STRUCTURE AND FUNCTION:

- Made up of the numerous bones of the human body
- Gives support and framework to the body
- Protects vital organs
- Manufactures blood cells
- Storage of calcium and minerals
- Assists in movement

The Skeletal System

Made up of the numerous bones of the human body
Gives support and framework to the body
Protects vital organs
Manufactures blood cells
Storage of calcium and minerals
Assists in movement

Axial Skeleton

The Axial Skeleton makes up the central bony axis of the body and is composed of:
- the skull
- hyoid bone
- sternum
- ribs
- vertebral column
- sacrum
- coccyx
Just as the name suggests, the appendicular skeleton is composed of the appendages or extremities:

- This includes the supporting structures

**Joints**

- A "connection" between 2 or more bones
- A pivot point for bony motion
- The “features” of the joint help determine
  - The ROM
  - Degrees of freedom
  - Functional potential of the joint

ANATOMY & FUNCTION

BONE
Composition of Bone

1/3 organic (living) material
- Gives bone elasticity
2/3 inorganic (nonliving) material
- Provides strength and hardness

Primary Types of Tissue

- Cortical (compact) – outmost portions of bone
  - Strong
  - Dense
  - Absorptive (forces)
- Cancellous (spongy) – inner portions of bone
  - Porous
  - Lightens the bone
  - Redistributions forces & is covered by articular cartilage

Structural Features of Bone

- Diaphysis
- metaphysis
- Epiphyses (2)
  - Proximal
  - Distal
- Articular cartilage
  - hyaline cartilage
- Periosteum
- Medullary canal
- Endosteum
Five categories
- Long
- Sesamoid
- Irregular
- Flat
- Short

Synarthrosis
Allows little to no movement
Sutures in the skull
Distal tibiofibular joint

Amphiarthrosis
- Formed by fibro and hyaline cartilage
- Shock absorbers
- Allows limited motion
Joint Classifications

Diarthrosis (Synovial Joints)
- Contains fluid-filled cavity between 2 or more bones
- There are 7 categories with 7 common elements!

<table>
<thead>
<tr>
<th>What</th>
<th>Why</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synovial fluid-</td>
<td>for joint lubrication &amp; nutrition</td>
</tr>
<tr>
<td>Articular cartilage-</td>
<td>to spread out and absorb forces</td>
</tr>
<tr>
<td>Articular capsule-</td>
<td>to contain the joint</td>
</tr>
<tr>
<td>Synovial membrane-</td>
<td>produce the fluid for the joint</td>
</tr>
<tr>
<td>Capsular ligaments-</td>
<td>to limit excessive joint motion</td>
</tr>
<tr>
<td>Blood vessels-</td>
<td>to provide nutrients, permit healing to occur!</td>
</tr>
<tr>
<td>Sensory nerves-</td>
<td>transmit pain and awareness of position</td>
</tr>
</tbody>
</table>

The structure of the joint determines the functional potential for the joint. Most of the names intentionally resemble functional structures!

Hinge
Pivot
Ellipsoid
Ball-and-Socket

Condylar
Saddle
Plane

Hinge Joint

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Motions</td>
<td>Flexion and extension</td>
</tr>
<tr>
<td>Mechanical Analogy</td>
<td>Door hinge</td>
</tr>
<tr>
<td>Anatomic Examples</td>
<td>Humero-ulnar joint, interphalangeal joints</td>
</tr>
</tbody>
</table>
### Pivot Joint

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Motions</td>
<td>Spinning one member on an axis</td>
</tr>
<tr>
<td>Mechanical Analogy</td>
<td>Door knob</td>
</tr>
<tr>
<td>Anatomic Examples</td>
<td>Proximal radioulnar joint</td>
</tr>
</tbody>
</table>

### Ellipsoid Joint

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Motions</td>
<td>Flex &amp; Ext, ABD &amp; ADD</td>
</tr>
<tr>
<td>Mechanical Analogy</td>
<td>Flattened convex with concave trough</td>
</tr>
<tr>
<td>Anatomic Examples</td>
<td>Radiocarpal joint</td>
</tr>
</tbody>
</table>

### Ball & Socket Joint

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Motions</td>
<td>Flex &amp; Ext, ABD &amp; ADD, IR &amp; ER</td>
</tr>
<tr>
<td>Mechanical Analogy</td>
<td>Spherical convex surface &amp; concave cup</td>
</tr>
<tr>
<td>Anatomic Examples</td>
<td>Glenohumoral joint and hip</td>
</tr>
</tbody>
</table>
### Plane Joints

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Motions</td>
<td>Slide &amp;/or rotation</td>
</tr>
<tr>
<td>Mechanical Analogy</td>
<td>Book sliding or spinning on a table</td>
</tr>
<tr>
<td>Anatomic Examples</td>
<td>Intercarpal joints, intarsal joints</td>
</tr>
</tbody>
</table>

### Saddle Joints

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Motions</td>
<td>Biplanar, excluding spin</td>
</tr>
<tr>
<td>Mechanical Analogy</td>
<td>Horseback rider on a saddle</td>
</tr>
<tr>
<td>Anatomic Examples</td>
<td>CMC joint of the thumb, Sternoclavicular joint</td>
</tr>
</tbody>
</table>

### Condyloid Joint

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Motions</td>
<td>Biplanar Motion</td>
</tr>
<tr>
<td>Mechanical Analogy</td>
<td>Spherical convex surface &amp; concave cup</td>
</tr>
<tr>
<td>Anatomic Example</td>
<td>Tibiofemoral joint, MCP joint</td>
</tr>
</tbody>
</table>
All connective tissues that support the joints of the body are composed of:
- Fibers
  - These are 3 types of fibers
    - Type I collagen
      - Thick and resist stretching
      - Ligaments, tendons & fibrous capsules
    - Type II collagen
      - Thinner and less stiff
      - Provide a flexible framework to maintain the shape & consistency of the structures such as hyaline cartilage
    - Elastin
      - Elastic and help prevent injury due to ability to "give" and not break

- Ground substance
  - Collagen & elastin within a water saturated matrix
- Cells
  - Responsible for maintenance & repair
**Connective Tissue: Joint “support”**

Ground substance
- Disperses repetitive forces
  - Water
  - Glycosaminoglycans
  - Solutes

Cells – “cytes”
Cells for maintenance and repair.
- Blastocyes
- Phagocytes

Why do bones need maintenance & repair?

**Types of Connective Tissue in Joints**
- Dense Irregular Connective Tissue
  - Binds bones together
  - Makes up ligaments & external joint capsule
  - Type I collagen

Injuries
- Ruptured Lateral Collateral ligaments in the ankle, instability in the talocrural ligament

**Articular Cartilage**
- Resists compressive and shear forces in articular surfaces
- Covers the ends of articulating surfaces of bones in synovial joints
- High % type II collagen content which helps to anchor the cartilage to the bone

Injuries
- Wear & tear decreases it’s effectiveness in reducing compression leading to OA and joint pain & inflammation.
Fibrocartilage
- Provides support & stabilization to joints, resists compression & shear forces
- Makes up the intervertebral discs and menisci of the knees
- Multidirectional bundles of type I collagen

Injuries
- Tearing can cause disruption of the integrity of the structure and pain with loss of function

Bone
- Forms primary supporting structure of the body & a rigid level to transmit the force of muscle to move & stabilize the body
- Forms internal levers of musculoskeletal system
- Specialized arrangement of Type I collagen & framework for hard mineral salts

Injuries
- Osteoporosis

Types of Connective Tissue in Joints

1. Dense irregular (attachment points)
   a. Ligaments
   b. Joint capsule
2. Articular cartilage (ease of movement)
   a. Covering at the end of bones of synovial joints
3. Fibrocartilage (the shock absorbers)
   a. Menisci pleural of "meniscus"
   b. Intervertebral discs
4. Bone – (the levers in the musculoskeletal system)
Why are there different types of joints?
What are the advantages of some of the structures and potential disadvantages?
What purpose do joint structures serve and what happens when they become injured?
What is connective tissue and what purpose does it serve?