Overview

- **Integumentary System** – consists of the skin and its accessory organs
  - hair, nails, and cutaneous glands
- skin is the most vulnerable organ
  - exposed to radiation, trauma, infection, and injurious chemicals
- receives more medical treatment than any other organ system
- **dermatology** – scientific study and medical treatment of the integumentary system

Structure of the Skin

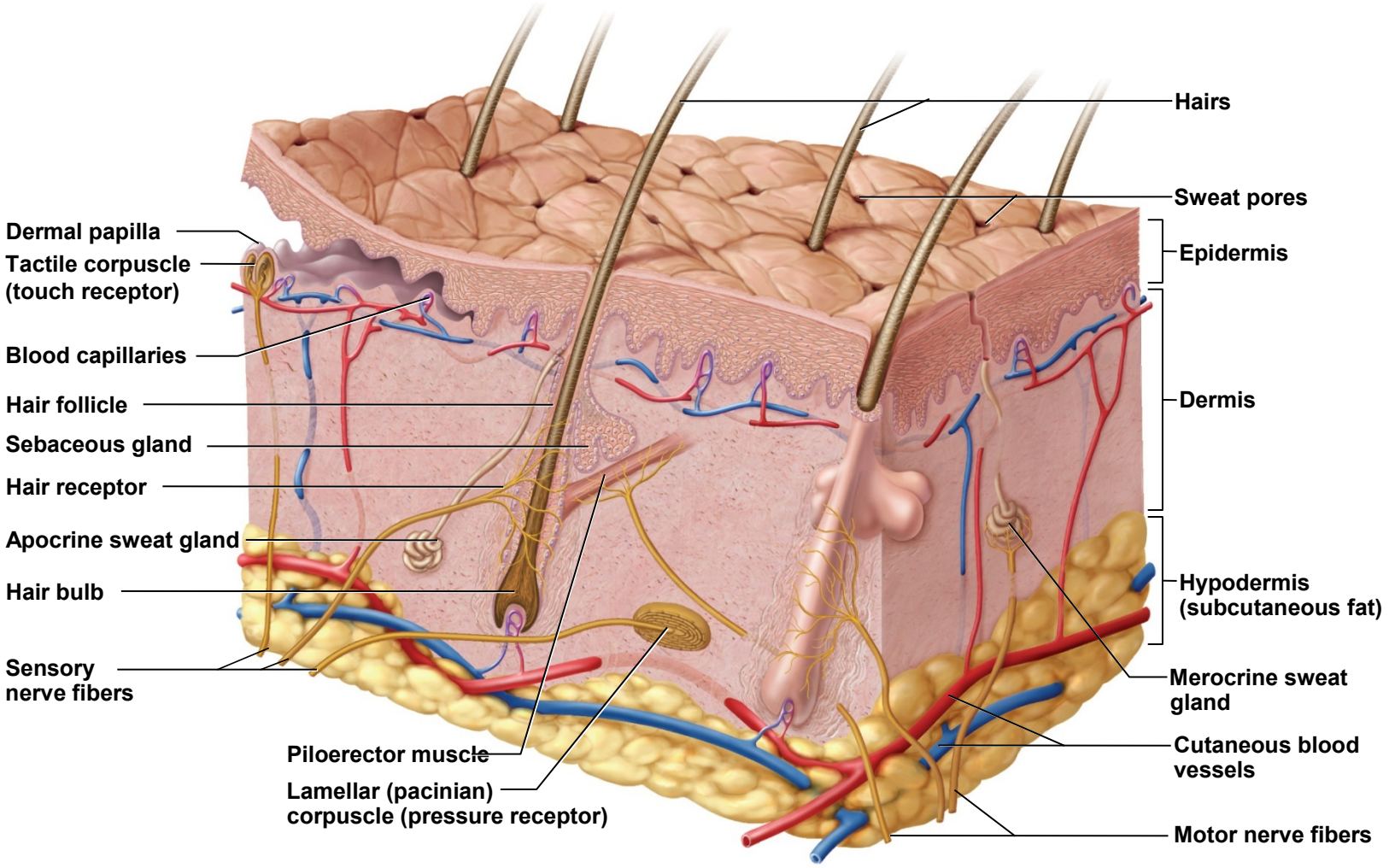


Figure 6.1

Skin and Subcutaneous Tissue

- the body's largest and heaviest organ
  - 15 % of body weight
- consists of two layers:
  - **epidermis** – stratified squamous epithelium
  - **dermis** – connective tissue layer

Functions of the Skin

- **resistance to trauma and infection**
  - keratin
  - acid mantle
- **other barrier functions**
  - waterproofing
  - UV radiation
  - harmful chemicals
- **vitamin D synthesis**
  - skin first step
  - liver and kidneys complete process
- **sensation**
  - skin is our most extensive sense organ
- **thermoregulation**
  - thermoreceptors
  - vasoconstriction / vasodilation
- **transdermal absorption**
  - administration of certain drugs steadily through thin skin – adhesive patches

Epidermis

- **epidermis** – keratinized stratified squamous epithelium
  - dead cells at the surface packed with tough protein – **keratin**
  - lacks blood vessels
  - depends on the diffusion of nutrients from underlying connective tissue
  - sparse nerve endings for touch and pain

Cells of Epidermis

- five types of cells of the epidermis
  - **stem cells**
    - undifferentiated cells that give rise to keratinocytes
    - in deepest layer of epidermis (stratum basale)
  - **keratinocytes**
    - great majority of epidermal cells
    - synthesize **keratin**
  - **melanocytes**
    - occur only in stratum basale
    - synthesize pigment **melanin** that shields DNA from ultraviolet radiation
    - branched processes that spread among keratinocytes
  - **tactile (merkel) cells**
    - in basal layer of epidermis
    - touch receptor cells associated with dermal nerve fibers
  - **dendritic (langerhans) cells**
    - macrophages originating in bone marrow that guard against pathogens
    - stand guard against toxins, microbes, and other pathogens that penetrate skin

Cell Types and Layers of the of the Epidermis

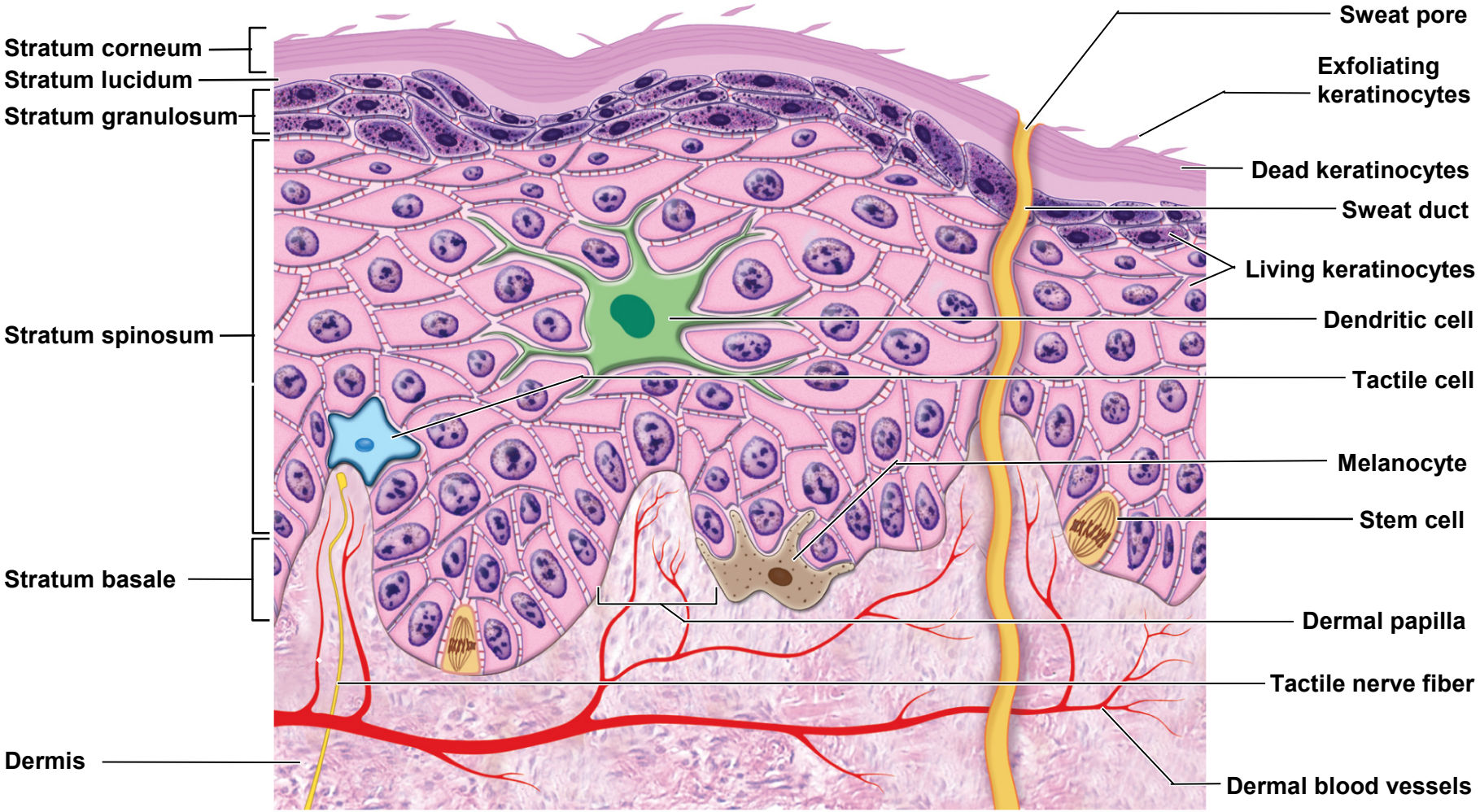


Figure 6.3

Stratum Basale

- a single layer of **stem cells** and **keratinocytes** resting on the basement membrane
  - **melanocytes** and **tactile cells** are scattered among the stem cells and keratinocytes

- **stem cells of stratum basale divide**
  - give rise to keratinocytes that migrate toward skin surface
  - replace lost epidermal cells

Stratum Spinosum

- consists of **several layers of keratinocytes**
- **thickest stratum in most skin**
  - in thick skin, exceeded by stratum corneum
- **deepest cells remain capable of mitosis**
  - cease dividing as they are pushed upward
- produce more and more **keratin filaments** which causes cell to flatten
  - higher up in this stratum, the flatter the cells appear
- **dendritic cells** found throughout this stratum

Stratum Granulosum

- consists of **3 to 5 layers** flat keratinocytes

Stratum Lucidum

- seen **only in thick skin**
- **thin translucent zone** superficial to stratum granulosum

Stratum Corneum

- up to 30 layers of dead, scaly, keratinized cells
- form durable surface layer
  - surface cells flake off (exfoliate)
- resistant to abrasion, penetration, and water loss

Life History of Keratinocytes

- **keratinocytes** are produced deep in the epidermis by stem cells in **stratum basale**
- newly formed keratinocytes push the older ones toward the surface
- Flake off in **30 - 40 days**
- in **stratum granulosum** three important developments occur
  - keratinocyte nucleus and other organelles degenerate, **cells die**
  - release a protein **filaggrin** which binds the keratin filaments together
  - membrane-coating vesicles release lipid mixture that spreads out over cell surface and **waterproofs** it

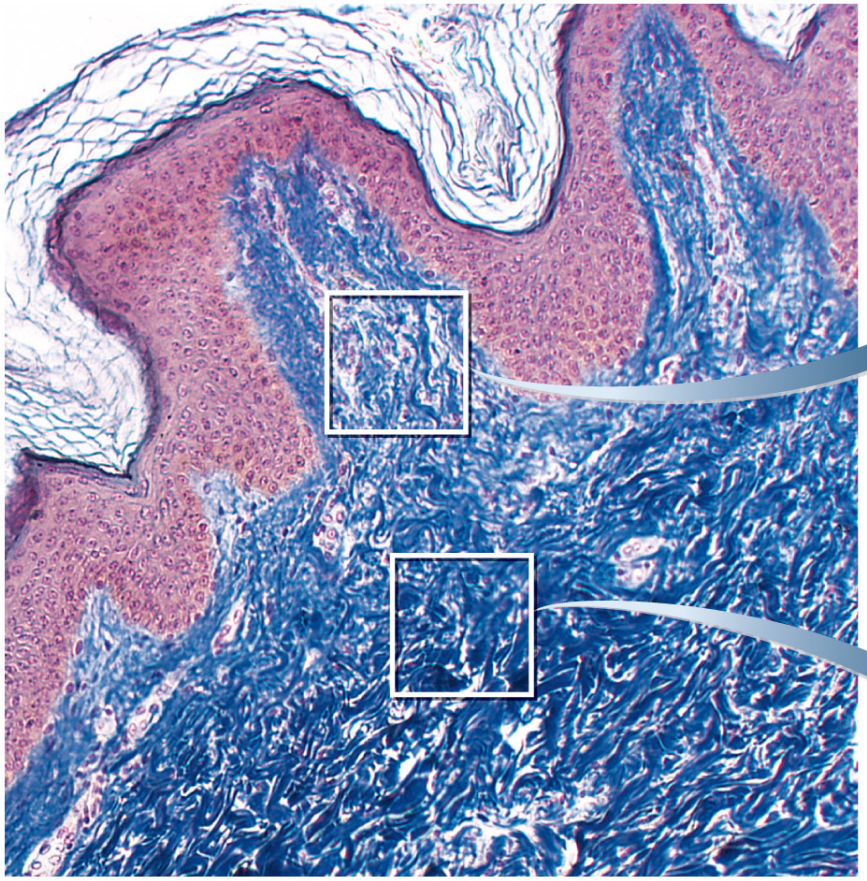
Dermis

- **dermis** – connective tissue layer beneath the epidermis
- composed mainly of collagen with elastic fibers, reticular fibers, and fibroblasts
- well supplied with **blood vessels**, **sweat glands**, **sebaceous glands**, and **nerve endings**
- **hair follicles** and **nail roots** are embedded in dermis
- smooth muscle (**piloerector muscles**) associated with hair follicles
  - contract in response to stimuli, such as cold, fear, and touch – **goose bumps**

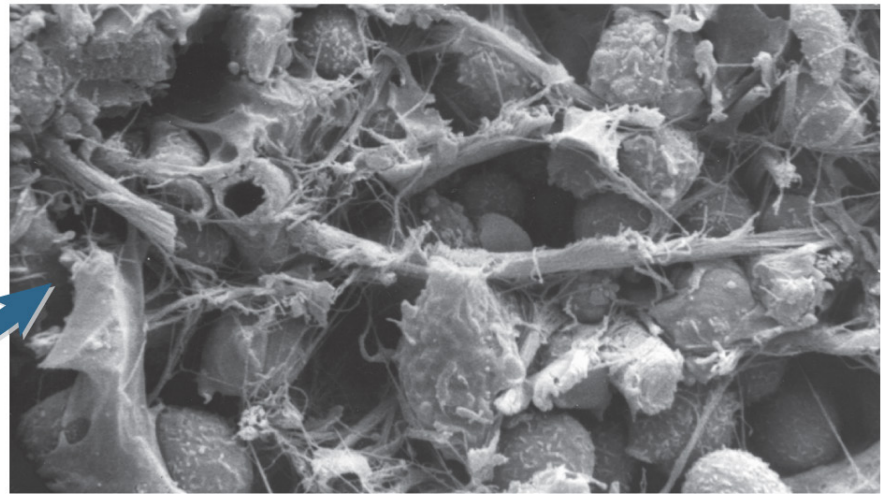
Dermis

- **dermal papillae** – upward fingerlike extensions of the dermis
  - **friction ridges** on fingertips that leave fingerprints
- **papillary layer** – superficial zone of dermis
  - thin zone of areolar tissue in and near the dermal papilla
  - allows for mobility of leukocytes and other defense cells should epidermis become broken
  - rich in small blood vessels
- **reticular layer** – deeper and much thicker layer of dermis
  - consists of dense, irregular connective tissue

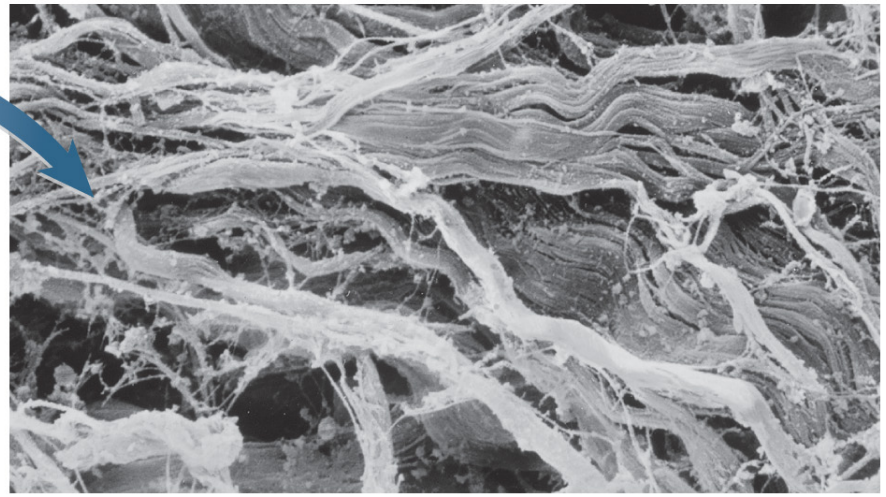
Structure of the Dermis



(a)



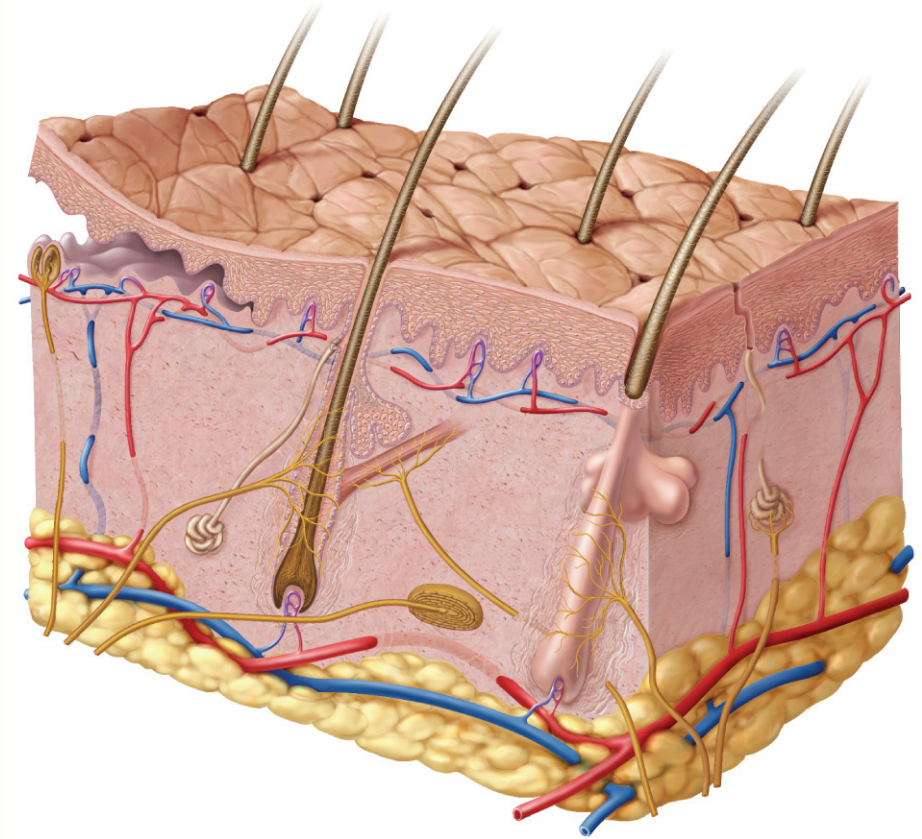
(b) Papillary layer of dermis



(c) Reticular layer of dermis

Figure 6.5

Hypodermis



- subcutaneous tissue
- more areolar and adipose than dermis
- pads body
- binds skin to underlying tissues
- drugs introduced by injection
  - highly vascular & absorbs them quickly
- subcutaneous fat
  - energy reservoir
  - thermal insulation
  - 8% thicker in women

Skin Color

- **melanin** – most significant factor in skin color
  - produced by **melanocytes**

- people of different skin colors have the **same number of melanocytes**

Evolution of Skin Color

- **UVR has two adverse effects:**
  - causes **skin cancer**
  - **breaks down folic acid** needed for normal cell division, fertility, and fetal development
- **UVR has a desirable effect:**
  - stimulates **synthesis of vitamin D** necessary for dietary calcium absorption

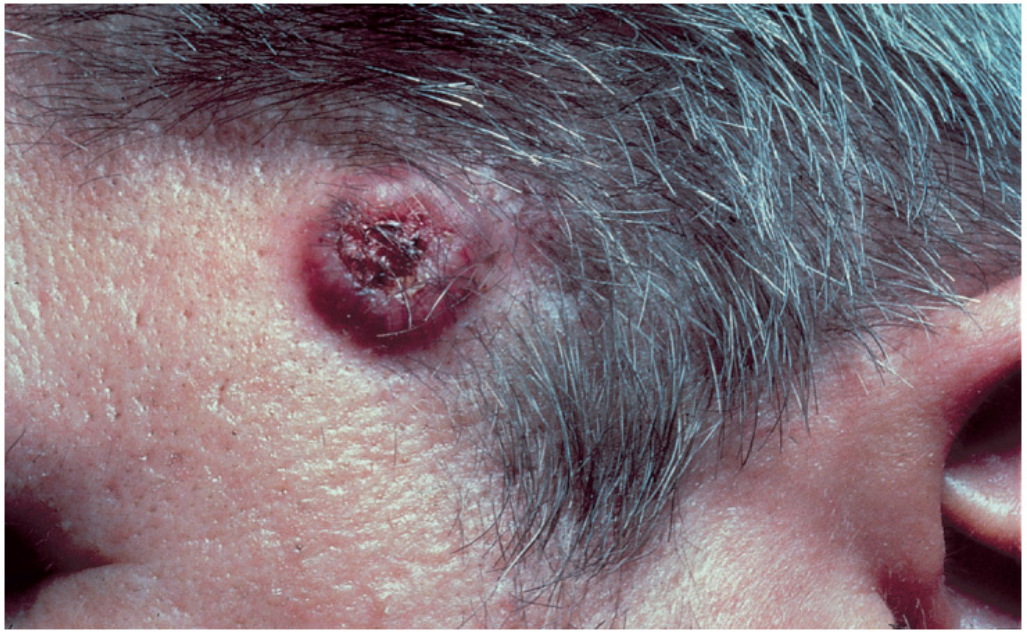
Hair and Nails

- **hair**, **nails**, and **cutaneous glands** are accessory organs of the skin
- **hair** and **nails** are composed of mostly of dead, keratinized cells
  - pliable **soft keratin** makes up stratum corneum of skin
  - compact **hard keratin** makes up hair and nails
    - tougher and more compact due to numerous cross-linkages between keratin molecules

Skin Cancer

- **skin cancer –** induced by the **ultraviolet rays of the sun**
  - most often on the head and neck
  - most common in fair-skinned people and the elderly
  - one of the most common cancers
  - one of the easiest to treat
  - has one of the highest survival rates if detected and treated early
  - **three types** of skin cancer named for the epidermal cells in which they originate
  - **basal cell carcinoma**, **squamous cell carcinoma**, and **malignant melanoma**

Basal Cell Carcinoma



(a) Basal cell carcinoma

- most common type
- least dangerous because it seldom metastasizes
- forms from cells in stratum basale

Squamous Cell Carcinoma

(b) Squamous cell carcinoma

- arise from keratinocytes from stratum spinosum
-- chance of recovery good with early detection and surgical removal
- tends to metastasize to lymph nodes and may become lethal

Malignant Melanoma

(c) Malignant melanoma

- skin cancer that arises from melanocytes
- often in a preexisting mole
- less than 5% of skin cancers, but most deadly form
- treated surgically if caught early
- metastasizes rapidly - unresponsive to chemotherapy - usually fatal

- person with metastatic melanoma lives only 6 months from diagnosis
- 5% - 14% survive 5 years

UVA, UVB and Sunscreens

- both increase risk of skin cancer
- Damage DNA and affect protein function