Skin & the Integumentary System 6.1-6.2

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Chapter 6: Skin & the Integumentary System

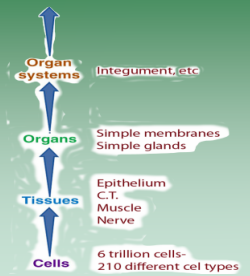
- 6.1 Skin and its Tissues
- 6.2 Accessory Organs of the Skin
- 6.3 Regulation of Body Temperature
- 6.4 Healing of Wounds

The Big Idea

- The Integumentary System & Homeostasis
  - The integumentary system contributes to homeostasis by protecting the body and helping regulate body temperature. It also allows you to sense pleasurable, painful, and other stimuli in your external environment

- The Integumentary System includes the skin, hair, nails, oil and sweat glands, as well as blood vessels, muscles and nerves
  - Note that all 4 of the basic tissue types are well-represented in this organ system:
    - Epithelium in the hair, nails, and the epidermis of the skin
    - The dermis contains CT
    - Muscle is found attached to the hair follicles, and in the substance of arteries and veins
    - Nerves provide an abundance of sensation

- The integument is an organ system comprised of many organs such as hair and multiple types of glands



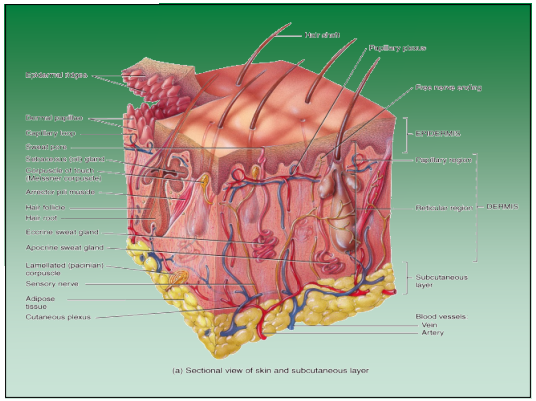
- The integument can also be thought of as a cutaneous membrane that covers the outer surface of the body
  - It is the largest organ by surface area and weight
    - Its area is about 2 square meters (22 square feet) and weighs 4.5–5kg (10–11 lb), about 16% of body weight
    - It is 0.5–4 mm thick, thinnest on the eyelids, thickest on the heels
  - We lose almost a kg of skin epithelium a year that becomes a major part of household "dust"

- Besides protection, the skin contributes to:
  - Regulation of body temperature
  - Sensory perceptions
  - Synthesis of vitamin D
  - Emotional expression
- It also serves as an important reservoir of blood

6.1 Skin & Its Tissues

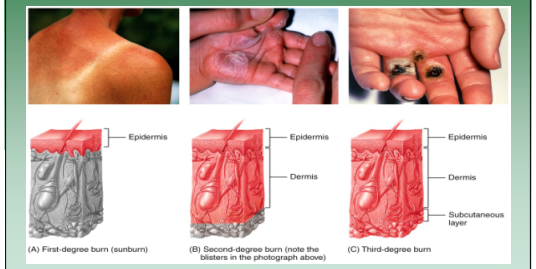
- Objectives
  - Describe the structure of the layers of the skin
  - List the general functions of each layer of skin
  - Summarize the factors that determine skin color

- The skin has 3 major layers:
  - The outer, thinner layer is called the epidermis and consists of epithelial tissue
  - The inner, thicker layer is called the dermis and consists of CT
- The subcutaneous (subQ) layer (also called the hypodermis) is located underneath the dermis and is not a part of the skin
  - It is a loose areolar/adipose CT that attaches the skin to the underlying tissues and organs
  - It contains pacinian (lamellated) corpuscles



(a) Sectional view of skin and subcutaneous layer

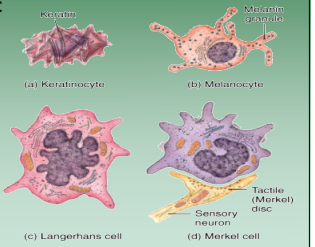
- Dermatologist are doctors who treat disorders of all layers of the integumentary system



(A) First-degree burn (sunburn) (B) Second-degree burn (note the blisters in the photograph above) (C) Third-degree burn

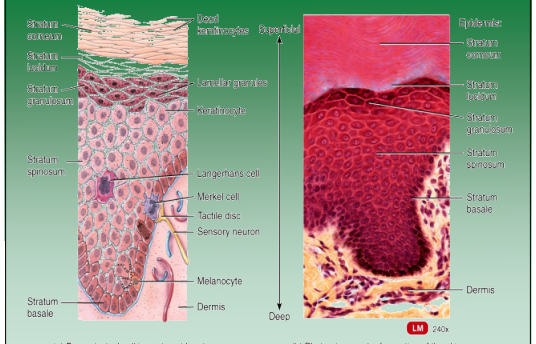
Epidermis

- The epidermis is composed of keratinized stratified squamous epitheliumwhich contains four major types of cells:
  - Keratinocytes
  - Melanocytes
  - Langerhans cells
  - Merkel cells



(a) Keratinocyte (b) Melanocyte (c) Langerhans cell (d) Merkel cell

- Keratinocytes make up 90% of the cells. They produce keratin - a tough fibrous protein that provides protection
- Melanocytes produce the pigment melanin that protects against damage by ultraviolet radiation
- Langerhans cells are macrophages that originated in the red bone marrow. They are involved in the immune responses
- Merkel cells function in the sensation of touch along with the other adjacent tactile discs (receptors)



(a) Four principal cell types in epidermis (b) Photomicrograph of a portion of the skin

- The epidermis is composed of four layers in thin skin, and five layers in thick skin
  - The stratum basale or stratum germinativum is always the bottom (deepest) layer
    - Continuous cell division occurs here and produces all the other layers.
  - The stratum spinosum is a layer of 8–10 keratinocytes
  - The non-dividing cells of the 3rd layer (stratum granulosum) are filled with granules of keratin

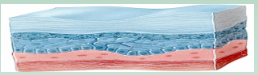
  - The stratum lucidum is the 4th layer but is only present in thick skin (the skin of the fingertips, palms, and soles)
  - The stratum corneum is always outermost, composed of approximately 20 layers of flat cell-remnants that are like "bags of turtle wax" (dead keratinocytes with no cellular organelles filled with only keratin protein)
- Stem cells in the stratum basale undergo continuous cell division, producing keratinocytes for other layers

Subcutaneous Layer

- The subcutaneous layer is also called the hypodermis, and it attaches the skin to underlying tissues and organs
  - It contains blood vessels and nerves in transit to the more superficial layers
  - It also contains lamellated (pacinian) corpuscles that detect external pressure applied to the skin

Multiple Layers

- Multiple layers in the skin allow for specialization
  - Adapted to fast turn-over, the epidermis resists damage and offers protection to underlying tissues
  - The dermis provides temperature stability and prevents dehydration, and yet is capable of limited healing
  - The subcutaneous tissues insulate, store fat, and anchor the skin



Sensory Receptors

- The skin contains different types of sensory receptors to differentiate between the different tactile ("touch") sensations
  - Light touch, pressure, vibration, itch and tickle
- These sensory receptors are found in different layers:
  - Superficially
    - Merkel discs, free nerve endings (detect many stimuli), Meissner corpuscles, and hair root plexuses
  - Deep
    - Pacinian corpuscles

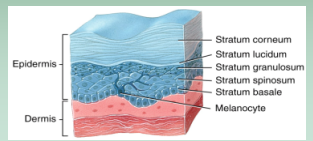
Keratinization & Growth of the Epidermis

- Keratinization is the process of replacing viable cells in the stratum basale with more and more of the waxy keratin protein as cells move from the deepest layer to the surface layer
  - Constant friction can stimulate the process and produce a callus (an even thicker buildup of keratinocytes in the stratum corneum)
  - Dandruff is an excess of keratinized cells shed from the scalp

Dermis

- The dermis is composed of dense irregular connective tissue containing collagen and elastic fibers
- It contains two regions:
  - The papillary region lies just below the epidermis and consists of areolar connective tissue containing thin collagen and fine elastic fibers, dermal papillae (including capillary loops), Meissner corpuscles of touch and free nerve endings

- The reticular region contains bundles of collagen and coarse elastic fibers, fibroblasts, macrophages, adipose cells, hair follicles, nerves, sebaceous (oil) glands, and sudoriferous (sweat) glands
  - Tears or excessive stretching in this region cause stretch marks (also called *striae*)

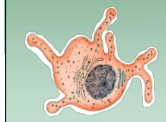


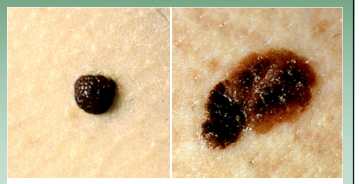
- Lines of cleavage are "tension lines" in the skin that indicate the predominant direction of underlying collagen fibers
  - Plastic surgeons make their incisions parallel to the normal cleavage lines in order to minimize scarring
- Epidermal ridges reflect contours of the underlying dermal papillae and form the basis for fingerprints (and footprints)
  - Function to increase firmness of grip by increasing friction

The Structural Basis of Skin Color

- Melanin is produced by melanocytes in the stratum basale
  - Eumelanin (brown to black)
  - Pheomelanin (yellow to red)
- Freckles are clusters of concentrated melanin triggered by exposure to sunlight
- Having more freckles is a genetic trait

- Nevi ("birthmarks" or moles) are chronic lesions of the skin – they are, by definition, benign
- Malignant melanoma is a cancer of melanocytes





(a) Normal nevus (mole) (b) Malignant melanoma

- Vitiligo is a chronic disorder that causes depigmentation patches in the skin
  - The precise pathogenesis, or cause, is not known, but is most likely a combination of genetic factors coupled with a disorder of the immune system (autoimmune disease)

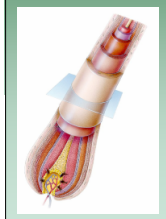
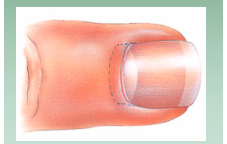
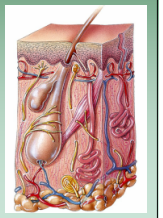
- Albinism is a congenital disorder characterized by the complete or partial absence of pigment in the skin, hair, and eyes due to a defect of an enzyme involved in the production of melanin

Tattooing & Body Piercing

- In tattooing, a pigment is deposited with a needle in the dermis
- Body piercing is the insertion of jewelry through an artificial opening

6.2 Accessory Organs of the Skin

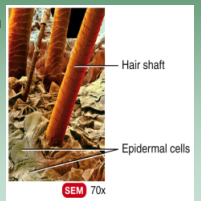
- Objectives
  - Describe the accessory organs associated with the skin

Hair

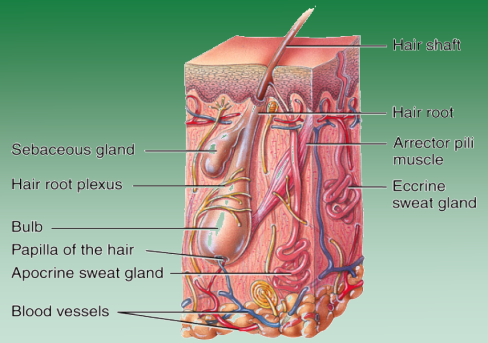
- Hair is associated with the word "pili"
- It is present on most surfaces except the palms, anterior surfaces of fingers, and the soles of the feet
- It is composed of dead, keratinized epidermal cells
- Genetics determines thickness and distribution
- Hair helps with touch sensations and protects the body against the harmful effects of the sun and against heat loss

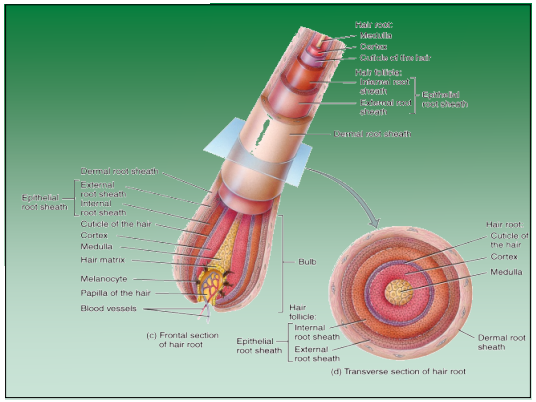
- The parts of a hair include:
  - The shaft (above the skin surface)
  - The follicle (below the level of the skin)
  - A root that penetrates into the dermis includes:
    - An epithelial root sheath
    - A dermal root sheath



(b) Several hair shafts showing the shinglelike cuticle cells

- Associated with each hair follicle is a sebaceous gland, an arrector pili muscle, and a hair root plexus
- New hairs develop from the division of hair matrix cells in the bulb
  - Hair replacement and growth occur in a cyclical pattern consisting of growth, regression, and resting stages





- Types of hairs
  - Lanugo is fine, nonpigmented, downy hairs that cover the body of the fetus
  - Vellus hairs are short, fine, pale hairs barely visible to the naked eye
    - Most body hair on females
  - Terminal hairs are long, coarse, heavily pigmented hairs
    - Most body hair on men
- Hair color is determined by the amount and type of melanin

Skin Glands

- Glands are epithelial cells that secrete a substance
- Sebaceous (oil) glands are connected to hair follicles
  - They secrete an oily substance called sebum
    - Prevents dehydration of hair and waterproofs the skin
    - Clogged sebaceous glands may produce acne

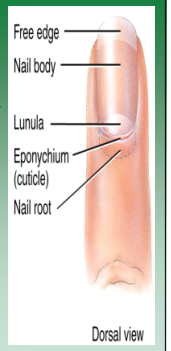
- In addition to oil glands, there are 2 types of skin sweat glands (also called sudoriferous glands). Both are simple, coiled tubular glands
  - Eccrine sweat glands are the most numerous and their ducts terminate at pores at the surface of the epidermis
    - They secrete a watery solution (600 ml per day) that helps to cool the body and eliminates small amounts of waste
  - Apocrine sweat glands are located mainly in the skin of the axilla, groin, areolae, and bearded facial regions of adult males
    - Their ducts open into hair follicles and secrete a slightly viscous sweat

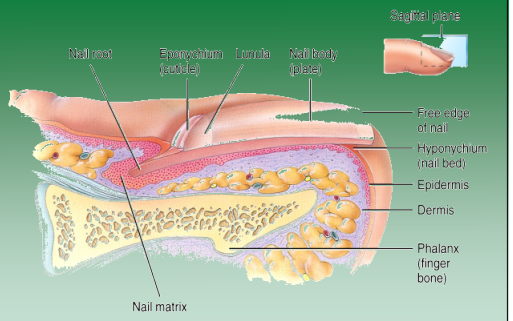
- Eccrine sweat glands release sweat in response to an emotional stress such as fear or embarrassment
  - This type of sweating is referred to as emotional sweating or a "cold sweat"
- The secretory portion of apocrine sweat glands is located mostly in the subcutaneous layer, and the excretory duct opens into hair follicles, with sweat secreted during emotional stress and sexual excitement
  - Much of body odor is due to apocrine sweat

- Ceruminous glands are modified sweat glands located in the ear canal
  - Along with nearby sebaceous glands, they are involved in producing a waxy secretion called cerumen (earwax) which provides a sticky barrier that prevents entry of foreign bodies into the ear canal

Nails

- Nails are composed of hard, dead, keratinized epidermal cells located over the dorsal surfaces of the ends of fingers and toes
- Nail structures include:
  - Free edge
  - Transparent nail body (plate) with a whitish lunula at its base
  - Nail root embedded in a fold of skin
- Cell division of the nail matrix cells produces new nails





(b) Sagittal section showing internal detail