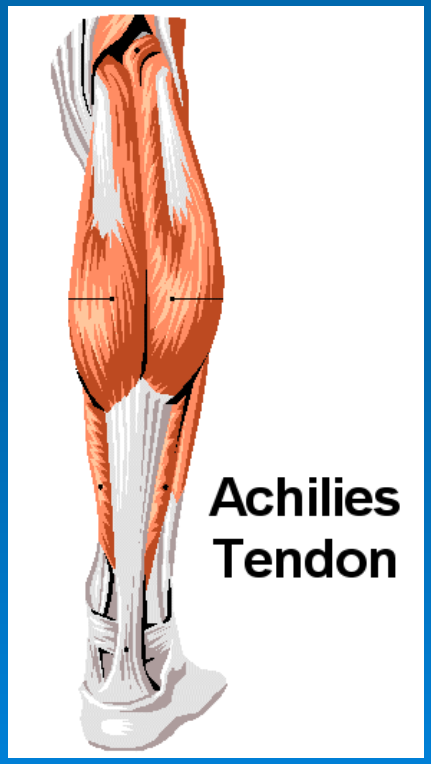
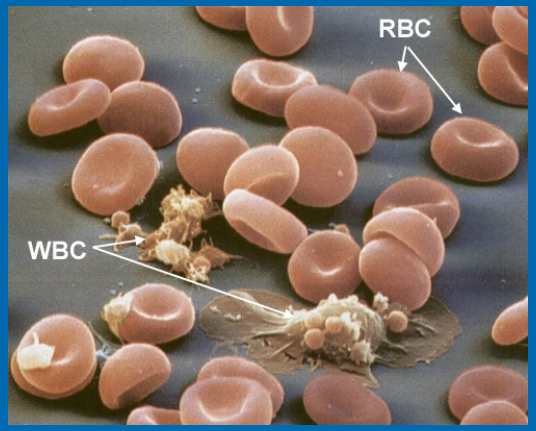
Histology

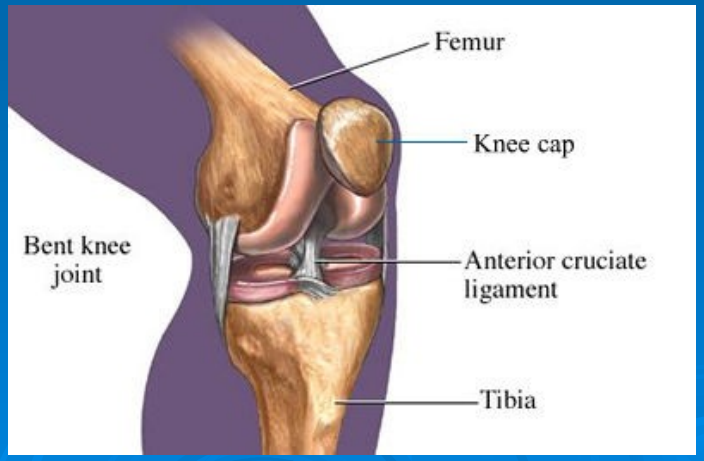
Connective Tissue

Connective Tissue

- Examples

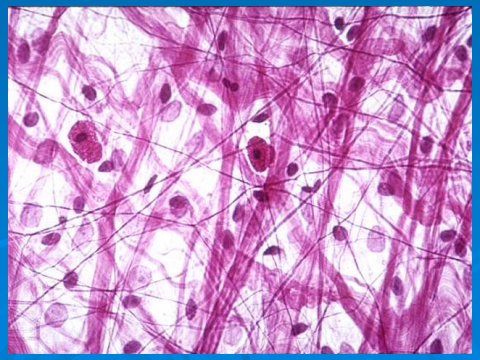
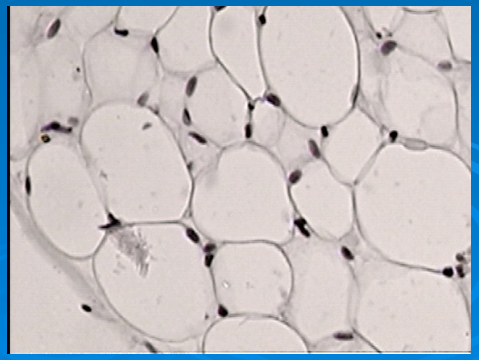






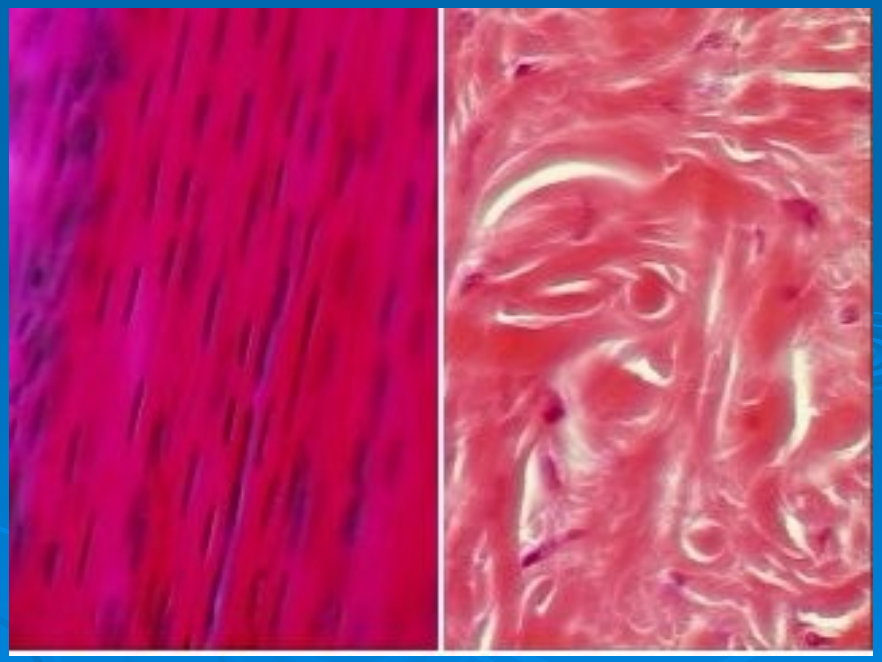
Connective Tissue

- General characteristics
  - **Vascularized**
  - Lots of extracellular matrix
    - Protein fibers, ground substance, fluid.
  - Cell types:
    - **blast, cyte, clast**

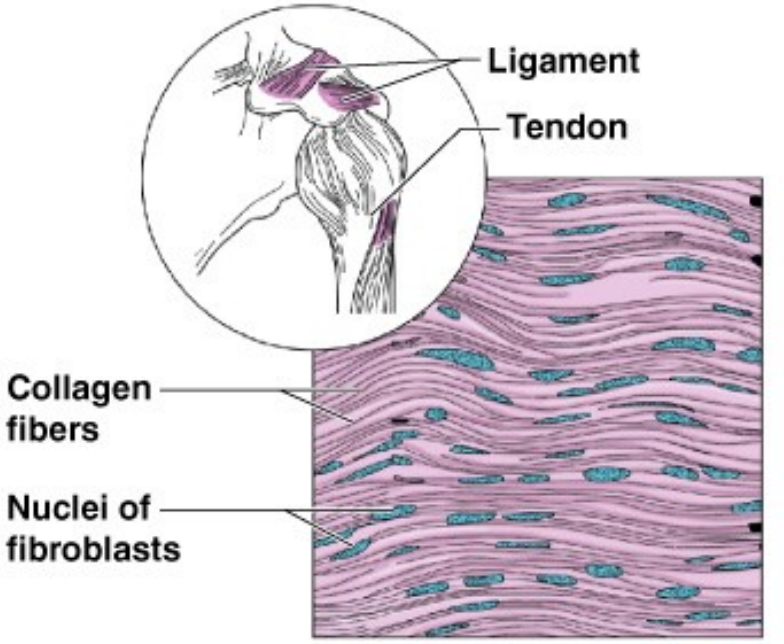




Dense Connective Tissue

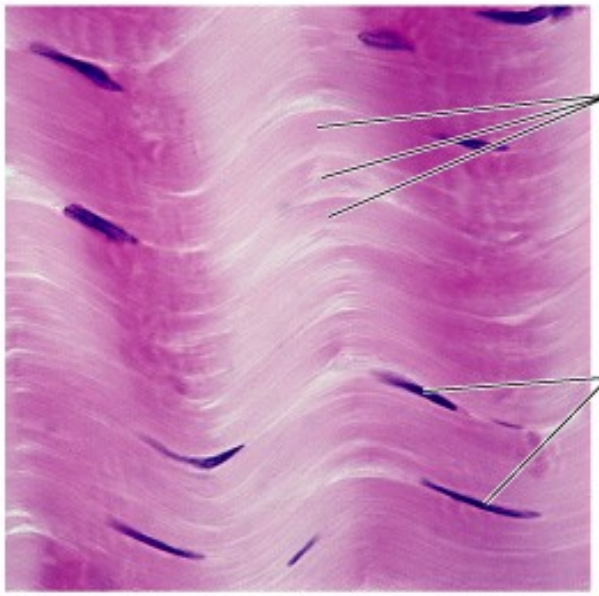
- Tendons, ligaments, dermis, organ capsules
- Matrix mostly **collagen** fibers
  - Regular vs. irregular
  - Cells: **fibroblasts**



Dense Connective Tissue



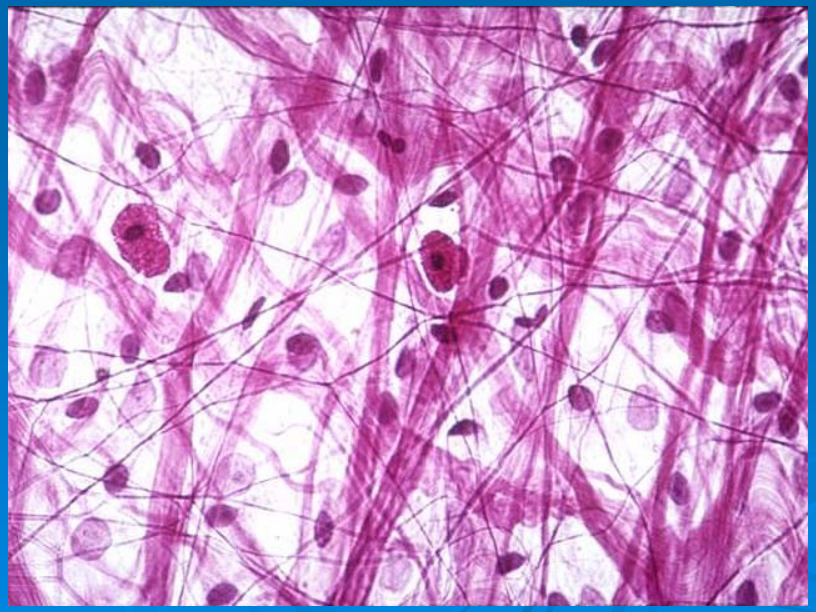
(d) Diagram: Dense fibrous



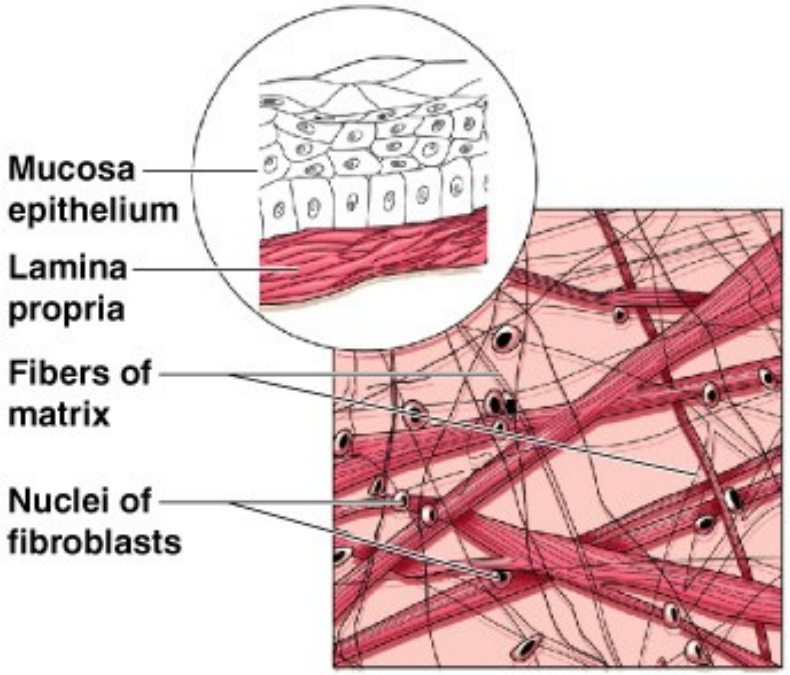
Photomicrograph: Dense fibrous connective tissue from a tendon (1000x).

Loose Connective Tissue

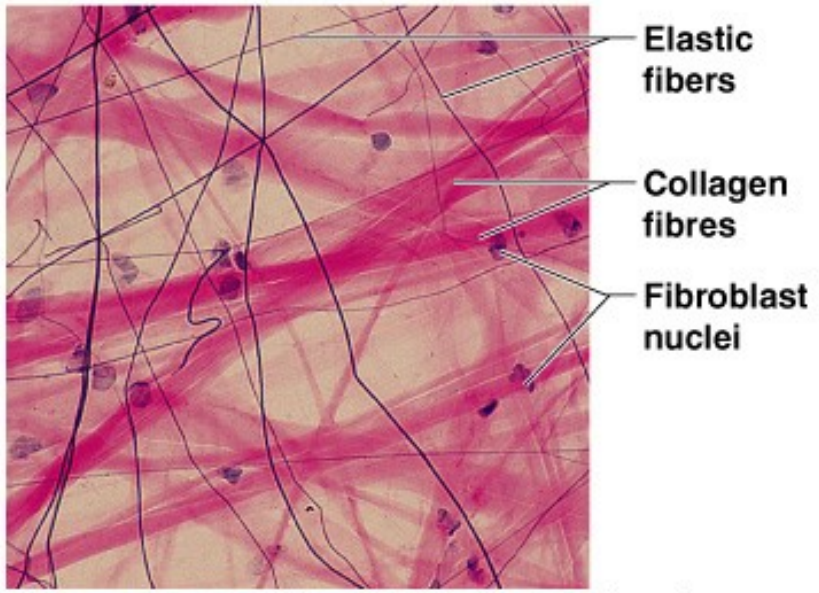
- **Areolar tissue**:
  - "Packing material" of organs
  - **Propria lamina**
  - Matrix mostly collagen fibers & fluid



Loose Connective Tissue



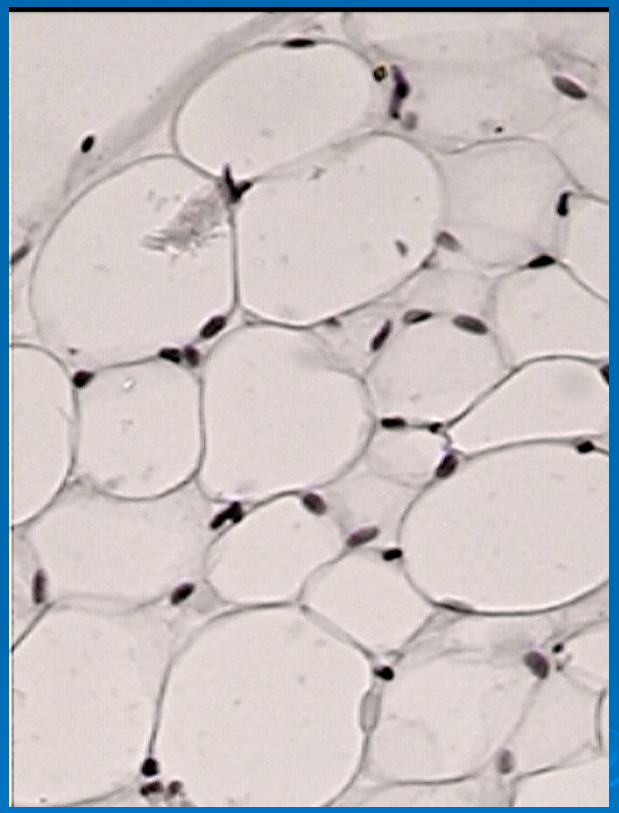
(e) Diagram: Areolar



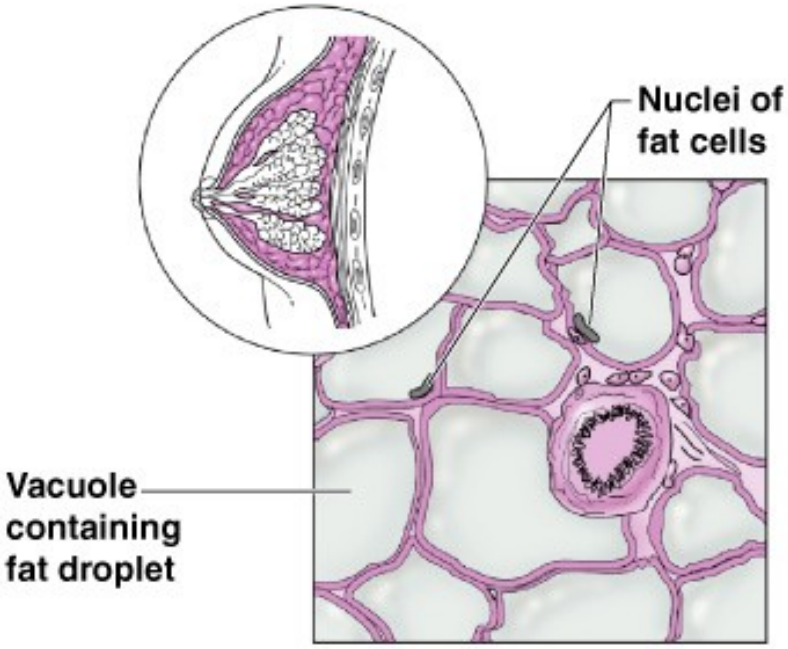
Photomicrograph: Areolar connective tissue, a soft packaging tissue of the body (400x).

Loose Connective Tissue

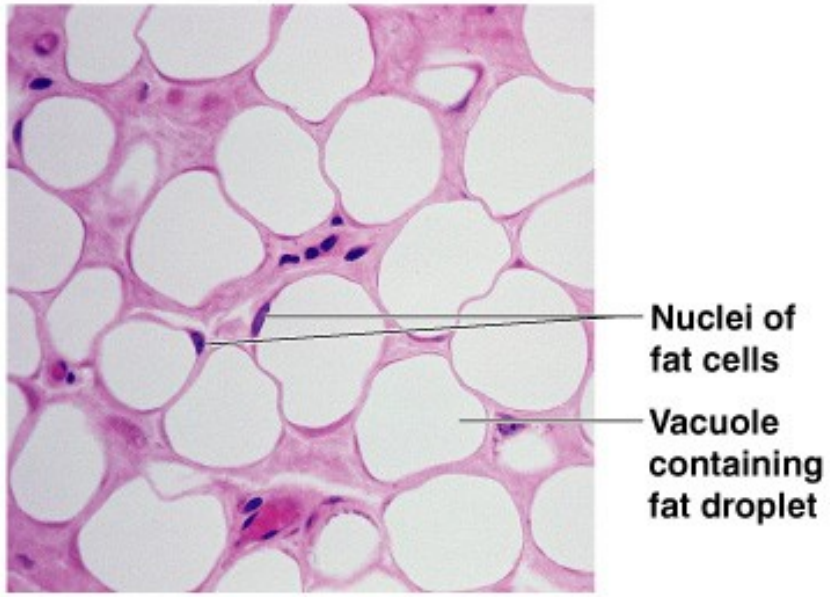
- **Adipose** (fat) tissue:
  - Very little matrix
  - Specialized areolar tissue
  - Locations & functions



Loose Connective Tissue



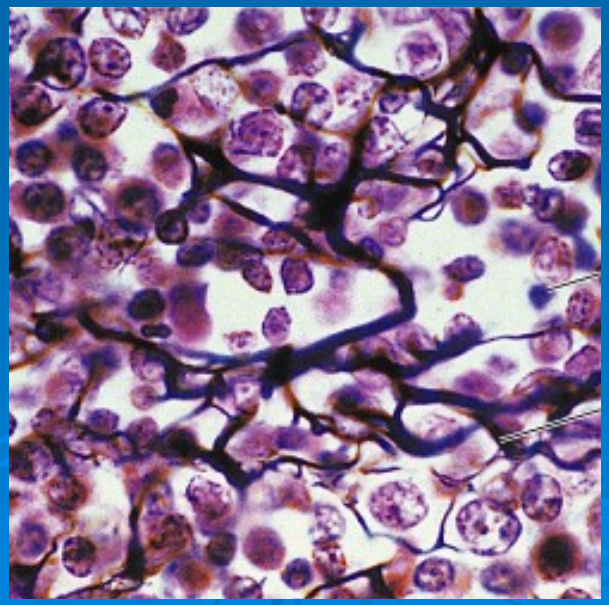
(f) Diagram: Adipose



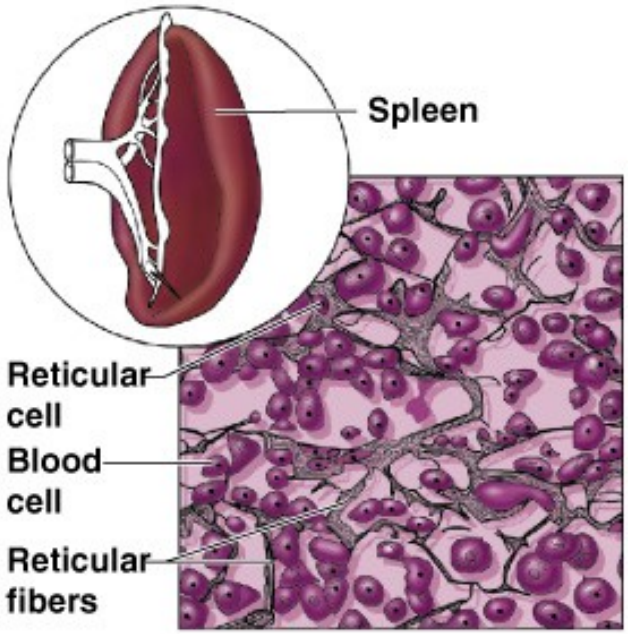
Photomicrograph: Adipose tissue from the subcutaneous layer beneath the skin (600x).

Loose Connective Tissue

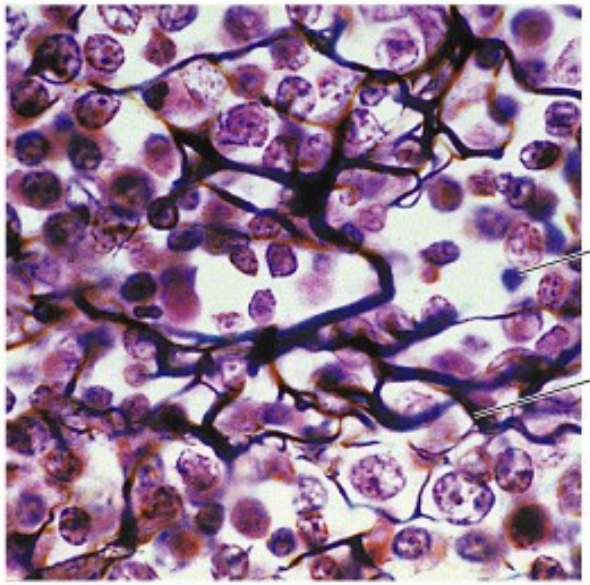
- **Reticular connective tissue**
  - Lymphatic organs
    - **Stroma** & lymphocytes
  - Matrix mostly reticular fibers



Loose Connective Tissue



(g) Diagram: Reticular

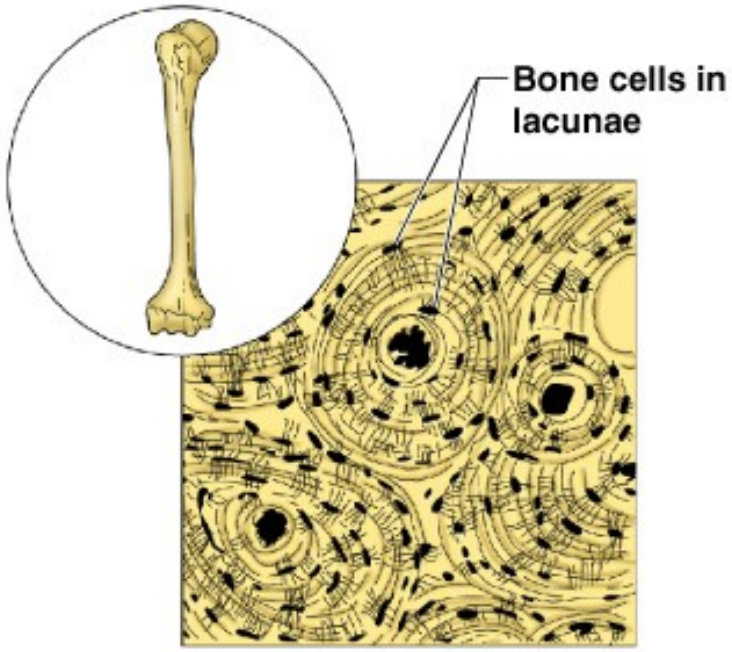


Photomicrograph: Dark-staining network of reticular connective tissue (350x).

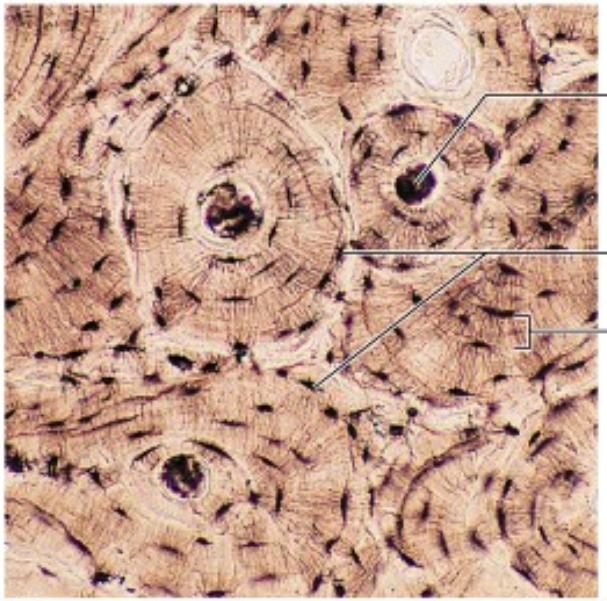
Bone

- Matrix mostly ground substance (calcium phosphate) and collagen fibers.
- Cells: **osteocytes** in **lacunae**
- **Compact bone** vs. **cancellous bone**.

Bone



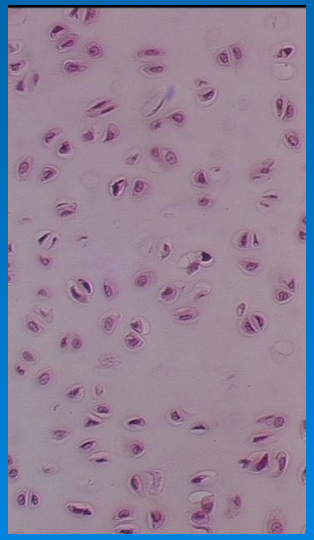
(a) Diagram: Bone

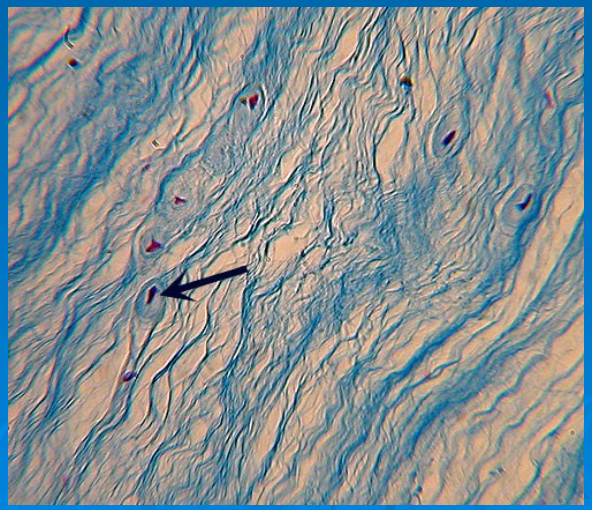


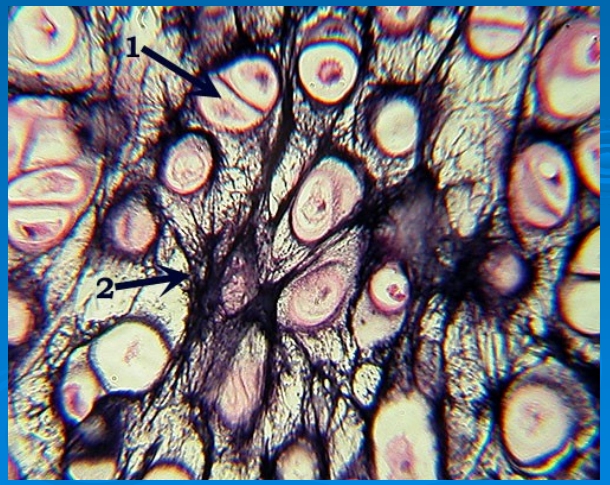
Photomicrograph: Cross-sectional view of ground bone (70x).

Cartilage

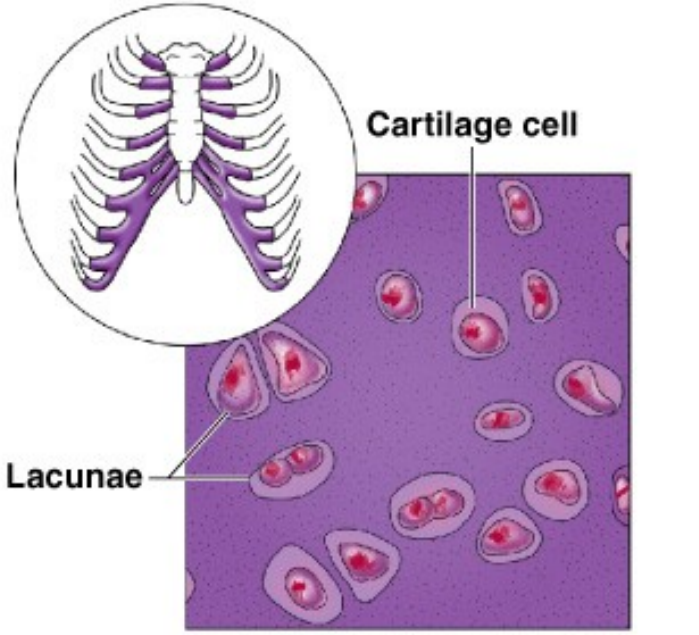
- Matrix protein fibers & ground substance
- Cells: **chondrocytes** in lacunae
- **Hyaline cartilage**, **fibrocartilage** & **elastic cartilage**



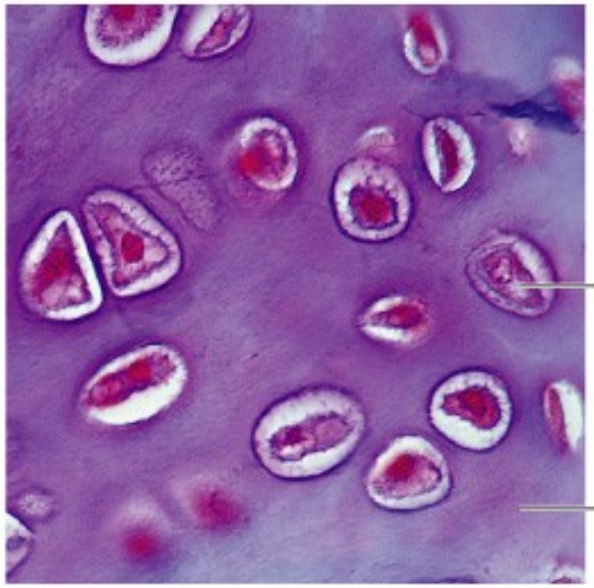




Cartilage



(b) Diagram: Hyaline cartilage

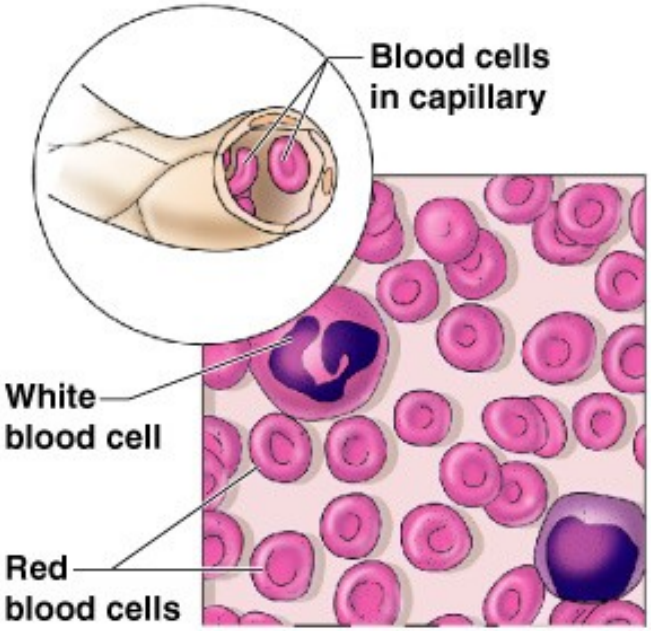


Photomicrograph: Hyaline cartilage from the trachea (300x).

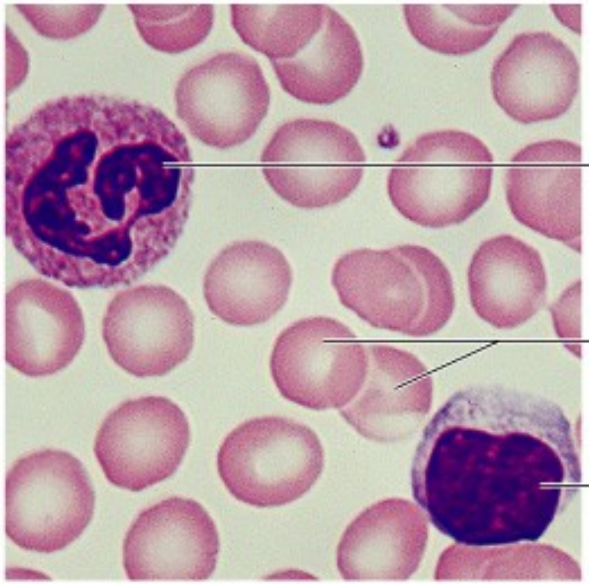
Blood

- Matrix mostly fluid (**plasma**)
- Cells: **erythrocytes**, **leukocytes**, **plateletes**

Blood



(h) Diagram: Blood



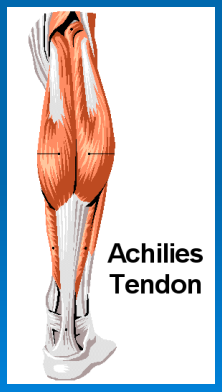
Photomicrograph: Smear of human blood (1500x); two white blood cells are seen among the red blood cells.

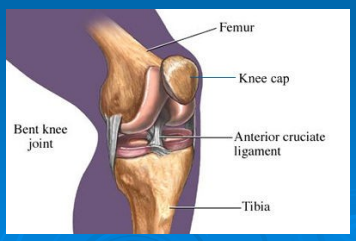
Histology

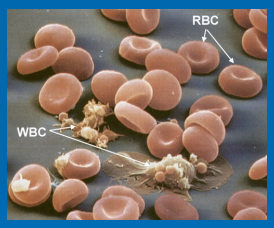
Connective Tissue

Connective Tissue

- Examples

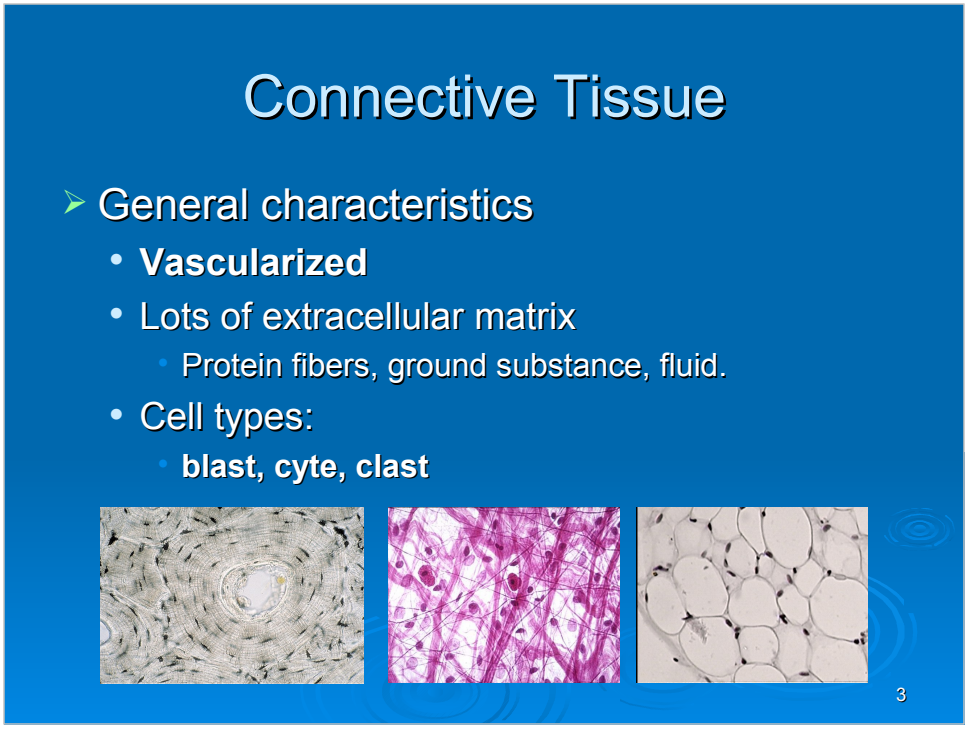






2

Connective tissues join other tissues in the body together. As with epithelium, there are many different types of cells that are found in different locations in the body and serve different functions. Some examples include tendons (attach muscles and bones), ligaments (attach bones at joints), bone, cartilage, blood, and adipose (fat) tissue.



Structurally, connective tissue is *very* different from epithelium. Recall that epithelium was avascular (it did not have blood vessels). Connective tissue, though, is **vascular**. Even bone has blood vessels running through it. Also unlike epithelium, connective tissue has lots of extracellular matrix. In fact, most connective tissue is *mostly* matrix, with just a smattering of living cells scattered here and there.

The extracellular matrix consists of three parts:

Protein fibers make up the bulk of some connective tissues. There are three main protein fibers we'll be concerned with. By far, most protein fibers in the matrix of connective tissue are **collagen** fibers. Collagen fibers are great for the matrix of connective tissue because it resists stretching (it's very strong), but it's very flexible. There are also **elastic fibers** (which do stretch, but recoil to their original length) and **reticular fibers** (which form a net-like "mesh" in some organs that gives white blood cells a place to anchor themselves while they monitor flowing lymph or blood for pathogens.)

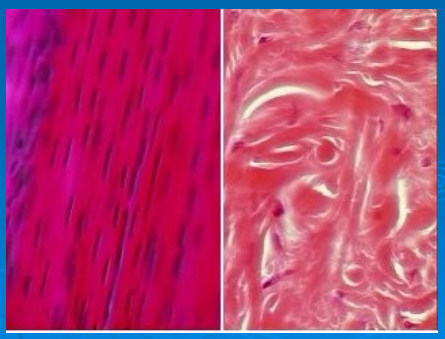
Ground substance includes the mineral content and other molecules that give structure to the tissue. For example, bone is mostly ground substance consisting of calcium phosphate to give it rigidity and strength.

Fluid is also found in the matrix of some connective tissue, most notably blood. (There is also some in areolar tissue).

The living cells found in connective tissue mostly work to produce, maintain or break down the matrix. **Blast** cells build new matrix, **cyte** cells maintain existing matrix and **clast** cells break down matrix. These are roots, so we usually add a prefix with them. **Fibro-** means protein fibers, **osteo-** means

Dense Connective Tissue

- Tendons, ligaments, dermis, organ capsules
- Matrix mostly **collagen** fibers
  - Regular vs. irregular
  - Cells: **fibroblasts**



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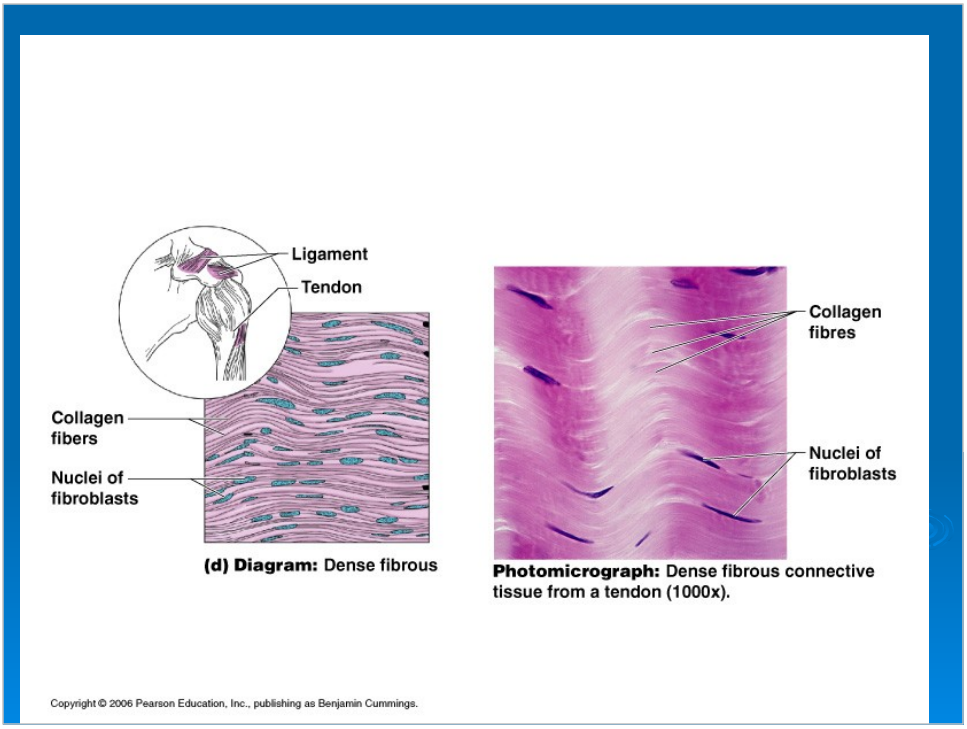
Dense connective tissue has a matrix consisting of densely-packed collagen fibers. Since the collagen fibers are so dense, there's not really room for any other matrix components. Tendons, ligaments, the dermis of the skin and organ capsules (a protective layer that surrounds most organs) are all made of dense connective tissue.

Since the matrix of dense connective tissue is so rich in collagen fibers, the main type of cell found in this tissue is **fibroblasts**.

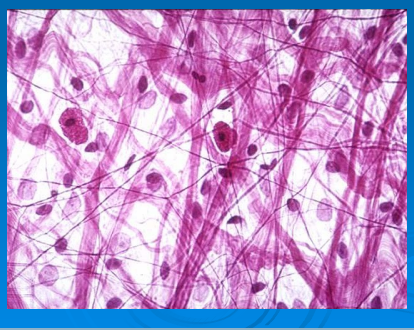
There are two types of dense connective tissue. **Regular dense connective tissue** has all of its collagen fibers oriented in the same direction – it is good when the tissue will only be pulled in one direction (tendons and ligaments). **Irregular dense connective tissue** has collage fibers oriented in every direction. It is good for tissues that will be pulled in many different directions (skin and organ capsules).



This is a figure from your book showing some regular dense connective tissue. Note the huge number of collagen fibers with a few fibroblasts interspersed.

Loose Connective Tissue

- **Areolar tissue**:
  - "Packing material" of organs
  - **Propria lamina**
  - Matrix mostly collagen fibers & fluid



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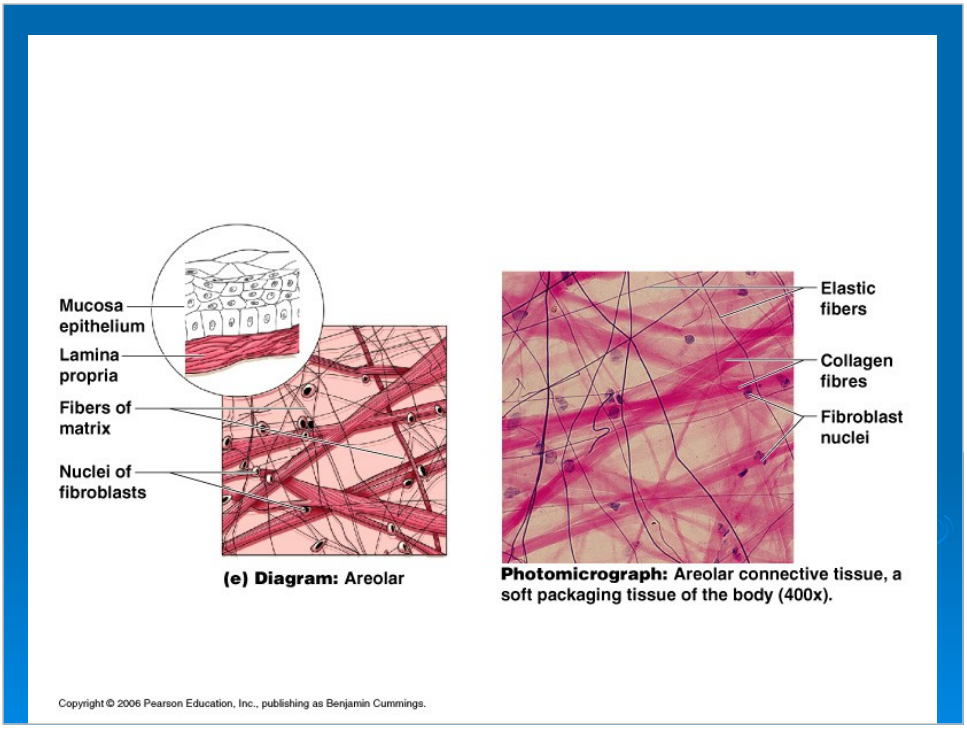
Loose connective tissue also has a lot of collagen fibers, but they're not nearly as densely-packed as in dense connective tissue. We'll discuss three types of loose connective tissue.

Areolar tissue is a loose connective tissue that often anchors epithelium to underlying tissues (often muscle) so you can think of it as a "packing material" that surrounds and cushions organs. It's matrix consists of protein fibers (mostly collagen fibers), but there is also some fluid in the spaces between the fibers. This is important because the fluid-filled spaces give white blood cells called **macrophages** an opportunity to move through the tissue, patrolling for bacteria and other pathogens. In addition to the macrophages, we also find fibroblasts here.

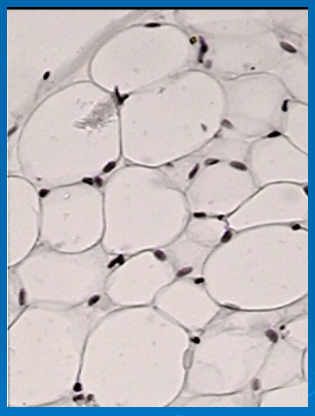
One areolar tissue that we'll mention several times is **propria lamina**. The propria lamina is a sheet of areolar tissue that sits under all mucous membranes and anchors the mucous membranes to muscle and fat.



This figure from your book doesn't have any macrophages, but you can see the collagen and elastic fibers, as well as the fibroblasts that built them.

Loose Connective Tissue

- **Adipose** (fat) tissue:
  - Very little matrix
  - Specialized areolar tissue
  - Locations & functions



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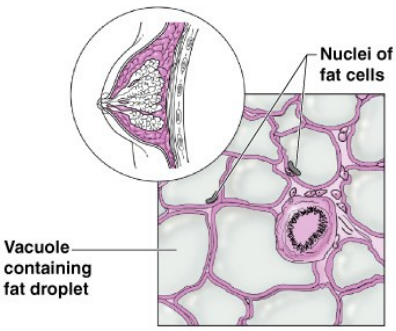
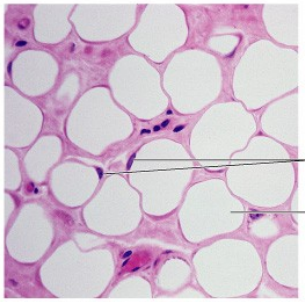
Adipose tissue includes the "fat cells" of the body. The adipose cells are stuffed full of fat droplets. They're so stuffed, in fact, that the nuclei get shoved off to the sides of the cells. They're so stuffed that they become engorged and push together, so there's not much matrix of any kind in adipose tissue.

Three major functions of adipose tissue in the human body are *temperature regulation* (the lipid-filled adipose cells insulate the body against heat loss), *cushioning of organs*, and *a reserve of energy* (if carbohydrates are unavailable, the body can metabolize fats to make ATP).

Adipose tissues are found surrounding most organs, underneath the skin, and in the female breast. It's the adipose tissue under the skin that we call "body fat."



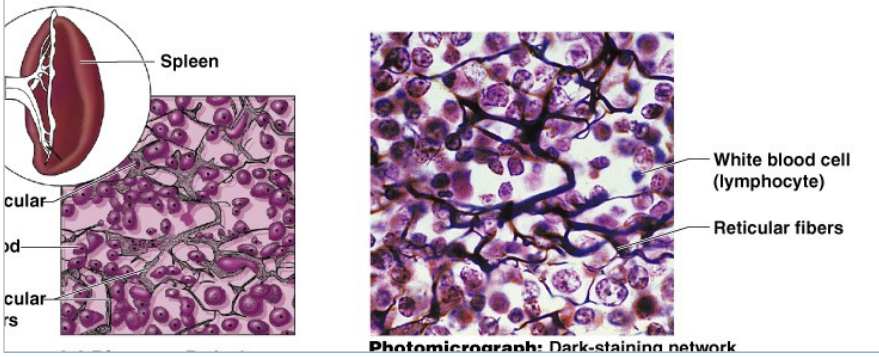
(f) Diagram: Adipose



Photomicrograph: Adipose tissue from the subcutaneous layer beneath the skin (600x).

Another example of adipose tissue.

Loose Connective Tissue



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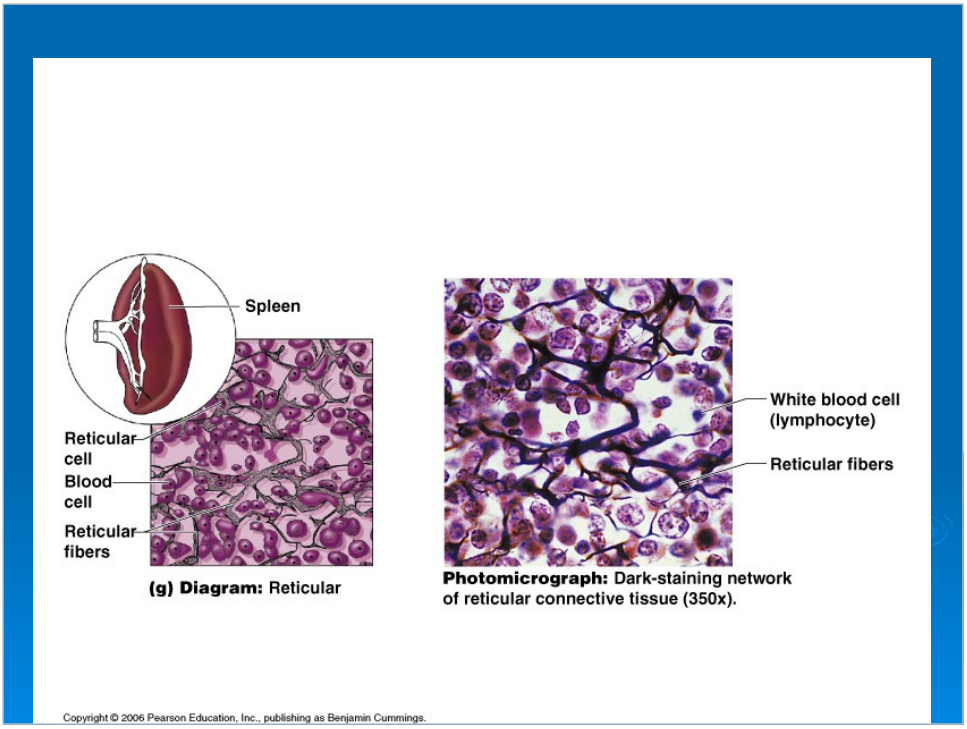
Reticular connective tissue consists mostly of reticular protein fibers. It forms a net-like “mesh” of cells that lymph or blood flows through in some of the lymphatic (immune system) organs of the body. White blood cells (T lymphocytes mostly) anchor themselves to this mesh of protein fibers (called a **stroma**) and monitor the passing fluid for pathogens.

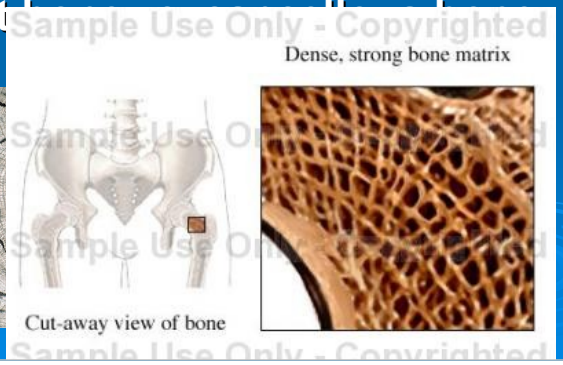
Reticular connective tissue forms a stroma in the spleen, the thymus and the lymph nodes.



Another view of reticular connective tissue from the spleen.

Bone

- Matrix mostly ground substance (calcium phosphate) and collagen fibers.
- Cells: **osteocytes** in **lacunae**
- **Compact**



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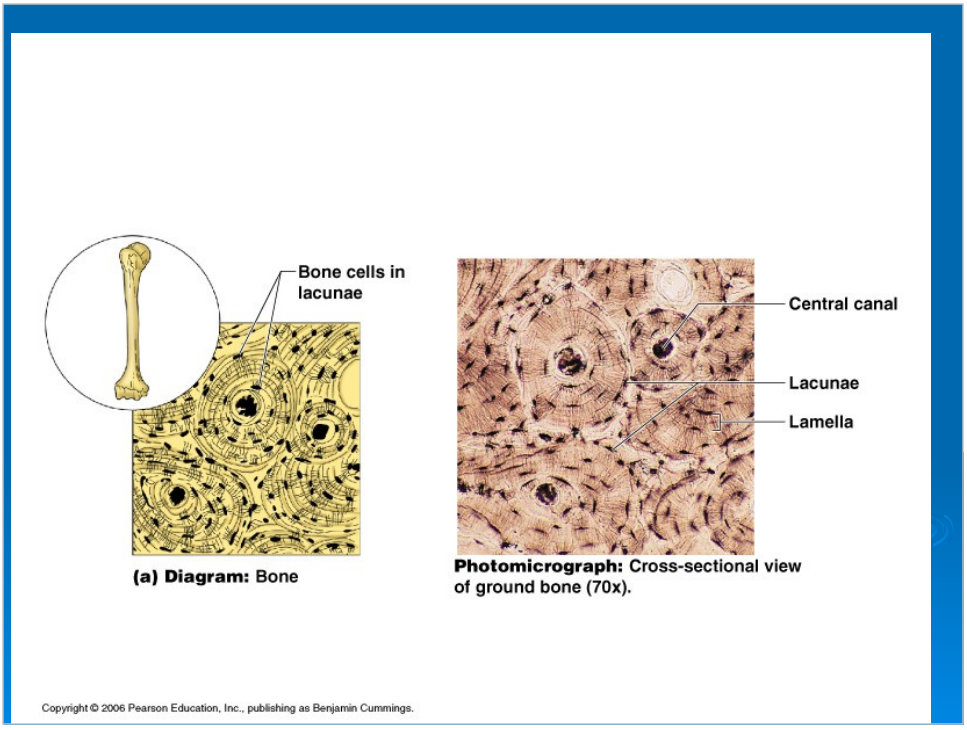
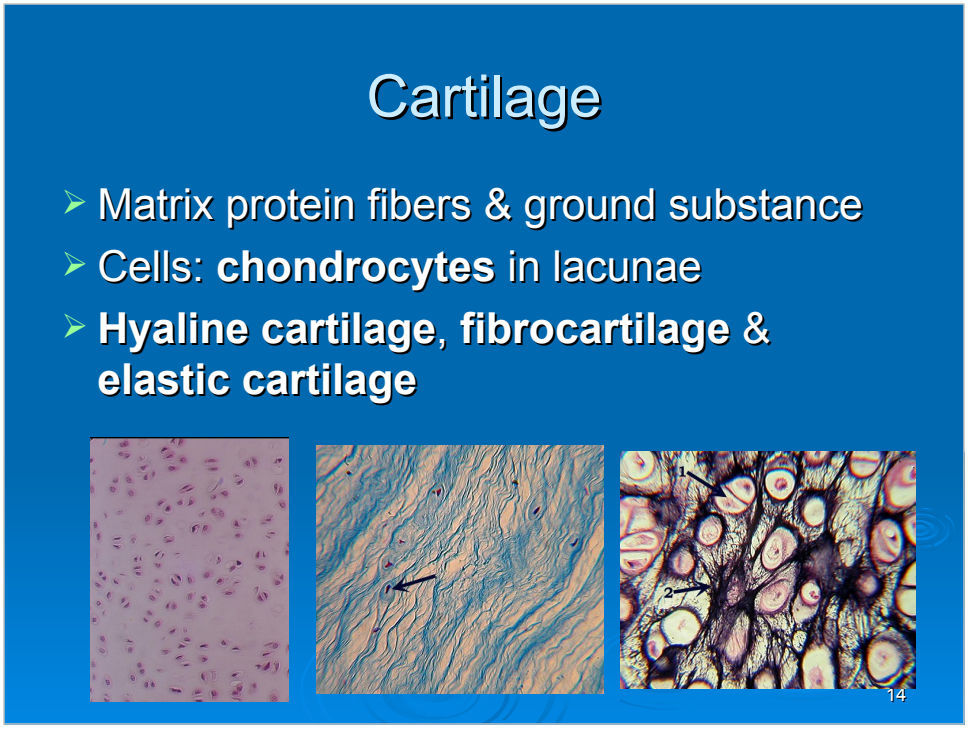
Bone is noteworthy because it is so strong and rigid, making it excellent for support and protection. It gets its rigidity from its ground substance, which is mostly calcium phosphate and collagen fibers. Trapped inside the bone tissue are several **osteocytes**, which are actually all interconnected through tubes called *canaliculi*. The osteocytes reside in holes in the matrix called **lacunae**.

There are two categories of bone. **Compact bone** is very dense and very strong, but also very heavy. **Cancellous bone** has lots of holes in it filled with bone marrow, which makes it lighter. All bones have both compact bone tissue and cancellous bone tissue.



Another slide of compact bone.



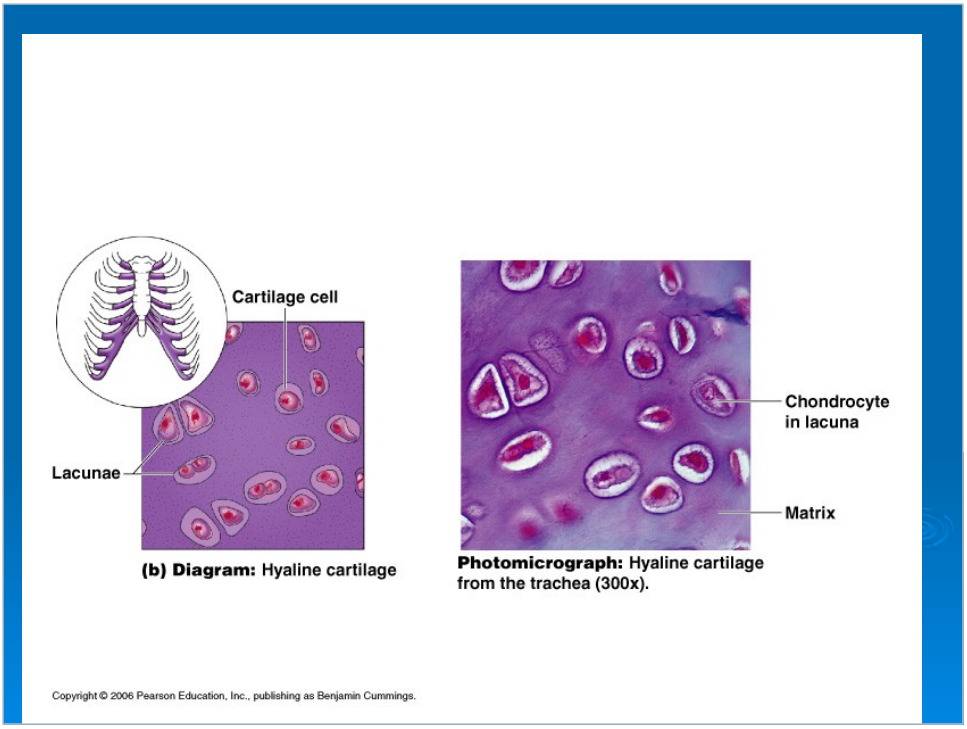
Cartilage has a matrix very similar to bone (in fact, the human skeleton starts out as cartilage and is gradually replaced by bone tissue), but the ground substance is different.

Hyaline cartilage, which is found lining the ends of bones in moveable joints, has a ground substance consisting mostly of collagen fibers and molecules called **proteoglycans**. The proteoglycans trap and store huge amounts of water, which makes the hyaline cartilage very smooth, very slippery, and very cushiony – ideal for protecting the ends of bones in moveable joints. Hyaline cartilage is also found anchoring the ribs to the sternum.

Fibrocartilage is found between each vertebra in the spine. Its ground substance is similar to hyaline cartilage, but it has more elastic fibers so it can stretch. Whenever we bend over or tilt our head, the vertebrae tilt away from each other, so the cartilage between these bones needs to be able to stretch.

Elastic cartilage has even more elastic fibers so it can bend, and then recoil to its original shape. Elastic cartilage makes up our outer ears and the tips of our noses.

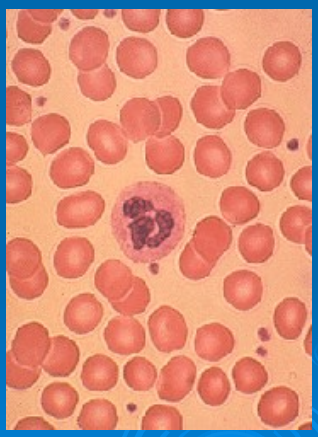
Cells in cartilage are also trapped in lacunae, and are called **chondrocytes**.



This figure shows chondrocytes trapped in the lacunae of hyaline cartilage.

Blood

- Matrix mostly fluid (**plasma**)
- Cells: **erythrocytes**, **leukocytes**, **plateletes**



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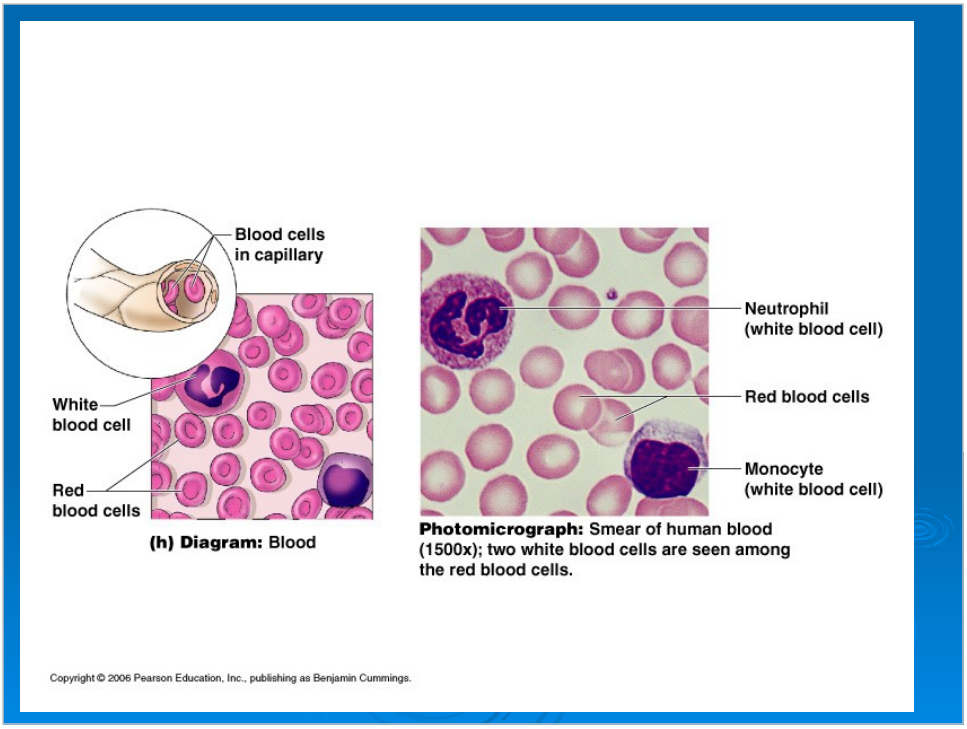
Blood has a matrix consisting (obviously) mostly of fluid. This fluid is called **plasma** and while it's mostly water, it also contains dissolved minerals, gasses, hormones and nutrients. There are three types of cells in blood:

Erythrocytes (red blood cells) are filled with a molecule called *hemoglobin* which carries oxygen throughout the body. (Hemoglobin also carries some carbon dioxide)

Leukocytes (white blood cells) are involved in defending the body against pathogens. There are several types of white blood cells which we'll learn about later, but they're all involved in defense.

Platelets are small fragments of cells that clump together to stop blood loss when a blood vessel is damaged.



Erythrocytes are the most numerous of the blood cells.