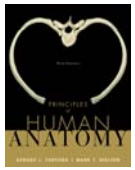
Chapter 5
The Integumentary System



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Introduction

- Tissues are organized to form an organ, and organs are organized to form systems
- 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
- **Dermatology** is the medical specialty for the diagnosis and treatment of disorders of the integumentary system.

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Structure of the Skin

- The skin (**cutaneous membrane)** covers the body and is the largest organ of the body by surface area and weight
- Its area is about 2 square meters (22 square feet) and weighs 4.5-5kg (10-11 lb), about 16% of body weight
- It is 0.5 – 4 mm thick, thinnest on the eyelids, thickest on the heels; the average thickness is 1 – 2 mm

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Structure of the Skin

- It consists of two major layers:
- outer, thinner layer called the **epidermis**, consists of epithelial tissue
- inner, thicker layer called the **dermis**
- Beneath the dermis is **a subcutaneous (subQ) layer** (also called **hypodermis**) which attaches the skin to the underlying tissues and organs. (Fig. 5.1a,b)

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Structure of the Skin

- The **epidermis** has a number of important characteristics:
- the epidermis is composed of keratinized stratified squamous epithelium
- it contains four major types of cells:
- **Keratinocytes** (90% of the cells) produce keratin which is a tough fibrous protein that provides protection

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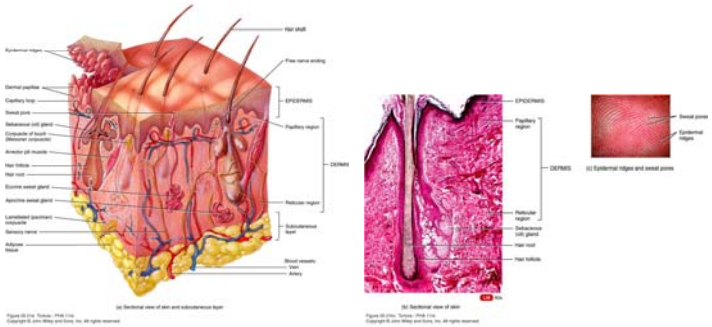
Components of the Integumentary System (Fig. 5.1)



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Structure of the Skin

- **Melanocytes**, which produce the pigment **melanin** that protects against damage by ultraviolet radiation
- **Langerhans cells** (or **intraepidermal macrophage cells**), which are involved in immune responses, arise from red bone marrow
- **Merkel cells** (or **tactile epithelial cells**), which function in the sensation of touch along with the adjacent **tactile** (or **Merkel**) **discs** (Fig. 5.2)

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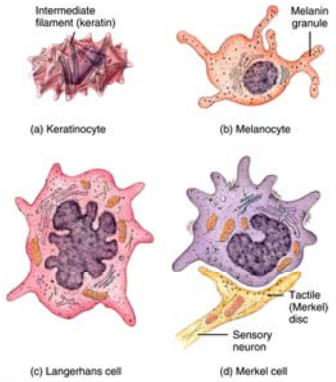
Types of Cells in the Epidermis (Fig. 5.2)



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Epidermis

- The epidermis contains four major layers (**thin skin**) or five major layers (**thick skin**); see Table 5.1:
- **Stratum basale** (deepest layer) or **stratum germinativum**, where continuous cell division occurs which produces all the other layers
- **Stratum spinosum**, 8-10 layers of keratinocytes
- **Stratum granulosum,** which includes **keratohyalin** and **lamellar granules**

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Epidermis

- **Stratum lucidum** is present only in **thick skin** (i.e., the skin of the fingertips, palms, and soles)
- **Stratum corneum** (surface layer), composed of many sublayers of flat, dead keratinocytes called **corneocytes** or **squames** that are continuously shed and replaced by cells from deeper strata; constant friction can stimulate formation of a **callus** (Fig. 5.3)
- **Keratinization**, the accumulation of more and more protective keratin, occurs as cells move from the deepest layer to the surface layer
- **Dandruff** - an excess of keratinized cells shed from the scalp

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Layers of the Epidermis (Fig. 5.3)

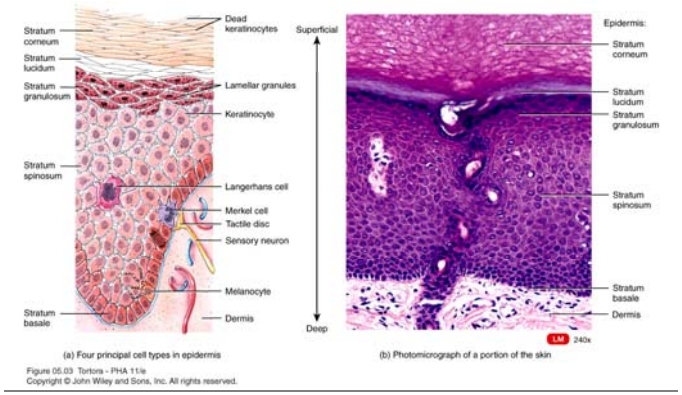

Figure 05.03 Tortora - PHA 11/e
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Dermis

- The **dermis** has several important characteristics:
- is composed of connective tissue containing collagen and elastic fibers
- contains two layers (see Table 5.2)
- the outer **papillary region** consists of areolar connective tissue containing thin collagen and elastic fibers, **dermal papillae** (including **capillary loops**), **corpuscles of touch (Meissner's corpuscles)**, and **free nerve endings**

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Dermis

- the deeper **reticular region** consists of dense irregular connective tissue containing collagen and elastic fibers (which provide strength, extensibility, and elasticity to the skin), adipose cells, hair follicles, nerves, sebaceous (oil) glands, and sudoriferous (sweat) glands
- **striae** or **stretch marks** can appear if the skin is stretched too much

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Dermis

- **Lines of cleavage** - "tension lines" in the skin indicate the predominant direction of underlying collagen fibers (Fig. 5.4)
- **Epidermal ridges** reflect contours of the underlying dermal papillae and form the basis for **fingerprints** (and footprints); their function is to increase firmness of grip by increasing friction.
- **Dermatoglyphics** - the study of the pattern of epidermal ridges

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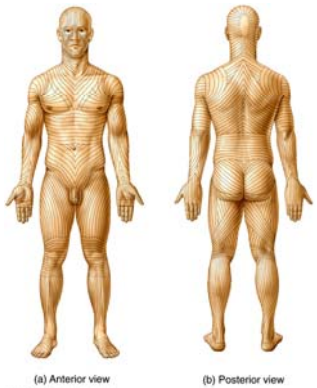
Lines of Cleavage (Fig. 5.4)



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Structural Basis of Skin Color

- Variations in skin color arise from variations in the amounts of three pigments: melanin, carotene, and hemoglobin
- **Melanin** - a yellow-red or brown-black pigment produced by melanocytes (located mostly in the epidermis, where it absorbs UV radiation)
- The amount of melanin causes the skin's color to vary from pale yellow to red to tan to black
- The number of melanocytes are about the same in all people; differences in skin color is due to the amount of pigment produced
- Freckles are accumulation of patches of melanin

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Structural Basis of Skin Color

- A benign localized overgrowth of melanocytes is a **nevus** or mole
- **Albinism** is an inherited inability to produce melanin - **vitiligo** is a condition in which there is a partial or complete loss of melanocytes from patches of skin
- **Carotene** - yellow-orange pigment (found in the stratum corneum, dermis, and subcutaneous layer)
- **Hemoglobin** - red color (located in erythrocytes flowing through dermal capillaries)

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Subcutaneous Layer

- **Subcutaneous (subQ) layer** (also called **hypodermis**) is not part of the skin but, among its functions, it attaches the skin to the underlying tissues and organs; this layer (and sometimes the dermis) contains **lamellated (pacinian) corpuscles** which detect external pressure applied to the skin.

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Skin Color as Diagnostic Tool

- **Cyanotic** - bluish color of mucous membranes, nail beds, and skin due to inadequate supply of oxygen
- **Jaundice** - yellow pigment due to buildup of bilirubin in the blood, skin and whites of eyes
- **Erythema** - redness of the skin, engorgement of capillaries with blood

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Accessory Structures of the Skin

- Organs that develop from the embryonic epidermis
- These organs include hair, skin glands, and nails
- **Hairs (pili)** have a number of important characteristics:
- the primary functions of hair are protection, reduction of heat loss, and sensing light touch

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Accessory Structures of the Skin - Hair

- Hair is composed of dead, keratinized epidermal cells
- each hair consists of:
- **shaft** which mostly projects above the surface of the skin
- **root** which penetrates into the dermis
- **hair follicle** which surrounds the root; it consists of an **epithelial root sheath** which in turn is surrounded by a **dermal root sheath** (Fig. 5.5)

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Accessory Structures of the Skin-Hair

- located at the base of a hair follicle is the **bulb**; it has an indentation called the **papilla of the hair** where blood vessels provide nourishment to the growing hair
- hair grows due to cell division occurring in the **hair matrix** of the bulb; there is a growth cycle that includes **growth, regression** and **resting stages**
- associated with hairs are sebaceous (oil) glands, **arrector pili** muscles, and **hair root plexuses**

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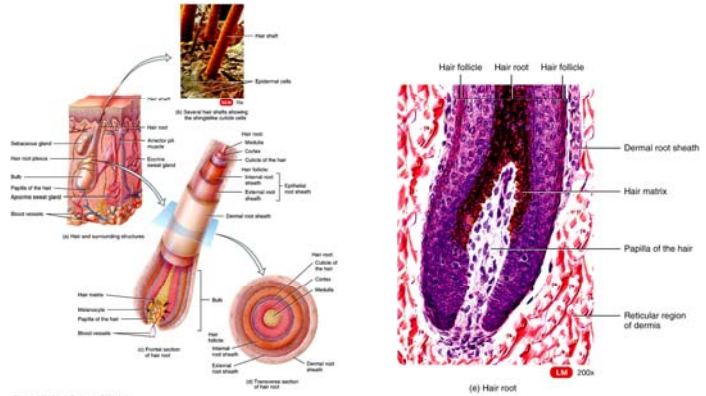
Hair (Fig. 5.5)



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Accessory Structures of the Skin

- there are different types of hairs including **lanugo**, **vellus hairs** and **terminal hairs**
- the color of hair is determined primarily by the amount and type of melanin
- **Sebaceous (oil) glands** have several important characteristics:
- they are typically connected to hair follicles

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Skin Glands

- Sebaceous glands secrete an oily substance called **sebum** which prevents dehydration of hair and skin, and inhibits growth of certain bacteria
- **Sudoriferous (sweat) glands** produce sweat (perspiration); there are two types of sweat glands (see Table 5.3):
- **Eccrine** and **apocrine** sweat glands (Fig. 5.6)

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Sudoriferous (Sweat) Glands

- numerous **eccrine** (or **merocrine**) **sweat glands** which have an excretory duct that opens at a pore at the surface of the epidermis; the sweat secreted by these glands helps to cool the body by evaporating, and also eliminates small amounts of wastes - this sweat may be lost as **insensible perspiration** or **sensible perspiration**
- **apocrine sweat glands** which are located mainly in the skin of the axilla, groin, areolae, and bearded facial regions of adult males; their excretory ducts open into hair follicles- this sweat is secreted during emotional stress and sexual excitement; it is commonly called “cold sweat”

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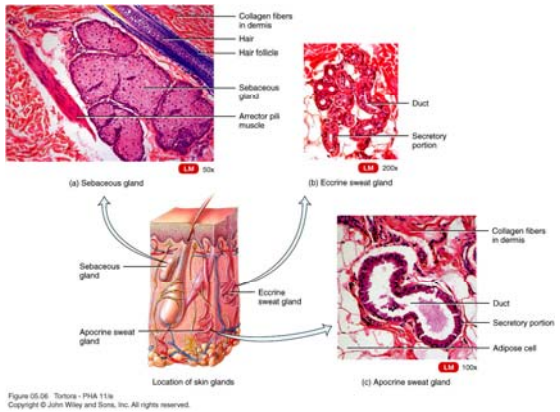
Histology of Skin Glands (Fig. 5.6)



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Ceruminous Glands

- **Ceruminous glands** are modified sweat glands located in the ear canal; along with nearby sebaceous glands, they are involved in producing a waxy secretion called **cerumen** (earwax) which provides a sticky barrier that prevents entry of foreign bodies into the ear canal**.**

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Accessory Structures of the Skin-Nails

- Nails are composed of hard, keratinized epidermal cells located over the dorsal surfaces of the ends of fingers and toes
- Each nail consists of a:
- **free edge**
- transparent **nail body (plate)** with a whitish **lunula** at its base
- **nail root** embedded in a fold of skin

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The Nail

- Associated with a nail are:
- **hyponychium** or **nail bed** (located under the free edge) attaches the nail to the fingertip
- **eponychium (cuticle)** attaches the margin of nail wall to neighboring epidermis
- **nail matrix** in which cell division occurs resulting in growth of the nail (Fig. 5.7)

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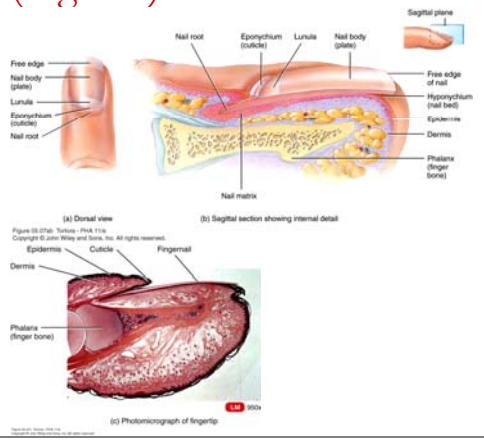
Nails (Fig. 5.7)



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The Nail

- The **functions** of nails include helping to grasp and manipulate objects, providing protection against trauma to the ends of the digits, scratching various body parts, and providing support and counterpressure to the palmar surface of the finger to enhance touch perception and manipulation.

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Types of Skin

- There are two major types of skin (see Table 5.4):
- **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

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Functions of the Skin

- regulation of body temperature
- blood reservoir
- protection
- cutaneous sensations
- excretion and absorption
- synthesis of vitamin D

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Blood Supply of the Integumentary System

- The epidermis is avascular
- The dermis receives blood from:
- branches of arteries supplying skeletal muscles and:
- arteries that supply the skin directly, including: **cutaneous plexus** and **papillary plexus**
- Venous plexuses drain blood from the dermis into larger subcutaneous veins.

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Aging and the Integumentary System

Effects:

- wrinkling
- decrease of skin's immune responsiveness
- dehydration and cracking of the skin
- decreased sweat production
- decreased numbers of functional melanocytes resulting in gray hair and atypical skin pigmentation
- loss of subcutaneous fat
- a general decrease in skin thickness
- an increased susceptibility to pathological conditions

- Growth of hair and nails decreases; nails may also become more brittle with age.

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End of Chapter 5

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