

Lecture Objectives:

- Describe general characteristics of epithelial tissue.
- Discuss microscopic structure and distribution of different types of epithelial membranes.
- Classify glandular epithelium according to different parameters.
- Enumerate the functions of epithelial tissue.
- Understand the following clinical applications:
 - Immotile cilia syndrome (Kartagener's Syndrome)
 - Metaplasia

Histology Lecture (2): Epithelial Tissue

REMINDER:

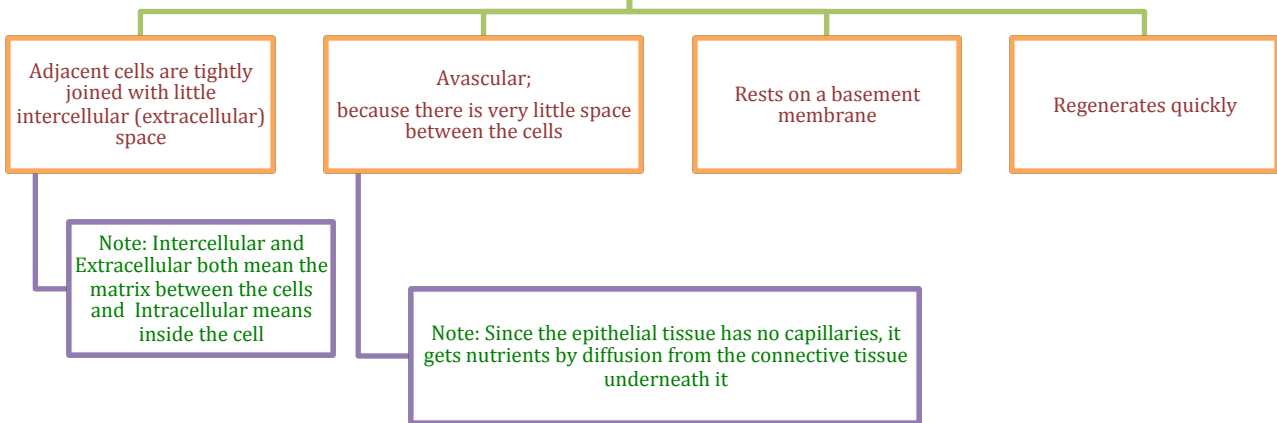
What is the body made of?

Body -> Systems -> Organs -> Tissue-> Cell

Types of tissue:

1. Epithelial
2. Connective
3. Muscular
4. Nervous

**Epithelial Tissue
Characteristics:**



Classification of epithelium:

Epithelial Membranes:
It is divided into two kinds depending on number of cell layers into:

Epithelial Glands (Glandular Epithelium)

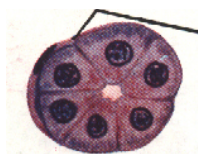


Figure: Glandular Epithelium

Simple Epithelium:
One layer of cells

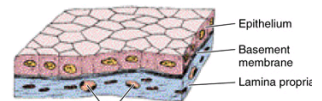


Figure 1: Simple Epithelium

Stratified Epithelium:
More than one layer

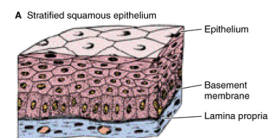


Figure 2: Stratified Epithelium

Note: Epithelial membranes can also be divided into two kinds, depending on where it is located:

Lining: (on the inside) mostly found in hollow organs

e.g.: stomach

Covering: (on the outside) On the surface

e.g.: Skin

It is easier to identify the type of epithelial cells (squamous, cuboidal, columnar) by the shape of their nuclei because they are darker and are easier to see in microscope.

- Squamous = Flattened nuclei
- Cuboidal = Central rounded nuclei
- Columnar = Basal oval nuclei

Epithelial Membranes: (1) Simple Epithelium

1) Simple Squamous Epithelium:

- One layer
- Flat cells
- Flat Nuclei
- Provides smooth thin surface

Examples of sites:

- Endothelium (Simple Squamous Epithelium of Cardiovascular System): lines the CVS

Note: Endothelium is a special name for this kind of epithelium (simple squamous) only in the CVS

- Alveoli: in the lung (one layer to allow gas exchange)

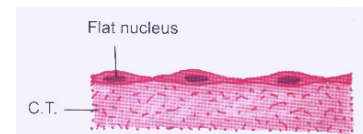


Figure 1: Simple Squamous Epithelium

2) Simple Cuboidal Epithelium:

- One layer
- Cuboidal cells
- Central rounded nuclei

Examples of sites:

- Thyroid Follicles

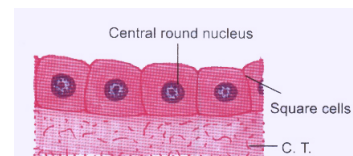


Figure 2: Simple Cuboidal Epithelium

3) Simple Columnar Epithelium:

- One layer
- Columnar cells
- Basal oval nuclei

Types:

- * Non-ciliated Simple Columnar Epithelium :

Example of site:

- Lining of Stomach
- Lining of Intestines (with goblet cells)
Note: In the small and large intestines between every few cells there are goblet cells that secrete mucus
- Gall Bladder

- * Ciliated Simple Columnar Epithelium: Has cilia on free side (on apex)

Example of site:

- Fallopian tubes

Note: So we can say that Simple columnar epithelium has three types:

- * Simple columnar epithelium
- * Simple columnar epithelium with goblet cells
- * Simple columnar ciliated epithelium

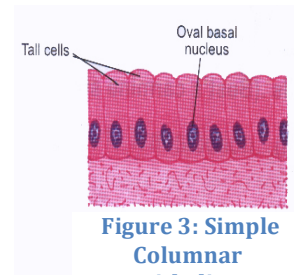


Figure 3: Simple Columnar Epithelium

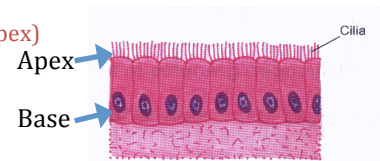


Figure 4: Simple Columnar Ciliated Epithelium

4) Pseudo-Stratified Columnar: (pseudo= false, not)

- One layer
- Columnar cells
- Some cells are tall (reach lumen)
- Some cells are short and don't reach the surface (don't reach lumen)
- Both rest on the basement membrane
- Nuclei appear at different levels

Types:

- * Non-ciliated:

Example of site:

- Vas deferens

- * Ciliated with Goblet Cells:

Example of site:

- Trachea

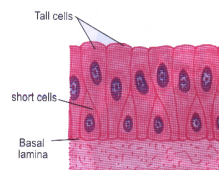


Figure 5: Pseudo-stratified Columnar Epithelium

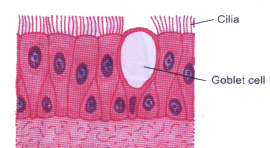


Figure 6: Pseudo-stratified Columnar Ciliated Epithelium

Note: the mucus stored in the goblet cells washes out during the preparation of the slides for the microscope so they appear like empty circles

Epithelial Membranes: (2) Stratified Epithelium

All Stratified Epithelium have a few things in common which are:

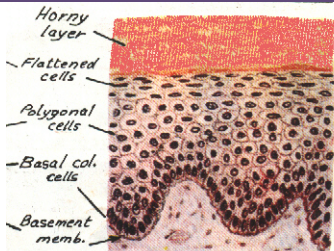
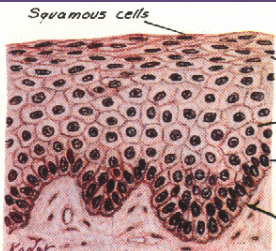
- Multiple layers of cells
- Never have goblet cells or cilia
- Columnar basal cells with basal oval nuclei
- Polygonal intermediate cells with central rounded nuclei

They differ, however, in their surface cells and based on these differences we classify them into:

1) Stratified Squamous Epithelium:

- Multiple layers of cells
- Basal cells are columnar with basal oval nuclei
- Intermediate cells are polygonal with central rounded nuclei
- Surface cells are flat with flattened nuclei

Types:

Keratinized Stratified Squamous Epithelium	Non-keratinized Stratified Squamous Epithelium
<ul style="list-style-type: none"> • Has a layer of keratin on the surface of the tissue • Keratin layer = Horny layer with pink colour (Figure 7) • Keratin layer is made of dead cells full of keratin • No nuclei in keratin layer • Keratin layer exists for protection • Thickness of keratin layer differs but the thickest layer of it exists on the palm of the hand and the sole of the foot 	<ul style="list-style-type: none"> ○ Without layer of keratin on the surface ○ Covers surfaces that are open to outside environment but are protected (hiding) (e.g. esophagus, vagina, anal canal)
 <p>Figure 7: Keratinized Stratified Squamous Epithelium</p>	 <p>Figure 8: Non-keratinized Stratified Squamous Epithelium</p>
<p>Example of site:</p> <ul style="list-style-type: none"> ▪ Epidermis of skin 	<p>Example of site:</p> <ul style="list-style-type: none"> ▪ Esophagus

2) Transitional Epithelium:

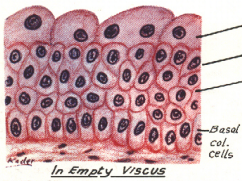
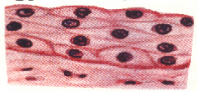
- Multiple layers of cells
- Basal cells are columnar with basal oval nuclei
- Intermediate cells are polygonal with central rounded nuclei
- Surface cells are large cuboidal with convex (dome-shaped) free surface

Note: The dome-shaped free surface is a unique feature of the transitional epithelium

Example of site:

- Urinary bladder

Note: As the bladder fills up with urine the cells of the transitional epithelium slide (glide) over one another to line the wall of the bladder as it stretches and gets larger and so the layers of the transitional epithelium decrease and change shape. Then when human empties the bladder it goes back to original number of layers

Empty Bladder	Bladder with some Urine	Full Bladder
5-6 layer shows	2-3 layers of stretched squamous cells	1 layer of simple squamous epithelium (Highly stretched)
 <p>Figure 9: Transitional Epithelium</p>	 <p>Figure 10: Transitional Epithelium (Half-full Bladder)</p>	

3. Stratified Columnar Epithelium:

- Multiple layers of cells
- Basal cells are columnar with basal oval nuclei
- Intermediate cells are polygonal with central rounded nuclei
- Surface cells are columnar

Example of site:

- Large ducts of glands

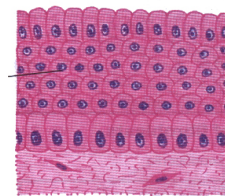
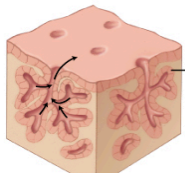
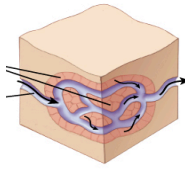


Figure 11: Stratified Columnar Epithelium

Epithelial Glands (Glandular Epithelium)

Methods of Classification:


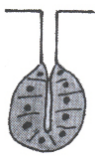
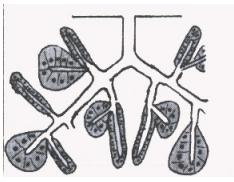
1) According to Presence or Absence of Ducts:

a. Exocrine:	b. Endocrine:	c. Mixed:
the glands have ducts that secrete into cavity (e.g. Salivary gland) or to the outside (e.g. Sweat glands)	the glands don't have any ducts but secrete into the blood	Secretes through ducts as well as into blood
Example of site: <ul style="list-style-type: none"> ▪ Salivary Gland ▪ Goblet Cells (No ducts but it secretes to the outside not in blood) 	Example of site: <ul style="list-style-type: none"> ▪ Thyroid Gland 	Example of site: <ul style="list-style-type: none"> ▪ Pancreas
		
Figure 15: Exocrine Gland	Figure 16: Endocrine Gland	

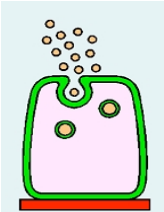
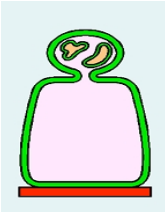

2) According to the Number of Cells:

- a. Unicellular:
 - E.g. Goblet cells (it is only unicellular gland in the body)
- b. Multicellular:
 - E.g. Salivary Glands

3) According to Shape of Secretory Part (in exocrine):

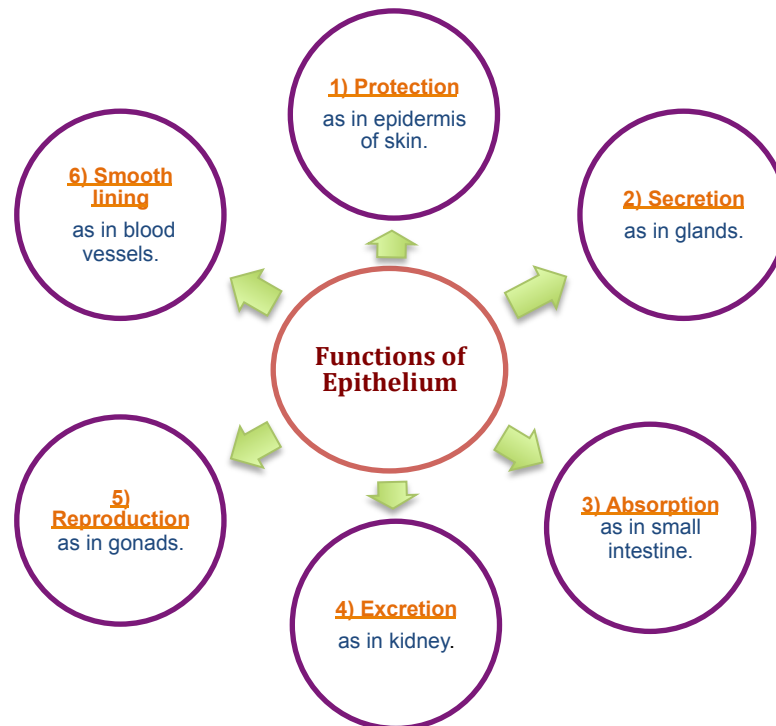
Tubular	Alveolar (Acinar)	Tubulo-alveolar
Example of site: <ul style="list-style-type: none"> • Intestinal Gland 	Example of site: <ul style="list-style-type: none"> ▪ Mammary Gland 	Example of site: <ul style="list-style-type: none"> ▪ Pancreas
		
Figure 17: Tubular	Figure 18: Alveolar	Figure 12: Tubulo-alveolar

4) According to Mode of Secretion from Cell:

a. Merocrine:	b. Apocrine:	c. Holocrine:
<ul style="list-style-type: none"> No part of the cell is lost during secretion Vesicle with secretion fuses with the cell membrane so only the secretion exits It is most common kind 	<ul style="list-style-type: none"> The top of the cell (apex) is lost with the secretion The vesicle exits with secretion inside 	<ul style="list-style-type: none"> The whole cell detaches with the secretion The cell accumulates the secretion then it detaches The nucleus degenerates
<p>Example of site:</p> <ul style="list-style-type: none"> Salivary glands 	<p>Example of site:</p> <ul style="list-style-type: none"> Mammary gland 	<p>Example of site:</p> <ul style="list-style-type: none"> Sebaceous glands
 <p>Figure 20: Merocrine</p>	 <p>Figure 13: Apocrine</p>	 <p>Figure 22: Holocrine</p>

5) According to Nature of Secretion:

a. Serous (The nucleus is round and central)	b. Mucous (The nucleus is flat and basal)	c. Muco-Serous	d. Watery
<p>Example of Site:</p> <ul style="list-style-type: none"> Parotid Gland (it is one of the salivary glands) Pancreas 	<p>Example of Site:</p> <ul style="list-style-type: none"> Goblet Cells 	<p>Example of Site:</p> <ul style="list-style-type: none"> Sublingual Gland (Also one of the salivary glands) 	<p>Example of Site:</p> <ul style="list-style-type: none"> Sweat Gland
 <p>Figure 23: Serous Gland</p>	 <p>Figure 14: Mucous Gland</p>	 <p>Figure 15: Muco-serous Gland</p>	 <p>Figure 16: Watery Gland</p>



Clinical Applications

Immotile Cilia Syndrome (Kartagener's Disease):

- Disorder that causes:
 - * Infertility in male
 - * Chronic respiratory tract infection in both sexes
- It is caused by immobility of *cilia* and *flagella* induced by deficiency of *dynein*.
- Dynein protein is responsible for movements of cilia and flagella.

Metaplasia:

- It is the *transformation* of one type of tissue to another in response to injury.
- This condition is usually *reversible* if the injury is removed.
- Example: pseudo-stratified ciliated columnar epithelium of the respiratory passages e.g. trachea, of heavy smokers may undergo *squamous metaplasia*, transforming into stratified squamous epithelium.

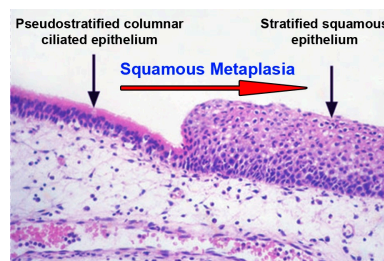


Figure 17: Squamous Metaplasia