Chapter 05

Lecture Outline

See separate PowerPoint slides for all figures and tables pre-inserted into PowerPoint without notes.
Chapter 5-Integumentary System

- What does integument mean? covering

- Components:
  - skin
  - hair
  - nails
  - glands
Functions

1. **Protection:**
   - water loss, microbes, UV light

2. **Sensation:**
   - hot, cold, pain, pressure

3. **Temperature regulation:**
   - helps maintain homeostasis
4. Excretion:
   removes waste

5. Vitamin D production:
   UV light stimulates production
Skin Facts

• Weighs 9 lbs.

• Used to determine body fat

• 2 main regions: epidermis and dermis
Figure 5.2 Epidermis and Dermis
(a) The epidermis rests on the dermis. Dermal papillae project toward the epidermis. (b) Photomicrograph of the epidermis resting on the dermis. Note the strata of the epidermis and the papillae of the dermis.
Epidermis

• 1st major skin region (outside)

• Composed of stratified squamous epithelium

• Keratinization:
  - process in which new cells (with keratin) push old cells to surface
  - 40-56 days for new cells to reach surface
Strata of Epidermis

- **Stratum corneum:**
  - outermost layer of epidermis
  - 20-30 layers of dead squamous cells filled with keratin
  - accounts for 75% of epidermal thickness
  - **dandruff** is this layer flaking off scalp

- **Callus:**
  forms when stratum corneum has frequent friction
• **Stratum basale:**
  - deepest layer of epidermis
  - single layer of cells
  - firmly attached to dermis
Dermis

- 2nd major skin region
- Dense connective tissue
- Contains collagen and elastic fibers
- Contains fibroblasts, nerve endings, smooth muscle, glands, blood vessels, and hair follicles
- Cleavage lines:
  - area where skin is most resistant to stretching
  - due to orientation of collagen fibers
  - important in scarring
An incision made across cleavage lines can gap, increasing the time needed for healing and resulting in increased scar tissue formation.

An incision made parallel to cleavage lines results in less gapping, faster healing, and less scar tissue.

Figure 5.3 Cleavage Lines
The orientation of collagen fibers produces cleavage lines, or tension lines, in the skin.
Layers of Dermis

• Papillary layer:
  - thin connective tissue layer that contains blood vessels

- Dermal papillae:
  - projections that extend up into epidermis
  - remove waste and help regulate body temp.
  - ridged on hands and feet (fingerprints)
  - pattern is genetically determined
• Reticular layer:
  - deepest layer of dermis
  - accounts for 80% of dermis
Hypodermis

- Below dermis
- Foundation of skin
- Attaches skin to underlying muscle and bone
- Contains loose and adipose tissue
- Contains $\frac{1}{2}$ of body’s fat
- Body fat for females 20-23%, males 13-25%
Skin Color and Variations

- Determined by:
  - pigments
  - genetics
  - blood circulation
  - thickness of stratum corneum

- Melanocytes of darker skinned people produce more and darker melanin than fairer skinned people

- All races have same number of melanocytes
Skin Pigments

- **Melanin:**
  - produced by *melanocytes*
  - ranges from yellow to reddish-brown to black
  - responsible for hair and eye color
  - provides protection against UV light
  - amt. produced determined by genetics, UV light, hormones
  - freckles are accumulation of melanin
  - albinism is absence of melanin
Melanosomes are produced by the Golgi apparatus of the melanocyte.

Melanosomes move into the melanocyte cell processes.

Epithelial cells phagocytize the tips of the melanocyte cell processes.

The melanosomes, which were produced inside the melanocytes, have been transferred to epithelial cells and are now inside them.

**PROCESS Figure 5.4  Melanin Transfer to Epithelial Cells**

Melanocytes make melanin, which is packaged into melanosomes and transferred to many epithelial cells.
• Carotene:
  - yellow-orange pigment found in plants
  - accumulates in stratum corneum

• Hemoglobin:
  - gives pinkish-red color
  - found in red blood cells
Tanning and Sunburns

• Exposure to UV light stimulates melanocytes to increase production of melanin
• Melanin builds up to help protect skin against UV radiation (tan)
• A sunburn is the skin reacting to UV exposure
• UV light causes elastic fibers to clump and become leathery
• UV light can alter DNA in cells causing them to mutate (cancer)
Skin Color and Disease

• **Redness:**
  fever, hypertension, inflammation, allergies

• **Pallor:**
  anemia or low blood pressure

• **Jaundice:**
  liver disorder (yellow)

• **Bronzing:**
  Addison’s disease (kidney disease)

• **Bruising:**
  broken blood vessels
Hair Components

• **Hair/shaft:**
  flexible strands of keratinized cells

• **Root:**
  below skin (scalp)
• Hair Bulb:
  - base of root
  - where hair is produced

• Hair Follicle:
  - group of cells that surround root and bulb
  - gives hair different shapes
Figure 5.5 Hair Follicle

(a) Hair within a hair follicle. (b) Enlargement of the hair bulb and hair follicle wall.
How is Hair Produced?

• Hair is produced in hair bulb

• Hair bulb rests on blood vessels to supply it with nutrients

• Hair grows longer as cells are added to base of hair bulb
Hair Facts

• Testosterone and good nutrition promote hair growth
• Growth occurs in cycles: active and resting
• Scalp hair grows for 3 years and rests for 1 year
• Eyelashes grow for 30 days and rest for 105 days
• We lose about 90 scalp hairs/day
• Grey hair is the loss or fading of melanin
• Male pattern baldness is from the loss of the hair follicle
Hair Muscles

• Arrector Pili:
  - smooth muscle that surrounds each hair follicle
  - contracts and hair stands on end (goose bumps)
Glands

• **Sebaceous glands:**
  - connected to hair follicle
  - **sebum:** oily substance that lubricates hair and skin to prevent drying

• **Eccrine sweat glands:**
  - all over body and open into sweat pores
  - water and salt secretions
• Apocrine sweat glands:
  - open into hair follicle
  - only in armpits and genitalia
  - thick, rich secretions
  - become active during puberty and cause body odor
Nails

• **What are they?**

  thin plate with layers of dead stratum corneum cells with hard keratin
Nail Structure

• **Nail body:**
  visual part

• **Nail root:**
  covered by skin

• **Cuticle:**
  stratum corneum that extends into nail body
• **Nail matrix:**
  - continuation of nail root
  - gives rises to most of nail

• **Nail bed:**
  attaches to nail and is distal to nail matrix

• **Lunula:**
  - part of nail matrix
  - whitish, crescent shaped area
  - base of nail
Figure 5.7 Nail
(a) Dorsal view of the exterior nail. (b) Lateral view of a sagittal section through the nail. Most of the epidermis is absent from the nail bed.
Vitamin D Production

1. UV light causes skin to produce a precursor molecule of vitamin D
2. Precursor is carried by blood to liver where it is modified
3. Next to kidneys where it is modified again to form active vitamin D
   • Vitamin D can also be ingested through fish oils, fortified milk, eggs, and butter.
   • Vitamin D stimulates intestine to absorb calcium and phosphate (bone growth and muscle function)
Temperature Regulation

• Body temp. should be 98.6°C
• Rate of chemical reactions (metabolism) is altered by changes in temp.
• To cool body:
  blood vessels in dermis dilate and heat is transferred from deep in tissues to skin and sweat is produced
• Too heat body:
  blood vessels constrict to reduce blood flow to skin and heat is retained
1. Blood vessel dilation results in increased blood flow toward the surface of the skin.

2. Increased blood flow beneath the epidermis results in increased heat loss (gold arrows).

3. Blood vessel constriction results in decreased blood flow toward the surface of the skin.

4. Decreased blood flow beneath the epidermis results in decreased heat loss.

PROCESS Figure 5.8  Heat Exchange in the Skin
Aging and the Integument

- Blood flow decreases and skin becomes thinner due to decreased amounts of collagen

- Decreased activity of sebaceous and sweat glands make temperature regulation more difficult

- Loss of elastic fibers cause skin to sag and wrinkle
Classification of Burns

• 1\textsuperscript{st} degree:
  - damages only epidermis
  - redness, slight swelling, pain
  - heals within 2-3 days (usually no scar)
  - includes sunburns or exposure to cold

• 2\textsuperscript{nd} degree:
  - damages epidermis and upper dermis
  - redness, swelling, pain, blisters
  - heals in 2 weeks with some scarring
• 3<sup>rd</sup> degree:
  - destroys epidermis and dermis
  - burned areas are cherry red to black
  - nerve endings are destroyed
  - skin graft might be necessary
Epidermis

Dermis

Subcutaneous tissue

Partial-thickness

First-degree

Second-degree

Full-thickness

Third-degree
Skin Cancer

• Most common cancer
• Mainly caused by UV light exposure
• Fair-skinned people more prone
• Prevented by limiting sun exposure and using sunscreens
• UVA rays cause tan and is associated with malignant melanomas
• UVB rays cause sunburns
• Sunscreens should block UVA and UVB rays
Types of Skin Cancer

• **Basal cell carcinoma:**
  - cells in stratum basale affected
  - cancer removed by surgery

• **Squamous cell carcinoma:**
  - cells above stratum basale affected
  - can cause death

• **Malignant melanoma:**
  - arises from melanocytes in a mole
  - rare type
  - can cause death