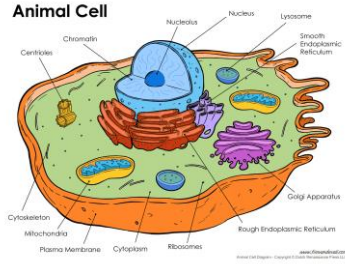


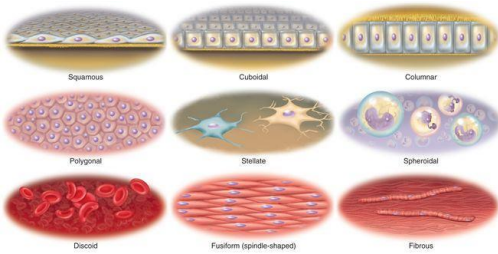
Tissues



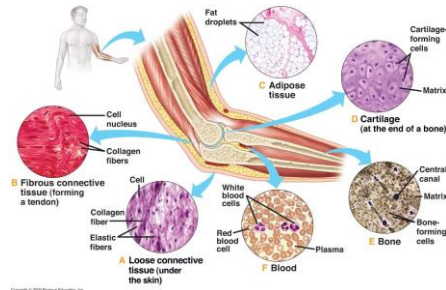
- This is a generalized cell diagram. It shows the anatomy of a cell, but most cells do not actually look like this.



- Cells can have a wide variety of shapes and sizes, depending on their function.

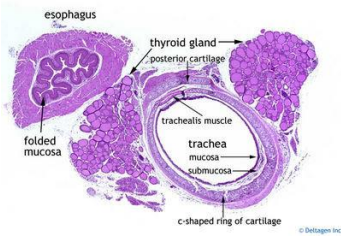


- Groups of cells that work together to perform a specific function are called **tissues**.

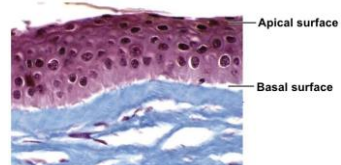


Epithelial Tissue

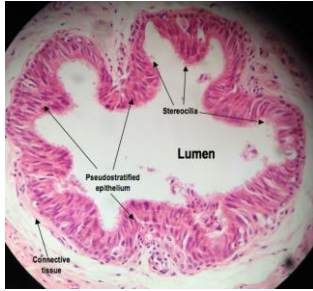
- Cells that cover internal or external surfaces form **epithelial tissue**.



- Epithelial tissue has two surfaces:
 - An **apical surface** is exposed to the exterior of the body of the cavity of an organ.
 - A **basal surface** that is attached to underlying tissues. This surface will have a network of protein fibers called a **basement membrane** that attaches it to the underlying tissue.



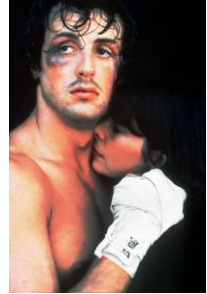
- Epithelial tissue often line a **lumen**, or an empty inner body cavity.



Cross-section of the lumen of the vas deferens.

Functions of Epithelium

- Physical protection of external and internal surfaces from abrasion, dehydration, or chemical destruction.



- Epithelium controls **permeability** by allowing or preventing substances from entering the body.



The skin is impermeable to most substances, including ink.

- Epithelial cells have **sensation**; the ability to detect changes in the environment and relay those changes to the nervous system.



Monofilament sensation test for diabetics.

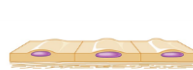
- Epithelium may contain cells that **secrete** substances out of the body or into an organ cavity.

- **Exocrine glands** discharge secretions to surfaces exposed to the outside, such as the lining of the digestive tract or skin.
- **Endocrine glands** secrete directly into tissue fluid or blood.



Classification of Epithelium

- **Simple epithelium** consists of a thin, single layer of cells covering the basement membrane.
 - Found in areas that need to be highly permeable.
- **Stratified epithelium** has several layers of cells above the basement membrane, creating a greater degree of protection.
 - Found in areas that experience a lot of physical abrasion.

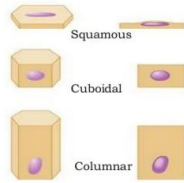


Simple

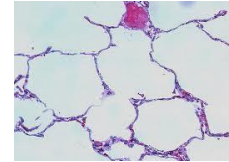
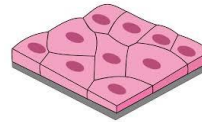


Stratified

- Epithelial cells are also classified by shape:
 - **Squamous** cells are flattened.
 - **Cuboidal** cells are square-shaped.
 - **Columnar** cells are rectangular.

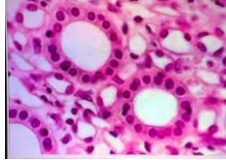
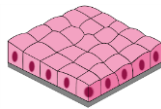


- **Simple squamous epithelium** allows for diffusion in areas where substances are absorbed or released.
 - Examples: Lining of the heart, blood vessels, kidney tubules, air sacs of lungs.



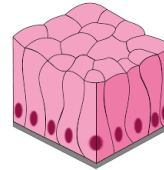
Cross-section of alveoli; air sacs within the lungs.

- **Simple cuboidal epithelium** contains larger cells that are able to secrete and absorb more material.
 - Examples: Pancreas, salivary glands, urine production areas of kidneys.



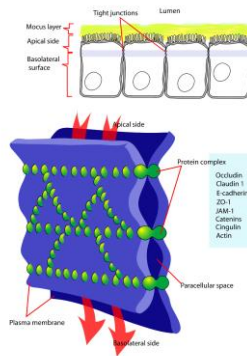
Cross-section of tubules within the kidneys.

- **Simple columnar epithelium** provides more protection than cuboidal in areas of absorption and secretion.
 - Examples: Stomach lining, intestinal tract.

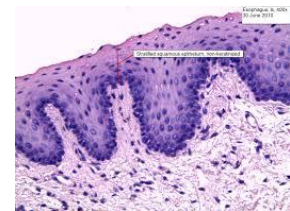
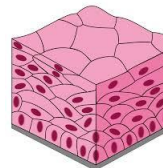


Projections in the small intestines called villi.

- Cells in simple columnar epithelium are held together by **tight junctions**; waterproof attachments by membrane proteins.

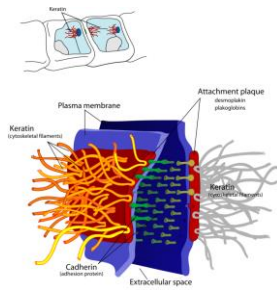


- **Stratified squamous epithelium** is a thick, protective lining of cells that are flattened at the apical surface.
 - Examples: Lining of the mouth, skin, esophagus, and anus.



Epidermis layer of the skin.

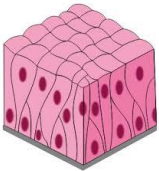
- Stratified squamous cells are held together by **desmosomes**, which are protein filaments that pass through the cell membranes of neighboring cells.
 - Causes the cells to peel off in sheets instead of individually..



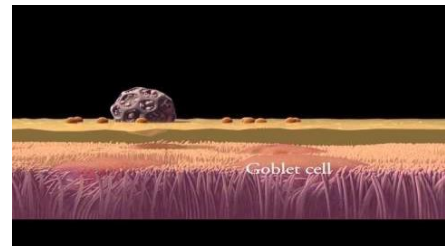
- Desmosome junctions are the reason why skin cells often peel off in sheets instead of individually.



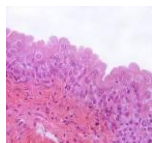
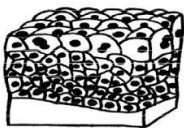
- **Pseudostratified ciliated columnar epithelium** appears layered, but each cell touches the basement membrane.
 - Examples: Lining of the nasal cavity, trachea, and bronchi.



- The cilia are able to move independently, pushing secreted mucus (and trapped foreign particles) out of the respiratory tract.



- **Transitional epithelium** contains rounded cells that, when stretched, may appear flattened.
 - Examples: Urinary bladder.

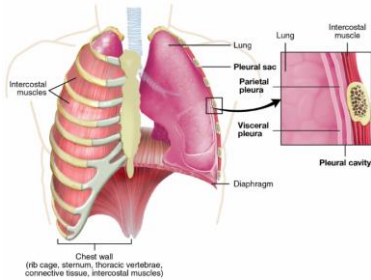


Connective Tissue

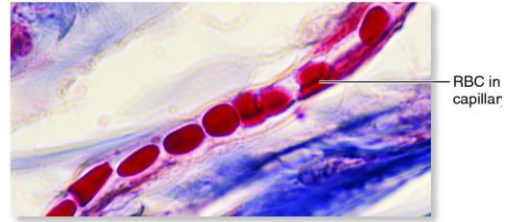
- **Connective tissue**, unlike epithelium, is never exposed to the outside environment, and has a much more diverse set of functions and properties.



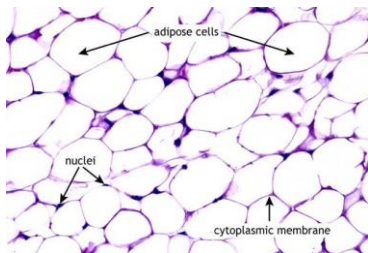
- Some connective tissues, like bone, contain minerals (Ca, P) and protein fibers that protect other organs and tissues.



- Fluid connective tissues, like blood, are the primary mechanism of transport through the body.



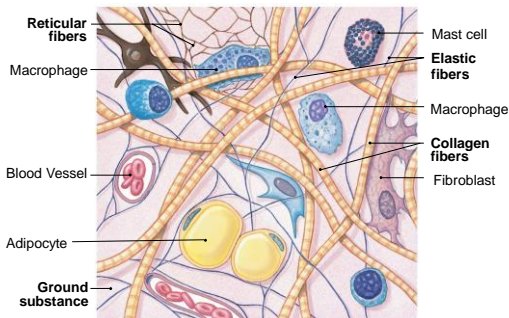
- Long-term energy storage (glycogen and triglycerides) takes place within connective tissue.



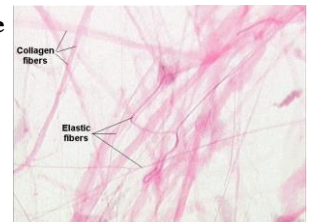
Connective Tissue Composition

- Connective tissues are mixtures of cells and a mixture of proteins and minerals called **extracellular matrix**.

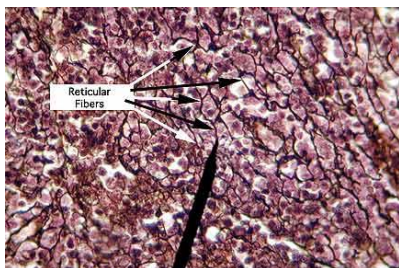
- This is one type of connective tissue, showing the **extracellular matrix** components in bold.



- Collagen fibers** are the thickest and strongest type of protein fiber found in extracellular matrix.
- Elastic fibers** are much thinner, but can stretch and recoil.
- Ground substance** is the clear, gel-like substances that cells and other protein fibers.



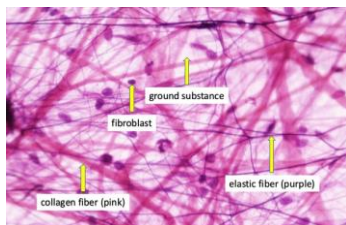
- **Reticular fibers** are also thin, but crosslink with each other to form a mesh-like network.



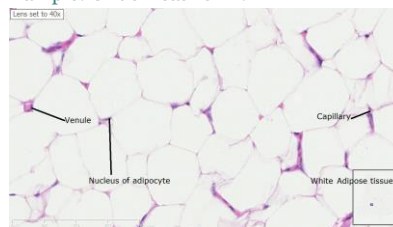
Loose Connective Tissues

- **Loose connective tissues** are the “packing materials” of the body, filling in spaces to provide cushioning and support.

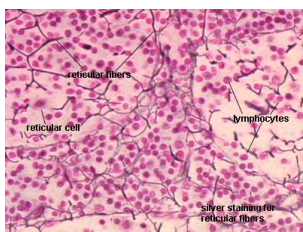
- **Areolar tissue** contains a mixture of collagen and elastic fibers and multiple cell types.
 - **Function:** Strongly and flexibly binds tissues together.
 - **Example:** Between the skin and muscle.



- **Adipose tissue** is a collection of fat cells, also called **adipocytes**.
 - **Function:** Energy storage, shock absorption, and thermal insulation.
 - **Example:** Underneath skin.



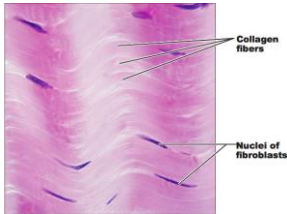
- **Reticular tissue** is mostly made of reticular fibers holding cells in place.
 - **Function:** Red blood cell, white blood cell storage.
 - **Example:** Spleen, bone marrow, lymph nodes.



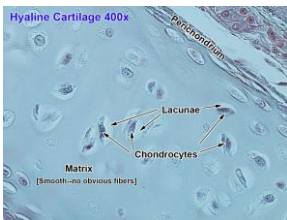
Dense Connective Tissues

- **Dense connective tissues** consist mostly of collagen fibers, with fewer cells and less ground matter.
- Dense connective tissue contains many **fibroblasts**, cells that produce collagen, elastic, or reticular fibers.

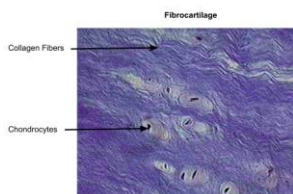
- **Dense regular connective tissue** contain high amounts of collagen fibers
 - Function: Providing a tissue connection that resists tension forces.
 - Example: Tendons.



- **Hyaline cartilage** contains densely packed collagen fibers and ground substance.
 - Function: Smooth surface, flexibility, and support.
 - Example: Respiratory tract, connecting ribs to sternum, and covering the ends of bones.



- **Fibrocartilage**, like dense regular tissue, is tightly-packed with collagen fibers but has fewer cells.
 - Function: Able to resist compression.
 - Example: Spinal cord, between bones of pelvis.

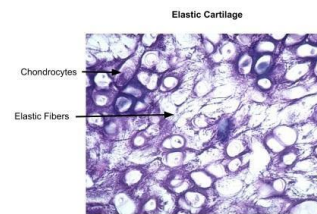


Cartilage

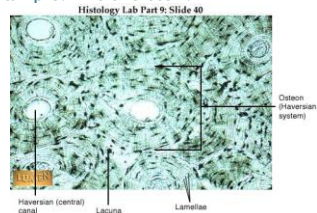
- **Cartilage** is a firm but flexible group of tissues that provide structure and connections with the skeleton.
- Cartilage contains **chondrocytes**, cells that produce extracellular matrix and enable fluid exchange within the cartilage.
 - Chondrocytes are found within small pits within the matrix called **lacunae**.



- **Elastic cartilage** is made of densely-packed elastic fibers.
 - Function: Withstand repeated bending while maintaining its original shape.
 - Example: External ear.

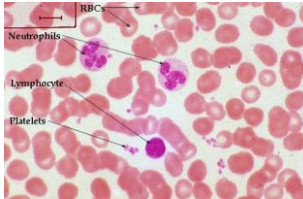


- **Bone** is the only tissue with a mineralized matrix. About 70% of the tissue is calcium phosphate. Bone contains concentric circular layers called **lamellae**.
 - Function: Support, structure, movement
 - Example: The skeleton.



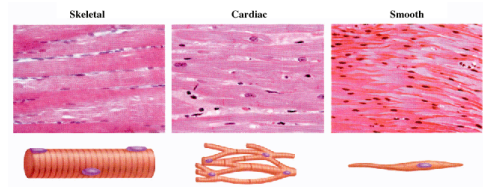
Fluid Connective Tissues

- Blood is a mixture of red blood cells, white blood cells, and liquid plasma.
 - Functions: Transport of nutrients, blood gases, hormones, and defense from disease.

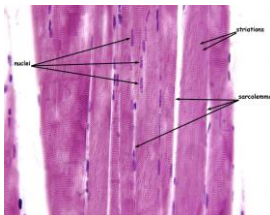


Muscle Tissue

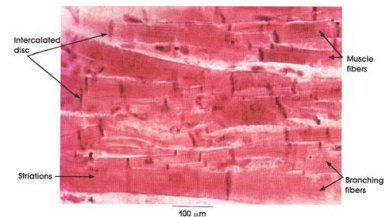
- **Muscle tissue** is made of elongated cells that are able to generate force by pulling.



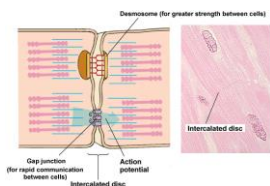
- **Skeletal muscle** tissue is made of large, *multinucleated* cells that can be up to a foot long. The repeating groups of muscle filaments create a series of bands called **striations**.
 - Function: Movement of the skeleton.
 - Example: All voluntary muscles.



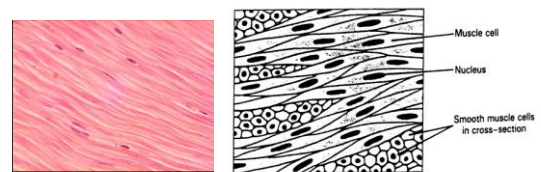
- **Cardiac muscle** tissue is also striated, but has shorter cells that each have a single nucleus and are connected with visible **intercalated discs**.
 - Function: Movement of blood.
 - Example: Heart



- Like skin, cardiac muscle cells have desmosomes for strong attachments between cells.
- The cells also have **gap junctions**, which allow ions and electrical impulses to travel quickly between cells.
 - Directly connects the cytoplasm of each cell.



- **Smooth muscle** cells are spindle-shaped, with a wide middle and narrow ends. They are not striated.
 - Function: Contraction of a hollow organ.
 - Example: Stomach, intestines.



Nervous Tissue

- **Nervous tissue** contains a combination of supporting cells called **neuroglia** and long, branched **neurons**.
 - **Function:** Transmission of electrical impulses.
 - **Location:** Mostly in the brain and spinal cord.

