

The Integumentary System

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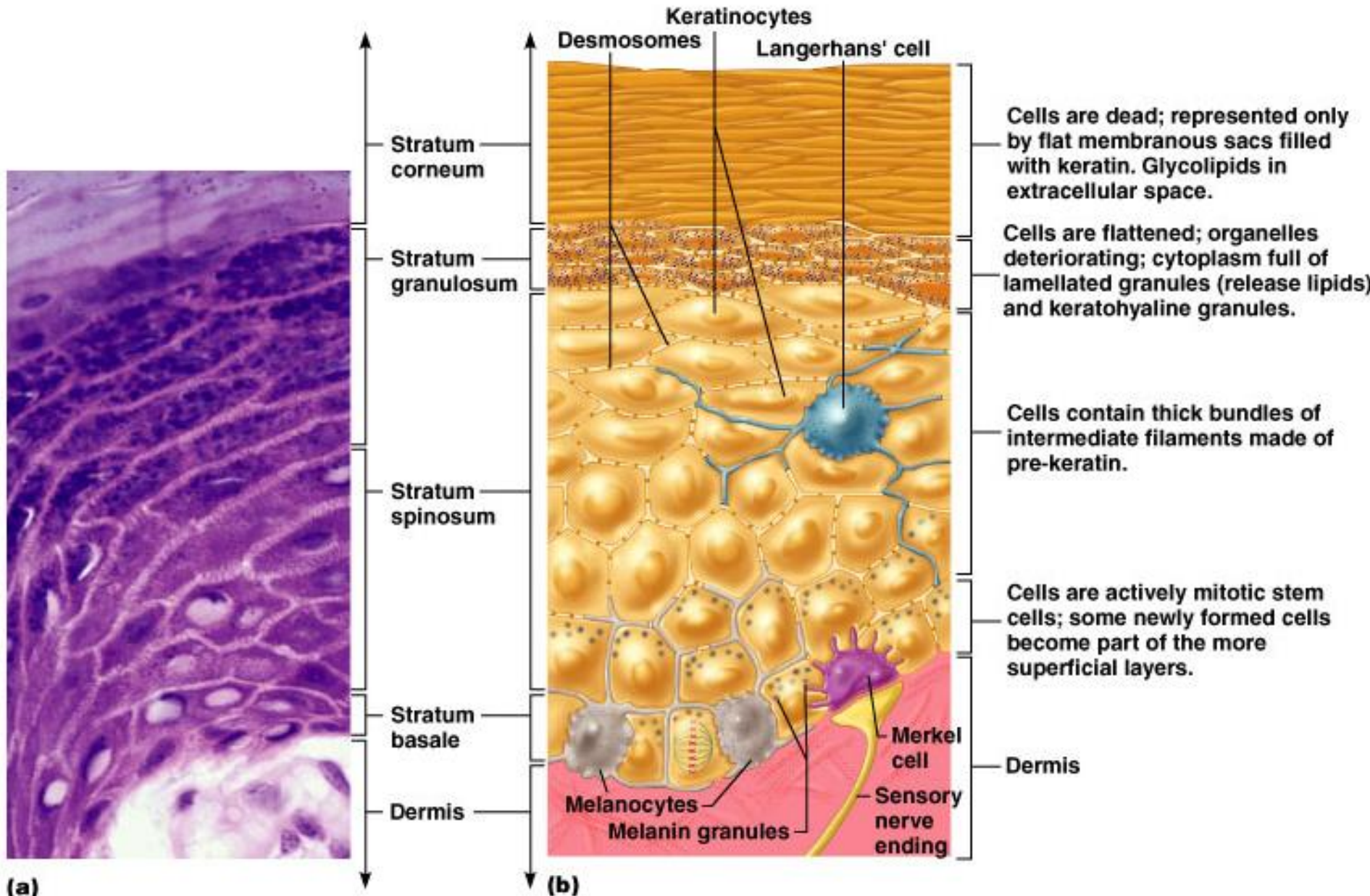
- Integument is skin
- Skin and its appendages make up the integumentary system
- A fatty layer (hypodermis) lies deep to it
- Two distinct regions
 - Epidermis
 - Dermis

Epidermis

- Keratinized stratified squamous epithelium
- Four types of cells
 - Keratinocytes – deepest, produce keratin (tough fibrous protein)
 - Melanocytes - make dark skin pigment melanin
 - Merkel cells – associated with sensory nerve endings
 - Langerhans cells – macrophage-like dendritic cells
- Layers (from deep to superficial)
 - Stratum basale or germinativum – single row of cells attached to dermis; youngest cells
 - Stratum spinosum – spinyess is artifactual; tonofilaments (bundles of protein) resist tension
 - Stratum granulosum – layers of flattened keratinocytes producing keratin (hair and nails made of it also)
 - Stratum lucidum (only on palms and soles)
 - Stratum corneum – horny layer (cells dead, many layers thick)

(see figure on next slide)

Epithelium: layers (on left) and cell types (on right)

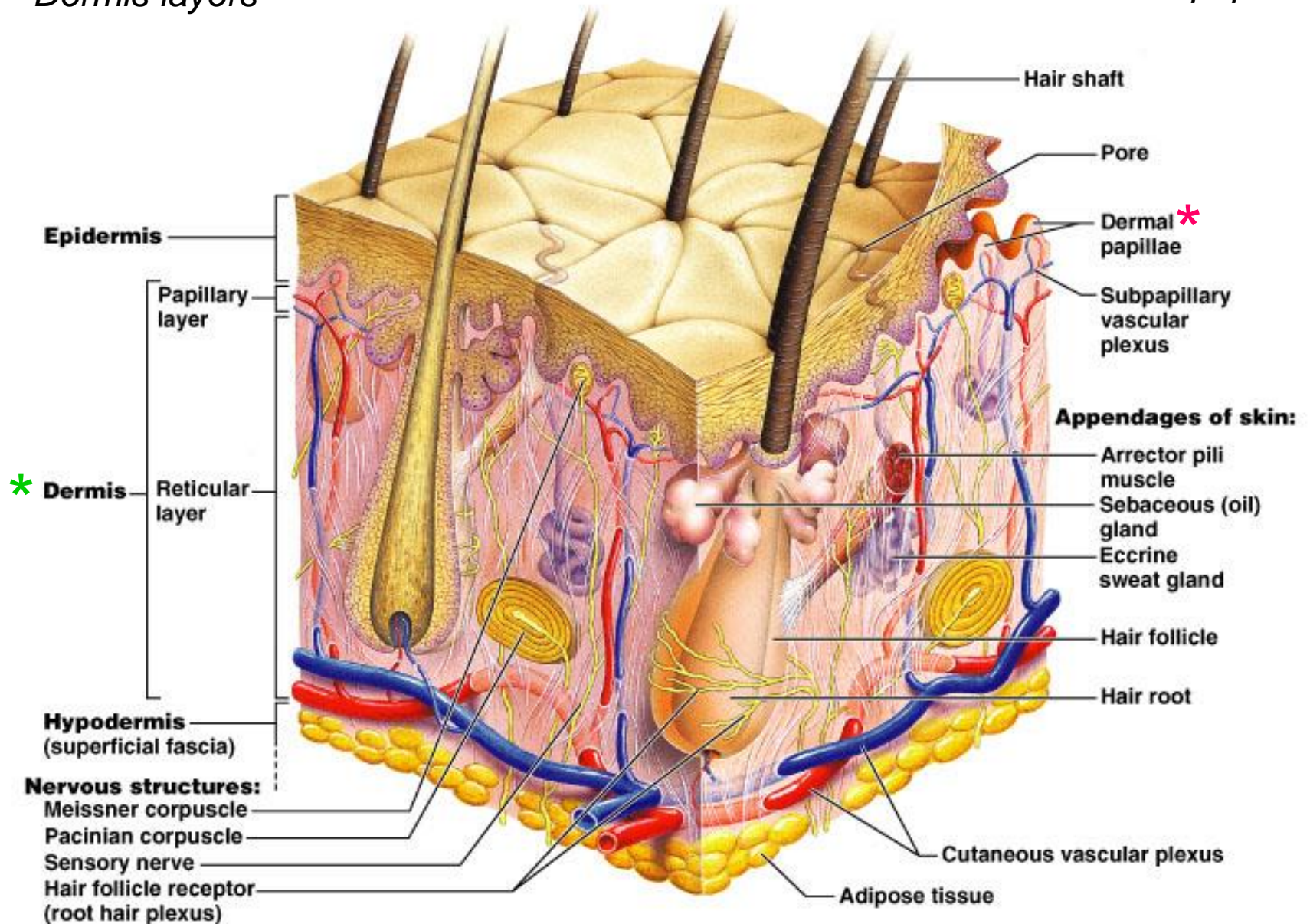


Dermis

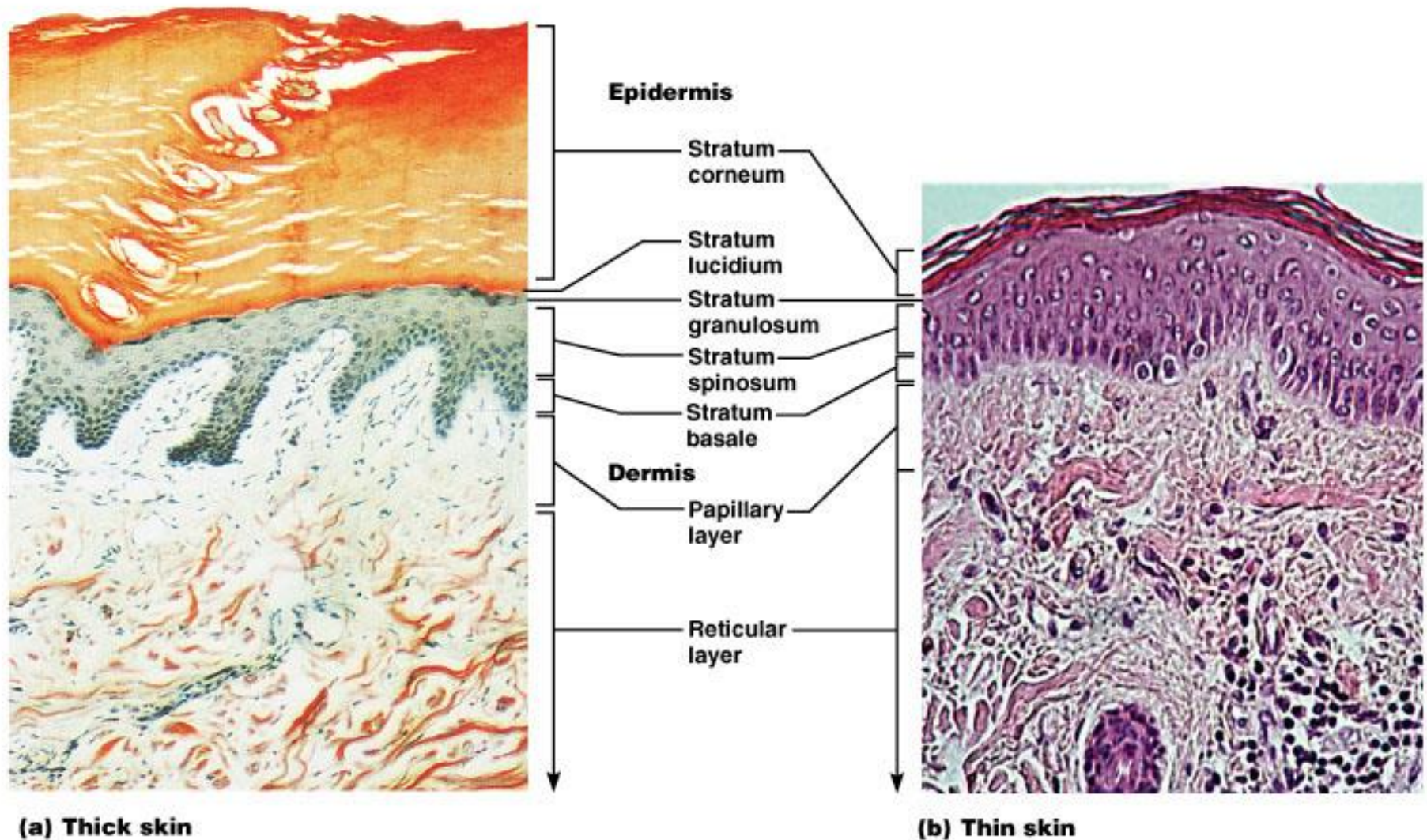
- Strong, flexible connective tissue: your “hide”
- Cells: fibroblasts, macrophages, mast cells, WBCs
- Fiber types: collagen, elastic, reticular
- Rich supply of nerves and vessels
- Critical role in temperature regulation (the vessels)
- Two layers (see next slides)
 - Papillary – areolar connective tissue; includes dermal papillae
 - Reticular – “reticulum” (network) of collagen and reticular fibers

* *Dermis layers*

* *Dermal papillae*



Epidermis and dermis of (a) thick skin and (b) thin skin (which one makes the difference?)



Fingerprints, palmprints, footprints

- Dermal papillae lie atop dermal ridges
- Elevate the overlying epidermis into epidermal ridges
- Are “sweat films” because of sweat pores
- Genetically determined

Flexion creases

- Deep dermis, from continual folding

Fibers

- Collagen: strength and resilience
- Elastic fibers: stretch-recoil
 - Striae: stretch marks
- Tension lines (or lines of cleavage)
 - The direction the bundles of fibers are directed

The dermis is the receptive site for the pigment of tattoos



Hypodermis

- “Hypodermis” (Gk) = below the skin
- “Subcutaneous” (Latin) = below the skin
- Also called “superficial fascia”
 - “fascia” (Latin) = band; in anatomy: sheet of connective tissue
- Fatty tissue which stores fat and anchors skin (areolar tissue and adipose cells)
- Different patterns of accumulation (male/female)

Skin color

- Three skin pigments
 - Melanin: the most important
 - Carotene: from carrots and yellow vegies
 - Hemoglobin: the pink of light skin
- Melanin in granules passes from melanocytes (same number in all races) to keratinocytes in stratum basale
 - Digested by lysosomes
 - Variations in color
 - Protection from UV light vs vitamin D?

Albinism

- A single mutation can cause a deficiency or complete absence of melanin.
- Albinos have fair skin, white hairs, and unpigmented eyes





Functions of Skin

- **Mechanical/Chemical damage** – keratin toughens cells; fats cells cushion blows; and pressure receptors to measure possible damage
- **Bacterial damage** – skin secretions are acidic and inhibit bacteria.
- **Ultraviolet radiation** – melanin produced to protect from UV damage

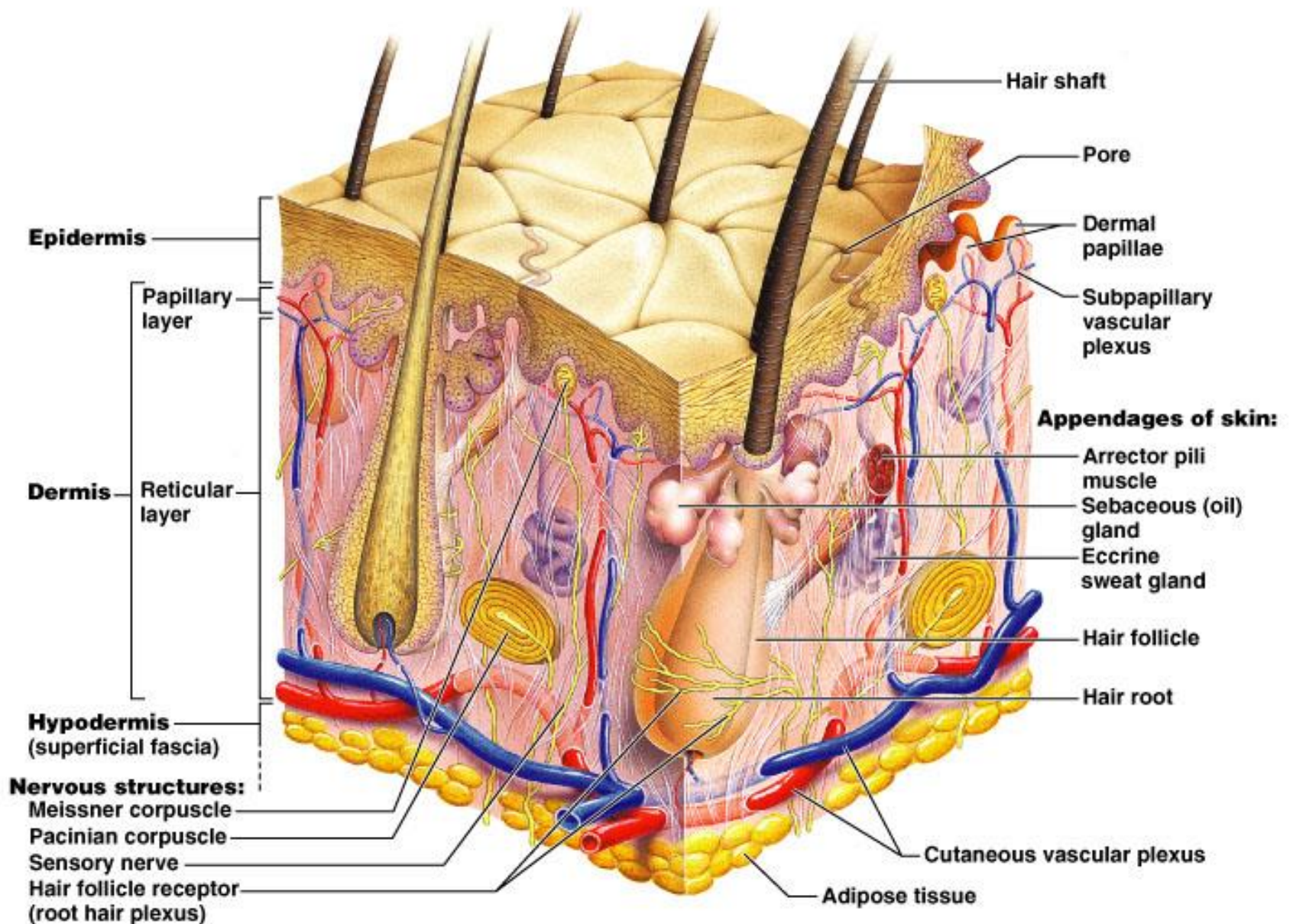


Skin Functions

- **Thermal control** – regulates body temperature
 - Heat loss: sweat to cool the skin
 - Heat retention: prevents blood to rush into capillary beds
- **Waterproofing** – contains lipids to prevent drying out
- **Excretion of waste** – urea and uric acid secreted in sweat
- **Makes vitamin D** – modifies cholesterol molecules in skin and converts it to vitamin D

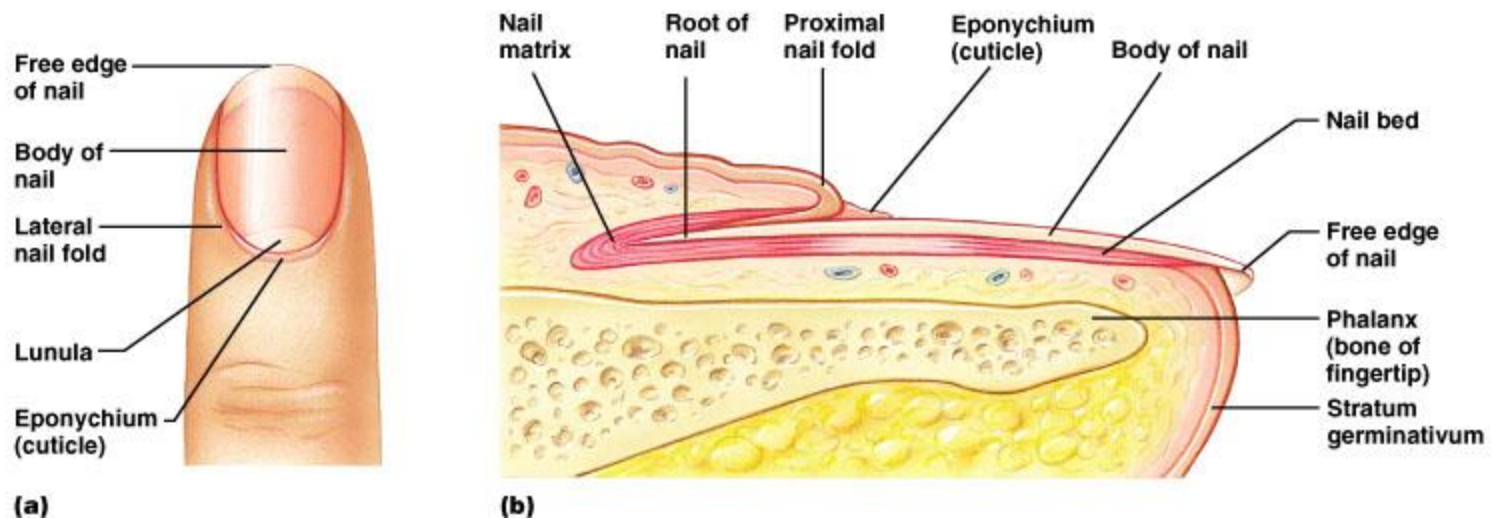
Skin appendages

- Derived from epidermis but extend into dermis
- Include
 - ☐ Hair and hair follicles
 - ☐ Sebaceous (oil) glands
 - ☐ Sweat (sudoriferous) glands
 - ☐ Nails



Nails

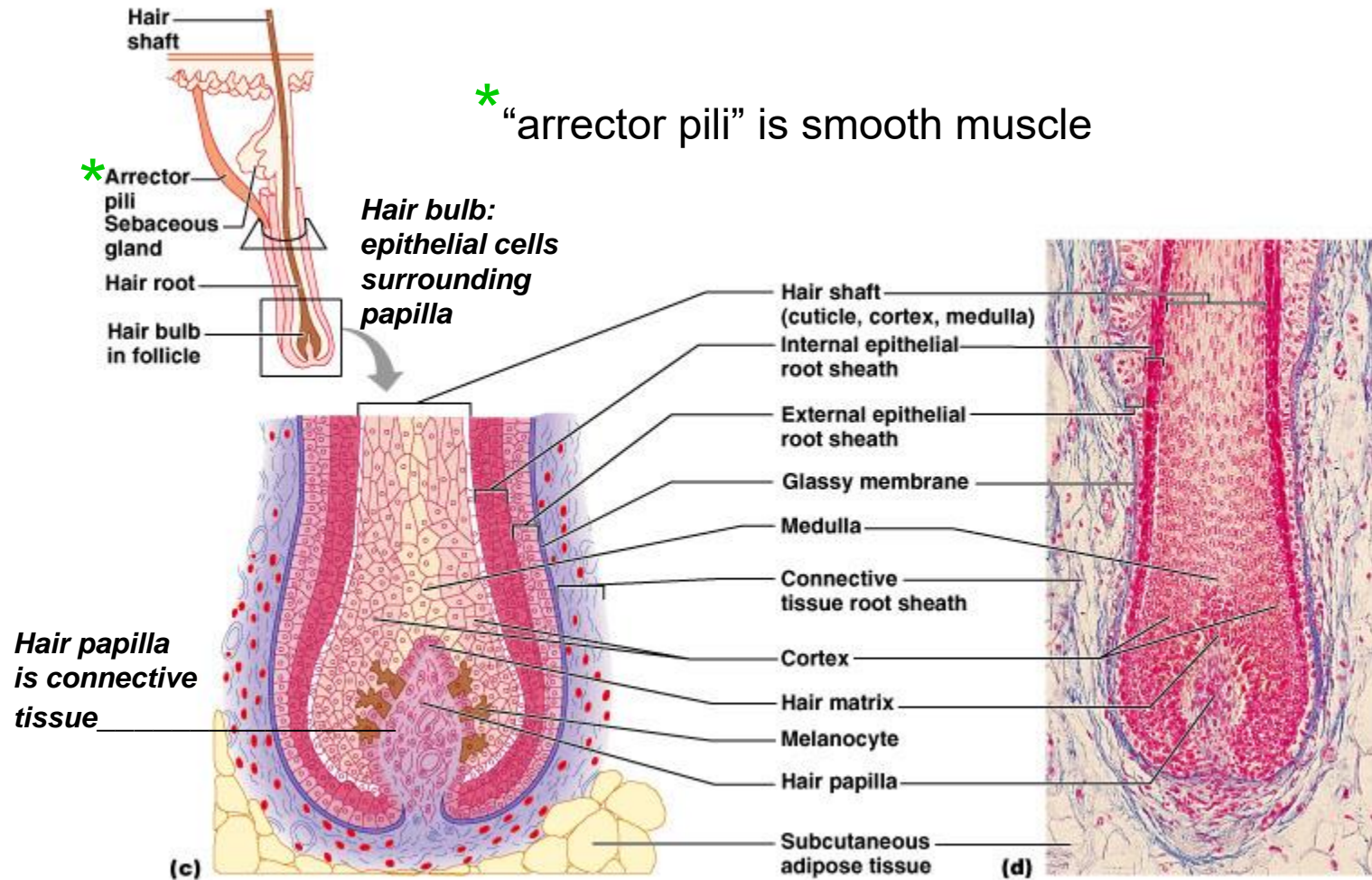
- Of hard keratin
- Corresponds to hooves and claws
- Grows from nail matrix



Hair and hair follicles: complex

Derived from epidermis and dermis

Everywhere but palms, soles, nipples, parts of genitalia



■ Functions of hair

- Warmth – less in man than other mammals
- Sense light touch of the skin
- Protection - scalp

■ Parts

- Root imbedded in skin
- Shaft projecting above skin surface

■ Make up of hair – hard keratin

■ Three concentric layers

- Medulla (core)
- Cortex (surrounds medulla)
- Cuticle (single layers, overlapping)

■ Types of hair

- Vellus: fine, short hairs
- Intermediate hairs
- Terminal: longer, courser hair

■ Hair growth: averages 2 mm/week

- Active: growing
- Resting phase then shed

■ Hair loss

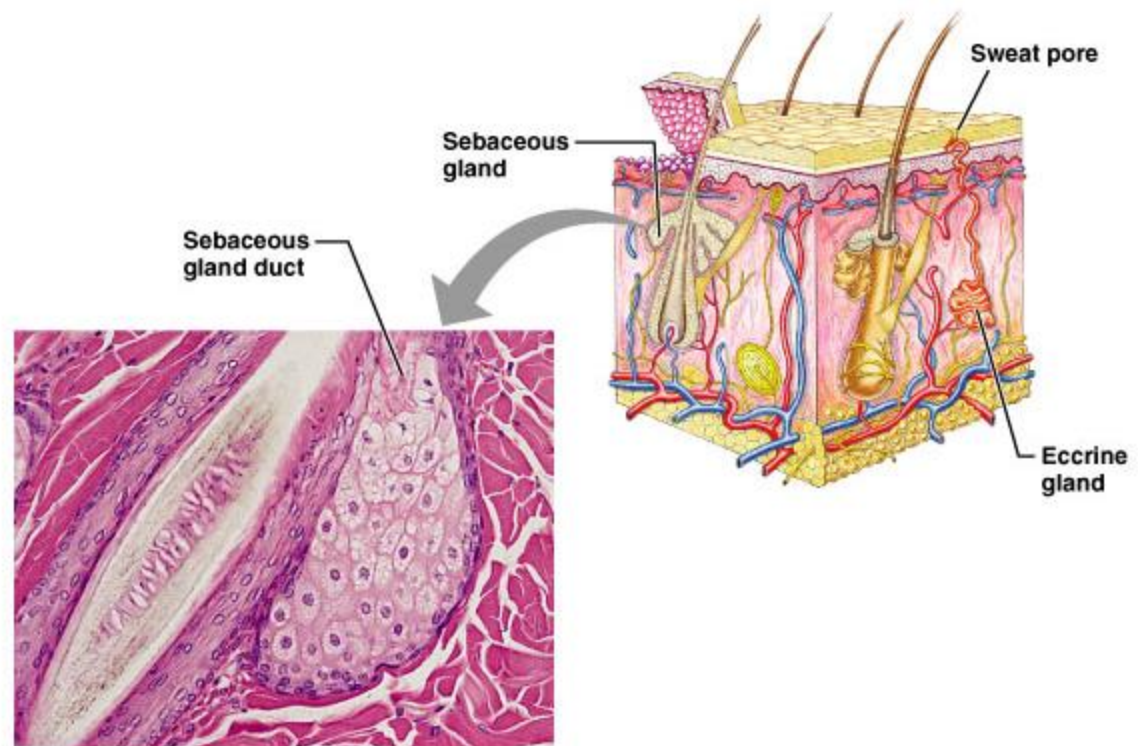
- Thinning – age related
- Male pattern baldness

■ Hair color

- Amount of melanin for black or brown; distinct form of melanin for red
- White: decreased melanin and air bubbles in the medulla
- Genetically determined though influenced by hormones and environment

Sebaceous (oil) glands

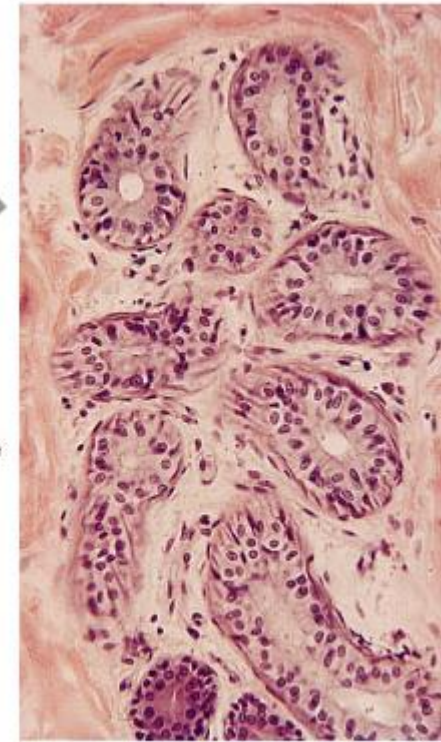
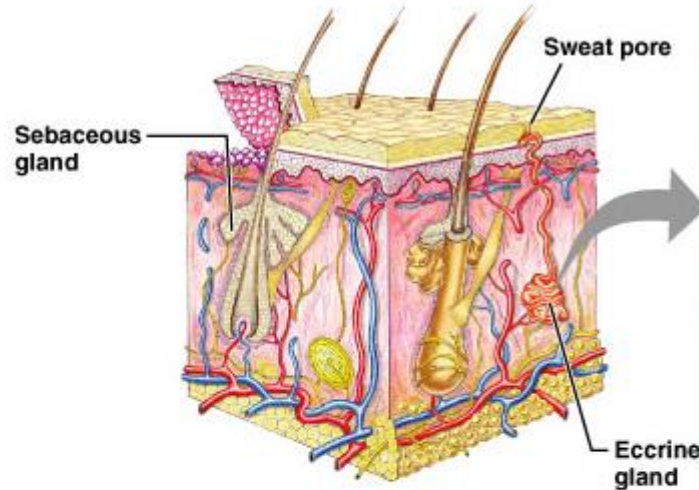
- Entire body except palms and soles
- Produce *sebum* by holocrine secretion
- Oils and lubricates



(a) Sectioned sebaceous gland

Sweat glands

- Entire skin surface except nipples and part of external genitalia
- Prevent overheating
- 500 cc to 12 l/day!
(is mostly water)
- Humans most efficient (only mammals have)
- Produced in response to stress as well as heat



(b) Sectioned eccrine gland

Types of sweat glands

■ Eccrine or merocrine

- ☐ Most numerous
- ☐ True sweat: 99% water, some salts, traces of waste
- ☐ Open through pores

■ Apocrine

- ☐ Axillary, anal and genital areas only
- ☐ Ducts open into hair follicles
- ☐ The organic molecules in it decompose with time - odor

■ Modified apocrine glands

- ☐ Ceruminous – secrete earwax
- ☐ Mammary – secrete milk

Disorders of the integumentary system

■ Burns

□ Threat to life

- Catastrophic loss of body fluids
- Dehydration and fatal circulatory shock
- Infection

□ Types

- First degree – epidermis: redness (e.g. sunburn)
- Second degree – epidermis and upper dermis: blister
- Third degree - full thickness

■ Infections

■ Skin cancer

Tumors of the skin

- Benign, e.g. warts
- Cancer – associated with UV exposure (also skin aging)