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 ¾ 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