Skin (Integument)

- Consists of three major regions
  - Epidermis – outermost superficial region
  - Dermis – middle region
  - Hypodermis – deepest region

Skin (Integument)

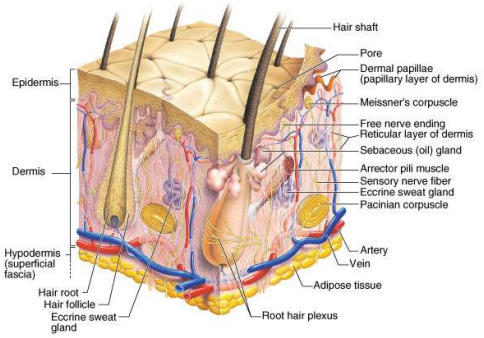


Figure 5.3

Epidermis

- Composed of keratinized stratified squamous epithelium, consisting of four distinct cell types and four or five layers
- Cell types include keratinocytes, melanocytes, Merkel cells, and Langerhans' cells
- Outer portion of the skin is exposed to the external environment and functions in protection

Cells of the Epidermis

- Keratinocytes – produce the fibrous protein *keratin*
- Melanocytes – produce the brown pigment *melanin*
- Langerhans' cells – epidermal macrophages that help activate the immune system
- Merkel cells – function as touch receptors in association with sensory nerve endings

Layers of the Epidermis: Stratum Basale (Basal Layer)

- Deepest epidermal layer firmly attached to the dermis
- Consists of a single row of the youngest keratinocytes
- Cells undergo rapid division, hence its alternate name, *stratum germinativum*

Layers of the Epidermis: Stratum Basale (Basal Layer)

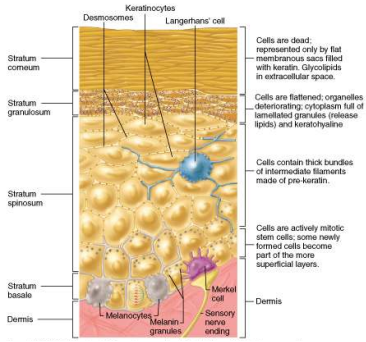


Figure 5.2

Layers of the Epidermis: Stratum Spinosum (Prickly Layer)

- Cells contain a weblike system of intermediate filaments attached to desmosomes
- Melanin granules and Langerhans' cells are abundant in this layer

Layers of the Epidermis: Stratum Granulosum (Granular Layer)

- Thin; three to five cell layers in which drastic changes in keratinocyte appearance occurs
- Keratohyaline and lamellated granules accumulate in the cells of this layer

Layers of the Epidermis: Stratum Lucidium (Clear Layer)

- Thin, transparent band superficial to the stratum granulosum
- Consists of a few rows of flat, dead keratinocytes
- Present only in thick skin

Layers of the Epidermis: Stratum Corneum (Horny Layer)

- Outermost layer of keratinized cells
- Accounts for three quarters of the epidermal thickness
- Functions
  - Waterproofing
  - Protection from abrasion and penetration
  - Renders the body relatively insensitive to biological, chemical, and physical assaults

Dermis

- Second major skin region containing strong, flexible connective tissue
- Cell types include fibroblasts, macrophages, and occasionally mast cells and white blood cells
- Composed of two layers – papillary and reticular

Layers of the Dermis: Papillary Layer

- Papillary layer
  - Areolar connective tissue with collagen and elastic fibers
  - Its superior surface contains peglike projections called *dermal papillae*
  - Dermal papillae contain capillary loops, Meissner's corpuscles, and free nerve endings

Layers of the Dermis: Reticular Layer

- Reticular layer
  - Accounts for approximately 80% of the thickness of the skin
  - Collagen fibers in this layer add strength and resiliency to the skin
  - Elastin fibers provide stretch-recoil properties

Hypodermis

- Subcutaneous layer deep to the skin
- Composed of adipose and areolar connective tissue

Skin Structure

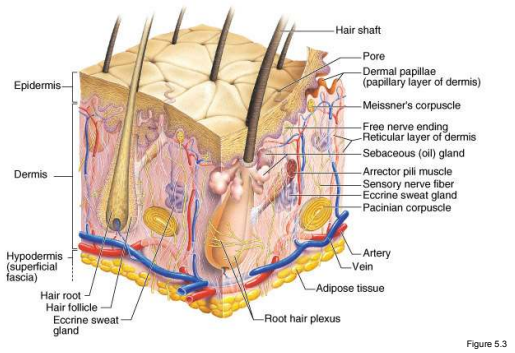


Figure 5.3

Skin Color

- Three pigments contribute to skin color
  - Melanin – yellow to reddish-brown to black pigment, responsible for dark skin colors
    - Freckles and pigmented moles – result from local accumulations of melanin
  - Carotene – yellow to orange pigment, most obvious in the palms and soles of the feet
  - Hemoglobin – reddish pigment responsible for the pinkish hue of the skin

Sweat Glands

- Different types prevent overheating of the body; secret cerumen and milk
  - Eccrine sweat glands – found in palms, soles of the feet, and forehead
  - Apocrine sweat glands – found in axillary and anogenital areas
  - Ceruminous glands – modified apocrine glands in external ear canal and secrete cerumen
  - Mammary glands – specialized sweat glands that secret milk

Sebaceous Glands

- Soften skin when stimulated by hormones
- Simple alveolar glands found all over the body
- Secrete an oily secretion called sebum

Hair

- Helps maintain warmth, alerts the body to presence of insects on the skin, and guards the scalp against physical trauma, heat loss, and sunlight
- Filamentous strands of dead keratinized cells produced by hair follicles
- Contains hard keratin, which is tougher and more durable than the soft keratin of the skin
- Made up of the shaft projecting from the skin and the root embedded in the skin
- Consists of a core called the medulla, a cortex, and an outermost cuticle

Hair

- Pigmented by melanocytes at the base of the hair

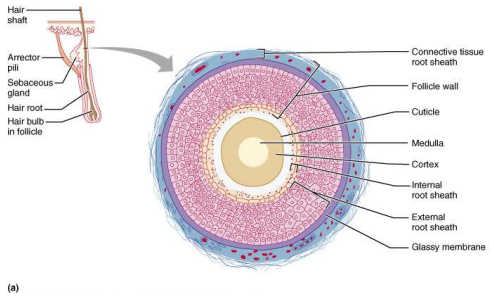


Figure 5.6a

Hair Follicle

- Root sheath extending from the epidermal surface into the dermis
- Deep end is expanded forming a hair bulb
- A knot of sensory nerve endings (a root hair plexus) wraps around each hair bulb
- Bending a hair stimulates these endings, hence our hairs act as sensitive touch receptors

Hair Follicle

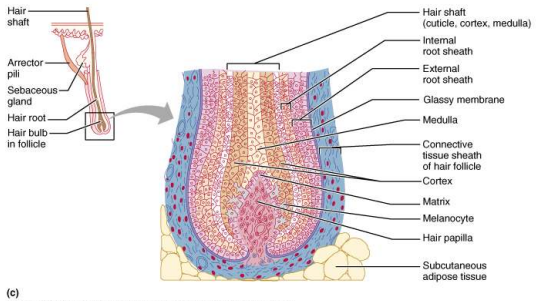


Figure 5.6c

Types of Hair

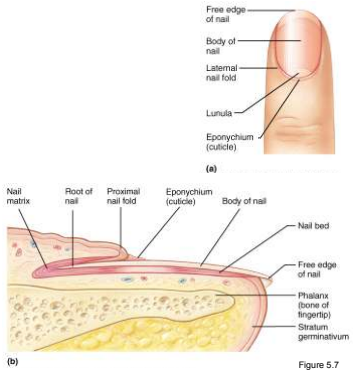
- Vellus – pale, fine body hair found in children and the adult female
- Terminal – coarse, long hair of eyebrows, scalp, axillary, and pubic regions

Hair Thinning and Baldness

- Alopecia – hair thinning in both sexes
- True, or frank, baldness – genetically determined and sex influenced condition (i.e., male pattern baldness)

Structure of a Nail

- Scalelike modification of the epidermis on the distal, dorsal surface of fingers and toes



Functions of the Integumentary System

- Protection – chemical, physical, and mechanical barrier
- Body temperature
  - Regulated by dilation (cooling) and constriction (warming) of dermal vessels
  - Sweat glands increase secretions to cool the body
- Cutaneous sensation – exoreceptors sense touch and pain

Functions of the Integumentary System

- Metabolic functions – synthesis of vitamin D in dermal blood vessels
- Blood reservoir – skin blood vessels store up to 5% of the body's blood volume
- Excretion – limited amounts of nitrogenous wastes are eliminated from the body in sweat

Skin Cancer

- Basal cell carcinoma
- Squamous cell carcinoma
- Melanoma

Basal Cell Carcinoma

- Least malignant and most common skin cancer
- Stratum basale cells proliferate and invade the dermis and hypodermis
- Slow growing and do not often metastasize
- Can be cured by surgical excision in 99% of the cases

Squamous Cell Carcinoma

- Arises from keratinocytes of stratum spinosum
- Arise most often on scalp, ears, and lower lip
- Grows rapidly and metastasizes if not removed
- Prognosis is good if treated by radiation therapy or removed surgically

Melanoma

- Cancer of melanocytes is the most dangerous type of skin cancer
- Melanomas have the following characteristics (ABCD rule):
  - A: Asymmetry; the two sides of the pigmented area do not match
  - B: Border is irregular and exhibits indentations
  - C: Color (pigmented area) is black, brown, tan, and sometimes red or blue
  - D: Diameter is larger than 6 mm (size of a pencil eraser)

Melanoma

- Treated by wide surgical excision accompanied by immunotherapy
- Survival is poor if the lesion is over 4 mm thick

Burns

- First-degree – only the epidermis is damaged
  - Symptoms include localized redness, swelling, and pain
- Second-degree – the epidermis and upper regions of dermis damaged
  - Symptoms mimic first degree burns, but blisters also appear
- Third-degree – involve entire thickness of the skin
  - Burned area appears gray-white, cherry red, or black, and there is no initial edema nor pain (since nerve endings are destroyed)

Rule of Nines

- Estimates the severity of burns
- Burns considered critical if:
  - Over 25% of the body has second-degree burns
  - Over 10% of the body has third-degree burns
  - There are third-degree burns on face, hands, or feet

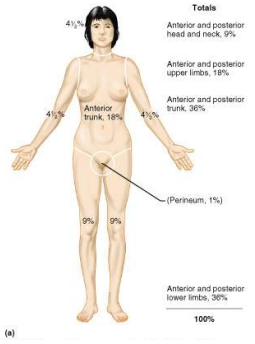


Figure 5.9a