



MD532 109 Skin and Related Connective Tissues

Organ structure & functions

Lectured by

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Objectives

After studying of this topic, the student can be able to

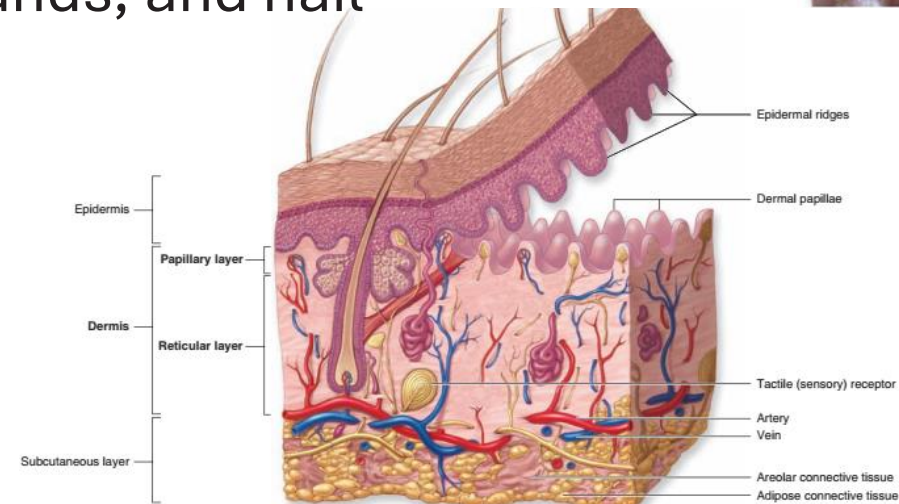
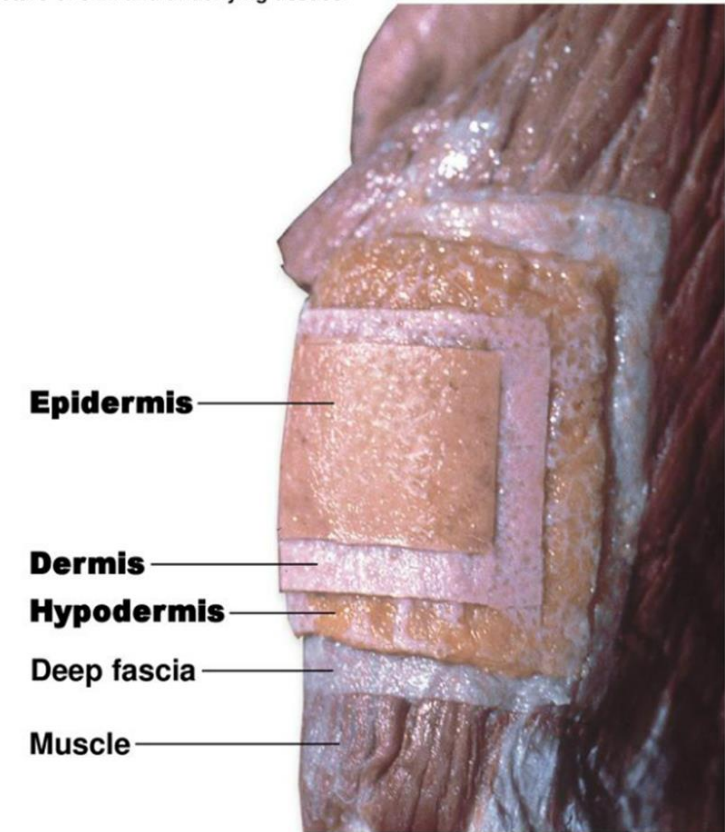
1. Describe the structure of skin including epidermis, dermis & hypodermis
2. Explain the differences between thin and thick skins
3. Describe cell types of epidermis
4. Explain the receptors of skin
5. Describe the structure and function of skin appendages

Overview

The integument

- the largest organ of the body
- composed of
 1. **Skin** (0.5 - 3 mm thickness, varies regionally)
 - Epidermis
 - Dermis
 - Hypodermis
 2. **Skin appendages:**
hair, sweat glands, sebaceous glands, and nail

Figure 5.2 Gross structure of skin and underlying tissues.



The functions of the skin

1. Metabolism

- synthesis of vitamin D in the presence of sunlight
- Remove excess electrolytes in sweat

2. Protection

Prevents mechanical impact

Protects tissue against chemical and physical damage

Prevents micro-organisms from penetrating

Destruction of inoculated micro-organisms

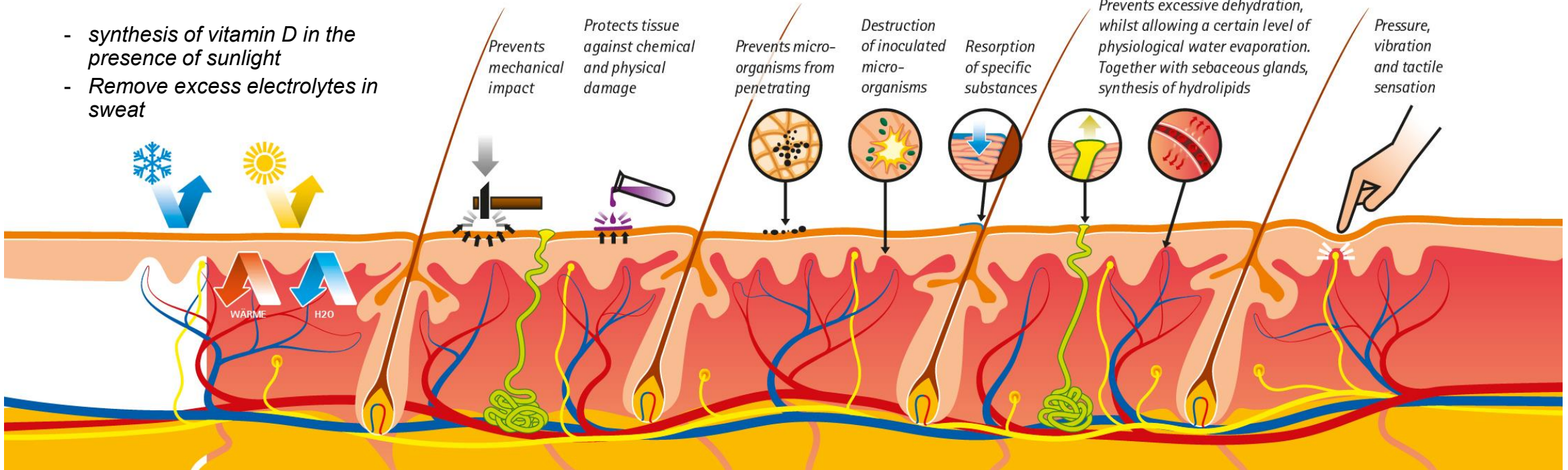
Resorption of specific substances

3. Thermoregulatory

Prevents excessive dehydration, whilst allowing a certain level of physiological water evaporation. Together with sebaceous glands, synthesis of hydrolipids

4. Sensory

Pressure, vibration and tactile sensation



5. Social identification



Skin structure

1. ชั้นหนังกำพร้า (Epidermis)

Stratum basale

Stratum spinosum

Stratum granulosum

Stratum lucidum

Stratum corneum

2. ชั้นหนังแท้ (Dermis)

Papillary layer

Reticular layer

3. ชั้นใต้หนังแท้ (Hypodermis)

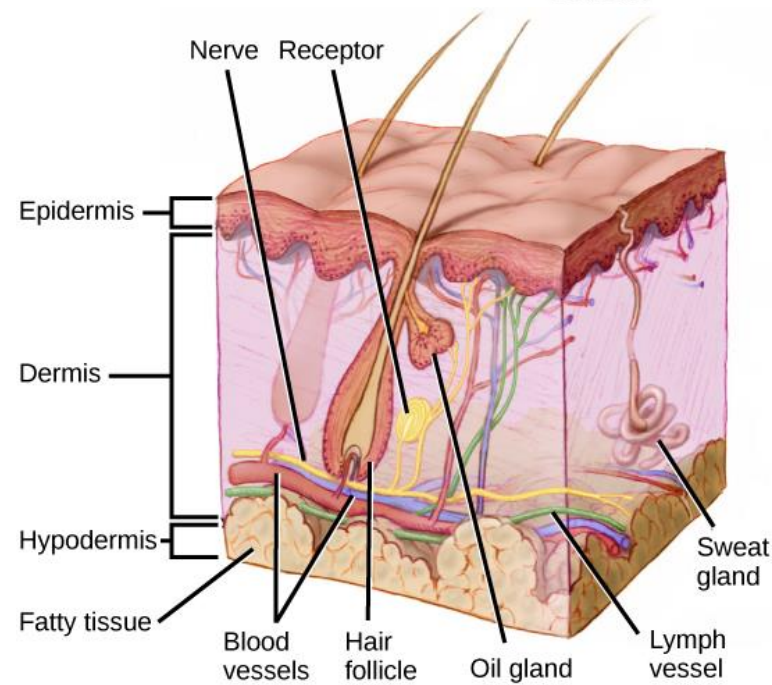
Epidermis

Dermis

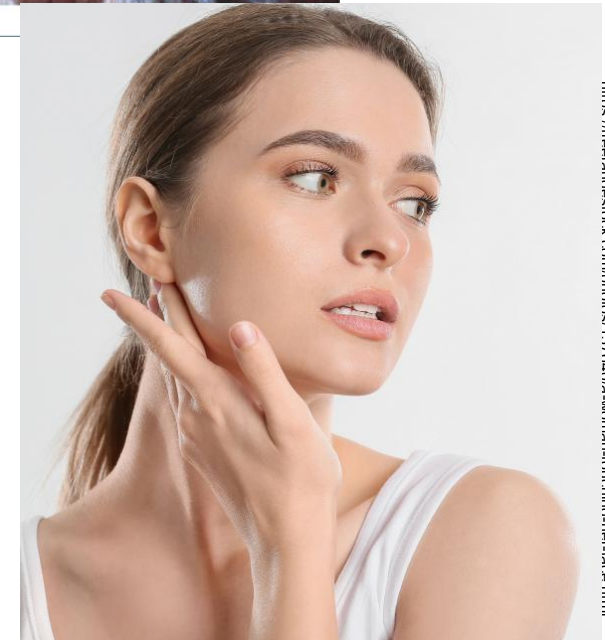
Hypodermis

Deep fascia

Muscle

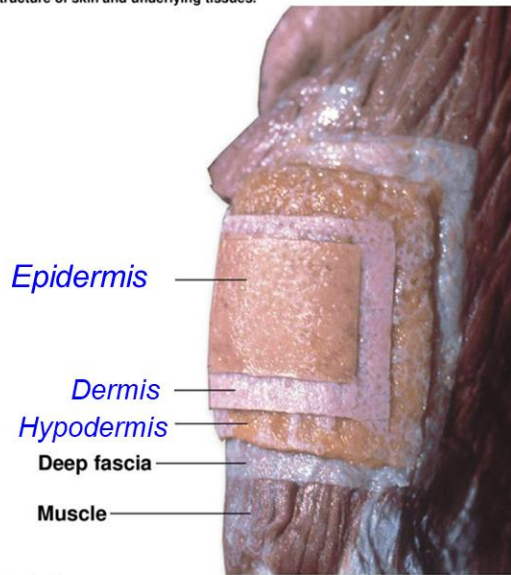


https://commons.wikimedia.org/wiki/File:Figure_36_02_01.jpg



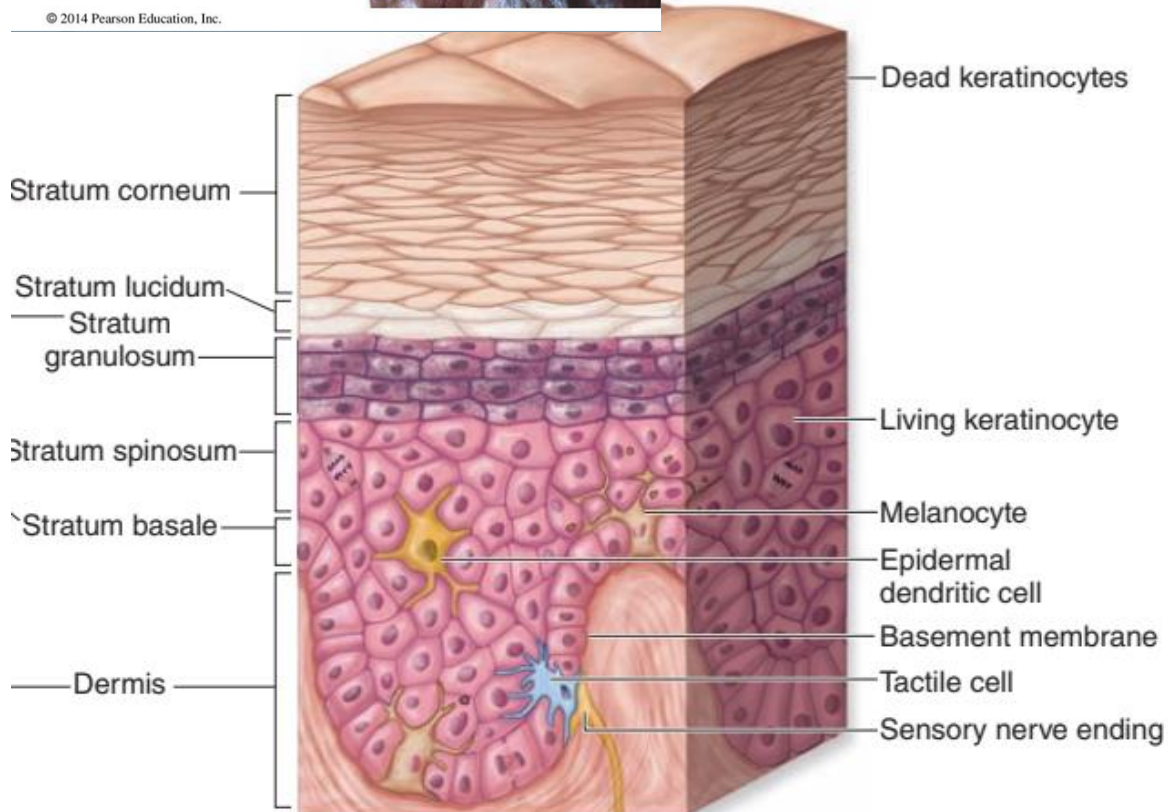
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The epidermis

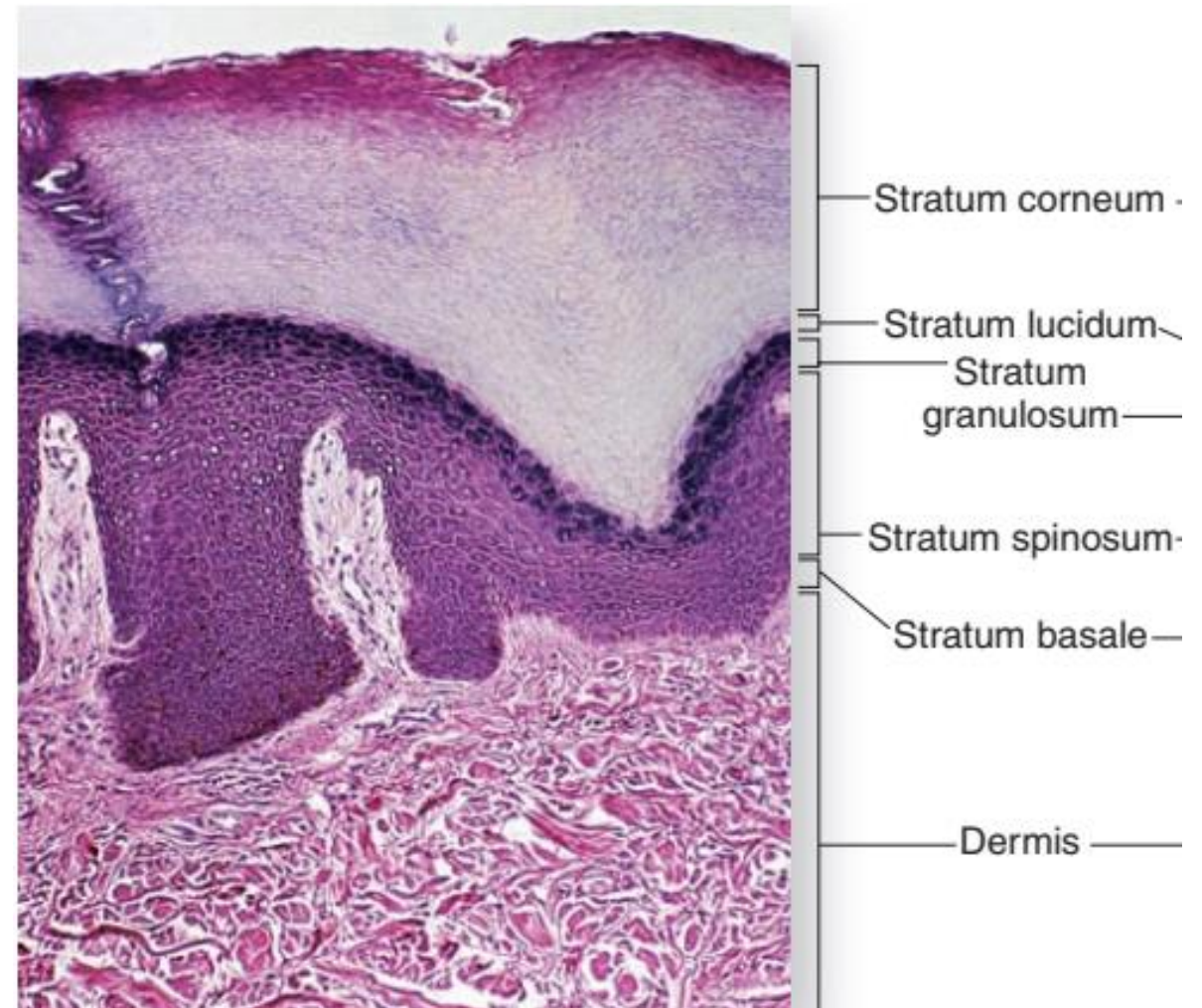
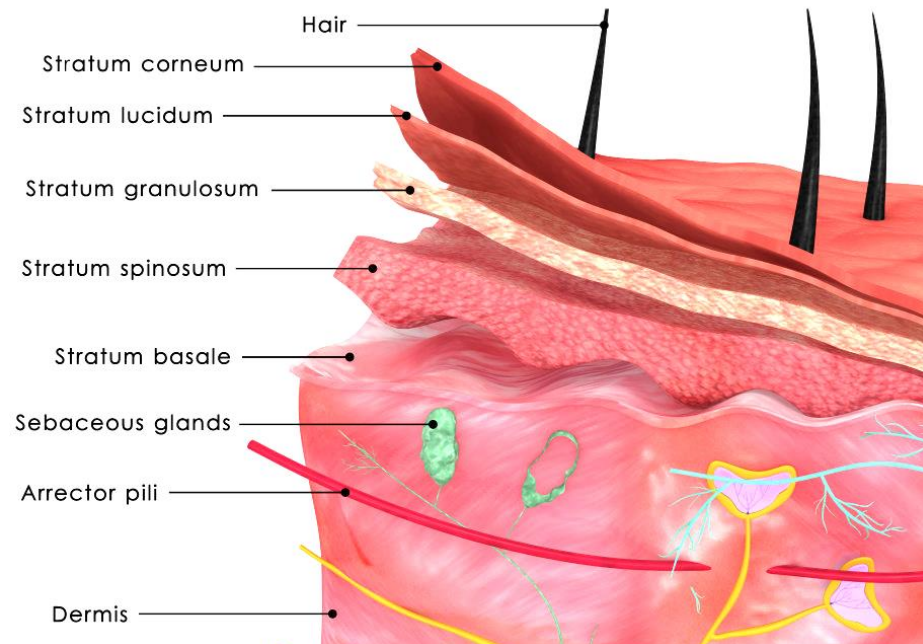
- is the superficial layer of the skin
- Primarily of ectodermal origin
- a stratified squamous keratinized epithelium
- Avascular layer
- composed of
 - Keratinocytes: main component cells
 - Melanocytes: pigment-producing cells
 - Langerhans cells: antigen-presenting cells
 - Merkel cells: tactile epithelial cells



Histology of the epidermis

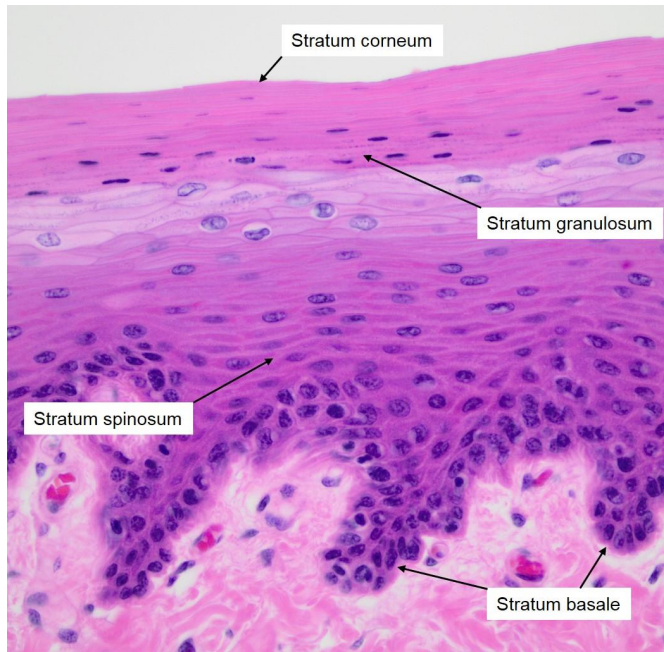
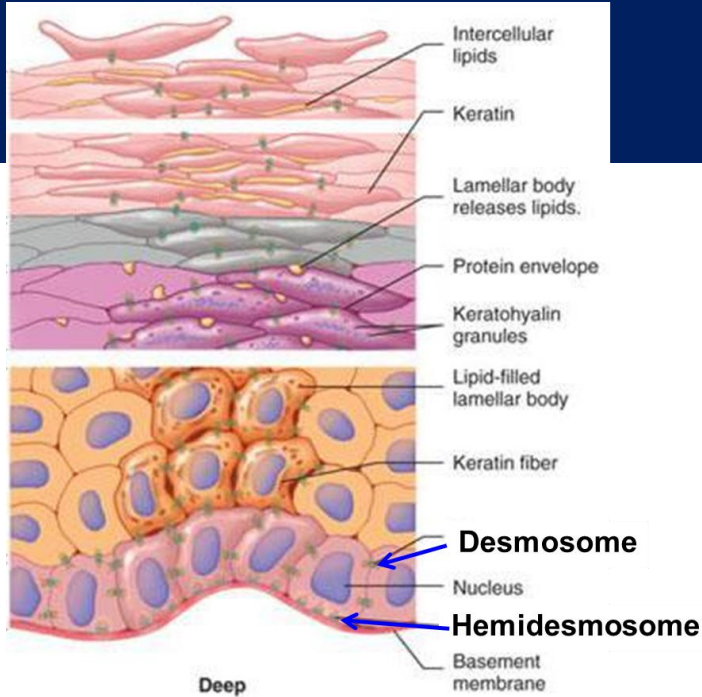
The epidermis consists of five layers of keratinocytes (or four layers in thin skin)

1. Stratum basale (basal layer)
2. Stratum spinosum (spinous layer)
3. Stratum granulosum (granular layer)
4. Stratum lucidum
5. Stratum corneum

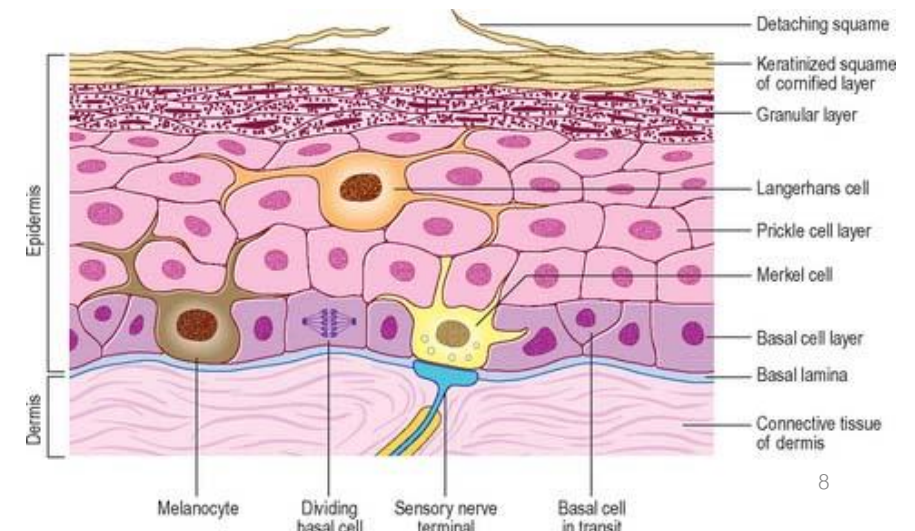


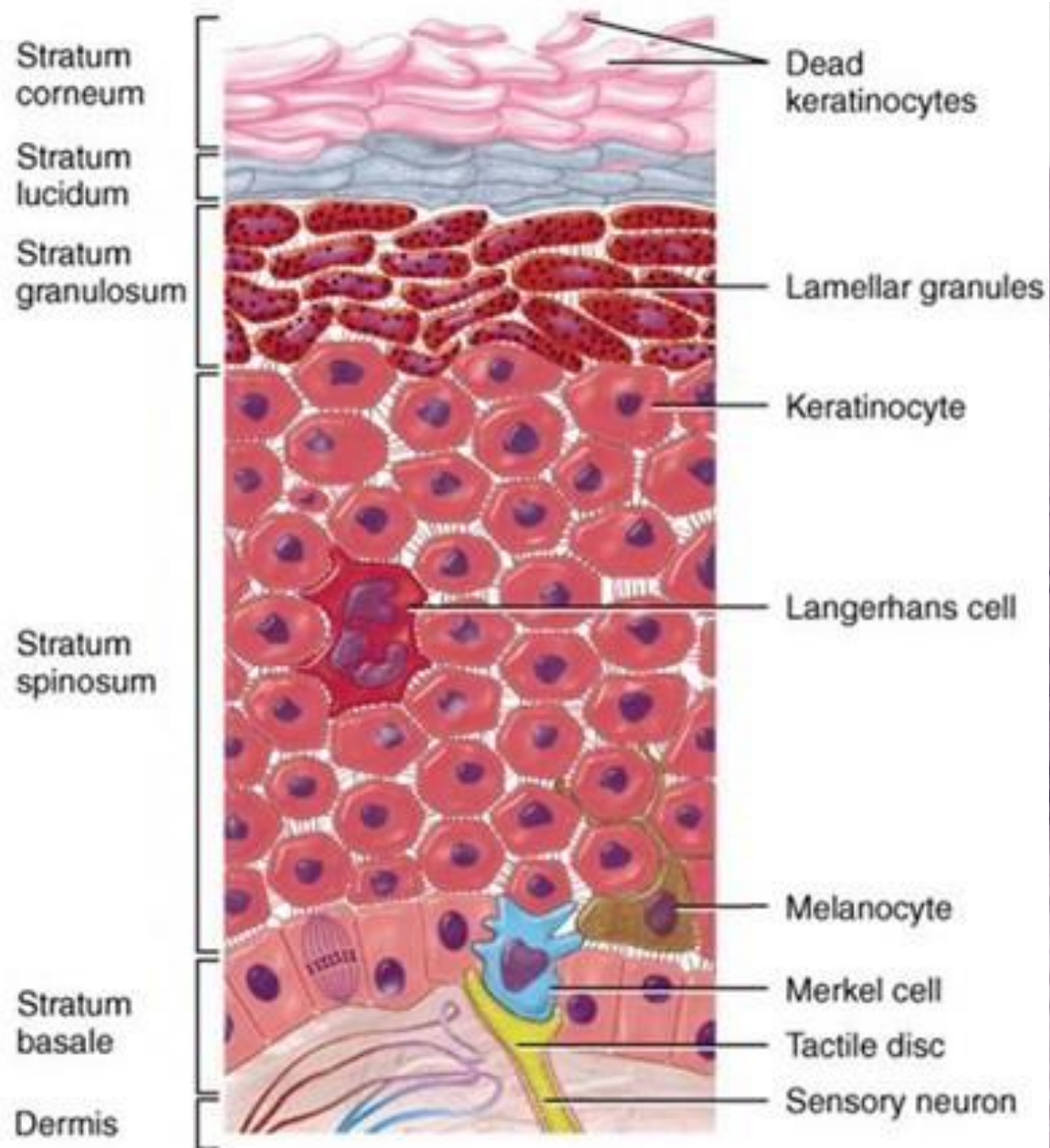
Stratum basale (stratum germinativum)

- the deepest layer of the epidermis
- single layer of cuboidal or columnar cells on the basement membrane
- hemidesmosomes join these cells to the basal lamina
- desmosomes bind the cells lateral and upper surfaces
- intense mitotic activity
- contain **cytoskeletal keratins or tonofilament** (intermediate filaments)
- the cells move upward

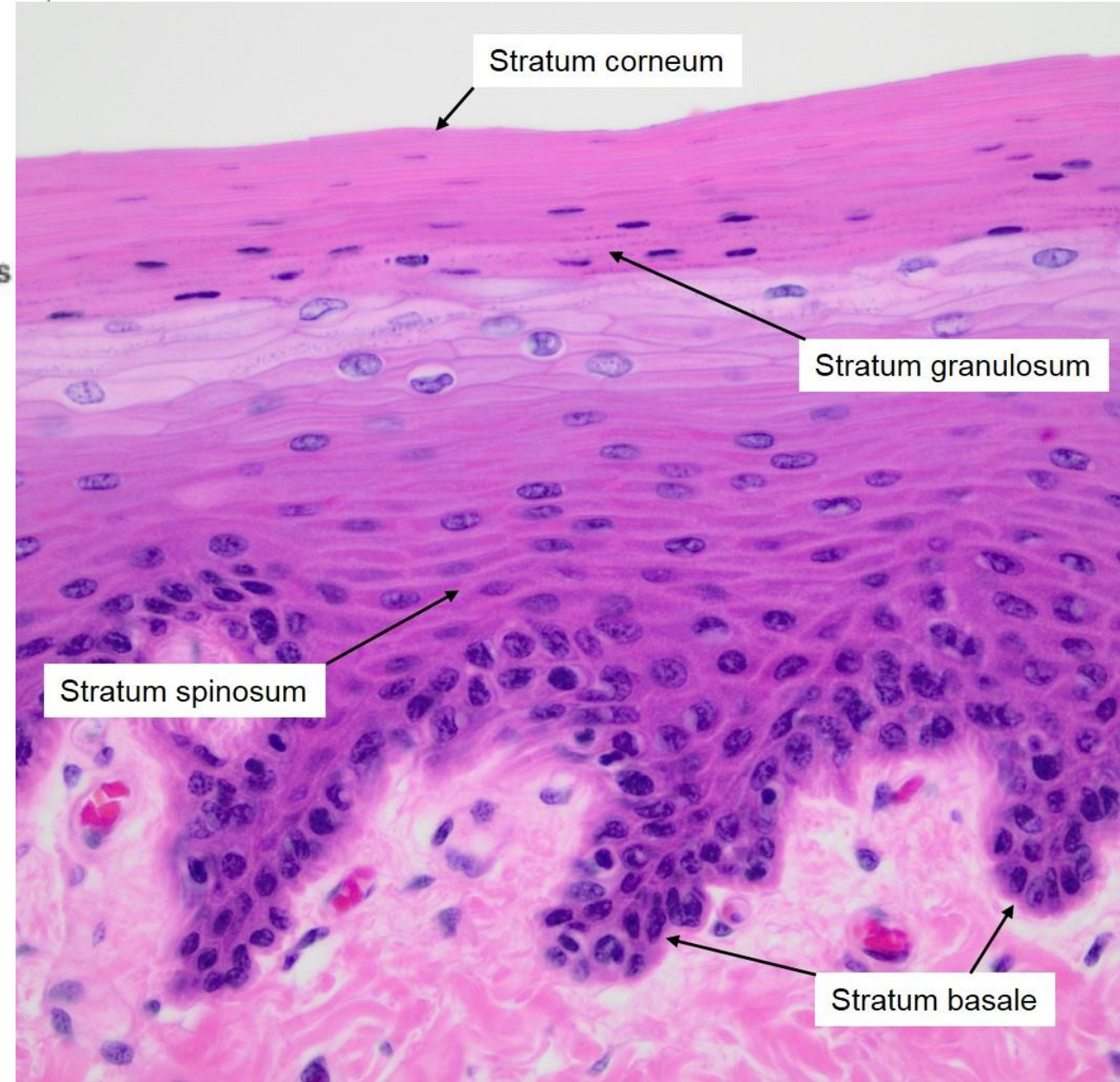


The melanocytes and Merkel cells are present in this layer



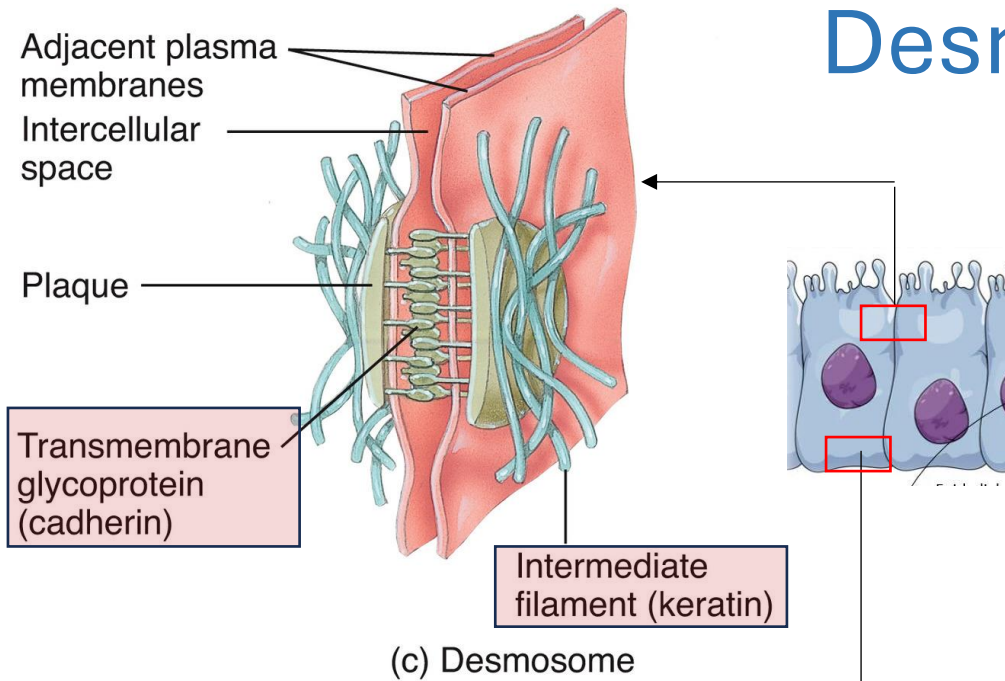


<https://www.earthslab.com/physiology/cells-layers-epidermis/>



<https://ohiostate.pressbooks.pub/vethisto/chapter/7-structure-of-the-epidermis/>

Desmosome and hemidesmosome

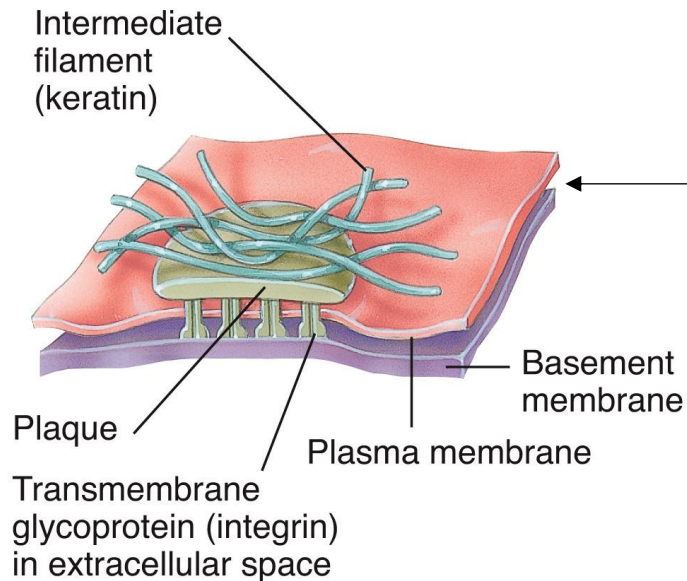


Desmosome

- intercellular junctions
- strong adhesion between adjacent cells
- Strengthening the tissue
- Major transmembrane link proteins → **cadherin**
- intermediate filaments → **keratins**

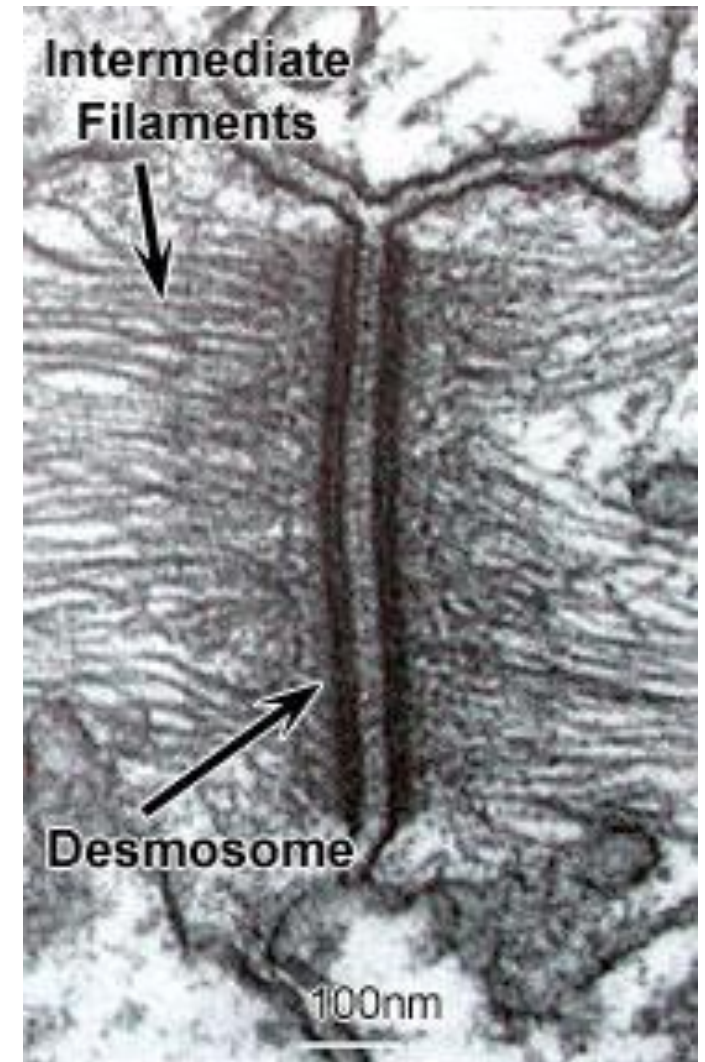
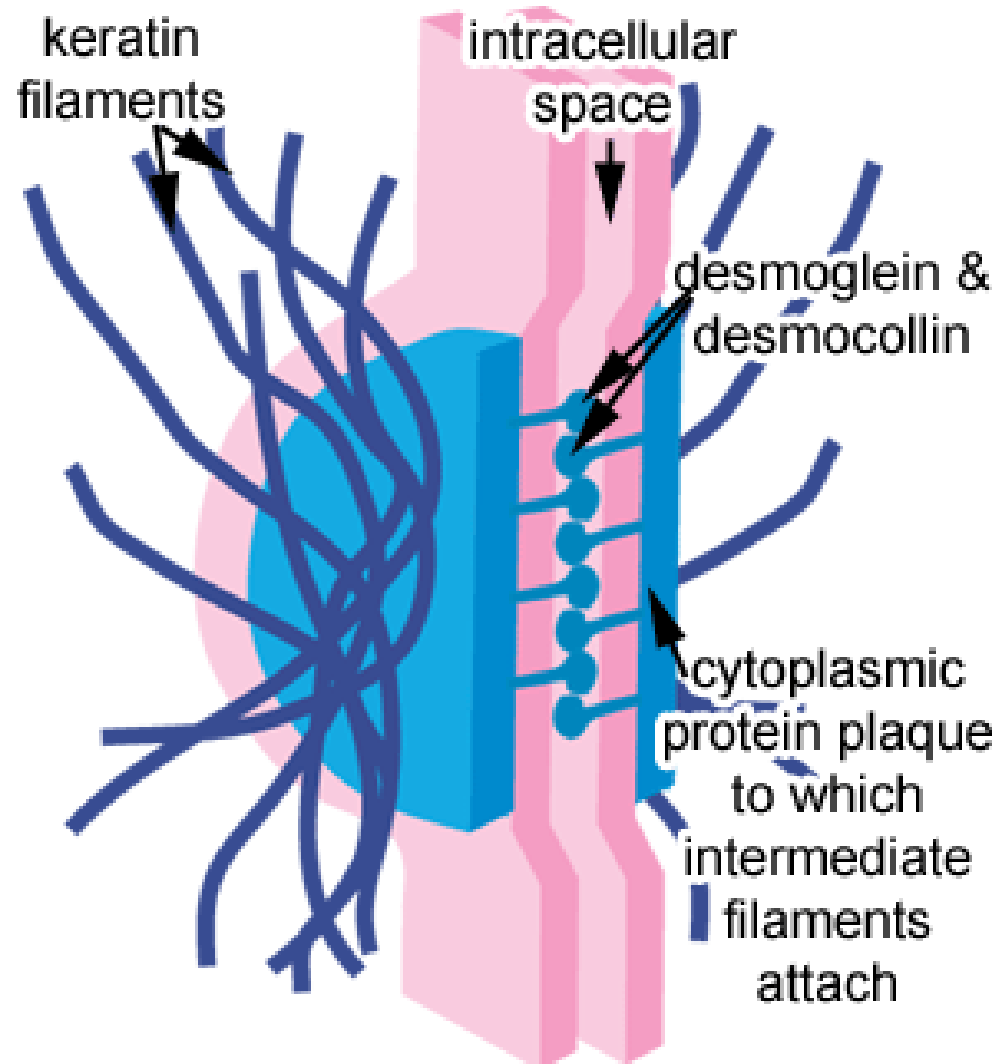
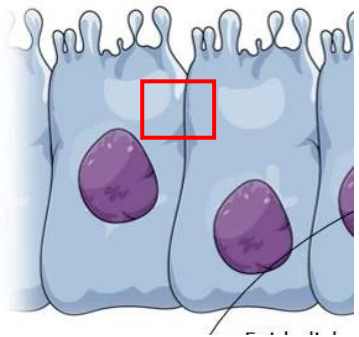
Hemidesmosome

- Half of desmosome
- stable adhesion of basal epithelial cells to the underlying basement membrane
- Major transmembrane link proteins → **integrins**
- intermediate filaments → **keratins**

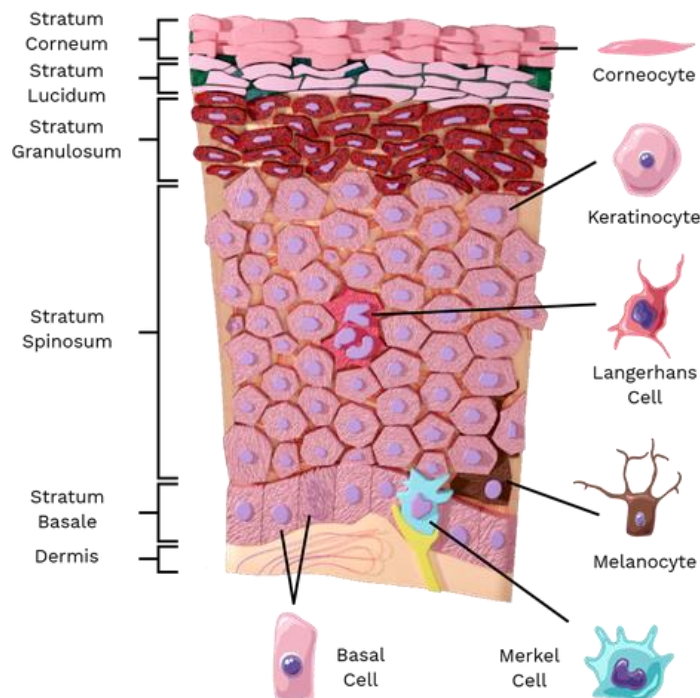


(d) Hemidesmosome

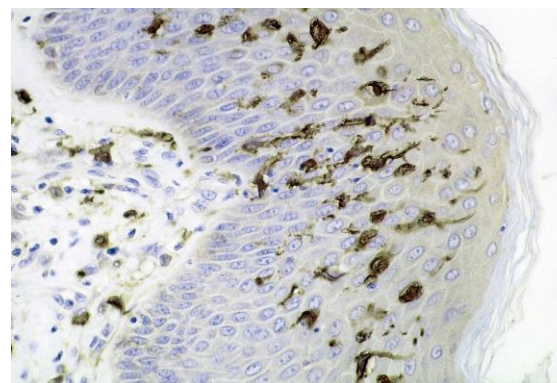
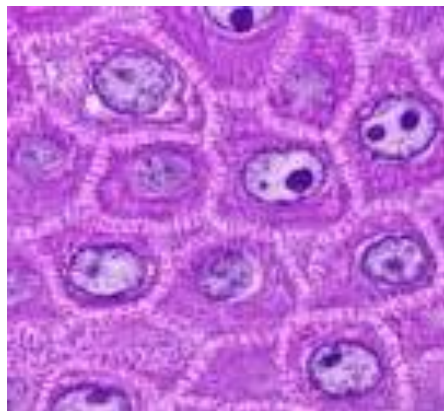
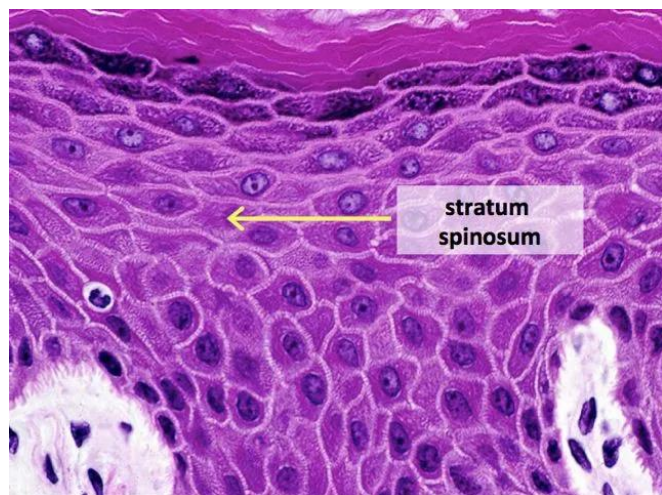
Desmosome



Stratum spinosum



- 5 – 10 cell layer thickness of keratinocyte
- polygonal shapes
- spinous processes (desmosomes)
- cells in the surface become flattened
- the nuclei become elongate, matching the acquired squamous shape of the cells.

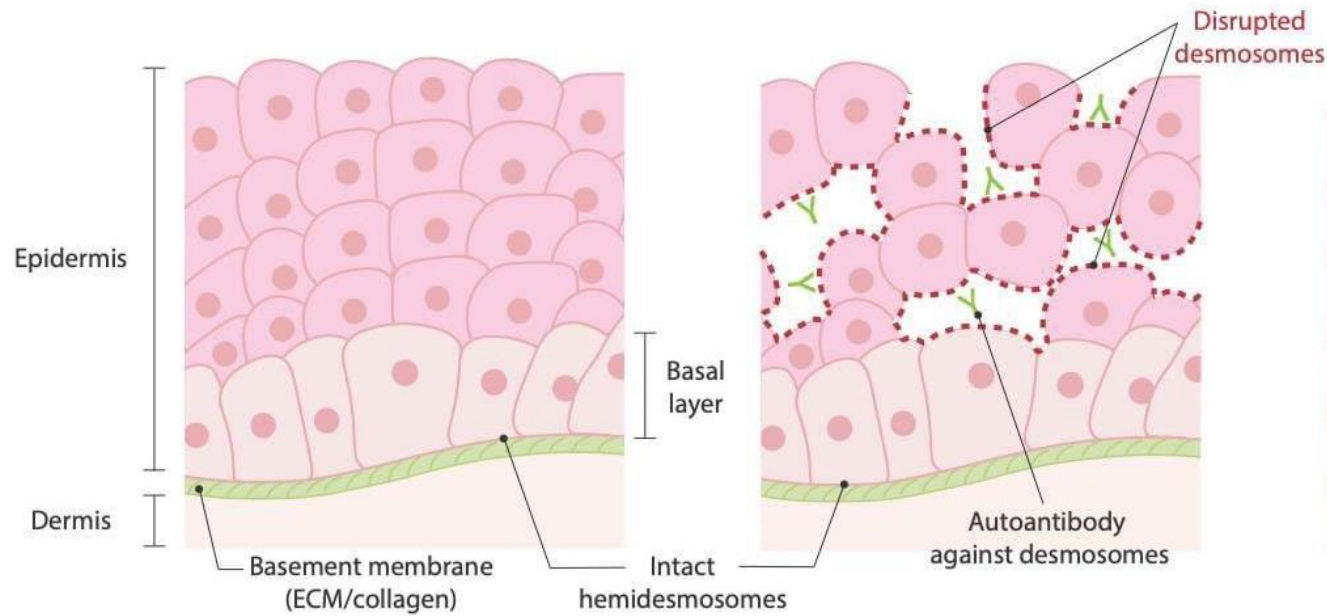


Langerhans cell

- dendritic cell
- tissue-resident macrophage
- originate from the bone marrow

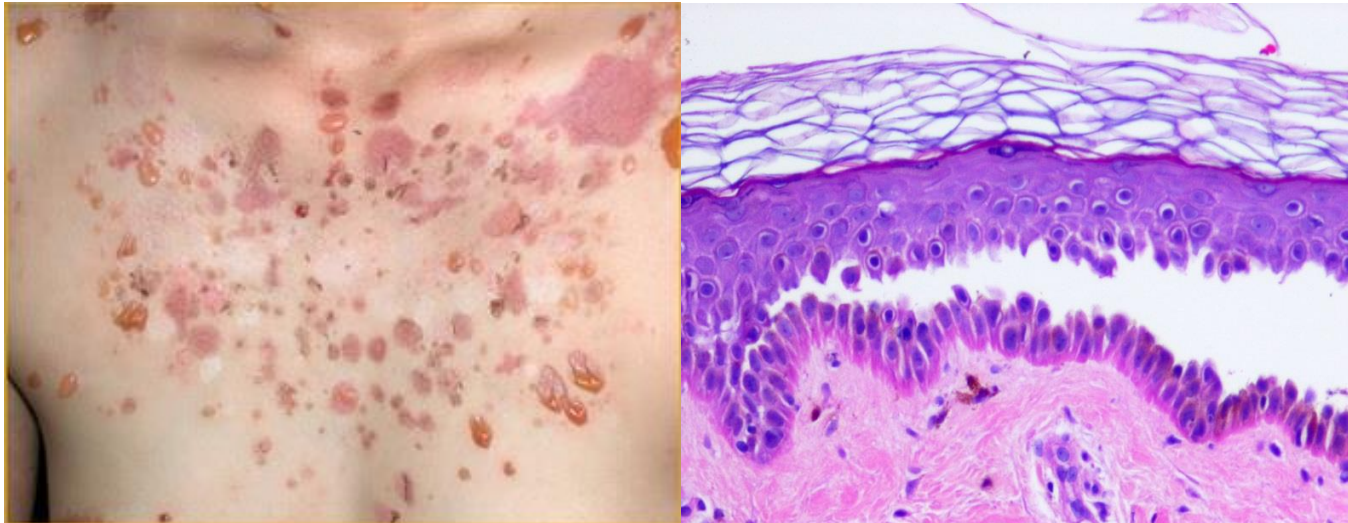
Normal

Pemphigus Vulgaris

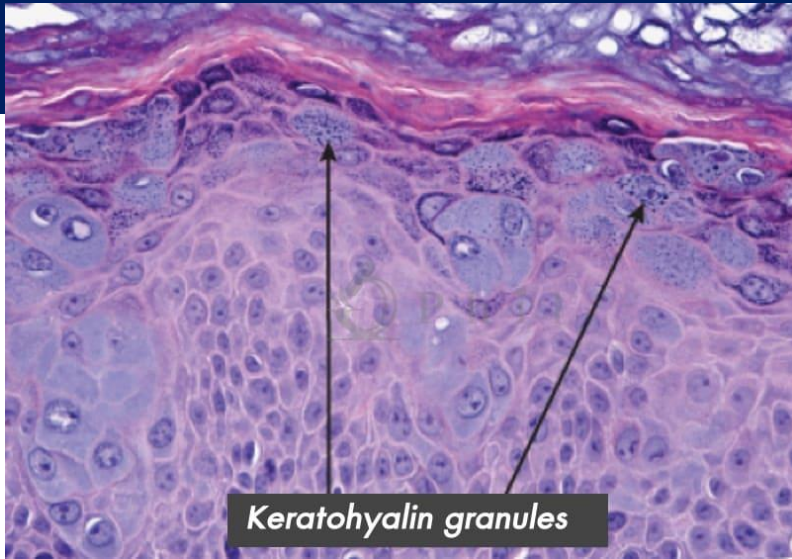


Pemphigus (โรคตุ่มน้ำพอง)

- desmosomal disease
- loss of desmosomes
- blistering of the skin



Stratum granulosum



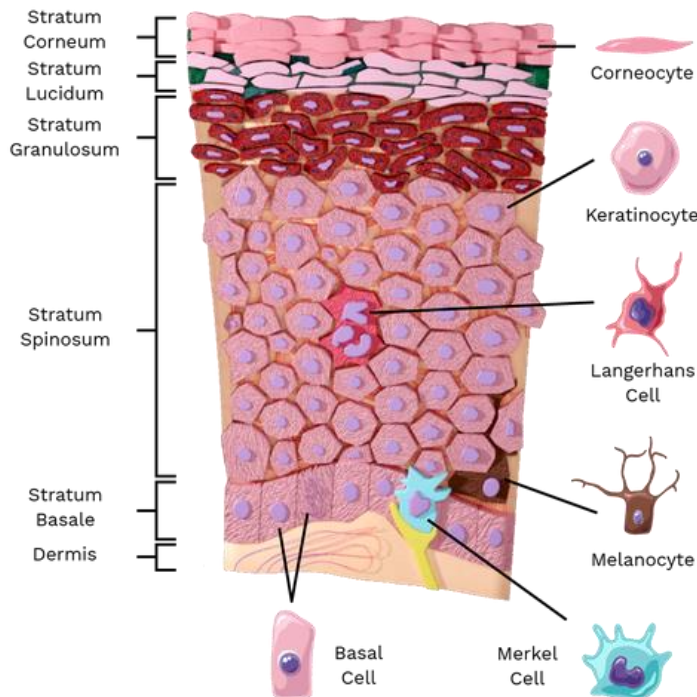
- the most superficial layer of nonkeratinized portion of the epidermis
- 3-5 cell layers
- flatter and irregular keratinocytes
- begins [keratinization](#) (the keratinocytes fill up with the protein keratin)
 - keratin filaments (intermediate filaments) begin to develop
 - The nucleus and all organelles disintegrate, and the cells start to die
 - contain two types of granule

1. Keratohyalin granules:

มีสีน้ำตาล หรือดำ ภายในบรรจุ Profilaggrin ซึ่งจะถูกเปลี่ยนเป็น filaggrin ที่ชั้น Stratum corneum ทำหน้าที่เป็นเสมือนกาวยึดกับ keratin filament ทำให้เกิดเป็นร่างแหของ keratin

2. Lamellar granules (Odland bodies):

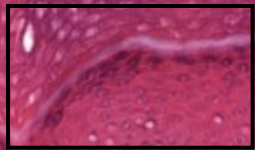
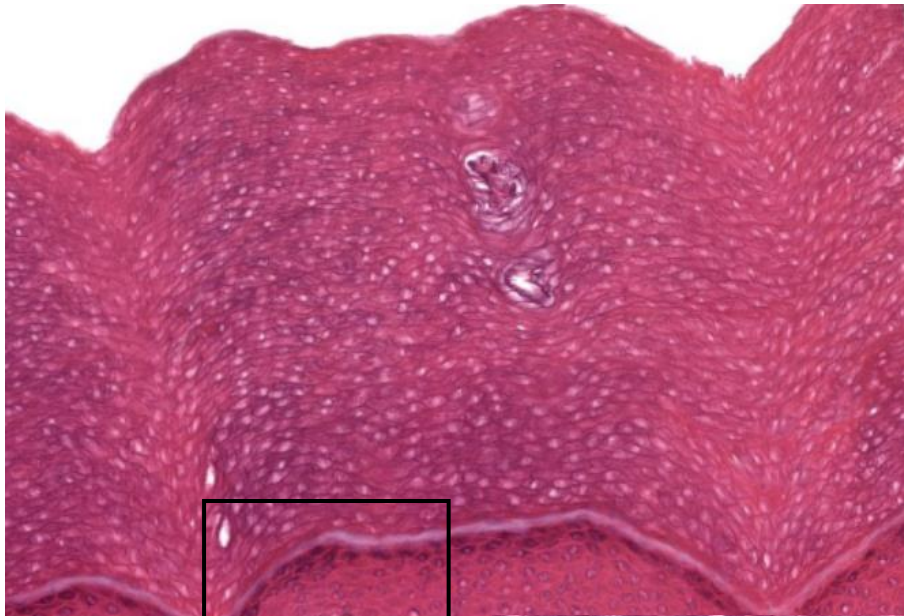
ภายในบรรจุ lipids ซึ่งจะถูกปล่อยออกมาในชั้น stratum corneum เพื่อป้องกันการสูญเสียน้ำออกจากร่างกาย



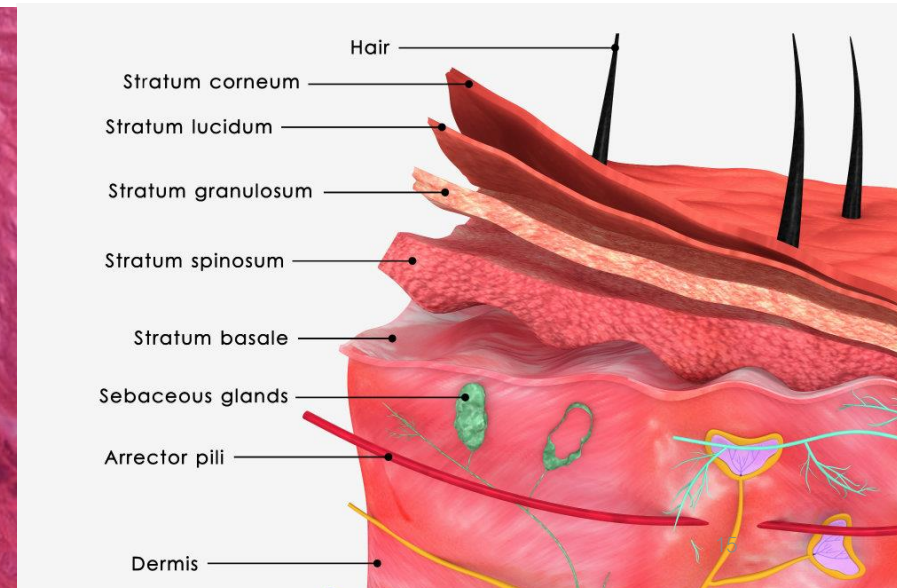
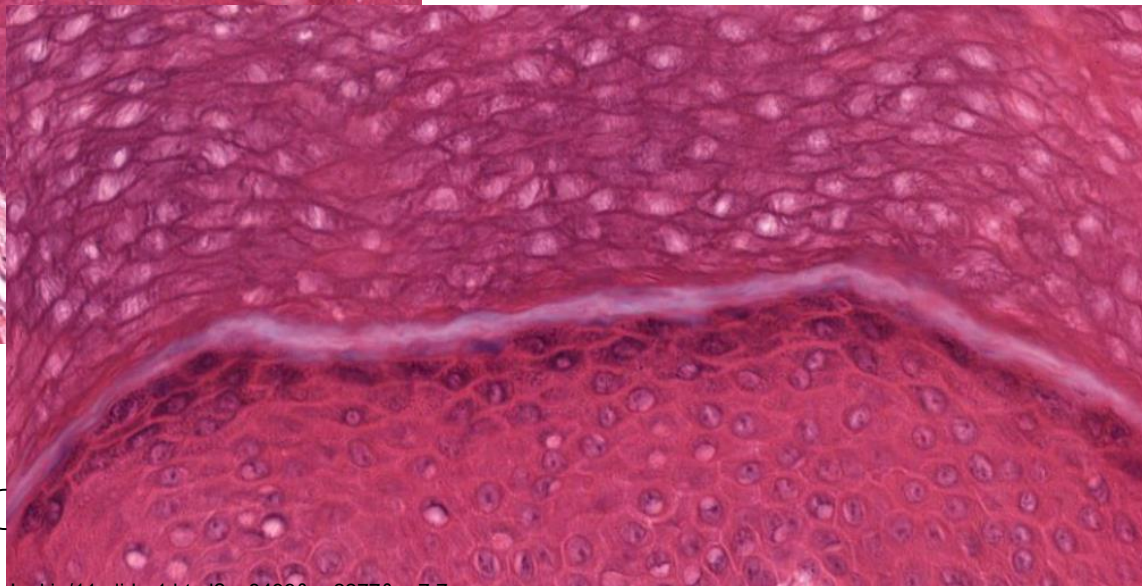
Stratum lucidum

- clear layer
- found only in thick skin
- the cell gradually fills with keratin
- The nucleus and cytoplasmic organelles become disappear
- It often has a refractile appearance and may stain poorly.

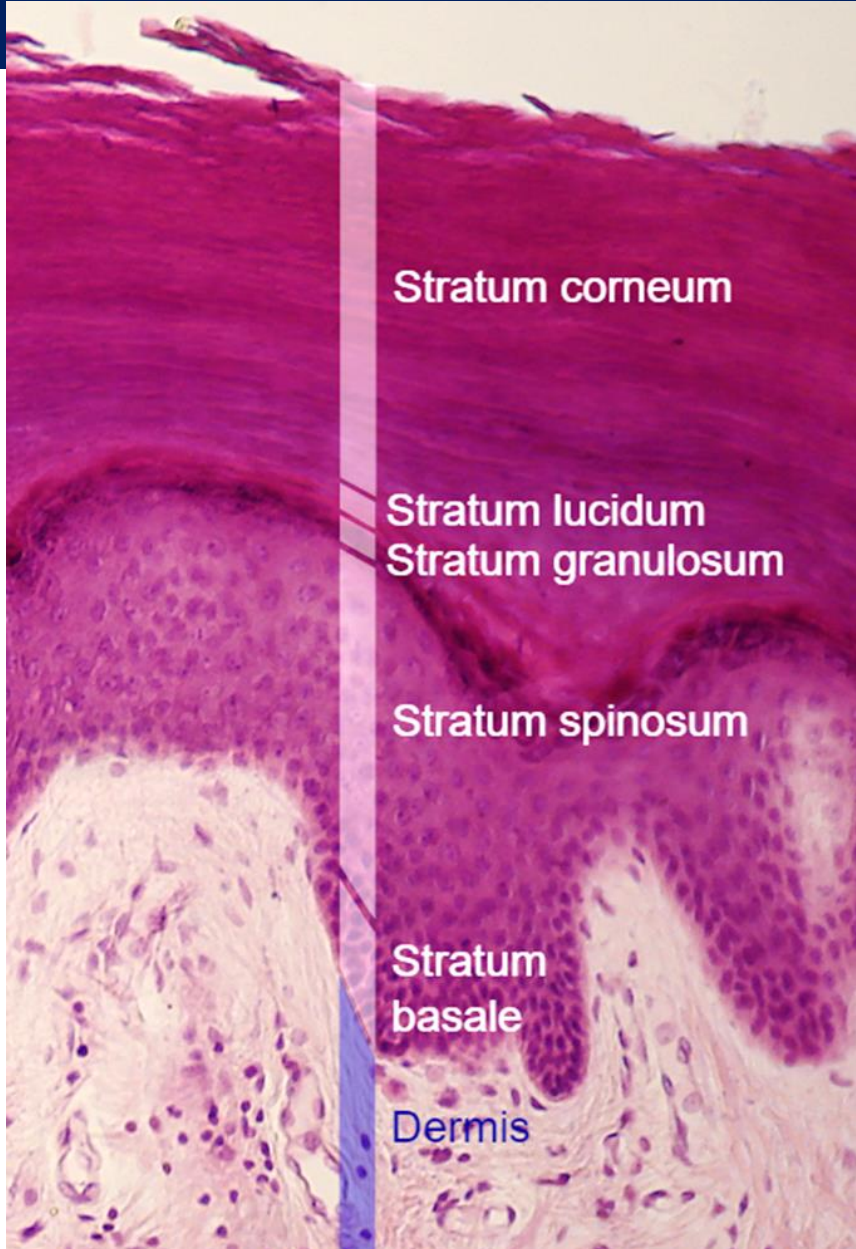
The keratinocytes within this layer are flattened and filled with the protein **eleidin** (the clear intracellular protein)



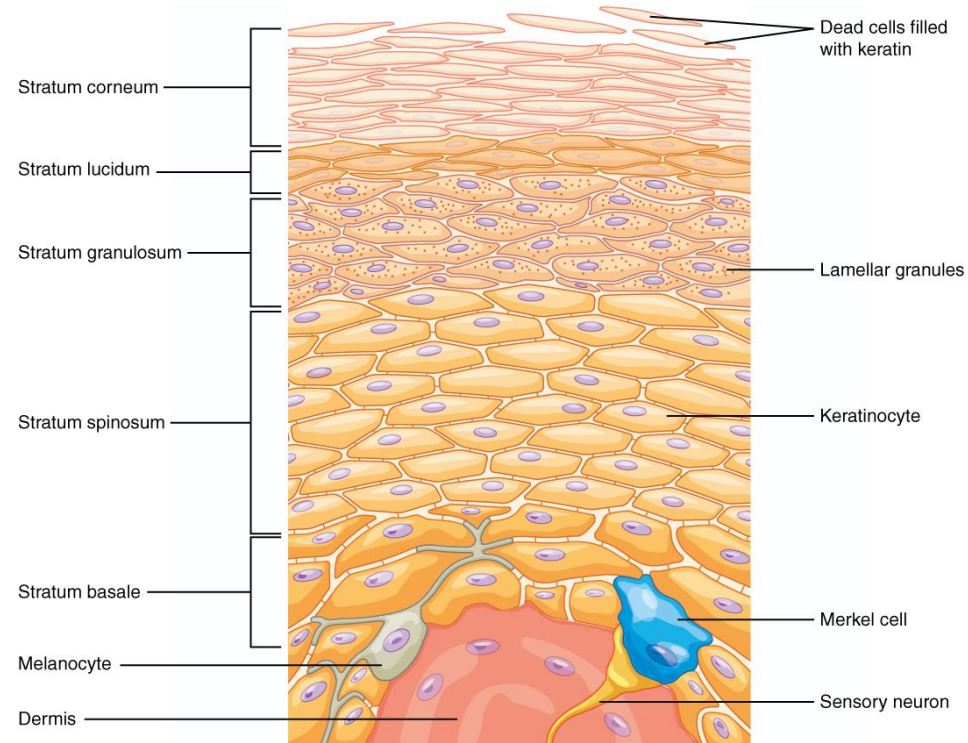
Stratum lucidum {



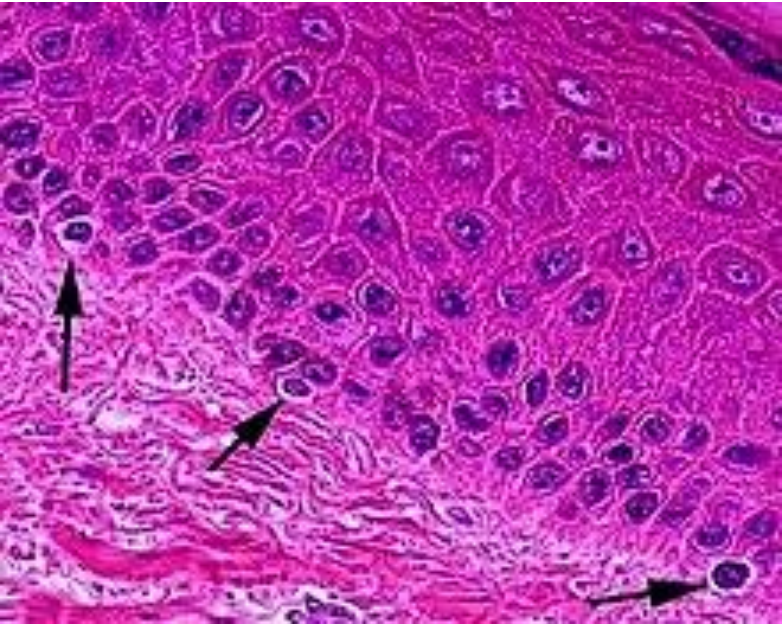
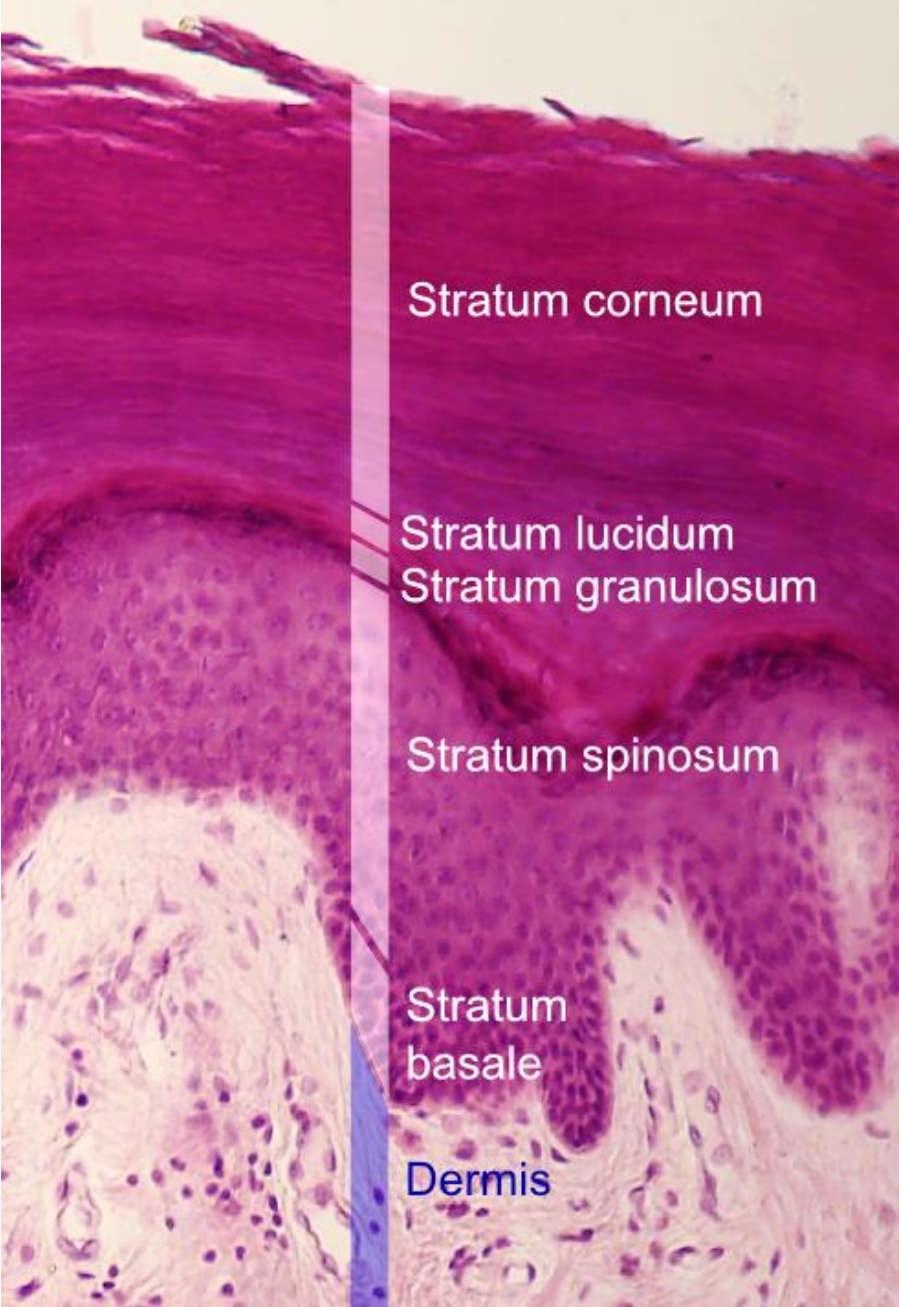
Stratum corneum



- the most superficial layer of the epidermis
- you see when you look at your skin
- consists of 20-30 layers of dead keratinized cells called **corneocytes**
- cells lose the nucleus and organelles
- contains large amounts of keratin

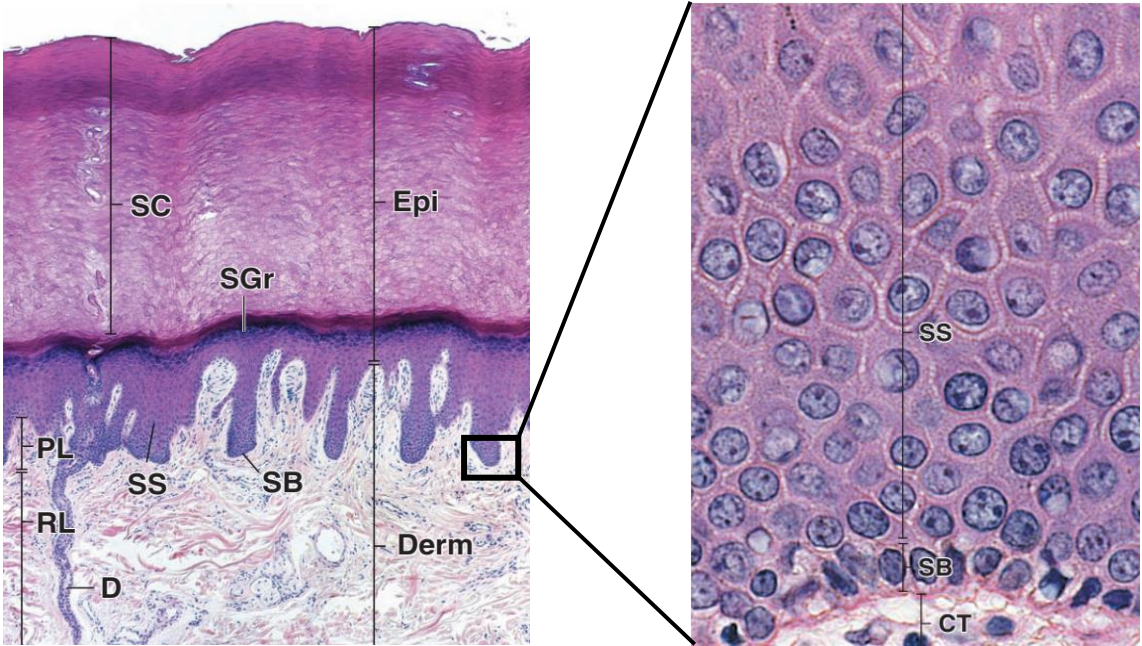


- the cells are further sloughed off from external surface (**desquamation**)
- the life cycle of keratinocyte cells takes around 30 days



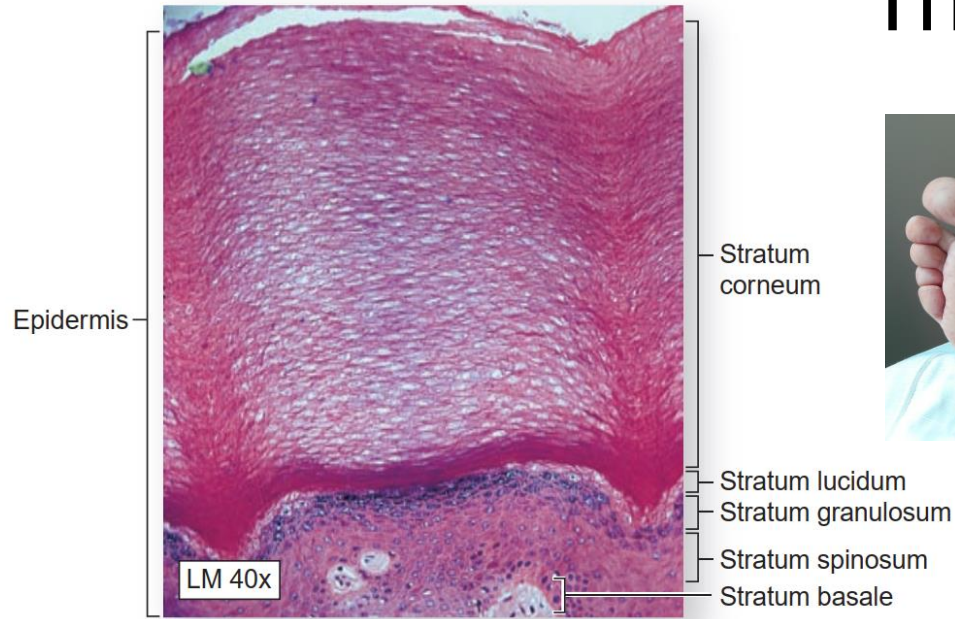
<https://www.wikidata.org/wiki/Q247101>

The melanocytes



(Ross and Pawlina, 2016)

Thick and thin skin

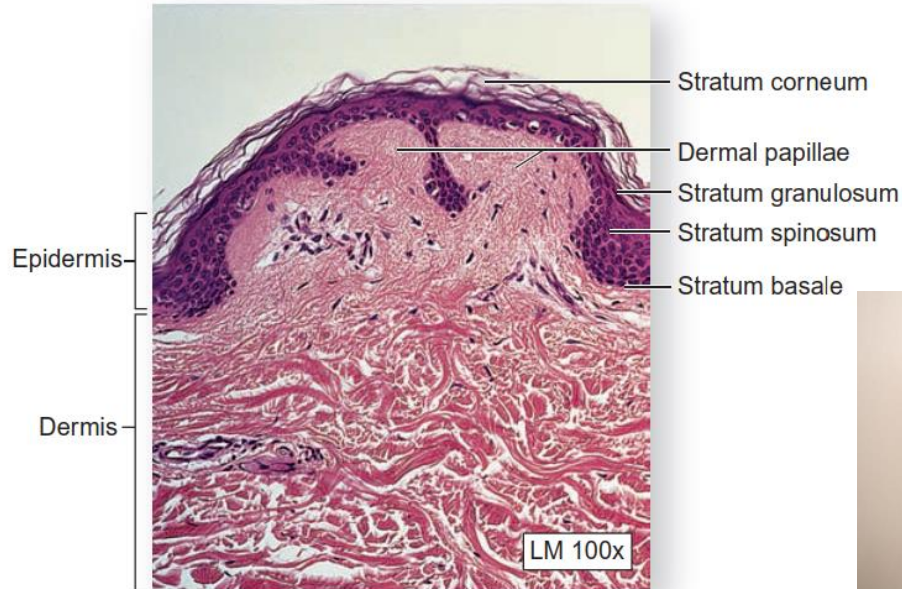


<https://quizlet.com/622721068/integumentary-flash-cards/>



Thick skin

- Thickness is 0.8-1.5 mm
- five epidermal strata occur
- contains sweat glands
- **no hair follicles or sebaceous glands**



<https://buffl.co/community/c/646a066c7f89acda9f03e62c>

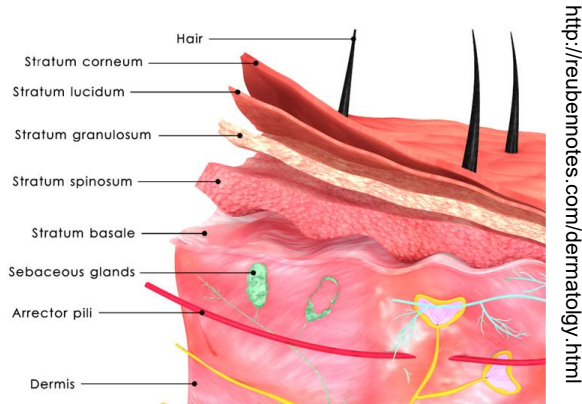
Thin skin

- Thickness is 0.07-0.15 mm
- lacks the stratum lucidum
- contains: hair follicles, sebaceous glands, and sweat glands

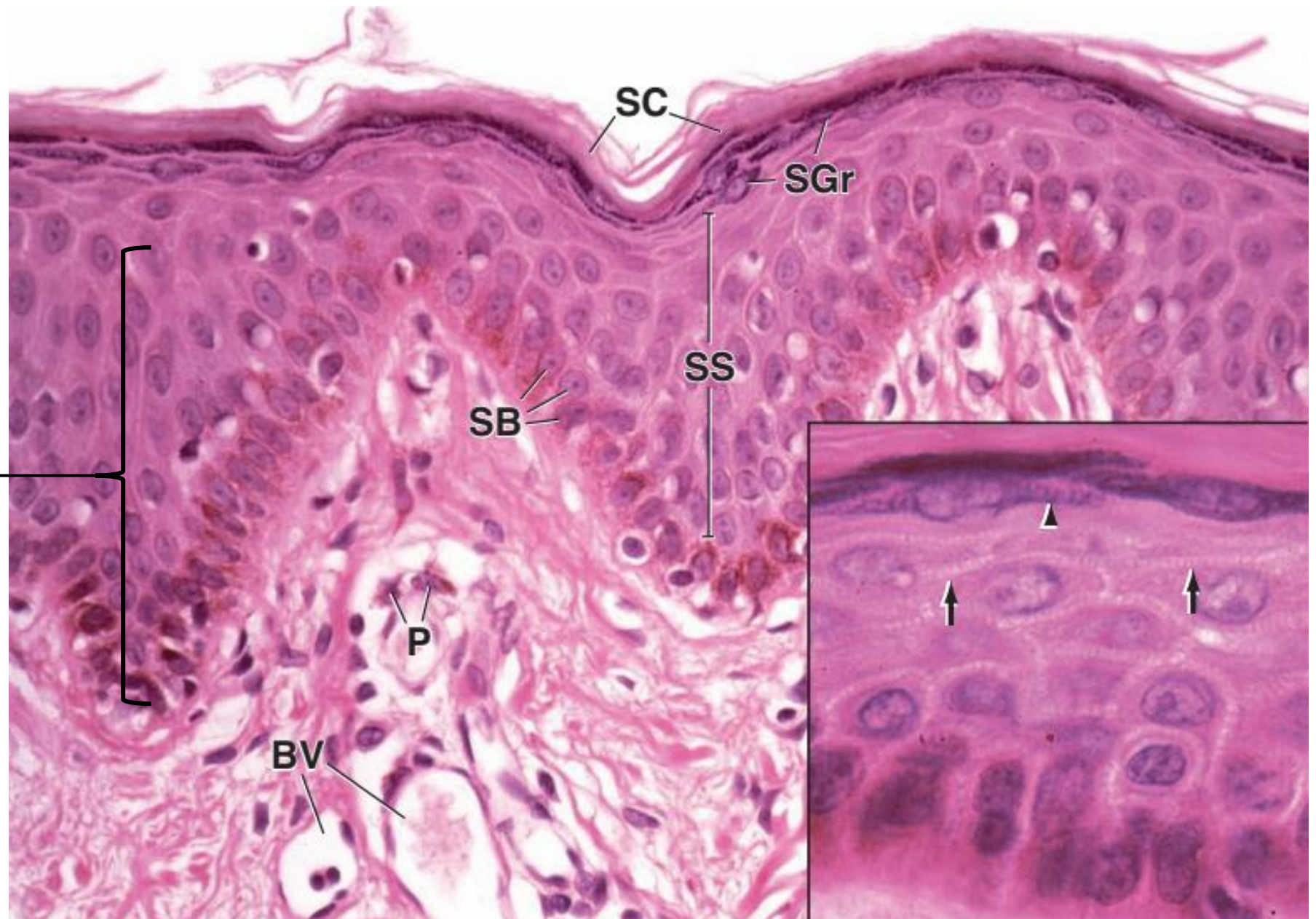


<https://freerangestock.com/photos/168957/elegant-woman-s-back-with-natural-hair-flow.html>

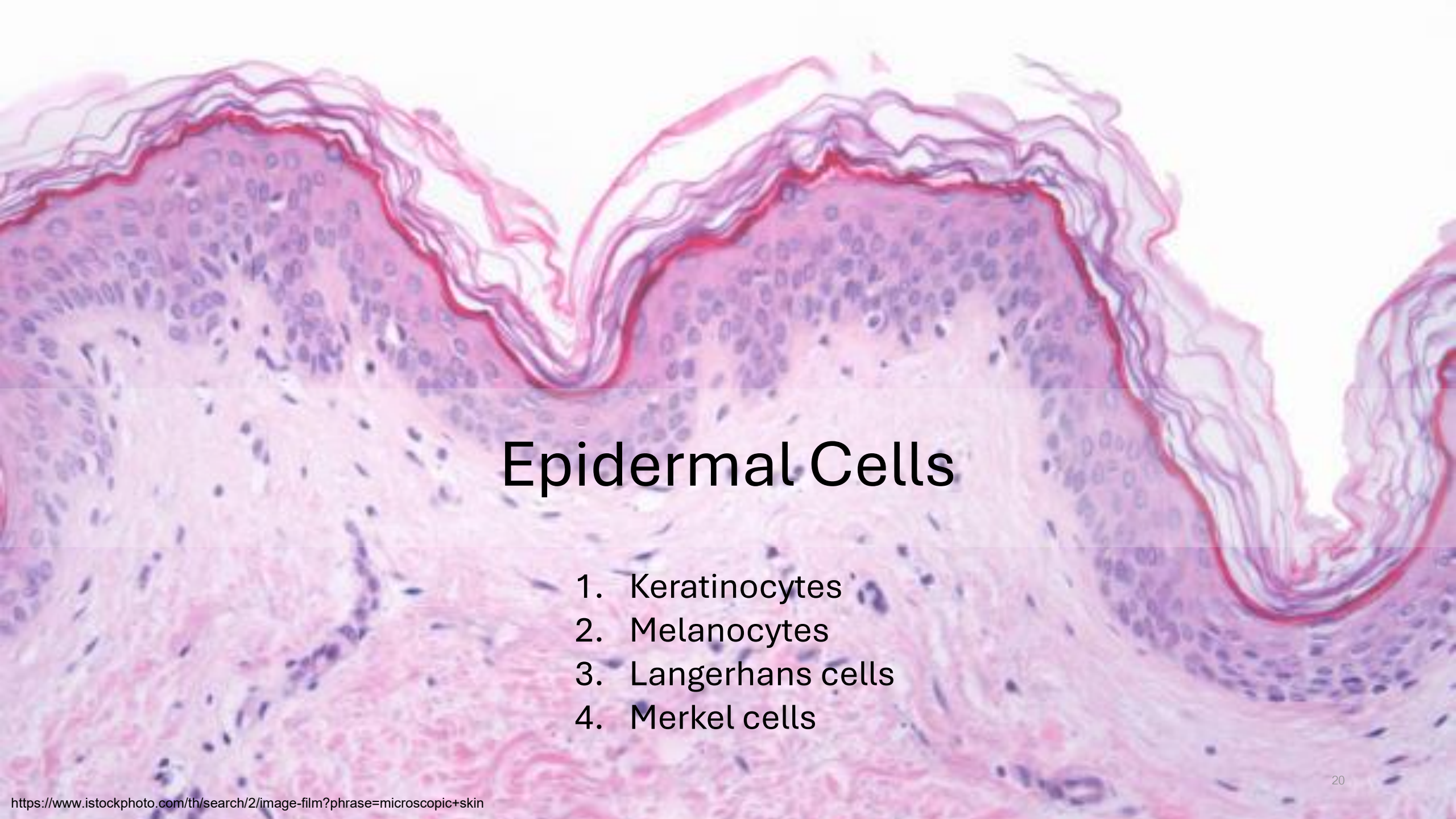
https://commons.wikimedia.org/wiki/File:Hand_Foot_Mouth_Disease_Adult_36Years.jpg



Epidermal ridge



BV, blood vessels; SB, stratum basale; SC, stratum corneum; SGr, stratum granulosum; SS, stratum spinosum; arrowhead, granules in cell of stratum granulosum; arrows, intercellular bridges

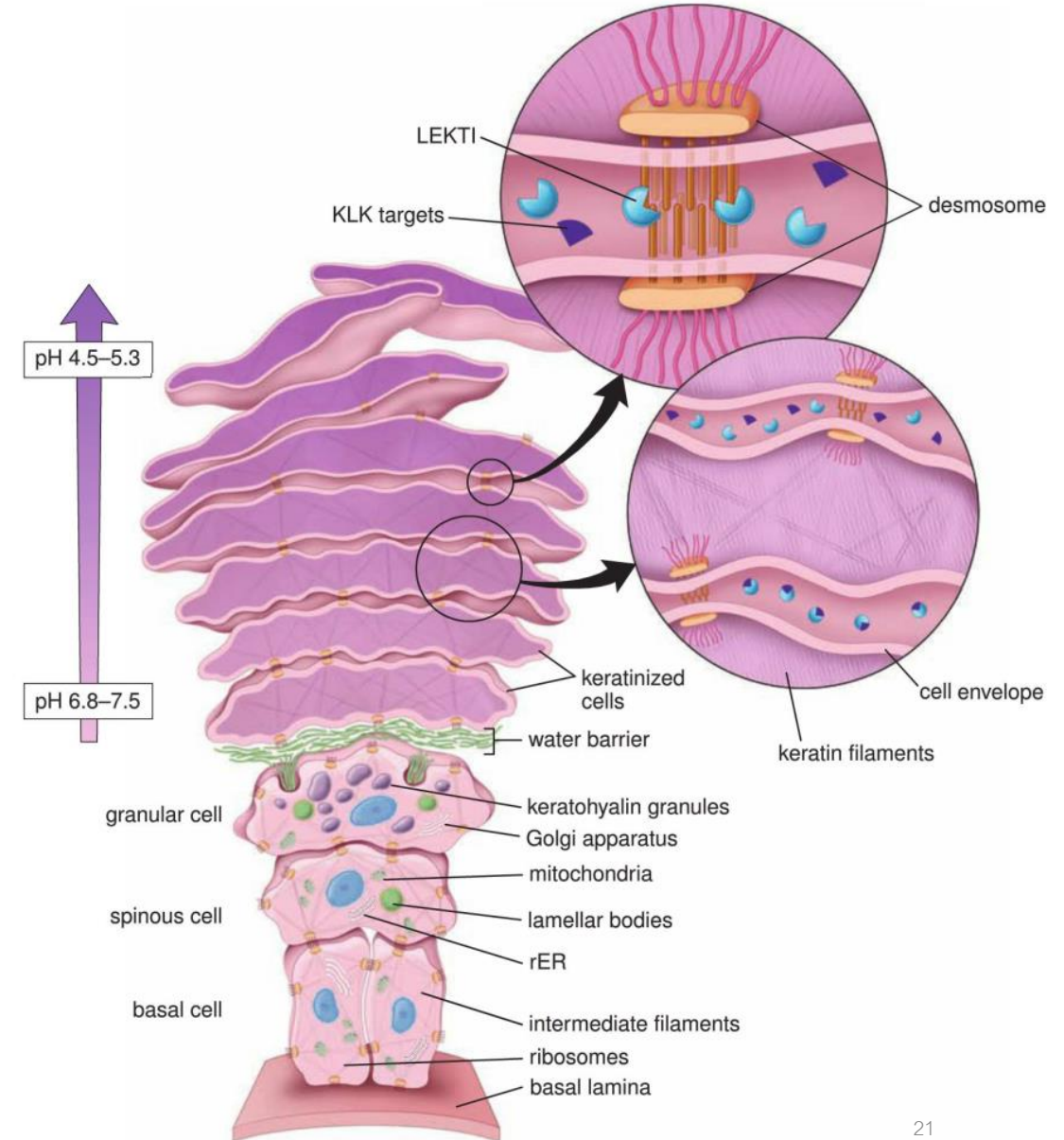
A histological section of skin stained with hematoxylin and eosin (H&E). The image shows the epidermis, which is the outer layer of the skin, and the dermis, which is the layer beneath it. The epidermis is composed of several layers of cells, with the outermost layer being the stratum corneum. The dermis contains various types of cells, including keratinocytes, melanocytes, Langerhans cells, and Merkel cells. The text "Epidermal Cells" is overlaid on the image, and a list of cell types is provided below it.

Epidermal Cells

1. Keratinocytes
2. Melanocytes
3. Langerhans cells
4. Merkel cells

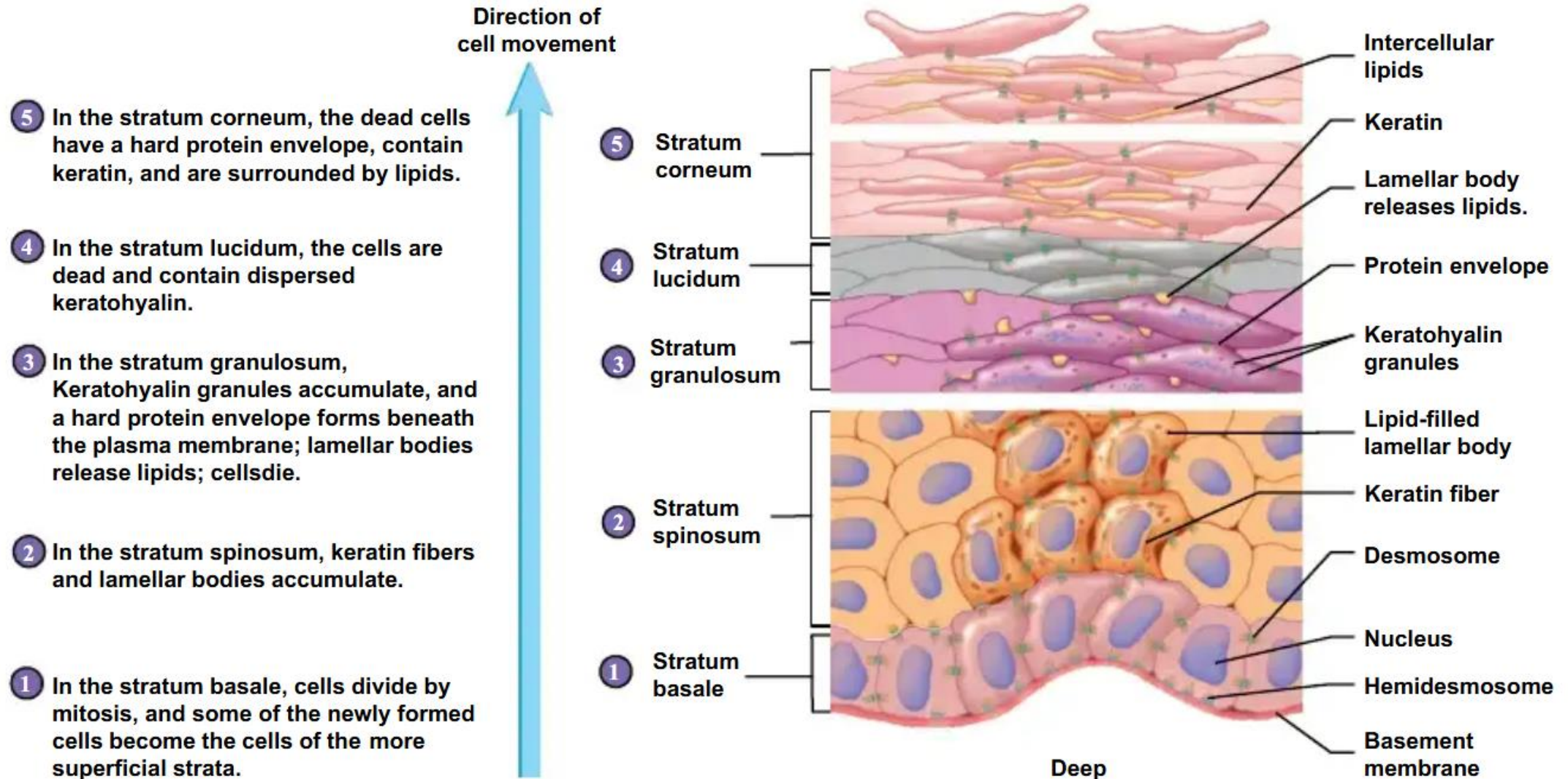
1. Keratinocytes

- Most cells of the epidermis
- **The basal layer:** cells synthesize intermediate filaments (keratin)
- **The spinous layer (at upper part) :** formation of keratohyalin granules and glycolipid-containing lamellar bodies
- **The granular layer:**
 - the cell discharges lamellar bodies to formation of the water barrier of the epidermis
 - **The keratohyalin granules** important in the formation of the protective skin barrier



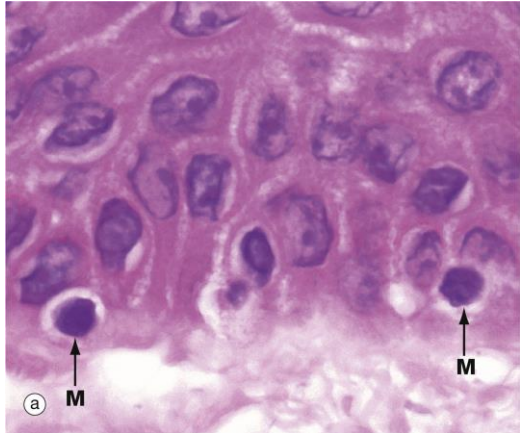
Keratinization

process of keratinocyte differentiation

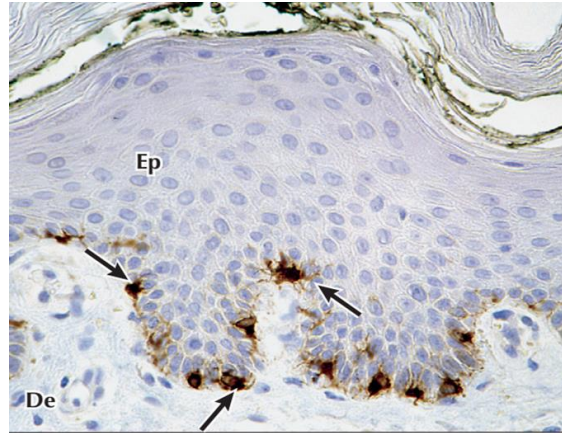


Skin cell turnover = 40 -56 days

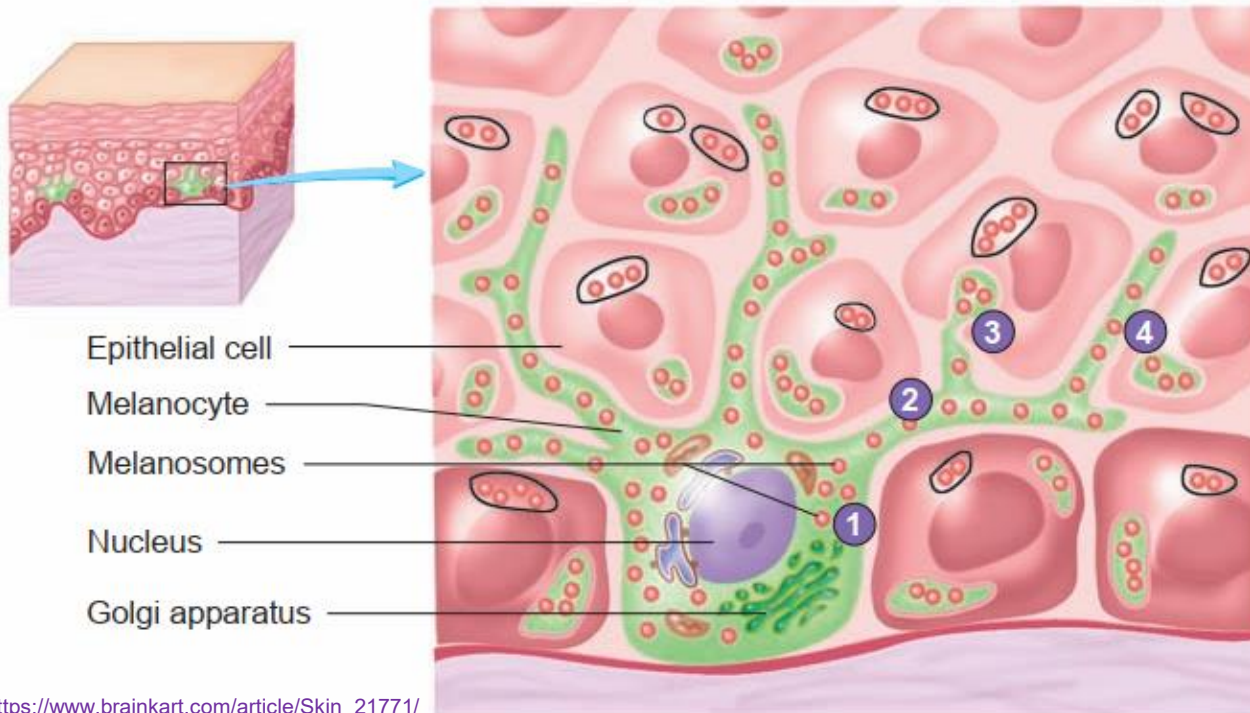
2. Melanocytes



(Ovalle and Nahirey, 2008)



- branched, or dendritic cell
- second most populous cell type in the epidermis
- present in stratum basale and hair follicle
- derived from neural crest cells
- produce melanin pigment



Melanin synthesis

1. Melanosomes are produced by the Golgi apparatus of the melanocyte.
2. Melanosomes move into melanocyte cell processes.
3. Epithelial cells phagocytize the tips of the melanocyte cell processes.
4. The melanosomes, which were produced inside the melanocytes, have been transferred to epithelial cells and are now inside them.

สีผิว (skin color)

1. **Constitutive skin color:** เป็นสีผิวตามธรรมชาติที่แท้จริง ถูกกำหนดโดยปัจจัยทางพันธุกรรมเพียงอย่างเดียว เช่น สีผิวของทารกแรกเกิด

2. **Facultative skin color:** สีผิวที่สามารถเปลี่ยนแปลงไปจากสีผิวเดิมตามพันธุกรรม โดยเป็นผลมาจากปัจจัยกระตุ้นทั้งภายในและภายนอกร่างกาย เช่น แสงแดด, ultraviolet radiation, การตั้งครรภ์, หรือการอักเสบ



PANTONE. 319-2 C



PANTONE. 92-9 C



PANTONE. 53-7 C



PANTONE. 38-8 C



PANTONE. 62-6 C



PANTONE. 99-8 C



PANTONE. 59-5 C



PANTONE. 320-2 C



PANTONE. 58-7 C



PANTONE. 51-8 C

Role of pigmentation



<https://commons.wikimedia.org/wiki/File:Vesnuschki.jpg>



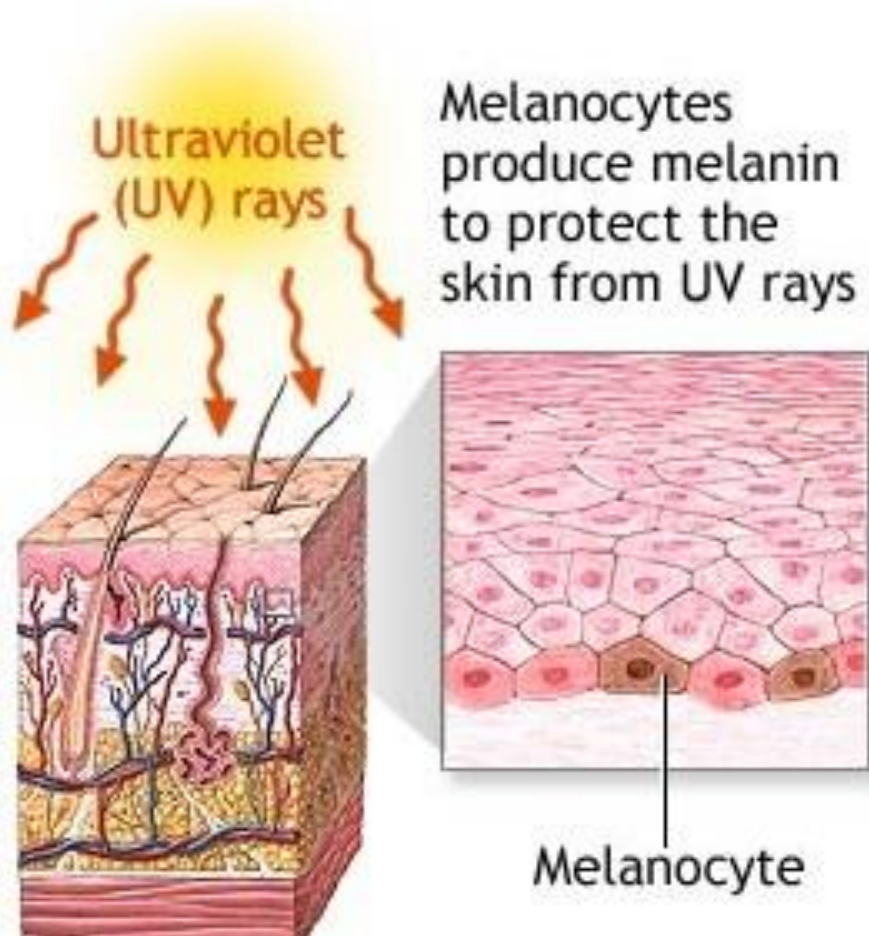
<https://www.allaboutvision.com/conditions/related/how-albinism-affects-vision/>

- **Melanin** is brown, yellow-brown, or black, produced by **melanocytes** near stratum basale cells, absorbs **ultraviolet (UV) radiation** protecting deeper layers
 - Freckles are areas of greater melanin production
 - Small amount of UV – good for stimulating vitamin D
 - Larger amounts cause burns
- Variations in skin color are due to differences in melanin production not number of cells

Albinism

- Light colored skin or hair
- Melanin is not produced in melanocytes even though of normal abundance

Melanin and sunburn



If UV rays exceed what can be blocked by your level of melanin, sunburn results



<https://ufhealth.org/conditions-and-treatments/sunburn>

Cyanosis

a bluish coloration, occurs when blood oxygen supplies are diminished



<https://simple.wikipedia.org/wiki/Cyanosis>

Jaundice



Jaundice is a condition that causes yellowing of the skin and eyes. It occurs when there is a buildup of bilirubin, a yellow pigment that is produced when red blood cells break down, in the blood. When the levels of bilirubin become too high, it can cause jaundice.

26

<https://redcliffelabs.com/myhealth/liver/is-jaundice-contagious-check-the-facts/>

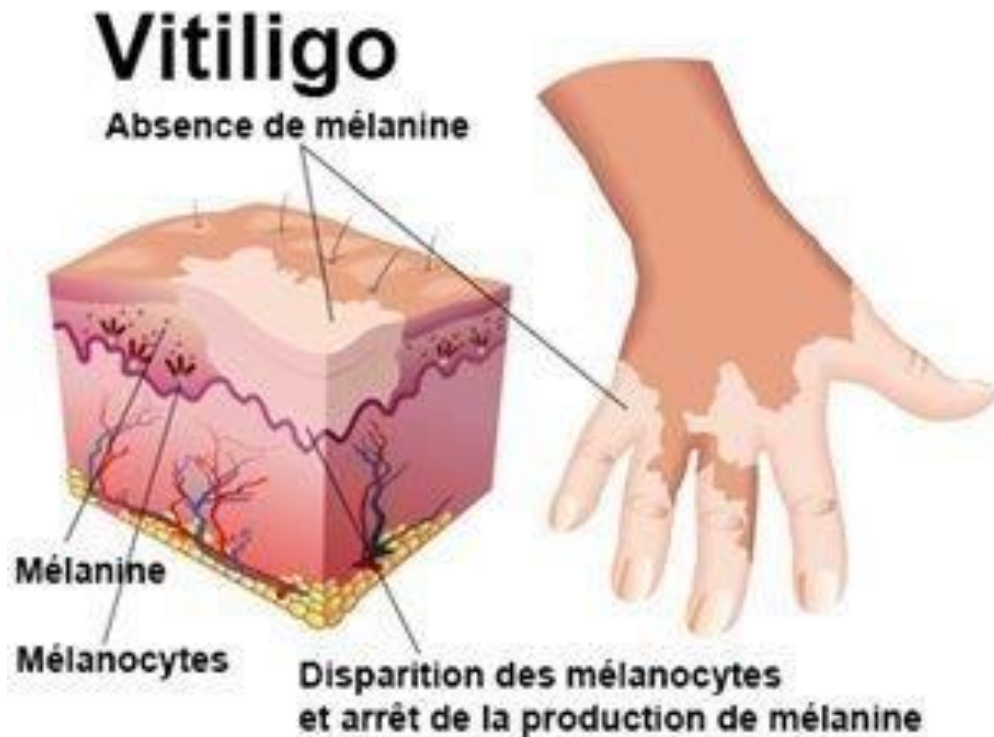


<https://my.clevelandclinic.org/health/diseases/12419-vitiligo>

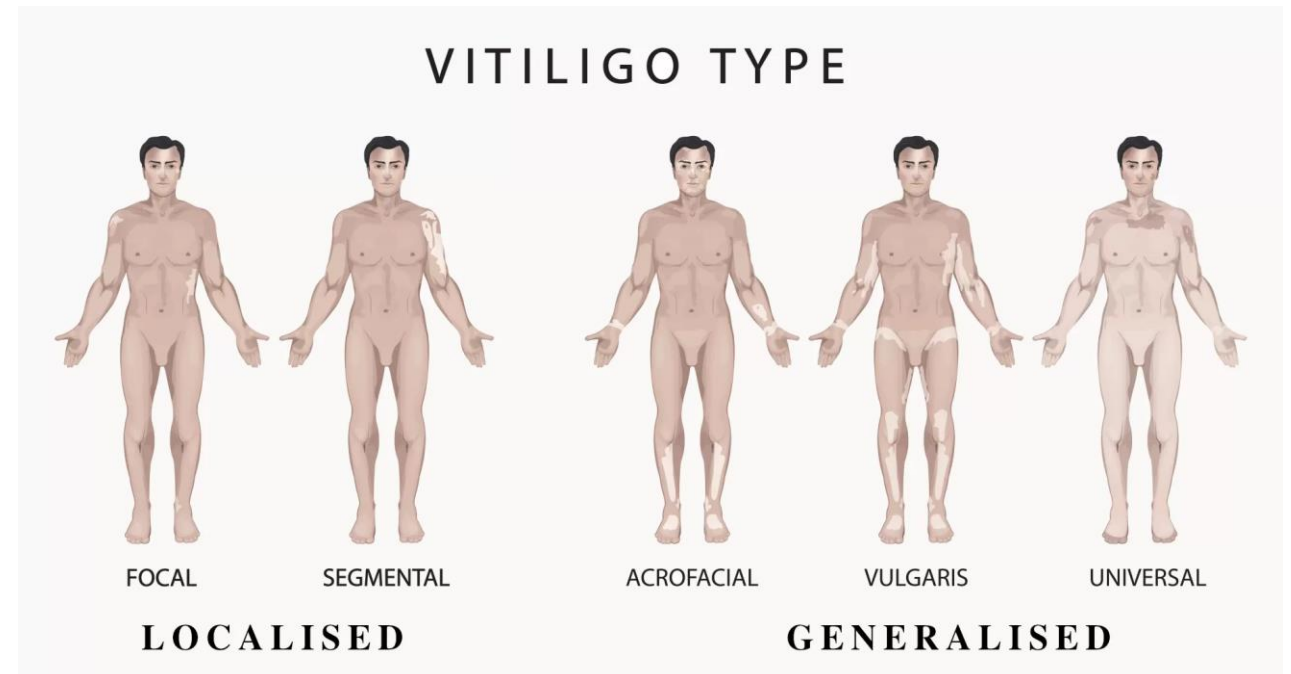
<https://www.zenithskindental.com/vitiligo/>

Vitiligo

- a chronic autoimmune disorder
- pigment-producing cells (melanocytes) die or stop producing melanin
- patches of skin to lose pigment or color
- cause of vitiligo is unknown
- may be related to immune system changes, genetic factors, stress, or sun exposure

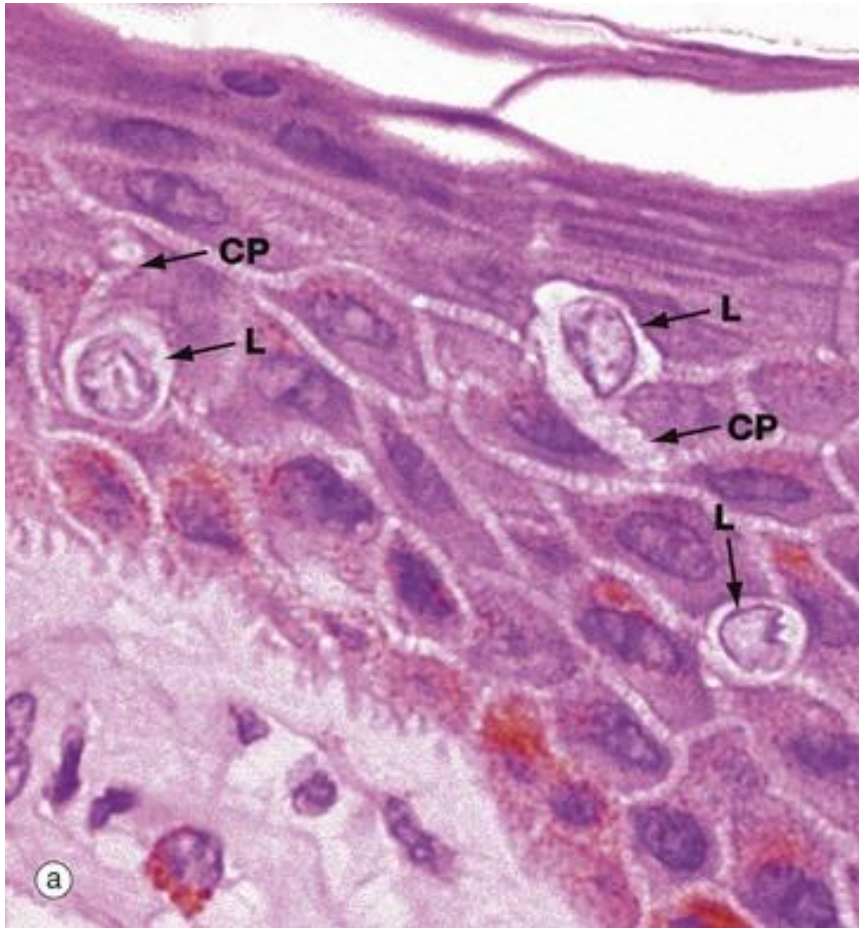


<https://rejuvenatehairtransplant.com/vitiligo/>



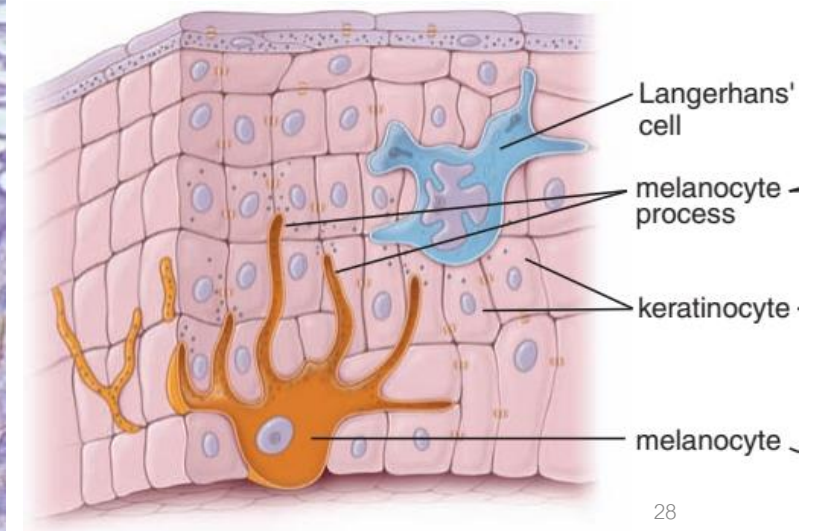
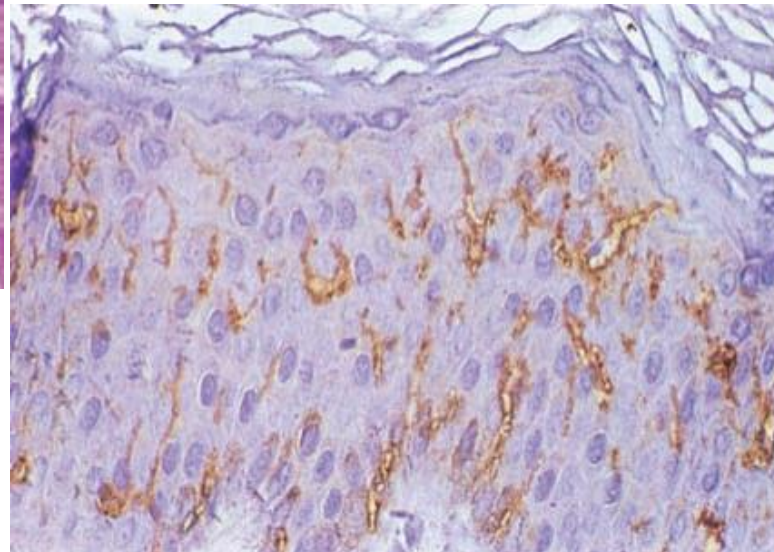
<https://vitigosociety.org/about-vitiligo/>

3. Langerhans cells



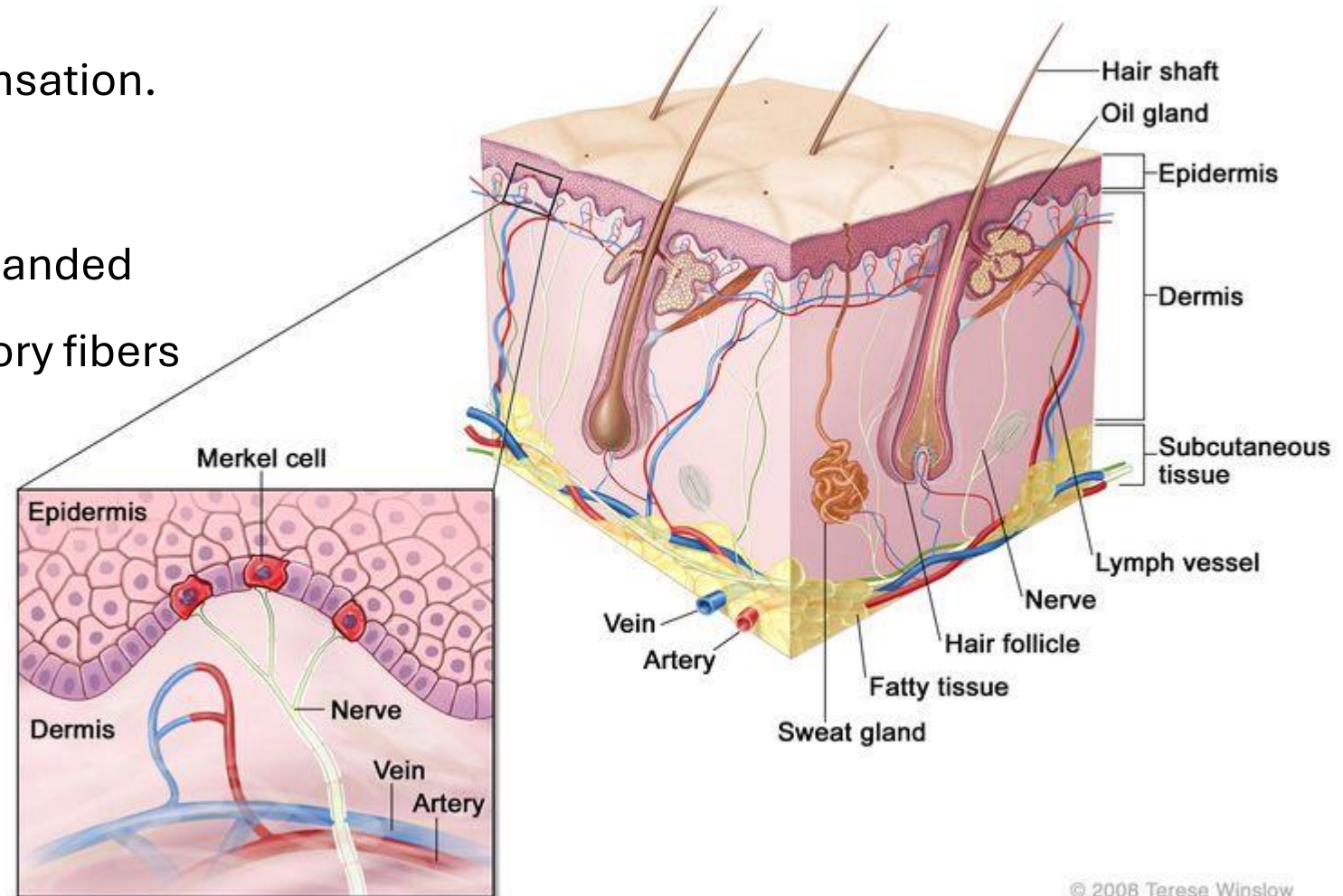
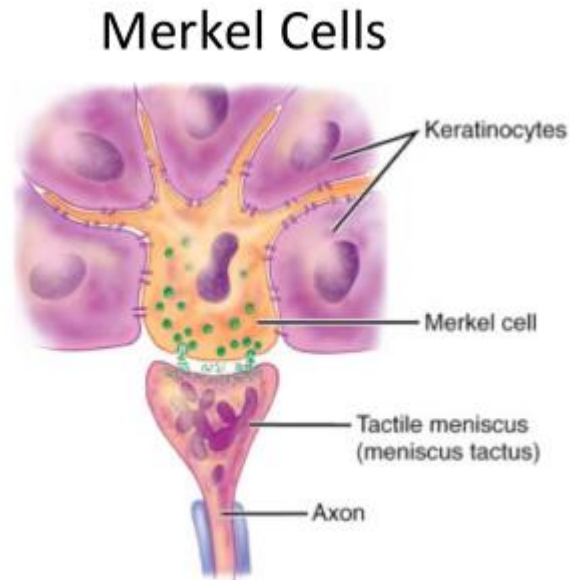
<https://basicmedicalkey.com/skin-5/>

- dendritic cell
- do not form cellular junctions with neighboring cells
- derived from bone marrow
- located in the stratum spinosum
- antigen-presenting cells
- present antigens to T lymphocytes
- 2-8% of the epidermal cells



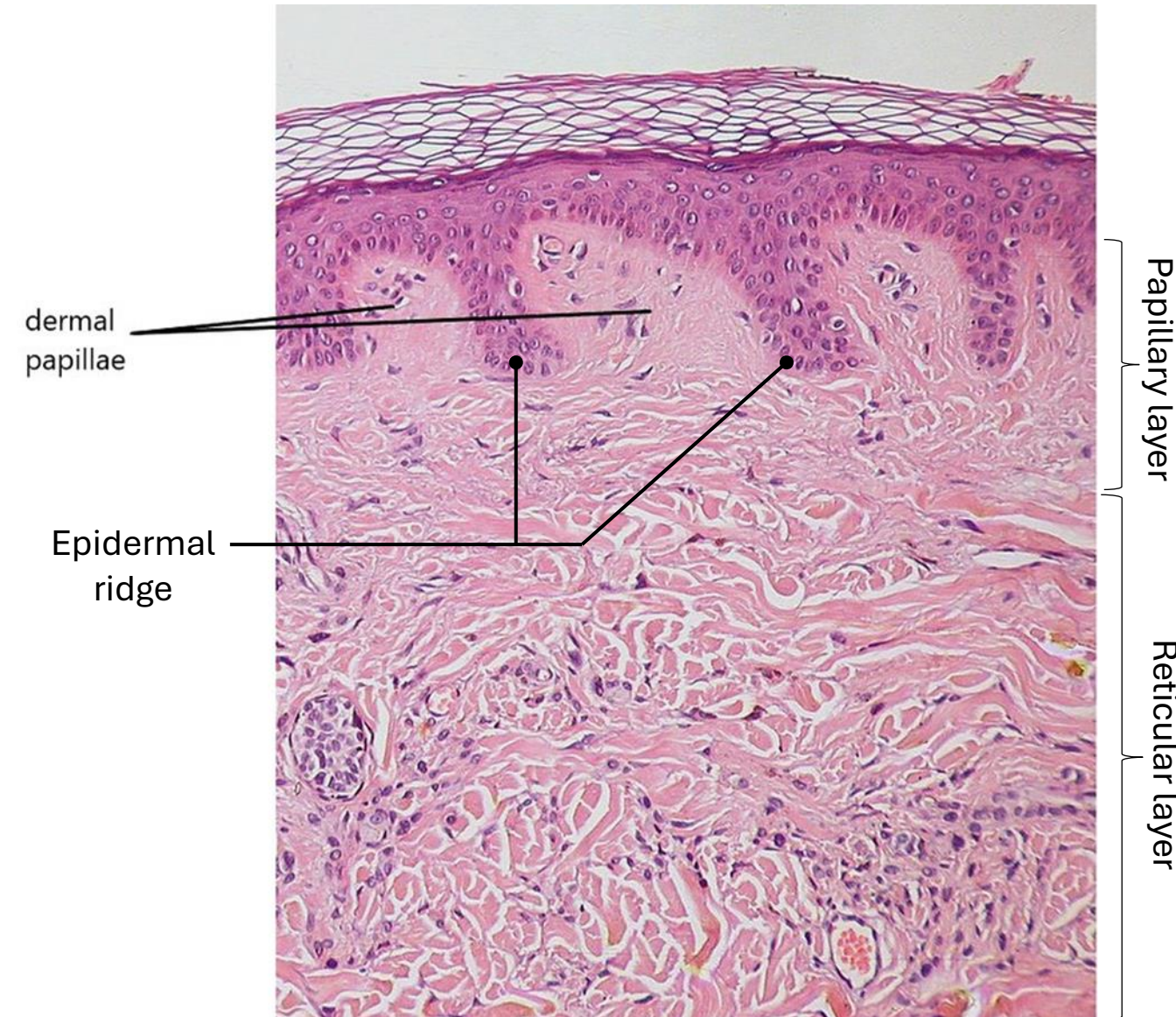
4. Merkel's cells

- Stratum basale
- Mechanoreceptors for light touch sensation.
- abundant fingertips and hair follicles
- The basolateral surfaces contact expanded terminal discs of unmyelinated sensory fibers

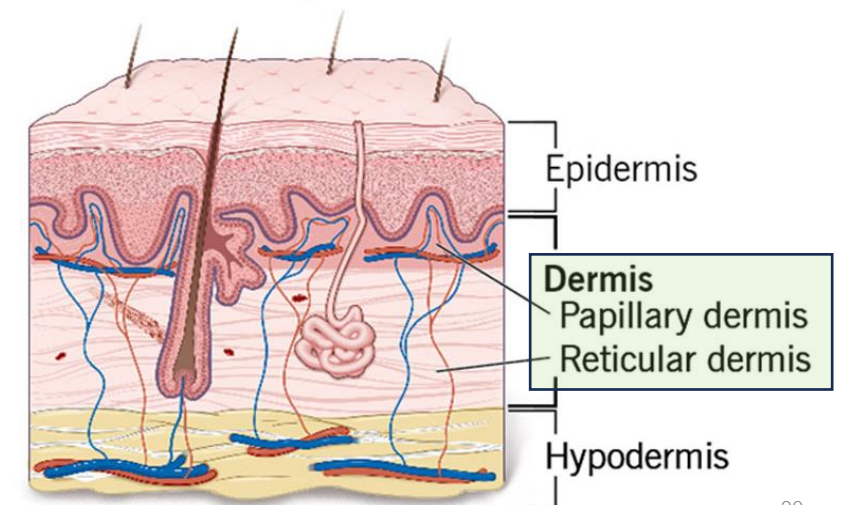


© 2008 Terese Winslow
U.S. Govt. has certain rights

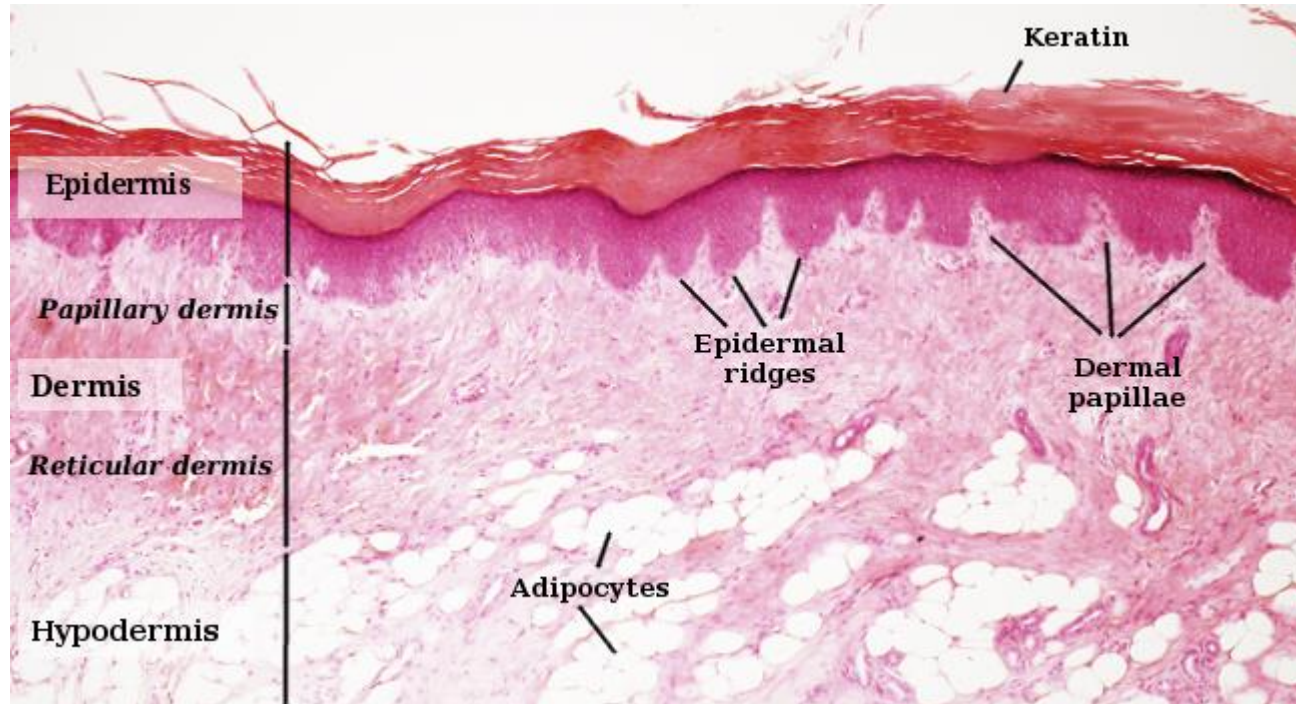
Dermis



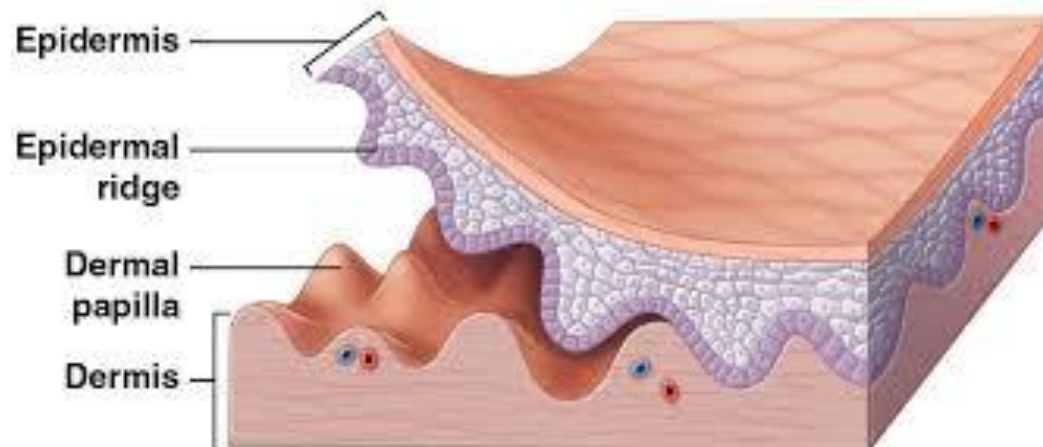
- Dense irregular collagenous CNT
- Contain capillaries, nerves, sensory organs, hair follicles sweat and sebaceous glands, and arrector pili muscles
- Dermal papilla and epidermal ridge
- Divided into
 - The papillary layer
 - The reticular layer



Epidermal ridges and dermal papillae

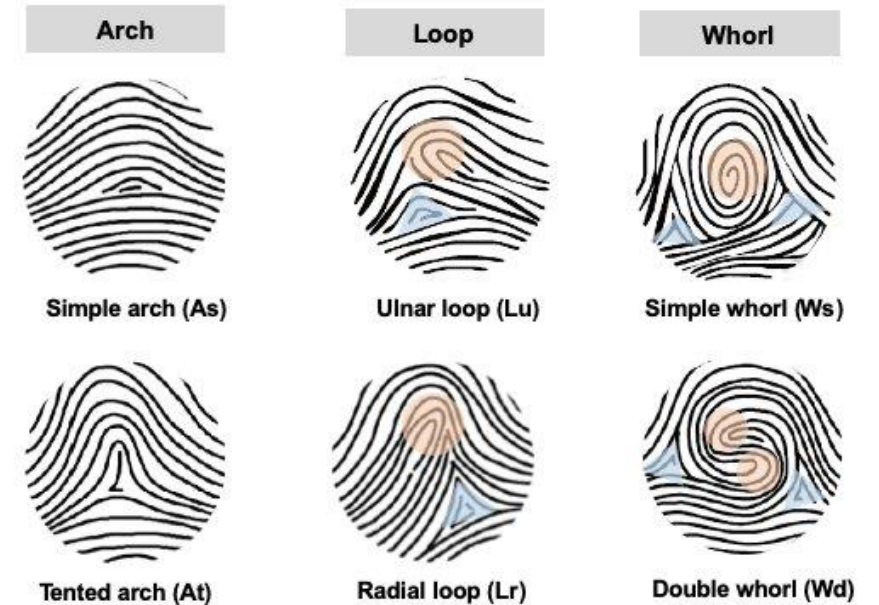


<https://quizlet.com/gb/765637282/n5b-cutaneous-sensation-histology-diagram/>



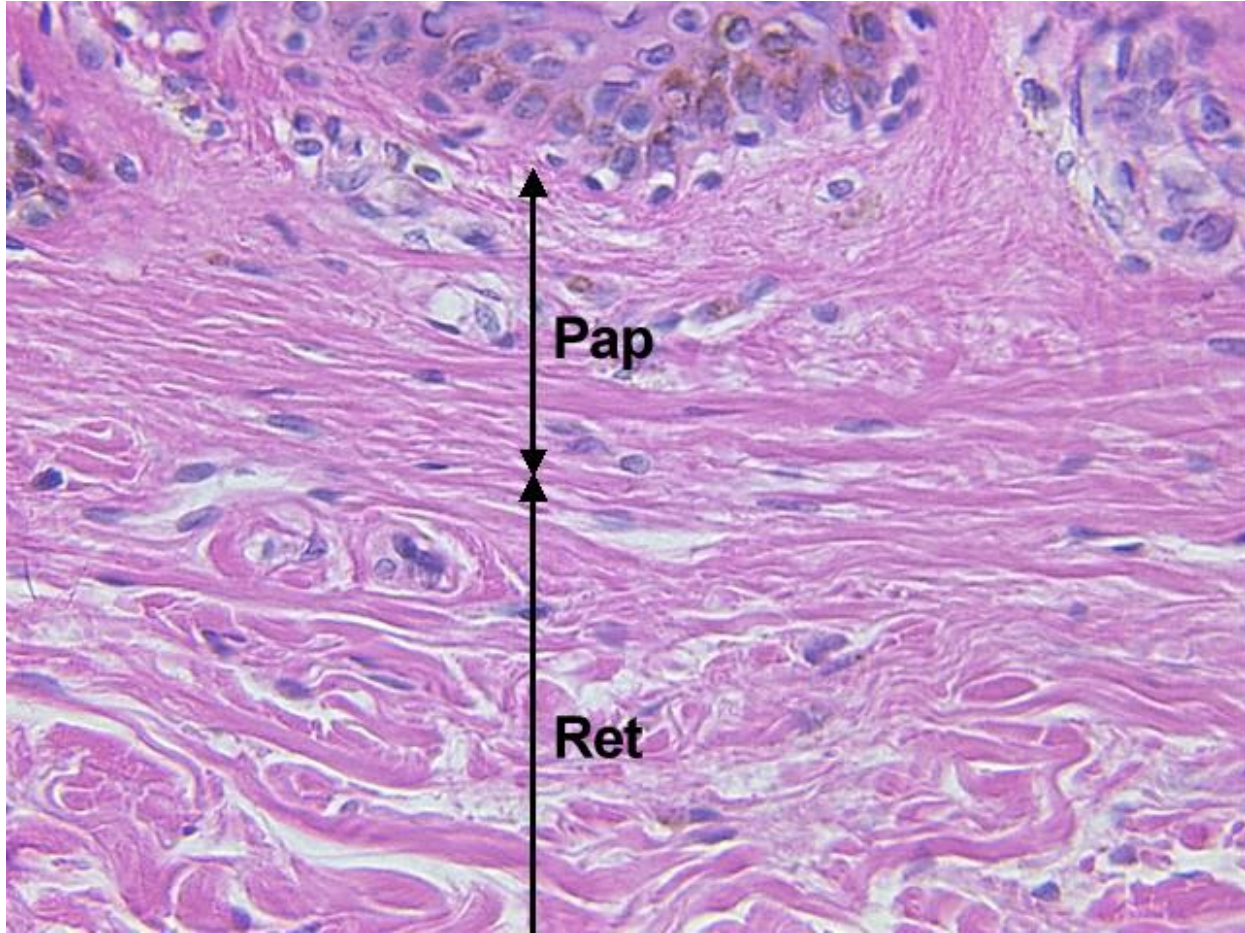
<https://quizlet.com/gb/765637282/n5b-cutaneous-sensation-histology-diagram/>

Fingerprint



<https://sites.rutgers.edu/fingerprinting/introduction-what-are-fingerprints/>

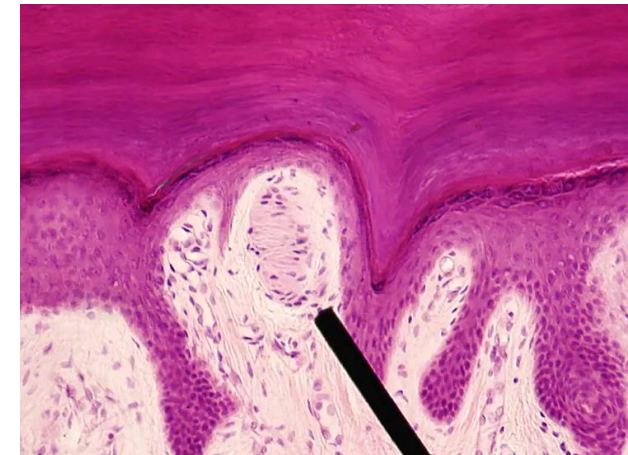
Papillary layer



- loose connective tissue
- The collagen fibers (type I and type III) are not as thick as those in the deeper portion.
- The elastic fibers are threadlike and form an irregular network.
- This layer is relatively thin
- Contain free nerve ending (pain receptor) and Meissner's corpuscle (touch receptor) and blood vessels



<https://kku.world/422y08>

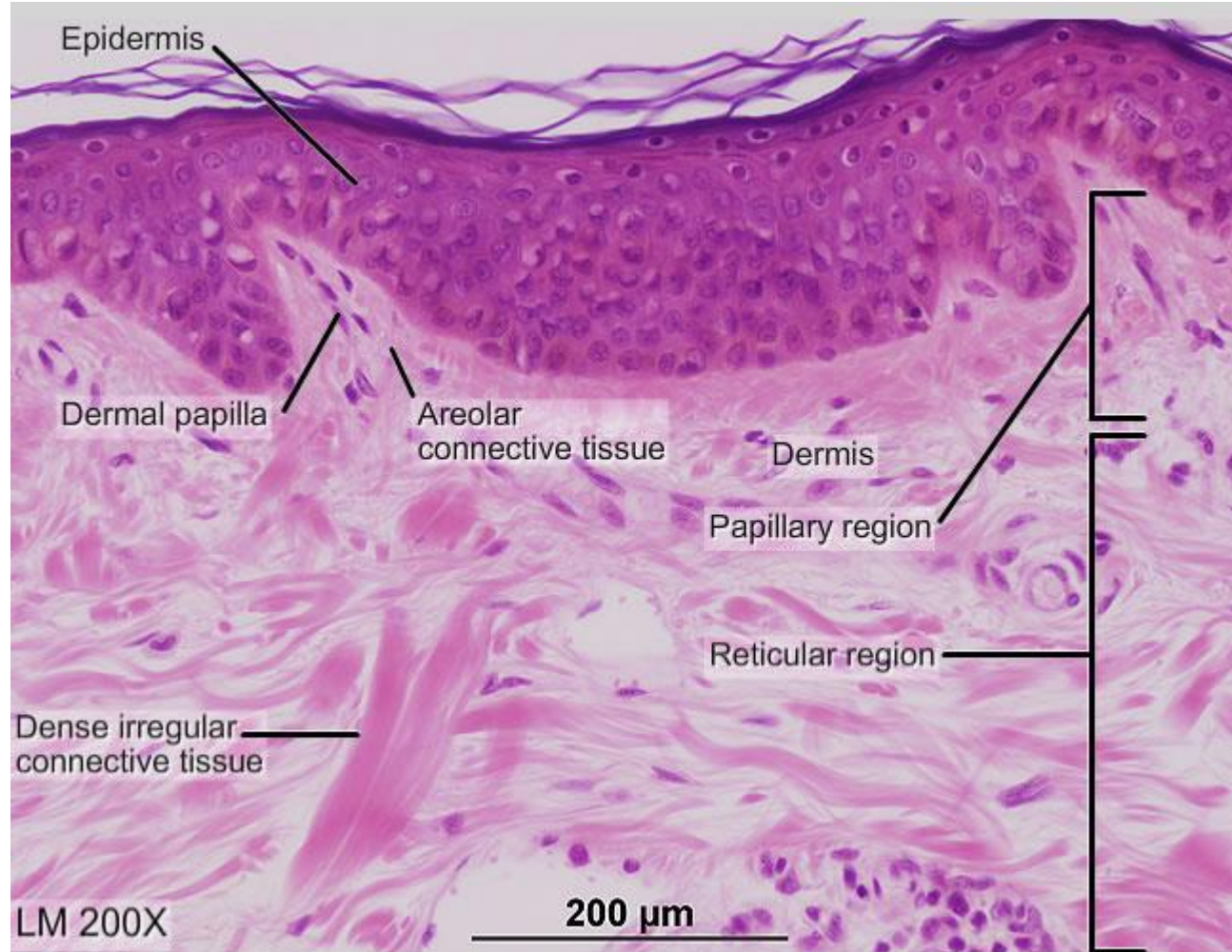


<https://www.britannica.com/science/Meissner-corpuscle>

Copied from: http://stevegallik.org/histologyolm_Ch13_P04.html

Pap: papillary layer; Ret: reticular layer

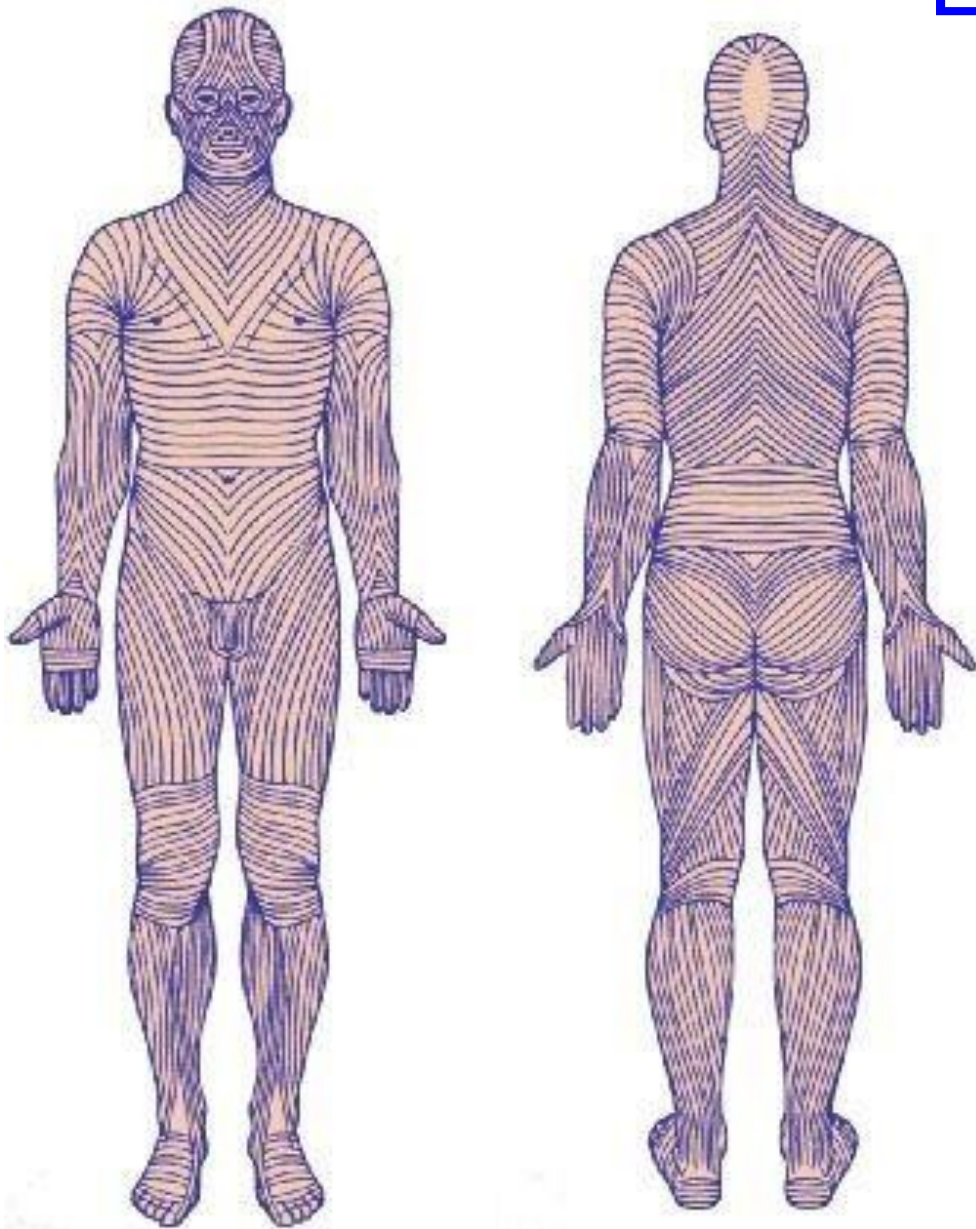
Reticular layer



Light micrograph of skin.

- is much thicker
- dense irregular connective tissue
- Bundle of type I collagen and thick elastic fibers , with more fibers and fewer cells than the papillary layer
- Langer's line: เส้นใยคอลลาเจนของผิวหนังชั้น dermis ซึ่งเป็นแนวที่ขนานไปกับแนวเส้นมัดกล้ามเนื้อ การผ่าตัดจะผ่าตามแนว Langer's line เพื่อให้แผลสมานตัวดีขึ้น และลดการเกิดแผลเป็น

Langer's line



- also known as cleavage lines
- the natural orientation of collagen fibers in the dermis
- significant implications in surgery

<https://basicmedicalkey.com/plastic-surgery-2/>



Langer's Lines head from Marx J., Hockberger R, Walls R Eds. Rosen's Emergency Medicine: Concepts and Clinical Practice 2002

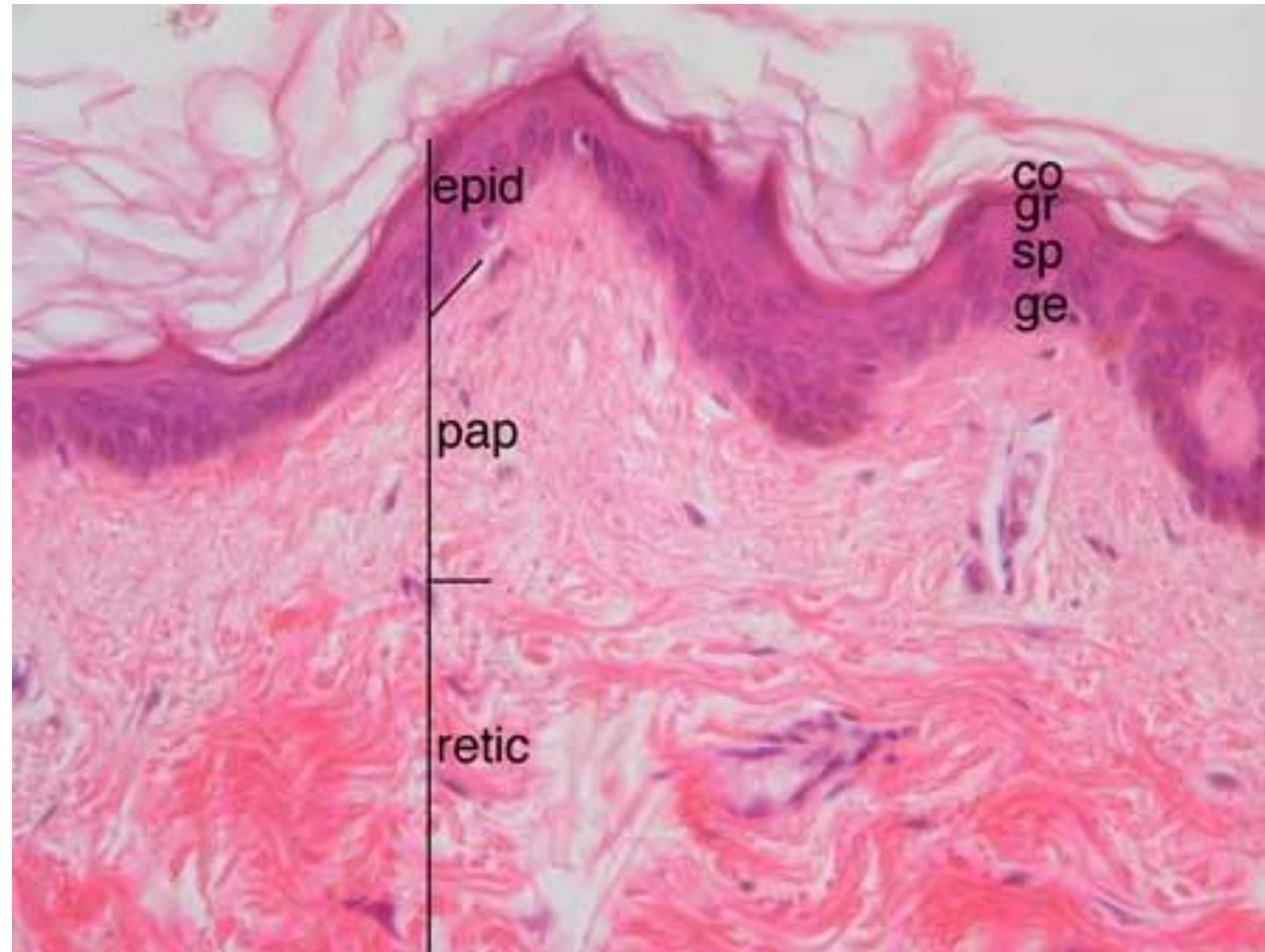


Langer's Lines head from The Open Access Atlas of Otolaryngology, Head & Neck Operative Surgery by Johan Fagan (Editor) johannes.fagan@uct.ac.za accessed 22 Sept 2016

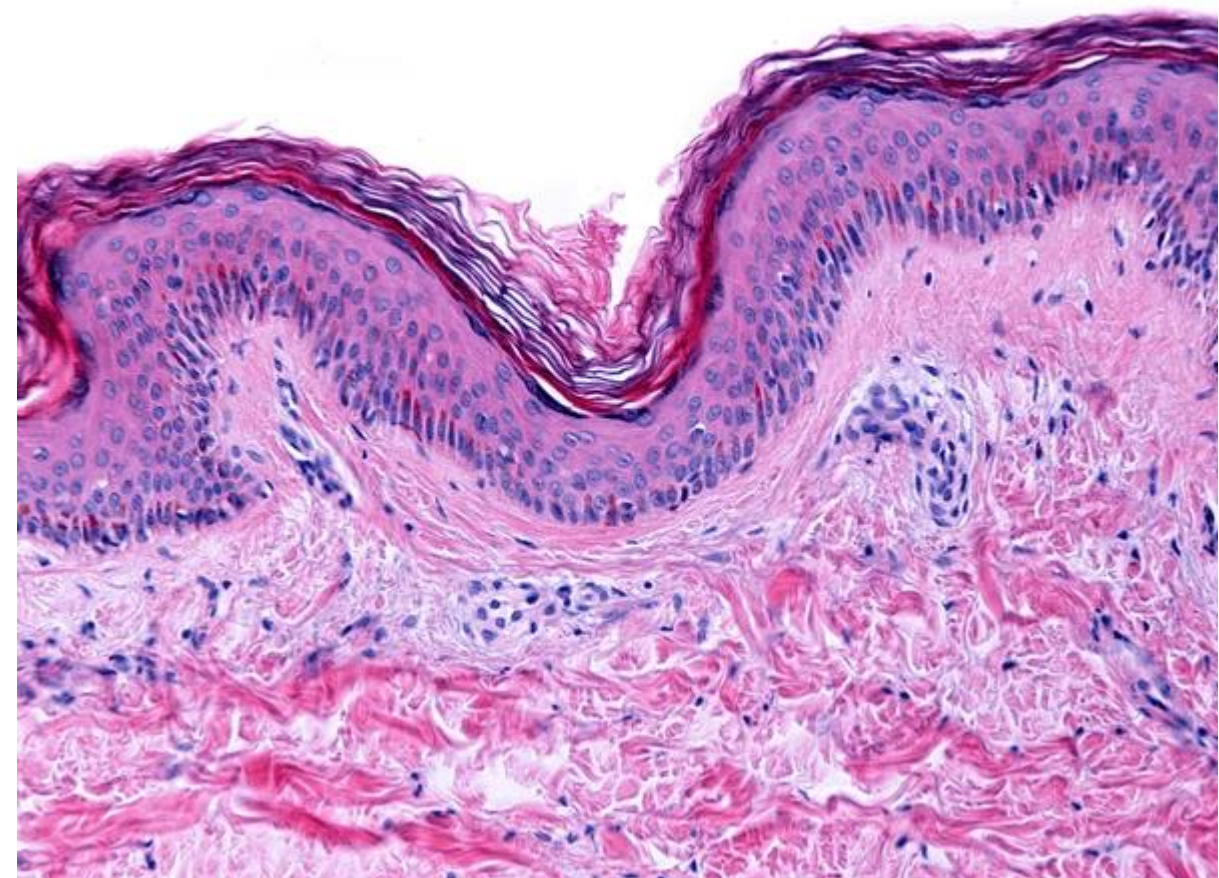


Karl Langer
Austrian anatomist

Papillary and reticular layers



<https://eugraph.com/histology/skin/skinimag/ladermep.jpg>



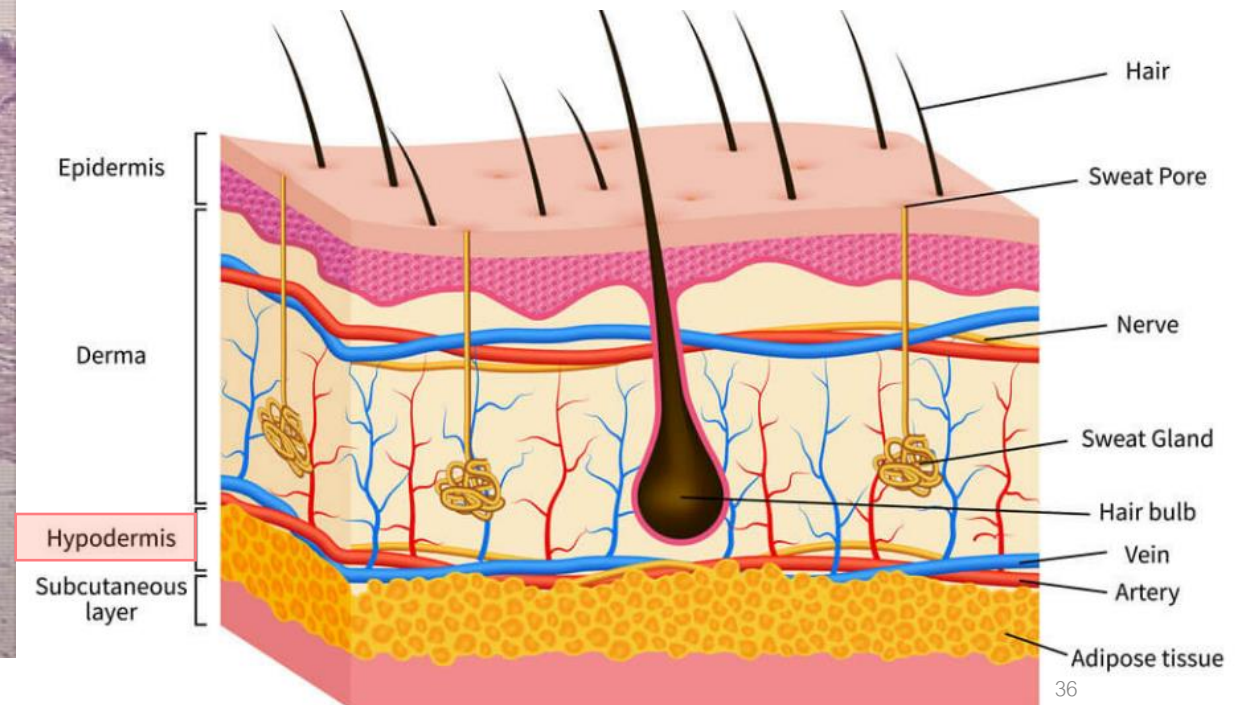
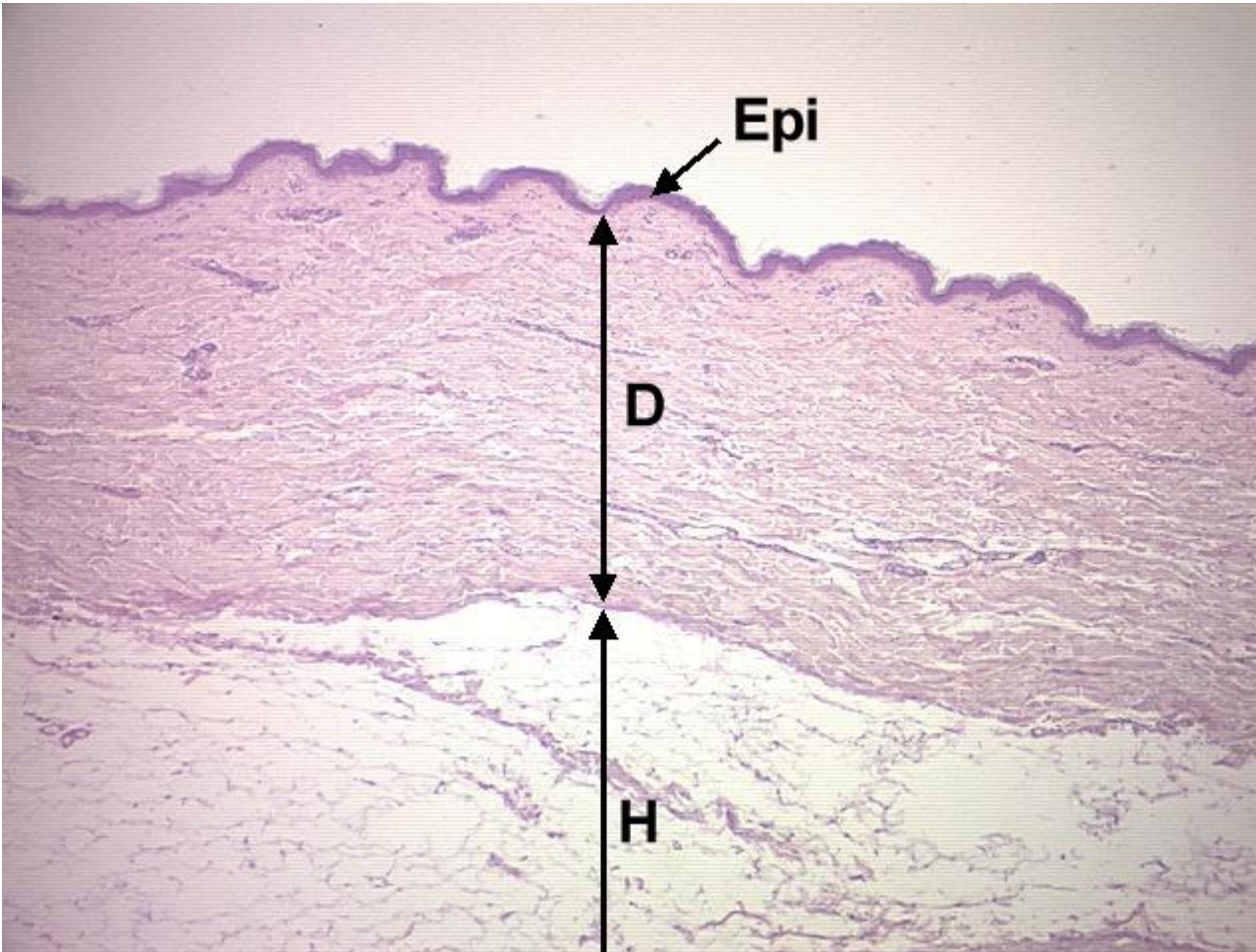
<https://www.shutterstock.com/image-photo/thin-skin-showing-epidermis-different-600nw-1136062742.jpg>

Hypodermis

(subcutaneous tissue or superficial fascia)

- loose CNT and adipocytes
- extensive vascular supply

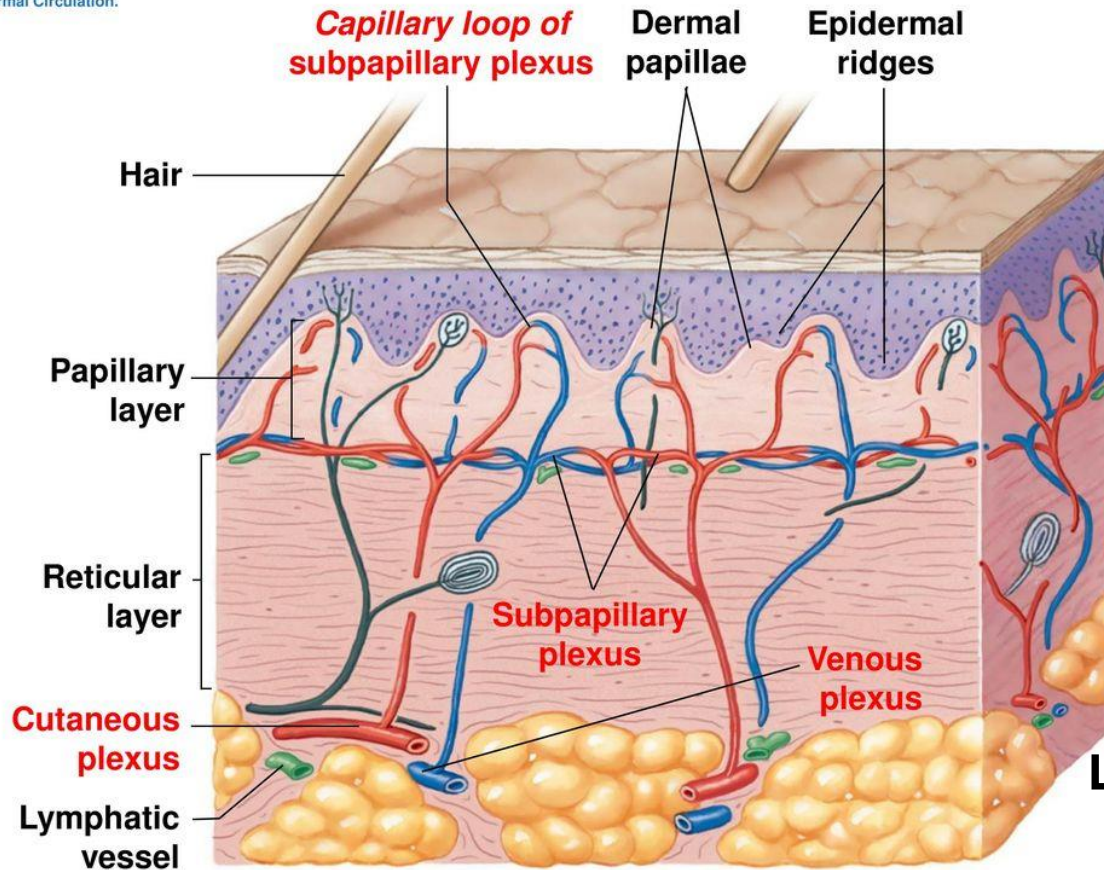
adipocytes vary in number in different body regions and vary in size according to nutritional state



Blood supply, lymphatics of the skin

Blood supply

Dermal Circulation.



© 2012 Pearson Education, Inc.

- Horizontal cutaneous plexus (between hypodermis and reticular layer)
- Ascending arteriole
- Subpapillary plexus (between reticular and papillary layer)
- Capillary loop (dermal papilla)

- Descending venous capillary loop
- Descending venule (between reticular and papillary layer)
- Venous plexus

Arteriovenous anastomoses
(between horizontal cutaneous plexus and subpapillary plexus)

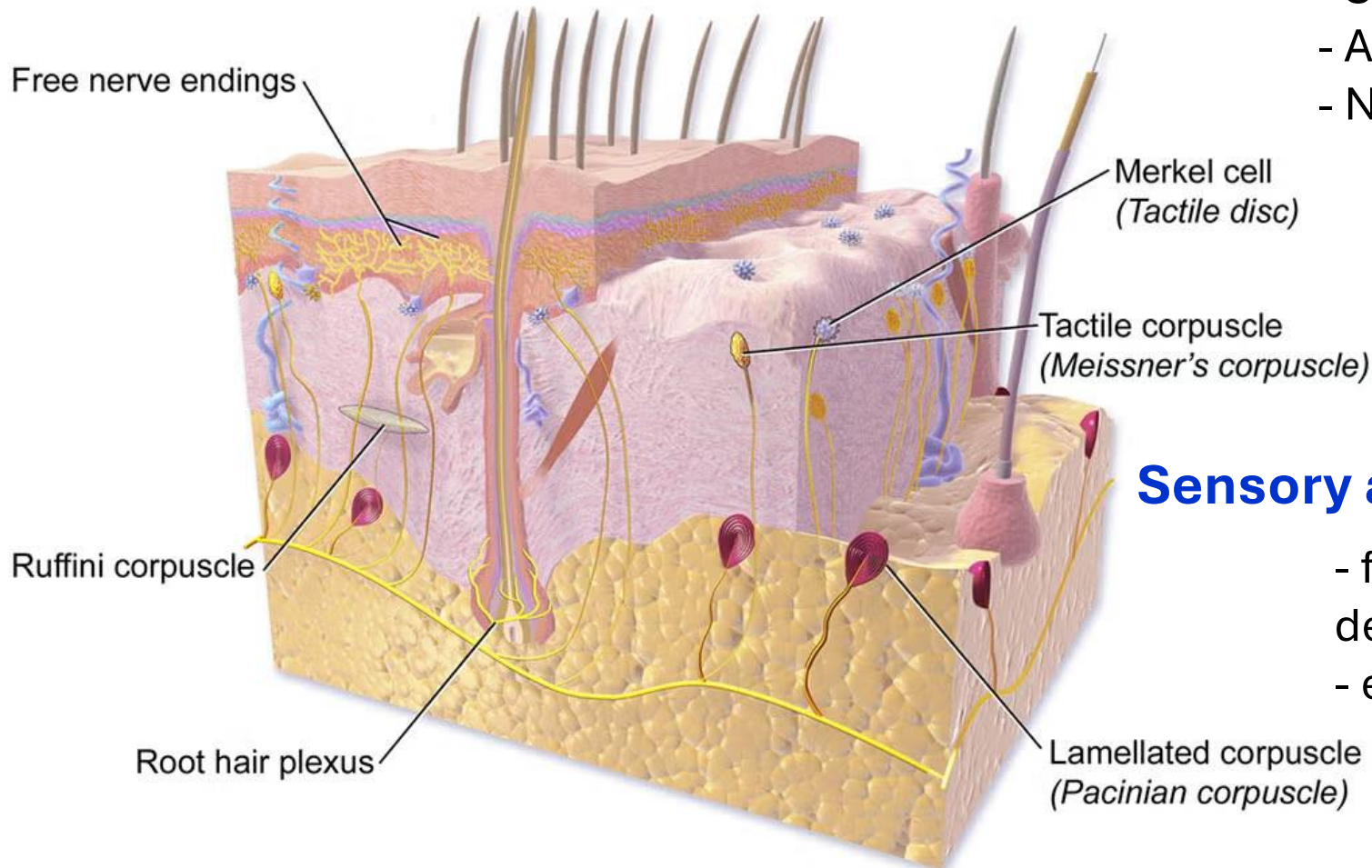
Lymphatic of the skin

- Dermal papilla
- Lymphatic vessel

Nerve ending

Autonomic system (sympathetic nervous system)

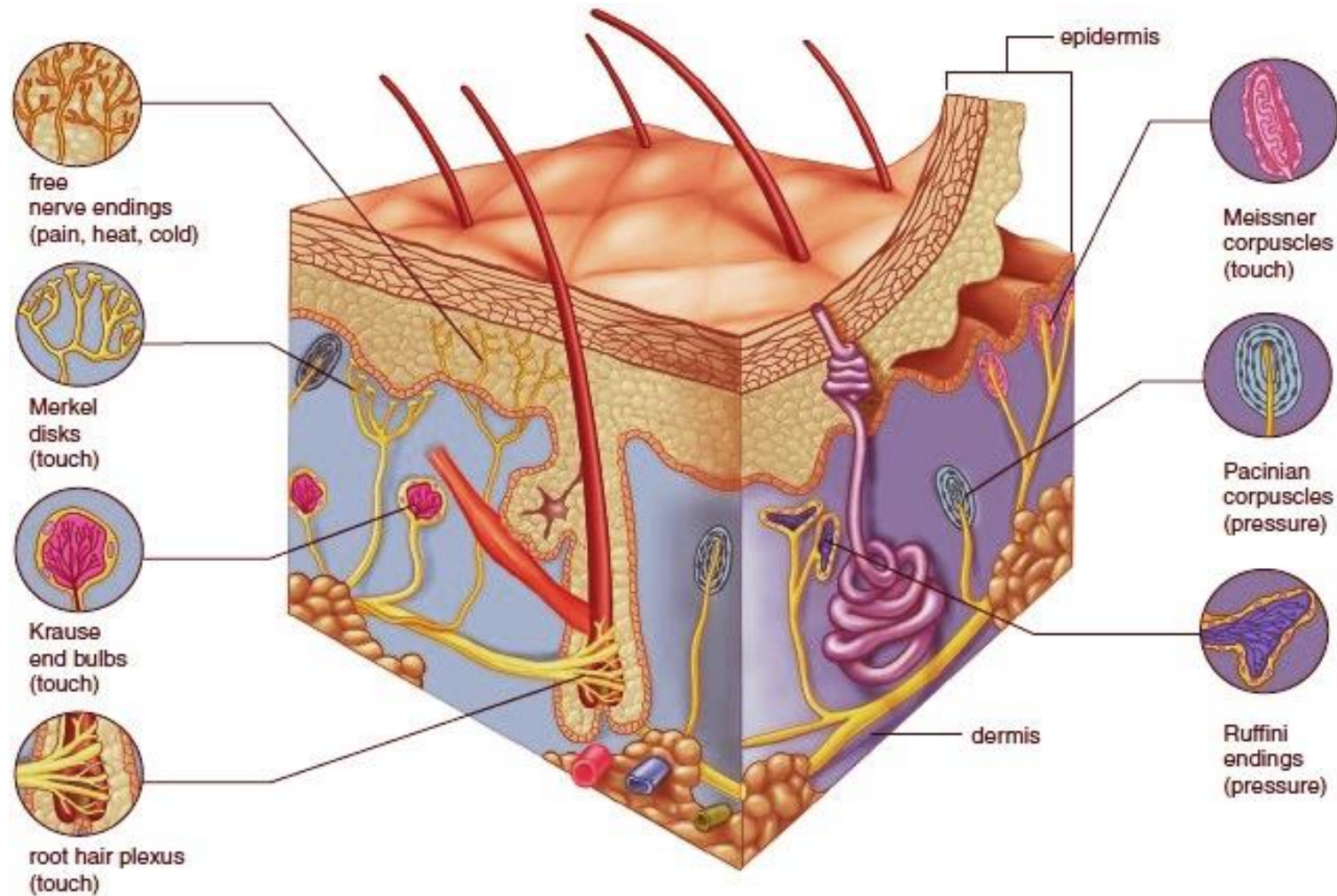
- Sweat glands
- Arrector pili muscle
- No parasympathetic innervation



Sensory afferent nerve fiber

- form a network in the papillary layer of dermis and around hair follicles
- ending at epithelial and dermal receptors

Sensory receptors



The unencapsulated receptors

- Free nerve endings
- Merkel cells
- Root hair plexuses

The encapsulated receptors

- Meissner (tactile) corpuscles
- Pacinian (lamellate) corpuscle
- Krause end bulbs
- Ruffini corpuscles

Sensory receptors

The unencapsulated receptors

Free nerve endings

- extend into the middle of the epidermis
- temperatures, pain, and itching
- tactile receptors

Merkel cells

- stratum basale
- light touch

Root hair plexuses

- reticular dermis
- bases of hair follicles
- detects movements of the hairs

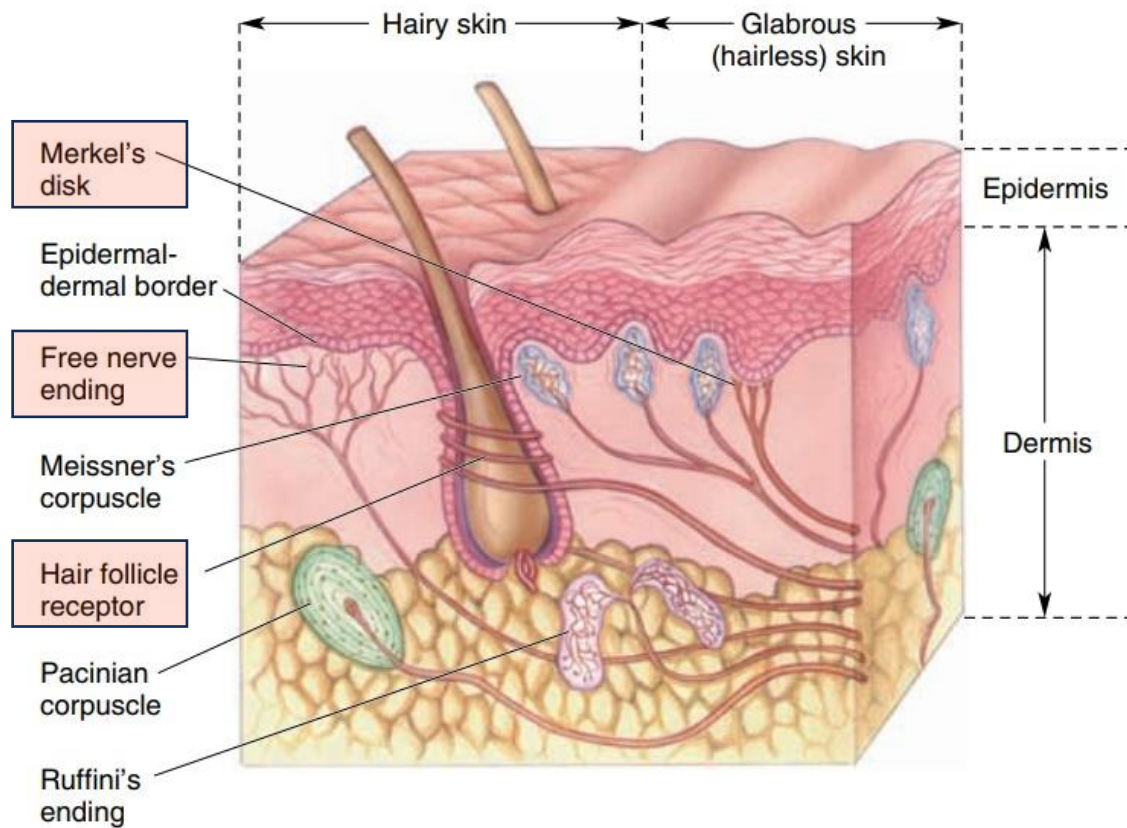


FIGURE 5.12. Anatomic Structure of Certain Cutaneous Receptors

Sensory receptors

The encapsulated receptors

Pacinian corpuscles

- pressure and vibrations
- reticular layer of dermis and hypodermis

Meissner's corpuscles

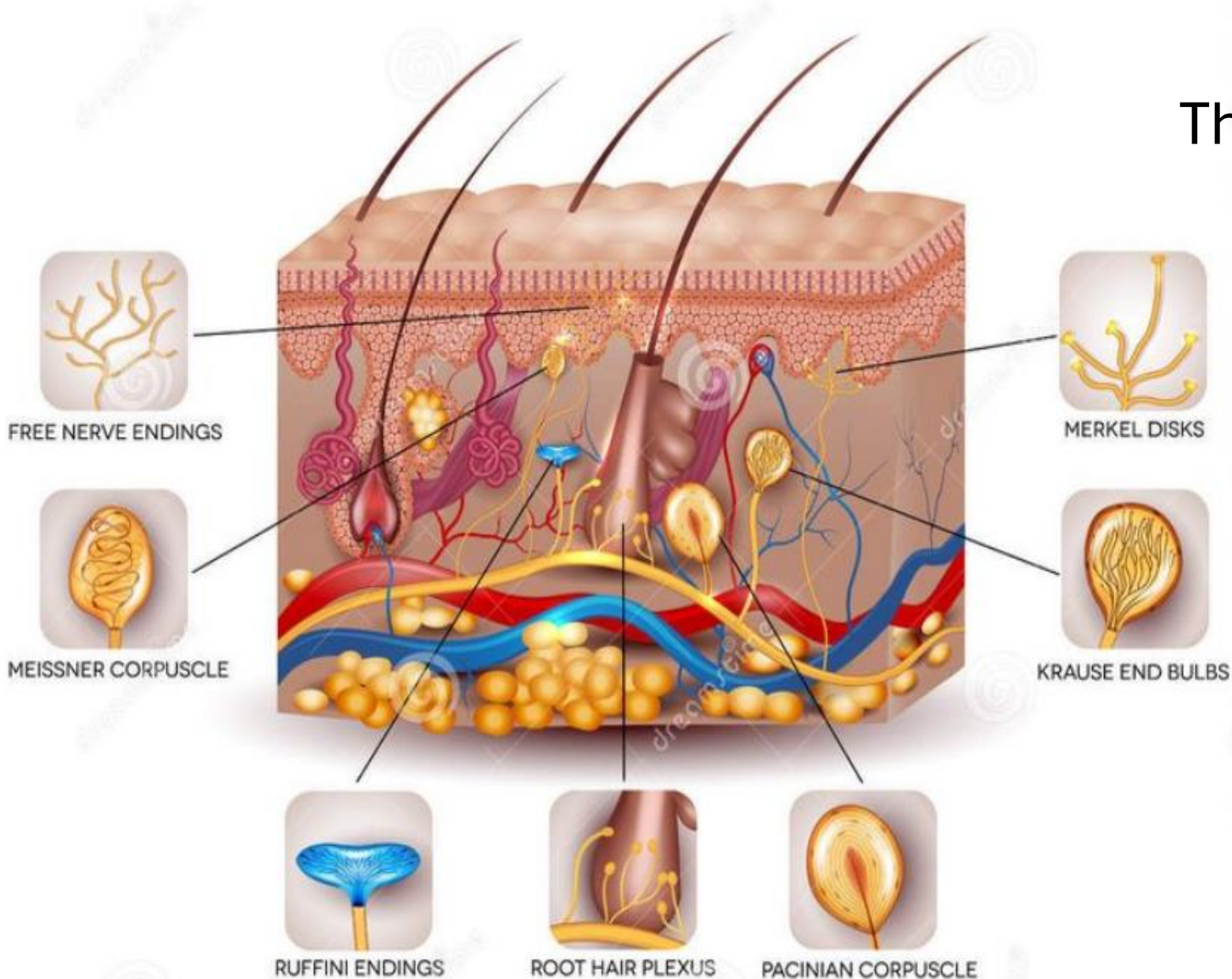
- light touch
- dermal papilla

Ruffini's corpuscles

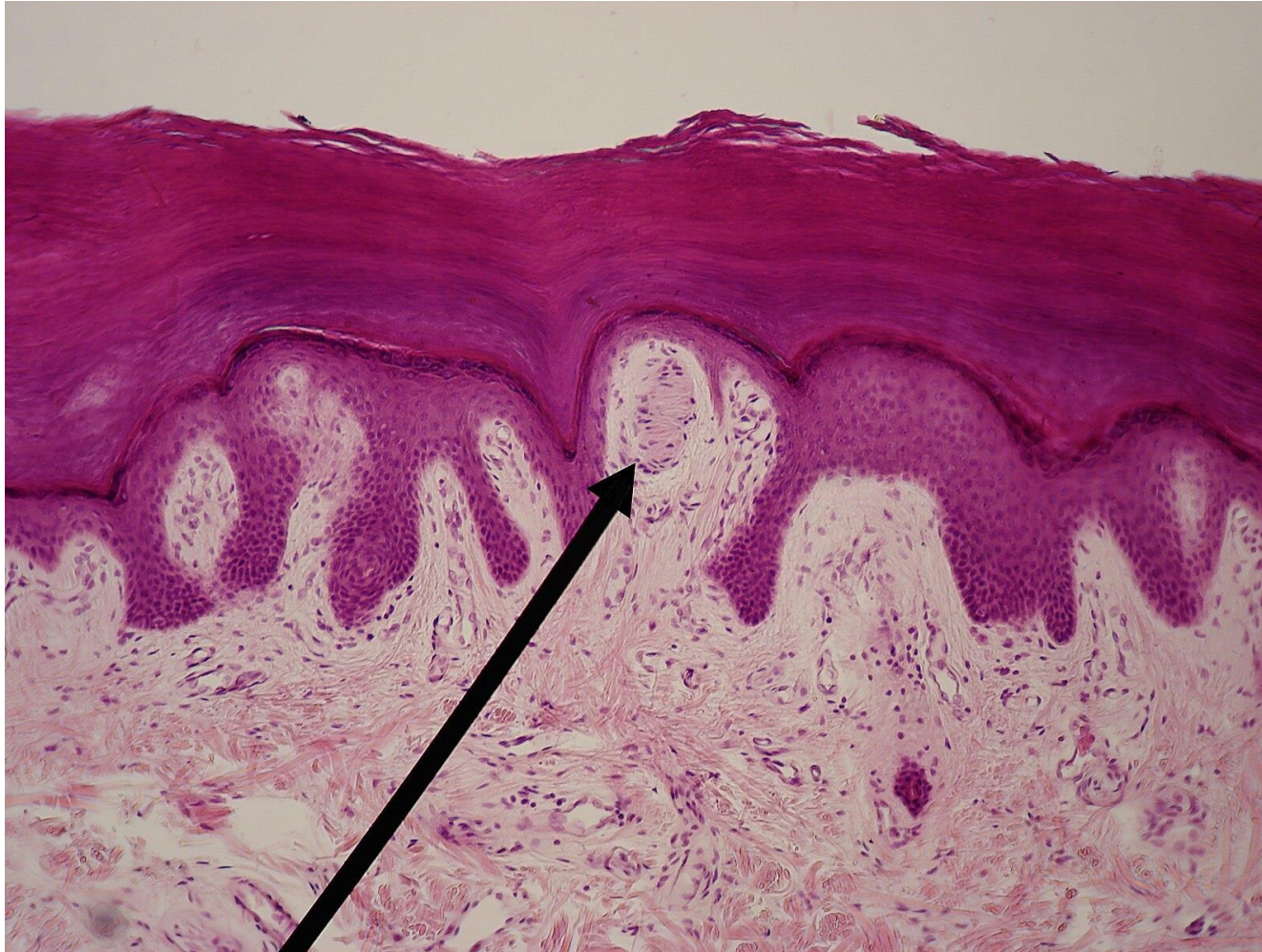
- stretch and torque

Krause end bulbs

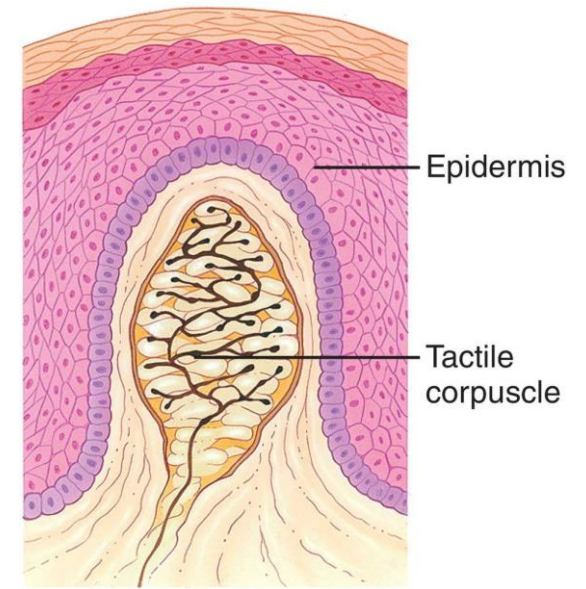
- low frequency vibrations



Meissner's corpuscles

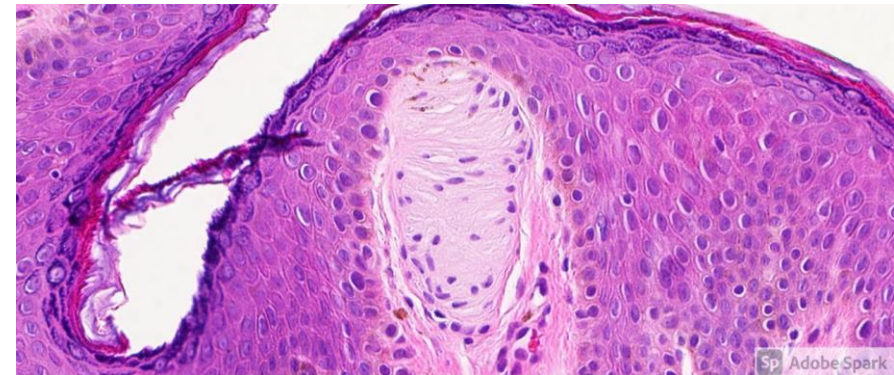


https://th.m.wikipedia.org/wiki/%E0%B9%84%E0%B8%9F%E0%B8%A5%E0%B9%8C:WVSOM_Meissner%27s_corpuscle.JPG



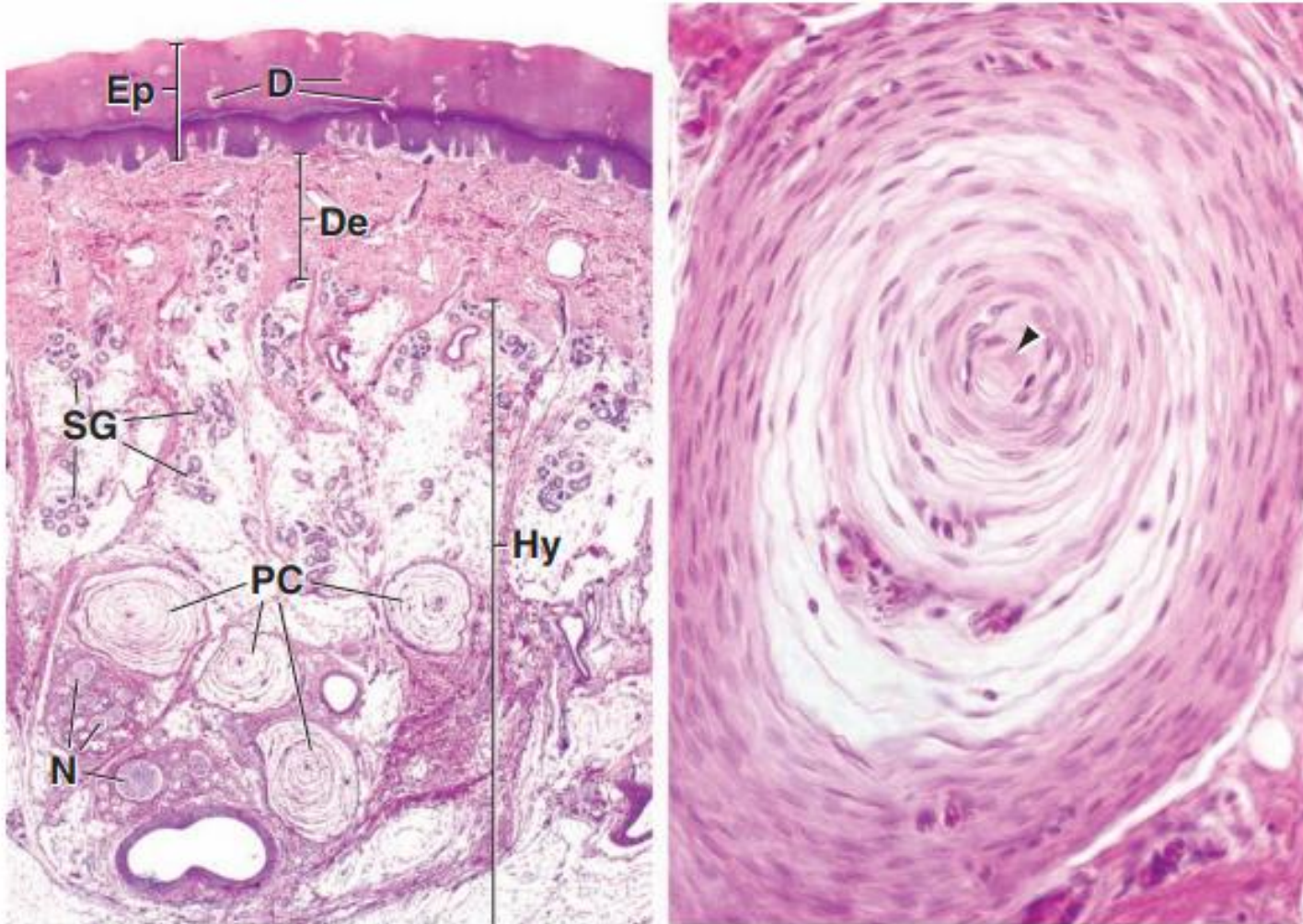
<https://kku.world/f686u5>

- dermal papillae
- light touch
- fingertips, palms, and soles

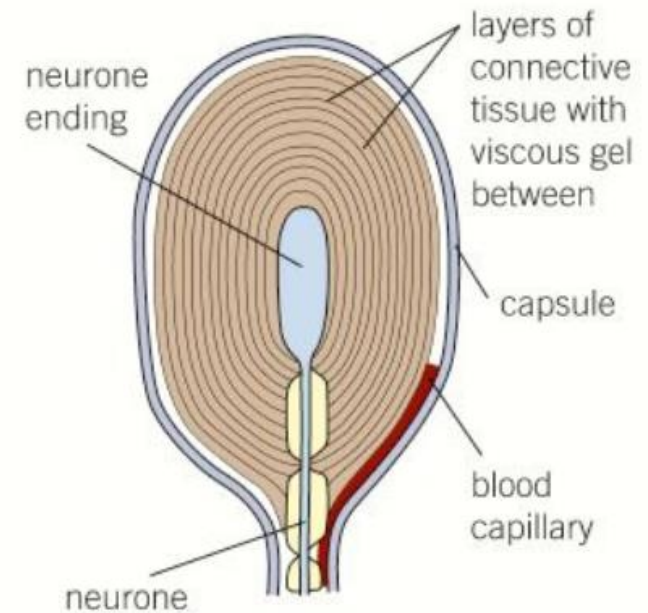


<https://kikoxp.com/posts/7796/public>

Pacinian corpuscles

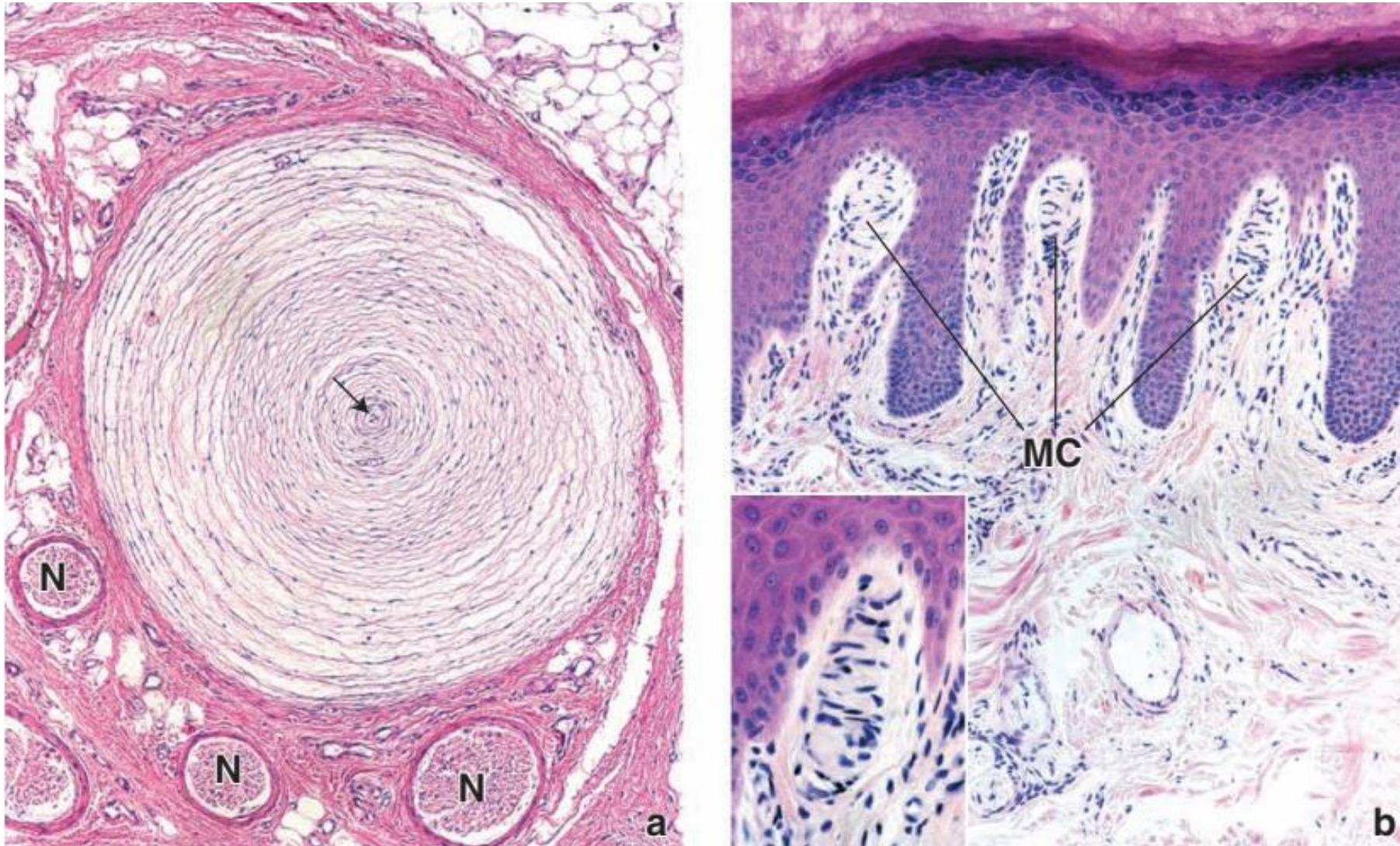


- large oval structures
- reticular dermis and hypodermis

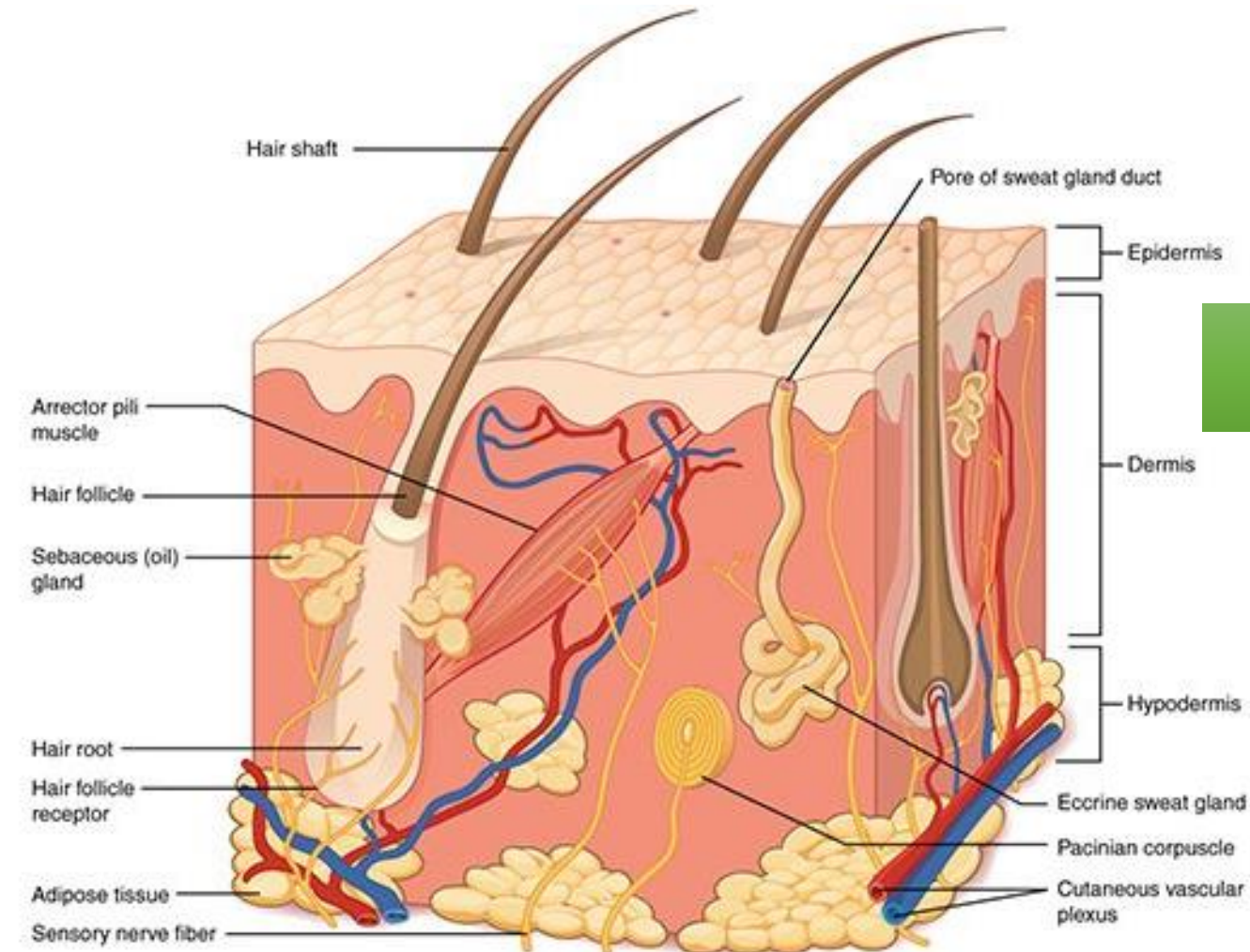


<https://quizlet.com/gb/445492774/144-receptors-flash-cards/>

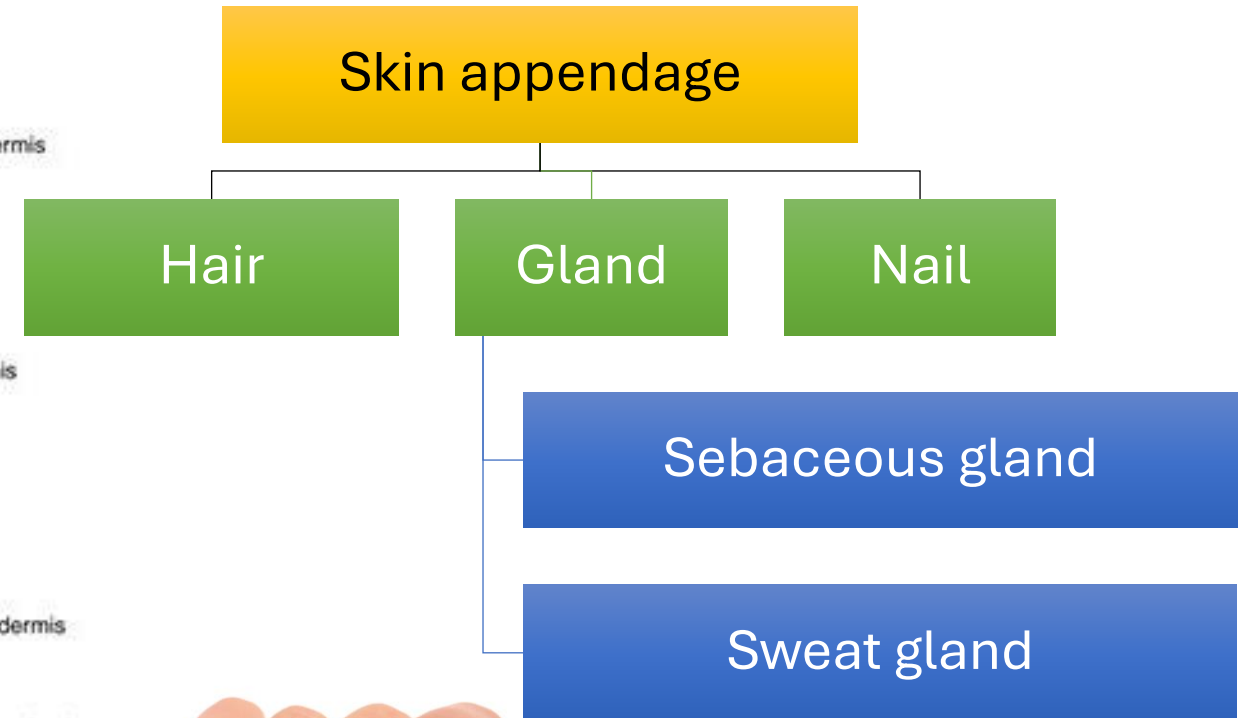
Pacinian and Meissner's corpuscles in H&E staining



Skin appendage



<https://teachmeanatomy.info/the-basics/ultrastructure/skin/>

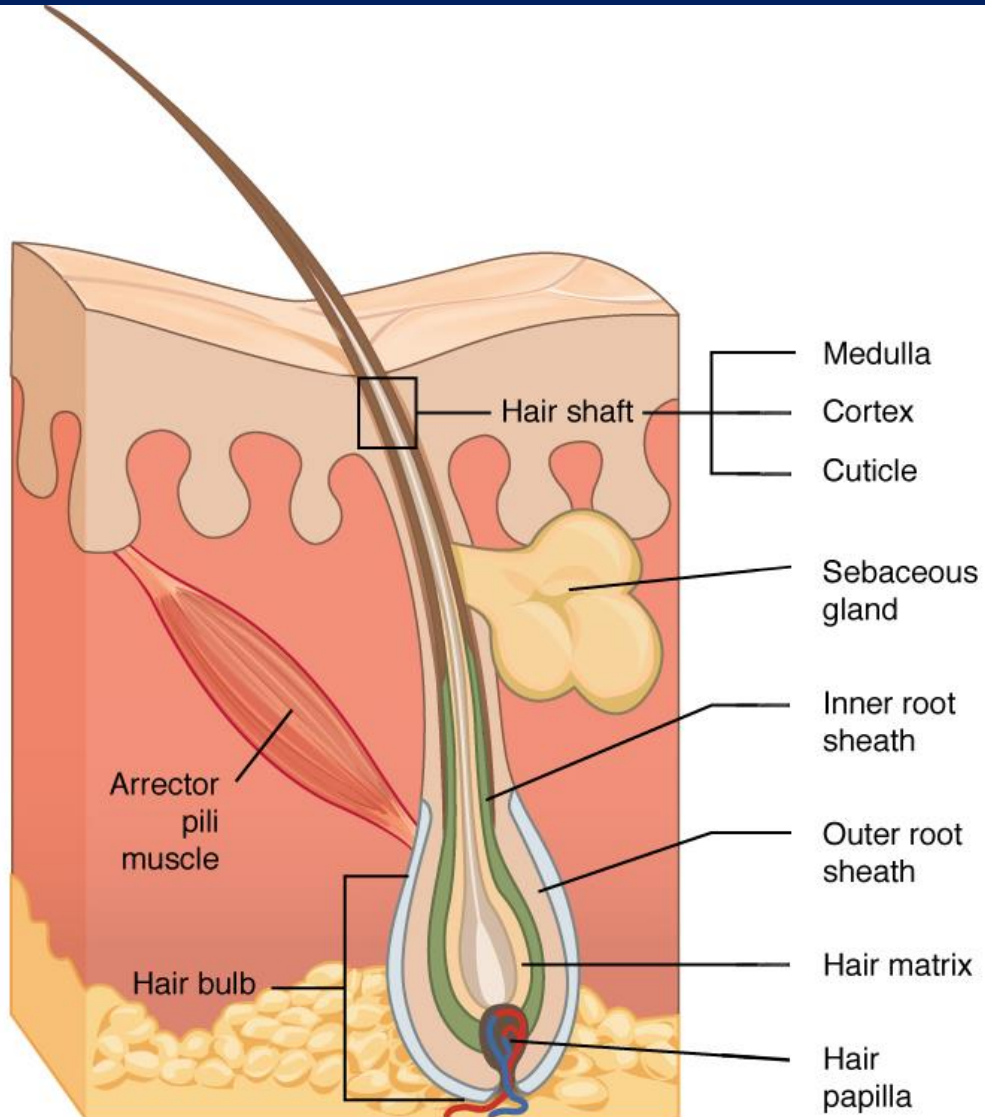


<https://stylecaster.com/beauty/hair-nails/430233/nails-health/>

Hairs

หน้าที่

- ป้องกันไม่ให้ร่างกายสูญเสียความร้อน
- ป้องกันไม่ให้ผิวหนังได้รับอันตราย เช่น เส้นผม ขนจมูก
- รับความรู้สึกสัมผัสจาก **Root hair plexuses**
- เป็นตัวนำสารออกจากร่างกายเช่น ไขมัน หรือเหงื่อ

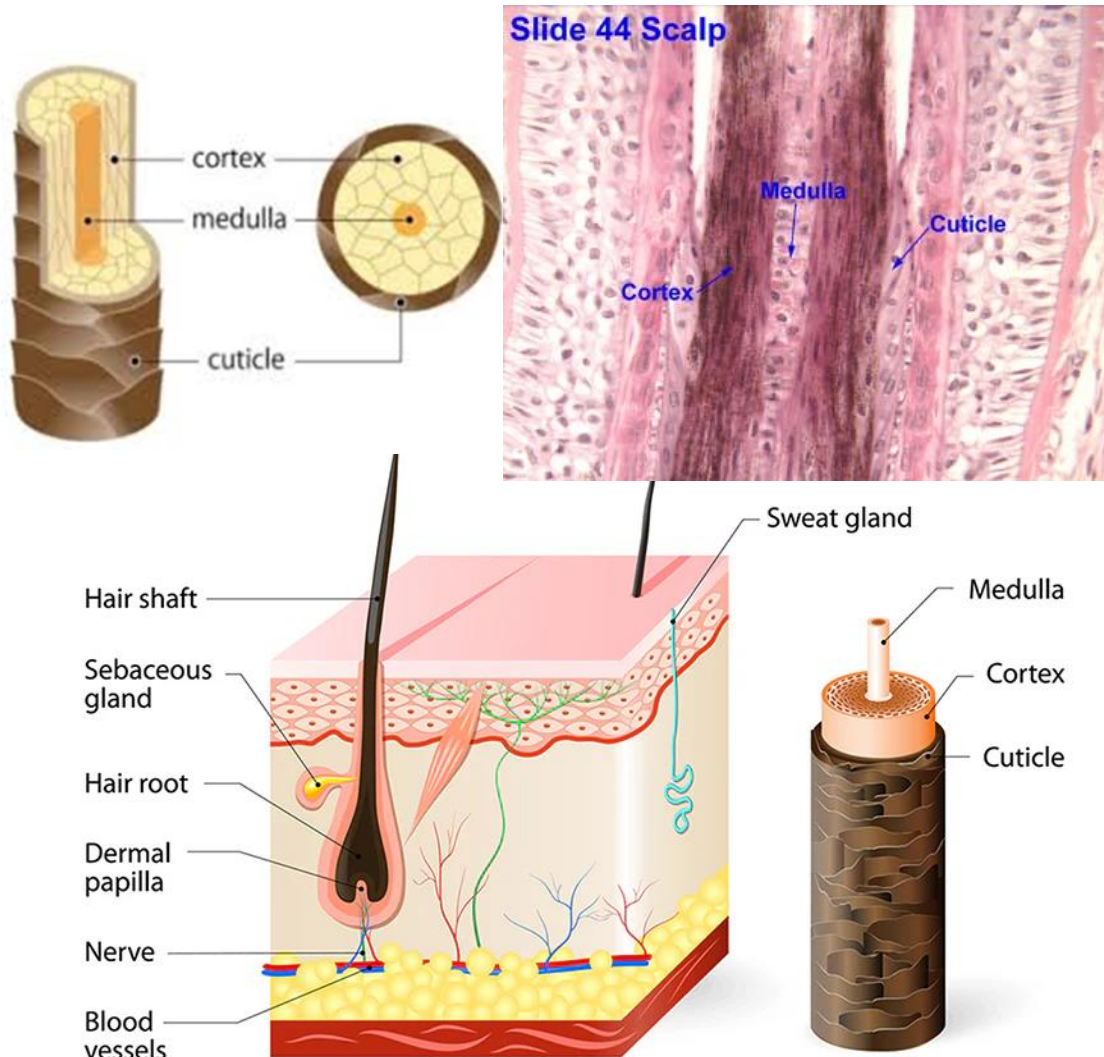


พบได้ทุกส่วนของร่างกาย

ยกเว้น!! ฝ่ามือฝ่าเท้า รูเปิดของทวารหนัก ริมฝีปาก

glans penis, prepuce, clitoris, labia minora และด้านในของ labia majora

Hairs

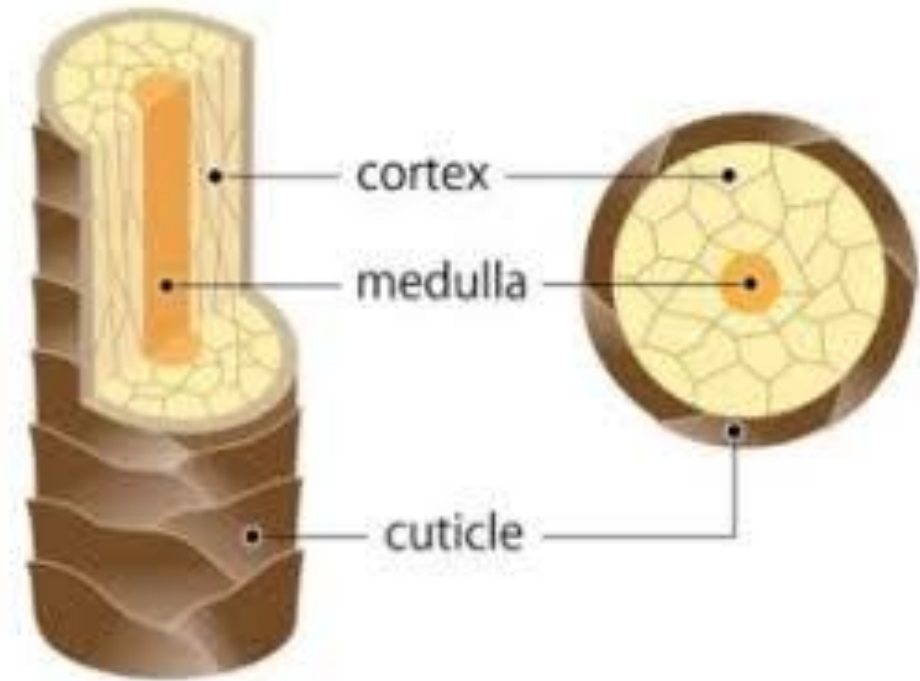
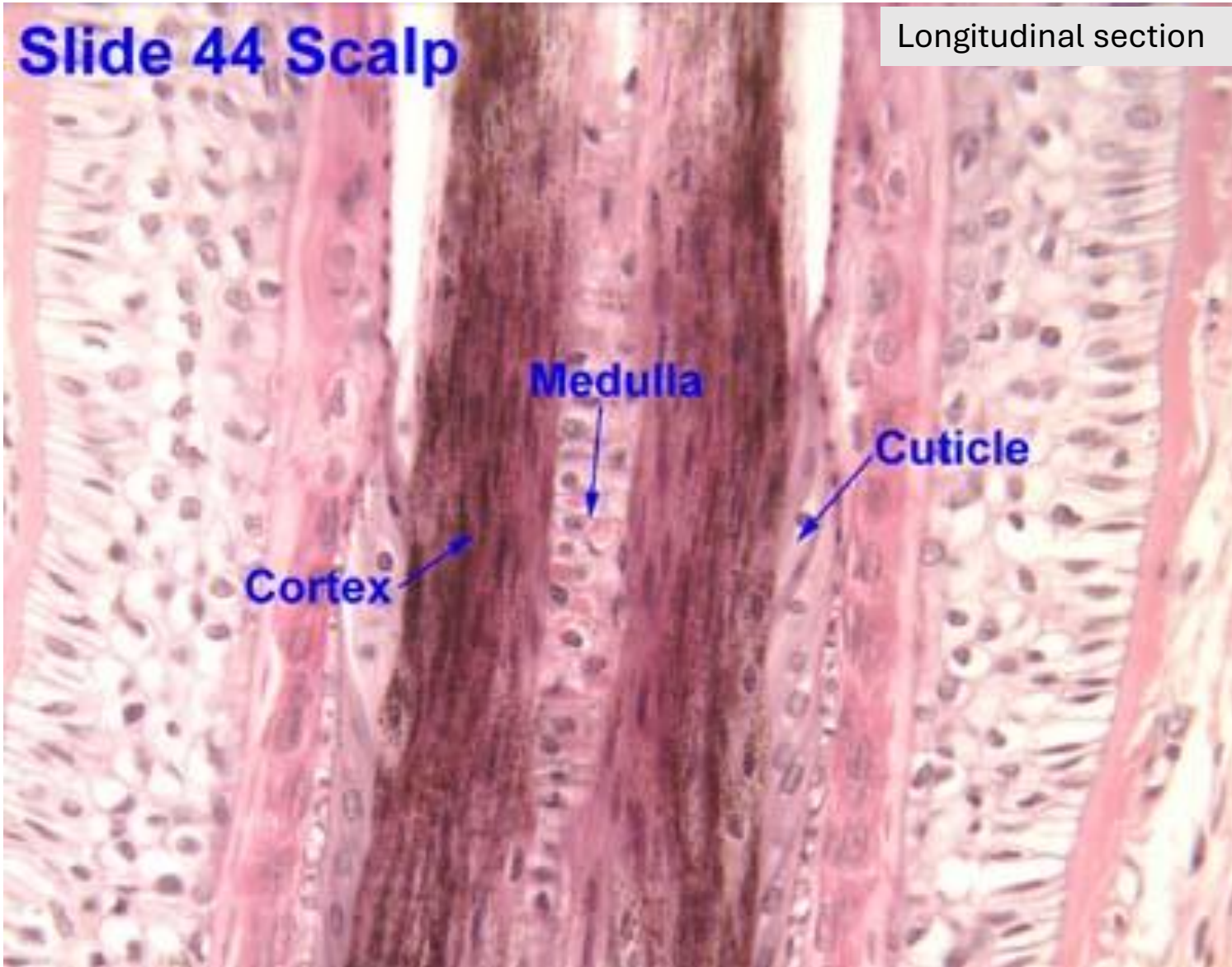


ขนแบ่งเป็น 2 ส่วน ได้แก่ เส้นขน (hair shaft) และ รากขน (hair root) ที่อยู่ภายในรูขุมขน (hair follicle)

โครงสร้างของเส้นขน (hair shaft) แบ่งเป็น 3 ชั้น ได้แก่

1. **Medulla:** เป็นแกนกลาง ประกอบด้วยชั้นของเซลล์ขนาดใหญ่ เรียง 2-3 แถว ช่องระหว่างเซลล์มีอากาศแทรก ขนอ่อนและขนสั้น จะไม่มี medulla
2. **Cortex:** เป็นชั้นที่มีความหนาที่สุด เป็นส่วนเปลือก ประกอบด้วย เซลล์ที่มีรูปร่างยาวและแบน เรียงตัวหลายชั้น ชั้นนี้ประกอบด้วย ช่องอากาศ (Air space) protein keratin และ melanin pigment
3. **Cuticle:** เป็นส่วนผิว มีลักษณะคล้ายเกล็ดปลาเกยกัน มีปริมาณ ของ keratin มากที่สุด เพื่อทำหน้าที่ป้องกันเส้นขนจากการเสียดสี และทำให้เซลล์ที่อยู่ข้างในอัดแน่นแข็งแรง

Hair shaft



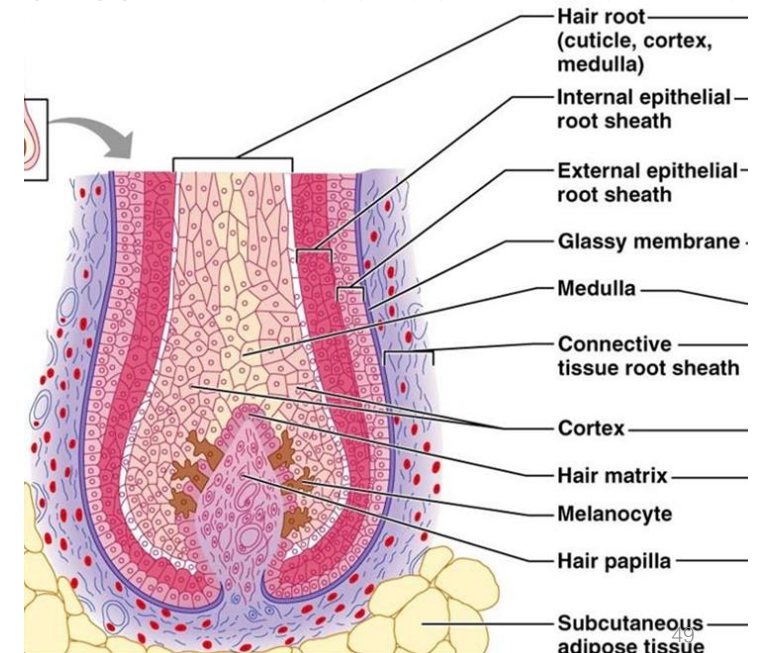
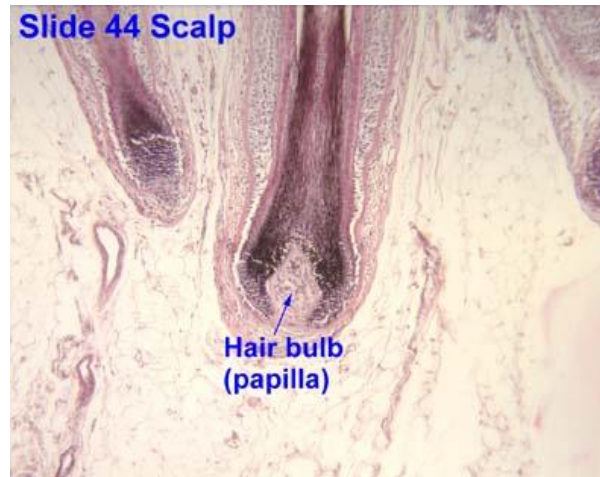
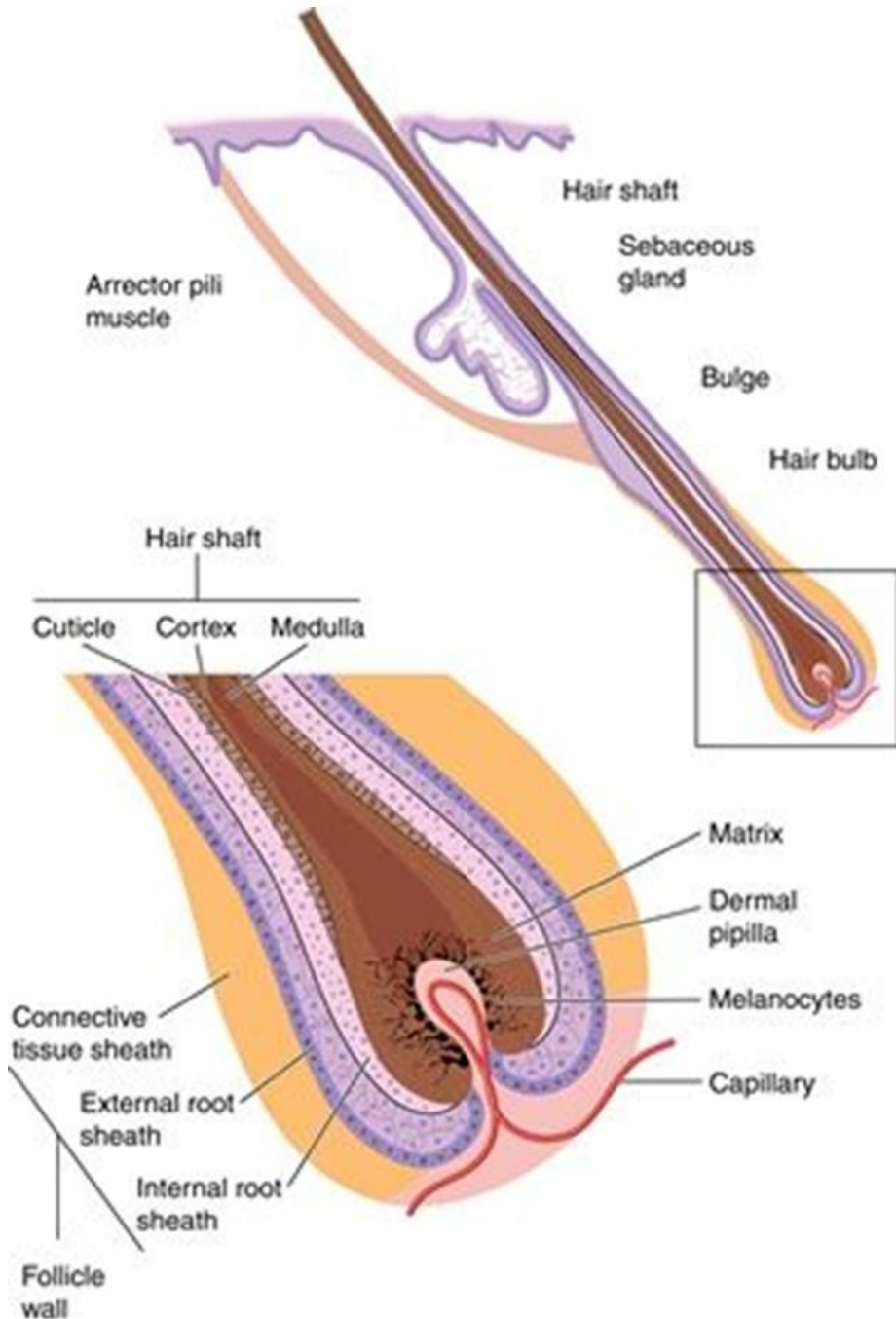
<https://www.harleystreethairtransplant.co.uk/hair-structure/>

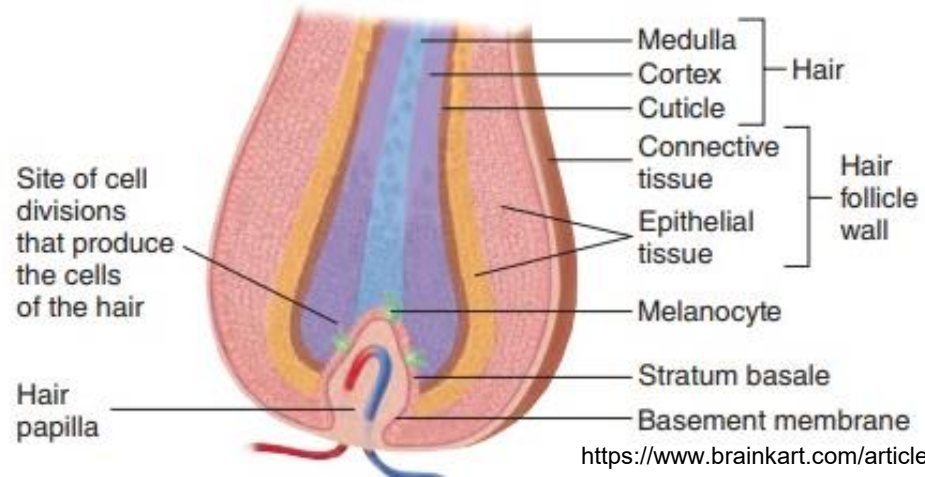
Hair root

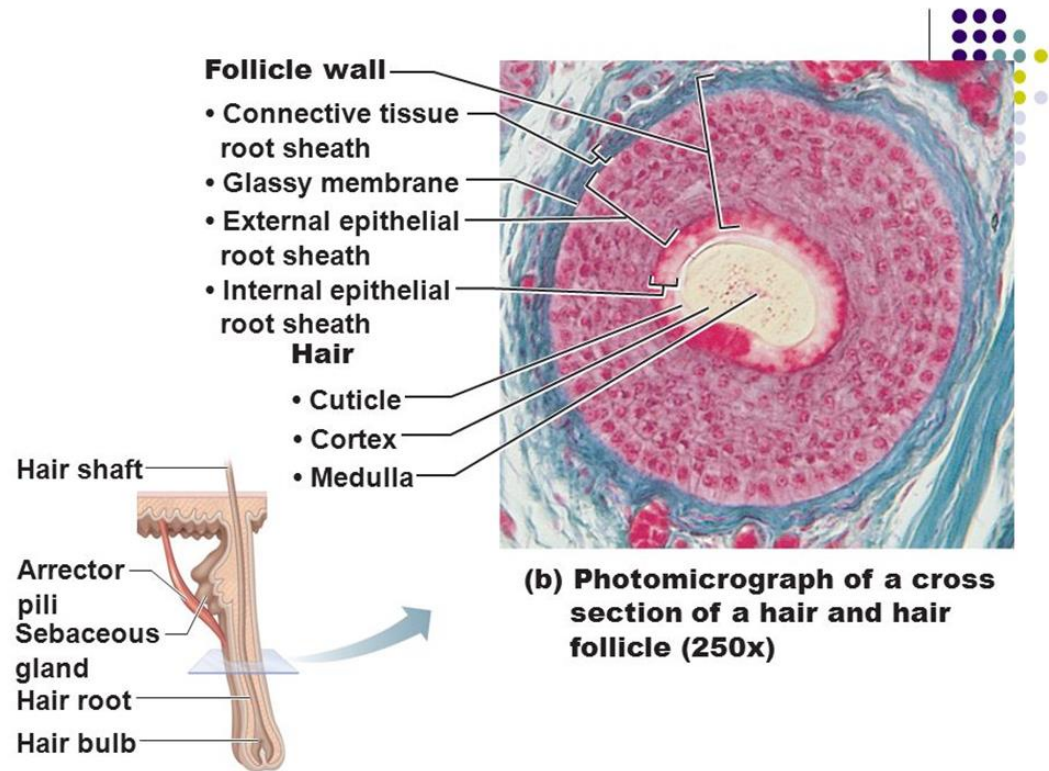
รากขน ประกอบด้วย

1. Hair follicle

- เป็น epidermis ที่หว่าตัว (invagination) เข้าไปใน dermis
- ส่วนปลายขยายออกเรียกว่า **hair bulb** พบ **hair papilla** มีหลอดเลือดภายใน
- hair papilla มีการเหนี่ยวนำให้เกิดการสร้างขน
- พบ **hair matrix** ที่เป็น epidermal cell ทำให้ผมยาวขึ้นและสร้างเส้นผมใหม่
- ที่ hair bulb มี melanocyte







Hair root (cont.)

2. Internal root sheath

- อยู่ติดกับ cuticle ของ hair shaft
- ประกอบด้วย 3 ชั้นคือ Henle's layer, Huxley's layer และ cuticle
- พบตั้งแต่โคนผมถึงบริเวณที่ sebaceous gland duct เปิดเข้าสู่ hair follicle

3. External root sheath

- ต่อมาจาก stratum basale และ stratum spinosum
- เซลล์เรียงตัวหลายชั้นยกเว้น hair bulb ที่มี stratum basale ชั้นเดียว

4. Glassy membrane

- เยื่อหุ้มเกิดจากการหนาตัวของ external root sheath ที่กั้นแยก hair follicle ออกจาก dermis
- มี arrector pili muscle ที่มีจุดเกาะต้นที่ papillary layer มาเกาะควบคุมด้วย Post ganglionic sympathetic nervous system

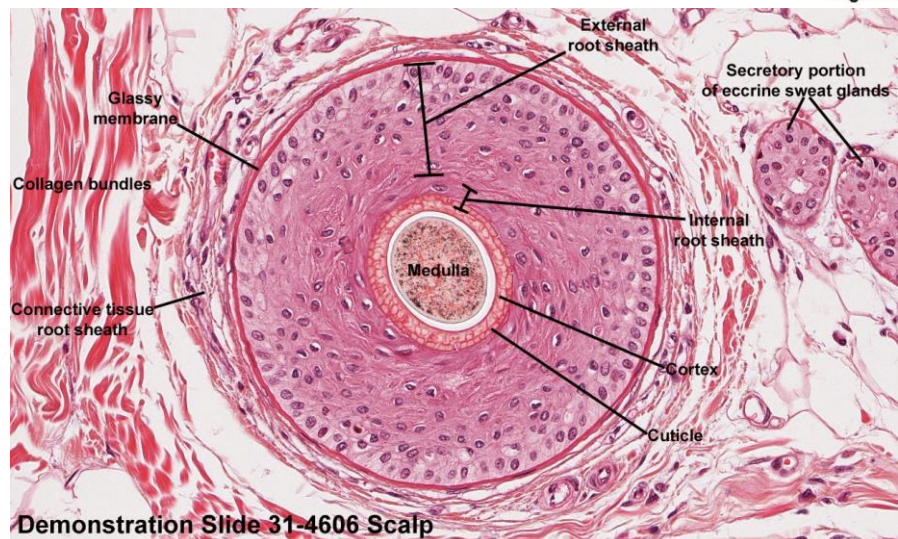
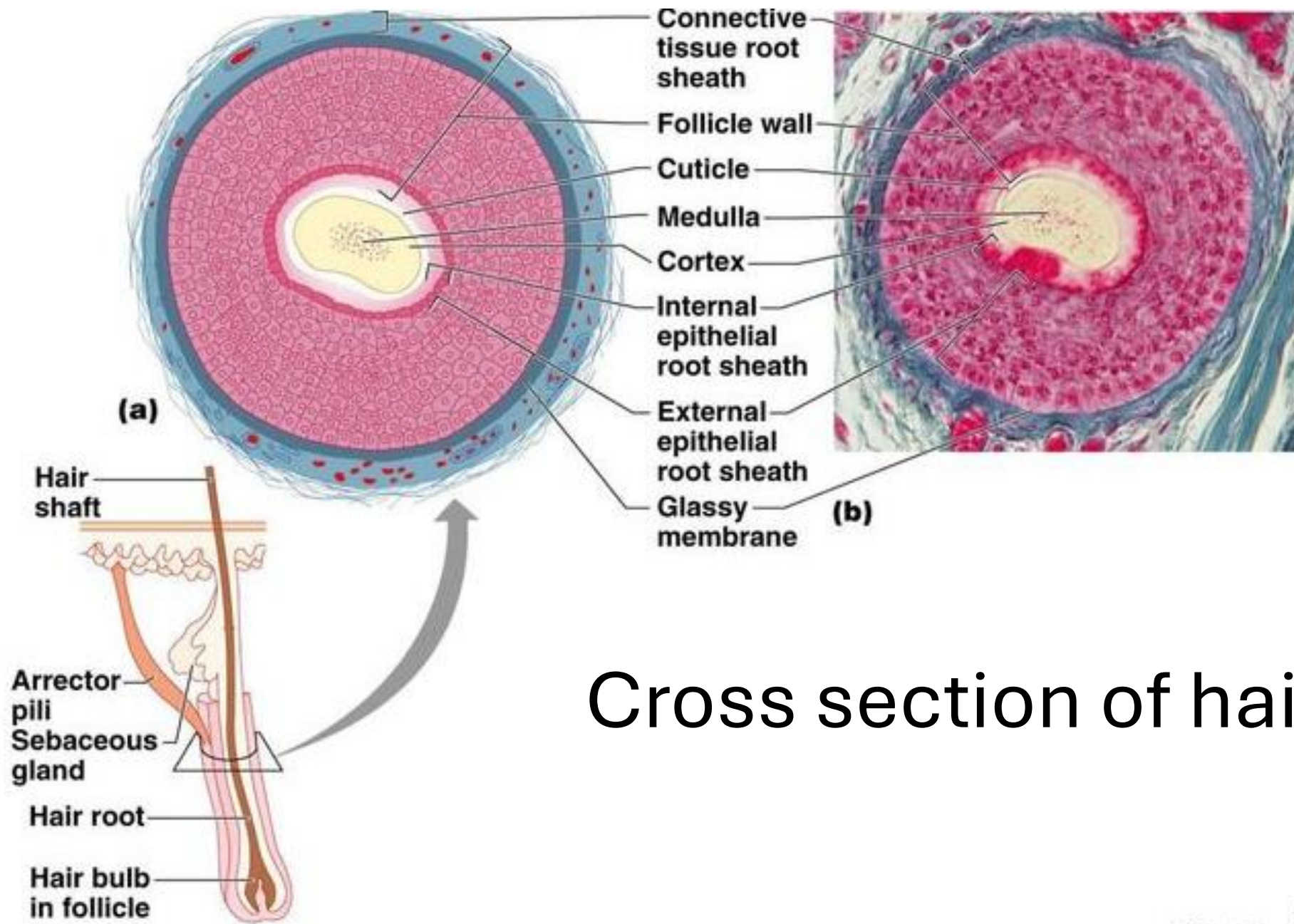


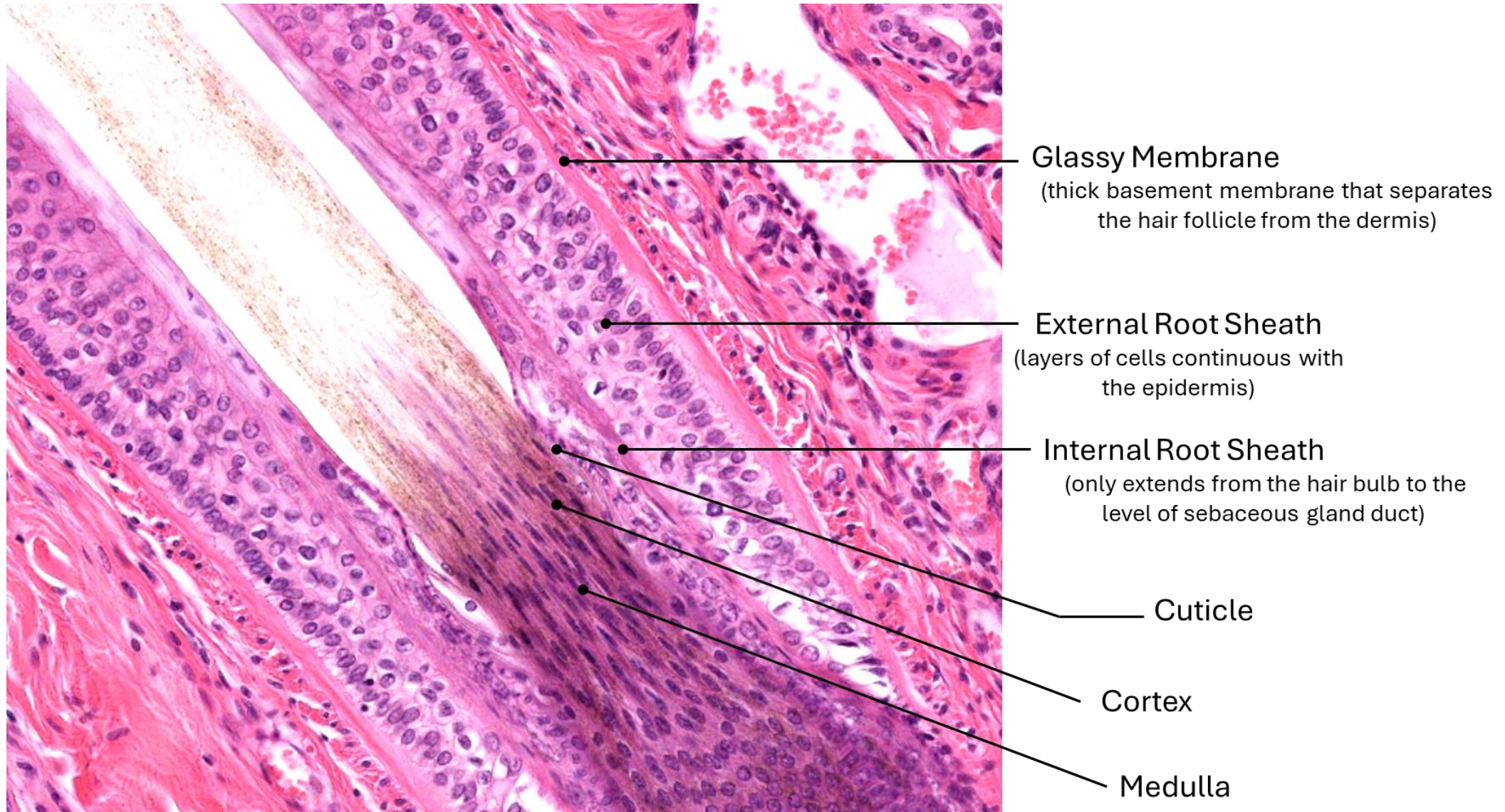
Figure 5.6b



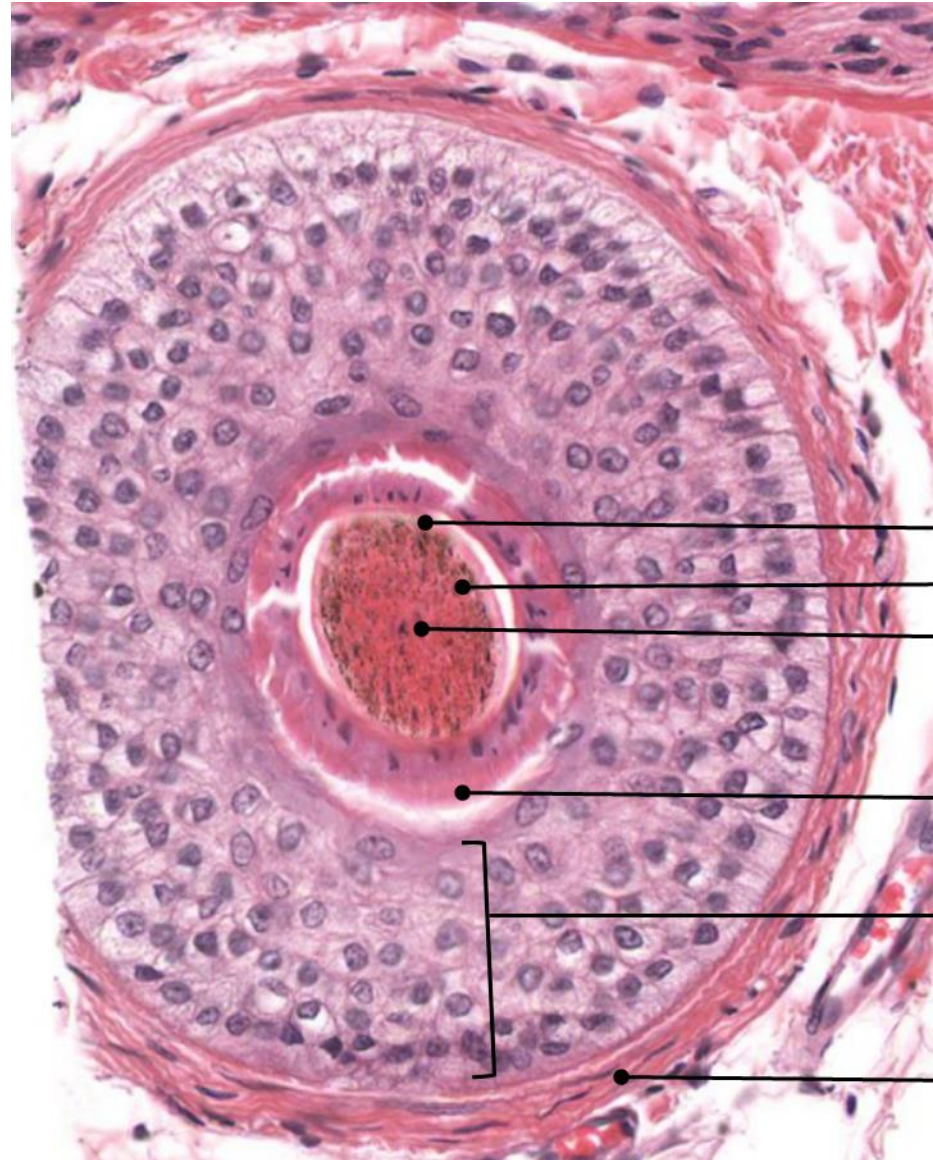
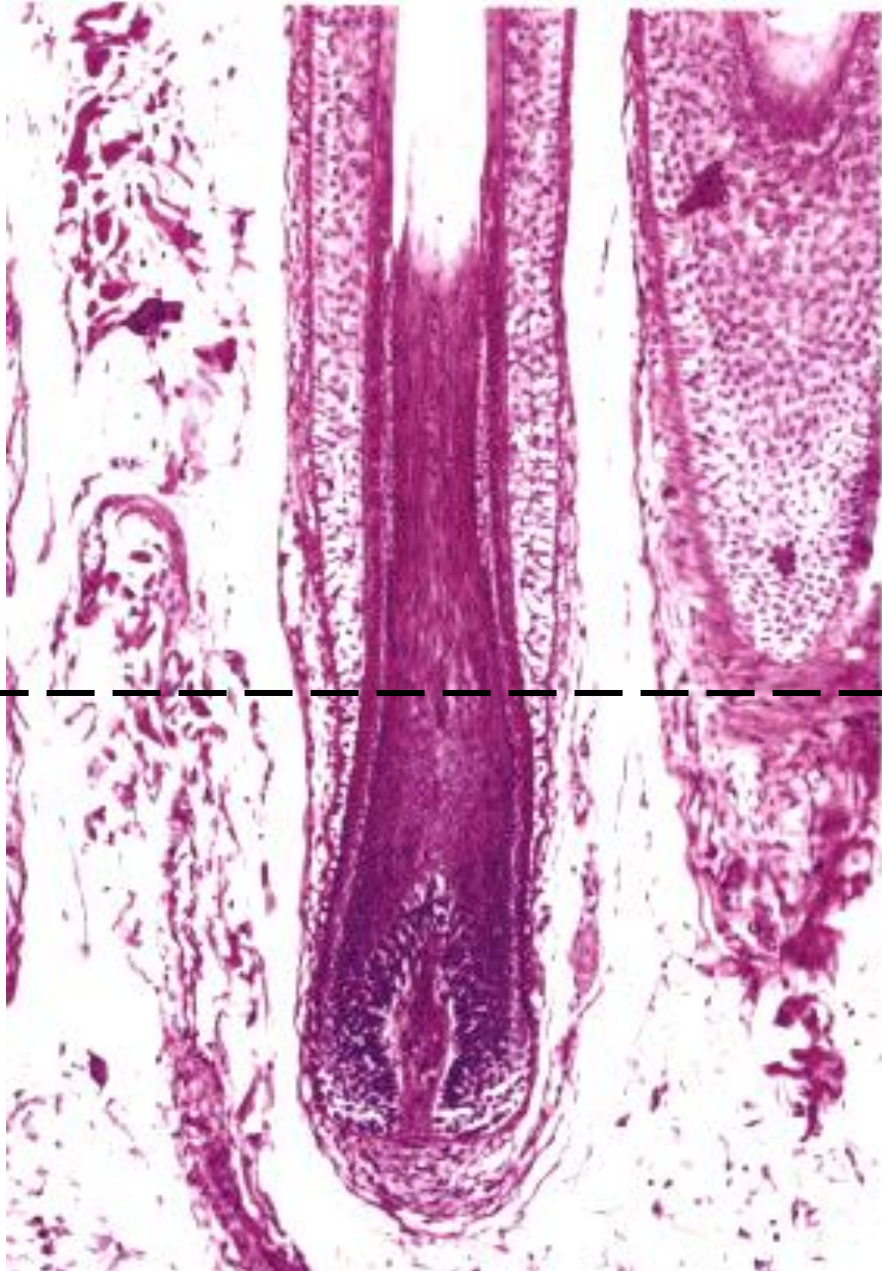
Cross section of hair

a,

Hair root (within hair follicle)



Hair follicle



Hair Shafts

Cuticle

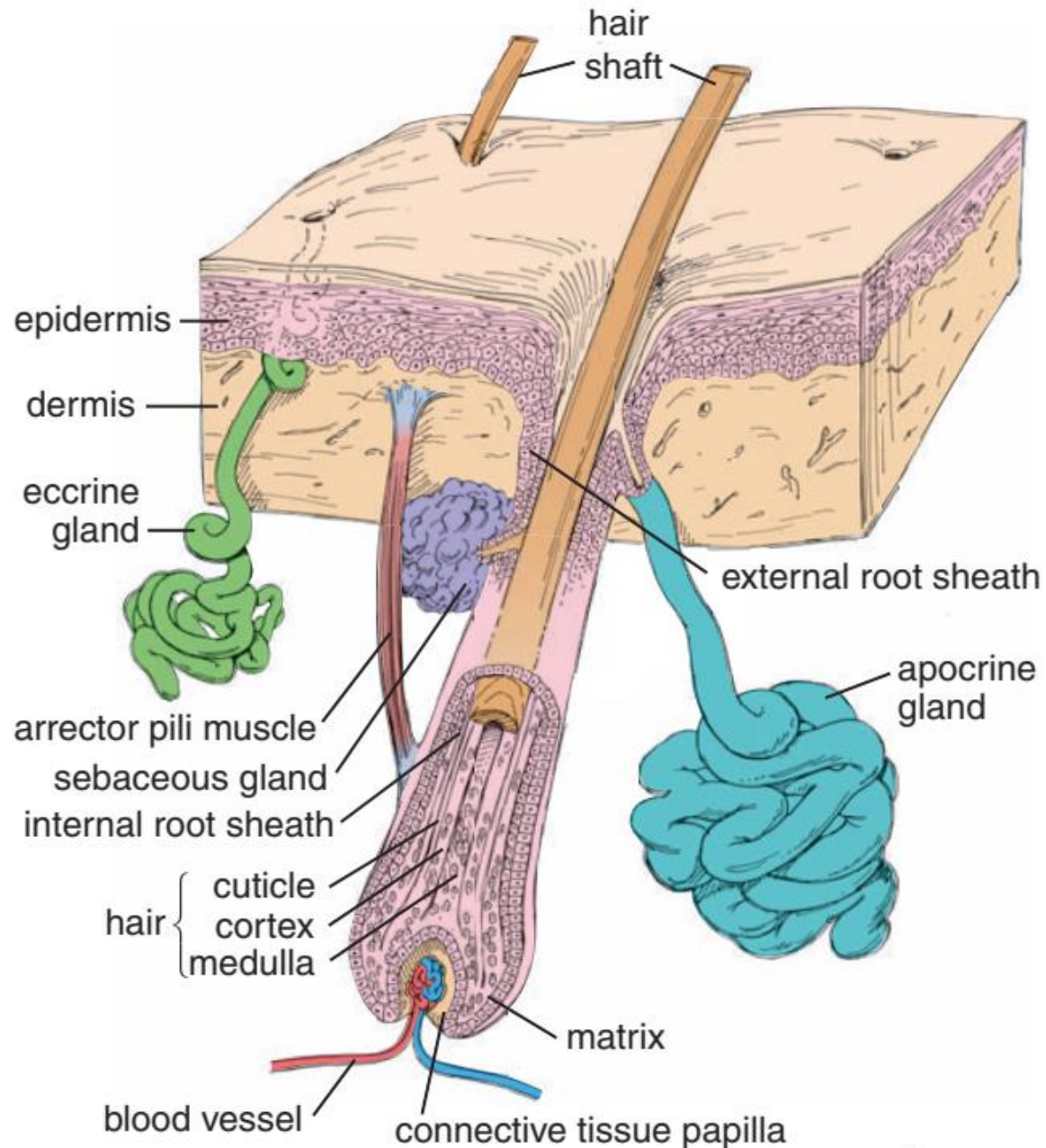
Cortex

Medulla

Internal Root Sheath

External Root Sheath

Glassy membrane



Hair follicle

รูขุมขน (hair follicle) มีรูปร่างทรงกระบอก เจริญจากหนังกำพร้าที่ยื่นยาวลงไปชั้นหนังแท้ เป็นที่อยู่ของรากขน (hair root)

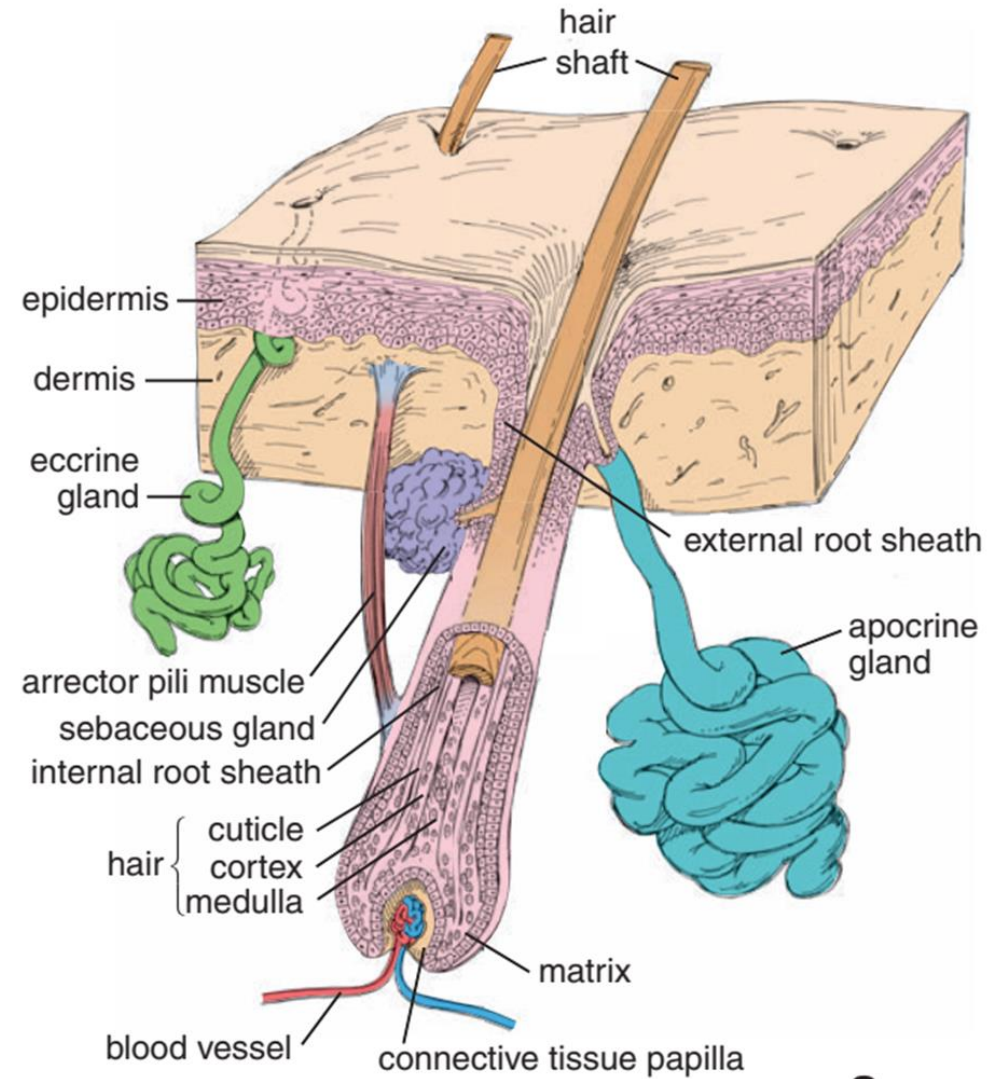
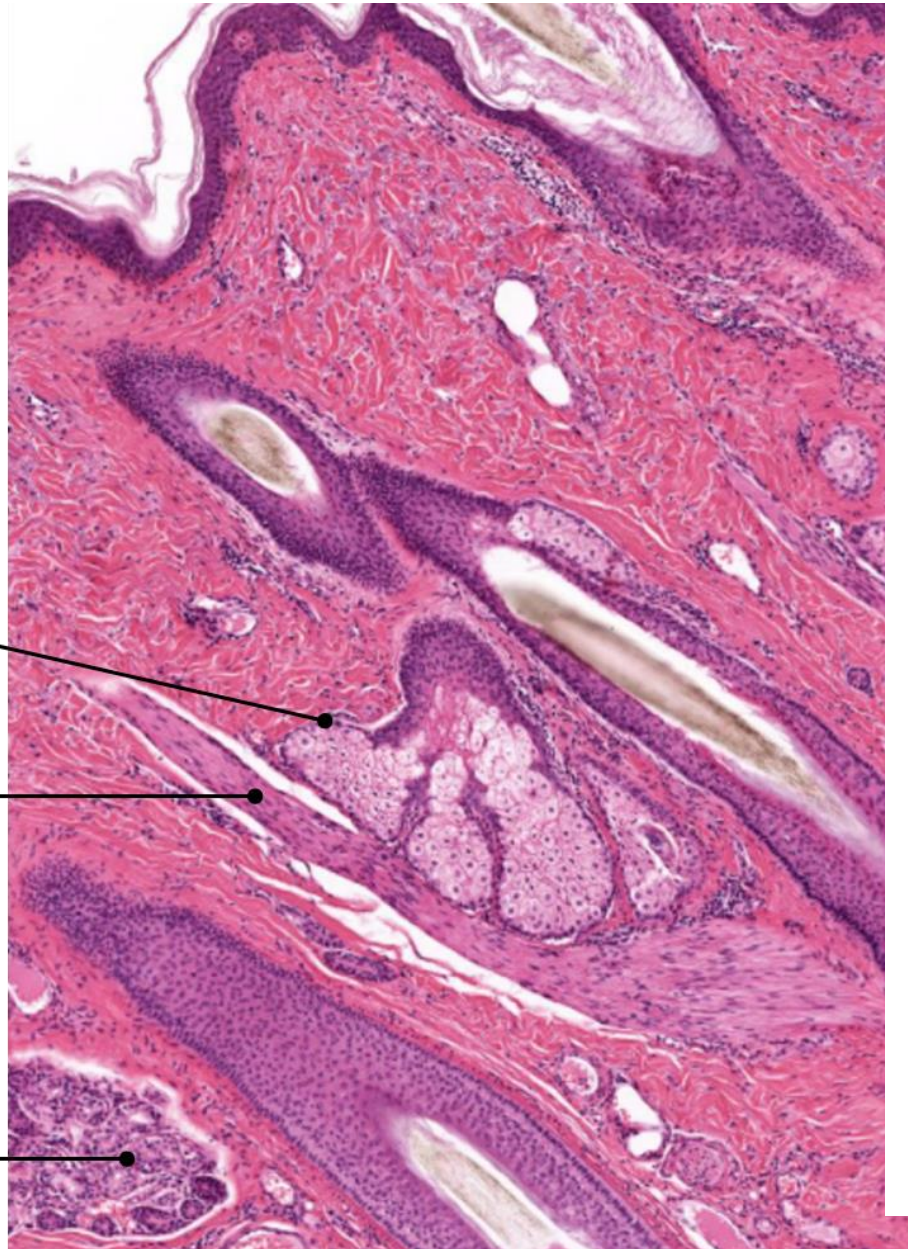
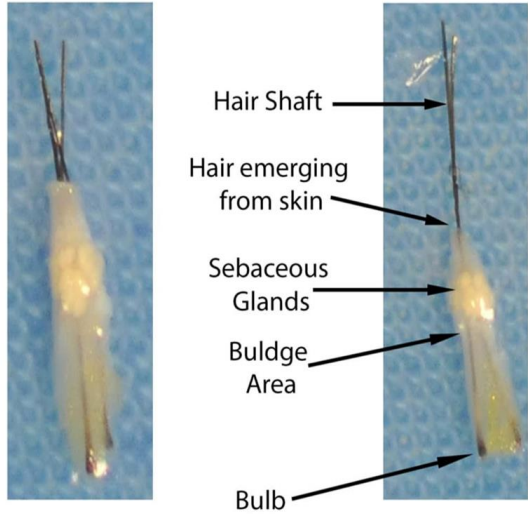
3 hair bulges (กระเปาะ)

- **Lower hair bulges:** ที่เกาะของ arrector pili muscle (smooth muscle) ถ้าหดตัว → ขนลุก (goose bump)
- **Middle hair bulges:** รูเปิดของ sebaceous glands
- **Upper hair bulges:** รูเปิดของ apocrine glands

สีของขน เกิดจาก

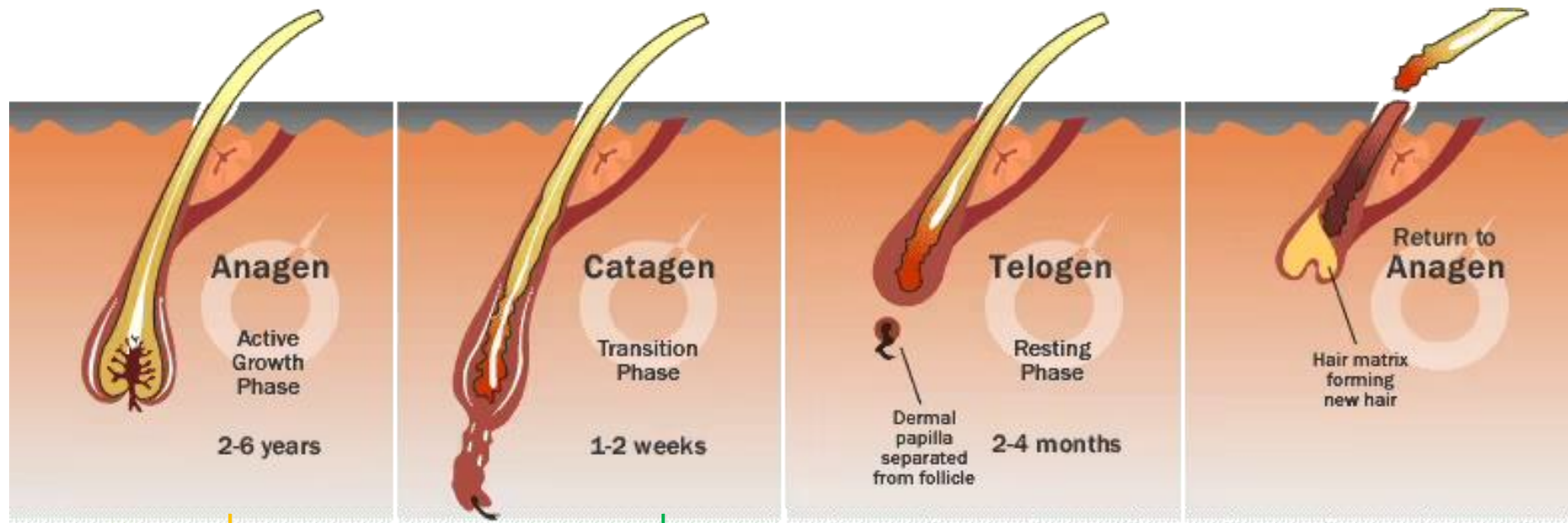
- melanin pigment ในเส้นผม
- Eumelanin: Brown/Black
- Pheomelanin: Red/Bronz
- ฟองอากาศในเส้นผม: white

Anatomy of a Hair Follicle



a

วงจรชีวิตของ Hair (Hair growth cycle)



- เป็นระยะเจริญเติบโต
- เซลล์มีการแบ่งตัว
- melanocyte สร้าง melanin ตลอดเวลา (Active melanization)
- Hair follicle จะอยู่ลึกลงไปถึงชั้น Hypodermis
- ระยะนี้กินเวลาเฉลี่ยประมาณ 2-6 ปี
- > 80% of hair in the normal scalp

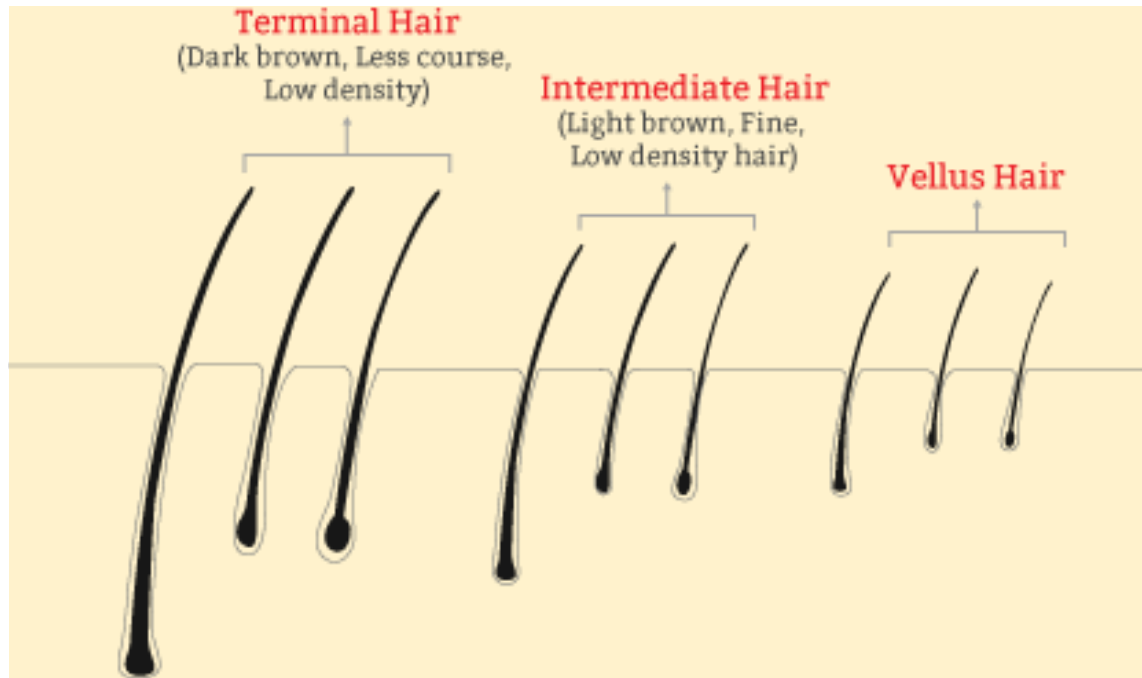
- เป็นระยะที่ต่อเนื่องมาจาก Anagen stage
- Hair จะหยุดการเจริญเติบโต
- melanocytes หยุดสร้าง melanin
- Hair follicle ที่เดิมอยู่ลึกลงไปในชั้น Hypodermis จะเริ่มหดสั้นมาที่ชั้น dermis
- ระยะนี้กินเวลาเฉลี่ยประมาณ 2 สัปดาห์

- เป็นระยะที่ต่อเนื่องมาจาก Catagen stage
- บริเวณโคน Hair จะเห็นเป็นรูป Club-shaped
- Hair ก็จะเริ่มหลุดร่วงออกมา
- ระยะนี้กินเวลาเฉลี่ยประมาณ 1-3 เดือน และก็เวียนกลับไปสู่ระยะ Anagen stage ใหม่เป็นวงจร

Hair types

1. Lanugo hairs:

soft, fine, downy hair that covers a developing fetus in the womb



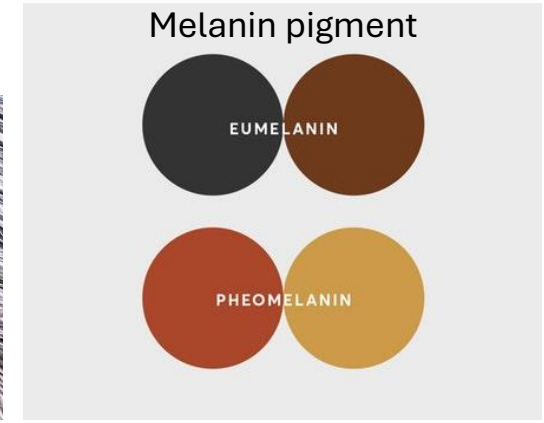
2. Vellus hairs:

short, fine, and usually light-colored hairs that cover most of the human body

3. Terminal hairs:

thick, long, coarse, and pigmented hair scalp, eyebrows, eyelashes, armpits, and pubic area

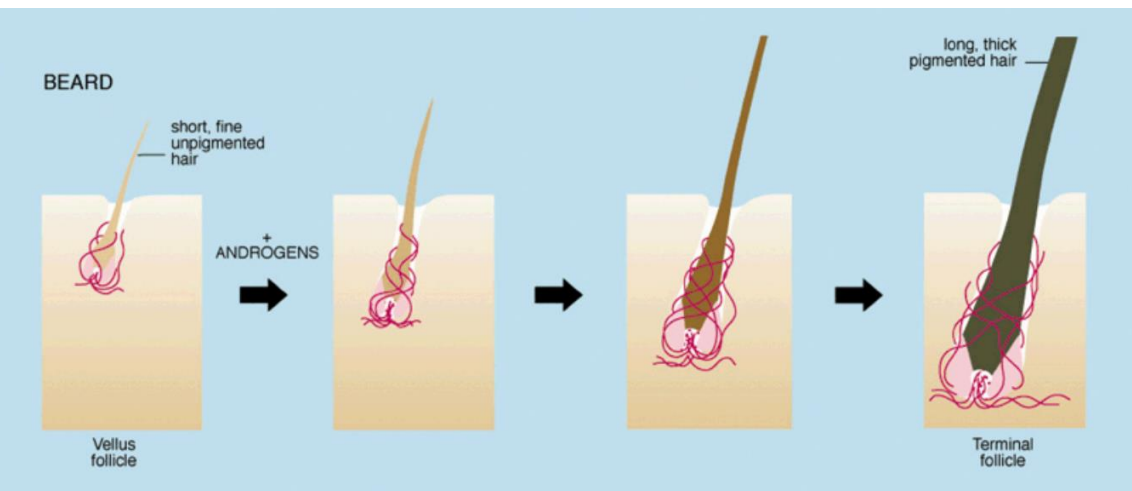
Hair color



<https://drtarinee.com/wp-content/uploads/2023/04/gray-hair-vitamin-deficiency-2.webp>



Hair follicle and androgen



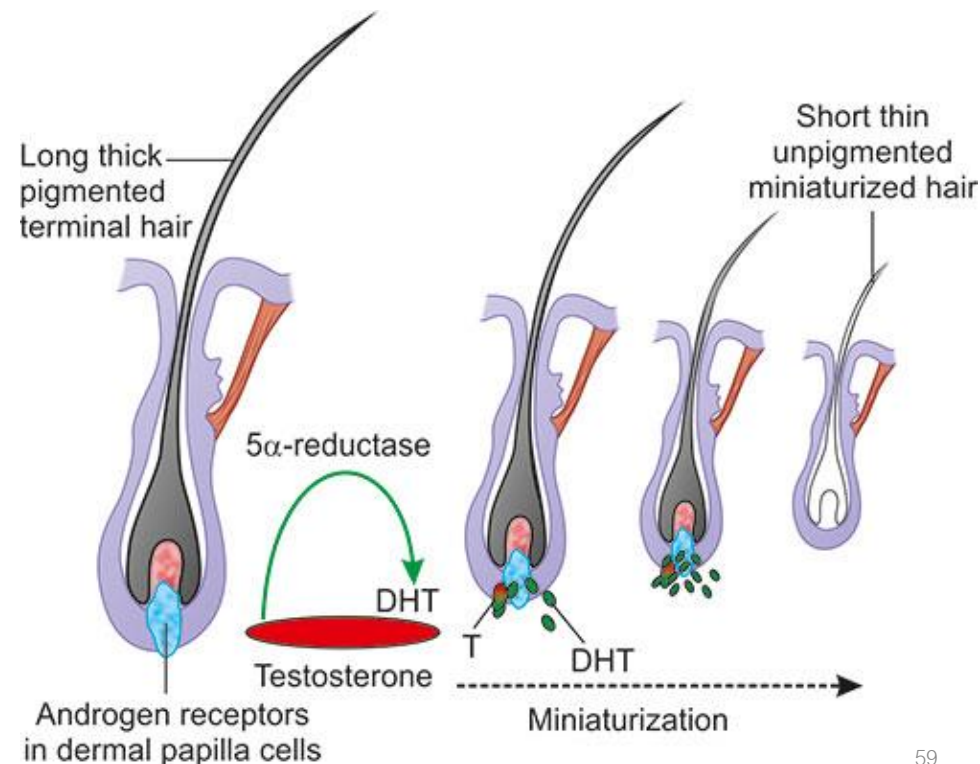
Androgens in puberty

- key factors in terminal hair growth
- Convert vellus hairs into terminal hairs
- androgen receptors in the dermal papilla
- Armpit, pubic area, and beard

Androgenetic alopecia (AGA)

- characterized by the **miniaturization** of hair follicles
- progressive loss of terminal hair of the scalp
- suppress hair growth
- Terminal follicle → vellus follicle

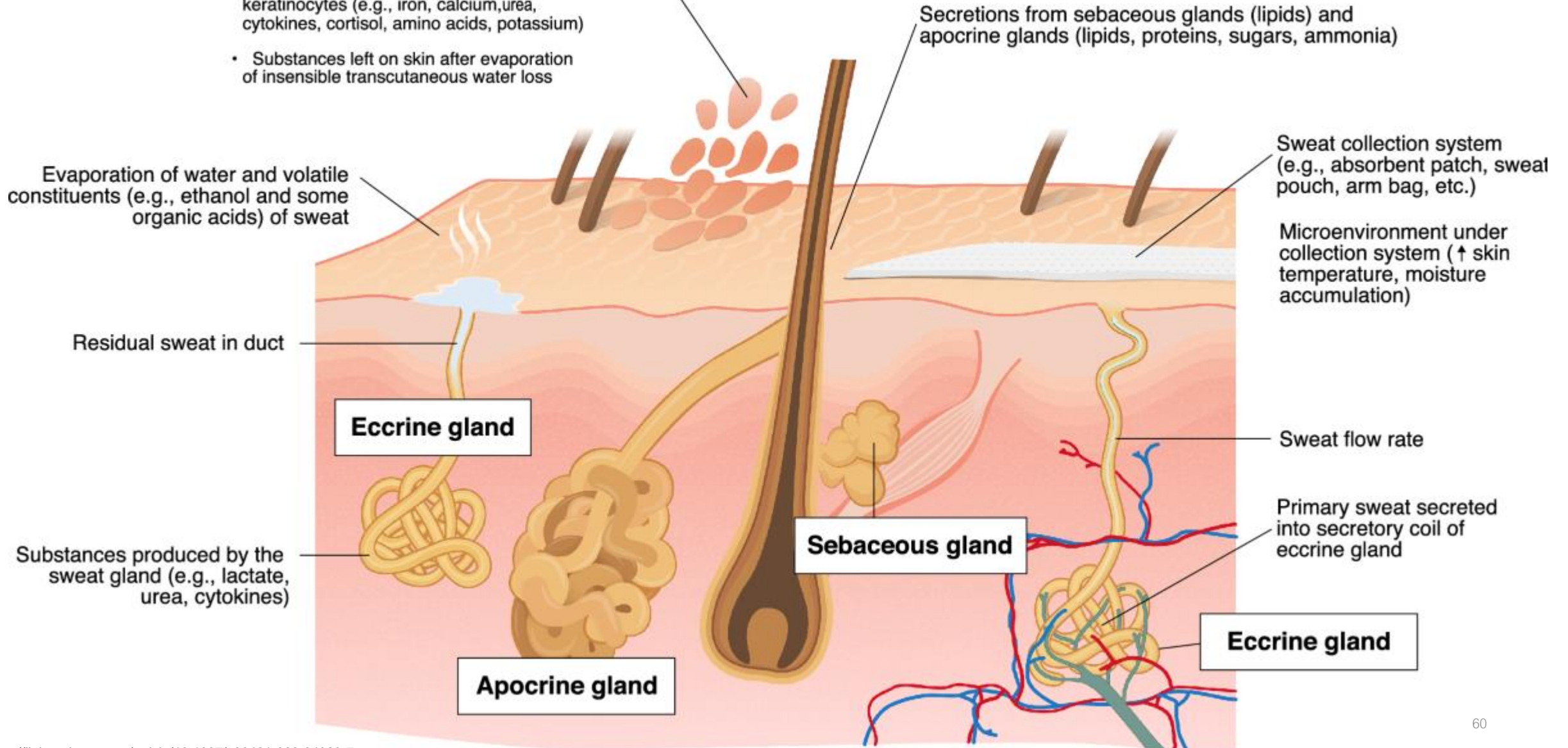
androgen paradox



Glands

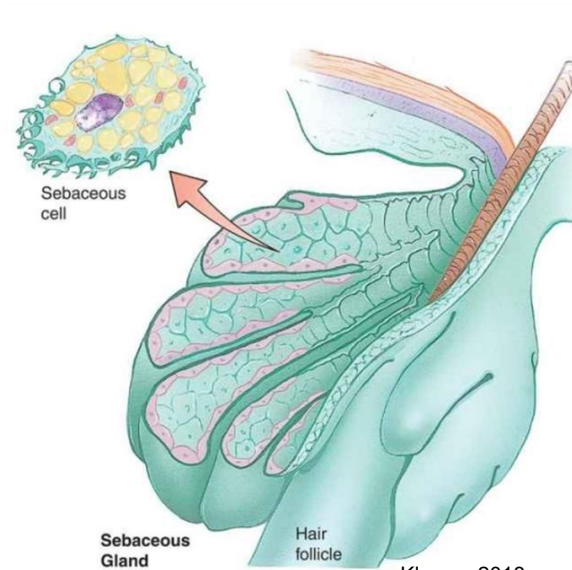
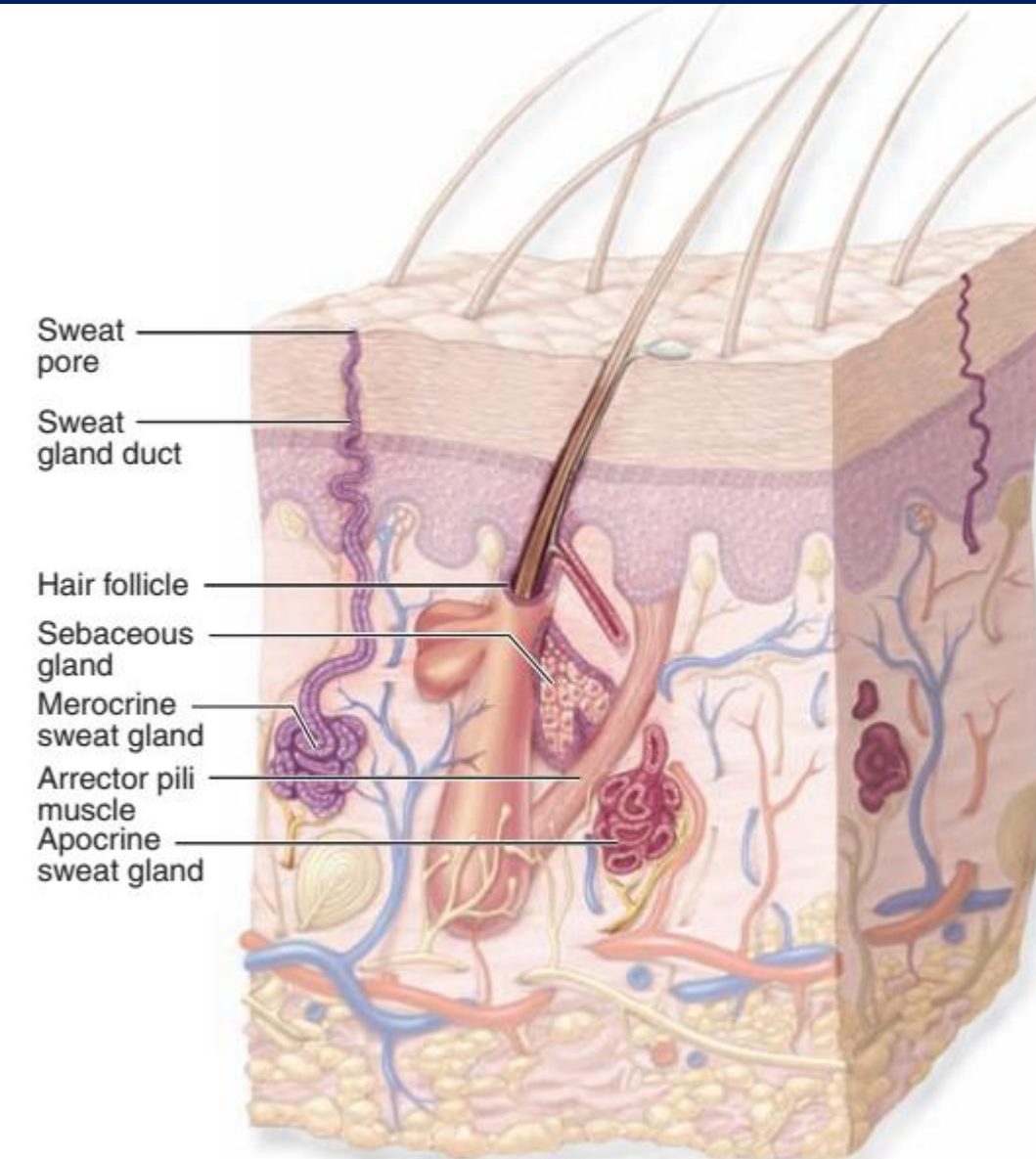
Skin surface contamination

- Shedding of desquamated skin cells
- Substances present in/produced by keratinocytes (e.g., iron, calcium, urea, cytokines, cortisol, amino acids, potassium)
- Substances left on skin after evaporation of insensible transcutaneous water loss

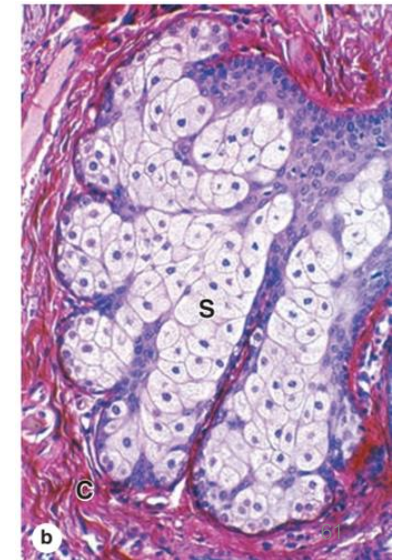


Sebaceous glands

- Simple branched acinar glands embedded in the dermis
- holocrine secretion
- associated with hair follicles
- most numerous in the skin of the scalp and face
- **except** palms and soles, penis, clitoris, eyelids, and nipples
- Its duct empties into the upper portion of a hair follicle
- **Sebum:** the main secretory product of sebaceous glands

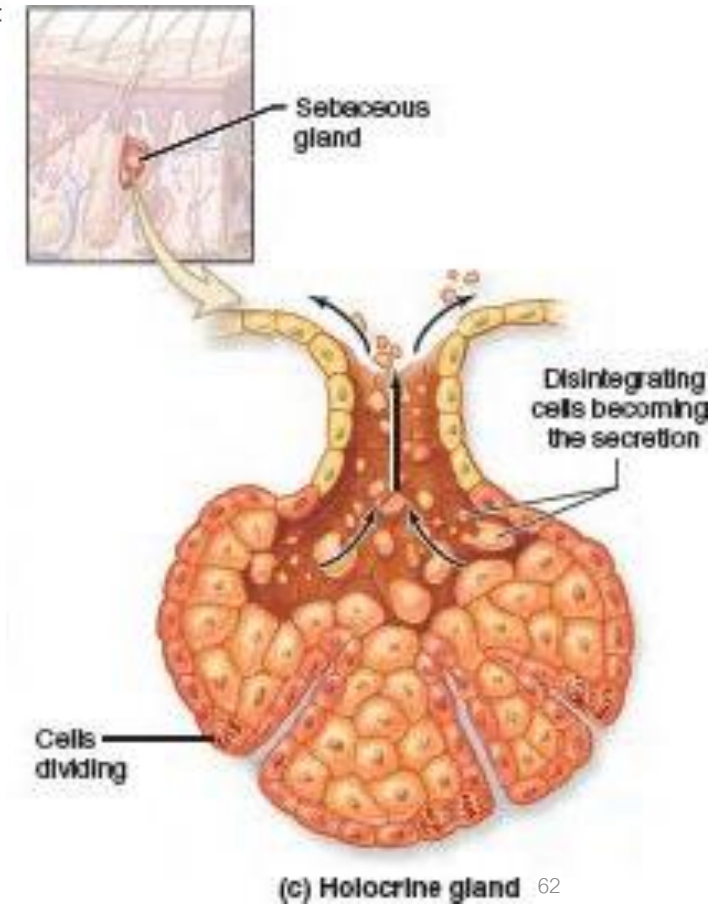
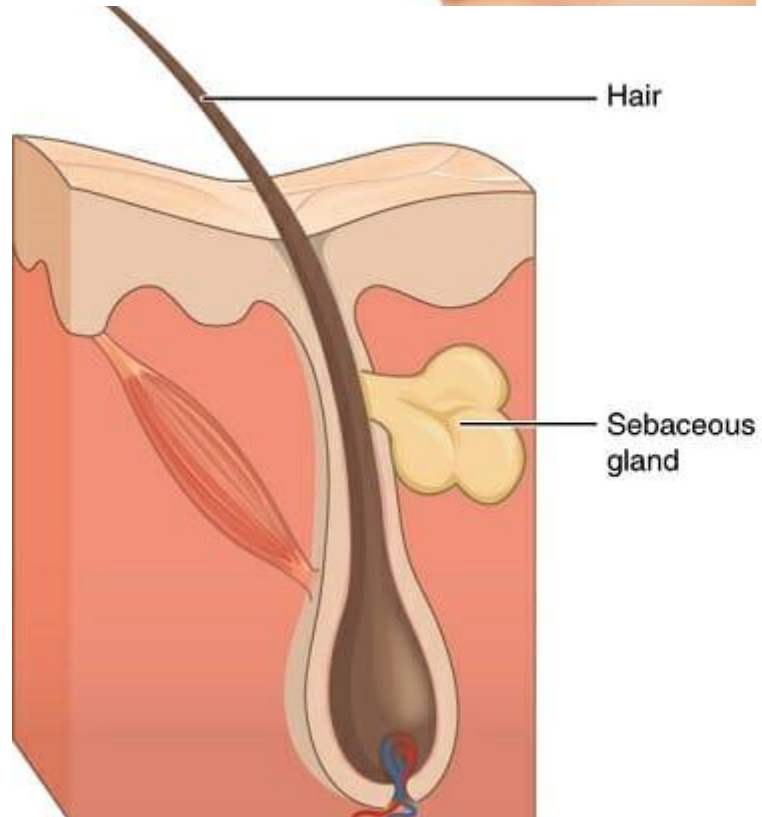
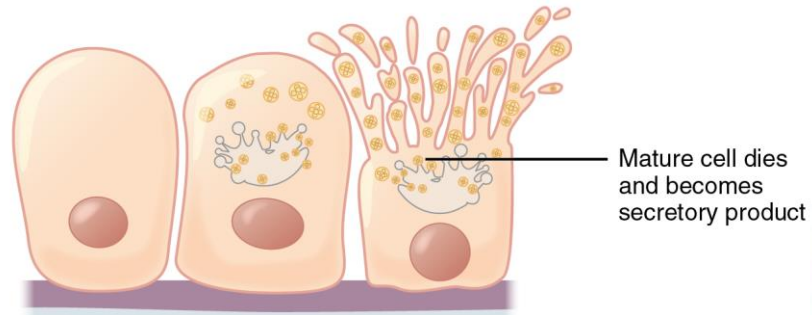


Sebaceous glands are branched acinar holocrine glands whose short ducts empty into a hair follicle into the space created by the disappearance of the internal root sheath.

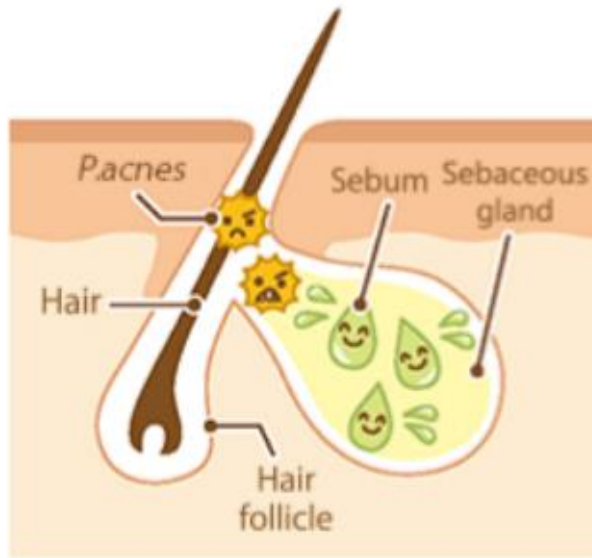


<https://www.slideserve.com/jake/integument>

Sebaceous glands

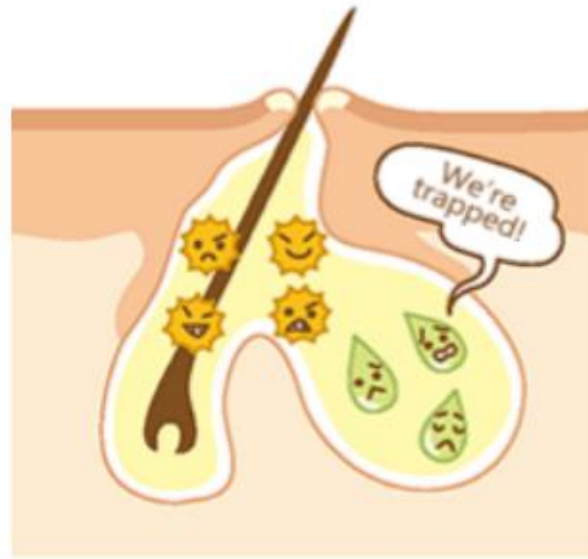


The progression of acne



P. acnes can be found even in normal pores.

Sebum produced in sebaceous glands is excreted from pores up to the surface of the skin.

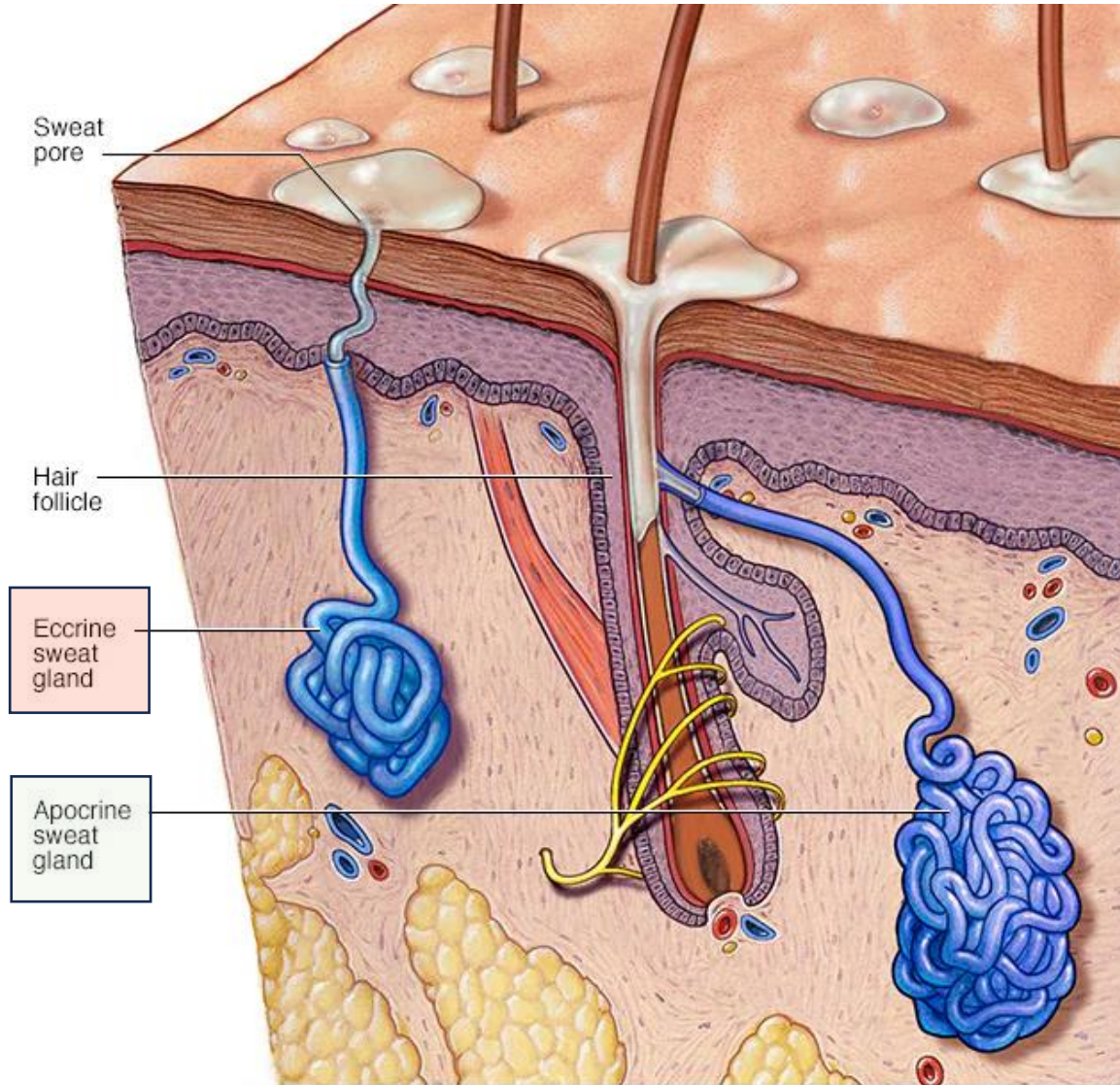


If abnormal keratinization occurs near the exit of a pore, the pore becomes blocked, trapping sebum inside (referred to as a comedo).



When sebum builds up, *P. acnes*, which live primarily on fatty acids in the sebum, increase. *P. acnes* produces a variety of substances that cause inflammation, resulting in a reddish inflammation (papules).

Sweat glands

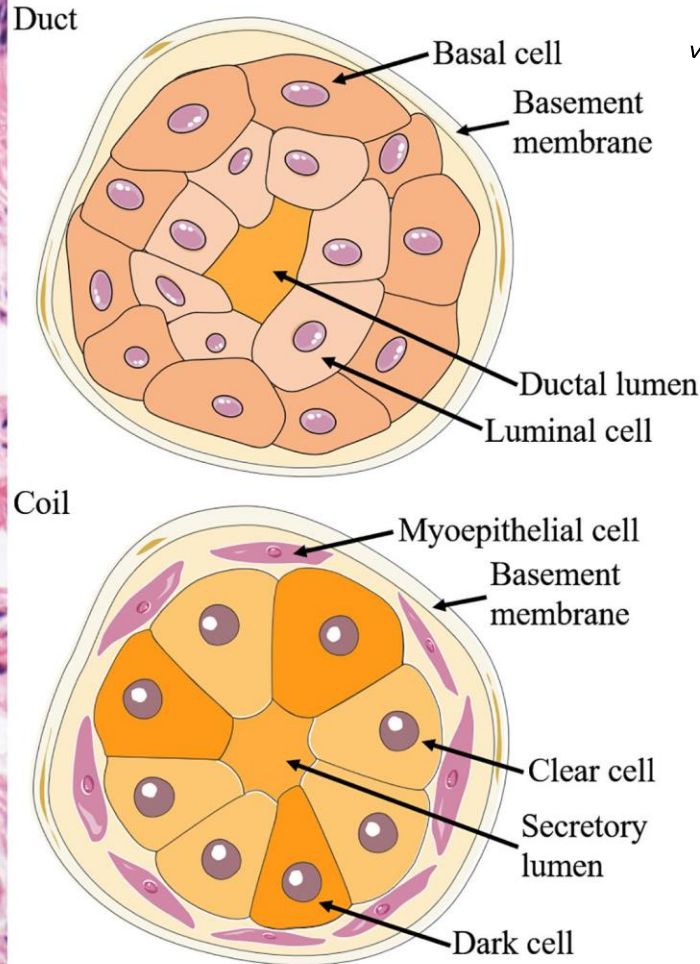
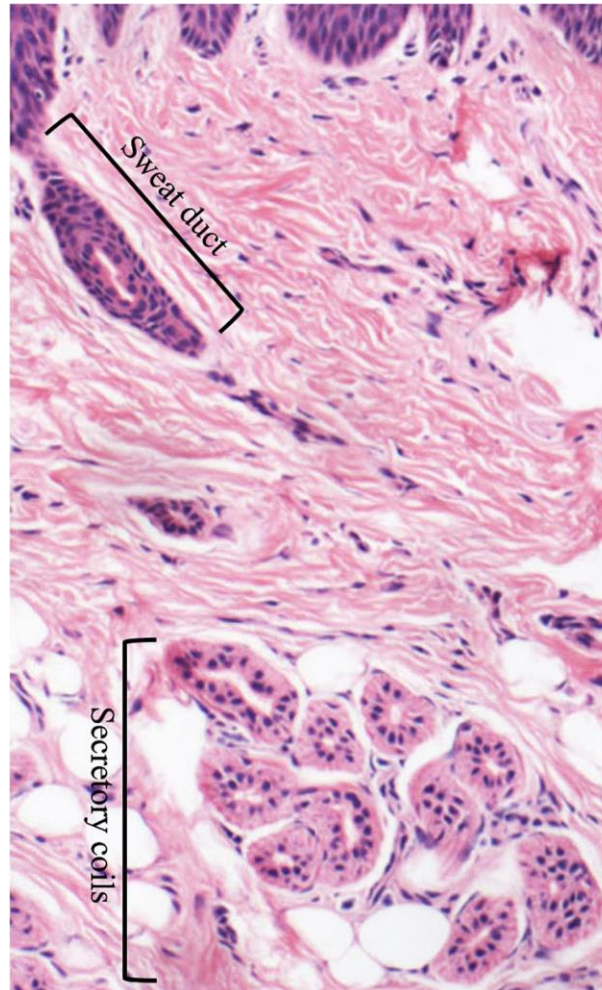


- Simple coiled tubular gland

ต่อมเหงื่อ (Sweat glands) แบ่งได้ 3 ชนิด

1. Eccrine glands: พบได้ทั่วไปทั่วร่างกาย
2. Apocrine glands: พบได้บางบริเวณ เช่น perineum, axilla, external acoustic meatus (ceruminous gland), mammary gland (modified sweat gland)
3. Apoeccrine sweat gland: พบที่ axilla

Eccrine sweat glands

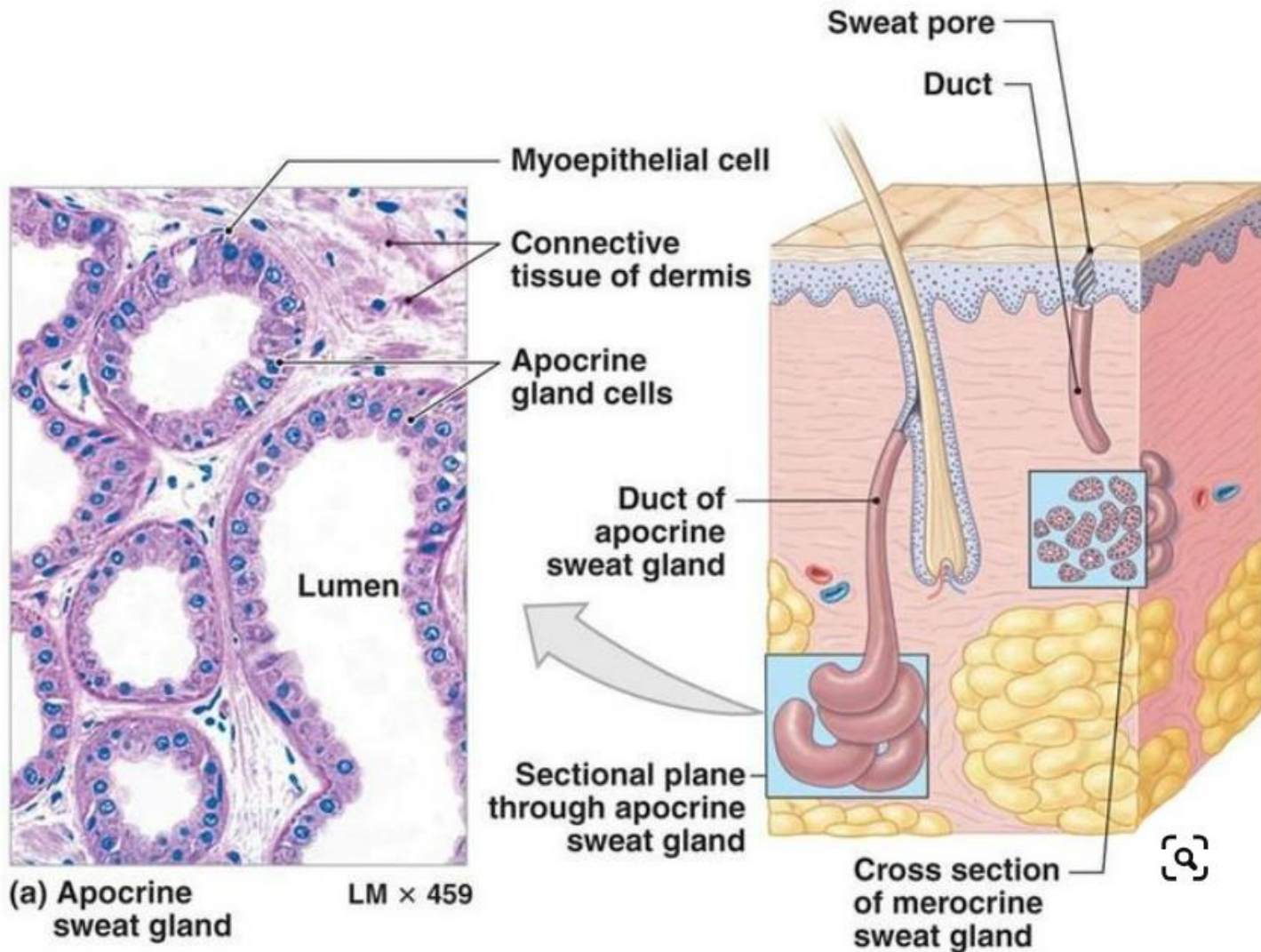


พบได้ทั่วไปในร่างกาย และพบมากที่ฝ่ามือฝ่าเท้า
ไม่พบที่ glans penis, clitoris และ labia minora

ประกอบด้วย 2 ส่วน

1. **Secretory portion:** simple cuboidal epithelium
 - **Clear cells:** production of sweat for thermoregulation
 - **Dark cells:** secreting the watery, electrolyte-rich component of sweat for antimicrobial defense
 - **Myoepithelial cells:** contract to move the watery secretion into the duct
2. **Excretory portions:** stratified cuboidal epithelium

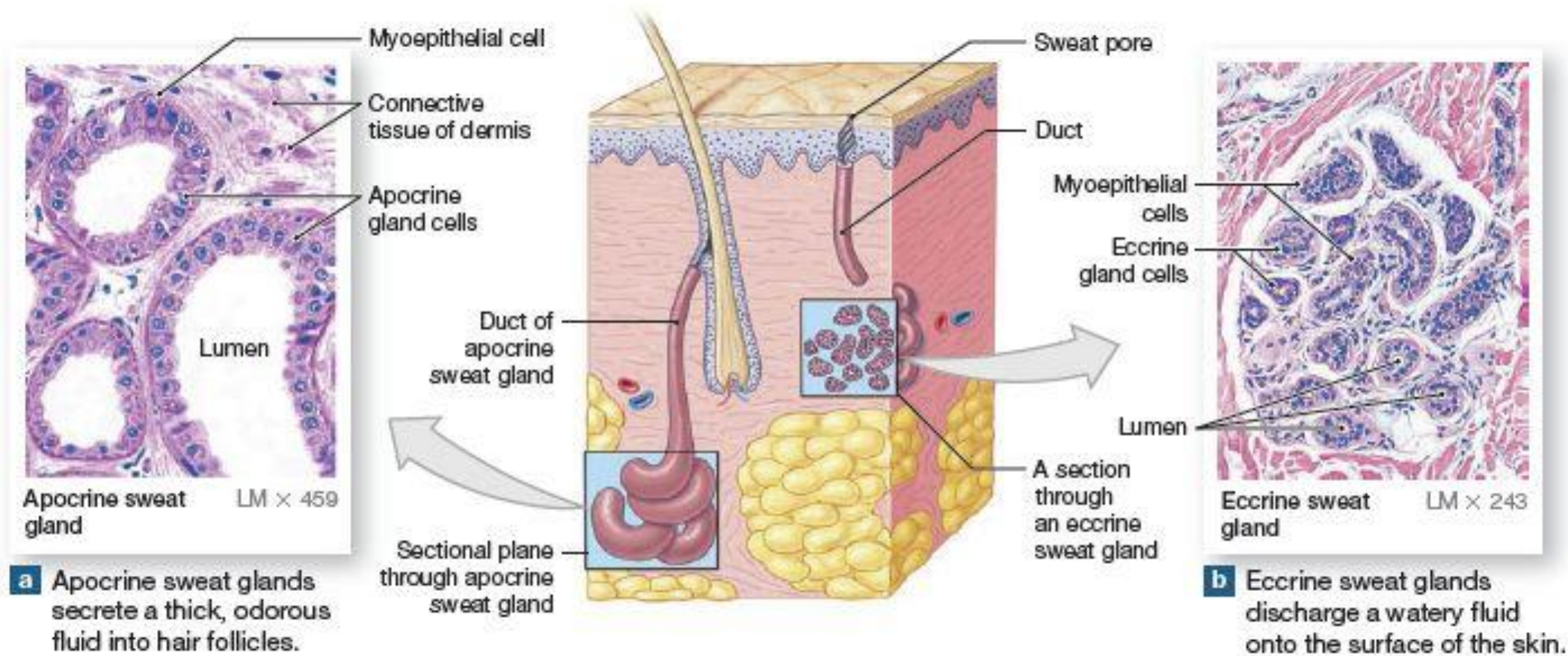
Apocrine sweat glands



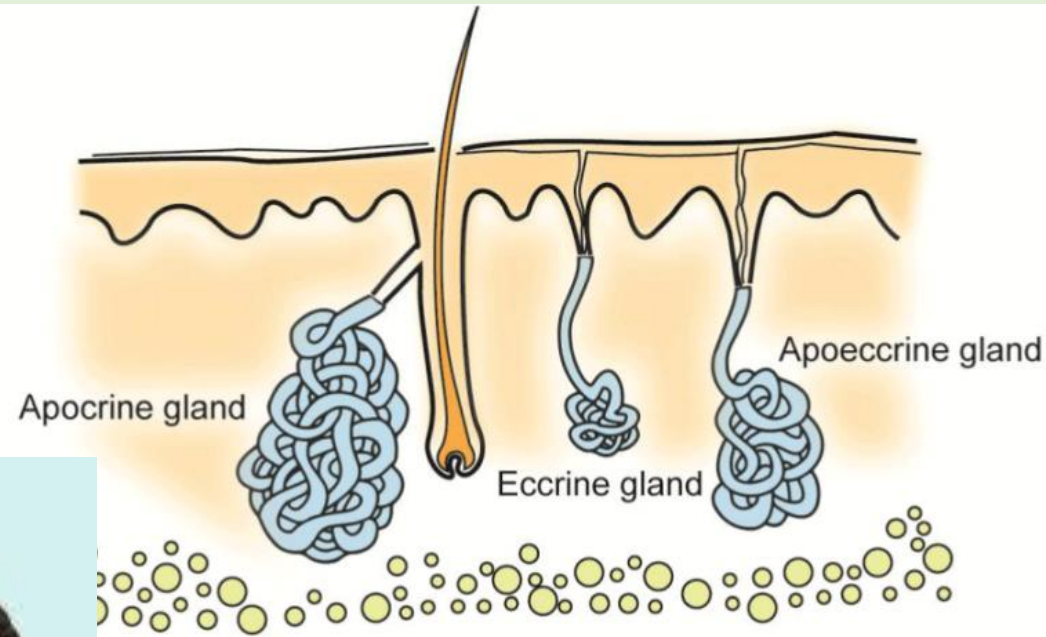
- เป็นต่อมที่มีขนาดใหญ่
- เริ่มเจริญและทำงานเมื่อเข้าสู่วัยรุ่น
- ฮอร์โมนเพศส่งผลให้เกิดการเจริญของต่อม
- ผลิตสารน้ำที่มีลักษณะเหนียวข้น (Viscous milk-to-clear fluid)

โครงสร้างต่อมคล้าย eccrine glands แต่มี dark cells มากกว่า clear cells และมี myoepithelial cells โอบรอบที่ฐานเซลล์ มี basement membrane หนา

Eccrine and apocrine sweat glands



Apoecrine sweat glands



- New family of sweat glands
- เริ่มเจริญในระยะ puberty
- พบตลอดไปบริเวณ axillae ของผู้ใหญ่



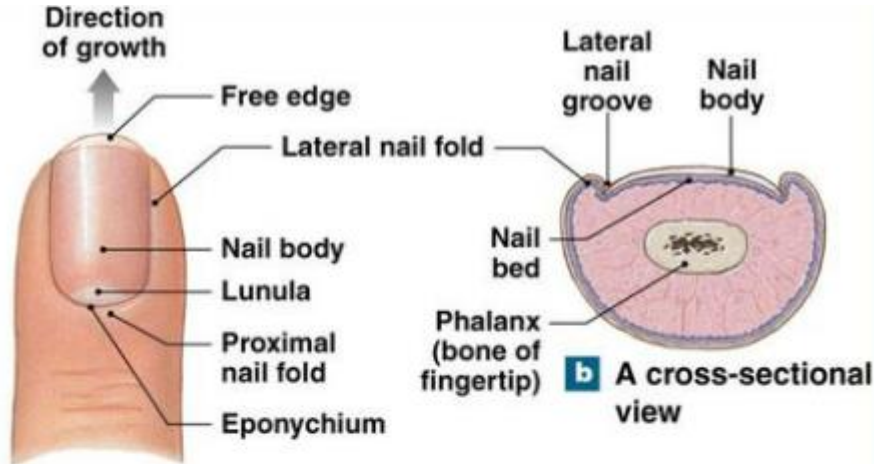
Axillary hyperhidrosis

ผู้ป่วยที่มีภาวะเหงื่อออกรักแร้มากผิดปกติ (Axillary hyperhidrosis) จะพบว่ามากกว่า 50% ของต่อมเหงื่อบริเวณรักแร้เป็นชนิด Apoecrine glands

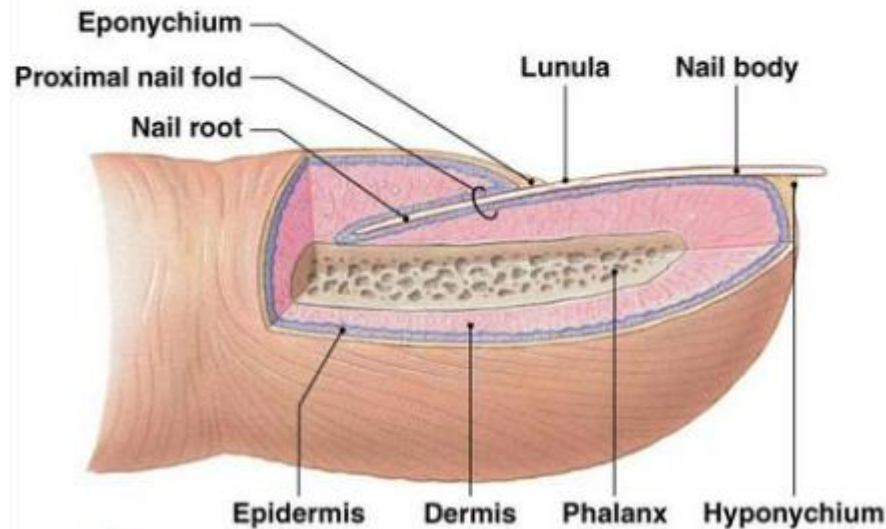
Nails

hard plates of keratin on the dorsal surface of each distal phalanx

- **Nail plate (nail body):** translucent plate at outer portion of the nail unit, formed by layers of hard keratin
- **Nail bed:** the pinkish-colored soft tissue underneath the nail plate (*Stratum basale and stratum spinosum*)
- **Nail folds:** skin that surrounds and protects the proximal and lateral margins of the nail plate
- **Nail root:** area at the back of the nail, under the cuticle
- **Nail matrix:** the area where the nail start to grow

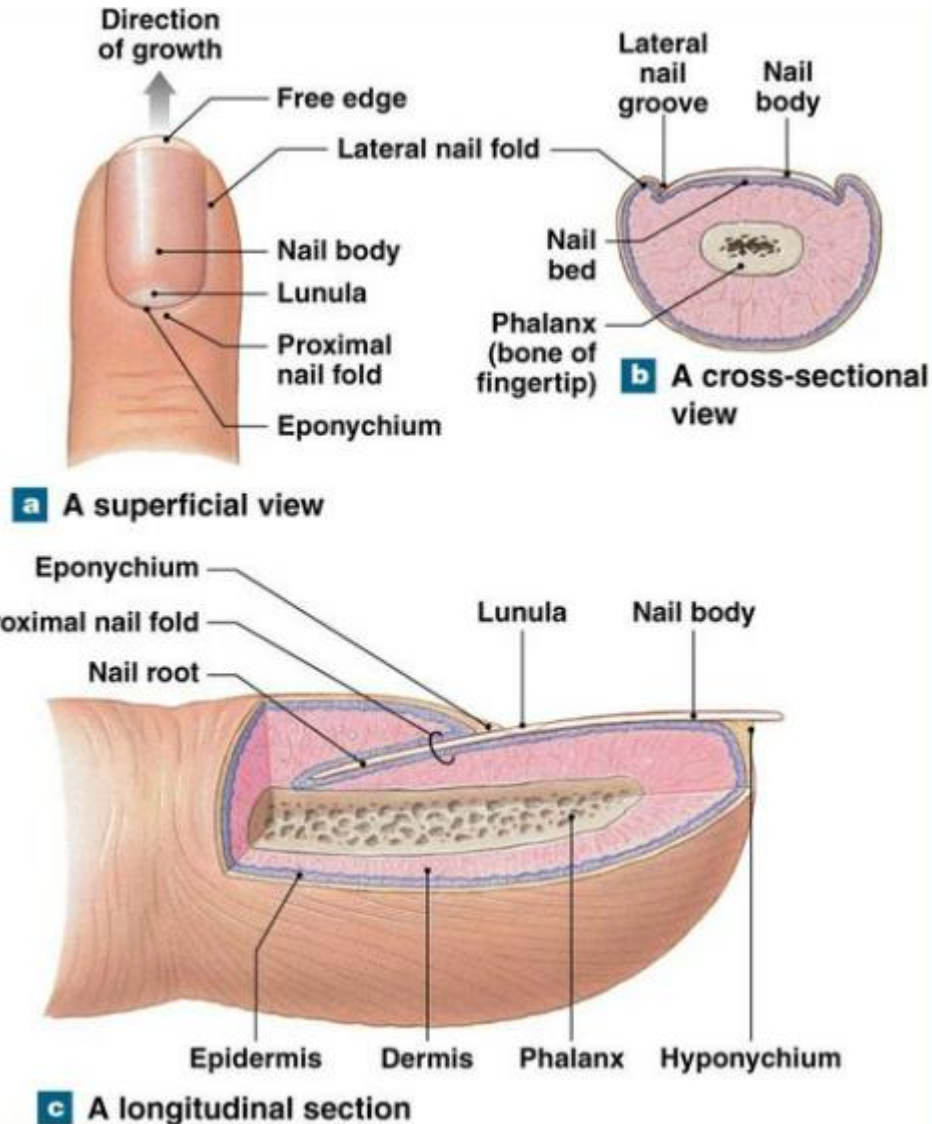


a A superficial view



c A longitudinal section

Nails



- Free edge

- Hyponychium: layer of stratum corneum under the free edge where the nail separates from the fingertip

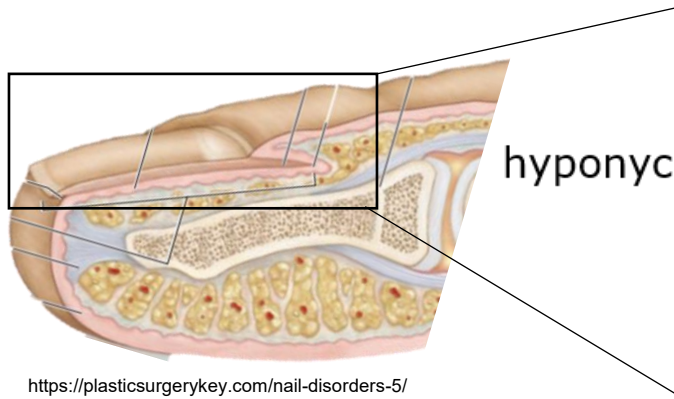
function: preventing pathogens like bacteria and fungi from getting under the nail plate and into the nail bed.

- Eponychium (cuticle): layer of stratum corneum which extends between the skin of the finger and proximal nail plate.

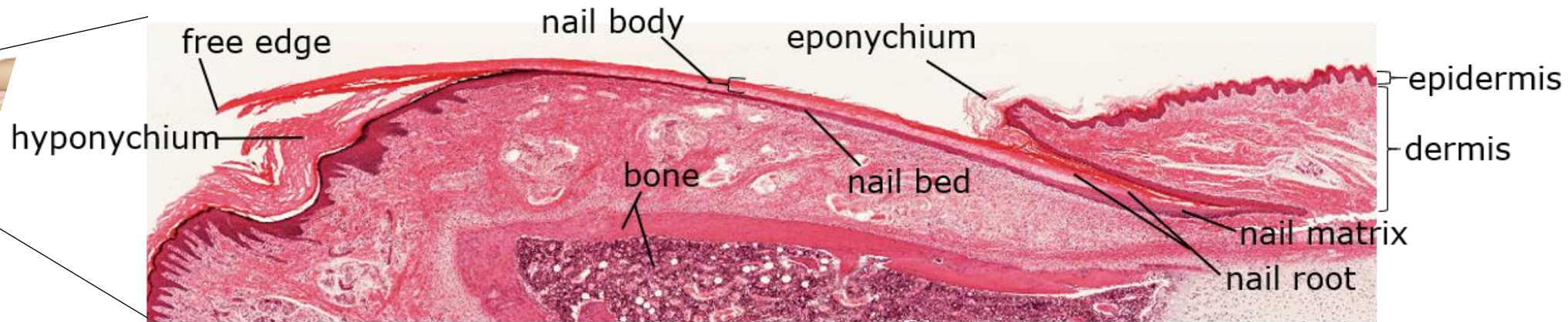
function: preventing pathogens like bacteria and fungi from getting under the nail bed and into the nail matrix.

- Lunula: white 'half-moon' appearance of the germinal matrix through the proximal nail plate

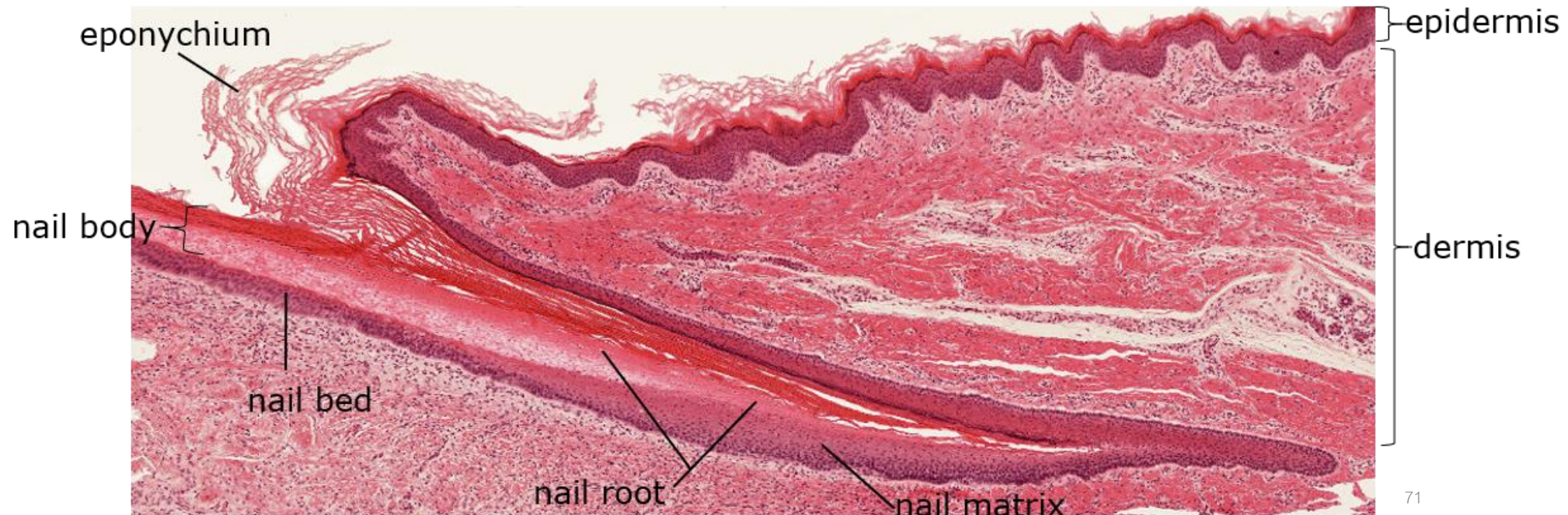
Nail histology



<https://plasticsurgerykey.com/nail-disorders-5/>



<https://www.ncbi.nlm.nih.gov/books/NBK534769/bin/NailAnatomy-01.jpg>



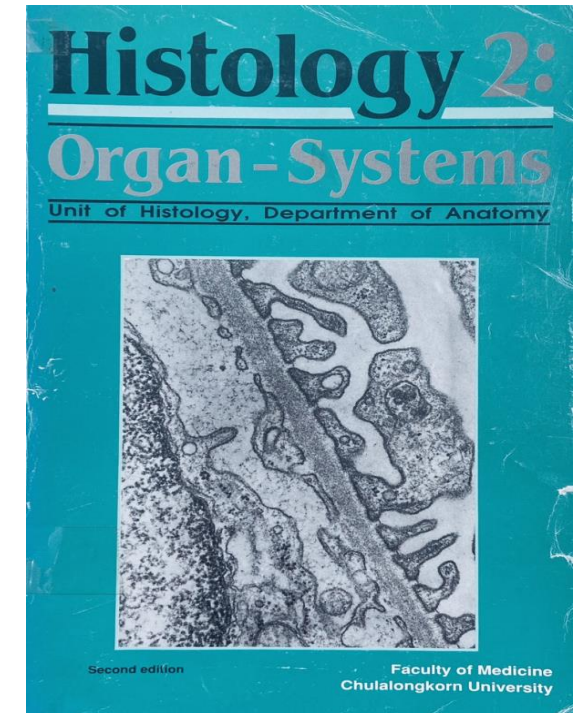
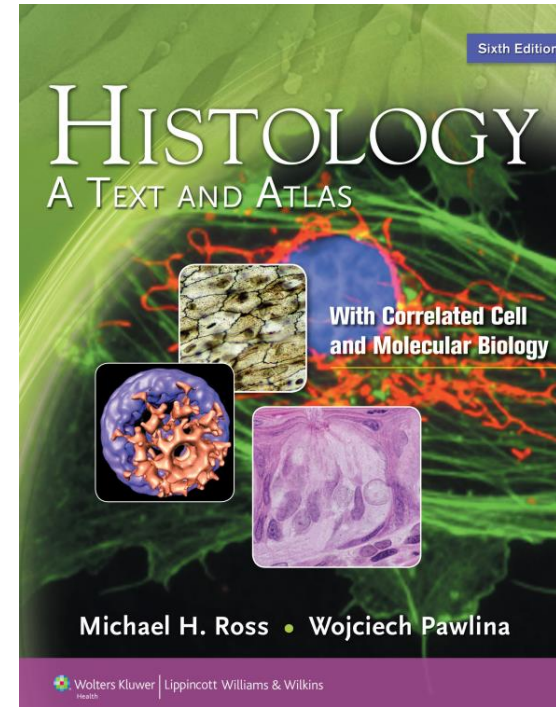
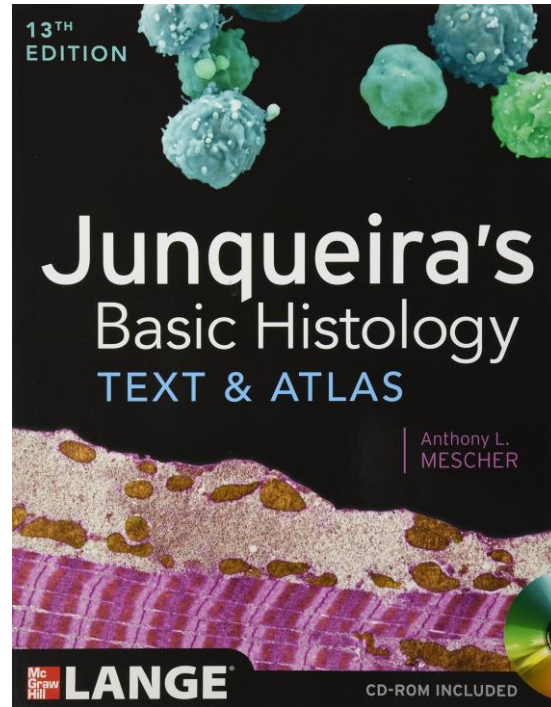
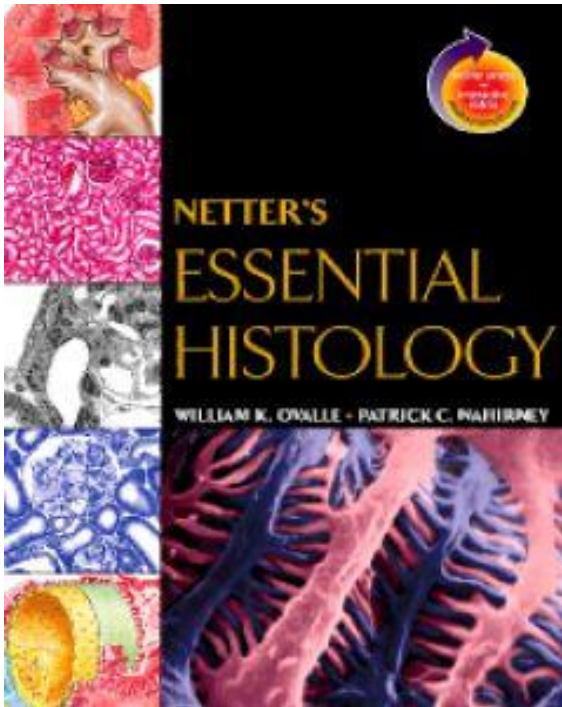
<https://bit.ly/3swLp2q>

Nails

หน้าที่ของเล็บ

- ป้องกัน (protection) อันตรายที่จะเกิดต่อนิ้วส่วนปลาย (distal phalanges)
- ช่วยทำให้นิ้วมือสามารถหยิบจับสิ่งของที่มีขนาดเล็กได้ดี
- ช่วยให้การเคลื่อนไหวของเท้าได้ดียิ่งขึ้น (pedal biomechanics)
- เป็นแหล่งเป็นอาการแสดง (signs) ของโรคบางชนิด
- เป็นอาวุธของร่างกายตามธรรมชาติ เช่น การขีด, ข่วน เพื่อต่อสู้กับอันตราย

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Histology Guide

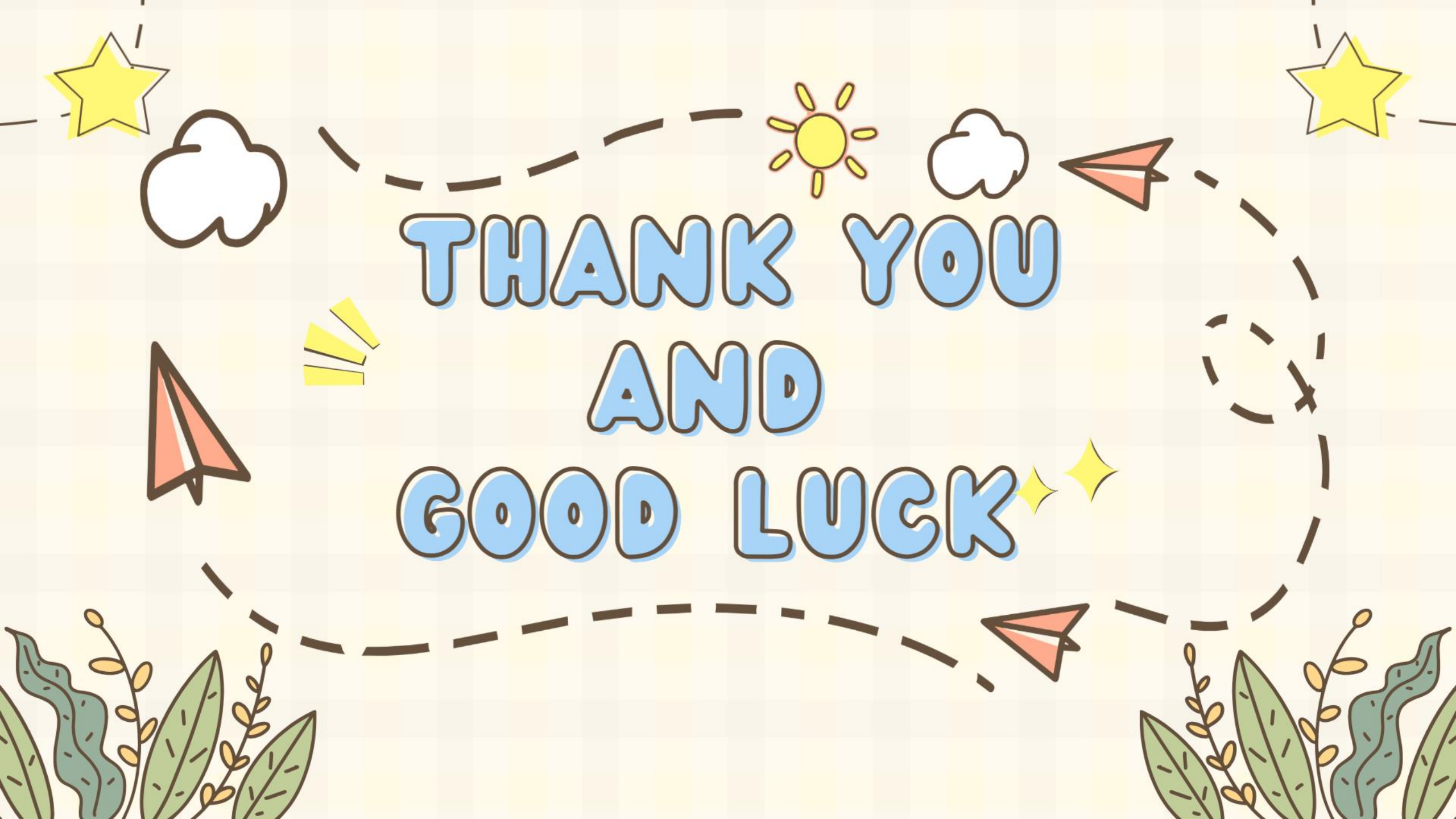
virtual microscopy laboratory

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THANK YOU
AND
GOOD LUCK