THE SKIN
(Integumentary System)

By: Everlyn Abuga

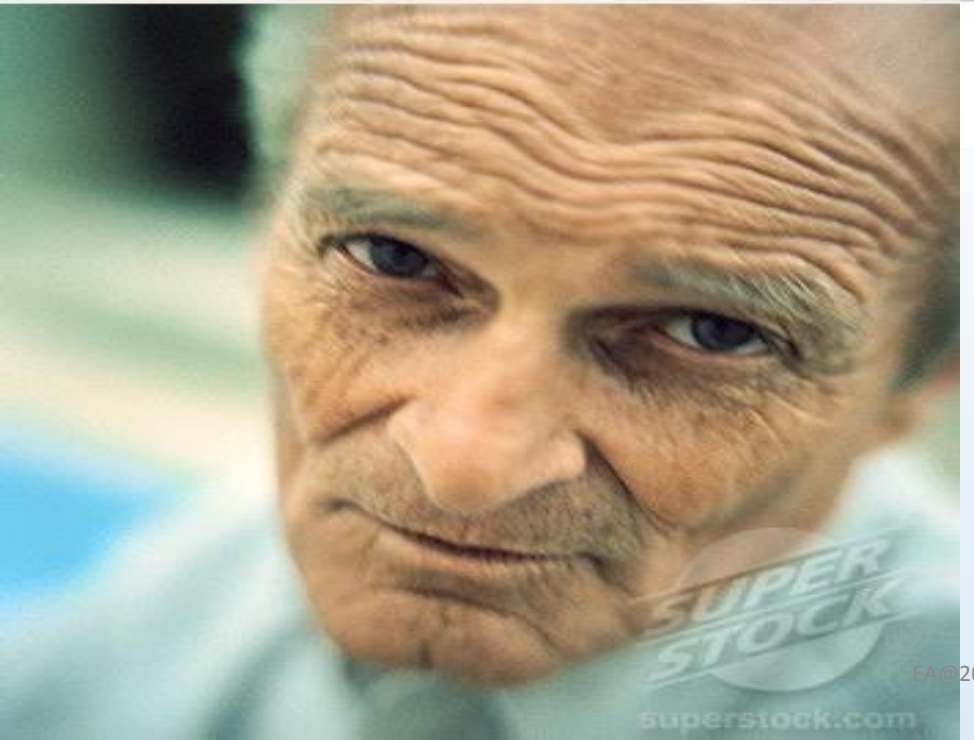
Introduction

- The skin also known as cutaneous membrane or integument, covers the external surface of the body and protects the interior of the body.
- It is a sensory organ which is **the largest organ of the body in both surface area and weight**.

  - ✓ **It covers an area about 1.5 - 2 sq.mts (22 sq.ft),**
  - ✓ **Weighs about 4.5 to 5kg**
  - ✓ **Is 16% of the body weight**.

Introduction....

- It is continuous with mucous membrane of body orifices
- It varies in thickness *(Avg thickness: 1 - 2 mm).*
  - ***Thinest - Eye lid - 0.5 mm***
  - ***Thickest - Palm and soles - 6 mm***
- Skin pH: 4 to 5.6
- Renewal of skin takes place in 28 to 50 days
- Contains accessory structures;
  - ✓ Glands
  - ✓ Hair
  - ✓ Nails



Skin changes According to age

Structure of the Skin

Epidermis

Superficial layer

Composed of

Keratinised stratified squamous epithelium

Dermis

Deeper layer

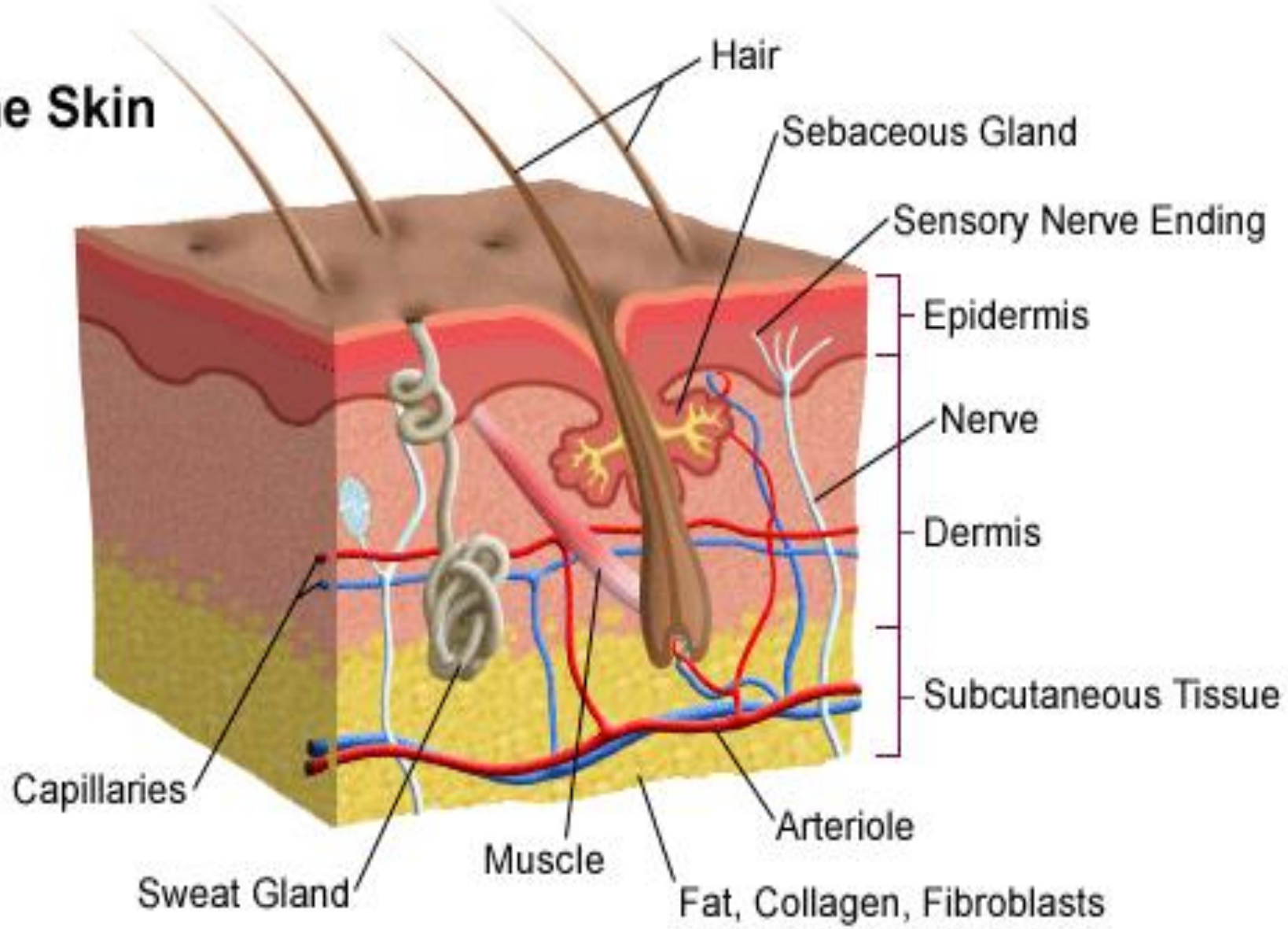
Composed of connective tissue

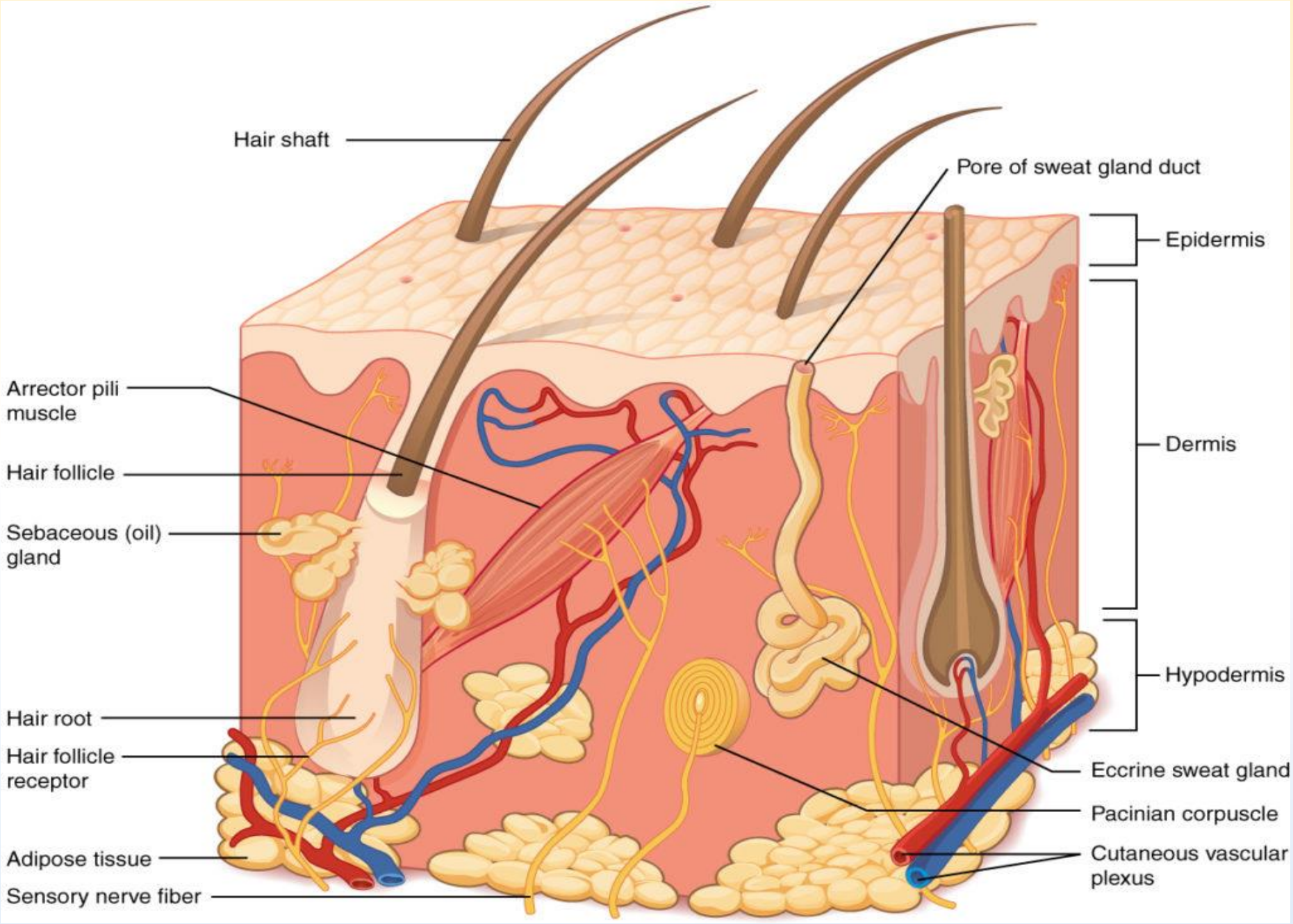
Subcutaneous Layer (Hypodermis).

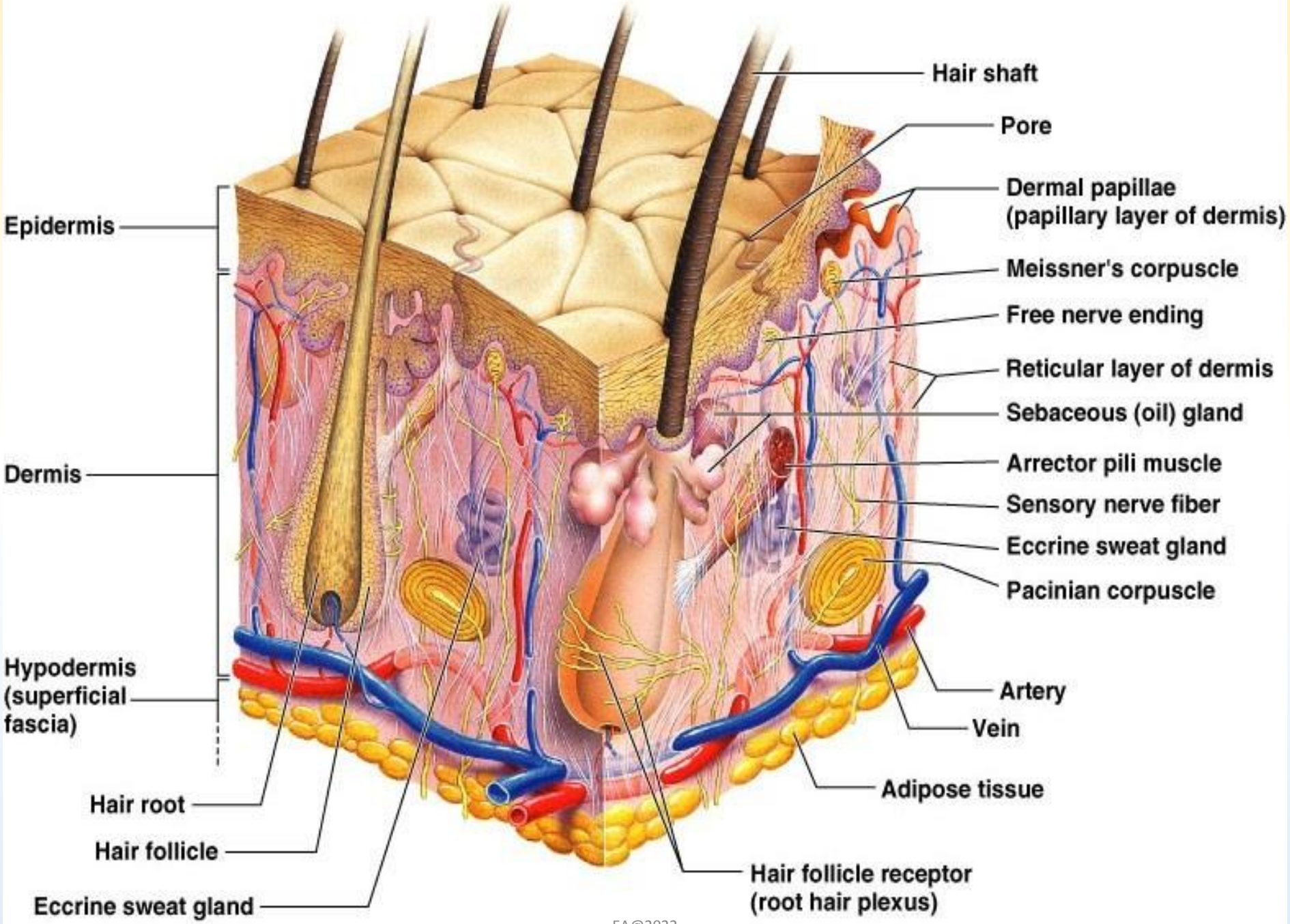
Layer below dermis

Consists of areolar and adipose tissue

The Skin


Hair
Sebaceous Gland
Sensory Nerve Ending
Epidermis
Nerve
Dermis
Subcutaneous Tissue
Capillaries
Sweat Gland
Muscle
Arteriole
Fat, Collagen, Fibroblasts


Hair shaft
Pore of sweat gland duct
Epidermis
Dermis
Hypodermis
Arrector pili muscle
Hair follicle
Sebaceous (oil) gland
Hair root
Hair follicle receptor
Adipose tissue
Sensory nerve fiber
Eccrine sweat gland
Pacinian corpuscle
Cutaneous vascular plexus



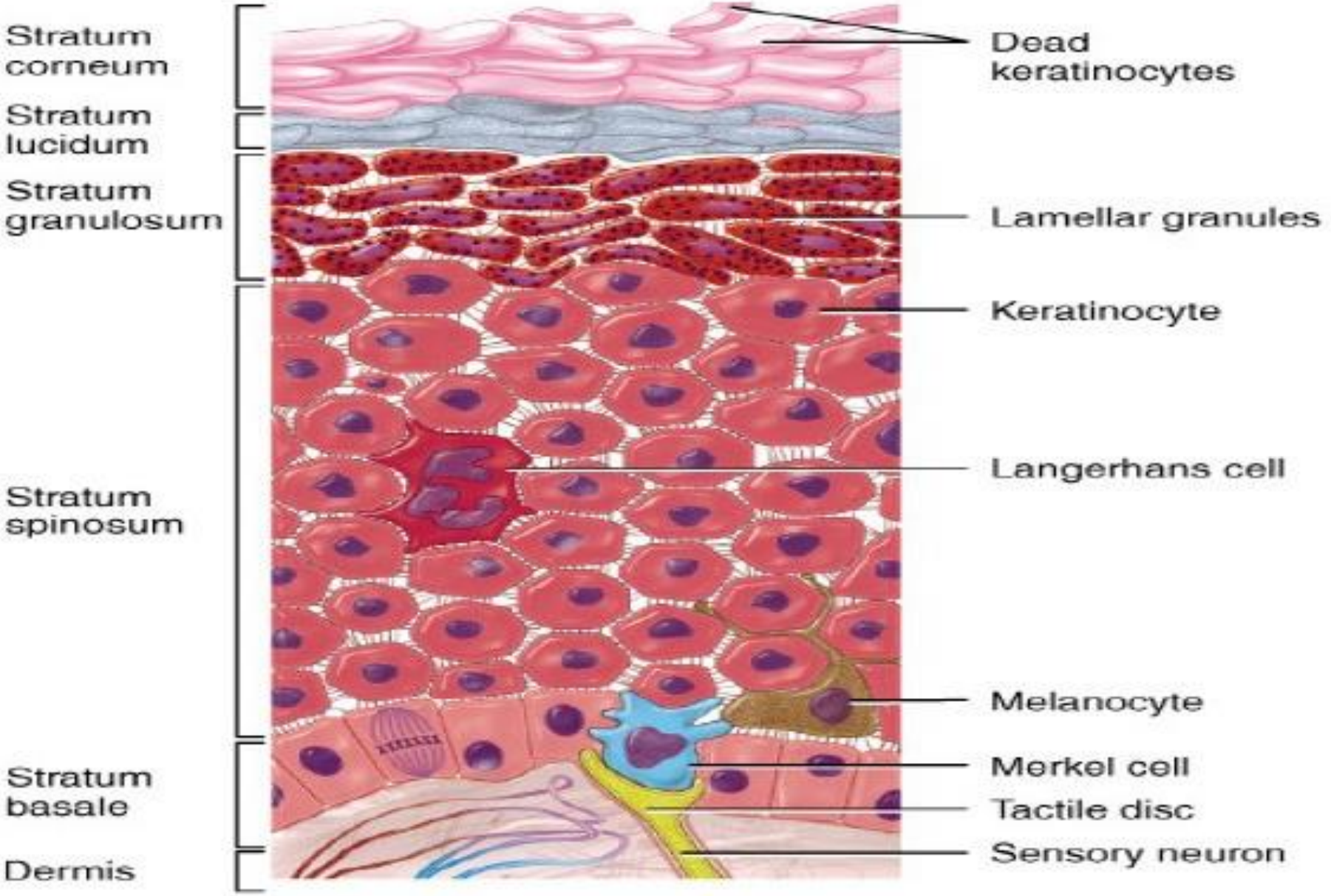
The Epidermis

- This is the most superficial layer and is composed of *stratified keratinized squamous epithelium*
- It varies in thickness *(thickest on the palms & soles)*.
- It has no blood vessels or nerve endings
- Hairs, secretions from sebaceous glands and ducts of sweat glands pass through the epidermis to reach the surface.
- Its deeper layers are bathed in interstitial fluid from the dermis, which provides oxygen and nutrients, and drains away as lymph.

Layers of the Epidermis

From the most superficial to the deepest:

1. Stratum corneum
2. Stratum lucidum *(only in palms and soles)*
3. Stratum granulosum
4. Stratum spinosum
5. Stratum basale (stratum germinativum)



(a) Four principal cell types in epidermis

Stratum Basale (stratum germinativum)

- Deepest layer of the epidermis
- Composed of simple cuboidal or simple columnar keratinocytes

Main functions

- Formation of new cells
- Attachment of the epidermis to the dermis (Separated from the dermis by the basement membrane (basal lamina)

Stratum Spinosum

- This layer mostly consists of keratinocytes held together by sticky proteins called desmosomes
- Dendritic cells can be found in this layer.

Function: **It helps make skin flexible and strong**.

Stratum granulosum

- Contains diamond shaped cells with **Keratohyalin granules** and **Lamellar granules.**

  - ✓**Keratohyalin granules** contain keratin precursors that eventually aggregate, crosslink, and form bundles.

  - ✓**The lamellar granules** contain the glycolipids that get secreted to the surface of the cells and function as a glue, keeping the cells stuck together.

Stratum Lucidum

- present in thicker skin found in the palms and soles,

Stratum corneum

- The uppermost layer, made up of keratin and horny scales made up of dead keratinocytes, known as anucleate squamous cells.
- This layer provides the 1st line of defense.

Four Principle cells of the Epidermis

1. Keratinocytes
2. Melanocytes
3. Langerhans cells
4. Merkel cells

Keratinocytes

- They are produced in the deepest layer of the epidermis (stratum basale) and move up to the stratum corneum.

- **Make up approx. 90% of cells of the epidermis**

- **They produce;**
  - Keratin – a fibrous protein, - helps protect the skin and underlying tissue from heat, microbes, and chemicals,
  - **Lamellar granules** - release a waterproof sealant
  - Cytokines, interleukins and complement factors – play a role in immunity.

Functions of keratinocytes

1. Protection

- They form a tight barrier that prevents foreign substances from entering the body
- Minimize the loss of moisture, heat, and other constituents.
- Restore the epidermis following injuries *(a process called re-epithelialization)*

2. Structural role,

- Form tight bonds with the other cells in the epidermis and maintain them in their locations.

3. Function as immunomodulators following skin injuries – Interact with lymphocytes & Langerhans cells

Melanocytes

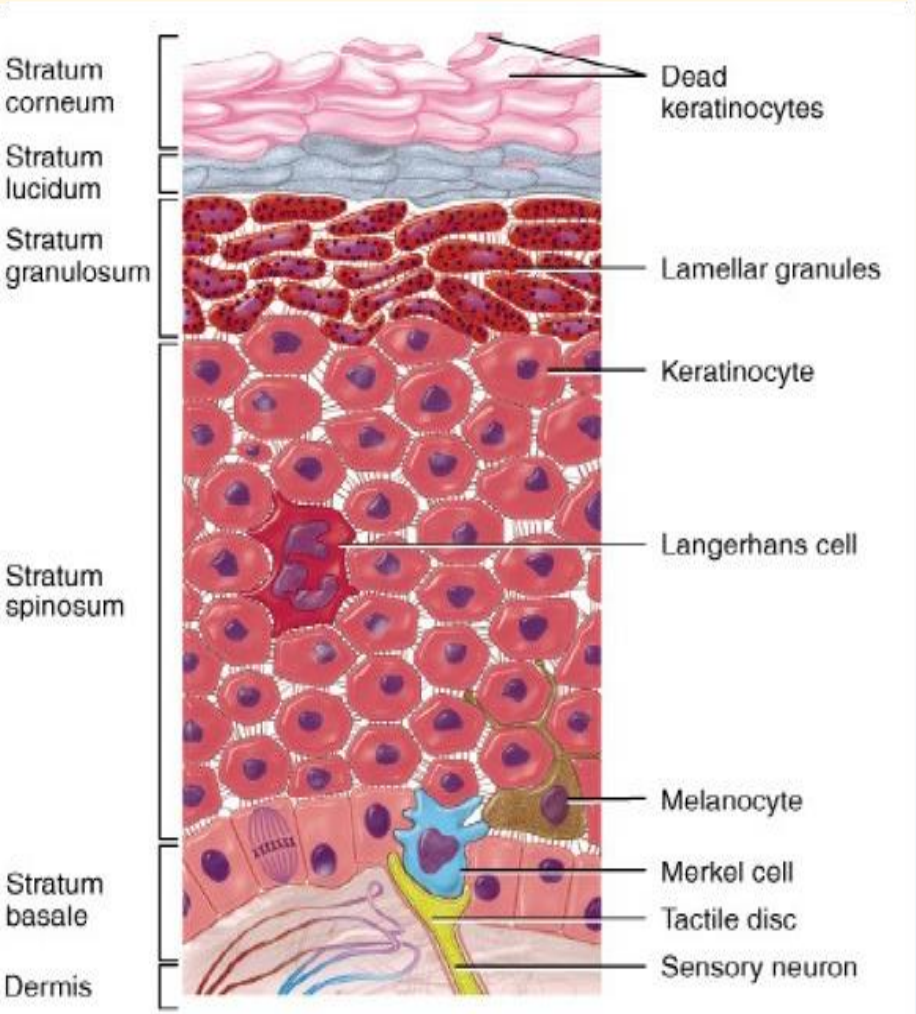
- **Found in the stratum basale layer**
- They produce the pigment melanin which contributes to skin color and protects from damaging ultraviolet (UV) light

Langerhans cells

- **Found in the stratum spinosum layer**
- Provide 1st line of immunity & participate in the immune response
  - ✓ Are tissue-resident macrophages
  - ✓ Have the ability to migrate from the epidermis to draining lymph nodes

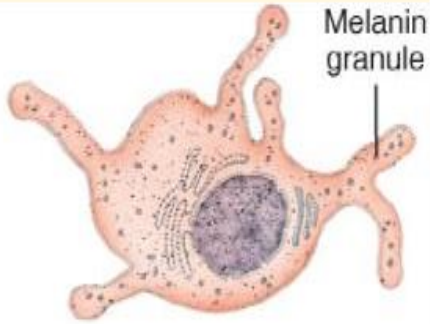
Merkel cells - contain a sensory structure called *a tactile (Merkel) disc* and function in the sensation of touch

Four Principle Cells of the Epidermis

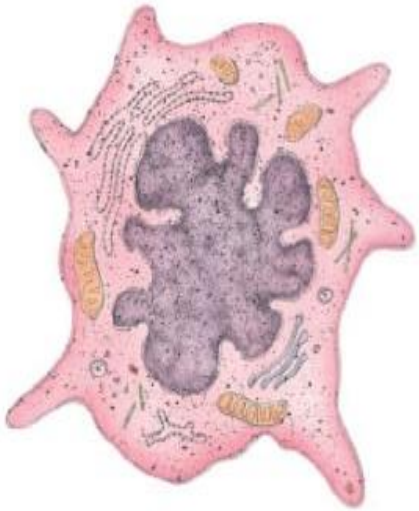


(a) Four principal cell types in epidermis

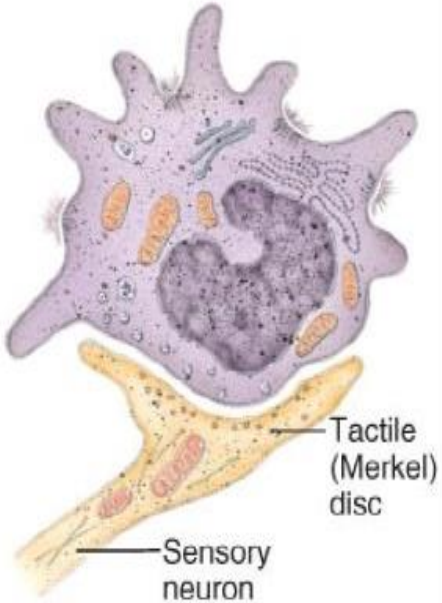
(a) Keratinocyte



(b) Melanocyte



(c) Langerhans cell



(d) Merkel cell

The Dermis

- The dermis is connected to the epidermis at the level of the basement membrane

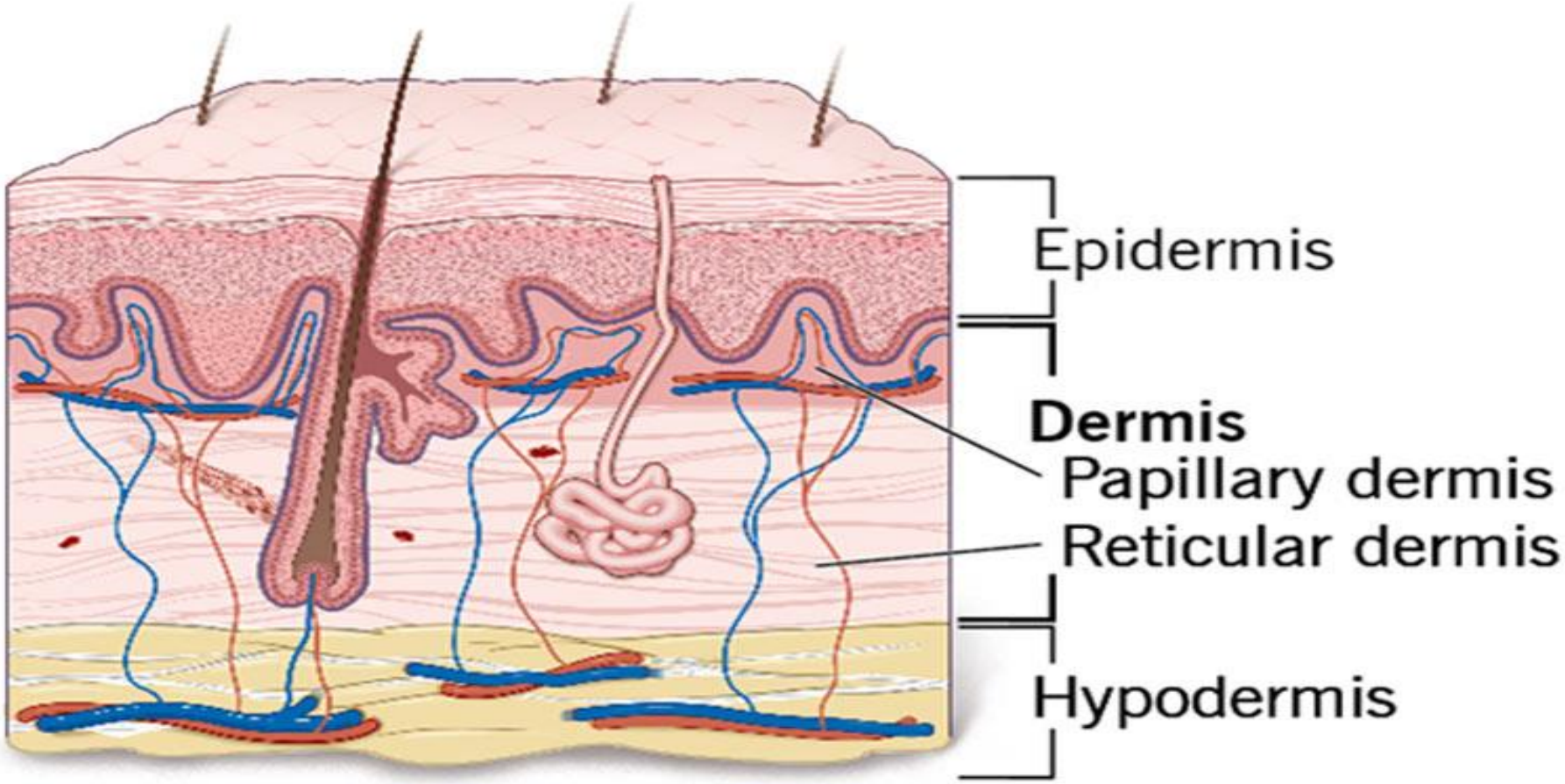
- A Connective tissue layer composed of collagen & elastic fibers, fibroblasts, macrophages & fat cells
  - ✓Collagen fibers bind water and give the skin its tensile strength, but as this ability declines with age, wrinkles develop.

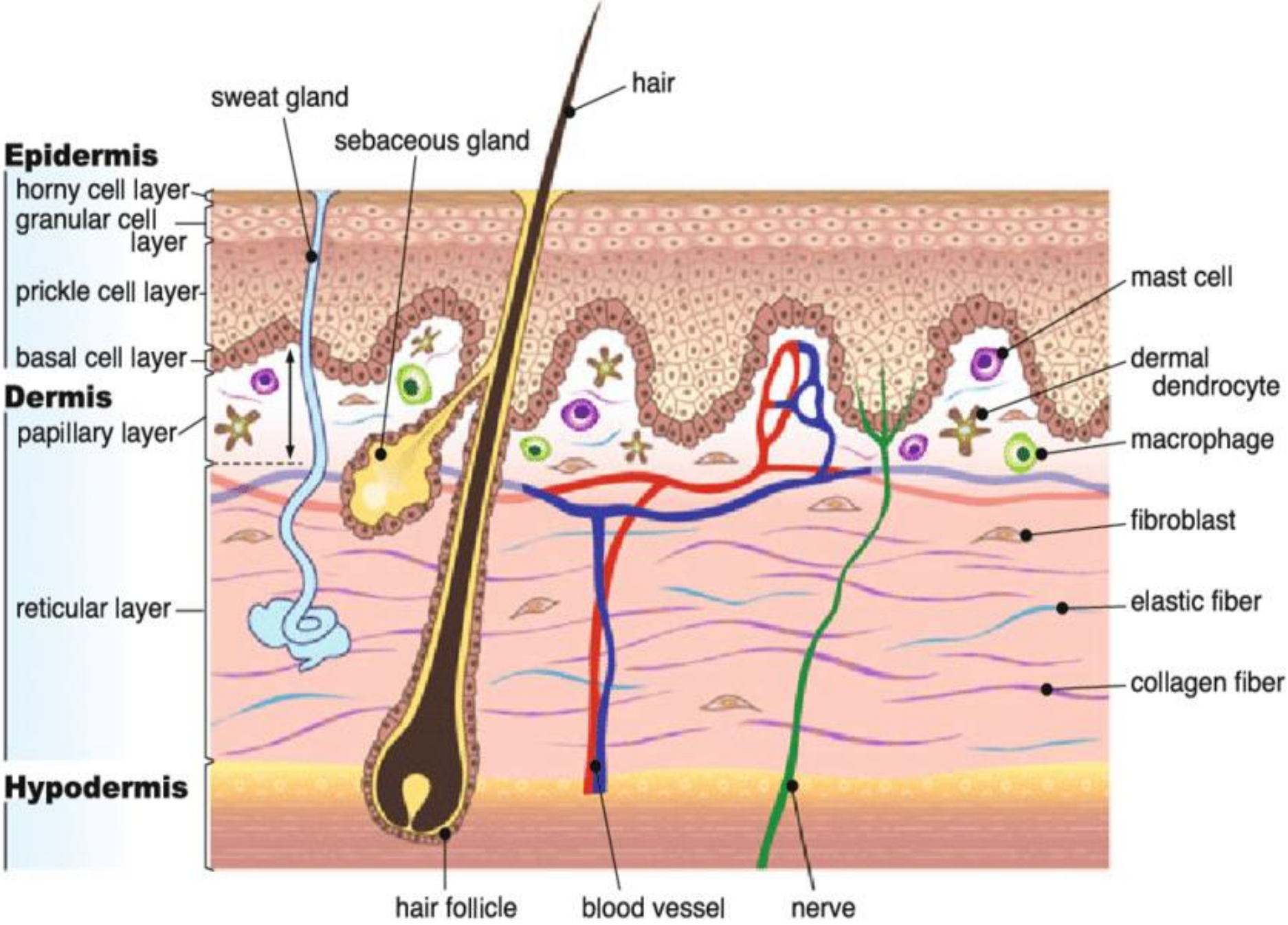
- It houses **the sweat glands & their ducts, hairs, hair follicles, arrector pili muscles, sensory nerve endings, and blood & lymph vessels**.

The Dermis

- It consists of two layers, of connective tissue, *which merge together without clear demarcation;*
  - ✓The **papillary layer** - the upper layer, thinner, composed of loose connective tissue and contacts epidermis.
  - ✓The **reticular layer** - the deeper layer, thicker, less cellular, and consists of dense connective tissue/ bundles of collagen fibers.

Layers of the Skin

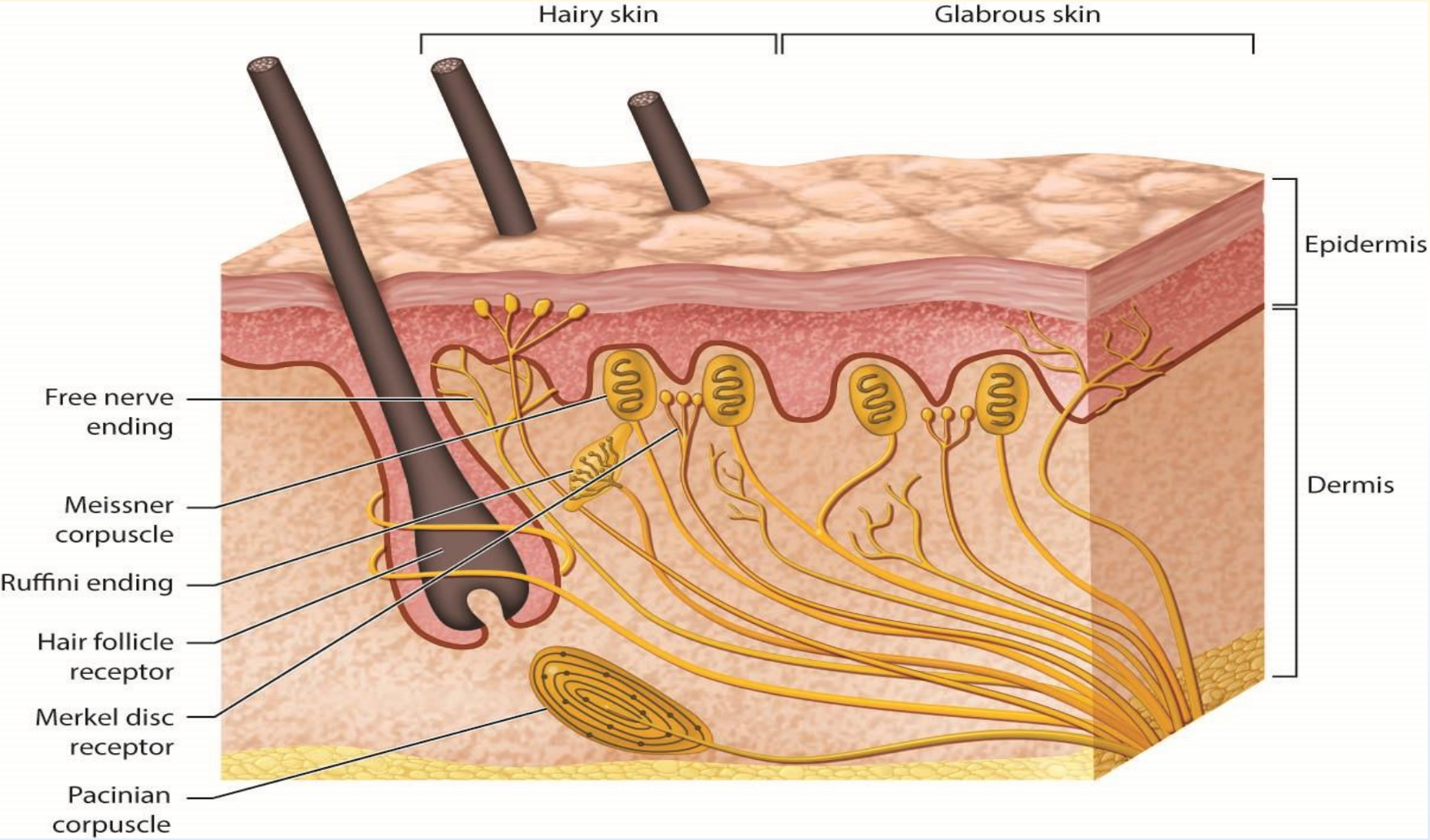



sweat gland
hair
sebaceous gland
Epidermis
horny cell layer
granular cell layer
prickle cell layer
basal cell layer
Dermis
papillary layer
reticular layer
Hypodermis
mast cell
dermal dendrocyte
macrophage
fibroblast
elastic fiber
collagen fiber
hair follicle
blood vessel
nerve

Dermis - Papillary Layer

- Top 20% of dermis.
- Finger like projections called **dermal papillae** **anchor epidermis to dermis.** and **allow passage and exchange of nutrients and wastes to the lower part of the epidermis**
- Contains capillaries that feed epidermis.
- Contains sensory receptors;- *send signals to cerebrum*
  - ✓ Meissner's corpuscles - near dermo-epidermal junction. (Detection of sensations of touch, shape and texture).
  - ✓ Pacinian's corpuscles - deep pressure and vibrational sensations.
  - ✓ Free nerve endings for sensations of heat, cold, pain, tickle, and itch.

Papillary layer

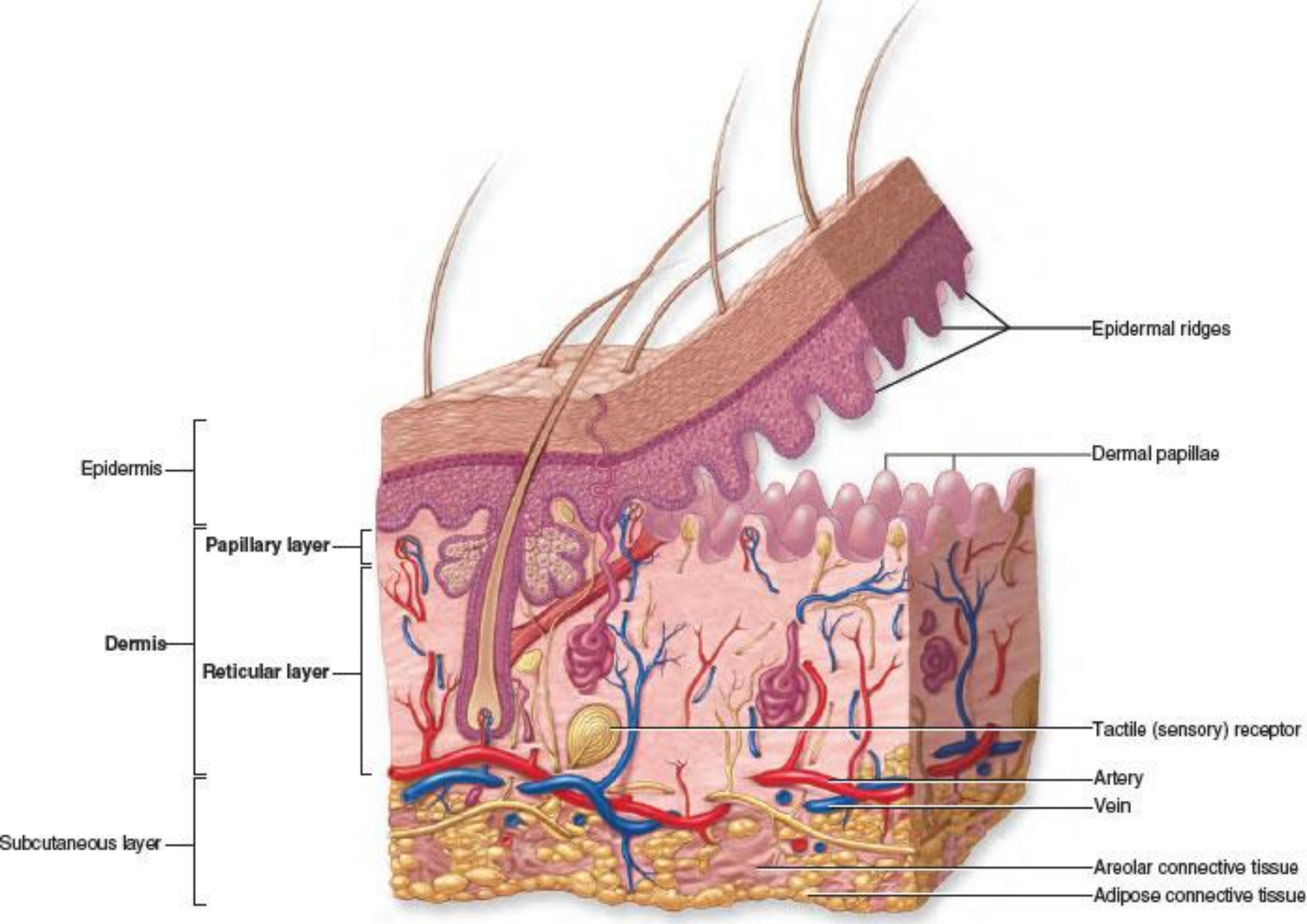


Dermis - Reticular Layer

- Dense irregular connective tissue.
  - Contains interlacing collagen and elastic fibers.
  - ✓ Packed with sebaceous glands, sweat gland ducts, fat & hair follicles.

- Provides strength, extensibility & elasticity to skin.
  - stretch marks are dermal tears from extreme stretching.

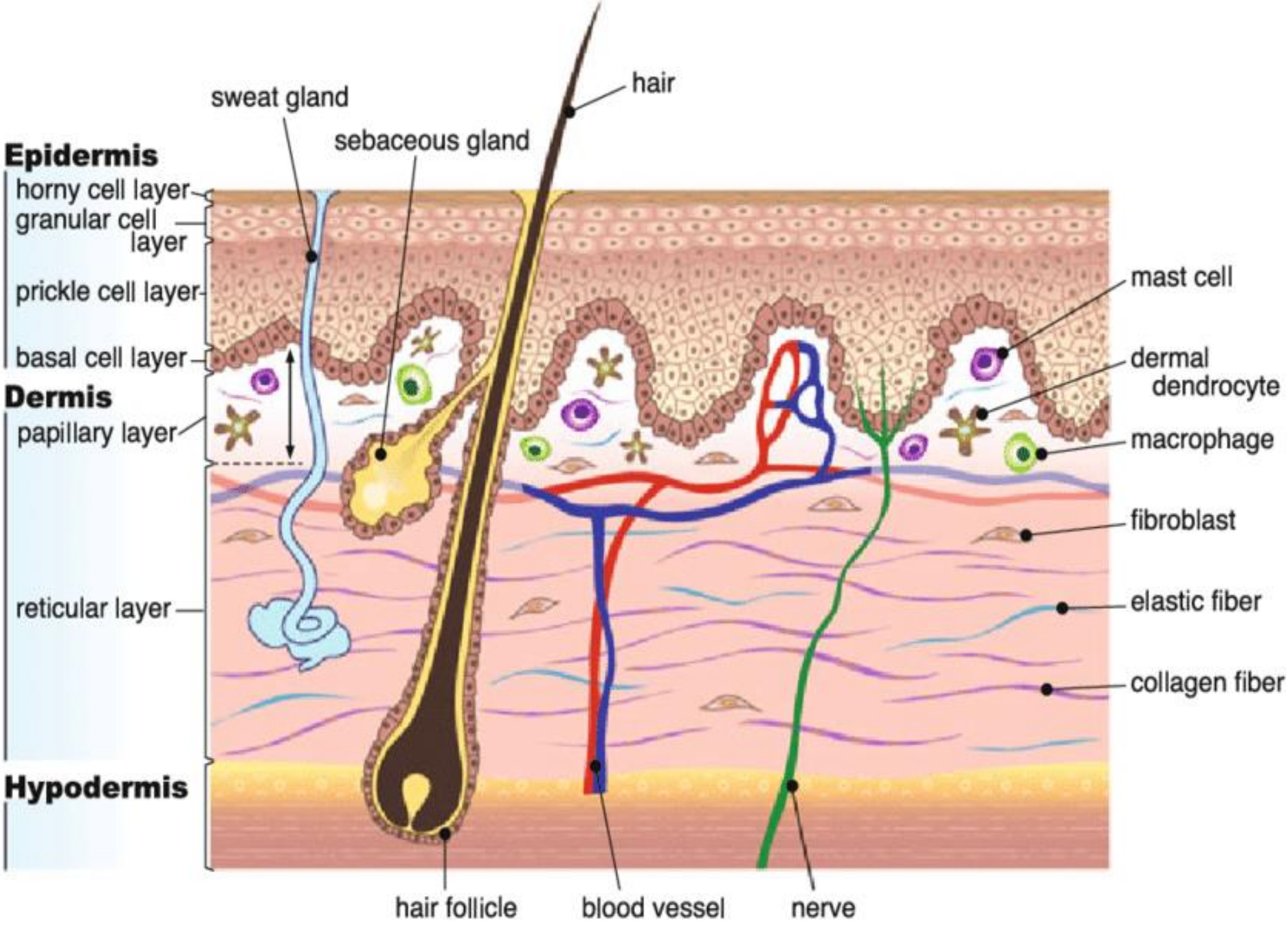
- Epidermal ridges form in-utero.
  - Fingerprints are left by sweat glands open on ridges
  - Ridges increase grip of hand


Epidermal ridges
Dermal papillae
Epidermis
Papillary layer
Dermis
Reticular layer
Tactile (sensory) receptor
Artery
Vein
Subcutaneous layer
Areolar connective tissue
Adipose connective tissue

The Hypodermis

- Layer deep to the dermis. It consists of areolar and adipose tissue.
- Is also called subcutaneous fascia/ **Subcutaneous Layer**
- It is the deepest layer of skin and contains;
  - ✓Adipose lobules
  - ✓Some skin appendages - hair follicles, sensory neurons, and blood vessels

  Functions: fat storage, an area for blood vessel passage, and an area of pressure sensing nerve endings.


sweat gland
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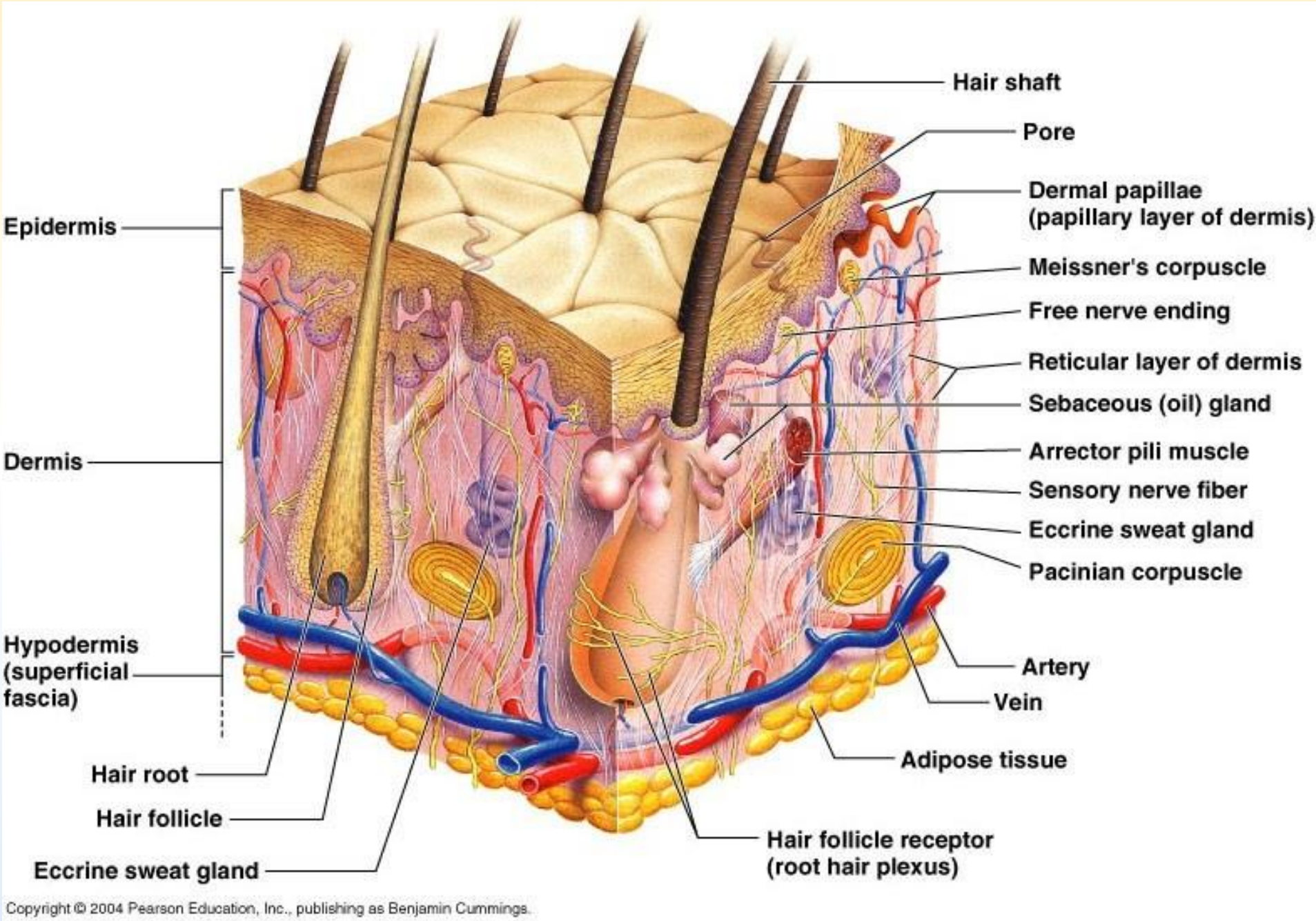


The arrector pili muscles

- Are bundles of smooth muscle fibers that attach to the connective tissue sheath of hair follicles.

- When the muscles contract, they pull the hair follicle outward resulting in the hair erecting up & also compresses the sebaceous glands, resulting in the secretion of their contents.

- Hair does not exit perpendicularly, but instead at an angle. This erection of hair also produces goosebumps,

Accessory Structures of The Skin

- Accessory structures of the skin are;
  - ✓ **Hair**
  - ✓ **Glands**
  - ✓ **Nails**

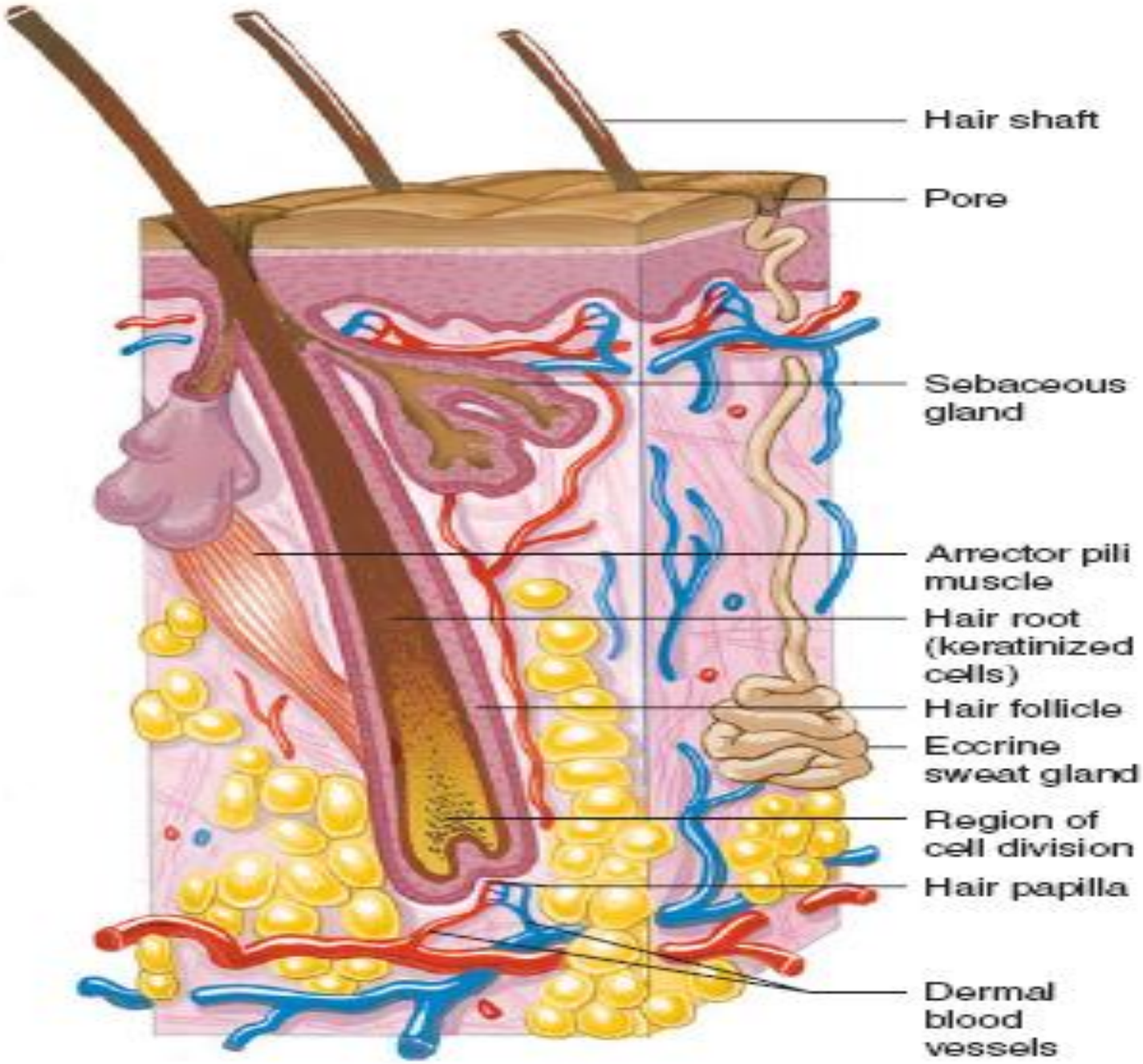
- Hair and nails protect the body while sweat glands help to regulate temperature

Hair

- Present on most skin surfaces except soles and palms
- Contains columns of dead keratinised cells

- The hair follicle surrounds the root of the hair

- **Has 2 regions;**
  - The shaft - projects from the skin surface
  - The root - deep in the shaft and penetrates into the surface


Hair shaft
Pore
Sebaceous gland
Arrector pili muscle
Hair root (keratinized cells)
Hair follicle
Eccrine sweat gland
Region of cell division
Hair papilla
Dermal blood vessels
(a)

Functions of hair

- **On the scalp**
  - ✓It guards the scalp from injury and sun rays
  - ✓It decreases heat loss from the scalp
- **Eye brows and lashes** protect the eyes from foreign bodies
- **In the nostrils and ear canal** provides protection from foreign bodies
- Body hair helps in **sensing light touch**

Glands of the Skin

Specialized exocrine glands found in dermis are;

- **Sebaceous (oil) glands**
- **Sudoriferous (sweat) gland**
- **Ceruminous (wax) glands**
- **Mammary (milk) glands**

Sebacoeus (oil) glands

- Are connected to hair follicles;
- They are absent in the palms and soles

- **Secrete sebum** whose functions are to;
  - ✓Coat the surface of hairs and keep them from becoming dry and brittle
  - ✓Prevent excessive evaporation of H_2O from the skin
  - ✓Keeps the skin soft and pliable
  - ✓Inhibit the growth of bacteria thus protecting the skin

Sudoriferous (sweat) glands

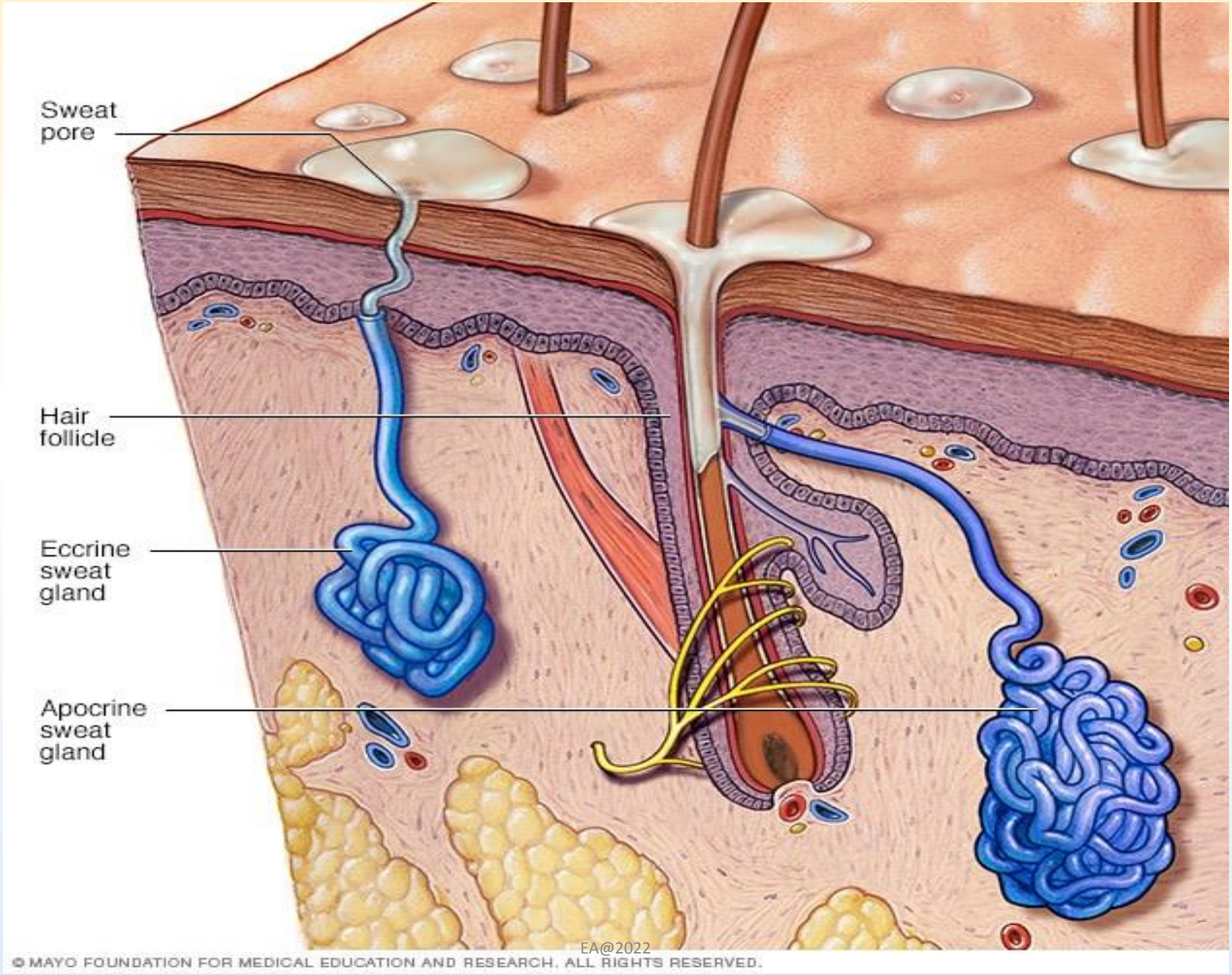
- **Produce sweat.** When sweat evaporates from the skin heat is lost
- **There are 2 types of sweat glands;**

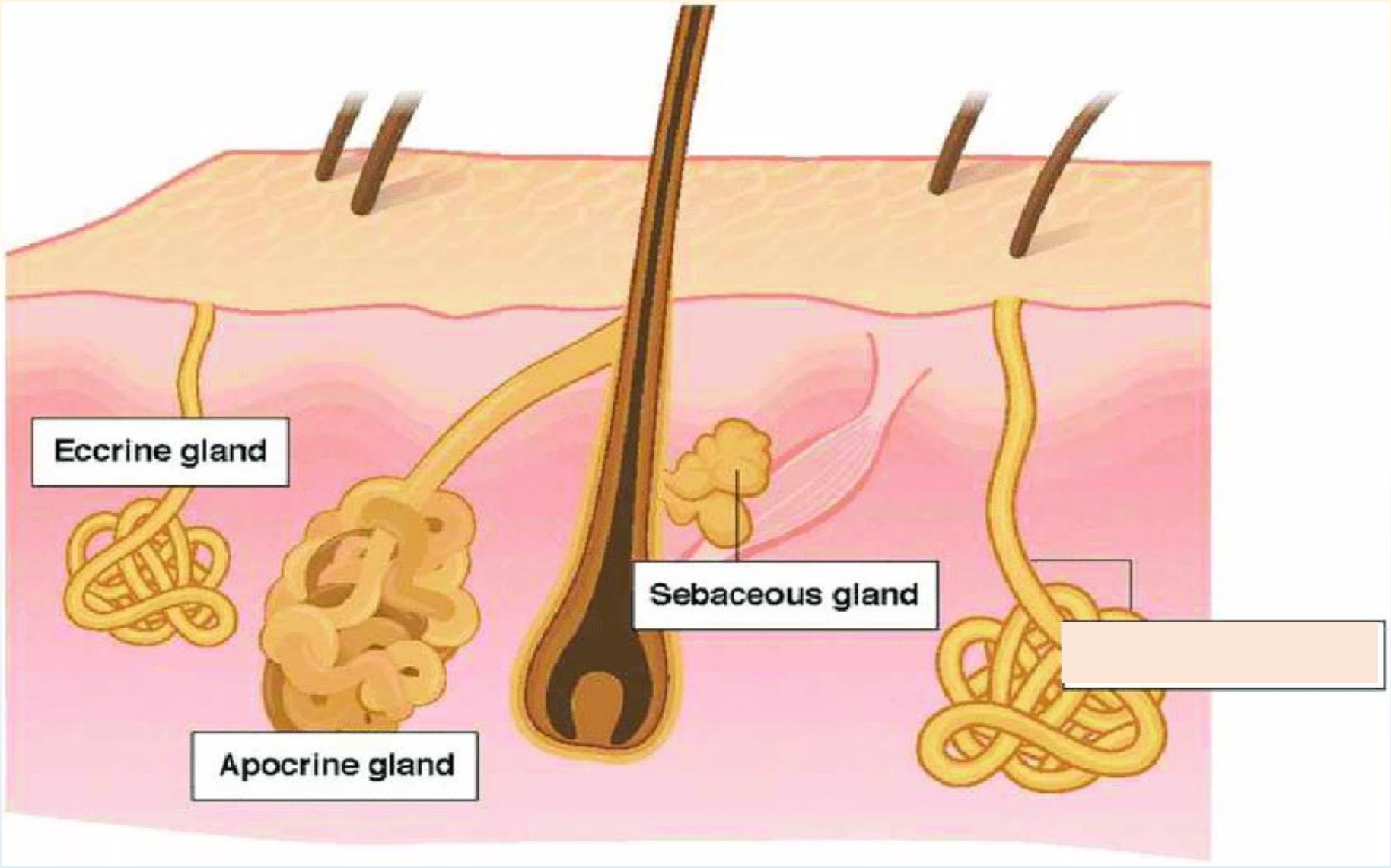
1. ***Eccrine sweat glands*** (most areas of skin)
   - ✓ **Open directly onto the surface of the skin.**
   - ✓ Regulate body temperature through evaporation (perspiration)
   - ✓ Help eliminate wastes such as urea

2. ***Apocrine sweat glands*** (skin of the axilla, pubis, areola & labia minora)
   - ✓ **Open into hair follicles, leading to the surface of the skin**
   - ✓ They release secretions that are more viscous
   - ✓ Begin to function at puberty
   - ✓ Are stimulated during emotional stress and sexual excitement

Ceruminous glands

- **Found in the external auditory meatus**
- Produce a waxy substance **called cerumen**.
- Cerumen provides a barrier for entrance of foreign bodies



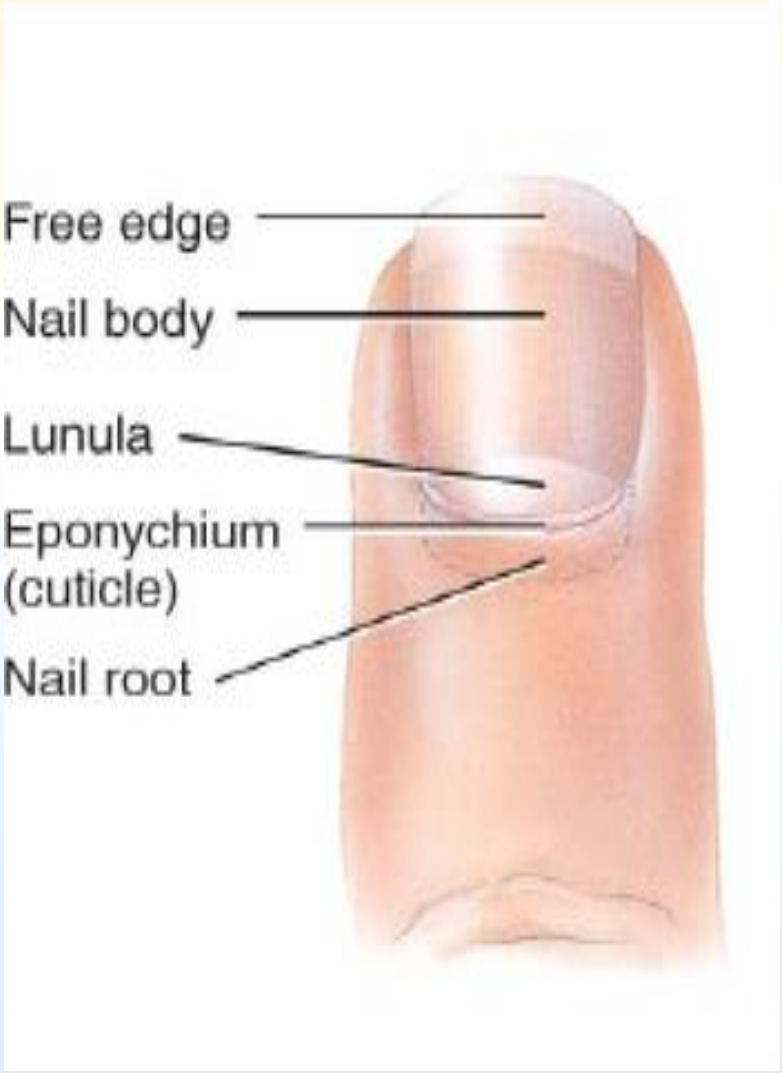

Eccrine gland
Apocrine gland
Sebaceous gland

Nails

- Are plates of tightly packed hard keratinised epidermal cells

- The cells form a solid covering over dorsal surfaces of the distal portions of the digits

Structure of Nails

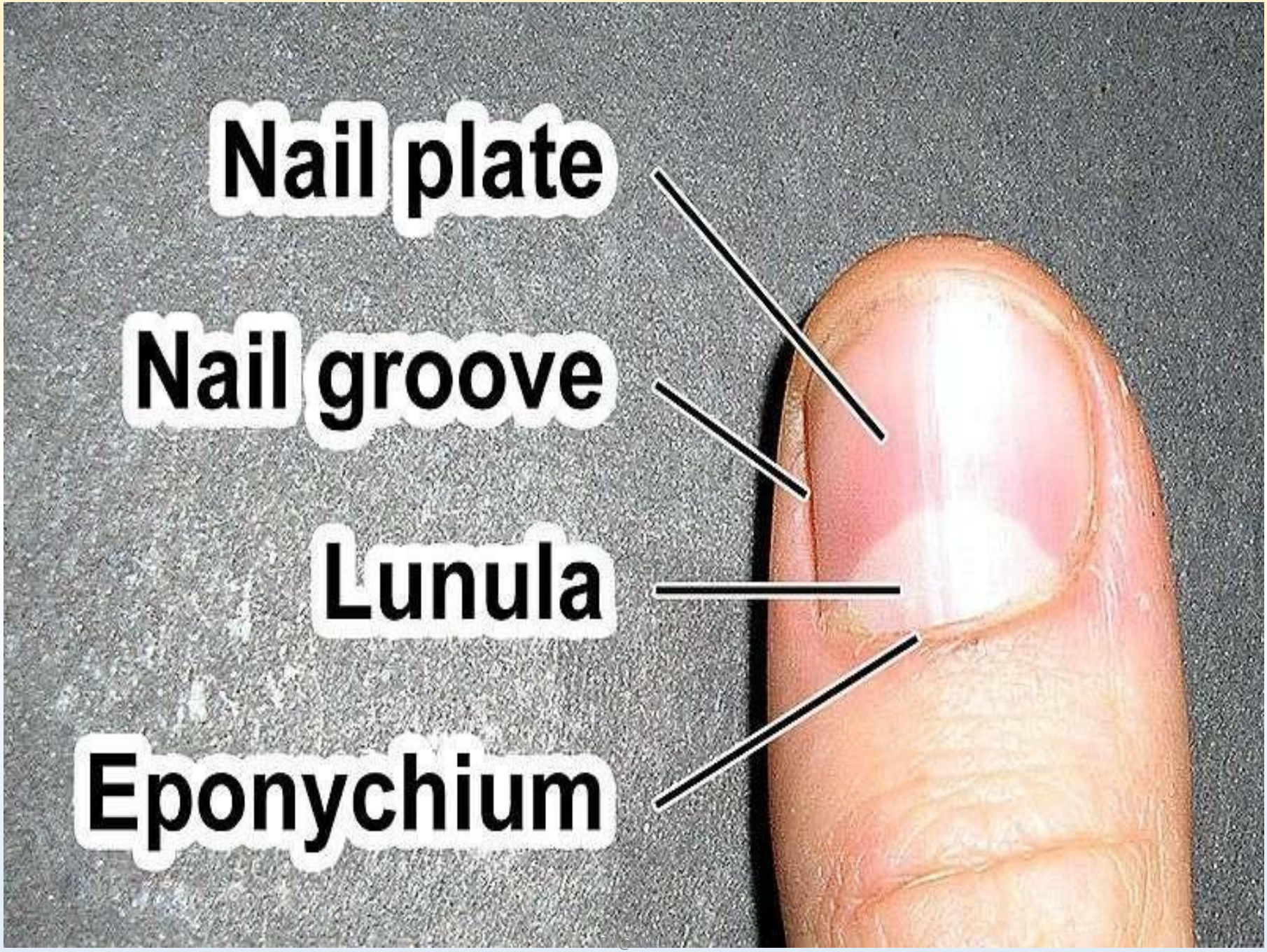


Each nail has;

- **Nail body**
  - visible portion; pink due to underlying capillaries
  - Free edge appears white

- **Nail root**
  - Buried under skin layers
  - lunula is white due to thickened stratum basale

- **Eponychium (cuticle)**
  - stratum corneum layer


Nail plate
Nail groove
Lunula
Eponychium

FUNCTIONS OF SKIN

- Protection
- Thermoregulation
- Sensation
- Vitamin D synthesis
- Excretion & Absorption
- Psychological and social functions

Protection

- Physical, chemical and biological barriers
- Tight cell junctions prevent bacterial invasion
- Lipids released retard evaporation
- Melanin Pigment protects from UV light rays
- Skin is the first site of immunological defense by the action of the Langerhans cells in the epidermis which are dendritic epidermal T lymphocytes and part of the adaptive immune system
- Adipose tissue stores fat – acts as an insulator

Thermoregulation

- **Perspiration & its evaporation**
  - lowers body temperature
  - flow of blood in the dermis is adjusted
- **Exercise**
  - in moderate exercise, more blood brought to surface helps lower temperature
  - with extreme exercise, blood is shunted to muscles and body temperature rises
- **Shivering and constriction of surface vessels**
  - raise internal body temperature as needed

- The primary means of body heat loss is **radiation**, by which heat rays escape from warmer surfaces

- In **conduction**, heat moves from the body directly into the molecules of cooler objects in contact with its surface.

- **Evaporation -** When the body temperature rises above normal, the nervous system stimulates eccrine sweat glands to release sweat onto the surface of the skin.
  - As this fluid evaporates (changes from a liquid to a gas), it carries heat away from the surface, cooling the skin.

Cutaneous Sensations

- The skin helps in tactile sensations due to the presence of abundantly distributed nerve endings which act as receptors.
- These are sensations of;
    - ✓ Touch,
    - ✓ Pressure,
    - ✓ Vibration,
    - ✓ Tickle,
    - ✓ Heat & Cold (Thermal)
    - ✓ Pain & Itch (Noxious)

Synthesis of Vitamin D

- A compound *(dehydrocholesterol)* in the skin is synthesized into vitamin D in the presence of ultraviolet light rays; this is the precursor molecule in the skin
  - ✓ Enzymes in the liver and kidneys modify the activated molecule to produce calcitriol, the most active form of vitamin D.
- Vitamin D is the necessary vitamin for absorption of calcium from food in the gastrointestinal tract

Excretion & Absorption

Excretion

- 400 ml ofwater/day,
- Small amounts Na+ & Cl-,
- Waste products;
  - ✓ Ammonia
  - ✓ Urea

Absorption

- ➢ Lipid soluble Vitamins - A, D, E, K
- ➢ Organic solvents
- ➢ Heavy metals
- ➢ Topical medicines

Determinants of skin color

- Skin color is largely due to the amount of melanin in the epidermis.

1. Genetic factors

- Each person inherits genes for melanin production.

(a) Dark skin is due to genes that cause large amounts of melanin to be produced; lighter skin is due to genes that cause lesser amounts of melanin to form.

(b) Mutant genes may cause a lack of melanin in the skin.

2. Environmental factors

- These factors darken existing melanin and stimulate additional melanin production. They include;
  - ✓Sunlight, ultraviolet light, and X rays.

Skin color….

3. Physiological factors

- The oxygen content of the blood in dermal vessels may cause the skin of light complexioned persons to appear pinkish or bluish.
- Carotene in the subcutaneous layer may cause the skin to appear yellowish.
- Disease may affect skin color (e.g. Liver disease – jaundice = yellow skin color)

Determinants of skin color – summary

Genetic Factors

- Amount of melanin – determined by DNA
- varying size of melanin granules
- albinos lack melanin

Environmental Factors

- UV rays
- Chemicals
- Drugs (antihistamines & antibiotics)

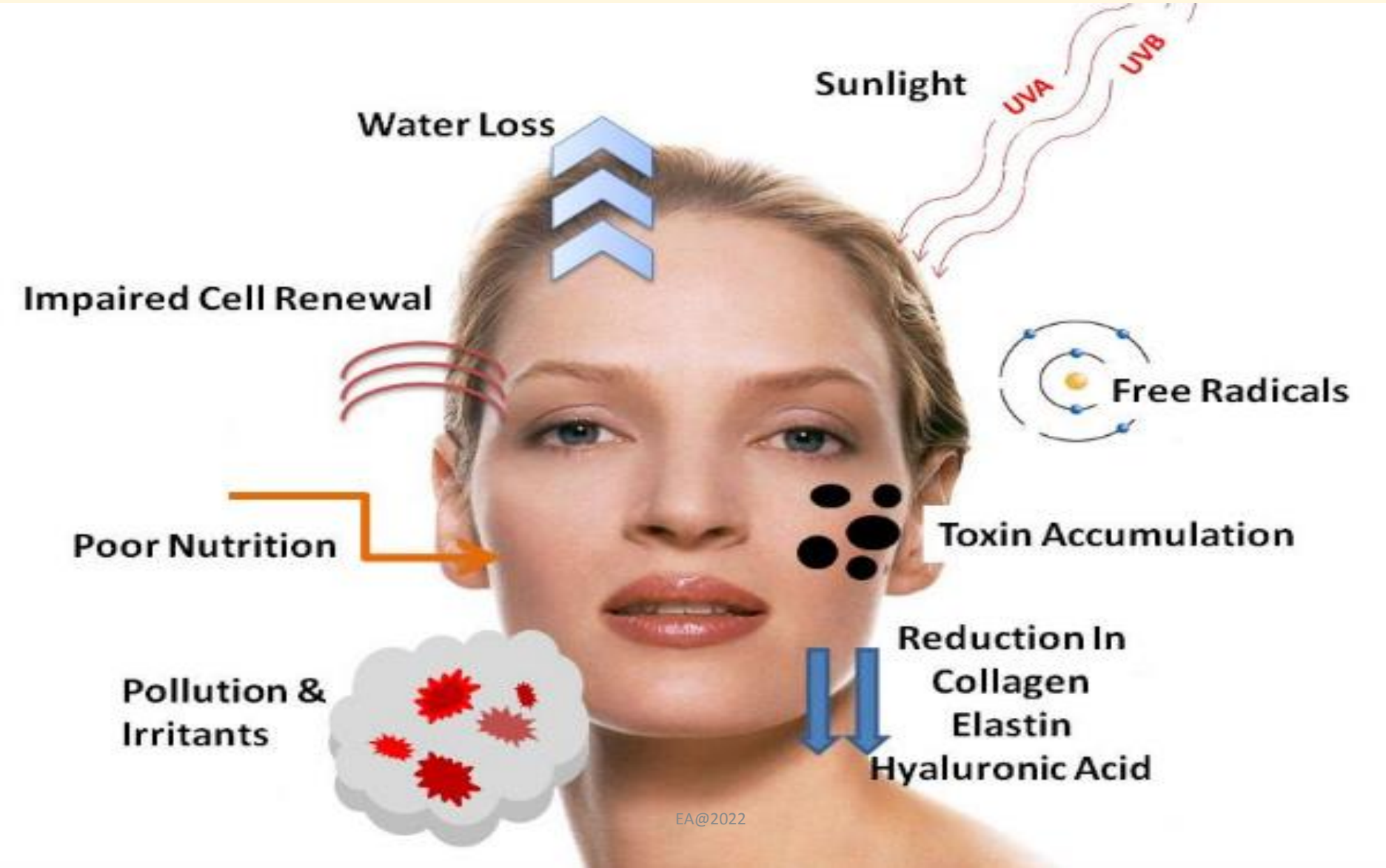
Physiological Factors – affect skin color but not melanin production

- Hemoglobin in dermal blood vessels = pink/blush
- Lack of hemoglobin in dermal blood vessels = blue (cyanosis)
- Inability to breakdown hemoglobin (liver problems) = jaundice - yellow

Skin shedding

- Skin is continuously shedding and desquamating and varies slightly depending on the body region. There are more layers of cells in thicker hairless skin with an additional layer, known as the stratum lucidum. Overall, the process of cell division, desquamation, and shedding go as follows:
  - ✓Cell division occurs in stratum basale/germinativum. One cell remains, another cell is pushed toward the surface. Basal cells begin synthesis of tonofilaments (composed of keratin) which are grouped into bundles (tonofibrils).
  - ✓Cells are pushed into stratum spinosum. In the upper part of the spinous layer, cells begin to produce keratohyalin granules having intermediate-associated proteins, filaggrin, and trichohyalin; helps aggregate keratin filaments and conversion of granular cells to cornified cells, i.e. keratinization. Cells also produce lamellar bodies.
  - ✓Cells are pushed into stratum granulosum and become flattened and diamond shaped. The cells accumulate keratohyalin granules mixed between tonofibrils.
  - ✓Cells continue to stratum corneum where they flatten and lose organelles and nuclei. The keratohyalin granules turn tonofibrils into a homogenous keratin matrix.
  - ✓Finally, cornified cells reach the surface and are desquamated via a break-down of desmosomes. Proteinase activity of KLK (kallikrein-related serine peptidase) is triggered by lowered pH near the surface.

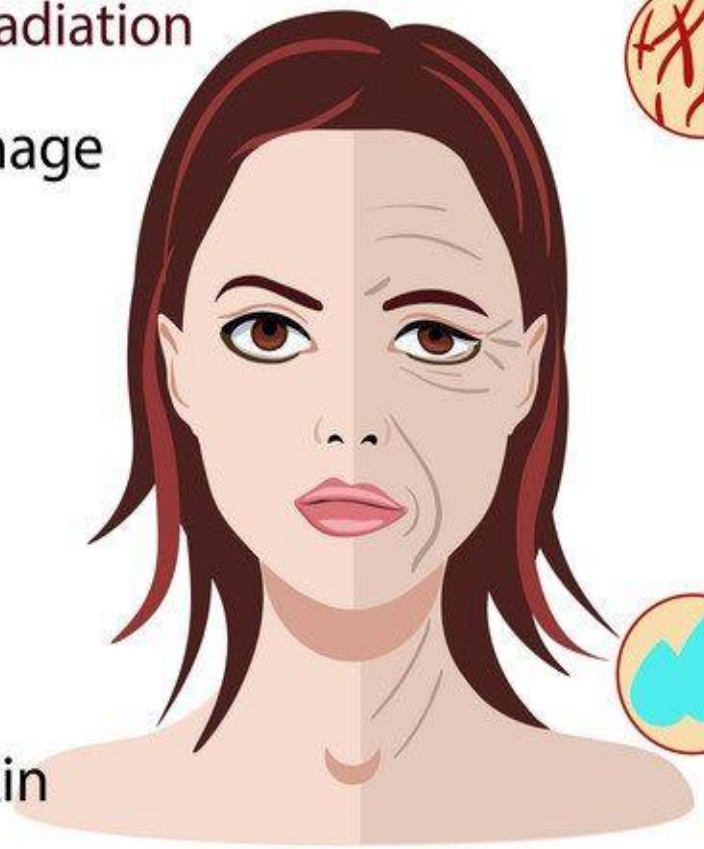
Causes of skin aging



4 main causes of aging

ultraviolet (UV) radiation

Lipid layer damage



lack of collagen

The skin loses its elasticity

toxins

The colour of skin worsens

lack of hydration

Hydration is main factor of youth

Stages of skin aging

up to 25 years

- smooth and elastic skin
- bright skin
- defined face contour

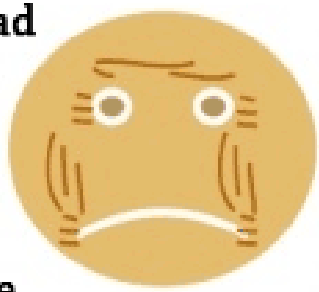
from 25 to 35 years

- eye contour wrinkles
- wrinkles on the forehead

from 35 to 50 years

- wrinkles on the forehead increase
- the eye contour lines increase
- the first wrinkles on the forehead are formed

over 50 years



- wrinkles become widespread
- the face less and less defined
- the skin is opaque with dark spots

Thank

You