

Skin

# The Skin

The largest organ in the human body.

Forms ~ 15% of the body weight.

Covers a surface area of 1.5-2.2 m<sup>2</sup>.

Composed of 2 layers, separated by a basal lamina or the epidermal-dermal junction:

- Cellular **EPIDERMIS**
- Fibrous **DERMIS**

A layer of adipose tissue lies underneath the dermis and is called **hypodermis** (superficial fascia, panniculus adiposus).

# Structure of skin

## Epithelial tissue

- stratified squamous (keratinized)

## Basement membrane

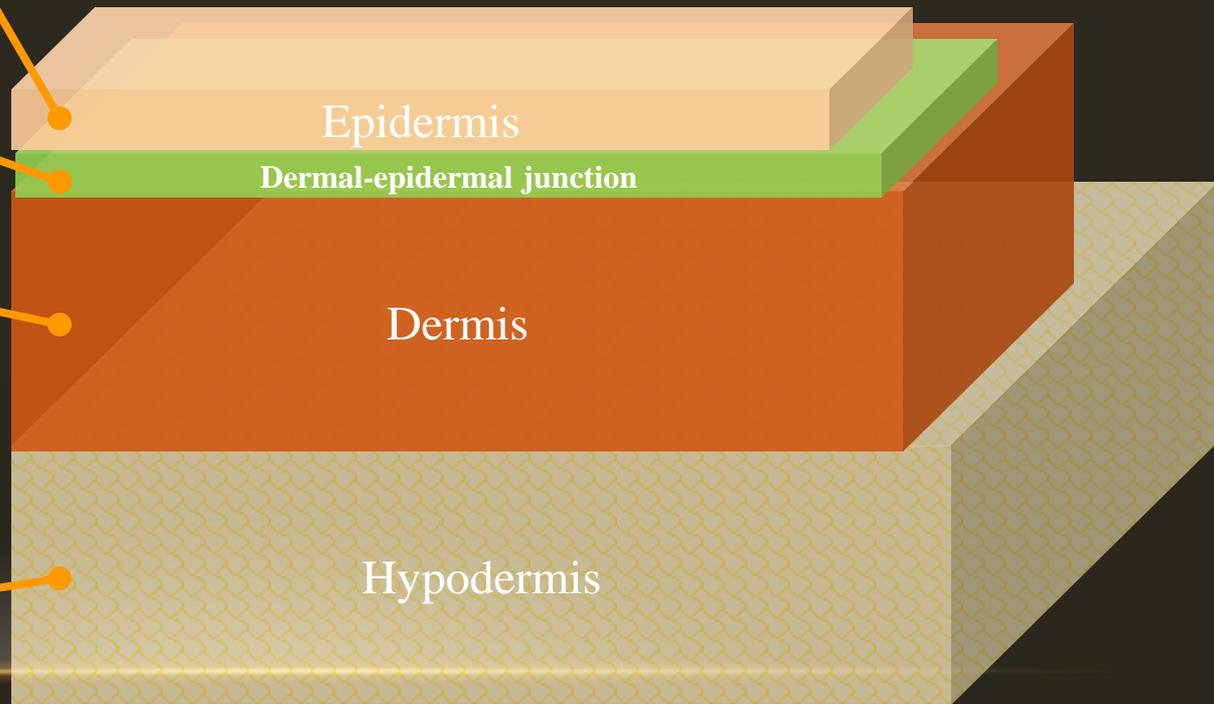
- glue-like layer

## Connective tissue

- dense, fibrous connective tissue
- blood vessel, nerves, etc.

## Areolar & adipose tissue

- superficial fascia
- subcutaneous tissue



Integumentary system =  
skin + appendages

# Functions of the skin

Protection - protects against invasion of microorganisms, protects from water loss and dehydration, and UV rays.

Defense - contains macrophages, lymph nodes and other structures which identify pathogens and provide first line of defense against them .

Sensation - the skin contains sense organs for light touch, pressure, temperature, and pain .

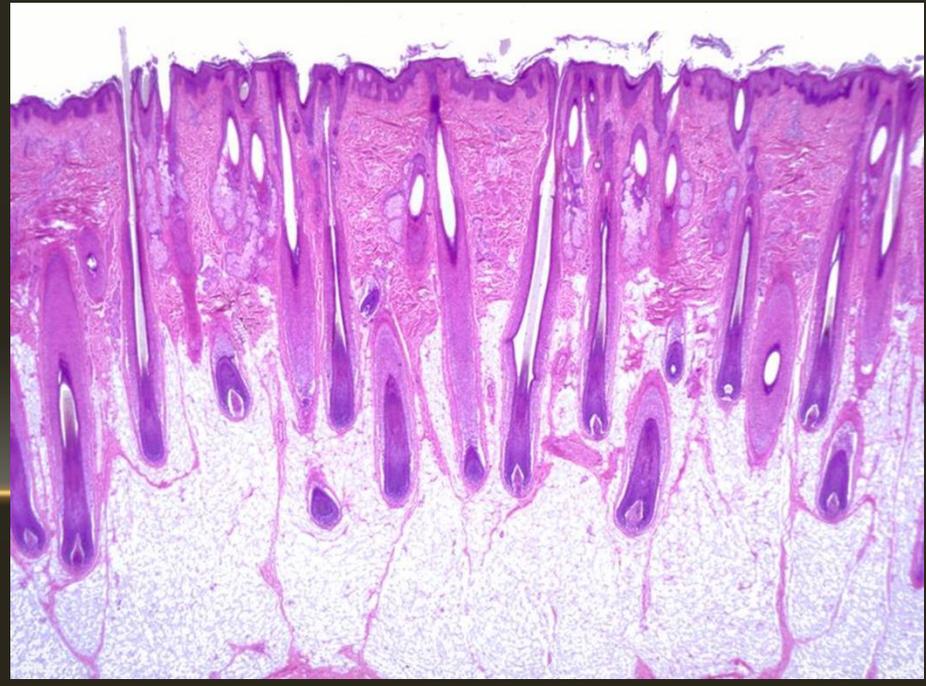
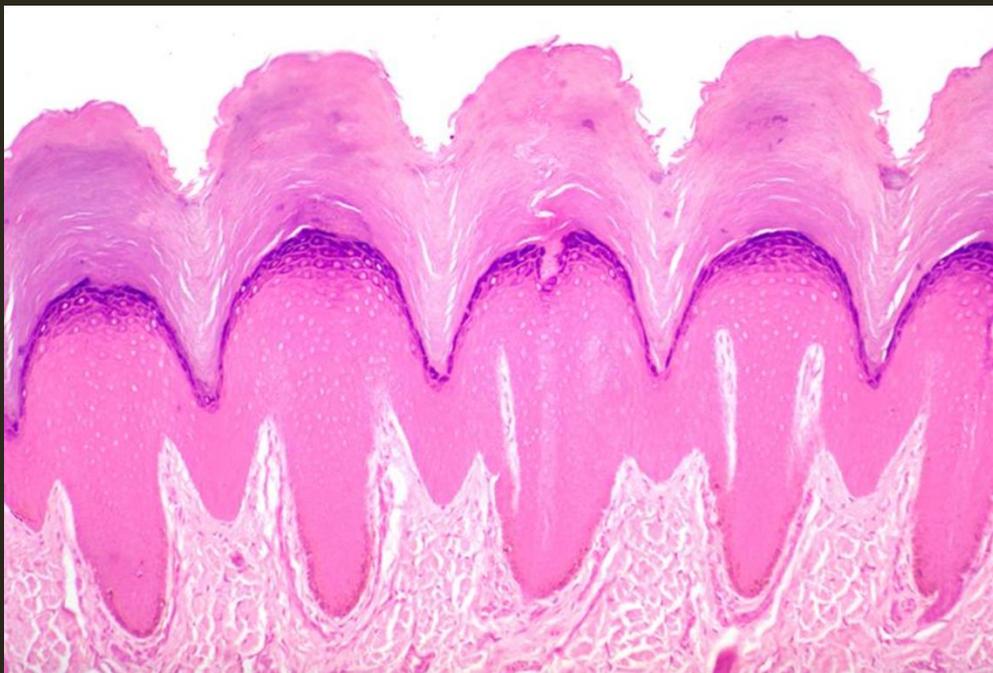
Secretion - the skin secretes the precursor to Vitamin D (this is then activated in the liver and kidney), and melanin .

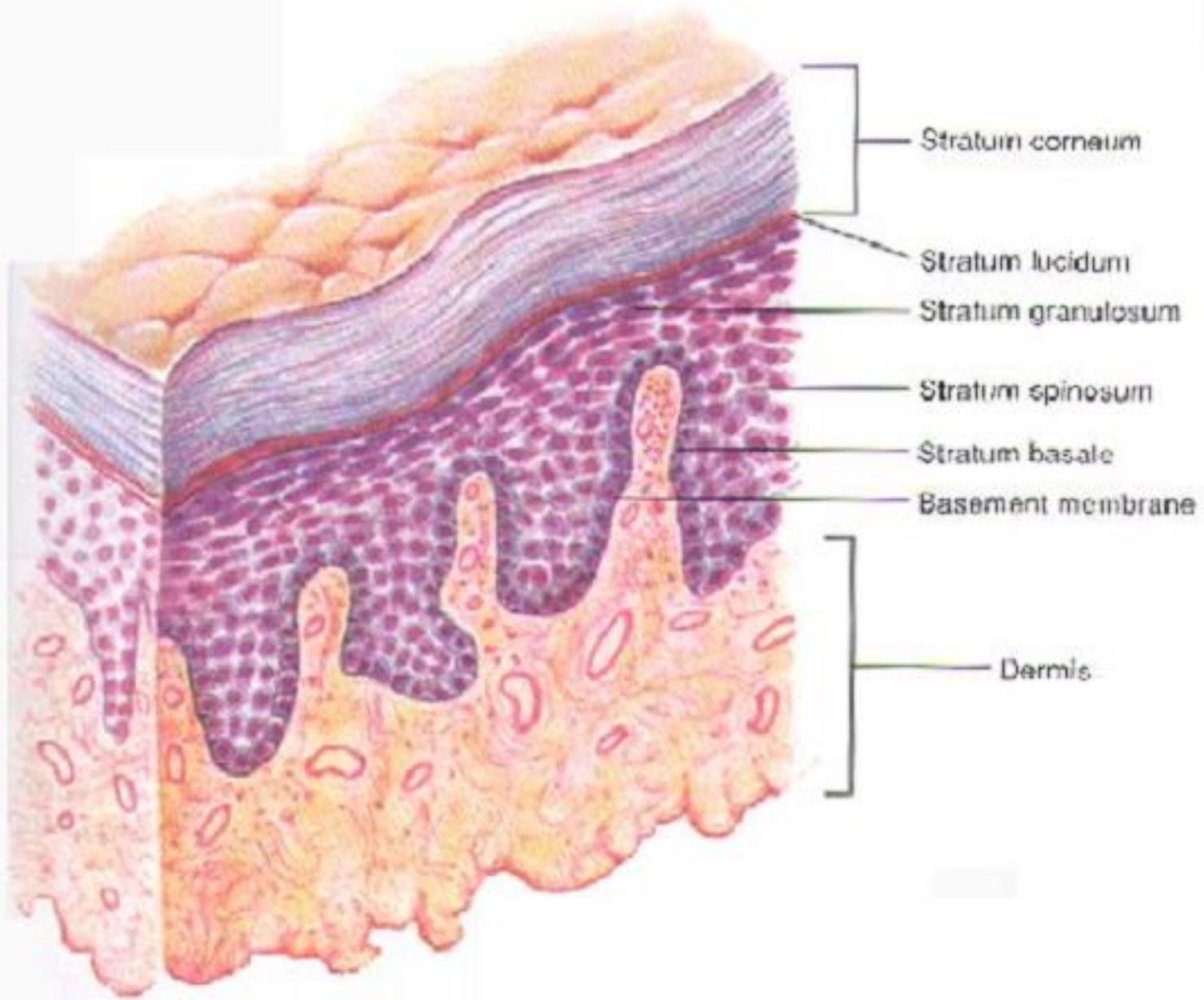
Thermoregulation - by diverting blood into or away from the skin the body can release or conserve heat.

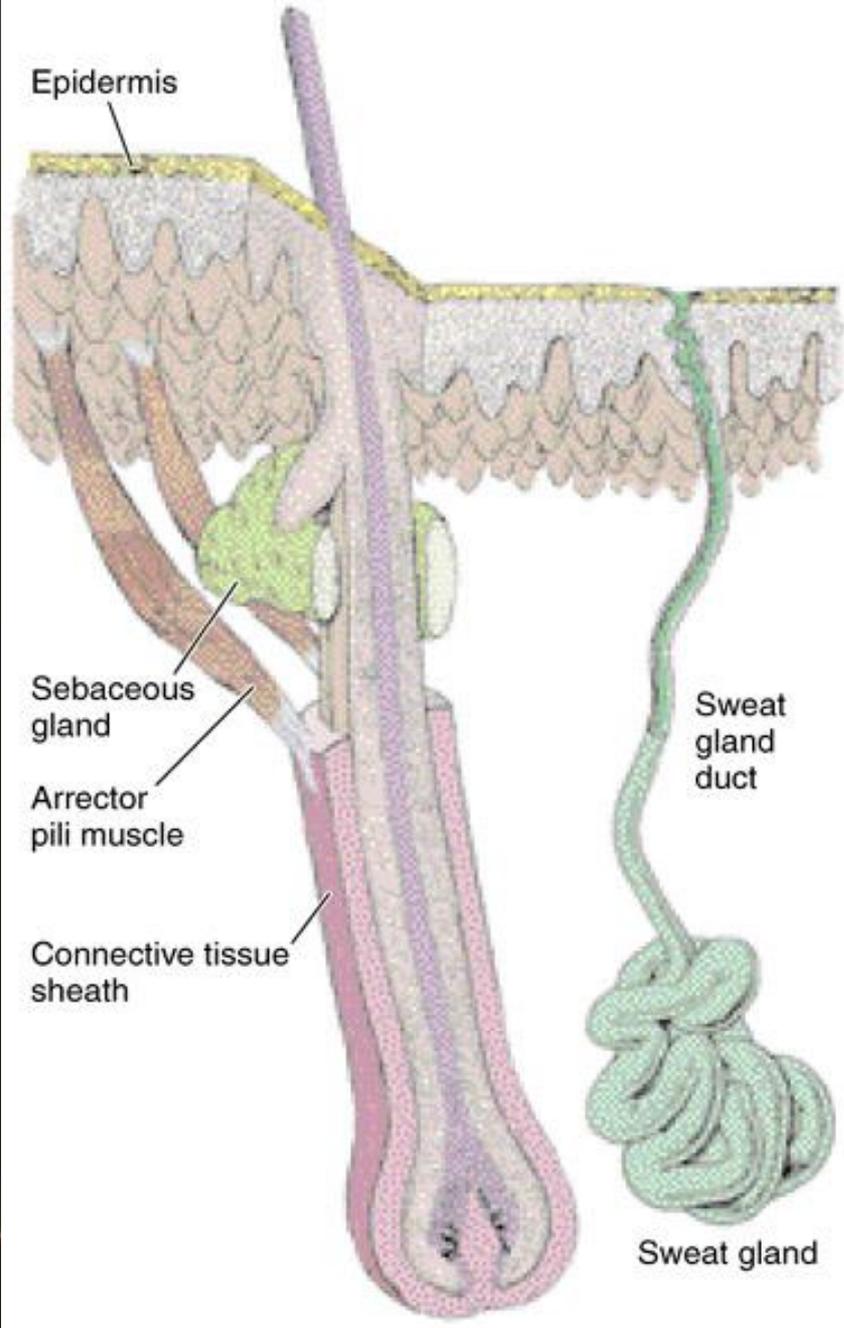
# Types of the Skin

Thick skin: limited to the palms of hands and soles of the feet, non hairy.

Thin skin: the rest of the skin all over the body, hairy.







# Types of Cells in the Epidermis

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graph TD; A[Types of Cells in the Epidermis] --> B[Keratinocytes: > 90% of cells]; A --> C[Non-Keratinocytes ~ 10% of cells]; C --> D[Melanocytes]; C --> E[Langerhans Cells]; C --> F[Merkel Cells];
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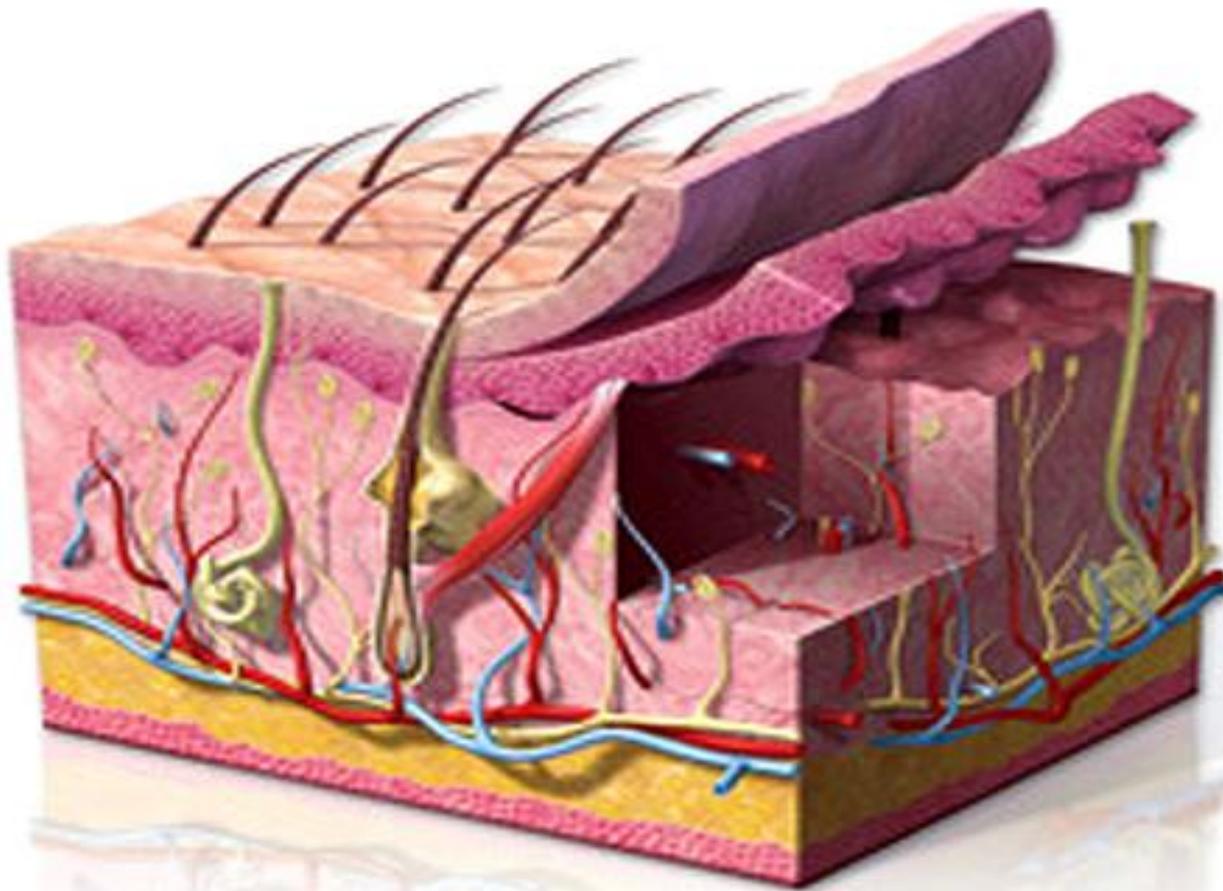
Keratinocytes:  
> 90% of cells

Non-  
Keratinocytes  
~ 10% of cells

Melanocytes

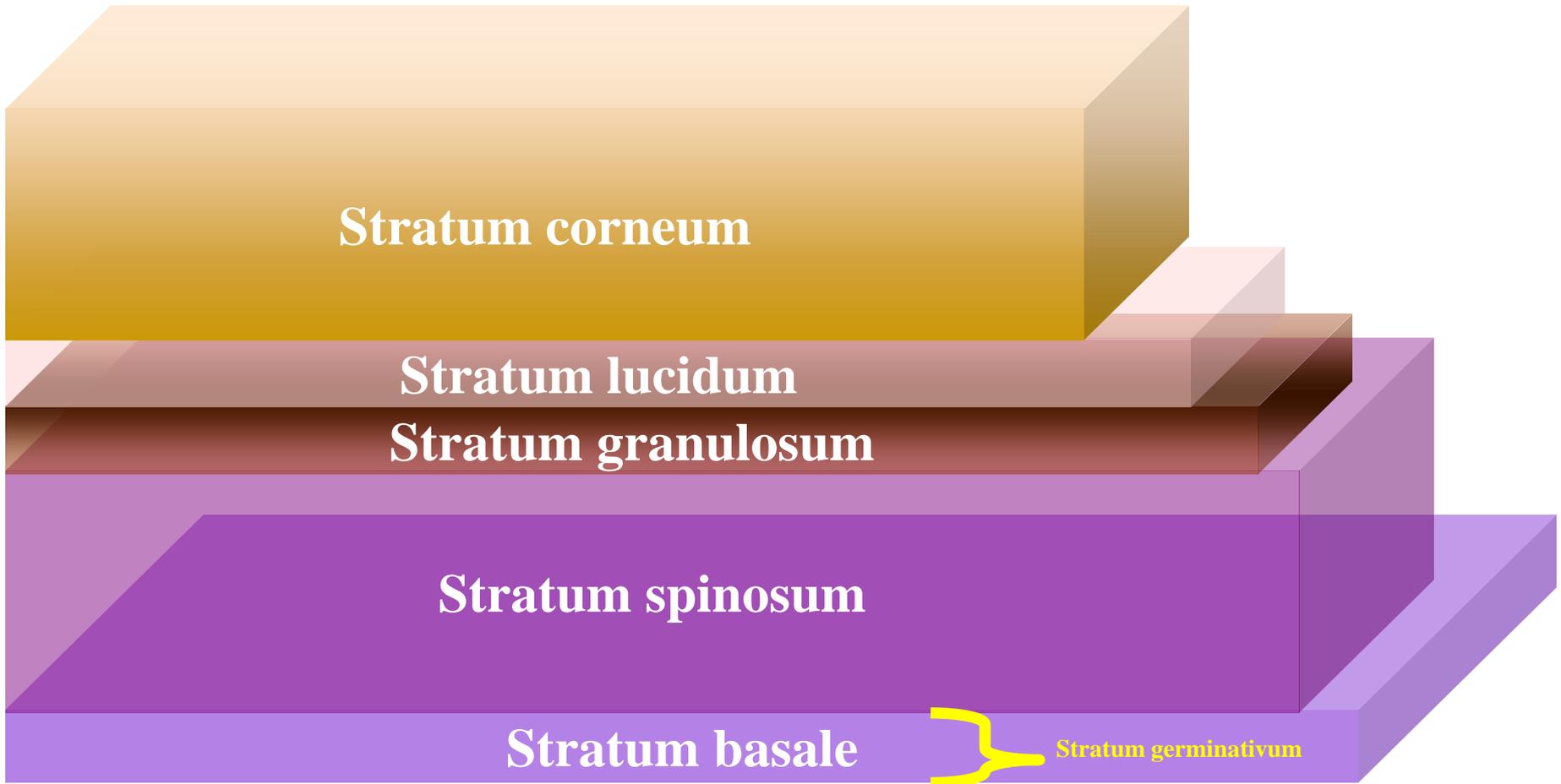
Langerhans  
Cells

Merkel Cells



The epithelium is of variable thickness and forms rete ridges (pegs).

# Layers (strata) of the epidermis



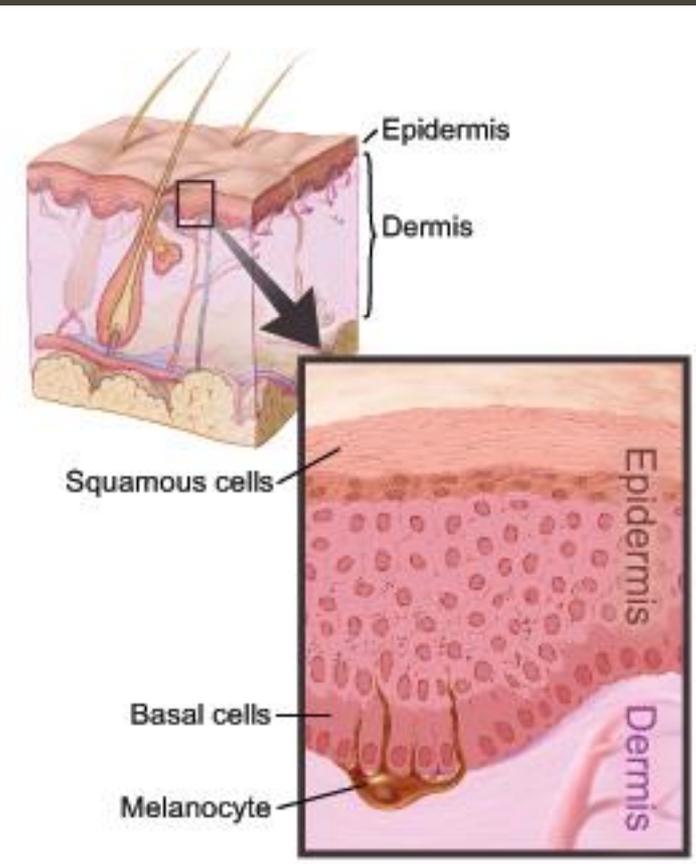
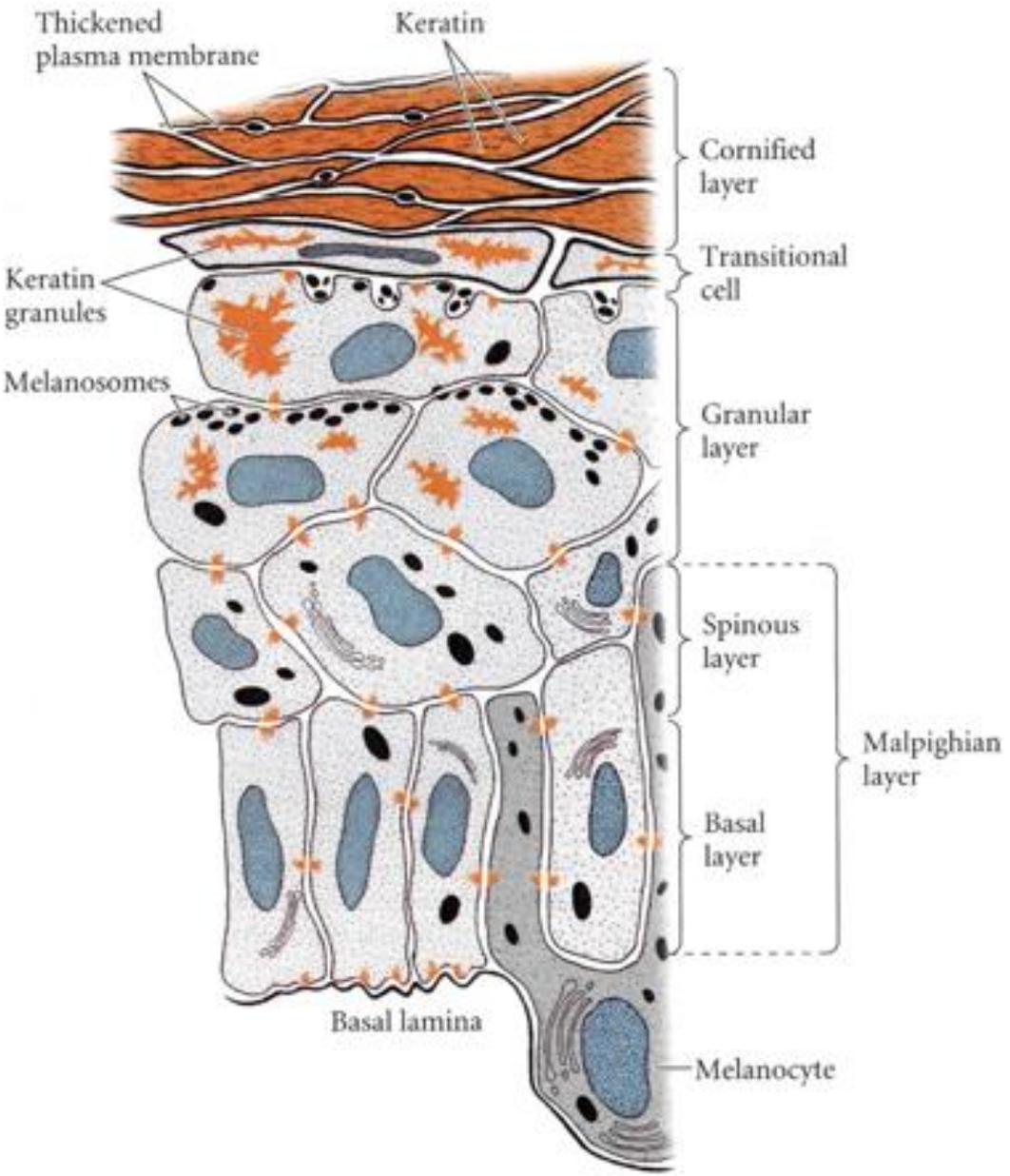
# EPIDERMIS

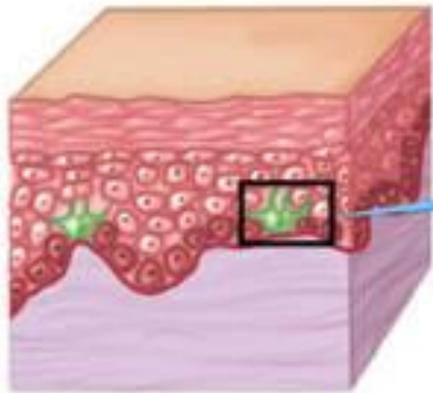
1/13

Keratinocytes form the stratified squamous epithelium of the keratinized type.

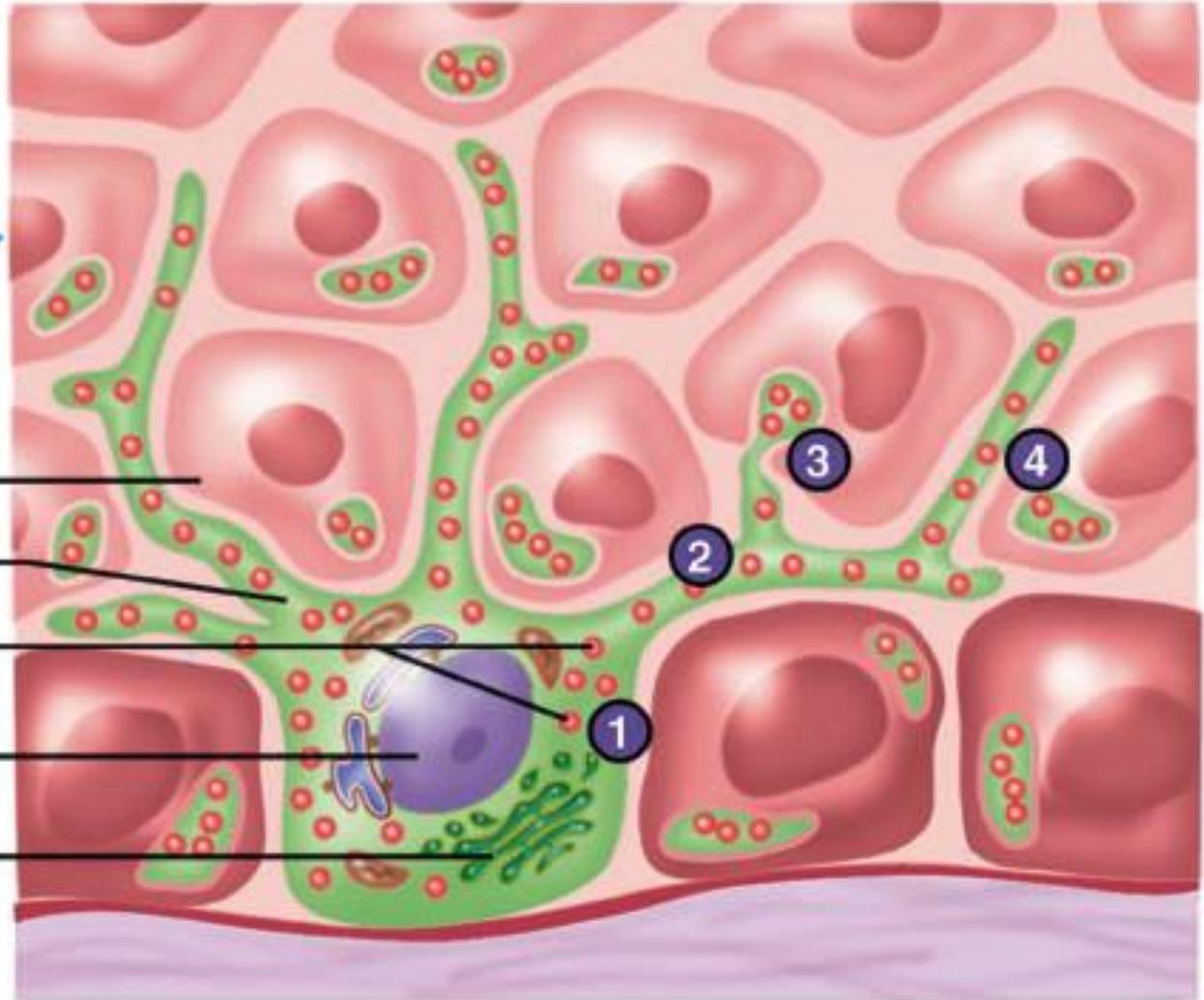
Thickness of the epidermis (and skin) varies from one part to the other.

From the basal lamina outwards the epidermis consists of 4-5 strata: stratum: Basale → Spinosum → Granulosum → (?Lucidum) → Corneum.





**Epithelial cell**  
**Melanocyte**  
**Melanosomes**  
**Nucleus**  
**Golgi apparatus**



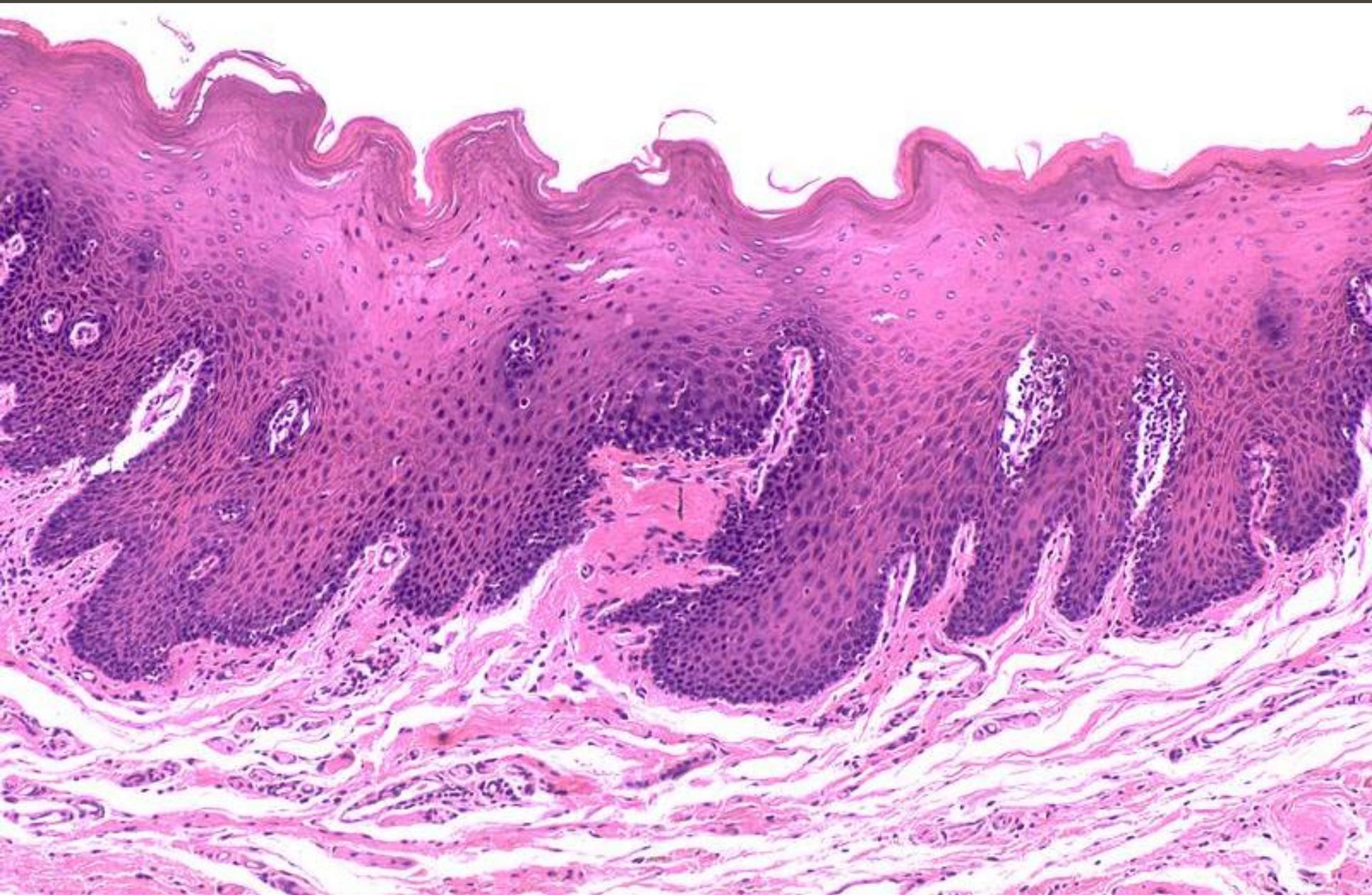
## Keratinocytes

## EPIDERMIS ..2

Change their shape as they ascend in the epidermis  
cuboidal-columnar → polyhedral → squamous.

Contain intermediate size filaments IF (cytokeratin)  
which increases in amount as the cell ascends.

IF collect to form bundles → tonofilaments.



# STRATUM BASALE (GERMINATIVUM)

## EPIDERMIS ..3

Single layer of cuboidal-columnar cells.

Cells appear basophilic.

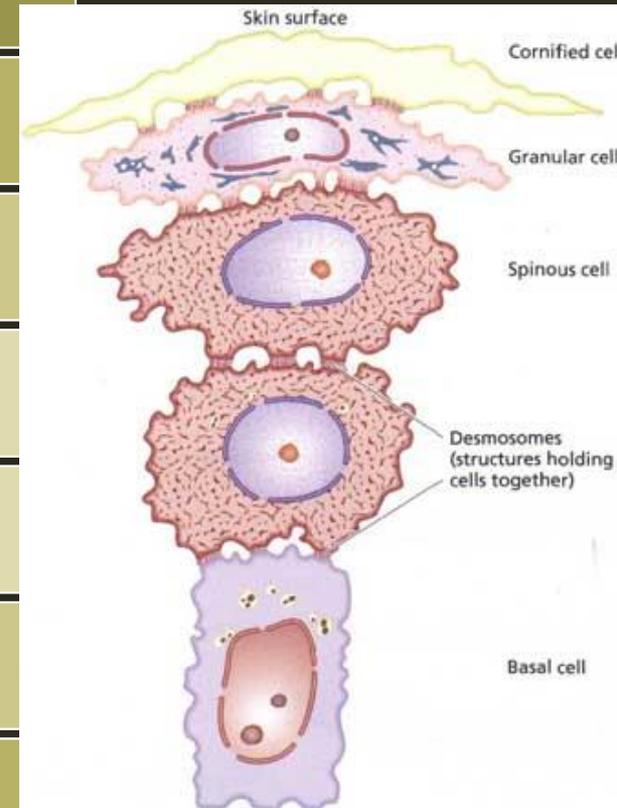
Cells are attached together by desmosomes.

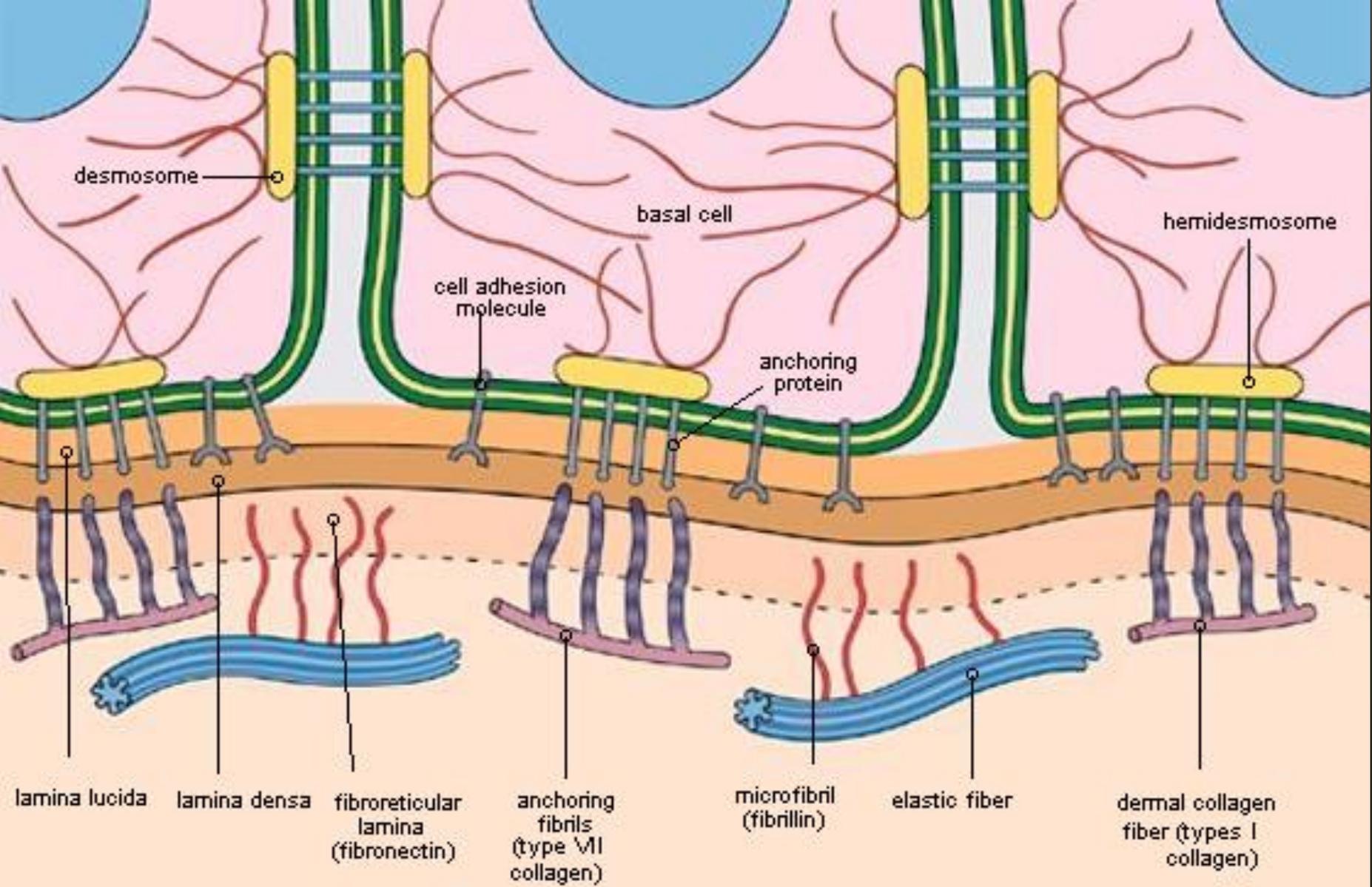
Cells are attached to the basal lamina by hemidesmosomes.

Cells show high mitotic activity.

This layer is close to blood vessels in the dermis.

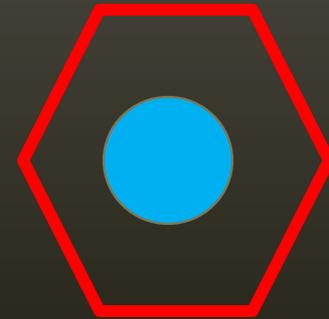
Mitotic activity are restricted to this layer under normal conditions; new cells are pushed upwards





# STRATUM SPINOSUM

EPIDERMIS .4



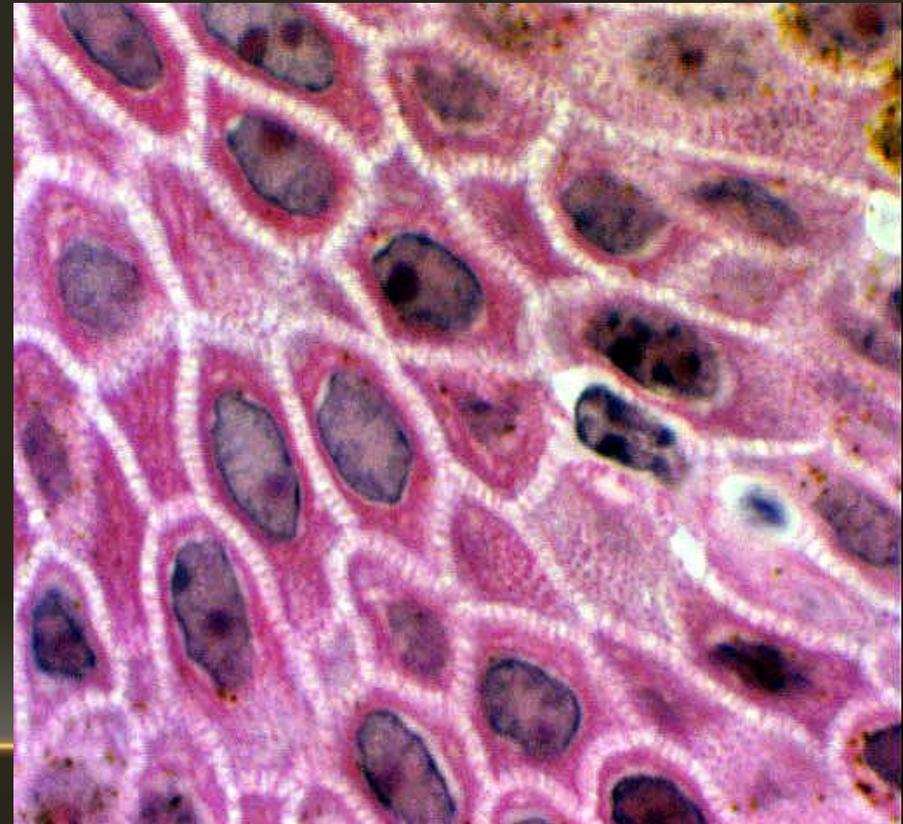
Consists of 3-30 layers.

Cells are polyhedral with central nucleus.

Desmosomes appear projecting from the cells (spines).

Thicker in areas subjected to pressure and friction.

In upper layers cells show lamellated bodies. (secrete NMF)



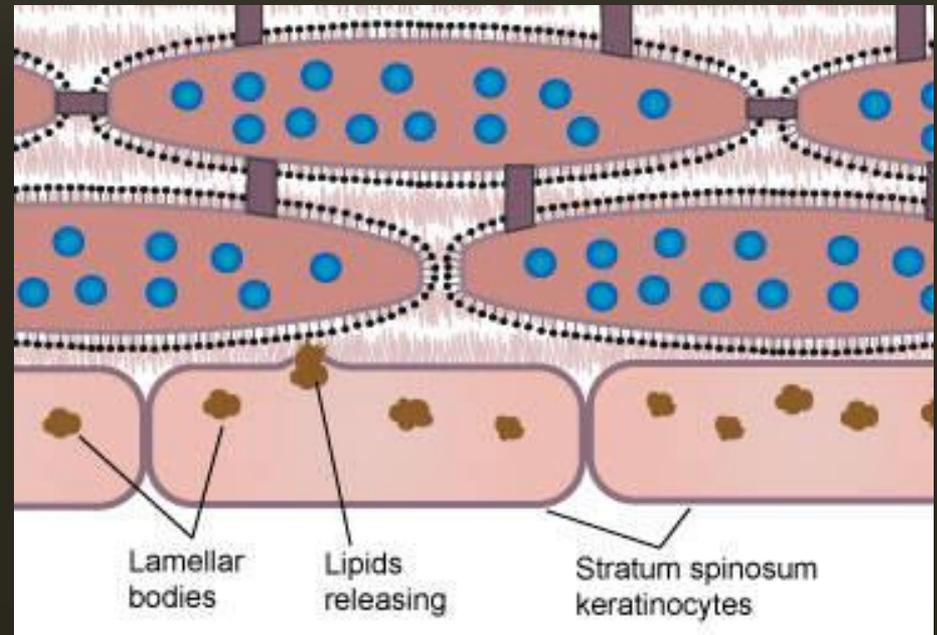
# LAMELLATED BODIES (ODLAND)

Start to appear in the upper layers of the stratum spinosum, and continue to appear in the stratum granulosum.

When the keratinocyte matures to the stratum corneum, enzymes degrade the outer envelope of the lamellar bodies releasing types of lipids called free fatty acids and ceramides.

Free fatty acids and ceramides that are released from the lamellar bodies fuse together in the stratum corneum to form a continuous layer of lipids.

Because there are two types of lipids, this layer is referred to as a lamellar lipid bilayer. This lipid bilayer plays a major role in maintaining the barrier properties of the skin.



# STRATUM GRANULOSUM

EPIDERMIS ..5/13

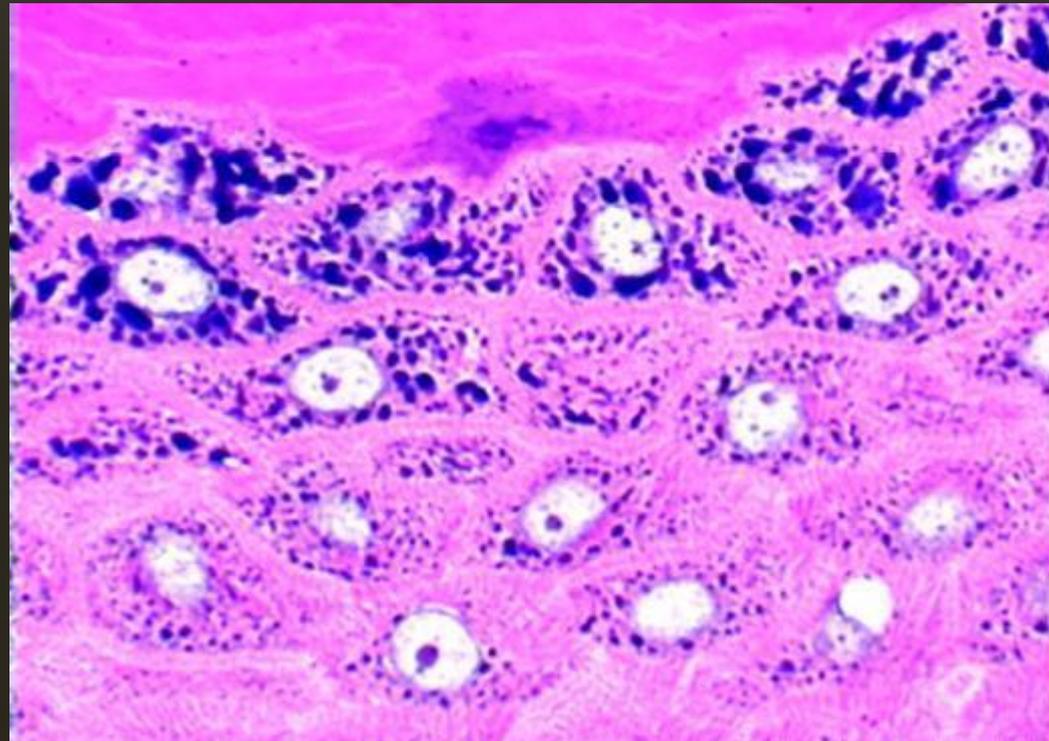
Consists of 1-9 layers.

Cells are flattened and polygonal.

Cells contain darkly stained basophilic non-membrane bound *keratohyalin* granules:

- Contain cystine+histidine.

Cells contain lamellated bodies



# STRATUM LUCIDUM

EPIDERMIS .6

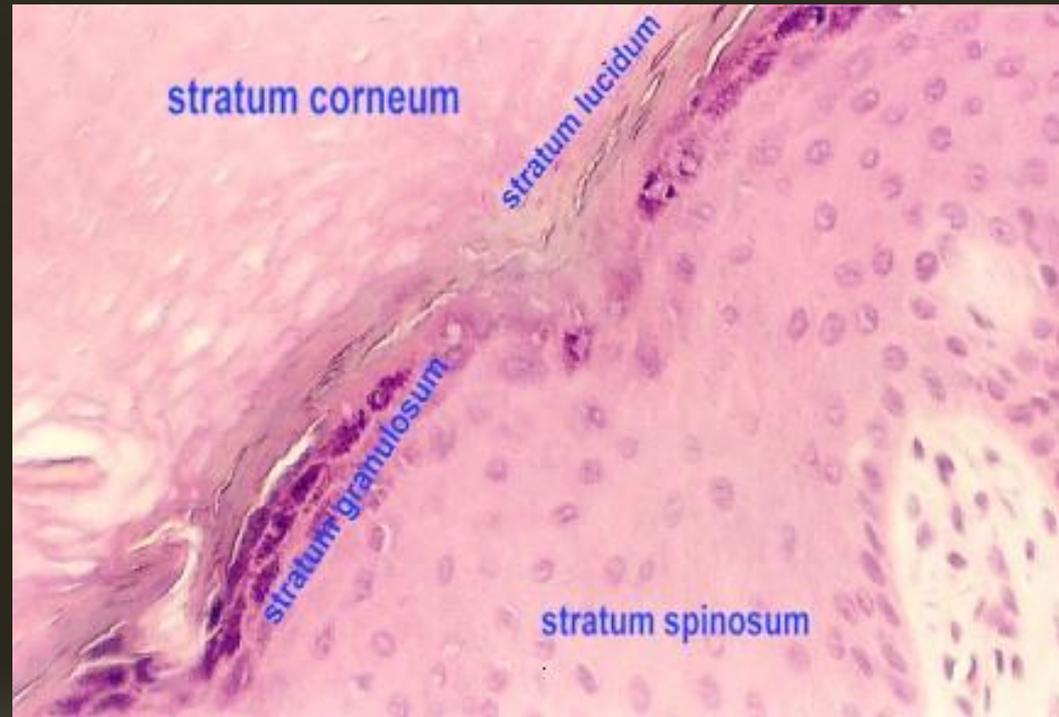
Seen only in thick skin.

Consists of 1-3 layers.

Contains densely packed keratin filaments.

Remnants of organelles may be seen in the cells.

Cells are connected by desmosomes.



# STRATUM CORNEUM

## EPIDERMIS .7

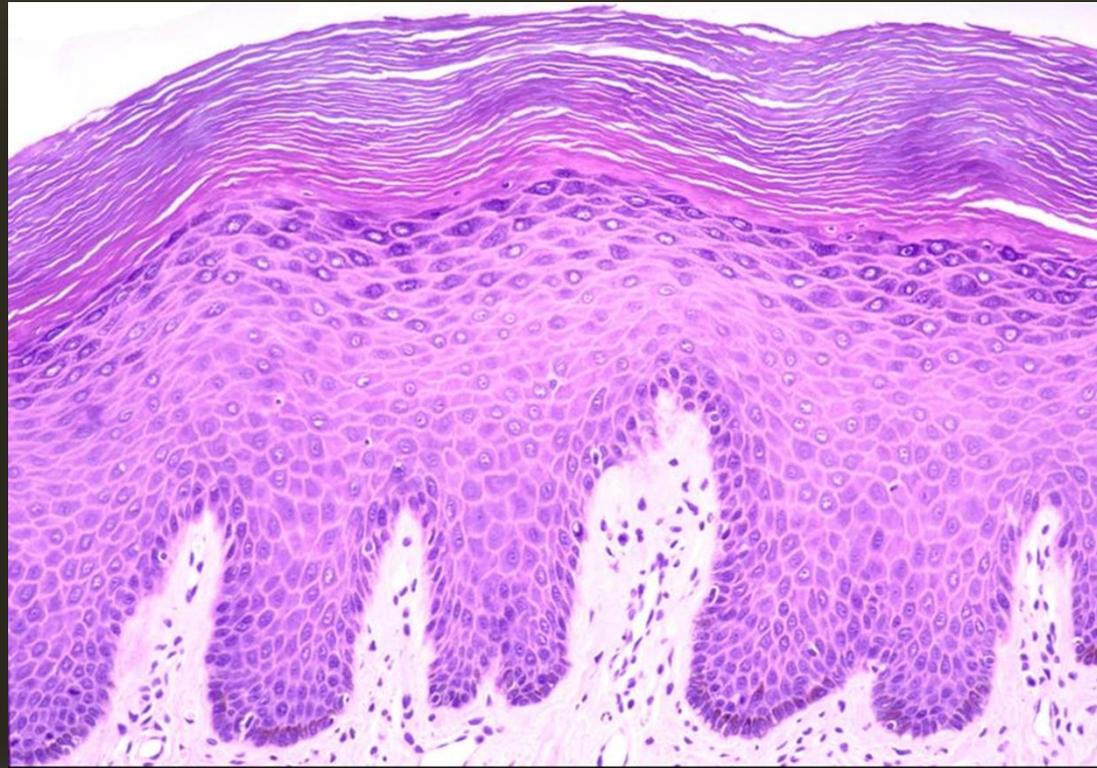
Consists of 5-50 layers.

Cells are flattened and non nucleated, with thick plasmalemma.

Cells are filled with keratin.

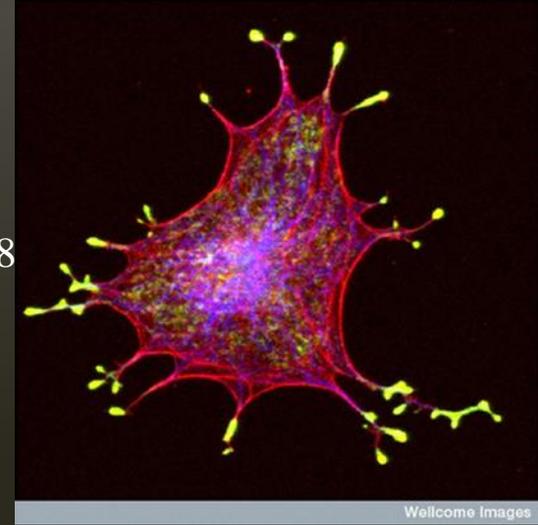
Cytokeratin in this layer is of high molecular weight.

Cells are continuously shed of the surface (~1000 cell/hour/cm<sup>2</sup>).



# MELANOCYTES..1

EPIDERMIS ..8



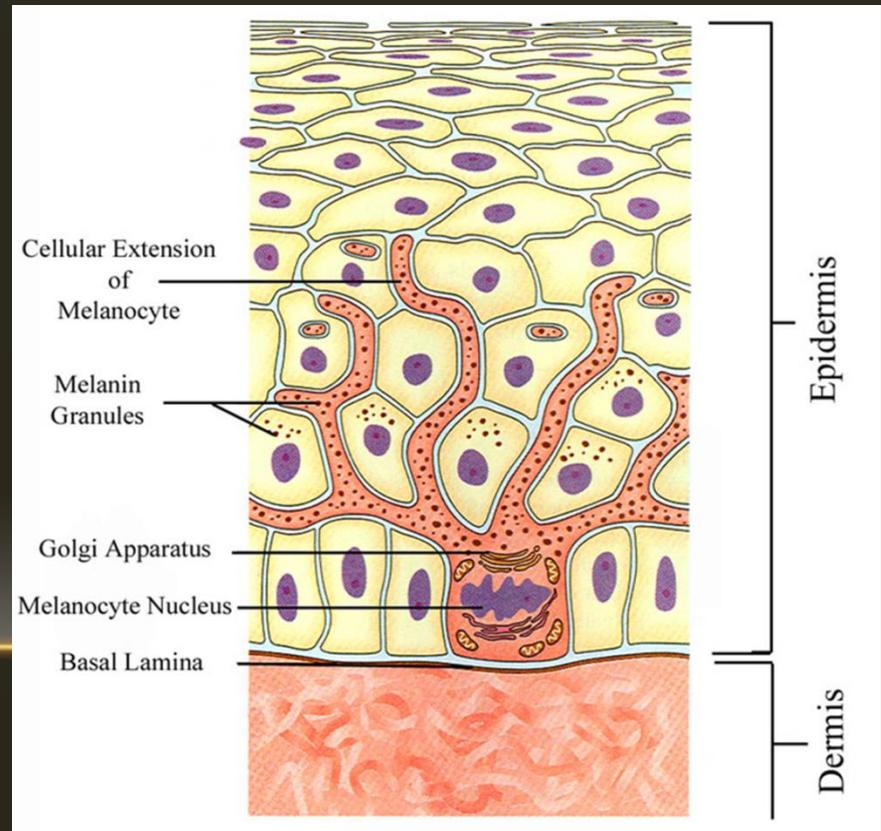
Wellcome Images

Originate from the neural crest .

Reach the epidermis in the 11<sup>th</sup> week of intrauterine life.

They are dendritic cells situated between the cells of stratum basale at a lower level.

Tips of dendrites come in contact with keratinocytes → *Epidermal Melanin Unit*.



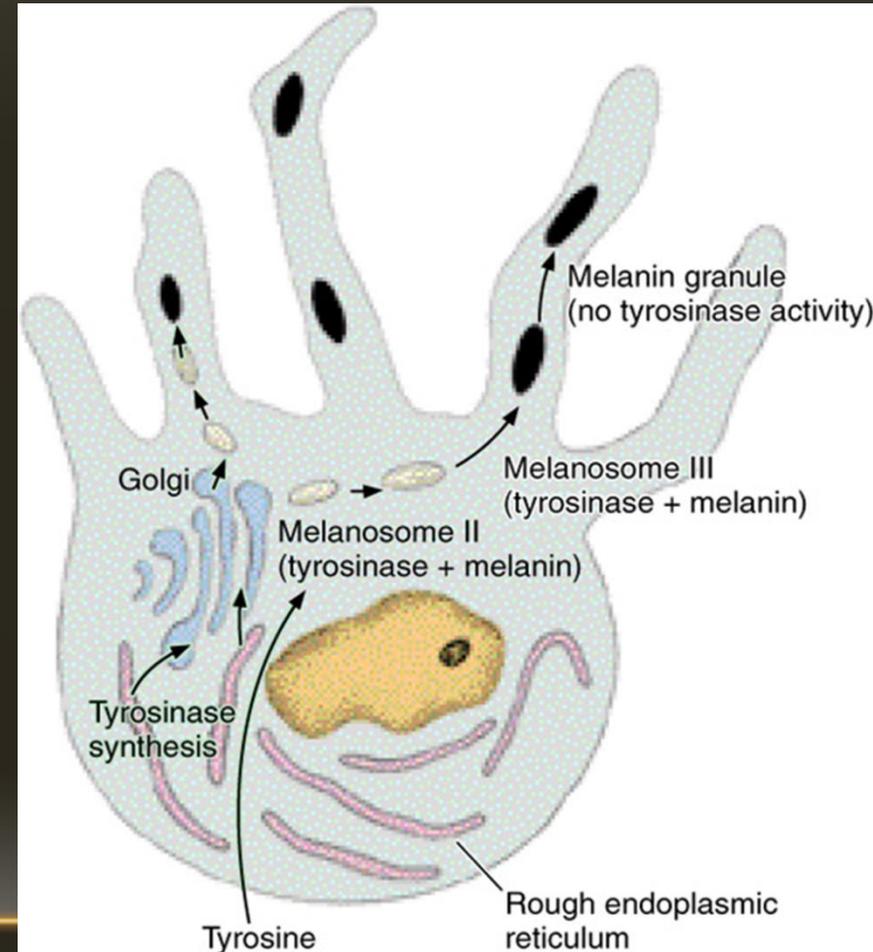
# MELANOCYTES..2

Difficult to stain by H & E.

Not attached to keratinocytes but attached to the basal lamina by hemidesmosomes.

Cytoplasm contains well developed Golgi, rER, numerous small mitochondria.

## EPIDERMIS .9



# MELANOCYTES..3

EPIDERMIS ..10

Types of melanin:

- Eumelanin: dark brown.
- Pheomelanin: dusky black.

Tyrosinase is essential for melanin synthesis.

Tyrosine →dopa →dopaquinone →melanin.

Melanin is injected into keratinocytes above the nucleus.

The number of melanocytes / unit area is the same in all races.

Clinical notes: albinism, vitiligo.

Budding melanin granules

Melanin granules

Developing melanin granule



Stage 4

Stage 3

Stage 2

Stage 1

# Factors Determining Skin Color

Melanocyte activity.

Carotene content of keratinocytes and the hypodermis.

Vascularity of the dermis.

State of hemoglobin in the vessels.

# LANGERHANS CELLS

EPIDERMIS .12

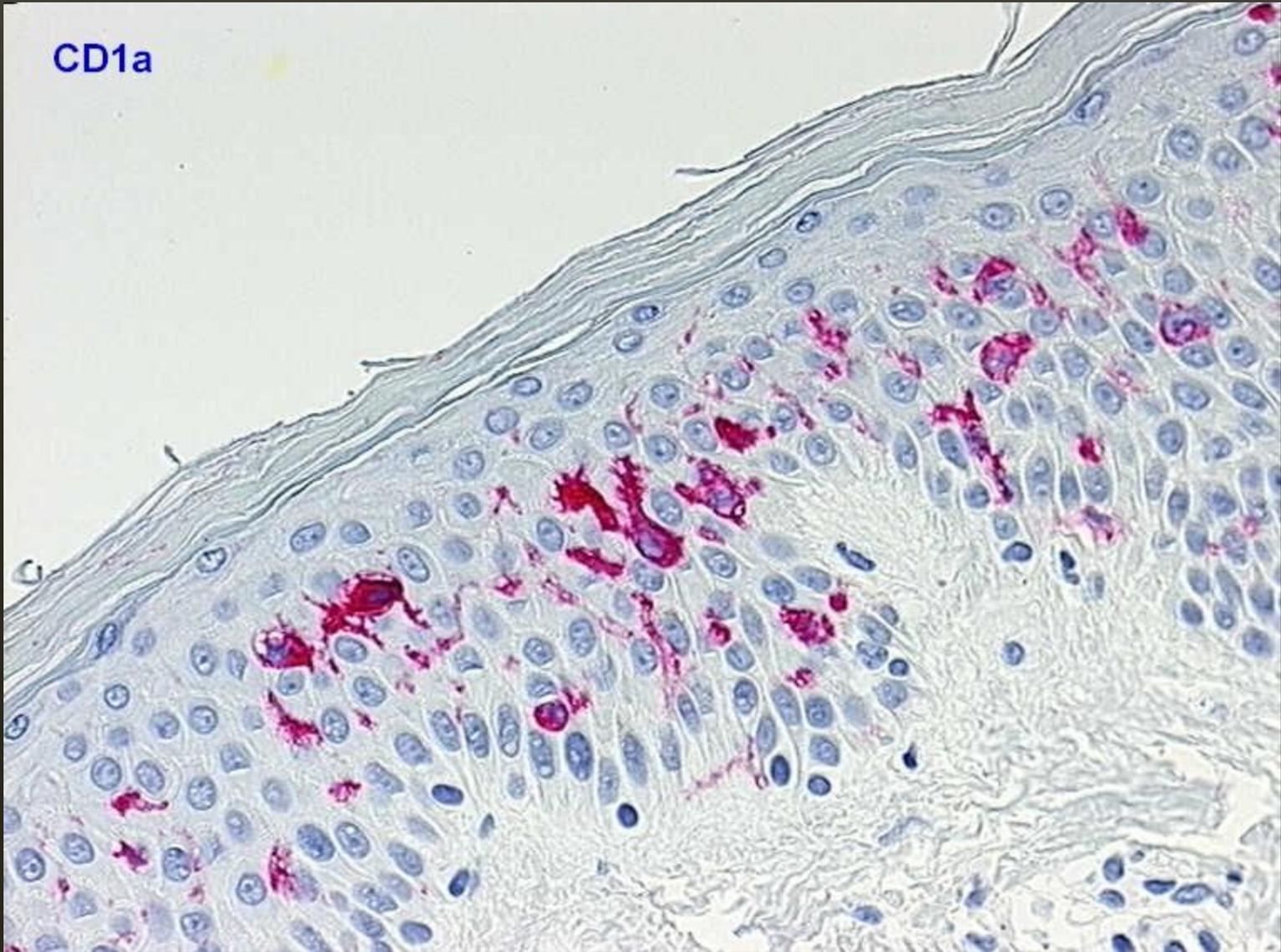
Dendritic cells derived from the bone marrow, not stained by H&E.

Seen among the cells of stratum spinosum.

They are antigen presenting cells.

Contain racket shaped Birbeck granules (?).

CD1a



## Merkel's Cells

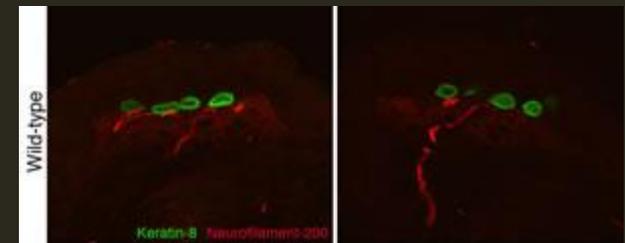
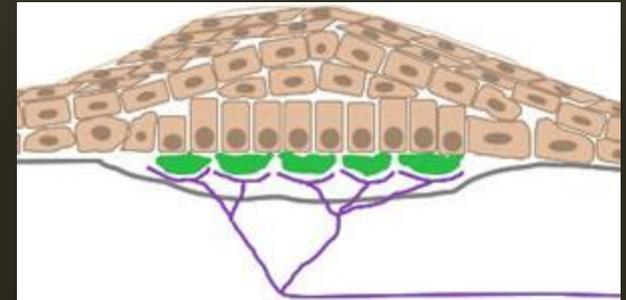
EPIDERMIS ..13/13

Unknown origin, resemble keratinocytes.

Found mainly in thick skin.

Free nerve endings with dilated ends are closely related to these cells.

They are mechanoreceptors and part of the DNES.



# The Epidermal-Dermal Junction

The basal lamina is undulating.

Contains specific antigens  
(pemphegoid).

Becomes straight in old age and  
following long exposure to sun light.

# DERMIS..1

Divided into two parts:

- Superficial (papillary).
- Deep (reticular).

Variable thickness.

Projections from the dermis (*dermal papilla*) reinforce the dermal-epidermal junction.

## Papillary Dermis

DERMIS..2

loose connective tissue.

Contains cells: fibroblasts, mast cells, macrophages and WBCs.

Collagen fibrils anchor this layer to the basal lamina.

Dermal papilla are more in skin subjected to friction.

## Reticular Dermis

DERMIS..3

Thicker, contains dense irregular connective tissue.

Collagen is mainly type I.

Cells are fewer than in the papillary dermis.

Contains elastic fibers.

# Blood Vessels of the Dermis

## DERMIS..4

Two arterial plexuses are present in the dermis:

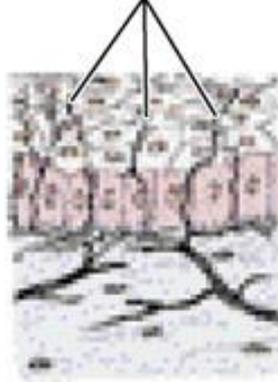
- Superficial: at the interface between the papillary and reticular dermis.
- Deep: at the interface between the reticular dermis and hypodermis.

Three venous plexuses are present:

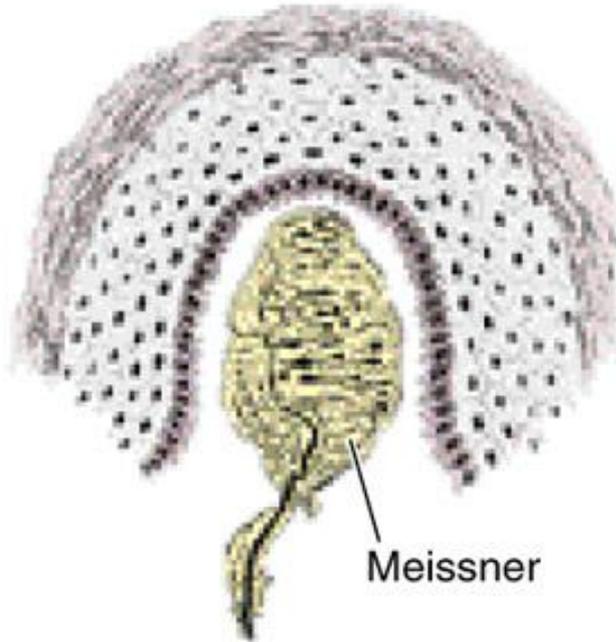
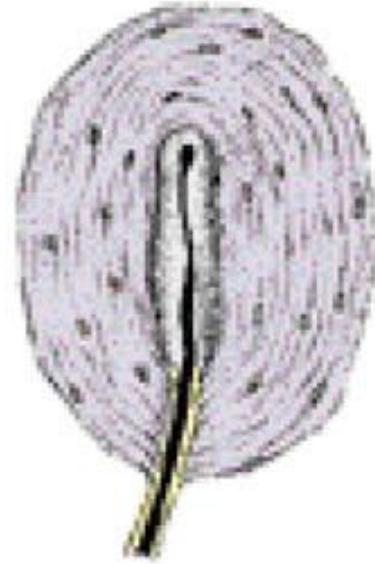
- Superficial:
- Deep:
- Intermediate: lies in the middle of the dermis.

Arteriovenous anastomoses are common

Free endings



Pacinian



Krause



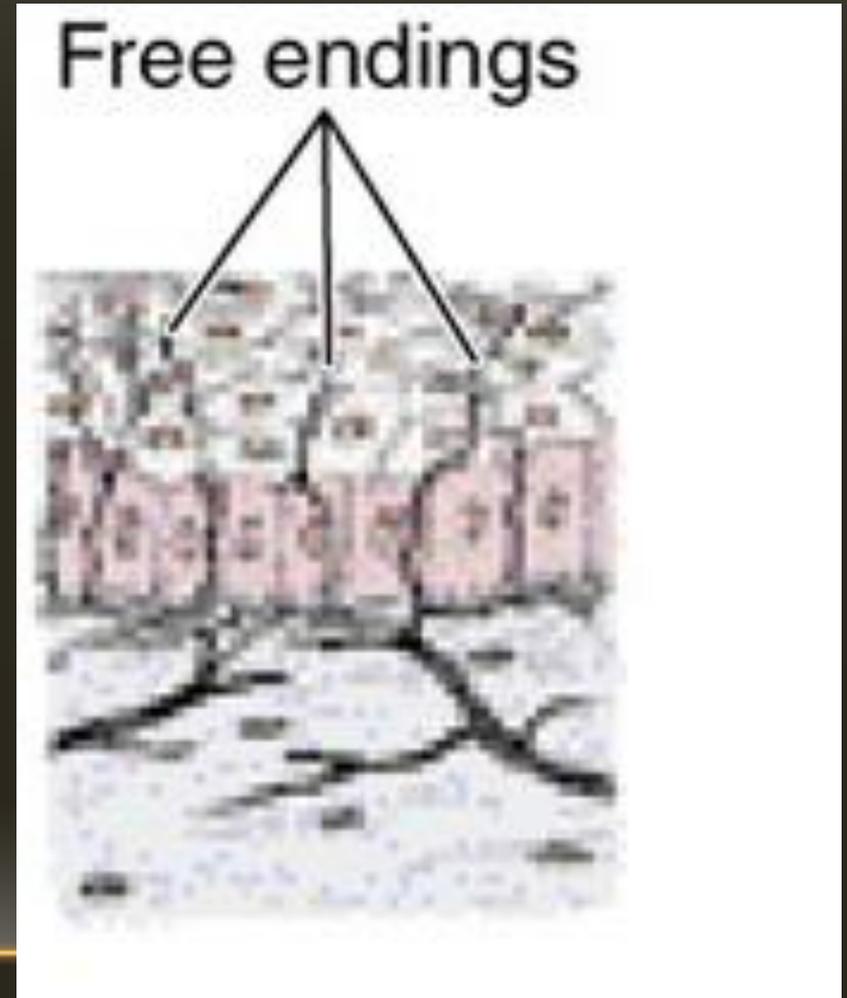
# FREE NERVE ENDINGS

The most common type of nerve ending, and are most frequently found in the skin.

Penetrate the epidermis and end in the stratum granulosum.

Infiltrate the middle layers of skin and surround hair follicles.

Detect temperature, mechanical stimuli (touch, pressure, stretch) or pain.



# PACINIAN - VATER CORPUSCLE

oval shaped and ~ 1 mm in length. The entire corpuscle is wrapped by a layer of connective tissue.

ending located in the subcutaneous tissue of the skin; occurs abundantly in the skin of palms and soles and joints and genitals.

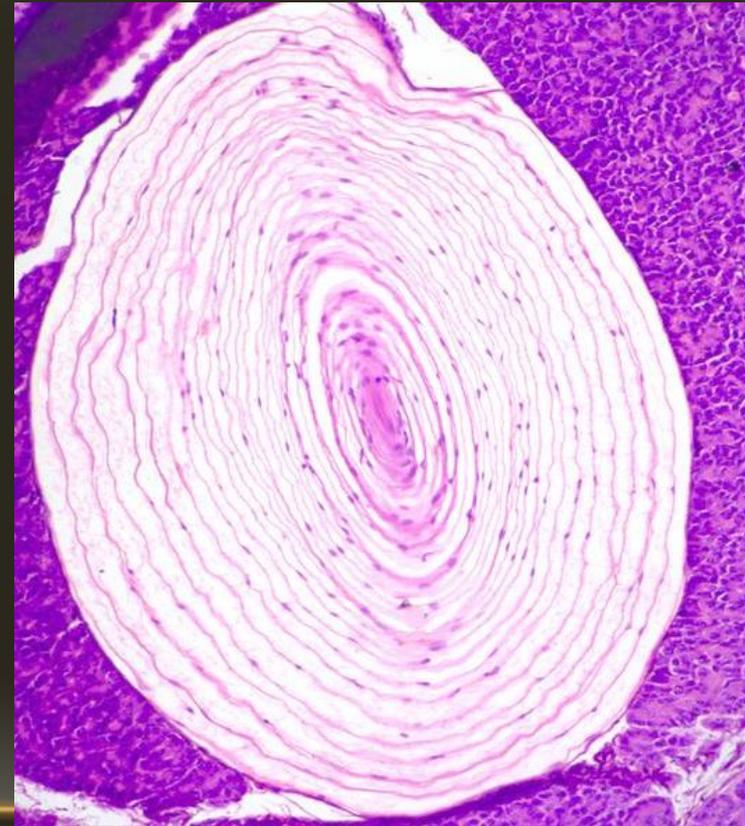
It has 20 to 60 concentric lamellae composed of fibrous connective tissue and fibroblasts, separated by gelatinous material.

The lamellae are very thin, flat, modified Schwann cells.

In the center of the corpuscle is the inner bulb, a fluid-filled cavity with a single afferent unmyelinated nerve ending.

It is rapidly adapting receptor.

Receives deep pressure and vibrations.



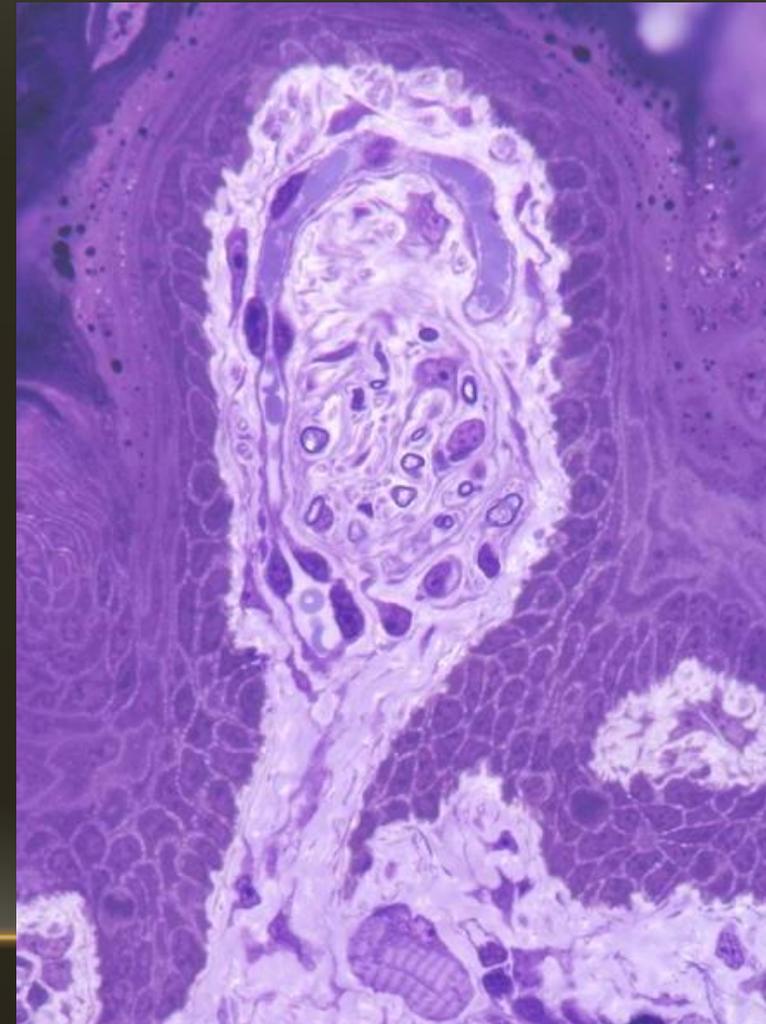
# MEISSNER'S CORPUSCLES

Encapsulated unmyelinated nerve endings, which consist of flattened supportive cells arranged as horizontal lamellae surrounded by a connective tissue capsule.

The corpuscle is between 30-140  $\mu\text{m}$  in length and 40-60  $\mu\text{m}$  in diameter.

They have highest sensitivity (lowest threshold) when sensing vibrations lower than 48 Hertz.

They are rapidly adaptive receptors.



# EPIDERMAL DERIVATIVES (EPIDERMAL ADNEXA, SKIN APPENDAGES)

SWEAT GLANDS

SEBACEOUS GLANDS

HAIR

NAILS

# Sweat Glands

They are of two types:

- Merocrine (eccrine):
- Apocrine

# Eccrine Sweat Glands ..1

Simple tubular coiled glands.

Widely distributed all over the body except in the glans penis, margin of the lip and nail bed.

Innervated by cholinergic fibers.

The duct opens directly on the skin surface; its intra epidermal part is called acrosyrengium.the secretory part shows 3 types of cells:

- Dark
- Clear
- Myoepithelial cells

# Eccrine Sweat Glands ..2

## Dark cells:

- Pyramidal .
- Lie close to the lumen, do not reach the basal lamina.
- Abundant apical glycoprotein granule.

## Clear cells:

- Rest on the basal lamina.
- Devoid of granules.
- Basal part of plasmalemma has many folds.

# Eccrine Sweat Glands ..3

## Myoepithelial cell:

- Surround the secretory part and the duct system.
- ?? Contraction may evacuate the secretory part.

## Duct of eccrine sweat gland:

- Appear darker in color than the secretory part.
- The intradermal part is stratified cuboidal.
- Cells close to the lumen have many microvilli.

# Eccrine Sweat Glands ..4

## Sweat secreted from eccrine glands:

- Not viscous (little protein).
- Contains: 85 mEq Na<sup>+</sup>/L, urea, ammonia, uric acid.
- Ducts absorb some of the Na<sup>+</sup> secreted by the secretory cells.

# Apocrine Sweat Glands

Found in the axilla, areola, umbilical and anal regions.

Secretory part is larger than that of eccrine glands and may be embedded in the hypodermis.

Their ducts open into hair follicles.

Their secretion is viscous and odorless.

Innervated by adrenergic fibers.

Modified apocrine glands: female breast, Moll's glands, ceruminous glands.

# Sebaceous Glands

Simple acinar, holocrine glands.

Their ducts open into the upper part of the hair follicle.

The ducts in certain regions may open directly onto the surface.

The acini show two types of cells:

- Basal undifferentiated.
- Rounded cells filled with sebum.

Clinical Note: Acne Vulgaris.

# Hair ...1

Derived from invaginations of the epidermis.

Color, thickness and distribution are genetically determined.

Hair growth is periodical, in patches.

Phases of her growth take variable times (anagen, catagen, telogen).

Hair growth is influenced by sex hormones, thyroid and adrenal hormones.

# Hair ...2

The hair is surrounded and originated from a hair follicle.

The terminal dilated part of the hair follicle is called hair bulb.

The base of the hair bulb is evaginated by dermal papilla.

Dermal papilla contains nerves and blood vessels.

# Hair ...3

Cells directly overlying dermal papilla form the hair root.

Hair root is continuous with the stratum basale.

Cells in the hair root divide and differentiate to form the hair.

# HAIR ...4

Central cells in the root → MEDULLA.

Peripheral root cells → CORTEX.

- Cuboidal cells → Change into columnar → squamous heavily keratinized cells → CUTICLE.

Outermost root cells → INTERNAL ROOT SHEATH.

- Disappears at the level of sebaceous gland.

# Hair ...5

The external root sheath is continuous the epidermis.

The external root sheath becomes thinner near the bulb. Corresponds to the st. basale.

The follicle is surrounded by glassy membrane. It is a thickened basal lamina.

Arrector pili muscle: is a oblique smooth muscle running from under the epidermis to below sebaceous gland.

Arrector pili contraction ☞ gooseflesh skin

# CLINICAL APPLICATIONS

Repair of the skin.

Albinism.

Vitiligo.

Basal cell carcinoma.

Squamous cell carcinoma.

Psoriasis.

Melanoma.

Acne vulgaris.

# Basal Cell Carcinoma



# Squamous Cell Carcinoma



# Vitiligo



# Psoriasis

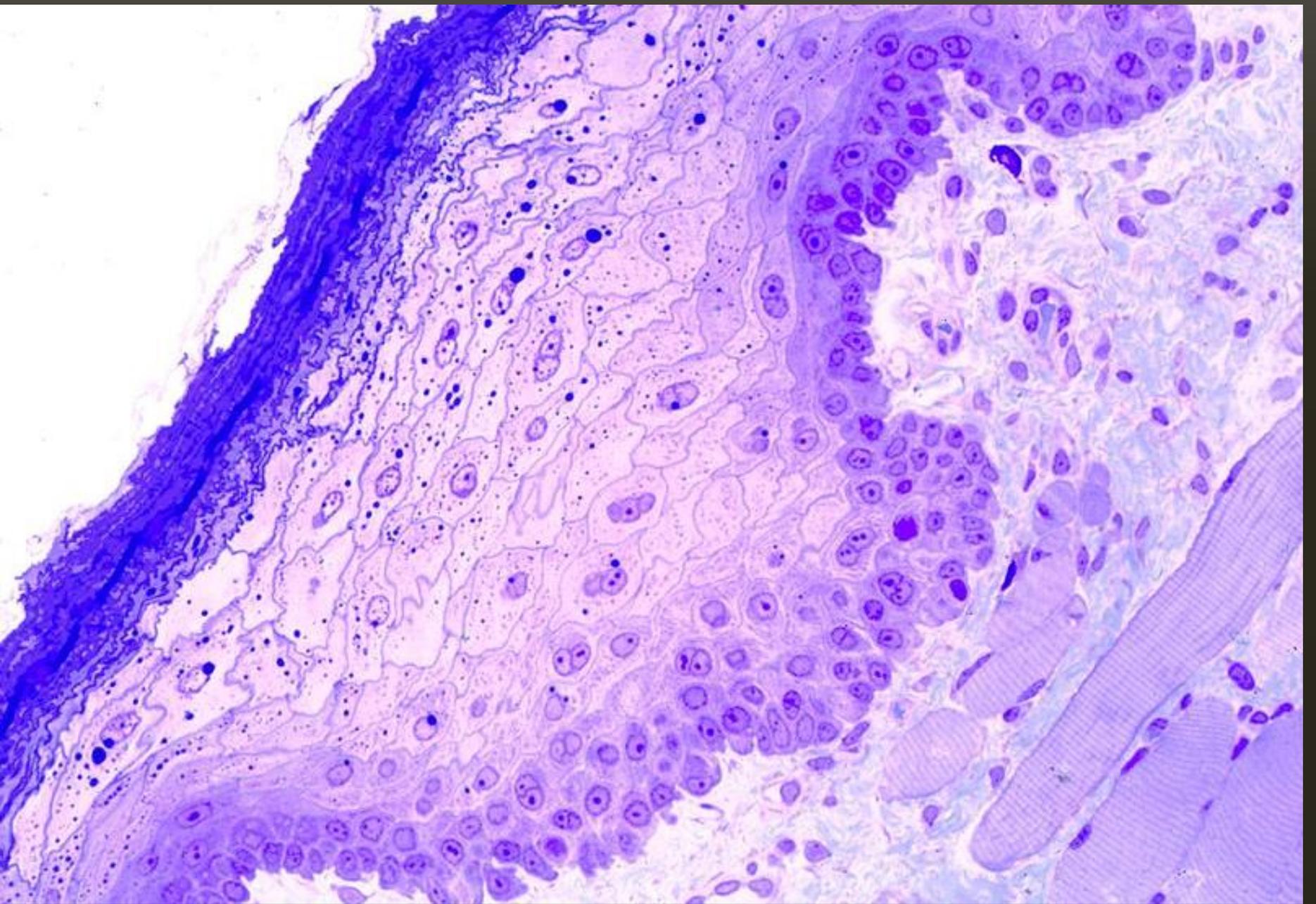


# Melanoma



# Acne vulgaris

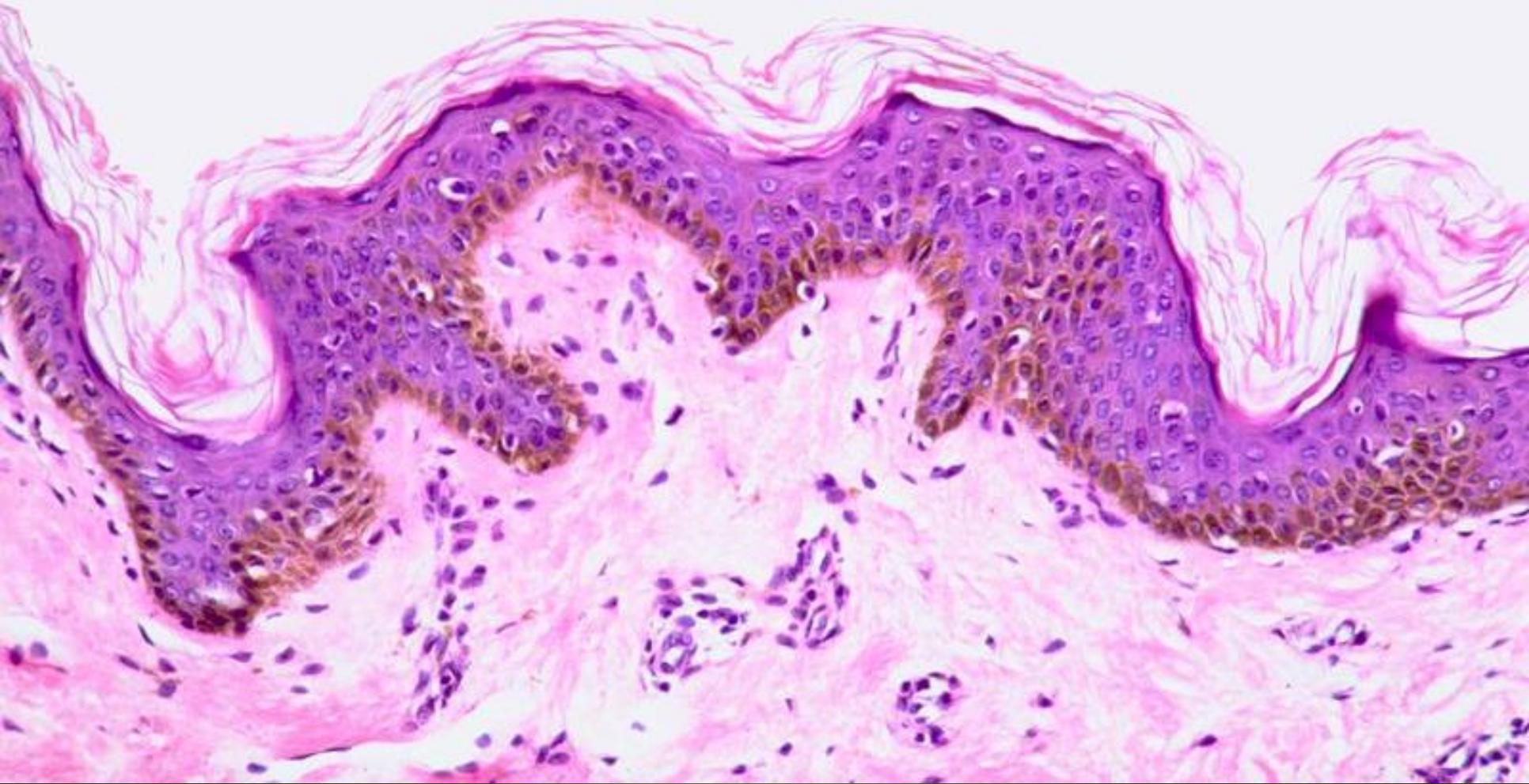




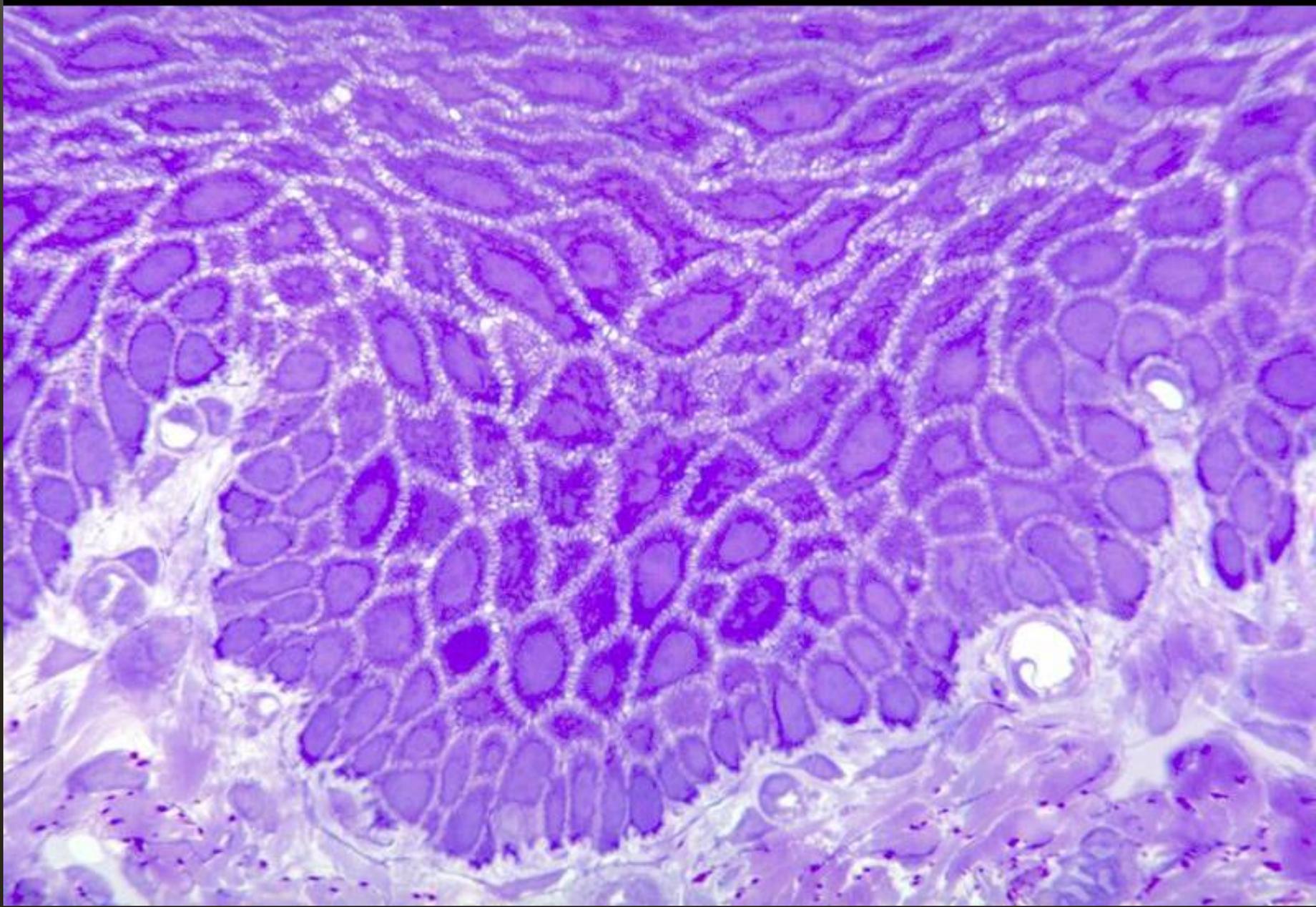
# Stratum Spinosum

Melanocyte

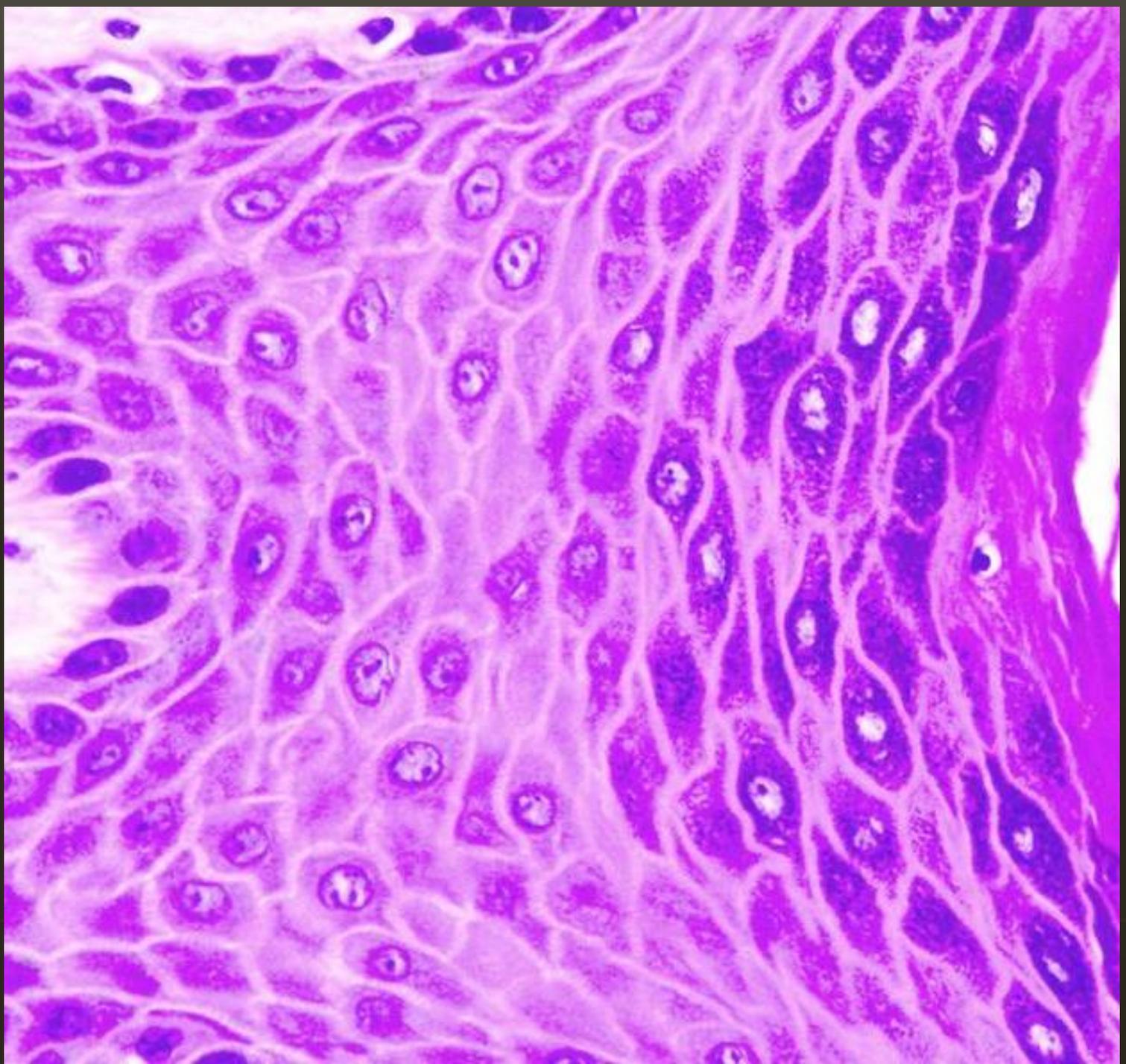


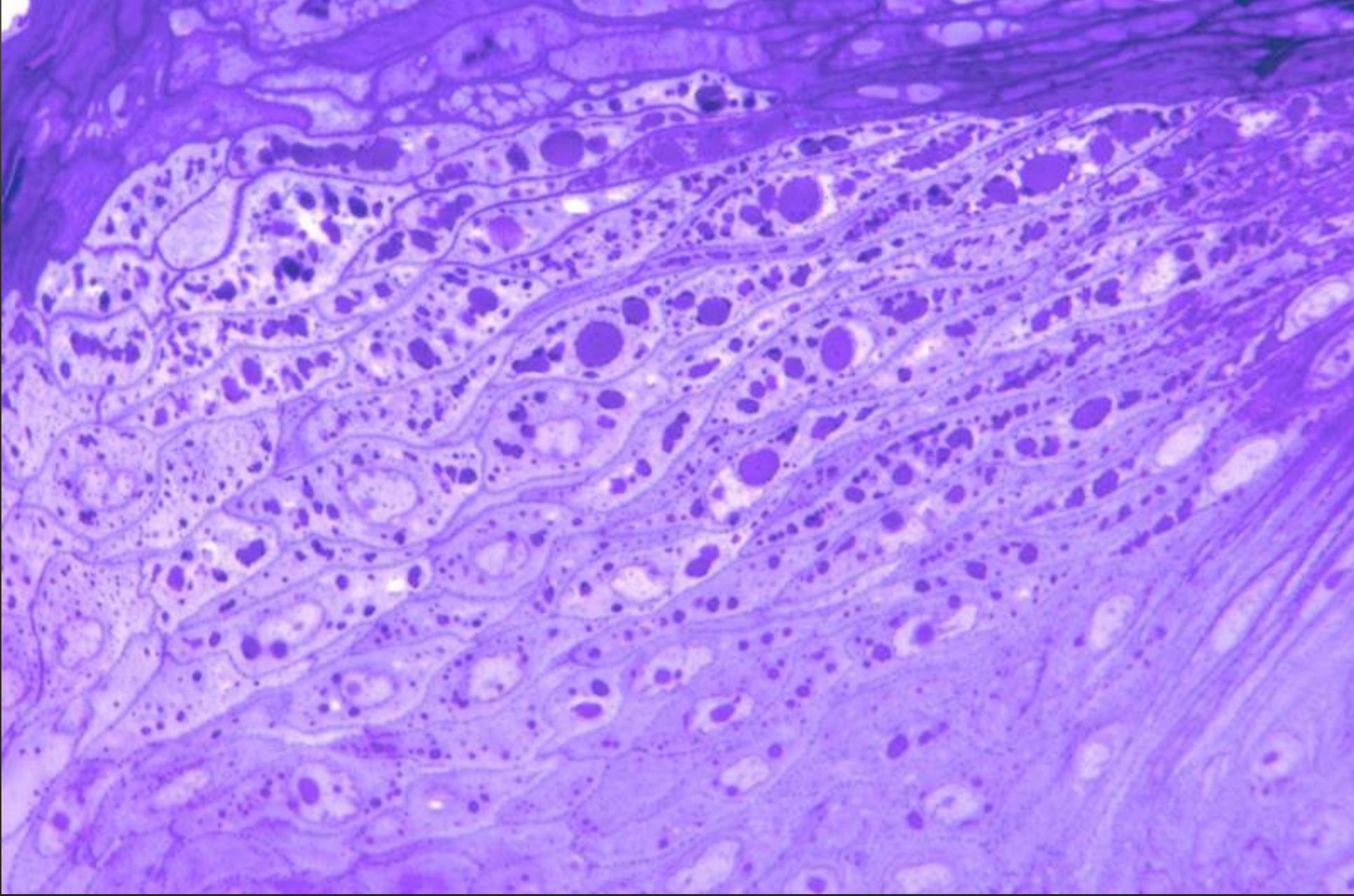


Dark Skin

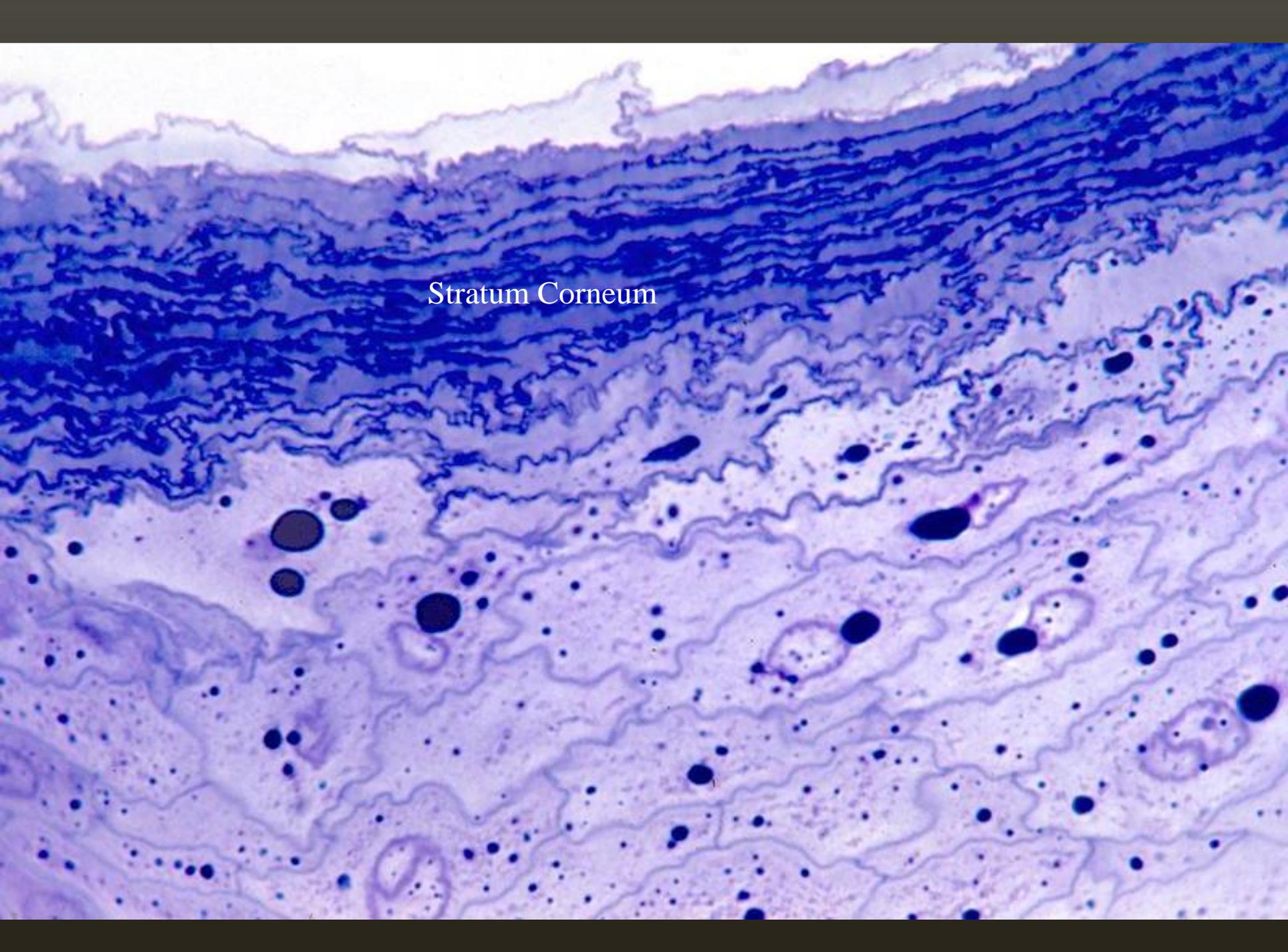


Stratum Basale



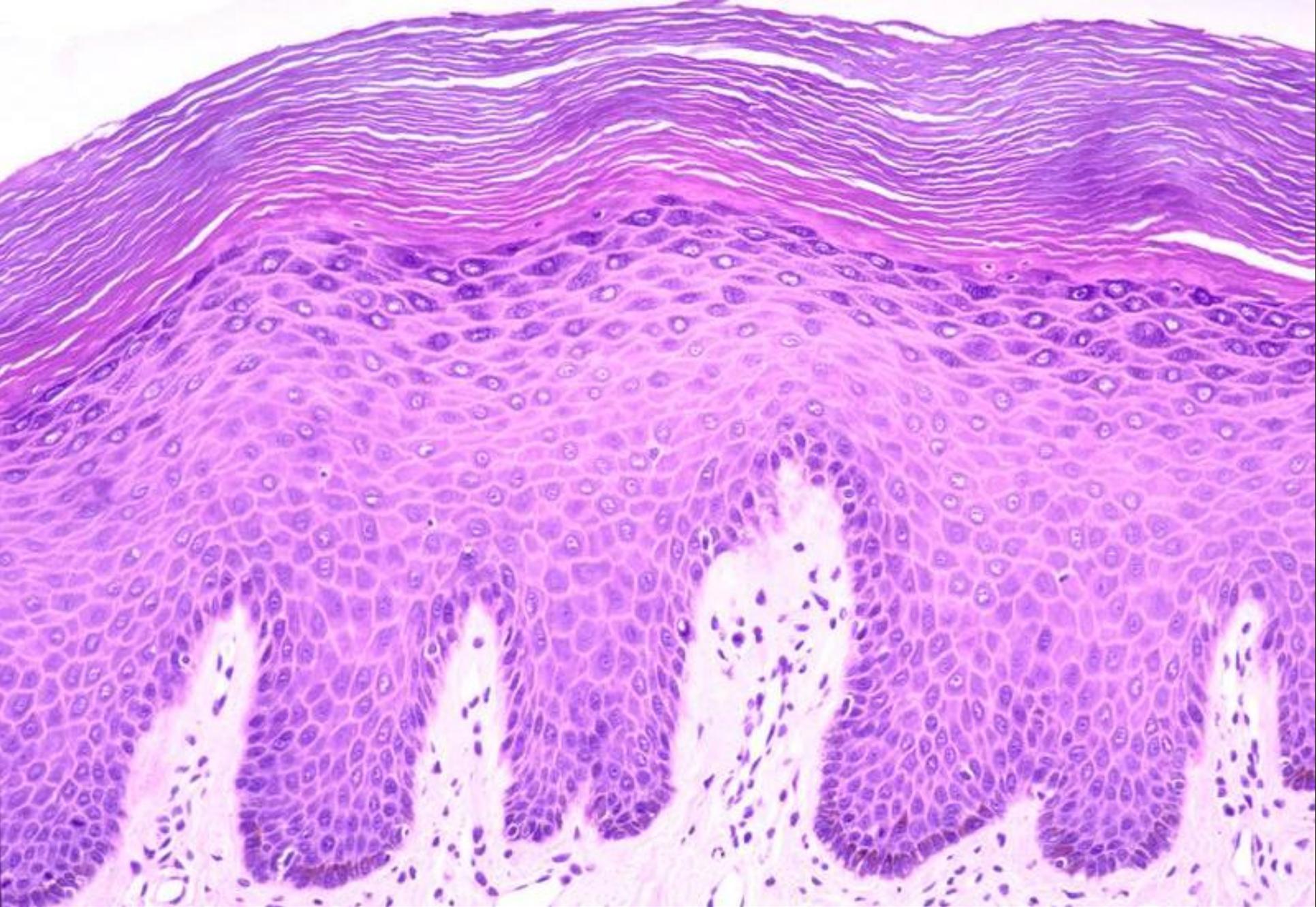


Stratum Granulosum

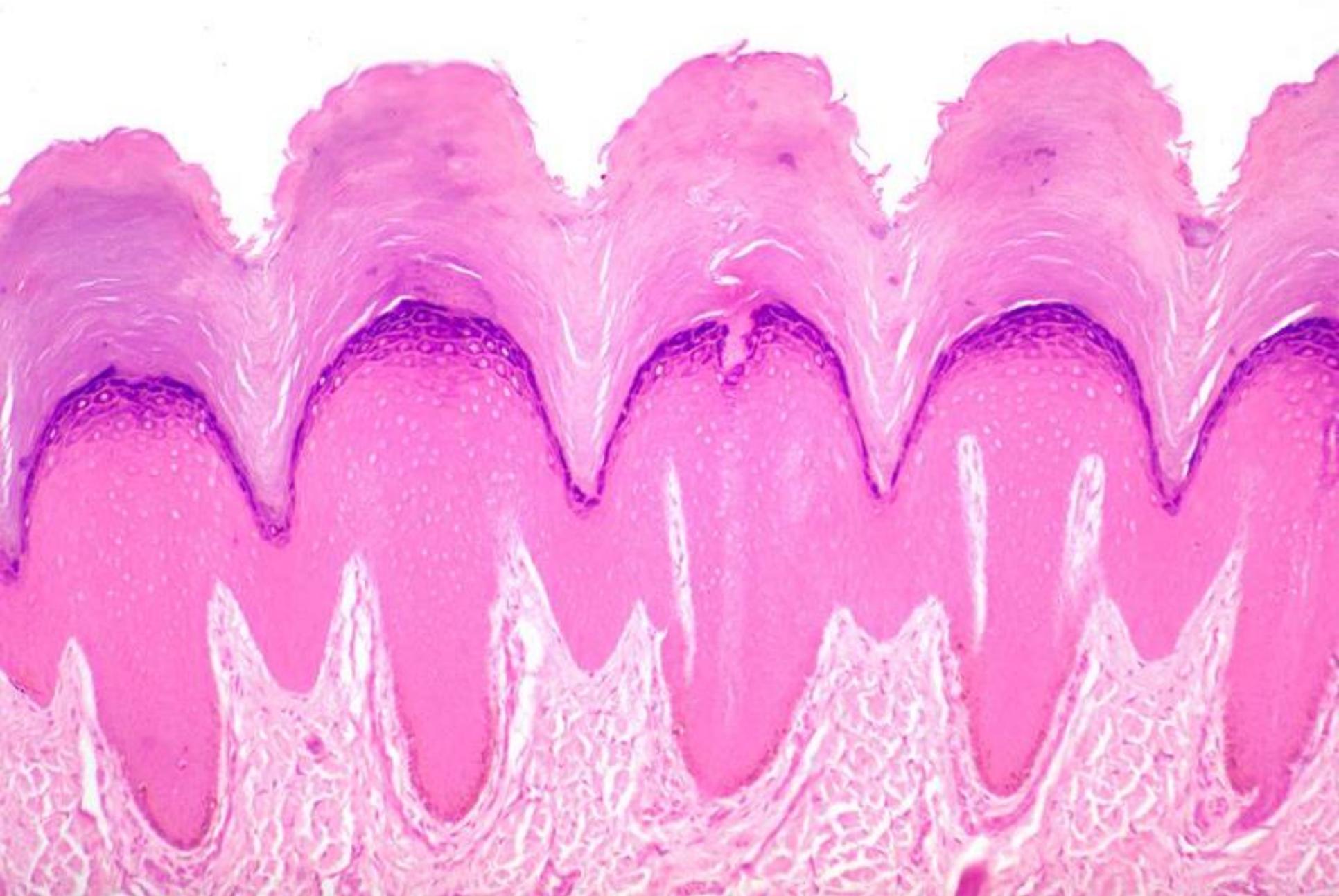


Stratum Corneum

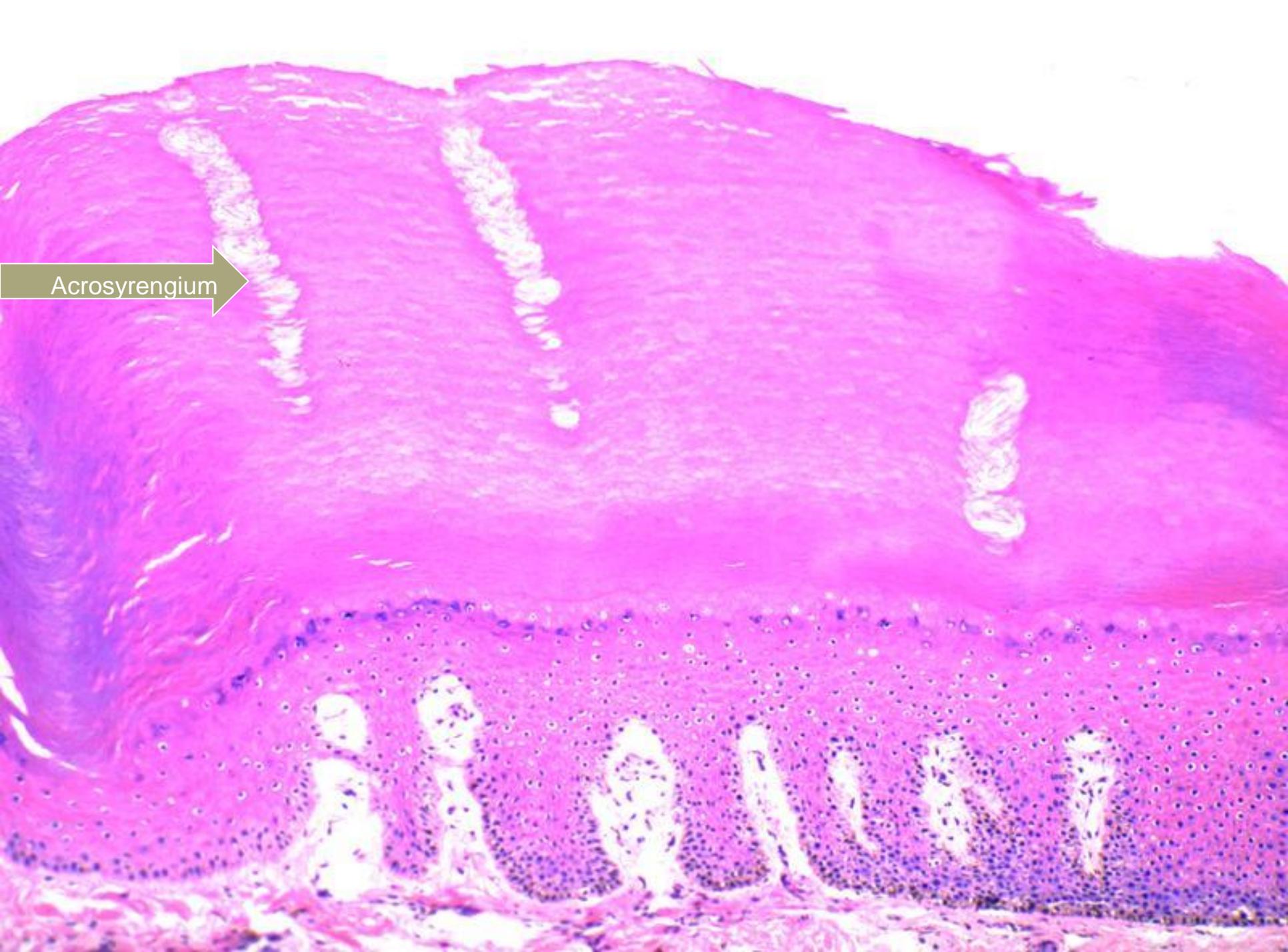
This histological micrograph displays the stratum corneum, the outermost layer of the epidermis. It is characterized by numerous layers of flattened, keratinized cells. The cells are arranged in a brick-like pattern, with their nuclei pushed toward the base of each layer. The overall appearance is that of a thick, multi-layered barrier. The staining is a deep purple, highlighting the dense structure of the keratinized cells.



Thick Skin



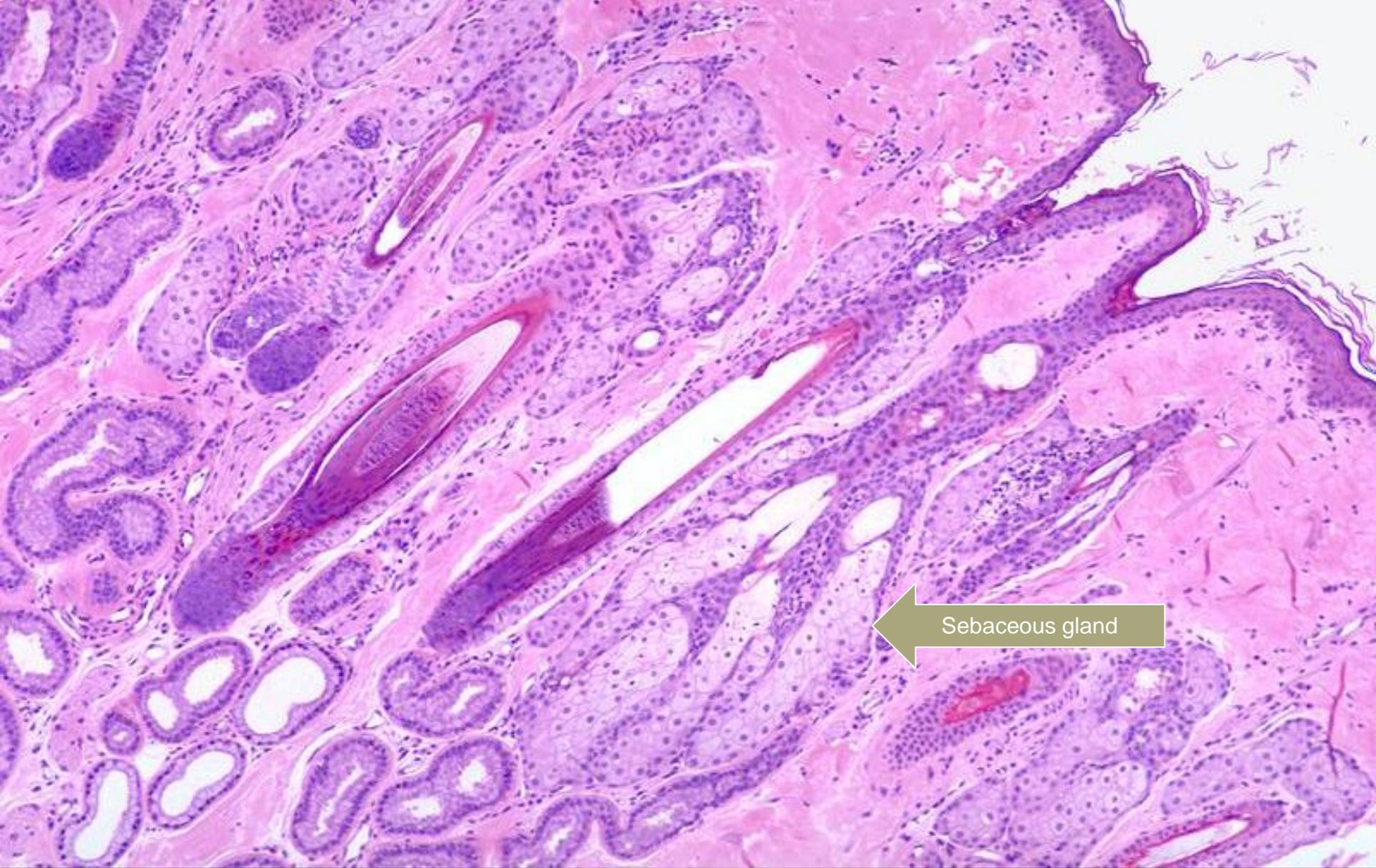
Thick Skin



Acrosyngium



Thin Skin

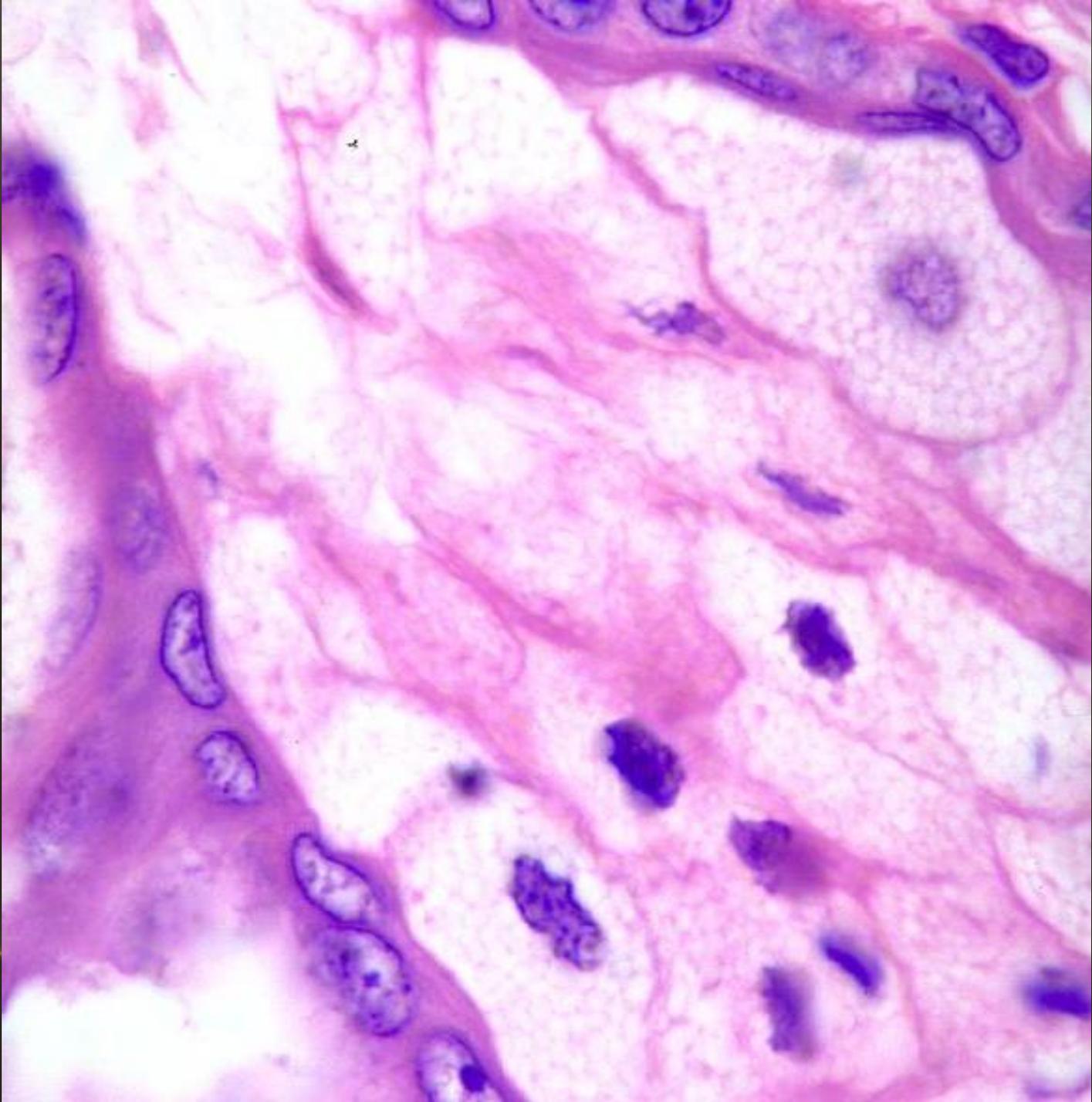


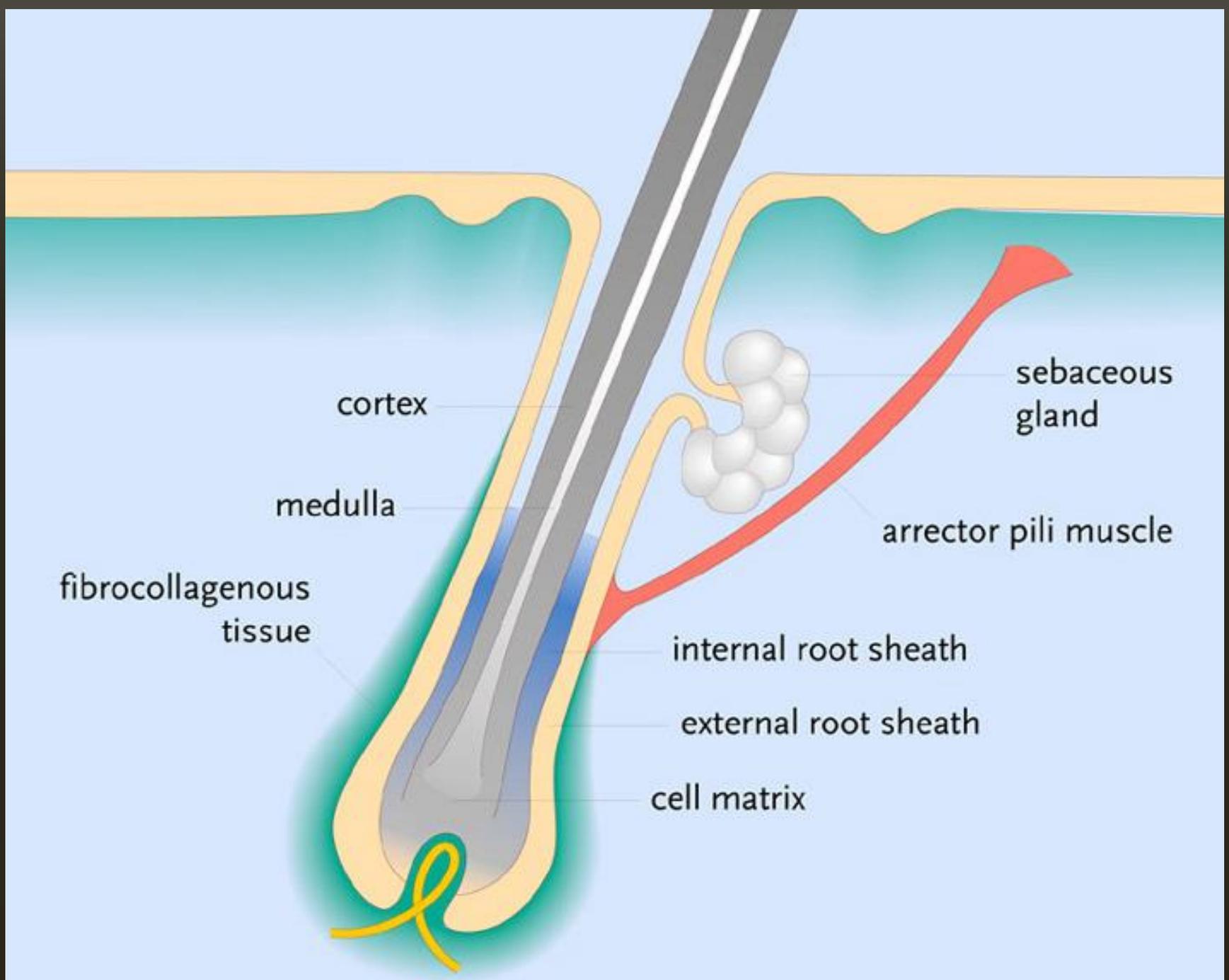
Sebaceous gland



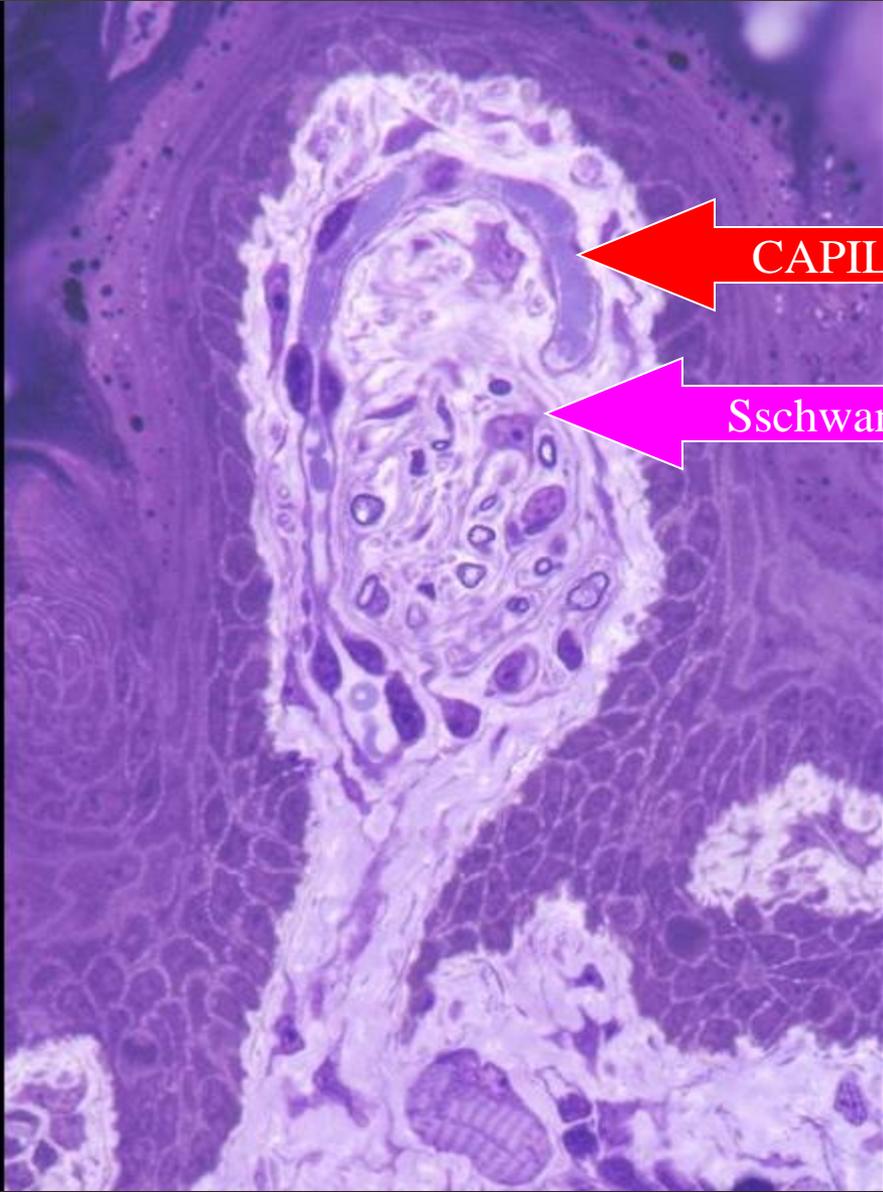
Duct of sebaceous gland

Ruptured cells  
of sebaceous  
gland  
(Holocrine)





Meissner's corpuscle in papillary dermis



← CAPILLARY

← Schwann cell

## Paccinian Corpuscles

