

#### Tissues

 Groups of cells similar in structure and function

#### The four types of tissues

- Epithelial
- Connective
- Muscle
- Nerve













Epithelial tissue



Nervous tissue



## **Epithelial Tissue**

Cellularity – composed almost entirely of cells

- Special contacts form continuous sheets held together by tight junctions and desmosomes
- Polarity apical and basal surfaces



## **Epithelial Tissue**

Supported by connective tissue – reticular and basal laminae

Avascular but innervated – contains no blood vessels but supplied by nerve fibers

<u>Regenerative</u> – rapidly replaces lost cells by cell division



## Function of the epithelial tissue

- Protection Epithelial cells from the skin protect underlying tissue from mechanical injury, harmful chemicals, invading bacteria and from excessive loss of water.
- Sensation Sensory stimuli penetrate specialised epithelial cells. Specialised epithelial tissue containing sensory nerve endings is found in the skin, eyes, ears, nose and on the tongue.
- Secretion In glands, epithelial tissue is specialised to secrete specific chemical substances such as enzymes, hormones and lubricating fluids.
- Absorption Certain epithelial cells lining the small intestine *absorb nutrients from the digestion of food*.
- Excretion Epithelial tissues in the kidney excrete waste products from the body and reabsorb needed materials from the urine. Sweat is also excreted from the body by epithelial cells in the sweat glands.

#### Function

- Diffusion Simple epithelium promotes the diffusion of gases, liquids and nutrients. Because they form such a thin lining, they are ideal for the diffusion of gases (eg. walls of capillaries and lungs).
- Cleaning Ciliated epithelium assists in removing dust particles and foreign bodies which have entered the air passages.
- Reduces Friction The smooth, tightly-interlocking, epithelial cells that line the entire circulatory system reduce friction between the blood and the walls of the blood vessels.

#### Epithelialization

- occurs within 24 hours after the injury and is characterized by the detachment, migration, proliferation, and differentiation of cells at the base of the epidermis along the wound.
- Another way to put it is that after an injury mitosis increases, therefore cell production increases and those newly formed cells migrate to any exposed dermis and provide a temporary protection.
- Epithelialization is the second step in wound healing, the first step is inflammation, such as redness and heat, followed by epithelialization, then collagen synthesis, contraction, and remodeling.





One of the features of epithelia which has a great deal of clinical significance is its capacity for regeneration. In most epithelia, production of new cells is a more or less constant process, and one can express the activity of a tissue in terms of it mitotic index, the ratio of dividing cells to non-dividing ones.



#### **Classification of Epithelia**



Simple
 or
 stratified







Figure 4.1a

#### squamous cells





cuboidal cells



columnar cells







#### perpendicular secetion



#### simple columnar epithelium





#### oblique section



# Classification of Epithelia







**S**quamous









Cuboidal



Columnar

(b)

## Epithelia: Simple Squamous

- Single layer of flattened cells with disc-shaped nuclei and sparse cytoplasm
- Functions
  - Diffusion and filtration
  - Provide a slick, friction-reducing lining in lymphatic and cardiovascular systems
- Present in the
  - kidney glomeruli,
  - *lining of heart,*
  - blood vessels [endothelial cell],
  - lymphatic vessels,
  - and serosa [pleuretic,pericardial,peritoneal,meningial]







# simple squamous epithelium basement membrane nuclei

## Epithelia: Simple Squamous

#### (a) Simple squamous epithelium

**Description:** Single layer of flattened cells with disc-shaped central nuclei and sparse cytoplasm; the simplest of the epithelia.



Function: Allows passage of materials by diffusion and filtration in sites where protection is not important; secretes lubricating substances in serosae.

Location: Kidney glomeruli; air sacs of lungs; lining of heart, blood vessels, and lymphatic vessels; lining of ventral body cavity (serosae).





**Photomicrograph:** Simple squamous epithelium forming part of the alveolar (air sac) walls (400×).



## BLOOD VESSEL [ARTERY ] = ENDOTHELIUM ENDOTHELIOCELLS





MESOTHELIUM = SIMPLE SQUAMOUS EPITHELIUM = SEROSA'S=PLEURA, PERICARDIUM, PERITONEUM

## The mesothelium

- is a membrane that forms the lining of several body cavities:
- The pleura (thoracic cavity),
- Peritoneum (abdominal cavity including the mesentery)
- Pericardium (heartsac).
- Mesothelial tissue also surrounds
  - The male internal reproductive organs (the tunica vaginalis testis)
  - covers the internal reproductive organs of women (the tunica serosa uteri).
- Mesothelium that covers the internal organs called visceral mesothelium,
- the layer that covers the body walls is called the parietal mesothelium.

## Epithelia: Simple Cuboidal

 Single layer of cube-like cells with large, spherical central nuclei

Function in secretion and absorption

#### Present in

- kidney tubules, nephrons
- *ducts and secretory portions of small glands,* the eye and thyroid. GLANDS IN GENERAL
- ovary surface







#### Histology Lab Part 1: Slide 5





AB061A [RM] © www.visualphotos.com

## Epithelia: Simple Cuboidal

#### (b) Simple cuboidal epithelium

**Description:** Single layer of cubelike cells with large, spherical central nuclei.



**Function:** Secretion and absorption.

**Location:** Kidney tubules; ducts and secretory portions of small glands; ovary surface.





**Photomicrograph:** Simple cuboidal epithelium in kidney tubules (400×).

## Epithelia: Simple Columnar

- Single layer of tall cells with oval nuclei; many contain cilia
- <u>Goblet cells</u> are often found in this layer
- Function in absorption and secretion
  - Nonciliated type line digestive tract and gallbladder
  - <u>Ciliated type</u> line <u>small bronchi, uterine tubes, and some regions</u> of the uterus
- Cilia help move substances through internal passageways


















## Epithelia: Simple Columnar

#### (c) Simple columnar epithelium

**Description:** Single layer of tall cells with *round* to *oval* nuclei; some cells bear cilia; layer may contain mucus-secreting unicellular glands (goblet cells).



Function: Absorption; secretion of mucus, enzymes, and other substances; ciliated type propels mucus (or reproductive cells) by ciliary action.

**Location:** Nonciliated type lines most of the digestive tract (stomach to anal canal), gallbladder, and excretory ducts

of some glands; ciliated variety lines small bronchi, uterine tubes, and some regions of the uterus.





epithelium of the stomach mucosa (1300×).

### Epithelia: Pseudostratified Columnar

- Single layer of cells with different heights; some do not reach the free surface
- Nuclei are seen at different layers
- Function in secretion and propulsion of mucus
- Ciliated pseudostratified columnar epithelia are found in the lines of the trachea as well as the upper respiratory tract.
- Non-ciliated pseudostratified columnar epithelia are located in the membranous part of male vas deferens.
- Pseudostratified columnar epithelia with stereocilia are located in the epididymis. Stereocilia of the epididymis are not cilia. They might be better defined as giant microvilli.













Epididymis van Gieson



## Epithelia: Pseudostratified Columnar

#### (d) Pseudostratified columnar epithelium

**Description:** Single layer of cells of differing heights, some not reaching the free surface; nuclei seen at different levels; may contain goblet cells and bear cilia.

**Function:** Secretion, particularly of mucus; propulsion of mucus by ciliary action.

Location: Nonciliated type in male's sperm-carrying ducts and ducts of large glands; ciliated variety lines the trachea, most of the upper respiratory tract.





# Epithelia: Stratified Squamous

- Thick membrane composed of several layers of cells
- Function in protection of underlying areas subjected to abrasion
- Forms the external part of
  - the skin's epidermis (keratinized cells),
  - linings of the esophagus,mouth, and vagina (nonkeratinized cells)



Vagina

## Epithelia: Stratified Squamous

#### Keratinization

 Stratified squamous epithelium is further classified by the presence or absence of keratin, a tough protective protein, at the apical surface.

#### **Nonkeratinized**

- Non-keratinised surfaces must be kept moist by bodily secretions to prevent them drying out and dying.
- Types of non-keratinised stratified squamous epithelium include cornea (see also corneal epithelium), oral cavity, esophagus, anal canal, vagina, and the internal portion of thelips

#### **Keratinized**

- Keratinised surfaces are protected from abrasion by keratin and kept hydrated and protected from dehydration by glycolipids produced in the stratum granulosum.
- Types of keratinized stratified squamous epithelium include skin, tongue (filiform papillae), and the external portion of the lips















# Epithelium Lamina propria Muscularis mucosae







## Epithelia: Stratified Squamous

#### (e) Stratified squamous epithelium

**Description:** Thick membrane composed of several cell layers; basal cells are cuboidal or columnar and metabolically active; surface cells are flattened (squamous); in the keratinized type, the surface cells are

full of keratin and dead; basal cells are active in mitosis and produce the cells of the moresuperficial layers.



Function: Protects underlying tissues in areas subjected to abrasion.

Location: Nonkeratinized type forms the moist linings of the esophagus, mouth, and vagina; keratinized variety forms the epidermis of the skin, a dry membrane.



# Epithelia: Stratified Cuboidal and Columnar

- Stratified cuboidal
  - Quite rare in the body
  - Found in some sweat and mammary glands [BREAST]
  - Typically two cell layers thick









## Epithelia: Stratified Cuboidal and Columnar

- Stratified columnar
  - Limited distribution in the body
  - Found in
    - $\cdot$  the pharynx,
    - male urethra,
    - and lining some glandular ducts



 Also occurs at transition areas between two other types of epithelia







## Epithelia: Transitional

 Several cell layers, basal cells are cuboidal, surface cells are dome shaped

 Stretches to permit the distension of the urinary bladder
Slide 37 Urinary bladder

Lines the

- urinary bladder,
- ureters,
- and part of the urethra














# **Epithelia:** Transitional

#### (f) Transitional epithelium

**Description:** Resembles both stratified squamous and stratified cuboidal: basal cells cuboidal or columnar; surface

cells dome shaped or squamouslike, depending on degree of organ stretch.



Function: Stretches readily and permits distension of urinary organ by contained urine.

Location: Lines the ureters. bladder, and part of the urethra.





Photomicrograph: Transitional epithelium lining the bladder, relaxed state (500×); note the bulbous, or rounded, appearance of the cells at the surface; these cells flatten and become elongated when the bladder is filled with urine.

# Villi and cilia



Intestinal villi (singular: villus) are tiny, finger-like structures that protrude from the and have additional <u>wall of the</u> <u>intestine</u> extensions called microvilli (singular: microvillus) which protrude from epithelial cells lining villi.

They increase the absorptive area of the intestinal wall.

It is important that the food is absorbed at a considerably fast rate so as to allow more food to be absorbed.(If the process is too slow, the concentration of the blood in the blood vessels and the food will be equal, thus, diffusion will not occur.) Digested nutrients (including sugars and amino acids) pass into the villi through diffusion. Circulating blood then carries these nutrients away







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#### Microvilli:

•Closely packed, finger-like projections of cytoplasm that increase surface area of the cell.

•Number and shape on cell surface correlate with absorptive capacity.

•Can be seen under LM ("brush border" or "striated border").

•Contain a core of Actin filaments, which are anchored to Villin in tip.

Actin also extends downward into apical cytoplasm where attaches to *terminal web*:
Horizontal network of Actin filaments lying just below base of microvillus.

•These Actin filaments are stabilized by **Spectrin**. Spectrin anchors terminal web to apical membrane of cell.

•Also contains myosin II and tropomyosin filaments, which allows microvillus to contract.

Usually present on surface of microvilli is an amorphous cell coat of glycoprotein "*glycocalyx*". *Examples of where found*: kidney and intestine (fluid and metabolites actively transported and absorbed).









## Stereocilia:

•Long microvilli.

•Apical cytoplasmic protrusions, with intermingling thin and thick regions.

•Cytoplasmic bridges interconnect thick regions.

•Actin filament bundles that are cross-linked by *fimbrin* support them.

•Actin bundles in stem portion are anchored to network of  $\infty$ -actinin present in cross-bridges and apical cytoplasm of cell.

•Erzin, a plasma membrane molecule, anchors the actin bundles to plasma membrane.

•Villin is not found in tip of stereocilium.

•Can be seen under LM

•Where found: limited to the <u>male reproductive tract (epididymis and ductus</u> <u>deferens) and the receptor hair cells in the ear.</u>





# **Slide 30 Epididymis Efferent ducts** Stereocilia



Head of Epididymis (cross section of tubule)

> Pseudostratified Columnar Epithelium

Smooth Muscle

(black dots)

**Basal Cells** 

Stereocilia



### Cilia:

•Motile cytoplasmic structures capable of actively propelling particles along cell surface.

•Beat in a synchronous pattern and utilize ATP for movement.

•Arranged into orderly rows (respiratory tract) OR occur as single structure (rete testis or vestibular cells of ear).

•By LM, cilia appear as hair-like structures from apical surface. They are anchored into apical cytoplasm by a basal body:

•Modified centriole that contains nine microtubule triplets in its core forming a ring structure.

•Under LM, basal bodies appear as a thin, dark-staining band at cilia base.

•Each cilium contains an inner core of *microtubules* arranged in a **9+2** pattern. There are nine pairs or doublets of microtubules that are circularly arranged around 2 central microtubules.

•The microtubules composing each doublet are designated as the "A microtubule" and the "B microtubule".

•"A" microtubule: 13 tubulin dimers arranged in a side-by-side manner.

•"B" microtubule: 10 tubulin dimers and does not form a complete circle. Instead it "shares" a portion of its wall with "A" microtubule.

•Each doublet contains a "*pair of arms*" that extends off the "A" microtubule to form cross-bridges with the "B" microtubule in the adjacent doublet. These arms contain "*dynein*".

•The protein "nexin" links the doublets together.

•Radial spokes extend from the nine outer doublets to the central doublet.

#### •Where found: respiratory epithelium-nasal cavity, trachea, bronchus, oviducts.







Recommended site:

http://student.ttuhsc.edu/JBuchanan/histology.htm

