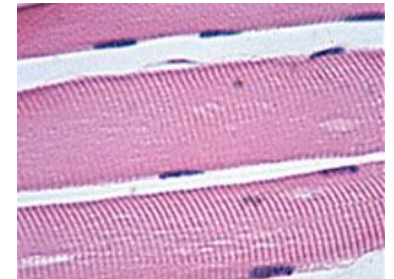
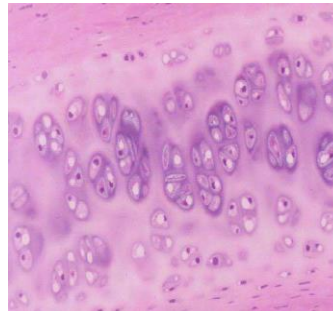
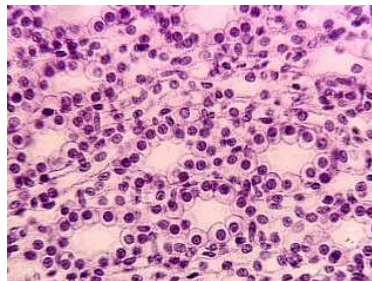
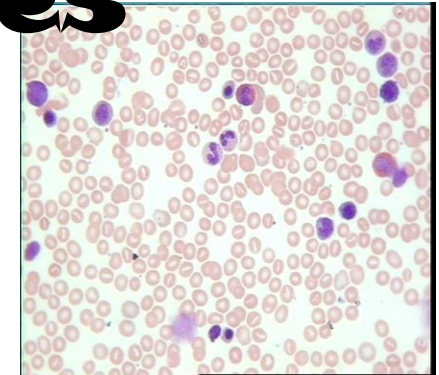
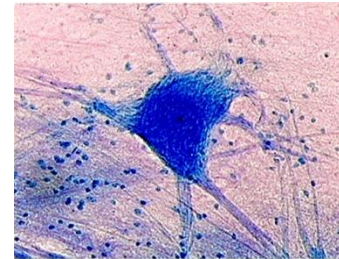
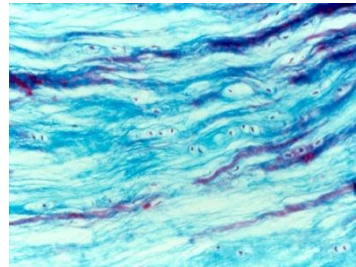
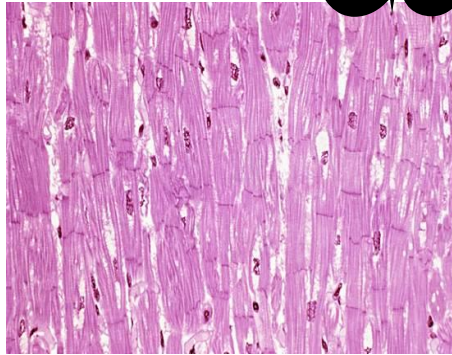


Chapter 4 - Connective Tissues



Connective Tissue

- Functions
 - Binding and support
 - Protection
 - Insulation
 - Transportation

Connective Tissue - Characteristics

- Common Origin
 - All arise from the mesenchyme (embryonic tissue)
- Degrees of vascularity
 - Supply of blood vessels – vascularized to poorly vascularized.
- Extracellular matrix
 - All other tissues are composed of cells. CT is composed mainly of the nonliving extracellular matrix which separates the living cells of the tissue. This allows it to bear weight, withstand tension, physical trauma, etc.

Connective Tissue

- Structural elements
 - Ground Substance (matrix)
 - Fibers (matrix)
 - Cells

Connective Tissue

- Ground Substance
 - Fills the space between the cells and contains the fibers.
 - Composed:
 - Interstitial fluid
 - Cell adhesion proteins
 - Glue to allow cells to attach themselves to matrix elements
 - Proteoglycans
 - Glycosaminoglycans (GAGs) attach and trap water to form anything from a fluid to a viscous gel – more GAGs, more viscous.

Connective Tissue - Fibers

- Provide support
- Types of fibers
 - Collagen fibers
 - “white fibers” → has a white appearance
 - Very strong → stronger than steel fibers!
 - Found in tendons and ligaments
 - Elastic fibers
 - “yellow fibers” → has a yellow appearance
 - Able to stretch (protein elastin) – allows tissue to return to normal length and shape
 - Reticular fibers
 - Short, fine, collagenous fibers and are continuous with collagen fibers.
 - Reticul → network
 - Often seen where connective tissue connects with other tissues → forms a fuzzy “net” that allows more “give”

Connective Tissue - Cells

- Each major class of c.t. has a fundamental cell.
 - Undifferentiated cells, indicated by *-blast* (“bud” “forming”)
 - **Fibroblast** – Connective tissue proper
 - **Chondroblast** – Cartilage
 - **Osteoblast** – Bone
 - **Hematopoietic** stem cell - Blood
 - Actively mitotic cells!!

Connective Tissue - Cells

- Once the *-blast* cells synthesize the matrix, they assume their less active, mature mode, indicated by *-cyte* (*fibrocyte, osteocyte....*)
- These cells maintain the health of the matrix!
- If matrix is injured → can revert back to *-blast*.

Connective Tissue - Cells

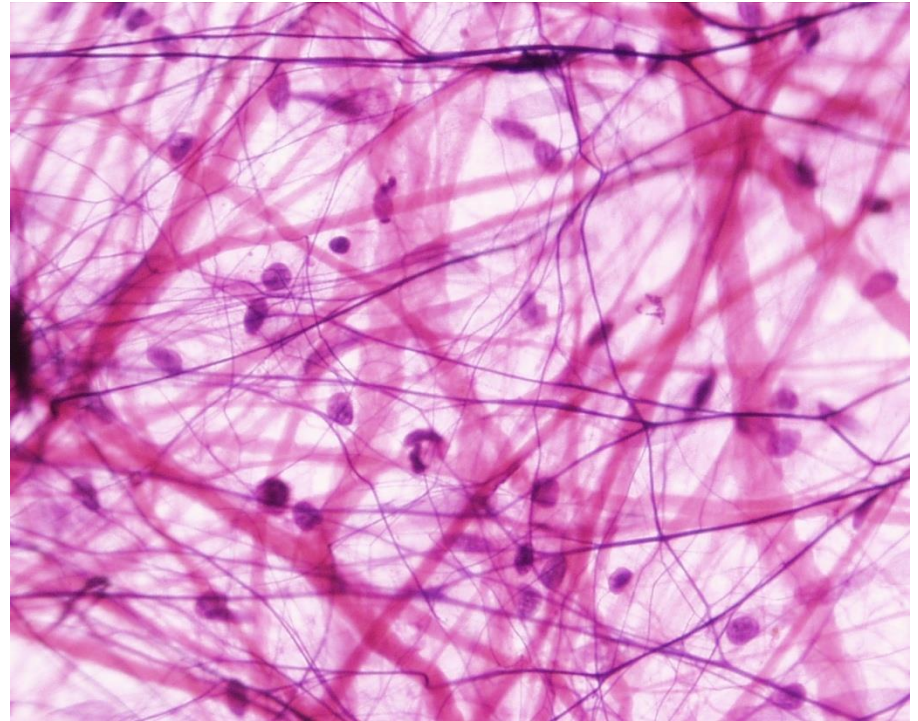
- Other cells found within C.T.
 - White blood cells – defensive (neutrophils, eosinophils, lymphocytes)
 - Plasma cells – produces antibodies
 - Mast cells – oval, typically cluster along blood vessel walls. Detect foreign substances and initiate inflammatory response
 - Macrophages – large, irregularly shaped cells that phagocytize foreign materials. Found throughout loose C.T., bone marrow, and lymphatic tissue.

Connective Tissue

- Most abundant and widely distributed tissue
- Four main classes:
 - Connective tissue proper
 - Loose Connective Tissues
 - Areolar, adipose, and reticular
 - Dense Connective Tissues
 - Dense regular, dense irregular, elastic
 - Cartilage
 - Hyaline, elastic, fibrous
 - Bone Tissue
 - Blood

Connective Tissue Areolar

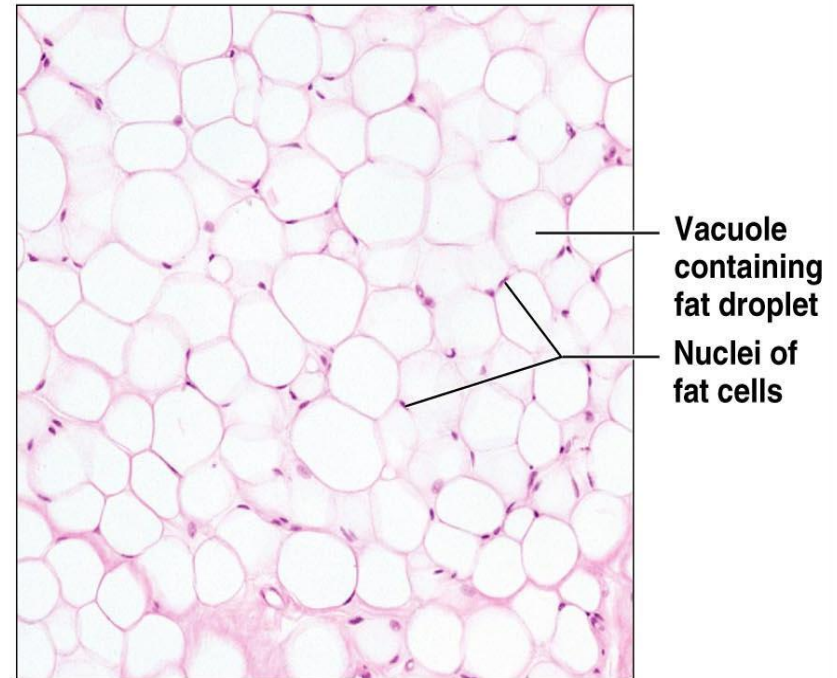
- Description
 - Gel-like matrix with all three fiber types; cells: fibroblasts, macrophages, mast cells and some wbc's
- Function
 - Wraps and cushions organs; its macrophages phagocytize bacteria; plays important role in inflammation; holds and conveys tissue fluid.
- Location
 - Widely distributed under epithelia of body.



Connective Tissue

Adipose

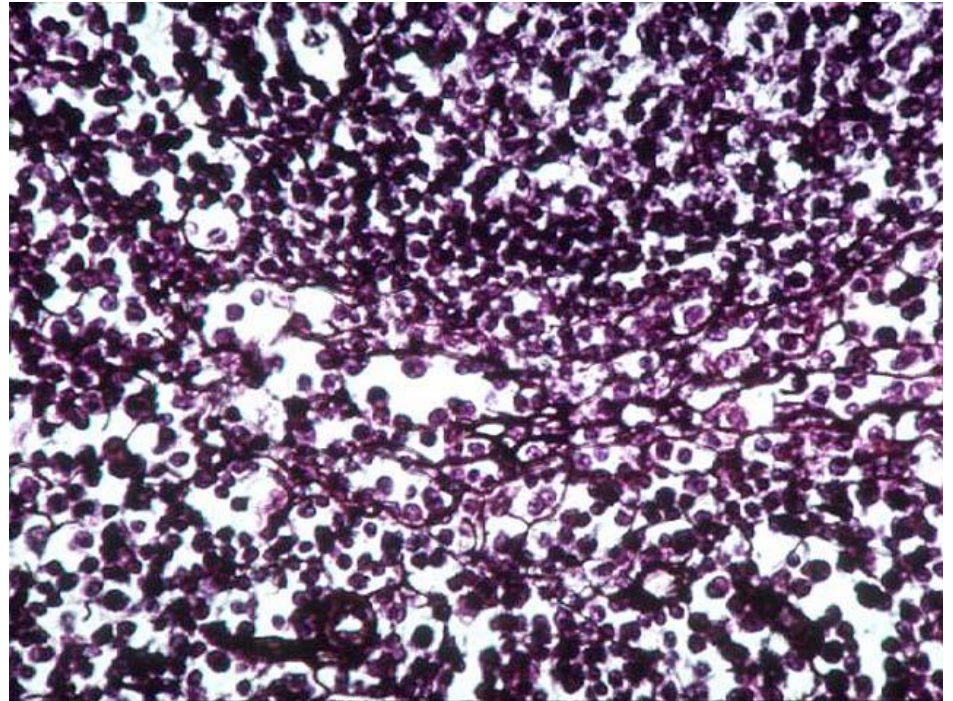
- Description
 - Fat!!
 - Accounts for about 18% of body weight
- Function
 - Provides reserve food fuel; insulates against heat loss; supports and protects organs
- Location
 - Under skin; around kidneys and eyeballs; within abdomen; in breasts



Photomicrograph: Adipose tissue from the subcutaneous layer under the skin (450×).

Connective Tissue Reticular

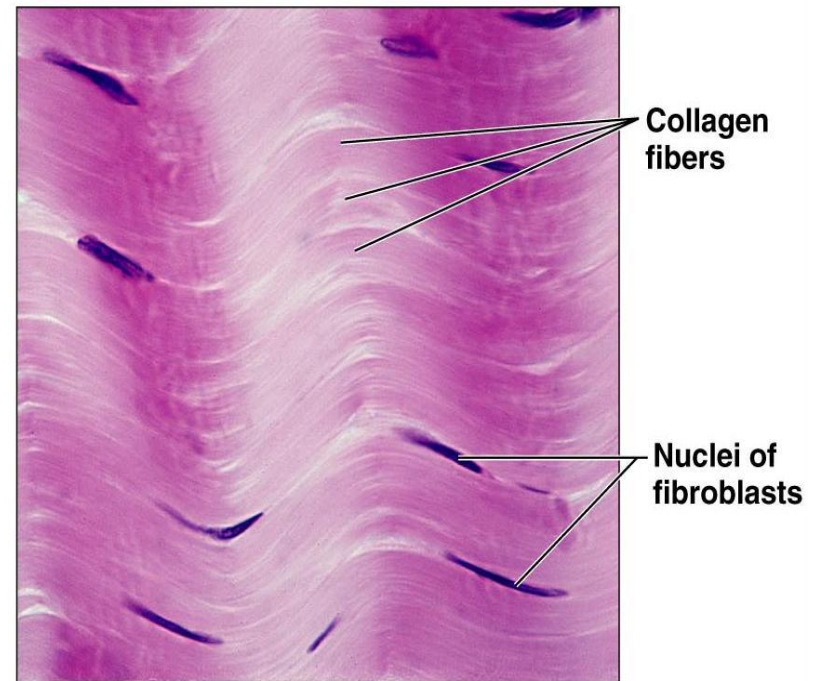
- Description
 - Network of reticular fibers in a typical loose ground substance; reticular cells lie on the network.
- Function
 - Fibers from a soft internal skeleton (stroma) that supports other cell types including wbc's, mast cells, and macrophages.
- Location
 - Lymphoid organs (lymph nodes, bone marrow, and spleen).



Connective Tissue

Dense Regular

- Description
 - Closely packed collagen fibers all running in the same direction
 - Poorly vascularized
- Function
 - Attaches muscles to bones or to muscles; attaches bones to bones; withstands great tensile stress when pulling force is applied in one direction
- Location
 - Tendons and ligaments

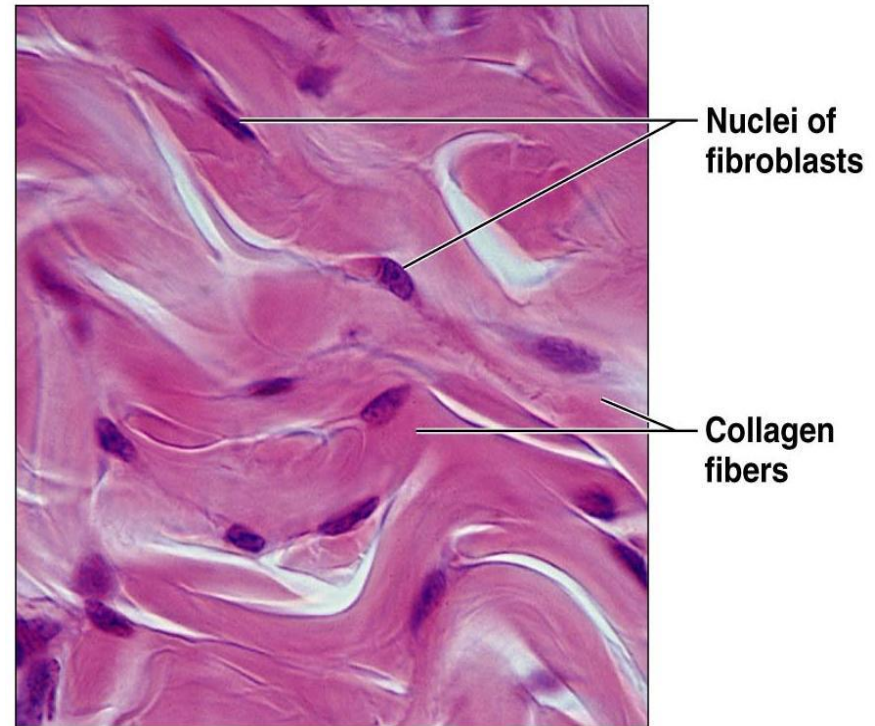


Photomicrograph: Dense regular connective tissue from a tendon (1000x).

Connective Tissue

Dense Irregular

- Description
 - Thick collagen fibers that run in all directions
- Function
 - Able to withstand tension exerted in many directions; provides structural strength
- Location
 - Dermis of the skin; submucosa of digestive tract; fibrous capsules of organs and of joints



Photomicrograph: Dense irregular connective tissue from the dermis of the skin (400×).

Connective Tissue

Hyaline Cartilage

- Description
 - Gristle
 - Most common
 - Amorphous but firm matrix; collagen fibers form an imperceptible network; chondroblasts produce the matrix and when mature (chondrocytes) lie in lacunae

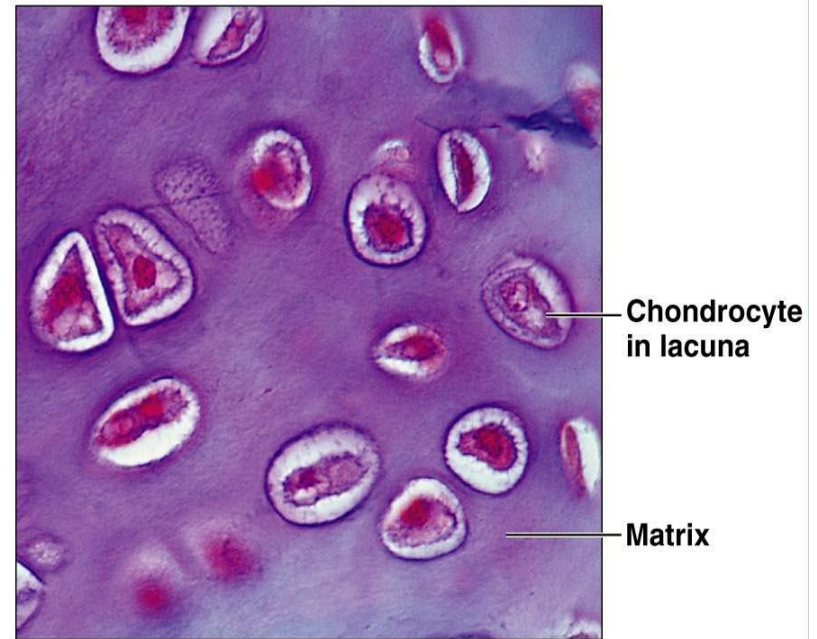


Photomicrograph: Hyaline cartilage from the trachea (300 \times).

Connective Tissue

Hyaline Cartilage

- **Function**
 - Supports and reinforces; has resilient cushioning properties; resists compressive stress
- **Location**
 - Forms most of the embryonic skeleton; covers the ends of long bones in joint cavities; forms costal cartilages of the ribs; cartilages of the nose, trachea and larynx

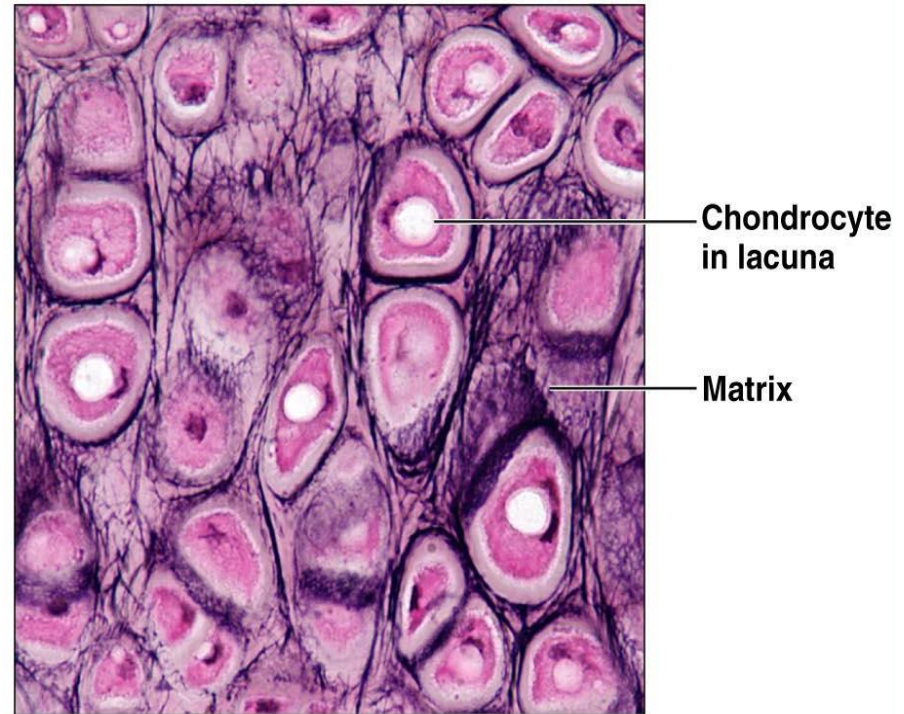


Photomicrograph: Hyaline cartilage from the trachea (300 \times).

Connective Tissue

Elastic Cartilage

- Description
 - Similar to hyaline cartilage, but more elastic fibers in the matrix
- Function
 - Maintains the shape of a structure while allowing great flexibility
- Location
 - Ear, tip of nose, epiglottis

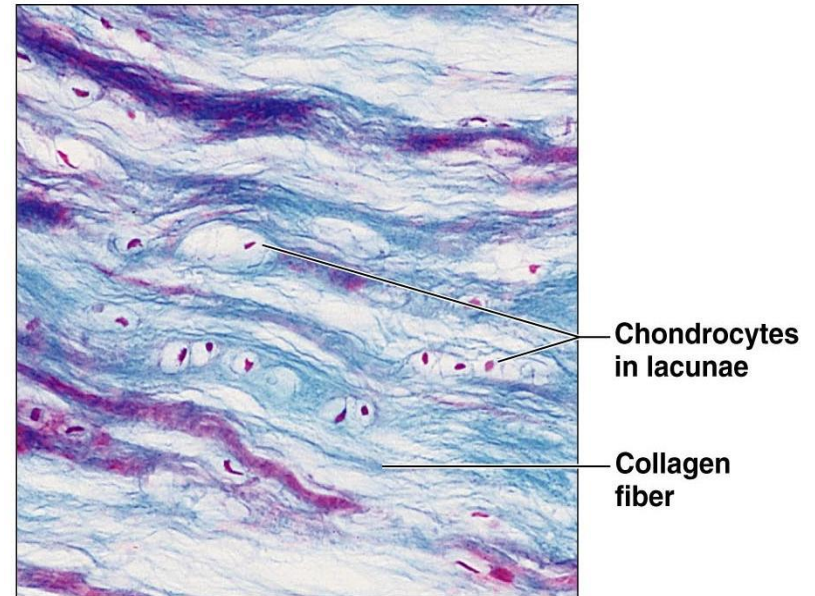


Photomicrograph: Elastic cartilage from the human ear pinna; forms the flexible skeleton of the ear (640 \times).

Connective Tissue

Fibrocartilage

- Description
 - Found in areas of high stress
 - Matrix similar to but less firm than hyaline; thick collagen fibers predominate
 - Avascular
- Function
 - Tensile strength with the ability to absorb compressive shock, prevents bone-to-bone contact, shock absorber
- Location
 - Spinal discs, pads within knee joint

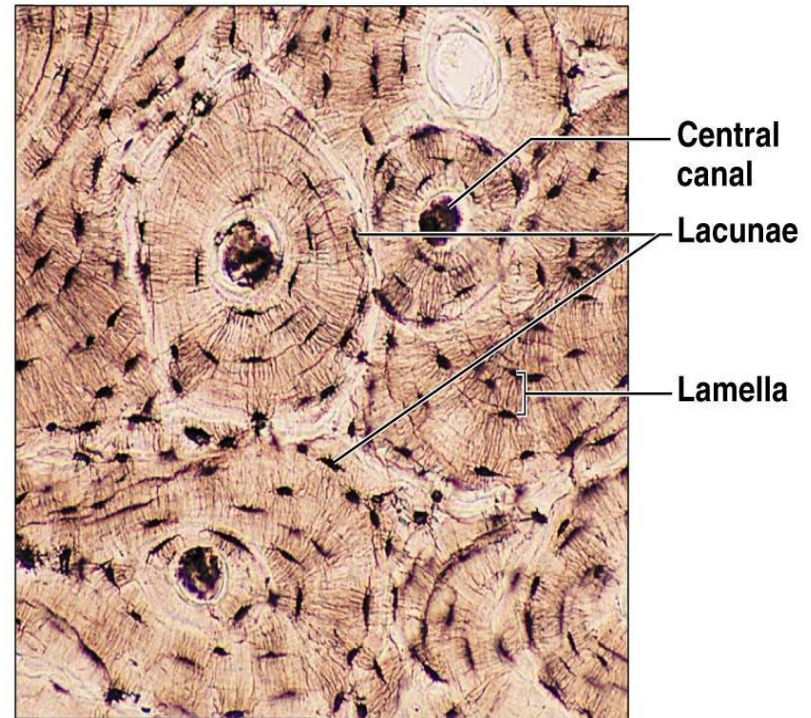


Photomicrograph: Fibrocartilage of an intervertebral disc (200 \times). Special staining produced the blue color seen.

Connective Tissue

Bone

- Description
 - Hard, calcified matrix contain many collagen fibers; osteocytes lie in lacunae
 - Highly vascularized
- Function
 - Supports and protects; levers for the muscles; stores calcium and other minerals and fat; marrow on inside make blood cells
- Location
 - Bone

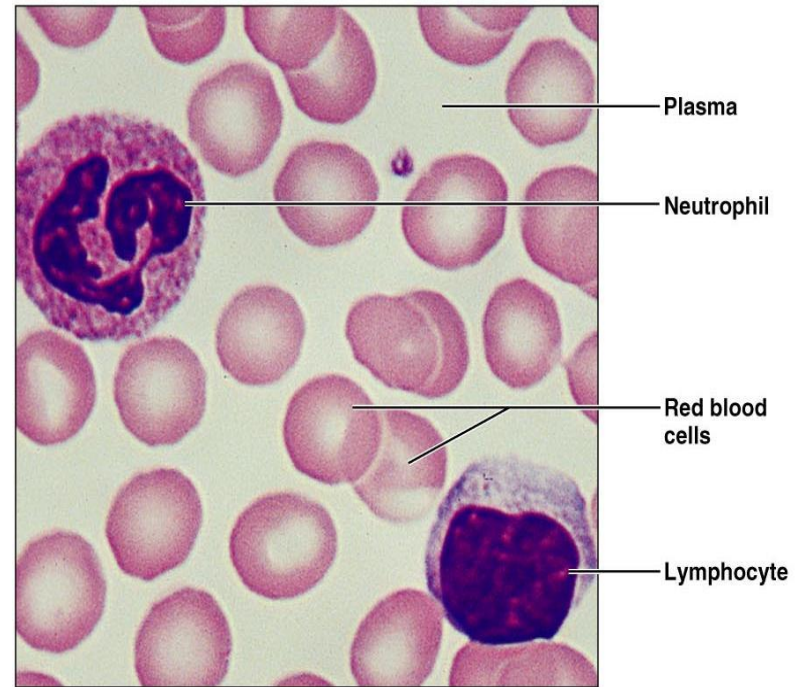


Photomicrograph: Cross-sectional view of bone (70x).

Connective Tissue

Blood

- Description
 - Red and white blood cells in a fluid matrix (plasma)
- Function
 - Transport respiratory gases, wastes, nutrients, immune response, and blood clotting
- Location
 - Contained within blood vessels



Photomicrograph: Smear of human blood (1500 \times); two white blood cells (neutrophil in upper left and lymphocyte in lower right) are seen surrounded by red blood cells.