Chapter 6
Skin and the Integumentary System

• Composed of several tissues
• Maintains homeostasis
• Protective covering
• Retards water loss
• Regulates body temperature
• Houses sensory receptors
• Contains immune system cells
• SYNthesizes chemicals, including Vitamin D
• Excretes small amounts of waste
Layers of Skin

- Epidermis
- Dermis
- Subcutaneous layer

Stratified squamous epithelium
Irregular dense connective tissue
Glandular epithelium
Adipose tissue
Epidermis, Dermis, & Basement Membrane

- Epidermis is subdivided into layers of stratified squamous epithelium.
- Dermis is made up of connective tissue, epithelial tissue, smooth muscle tissue, nervous tissue, and blood.
- Basement membrane is anchored to the dermis by short fibrils and separates these two layers of skin.
Epidermis

- lacks blood vessels
- keratinized
- thickest on palms and soles (0.8-1.4mm)
- melanocytes provide melanin
- rests on basement membrane
- stratified squamous
Layers of Epidermis
- stratum corneum
- stratum lucidum
- stratum granulorum
- stratum spinosum
- stratum basale
## Layers of the Epidermis

<table>
<thead>
<tr>
<th>Layer</th>
<th>Location</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stratum corneum</td>
<td>Outermost layer</td>
<td>Many layers of keratinized, dead epithelial cells that are flattened and nonnucleated</td>
</tr>
<tr>
<td>Stratum lucidum</td>
<td>Between stratum corneum and stratum granulosum on soles and palms</td>
<td>Cells appear clear; nuclei, organelles, and cell membranes are no longer visible</td>
</tr>
<tr>
<td>Stratum granulosum</td>
<td>Beneath the stratum corneum</td>
<td>Three to five layers of flattened granular cells that contain shrunken fibers of keratin and shrieveled nuclei</td>
</tr>
<tr>
<td>Stratum spinosum</td>
<td>Beneath the stratum granulosum</td>
<td>Many layers of cells with centrally located, large, oval nuclei and developing fibers of keratin; cells becoming flattened</td>
</tr>
<tr>
<td>Stratum basale (basal cell layer)</td>
<td>Deepest layer</td>
<td>A single row of cuboidal or columnar cells that divide and grow; this layer also includes melanocytes</td>
</tr>
</tbody>
</table>
## Skin Changes: Rashes

<table>
<thead>
<tr>
<th>Illness</th>
<th>Description of Rash</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken pox</td>
<td>Tiny pustules start on back, chest, or scalp and spread for three to four days. Pustules form blisters, then crust, then fall away.</td>
<td><em>Herpes varicella</em></td>
</tr>
<tr>
<td>Fifth disease</td>
<td>Beginning with “slapped cheek” appearance, then red spots suddenly cover entire body, lasting up to two days.</td>
<td><em>Human parvovirus B19</em></td>
</tr>
<tr>
<td>Impetigo</td>
<td>Thin-walled blisters and thick, crusted lesions appear.</td>
<td><em>Staphylococcus aureus, Streptococcus pyogenes</em></td>
</tr>
<tr>
<td>Lyme disease</td>
<td>Large rash resembling a bull’s-eye usually appears on thighs or trunk.</td>
<td><em>Borrelia burgdorferi</em></td>
</tr>
<tr>
<td>Rosacea</td>
<td>Flushing leads to sunburned appearance in center of face. Red pimples and then wavy red lines develop.</td>
<td>Unknown, but may be a microscopic mite living in hair follicles</td>
</tr>
<tr>
<td>Roseola infantum</td>
<td>Following high fever, red spots suddenly cover entire body, lasting up to two days.</td>
<td><em>Herpesvirus 6</em></td>
</tr>
<tr>
<td>Scarlet fever</td>
<td>Rash resembling sunburn with goose bumps begins below ears, on chest and underarms, and spreads to abdomen, limbs, and face. Skin may peel.</td>
<td><em>Group A Streptococcus</em></td>
</tr>
<tr>
<td>Shingles</td>
<td>Small, clear blisters appear on inflamed skin. Blisters enlarge, become cloudy, crust, then fall off.</td>
<td>The virus that causes chicken pox stays in peripheral nerves, affecting the area where the nerve endings reach the skin.</td>
</tr>
</tbody>
</table>
All people have the same number of melanocytes in their skin
Albinism: Lack of Melanin
Paul Bettany in Columbia Pictures' The Da Vinci Code - 2005

THE ALBINO MONK?
Dermis

- on average 1.0-2.0mm thick
- dermal papillae
- binds epidermis to underlying tissues
- irregular dense connective tissue
- muscle cells
- nerve cell processes
- blood vessels
- hair follicles
- glands
- hypodermis
- loose connective tissue
- adipose tissue
- insulates
- major blood vessels
- epidermal cells
- tube-like depression
- extends into dermis
- hair root
- hair shaft
- hair papilla
- dead epidermal cells
- melanin
- arrector pili muscle
Keratinized cells of hair shaft

Keratinized squamous cells of epidermis
With age, a loss of melanin in hair can lead to grayness.

Everyone except albinos have various amounts of melanin in their hair.

Red Heads have iron pigment (trichosiderin).

Examples of hair color variation.
Nails

- protective coverings
- nail plate
- nail bed
- lunula
Sebaceous Glands

- usually associated with hair follicles
- holocrine glands – disintegrating cell and its contents for the secretion
- secrete sebum
- absent on palms and soles
Hair shaft
Epidermis
Hair follicle
Dermis
Sebaceous gland
Sweat or Sudoriferous Glands

- widespread in skin
- deeper dermis or hypodermis

- eccrine glands – types of merocrine gland that secrete fluid (sweat) product released through the cell membrane

- apocrine sweat, ceruminous (wax), & mammary (milk) glands – types of apocrine glands that secrete cellular product and portion of the free ends of cells
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Function</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Sebaceous glands</td>
<td>Groups of specialized epithelial cells</td>
<td>Keep hair soft, pliable, waterproof</td>
<td>Near or connected to hair follicles, everywhere but on palms and soles</td>
</tr>
<tr>
<td>Eccrine sweat glands</td>
<td>Abundant sweat glands with odorless secretion</td>
<td>Lower body temperature</td>
<td>Originate in deep dermis or subcutaneous layer and open to surface on forehead, neck, and back</td>
</tr>
<tr>
<td>Apocrine sweat glands</td>
<td>Less numerous sweat glands with secretions that develop odors</td>
<td>Wet skin during pain, fear, emotional upset, and sexual arousal</td>
<td>Near hair follicles in armpit, groin, around nipples</td>
</tr>
<tr>
<td>Ceruminous glands</td>
<td>Modified sweat glands</td>
<td>Secrete earwax</td>
<td>External ear canal</td>
</tr>
<tr>
<td>Mammary glands</td>
<td>Modified sweat glands</td>
<td>Secrete milk</td>
<td>Breasts</td>
</tr>
</tbody>
</table>
Regulation of Body Temperature
Control center
Hypothalamus
detects the deviation
from the set point and
signals effector organs.

Stimulus
Body temperature rises
above normal.

Response
Body heat is lost to surroundings,
temperature drops toward normal.

Normal body temperature
37°C (98.6°F)

too high

Stimulus
Body temperature drops below normal.

Response
Body heat is conserved,
temperature rises toward normal.

too low

Receptors
Thermoreceptors
send signals to the
control center.

Effectors
Dermal blood vessels dilate and sweat glands
secrete.

Effectors
Dermal blood vessels constrict and sweat glands
remain inactive.

Effectors
Muscle activity generates body heat.

If body temperature continues to drop,
control center signals muscles to contract
involuntarily.
Problems in Temperature Regulation

Hyperthermia – abnormally high body temperature

Human Body Temperature = $37^\circ$ C or $98.6^\circ$ F.

Hypothermia – abnormally low body temperature
Skin Color

Genetic Factors
- varying amounts of melanin
- varying size of melanin granules
- albinos lack melanin

Environmental Factors
- sunlight
- UV light from sunlamps
- X rays

Physiological Factors
- dilation of dermal blood vessels
- constriction of dermal blood vessels
- carotene
- jaundice

George Hamilton – sun worshiper?
The Tan Man at The University of Kansas

http://www2.ljworld.com/news/2006/may/03/hes_still_tan_after_all_these_years/?city_local
Healing of Cuts

(a) Site of injury
(b) Blood cells
(c) Blood clot
(d) Scab
(e) Scar tissue
(f) Fibroblasts
Healing of Burns

First degree burn – superficial partial-thickness (epidermis damaged)

Second degree burn – deep partial-thickness (epidermis & dermis damaged)

Third degree burn – full-thickness (epidermis, dermis, & accessory skin structures)
  • autograft (self-transplant)
  • homograft (temporary transplant from donor)
  • various skin substitutes
  • extensive scars
Rule of Nines

Anterior head and neck 4 1/2%
Anterior trunk 18%
Anterior upper extremities 9%
Anterior lower extremities 18%
Anterior and posterior trunk 36%
Anterior and posterior lower extremities 18%
Posterior head 4 1/2%
Posterior trunk 18%
Posterior upper extremities 9%
Posterior lower extremities 18%
Perineum 1%
100%
Life Span Changes

- Scaly skin
- Age spots
- Dermis becomes reduced
- Loss of fat
- Wrinkles
- Sagging
- Sebaceous glands secrete less oil
- Melanin production slows
- Hair thins
- Number of hair follicles decrease
- Impaired nail growth
- Sensory receptors decline
- Inability to control body temperature
- Less vitamin D production
Life Span Changes - Skin
Acne Vulgaris

• most common skin disorder
• sebum and epithelial cells clog glands
• produces whiteheads and blackheads (comedones)
• anaerobic bacteria trigger inflammation (pimple)
• largely hormonally induced
• androgens stimulate sebum production
• treatments include antibiotics, topical creams, birth control pills
<table>
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<tr>
<th>Condition</th>
<th>Treatment</th>
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<tr>
<td>Noninflammatory comedonal acne (blackheads and whiteheads)</td>
<td>Topical tretinoin or salicylic acid</td>
</tr>
<tr>
<td>Papular inflammatory acne</td>
<td>Topical antibiotic</td>
</tr>
<tr>
<td>Widespread blackheads and pustules</td>
<td>Topical tretinoin and systemic antibiotic</td>
</tr>
<tr>
<td>Severe cysts</td>
<td>Systemic isotretinoin</td>
</tr>
<tr>
<td>Explosive acne (ulcerated lesions, fever, joint pain)</td>
<td>Systemic corticosteroids</td>
</tr>
</tbody>
</table>
Common Skin Disorders

- Athlete’s foot – tinea pedis or ringworm fungal infection of the foot.
- Birthmark – congenital blemish or spot on the skin.
- Boil – bacterial infection of the skin produced when bacteria enter a hair follicle.
- Carbuncle – bacterial infection, similar to a boil, that spreads into the subcutaneous tissues.
- Cyst – fluid-filled capsule.
- Eczema – noncontagious skin rash.
- Erythema – reddening of the skin due to dilation of dermal blood vessels in response to injury or inflammation.
- Herpes – characterize by a recurring formations of small clusters of vesicles; usually caused by herpes simplex virus; contagious.
- Keloid – elevated enlarging fibrous scar usually initiated by an injury.
- Mole – fleshy skin tumor that is usually pigmented.
- Pediculosis – disease produced by an infestation of lice.
- Pruritus – itching of the skin.
- Pusule – elevated, pus-filled area.
Xeroderma Pigmentosum

- Extreme freckling and skin cancer due to lack of DNA repair enzymes.
Types of Skin Cancer

(a) Squamous cell carcinoma – derived from epithelial tissue
(b) Basal cell carcinoma – derived from epithelial tissue
(c) Malignant melanoma – derived from melanocytes