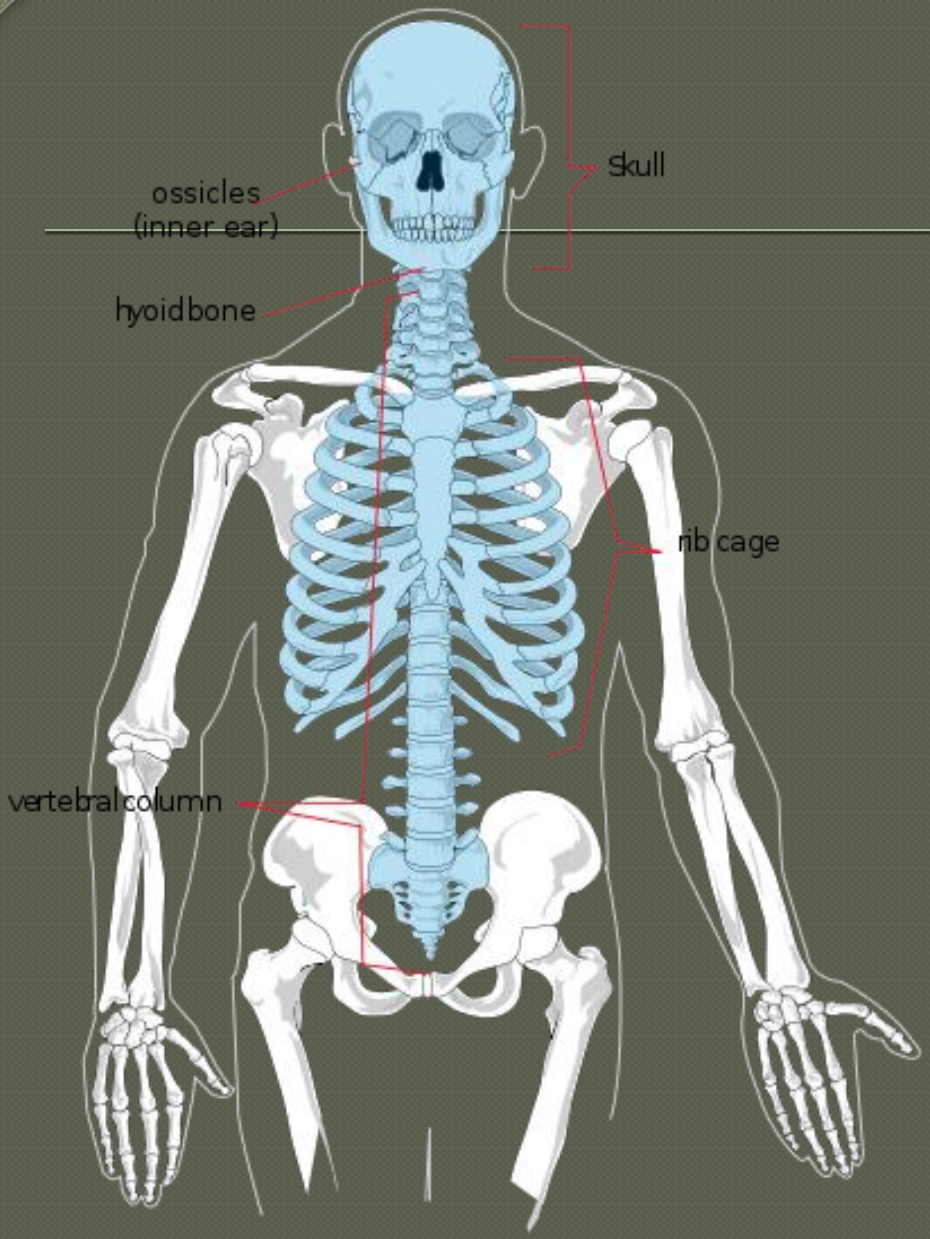
- Use the terminology associated with the skeletal system
- Learn about the following
  - Skeleton structure
  - Bone structure and types
  - Bone function
  - Bone tissue
  - Bone development and growth
  - Bone physiology
  - Bone articulations
- Understand the aging and pathology of the skeletal system

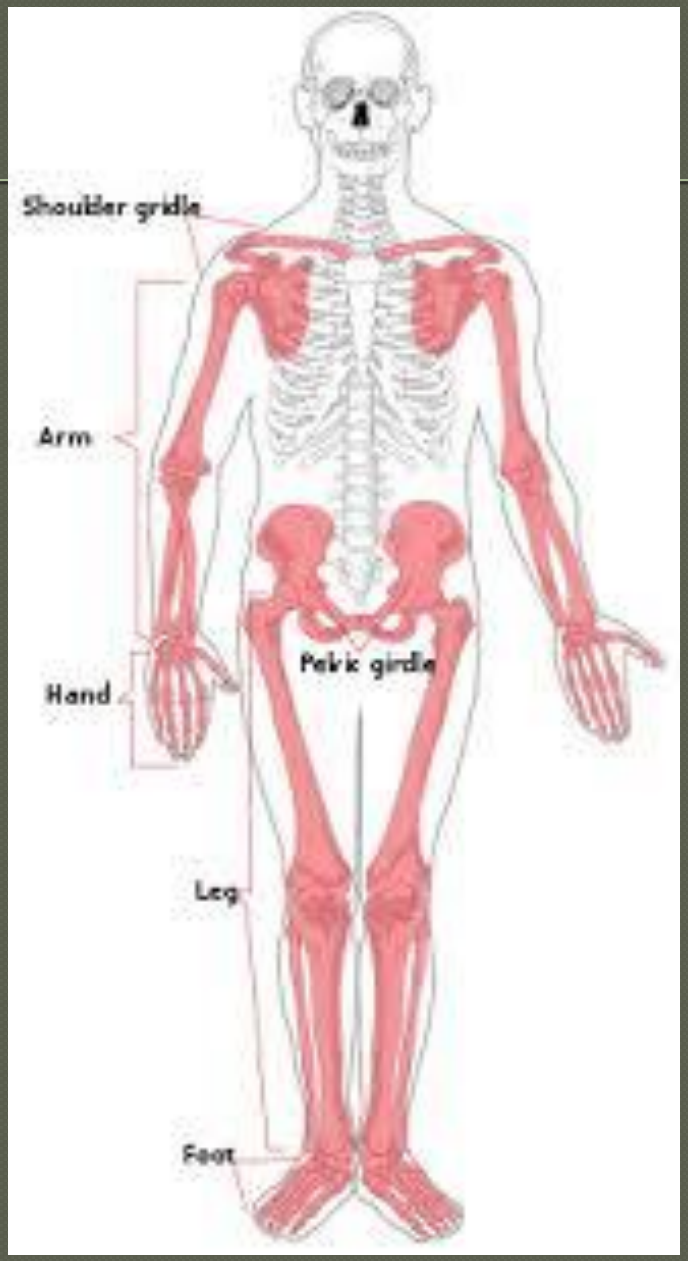
Overview

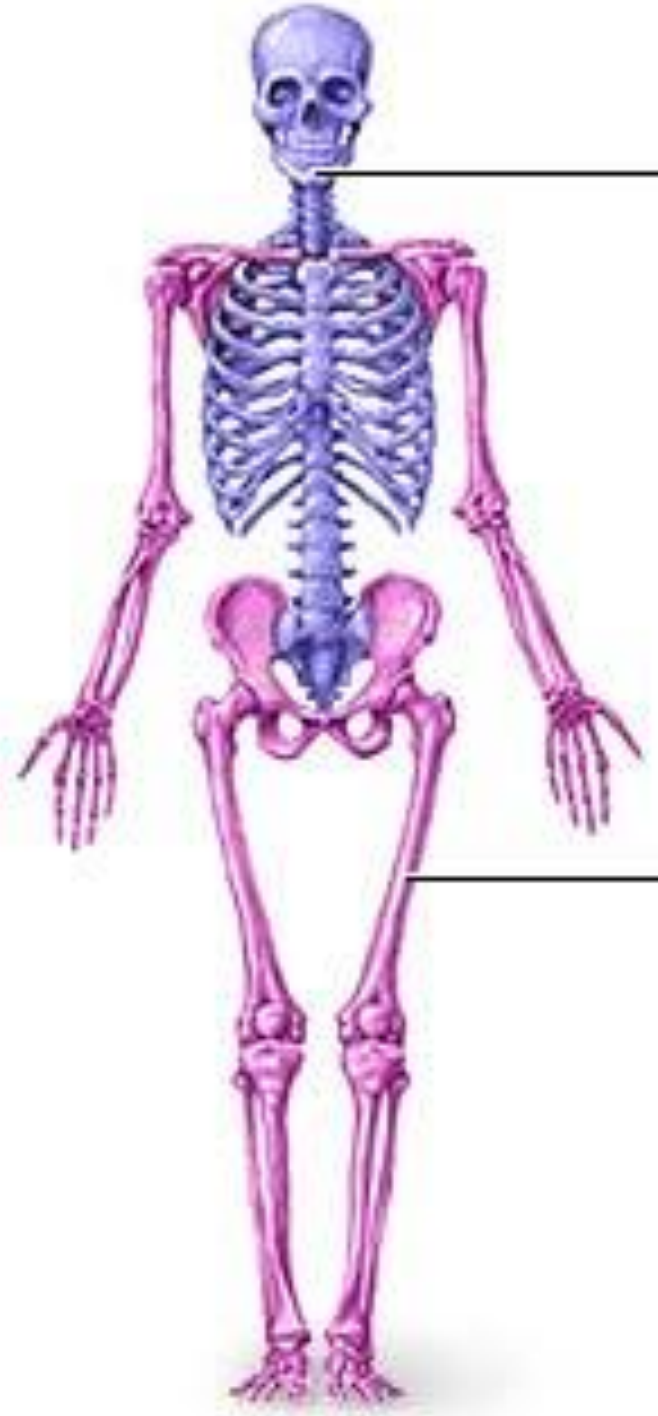
- Endoskeleton – internal skeleton, develops from mesenchyme cells of the embryonic mesoderm
- Organ system composed of:
  - Bones
    - Hard connective tissue
      - Associated with blood vessels, nerves, and stem cells
  - Cartilage
    - Flexible connective tissue
  - Ligaments
    - Connective tissue that joins bone to bone
  - Tendons
    - Connective tissue that joins muscle to bone
- Provides movement, protection, shape, and support

The Human Skeletal System

- Divided into 2 anatomically distinct regions
  - Axial
    - Spine, rib cage, hyoid bone, and skull
    - Basis of much age-related pathology
  - Appendicular
    - Upper appendages
      - Shoulders, arms, wrists, and hands
    - Lower appendages
      - Bones of feet, ankles, legs, kneecap, and hips
  - Pathology typically takes toll on joints
    - Articulations – junction between two or more joints


ossicles
(inner ear)
Skull
hyoid bone
rib cage
vertebral column


Shoulder girdle
Arm
Hand
Pelvic girdle
Leg
Foot



Axial skeleton (blue)

Appendicular skeleton (pink)

A.D.A.M.

Characteristics of Bones

- Surface features – each bone has characteristic markings
  - Protrusions and edges on bone formed by the pull of ligaments and tendons
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Axial Skeleton

- Composed of all the bones that are located along the vertical axis of the body
  - Skull – superior
  - Vertebral – medial
  - Ribs - inferior

SKULL

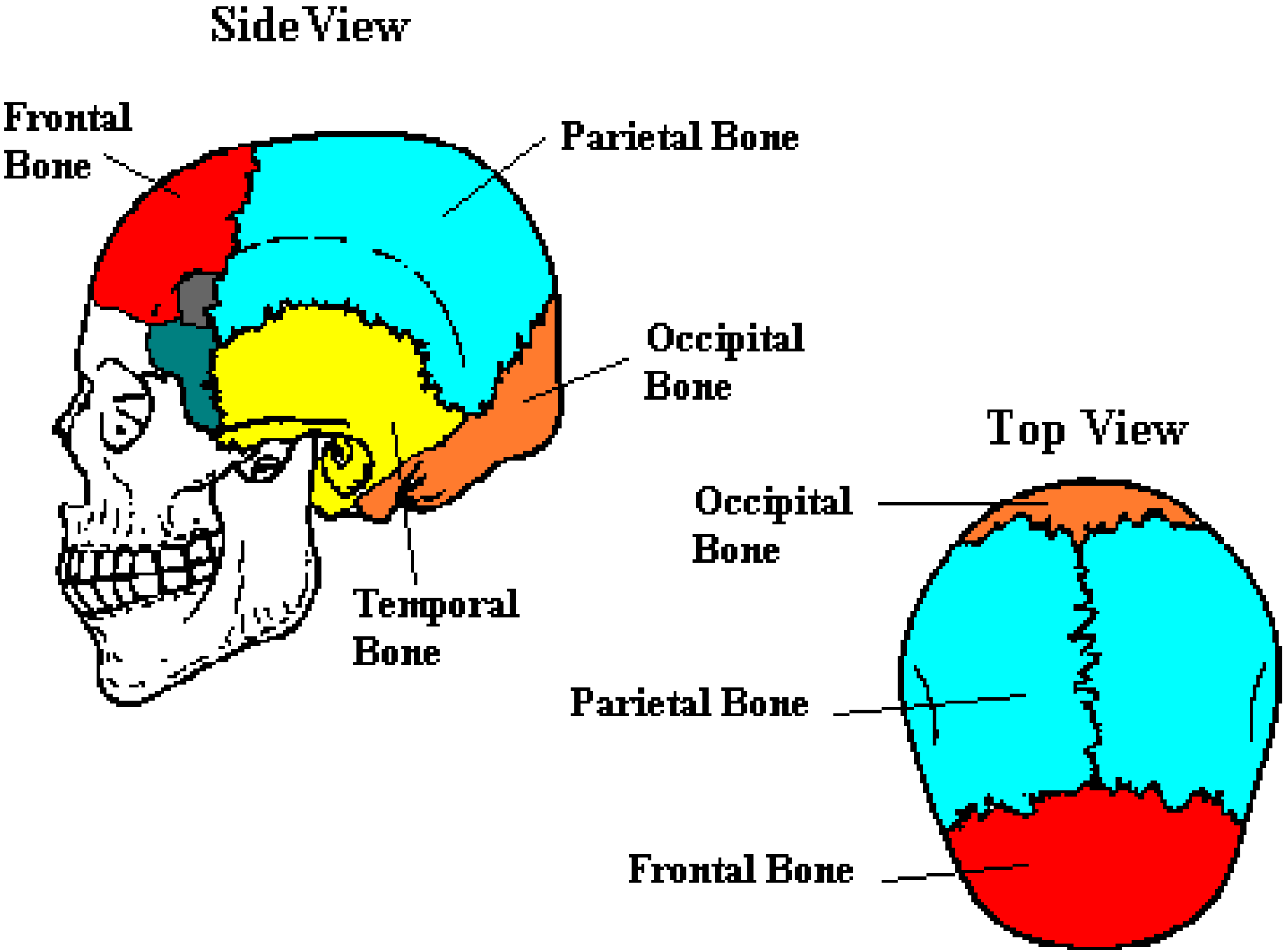
- Cranium – the skull
- Cranial bones – protect brain, ears, and eyes from physical damage
- 2 categories
  - Calvaria – dome shaped superior portion
  - Cranial base – composed of the ethmoid and sphenoid bonds

Calvaria

- Frontal bone
  - Front part, forms forehead and eyebrow ridges
  - Two bones that fuse together at birth
- Occipital bone
  - Back part of skull
- Parietal Bones
  - One either side of skull, roof of skull
- Flat portion of temporal bone
  - Form sides and base of skull

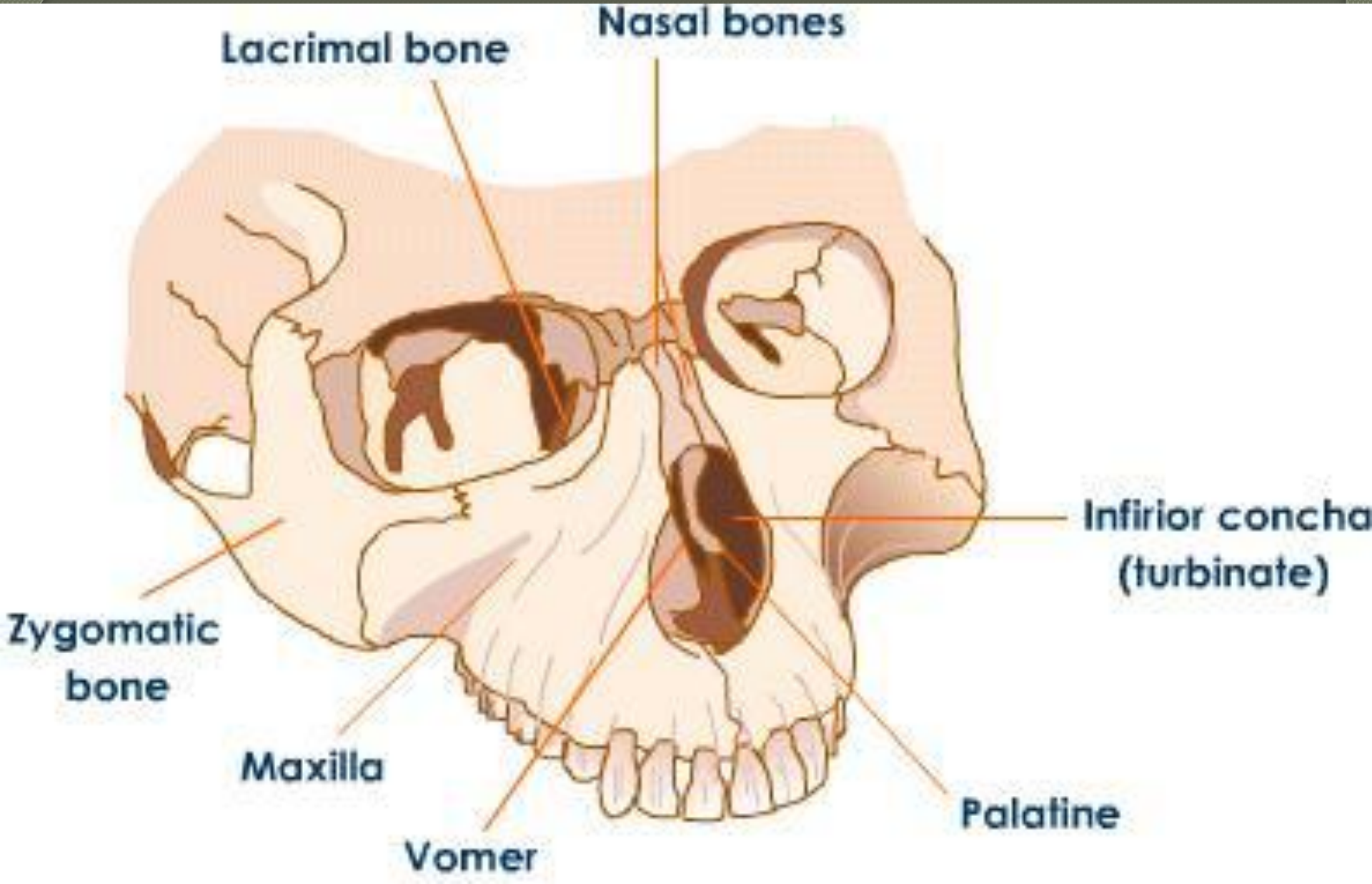
Cranial Base

- Ethmoid
  - Roof of the nasal cavity, inner wall of eye socket
- Sphenoid
  - Anterior base of cranium and the posterior orbit


Side View
Frontal Bone
Parietal Bone
Occipital Bone
Temporal Bone
Top View
Occipital Bone
Parietal Bone
Frontal Bone

Facial Bones – 15 total

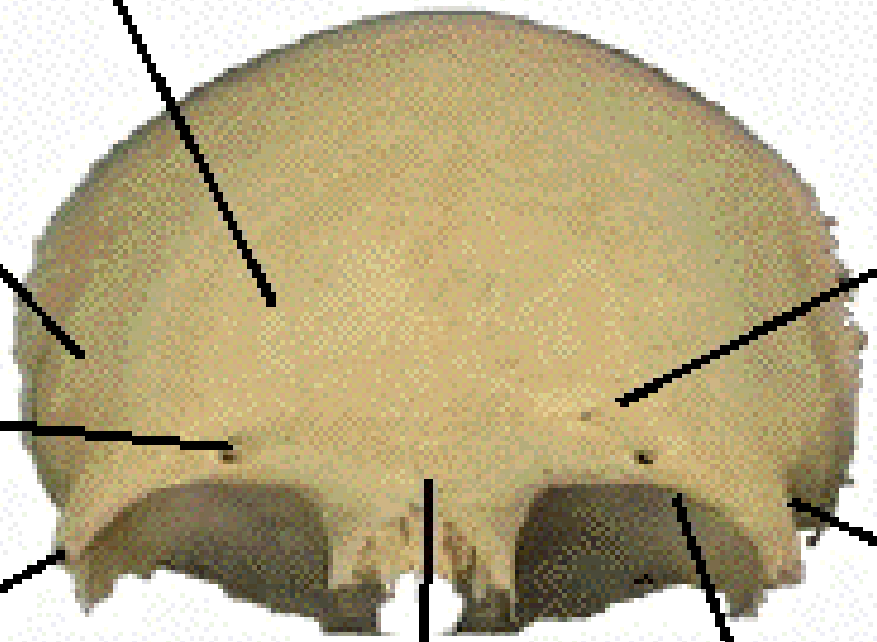
- Inferior nasal conchae
  - Inferior protrusion in nasal cavity
- Lacrimal bones
  - Forms medial region of the orbit
- Mandible
  - Lower jawbone
- Maxillary bones
  - Upper jawbone
- Nasal bones
  - Bridge of nose
- Palatine bones
  - Walls of nasal cavity and posterior roof of mouth
- Vomer
  - Inferior part of nasal septum
- Zygomatic
  - cheeks


Lacrimal bone
Nasal bones
Infirior concha
(turbinate)
Zygomatic
bone
Maxilla
Palatine
Vomer

Frontal Bone Characteristics

- Forms upper part of eye sockets, or orbits
- Orbital ridge – thickened area of frontal bone above each orbit
  - Underlies the eyebrows and varies among people
  - Males have thicker ridge than females
  - Males eyebrows sit lower on the orbital ridge
- Left and right sinuses
  - Not present at birth
    - Develop at 2 to 5 years
    - Lighten the weight of the skull and warm the air taken in for breathing
- Coronal suture
  - Where frontal bone is joined to the two parietal bones
- Sagittal suture – where parietal bones are joined medially

The Frontal Bone



Frontal Eminence

Temporal Line

Supra-Orbital Foramen

Zygomatic Process

Metopic Suture

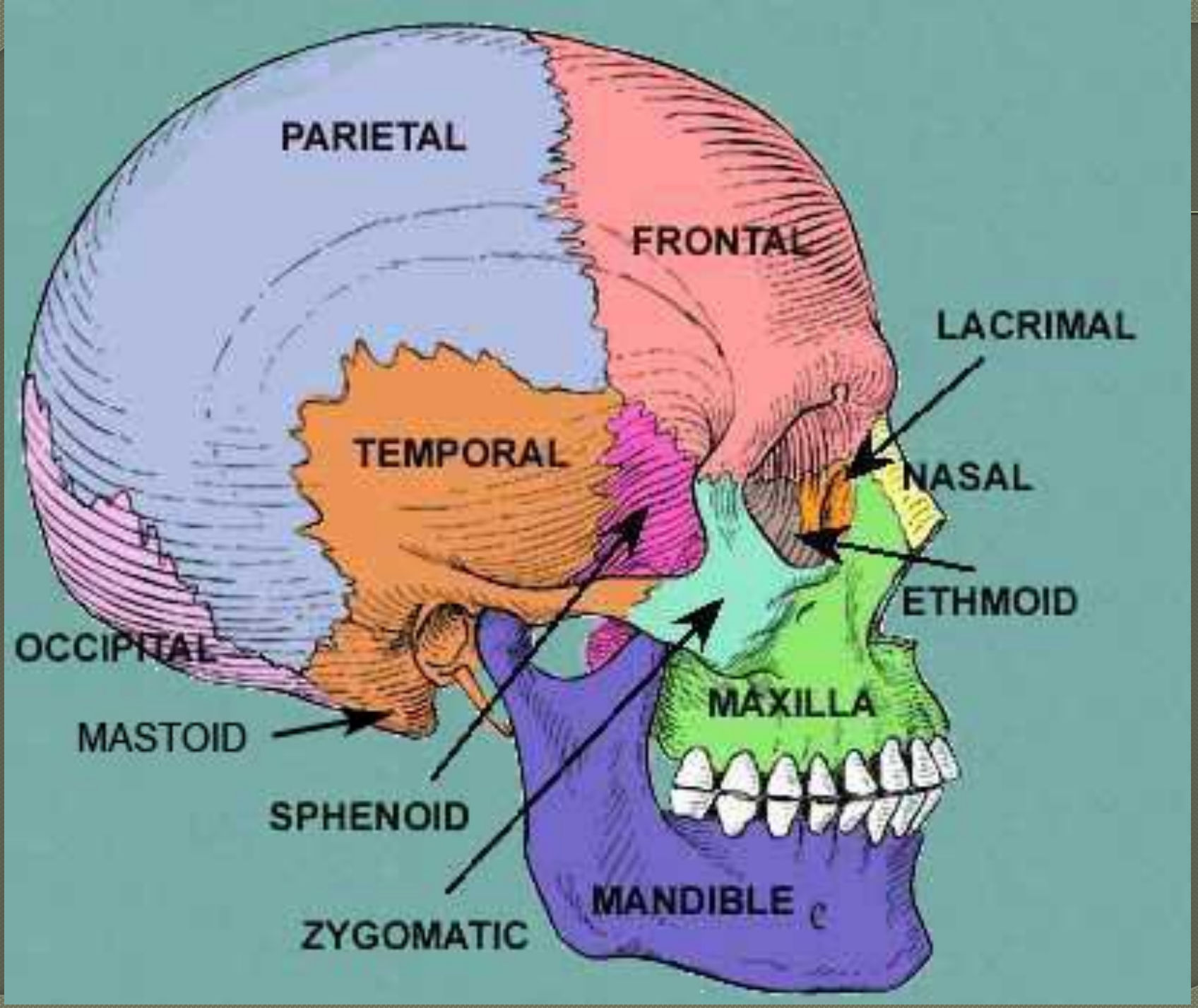
Supra-Orbital Margin

Brow Ridge

Frontal Crest

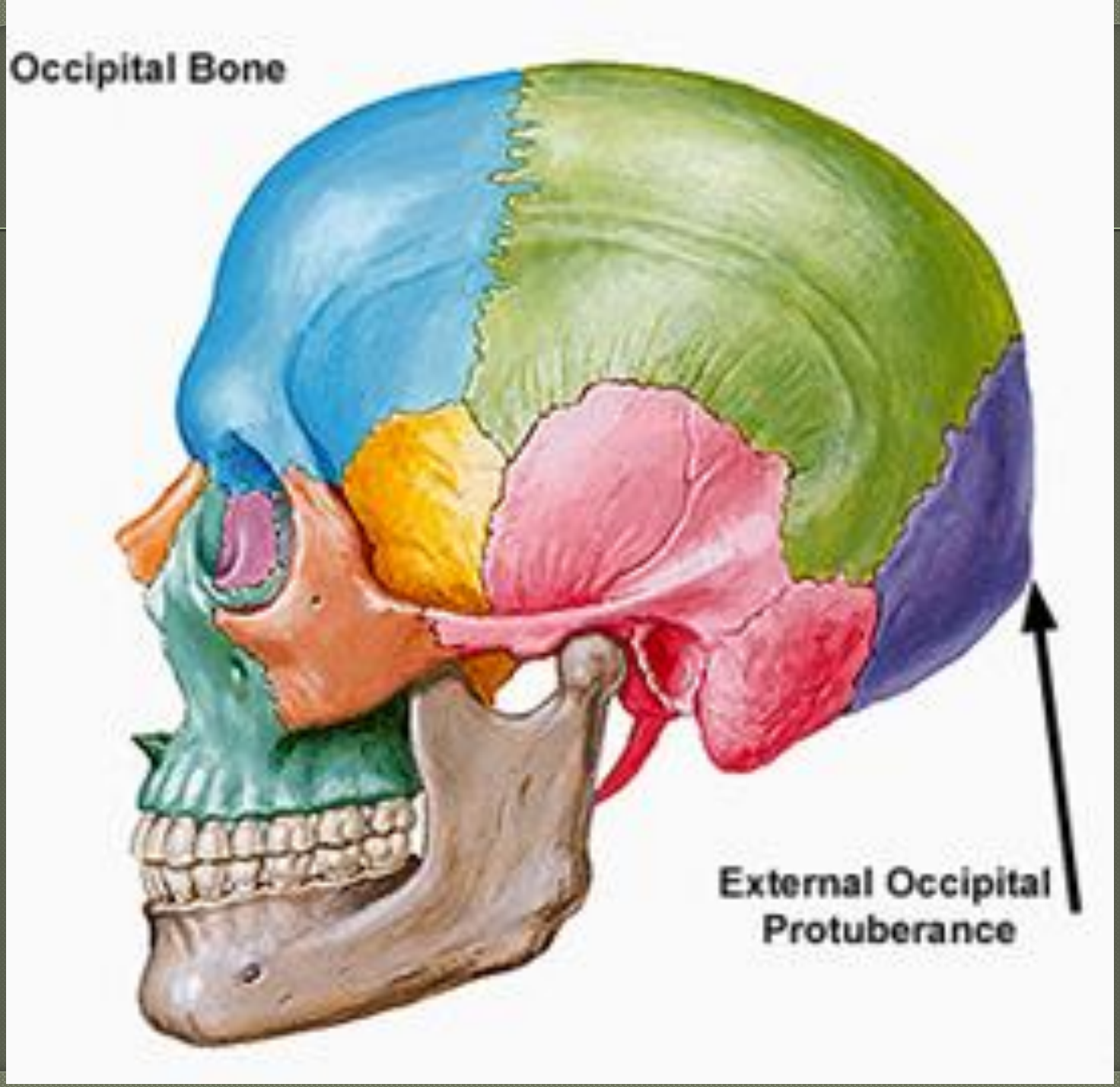
Temporal Bone Characteristics

- Squamousal suture – fused to the parietal bones
- Mastoid process
  - Attachment for neck muscles
- Styloid process
  - Slender process that projects from the temporal bone
- Tympanic region
  - Region containing ear bones
- Zygomatic process
  - Articulates with the zygomatic bone to form cheek


PARIETAL
FRONTAL
LACRIMAL
TEMPORAL
NASAL
ETHMOID
OCCIPITAL
MAXILLA
MASTOID
SPHENOID
MANDIBLE
ZYGOMATIC

Occipital Bone

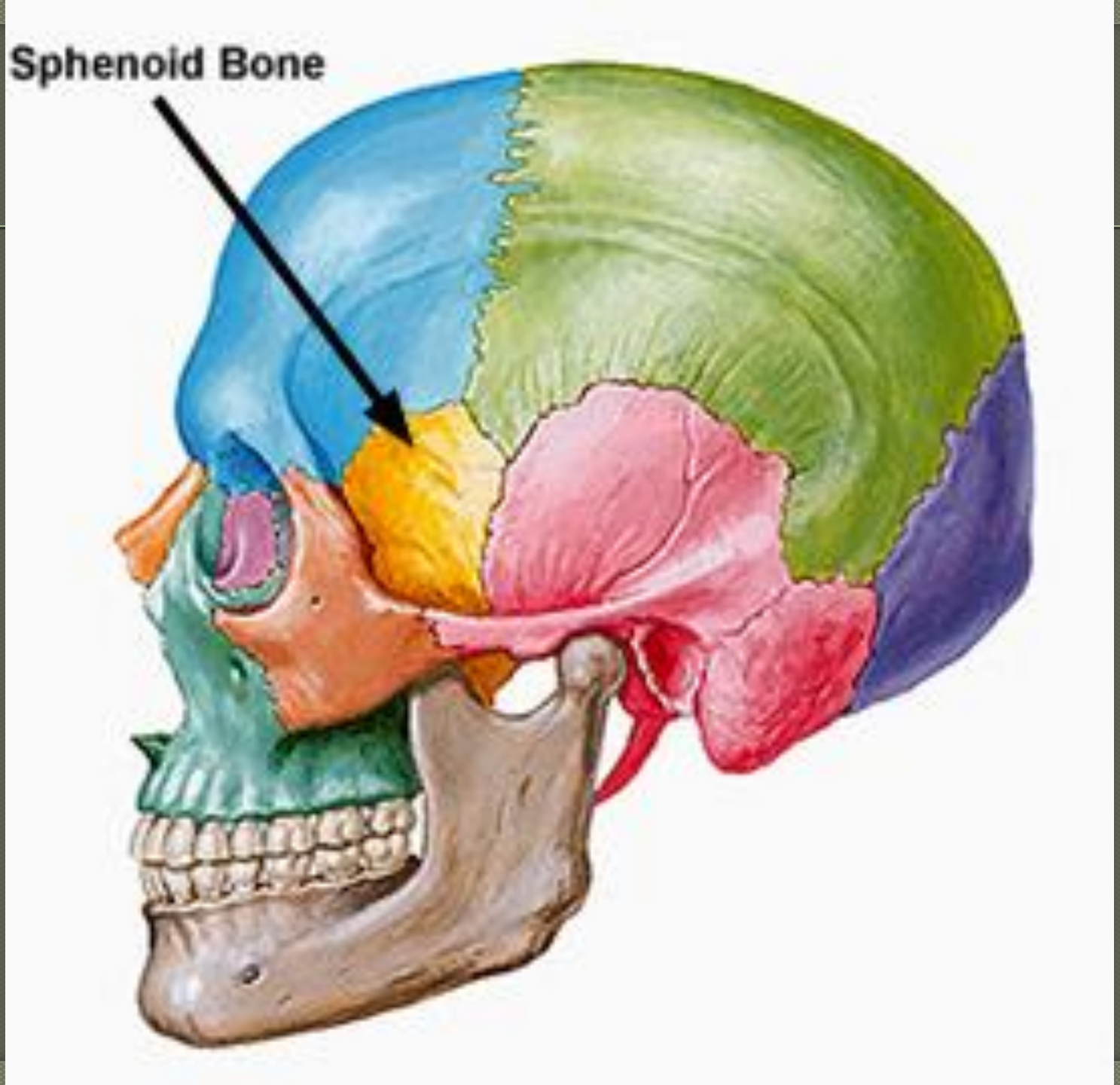
- Foramen magnum, or occipital foramen
  - Opening where spinal cord enters the brain
- Occipital condyles
  - Attach the head to the vertebral column, allow head movement


Occipital Bone
External Occipital
Protuberance

Sphenoid Bone

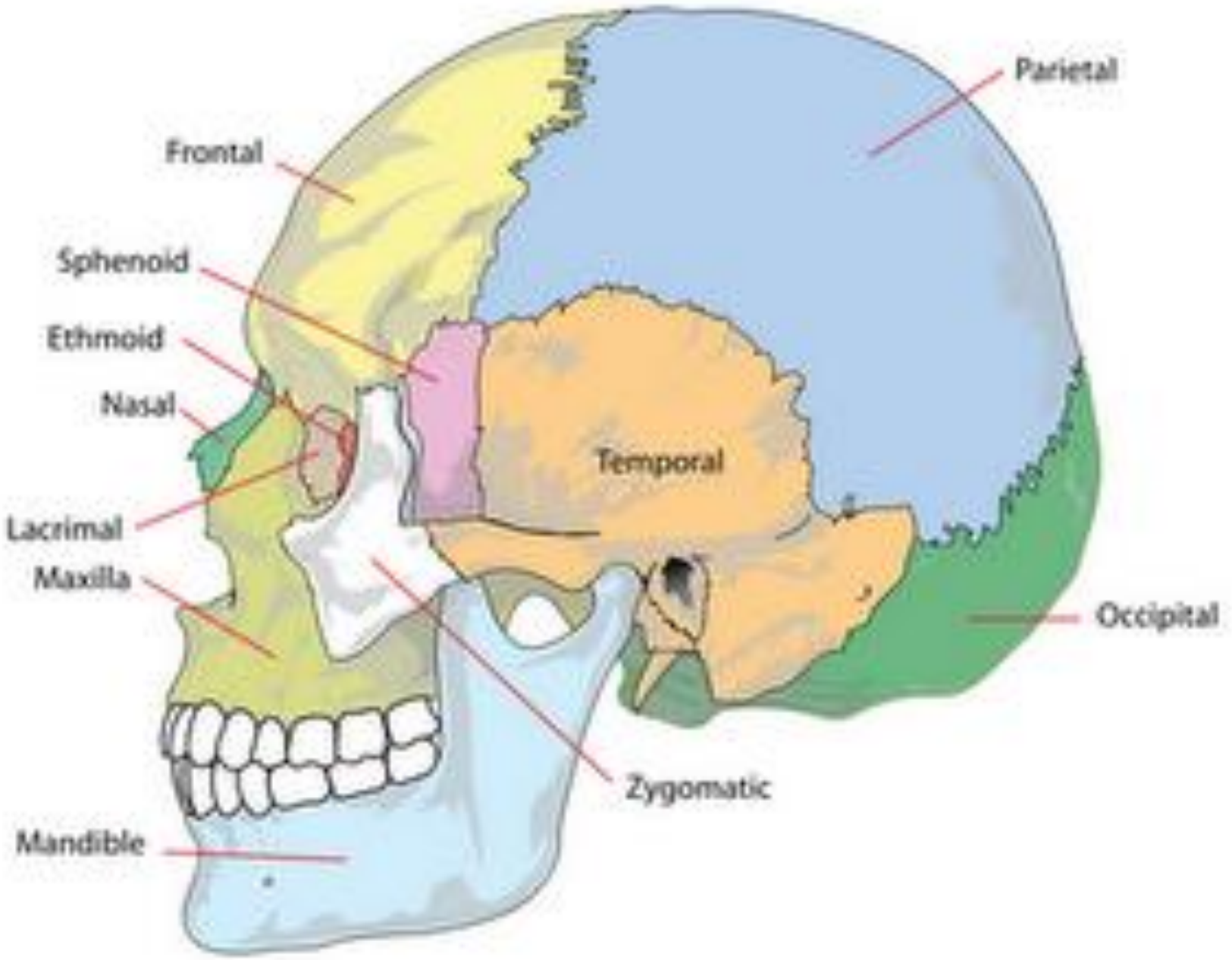
- Sphenoidal sinuses
  - Connected to inner part of nasal cavities
- Sella turcica
  - Encases pituitary gland

- Major blood vessels, and nerves of the face pass through this bone


Sphenoid Bone

Ethmoid Bone

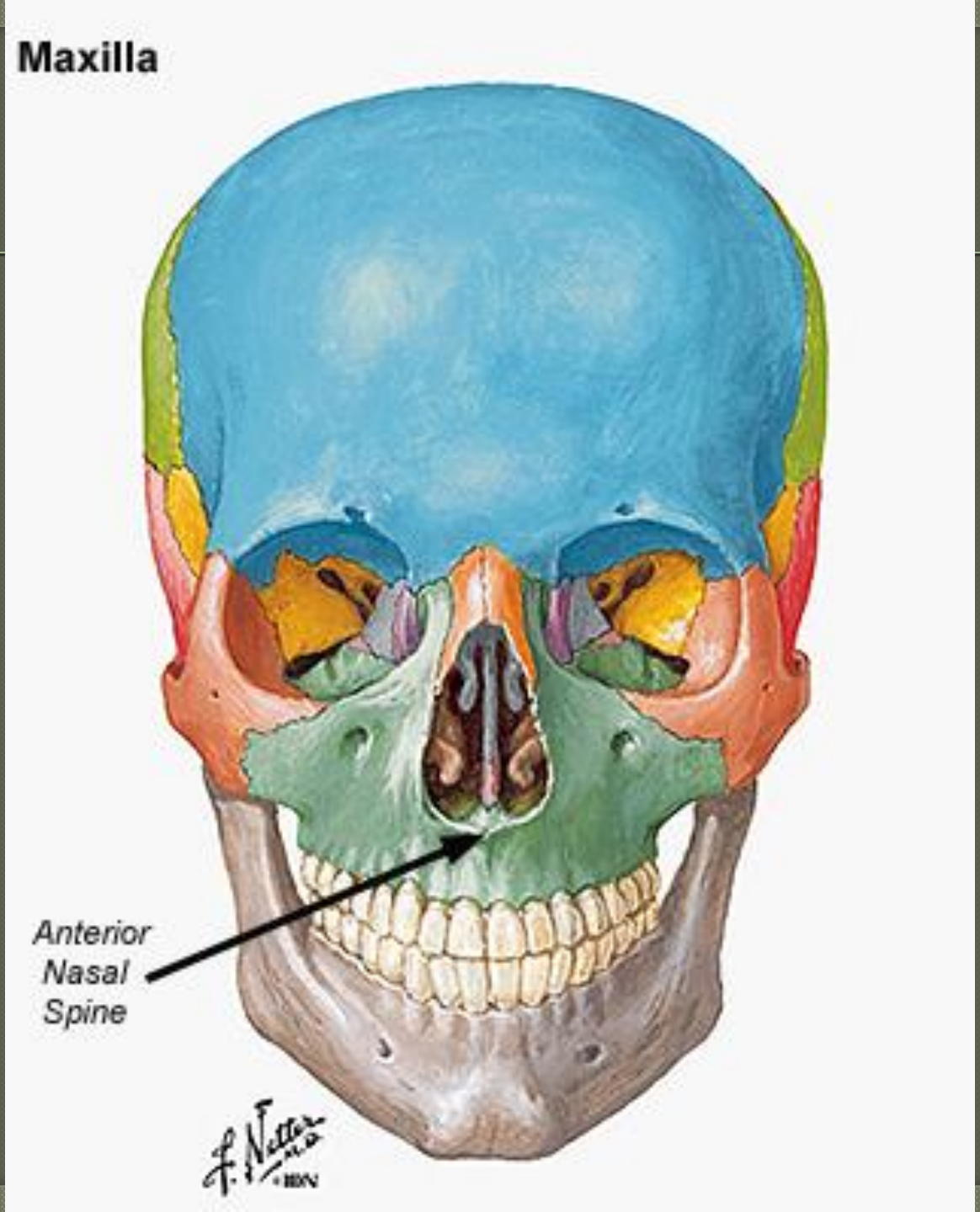
- Cribriform plate
  - Passageway for nerves that detect smell
- Ethmoid labyrinth
  - Forms upper part of nasal cavity
    - Believed to clean and moisten air that enters the nose


Parietal
Frontal
Sphenoid
Ethmoid
Nasal
Temporal
Lacrimal
Maxilla
Occipital
Zygomatic
Mandible

Maxillary

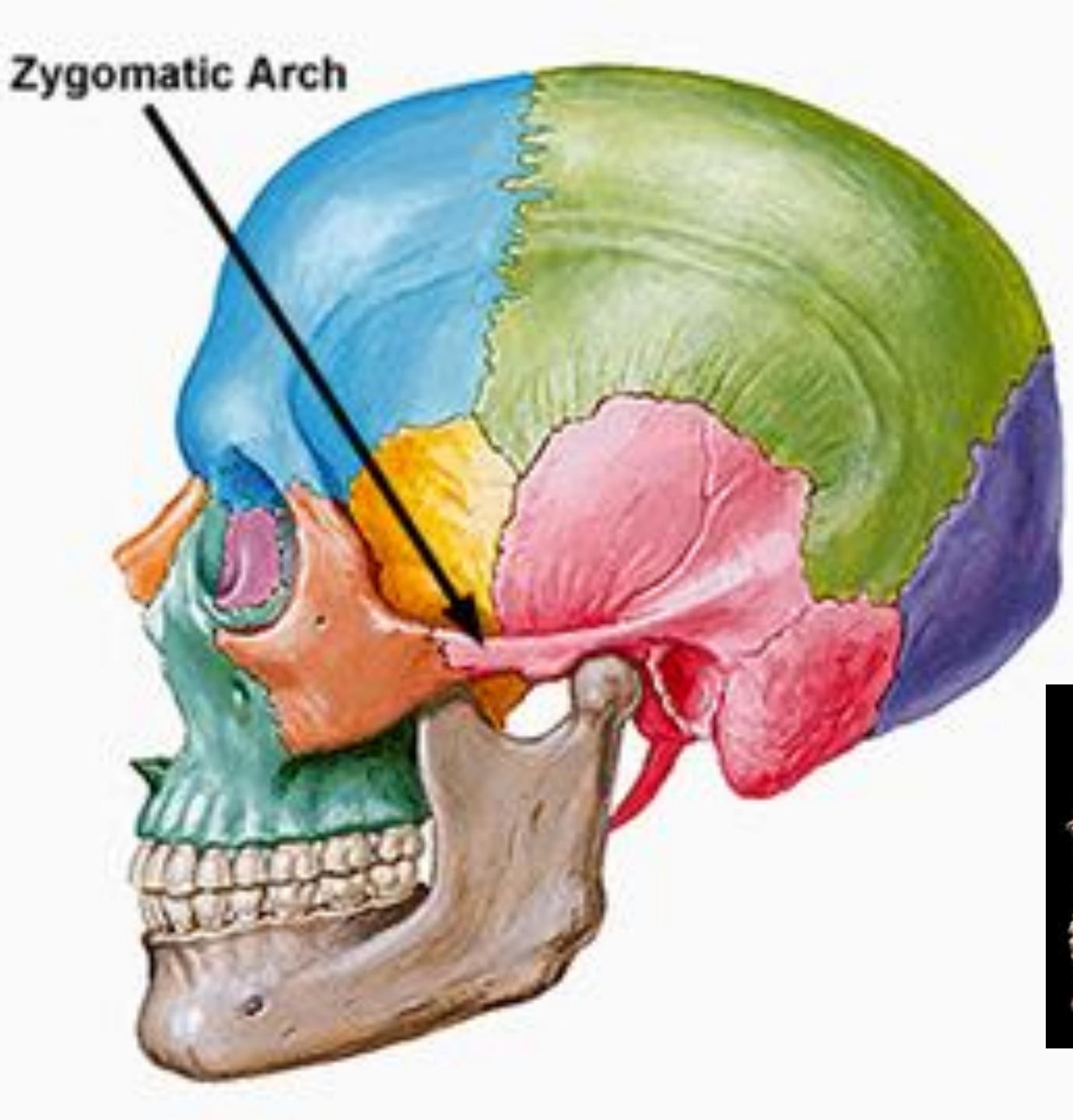
- Inferior orbital foramen – passageway for major blood vessels
- 2 large sinuses (maxillary sinuses) – speculative functions

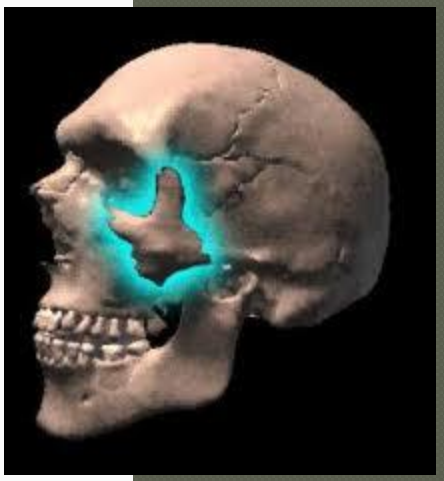
Maxilla



Zygomatic

- Zygomatic arch – composed of zygomatic and temporal bones
  - Muscles that assist with chewing
    - Sits higher and further forward in females


Zygomatic Arch

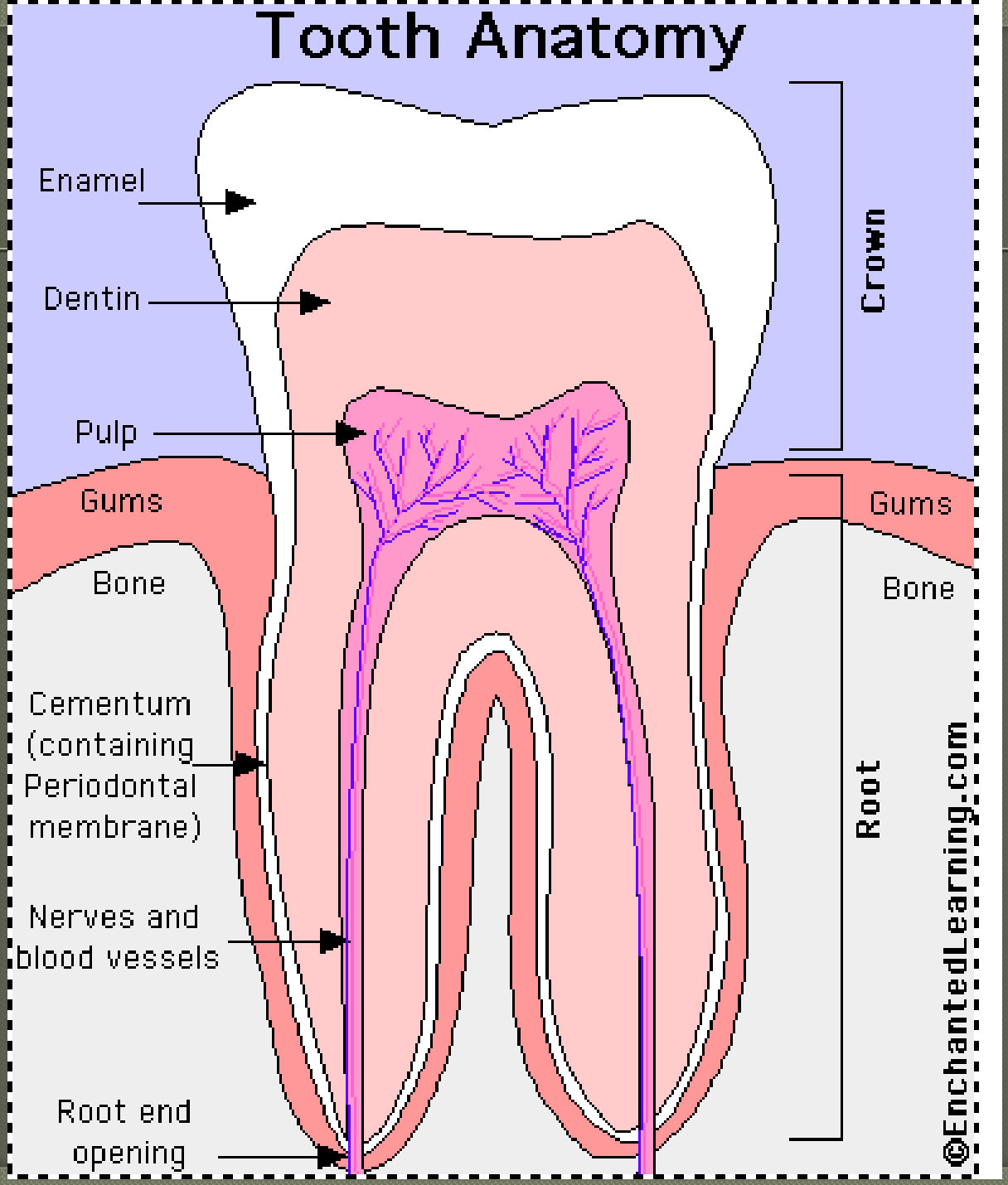


Mandible

- Largest of facial bones
  - In males, thicker and larger
- Alveolus
  - Socket in jawbone out of which teeth grow
- Body
  - Contains teeth
- Condyle
  - Articulates with the temporal bones
- Ramus
- Mental foramina – passageway to teeth for blood vessels and nerves
- Mandible and hyoid bones – only bones NOT fused to the rest of the skull

The Tooth

- Have a crown and a root
- Crown – projects above the gum
  - Enamel – hard material that covers crown
    - Hard, thin, transparent layer of calcium and protein, protects dentin
  - Dentin – layer of tooth that protects pulp
- Root – imbedded in alveous


Tooth Anatomy
Enamel
Dentin
Pulp
Gums
Bone
Cementum (containing Periodontal membrane)
Nerves and blood vessels
Root end opening
Crown
Gums
Bone
Root
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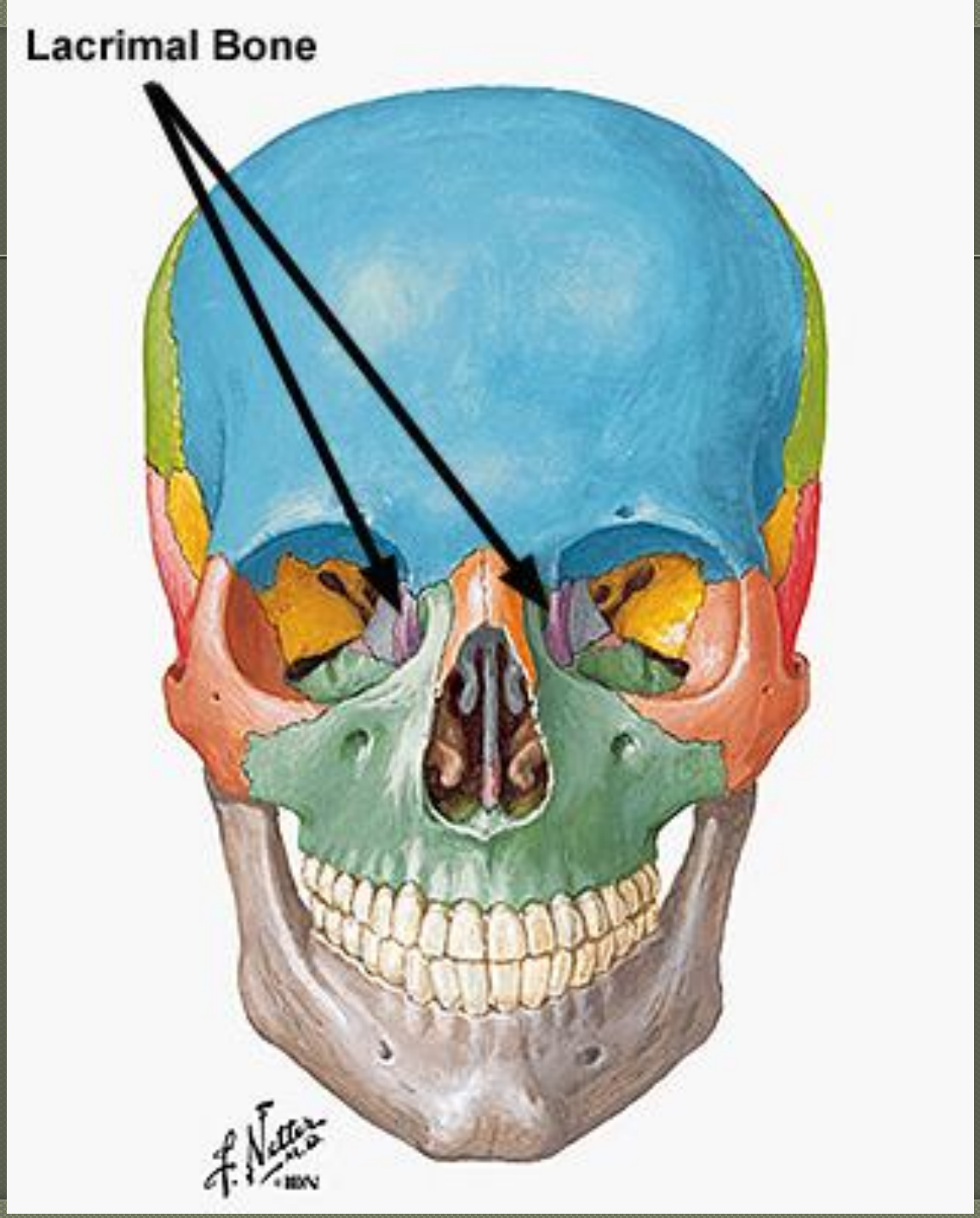
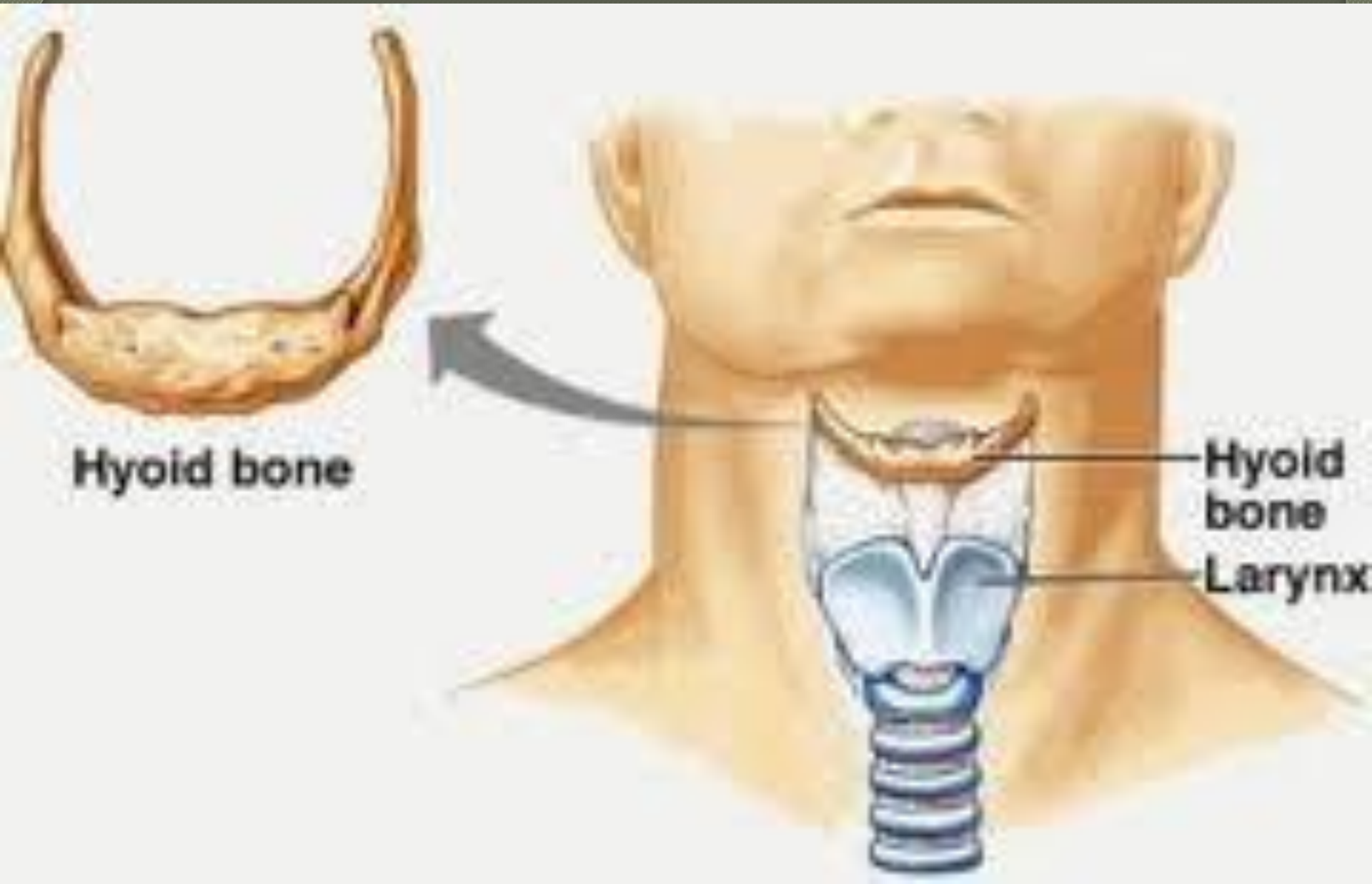
Lacrimal

- Smallest, most fragile facial bone
- Sliver of bone on anterior region of each orbit


Lacrimal Bone

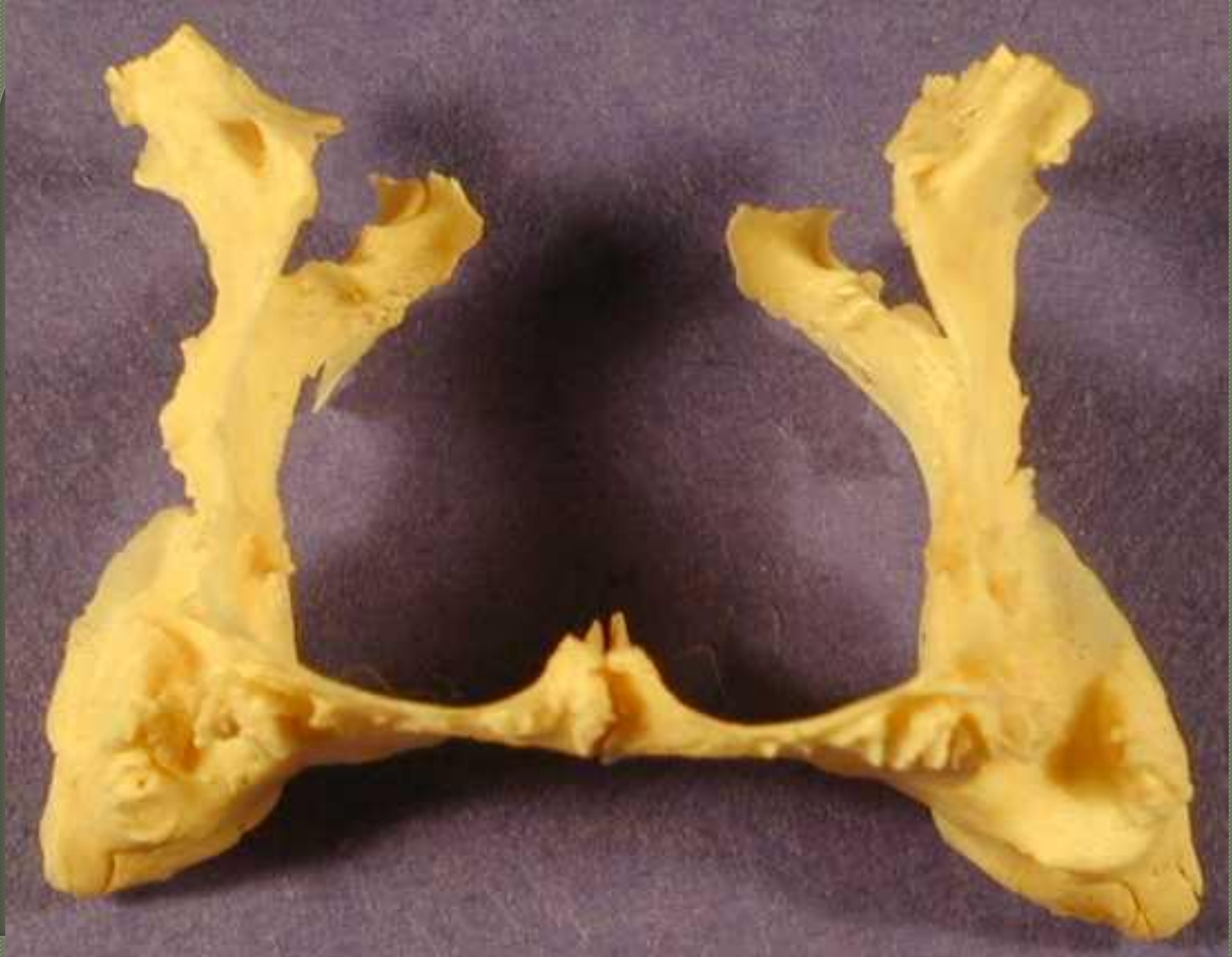
Hyoid Bone

- U-shaped bone in neck supporting the muscles of tongue, larynx, and pharnyx
- Suspended, not attached


Hyoid bone
Hyoid bone
Larynx

Palatine Bones

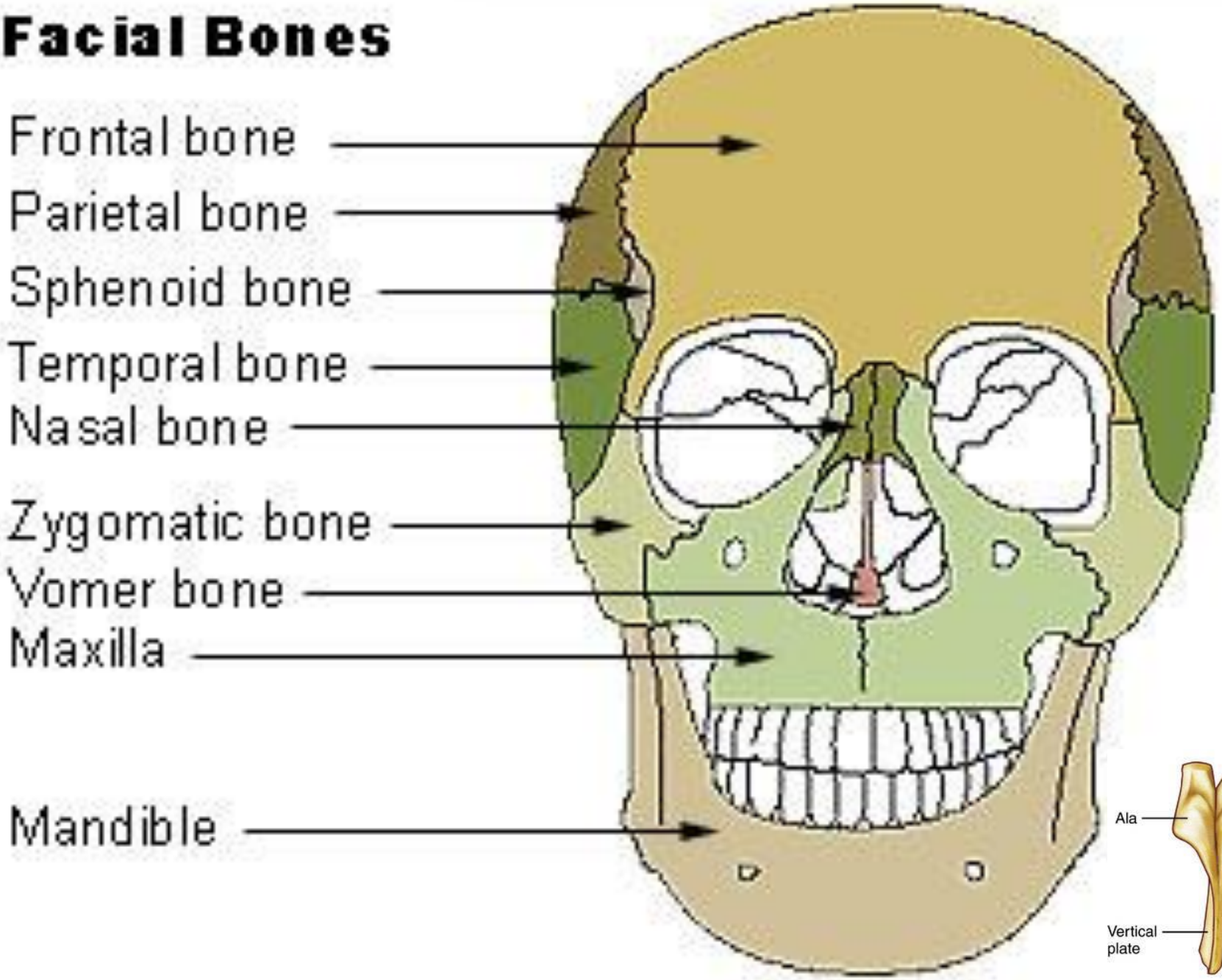
- Back part of nasal cavity, between maxillary and sphenoid
- Forms walls of the nasal cavity, roof of mouth, and bottom of orbits
- Grows in height as facial features mature from birth through adolescence

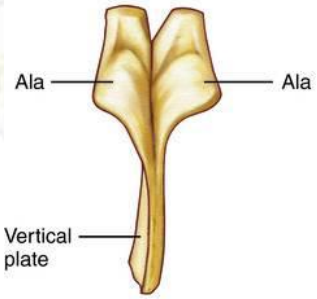


Vomer

- Sits medially in nasal cavity
  - Fused to ethmoid and sphenoid
- Starts out as sliver of cartilage
  - Completely hardens after puberty
- Nasal septum – plate that divides the nasal cavity
  - Formed by ethmoid, vomer, and cartilage
- Inferior nasal conchae – lateral sides of nasal cavity
  - Covered with mucous membranes that clean, warm, and moisturize air.

Facial Bones





5.2 Vertebral Column and Rib Cage

- Vertebral column is flexible column formed of series of bones called vertebrae
  - 5 distinct regions
    - Cervical (neck) – 7 vertebrae
    - Thoracic (articulates with rib cage) – 12 vertebrae
    - Lumbar (lower back) – 5 vertebrae
    - Sacral (articulate with hipbone) – 5 fused vertebrae
    - Coccygeal – (tail end) – 3 to 5 fused vertebrae
- # of vertebrae can vary from person to person, cervical vertebrae rarely varies

True vs. False Vertebrae

- Upper 3 regions – TRUE, or movable vertebrae
- Sacral and coccygeal are false, or fixed
  - Because they are fused together are false

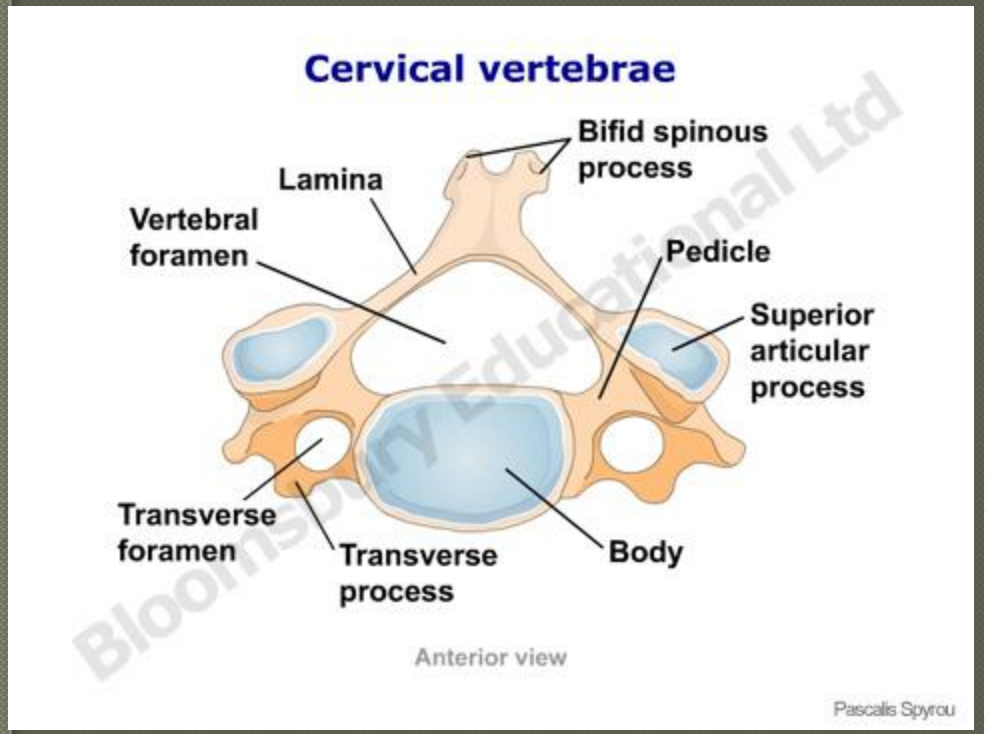
Typical Vertebral Bone

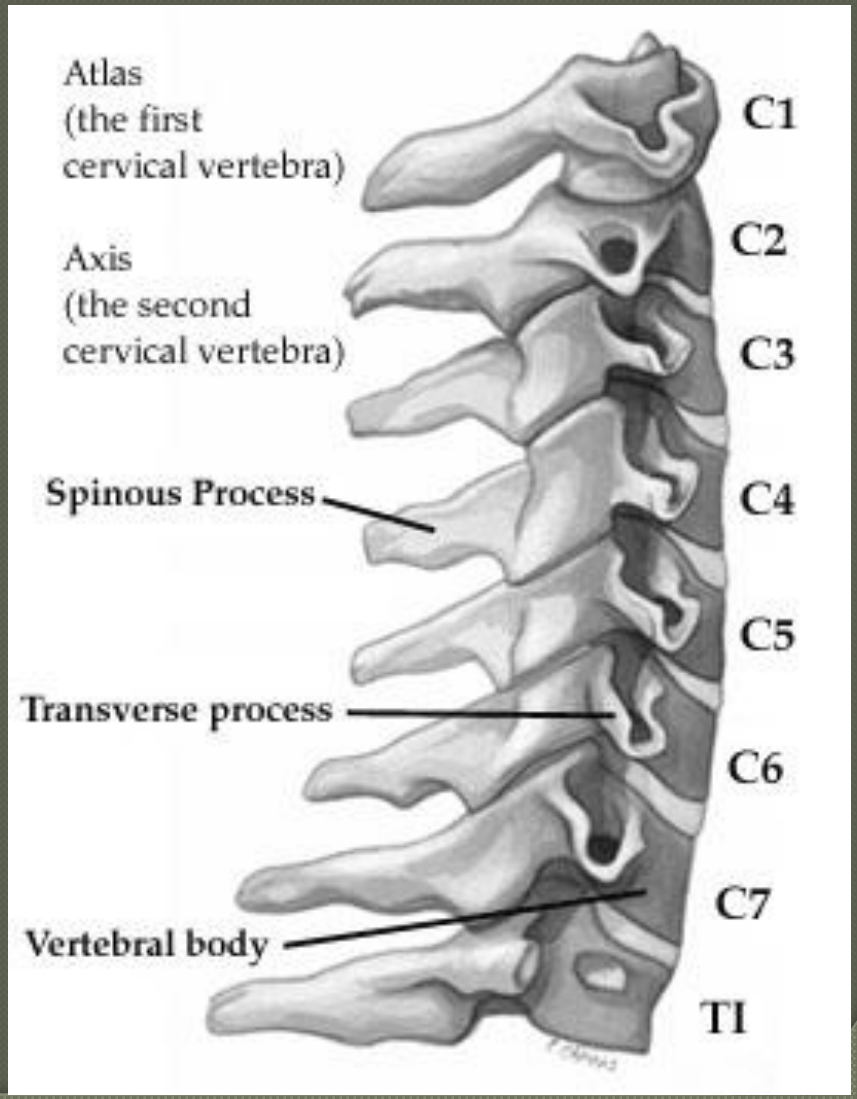
- Vertebral body
  - Supports the weight of the body
- Vertebral arch
  - Composed of a pair of pedicles, four articular processes, two laterally projecting transverse processes, and a spinous process
    - Processes are important muscle attachment points
    - Articular processes – articulate vertebrae with each other
- Vertebral foramen
  - Passageway for the spinal cord

Cervical Vertebrae Specifics

- Smaller body than others
- Small transverse processes, short spinous process
- Two transverse foramina
  - Passageways for major blood vessels into the skull
- 2 specialized vertebrae
  - Atlas
    - Supports skull, lacks a body, has large set of articular surfaces that attach to the occipital bone
  - Axis
    - Allows atlas and head to rotate
    - Has large protrusion called the dens, or odontoid process

Cervical Vertebrae

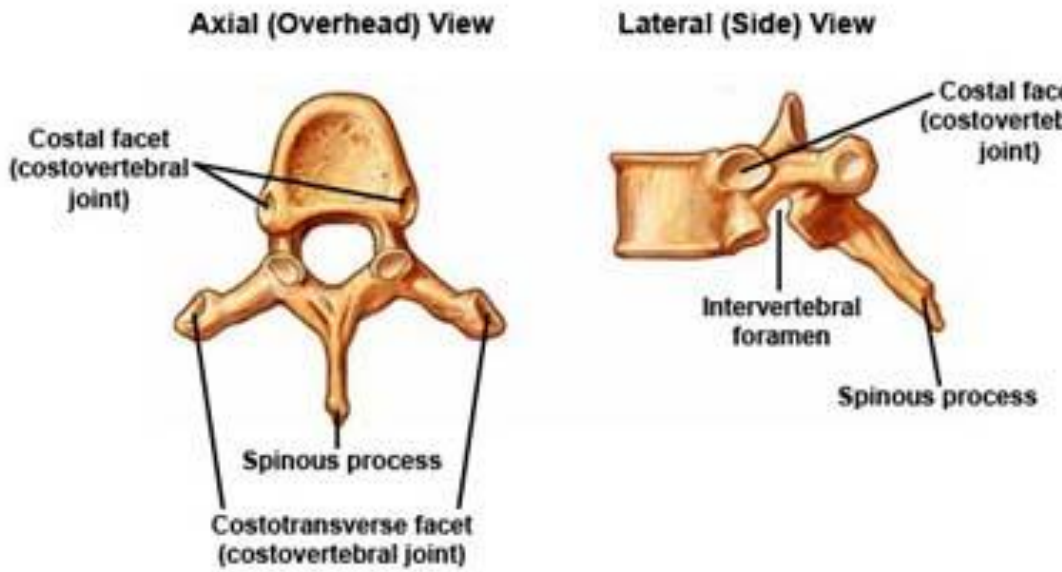


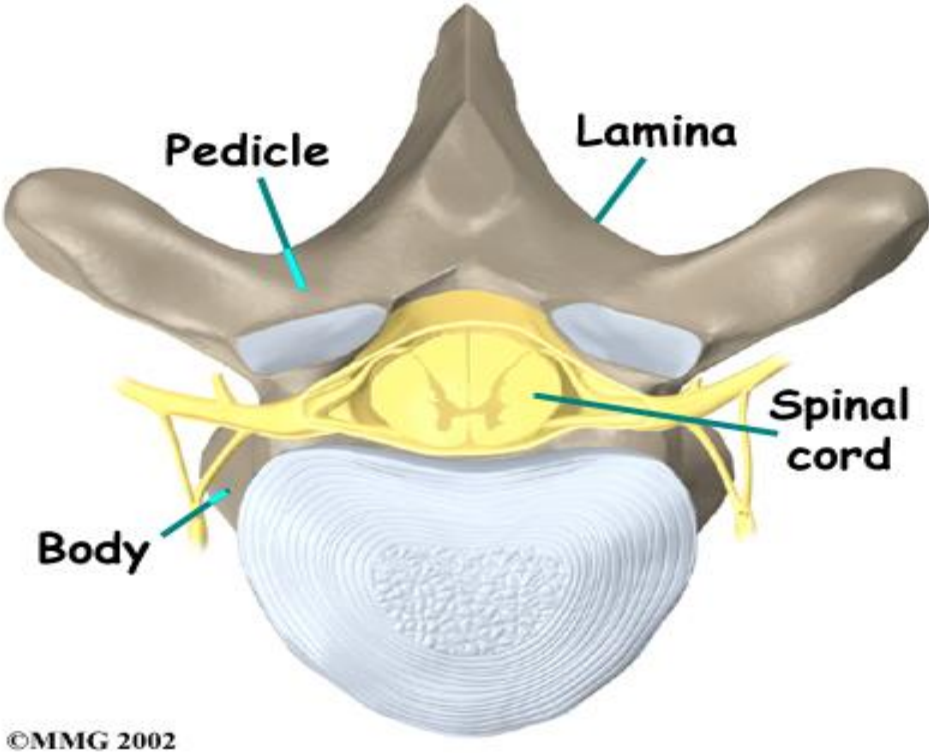


Thoracic Vertebrae Specifics

- Larger body than cervical vertebrae
- Spinous process is long and narrow
- Two articulation points with the ribs
  - Each transverse process has articulation point with one rib
  - Dorsal portion of body – permits the ribs to flex for breathing

Thoracic Vertebrae

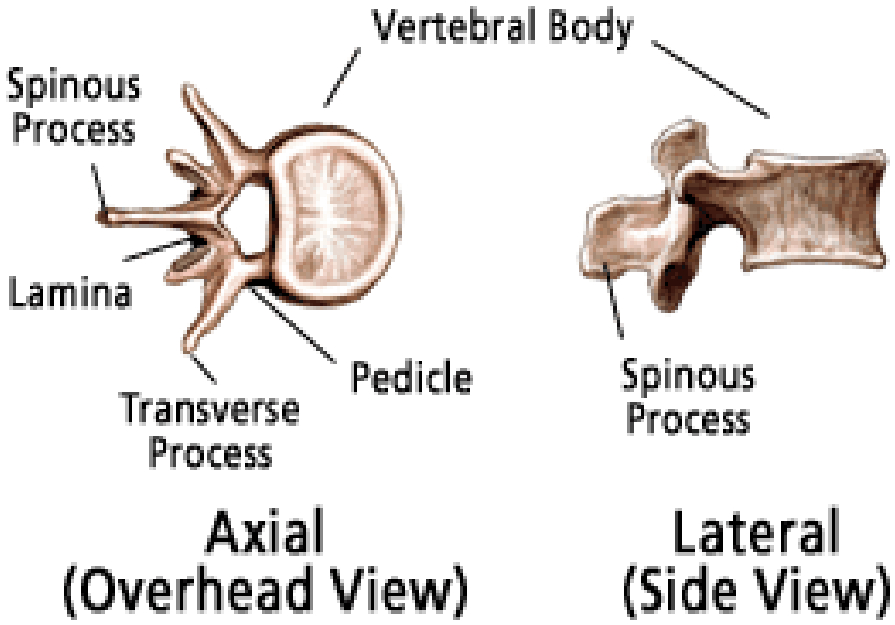




Lumbar Vertebrae Specifics

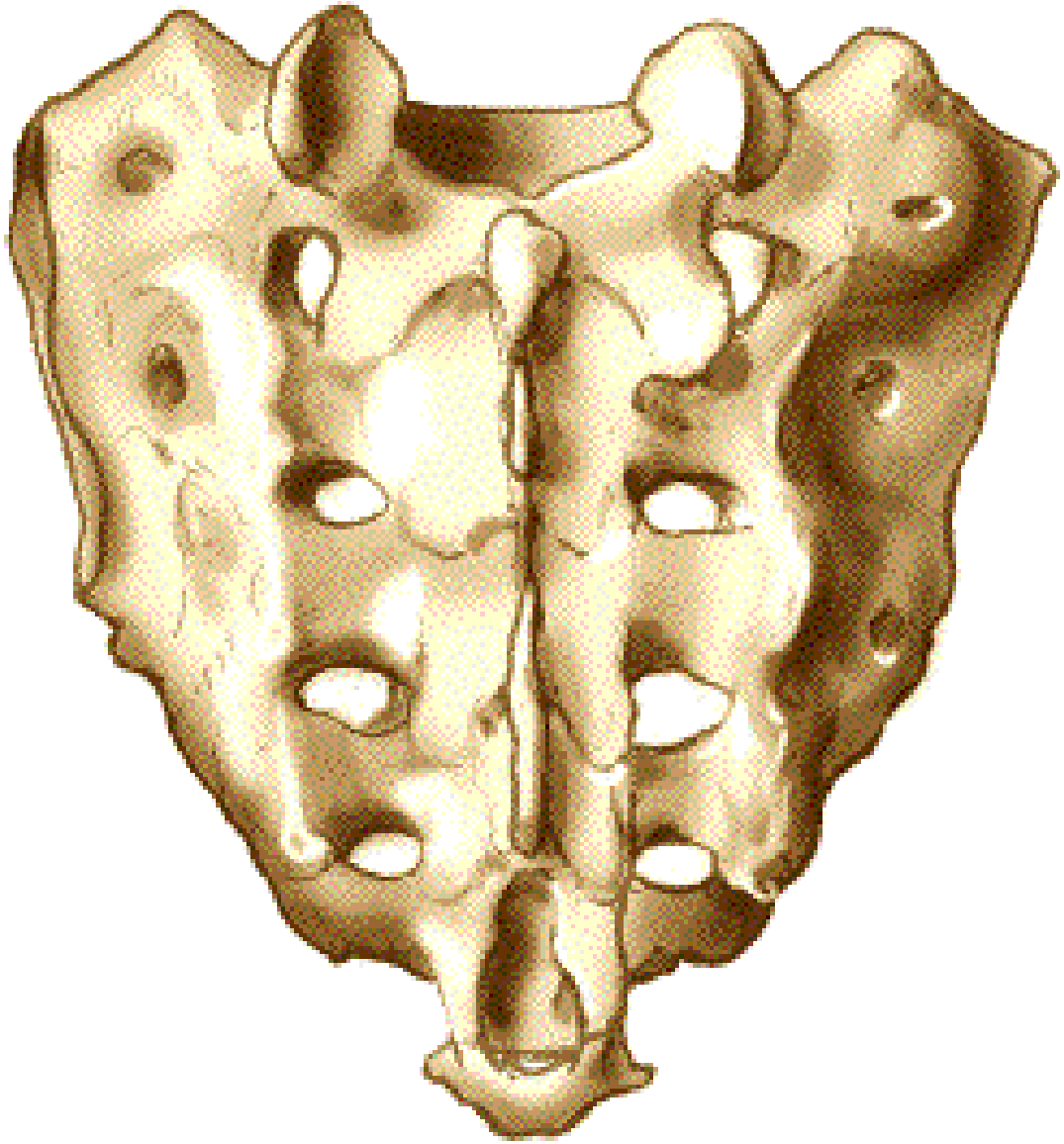
- Larger and thicker than other vertebrae
  - Support most of the body's weight
- Work with back muscles to balance the body
- Spinous process is short and stubby, allowing body to bend backward

Lumbar Vertebrae



Sacral Vertebrae Specficis

- 5 vertebrae are tightly fused to form sacrum
- Lateral portions of sacrum have large articular surface that fuses with the hipbones
  - In female, short, wider, and less curved than in the male



Sacrum

Coccygeal Vertebrae Specifics

- Fused to form coccyx
  - Tailbone
- No vertebral foramen
- Serves as attachment point for muscles of the upper leg

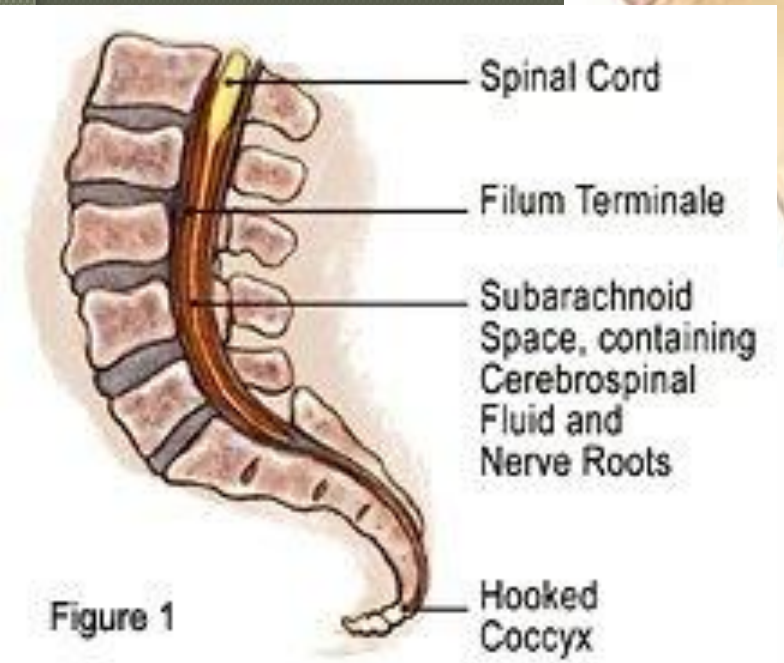
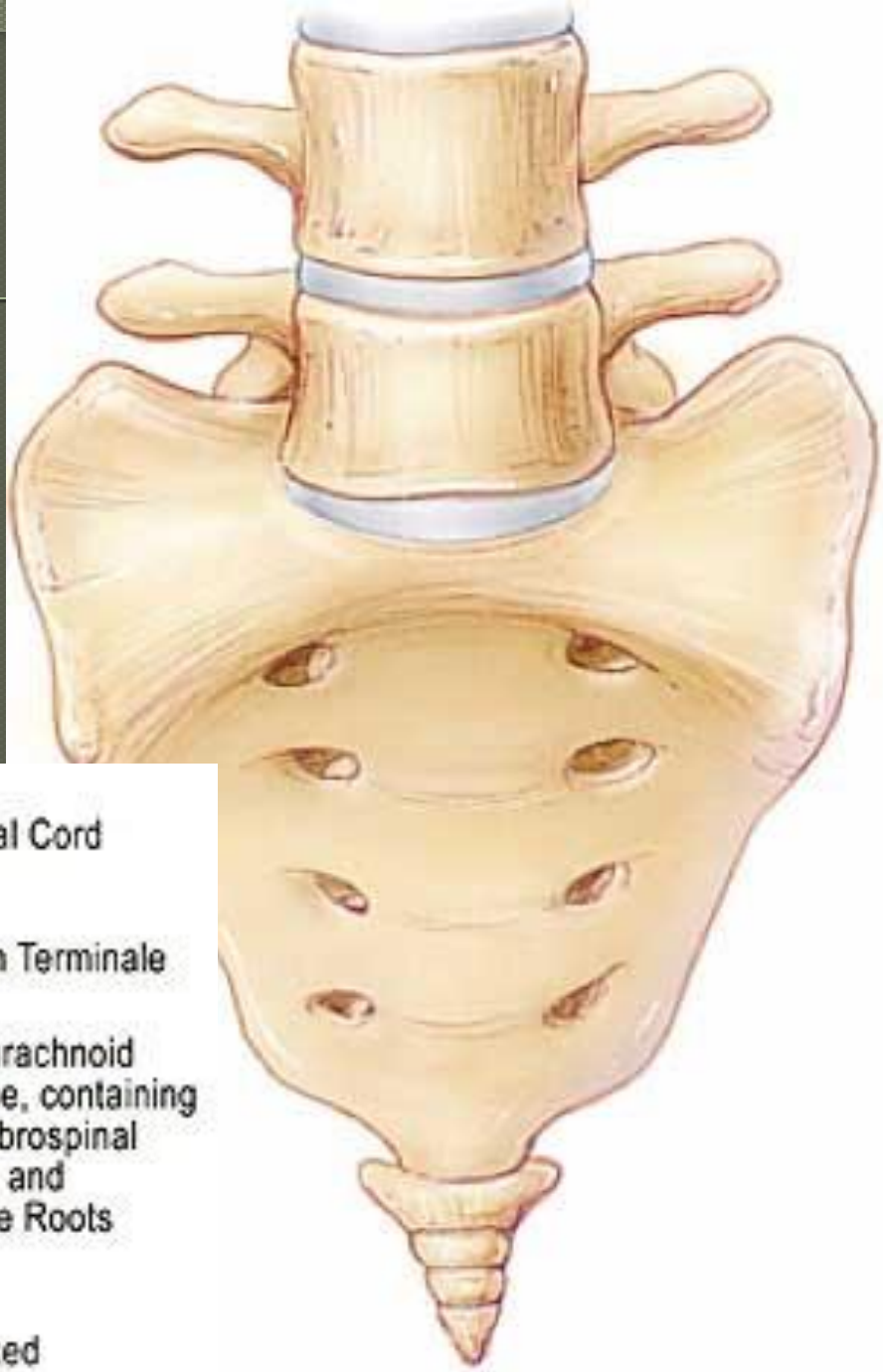


Figure 1

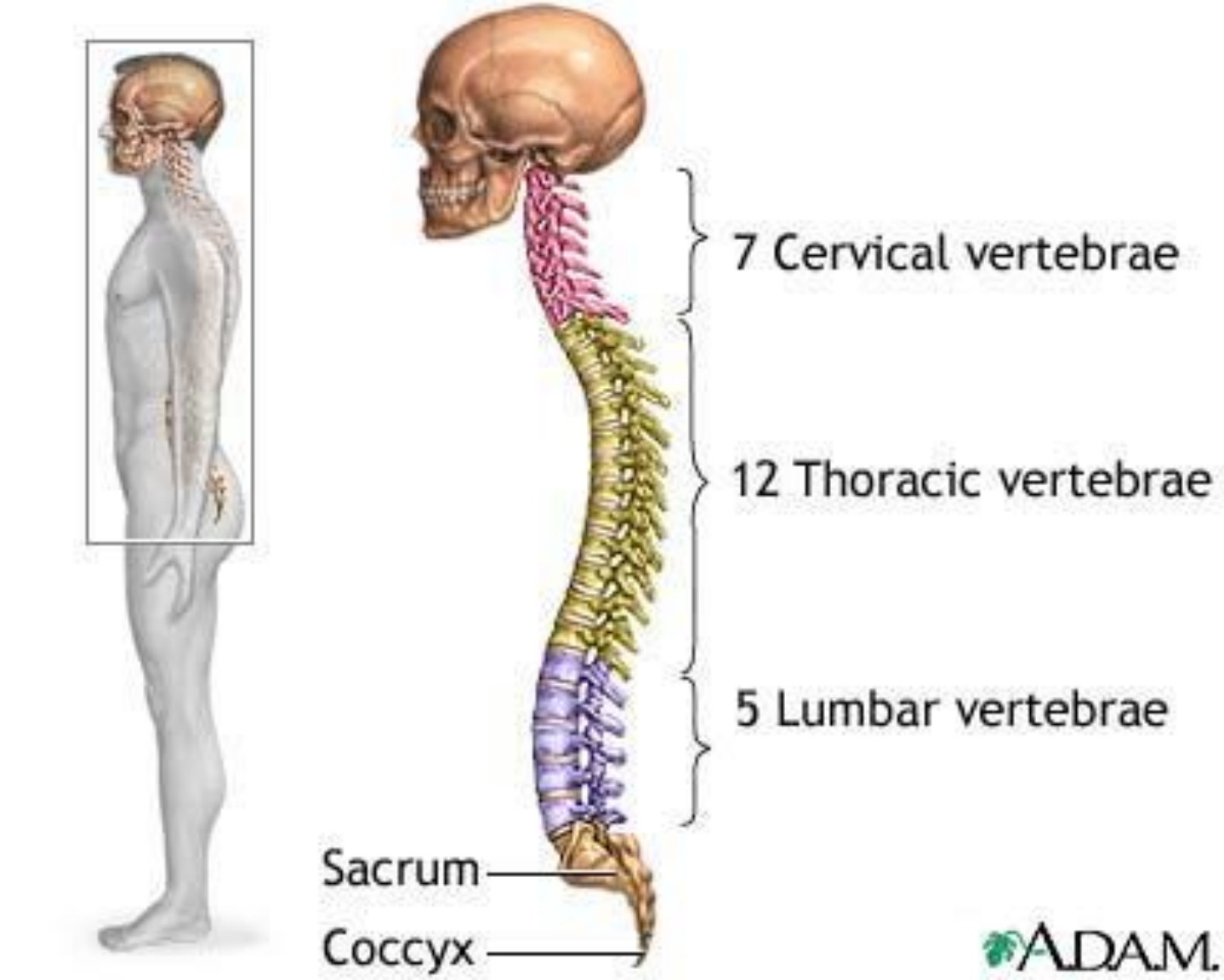


sacrum

coccyx

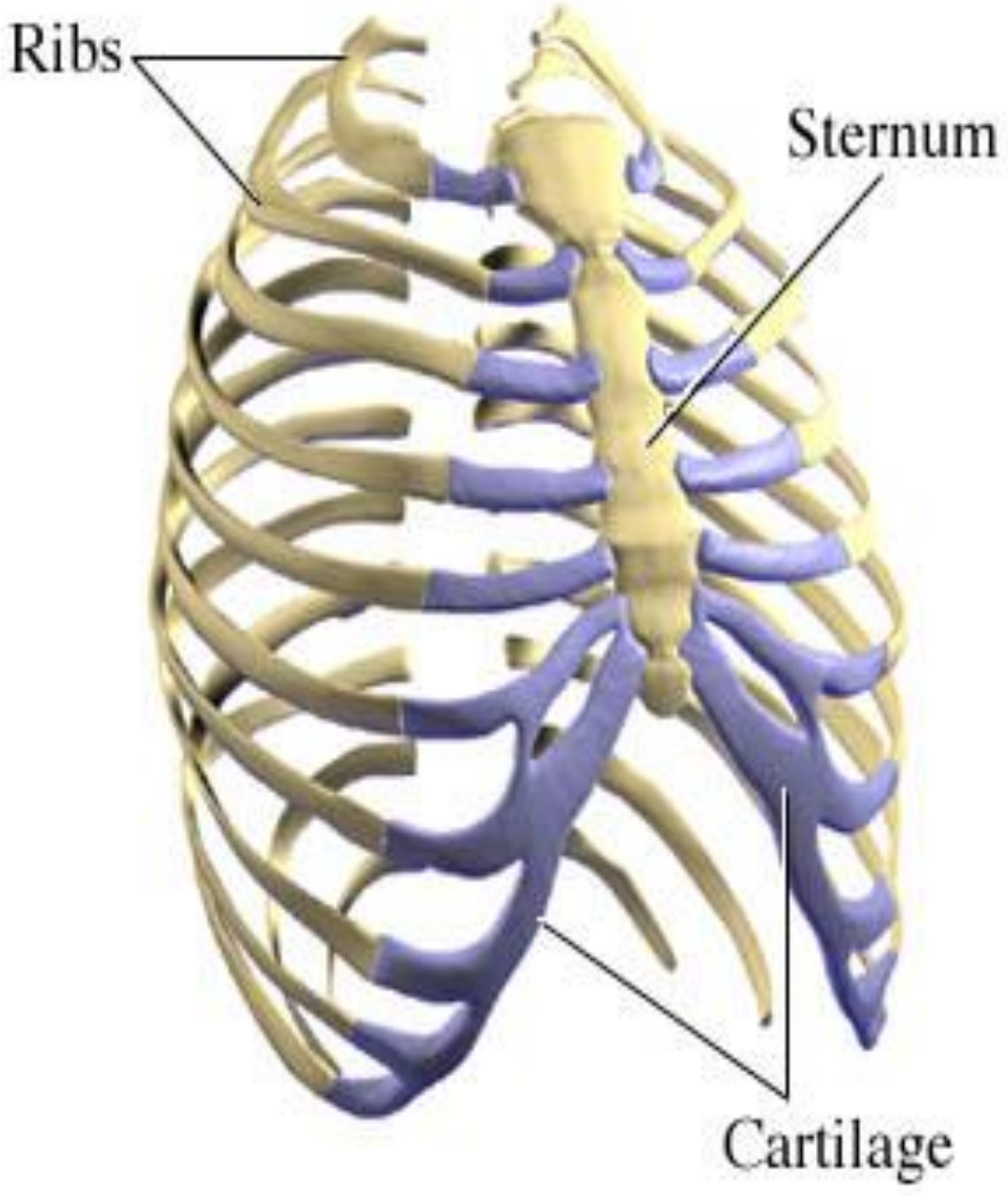
Carlyn Iverson

Vertebrae Review



RIB CAGE, or thorax

- Composed of costal cartilage, ribs, and sternum
- Protective structure that assists with breathing
- Ribs are large arches of bone that articulate with thoracic vertebrae and sternum
- Normally have 12, some are born with additional small cervical and lumbar ribs

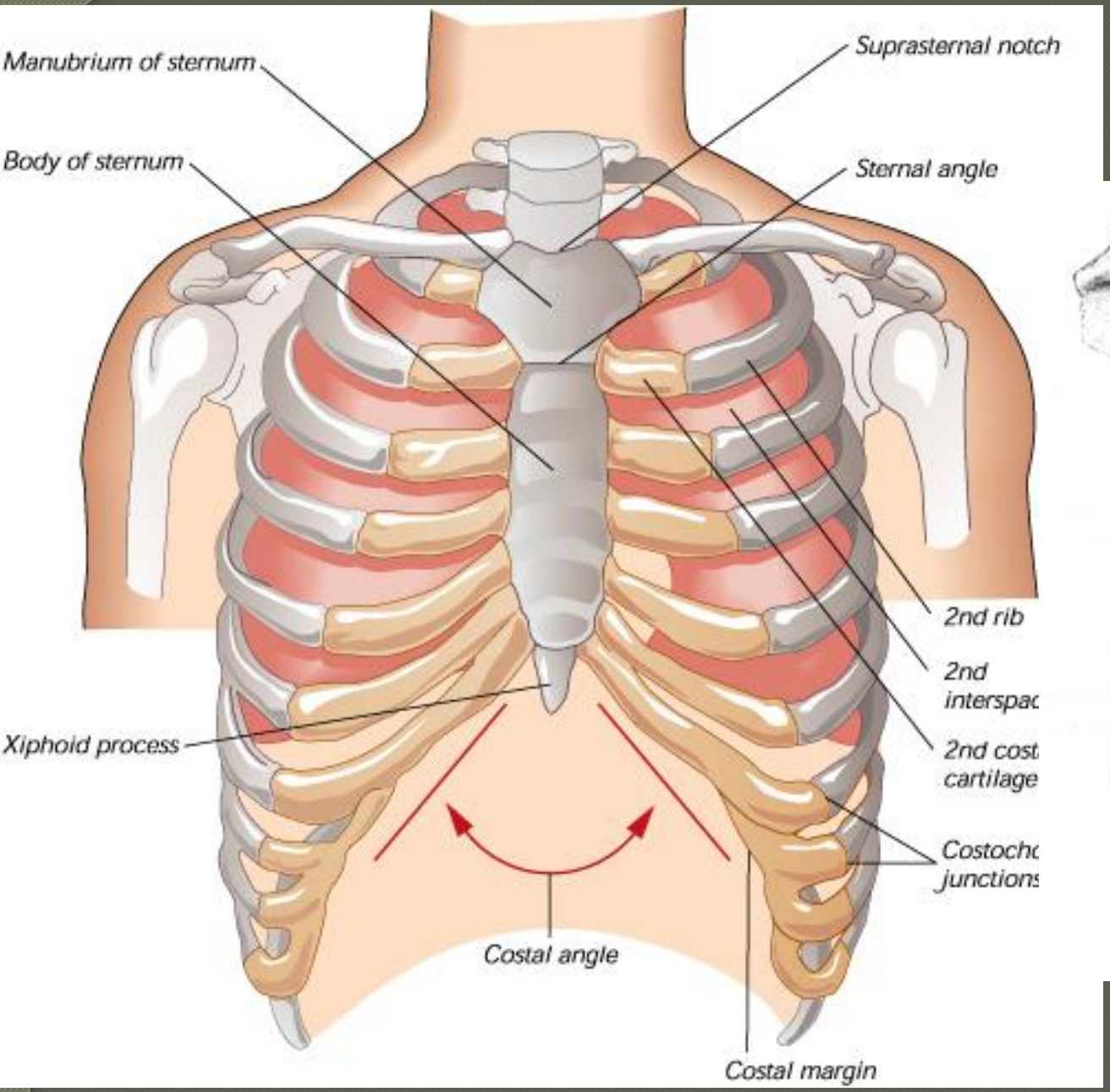

Ribs
Sternum
Cartilage

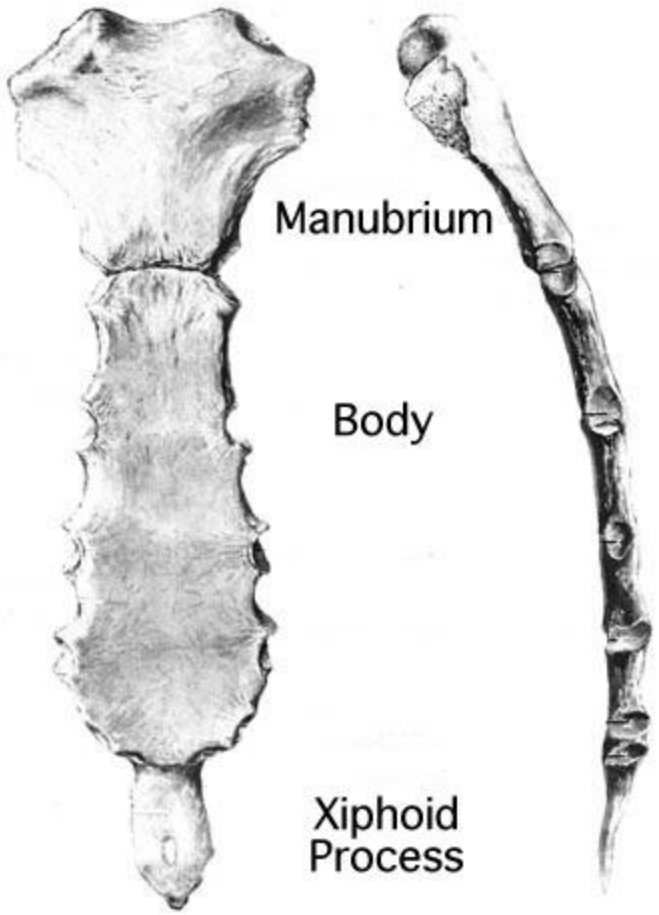
Ribs, cont.

- 7 upper ribs – true ribs
  - Attach directly to sternum via flexible costal cartilages
- 8-10 ribs are attach to the costal cartilage of the rib above and are called false ribs
- The 2 bottom ribs are not attached to costal cartilage, floating, or vertebral ribs

Sternum

- Lies medially and ventrally in the rib cage
- Divided into three regions
  - Manubrium – articulates with collarbones and ribs 1-2, attachment point for chest and shoulder muscles
  - Gladiolus, or body – articulates with 2-7 ribs, also has chest attachment point
  - Xiphoid process – lower portion, thin, elongated formed of cartilaginous material in children, turns to bone in adults. Attachment point for stomach muscles


Manubrium of sternum
Suprasternal notch
Body of sternum
Sternal angle
2nd rib
2nd interspac
2nd cost cartilage
Xiphoid process
Costocho junctions
Costal angle
Costal margin


Manubrium
Body
Xiphoid Process

5.3 Appendicular Skeleton

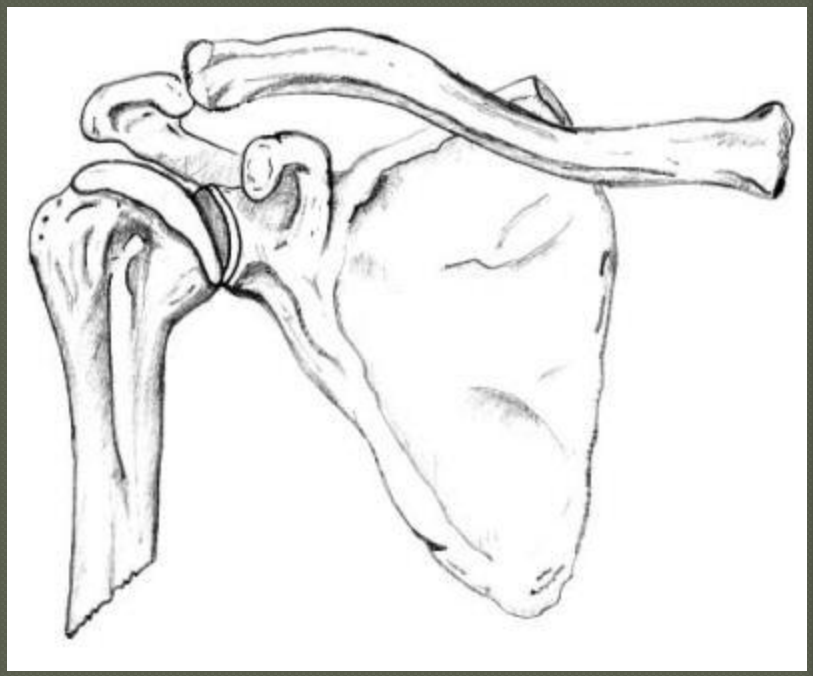
- Makes up the extremities
  - Upper and lower limbs
    - Upper – superior extremities, pectoral appendages
      - Attached to rib cage by ligaments
      - Lightweight and flexible compared to pelvic
    - Lower – inferior extremities, pelvic appendages
      - Fused to sacrum in region called pelvic girdle
      - Functions
        - Support weight of body
        - Maintain an upright position

Bone Tally

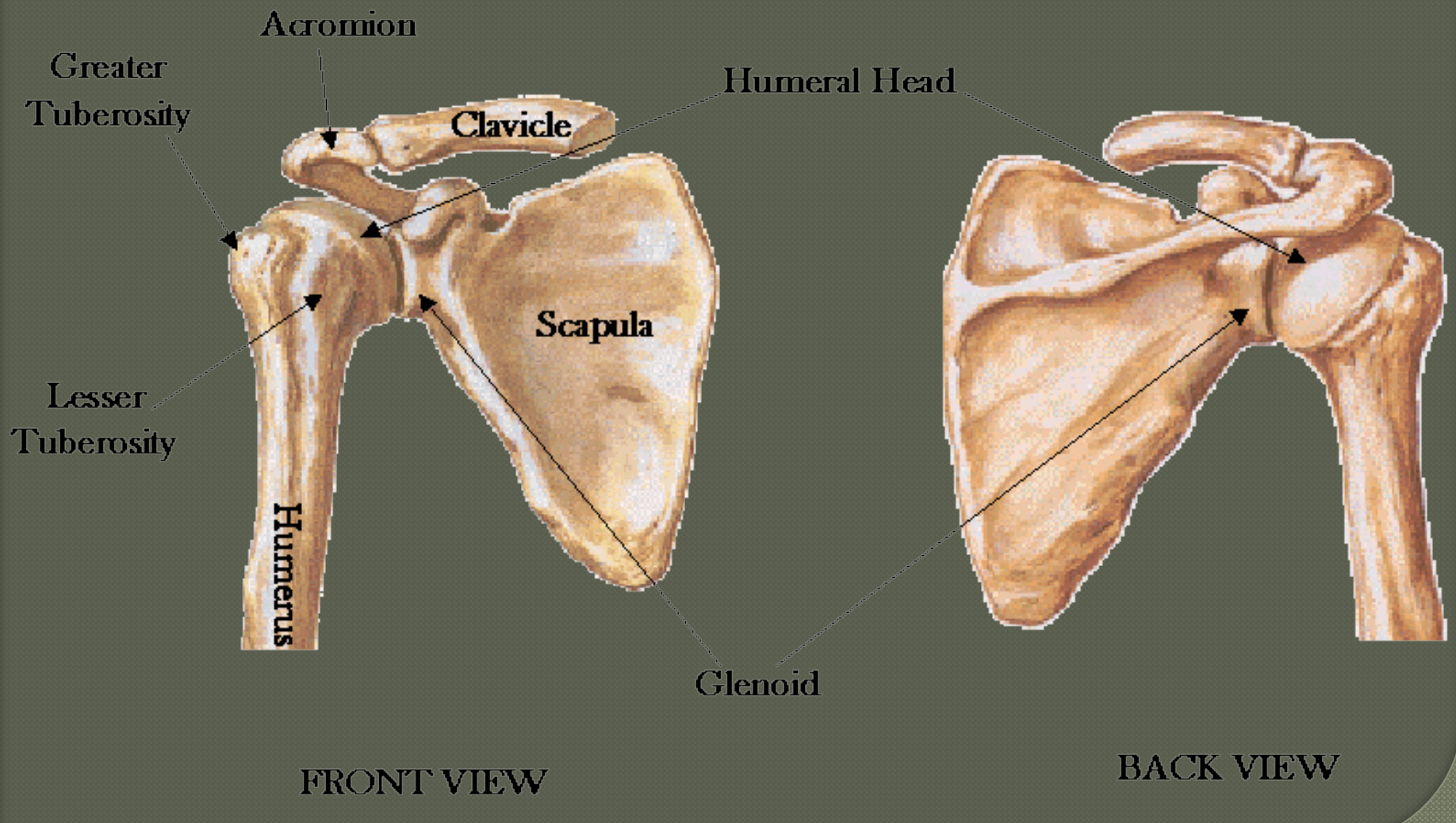
- Upper Extremity
  - 2 shoulder (4 total…. Both sides)
  - 3 arm
  - 8 wrist
  - 19 hand
- Lower Extremity
  - 3 fused hipbones
  - 4 leg
  - 7 ankle
  - 19 foot

Shoulder Girdle

- Clavicle, or collar bone
  - Long, curved – runs parallel to the 1st rib
- Scapula, shoulder blade
  - Flat, triangular – blade-like medial surface

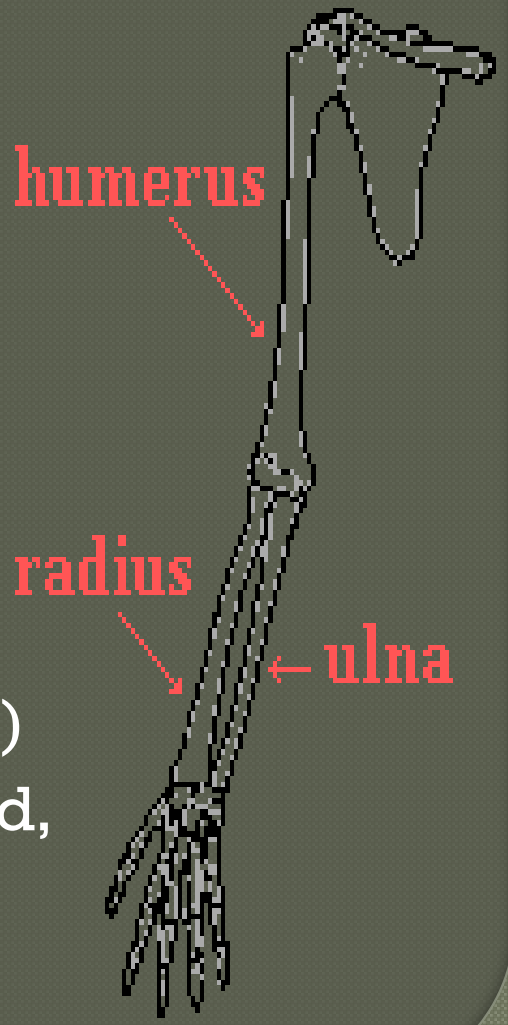


Shoulder Girdle



Arm Bones

- Humerus
  - With radius and ulna form elbow joint
- Radius
  - Forms part of forearm
  - Palm up – lateral to ulna (thumb side)
- Ulna
  - Forms part of forearm
  - Palm up – medial to radius (pinky side)
  - Olecranon process "funny bone" – hard, pointy part of the elbow



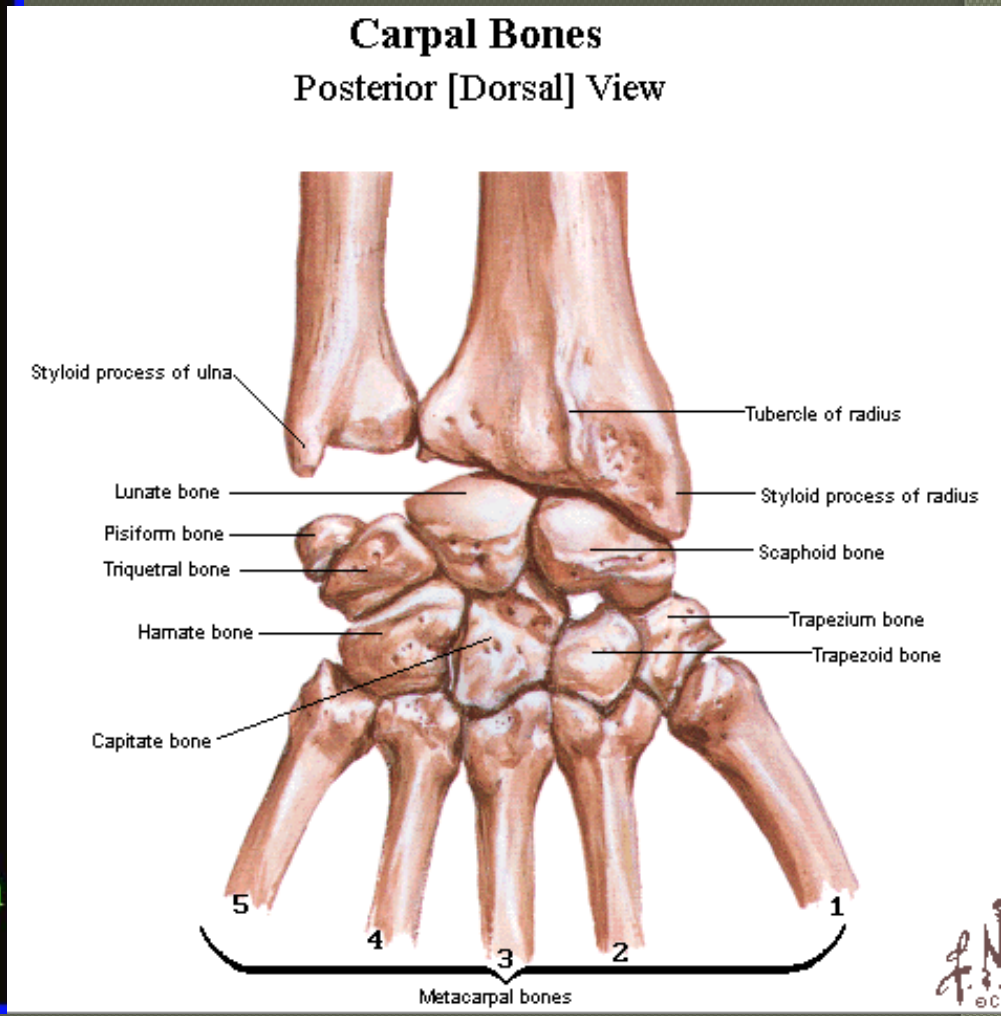
Wrist Bones

- Carpals, or wrist
- Composed of:
  - navicular (or schapoid)
  - lunate,
  - triangular(or triquetral)
  - Pisiform
  - Trapezium
  - Trapezoid
  - Capitate
  - hamate

Articulate with radius and ulna

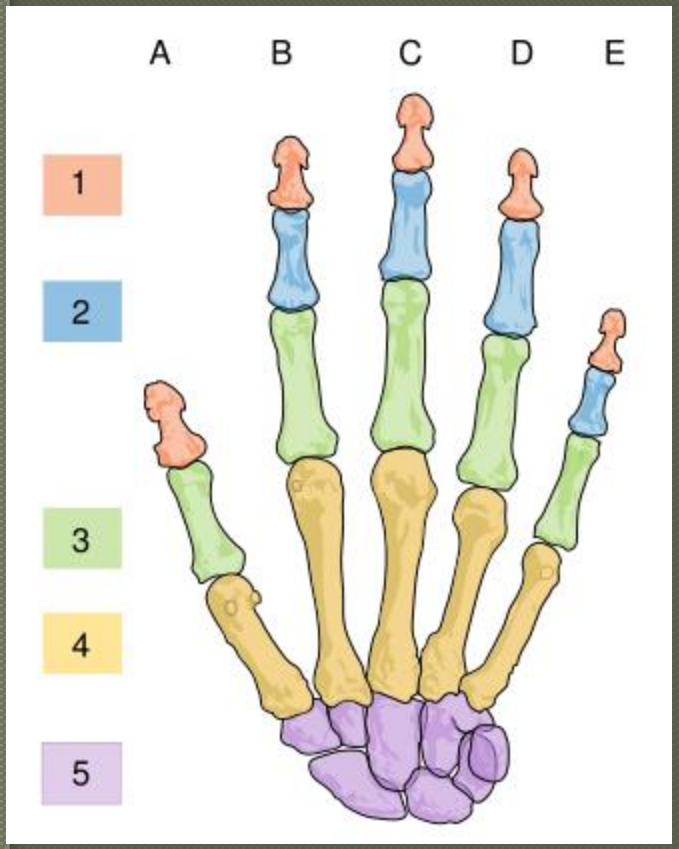
Distal row of carpals

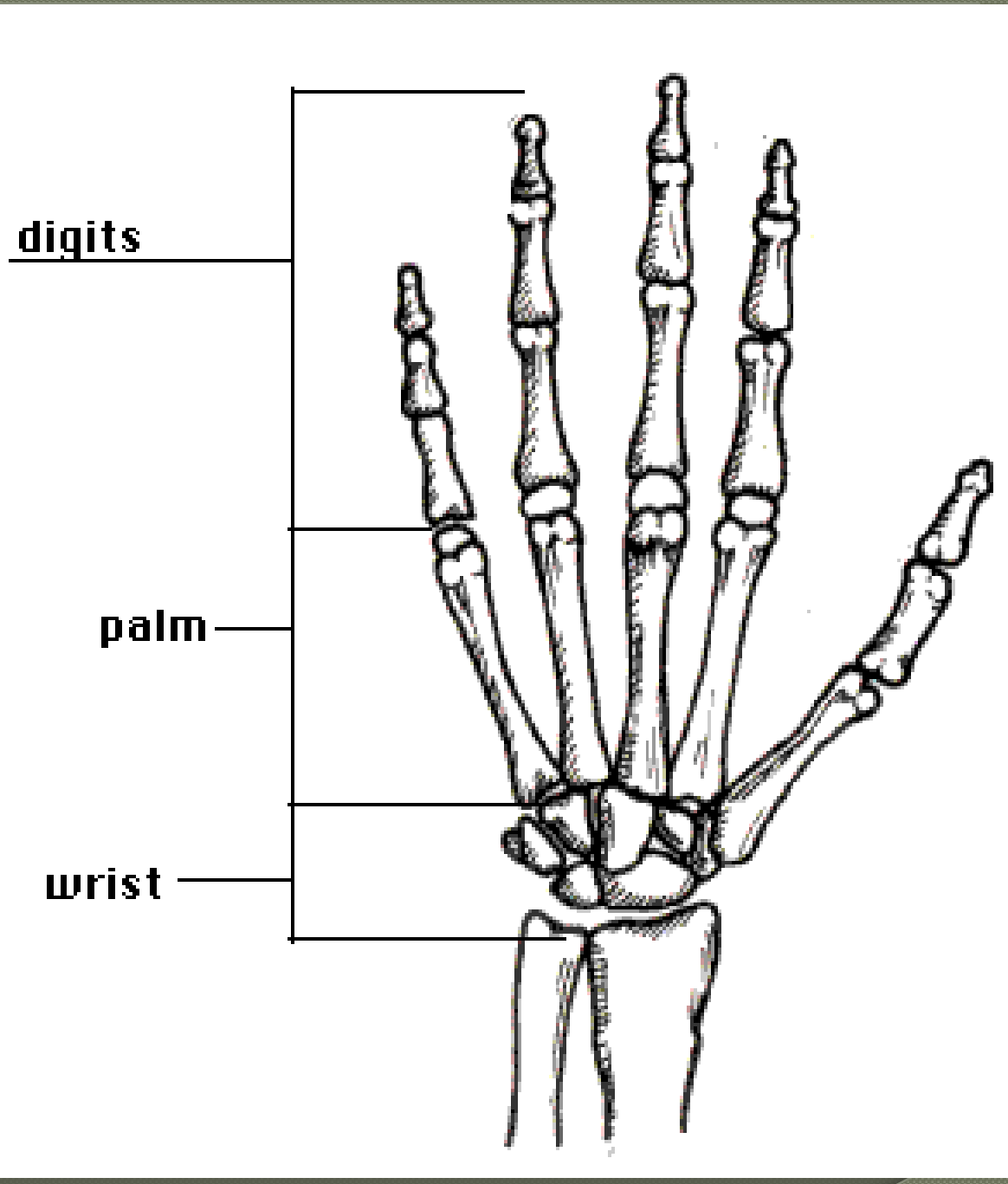

Carpal Bones
hamate
capitate
multangular (trapezoid)
greater multangular (trapezoid)
navicular (scaphoid)
lunate
triquetrum
pisiform


Carpal Bones
Posterior [Dorsal] View
Styloid process of ulna
Tubercle of radius
Lunate bone
Styloid process of radius
Pisiform bone
Scaphoid bone
Triquetral bone
Trapezium bone
Hamate bone
Trapezoid bone
Capitate bone
5
4
3
2
1
Metacarpal bones

Hand Bones

- Distal row of carpals articulate with 5 metacarpals – palm of hand
- Phalanges – articulate with metacarpals – finger bones
  - Singular – phalanx
- With exception of thumb….
  - Each finger has 3 phalanges (proximal, middle, and distal)
    - Thumb has not middle phalanx


A
B
C
D
E
1
2
3
4
5


digits
palm
wrist

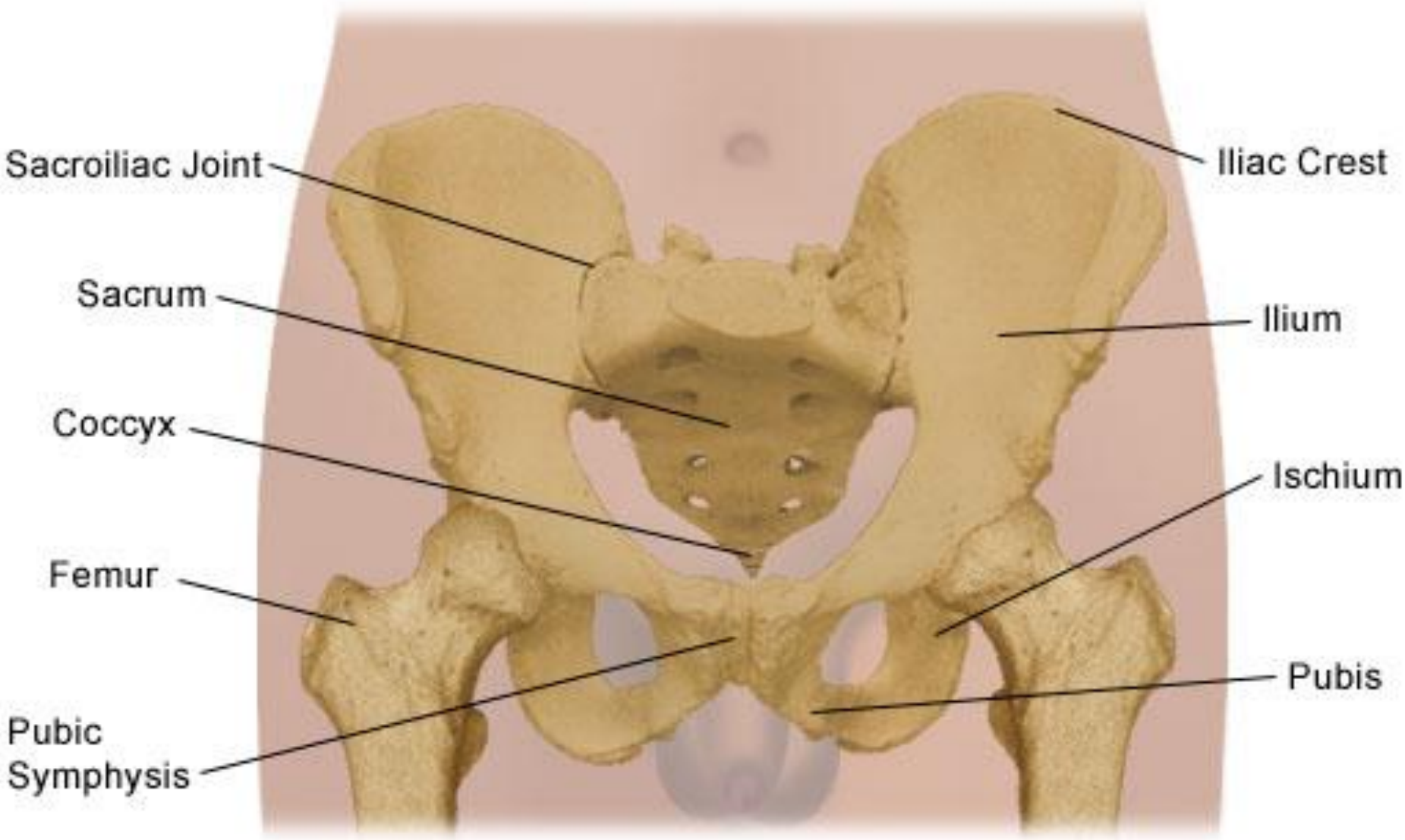
Pelvic Girdle

- Brace the body and lower extremities
- Three bones – separate at birth, fused in adulthood to form coxal (coxae) bone
  - Ilium
  - Ischium
  - Pubis (pubic bones)
- Acetabulum – cup-shaped articular surface where pubic bones fuse to each other, forms hip joint with femus
- Pubic symphysis – where pelvic bones meets on an articulation on the pubic bones

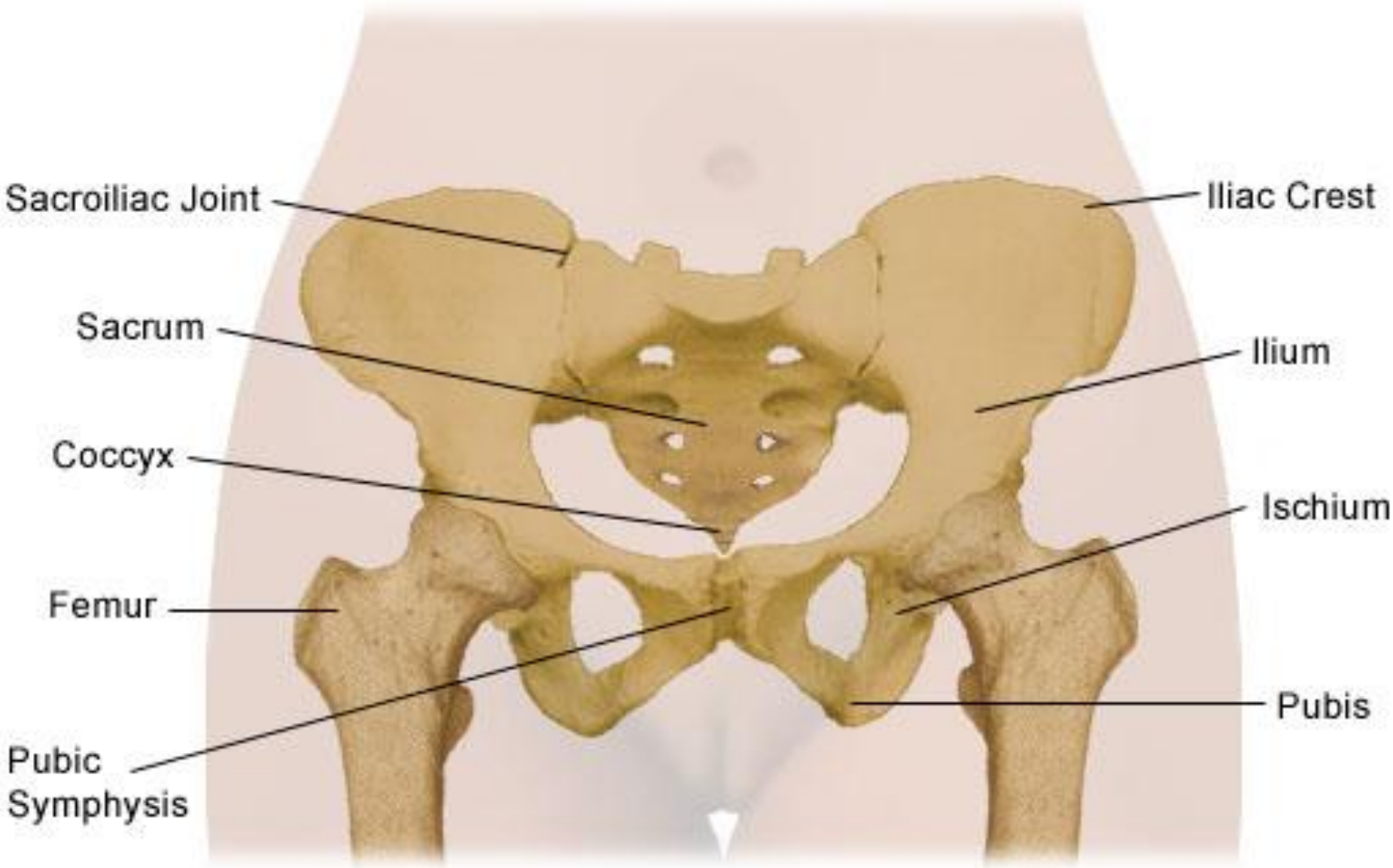
Pelvic Girdle, cont.

- Obturator foramen – (2) located on the ischium laterally of the pubis
  - Passageways for major vessels and nerves
    - Males – large and oval
    - Females – small, somewhat triangular
- Pubic arch – angle formed by dorsal union of pubic bones
  - Males – sharp angle
  - Female – wider arch

Male Pelvis

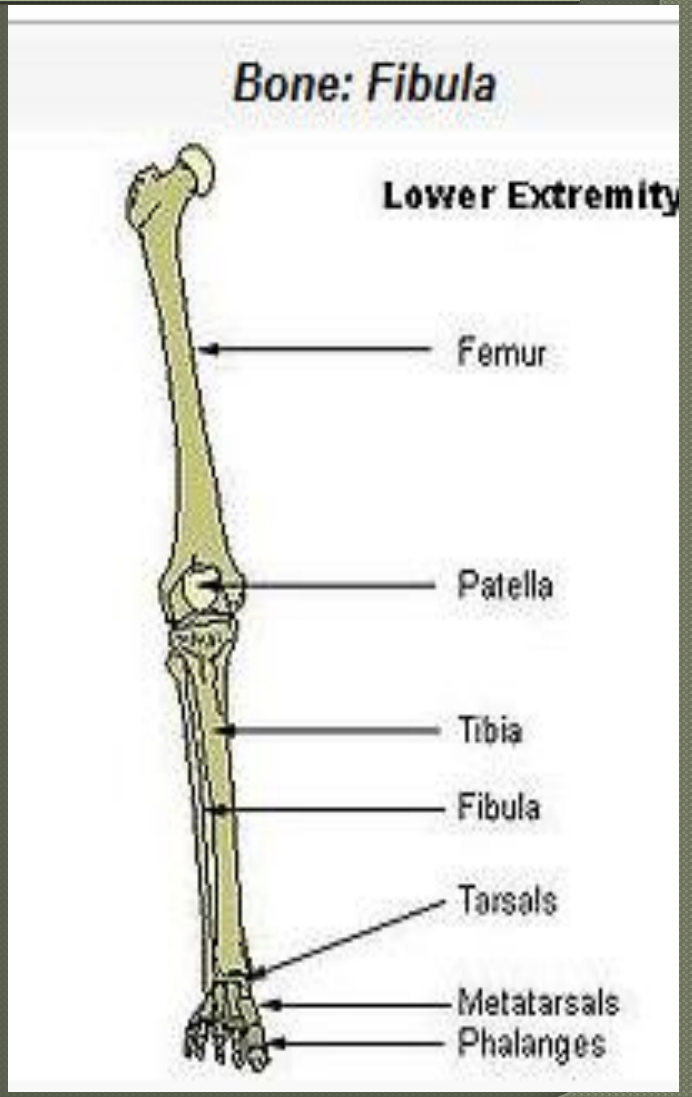

Sacroiliac Joint
Sacrum
Coccyx
Femur
Pubic Symphysis
Iliac Crest
Ilium
Ischium
Pubis

Female Pelvis



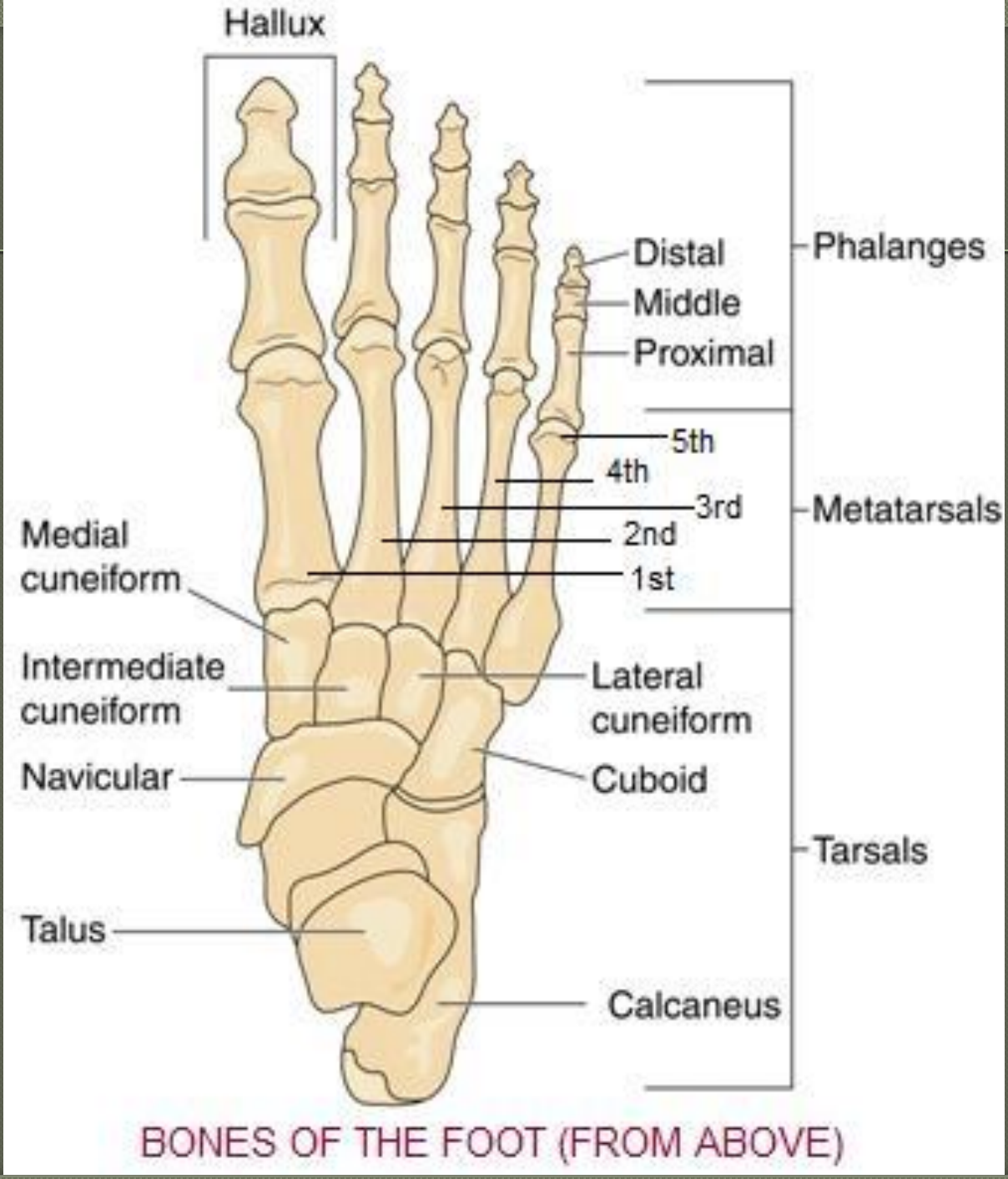
Leg Bones

- Femur – longest and strongest bone in body
- Tibia – medial side
- Fibula – lateral side
- Patella – knee-cap, flat, triangular bone located on the front of knee joint
  - Protects joint and increases leverage



Foot Bones

- Three groupings
  - Tarsals (7)
    - Calcaneus, cuboid, navicular, talus, 1st-3rd cuneiforms
      - Talus – forms the articulation with the leg
      - Calcaneus – largest – forms the heel and part of the foot arch
  - Metatarsal (5)
  - Phalanges
    - Match up to # and organization of phalanges in the hand
      - Shorter and flatter than those in hand



BONES OF THE FOOT (FROM ABOVE)

Bellringer

- Why does a broken clavicle restrict head and arm movement?

5.4 Bone

- Bone – living organ made up of complex arrangement of tissues
  - Composed of:
    - Bone(osseus tissue), blood vessels, nervous tissue, ligaments, tendons, and specialized connective tissue capable of making stem cells
  - Classified by:
    - Shape
    - Composition – spongy v. compact
    - How they develop

Bone Shape

- Shape is key to role it plays in body
- Flexible, can modify depending on how gravity places strains on the body
- Nutrition affects growth and development

Bone Types by Shape

- Generally categorized into 4 shapes
  - Long
    - Work as levers for appendages
      - Femur, humerus, metacarpals, etc.0
  - Short
    - Small four-sided bones with limited movement
      - Carpals and tarsals
  - Irregular
    - Highly sculptured, many processes
      - Vertebrae, facial bones
  - Flat
    - Sheet-like surfaces for encasing structures
      - Cranial bones, ileum, nasal bones, patella, ribs, etc.

Bone Types by Development

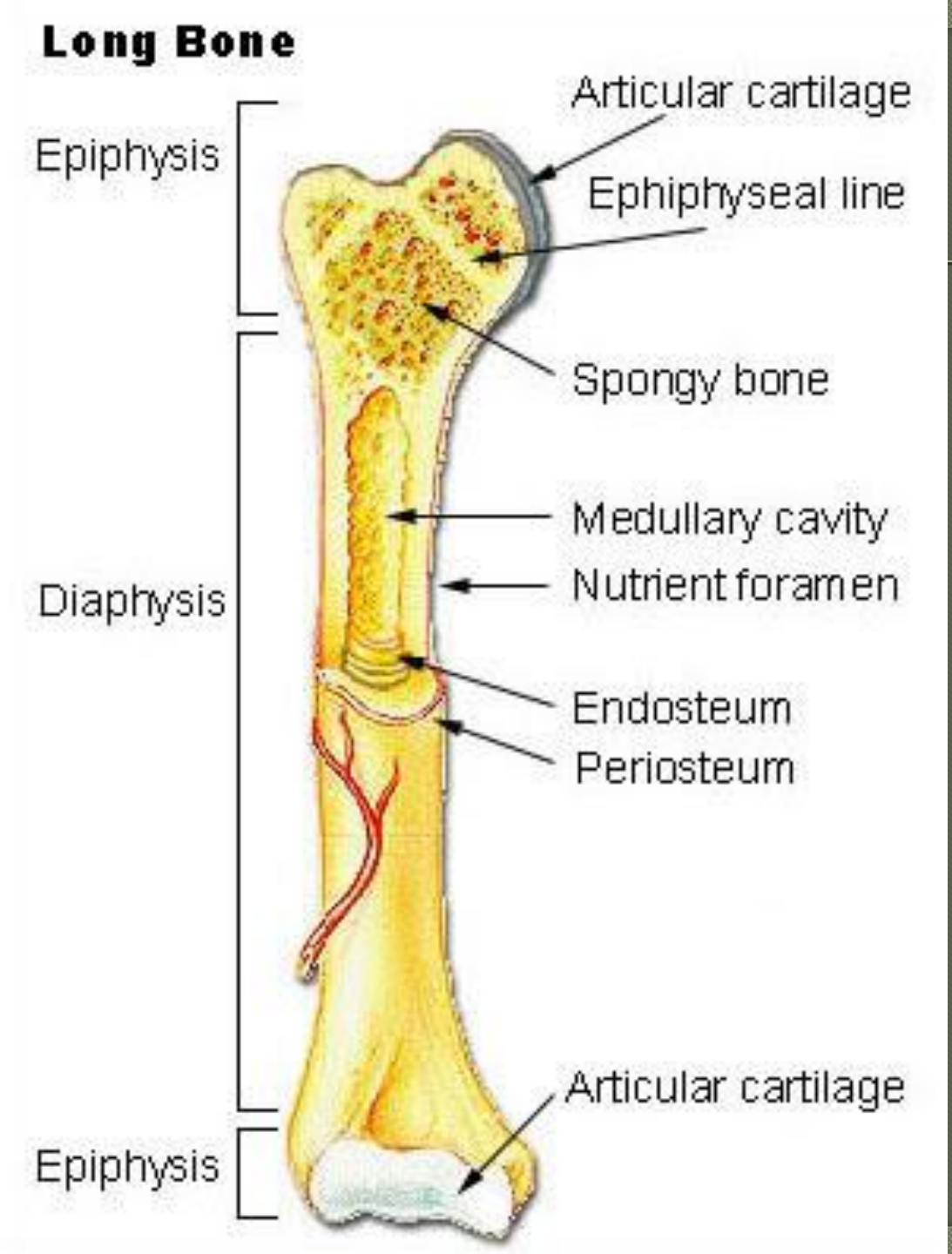
- Endochronal – from embryonic cartilage
  - Face and appendages
- Dermal – from embryonic connective tissue
  - Clavicle, scapula, flat cranial bones
- Alveolar – from special cells found only in jaw bones
  - Mandible & maxilla
- Sesamoid – within tendons
  - Patella, pisiform, metacarpals, metatarsals
- Wormian (sutural) – within the flat bones of the skull
  - Form haphazardly, not understood
  - Skull formation disorders are characterized by these

Bone Structure – External Features

- Fibrous sheet of connective tissue that covers surface of bone = periosteum
  - Means to "surround the bone"
    - Contains blood vessels and nerves, provide bone with nutrition and sensation
    - Important in bone growth, maintenance, and healing
- Ligaments and tendons attach to periosteum
  - Ligaments – bands of connective tissue that connect bone to bone, or bone to cartilage
  - Tendons – connective tissue that connect muscle to periosteum

Long Bone Features

- Diaphysis – main body of long bone
- Epiphysis – end of a long bone that makes up a joint
- Epiphyseal plate – actively growing area of bone
  - Bones that are still maturing
    - Replaced by ephiphyseal line when growth stops
- Epiphyseal line – underneath epiphysis
  - Thin strip of bone marking fusion of epiphyses to diaphysis
- Hyaline cartilage – smooth cartilage covering articular surface bones
  - Proximal and distal ends of long bones


Long Bone
Articular cartilage
Epiphysis
Ephiphyseal line
Spongy bone
Medullary cavity
Diaphysis
Nutrient foramen
Endosteum
Periosteum
Articular cartilage
Epiphysis

Short Bone Features

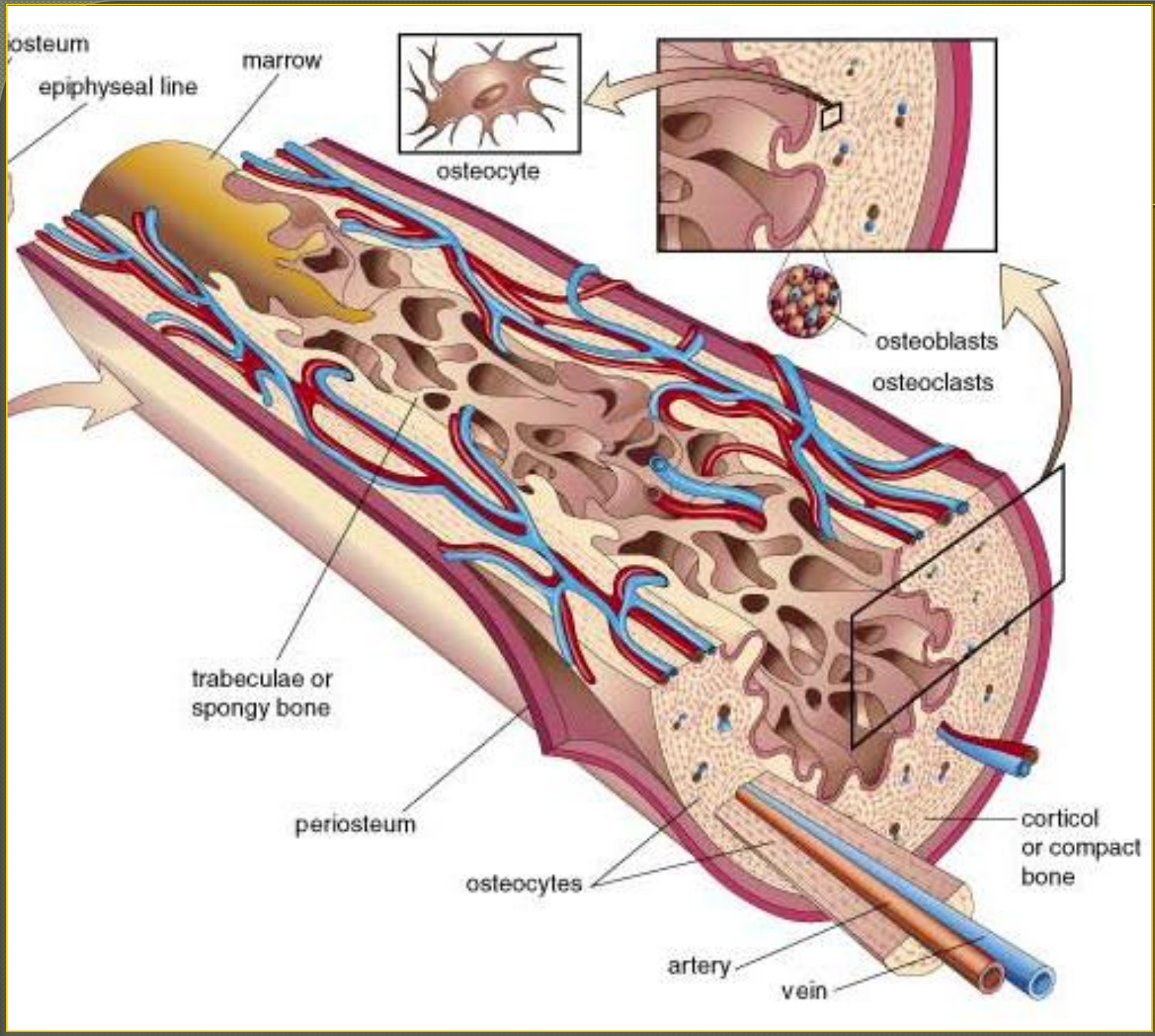
- No recognizable diaphysis
- Defined by dominant surface features of bone
- Various types of growth regions unlike epiphyseal plates

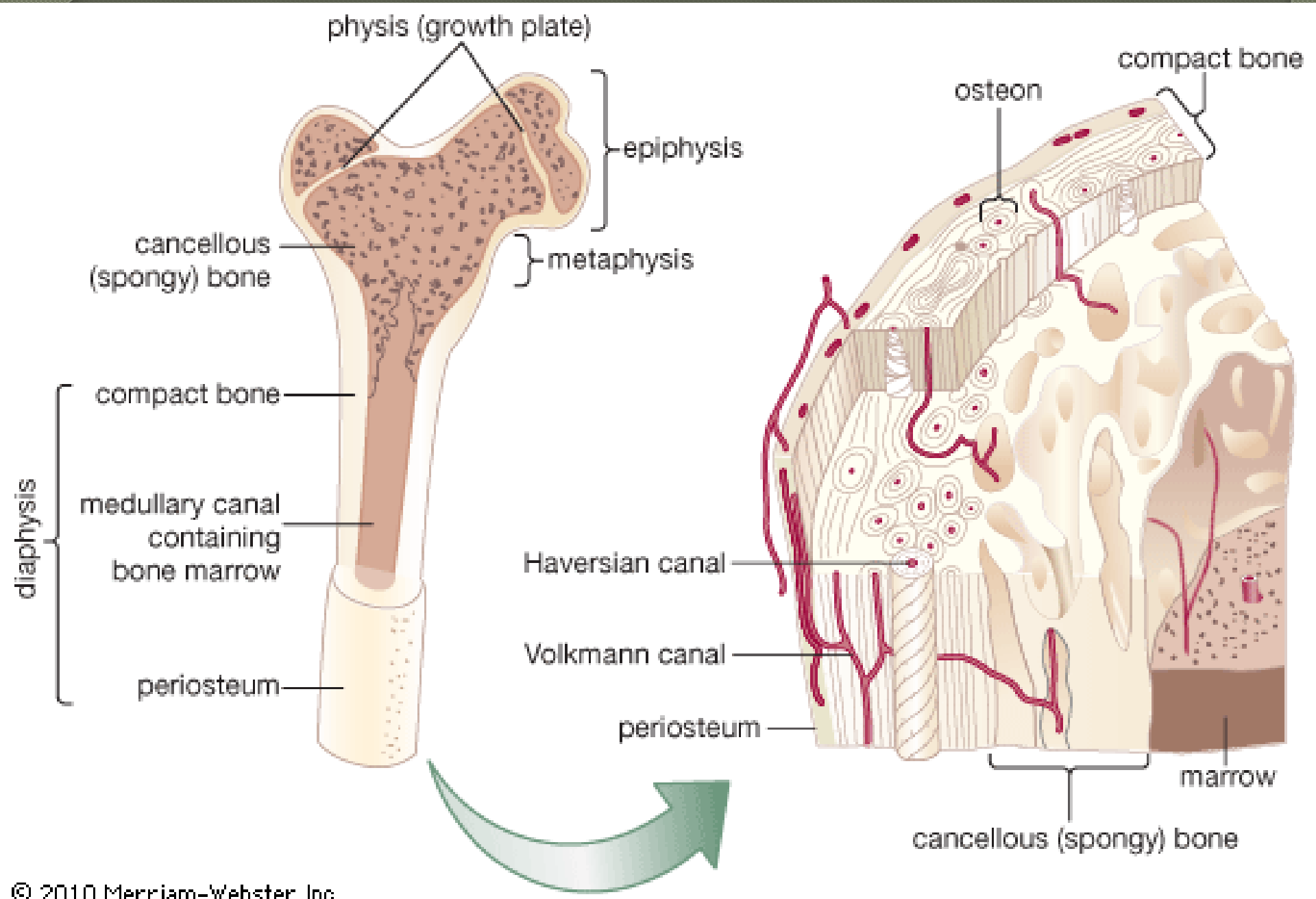
Bone – Internal Features Compact v. Spongy Bone

- Compact bone – 20% of skeletal structure
  - 80% of skeletal weight
  - Forms rigid, supportive outer shell around each bone
  - Composed of mineral deposits in a collagen matrix
  - Osteon – structural unit of compact bone
    - Forms arrangement of concentric circles of hollow tubes of bone matrix around a central Harversian canal.
      - Blood vessels and nerves pass through this opening
  - Osteocytes – surround Harversian canals
    - Secrete bone matrix
      - Composed of protein called osteocalin
  - Lacunae – cavities that store osteocytes
  - Canaliculi – channels that connect osteocytes
  - Volkmann's canals – canals in osteon where nerves and blood vessels pass from periosteum to Harversian canals

Bone – Internal Features Compact v. Spongy Bone, cont.

- Spongy (trabecular) Bone
  - Has many "open spaces" as does sponge
  - Honey-comb like network
  - Trabeculae – archlike brace system made of minerals and collagen
  - Less dense, more flexible than compact bone
  - Medullary (marrow) cavity – hollow space in long bones
    - Bordered by spongy bone
    - Lined with layer of connective tissue called endosteum
      - Endosteum – can generate new bone cells
        - Filled with soft tissue called bone marrow
          - 2 types: yellow and red
            - Yellow – fat cells, found in most bones – food reserve for bone cells
            - Red – mainly in spongy bones – ends of lone bones
              - composed of stem cells that form blood components


osteum
epiphyseal line
marrow
osteocyte
osteoblasts
osteoclasts
trabeculae or
spongy bone
periosteum
osteocytes
corticol
or compact
bone
artery
vein



5.5 Joints

- 2 functions:
  - Attach bones, providing support and protection
  - Allow muscles to reposition two or more articulated bones to produce body movement
- Categorized using 2 criteria
  - Structural classification
    - Based on tissue and structural complexity
  - Functional classification
    - Based on way joint moves

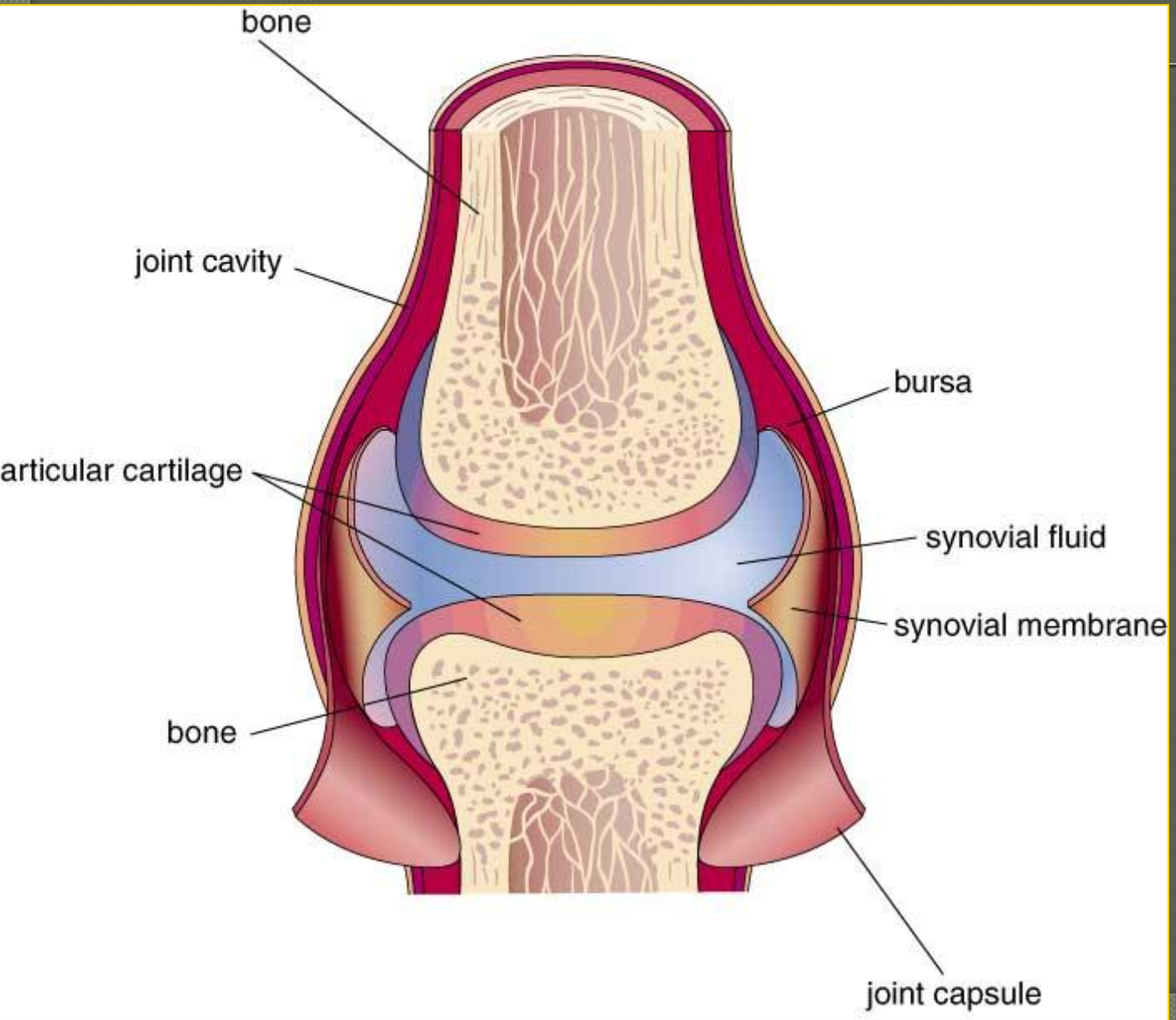
Joints, cont.

- Bursa – fibrous sack filled with synovial fluid
  - Around certain moveable joints
  - Contains thick, lubricating fluid called synovial fluid
    - Protects a joint and its surface
    - Secreted by epithelium cells
  - Provide cushion against rubbing
  - Bursitis – condition in which the bursa becomes inflamed due to damage

Joint Structure

- Cartilaginous – formed of cartilage
  - Covers articulating bone surfaces
- Fibrous – fibrous connective tissue
  - Attach radius and ulna to each other
- Synovial – formed by synovial capsule
  - Elbows and knees
  - Synovial capsule – fluid filled sack
    - Similar to fluid found in bursa

Joint Structure

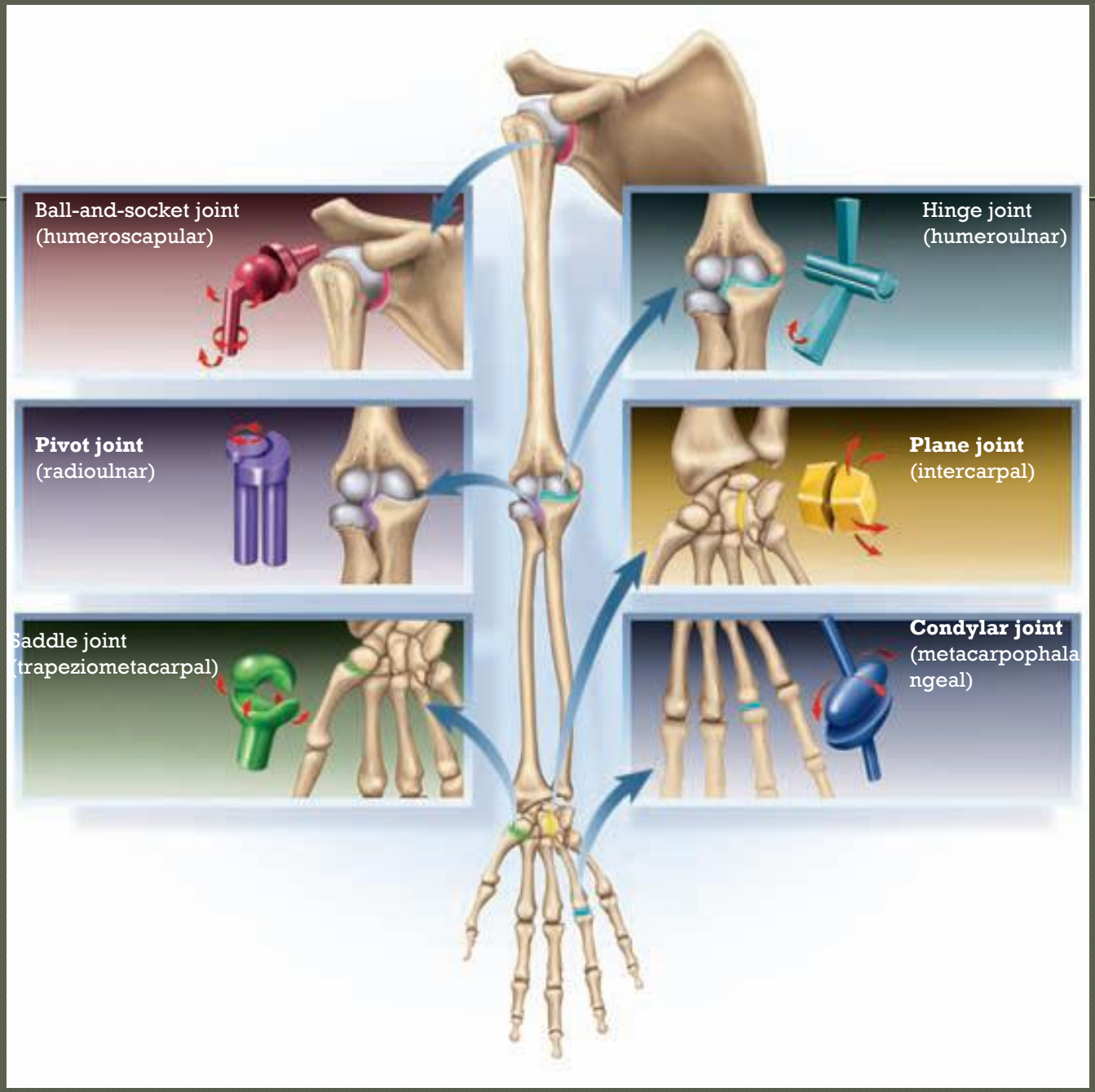


Joint Function

- Synarthrosis
  - Does not permit movement
  - Four categories (workbook purposes only)
- Amphiarthrosis
  - Slight movement
- Diarthrosis
  - Variety of movements

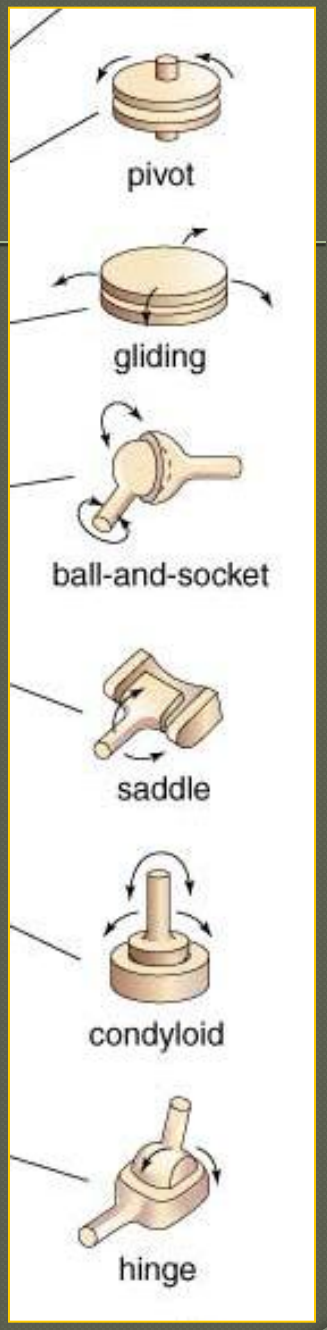
Major Synovial Joints

- Ball and socket – hip, shoulder girdle
- Condyloid – ball-like articular surface rests against the curve-shaped end of another articular surface
  - Wrist joint
- Gliding joint – side to side movements
  - Carpals and vertebrae
- Hinge – permits angular motion along one plane
  - elbow
- Pivot – rotation
  - Superior radioulnar joint
- Saddle – one articular surface rocks back and forth upon another
  - thumb


Ball-and-socket joint
(humeroscapular)
Hinge joint
(humeroulnar)
Pivot joint
(radioulnar)
Plane joint
(intercarpal)
Saddle joint
(trapeziometacarpal)
Condylar joint
(metacarpophalangeal)

Joints, cont.

- Joint Tutorial
- You need 4 index cards.
- Write the letters
  - A
  - B
  - C
  - D
    - VERTICALLY on the index card large enough for me to see at the front of the room



- Which of the following is not a function of joints?

  A. Attach bones

  B. Provide support and protection

  C. Allow muscles to reposition causing body movement

  D. Allows body to maintain homeostasis

  Answer: D

- Joints are categorized by which criteria?
  - A. Structure
  - B. Function
  - C. Both Structure and function
- Answer: C

- Sack filled with synovial fluid is called?
  - A. Fiber
  - B. Cartilage
  - C. Bursa
  - D. Bursitis
- Answer: C

- The function of bursa is to
  - A. Lubricate
  - B. Nourish
  - C. Protect joint surface
  - D. All of the above
- Answer: All of the above

- Joint structure is classified into which three types
  - A. Synarthrosis, Amphiarthrosis, diarthrosis
  - B. Cartilaginous, fibrous, synovial
  - C. Synovial, diarthrosis, cartilaginous
- Answer: B

- Synovial joints can also be classified by function as
  - A. Amphiarthrosis
  - B. Synarthrosis
  - C. Diarthrosis

  Answer: C

- The study of kinesiology is?
  - A. Study of human movement
  - B. Study of human bones
  - C. Study of joints
  - D. Study of how the body functions

  Answer: A

- True or False. Synovial joints allow free movement in human body.
  A. True
  B. False

- Answer: True

- The shoulder joint is an example of which synovial joint
  - A. Pivot
  - B. Saddle
  - C. Gliding
  - D. Ball and socket
- Answer: D

- A shallow socket can also be called

  A. Fossa

  B. Ball

  C. Condyloid

  Answer: A

- Which is not an example of a hinge joint
  A. Elbow
  B. Hip
  C. Ankle
  D. Inter-phalangeal joints

- Answer: B

- Hinge joints make movements of
  - A. Flexion
  - B. Abduction
  - C. Abduction
  - D. None of these

  Answer: A

- A pivot joint allows bones to
  A. Slide on each other
  B. Move in all directions
  C. Rotate

- Answer: C

- What type of joint allows us to turn our head saying “no”
  A. Condaloid
  B. Ball and socket
  C. Pivot
  D. Hinge

- Answer: C

- Which synovial joint are the bones of the wrist an example of
  A. Saddle
  B. Condaloid
  C. Pivot
  D. Hinge

- Answer: B

- Condaloid joints allow which types of movements
  - A. Extension
  - B. Flexion
  - C. Abduction
  - D. All of these

  Answer: D (also adduction)

- The thumb is an example of which joint
  - A. Saddle
  - B. Hinge
  - C. Condaloid
  - D. Ball and socket
- Answer: A

- Another name for gliding joint is?
  - A. Slidding
  - B. Propelling
  - C. Planer
- Answer: C

- Which synovial joint allows movement in all directions?
  - A. Saddle
  - B. Condaloid
  - C. Ball and socket
  - D. Hinge
- Answer: C

- Jaw movement is allowed because of which type of joint?
  A. Condaloid
  B. Hinge
  C. Pivot
  D. Saddle

- Answer: A

Tutorial Answers

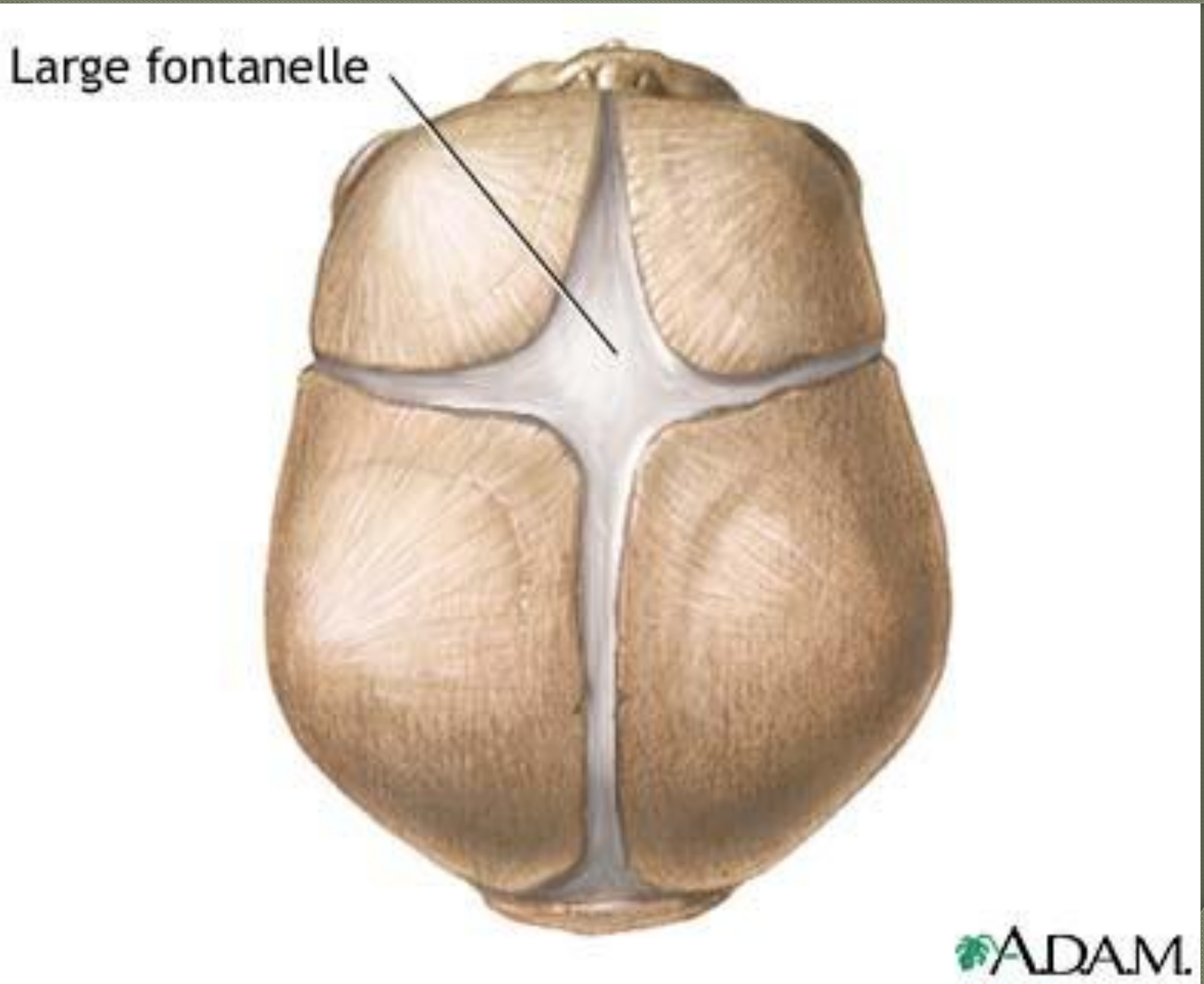
1. C
2. B
3. A
4. C
5. D
6. C
7. E
8. B
9. C
10. A
11. A
12. E
13. C
14. C
15. D
16. A
17. B
18. E
19. D
20. C
21. A
22. D

5.6 Bone Development and Healing

- Ossification – conversion of embryonic tissues into recognizable bone
  - 2 ways:
    - Endochondral ossification
      - Begins within a cartilage
        - Ex – long bones
    - Intramembranous ossification
      - From connective tissue membranes
        - Ex – flat bones

Bone development cont.

- Calcification – process of bone hardening
- Osteoblasts – bone building cells
- Osteoclasts – cells that break down bone and cartilage
- Fontanelle – soft spot on infant's skull where intramembranous development has not completed

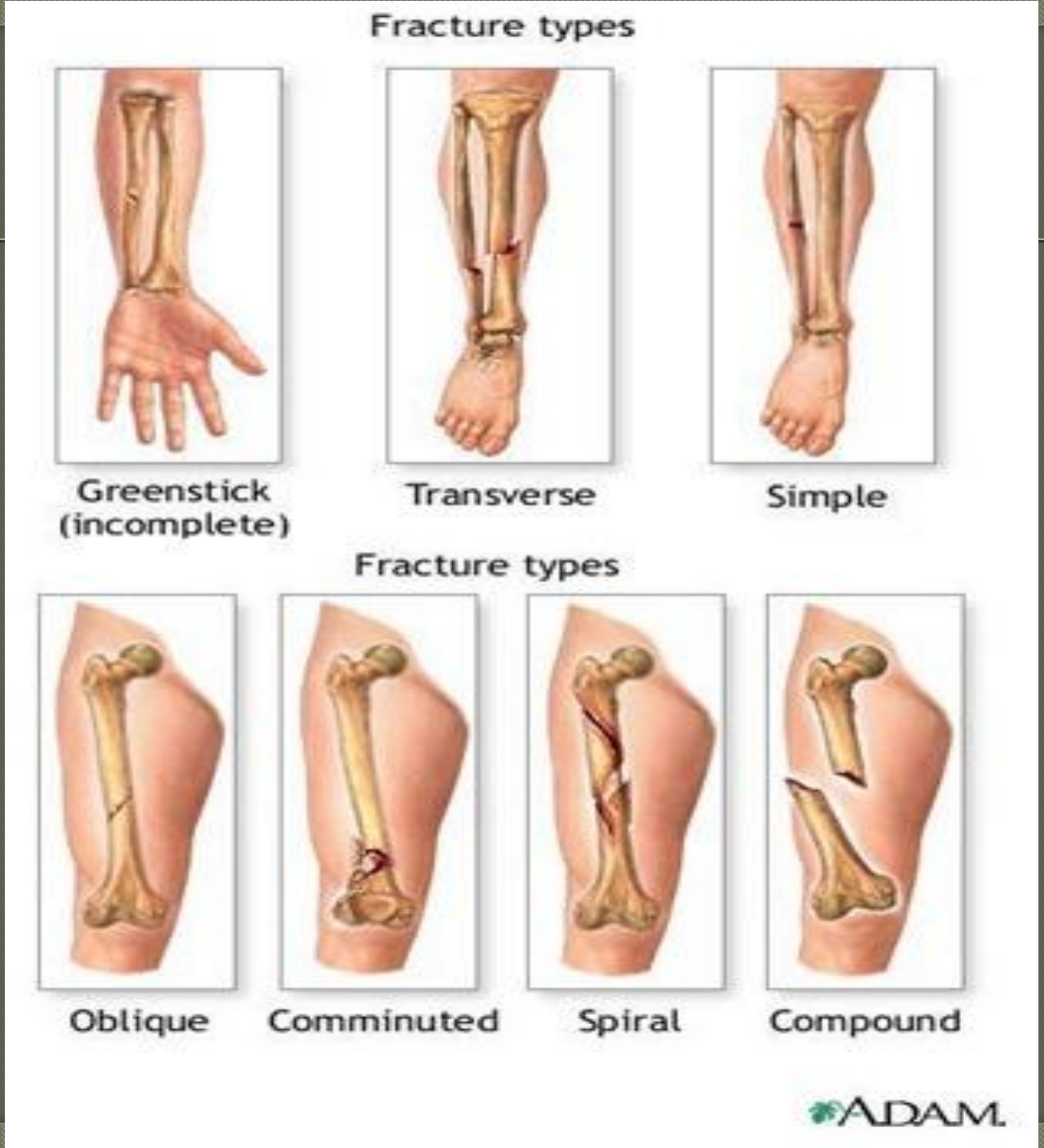

Large fontanelle
A.D.A.M.

Bone Injuries

- Fractures – most common type of bone damage
  - bone becomes cracked or splintered
- Fracture categories
  - Simple – least severe – a crack on the bone structure
  - Greenstick – common in children – one side of the bone is frayed from the fracture, while the other is twisted, but not broken

Bone injuries, cont.

- Comminuted, or compound – one or more areas of bone are displaced or shattered
  - Open – tearing of the skin
  - Becomes easily infected
- Transverse – horizontal
- Oblique – angles
- Spiral – twisting
  - Angulation – twisted change in original shape


Fracture types
Greenstick (incomplete)
Transverse
Simple
Fracture types
Oblique
Comminuted
Spiral
Compound
ADAM.

Bone Healing

- Involves same cells involved in growth and development
- For bone healing to begin, damage must cause blood accumulation in the injured bone tissue
  - Possible for fractures to occur without bone restoration

Pathology of the Skeletal System

- Shin splint – painful condition of the anterior lower leg, from overuse of ankle joint
- Stress fracture – break in bone that may be too small to detect, generally does not heal
- Arthritis – swelling and stiffness in the joints
  - Affects 1 in 6 Americans
- Osteoarthritis – deterioration of articular cartilage at ends of bones
- Rheumatoid arthritis – immune system attacks connective tissue
  - Most serious and disabling form of arthritis, most common in females

Pathology of the Skeletal System, cont.

- Ankylosing spondylitis – arthritis of the spine
- Juvenile arthritis – arthritis that affects children
- Gout – metabolic disorder that causes severe inflammation of joints
  - Most often affects males, small joints of foot
- Lupus – autoimmune disorder that causes inflammation of connective tissues throughout the body
  - Immune system accidently attacks on CT, most common in women
- Scleroderma – connective tissue disorder causing thickening of the skin
  - Mostly occurs in patches

Pathology of the Skeletal System, cont.

- Fibromyalgia – disorder that causes widespread joint pain
  - Affects mostly women, cause unknown
- Tooth decay – type of skeletal disease caused by bacteria, leads to tooth destruction
  - Cavity – hole in tooth caused by decay
- Myeloma – cancer of the red bone marrow
- Osteomyelitis – inflammation of the bone caused by bacterial blood infections
- Osteonecrosis – caused by osteocyte death due to the obstruction of blood flow
  - Common in divers and fighter pilots who develop bubbles of gas in their blood… bubbles block small blood vessels

OSTEOPOROSIS

- Osteoporosis – degenerative bone disorder
  - Affects mostly women
  - 4% of North Americans, 68% women
    - Bone density loss – mild form of osteoporosis – gradual loss of osteons
  - Decreased levels of sex hormones – menopause..
  - Malnutrition and undernutrition other causes
  - Lack of vitamin D and calcium
  - Smoking, excessive alcohol intake
  - Responsible for more than 1.5 million bone fractures annually in North America

Normal bone

Bone with Osteoporosis

Why bones pop or crack

- Joints are the meeting points of two separate bones, held together and in place by connective tissues and ligaments. All of the joints in our bodies are surrounded by synovial fluid, a thick, clear liquid. When you stretch or bend your finger to pop the knuckle, you're causing the bones of the joint to pull apart. As they do, the connective tissue capsule that surrounds the joint is stretched. By stretching this capsule, you increase its volume. And as we know from chemistry class, with an increase in volume comes a decrease in pressure. So as the pressure of the synovial fluid drops, gases dissolved in the fluid become less soluble, forming bubbles through a process called **cavitation.** When the joint is stretched far enough, the pressure in the capsule drops so low that these bubbles burst, producing the pop that we associate with knuckle cracking.

- Normal movement causes some cracking and creaking in even the healthiest joints and cartilage. Some noises, though, are the result of cartilage damage from injury, loss of muscle tissue or conditions such as osteoarthritis.

- **Totally Normal Noises**
- One of the most common sources of noise is gas — but not the intestinal kind. The joint capsule is filled with synovial fluid, which lubricates the joint and provides nourishment to the cells that form cartilage. The fluid contains dissolved gases, including carbon dioxide, nitrogen and oxygen. When the joint ligaments are stretched, either intentionally (knuckle cracking) or by accident (arching your back), the pressure within the capsule changes and it releases carbon dioxide in the form of bubbles. The cracking sound you hear comes from those gas bubbles bursting. When these bubbles burst, people experience a sense of spaciousness within the joint and a temporary increase in its range of motion.
- Another common cracking or popping sound doesn't come from within the joint at all. During movement, tendons and ligaments that cross the joint can temporarily shift position or drag across a bone. When they return to their normal position, they make a snapping noise. You may have heard this in your knees when you rose from a sitting position, or in your neck when you turned your head. It's also common in the shoulders. Loss of muscle mass from aging hastens this effect because more bone is exposed. This sounds scarier than it is; it's actually a normal and harmless occurrence.

*Intramembranous Ossification – bone generated on or within connective tissue membranes

1. Mesochyme cells will differentiate into osteoblasts in ossification centers—in a few days osteocytes form.
2. Trabeculae develops, start of our (spongy bone)
3. Blood and lymphatic vessels grow and develop red bone marrow

* Intramembranous Ossification

- 4. periosteum forms
- 5. At birth skull bones are separated by Fontanelles (soft spots)
- 6. The sutures form out of fibrous tissues
- 7. By late adolescence these fontanelles are fully ossified into sutures
  - which aids in the protection of brain

*Endochondral Ossificaton

- 1.Replacement of cartilage by bone (occurs in most bones of skeleton)
- 2. Mesenchyme cells condense and turn into chondroblasts
- 3. nutrient artery will penetrate perichondrium
- 4.osteoblasts form and they secrete matrix that forms periosteum
- 5.This causes capillaries to grow into cartilage
- 6.This leads to ossification center formation which creates osteoblasts.
- 7. Osteoblasts replace cartilage matrix and form trabeculae (spongy bone)