I. Structure of the Skin
   a. The skin, or cutaneous membrane, covers the entire body and is the largest organ in the body in terms of surface area and weight.
   b. The skin has two main layers:
      i. Epidermis: the superficial layer of the skin
         1. composed of epithelium
         2. the thinner of the two layers
      ii. Dermis: the deeper layer
         1. Composed of connective tissue
         2. The thicker of the two layers
   c. Hypodermis: the subcutaneous layer deep to the dermis, but not part of the skin.
      i. Areolar CT and Adipose tissue
      ii. Fibers from the dermis anchor the skin to the hypodermis, which attaches to the underlying tissues and organs.
      iii. The hypodermis serves as a storage layer for fat and contains the blood vessels that supply the skin

II. The Epidermis
   a. Composed of keratinized stratified squamous epithelium
   b. Contains 4 types of cells
      i. Keratinocytes: produce the protein Keratin
         1. 90% of the epidermal cells
      ii. Melanocytes: produce the brown/black pigment melanin, which contributes to skin color and absorbs harmful UV light rays, which can cause cancer.
         1. 8% of the epidermal cells
         2. Melanocytes divide quickly and therefore are at higher risk for malignant tumor production
         3. A tumor of melanocytes is called melanoma and may present as a mole.
      iii. Langerhans Cells: help the immune response to microbes that enter the skin
      iv. Merkel Cells: Associated with sensory neurons in the deepest layer of the epidermis
   c. Most of the epidermis has 4 layers (figure 6.3), however the thicker skin of the fingertips, palms, & soles of the feet, have 5.
      i. Stratum Basale: the deepest layer
         1. Composed of a single layer of cuboidal or columnar keratinocytes
         2. Contains stem cells that continually undergo cell division, producing new keratinocytes to rejuvenate the epidermis
         3. If the stratum basale is damaged, the epidermis cannot regenerate, therefore a skin graft is performed
            a. A healthy section of skin is taken from another site on the same body, or from a donor, and attached to the damaged site to help replace and regenerate the skin.
      ii. Stratum Spinosum: Superficial to the Stratum Basale
         1. provides strength and flexibility to the skin
      iii. Stratum Granulosum: The middle of the epidermis
         1. Contains membrane-enclosed Lamellar Granules
            a. Lamellar granules release a lipid-rich secretion that fills the intercellular spaces in the superficial layers of the epidermis
            b. This secretion functions as a water repellent to prevent fluid loss through the skin and the entrance of foreign materials.
iv. **Stratum Lucidum**: Only found in fingertips, palms, and soles of feet
   1. Contains 3-5 layers of flattened, clear, dead keratinocytes.

v. **Stratum Corneum**: The most superficial layer of the epidermis
   1. These cells are continuously shed and replaced from the deeper layers.
   2. The lipids from the lamellar granules are between these cells providing the water-resistant property of skin.
   3. The multiple layers of dead cells protect the deeper layers from injury and microbe invasion.
   4. *Callus* is an abnormal thickening of the stratum corneum resulting from constant exposure to friction.

vi. **Keratinization**: the production of new cells in the stratum basale and the pushing of them to the surface as dead cells are removed.

**d. The Dermis**
   i. Blood vessels, nerves, glands, and hair follicles are embedded in dermal tissue
   ii. Divided into two regions
      1. **Papillary Region**: superficial part
         a. Approx. 1/5 of the total thickness
         b. **Dermal Papillae**: small, finger-like projections that indent the epidermis and increase the surface area of the dermis.
            i. Also contain nerve-endings for touch, temperature, pain, itch, and tickle.
      2. **Reticular Region**: Deeper layer of the dermis
         a. Dense Irregular CT, adipose, hair follicles, sebaceous glands, & sweat glands.
         b. Provides strength and elasticity
            i. Extreme stretching may tear the dermis, causing *striae*, or *stretch marks*
   iii. The surface of the palms, soles, fingers, and toes have a series of ridges and grooves called *epidermal ridges*, designed to increase friction for grip and traction.
      1. They are arranged in straight lines, whorls, or loops.
      2. Produced by the projection of dermal papillae toward the surface and developed in the fetal stages.
      3. The pattern of these ridges is unique from person to person
      4. Sweat glands are found in between the ridges and produce a fingerprint when you touch something.
      5. **Dermatoglyphics**: the study of the epidermal ridges

**III. Structural Basis of Skin Color**
   a. Melanocytes produce a pigment (melanin) in the skin that causes the skin to vary from pale yellow to tan to black.
      i. The actual number of melanocytes in the body is about the same from person to person
      ii. The difference in skin color is dependant on how much melanin is produced.
      iii. Exposure to UV light activates melanocytes and causes them to produce more melanin and resulting in a “tan”, which is lost when the melanin-containing keratinocytes are shed.
   iv. An inability to produce melanin is called *Albinism* and results in loss of pigment all over the body, including skin, hair, and eyes.
   v. A partial or complete loss of melanocytes in patches of skin is called *Vitiligo* and results in loss of pigment in patches.
   b. **Carotene**: a yellow-orange pigment that is a pre-cursor to vitamin A.
      i. Can be found in the stratum corneum and fatty areas of the dermis and hypodermis.

**IV. Accessory Structures of the Skin**
a. **Hair (figure 6.7):** or *pili* are present on most skin surfaces except palms of hands and finger and plantar surfaces of feet and toes.
   i. Hair is composed of columns of dead, keratinized cells bonded together by extracellular proteins
   ii. The superficial portion that projects out of the skin is called the **shaft**
   iii. The **root** is the portion deep to the shaft that penetrates into the dermis.
   iv. The **hair follicle** surrounds the root
   v. The base of the hair follicle has an onion-shaped structure called the **bulb**
   vi. **Arrector Pili** muscles extend from the dermis to the hair follicle and under emotional or physiological stress, such as cold or fright, they contract making the hair stand up off the skin.
   vii. The hair bulb also contains melanocytes, which produce melanin to give the hair color.
   viii. As new cells are added to the base of the root, the hair grows longer.

b. **Functions of Hair**
   i. Protection from heat loss and the sun’s rays
   ii. Protects the eyes, nostrils and ear canals from foreign particles
   iii. Associated with the nervous system’s touch receptors.

V. **Skin Glands:** there are several exocrine glands associated with the skin

a. **Sebaceous Glands:** oil glands
   i. Simple, branched acinar glands
   ii. Lie in the dermis and usually open into a hair follicle.
   iii. Absent in the palms and soles
   iv. Abundant in the skin of the breast, neck, face, and upper chest
   v. Secrete an oily substance called **sebum**
      1. coats the surface of hairs to help keep them from becoming dry and brittle
      2. Also prevents excessive water evaporation from the skin, keeps skin soft and pliable, inhibits growth of certain bacteria

b. **Sudoriferous (Sweat) Glands:** release secretions via exocytosis into a hair follicle or onto the skin’s surface
   i. There are two types of Sweat Glands
      1. Eccrine & Apocrine Glands
         a. Both simple, coiled, tubular glands.
         b. Apocrine glands were once thought to be actual apocrine glands, but are now known to be merocrine glands secreting via exocytosis. However, the name remains the same.
         c. Eccrine Glands are primarily used for thermoregulation and their ducts secrete sweat onto the surface of skin.
         d. Apocrine sweat glands are thought to contribute a scent and secrete a slightly thicker (more viscous) sweat into a hair follicle.
            i. the sweat from apocrine glands is initially odorless, but when it comes in contact with the bacterial flora of the armpits or genitals, the result is a scent.
            ii. Apocrine sweat glands are typically inactive before puberty are activated by hormonal stimulation during puberty.
            iii. mamillary glands of the breasts & ceruminous glands of the ears are modified apocrine sweat glands.

   c. **Ceruminous Glands:**
      i. Secrete ear wax, or **cerumen**, which protects the ears from the entrance of foreign bodies.

VI. **Nails:** plates of tightly packed, hard, keratinized epidermal cells.

a. **Nail body:** visible portion of the nail
b. **Free edge:** the part that extends past the finger
c. **Nail root:** buried in the fold of skin
d. Nails appear pink because they have an underlying bed of capillary vessels.
e. **Lunula:** the crescent-shaped whitish portion near the root of the nail
   i. The stratum basale is thicker in this region and the capillaries do not show through.

**VII. Functions of the Skin**
a. **Thermoregulation:** by liberating sweat at the skin surface and controlling blood flow through the dermis, the skin helps regulate the homeostatic control of body temperature.
   i. When the body core temperature increases, the sweat glands secrete sweat, which is evaporated, cooling the skin surface and the blood in surface vessels. The cooled blood returns to the core to cool it off.
b. **Protection:** protects the underlying tissues from microbes, abrasion, heat, UV light, water loss, & chemicals
c. **Cutaneous Sensations:** Touch, pressure, tickle, itch, temperature, and vibration are all received by nerve receptors in the skin.
d. **Excretion and absorption:** Small role in excretion of some products out of the body and absorption of some products into the body (i.e. topical drugs)
e. **Synthesis of Vitamin D:** vitamin D is activated by UV light absorbed by the skin.

**VIII. Wound Healing (chapter 5)**
a. Damaged skin can be repaired to a normal or near-normal state.
b. Two types:
   i. **Epidermal Wound Healing:** occurs when the wound only penetrates the epidermis.
      1. Abrasions and minor burns are common epidermal wounds
      2. In response to injury Basal cells of the epidermis break contact with the basement membrane and migrate toward the wound to replace the injured cells until opposite sides of the wound meet.
         a. A cellular response called **contact inhibition** causes the cells to stop migrating when they meet.
      3. **Epidermal Growth Factor** stimulates the stem cells to divide and create new cells to replace the migrating cells.
      4. This continues until the wound is resurfaced.
   ii. **Deep Wound Healing:** When the injury extends to the dermis or subcutaneous layer
      1. More complex than epidermal and scar tissue forms that may lose some of the normal function of the injured tissue.
      2. Four Phases Occur:
         a. **Inflammatory Phase:** A blood clot forms in the wound and loosely unites the wound edges
         i. **Inflammation:** a vascular and cellular response that eliminates microbes, dead cells, and foreign materials from the wound site.
         b. **Migratory Phase:** The clot becomes a scab and epithelial cells form beneath the scab to bridge the wound.
            i. **Scar tissue** (made of collagen fibers and glycoproteins) begins to form and damaged blood vessels begin to reform.
            ii. The tissue filling the wound in this phase is called **granulation tissue**
         c. **Proliferative Phase:** extensive growth of epithelial cells beneath the scab, continued growth of blood vessels, and deposition of fibroblasts and collagen fibers in random patterns happens during this phase.
d. **Maturation Phase:** The scab is shed once the epithelium has returned to normal thickness
   i. Collagen fibers become more organized
   ii. Blood vessels are restored to normal.

3. **Fibrosis:** the process of scar formation
   a. Sometimes the scar tissue is so extensive, it forms a scar raised above the skin tissue
      i. If this scar is within the boundaries of the original wound, it is a **hypertrophic scar**
      ii. If it exceeds the boundaries, it is a **keloid scar**
   b. Scar tissue differs from normal tissue in that has more densely arranged collagen fibers, fewer hairs, blood vessels, sensory structures and glands.
      i. Because of this, scars also look different than normal skin in terms of shape, texture, and color.