

# 4.2 Epithelial Tissue

- Epithelial tissue (**epithelium**) is a sheet of cells that *covers body surfaces or cavities*
  - They form boundaries
- Two main forms:
  - **Covering and lining epithelia**
    - on external and internal surfaces (example: skin)
  - **Glandular epithelia**
    - secretory tissue in glands (ex: salivary glands)

## Main functions of epithelial tissue:

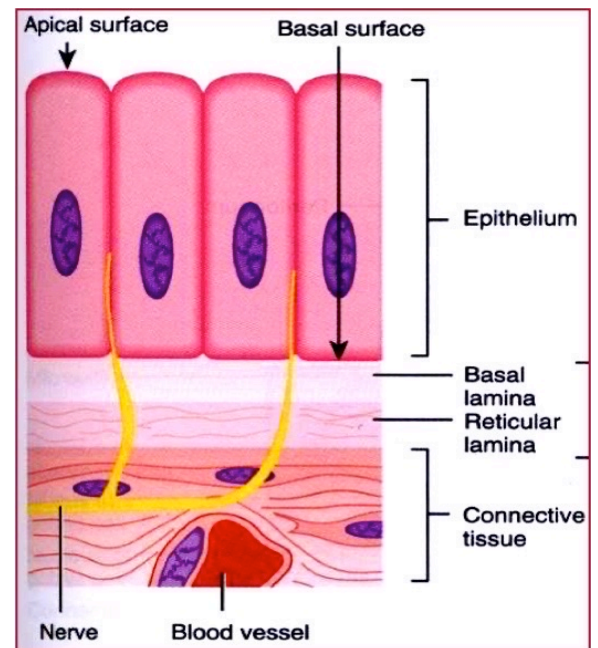
1. Protection
2. Absorption
3. Filtration
4. Excretion
5. Secretion
6. Sensory reception

## Characteristics of Epithelial Tissues

Five distinguishing characteristics:

### 1. **Polarity** → basement membrane anchors epithelial tissues, apical surface are for sensing

- a. Apical and basal surfaces; apical surface often specialized including *microvilli or cilia*
  1. There's polarity so the epithelial cells will orient themselves in the same way
  2. The **top part** is the **apical surface** (specialized parts of the plasma membrane like receptors, proteins, glycoproteins, etc.) This allows the epithelial tissue to *sense the environment*.
  3. The **basal surface connects** to the rest of the organs; epithelial tissue in the stomach, connective and muscle tissue connects them together, and the basal side connects to the "basement membrane".



### 2. **Specialized contacts** → that stitch together the epithelial cells and the tissue, provide extra structure and strength (**INTERNAL FRAMEWORK**)

- a. Tight junctions and desmosomes
  1. Desmosomes are cell structures for cell-to-cell *adhesion*

### 3. **Supported by connective tissues**

- a. Supported by the basement membrane *composed* of a basal lamina and a reticular lamina which *holds everything together*
  1. Lamina means "plate/layer"
  2. Basal lamina: extracellular matrix secreted by epithelial cells on which the epithelium sits (NOT the basement membrane)
  3. Reticular lamina: thin extracellular layer below the basal lamina

4. **Avascular, but innervated** → no blood vessels but there are nerves that coordinate function within organ

- a. There are no blood vessels in epithelial tissue (normally blood vessels feed cells in body with glucose, oxygen, etc.)
  - 1. Epithelial tissue gets nutrients from the basal side of the tissue, then the nutrients diffuse through the basement membrane to the epithelial tissue
- b. Nerves coordinate functions between epithelial tissue within the organ

5. **Regeneration** → they divide quickly

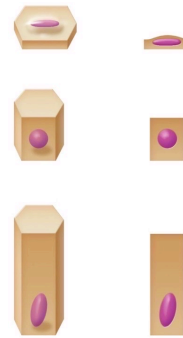
- a. Has a high regenerative capacity
  - 1. This risks *cancer!!!* (80-90% of cancer starts from epithelial)
    - A. *Easier* for cancer to start from epithelial tissue because it already has the ability to quickly multiply into tumours; if cancer starts in a slow regenerative place, it will grow slower too

1.4.5 Indicate the 2 criteria used to classify epithelial cells

## Classifying Epithelial Cells

### CELL SHAPE

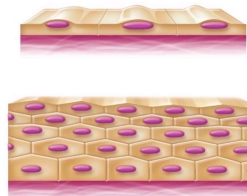
- A. **Squamous**
  - a. shaped like an egg/square, flat, centered nuclei
- B. **Cuboidal**
  - a. shaped like a cube, centered nuclei
- C. **Columnar**
  - a. shaped like a column, nuclei is **not** centered



### LAYERS

(attached to the basement membrane)

- A. **Simple** - 1 layer
- B. **Stratified** - more than 1 layer



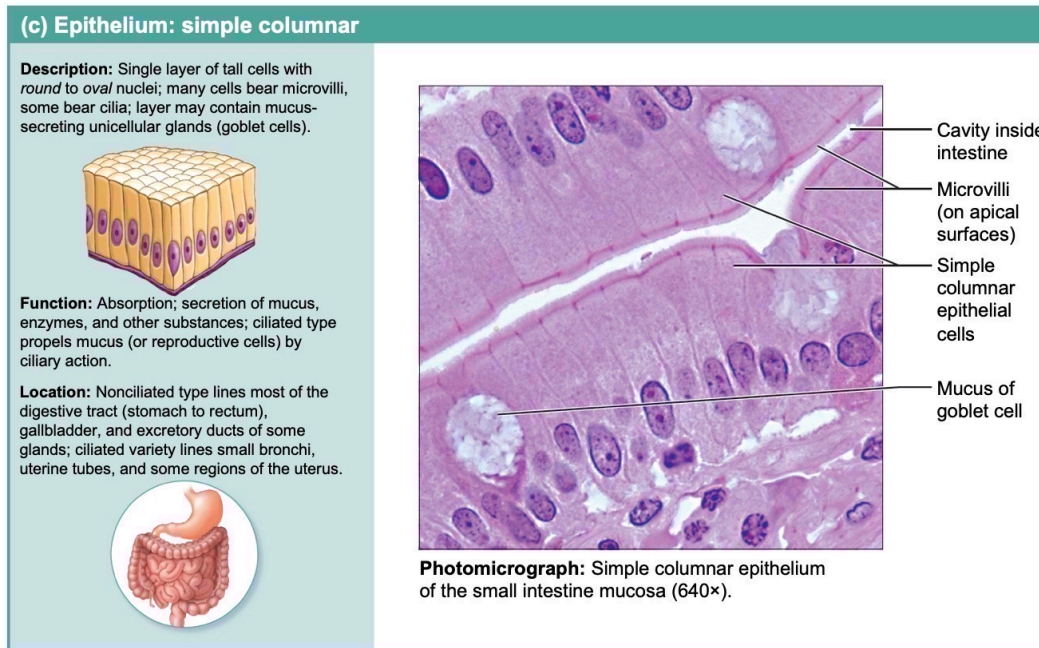
1.4.6 list the 4 types of simple epithelia, indicate primary functions

**Examples of SIMPLE Epithelial [functions: absorption, secretion, filtration]:**

1. **Simple squamous epithelium:** thin & permeable because they're flat  
[filtration, diffusion]

- a. e.g. endothelium in kidney (filter nitrogen into urine) and lungs (diffusion of gas)

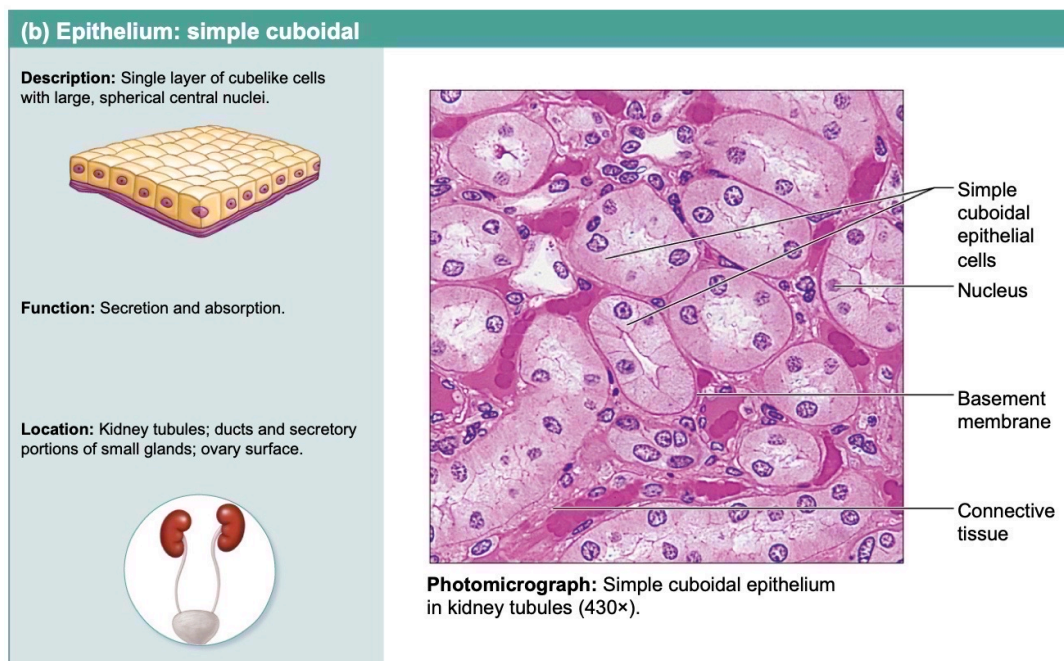
**Figure 4.4c Epithelium: simple columnar**



2. **Simple cuboidal epithelium:** not very common  
[secretion, absorption]

- a. e.g. kidney tubules, small glands

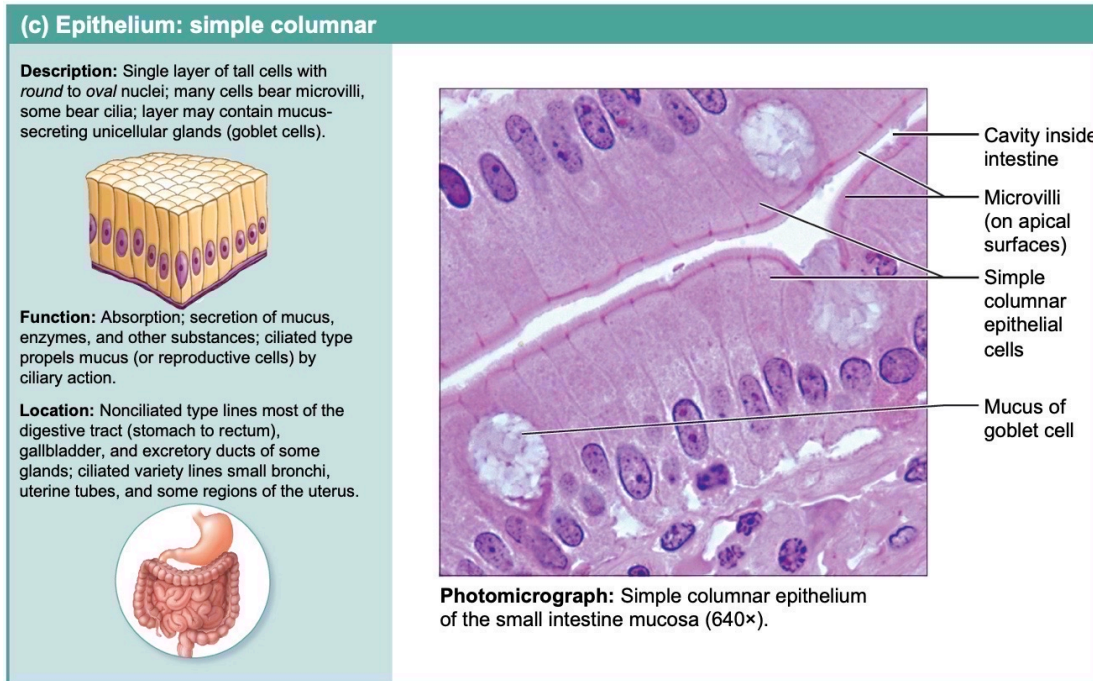
**Figure 4.4b Epithelium: simple cuboidal**



3. *Simple columnar epithelium*: extensive, might be cilia or mucus  
[digestion, secretion, absorption]

- a. e.g. digestive tract, in airways like the trachea (secretion of mucus)

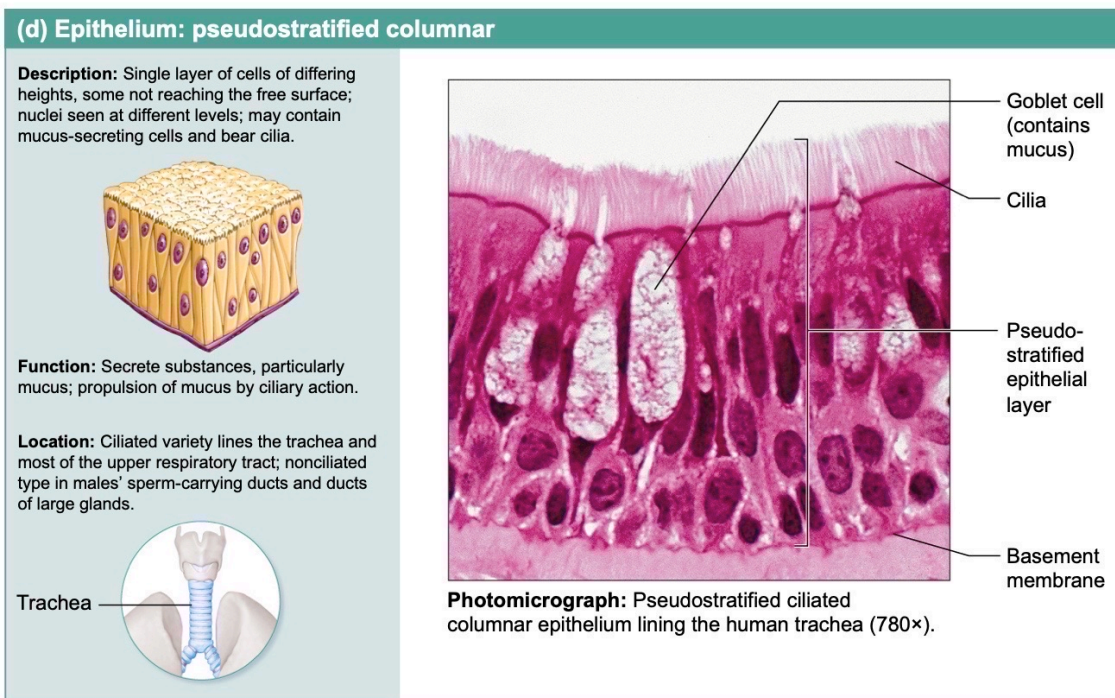
Figure 4.4c Epithelium: simple columnar



4. *Pseudo-stratified columnar epithelium*: a single layer that looks like it's made of more than one layer

- a. e.g. parts of a respiratory tract where cilia move debris out of lungs and mucus secretion are local specializations

Figure 4.4d Epithelium: pseudostratified columnar



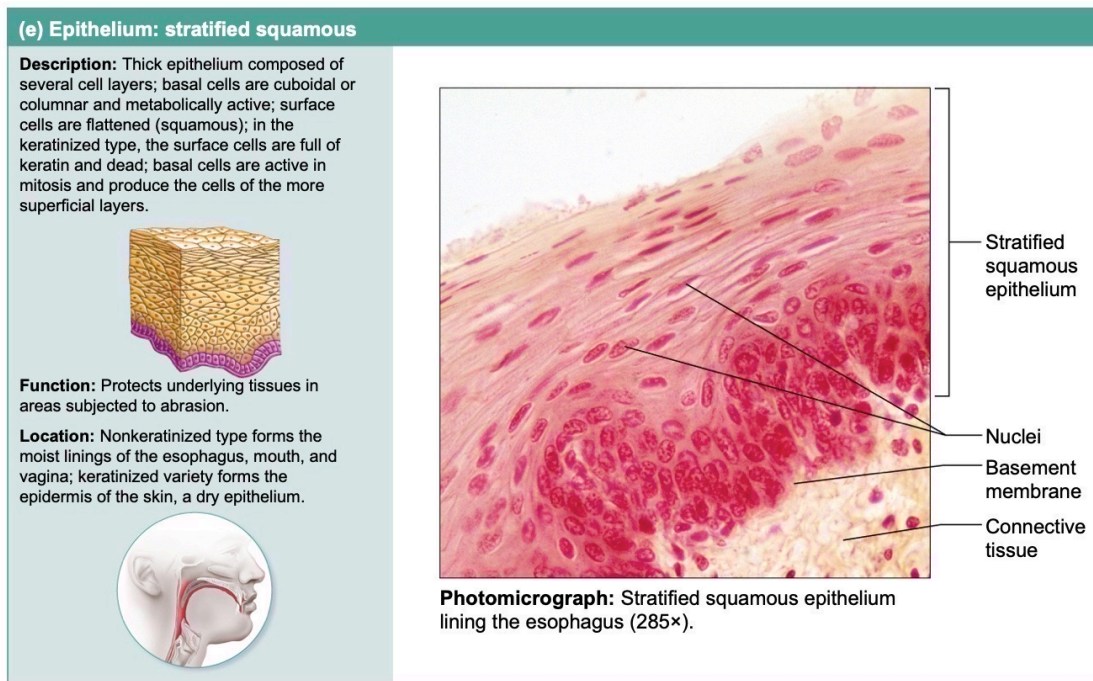
## Examples and Properties of STRATIFIED Epithelia [protection]:

- Involve 2 or more layers of cells
- New cells regenerate from below, shed off at the top (aka basal cells divide and mitigate toward surface)
- More durable than simple epithelia because protection is the major role

### 1. Stratified squamous epithelial: most common

- Most widespread of all stratified (more than one cell layer for this)
- Free surface** (top) is squamous, underneath are cuboidal or columnar layers
- Located in areas of **high wear and tear**
  - e.g. skin
- Keratinized cells found in skin (i.e. face); non keratinized cells are found in moist linings (i.e. inside of cheek)
  - In the skin, the upper most layer of cells is full of proteins called keratin; it makes the cell more durable and waterproof and protects against evaporation (the skin would dry quickly without it)

## Figure 4.4e Epithelium: stratified squamous



### 2. Stratified Cuboidal Epithelium

- Quite rare
- Found in some sweat and mammary glands
- Typically only 2 cell layers

### 3. Stratified Columnar Epithelium

- Also very limited
- Small amounts found in pharynx, in male urethra, and lining some glandular ducts
- Usually occurs at **transition areas** between two other types of epithelia
- Only **apical layer** is columnar

See atlas for pictures of these two rare types.

#### 4. Transitional epithelium

- a. Forms lining of hollow (but stretched) urinary organs
  1. Found in bladder, ureters, urethra
- b. Basal layer cells are cuboidal or columnar
- c. Ability of cells to change shape when stretched (hence the term transitional) allows for increased flow of urine and in the case of bladder more storage space
  1. Before urination looks squamous
  2. After urination looks cuboidal

## Glandular Epithelia

### • Gland

- One or more cells that makes and secretes an aqueous fluid called a **secretion**

### • Classified by:

- Site of product release
  - **Endocrine:** internally secreting (ex: hormones)
  - **Exocrine:** externally secreting (ex: sweat)
- Relative number of cells forming the gland
  - Unicellular (ex: goblet cells) or multicellular (ex: salivary)

*\* pooping is also considered external secretion since it is unwanted*

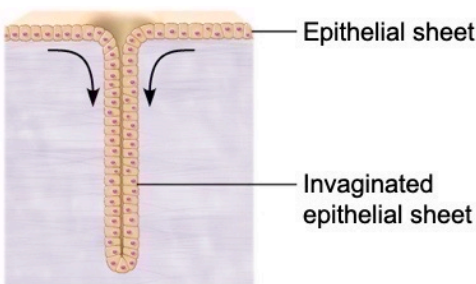
*aqueous fluid w/ protein, oil, or sugar*

*→ infuse into blood supply*

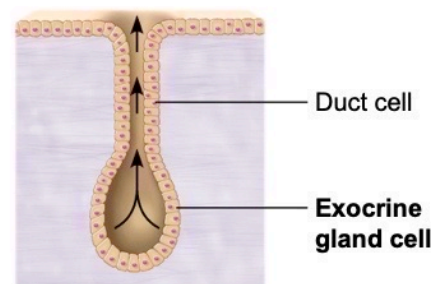
*where it releases secretion*

*how many cells make up gland*

Multicellular epithelial glands form by invagination (inward growth) of an epithelial sheet.

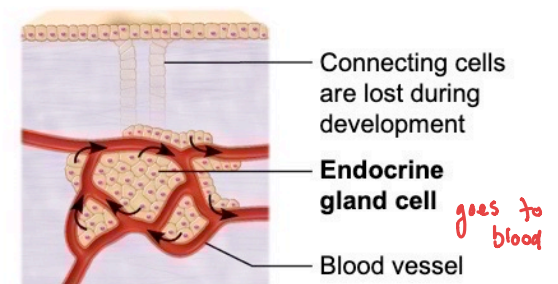


Exocrine glands retain the connecting cells, which form a duct that transports secretions to the epithelial surface.



*outside*

Endocrine glands lose their ducts during development. They secrete hormones into the interstitial fluid. These hormones then enter the blood.



*goes to blood*

Figure 4.5 Formation of Multicellular Exocrine and Endocrine Glands

### Endocrine glands

- Ductless glands *have lost their duct*
  - Secretions are not released into a duct; are released into **surrounding interstitial fluid**, which is picked up by the circulatory system
- Secrete (by exocytosis) **hormones**, messenger chemicals that travel through **lymph** or **blood** to their specific target organs
- Examples: hormones, messenger chemicals
- Target organs respond in some characteristic way

*in between cells of the gland, where next tissue starts*

*→ adrenal gland is on top of the kidneys and produces adrenaline, goes to interstitial, blood, the stimulates nervous system  
↳ pancreas, thymus, testicles  
all act on a target organ*

### Exocrine glands

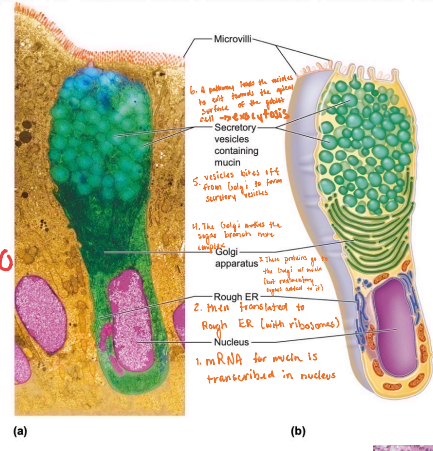
- Secretions are released onto **body surfaces**, such as skin, or into **body cavities**
- More numerous than endocrine glands
- Secrete products into ducts
- Examples: mucous, sweat, oil, salivary glands
- Can be **unicellular** or **multicellular**

mucous : digestive tract  
 goblet : respiratory ; intestinal

Figure 4.6 Goblet cell (unicellular exocrine gland).

**Unicellular exocrine glands**

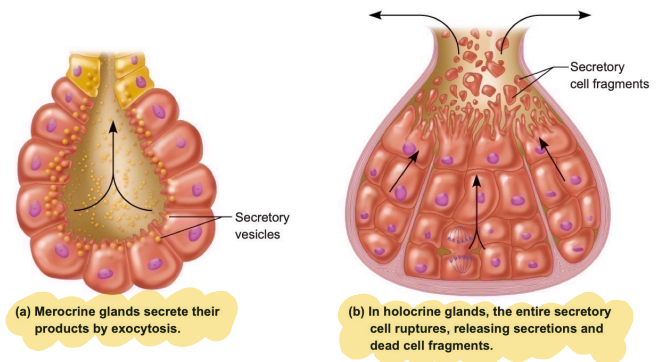
- The only important unicellular glands are **mucous cells** and **goblet cells**
- Found in epithelial linings of intestinal and respiratory tracts
- All product **mucin**, a sugar-protein that can dissolve in water to form mucus; a slimy, protective, lubricating coating *to gastro intestinal ; respiratory*



**Multicellular exocrine glands**

- Multicellular exocrine glands are composed of a **duct** and a **secretory unit**
- Usually surrounded by supportive connective tissue that supplies blood and nerve fibers to gland
  - Connective tissue can form capsule around gland, and also extend into gland, dividing it into lobes
- Classified by: **structure** and **mode of secretion**
- **Mode of secretion:**

Figure 4.8 Chief modes of secretion in human exocrine glands.



- **Merocrine:** most secrete products by exocytosis as secretions are produced (sweat, pancreas) *more common ->*
- **Holocrine:** accumulate products within, then rupture (sebaceous oil glands) *in humans*
- **Apocrine:** accumulate products within, but only apex ruptures
  - whether this type exists in humans is controversial (maybe mammary cells?)

**Question:** Goblet cells are found in this kind of epithelium.  
 a) simple squamous b) simple cuboidal c) transition d) **simple columnar**

**Question:** Which of the following is the most widespread epithelium?  
 a) simple cuboidal b) **stratified squamous** c) simple columnar d) stratified cuboidal

**Question:** Goblet cells are found in this kind of epithelium.  
 a) simple squamous b) simple cuboidal c) transition d) **simple columnar**

**Question:** Glands that secrete by rupture of cells are classified as \_\_\_\_\_.  
 a) endocrine b) merocrine c) **holocrine** d) unicellular

**Question:** An epithelial tissue has four layers of cells. The apical layer is flat, and the cells of the basal layer are taller than they are wide. This epithelial tissue would be classified as \_\_\_\_\_.  
 a) simple squamous b) simple columnar c) **stratified squamous** d) stratified columnar

