Chapter 5: Tissue: The Integumentary System

Objectives:
1. Name the tissue types composing the epidermis and dermis. List the major layers of each and describe the functions of each layer.
2. Describe the factors that normally contribute to skin color. Briefly describe how changes in skin color may be used as clinical signs of certain disease states.
3. Compare the structure and locations of sweat and oil gland. Also compare the composition and functions of their secretions.
4. Compare and contrast eccrine and apocrine glands.
5. List the parts of a hair follicle and explain the function of each part. Also describe the functional relationship of arrector pili muscles to the hair follicle.
6. Name the regions of a hair and explain the basis of hair color. Describe the distribution, growth, replacement, and changing nature of hair during the life span.
7. Describe the structure of nails.
8. Describe how the skin accomplishes at least five different functions.
9. Summarize the characteristics of the three major types of skin cancers.
10. Explain why serious burns are life threatening. Describe how to determine the extent of a burn and differentiate first-, second-, and third-degree burns.
11. Describe and attempt to explain the causes of changes that occur in the skin from birth to old age.

Integumentary System – the skin and derivatives (sweat and oil glands, hair, nails)

I. The Skin (integument)
   A. Consists of three major regions
      1. Epidermis – outermost superficial region
      2. Dermis – middle region
      3. Hypodermis (superficial fascia) – deepest region
   B. Epidermis
      1. Composed of keratinized stratified squamous epithelium
      2. Consisting of four distinct cell types and four or five layers
      3. Cell types
a. keratinocytes  
b. melanocytes  
c. Merkel cells  
d. Langerhans’ cells  
4. Outer portion of the skin, exposed to the external environment functions in protection  

C. Cells of the Epidermis  
1. Keratinocytes – produce the fibrous protein keratin  
2. Melanocytes – produce the brown pigment melanin  
3. Langerhans’ cells – epidermal macrophages that help activate the immune system  
4. Merkel cells – function as touch receptors in association with sensory nerve endings  

D. Layers of the Epidermis  
1. Stratum Basale (Basal Layer)  
a. Deepest epidermal layer firmly attached to the dermis  
b. Consists of a single row of the youngest keratinocytes  
c. Cells undergo rapid division, hence its alternate name, stratum germinativum  
2. Stratum Spinosum (Prickly Layer)  
a. Cells contain a weblike system of intermediate filaments attached to desmosomes  
b. Melanin granules and Langerhans’ cells are abundant in this layer  
3. Stratum Granulosum (Granular Layer)  
a. Thin; three to five cell layers in which drastic changes in keratinocyte appearance occurs  
4. Stratum Lucidum (Clear Layer)  
a. Thin, transparent band superficial to the stratum granulosum  
b. Consists of a few rows of flat, dead keratinocytes  
c. Present only in thick skin  
5. Stratum Corneum (Horny Layer)  
a. Outermost layer of keratinized cells  
b. Accounts for three quarters of the epidermal thickness  
c. Functions  
1) Waterproofing  
2) Protection from abrasion and penetration  
3) Rendering the body relatively insensitive to biological, chemical, and physical assaults
E. Dermis
1. Second major skin region containing strong, flexible connective tissue
2. Cell types
   a. fibroblasts
   b. macrophages
   c. mast cells
   d. white blood cells
3. Two layers
   a. papillary
   b. reticular

F. Layers of the Dermis
1. Papillary Layer
   a. Areolar connective tissue with collagen and elastic fibers
   b. superior surface contains peglike projections called dermal papillae
   c. Dermal papillae contain
      1) capillary loops
      2) Meissner’s corpuscles
      3) free nerve endings
2. Reticular Layer
   a. Accounts for approximately 80% of the thickness of the skin
   b. Collagen fibers in this layer add strength and resiliency to the skin
   c. Elastin fibers provide stretch-recoil properties

G. Hypodermis
1. Subcutaneous layer deep to the skin
2. Composed of adipose and areolar connective tissue

H. Skin Color
1. Three pigments contribute to skin color
   a. Melanin – yellow to reddish-brown to black pigment, responsible for dark skin colors
      1. Freckles and pigmented moles – result from local accumulations of melanin
   b. Carotene – yellow to orange pigment, most obvious in the palms and soles of the feet
   c. Hemoglobin – reddish pigment responsible for the pinkish hue of the skin

II. Appendages of the Skin
A. Sweat Glands (Sudoriferous)
1. Prevent overheating of the body
2. Secrete cerumen and milk
3. Types
   a. Eccrine sweat glands – found in palms, soles of the feet, and forehead
   b. Apocrine sweat glands – found in axillary and anogenital areas
   c. Ceruminous glands – modified apocrine glands in external ear canal that secrete cerumen
   d. Mammary glands – specialized sweat glands that secrete milk

B. Sebaceous Glands
1. Simple alveolar glands found all over the body
2. Soften skin when stimulated by hormones
3. Secrete an oily secretion called sebum

C. Hair
1. Filamentous strands of dead keratinized cells produced by hair follicles
2. Contains hard keratin which is tougher and more durable than soft keratin of the skin
3. Made up of the shaft projecting from the skin, and the root embedded in the skin
4. Three parts
   a. medulla
   b. cortex
   c. cuticle
5. Pigmented by melanocytes at the base of the hair
6. Functions of hair
   a. helping to maintain warmth
   b. alerting the body to presence of insects on the skin
   c. guarding the scalp against physical trauma, heat loss, and sunlight
7. Distribution
   a. entire skin surface except:
      1) palms, soles, and lips
      2) nipples and portions of the external genitalia

D. Hair Follicle
1. Root sheath extending from the epidermal surface into the dermis
2. Deep end is expanded forming a hair bulb
3. A knot of sensory nerve endings (a root hair plexus) wraps around each hair bulb
4. Bending a hair stimulates these endings, act as sensitive touch receptors

E. Nail
   A. Scale-like modification of epidermis
   B. Forms clear protective covering on dorsal surface of distal part of finger or toe
   C. Contain hard keratin
   D. Three parts
      1. free edge
      2. body – visible or attached portion
      3. root – embedded in skin
   E. Nail bed
      1. deeper layers of epidermis extend beneath nail
   F. Nail Matrix
      1. thickened proximal portion in nail bed
      2. responsible for growth
   G. Lunula
      1. little moon
      2. lies over thick nail matrix
   H. Nail Folds
      1. Cuticle (Eponychium)
         a. on the nail
      2. Hyponychium
         b. below the nail

III. Functions of the Integumentary System
   A. Protection
      1. chemical, physical, and mechanical barrier
   B. Body temperature regulation
      1. Dilation (cooling) and constriction (warming) of dermal vessels
      2. Increasing sweat gland secretions to cool the body
      3. Cutaneous sensation – exoreceptors sense touch and pain
   C. Metabolic functions
      1. Synthesis of vitamin D in dermal blood vessels
   D. Blood reservoir
      1. Skin blood vessels store up to 5% of the body’s blood volume
   E. Excretion
      1. Limited amounts of nitrogenous wastes are eliminated from the body in sweat
IV. Homeostatic Imbalances of Skin

A. Skin Cancer

1. Most skin tumors are benign and do not metastasize
2. Three major types
   a. Basal cell carcinoma
   b. Squamous cell carcinoma
   c. Melanoma
3. Basal Cell Carcinoma
   a. Least malignant and most common skin cancer
   b. Stratum basale cells proliferate and invade the dermis and hypodermis
   c. Slow growing and do not often metastasize
   d. Can be cured by surgical excision in 99% of the cases
4. Squamous Cell Carcinoma
   a. Arises from keratinocytes of stratum spinosum
   b. Arise most often on scalp, ears, and lower lip
   c. Grows rapidly and metastasizes if not removed
   d. Prognosis is good if treated by radiation therapy or removed surgically
5. Melanoma
   a. Cancer of melanocytes is the most dangerous type of skin cancer because it is:
      1) Highly metastatic
      2) Resistant to chemotherapy
   b. Melanomas have the following characteristics (ABCD rule)
      1) A: Asymmetry; the two sides of the pigmented area do not match
      2) B: Border is irregular and exhibits indentations
      3) C: Color (pigmented area) is black, brown, tan, and sometimes red or blue
      4) D: Diameter is larger than 6 mm (size of a pencil eraser)
   c. Treated by wide surgical excision accompanied by immunotherapy
   d. Chance of survival is poor if the lesion is over 4 mm thick

B. Burns

1. First-degree
   a. only the epidermis is damaged
   b. Symptoms include localized redness, swelling, and pain
2. Second-degree
   a. epidermis and upper regions of dermis are damaged
b. Symptoms mimic first degree burns, but blisters also appear

3. Third-degree
   a. entire thickness of the skin is damaged
   b. Burned area appears gray-white, cherry red, or black
   c. no initial edema or pain (since nerve endings are destroyed)

4. Rule of Nines
   a. Estimates the severity of burns
   b. Burns considered critical
      1. Over 25% of the body has second-degree burns
      2. Over 10% of the body has third-degree burns
      3. There are third-degree burns on face, hands, or feet

V. Developmental Aspects of the Integument

A. Fetal
   1. Epidermis develops from ectoderm
   2. Dermis and hypodermis develop from mesoderm
   3. Lanugo – downy coat of delicate hairs covering the fetus
   4. Vernix caseosa – substance produced by sebaceous glands that protects the skin of the fetus in the amnion

B. Adolescent to Adult
   1. Skin and hair become oilier and acne may appear
   2. Skin shows the effects of cumulative environmental assaults around age 30
   3. Scaling and dermatitis become more common

C. Old Age
   1. Epidermal replacement of cells slows and skin becomes thinner
   2. Skin becomes dry and itchy
   3. Subcutaneous fat layer diminishes, leading to intolerance of cold
   4. Decreased elasticity and loss of subcutaneous tissue leads to wrinkles
   5. Decreased numbers of melanocytes and Langerhans' cells increase the risk of skin cancer