INTEGUMENTARY SYSTEM & GLANDS
In Anatomy Today
Integumentary System

• Components
  – Skin – integument
    • Dermis and epidermis
    • Supported by hypodermis
  – Accessory structures
    • Hair
    • Nails
    • Cutaneous glands
Functions

• Protection from trauma and infection
  – Sensory functions
  – Physical barrier
  – Immune cells
• Prevents desiccation and water imbalance
  – Keratin and waterproofing
• Synthesis of Vitamin D
  – Important for uptake of Ca$^{2+}$
• Regulation of temperature
  – Insulation
  – Vasoconstriction and vasodilation
Thick Skin vs. Thin Skin

• Thick skin
  – Palms and soles
  – Epidermis = 4-6mm thick
  – 5 layers
  – Has sweat glands
  – No hair follicles, sebaceous glands, arrector pili muscles

• Thin skin
  – Rest of body
  – Epidermis = .75-1.50 mm thick
  – Thin stratum corneum
  – Stratum lucidum and granulosum not present in distinct layers
Skin Histology

Thick Skin

Thin Skin
Stratum Corneum

- Up to 30 layers of dead keratinized cells
- Water resistant
Stratum Lucidum

- Only found in thick skin
- Cells are anucleate and lack organelles
Stratum Granulosum

- 3-5 layers of flattened keratinocytes
- Contain keratohyaline granules
Stratum Spinosum

- Thickest stratum in thin skin
- Cells flatten and fill with keratin as move to the top
- Connected by desmosomes = confers a spiny appearance
Stratum Basale

- Single layer of cells resting on basement membrane
  - Stem cells
  - Keratinocytes
  - Merkel cells
  - Melanocytes
- Germinative layer
  - Mitosis
- Gives rise to cells that are moved to the upper layers
Epidermal Cell Types

- Keratinocytes
- Nonkeratinocytes
  - Melanocytes
  - Merkel cells
    - Tactile for shapes and textures
    - Stratum basale
  - Langerhans cells
    - A type of dendritic cell in the skin
    - Immune cell
    - APC
Keratinocytes

- 90% of epidermal cells
- Undergo mitosis in stratum basale at night
- Life expectancy: 20-30 days
- Accumulation of keratin filaments causes death and sloughing off
- Cytomorphosis of keratinocytes is responsible for 5 tissue layers in epidermis
Melanocytes

- Found in the stratum basale
- Sometimes in superficial dermis
- Melanosomes
  - Granules containing melanin
The Dermis

- Papillary layer
  - Folded area immediately deep to the epidermis
  - Areolar CT

- Reticular layer
  - The deepest, largest part of the dermis
  - Dense irregular CT
The Hypodermis

- Subcutaneous layer
- Deep to the dermis
- Contains adipose and areolar CT
- Very vascular
- Function
  - Binds skin to underlying tissues
  - Padding
Human Skin Pigments

• Melanin
  – Eumelanin (Brown to black)
  – Pheomelanin (Yellow to red)
  – Protection from UV light

• Carotene
  – Yellowish pigment found in certain vegetables (carrots) accumulates in the fatty parts of the dermis

• Hemoglobin
  – blood pigment, adds “redness” to skin color
Epidermal Derivatives

• Accessory structures associated with the skin are actually derived from the epidermis during development
  – Hair
  – Nails
  – Glands
Hair (Pili)

- Hard keratin growing from hair follicle
- Glabrous skin
  - Hairless
  - Lips, nipples, soles, palms
- Function
  - Insulation
  - Protection
- Types of hair
  - Lanugo
  - Vellus
  - Terminal hair
Structure of Hair and Follicle

Longitudinal Section

- **Hair Follicle**
  - Papilla
    - Access for blood supply
- **Hair Root**
  - Bulb
    - Epithelial cells that surround the papilla
  - Matrix
    - Epithelial cells, melanocytes
    - Cell division produces the hair fiber
    - Rapidly dividing cells
- **Hair Shaft**
  - Above skin surface
  - Cells packed with keratin
Structure of Hair and Follicle

Cross Section

- Medulla
  - Pith or marrow of hair
  - Mostly air space
- Cortex
  - Thickest layer
  - Pigmented
  - Pigment denser near the cuticle
- Cuticle
  - Outermost part of hair shaft
  - Hard layer of dead cells
  - Mechanical strength
  - Water resistant
- Root Sheath
  - Stratum basal/spinosum of epidermis
Hair texture = cross sectional shape

Hair color = pigment granules
Nails

- Direction of growth
- Free edge
- Lateral nail fold
- Lateral nail groove
- Nail body
- Phalanx (bone of fingertip)
- Eponychium
- Proximal nail fold
- Nail root
- Lunula
- Nail body
- Hyponychium
- Epidermis
- Dermis
- Phalanx
Cutaneous Glands

- Cutaneous means skin
- Exocrine glands
  - Secretory portion secretes a product into a duct
  - Ductal portion opens to the surface of skin – including a hair follicle

<table>
<thead>
<tr>
<th>Name of Gland</th>
<th>Secretory Product</th>
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<tbody>
<tr>
<td>Eccrine sweat glands</td>
<td>Sweat</td>
</tr>
<tr>
<td>Apocrine sweat glands</td>
<td>Sweat*</td>
</tr>
<tr>
<td>Mammary glands</td>
<td>Milk</td>
</tr>
<tr>
<td>Sebaceous glands</td>
<td>Sebum (oil)</td>
</tr>
<tr>
<td>Ceruminous glands</td>
<td>Cerumen (ear wax)</td>
</tr>
</tbody>
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Classification by Mode of Secretion

• Merocrine Secretion
  – Eccrine sweat glands

• Apocrine Secretion
  – Apocrine sweat glands
  – Mammary glands

• Holocrine Secretion
  – Sebaceous glands
  – Ceruminous glands
Merocrine Secretion

- Secretion by exocytosis without any loss of cellular components
- Majority of glands in body
- Examples
  - Eccrine sweat glands
Eccrine Sweat Glands

- “Regular” sweat glands
- Merocrine secretion
- Most numerous sweat glands
- Sensitive to body temperature increases
Apocrine Secretion

- Apical surface of cell is pinched off
  - Decapitation secretion
- Products are milky
- Cellular products support bacterial growth
  - Secretions are often associated with an odor
- Examples
  - Apocrine sweat glands
  - Mammary glands
Apocrine Sweat Glands

- Located in the axillary and pubic regions
- Apocrine secretion
- Product is secreted into a hair follicle
- Product is an oily compound that acts as a pheromone (protein, lipid, steroids)
- Sensitive to adrenaline
  - React to anxiety, stress, fear, sexual stimulation, pain

Myoepithelial cells
Mammary Glands

- Mammary glands are a modified apocrine gland
- Modified in females to secrete milk
  - Milk-secreting cuboid cells
- Apocrine secretion

Myoepithelial cells
Holocrine Secretion

- Entire cell is secretory product
- Oily, waxy product
- Examples
  - Sebaceous Glands
  - Ceruminous glands
Sebaceous Glands

Oil Glands

- Associated with hair follicles
- Holocrine mode of secretion
- Duct opens into hair follicle
- Secretes sebum
  - Hair oil
Ceruminous Glands

Wax Glands

- Modified apocrine sweat glands
- Secrete cerumen
  - **Ear wax** is a mixture of less viscous secretions from modified apocrine sweat glands, sebum and dead epithelial cells
- Holocrine mode of secretion
- Found only in the external auditory meatus
- Drain into guard hairs in the ear