Grade 12 NTI Day #7 Anatomy

Assignment: Please read the excerpt below as an independent reading assignment. Then read and answer the questions below the excerpt.

START Here
(READ 3.5)

3.5 Connective Tissue

Connective tissue, as its name suggests, connects body parts. It is found everywhere in the body. It is the most abundant and widely distributed of the tissue types. Connective tissues perform many functions, but they are primarily involved in *protecting*, *supporting*, *cushioning*, and *insulating* other body tissues.

3.5a Hallmarks of Connective Tissue

The distinguishing characteristics of connective tissue include the following:

- **Variations in blood supply.** Many connective tissues are well *vascularized* (that is, they have a good blood supply), but there are exceptions. Tendons and ligaments, for example, have a poor blood supply, and cartilages are avascular. Consequently, all these structures heal very slowly when injured. (This is why some people say that, given a choice, they would rather have a broken bone than a torn ligament.)

- **Extracellular matrix.** Connective tissues are made up of many different types of cells plus varying amounts of a nonliving substance found outside the cells, called the *extracellular matrix.*

3.5b Extracellular Matrix

The **extracellular matrix** deserves a bit more explanation because it is what makes connective tissue so different from the other tissue types. The matrix, which is produced by the connective tissue cells and then secreted to their exterior, has two main elements, a structureless ground substance and fibers. The *ground substance* of the matrix is composed largely of water plus some cell adhesion proteins and large, charged polysaccharide molecules. The cell adhesion proteins serve as a glue that allows the connective tissue cells to attach themselves to the matrix fibers embedded in the ground substance. The charged polysaccharide molecules trap water as they intertwine. As these polysaccharides become more abundant, they cause the matrix to vary from fluid to gel-like to firm in its consistency.

Depending on the connective tissue type, various types and amounts of fibers contribute to the matrix. These include collagen fibers distinguished by their high tensile strength; elastic fibers, which have the bility to stretch and recoil; and reticular fibers, hich are fine collagen fibers that form the internal skeleton" of soft organs such as the spleen. The building blocks, or *monomers*, of these fibers are made by the connective tissue cells and secreted into the ground substance in the extracellular space, where they join together to form the various fiber types.

Because of the variations in extracellular matrix, connective tissues are able to form soft packing tissues around other organs, to bear weight, and to withstand stretching and other abuses, such as abrasion, that no other tissue could endure.

3.5c Types of Connective Tissue

As noted previously, all connective tissues consist of living cells surrounded by extracellular matrix. Their major differences reflect specific cell types, fiber types, and the number of fibers in the matrix. At one extreme, bone and cartilage have very few cells and large amounts of hard matrix, which makes them extremely strong. At the opposite extreme, fat tissue is composed mostly of cells, and the matrix is soft. From most rigid to softest or most fluid, the major connective tissue classes are *bone, cartilage, dense connective tissue, loose connective tissue,* and *blood.* Find the various types of connective tissues in Figure 3.19 as you read the following descriptions.

Bone

Bone, sometimes called *osseous* (os'e-us) *tissue*, is composed of *osteocytes* (os'te-o-sīts; bone cells) sitting in cavities called *lacunae* (lah-ku'ne; "pits"). These pits are surrounded by layers of a very hard matrix that contains calcium salts in addition to large numbers of collagen fibers (Figure 3.19a). Because of its rocklike hardness, bone has an exceptional ability to protect and support other body organs (for example, the skull protects the brain). (We consider bone in detail in Chapter 5.)

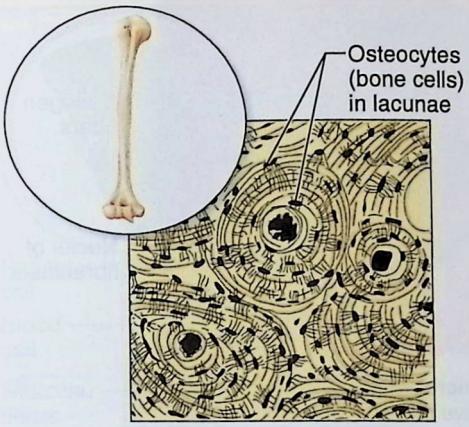
Cartilage

Cartilage is less hard and more flexible than bone. Its major cell type is *chondrocytes* (cartilage cells). It is found in only a few places in the body. Most widespread is **hyaline** (hi'ah-lin) **cartilage**, which has abundant collagen fibers hidden by a rubbery matrix with a glassy (*hyalin* = glass), blue-white appearance (Figure 3.19b). It forms the trachea, or windpipe, attaches the ribs to the breastbone, and covers bone ends at joints. The skeleton of a fetus is made largely of hyaline cartilage; but by the time the baby is born, most of that cartilage has been replaced by bone. The exceptions include the *epiphyseal*, or growth, *plates* in long bones, which allow the bones to grow in length.

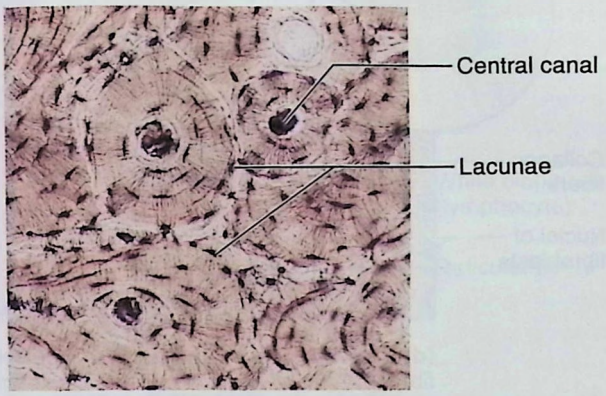
Although hyaline cartilage is the most abundant type of cartilage in the body, there are others. Highly compressible **fibrocartilage** forms the cushionlike disks between the vertebrae of the spinal column (Figure 3.19c). **Elastic cartilage** is found in structures with elasticity, such as the external ear. (Elastic cartilage is not illustrated in Figure 3.19.)

Dense Connective Tissue

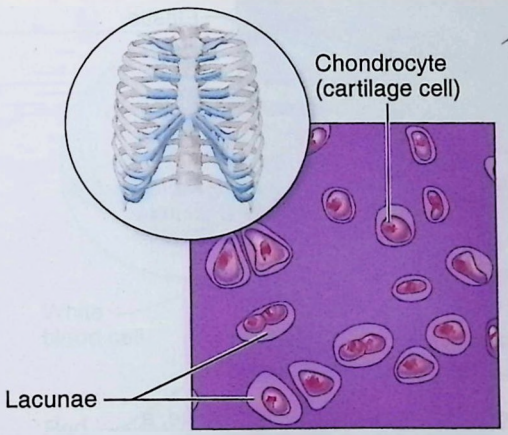
In **dense connective tissue**, also called **dense regular fibrous tissue**, collagen fibers are the main matrix element (Figure 3.19d). Crowded between the collagen fibers are rows of *fibroblasts* (fiber-forming cells) that manufacture the building blocks of the fibers. Dense regular connective tissue forms strong, ropelike structures such as tendons and ligaments that withstand tension in one direction. **Tendons** attach skeletal muscles to bones; **ligaments** connect bones to bones at joints. Ligaments are more stretchy and contain more elastic fibers than do tendons. Another dense connective tissue, dense irregular



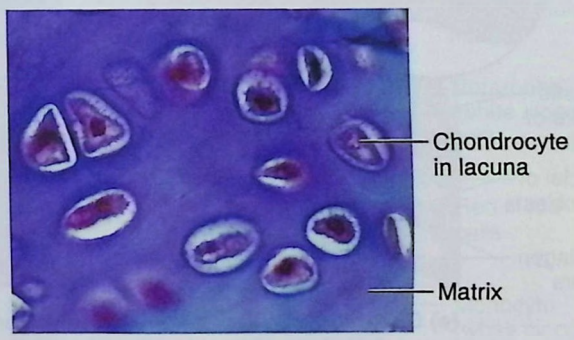
(a) **Diagram:** Bone



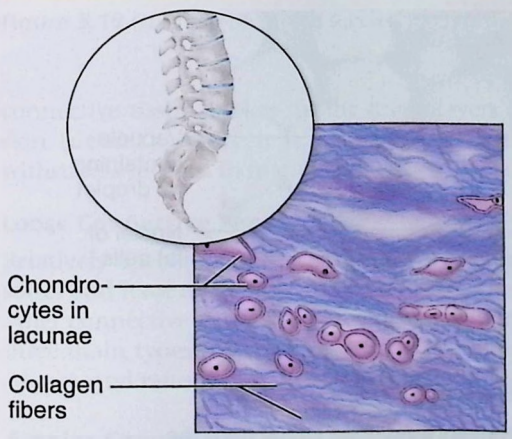
Photomicrograph: Cross-sectional view of bone (165×).



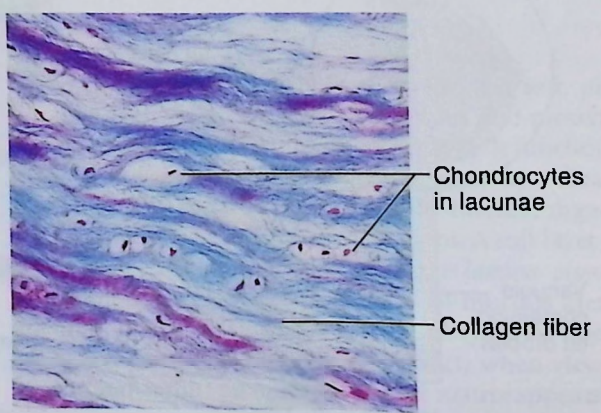
(b) **Diagram:** Hyaline cartilage



Photomicrograph: Hyaline cartilage from the trachea (400×).



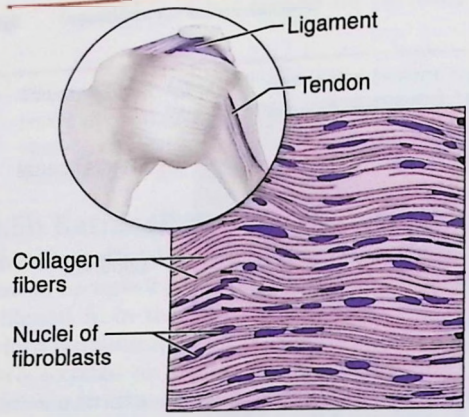
(c) **Diagram:** Fibrocartilage



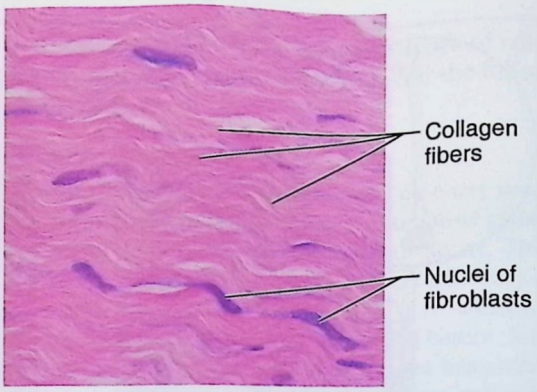
Photomicrograph: Fibrocartilage of an intervertebral disc (150×).

Figure 3.19 Connective tissues and their common body locations.

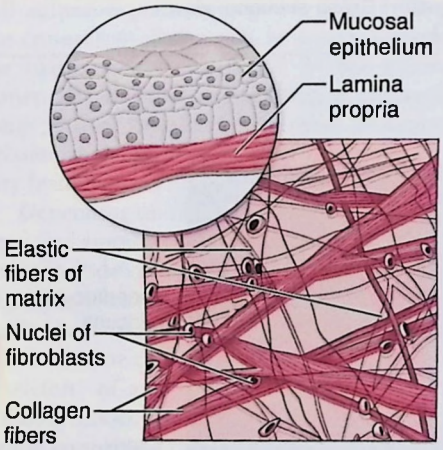
(Figure continues on page 94.)



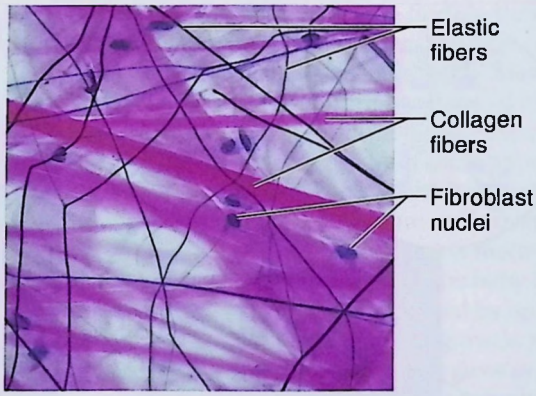
(d) Diagram: Dense regular fibrous



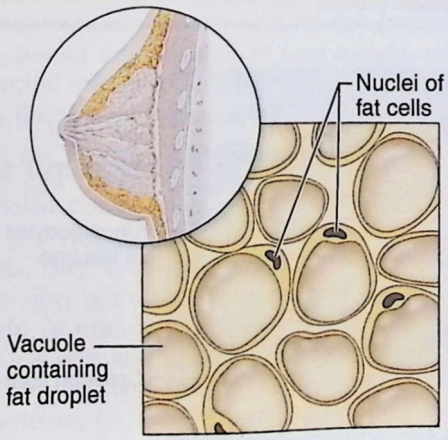
Photomicrograph: Dense regular fibrous connective tissue from a tendon (475×).



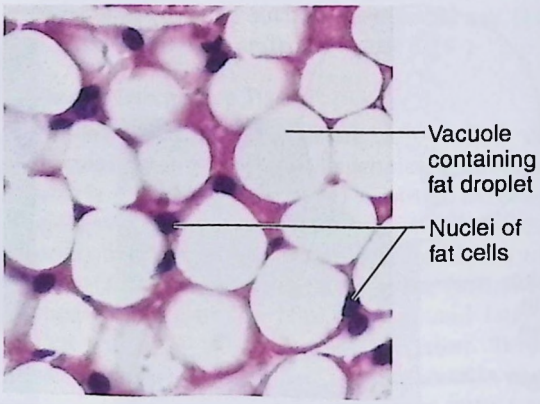
(e) Diagram: Areolar



Photomicrograph: Areolar connective tissue, a soft packaging tissue of the body (270×).

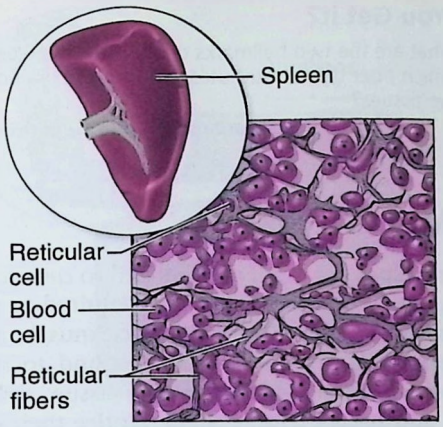


(f) Diagram: Adipose

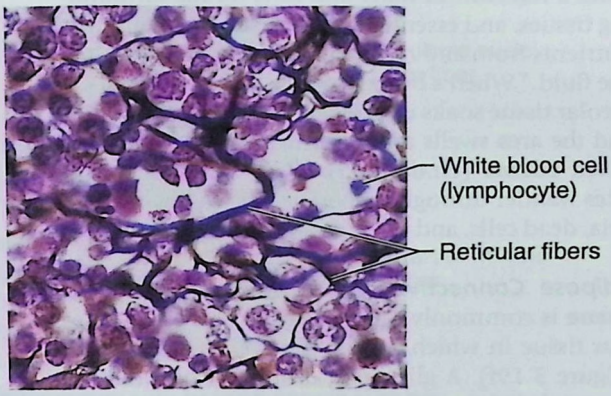


Photomicrograph: Adipose tissue from the subcutaneous layer beneath the skin (570×).

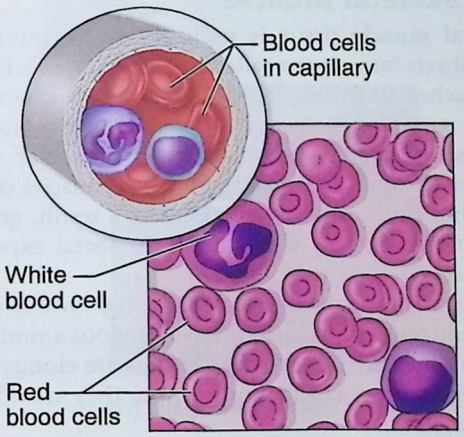
Figure 3.19 *(continued)* **Connective tissues and their common body locations.**
(e) and **(f)** are subclasses of loose connective tissues.



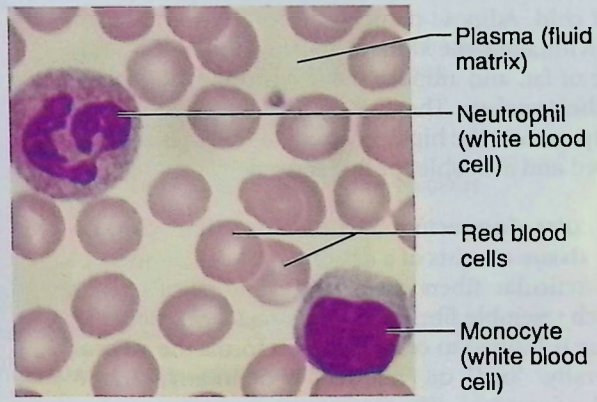
(g) **Diagram:** Reticular



Photomicrograph: Dark-staining network of reticular connective tissue (400×).



(h) **Diagram:** Blood



Photomicrograph: Smear of human blood (1290×)

Figure 3.19 *(continued)* **(g)** is a subclass of loose connective tissue.

connective tissue, makes up the lower layers of the skin (dermis), where it is arranged in sheets and withstands tension in many directions (not shown).

Loose Connective Tissue

Relatively speaking, **loose connective tissues** are softer and have more cells and fewer fibers than any other connective tissue type except blood. There are three main types of loose connective tissue: *areolar*, *adipose*, and *reticular*.

Areolar Connective Tissue **Areolar** (ah-re'o-lar) **connective tissue**, the most widely distributed connective tissue variety in the body, is a soft, pliable, "cobwebby" tissue that cushions and protects the body organs it wraps (Figure 3.19e). It functions as a universal packing tissue and connective tissue "glue" because it helps to hold the internal organs together and in their proper positions. A soft layer of areolar connective tissue called the *lamina propria* (lă'mĭ-nah pro'pre-ah) underlies all mucous membranes. Its fluid matrix contains all types of fibers, which form a loose network. In fact, when viewed through a microscope, most of the matrix appears to be empty space, which explains the name of this tissue type (*areola* = small open space). Because of its

loose and fluid nature, areolar connective tissue provides a reservoir of water and salts for the surrounding tissues, and essentially all body cells obtain their nutrients from and release their wastes into this "tissue fluid." When a body region is inflamed, the local areolar tissue soaks up the excess fluid like a sponge, and the area swells and becomes puffy, a condition called **edema** (eh-de'mah). Many types of phagocytes wander through this tissue, scavenging for bacteria, dead cells, and other debris, which they destroy.

Adipose Connective Tissue **Adipose** (ad'ĭ-pōs) **tissue** is commonly called *fat*. Basically, it is an areolar tissue in which *adipose* (fat) cells predominate (Figure 3.19f). A glistening droplet of oil occupies most of a fat cell's volume and compresses the nucleus, displacing it to one side.

Adipose tissue forms the subcutaneous tissue beneath the skin, where it insulates the body and protects it from bumps and extremes of both heat and cold. Adipose tissue also protects some organs individually—the kidneys are surrounded by a capsule of fat, and adipose tissue cushions the eyeballs in their sockets. There are also fat "depots" in the body, such as the hips, breasts, and belly, where fat is stored and available for fuel if needed.

Reticular Connective Tissue **Reticular connective tissue** consists of a delicate network of interwoven reticular fibers associated with *reticular cells*, which resemble fibroblasts (Figure 3.19g). Reticular tissue is limited to certain sites: It forms the **stroma** (literally, "bed" or "mattress"), or internal framework of an organ. The stroma can support many free blood cells (largely white blood cells called lymphocytes) in lymphoid organs such as lymph nodes, the spleen, and bone marrow. It may help to think of reticular tissue as "cellular bleachers" where other cells can observe their surroundings.

Blood

Blood, or *vascular tissue*, is considered a connective tissue because it consists of *blood cells* surrounded by a nonliving, fluid matrix called *blood plasma* (Figure 3.19h). The "fibers" of blood are soluble proteins that become visible only during blood clotting. Still, blood is quite atypical as connective tissues go. Blood is the transport vehicle for the cardiovascular system, carrying nutrients, wastes, respiratory gases, white blood cells, and many other substances throughout the body. (We consider blood in detail in Chapter 10.)

STOP HERE. Skip to Question Sheet.

Anatomy NTI Day #7 Questions

Multiple Choice Questions

1. **What are the two hallmarks of connective tissue?**
   a) Avascular and tightly packed cells
   b) Variations in blood supply and an extracellular matrix
   c) Specialized cell junctions and rapid regeneration
   d) Multiple layers and elasticity
2. **Which type of connective tissue consists primarily of collagen fibers and forms strong, ropelike structures such as tendons and ligaments?**
   a) Areolar connective tissue
   b) Dense connective tissue
   c) Adipose tissue
   d) Reticular connective tissue
3. **What is the primary function of adipose tissue?**
   a) Transport nutrients and gases
   b) Form the framework of soft organs
   c) Store energy, insulate, and cushion the body
   d) Support and protect bones

Short Answer Question

4. **Explain why blood is classified as a connective tissue even though it has a fluid matrix.**
