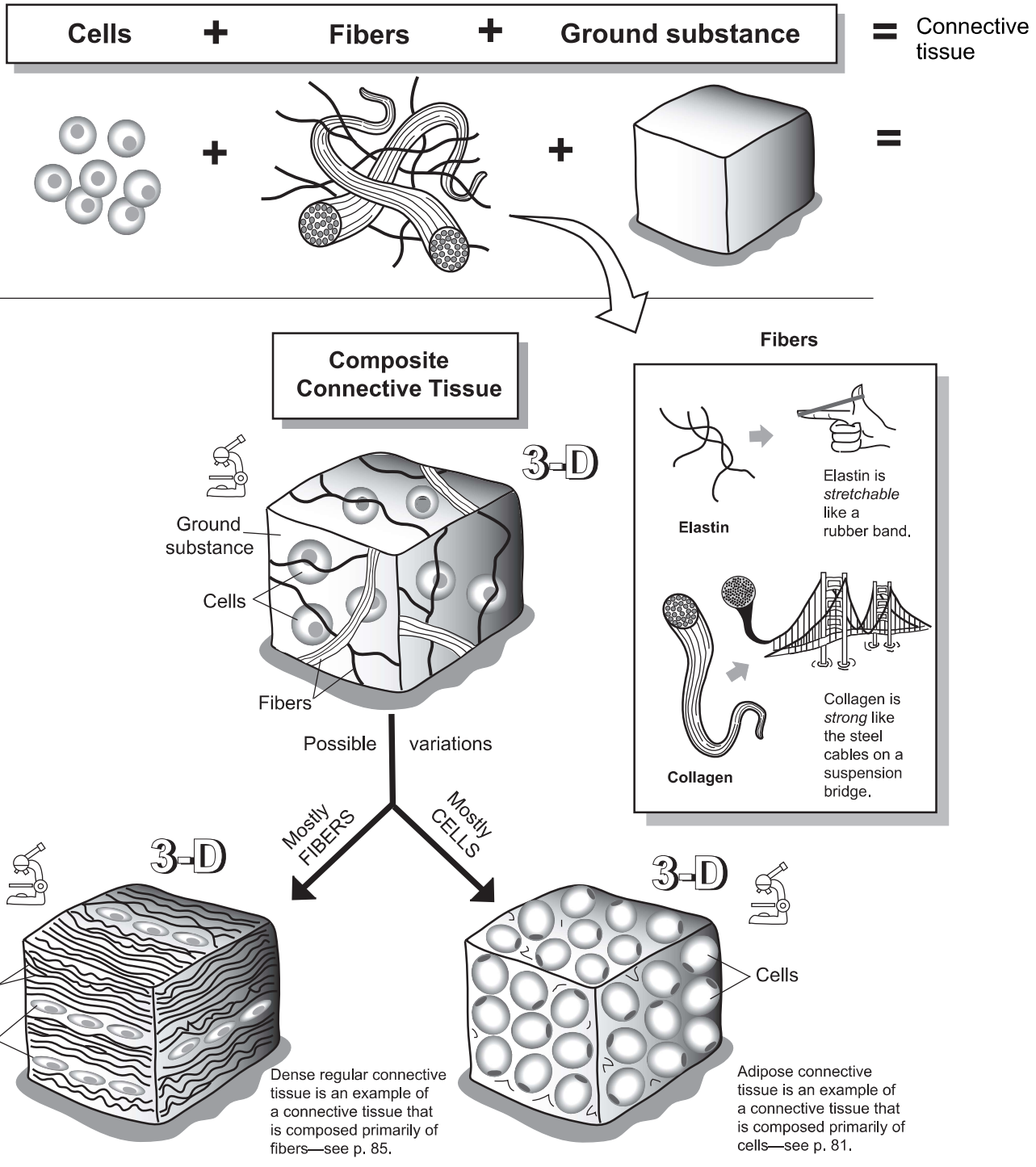
All connective tissues contain the following basic components:



Areolar Connective Tissue

Description

Connective tissues primarily give structural support to other tissues and organs in the body. Though there are a wide variety of types, all are composed of cells, fibers, and ground substance. The most common cell type is called a **fibroblast**, which manufactures the fibers and other extracellular material. The two most common types of protein fibers produced are **collagen** and **elastin**. Collagen is for strength and elastin is for elasticity. The cells and the fibers are both embedded in a gel-like material called the **ground substance**. The ground substance varies in consistency from being gelatin-like to a much more rigid material.

Loose connective tissues have fewer fibers than other connective tissues and serve as a protective padding in the body. The three tissues classified as loose connective tissues are: *areolar connective tissue*, *adipose connective tissue*, and *reticular connective tissue*.

Areolar connective tissue has a random arrangement of cells, fibers, and ground substance. It contains all the basic components of any connective tissue without being specialized.

Location

Beneath epithelial tissues all over the body; between skin and skeletal muscles; surrounding blood vessels; within skin; around organs; around joints

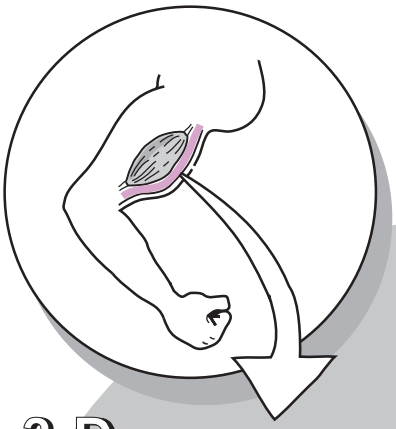
Function

Cushions and protects organs; its phagocytes protect against pathogens; holds tissue fluid

Key to Illustration

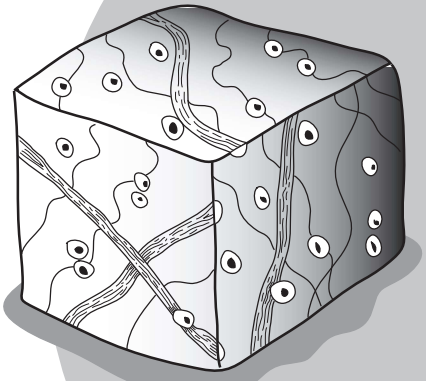
1. Collagen fibers
2. Elastin fibers
3. Fibroblast nuclei

Location



Fun Fact: When hunters skin an animal, the tissue they break to separate skin from muscle is areolar connective tissue.

3-D

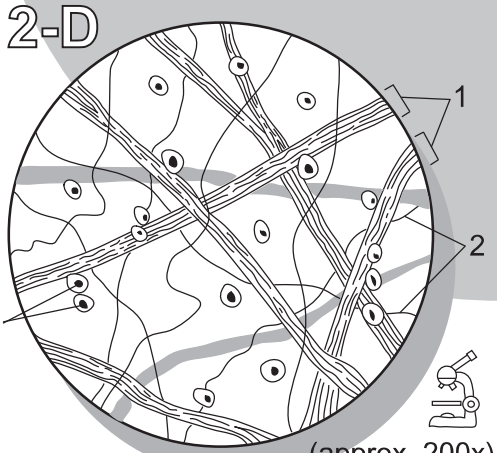


RANDOM

This tissue type is not specialized, so it does not look like anything in particular. It has a random arrangement of fibers and cells—nothing special!

2-D

Color the cells and fibers different colors.



(approx. 200x)

1. _____
2. _____
3. _____

My drawing of areolar connective tissue

Adipose Connective Tissue

Description

Connective tissues primarily give structural support to other tissues and organs in the body. Though there are a wide variety of types, all are composed of cells, fibers, and ground substance. The most common cell type, called a **fibroblast**, manufactures fibers and other extracellular material. The two most common types of protein fibers produced are **collagen** and **elastin**. Collagen is for strength and elastin is for elasticity. The cells and the fibers are both embedded in a gel-like material called the **ground substance**. The ground substance varies in its consistency from being gelatin-like to a much more rigid material.

Loose connective tissues have fewer fibers than other connective tissues and serve as a protective padding in the body. There are three tissues classified as loose connective tissues: *areolar connective tissue*, *adipose connective tissue*, and *reticular connective tissue*.

Adipose connective tissue is fat tissue. It is composed almost entirely of fat cells called **adipocytes** along with some blood vessels. These cells have a large vacuole to store lipids (*fats*). Though adipocytes are not able to divide, they do change in size by expanding or shrinking depending on the amount of lipid that is stored inside their vacuoles. For example, as a person loses weight, the amount of lipid in the adipocyte's vacuole decreases, causing the cell to shrink in size. Unfortunately, if a person regains that weight, the cells are able to expand back to their original size.

Location

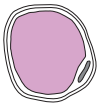
Under all skin but especially in abdomen, buttocks, and breasts; around some organs such as eyeballs and kidneys.

Function

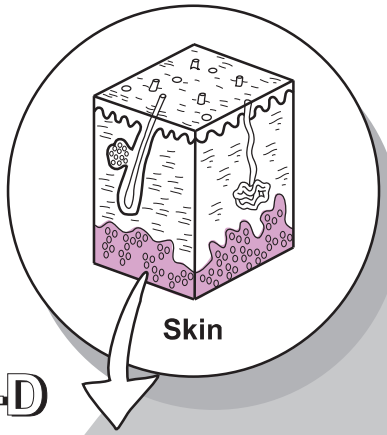
Protects certain organs and other structures; insulates against heat loss through the skin; stores energy as a reserve fuel.

Key to Illustration

1. Blood vessel
2. Nuclei of adipocytes *(fat cells)*
3. Vacuole for lipid storage
4. Plasma membrane of adipocyte *(fat cell)*

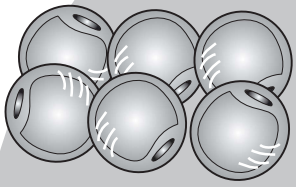


Location

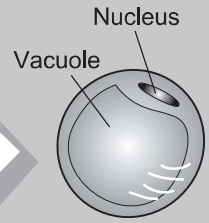


Fun Fact: Excess adipose tissue can be removed by a surgical procedure called liposuction, but it does have some risks.

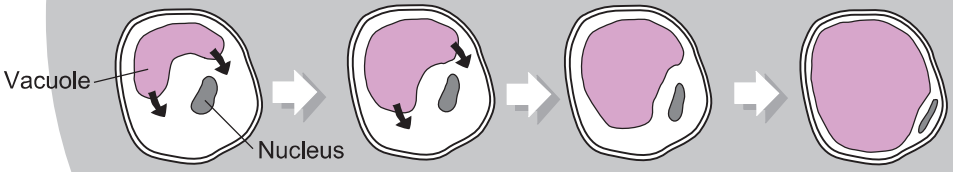
3-D



A cluster of six adipocytes *(fat cells)*



One adipocyte *(fat cell)*

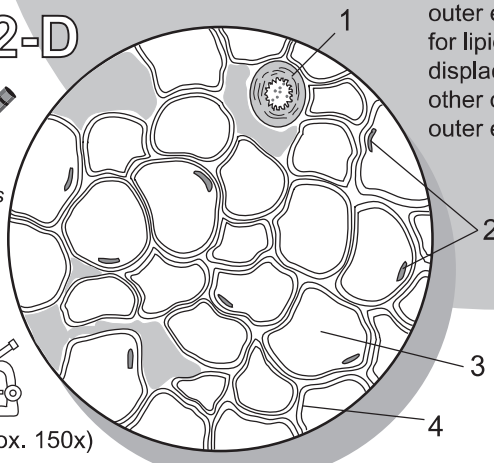


Adipocyte

Why is an adipocyte's nucleus located at the outer edge of the cell? Because the vacuole for lipid storage expands as it fills, and displaces the nucleus and other organelles to the outer edge of the cell.

2-D

Color the adipocytes the same color.



(approx. 150x)

1. _____
2. _____
3. _____
4. _____

My drawing of adipose connective tissue

Reticular Connective Tissue

Description

Connective tissues primarily give structural support to other tissues and organs in the body. Though there are a wide variety of types, all are composed of cells, fibers, and ground substance. The most common cell type, called a **fibroblast**, manufactures fibers and other extracellular material. The two most common types of protein fibers produced are **collagen** and **elastin**. Collagen is for strength and elastin is for elasticity. The cells and the fibers are both embedded in a gel-like material called the **ground substance**. The ground substance varies in its consistency from being gelatin-like to a much more rigid material.

Loose connective tissues have fewer fibers than other connective tissues and serve as a protective padding in the body. There are three tissues classified as loose connective tissues: *areolar connective tissue*, *adipose connective tissue*, and *reticular connective tissue*.

Reticular (*reticulata* = net) **connective tissue** primarily consists of a network of reticular fibers. The most common cell type is the reticular cell, but it also contains fibroblasts and macrophages.

Analogy

Reticular connective tissue is like **many cobwebs**. The **cobweb** itself is like the **network of reticular fibers** scattered throughout the tissue, which physically supports a variety of cell types.

Location

Spleen, bone marrow, lymph nodes, liver, and kidney

Function

Fibers form a supportive net-like structure for a variety of cell types.

Key to Illustration

1. Reticular fibers

Dense *(fibrous)* Regular Connective Tissue

Description

Connective tissues primarily give structural support to other tissues and organs in the body. Though there are a wide variety of types, all are composed of cells, fibers, and ground substance. The most common cell type is called a **fibroblast,** which manufactures fibers and other extracellular material. The two most common types of protein fibers produced are **collagen** and **elastin**. Collagen is for strength, and elastin is for elasticity. The cells and fibers are both embedded in a gel-like material called the **ground substance**. The ground substance varies in its consistency from being gelatin-like to a much more rigid material.

Dense regular connective tissue is composed primarily of collagen fibers, so it is also called *fibrous connective* or *collagenous tissue*. The body has two types of dense connective tissue: dense *regular* connective and dense *irregular* connective. Dense *regular* connective tissue is characterized by a large proportion of collagen fibers that are stacked on top of each other in an orderly arrangement.

Analogy

Layers of **collagen fibers** are strong like the **steel cables on a suspension bridge**.

Location

Tendons and aponeuroses; ligaments; covering around skeletal muscles.

Function

Anchors skeletal muscle to bone; attaches bone to bone; packages skeletal muscles; stabilizes bones within a joint.

Study Tips

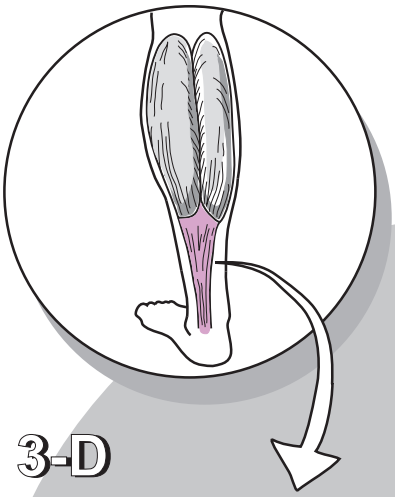
- Fibroblasts are in rows sandwiched between collagen fibers.
- Collagen fibers are layered in an organized arrangement.

Key to Illustration

1. Collagen fibers
2. Nuclei of fibroblasts

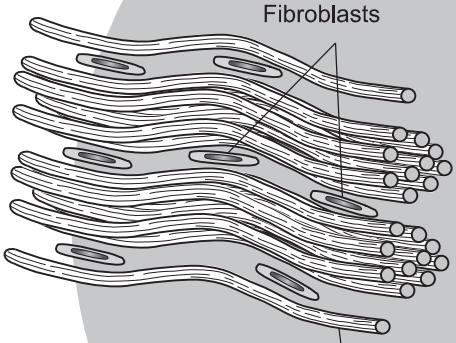
Dense *(fibrous)* Regular Connective Tissue

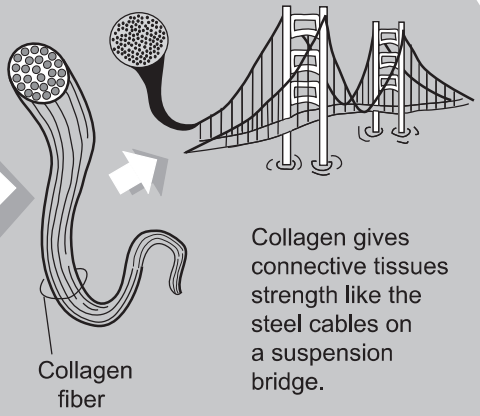
Location



Fun Fact: The calcaneal, or Achilles' tendon is the strongest tendon in the body.

3-D

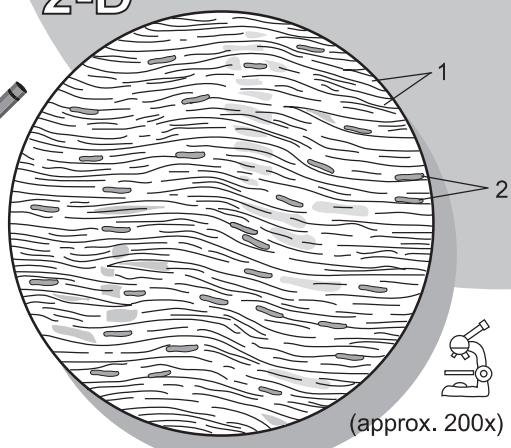




Collagen gives connective tissues strength like the steel cables on a suspension bridge.

2-D

Color the collagen fibers the same color.



(approx. 200x)

1. _____
2. _____

My drawing of
dense regular connective tissue

Dense Irregular Connective Tissue

Description

Connective tissues primarily give structural support to other tissues and organs in the body. Though they are of a wide variety of types, all are composed of cells, fibers, and ground substance. The most common cell type is called a **fibroblast**, which manufactures the fibers and other extracellular material. The two most common types of protein fibers produced are **collagen** and **elastin**. Collagen is for strength and elastin is for elasticity. The cells and the fibers are both embedded in a gel-like material called the **ground substance**. The ground substance varies in its consistency from being almost like gelatin to a much more rigid material.

There are two types of dense connective tissue in the body, namely, dense *regular* connective and dense *irregular* connective. Dense *irregular* connective tissue is characterized by a random arrangement of collagen fibers and a greater proportion of ground substance.

Location

Dermis of the skin; periosteum; visceral organ capsules; around muscles.

Function

Resists stresses applied in many different directions

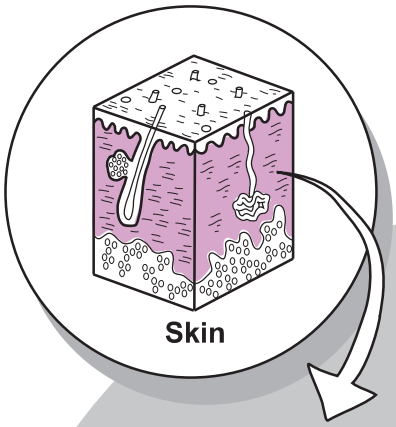
Study Tips

- Fibroblasts are more scattered throughout the tissue
- Collagen fibers are **not** stacked on top of each other, randomly arranged

Key to Illustration

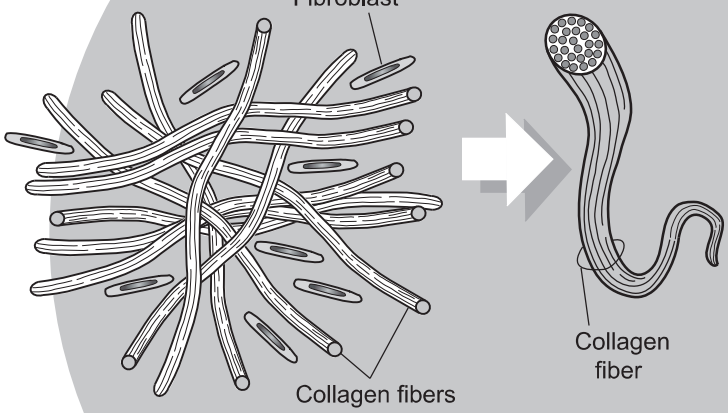
1. Nucleus of fibroblast
2. Collagen fibers
3. Ground substance

Location



FUN FACT: Collagen in the dermis of the skin breaks down as we age. Collagen injections are a cosmetic procedure used to smooth facial lines.

3-D

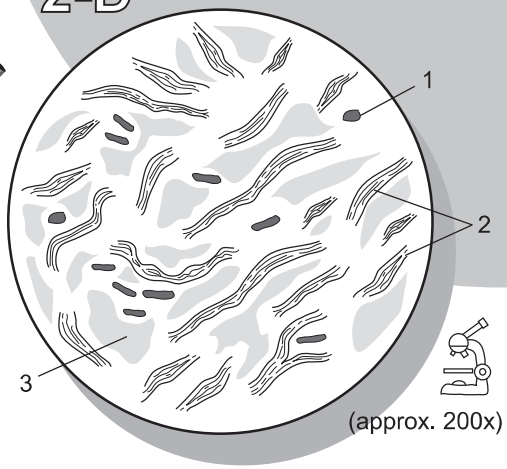


Irregular = RANDOM

Compared to dense regular connective tissue, this tissue has its collagen fibers arranged more randomly

2-D

Color the collagen fibers the same color.



1. _____
2. _____
3. _____

My drawing of
dense irregular connective tissue

Description

Connective tissues primarily give structural support to other tissues and organs in the body. Though there are a wide variety of types, all are composed of cells, fibers, and matrix.

Cartilage is a specialized type of connective tissue. It is characterized by three traits: **lacunae**, **chondrocytes,** and a rigid **matrix**. The **matrix** is a firm gel material that contains protein fibers and other substances. Within the matrix are small cavities called **lacunae**. Within the lacunae are living cartilage cells called **chondrocytes**. Because cartilage lacks blood vessels, chondrocytes rely on the diffusion of nutrients into the matrix to survive.

The three basic types of cartilage in the body are:

- **Hyaline cartilage**
- **Elastic cartilage**
- **Fibrocartilage**

Hyaline cartilage is the most common type of cartilage.

Analogy

Three dimensionally, a piece of **any type of cartilage** is similar to a **block of Swiss cheese** in its structure and general consistency. Though cartilage is much stronger, both are solid and flexible. The **cheese** itself is the **matrix** and the **holes** are the **lacunae**.

Location

Covers ends of long bones in synovial joints; between ribs and sternum; cartilages of nose, trachea, larynx, and bronchi; most portions of embryonic skeleton.

Function

Structural reinforcement, slightly flexible support; reduces friction within joints.

Study Tip

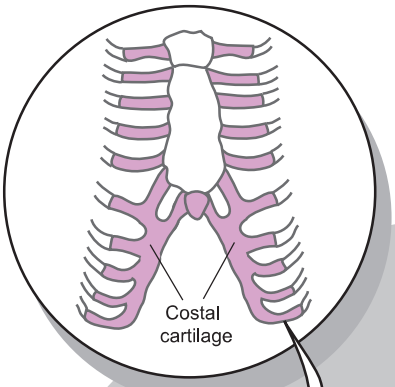
To identify this tissue either under the microscope or from a photograph, look for the following:

- This is the **only cartilage type with no apparent fibers** (*they are present but do not stain well*).
- Chondrocytes are evenly scattered within matrix.

Key to Illustration

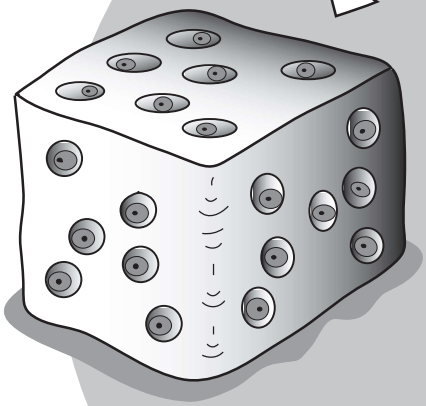
1. Matrix
2. Lacunae
3. Chondrocytes *(cartilage cells)*
4. Nucleus of a chondrocyte

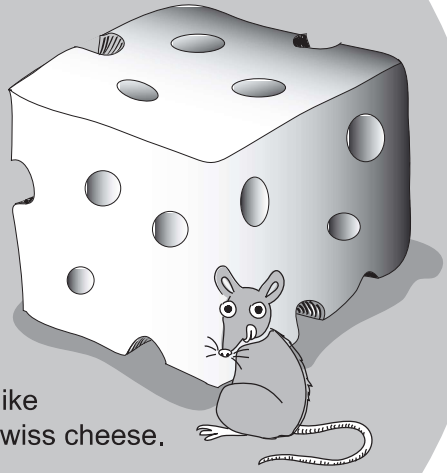
Location



Fun Fact: Most of the bones in the fetus are made of hyaline cartilage and later ossify into bone.

3-D

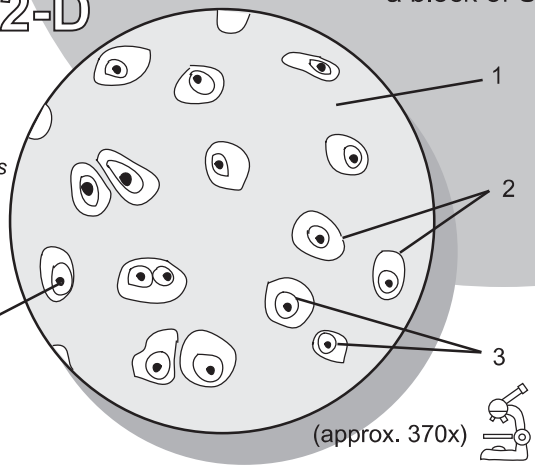




A block of cartilage is like a block of Swiss cheese.

2-D

Color the chondrocytes the same color.



(approx. 370x)

1. Interteritorial matrix
2. Territorial matrix
3. _____
4. Chondrocytes

My drawing of hyaline cartilage

Elastic Cartilage

Description

Connective tissues primarily give structural support to other tissues and organs in the body. Though there are a wide variety of types, all are composed of cells, fibers, and matrix.

Cartilage is a specialized type of connective tissue. It is characterized by three traits: **lacunae**, **chondrocytes,** and a rigid **matrix**. The **matrix** is a firm gel material that contains protein fibers and other substances. Within the matrix are small cavities called **lacunae**. Within the lacunae are living cartilage cells called **chondrocytes**. Because cartilage lacks blood vessels, chondrocytes rely on the diffusion of nutrients into the matrix to survive.

The three basic types of cartilage in the body are:

- **Hyaline cartilage**
- **Elastic cartilage**
- **Fibrocartilage**

Elastic cartilage is the most durable and flexible type of cartilage, because of the presence of many elastic fibers.

Analogy

Three dimensionally, a piece of **any type of cartilage** is similar to a **block of Swiss cheese** in its structure and general consistency. Though cartilage is much stronger, both are solid and flexible. The **cheese** itself is the **matrix** and the **holes** are the **lacunae**.

Location

External ear; epiglottis; auditory canal

Function

Provides support while easily returning to original shape when distorted.

Study Tip

To identify this tissue either under the microscope or from a photograph, look for the following:

- Chondrocytes appear larger than other cartilages.
- Numerous elastic fibers have appearance of plant roots branching in the soil.

Key to Illustration

1. Matrix
2. Lacunae
3. Chondrocytes *(cartilage cells)*
4. Elastin fiber
5. Nucleus of chondrocyte

Fibrocartilage

Description

Connective tissues primarily give structural support to other tissues and organs in the body. Though there are a wide variety of types, all are composed of cells, fibers, and matrix.

Cartilage is a specialized type of connective tissue. It is characterized by three traits: **lacunae**, **chondrocytes,** and a rigid **matrix**. The **matrix** is a firm gel material that contains protein fibers and other substances. Within the matrix are small cavities called **lacunae**. Within the lacunae are living cartilage cells called **chondrocytes**. Because cartilage lacks blood vessels, chondrocytes rely on the diffusion of nutrients into the matrix to survive.

The three basic types of cartilage in the body are:

- **Hyaline cartilage**
- **Elastic cartilage**
- **Fibrocartilage**

Fibrocartilage is the strongest of the three types because of the presence of many **collagen** fibers.

Analogy

Three dimensionally, a piece of **any type of cartilage** is similar to a **block of Swiss cheese** in its structure and general consistency. Though cartilage is much stronger, both are solid and flexible. The **cheese** itself is the **matrix** and the **holes** are the **lacunae**.

Location

Intervertebral discs; pubic symphysis; pads within knee joint

Function

Shock absorber in a joint; resists compression

Study Tips

To identify this tissue either under the microscope or from a photograph, look for the following:

- Has the most collagen fibers of any cartilage.
- Collagen fibers often appear in a wavy pattern.
- Chondrocytes are often seen in rows and/or small clusters.

Key to Illustration

1. Lacuna
2. Chondrocyte
3. Nucleus of a chondrocyte
4. Matrix

Bone *(osseous)* Tissue

Description

Connective tissues primarily give structural support to other tissues and organs in the body. Though there are a wide variety of types, all are composed of cells, fibers, and matrix.

Bone is a specialized type of connective tissue that has calcified into a hard substance. It is composed of organic and inorganic substances. The inorganic portion that constitutes about two-thirds of bone mass is made of modified calcium phosphate compounds called **hydroxyapatite**, while the organic portion is composed of **collagen** fibers. The two general types of bone are: spongy and compact. Spongy bone is less organized and is found in the ends of long bones and other places. Compact bone is more complex and orderly in structure and is found in the shaft of long bones and other locations.

Let's examine compact bone in more detail. The individual units in compact bone are tall, cylindrical towers called **osteons** (*Haversian systems*). In the middle of each osteon is a **central canal** that serves as a passageway for blood vessels. Around this canal are concentric rings of bony tissue called **lamellae**. Along each of these rings at regular intervals are small spaces called **lacunae** that contain a mature bone cell or **osteocyte**. Branching between individual lacunae are smaller passageways called **canaliculi**, which allow fluid with dissolved nutrients to travel to osteocytes.

Analogy

Each **surface of an osteon** looks like a **tree stump**. Both structures are made of hard, dense materials. Like the **growth rings** in a tree, the osteon has concentric rings called **lamellae**.

Location

Bones

Function

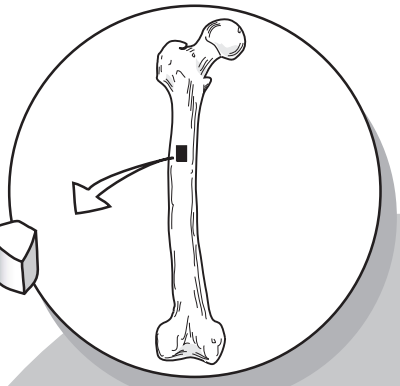
Bone supports body and protects vital organs; provides attachments for muscle to form a lever system for movement; stores calcium compounds and fat. Marrow contains stem cells that produce all blood cell types.

Key to Illustration

1. Osteon
2. Central canal
3. Osteocytes inside lacunae

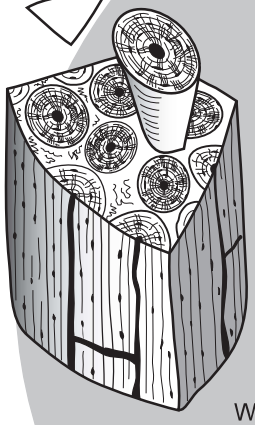
Bone *(osseous)* Tissue

Location

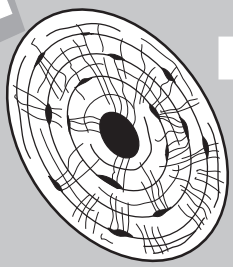


Fun Fact: Bone is stronger than concrete and nearly as strong as steel.

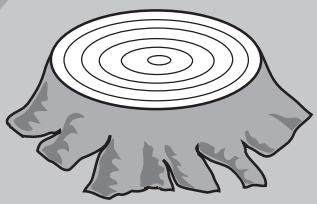
3-D



Wedge of compact bone



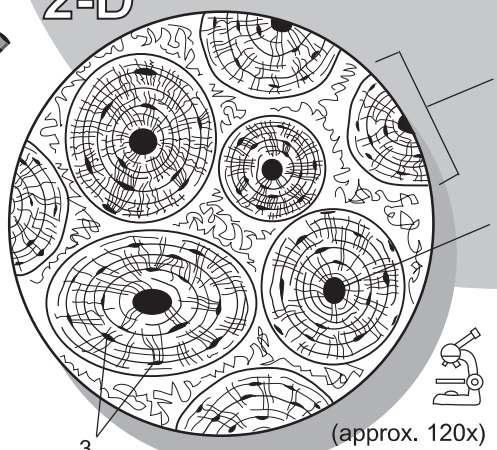
The surface of one osteon



From a superior view, each osteon looks like a tree stump.

2-D

Color the osteons the same color.



(approx. 120x)

1. _____
2. _____
3. _____

My drawing of compact bone