HISTOLOGY

The Study of Tissues
The body is packed with different kinds of tissues.

Some are highly organized and some are not.

When studying tissues it helps to think about the relationship between the structure of a tissue and its function.
Let’s look at how tissues are categorized. There are 4 main categories of in the human body:

- Epithelium
- Connective
- Muscular
- Nervous
Epithelium is a tissue that covers other structures. Therefore one side is always exposed to the outside (which could still be inside the body).

You will see epithelial tissue covering the inside of body cavities and organs. The outer or superficial portion of your skin is an epithelial tissue.
Epithelial tissue does not have a blood supply (avascular). Therefore nutrients must enter the tissue by diffusion.

Do you remember DIFFUSION?
Here is an example of an epithelial tissue. Note that one side of the tissue is exposed to the outside and the tissue is connected by a basement membrane.
Epithelial tissue is categorized according to the shape of the cells and number of layers.

**Three basic shapes:**

- Squamous
- Cuboidal
- Columnar
Squamous cells are flat. From the side they look something like a fried egg.
Cuboidal epithelium cells are shaped like their name implies. Like little cubes.
Columnar epithelium cells are rectangular in shape.
Epithelium is also categorized according to number of layers.

- Simple
- Stratified
- Pseudo-Stratified
This is stratified squamous epithelium. This is a slide of the most superficial layer of the skin known as the epidermis. Here we see the cells becoming so flattened that they eventually come off.

Stratified squamous is also found in the oral cavity, anal canal and vagina.
Here’s our picture of cuboidal epithelium. Since there is only one layer, we can call this “simple cuboidal epithelium.”

Simple cuboidal epithelium is commonly found in ovaries, kidney tubules, ducts.
Here is a nice single layer of columnar cells. We can call this “simple columnar epithelium.” Simple columnar epithelium can be ciliated or non-ciliated. Ciliated is found in the female reproductive tract. Non-ciliated is found in the uterus and digestive tract.
A special type of cell known as a goblet cell is usually associated with columnar epithelium. The goblet cell secretes mucous.
Cilia are also seen on columnar cells. The cilia and goblet cells work together to move substances along the cells. An example of this is in the respiratory system.
There are some special cases of epithelium. The first special case is called pseudostratified columnar epithelium.

It is called pseudostratified because it looks like it’s stratified (more than one layer) but it’s not.

It looks stratified because the nuclei of the cells are at various levels. But in reality there is only one layer.
This is an example of pseudostratified columnar epithelium. Note that the nuclei are at different levels.
Here is pseudostratified next to simple columnar epithelium.
The other special case of epithelium is called transitional.

Transitional epithelium looks somewhat like stratified squamous, but there is a difference.
In transitional epithelium the cells are rounded both at the base of the tissue and the section exposed to the outside.
Transitional epithelium is found in the urinary bladder. The multiple layers allow for the bladder to distend and contract.

The epithelium also forms a barrier to help protect the bladder from infection.
Glandular Epithelium:

A collection of cells within epithelium tissue that can secrete substances:

- **Endocrine glands** – Blood Stream
- **Exocrine glands** - Ducts
Connective Tissue
Connective tissue is the most abundant tissue in the body.

It consists of cells separated and spread out in a matrix of extracellular material.
There are specialized cells in connective tissue that make and maintain the extracellular matrix.

There are 3 types of these cells:

- **Blasts** – Create the Matrix
- **Cytes** – Maintain the Matrix
- **Clasts** – Break the Matrix down for remodeling.
These cells that create and maintain the extracellular matrix are found in several different types of connective tissue matrix:

**Fibro** . . . Fibrous Tissue

**Chondro** . . . Cartilage Tissue

**Osteo** . . . Bone Tissue

**Adipo** . . . Fat / Lipid Tissue
There are also cells found in connective tissue that form special functions:

**Mast Cells** – Found in loose connective tissue and release chemicals in response to injury or infection (cause inflammation)

**White Blood Cells** – Continuously move from blood vessels into connective tissue. Helps fight infections.
There are also cells found in connective tissue that form special functions:

**Macrophages** – Fixed or wandering cells that digest injured or foreign cells. Important in the fight of infections.

**Mesenchymal (stem) Cells** – Undifferentiated cells that develop into adult cell types.
There are 6 general classifications of connective tissue:

- Loose
- Dense
- Cartilage
- Bone
- Blood (Hemopoietic)
- Special (Adipose & Reticular)
Loose connective tissue (areolar tissue) is not very well organized. It contains fibroblasts, matrix, and some fibers scattered about. Loose connective tissue is found in the dermis and subcutaneous layers of the skin as well as surrounding muscles.
Dense connective tissue contains thick collagenous or elastic fibers. It is found in ligaments and tendons which have a high tensile strength.

Dense connective tissue has a poor blood supply which is why tendons and ligaments do not heal well.
Cartilage is rigid and strong so it can provide support and protection. It also forms a structural model for developing bones.

Cartilage has no direct blood supply so nutrients must enter by diffusion.

Since the nutrients for cartilage diffuse into the tissue, the tissue needs water to help move these substances in. As humans age cartilage tends to “dry up” or become dehydrated which lends to degeneration of the tissue.

There are 3 types of Cartilage:
Hyaline cartilage has chondrocyte cells in a matrix with a “ground glass” appearance. It is found at the ends of bones, soft part of the nose, larynx and trachea. Hyaline cartilage serves as a model for bone growth.
Elastic cartilage also has the characteristic chondrocyte along with elastic fibers.

This cartilage is found in the larynx and the ear.
Fibrocartilage is characterized by rows of chondrocytes (in lacunae). It is a very strong cartilage and is found in the intervertebral discs.
Bone is the most rigid of connective tissues. Its hardness comes from mineral salts such as calcium phosphate and calcium carbonate. It is highly organized into units called Haversian systems. The primary cell of bone is the osteocyte.
Blood is also considered a connective tissue. It basically consists of cells suspended in a matrix of fluid called plasma.

It transports gasses such as oxygen and carbon dioxide and functions in clotting and immunity.
Adipose connective tissue consists of cells containing lipid (fat) called adipocytes. The lipid is used to store energy to be used by the body if needed.

Adipose tissue is also found around some organs and joints. It forms a cushion for shock absorption.

Adipose tissue also insulates the body.
Reticular connective tissue consists of a thin supportive network of collagen fibers. It is found supporting the walls of the liver, spleen and lymphatic system.
Muscle Tissue
Nervous Tissue
Skeletal muscle is striated. The striations are caused by the density of overlapping protein filaments called actin and myosin.
Cardiac muscle is also striated but has a unique structure called an intercalated disk. The disks are special intercellular junctions that allow electrochemical impulses to be conveyed across the tissue.
Smooth muscle is not striated because the myofilaments are not as dense as in cardiac and skeletal muscle. Smooth muscle is found in organs such as in the gastrointestinal system and the arteries.
Nervous tissue contains neurons and glial cells.