Connective Tissue

- Found everywhere in the body.
- Most abundant and widely distributed.
- Never exposed to the outside environment.

Connective Tissue

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

Connective Tissue - Characteristics

- Common Origin
  - All arise from the mesenchyme (embryonic tissue)
- Degrees of vascularity
  - Vascularized to poorly vascularized.
- Extracellular matrix
  - Ct is largely non-living extracellular matrix which separate the living cells
  - Allows it to bear weight, withstand tension, physical trauma, etc., that no other tissue would be able to tolerate

Connective Tissue

- 3 Main Structural Elements
  - Ground Substance (matrix)
  - Fibers (matrix)
  - Cells

Connective Tissue

- Ground Substance
  - Fills the space between the cells and contains the fibers. It is not alive!!
  - 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

- Collagen fibers (contain protein collagen)
  - "white fibers" → has a white appearance when fresh
  - Very strong and most abundant → stronger than steel fibers!
  - Found in tendons and ligaments

Connective Tissue - Fibers

- Elastic Fibers
  - "yellow fibers" → has a yellow appearance when fresh
  - Able to stretch (protein elastin) – allows tissue to return to normal length and shape
  - Found where greater elasticity is needed – skin, lungs, blood vessel walls

Connective Tissue - Fibers

- Reticular Fibers
  - Short, fine, collagenous fibers and are continuous with collagen fibers.
  - Branch extensively, forming delicate networks (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

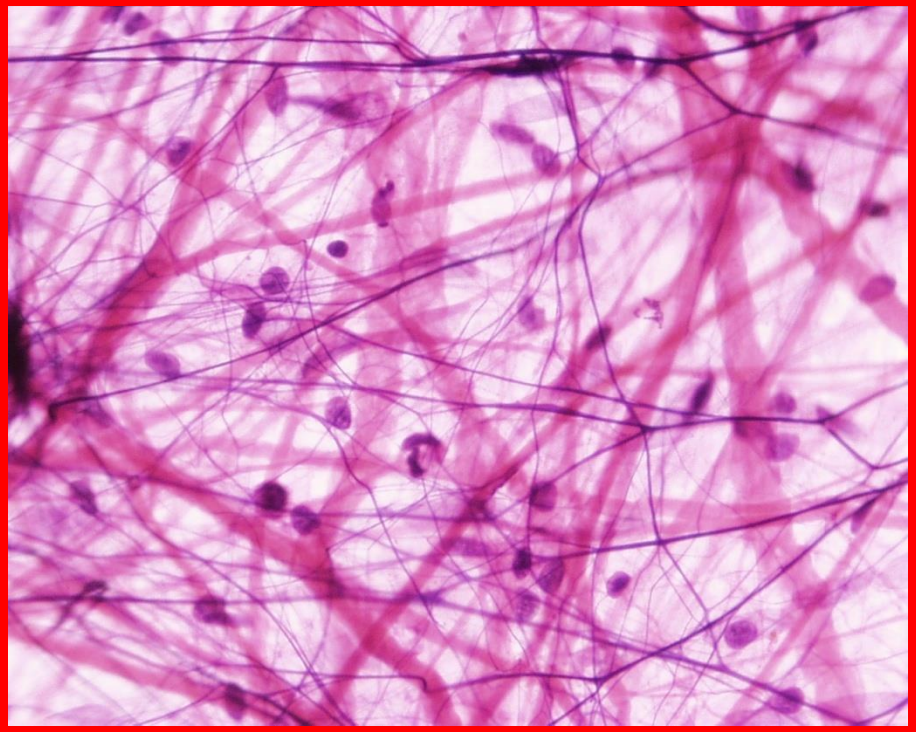
- Other cells found within C.T.
  - White blood cells – defensive (neutrophils, eosinophils, lymphocytes)
  - Plasma cells – produces antibodies
  - Mast cells – oval, typically cluster along blood vessel walls. Detect foreign substances and initiate inflammatory response
  - Macrophages – large, irregularly 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

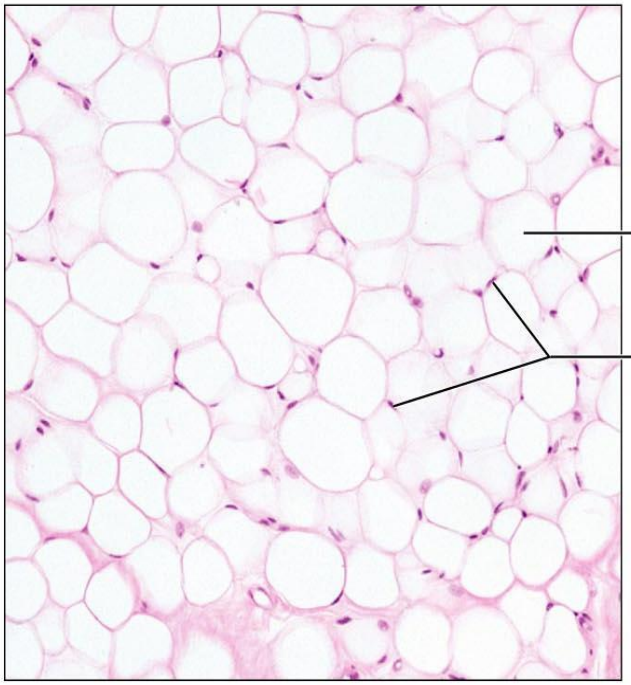
Areolar

- 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.



Adipose

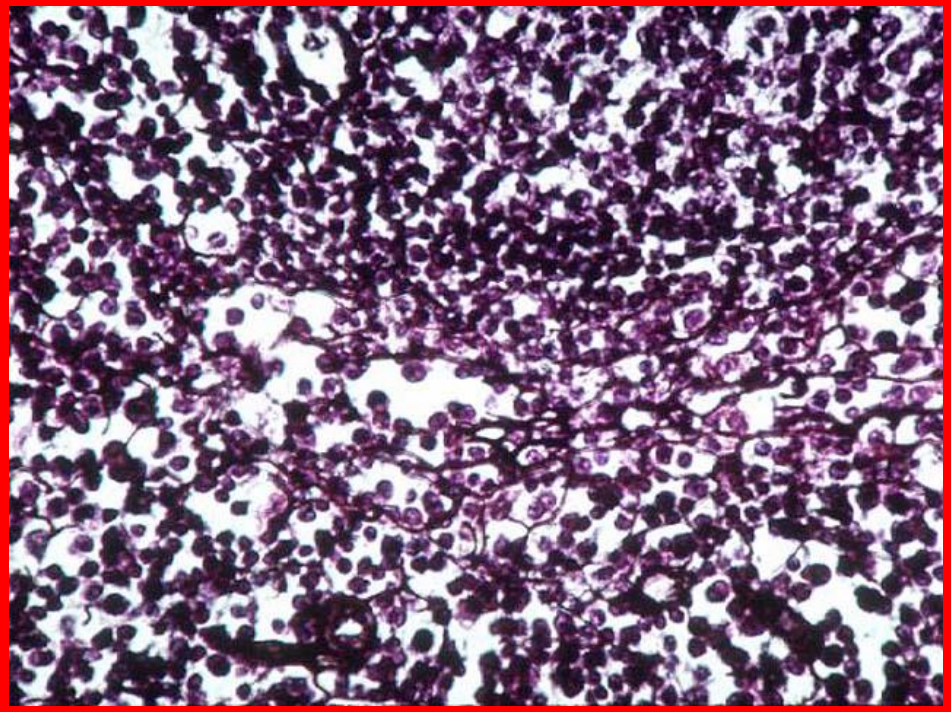
- Description
  - Fat!! (~18% of body weight)
  - Closely backed adipocytes (fat cells) have nucleus pushed to the side by large fat droplet
- Function
  - Provides reserve food fuel; insulates against heat loss; supports and protects organs
- Location
  - Under skin; around kidneys and eyeballs; within abdomen; in breasts



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

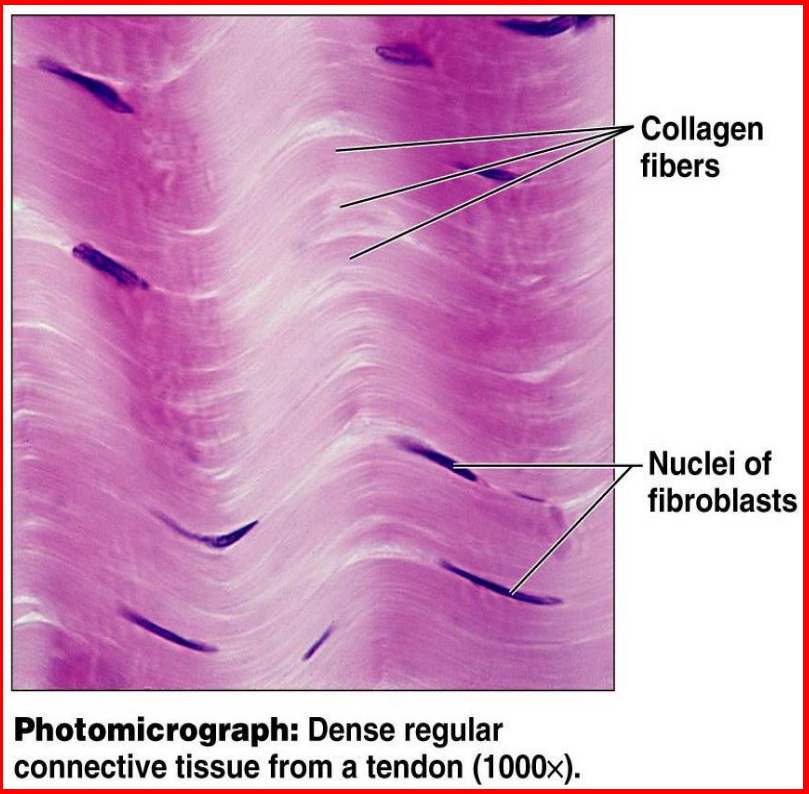
Reticular

- 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).



Dense Regular

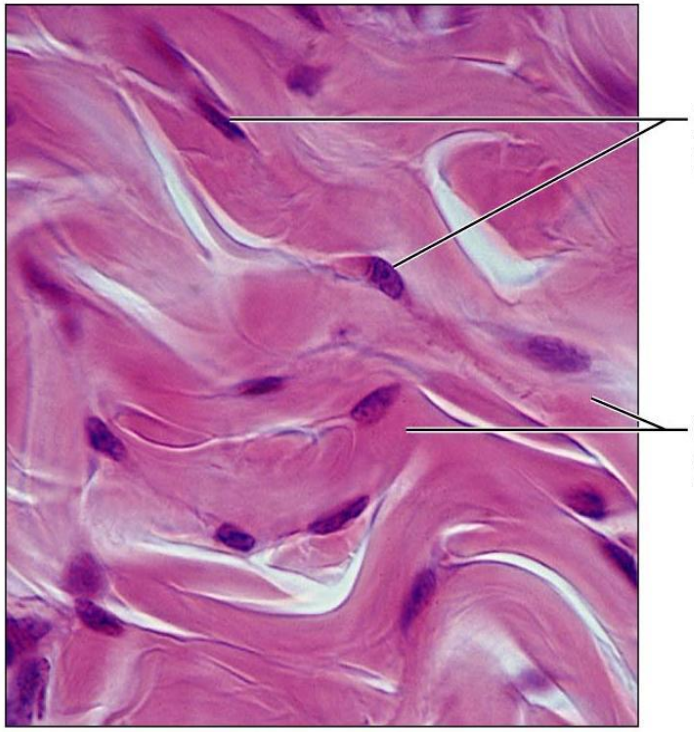
- Description
  - Closely packed collagen fibers all running in the same direction
  - Poorly vascularized
- Function
  - Attaches muscles to bones or to muscles; attaches bones to bones; withstands great tensile stress when pulling force is applied in one direction
- Location
  - Tendons and ligaments



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

Dense Irregular

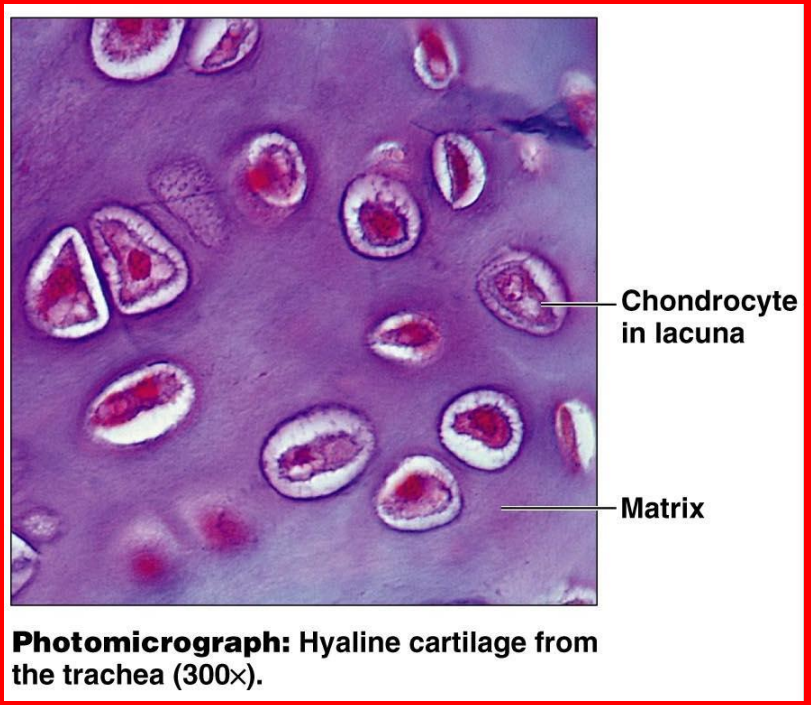
- Description
  - Thick collagen fibers that run in all directions
- Function
  - Able to withstand tension exerted in many directions; provides structural strength
- Location
  - Dermis of the skin; submucosa of digestive tract; fibrous capsules of organs and of joints



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

Hyaline Cartilage

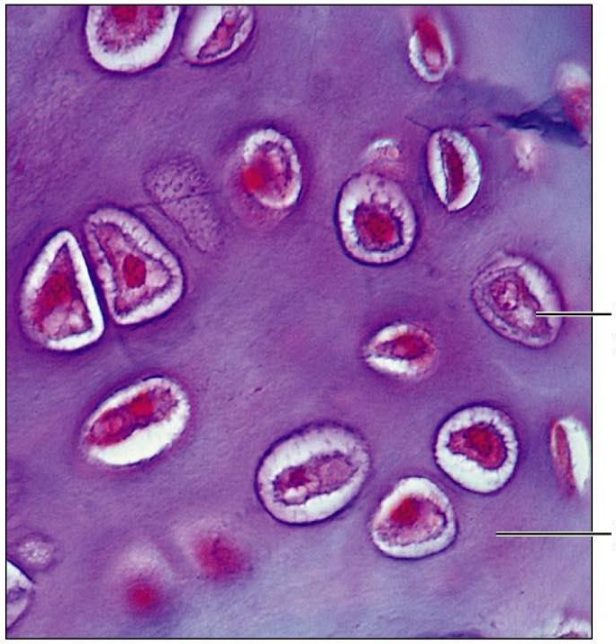
- Description
  - Gristle
  - Most common
  - Amorphous but firm matrix; collagen fibers from and imperceptible network; chondroblasts produce the matrix and when mature (chondrocytes) lie in lacunae



Photomicrograph: Hyaline cartilage from the trachea (300×).

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×).

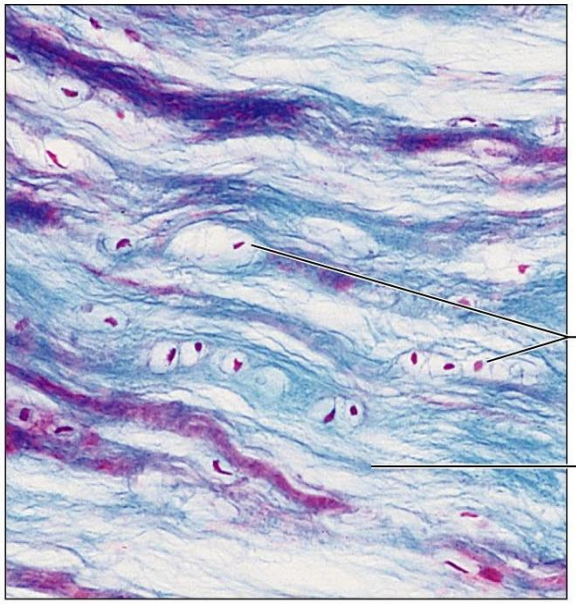
Elastic Cartilage

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

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

Fibrocartilage

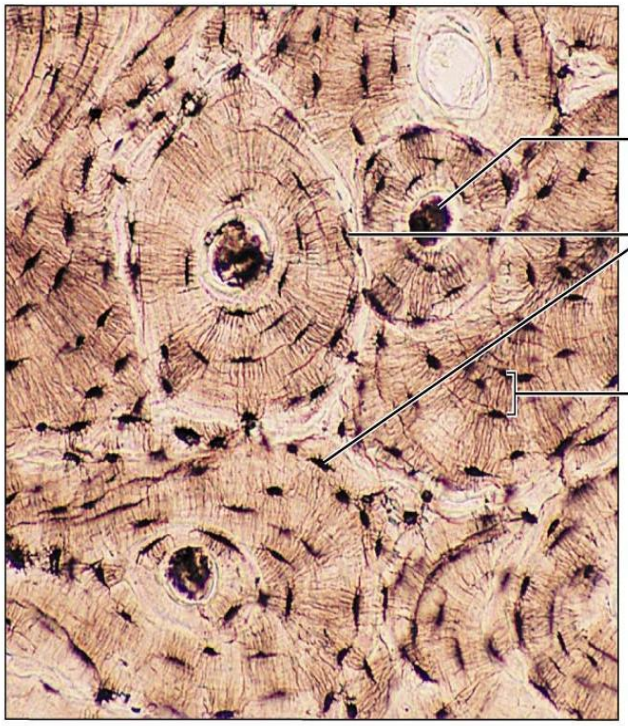
- Description
  - Found in areas of high stress
  - Matrix similar to but less firm that hyaline; thick collagen fibers predominate
  - Avascular
- Function
  - Tensile strength with the ability to absorb compressive shock, prevents bone-to-bone contact, shock absorber
- Location
  - Spinal discs, pads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



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

Bone

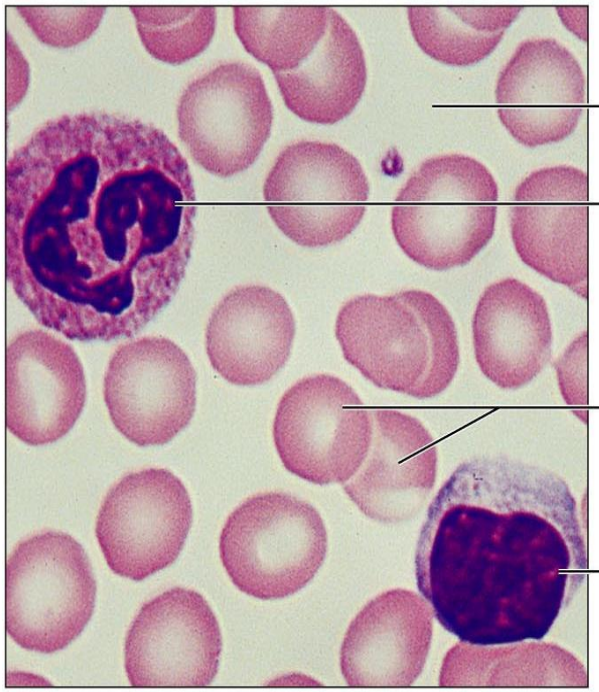
- Description
  - Hard, calcified matrix contain many collagen fibers; osteocytes lie in lacunae
  - Highly vascularized
- Function
  - Supports and protects; levers for the muscles; stores calcium and other minerals and fat; marrow on inside make blood cells
- Location
  - Bone



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

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×); two white blood cells (neutrophil in upper left and lymphocyte in lower right) are seen surrounded by red blood cells.