

The Integumentary System

Outline

- 5.1 The skin consists of two layers: the epidermis and dermis (pp. 150–151; Fig. 5.1)
 - A. The skin consists of two regions: the outermost epidermis, an epithelial tissue; and the inner dermis, a connective tissue. (p. 151; Fig. 5.1)
 - B. The hypodermis, also called the superficial fascia, is subcutaneous tissue beneath the skin consisting mostly of adipose tissue that anchors the skin to underlying muscle, allows skin to slide over muscle, and acts as a shock absorber and insulator. (p. 151; Fig. 5.1)
- 5.2 The epidermis is a keratinized stratified squamous epithelium (pp. 152–154; Fig. 5.2)
 - A. Cells of the Epidermis (pp. 152–153; Fig. 5.2)
 - 1. The majority of epidermal cells are keratinocytes that produce a fibrous protective protein called keratin.
 - 2. Melanocytes are epithelial cells that synthesize the pigment melanin.
 - 3. Dendritic cells are macrophages that help activate the immune system.
 - 4. Tactile, or Merkel, cells are associated with sensory nerve endings.
 - B. Layers of the Epidermis
 - 1. The stratum basale (basal layer) is the deepest epidermal layer and is the site of mitosis.
 - 2. The stratum spinosum (prickly layer) is several cell layers thick and contains keratinocytes, melanin granules, and the highest concentration of dendritic cells.
 - 3. The stratum granulosum (granular layer) contains keratinocytes that are undergoing a great deal of physical changes, turning them into the tough outer cells of the epidermis.
 - 4. The stratum lucidum (clear layer) is found only in thick skin and is composed of dead keratinocytes.
 - 5. The stratum corneum (horny layer) is the outermost protective layer of the epidermis composed of a thick layer of dead keratinocytes.
- 5.3 The dermis consists of papillary and reticular layers (pp. 154–156; Figs. 5.3–5.5)
 - A. The dermis is composed of strong, flexible connective tissue and is well supplied with blood vessels, nerves, and lymphatic vessels.
 - B. The dermis is made up of two layers: the thin, superficial papillary layer that forms dermal papillae that give rise to fingerprints; and the reticular layer, accounting for 80% of the thickness of the dermis, which forms cleavage and flexure lines.
- 5.4 Melanin, carotene, and hemoglobin determine skin color (pp. 156–157)
 - A. Melanin comes in two forms that range in color from reddish yellow to brownish black: Sunlight causes keratinocytes to secrete a signal that stimulates production of melanin, which protects DNA from damaging UV rays. (p. 156)
 - B. Carotene is a yellow-orange pigment found in certain foods. It tends to accumulate in the stratum corneum and hypodermis, and intensifies as more carotene-containing foods are eaten. (p. 156)

- C. The pinkish hue seen in fair skin is due to hemoglobin in the blood, seen through the transparency of the skin. (p. 157)
- 5.5 Hair consists of dead, keratinized cells (pp. 157–160; Fig. 5.6)
- A. Structure of a Hair (pp. 158–160; Fig. 5.6)
 - 1. Hairs, or pili, are flexible strands produced by hair follicles that consist of dead, keratinized cells.
 - a. The main regions of a hair are the shaft, which projects from the skin, and the root, which embeds in the skin.
 - b. A hair has three layers of keratinized cells: the inner core is the medulla, the middle layer is the cortex, and the outer layer is the cuticle.
 - c. Hair pigments (melanins of different colors) are made by melanocytes at the base of the hair follicle and transferred to the cortical cells.
 - B. Structure of a Hair Follicle (p. 159; Fig. 5.6)
 - 1. Hair follicles fold down from the epidermis into the dermis and occasionally into the hypodermis.
 - 2. The deep end of a hair follicle is expanded, forming a hair bulb, which is surrounded by sensory nerve endings called a hair follicle receptor, or root hair plexus.
 - 3. The wall of a hair follicle is composed of a peripheral connective tissue sheath, a thickened basement membrane, and an inner epithelial root sheath.
 - 4. The hair matrix within the hair bulb is a group of actively dividing cells that produce the hair.
 - 5. Associated with each hair follicle is a bundle of smooth muscle cells called an arrector pili muscle, which, when contraction occurs, causes the hair to stand upright.
 - C. Types and Growth of Hair (pp. 159–160)
 - 1. Hairs can be classified as pale, fine vellus hairs, or longer, coarser terminal hairs.
 - 2. The rate of hair growth varies from one body region to another and with sex and age.
 - 3. Hair growth and density are influenced by many factors, such as nutrition and hormones.
 - D. Hair Thinning and Baldness (p. 160)
 - 1. Follicles have a limited number of cycles, and after age 40, hair is not replaced as quickly as it is lost, which leads to hair thinning and some degree of balding, or alopecia, in both sexes.
 - 2. True baldness, such as male pattern baldness, is a genetically determined, sex-influenced condition caused by a gene that changes the hair follicle response to DHT.
- 5.6 Nails are scale-like modifications of the epidermis (pp. 160–161; Fig. 5.7)
- A. A nail is a scale-like modification of the epidermis that forms a protective covering on the dorsal side of the distal finger or toe. (p. 160; Fig. 5.7)
 - B. Nails are made up of hard keratin and have a free edge, a nail plate attached to the skin, and a root embedded in the skin. (p. 160; Fig. 5.7)
 - C. The nail matrix, located within the proximal part of the nail bed, is responsible for nail growth. (p. 160; Fig. 5.7)

- 5.7 Sweat glands help control body temperature, and sebaceous glands secrete sebum (pp. 161–162; Figs. 5.8–5.9)
- A. Sweat (Sudoriferous) Glands (pp. 161–162; Fig. 5.8)
1. Eccrine, or merocrine, sweat glands produce true sweat and are abundant on the palms of the hands, soles of the feet, and forehead.
 - a. Secretion of eccrine glands is regulated by the sympathetic nervous system and is used to prevent the body from overheating.
 2. Apocrine sweat glands are confined to the axillary and anogenital areas, and produce a fat- and protein-rich true sweat.
 3. Ceruminous glands are modified apocrine glands found lining the ear canal that secrete earwax, or cerumen.
 4. Mammary glands are modified sweat glands that secrete milk.
- B. Sebaceous (Oil) Glands (p. 162; Fig. 5.9)
1. Sebaceous glands secrete sebum, an oily secretion, and are found all over the body, except the palms of the hands and soles of the feet.
 2. The sebaceous glands function as holocrine glands, secreting their product into a hair follicle or to a pore on the surface of the skin.
 3. Most sebaceous glands secrete sebum from the base of hair follicles, or to a pore in the skin: Sebum functions to soften and lubricate the hair and skin, slow water loss, and is bactericidal.
- 5.8 First and foremost, the skin is a barrier (pp. 162–164)
- A. Protection (p. 163)
1. Chemical barriers include skin secretions that are low in pH, or inhibit bacterial growth, and melanin that protects skin from UV damage.
 2. Physical or mechanical barriers are provided by the continuity of the skin and the hardness of the keratinized cells.
 3. Biological barriers include the dendritic cells and the macrophages of the dermis, and DNA, which helps convert UV radiation to dissipated heat.
- B. The skin plays an important role in body temperature regulation by manufacturing sweat to cool the body, and causing constriction of dermal capillaries to prevent heat loss. (pp. 163–164)
- C. Cutaneous sensation is made possible by cutaneous sensory receptors, which are part of the nervous system, in the layers of the skin. (p. 164)
- D. The skin provides the metabolic function of making vitamin D, which is important for calcium absorption, when it is exposed to sunlight. (p. 164)
- E. The skin may act as a blood reservoir by holding up to 5% of the body's blood supply, which may be diverted to other areas of the body should the need arise. (p. 164)
- F. Limited amounts of nitrogenous wastes are excreted through the skin. (pp. 164)
- 5.9 Skin cancer and burns are major challenges to the body (pp. 164–167; Figs. 5.10–5.12)
- A. Skin Cancer (pp. 164–165; Fig. 5.10)
1. Basal cell carcinoma results from invasive proliferation of cells of the stratum basale and is the least malignant and the most common skin cancer.
 2. Squamous cell carcinoma derives from the keratinocytes of the stratum spinosum and tends to grow rapidly and metastasize if not removed.

3. Melanoma is a cancer of the melanocytes and is the most dangerous of the skin cancers because it is highly metastatic and resistant to chemotherapy.
 4. The ABCD rule is used to evaluate moles or pigmented spots for cancer and corresponds to Asymmetry, Border irregularity, Color, and Diameter.
- B. Burns (pp. 165–167; Figs. 5.11–5.12)
1. A burn is tissue damage resulting from intense heat, electricity, radiation, or certain chemicals, all of which denature cell proteins and cause cell death to affected areas.
 2. Risks to a burn patient include dehydration and electrolyte imbalance due to fluid loss, as well as infection of burned areas.
 3. The rule of nines divides the body surface into 11 areas of 9% each, plus 1% for genitalia, and is used to evaluate fluid loss through burns.
 4. Burns are classified according to their severity.
 - a. First-degree burns involve damage only to the epidermis.
 - b. Second-degree burns injure the epidermis and the upper region of the dermis.
 - c. Third-degree burns involve the entire thickness of the skin.

Developmental Aspects of the Integumentary System (pp. 167, 169)

- A. The epidermis develops from the embryonic ectoderm, and the dermis and the hypodermis develop from the mesoderm. (p. 167)
- B. By the end of the fourth month of development, the skin is fairly well formed. (p. 167)
- C. During infancy and childhood, the skin thickens and more subcutaneous fat is deposited. (p. 167)
- D. During adolescence, the skin and hair become oilier as sebaceous glands are activated. (p. 167)
- E. The skin reaches its optimal appearance when we reach our 20s and 30s; after that time, the skin starts to show the effects of cumulative environmental exposure. (p. 167)
- F. As we age, the rate of epidermal cell replacement slows and the skin thins, becoming more prone to bruising and other types of injuries. (p. 167)