

Tissues and Membranes

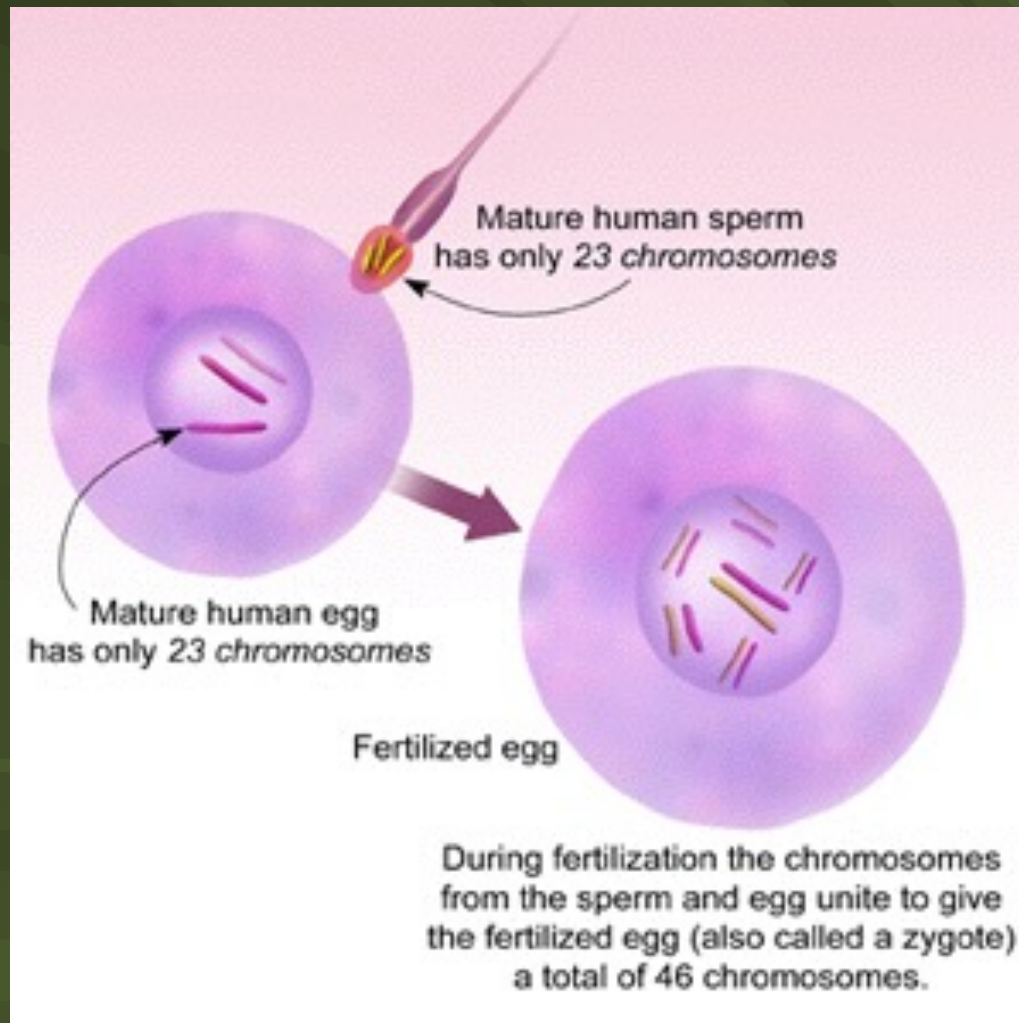
What you will learn...

- 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

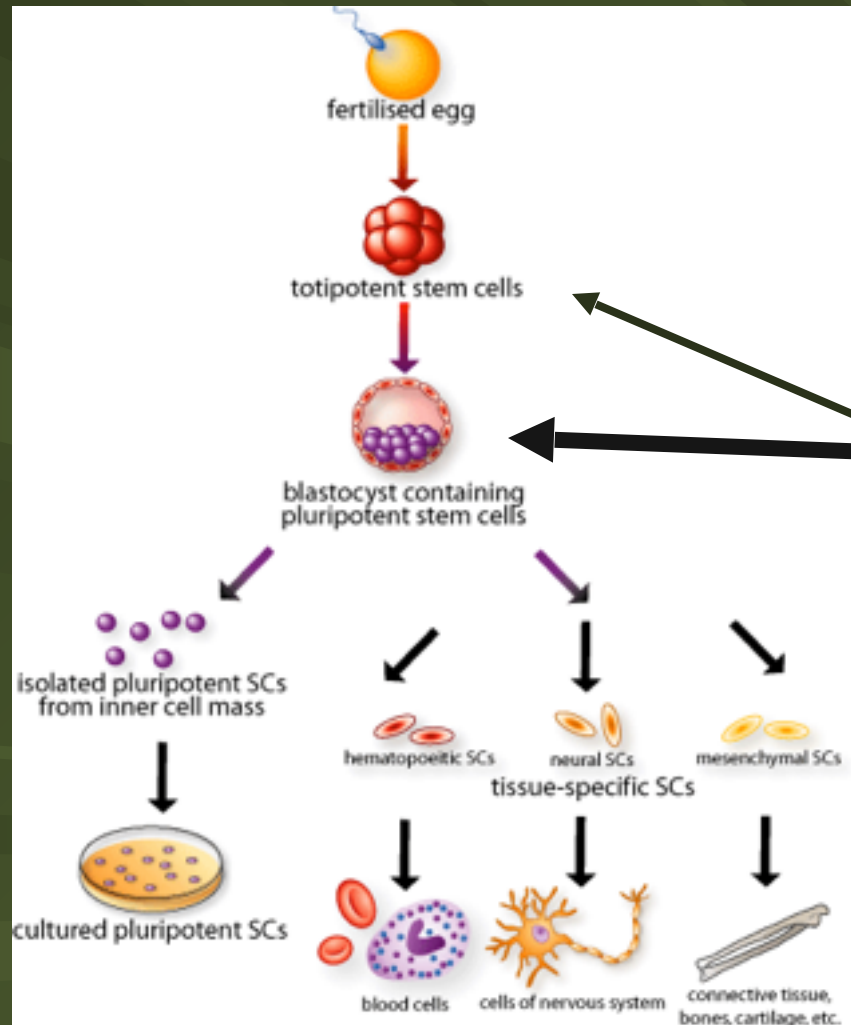




1 cell divides to make 2; 2 divide to make 4;
4 divide to make 8

Up to this point in humans (8 cells), stem cells are **totipotent**. Each could form a whole organism.

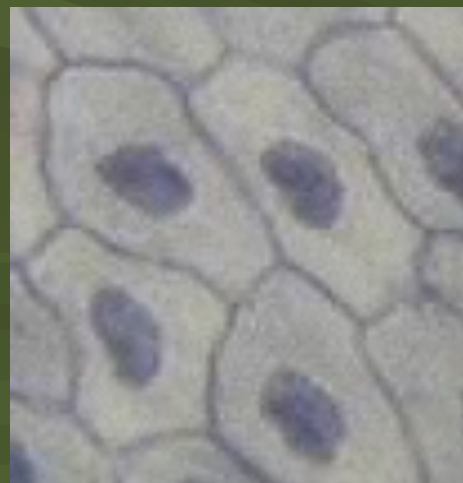
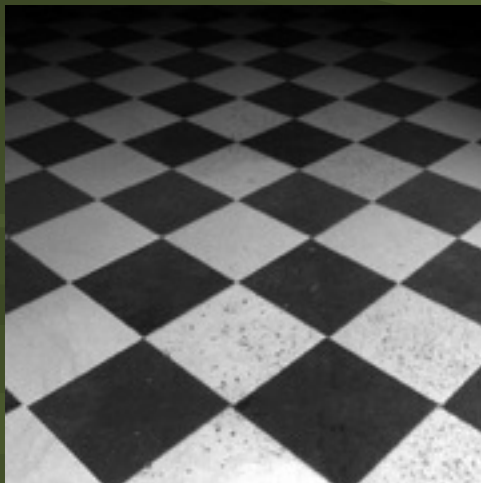
And then begins a division of labor, or specialization of cells.



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

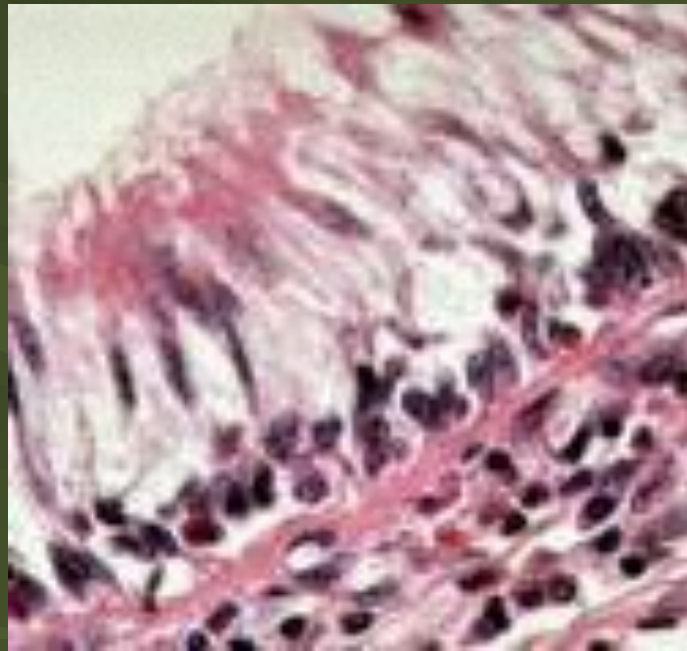
- Forms continuous sheets

- 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

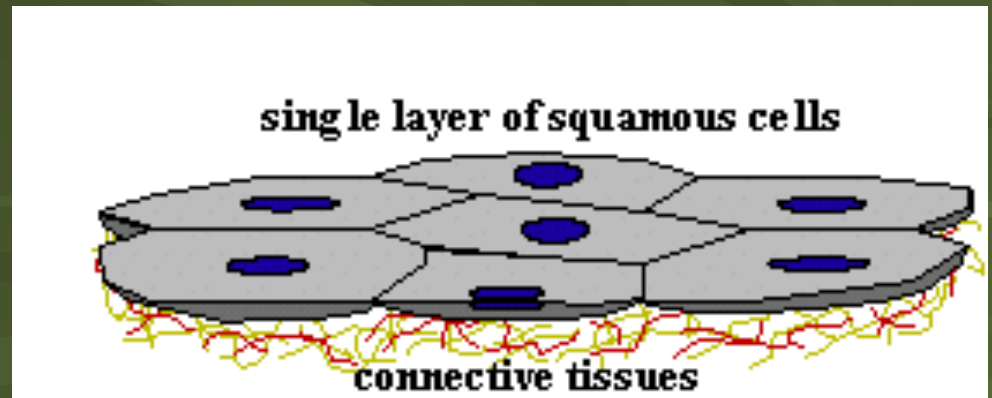
- shape
- numbers of layers

■ Has 3 shapes

- squamous
- cuboidal
- columnar

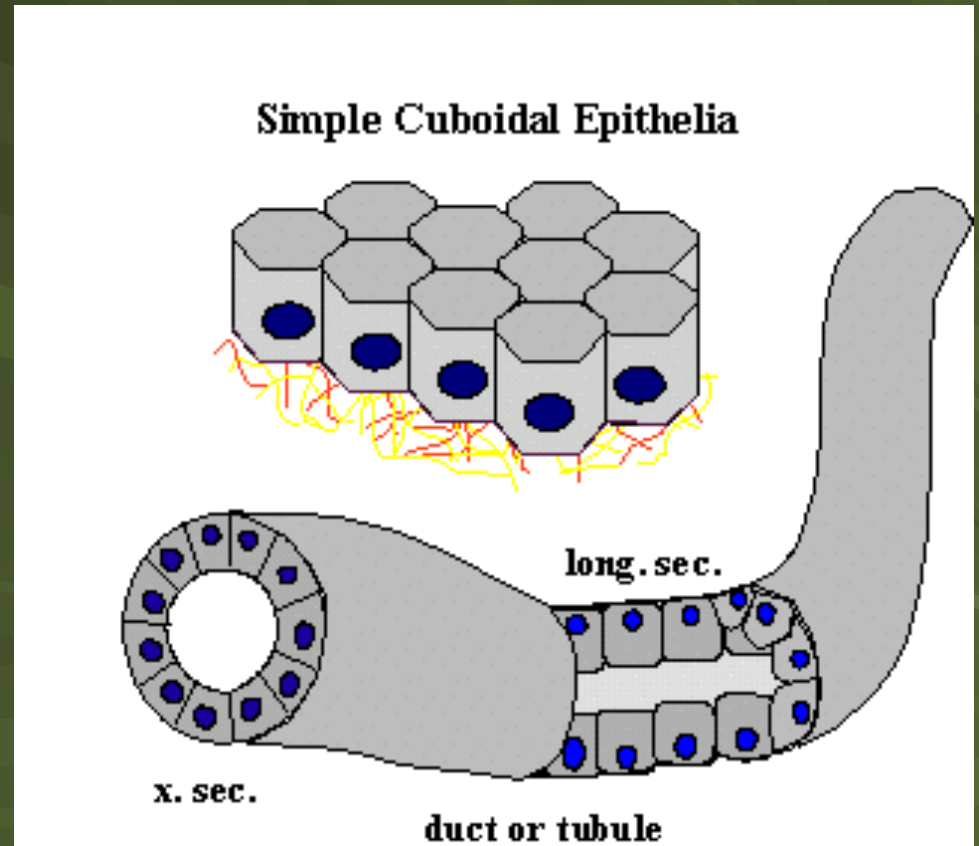
Squamous Epithelium

Thin, flat, and look like fish scales



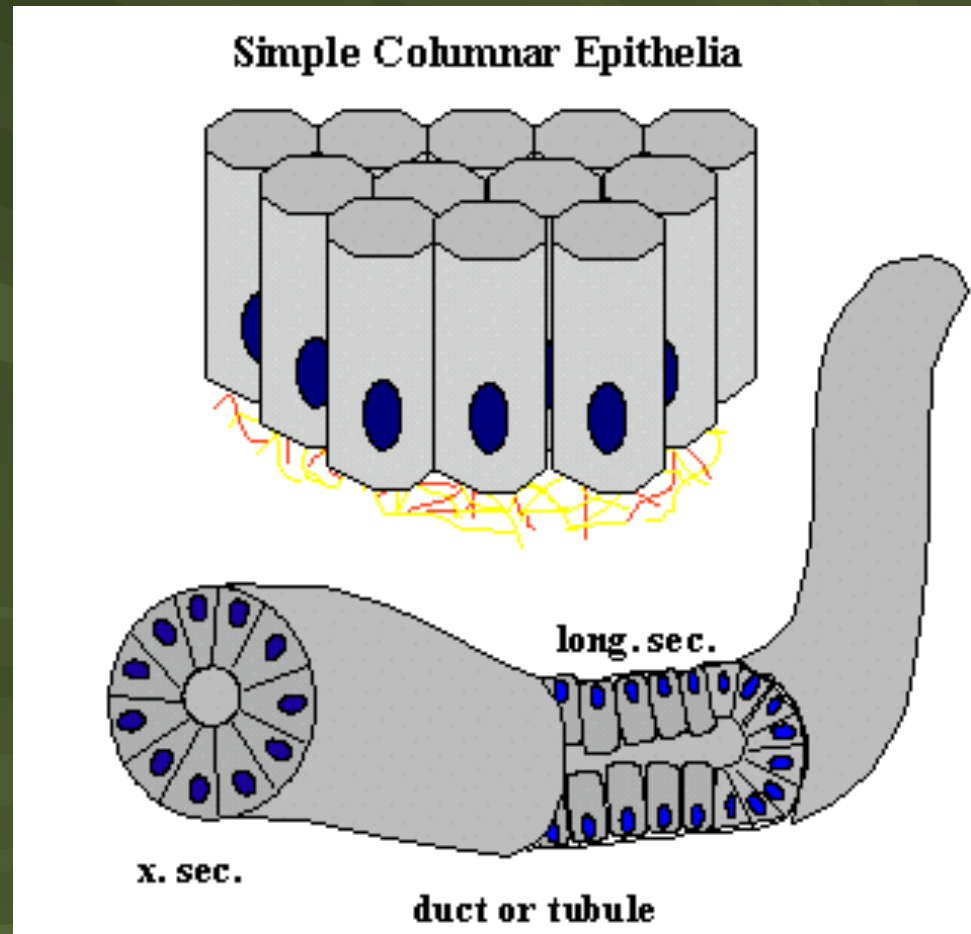
Cuboidal Cells

■ 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

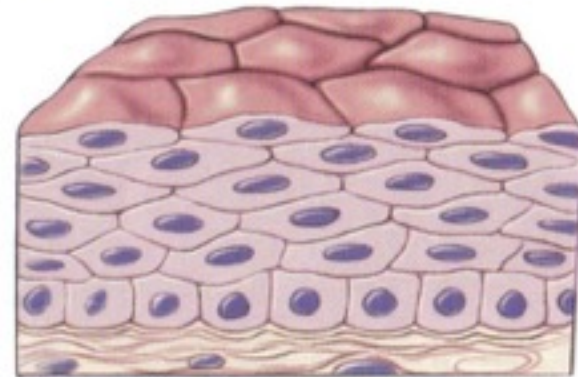
Ex – simple squamous epithelium

Simple vs Stratified

Types of cell layers:



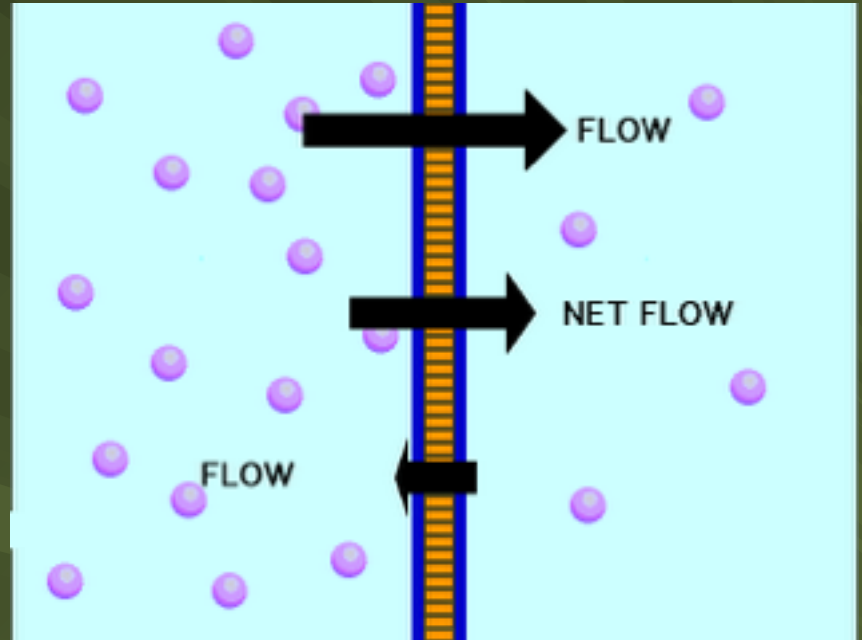
Simple



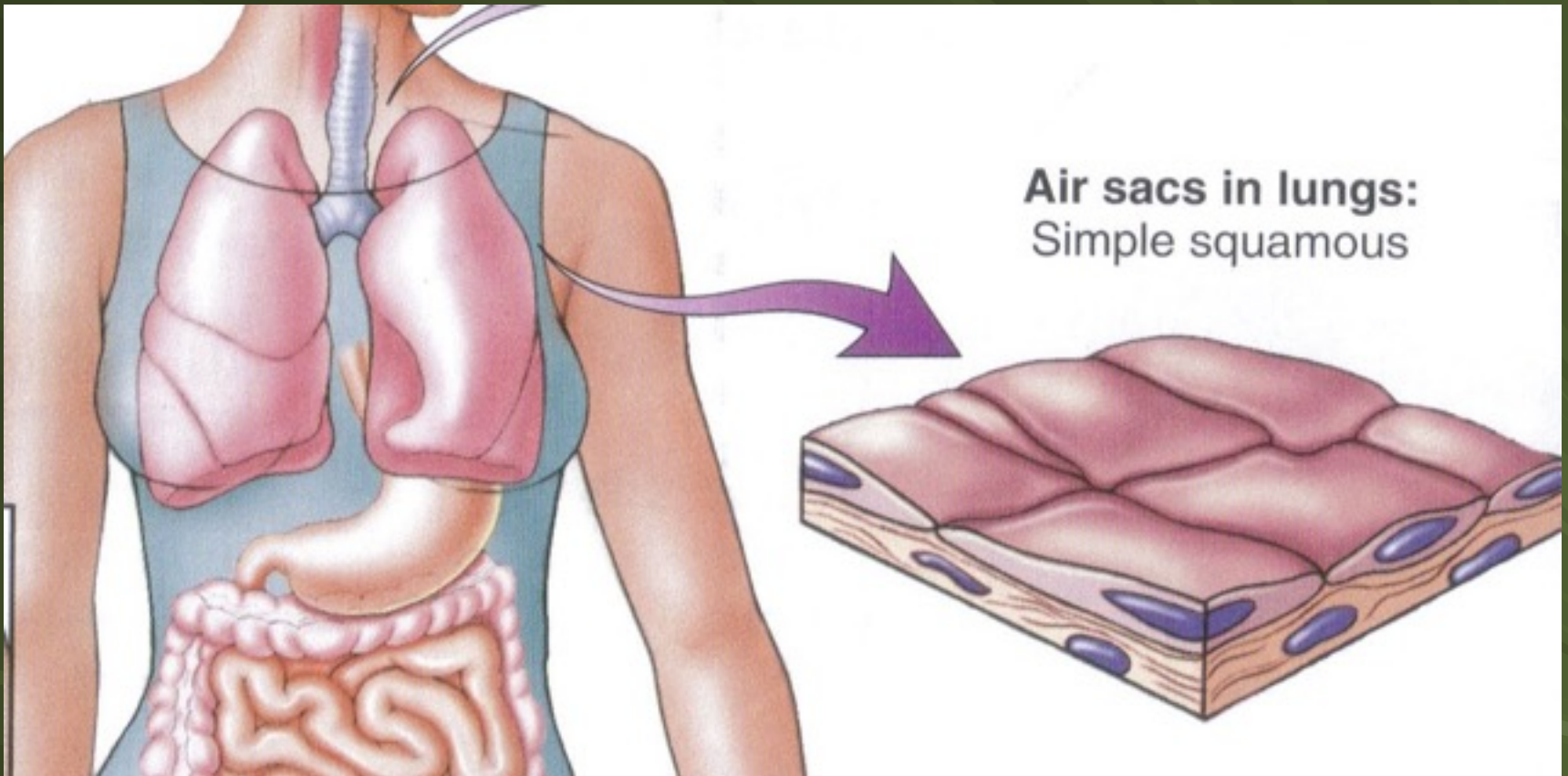
Stratified

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)

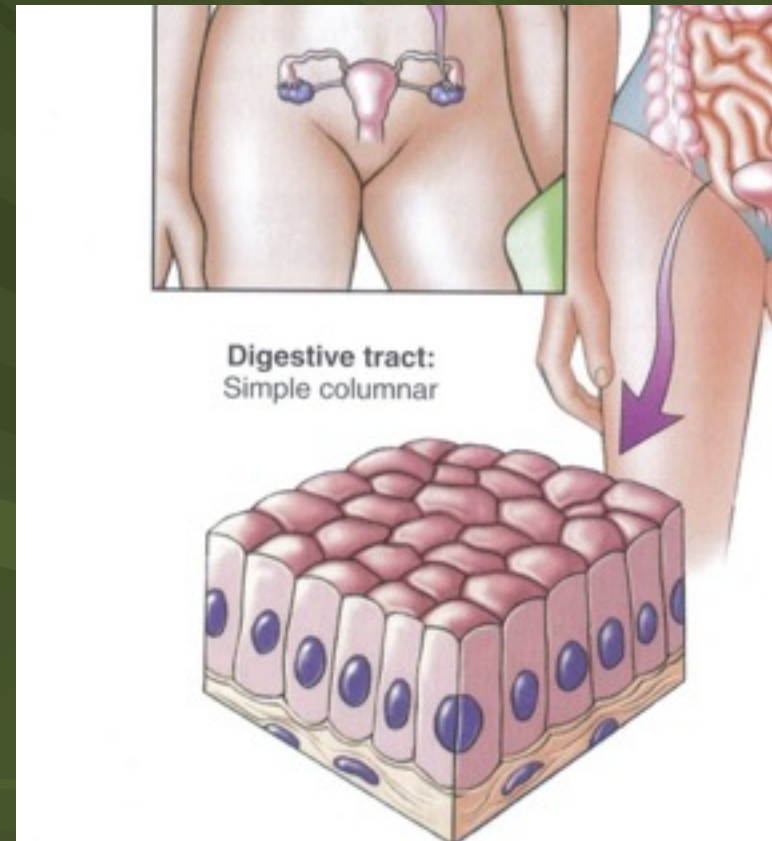


Simple Squamous Epithelium



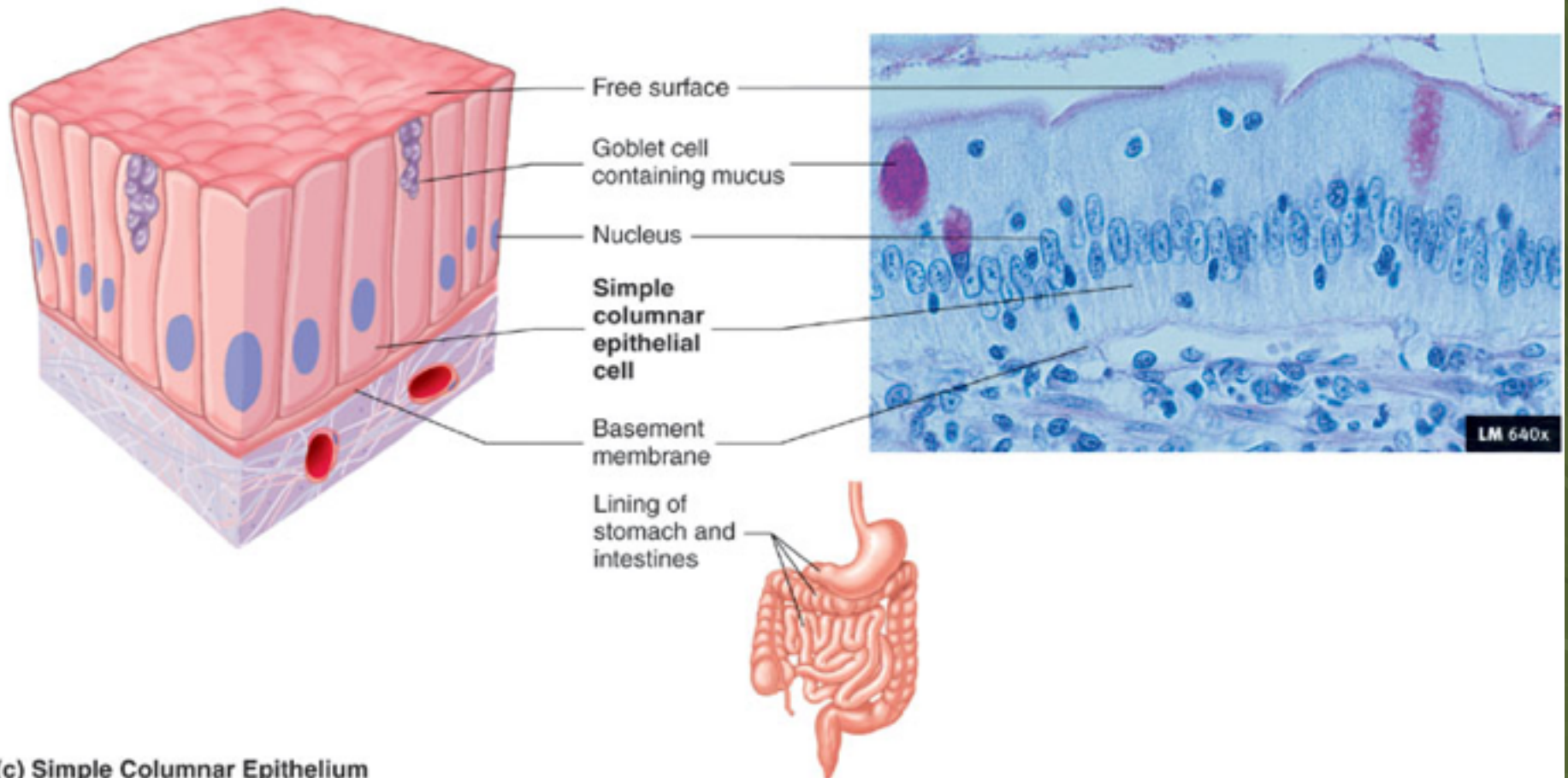
Simple Columnar Epithelium

- Single layer of columnar cells attached to a basement membrane
- Cells line the digestive tract
- *absorbs the products of digestion*



Simple Columnar Epithelium

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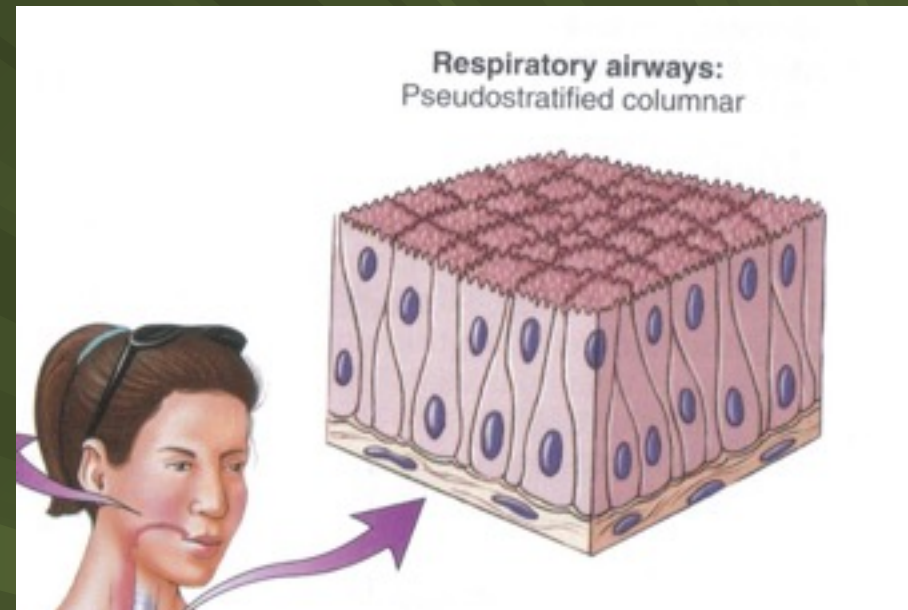
(c) Simple Columnar Epithelium

Pseudostratified Ciliated Columnar Epithelium

- Single layer of columnar cells
- Cells APPEAR multilayered but are not

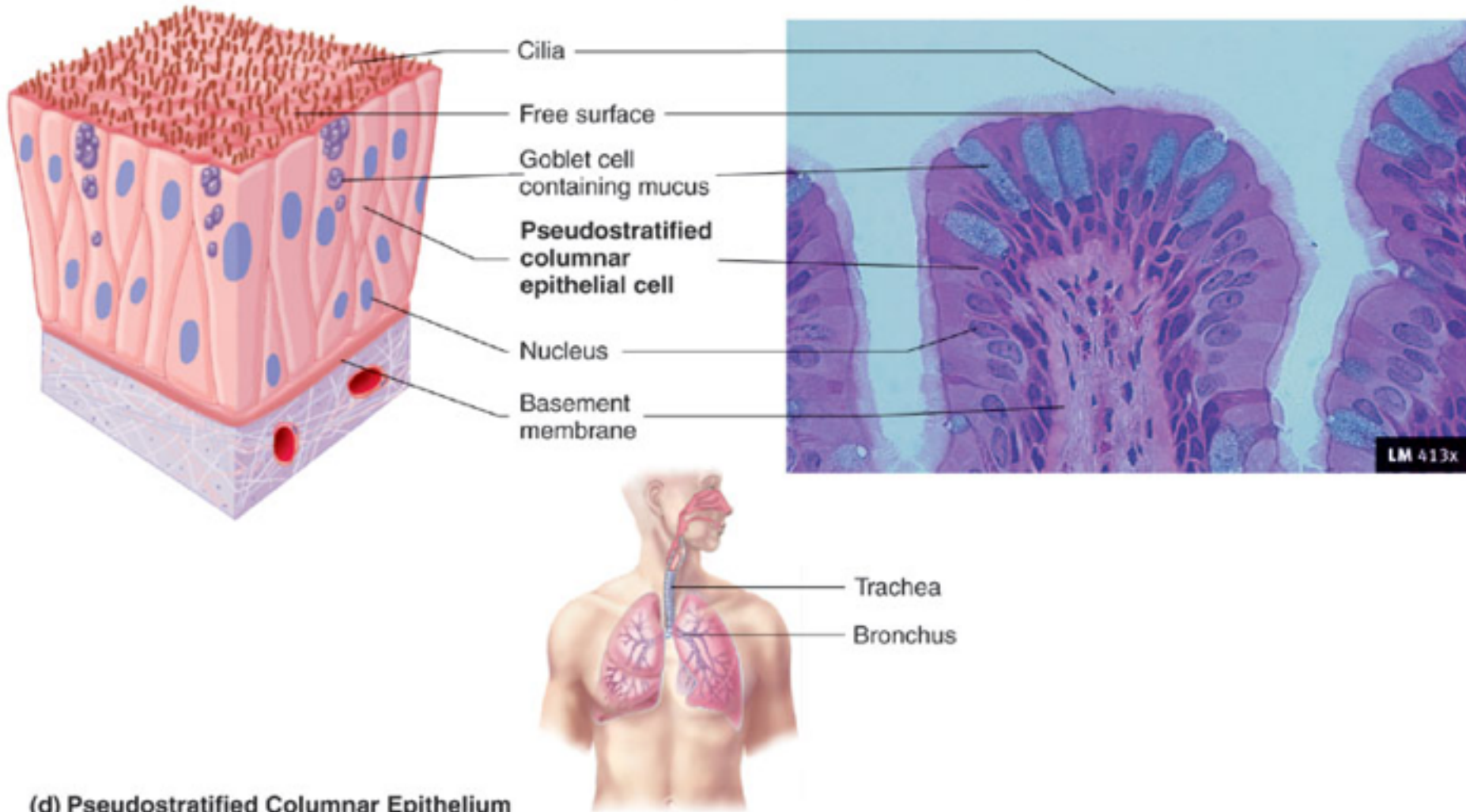
- Pseudo means false
- Stratified means layers

- Cilia: hair-like projections that push dirt and bacteria away from cell surface



Pseudostratified Ciliated Columnar Epithelium

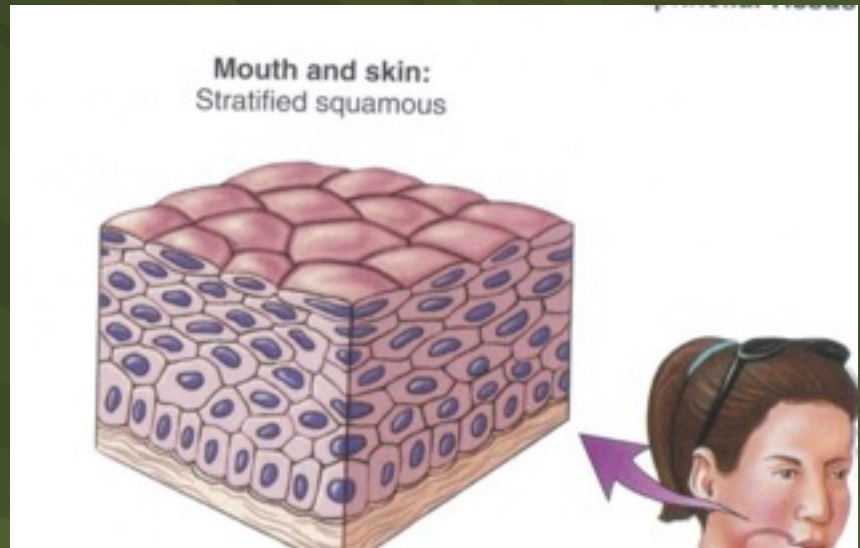
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(d) Pseudostratified Columnar Epithelium

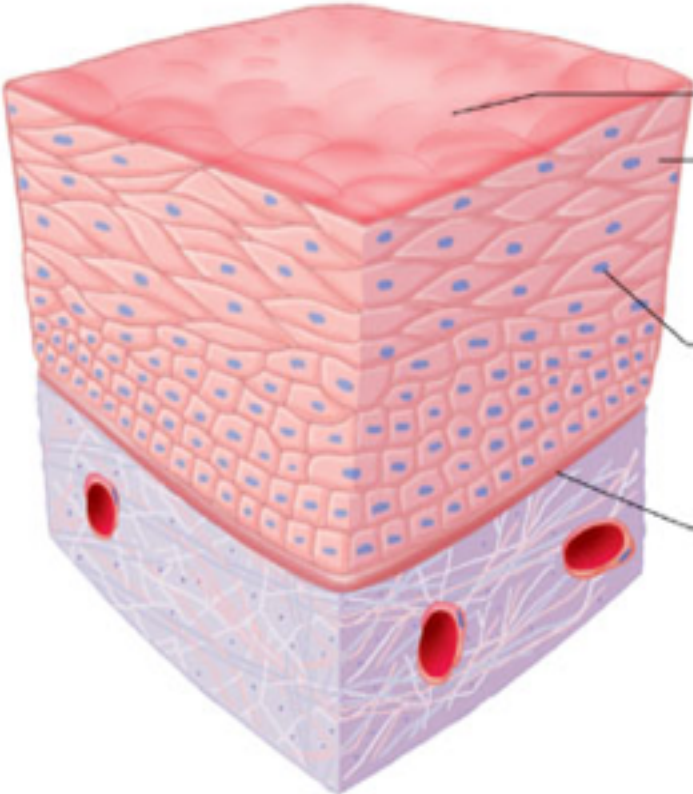
Stratified Epithelium

- 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

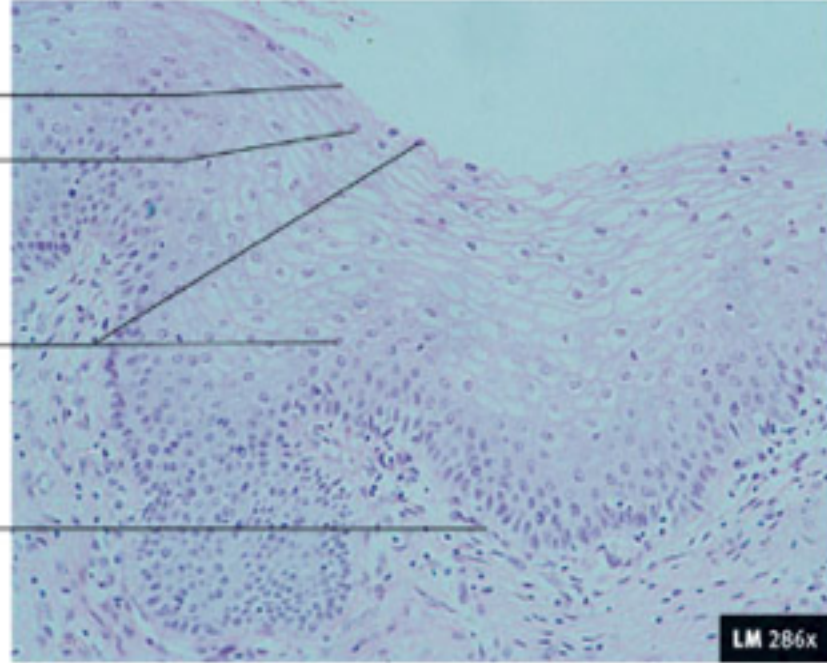


Stratified Squamous Epithelial

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Free surface
Nonkeratinized stratified squamous epithelial cell
Nuclei
Basement membrane



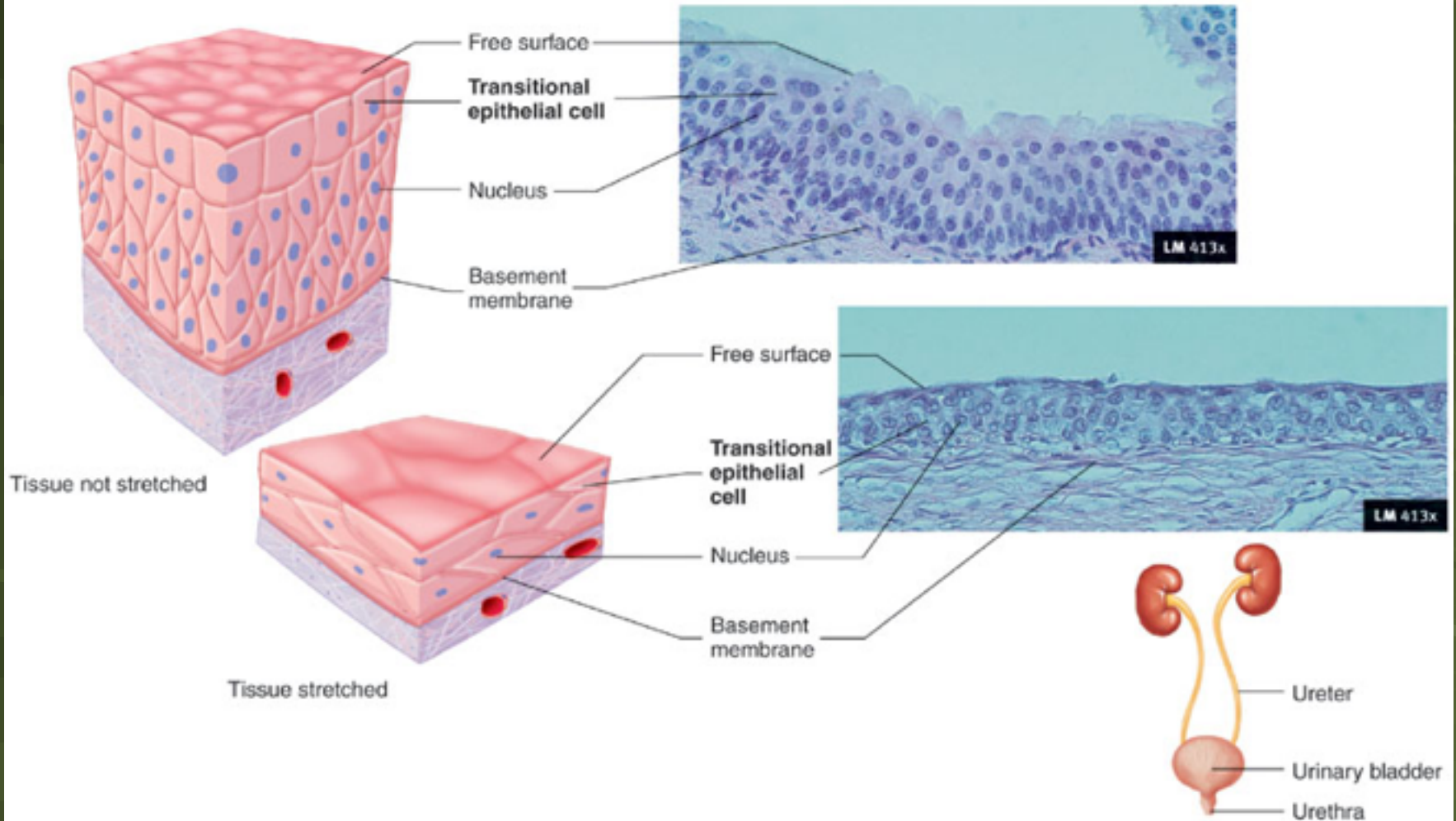
(e) Stratified Squamous Epithelium

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)

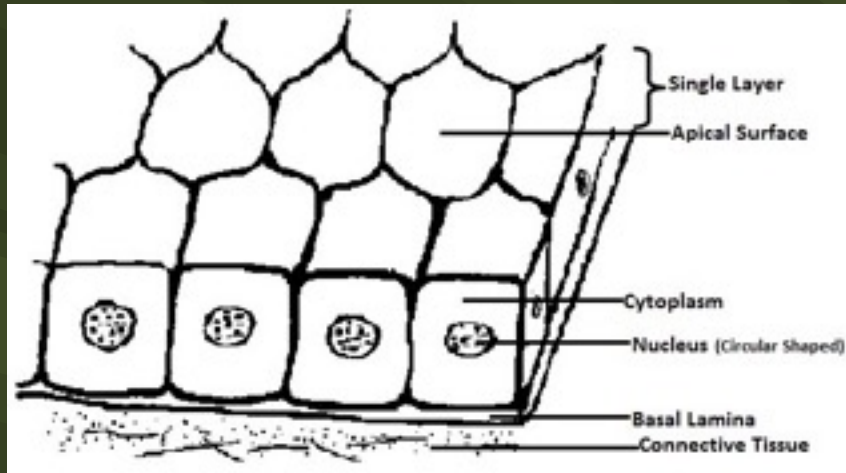
Transitional Epithelial Tissue

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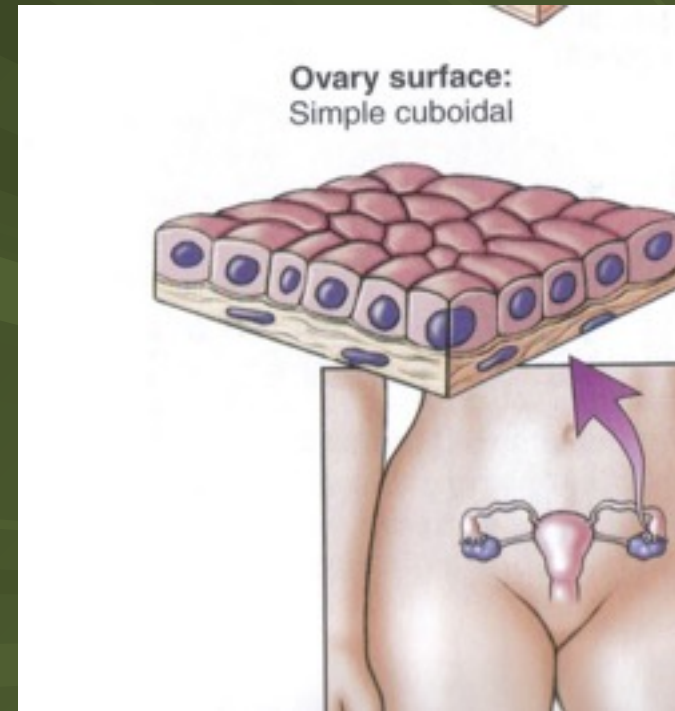
(f) Transitional Epithelium

Simple Cuboidal Epithelium



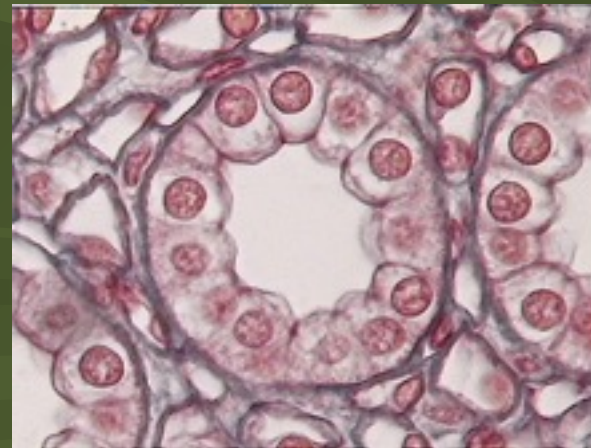
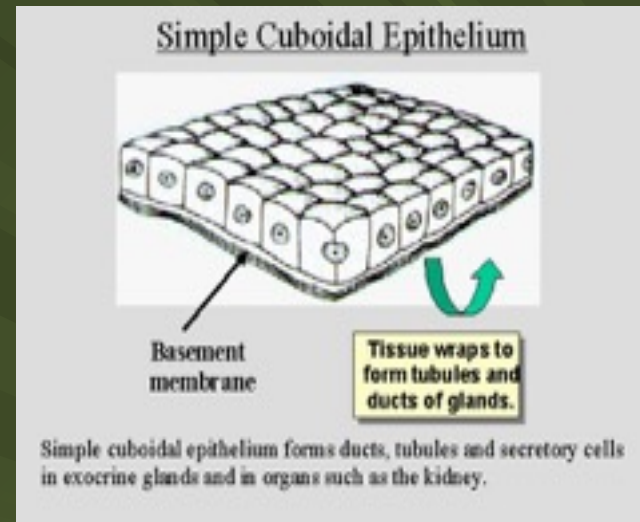
■ Single layer

■ Cube shape



Glandular Epithelium

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

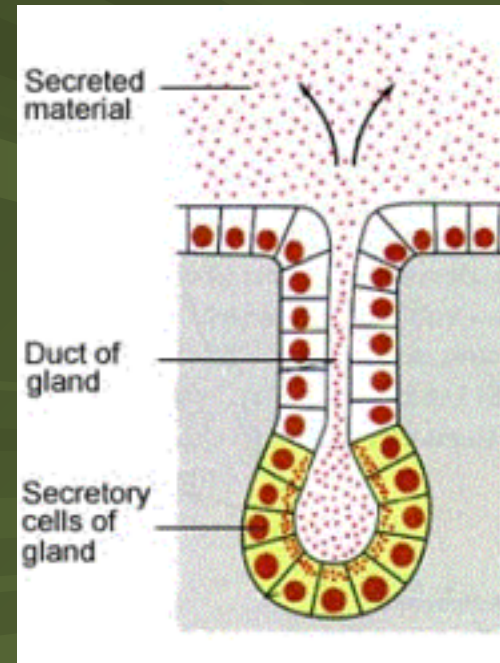


2 Types of Glands

■ EXOCRINE GLANDS

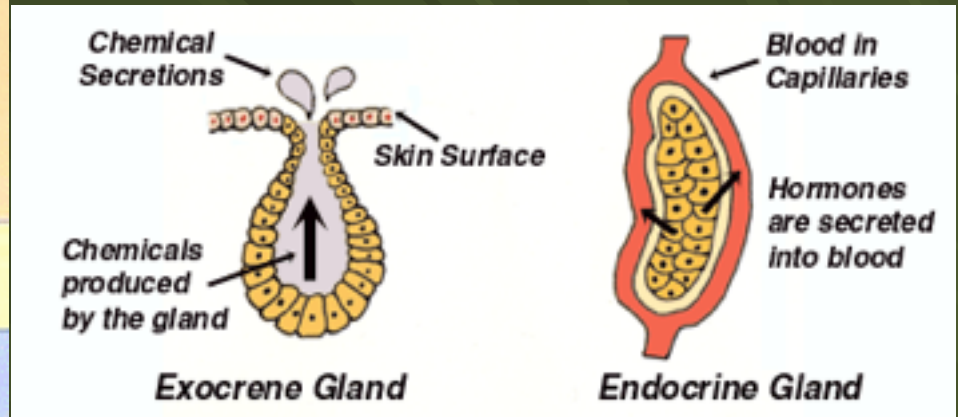
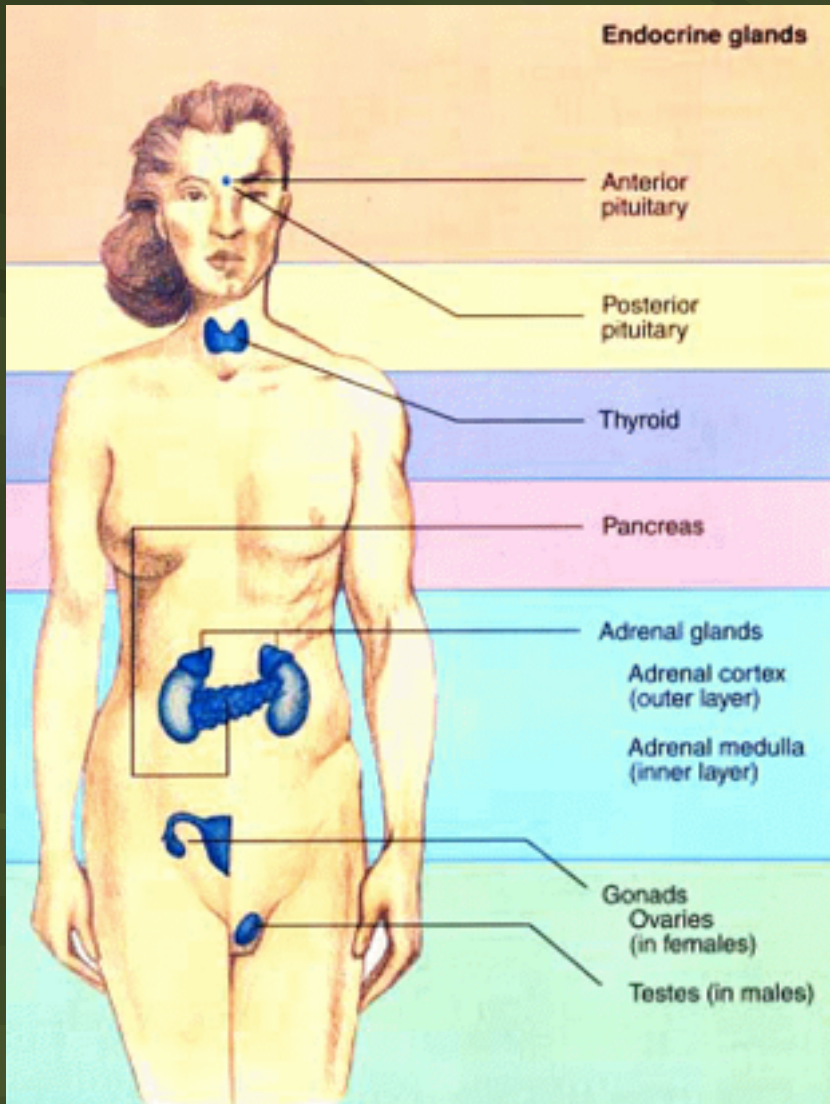
– have ducts, or tiny tubes, into which the exocrine secretions are released before reaching body surfaces or body cavities

■ 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

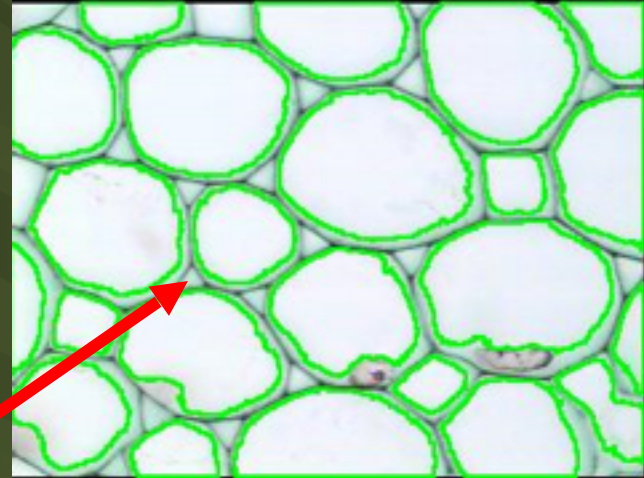
■ Although connective tissue types do not resemble each other very closely, they share two characteristics:

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

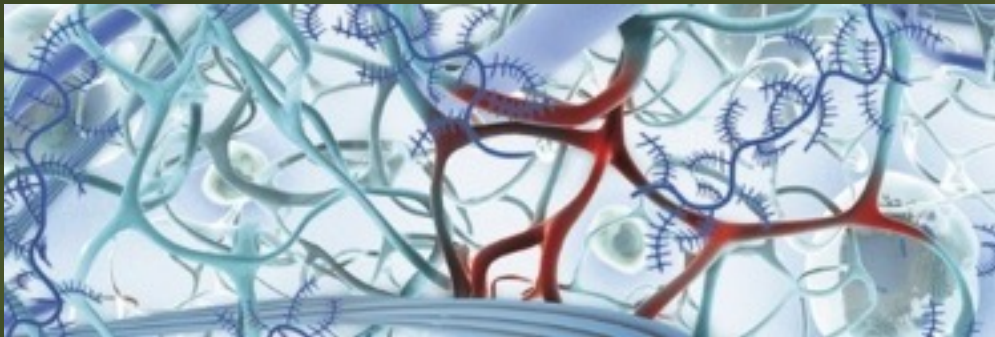
■ **EXTRACELLULAR MATRIX** – material located outside the cell



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



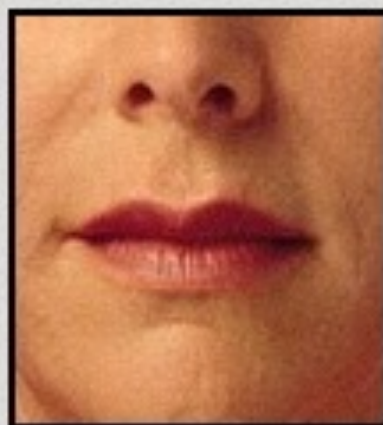
Pre-Treatment



Post-Treatment



Pre-Treatment

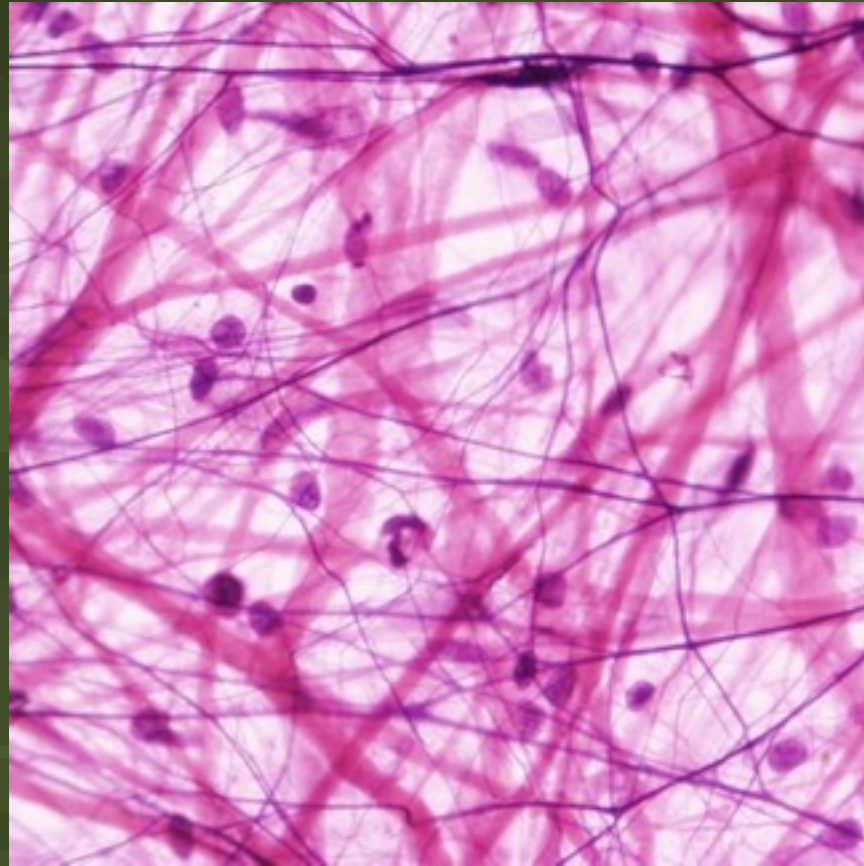


Post-Treatment

Types of Connective Tissue

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

Loose Connective Tissue

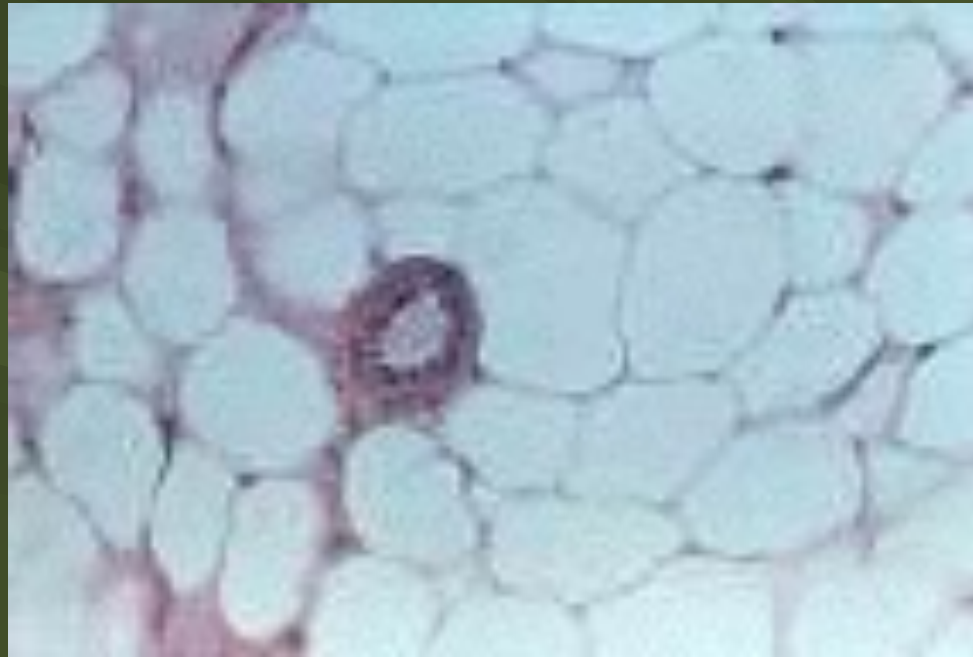


Loose Connective Tissue

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

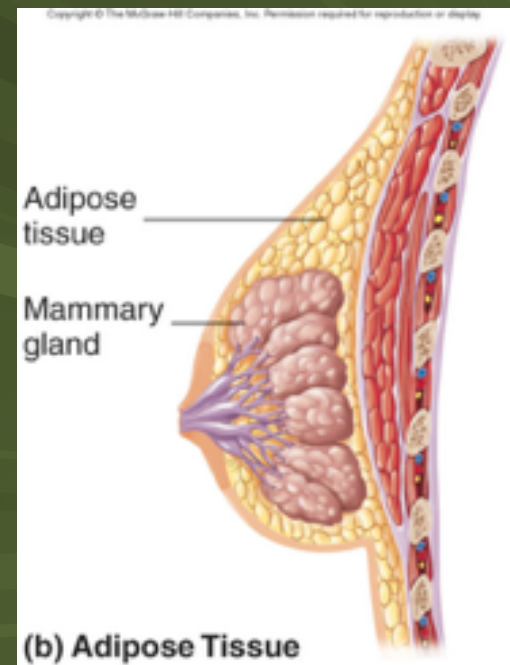
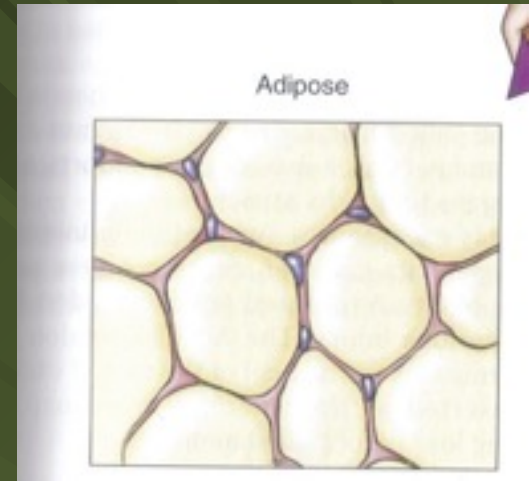


Adipose Tissue (fat)



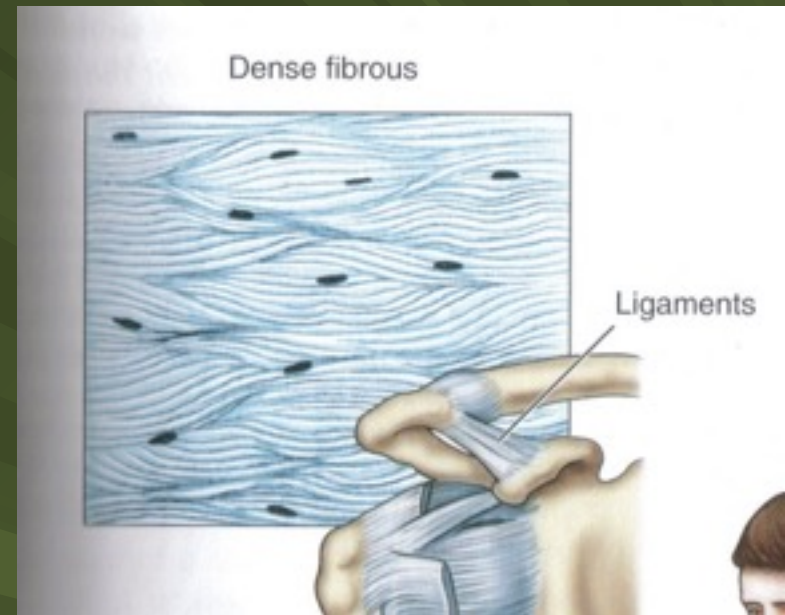
Adipose Tissue

- 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



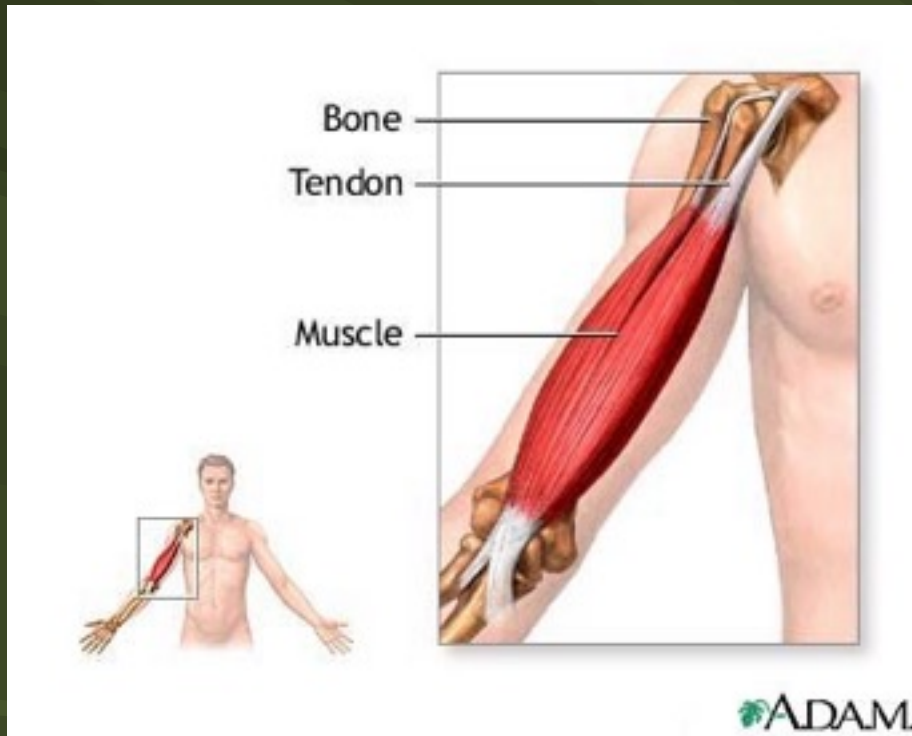
Dense Fibrous Connective Tissue

- 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

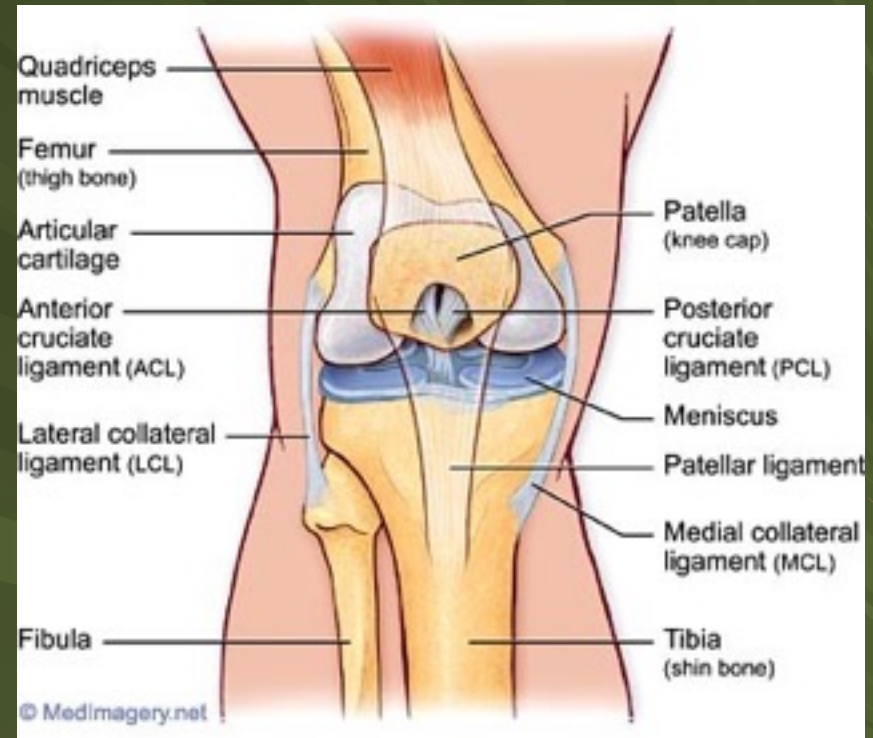


- **Tendons** – cord-like structures that attach muscles to bones
- **Ligaments** – crossover joints and attach bone to bone
- Ligaments contain more elastic fibers than tendons do, they stretch more easily
- This is important – prevents tearing of the ligaments when joints bend

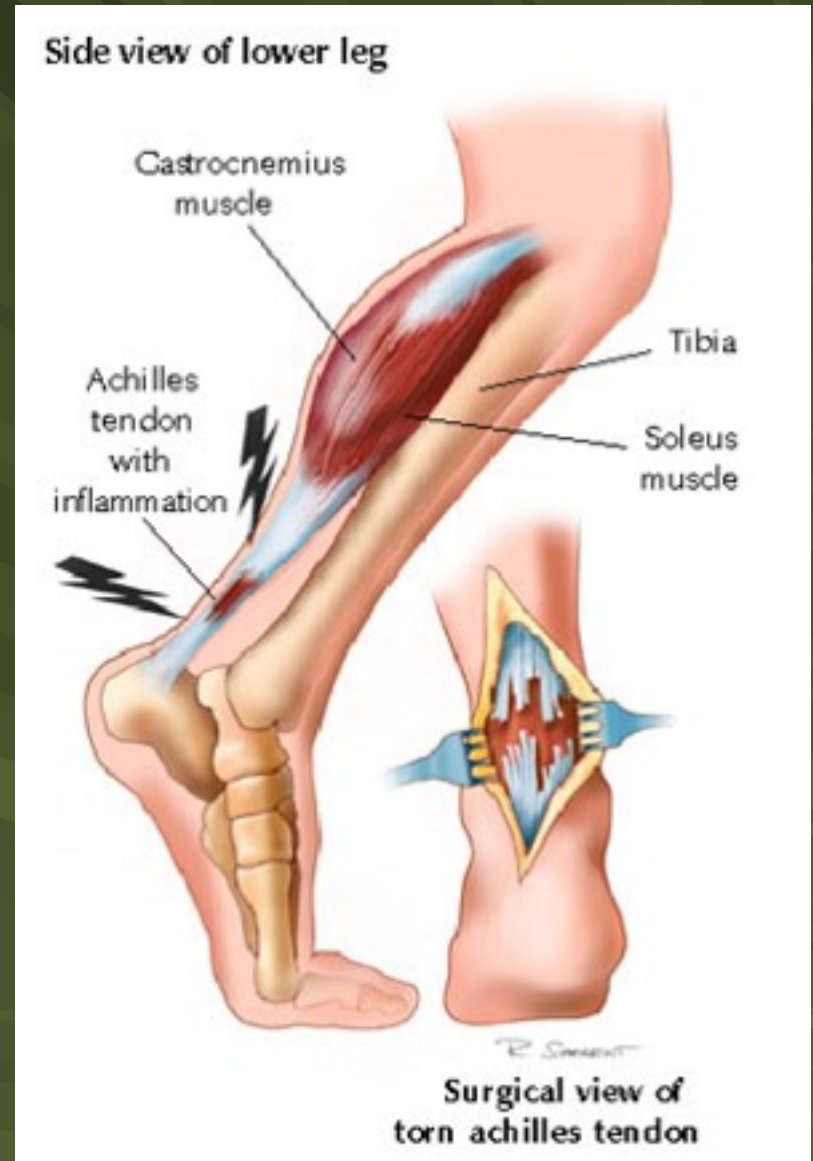
Tendon



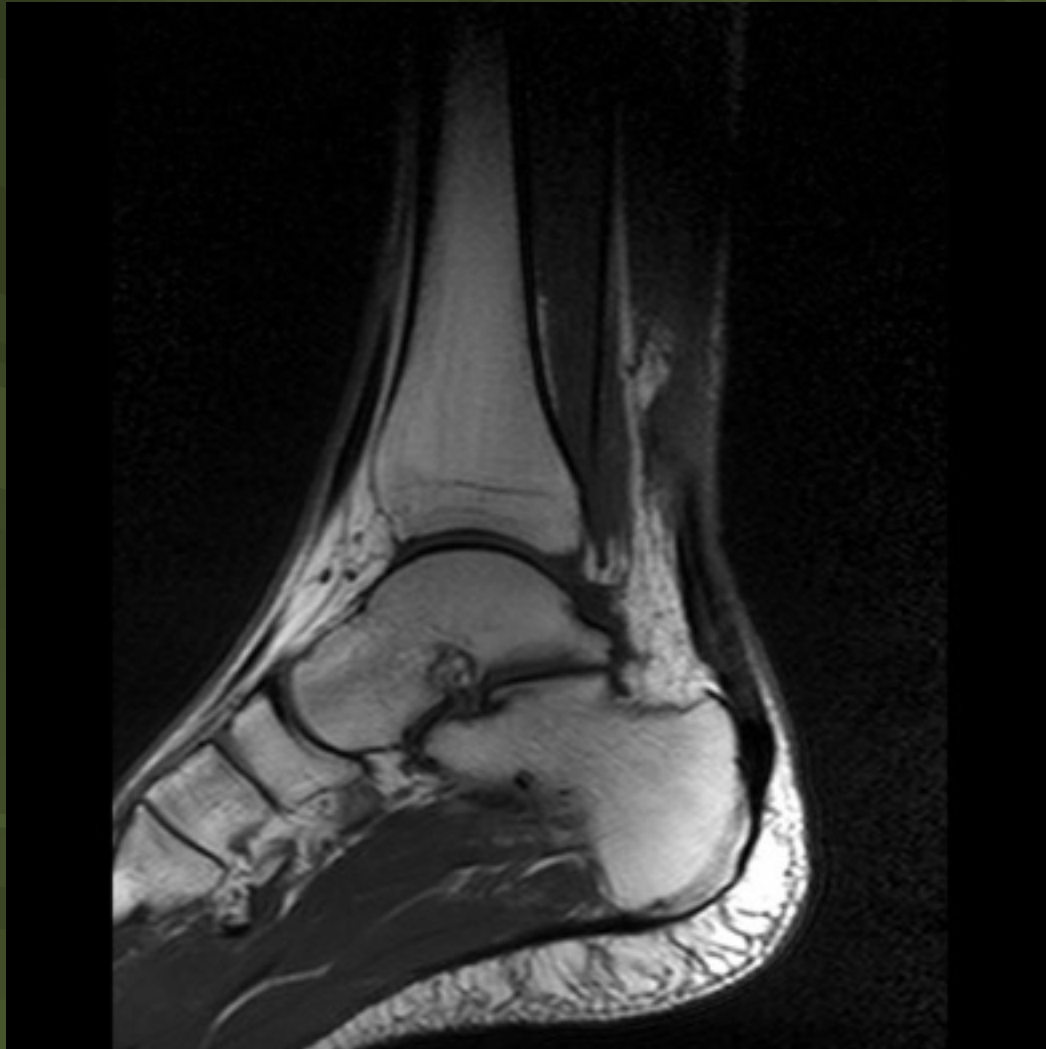
Ligament



- 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

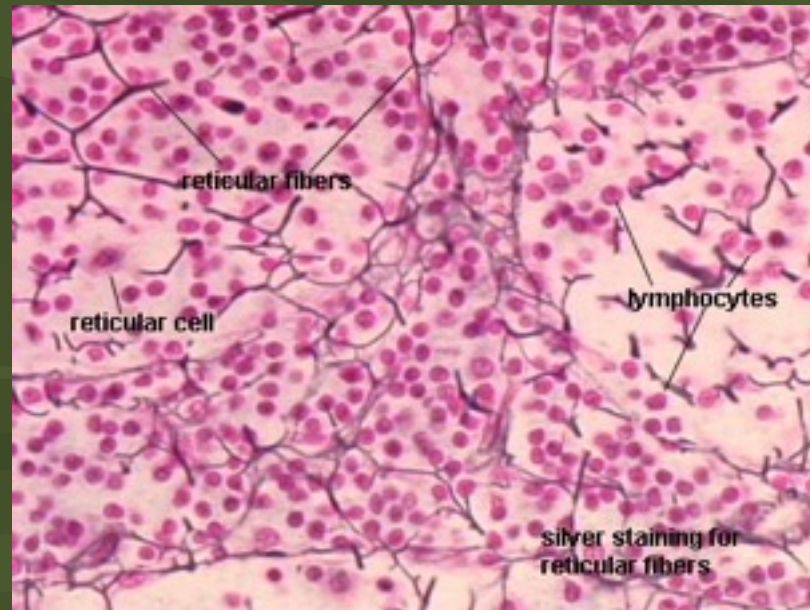


Ruptured Achilles Tendon



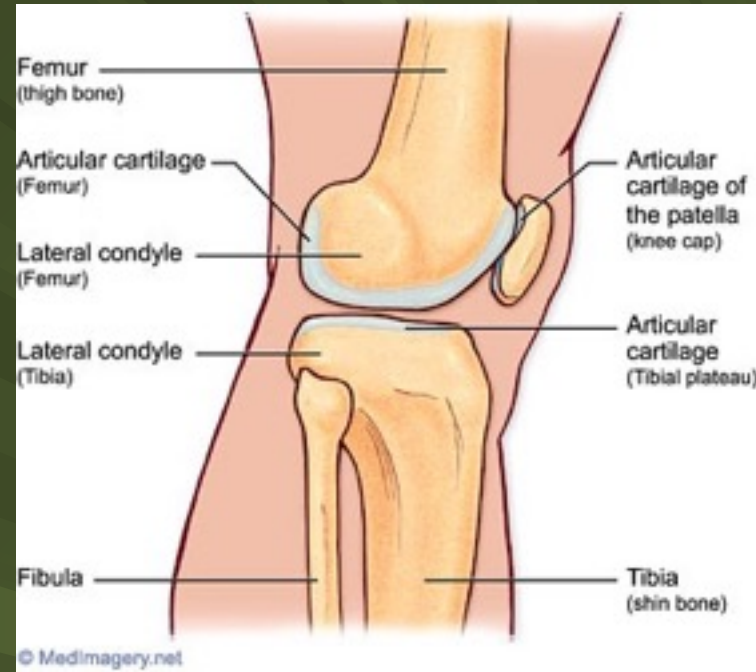
Reticular Connective Tissue

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



Cartilage

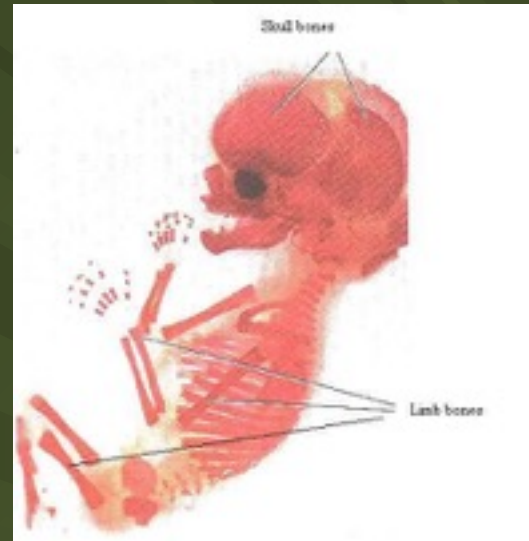
- **Cartilage** is formed by **CHONDROCYTES** – cartilage cells
- The chondrocytes secrete a protein extracellular matrix that is firm, smooth, flexible
- Although cartilage is firm, it is not solid like bone



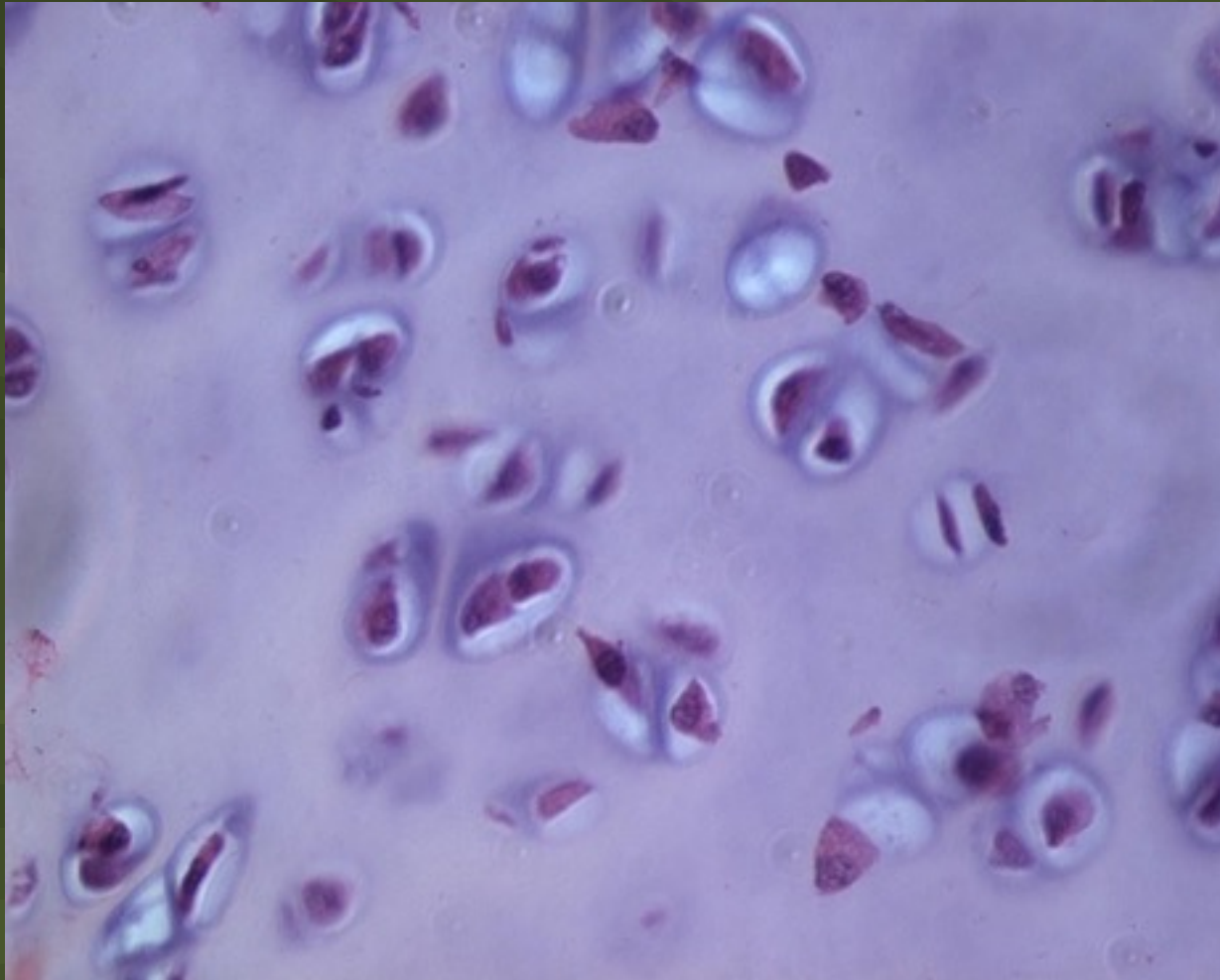
There are 3 types of cartilage: **hyaline, elastic, fibrocartilage**

■ **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

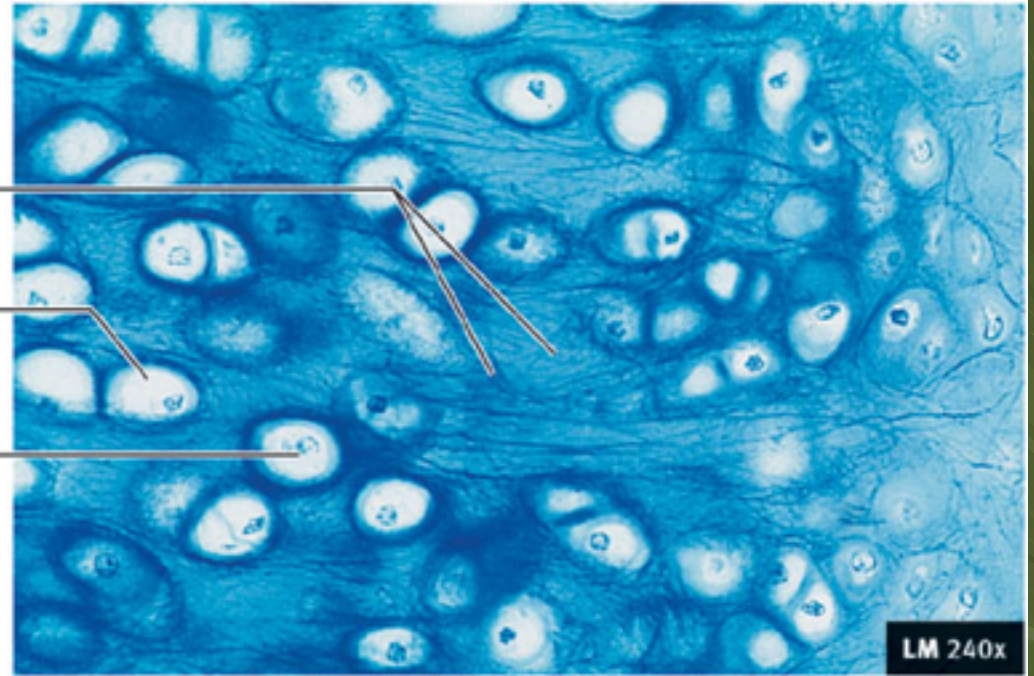
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Elastic fibers
in matrix

Chondrocytes
in lacunae

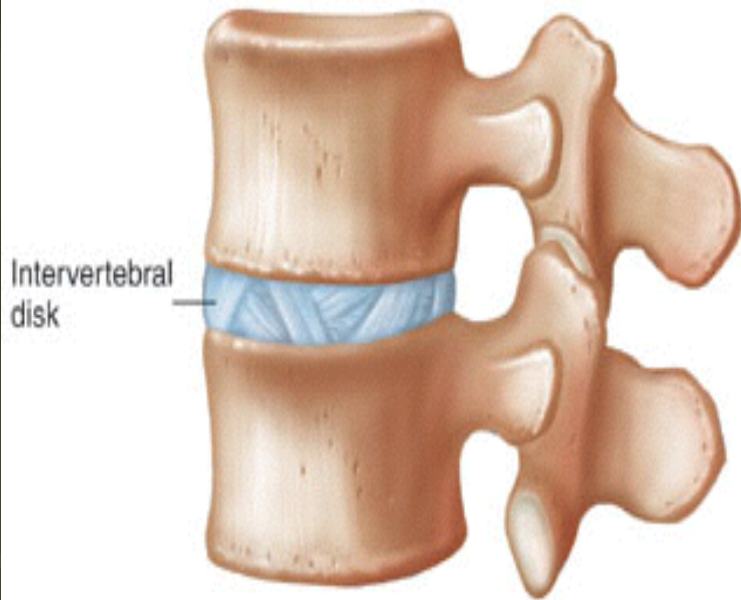
Nucleus



(g) Elastic Cartilage

Fibrocartilage: found in between vertebral discs, meniscus of knee, & pubic area

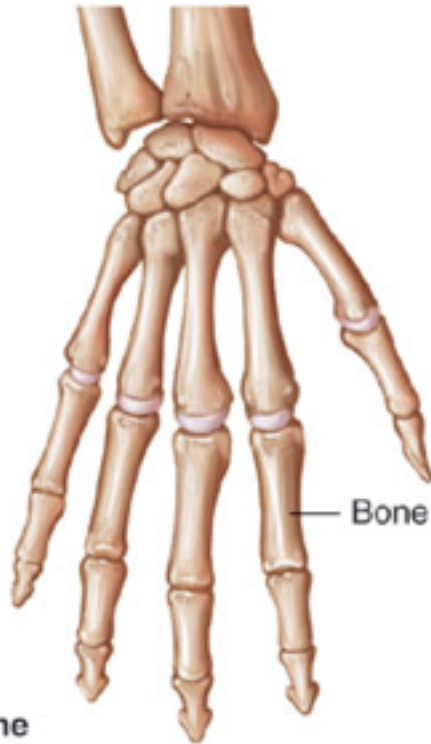
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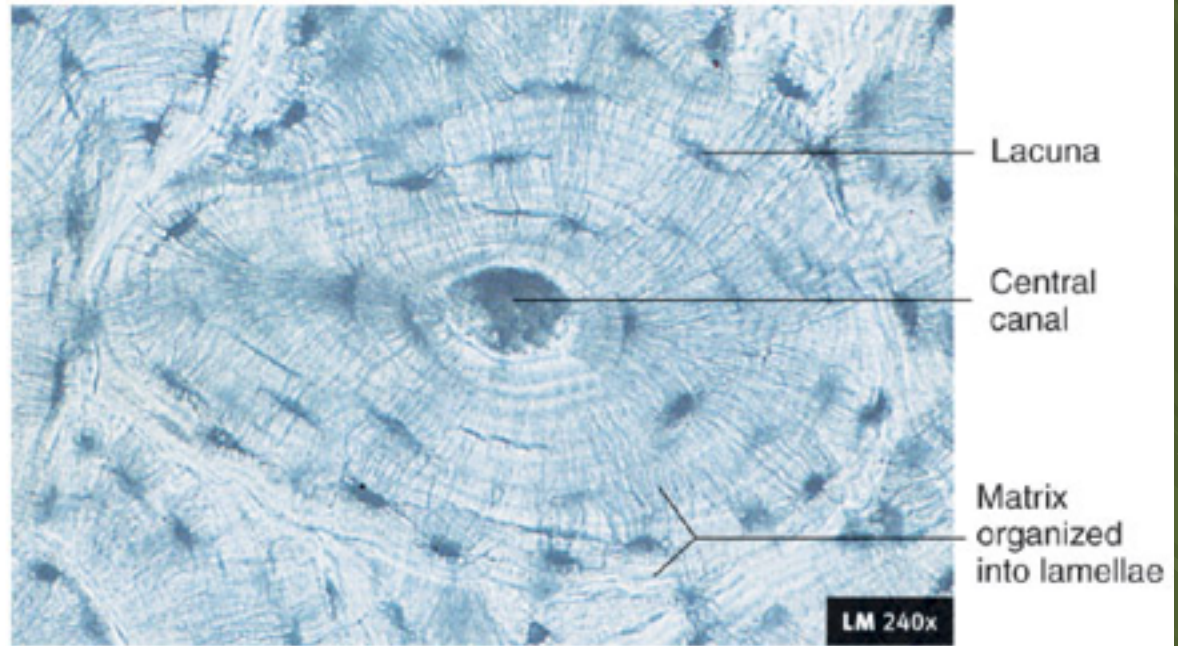
(f) Fibrocartilage

Connective Tissue - Bone

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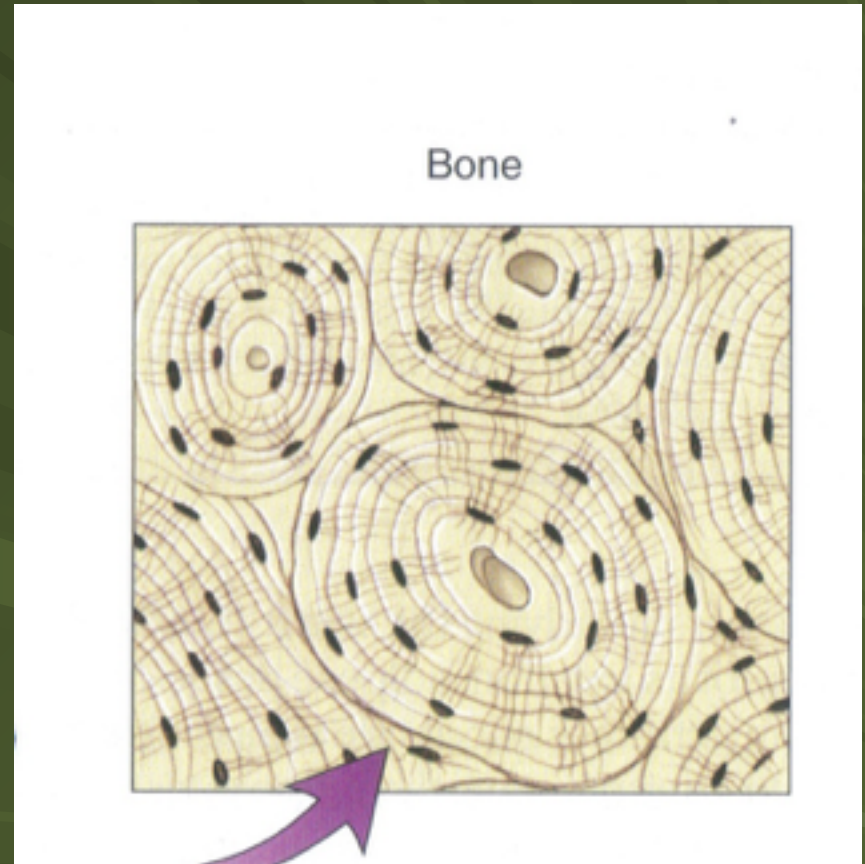


(h) Bone



Bone

- Also called OSSEOUS TISSUE
- Bone cells are called OSTEOCYTES
- 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

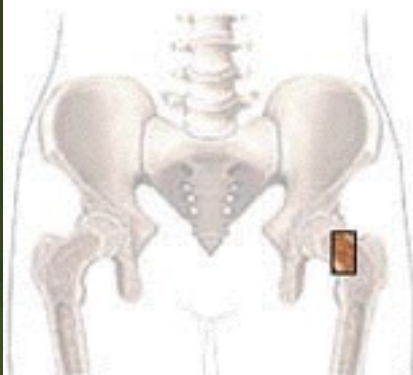


- When this mineralization of bone tissue is diminished, as in osteoporosis, the bone is weakened and tends to break easily
- Adequate dietary intake of calcium is essential for strong bones
- Calcium is needed throughout the life cycle, but is especially important during childhood, when bones are growing, and after menopause, when estrogen levels in women decline

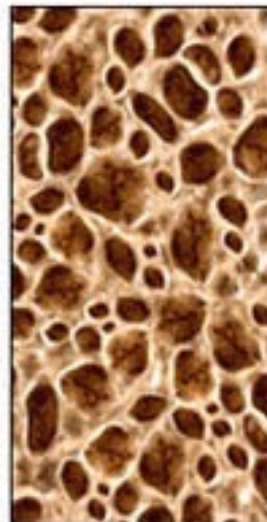


Solid
bone matrix

Weakened
bone matrix



Bone section
through hip



Exercise and weight-bearing workouts encourage calcium deposition within bones



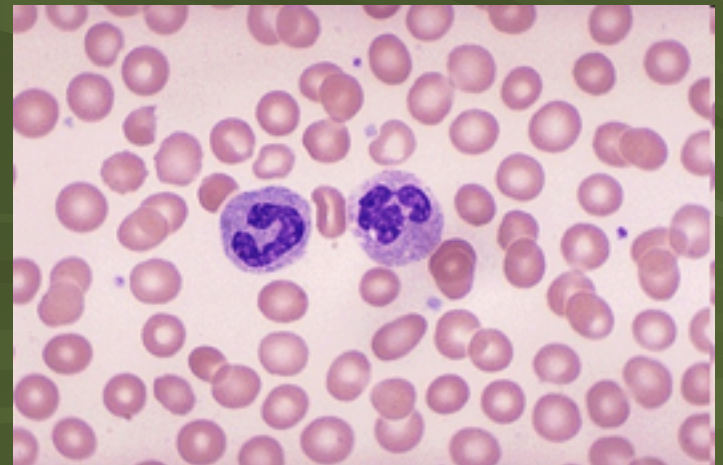
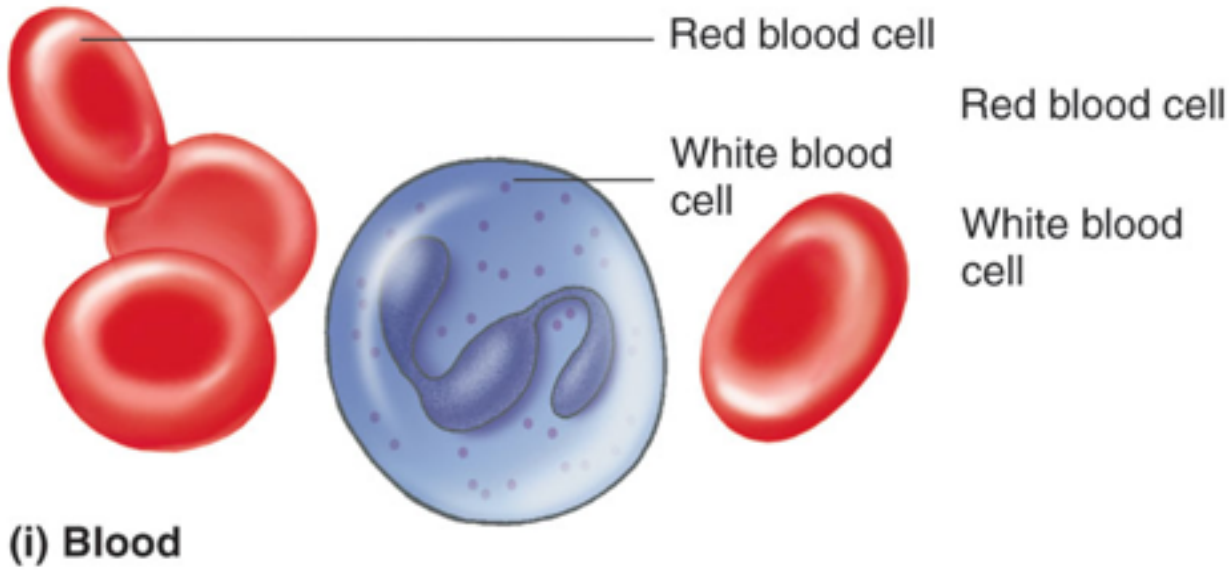
Blood



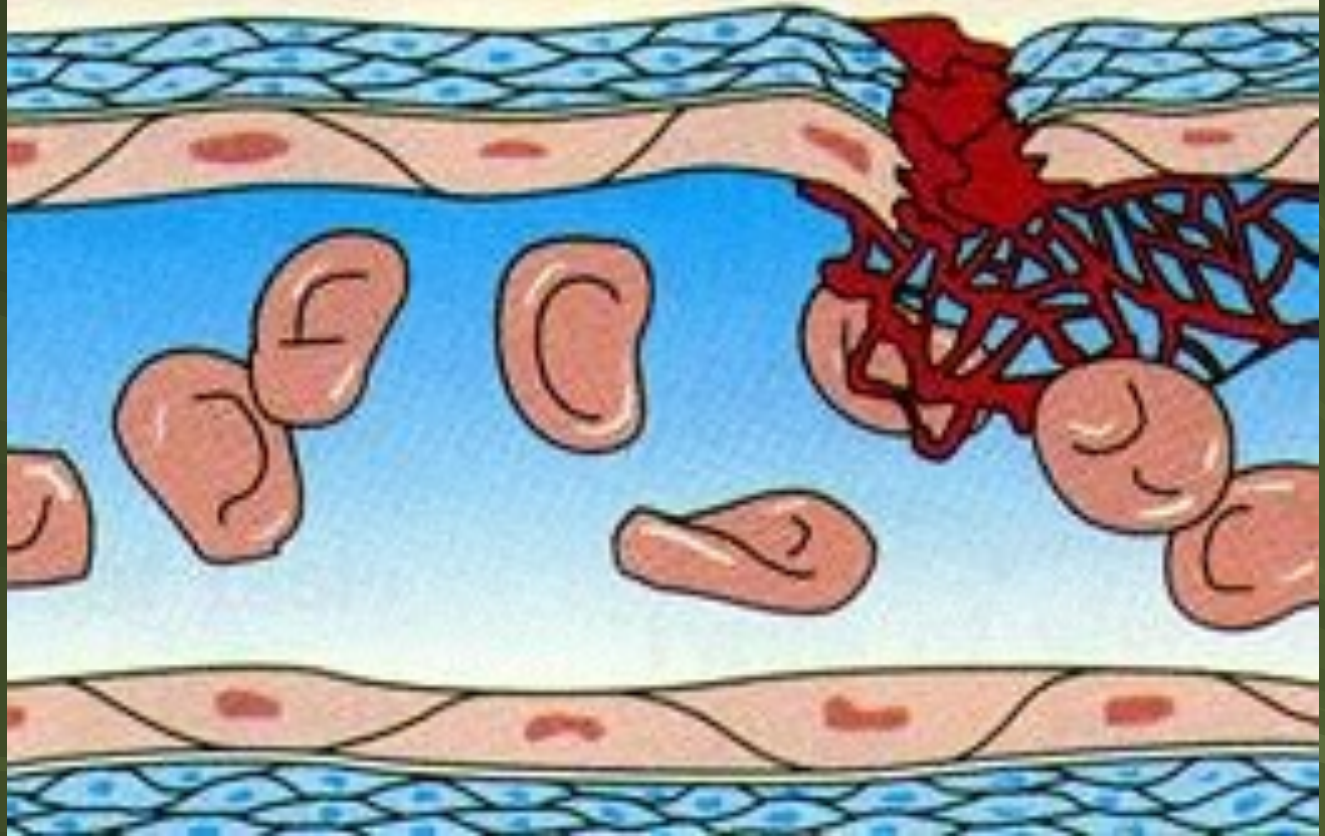
- Blood is a unique type of connective tissue
- Consists of blood cells surrounded by a fluid matrix called PLASMA
- Plasma contains fibrous plasma proteins that are not seen unless clots form
- Blood – transports substances throughout the body

Blood

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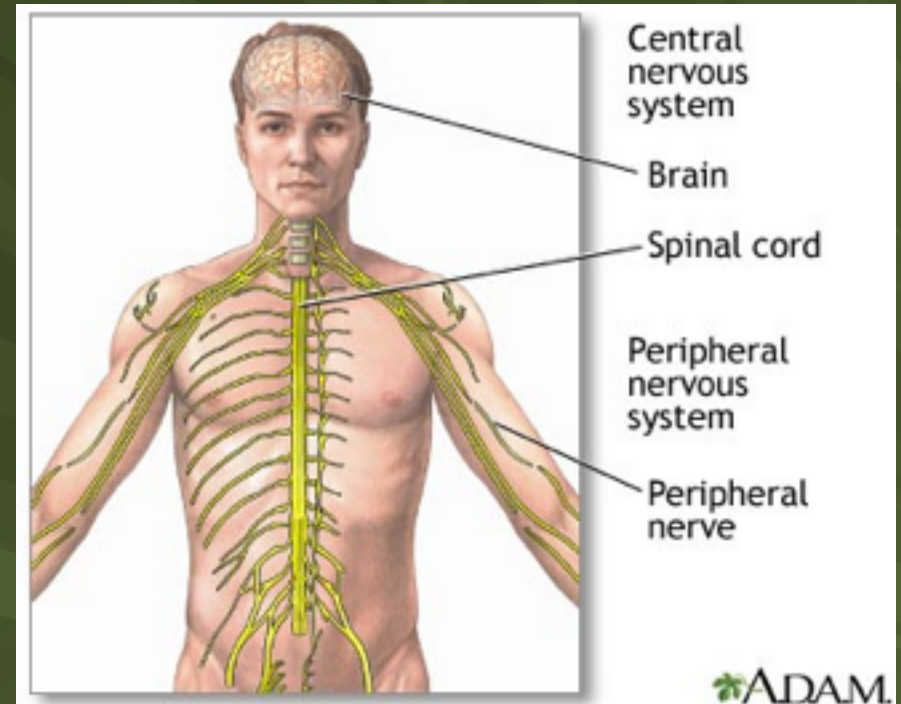


C. Fibrin mesh



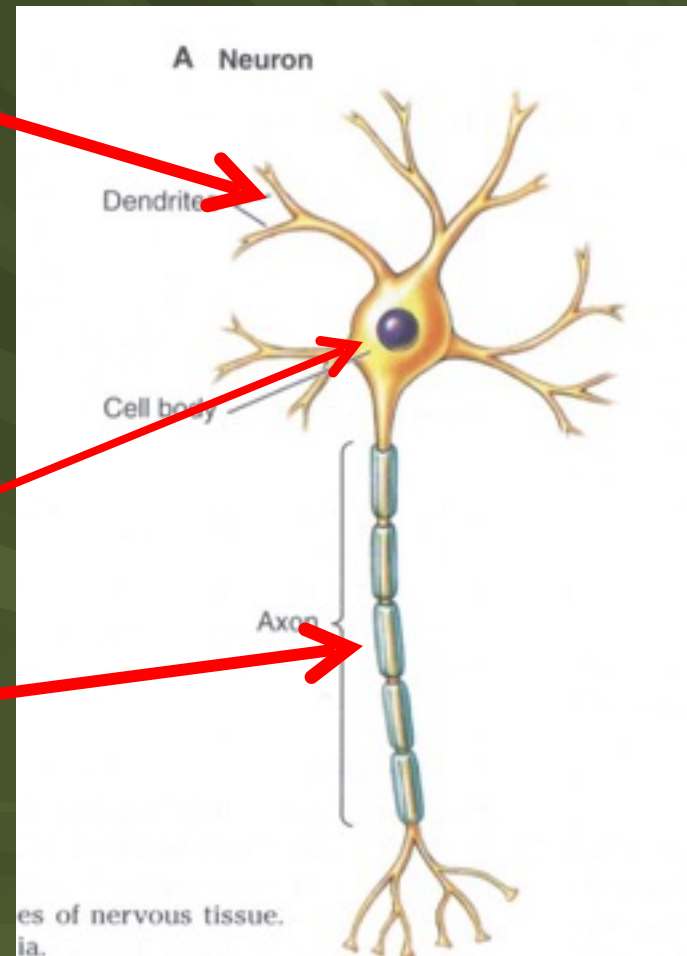
Nervous Tissue

- 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

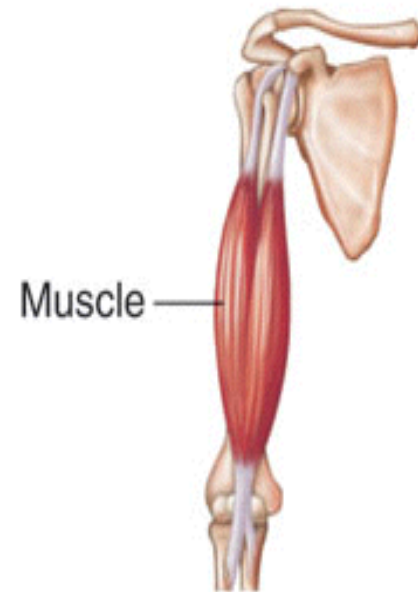
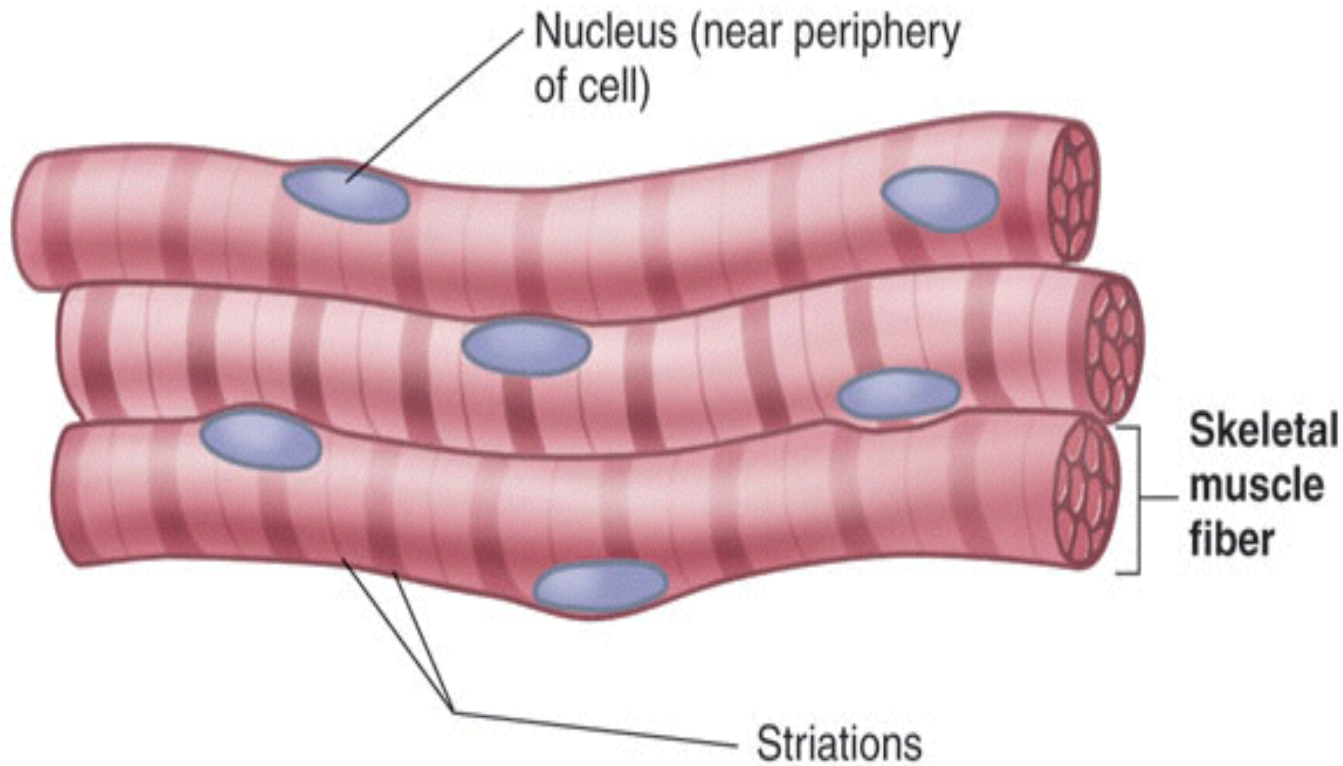
- Three types of muscle: **skeletal, smooth, cardiac**

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)

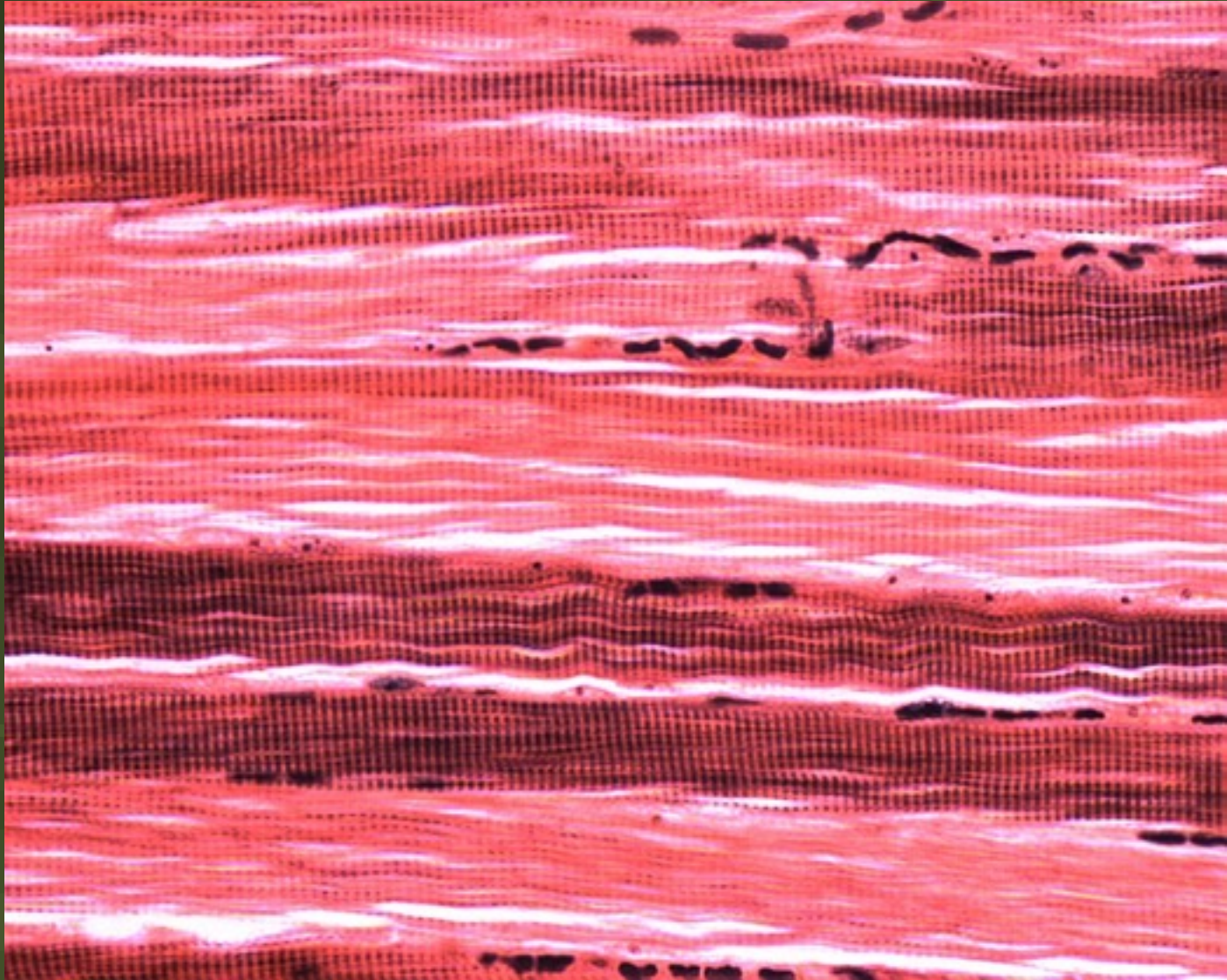
Skeletal muscle move the skeleton, maintain posture, stabilize joints

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(a) Skeletal Muscle

Skeletal Muscle

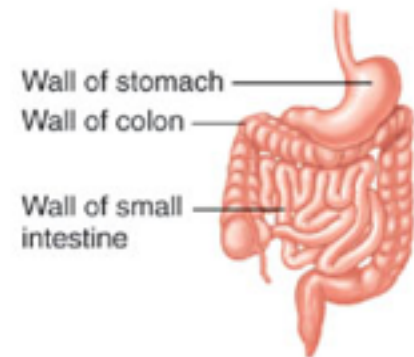
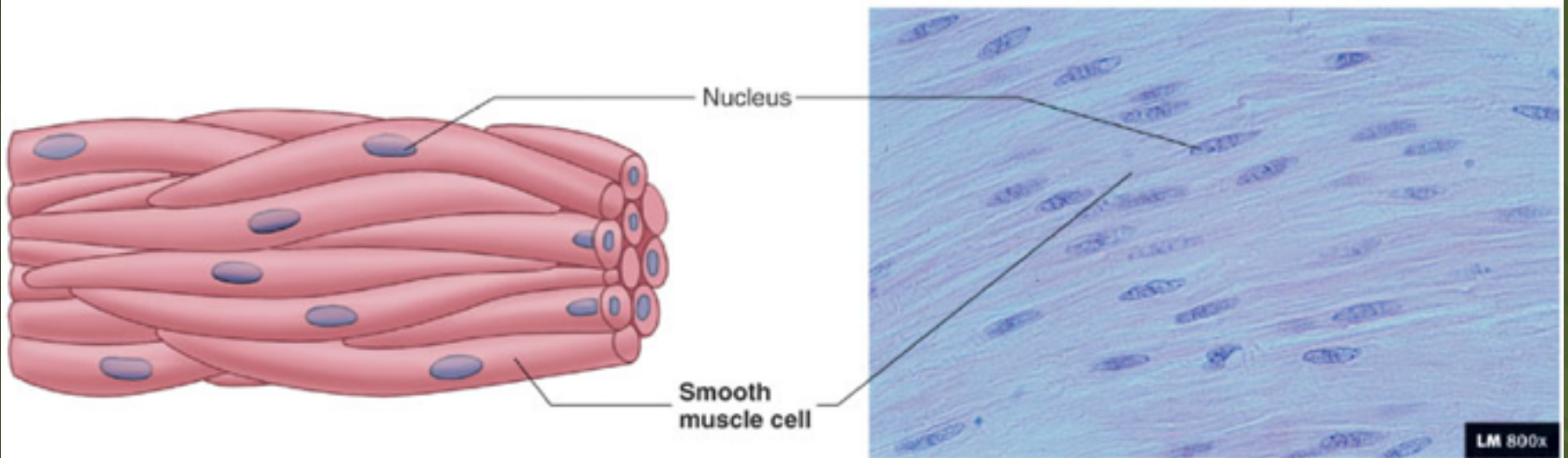


Smooth Muscle

- 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**

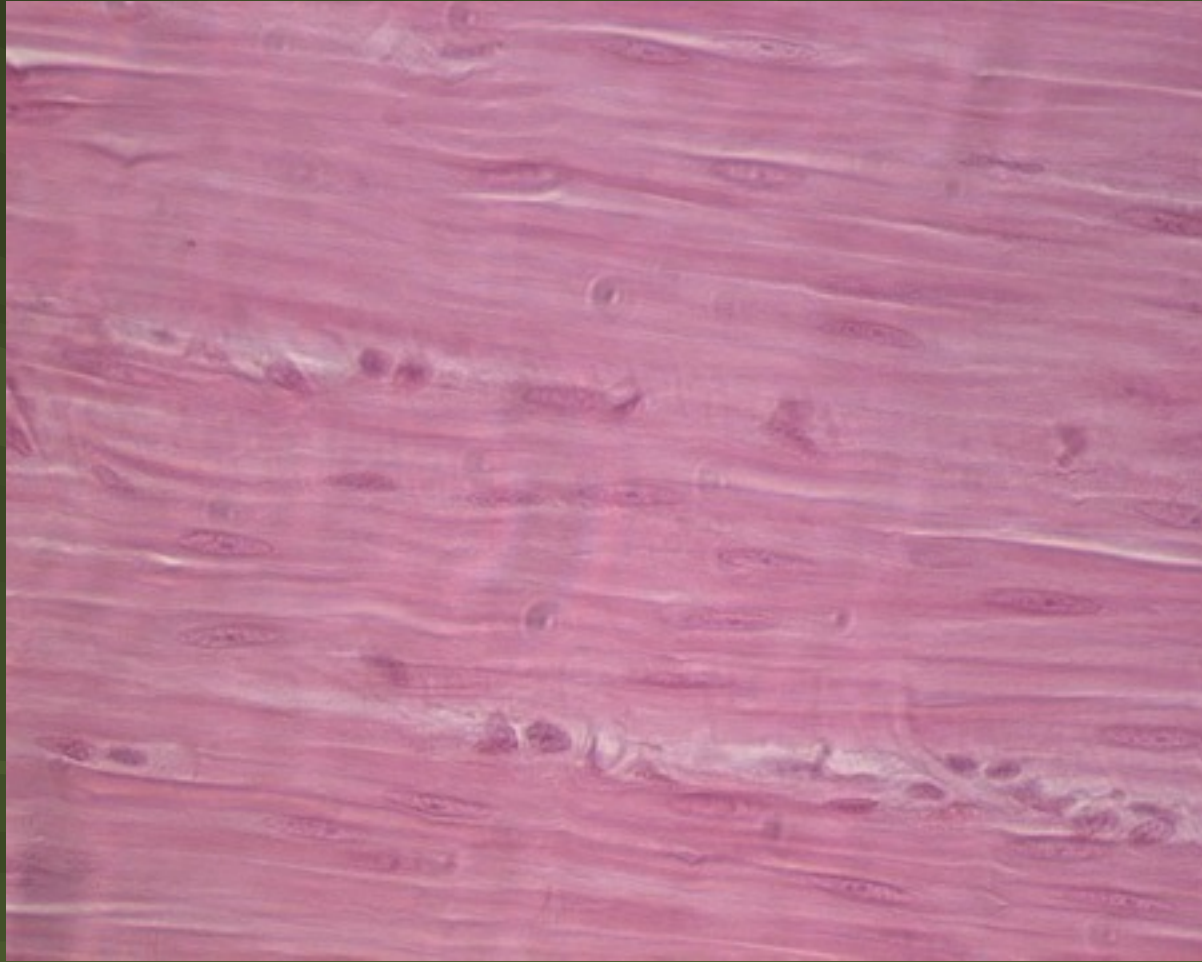
Smooth muscle does NOT appear striped, or striated, called **nonstriated muscle**

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(c) Smooth Muscle

Smooth Muscle

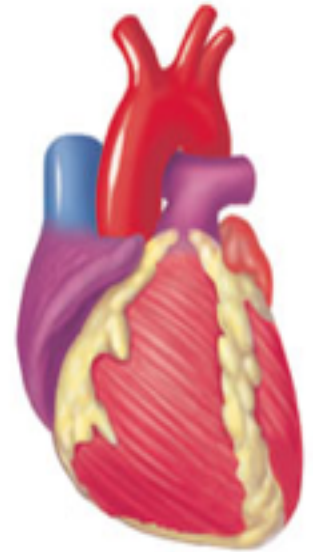
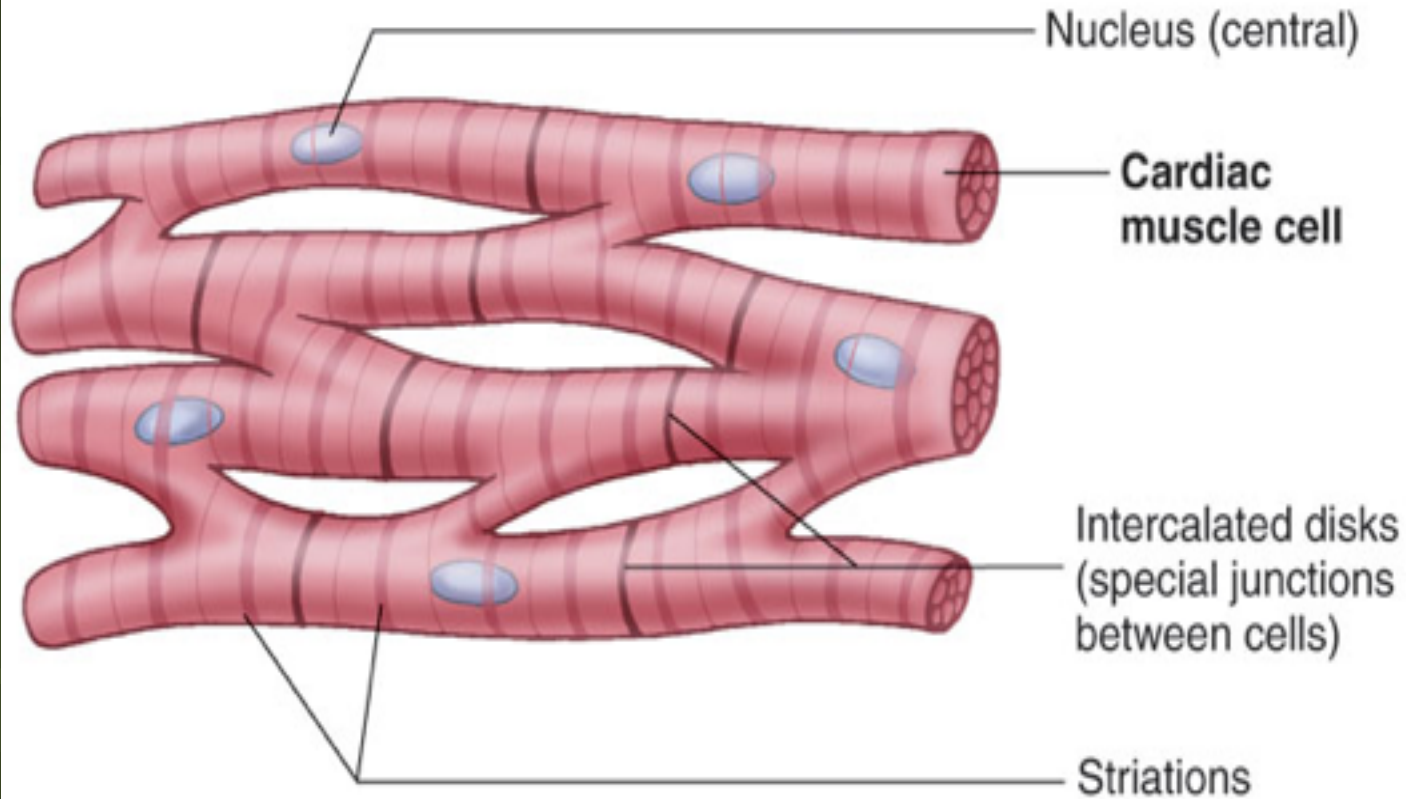


Cardiac Muscle

- 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

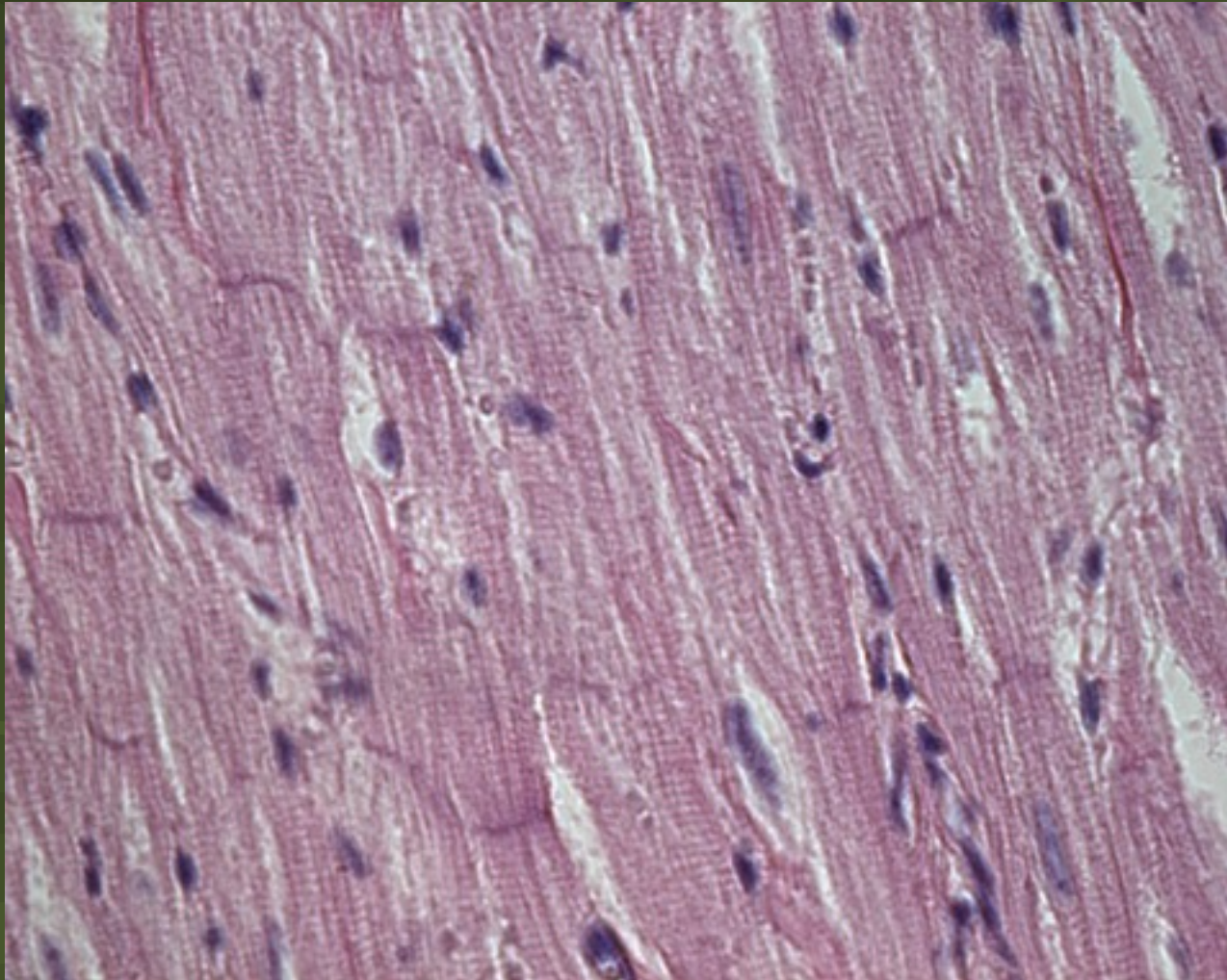
Cardiac Muscle

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(b) Cardiac Muscle

Cardiac Muscle

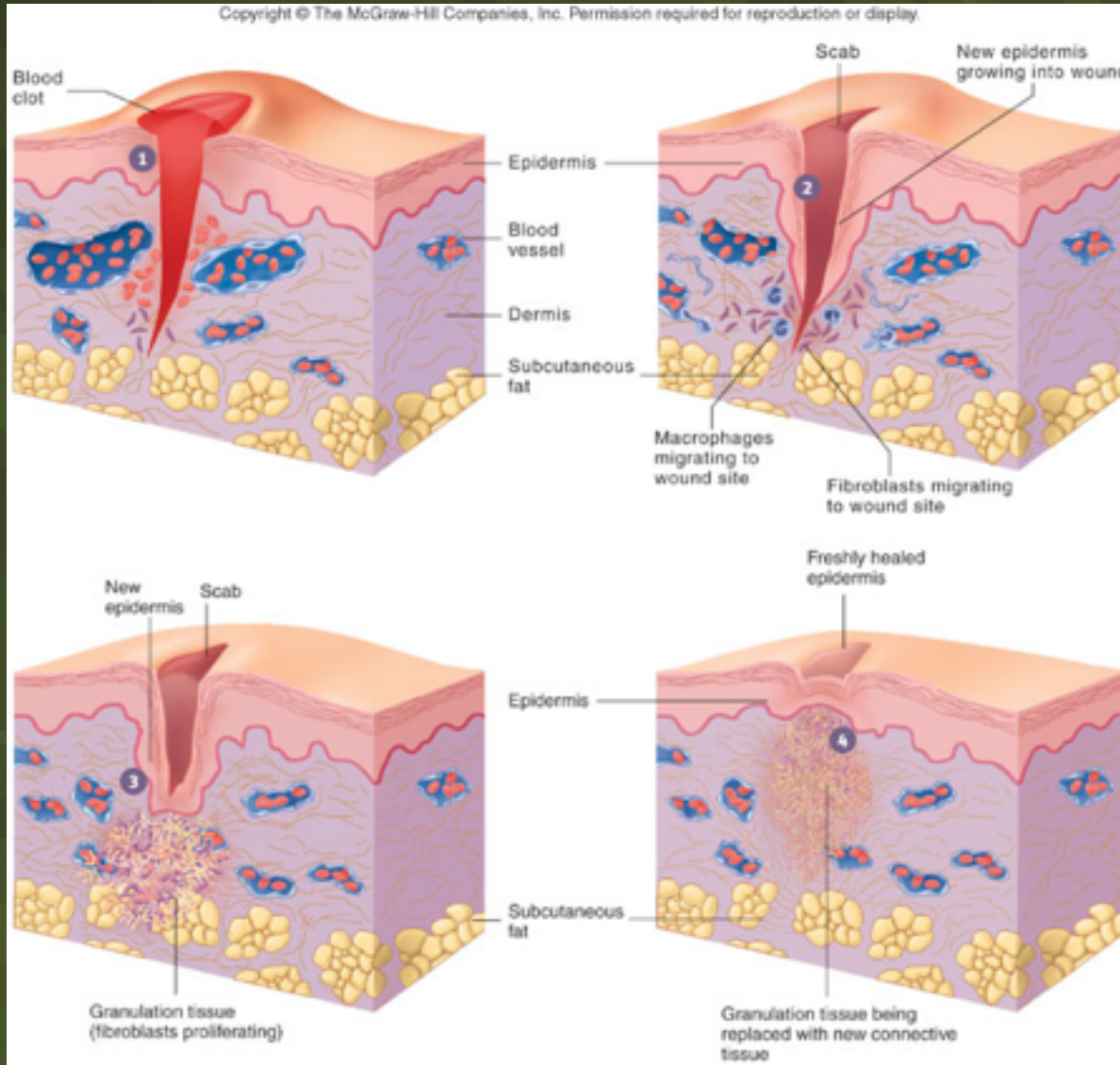


Tissue Repair

- 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

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■ **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

■ **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

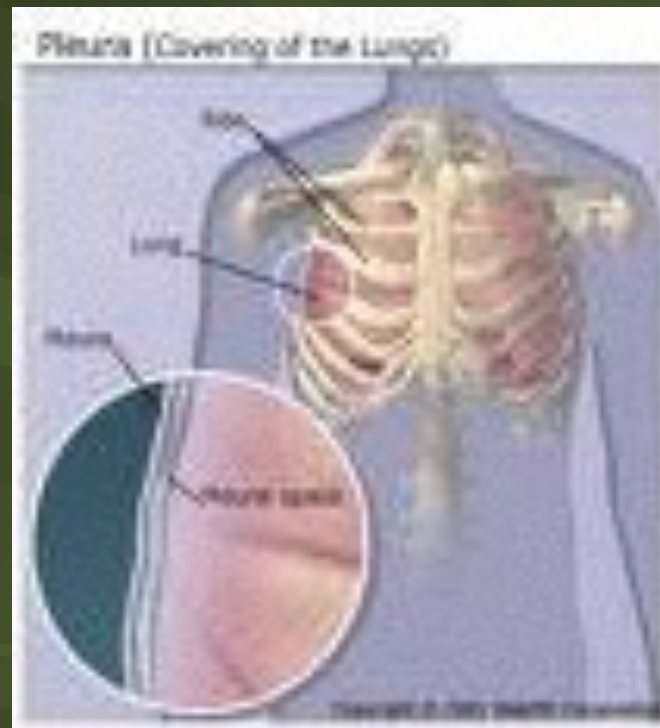
- **Mucous membranes** – line all body cavities that **OPEN** to the outside of body
- Include digestive, urinary, reproductive, respiratory tracts
- Most secrete mucus that keeps the membrane moist and lubricated

■ **Serous Membranes** – line the ventral body cavities which are **NOT OPEN** to the outside of body

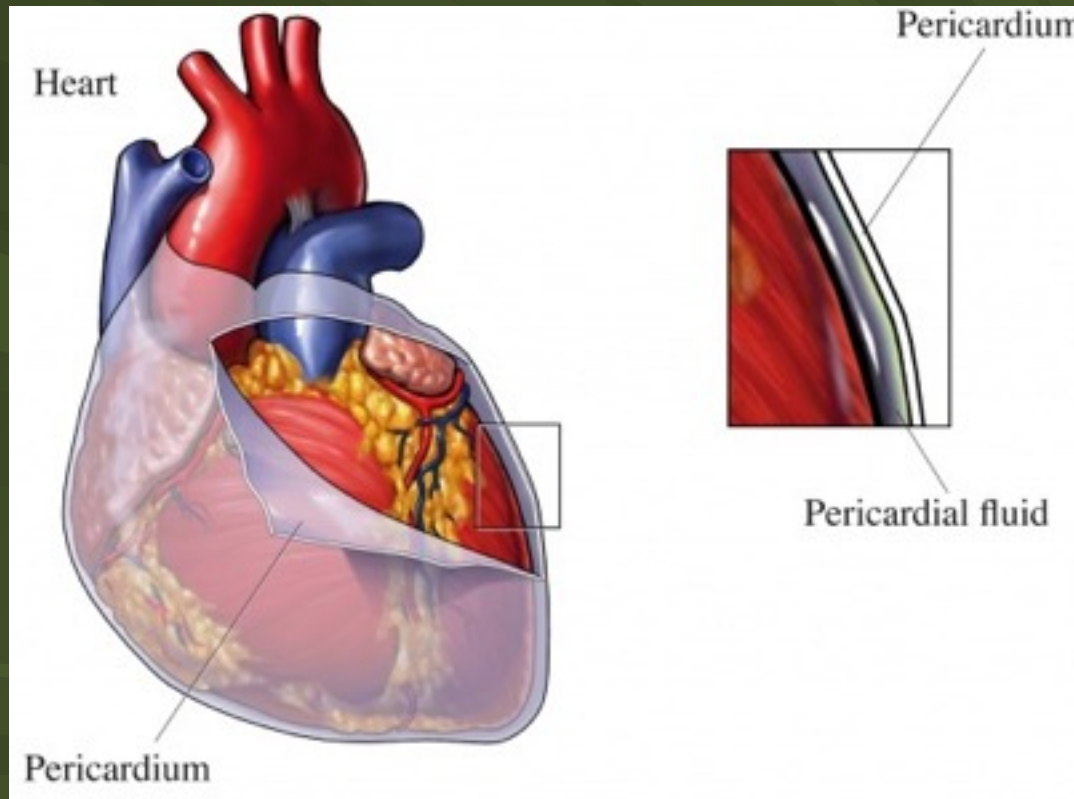
■ They secrete a thin, watery fluid that allows membranes to slide past one another with little friction

■ 3 serous membranes:

1. **pleura** – lines the thoracic cavity



■ 2. Pericardium – lines the outside of the heart



3. Peritoneum – lines the abdominal cavity

