CHAPTER 5
The Integumentary System

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Principles of Human Anatomy
Eleventh Edition
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Integumentary System

- Skin and accessory organs
- Hair, nails, glands, muscles, nerves
- Dermatology
  - Medical specialty that deals with skin disorders
- Anatomy: 2 major layers
  - Epidermis
  - Dermis
- Subcutaneous layer is not part of the skin

Cells of the Epidermis

- Keratinocytes
  - 90% of epidermal cells
  - Produce keratin
  - Protects from light heat & bacteria
- Melanocytes
  - 8% of cells
  - Produce melanin
  - Protects against UV light
- Langerhan's cells
  - Immune response
- Merkel cells
  - Touch sensation

Layers of the Epidermis

- Composed of connective tissue
  - Areolar – Papillary Region
  - Dense irregular - Reticular Region
- Fibroblasts, macrophages adipocytes
- Blood vessels, nerves, glands, hair follicles
- Thick in palms & soles/Thin in eyelids, penis & scrotum
- Thicker-posterior body and lateral limbs/Thinner-anterior body and medial limbs
Layers of the Dermis

<table>
<thead>
<tr>
<th>Table 5.2 Summary of Papillary and Reticular Regions of the Dermis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
</tr>
<tr>
<td>Papillary region</td>
</tr>
<tr>
<td>Reticular region</td>
</tr>
</tbody>
</table>

Increase the grip of the hand or foot: Sweat glands open at the top of the ridge. Produce fingerprints or footprints: Dermatoglyphics is the study of epidermal ridge patterns.

Lines of Cleavage

- Indicate the main direction of collagen fibers in reticular region
- Important in surgery, esp. plastic surgery
- Incisions parallel to these lines heal with fine scars
- Incisions made across these lines make broad thick scars

Subcutaneous Layer

- Not actually a layer of the skin!
- Also called:
  - Sub-Q
  - Superficial fascia
  - Hypodermis
  - Areolar CT and adipose tissue
- Contains Pacinian corpuscles
- Pressure sensors

Functions of the Skin

- Regulation of body temperature (Thermoregulation)
- Changes in blood flow to the skin
- Sweating by sudoriferous glands
- Protection
- Physical barrier to the external environment
  - Abrasion, bacteria, dehydration, UV light
- Sensation
  - Nerve endings/receptors/sensors
  - Touch – Merkel or Meissner’s
  - Pressure – Pacinian corpuscles
  - Temperature
  - Pain - nociception

Functions of the Skin cont.

- Excretion
  - Lactic acid, urea, ions (K+) in sweat
- Immunity
  - Langerhan’s cells
- Blood reservoir
  - Regulated by vasoconstriction & vasodilation of arterioles
- Synthesis of Vitamin D
  - UV light
  - Vitamin D is considered a hormone
  - Absorption of Ca²⁺
- Skin is an endocrine organ
Skin Color

- 3 major pigments
  - Melanin
    - Pale yellow to black
    - Produced by melanocytes
      - Amount of melanin secretion is different
    - More melanocytes in areola, penis, face, limbs
    - Cause freckles, liver/age spots
    - Synthesis of melanin increases with UV exposure
    - Protective
  - About the same # in all races
  - Lack of melanin - albinism

- Carotene
  - Yellow to orange
  - Precursor to Vitamin A
  - Found in carrots, egg yolk, yellow/orange fruits

- Hemoglobin
  - Pigment in RBCs that carries $O_2$
  - Red when oxygenated
  - Blue when deoxygenated

Accessory organs of the Skin

- Hair
- Glands
- Nails

Hair Anatomy

- Shaft (Part that you can see)
- Root (Part you can’t see)
- 3 layers
  - Medulla
  - Cortex
  - Cuticle
- Hair follicle
  - Surrounds the root
  - 2 layers
  - Internal & external root sheaths
  - Extensions of the epidermis
- Bulb area
  - Papillae of the hair
  - Matrix of the hair
    - Derived from the stratum basale

Hair Growth

- 2 stages
  - Growth
    - Cells dividing in the matrix making hair longer
    - About 3 years in the scalp
  - Resting
    - No new cells
    - 1-2 years
Hair Color

- Melanin
- Melanocytes located in the matrix of the bulb
- Dark hair – true melanin
- Blond hair – melanin variant containing sulfur
- Red hair – melanin variant containing iron

Structures assoc. w/ Hair

- Arrector pili muscle
- Smooth muscle
- Contract in response to cold or fear
- Hair root plexuses
- Light touch receptors
- Sabaceous (oil) glands

Glands

- Sabaceous (oil) glands
  - Secrete onto hair or skin surface
- Sudoriferous (sweat) glands
  - 2 types eccrine and apocrine
- Ceruminous Glands
  - Produce cerumen = “ear wax”

Eccrine & Apocrine Sweat Glands

<table>
<thead>
<tr>
<th>TEXTURE</th>
<th>ECCRINE SWEAT GLANDS</th>
<th>APOCRINE SWEAT GLANDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>Throughout sites of most regions of the body, especially on sides of fingers, palms, and soles. Mostly in deep dermis.</td>
<td>Sites of the axilla, groin, armpit, and lateral aspects of the face, cervical, and lateral aspects. Mostly in subcutaneous layer.</td>
</tr>
<tr>
<td>Location of secretory portion</td>
<td>Surface of epidermis.</td>
<td>Hair follicles.</td>
</tr>
<tr>
<td>Termination of secretory duct</td>
<td>Deep to epidermis.</td>
<td>Most common, consists of the same components as eccrine sweat glands plus lymphatics.</td>
</tr>
<tr>
<td>Secretion</td>
<td>Low volume, contains water, lactate (L), urea, urease, melanin, protein, and keratin.</td>
<td>High volume, contains the same components.</td>
</tr>
<tr>
<td>Functions</td>
<td>Regulation of body temperature, water removal, and stimulated during emotional stress.</td>
<td>Stimulated during emotional stress and sexual excitement, Polarity.</td>
</tr>
<tr>
<td>Depth of function</td>
<td>Seen after birth.</td>
<td>Linearly.</td>
</tr>
</tbody>
</table>

Nails

- Grow about 1mm per week
- Toe nails grow slower
- It takes approx. 8 mo. for a toenail to grow out
- Longer digits have faster growing nails
- Nails grow faster in warmer months
- Function to aid in grasping and scratching
- As long as you have no diet deficiencies, taking gelatin doesn’t help growth of nails.
Thin vs. Thick Skin

**Table 1:** Comparison of Thin and Thick Skin

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>THICK</th>
<th>THIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>All parts of the body except areas such as palms,</td>
<td>Areas such as palms, palmar surface of fingers,</td>
</tr>
<tr>
<td></td>
<td>and palmar surface of fingers, and palms.</td>
<td>and soles.</td>
</tr>
<tr>
<td>Epidermal thickness</td>
<td>0.08-0.15 mm (0.003-0.06&quot; in.)</td>
<td>0.02-0.03 mm (0.0008-0.0012&quot; in.)</td>
</tr>
<tr>
<td>Suprannular tissue</td>
<td>Stratum basale contains keratinizing squamous</td>
<td>Stratum basale contains keratinizing squamous</td>
</tr>
<tr>
<td></td>
<td>squamous epithelium.</td>
<td>squamous epithelium.</td>
</tr>
<tr>
<td>Hair follicles and arrector pilo muscles</td>
<td>Present.</td>
<td>Absent.</td>
</tr>
<tr>
<td>Sebaceous glands</td>
<td>Present.</td>
<td>Absent.</td>
</tr>
<tr>
<td>Sweat glands</td>
<td>Present.</td>
<td>Most are sweat glands.</td>
</tr>
<tr>
<td>Sensory receptors</td>
<td>Present.</td>
<td>Distant.</td>
</tr>
</tbody>
</table>

Learning Objectives

- Discuss the general features (layers/organs) of the skin
- Describe the major cell types in the skin
- Discuss the function of keratin
- Know in detail the descriptions of the layers of the epidermis
- Describe the layers of the dermis in terms of the tissues and organs present
- What causes fingerprints?
- Know the major functions of the skin
- Know the pigments responsible for skin color
- Discuss the different sensory receptors present and what they are designed to sense

Learning Objectives

- Describe the anatomy of a hair and its follicle
- Discuss the 3 structures associated with hair
- What are the grow stages of hair
- Discuss the different exocrine glands in the skin and their secretions
- What are the differences between apocrine and eccrine glands

Learning Objectives

- Describe the major parts of a nail
- What layer of the skin do hair and nails grow from?
- Discuss some factors that effect nail growth
- Discuss the ‘lines of cleavage’ and why they are clinically important