Tissues and Membranes
What you will learn...

- The 4 basic types of tissues
- The functions of epithelial, connective, muscle, and nervous tissues
- How epithelial tissues are classified
- Differences between endocrine and exocrine glands
- The types of epithelial and connective tissue membranes
- Differentiate between mucous and serous membranes
In the beginning ....
Egg + Sperm -> Zygote or Fertilized egg

During fertilization, the chromosomes from the sperm and egg unite to give the fertilized egg (also called a zygote) a total of 46 chromosomes.
1 cell divides to make 2; 2 divide to make 4; 4 divide to make 8 ....
Up to this point in humans (8 cells), stem cells are totipotent. Each could form a whole organism.
And then begins a division of labor, or specialization of cells.

Pluripotent - How are they different than totipotent stem cells?
Tissues

TISSUES are groups of cells that are similar to each other in structure and function.

Like the individual tiles arranged on a floor, cells are placed in various patterns to make different tissues.
Epithelial Tissue

Also called EPITHELIUM

Forms large, continuous sheets

Forms the skin and covers the outer surface of the body

Also lines most of the inner cavities…mouth, respiratory tract, reproductive tract
Epithelial Tissue
What does epithelial tissue do?

**Protection** – skin protects us from invasion of bacteria, dirt, debris

**Absorption** – water and nutrients are absorbed across the epithelium in the digestive tract

**Secretion** – respiratory tract secretes mucus which traps dust inhaled in air
Epithelial tissue characteristics

- Forms continuous sheets
- Has 2 surfaces
  1 – unattached surface is the APICAL SURFACE
  2 – the bottom is attached to a BASEMENT MEMBRANE – a very thin material that anchors the epithelium to the underlying structure
Basement Membrane
Epithelial Tissue Characteristics continued

- Has NO blood supply of its own – it is AVASCULAR – it gets nourishment from blood supply of underlying tissue
- Regenerates, or repairs, quickly if injured
Classifying Epithelial Tissue

- Classified according to
  - shape
  - numbers of layers

- Has 3 shapes
  - squamous
  - cuboidal
  - columnar
Squamous Epithelium

Thin, flat, and look like fish scales
Cuboidal Cells

Cube-like and look like dice
Columnar Cells

Are tall and narrow and look like columns
Epithelial that are one layer thick are called **SIMPLE EPITHELIUM**

Two or more layers of cells are called **STRATIFIED EPITHELIUM**

Shape and number of layers are used to describe the various types of epithelium

Ex – **simple squamous epithelium**
Simple vs Stratified
Simple Squamous Epithelium

- Single layer of squamous cells
- Cells are thin, they are found where substances move by *rapid diffusion* or *filtration*
- Ex – the wall of capillaries, walls of alveoli (air sacs of the lungs)
Simple Squamous Epithelium
Simple Columnar Epithelium

- Single layer of columnar cells attached to a basement membrane
- Cells line the digestive tract
- absorbs the products of digestion
Simple Columnar Epithelium
Pseudostratified Ciliated Columnar Epithelium

- Single layer of columnar cells
- Cells APPEAR multilayered but are not
  - Pseudo means false
  - Stratified means layers
- Cilia: hair-like projections that push dirt and bacteria away from cell surface
Pseudostratified Ciliated Columnar Epithelium
Stratified Epithelium

- Multilayered (having 2 or more layers)
- Stronger than simple epithelium
- Perform a protective function
- Found in tissue exposed to everyday wear and tear – mouth, esophagus, skin
Stratified Squamous Epithelial
Transitional Epithelium

Found primarily in organs that need to *stretch* – the urinary bladder

They are transitional because the cells slide past one another when the tissue is stretched

The cells appear stratified when the urinary bladder is empty (unstretched) and simple when the bladder is full (stretched)
Transitional Epithelial Tissue
Simple Cuboidal Epithelium

- Single layer
- Cube shape
Glandular Epithelium

- **GLAND** – made up of one or more cells that *secrete* a particular substance
- Simple cuboidal epithelium wrapped in a tube
2 Types of Glands

**EXOCRINE GLANDS**
- have ducts, or tiny tubes, into which the exocrine secretions are released before reaching body surfaces or body cavities

Ex: mucus, sweat, saliva, liver, pancreas and digestive enzymes
ENDOCRINE GLANDS – secrete HORMONES, such as thyroid hormones

Do NOT have ducts – called ductless glands

Hormones are secreted directly into the blood stream

The blood then carries them to their sites of action

Ex – pituitary, thyroid, adrenal glands
Endocrine glands
Connective Tissue

The most abundant of the 4 tissue types, widely distributed throughout the body

Connective tissue connects, or binds together, the parts of the body

Found under the skin, around organs
Although connective tissue types do not resemble each other very closely, they share two characteristics:

1. Most connective tissues have a good blood supply (ligaments, tendons have a poor blood supply, cartilage has no blood supply – this is why these areas take so long to heal when injured)

2. They have an abundance of extracellular matrix
Extracellular Matrix

- Is what makes the various types of connective tissues so different

**EXTRACELLULAR MATRIX** – material located outside the cell
Extracellular Matrix

The cell makes the matrix and secretes it into the extracellular spaces. In other words, they make the bed that they lie in.

The hardness can vary from cell type to the next.
The extracellular matrix may be:

- **liquid** – as in blood
- **gel-like** – as in fat tissue
- **hard** – as in bone

The amount of extracellular matrix varies from one cell type to the next:

- fat tissue has many cells, close together, with little extracellular matrix
- bone has very few cells, large amounts of extracellular matrix
Also found in the matrix of most connective tissue are protein **FIBERS**

**Types of fibers:**

- **collagen** – strong, flexible, only slightly elastic (stretchy)
- **elastin** – not very strong, stretchy like a rubber band, will return to original length when tension removed
- **reticular** – fine collagen
Collagen Injections

Recently, injections of collagen have been used cosmetically to remove unwanted lines and wrinkles.

Obtained from cattle, or patient’s own hips, thighs, abdomen.

Injected under patient’s skin; acts like a filler, smoothing out unwanted lines.
Collagen Injections

Pre-Treatment

Post-Treatment

Pre-Treatment

Post-Treatment
Types of Connective Tissue

- Loose
- Adipose
- Dense fibrous connective
- Reticular connective
- Cartilage
- Bone
- Blood
Loose Connective Tissue
Loose Connective Tissue

- Made up of fibroblasts and gel-like intercellular matrix
- Soft, surrounds, protects, cushions many organs
- Acts like “tissue glue”, holding organs in position
Adipose Tissue (fat)
Adipose Tissue

- Fat tissue
- A type of loose connective tissue in which the fibroblasts enlarge and store fat
- Forms the tissue layer underlying the skin
- Acts as insulation
Dense Fibrous Connective Tissue

- Composed of fibroblasts and intercellular matrix that contains many collagen and elastic fibers
- The fibroblasts secrete fibers into the intercellular matrix
- The fibers form strong, supporting structures such as tendons, ligaments, dermis of the skin
**Tendons** – cord-like structures that attach muscles to bones

**Ligaments** – crossover joints and attach bone to bone

Ligaments contain more elastic fibers than tendons do, they stretch more easily

This is important – prevents tearing of the ligaments when joints bend
If stretching is excessive, tendons and ligaments can tear, causing severe pain and impaired mobility.

A ruptured Achilles tendon is a serious injury – it attaches the leg muscles to the heel.
Ruptured Achilles Tendon
Reticular Connective Tissue

- Characterized by a network of delicately interwoven reticular (fine collagen) fibers
- Forms the internal framework for lymphoid tissue – spleen, lymph nodes, bone marrow
**Cartilage** is formed by **CHONDROCYTES** – cartilage cells

The chondrocytes secrete a protein extracellular matrix that is firm, smooth, flexible

Although cartilage is firm, it is not solid like bone
There are 3 types of cartilage: **hyaline, elastic, fibrocartilage**

- **Hyaline** – found in voicebox, rings of the trachea, nose, between ribs and breastbone
- Hyaline is also found in large quantities in the fetal skeleton – as the fetus matures, the cartilage ossifies, or is converted to bone
Hyaline Cartilage
Elastic Cartilage
Fibrocartilage: found in between vertebral discs, meniscus of knee, & pubic area
Connective Tissue - Bone
Bone

Also called OSSEOUS TISSUE

Bone cells are called OSTEOCYTetes

Osteocytes secrete an intercellular matrix that includes collagen, calcium salts, minerals – which makes the bone hard
Bone

- The hardness of bones protects organs like the brain.
- The hardness helps support the weight of the body for standing and moving.
- The bone also acts like a storage site for mineral salts, especially calcium and phosphorus.
When this mineralization of bone tissue is diminished, as in osteoporosis, the bone is weakened and tends to break easily.

Adequate dietary intake of calcium is essential for strong bones.

Calcium is needed throughout the life cycle, but is especially important during childhood, when bones are growing, and after menopause, when estrogen levels in women decline.
Exercise and weight-bearing workouts encourage calcium deposition within bones.
Blood

Blood is a unique type of connective tissue.

Consists of blood cells surrounded by a fluid matrix called PLASMA.

Plasma contains fibrous plasma proteins that are not seen unless clots form.

Blood – transports substances throughout the body.
Blood
C. Fibrin mesh
Nervous Tissue

- Nervous tissue makes up the brain, spinal cord, and nerves
- Consists of 2 types of cells: the neurons and the neuroglia (glia cells)
- Neurons – nerve cells that transmit electrical signals to and from the brain and spinal cord
The neuron has 3 parts

- the **dendrites** – receive information from other neurons and then transmits the information *toward* the cell body
- the **cell body** – contains the nucleus
- the **axon** – transmits information *away from* the cell body
Muscle Tissue

- Composed of cells that shorten, or contract
- In doing so, they cause movement of the body part
- Because the cells are long and slender, they are called fibers rather than cells
- Three types of muscle: skeletal, smooth, cardiac
Skeletal Muscle

- Generally attached to bone

- Because skeletal muscle can be controlled voluntarily ("I choose to move my leg"), it is also called voluntary muscle

- These cells have striations, or stripes.

- Multinucleate (more than one nucleus)
Skeletal muscle move the skeleton, maintain posture, stabilize joints
Skeletal Muscle
Smooth Muscle

Smooth muscle is found in the walls of the viscera (organs), such as stomach, intestines, bladder.

Also found in tubes, such as bronchioles (breathing passages) and blood vessels.

Smooth muscle is NOT voluntarily controlled, and is called involuntary muscle.
Smooth muscle does NOT appear striped, or striated, called **nonstriated muscle**
Smooth Muscle
Cardiac Muscle

Cardiac muscle is found only in the heart

Pumps blood into a vast network of blood vessels

Is striated and involuntary

Has intercalated disks so cells can communicate with each other efficiently
Cardiac Muscle

- Nucleus (central)
- Cardiac muscle cell
- Intercalated disks (special junctions between cells)
- Striations

(b) Cardiac Muscle
Cardiac Muscle
Tissue Repair

How does tissue repair itself after an injury?

Two ways: REGENERATION and FIBROSIS

Regeneration: replacement of tissues by cells that are IDENTICAL to the original cells

Regeneration occurs only in tissues whose cells undergo mitosis, such as the skin
Regeneration
**Fibrosis** – replacement of injured tissue by the formation of fibrous connective tissue, or scar tissue

The fibers of scar tissue pull the edges of the wound together and strengthen the area.

Damaged skeletal muscle, cardiac muscle, and nervous tissue do not undergo mitosis and must be replaced by scar tissue.
Scarring

- Depends on
  - Severity of the injury
  - Type of tissue
Membranes are thin sheets of tissues that cover surfaces, line body cavities, surround organs.

Cutaneous membrane – is the skin – protects the body from invading microorganisms, and from drying out.
Mucous membranes – line all body cavities that OPEN to the outside of body

Include digestive, urinary, reproductive, respiratory tracts

Most secrete mucus that keeps the membrane moist and lubricated
Serous Membranes – line the ventral body cavities which are **NOT OPEN** to the outside of body

They secrete a thin, watery fluid that allows membranes to slide past one another with little friction
3 serous membranes:

1. pleura – lines the thoracic cavity
2. Pericardium – lines the outside of the heart
3. Peritoneum – lines the abdominal cavity