THE SKELETAL SYSTEM
Functions of the Skeletal System

Support and protection

Body movement

Blood cell formation = hemopoiesis (occurs in bone marrow)

Storage of inorganic materials (salt, calcium, potassium....)
About 206 bones

2 Main Divisions
Axial Skeleton

- Head, neck, trunk
- Skull
- Hyoid Bone
- Vertebral Column
- Thoracic Cage (ribs, 12 pairs)
- Sternum
Hyoid Bone
Appendicular Skeleton

Limbs & Bones that connect to the

**Pectoral Girdle** (scapula, clavicle, arms)
**Pelvic Girdle** (coxal bones, legs)
1. Epiphysis (end)
2. Diaphysis (shaft)
3. Articular Cartilage
   (hyaline cartilage, padding)
4. Periosteum
   (membrane that covers entire bone)
Inside the Long Bone

5. 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
Assignment

- Coloring of a Long Bone
Review the Structure of a Long Bone

Matching quiz at http://www.mhhe.com/biosci/app/holehaap/student/olc2/chap07matching01.html
Microscopic Structure

Bone tissue is called **OSSEOUS** tissue
- the matrix is composed of collagen and inorganic salts

**OSTEOCYTES** - mature bone cells, enclosed in tiny chambers called **LACUNAE**
- these form rings called lamella around a **HAVERSIAN CANAL** which houses blood vessels

**CANALICULI** - tiny canals that link osteocytes

Haversian and Volkmann canals provide passageways for blood vessels
Osteocytes
Haversian Canal
Volkmann’s Canal
lamellae
spongy bone
osteon
blood vessels
periosteum
Haversian Canal
Test Yourself

Find the...

Haversian Canal
Volkman's Canal
Lamellae
Spongy Bone
Compact Bone
BONE DEVELOPMENT & GROWTH

1. Intramembranous bones – flat, skull
2. Endochondral bones – all other

Bones first form as hyaline cartilage. The cartilage then gradually changes into bone tissue - a process called **OSSIFICATION**

PRIMARY OSSIFICATION CENTER (shaft)

SECONDARY OSSIFICATION CENTER (ends)
EPIPHYSEAL DISK (growth plate) is a band of cartilage between the epiphysis and diaphysis. These areas increase bone length as the cells ossify.
OSTEOBLASTS produce cells called osteocytes.
RESORPTION

OSTEOCLASTS - dissolve bone tissue to release minerals, process is called RESORPTION
Bone Growth

1. Formation of bone collar around hyaline cartilage model.
2. Cavitation of the hyaline cartilage within the cartilage model.
3. Invasion of internal cavities by the periosteal bud and spongy bone formation.
4. Formation of the medullary cavity as ossification continues; appearance of secondary ossification centers in the epiphyses in preparation for stage 5.
5. Ossification of the epiphyses; when completed, hyaline cartilage remains only in the epiphyseal plates and articular cartilage.
Bone Growth

* Assignment - Coloring of the Aging Hand
Types of Joints (articulations)

Synarthrotic (not moveable, aka sutures)
  * skull

Amphiarthrotic (slightly movable)
  * vertebrae

Diarthrotic (moveable joint)
  * knees, elbows, wrist, shoulder..etc
  * synovial fluid for lubrication
Types of Synovial Joints

1. Ball and Socket (shoulder / hip)

2. Hinge (elbow, knee)

3. Pivot (lower arm)

4. Saddle (thumb)
BONES OF THE SKULL

1. Frontal -
2. Parietal -
3. Temporal -
4. Occipital -
5. Sphenoid -
6. Ethmoid -
7. Maxilla -
8. Mandible -
9. Zygomatic -
Sphenoid Bone

Names for its shape
- a butterfly!
Sutures - connection points

1. Coronal - between frontal and parietal bones

2. Lambdoidal - between occipital and parietal bones

3. Squamosal - between temporal and parietal bones

4. Sagittal - between parietal bones
Suture - refers to any connection between large bones (in fetal skulls, these are called fontanels)

Fissure - any wide gap between bones
Fontanels are “soft spots” on an infant’s skull.
TOPOGRAPHY OF THE SKULL

Foramen - refers to any opening in the skull, nerves and blood vessels leave this opening to supply the face.
Foramen Magnum

* Assignment: Skull Labeling
1. Coronal Suture
2. Frontal
3. Parietal
4. Nasal
5. Squamosal Suture
6. Ethmoid
7. Lacrimal
8. Sphenoid
9. Lamdoidal Suture
10. Occipital
11. Temporal
12. Zygomatic
13. Maxilla
14. Mandible
Frontal

Coronal Suture

Parietal

Sagittal Suture

Lambdoid Suture
The Rest of the Bones

**Skull:**
- frontal bone
- zygomatic bone
- maxilla
- mandible

**Pectoral girdle:**
- clavicle
- scapula

**Thoracic cage:**
- sternum
- ribs
- costal cartilages

**Pelvic girdle:**
- coxal bones
- sacrum
- coccyx

**Skull:**
- parietal bone
- temporal bone
- occipital bone

**Vertebral column:**
- vertebrae
- clavicle
- scapula
- humerus
- ulna
- radius
- carpals
- metacarpals
- phalanges
- femur
- fibula
- tibia
- metatarsals
- phalanges
Vertebral Column

Cervical (C1-C7)

Thoracic (T1-T12)

Lumbar (L1-L5)

Sacrum and Coccyx
Thoracic Cage → 12 pairs of ribs

**True Ribs** = First seven
**False Ribs** = Next 3 pairs
**Floating Ribs** = Last two pairs
Pectoral Girdle

SCAPULAS (shoulderblade)

CLAVICLES (collarbones)

HUMERUS (arm)
Bones of the Arm

Ulna goes to pinky (P-U)

Radius goes to thumb
**Wrist Bones**

Wrist - 8 small bones called **carpels**

**Metacarpals** (hand)

**Fingers:** **Phalanges**
Name the carpals for *extra credit on test.
How to learn the carpals?

Some Lemurs Try Peanuts That They Can’t Handle
a. Scaphoid  
b. Lunate  
c. Triquetrum  
d. Pisiform  
e. Trapezium  
f. Trapezoid  
g. Capitate  
h. Hamate
Pelvic Girdle

two large COXAL BONES
The **SACRUM** is between coxal bones, **COCCYX** is the tailbone.
Bones of the Leg

- **Upper Leg** - FEMUR
- **Kneecap** - PATELLA
- **Lower Leg** - TIBIA & FIBULA
Bones of the Ankle

Ankle and Upper foot - 7 bones called Tarsals

Large heel bone is the calcaneous

Foot = metatarsals
Toes = phalanges
Assignment – Foot Coloring

- medial cuneiform
- lateral cuneiform
- intermediate cuneiform
- navicular
- cuboid
- talus
- calcaneus
Assignment – Skeleton Labeling
Broken Bones

Closed
Open
Multiple
Comminuted
Greenstick
Spiral
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.

Warning: Next slide is graphic!
Bone Disorders

1. **BONE SPURS**, also known as osteophytes, occur when the body grows small projections on the edges of bones.
2. Plantar fasciitis
- common cause of heel pain.
- inflammation of the plantar fascia
- walking can be painful
3. OSTEOPOROSIS: Increased activity of osteoclasts cause a breakdown of bone, bones become more fragile.

The spongy bone especially becomes more porous.
Causes of Osteoporosis:

1. Lack of exercise
2. Poor diet
3. Genetics
4. Ethnicity
5. Gender
Why do older people break their hips?

A femoral neck fracture is common among older adults and can be related to osteoporosis. This type of fracture may cause a complication because the break usually cuts off the blood supply to the head of the femur.
4. **Rheumatoid arthritis** is an autoimmune disease which causes joint stiffness and bone deformity.

Source: [http://www.thetimes.co.uk/tto/public/article3233439.ece](http://www.thetimes.co.uk/tto/public/article3233439.ece)
5. Rickets

This preventable bone disease affects young children and is caused by a deficiency of the nutrient vitamin D. Rickets causes weak, brittle bones that fracture easily and bone and muscle pain.
6. ABNORMALITIES OF THE SPINE

a) **KYPHOSIS** is a hunchback curve

b) **LORDOSIS** is a swayback in the lower region.
c) ANKYLOSIS is severe arthritis in the spine and the vertebrae fuse.
d) SCOLIOSIS

- Abnormal curve of spine
- Ribs
- Pelvis
- Scoliosis
7. Fibrodysplasia ossificans progressiva (FOP) → soft tissue regrows as bone. Sufferers are slowly imprisoned by their own skeletons.

Munchmeyer disease” or “stone man syndrome”
8. Osteosarcoma

Most common bone cancer, primarily affecting the long bones, particularly those in the knee, hip, or shoulder regions. Most commonly affects teenagers and young adults.
FUN FACTS ABOUT BONES
Bone is made of the same type of minerals as limestone.

- 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 5 mph.