

# Structural Organization of the Human Body

September 6, 2013 12:52 PM

Assignment #1: Cells and Tissues due Tuesday September 17th, 2013

## 1.1 Describe the levels of structural organization of the body.

**Atom:** smallest particle of an element with all the properties of that element.

What are the different parts of an atom? --> proton, neutron and electron

**Molecule:** the smallest amount of a substance that can exist alone; a combination of atoms (ex. Water is hydrogen and oxygen)

**Organelle:** molecules associate in specific ways to form organelles which are the basic components of living cells.

List 5 examples of cell organelles.--> mitochondria, nucleus, endoplasmic reticulum, golgi body, lysosome

**Cell:** fundamental structure and functional unit of a living thing; cells vary widely in size and shape, reflecting unique functions in the body

**Tissue:** groups of similar cells with a common function

Epithilium	Muscle	Connective tissue	Nervous tissue
Provides protective barrier	Contraction to move (blood, water, bones, etc.)	Supplies support	Transmits signals/ information

**Organ:** structure composed of at least two (usually 4) tissue types that perform specified functions

Give an example and describe its tissue types and their specific functions.

Artery--> connective tissue

--> smooth muscle --> constriction of vessel to move the blood

--> endothelium tissue --> allows exchange between blood and extracellular fluid

**Organ system:** organs that work closely with one another to accomplish a common purpose

Give an example of a system and list some of the organs.

## Cardiovascular System

-->[heart](#)

-->[veins](#)

-->[arteries](#)

-->lungs

-->gastrointestinal tract

### 1.2 Cells: summarize the major organelles, their structure and their function.

Structure	Function
Plasma Membrane	Regulates the relationship between intercellular and extracellular fluids
Mitochondria	Energy production and synthesis
Ribosomes	Protein synthesis
Rough ER	Organized "factory" for proteins to be exported
Smooth ER	Complex molecule synthesis
Golgi apparatus	Shipping and receiving of synthesized particles in the cell
Lysosome	Breaks down used components of organelles and has an acidic environment
Peroxisomes	Break down toxic chemicals in the body
Microtubule	Largest component of the cytoskeleton... think of it as the femur of the cytoskeleton
Microfilaments and intermediate filaments	Components of the cytoskeleton, intermediate filaments being bigger than microfilaments
Centriole	Organizational centre for the cytoskeleton
Cilia	Movement of liquids, present on most epithelial linings (ex. trachea)
Flagellum	Allow for movement of the cell, the flagella is the long tail that provides movement for the sperm cell
Microvilli	Increase surface area to increase absorption
Nucleolus	Manufactures ribosomes
Nuclear envelope	Mediates exchange of information with the nucleus

### 1.3 Describe the different tissues of the human body.

1.3.1 Define tissue and demonstrate how the organization of cells into tissues contributes to overall homeostasis.

1.3.2 List the four primary types of tissues

1.3.3 Define epithelial tissue; list 6 functions associated with epithelia

- Individual body cells specialized; division of labour; sophistication of function
- At organ level, cooperation for organ to work as a whole

TISSUE: groups of structurally similar cells that perform common/ related functions.

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- 1) Epithelial..... Covering
- 2) Connective..... Support
- 3) Muscle..... Movement
- 4) Nervous..... Control (regulation)

Usually takes all 4 to make up and organ such as the kidney or the heart

- Histology: the study of tissues and their cellular organization

A. Epithelial Tissue

- Sheet of cells that covers a body surface or lines a body cavity

- 1) Covering and lining epithelium- ex. The skin
- 2) Glandular epithelium

Both create boundaries

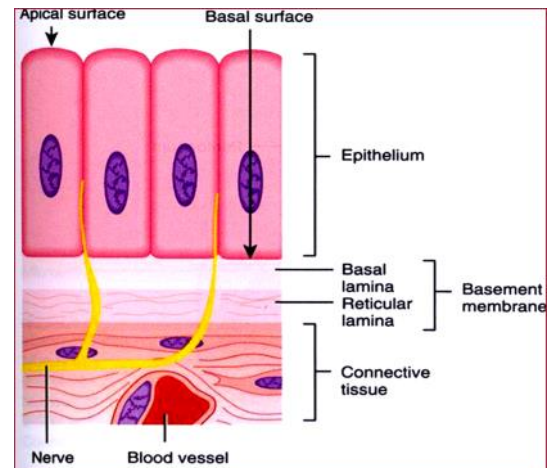
Functions of Various Epithelia:

- Protection (mechanical, chemical, infectious)- the skin
- Absorption- gastrointestinal tract (also provides protection in this case)
- Filtration- kidney
- Excretion- kidney
- Secretion- glands, stomach, pancreas
- Sensory reception- taste buds, olfactory membranes...

1.3.4 List and demonstrate your understanding of 7 special structural characteristics of epithelial tissue.

Special Characteristics of Epithelium:

- Cellularity
- Specialized contacts: tight junctions and desmosomes seal the space between adjacent cells.
- Polarity: apical and basal surfaces; apical surface often specialized such as having secretion and absorption
- Basal lamina: noncellular, underlying supportive sheet of primarily glycoproteins; two main of functions of providing structural integrity and filtration properties
- Supported by connective tissue: **basement membrane**= basal lamina + underlying reticular CT



**RETICULAR CONNECTIVE TISSUE:** reticular connective tissue is a type of connective tissue formed from mainly type III collagen that forms a branched connective network that provides a somewhat soft skeletal support system.

An important feature of cancerous epithelial cells is failure to respect the boundary imposed by the basement membrane.

- Innervated but avascular: nourished by diffusion; diffusion occurs over short distances therefore the top (apical) layers of epithelium shed or fall off
- Regeneration: high regenerative capacity; cells need to be resynthesized by underlying stem cells on a regular basis (especially in the oral cavity (every 5-7 days)) due to damage from being exposed to the external environment

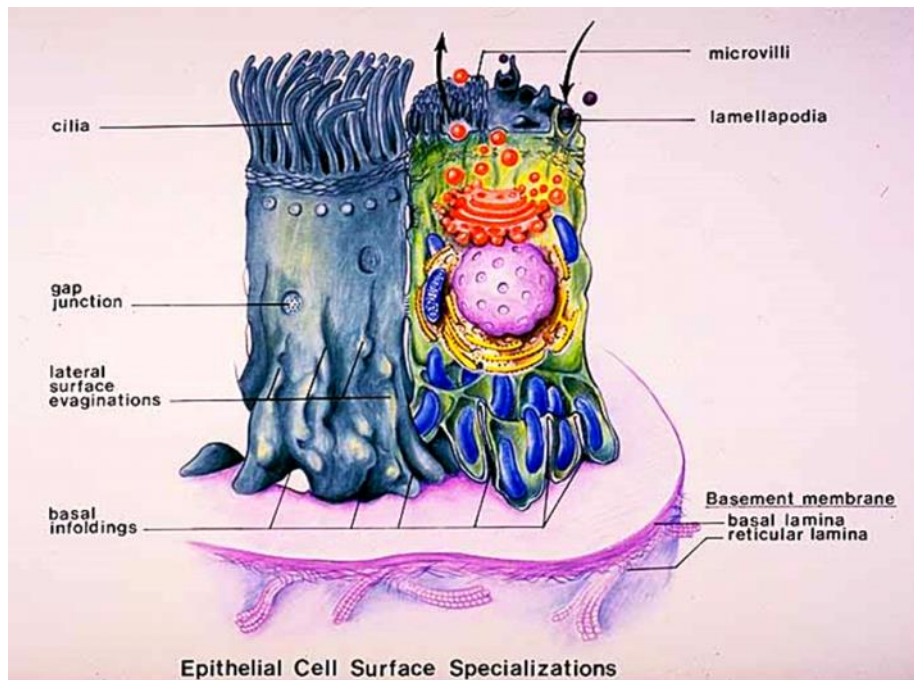
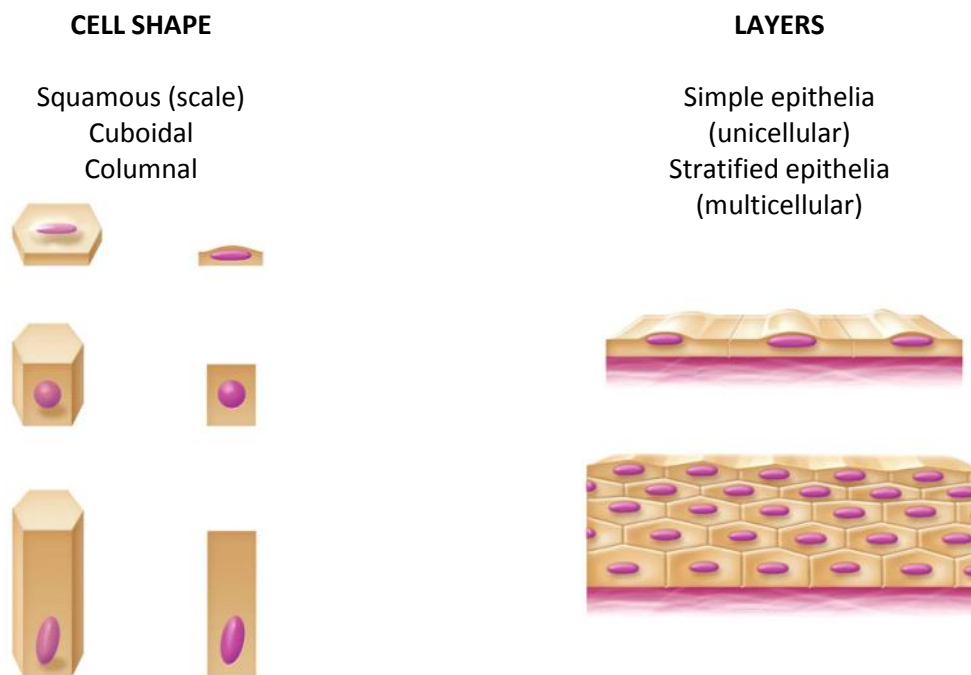


Figure 24. Surface specializations characteristically found in epithelial cells.

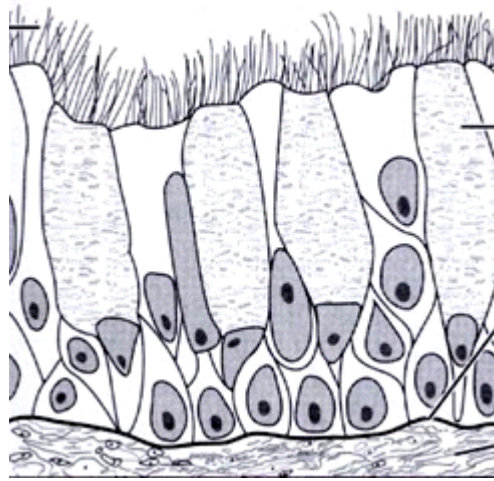
1.3.5 Indicate the 2 criteria used to classify epithelial cells.



1.3.6 List the 4 types of simple epithelia; indicate primary functions associated with each and sample body locations.

Examples of **Simple Epithelia**: (absorption, secretion, filtration):

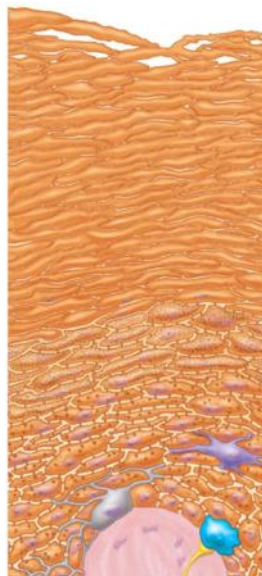
- **Simple squamous epithelium**: thin and permeable- filtration and diffusion- ex. *Endothelium* in kidney and lungs
- **Simple cuboidal epithelium**: secretion and absorption- ex. Kidney tubules and small glands
- **Simple columnar epithelium**: also digestion and secretion- ex. Digestive tract
- **Pseudostratified columnar epithelium**: single layer- ex. Respiratory tract where cilia and mucus secretion are local specializations



**Transitional epithelium (*not simple!*):** lines the bladder, an organ that has to fill- the basal layers are columnal to cuboidal and the apical layers become increasingly flattened and squamous-like as the bladder fills.

1.3.7 Describe the structure of stratified squamous epithelium and give a sample body location.

- Protective role
- Basal cells are cuboidal and undergo mitosis to continue regenerating from below
- The most widespread example of stratified squamous epithelium is the skin
- The apical layer of cells die and fall off because there are no blood vessels in close distance to diffuse with and therefore they die to make room for newer, healthier cells to move up from below.
- The apical layer makes up the leathery surface of the skin that is visible to the human eye.



1.3.8 Define: gland, endocrine gland, exocrine gland

Glandular epithelia:

- **Gland:** 1 or more cells that make and secrete a particular product
- Glands are endocrine (ex. Pancreas), exocrine (ex. Pancreas and salivary gland) and are either unicellular or multicellular

Endocrine Glands:

- Release substances into the body
- Ductless
- Products are called hormones

### Exocrine Glands:

- Release substances into the external environment
  - Mucous, sweat, oil/ salivary glands, liver, pancreas, etc.
- a) **Unicellular exocrine glands:** no ducts because they're only one cell, really just the goblet cells (digestive and respiratory tracts)
- b) **Multicellular exocrine glands:** epithelium-derived duct and secretory cells; surrounded by supportive connective tissue which brings blood vessels and nerves.

### Secretory Method

**Merocrine/ eccrine:** exocytosis; most common type (ex. Pancreas, salivary glands, most sweat glands)

**Holocrine:** cell rupture; only sebaceous glands; can repair itself for several cycles before it needs to be replaced.

**Apocrine:** cell apex pinches off with the secretory product in it

The mammary gland is apocrine: large volumes released over shorter periods of time.

1.3.9 List the 5 types of connective tissue; list the 4 main functions associated with connective tissues.

- **Five major types:** mesenchyme, connective tissue proper, cartilage, bone and blood
- **Main functions:** binding or support, protection, insulation and transportation

1.3.10 Describe the structural organization of CT in general; distinguish between collagen, elastic and reticular fibers; distinguish between "blast" and "cyte" types of CT cells.

#### 1. The Structural Elements of CT:

- a. **Ground substance:** interstitial fluid + cell adhesion proteins and proteoglycans: molecular sieve
- i. Fibronectin, laminin- help cells attach to CT elements
  - ii. Proteoglycans- polymerization of ground substance
- b. **Fibers**
- i. **Collagen fibers:** high tensile strength
  - ii. **Elastic fibers:** elastin has coiled structure to allow stretch and recoil
  - iii. **Reticular fibers:** thin collagen protein; fine network to support blood vessels and other soft tissues
- c. **Cells:** imature ("blast") forms vs. mature ("cyte") forms
- i. **"blasts"** are actively dividing/ synthesizing cells during growth and repair
  - ii. **"cytes"** primarily provide a level of maintenance

Tissue Type	"blast"	"cyte"
CT proper	Fibroblast	Fibrocyte
Cartilage	Chondroblast	Chondrocyte
Bone	Osteoblast	Osteocyte
Blood	Hemoctyoblast	RBCs, WBCs, platelets

#### 2. Types of CT:

- a. **Mesenchyme:** first tissue formed from mesoderm germ layer- mesenchymal cells + fluid ground substance and fine fibrils = the source of all other CTs

- i. CT proper: 2 subclasses
  - 1) Loose CT (areolar, adipose, reticular)
  - 2) Dense CT (dense regular, dense irregular, elastic)

1.3.11 List and briefly describe the 3 types of loose CT; include key functions for each type as well as sample body locations.

#### Areolar CT

- Gel-like matrix with all 3 fiber types; cells= fibroblasts, macrophages, mast cells and some white blood cells
- **Description:** loose arrangement of fibers; reservoir of water and salts but is also a prime site of edema during inflammatory reaction
- **Location:** widely distributed under epithelia of the body
- **Function:** cushioning of organs, immunity (macrophages) and inflammation; fluid reservoir

#### Adipose Tissue

- Areolar CT modified to store nutrients; adipocytes
- **Description:** fat-filled adipocytes with displaced nuclei; do not reproduce; scanty matrix
- **Location:** under skin, around kidneys and eyeballs, in bones and within abdomen, in breasts 18% of average weight (15% for males and 22% for females)
- **Function:** fuel reservoir, insulation, supports and protects organs

#### 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

1.3.12 List and briefly describe the 3 types of dense CT

#### Dense Regular CT

- Bundles of collagen (white, flexible tissue with great resistance to tension) fibers running parallel to direction of pull
- **Location:** tendons (attach muscle to bone), ligaments (attach bone to bone at joints), also aponeuroses
- **Function:** attachment with strength

#### Dense Irregular CT

- Same as regular, but collagen bundles thicker and arranged irregularly
- **Location:** dermis, submucosa of digestive tract, fibrous capsules of organs and joints
- **Function:** withstand tension exerted in many directions; strength

#### Elastic CT

- Like dense regular CT, but a very high content of elastic fibers, found in some very elastic ligaments

1.3.13 List the other remaining types of connective tissue.

#### Cartilage

- Features between dense CT and bone; tough but flexible
- Avascular, devoid of nerve fibers
- Ground substance contains lots of the GAGs chondroitin sulfate and hyaluronic acid- also chondronectin (adhesive protein)
- Collagen fibers (can have some elastic fibers)
- Up to 80% water

### Bone

- Calcium salts give hardness and strength for support/ protection of softer tissues; cavities for fat storage and synthesis of blood cells
- **Osteoblasts:** make bond
- **Osteocytes:** are mature bone
- **Osteoclasts:** remove old and damaged bone

### Blood

- Classified as a CT because it consists of cells (RBCs and WBCs) surrounded by a nonliving fluid matrix, blood plasma
- "fiber" components are soluble protein molecules- only visible during clotting