

## **Anatomy and Physiology 121: The Integumentary System**

### Functions of the Integumentary System

1. Protection
2. Body Temperature Regulation
3. Metabolic Functions
4. Blood Reservoir
5. Excretion
6. Cutaneous Sensation

Integumentary system = skin, hair, nails, sweat and oil glands

*Integument = covering (like the skin)*

Composed of two regions:

1. Epidermis = outermost layer composed of epithelial tissue (cells)
2. Dermis = underlying tough, leathery layer composed of fibrous connective tissue

Epidermis = thick keratinized stratified squamous epithelium

Consists of:

- 4 distinct cell types
- 4-5 distinct layers

### Cells of the Epidermis:

1. Keratinocytes = bulk of epithelial cells, produce keratin
2. Melanocytes = produce the pigment melanin, found in basal layer of epidermis
3. Langerhan's cells = macrophages that help activate the immune response
4. Merkel cells = found at epidermal-dermal junction, associated with sensory nerve endings  
*Merkel disc* = functions as sensory receptor for light touch

Layers of the Epidermis: from deepest to most superficial

Thin Skin: consists of 4 layers

- Stratum Basale
- Stratum Spinosum
- Stratum Granulosum
- Stratum Corneum

Thick Skin: consists of 5 layers

Stratum Basale

Stratum Spinosum

Stratum Granulosum

Stratum Lucidum

Stratum Corneum

### Stratum Basale (Basal Layer)

- Deepest epidermal layer
- Consists of a single row of cells
- Only layer to undergo continuous mitosis
- 10-20% of cells are melanocytes
- Some Merkel Cells

### Stratum Spinosum (Prickly Layer)

- Thickest layer, several cell layers thick
- Cells start to develop a network of keratin
- Keratinocytes starting to flattened and become irregular in shape
- Granules of melanin present along with Langerhan's Cells

### Stratum Granulosum (Granular Layer)

- Three to five cell layers thick
- Cells continue to flatten, nuclei and organelles disintegrate and disappear
- Plasma membrane thickens, lipids coat outer membrane surface = waterproofing
- Cells start to die

### Stratum Lucidum (Clear Layer)

- Found in thick skin only
- Consists of a few rows of clear, flattened, dead keratinocytes

- Indistinct cell boundaries

### Stratum Corneum (Horny Layer)

- 20 to 30 cell layers thick
- *Cornified* or *horny* cells
- Up to  $\frac{3}{4}$  of epidermal thickness in some areas
- Keratin and thickened cell membranes of cells protect skin against abrasion and penetration
- Glycolipids between cells waterproofs this layer

### Dermis

Strong, flexible connective tissue layer, supplies nutrients

Consists of:

- Fibroblasts, macrophages, mast cells and other white blood cells
- Matrix of collagen, elastic and reticular fibers

Dermis is richly supplied with blood and lymphatic vessels, and nerve endings  
Hair follicles, oil glands and sweat glands reside in dermis

### Dermis has Two Major Sublayers

#### 1. Papillary Layer

- Thin, superficial layer of loose connective tissue
- Fibers form loosely woven mat
- Well-vascularized
- *Dermal Papillae* = small projections on surface of dermis which contain
  - Capillary loops
  - Free nerve endings
  - Meissner's Corpuscles = touch receptors

- Dermal ridges: larger papillae mounds atop which the epidermis sits, leads to epidermal ridges, i.e. **Finger Prints**

## 2. Reticular Layer

- Deepest skin layer
- Typical dense irregular connective tissue
- 80% of thickness of dermis
- Thick bundles of interlacing collagen fibers, some elastic fibers
- *Tension Lines* or *Lines of Cleavage*
- *Flexure Lines*
- Blisters

## Appendages of the Skin

Hair and Hair Follicles, Nails, Sweat Glands and Sebaceous Glands

### Sudoriferous (sweat) Glands

Two Types:

*Eccrine sweat glands*: palms, soles and forehead

- Pore at skin surface
- Common sweat
- Prevents overheating

*Apocrine sweat glands*: axillary and anogenital areas

- Ducts empty into hair follicles
- Associated with body odor
- Little to no role in thermoregulation

### Modified Apocrine Sweat Glands

- Ceruminous Glands:
  - Lining of external ear
  - Secrete cerumen (earwax)
- Mammary Glands:
  - Thoracic region
  - Secrete milk

## Sebaceous (oil) Glands

- Simple clustered glands attached to hair follicle
- All over body except soles of feet and palms of hands
- Secrete sebum (oil)
- Bactericidal
- Seborrhea

## Hair and Hair Follicles

Structure of hair (pili):

Advantages of harder keratin = in hair and nails

1. Tougher and more durable
2. Cells do not flake off

Two Basic types of hair:

1. Vellus hair = children and adult females, fine and pale
2. Terminal hair = coarser, longer hair

Alopecia = hair baldness

## Hair and Follicle Structure

- Regions of hair:
  - Shaft = projects from skin
  - Root = embedded in skin
  - Bulb = expanded deep end where growth occurs
- Three concentric layers of keratinized cells:
  - Medulla = central core
  - Cortex = bulk layer surrounding medulla, thickest
  - Cuticle = outer most layer, single layer of cells

## Structure of a Hair Follicle

- Hair follicles = open pit of skin for growth and passage of hair, extends from epidermis into dermis
- Root hair plexus = knot of nerve endings that wrap around hair bulb
- Papilla = supplies nutrients to bulb
- Hair matrix = actively dividing region of hair located in bulb
- Arrector pili = muscles associated with hair

## Nails

- Scale-like form of epidermis
- Each nail has:
  - Free edge
  - Nail body (attached portion)
  - Root (proximal part)
- Nail bed = layers of epidermis beneath nail
- Nail matrix = nail growth at proximal end
- Nail folds, *lunula*, *eponychium*

## Skin Pigmentation

Three pigments contribute to skin color

- Melanin
  - Only one made in skin, made by melanocytes
  - Color ranges from yellow to reddish-brown to black
- Carotene
  - Yellow to orange pigment from certain plant products
- Hemoglobin
  - Pinkish hue of skin color, particularly in lighter skinned people
  - Reflects oxygenated blood in dermal layer
- Damages and Diseases of the Skin

## Burns

1. First-degree: only some of epidermis damaged
2. Second-degree: damage to epidermis and upper region of dermis
3. Third-degree: damage through entire thickness of skin

## Skin Cancer

1. Basal Cell Carcinoma
2. Squamous Cell Carcinoma
3. Malignant Melanoma

## Changes in Skin Color

*Albinism, Cyanosis, Redness or Erythema, Pallor or Blanching, Jaundice, Bronzing, Bruises*