

# INTEGUMENTARY SYSTEM

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## OBJECTIVES/RATIONALE

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To pursue a career in health care, proficiency in anatomy and physiology is vital. The student will describe biological and chemical processes that maintain homeostasis; analyze forces and the effects of movement, torque, tension, and elasticity on the human body; associate the disease process with changes in homeostasis; identify changes in structure and function due to trauma and disease; and identify normal and abnormal anatomy and physiology.

TEKS: 121.3 (c)(1)(F)(H),  
121.4 (c)(1)(G)(H)(I),  
121.5 (c)(1)(E)(F)(G)

TAKS ELA 1, 3, 4  
Science 1, 2, 3, 4

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## KEY POINTS

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### Power Point

- I. Introduction
  - A. Largest organ of the body
  - B. 21 square feet, 1.5-2 square meters
  - C. 4 kilograms, 9 pounds, 7% - 15% of total body weight
  - D. One square inch contains
    - 1. 20 blood vessels
    - 2. 65 hairs and hair muscles
    - 3. 78 nerves
    - 4. 78 sensors for heat
    - 5. 13 sensors for cold
    - 6. 160 sensors for pressure
    - 7. 100 sebaceous/oil glands
    - 8. 650 sudoriferous/sweat glands
    - 9. 1300 nerve endings
    - 10. 19,500,000 cells
    - 11. 0.5 million cells dying and being replaced
  - E. Complex combination of tissues
  - F. Covers whole body as a continuous layer
- II. Layers of the Skin
  - A. Epidermis (epithelial cells)
  - B. Dermis (tough, leathery fibrous connective tissue; only part that is vascularized) – also called the corium
  - C. Subcutaneous (hypodermis)
    - 1. Not skin
    - 2. Adipose and areolar connective tissue
    - 3. Stores fat

4. Anchors skin to underlying structures (muscles)
  5. Allows skin to slide freely
  6. Shock absorber, insulator
  7. Thickens with weight gain
- III. Functions
- A. Protection: barrier against microbes, dirt, chemicals; shock absorber
  - B. Water balance: prevents loss of water and absorption
  - C. Temperature regulation: blood vessels near surface vasoconstriction/vasodilation
    1. Radiation: transfer to cooler surface
    2. Conduction: direct transfer to objects
    3. Convection: transfer from skin by air
    4. Evaporation: of perspiration
  - D. Waste disposal: excretion of oil, water, Na<sup>+</sup>, CO<sub>2</sub>, etc.
  - E. Receptor organs: sensations of touch, pain, heat, cold, pressure
  - F. Vitamin D production
- IV. Epidermis: outer layer of stratified squamous epithelial tissue, avascular, complete regeneration approximately 35 days; (i.e. some regions are thicker than others; thinner on scalp and armpit than on sole of foot)
- A. Stratum basale (stratum germinativum): basal layer of cells that are actively dividing to replace old cells
    1. Deepest layer
    2. Single row of cells (mostly stem cells)
    3. 10-25% of cells are melanocytes → secrete melanin, amount determines skin color, amino acid tyrosine converts melanin granules, albinism = genetic absence of enzyme tyrosinase
  - B. Stratum spinosum
    1. Spiny layer
    2. Several cell layers thick
    3. Cells have thick bundles of tonofilaments (tension filaments) → tension resisting protein
    4. Keratinocytes → spiny projections = prickles
  - C. Stratum granulosum (granular layer)
    1. 3 – 5 layers of flattened keratinocytes
    2. Lots of lysosome enzymes in cytoplasm to begin keratin replacement process
    3. Abundant tonofilaments
    4. Keratohyaline granules = contributes to formation of keratin in more superficial layers
    5. Lamellated granules: waterproofing glycolipid which is a major factor in slowing water loss across epidermis
    6. Receives nutrients from tissue fluids
    7. Above this layer the cells die!!
  - D. Stratum lucidum (clear layer) → absent in thin skin
    1. Thin translucent band of flattened dead keratinocytes
    2. Closely packed, clear cells, nuclei absent

3. Keratohyaline –tonofilaments → keratin fibrils
  4. Thickest in soles of feet and palms
  5. Cytoplasm filled with eleidin, a water barrier
- E. Stratum corneum (horny layer)
1. 20 – 30 cell layers thick
  2.  $\frac{3}{4}$  of epidermal thickness
  3. Cytoplasm replaced by keratin
  4. keratin and thickened plasma membranes of dead cells → protection against abrasion and penetration
  5. Glycolipid → waterproof coat
  6. Cornified/horny cells → dandruff, dry skin shedding = 40 pounds in a lifetime
  7. Hyperkeratosis = thick, dry, scaly skin
- F.
- G.
- V. Cells of Epidermis
- A. Keratinocytes (produce keratin; millions rubbed off every day)
  - B. Melanocytes (pigment cells)
  - C. Langerhans cells (macrophages that activate immune system)
  - D. Merkel cells (sensory nerve receptors)
- VI. Dermis = true skin; dense fibrous connective tissue
- A. Strong, flexible connective tissue
  - B. Fibroblasts, macrophages, mast cells, White Blood Cells (WBCs)
  - C. Collagen, elastin (stretch-recoil), reticular fibers
    1. Loss of elastin and loss of subcutaneous fat = wrinkling of elderly
  - D. Contains
    1. Blood vessels and capillaries
    2. Lymphatic vessels
    3. Nerves
    4. Hair shafts and hair follicles
    5. Sensory receptors
- E. Layers
1. Papillary layer: connective tissue with many blood vessels
    - a. Capillaries, pain receptors, touch receptors (Meissner's corpuscles)
    - b. Dermal ridges (palms and soles) create epidermal ridges for friction and gripping; sweat on ridges → fingerprints
  2. Reticular layer: deep dermis of collagen for elasticity
    - a. 80% of dermis
    - b. Collagen (strength, resilience, hydration)
    - c. Lines of cleavage, tension lines (longitudinal – head and limbs; circular – neck and trunk)
    - d. Parallel incisions heal faster
- F. Extreme stretching → tears dermis → silvery white scars = “stretch marks”

- G. Separation of epidermal and dermal layers by fluid filled pocket = blister
- H. Flexure lines: skin marking; dermal folds at or near joints; deep skin creases

## VII. Accessory Organs of the Integumentary System

A. Nails: keratinized/dead epidermis that grows under the lunula (white portion) of nailbed, cells replace it if nailbed is OK

### B. Hair

1. follicles
  - a. anagen = growing follicles
  - b. telogen = resting follicles)
2. shafts
3. arrecton pili – hair muscles
4. Growth
  - a. lanugo = fetal hair, lost before birth;
  - b. puberty = coarse hair, rapid mitosis so hair grows ½ inch per month

### C. Glands

1. Sudoriferous/sweat glands (opening is called a pore)
  - a. Eccrine: ordinary sweat gland
  - b. Apocrine: large glands in anus, axilla, genital areas
2. Sebaceous/oil glands: secretes sebum as lubricant, most open onto a hair follicle (plugged = blackhead)
3. Ceruminous glands: secrete cerumen (earwax)

## VIII. Skin color

### A. Pigments

1. Melanin
  - a. Only pigment made in the skin
  - b. Yellow to reddish-brown to black
  - c. Synthesis depends on enzyme in melanocytes
  - d. Racial differences in skin color → kind and amount of melanin made
  - e. Local accumulations → freckles and pigmented moles
  - f. Exposure to sunlight increase manufacture of melanin → prolonged exposure → melanin buildup → protects DNA from UV damage and results in a tan
2. Carotene
  - a. Yellow to orange
  - b. Accumulates in the stratum corneum and fatty tissue of hypodermis
  - c. Color obvious in palms and soles

### B. Abnormal colors/homeostatic imbalances

1. Erythema (redness)
  - a. Congestion of blood in blood vessels
  - b. Burns
  - c. Embarrassment (blushing)
  - d. Fever

- e. Hypertension
- f. Inflammation
- g. Allergy
- 2. Pallor (blanching)
  - a. Emotional stress
  - b. Anemia
  - c. Low blood pressure
- 3. Jaundice (yellow)
  - a. Liver disorder
  - b. Biliary disorder
  - c. Presence of bile in blood
  - d. Diseases involving destruction of RBCs
- 4. Bronzing (metallic)
  - a. Addison's disease (hypofunction of adrenal cortex)
- 5. Cyanosis (blue)
  - a. Insufficient oxygen in tissues
- 6. Gray/brown
  - a. Chronic poisonings
- 7. Vitiligo
  - a. Loss of pigment in certain areas, usually acquired
- 8. Albinism
  - a. Absence of pigment color
- 9. Bruises
  - a. Blood escapes and clots beneath skin
  - b. Hematoma
  - c. Vitamin C deficiency
  - d. Hemophilia

## IX. Skin Injuries

- A. Excessive sun exposure
  - 1. Clumps elastin fibers → "leathery" skin
  - 2. Temporary depression of immune system
  - 3. DNA alteration → cancer
  - 4. Sun types
    - a. Type 1: always burns easily, never tans, very fair, SPF 30
    - b. Type 2: Always burns easily, tans minimally, fair skin, SPF 30 or SPF 15
    - c. Type 3: burns moderately, tans gradually, fair to medium skin, SPF 30 or SPF 15 or SPF 8
    - d. Type 4: burns minimally, always tans well, medium skin, SPF 30, SPF 15, SPF 8
    - e. Type 5: rarely burns, tan profusely, olive or dark skin, SPF 15 or SPF 8
    - f. Type 6: never burns, deeply pigmented, very dark skin, SPF 8
- B. Burns: 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> (superficial, partial thickness, full thickness) degree depending on depth of burn

- C. Blisters: injury damages chemical bonds of skin layers at dermal/epidermal junction
- D. Callous: abnormally thick stratum corneum
- X. Skin Lesions
  - A. Bullae: blebs, blisters with serous fluid
  - B. Desquamation: peeling of skin
  - C. Macule: level, circumscribed areas on the skin i.e. freckles
  - D. Nodules: large circumscribed solid elevations
  - E. Papules: smaller circumscribed solid elevations
  - F. Pustules: small elevations that contain pus
  - G. Tumors: soft or firm masses that are either freely movable or fixed
  - H. Vesicles: small blisters
  - I. Wheals: edematous elevations with itching (pruritis)
  - J. Crusts: dried pus/blood i.e. scabs
  - K. Furuncles: boils, usually staph in hair follicles
  - L. Carbuncles: groups of fused boils
  - M. Urticaria: hives due to allergic reaction
  - N. Eczema: inflammatory dermatitis with papules and vesicles
  - O. Excoriation: skin with shallow ulcers due to scratching
  - P. Fissure: linear break in skin
  - Q. Exudate: drainage
    1. Serous = watery
    2. Purulent = pus
    3. Sanguineous = blood
- XI. Skin Diseases/Disorders
  - A. Acne: overactive secretion of sebaceous glands
    1. Inflamed plug = comedo
    2. Pimples and blackheads
    3. Teens to early twenties
    4. Treatment: thorough washing, steroid creams, UV light, Isoretinoin, avoidance of certain foods, chemical face peel and dermabrasion (for scarring)
  - B. Seborrheic Dermatitis
    1. Dandruff: oily scalp, itching, irritation, greasy scales
    2. Treatment: frequent shampooing (tincture of green soap), brushing hair, massaging scalp
  - C. Eczema
    1. Vesicles on reddened skin which burst and weep → crusts
    2. Treatment: tranquilizers (stress aggravates condition), antihistamines, steroids, wet dressings, starch baths
  - D. Urticaria
    1. Hives → allergy or emotional stress
    2. Treatment: steroids, antihistamines
  - E. Contact Dermatitis

1. Redness, itching, blisters edema
  2. Causes: poison ivy, poison oak, poison sumac, cleansing agents, cosmetics, metals
  3. Treatment: clean with soap and water then apply alcohol, antipruritic lotions, cold and wet dressings, desensitization
- F. Psoriasis
1. Patchy erythema and scales
  2. Chronic inflammatory disease, genetic
  3. Treatment: ointments, UV light, low fat diets, steroids, antihistamines, tranquilizers
- G. Impetigo
1. Very contagious
  2. Erythema, vesicles with sticky yellow crusts
  3. Infection with staph or strep
  4. Treatment: remove crusts then apply antibiotic ointment
- H. Warts
1. Painless except for Plantar warts
  2. Caused by a virus
  3. Treatment: nitric or sulfuric acid applications deep into root of wart or freezing with liquid nitrogen
- I. Herpes simplex I (cold sores)
1. Caused by virus
  2. Blisters, inflamed skin around mouth
  3. Treatment: tincture of benzoin, acyclovir
- J. Herpes zoster (shingles)
1. Viral infection with fever and malaise
  2. Erythema and vesicles along the course of a nerve
  3. Treatment: analgesics, calamine lotion, acyclovir orally
- K. Tinea (dermatophytosis)
1. Fungal infections i.e. athlete's foot, ringworm, jock itch
  2. Infectious, contagious
  3. Treatment: antifungal agents, dry feet, change socks and shoes frequently
- L. Furuncles (boils) and Carbuncles (large, swollen erythematous lesions)
1. Staph or Strep infection
  2. Treatment: hot, moist compresses; incise and drain lesion; antibiotics
- M. Decubitus ulcer: bedsores due to decreased circulation to a specific area
- N. Paronychia
1. Infected hangnail
  2. Treatment: soak frequently in warm water, remove nail surgically
- O. Sebaceous Cysts
1. Blockage of duct of sebaceous gland
  2. Treatment: lance and drain
- P. Diaper rash

1. Treatment: antibacterial cream, mineral oil cleansing, exposure to air to dry the rash
- Q. Corns (hard, raised painful areas) and Callouses (flat, thickened patches)
1. Caused by friction of poorly fitted shoes
  2. Treatment: relieve friction, keratolytic agents i.e. salicylic acid
- R. Infestations and Bites
1. Pediculosis (lice): scalp hair, body hair, pubic hair; treatment: ointments, powders, lotions with benzylbenzoate or benzene hexachloride
  2. Scabies (mites): treatment: thorough bathing then benzyl benzoate or benzene hexachloride
- S. Lupus erythematosus (usually fatal)
1. Erythematous macular lesions in butterfly pattern on face
  2. Dysfunction of kidneys, joints, lungs, and heart
  3. Treatment: aspirin, steroids
- T. Scleroderma
1. Systemic autoimmune disease of skin, muscles, bones, heart, lungs
  2. Skin → smooth, hard, tight
  3. Progressive
  4. Treatment: ointments, massage, heat, steroids
- U. Pilonidal Sinus
1. Sac containing a hair that becomes infected and develops into a draining sinus
  2. Treatment: warm water compresses, sitz baths, deep wide V-shaped incision packed with gauze
- V. Carcinoma: cancerous tumor
1. Squamous cell: slow growing, hard, raised nodule
  2. Basal cell: papules that erode in center
- W. Malignant melanoma
1. Nevus.mole becomes dark, spreads unevenly, bleeds some
  2. Death in 1:4 cases
  3. Metastatic
  4. Cause = overexposure to UV radiation (sun or tanning bed)
- X. Kaposi's sarcoma: purple papules spread to lymph nodes and other organs, may be associated with AIDS

## XII. Diagnostic Procedures for Skin

- A. Direct examination (good lighting)
1. Distribution of lesions (local or general)
  2. When lesions are most bothersome
  3. Change in patient's way of living
  4. Wood's light (for ringworm)
  5. Microscopic exam for scales or fungi
- B. Biopsy

1. Dermal punch
  2. Examined by histologist or pathologist
- C. Sensitivity tests
1. Patch test
  2. Percutaneous test (scratch test)
  3. Intradermal test

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### **ACTIVITIES**

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- I. Create a 3-dimensional skin model.
- II. Complete Suturing Laboratory Investigation.
- III. Complete Sunscreen laboratory investigation.

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### **MATERIALS NEEDED**

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Sunscreen Kit from Carolina Biologicals  
Suture materials (needle holders, scissors, suture sets with large needles)  
Pigs feet  
Arts and Crafts Materials  
Integumentary System Terminology

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### **ASSESSMENT**

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Completion of 3-dimensional skin model

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### **ACCOMMODATIONS**

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For reinforcement, the student will create flashcards for each of the integumentary system vocabulary terms.

For enrichment, the student will compare and contrast skin cancer statistics of different population groups.

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### **REFLECTIONS**

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