MU-Varna Cytology • EPITHELIAL TISSUE

Exam-perfect chapter summary aligned to MU-Varna Cytology exam logic and audited against the epithelial-related questions in your pool. Focus: classification rules, basement membrane, junction-to-cytoskeleton mapping, apical specializations, glandular epithelium axes, and classic “EXCEPT” traps.

How to avoid losing points

Use this on every epithelial MCQ

Classification-first answering

Always classify by: **number of layers** → **shape of surface cells** → **specializations** (cilia, microvilli/brush border, keratin, dome “umbrella” cells).

EXCEPT pattern (MU-Varna style)

The wrong option is usually a **true concept placed in the wrong tissue, location, or axis**: e.g., “blood vessels pass through basal lamina”, “microtubules in microvilli”, “gap junction linked to cytoskeleton”.

I. Core properties of epithelial tissue

Polarity • avascularity • regeneration

Definition & organization

- Sheets of **closely apposed cells** with **minimal extracellular matrix**.
- Cover surfaces (covering epithelium) or form secretory units (glandular epithelium).
- **Polarity:** apical, lateral, and basal domains differ in structure and function.
- High **renewal capacity** via basal stem/progenitor cells.

Supply & what epithelium cannot do (tested)

- **Avascular:** no blood vessels within the epithelium itself.
- Nutrients/oxygen by **diffusion** from underlying connective tissue.
- **Innervation may be present** (nerve fibers can penetrate epithelium).
- **Not a contractile tissue** (EXCEPT trap).

MU-VARNA TRAPS

- "Epithelial tissue contracts" is **FALSE**.
- "Blood vessels pass through basal lamina into epithelium" is **FALSE**.

II. Basement membrane

Basal lamina • reticular lamina • anchoring

Composition (exam precision)

- **Basement membrane** = **basal lamina** + **reticular lamina**.
- **Basal lamina** is produced by **epithelial cells** (key molecules: laminin, type IV collagen).
- **Reticular lamina** is produced by **connective tissue** (reticular fibers: type III collagen).
- **Type VII collagen** forms **anchoring fibrils** linking the layers.

Functions

- Mechanical support and tissue compartmentalization.
- Maintains epithelial polarity.
- Selective filtration (important concept in specialized epithelia).
- Scaffold for regeneration after injury.

EXCEPT TRAP (tested)

- Keratinizing stratified squamous epithelium does **not** have “openings” in basal lamina for blood vessels.

III. Cell junctions & cytoskeleton mapping

Zonula occludens • zonula adherens • desmosomes • hemidesmosomes • focal adhesions • gap junctions

Junction	Type	Main proteins	Cytoskeleton link (tested)	Core function
Tight junction (zonula occludens)	Cell–cell	Claudins, occludin	—	Seal; blocks paracellular flow; polarity barrier
Adherens junction (zonula adherens)	Cell–cell	Cadherins	**Actin filaments**	Mechanical coupling (“belt”)
Desmosome (macula adherens)	Cell–cell	Desmoglein/desmocollin	**Intermediate filaments (keratin)**	Strong adhesion (“spot weld”)
Hemidesmosome	Cell–matrix	Integrins	**Intermediate filaments**	Anchors epithelium to basal lamina
Focal adhesion	Cell–matrix	Integrins	**Actin filaments**	Dynamic adhesion, migration, mechanosensing
Gap junction (nexus)	Cell–cell	Connexins → connexons	**No cytoskeleton association**	Intercellular communication (ions/small molecules)

MU-VARNA “EXCEPT” LOCK

- “All junctions are associated with the cytoskeleton EXCEPT …” → **Gap junction (nexus)**.
- “Which junction allows easiest passage from cell to cell?” → **Gap junction**.
- Hemidesmosomes are situated in the **basal area** of epithelial cells.

IV. Apical specializations

Microvilli • brush border • stereocilia • cilia • axoneme (9+2)

Specialization	Cytoskeleton	Function	High-yield location
Microvilli	**Actin**	Increase surface area (absorption)	Intestinal epithelium; kidney proximal tubules
Brush border (LM equivalent)	**Microvilli**	Light microscope appearance of dense microvilli	Enterocytes
Stereocilia	**Actin**	Absorption/sensory; long microvilli-like	Epididymis
Cilia	**Microtubules** (axoneme 9+2)	Motile transport of fluid/mucus	Trachea/respiratory epithelium

LOCALIZATION TRAP (tested)

- Microtubules can be localized in **cytosol**, **centrosomes**, **cilia**, **flagella** — but **not** in microvilli.

Clinical anchor

A genetic defect of the motor protein **dynein** (cilia) is linked to **Kartagener syndrome**.

V. Classification of covering epithelium

Simple • stratified • pseudostratified • transitional

Rule (must memorize)

Epithelium is classified by **number of layers** and **shape of surface cells** (not basal cells).

Type	Definition	High-yield location	Main function
Simple squamous	One layer of flat cells	Endothelium, mesothelium, alveoli	Diffusion/filtration
Simple cuboidal	One layer of cube cells	Kidney tubules, ducts, thyroid follicles	Secretion/absorption
Simple columnar	One layer of tall cells	Intestine (resorptive epithelium)	Absorption/secretion
Pseudostratified ciliated columnar	All cells touch basal lamina; nuclei at different heights	Trachea	Mucociliary clearance
Stratified squamous (non-keratinized)	Many layers; surface squamous; no keratin	Oral cavity, esophagus	Protection from abrasion
Stratified squamous (keratinized)	Surface anuclear keratin layer	Epidermis	Protection + water barrier
Transitional (urothelium)	Special stratified epithelium with dome surface cells	Urinary system (kidney pelvis, ureter, bladder, urethra)	Stretch/distension

BIG MU-VARNA TRAP

- "Which statement about stratified epithelium is TRUE?" → **None of the answers are true** (common exam format).
- Pseudostratified epithelium is **not** stratified (it is **simple**).

Transitional epithelium (tested phrases)

Found only in **urinary system**, adapts to **stretch**, outermost layer has **dome-shaped** cells.

LOCATION FACT (tested)

- Stratified cuboidal epithelium is found in **larger ducts of exocrine glands**.

VI. Glandular epithelium (3 independent classification axes)

Destination • number of cells • secretory product • secretion mechanism • duct architecture

Axis 1: Destination of secretion

- **Exocrine:** via ducts to a surface/lumen.
- **Endocrine:** directly into **blood** (no ducts).
- **Mixed:** both endocrine + exocrine (e.g., pancreas).

Axis 2: Number of cells

- **Unicellular** (e.g., goblet cell).
- **Multicellular**.

Axis 3: Secretory product (exocrine)

- **Serous** (watery, protein-rich).
- **Mucous** (mucins, viscous).
- **Mixed** (serous + mucous).

EXAM ANCHOR

- **Giannuzzi demilunes** are typical for **mixed acini**.
- "Purely serous gland" (tested example) → **Lacrimal gland**.

Axis 4: Mode of secretion

- **Merocrine:** via exocytosis.
- **Apocrine:** apical cytoplasm loss with secretion.
- **Holocrine:** whole secretory cell is released.

Duct architecture (exocrine)

- **Simple glands:** unbranched duct.
- **Compound glands:** branched duct system.

TESTED PHRASE

- Compound glands have a **branched system of main "exit" ducts**.
- Intraepithelial glands are **exocrine**.

Shape of secretory portion

- **Tubular**, **acinar (alveolar)**, **tubuloacinar**.

TESTED WORDING

- “According to the shape of the secretory portion …” → **acinar** is a key category.

Endocrine cells — where the secretory product goes

In endocrine glands, the secretory product is released **directly into the blood** (no ducts).

VII. Embryologic origin of epithelia (high-yield mapping)

Endoderm • ectoderm • mesoderm

Germ layer	High-yield epithelial derivatives (tested patterns)
Endoderm	Epithelium of GI tract, liver, pancreas, lungs; thyroid epithelium
Surface ectoderm	Epidermis; hair, nails, cutaneous glands
Intermediate mesoderm	Urogenital epithelium
Somatopleuric lateral plate mesoderm	Serous membranes: pleura, pericardium, peritoneum

Audit note: This summary is source-locked to your chapter material and explicitly completed using the epithelial-related MU-Varna question patterns in your pool (junction mapping, stratified “NONE true” trap, basal lamina blood vessel trap, gland axes, and germ-layer epithelial origins).