Terminal Learning Objective

- Action: Communicate knowledge of “The Skeletal System”
- Condition: Given a lecture in a classroom environment
- Standard: Received a minimum score of 75% on the written exam IAW course standards

References

- *Essentials of Anatomy and Physiology* (6th edition; 2013; Martini; Bartholomew)
Reason

In addition to supporting the body and providing movement, the Skeletal System plays a major role in homeostasis of the human body.

As a SOCM Medic / Corpsman your knowledge of this system will enhance your patient treatment skills.

Agenda

- Define the medical vocabulary components related to the skeletal system
- Communicate the functions of the skeletal system
- Identify the structures and functions of compact and spongy bone
- Communicate bone growth, development, and variations in the internal structure of specific bones

Agenda

- Communicate the remodeling and repair of the skeleton and homeostatic mechanisms responsible for regulating mineral deposition and turnover
- Identify the components and functions of the axial and appendicular skeletons
- Identify the bones of the skull
Agenda

- Communicate the differences in structure and function of the various vertebrae
- Identify the structural differences between the pectoral and pelvic girdles to their various functional roles
- Identify among different types of joints, and link structural features to joint functions

Agenda

- Identify the dynamic movements of the skeleton and the structure of representative articulations
- Communicate the relationship between joint structure and mobility, using specific examples
- Communicate the functional relationships between the skeletal system and other body systems

The Medical Vocabulary
Components Related to the Skeletal System
Vocabulary Development

- **ab-** from; abduction
- **acetabulum** a vinegar cup; acetabulum of the hip joint
- **ad-** toward, to; adduction
- **amphi-** on both sides; amphiarthrosis
- **arthros** joint; synarthrosis
- **blast** precursor; osteoblast
- **circum-** around; circumduction

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Vocabulary Development

- **clast** break; osteoclast
- **clavius** clavicle; clavicle
- **concha** shell; middle concha
- **corona** crown; coronoid fossa
- **cranio-** skull; cranium
- **cribrum** sieve; cribriform plate
- **dens** tooth; dens
- **dia-** through; diarthrosis

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Vocabulary Development

- **duco** to lead; adduction
- **e-** out; eversion
- **gennan** to produce; osteogenesis
- **gomphosis** a bolting together; gomphosis
- **in-** into; inversion
- **infra-** beneath; infraspinous fossa
- **lacrimeae** tears; lacrimal bones
- **lamella** thin plate; lamellae of bone
Vocabulary Development

- malleolus little hammer; medial malleolus
- meniscus crescent; menisci
- osteon bone; osteocytes
- penia lacking; osteopenia
- planta sole; plantar
- porous porous; osteoporosis
- septum wall; nasal septum
- stylus pillar; styloid process

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Vocabulary Development

- supra- above; supraspinous fossa
- sutura a sewing together; suture
- teres cylindrical; ligamentum teres
- trabecula wall; trabeculae in spongy bone
- trochlea pulley; trochlea
- vertere to turn; inversion

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The Functions of the Skeletal System
The Skeletal System

- Functions of the Skeletal System
  - Support against gravity
  - Storage
    - Mineral reserve – calcium salts maintain normal concentrations of calcium and phosphate ions in body fluids
    - Lipids – yellow lipids = energy reserve
  - Blood cell production
  - Protection of soft internal organs
  - Leverage for muscle action

Check on Learning

- What are the five major functions of the skeletal system?
  A. Protection / Maintain posture and body position / Support soft tissue / Guard entrances and exits / Maintain body temperature.
  B. Support / Storage / Blood production / Protection / Leverage.
  C. Protection / Temperature maintenance / Synthesis and storage of nutrients / Sensory reception / Excretion and secretion.
  D. None of the above.

The Structures and Functions of Compact and Spongy Bone
The Structure of Bone

- Bone (Osseous Tissue)
  - Specialized cells
    - 2% of bone weight
  - Strong flexible matrix
    - Calcium phosphate crystals
      - Two-thirds of bone weight
    - Collagen fibers

Macroscopic Features of Bone
- General shapes of bones
  - Long bones (e.g., humerus)
  - Short bones (e.g., carpal bones)
  - Flat bones (e.g., scapulae)
  - Irregular bones (e.g., vertebra)
The Structure of Bone

• Features in a Long Bone
  - Diaphysis (shaft)
    - Compact (dense) bone
    - Marrow cavity
  - Epiphyses (ends)
    - Spongy (cancellous) bone
    - Articular cartilage
    - Periosteum (covering)
    - Endosteum (lining)

The Structure of Bone

• Microscopic Features of Bone
  - Periosteum
    - Outer fibrous layer
    - Inner cellular layer
  - Osteocytes
    - Within lacunae (holes) in matrix
    - Between lamellae of matrix
    - Branches within canaliculi
The Structure of Bone

- Microscopic Features of Bone
  - Osteon—Basic functional unit of compact bone; columnar in shape
    - Strong in long axis of bone
    - Concentric layers of osteocytes
    - Concentric layers of matrix (lamellae)
  - Central (Haemovarian canal) canal
    - Axial tunnel for blood vessels
  - Perforating canal
    - Radial tunnel for blood vessels
The Structure of Bone

● Microscopic Features of Spongy Bone
  ➢ No osteons
  ➢ Lamellae as *trabeculae*
    • Arches, rods, plates of bone
    • Branching network of bony tissue
    • Strong in many directions
    • Red marrow (blood forming) spaces

The Structure of Bone

● Cells in Bone
  ➢ Osteocytes
    • Mature bone cells between lamellae
  ➢ Osteoclasts
    • Source of acid, enzymes for osteolysis
    • Calcium homeostasis
  ➢ Osteoblasts
    • Responsible for osteogenesis (new bone)
    • Source of collagen, calcium salts

Check on Learning

● Which type of bone is found where stress comes from many directions?
  A. Spongy bone.
  B. Periosteum.
  C. Endosteum.
  D. Compact bone.
Bone Growth, Development, and Variations in the Internal Structure of Specific Bones

Bone Formation and Growth

- Intramembranous Ossification
  - Ossification—Process of converting other tissues to bone
  - Forms flat bones of skull, mandible, clavicle
  - Stem cells differentiate to osteoblasts
  - Produces spongy bone, then compact bone

Bone Formation and Growth
Bone Formation in 16-Week-Old Fetus
Bone Formation and Growth

- Endochondral Ossification
  - Most bones formed this way
  - Cartilage model replaced by bone
  - Replacement begins in middle (diaphysis)
  - Replacement follows in ends (epiphyses)

Step 1
- Chondrocytes at the center of the cartilage model die as the cartilage calcifies.

Step 2
- Necrotic chondrocytes near the diaphysis of bone

Step 3
- Blood vessels penetrate cartilage. New osteoblasts form a primary ossification center.

Step 4
- The bone of the shaft thickens, and the cartilage near each epiphysis is replaced by shafts of bone.

Step 5
- Blood vessels invade the epiphyses and new bone forms secondary centers of ossification.

Cartilage model

Bone formation

Epiphysis

Diaphysis

Marrow cavity

Primary ossification center

Blood vessel

Secondary ossification center

Marrow cavity

Epiphyseal cartilage

Articular cartilage
Enlarging chondrocytes within calcifying matrix

Chondrocytes at the center of the growing cartilage model enlarge and then die as the matrix calcifies.

Newly derived osteoblasts cover the shaft of the cartilage in a thin layer of bone.

Blood vessels penetrate the cartilage. New osteoblasts form a primary ossification center.

The bone of the shaft thickens, and the cartilage near each epiphysis is replaced by shafts of bone.
Bone Formation and Growth

Appositional Bone Growth

- Bone deposited by osteoblasts
- Bone resorbed by osteoclasts

Requirements for Normal Bone Growth

- **Minerals**
  - Calcium, phosphate
- **Vitamins**
  - Vitamin D3
    - Deficiency = Rickets
  - Vitamin C
    - Deficiency = Scurvy
  - Vitamin A
    - Deficiency = Vision Loss
- **Hormones**
  - Growth Hormone
  - Sex hormones, thyroid hormone, others
Check on Learning

- How could an X-ray be used to determine if a person is at his full height?
  A. If the diameter of the diaphysis is greater than the diameter of the proximal and distal epiphysis the person has not reached full height.
  B. If the diameter of the diaphysis is less than the diameter of the proximal and distal epiphysis the person has not reached full height.
  C. If you can still see the epiphyseal plate they have not reached their full height.
  D. None of the above.

The Remodeling and Repair of the Skeleton and Homeostatic Mechanisms Responsible for Regulating Mineral Deposition and Turnover

Bone Remodeling/Homeostasis

- Role of Remodeling in Support
  - Remodeling—Continuous breakdown and reforming of bone tissue
  - Shapes reflect applied loads
  - Mineral turnover enables adapting to new stresses
Bone Remodeling/Homeostasis

Key Note
What you don’t use, you lose. The stresses applied to bones during exercise are essential to maintaining bone strength and bone mass. STRESS IS GOOD!

Bone Remodeling/Homeostasis

- Homeostasis and Mineral Storage
  - Bones store calcium
    - Contain 99% of body calcium
    - Store up to two kg's of calcium
    - Hormones control storage/release
      - PTH, calcitriol release bone calcium
      - Calcitonin stores bone calcium
    - Blood levels kept constant

Bone Remodeling/Homeostasis

- Injury and Repair
  - Fracture—A crack or break in a bone
  - Steps in fracture repair
    - Fracture hematoma
    - Mitoses in periosteum, endosteum
      - Internal callus
      - External callus
    - Bone remodeling
Immediately after the fracture, extensive bleeding occurs. Over a period of several hours, a large blood clot, or fracture hematoma, develops. A swelling initially marks the location of the fracture. Over time, this region will be remodeled, and little evidence of the fracture will remain.

An internal callus forms as a network of spongy bone unites the inner edges, and an external callus of cartilage and bone stabilizes the outer edges. The cartilage of the external callus has been replaced by bone, and struts of spongy bone now unite the broken ends. Fragments of dead bone and the areas of bone closest to the break have been removed and replaced.
Immediately after the fracture, extensive bleeding occurs. Over a period of several hours, a large blood clot, or fracture hematoma, develops.

A swelling initially marks the location of the fracture. Over time, this region will be remodeled, and little evidence of the fracture will remain.

**Aging and the Skeletal System**

- **Osteopenia**—Less than normal ossification (mineral content) in bone
  - Osteopenia starts before age 40
    - Women lose 8% per decade
    - Men lose 3% per decade
  - Spongy bone most affected
    - Epiphyses
    - Vertebrae
    - Jaws
Check on Learning

- How long will healing take in a severely fractured bone?
  A. Two or three weeks.
  B. One month.
  C. Two or three months.
  D. More than a year.

The Components and Functions of the Axial and Appendicular Skeletons

An Overview of the Skeleton

- Bone Markings (Selected)
  - Tuberosity
  - Condyle
  - Trochlea
  - Facet
  - Fossa
  - Foramen
  - Sinus
An Overview of the Skeleton

<table>
<thead>
<tr>
<th>Surface Features of Bones</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinus (cavities within a bone)</strong></td>
</tr>
<tr>
<td><strong>Process</strong></td>
</tr>
<tr>
<td><strong>Head</strong></td>
</tr>
<tr>
<td><strong>Neck</strong></td>
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<tr>
<td><strong>Foot</strong></td>
</tr>
<tr>
<td><strong>Fossa</strong></td>
</tr>
<tr>
<td><strong>Fovea</strong></td>
</tr>
<tr>
<td><strong>Tuberosity</strong></td>
</tr>
</tbody>
</table>

Skeletal Divisions

- **Axial skeleton**
  - Skull
  - Thoracic cage and sternum
  - Vertebral column
- **Appendicular skeleton**
  - Upper, lower limbs
  - Pectoral girdle
  - Pelvic girdle
An Overview of the Skeleton

The Anterior Skeleton

An Overview of the Skeleton

The Posterior Skeleton
Check on Learning

• Which of the following statements about the axial skeleton and appendicular skeleton are true?

A. The sacrum, clavicles and scapula are part of the axial skeleton and the humerus radius and patella are part of the appendicular skeleton.

B. The femur, tibia and fibula are part of the axial skeleton and the sacrum, sternum and coccyx are part of the appendicular skeleton.

C. The patella, tibia and radius are part of the axial skeleton and the sternum, sacrum and the vertebrae are part of the appendicular skeleton.

D. The bones of the cranium, sternum and coccyx are part of the axial skeleton and the clavicles, scapula and the phalanges are part of the appendicular skeleton.

The Bones of the Skull

The Axial Division: The Skull

• Bones of the Cranium
  ➢ Frontal bone
    • Forehead, superior surface of orbits
  ➢ Parietal bones
    • Sides, roof
  ➢ Occipital bone
    • Foramen magnum
  ➢ Temporal bones
    • Sides, base
The Axial Division: The Skull

- Bones of the Cranium (continued)
  - Sphenoid bone
    - Bridge between cranial and facial bones
  - Ethmoid bone
    - Cribriform plate
    - Nasal septum

The Axial Division: The Skull

The Adult Skull (Part I)

- Maxillary bones
- Palatine bones
- The Vomer
- Zygomatic bones
  - Zygomatic arch (with temporal bones)
The Axial Division: The Skull

- Bones of the Face (continued)
  - Nasal bones
  - Lacrimal bones
  - Inferior nasal conchae

The Axial Division: The Skull

- Bones of the Face (continued)
  - Nasal complex
    - Nasal septum
  - Paranasal sinuses
    - Frontal
    - Sphenoidal
    - Ethmoidal
    - Palatine
    - Maxillary
  - Mandible

The Axial Division: The Skull

The Adult Skull (Part II)
The Axial Division: The Skull
Sectional Anatomy of the Skull

The Paranasal Sinuses

The Hyoid Bone
Check on Learning

- The skull is made up of 22 bones, 14 bones of the face and 8 bones of the cranium. Which of the following are bones of the cranium?
  A. Frontal bone / Zygomatic bones / Mandible.
  B. Occipital bone / Temporal bones / Maxillary bones.
  C. Parietal bones / Occipital bones / Sphenoid bone.
  D. Palatine bones / Lacrimal bones / Ethmoid bone.
The Differences in Structure and Function of the Various Vertebrae

Vertebral Column/Thoracic Cage

- Vertebral Column (Spine)
  - 26 Bones
    - 7 Cervical vertebrae (C1 to C7)
    - 12 Thoracic vertebrae (T1 to T12)
    - 5 Lumbar vertebrae (L1 to L5)
    - Sacrum (1-5 fused)
    - Coccyx (tailbone 3-5 fused)

Vertebral Column/Thoracic Cage

- Spinal Curvature
  - Alignment of body weight
  - Primary curves
    - Thoracic
    - Sacral
  - Secondary curves
    - Cervical
    - Lumbar
Vertebral Column/Thoracic Cage

- Vertebral Anatomy
  - Body
  - Arch
    - Transverse, spinous processes
    - Pedicle, lamina
    - Vertebral foramen
      - Vertebral canal
  - Articular processes
    - Articular facets
  - Intervertebral discs

Regional Differences in Vertebrae

- Cervical
  - Oval body
  - Transverse foramina
- Thoracic
  - Heart-shaped body
- Lumbar
  - Massive (heaviest loading)
  - Blade-like transverse processes

- Abnormal distortions of the spinal curvature
  - Kyphosis
  - Lordosis
  - Scoliosis
Vertebral Column/Thoracic Cage

Typical Vertebrae of the Cervical, Thoracic, and Lumbar Regions

Functions of Sacrum

- Protects pelvic organs
- Base articulates with lumbar vertebra
- Apex articulates with coccyx

The Sacrum and Coccyx

- Sacral canal
- Articular process
- Median sacral crest
- Sacral hiatus
- Coccyx

(a) Posterior surface
Components of Thoracic Cage

- Thoracic vertebrae
- Ribs
  - Seven pairs of true ribs
    - Cartilaginous joint with sternum
  - Five pairs of false ribs
- Sternum
  - Manubrium, body, xiphoid process
Vertebral Column/Thoracic Cage

Check on Learning

- The vertebral column is divided into five major regions with four spinal curves. Which of the following statements are correct?
  A. The five major regions are the; Cervical / Thoracic / Lumbar / Sacral / Coccygeal.
  B. The four spinal curves are the; Cervical / Thoracic / Lumbar / Sacral.
  C. The Lumbar vertebra are larger then the cervical vertebra.
  D. All of the above.

The Structural Differences Between the Pectoral and Pelvic Girdles to Their Various Functional Roles
Appendicular Division

- Pectoral Girdle (Shoulder Girdle)
  - Components
    - Scapulae ("shoulder blade")
    - Coracoid process
    - Acromion
    - Scapular spine
  - Clavicles ("collar bone")
  - Functions
    - Shoulder, arm movement
    - Articulation for arm

Appendicular Division

The Clavicle

Appendicular Division

The Scapula
Appendicular Division

- Upper Limb
  - Humerus
    - Head articulates with scapula
    - Muscles attach to:
      - Greater, lesser tubercles
      - Deltoid tuberosity
      - Medial, lateral epicondyles
    - Distal condyle articulates with forearm

Appendicular Division

- Upper Limb Anatomy
  - Distal articulation of humerus
    - Coronoid fossa
    - Olecranon fossa
    - Trochlea

Appendicular Division

The Humerus
Appendicular Division

- Bones of the Forearm
  - Radius
    - Lateral (thumb side)
    - Head articulates with humerus
    - Radial tuberosity attaches biceps brachii
    - Participates in wrist joint
  - Ulna
    - Trochlear notch articulates with humerus
    - Olecranon forms point of elbow

Appendicular Division

The Radius and Ulna

Appendicular Division

- Bones of the Wrist and Hand
  - Two rows of carpal bones
    - Proximal articulation with radius
    - Distal articulation with metacarpal bones
  - Proximal phalanges (finger bones) articulate with metacarpals
    - Three phalanges/finger
    - Two phalanges/thumb (pollex)
Appendicular Division

The Pelvic Girdle
- Formed by two coxae (hip bones)
  - Coxa formed by fusion of:
    - Ilium
    - Ischium
    - Pubis
  - Pubic symphysis limit movement
- Pelvis formed by coxae, sacrum, coccyx
Differences in the Anatomy of the Pelvis in Males and Females

- Males: pelvic outlet relatively narrow
- Females: pelvic outlet relatively broad

90° or less pubic angle for males
100° or more pubic angle for females
Appendicular Division

- Bones of the Lower Limb
  - Femur (thighbone)
  - Patella (kneecap)
  - Tibia (shinbone)
  - Fibula
  - Ankle bones
  - Foot bones

Appendicular Division

The Femur

- Tibial tuberosity
  - Patellar tendon attachment
- Anterior crest
- Medial malleolus

Appendicular Division

- Bones of the Lower Limb
  - Features of the tibia
    - Tibial tuberosity
      - Patellar tendon attachment
    - Anterior crest
    - Medial malleolus
  - Features of the fibula
    - Articulation of head with tibia
    - Lateral malleolus
Appendicular Division
The Right Tibia and Fibula

Appendicular Division
The Bones of the Ankle and Foot
- Ankle
  - Seven tarsal bones
  - Talus
    - Joint with tibia, fibula
- Foot
  - Calcaneus (heel bone)
  - Major load-bearing bone
  - Metatarsal bones
  - Five phalanges (toes)
Check on Learning

- The pelvic and pectoral girdles articulate with the bones of the lower and upper extremities. Which of the following statements are correct?
  A. Each upper limb articulates with the trunk at the pelvic girdle.
  B. The bones of the pectoral girdle are more massive than the bones of the pelvic girdle.
  C. The pelvic girdle is more firmly attached to the axial skeleton.
  D. All of the above.
Articulations

- Classification of Joints (Articulations)
  - Joint—Where two bones interact
  - Three functional classes of joint
    - Synarthroses
      - Immovable
    - Amphiarthroses
      - Slightly movable
    - Diarthroses
      - Freely movable

Articulations

- Examples of Joints
  - Synarthroses
    - Suture – sagittal, lambdoidal, etc
    - Gomphosis – tooth within the alveolus
    - Synchondrosis – epiphysial plate
  - Amphiarthroses
    - Syndesmosis – distal articulation between the tibia and fibula
    - Symphysis – pubic symphysis
  - Diarthroses
    - Synovial joints – shoulder, knee

Articulations

- Synovial Joints (Diarthroses)
  - Epiphyses covered by articular cartilage
  - Lubricated by synovial fluid
  - Enclosed within joint capsule
  - Other synovial structures include:
    - Menisci
    - Bursae
    - Fat pads
    - Ligaments
Check on Learning

- Joints can be classified according to their structure or function. What are the structural classifications of joints?
  A. Synarthroses / Amphiarthroses / Diarthroses.
  B. Fibrous / Cartilaginous / Synovial.
  C. Gliding / Angular motion / Rotation.
  D. All of the above.
The Dynamic Movements of the Skeleton and the Structure of Representative Articulations

Articulations

• Synovial Joints: Movements
  ➢ Flexion
  ➢ Extension
  ➢ Hyperextension
  ➢ Abduction
  ➢ Adduction
  ➢ Circumduction
  ➢ Rotation
  • Pronation, supination

Articulations
Angular Movements

1. Flexion
2. Extension
3. Hyperextension
4. Circumduction
5. Rotation
6. Pronation, supination
Articulations
Rotational Movements

- Foot and ankle
  - Inversion, eversion
  - Dorsiflexion, plantar flexion

- Hand
  - Opposition of thumb, palm

- Head
  - Protraction, retraction
  - Depression, elevation (jaw)
Check on Learning

- Which of the following movements are examples of abduction?
  A. In the frontal plane, swinging the upper limb to the side (away from the body).
  B. In the anterior–posterior plane, bringing the head toward the chest.
  C. Bring the fingers or toes together from a position where they were spread apart.
  D. All of the above.
Articulations

- Structural Classification of Synovial Joints
  - Gliding (e.g., vertebra–vertebra)
  - Hinge (e.g., knee)
  - Pivot (e.g., atlas–axis)
  - Ellipsoidal (e.g., distal radius)
  - Saddle (e.g., thumb)
  - Ball-and-Socket (e.g., hip)
Articulations
Structural Classification of Synovial Joints

(c) Pivot joint

Articulations
Structural Classification of Synovial Joints

(d) Ellipsoidal joint

Articulations
Structural Classification of Synovial Joints

(e) Saddle joint
Articulations
Structural Classification of Synovial Joints

Humerus
Scapula

(f) Ball-and-socket joint

Articulations

Key Note
A joint cannot be both highly mobile and very strong. The greater the mobility, the weaker the joint, because mobile joints rely on support from muscles and ligaments rather than solid bone-to-bone connections.

Articulations

- Intervertebral Articulations
  - Two kinds join adjacent vertebrae
    - Gliding joints
      - Between superior and inferior articular processes
      - Permit small movements
    - Symphysial joints
      - Intervertebral discs composed of fibrocartilage
      - Cushion and connect
Articulations

Intervertebral Articulations

- Outer fibrocartilage layer
- Intervertebral gelatinous core/disc
- Intervertebral foramen
- Posterior ligaments
- Superior articulating process
- Inferior articulating process
- Spinal cord
- Spinal nerve
- Anterior ligament

The Shoulder Joint

- Ball-and-socket design frees movement
  - Humerus head mates with glenoid cavity
- Joint capsule extends from scapular neck to humerus
- Joint dislocates easily
- Bursae reduce friction
  - Bursitis restricts motion, causes pain
Articulations

- The Elbow Joint
  - Two articulations
    - Humerus–radius
    - Humerus–ulna
      - Interlocking hinge design
      - Limited movement
      - Flexion and extension only
      - Strong ligaments

Articulations of the Lower Limb

- Joints of the hip, ankle, and foot
  - Sturdier than corresponding locations in the upper limb
  - Smaller range of motion
    - Knee and elbow range of motion is comparable, but knee is subjected to much greater forces, therefore is less stable
Articulations

- The Hip Joint
  - *Acetabulum* and head of femur
  - Extremely strong, stable joint
    - Many strong ligaments
    - Tough joint capsule
    - Bulky muscles
  - Versatile movements
    - Flexion, extension, adduction, abduction, circumduction, rotation

Articulations

The Hip Joint

![Diagram of the Hip Joint]

- The Knee Joint
  - Complex hinge joint
    - Three separate articulations
      - Femur-tibia (between condyles—lateral and medial)
      - Femur-patella
  - Fibrocartilage pads
    - Medial and lateral menisci
  - Ligaments
    - Cruciate ligaments inside joint
Check on Learning

- The hinge joint of the elbow provides stability but limits movement. Why is the elbow joint extremely stable?
  A. The bony surfaces of the humerus and ulna interlock.
  B. The Joint capsule is very thick.
  C. The capsule is reinforced by ligaments.
  D. All of the above.
The Integumentary System

- Synthesizes vitamin D₃, essential for calcium and phosphorus absorption (bone maintenance and growth)
- Provides structural support

The Muscular System

- Stabilizes bone positions; tension in tendons stimulates bone growth and maintenance
- Provides calcium needed for normal muscle contraction; bones act as levers to produce body movements

The Nervous System

- Regulates bone position by controlling muscle contractions
- Provides calcium for neural function; protects brain, spinal cord; receptors at joints provide information about body position
The Endocrine System
- Skeletal growth regulated by growth hormone, thyroid hormones, and sex hormones; calcium mobilization regulated by parathyroid hormone and calcitonin
- Protects endocrine organs, especially in brain, chest, and pelvic cavity

The Cardiovascular System
- Provides oxygen, nutrients, hormones, blood cells; removes waste products and carbon dioxide
- Provides calcium needed for cardiac muscle contraction, blood cells produced in bone marrow

The Lymphatic System
- Lymphocytes assist in the defense and repair of bone following injuries
- Lymphocytes and other cells of the immune response are produced and stored in bone marrow
The Respiratory System

- Provides oxygen and eliminates carbon dioxide
- Movements of ribs important in breathing; axial skeleton surrounds and protects lungs

The Digestive System

- Provides nutrients, calcium, and phosphate
- Ribs protect portions of liver, stomach, and intestines

The Urinary System

- Conserves calcium and phosphate needed for bone growth; disposes of waste products
- Axial skeleton provides some protection for kidneys and ureters; pelvis protects urinary bladder and proximal urethra
### The Reproductive System

- Sex hormones stimulate growth and maintenance of bones; surge of sex hormones at puberty causes acceleration of growth and closure of epiphyseal cartilages.
- Pelvis protects reproductive organs of female, protects portion of ductus deferens and accessory glands in males.

### Check on Learning

Which of the body systems synthesizes vitamin D₃ essential for calcium and phosphorus absorption necessary for bone growth and maintenance?

A. Endocrine system.
B. Lymphatic system.
C. Integumentary system.
D. Cardiovascular system.

### Questions?
Terminal Learning Objective

- **Action**: Communicate knowledge of “The Skeletal System”
- **Condition**: Given a lecture in a classroom environment
- **Standard**: Received a minimum score of 75% on the written exam IAW course standards

Agenda

- Define the medical vocabulary components related to the skeletal system
- Communicate the functions of the skeletal system
- Identify the structures and functions of compact and spongy bone
- Communicate bone growth, development, and variations in the internal structure of specific bones

Agenda

- Communicate the remodeling and repair of the skeleton and homeostatic mechanisms responsible for regulating mineral deposition and turnover
- Identify the components and functions of the axial and appendicular skeletons
- Identify the bones of the skull
Agenda

- Communicate the differences in structure and function of the various vertebrae
- Identify the structural differences between the pectoral and pelvic girdles to their various functional roles
- Identify among different types of joints, and link structural features to joint functions

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Agenda

- Identify the dynamic movements of the skeleton and the structure of representative articulations
- Communicate the relationship between joint structure and mobility, using specific examples
- Communicate the functional relationships between the skeletal system and other body systems

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Reason

In addition to supporting the body and providing movement, the Skeletal System plays a major role in homeostasis of the human body.

As a SOCM Medic / Corpsman your knowledge of this system will enhance your patient treatment skills.
Break