Connective Tissues

- Connect epithelium to the rest of the body (**basal lamina**)
- Provide structure (bone)
- Store energy (fat)
- Transport materials (blood)
- Have no contact with environment

Connective Tissues

- Characteristics of Connective Tissues
  - Specialized cells
  - Solid extracellular **protein fibers**
  - Fluid extracellular **ground substance**

  } **Matrix**
- The extracellular components of connective tissues (fibers and ground substance) make up **the matrix**
  - Majority of tissue volume
  - Determines specialized function

Connective Tissues

- **Ground Substance**
  - Is clear, colorless, and viscous
  - Fills spaces between cells and slows pathogen movement

Connective Tissues

- Classification of Connective Tissues
  - **Connective tissue proper**
    - Connect and protect
  - **Fluid connective tissues**
    - Transport
  - **Supportive connective tissues**
    - Structural strength

Connective Tissues

- Categories of Connective Tissue Proper
  - **Loose connective tissue**
    - More ground substance, less fibers
    - For example, fat (adipose tissue)
  - **Dense connective tissue**
    - More fibers, less ground substance
    - For example, tendons

Connective Tissues

- Connective Tissue Fibers
  - **Collagen fibers**
    - Most common fibers in connective tissue proper
    - Long, straight, and unbranched
    - Strong and flexible
    - Resist force in one direction
    - For example, **tendons** and **ligaments**

Connective Tissues

- Connective Tissue Fibers
  - **Reticular fibers**
    - Network of interwoven fibers (stroma)
    - Strong and flexible
    - Resist force in many directions
    - Stabilize functional cells (parenchyma) and structures
    - For example, sheaths around organs

Connective Tissues

- Connective Tissue Fibers
  - **Elastic fibers**
    - Contain **elastin**
    - Branched and wavy
    - Return to original length after stretching
    - For example, **elastic ligaments** of vertebrae

Connective Tissues

- Loose Connective Tissues
  - The packing materials of the body
  - Three types in adults
    - **Areolar**
    - **Adipose**
    - **Reticular**

Connective Tissues

- Areolar Tissue
  - Least specialized
  - Open framework
  - Viscous ground substance
  - **Elastic fibers**
  - Holds blood vessels and capillary beds
    - For example, under skin (subcutaneous layer)

Connective Tissues

- Adipose Tissue
  - Contains many **adipocytes** (fat cells)
  - Types of adipose tissue
    - **White fat**:
      - most common
      - stores fat
      - absorbs shocks
      - slows heat loss (insulation)
    - **Brown fat**:
      - more vascularized
      - adipocytes have many mitochondria
      - when stimulated by nervous system, fat break down accelerates, releasing energy
      - absorbs energy from surrounding tissues

Connective Tissues

- Adipose Tissue
  - Adipose cells
    - **Adipocytes** in adults do not divide:
      - expand to store fat
      - shrink as fats are released

Connective Tissues

- **Reticular Tissue**
  - Provides support
  - Complex, three-dimensional network
  - Supportive fibers (**stroma**)
    - Support functional cells (**parenchyma**)
  - Reticular organs
    - Spleen, liver, lymph nodes, and bone marrow

Connective Tissues

- Dense Connective Tissues
  - Connective tissues proper, tightly packed with high numbers of collagen or elastic fibers
    - **Dense regular connective tissue**
    - **Dense irregular connective tissue**
    - **Elastic tissue**

Connective Tissues

- Dense Regular Connective Tissue
  - Tightly packed, parallel collagen fibers
    - **Tendons** attach muscles to bones
    - **Ligaments** connect bone to bone and stabilize organs
    - **Aponeuroses** attach in sheets to large, flat muscles

Connective Tissues

- Dense Irregular Connective Tissue
  - Interwoven networks of collagen fibers
    - Layered in skin
    - Around cartilages (**perichondrium**)
    - Around bones (**periosteum**)
    - Form capsules around some organs (e.g., liver, kidneys)

Connective Tissues

- Elastic Tissue
  - Made of elastic fibers
    - For example, elastic ligaments of spinal vertebrae

Connective Tissues

- Fluid Connective Tissues
  - Blood and lymph
  - Watery matrix of dissolved proteins
  - Carry specific cell types (**formed elements**)
    - Formed elements of blood
      - red blood cells (**erythrocytes**)
      - white blood cells (**leukocytes**)
      - **platelets**

Connective Tissues

- Fluid Elements of Fluid Connective Tissues
  - Extracellular
    - **Plasma**
    - **Interstitial fluid**
    - **Lymph**

Connective Tissues

- **Lymph**
  - Extracellular fluid
    - Collected from *interstitial space*
    - Monitored by *immune system*
    - Transported by lymphoid (*lymphatic) system*
    - Returned to *venous system*

Connective Tissues

- Fluid Tissue Transport Systems
  - Cardiovascular system (blood)
    - Arteries
    - Capillaries
    - Veins
  - Lymphoid (lymphatic) system (lymph)
    - Lymphatic vessels

Supportive Connective Tissues

- Support soft tissues and body weight
  - **Cartilage**
    - Gel-type ground substance
    - For shock absorption and protection
  - **Bone**
    - **Calcified** (made rigid by calcium salts, minerals)
    - For weight support

Supportive Connective Tissues

- Cartilage Matrix
  - Proteoglycans derived from chondroitin sulfates
  - Ground substance proteins
- **Chondrocytes** (cartilage cells) surrounded by lacunae (chambers)

Supportive Connective Tissues

- Cartilage Structure
  - No blood vessels:
    - Chondrocytes produce antiangiogenesis factor
  - **Perichondrium**:
    - Outer, fibrous layer (for strength)
    - Inner, cellular layer (for growth and maintenance)

Supportive Connective Tissues

- Types of Cartilage
  - **Hyaline cartilage**
    - Stiff, flexible support
    - Reduces friction between bones
    - Found in synovial joints, rib tips, sternum, and trachea
  - **Elastic cartilage**
    - Supportive but bends easily
    - Found in external ear and epiglottis
  - **Fibrous cartilage (fibrocartilage)**
    - Limits movement
    - Prevents bone-to-bone contact
    - Pads knee joints
    - Found between pubic bones and intervertebral discs

Supportive Connective Tissues

- **Bone** or **osseous tissue**
  - Strong (**calcified**: calcium salt deposits)
  - Resists shattering (flexible collagen fibers)
- Bone cells or **osteocytes**
  - Arranged around **central canals** within matrix
  - Small channels through matrix (**canaliculi**) access blood supply
- **Periosteum**
  - Covers bone surfaces
  - Fibrous layer
  - Cellular layer