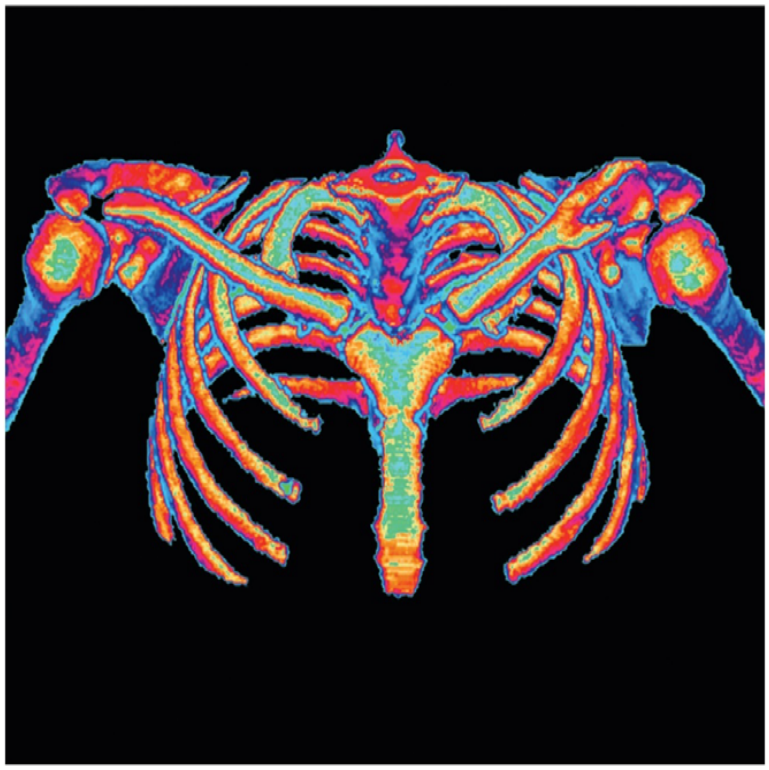
Chapter 8

An Introduction to the Skeleton System and the Anatomy of the Boney Spinal Column



Overview of the Skeleton

- The two regions of the skeleton
  - axial skeleton = forms the central supporting axis of the body
    - skull, auditory ossicles, hyoid bone, vertebral column, and thoracic cage (ribs and sternum)
  - appendicular skeleton
    - pectoral girdle and the bones of the upper limbs
    - pelvic girdle and bones of the lower limbs

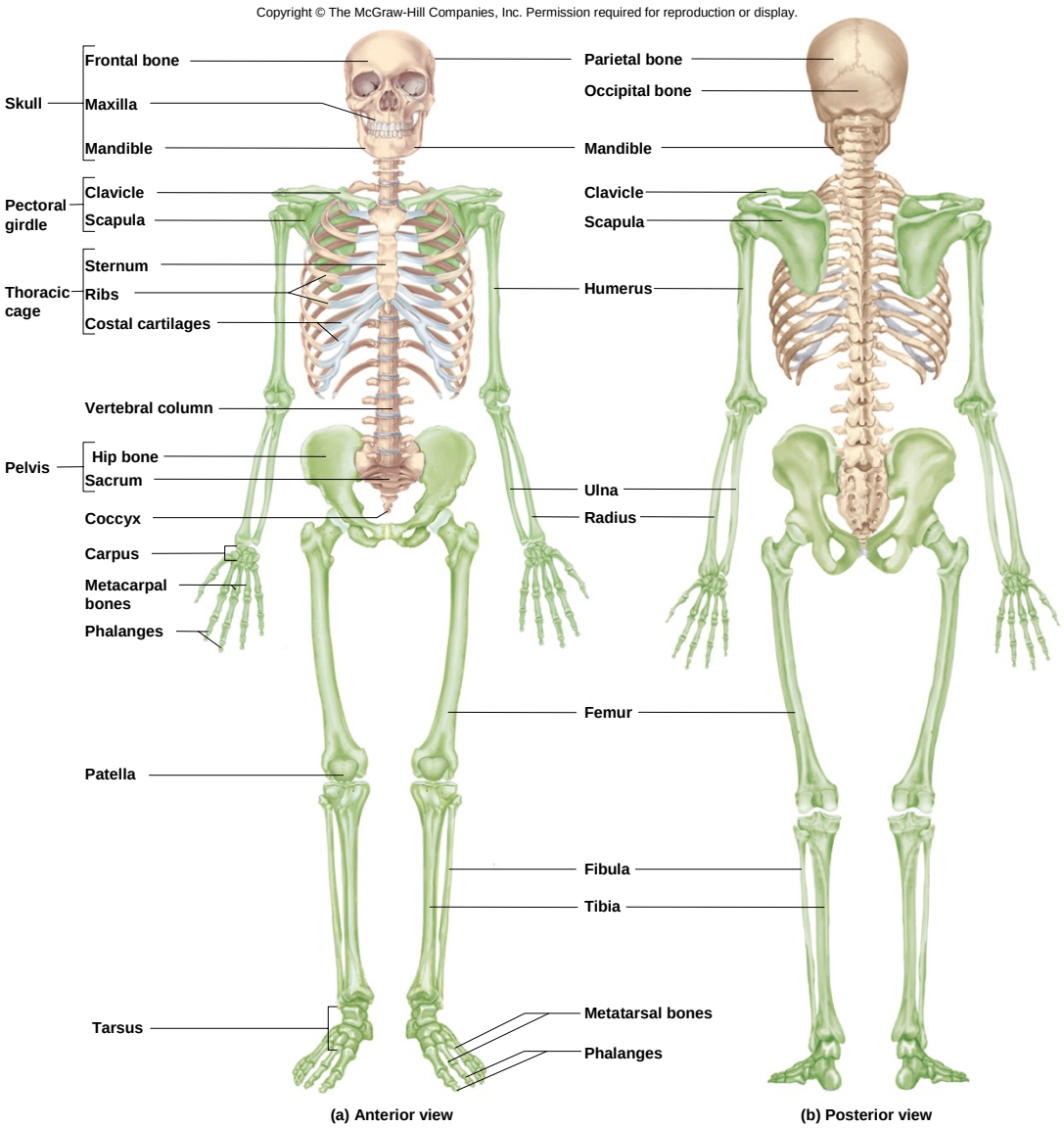
Overview of the Skeleton

Number of bones changes throughout life (270 bones at birth, decreases with fusion)

206 in typical adult skeleton (many bones fuse!)

- varies with development of sesamoid bones (e.g. patella)
  - bones that form within some tendons in response to stress
- Bone count number also varies with presence of sutural (wormian) bones in skull
  - extra bones that develop in skull suture lines

Axial and Appendicular Skeleton



- **axial skeleton** is colored **tan**
  - skull, vertebrae, sternum, ribs, sacrum and hyoid
- **appendicular skeleton** is colored **green**
  - pectoral girdle / upper extremity
  - pelvic girdle / lower extremity

TABLE 8.1 Bones of the Adult Skeletal System

Axial Skeleton

Skull (22 bones)
Cranial bones
- Frontal bone (1)
- Parietal bone (2)
- Occipital bone (1)
- Temporal bone (2)
- Sphenoid bone (1)
- Ethmoid bone (1)

Facial bones
- Maxilla (2)
- Palatine bone (2)
- Zygomatic bone (2)
- Lacrimal bone (2)
- Nasal bone (2)
- Vomer (1)
- Inferior nasal concha (2)
- Mandible (1)

Auditory ossicles (6 bones)
- Malleus (2)
- Incus (2)
- Stapes (2)

Hyoid bone (1 bone)

Vertebral column (26 bones)
- Cervical vertebrae (7)
- Thoracic vertebrae (12)
- Lumbar vertebrae (5)
- Sacrum (1)
- Coccyx (1)

Thoracic cage (25 bones plus thoracic vertebrae)
- Ribs (24)
- Sternum (1)

Appendicular Skeleton

Pectoral girdle (4 bones)
- Scapula (2)
- Clavicle (2)

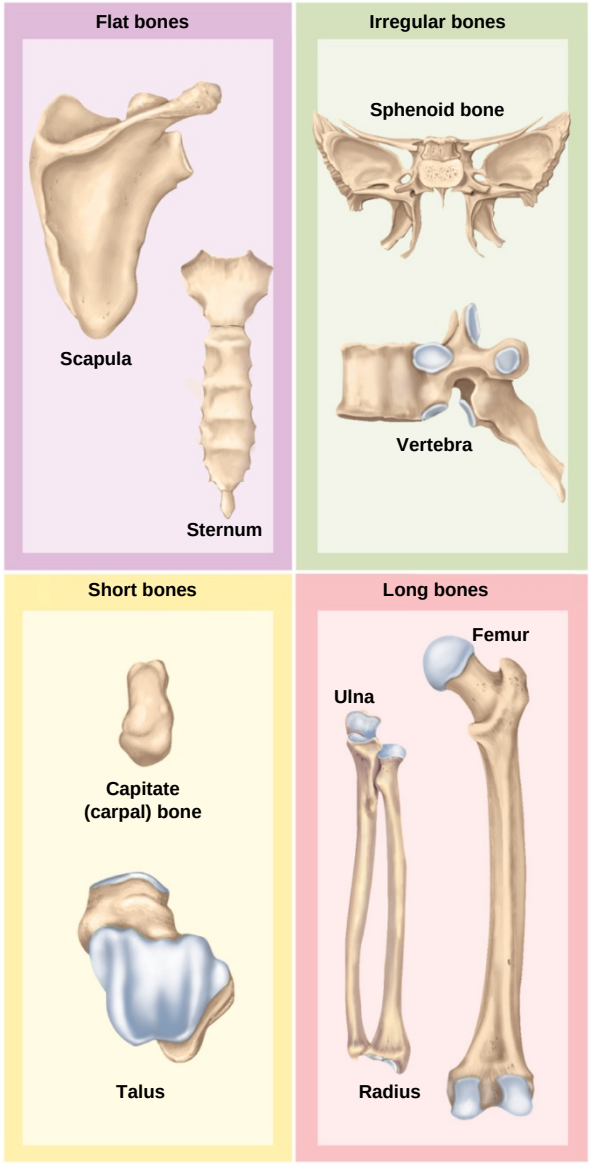
Upper limb (60 bones)
- Humerus (2)
- Radius (2)
- Ulna (2)
- Carpals (16)
- Metacarpals (10)
- Phalanges (28)

Hip bones (2)

Lower limb (60 bones)
- Femur (2)
- Patella (2)
- Tibia (2)
- Fibula (2)
- Tarsals (14)
- Metatarsals (10)
- Phalanges (28)

Grand Total: 206 Bones

Shapes of Bones

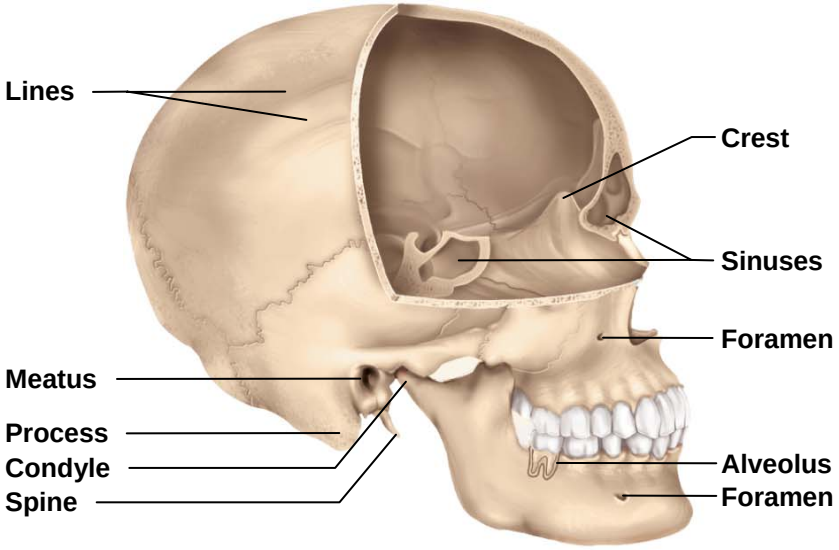


- **long bones**
  - longer than wide
  - rigid levers acted upon by muscles
- **short bones**
  - equal in length and width
  - glide across one another in multiple directions
- **flat bones**
  - protect soft organs
  - curved but wide & thin
- **irregular bones**
  - elaborate shapes that don't fit into the other categories

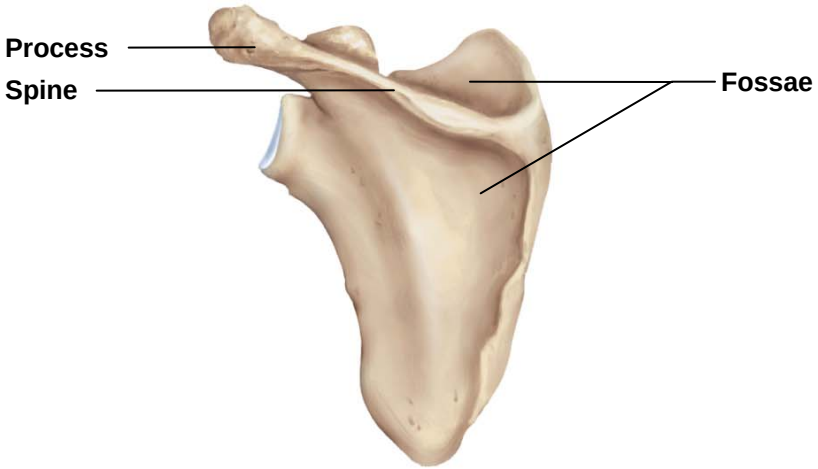
Anatomical Features (Markings) of Bones

Term	Description and Example
Articulations	
Condyle	A rounded knob that articulates with another bone (occipital condyles of the skull)
Facet	A smooth, flat, slightly concave or convex articular surface (articular facets of the vertebrae)
Head	The prominent expanded end of a bone, sometimes rounded (head of the femur)
Extensions and projections	
Crest	A narrow ridge (iliac crest of the pelvis)
Epicondyle	An expanded region superior to a condyle (medial epicondyle of the femur)
Line	A slightly raised, elongated ridge (nuchal lines of the skull)
Process	Any bony prominence (mastoid process of the skull)
Protuberance	A bony outgrowth or protruding part (mental protuberance of the chin)
Spine	A sharp, slender, or narrow process (mental spines of the mandible)
Trochanter	Two massive processes unique to the femur
Tubercle	A small, rounded process (greater tubercle of the humerus)
Tuberosity	A rough elevated surface (tibial tuberosity)
Depressions	
Alveolus	A pit or socket (tooth socket)
Fossa	A shallow, broad, or elongated basin (mandibular fossa)
Fovea	A small pit (fovea capitis of the femur)
Sulcus	A groove for a tendon, nerve, or blood vessel (intertubercular sulcus of the humerus)
Passages and cavities	
Canal	A tubular passage or tunnel in a bone (auditory canal of the skull)
Fissure	A slit through a bone (orbital fissures behind the eye)
Foramen	A hole through a bone, usually round (foramen magnum of the skull)
Meatus	An opening into a canal (external acoustic meatus of the ear)
Sinus	An air-filled space in a bone (frontal sinus of the forehead)

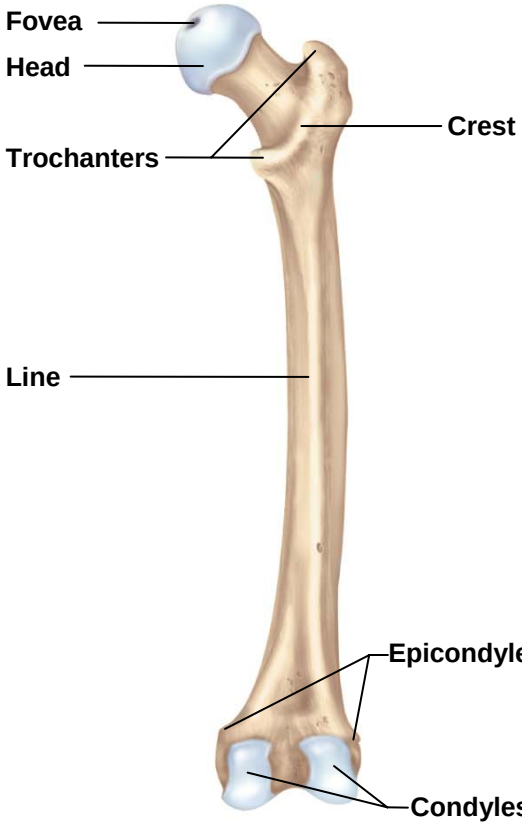
Anatomical Features of Bones



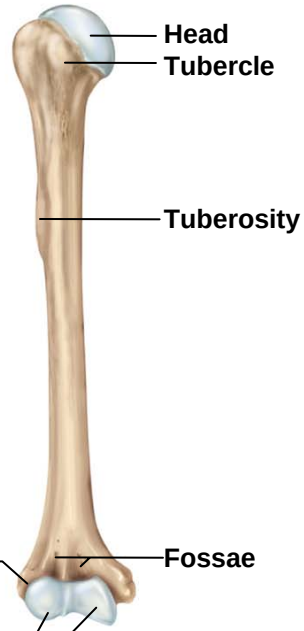
(a) Skull (lateral view)



(b) Scapula (posterior view)

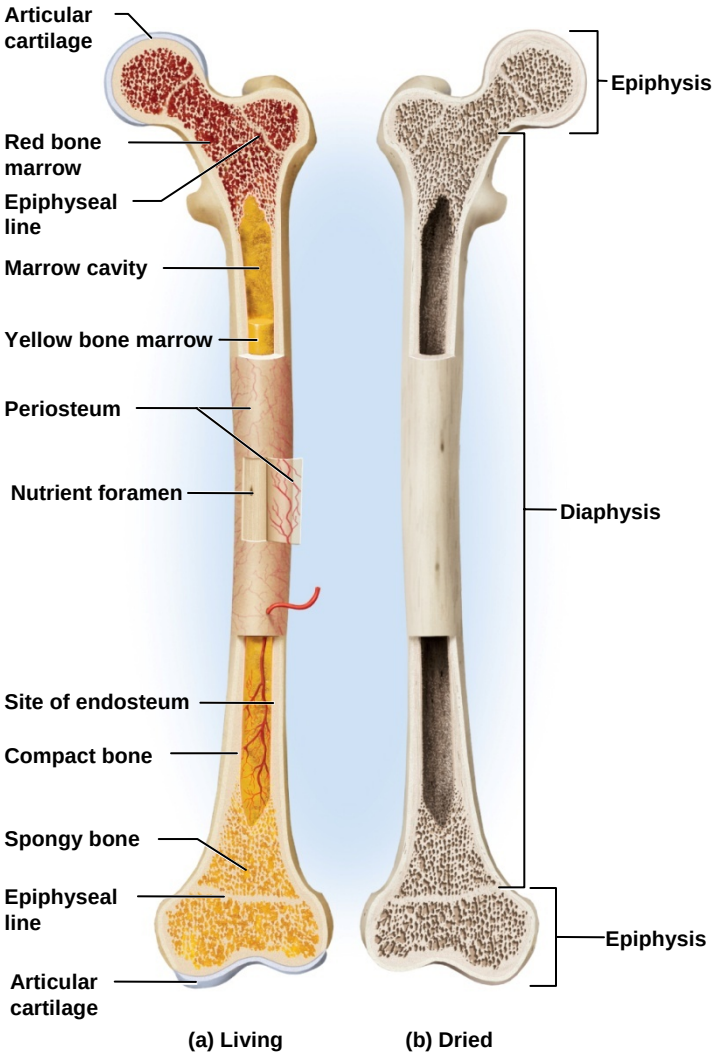


(c) Femur (posterior view)



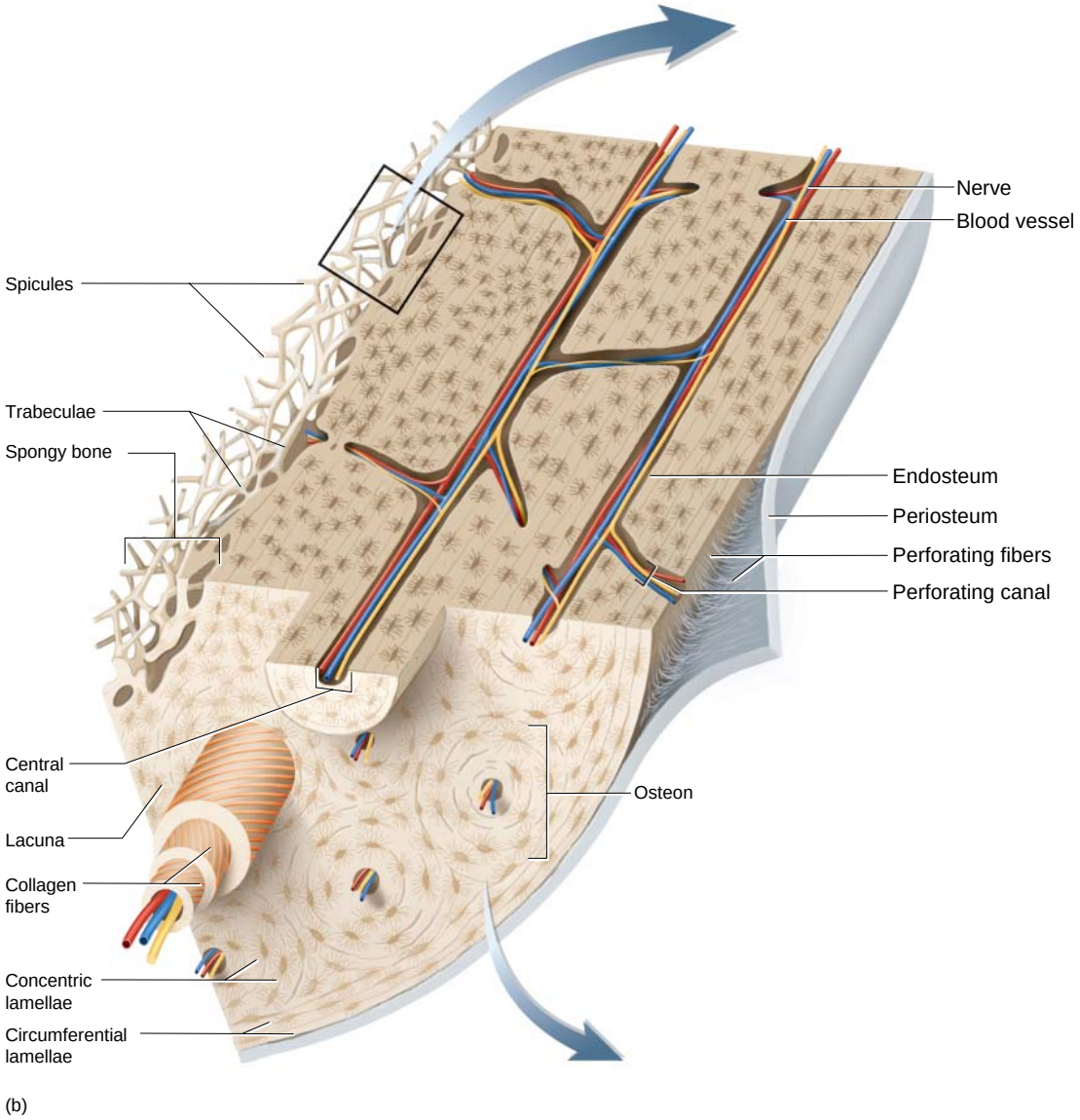
(d) Humerus (anterior view)

Structure of a Long Bone



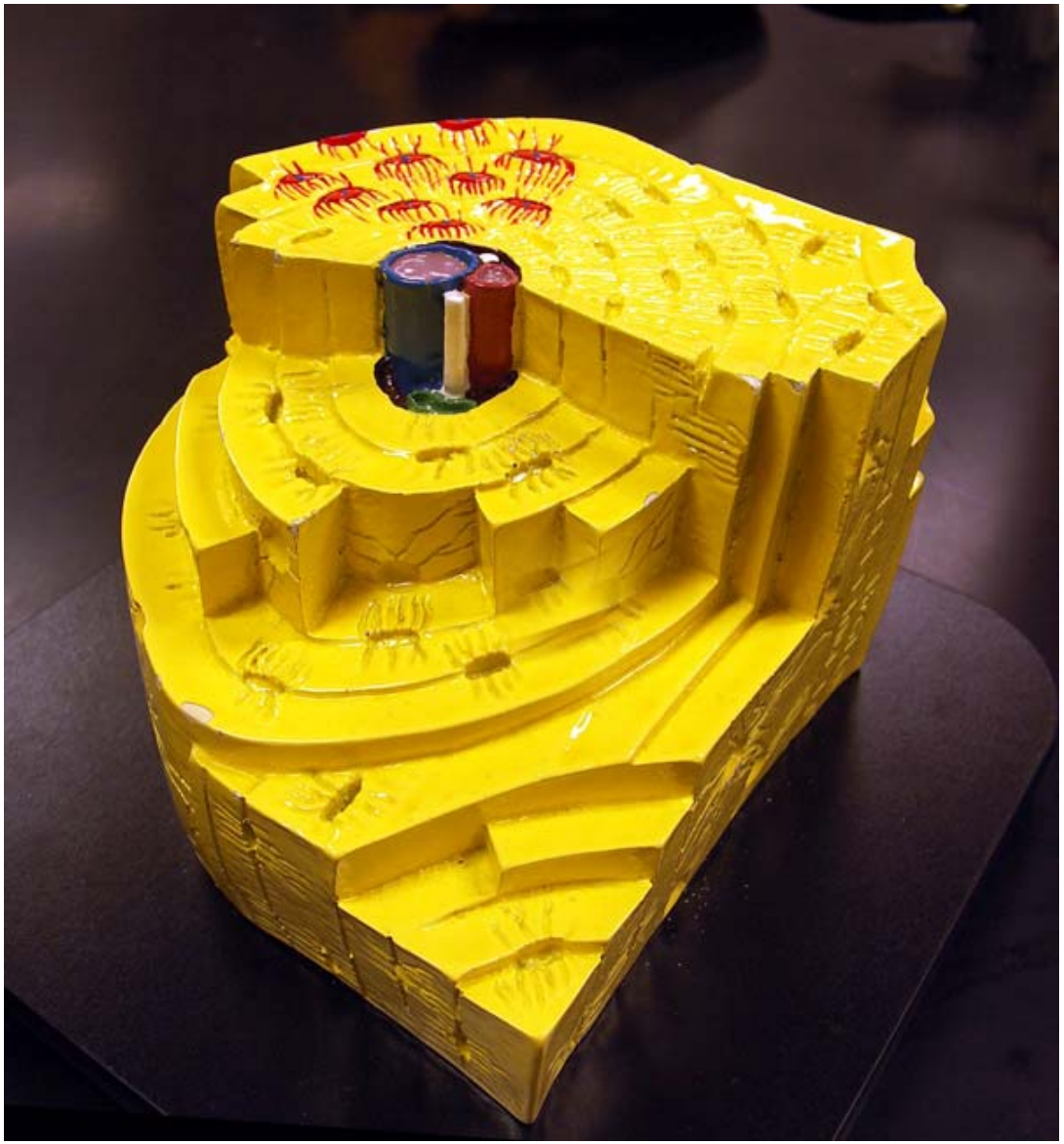
- epiphyses and diaphysis
- compact and spongy bone
- marrow cavity
- articular cartilage
- periosteum

The Osteon and the Blood Vessels of Bone



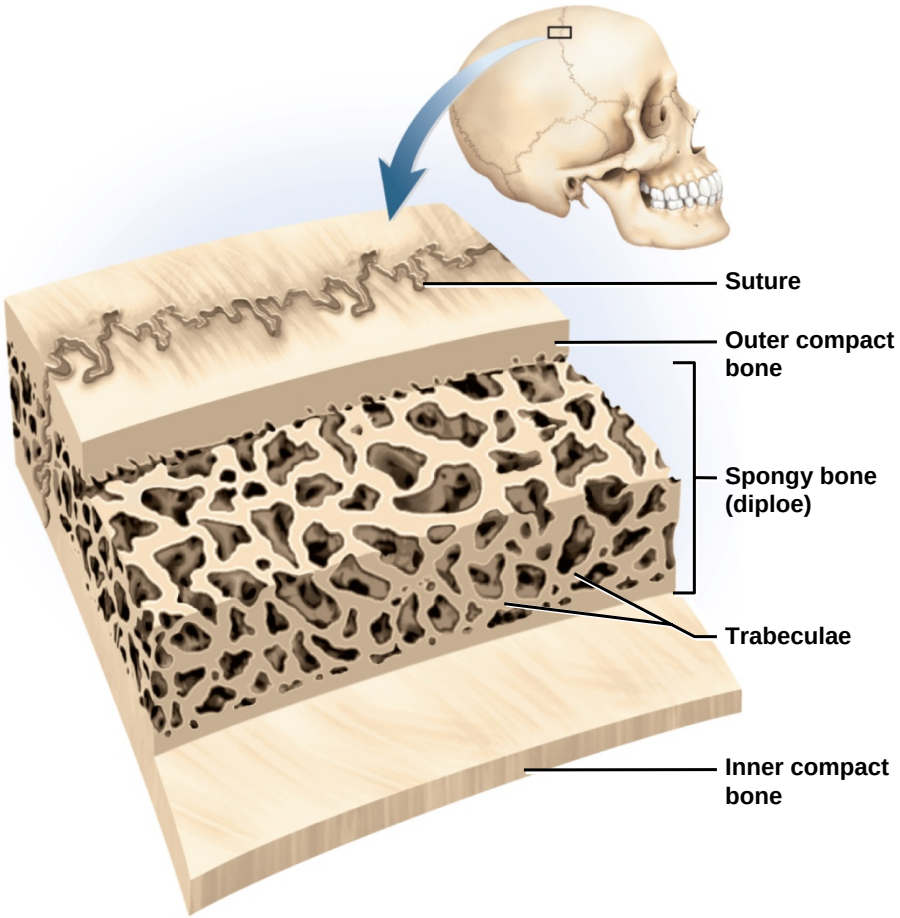
- **nutrient foramina** – on bone surface
- **perforating (Volkmann's) canals** – transverse or diagonal canals
- **central canals** – vertical canals
- circumferential lamellae
- interstitial lamellae

The Osteon



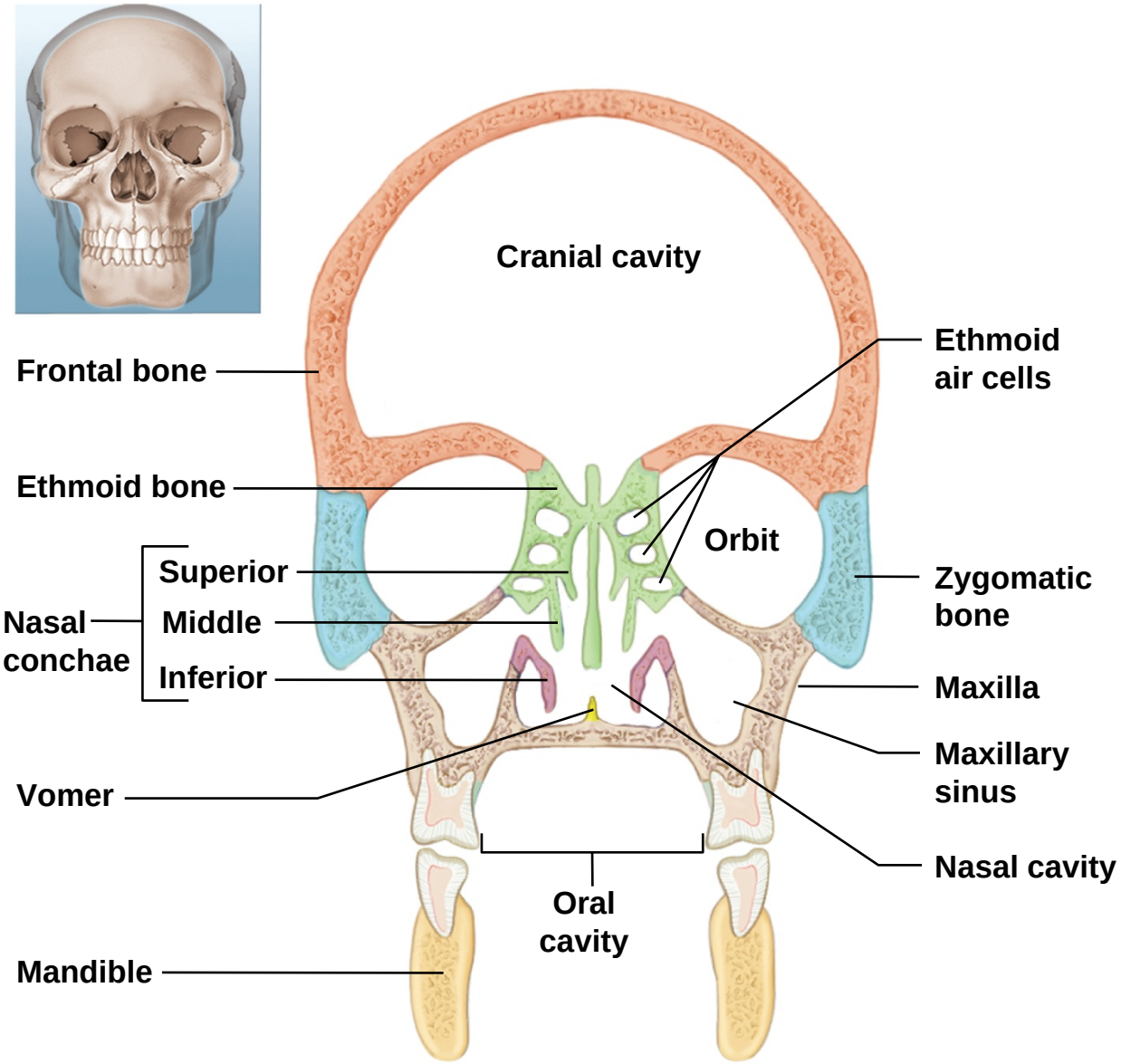
The Osteon

Structure of a Flat Bone



- sandwich-like construction
- two layers of compact bone enclosing a middle layer of spongy bone
  - both surfaces of flat bone covered with periosteum
- **diploe** – spongy layer in the cranium
  - absorbs shock
  - marrow spaces lined with endosteum

Major Skull Cavities



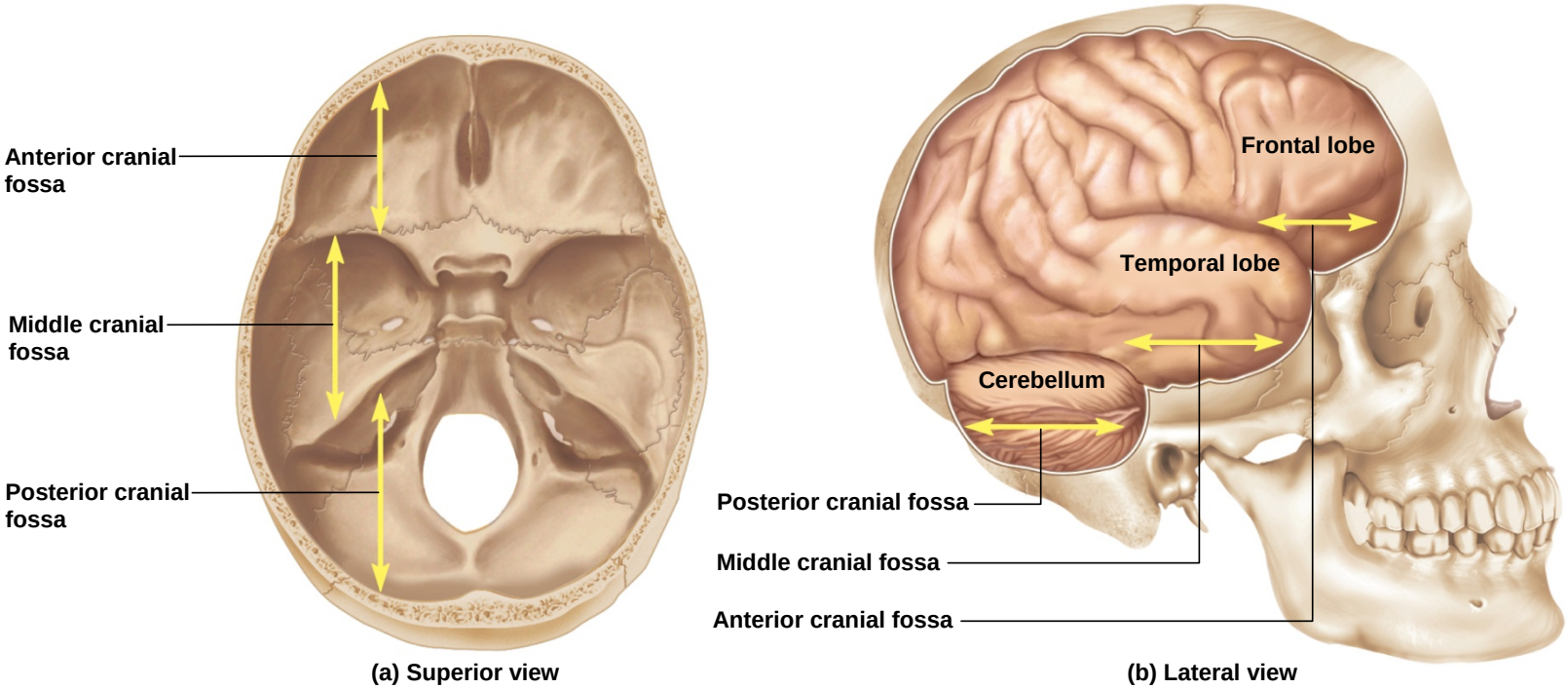
Cranium (Braincase)

- protects the brain and associated sense organs

- swelling of the brain inside the rigid cranium may force tissue through foramen magnum resulting in death

- consists of two parts:
  - the **calvaria** (skullcap)
  - and the cranial **base**

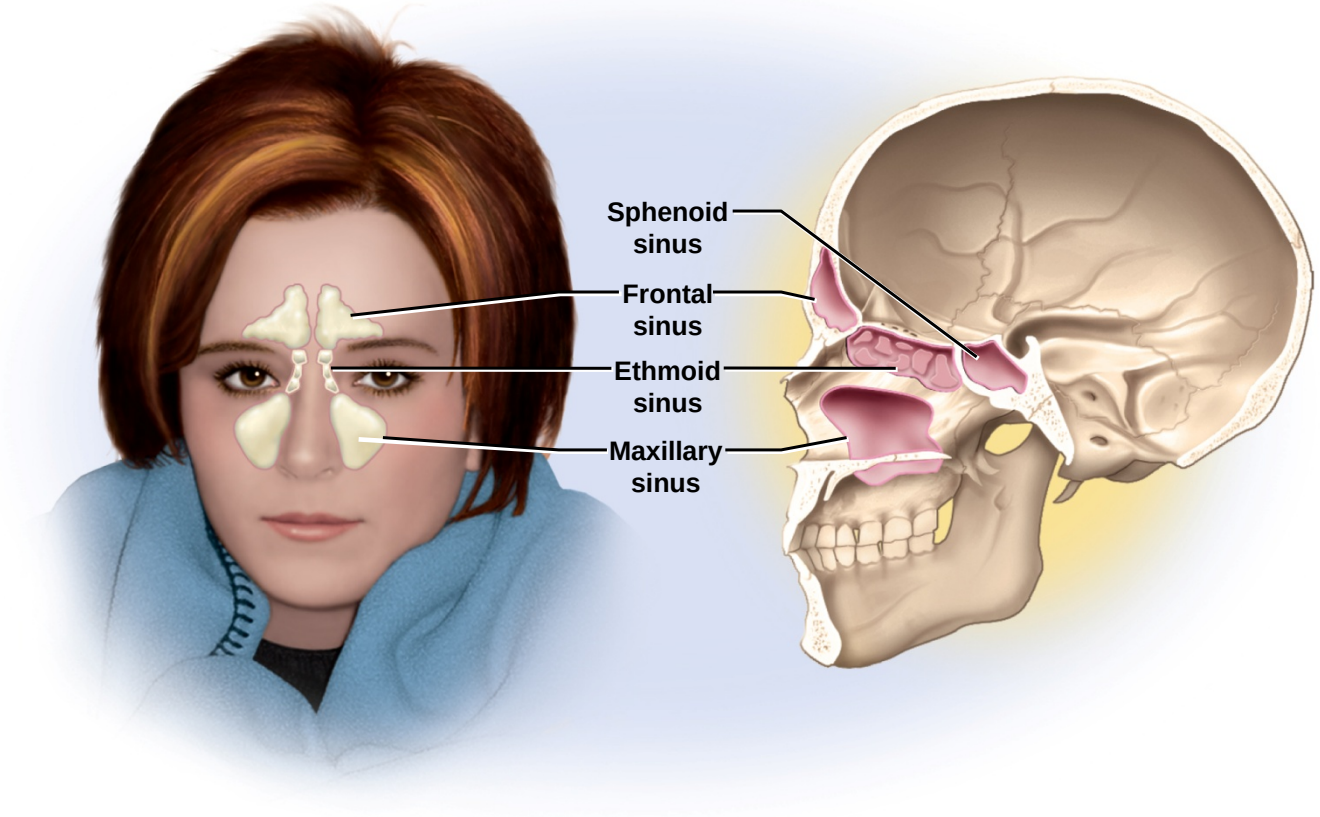
Cranial Base & Fossa



base is divided into three basins that comprise the cranial floor

- anterior cranial fossa holds the frontal lobe of the brain
- middle cranial fossa holds the temporal lobes of the brain
- posterior cranial fossa contains the cerebellum

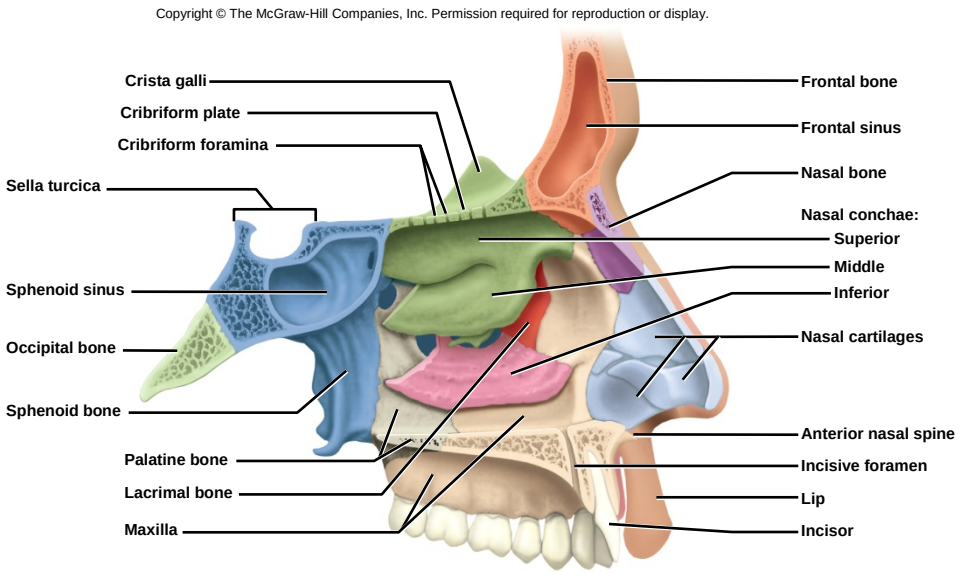
Location of Maxillary Sinus



- **maxillary sinus** fills maxillae bone
  - larger in volume than frontal, sphenoid and ethmoid sinuses

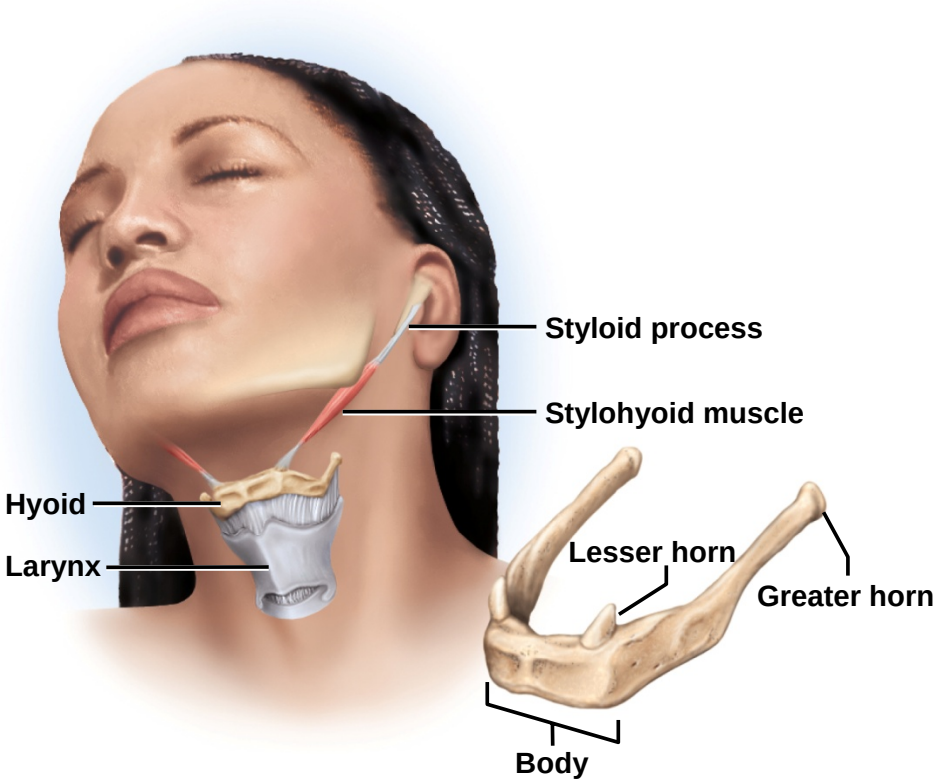
Inferior Nasal Conchae

- three conchae in the nasal cavity
  - superior and middle are part of the ethmoid bone
- **inferior nasal concha** is a separate bone
- largest of the three

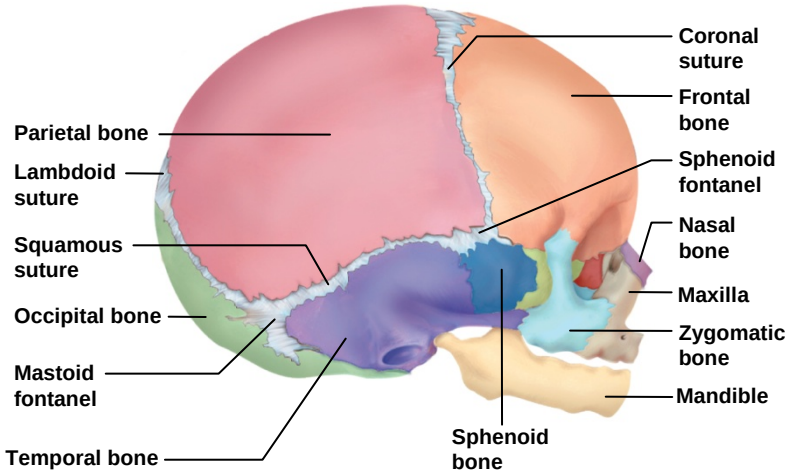


Bones Associated With Skull

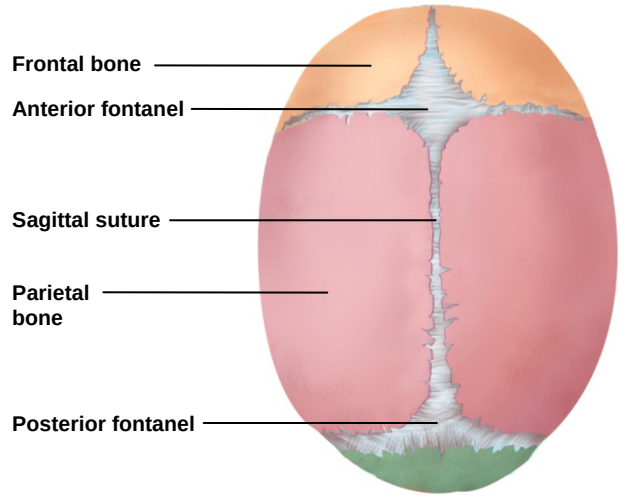
- **auditory ossicles**
  - three in each middle-ear cavity
  - **malleus**, **incus**, and **stapes**
- **hyoid bone**
  - slender u-shaped bone between the chin and larynx
  - does not articulate with any other bone
  - suspended from styloid process of skull by muscle and ligament
  - **body** and **greater and lesser horns (cornua)**
  - fractured hyoid bone is evidence of strangulation



Skull in Infancy and Childhood



(a) Lateral view



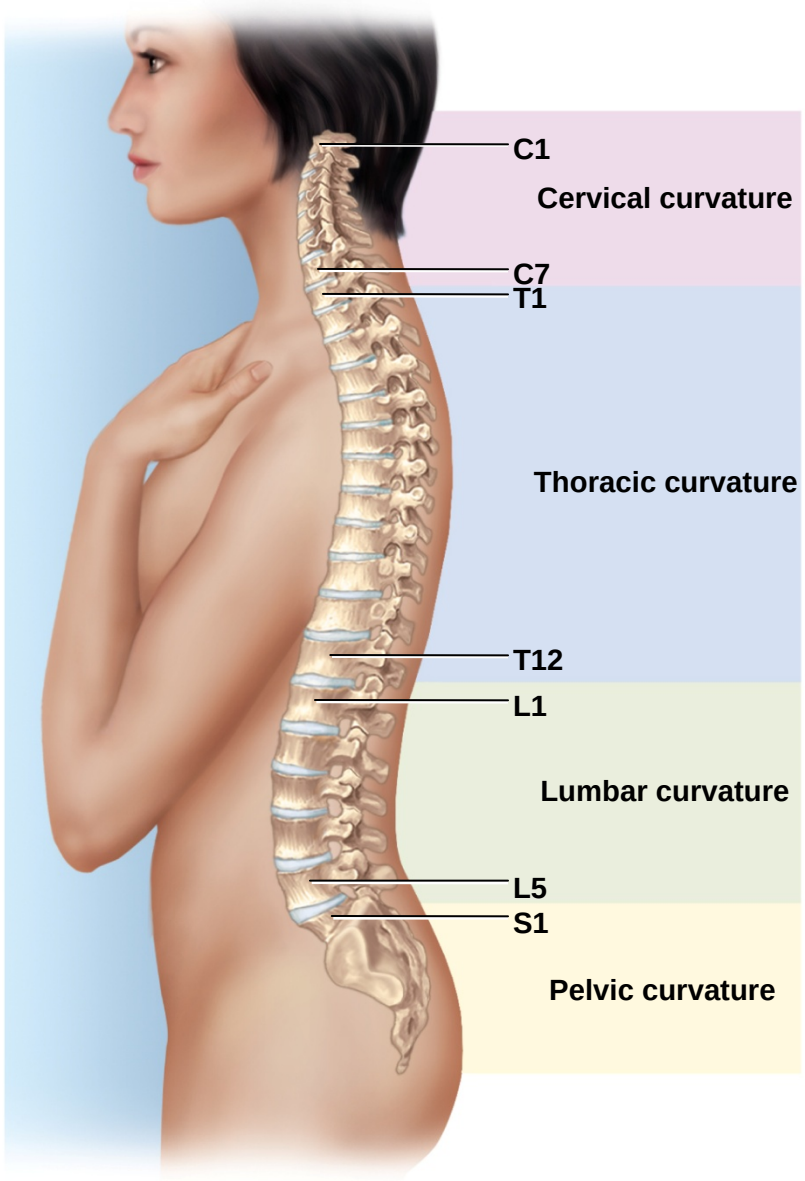
(b) Superior view

- **fontanels** - spaces between unfused bones
  - filled with fibrous membrane
  - allow shifting of bones during birth and growth of brain
  - **anterior**, **posterior**, **sphenoid** (anterolateral), and **mastoid** (posterolateral **fontanels**
  - feel pulse
  - allow insight about hydration
- two frontal bones fuse by age 6 (**metopic suture**)
- skull reaches adult size by 8 or 9 years of age

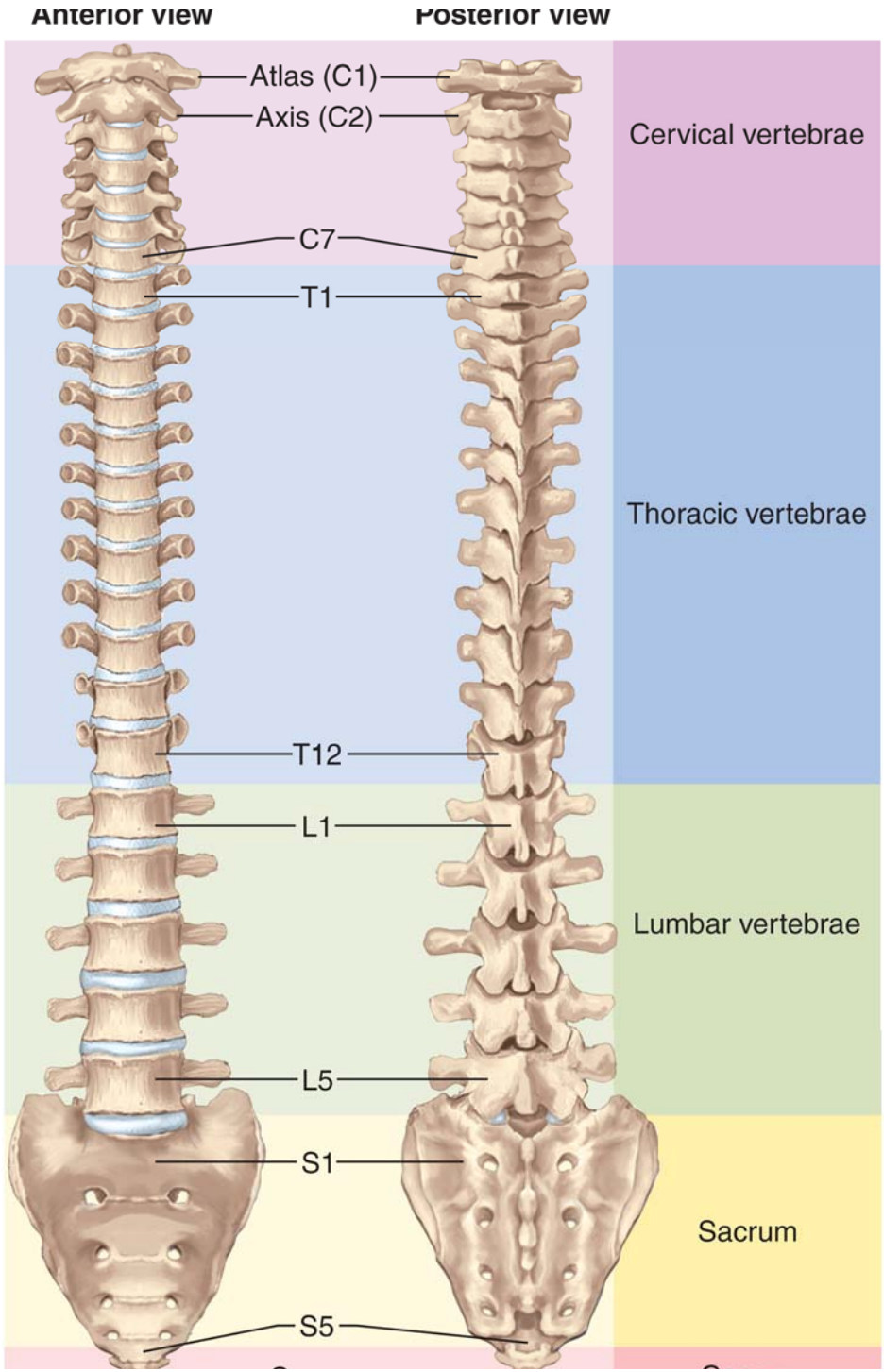
Newborn Spinal Curvature

- Newborn's spine exhibits one continuous C-shaped curve at birth
- known as primary curvature

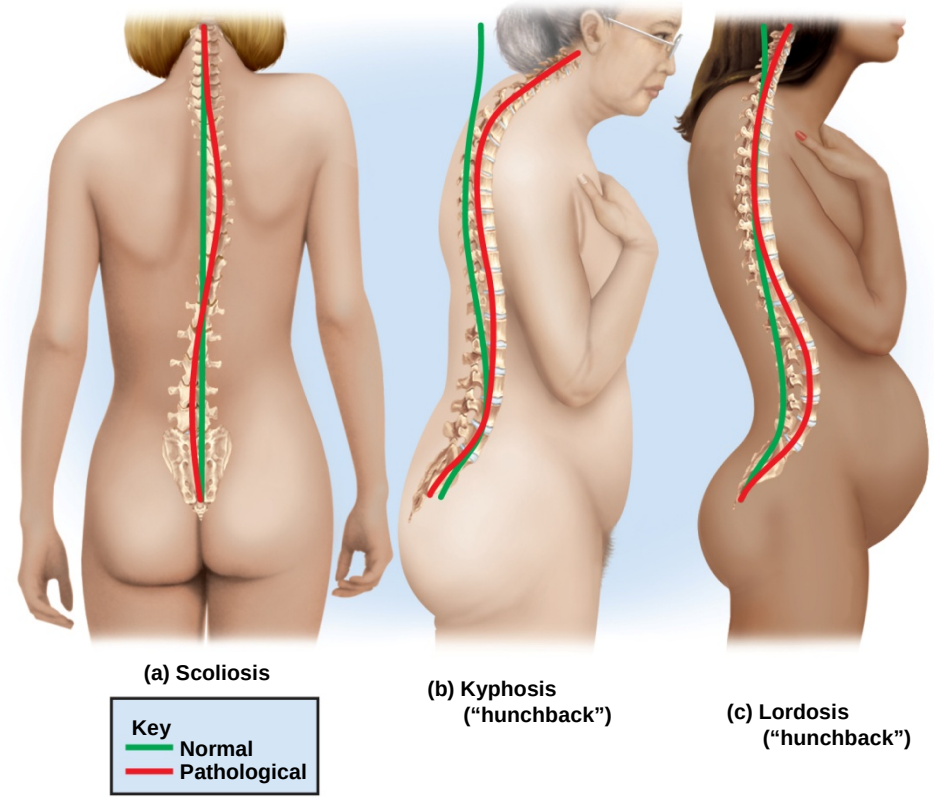
Adult Spinal Curvatures



- s-shaped vertebral column with **four normal curvatures**
  - **cervical**
  - **thoracic**
  - **lumbar**
  - **pelvic**
- **primary curvatures** – present at birth
  - **thoracic and pelvic**
- **secondary curvatures** – develop later
  - **cervical and lumbar**
  - lifting head as it begins to crawl develops cervical curvature
  - push up with arms before walking start to develop lumbar
  - walking upright develops lumbar curvature


Anterior view
Posterior view
Atlas (C1)
Axis (C2)
C7
T1
T12
L1
L5
S1
S5
Cervical vertebrae
Thoracic vertebrae
Lumbar vertebrae
Sacrum

Abnormal Spinal Curvatures



- from disease, paralysis of trunk muscles, poor posture, pregnancy, or congenital defect
- **scoliosis** – abnormal lateral curvature
  - most common
  - usually in thoracic region
  - particularly of adolescent girls
  - developmental abnormality in which the body and arch fail to develop on one side of the vertebrae
- **kyphosis** (hunchback) – exaggerated thoracic curvature
  - usually from osteoporosis, also osteomalacia or spinal tuberculosis, or wrestling or weightlifting in young boys
- **lordosis** (swayback) – exaggerated lumbar curvature
  - is from pregnancy or obesity