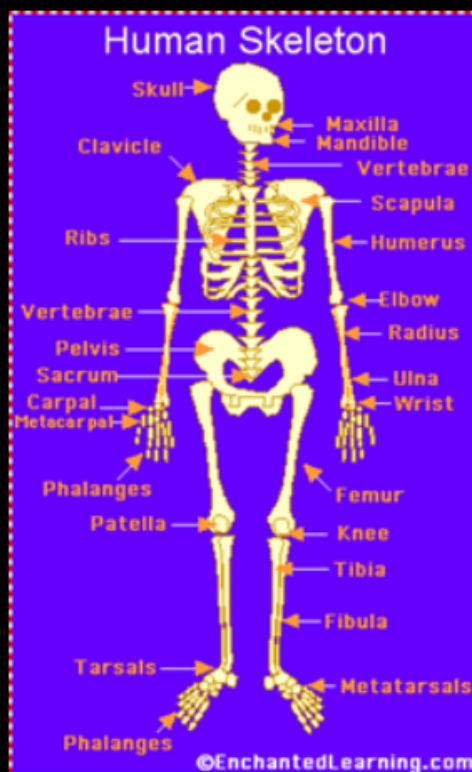


The Skeletal System



<http://www.innerbody.com/image/skelfov.html>

Skeletal System Gross and Cool Facts

- The human hand has 27 bones; your face has 14.
- The longest bone in your body? Your thigh bone, the femur -- it's about 1/4 of your height. The smallest is the stirrup bone in the ear which can measure 1/10 of an inch.
- Did you know that humans and giraffes have the same number of bones in their necks? Giraffe neck vertebrae are just much, much longer!
- You have over 230 moveable and semi-moveable joints in your body.

http://www.abcya.com/skeletal_system.htm

■ Introduction:

■ Introduction:

- A. Bones are very active tissues.
- B. Each bone is made up of several types of tissues and so is an organ.
- C. Bone functions include: muscle attachment, protection and support, blood cell production, and storage of minerals.

**Tissues of Bone:

epithelium (1 type: endothelium)

connective (6 types: areolar, adipose, hyaline cartilage,
fibro-cartilage, spongy & compact)

nervous (1 type: neuron)

hemopoietic (1 type: blood)

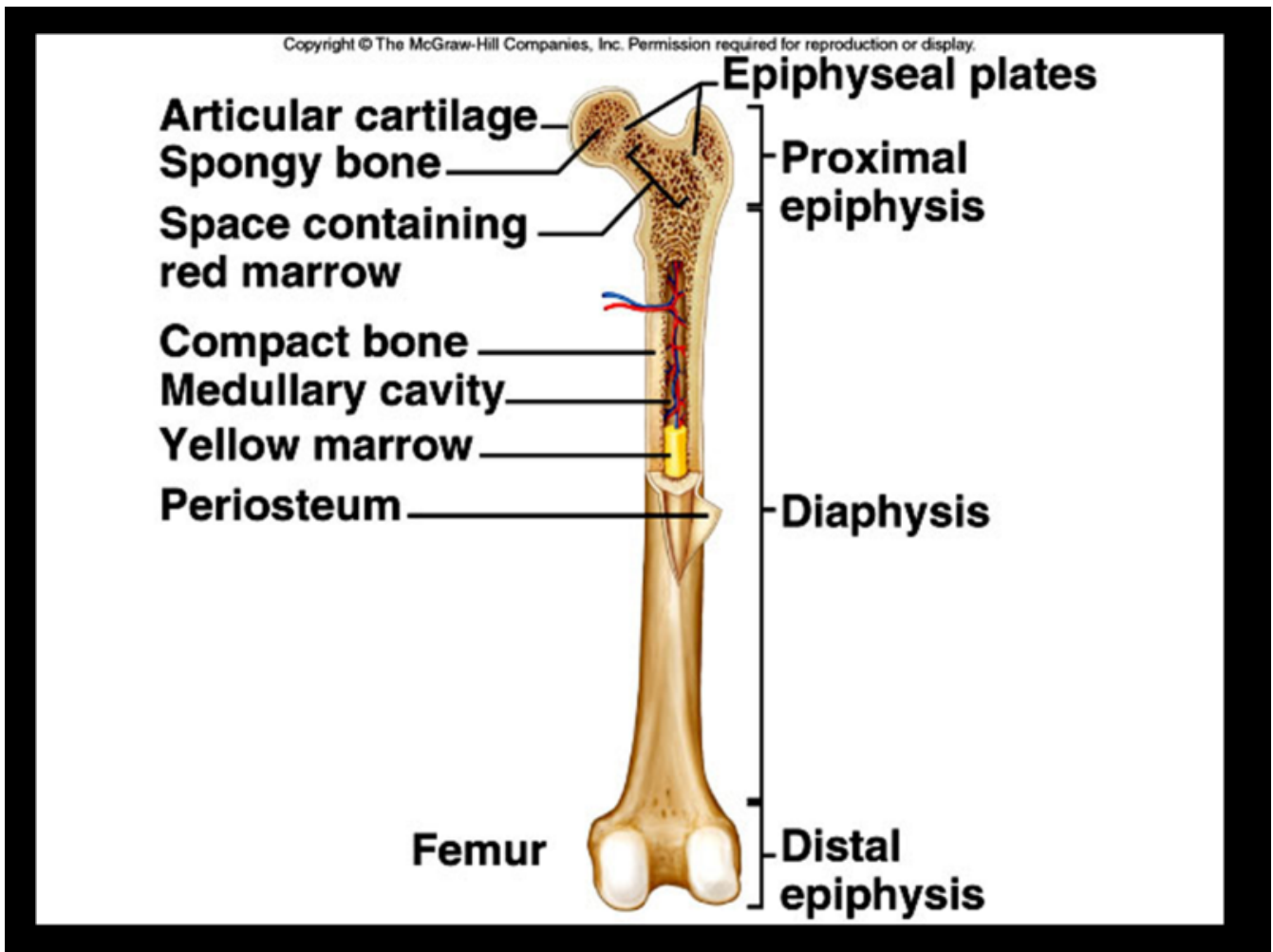
Bone Structure

A. Bones differ in size and shape, yet are similar in several ways.

B. Parts of a Long Bone

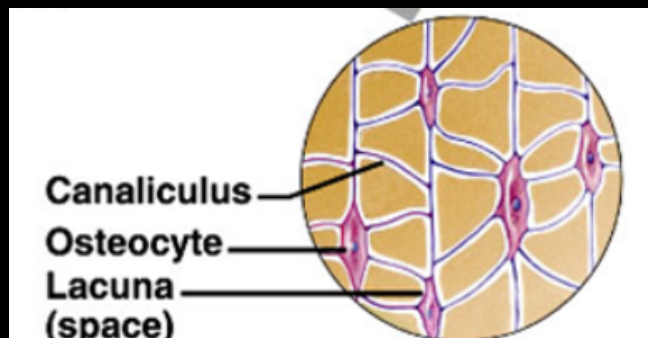
1. Expanded ends of bones that form joints with adjacent bones are called **epiphyses**.
2. **Articular cartilages** (hyaline cartilage) cover the epiphyses.
3. The shaft of the bone is the **diaphysis**.
4. A tough layer of vascular connective tissue, called the periosteum, covers the bone and is continuous with ligaments and tendons.

5. A bone's shape makes possible its function; bony processes or grooves indicate places of attachment for muscles.
6. **Compact** bone makes up the wall of the diaphysis; the epiphyses are filled with spongy bone to reduce the weight of the skeleton.
7. The diaphysis contains a hollow **medullary cavity** that is lined with **endosteum** and filled with marrow.



C. Microscopic Structure

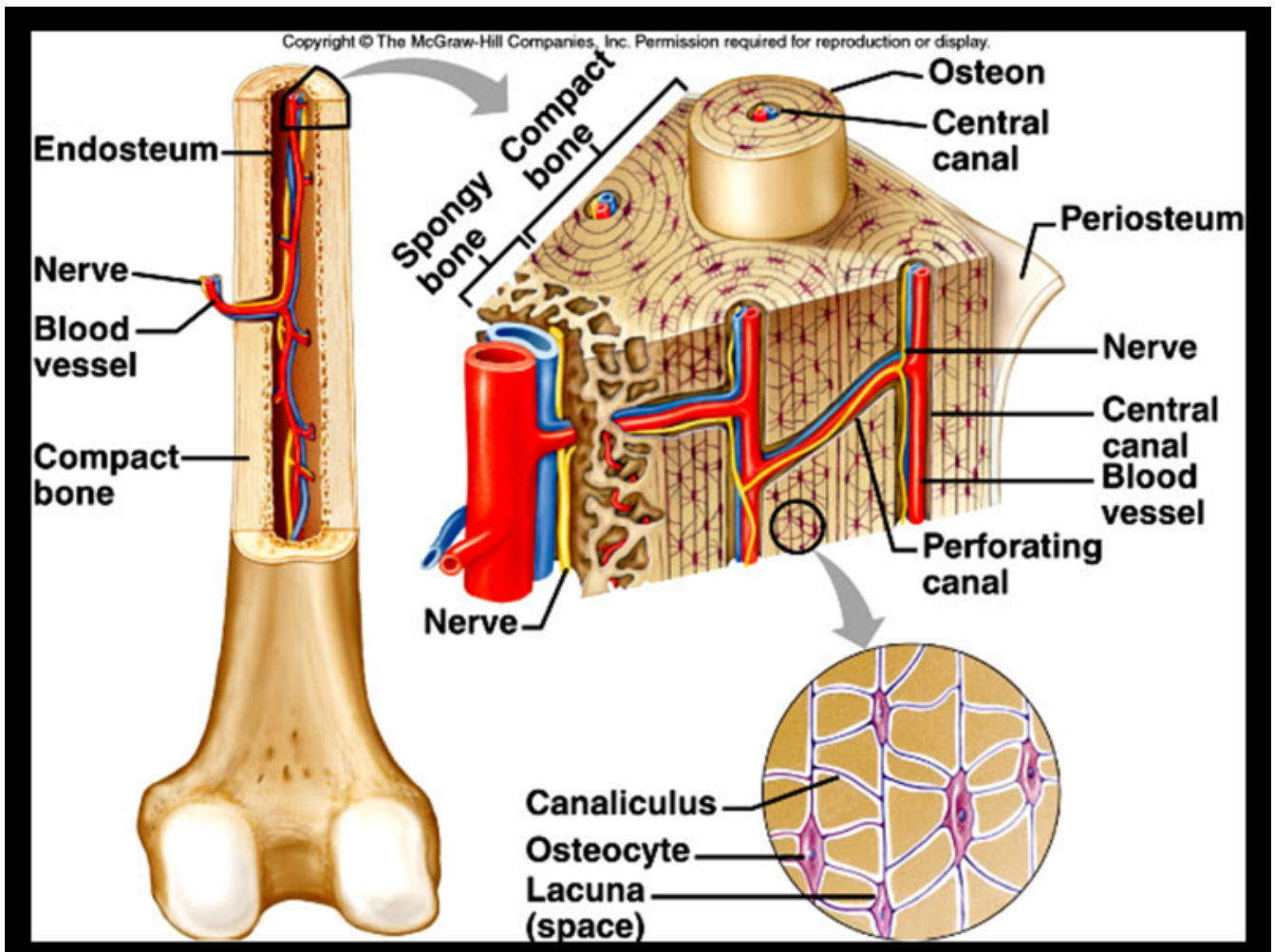
1. Bone cells (**osteocytes**) are located within **lacunae** that lie in concentric circles around **osteonic canals**.
2. Osteocytes pass nutrients and gasses the matrix through **canaliculi**.
3. Intercellular material consists of collagen and inorganic salts.



4. In compact bone, osteocytes and intercellular material are organized into osteons that are cemented together.
5. Osteonic canals contain blood vessels and nerve fibers, and extend longitudinally through bone.
6. Osteonic canals are interconnected by transverse perforating canals.
7. Unlike compact bone, the osteocytes and intercellular material in spongy bone are not arranged around osteonic canals.

<http://www.youtube.com/watch?v=gc1SnqTz0Is>





■ Bone Development and Growth

- A. Bones form by replacing connective tissue in the fetus.
- B. Some form within sheetlike layers of connective tissue (intramembranous bones), while others replace masses of cartilage (endochondral bones).
- C. **Intramembranous Bones**
 1. The flat bones of the skull form as intramembranous bones that develop from layers of connective tissue.
 2. Osteoblasts deposit bony tissue around themselves.

<http://www.youtube.com/watch?v=thVzMkKs2G0>



3. Once osteoblasts deposit bone located in lacunae, they are called osteocytes.
4. Cells of the membranous connective tissue that lie outside the developing bone give rise to the periosteum.

D. Endochondral Bones

1. Most of the bones of the skeleton fall into this category.
2. They first develop as hyaline cartilage models and are then replaced with bone.

Endochondral Bones Continued

3. Cartilage is broken down in the diaphysis and progressively replaced with bone while the periosteum develops on the outside.
4. Cartilage tissue is invaded by blood vessels and osteoblasts that first form spongy bone at the primary ossification center in the diaphysis.
5. Osteoblasts beneath the periosteum lay down compact bone outside the spongy bone.
6. Secondary ossification centers appear later in the epiphyses.

Endochondral Bones Continued

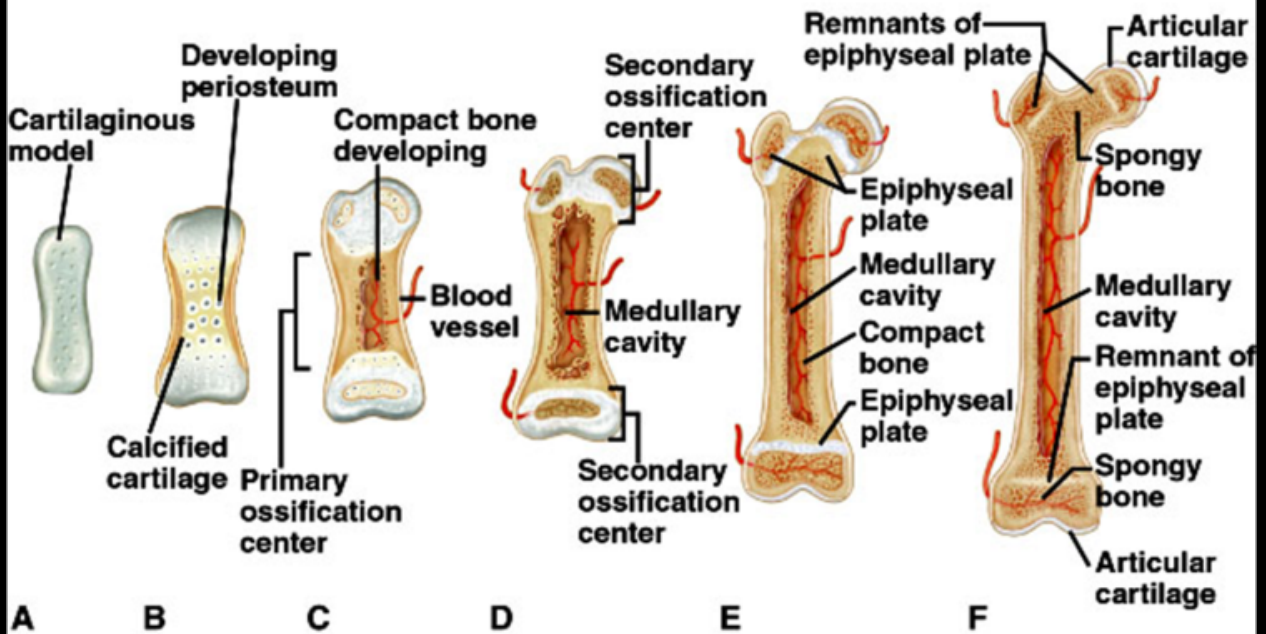
7. A band of hyaline cartilage, the epiphyseal plate, forms between the two ossification centers.
8. Layers of cartilage cells undergoing mitosis make up the epiphyseal plate.
9. Osteoclasts break down the calcified matrix and are replaced with bone-building osteoblasts that deposit bone in place of calcified cartilage.

Endochondral Bones Continued

10. Epiphyseal plates are responsible for lengthening bones while increases in thickness are due to intramembranous ossification underneath the periosteum.
11. A medullary cavity forms in the region of the diaphysis due to the activity of osteoclasts.

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Endochondral Bone Development



E. Homeostasis of Bone Tissue

1. Osteoclasts tear down and osteoblasts build bone throughout the lifespan with the processes of resorption and deposition, with an average of 3% to 5% of bone calcium exchanged annually.

■ Bone Function

A. Support and Protection

1. Bones give shape to the head, thorax, and limbs.
2. Bones such as the pelvis and lower limbs provide support for the body.
3. Bones of the skull protect the brain, ears, and eyes.

B. **Body Movement**

1. Bones can act as levers.
 - a. A lever has four components:
 - i. a rigid bar,
 - ii. a pivot or fulcrum,
 - iii. an object
 - iv. that is moved against resistance, and a force that supplies energy.

C. Blood Cell Formation

1. Two kinds of marrow occupy the medullary cavities of bone.

- a. **Red marrow** functions in the formation of red blood cells, white blood cells, and platelets, and is found in the spongy bone of the skull, ribs, sternum, clavicles, vertebrae, and pelvis.
- b. **Yellow marrow**, occupying cavities of most bones, stores fat.

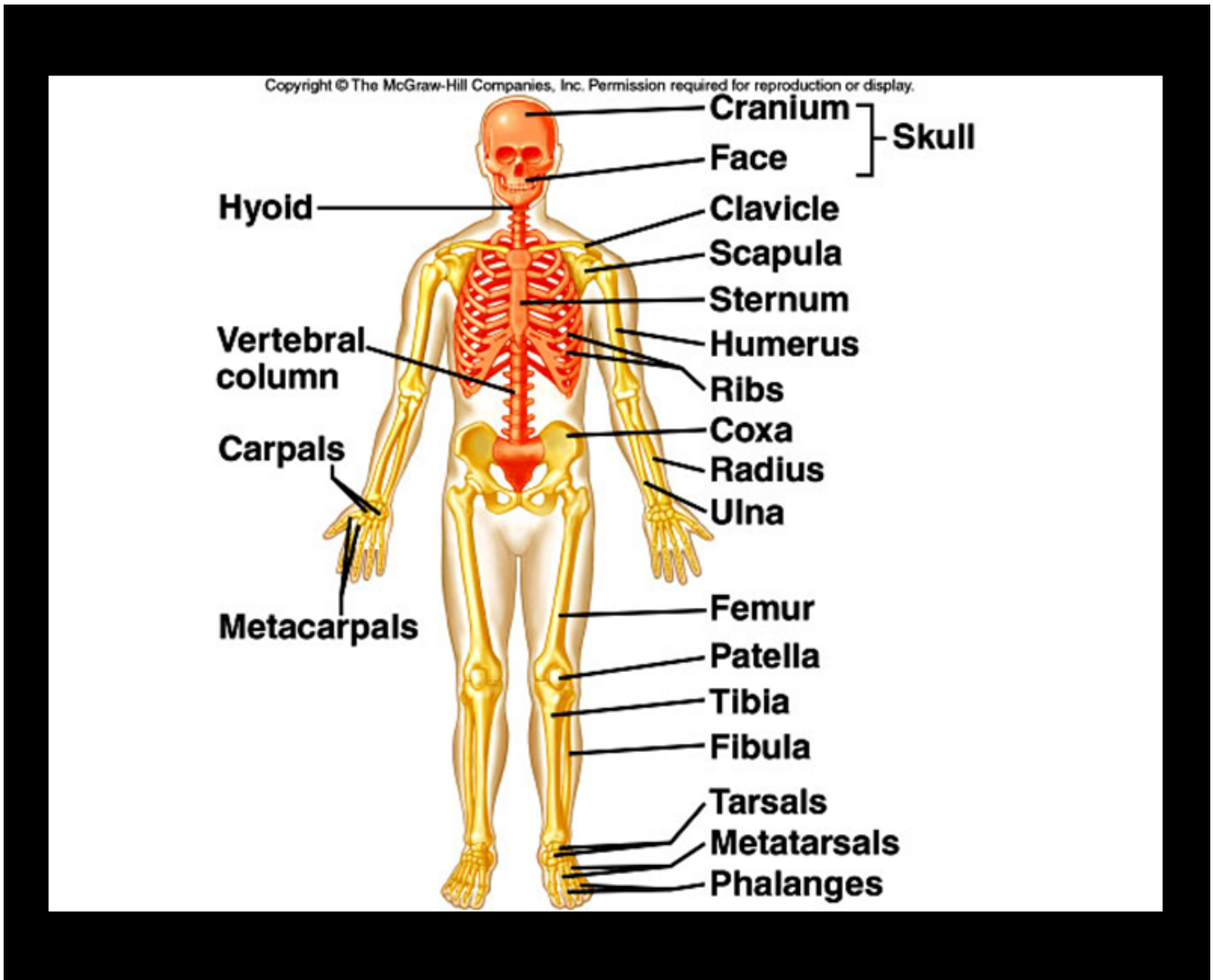
D. **Storage of Inorganic Salts**

1. The inorganic matrix of bone stores inorganic mineral salts in the form of calcium phosphate that is important in many metabolic processes.
2. Calcium in bone is a reservoir for body calcium; when blood levels are low, osteoclasts release calcium from bone.

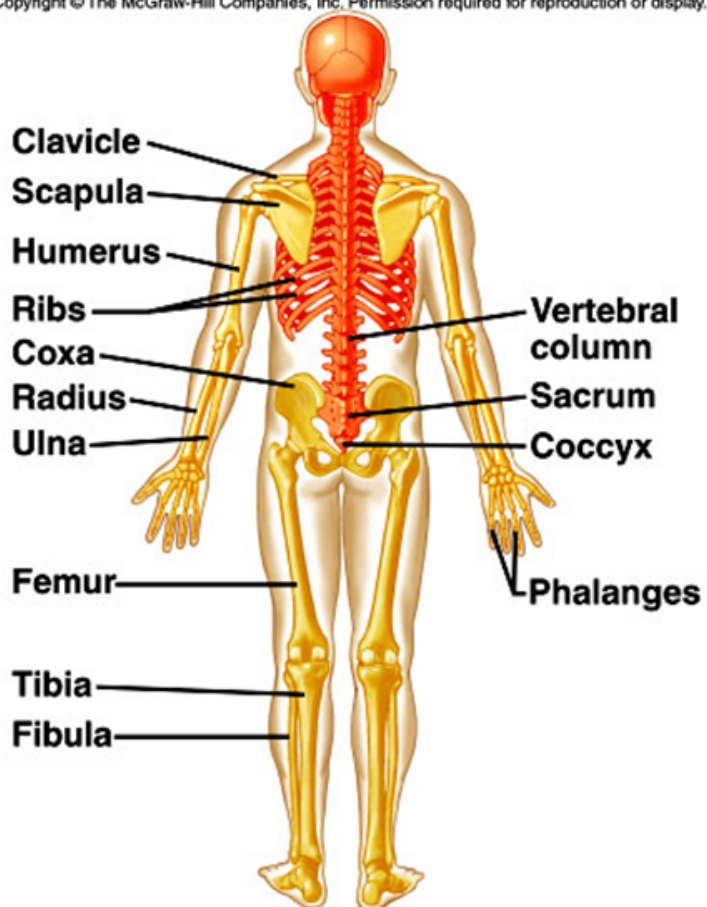
3. Calcium is stored in bone under the influence of calcitonin when blood levels of calcium are high.
4. Bone also stores magnesium, sodium, potassium, and carbonate ions.
5. Bones can also accumulate harmful elements, such as lead, radium, and strontium.

■ **Skeletal Organization**

- A. The **axial skeleton** consists of the skull, hyoid bone, vertebral column (vertebrae and intervertebral disks), and thorax (ribs and sternum).
- B. The **appendicular skeleton** consists of the pectoral girdle (scapulae and clavicles), upper limbs (humerus, radius, ulna, carpals, metacarpals, and phalanges), pelvic girdle (coxal bones articulating with the sacrum), and limbs (femur, tibia, fibula, patella, tarsals, metatarsals, phalanges).

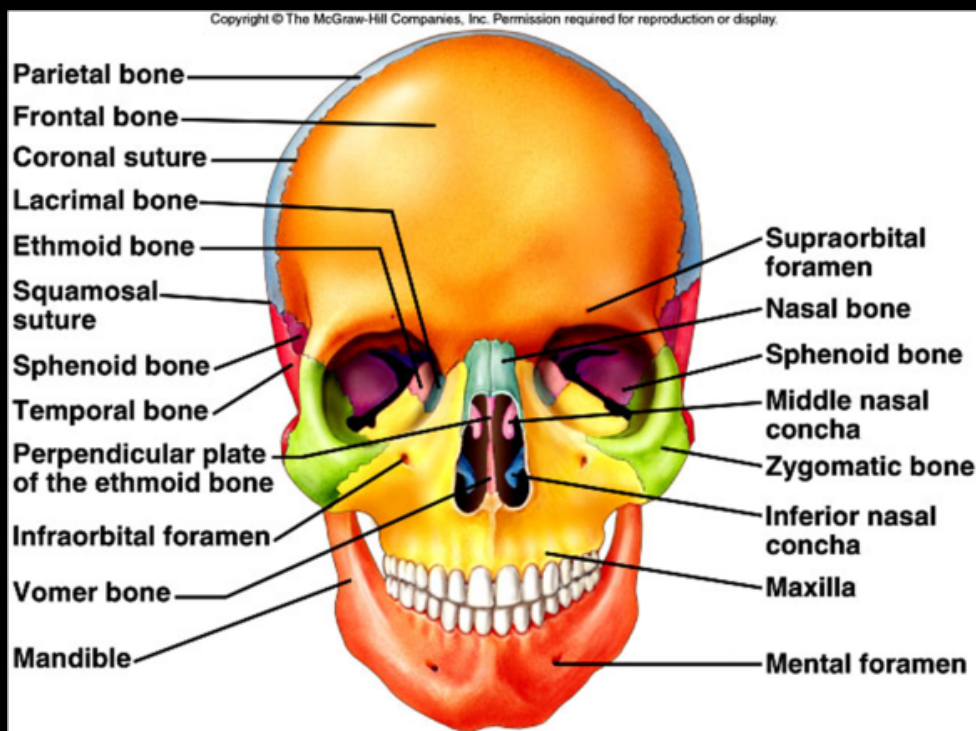


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• Skull

A. The skull is made up of 22 bones, including 8 cranial bones, 13 facial bones, and the mandible.



B. Cranium

1. The cranium encloses and protects the brain, provides attachments for muscles, and contains air-filled sinuses that reduce its weight.
2. Features of the frontal bone include supraorbital foramina and frontal sinuses.

3. Parietal bones lie at the sides of the skull and join at the sagittal suture.
4. Features of the occipital bone include the lambdoidal suture, foramen magnum, and occipital condyles.
5. Each temporal bone includes the squamosal suture, external auditory meatus, mandibular fossae, mastoid process, styloid process, and zygomatic process.

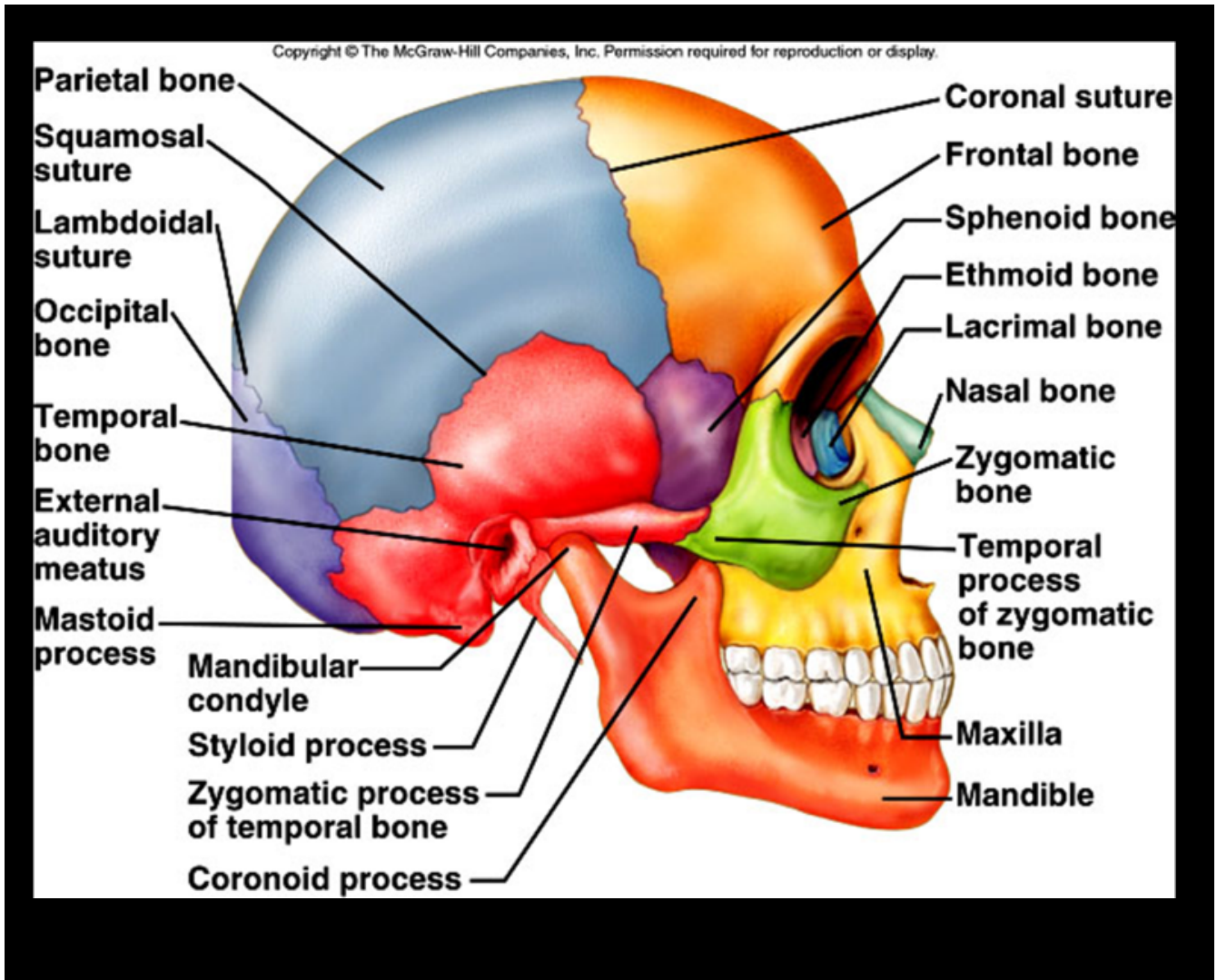
6. Features of the winged sphenoid bone include the sella turcica and sphenoidal sinuses.
7. Features of the ethmoid bone include the cribriform plates, a perpendicular plate, superior and middle nasal conchae, ethmoidal sinuses, and the crista galli.

C. Facial Skeleton

1. The 13 immovable facial bones and mandible form the basic face and provide attachments for muscles of mastication and expression.
2. The maxillae form the upper jaw, hard palate, floor of the orbits, sides of the nasal cavity, house the upper teeth, and contain large maxillary sinuses.

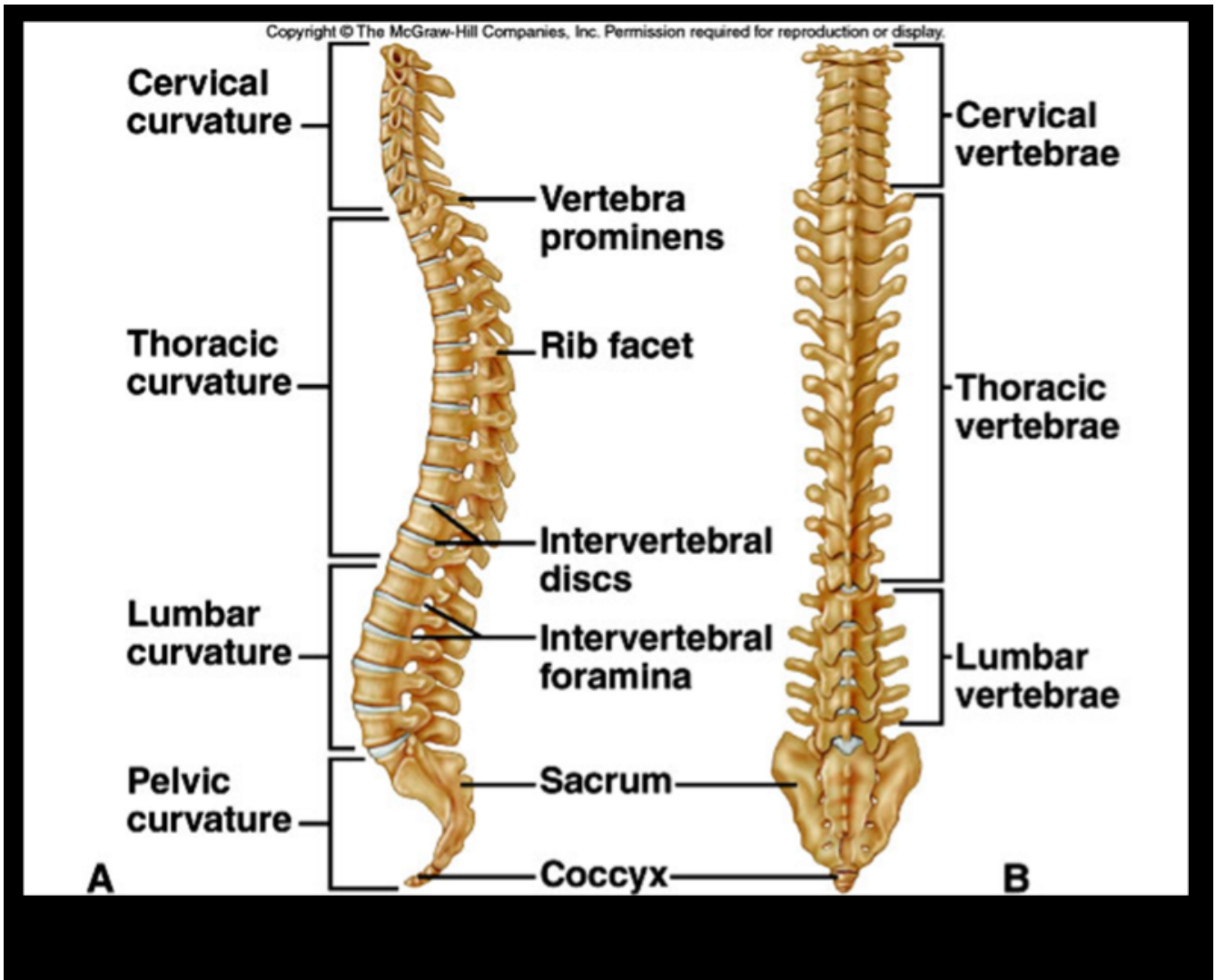
3. Palatine bones are L-shaped bones located behind the maxillae that form the floor of the nasal cavity and hard palate.
4. Zygomatic bones make up the cheekbones and join with the temporal bones to form the zygomatic arches.
5. The lacrimal bones form part of the medial walls of the orbits.
6. Nasal bones form the bridge of the nose.

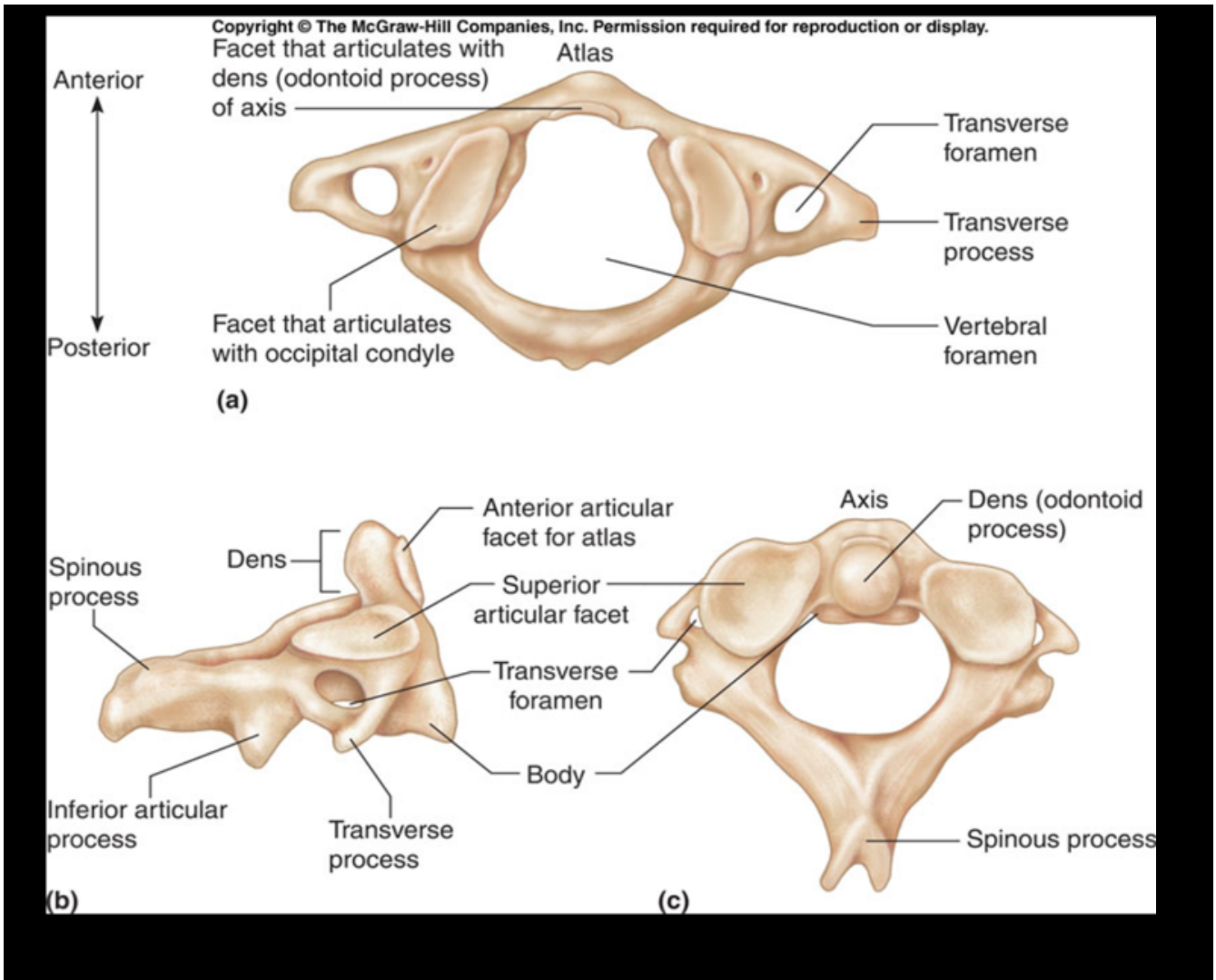
7. The vomer bone makes up a portion of the nasal septum.
8. Inferior nasal conchae are fragile, scroll-shaped bones that support mucous membranes within the nasal cavity.
9. The mandible, or lower jawbone, supports the lower teeth and includes a mandibular condyle, coronoid process, and alveolar arch.



D. Cervical Vertebrae

1. These seven bones are the smallest of the vertebrae that comprise the neck and support the head.
2. The first vertebra is the atlas, which appears as a bony ring and supports the head.



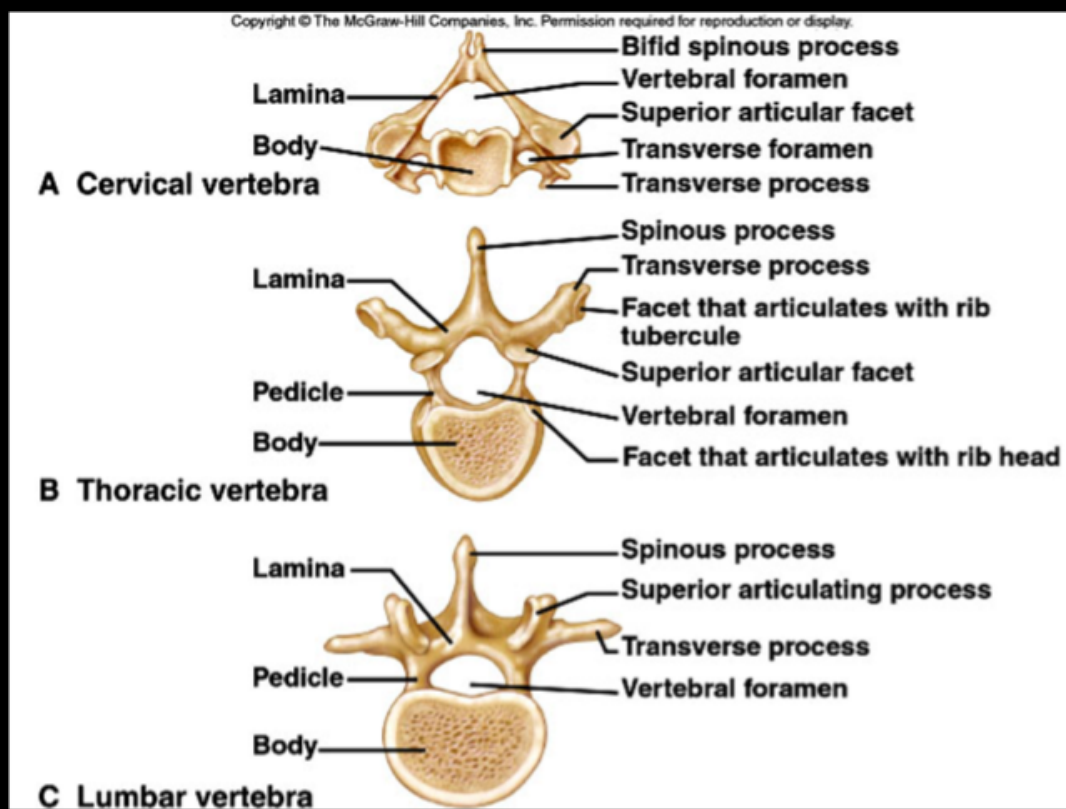


E. Thoracic Vertebrae

1. Twelve thoracic vertebrae articulate with the ribs.
2. These bones are larger and stronger than the cervical vertebrae.

F. Lumbar Vertebrae

1. The five massive lumbar vertebrae support the weight of the body.

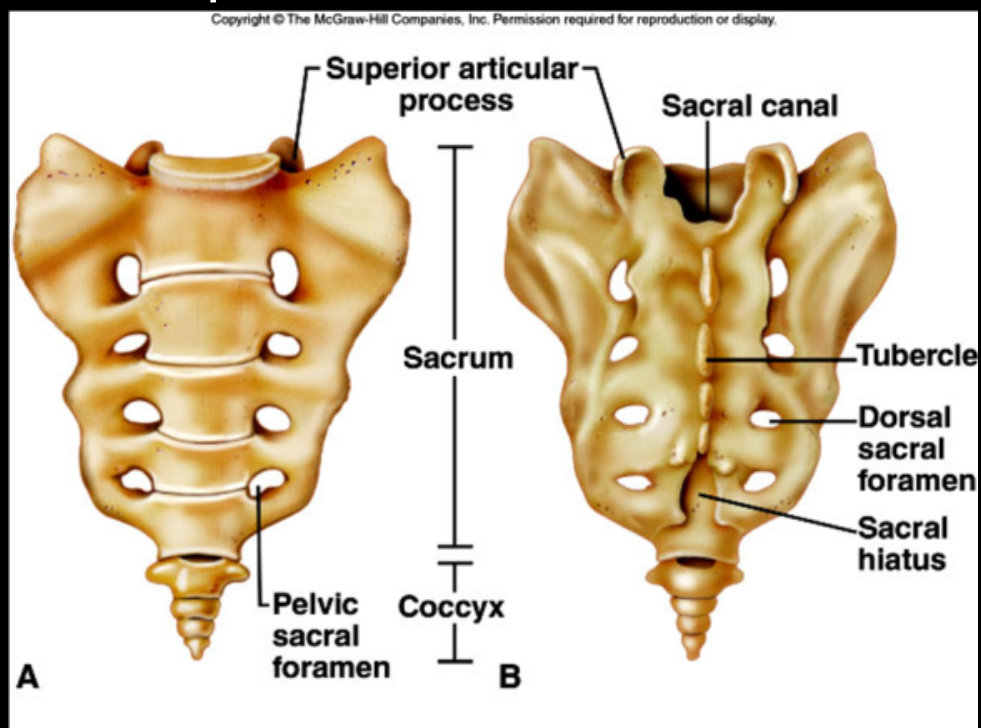


G. Sacrum

1. The sacrum is a triangular structure at the base of the vertebral column made up of five vertebrae fused into one bone.
2. The spinous processes of these vertebrae fuse to form a ridge of tubercles that have dorsal sacral foramina along their sides.
3. On the ventral surface of the sacrum, four pairs of pelvic sacral foramina provide passageways for nerves and blood vessels.

H. Coccyx

1. The coccyx is the lowermost portion of the vertebral column and is composed of four fused vertebrae.



■ Thoracic Cage

- A. The thoracic cage includes the ribs, thoracic vertebrae, sternum, and costal cartilages.
- B. It supports the pectoral girdle and upper limbs, functions in breathing, and protects thoracic and upper abdominal organs.

C. Ribs

1. Normally, there are 12 pairs of ribs that attach to the thoracic vertebrae.
2. The first seven pairs of ribs are true (or vertebrosteral) ribs that join the sternum directly by their costal cartilages.
3. The remaining five pairs are false ribs: the first three pairs are vertebrochondral ribs, and the last two pairs are floating ribs.

4. Features of a typical rib include a shaft, costal groove, anterior (sternal) end, head, neck, and tubercle.
 - a. The head articulates with the vertebrae; the tubercle articulates with the transverse process of the thoracic vertebrae.

D. Sternum

1. The sternum (breastbone) is located along the anterior midline of the thoracic cage.
2. It consists of an upper manubrium, middle body, and lower xiphoid process.

