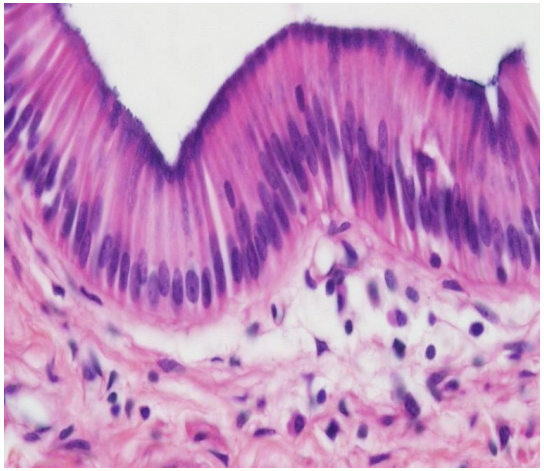
Foundation Module

1st Year MBBS(LGIS)

Epithelial Tissue

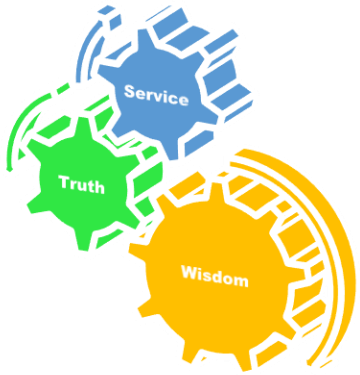


Presenter: Dr. Mohtasham Hina
(Associate Professor)

Date: 23-01-25

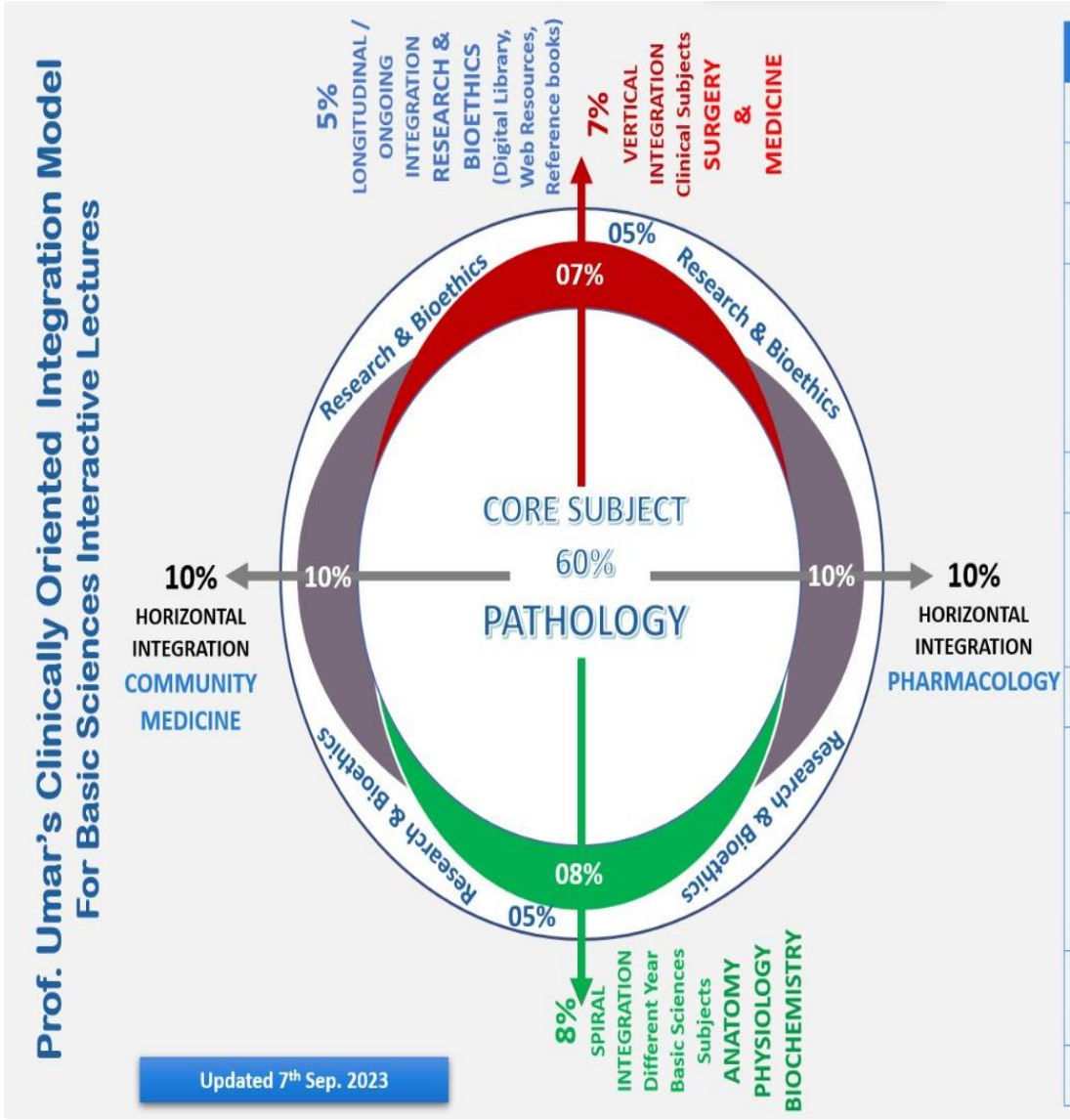
Vision; The Dream/Tomorrow

- **Motto**



- To impart evidence based research oriented medical education
- To provide best possible patient care
- To inculcate the values of mutual respect and ethical practice of medicine

Professor Umar Model of Integrated Lecture



Model 3rd Year Pathology LGIS (≈30 slides)	
Core Subject – 60% (≈ 18-20 slides)	
Pathology (≈ 18-20 slides)	
Horizontal Integration – 20% (≈ 5-6 slides)	
Same Year Subjects	• Pharmacology (10%) (≈ 2-3 slides) • Community Medicine (10%) (≈ 2-3 slides)
Vertical Integration – 07% (≈ 2-3 slides)	
Clinical Subjects	• Medicine (3-5%) (≈ 1-2 slides) • Surgery (3-5%) (≈ 1-2 slides)
Spiral Integration – 08% (≈ 2-3 slides)	
Different Year Basic Sciences Subjects	• Anatomy (1-3%) (≈ 1-2 slides) • Physiology (1-3%) (≈ 1-2 slides) • Biochemistry (1-3%) (≈ 1-2 slides)
Longitudinal / Ongoing Integration – 05% (≈ 1-2 slides)	
Research & Bioethics (≈ 1-2 slides)	

Prof. Umar Teaching Strategy Model

- Lecture available on website : https://rmur.edu.pk/department-of-anatomy/

- **SDL Assessment**

1. Which type of epithelium is best suited for diffusion and filtration?
A) Stratified squamous
B) Simple squamous
C) Pseudostratified columnar
D) Transitional
E) Stratified cuboidal

2. The presence of cilia is a characteristic feature of which epithelial tissue?
A) Simple cuboidal
B) Simple columnar
C) Pseudostratified columnar
D) Stratified squamous
E) Transitional

SDL Evaluation

3. Which epithelium lines the urinary bladder, allowing it to stretch and recoil?
A) Simple cuboidal
B) Stratified columnar
C) Transitional
D) Simple squamous
E) Pseudostratified columnar

4. Goblet cells, which secrete mucus, are commonly found in which type of epithelium?
A) Simple squamous
B) Pseudostratified columnar
C) Transitional
D) Stratified squamous
E) Simple cuboidal

5. Which type of epithelium is specialized for absorption in the intestines?
A) Stratified squamous
B) Simple columnar
C) Transitional
D) Pseudostratified columnar
E) Simple squamous

- 1.b
- 2.c
- 3.c
- 4.b
- 5.b

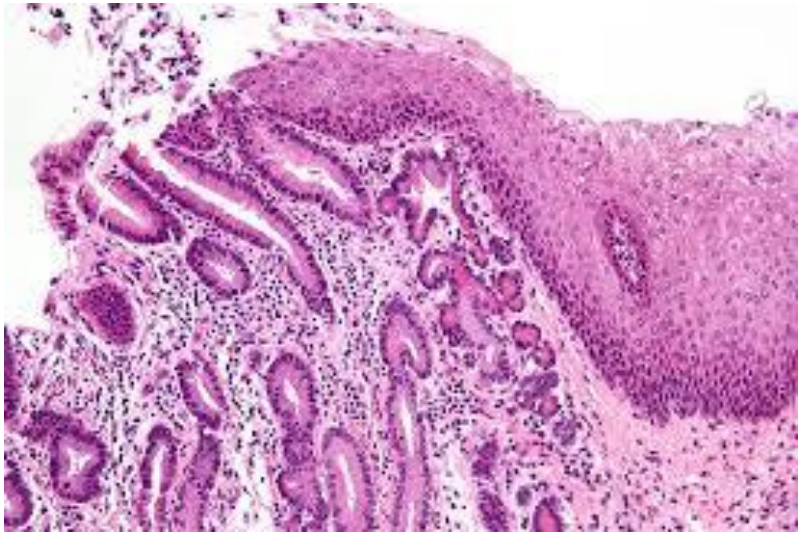
Learning Objectives

At the end of lecture 1st year students should be able to

- Define epithelium
- Classify epithelium
- Explain histological structure of simple and stratified epithelium
- Location and functions of epithelia
- correlate clinical aspects of epithelia
- To understand bio-physiological aspect of different types of epithelia
- Read a research article
- Use digital library

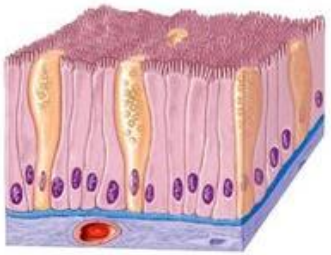
Interactive Session

A 55-year-old male smoker with a 30-year history presents with chronic cough, occasional blood-streaked sputum, and hoarseness. Examination reveals scattered wheezes on auscultation. Chest X-ray shows a right upper lobe opacity. Bronchoscopy with biopsy confirms squamous metaplasia of the bronchial epithelium, a precursor lesion in chronic smokers due to persistent irritation and inflammation.



Basic Tissues Of Body

- Of all the cells in the body, they combine to make only 4 basic tissue types:
  - **Epithelial tissues**
  - **Connective tissues**
  - **Muscular tissues**
  - **Nervous tissues**



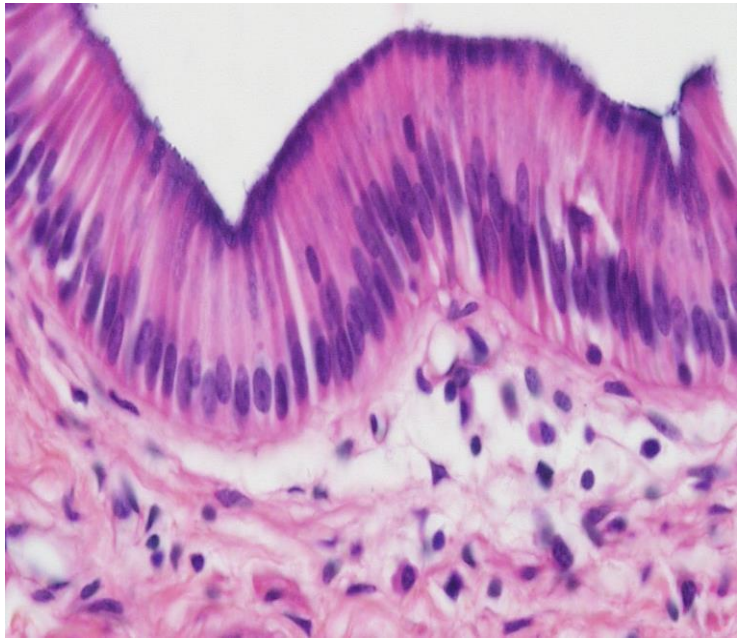
Epithelium

Definition

- Collection of closely packed cells with very small amount of intercellular substance

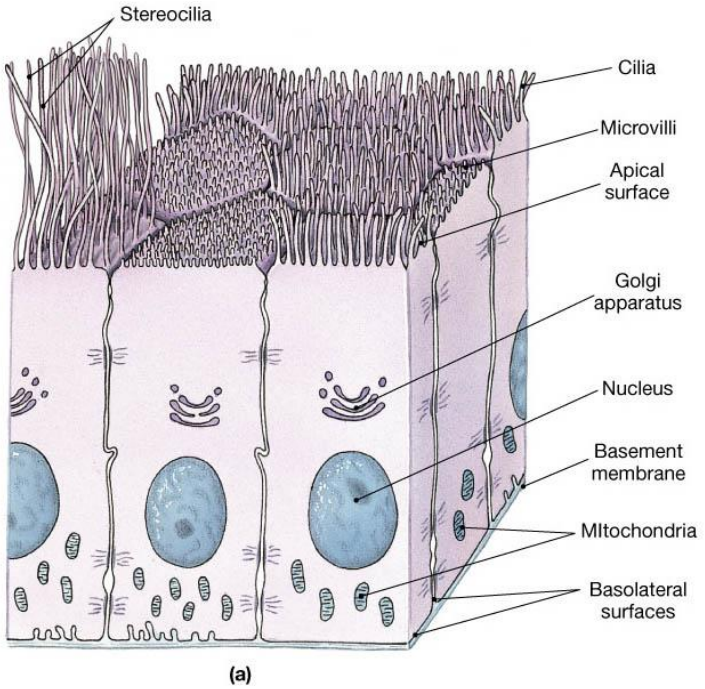
Characteristic Features of Epithelial Cells

- Specific shape
- Nuclear shape corresponds to cell shape
- Axis of nuclei
- Basal lamina/ basement membrane
- Indistinct cell boundaries
- Rests on lamina propria
- Papillae
- Polarity
- avascular



Core Knowledge

Cell Polarity



- **Apical domain**
  - Microvilli
  - Sterocilia
  - cilia
- **Lateral domain**
  - Junctional complexes
  - plica
- **Basal domain**
  - Basement membrane
  - Cell-to-extracellular matrix junctions
  - Basal cell membrane infoldings

Core Knowledge

Plica

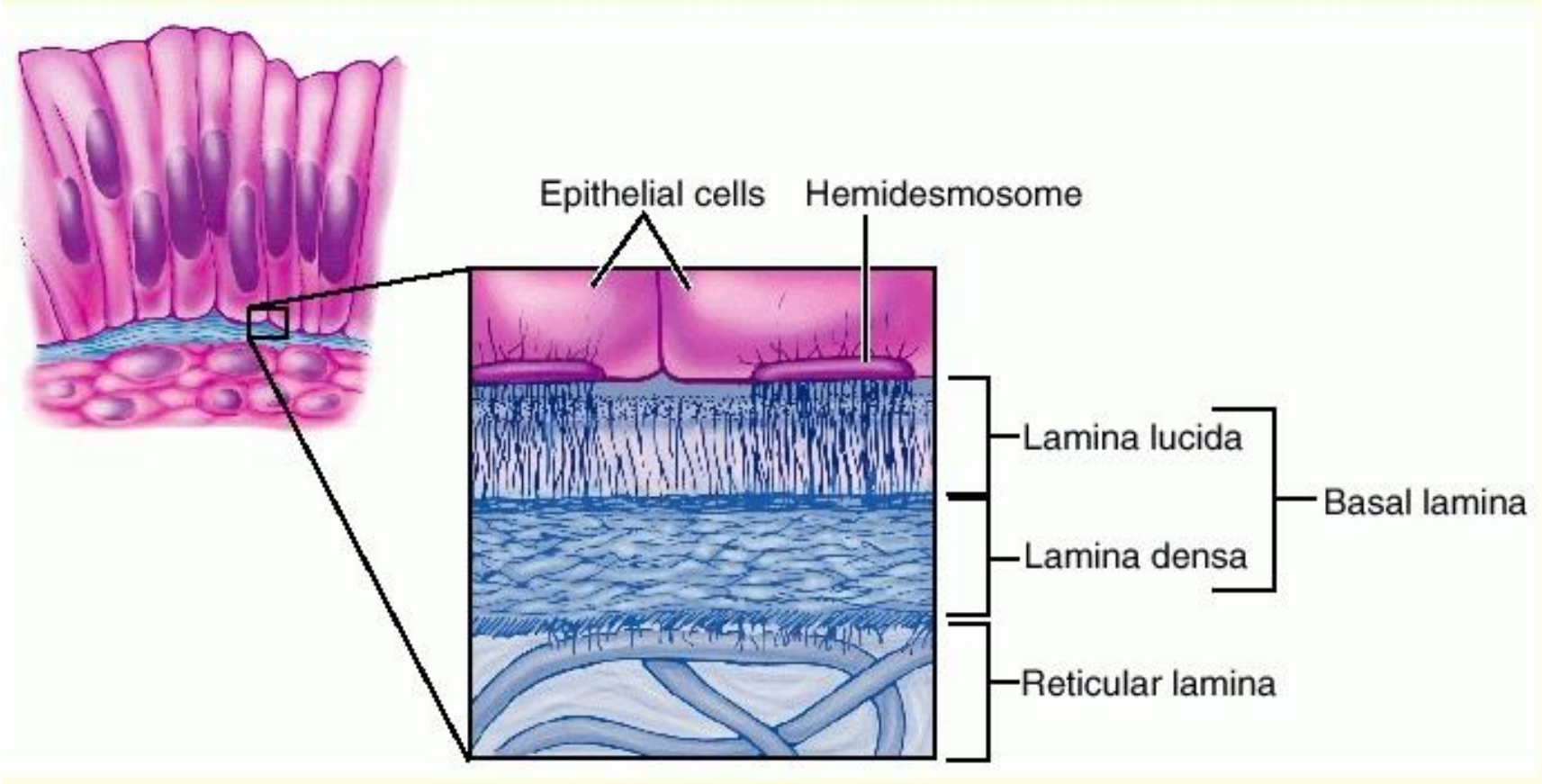
Core Knowledge

Basal Lamina (20-100nm)

- Collagen
  - **type IV collagen**
- **Laminins**
- **Entactin**
- **Proteoglycans**

Core Knowledge

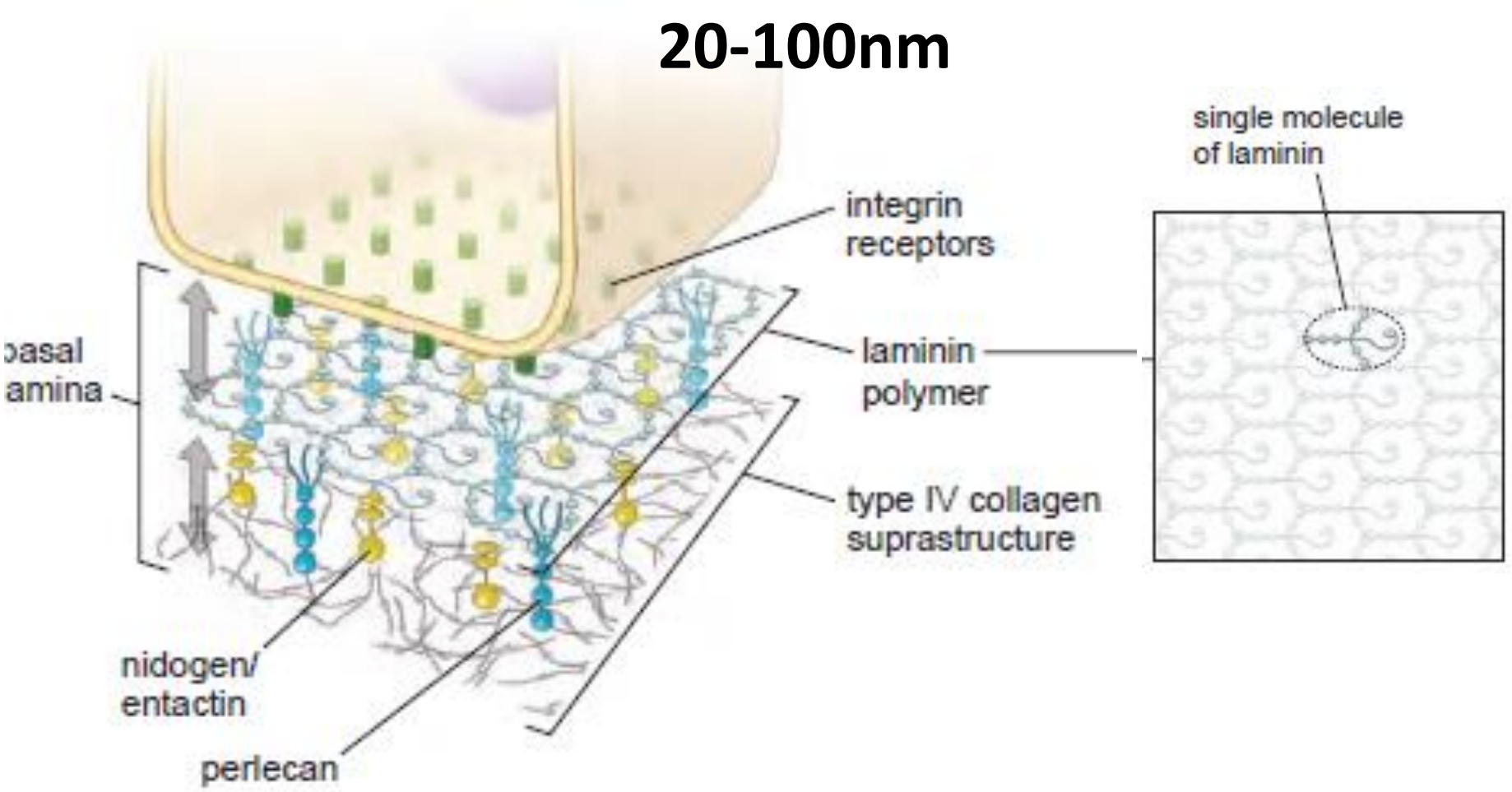
Basement Membrane



Core Knowledge

Basal lamina

20-100nm

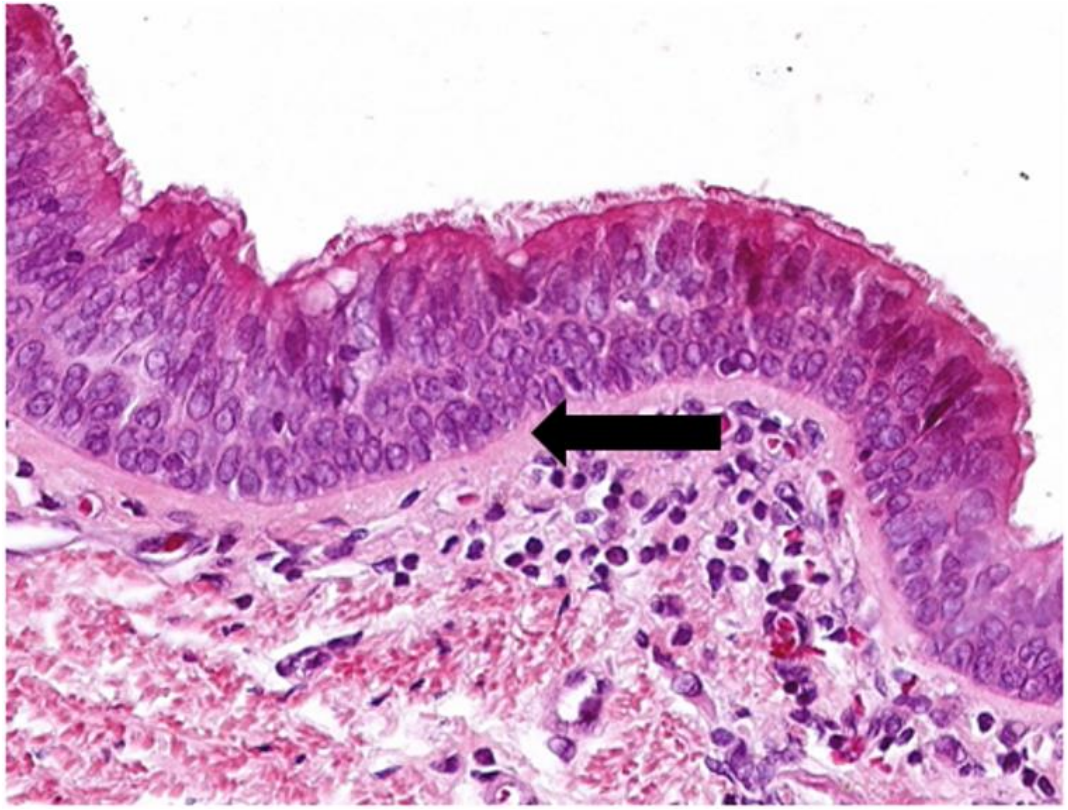


Lamina lucida: fibronectin, laminin receptors

Core Knowledge

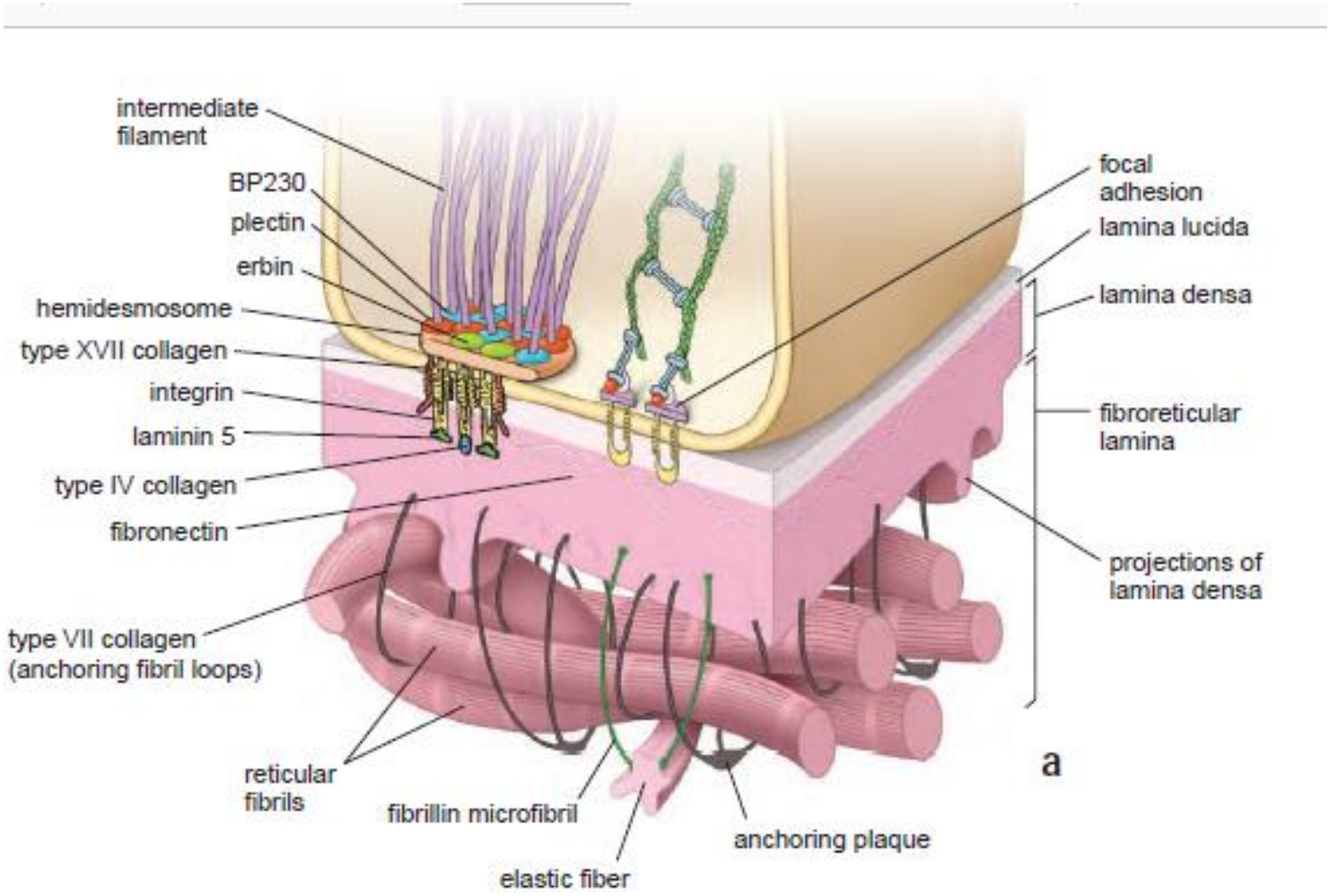
Basement Membrane

- Basal lamina + Reticular lamina = basement membrane



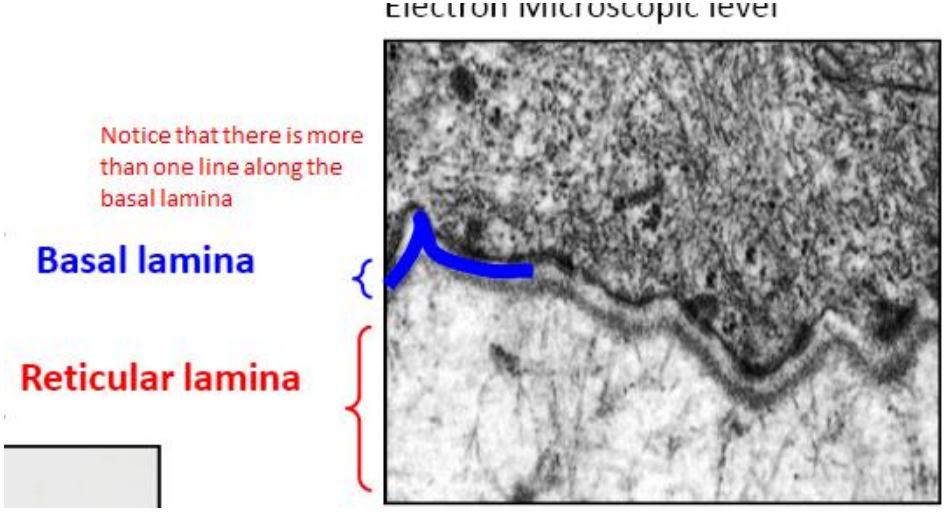
Core Knowledge

Basement Membrane



Basement Membrane

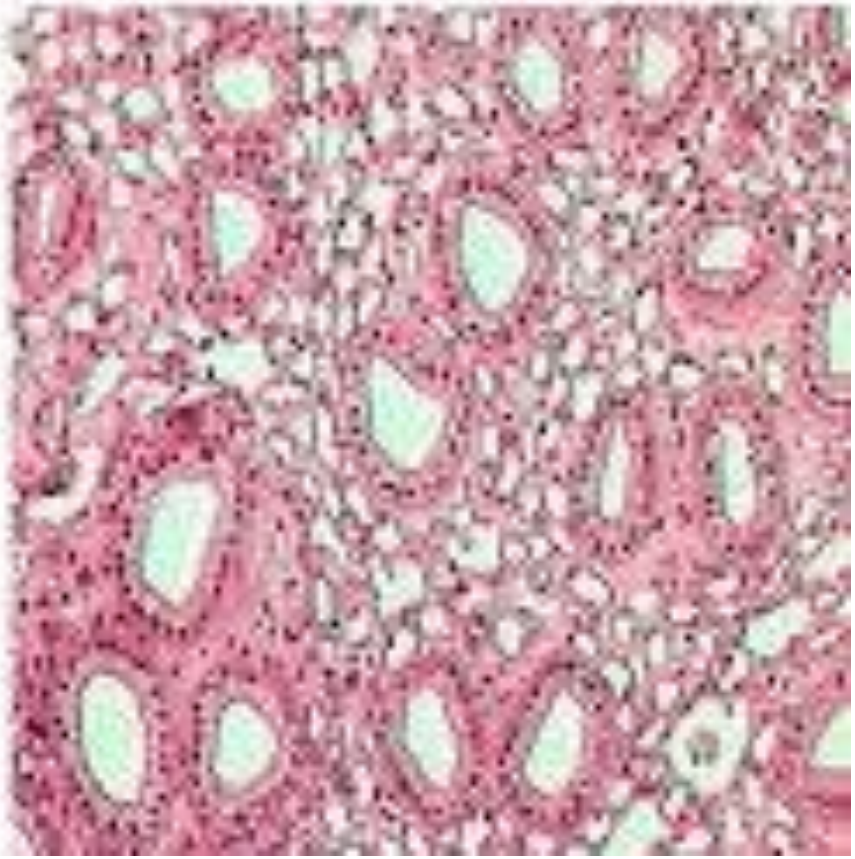
- **Functions**
  - Structural attachment.
  - Compartmentalization.
  - Filtration.
  - Regulation and signaling



Core Knowledge

Types of Epithelia

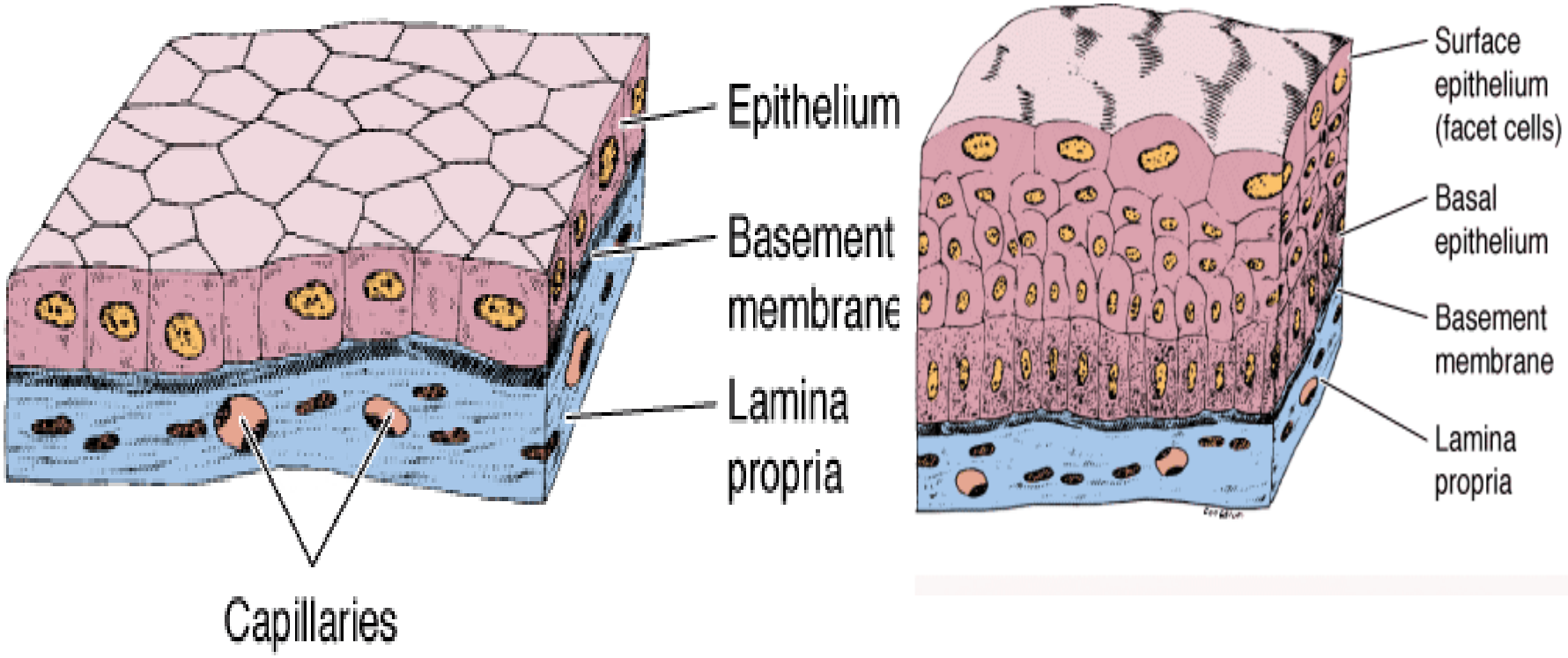
- Covering
- Glandular



Core Knowledge

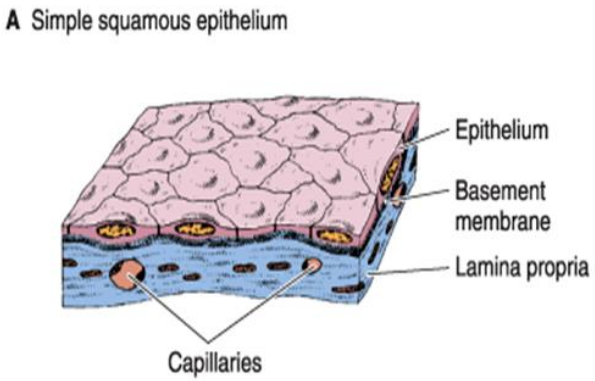
Covering Epithelia

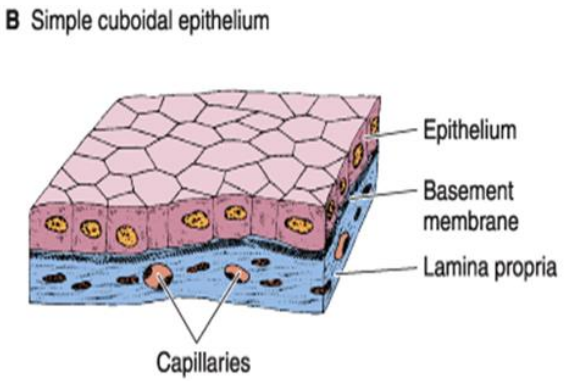
- Simple Epithelium
- Stratified Epithelium

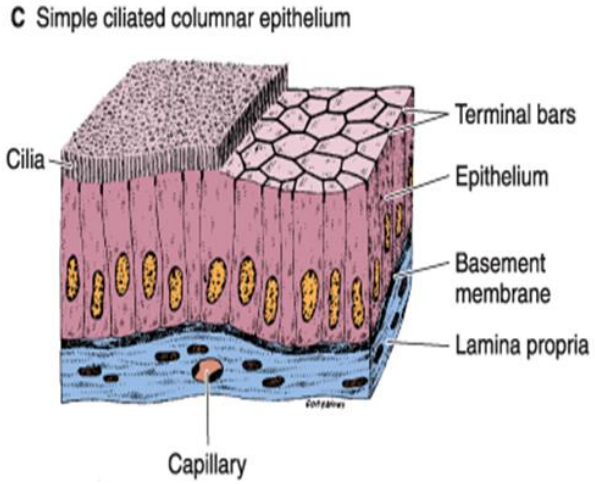


Core Knowledge

Simple Epithelia



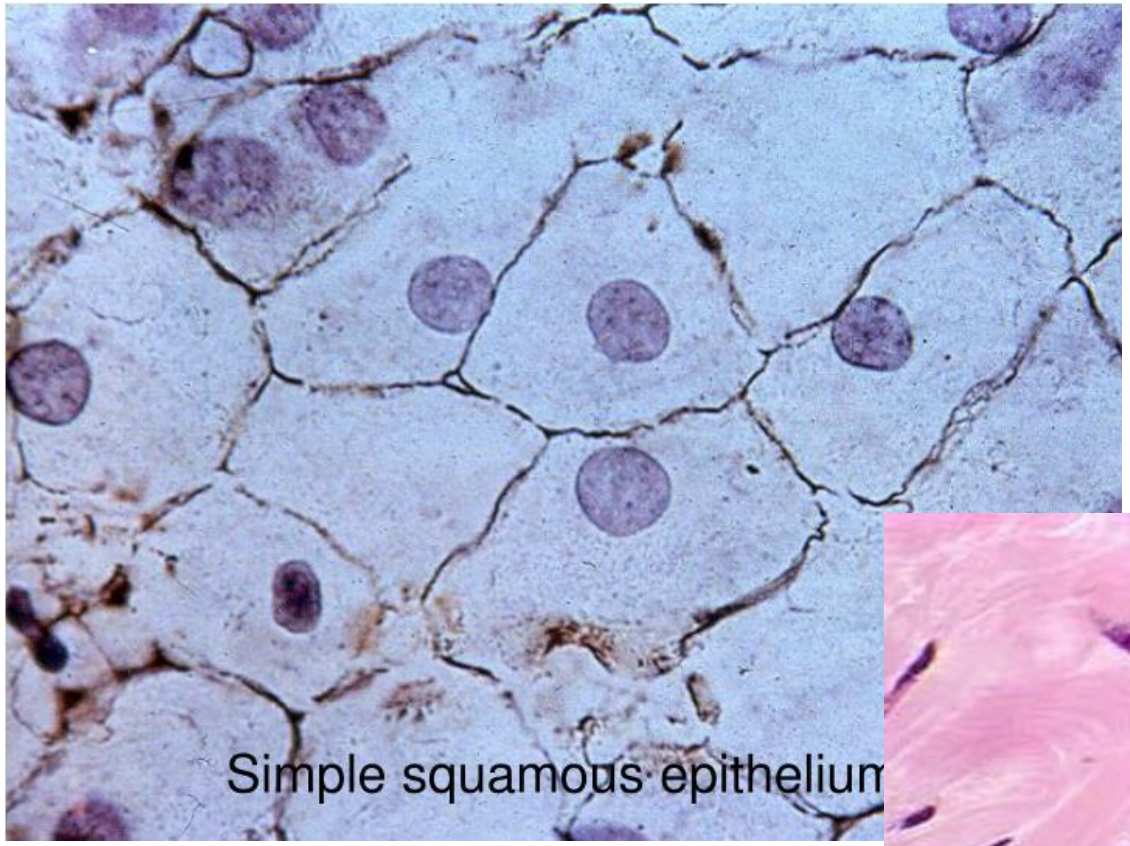


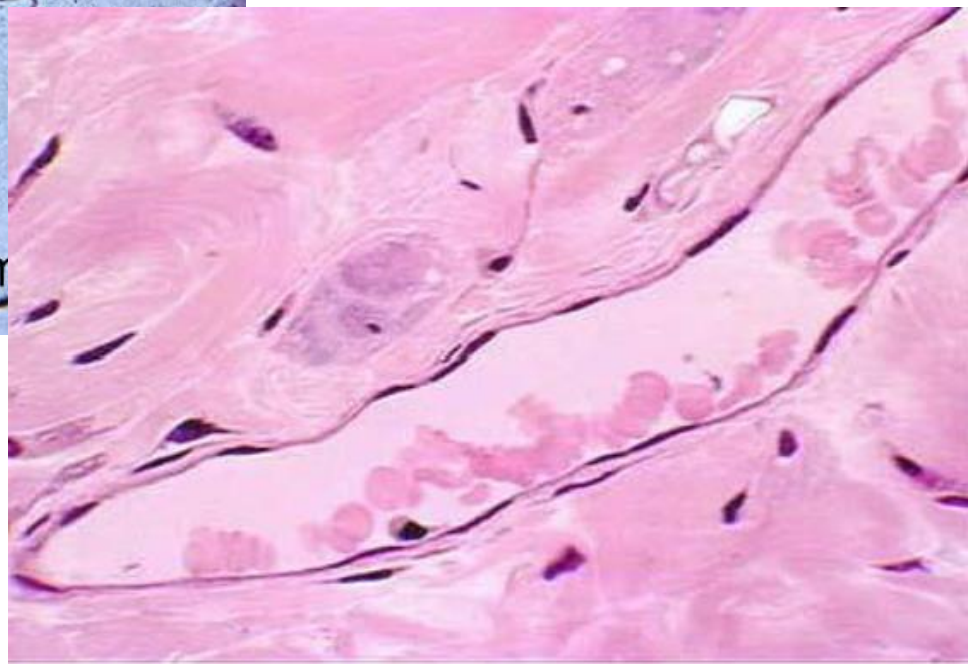


Zonula occludens

Core Knowledge

Simple Squamous

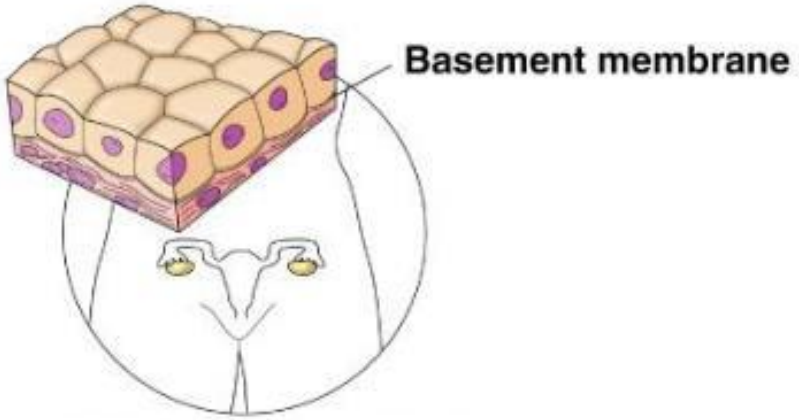




Core Knowledge

Simple Cuboidal

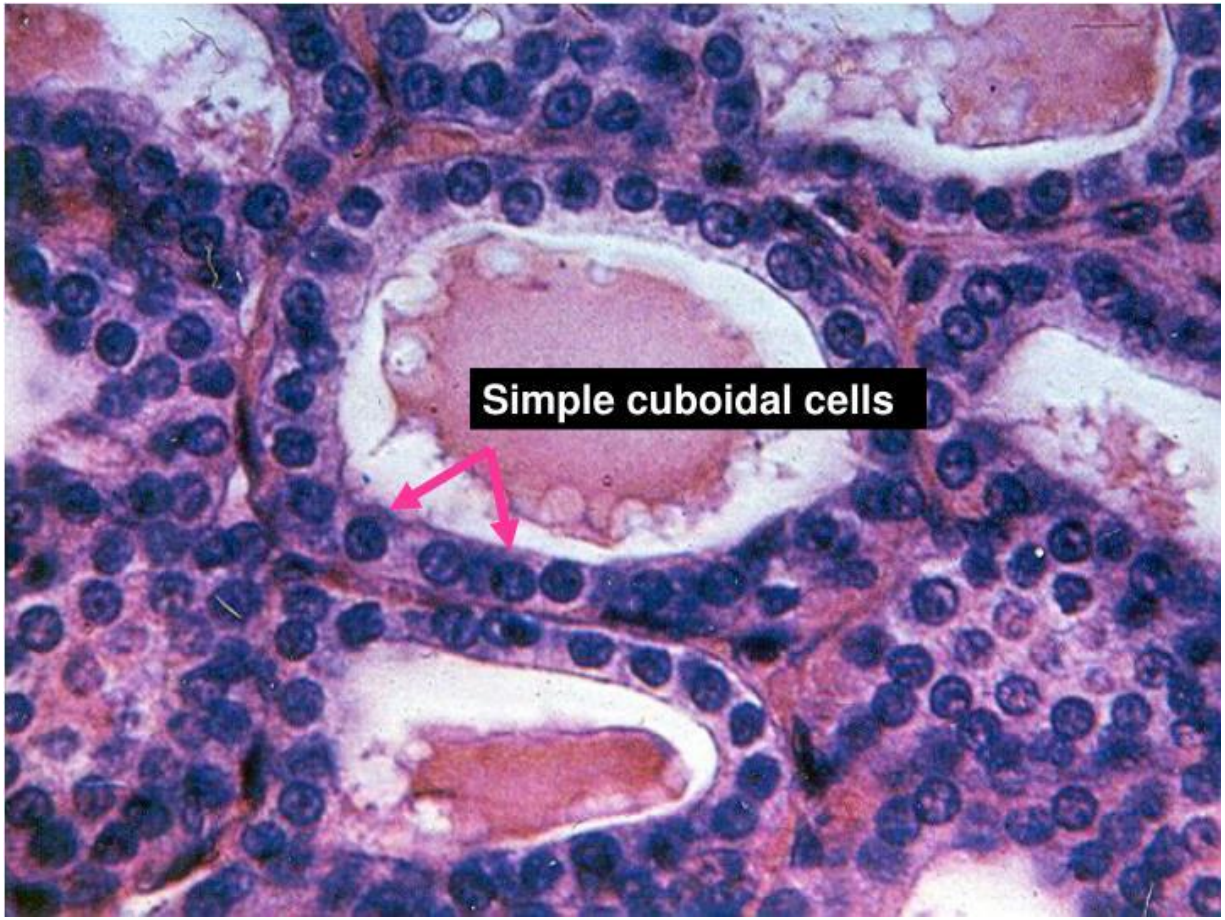
- Single layer of cube-like cells
- Common in glands and their ducts
- Forms walls of kidney tubules
- Covers the ovaries



(b) Simple cuboidal

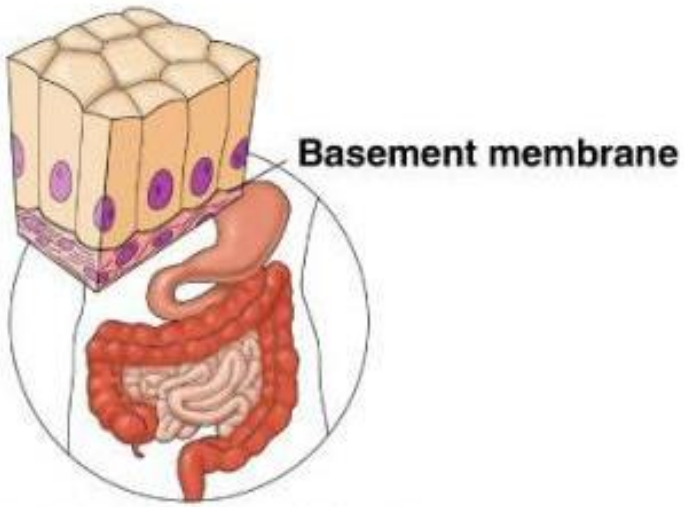
Core Knowledge

Simple Cuboidal Epithelium



Simple Columnar

- Single layer of tall cells
- Often includes goblet cells, which produce mucus
- Lines digestive tract



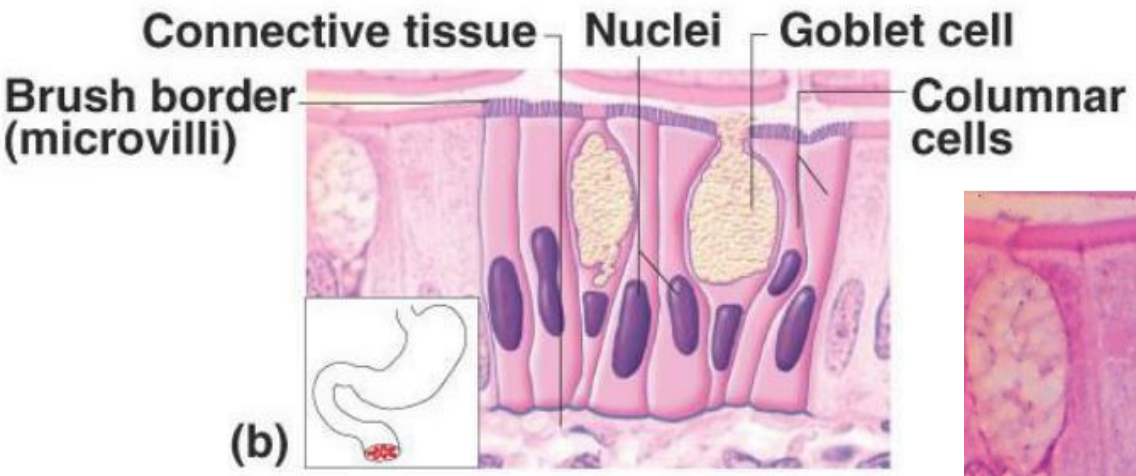
(c) Simple columnar

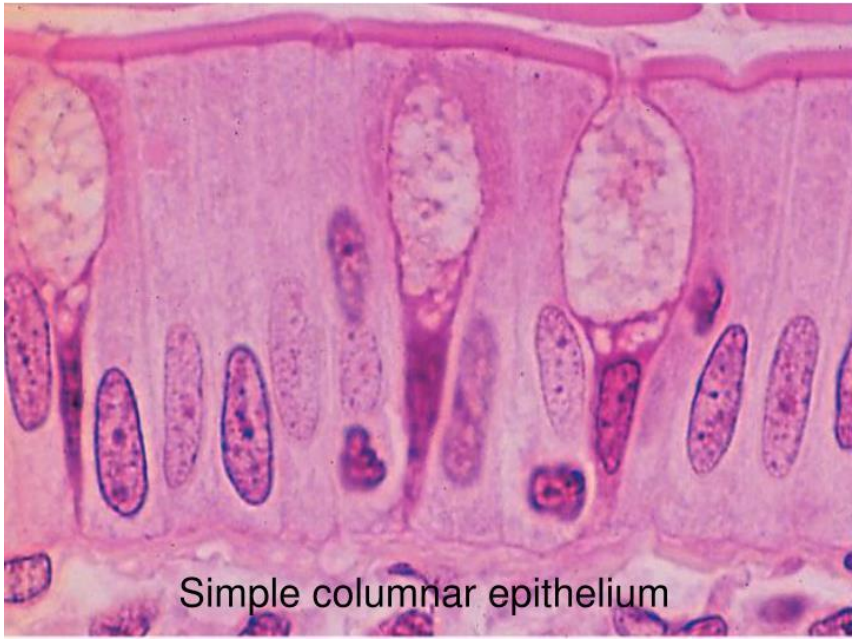
Core Knowledge

Simple Columnar Epithelium

Core Knowledge

(a)

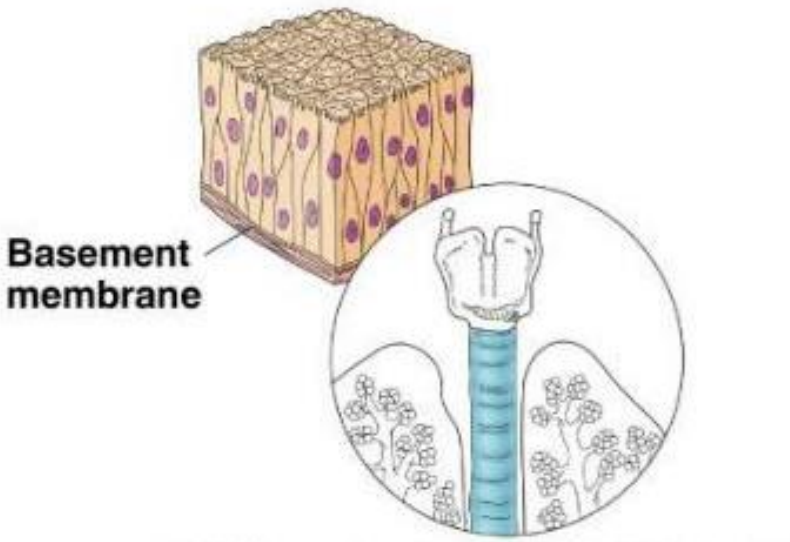




Simple columnar epithelium

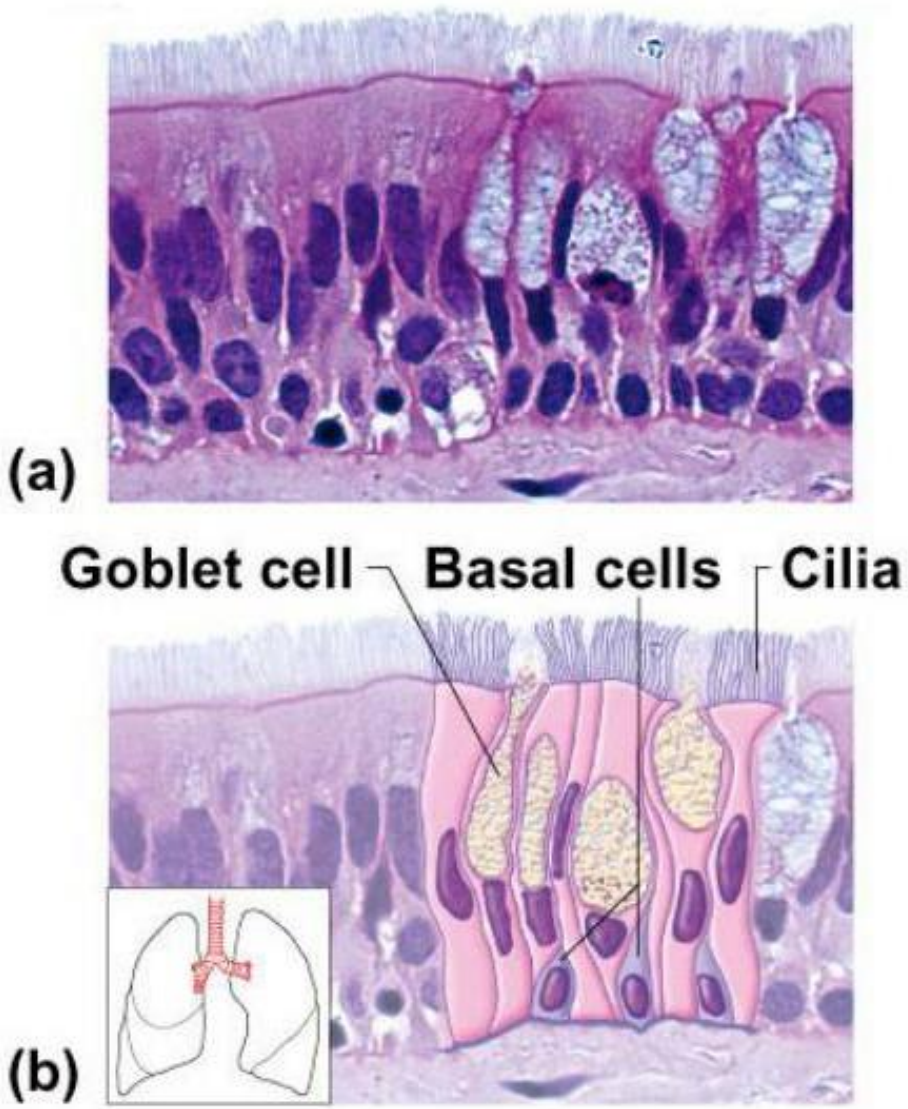
Pseudostratified Columnar

- Single layer, but some cells are shorter than others
- Often looks like a double cell layer
- Sometimes ciliated, such as in the respiratory tract
- May function in absorption or secretion

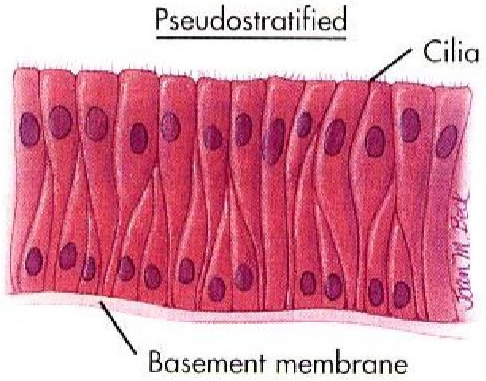


(d) Pseudostratified (ciliated) columnar

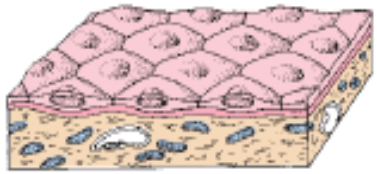
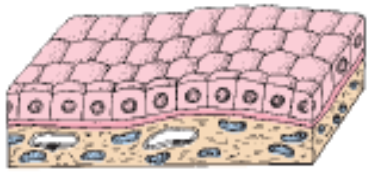
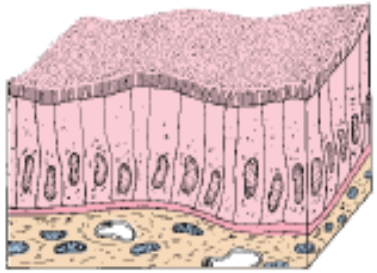
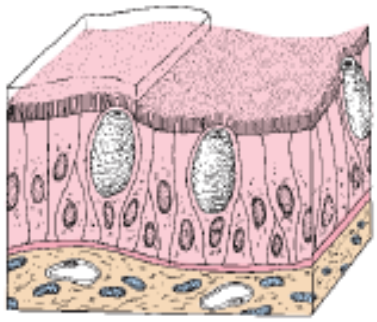
Core Knowledge



Pseudostratified Columnar Epithelium

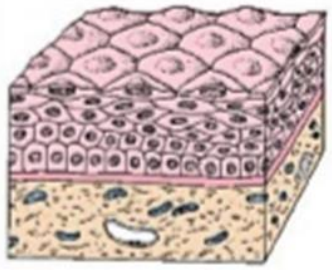


Core Knowledge

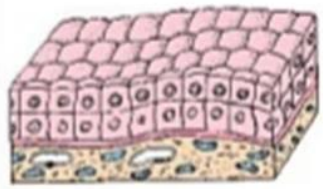
	Classification	Some Typical Locations	Major Function
	Simple squamous	Vascular system (endothelium) Body cavities (mesothelium) Bowman's capsule (kidney) Respiratory spaces in lung	Exchange, barrier in central nervous system Exchange and lubrication Barrier Exchange
	Simple cuboidal	Small ducts of exocrine glands Surface of ovary (germinal epithelium) Kidney tubules Thyroid follicles	Absorption, conduit Barrier Absorption and secretion
	Simple columnar	Small intestine and colon Stomach lining and gastric glands Gallbladder	Absorption and secretion Secretion Absorption
	Pseudostratified	Trachea and bronchial tree Ductus deferens Efferent ductules of epididymis	Secretion, conduit Absorption, conduit

Core Knowledge

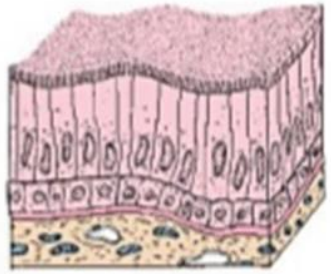
Stratified Epithelium



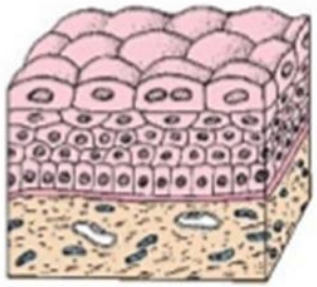
Stratified squamous	Epidermis Oral cavity and esophagus Vagina	Barrier, protection



Stratified cuboidal	Sweat gland ducts Large ducts of exocrine glands Anorectal junction	Barrier, conduit



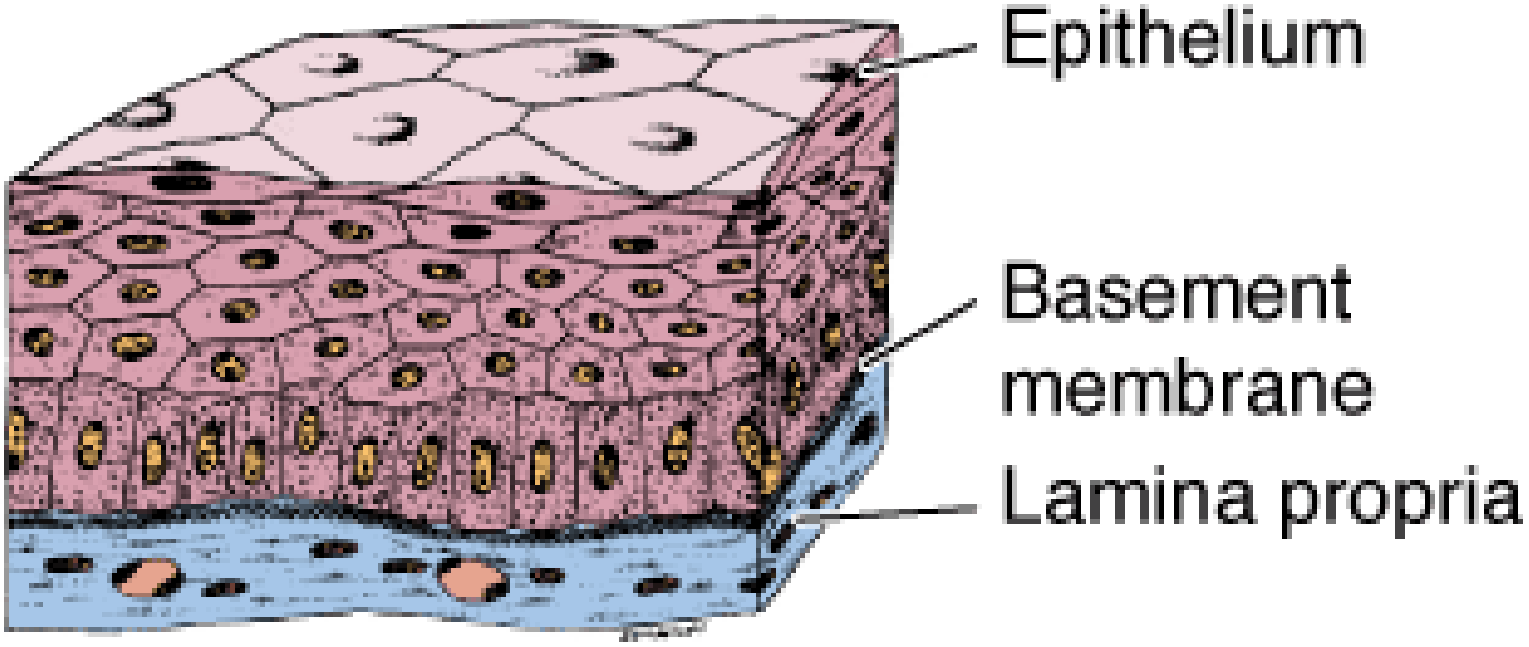
Stratified columnar	Largest ducts of exocrine glands Anorectal junction	Barrier, conduit



Transitional (urothelium)	Renal calyces Ureters Bladder Urethra	Barrier, distensible property

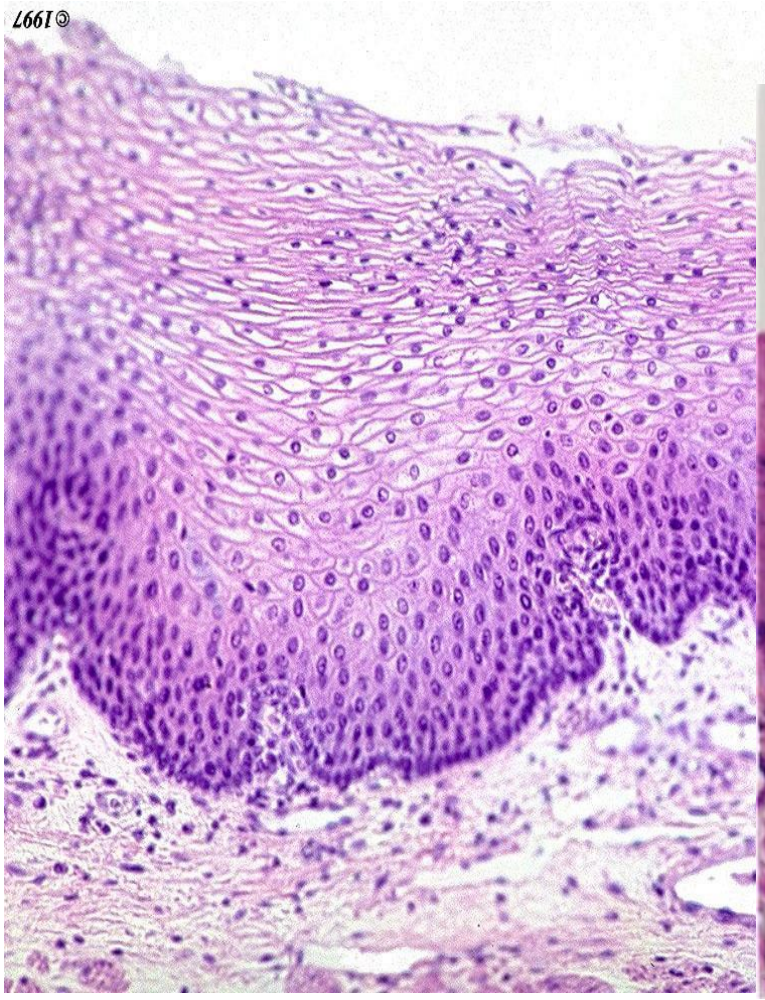
Core Knowledge

Stratified Squamous



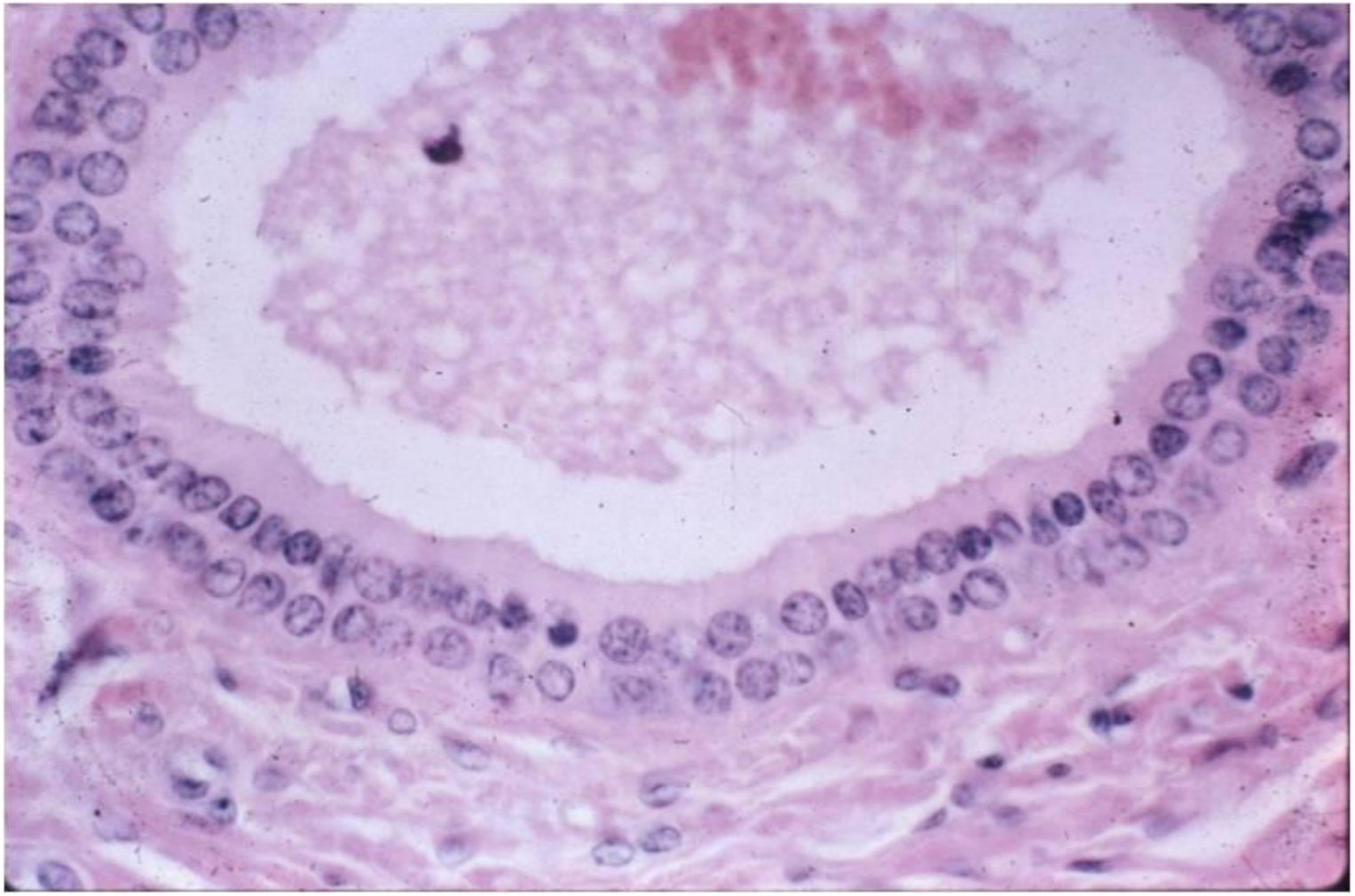
Core Knowledge

Stratified Squamous Epithelium



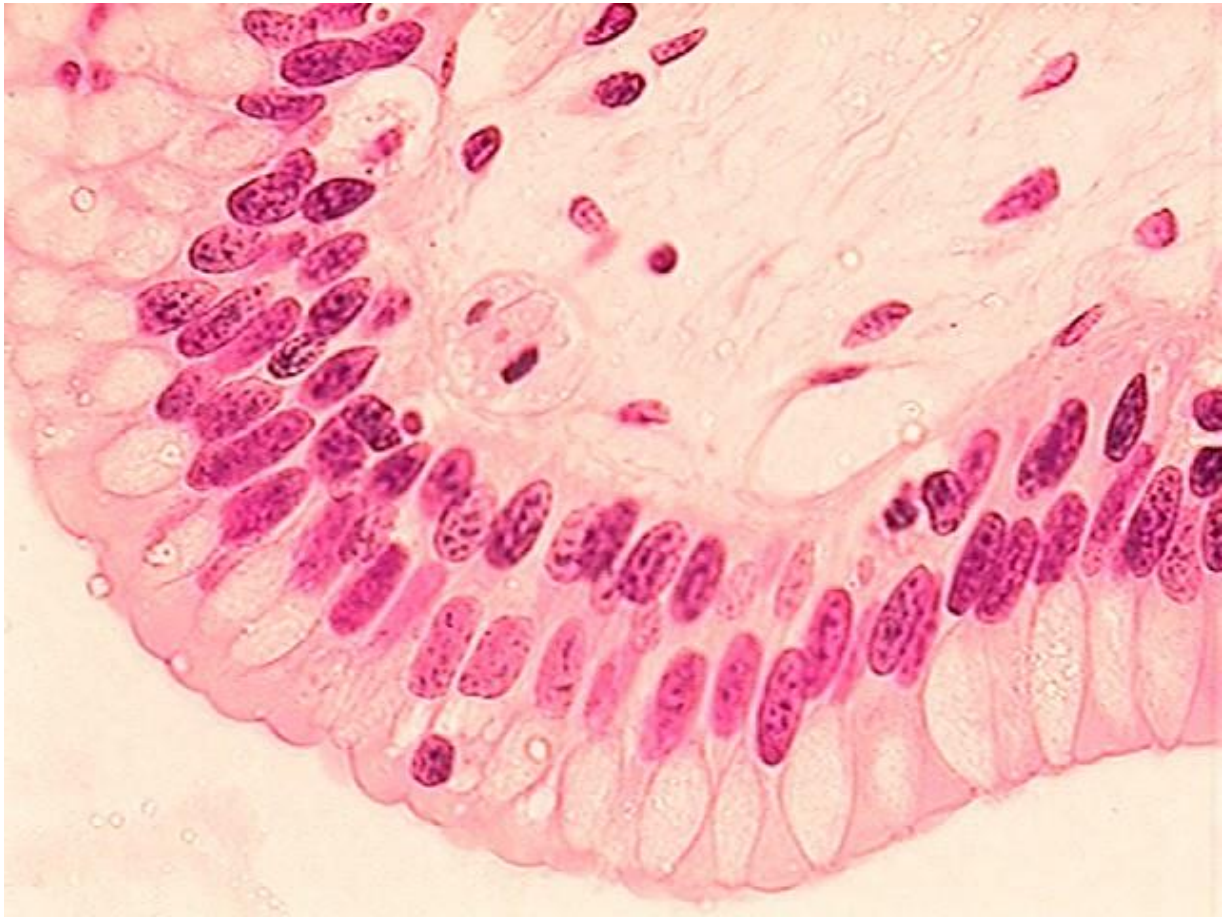
Core Knowledge

Stratified Cuboidal Epithelium



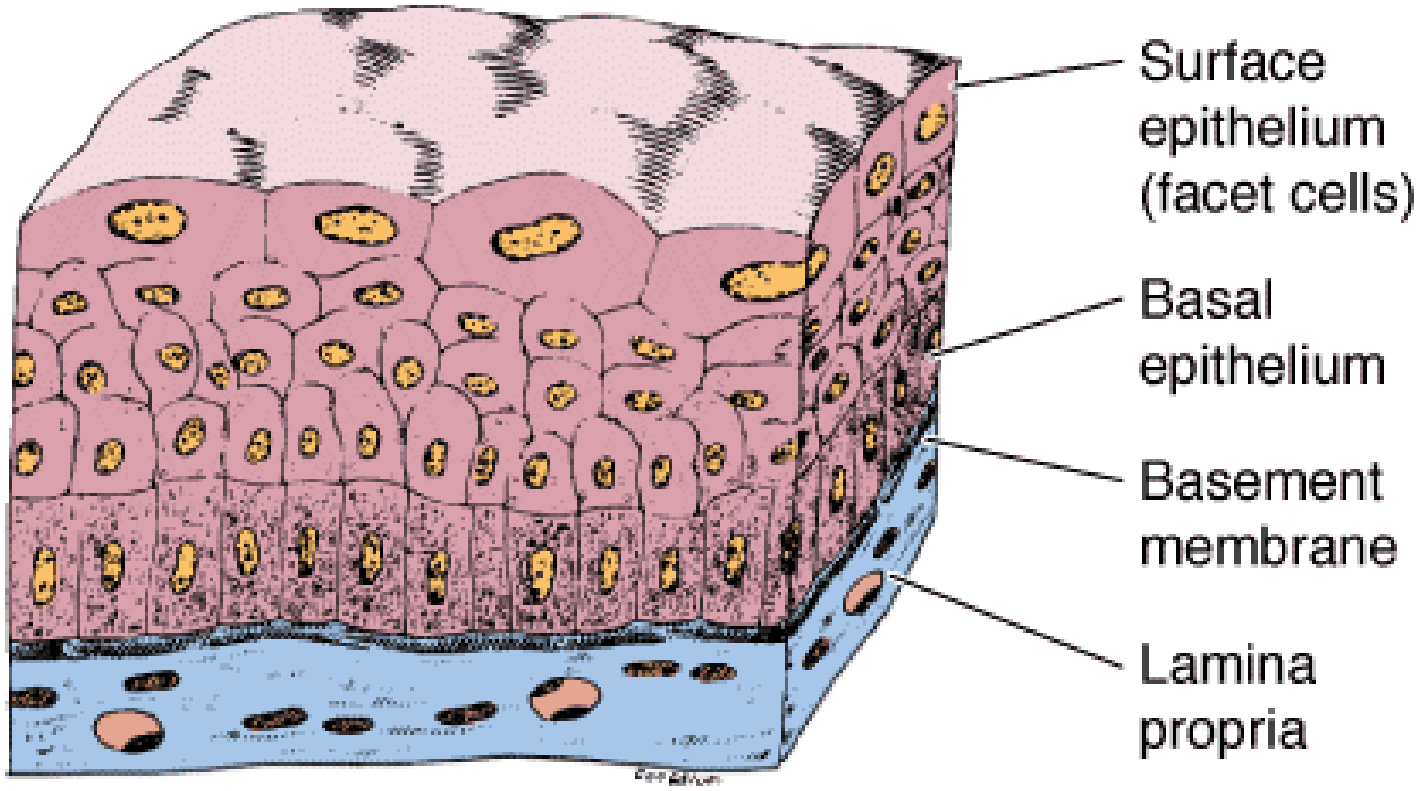
Core Knowledge

Stratified Columnar Epithelium



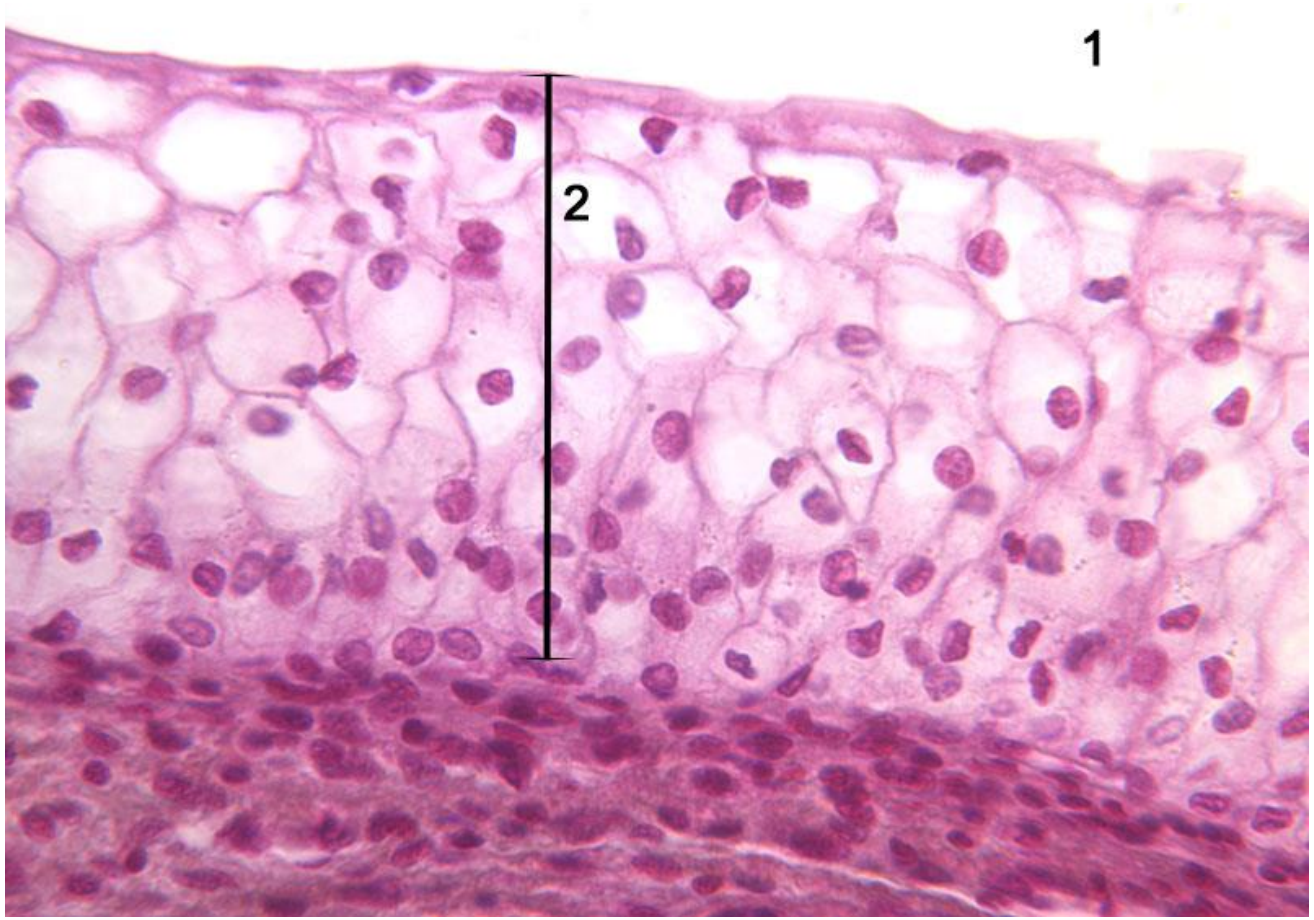
Core Knowledge

Urothelium



Core Knowledge

Urothelium



Bio-physiological Aspects of Epithelium

- Epithelium is an avascular tissue
- cell junctions
- free surface or apical domain, a lateral domain, and a basal domain
- Epithelium creates a selective barrier between the external environment and the underlying connective tissue

Vertical Integration

linteractive Session

- Epithelial metaplasia
- conversion of one epithelial type to another in response to stimuli
- Adaptive response to stimuli or stress
- **squamous metaplasia** frequently occurs in the pseudostratified respiratory epithelium of the trachea and bronchi in response to prolonged exposure to cigarette smoke

Bioethical Principals Related To Pulmonary Metaplasia

- **Informed Consent:**
Patients diagnosed with pulmonary metaplasia should be fully informed about the condition
- **Autonomy:**
Patients have the right to make decisions about their care, including whether to undergo interventions.
- **Non-Maleficence:**
Clinicians must avoid harm by ensuring accurate diagnosis and recommending interventions that prevent further damage to lung tissue, such as lifestyle changes or medications.

Public Health Responsibility:
Given the link between smoking and metaplasia, there is a duty to advocate for tobacco control policies and education to reduce exposure and prevent disease at a population level.

Role of AI in Pulmonary Metaplasia

- AI can potentially aid in **enhancing diagnostic accuracy and efficiency.**
- AI-powered decision support systems can also help clinicians in **selecting appropriate treatment modalities**
- AI-driven predictive models may help **anticipate the risk of Pulmonary Metaplasia** in susceptible populations

Squamous Metaplasia Is Increased in the Bronchial Epithelium of Smokers with Chronic Obstructive Pulmonary Disease

- Helen M. Rigden,[1] Ahmad Alias,[1] Thomas Havelock,[1,2] Rory O'Donnell,[1] Ratko Djukanovic,[1,2] Donna E. Davies,[1,2] and Susan J. Wilson
- https://pubmed.ncbi.nlm.nih.gov/?term=Wilson%20SJ%5BAuthor%5D

The extent of squamous metaplasia was significantly increased in both COPD1 and COPD2 compared to healthy smokers and healthy non-smokers. The amount of fully differentiated squamous epithelium was also increased in COPD1 and COPD2 compared to healthy non-smokers, as was the expression of carcinoembryonic antigen

How To Access Digital Library

- **Steps to Access HEC Digital Library**

a) Go to the website of HEC National Digital Library
b) On Home Page, click on the INSTITUTES
c) A page will appear showing the universities from Public and Private Sector and other Institutes which have access to HEC National Digital Library HNDL
d) Select your desired Institute
e) A page will appear showing the resources of the institution
f) Journals and Researches will appear
g) You can find a Journal by clicking on JOURNALS AND DATABASE and enter a keyword to search for your desired journal

Learning Resources

- Junqueira’s Basic Histology 12th Edition, Chapter 4
- Histology , A text and Atlas by Michael H.Ross 7th Edition, Chapter 5
- DiFiore's Atlas of Histology with Functional Correlations 11th Edition, Chapter 2
- Google scholar