

## The Skin and the Hypodermis

- Skin—our *largest organ*
  - Accounts for *7% of body weight*
  - Varies in thickness from 1.5–4.4mm
  - Divided into *two distinct layers*
    - **Epidermis**
    - **Dermis**
  - **Hypodermis**—lies deep to the dermis
    - Composed of areolar and adipose tissues
    - Not part of the integumentary system, but shares some of skin's properties

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## Skin Structure

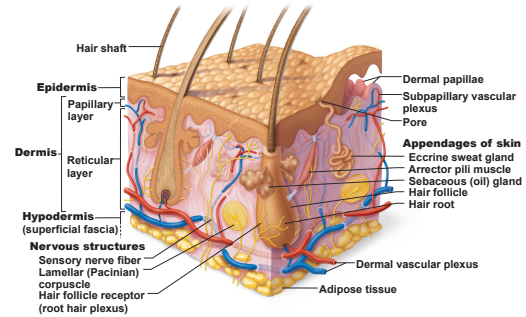


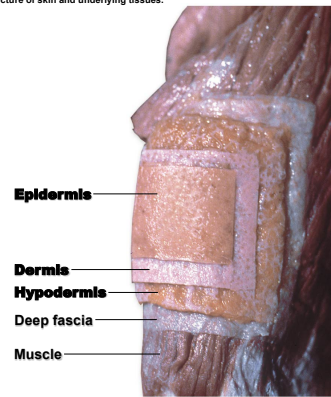
Figure 5.1

## The Skin and Hypodermis

- **Functions**
  1. **Protection**—cushions organs and protects from bumps, chemicals, water loss, UV radiation
  2. **Regulation of body temperature**—Capillary network and sweat glands regulate heat loss
  3. **Excretion**—urea, salts, and water lost through sweat
  4. **Production of vitamin D**—Epidermal cells use UV radiation to synthesize vitamin D
  5. **Sensory reception**—Contains sense organs associated with nerve endings

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Figure 5.2 Gross structure of skin and underlying tissues.



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## Epidermis

- Is composed of keratinized stratified squamous epithelium
- Contains four main cell types
  - **Keratinocytes**
    - Location—stratum spinosum; produce keratin a fibrous protein
  - **Melanocytes**
    - Location—basal layer; manufacture and secrete the pigment melanin
  - **Tactile epithelial cells (Merkel cells)**
    - Location—basal layer; attached to sensory nerve endings
  - **Dendritic cells (Langerhans cells)**
    - Location—stratum spinosum; part of immune system; macrophage-like

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## Epidermis

- **Keratinocytes**—most abundant cell type in epidermis
  - Arise from *deepest layer of epidermis*
  - Produce **keratin**, a tough fibrous protein
  - Produce **antibodies** and **enzymes**
  - Keratinocytes are *dead at skin's surface*

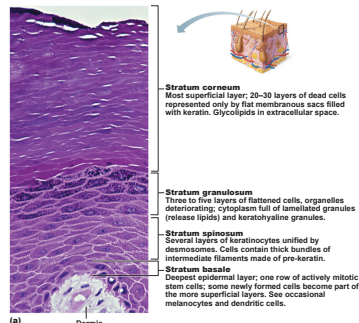
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## Layers of the Epidermis

- Stratum basale (stratum geminativum)
- Stratum spinosum
- Stratum granulosum
- Stratum lucidum (only in thick skin)
- Stratum corneum

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## Epidermal Cells and Layers of the Epidermis



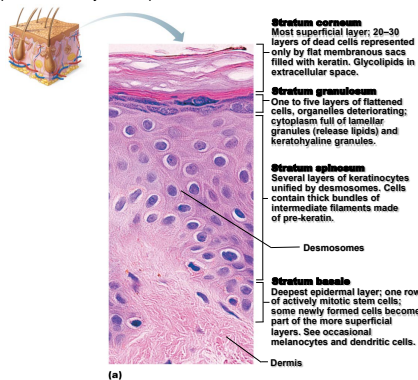
- Stratum corneum**  
Most superficial layer; 20–30 layers of dead cells represented only by flat membranous sacs filled with keratin. Glycolipids in extracellular space.
- Stratum granulosum**  
Three to five layers of flattened cells, organelles deteriorating; cytoplasm full of lamellar granules (release lipids) and keratohyaline granules.
- Stratum spinosum**  
Several layers of keratinocytes unified by desmosomes. Cells contain thick bundles of intermediate filaments made of pre-keratin.
- Stratum basale**  
Deepest epidermal layer; one row of actively mitotic stem cells; some newly formed cells become part of the more superficial layers. See occasional melanocytes and dendritic cells.

(a) Dermis

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Figure 5.3a

Figure 5.3a Epidermal cells and layers of the epidermis.

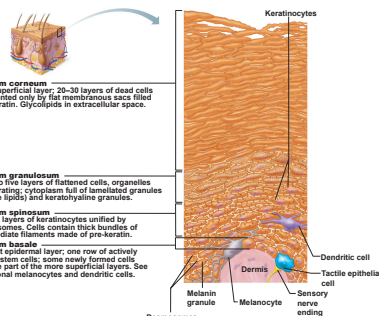


- Stratum corneum**  
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(a)

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## Epidermal Cells and Layers of the Epidermis



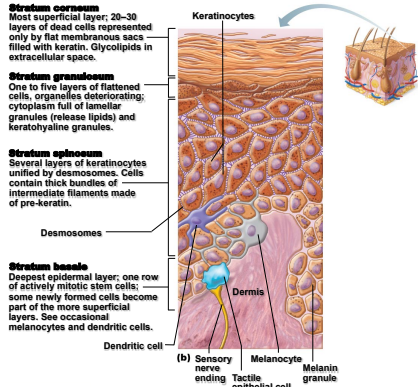
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- Stratum basale**  
Deepest epidermal layer; one row of actively mitotic stem cells; some newly formed cells become part of the more superficial layers. See occasional melanocytes and dendritic cells.

(b)

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Figure 5.3b

Figure 5.3b Epidermal cells and layers of the epidermis.



- Stratum corneum**  
Most superficial layer; 20–30 layers of dead cells represented only by flat membranous sacs filled with keratin. Glycolipids in extracellular space.
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One to five layers of flattened cells, organelles deteriorating; cytoplasm full of lamellar granules (release lipids) and keratohyaline granules.
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Deepest epidermal layer; one row of actively mitotic stem cells; some newly formed cells become part of the more superficial layers. See occasional melanocytes and dendritic cells.

(b)

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## Layers of the Epidermis

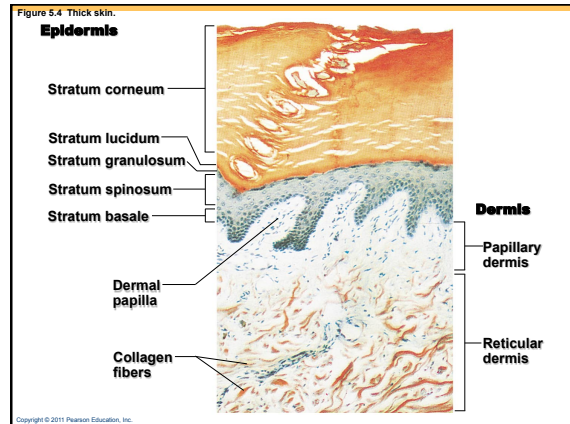
- **Stratum basale**
  - Deepest layer of epidermis
  - Attached to underlying dermis
  - Cells actively divide
  - Stratum basale contains
    - Tactile epith. Cells/Merkel cells—associated with sensory nerve ending
    - Melanocytes—secrete the pigment melanin
- **Stratum spinosum (spiny layer)**
  - “Spiny” appearance caused by:
    - Artifacts of histological preparation
  - Contains thick bundles of intermediate filaments (tonofilaments)
    - Resist tension
    - Contain protein prekeratin
  - Contains star-shaped dendritic cells
    - A type of macrophage
    - Function in immune system

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## Layers of the Epidermis

- **Stratum granulosum**
  - Consists of keratinocytes and tonofilaments
  - Tonofilaments contain:
    - Keratohyaline granules—help form keratin
    - Lamellated granules—contain a waterproofing glycolipid
- **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
- **Stratum corneum** (horny layer)
  - Thick layer of dead keratinocytes and thickened plasma membranes
  - Protects skin against abrasion and penetration

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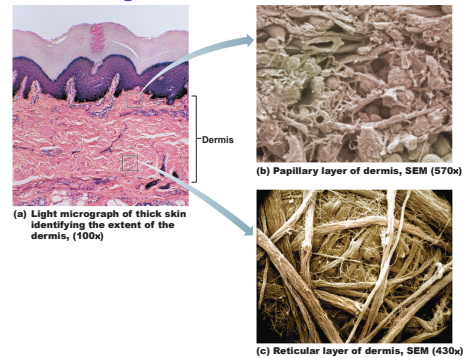
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## Dermis

- Second major layer of the skin
- Strong, flexible connective tissue
- Richly supplied with blood vessels (important role in temperature control) and nerves
- Has two layers
  - **Papillary layer**—includes dermal papillae
  - **Reticular layer**
    - Deeper layer—80% of thickness of dermis
- **Flexure lines**
  - Creases on palms

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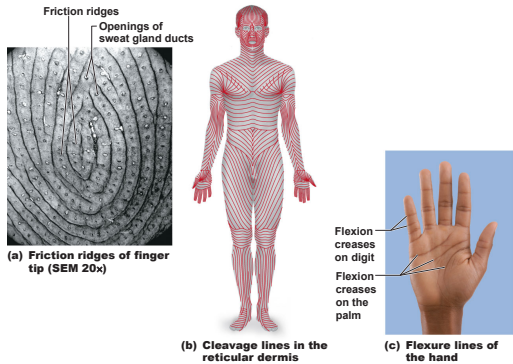
## The Two Regions of the Dermis



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Figure 5.5

## Dermal Modifications



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Figure 5.6

## Hypodermis

- Deep to the skin—also called **superficial fascia** or **subcutaneous layer**
- Contains **areolar** and **adipose CT**
- Anchors skin to underlying structures
- Helps *insulate* the body
- Has different distribution in males and females

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## Skin Color

- Three pigments contribute to skin color
  - **Melanin**
    - Most important pigment—made from tyrosine
  - **Carotene**
    - Yellowish pigment from carrots and tomatoes
  - **Hemoglobin**
    - Caucasian skin contains little melanin
    - Allows crimson color of blood to show through

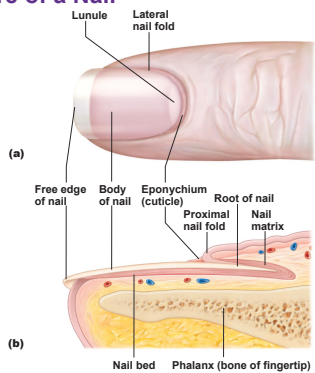
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## Nails

- **Nails**—scalelike modification of epidermis
  - Made of hard keratin
  - Parts of the nail
    - Free edge
    - Body
    - Root
    - Nail folds
    - Eponychium—cuticle

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## Structure of a Nail



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Figure 5.7

## Appendages of the Skin

- **Hair**
  - Flexible strand of dead, keratinized cells
  - Hard keratin—tough and durable
  - Chief parts of a hair
    - **Root**—imbedded in the skin
    - **Shaft**—projects above skin's surface

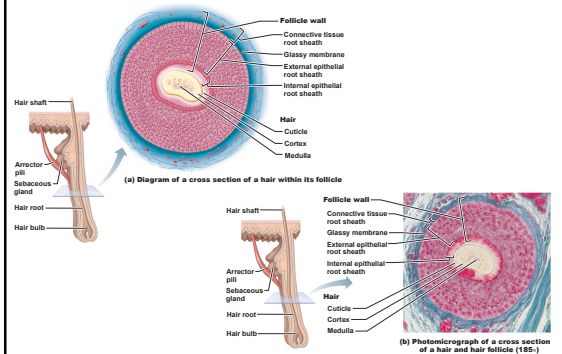
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## Appendages of the Skin

- Hair has three concentric layers of keratinized cells
  - **Medulla**—central core
  - **Cortex**—surrounds medulla
  - **Cuticle**—outermost layer
- **Hair follicles**
  - Extend from epidermis into dermis
- **Hair bulb**
  - Deep, expanded end of the hair follicle
- **Root plexus**
  - Knot of sensory nerves around hair bulb

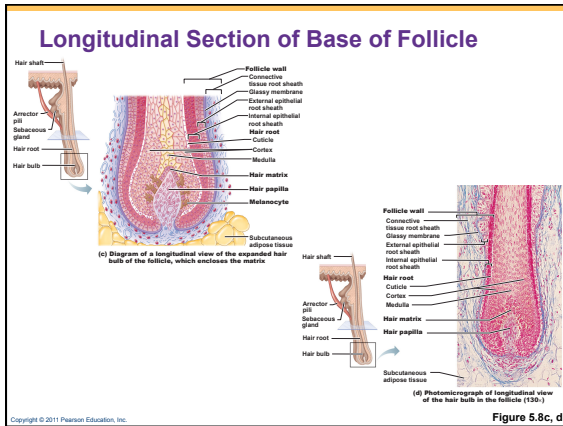
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## Cross Section of a Hair



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Figure 5.8a, b

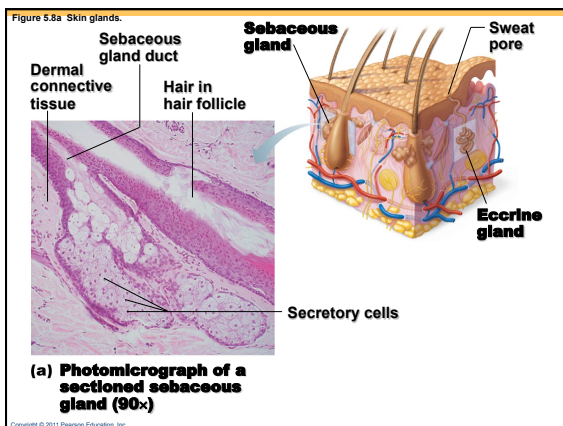
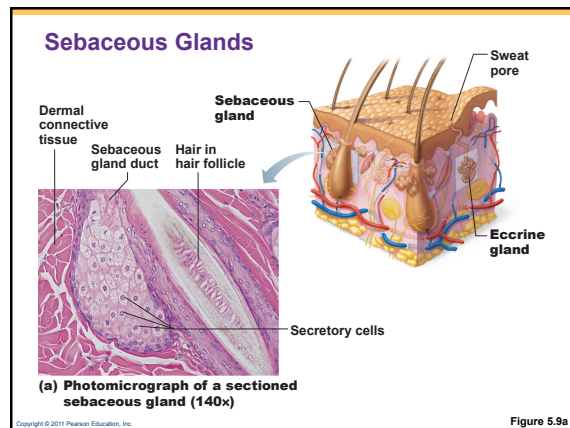


### Appendages of the Skin

- **Arrector pili** muscle
  - Bundle of **smooth muscle**
  - Hair stands erect when *arrector pili* contracts
- **Vellus hairs**
  - Body hairs of women and children
- **Terminal hairs**
  - Hair of scalp
  - Axillary and pubic area (at puberty)
- Hair thinning and baldness
  - Due to aging
  - Male pattern baldness

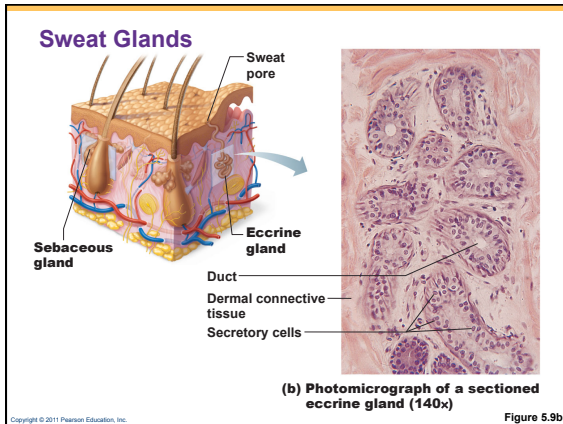
### Sebaceous Glands

- Occur over entire body
  - Except palms and soles
- Secrete **sebum**—an oily substance
  - **Simple alveolar glands**
  - **Holocrine secretion**—entire cell breaks up to form secretion
  - Most are associated with a hair follicle
- Functions of **sebum**
  - Collects dirt; softens and lubricates hair and skin



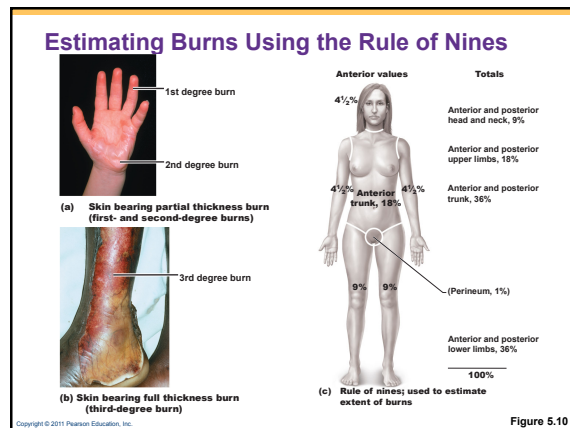
### Sweat Glands

- **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

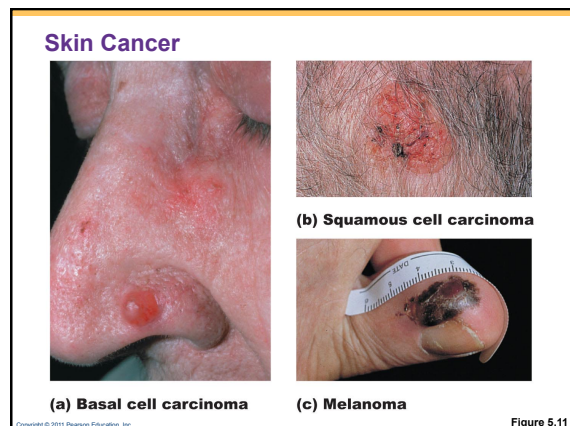


- ### Sweat Glands
- Two types of sweat gland
    - **Eccrine gland** (merocrine)
      - Most numerous—these produce true sweat
    - **Apocrine gland**
      - Confined to axillary, anal, and genital areas
      - Produce a special kind of sweat
        - Musky odor—attracts a mate
        - Signal information about a person's immune system, MHC
    - Ceruminous glands and mammary glands
      - Modified apocrine glands

- ### Burns
- Classified by **severity**
    - **First-degree burn**—only upper epidermis is damaged
    - **Second-degree burn**—upper part of dermis is also damaged
      - Blisters appear
      - Skin heals with little scarring
    - **Third-degree burn**
      - Consumes thickness of skin
      - Burned area appears white, red, or blackened
- loss of body fluids, infection, loss of temperature control



- ### Skin Cancer
- The most common type of cancer
- **Basal cell carcinoma**
    - Least malignant and most common
  - **Squamous cell carcinoma**
    - Arises from keratinocytes of stratum spinosum
  - **Melanoma**
    - A cancer of melanocytes
    - The most dangerous type of skin cancer



### 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

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