Integumentary System

Chapter 5

- Objectives:

1- Describe the functions of the integumentary system.

2- Identify the major structures found in the three layers of the skin.

3. Describe the anatomy and physiology of hair and nails

4. Define some common dermatopathological disorders.

- This system is divided into:

  1- skin

  2- hair

  3- glands

  4- nails

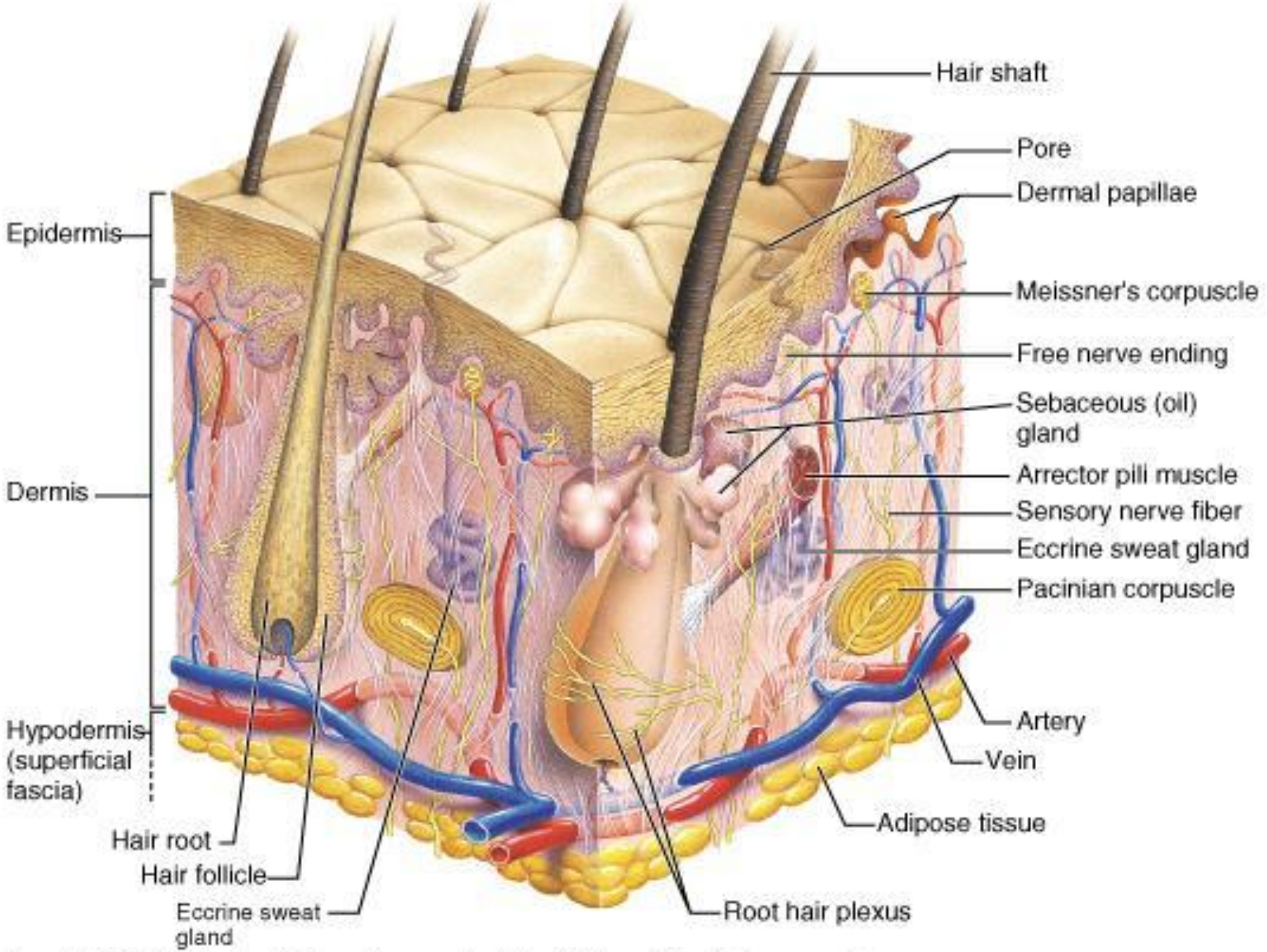
  5- nerve endings

  I) Skin

  Skin is an organ because it consists of different tissues that are joined to perform a specific function.

  Largest organ of the body in surface area and weight.

  Dermatology is the medical specialty concerning the diagnosing and treatment of skin disorders.


Hair shaft
Pore
Dermal papillae
Epidermis
Meissner's corpuscle
Free nerve ending
Sebaceous (oil) gland
Dermis
Arrector pili muscle
Sensory nerve fiber
Eccrine sweat gland
Pacinian corpuscle
Artery
Hypodermis (superficial fascia)
Vein
Adipose tissue
Hair root
Hair follicle
Eccrine sweat gland
Root hair plexus

Anatomy (structure)

Epidermis (thinner outer layer of skin)

Dermis (thicker connective tissue layer)

Hypodermis (subcutaneous layer or Sub-Q)

Muscle and bone

Physiology (function)

1- Protection

- physical barrier that protects underlying tissues from injury, UV light and bacterial invasion.
- mechanical barrier is part **non specific immunity** (skin, tears and saliva).

2- Regulation of body temperature

- high temperature or strenuous exercise; sweat is evaporated from the skin surface to cool it down.

- **vasodilation** (increases blood flow) and **vasoconstriction** (decrease in blood flow) regulates body temp.

3-Sensation

- nerve endings and receptor cells that detect stimuli to temp., pain, pressure and touch.

4- Excretion

- sweat removes water and small amounts of salt, uric acid and ammonia from the body surface

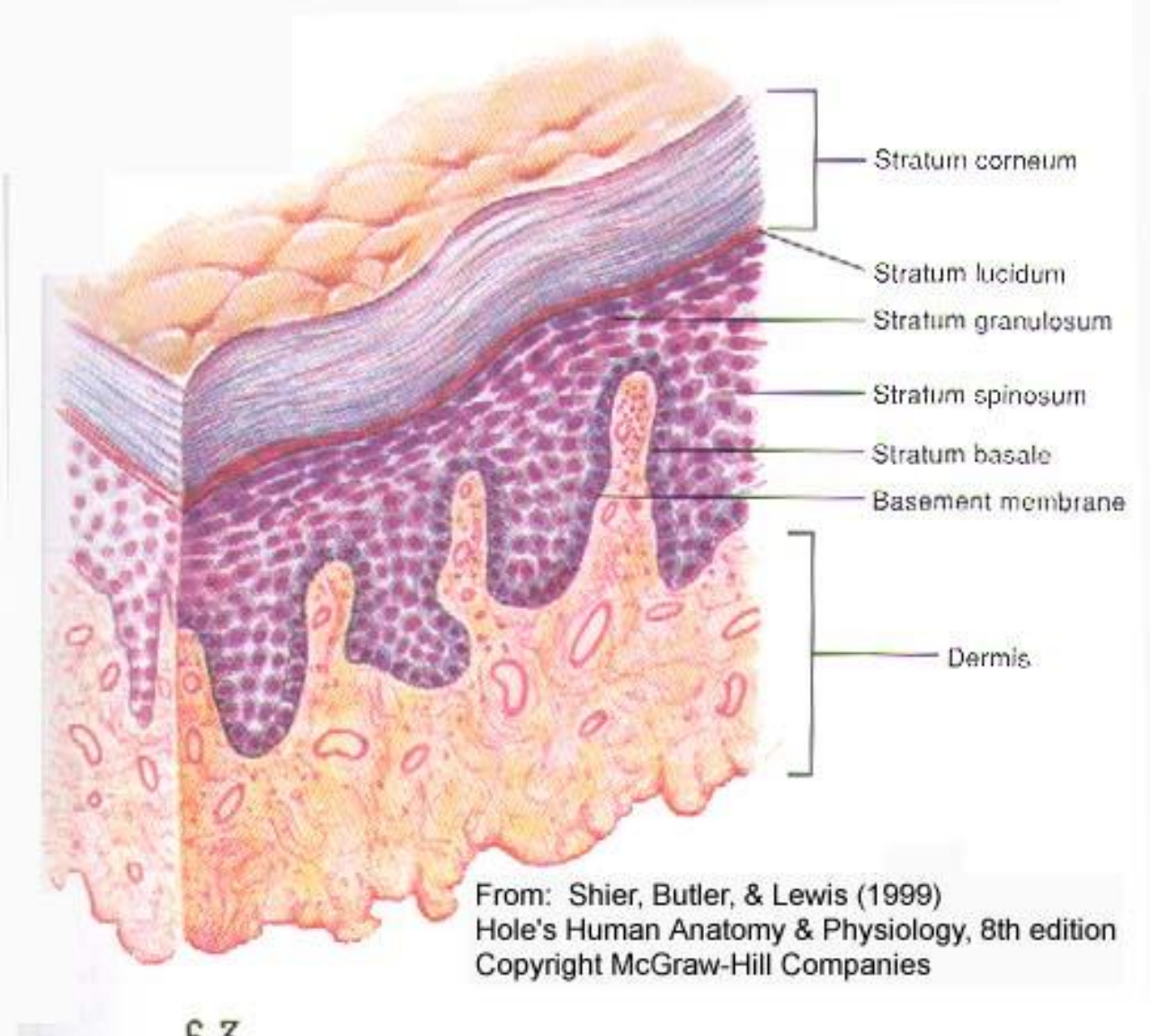
5- Blood reservoir

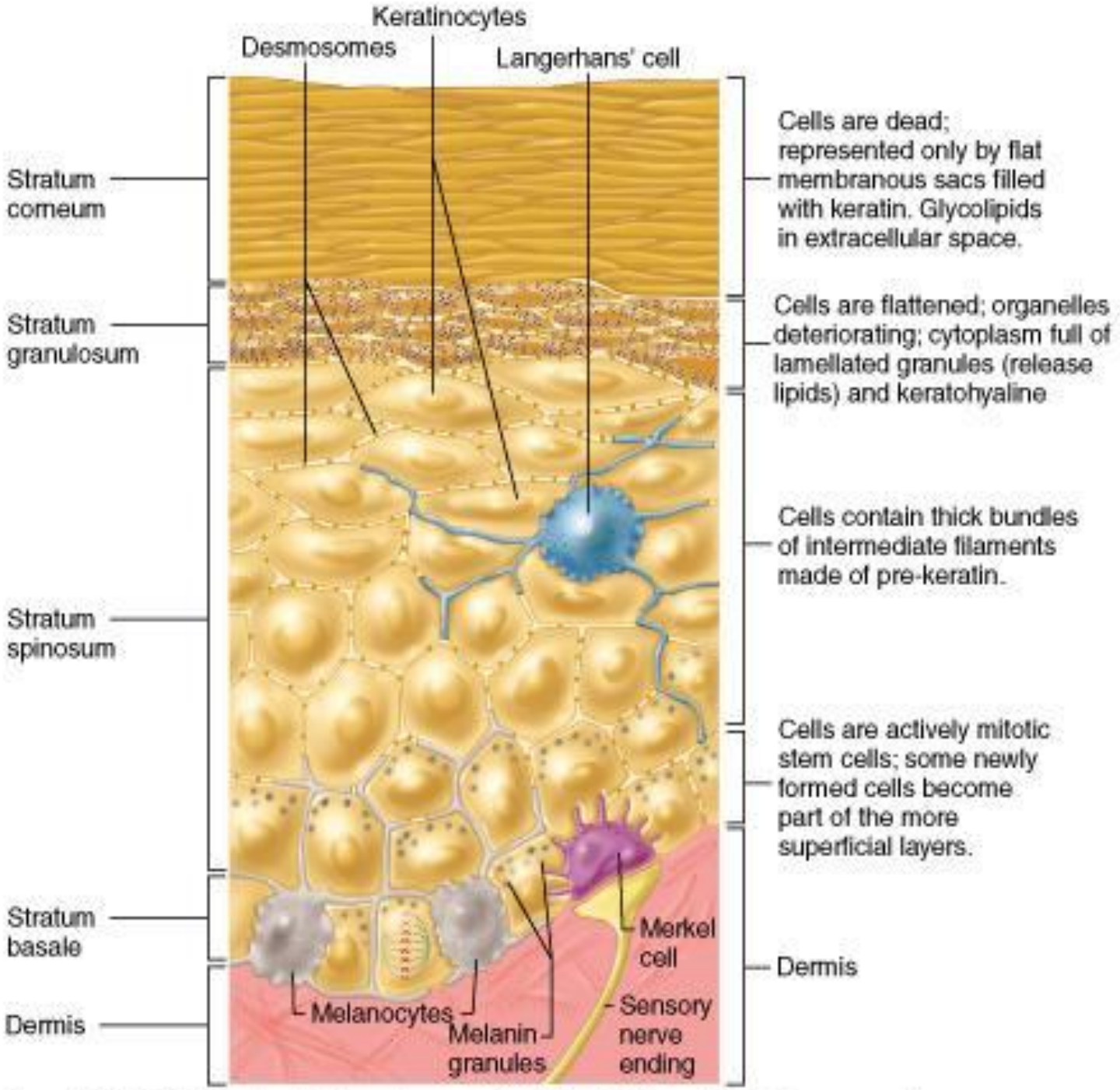
- dermis houses an extensive network of blood vessels carrying 8-10% of total blood flow in a resting adult.

6- Synthesis of Vitamin D (cholecalciferol)

-UV rays in sunlight stimulate the production of Vit. D. Enzymes in the kidney and liver modify and convert to final form; **calcitriol** (most active form of Vit. D.) Calcitriol aids in absorption of calcium from foods and is considered a hormone.

- Epidermis: keratinized stratified squamous epithelium with four distinct cell types and five distinct layers.



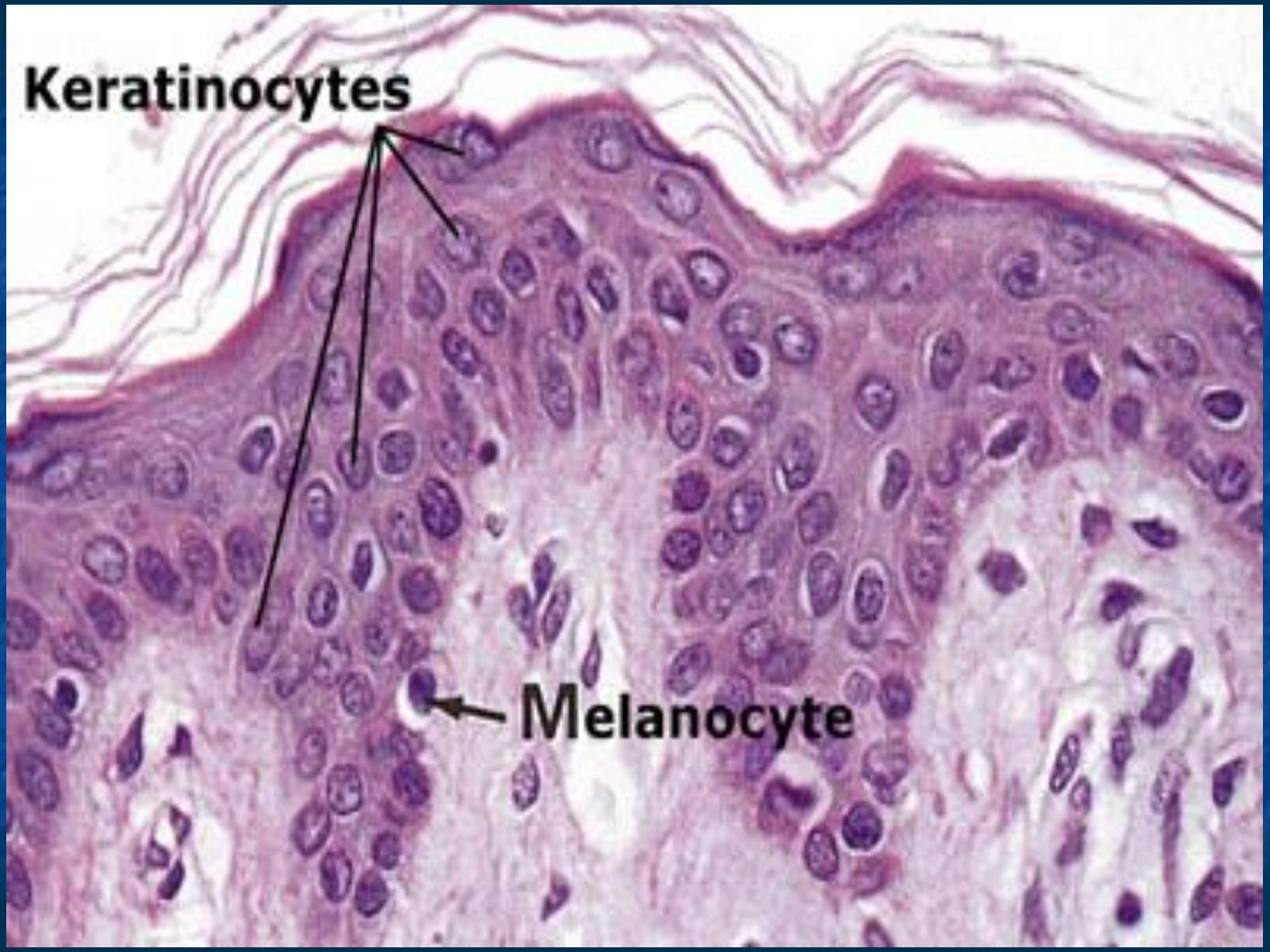

Keratinocytes
Desmosomes
Langerhans' cell
Stratum corneum
Stratum granulosum
Stratum spinosum
Stratum basale
Dermis
Cells are dead; represented only by flat membranous sacs filled with keratin. Glycolipids in extracellular space.
Cells are flattened; organelles deteriorating; cytoplasm full of lamellated granules (release lipids) and keratohyaline
Cells contain thick bundles of intermediate filaments made of pre-keratin.
Cells are actively mitotic stem cells; some newly formed cells become part of the more superficial layers.
Dermis
Merkel cell
Melanocytes
Melanin granules
Sensory nerve ending

Cells in the epidermis:

- keratinoytes
- melanocytes
- Merkel cells
- Langerhans' cells

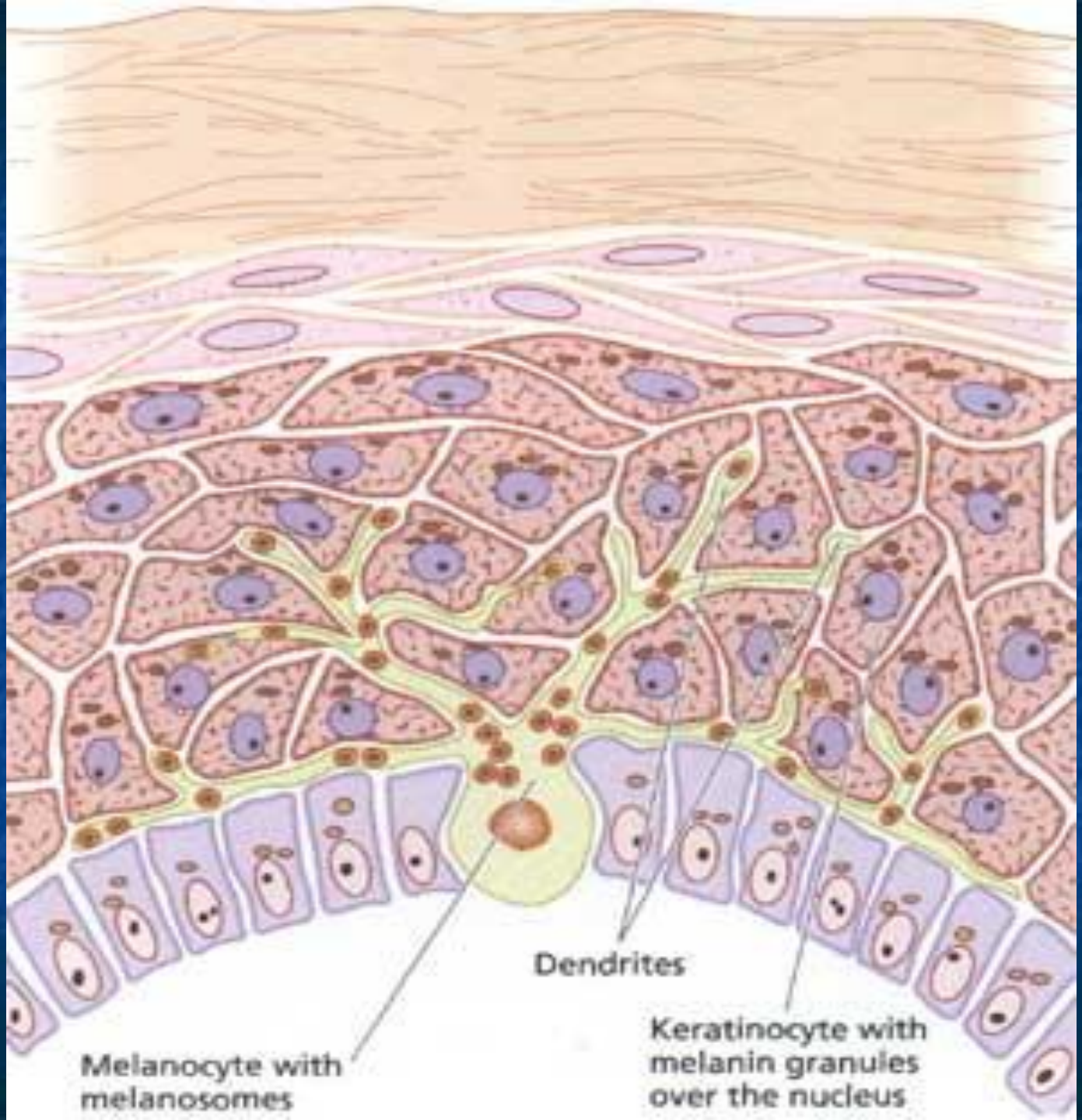
1- Keratinocytes: most abundant

- produce keratin (fibrous protein)
- protective; waterproofing the skin
- continuous mitosis
- form in the deepest layer called the stratum basale
- cells push their way up to the surface where they are dead cells filled with keratin; will slough off. Regenerates every 25-45 days.


Keratinocytes
Melanocyte

2- Melanocytes:

- cells produce brownish/black pigment called melanin. (8% of epidermal cells)
- stratum basale
- branching processes (dendrites)
- melanin accumulates in melanosomes and transported along dendrites of the melanocytes to keratinocytes.
- melanin accumulates on the superficial aspect of the keratinocyte shielding its nucleus from harmful UV light.
- lack of melanin: albino

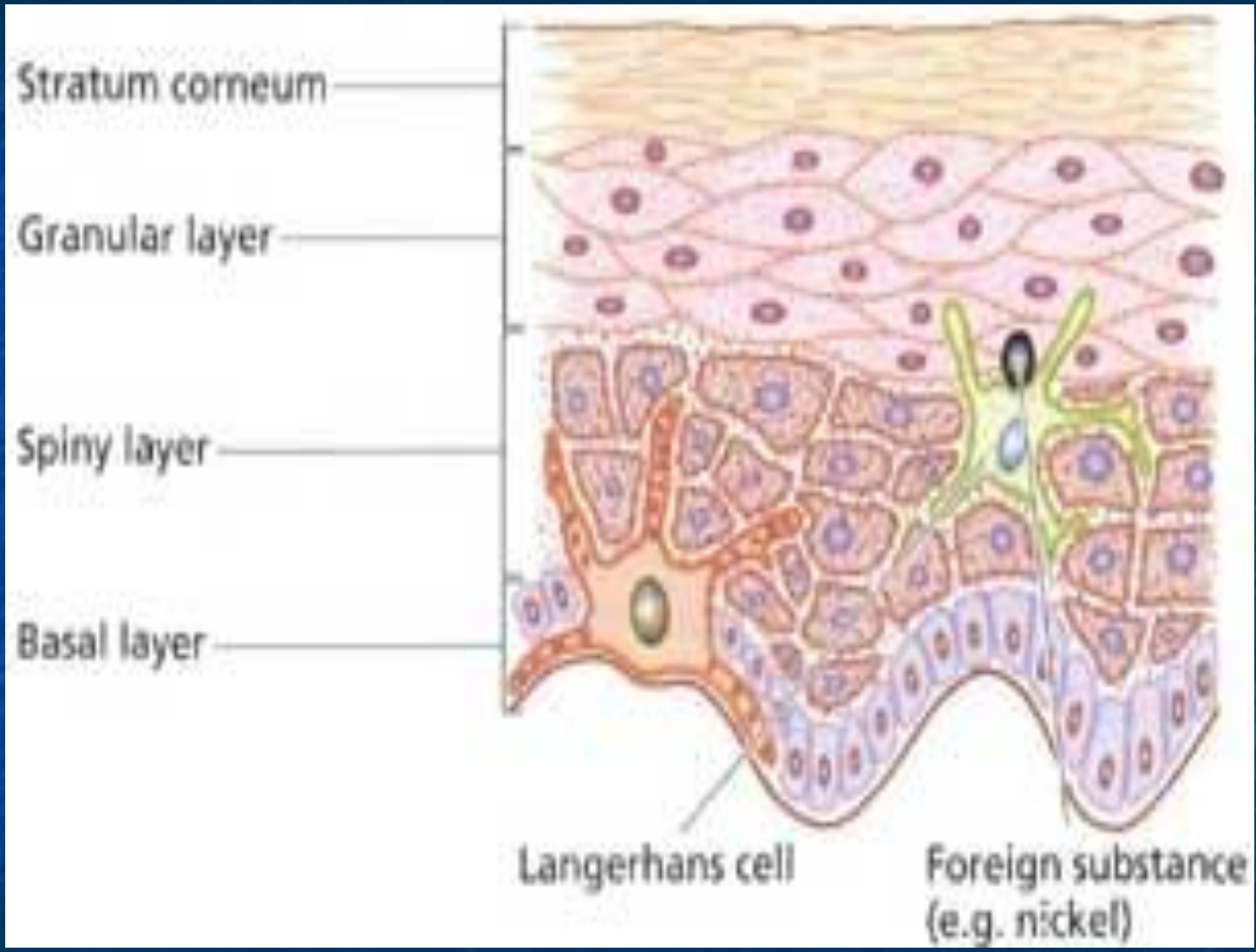

Dendrites
Melanocyte with melanosomes
Keratinocyte with melanin granules over the nucleus

3- Merkel cells:

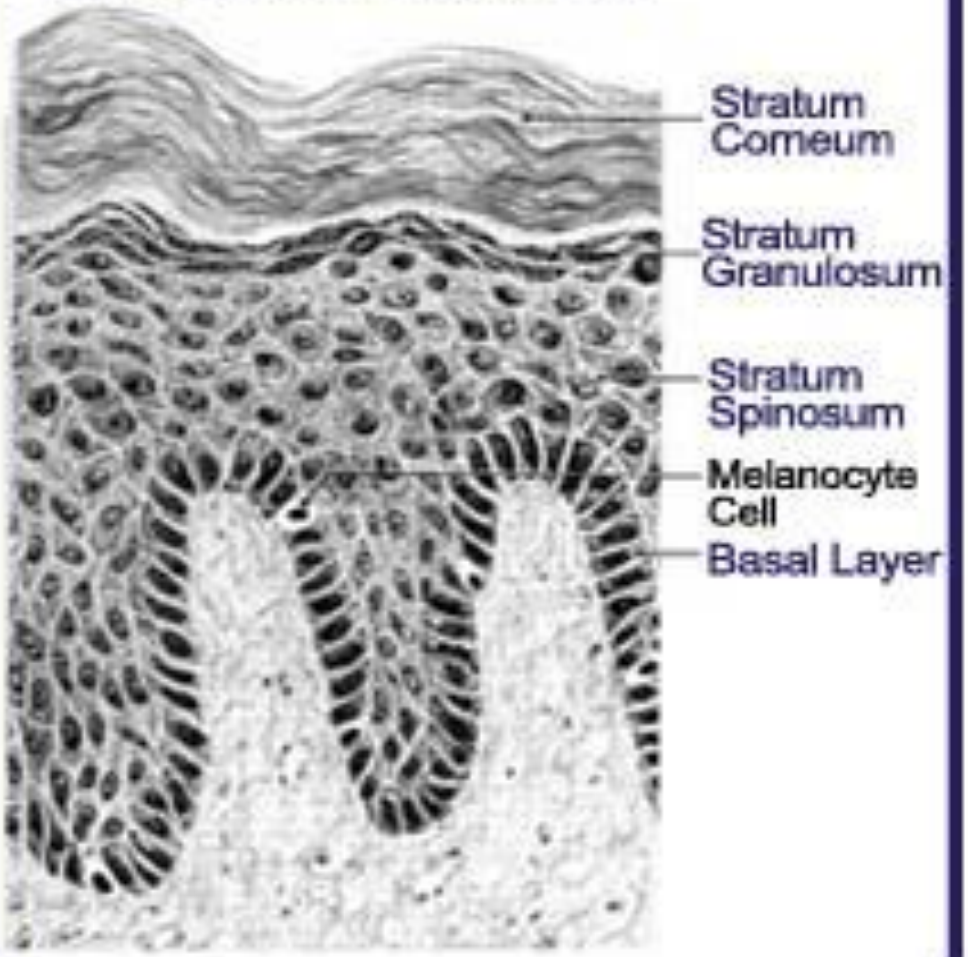
- stratum basale
- epidermis of hairless skin
- attach to keratinocytes by desmosomes
- make contact with a sensory neuron ending called a Merkel disc (touch).

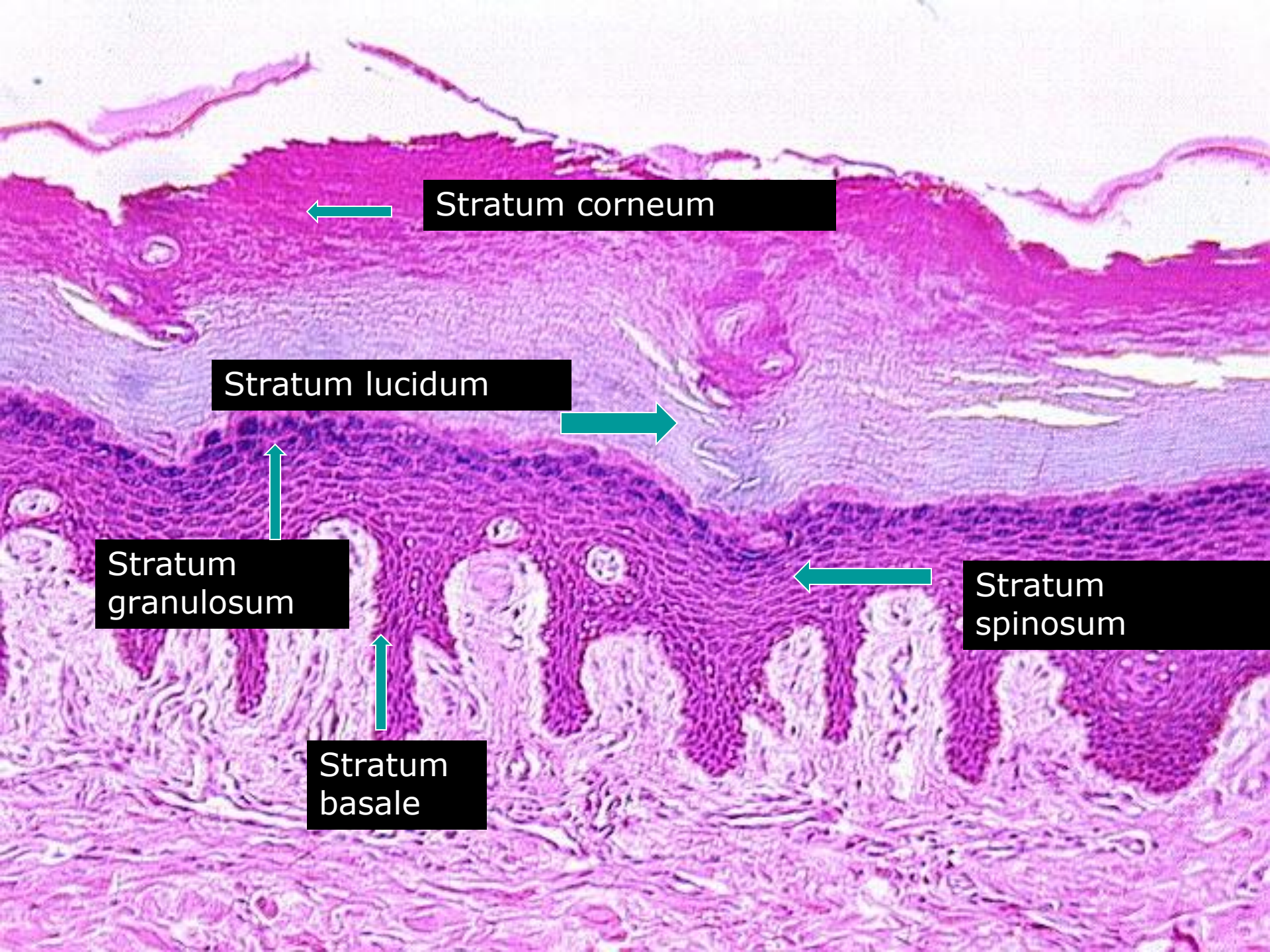
4- Langerhans' cells:

- star-shaped cells arising from bone marrow that migrate to epidermis.
- epidermal dendritic cells (macrophages)
- interact with a WBC called a T- helper cell
- easily damaged by UV light.


Stratum corneum
Granular layer
Spiny layer
Basal layer
Langerhans cell
Foreign substance
(e.g. nickel)

Layers of the Epidermis




Stratum corneum
Stratum lucidum
Stratum granulosum
Stratum spinosum
Stratum basale

5 layers of the epidermis:

1- **Stratum corneum (horny layer)**

- layer has many rows of dead cells filled with keratin
- continuously shed and replaced **(desquamation)**
- effective barrier against light, heat and bacteria
- 20-30 cell layers thick
- dandruff and flakes
- 40 lbs. of skin flakes in a lifetime (dust mites!)

2- **Stratum lucidum**

- seen in thick skin of the palms and soles of feet.
- 3-5 rows of clear flat dead cells
- keratohyalin (precursor) to keratin

3- **Stratum granulosum**

- 3-5 rows of flattened cells
- nuclei of cells flatten out
- organelles disintegrate cells eventually die
- keratohyalin granules (darkly stained) accumulate
- lamellated granules secrete glycolipids into extracellular spaces to slow water loss in the epidermis

4- **Stratum spinosum**: “spiny layer”

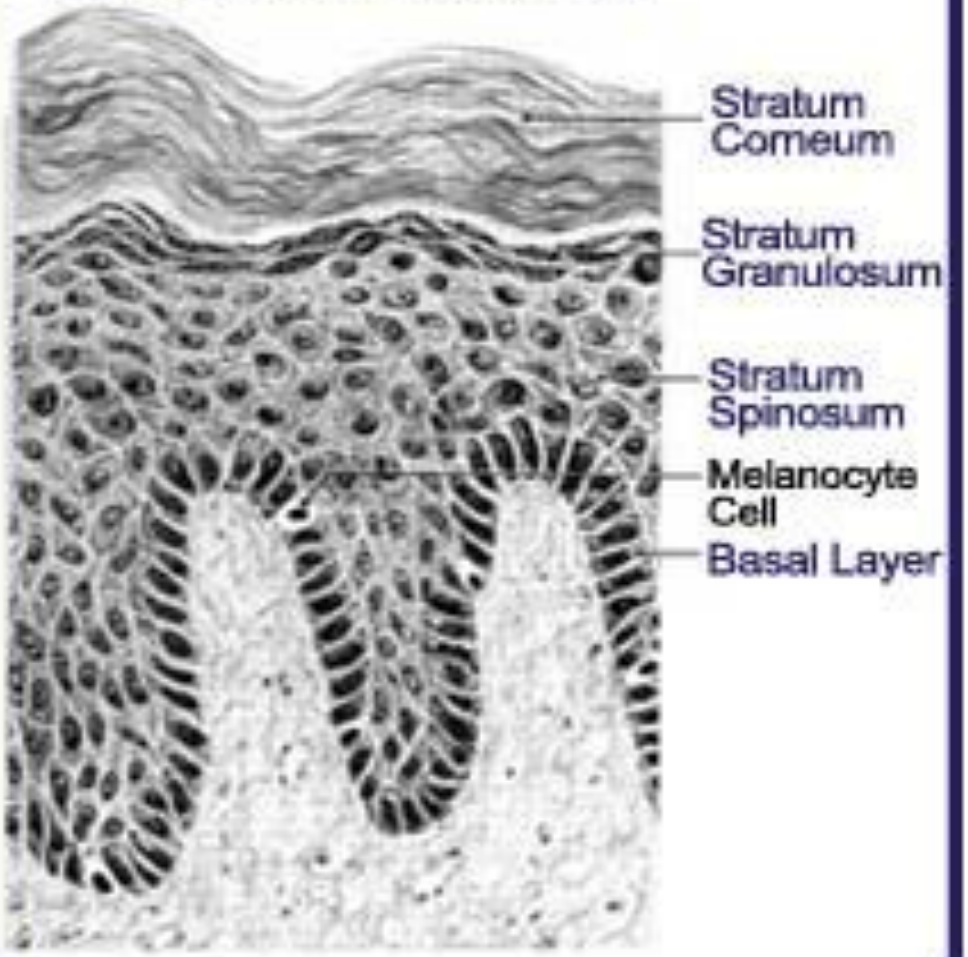
- 8-10 rows of polyhedral (many sided) cells
- appearance of prickly spines
    - shrink when prepared for slide
- melanin granules and Langerhans’ cell predominate

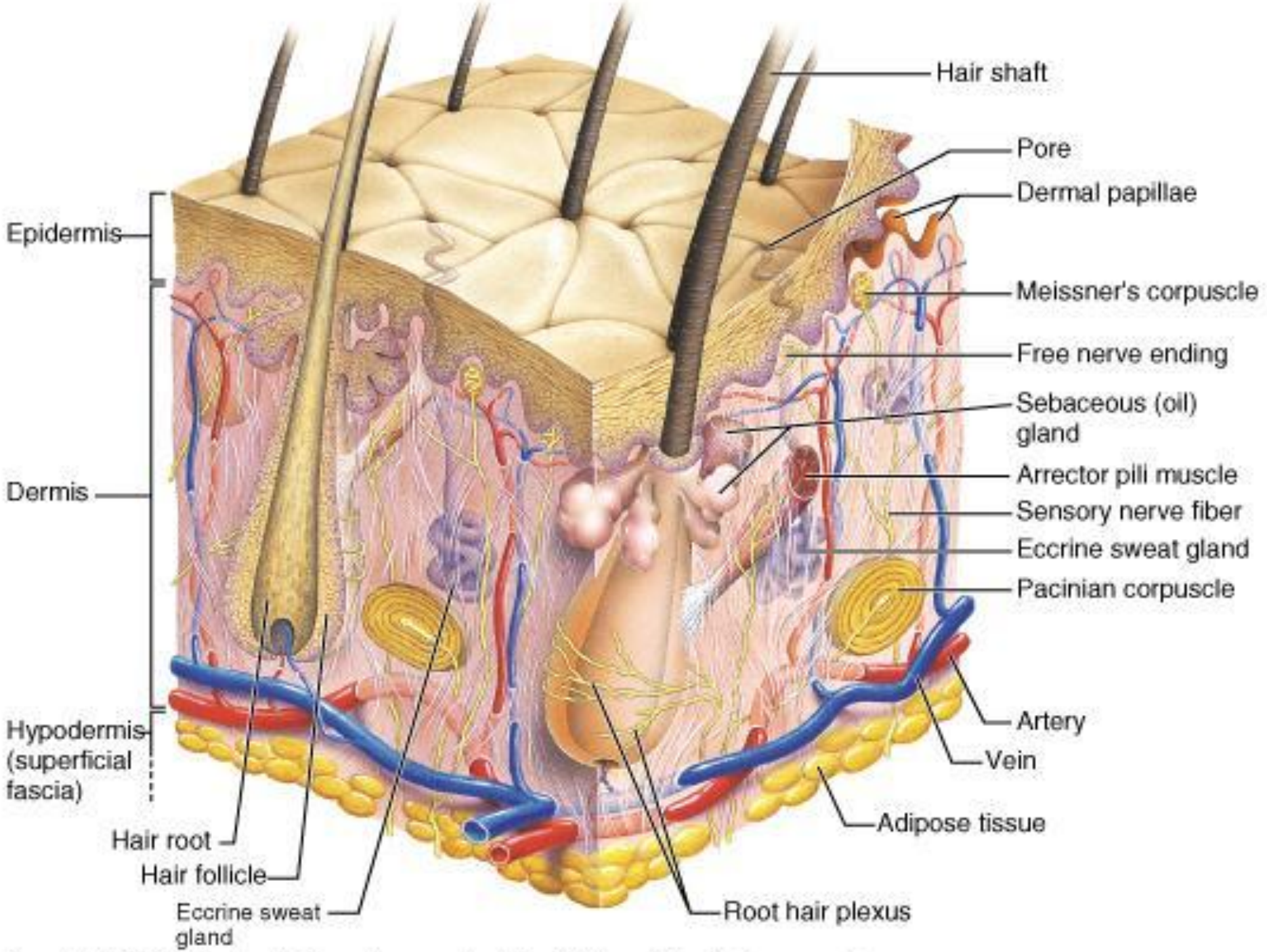

stratum lucidum
stratum granulosum
stratum spinosum

5- **Stratum basale:** deepest epidermal layer

- attached to dermis
- single row of cells
  - mostly columnar keratinocytes
  - with rapid mitotic division
    - stratum germinativum
- contain merkel cells and melanocytes
  - 10-25%

Layers of the Epidermis

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Vein
Adipose tissue
Hair root
Hair follicle
Eccrine sweat gland
Root hair plexus

- Dermis:
  - flexible and strong connective tissue
  - elastic, reticular and collagen fibers
  - cells: fibroblasts, macrophages (WBC), mast cells (histamine).
  - nerves, blood and lymphatic vessels
  - oil and sweat glands originate
  - two layers: papillary and reticular

1- Papillary layer:

- loose connective tissue with nipple like surface projection called dermal papilla.
- capillaries
- contain pain receptors
- contain touch receptors (Meissner's corpuscles
- dermal ridges- epidermal ridges- pattern called fingerprints

2- Reticular layer:

- dense irregular c.t.
- collagen fibers offer strength
- holds water
- dermal tearing causes stretch marks.
  - striae

Skin color: attributed to melanin, hemoglobin and carotene.

Race is determined by amount of melanin not # of melanocytes.

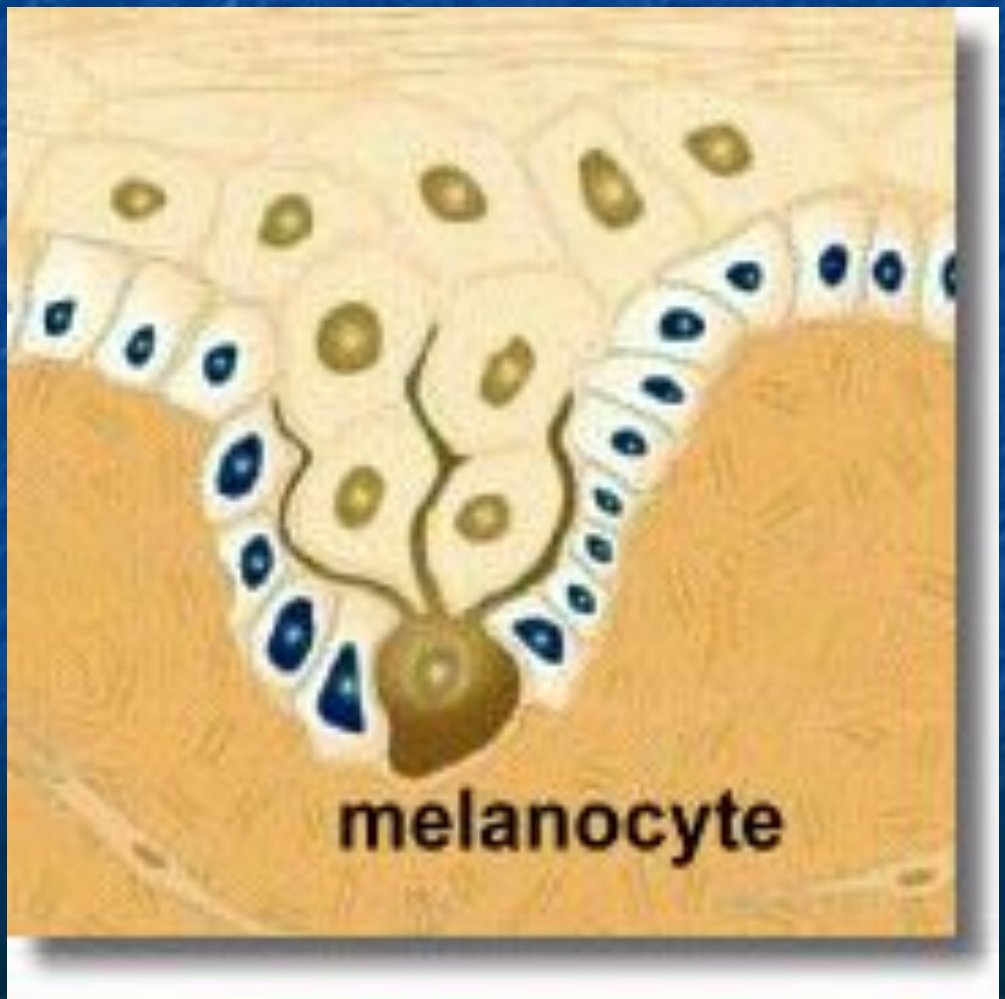
Local accumulation of melanin will result in freckles and pigmented moles.

- Melanin is made through interaction with tyrosinase present in melanocytes

UV light stimulates melanin production. Excessive UV light can damage DNA and cause solar elastosis (elastin fibers clump)

Carotene is formed from Vit. A and deposits in stratum corneum and imparts an orange tone to skin

Freckles



Hemoglobin (blood) will impart pinkish tones to skin. Blushing

1- Redness (erythema) - reddened skin, embarrassment, fever, hypertension, inflammation, or allergy

2- Pallor/blanching - pale skin, emotional distress or anemia, low blood pressure

3- Jaundice - liver disease, bile deposited in tissue

4- Bronzing - bronze coloration (Addison's disease) hypofunction of adrenal cortex

5- Black & blue - bruises, escaped blood clots in tissue spaces (clotted blood masses = hematomas)

Hair color:

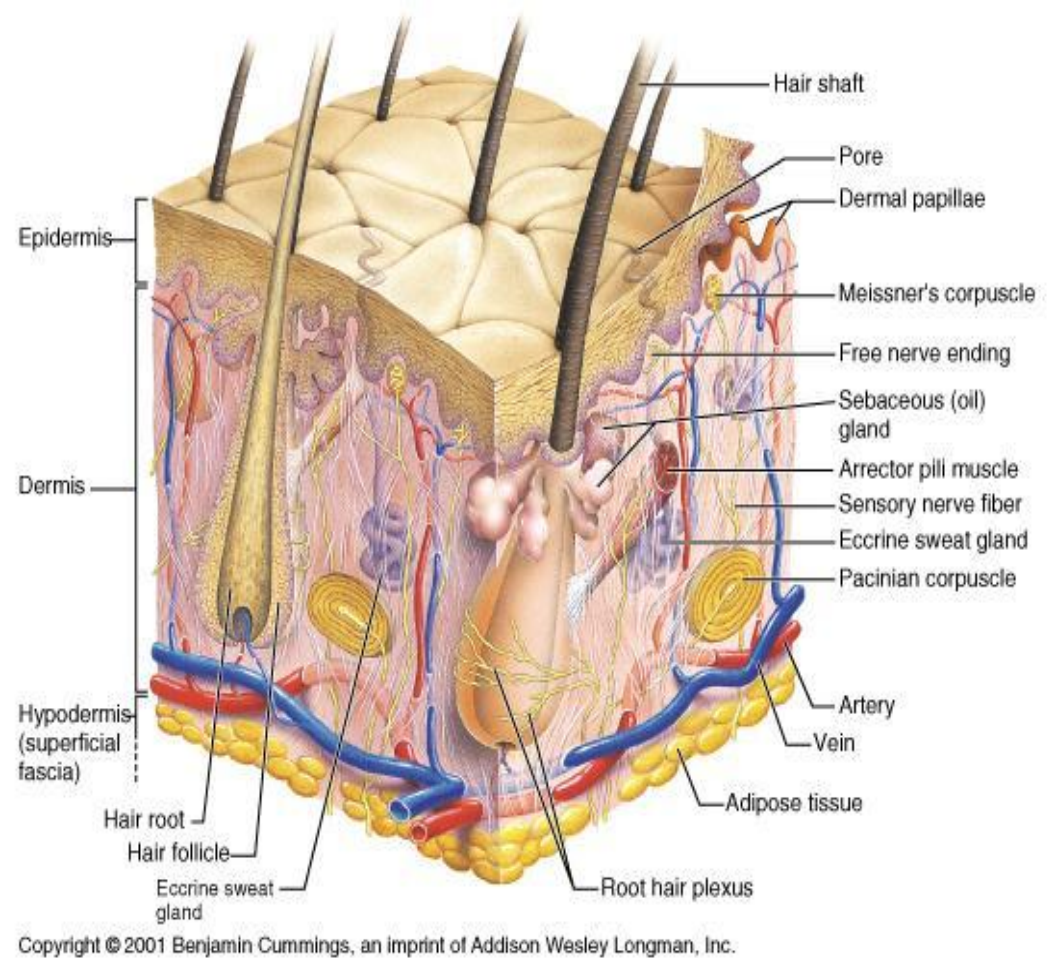
Dark hair: mostly melanin

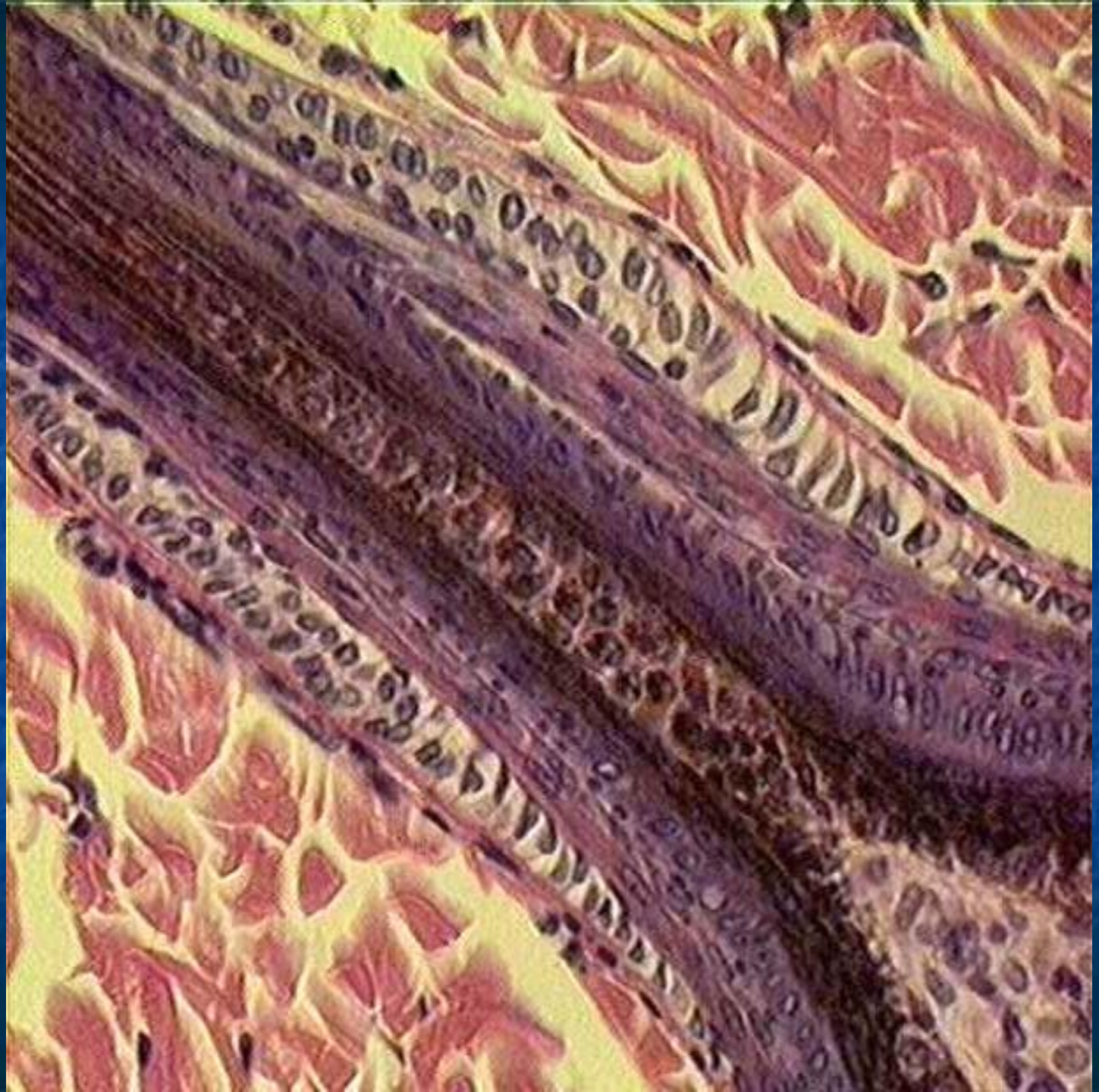
Blond and red hair: melanin with Fe and S.

Gray hair: loss of pigment (decr. tyrosinase)

White hair: air bubbles in the medullary hair shaft.

- Hair (pili)
  - main function is protection
  - hair root nerve plexus for touch
  - normal hair loss in adult 70-100 hairs/day





Hair anatomy:

- composed of dead columns of keratinized cells.
- shaft: is the superficial portion of hair
- root: below the surface in the dermis

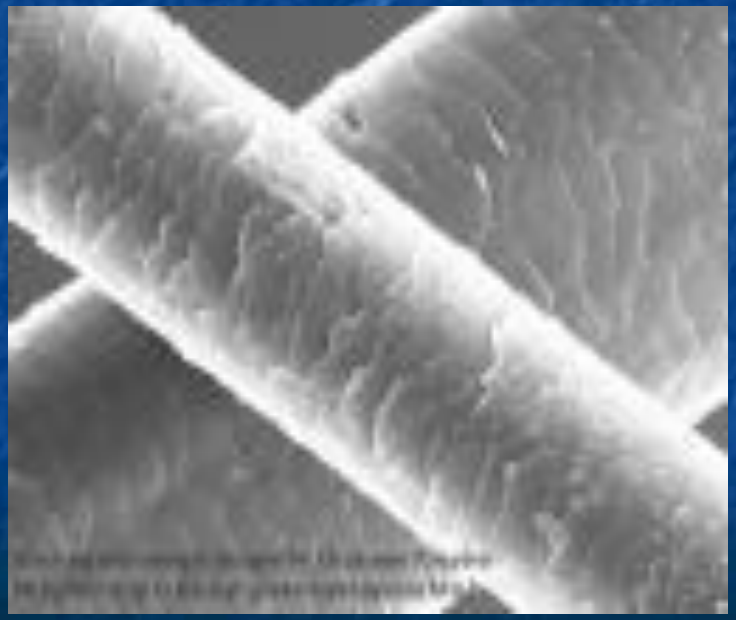
Shaft and root are composed of three layers: inner medulla, middle cortex and outer cuticle.

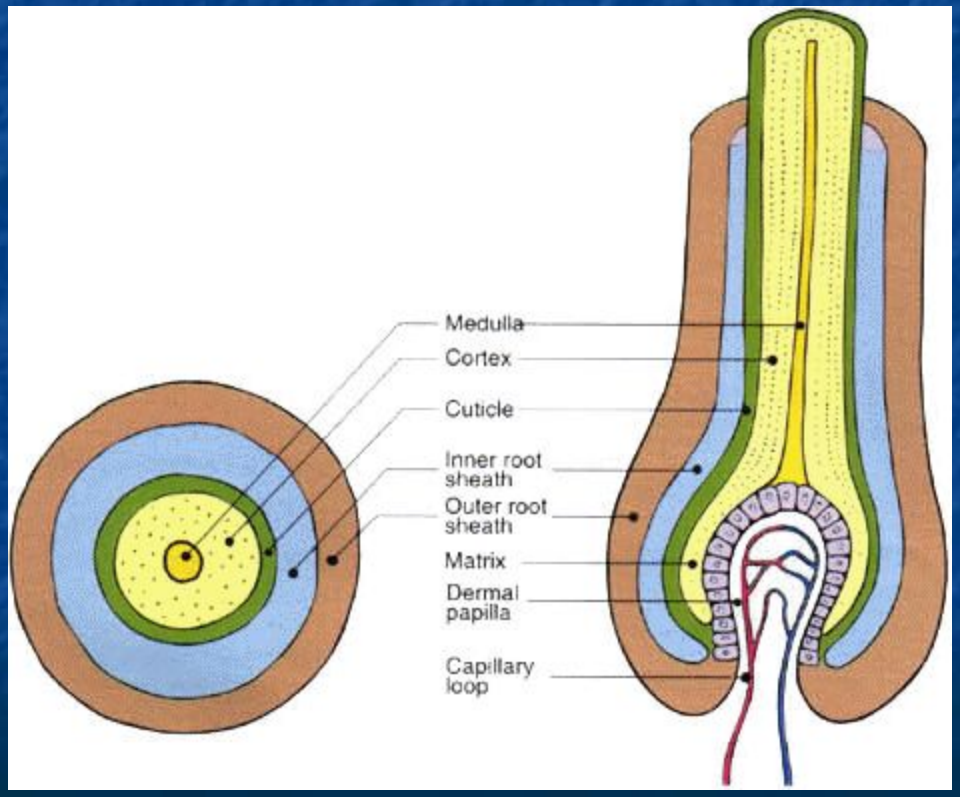
Inner medulla has 2-3 rows of polyhedral cells where pigment is located

Cortex is major portion of shaft

Cuticle is scaly and heavily keratinized (shingles)

Vellus hair: fine hair
Terminal hair : coarser hair; axillary and pubic region. Grow in response to sex hormones
Hirsutism: excessive hairiness: incr. androgens



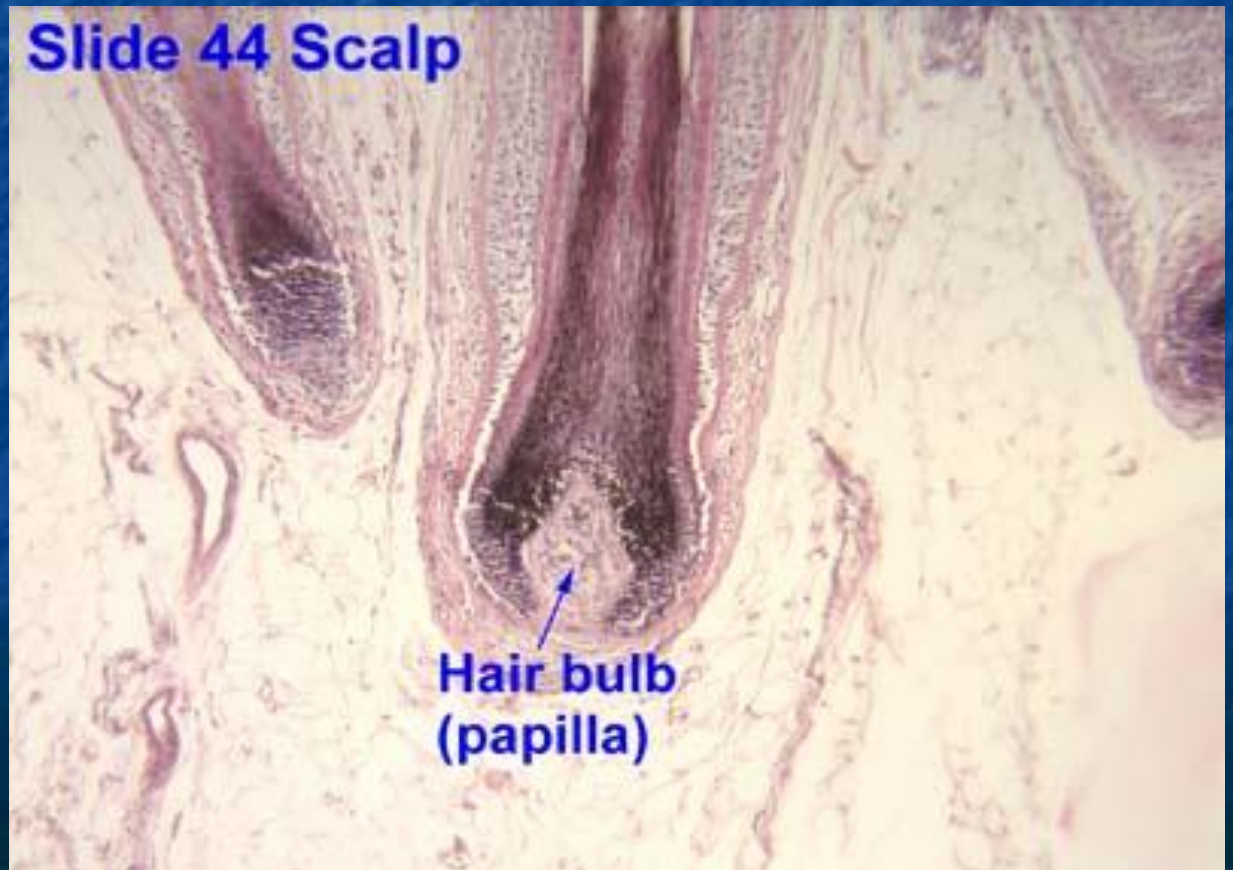


Hair follicle surrounds the root.

Bulb is the enlargement at the end of the follicle.

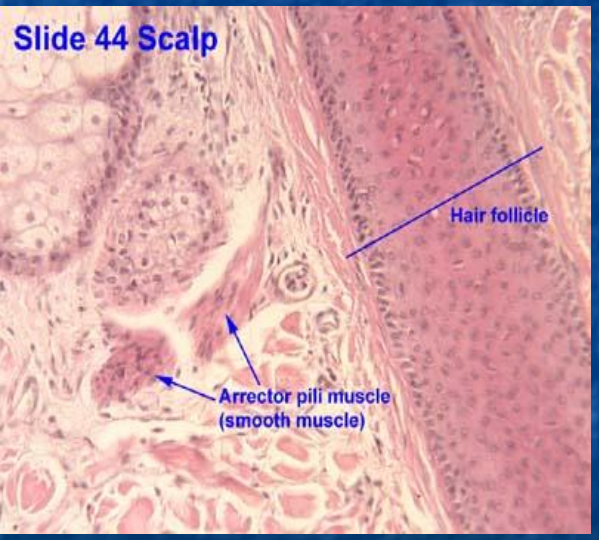
- Also houses the germinal layer

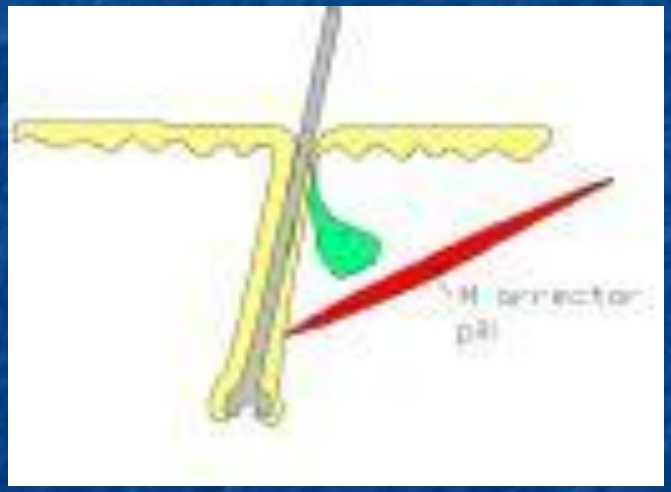
Papilla (nipple like) is located in the bulb and is where the blood supply nourishes the hair.

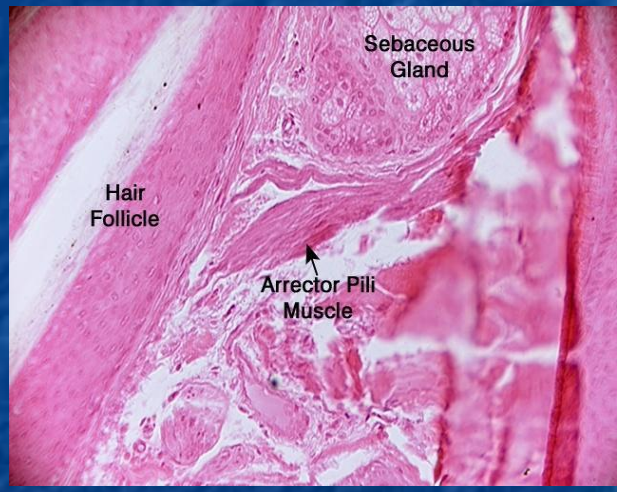


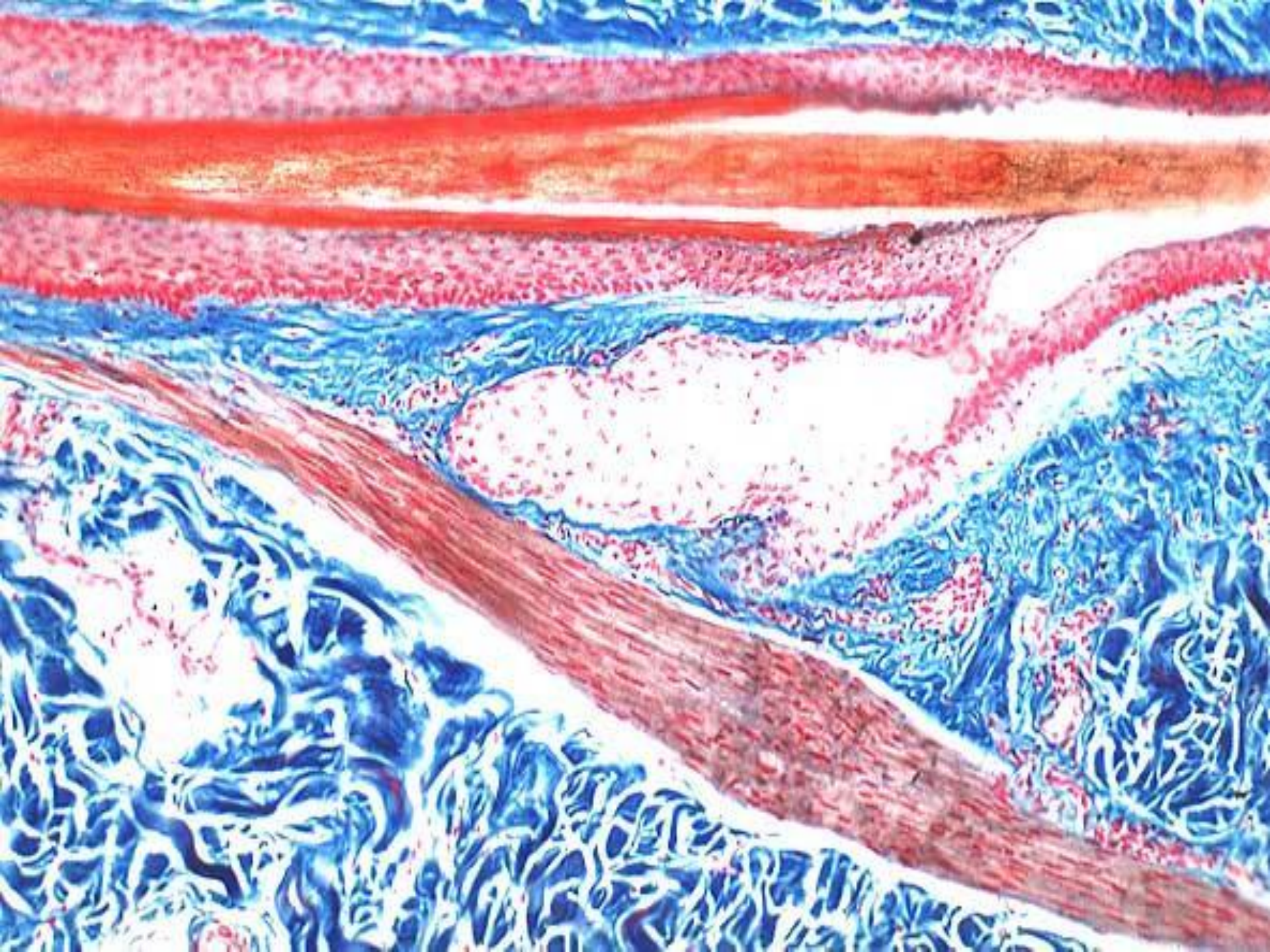
Arrector pili (pl. pilorum) is smooth muscle located in the dermis and is attached to the side of the hair shaft.

- fright, cold and emotions will contract muscle and pull hair in vertical position. "Goose bumps".









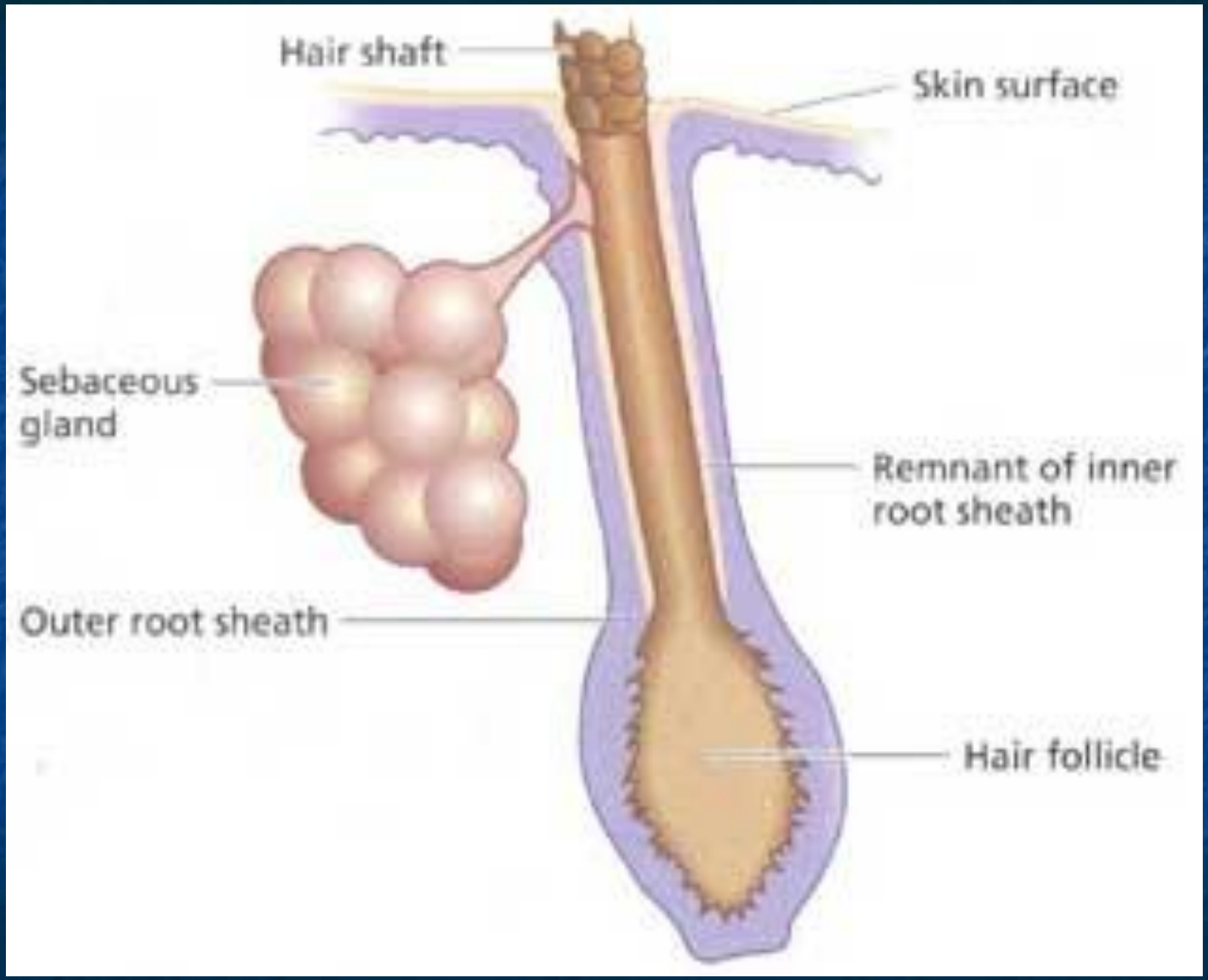
Glands:

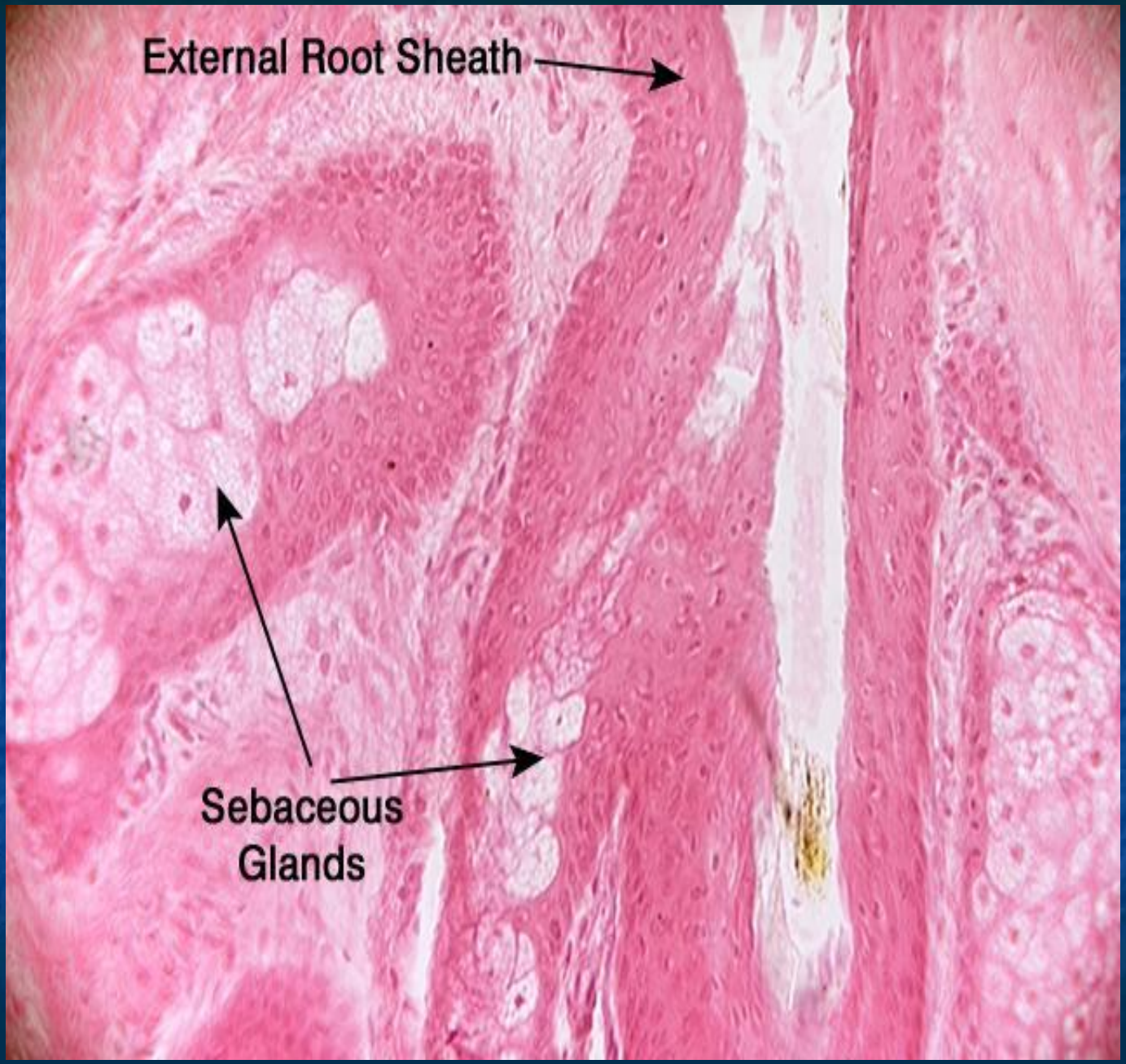
Two types of glands exist in the integument.

- Sebaceous glands (oil glands)
- Sudoriferous glands (sweat glands)

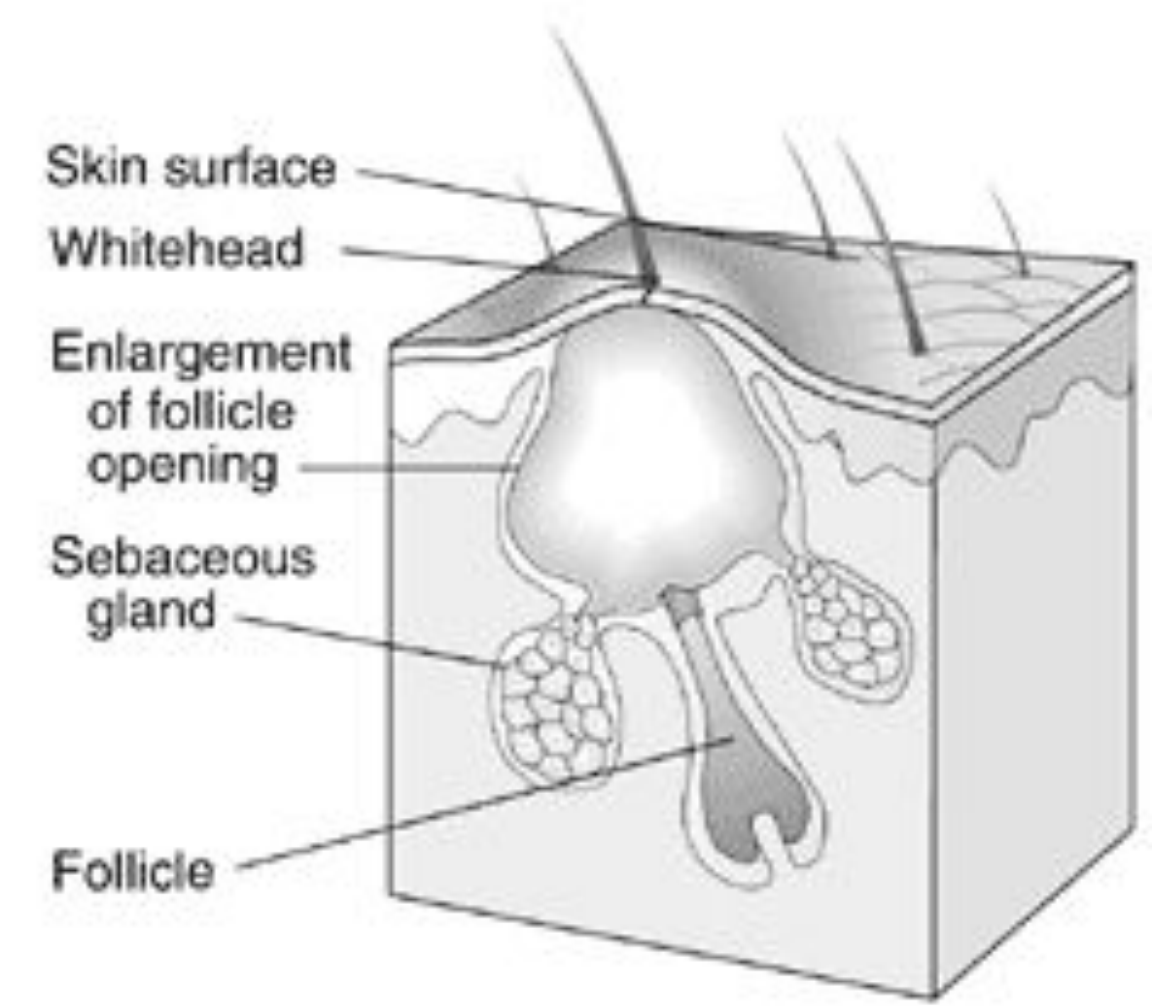
Sebaceous glands: (holocrine glands)

- connected to hair follicle
- not found on palms and soles of feet
- secretes sebum (fats, cholesterol and proteins
- keep hair from drying out, keeps skin moist
- whiteheads, blackheads and acne

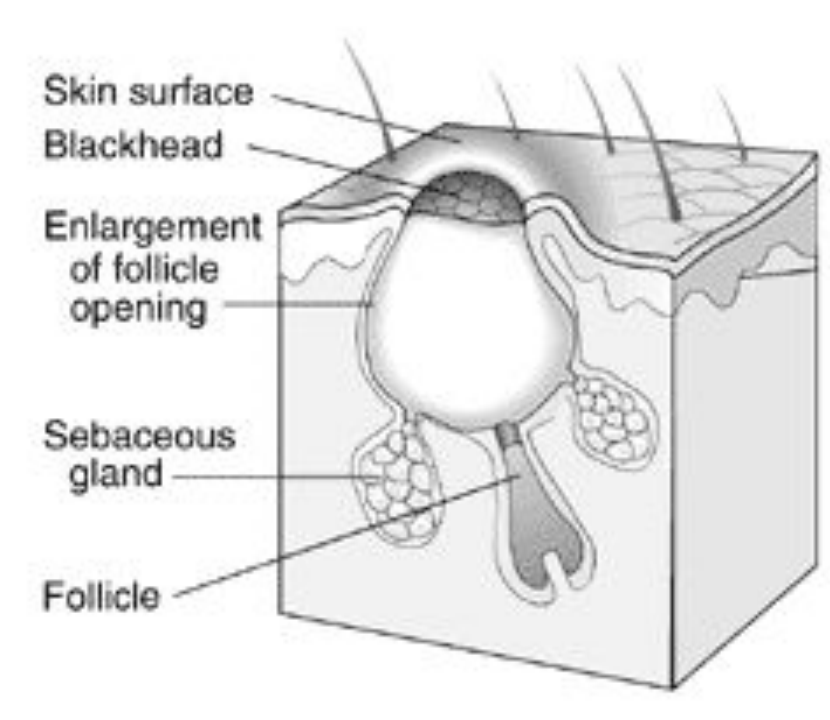

Hair shaft
Skin surface
Sebaceous gland
Remnant of inner root sheath
Outer root sheath
Hair follicle


External Root Sheath
Sebaceous
Glands

Whitehead: When the trapped sebum and bacteria stay below the skin surface, a **whitehead** is formed.

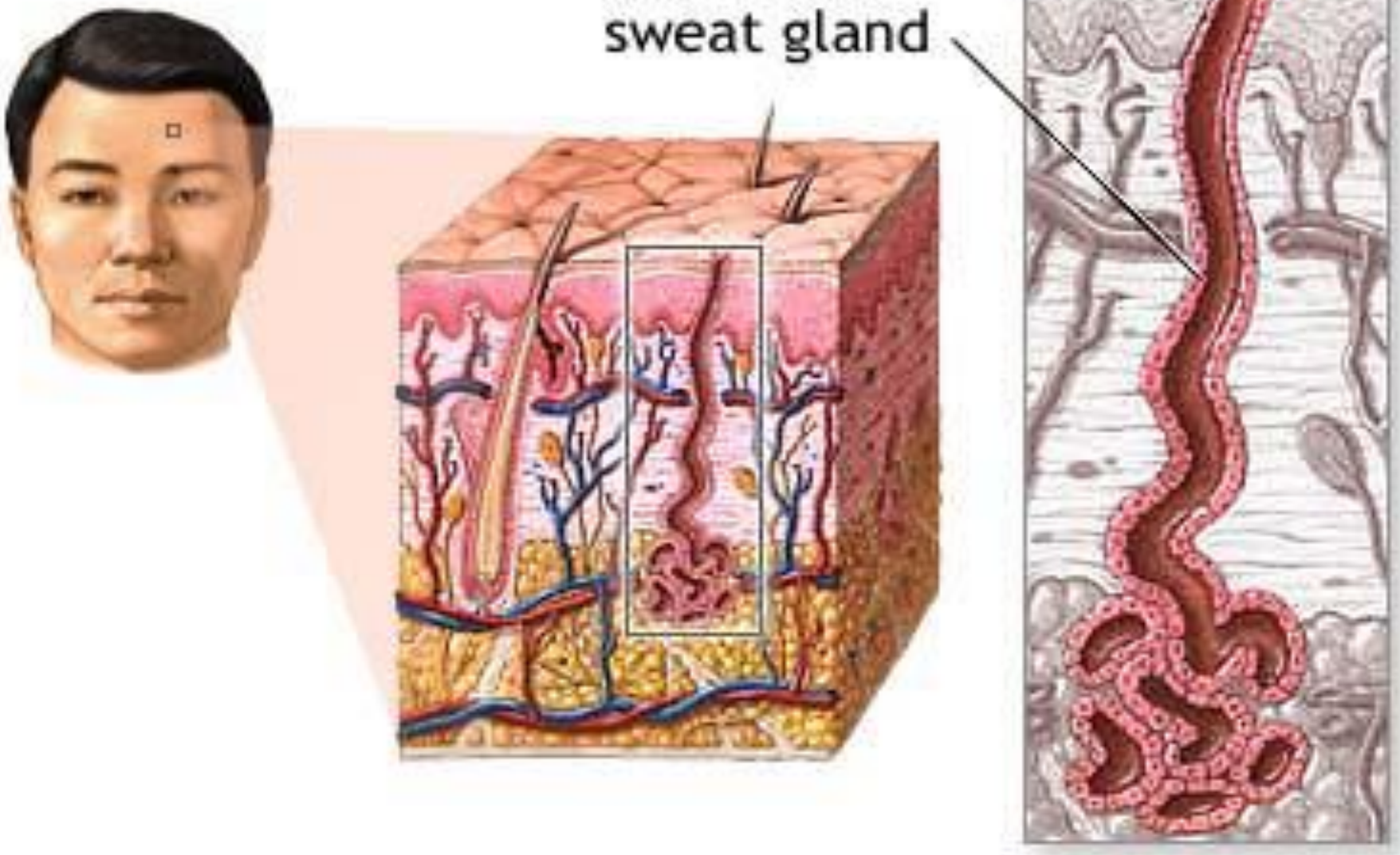


Blackhead: A **blackhead** occurs when the trapped sebum and bacteria partially open to the surface and turn black due to melanin, the skin's pigment. Blackheads can last for a long time because the contents very slowly drain to the surface.

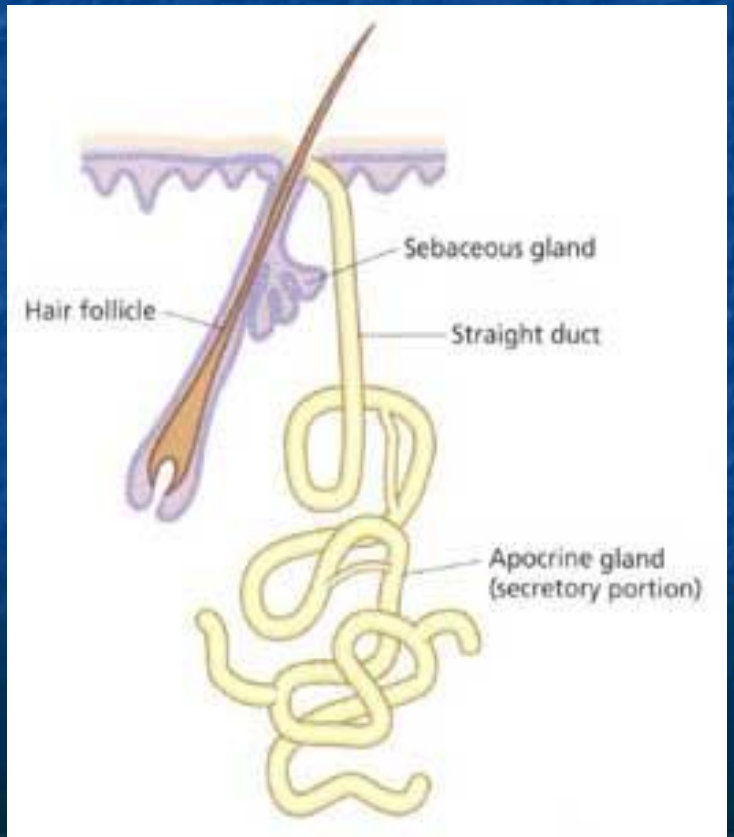


Sudoriferous glands: exocrine glands

- millions located throughout the skin
- two types:
  - eccrine: more common (merocrine)
    - originate in subQ layer
    - duct empties on skin surface
    - palms and soles of feet
    - sweat is watery (99% H_20)
    - sweating regulated by sympathetic nervous system

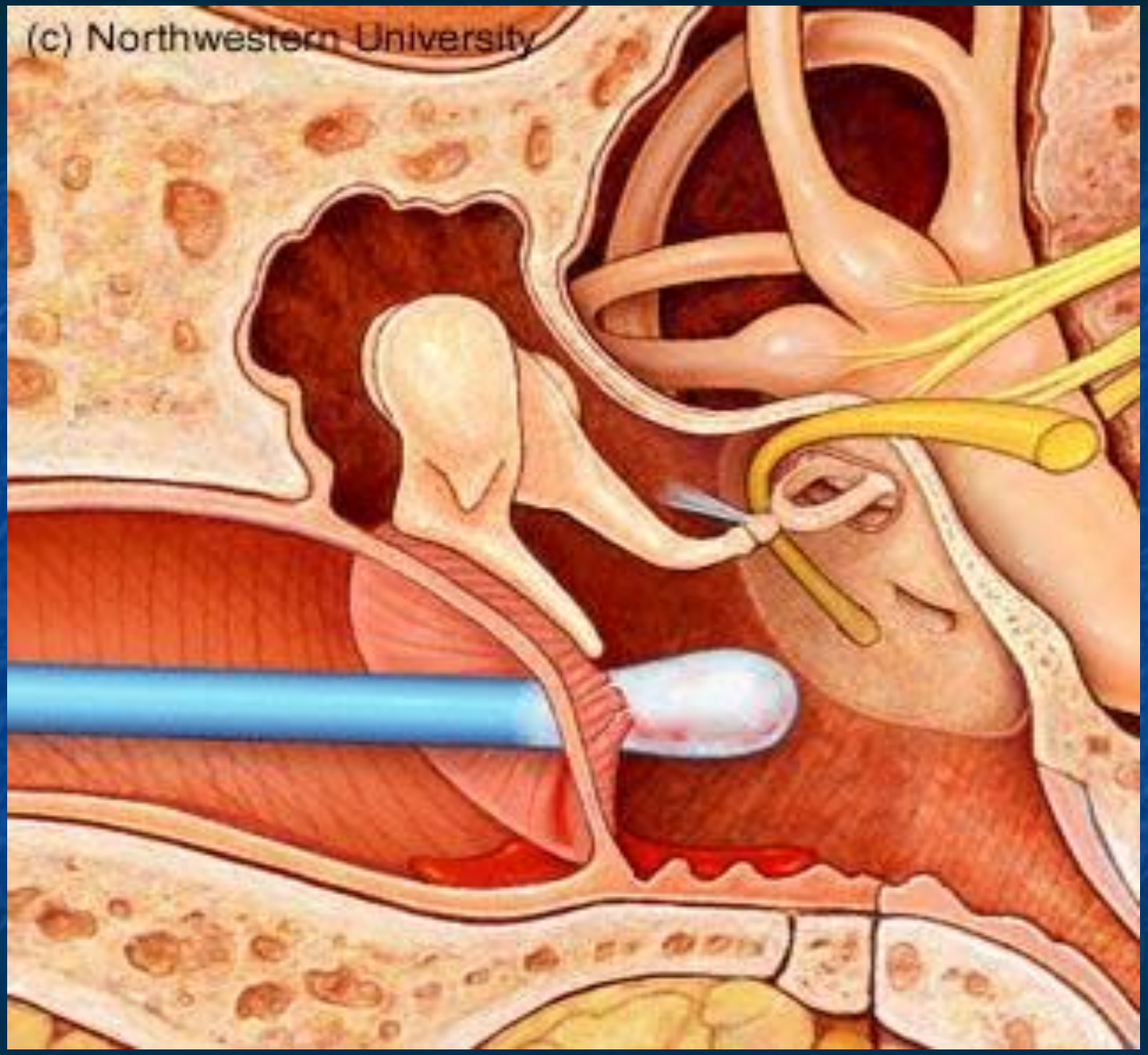


- apocrine: axillary and pubic region
  - duct empties onto hair follicle
  - viscous fluid
  - causes body odor (“b-o “) when bacteria break it down



Ceruminous glands: located in ear only

- modified apocrine glands
- originate in Sub Q layer
- ducts open onto EAM.
- produces cerumen (ear wax) : brown sticky substance that prevents foreign material from entering.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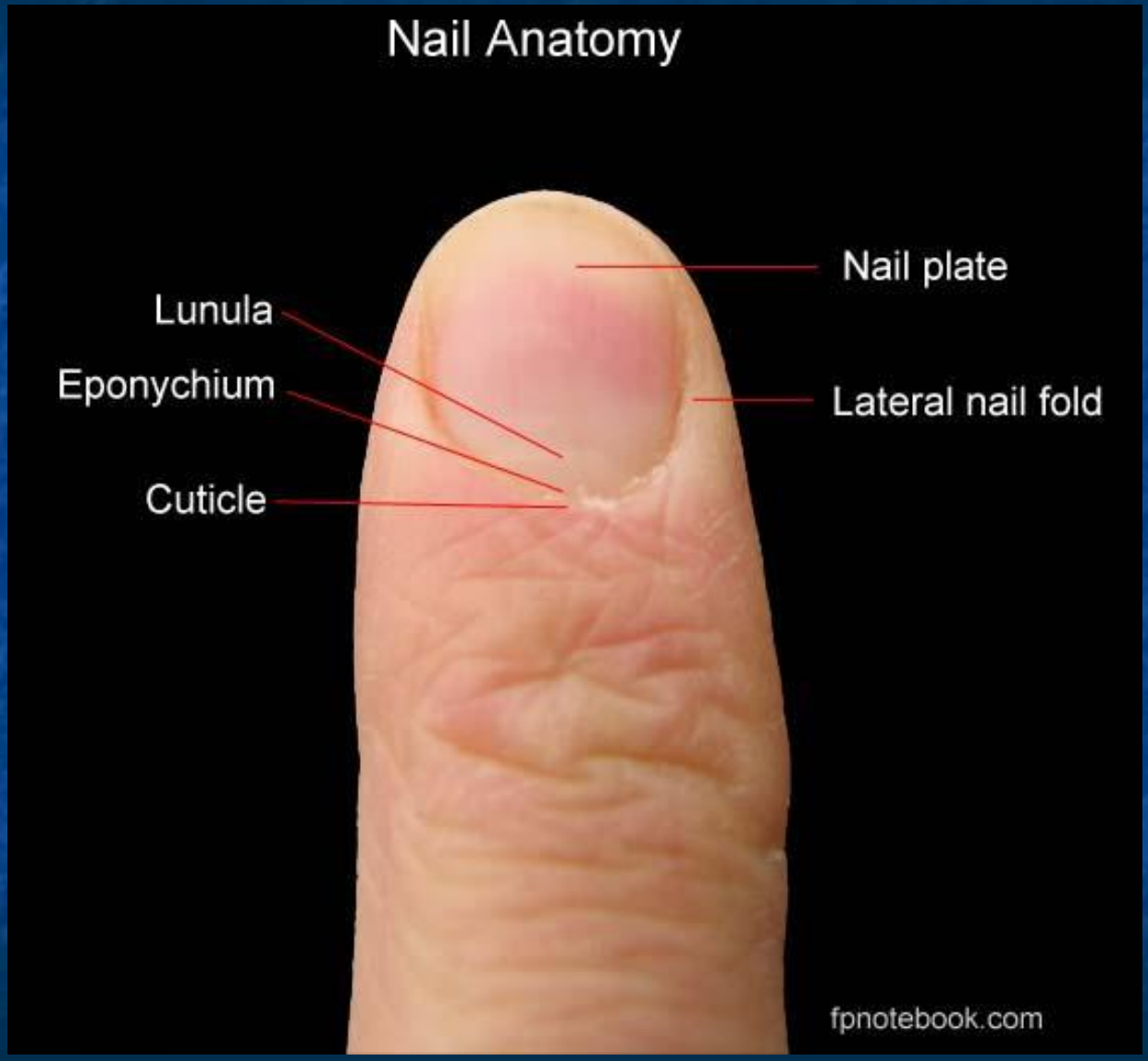
Nails:

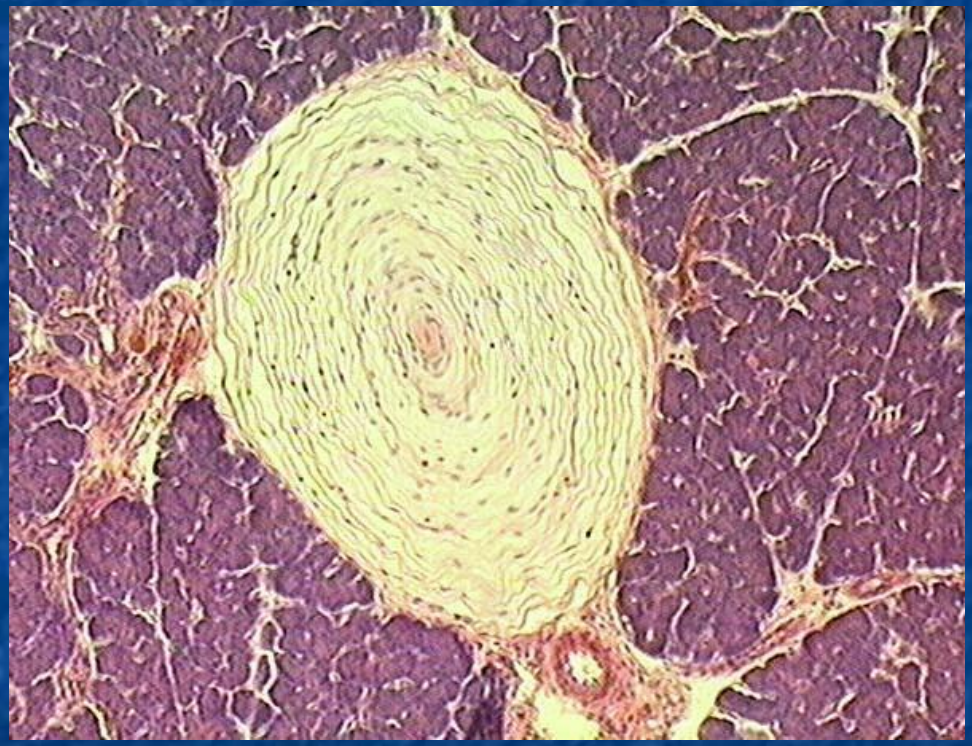
- Produced by cells in the epidermis
- Nail plate (body): visible portion
- Nail root: located under cuticle
- Lunula: half moon crescent shaped white portion under cuticle
- Nail bed: located under nail plate
- Hypoxia: decr. oxygen in blood, nail bed will turn blue- cyanosis


Nail Anatomy
Nail plate
Lunula
Eponychium
Lateral nail fold
Cuticle
fpnotebook.com

Nerve endings:

- Exteroceptors (stimulus outside of body)
  - Pacinian (lamellated) corpuscles: deep pressure and stretch
  - Meissner's (tactile) corpuscles: light touch, vibration and discriminative touch.
  - hair root plexus
  - free (naked) nerve endings: nociceptors (pain) and thermoreceptors (hot – deep and cold- surface)
  - Ruffini's corpuscles: deep pressure

Pacinian corpuscle



- Hypodermis
  - called subcutaneous, Sub-Q or superficial fascia
  - anchors skin to underlying structures
  - contains adipose tissue and blood vessels
  - common site for injection

Dermatopathological terms

- Macule – flat spot on skin with color (freckle)
- Wheal – round and temp. elevation of skin (hives)
- Papule - solid elevated area, epidermal and papillary (insect bite)
- Nodule - large papules extending into subcutaneous layer (cyst)
- Vesicle - papule with fluid core (varicella zoster virus)
- Pustule - papule with pus core (acne)
- Erosion - ruptured vesicle (ulcer)
- Xeroderma - "dry skin"
- Hemangiomas - benign tumor in the dermis (capillary and cavernous)

- Sebaceous hyperplasia - enlargement of the sebaceous gland
- Pruritis - irritating itching sensation of the skin
- Seborrheic dermatitis - inflammation around abnormally active sebaceous glands
- Basal cell carcinoma - malignant cancer originating in the germinative layer
- Squamous cell carcinoma - malignant cancer originating in the top layer of the skin
- Malignant melanomas - metastasizing melanocytes

Normal Mole	Melanoma	Sign	Characteristic
		Asymmetry	when half of the mole does not match the other half
		Border	when the border (edges) of the mole are ragged or irregular
		Color	when the color of the mole varies throughout
		Diameter	if the mole's diameter is larger than a pencil's eraser

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