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Cells and Tissues Sequence
Medical Histology

Integumentary System,
Glands/mammary gland

Fall, 2008

Cell and Developmental Biology

The Integument

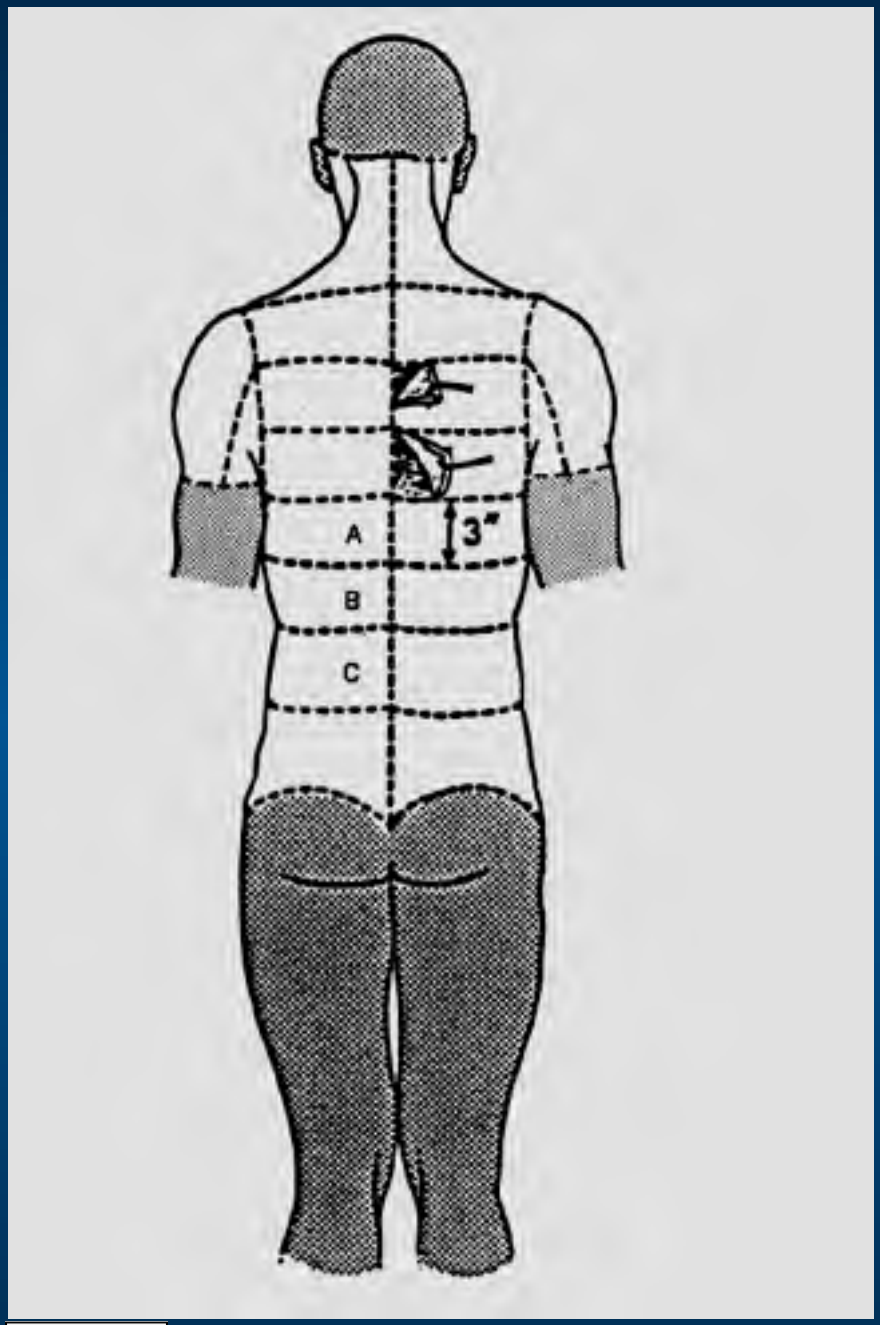
1. Skin: *Epidermis and Dermis*
   Hypodermis (a.k.a. superficial fascia)
2. Appendages: *Specialization of epidermis*

   A. Pilosebaceous apparatus
      - *Hair*
      - *Sebaceous glands*
      - *Arrecto pili muscle*

   B. Sweat glands
      - *Eccrine sweat glands*
      - *Apocrine (odoriferous) sweat glands*

   C. Nail

"Mammary gland"



 UM Medical School Anatomy Laboratory Manual

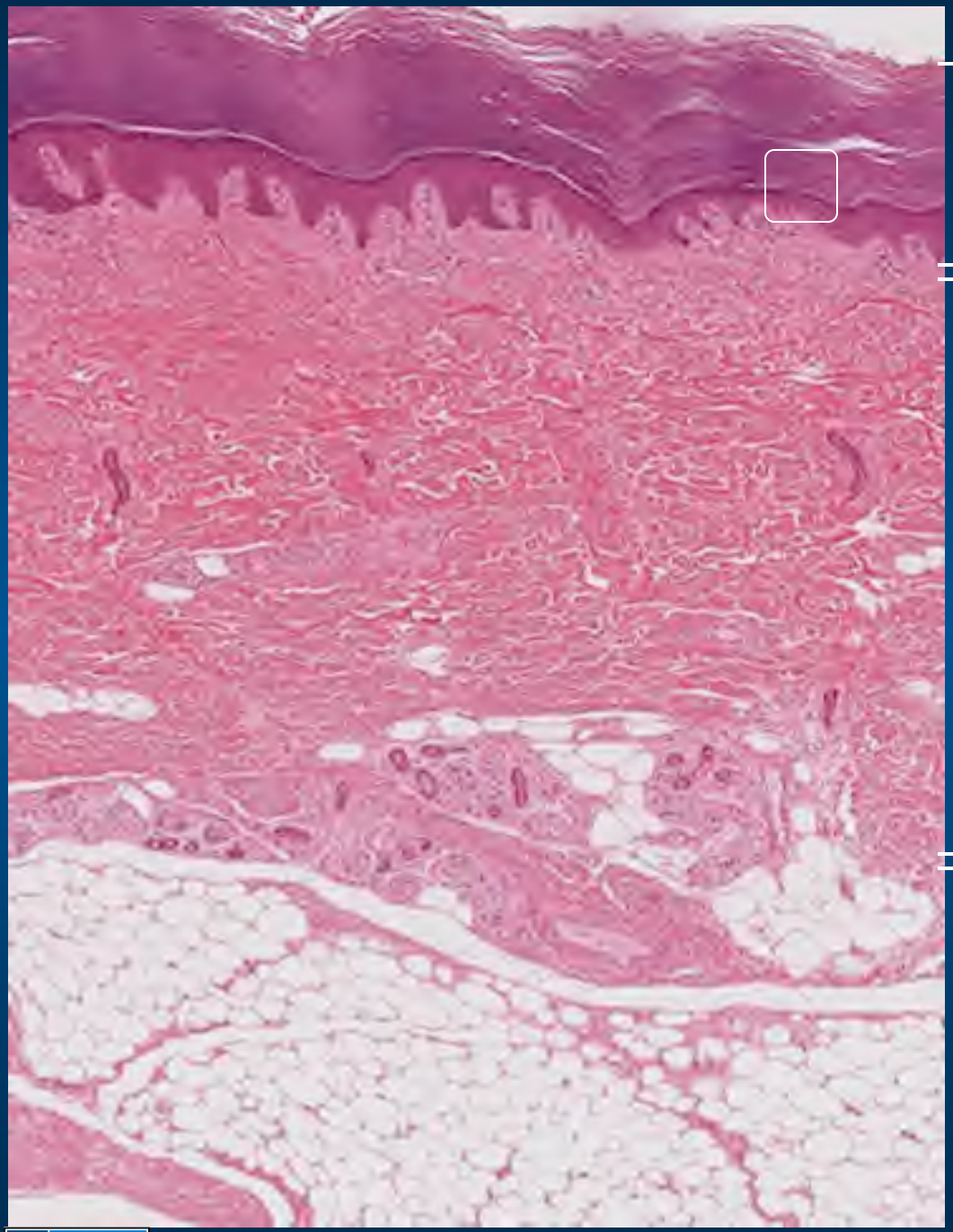
The skin consists of epidermis and dermis

and is the largest organ in the body,

accounting for about 16% of the body weight.

Functions of skin

1. *Protection (from abrasion, friction, infection, UV rays)*
   - *Keratin, melanin*
2. *Permeability Barrier (prevention of extreme water loss)*
   - *Keratin, lipid, sebum*
3. *Thermoregulation*
   - *Sweat glands, blood vessels, fat*
4. *Sensory Perception*
   - *Free and encapsulated nerve endings*
5. *Immunologic Defense*
   - *Keratinocytes, Langerhans cells*
6. *Dermatoglyphics (fingerprints)*



Skin

Epidermis:

Keratinized, strat. sq. epithelium

Dermis:

Dense irregular ct.

Type III and

Type I collagen

Elastic fibers

Sweat Glands:

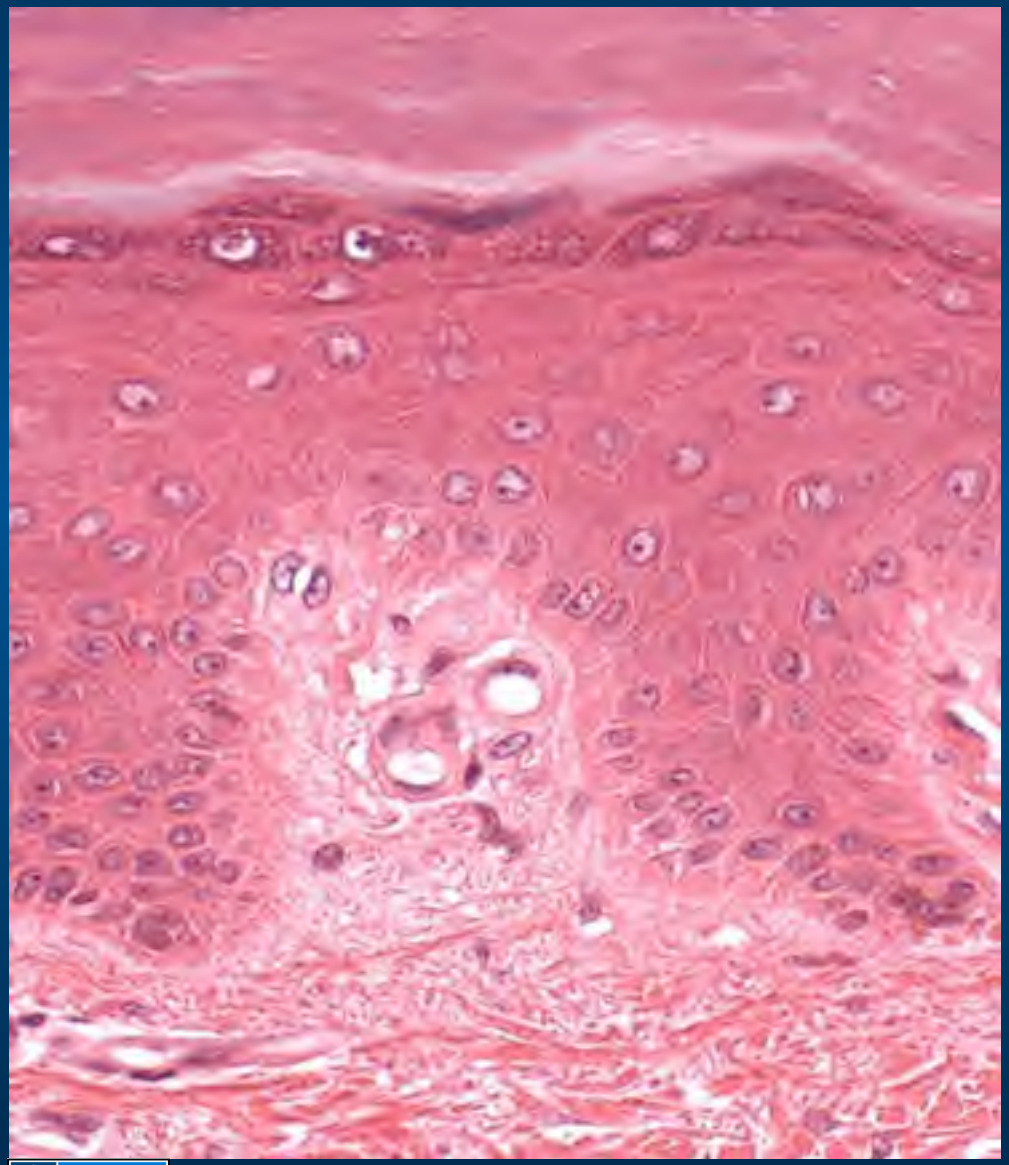
Eccrine and

Apocrine glands

Hypodermis (superficial fascia):

Fatty conn. Tissue

Cells of the Epidermis



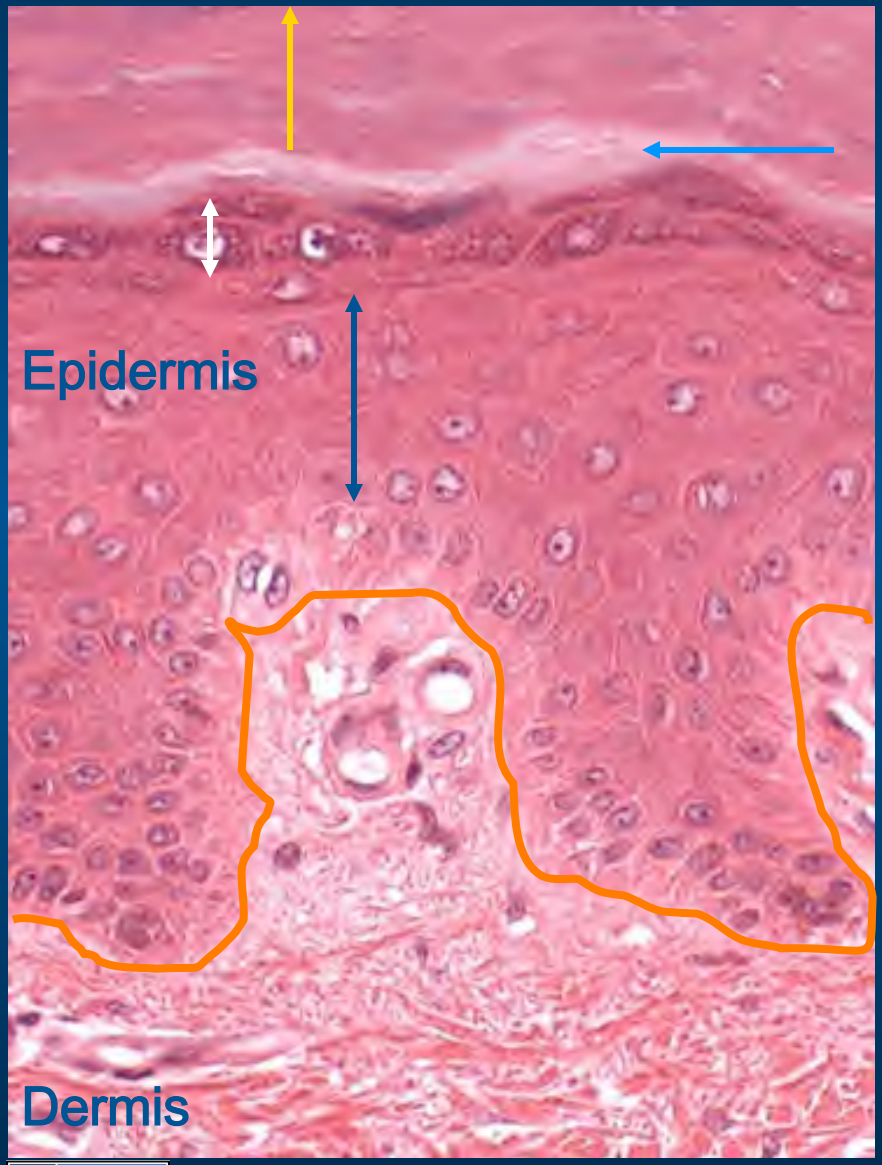
Keratinocytes *(*80%)

Melanocytes *(5-10%)*

Langerhans cells *(5%)*

Merkel cells *(<1%)*

Cellular Layers of the Epidermis



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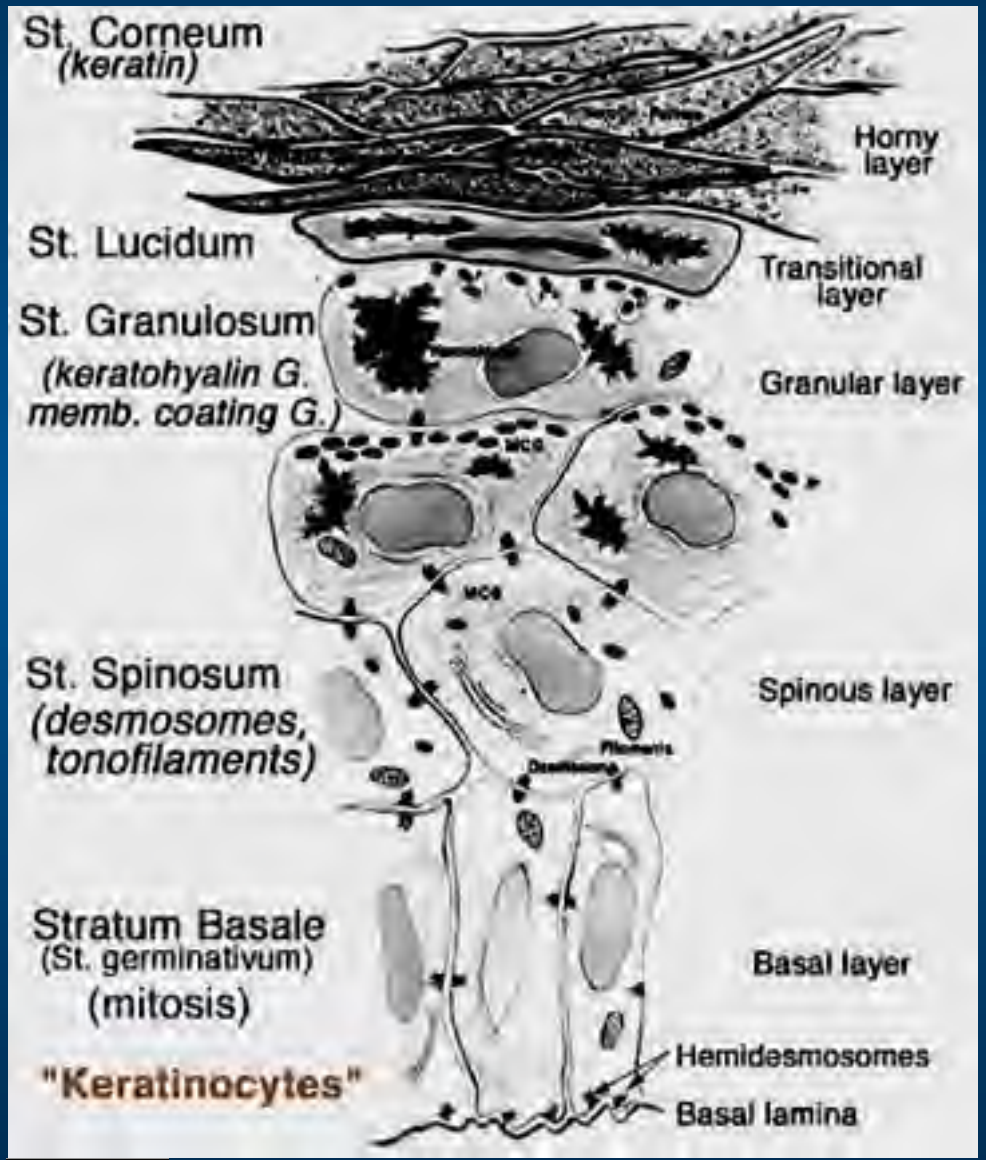
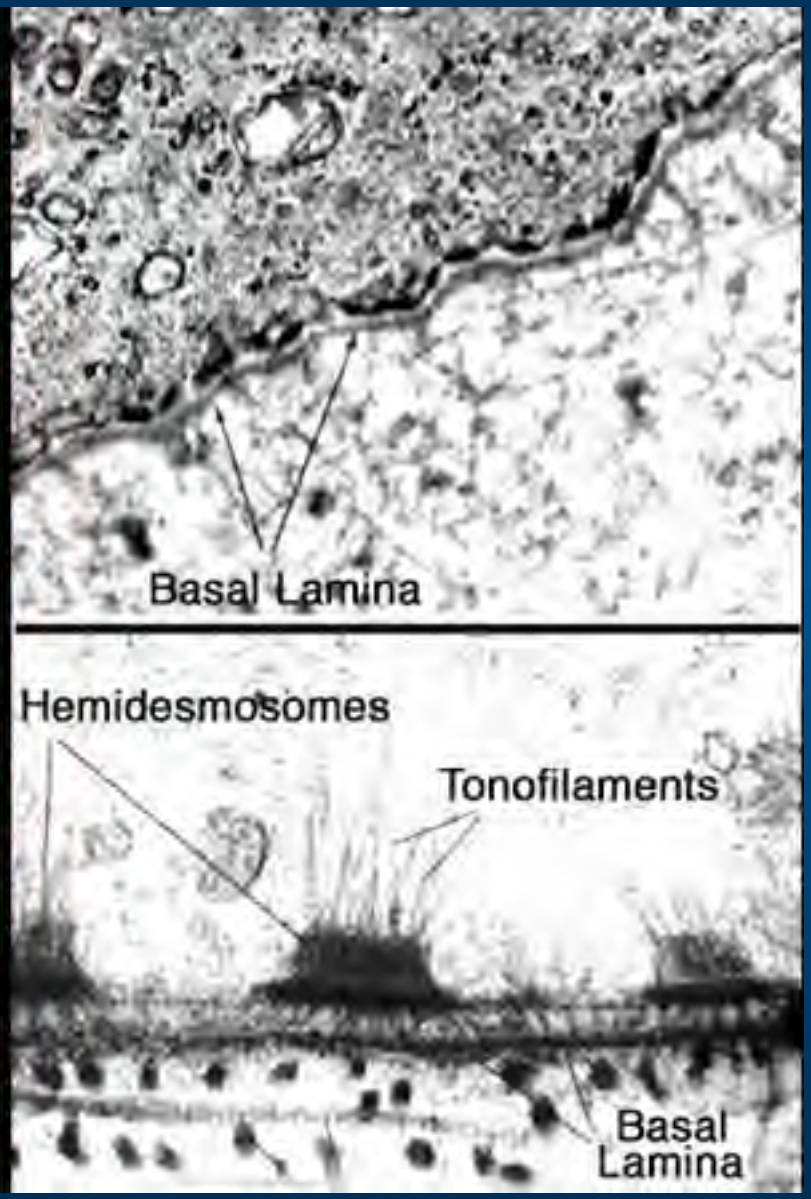
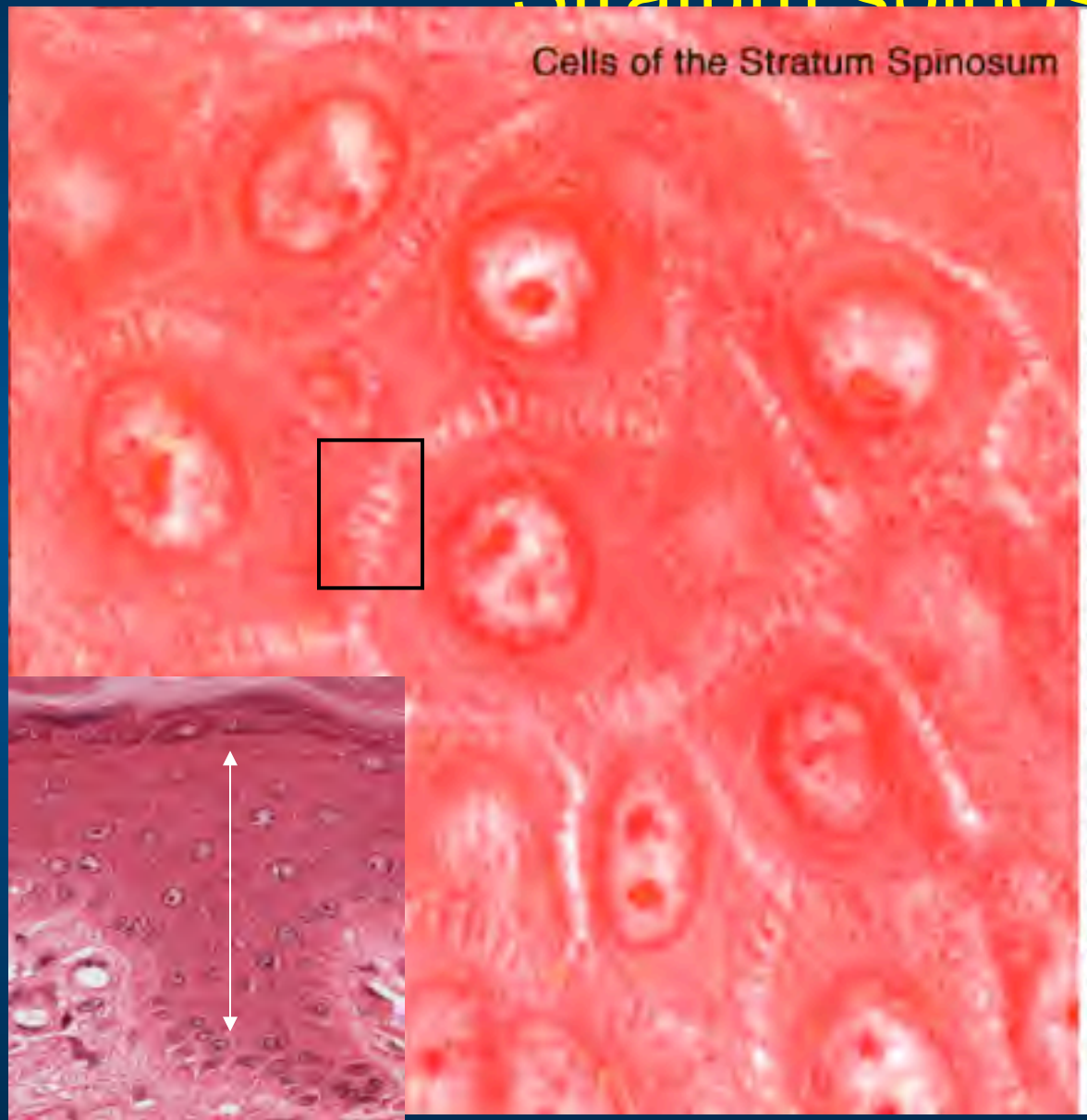


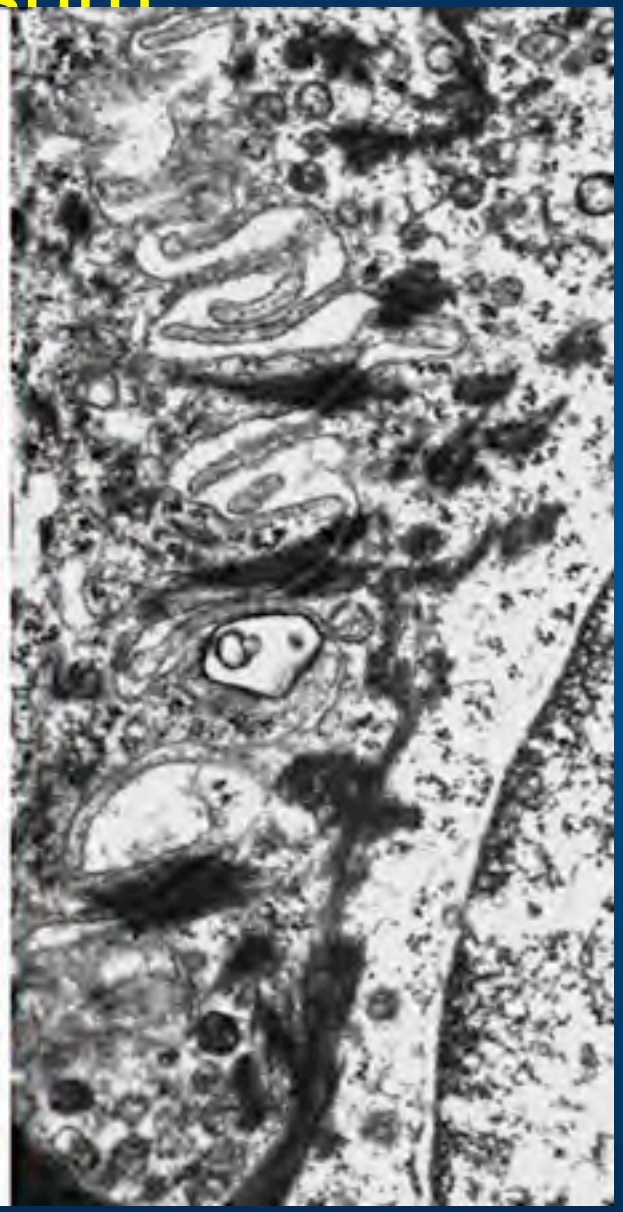
PD-INEL Weiss, L., Cell and Tissue Biology 6th ed. P. 543

Cells of the Stratum Basale



Stratum spinosum





Blistering Skin Disorders

Pemphigus: *Separation of epidermal cells from each other (acantholysis) caused by loss of desmosome functions.*

Bullous pemphigoid: *Separation of epidermis from the dermis due to blistering in the basement membrane caused by loss of anchoring filaments and hemidesmosomes.*

Stratum Granulosum

Keratohyalin Granules (KG)

Histidine-rich protein (filaggrin: filament aggregating protein that cross -links keratin)

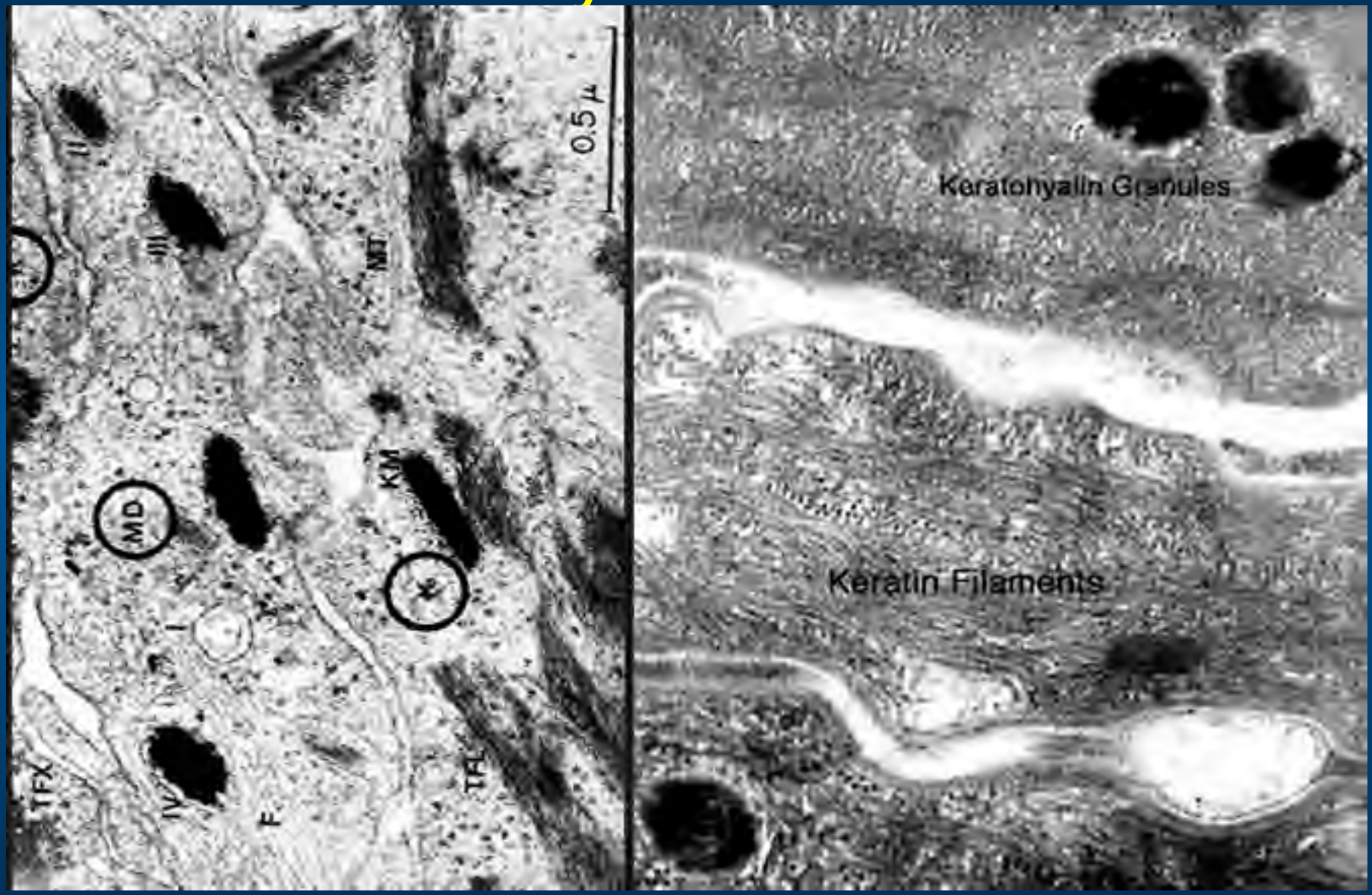
Polysaccharides and lipids

Membrane-coating granules (MCG)

(a.k.a. lamellar granules, Odland bodies)

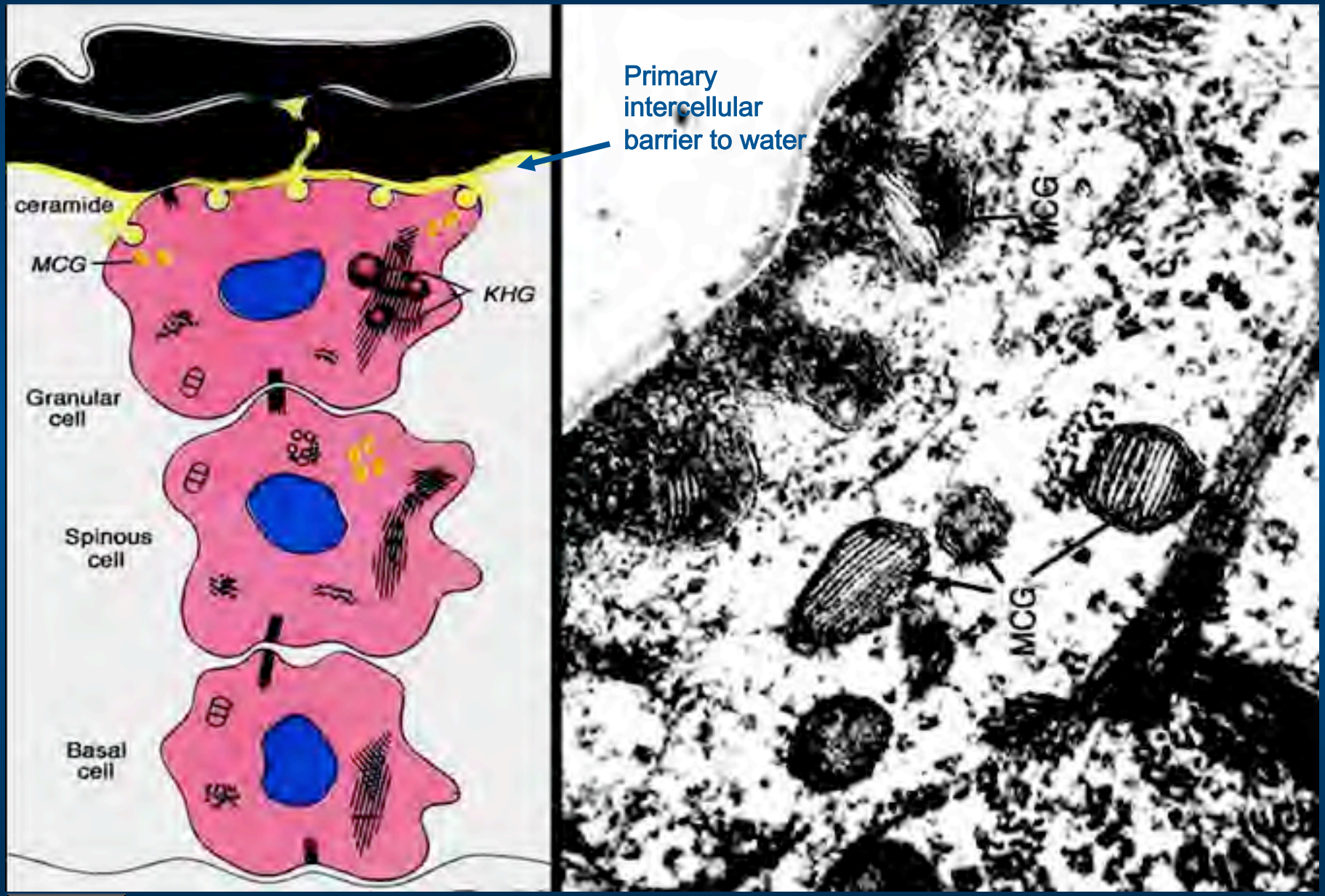
Primary intercellular lipid barrier to water - ceramide cross-links cell membranes.

Keratohyalin Granules



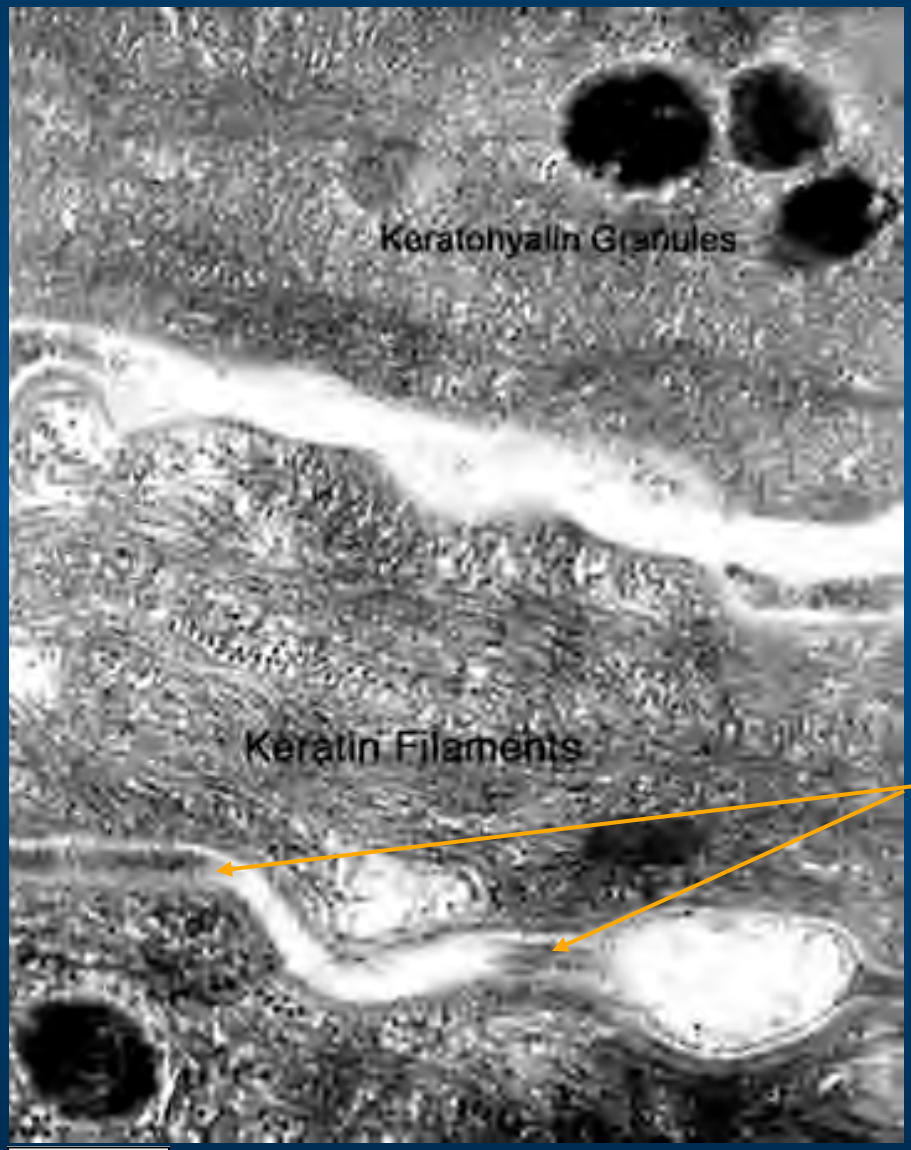
 Weiss, L., Cell and Tissue Biology 6th ed. P. 549

Membrane Coating Granules



 Weiss, Cell and Tissue Bilogy6th ed. P. 547

Stratum corneum

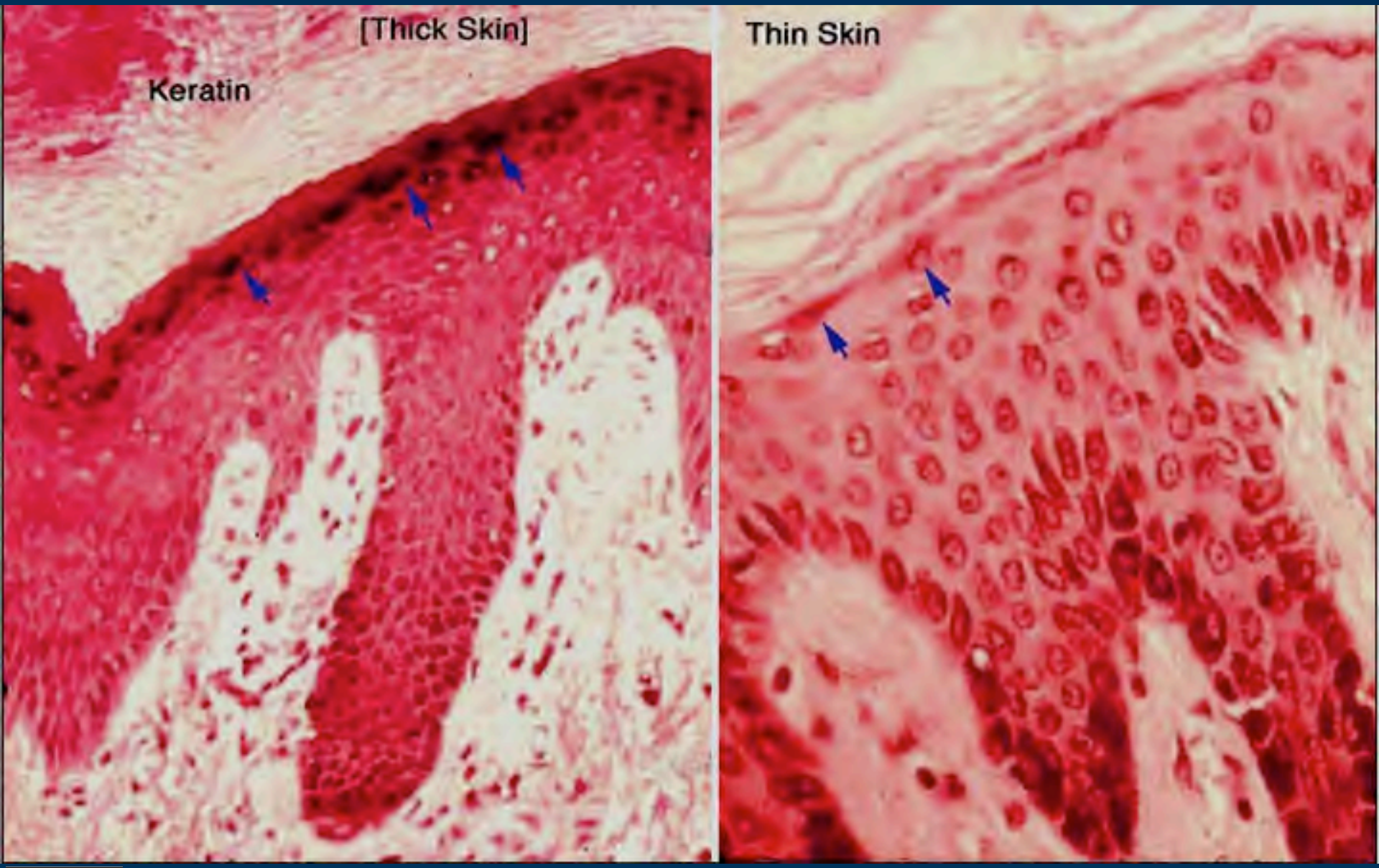


15-20 layers of non-nucleated flattened cells filled with keratain filaments.

Keratin filaments are cross-linked with filaggrin.

The keratin-filaggrin deposited on the inside of the plasma membrane form a thickened cell envelope.

Thick and thin skin



Blue arrows: Cells of the stratum granulosum

Melanocytes

Skin color

Red blood cells *in the dermal vascular beds*.

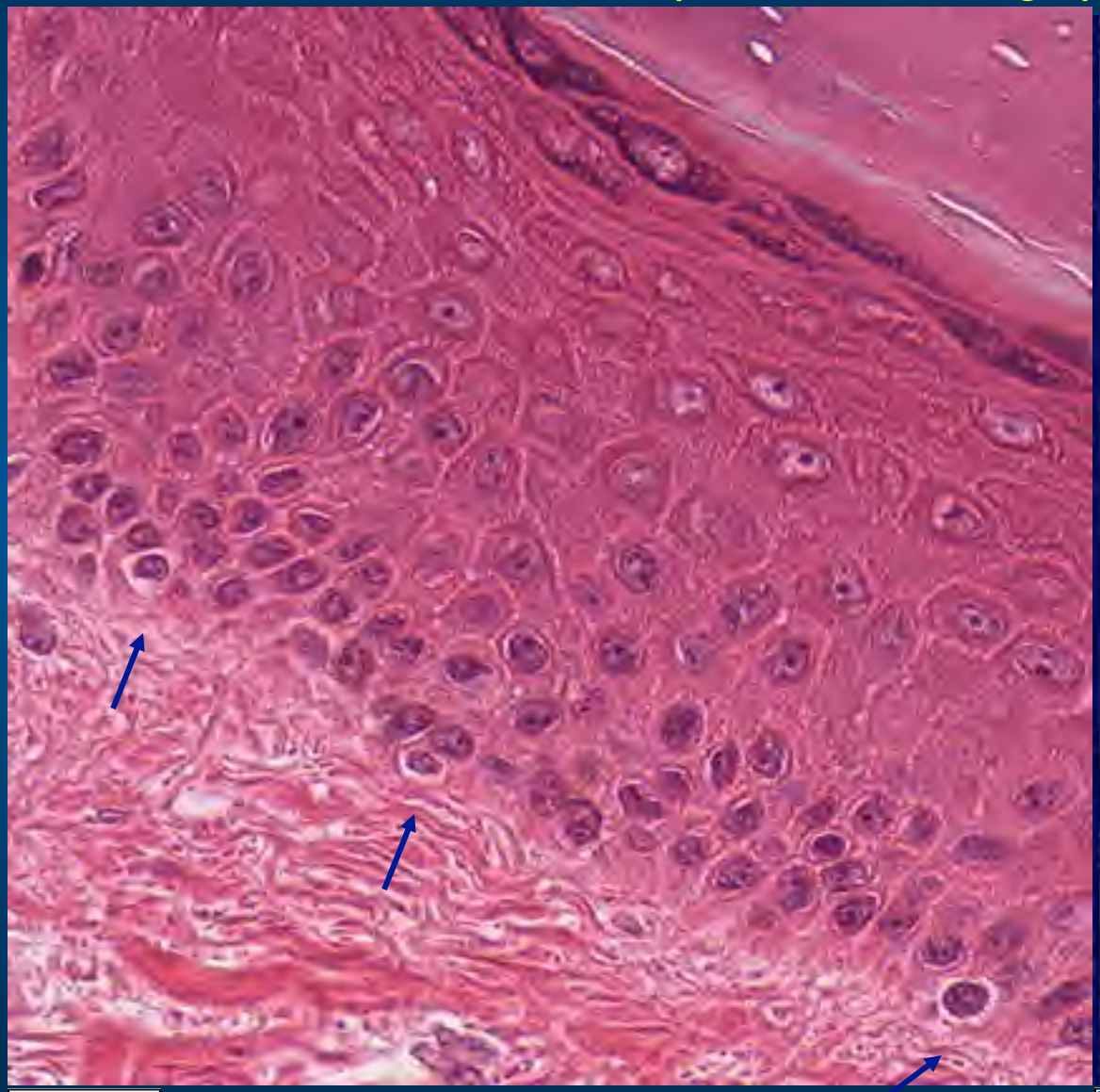
Carotenes *from exogenous foods stored in fatty tissues*.

Hemoglobin and bilirubin (*endogenous degradation products*).

Melanin (*pigment produced by melanocytes*)

Melanocytes

(neural crest origin)



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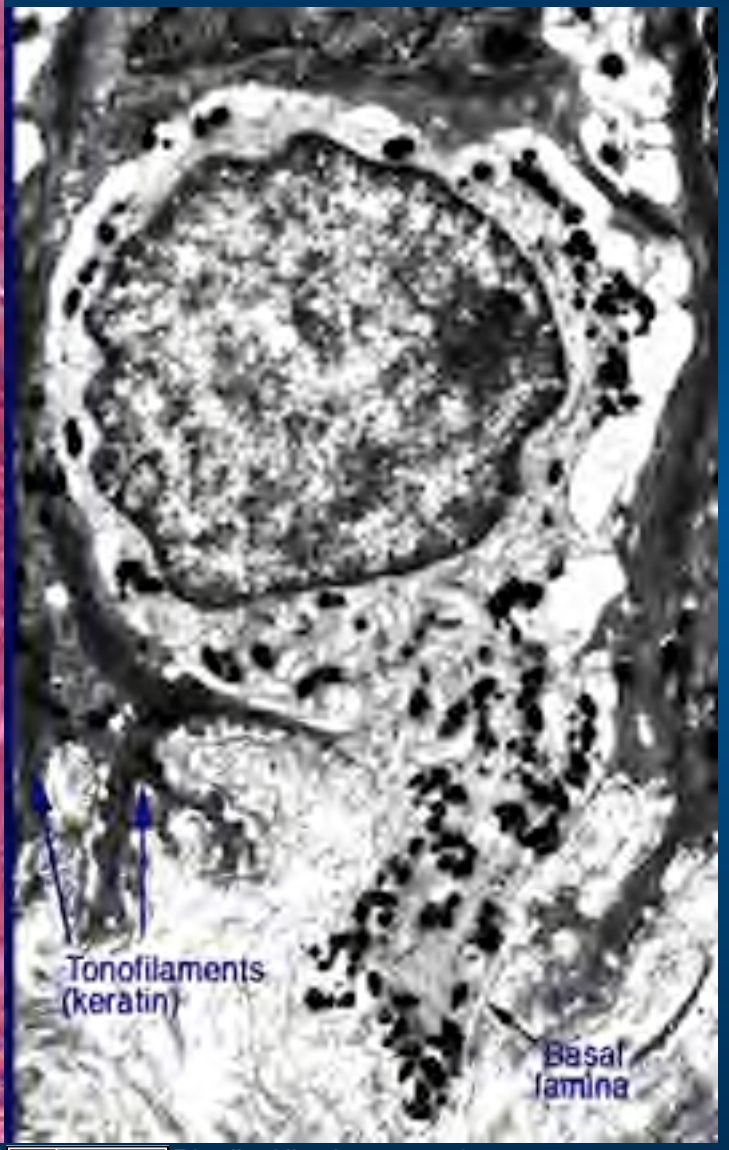


PD-INEL Rhodin, Histology, pp. 485

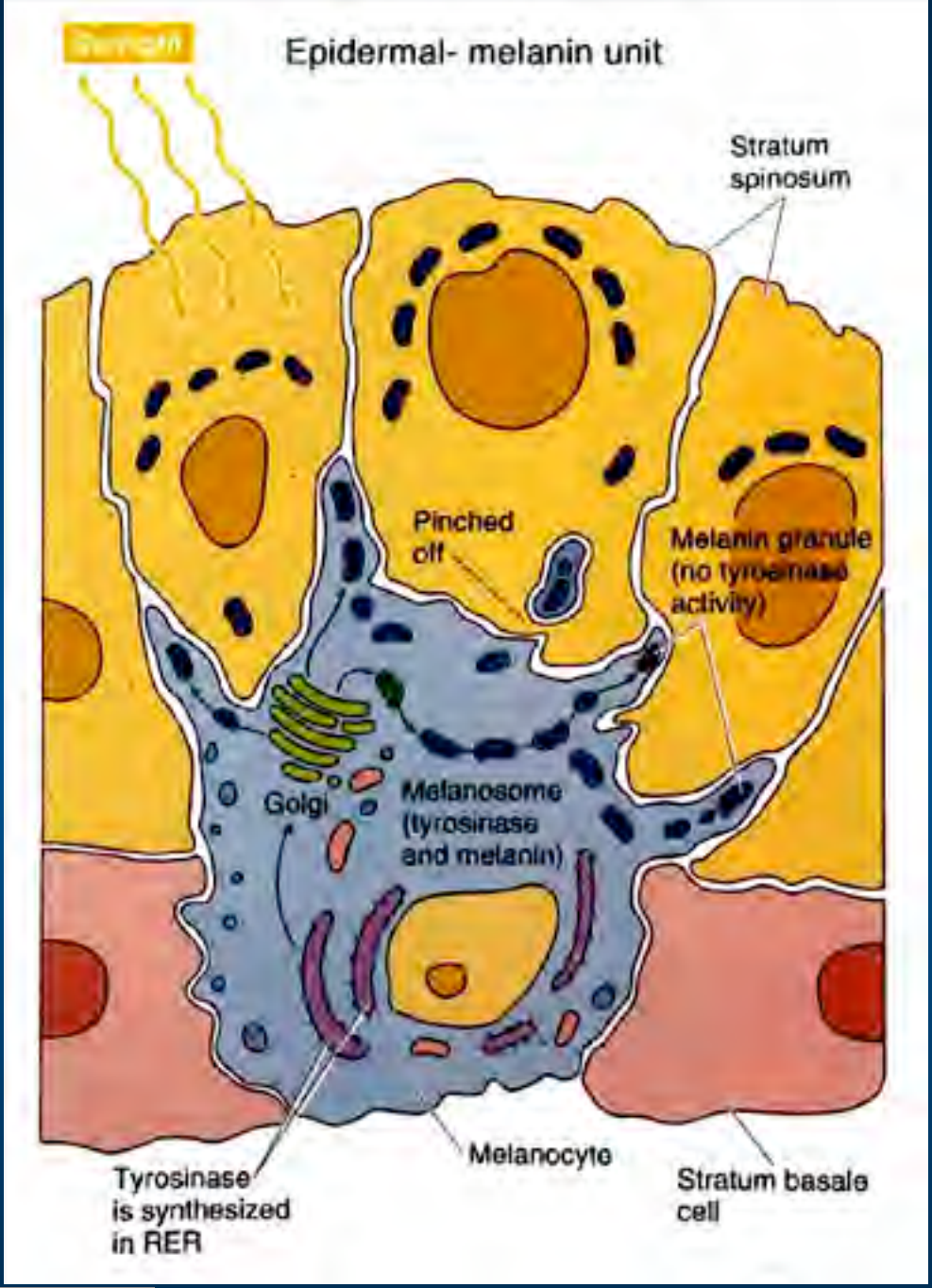
Melanocytes produce Melanin

Melanin: Eumelanin
Pheomelanin

Tyrosinase (deficiency: albinism)

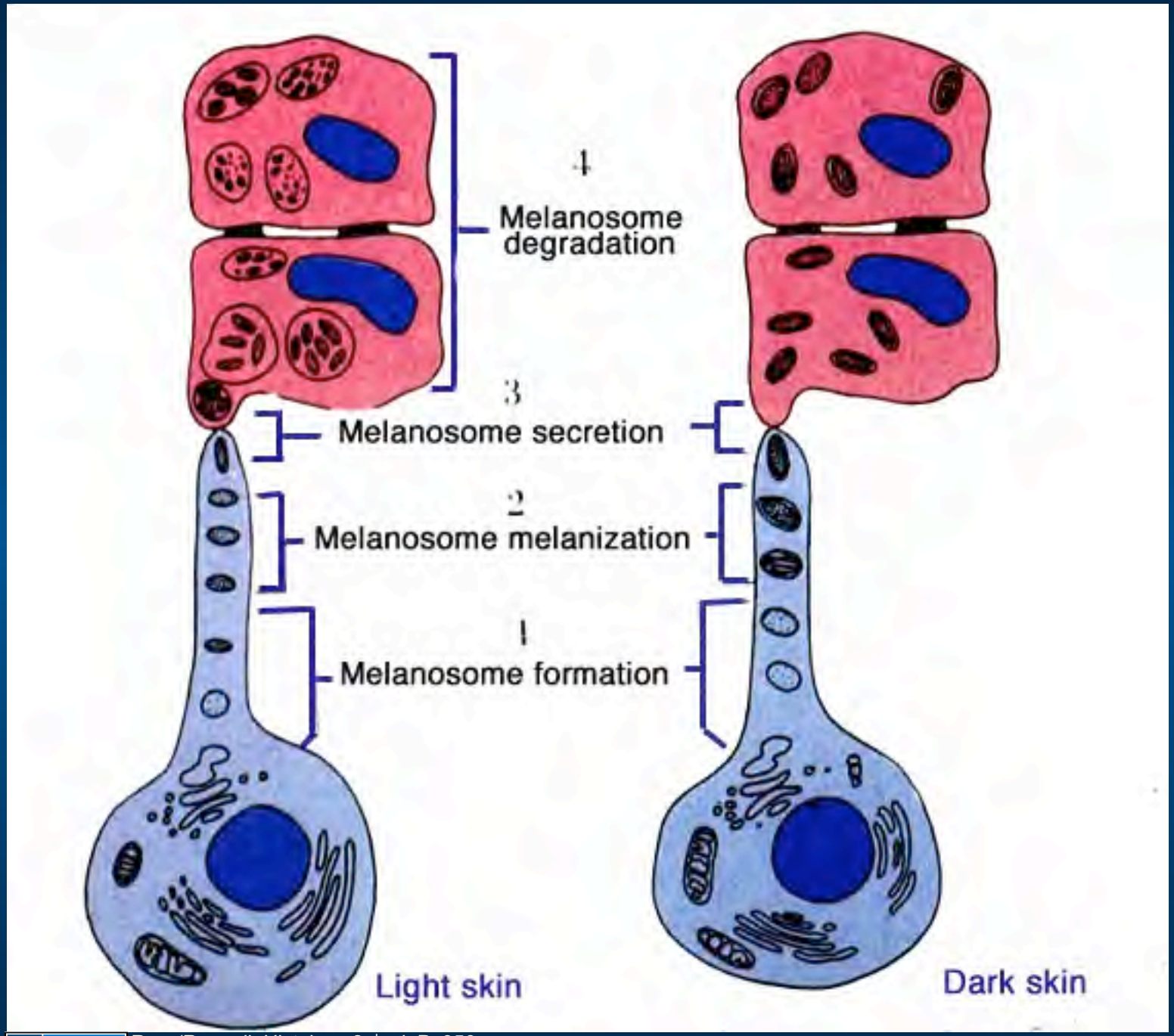
Tyrosine → 3,4-dihydroxyphenyalanine (dopa)

→ dopaquinone → → Melanin



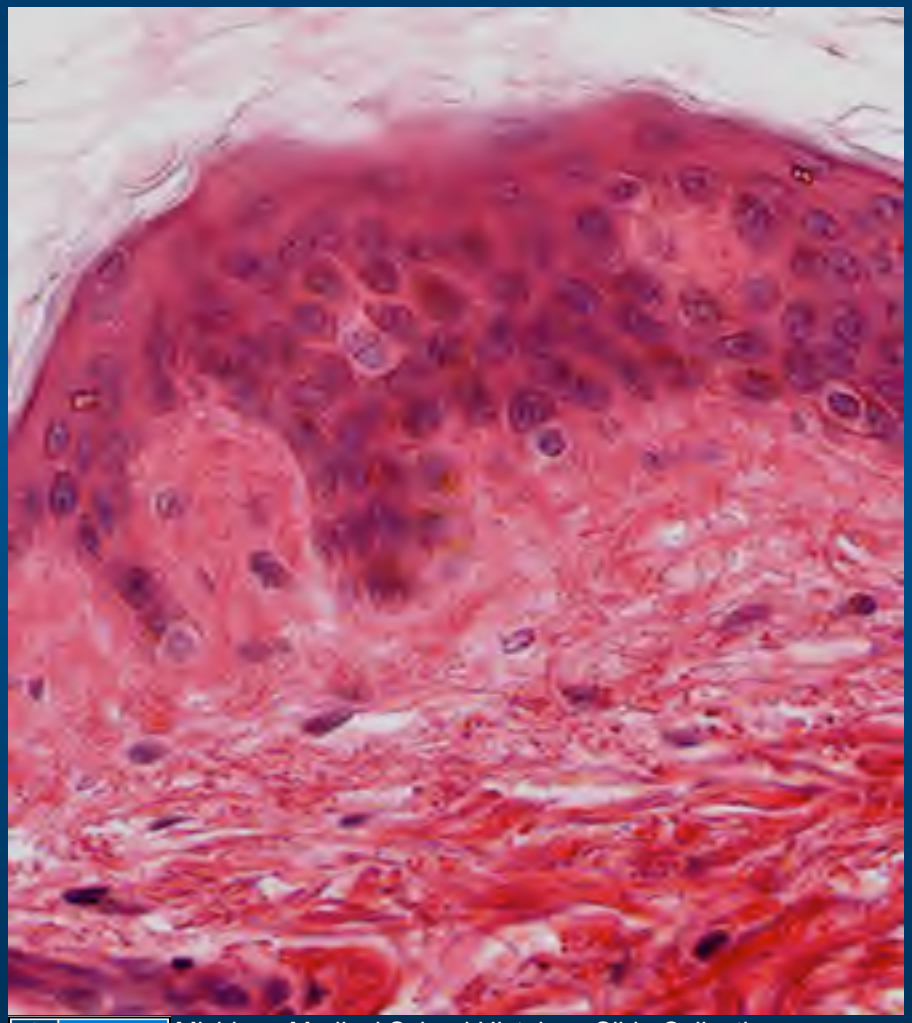
Epidermal-melanin unit

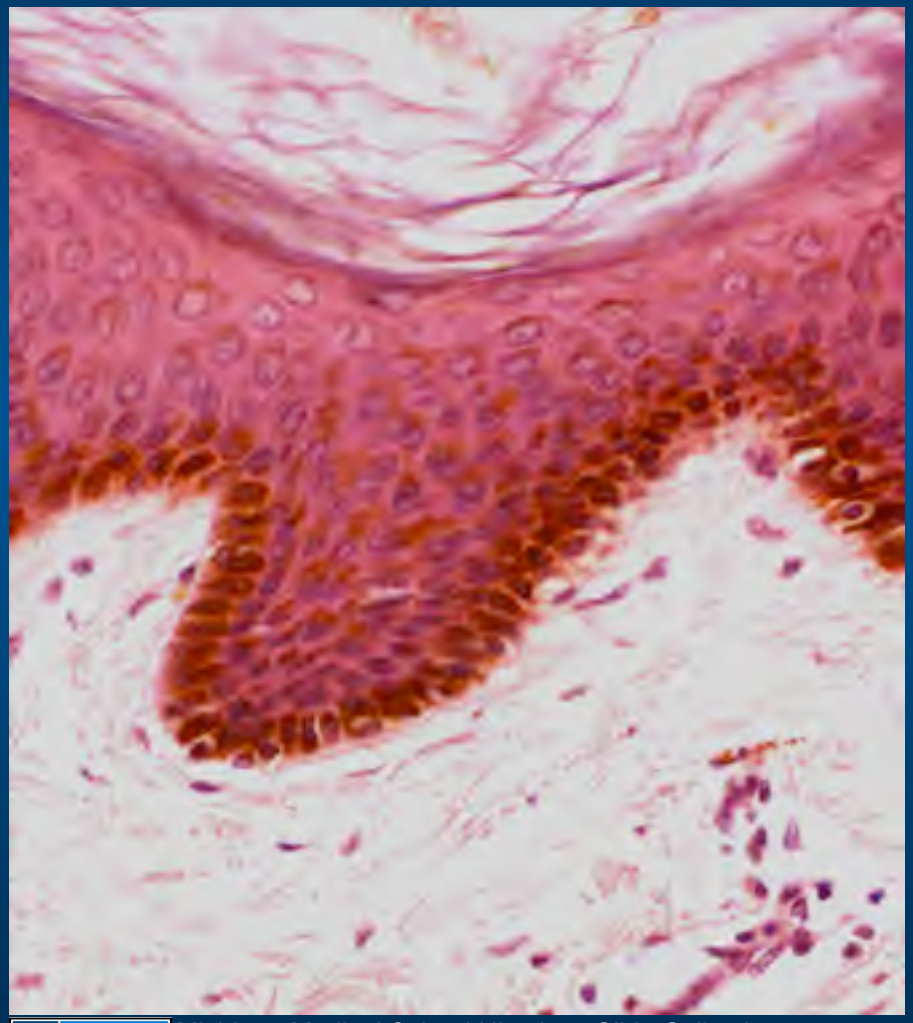
Cytocrine secretion



 Ross/Romrell, Histology 2nd ed. P. 356

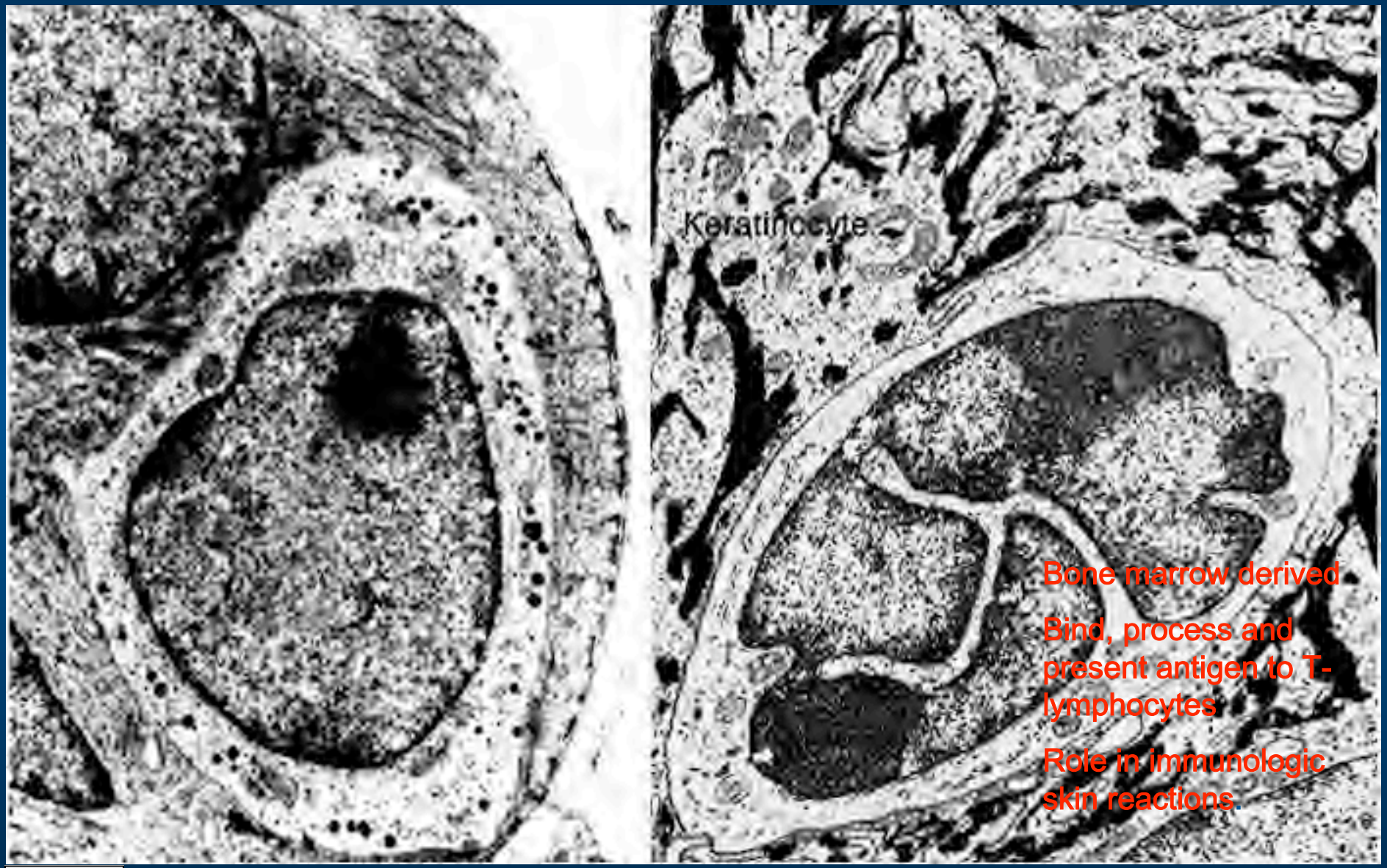
Pigment distribution in light (left) and dark (right) skin





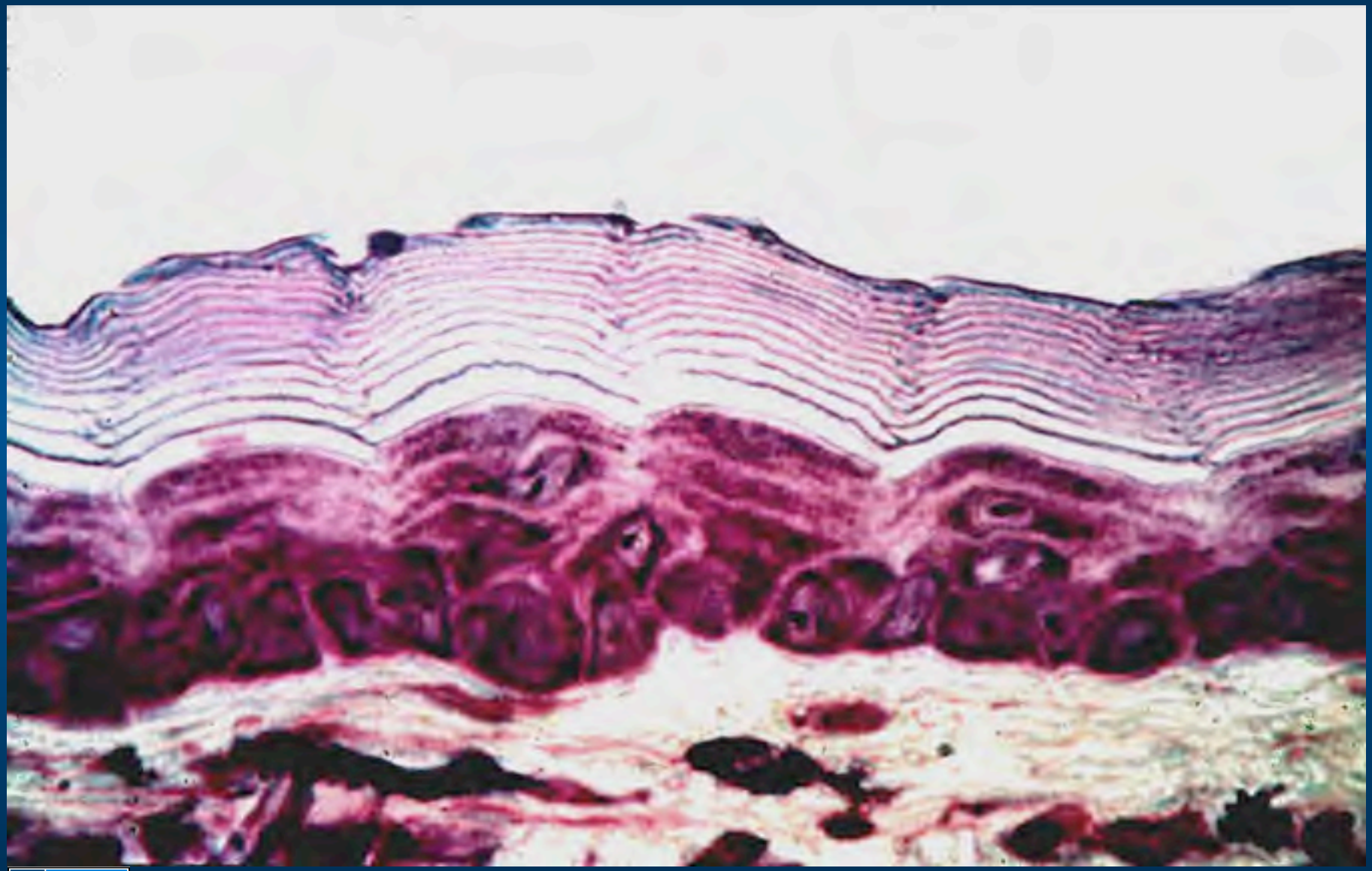
Merkel's cell

Langerhans cell



 Fawcett, Histology, pp. 536

Proliferation and Maturation of Epithelial Cells



Psoriasis

Dermis

Papillary Dermis

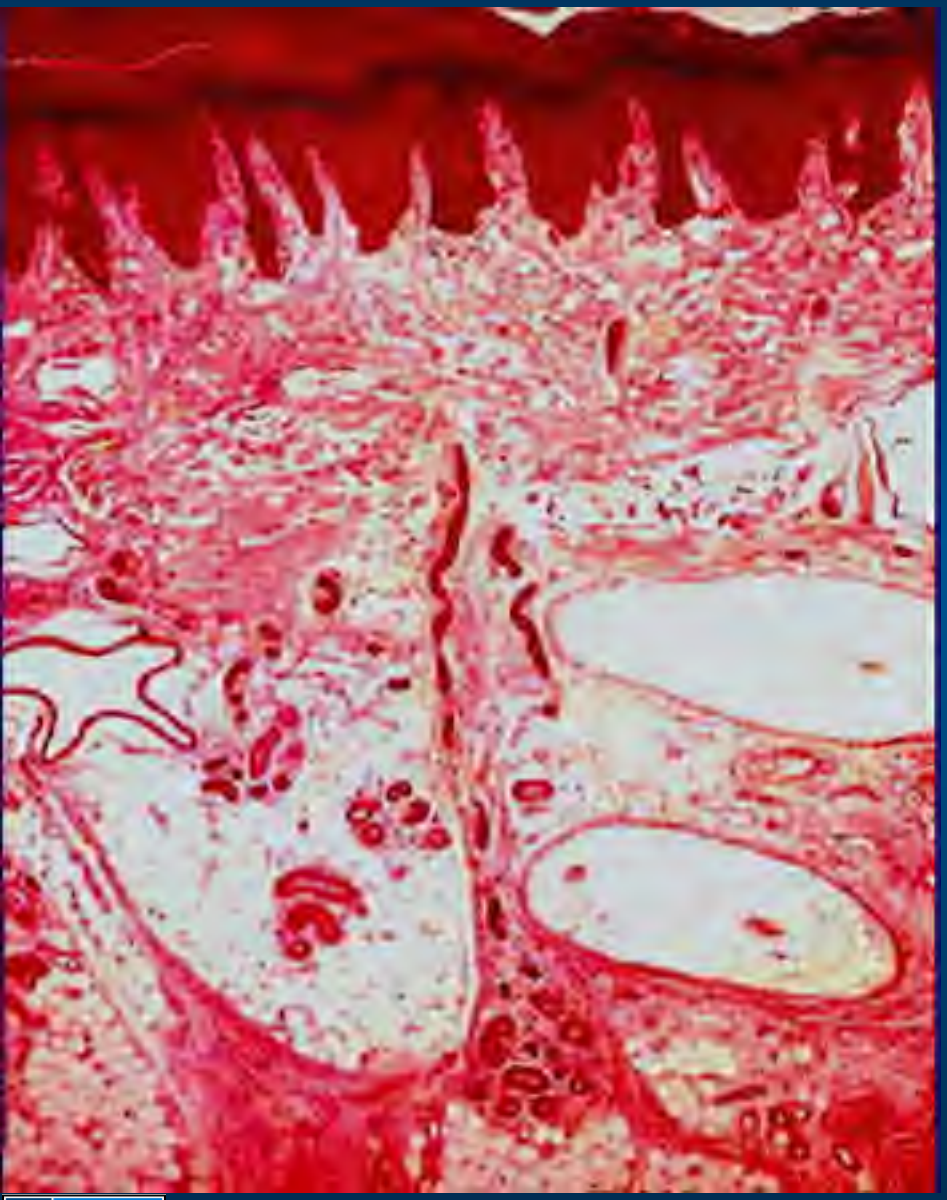
Reticular Dermis

Contains blood and lymphatic vessels, nerves, hair follicles, sebaceous glands, arrecto pili muscle, and sweat (eccrine and apocrine) glands

Hypodermis

(superficial fascia with fat cells)

Epithelial Pegs and Dermal Papillae



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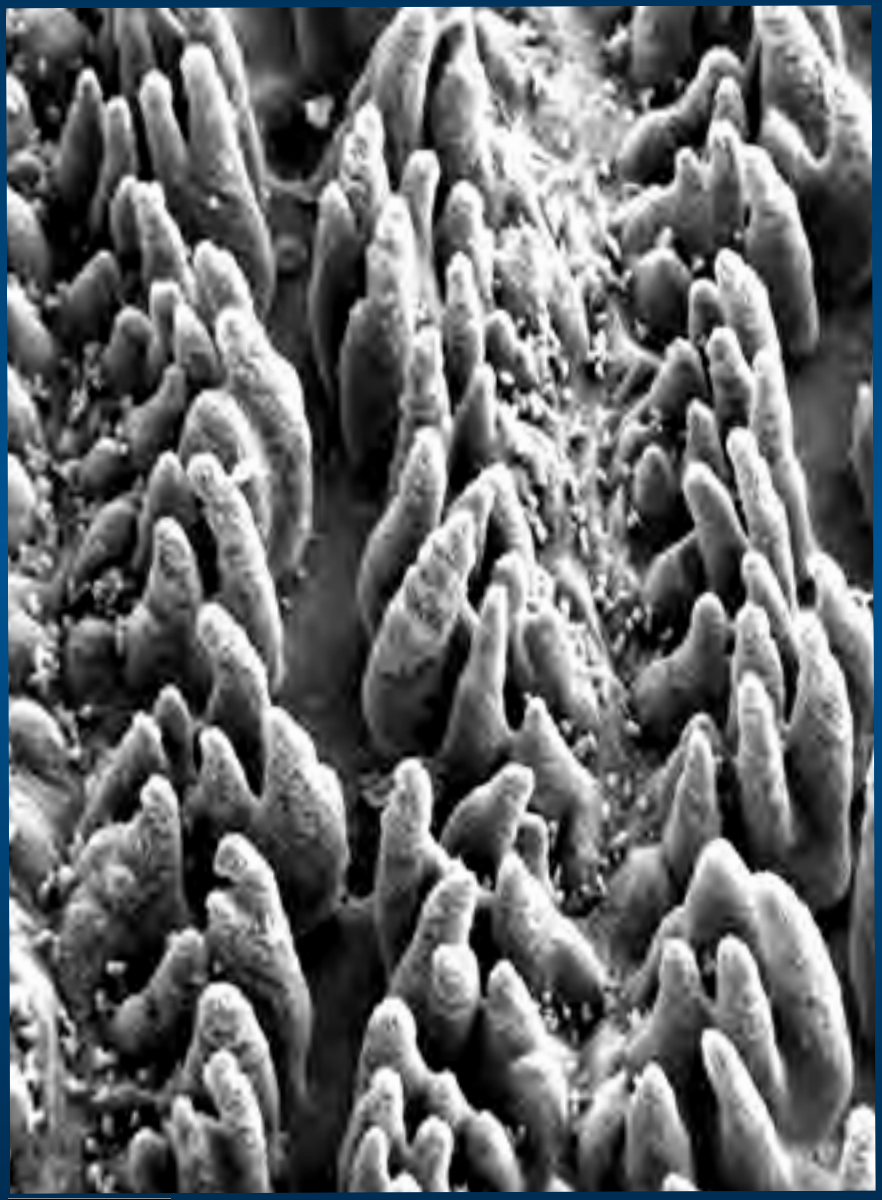

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Papillary (PL) and Reticular (RL) Dermis

Papillary Dermis

houses blood vessels, nerve endings, etc.

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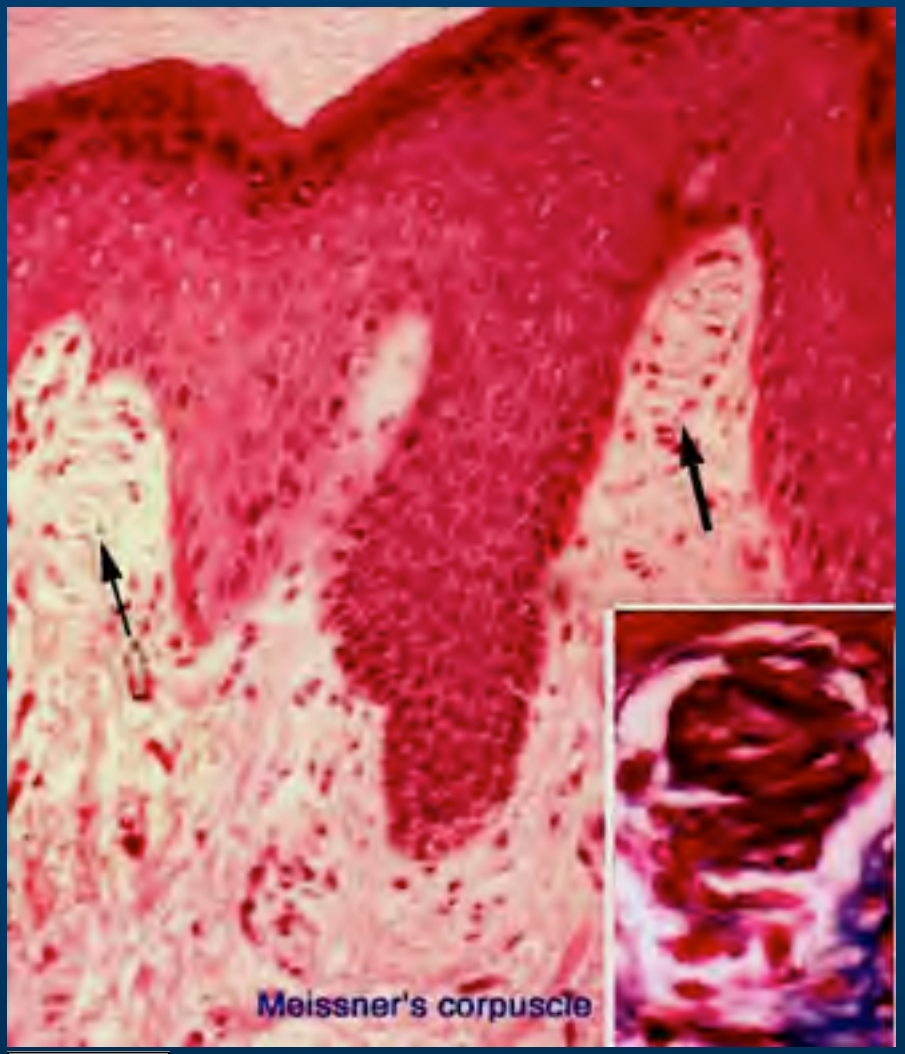

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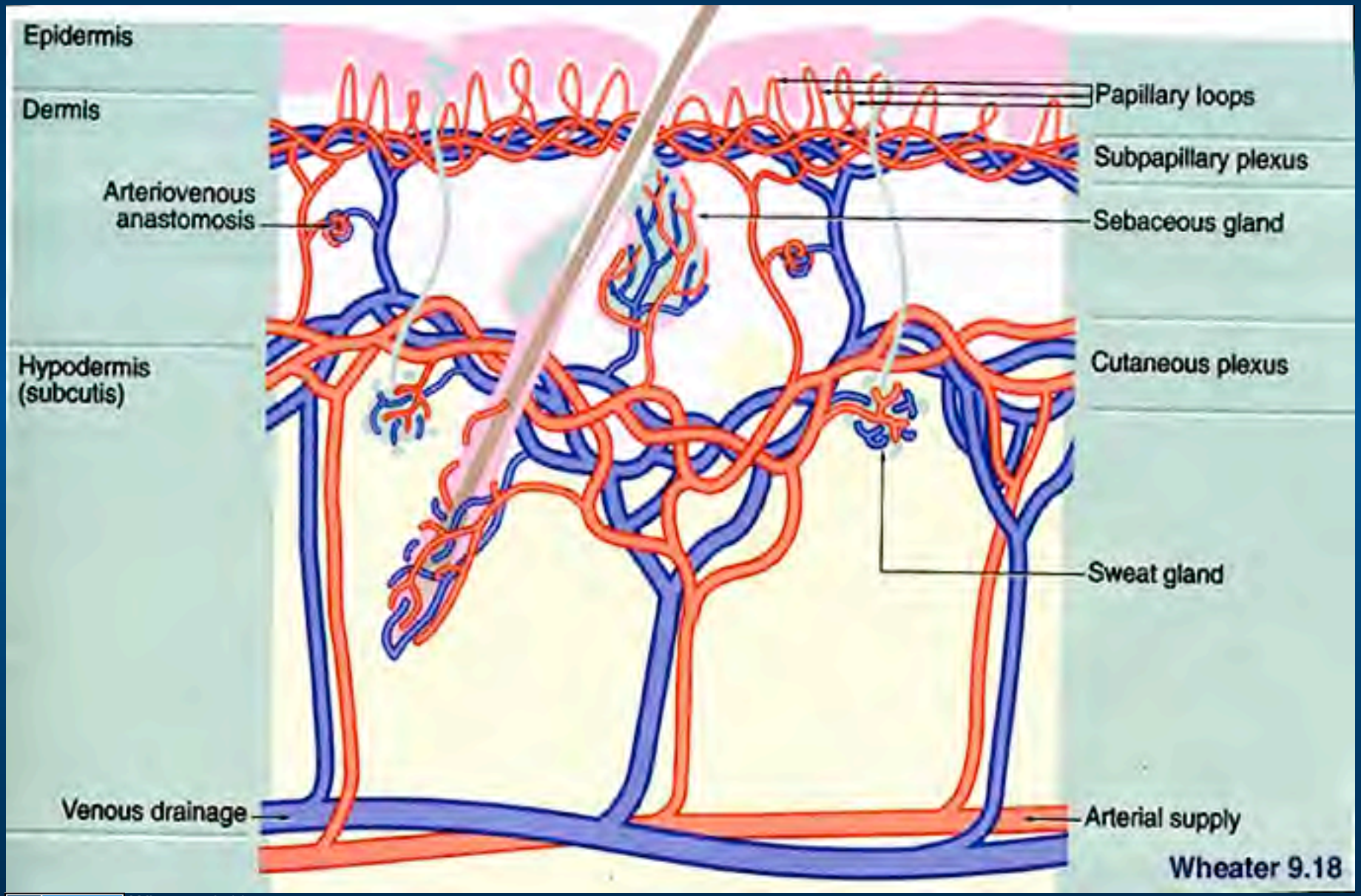
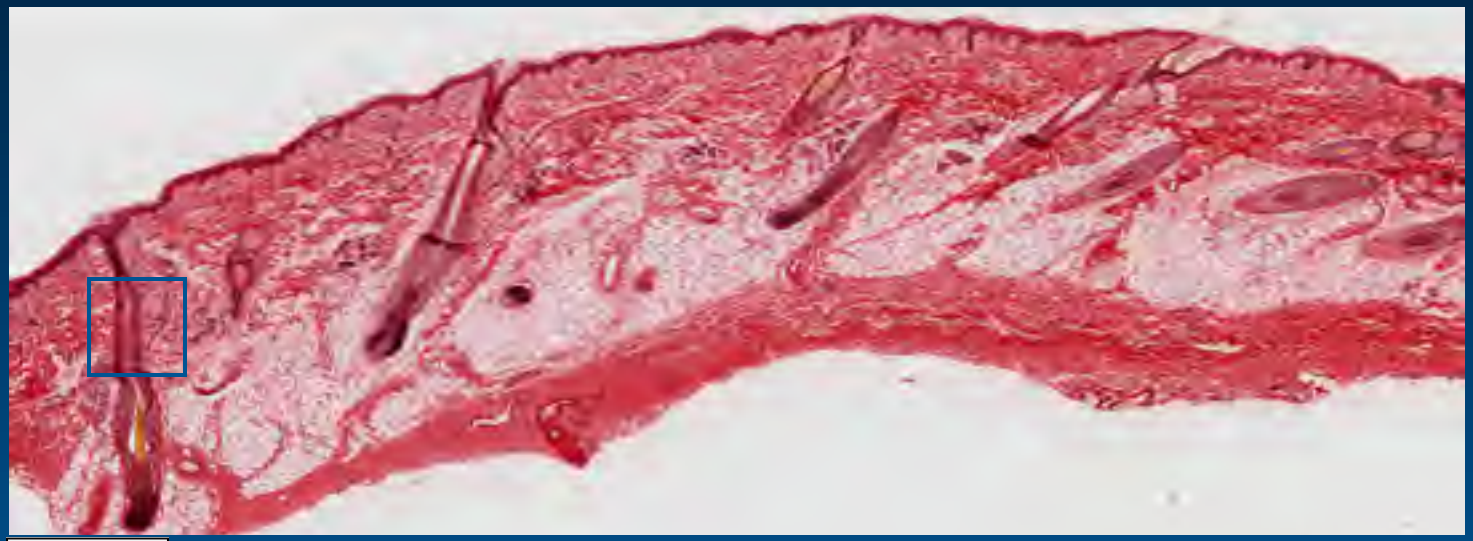
Dermis and skin circulation

Wheater Fig. 9.18



 Wheater 9.18



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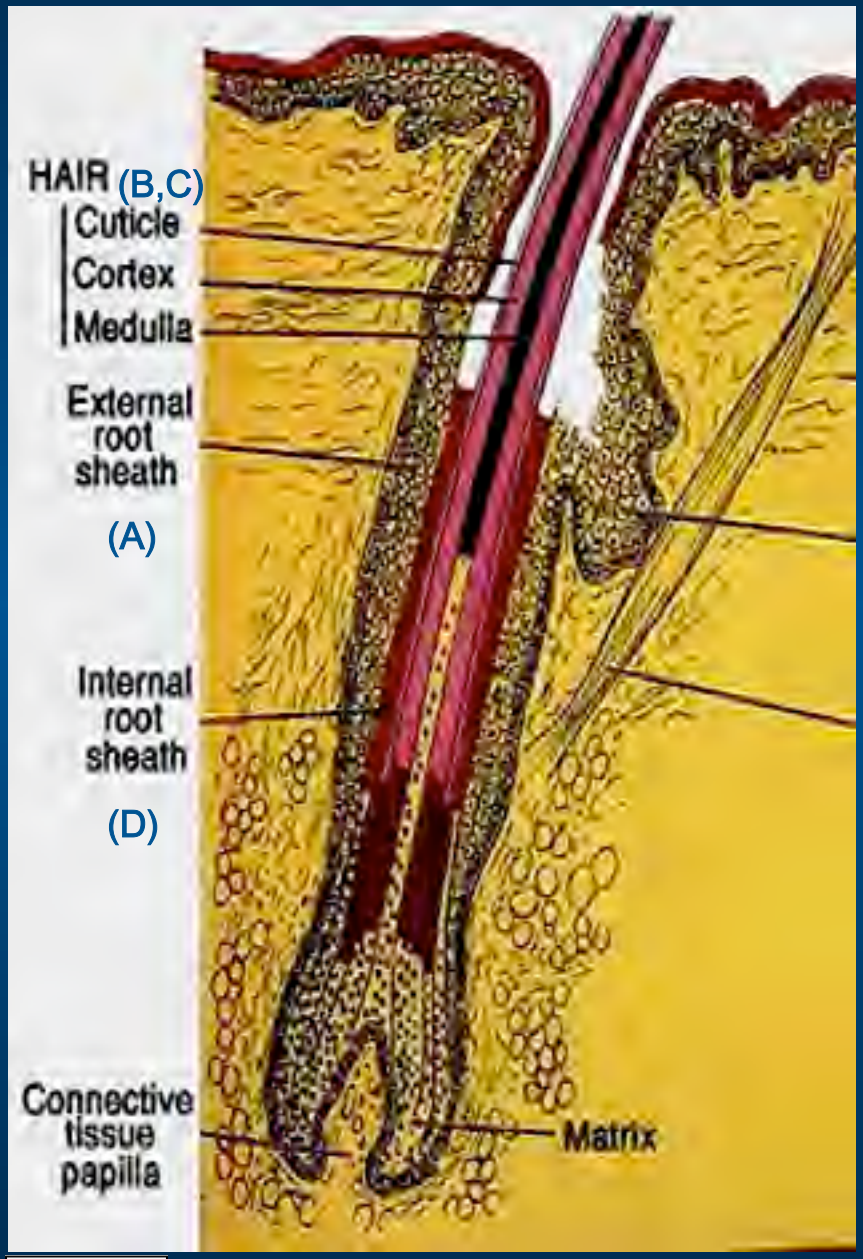
Pilosebaceous apparatus

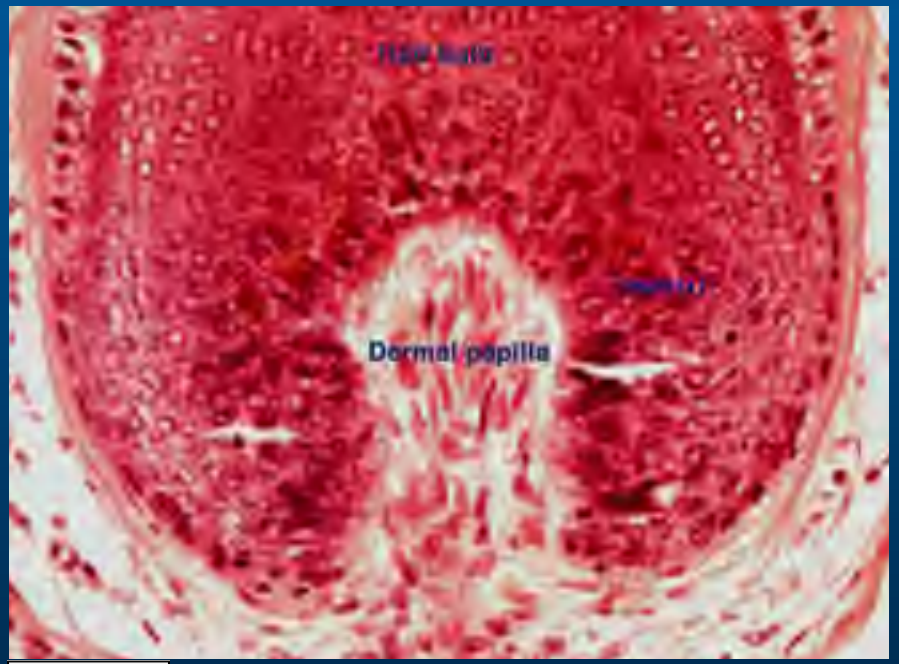
hair, sebaceous gland and arrecto pile muscle

Hair follicle: hair bulb and hair shaft



PD-INEL Ross/Romrell, Histology 2nd ed. P. 361

PD-INEL Young/ Heath Wheater's Histology 4th ed. P. 167



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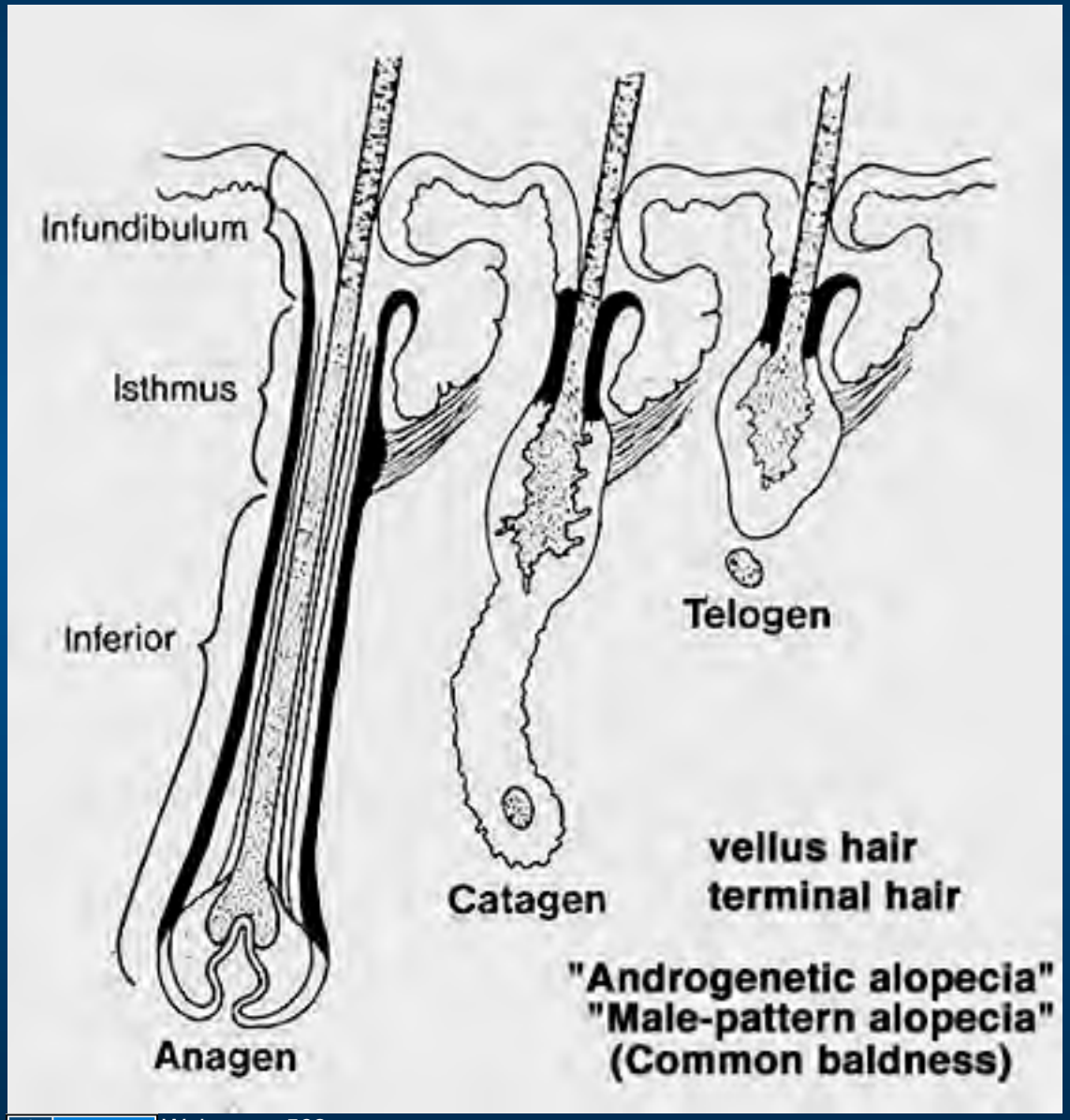
Growth Cycle of the Hair Follicle



PD-INEL Weiss, pg. 562

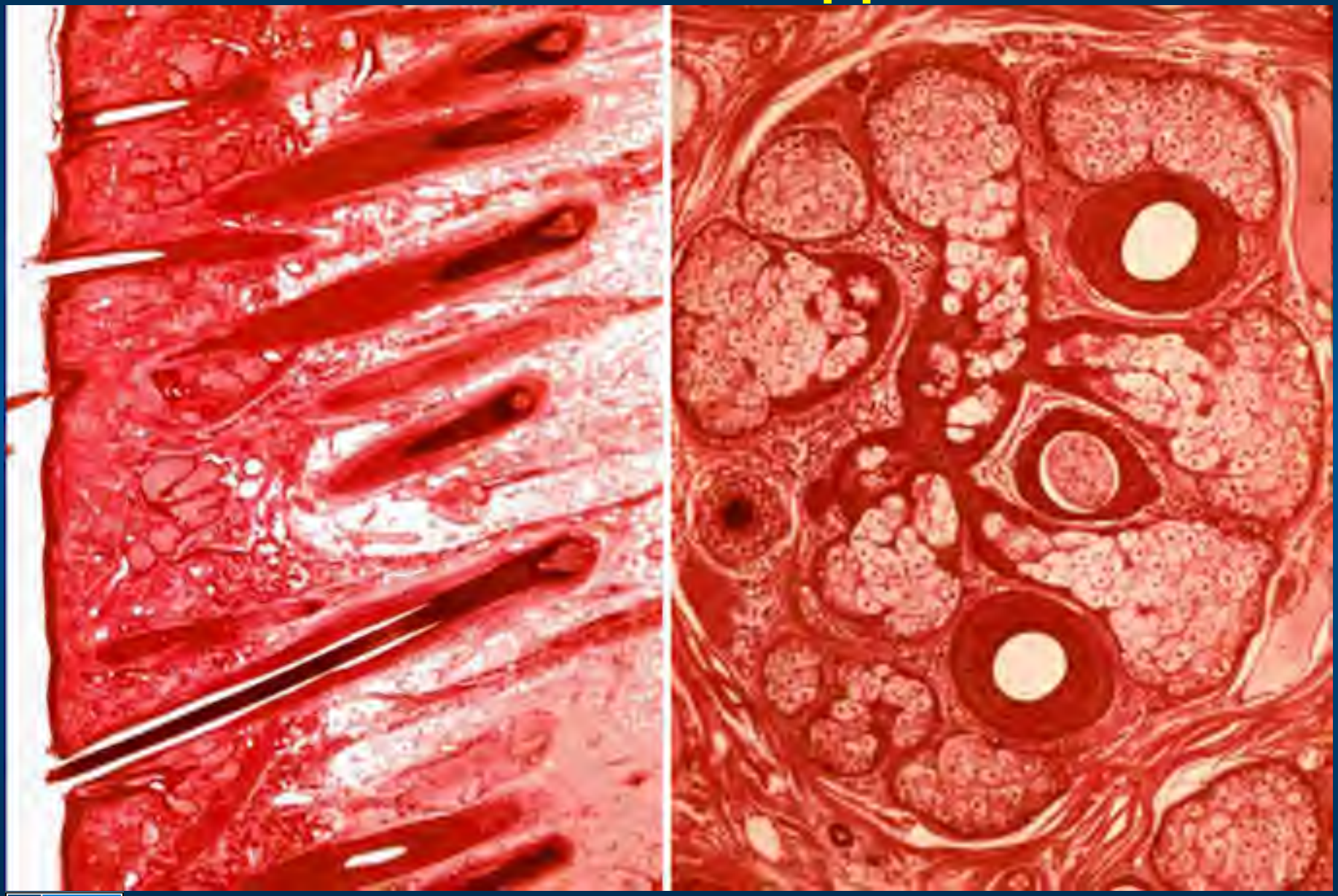
testosterone

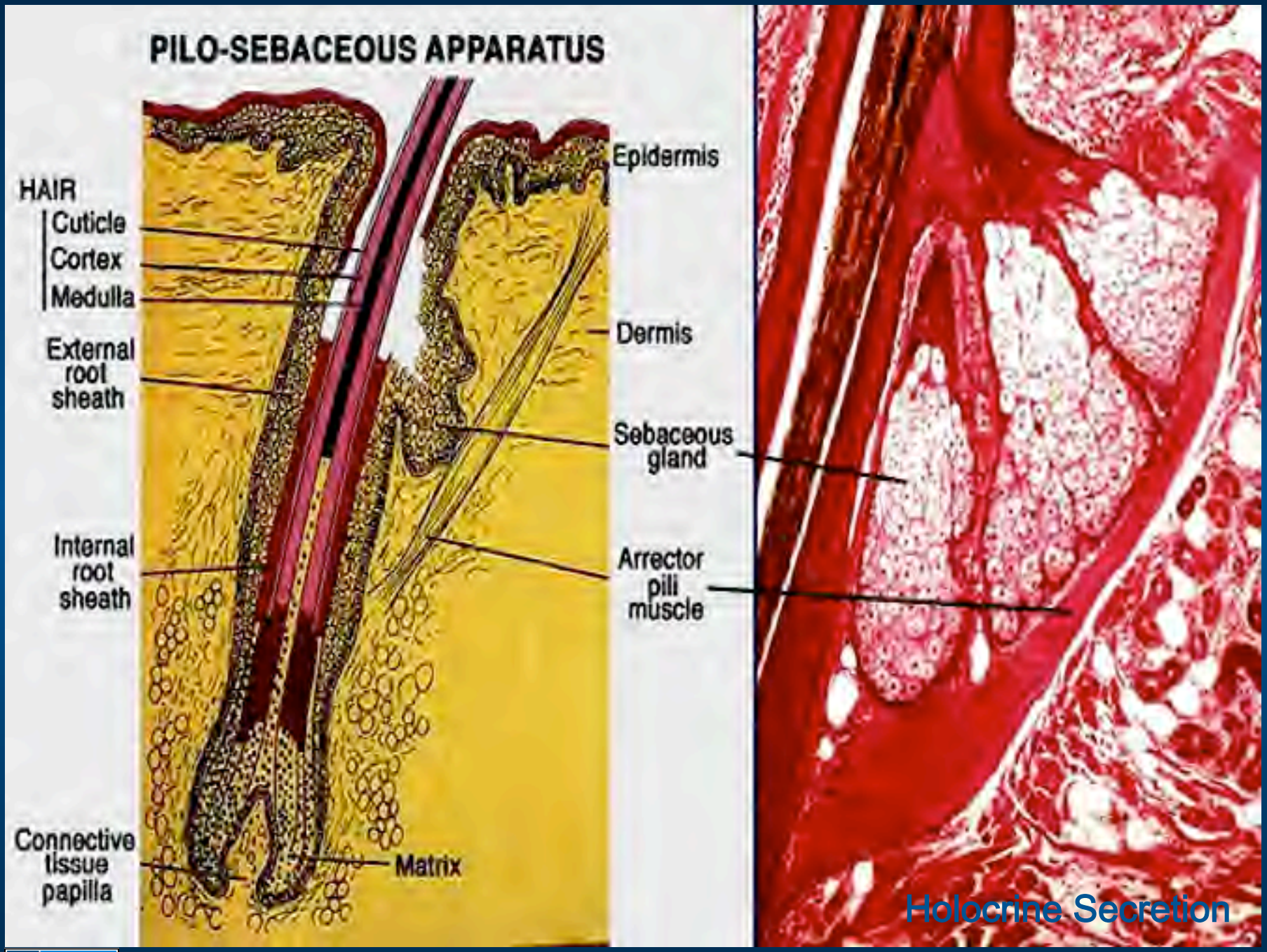
↓ 5α-reductase (?)

5α dihydrotestosterone,

which binds the intracellular receptors and Inhibits the metabolism of condemned follicles.

Pilo-sebaceous Apparatus





Mode of Secretion

Merocrine (Exocytosis)

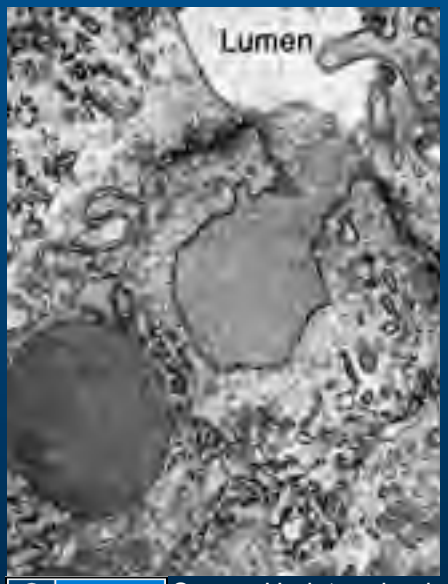
Almost all exocrine glands, including eccrine and apocrine sweat glands.

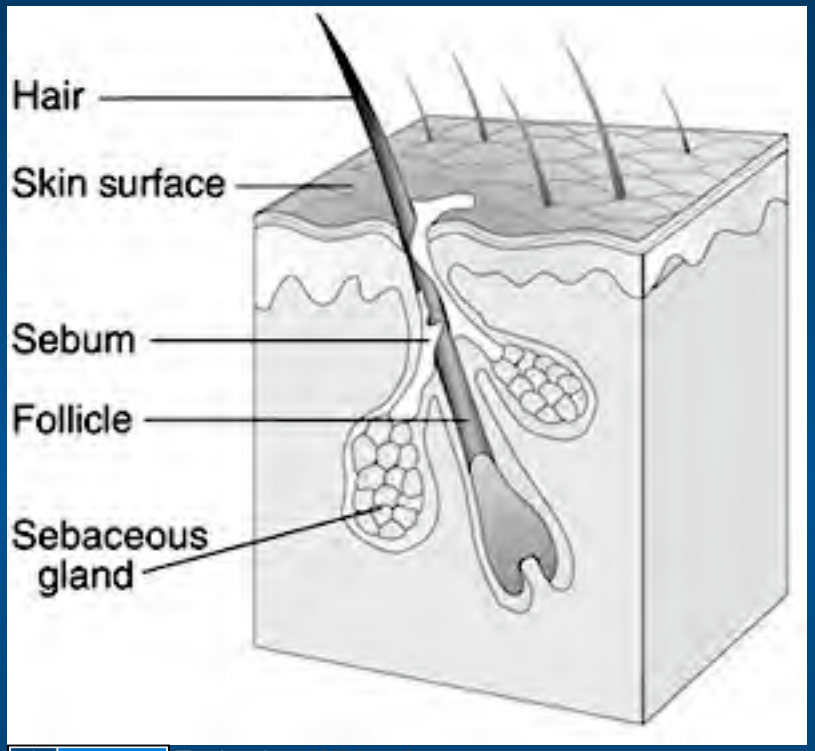
Apocrine (some parts of cells are secreted)

Mammary glands (lipid secretion)

Holocrine (whole cells are secreted)

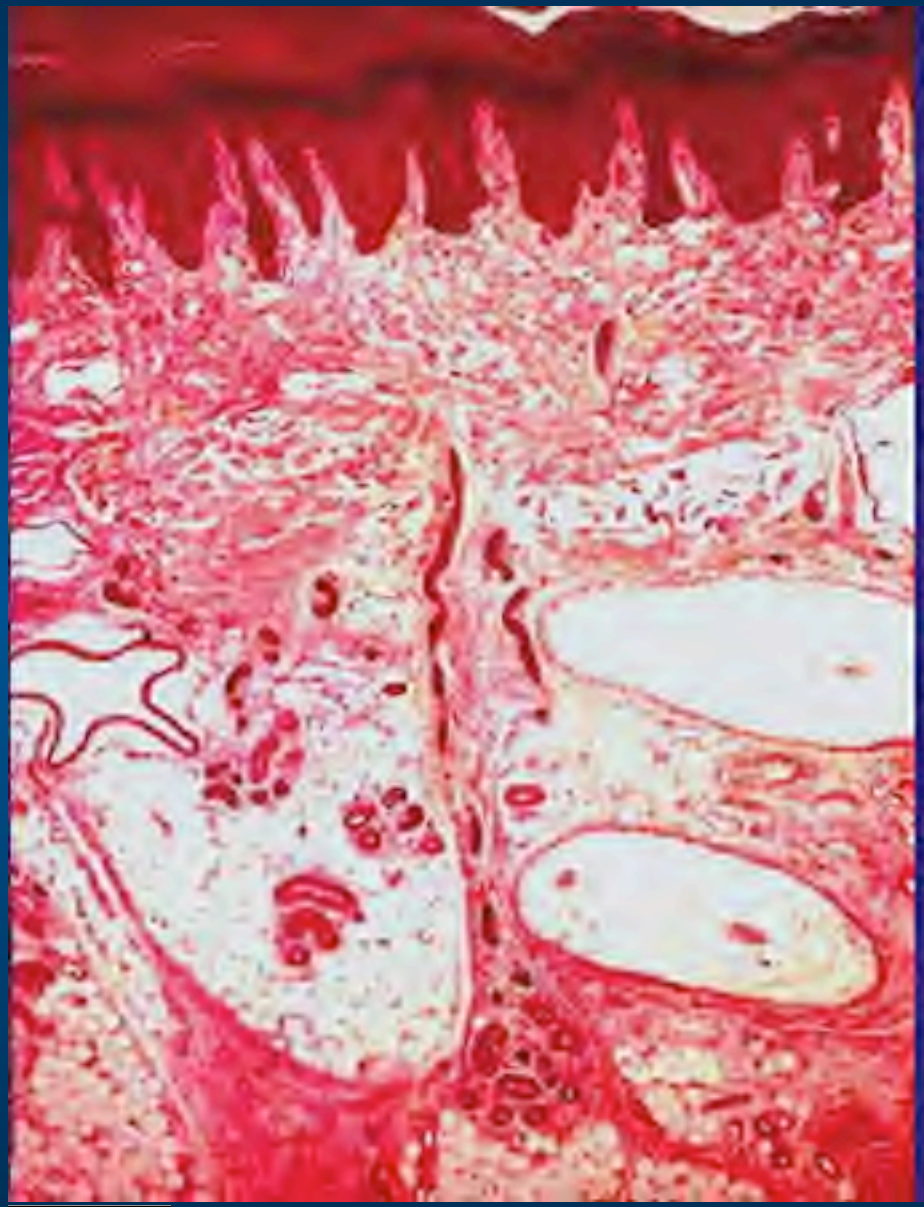
Sebaceous glands





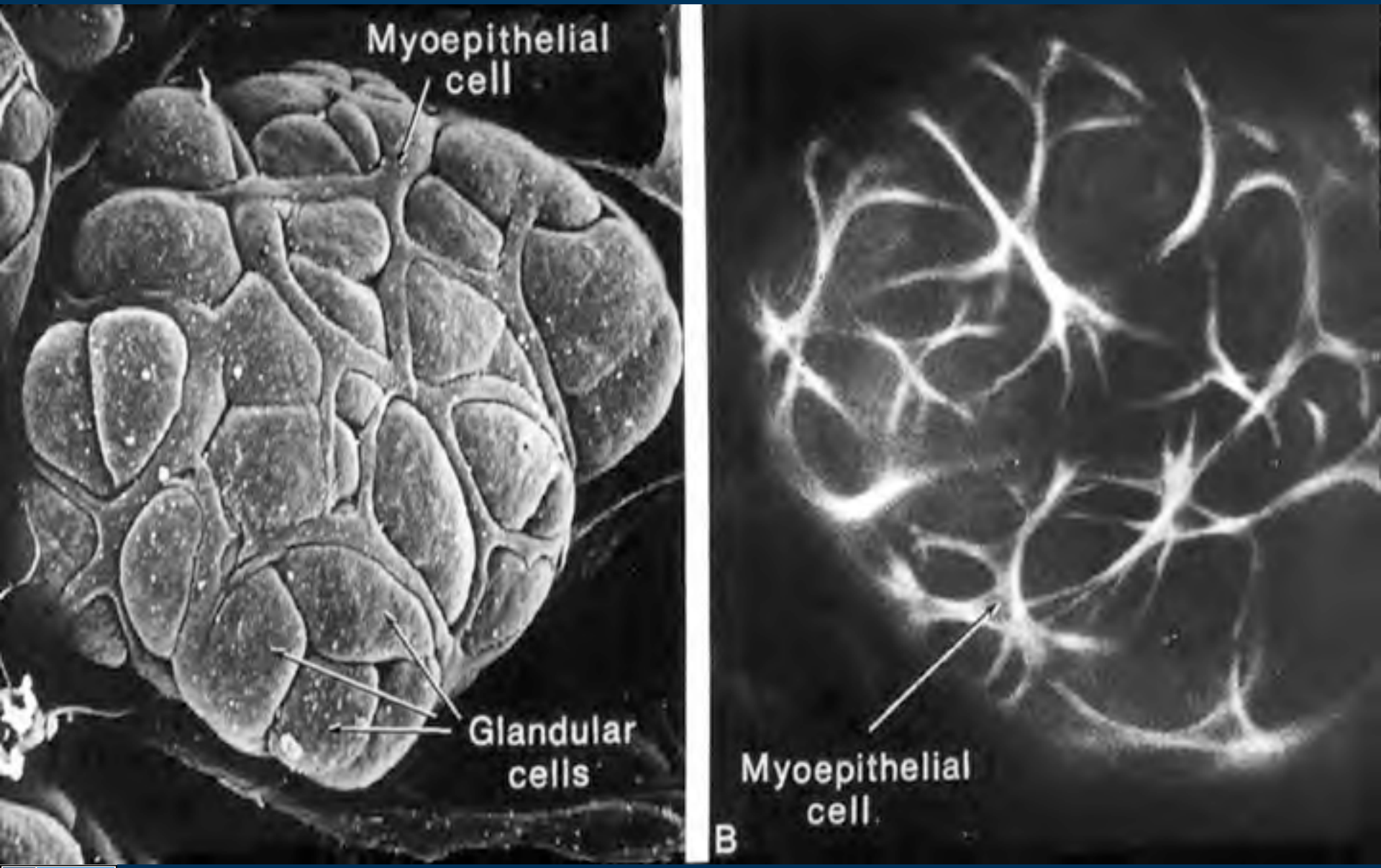
Hair follicle and it's associated structures

Eccrine Sweat Glands

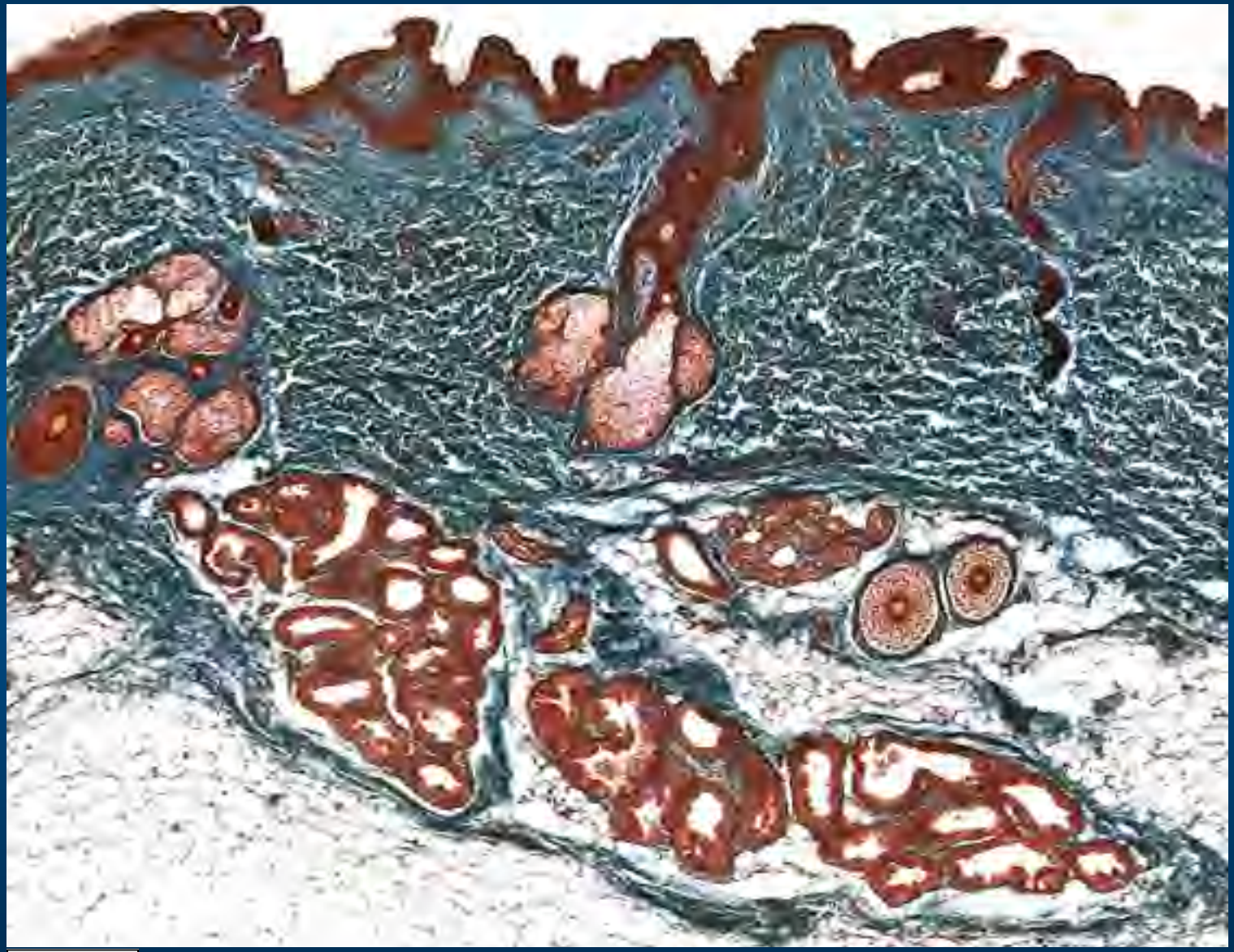


Eccrine Sweat Gland

Myoepithelial Cells

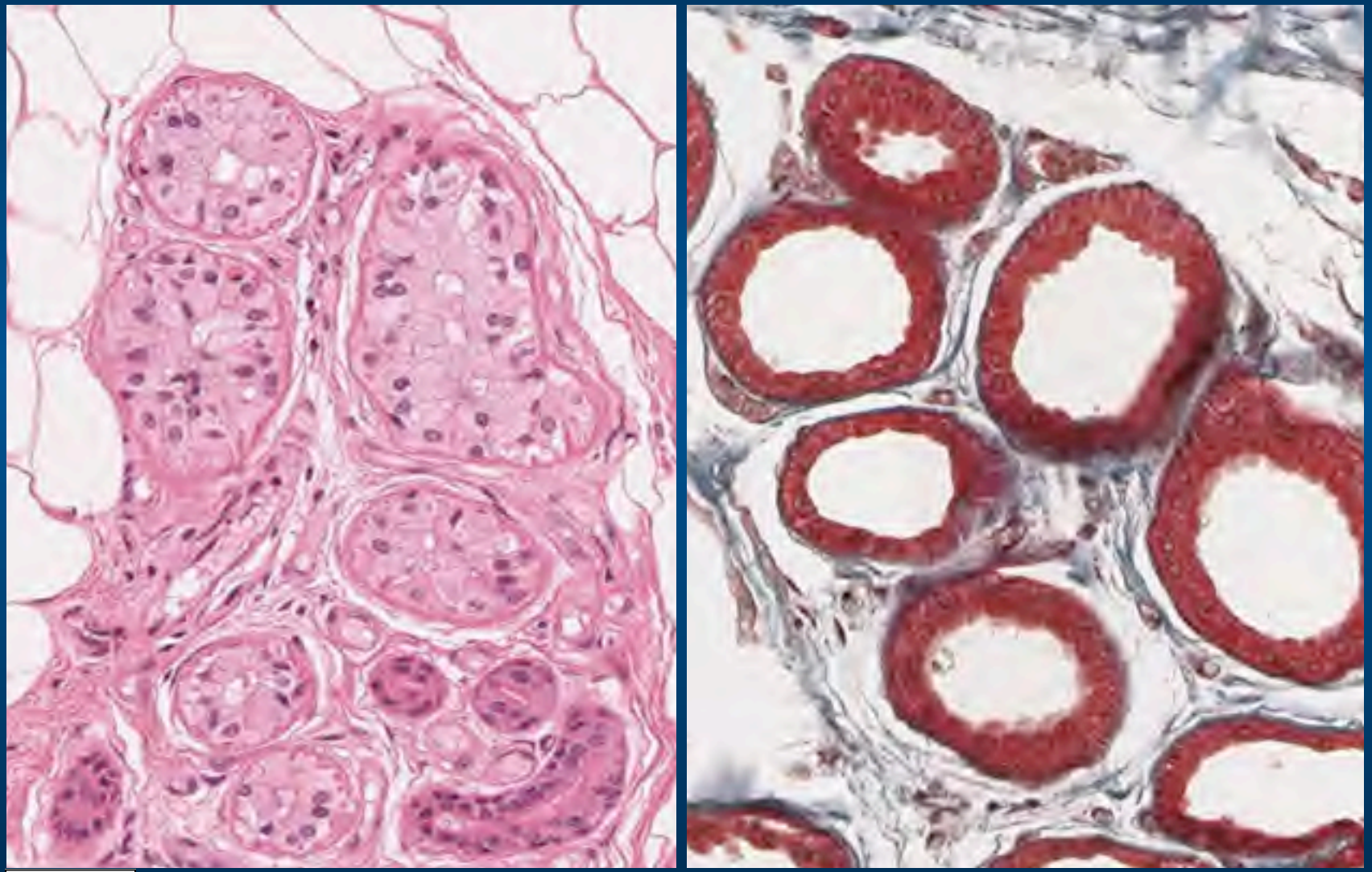


Apocrine Sweat Glands

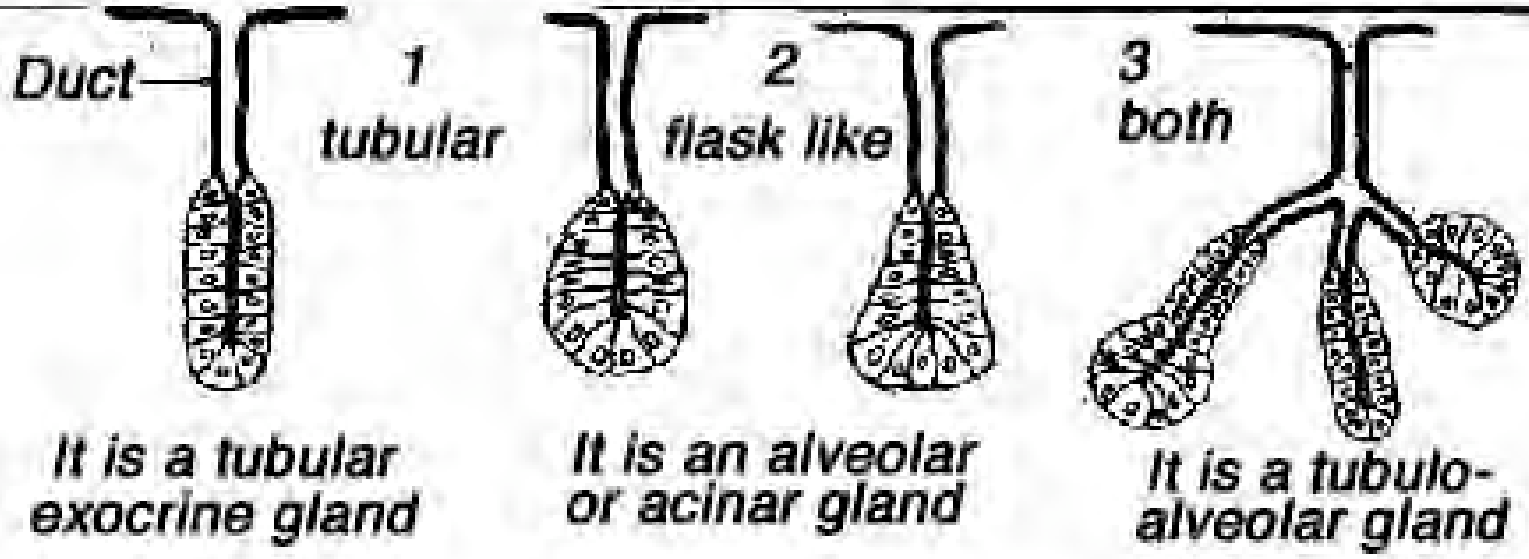


Apocrine Sweat Glands

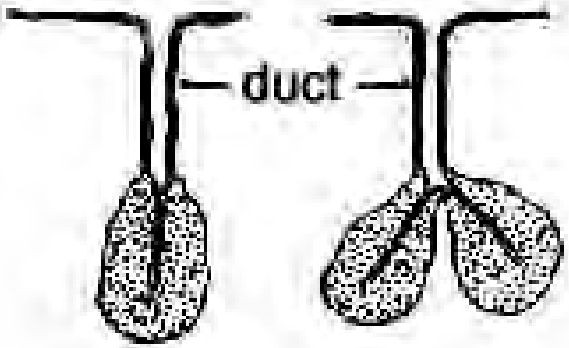
Secretory Portions of Eccrine and Apocrine Sweat Glands



Histological Classification of Glands

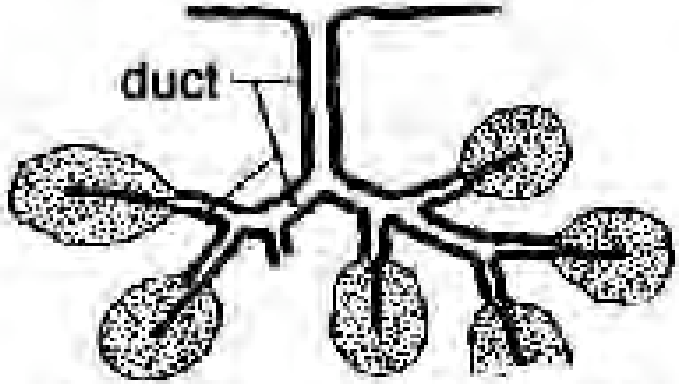


If duct does'nt branch:



It's a simple gland

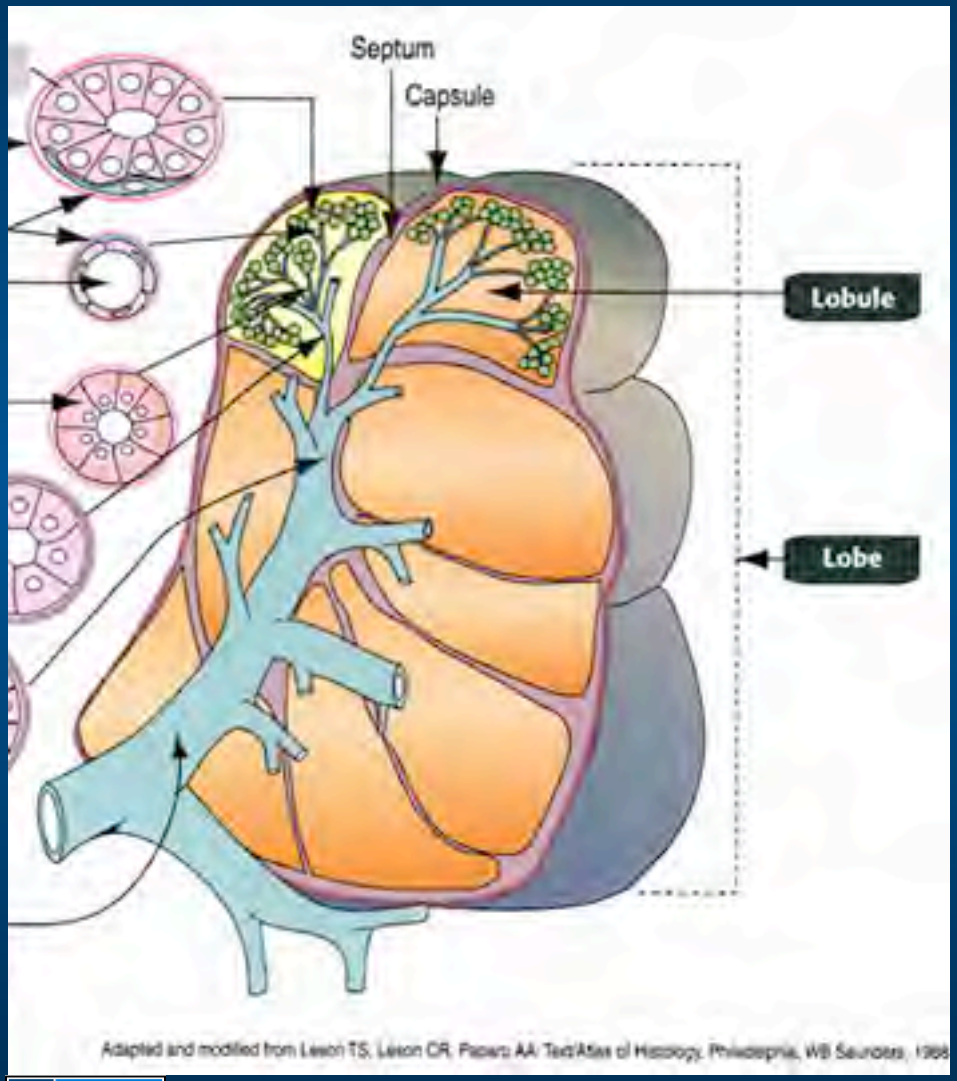
If duct branches:



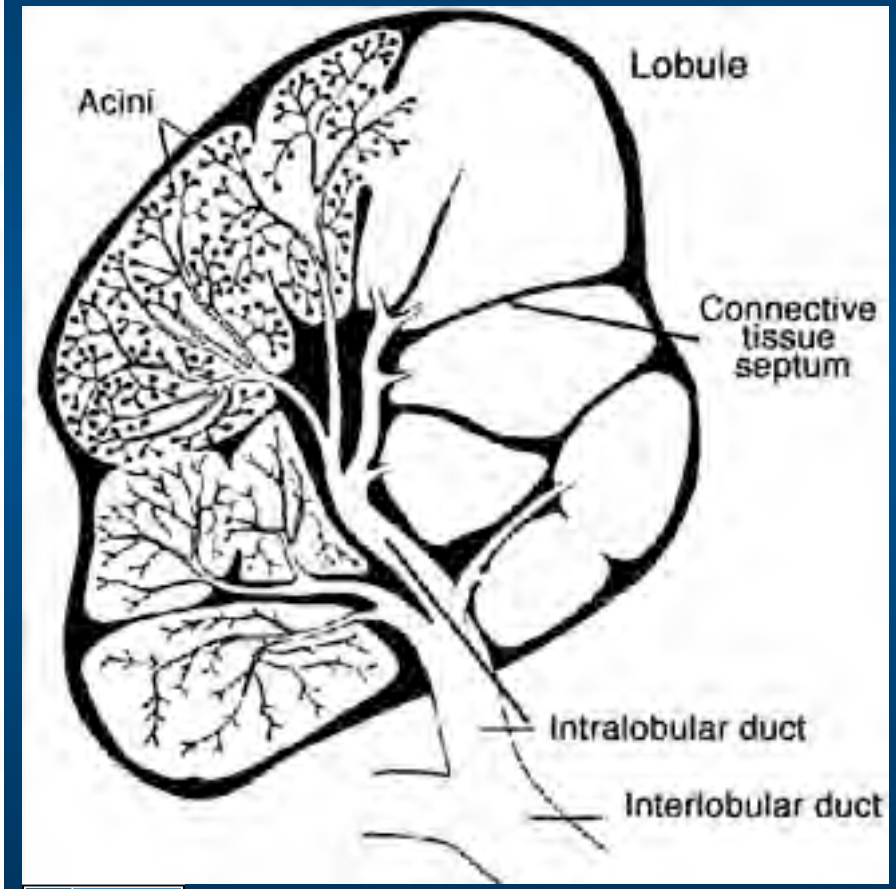
It's a compound gland

Glandular Lobules and Lobes

Many *Lobules* form a *Lobe*.



PD-INEL Adapted and modified from Leson TS, Leson CR, Paparo AA: Text/Atlas of Histology. Philadelphia, WB Saunders, 1988



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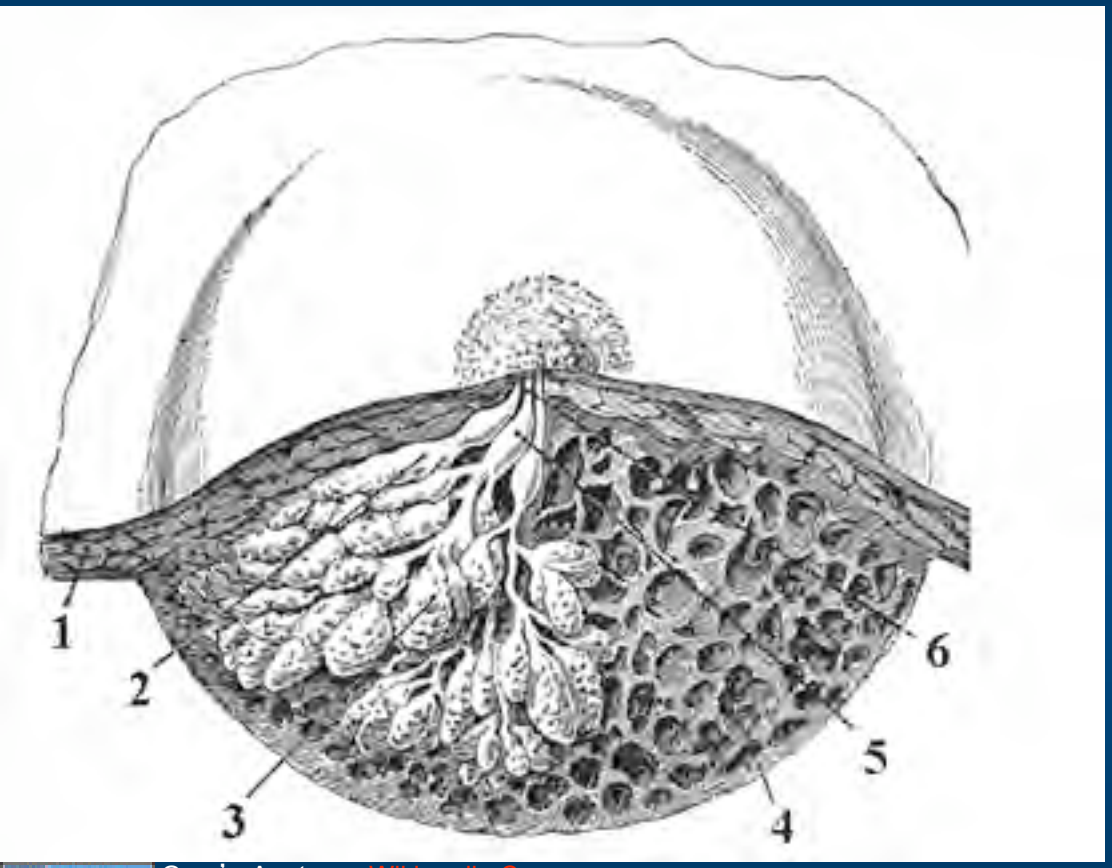
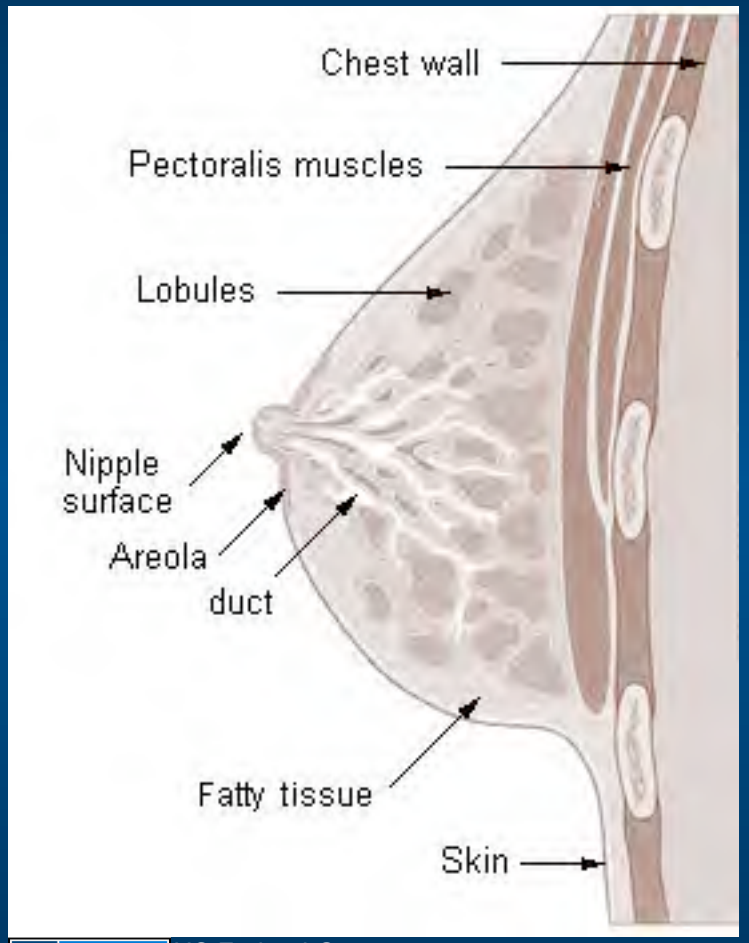
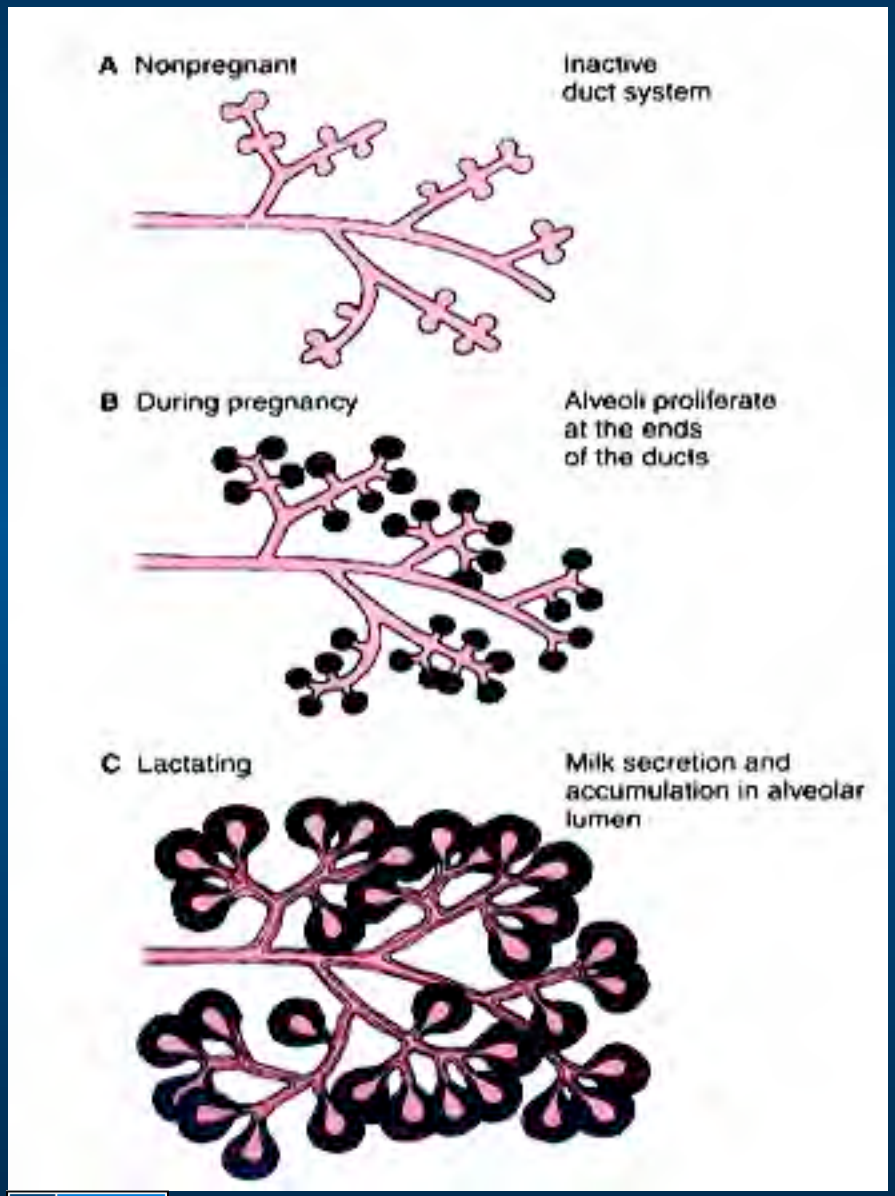


PD-EXP Gray' s Anatomy, Wikimedia Commons



PD-GOV US Federal Government

Change in Mammary Gland Alveoli and Ducts



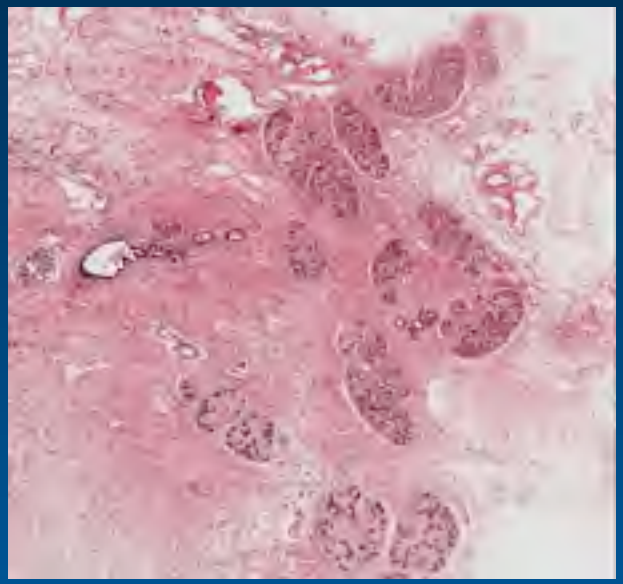
Inactive: *No alveoli and undifferentiated terminal ducts.*

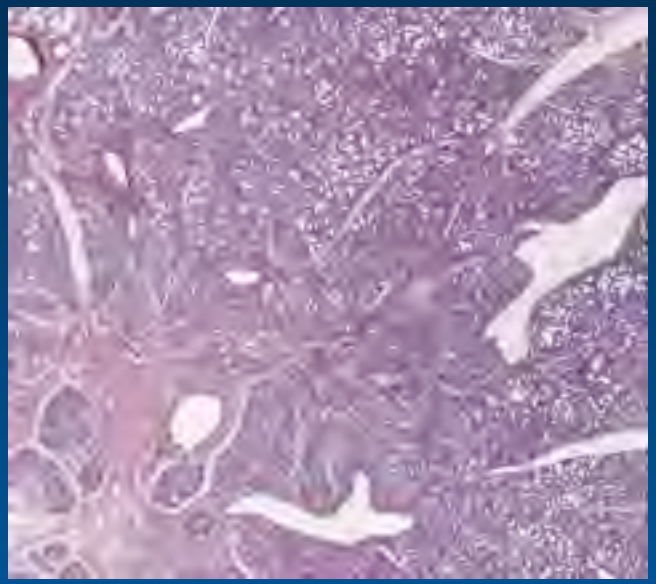
Active (during pregnancy)**:**

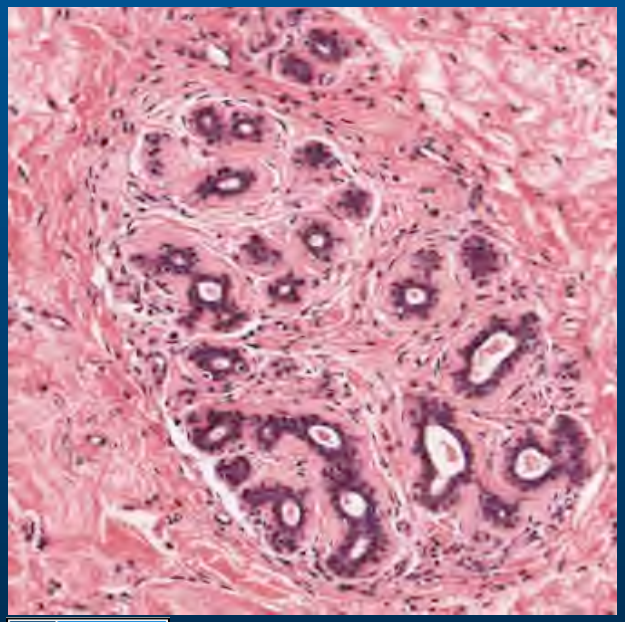
Proliferation and differentiation of alveoli.

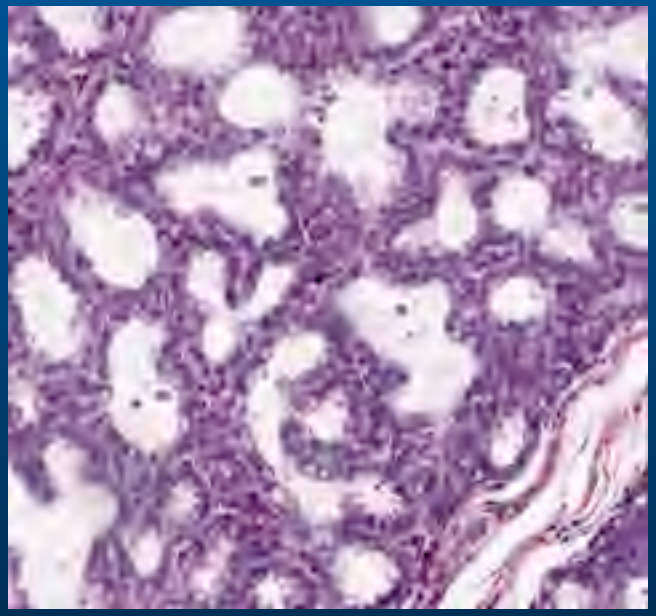
Active (lactating)**:** *Secretion of milk and accumulation in alveolar lumen.*

Inactive and active mammary glands





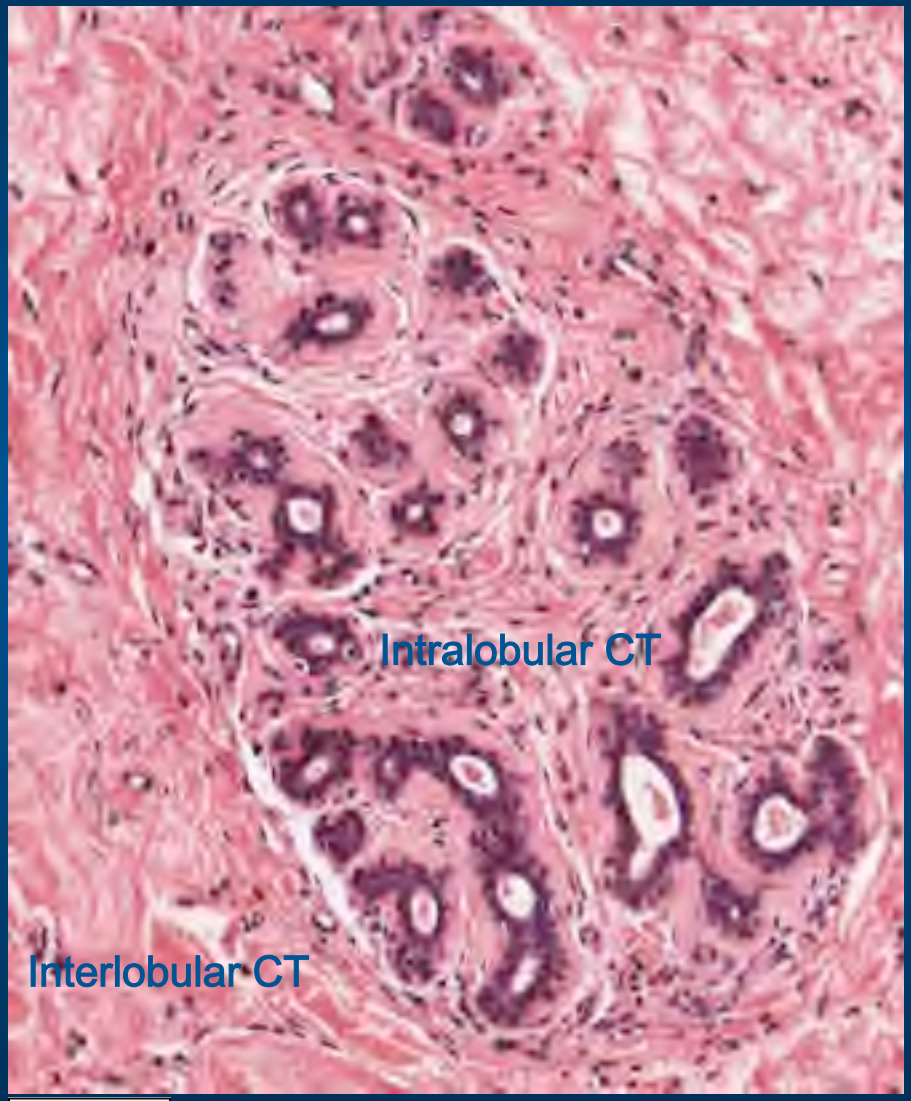




Inactive gland (left):
Lobules are arranged sparsely and each lobule consists of mainly bluntly ending ducts with no secretory alveoli.

Active gland (right):
Lobules are well developed and pack the gland. In each lobule, secretory alveoli have formed and their lumens are highly dilated.

The stroma of the mammary gland



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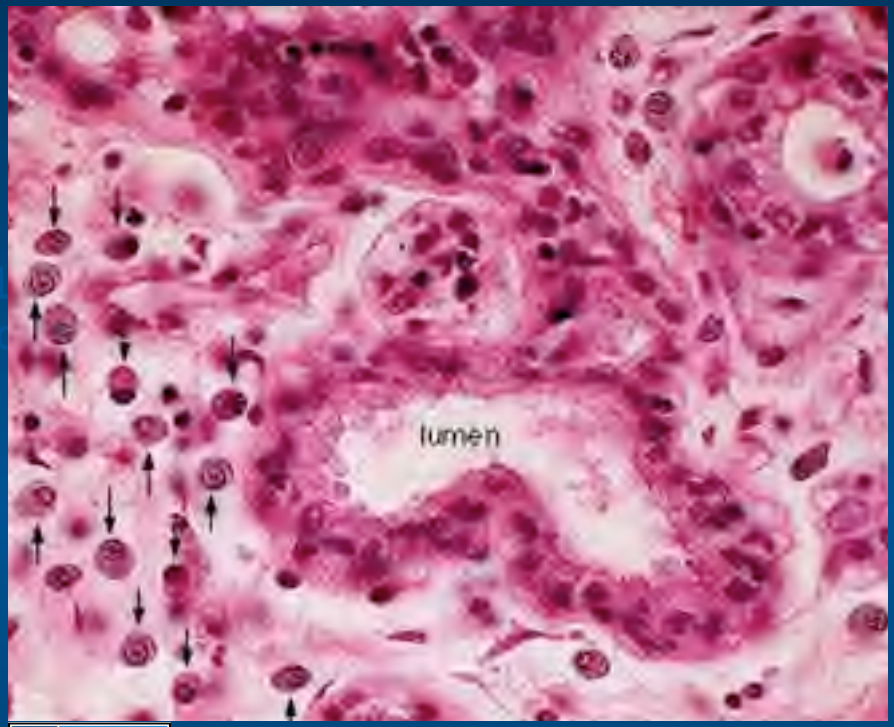

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The loose, more cellular and less fibrous, intralobular connective tissue makes the stroma distensible for the hypertrophy of the epithelial elements and differentiation of the alveoli. Numerous plasma cells (arrows above), which appear in the intralobular connective tissue during pregnancy and lactation, produce immunoglobulin IgA. IgA is taken up by the epithelial cells, secreted in the milk, and transported to the infant's intestine where the antibodies resist bacterial infection.

The antibodies resist enteric infections.

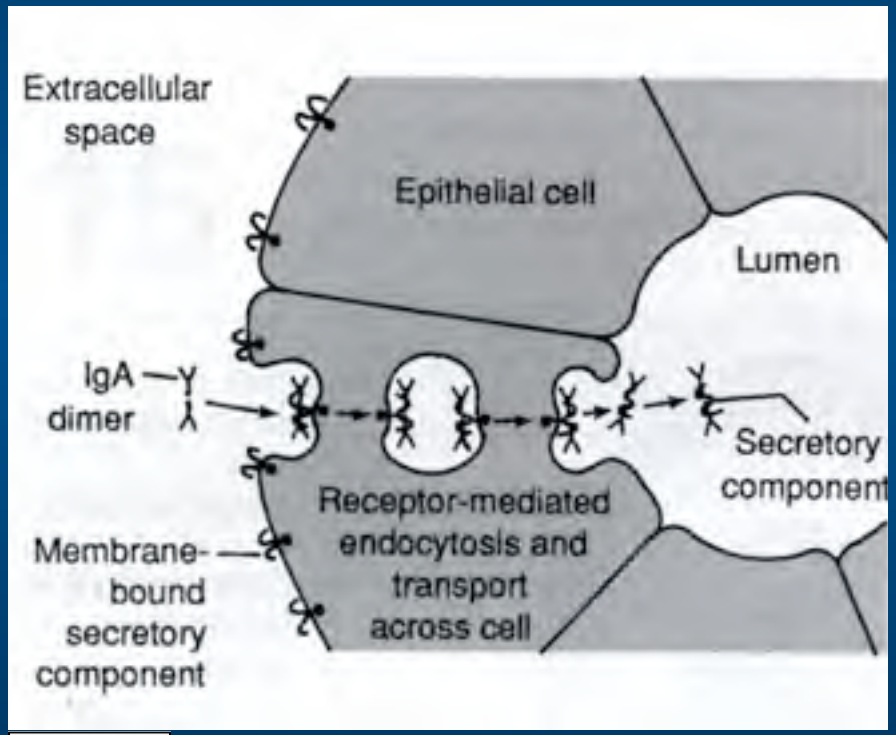
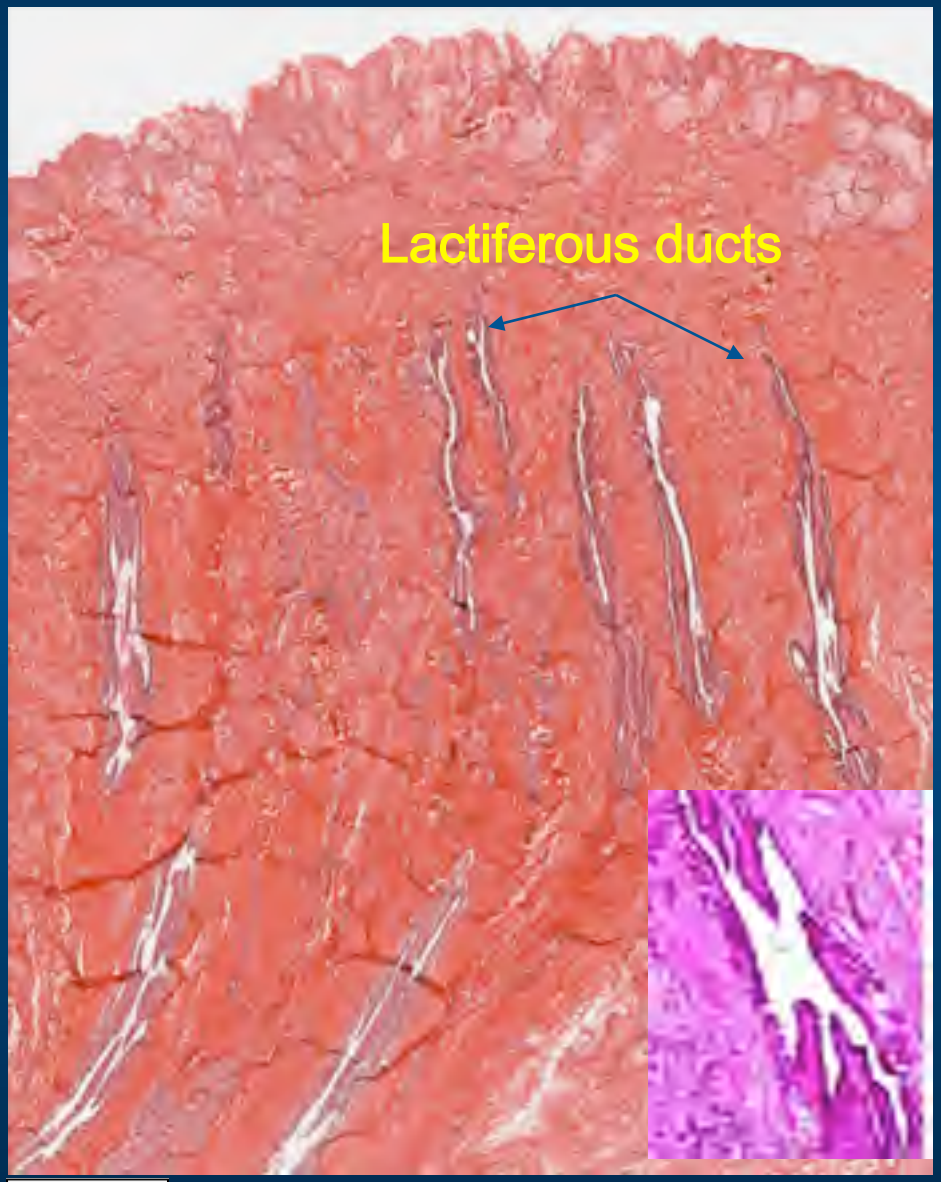


Image of mother breastfeeding infant antibodies removed

Nipple - Lactiferous ducts



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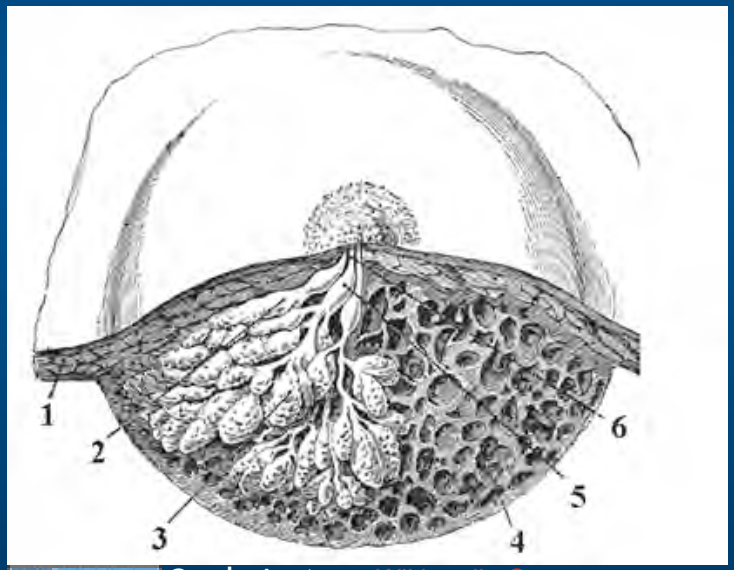
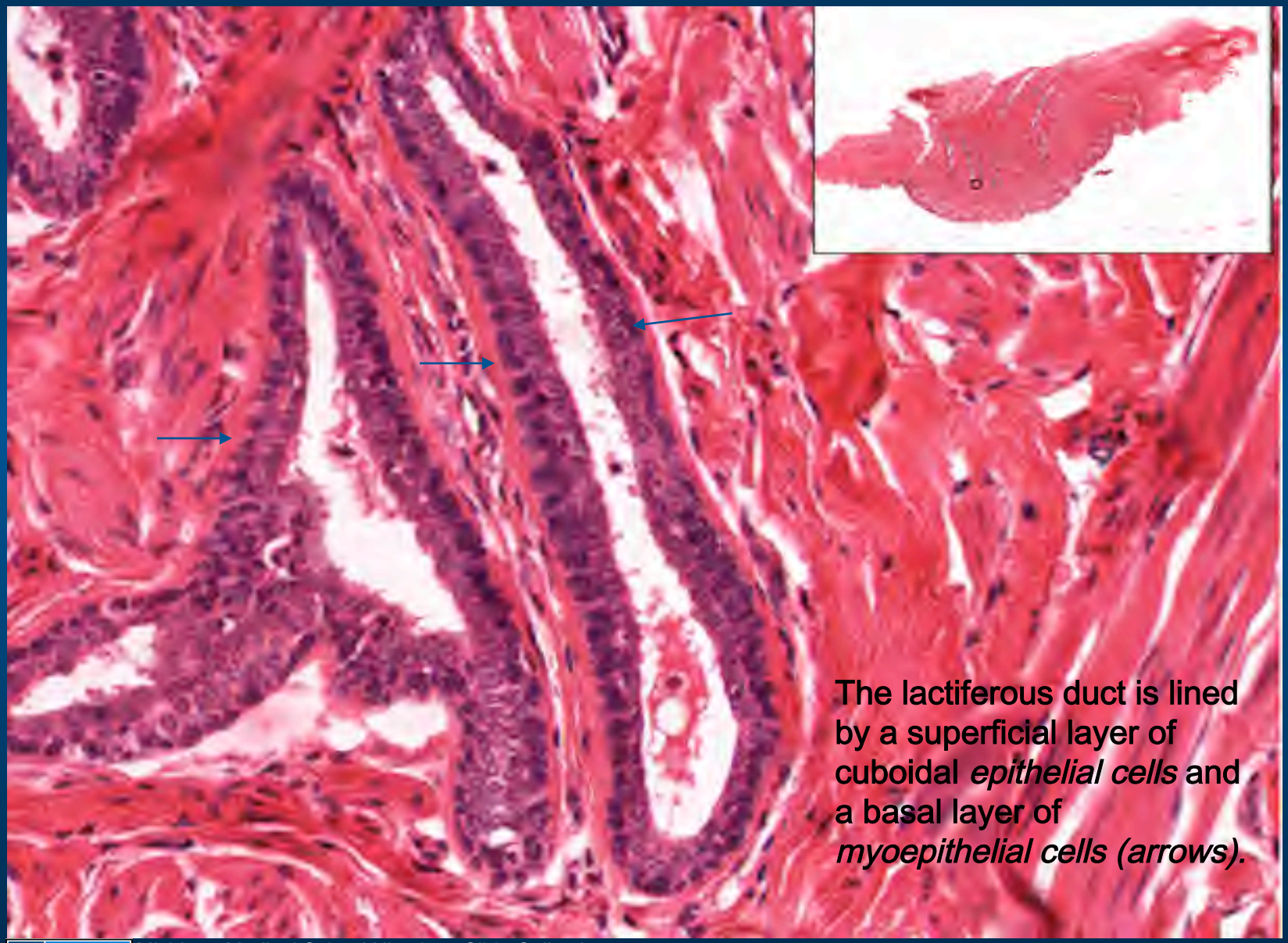
15-20 independent *lactiferous ducts*, each draining one of the lobes of the gland, open at the tip of the nipple. Within the nipple, each duct is slightly dilated to form a *lactiferous sinus* (inset).



PD-EXP Gray' s Anatomy, Wikimedia Commons

#265 (nipple) Lactiferous ducts



The lactiferous duct is lined by a superficial layer of cuboidal *epithelial cells* and a basal layer of *myoepithelial cells (arrows).*

Learning Objectives

- Be able to identify principal layers of the skin (epidermis, dermis and hypodermis) at the light microscope level and know the major functions of each layer.
- Be able to identify the strata of the epidermis in thick and thin skin and know the major cellular events that take place in each layer in the process of keratinization.
- Be able to identify the cells in different layer of the epidermis at the electron microscope level by recognizing characteristic organelles and structures present in each layer.
- Be able to recognize melanocytes and know the process of pigment formation in the skin.
- Be able to identify eccrine and apocrine sweat glands at the light microscope level and distinguish ductal and secretory portions.
- Be able to identify the components of the pilosebacous apparatus and know the structural relationship between each component and the epidermis.
- Be able to identify the mammary gland, by recognizing its structural components (lactiferous ducts, alveoli, lobules, the stromal connective tissue), and know the histological differences in active and inactive glands.

Additional Source Information

for more information see: http://open.umich.edu/wiki/CitationPolicy

Slide 5: UM Medical School Anatomy Laboratory Manual

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Slide 31: Wheater 9.18

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Slide 33: Sources Undetermined

Slide 34: Weiss, pg. 562

Slide 35: Source Undetermined

Slide 36: Source Undetermined

Slide 37: Source Undetermined

Slide 38: Tsaitgaist, Wikipeda, http://en.wikipedia.org/wiki/File:Hair_follicle-en.svg

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Slide 46: Adapted and modified from Leson TS, Leson CR, Paparo AA: Text/Atlas of Histology. Philadelphia, WB Saunders, 1988; Source Undetermined

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