The Integumentary System

Of all the body’s organs, none is more easily inspected or more exposed to infection, disease, and injury than the skin. Because of its visibility, skin reflects our emotions and some aspects of normal physiology, as evidenced by frowning, blushing, or sweating.

Contents: The skin and its derivatives: hair, nails and glands

Functions:

1. Regulation of body temperature - sweating
2. Protection - dehydration, abrasion and UV light
3. Sensory input ex: pain, temperature, touch, pressure
4. Excretion – small amounts of urea
5. Immunity – prevents microorganisms from entering body
6. Blood reservoir – 8-10% total blood volume in skin
7. Production of vitamin D – begins with exposure to sunlight on skin. Ends in liver and kidney.

1. Skin
- largest organ of the human body
- weighs about 7% total body weight and covers about 2 square meters
- dermatology= the medical specialty that diagnoses and treats disorders of the skin
- consists of three layers of tissue:
   1. Hypodermis (deepest layer)
   2. Dermis
   3. Epidermis (superficial layer)
2. Hypodermis = subcutaneous tissue (HYPO=below)

A thin layer of areolar and adipose has collagen and elastic fibers

main cell $\rightarrow$ Adipocytes approx. 50% of all body fat is in hypodermis. Much more if a person is overweight or obese.

Contains many large blood vessels and nerves. Small branches of both are sent superficially into dermis

a) tissue: areolar and adipose

b) function: insulation, protection and energy storage.

3. Dermis = middle layer of skin
- consists of two sublayers

--- EPIDERMIS ---

| Superficial layer of the dermis (20%) | Tissue areolar |
| PAPILLARY LAYER | many sensory receptors located here |
| | Folds in tissue $\rightarrow$ fingerprints |

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| Deep layer of dermis (80%) | Tissue is dense irregular |
| RETICULAR LAYER | Can become overstretched and leave stretch marks |
| | When processed (cow) made into leather |

--- HYPODERMIS ---
4. Epidermis = superficial layer of skin \((EPI = \text{above})\)

- most superficial tissue of the body
  * Tissue is stratified squamous (keratinized)
  * Avascular – nutrients must diffuse from underlying dermis
- Epidermis varies in thickness
  - thin – eyelid and lips
  - thick – plantar surface, palmar surface.
- Outer squamous cells are constantly scraped off (desquamation)

Layers of epidermis:

(Superficial)

1) **Stratum Corneum** – all cells are dead. Removed by desquamation

2) **Stratum Lucidum** – all cells are dead. Functional Keratin present (waterproofing protein) only found in thick layered skin (soles, palms, fingertips).

3) **Stratum Granulosum** – \(\frac{1}{2}\) cells living, \(\frac{1}{2}\) cells dead. Percursor to keratin

4) **Stratum spinosum** - all cells living but beginning to starve. Cells flatten into squamous shape.

5) **Stratum basale** – all cells living. Active mitosis.

5. Skin coloration

-normal skin color is a blend of 3 pigments. Sometimes short-term physiologic effects can alter color. (anger, embarrassment, cold)

a) **melanin**, a dark brown to black pigment secreted by melanocytes (located in Stratum basale), There is a high concentration in freckles and moles. Function is to protect us from UV light.
b) **carotene**  a yellow pigment found in skin and retina of eye. Also found in carrots and other orange/yellow vegetables. Eat too much and your skin will turn an orange hue.

c) **hemoglobin**  a red pigment found in red blood cells. When RBC’s bind with O\textsubscript{2}, hemoglobin turns bright red. The red color shows through superficial blood vessels (hold a flashlight to your hand at night).

d) **cyanosis**  abnormal blue color to skin. Caused by low \(O_2\) in blood or extreme cold.

e) **jaundice**  abnormal yellow color to skin and whites of eyes. It is caused by liver disease. Liver releases bile pigments (**yellow** in color) into the blood.

6. Glands found in skin = integumentary glands

   - embryologically derived from same cells as spidermis
   - as skin forms, glands migrate deeper into dermis and hypodermis
   - ducts from glands grow superficially to release secretions onto surface of skin or hair

   a) sweat glands = sudoriferous glands

      - average body has about 2 M
      - some glands contain bacteria (B O)
      - function: decrease body temperature by cooling skin.

   b) oil glands = sebaceous glands

      - gland physically attached to hair follicle in dermis
      - secretes oil (**sebum**)
      - some glands contain bacteria \(\rightarrow\) **acne**
      - Function: lubricate and help waterproof skin and hair.

   c) wax glands = ceruminous glands

      - a modified sweat gland
      - secretes earwax (**cerumen**)
      - Function: protection of eardrum from injury
d) mammary glands = milk glands
- a modified sweat gland which produces sweat, proteins, lipids and sugar (milk)
- just prior to childbirth milk production begins (*lactation*)
Function: nourishment for newborn

7. Hair

made of dead, keratinized squamous cells that are fused together. Located everywhere except plantar and palmar surfaces.

Composition:
1. shaft – portion above skin surface
2. root – portion below skin surface
3. follicle – specialized cells that surround and protect root.

Matrix cells – divide by mitosis for hair growth
Arrectorpili muscle – smooth muscle that pulls hair erect → goose bumps

Functions: Protects scalp from UV light
Decreases heat loss
Blocks entrances to eyes, nose and ears

8. Nails

- Made of dead, keratinized squamous cells that are fused together

- Nail composition
  o Body – portion above skin surface
  o Root – portion below skin surface

- Matrix cells – divide by mitosis for nail growth

- Lunula – white, half-moon portion of nail visible at proximal end.

Function: protect distal end of digits and help keep shape of distal ends of digits.
9. Sensory innervation of the skin
   - involves specialized cells (neurons)
   - these cells are capable of detecting external stimuli
   - called: cutaneous receptors

   a) pain receptors = free nerve endings
   - naked dendrite of a neuron
   - located in epidermis and dermis

   b) temperature receptors = free nerve endings
   - naked dendrite of a neuron
   - located in epidermis and dermis

   c) touch receptors
   -- end of dendrite is covered with layers of connective tissue
   - found in dermis

   d) pressure receptors
   -- end of dendrite is covered with layers of connective tissue
   - found in hypodermis

10. Wounds and self-repairing of the skin
    - an example of homeostasis

   a) epidermal wounds (shallow paper-cut, minor sun burn, minor scrape)
   - no bleeding occurs
   - cells of stratum basale enlarge and divide
   - new cells migrate toward center of wound
   - basale cells continue to divide, pushing older cells superficially
   - reform all stratum layers

   b) dermis and deeper wounds (deep cut, major scrape)
   - bleeding occurs
   - bleeding allows WBC’s and platelets to enter wound
   - platelets stop flow of blood by forming a clot
   - SCAB – blood clot also containing dead cells and collagen
   - underneath scab, cells repair damaged tissues
   - SCAR- dense irregular connective tissue, collagen fibers lash skin edges together to close wound.

a) albinism
-an inherited genetic disorder
-melanocytes are not able to produce functional melanin for skin or hair
-result: pale skin, yellow or white hair, pink eyes, poor vision

b) bedsores = decubitus ulcer
-common in people who are bedridden for long periods of time
-bony areas of body (hips, ankles) push on skin and decrease blood flow
-leads to ulceration ( )

c) viral infections
- various viruses cause mild skin eruptions ( )
-easilypread from person to person
-eventually immune system kills off virus

d) burns [http://www.4doctors.net/nucleusanimation/burns-classification-and-treatment-video_7defd298e.html]
-tissue damage due to
  1) 
  2) 
  3) 
  4) 
-Proteins in skin ( ) denature
*skin now open to infections and fluid loss

1. first degree burn
- involves damage to epidermis ( )
-mild pain, mild redness, “peeling” of skin

2. second degree burn
-involves destruction of epidermis and damage to dermis ( )
-moderate to major pain, major redness, blistering
4. third degree burn

- involves destruction of epidermis and dermis plus damage to hypodermis
- severe pain and fluid loss
- lose all skin functions
- need skin graft to replace lost skin
SKIN RECEPTORS
Touch, Temperature, Pain, and Pressure

Epidermis

Dermis
Dense Connective Tissue

Hair Root Plexus (touch)

Corpuscle of Touch (touch)

Free Nerve Endings (temperature & pain) (itch & tickle)

Tactile Disc (discriminative touch)

Type II Cutaneous Mechanoreceptor (heavy touch)

Lamellated Corpuscle (pressure)

Subcutaneous Layer
Loose Connective Tissue

sensory nerve fibers
Figure 4.4 Hair Follicle. Note location of sebaceous gland; contraction of arrector pili muscle squeezes sebaceous gland, which discharges sebum into hair follicle.

Figure 4.5 Nail Follicle. Fingernails and toenails develop in folliclelike structures similar to hair follicle.