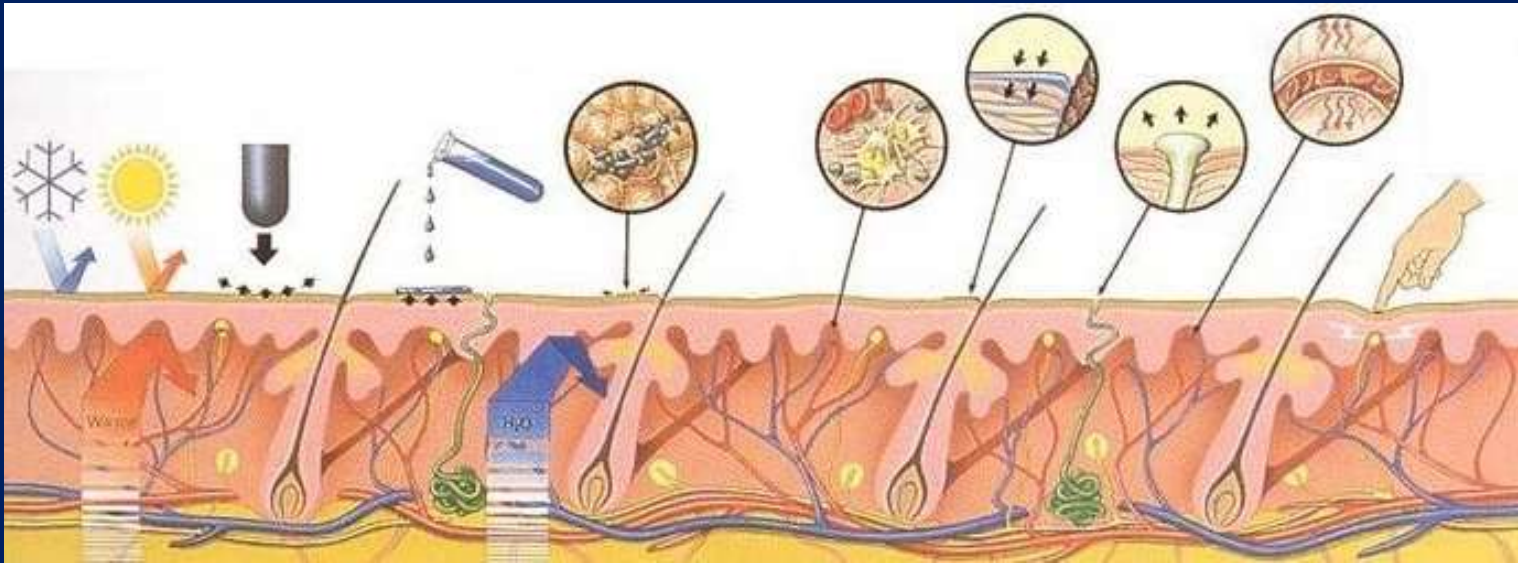
A histological micrograph of skin tissue, stained with hematoxylin and eosin (H&E). The image shows the epidermis at the top, characterized by a wavy, undulating boundary with the underlying dermis. The epidermis consists of several layers of stratified squamous epithelium. The dermis below is composed of dense, fibrous connective tissue with scattered nuclei of fibroblasts and other cells. The overall appearance is that of a cross-section of mammalian skin.

INTEGUMENT (SKIN)

INTEGUMENT

- **~16% BODY MASS**
- **SURFACE: 1.2 - 2.3 m²**
- **THICKNESS: 0.3 - 4.0 mm**
(depending on thickness of epidermis)

Functions of the skin

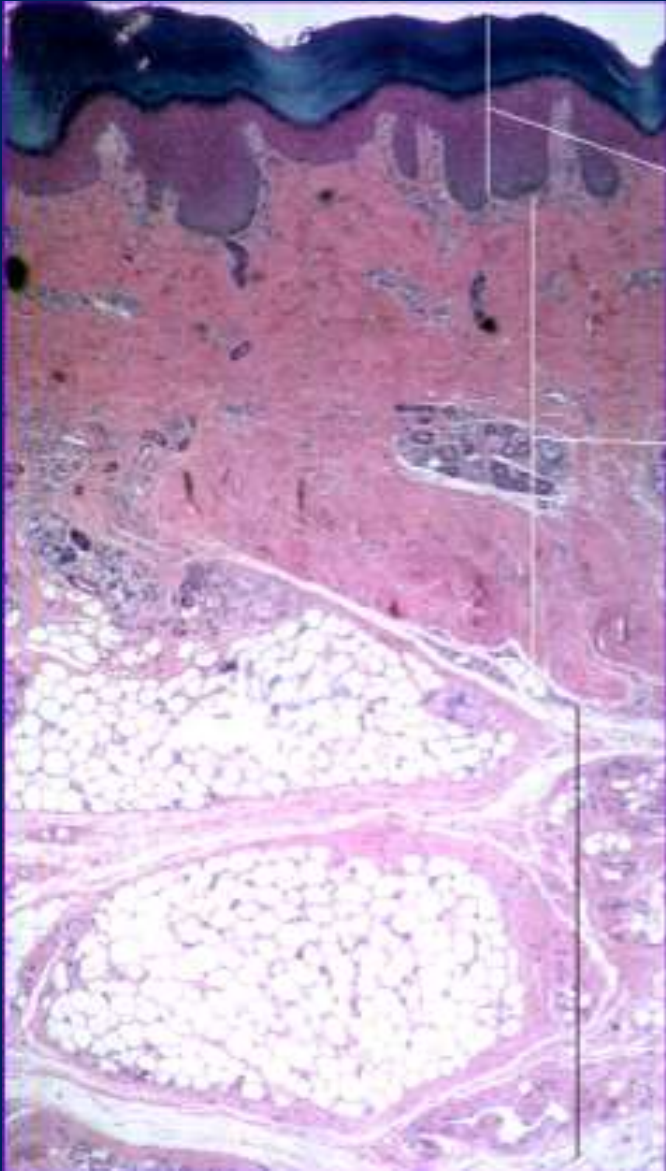


1. Protection from cold, heat and radiation
2. Protection from pressure, blows and abrasions
3. Protection from the actions of chemical substances
4. Protection from the invasion by microorganisms
5. Absorption of certain substances
6. Perspiration (cooling)
7. Circulatory and thermal regulation by means of the dermal vascular system
8. Pressure, vibration, tactile, pain and temperature sensory organs
9. Absorption of UV radiation from the sun for the synthesis of vitamin D

INTEGUMENT

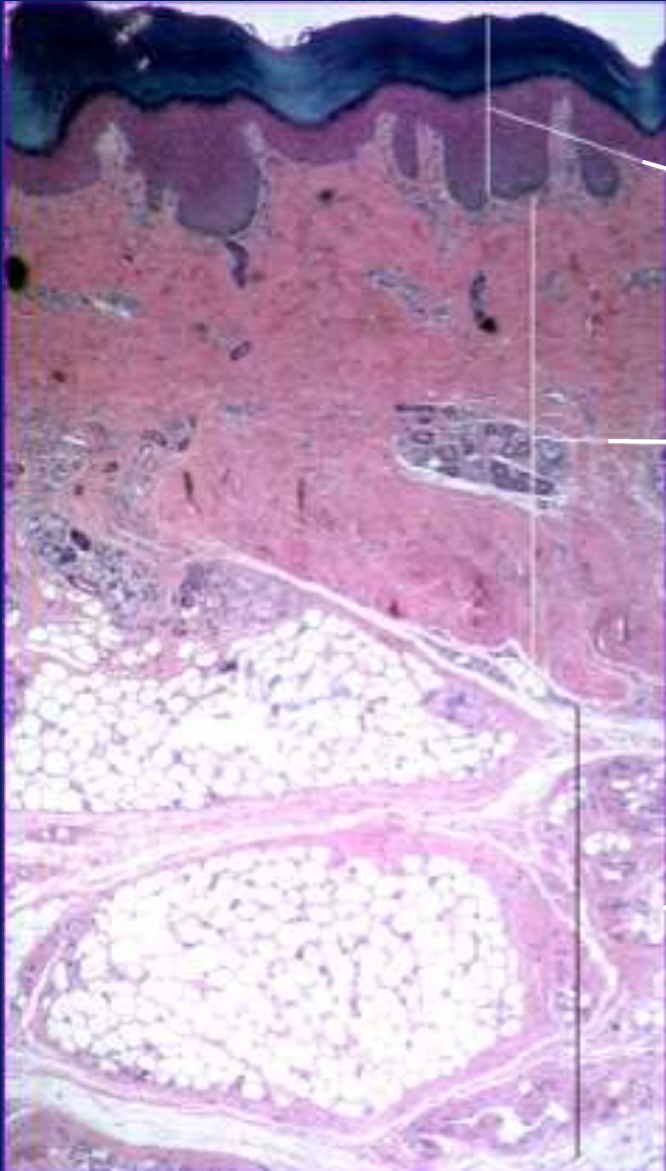
- EPIDERMIS
- DERMIS
 - PAPILLARY LAYER
 - RETICULAR LAYER
- SUBCUTANEOUS TISSUE
- ACCESSORY STRUCTURES:
 - SEBACEOUS GLANDS
 - SWEAT GLANDS
 - HAIR
 - NAILS

TYPES OF THE SKIN



- **THICK**
 - PALMS AND SOLES
 - NONHAIRY
 - DERMATOGLYPHICS (FINGERPRINTS)
- **THIN**
 - HAIRY
 - CONTAINS ACCESSORY STRUCTURES

SKIN LAYERS



- **EPIDERMIS** - cornifying squamous stratified epithelium
- **DERMIS** - connective tissue proper, blood and lymphatic vessels, nerve fibers and endings, and glands
- **SUBCUTANEOUS TISSUE** - connective tissue proper, white adipose tissue

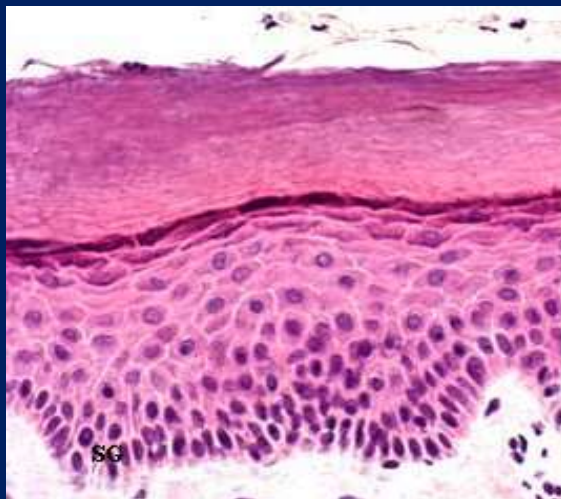
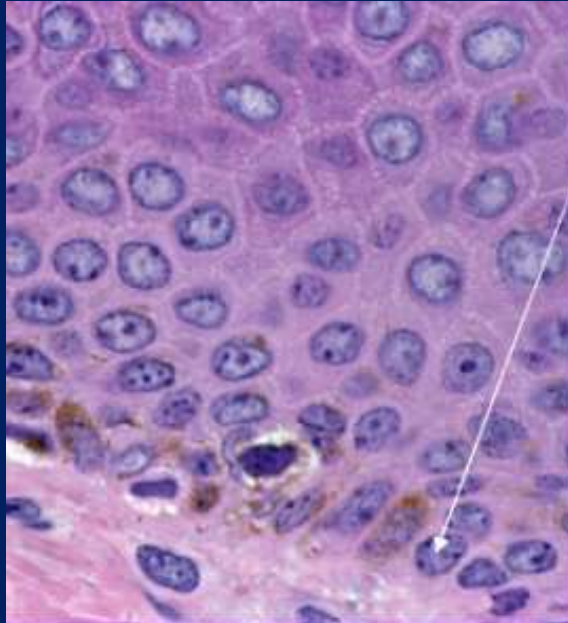
EPIDERMIS

CORNIFYING SQUAMOUS STRATIFIED EPITHELIUM (KERATINOCYTES)



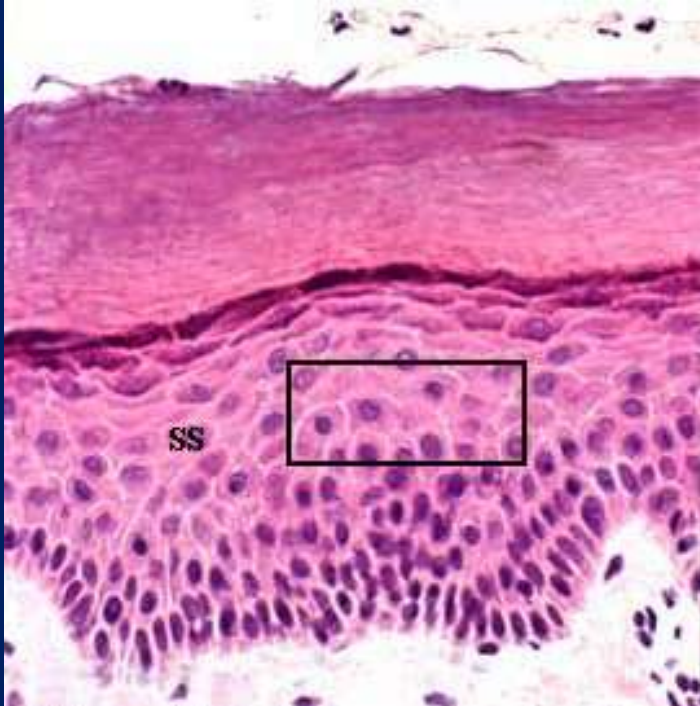
- STRATUM CORNEUM
- STRATUM LUCIDUM
(ONLY THICK SKIN)
- STRATUM GRANULOSUM
- STRATUM SPINOSUM
- STRATUM BASALE

STRATUM BASALE



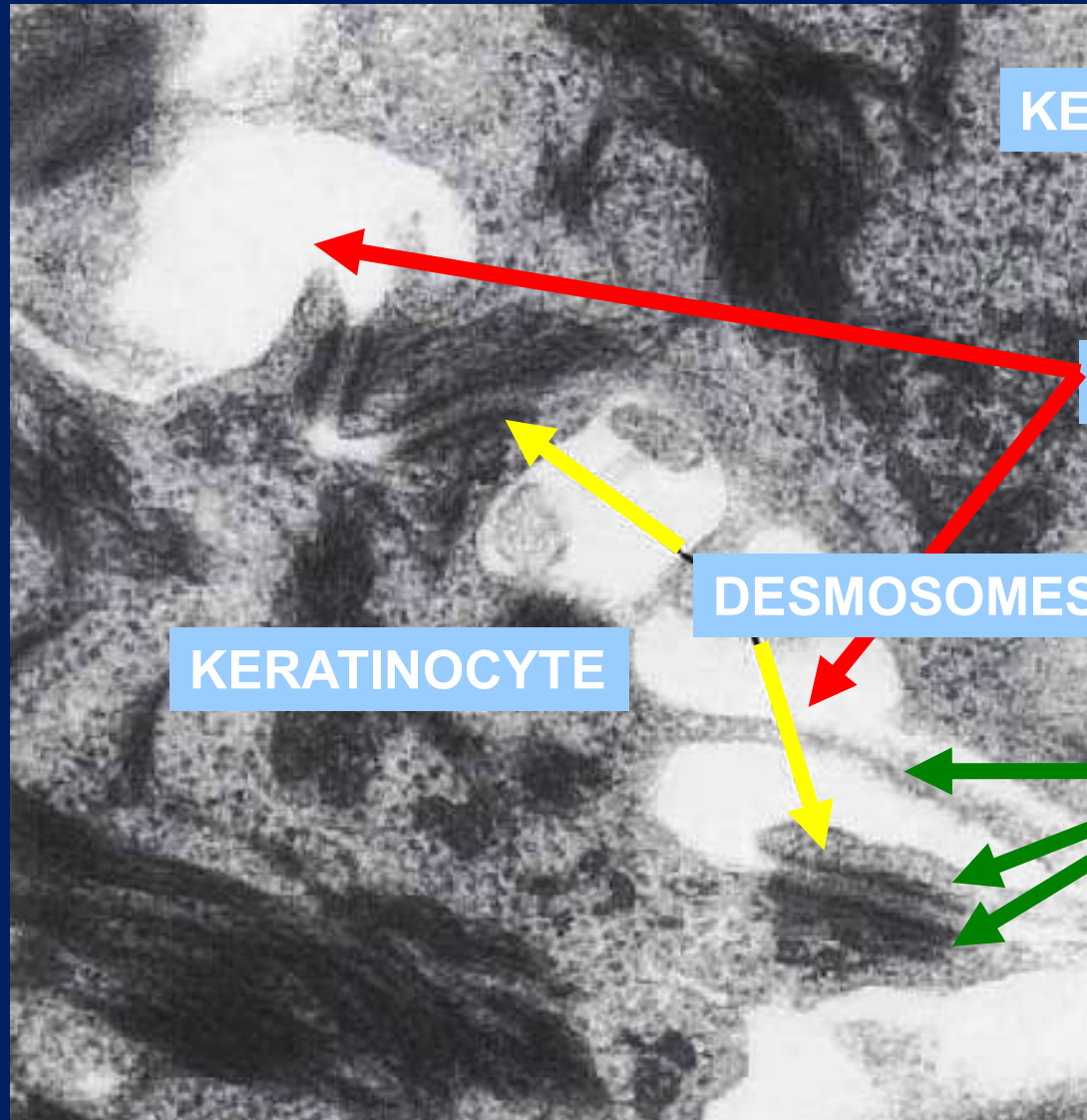
- GERMINATIVE LAYER WITH NUMEROUS ASYMETRIC MITOSES
- CONTAINS STEM CELLS LOCATED IN INVAGINATIONS AND CLOSE TO HAIR FOLLICLES
- COMPOSED OF SINGLE LAYER OF COLUMNAR OR CUBOID CELLS
- THE CELLS BIND TO BASAL LAMINA VIA HEMIDESMOSOMES AND TO THEIR NEIGHBOURS VIA DESMOSOMES

STRATUM SPINOSUM



- GERMINATIVE LAYER WITH SINGLE MITOSES
- SEVERAL LAYERS OF CUBOID CELLS
- THE CELLS BINDS TO NEIGHTBOURS VIA DESMOSOMES (SPINY PROJECTIONS)
- KERATINOCYTES PRODUCE AND RELEASE STEROIDS, PHOSPHOLIPIDS, GLYCOSPHINGOLYPIDS THAT PARTICIPATE IN FORMATION OF WATER LOSS PROTECTION BARRIER

DESMOSOMES



KERATINOCYTE

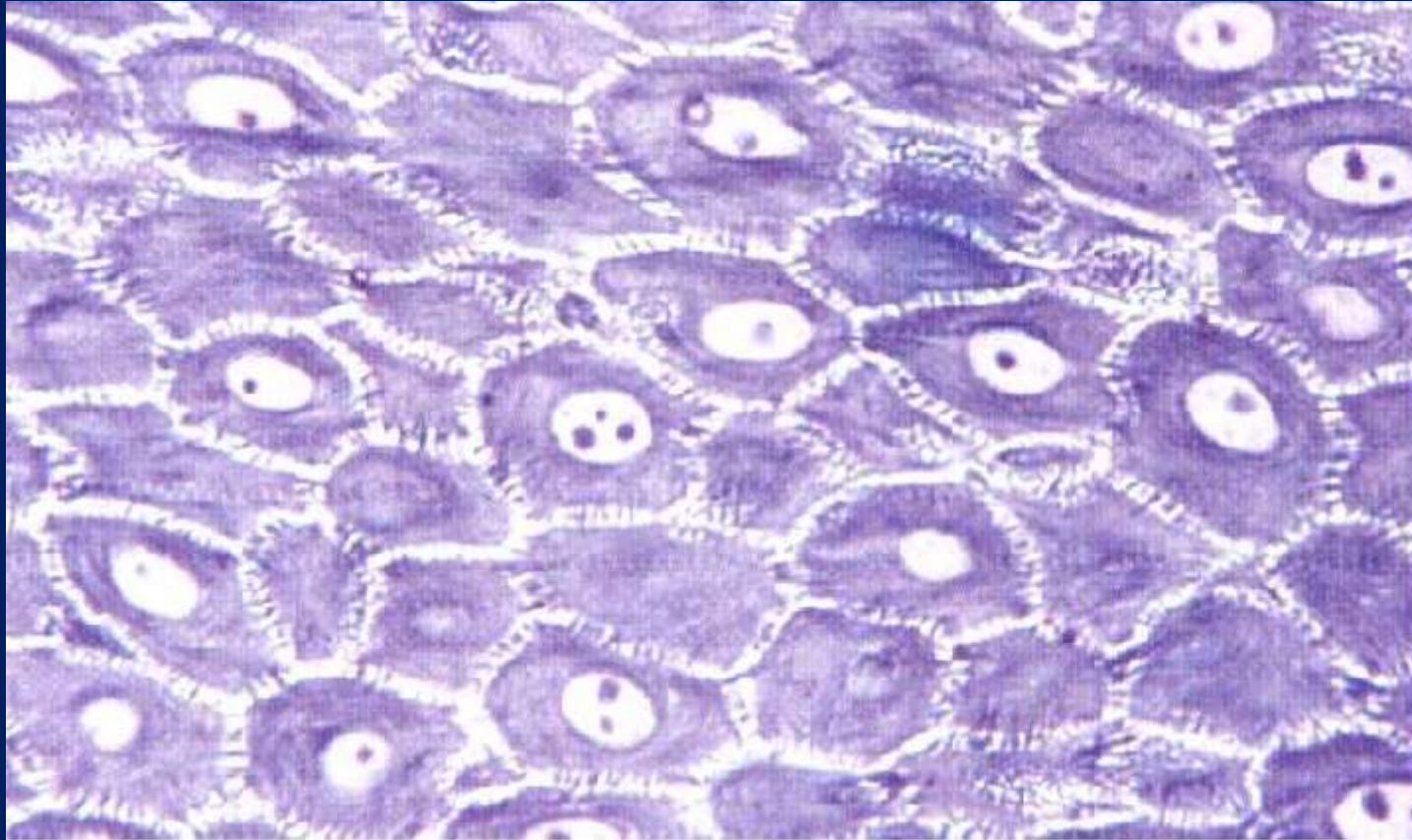
INTERCELLULAR SPACE

DESMOSOMES

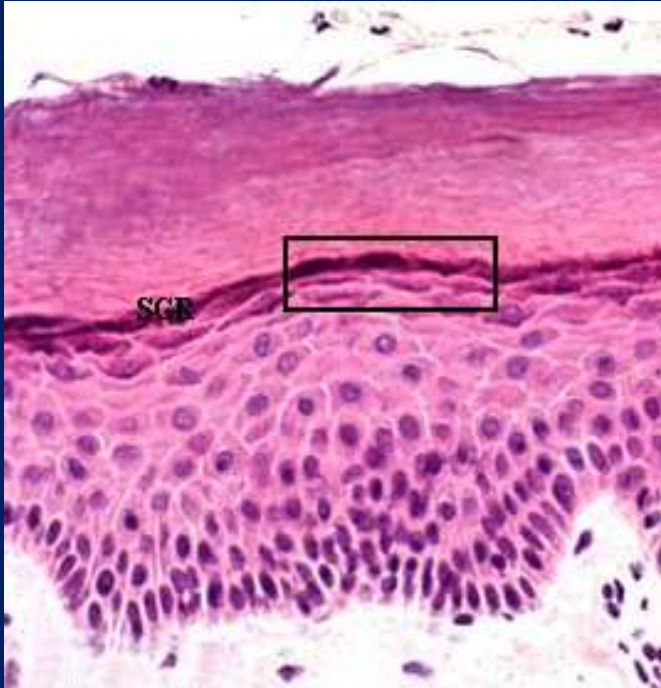
KERATINOCYTE

CELLULAR PROJECTIONS

DESMOSOMES IN SPINOUS LAYER

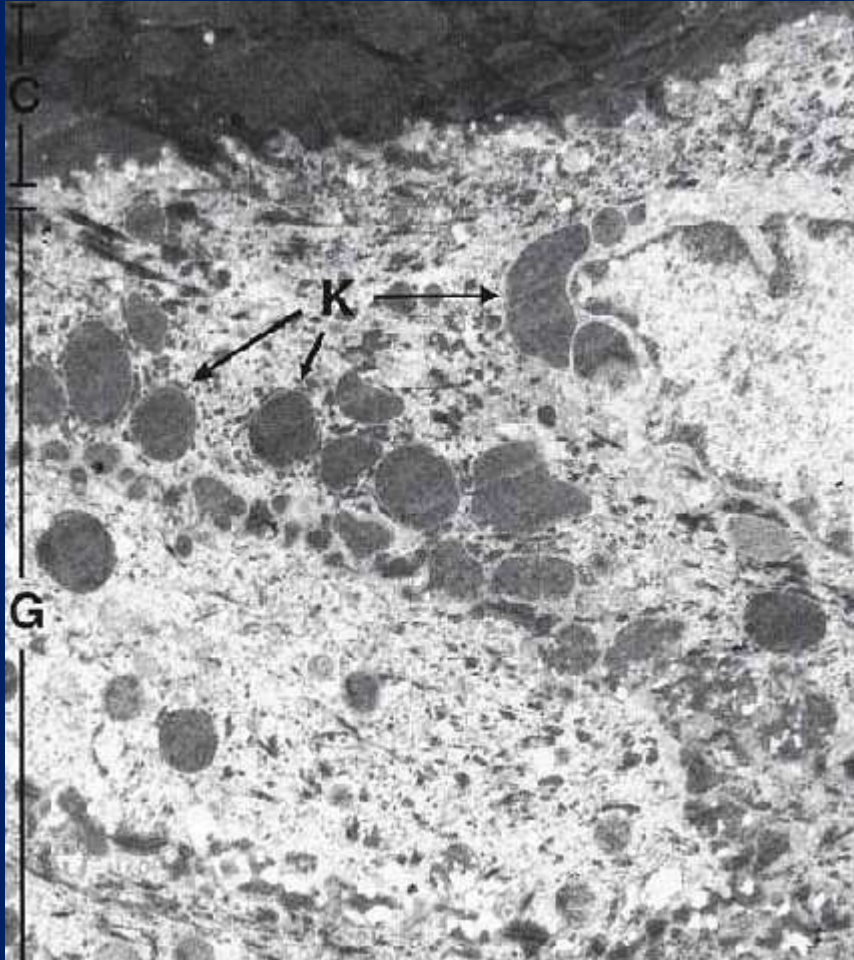


STRATUM GRANULOSUM



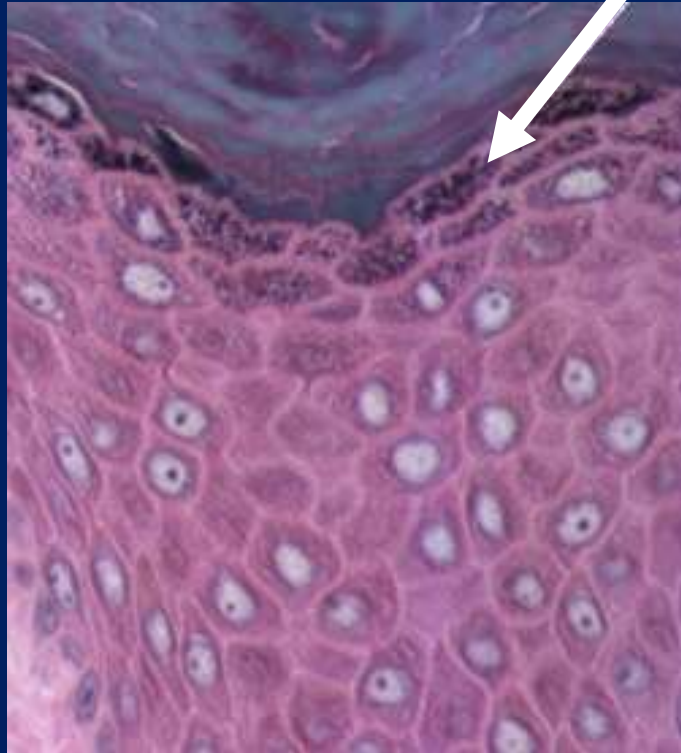
- 3-5 LAYERS OF STRONGLY ATTACHED FLATTENED POLYGONAL CELL WITHOUT PROLIFERATION CAPABILITIES
- NUCLEI STILL PRESENT
- THE CELLS CONTAIN KERATOHYALIN GRANULES WITH HISTIDYNE AND CYSTEINE RICH PROTEINS (INVOLUCRIN AND PROFILLAGRIN) AND LAMELLAR BODIES WITH LIPIDS AND PROTEINS RESPONSIBLE FOR FORMATION OF BARRIER PROTECTING FROM WATER LOSS
- CONCENTRATION OF KERATIN FILAMENT BUNDLES

STRATUM GRANULOSUM



**KERATOHYALINE
GRANULES**

STRATUM GRANULOSUM



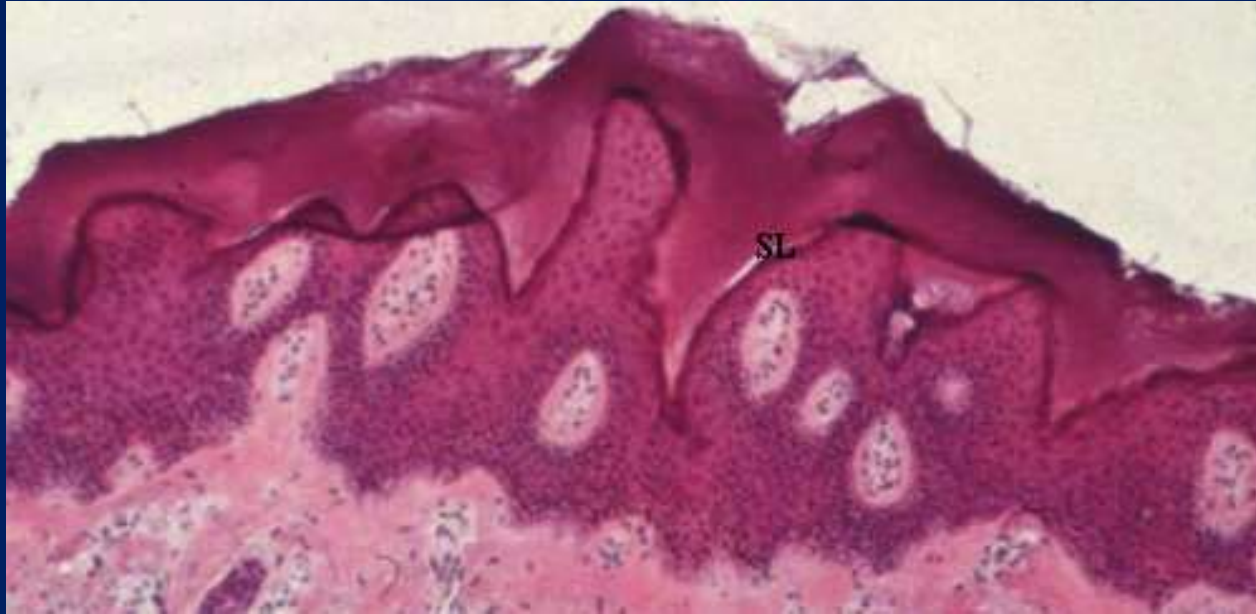
INVOLUCRIN

PARTICIPATES IN KERATIN FORMATION
VIA PRODUCTION OF CROSS-LINKS

PROFILLAGRIN

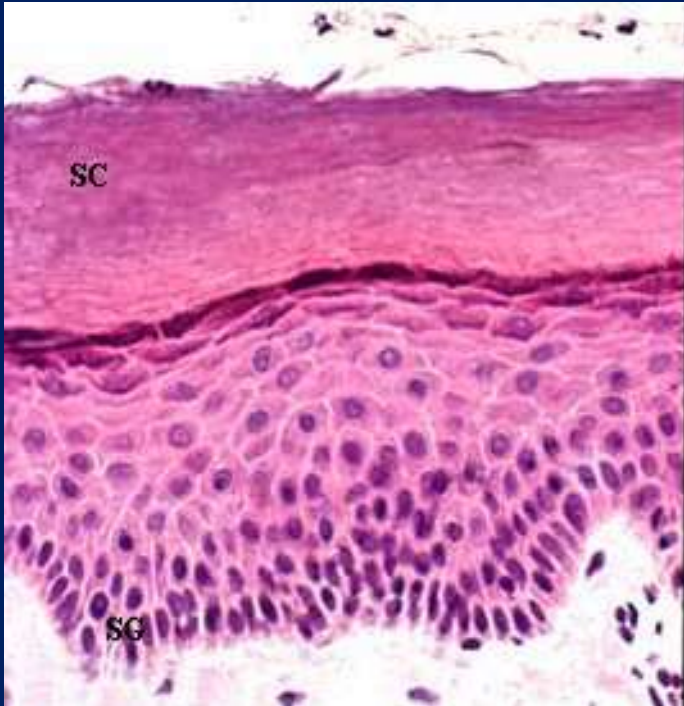
BECOMES TRANSFORMED INTO
FILLAGRIN THAT BINDS CYTOKERATIN
FILAMENT BUNDLES INTO KERATIN
MASS

STRATUM LUCIDUM



- **PRESENT ONLY IN THICK SKIN**
- **1-2 LAYERS OF FLAT NONNUCLEATED CELLS WITH ACIDIC CYTOPLASM FULLFILLED WITH KERATOHYALINE GRANULES AND CYTOKERATIN FIBER BUNDLES**
- **INTRACELLULAR SPACE CONTAINS LAMELLAR BODIES CONTAINING ACYLGLYCOCERAMIDE FORMING A WATER BARRIER**

STRATUM CORNEUM

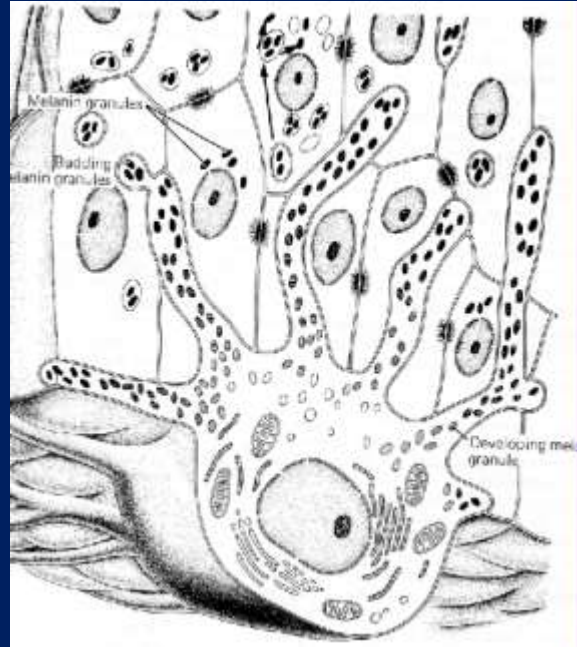


- COMPOSED OF 2-5 (THIN SKIN) OR 100-200 (THICK SKIN) DEAD HORNY CELLS
- THE CELLS ARE COMPLETELY FILLED WITH CYTOKERATIN AND KERATOHYALYNE GRANULES AND INTERCELLULAR SPACE CONTAINS WATER-RESISTANT GLYCOLIPIDS
- STRATUM CORNEUM IS HIGHLY RESISTANT, ELASTIC, AND WATER RESISTANT

EPIDERMAL CELLS

- **KERATINOCYTES**
- **MELANOCYTES**
- **LANGERHANS CELLS (DENDRITIC CELLS)**
- **MERKEL'S CELLS**

MELANOCYTES



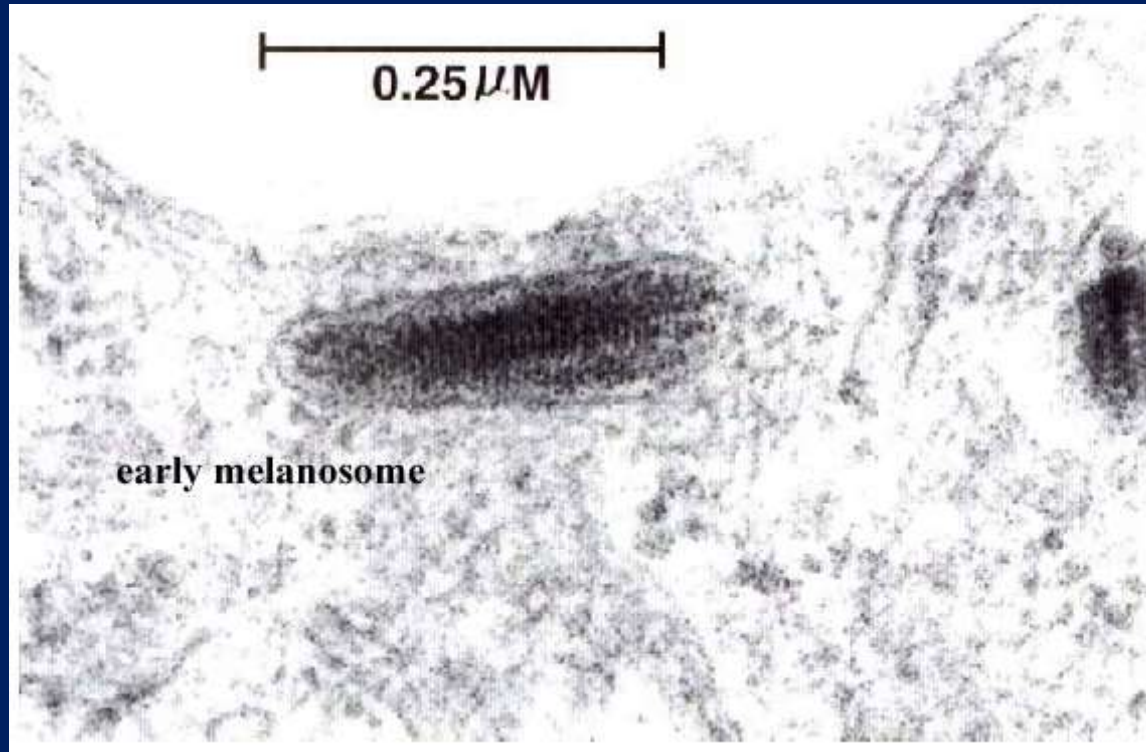
MELANIN IN KERATINOCYTES

UNDER INFLUENCE OF MSH PRODUCE AND RELEASE MELANIN THAT PROTECTS KERATINOCYTES FROM UV RADIATION

MELANOCYTES



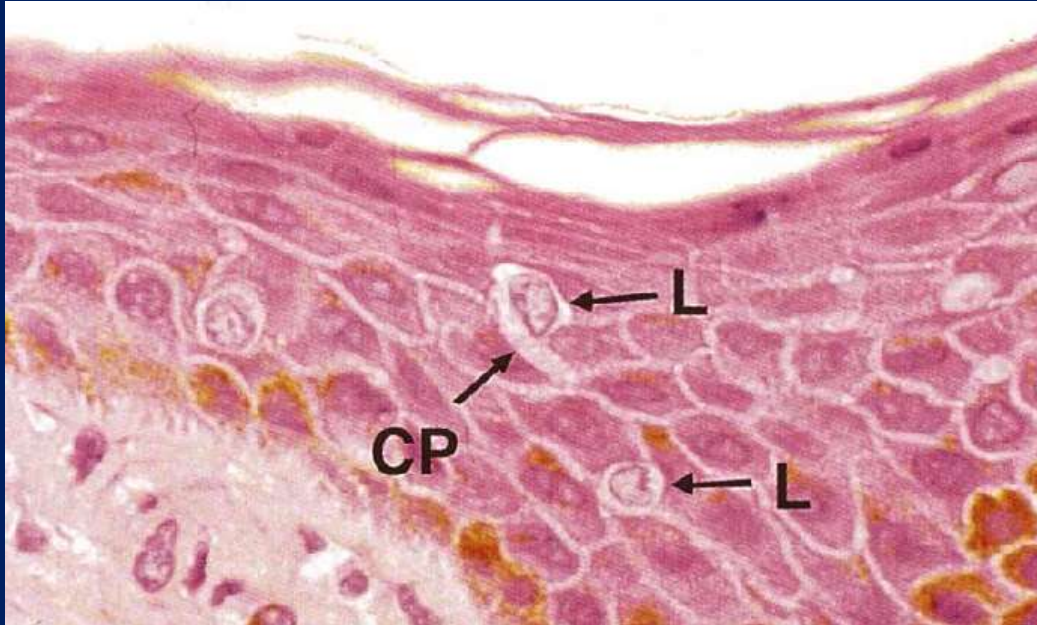
MELANOCYTES



MERKL'S CELLS

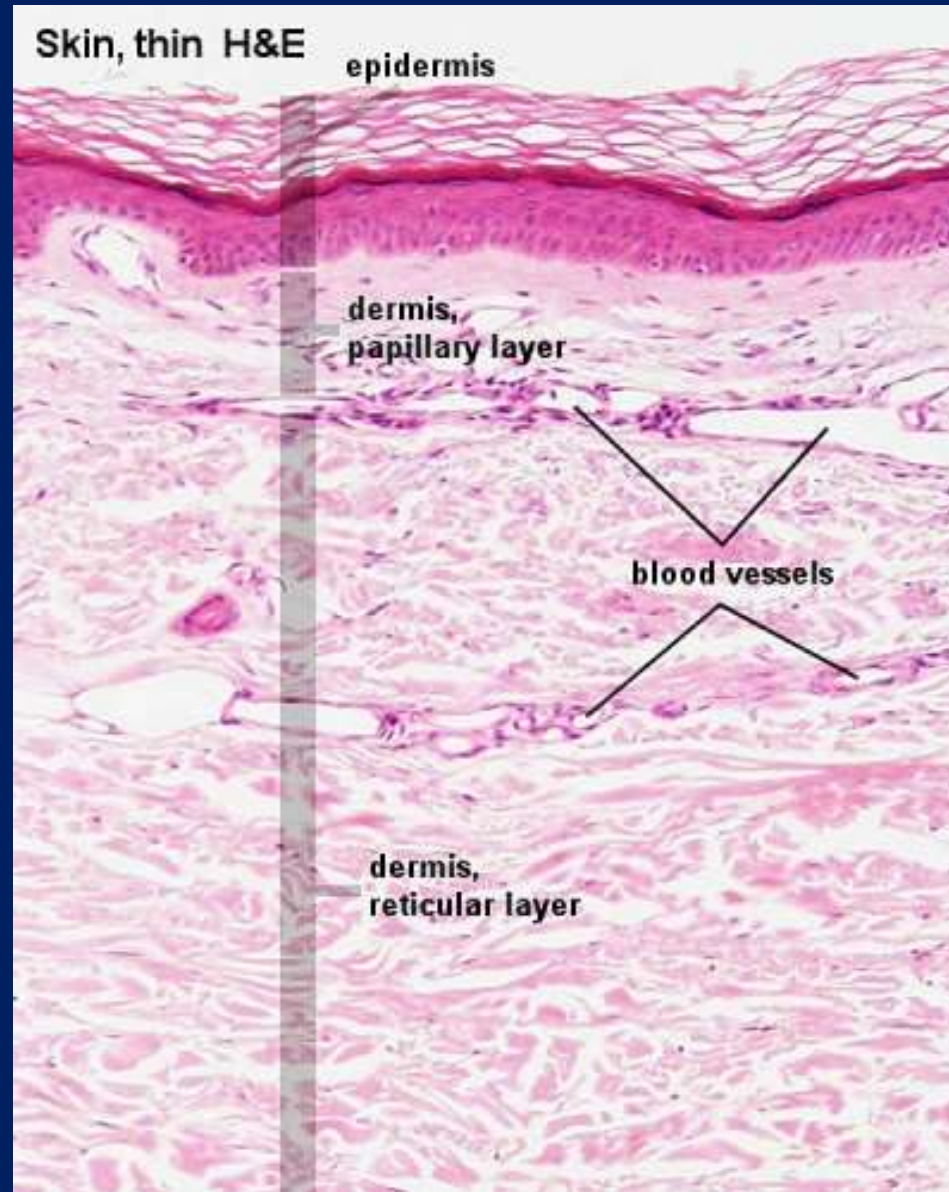
- **CELLS OF ECTODERMAL ORIGIN**
- **FORM SYNAPTIC CONNECTIONS WITH NERVE ENDINGS**
- **SYNTHESIZE AND RELEASE PEPTIDE NEUROMEDIATORS**
- **SERVE AS MECHANORECEPTORS**

LANGERHANS CELLS



- DENDRITIC CELLS OF BONE MARROW (MONOCYTIC) ORIGIN
- PARTICIPATE IN ANTIGEN PRESENTATION TO T LYMPHOCYTES

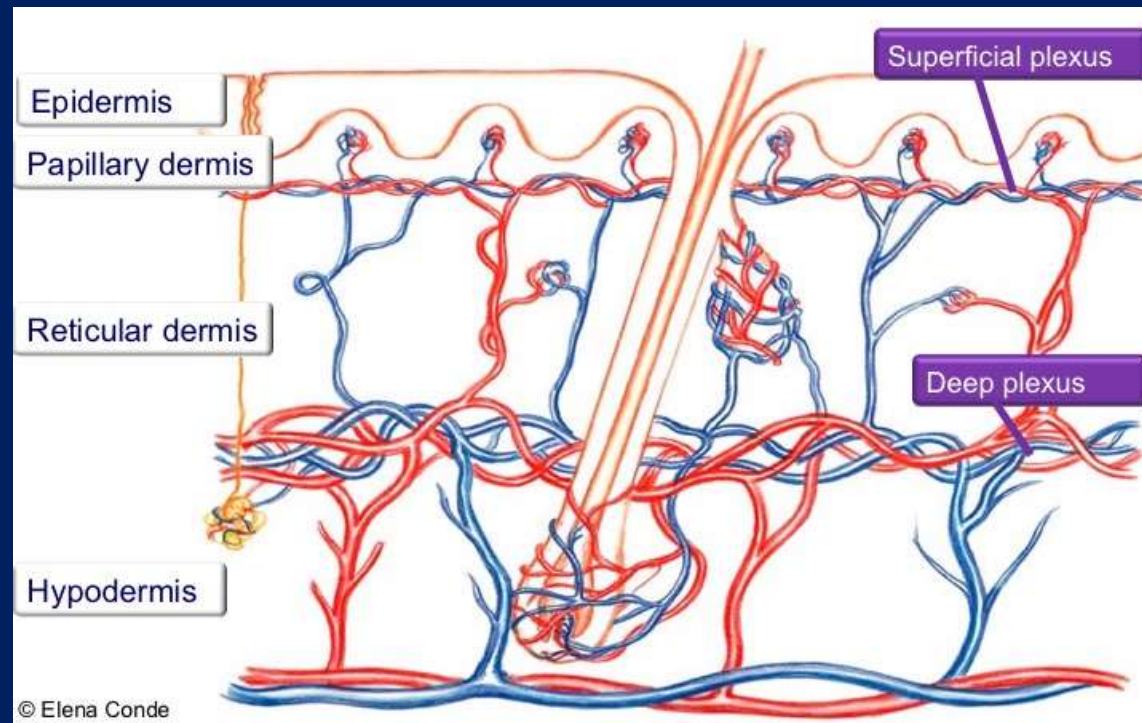
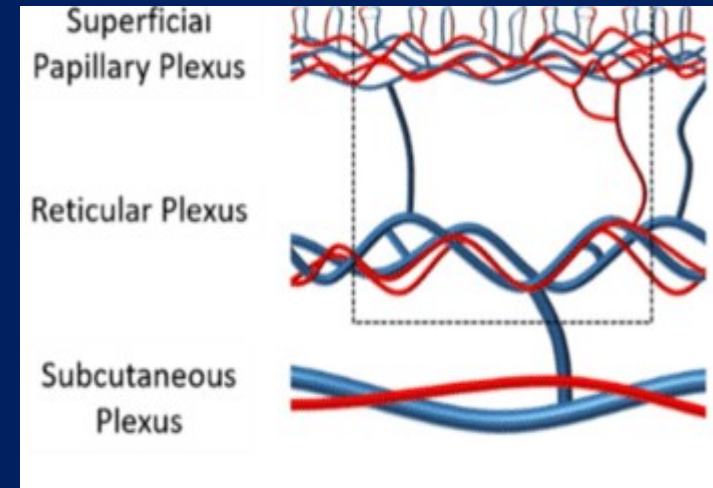
DERMIS



DERMIS VASCULATURE

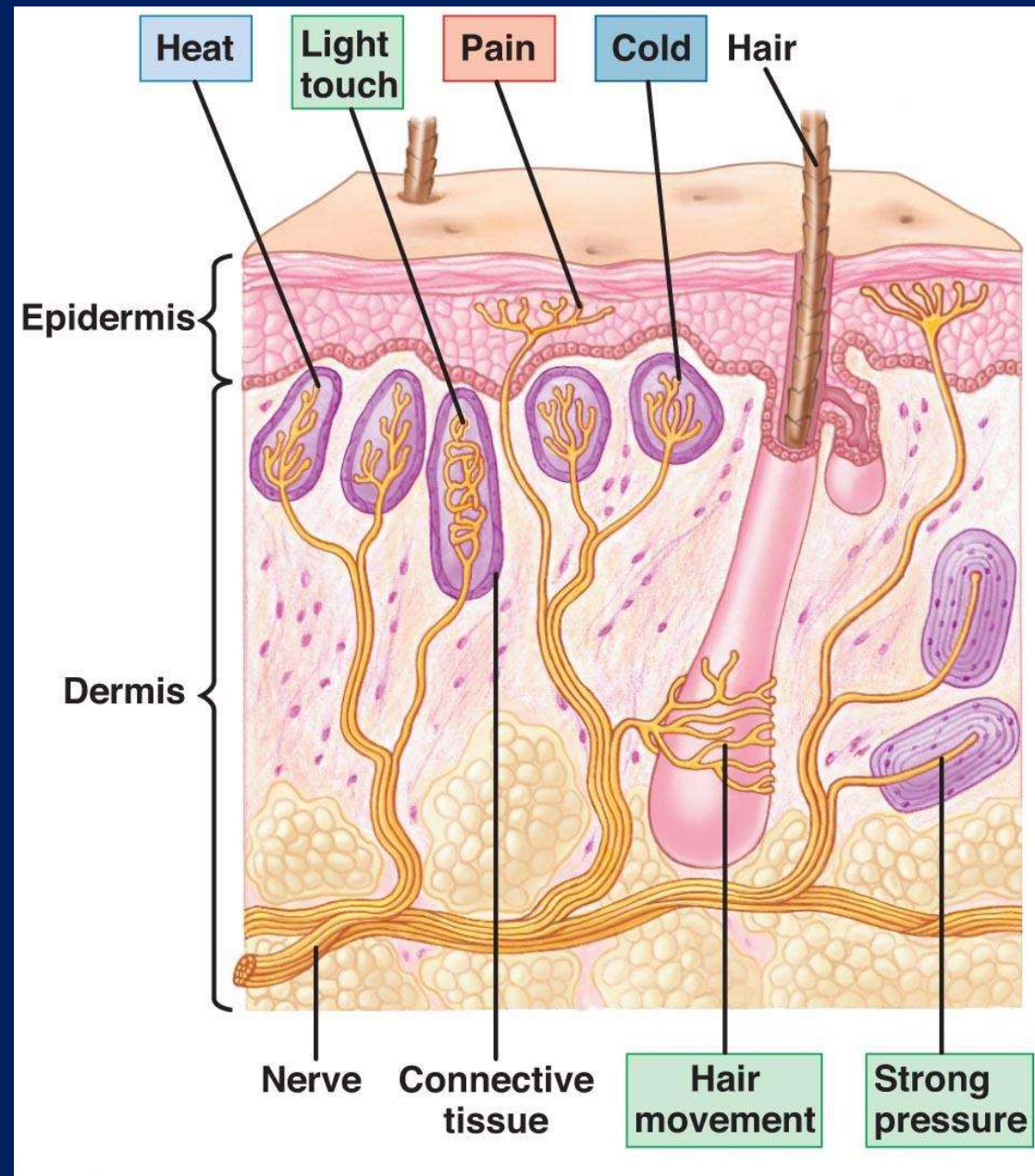
The dermal vasculature is made up of two intercommunicating plexuses:

- Subpapillary (superficial plexus) - at the junction of the papillary and reticular dermis
- Lower plexus at the dermal-subcutaneous interface.



SPECIALIZED PERIPHERAL RECEPTORS

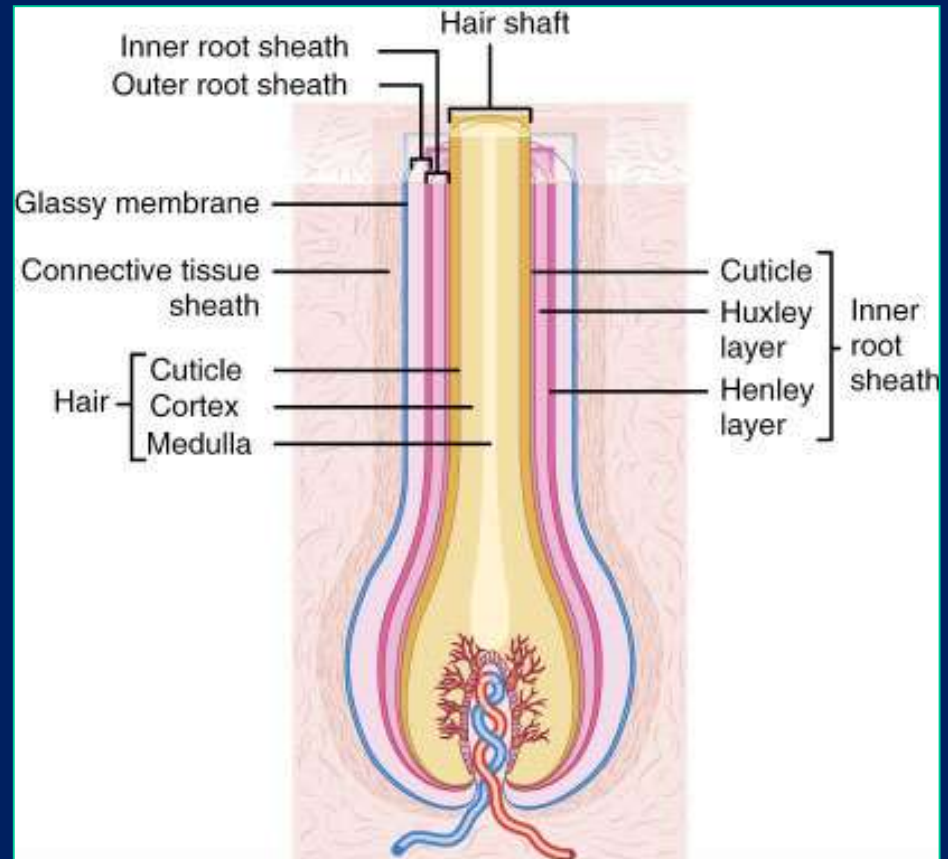
- Mechanoreceptors – sensory cells respond to touch and pressure.
- Thermoreceptors - naked endings of nerve fibers in epidermis respond to temperature differences.
- Nociceptors – naked endings of nerve fibers, that branch in dermis before entering the epidermis, responsible for pain perception



Skin appendages

HAIR FOLLICLES

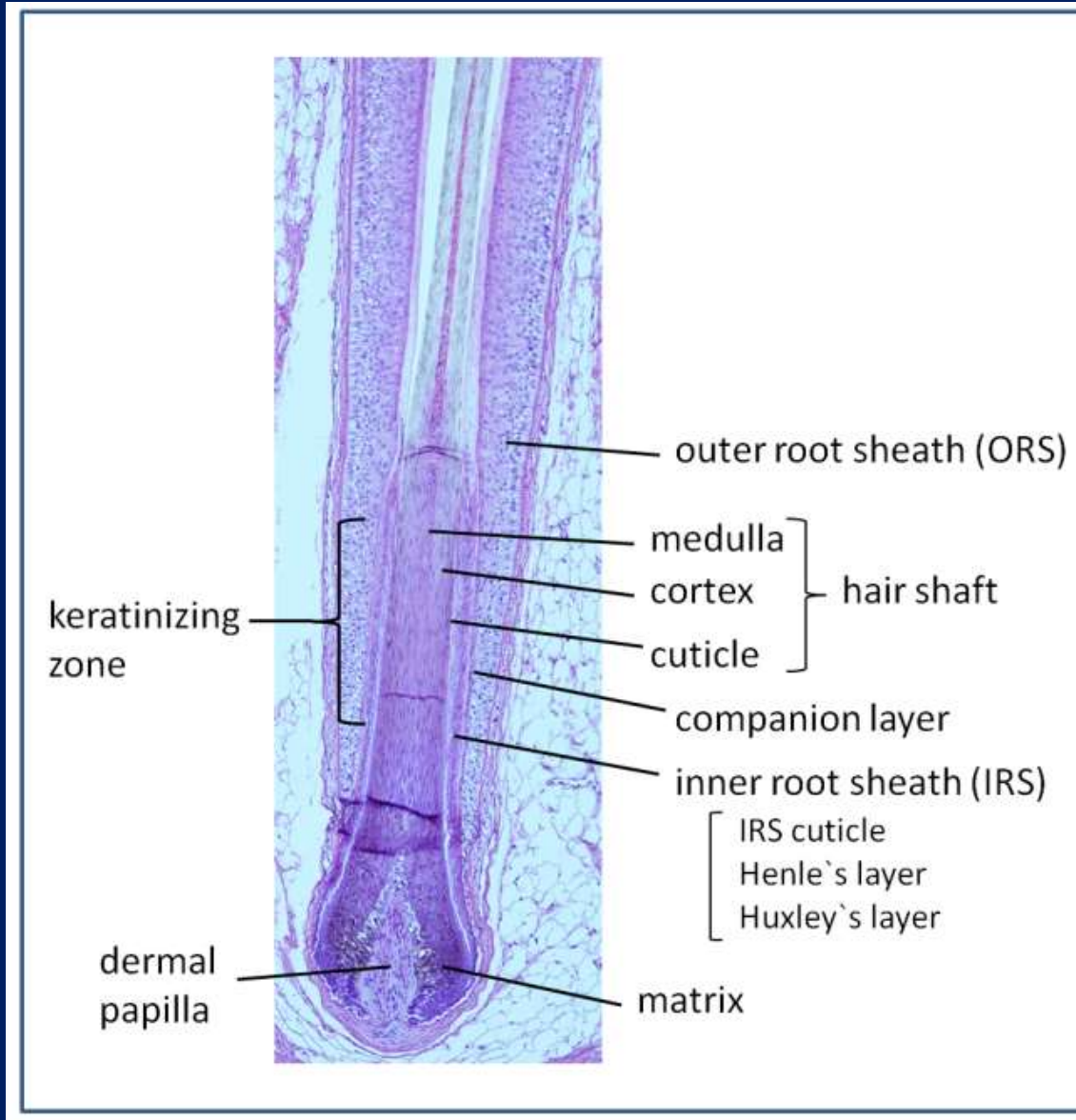
- Invaginations of epidermis surrounded by connective tissue of dermis.
- Glassy membrane (homogenous modified basement membrane)^{Smooth} separates epidermis from dermis.
- External root sheath – single layer of cells at the hair root, several layers near the surface of the skin.



- Internal root sheath (3-4 cell layers) - ends where the duct of sebaceous gland attaches to the hair follicle.
- The hair shaft consists of 3 regions: medulla, cortex and hair cuticle. Medulla is present only in thick hair. The cells of cortex synthesize keratin filaments and trichohyalin granules (similar to keratohyalin granules in epidermis).

Skin appendages

HAIR FOLLICLES



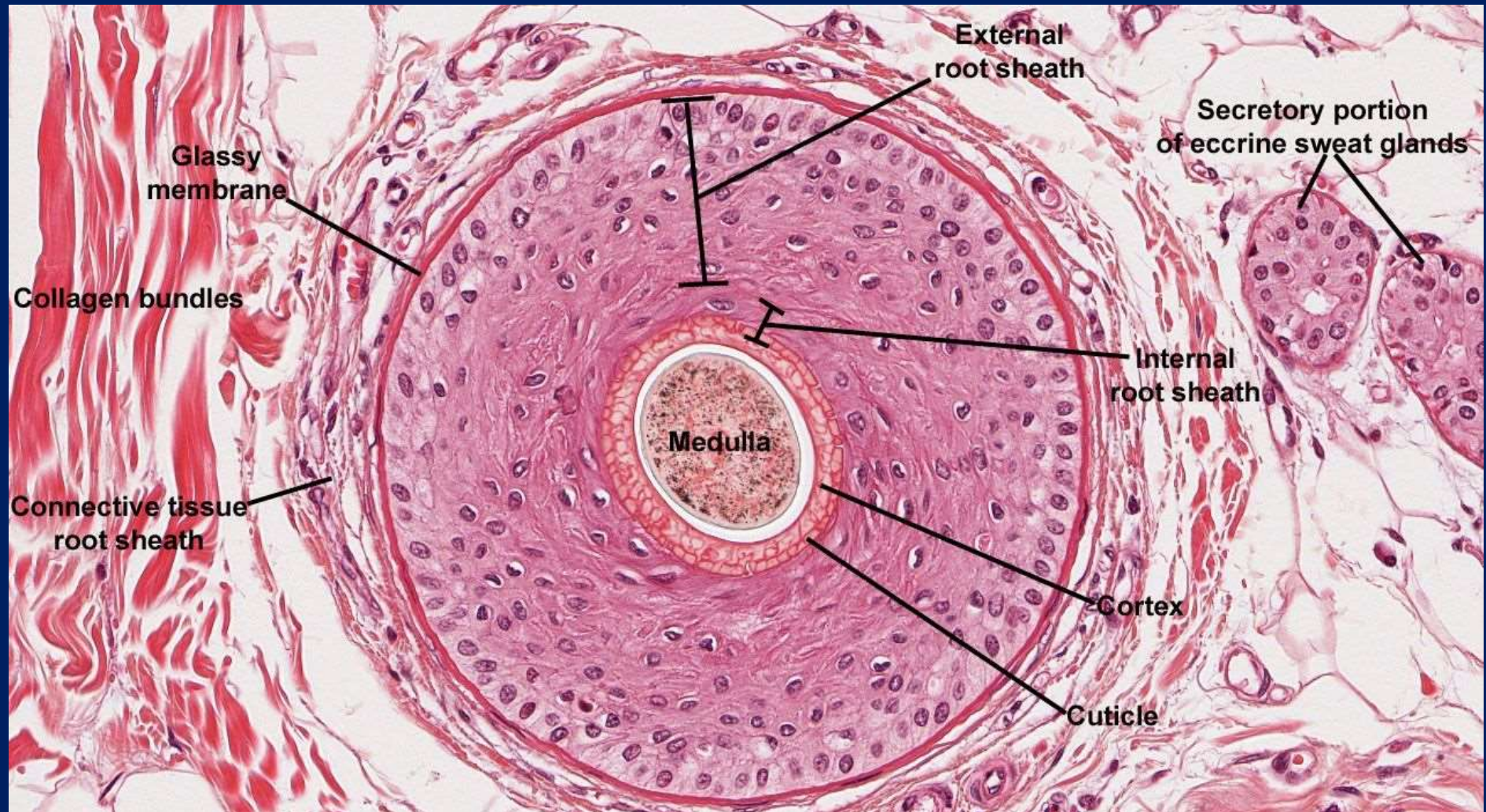
- The hair root and dermal papilla form hair bulb. Over bulb stem is located.

- Melanocytes are present among the cells of matrix (color of the hair).



Skin appendages

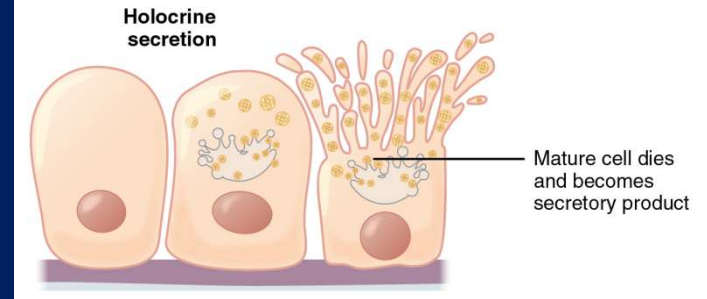
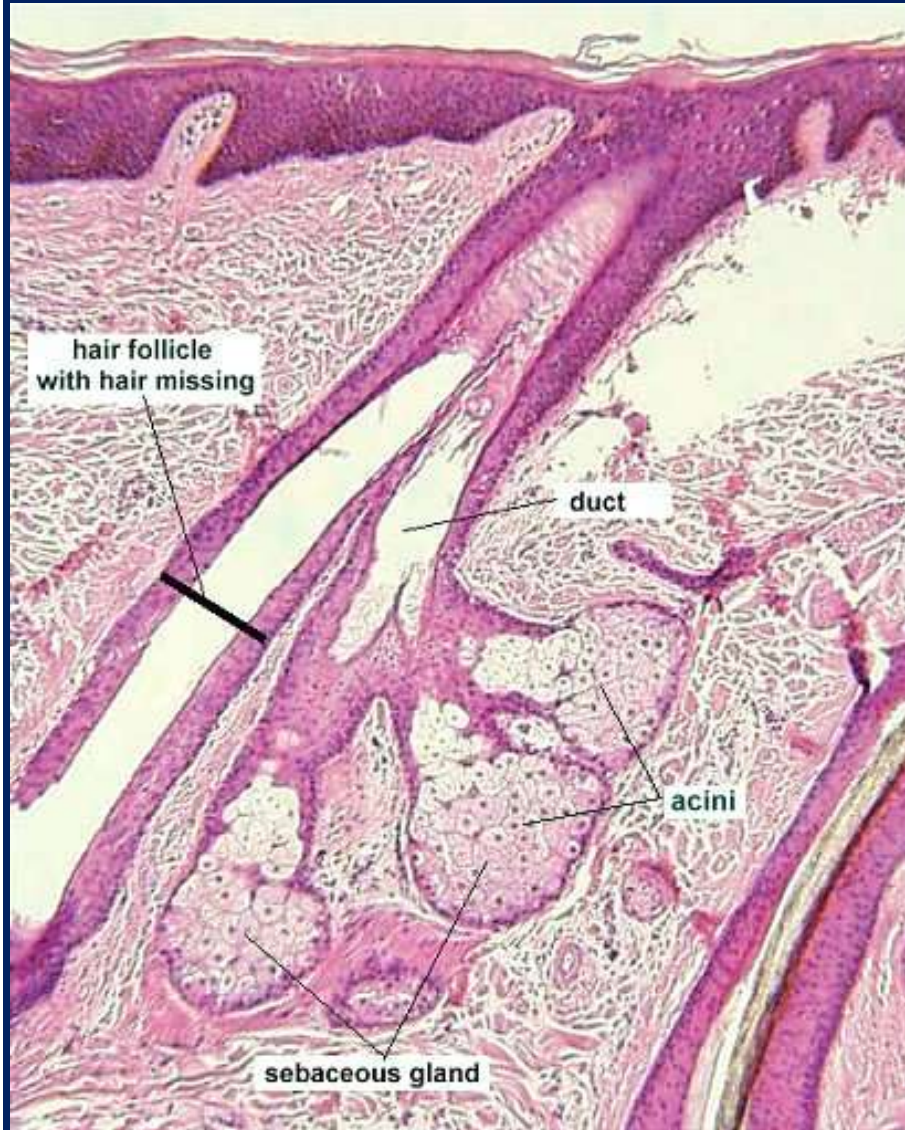
HAIR FOLLICLES



Root of the hair in cross-section

Skin appendages

SEBACEOUS GLANDS (HOLOCRINE GLANDS)

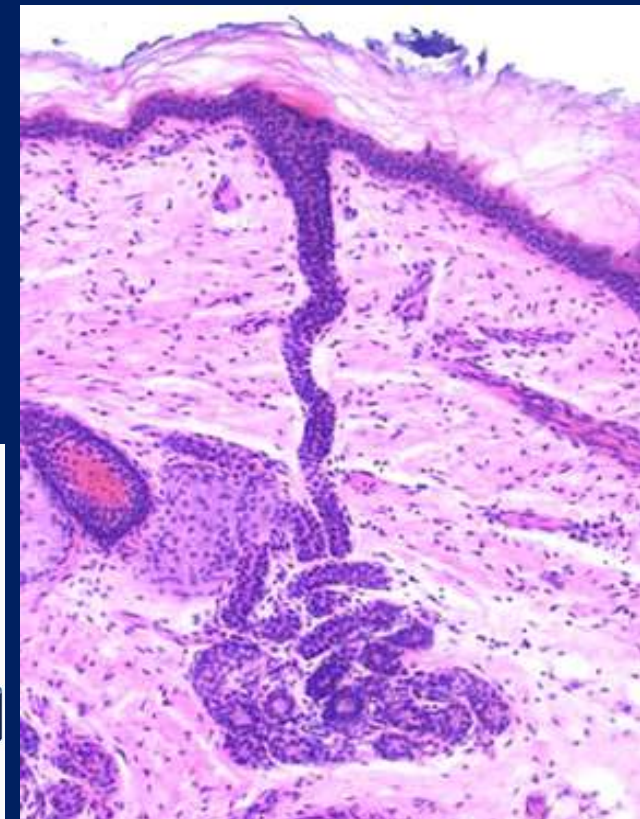
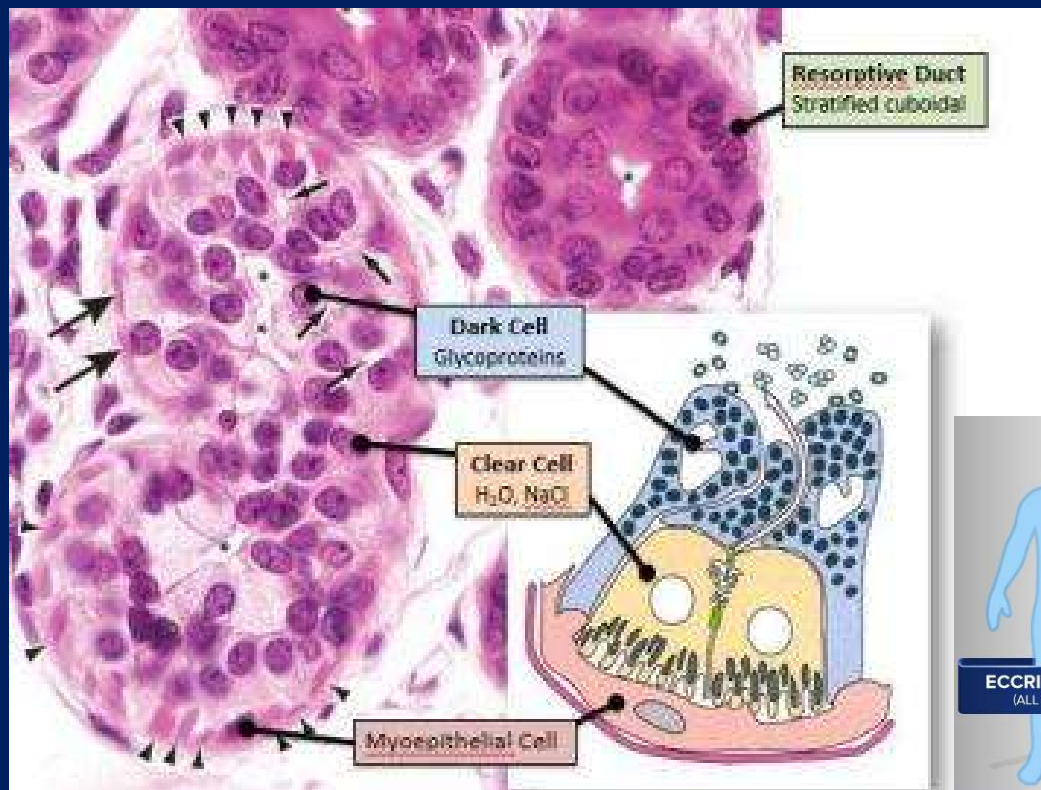


- Cells of the sebaceous glands contain abundant lipid droplets known as sebum
- Lobular glands with clusters of acini opening into short duct (stratified squamous epithelium).
- Basaloid germinative cells surrounding the lobule give rise to the lipid-filled cells, which are then expelled into the infundibular segment of the hair follicle via the sebaceous duct.
- Are under influence of sex hormones and increase their activity after puberty.

Skin appendages

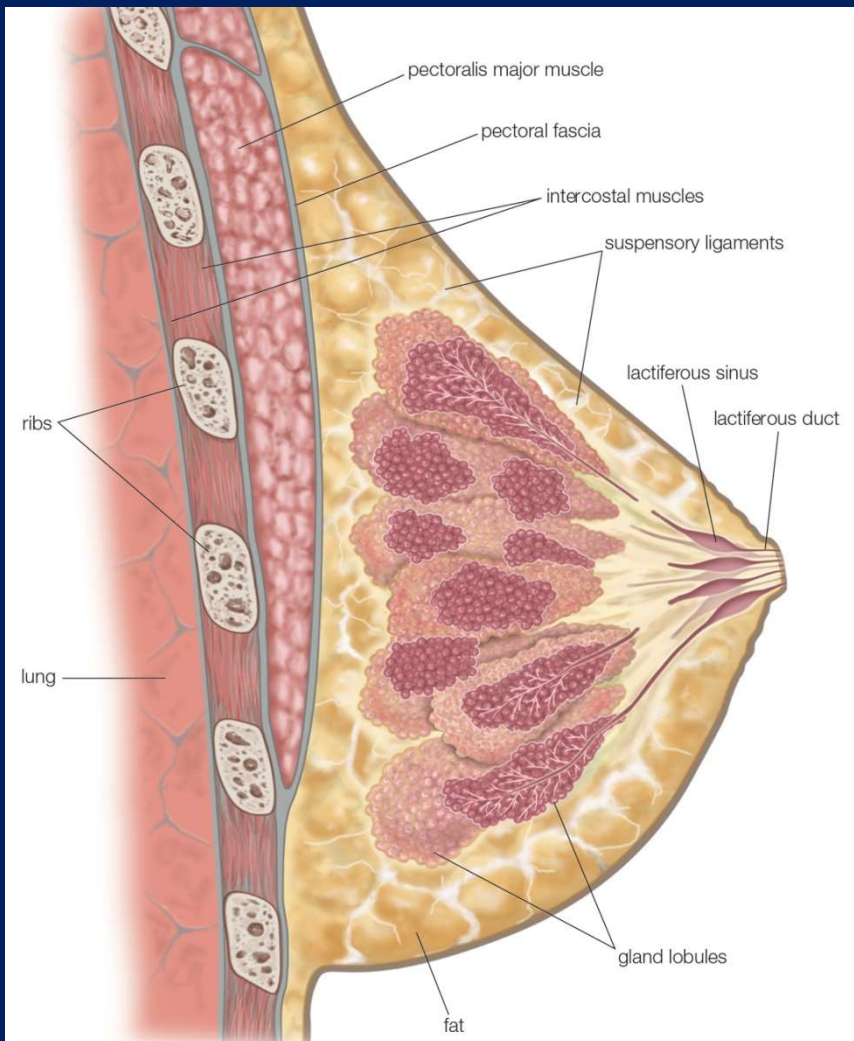
SWEAT ECCRINE (MEROCRINE) GLANDS

- Abundant (especially in thick skin). They can reach up even to hypodermis.
- Each gland contains a single coiled secretory unit (simple cuboidal to low columnar) and a single duct (2 layers columnar epithelium) coiled in dermis.
- Secretory unit is composed of dark cells (produce mucus) and clear cells (watery solution). Secretory unit is surrounded by mioepithelial cells (contraction).



MAMMARY GLANDS

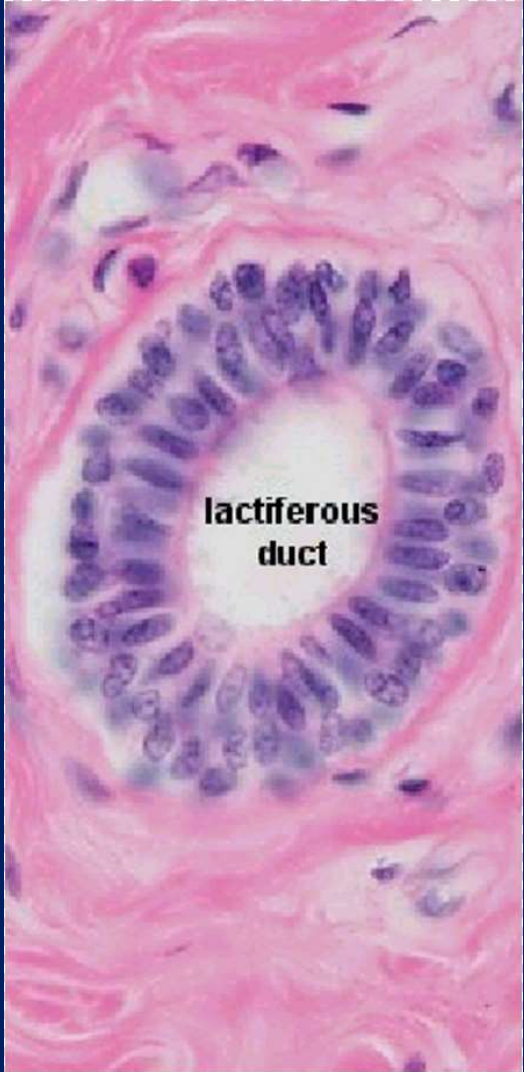
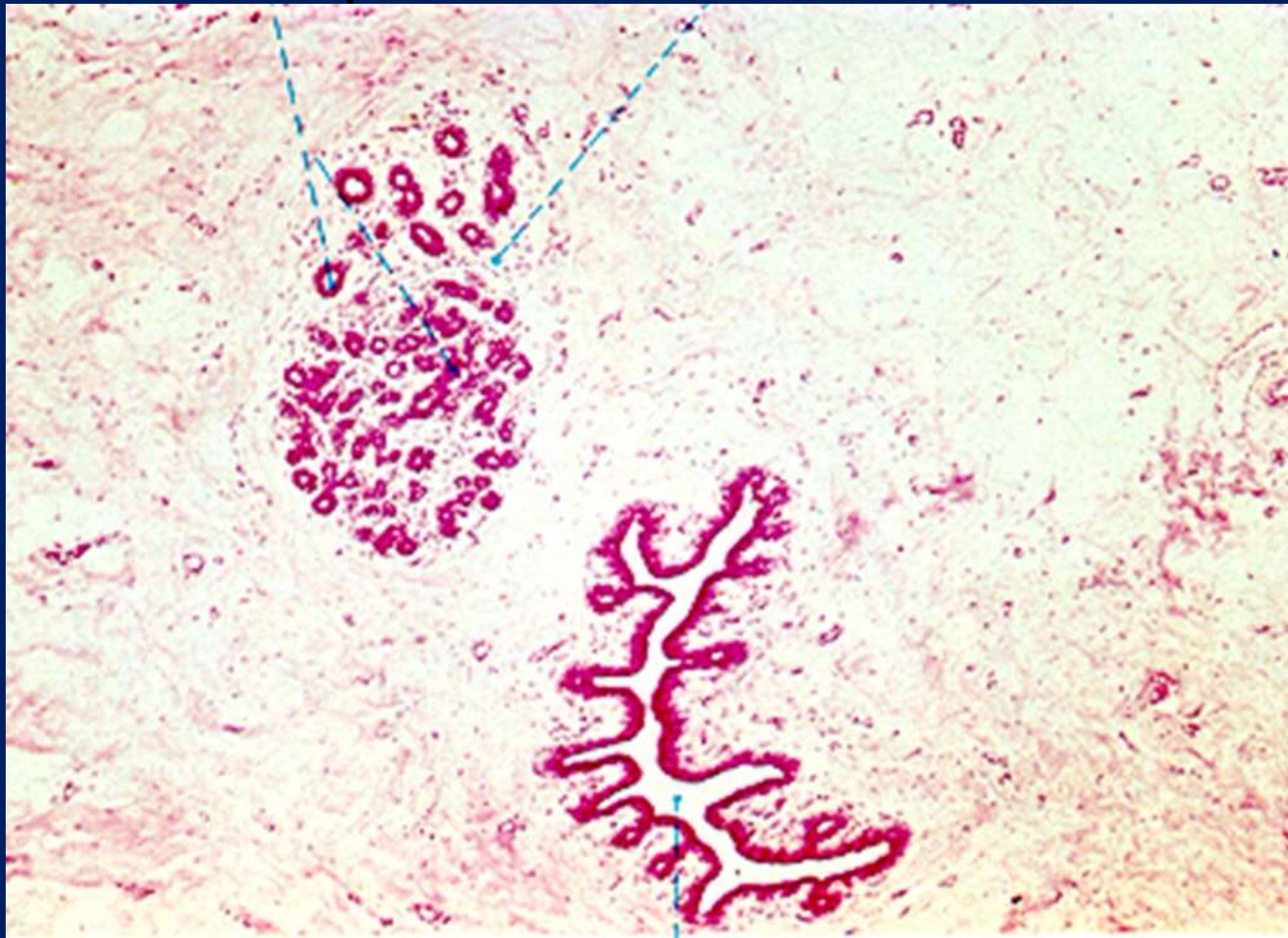
Production of colostrum (protein rich fluid) and later milk (fluid with proteins, lipids, lactose, white blood cells, IgA antibodies, minerals, vitamins) to nourish the newborn.



- **Compound tubuloalveolar glands composed of 15-20 lobes radiating from the nipple and separated from each other by adipose and collagenous connective tissue (stroma).**
- **Each lobe is drained by lactiferous duct leading to the nipple, where it opens.**
- **Ducts possess dilated lactiferous sinuses for milk storage.**

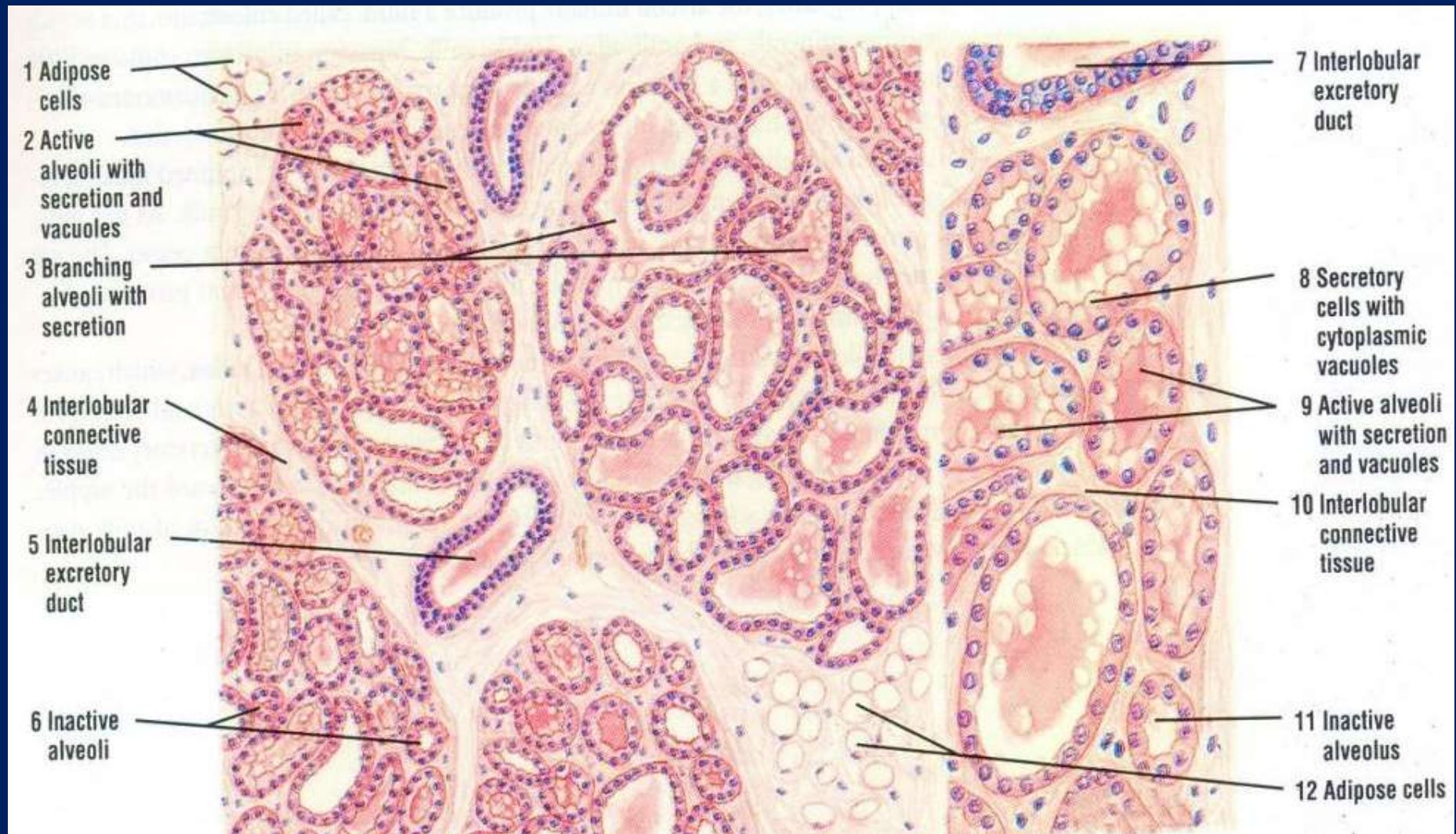
INACTIVE MAMMARY GLAND OF NULLIPAROUS WOMAN

Resting gland **Surrounding
connective tissue**

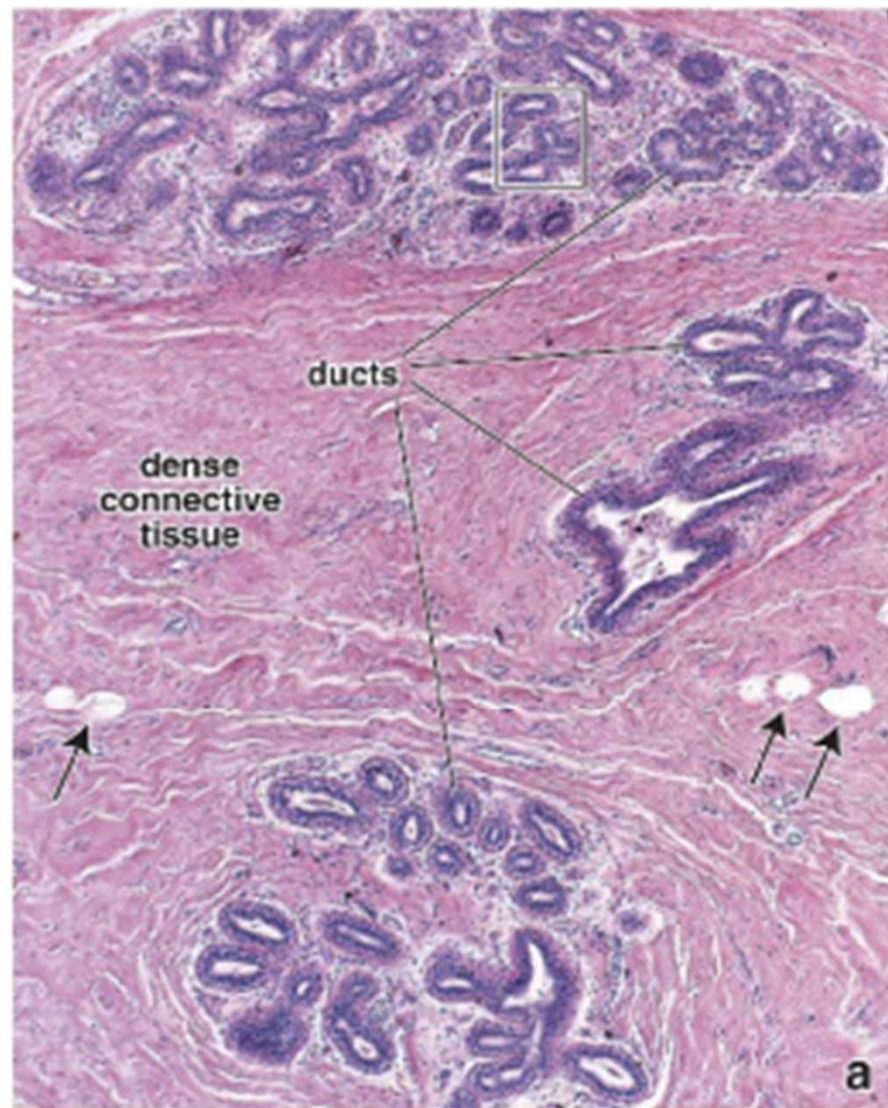


excretory duct

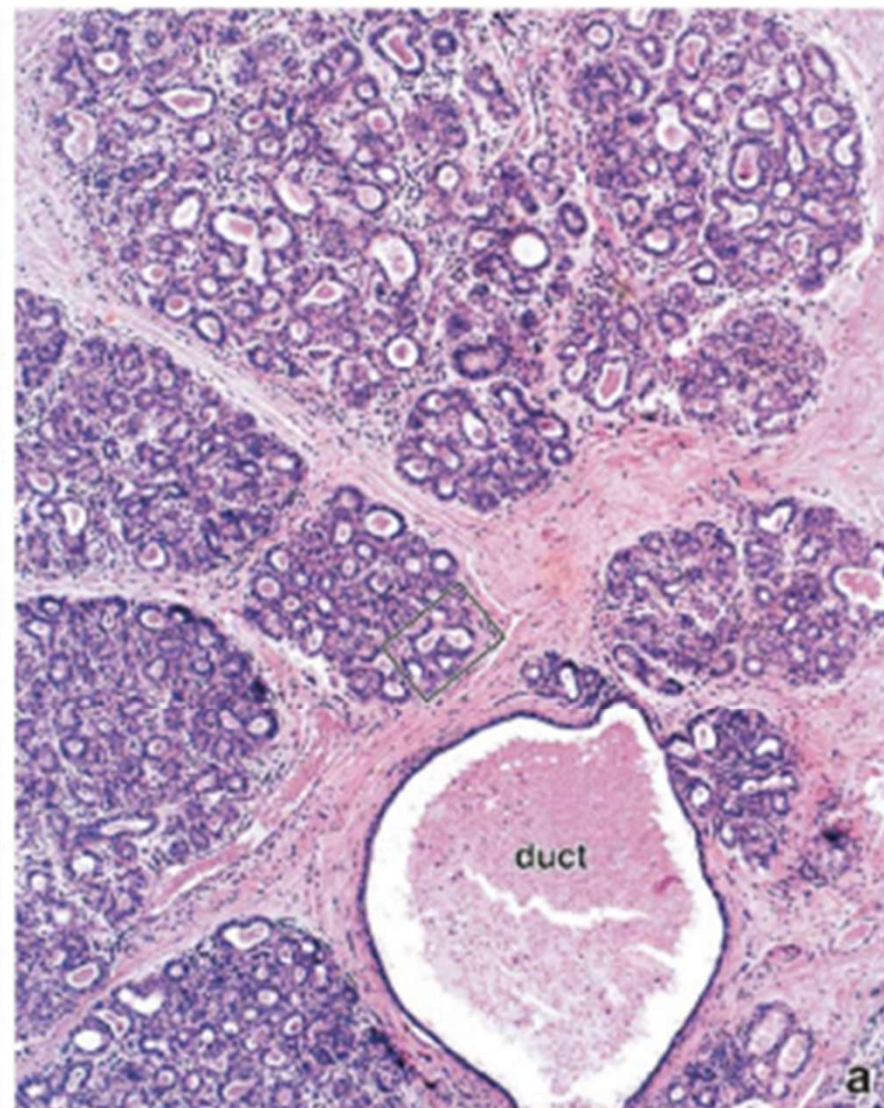
ACTIVE (LACTATING) MAMMARY GLAND



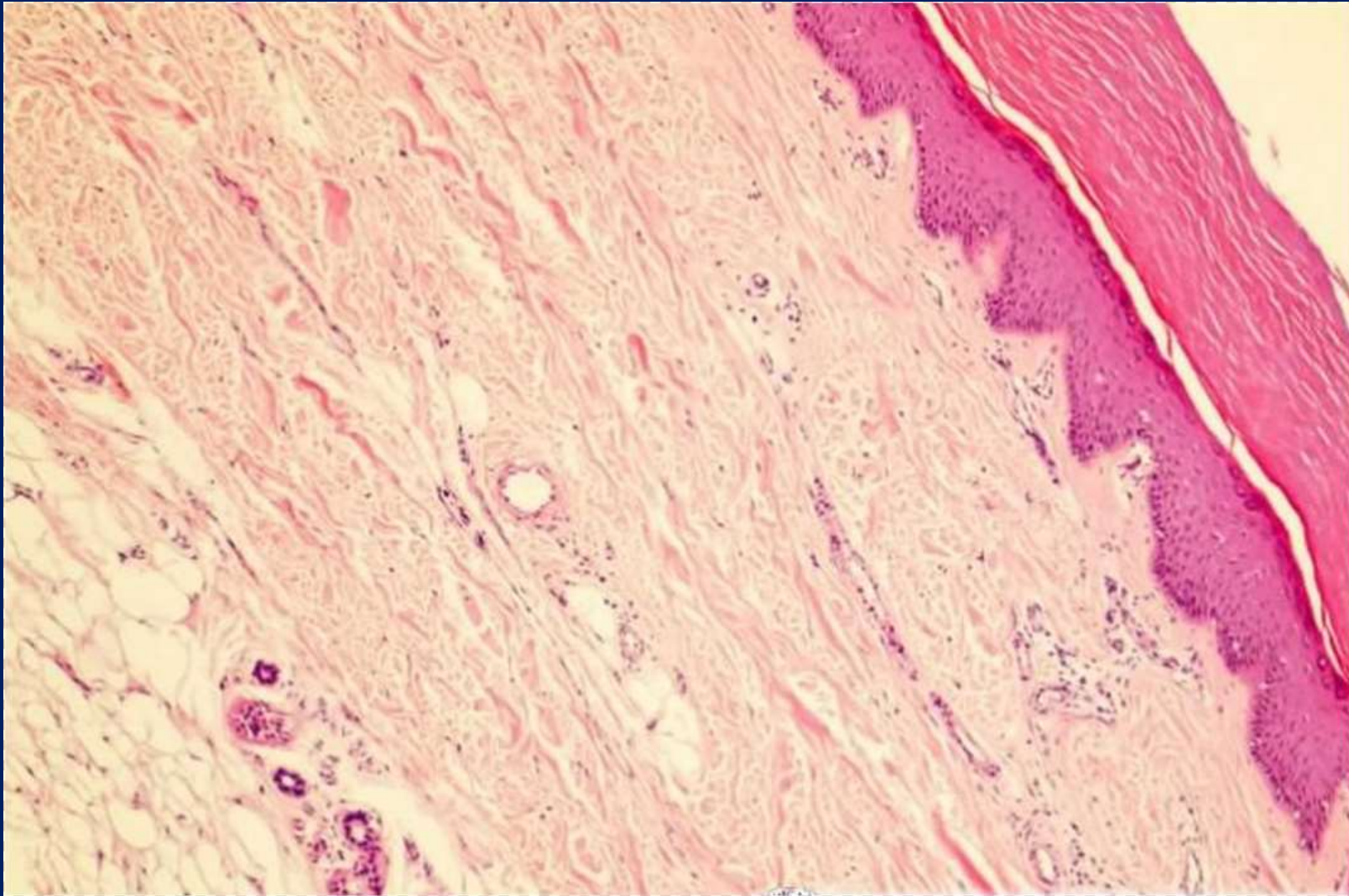
Inactive Mammary Gland



Active Mammary Gland

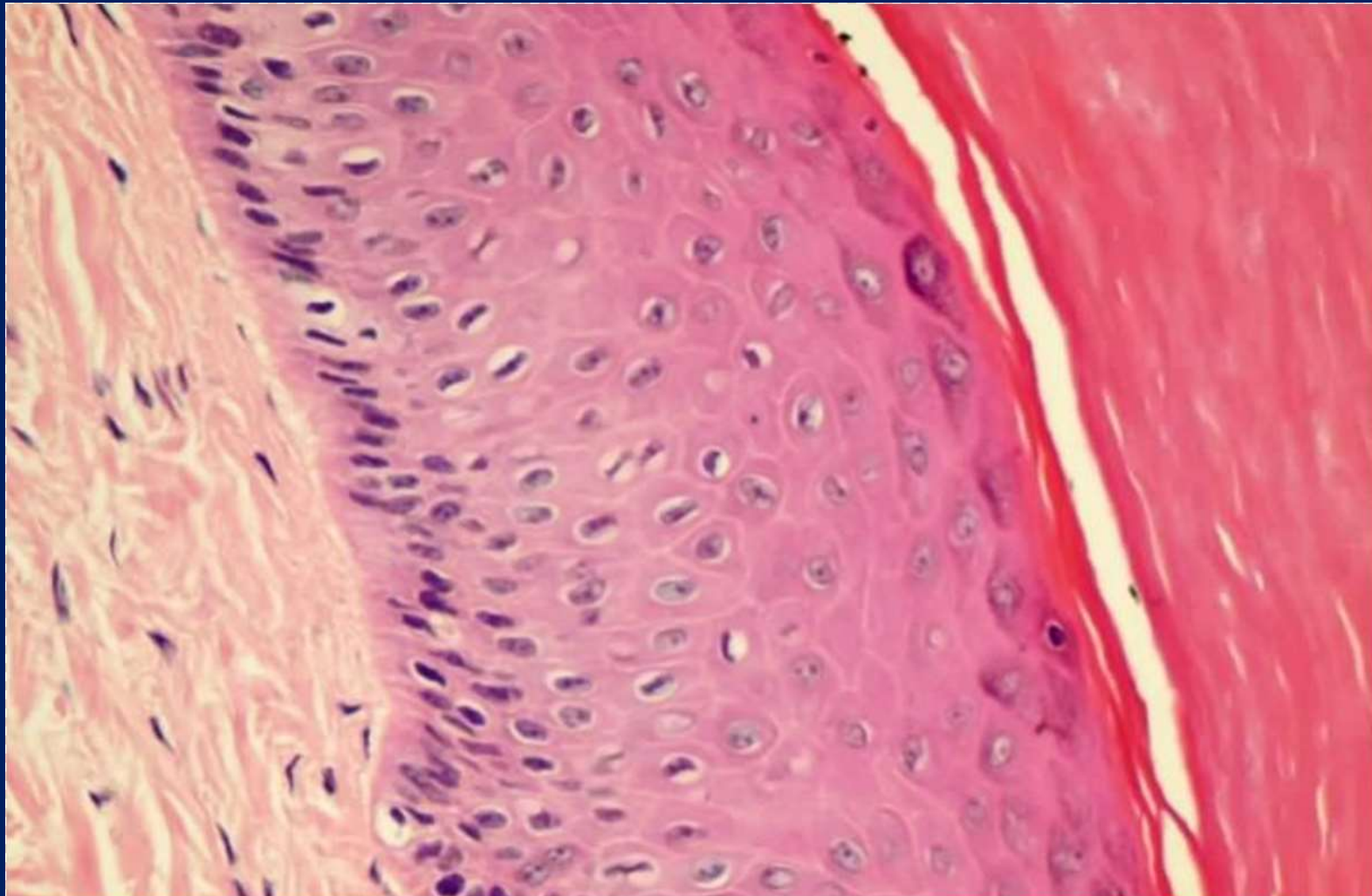


NO HAIRY SKIN NO.83



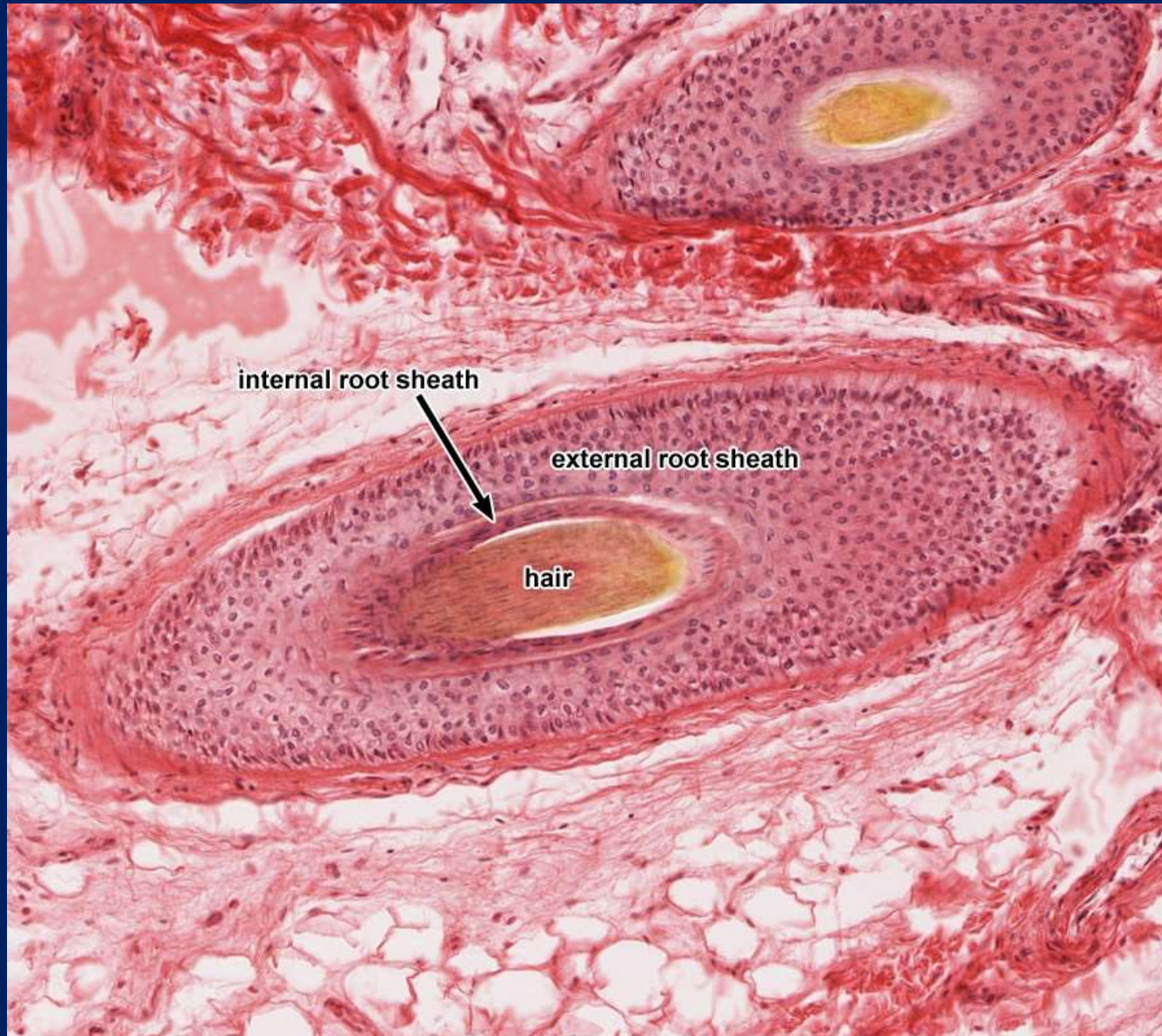
Draw and describe: epidermis, papillary layer, reticular layer, hypodermis and sweat glands if it is possible

NO HAIRY SKIN NO.83

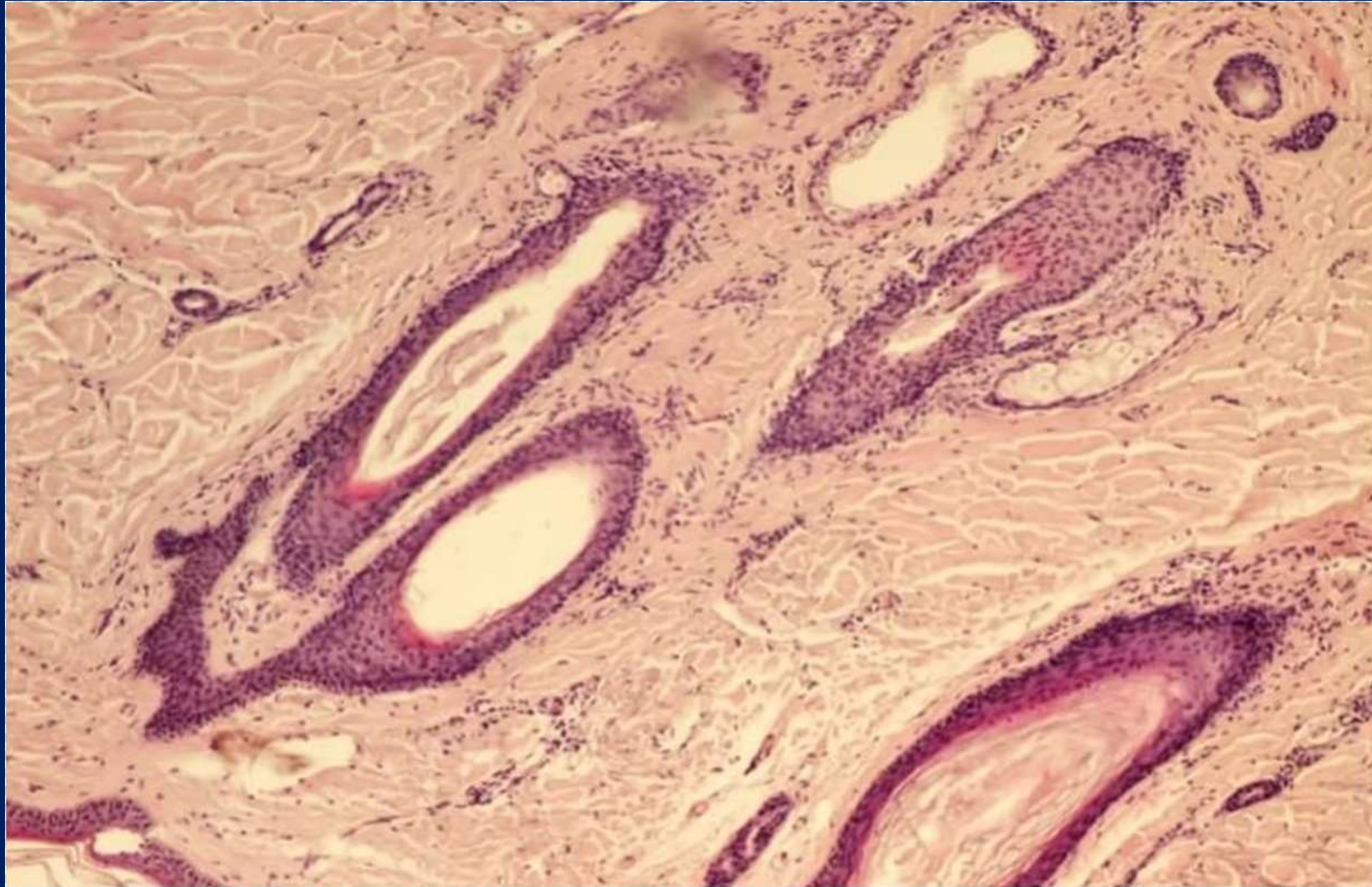


Draw and describe: stratum basale, spinosum, granulosum and corneum and, if it is possible, stratum lucidum

HAIRY SKIN NO. 85

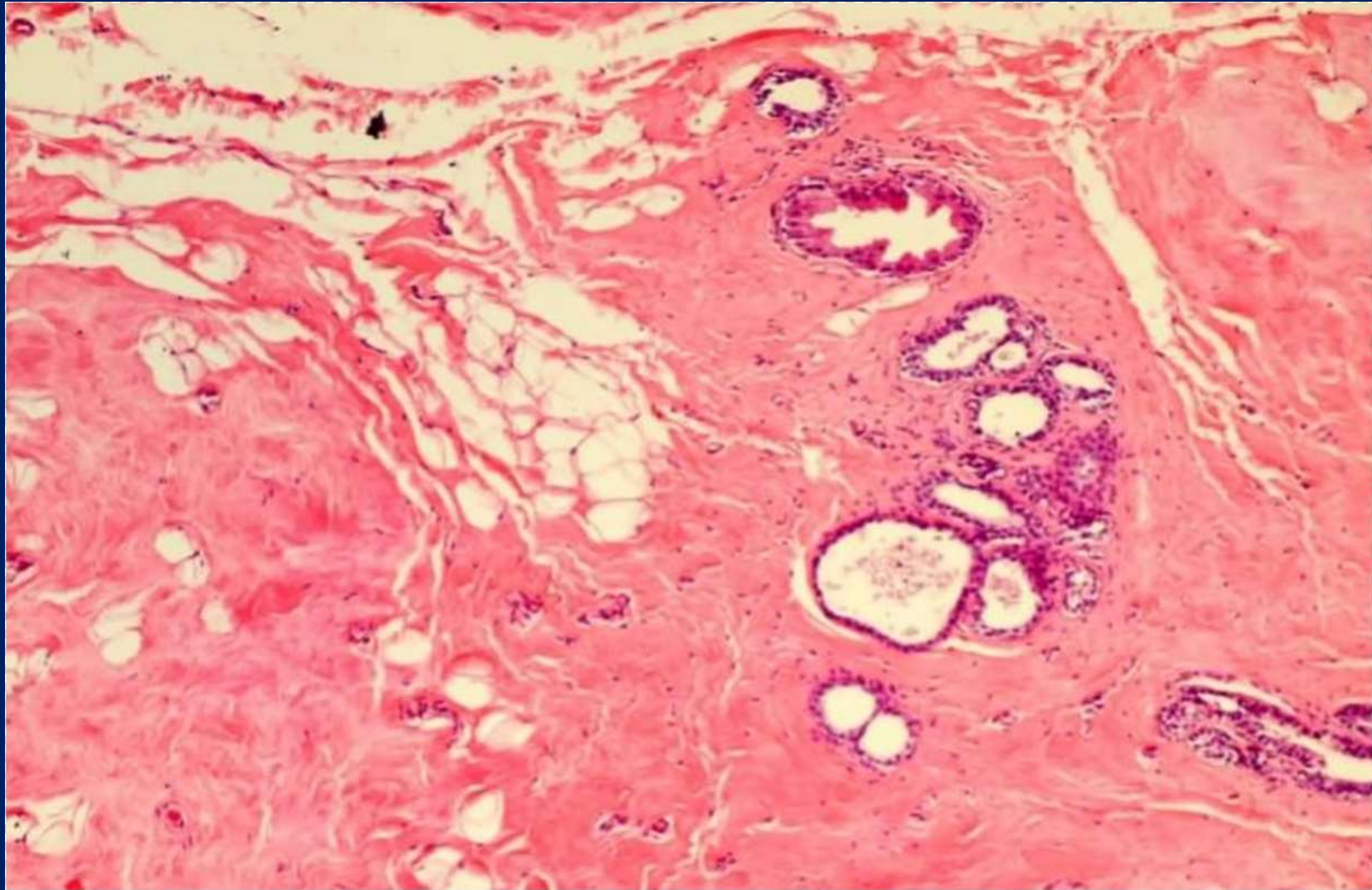


HAIRY SKIN NO. 85

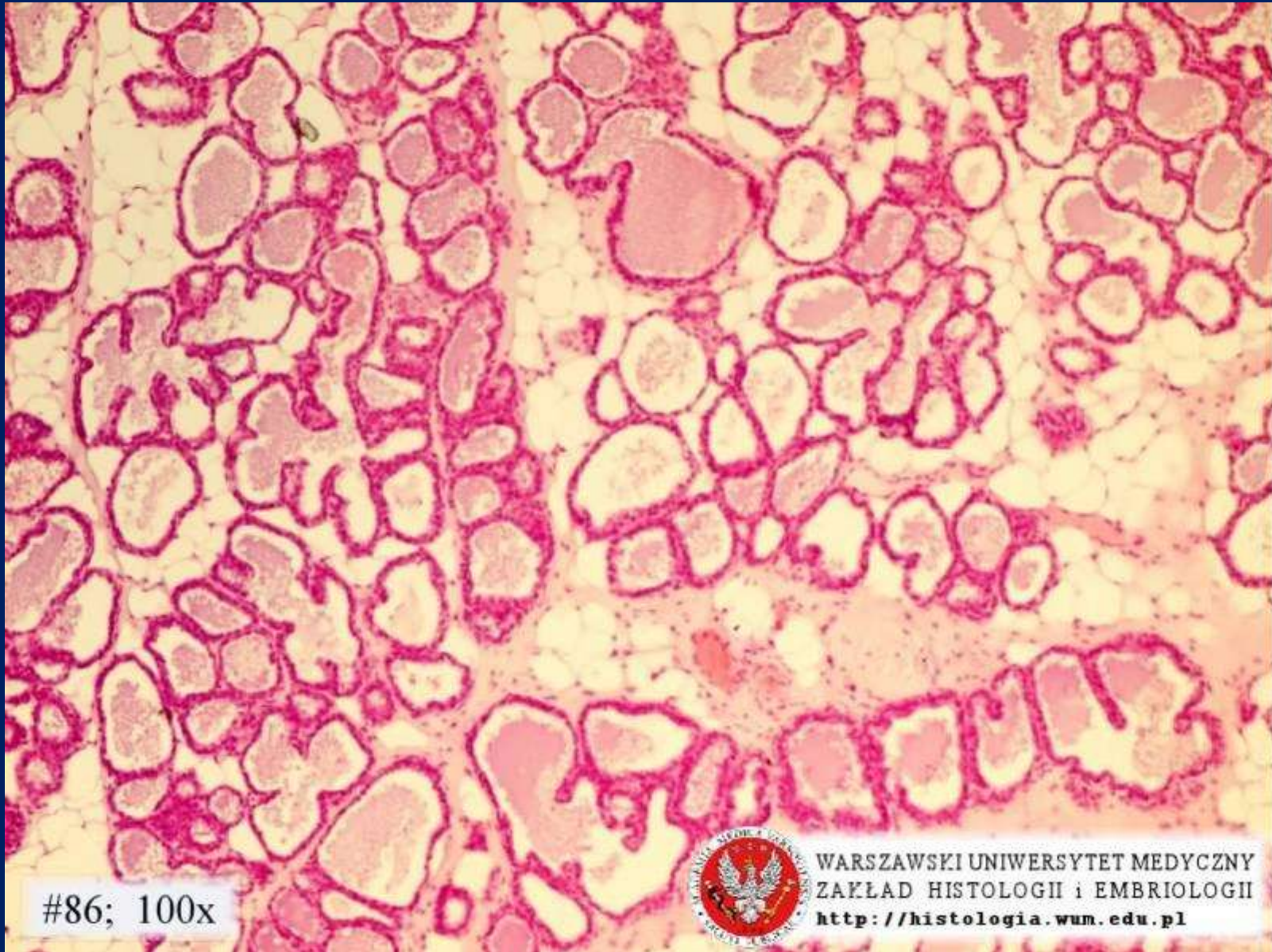


Draw and describe; hair follicle, external root sheath, sebaceous gland and, if it is possible, hair bulb with dermal papilla.

INACTIVE MAMMARY GLAND NO. 87



ACTIVE (LACTATING) MAMMARY GLAND NO. 86



#86; 100x

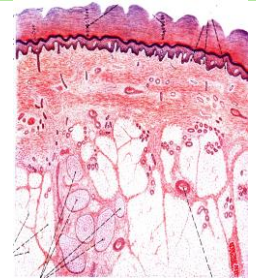


WARSZAWSKI UNIWERSYTET MEDYCZNY
ZAKŁAD HISTOLOGII i EMBRIOLOGII
<http://histologia.wum.edu.pl>

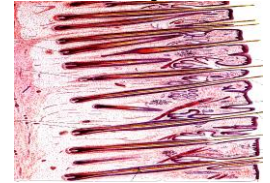
Seminar: Structure and function of skin, development of the mammary gland. The sense organs. Structure of the eye.

Practical class: Skin & its appendages, mammary gland. Eye ball.

- nohairy skin (no. 83),
- hairy skin (no. 85),
- active (lactating) mammary gland (no. 86),
- inactive mammary gland (no. 87),
- eye ball (no.81),



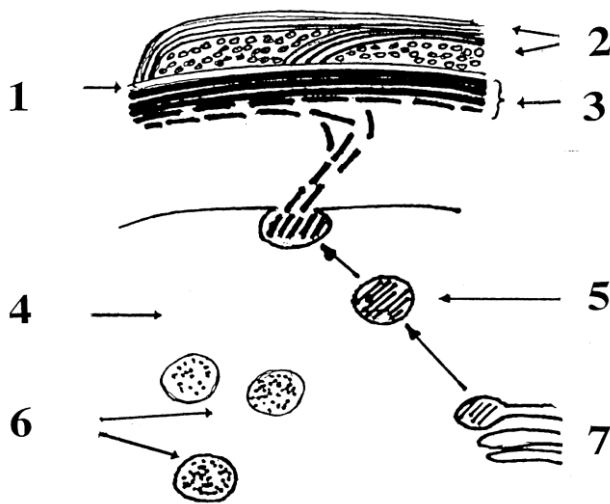
nonhairy skin



hairy skin

- keratinization (fig. # 14),
- hemidesmosomes in epidermis, the border epidermis – dermis (EM # 131),
- the structure of human epidermis (fig. # 15),

Schema # 14

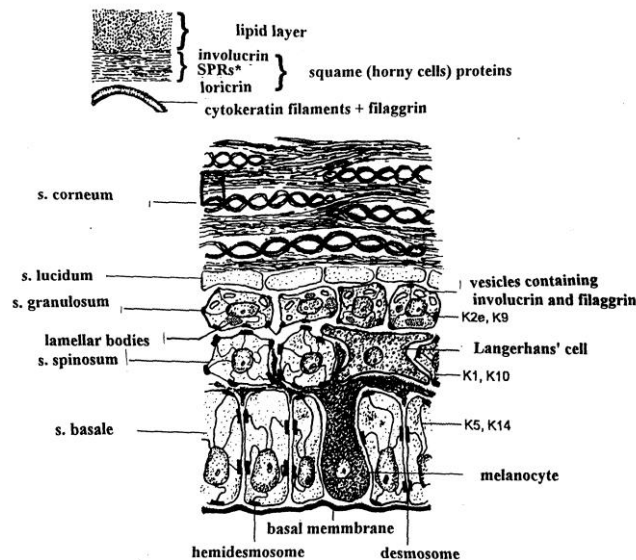


- 1- Cell from stratum corneum
- 2- keratin + involucrin, cytokeratins and filaggrin
- 3- ceramide layer - 4- stratum granulosum cells
- 5- lamellar bodies
- 6- vesicles containing profilaggrin and involucrin
- 7- Golgi apparatus

Epidermal cells of stratum granulosum and stratum lucidum synthesize proteins: profilaggrin and involucrin, as well as lipid acylglycosylceramide. These compounds are localized in the cytoplasmic granules, formerly known as "keratohyaline granules". In keratinizing cells the polypeptide filaggrin (name derived from filament aggregation) binds cytokeratin filaments and produce keratinizing masses in the internal (proximal) part of keratinizing cells. Involucrin molecules aggregate and produce keratinizing masses in the external (distal) part of the keratinizing cell.

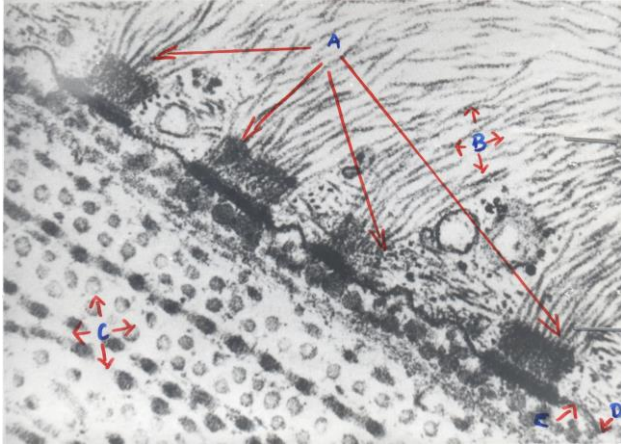
Ceramide forms lamellae in the cytoplasmic vesicles, thus such vesicles are named "lamellar bodies". Ceramide lamellae are secreted into the space between the granular and keratinizing cells, and under the cell membrane of keratinizing cells they form a lipid layer, which is not permeable to water.

Fig. # 15 THE STRUCTURE OF HUMAN EPIDERMIS



* small proline rich proteins

EM # 131



Hemidesmosomes in epidermis, the border of epidermis and dermis, collagen fibres

- A - Hemidesmosomes
- B - cytokeratin filaments
- C - cross-sections of collagen fibres
- D - keratinocyte cell membrane
- E - basal lamina
- D+E - border lines between epidermis and dermis