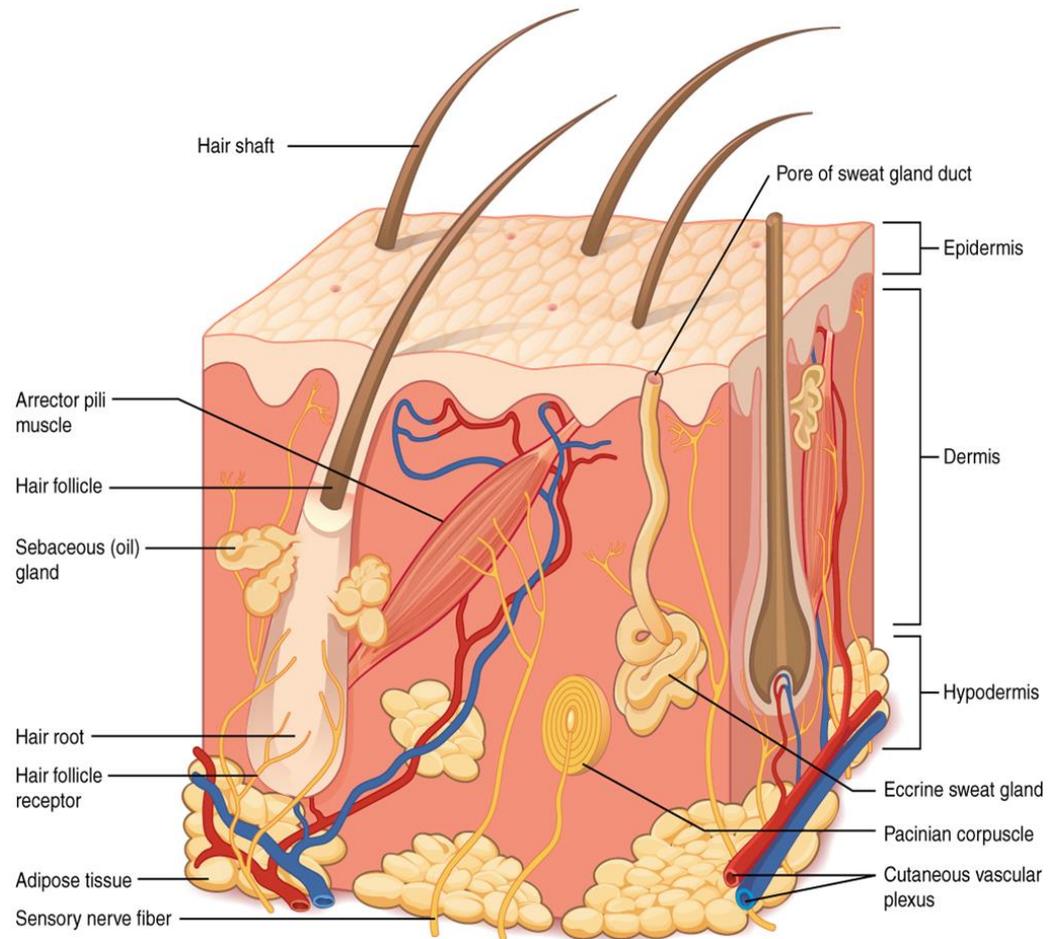


INTEGUMENTARY SYSTEM

Ass. Prof Dr. Heba
Hassan Abd El-Gawad



SKIN

- The integumentary system is composed of skin and its appendages.
- Skin is the heaviest single organ of the body (about 16% of the total body weight). It consists of:
 - 1- **Epidermis:** an epithelial layer of ectodermal origin.
 - 2- **Dermis:** a connective tissue layer of mesodermal origin.
- The skin appendages develop from epidermis. They are **sweat glands, sebaceous glands, hairs and nails.**
- The hypodermis (superficial fascia) is not a part of the skin. It connects the skin with the underlying structures and it is formed of loose connective tissue that may contain a pad of adipose tissue.

I- EPIDERMIS

- It is the outer layer of the skin and is a sort of **keratinized stratified squamous epithelium** (keratinocytes) , other less abundant cells in the epidermis (**non-keratinocytes**) are melanocytes, Langerhans cells and Merkel's cells.

- - Keratinocytes are arranged in **5** layers:

a- Stratum basale

b- Stratum spinosum

c- Stratum granulosum

d- Stratum lucidum

e- Stratum corneum



Stratum corneum

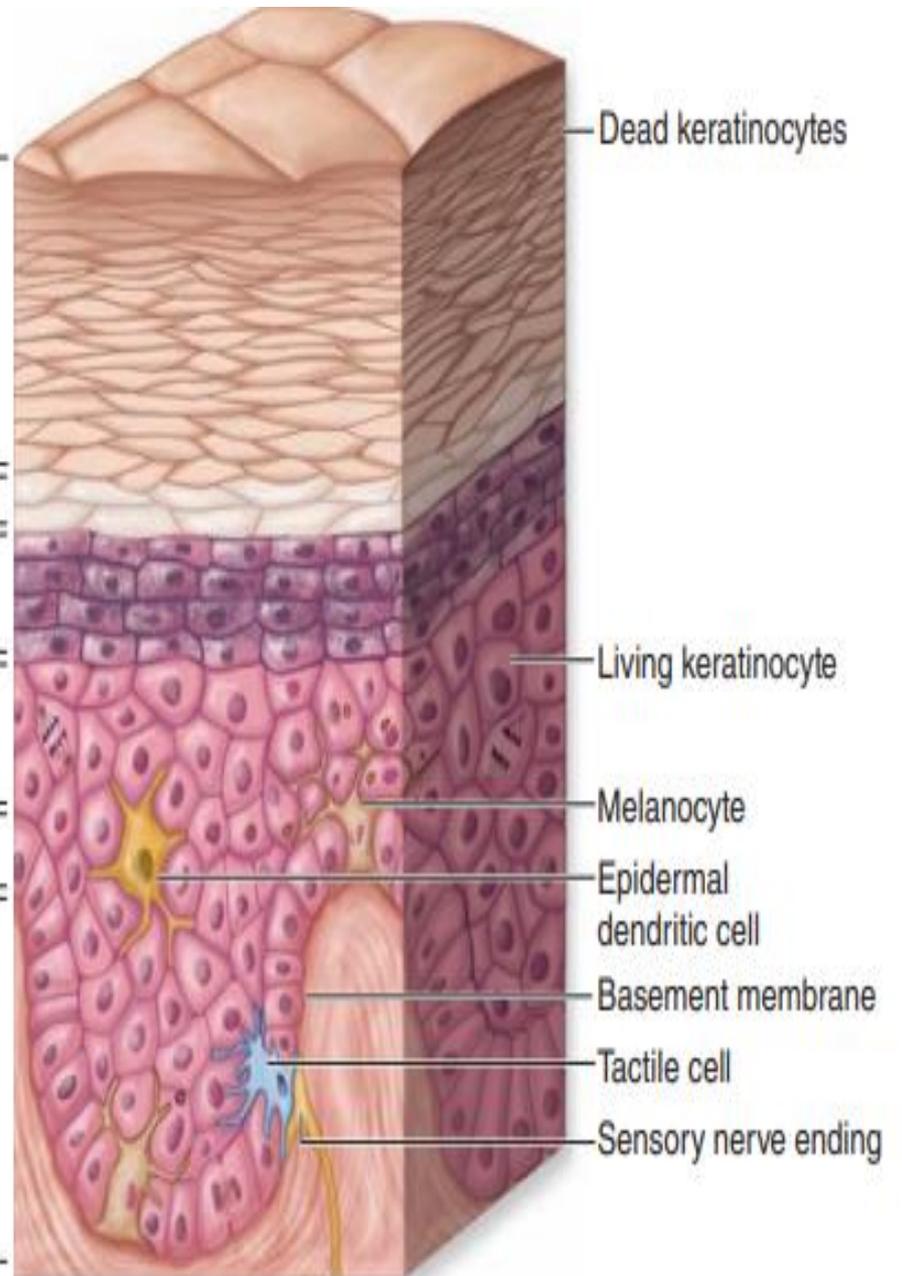
Stratum lucidum

Stratum granulosum

Stratum spinosum

Stratum basale

Dermis



Dead keratinocytes

Living keratinocyte

Melanocyte

Epidermal dendritic cell

Basement membrane

Tactile cell

Sensory nerve ending

a

b

1- Stratum basale (germinal layer):

LM:

- It consists of a **single layer of columnar** cells resting on a basement membrane separating dermis from epidermis.
- The cytoplasm is **basophilic** due to high content of **ribosomes**.
- Many **mitotic figures** are seen.

EM:

- The cytoplasm contains intermediate filaments (**tonofilaments**).
- There are **desmosomes** between cells and **hemidesmosomes** between them and the basement membrane.

2- Stratum spinosum (prickle cell layer):

LM:

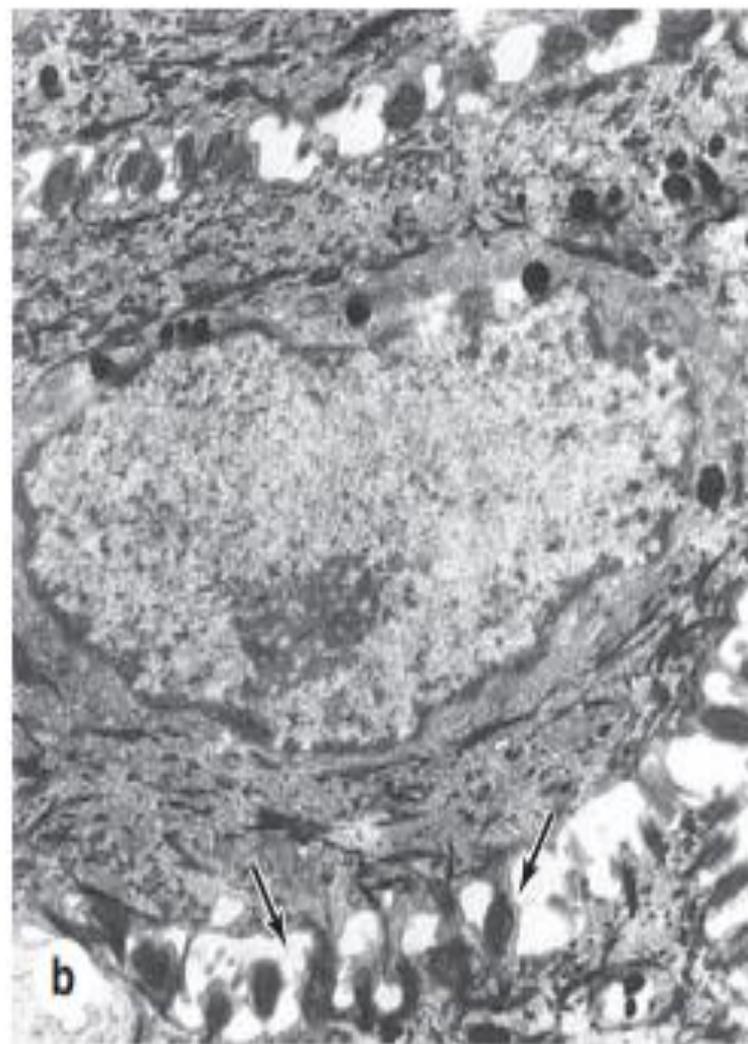
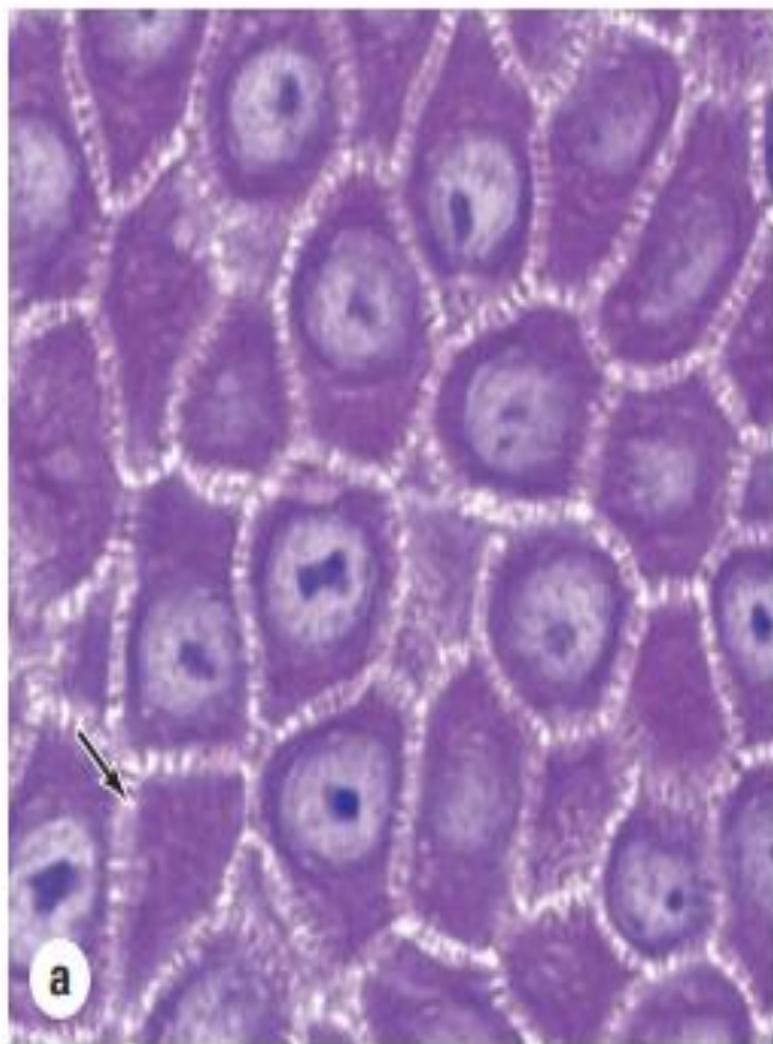
- It is formed of **several layers** of **polygonal** cells with central nuclei.
- Some **mitotic figures** can be seen in the deeper part of this layer.

EM:

- They are connected by many **spinous** interdigitating **processes** or intercellular bridges ending with **desmosomes**.
- There are many **tonofilaments** in the cytoplasm.

Stratum **basale** and deeper part of stratum **spinosum** are called together **Malpighian layer**. Renewal of the epidermis occurs every 15-30 days by mitosis of the cells of Malpighian layer.

FIGURE 18-4 Keratinocytes of the stratum spinosum.



3-Stratum granulosum (granular layer):

LM:

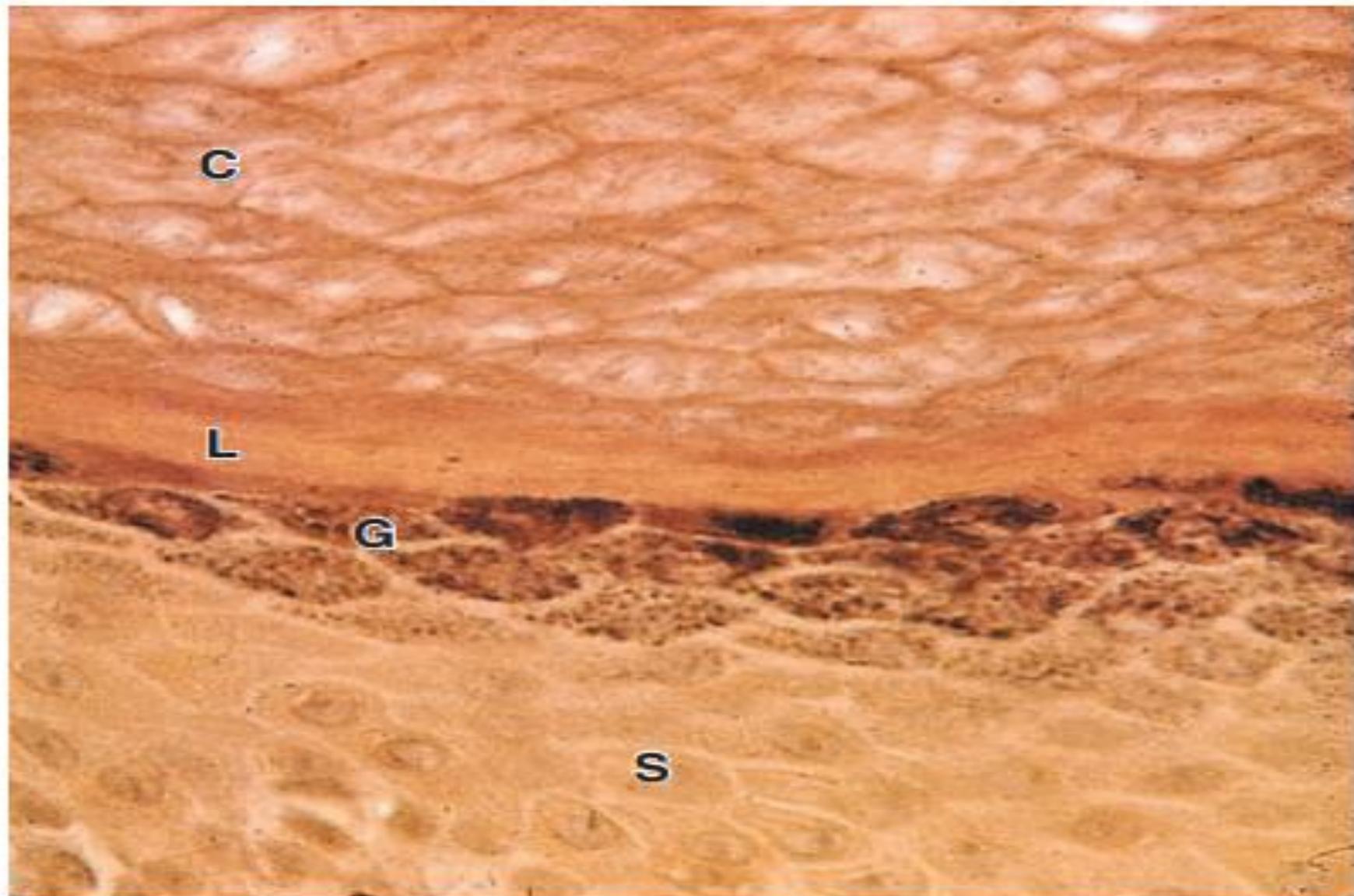
- **3 to 5** layers of **polygonal** cells with central nuclei.
- The cytoplasm contains **basophilic** non-membranous granules called **keratohyaline** granules.

EM:

There are **another** characteristic membrane coated lamellar **granules** that release **lipid-containing** substance in the intercellular space.

This substance forms a **barrier against** invasion with foreign materials, resembling **intercellular cement**.

FIGURE 18–5 Stratum granulosum and stratum lucidum: thick skin.



4- Stratum lucidum (clear layer):

LM: It is a **translucent**, thin layer of **eosinophilic** flattened cells containing **eleidin**

EM:

- The cells have **no organelles, no nuclei** and the cytoplasm is formed mainly of closely **packed tonofilaments** embedded in an electron dense matrix.
- **Desmosomes** are still evident between the adjacent cells.

5- Stratum corneum (horny layer):

The superficial cells are **continuously shed**.

LM:

It consists of many layers of **flattened non-nucleated keratinized cells**.

EM:

- Cytoplasm is filled with filamentous **scleroprotein** called **keratin**.
- **Besides keratinocytes (85%), the epidermis contains other cell types (Non-keratinocytes):**

1- Melanocytes

2- Langerhan's cells

3- Merckel's cells

1- Melanocyte

Origin:

-They are derived from the neural crest. They migrate to the skin early in development.

Site:

-They are located between the cells of **stratum basale** and in hair follicles.

LM:

-They have **rounded** cell bodies with **central** nuclei. Their long extensive cytoplasmic processes extend between the cells of **Malpighian layer**.

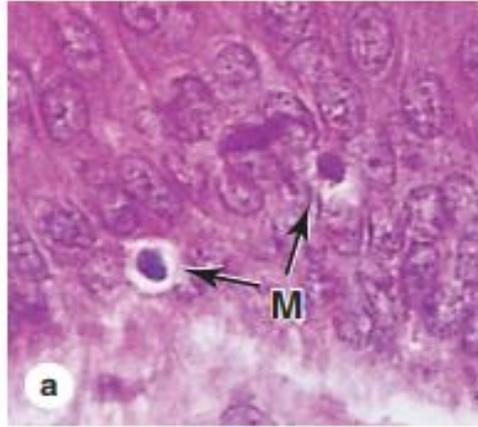
EM:

-The cytoplasm contains numerous small mitochondria, well developed Golgi and rER.

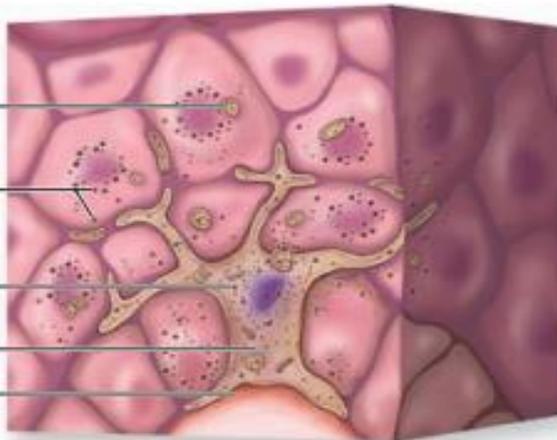
-They are **not attached** to the adjacent keratinocytes by desmosomes, but **hemidesmosomes** bind melanocytes to the basal lamina.

-One melanocyte maintains an association with a given number of keratinocyte (**epidermal-melanin unit**).

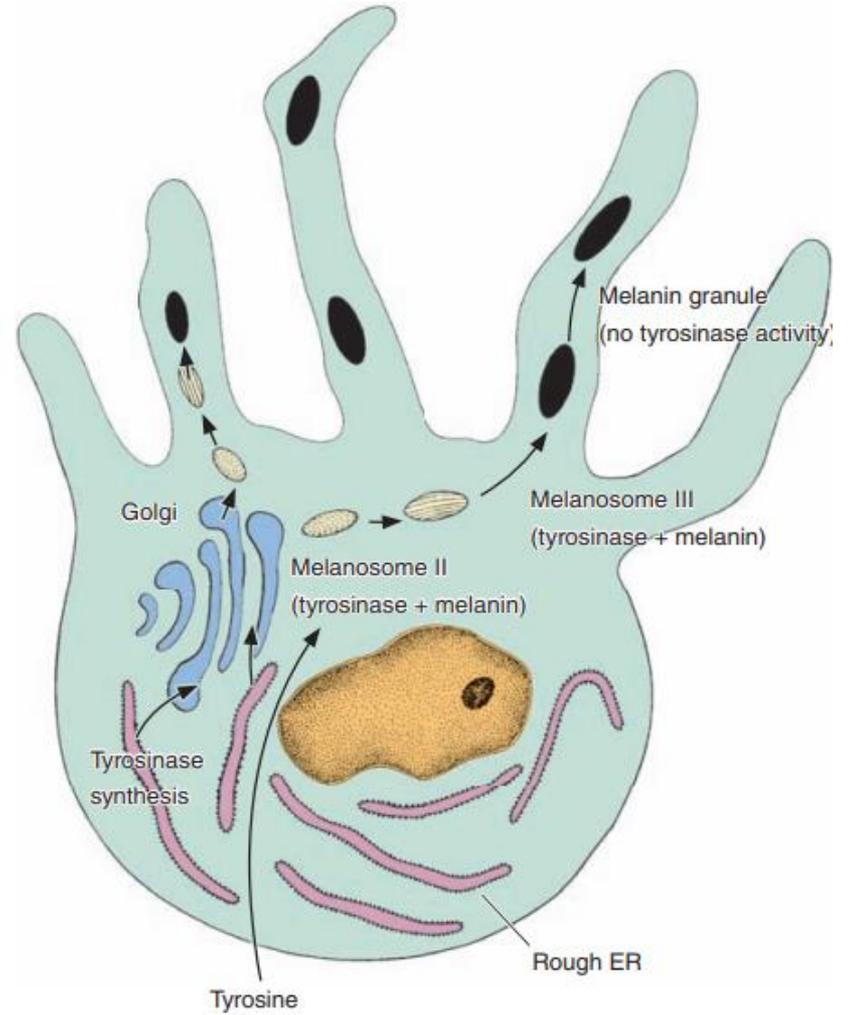
FIGURE 18-6 Melanocytes.



Vesicle filled with melanin
Melanin pigment in keratinocyte
Melanin pigment
Melanocyte
Basement membrane



b



-Melanin granules pass through the cytoplasmic processes of melanocytes to keratinocytes of Malpighian layer by **phagocytosis**.

-Then, they fuse with lysosomes and occupy a **supranuclear** position **protecting the dividing nuclei** from the harmful effect of sun rays and causing pigmentation of the skin.

-NB: Albinism is a genetic defect in tyrosinase enzyme, so no melanin is formed causing white coloration of hairs and skin.

DOPA reaction:

- If fresh sections of skin are incubated with DOPA (dihydroxy-phenylalanine), the tyrosinase enzyme present in melanocytes converts DOPA into melanin (black pigment). This is called DOPA reaction and melanocytes are called DOPA +ve.

2- Langerhans' cells

Origin: They are derived from **bone marrow** (mesenchymal origin).

Site : They are located inbetween cells of **stratum spinosum**.

Structure:

-They are branched **star shaped** cells, with indented nuclei and clear cytoplasm.

-They have characteristic rod-shaped granules (**Birbeck's granules**).

Function:

-They act as **antigen presenting** cells for lymphocytes.

3-Merkel's cells

Site: They are present in **thick skin**.

Structure:

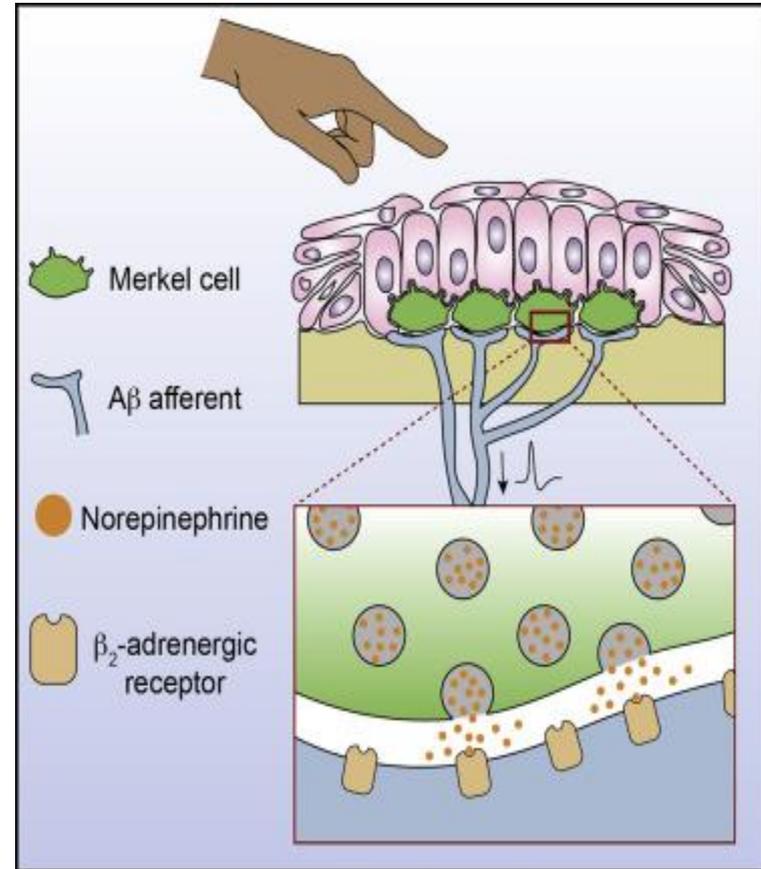
They are **large dark** cells.

They **resemble keratinocytes**, but the cytoplasm contains small dense granules.

They are associated with **nerve endings**.

Function:

-They may act as **sensory mechanoreceptors**.



II- DERMIS

It is subdivided into two indistinct layers.

1- Papillary layer:

It is the **outer layer** beneath the epidermis.

It consists of **loose connective tissue** rich in cells, free nerve endings, and blood capillaries for **nutrition** of the epidermis.

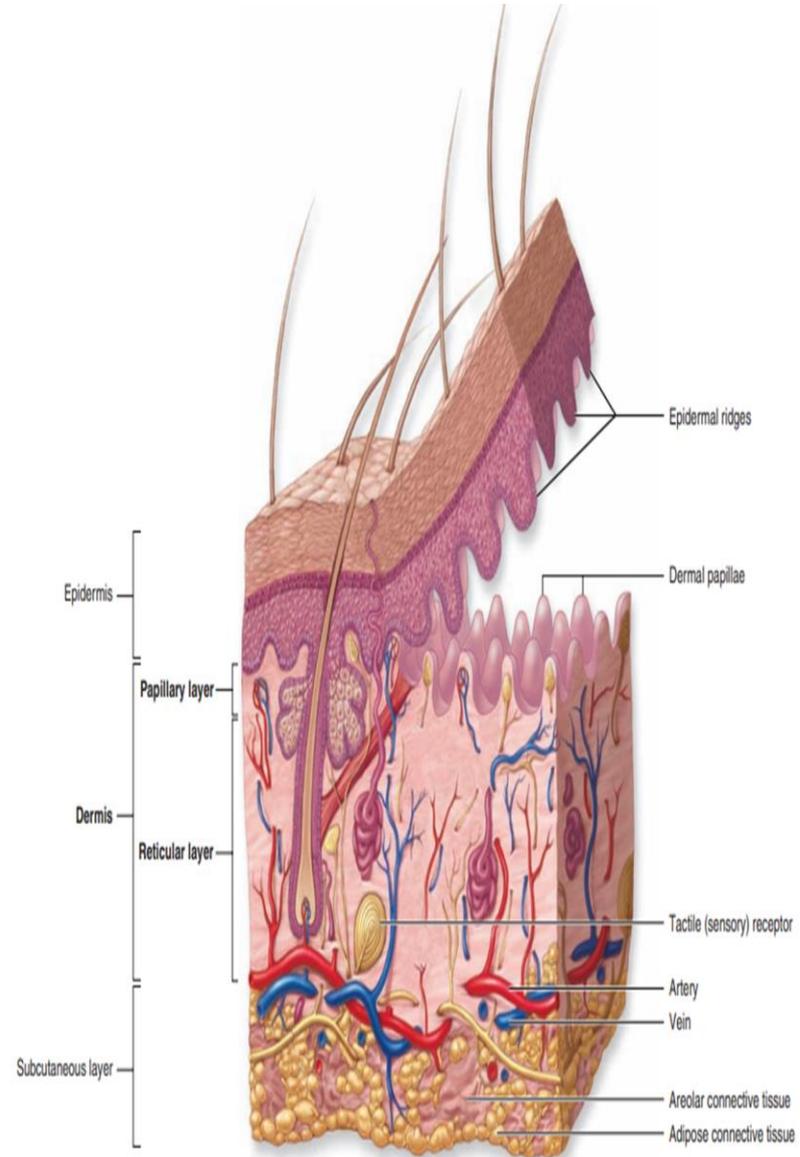
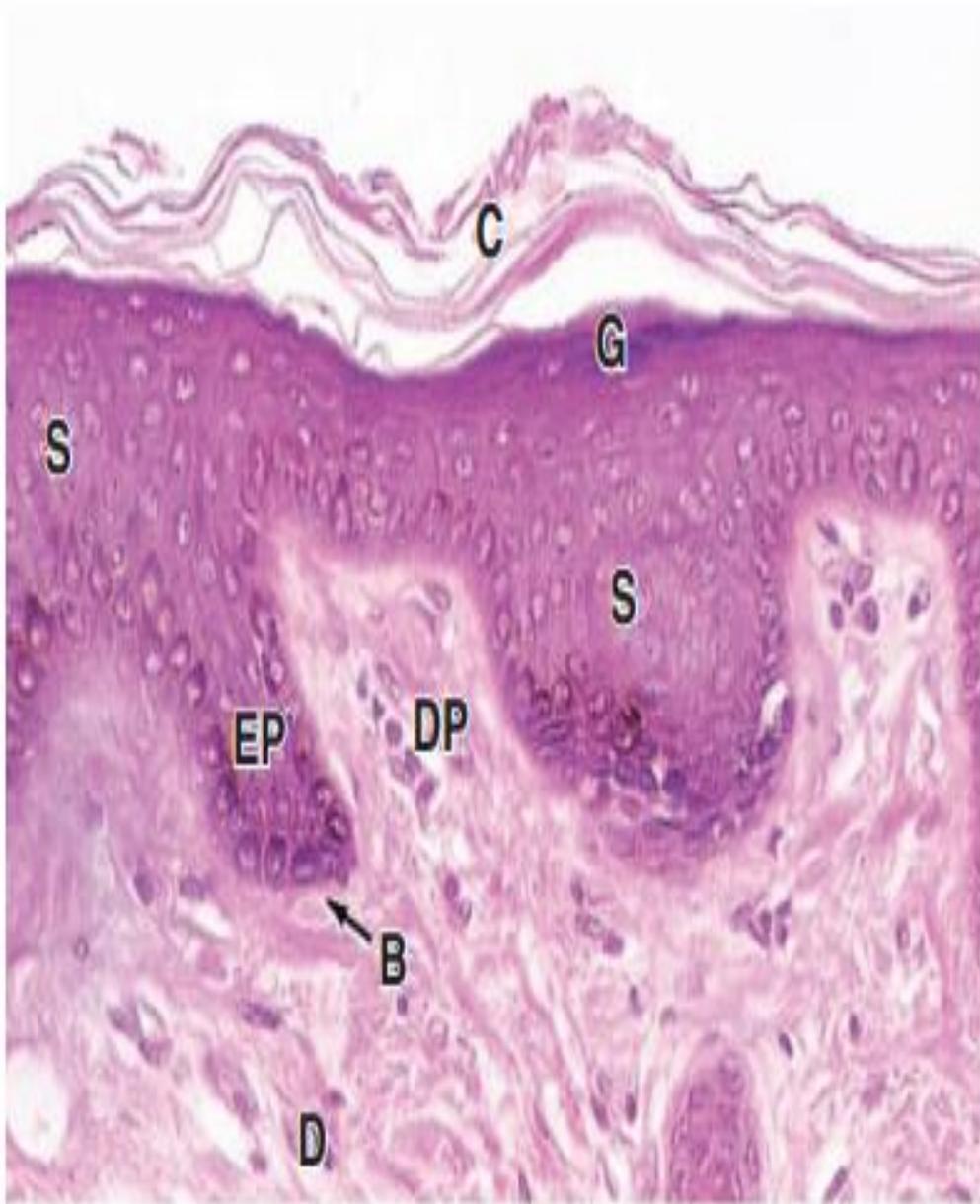
2- Reticular layer:

It is the **deeper** thick layer.

It consists of **dense connective tissue** rich in collagen fibers type I and elastic fibers.

The dermis contains sweat glands, hair follicles and sebaceous glands.

It also contains sympathetic nerve fibers, free nerve endings and encapsulated sensory organs (e.g. Pacinian corpuscles).

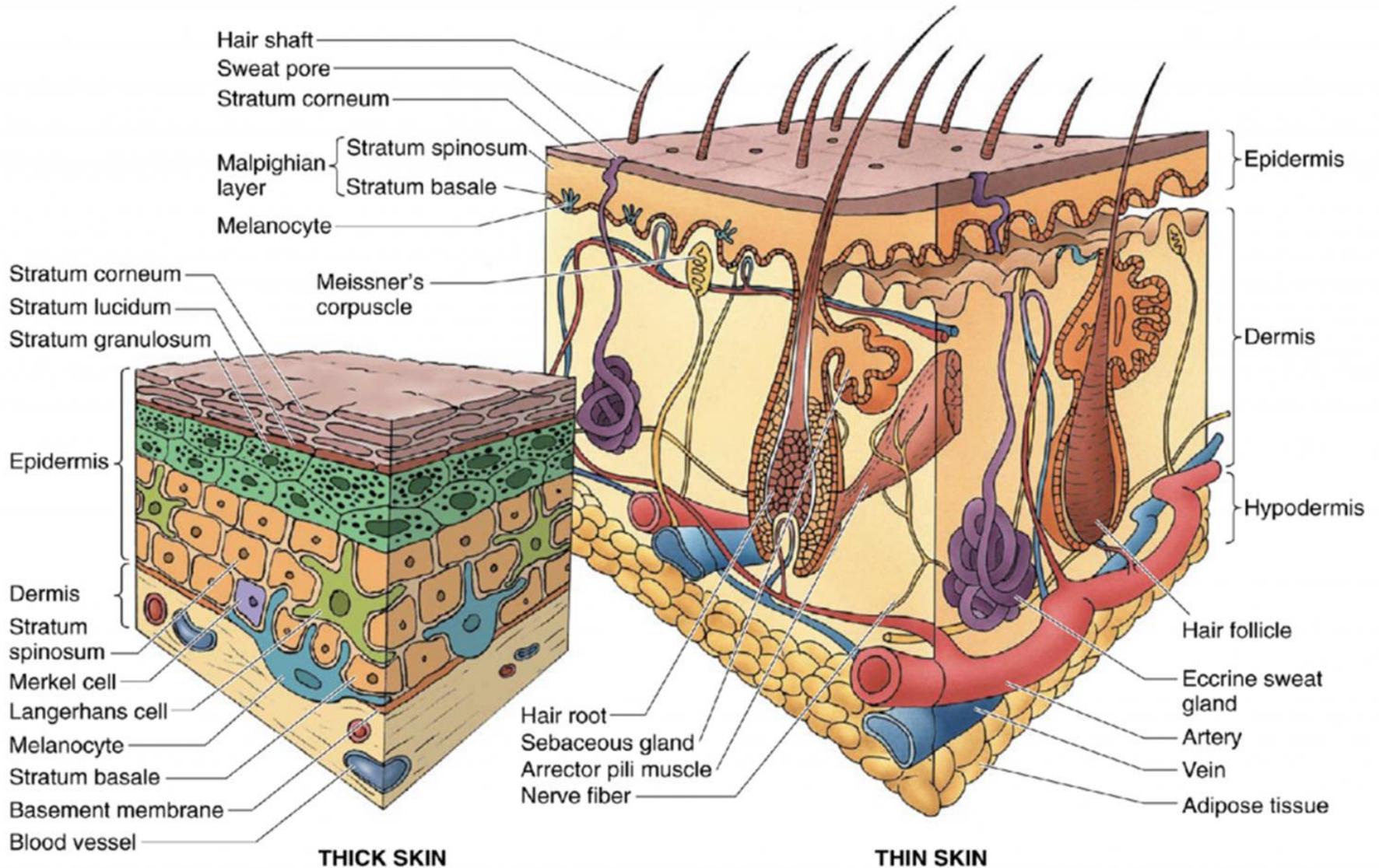


**** Dermo-epidermal junction:**

- This junction has the appearance of **zigzagging** interdigitations between conical projections of dermis (**dermal papillae**) and epidermis (**epidermal ridges**). They are called **papillary ridges**.
- It develops in fetus and remains unchanged throughout life.

The pattern of papillary ridges is responsible for **finger prints** which are unique for every individual. This has been used with success for **personal identification** and in **criminal detection**.

- The skin varies in its thickness according to the thickness of its epidermis. Generally, there are two types; thick and thin skin.



• ****Differences between thick and thin skin:**

	Thick Skin	Thin Skin
Site	Covers palms and soles	Covers the whole body except palms and soles
Epidermis	Thicker	Thinner
Stratum Granulosa	Well developed	Not well developed
Sstratum corneum	Thicker	Thinner
Stratum lucidum	Apparent	Not apparent
papillary ridges	Characteristic (finger prints)	Not characteristic
Dermis	It has no hairs, hair follicles nor sebaceous glands but contains many sweat glands.	Contains hairs, hair follicles and sebaceous glands and fewer sweat glands,
Meissner's corpuscles	Many	Few
Elastic fibers	Few	More abundant



SKIN APPENDAGES

SKIN APPENDAGES

Skin Model - Accessory Structures

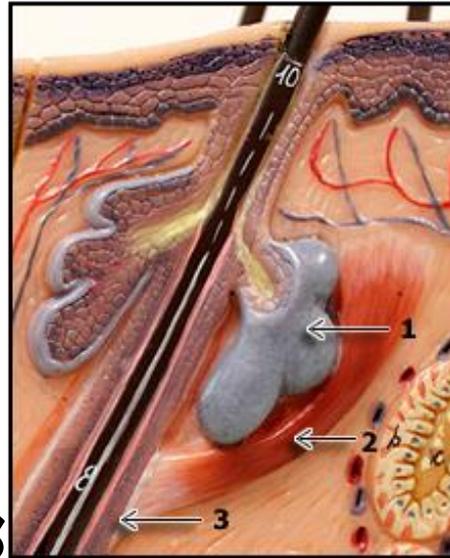
Drag the cursor over the labels to identify the parts

1- Hairs

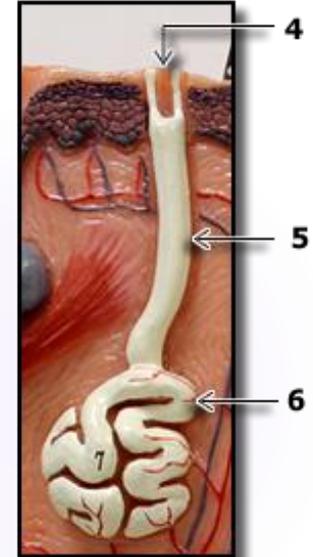
2- Nails

3- Sweat glands

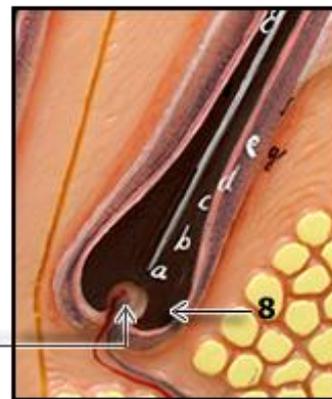
4- Sebaceous glands



Sebaceous gland and arrector pili



Sudoriferous gland



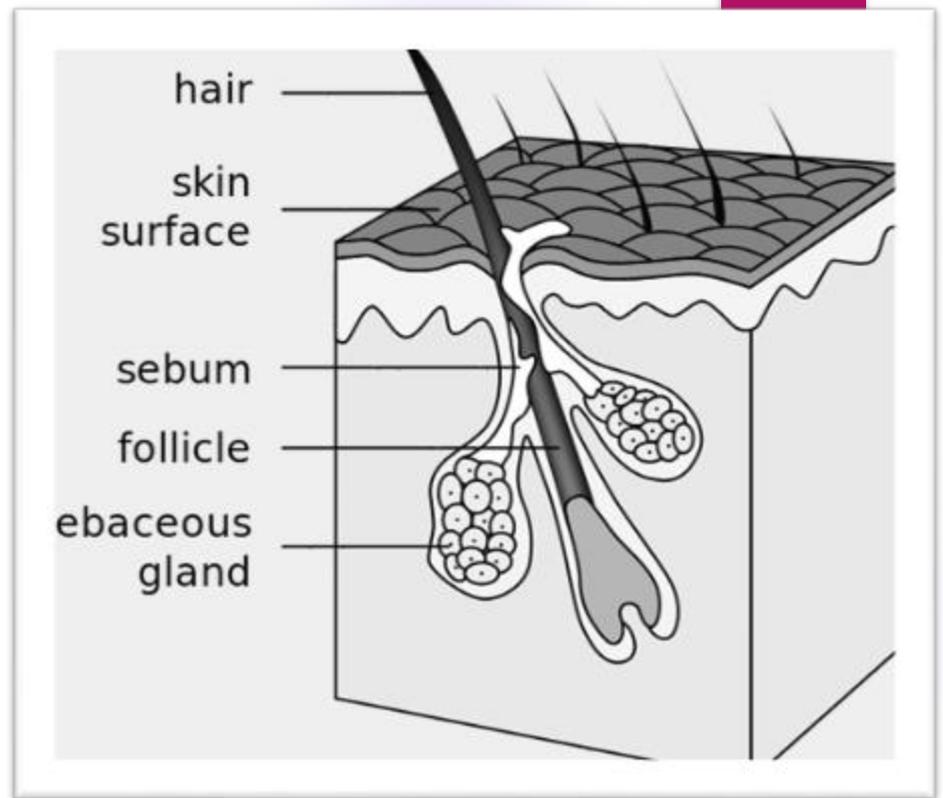
Hair



Hairs

▶ Shape: elongated keratinized structures derived from epidermal invaginations called hair follicles

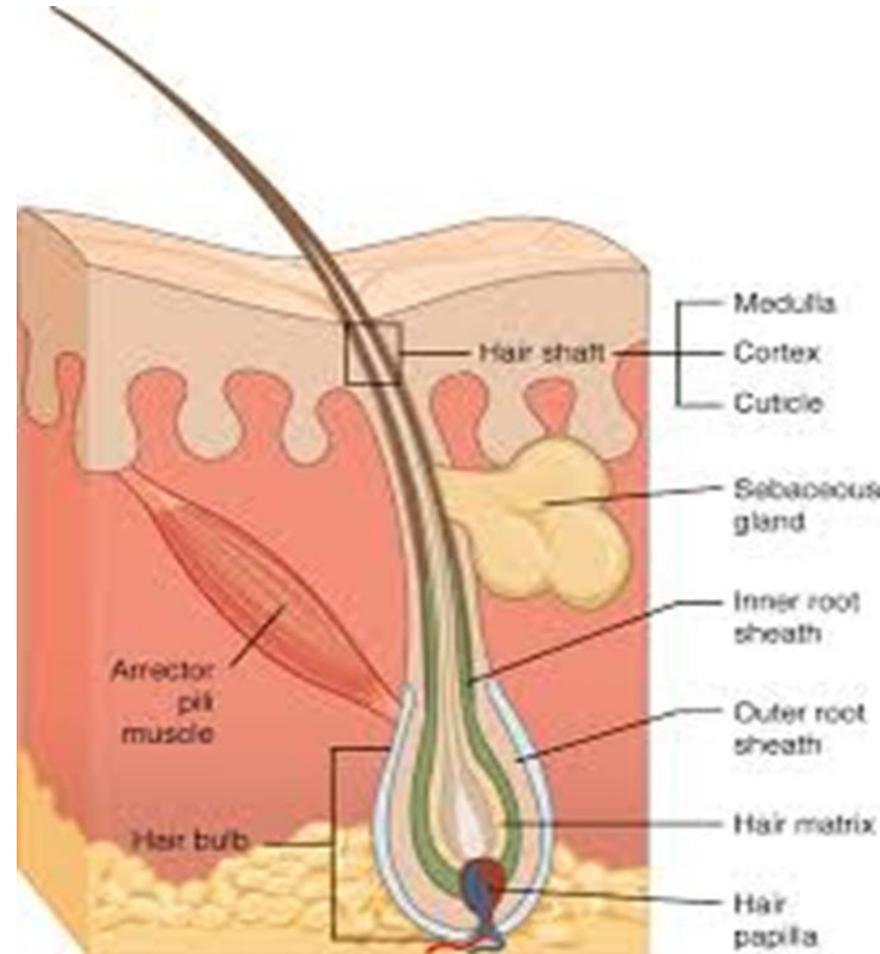
▶ Color, size and distribution: variable according to race, age, sex and body region.



▶ **Origin of hair follicles:** develop during embryonic life and no follicles develop after birth.

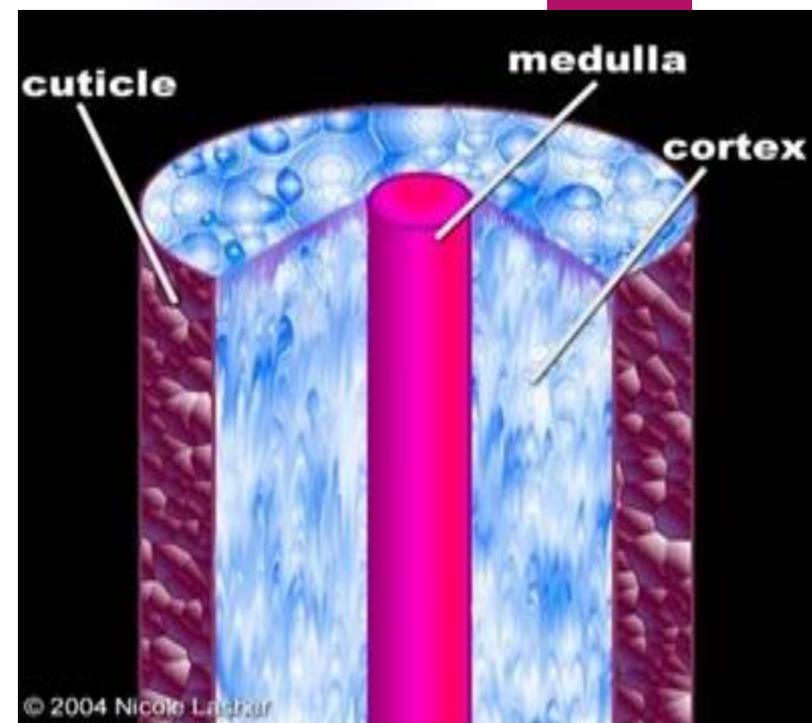
▶ Parts of hair:

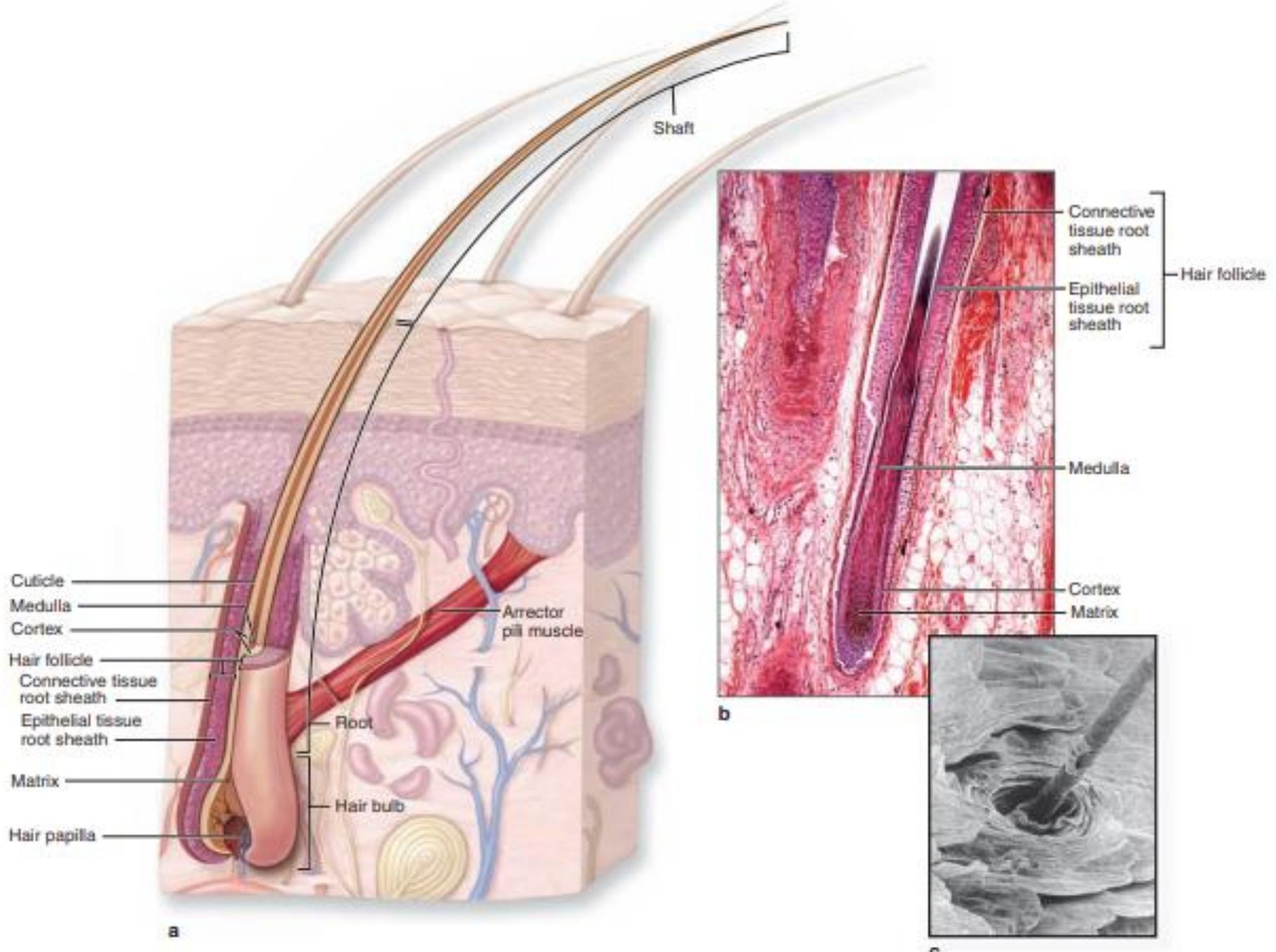
- 1) Root (inside follicle) and
- 2) shaft (on skin surface).



Structure of hair follicle from center to periphery:

- ▶ 1- Hair (medulla, cortex, cuticle).
 - ▶ 2- Epithelial sheathes
Then internal root sheath
Then external root sheath
 - ▶ 3-Then CT sheath.
-
- ▶ The glassy membrane is the thickened basement membrane separating the external root sheath from connective tissue sheath.
 - ▶ N.B: Melanin pigment of hair is present in medulla & cortex





- Cuticle
- Medulla
- Cortex
- Hair follicle
- Connective tissue root sheath
- Epithelial tissue root sheath
- Matrix
- Hair papilla
- Arrector pili muscle
- Root
- Hair bulb

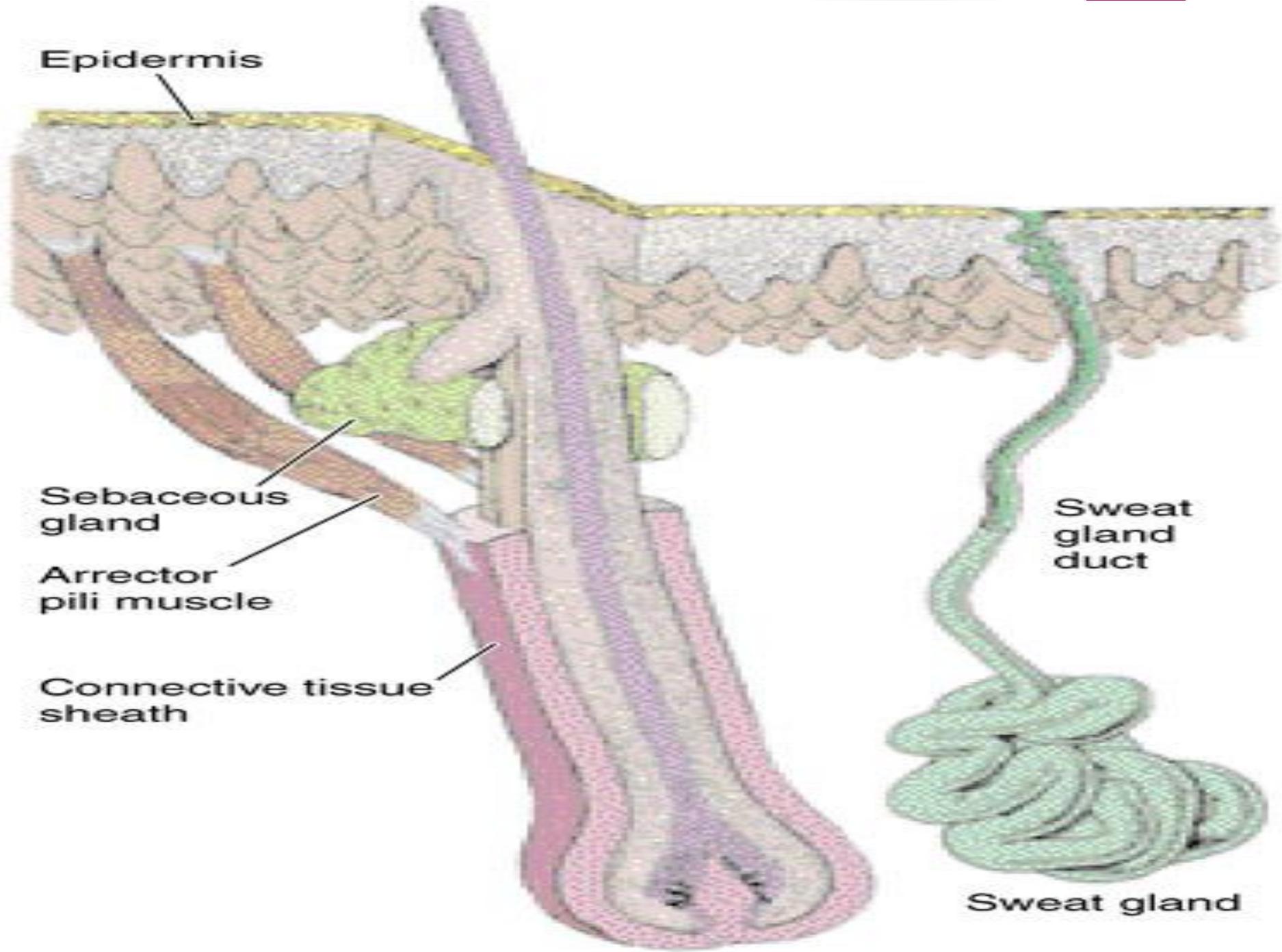
- Connective tissue root sheath
- Epithelial tissue root sheath
- Medulla
- Cortex
- Matrix
- Hair follicle

a

b

c

- 
- The hair follicle has a **terminal dilatation** called the **hair bulb**.
 - The hair bulb overlies a connective tissue called **dermal papilla**.
 - The **deepest cluster** of cells over the dermal papilla is called **germinal matrix**.
 - During growth of hair, the cells of the germinal matrix divide and differentiate into different parts of the hair and its follicle.



Epidermis

Sebaceous gland

Arrector pili muscle

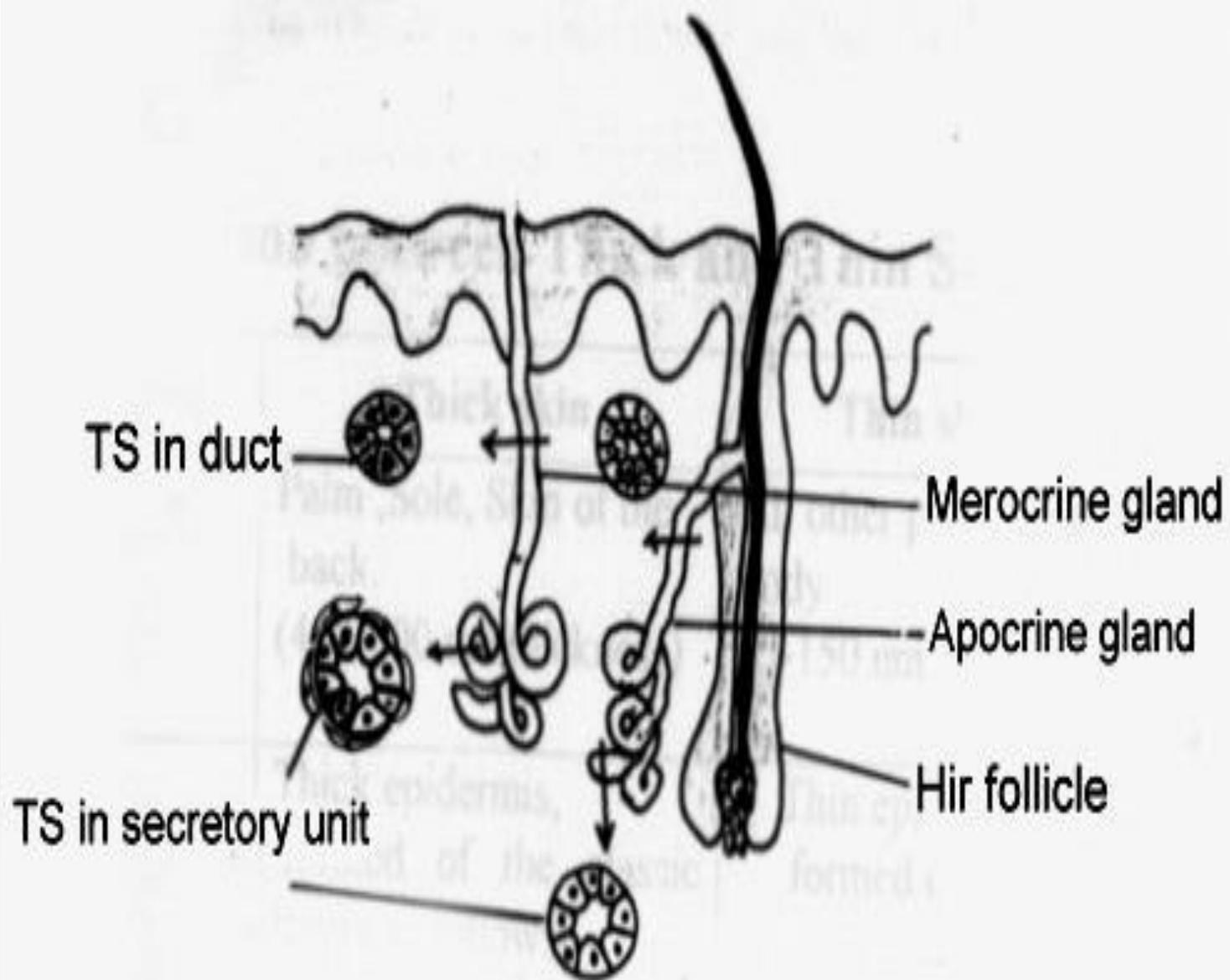
Connective tissue sheath

Sweat gland duct

Sweat gland

Errector pilli muscles

- ▶ Smooth muscles:(involuntary)
 - ▶ Bound to:
 - ▶ CT sheaths of hair follicles.
 - ▶ Papillary layer of dermis.
 - ▶ **Inserted below** level of **sebaceous gland opening**.
- ▶ Functions:
 - ▶ **Errect hair** in intense emotions (e.g. fear).
 - ▶ **Squeeze** sebaceous gland secretion.



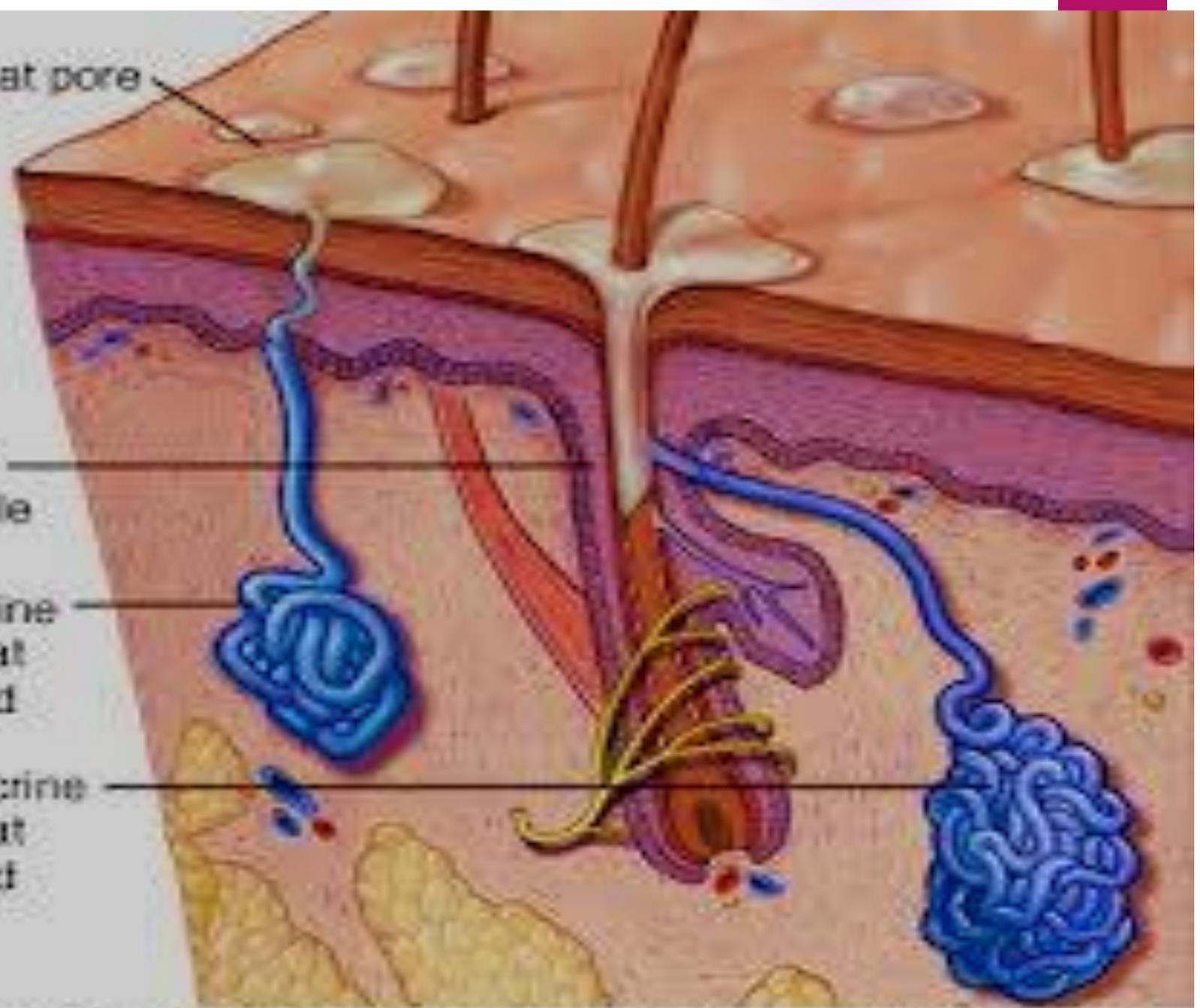
SWEAT GLANDS

Sweat pore

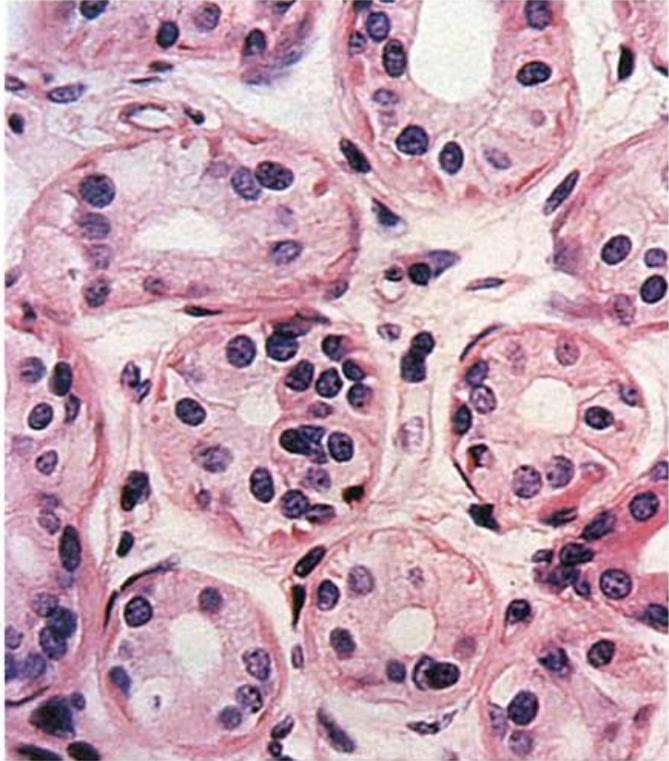
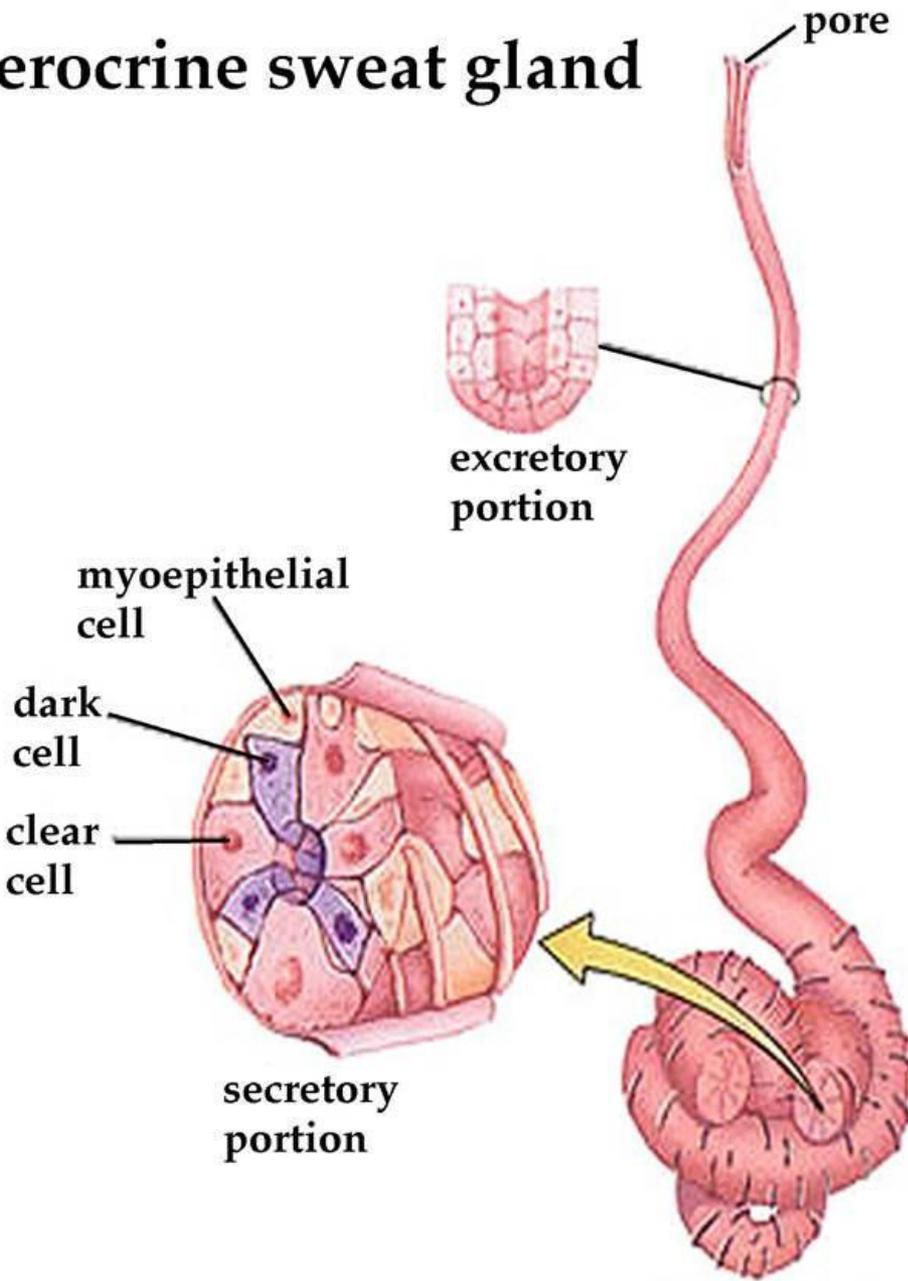
Hair
follicle

Eccrine
sweat
gland

Apocrine
sweat
gland



merocrine sweat gland

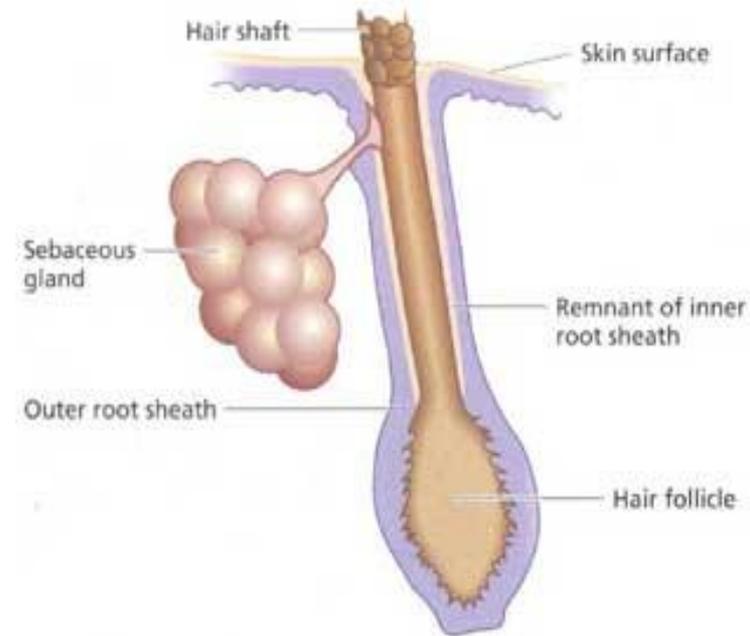


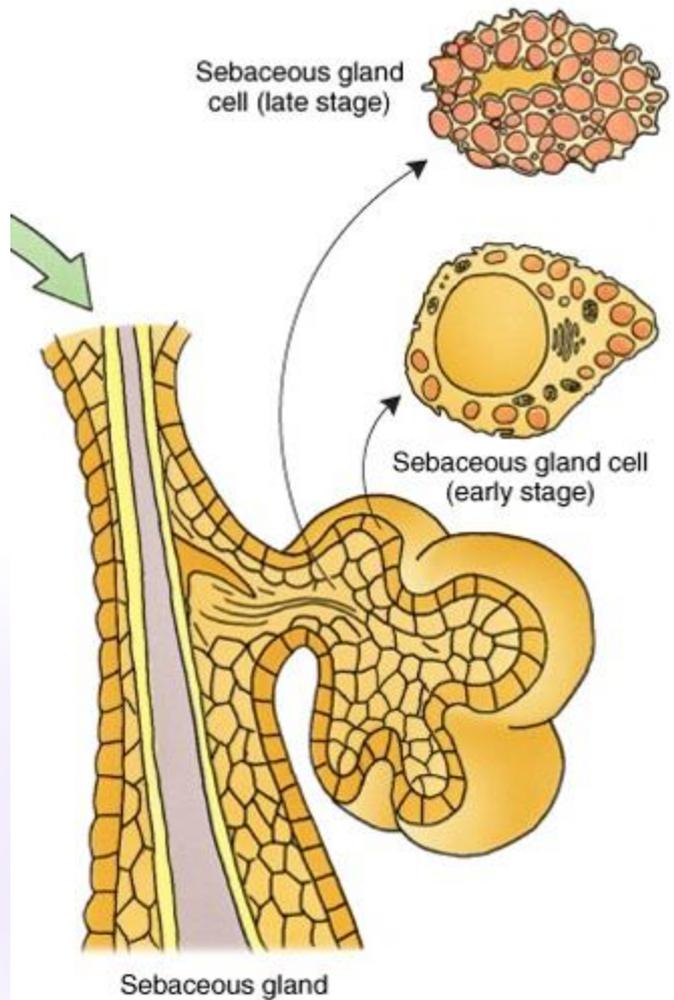
Sweat glands: types	2	Merocrine	Apocrine
Origin		Epidermis	<u>Hair follicles</u>
innervation		Cholinergic	Adrenergic
Site		skin, absent in red margin of lips and glans penis.	Axilla, anal and pubic regions, areola of breast.
Shape		Simple coiled tubular	
ducts open at		skin surface	<u>Hair follicle</u>, above opening of sebaceous glands.
Secretory part		in dermis surrounded by thick basement membrane and myoepithelial cells	

<p>Secretory cells</p>	<p>- columnar or cubical - 2 types: 1-Clear cells: ion transporting cells. 2-Dark cells: secretory granules. Basal surface does not touch basal lamina.</p>	<p>Similar to merocrine, but <u>no clear</u> cells</p>
<p>Excretory ducts</p>	<p>-darkly stained than secretory part -lined by 2 layers of cubical epithelium.</p>	
<p>Sweat</p>	<p>watery, contain proteins, NaCl ammonia, urea and uric acid</p>	<p>-viscous and odorless. -acquires its distinctive odor by bacterial decomposition.</p>
<p>Mechanism</p>	<p>Exocytosis</p>	<p>truly merocrine, not apocrine (no loss of apices during secretion).</p>
<p>Functions</p>	<p>Helps in control of body temperature and in excretion.</p>	

Sebacaceous glands

- ▶ Site: Thin skin only. (In the dermis of thin skin)
- ▶ Origin: Develop from epidermal epithelium of hair follicles.
- ▶ Shape: branched acinar holocrine glands with short ducts.



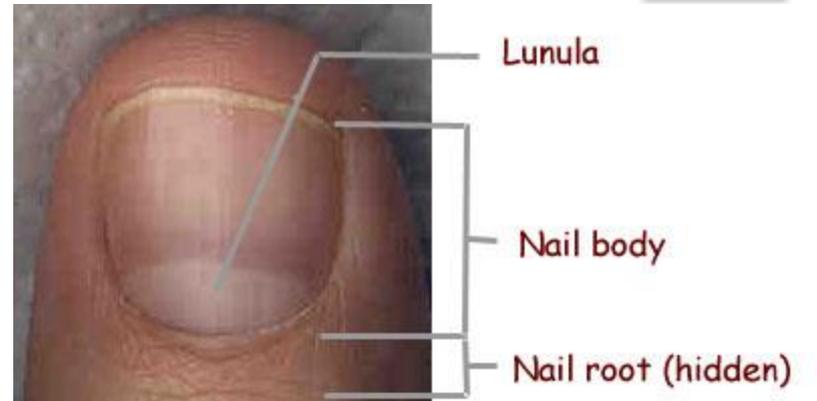


- ▶ Mechanism: **Holocrine**
- ▶ Ducts:
 - ▶ open into **upper part of hair follicles**.
 - ▶ in some areas (e.g. lips) they open directly onto skin surface.
- ▶ Acini: basal external layer of flat cells proliferate and differentiate into rounded cells fill acini and contain fat droplets in cytoplasm.

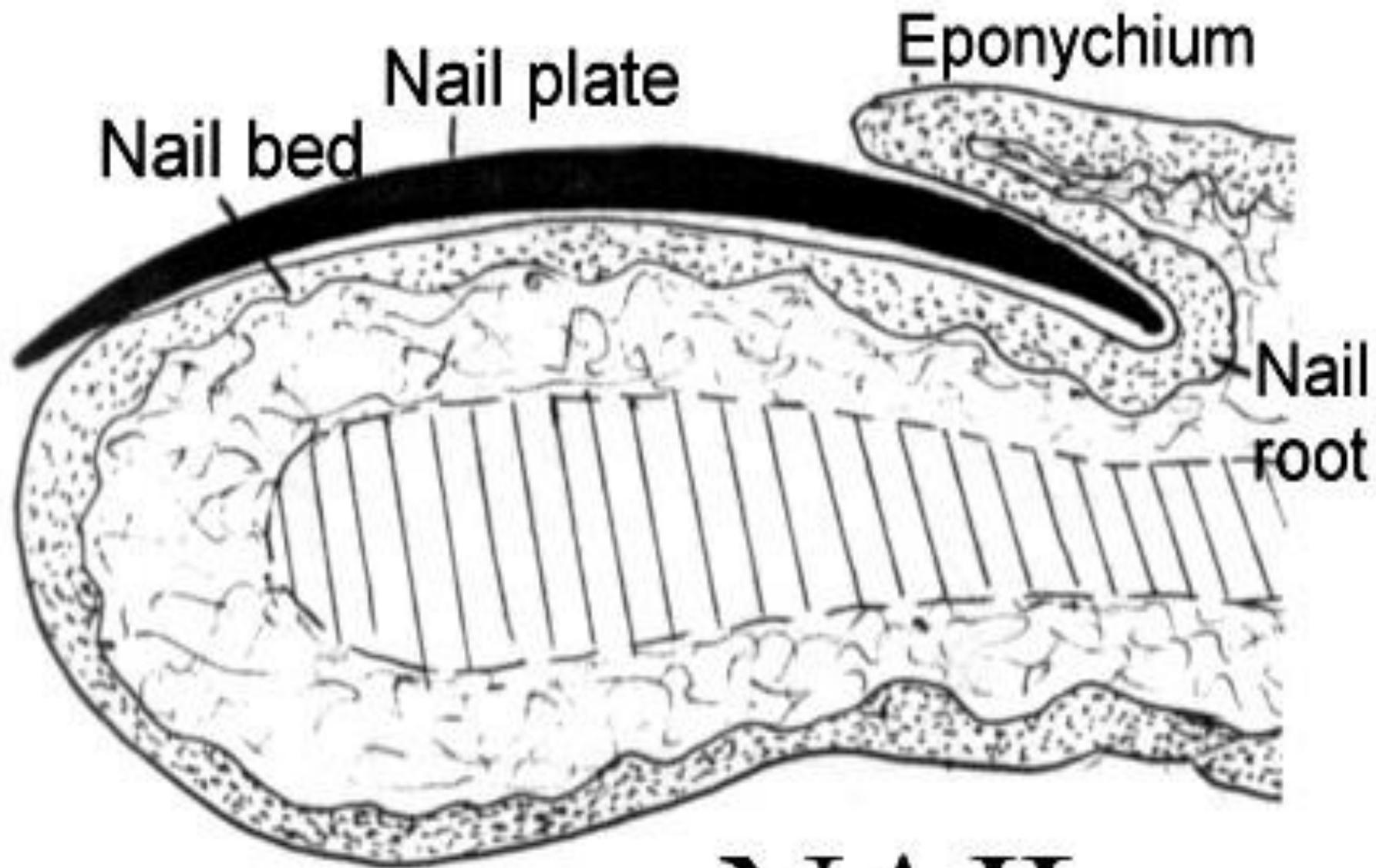
Sebum:

- ✓ secretion + degenerated cell remnants.
- ✓ **oils** hair and lubricates skin.
- ✓ **antibacterial** and **antifungal** effect.
- ✓ Disturbance in flow of sebum is an important cause for **acne**.

Nails



- ▶ **Definition:** Plates of keratinized cells.
- ▶ **Site:** dorsal surface of terminal phalanges of fingers and toes.



NAIL

N.B.:

Nail plate rests on **nail bed** (**stratum basale** and **spinosum**).

Hidden part of nail is **nail root**.
Skin over root is **nail fold**.

N.B.: Nail **grows** by **proliferation** of cells from **nail matrix** that lies behind nail root.

