Histology — tissues · Lab 1

Epithelial tissue

When	Monday 12 October 2026, 11:30–13:00
Room	A5/018
Teacher	dr hab. prof. UR Agata Wawrzyniak
Group	Lab group 2
Same day	Lecture 1, 08:00–09:30, A5/4: Microscopy

What the lab covers

Epithelial tissue: its classification, structure and examples. The syllabus lists the simple epithelia (squamous, cuboidal, columnar, ciliated pseudostratified) and the stratified ones (squamous, transitional, columnar).

How it is graded

- Recognising histological slides
- Attendance
- Two tests (at least 15 single- or multiple-choice questions each, one resit) and a practical in the winter semester
- A correctly completed exercise notebook
- Activity

The final practical exam: 15 slides under the microscope, a minute each, 60% to pass.

Bring: the exercise notebook (it is graded)

In this pack

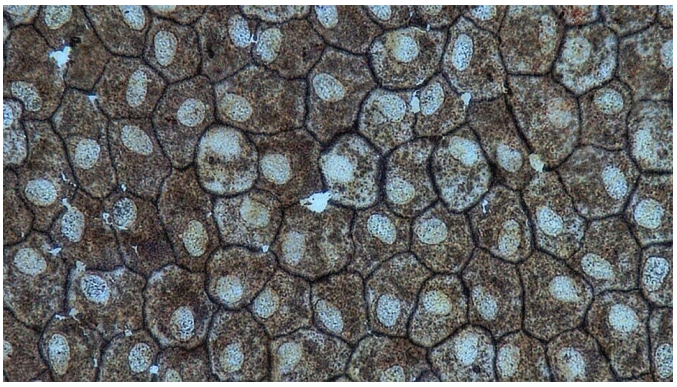
1	Recognising the slides (6)	page 2
2	Practice figures: name each numbered structure (6)	page 6
3	Key points	page 12
4	Light-microscope checklist	page 13
5	Self-test: 20 single-choice questions	page 14
	Answers: practice figures	page 16
	Answers: self-test	page 16

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1 · Recognising the slides

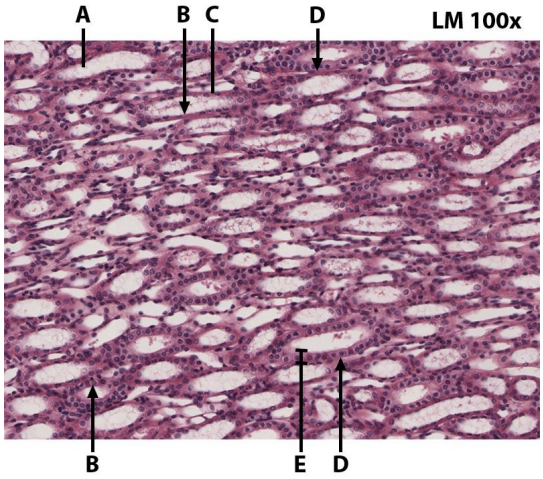
Each epithelium as the Slide Box shows it: its slides, how to recognise it, and what not to confuse it with. Test yourself online: medicine.kazimiri.com/semester-1/slides/?lab=1&m=test

Simple squamous epithelium · nabłonek jednowarstwowy płaski



Simple squamous epithelium in surface view (whole mount, 400x): flat polygonal cells fitted edge to edge, one nucleus each.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Epithelial_Tissues_Simple_Squamous_Epithelium_(41722161301).jpg



Real slide (100x): simple squamous and simple cuboidal epithelium side by side, each lining a lumen.

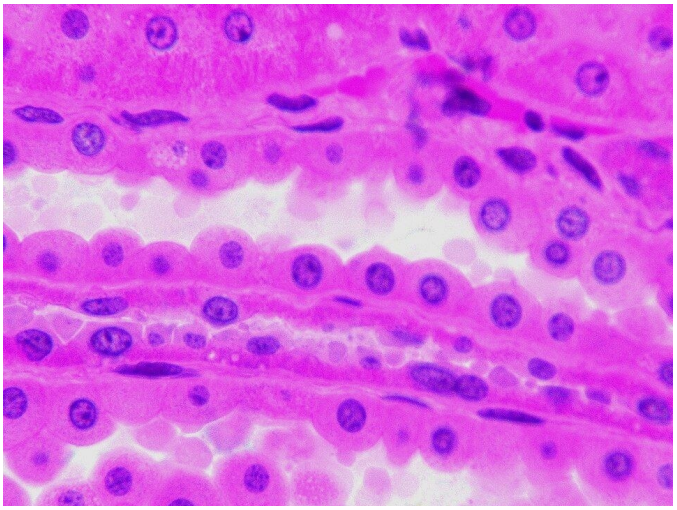
Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

How to recognise it

- One layer of flat cells; the nuclei are flattened and bulge into the lumen.
- In surface view (a whole mount of mesothelium), the cells fit together like polygonal paving stones.
- Lines blood vessels (endothelium), body cavities (mesothelium) and lung alveoli.

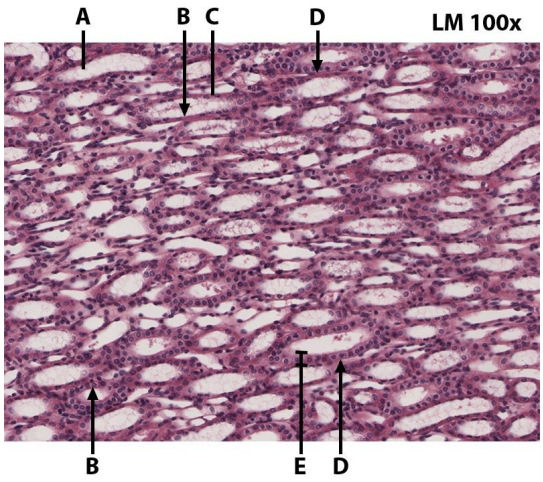
Don't confuse with: Flattened fibroblasts: these lie inside connective tissue and do not line a surface.

Simple cuboidal epithelium · nabłonek jednowarstwowy sześcienny



Simple cuboidal epithelium: one layer of cells about as tall as they are wide, each with a round central nucleus.

Echinaceapallida · CC BY-SA 4.0 · commons.wikimedia.org/wiki/File:Epith_simple_cuboidal4.jpg



Real slide (100x): simple squamous and simple cuboidal epithelium side by side, each lining a lumen.

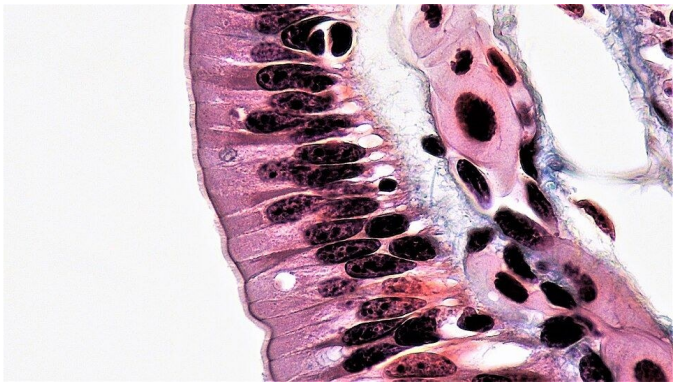
Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

How to recognise it

- One layer of cells about as tall as they are wide.
- Round, central, evenly spaced nuclei.
- Usually rings of cells round a lumen: kidney tubules, thyroid follicles, small ducts.

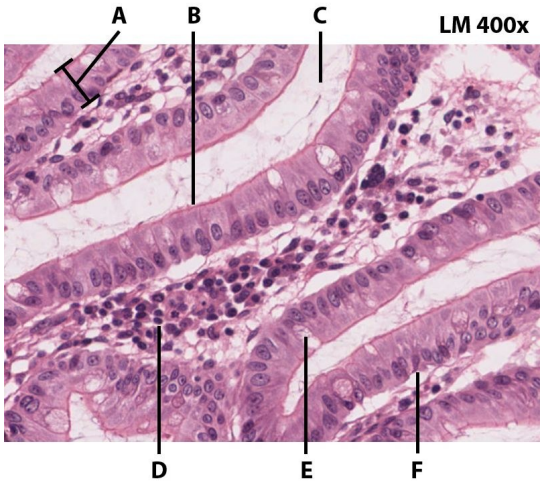
Don't confuse with: Simple columnar: taller cells with oval nuclei near the base.

Simple columnar epithelium · nabłonek jednowarstwowy walcowaty



Simple columnar epithelium lining mammalian gut (400x): one layer of tall cells with their nuclei in a row near the base.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Epithelial_Tissues_Simple_Columnar_Epithelium_(27854452618).jpg



Real slide (400x): simple columnar epithelium with goblet cells, over the connective tissue of the lamina propria.

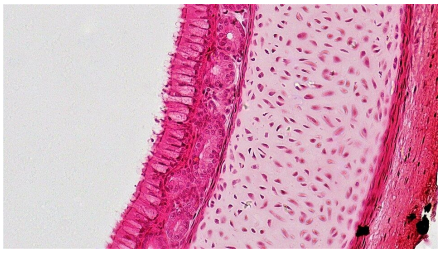
Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

How to recognise it

- One layer of tall cells; oval nuclei lined up in a row near the base.
- In the intestine: a pink brush (striated) border at the surface and pale goblet cells between.
- Stomach, intestines, gallbladder, uterine tube (there with cilia).

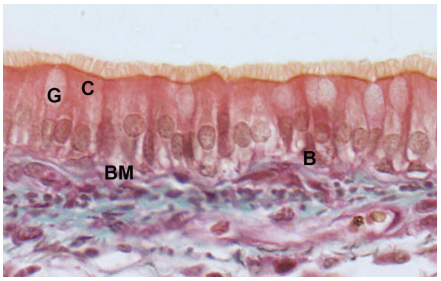
Don't confuse with: Pseudostratified: its nuclei sit at several heights.

Pseudostratified ciliated columnar epithelium · nabłonek wielorzędowy migawkowy



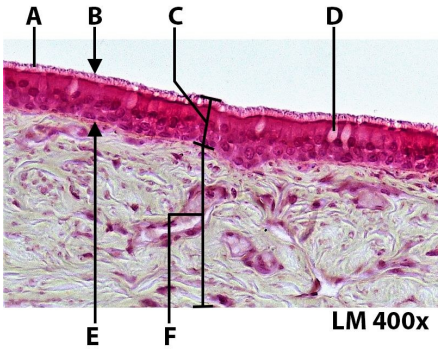
Pseudostratified ciliated columnar epithelium of the trachea (200x): nuclei at several levels but every cell on the basement membrane; hyaline cartilage deep to it.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Epithelial_Tissues_Pseudostratified_Columnar_Epithelium_(41783111911).jpg



Respiratory epithelium of the trachea (Masson's trichrome): ciliated cells (C), goblet cells (G) and basal cells (B) on the basement membrane (BM).

John.devos · CC BY-SA 4.0 · commons.wikimedia.org/wiki/File:Masson%27s_trichrome_staining_of_the_Human_trachea.jpg



Real slide (400x): pseudostratified columnar epithelium with cilia and goblet cells, on its basement membrane.

Jennifer Lange; micrograph: Berkshire Community College Bioscience Image Library (public domain) · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

How to recognise it

- Nuclei at different heights, so it looks layered, yet every cell touches the basement membrane.
- Cilia along the free surface; pale goblet cells between the ciliated cells.
- A thick basement membrane deep to it; seromucous glands and cartilage deeper in the trachea.

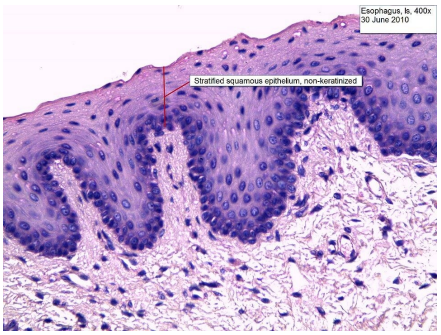
Don't confuse with: Stratified epithelium: no cilia, no goblet cells, and a flattened surface layer.

Stratified squamous epithelium · nabłonek wielowarstwowy płaski



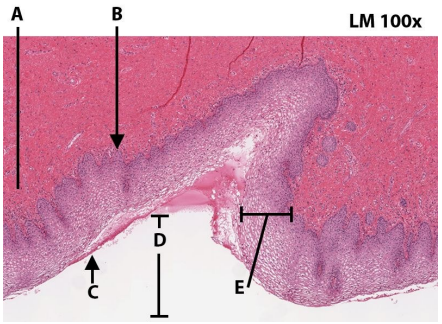
Stratified squamous epithelium (400x): many layers, cuboidal at the base and flattened towards the surface.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Epithelial_Tissues_Stratified_Squamous_Epithelium_(41994232802).jpg



Oesophagus (400x): non-keratinised stratified squamous epithelium over the lamina propria.

Nva1991 · CC BY-SA 3.0 · commons.wikimedia.org/wiki/File:Thuc_quan.jpg



Real slide (100x): stratified squamous epithelium, many layers thick, over the lamina propria.

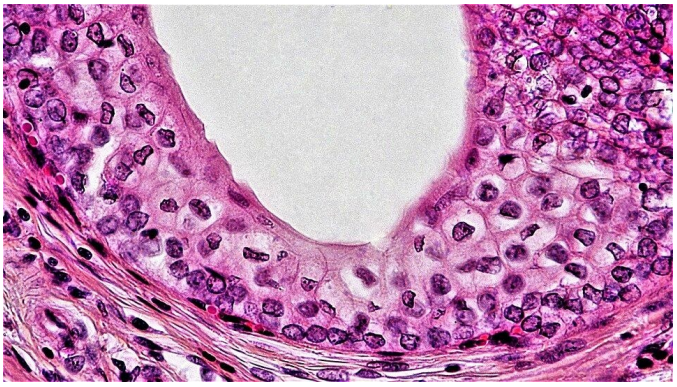
Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

How to recognise it

- Many layers: cuboidal cells at the base, flatter and flatter towards the surface.
- Non-keratinised (oesophagus, vagina, cornea): the surface cells keep their nuclei.
- Keratinised (skin): a superficial layer of anucleate keratin, with a granular layer deep to it.
- The base is wavy where connective tissue papillae push up into it.

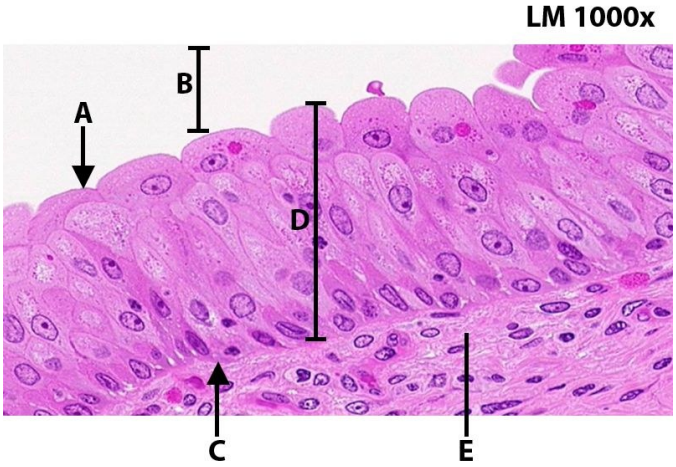
Don't confuse with: Transitional epithelium: dome-shaped surface cells instead of flat ones.

Transitional epithelium (urothelium) · nabłonek przejściowy (urotelium)



Transitional epithelium (urothelium) of the urinary bladder (400x): several layers, with large rounded "umbrella" cells at the surface.

Berkshire Community College Bioscience Image Library · CC0 · commons.wikimedia.org/wiki/File:Epithelial_Tissues_Transitional_(27025225607).jpg



Real slide (1000x): transitional epithelium, its surface cells large and rounded, over the lamina propria.

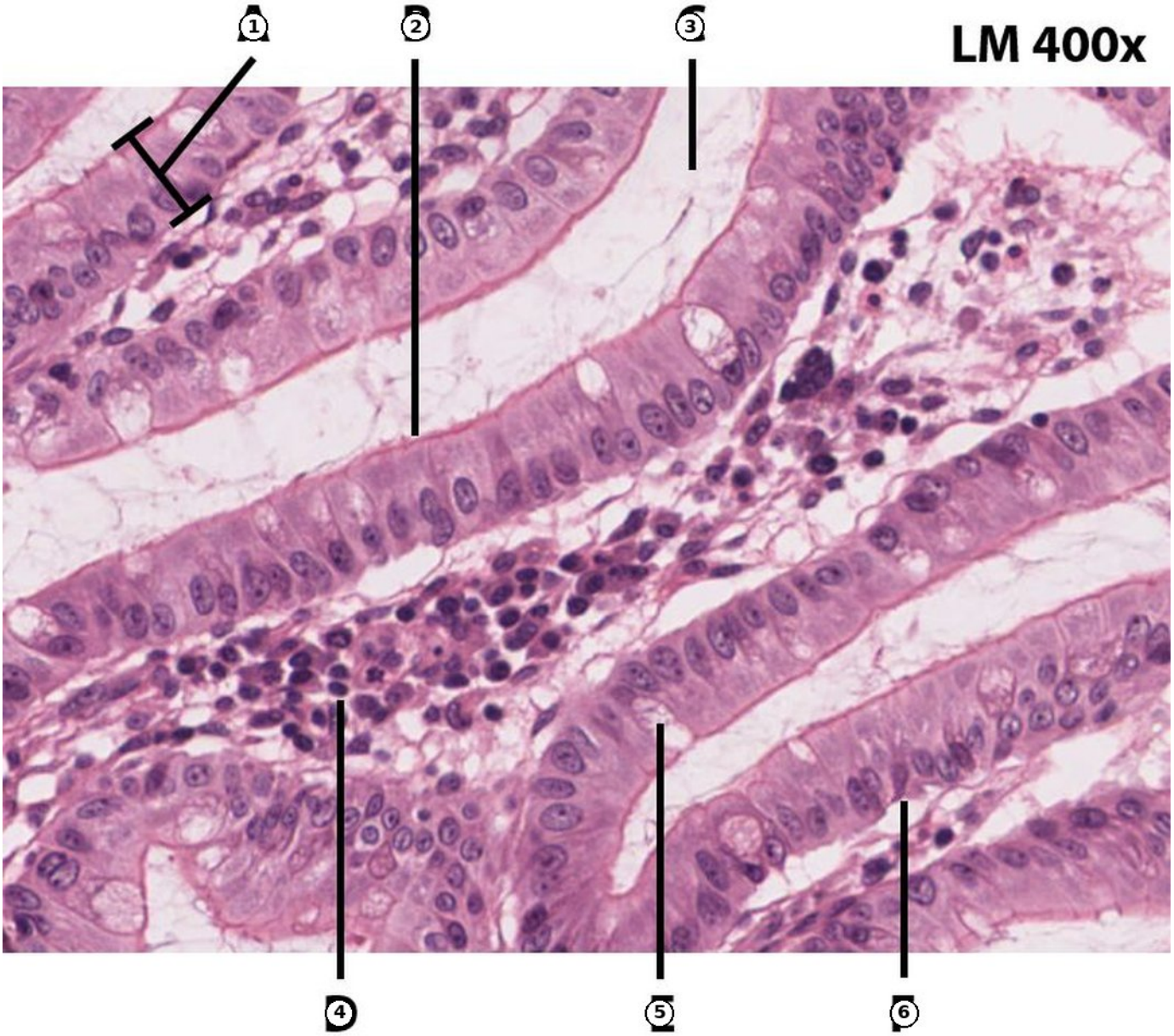
Jennifer Lange; slide: Regents of the University of Michigan Medical School · CC BY-NC-SA 4.0 · med.libretexts.org/Bookshelves/Anatomy_and_Physiology/Human_Anatomy_(Lange_et_al.)/03%3A_Tissue_Level_of_Organization/3.08%3A_Anatomical_Atlas_-_Tissues

How to recognise it

- Several layers; large dome-shaped "umbrella" cells on the surface, some with two nuclei.
- Surface cells are rounded when the bladder is empty and flatter when it is stretched.
- Lines the urinary tract only: renal pelvis, ureter, bladder, first part of the urethra.

Don't confuse with: Stratified squamous: its surface cells are flat.

A lining of tall cells, on a real slide



1 _____ **2** _____

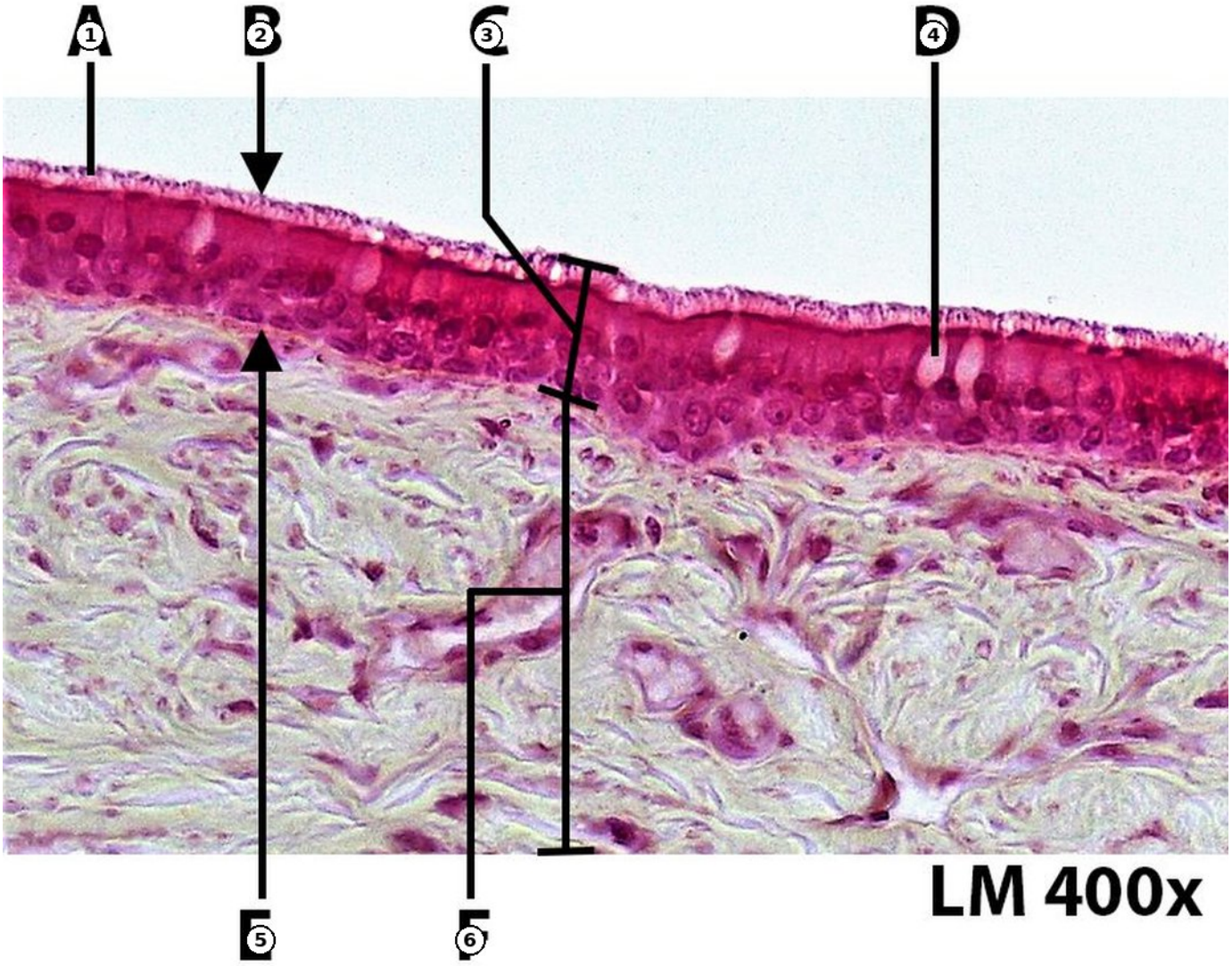
3 _____ **4** _____

5 _____ **6** _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-66b8712a4d

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A lining with nuclei at many levels, on a real slide



1 _____ **2** _____

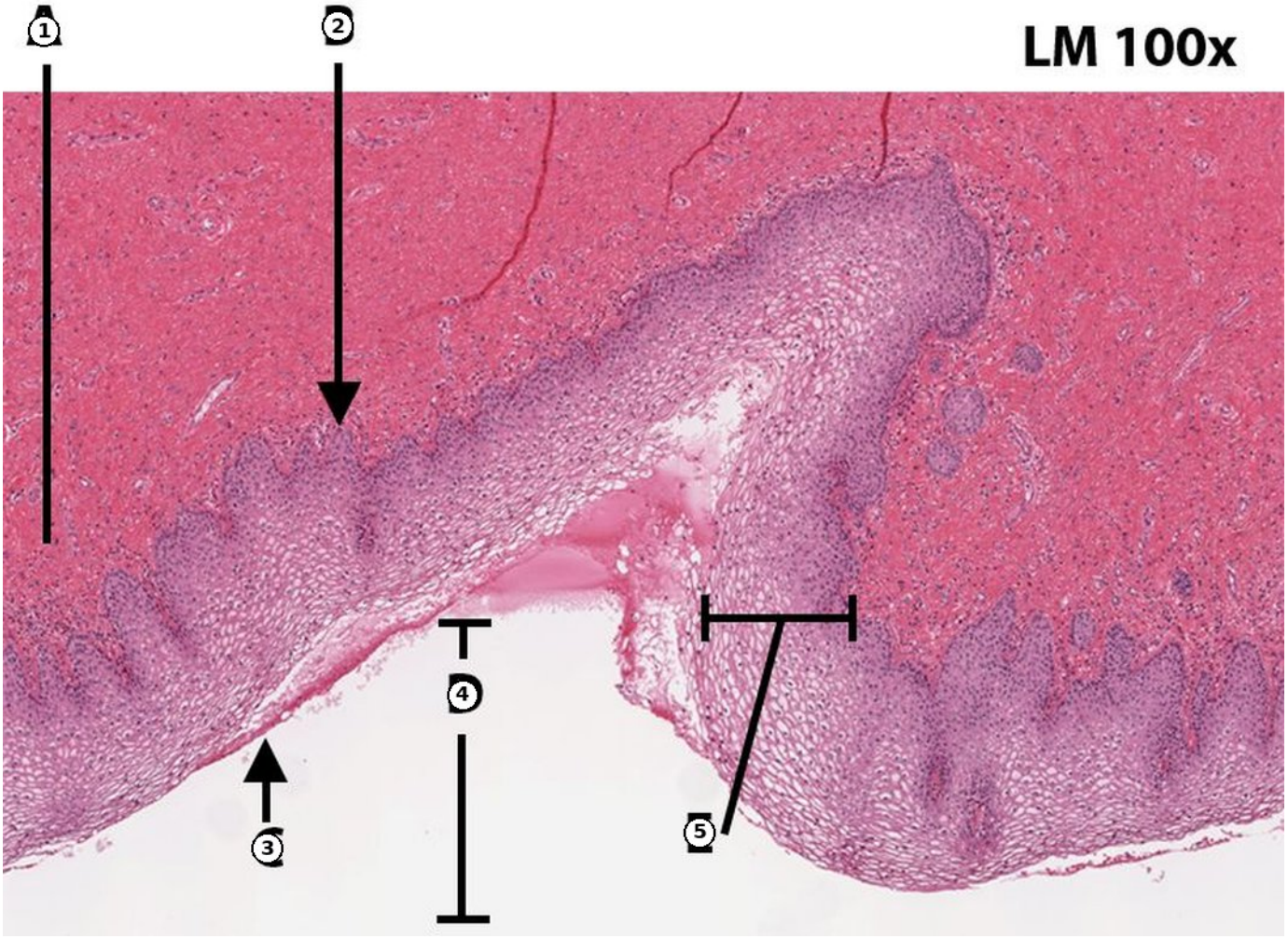
3 _____ **4** _____

5 _____ **6** _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-7a206ef6dd

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A many-layered lining, on a real slide



1 _____ **2** _____

3 _____ **4** _____

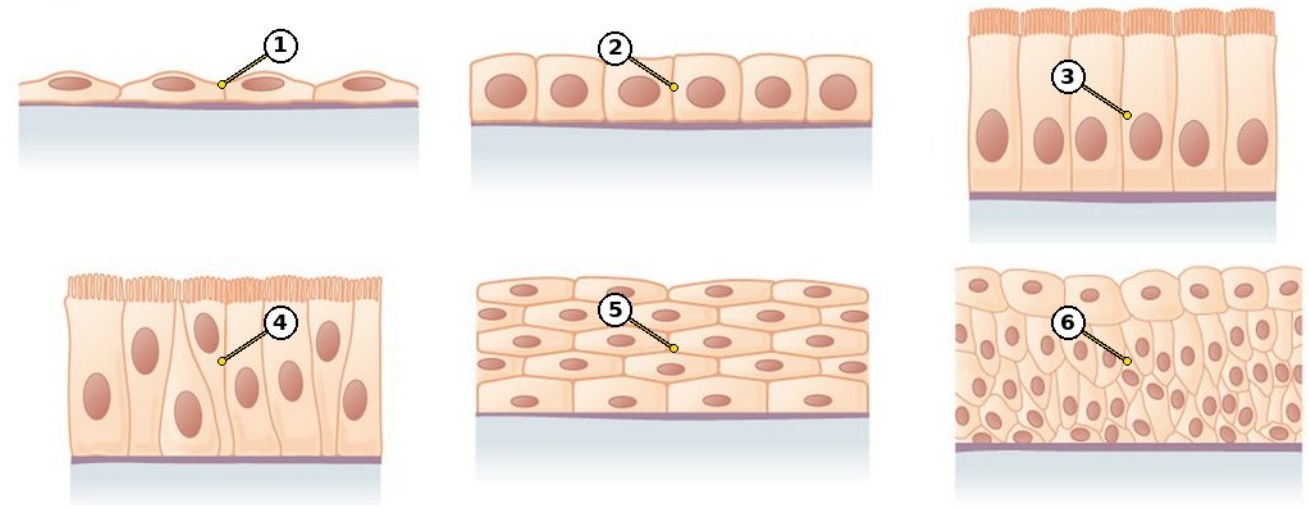
5 _____

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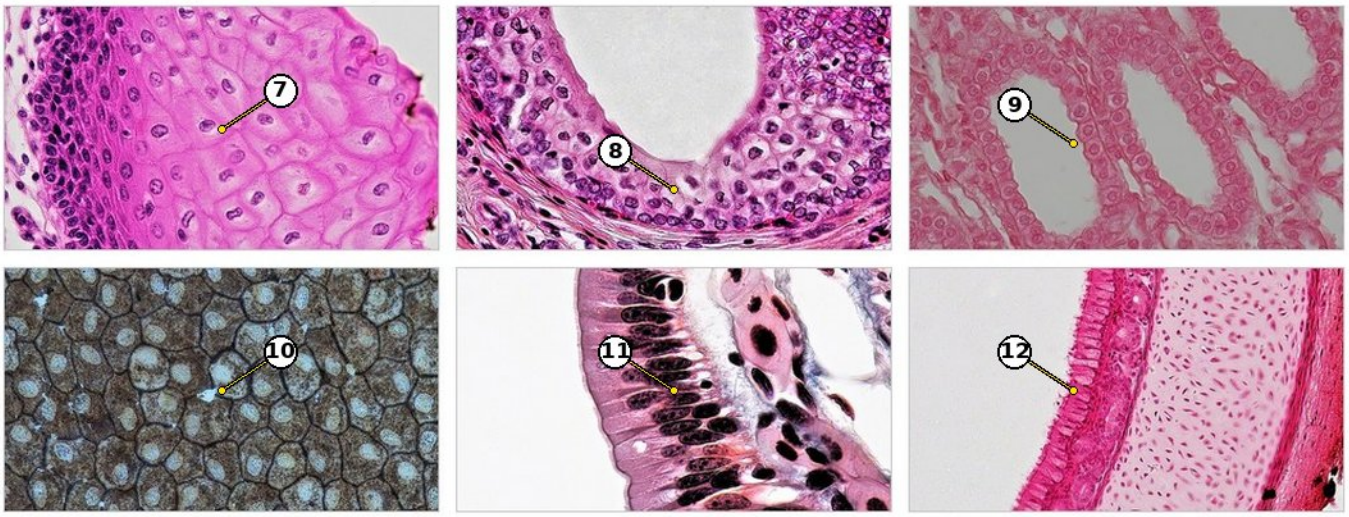
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Six epithelia, drawn and on real slides

Drawn



Real slides (light microscope)



1 _____ **2** _____

3 _____ **4** _____

5 _____ **6** _____

7 _____ **8** _____

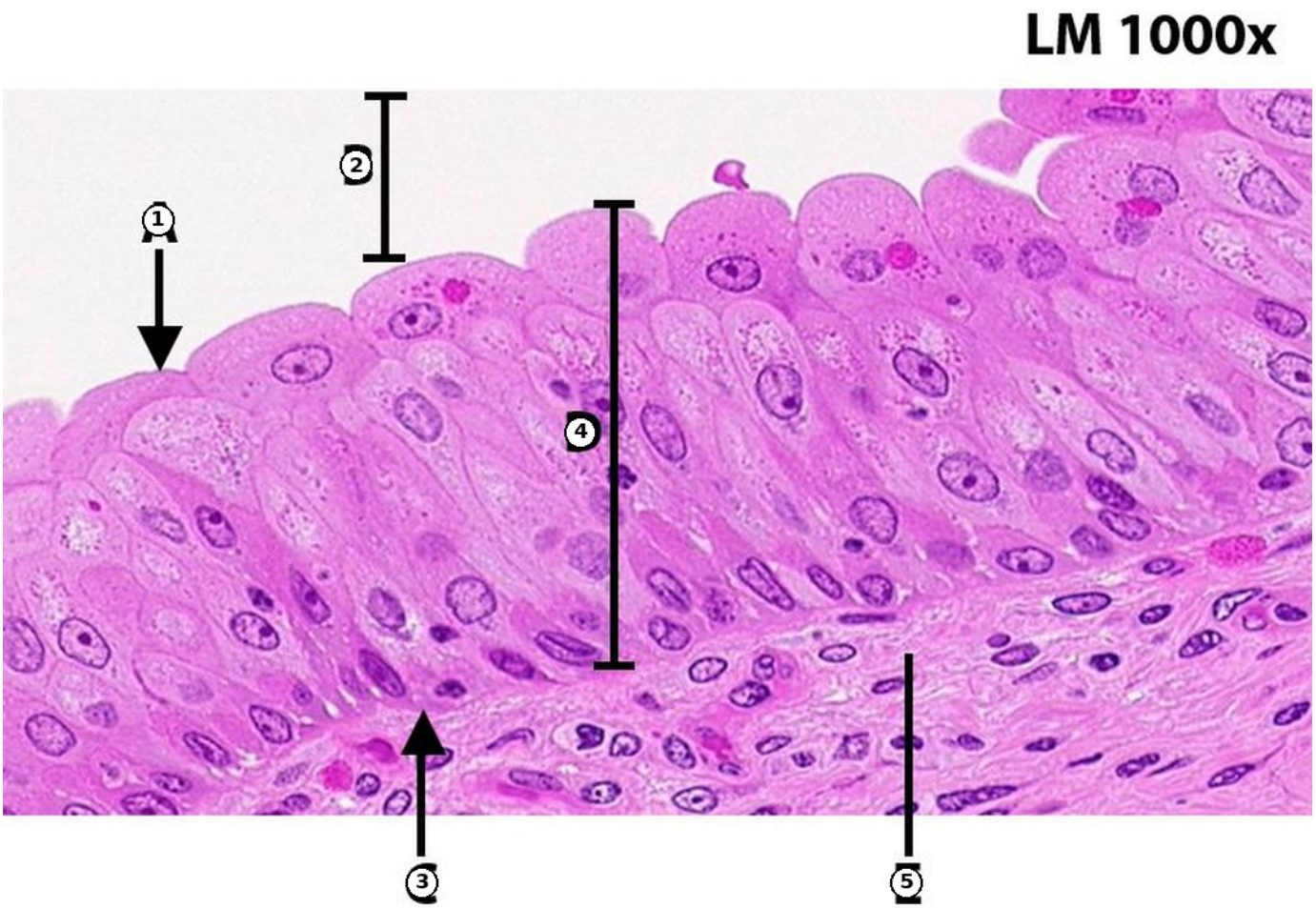
9 _____ **10** _____

11 _____ **12** _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-pair-epithelia

Credit: Drawings: OpenStax College (CC BY 3.0); slides: Berkshire Community College Bioscience Image Library (CC0) · CC BY 3.0 · commons.wikimedia.org/wiki/File:403_Epithelial_Tissue.jpg

The lining that stretches, on a real slide



1 _____ **2** _____

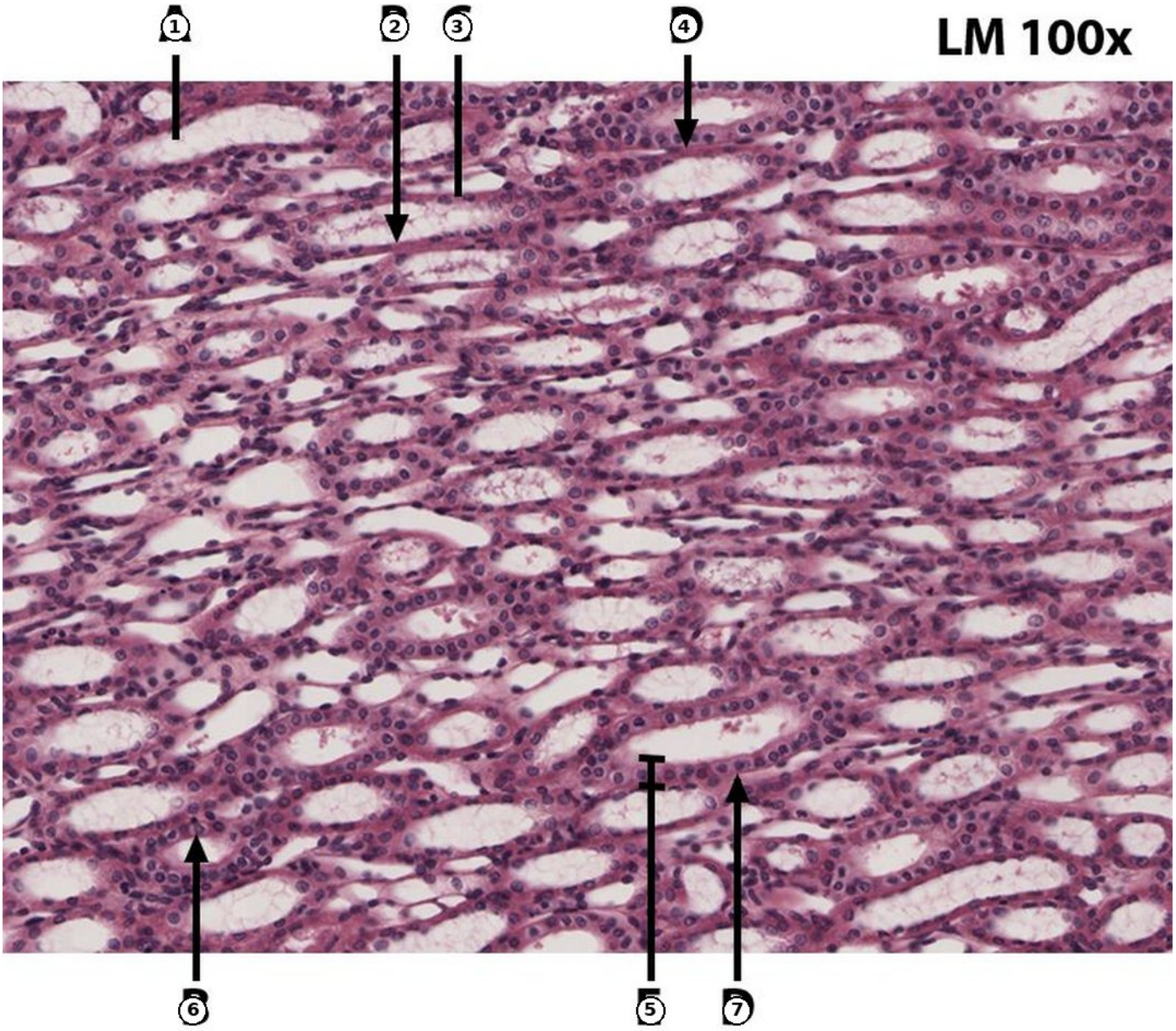
3 _____ **4** _____

5 _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-7eaa6b0dc8

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Two single-layer epithelia, on a real slide



1 _____ **2** _____

3 _____ **4** _____

5 _____ **6** _____

7 _____

Practise online: medicine.kazimiri.com/semester-1/label/?map=subj-histology-5a3460f220

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3 · Key points

The site's key points for these classes, word for word.

Lecture 1 · Monday 12 October, 08:00–09:30, A5/4 · Microscopy

Microscopy

- Light microscope resolves about 0.2 µm; the transmission electron microscope about 3 nm on biological samples (Junqueira; other books give 1-2 nm); SEM shows surfaces.
- Phase contrast shows living, unstained cells; fluorescence and confocal microscopy show labelled molecules.
- Resolution d = 0.61λ / NA. Immersion oil (n about 1.52) between the slide and the 100× objective raises the NA to about 1.4.
- Using the microscope: start at low power, centre the object, then go up; set the condenser and diaphragm; bring an objective near the slide while watching from the side, then focus by moving it away.
- Total magnification = objective × eyepiece (40 × 10 = 400×); magnifying beyond what the resolution supports adds no detail.
- Dark-field shows edges bright on black; polarised light shows birefringent structures (collagen, crystals, and amyloid, apple-green with Congo red).
- Newer methods: confocal and multiphoton microscopy (optical sections of thick tissue), super-resolution beyond the 0.2 µm limit (Nobel Prize 2014), cryo-electron microscopy (Nobel Prize 2017), and whole-slide digital scanning.

Lab 1 · Epithelial tissue

Epithelium

- Named by the number of layers (simple, stratified, pseudostratified) and by the shape of the surface cells (squamous, cuboidal, columnar); transitional = urothelium.
- Simple squamous: endothelium, mesothelium, alveoli. Simple cuboidal: kidney tubules, thyroid follicles. Simple columnar: stomach, intestine.
- Pseudostratified ciliated columnar with goblet cells: respiratory tract. Keratinised stratified squamous: epidermis; non-keratinised: oesophagus, mouth, vagina.
- Avascular, polarised, on a basement membrane. Glands secrete merocrine (most), apocrine or holocrine (sebaceous).
- Surface specialisations: microvilli (the striated border of the intestine and the brush border of the proximal kidney tubule: absorption), stereocilia (long microvilli of the epididymis and inner-ear hair cells), cilia (9+2, motile: trachea, uterine tube).
- The basement membrane is the basal lamina (collagen IV, laminin, made by the epithelium) plus a reticular lamina (collagen III, from the connective tissue). Epithelium has no vessels and is fed by diffusion through it.
- Exocrine glands by shape: simple or compound (branched ducts); tubular, acinar or tubuloacinar. By secretion: serous (watery, proteins: parotid, pancreas), mucous, or mixed (the sublingual mostly mucous, the submandibular mostly serous). The goblet cell is a one-cell gland.
- Myoepithelial cells around the acini and ducts of salivary, sweat and mammary glands contract to expel the secretion.
- Junctions of epithelial cells, apex to base: the tight junction (zonula occludens) seals the epithelium; the adherens junction and desmosomes (maculae adherentes) hold the cells together; gap junctions let ions pass between them; hemidesmosomes anchor the cell to the basal lamina.
- Epithelia renew quickly from stem cells (the intestinal lining about every week). Metaplasia is a change of type, like squamous metaplasia of the bronchi in smokers.

4 · Using the light microscope: checklist

- ☐ Carry the microscope with both hands, one on the arm and one under the base. Lamp at minimum before switching on.
- ☐ Start with the lowest-power objective (4× or 10×) clicked into place. Slide coverslip up, label to the side, held in the mechanical stage.
- ☐ Centre the section over the light with the naked eye first.
- ☐ Watching from the side, raise the stage close to the objective with the coarse focus. Then, looking through the eyepieces, focus by moving the stage AWAY from the objective. Set the eyepiece distance for your eyes.
- ☐ Light: lamp brightness and the condenser's aperture diaphragm. Close the diaphragm for more contrast, open it for more resolution.
- ☐ Higher power: turn the nosepiece; at 40× use the fine focus only.
- ☐ Oil immersion (100×), only when the teacher allows it: a drop of oil on the coverslip, swing in the 100× objective, fine focus only. Never let the 40× objective touch the oil. Wipe oil off the lens and the slide with lens paper afterwards.
- ☐ Total magnification = objective × eyepiece (40 × 10 = 400×). The light microscope resolves about 0.2 µm.
- ☐ At the end: lowest objective in place, stage down, slide out, lamp at minimum and off, dust cover on.

5 · Self-test: 20 single-choice questions

From the site's Histology — tissues quiz (Microscopy, Epithelium). One answer is right in each; circle it. Give yourself about a minute a question. The answers are on the last page.

1. Immersion oil is used to:

- **A** clean the lens
- **B** raise the numerical aperture, and so the resolution, of the 100× objective
- **C** stain the section
- **D** magnify beyond the eyepiece

2. Which epithelium lines the oesophagus?

- **A** non-keratinised stratified squamous
- **B** simple columnar
- **C** keratinised stratified squamous
- **D** transitional

3. A 40× objective with a 10× eyepiece gives a total magnification of:

- **A** 50×
- **B** 4000×
- **C** 40×
- **D** 400×

4. Goblet cells secrete:

- **A** surfactant
- **B** mucus
- **C** lysozyme
- **D** bile

5. Living, unstained cells are best seen with:

- **A** transmission electron microscopy
- **B** polarised light
- **C** phase contrast microscopy
- **D** H&E staining

6. The parotid gland is:

- **A** purely mucous
- **B** mixed, mostly mucous
- **C** endocrine
- **D** purely serous

7. Amyloid stained with Congo red shows, in polarised light:

- **A** red fluorescence
- **B** no colour
- **C** apple-green birefringence
- **D** blue-black staining

8. In smokers the bronchial lining may turn into:

- **A** transitional epithelium
- **B** simple cuboidal epithelium
- **C** ciliated columnar epithelium
- **D** stratified squamous epithelium (metaplasia)

9. Polarised light microscopy shows:

- **A** living, unstained cells best
- **B** fluorescent labels
- **C** birefringent structures, such as collagen and crystals
- **D** surfaces in 3D

10. Transitional epithelium (urothelium) lines the:

- **A** urinary bladder
- **B** oesophagus
- **C** trachea
- **D** small intestine

11. Magnifying beyond what the resolution supports:

- **A** doubles the resolution
- **B** adds no detail
- **C** is needed with immersion oil
- **D** improves the contrast

12. Pseudostratified ciliated columnar epithelium with goblet cells lines the:

- **A** trachea
- **B** oesophagus
- **C** stomach
- **D** renal collecting ducts

13. Super-resolution microscopy (Nobel Prize 2014):

- **A** uses electrons instead of light
- **B** needs no fluorescent labels
- **C** resolves detail finer than the 0.2 µm limit of light microscopy
- **D** shows only surfaces

14. A striated (brush) border of microvilli covers the:

A tracheal epithelium
B epidermis
C enterocytes of the small intestine
D endothelium

15. In a polarised epithelium (such as the intestinal or kidney tubule lining), the cells are sealed together near their apex by:

A gap junction
B desmosome
C hemidesmosome
D tight junction (zonula occludens)

16. Merocrine (eccrine) glands release their product by:

A exocytosis, losing no cytoplasm
B the apex of the cell pinching off
C the whole cell breaking down
D diffusion through tight junctions

17. Collagen type IV forms the:

A matrix of hyaline cartilage
B basal lamina
C fibres of tendons
D reticular fibres

18. Sebaceous glands secrete by:

A merocrine
B apocrine
C endocrine
D holocrine

19. Stereocilia are found in the:

A trachea
B epididymis
C uterine tube
D oesophagus

20. Which epithelium lines the alveoli of the lungs?

A simple squamous
B simple cuboidal
C pseudostratified ciliated columnar
D stratified squamous

Answers · practice figures

Figure 1 · A lining of tall cells, on a real slide

1 Simple columnar epithelium
2 Apical side
3 Lumen
4 Lamina propria
5 Goblet cell
6 Basal side

Figure 2 · A lining with nuclei at many levels, on a real slide

1 Cilia
2 Apical side
3 Pseudostratified columnar epithelium
4 Goblet cell
5 Basal side
6 Lamina propria

Figure 3 · A many-layered lining, on a real slide

1 Lamina propria
2 Basal side
3 Apical side
4 Lumen
5 Stratified squamous epithelium

Figure 4 · Six epithelia, drawn and on real slides

1 Simple squamous epithelium
2 Simple cuboidal epithelium
3 Simple columnar epithelium
4 Pseudostratified columnar epithelium
5 Stratified squamous epithelium
6 Transitional epithelium
7 Stratified squamous epithelium
8 Transitional epithelium
9 Simple cuboidal epithelium
10 Simple squamous epithelium
11 Simple columnar epithelium
12 Pseudostratified columnar epithelium

Figure 5 · The lining that stretches, on a real slide

1 Apical side
2 Lumen
3 Basal side
4 Transitional epithelium
5 Lamina propria

Figure 6 · Two single-layer epithelia, on a real slide

1 Lumen
2 Apical side
3 Simple squamous epithelium
4 Basal side
5 Simple cuboidal epithelium
6 Apical side
7 Basal side

Answers · self-test

1 B raise the numerical aperture, and so the resolution, of the 100× objective — Oil with the refractive index of glass (about 1.5) lets the 100× objective gather more light: its numerical aperture rises to about 1.4.

2 A non-keratinised stratified squamous — The epidermis is the keratinised one.

3 D 400× — Magnifying beyond what the resolution supports adds no detail.

4 B mucus — Goblet cells, one-cell glands of the airway and gut, release mucin that swells into mucus; type II pneumocytes make surfactant and Paneth cells lysozyme.

5 C phase contrast microscopy — Fluorescence and confocal microscopy show labelled molecules.

6 D purely serous — The parotid is purely serous, the submandibular mixed (mostly serous) and the sublingual mixed (mostly mucous).

7 C apple-green birefringence — Collagen and crystals are birefringent too.

8 D stratified squamous epithelium (metaplasia) — Squamous metaplasia: the ciliated pseudostratified epithelium is replaced by tougher stratified squamous epithelium, which cannot clear mucus.

9 C birefringent structures, such as collagen and crystals — Phase contrast shows living, unstained cells; fluorescence shows labels.

10 A urinary bladder — Urothelium stretches as the bladder fills: its dome-shaped umbrella cells flatten.

11 B adds no detail — Total magnification = objective × eyepiece; resolution sets the finest detail.

12 A trachea — Respiratory epithelium: every cell touches the basement membrane, but the nuclei sit at several heights.

13 C resolves detail finer than the 0.2 µm limit of light microscopy — Cryo-electron microscopy won the Nobel Prize in 2017.

14 C enterocytes of the small intestine — Microvilli multiply the absorbing surface of enterocytes; the trachea carries cilia, which are longer and motile.

15 D tight junction (zonula occludens) — Tight junctions (zonula occludens) ring the apex of polarised cells and seal the space between them, so most substances must go through the cells. How tight the seal is varies: leaky in the proximal tubule and small intestine, tight in the collecting duct and bladder.

16 A exocytosis, losing no cytoplasm — Merocrine: exocytosis of vesicles; apocrine: the apical cytoplasm is shed too; holocrine: the whole cell (sebaceous glands).

17 B basal lamina — Type IV collagen makes a meshwork, not fibrils: the lamina densa of basement membranes.

18 D holocrine — The whole cell breaks down to form the secretion.

19 B epididymis — They are long microvilli, not cilia.

20 A simple squamous — Type I pneumocytes form a simple squamous lining, thin enough for gas exchange.