**Chapter 4: Tissues**

**Tissues: The Living Fabric**

Tissue: A group of cells similar in structure; designed to perform a specialized function

### Primary Tissue Types:

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Cells:</th>
<th>Extracellular Matrix:</th>
<th>Function:</th>
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**Epithelial Tissue:**

1) **Epithelia:**
   - Cell layers covering internal / external surfaces
   - Functions:
     - Provide physical protection (e.g., skin)
     - Control permeability (e.g., blood vessels)
     - Provide sensation (e.g., eye – neuroepithelium)

   **Characteristics:**
   - High degree of cellularity

**Intracellular Connections:**

- **Tight Junction**
  - Impermeable junction (e.g., bladder)
- **Desmosome**
  - Anchoring junction (e.g., skin)
- **Gap Junction**
  - Communication junction (e.g., heart)

**Cell Adhesion Molecules (CAMs):**

- Transmembrane “sticky” proteins

**Epithelial Tissue:**

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   **Classification:**
   - Number of cell layers + cell shape = epithelium type
     - Simple
     - Stratified
     - Squamous
     - Cuboidal
     - Columnar

   **Characteristics:**
   - High degree of cellularity
   - Polarity (apical vs. basal surfaces)
   - Ciliated epithelium (e.g., bronchi)
   - Attachment (basement membrane)
   - Epithelia → connective tissue
   - Avascularity (no blood vessels)
   - Regenerative
   - Germinative cells (stem cells)

**Simple squamous epithelium**

- Absorption / secretion
  - Lining body cavities (mesothelium)
  - Lining blood vessels (endothelium)

**Stratified squamous epithelium**

- Physical protection
  - Surface of skin
  - Lining external openings
Epithelial Tissue:

2) Glandular epithelia:
   - Specialized epithelial cells for secretion:
     - Exocrine Glands: Release secretions to external environment (ducted)
     - Endocrine Glands: Release secretions to interstitial fluids (ductless)

1) Mode of Secretion
   - Merocrine Secretion
     - Product released via exocytosis
   - Holocrine Secretion
     - Product released via destruction of cell

2) Types of Secretions:
   - Serous Glands (water / enzymes)
   - Mucus Glands (mucins)
   - Mixed Glands

Epithelial Tissue:

2) Glandular:
   - Methods for classifying exocrine glands:
     3) Gland Structure
       - Uncellular Glands: Composed of individual secretory cells
         - e.g., Goblet cells (secrete mucus – respiratory / digestive system)
       - Multicellular Glands
         - Named by: 1) Duct structure (simple vs. compound)
         - Duct shape (tubule / alveolar / tubuloalveolar)
         - Duct / secretory region relationship (e.g., branched)

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**Connective Tissue:**
- Located throughout body (never exposed to outside environment)
- Primary functions:
  1. Structural framework for body
  2. Transport fluids / dissolved materials
  3. Protect delicate organs
  4. Insulate body

**Types of Connective Tissue:**

1. **Connective Tissue Proper**
   - A) **Mesenchyme**
     - Embryonic connective tissue
     - Star-shaped stem cells; fine fibers
   - B) **Loose Connective Tissue**
     - “Packing material” of body (fill space / cushion / stabilize / support)

2. **Areolar Tissue**
   - Least specialized CT in adults
   - Open framework; fiber network
   - Absorbs shock
   - Distort w/o damage; resilient
   - Fluid reservoir
   - Highly vascularized
   - Attaches epithelia to deeper structures

3. **Reticular Tissue**
   - Reticular fibers form complex 3-D structure (stroma)
   - Supports functional cells (parenchyma) of the organ
   - Located in liver / spleen / lymph nodes / bone marrow

4. **Dense Connective Tissue**
   - Dense Regular Connective Tissue
     - Collagen fibers run parallel to each other
     - Pack tightly; align with forces applied
     - Tendons attach muscle to bone (tendon pulley)
     - Ligaments attach bone to bone; stabilize position of internal organs
     - Aponeuroses tendon sheet; attaches muscle to bone

5. **Adipose Tissue**
   - Composed primarily of adipocytes
   - Provides padding, absorbs shock, insulates “fiber” around structures
   - Metabolically active; incapable of dividing but mesenchyme cells...
     - White fat (majority)
     - Brown fat (higher supply / mitochondria)
     - Thermogenesis (inhibits)

**Fiber types:**
- **Collagen**: Thick bundles; provide high tensile strength
- **Elastic**: Branched / wavy; allow for stretch (contain elastin)
- **Reticular**: Form fine framework; allow for cell attachment

**Cell types:**
- **Fibroblasts / Fibrocytes**: Produce / maintain fibers & ground substance
- **Macrophages / Microphages**: Defense cells; engulf foreign molecules
- **Adipocytes**: Store lipid droplets
- **Mast cells**: Stimulate inflammation response (te cells)

**Matrix**
- “Packing material” of body
- Star-shaped stem cells; fine fibers
- Syrupy matrix: (majority)

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Types of Connective Tissue:

1) **Connective Tissue Proper:** (Syrupy matrix)
   - **A) Mesenchyme:**
     - Embryonic connective tissue
     - Star-shaped stem cells; fine fibers
   - **B) Loose Connective Tissue:**
     - “Packing material” of body (space / cushion / stabilize / support)
   - **C) Dense Connective Tissue:**
     - Offer strength & support; occupied primarily by collagen fibers

Dense Irregular Connective Tissue

- Located underlying skin / around bones (periosteum) / around organs (capsules)

Dense Connective Tissue

- Collagen fibers run random to each other
- Support stress from many directions
- Contains variable amounts of elastic fibers

Located underlying skin / around bones (periosteum) / around organs (capsules)

Types of Connective Tissue:

2) **Blood:** (Watery matrix)

- Transports materials through body

3) **Cartilage:** (Gel-like matrix)

- Provides strong framework for supporting body
- Composition:
  - Matrix = firm gel; contain [T] chondroitin sulfates (polysaccharide derivatives)
  - Complex with proteoglycans in ground substance
  - Protein cores with glycosaminoglycans attached (carbohydrate chains)
  - Chondrocytes: Only cell in mature cartilage; sit in lacunae
  - Avascular (release antiangiogenesis factor)

Types of cartilage:

- **Hyaline Cartilage** (most common)
  - Stiff / flexible support
  - Resilient / flexible support
  - Dense / firm gel; contain [T] chondroitin sulfates
  - Durable / tough
  - Resist compression / absorb shock

- **Elastic Cartilage**
  - Resilient / flexible support
  - Pinna of ear / epiglottis

- **Fibrocartilage**
  - Durable / tough
  - Resist compression / absorb shock

Types of Connective Tissue:

4) **Bone** (Chapter 6)

- Intervertebral Disks
- Meniscus (knee joint)

Primary Tissue Types:

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  - Aggregated polyhedral cells
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  - Variable fixed / wandering cells
  - Abundant
  - Support and protection

- **Muscle** (Chapter 9)
  - Elongated contractile cells
  - Moderate
  - Movement

- **Nervous** (Chapter 11)
  - Interwining elongated processes
  - None
  - Transmission of electrical impulses

Types of Connective Tissue:

- **Bone:** (Chapter 6)

Tissue Repair:

- **Mechanisms of Repair:**
  1) **Regeneration:** Replacement of destroyed tissue with same tissue type
  2) **Fibrosis:** Replacement of tissue with fibrous connective tissue (i.e., scar)

- **Step 1:** Inflammation
  - Injury triggers chemical release
  - Clot forms (platelet plugs)
  - Scal = dried outer surface

- **Step 2:** Organization
  - Blood clot → granulation tissue
  - Fragile capillary beds
  - Fibroblasts (collagen fibers)
  - Macrophages ‘eat’ cell debris

- **Step 3:** Permanent Repair
  - Granulation tissue matures
  - Contraction occurs
  - Remains as fibrosed area
  - Epithelium regenerates / thicken