The Integumentary System

First System
- Organs are groups of tissues with specific function
- Systems are groups of organs that work together
- Other systems this semester
  - Skeletal
  - Muscular
  - Cardiovascular
  - Immune
  - Digestive

Skin
- Primary organ is the skin (one of the body’s larger organs)
- Other structures include hair, nails, glands, and nerve endings
- Primary components of skin
  - Epidermis: outer layer made of epithelium
  - Dermis: thicker middle layer made of many cell types
  - Hypodermis (subcutaneous layer, not part of skin): made of areolar and adipose connective tissue

Skin Functions
- Regulation of body temperature: blood flow and perspiration
- Protection: physical contact, pathogens, dehydration and UV exposure
- Sensation: temperature, touch, pressure and pain
- Excretion: ions and some organics
- Immunity: macrophages like Langerhans cells

More Skin Functions
- Blood reservoir: 8-10% of blood volume
- Synthesis of vitamin D: Critical to the absorption of calcium
  - UV light + precursor $\rightarrow$ calcitriol (in liver and kidney)

Epidermis
- Keratinized stratified squamous epithelium including four main cell types
  - Keratinocytes: 90% of cells, contain keratin and produce laminar granules
  - Melanocytes: produce melanin that’s transferred to keratinocytes
  - Langerhans cells (macrophage): a type of white blood cell that is produced in bone marrow
  - Merkel cells: sensory cell for touch, in hairless skin

More Epidermis
- Consists of 4-5 layers
  - Stratum basale: contain stem cells that produce keratinocytes, they mature, become filled with keratin, and die as they push to the surface (4 wks);
some melanocytes & Merkel cells
• Keratin is in the form of intermediate filaments, internally binding desmosomes and hemidesmosomes - increase durability
  – Stratum spinosum: extensions of melanocytes release melanin, melanin phagocized by keratinocytes

**Even More Epidermis**
– Stratum granulosum: 3-5 layers, flatten keratinocytes, nuclear degeneration
  • Presence of keratohyalin binding intermediate filaments into dense bundles
  • Membrane bound lamellar granules containing lipid secretion - when released extracellularly, serves to repel water
– Stratum lucidum (fingertips, palms & soles): 3-5 layers
– Stratum corneum: 25-30 layers, dead cells shedding

**Dermis**
• Composed of connective tissue and some cells (fibroblasts, macrophages & adipocytes)
• Two regions
  – Papillary: areolar connective tissue, contain capillaries, touch sensors (Meissner’s corpuscles or corpuscles of touch) and free nerve endings (hot and cold sensors, pain, etc.)
  – Reticular: dense irregular connective tissue (provides elasticity) plus other structures (hair follicle, sebaceous glands, and sudoriferous glands (or their ducts))

**Hypodermis**
• Also called superficial fascia
• Composed of areolar connective tissue binding skin to underlying muscle or bone
• Contains Pacinian or lamellated corpuscles (pressure sensitive) and some cold sensors

**More on Skin**
• Lines of cleavage
• Skin Color
  – Due to amount of melanin produced and presence of carotene (a precursor to Vit. A)in corneum and fatty tissue
  – UV enhances activity of tyrosinase which increases melanin production
  – Albinism: absence of tyrosinase
  – Freckles and liver spots related to uneven distribution of melanocyte activity
• Finger prints: ducts of sudoriferous (sweat) glands open onto dermal ridges

**Skin Color Signs**
• Cyanosis: blue tint caused by deoxygenated blood
• Jaundice: yellow color from bilirubin not being metabolized by liver
• Addison's disease: dark skin caused by excess production of melanocyte
stimulating hormone

- Erythema (blushing): vessel dilation due to a variety of reasons

**Dermal Derivatives**

- Hair & nails (on your own)
- Sebaceous glands:
  - Holocrine secretion
  - Typically open into neck of hair follicle, absent in palms & soles
  - Produce sebum (fats, cholesterol, proteins salts & pheromones) which moistens hair, waterproofs & softens skin, inhibits bacterial infection
  - Create blackheads (melanin & oxidized sebum), pimples & boils (bacterial infections)

**More Dermal Glands**

- Sudoriferous (sweat) glands
  - Merocrine secretion
  - Eccrine: merocrine glands, release sweat into ducts that exit at surface or hair follicles, concentrated in forehead, palms and soles, important for thermoregulation
    - Primarily in lower dermis with ducts to epidermal surface
  - Apocrine: also merocrine glands release sweat that exits into hair follicles, found in axilla, pubis areolae and bearded region of face, sweat components change at puberty
    - Mostly in hypodermis with ducts to hair follicles

**Even More Dermal Glands**

- Mammary glands: specialized sudoriferous glands
- Ceruminous glands (modified sudoriferous): produce waxy cerumen in external ear (includes sebaceous secretion)
  - Typically in hypodermis with ducts to surface or sebaceous ducts

**Wound Healing**

- Epidermal wounds: abrasion or 1st or 2nd degree burn
  - Basal cell enlargement and migration toward center of wound
  - Contact inhibition stops migration
  - Basal cell proliferation to fill wound lower layer
  - Normal stratification of epidermal cells

**More Wound Healing**

- Deep wounds that enter dermis and below
  - Inflammatory phase: blood clot, vasodilation (increase phagocytes), increase in fibroblasts
  - Migratory phase: epithelial cells bridge wound, fibroblasts synthesize scar tissue (collagen & glycoproteins), blood vessels regenerate
  - Proliferative phase: increase activities of previous phase

**No More Wound Healing**

- Maturation phase: scab sloughs off, epidermis returns to normal thickness,
reorganization of collagen fibers, fibroblasts decline, blood vessels normal

- Scarring: primarily dense collagen fibers
  - Hypertrophic - within border of wound
  - Keloid - beyond border of wound

**Thermoregulation**

- Negative feedback for cooling across at skin surface (diagram)

**Aging of Skin (late 40’s)**

- Decline in fiber organization (wrinkling)
- Slower growth of hair and nails
- Reduced activity of sebaceous glands (dryness)
- Reduced perspiration (possible heat stroke)
- Decrease melanocytes (gray hair, blotching)
- Reduced subQ fat (thinner skin)
- Decreased activity of fibroblasts & basal cells (slow healing and increased infection)

**Disorders**

- Burn
  - 1st: portions of epidermis only
  - 2nd: epidermis and portions of dermis
  - 3rd: epidermis, dermis and derivatives
- Skin grafts: needed when germinal portion of epidermis destroyed
  - from other portion of body
  - autologous (tissue culture)
  - heterographs: from other animals
  - synthetics

**More Disorders**

- Skin cancer
  - Basal cell carcinomas
  - Squamous cell carcinomas
  - Malignant melanomas
    - signs of malignancy - asymmetrical, uneven borders & color, greater than 6 mm diameter
    - high degree of metastasizing
- Bed Sores