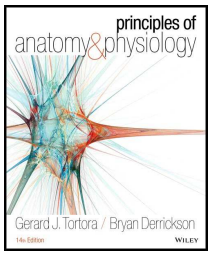



# Principles of Anatomy and Physiology

14th Edition

**CHAPTER 5**

The Integumentary System



## Introduction

The organs of the integumentary system include the skin and its accessory structures including hair, nails, and glands, as well as blood vessels, muscles and nerves.

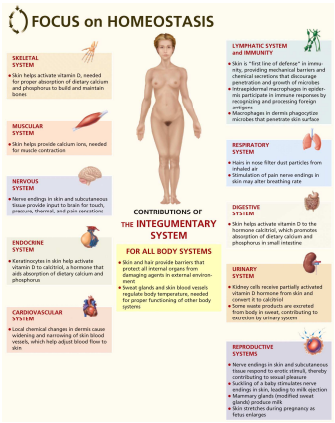


## Introduction

The integumentary system:

- Maintains the body's integrity
- Maintains temperature
- Converts inactive vitamin D to its active form
- Provides sensory information
- Maintains homeostasis.

## Introduction





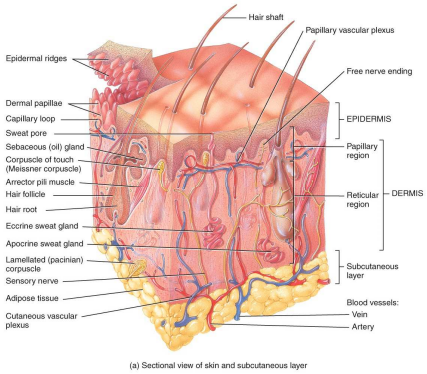

## Structures of the Skin

The skin has 3 major layers:

- The outer is called the **epidermis**
- The inner is called the **dermis**
- The subcutaneous (**subQ**) layer (also called the hypodermis) is located underneath the dermis.



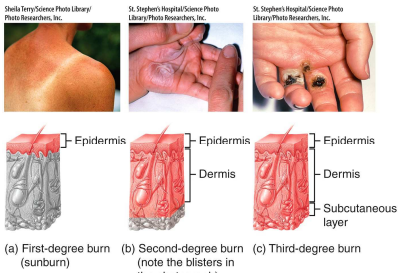
## Structures of the Skin




(a) Sectional view of skin and subcutaneous layer

## Structures of the Skin

Dermatologist are doctors who treat disorders of all layers of the integumentary system.



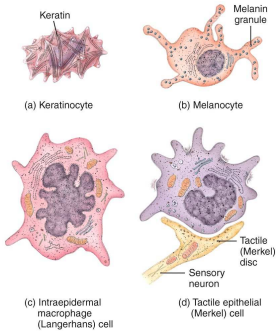

(a) First-degree burn (sunburn) (b) Second-degree burn (note the blisters in the photograph) (c) Third-degree burn



## The Epidermis

Contains four major types of cells:

- Keratinocytes
- Melanocytes
- Intraepidermal macrophages
- Tactile epithelial cells




(a) Keratinocyte (b) Melanocyte (c) Intraepidermal macrophage (Langerhans) cell (d) Tactile epithelial (Merkel) cell



## The Epidermis

**Keratinocytes** produce keratin - a tough fibrous protein that provides protection.

**Melanocytes** produce the pigment melanin

**Intraepidermal macrophages** are involved in the immune responses.

**Tactile epithelial cells** function in the sensation of touch.

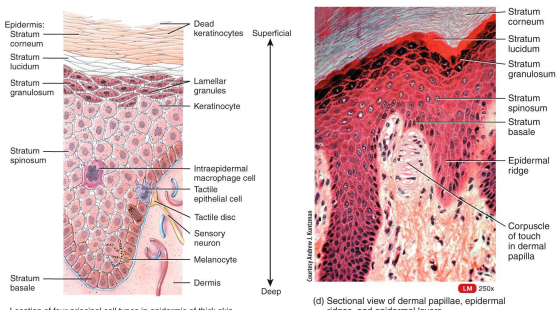
## The Epidermis

The epidermis is composed of four layers in thin skin, and five layers in thick skin. They are (from deep to superficial):

- The **stratum basale**
- The **stratum spinosum**
- The **stratum granulosum**
- The **stratum lucidum** (only present in thick skin)
- The **stratum corneum**



## The Epidermis




Location of four principal cell types in epidermis of thick skin




(d) Sectional view of dermal papillae, epidermal ridges, and epidermal layers



## The Epidermis

Types of skin:

- **Thin (hairy) skin** covers all body regions except the palms, palmar surfaces of digits, and soles.
- **Thick (hairless) skin** covers the palms, palmar
- surfaces of digits, and soles.

## The Epidermis

### Skin Pigments

- Melanin is produced by melanocytes in the stratum basale


(b) Melanocyte



## The Epidermis

### Skin Pigments

- Albinism is a congenital disorder characterized by the complete or partial absence of pigment in the skin, hair, and eyes due to a defect of an enzyme involved in the production of melanin.



## The Epidermis

### Skin Pigments

- Vitiligo is a chronic disorder that causes depigmentation patches in the skin. The precise cause, is not known, but is most likely a combination of genetic factors coupled with a disorder of the immune system (autoimmune disease).

## The Dermis

The dermis is composed of **connective tissue** containing collagen and elastic fibers.

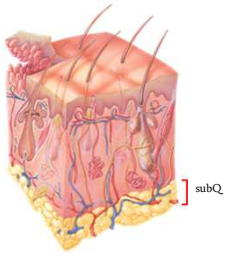
It contains two regions:

- The **papillary region** lies just below the epidermis
- The **reticular region** consists of **dense irregular connective tissue**



## The Subcutaneous Layer

The **subcutaneous layer** is also called the **hypodermis**, and it attaches the skin to underlying tissues and organs.



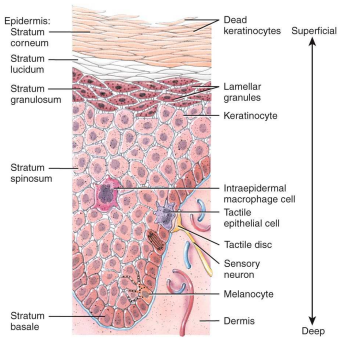



## Sensory Receptors

The skin contains different types of sensory receptors found in different layers:

- **Superficially**
  - Type I cutaneous mechanoreceptors, free nerve endings, corpuscles of touch and hair root plexuses
- **Deep**
  - Lamellated corpuscles

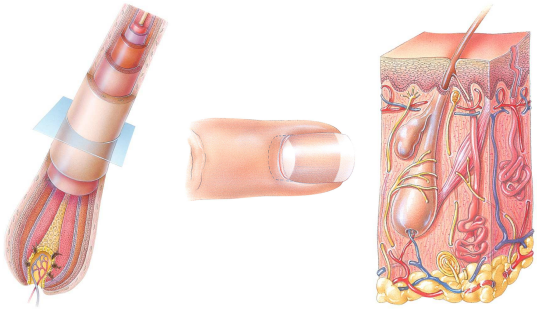
## Sensory Receptors




Location of four principal cell types in epidermis of thick skin



## Accessory Structures of the Skin





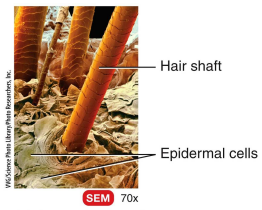
## Hair

- Present on most surfaces except the palms, anterior surfaces of fingers, and the soles of the feet.
- Composed of dead, keratinized epidermal cells.
- Genetics determines thickness and distribution.

## Hair

The parts of a hair include:

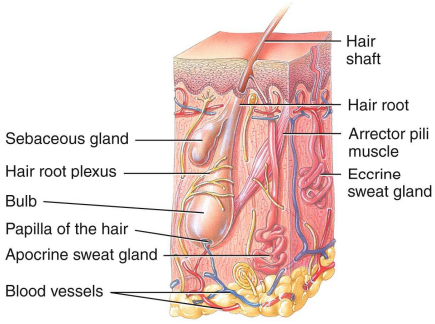
- The shaft (above the skin surface)
- The follicle (below the level of the skin)
- A root that penetrates into
- the dermis includes:
  - An epithelial root sheath
  - A dermal root sheath




(b) Several hair shafts showing the shinglelike cuticle cells



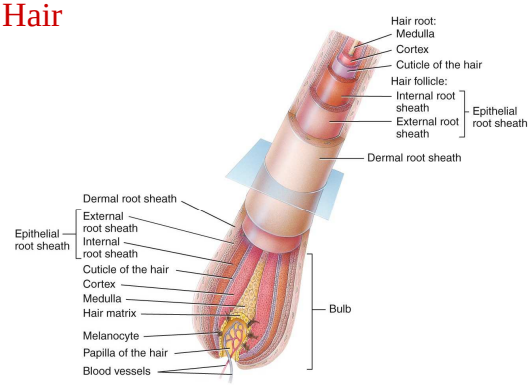
## Hair




(a) Hair and surrounding structures



## Hair




(c) Frontal and transverse sections of hair root

## Skin Glands

The skin contains 4 types of glands.

- **Sebaceous (oil) glands** are connected to hair follicles.
- **Eccrine sweat glands** are the most numerous.
- **Apocrine sweat glands** are located mainly in hairy skin.
- **Ceruminous glands** are modified sweat glands located in the ear canal.

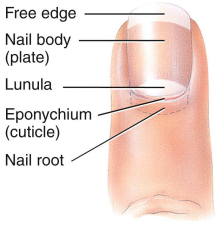


## Nails

Made of keratinized epidermal cells

Nail structures include:

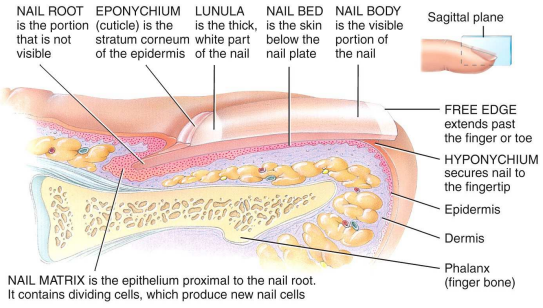
- Free edge
- Transparent nail body (plate) with a whitish lunula at its base
- Nail root embedded in a fold of skin




(a) Dorsal view



## Nails




(b) Sagittal section showing internal detail

# The Integumentary System

## Anatomy Overview:

The Integumentary System

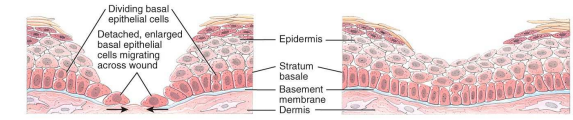
*You must be connected to the Internet and in Slideshow Mode to run this animation.*



# Wound Healing

Two kinds of wound-healing processes can occur, depending on the depth of the injury.

- **Epidermal wound healing** occurs following superficial wounds that affect only the epidermis.



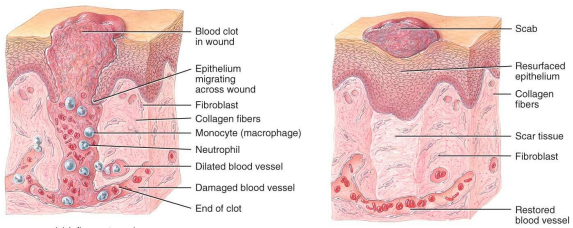

(a) Division of stratum basale cells and migration across wound (b) Thickening of epidermis

Epidermal wound healing



# Wound Healing

- **Deep wound healing** occurs when an injury extends to the dermis and subcutaneous layer.



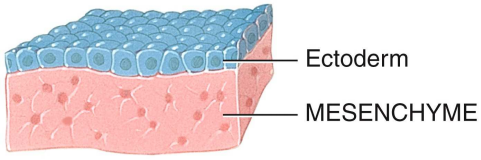

(c) Inflammatory phase (d) Maturation phase

Deep wound healing

## Development of the Integumentary System

The epidermis develops from the ectoderm.

- Nails, hair, and skin glands are epidermal derivatives.

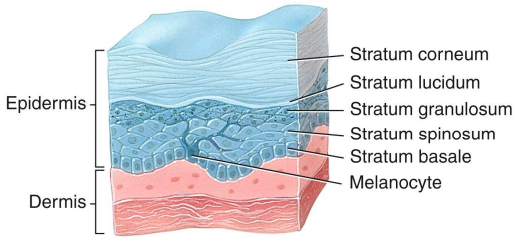



(a) Fourth week



## Development of the Integumentary System

The dermis develops from the mesoderm.




(h) At birth



## Aging

The integumentary system changes with age:

- Wrinkles develop.
- Dehydration and cracking occurs.
- Sweat production decreases.
- A decrease in the numbers of functional melanocytes results in gray hair and atypical skin pigmentation.
- Subcutaneous fat is lost, and there is a general decrease in skin thickness.
- Nails may also become more brittle.

## Aging

With age, there is also an increased susceptibility to pressure ulcers (“bed sores”).

Pressure ulcer on heel



## Skin Cancer

Excessive exposure to ultraviolet light (from the sun or tanning salons) is the most common cause of skin cancer. The three major types are basal cell carcinoma, squamous cell carcinoma and malignant melanoma.

(b) Malignant melanoma



## Burns

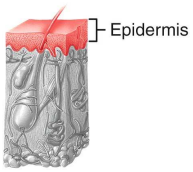
A **burn** is tissue damage caused by excessive heat, electricity, radioactivity, or corrosive chemicals that denature (break down) the proteins in the skin cells.

Burns are graded according to their severity.

## Burns

A **first-degree burn** involves only the epidermis (sunburn).

Sheila Terry/Science Photo Library/ Photo Researchers, Inc.




(a) First-degree burn (sunburn)



## Burns

A **second-degree burn** destroys the epidermis and part of the dermis (blister).

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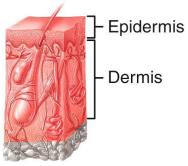


(b) Second-degree burn (note the blisters in the photograph)



## Burns

A **third-degree burn** is a full-thickness burn (destroys the epidermis, dermis, and subcutaneous layer).

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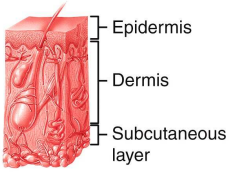
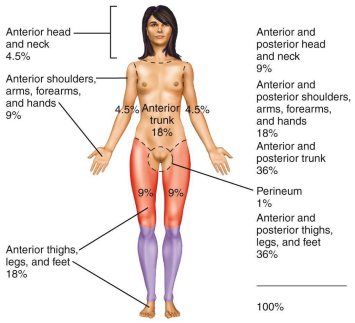



(c) Third-degree burn

## Burns

The rule of nines is used to estimate the surface area of an adult affected by a burn.




Anterior view



## End of Chapter 5