INTEGUMENTARY SYSTEM (SKIN)

Human Anatomy and Physiology

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CHS
What is the integumentary system?

- The integumentary system is 1 of 11 organ systems.
- It consists of the skin (cutaneous membrane), all of the appendages (all of the accessory structures), including:
  - Sweat glands (sudoriferous glands)
  - Oil glands (sebaceous glands)
  - Hair
  - Nails
THE SKIN

- 7% of total body weight
- 1.5-4.0mm in thickness
- 2 regions (dermis and epidermis)

Layers of the Skin

ClearSkinAcne.com
INTEGUMENTARY SYSTEM

- **Structure** - Epidermal layer, Dermal layer, Subcutaneous layer

- **Functions**
  
  A. Regulation of body temperature – sweat, vessels dilate for heat loss/heat retention through vessel constriction
  
  B. Protection – keeps water and other molecules in, keeps water and undesirable substances out
  
  C. Sensation – detect pain, pressure, temperature, touch
  
  D. Excretion – elimination of some nitrogenous waste, excess salt, water (sweat/perspiration)
  
  E. Immunity - macrophages
  
  F. Synthesis of Vitamin D – sunlight hits skin cells, cholesterol is converted to precursor molecule that aids in absorption of Ca and P
The skin is divided into 3 layers:
1. Epidermis—outer layer
2. Dermis—inner layer
3. Subcutaneous—below the skin (adipose)
EPIDERMIS — STRATIFIED SQUAMOUS EPITHELIUM, FIRST LAYER OF SKIN

Cells of the Epidermis:

a. **KERATINOCYTES** (95%)—make keratin, a fibrous protein which fills the cell, sealing them by secreting a cement into intracellular spaces, increasing cohesion between cells making skin an effective barrier; dead when they reach surface; made in deepest part of epidermis lose millions/day.

b. **MELANOCYTES** (5%)—Produce melanin (pigment); protect from UV damage; spider shaped.—only in deepest layer

c. **LANGERHANS CELLS** (2-5%)—immune cells, detect foreign bodies and carry them to lymph nodes in the dermis where they are destroyed by lymphocytes; star shaped.

d. **MERKEL CELLS** (6-10%)—sensory cells for touch, contact with nerve endings.
THICK AND THIN SKIN

- Thick skin: covers palms, finger tips, soles of feet
- Thin skin: covers rest of the body
  - (eyelids—some really thin)

On average, skin is about as thick as a paper towel.
THE LAYERS OF THE EPIDERMIS (THERE ARE 5)

1. Stratum Basale (Basal Layer)—mitotic layer
   - Aka Germinativum
   - Deepest layer
   - Single row of cells (Keratinocytes) held together by desmosomes; like a “pressure stud” structure.
   - Rapid cell division—millions of new cells made daily.
   - Each keratinocyte divides into 2 daughter cells, one stays to divide again and other pushes up, becomes keratinized, and replace the top layer.
   - Contains keratinocytes (1 row), melanocytes, Merkel cells; as they are pushed out become more keratinized; new turnover every 35-45 days
2. Stratum Spinosum (Prickly Layer)
   - Differentiation layer
   - Several layers thick, 8-15 cells deep, thickest layer
   - Weblike (Tension resisting filaments)
   - The layer at which keratinocytes grow and flatten.
   - Keratinocytes look spiny (hence PRICKLY)
   - Does not divide, but differentiates
   - Most abundant cells: Keratinocytes (several rows) and Langerhans’
LAYERS OF THE SKIN-EPIDERMIS

3. Stratum Granulosum (Granular Layer)

3-5 layers of flattened keratinocytes = water repellent
Last living layer; receives nourishment; everything beyond this layer is dead
LAYERS OF THE SKIN- EPIDERMIS

4. Stratum Lucidum (Clear Layer)
   - Few rows of clear, flat, dead, keratinocytes
   - Found only in thick skin areas--(pads of feet, palms of hands, calluses – no hair)
Layers of the Skin - Epidermis

5. Stratum Corneum (Horny Layer)

- Outer most
- Dead, keratin-filled cells, called corneocytes—completely flattened cells, with no nucleus or organelles.
- Protect cells from abrasion and penetration, UV, water loss, “hostile” environment; makes them waterproof.
- Flat and scale-like cells that flake off (dandruff and dead skin)
- Its surface is covered with furrows and crevices visible to the naked eye due to folds in the dermis.
LAYERS OF THE EPIDERMIS

- Stratum corneum
- Stratum lucidum
- Stratum granulosum
- Stratum spinosum
- Stratum basale
SECOND LAYER OF THE INTEGUMENTARY SYSTEM—THE DERMIS

The **dermis** is the thicker inner layer that contains dense irregular fibrous connective tissue. Made up of 80% water, elastin and collagen floating in a glycoprotein gel. It is vascularised, enabling it to provide energy and nutrition to epidermis, as well as assist in thermoregulation and healing. It is 10-40 times thicker than dermis.

- **Cells of the dermis**-
  - Fibroblasts—produce collagen and elastin
  - Macrophages—immune cells
  - Adipocytes—fats
THE DERMIS

2 Layers:

1. Papillary layer
   a. Areolar connective tissue
   b. Blood vessels especially in dermal papillae
   c. Free nerve endings
   d. Meissner’s corpuscles

2. Reticular layer (largest part)
   a. Dense irregular connective tissue (thick bundles of interlacing collagen fibers.)
   b. Cutaneous plexus
   c. Sweat glands (eccrine or appocrine)
   d. Sebaceous glands
   e. Hair follicles
• **Papillary Layer**
  - Meissner’s Corpuscles are nerve endings—(sensitive to touch, heat, cold, pain, and pressure)
  - Touch receptors close to surface; pressure receptors are deeper.

• **The Dermo-Epidermal Junction (75 nm)**
  At the junction of the dermis and epidermis is surface bristles with fibrous, vascular, and nervous projections—the dermal papillae.

**Dermal Papillae** –
Ridges in stratum germinativum that arise from dermis.
Create permanent ridges in fingers, palms, and soles of feed.
Cause fingerprints.
These “friction ridges” help with grip.
3. Hypodermis/Subcutaneous Layer

- This layer lies under the dermis (not really part of the integumentary system).
- This layer consists of dense, irregular connective tissue containing collagen and elastic fibers, adipose tissue, hair follicles, nerves, oil glands, and the ducts of sweat glands.

a. Fibrous Connective Tissue
Collagen (resistance to strain) and elastin fibers (elasticity) give skin its strength!

**Extensibility** – ability to stretch (ex. neck, elbow)
**Elasticity** – the ability to return to its original shape after extension or contraction (ex. pregnancy, tissue swelling)

b. Adipose Tissue—contains half of the body’s stored fat.
- padding
- insulation
- energy storage

c. Lamellated Corpuscles – a subcutaneous layer that is sensitive to pressure
SKIN COLOR AND PIGMENTATION

Pigments

1. Melanin – pigment in the epidermis
2. Carotene – pigment in the dermis
3. Hemoglobin – pigment in the RBC’s (passes through capillaries in the dermis)

Black, brown, or has a yellow tint, depending on racial origin.
The more melanin, the darker the skin.
Freckles are patches of melanin.
Albinism = no melanin
APPENDAGES OF THE SKIN

- sudoriferous (sweat) glands—99% water
- sebaceous (oil) glands--sebum
- ceruminous (wax)--cerumen
- hair
- nails
GLANDS – AN ORGAN SPECIALIZED TO SECRETE OR EXCRETE SUBSTANCES FOR FURTHER USE IN THE BODY OR FOR ELIMINATION

1. Sudoriferous (Sweat) Glands – Two types
   a. Apocrine Sweat Glands—
      Unclear function; drains into hair follicles; odorless
      Results from stress.

   b. Eccrine Sweat Glands –
      Higher density in palms, soles of feet, and scalp.
      Odorless, contains Na and electrolytes.
      Controls body temperature
      Exercise sweat
      Consists of a coiled secretory portion that opens to skin surface.
2. **Sebaceous Oil Glands** – secreting portion lies in the dermis and open into the necks of hair follicles or directly onto a skin surface.

*no sebaceous glands on the palms or soles

**Sebum** – oily secretion that ....
- Keeps hair from drying out
- Prevents excessive evaporation of water from skin
- Keeps skin soft
- Inhibits the growth of certain bacteria
Glands

3. Ceruminous Glands – located in the outer ear canal.
   a. EAR WAX = cerumen (cera = wax)
      *a combination of ceruminous secretions and sebaceous glands
   b. HAIRS + EAR WAX = provide a sticky barrier against foreign bodies.

Video: Skin Appendages
http://bio111guide.wordpress.com/140-2/lab-assignments/lab-3-integumentary-system/
Lab: Sweat Glands/Iodine
**Hair**

Primary function is **protection**; guards the scalp from injury and the sun's rays.

a. **Eyebrows and Eyelashes** – protect the eyes from foreign particles.

b. **Nostril hair** – protects against inhaling insects and foreign particles.

c. Found almost everywhere on the body.

d. Hair pigment is made by melanocytes in the hair bulb, and varying amounts of different types of melanin (yellow, rust, brown, and black) combine to produce all varieties of hair color.

e. The medical term for the loss of hair, or baldness, is called “alopecia”
**HAIR - COMPOSITION** *(Hair is Keratinized cells)*

a. **SHAFT** – projects above the surface of the skin. Dead material composed of protein.

b. **ROOT** – below the surface that penetrates into the dermis and into the subcutaneous layer.

c. **HAIR FOLLICLE** – composed of two layers of epidermal cells: External and Internal root sheaths surrounded by a connective tissue sheath.

d. **BULB** – onion shaped structure, contains papilla of the hair, which have many blood vessels and provide nourishment for the hair.

e. **MATRIX** – (growth zone) included in the bulb, produces new hairs by cell division when older hairs are shed.

*(arrector pilli—bundle of smooth muscle cells attached to each hair follicle)—”goosebumps”*
- A hair is produced by a hair follicle. The root is enclosed in the follicle.
- It is formed in the matrix (stratum basale epithelial cells) at the inferior end of the follicle.
- A hair (shaft) is a flexible, epithelial tissue. As daughter cells are pushed away from growing region, they become keratinized and die.
- Each hair consists of a central core called a medulla surrounded by a bulky cortex layer, which is enclosed by a cuticle, which is a single layer of cells that overlap like shingles on a roof. The cuticle keeps hair from matting. Split ends are the wearing away of the cuticle.
ANATOMY OF THE HAIR FOLLICLE:
Nails—Structure

Fingernails and toenails are plates of tightly packed, keratinized cells of the epidermis. (Epidermal cells fused together and fill with keratin)

a. Nail root—non-visible portion

b. Lunula—thickened, whitish semi-lunar area near the nail root and cuticle.

c. Nail body—visible portion of nail (pink part)—appears pink due to blood supply in dermis.

d. Free Edge—part that extends past the end of the finger or toe.

e. Nails are surrounded by nail folds. The thick proximal nail fold is the cuticle.
2. **Growth of the Nails**

a. Occurs by transformation of cells of the nail matrix into nail cells, as they become heavily keratinized and die.

b. The stratum basale of the epidermis extends beneath the nail as the nail bed.

c. The longer the digit and the more the hand is used, the faster the nail grows.

d. Growth slower in toenail

e. Nails help us grasp and manipulate objects and provide a protection against damage to the fingertips.
Skin Disorders

- Acne
- Albinism
- Alopecia
- Athlete’s Foot
- Boils
- Ringworm
- Dermatitis
- Eczema
- Pruritis
- Herpes
  - Genital herpes
  - Herpes simplex 1
  - Shingles (herpes zoster)
- Scabies
- Skin Cancer
  - basal cell carcinoma
  - squamous cell carcinoma
  - melanoma
- Skin Lesions
  - Warts (verrucae)
  - Impetigo
  - Urticaria (hives)
- Excoriation-abrasion