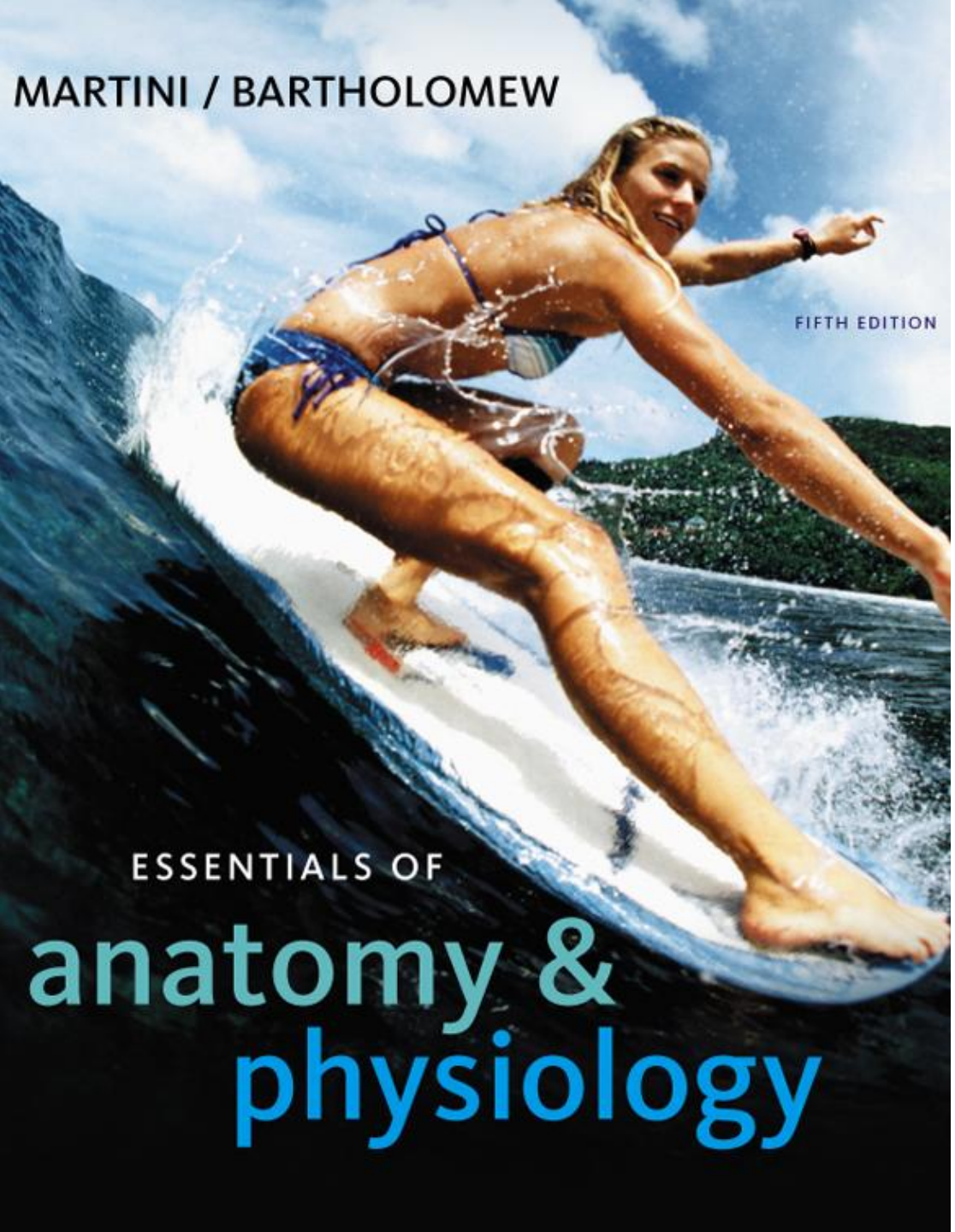


Chapter

5

The Integumentary System

PowerPoint® Lecture Slides
prepared by Jason LaPres
Lone Star College - North Harris

Introduction to the Integumentary System

- The **integument** is the largest system of the body
  - 16% of body weight
  - 1.5 to 2 m^2 in area
  - The integument is made up of two parts:
    - **Cutaneous membrane** (skin)
    - **Accessory structures**

Introduction to the Integumentary System

- The cutaneous membrane has two components
  - Outer **epidermis:**
    - Superficial epithelium (epithelial tissues)
  - Inner **dermis:**
    - Connective tissues

Introduction to the Integumentary System

- Accessory Structures
  - Originate in the dermis
  - Extend through the epidermis to the skin surface:
    - Hair
    - Nails
    - Multicellular exocrine glands

Introduction to the Integumentary System

- **Subcutaneous Layer** (Superficial Fascia or **Hypodermis**)
  - Loose connective tissue
  - Below the dermis
  - Location of hypodermic injections

General Structure of the Integumentary System

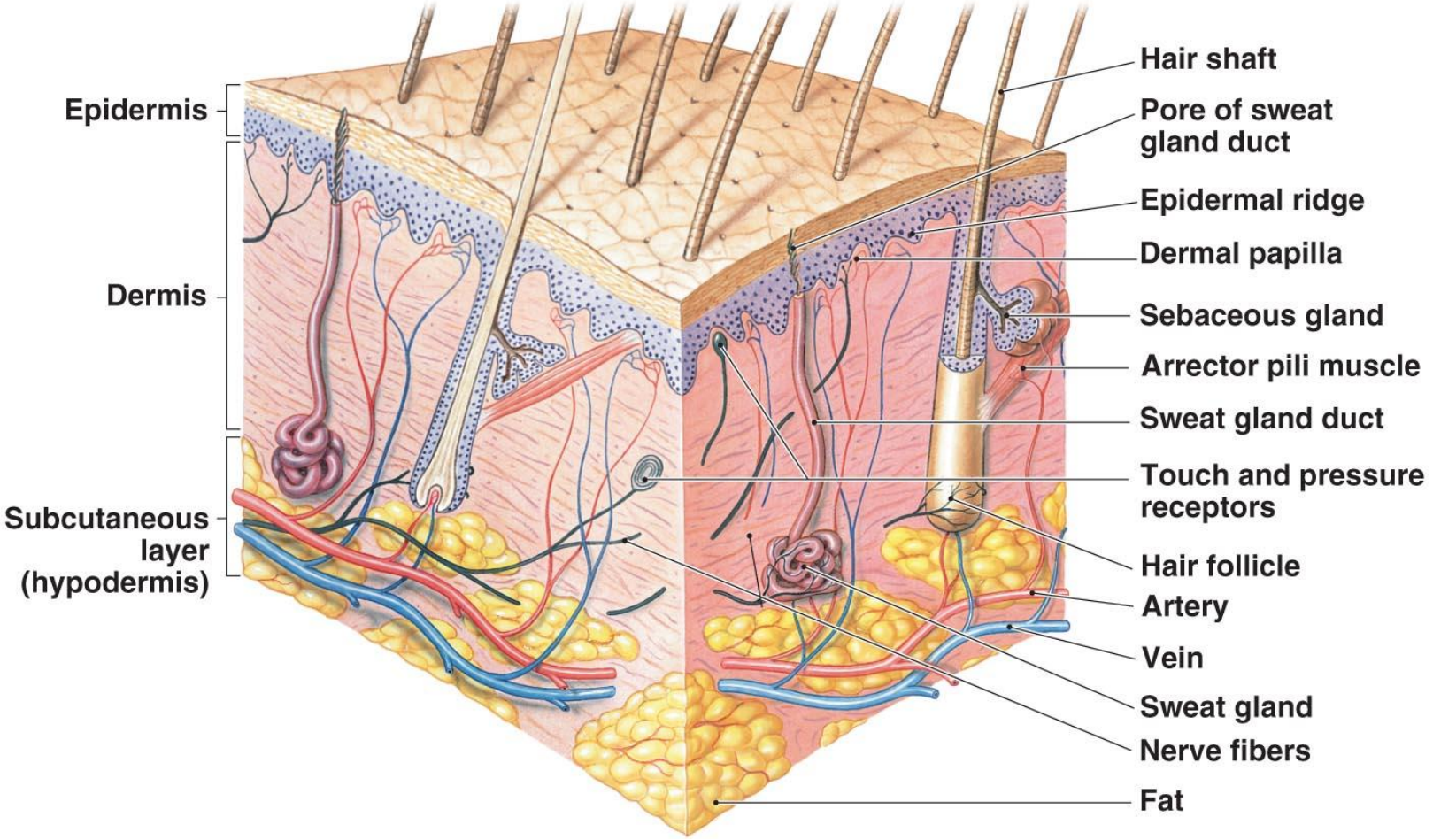


Figure 5-1

Introduction to the Integumentary System

- Functions of Skin
  - ***Protects*** underlying tissues and organs
  - ***Maintains*** body temperature (insulation and evaporation)
  - ***Synthesizes*** vitamin D_3
  - ***Stores*** lipids
  - ***Detects*** touch, pressure, pain, and temperature
  - ***Excretes*** salts, water, and organic wastes (glands)

5-1 The epidermis is composed of strata (layers) with various functions

Epidermis

- Epidermis is
  - Avascular stratified squamous epithelium:
    - Nutrients and oxygen diffuse from capillaries in the dermis

Epidermis

- **Thin Skin**
  - Covers most of the body
  - Has four layers of keratinocytes
- **Thick Skin**
  - Covers the palms of the hands and soles of the feet
  - Has five layers of keratinocytes

Structure of the Epidermis

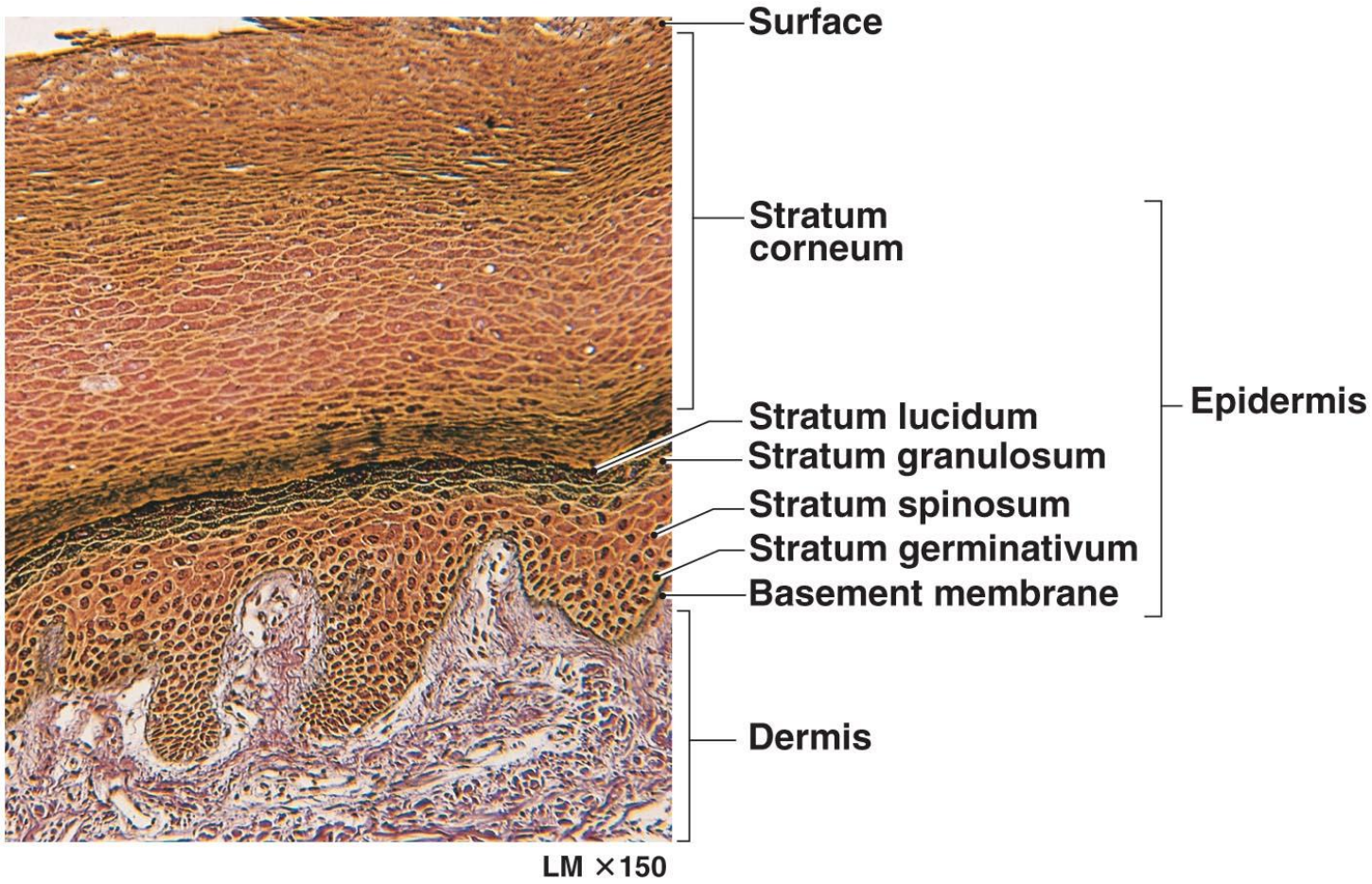


Figure 5-2

Epidermis

- Structures of the Epidermis
  - The five **strata** of keratinocytes in thick skin
  - From basal lamina to free surface:
    - **Stratum germinativum**
    - **Stratum spinosum**
    - **Stratum granulosum**
    - **Stratum lucidum**
    - **Stratum corneum**

Stratum Germinativum

- The “germinative layer”
  - Has many germinative (stem) cells or **basal cells**
  - Is attached to basal lamina by hemidesmosomes
  - Forms a strong bond between epidermis and dermis
  - Forms **epidermal ridges** (e.g., fingerprints)
  - **Dermal papillae** (tiny mounds):
    - Increase the area of basal lamina
    - Strengthen attachment between epidermis and dermis

Intermediate Strata

- **Stratum Spinosum**
  - The “spiny layer”:
    - Produced by division of stratum germinativum
    - Eight to ten layers of keratinocytes bound by desmosomes
    - Cells shrink until cytoskeletons stick out (spiny)

Intermediate Strata

- **Stratum Granulosum**
  - The “grainy layer”
  - Stops dividing, starts producing
- **Stratum Lucidum**
  - The “clear layer”:
    - Found only in thick skin
    - Covers stratum granulosum

Stratum Corneum

- The “Horn Layer”
  - Exposed surface of skin
  - 15 to 30 layers of keratinized cells
  - Water resistant
  - Shed and replaced every 2 weeks

Epidermis

- **Keratinization**
  - The formation of a layer of dead, protective cells filled with keratin
  - Occurs on all exposed skin surfaces except eyes
  - Skin life cycle
  - It takes 2 to 4 weeks for a cell to move from **stratum germinativum** to **stratum corneum**

5-2 Factors influencing skin color are epidermal pigmentation and dermal circulation

The Role of Pigmentation

- Two pigments
  - **Carotene:**
    - Orange-yellow pigment
    - Found in orange vegetables
    - Accumulates in epidermal cells and fatty tissues of the dermis
    - Can be converted to vitamin A
  - **Melanin:**
    - Yellow-brown or black pigment
    - Produced by **melanocytes** in stratum germinativum
    - Stored in transport vesicles (**melanosomes**)
    - Transferred to keratinocytes
- Blood circulation (red blood cells)

Melanocytes

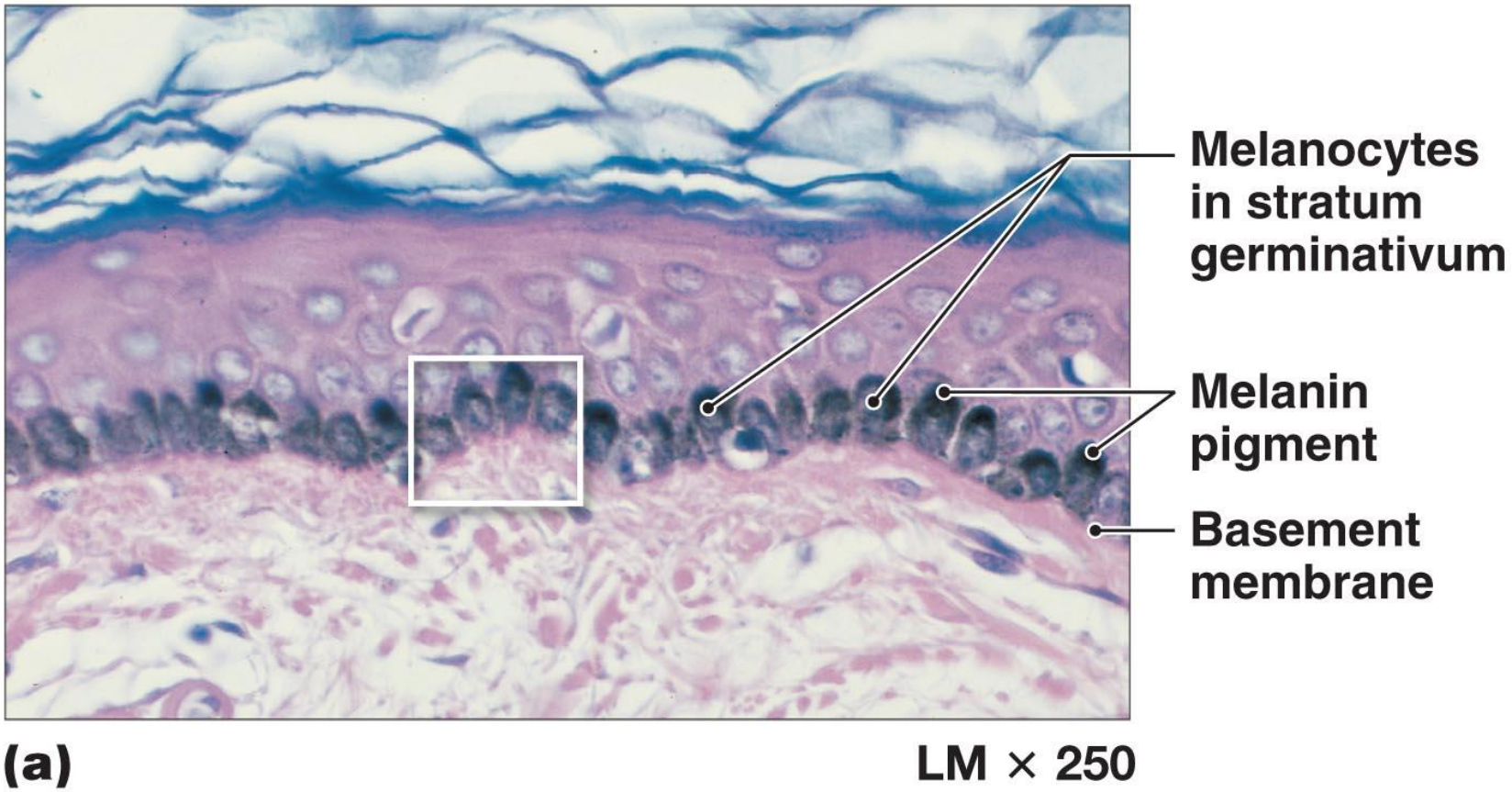


Figure 5-3

Melanocytes

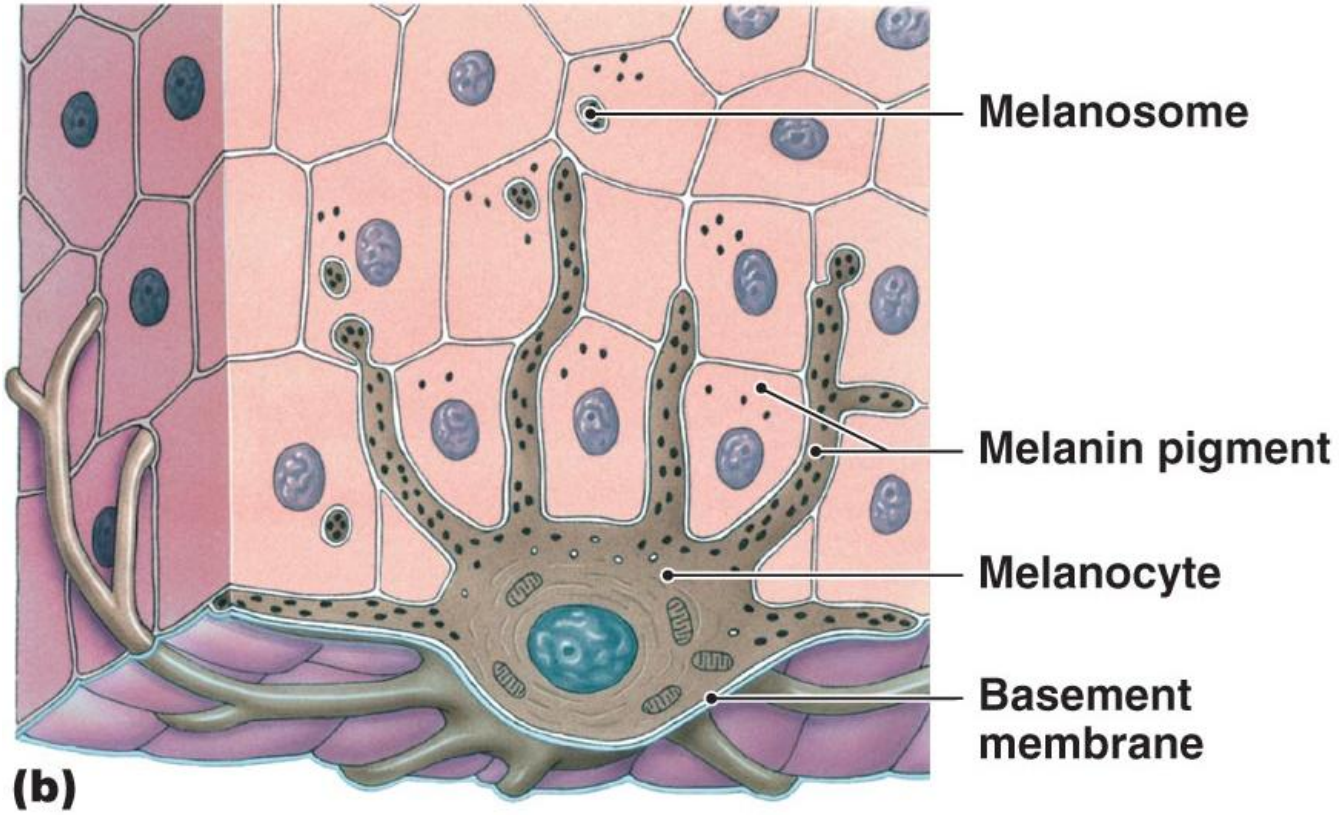


Figure 5-3

Skin Color

- Function of Melanocytes
  - Melanin protects skin from sun damage
  - **Ultraviolet (UV) radiation**
    - Causes DNA mutations and burns that lead to cancer and wrinkles
  - Skin color depends on melanin production, not on the number of melanocytes

Skin Color

- Capillaries and Skin Color
  - Oxygenated red blood contributes to skin color:
    - Blood vessels dilate from heat, skin reddens
    - Blood flow decreases, skin pales
  - **Cyanosis:**
    - Bluish skin tint
    - Caused by severe reduction in blood flow or oxygenation

5-3 Sunlight has detrimental and beneficial effects on the skin

The Epidermis and Vitamin D_3

- Vitamin D_3
  - Epidermal cells produce **cholecalciferol (vitamin D_3):**
    - In the presence of UV radiation
  - Liver and kidneys convert vitamin D_3 into **calcitriol:**
    - To aid absorption of calcium and phosphorus
  - Insufficient vitamin D_3:
    - Can cause *rickets*

Types of Skin Cancer

(a) Basal cell carcinoma

(b) Melanoma

Figure 5-4

5-4 The dermis is the tissue layer that supports the epidermis

The Dermis

- The **Dermis**
  - Is located between epidermis and subcutaneous layer
  - Anchors epidermal accessory structures (hair follicles, sweat glands):
  - Has two components
    - Outer **papillary layer**
    - Deep **reticular layer**

The Dermis

- **The Papillary Layer**
  - Consists of areolar tissue
  - Contains smaller capillaries, lymphatics, and sensory neurons
  - Has dermal papillae projecting between epidermal ridges
- **The Reticular Layer**
  - Consists of dense irregular connective tissue
  - Contains larger blood vessels, lymph vessels, and nerve fibers
  - Contains collagen and elastic fibers
  - Contains connective tissue proper

5-5 The hypodermis is tissue that connects the dermis to underlying tissues

The Hypodermis

- The **subcutaneous layer** or hypodermis
  - Lies below the integument
  - Stabilizes the skin
  - Allows separate movement
  - Is made of elastic areolar and adipose tissues
  - Is connected to the reticular layer of integument by connective tissue fibers
  - Has few capillaries and no vital organs
  - Is the site of **subcutaneous injections** using **hypodermic needles**

The Hypodermis

- Deposits of subcutaneous fat
  - Have distribution patterns determined by hormones
  - Are reduced by cosmetic liposuction (lipoplasty)

General Structure of the Integumentary System

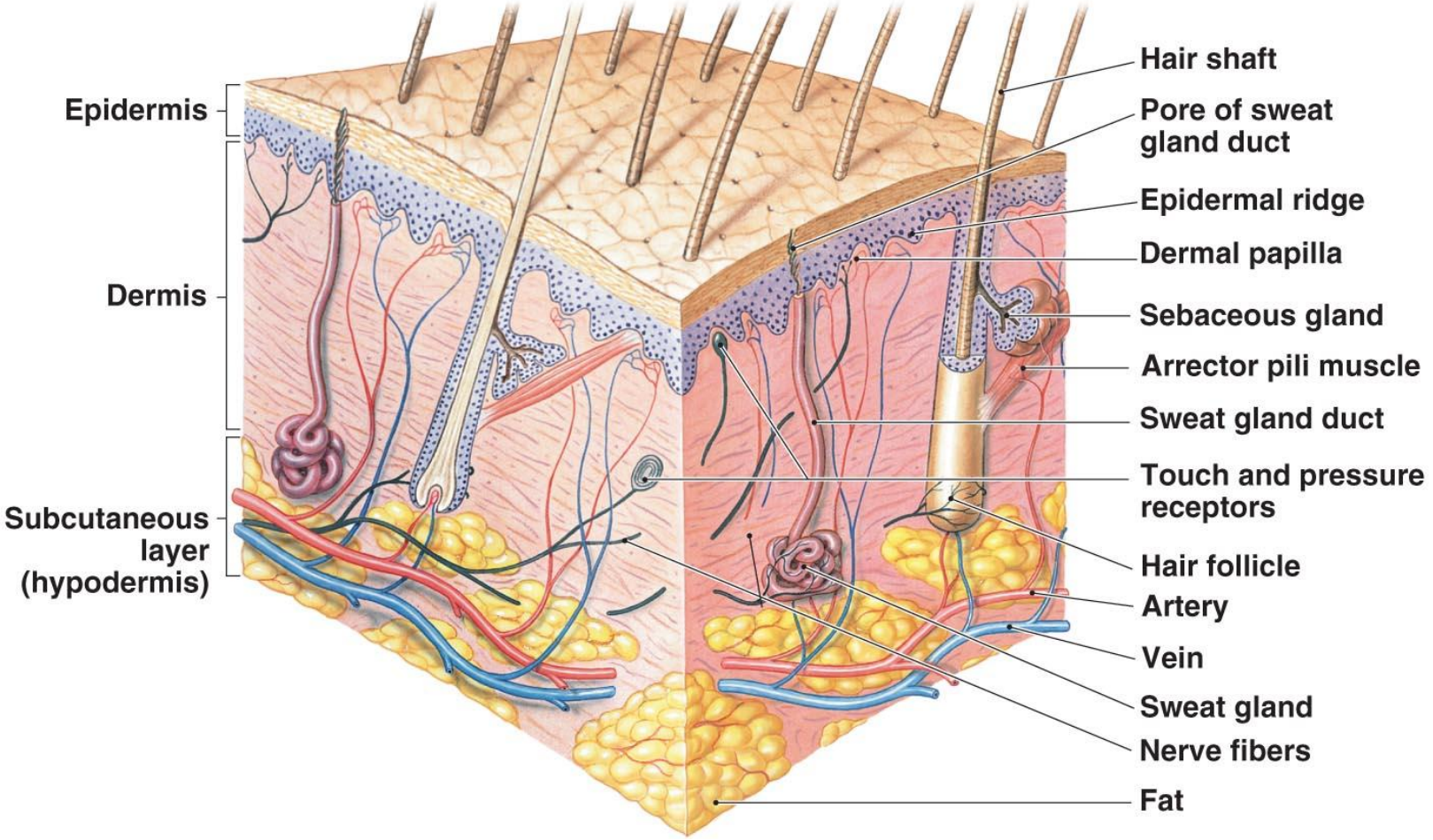


Figure 5-1

5-6 Hair is composed of keratinized dead cells that have been pushed to the surface

Hair

- **Hair, hair follicles, sebaceous glands, sweat glands**, and **nails**
  - Are integumentary accessory structures
  - Are located in dermis
  - Project through the skin surface

Hair

- The human body is covered with hair, *except*
  - Palms
  - Soles
  - Lips
  - Portions of external genitalia
- Functions of Hair
  - Protects and insulates
  - Guards openings against particles and insects
  - Is sensitive to very light touch

Hair Follicles and Hairs

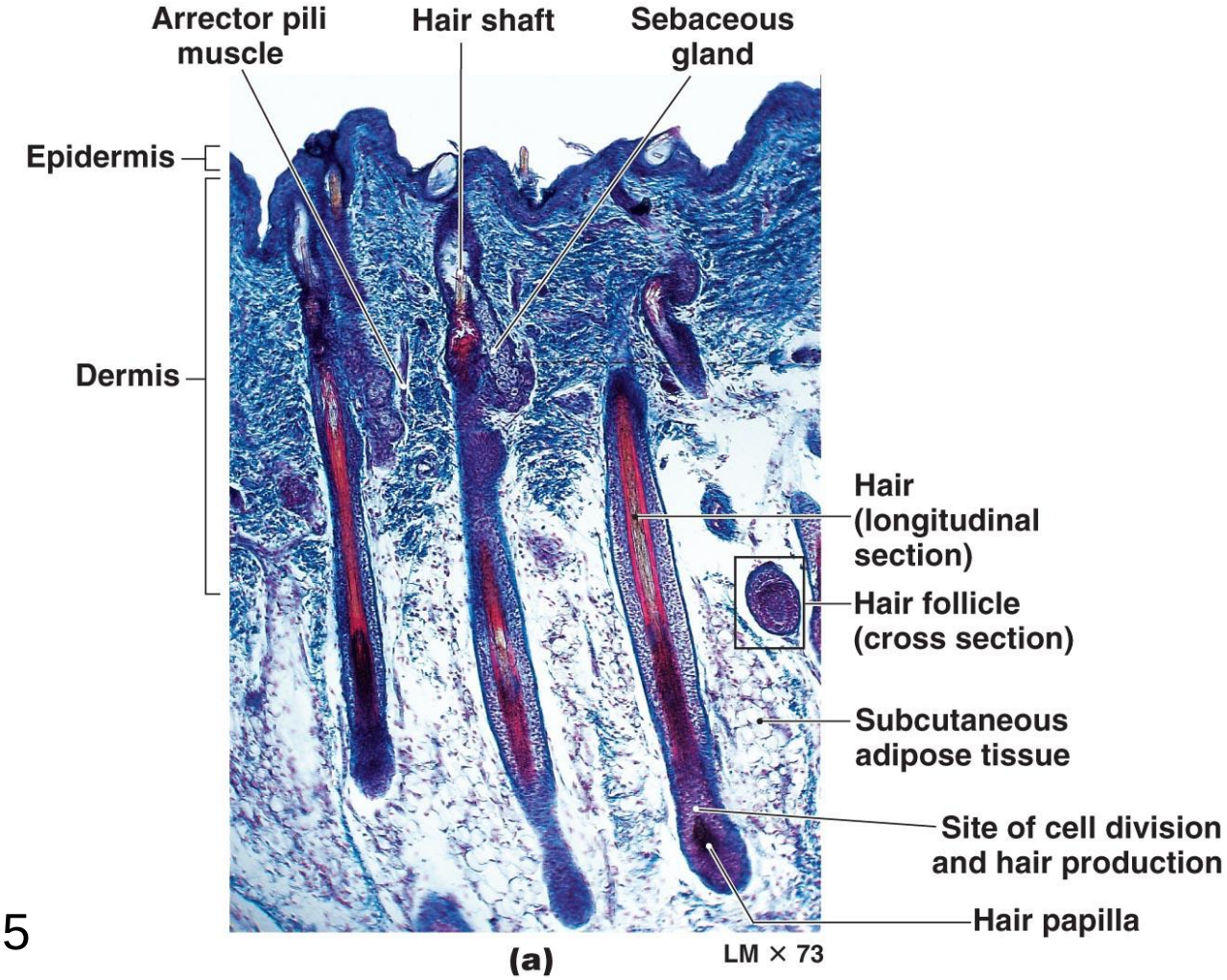


Figure 5-5

Hair Follicles and Hairs

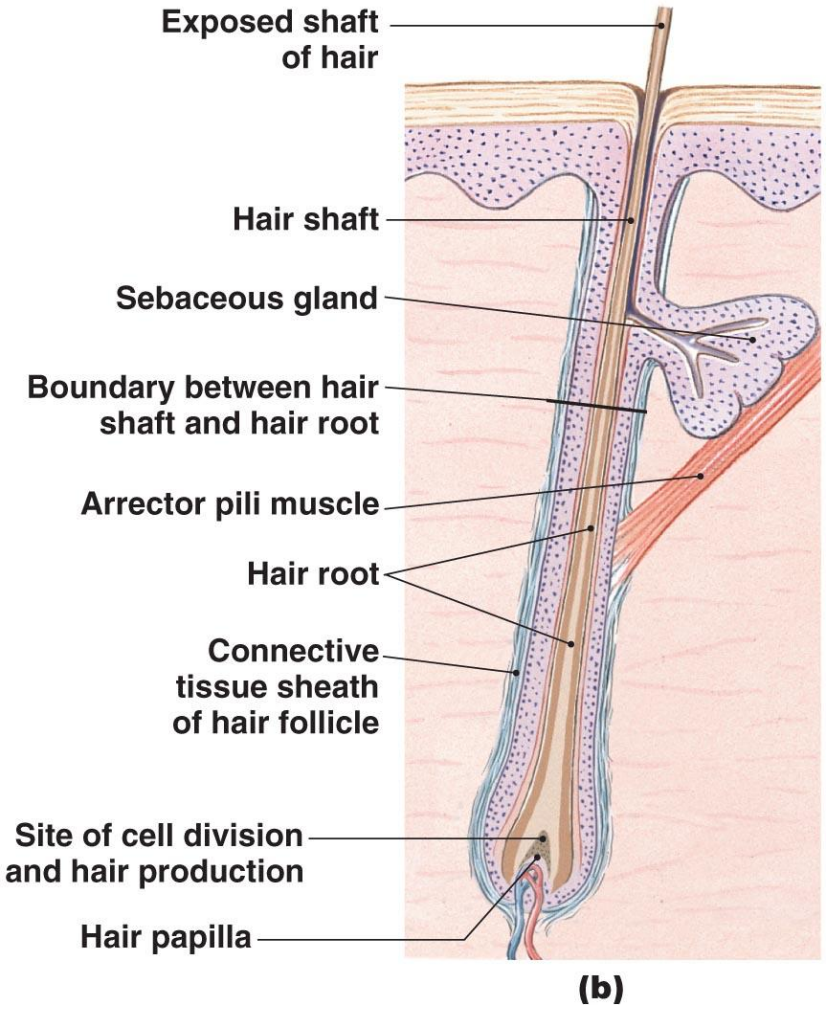


Figure 5-5

Hair Follicles and Hairs

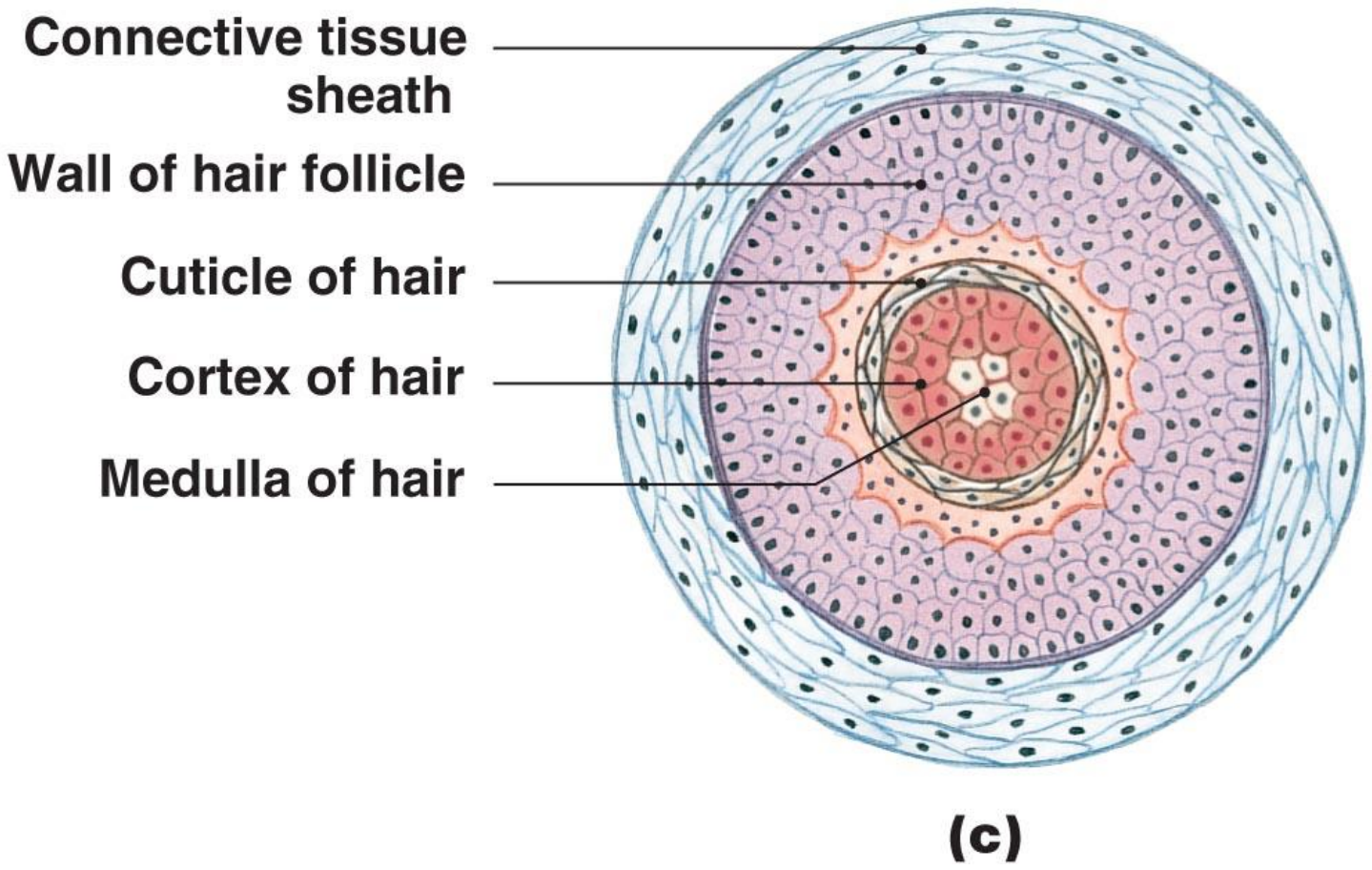


Figure 5-5

Hair

- Hair Color
  - Produced by melanocytes at the hair papilla
  - Determined by genes

5-7 Sebaceous glands and sweat glands are exocrine glands found in the skin

Exocrine Glands in Skin

- **Sebaceous Glands** (Oil Glands)
  - Holocrine glands
  - Secrete **sebum**
- **Sweat Glands**
  - Two types: apocrine glands and merocrine (eccrine) glands
  - Watery secretions

Sebaceous Glands and Sweat Glands

- Sebaceous (Oil) Glands
  - **Simple branched alveolar glands:**
    - Associated with hair follicles
  - **Sebaceous follicles:**
    - Discharge directly onto skin surface
    - Sebum:
      - contains lipids and other ingredients
      - lubricates and protects the epidermis
      - inhibits bacteria

Sebaceous Glands and Sebaceous Follicles

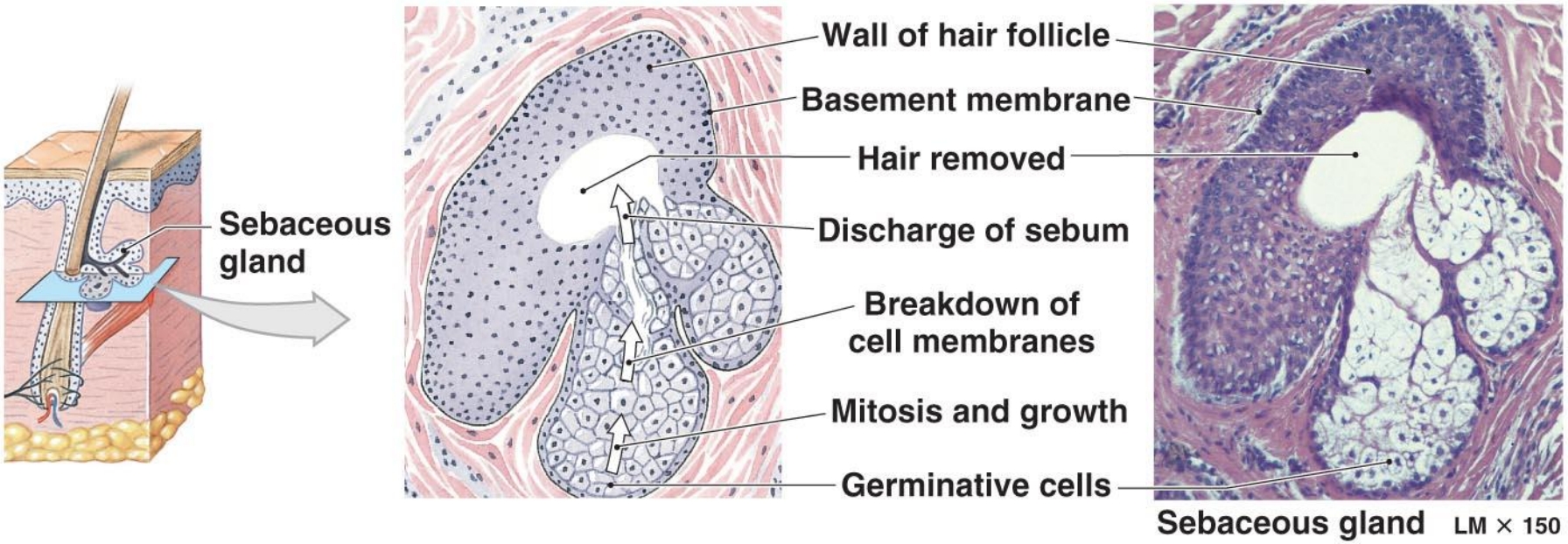


Figure 5-6

Sweat Glands

- **Apocrine sweat glands**
  - Found in armpits, around nipples, and groin
  - Secrete products into hair follicles
  - Produce sticky, cloudy secretions
  - Break down and cause odors
  - Surrounded by myoepithelial cells:
    - Squeeze apocrine gland secretions onto skin surface
    - In response to hormonal or nervous signal

Sweat Glands

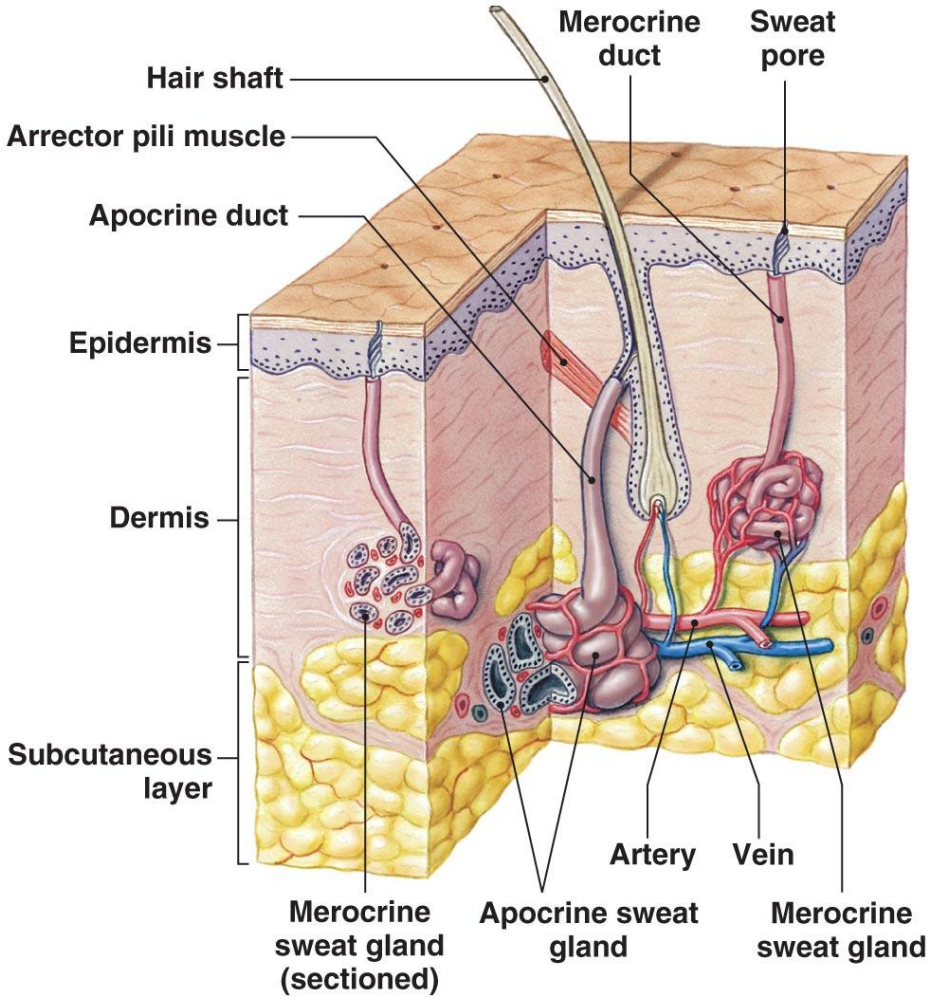


Figure 5-7

Sweat Glands

- **Merocrine (Eccrine) Sweat Glands**
  - Widely distributed on body surface
  - Especially on palms and soles
  - Discharge directly onto skin surface
  - Sensible perspiration
  - Water, salts, and organic compounds
  - Functions of merocrine sweat gland activity:
    - Cools skin
    - Excretes water and electrolytes
    - Flushes microorganisms and harmful chemicals from skin

5-8 Nails are keratinized epidermal cells that protect the tips of fingers and toes

Nails

- Nails protect fingers and toes
  - Made of dead cells packed with keratin
  - Metabolic disorders can change nail structure
- Nail production
  - Occurs in a deep epidermal fold near the bone called the **nail root**

The Structure of a Nail

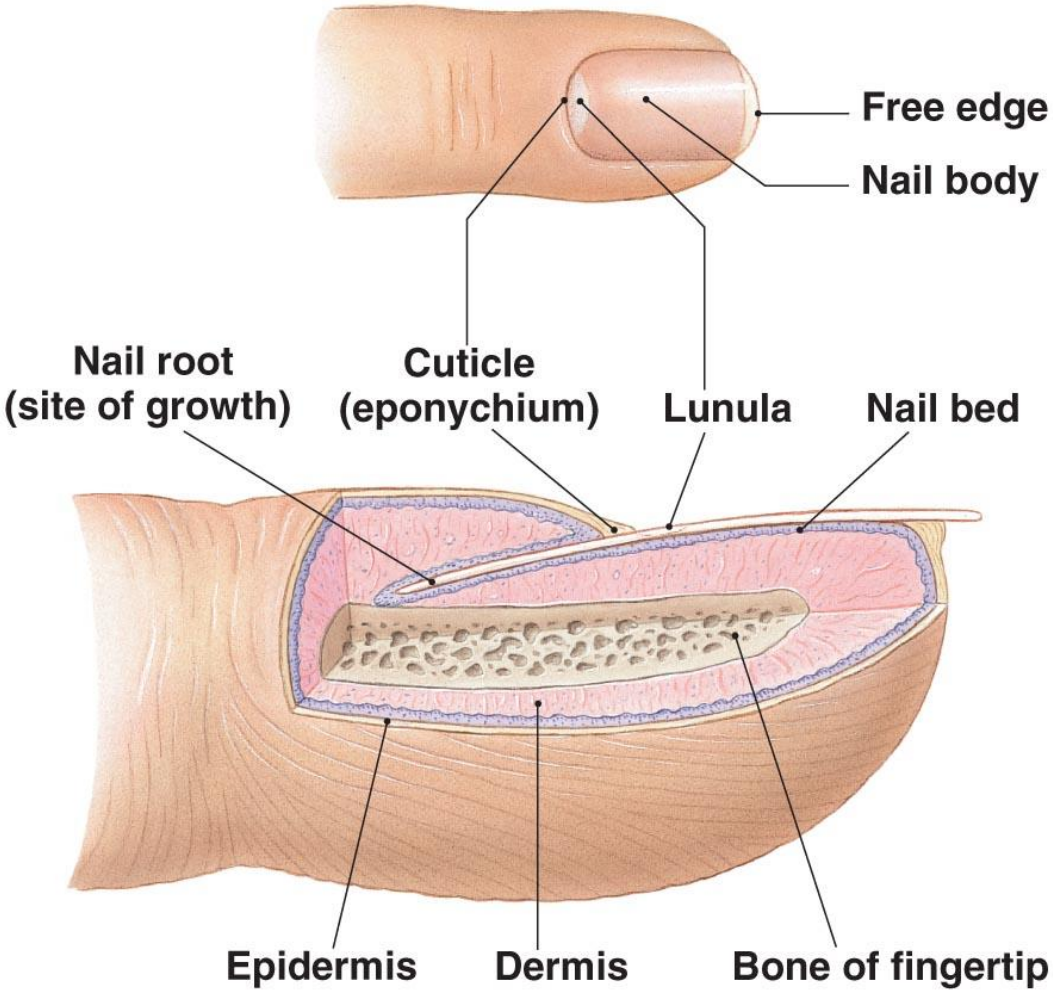
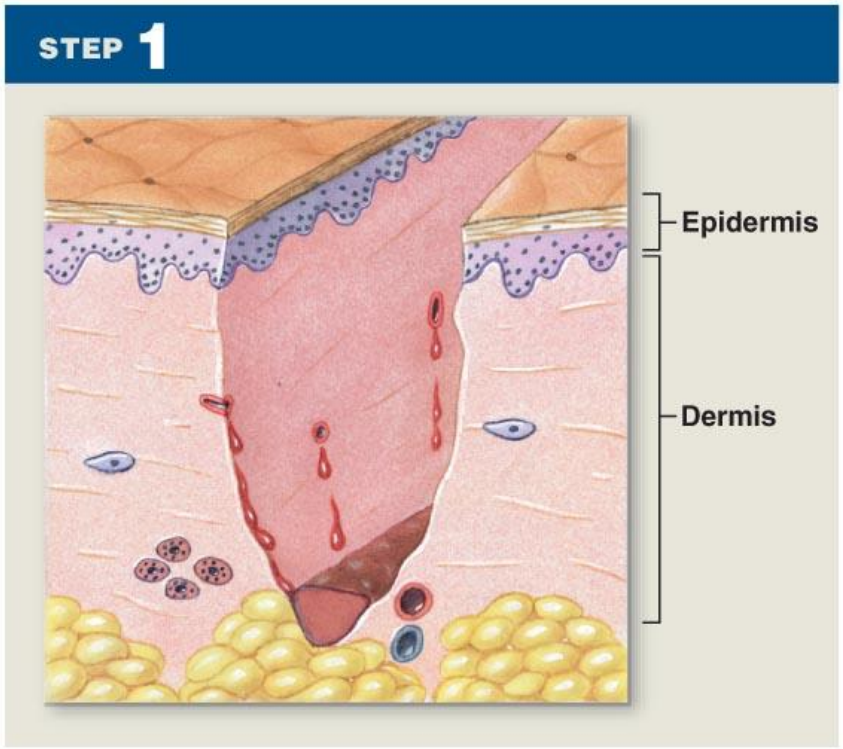


Figure 5-8

5-9 Several steps are involved in repairing the integument following an injury

Repair of Skin Injuries



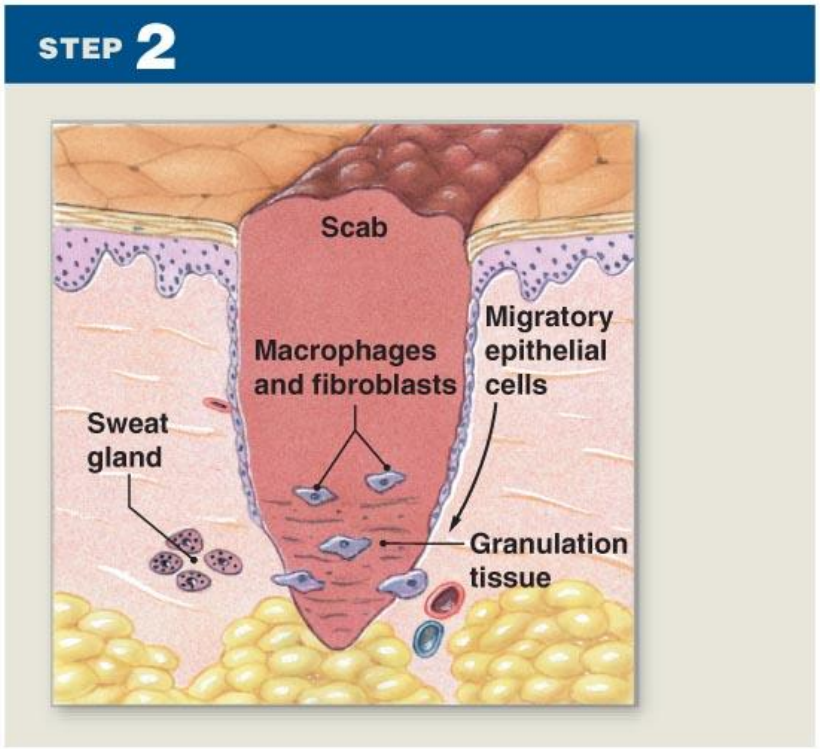


Figure 5-9

Repair of Skin Injuries

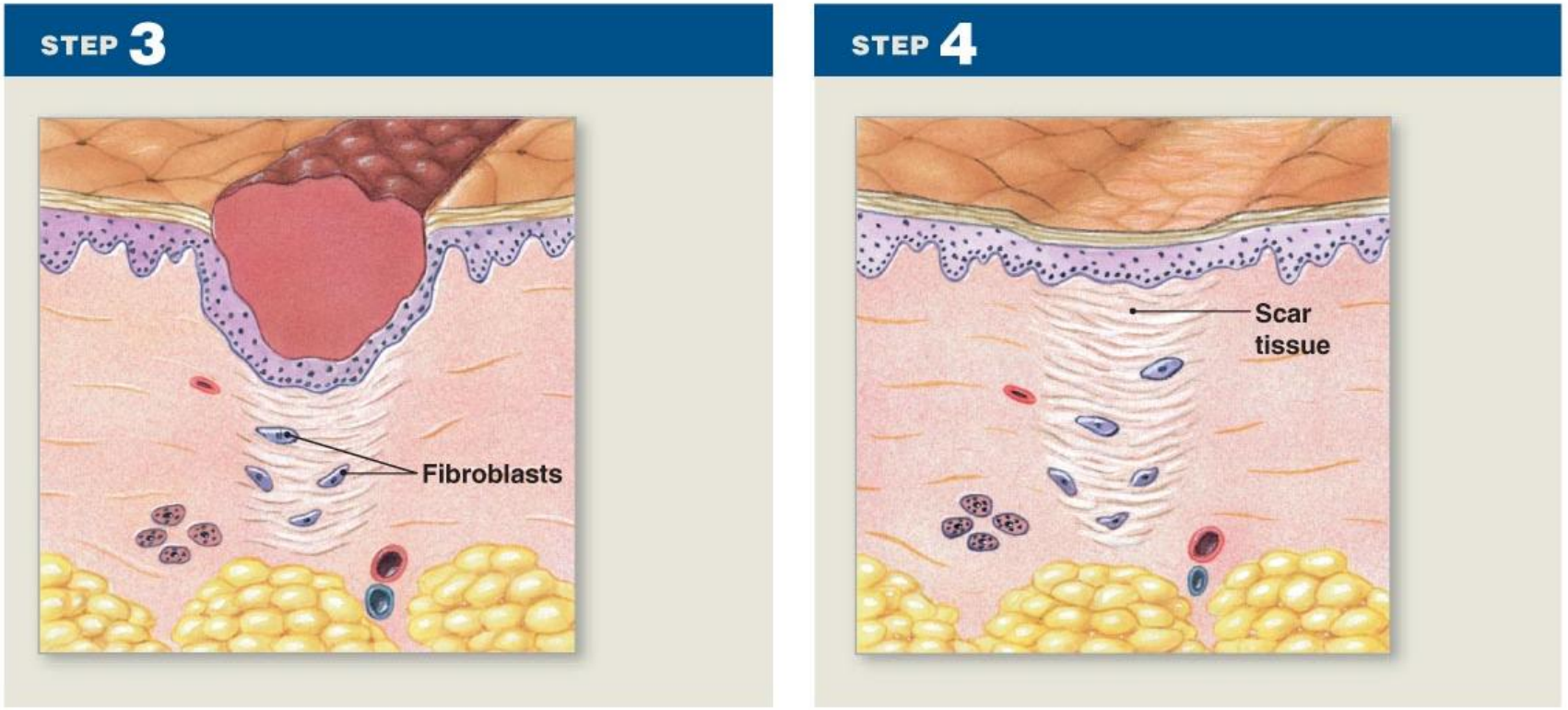


Figure 5-9

TABLE 5-1 A Common Classification of Burns

CLASSIFICATION	DAMAGE REPORT	APPEARANCE AND SENSATION
First-Degree Burn	*Killed:* superficial cells of epidermis *Injured:* deeper layers of epidermis, papillary dermis	Inflamed; tender
Second-Degree Burn	*Killed:* superficial and deeper cells of epidermis; dermis may be affected *Injured:* damage may extend into reticular layer of the dermis, but many accessory structures are unaffected	Blisters; very painful
Third-Degree Burn	*Killed:* all epidermal and dermal cells *Injured:* hypodermis and deeper tissues and organs	Charred; no sensation at all

5-10 Effects of aging include dermal thinning, wrinkling, and reduced melanocyte activity

Effects of Aging

- Skin injuries and infections become more common.
- The sensitivity of the immune system is reduced.
- Muscles become weaker, and bone strength decreases.
- Sensitivity to sun exposure increases.
- The skin becomes dry and often scaly.

Effects of Aging

- Hair thins and changes color.
- Sagging and wrinkling of the skin occur.
- The ability to lose heat decreases.
- Skin repairs proceed relatively slowly.

5-11 The integumentary system provides protection for all other body systems

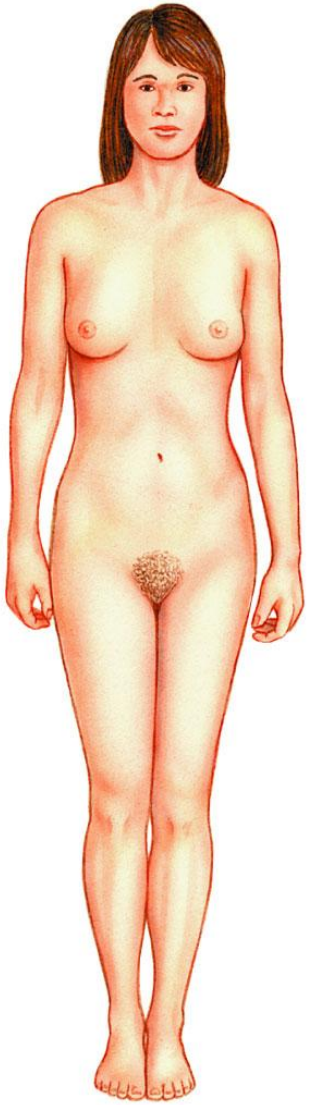
Importance of the Integumentary System

- Protects and interacts with all organ systems
- Changes in skin appearance are used to diagnose disorders in other systems

The Integumentary System in Perspective

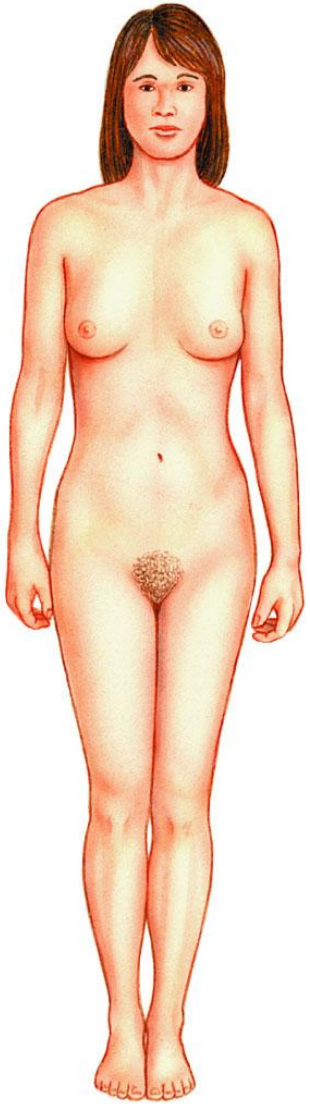
Functional Relationships Between
the Integumentary System and Other Systems

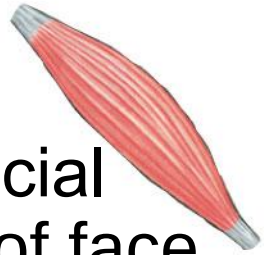
The Skeletal System



- The Skeletal System provides structural support
- The Integumentary System synthesizes vitamin D_3, essential for calcium and phosphorus absorption (bone maintenance and growth)

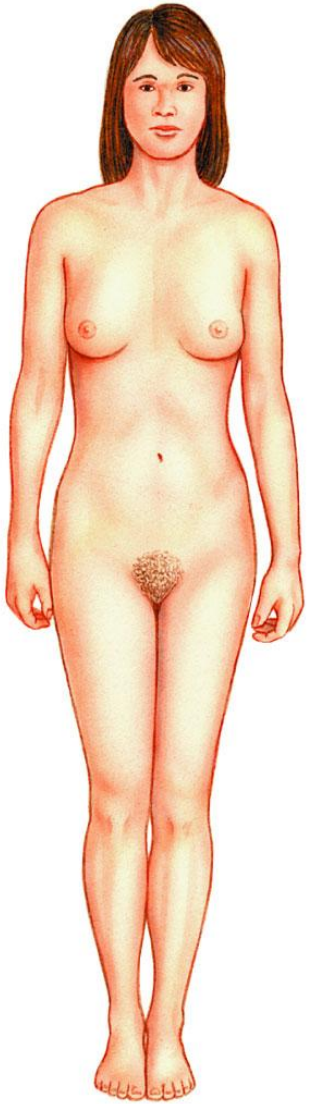
The Muscular System

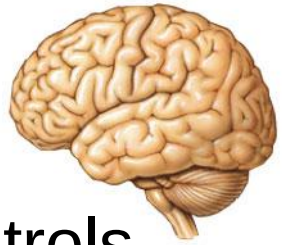




- The Muscular System's facial muscles pull against skin of face, producing expressions important in communication
- The Integumentary System synthesizes vitamin D_3 , essential for normal calcium absorption (calcium ions play an essential role in muscle contraction)

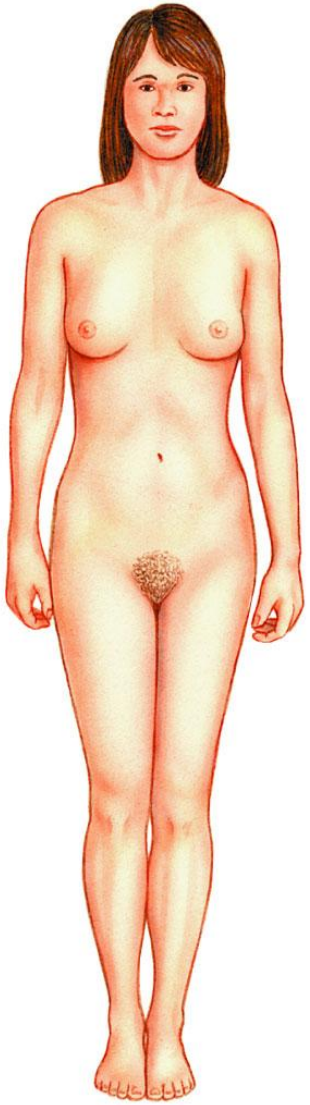
The Nervous System

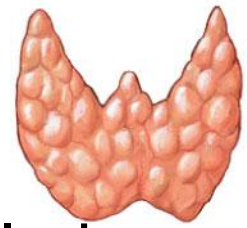




- The Nervous System controls blood flow and sweat gland activity for thermoregulation; stimulates contraction of arrector pili muscles to elevate hairs
- The Intergumentary System's receptors in dermis and deep epidermis provide sensations of touch, pressure, vibration, temperature, and pain

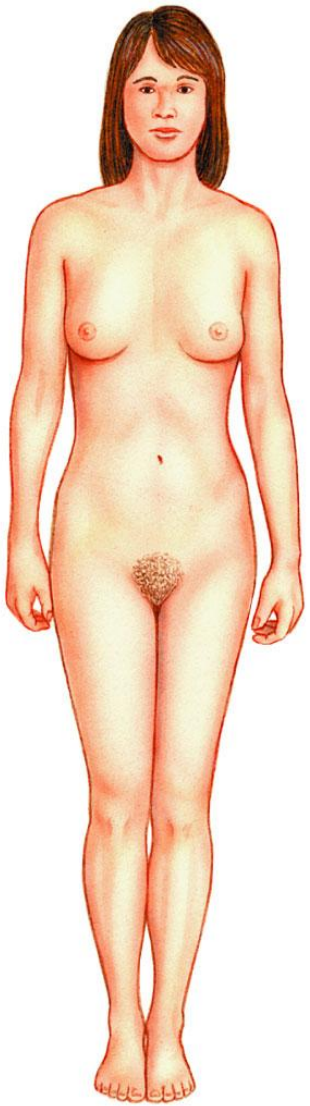
The Endocrine System

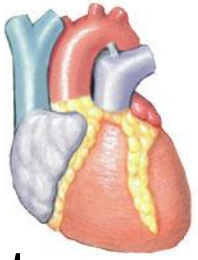




- The Endocrine System includes the sex hormones that stimulate sebaceous and apocrine gland activity, and develop secondary sexual characteristics; suprarenal hormones alter blood flow to skin and mobilize lipids from fat cells
- The Integumentary System synthesizes vitamin D_3, precursor of calcitriol, a hormone produced by the kidneys

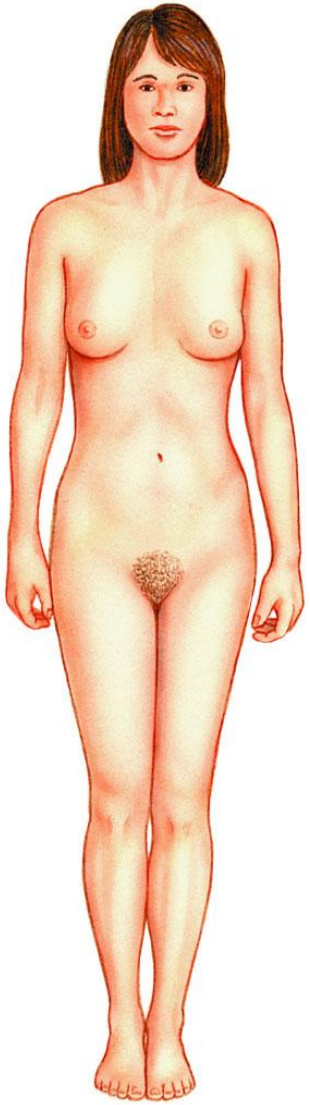
The Cardiovascular System





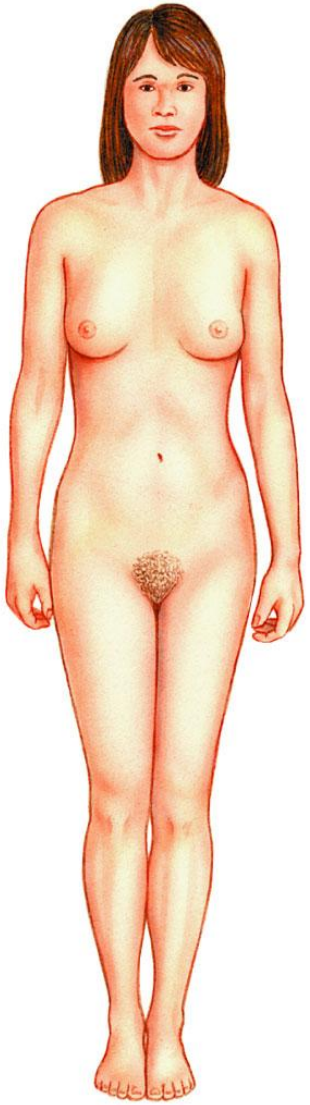
- The Cardiovascular System provides oxygen and nutrients; delivers hormones and cells of immune system; carries away carbon dioxide, waste products, and toxins; provides heat to maintain normal skin temperature
- The Integumentary System's mast cells produce localized changes in blood flow and capillary permeability

The Lymphatic System



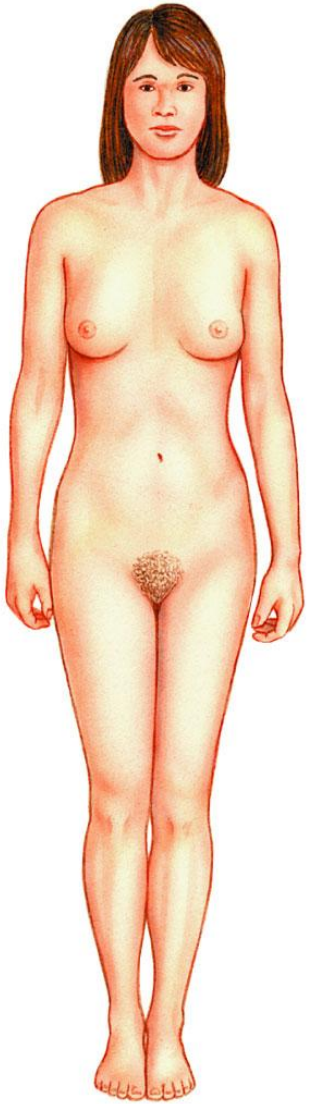
- The Lymphoid System assists in defending the integument by providing additional macrophages and mobilizing lymphocytes
- The Integumentary System provides physical barriers that prevent pathogen entry; macrophages resist infection; mast cells trigger inflammation and initiate the immune reponse

The Respiratory System



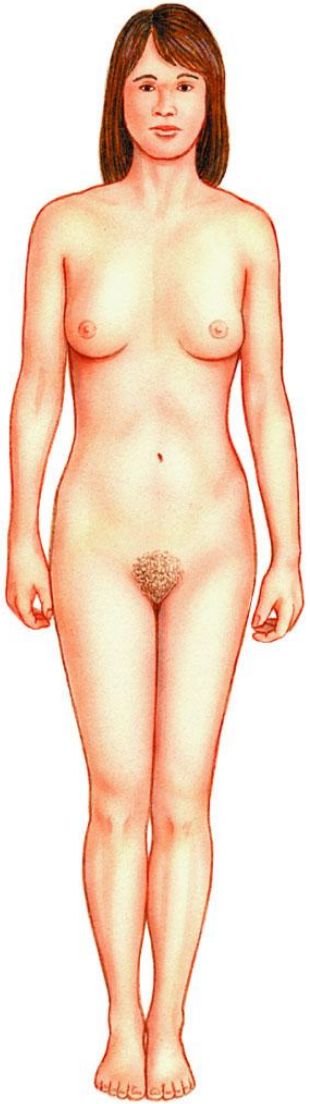
- The Respiratory System provides oxygen and eliminates carbon dioxide
- The Integumentary System's hairs guard entrance to nasal cavity

The Digestive System



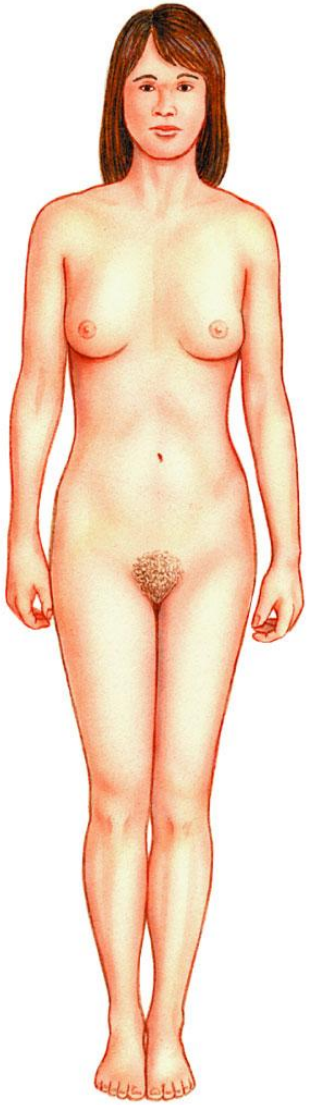
- The Digestive System Provides nutrients for all cells and lipids for storage by adipocytes
- The Integumentary System synthesizes vitamin D_3, needed for absorption of calcium and phosphorus

The Urinary System



- The Urinary System excretes waste products, maintains normal body fluid pH and ion composition
- The Integumentary System assists in elimination of water and solutes; keratinized epidermis limits fluid loss through skin

The Reproductive System



- The Reproductive System's sex hormones affect hair distribution, adipose tissue distribution in subcutaneous layer, and mammary gland development
- The Integumentary System covers external genitalia; provides sensations that stimulate sexual behaviors; mammary gland secretions provide nourishment for newborn infant