Chapter 4

The Integumentary System

PowerPoint® Lecture Slides
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The integumentary system or *integument* is composed of skin, hair, nails, sweat, oil, and mammary glands.

Skin tells clinicians about the overall health of the body and can be used to detect some internal problems.
Figure 4.1 Functional Organization of the Integumentary System
Function of the integument includes:

- Physical protection
- Regulation of body temperature
- Excretion (secretion)
- Nutrition (synthesis)
- Sensation
- Immune defense
**Integumentary Structure and Function**

- *Skin*, or the cutaneous membrane, has two subdivisions:
  - *Epidermis* is the stratified squamous epithelium
  - *Dermis* is the underlying loose connective tissue
- Deep to the dermis is the **subcutaneous layer**.
- **Accessory structures** include hair, nails, and many multicellular exocrine glands.
Figure 4.2  Components of the Integumentary System

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The Epidermis

- **Keratinocytes** are the most abundant cells in the epidermis.
  - At least four different cell layers can be found on most areas of the body.
- **Melanocytes** are pigment cells found deep in the epidermis.
- **Merkel cells** are sensory cells.
- **Langerhans cells** are fixed macrophages.
<table>
<thead>
<tr>
<th>Layer</th>
<th>Characteristics</th>
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| Stratum germinativum | Innermost, basal layer  
Attached to basal lamina  
Contains epidermal stem cells, melanocytes, and Merkel cells                                      |
| Stratum spinosum     | Keratinocytes are bound together by macula adherens attached to tonofibrils of the cytoskeleton  
Some keratinocytes divide in this layer  
Langerhans cells and melanocytes are often present                                                 |
| Stratum granulosum   | Keratinocytes produce keratohyalin and keratin  
Keratin fibers develop as cells become thinner and flatter  
Gradually the cell membranes thicken, the organelles disintegrate, and the cells die          |
| Stratum lucidum      | Appears as a “glassy” layer in thick skin only                                                                                                   |
| Stratum corneum      | Multiple layers of flattened, dead, interlocking keratinocytes  
Typically relatively dry  
Water resistant, but not waterproof  
Permits slow water loss by insensible perspiration                                                 |
Figure 4.3  The Structure of the Epidermis
Figure 4.5  The Epidermal Ridges of Thick Skin
Figure 4.6  Melanocytes
Figure 4.7 The Structure of the Dermis and the Subcutaneous Layer.

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The Dermis

Figure 4.8  Lines of Cleavage of the Skin
Hair Follicles and Hair

- **Hair** is a nonliving keratinized structure that extends beyond the surface of the skin in most areas of the body.
- 98% of the 5 million hairs on the body are not on the head.
- **Hair follicles** are the organs that form the hairs.
Figure 4.9a  Accessory Structures of the Skin

(a) Diagrammatic view of hair follicle

- Exposed shaft of hair
- Hair shaft
  - Boundary between hair shaft and hair root
- Hair root
- Sebaceous gland
- Arrector pili muscle
- Connective tissue sheath
- Hair bulb
- Hair papilla
Accessory Structures of the Skin

Figure 4.9b  Accessory Structures of the Skin

- Epidermis
- Dermis
- Hair shaft
- Sebaceous gland
- Arrector pili muscle
- Hair
- Hair follicle, cross section
- Glassy membrane
- External root sheath
- Connective tissue sheath of hair follicle
- Cortex
- Hair bulb

(b) Scalp, sectional view
Figure 4.10a  Hair Follicles
Accessory Structures

Figure 4.10b  Hair Follicles
Accessory Structures

Figure 4.11  The Hair Growth Cycle

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Accessory Structures

**EXOCRINE GLANDS**
- Assist in thermoregulation
- Excrete wastes
- Lubricate epidermis

**SEBACEOUS GLANDS** (see Figure 4.13)
- Secrete oily lipid (sebum) that coats hair shaft and epidermis
- Provide lubrication and antibacterial action
  - TYPICAL SEBACEOUS GLANDS
    - Secrete into hair follicles
  - SEBACEOUS FOLLICLES
    - Secrete onto skin surface

**SWEAT GLANDS**
- Produce watery solution by merocrine secretion
- Flush epidermal surface
- Perform other special functions
  - APOCRINE SWEAT GLANDS (see Figure 4.14)
    - Limited distribution (axillae, groin, nipples)
    - Produce a viscous secretion of complex composition
    - Possible function in communication
    - Strongly influenced by hormones
      - CERUMINOUS GLANDS
        - Secrete waxy cerumen into external ear canal
      - MAMMARY GLANDS
        - Apocrine glands specialized for milk production
  - MEROCRINE SWEAT GLANDS (see Figures 3.5, 3.10, and 4.14)
    - Widespread
    - Produce thin secretions, mostly water
    - Merocrine secretion mechanism
    - Controlled primarily by nervous system
    - Important in thermoregulation and excretion
    - Some antibacterial action

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Figure 4.12  A Classification of Exocrine Glands in the Skin

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Figure 4.13  Sebaceous Glands and Follicles
Figure 4.14  Sweat Glands
Figure 4.15  Structure of a Nail
Local Control of Integumentary Function

- The integument can respond independently of the endocrine system and nervous system.

- Mechanical stress can trigger stem cell divisions resulting in calluses.

- Regeneration occurs after damage.

- The inability to completely heal after severe damage may result in acellular scar tissue.
Figure 4.16   The Skin during the Aging Process

- **FEWER MELANOCYTES**
  - Pale skin
  - Reduced tolerance for sun exposure

- **DRY EPIDERMIS**
  - Reduction in sebaceous and sweat gland activity

- **THIN EPIDERMIS**
  - Slow repairs
  - Decreased vitamin D production
  - Reduced number of Langerhans cells

- **FEWER ACTIVE FOLLICLES**
  - Thinner, sparse hairs

- **CHANGES IN DISTRIBUTION OF FAT AND HAIR**
  - Due to reductions in sex hormone levels

- **REDUCED BLOOD SUPPLY**
  - Slow healing
  - Reduced ability to lose heat

- **REDUCED SWEAT GLAND ACTIVITY**
  - Tendency to overheat

- **THIN DERMIS**
  - Sagging and wrinkling due to fiber loss