

ANP1105.

THE STRUCTURAL ORGANIZATION OF THE HUMAN BODY.

ATOM- smallest particle of an element with all of the properties of that element.

*protons, neutrons, electrons.

MOLECULE- the smallest amount of a substance that can exist alone = a combination of atoms.

ORGANELLE- molecules associate in specific ways to form *organelles*= basic components of living cells.

*lysosomes, Golgi body.

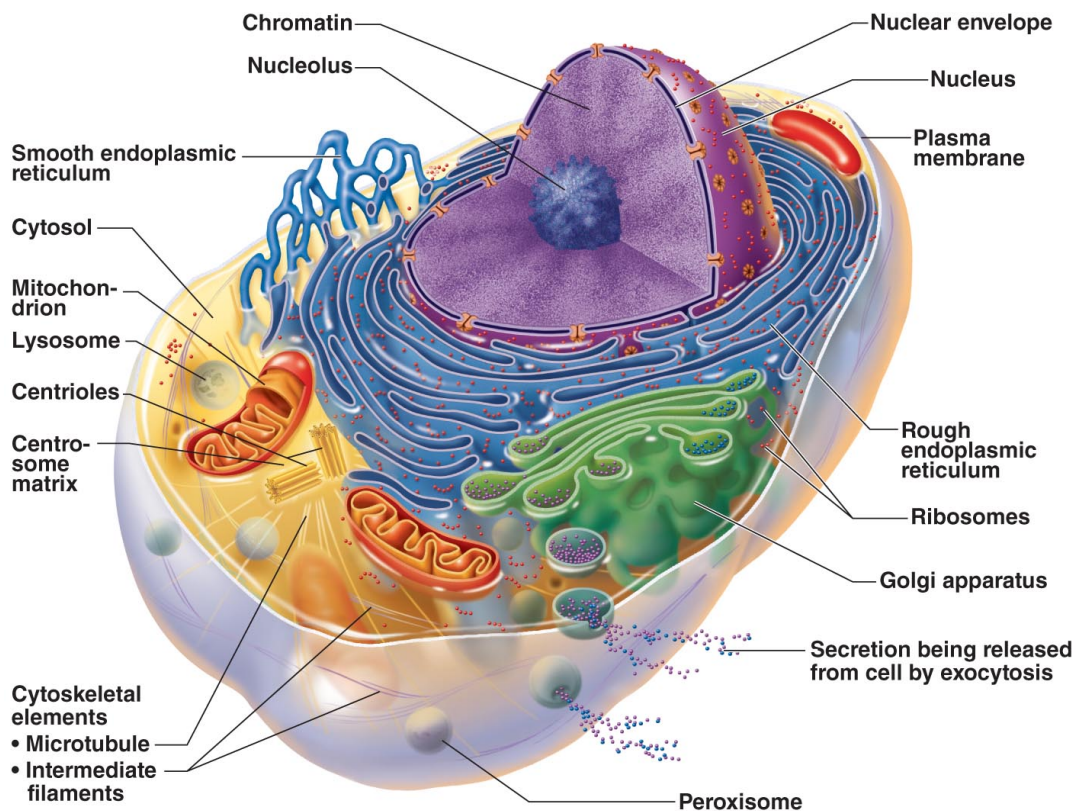
CELL- fundamental, structural & functional unit of a living thing; cells vary in size & shape.

TISSUE- groups of similar cells that have a common function:

*epithelium, muscle, connective tissue (CT), nervous tissue.

ORGAN- structure composed of at least 2 (however, usually 4) tissue types that performs a specific function for the body.

ORGAN SYSTEM- organs that work closely with one another to accomplish a common purpose.

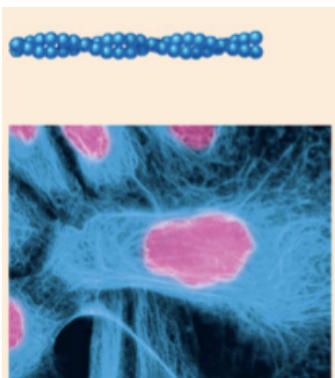


Structure	Function
Plasma membrane	separates the cell from surroundings, protection, base attachment for the cytoskeleton.
Mitochondria	cellular respiration.
Ribosomes	production of protein.
Rough Endoplasmic Reticulum	the point of attachment of ribosomes, takes part in export of proteins and hormones .
Smooth Endoplasmic Reticulum	production of lipids and steroids.
Golgi Apparatus	modifying, sorting and packaging of proteins for secretion.
Lysosomes	digestion of worn out organelles, food particles. REMOVAL OF WASTE.
Peroxisomes	break down of very long chains of fatty acids.
Microtubules	movements of organelles and chromosomes.

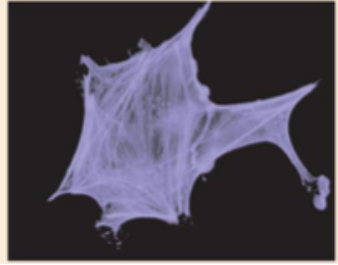
14

Structure	Function
Microfilaments	cell movement, made from actin.
Intermediate Filaments	mechanical support for the plasma membrane where it comes into contact with other cells.
Centriole	cell division in animal cells.
Cilia	move liquid past the surface of cell.
Flagella	movement.
Microvilli	absorption and secretion functions of cells.
Nucleus	DNA.
Nuclear Membrane	surrounding of nucleus, protection of DNA from other materials in cytoplasm.
Nucleoli	brain of nucleus. rewrites RNA and combines it with protein.
Chromatin	packaging DNA into small volume to fit into the nucleus and protect DNA.

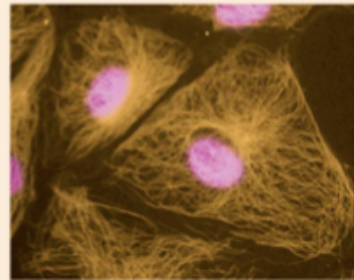
THREE TYPES OF CYTOSKELETAL FILAMENTS:



1. **Microfilaments**- composed of the protein actin, involved in muscle contraction.



2. Intermediate filaments- protein fibers, composition varies, resist mechanical forces acting on the cell.



3. Microtubules- cylindrical structures made of tubulin proteins, support the cell & give it shape, form centrioles, cilia and flagella.

WHY DO WE NEED A NUCLEUS IN EACH CELL?

- Stores DNA on chromosomes, repairs it.
- Organizes genes into chromosomes to allow cell division.
- Transports gene products through pores.
- Produces mRNA.
- Produces ribosomes.
- Organizes the uncoiling of DNA to replicate and decode genes.

WHAT IS CHROMATIN?

-DNA + associated proteins (histones & non-histones).

These proteins package the DNA into the nucleus so that specific genes can be found and made available to direct protein synthesis, also they make sure that DNA strands do not get broken

FROM NUCLEUS TO CYTOPLASM.

-mRNA -> brings instructions for protein synthesis out to the ribosomes.

-Ribosomal subunits -> ribosomes are made in the nucleus but work in cytoplasm.

-Nucleus pores do not allow assembled ribosomes back into the nucleus.

FROM CYTOPLASM TO NUCLEUS.

-Proteins for the construction of ribosomes: ribosomes are composed of various RNAs and proteins. The RNAs are made in the nucleus, but proteins are made in cytoplasm.

-Other regulatory and structural nuclear proteins: histones -> involved in DNA packaging.

TISSUES.

-Groups of structurally similar cells that perform common/related function.

-Histology- study of tissues.

4 TYPES:

- EPITHELIAL - covering
- CONNECTIVE- support
- MUSCLE- movement
- NERVOUS- control (regulation)

***USUALLY ALL 4 MAKE UP ORGANS LIKE HEART AND KIDNEY.**

1. EPITHELIAL TISSUE.

-Creates boundaries between different environments.

*Epithelium lining separates underlying cells of the bladder from a contact with urine.

-All substances pass through epithelium.

FUNCTIONS:

- Protection
- Absorption
- Filtration
- Excretion
- Secretion
- Sensory reception

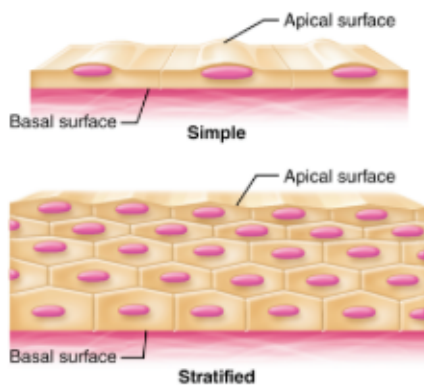
TYPES:

• **Covering and lining epithelium:**

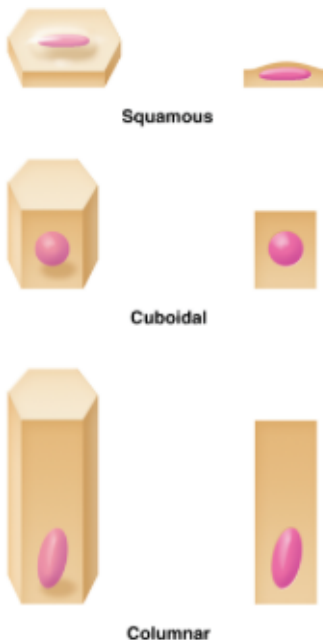
- outer layer of the skin.
- covers the walls and organs of the closed ventral body cavity.

• **Glandular Epithelium:**

- covers the glands of the body.



(a) Classification based on number of cell layers.



(b) Classification based on cell shape.

SPECIAL CHARACTERISTICS:

-All epithelia have an **apical surface** and a lower attached **basal surface**.

-Even though some apical surfaces are smooth, most have **microvilli**, **fingerlike extensions** of the plasma membrane.

-All epithelial sheets are supported by connective tissue.

*Under basal surface there is **reticular lamina**, which **contains collagen** protein fibers (strength).

***Two laminae** form the **basement membrane**, which **reinforces the epithelial sheet**, helps it resist stretching and tearing.

-**Avascular** (no blood vessels), **innervated** (supplied by nerve fibres).

-**High regenerative capacity** due to rapid cell division as the skin is damaged very often.

CLASSIFICATION:

1. Simple.

-single cell layer.

-found where **absorption, secretion, filtration** occur and a **thin epithelial barrier** is desirable.

2. Stratified.

-two or more cell layers stacked on top of each other.

-found where **protection is important**, such as **skin surface** or **lining of the mouth**.

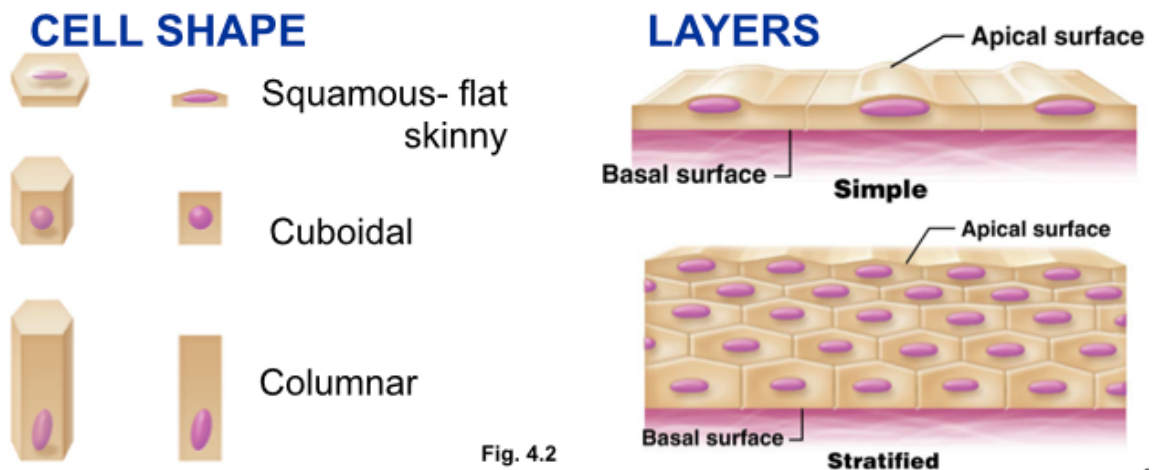
SHAPES:

- **Squamous cells** (flat, scale-like).
- **Cuboidal cells** (box-like).
- **Columnar cells** (tall and column shaped).

All epithelial tissues have two names

- One indicates shape of cells
- One indicates number of cell layers

In stratified epithelia, epithelia classified by cell shape in apical layer



*The shape of the nucleus determines the shape of the cell.

LAYERS:

-SIMPLE (absorption, secretion, filtration).

1. Simple Squamous Epithelium (filtration, diffusion) :

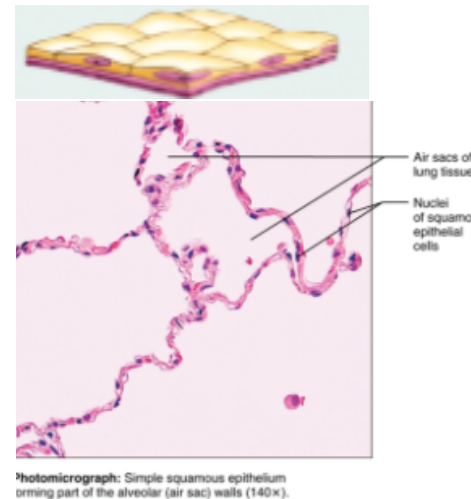
-Endothelium (inner covering).

*Provides a slick, friction-reducing lining in lymphatic vessels and organs of the cardiovascular system- blood vessels and a heart.

*Capillaries consist of endothelium. Since it is thin, there is an efficient exchange of nutrients and wastes between blood stream and surrounding tissue cells.

-Mesothelium (middle covering).

*Found in serous membranes that are lining the ventral body cavity and covering its organs (kidney, lungs).



2. Simple Cuboidal Epithelium (secretion, absorption) :

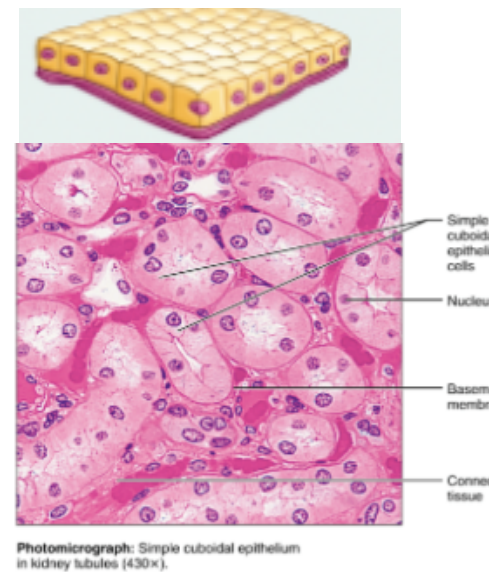
*Forms the walls of the smallest ducts of glands and of many kidney tubules.

3. Simple Columnar Epithelium (digestion, secretion):

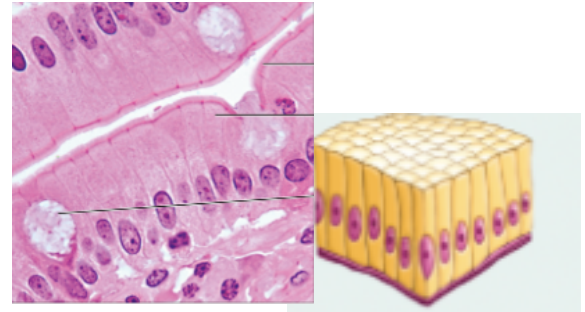
*Lines the digestive tract from the stomach through the rectum.

*The digestive tract lining has two distinct modifications that make it ideal for the function of absorption and secretion to be performed:

- Dense microvilli on the apical surface of absorptive cells.
- Tubular glands made primarily of cells that secrete mucus-containing intestinal juice.



*Some simple columnar epithelia display cilia on their free surfaces, which help move substances or cells through an internal passageway.



4. Pseudostratified Columnar Epithelium:

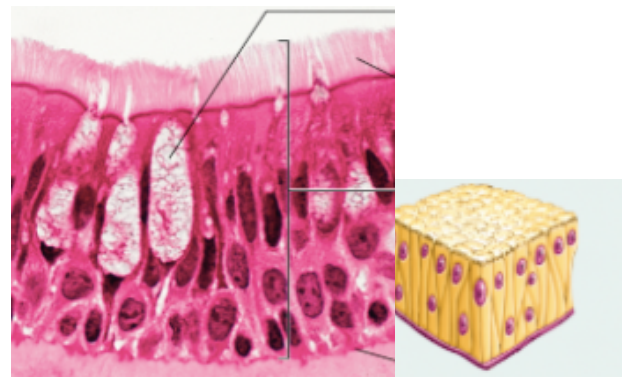
-The cells vary in height.

-Rest on basement membrane, but only the tallest reach the free surface of the epithelium.

-Nuclei at the different levels, that is why it seems like there are several layers of cells.

-Secretes or absorbs substances.

*Respiratory tract where cilia and mucus secretion are local specializations.



-STRATIFIED (protection).

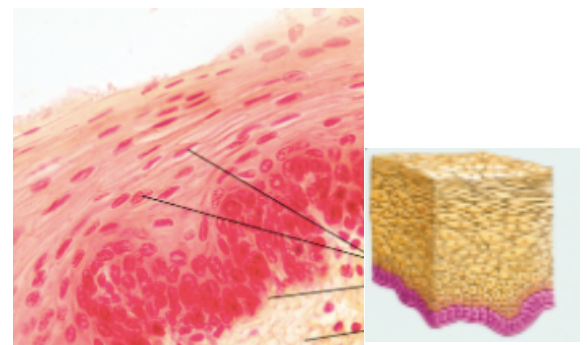
1. Stratified Squamous Epithelium.

-Several layers.

-Protective role.

-Wear and tear areas, surface cells are constantly being rubbed away and replaced.

-Contains keratin, a tough protective protein.



TRANSITIONAL EPITHELIUM.

- Lining of urinary organs, which stretch when filled with urine.
- Cells of basal layer are cuboidal or columnar.
- Transitional cells change the shape and allow a great volume of urine to be stored.

GLANDULAR EPITHELIUM.

*Gland - one or more cells that make & secrete a particular product.

MAY BE EITHER UNICELLULAR (scattered within epithelial sheets) OR MULTICELLULAR (form by inward growth of an epithelial sheet into the underlying connective tissue).

TWO TYPES:

1. **Endocrine** - releases the product into the bloodstream and from there the product reaches its destination.
2. **Exocrine** - delivers the product from point A to B using ducts (tubelike connections to the epithelial sheets).

ENDOCRINE GLANDS.

- *Ductless.
- *Produce hormones.

EXOCRINE GLANDS.

- Secrete their products onto body surfaces or into body cavities.
- Mucous, sweat, oil/salivary glands, liver, pancreas.

*Can be either multicellular or unicellular.

UNICELLULAR.

- No ducts because only one cell.
- Really just the GOBLET CELLS (digestive & respiratory tracts) - **produce mucous.**

MULTICELLULAR.

-Classified by structure and type of secretion.

-**Two basic parts:** epithelium-derived *duct* and a *secretory unit (acinus)* consisting of secretory cells.

*Supportive connective tissue surrounds the secretory unit, supplies it with blood vessels and nerve fibres.

*Multicellular exocrine glands classified by:

1. STRUCTURAL CLASSIFICATION:

-Can be either simple or compound.

-Simple glands have an unbranched duct, compound glands have a branched duct.

-Glands can either be:

- **Tubular**-secretory cells from tubes.
- **Alveolar**- secretory cells from small sacs.
- **Tubuloalveolar**- both types of secretory units.

2. MODES OF SECRETION:

-**Merocrine** (secretion of products by exocytosis, pancreas, sweat glands)

-**Holocrine** (accumulate their products within this until they get destroyed, ruptured)

-**Apocrine** (accumulate their products, but in this case only beneath the free surface, the apex of the cell pitches off, releases secretory granules and a small amount of cytoplasm, then repairs itself).

CONNECTIVE TISSUE.

5 major types:

- Mesenchyme
- CT proper
- Cartilage
- Bone & Blood

Main functions:

- Binding or support (cartilage).
- Protection (skull, blood).
- Insulation.
- Transportation (blood).

Three structural elements in CT:

- Ground substance
- Fibers
- Cells

*Composition and arrangement varies in different connective tissues.

a) Ground substance (unstructured material that fills the space between the cells and contains the fibers):

- Interstitial fluid + cell adhesion & proteoglycans: molecular **sieve**
 - *Fibronectin, laminin - help cells attach to CT elements.
 - * Proteoglycans - consist of protein core to which GAGs are attached.

b) Fibers (3 types to provide support):

- Collagen fibers: STRENGTH
- Elastic fibers: STRETCH + RECOIL
- Reticular fibers: thin collagen protein; SUPPORT blood vessels.

c) Cells.

- Immature (“blast”) forms vs. mature (“cyte”) forms.
 - * “Blasts” are actively dividing/ synthesizing cells during growth & repair.
 - * “Cytes” primarily provide a level of maintenance.

TISSUE TYPE	“BLAST”	“CYTE”
CT proper	fibroblast	fibrocyte
Cartilage	chondroblast	chondrocyte
Bone	osteoblast	osteocyte
Blood	hemocytoblast	RBCs, WBCs, platelets

Types of CT:

- 1) Mesenchyme: first tissue formed from mesoderm germ layer- mesenchymal cells + fluid ground substance & fine fibrils => source of all other CTs.
- 2) CT PROPER: 2 subclasses:

***Loose CT** (areolar, adipose, reticular).

***Dense CT** (dense regular, dense irregular, elastic).

LOOSE CT:

1. **Areolar CT**: gel-like matrix with all 3 fiber types; cells=fibroblasts, macrophages, mast cells & some WBCs.

Description: **loose** arrangement of fibres; reserves of water & salts but is also a prime site of **edema** during inflammatory reaction.

Location: under epithelia of body.

Function: cushioning of organs, immunity & inflammation; fluid reservoir.

2. **Adipose tissue**: areolar CT modified to store nutrients; *adipocytes*.

Description: fat-filled adipocytes with displaced nuclei; do not reproduce.

Location: under skin, around kidneys & eyeballs, in bones & within abdomen, in breasts; 18% of average weight (15% in men, 22% in women).

3. **Reticular CT**: like areolar CT, but **only reticular fibers**.

Location: lymphoid organs (lymph nodes, bone marrow, spleen).

Function: fibers form soft internal skeleton that supports free blood cells.

DENSE CT: (fibers are the predominant element!)

1. **Dense Regular CT:** bundles of collagen fibres running parallel to direction of pull a white, flexible tissue with great resistance to tension.

Location: tendons (muscles to bones), ligaments (bones to bones at joints), also aponeuroses (muscles of the forehead & back of the head).

Function: attachment with strenght

2. **Dense Irregular CT:** same as regular, but collagen bundles thicker & arranged irregularly (deals with all irregular movements)

Location: dermis, submucosa of digestive tract.

Function: withstand tension exerted in many directions; strength.

3. **Elastic CT:** like dense regular CT, but a very high content of elastic fibers; found in some very elastic ligaments.

CARTILAGE.

-Features between dense CT & bone , tough, but flexible.

-Avascular, devoid of nerve fibers.

-Collagen fibers (can have some elastic fibers)

-Up to 80% H₂O.

BONE:

-Calcium salts give hardness & strength for support/protection of softer tissues; cavities for fat storage & synthesis of blood cells.

1. **OSTEOBLASTS:** immature, adding new bone material in case of fracture.
2. **OSTEOCYTES:** maintaining bone structure.
3. **OSTEOCLASTS:** digest the matrix.

BLOOD:

-Classified as a CT because it consists of cells (RBCs, WBCs) surrounded by a nonliving fluid matrix, blood plasma.

-“**Fiber**” components are soluble protein molecules - only visible during clotting.

1. Which of the following fibrous elements give a CT high tensile strength?

- a) reticular fibers
- b) elastic fibers
- c) collagen fibers
- d) myofilaments

2. The cell that forms bone is the:

- a) fibroblast
- b) chondroblast
- c) hemocytoblast
- d) osteoblast
- e) reticular cell

3. Which kind of CT acts as a sponge, soaking up fluid when edema occurs?

- a) areolar CT
- b) adipose CT
- c) dense irregular CT
- d) reticular CT
- e) vascular tissue