NOTES: Skin and the Integumentary System (Ch 4)
• An **ORGAN** is composed of 2 or more kinds of tissues... an **ORGAN SYSTEM** is composed of 2 or more organs... so...
The **SKIN** is an **ORGAN**!...together with its accessory organs, it constitutes the **INTEGUMENTARY SYSTEM**!
TYPES OF MEMBRANES:

Serous
Mucous
Synovial

**Cutaneous**
(what we will study in this chapter!)
Skin and Its Tissues:

• Functions of Skin:
  - protective covering (i.e. UV, bacteria)
  - regulates body temperature
  - retards water loss
  - holds sensory receptors (heat, touch, …)
  - makes biochemicals
  - excretes wastes
  - synthesizes vitamin D with UV
• **Skin is composed of:**

  **EPIDERMIS** and **DERMIS** separated by a **BASEMENT MEMBRANE**
Epidermis:

• deepest layer (stratum basale) contains cells that divide

• cells undergo KERATINIZATION as they mature and are pushed toward surface

• outermost layer (stratum corneum) is made of dead epidermal cells
Epidermis:
- protects underlying tissues against water loss, injury, and harmful chemicals
Epidermis

- Keratinized stratified squamous epithelium
- Four types of cells
  - **Keratinocytes** – deepest, produce keratin (tough fibrous protein)
  - **Melanocytes** – make dark skin pigment melanin
  - **Merkel cells** – associated with sensory nerve endings
  - **Langerhans cells** – macrophage-like dendritic cells
• pigment **MELANIN** protects underlying cells from UV radiation

• **MELANOCYTES** (melanin-producing cells) transfer melanin to nearby epidermal cells
Skin Color

- all people have about the same concentration of melanocytes;
- where we differ is in the amount and distribution of melanin;
- environmental (sun exposure) and physiological factors, as well as GENES, influence skin color.
• Layers (from deep to superficial)
  – **Stratum basale** or germinatium – single row of cells attached to dermis; youngest cells

  – Stratum spinosum – spinyness is artifactual; tonofilaments (bundles of protein) resist tension

  – Stratum granulosum – layers of flattened keratinocytes producing keratin (hair and nails made of it also)

  – **Stratum lucidum** (only on palms and soles)

  – **Stratum corneum** – horny layer (cells dead, many layers thick)
Epithelium: layers (on left) and cell types (on right)

- **Stratum corneum**: Cells are dead; represented only by flat membranous sacs filled with keratin. Glycolipids in extracellular space.
- **Stratum granulosum**: Cells are flattened; organelles deteriorating; cytoplasm full of lamellated granules (release lipids) and keratohyaline granules.
- **Stratum spinosum**: Cells contain thick bundles of intermediate filaments made of pre-keratin.
- **Stratum basale**: Cells are actively mitotic stem cells; some newly formed cells become part of the more superficial layers.
- **Melanocytes**: Sensory nerve ending
- **Merkel cell**
- **Dermis**
DERMIS:

- binds epidermis to underlying tissues
- dermal blood vessels supply nutrients to all skin cells; also help regulate body temperature
**DERMIS:**

- nerve fibers are scattered throughout the dermis
  - some carry impulses to muscles and glands of the skin
  - some are associated with sensory receptors and carry impulses to the brain and spinal cord
- contains hair follicles, sebaceous glands, and sweat glands
• Strong, flexible connective tissue: your “hide”
• Cells: fibroblasts, macrophages, mast cells, WBCs
• Fiber types: collagen, elastic, reticular
• Rich supply of nerves and vessels
• Critical role in temperature regulation (the vessels)
Epidermis and dermis of (a) thick skin and (b) thin skin

*(which one makes the difference?)*
• Dermis is the site for
  – Fingerprints, palmprints, footprints
  – Receptive site for pigments of tattoos
  – **Striae**: stretch marks
**SUBCUTANEOUS LAYER:**

- “Hypodermis” (Gk) = below the skin
- “Subcutaneous” (Latin) = below the skin
- Also called “superficial fascia”
  
  “fascia” (Latin) = band; in anatomy: sheet of connective tissue
Hypodermis Function

- lies beneath the dermis; consists of loose connective and adipose tissues
- adipose tissue helps conserve body heat
- subcutaneous layer contains blood vessels that supply the skin and adipose tissue
- Fatty tissue which stores fat and anchors skin (areolar tissue and adipose cells)
Hypodermis Accumulation

• Males
  – subcutaneous fat accumulates primarily in the neck, arms, and lower back, above the buttocks, and in the abdominal region (the “paunch”)
Hypodermis Accumulation

- Females
  - Evenly distributed
  - Generally have proportionately more body fat subcutaneous and layers are generally thicker
    - Tend to have softer skin than do men
    - subcutaneous fat is especially prone to accumulate in the breasts, buttocks, hips, and thighs.
• Babies and young children have extensive deposits of “baby fat” in the hypodermis
  – Provides additional insulation against heat loss
  • Important because the smaller a warm-blooded animal is, the faster it tends to lose body heat across its skin surface
  • As children grow larger and become less vulnerable to heat loss, these fat layers (hopefully) become thinner.
• Derived from epidermis but extend into dermis

• Include
  – Hair and hair follicles
  – Sebaceous (oil) glands
  – Sweat (sudoriferous) glands
  – Nails
• Begin part 2
ACCESSORY ORGANS OF THE SKIN:

HAIR FOLLICLES

• derived from epidermis and dermis
• everywhere but palms, soles, nipples, parts of genitalia
• each hair develops from epidermal cells at the base of a tubelike hair follicle
• as new cells develop and grow, older cells are pushed toward the surface and undergo KERATINIZATION
HAIR FOLLICLES

- a bundle of smooth muscle cells is attached to each hair follicle (ARRECTOR PILI MUSCLE)

- hair color is determined by GENES that direct the amount of MELANIN produced by the melanocytes associated with the hair follicles.
• **Functions of hair**
  – **Warmth** – less in man than other mammals
  – **Sense light touch of the skin**
  – **Protection - scalp**

• **Parts**
  – **Root imbedded in skin**
  – **Shaft projecting above skin surface**
• Three concentric layers
  – Medulla (core)
  – Cortex (surrounds medulla)
  – Cuticle (single layers, overlapping)
• Types of hair
  – Vellus: fine, short hairs
  – Intermediate hairs
  – Terminal: longer, courser hair

• Hair color
  – Amount of melanin for black or brown; distinct form of melanin for red
  – White: decreased melanin and air bubbles in the medulla
  – Genetically determined though influenced by hormones and environment
ACCESSORY ORGANS OF THE SKIN:

➔ SEBACEOUS GLANDS

• usually associated with hair follicles
• secrete SEBUM (oily substance) – helps keep skin and hair soft and waterproof
  – Holocrine secretions
• found everywhere except palms and soles
ACCESSORY ORGANS OF THE SKIN:

➔ **NAILS**

- protective covers on ends of fingers and toes
- formed by specialized epidermal cells that are keratinized
- keratin in nails is harder than that produced by epidermal cells in skin
ACCESSORY ORGANS OF THE SKIN:

→ SWEAT GLANDS
• each sweat gland is a COILED TUBE
• sweat is mostly water (plus some salts and waste products)
• Entire skin surface except nipples and part of external genitalia
• **Prevent overheating**
• 500 cc to 12 l/day! (is mostly water)
• Humans most efficient (only mammals have)
• Produced in response to stress as well as heat
**SWEAT GLANDS**

- **ECCRINE** (merocrine)
  - sweat glands respond to elevated body temperature
  - most numerous
  - True sweat (mostly water, some salts, some wastes)
- **APOCRINE** sweat glands respond to emotional stress
  - Axillary, anal and genital areas only
  - Ducts open into hair follicles
  - The organic molecules in it decompose with time – odor
- Modified apocrine glands
  - Ceruminous – secrete earwax
  - Mammary – secrete milk
*Regulation of body temp. is vital because heat affects the rates of metabolic reactions. The normal temperature is close to a “set point” of 37°C (98.6°F). This is regulated by a part of the brain called the HYPOTHALAMUS.
REGULATION OF BODY TEMPERATURE

When body temperature…

➡️ **RISES**: dermal blood vessels dilate (we look "flushed") and sweat glands secrete sweat (evaporative cooling)

➡️ **DROPS**: dermal blood vessels constrict (we look pale) and sweat glands become inactive
REGULATION OF BODY TEMPERATURE

*excessive heat loss stimulates skeletal muscles to contract involuntarily (hair stands up; “goosebumps”)

**FEVER is the result of the hypothalamus raising the body’s temperature “set point”
HEALING OF WOUNDS:

*Skin injuries trigger **INFLAMMATION**. The affected area becomes red, warm, swollen, and tender.
HEALING OF WOUNDS:

• dividing epithelial cells fill in shallow cuts in the epidermis

• blood clots close deeper cuts (sometimes leaves a scar where connective tissue replaces skin)

• the healing of larger, open wounds may involve the formation of **GRANULATIONS** (a new branch of a blood vessel with a cluster of collagen-secreting fibroblasts); will leave a scar.
BURNS

• Threat to life
  – Catastrophic loss of body fluids
  – Dehydration and fatal circulatory shock
  – Infection

• Types
  – First degree – epidermis: redness (e.g. sunburn)
  – Second degree – epidermis and upper dermis: blister
  – Third degree - full thickness, destroying epidermis, dermis, part of hypodermis
First-degree
(epidermis only; redness)

Second-degree
(epidermis and dermis, with blistering)

Third-degree
(full thickness, destroying epidermis, dermis, often part of hypodermis)
Critical burns

- Over 10% of the body has third-degree burns
- 25% of the body has second-degree burns
- Third-degree burns on face, hands, or feet

Estimate by “rule of 9’s”
Tumors of the skin

• Benign, e.g. warts
• Cancer – associated with UV exposure (also skin aging)
  – Aktinic keratosis - premalignant
  – Basal cell - cells of stratum basale
  – Squamous cell - keratinocytes
  – Melanoma – melanocytes: most dangerous; recognition:
    • A - Asymmetry
    • B - Border irregularity
    • C - Colors
    • D - Diameter larger than 6 mm
Skin Cancer

(a) Basal cell carcinoma

(b) Squamous cell carcinoma

(c) Melanoma
COMMON SKIN DISORDERS:

- **ACNE**: disorder of the sebaceous glands; produces blackheads, whiteheads, pimples

- **ATHLETE’S FOOT**: fungal infection; usually affects skin of the toes and soles
COMMON SKIN DISORDERS:

• **IMPETIGO**: bacterial infection; pustules rupture and become covered with crust

• **MOLES**: fleshy skin tumors; usually pigmented (brown to black)
COMMON SKIN DISORDERS:

• **PEDICULOSIS**: lice infestation

• **SCABIES**: mite infestation
COMMON SKIN DISORDERS:

• **PSORIASIS**: red patches covered with scales

• **WARTS**: raised area caused by a virus
COMMON SKIN DISORDERS:

- **SHINGLES**: caused by herpes zoster virus (same virus as chicken pox); causes very painful rash; accompanied by feeling very tired and run down.