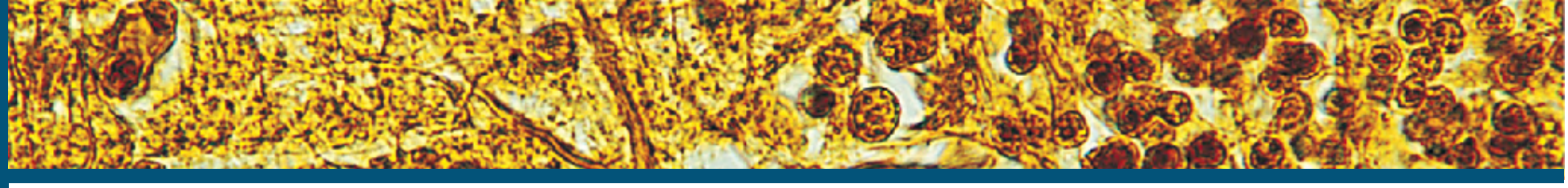


Epithelium

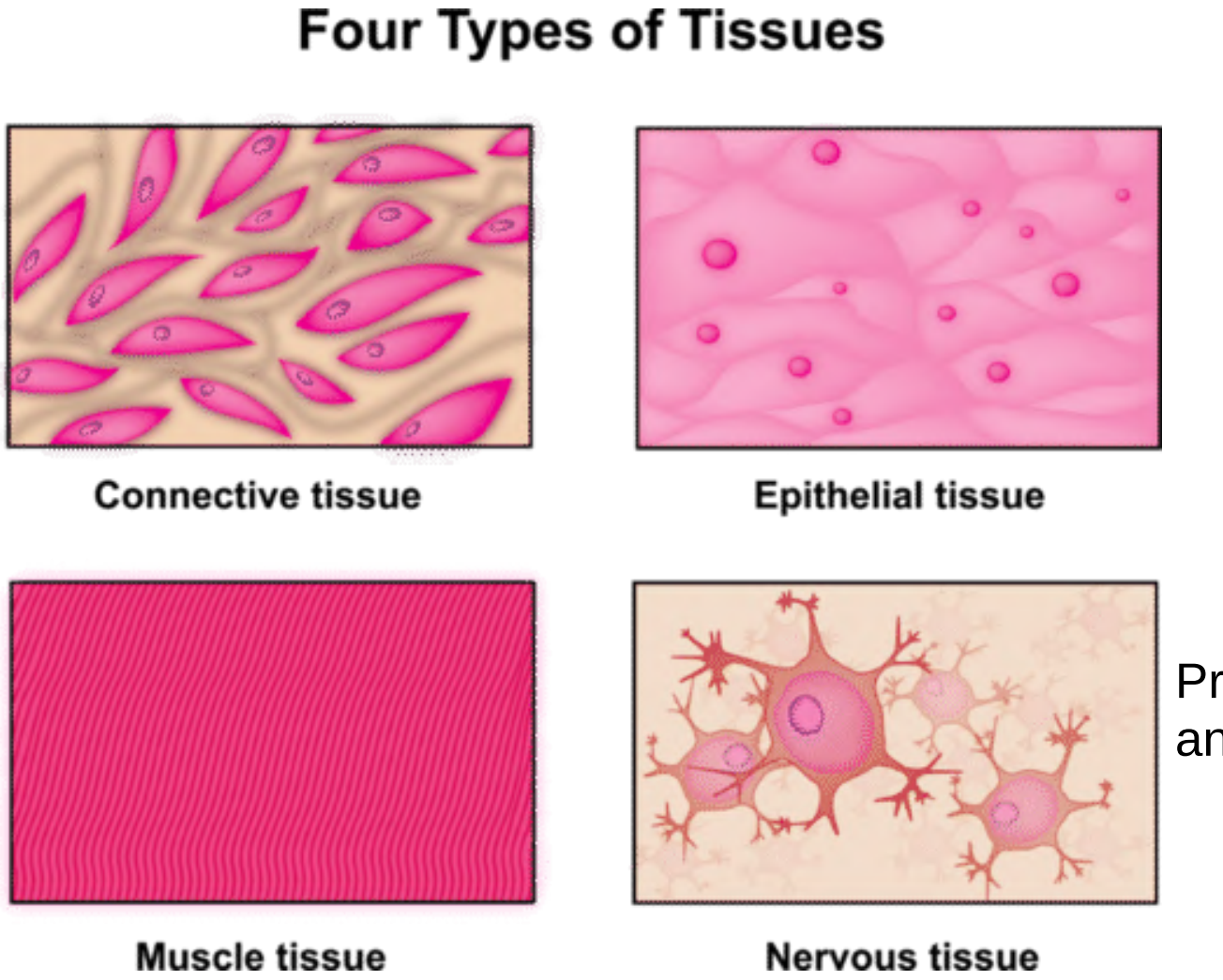
Color Textbook of Histology, 4th ed.

Gartner

- https://rps.unibo.it

https://rps.unibo.it

Four basic tissue types



Provides support

To cover and protect the body

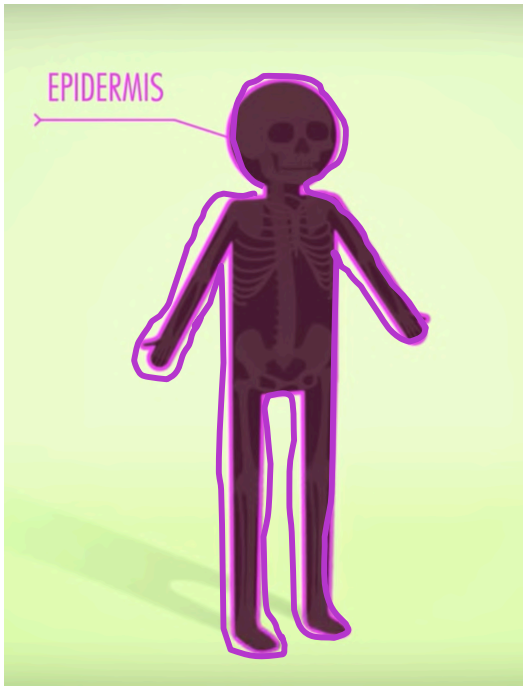
Movement

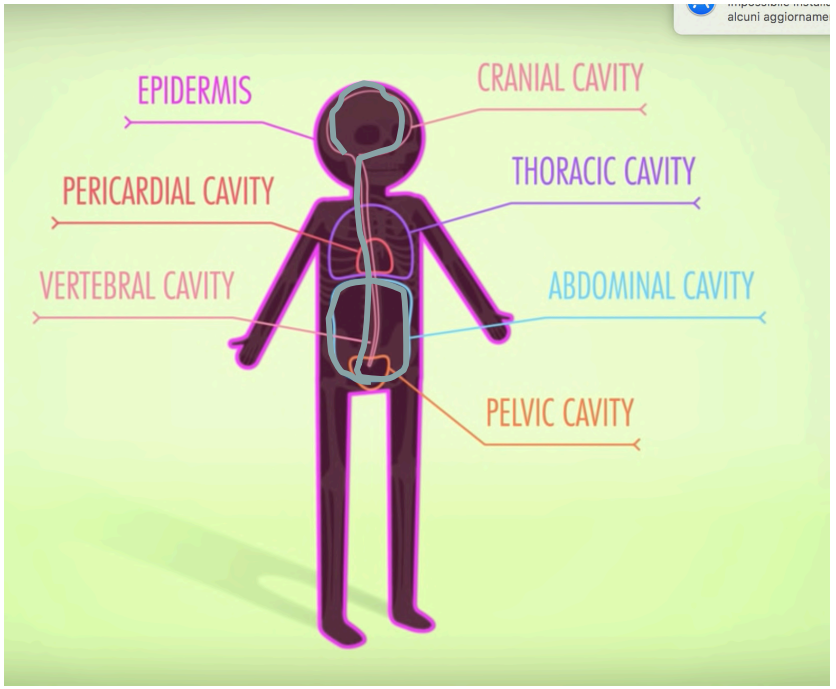
Provides control and communication

Epithelial Tissue

Is present in few forms:

As contiguous cells that cover the body on the external surface (**epithelial membrane)** or **mucosa membranes** that cover cavities connected to the outside (ex. digestive system) or **serous membranes that** line the body on its internal surface, as invagination of the epithelial tissue (ex. pelvic cavity)





Epithelial Tissue

Is present in two forms:

- As contiguous cells that cover the body on the external surface and line the body on its internal surface
- Glands: which originate from invaginated epithelial cells.

Embryonic germ layers' derivation of epithelial tissues

Ectoderm gives rise:

- Skin
- Oral mucosa
- Glands of the skin
- Mammary glands

Mesoderm

- Serous membranes lining the body cavities
- Kidney

Endoderm:

- Liver
- Pancreas
- Respiratory and gastrontestinal tract

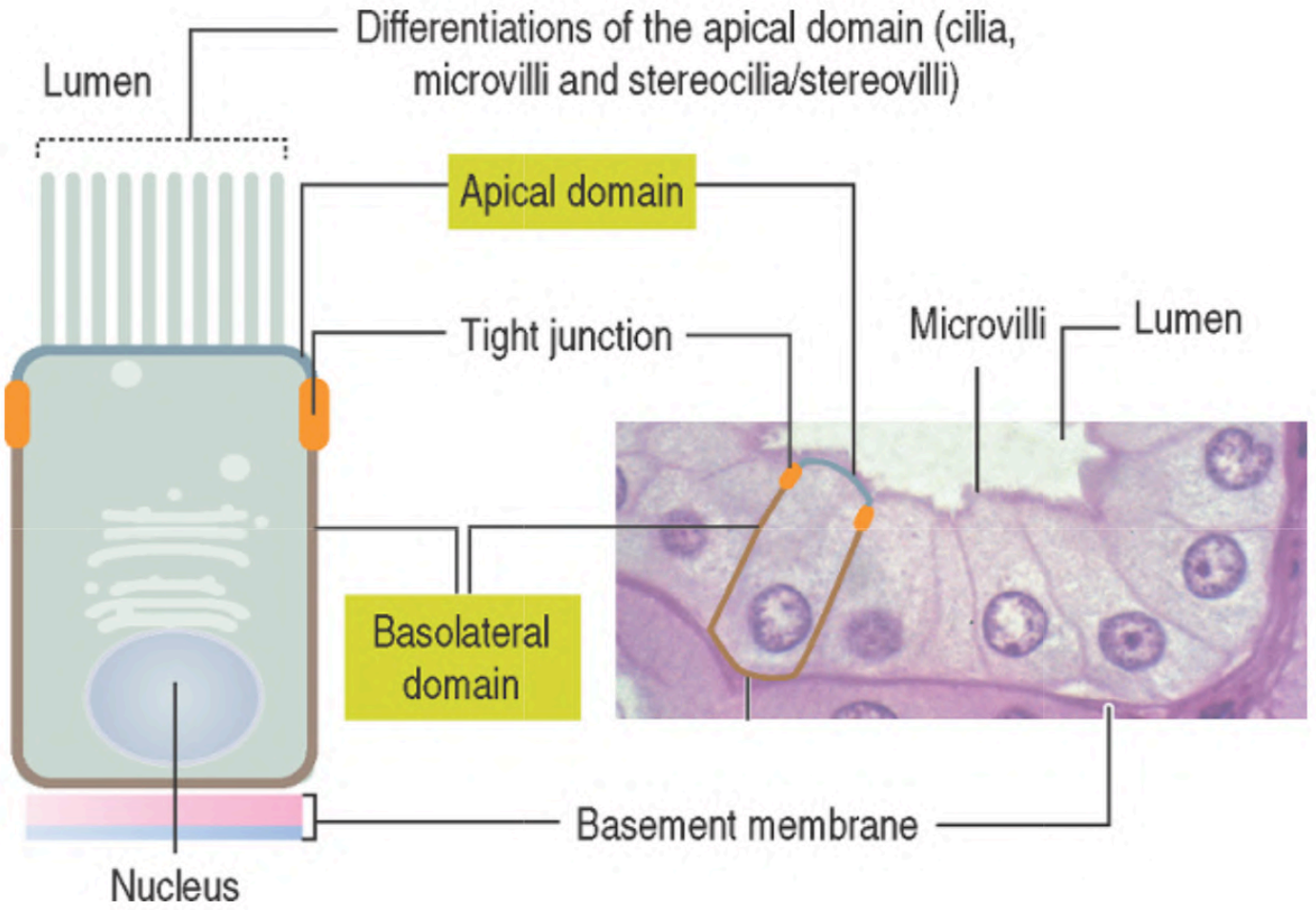
Epithelial Tissues functions

- Protection
- Secretion
- Absorption
- Selective permeability
- Detection of sensations: sensory epithelia

Epithelial cell polarity

An important aspect of an epithelium is its **polarity**. Polarity is essential to carry out specific functions of the various organ systems.

Polarity is determined by the distribution of plasma membrane proteins and lipids and the rearrangement of the cytoskeleton.



Epithelial cell polarity

- The **apical (uppermost) domain** is exposed to the lumen or external environment and displays **apical differentiations**.
- The l**ateral domain** faces neighboring epithelial cells linked to each other by **cell adhesion molecules** and **junctional complexes**.
- The **basal domain** is associated with a **basal lamina** that separates the epithelium from underlying connective tissue, representing the internal and nutritional supporting environment.

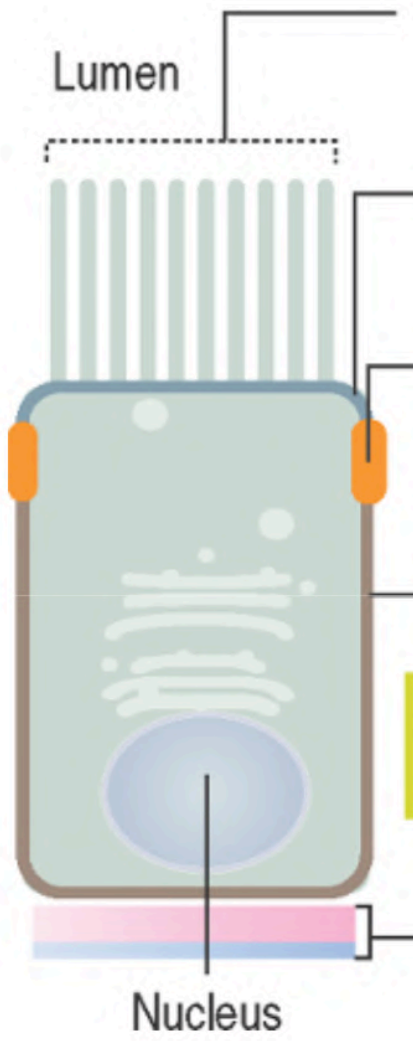
The basal lamina, of epithelial cell origin, is reinforced by components of the connective tissue. The *basal lamina–connective tissue* complex is the **basement membrane**.

Epithelial cell polarity

From the **functional** perspective, *sealing junctions* segregate the plasma membrane of an epithelial cell into an **apical domain** and a **basolateral domain**. This segregation is supported by the asymmetric distribution of transporting molecules, ensuring polarized secretory and absorptive functions of an epithelium.

For example, the apical domain has structures important for the **protection** of the epithelial surface (such as **cilia** in the respiratory tract) or for the **absorption** of substances (such as **microvilli** in the intestinal epithelium).

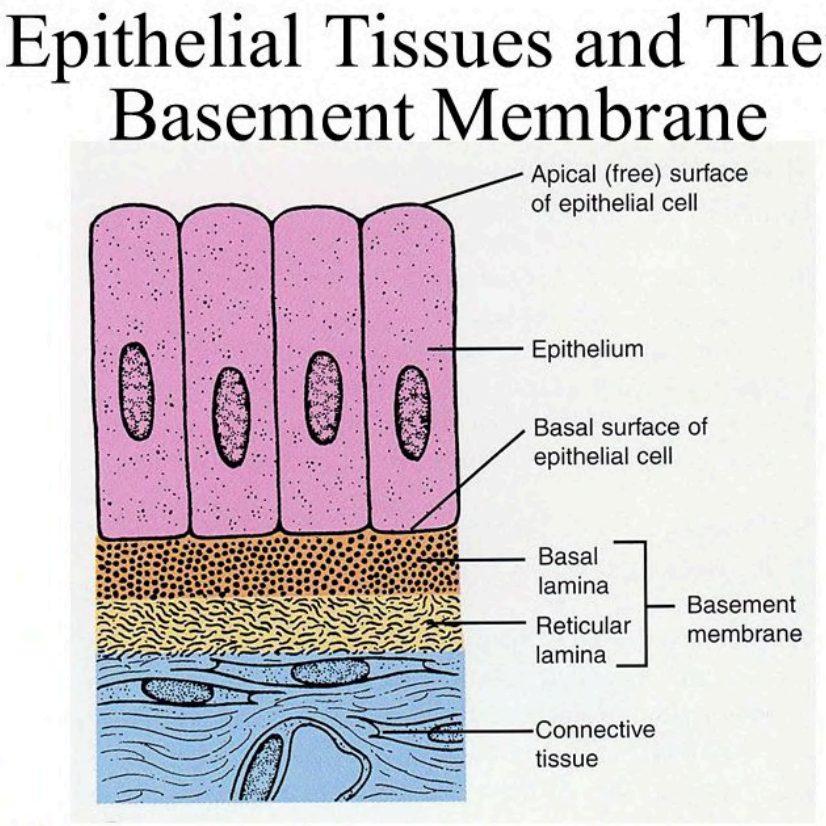
In contrast, the basolateral domain facilitates directional transport functions prevented from trespassing the sealing junctions.



Epithelial Tissues

- Epithelium is an **avascular tissue**, receives its nutrients from the vascular supply of the adjacent connective tissue.
- Tightly bound, closely packed cells, held together by junctional complexes, with little amount of extracellular matrix.
- Epithelium and connective tissue are separated from the basal lamina, and lay down on the basement membrane

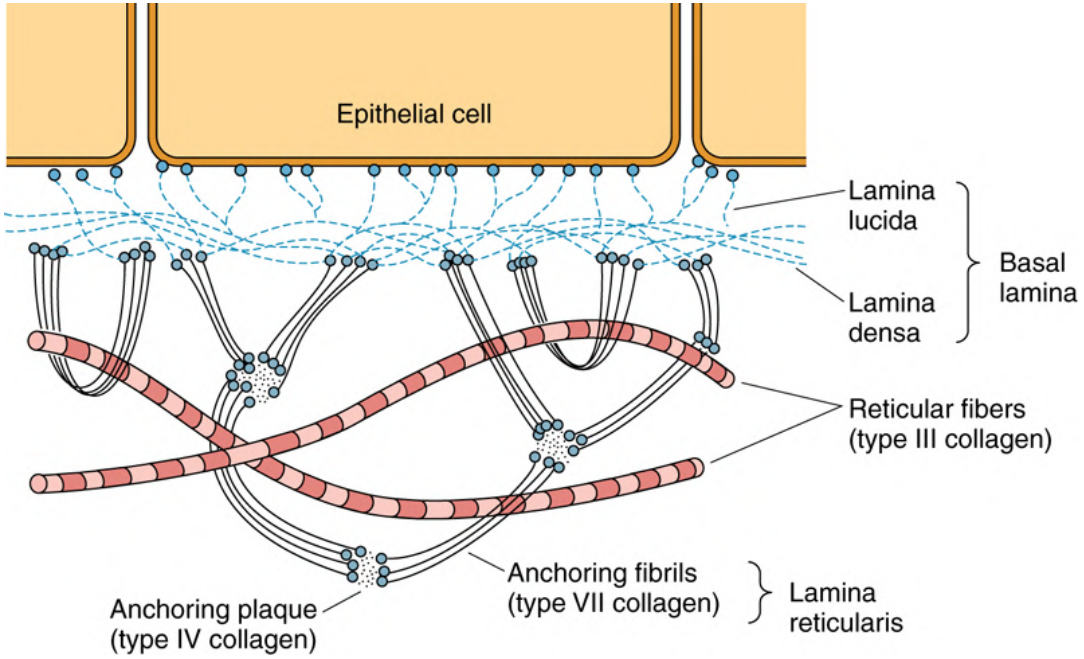
The basement membrane

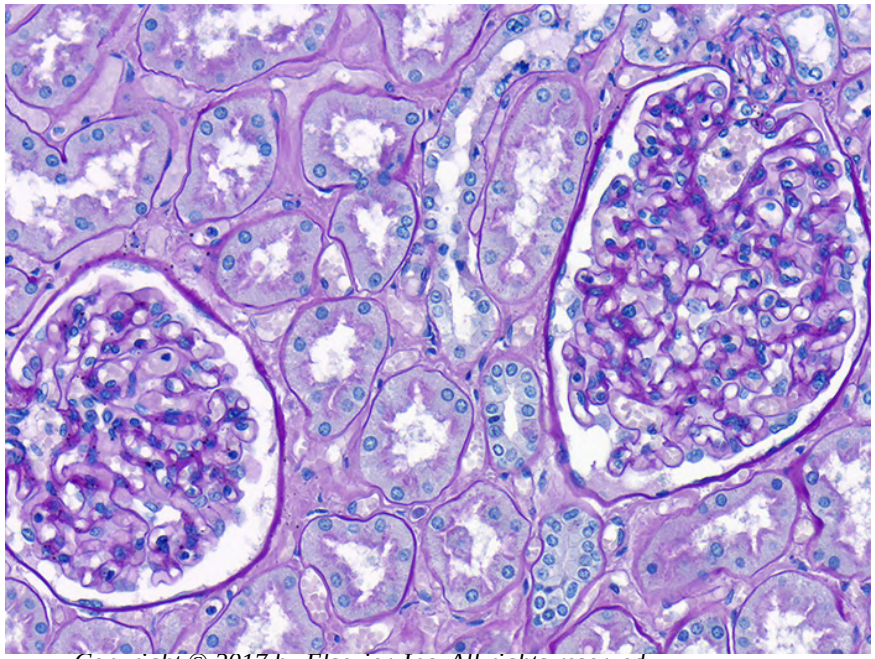


What function might the basement membrane serve in the repair of injury to the epithelium?

It serves as reservoirs of growth factors that direct and fine-tune cellular functions.

Basement Membrane





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Acellular region, as visible by light microscopy, is better defined by electron microscopy as having two constituents:

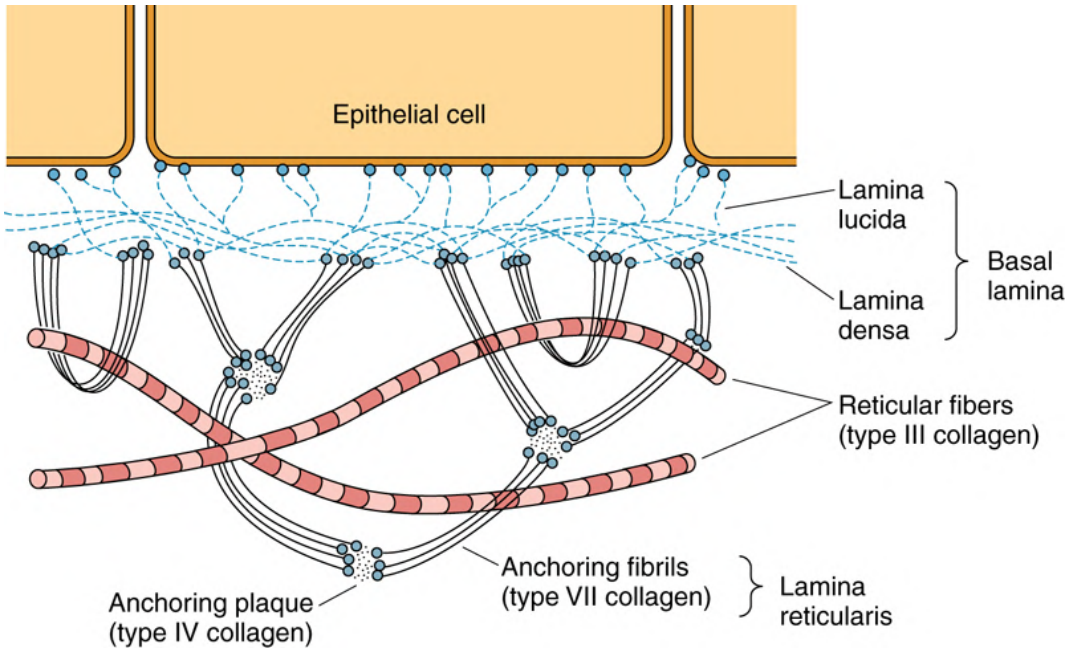
the **basal lamina,** elaborated by epithelial cells

and

the **lamina reticularis** manufactured by cells of the connective tissue.

https://unibo.smartzoom.com/s1241/course1776/f1777/i1790/

Basement Membrane



Basal lamina and lamina reticularis. *(Adapted from Fawcett DW: Bloom and Fawcett's A Textbook of Histology, 12th ed. New York, Chapman and Hall, 1994.)*

http://www.histologyguide.com/slideview/MH-136-trachea/02-slide-1.html?x=47820&y=27660&z=100.0

The **basal lamina** two regions: the lamina lucida, a 50-nm-thick electron-lucent region just beneath the epithelium, and the lamina densa, electron-dense region.

The **lamina lucida** consists mainly of the extracellular glycoproteins laminin and entactin as well as **integrins** and **dystroglycans,** transmembrane laminin receptors, that project from the epithelial cell membrane into the basal lamina.

The **lamina densa** comprises a meshwork of type IV collagen.

The lamina reticularis possesses **fibronectin.**

The lamina reticularis, a region of varying thickness, is manufactured by fibroblasts and is composed of type I and type III collagen. It is the interface between the basal lamina and the underlying connective tissue, and its thickness varies with the amount of frictional force on the overlying epithelium.

Functions of the basement membrane

The main functions of basement membrane are cell adhesion, diffusion barrier and regulation of cell growth

- First, it forms an adhesion interface between epithelial cells and underlying extracellular matrix
- Second, the basement membrane acts as permeability barrier, with pore size depending on the charge and spatial arrangement of its component GAG.
- Third, basement membrane probably controls cell organization and differentiation by the mutual interaction of cell surface receptors and molecules in the extracellular matrix. These interactions are the subject of intense research, particularly in the investigation of mechanisms that might prevent the spread and proliferation of cancer cells throughout the body.

Epithelia

On the surface and lining layer(s)

Cells close together

No blood vessels

Histology Classification

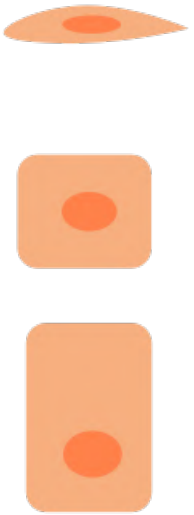
No Vascularization

Cell Sizes: Width 20-80 μm
Lenght 40-80 μm

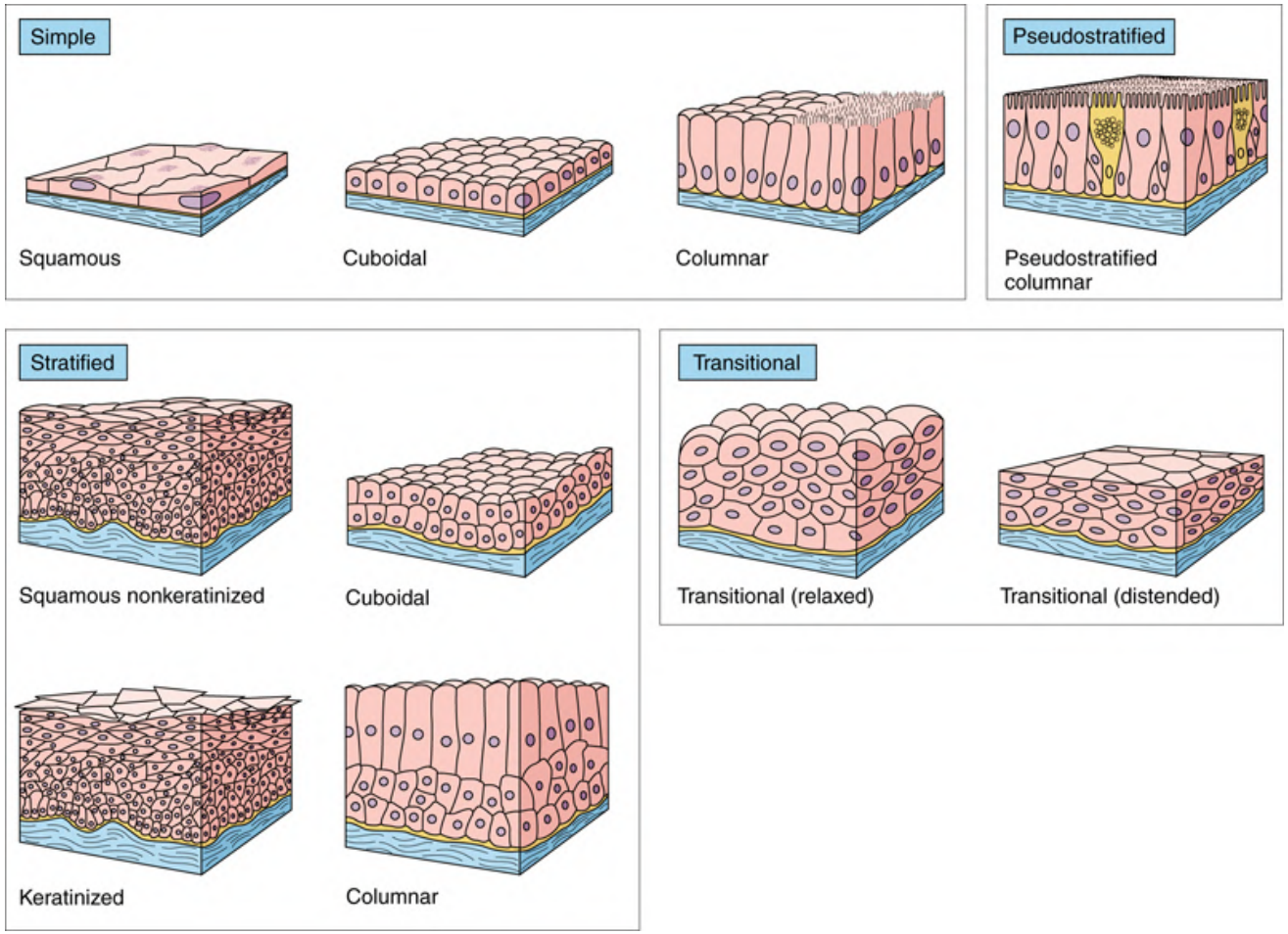
Classification

Cell Shape

- Squamous
- Cuboidal
- Coloumnar



Classification of Epithelia



Types of epithelia.

Epithelial membranes are classified according to the number of **cell layers between the basal lamina and the free surface** and by the morphology of the epithelial cells.

If the membrane is composed of a single layer of cells, it is called **simple epithelium**; if it is composed of more than one cell layer, it is called **stratified epithelium**.

The morphology of the cells may be squamous (flat), cuboidal, or columnar when viewed in cross section.

Stratified epithelia are classified by the morphology of the cells in their superficial layer only. In addition to these two major classes of epithelia, which are further identified by cellular morphology, there are two other distinct types: **pseudostratified and transitional.**

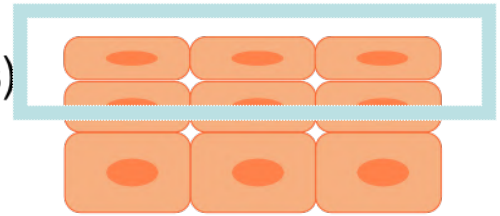
Histology Classification

Cell shape

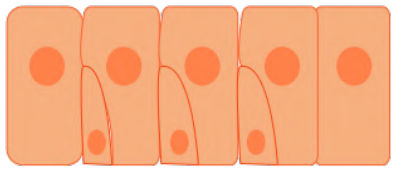
Number of Cell Layers

Simple-one layer
-Squamous
-Cuboidal
-Coloumnar

Stratified
(two or more layers)
-Squamous
-Coloumnar



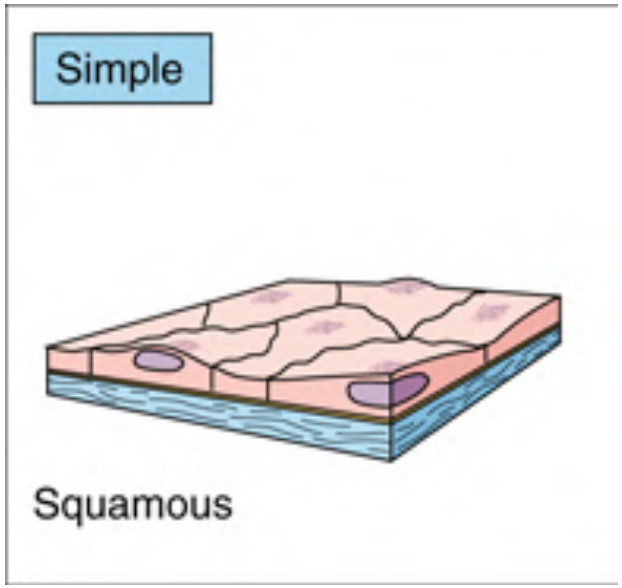
Pseudostratified-Coloumnar



- Tissue classification by the shape of the most external layer

- Layers of cells with nuclei at different levels;
- All cells adhere to basal lamina, and only few reach the surface

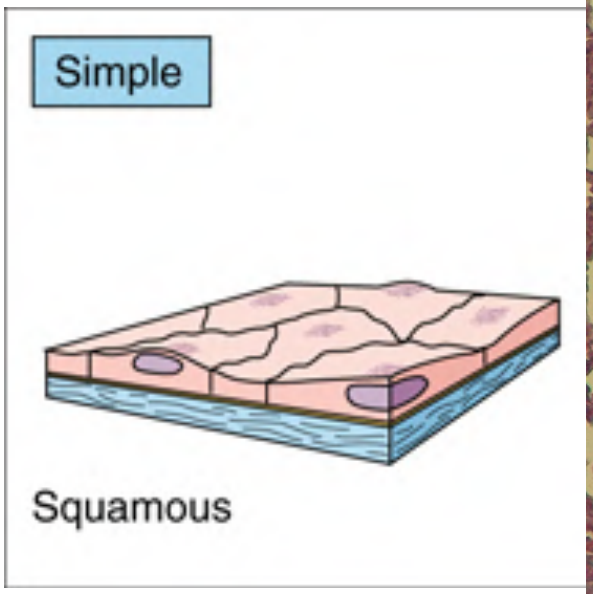
Simple squamous epithelium

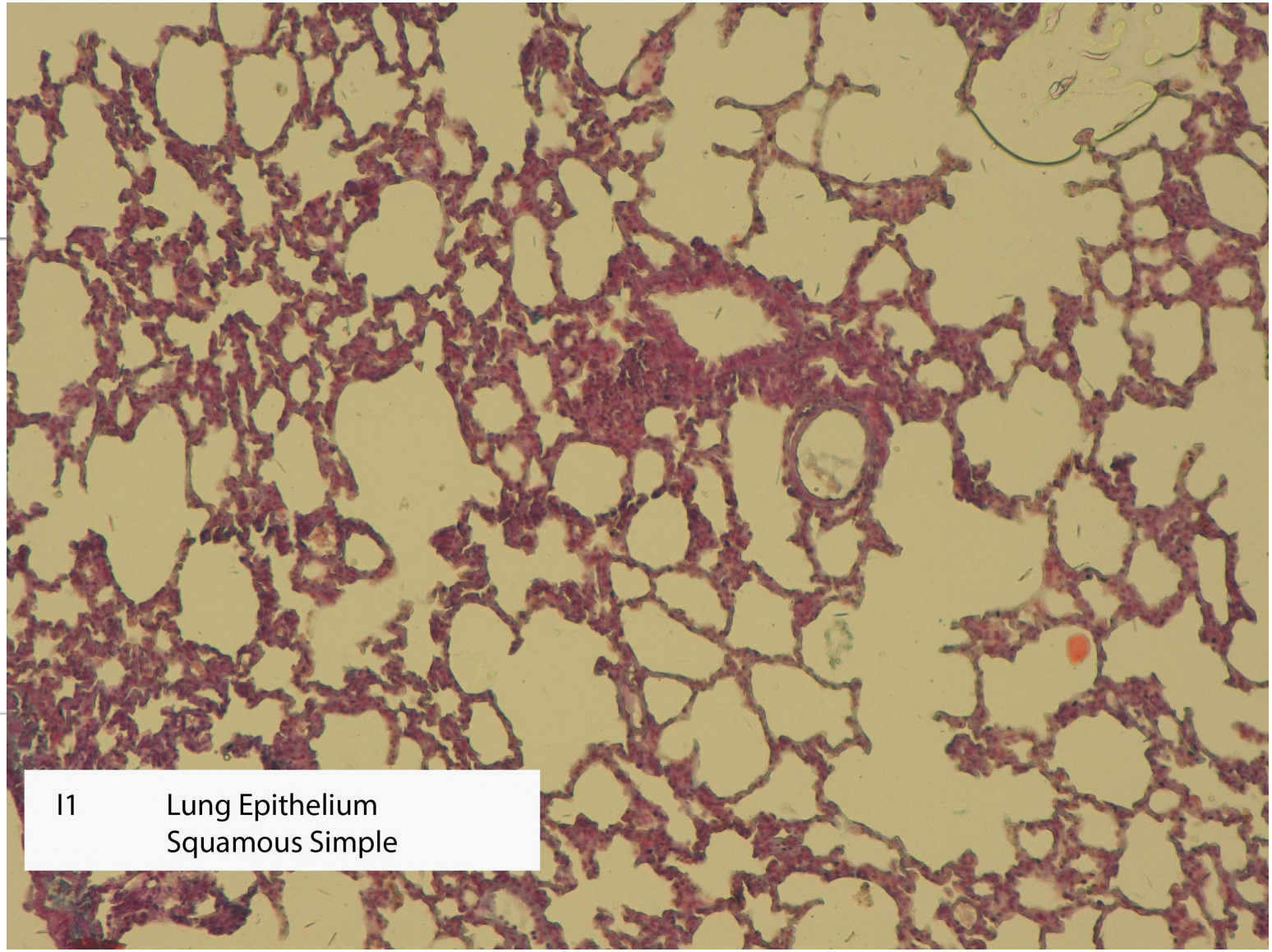


- It’s composed of a single layer of tightly packed, thin polygonal cells
- When viewed from the surface, the epithelia sheet looks like a tile floor, with centrally placed nuclei.
- Viewed in section, only some cells display nuclei because the plane section doesn’t encounter the nucleus.

- Pulmunary alveoli
- Bowman capsule
- Endothelial lining of the blood vessels

Simple squamous epithelium





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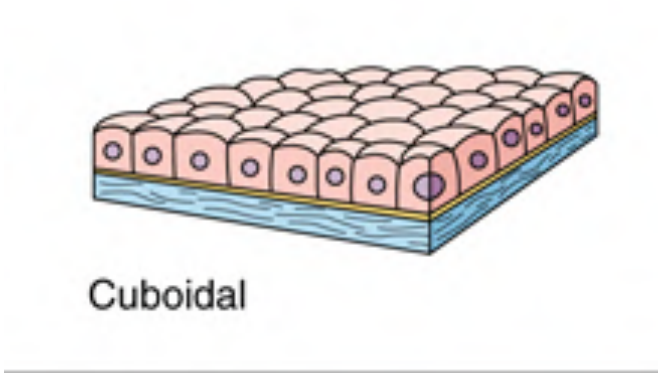
Simple cuboidal epithelium

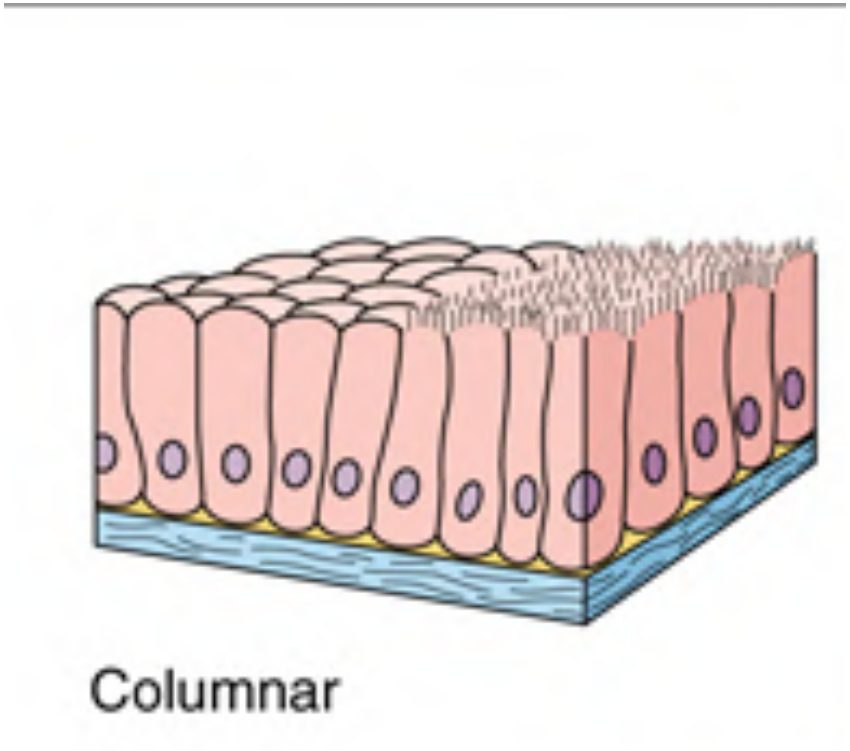


A single layer of cuboidal shaped cells.

Cells present a square profile with a centrally placed round nucleus.

- Ducts of many glands
- Covering of the ovary
- Kidney tubules

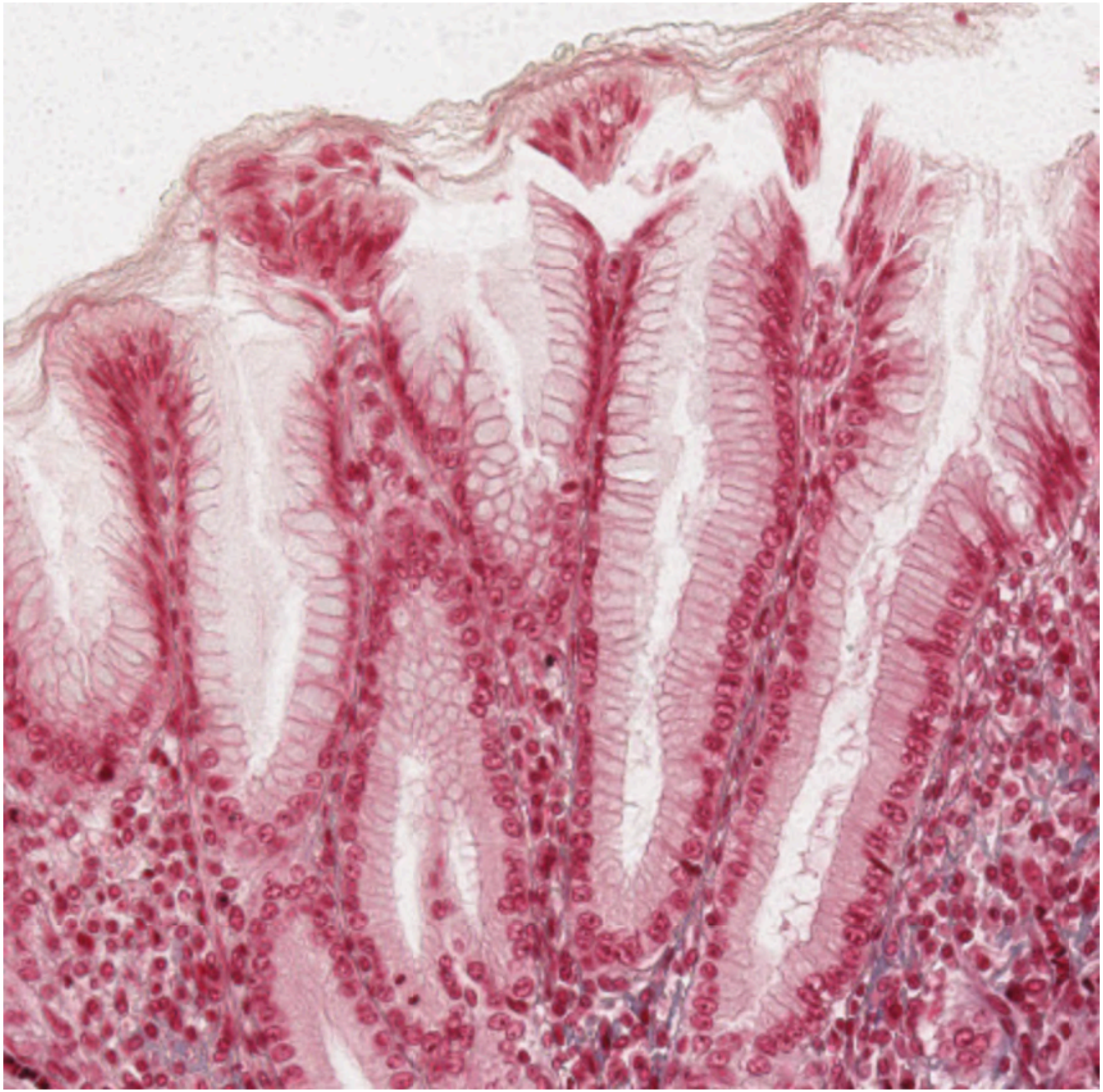
Simple columnar epithelium



- Single layer of tall, rectangular cells
- Nuclei are located at the same level in the basal half of the cell

Digestive tract, gallbladder and large ducts of glands

Simple columnar epithelium

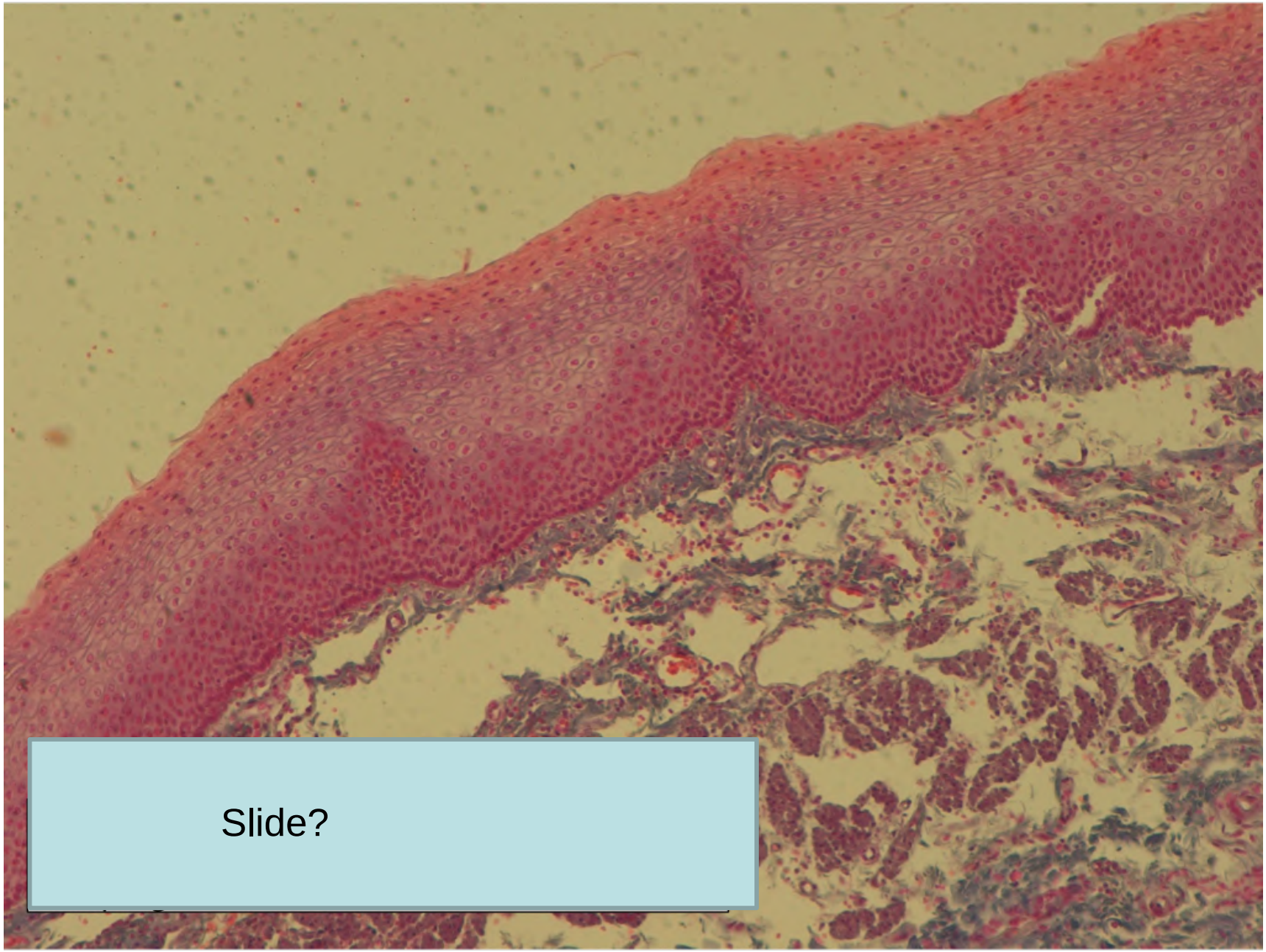


Stratified squamous epithelium

- Stratified squamous epithelium is composed of several layers of cells.
- Only the deepest layer is in contact with the basal lamina.

Lining the mouth
Oral pharynx
Vagina

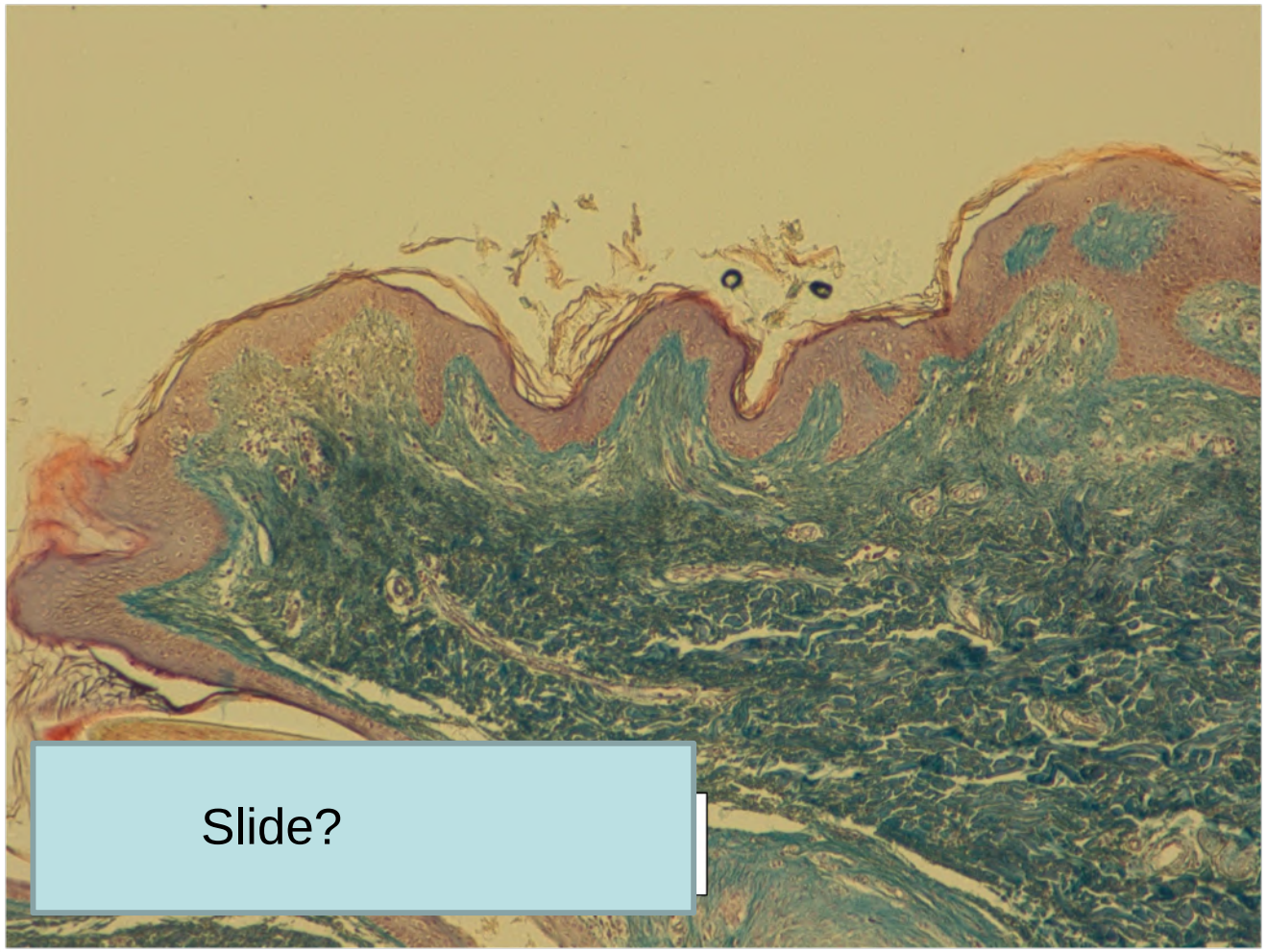
Stratified squamous epithelium



Stratified squamous (keratinized) epithelium

- Cells of the outmost layer are dead, non-nucleated and are filled with keratin.
- Thick layer of keratin resists friction and it is impermeable to water.

Stratified squamous (keratinized) epithelium



Stratified cuboidal/columnar epithelium

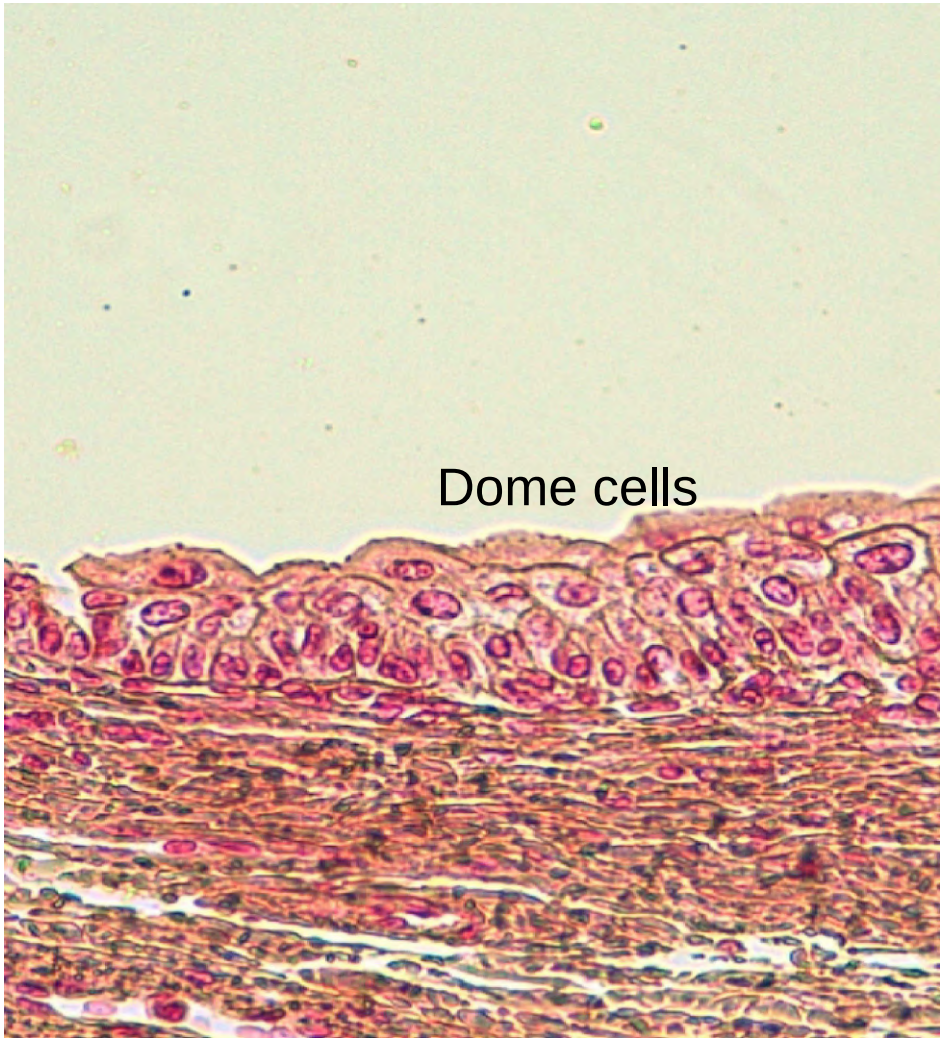
Two layers of cuboidal cells exist only in the duct of some sweat glands

Transitional Epithelium

Distinct type located in the urinary system

- Several layers of cells with the outmost layer larger and composed of dome/umbrella shaped cells
- It was erroneously believed to be in transition between stratified columnar and squamous epithelium
- The most superficial cells are occasionally binucleated and become flattened when the bladder is filled with urine – transitional

Transitional Epithelium



Relaxed bladder

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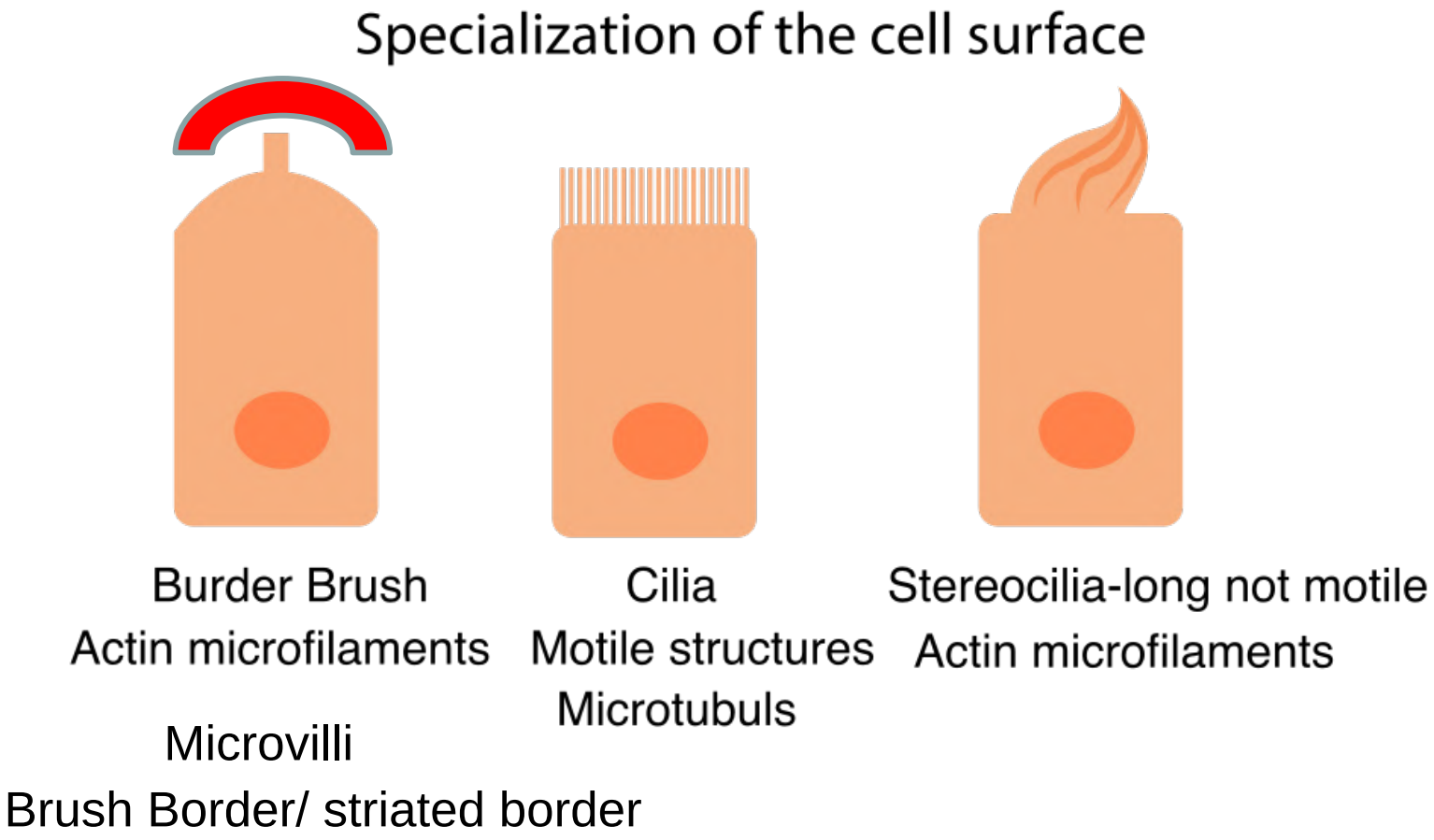
Histology

- Polarity and cell surface specializations
- Cell-cell Junctions
- Epigenetic regulation of stem cell homeostasis

Cell-Surface Specializations/apical domain

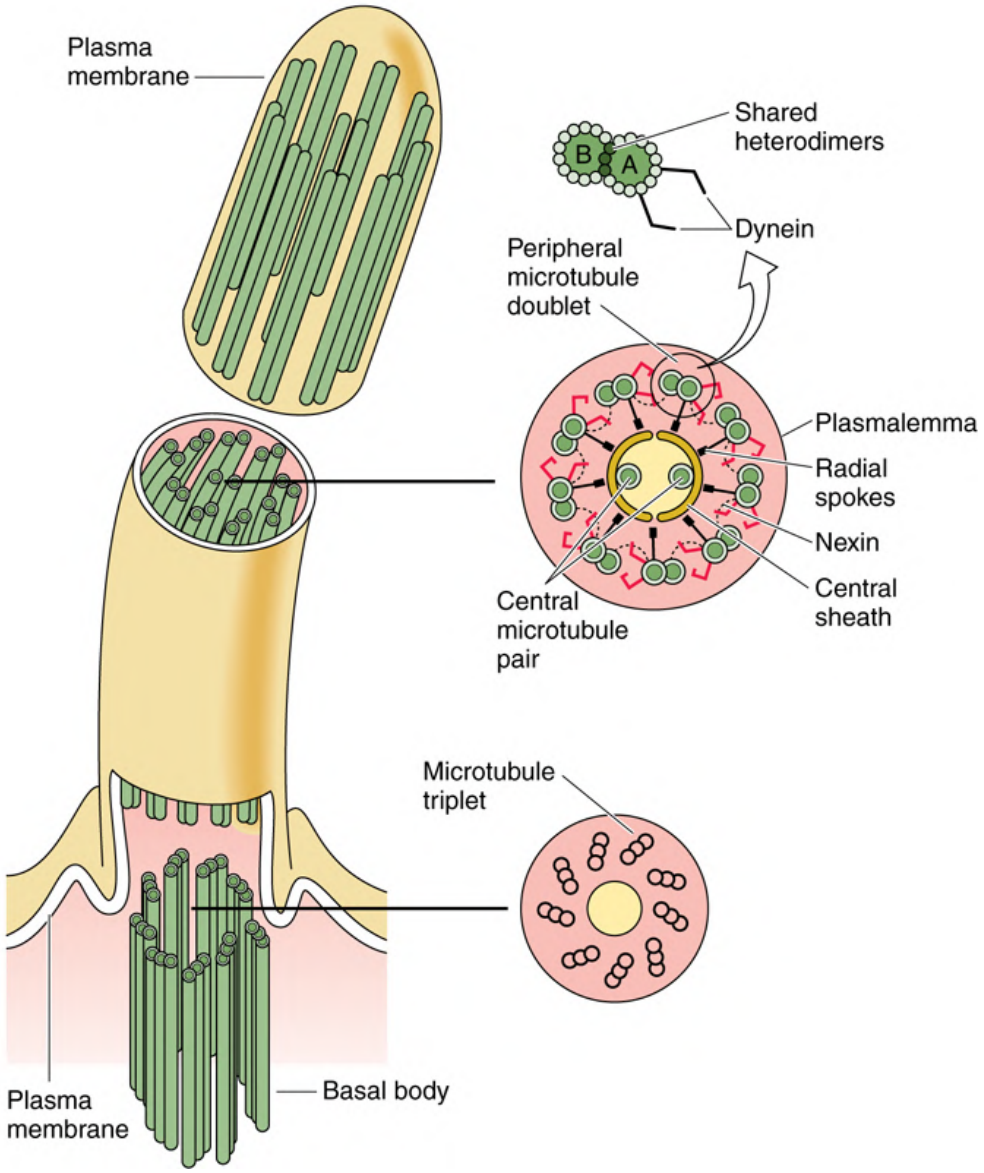


Apical domain- Cilia

Cilia
There are two types of **cilia: multiple motile cilia** and a **single** or a **primary non-motile cilium**.

Ciliogenesis, the assembly process of both types of cilia, is initiated by the **basal body**, a structure originated from a **basal body precursor** located in the **centrosome**.

Cilia

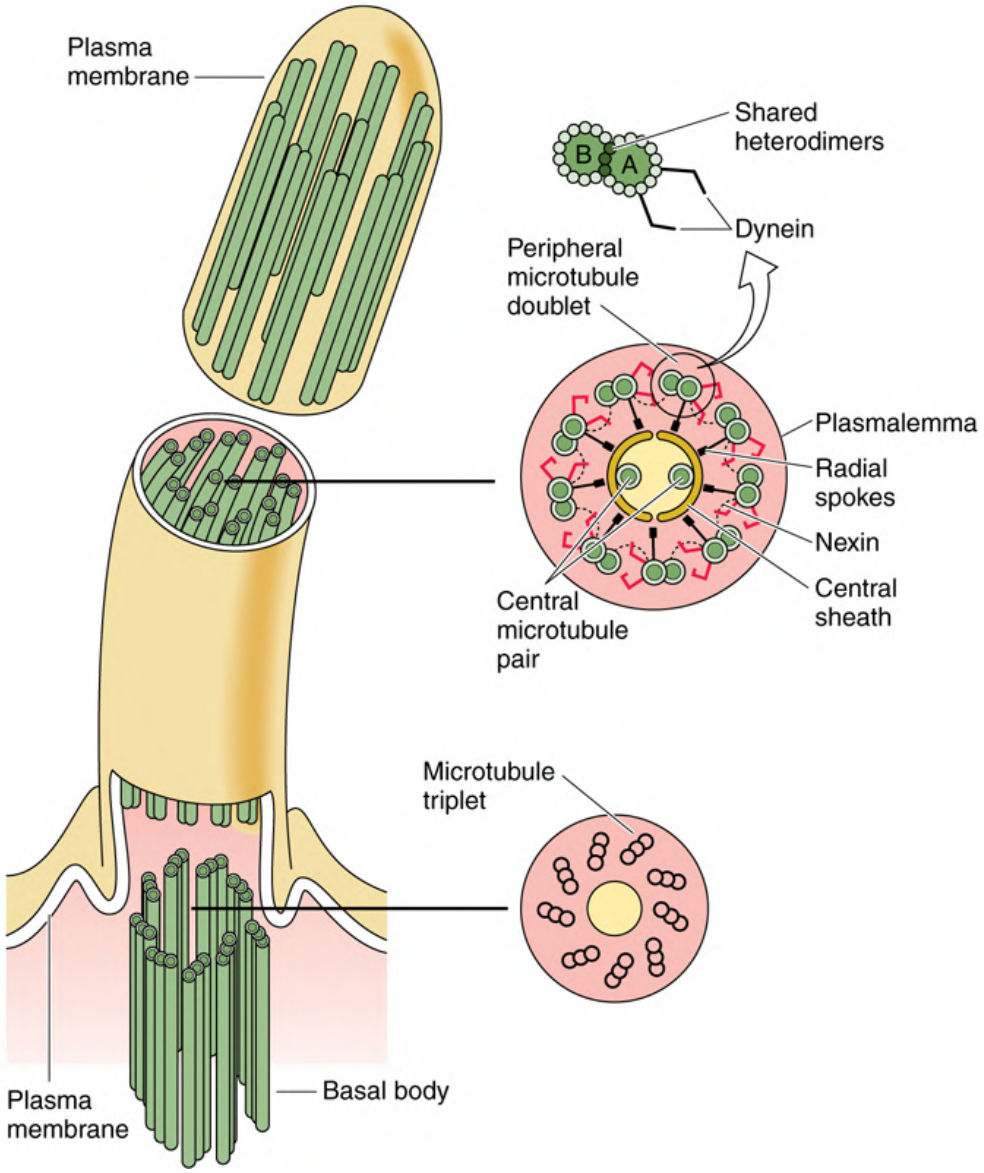


The microtubular arrangement of the axoneme in the cilium.

Cilia are motile, hair-like projections (diameter, 0.2 μm; length, 7 to 10 μm) that emanate from the surface of certain epithelial cells.

In the ciliated epithelia of the respiratory system (e.g., trachea and bronchi) and in the oviduct, there may be hundreds of cilia on the luminal surface of the cells.

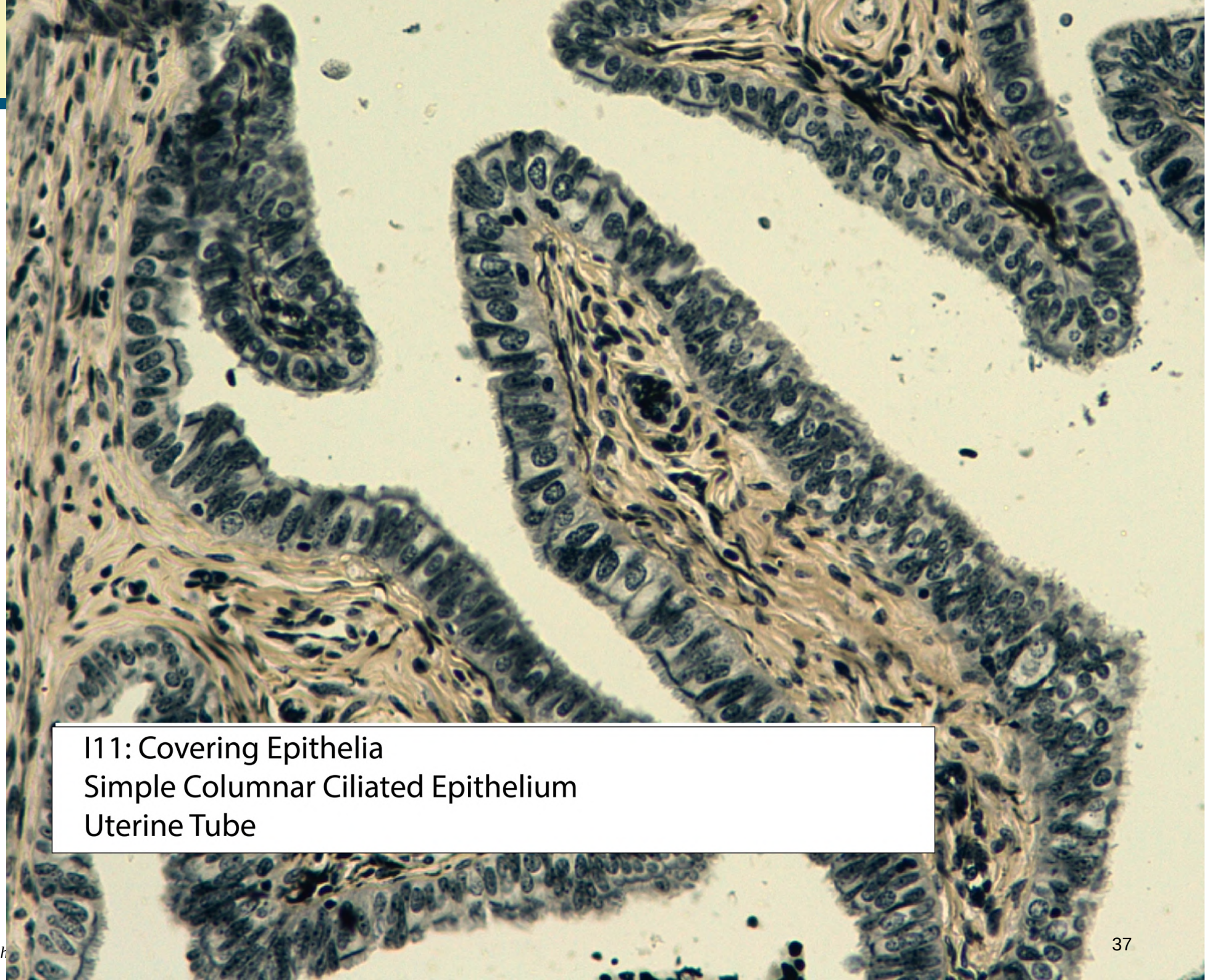
Cilia



The microtubular arrangement of the axoneme in the cilium.

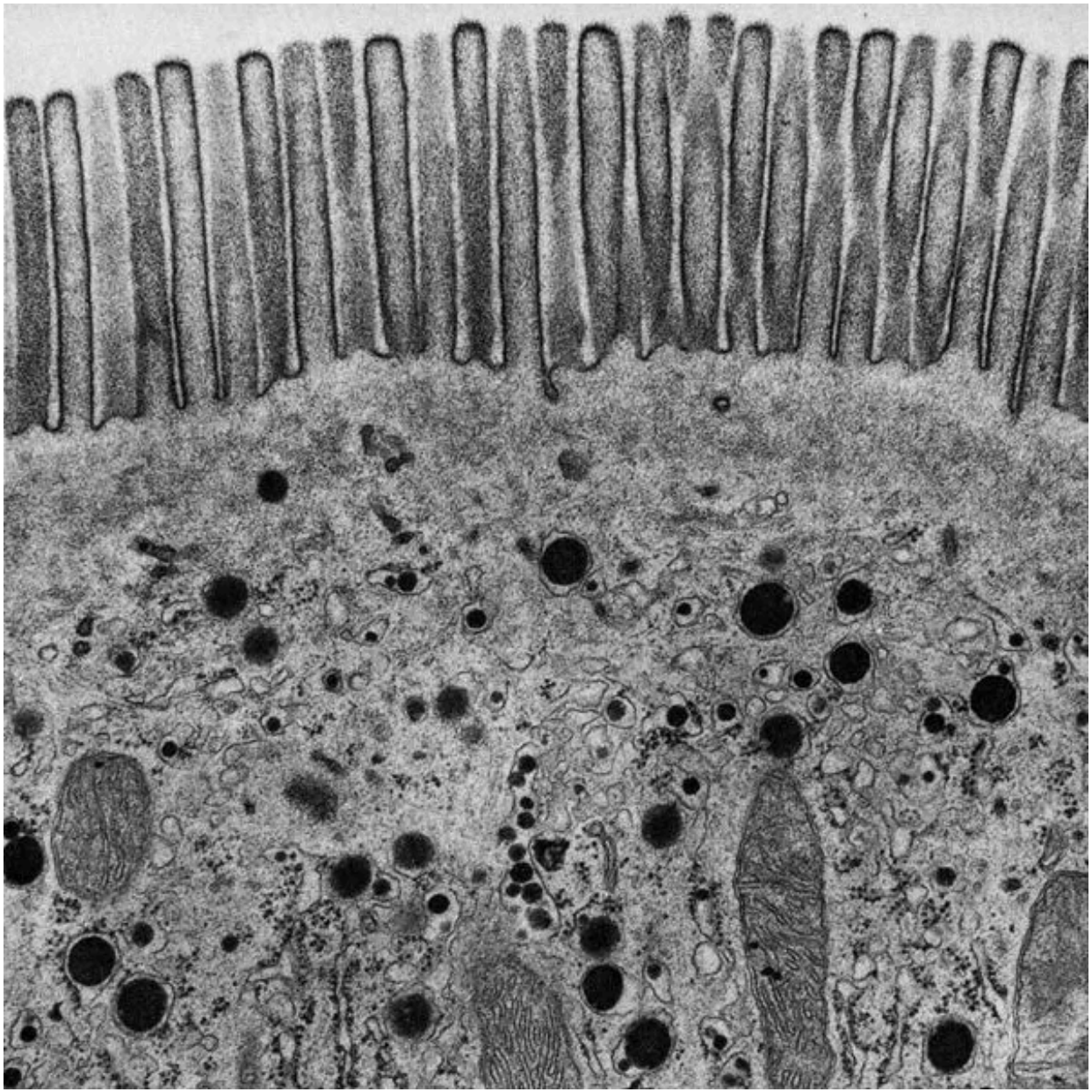
The core of the cilium contains a complex of microtubules called the **axoneme**.

The axoneme is composed of a constant number of longitudinal microtubules arranged in a consistent 9 + 2 centrally placed microtubules (**singlets**) are evenly surrounded by nine **doublets** of microtubules.

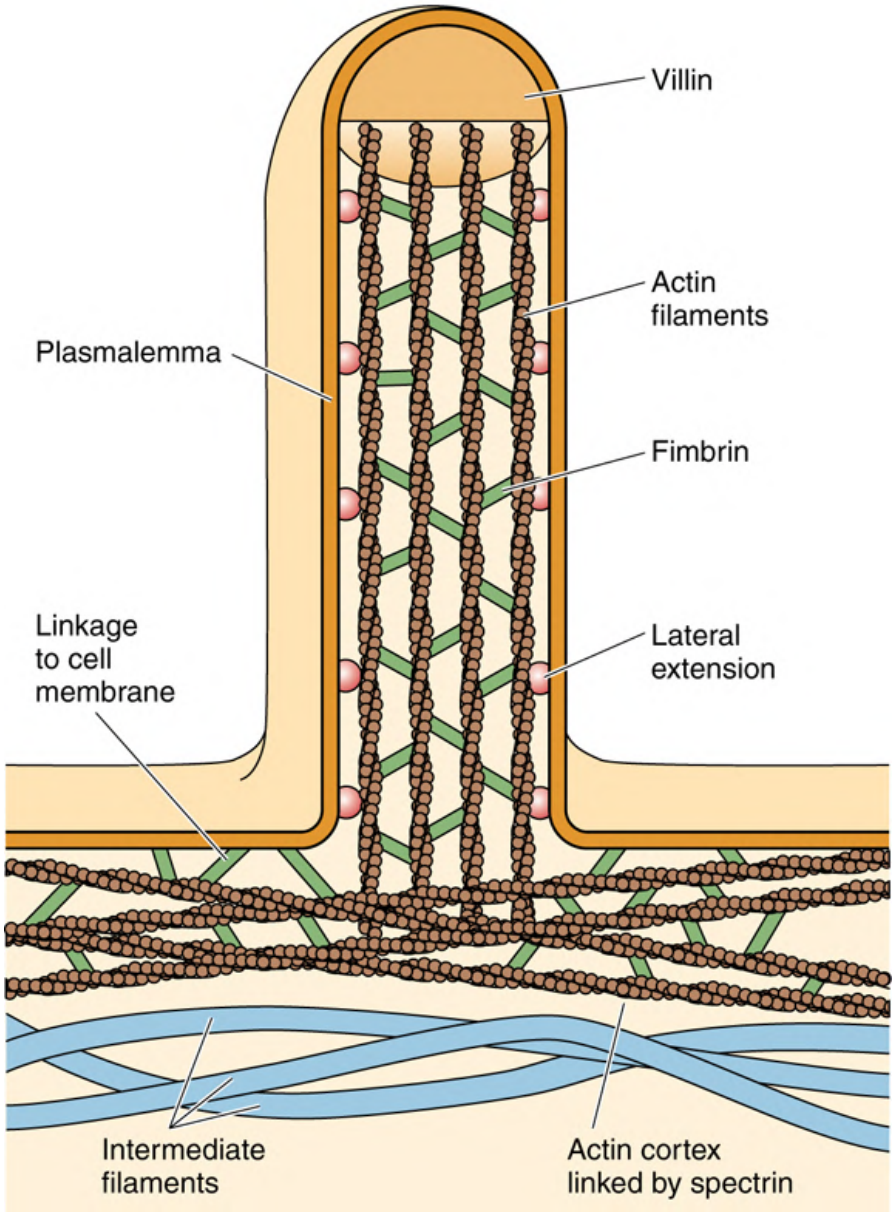


l11: Covering Epithelia
Simple Columnar Ciliated Epithelium
Uterine Tube

Microvilli by Electronic Microscopy



Microvilli/ **Single or primary non-motile cilium**



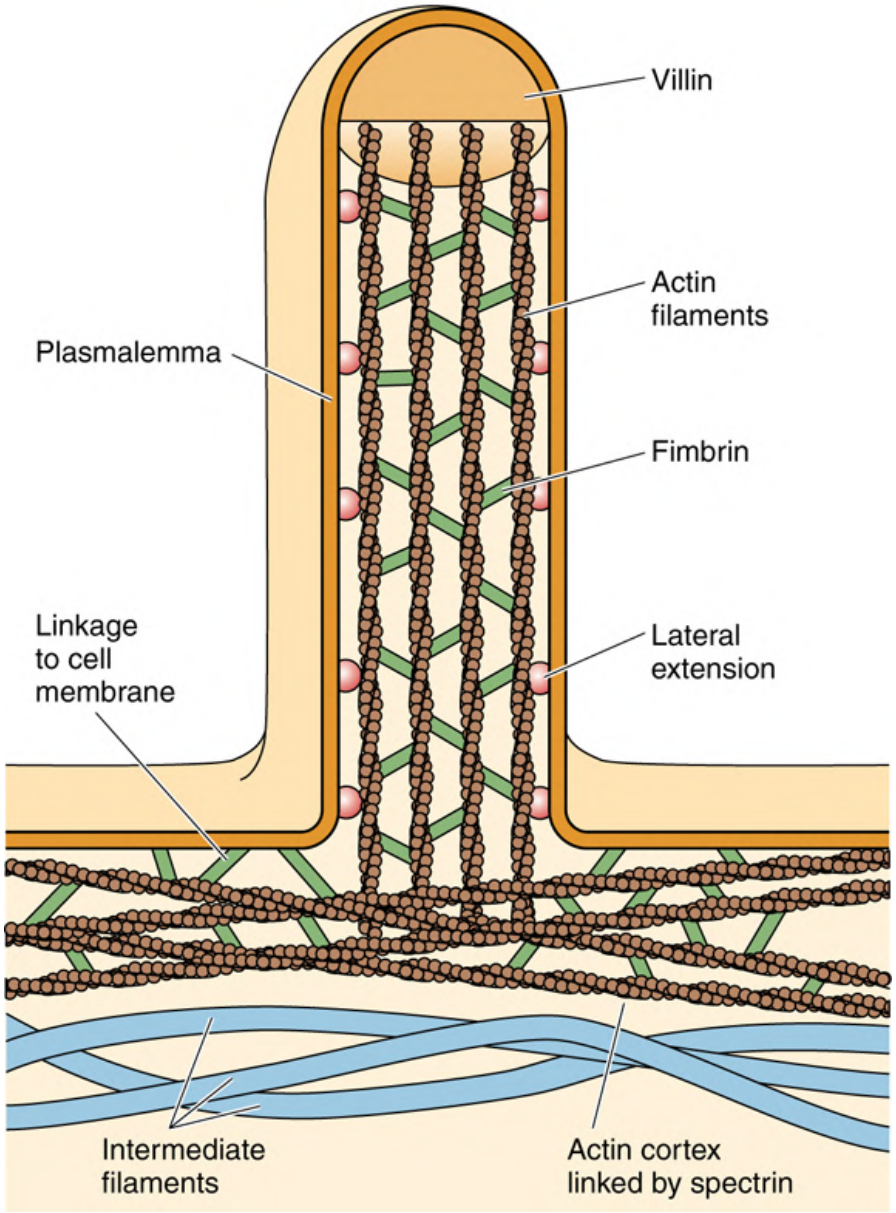
The structure of a microvillus.

Microvilli are cylindrical, membrane-bound projections of the cytoplasm emanating from the apical surface of the cells.

Microvilli represent the **striated border/ brush border** of the intestinal absorptive cells and in the kidney proximal tubule cells observed by light microscopy.

In less active cells, microvilli may be sparse and short; in intestinal epithelia, where the major function is transport and absorption, they are crowded and 1 to 2 μm in length. **Increasing the surface area of the cells.**

Microvilli

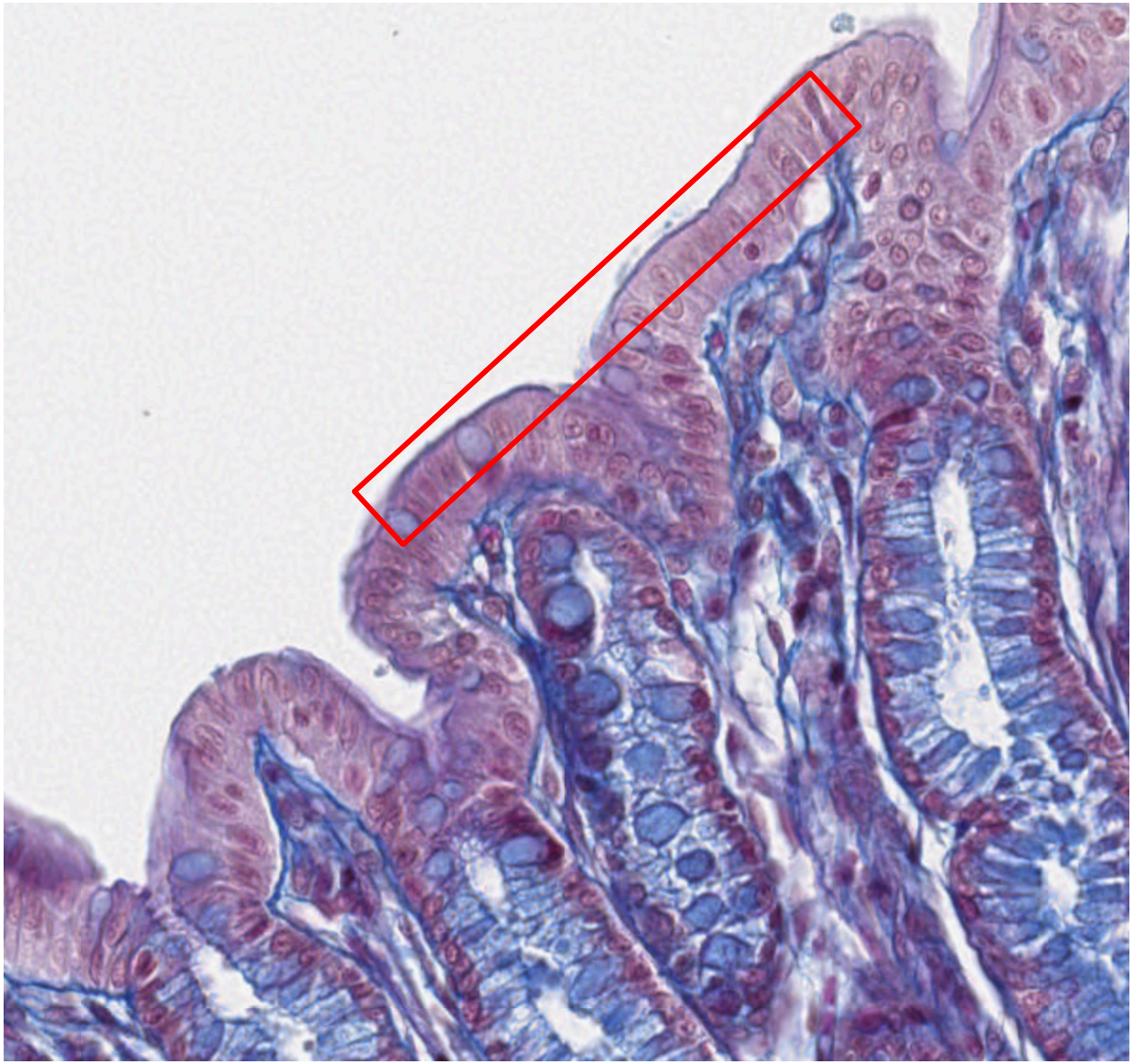


The structure of a microvillus.

Each microvillus contains a core of 25 to 30 **actin filaments**, cross-linked by **villin**, attached at the tip and extending into the cytoplasm, where the actin filaments are embedded into the terminal web.

The **terminal web** is a complex of actin and spectrin molecules as well as intermediate filaments located at the cortex of the epithelial cells.

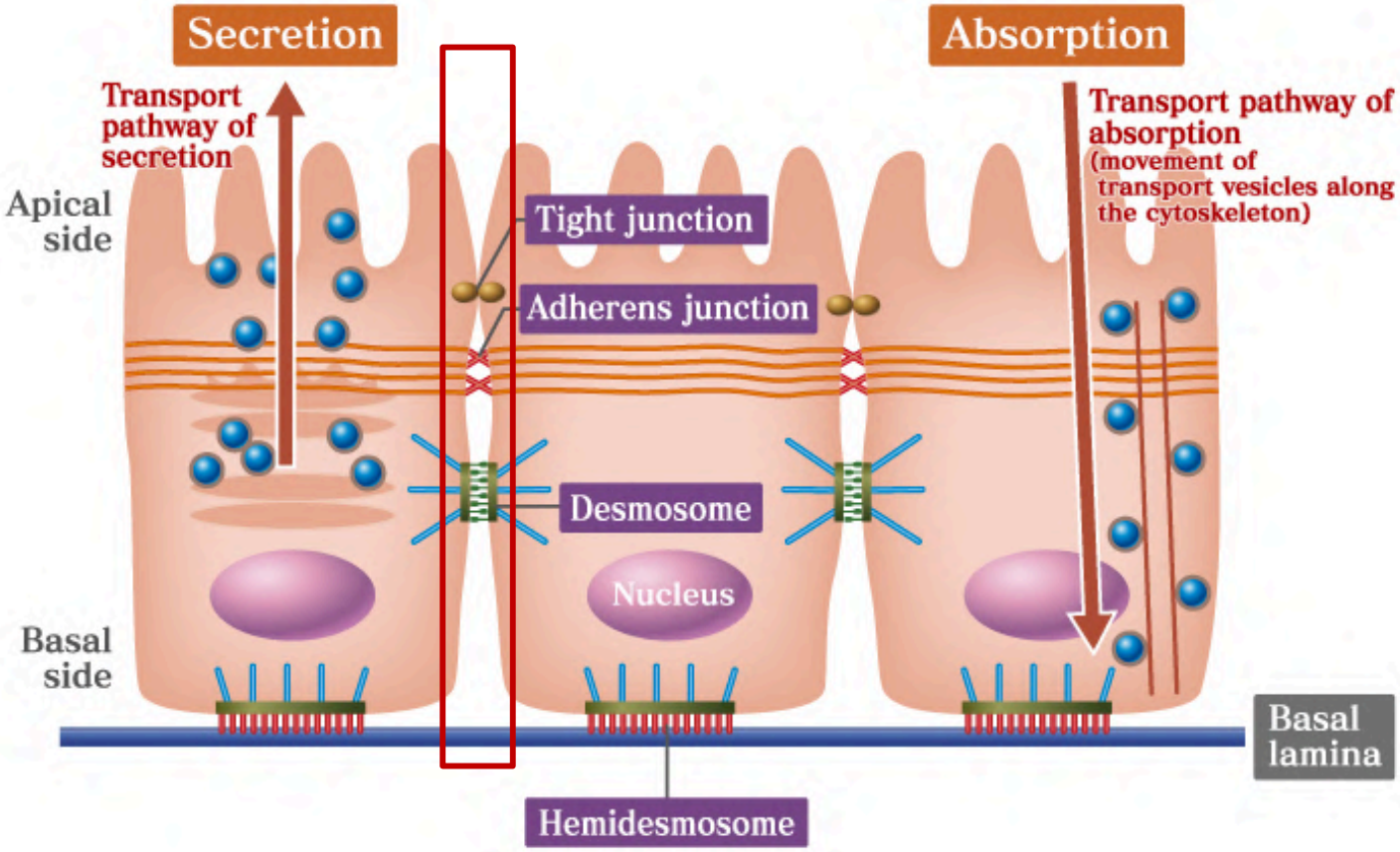
Microvilli/brush border or striated border



http://www.histologyguide.com/slideview/MH-017-stratified-epithelia/02-quiz-1.html?x=17062&y=20672&z=31.4&page=1

How cells define polarity

Terminal bars



Apical domain facing the lumen containing Aquaporins channels, responsible for the water balance

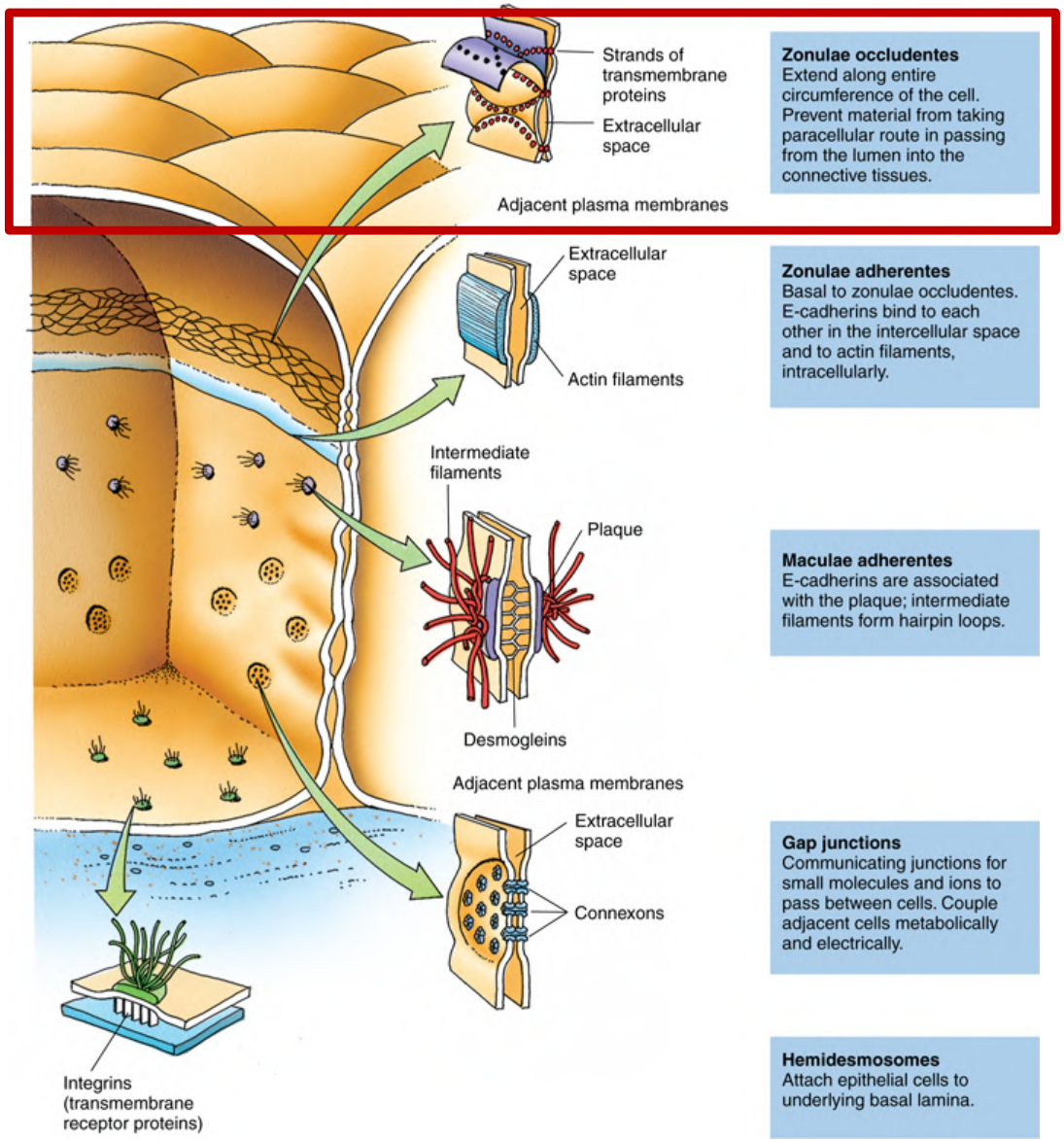
Basolateral domain in contact with the basal lamina

Terminal Bars

Three types of junctional complexes

- **Occluding junctions**: form impermeable barriers between cells, preventing material in passing across
- **Anchoring junctions**: maintain cell-to-cell, and cell-to-lamina anchoring
- **Communicating junctions:** permit movement of signalling molecules between cells

Tight Junctions or **Zonulae occludentes (ZO)**



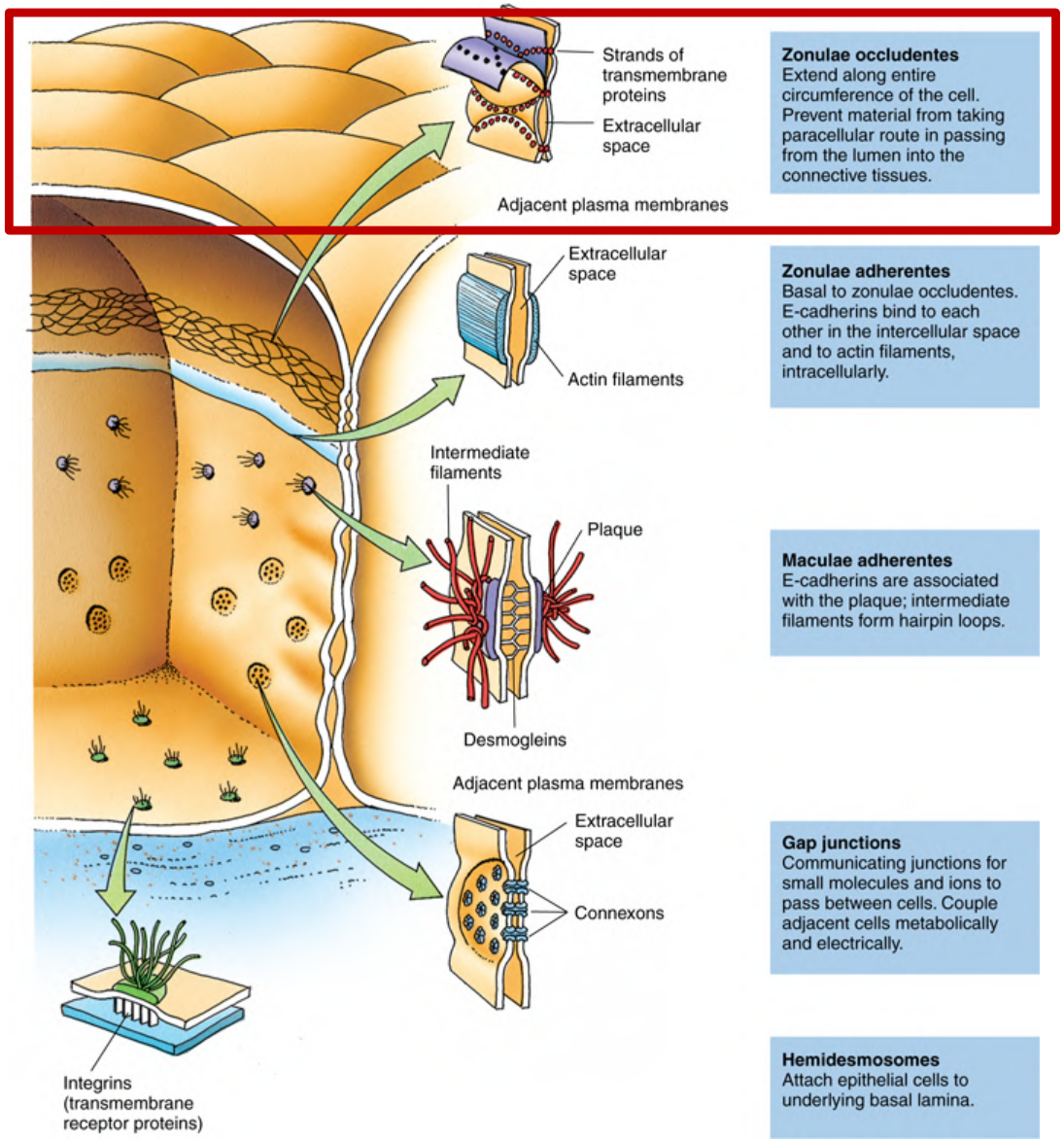
Junctional complexes, gap junctions, and hemidesmosomes.

Tight Junctions or are **occluding junctions (ZO)** and they are located between adjacent plasma membranes and are the most **apically located** junctions between the cells of the epithelia.

They form a “belt-like” junction that encircles the entire circumference of the cell.

ZO prevents material in passing from the lumen into the connective tissues.

Tight Junctions or **Zonulae occludentes (ZO)**

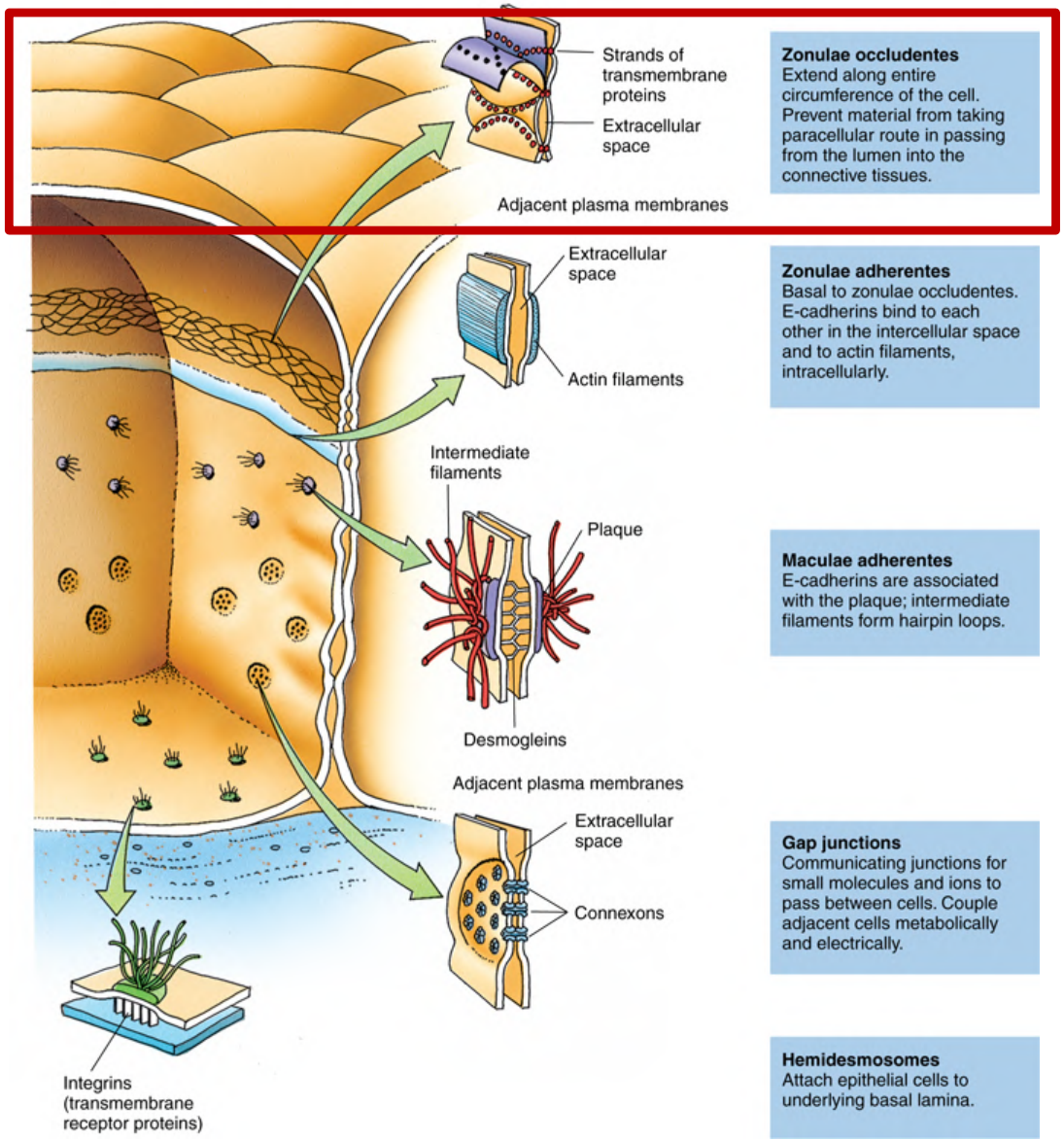


Junctional complexes, gap junctions, and hemidesmosomes.

Prevent the movement of membrane proteins from the apical domains to the basolater domain

Fuse plasma membranes of adjacent cells to each other to avoid water soluble molecules from passing between cells.

Tight Junctions or **Zonulae occludentes (ZO)**



Junctional complexes, gap junctions, and hemidesmosomes.

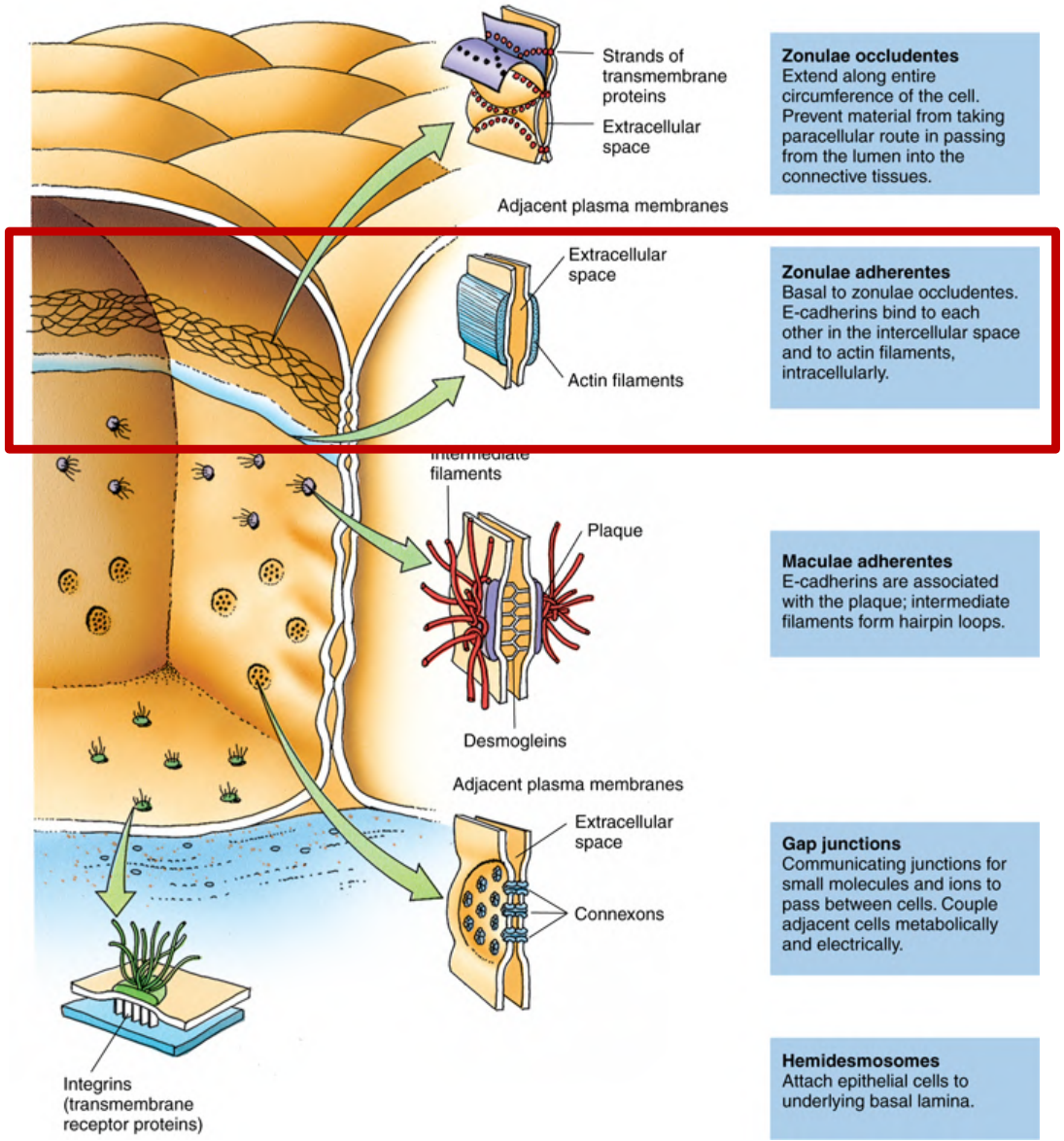
Tight Junctions at the fusion site are composed of four type of transmembrane proteins:

Claudins (major role)

Occludins, nectins and junctional adhesive molecules (JAM) have a role not yet known

Claudins need e-cadherins to form strong cell adhesion and complexes of Zonula Occludentes molecules ZO-1, ZO-2, ZO-3 and ZO-4

Junctional Complex- **zonula adherentes**



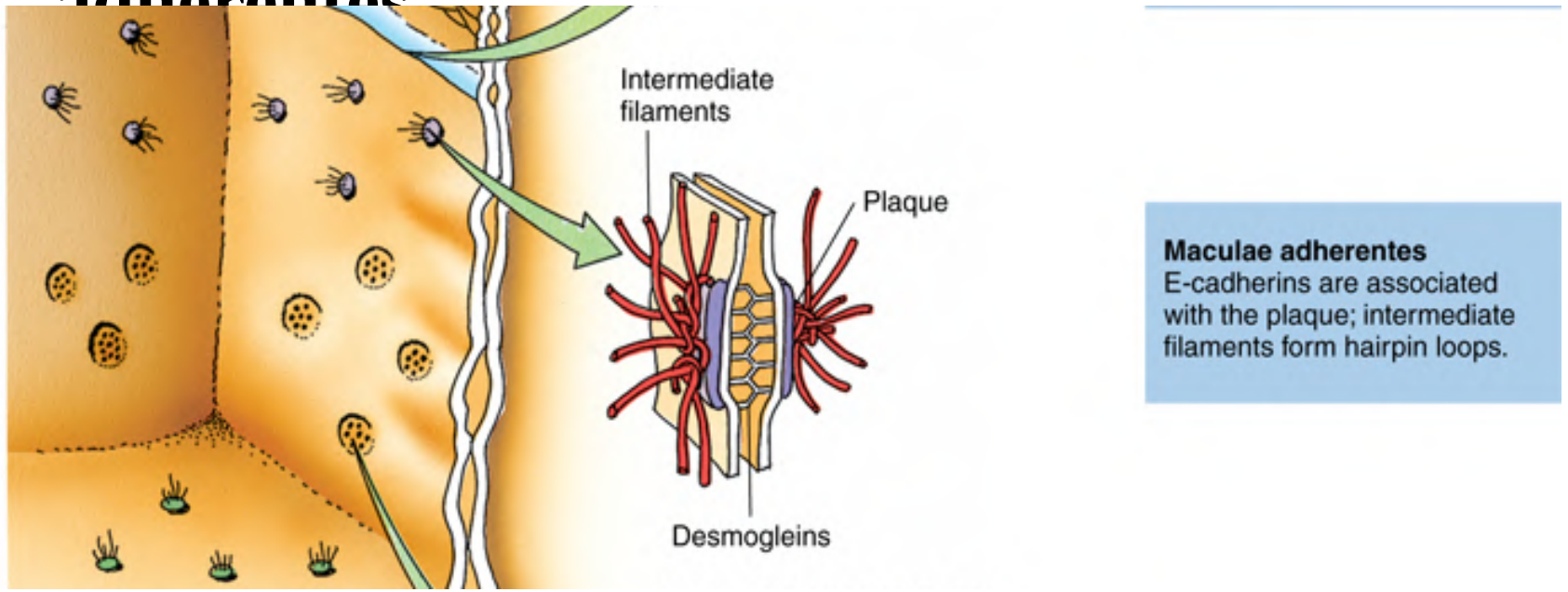
Junctional complexes, gap junctions, and hemidesmosomes.

Zonulae adherentes are anchoring junctions of epithelial cells are located just basal to the zonulae occludentes and also encircle the cell.

The intercellular space of 15 to 20 nm between the two adjacent cell membranes is occupied by **cadherins.** These Ca^{+}-dependent proteins of the cell membrane are **transmembrane linker proteins**.

Their intracytoplasmic aspect binds to a web of actin filaments that are attached to each other and to the cell membrane by **vinculin**, **catenin and α-actinin.**

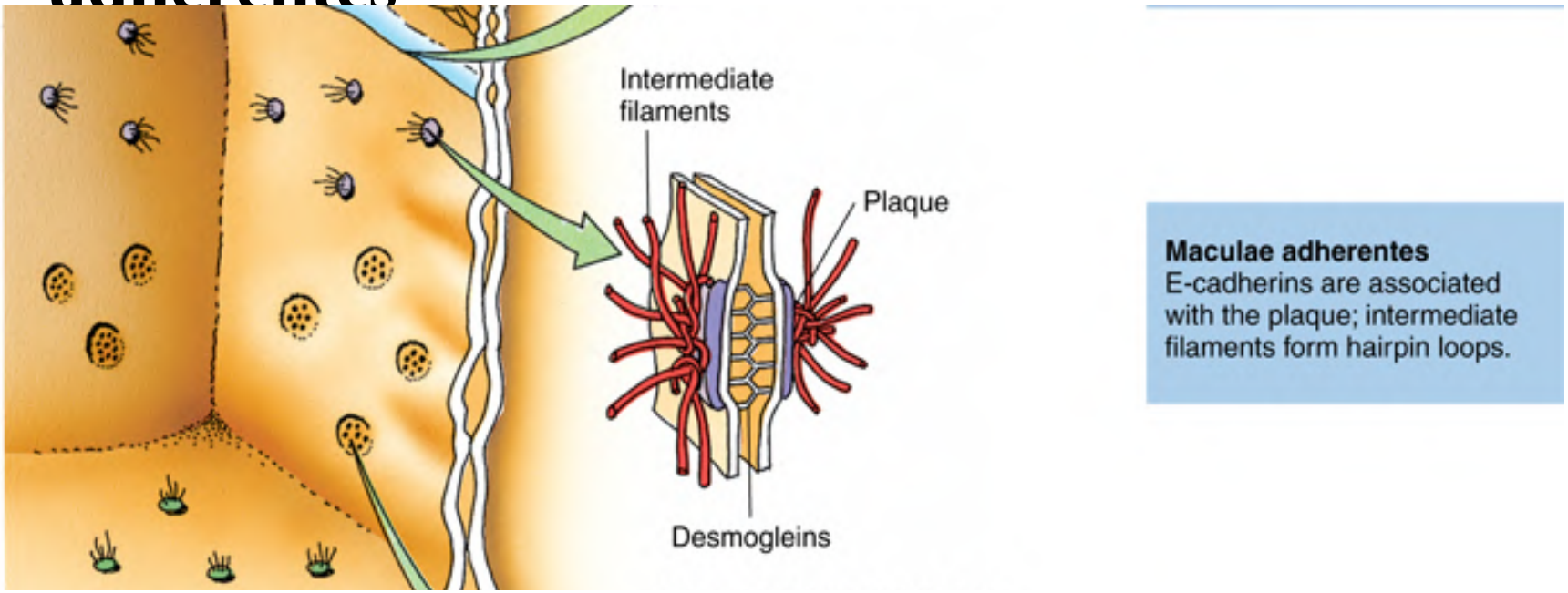
Junctional Complex -**Desmosomes or Macula adherentes**



Desmosomes are the last of the three components of the junctional complex.

Two disk-shaped forming the attachment plaques are located opposite each other on the cytoplasmic side of the plasma membranes of adjacent epithelial cells - Each plaque is composed of a series of attachment proteins.

Junctional Complex -**Desmosomes or Macula adherentes**



The intercellular space is of 30 nm and it is occupied with the extracellular domains of:

Desmocollins and desmogleins, are both cadherins (Calcium-dependent adhesion)

The outer dense plaque is adhering to the cytoplasm. It's composed of glycoproteins (**plakoglobins** and **plakophilins** held together by **desmoplakins**). Desmoplakins contact keratins (IF)

Junctional complexes, gap junctions, and hemidesmosomes.

Hemidesmosomes - Type I

Hemidesmosomes resemble half desmosomes and serve to attach the basal cell membrane to the basal lamina.

Type I hemidesmosome is more complex than II and is present in the basal layer of cells ***of the stratified squamous epithelia*** and ***pseudostratified epithelia***.

- α6β4 integrin molecules
- **Tonofilaments of K5 and K14** intermediate filaments
- **Plakin** proteins that bind to tonofilaments and α6β4 integrin
- **Erbin** facilitates the binding of integrin to plakins
- **CD151** that recruits integrins to ensure the formation of hemidesmosome

Attachment plaques, composed of desmoplakins and other associated proteins, are present on the cytoplasmic aspect of the plasma membrane.

Keratin tonofilaments insert into these plaques, unlike those in the desmosome, where the filaments enter the plaque and then make a sharp turn to exit it. The cytoplasmic aspects of **transmembrane linker proteins** are attached to the plaque, whereas their extracellular moieties bind to **laminin** and **type IV collagen** of the basal lamina.

Junctional complexes, gap junctions, and hemidesmosomes.

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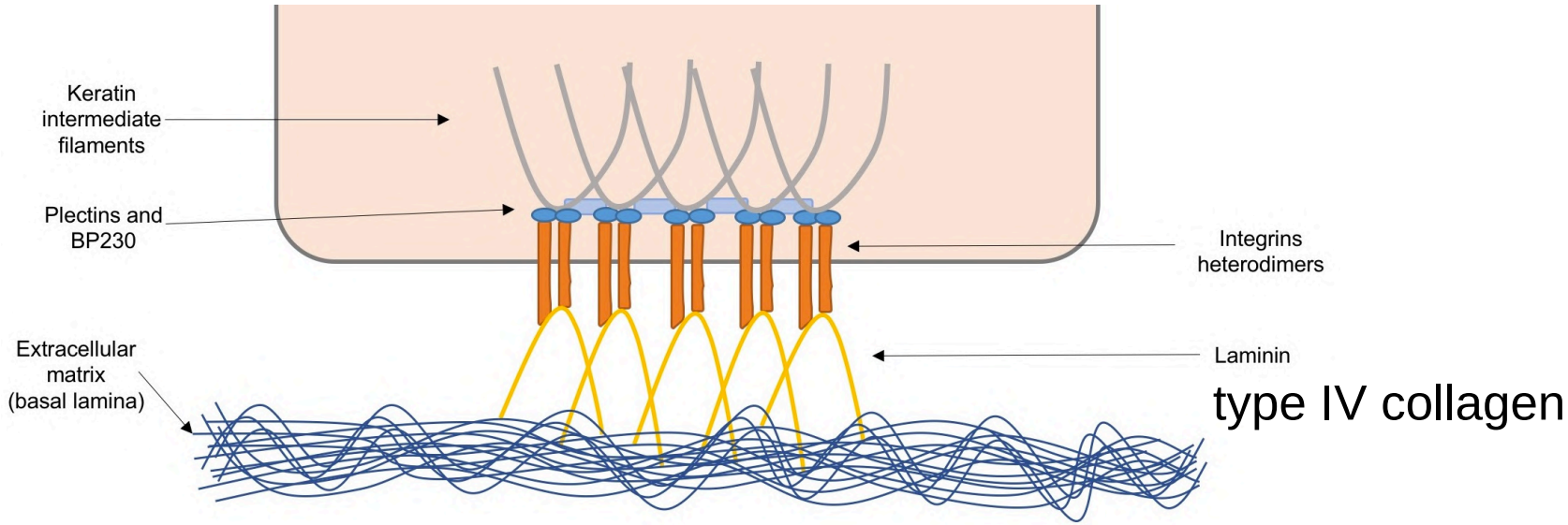
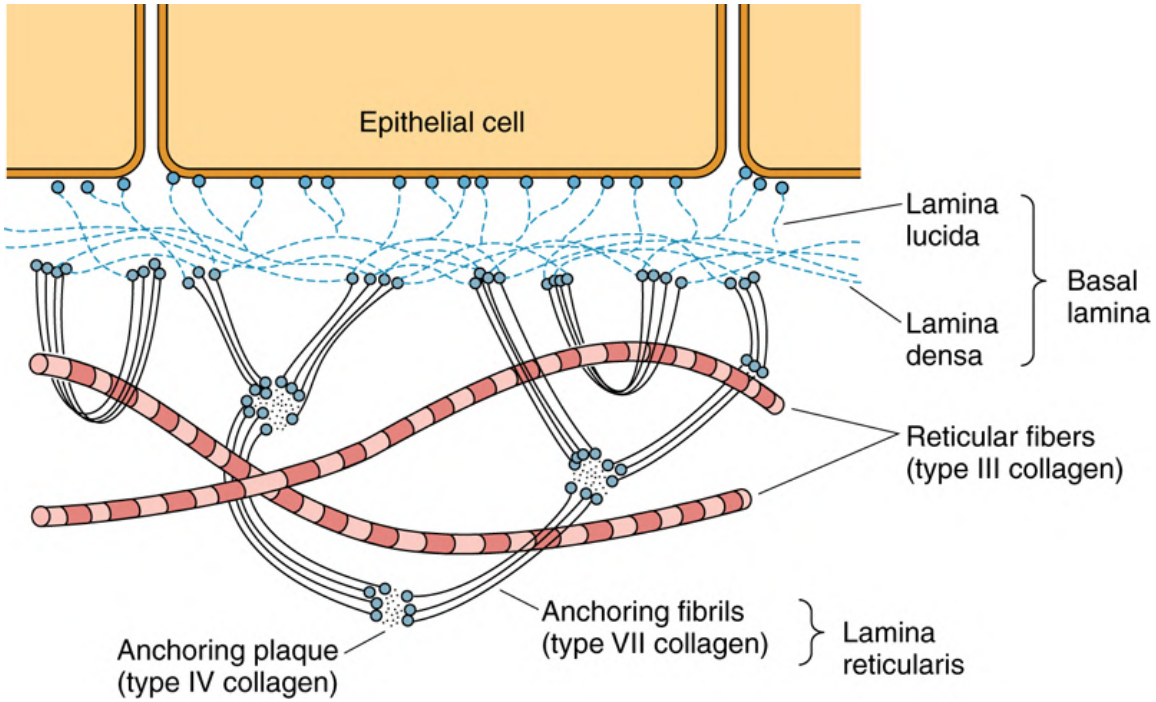


Basement Membrane



Basal lamina and lamina reticularis. *(Adapted from Fawcett DW: Bloom and Fawcett's A Textbook of Histology, 12th ed. New York, Chapman and Hall, 1994.)*

The lamina reticularis possesses **fibronectin.**

The lamina reticularis, a region of varying thickness, is manufactured by fibroblasts and is composed of type I and type III collagen. It is the interface between the basal lamina and the underlying connective tissue, and its thickness varies with the amount of frictional force on the overlying epithelium.

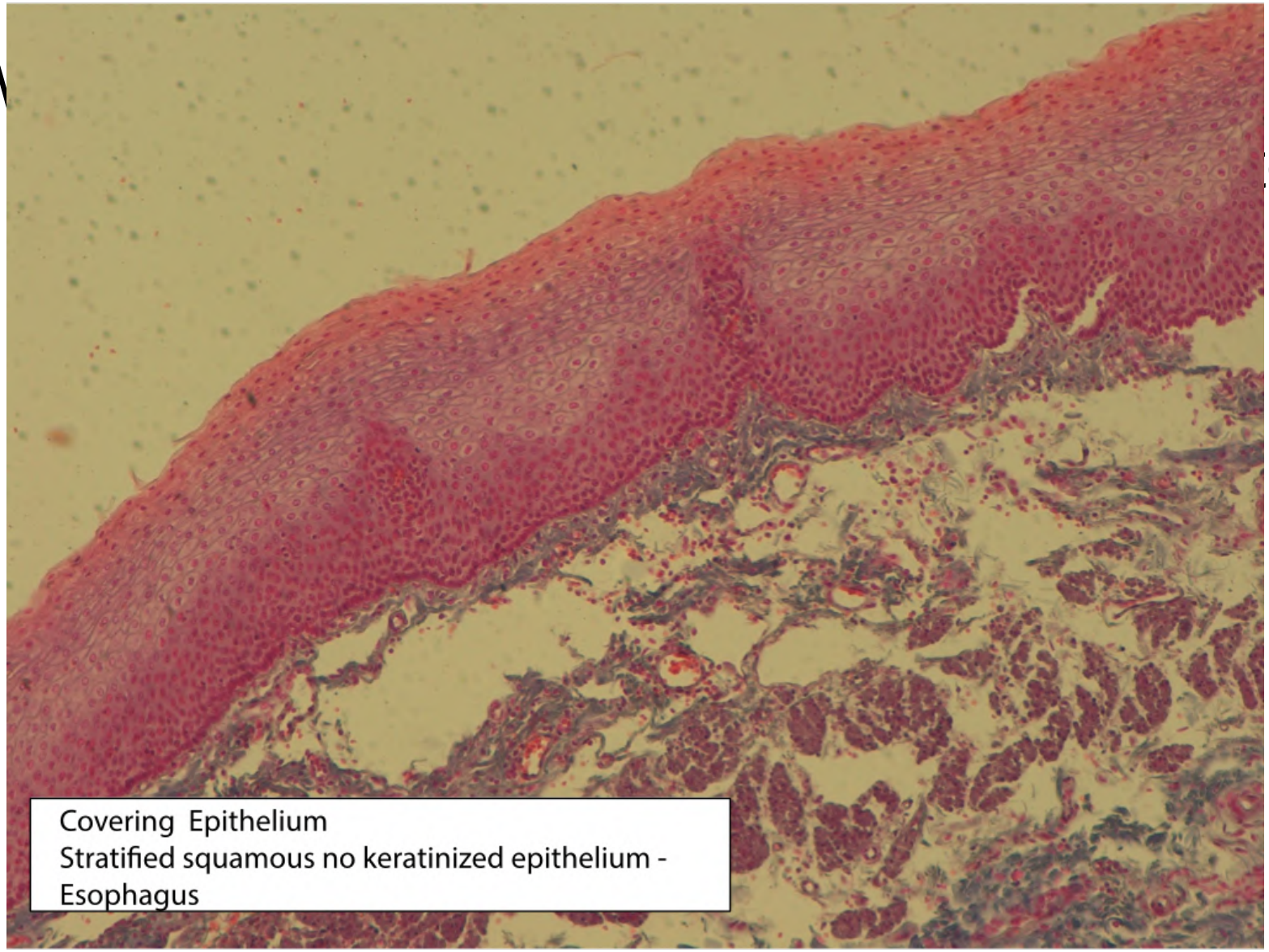
Hemidesmosomes - Type II

Hemidesmosomes Type II are present in the basal plasma membrane of simple columnar epithelial cells. They have large concentration of integrin molecules, which form bonds with keratin-8 and 18.

Both require the presence of calcium ions to maintain the attachment to the basal lamina.

Junctional complexes, gap junctions, and hemidesmosomes.

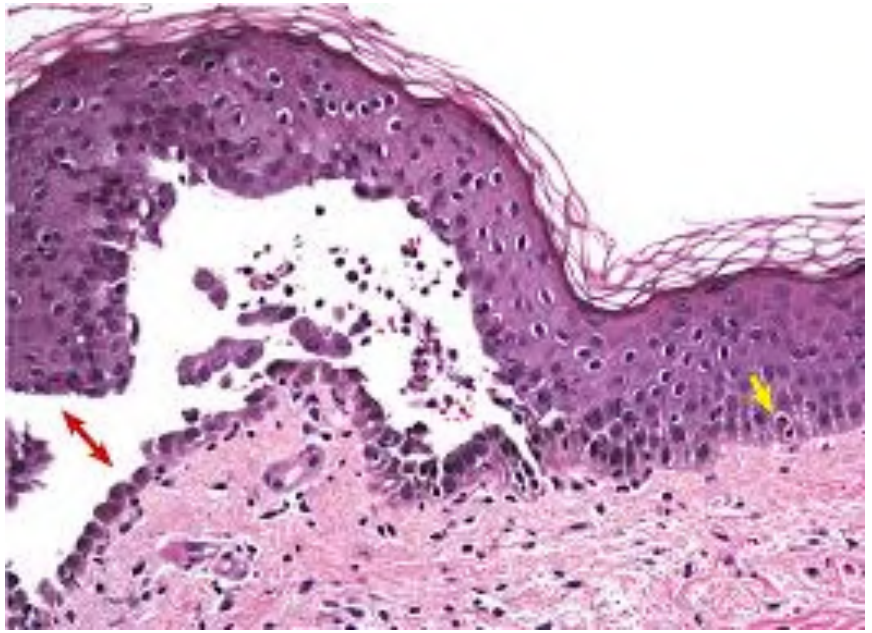
- W
  p eins?



Clinical Correlations

Autoantibodies against desmosomal proteins are responsible for a skin disease:

Pemphigus vulgaris



Treatments: Systemic steroids and immunosuppressive agents

Naxos Syndrome

- Middle East and in the Greek Island: Naxos
- Mutations in desmoplakins and plakoglobins

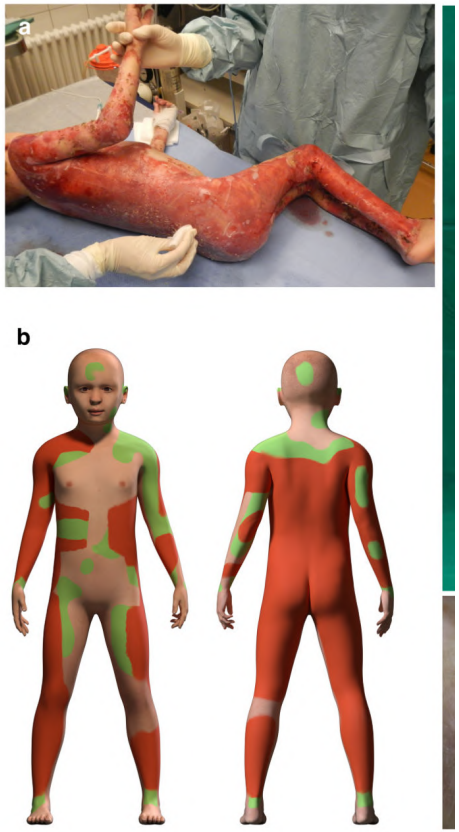
Keratoderma of the palm of the hands and of the feet

Cardiomiopathy involving right ventricular arrhytmia

Generalized Junctional Epidermolysis Bullosa (JEB)

- Skin and mucosal blisters and erosions occur within the lamina lucida of the basement membrane upon minor trauma
- JEB is caused by mutations in LAMA3, LAMB3 or LAMC2 genes

Clinical picture of the patient showing massive epidermal loss.



At the first surgery, the patient had complete epidermal loss on ~80%

Regeneration of the entire human epidermis by transgenic stem cells

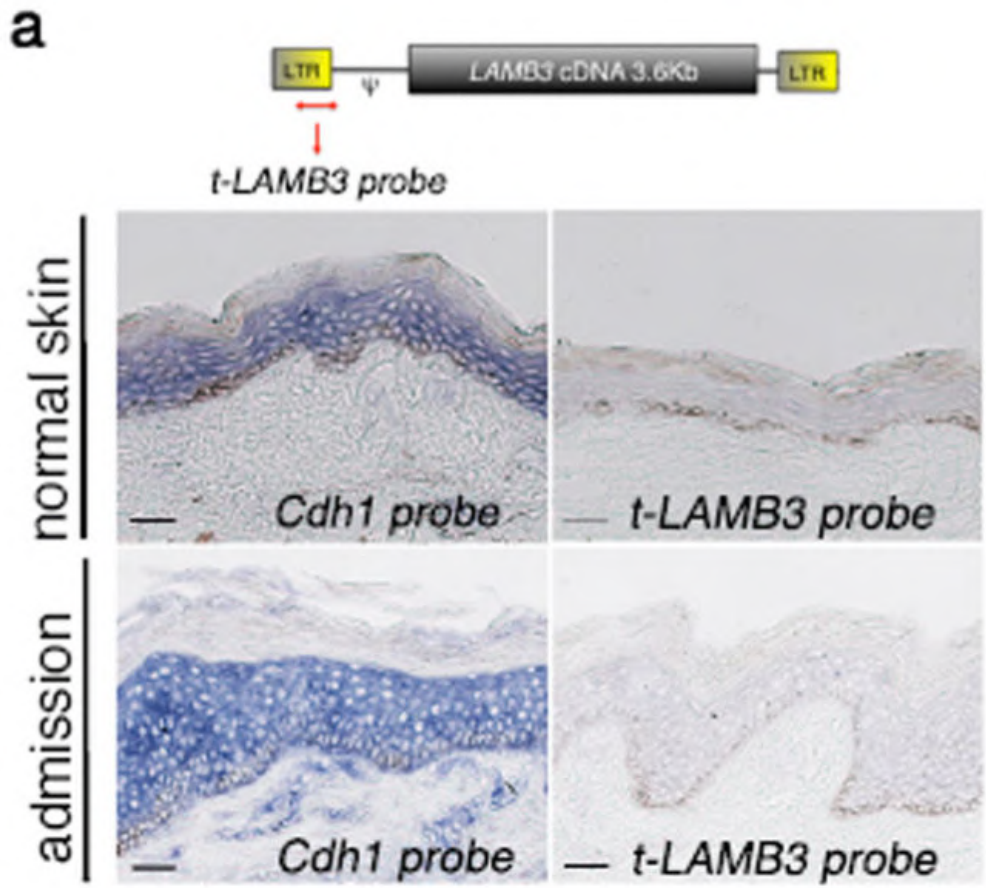
Tobias Hirsch[1,*], Tobias Rothoeft[2,*], Norbert Teig[2,*], Johann W. Bauer[3,*], Graziella Pellegrini[4,5,*], Laura De Rosa[5], Davide Scaglione[6], Julia Reichelt[3], Alfred Klausegger[3], Daniela Kneisz[3], Oriana Romano[7], Alessia Secone Seconetti[5], Roberta Contin[5], Elena Enzo[5], Irena Jurman[8], Sonia Carulli[9], Frank Jacobsen[1], Thomas Luecke[10], Marcus Lehnhardt[1], Meike Fischer[2], Maximilian Kueckelhaus[1], Daniela Quaglino[7], Michele Morgante[8], Silvio Bicciato[7], Sergio Bondanza[9], and Michele De Luca[5,#]

[1]Department of Plastic Surgery, Burn Centre, BG University Hospital Bergmannsheil - Ruhr-University Bochum, Germany

https://www.ncbi.nlm.nih.gov/pubmed/29144448

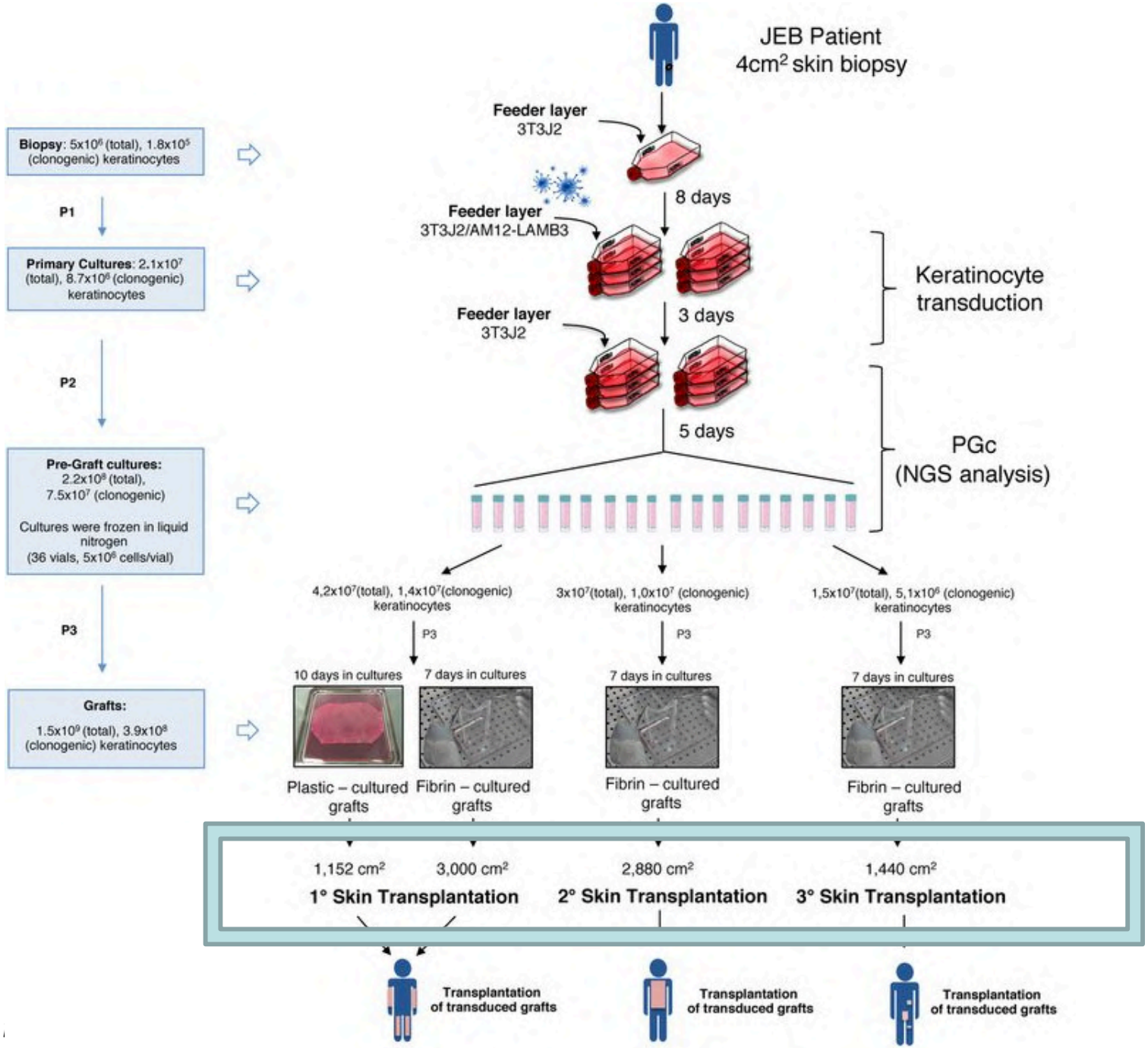
Experimental plan

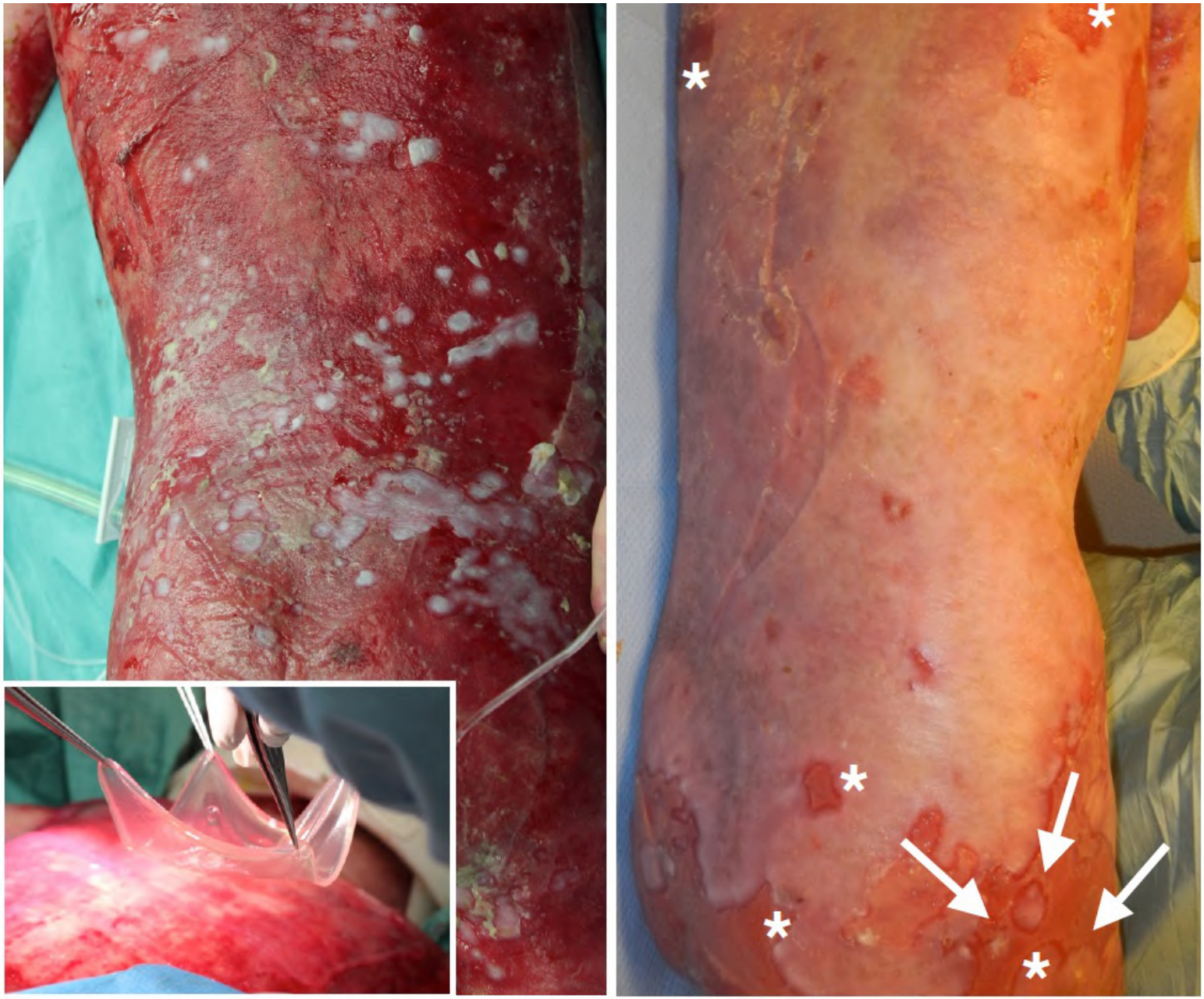
4-cm2 biopsy, taken from a currently non-blistering area of patient's left inguinal region, was used to establish primary keratinocyte cultures, which were then transduced with a retroviral vector (RV) expressing the full-length LAMB3 cDNA under the control of the Moloney leukaemia virus (strong promoter)



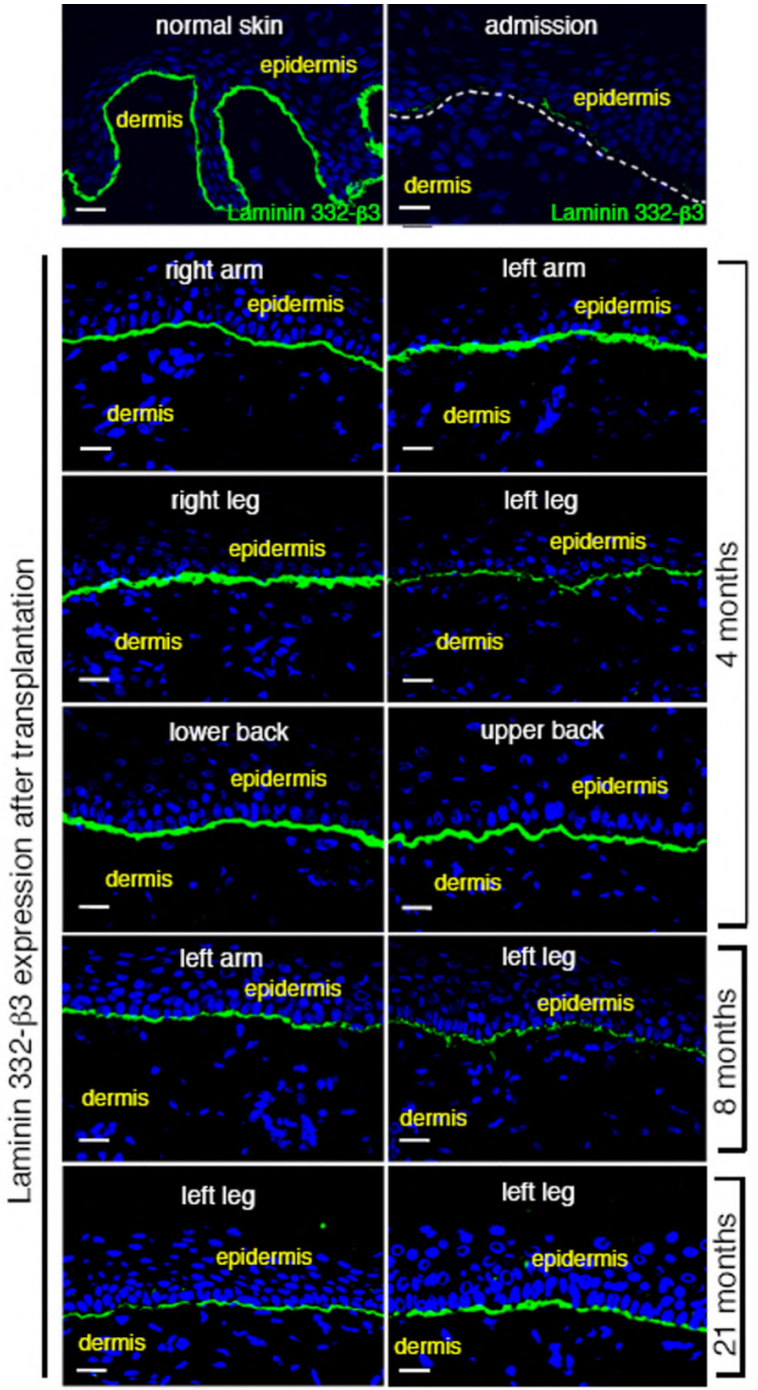
Center for Regenerative Medicine "Stefano Ferrari", Department of Life Sciences, University of Modena and Reggio Emilia, Modena, Italy

Experimental plan





Complete recovery after 21 months



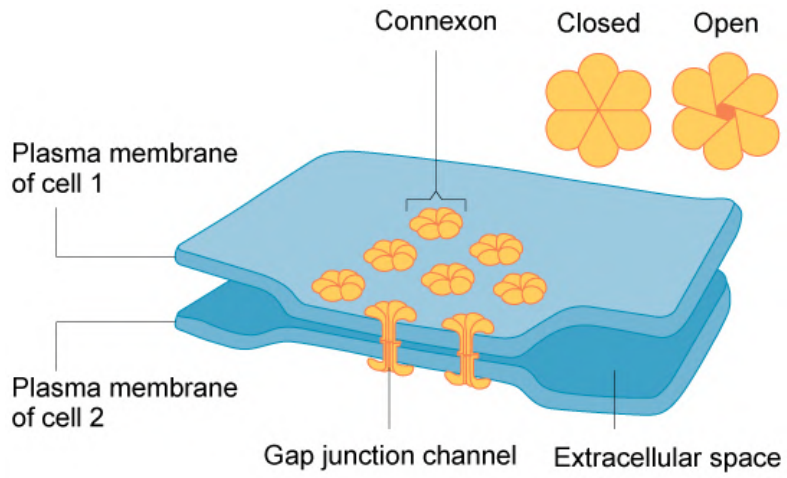
Gap junctions or communicating junctions

Gap junctions are widespread in epithelial tissues, neurons, muscle cells and cardiac cells, but NO skeletal muscle cells.

The GJs mediate intercellular communication by permitting the passage of small molecules.

They are built by six closely packed transmembrane proteins **(connexins)** that assemble to form structures called **connexons**, aqueous pores through the plasma membrane extending into the intercellular space.

Two connexons in adjacent cells are aligned, forming a Gap Junction.

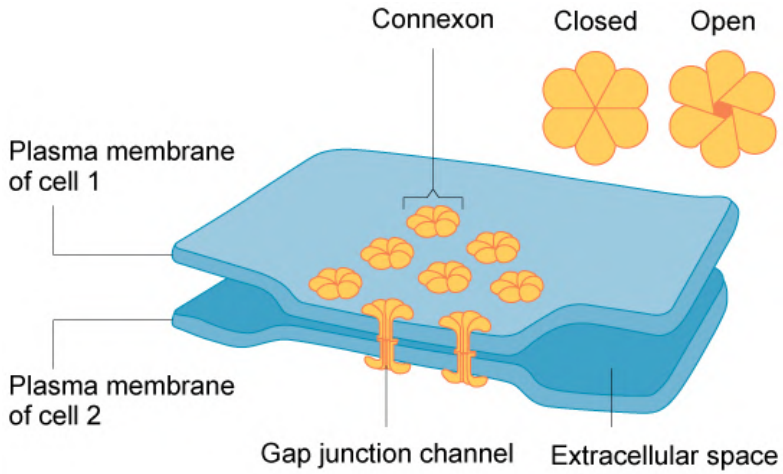


Junctional complexes, gap junctions, and hemidesmosomes.

Gap junctions or communicating junctions

Two connexons in adjacent cells are aligned, forming a Gap Junction.

The two connexons fuse, forming the functional intercellular communication channel. Gap junctions are regulated, so they may be opened or closed. Although the opening and closing mechanism is not understood, it has been shown experimentally that a decrease in cytosolic pH or an increase in cytosolic Ca^{2+} concentrations closes channels. Conversely, high pH or low Ca^{2+} concentration opens the channels.



Junctional complexes, gap junctions, and hemidesmosomes.

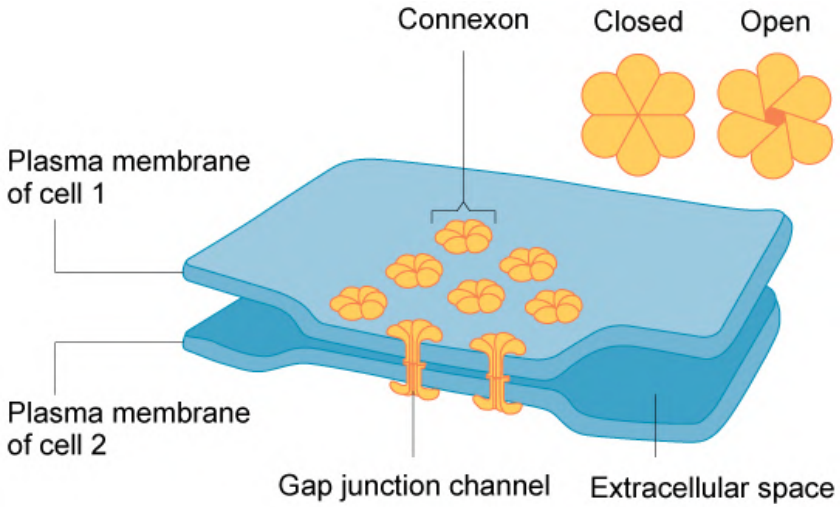
Gap junctions or communicating junctions

Gap junctions functions for sharing molecules for coordinating physiological continuity within a particular tissue

For example, when glucose is needed in the bloodstream, the nervous system stimulates hepatocytes to initiate glycogen breakdown.

Because not all the hepatocytes are individually stimulated, the signal is propagated to other hepatocytes by gap-junctions.

- Heart cells are also coordinated by gap-junctions
- Also gut muscle during peristalsis are coordinated by gap-junction



Clinical Correlations

A number of cardiac arrhythmias have been linked to gap junction anomalies. These are due to wrong number of gap junctions plaques or to the wrong location, in the lateral membrane instead of being at the end of the cells, compared to the healthy ventricular myocardial cells.

Renewal of epithelial cells

- Epithelial tissues exhibit a high turnover rate, which is related to their location and function.
- Epidermis takes approximately 28 days
- Cells lining the intestine are replaced every 4 to 6 days.

Clinical correlation

- Cells in an epithelium may transform into another epithelial type: **metaplasia**.
- Pseudostratified ciliated epithelium in heavy smokers undergo squamous metaplasia (transform into **stratified squamous epithelium**)
- Tumors that arise from epithelial cells are known as carcinoma
- Tumors that arise from glandular epithelium are known as adenocarcinoma

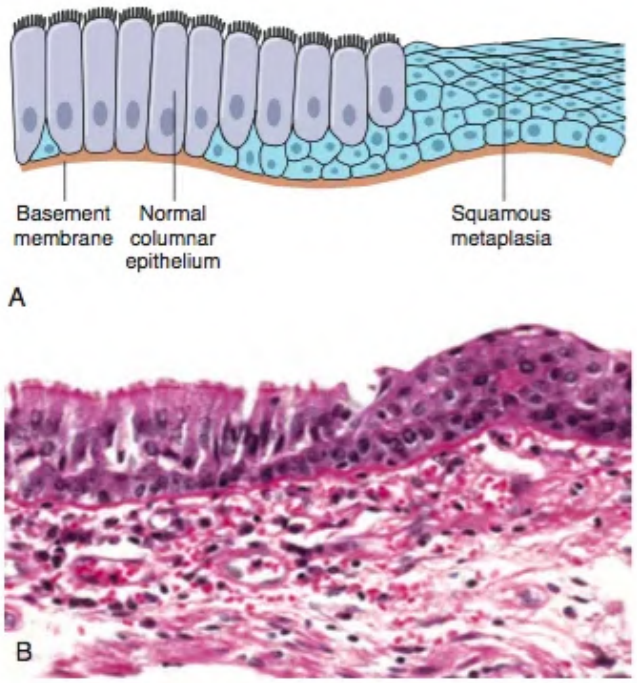
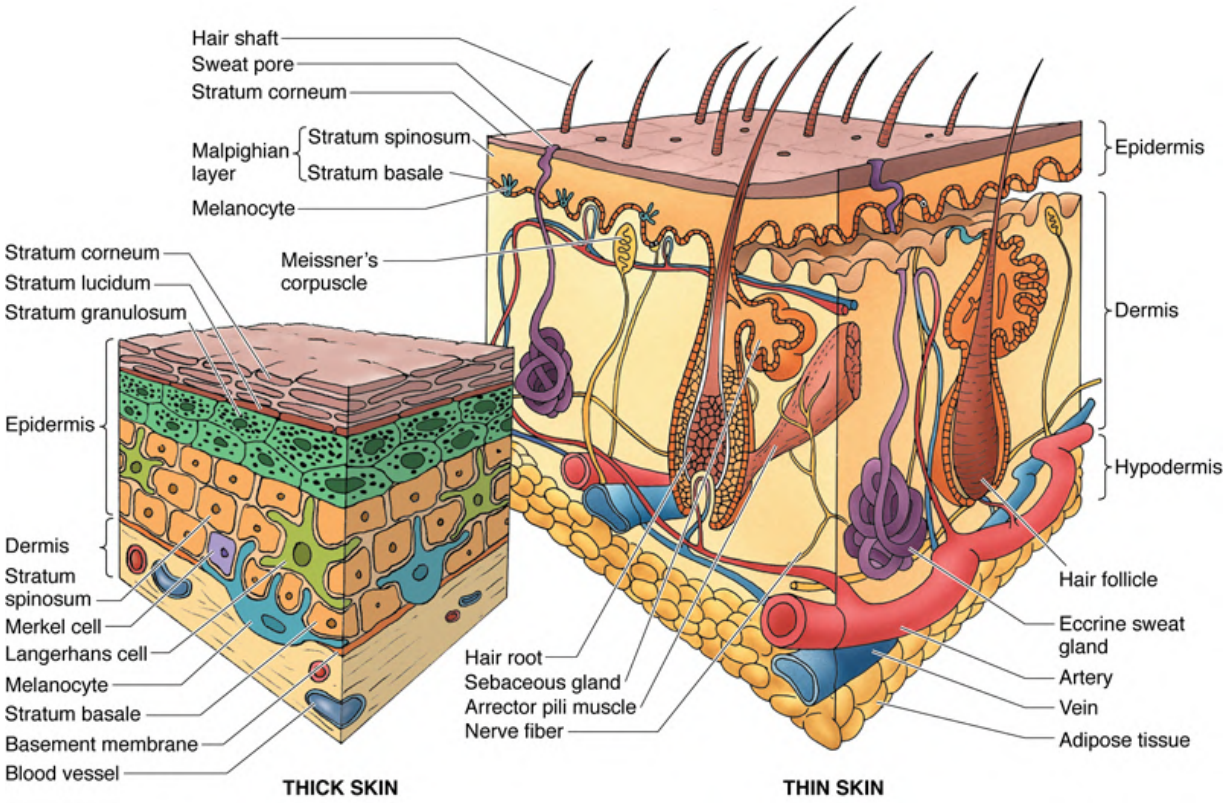


Figure 2-6 Metaplasia of columnar to squamous epithelium. **A,** Schematic diagram. **B,** Metaplasia of columnar epithelium *(left)* to squamous epithelium *(right)* in a bronchus.

Integument (Skin)



Comparison of thick skin and thin skin.

The **integument,** composed of **skin sweat glands, sebaceous glands, hair,** and **nails,** is the largest organ, constituting 16% of the body weight.

Besides providing a cover for the underlying soft tissues, skin performs many additional functions, including

(1) **protection** against injury, bacterial invasion, and desiccation;

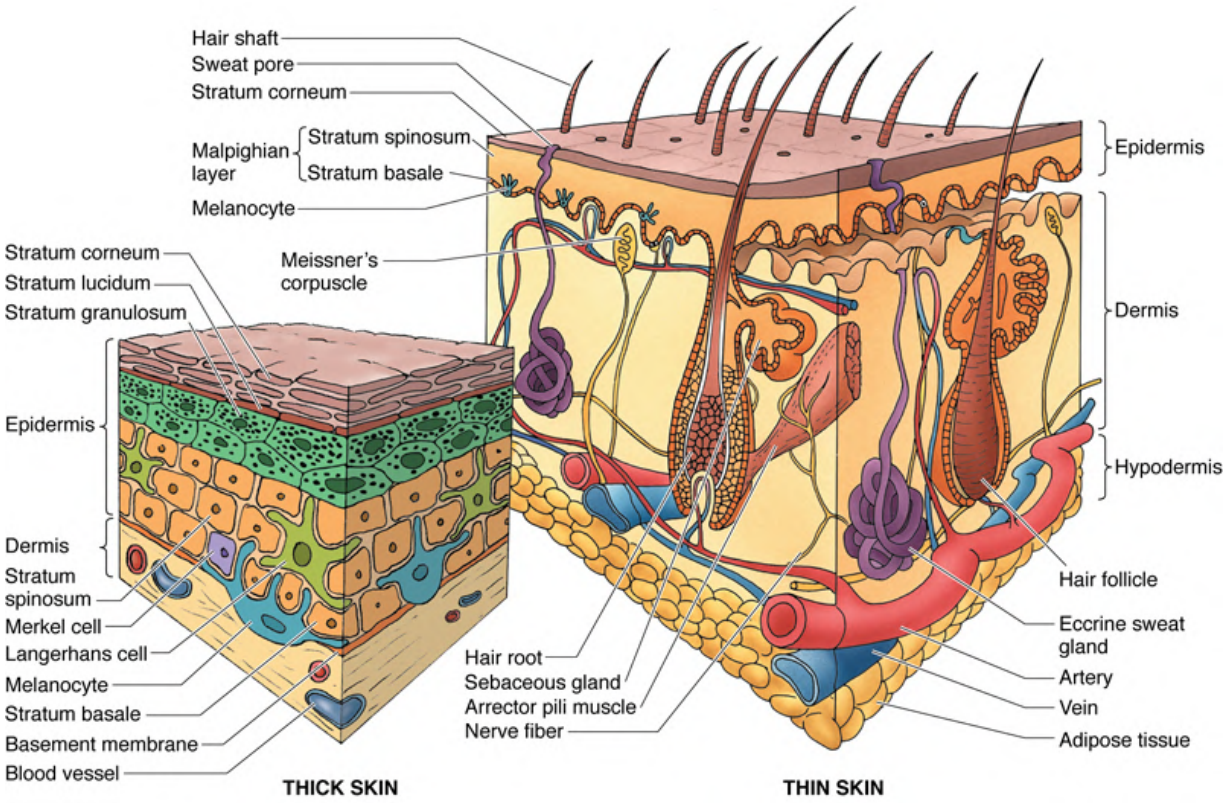
(2) **regulation of body temperature;**

(3) **reception** of sensations from the environment (e.g., touch, temperature, and pain);

(4) **excretion** from sweat glands;

(5) **absorption** of ultraviolet (UV) radiation from the sun for the synthesis of vitamin D.

Integument



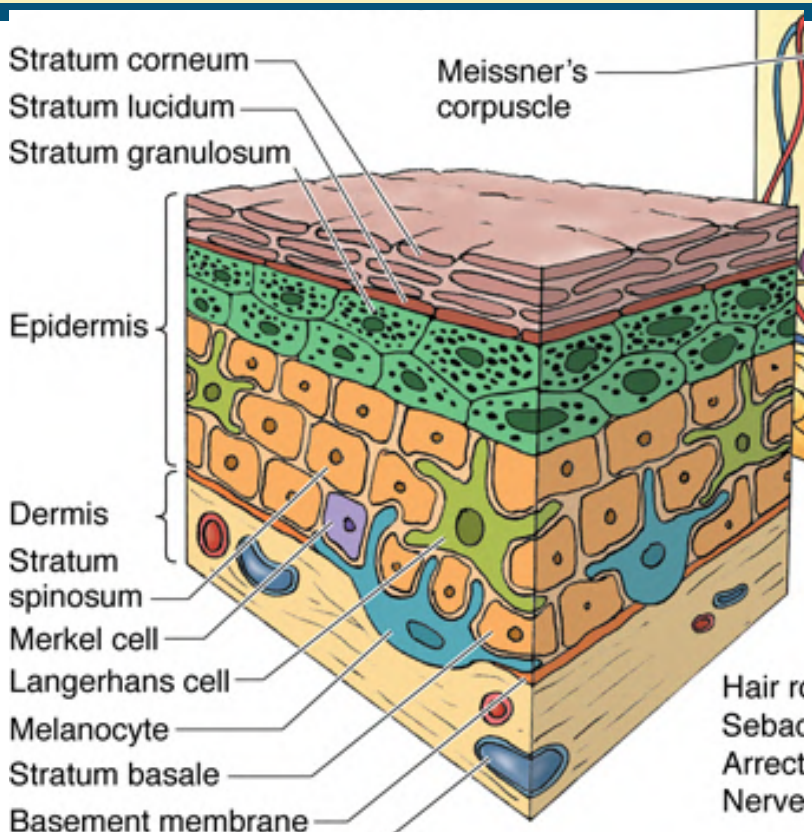
Comparison of thick skin and thin skin.

Skin consists of two layers:

an outer epidermis and a deeper connective tissue layer, the dermis.

The **epidermis** is composed of stratified squamous keratinized epithelium. Lying directly below and interdigitating with the epidermis is the **dermis,** composed of dense, irregular collagenous connective tissue. The interface between the epidermis and dermis is formed by the **dermal ridges (papillae),** which interdigitate with invaginations of the epidermis called **epidermal ridges**.

Epidermis



Comparison of thick skin and thin skin.

The **epidermis** is 0.07 to 0.12 mm in thickness over most of the body, with localized thickening on the palms of the hands and the soles of the feet (where it may be as much as 0.8 mm and 1.4 mm in thickness, respectively).

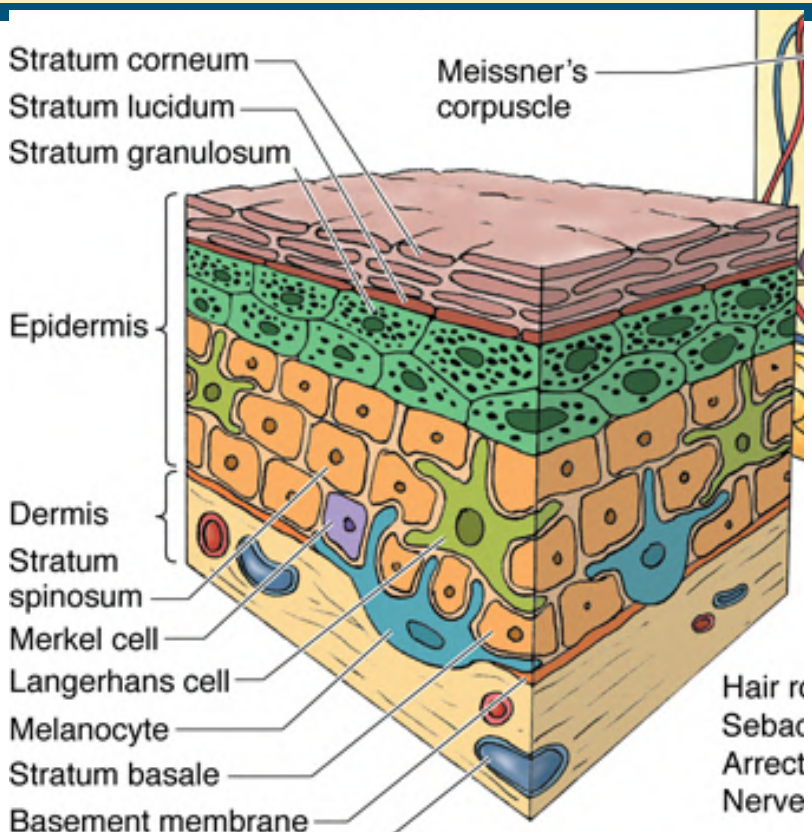
Keratinocytes, which form the largest population of cells, are arranged in five recognizable layers; the remaining three cell types:

Langerhans cells (antigen presenting cells derived from precursor in the bone marrow, modified macrophages),

Merkel cells (have mechanoreceptors and secrete neurocrine like substances, similar to Diffuse Neuro Endocrine System),

Melanocytes derive from the neural crest have processes known as dendrites, produce melanin responsible for pigmentation

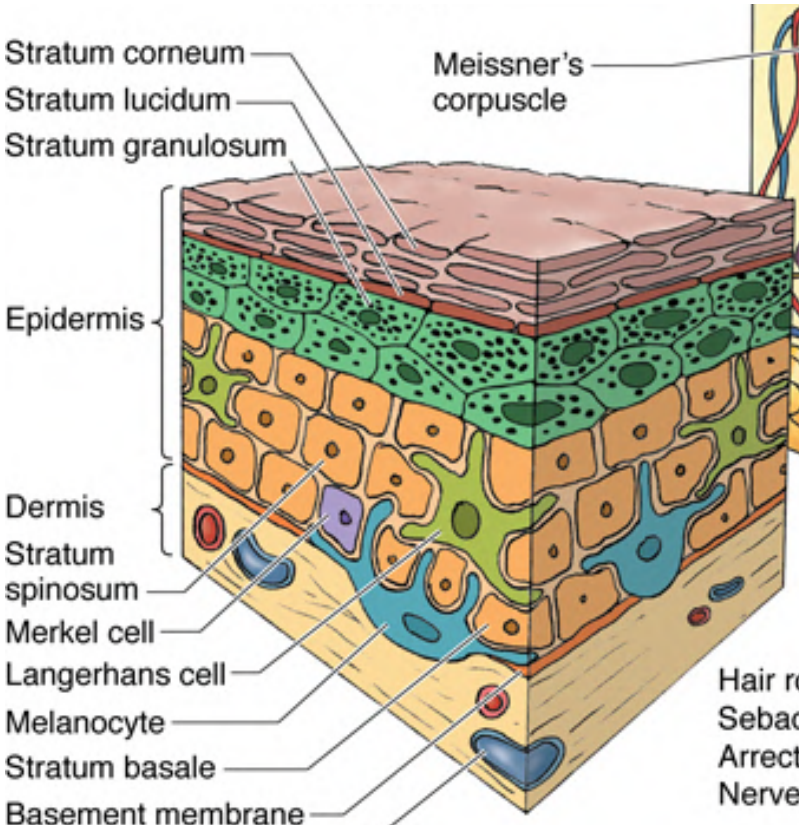
Epidermis



Comparison of thick skin and thin skin.

Because keratinocytes are being continually sloughed from the surface of the epidermis, this cell population must continually be renewed. Renewal is accomplished through mitotic activity of the keratinocytes in the basal layers of the epidermis and as the new cells are forming, the cells above continue to be pushed toward the surface. Along their way to the surface, the cells differentiate and begin to accumulate **keratin filaments** in their cytoplasm. Eventually, as they near the surface, the cells die and are sloughed off, a process that takes **20 to 30 days.**

Epidermis



Comparison of thick skin and thin skin.

Because of the **cytomorphosis** of keratinocytes during their migration from the basal layer of the epidermis to its surface, five morphologically distinct zones of the epidermis can be identified.

From the inner to the outer layer, these are the

(1) stratum basale (germinativum)

(2) stratum spinosum

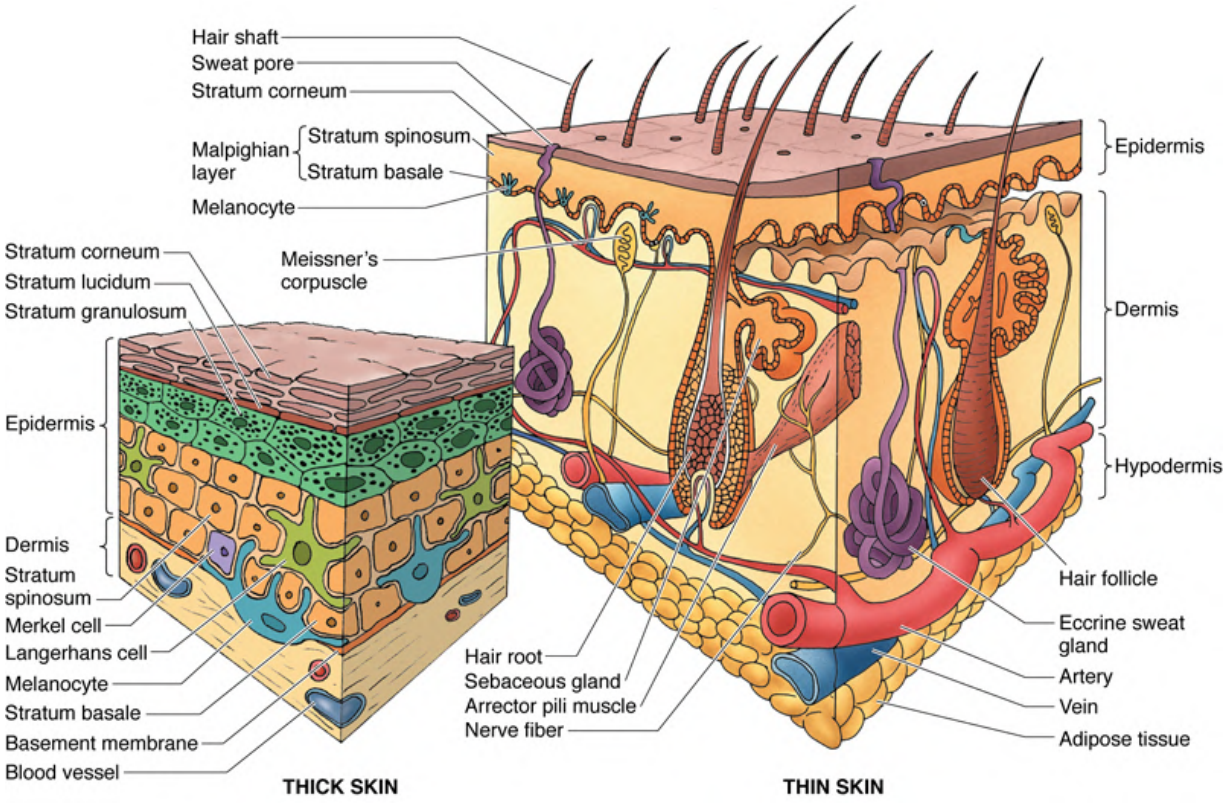
(3) s**tratum granulosum** (due to keratohyalin granules)

(4) stratum lucidum, and

(5) stratum corneum.

Skin is classified as **thick** or **thin** according to the thickness of the epidermis. However, these two types also are distinguished by the presence or absence of certain epidermal layers and the presence or absence of hair.

Dermis



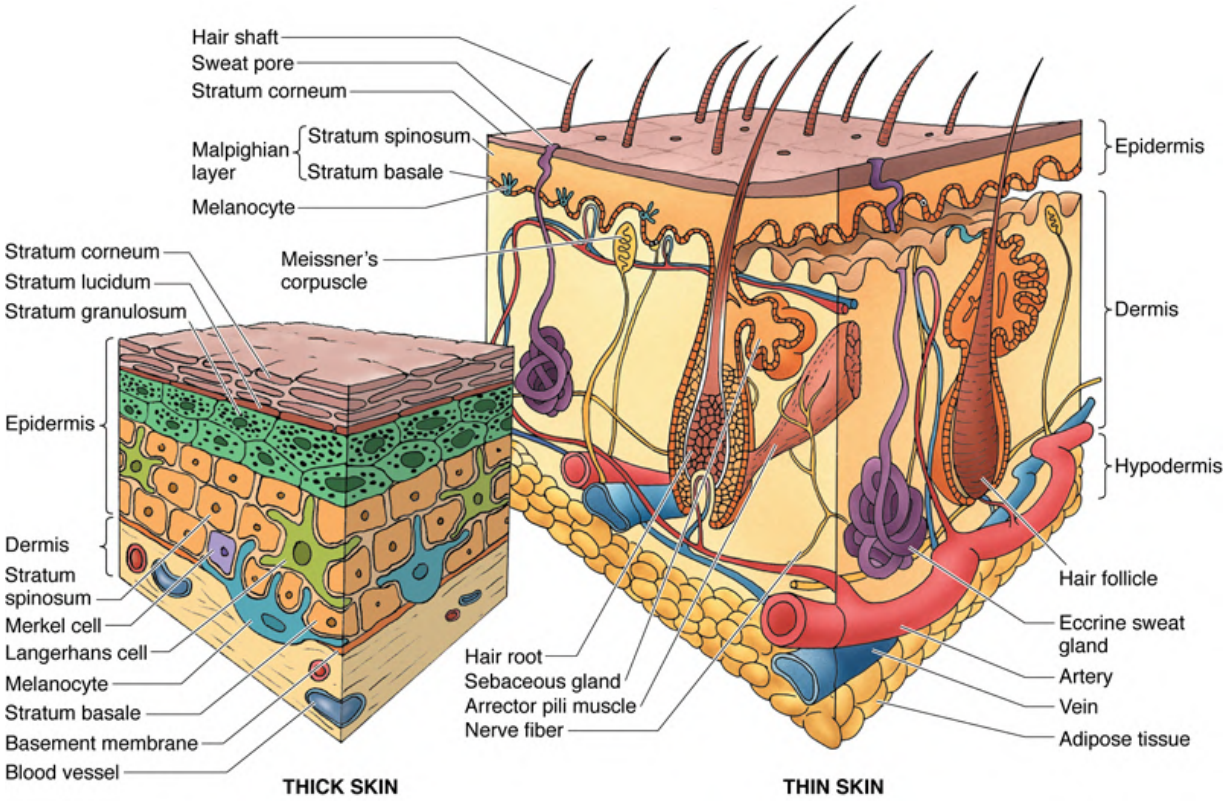
Comparison of thick skin and thin skin.

The region of the skin lying directly beneath the epidermis, called the **dermis** is divided into two layers:

the superficial, loosely woven **papillary layer** and the deeper, much denser **reticular layer.**

The dermis is composed of **dense, irregular collagenous connective tissue**, containing mostly type I collagen fibers and networks of elastic fibers, which support the epidermis and bind the skin to the underlying **hypodermis** (superficial fascia).

Dermis



Comparison of thick skin and thin skin.

The superficial papillary layer of the dermis is uneven where it interdigitates with the epidermis, forming the dermal ridges (**papillae**).

It is composed of a loose connective tissue whose thin **type III collagen fibers** and **elastic fibers** are arranged in loose networks.

The interface between the papillary layer and **reticular layer** of the dermis is indistinguishable. Characteristically, the reticular layer is composed of dense, irregular collagenous connective tissue, displaying thick **type I collagen fibers,** which are closely packed into large bundles lying mostly parallel to the skin surface. **Sweat glands, sebaceous glands,** and **hair follicles,** all derived from the epidermis, invade the dermis and hypodermis during embryogenesis, and remain there permanently.

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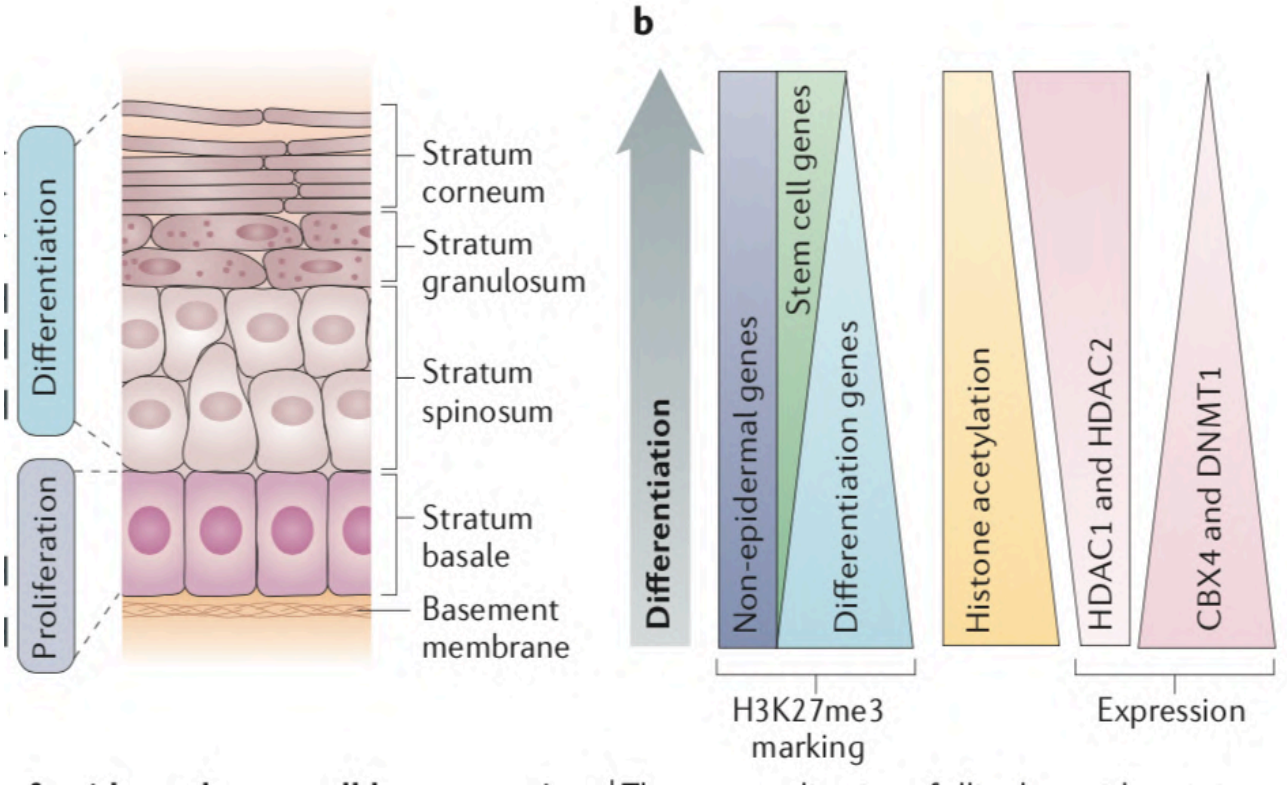
Epigenetic regulation of epidermal stem cell homeostasis



Epigenetic events controlling proliferative potential in the basal layer, as well as lineage commitment and differentiation,

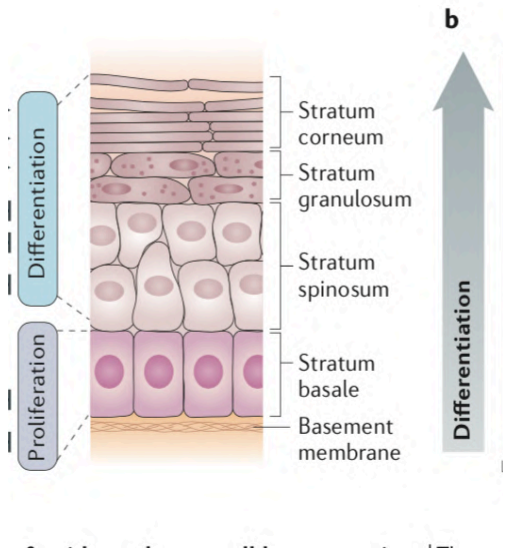
Stratified epithelium in which proliferation occurs exclusively in the basal layer (stratum basale). Post-mitotic cells migrate and differentiate through the different layers of the epidermis until they are ultimately shed from the stratum corneum.

CBX, chromobox; DNMT, DNA methyltransferase; EDC, epidermal differentiation complex; HDAC, histone deacetylase;

Epigenetic regulation of epidermal stem cell homeostasis

- Histone acetylation leads to loosening of the chromatin and therefore greater accessibility for the transcriptional machinery.

- DNMT1 (DNA methyltransferase) *DNA (de)methylases* levels in the epidermis are highest in undifferentiated basal epidermal progenitor cells and decrease with cellular differentiation



The chromatin state is dynamic during epidermal differentiation.
Histone H3 Lys27 trimethylation (H3K27me3) marking is highly locus specific, whereas histone acetylation and DNA methylation
generally decrease during differentiation.

Take Home Message

- Cilia/Microvilli/Stereocilia composition and function
- Junctional Complexes
- Epidermal Receptor Homeostasis
- Methylation and Acetylation differentiation markers

http://www.histologyguide.com/slideview/MH-017-stratified-epithelia/02-quiz-1.html?x=17062&y=20672&z=31.4&page=1