

# **Integumentary System**

Dr. Gary Mumaugh – Campbellsville University

## **Integumentary System**

- Skin
- Accessory organ
  - Sweat glands
  - Oil glands
  - Hair
  - Nail

## **Skin and Its Tissues**

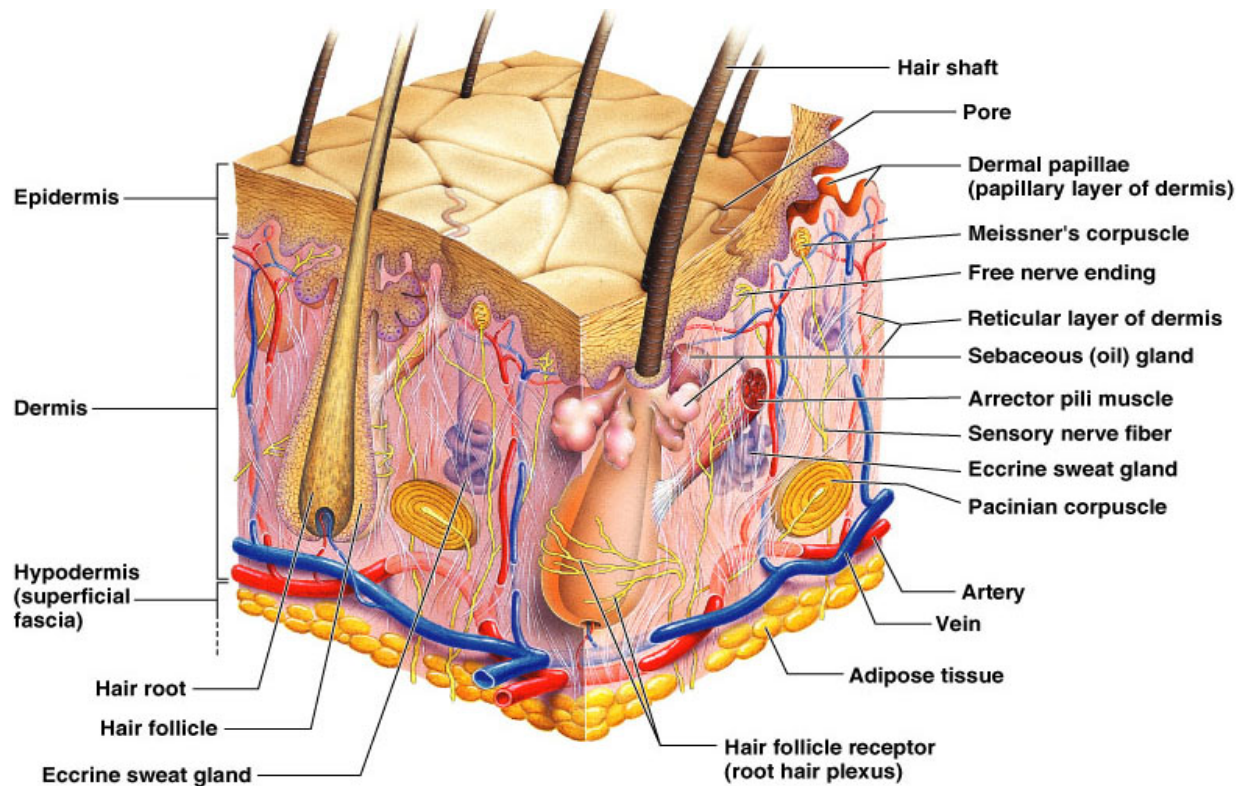
- Composed of several tissue types
- Maintains homeostasis
- Protective covering
- Retards water loss
- Regulates body temperature
- Houses sensory receptors
- Contains immune system cells
- Synthesizes chemicals
- Excretes small amounts of wastes

## **Functions of the Integumentary System**

- Protection – chemical, physical, and mechanical barrier
- Vitamin D synthesis
- Body temperature regulation is accomplished by:
  - Dilation (cooling) and constriction (warming) of dermal vessels
  - Increasing sweat gland secretions to cool the body
- Cutaneous sensation – sense receptors for touch and pain
- Metabolic functions – synthesis of vitamin D in dermal blood vessels
- Blood reservoir – skin blood vessels store up to 5% of the body's blood volume
- Excretion – limited amounts of nitrogenous wastes are eliminated from the body in sweat
- Communication – non verbal

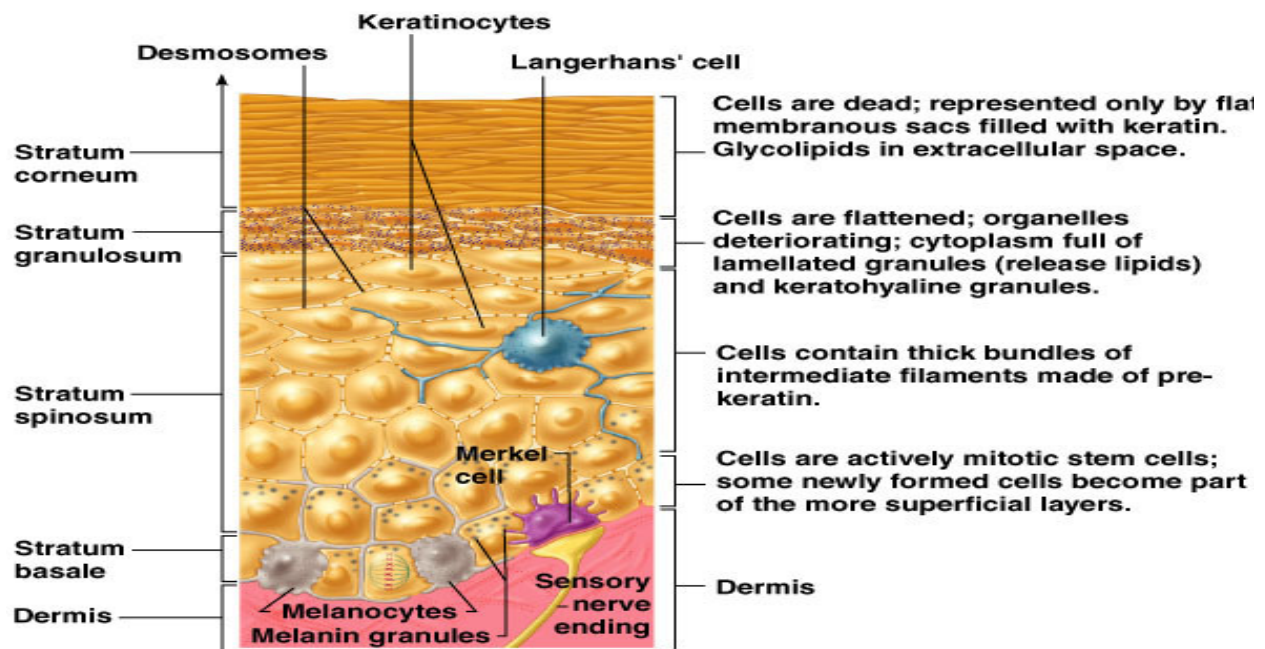
## **Skin (Integument)**

- Skin covers the entire body
  - Surface area of 3-7 square feet
  - Weighs 7% of adult weight (9-11 pounds)
- Consists of three major regions
  - Epidermis – outermost superficial region      - Cutaneous Membrane
  - Dermis – middle region                                      - Cutaneous Membrane
  - Hypodermis (superficial fascia) – deepest region



## Epidermis

- Lacks blood vessels
- Keratinocytes—most abundant cell type in epidermis
  - Arise from *deepest layer of epidermis*
  - Produce keratin, a tough fibrous protein
  - Produce antibiotics and enzymes
  - Keratinocytes are *dead at skin's surface*
- Thickest on palms and soles
- Melanocytes provide melanin
- Rests on basement membrane
- Composed of keratinized stratified squamous epithelium, consisting of four or five layers
- Outer portion of the skin is exposed to the external environment and functions in protection
- The epidermal cells start in the deepest layer and are pushed upward by the process of new cells
  - Millions of dead cells rub off daily, giving us a new epidermis every 25-45 days
  - In areas of the body subject to increased friction, cell production increases from the friction and forms a *callus*



### Layers of the Epidermis - Stratum Basale or Germinativum (Basal Layer)

- Deepest epidermal layer firmly attached to the dermis
- Cells undergo rapid division, hence its alternate name, stratum germinativum
- Stratum basale contains
  - Tactile epithelial cells—associated with sensory nerve ending
  - Melanocytes—secrete the pigment melanin

### Layers of the Epidermis - Stratum Spinosum (Prickly Layer) (Spiny layer)

- “Spiny” appearance caused by artifacts of histological preparation
- Contains thick bundles of intermediate filaments (tonofilaments)
- Resist tension and contain the protein prekeratin
- Among the keratinocytes are star-shaped dendritic cells
  - Are a type of macrophage
  - Function in immune system

### Layers of the Epidermis - Stratum Granulosum (Granular Layer)

- Consists of a few layers of keratinocytes
- Keratinocytes contain
  - Keratohyaline granules—help form keratin
  - Lamellar granules—contain waterproofing glycolipid
- Above stratum granulosum
- Cells are too far from dermal capillaries to receive nourishment

### **Layers of the Epidermis - Stratum Lucidum (Clear Layer)**

- Occurs only in thick skin
- Locations of thick skin—palms and soles
- Composed of a few rows of flat, dead keratinocytes

### **Layers of the Epidermis - Stratum Corneum (Horny Layer)**

- Thick layer of dead keratinocytes and thickened plasma membranes
- Protects skin against abrasion and penetration

### **Layers of the Epidermis - Layers of the Epidermis: Stratum Corneum**

- Outermost layer of keratinized cells
  - 20 to 30 cell layers thick
  - Accounts for three 3/4 of the epidermal thickness
- Functions include:
  - Waterproofing
  - Protection from abrasion and penetration
  - Rendering the body relatively insensitive to biological, chemical, and physical assaults
- The shingle-like cell remnants of this layer are called horny cells

### **Dermis**

- Second major skin region containing strong, flexible connective tissue
- The dermis binds the body together like a stocking
- It is “hide” and is similar to animal hide (leather)
- Rich supply of blood, nerve, and lymphatics
- Composed of two layers – papillary and reticular
  - Papillary Dermis
    - Papillary layer has connective tissue with collagen and elastic fibers
    - Includes dermal papillae
    - Increase surface area for exchange of gases, nutrients, and wastes
    - Dermal papillae lie on dermal ridges
    - Epidermal ridges (friction ridges)—elevations of dermal ridges
    - Are fingerprints
    - Increase gripping ability of hands and feet
  - Reticular Dermis
    - Accounts for approximately 80% of the thickness of the skin.
    - Collagen fibers in this layer add strength and resiliency to the skin.
    - Lines, wrinkles and “crows feet” occur in this layer.
    - Dense irregular connective tissue
    - Cleavage lines—separation between collagen fibers
    - Flexure lines - creases in palms, wrists, soles, fingers, and toes
    - Has rich nerve supply
    - Has two vascular plexuses
      - Dermal plexus
      - Subpapillary plexus
    - Blood vessels play important role in temperature regulation

### **Subcutaneous or Hypodermis**

- Subcutaneous layer deep to the skin
- Composed of adipose and areolar connective tissue
- This is the layer that fat accumulates
- Insulates
- Major blood vessels present

### **Skin Color**

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

### **Burns**

- First-degree – only the epidermis is damaged
  - Symptoms include localized redness, swelling, and pain
- Second-degree – epidermis and upper regions of dermis are damaged
  - Symptoms mimic first degree burns, but blisters also appear
- Third-degree – entire thickness of the skin is damaged
  - Burned area appears gray-white, cherry red, or black; there is no initial edema or pain (since nerve endings are destroyed)

### **Skin Cancer**

- The three major types of skin cancer are:
  - Basal cell carcinoma
  - Squamous cell carcinoma
  - Melanoma
- Most are benign and do not metastasize

### **Basal Cell Carcinoma**

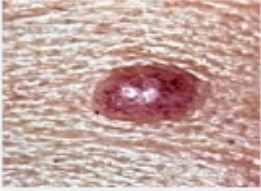



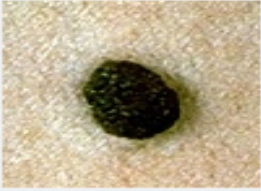



- Least malignant and most common skin cancer
- Slow growing and do not often metastasize
- Can be cured by surgical excision in 99% of the cases

### **Squamous Cell Carcinoma**

- Arise most often on scalp, ears, and lower lip
- Grows rapidly and metastasizes if not removed
- Prognosis is good if treated by radiation therapy or removed surgically

## Melanoma

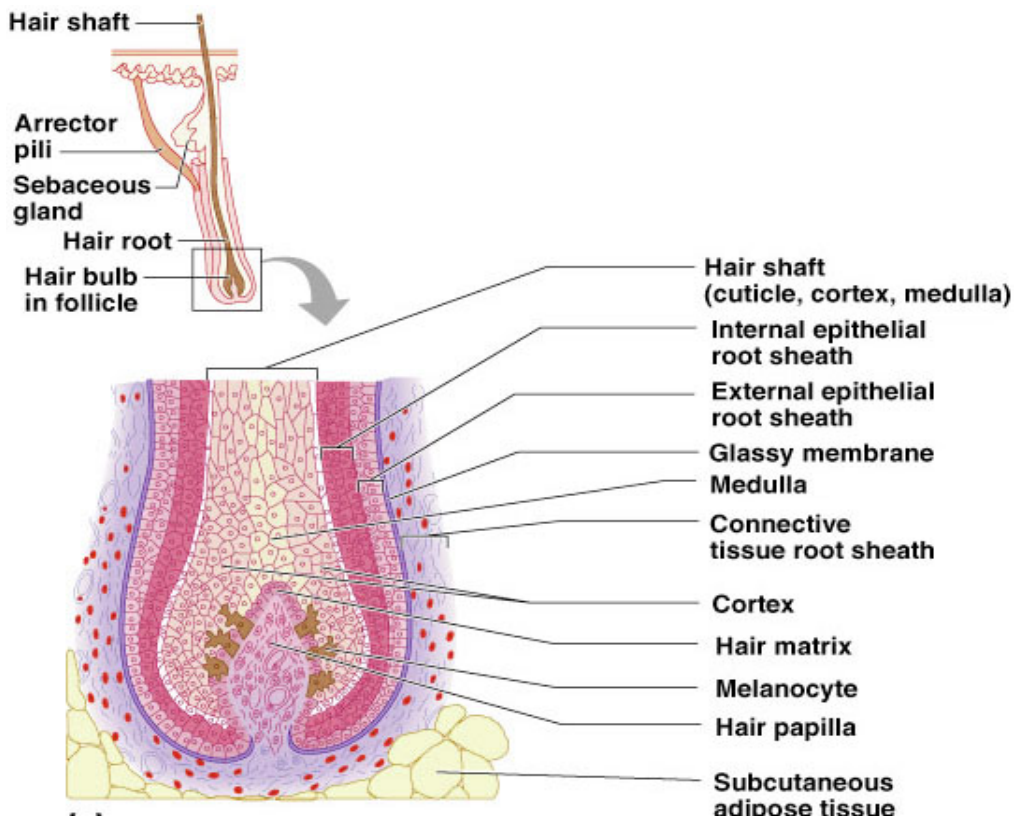
- Cancer of melanocytes is the most dangerous type of skin cancer because it is:
  - Highly metastatic
  - Resistant to chemotherapy
- Treated by wide surgical excision accompanied by immunotherapy
- Chance of survival is poor if the lesion is over 4 mm thick
- Melanomas have the following characteristics (ABCD rule)
  - A: Asymmetry; the two sides of the pigmented area do not match
  - B: Border is irregular and exhibits indentations
  - C: Color (pigmented area) is black, brown, tan, and sometimes red or blue
  - D: Diameter is larger than 6 mm (size of a pencil eraser)

Normal Mole	Melanoma	Sign	Characteristic
		Asymmetry	when half of the mole does not match the other half
		Border	when the border (edges) of the mole are ragged or irregular
		Color	when the color of the mole varies throughout
		Diameter	if the mole's diameter is larger than a pencil's eraser

*Photographs Used By Permission: National Cancer Institute*

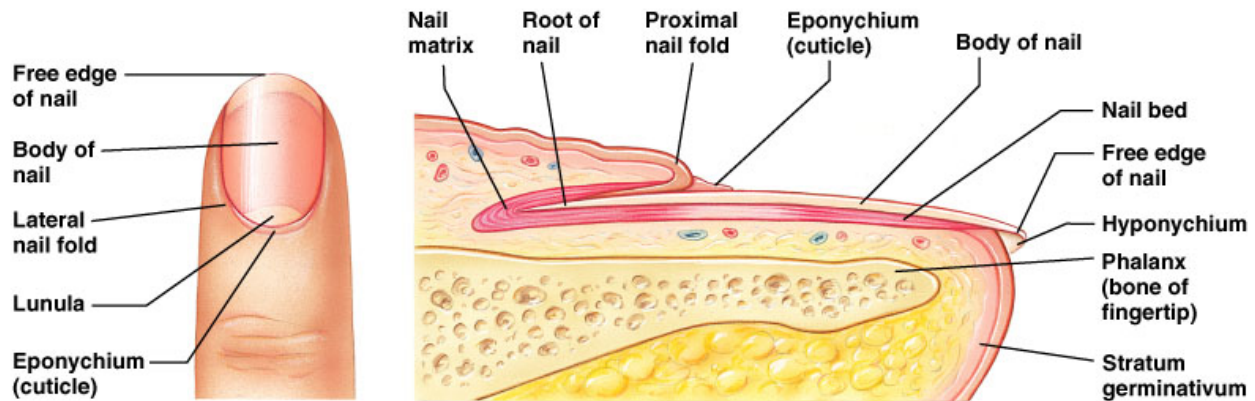
## Hair (Pili)

- Flexible strands of dead keratinized cells produced by hair follicles
- Contains hard keratin which is tougher and more durable than soft keratin of the skin
- Made up of the shaft projecting from the skin, and the root embedded in the skin
- Vellus hairs
  - Body hairs of women and children
- Terminal hairs
  - Hair of scalp
  - Axillary and pubic area (at puberty)
- Various proportions of melanins produce different hair colors
- Gray of white hair is from decreased melanin productions and air bubbles in the hair shaft
- Hair Function
  - Helping to maintain warmth
  - Alerting the body to presence of insects on the skin
  - Guarding the scalp against physical trauma, heat loss, and sunlight
- Hair Thinning and Baldness
  - Alopecia – hair thinning in both sexes
  - True, or frank, baldness
  - Genetically determined and sex-influenced condition
  - Male pattern baldness



## Structure of a Nail

- Scalelike modification of the epidermis on the distal, dorsal surface of fingers and toes



## Sebaceous Glands

- Simple alveolar glands found all over the body
  - Except palms and soles
- They are small on the body, trunks and limbs
- They are large of the face, neck and upper chest
- Secrete an oily secretion called sebum
  - Holocrine secretion—entire cell breaks up to form secretion
- Functions of sebum
  - Sebum has an important bactericidal effect
  - Softens and lubricates the hair and skin
  - Slows water loss from the skin
  - Collects dirt
- Most are associated with a hair follicle

## Sweat Glands

- Sweat glands (sudoriferous glands) widely distributed on body
- Sweat—is a blood filtrate
- 99% water with some salts
- Contains traces of metabolic wastes
- About 2% urea
- Two types of sweat gland
  - Eccrine gland (merocrine)
    - Most numerous—these produce true sweat
  - Apocrine gland
    - Confined to axillary, anal, and genital areas
    - Produce a special kind of sweat
    - Musky odor—attracts a mate
- Ceruminous glands – in external ear canal that secrete cerumen
- Mammary glands – specialized sweat glands that secrete milk



### **The Skin Throughout Life**

- Epidermis - Develops from embryonic ectoderm
- Dermis and hypodermis - Develop from mesoderm
- Melanocytes - Develop from neural crest cells

### **The Skin Throughout Life**

- Fetal skin
  - Well formed after the fourth month
- At 5–6 months, the fetus is covered with lanugo (downy hairs)
- Fetal sebaceous glands produce *vernix caseosa*

### **The Skin Throughout Life**

- Middle to old age
  - Skin thins and becomes less elastic
  - Shows harmful effects of environmental damage
  - Skin inflammations become more common