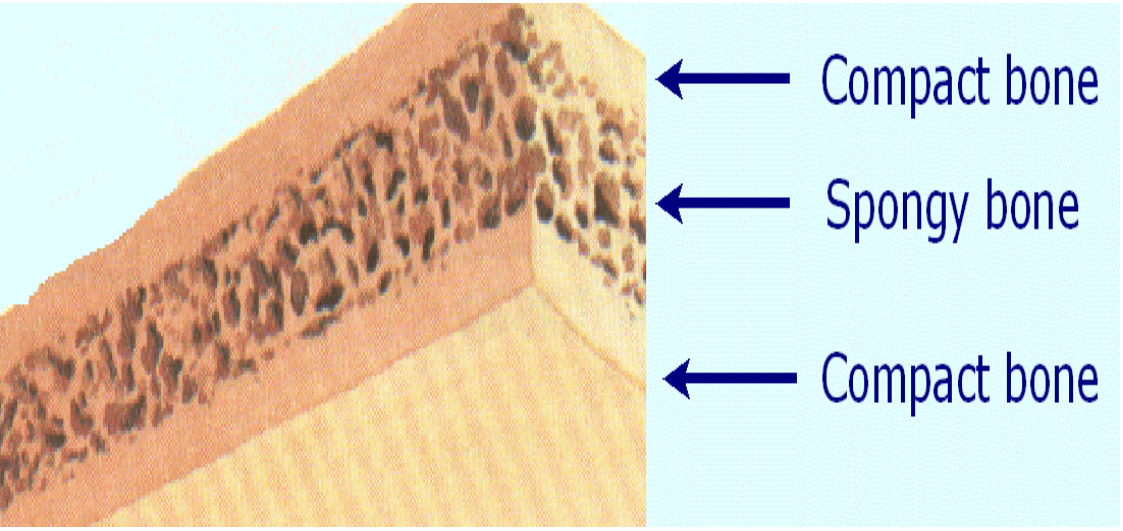
Chapter 7 and 8-Skeletal System

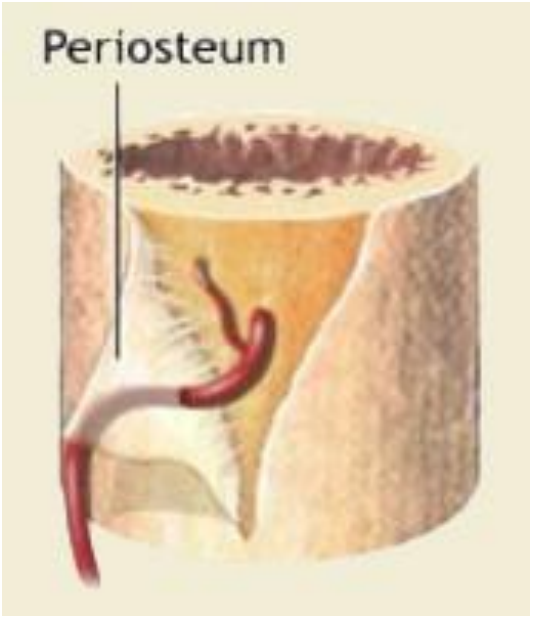
Bone Functions

- The **skeleton** is a framework of bones and cartilage that functions in movement and the protection of internal organs
- The skeleton provides **support** for soft tissues, gives a place of attachment for muscles for body **movement**, **protects** internal organs, **stores** minerals and fat, and **produces blood cells** in the marrow of certain bones.

Bones Have a Hard Outer Layer Surrounding Spongy Bone

- Bones have a hard outer layer of **compact bone** surrounding **spongy bone**
- The compact bone is covered by a **periosteum** containing blood vessels, nerves, and cells involved in bone growth and repair

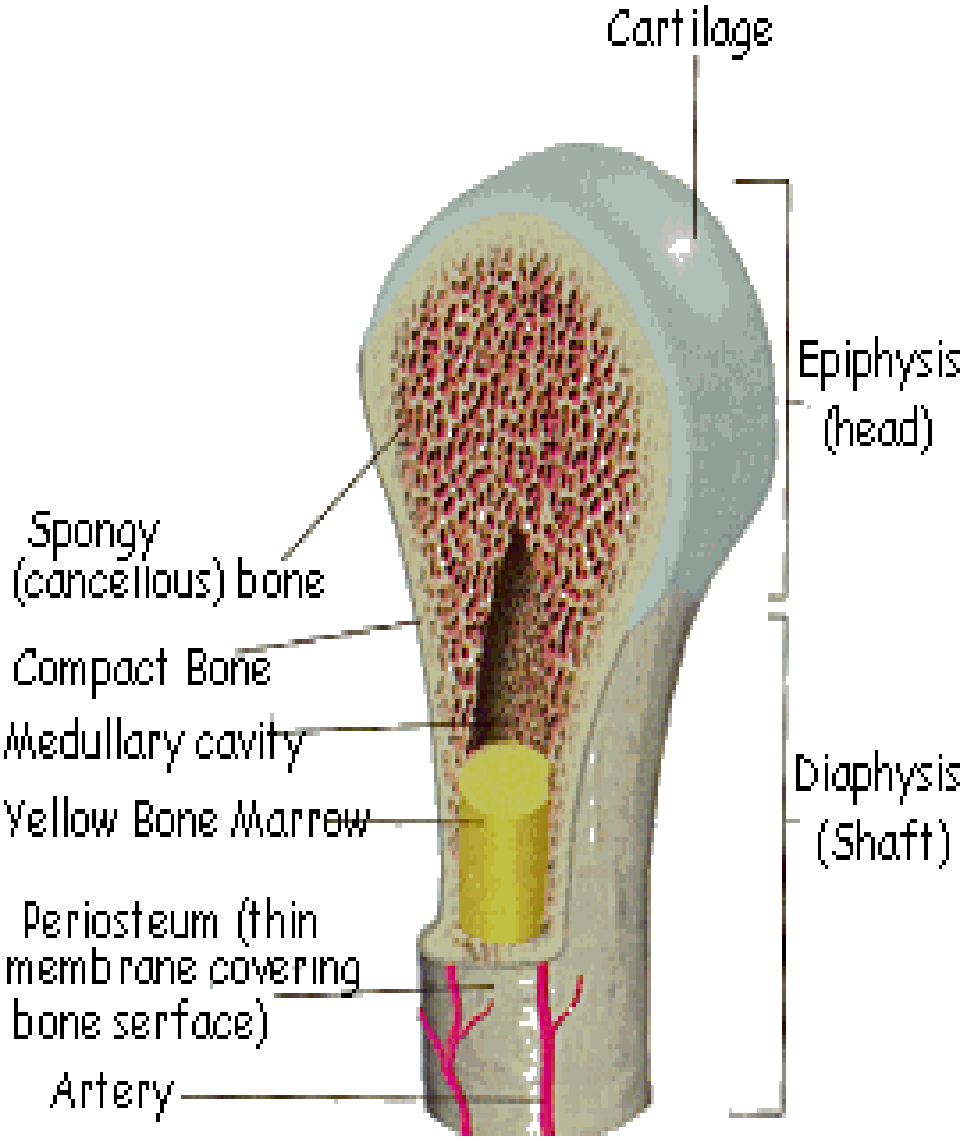




Spongy Bone

- Spongy bone is found in small, flat bones, and in the head and near the ends of the shafts of long bones

- In adults, the spaces of some spongy bones are filled with **red marrow**, which generates red blood cells, and the shaft is filled with **yellow marrow**, a fatty tissue for energy storage



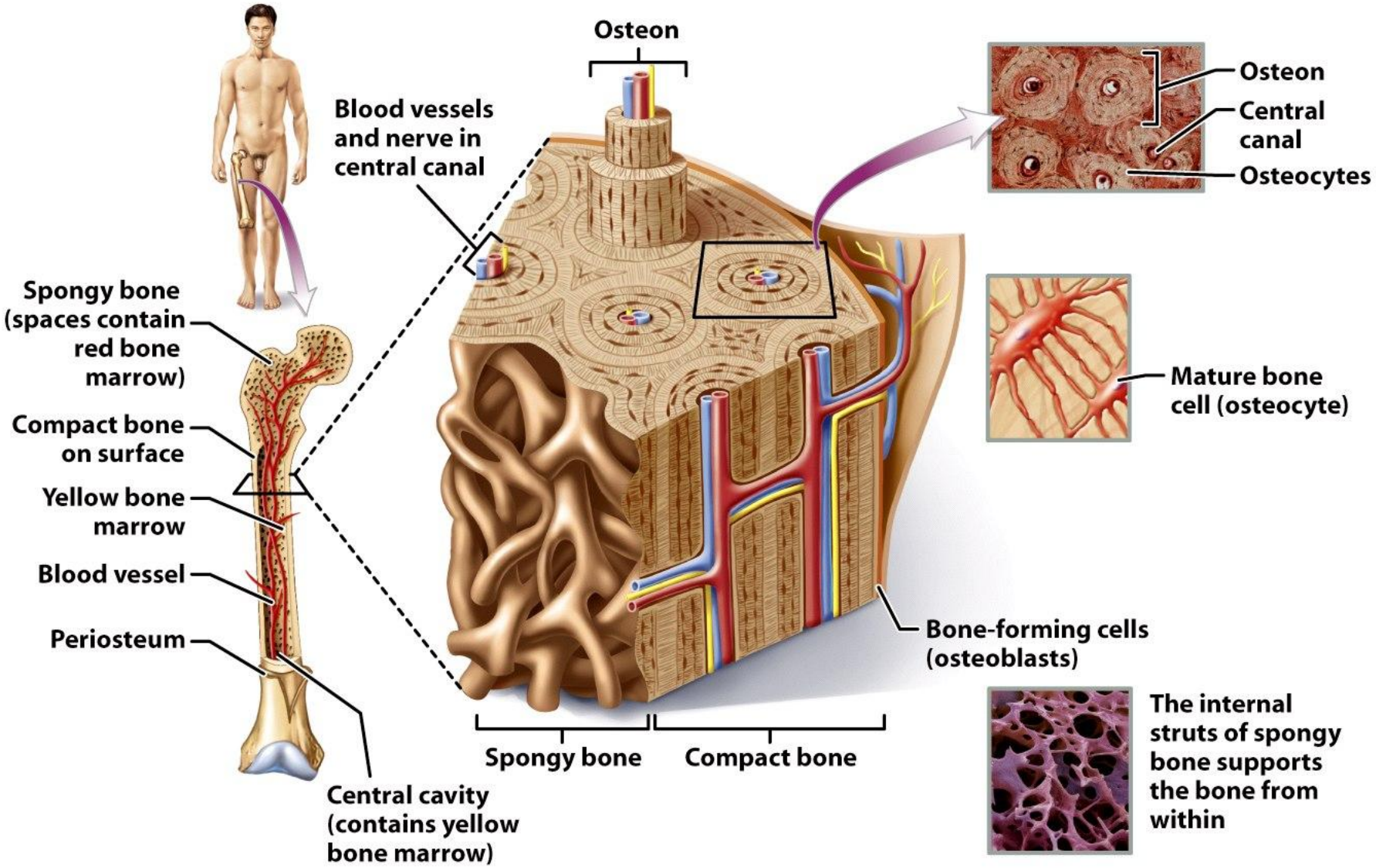


Figure 5-1 Biology of Humans, 2/e

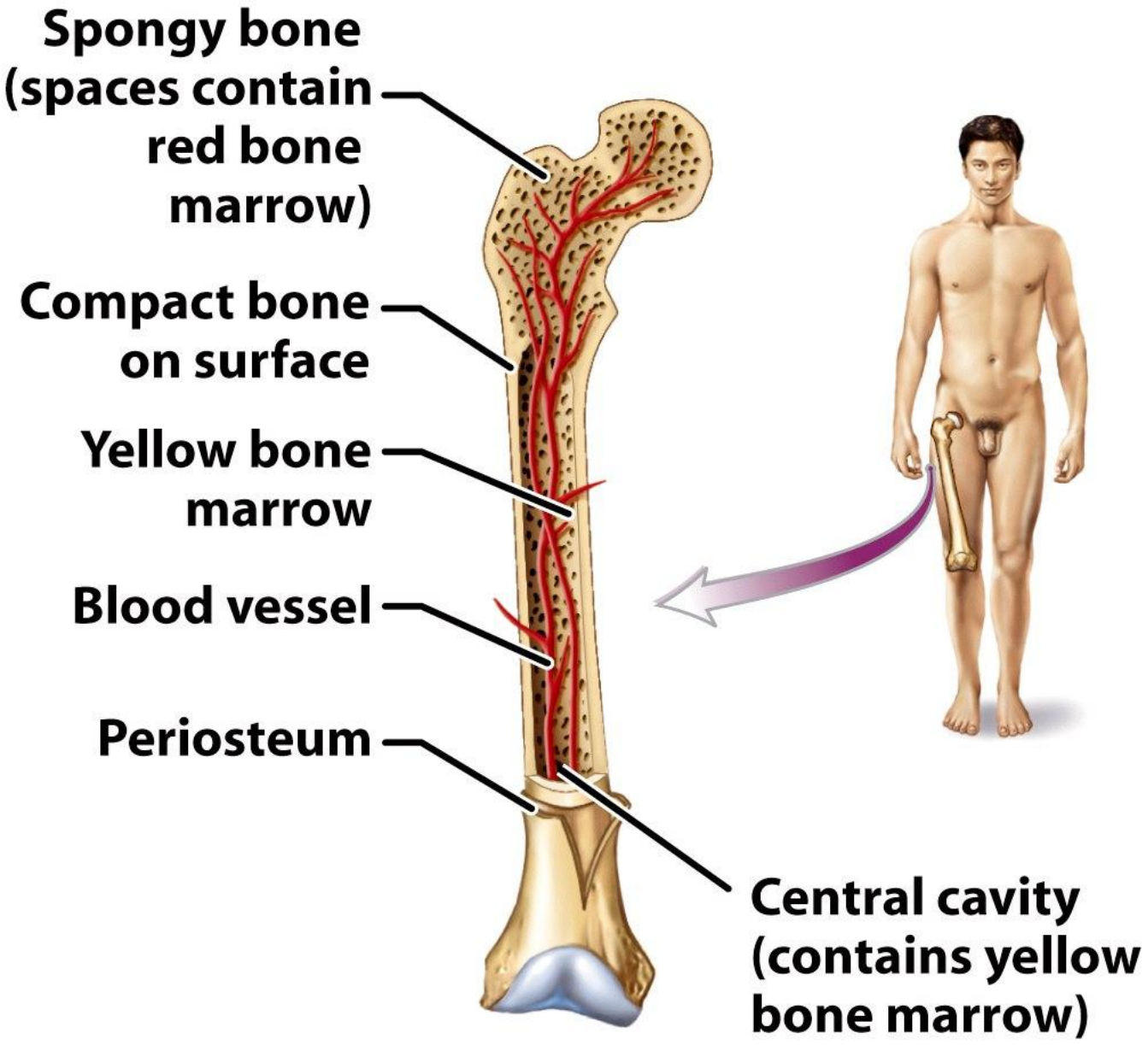


Figure 5-1a Biology of Humans, 2/e

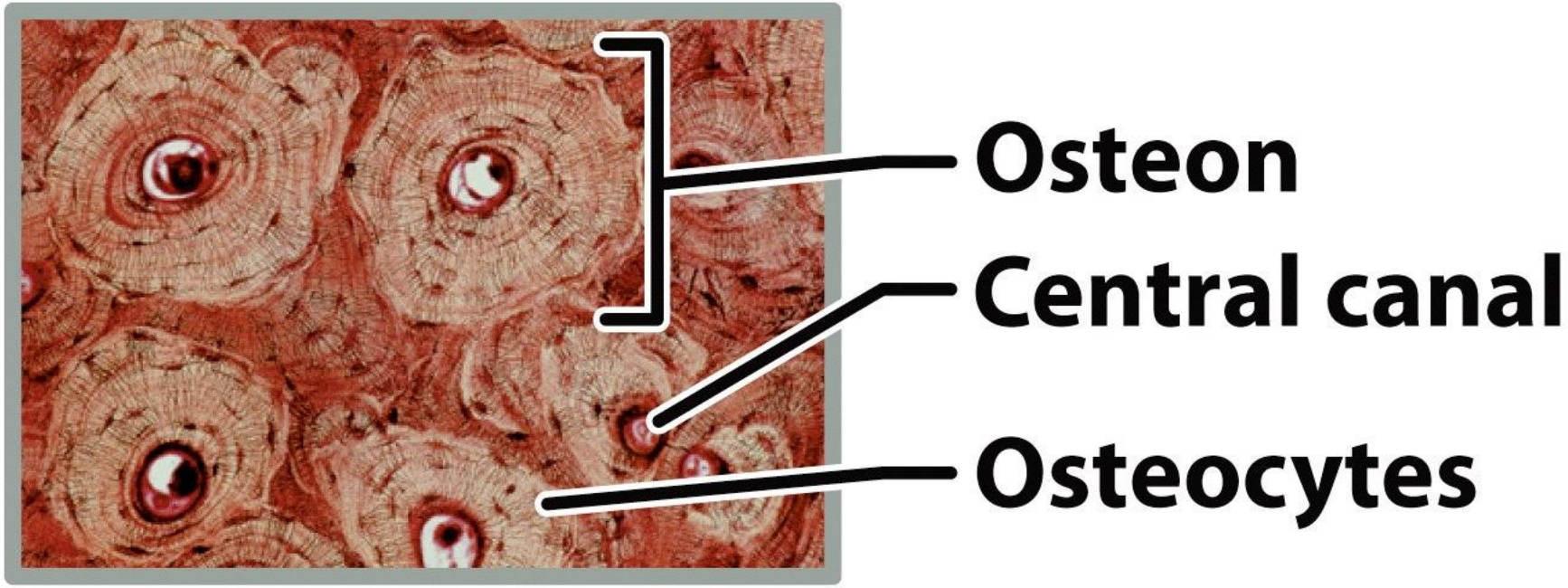
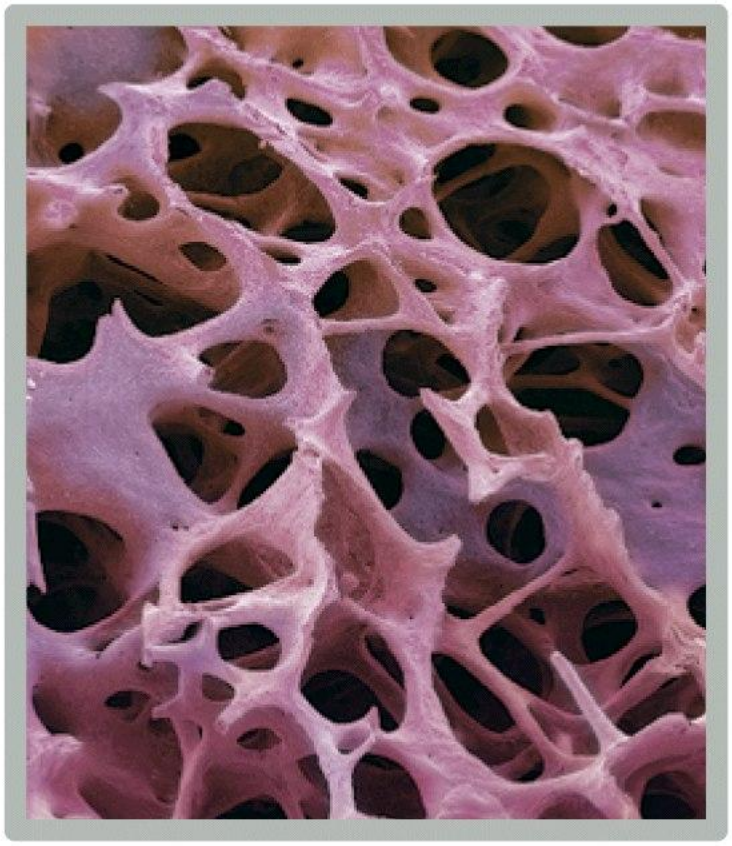


Figure 5-1c Biology of Humans, 2/e

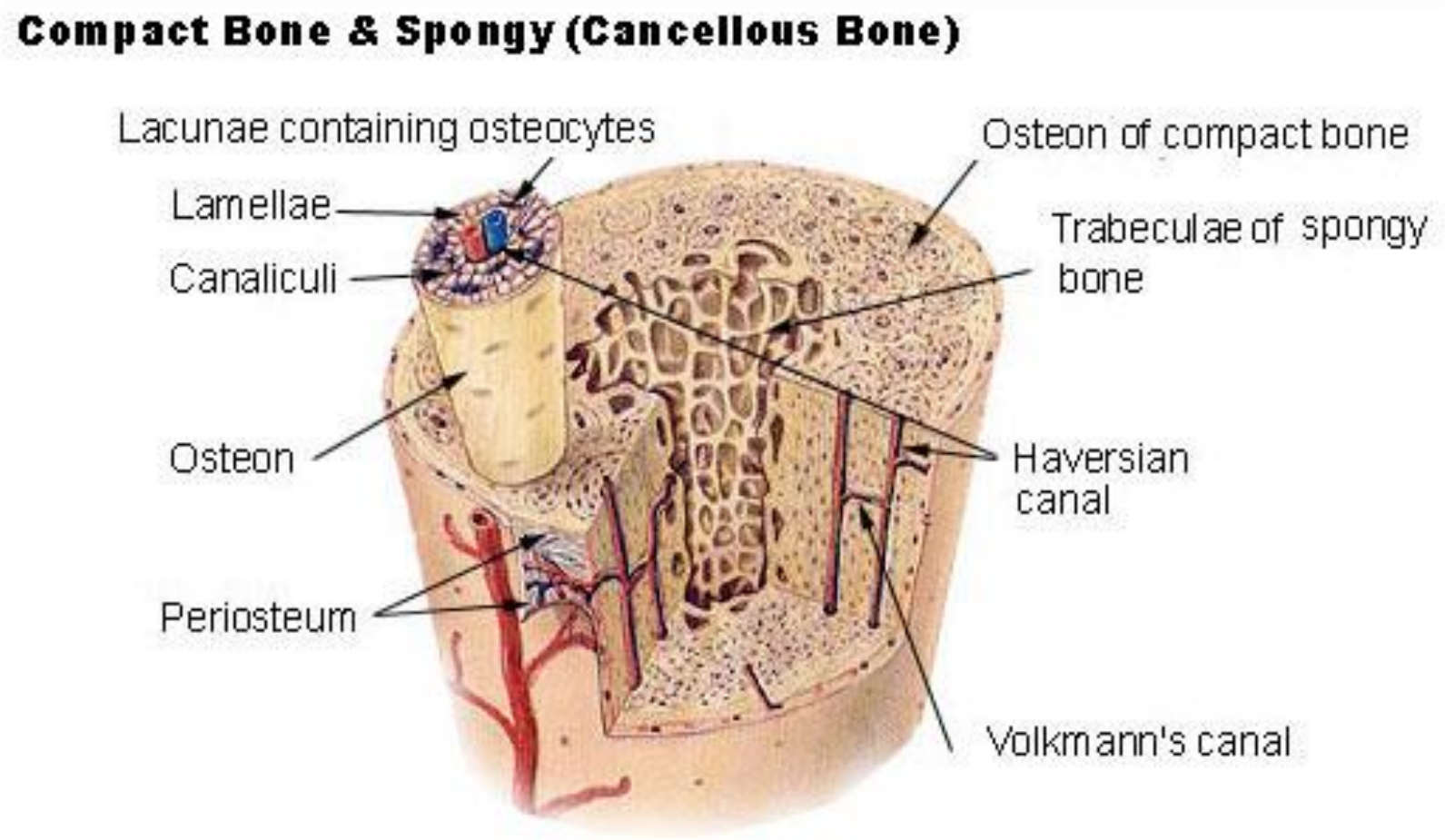


The internal struts of spongy bone supports the bone from within

Figure 5-1e Biology of Humans, 2/e

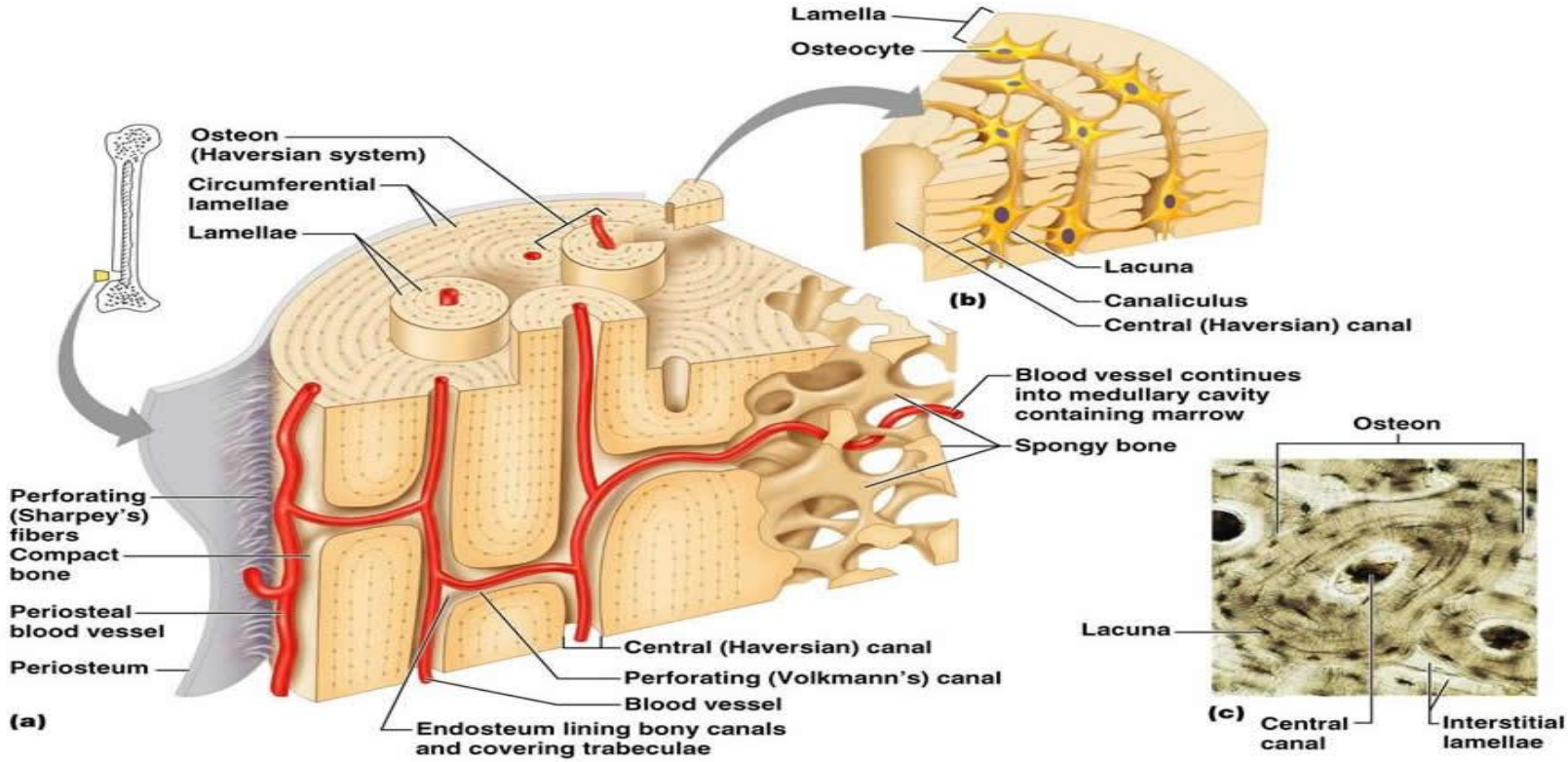
Bone Is Living Tissue

- The structural unit of compact bone is called an **osteon**

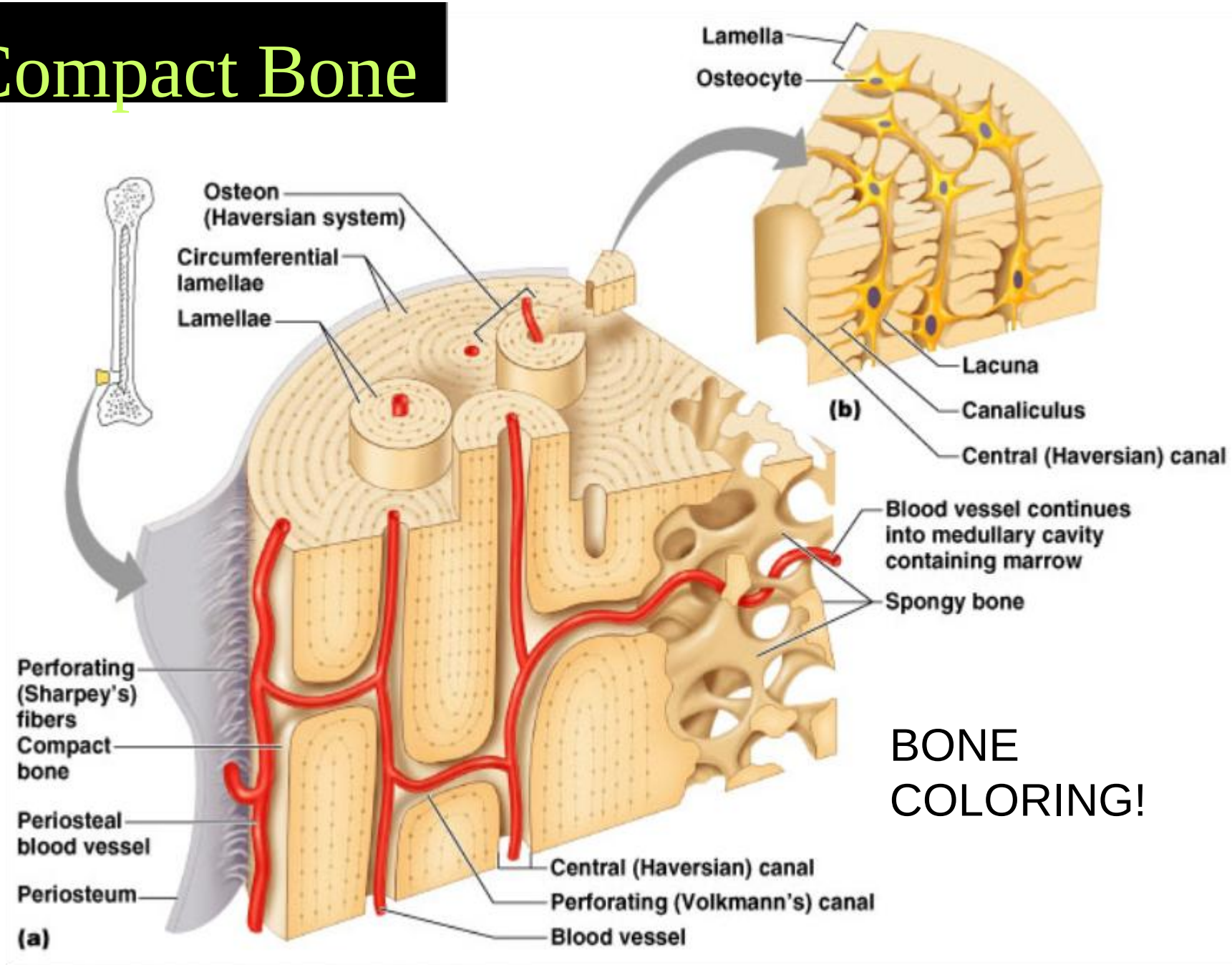


Bone Is Living Tissue

- Living bone cells, **osteocytes** are found in small spaces within the hard matrix
- Woven throughout the matrix are strands of elastic protein collagen for strength
- Bones are hardened with calcium and phosphorus salts
- During development bone is first formed of cartilage



Compact Bone



BONE COLORING!

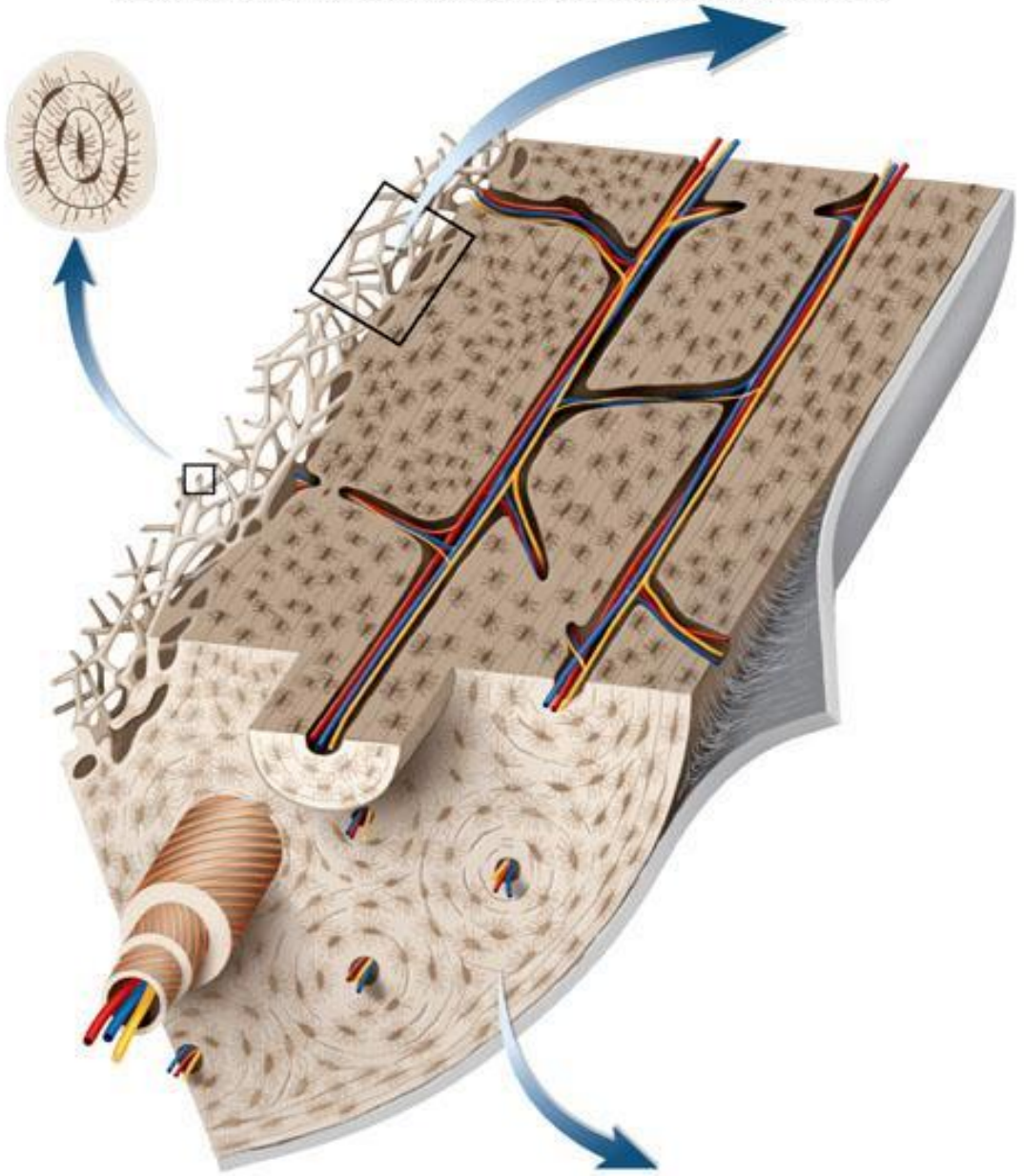
Test Yourself

Find the...

Haversian Canal
Volkman's Canal

Lamellae

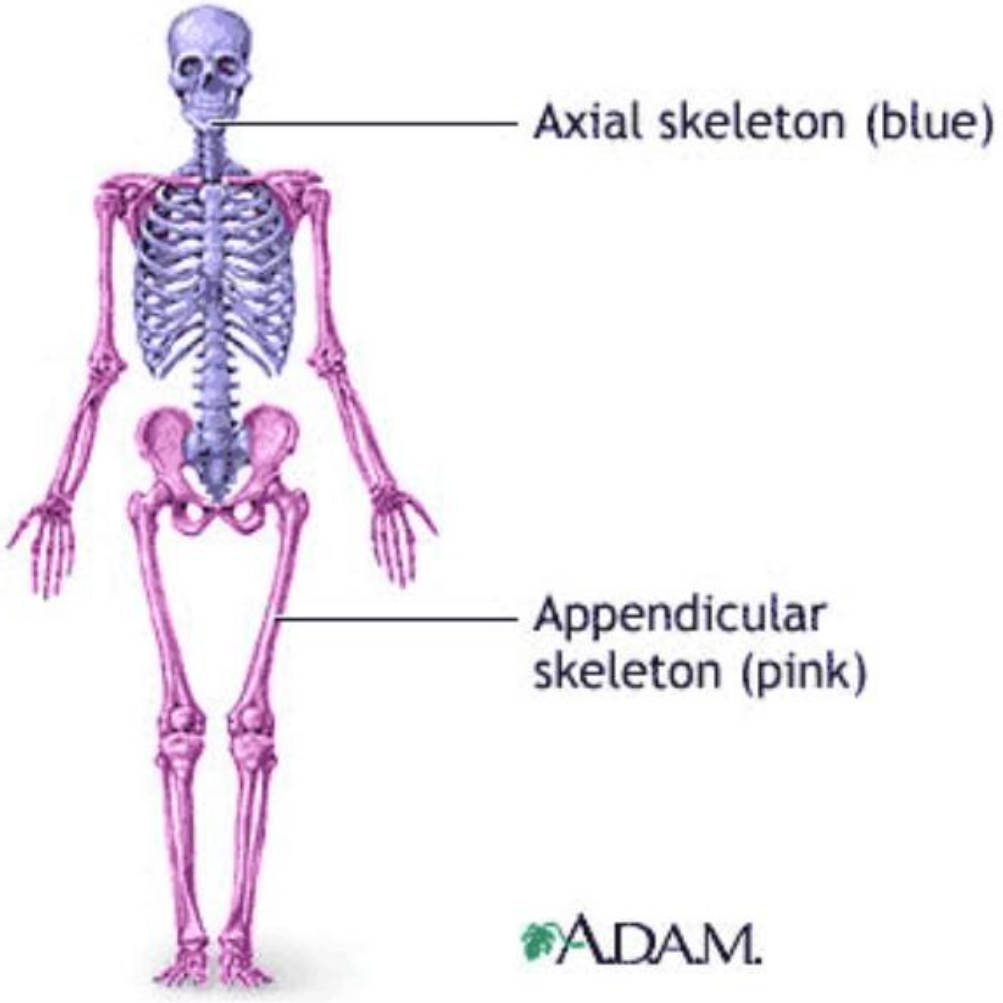
Spongy Bone
Compact Bone



(b)

We Divide the Human Skeleton into Two Parts

- About 206 bones in the body
- The bones of the human body are arranged into two groups…
- Axial and Appendicular

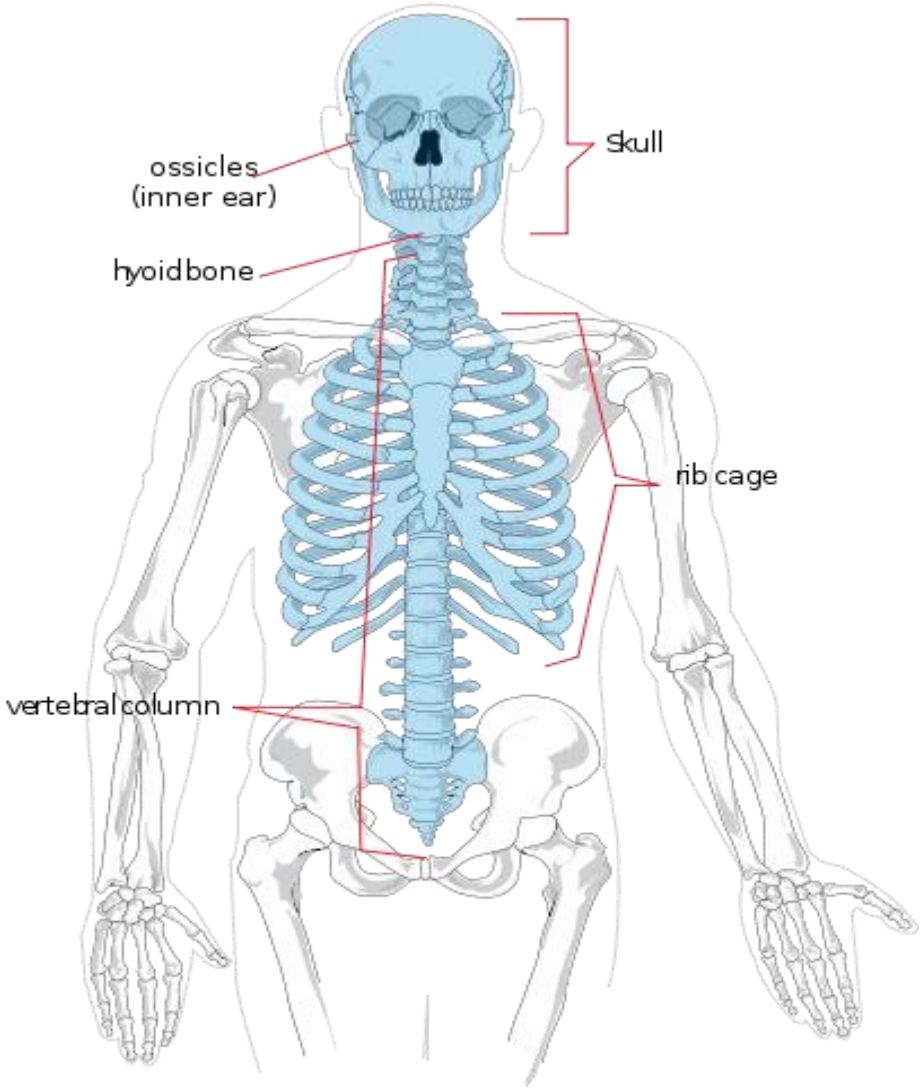


1st part: Axial Skeleton

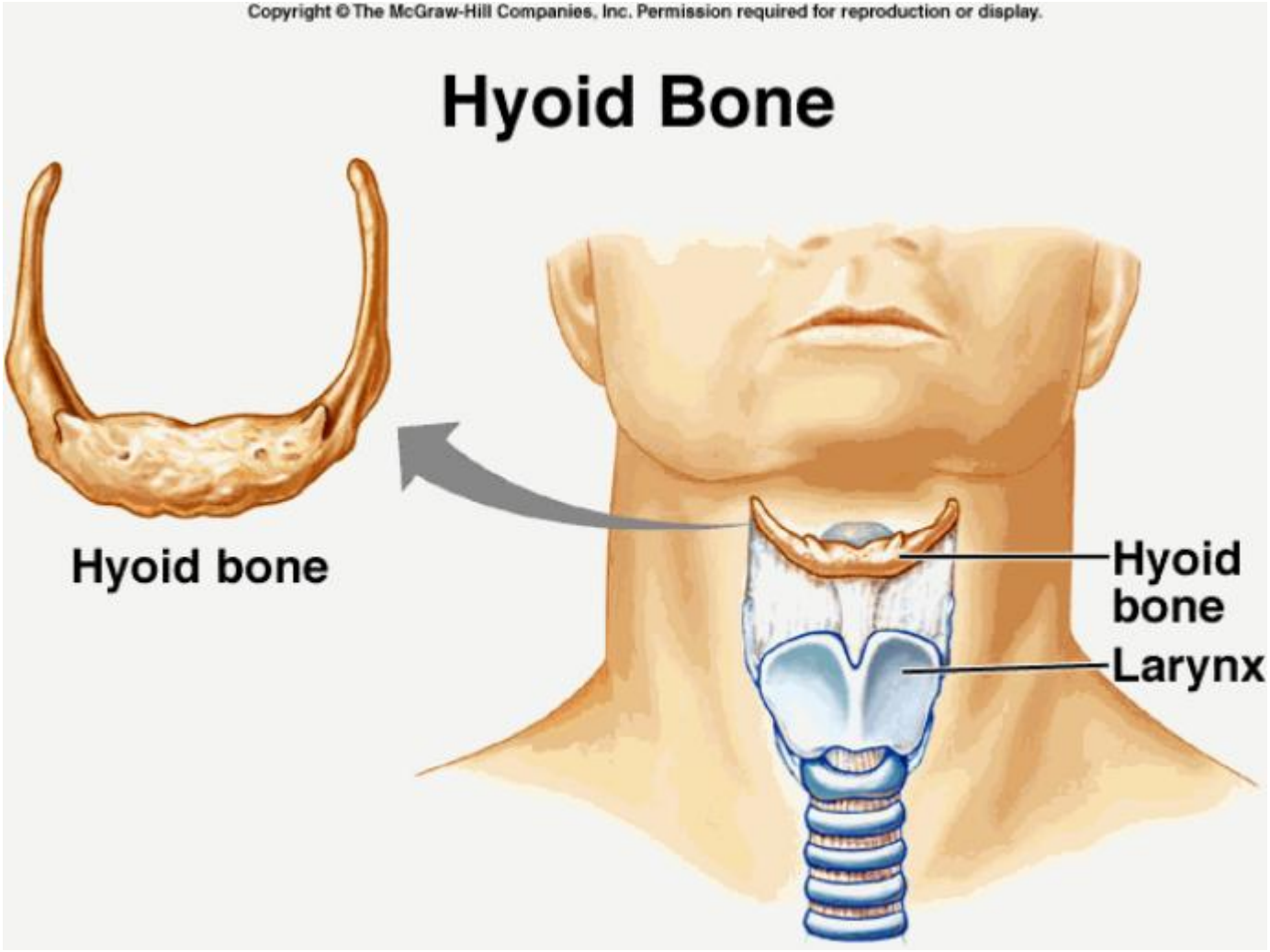
The Axial Skeleton consists of:

Head, neck, trunk:

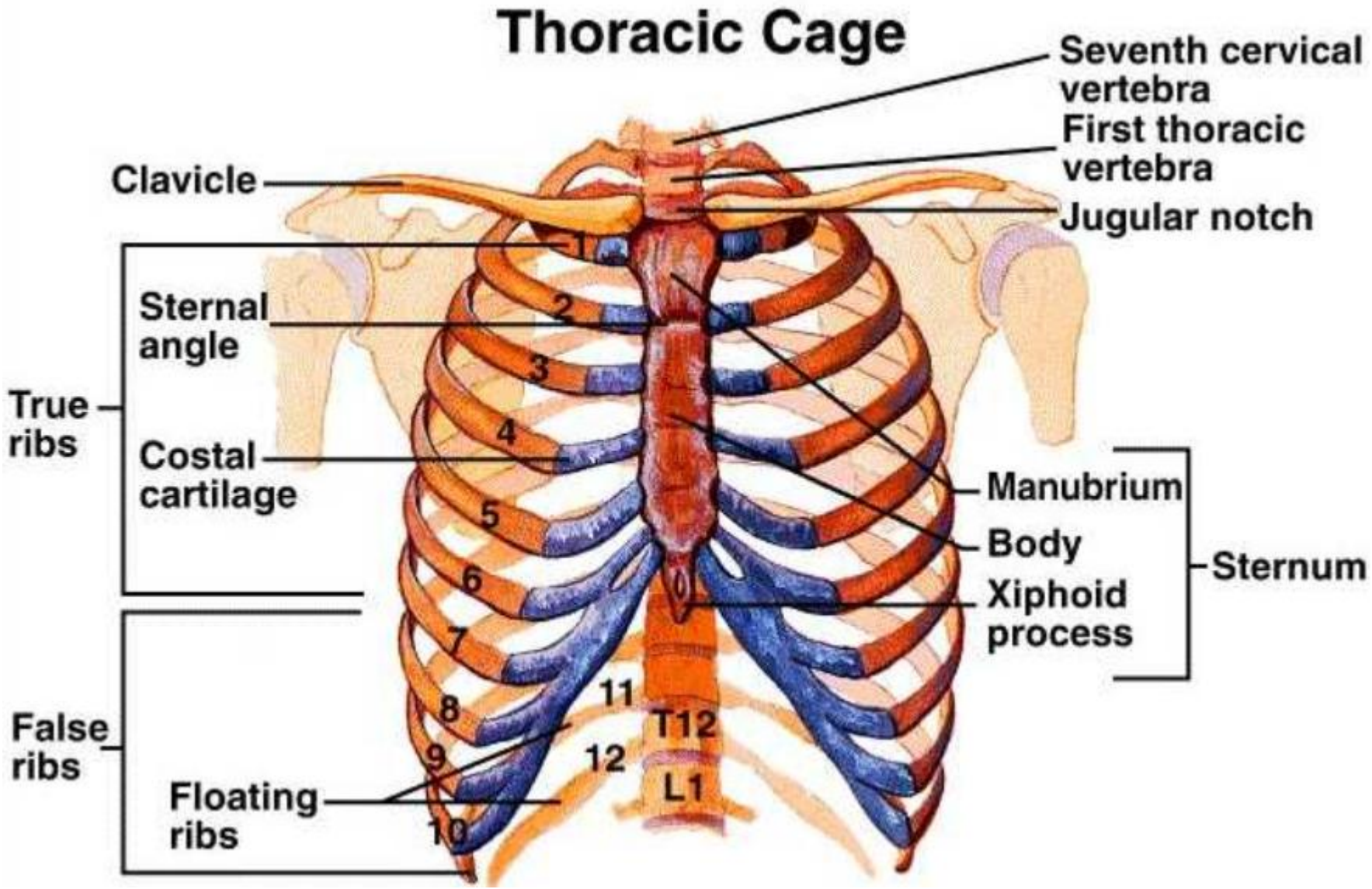
- Skull
- Hyoid Bone
- Vertebral Column
- Thoracic Cage (ribs, 12 pairs)
- Sternum



What's the Hyoid Bone?



Thoracic Cage and Sternum



Vertebral Column

- The bones of the vertebral column, called **vertebrae**, are cushioned with **intervertebral disks**

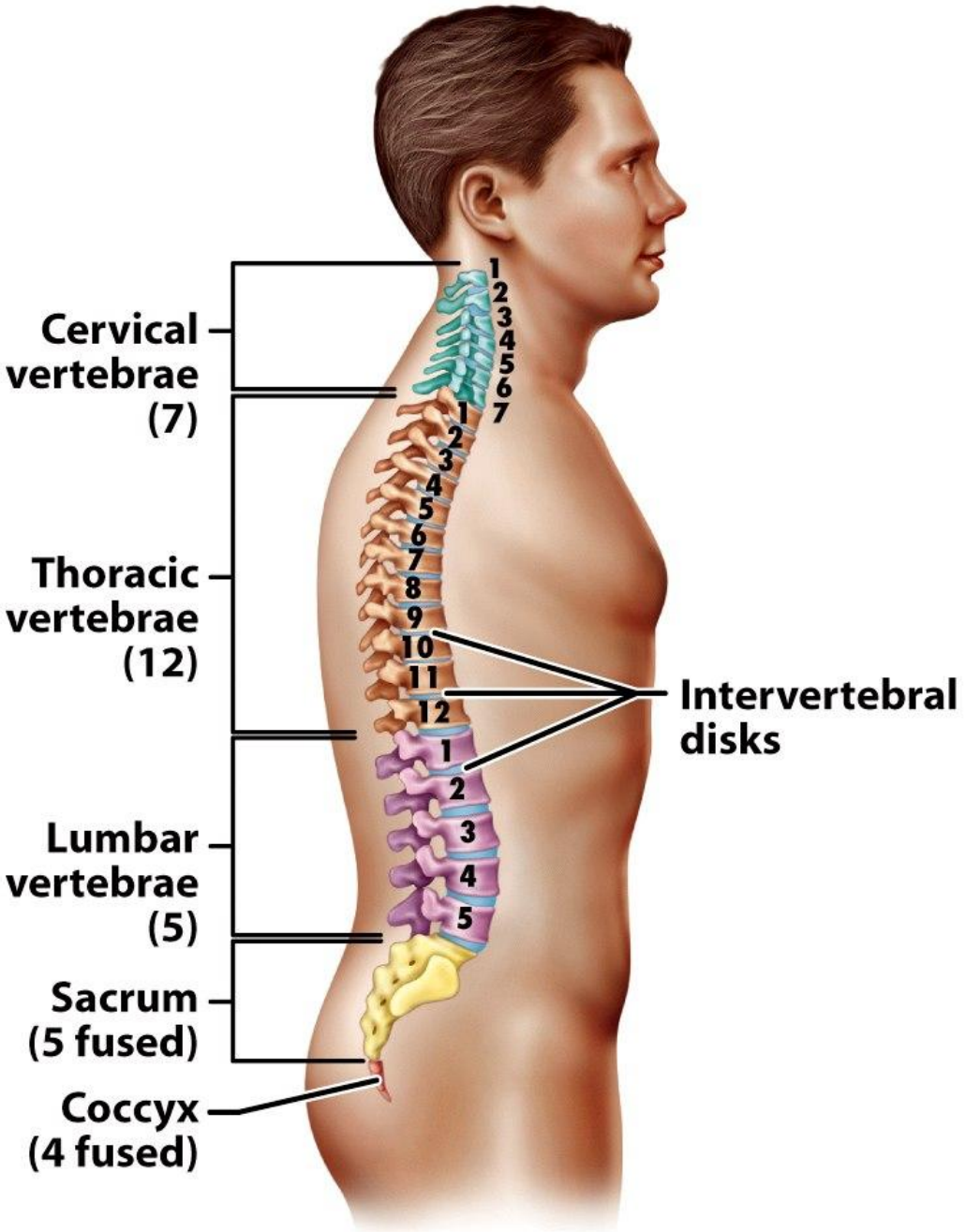


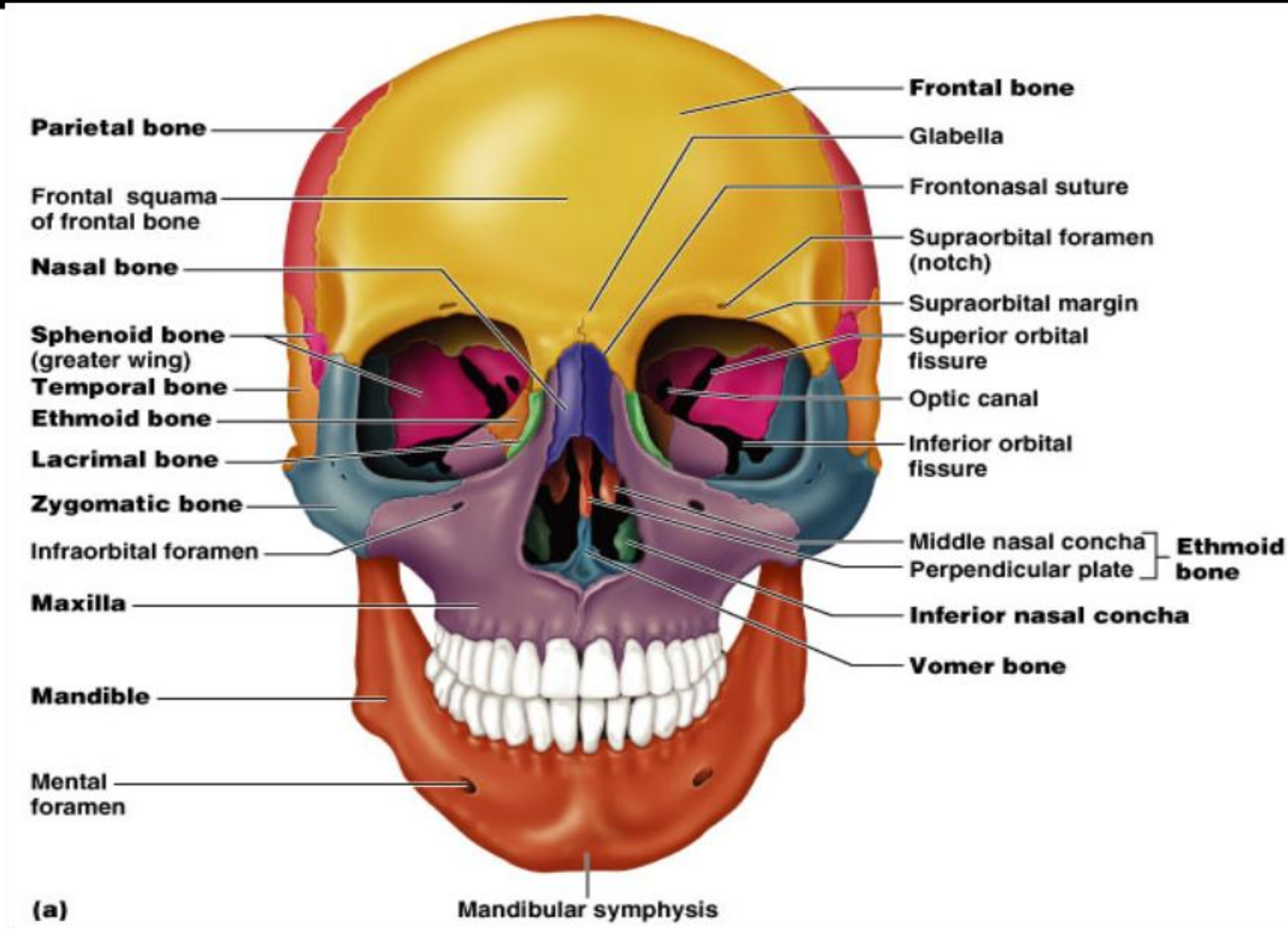
Figure 5-9 Biology of Humans, 2/e

The Skull

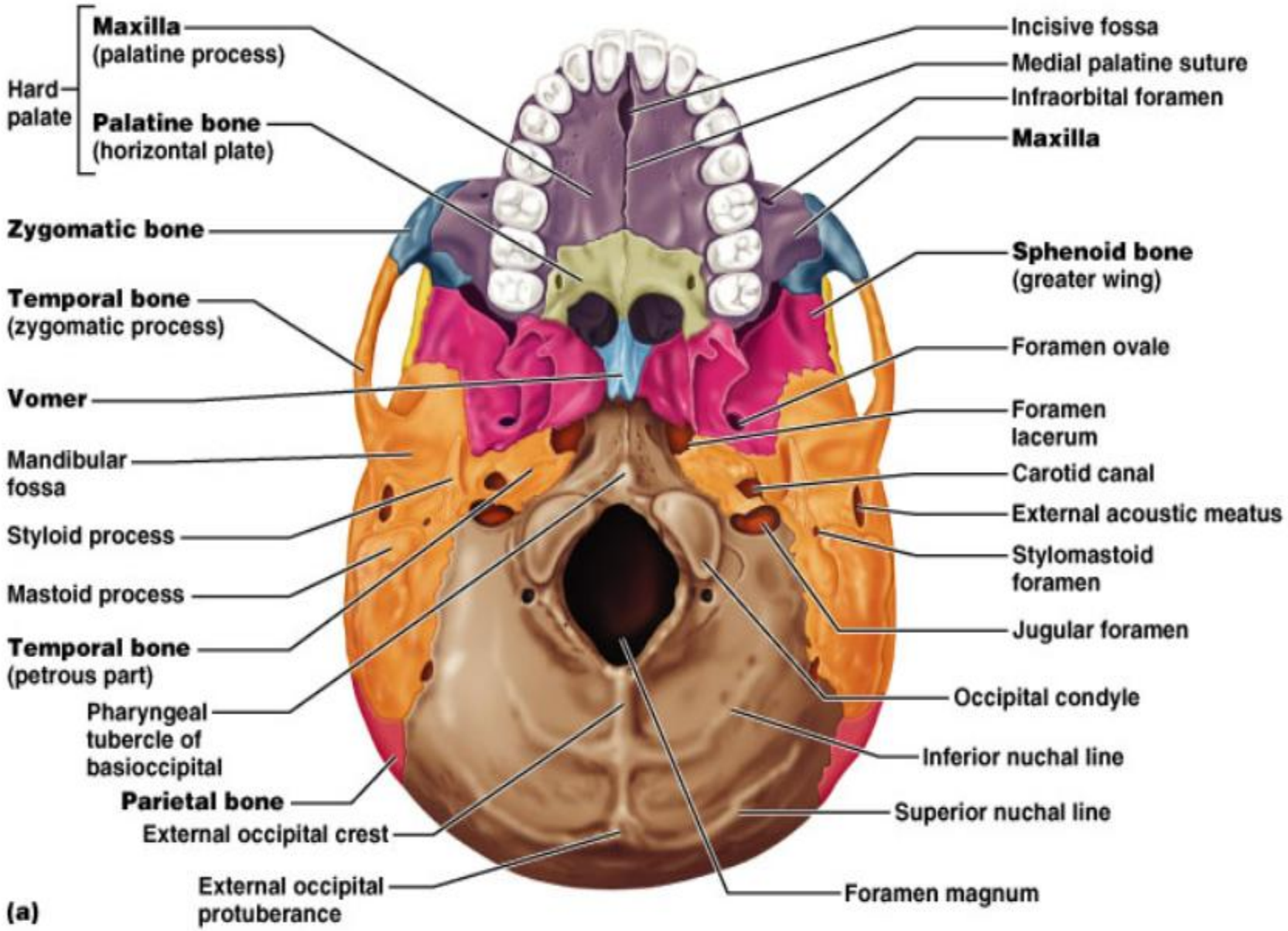
- Anterior View
- Inferior View
- Lateral View

Circle on your notes what you need to know!

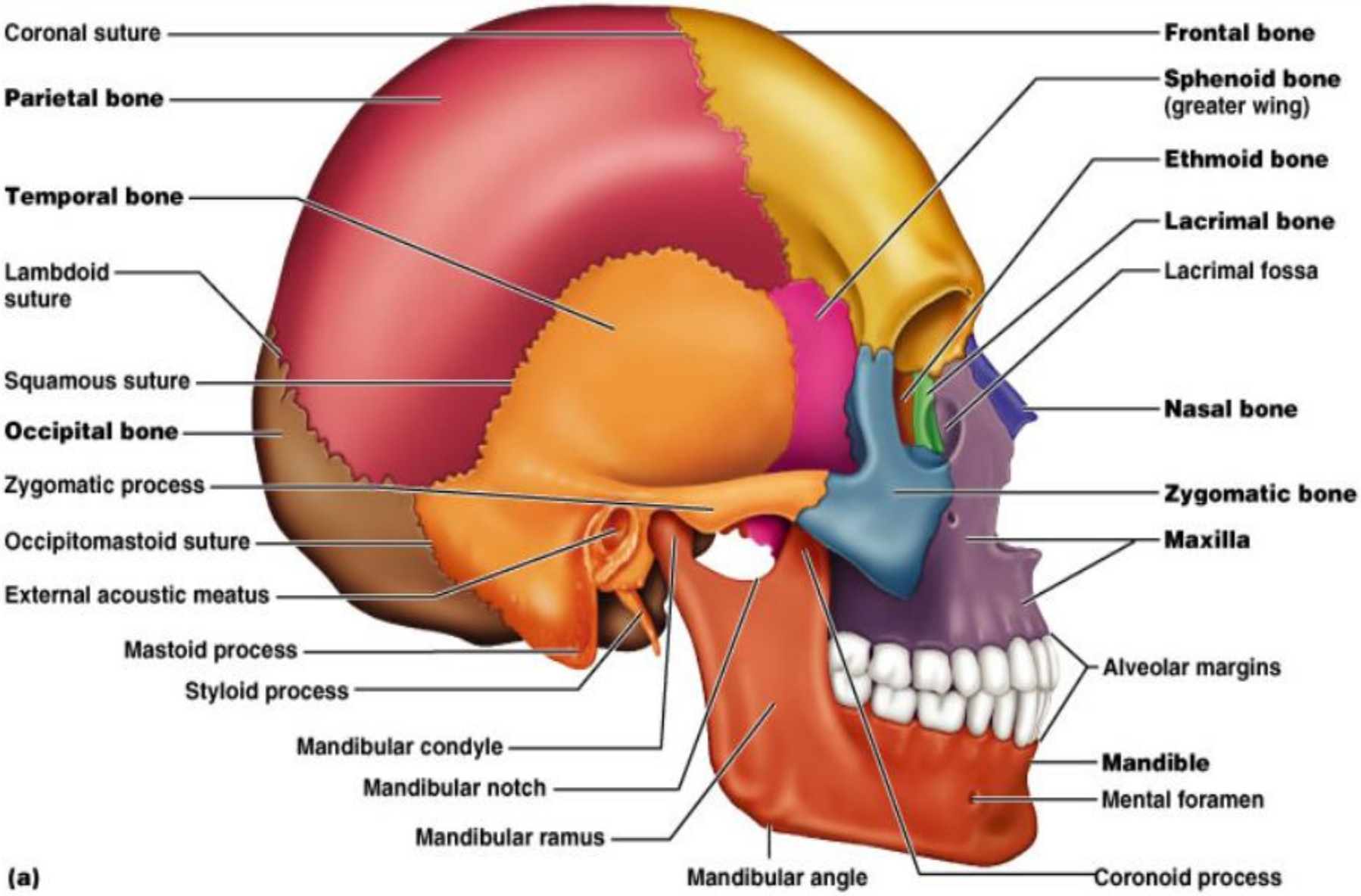
Anterior View



Inferior View



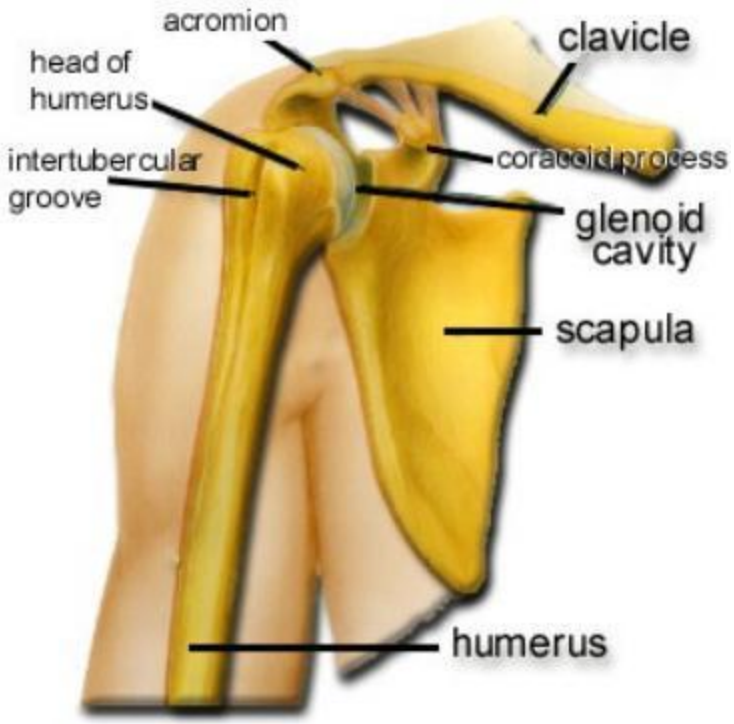
Lateral View

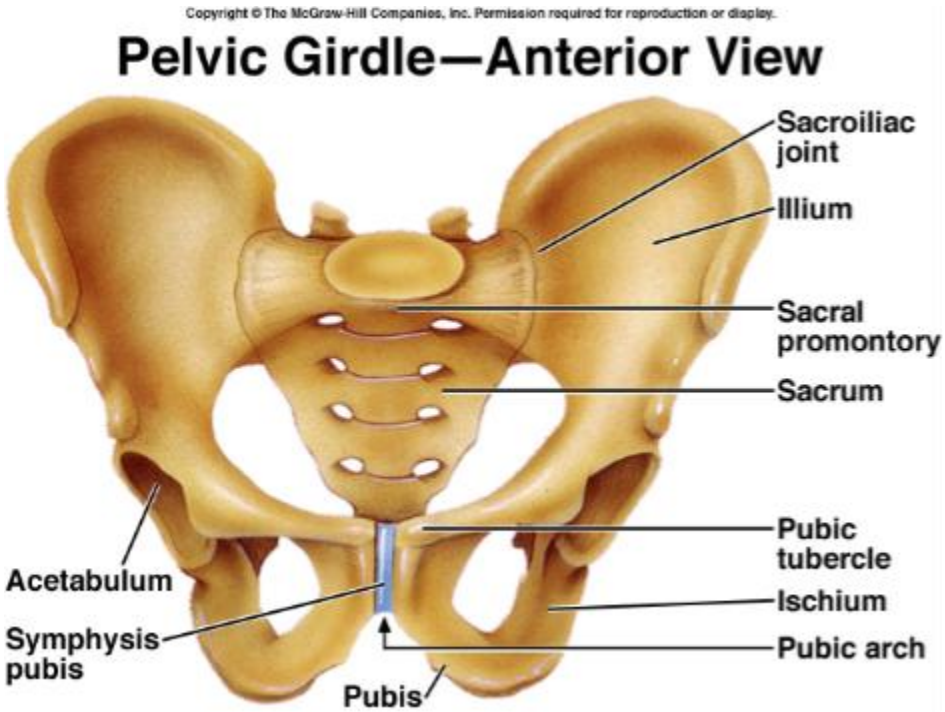


2nd part: Appendicular Skeleton

- Limbs & Bones that connect to the
  - Pectoral Girdle (shoulders)
  - Pelvic Girdle (hips)

The **pectoral girdle** connects the arms to the rib cage and the **pelvic girdle** connects the legs to the vertebral column .





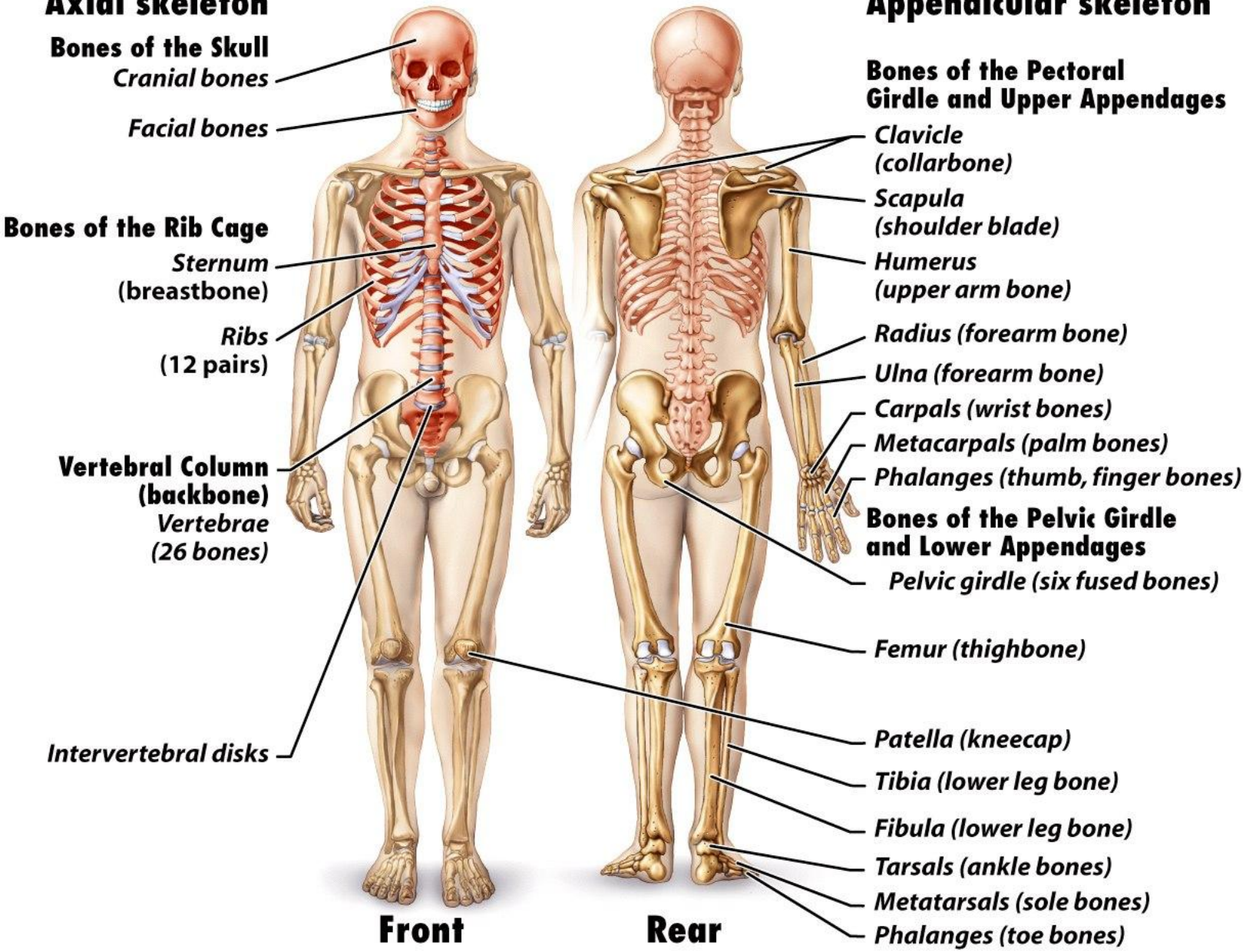


Figure 5-6 Biology of Humans, 2/e

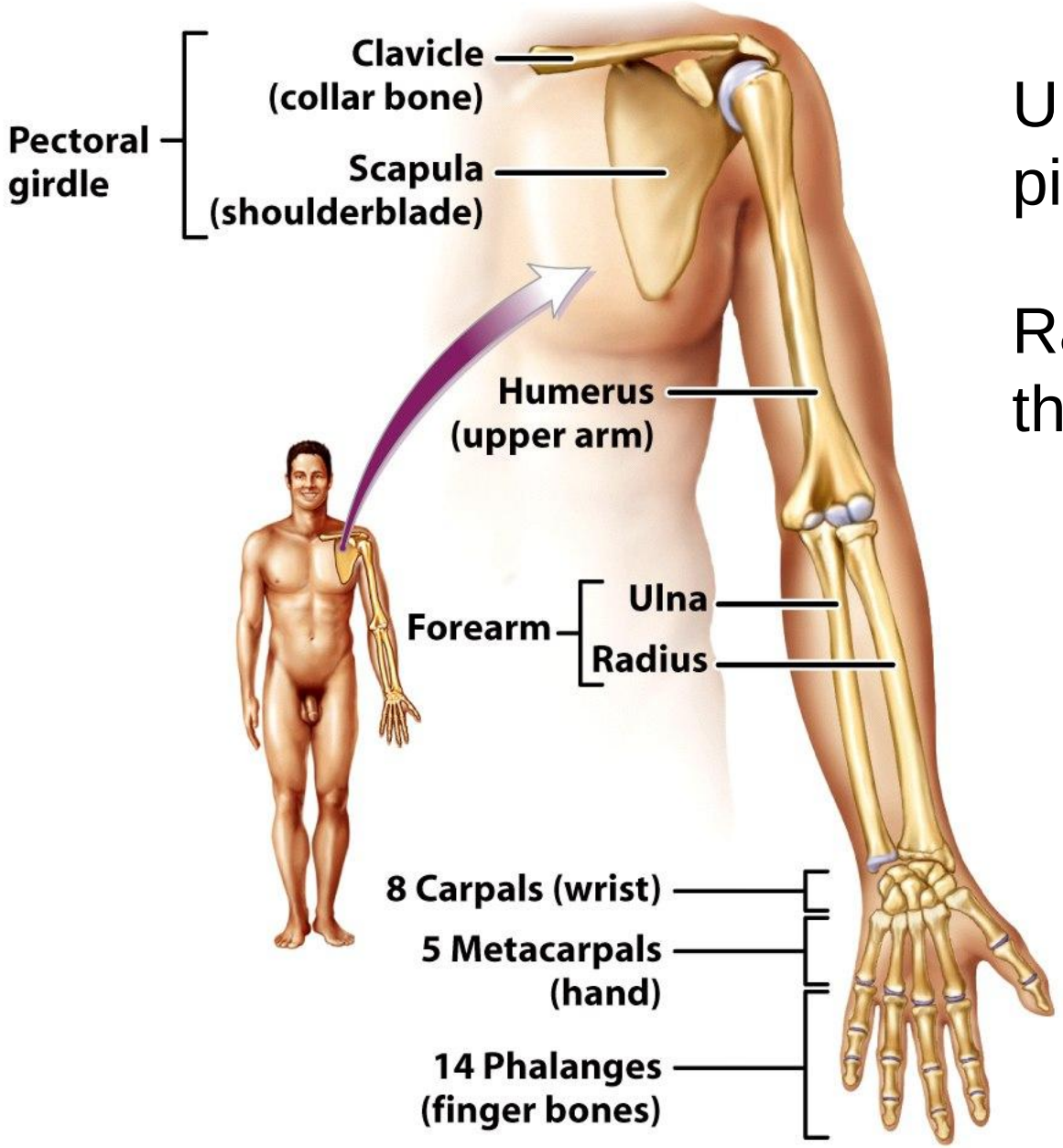


Figure 5-11 Biology of Humans, 2/e

Ulna goes to pinky (P-U)

Radius goes to thumb

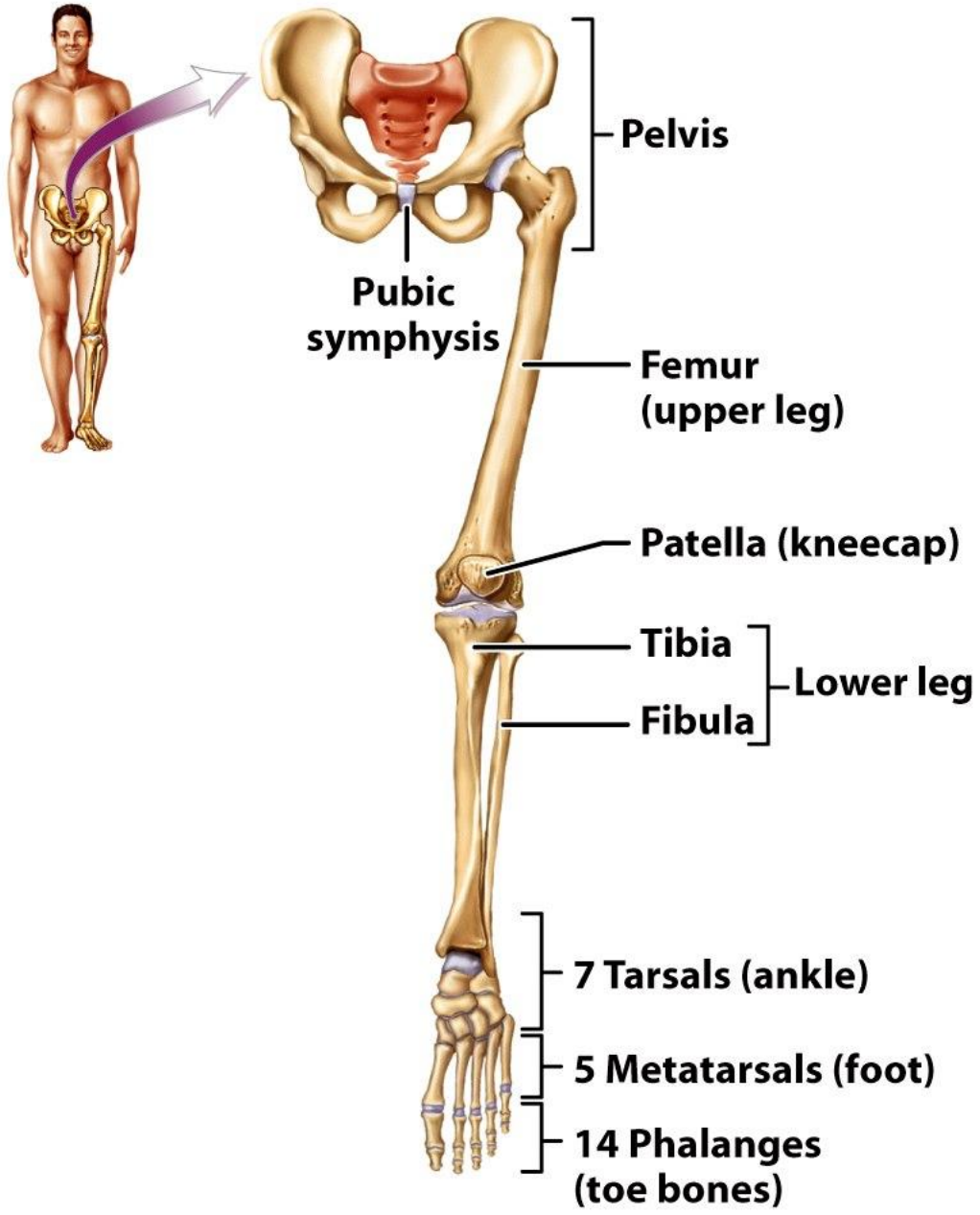


Figure 5-12 Biology of Humans, 2/e

Joints Are Junctures between Bones (Joints are AKA articulations)

- **Joints** are the places where bones meet
  - Synarthrosis-immovable
  - Amphiarthrosis-slightly movable
  - Diarthrosis-freely movable

Types of Joints (articulations)

1.Synarthrotic (not moveable, ex. Sutures or tooth in a jaw)

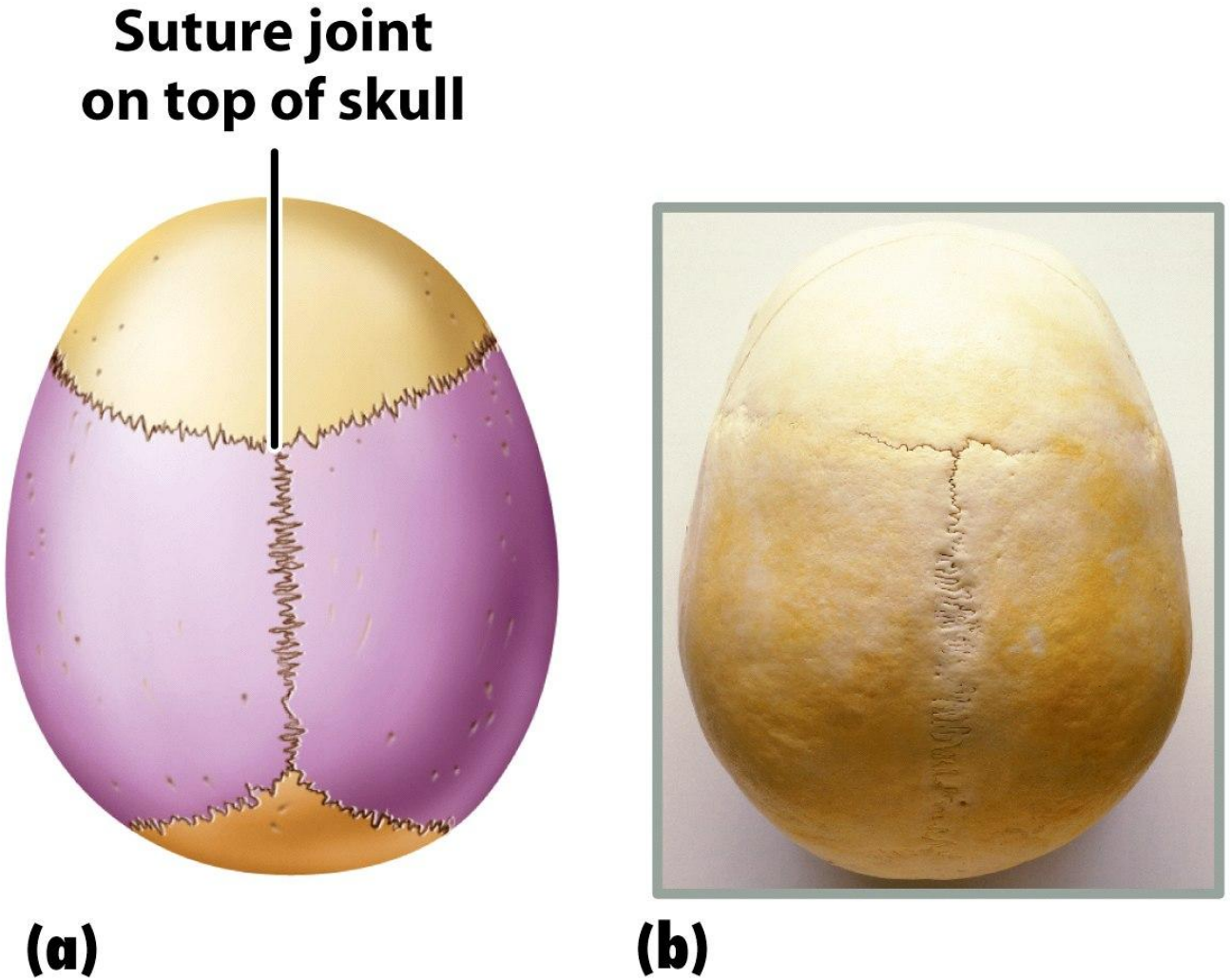
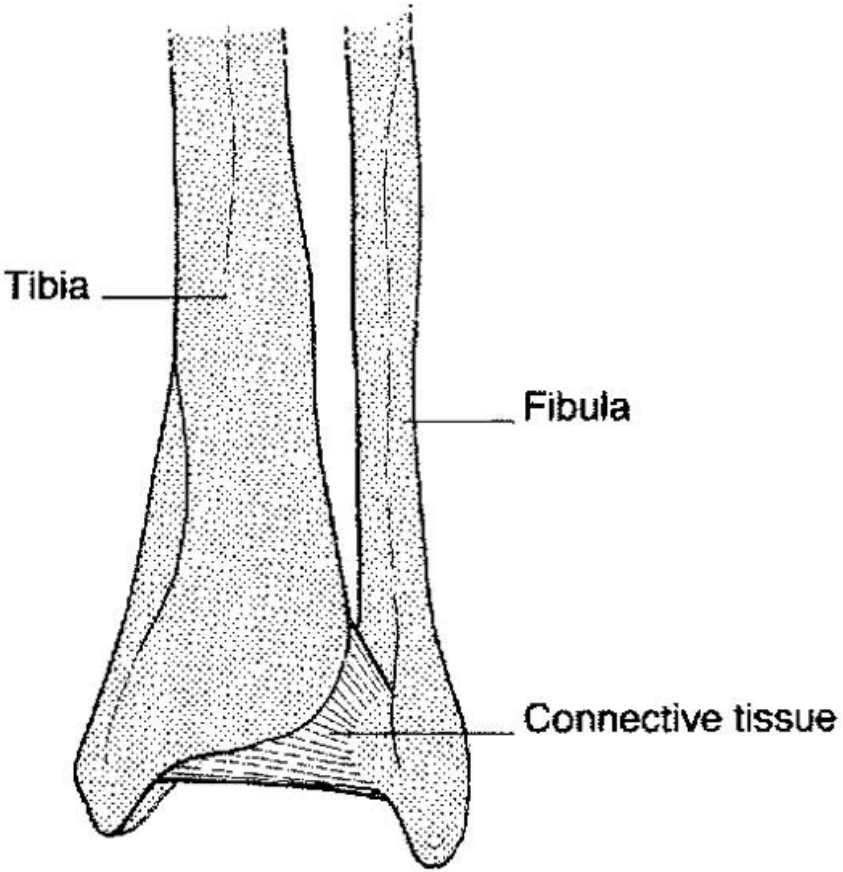
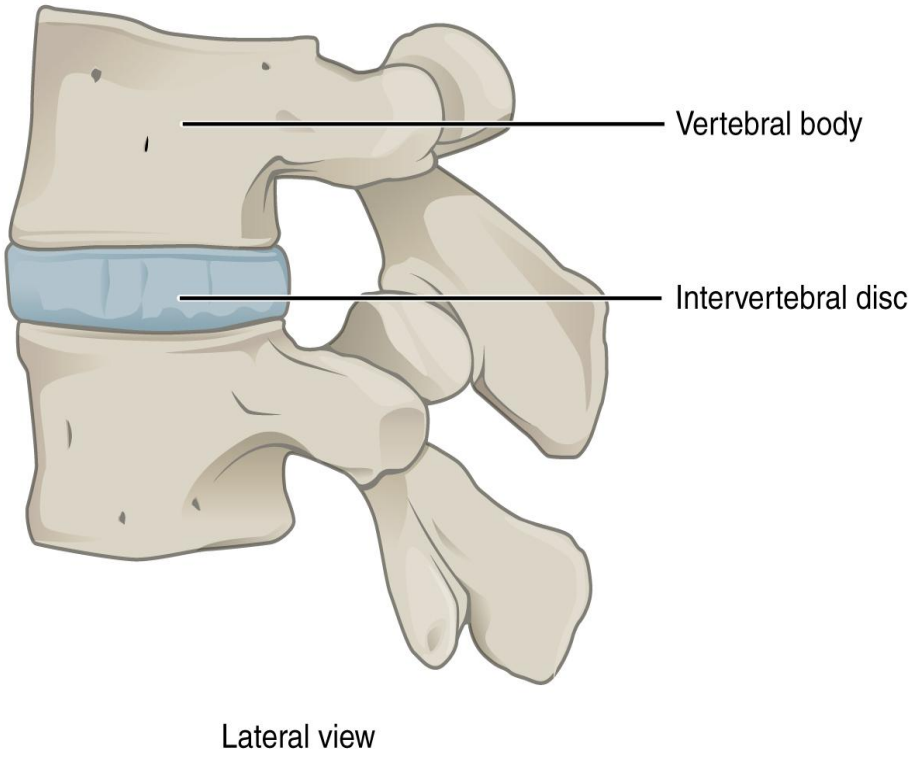


Figure 5-13 Biology of Humans, 2/e

Types of Joints (articulations)

2. Amphiarthrotic (slightly moveable, Ex. Vertebrae or between tibia and fibula)

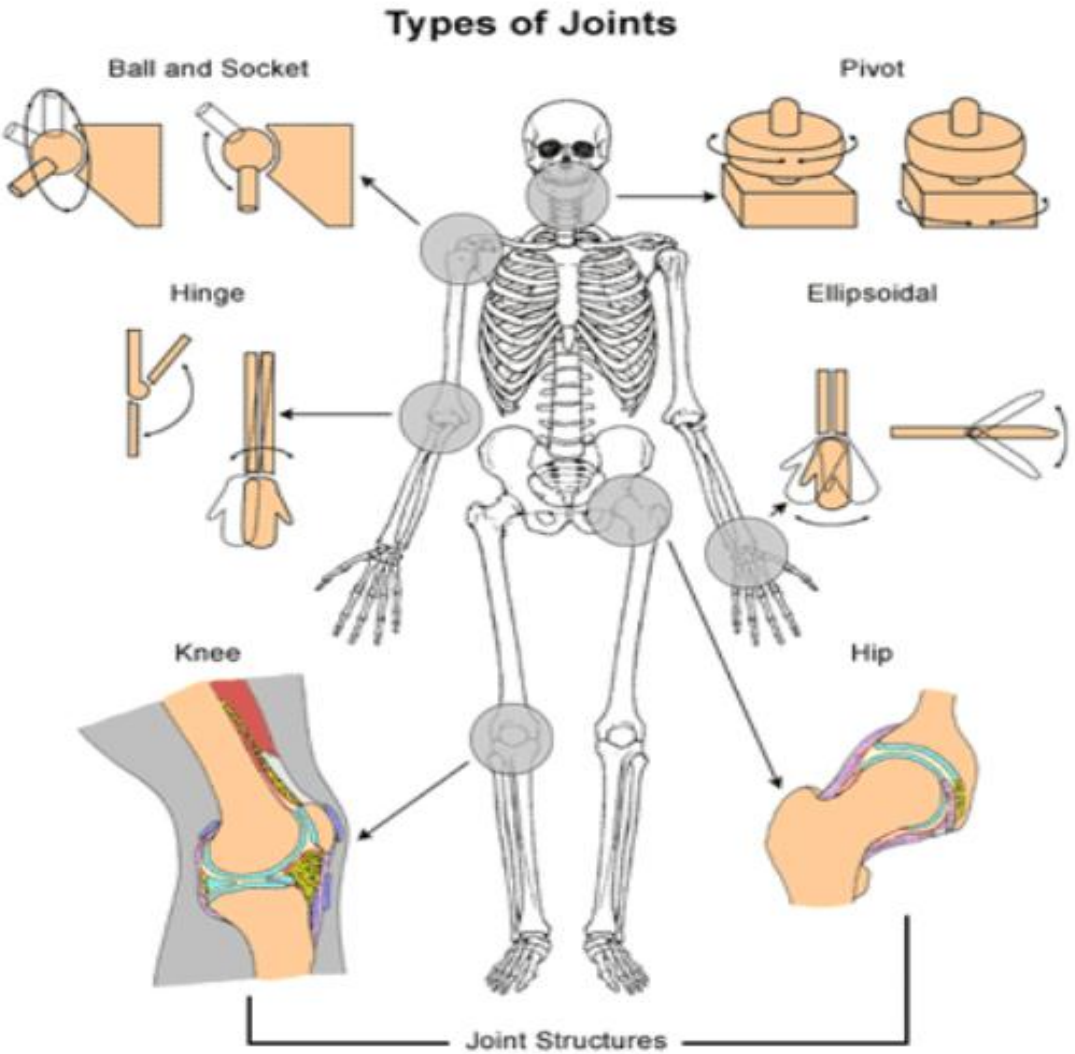




Lateral view

Types of Joints (articulations)

3.Diarthrotic (moveable joint, aka synovial joints)



Diarthrosis

- **Hinge Joint**- the convex surface of one bone fits into the concave surface of the other. Movement is in a single plane as that of a hinged door. Ex: knee, elbow, ankle, and between phalanges

- **Pivot Joint**- a rounded or pointed surface of one bone articulates within a ring formed partly by bone and partly by ligament. Ex: vertebrae, neck, palms forward to backward

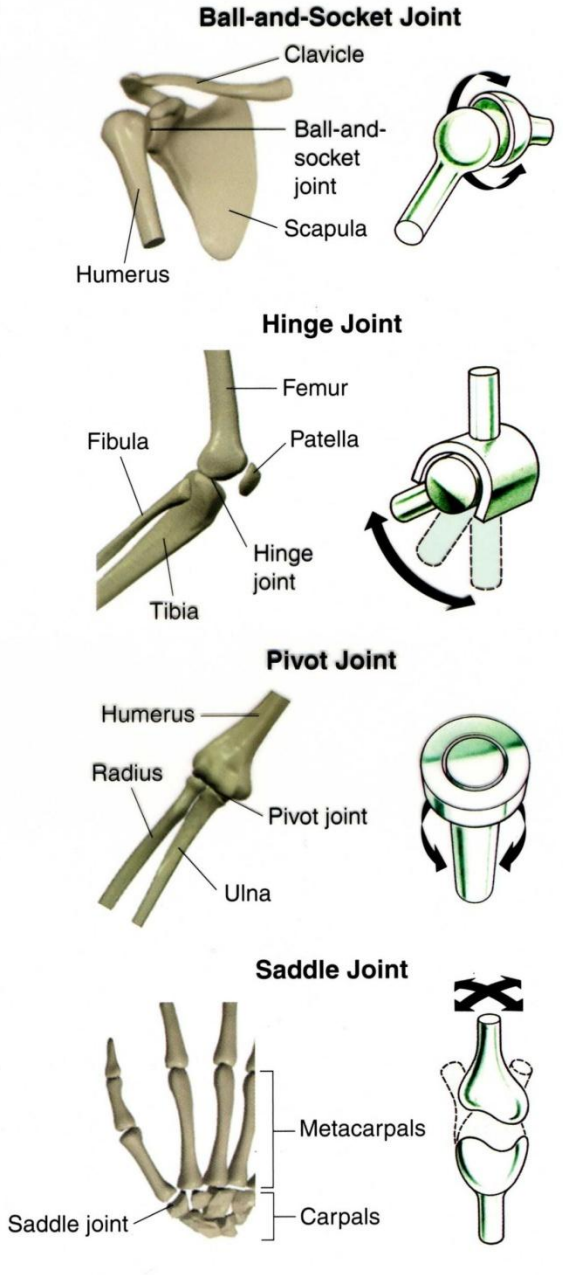
- **Saddle Joint-**the articular surface of one bone is saddle-shaped and the articular surface of the other is shaped like the legs of a rider sitting in a saddle. Ex: between wrist and thumb

- **Ball and Socket**- a ball-like surface of one bone fitted into a cuplike depression of another bone. Ex: shoulder, hip

Synovial fluid - fluid within the joints that helps to lubricate

Types of Joints

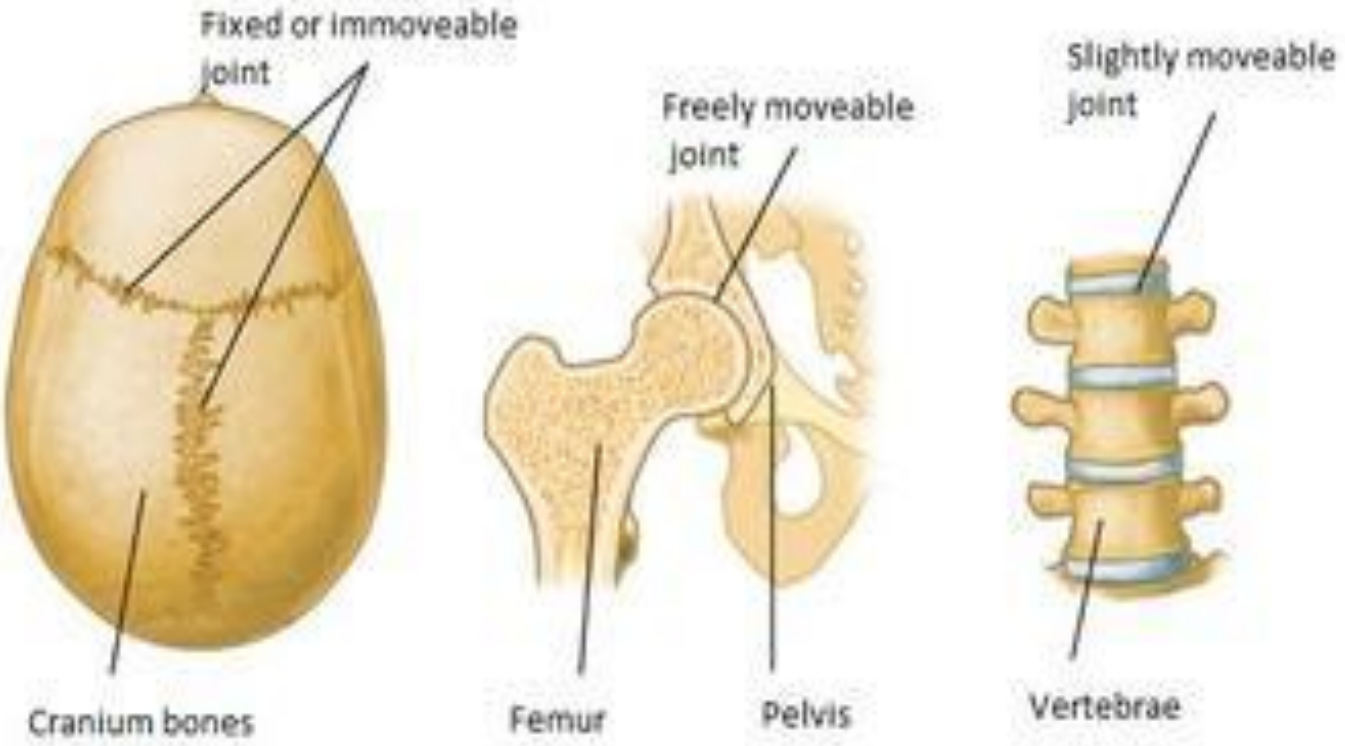
1. Ball and Socket
2. Hinge
3. Pivot
4. Saddle



Diarthrosis *(don't need to know for test)*

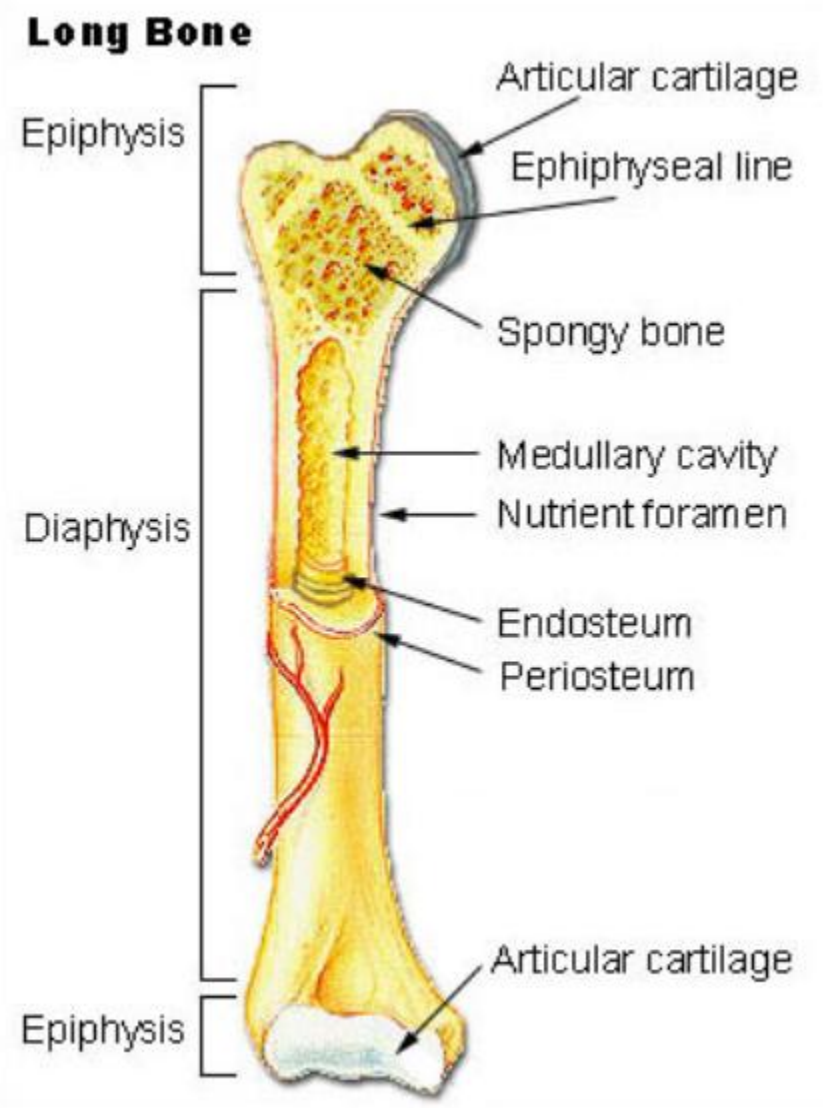
- ***Gliding Joint****- provides gliding movement in which surfaces move back and forth and from side to side without any angular or rotary motion. Ex: between the carpals or tarsals or sternum and clavicle*

- ***Condyloid Joint****- oval shaped articulating surface of one bone fits into a depression of another bone. Ex: between radius and carpals*


Fixed or immoveable joint
Cranium bones
Freely moveable joint
Femur
Pelvis
Slightly moveable joint
Vertebrae

BONE STRUCTURE - Long Bone

1. Epiphysis
2. Diaphysis
3. Articular Cartilage
4. Periosteum



Inside the Long Bone

Medullary Cavity – hollow chamber filled with bone marrow

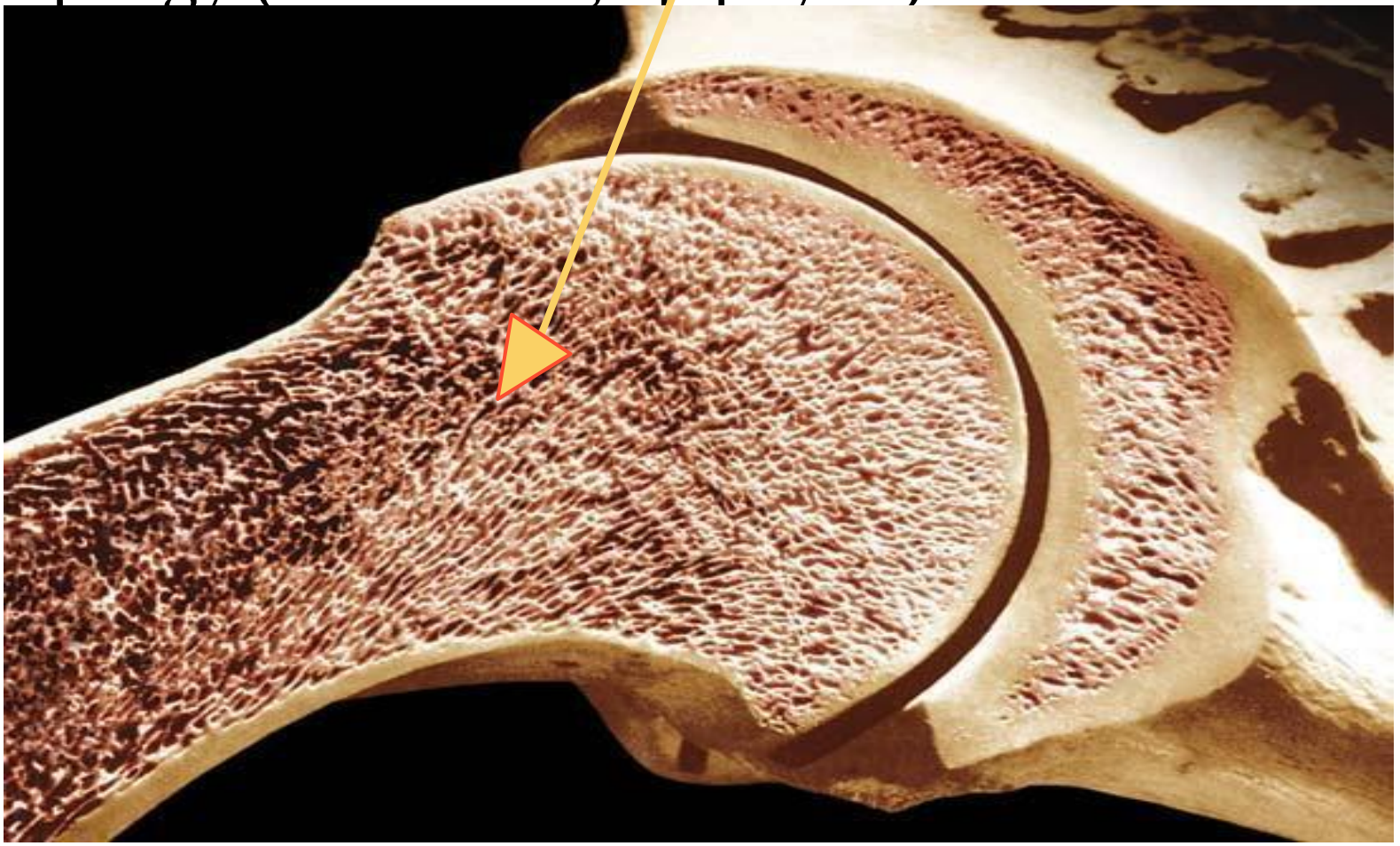
Red Marrow (blood)
Yellow Marrow (fat)

Endosteum – lining of the medullary

Types of Bone Tissue

Compact (wall of the diaphysis)

Spongy (cancellous, epiphysis) - red marrow



Structure of a Long Bone

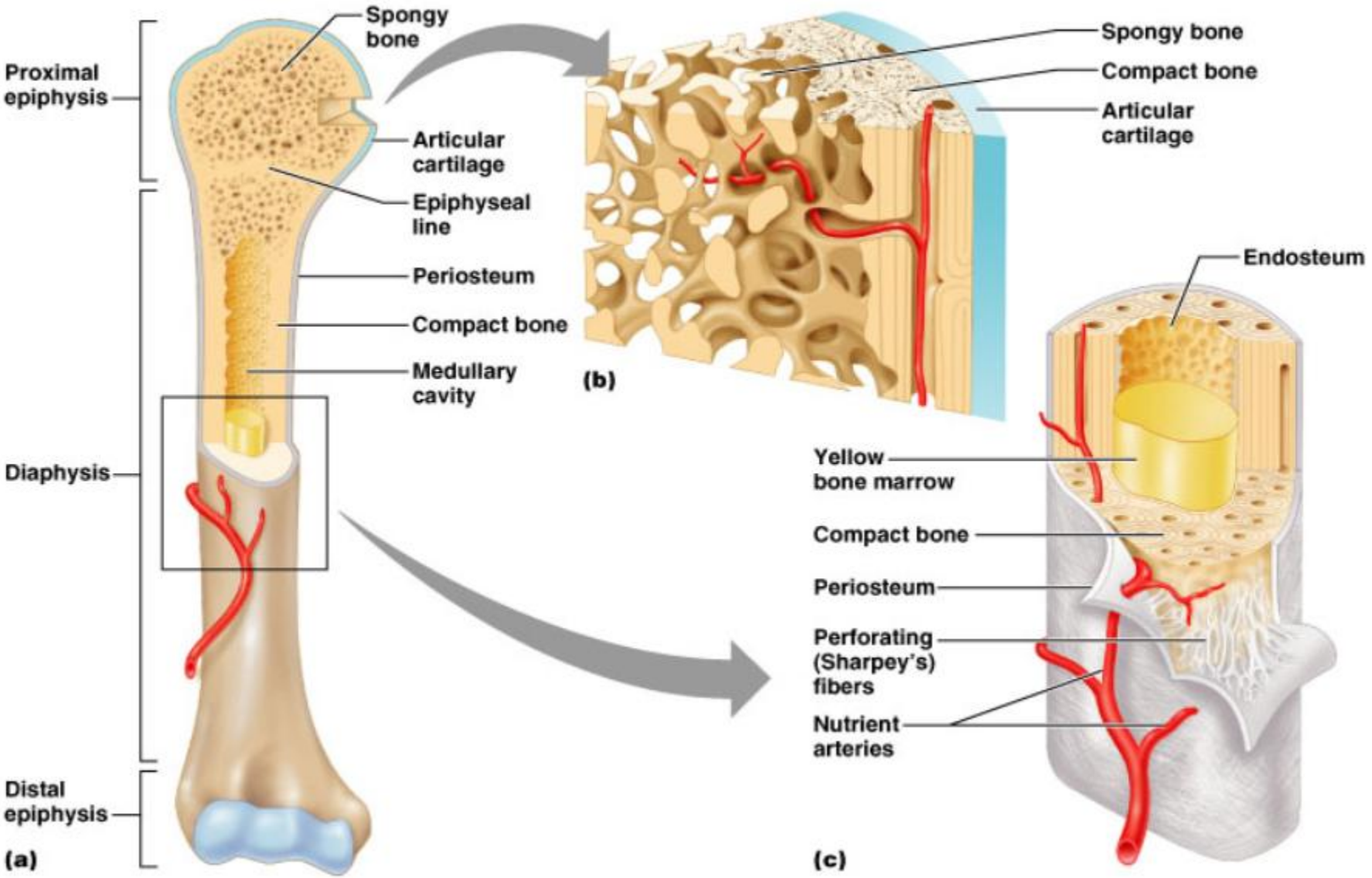
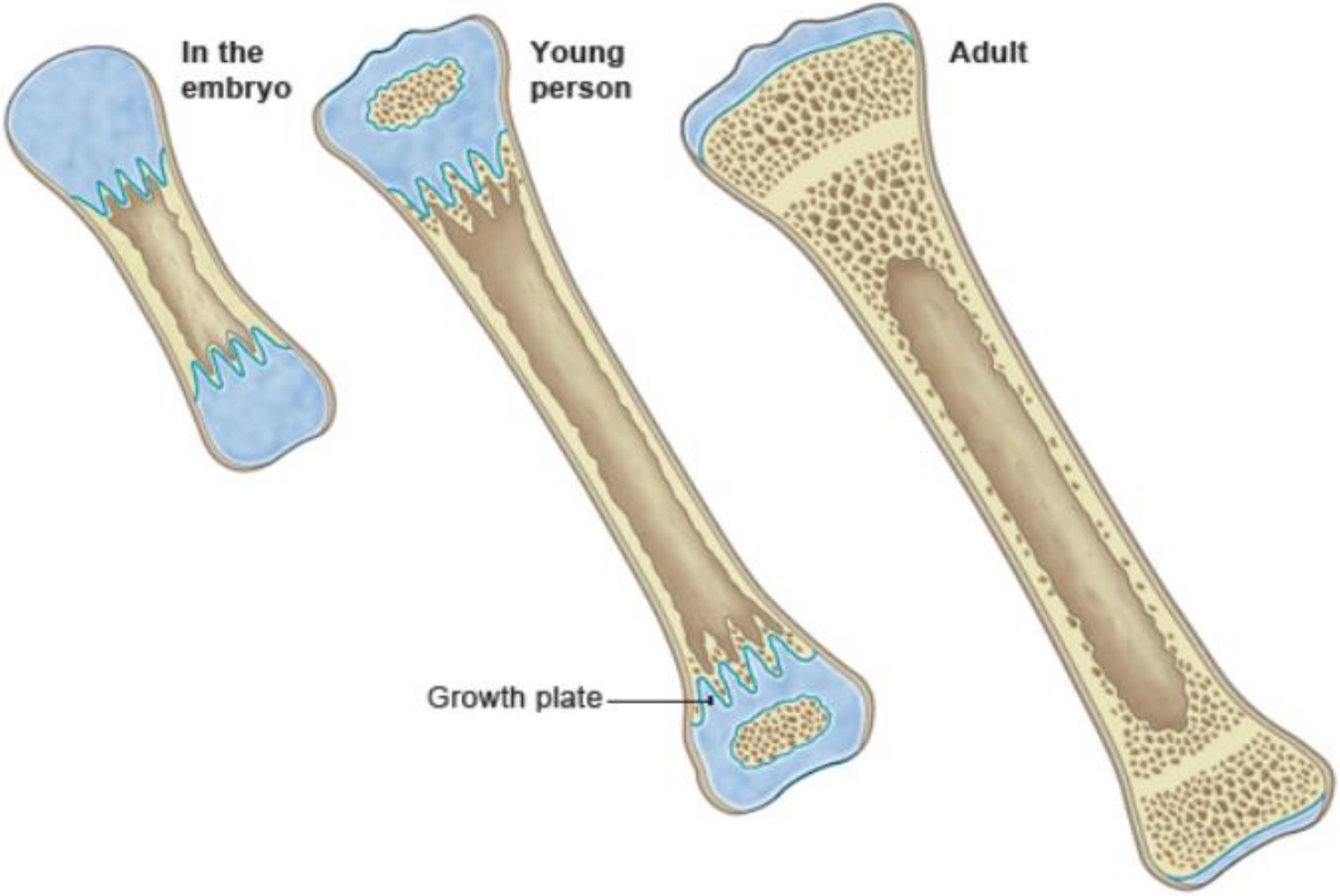


Figure 6.3a-c

So how do bones develop?



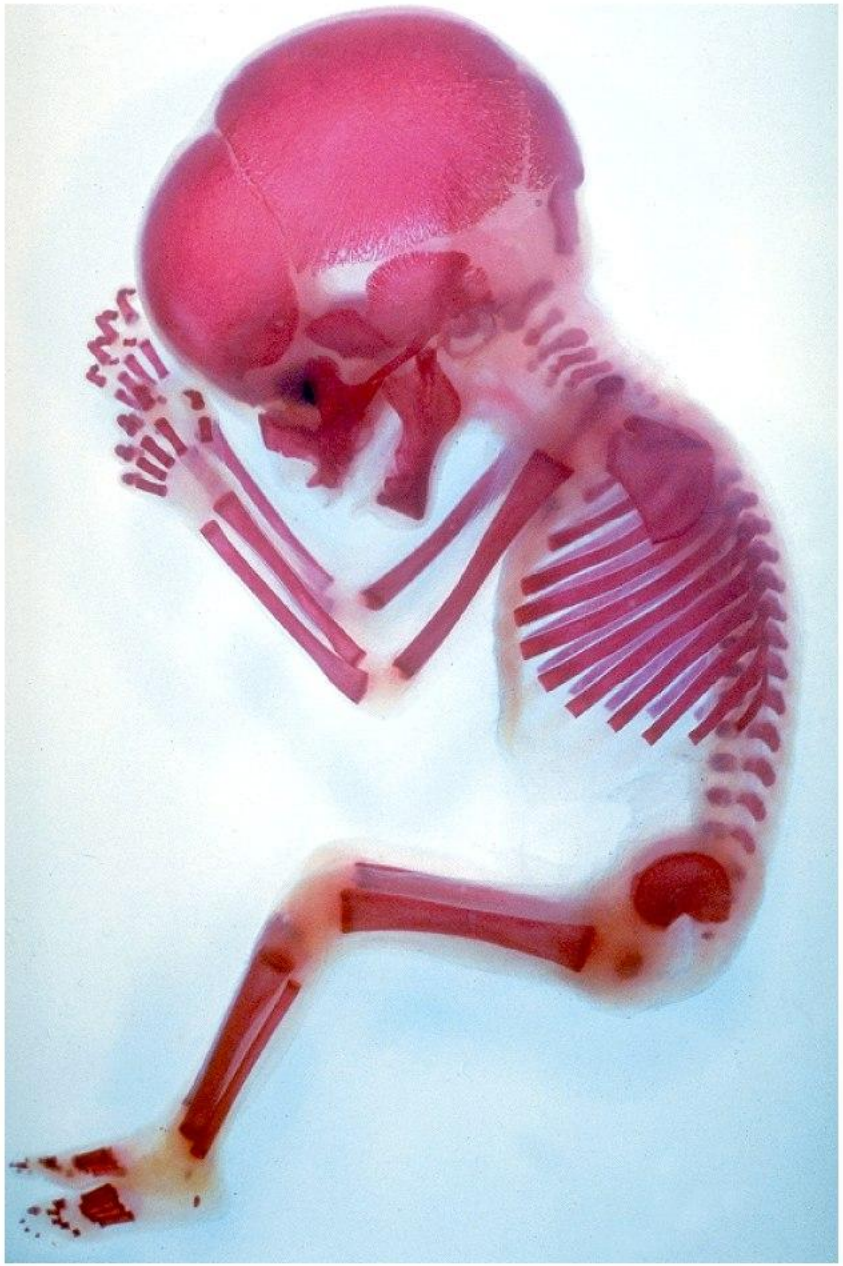


Figure 5-3 Biology of Humans, 2/e

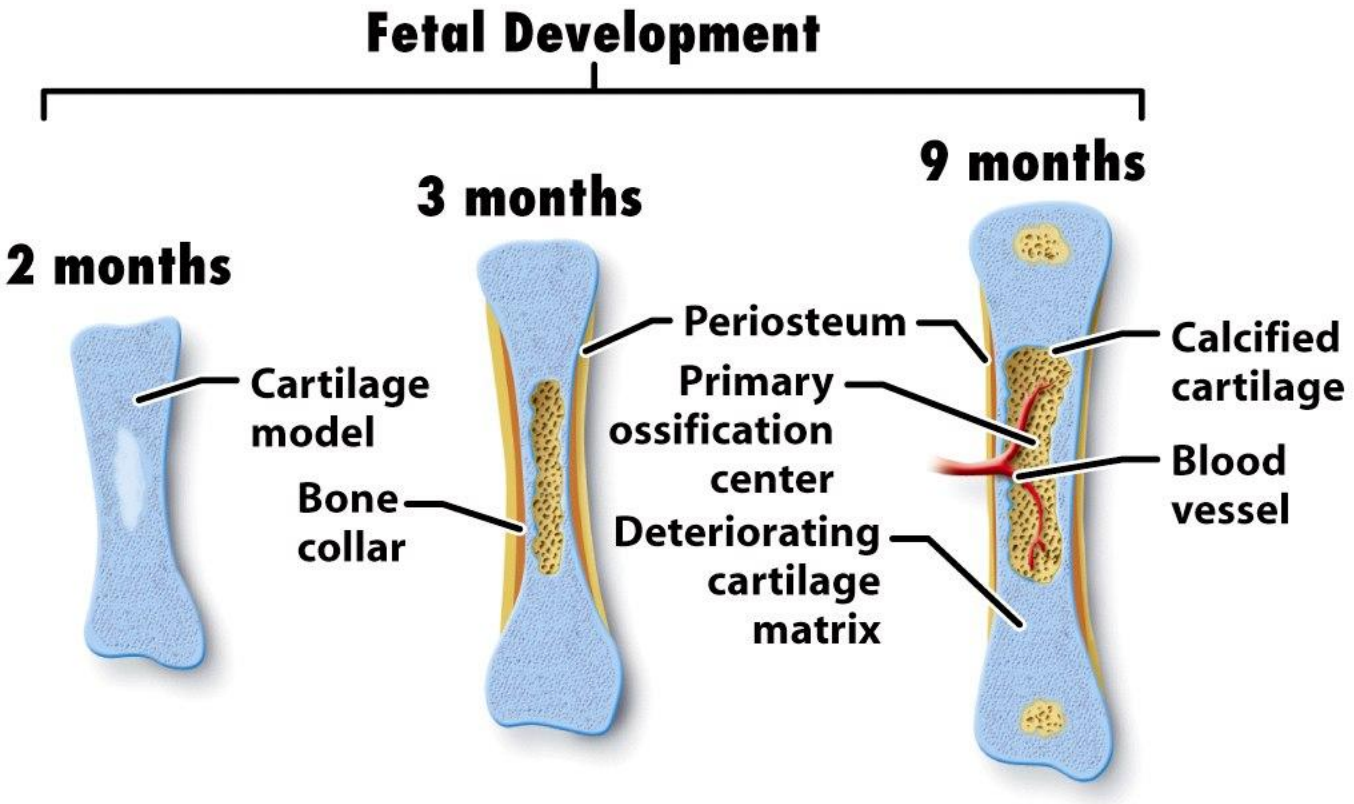


Figure 5-4 part 1 Biology of Humans, 2/e

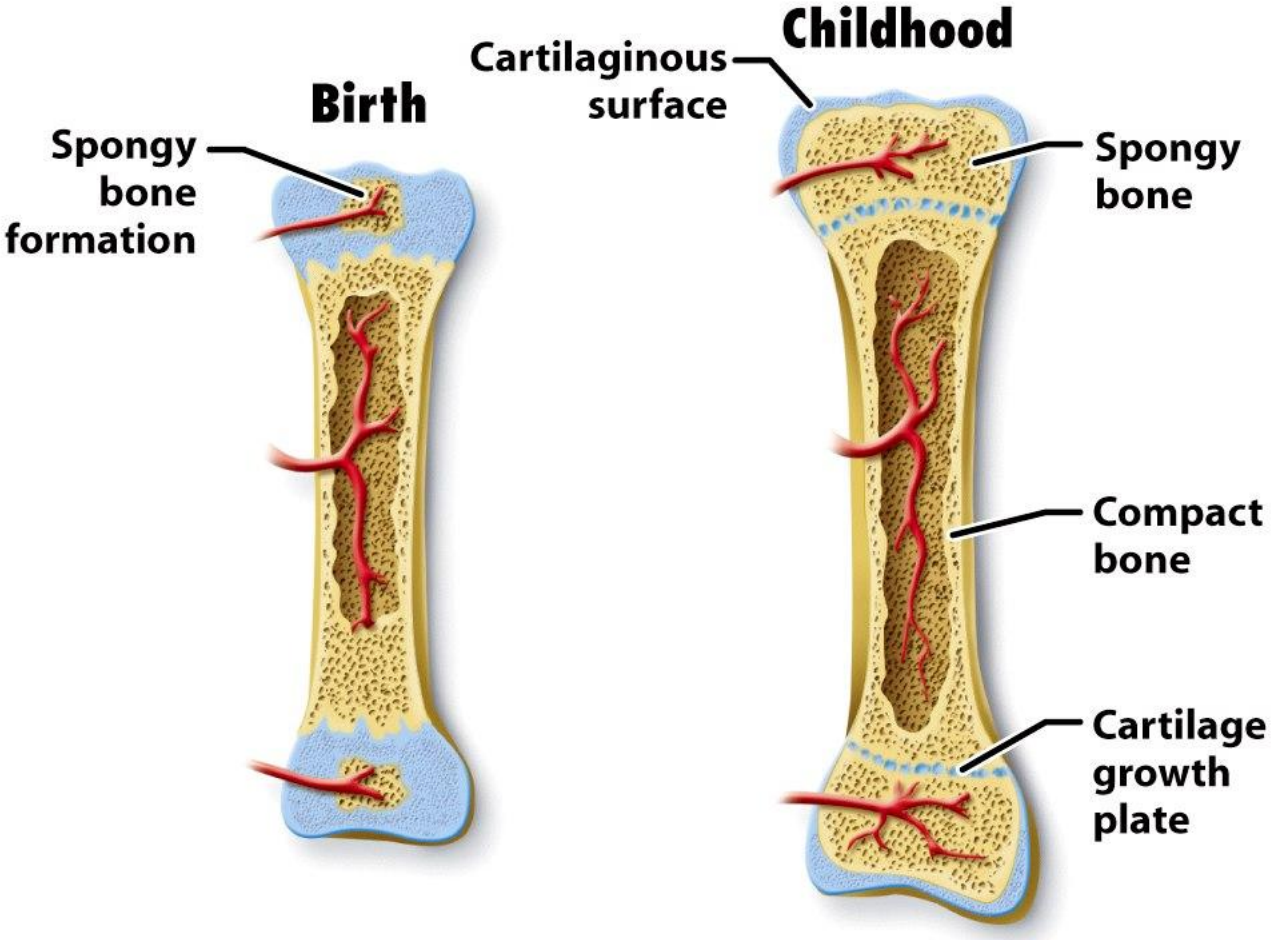


Figure 5-4 part 2 Biology of Humans, 2/e

Bone Is Living Tissue: Bone Growth and Development

ALL BONES START AS HYALINE CARTILAGE, areas gradually turn to bone: **Cartilage →OSTEOBLASTS →OSTEOCYTES**

- Long bones begin when **osteoblasts** form a collar of bone around the shaft of cartilage
- **Osteoblasts-** cells which originate in the bone marrow and contribute to the production of new bone
- Osteoblasts migrate to the bone marrow cavity to form spongy bone

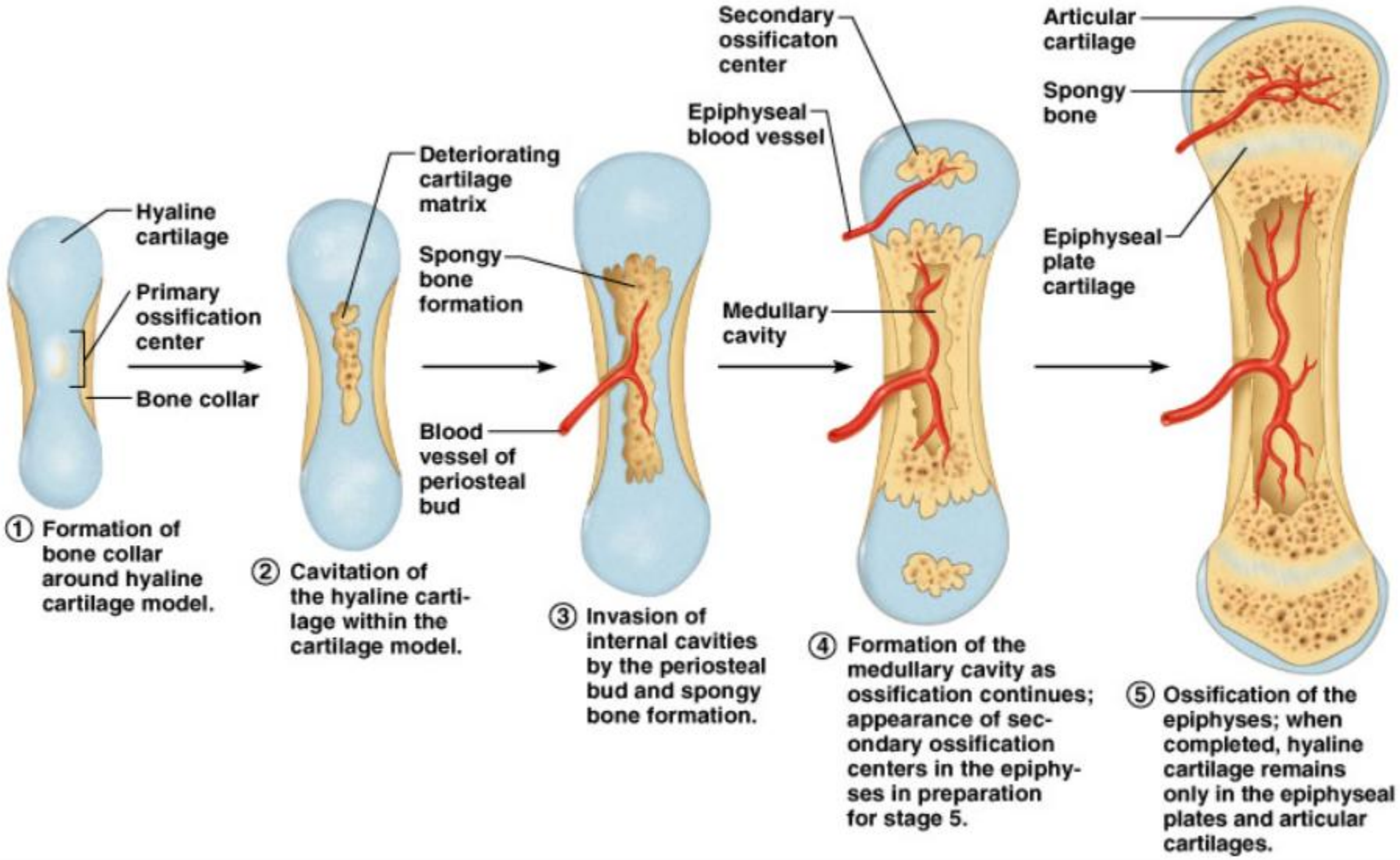
Bone Is Living Tissue: Bone Growth and Development

- Two regions of cartilage remain at each end of the long bone
- One is the cap that covers the surfaces that rub against other bones and the second is a plate of cartilage, called the **growth plate**.

EPIPHYSEAL DISK (growth plate) is a band of cartilage between the epiphysis and diaphysis

These areas increase bone length as the cells ossify

Bone Growth


Hyaline cartilage
Primary ossification center
Bone collar
① Formation of bone collar around hyaline cartilage model.
Deteriorating cartilage matrix
② Cavitation of the hyaline cartilage within the cartilage model.
Spongy bone formation
Blood vessel of periosteal bud
③ Invasion of internal cavities by the periosteal bud and spongy bone formation.
Secondary ossificaton center
Epiphyseal blood vessel
Medullary cavity
④ Formation of the medullary cavity as ossification continues; appearance of secondary ossification centers in the epiphyses in preparation for stage 5.
Articular cartilage
Spongy bone
Epiphyseal plate cartilage
⑤ Ossification of the epiphyses; when completed, hyaline cartilage remains only in the epiphyseal plates and articular cartilages.

Bones Are Continuously Remodeled

- Bones continually go through remodeling where new bone is deposited by osteoblasts and old bone is broken down by osteoclasts.

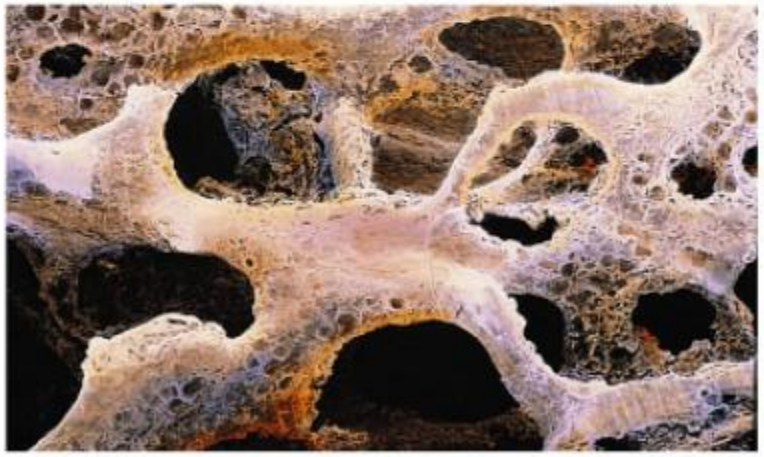
- **Osteoclasts** are the cells that resorb, or break down and absorb, bone tissue back into the body.

- The rate and extent of bone remodeling is in response to the stress felt by the bone.

- If bone is broken down faster than it is built **osteoporosis** results.

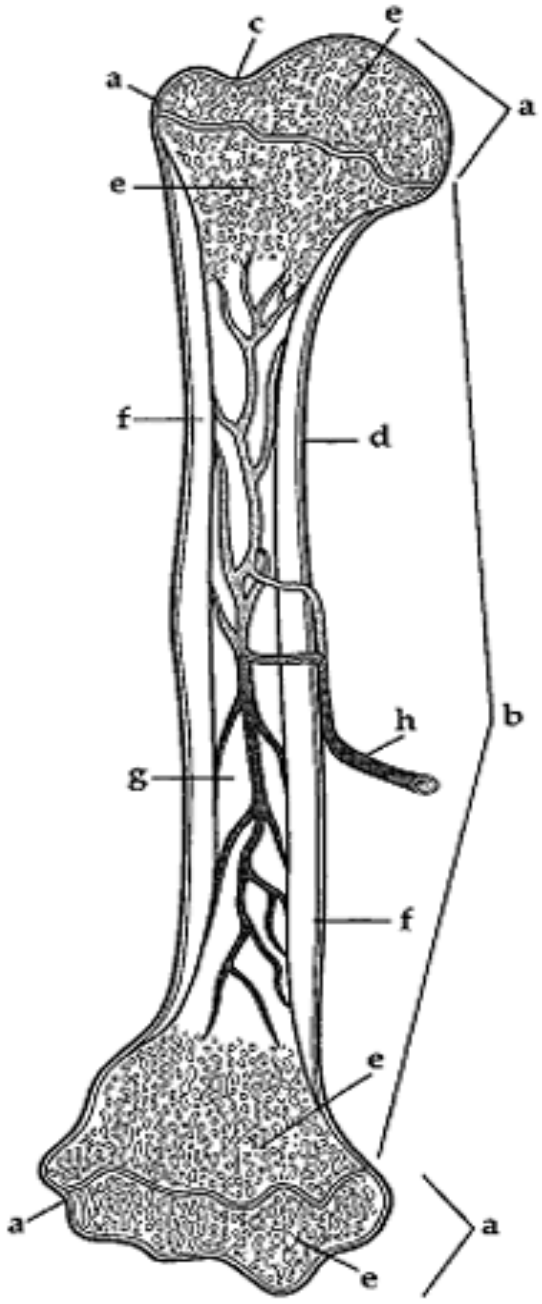
Osteoporosis

(a)



(b)

Figure 6.15



* Assignment

– Coloring of a Long Bone

Bone Fractures are Healed by Fibroblasts and Osteoblasts

- When a bone fracture occurs, fibroblasts secrete collagen fibers that form a callus linking the two parts of the bone
  - This cartilage is later replaced by bone

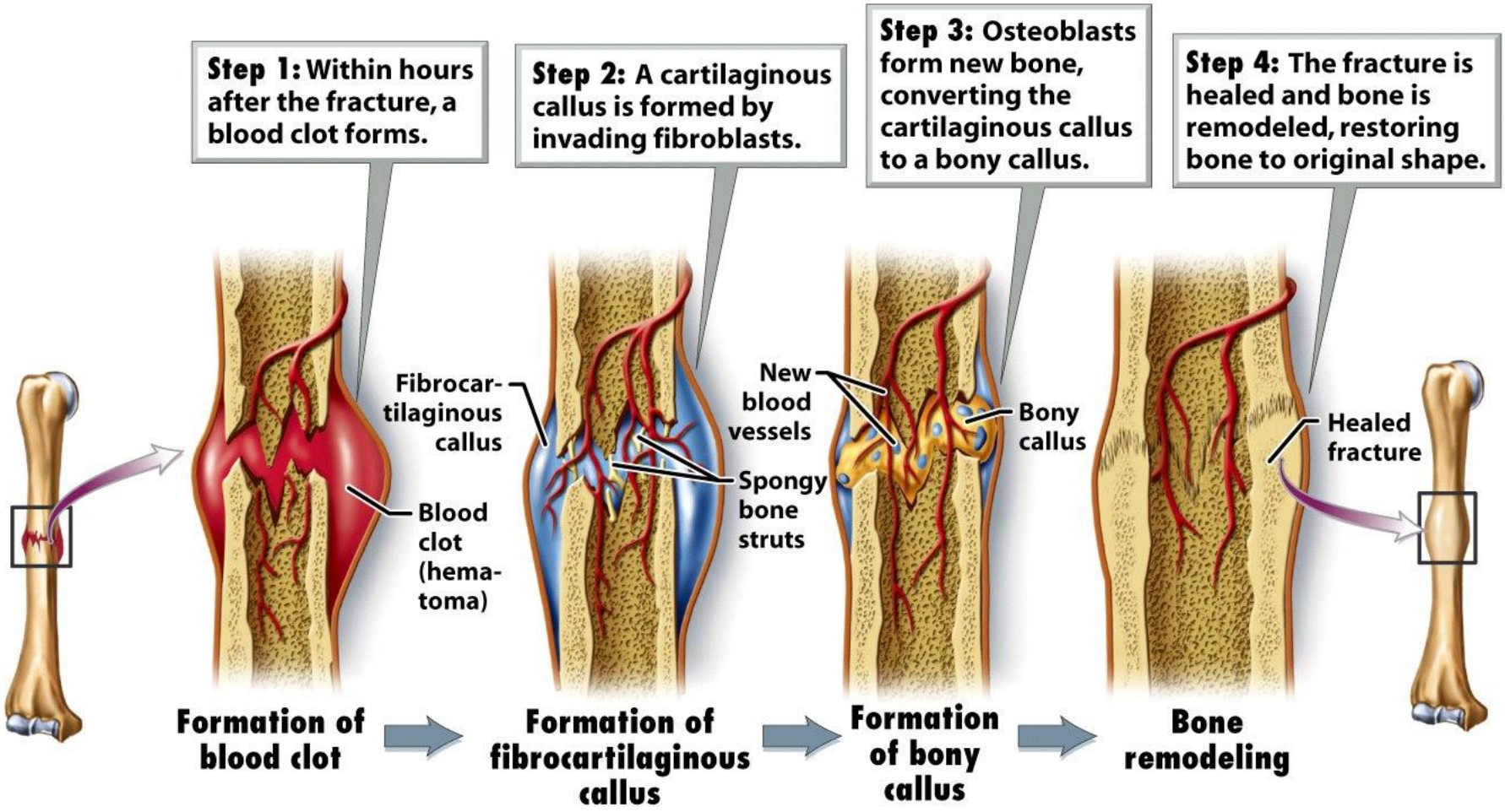


Figure 5-5 Biology of Humans, 2/e

Bone Fracture Types (1)

A *greenstick* fracture is incomplete, and the break occurs on the convex surface of the bend in the bone.

A *fissured* fracture involves an incomplete longitudinal break.

A *comminuted* fracture is complete and fragments the bone.

Bone Fracture Types (2)

A *transverse* fracture is complete, and the break occurs at a right angle to the axis of the bone.

An *oblique* fracture occurs at an angle other than a right angle to the axis of the bone.

A *spiral* fracture is caused by twisting a bone excessively.

FUN FACTS ABOUT BONES

- Babies are born with 300 bones, but by adulthood we have only 206 in our bodies.
- The giraffe has the same number of bones in its neck as a human: seven in total.
- The long horned ram can take a head butt at 25 mph. The human skull will fracture at 5mph.
- Bone is made of the same type of minerals as limestone.

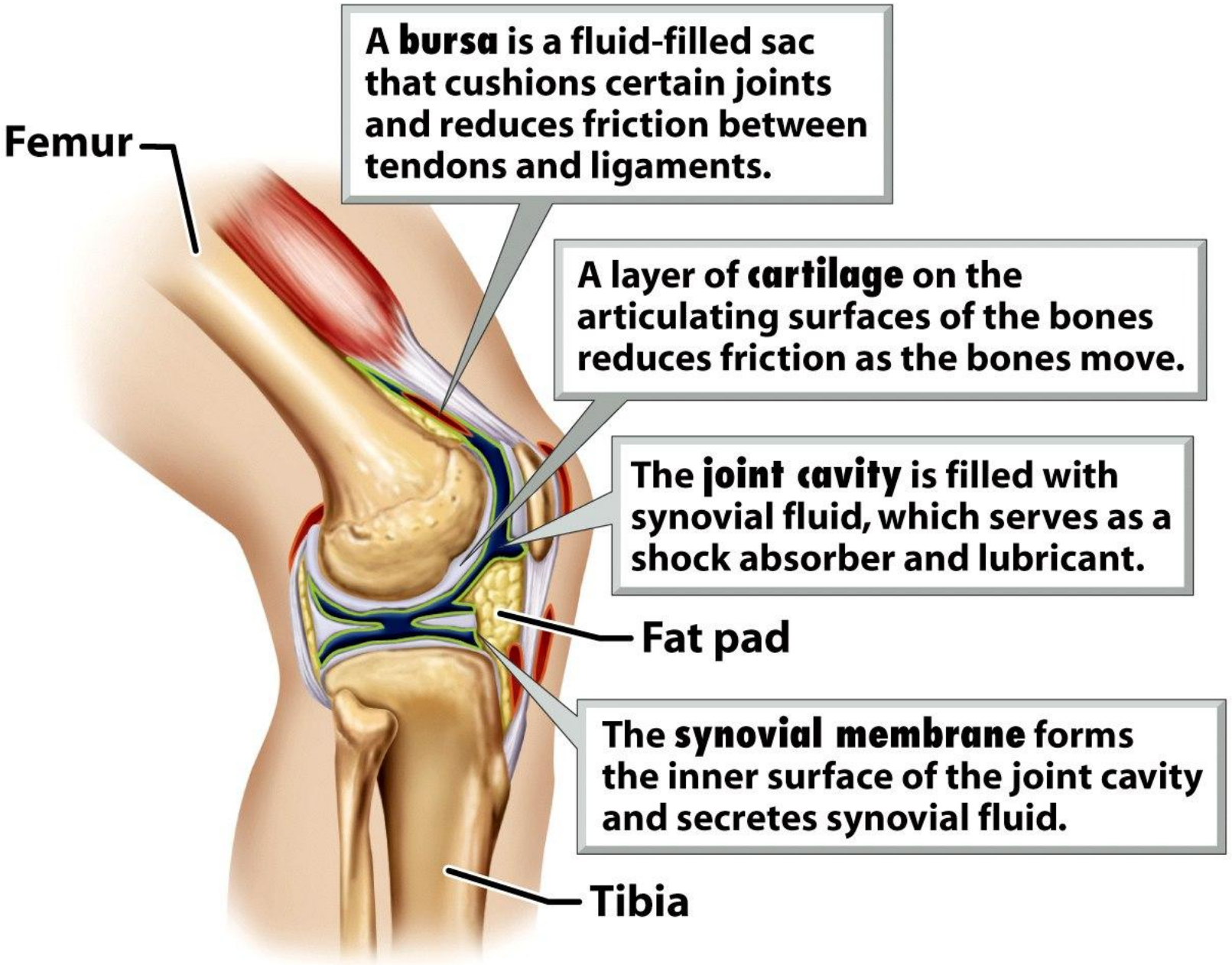


Figure 5-14a Biology of Humans, 2/e

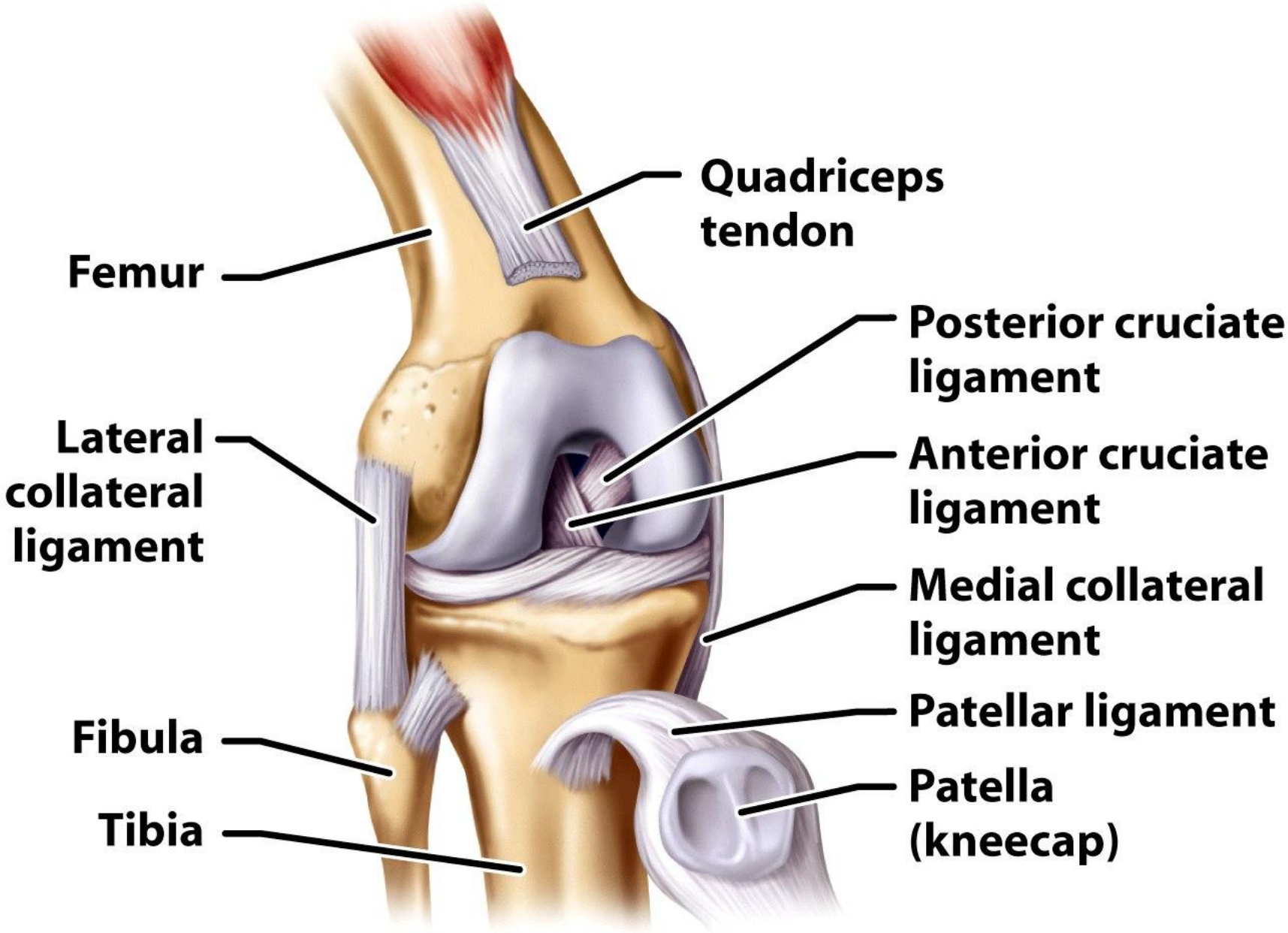


Figure 5-14b Biology of Humans, 2/e

Joints

- Most joints in the body are freely movable, **synovial joints**
- The surfaces of these joints move past one another on a thin layer of hyaline cartilage

Joints

- Synovial joints are surrounded by a thin capsule containing synovial fluid, a lubricant
- The entire joint is reinforced with **ligaments** that hold bones together and direct movement

ACL Reconstruction Surgery Dr. Eric Janssen – YouTube

Total Knee Replacement Surgery Part 2 - Update 2011 - YouTube

Bone Is Living Tissue

- Bone growth is stimulated by growth hormone
- Thyroid hormones ensure that the skeleton grows with the proper proportions

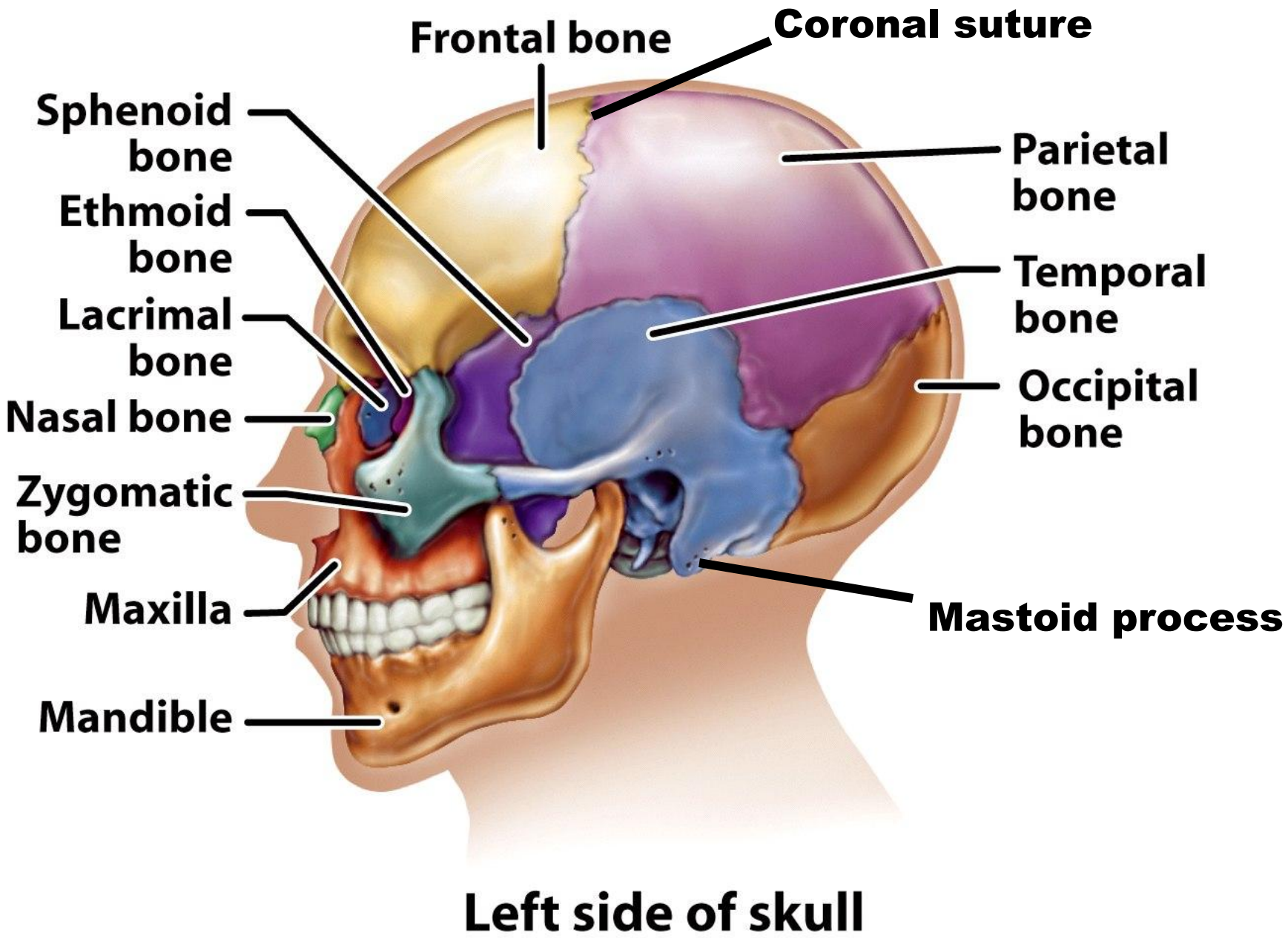


Figure 5-7a Biology of Humans, 2/e

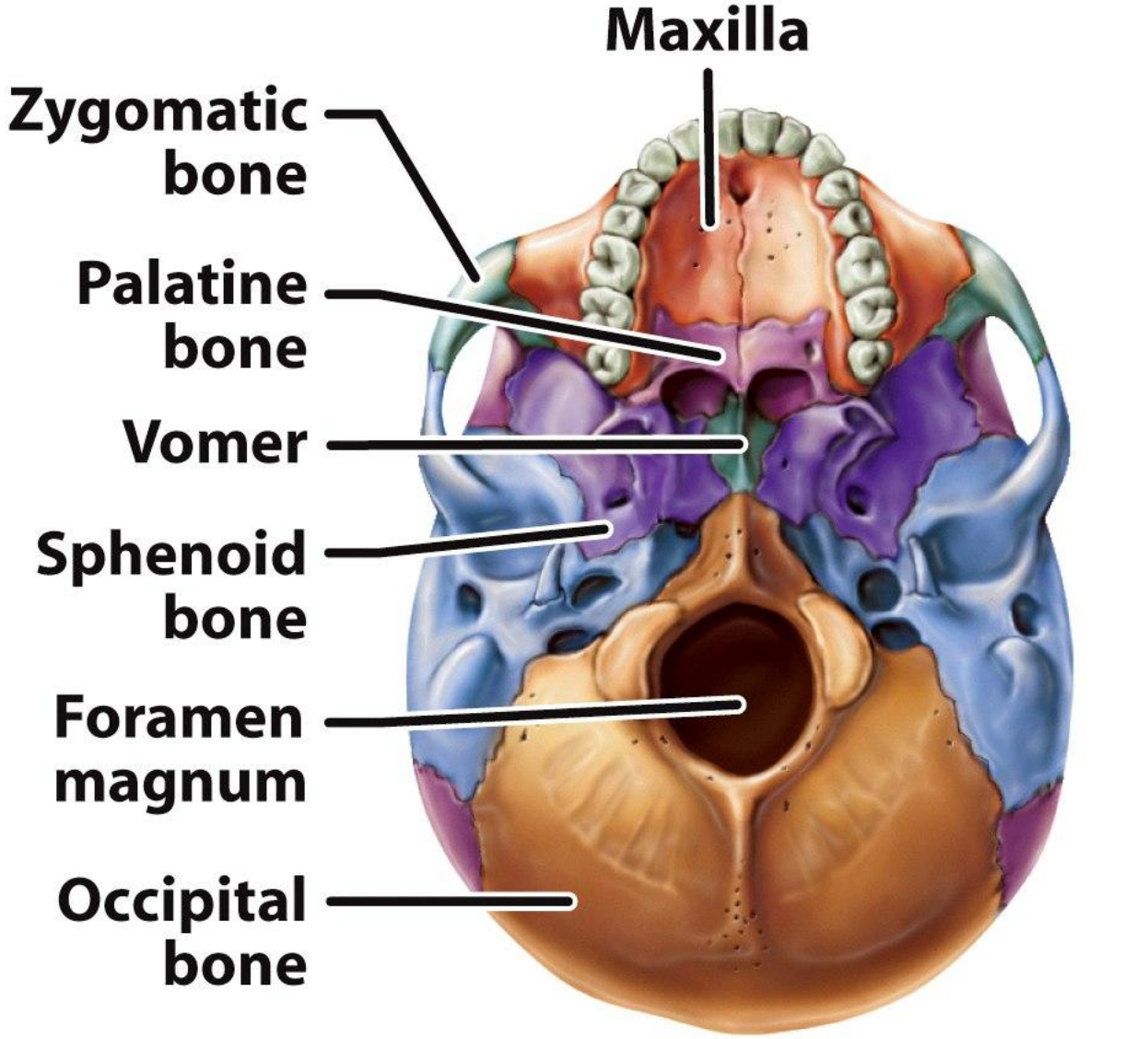
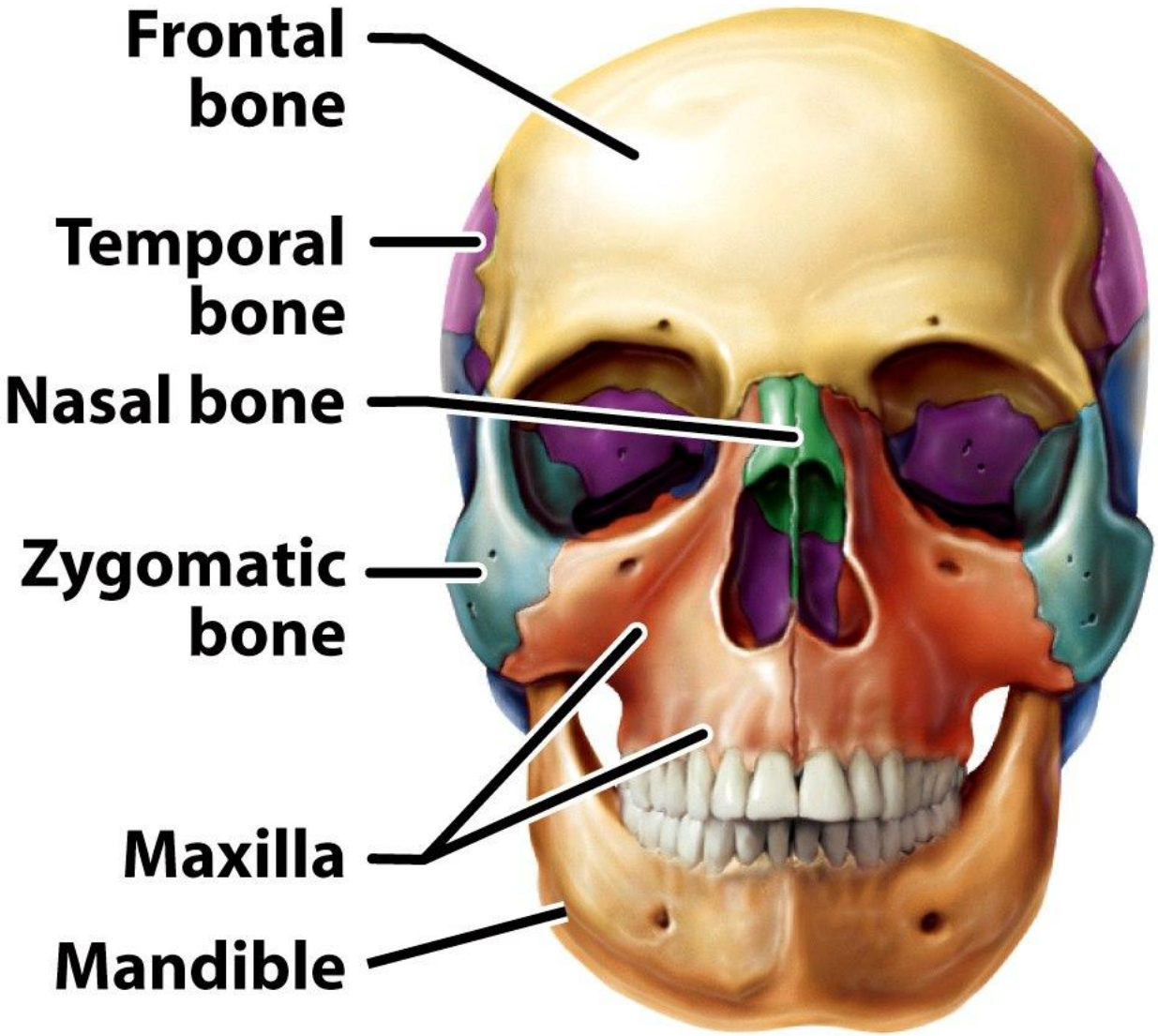


Figure 5-7b Biology of Humans, 2/e



Front view of skull showing facial bones

Figure 5-7c Biology of Humans, 2/e

Figure 5-8 Biology of Humans, 2/e

First Part of the Human Skeleton

- The bones of the vertebral column, called **vertebrae**, are cushioned with **intervertebral disks**

Second Part of the Human Skeleton

- The second part of the human skeleton is the **appendicular skeleton** including the pectoral girdle, the pelvic girdle and the limbs, allows you to move and interact with the environment
- The **pectoral girdle** connects the arms to the rib cage and the **pelvic girdle** connects the legs to the vertebral column

Second Part of the Human Skeleton

- The femur is the largest and strongest bone in the body. The structure of the wrists and hands parallel that of the feet and ankles

Synarthrosis

- **Suture**- a fibrous joint found between bones of the skull
- **Gomphosis**- a fibrous joint in which a cone-shaped peg fits into a socket. Ex: roots of the teeth in the alveoli (socket) of the maxillae and mandible.
- **Synchondrosis**- a cartilaginous joint in which the connecting material is hyaline cartilage. The joint is eventually replaced by bone.
    - Ex,: epiphyseal plate and joints between the rib and the sternum.

Amphiathrosis

- Syndesmosis- (band or ligament joint)-similar to a suture but there is much more fibrous tissue between the bones and the joint is not as tight, which permits some flexibility.
  - Ex: distal joint of the tibia and fibula
- Symphysis- (growing together)-a cartilage joint in which the connecting material is a broad, flat disc of fibrocartilage.
  - Ex: intervertebral joints and the pubic symphysis

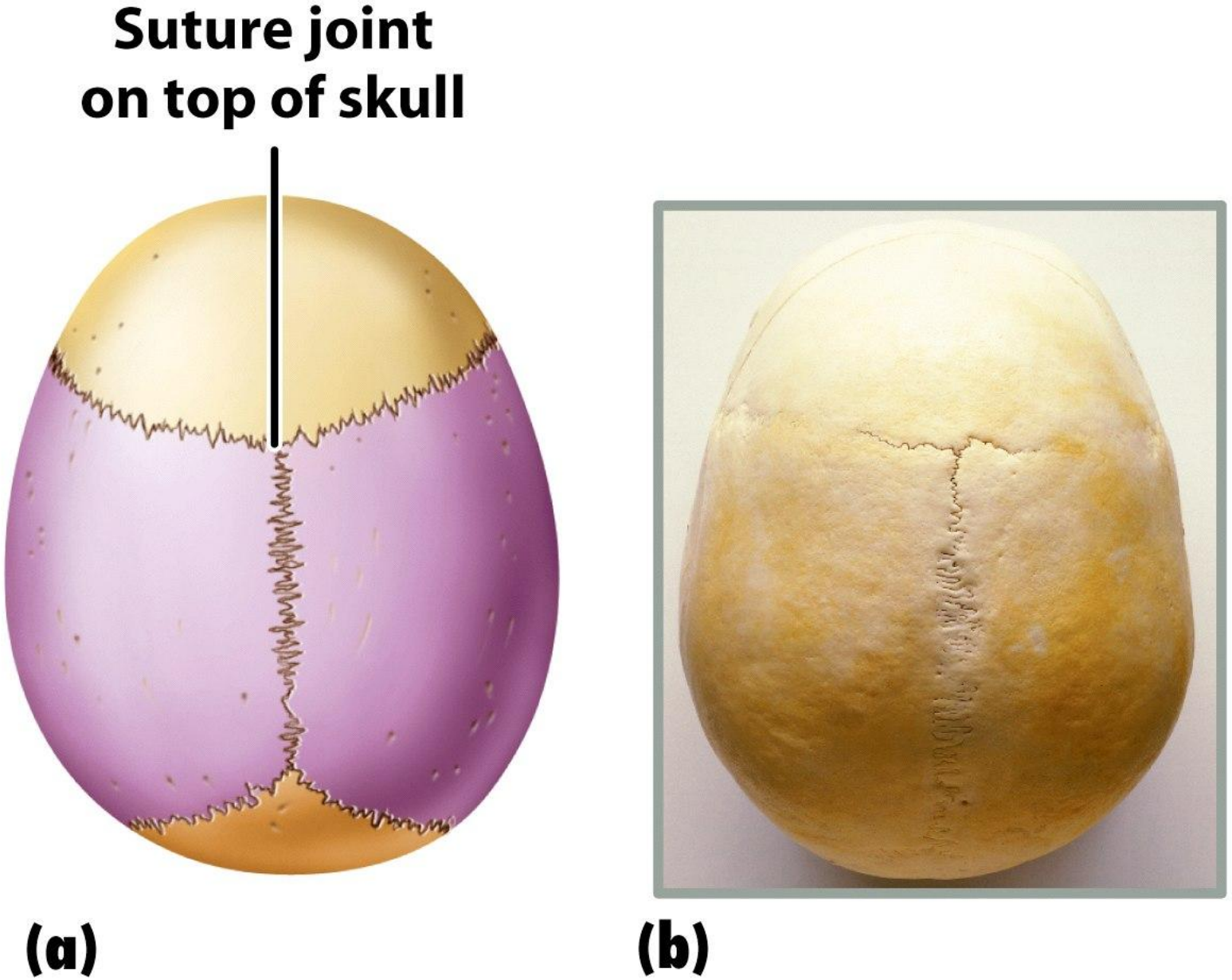


Figure 5-13 Biology of Humans, 2/e

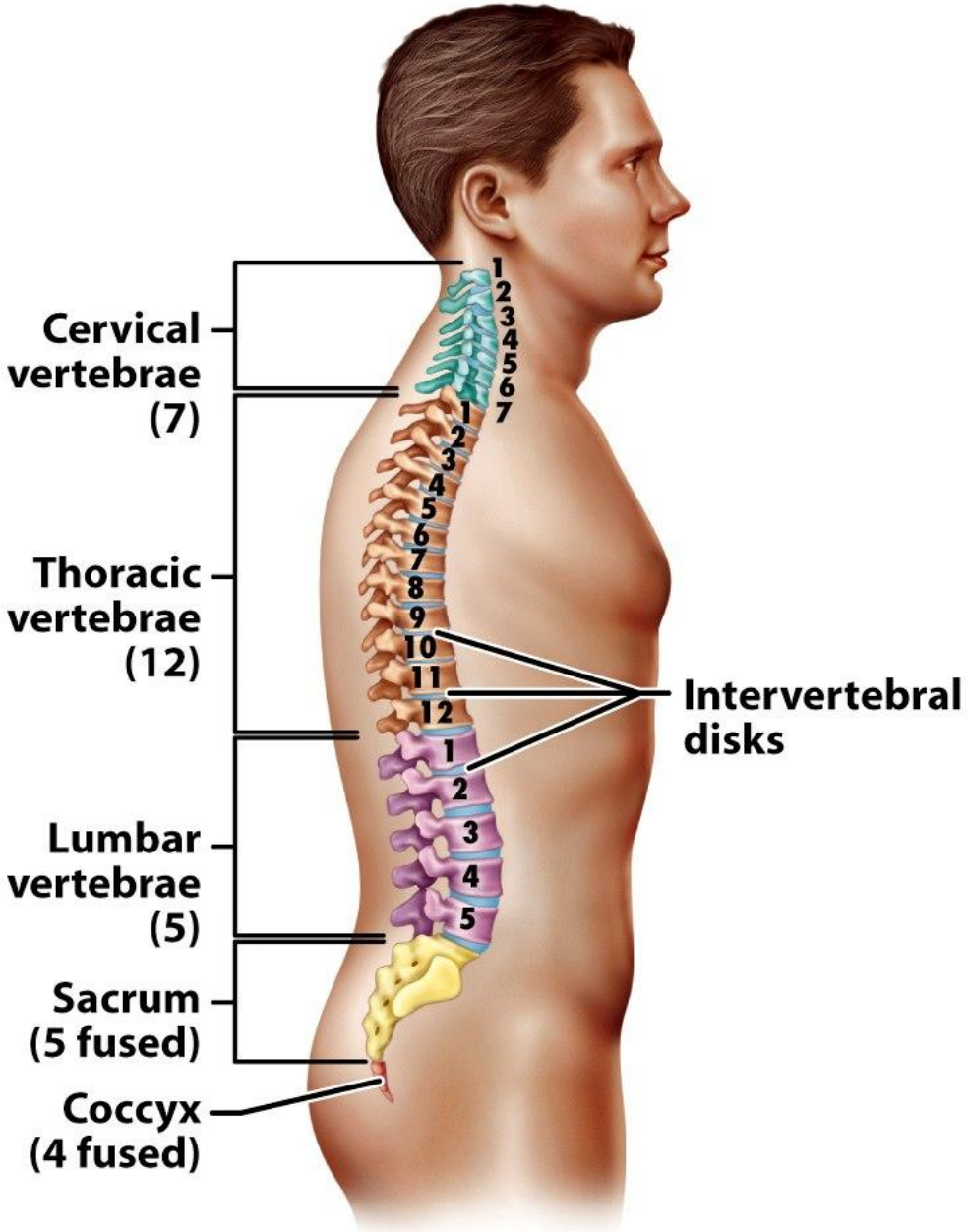
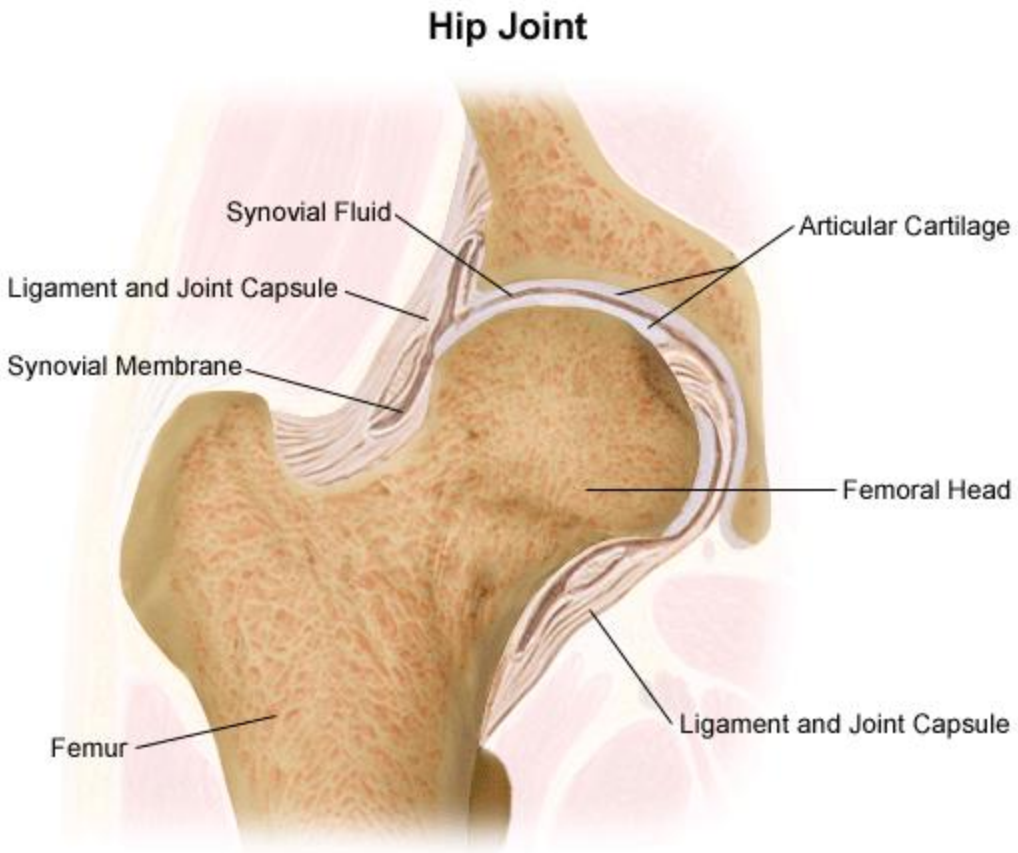


Figure 5-9 Biology of Humans, 2/e

Joints

- **Hinge joints** and **ball-and-socket joints** are so named for the movement they allow



Joints

- **Sprains** are injuries to ligaments
- Bursitis is an inflammation of the **bursae**, the sacks that surround and cushion joints

Joints

- **Arthritis** is joint inflammation
- Osteoarthritis is a degeneration of the surfaces of a joint over time while rheumatoid arthritis is an autoimmune condition marked by an inflammation of the synovial membrane

Figure 5-17 Biology of Humans, 2/e