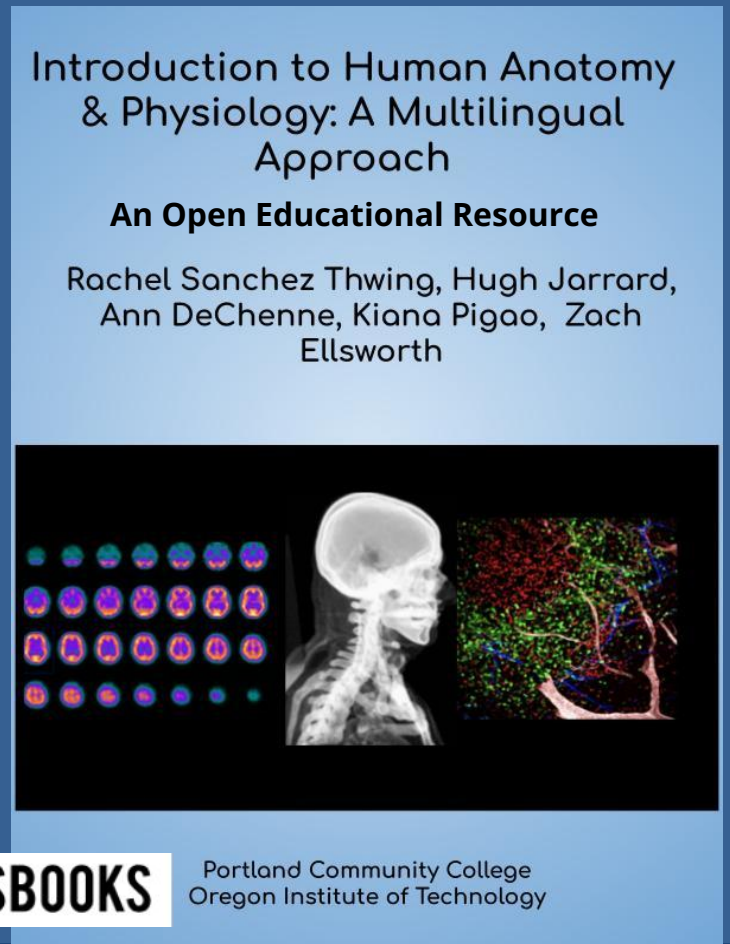
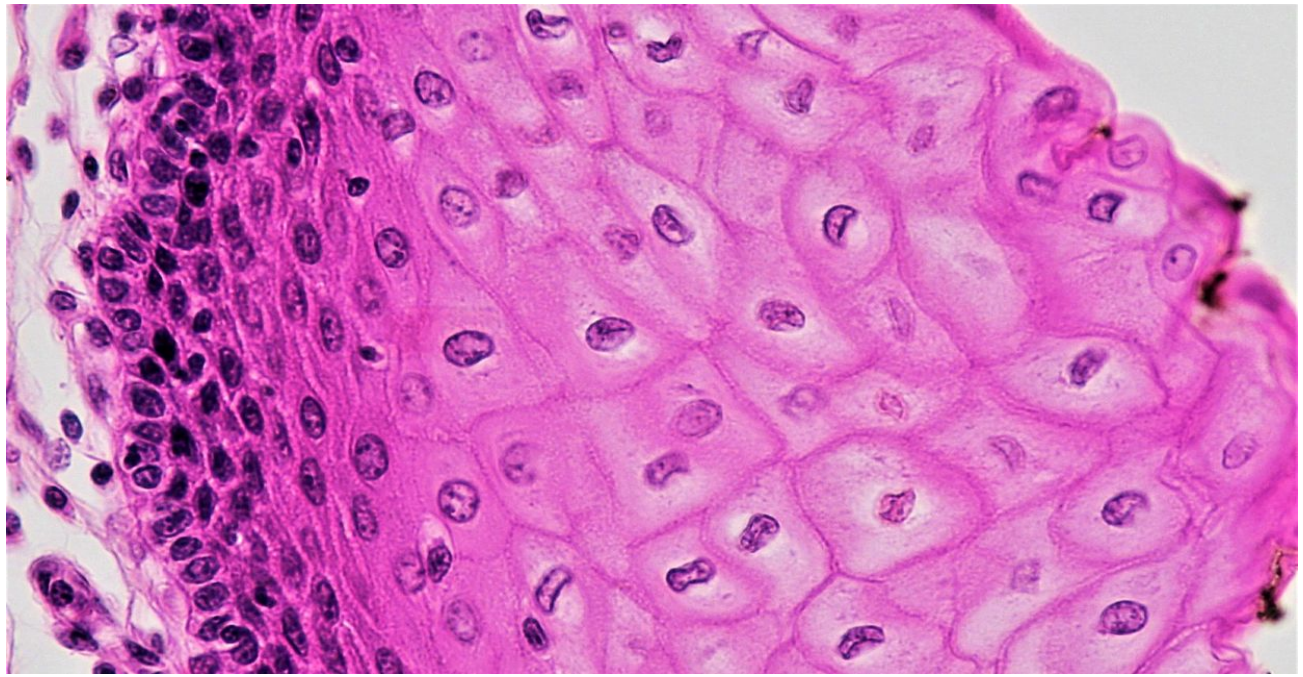
Integumentary System:
Structure and Function





"Epithelial Tissues: Stratified Squamous Epithleium" by Open courses tei athinas, CC0 1.0 Universal

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Translations done with ChatGPT 4.0

Lesson 1: Structure and Function of the Integumentary System

Learning Objectives:

- Explain the functions of the integumentary system
- Identify the principal structures and layers of human skin.
- Identify Accessory Structures and their function

See the Integumentary System Wordlist!

- Can be found in accompanying materials to this lecture
- Materials are available in English, Spanish, Russian, Vietnamese, Filipino, East African French, Kiswahili (Swahili) and Chinese.

Module 2 WORD LIST and DEFINITIONS Integumentary System

Epidermis
- stratum basale
- stratum corneum
- stratum granulosum
- stratum lucidum
- stratum spinosum
- Keratinocytes
- Basal cell
- keratin
- Langerhans cells
- Merkel cells
- Melanocytes
- Melanin

Dermis
- papillary layer
- dermal papillae
- Pacinian corpuscle
- Meissner corpuscles
- Reticular layer

Hypodermis
Reticular layer
Vitamin D

Hair
Hair follicle
Arrector pili muscles
Hair Shaft
Hair Root
Hair Matrix
Nail bed
nail body
nail cuticle

Apocrine Sweat glands
Eccrine sweat gland
Sebaceous glands

Acne
eczema

Basal cell carcinoma
Squamous cell carcinoma
Melanoma
ABCDE rule

first-degree burn
second-degree burn
third-degree burn
fourth-degree burn

Functions of the Integumentary System

Protection from:

- Mechanical damage
- Desiccation
- Chemical damage
- Microbe damage
- Ultraviolet (UV) radiation
- Thermal (heat or cold) damage

Aids in:

- Excretion
- Synthesis
- Thermoregulation

`Viking' by Rones via OpenClipArt

`Lifting Hand Outline' by Saturdays Off via TPT, Free

Protection: From Mechanical Damage

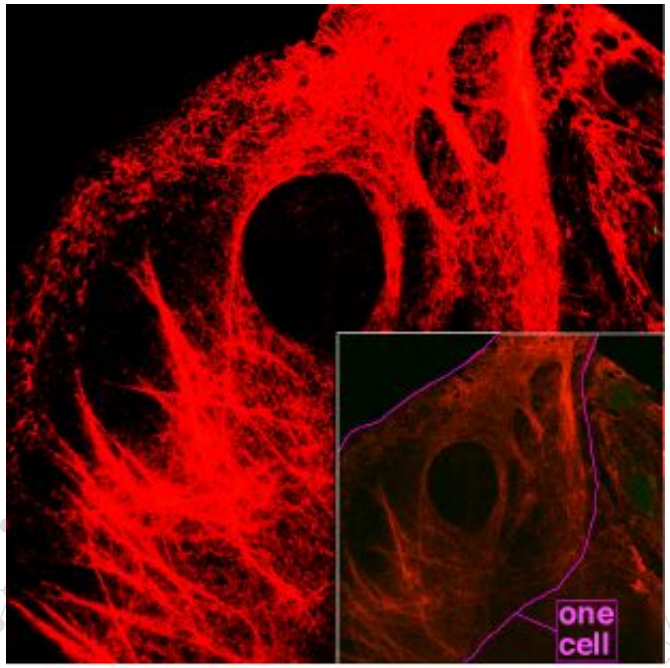
Functions:

Protects deeper tissues from

Mechanical damage
(bumps)

How accomplished

Physical barrier contains keratin, which toughens cells; fat cells to cushion blows; and both pressure and pain receptors, which alert the nervous system to possible damage.



Protection: From Chemical Damage

Functions:

Protects deeper tissues from

Chemical damage
(acids and bases)

How accomplished

Has relatively impermeable keratinized cells; contains pain receptors, which alert the nervous system to possible damage.

Protection: From Foreign Substances

Functions:

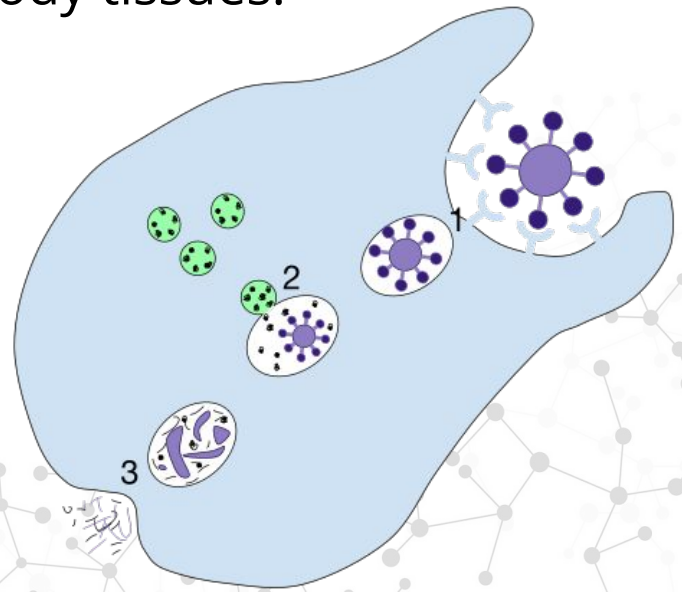
Protects deeper tissues from

Microbe damage

How accomplished

Has an unbroken surface and "acid mantle" (skin secretions are acidic and thus inhibit microbes, such as bacteria).

Phagocytes ingest foreign substances and pathogens, preventing them from penetrating into deeper body tissues.



Protection: From DNA Damage (UV radiation)

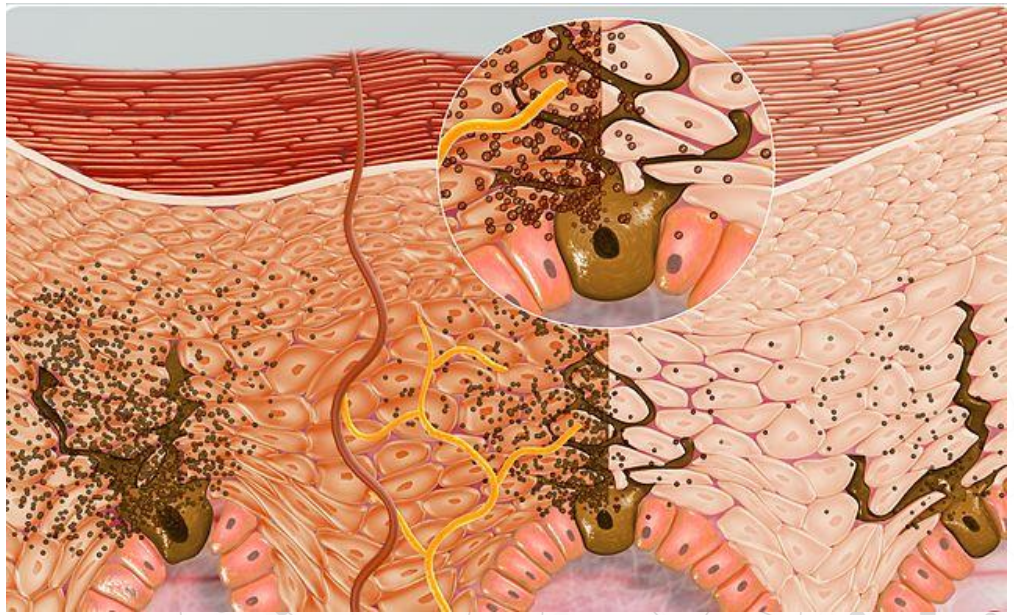
Functions:

Protects deeper tissues from

Ultraviolet (UV) radiation
(damaging effects of
sunlight or tanning beds)

How accomplished

Melanin produced by melanocytes offers protection from UV damage.



Protection: From Thermal Damage

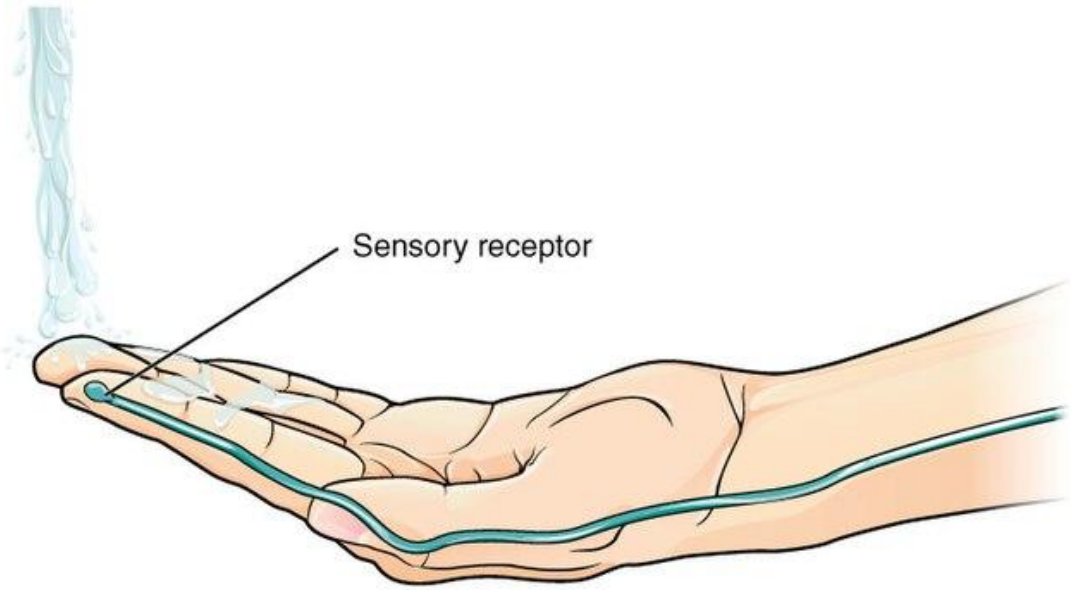
Functions:

Protects deeper tissues from

Thermal (heat or cold) damage

How accomplished

Contains heat/cold/pain receptors.



Protection: From Drying Out

Functions:

Protects deeper tissues from

Desiccation
(drying out)

How accomplished

Contains a water-resistant glycolipid and keratin.

Function: Excreting Nitrogenous Waste

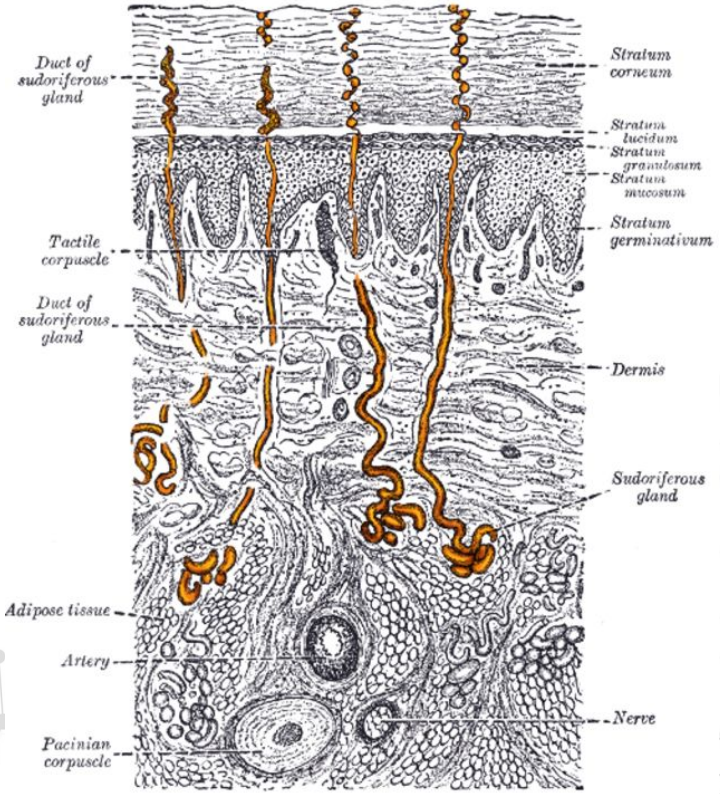
Functions:

Aids in Excretion

Excretion of urea and uric acid

How accomplished

Contained in perspiration produced by sweat glands.



`Sweat gland' via Wikimedia Commons, Public Domain.

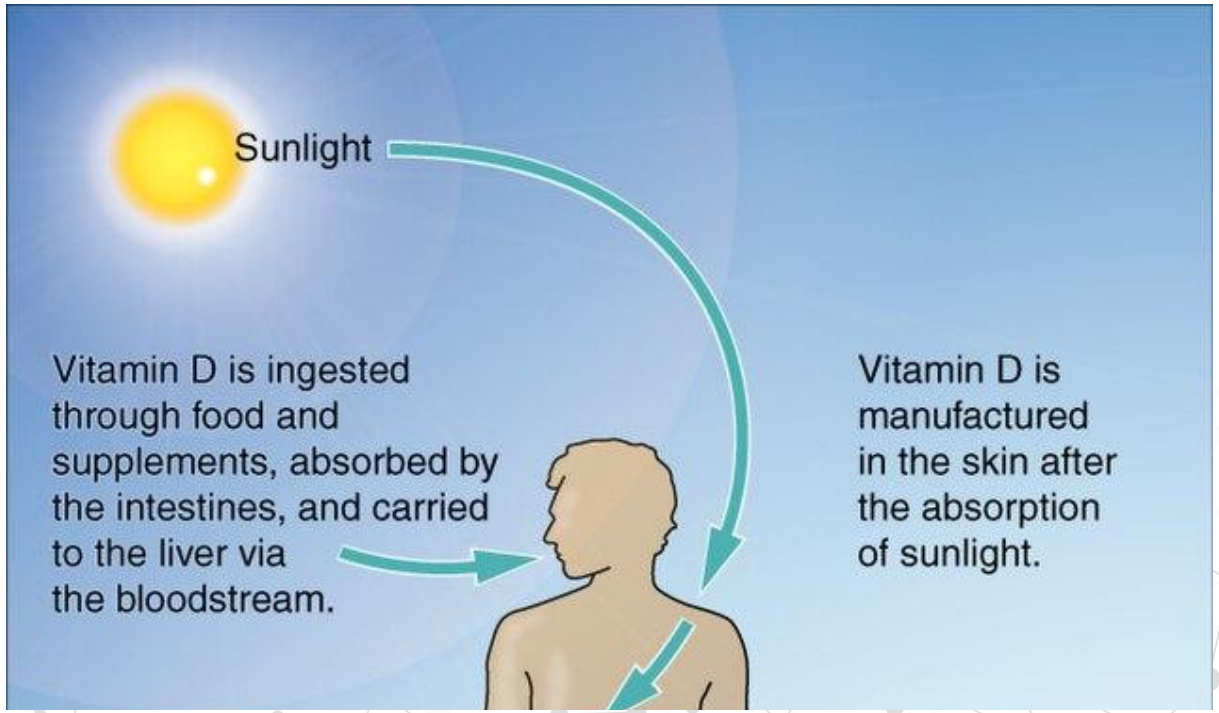
Function: Vitamin D Synthesis

Functions:

Synthesizes vitamin D

How accomplished

Modified cholesterol molecules in skin converted to vitamin D in the presence of sunlight.



`Synthesis of Vitamin D' via Wikimedia Commons, CC BY-SA 3.0

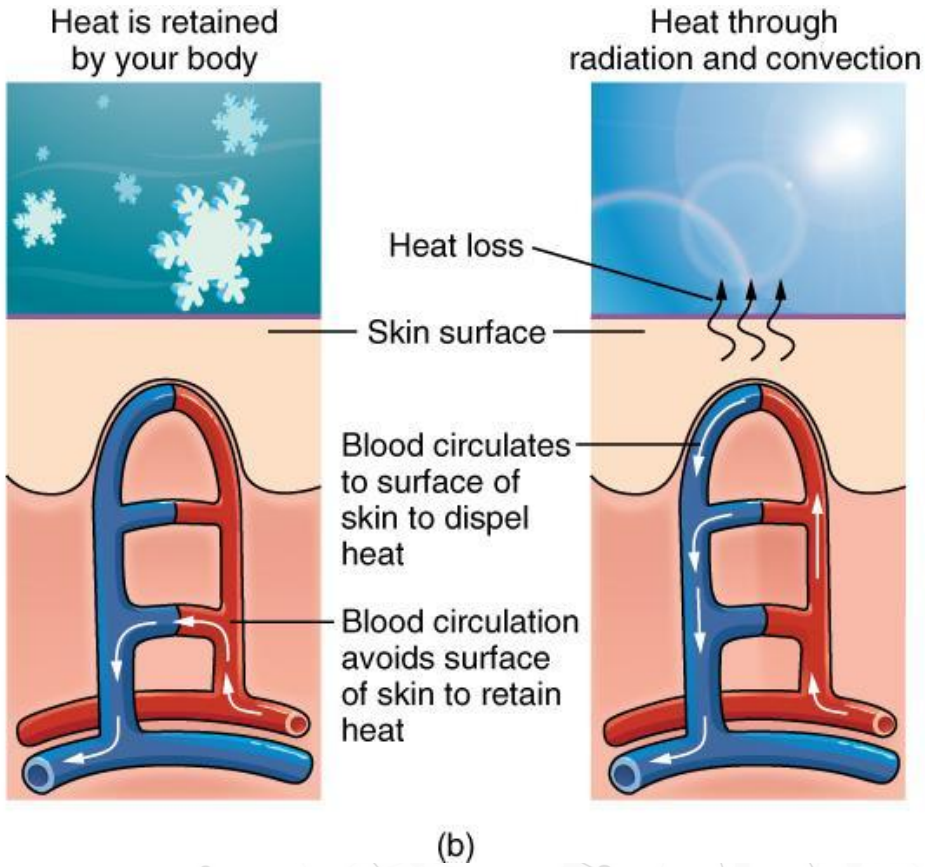
Function: Thermoregulation

Functions:
Thermoregulation

Aids in body heat loss or heat retention
(controlled by the nervous system)

How accomplished

Heat loss: capillaries serving glands are dilated and sweat glands vaporize water from them with body heat



Heat retention: capillaries are constricted so that blood does not flush into capillary beds serving the sweat glands

Modified from Figure 5.16, OpenStax A&P 2e

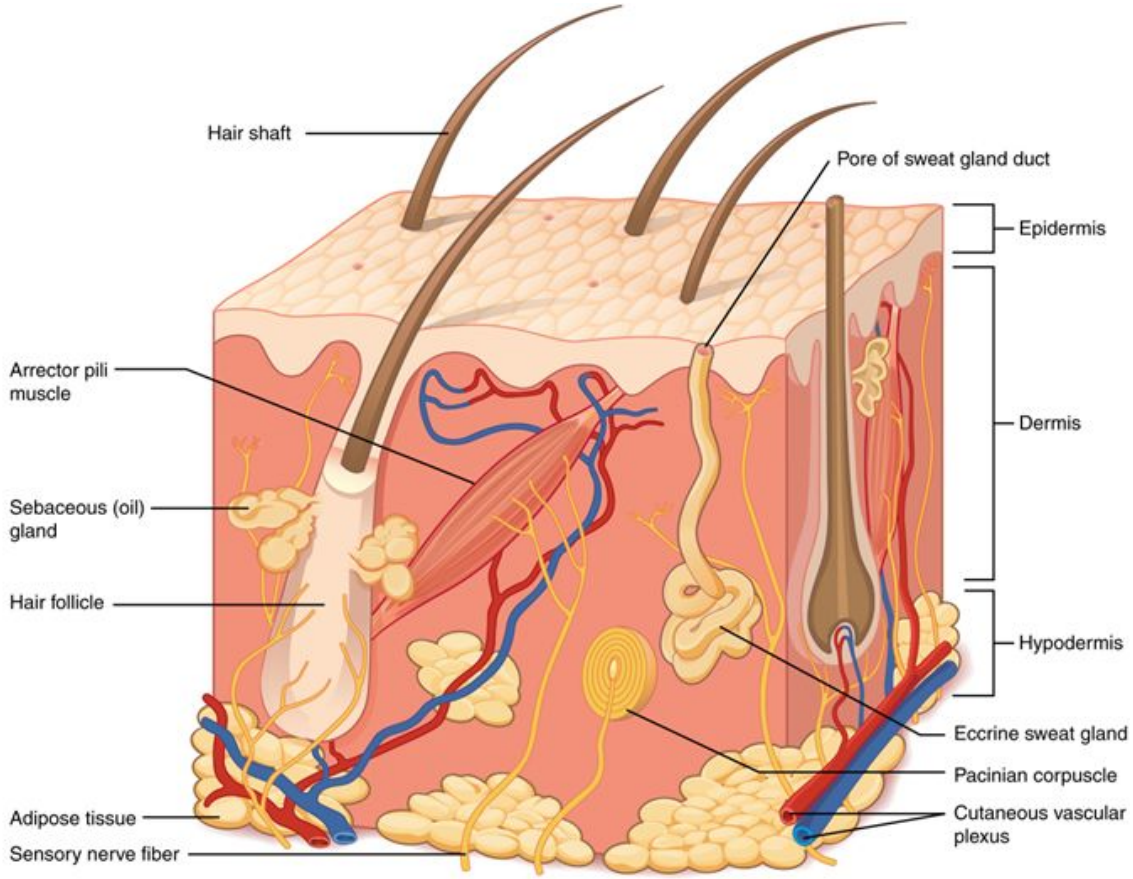
Structure of the Skin: Epidermis and Dermis

The skin consists of two main layers:

Epidermis:
outermost layer, composed of stratified squamous epithelium

Dermis:
deeper layer, contains connective tissue, blood vessels, and nerve endings

Hypodermis: not part of skin, contains adipose and connective tissues



Layers of Skin, Figure 5.2, OpenStax A&P 2e

Epidermis: The Outer Shield

Epidermis composed of several layers:

Made up of **keratinocytes**:

produce keratin, a tough protective protein

Arranged in four (or five) layers:

Stratum basale - contains dividing cells

Stratum spinosum - cells connected by `spines'

Stratum granulosum - cells accumulating granules of keratin

Stratum lucidum - a thin transparent layer found only in thick skin (soles of hands and feet)

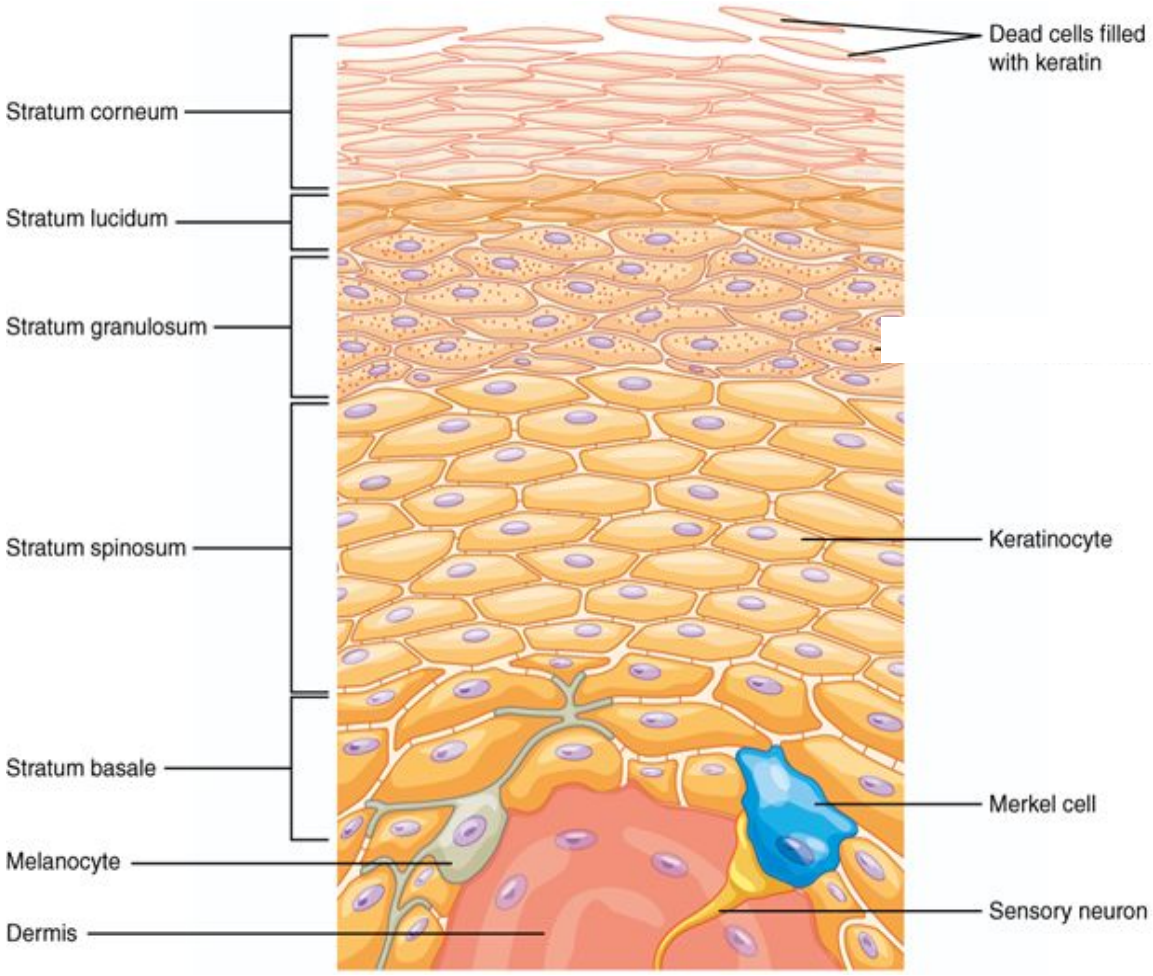
Stratum corneum - cells dead and flat

Also contains:

Merkel cells - touch receptors

Langerhans cells - phagocytotic

Melanocytes - produce melanin



Layers of Epidermis, Figure 5.5, OpenStax A&P 2e

Dermis: The Support Layer

Dermis binds the Epidermis to underlying layers and provides nutrients

Consists of:

Papillary Layer - peglike structure (dermal papillae)

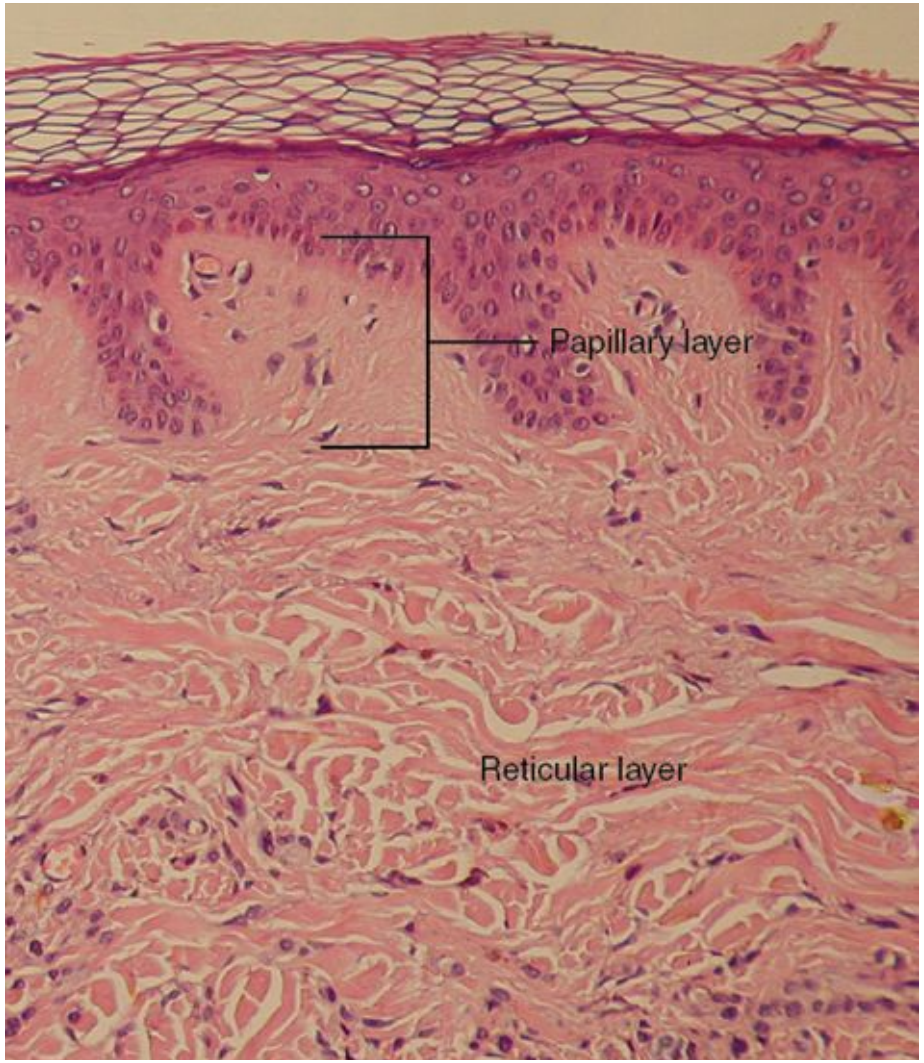
Reticular layer - made of irregular connective tissue

Contains:

blood vessels, hair follicles, and glands

nerve endings: sensory receptors for:

- touch,
- pressure
- temperature



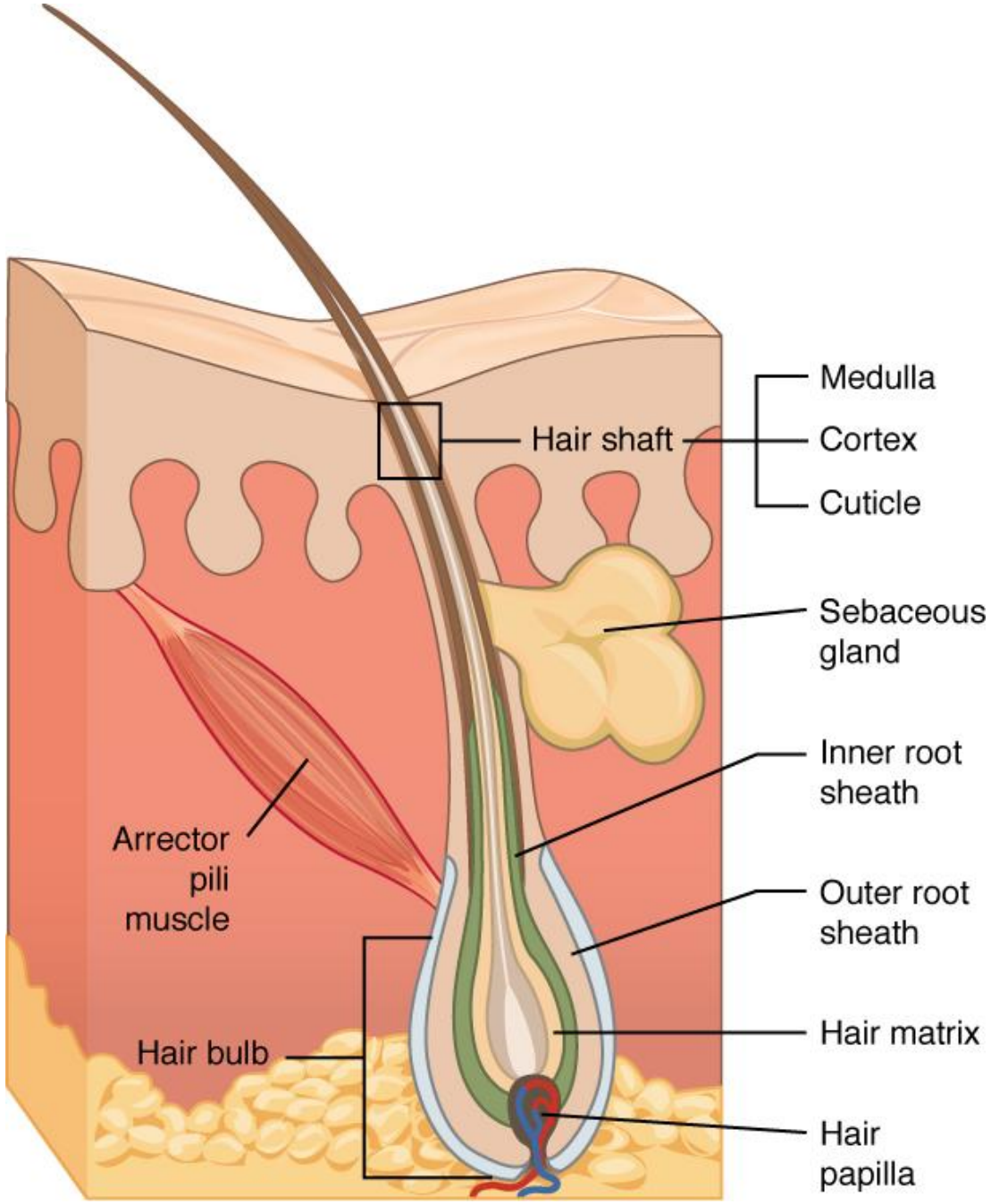
Layers of Dermis, Figure 5.7, OpenStax A&P 2e

Accessory Structure: Hair

Composed of:
dead, keratinized cells

Grows from hair follicles in the dermis
- hair shaft - visible above the skin
- hair root - present in the skin
- hair matrix - contains keratinocytes and melanocytes

Functions include:
protection, sensory reception, and temperature regulation (arrector pili muscles)



Hair, Figure 5.11, OpenStax A&P 2e

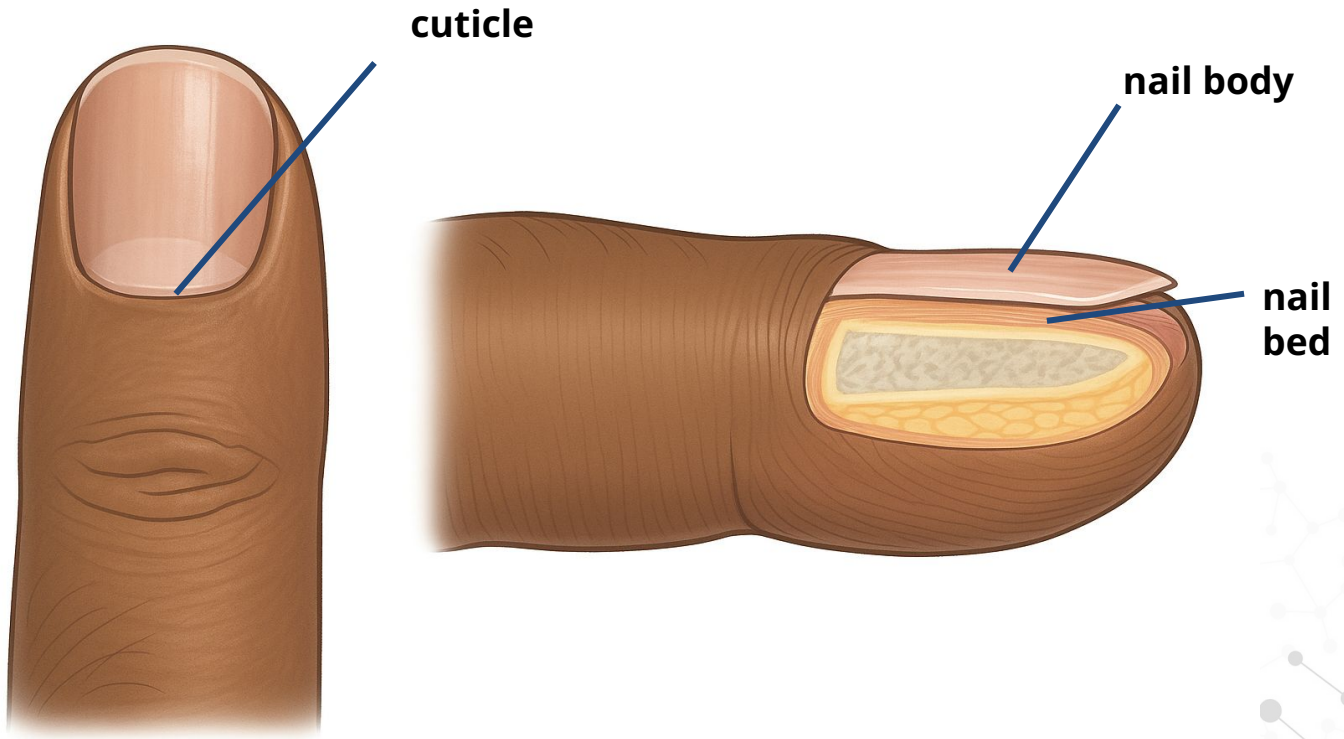
Accessory Structure: Nails

Composed of:
tough, keratinized cells

Consists of nail body lying atop nail bed, cuticle is a base

Functions as:
protective plate for the tips of fingers and toes

Aids in manipulating small objects



Modified from Nails, Figure 5.13, OpenStax A&P 2e

Accessory Structure: Glands of the Skin

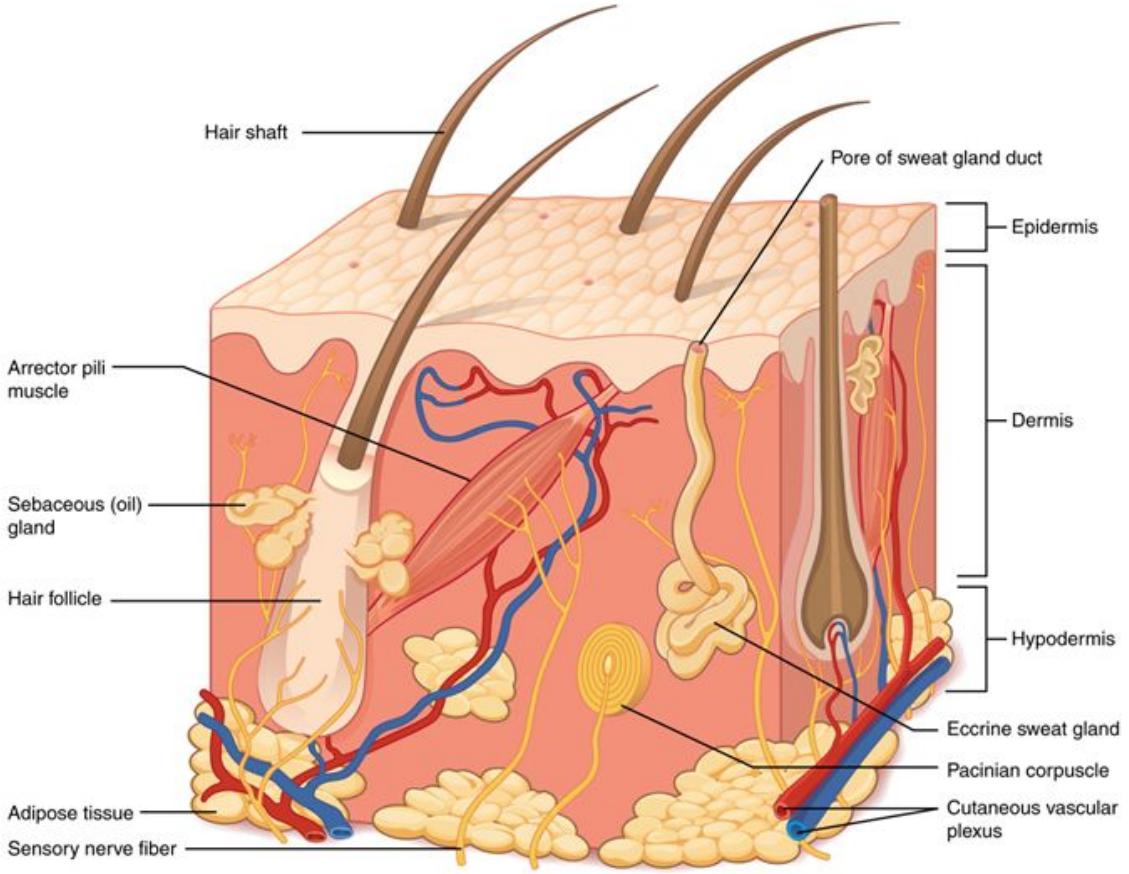
Sebaceous glands: produce sebum to lubricate and waterproof skin and hair

Sweat glands: produce sweat for temperature regulation and excretion

Eccrine sweat glands - produce watery odorless sweat important for temperature regulation

Apocrine sweat glands - specialized glands in armpits and genital area, produce thicker, milky sweat (leads to body odor)

both contribute to excretion of urea



Layers of Skin, Figure 5.2, OpenStax A&P 2e

Lesson 1: Structure and Function of the Integumentary System Summary

Summary:

- Explain the functions of the integumentary system
- Identify the principal structures and layers of human skin.
- Identify Accessory Structures and their function