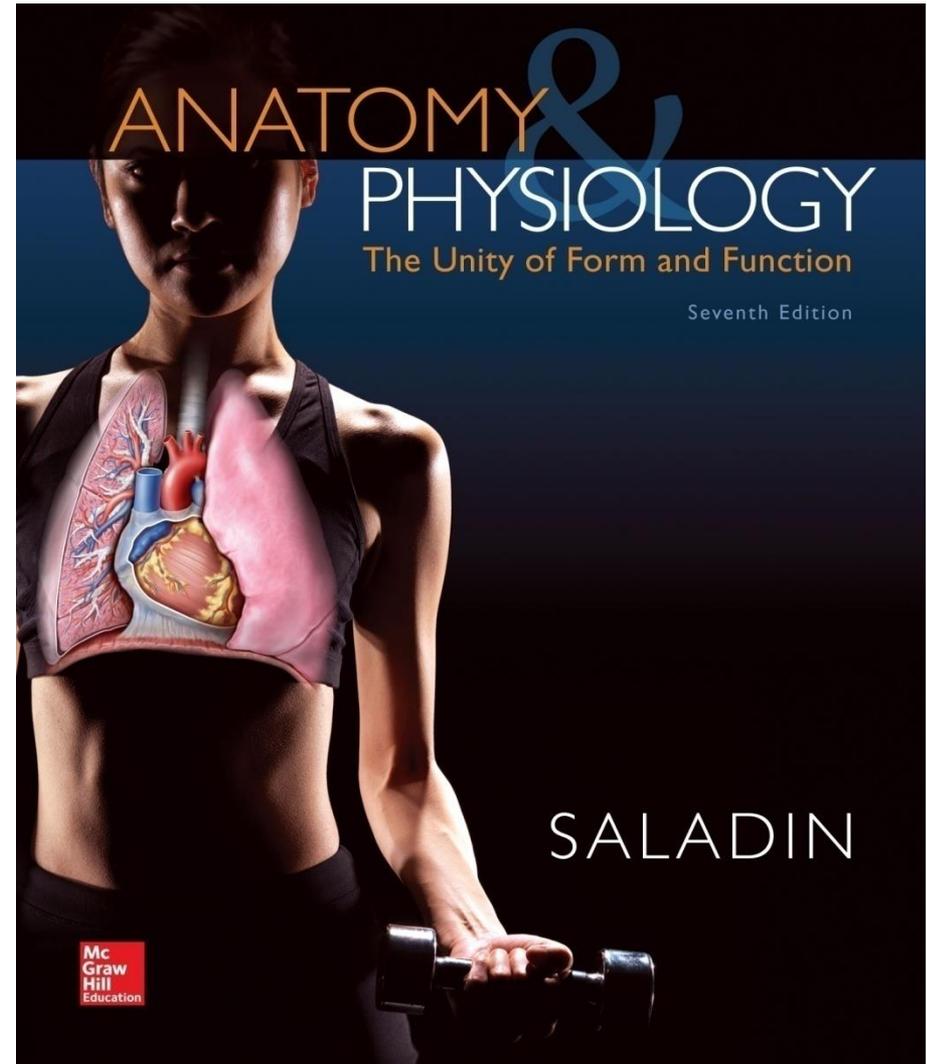


Chapter 06

Lecture Outline

See separate PowerPoint slides for all figures and tables pre-inserted into PowerPoint without notes.



Introduction

- **Integumentary system**
 - Consists of the skin and accessory organs; hair, nails, and cutaneous glands
- **Inspection of the skin, hair, and nails is significant part of a physical exam**
- **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

The Skin and Subcutaneous Tissue

- **Expected Learning Outcomes**

- List the functions of the skin and relate them to its structure.
- Describe the histological structure of the epidermis, dermis, and subcutaneous tissue.
- Describe the normal and pathological colors that the skin can have, and explain their causes.
- Describe the common markings of the skin.

The Skin and Subcutaneous Tissue

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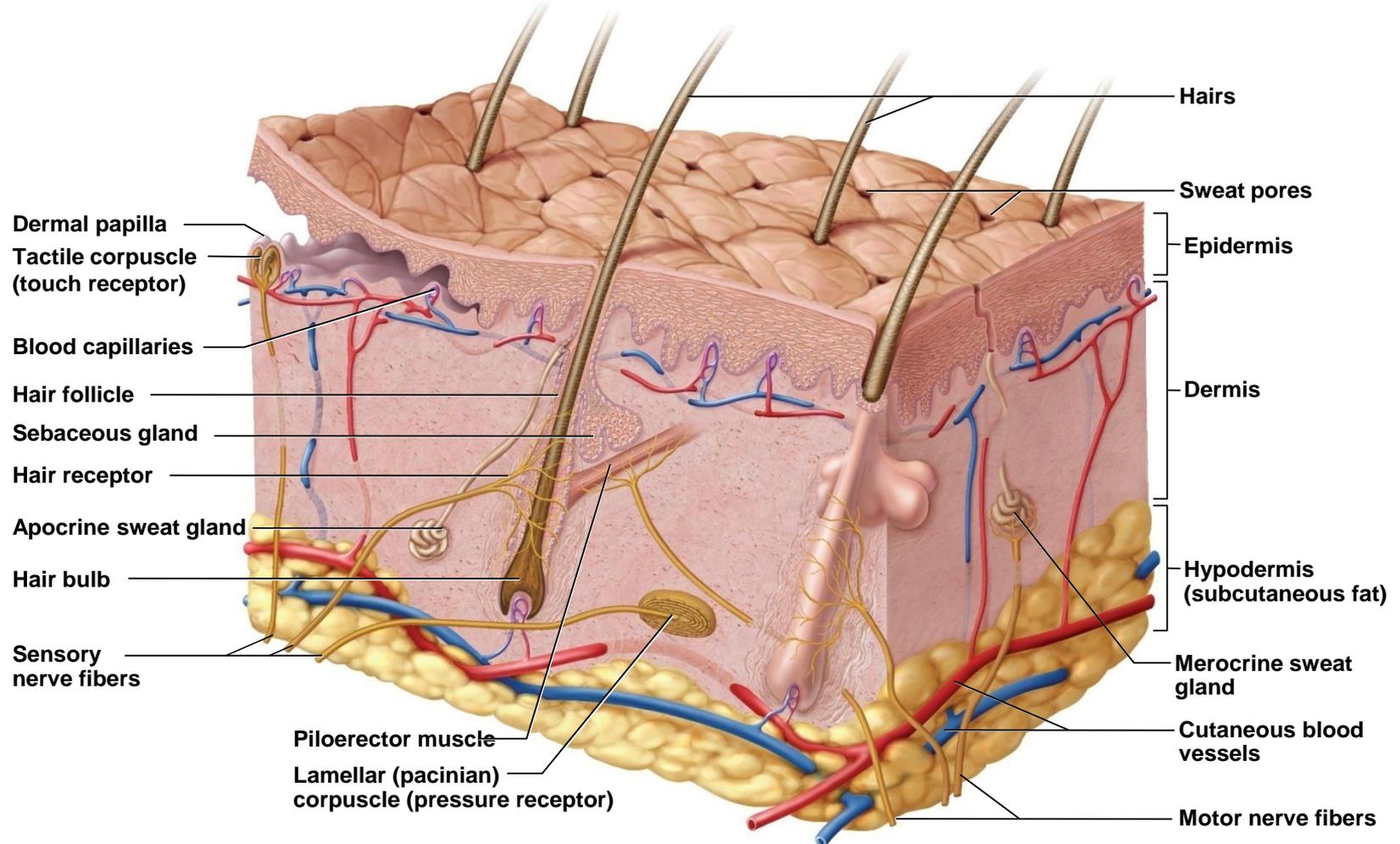


Figure 6.1

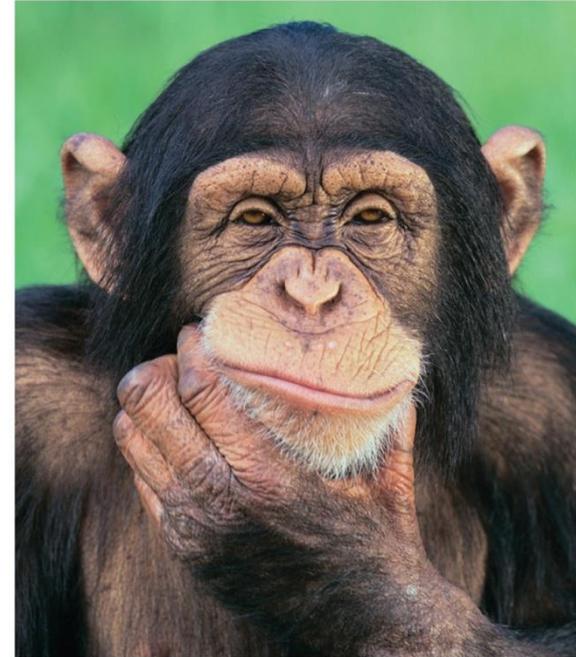
The Skin and Subcutaneous Tissue

- **Skin is body's largest and heaviest organ**
 - Covers 1.5 to 2.0 m² ; composes 15% of body weight
- **Layers**
 - **Epidermis:** stratified squamous epithelium
 - **Dermis:** deeper connective tissue layer
 - **Hypodermis**—connective tissue layer below dermis (not part of skin, but associated with it)
- **Skin thickness ranges from 0.5 to 6 mm**
 - **Thick skin** covers front of hands, bottoms of feet
 - Has sweat glands, but no hair follicles or sebaceous (oil) glands
 - Epidermis 0.5 mm thick
 - **Thin skin** covers rest of the body
 - Possesses hair follicles, sebaceous glands, and sweat glands
 - Epidermis about 0.1 mm thick

Functions of the Skin

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- **Resistance to trauma and infection**
 - Keratin
 - Dermacidin and defensins
 - Acid mantle
- **Other barrier functions**
 - Water
 - UV radiation
 - Harmful chemicals
- **Vitamin D synthesis**
 - Skin carries out first step
 - Liver and kidneys complete process



(a)

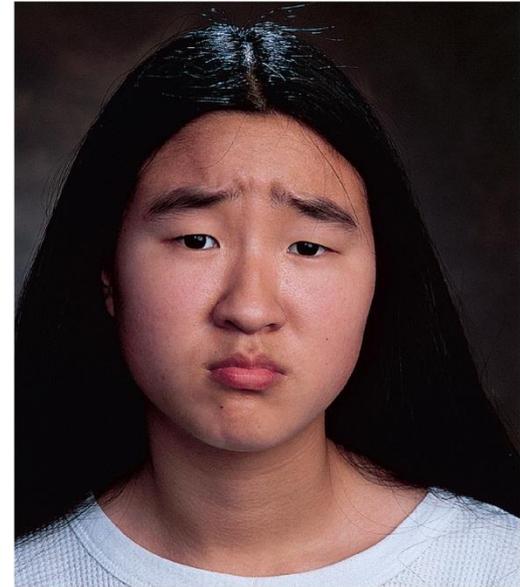
a: ©DLILLC/Corbis

Figure 6.2a

Functions of the Skin

- **Sensation**
 - Skin is an extensive sense organ
 - Receptors for temperature, touch, pain, and more
- **Thermoregulation**
 - Thermoreceptors
 - Vasoconstriction/vasodilation
 - Perspiration
- **Nonverbal communication**
 - Facial expression
 - Importance in social acceptance and self image

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(b)

b: ©McGraw-Hill Education/Joe DeGrandis

Figure 6.2b

The Epidermis

- **Epidermis**—keratinized stratified squamous epithelium
 - Includes dead cells at skin surface packed with tough **keratin** protein
 - Lacks blood vessels
 - Depends on the diffusion of nutrients from underlying connective tissue
 - Contains sparse nerve endings for touch and pain

Cells of the Epidermis

- **Five epidermal cell types**

- **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**

- Synthesize pigment **melanin** that shields DNA from ultraviolet radiation
 - Occur only in stratum basale but have branched processes that spread among keratinocytes and distribute melanin

Cells of the Epidermis

(Continued)

– Tactile cells

- Touch receptor cells associated with dermal nerve fibers
- In basal layer of epidermis

– Dendritic cells

- Macrophages originating in bone marrow that guard against pathogens
- Found in stratum spinosum and granulosum

The Epidermis

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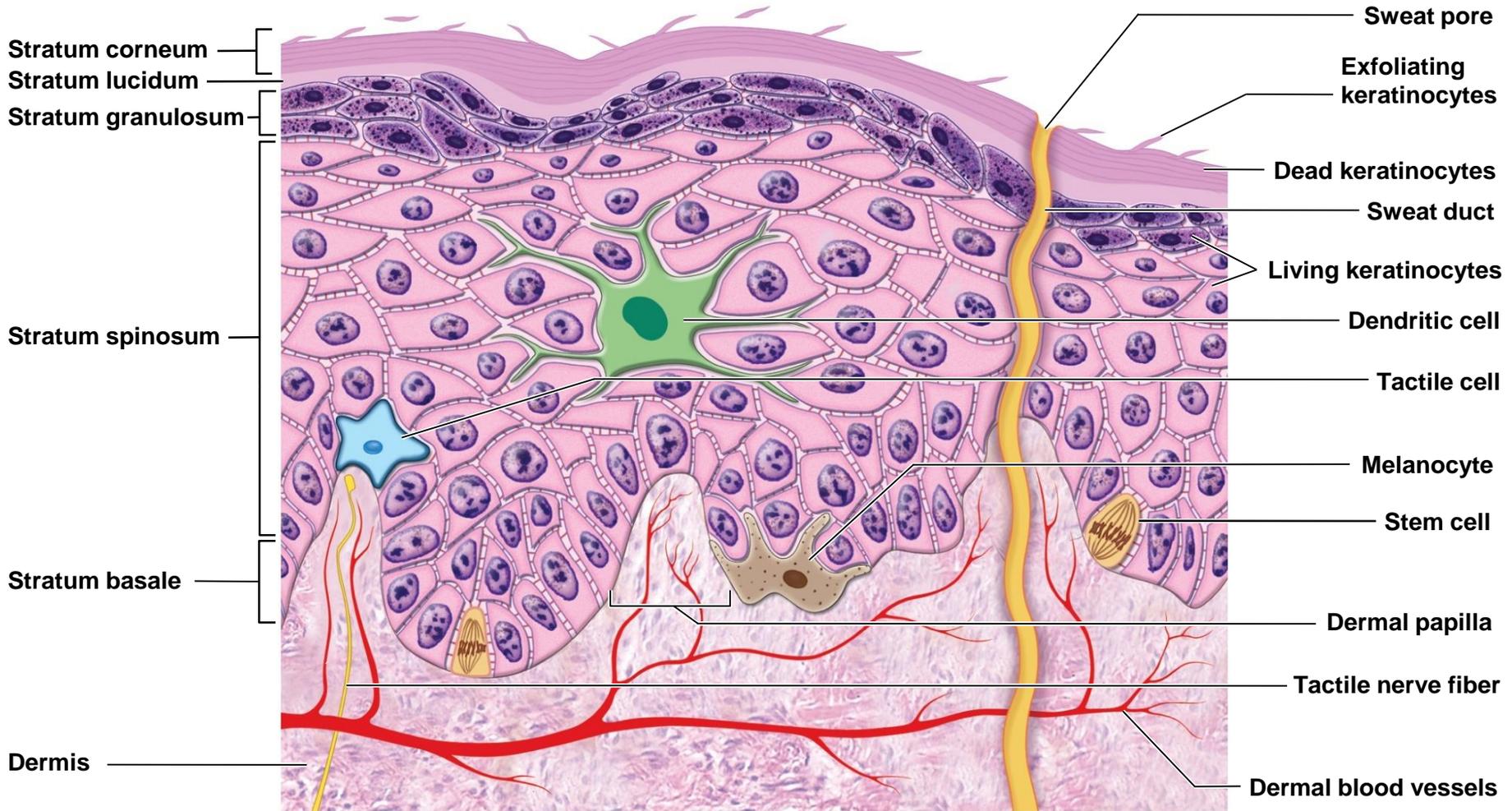


Figure 6.3

Layers of the Epidermis

- **Thin skin contains four strata; thick skin contains five strata**
- **Stratum basale (deepest epidermal layer)**
 - A **single layer** of stem cells and keratinocytes resting on the basement membrane
 - **Stem cells divide** and give rise to keratinocytes that migrate toward skin surface to replace lost cells
 - Also contains a few melanocytes and tactile cells
- **Stratum spinosum**
 - Several layers of keratinocytes joined together by desmosomes and tight junctions
 - Named for appearance of cells after histological preparation (spiny)
 - Also contains some dendritic cells

Layers of the Epidermis

(Continued)

- **Stratum granulosum**
 - Three to five layers of flat keratinocytes
 - Cells contain dark-staining **keratohyalin granules**
- **Stratum lucidum**
 - Thin, pale layer found **only in thick skin**
 - Keratinocytes packed with clear protein **eleidin**
- **Stratum corneum (surface layer)**
 - Several layers (up to 30) of dead, scaly, keratinized cells
 - Resists abrasion, penetration, water loss

The Life History of a Keratinocyte

- **Keratinocytes** are produced by mitosis of stem cells in stratum basale or mitosis of keratinocytes in deepest part of stratum spinosum
 - Mitosis requires abundant oxygen and nutrients, so once cells migrate away from blood vessels of the dermis, mitosis cannot occur
- **New keratinocytes push older ones toward the surface**
- **Over time, keratinocytes flatten, produce more keratin and membrane-coating vesicles**
- In **30 to 40 days** a keratinocyte makes its way to the skin surface and flakes off (exfoliates) as dander
 - Slower in old age
 - Faster in injured or stressed skin
 - **Calluses** or **corns**—thick accumulations of dead keratinocytes on hands or feet

The Life History of a Keratinocyte

- **Four important events occur in stratum granulosum**
 - Keratohyalin granules release filaggrin—a protein that binds keratin into tough bundles
 - Cells produce tough envelope proteins beneath their membranes
 - Membrane-coating vesicles release lipid mixture that spreads out over cell surface and waterproofs it
 - Keratinocytes' organelles degenerate and the cells die
- **Epidermal water barrier**
 - Water retention is fostered by tight junctions between skin cells and the waterproofing that occurs in the stratum granulosum
 - Helps prevent dehydration
 - Does not prevent the absorption of water by the stratum corneum when we soak in a bath (“prune fingers”)

The Dermis

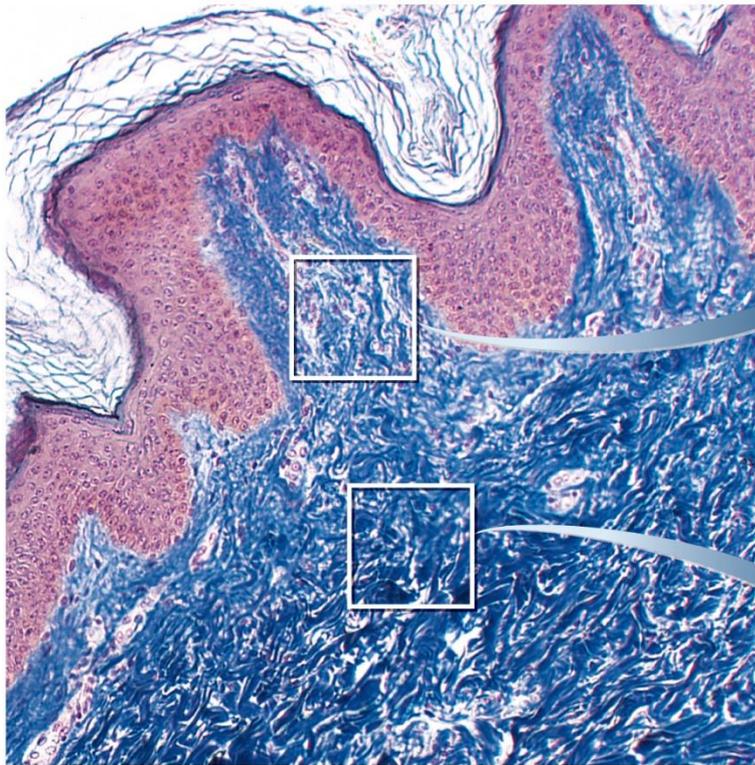
- **Dermis**—connective tissue layer beneath epidermis
 - Ranges from 0.2 mm (eyelids) to 4 mm (palms, soles)
 - Composed mainly of collagen
 - Well supplied with blood vessels, sweat glands, sebaceous glands, and nerve endings
 - Houses hair follicles and nail roots
 - Is the tissue of the facial skin to which skeletal muscles attach and cause facial expressions of emotion
 - Has a wavy, conspicuous boundary with the superficial epidermis
 - **Dermal papillae** are upward, finger-like extensions of dermis
 - **Epidermal ridges** are downward waves of epidermis
 - Prominent waves on fingers produce **friction ridges** of fingerprints

The Dermis

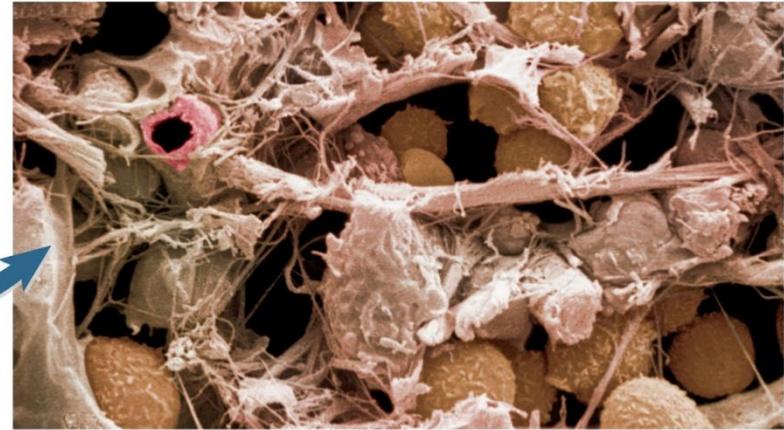
- **Papillary layer**—superficial zone of dermis
 - Thin zone of areolar tissue in and near the dermal papilla
 - Allows for mobility of leukocytes and other defense cells
 - Rich in small blood vessels
- **Reticular layer**—deeper and thicker layer of dermis
 - Consists of dense, irregular connective tissue
 - **Stretch marks (striae)**: tears in the collagen fibers caused by stretching of the skin due to pregnancy or obesity

The Dermis

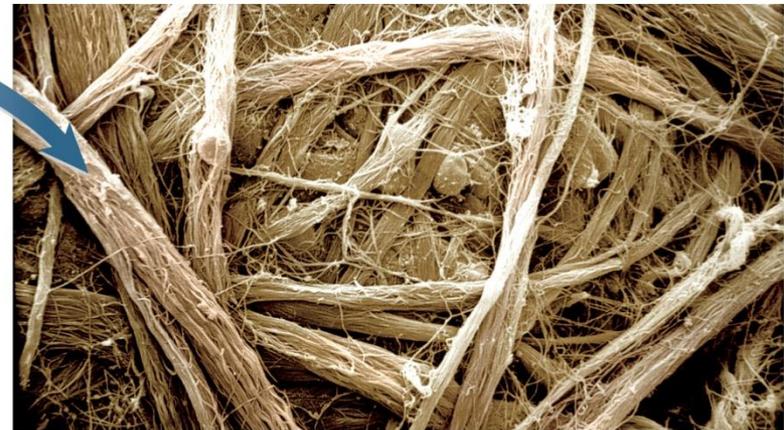
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(a)



(b) Papillary layer of dermis



(c) Reticular layer of dermis

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Figure 6.5

The Hypodermis

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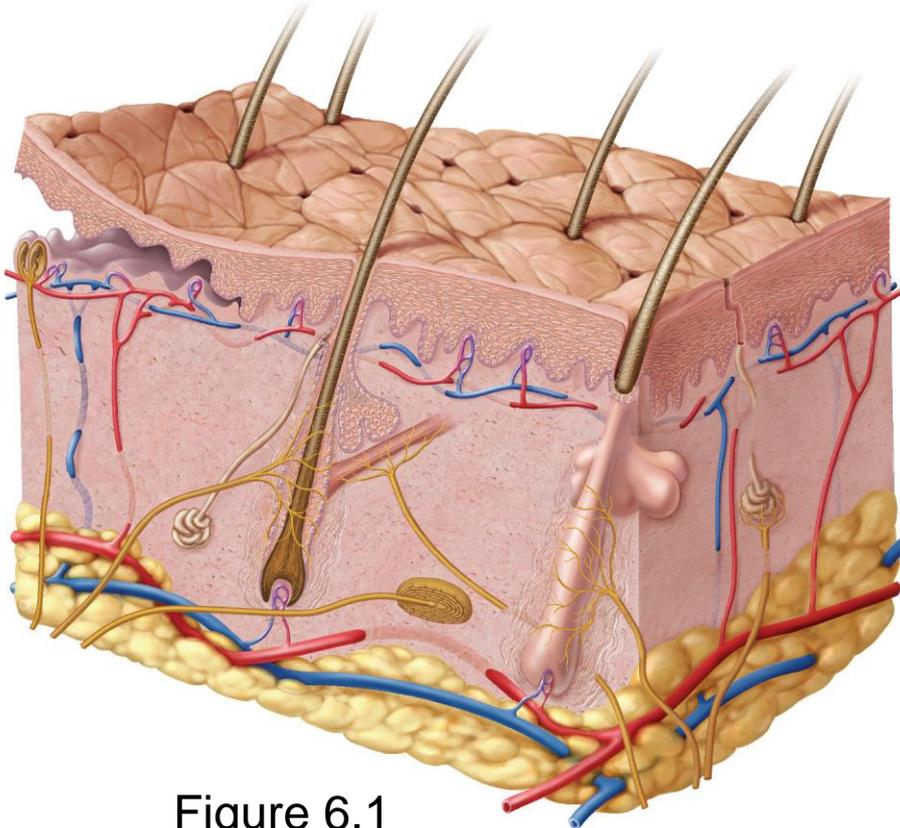


Figure 6.1

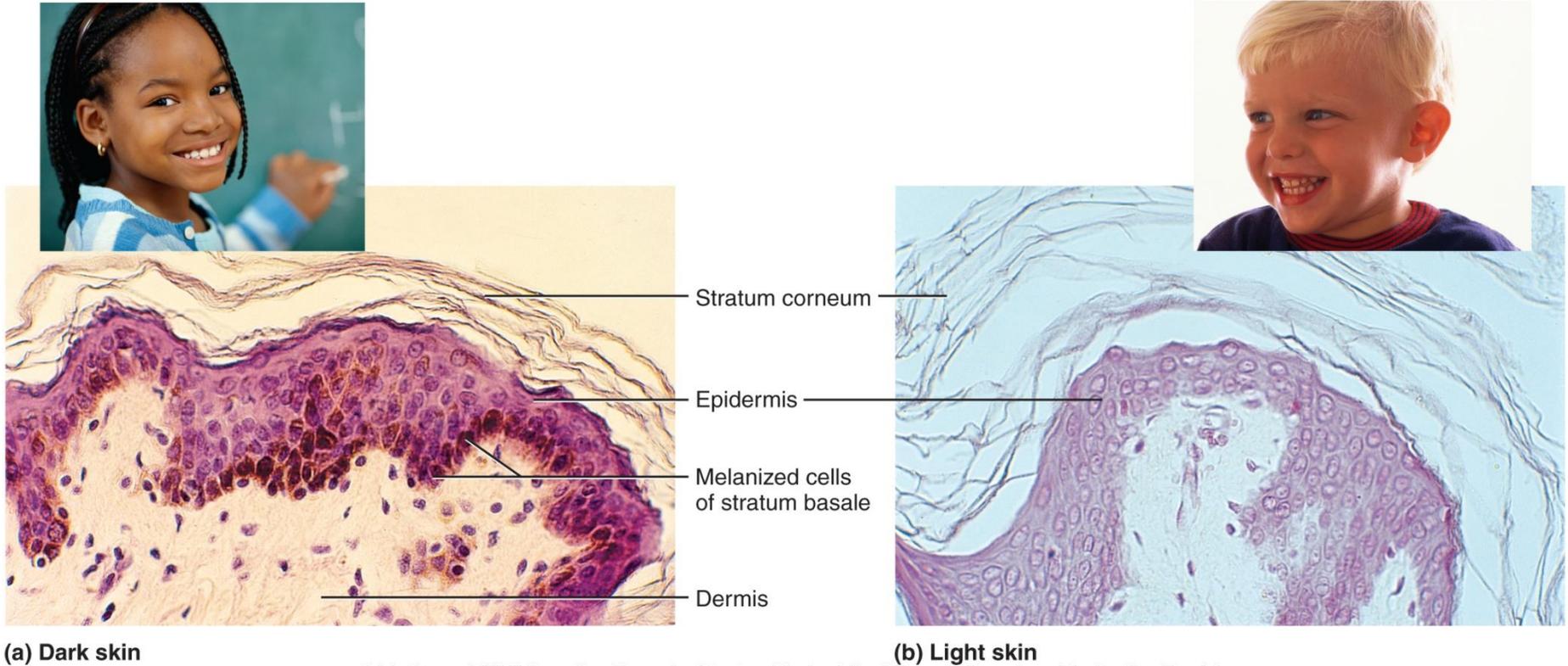
- **Hypodermis**
 - Subcutaneous tissue
 - Has more areolar and adipose than dermis has
 - Pads body and binds skin to underlying tissues
 - Common site of drug injection since it has many blood vessels
- **Subcutaneous fat**
 - Energy reservoir
 - Thermal insulation
 - Thicker in women
 - Thinner in infants, elderly

Skin Color

- **Melanin**—most significant factor in skin color
 - Produced by melanocytes, accumulates in keratinocytes
 - Two forms of the pigment:
 - **Eumelanin**—brownish black
 - **Pheomelanin**—reddish yellow (sulfur-containing)
- People of different skin colors have the **same number of melanocytes**
 - **Darker skinned people**
 - Produce greater quantities of melanin
 - Melanin breaks down more slowly
 - Melanin granules more spread out in keratinocytes
 - Melanized cells seen throughout the epidermis
 - **Lighter skinned people**
 - Melanin clumped near keratinocyte nucleus
 - Little melanin seen beyond stratum basale

Skin Color

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(a) Dark skin

(b) Light skin

a: ©McGraw-Hill Education/Dennis Strete; (dark girl): ©Tom & Dee Ann McCarthy/Corbis;
b: © McGraw-Hill Education/Dennis Strete; (light boy): ©Creatas/PunchStock RF

Figure 6.6a,b

Skin Color

- **Exposure to UV light stimulates melanin secretion and darkens skin**
 - This color fades as melanin is degraded and old cells are exfoliated
- **Other pigments can influence skin color**
 - **Hemoglobin**—pigment in red blood cells
 - Adds reddish to pinkish hue to skin
 - **Carotene**—yellow pigment acquired from egg yolks and yellow/orange vegetables
 - Concentrates in stratum corneum and subcutaneous fat

Skin Color

- **Colors of diagnostic value**
 - **Cyanosis**—blueness due to oxygen deficiency
 - **Erythema**—redness due to increased blood flow to skin
 - **Pallor**—paleness due to decreased blood flow to skin
 - **Albinism**—milky white skin and blue-gray eyes due to genetic lack of melanin synthesizing enzyme
 - **Jaundice**—yellowing due to bilirubin in blood (can be caused by compromised liver function)
 - **Hematoma**—bruising (clotted blood under skin)

The Evolution of Skin Color

- **Variations in skin color result from multiple evolutionary selection pressures, especially differences in exposure to UV light (UV accounts for up to 77% of skin tone variation)**
- **UV light has both harmful and beneficial effects**
 - Adversely: it causes skin cancer, breaks down folic acid
 - Beneficially: it stimulates vitamin D synthesis
- **Populations that evolved in the tropics have well-melanized skin to protect against excessive UV**

The Evolution of Skin Color

- **Populations that evolved in far northern and southern latitudes (weak sun) have light skin to allow adequate UV**
- **Populations that evolved at high altitudes or dry climates (less UV filtering) also are darker skinned**
- **Importance of vitamin D for calcium (crucial for pregnancy, lactation) might explain why women are lighter skinned than men**

The Evolution of Skin Color

- **Other factors complicate the association between UV exposure and skin tone**
 - Migration, cultural differences in clothing, and shelter
 - Intermarriage of people of different geographic ancestries
 - Sexual selection: a preference in mate choice for partners of light or dark complexion

Skin Markings

- **Friction ridges**—markings on the fingertips that leave oily fingerprints on surfaces we touch
 - Everyone has a unique pattern formed during fetal development that remains unchanged throughout life
 - Not even identical twins have identical fingerprints
 - Allow manipulation of small objects
- **Flexion lines (flexion creases)**—lines on the flexor surfaces of the digits, palms, wrists, elbows
 - Mark sites where skin folds during flexion of joints
 - Skin bound to deeper tissues along these lines

Skin Markings

- **Freckles and moles**—tan to black aggregations of melanocytes
 - **Freckles**—flat, melanized patches
 - **Moles (nevi)**—elevated, melanized patches often with hair
 - Moles should be watched for changes in color, diameter, or contour that may suggest cancer
- **Hemangiomas (birthmarks)**—patches of discolored skin caused by benign tumors of dermal capillaries
 - Some disappear in childhood, others last for life
 - Capillary hemangiomas, cavernous hemangiomas, port-wine stain

Hair and Nails

- **Expected Learning Outcomes**
 - Distinguish between three types of hair.
 - Describe the histology of a hair and its follicle.
 - Discuss some theories of the purposes served by various kinds of hair.
 - Describe the structure and function of nails.

Hair and Nails

- Hair, nails, and cutaneous glands are **accessory organs (appendages)** of the skin
- **Hair** and **nails** are composed of mostly 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

Hair

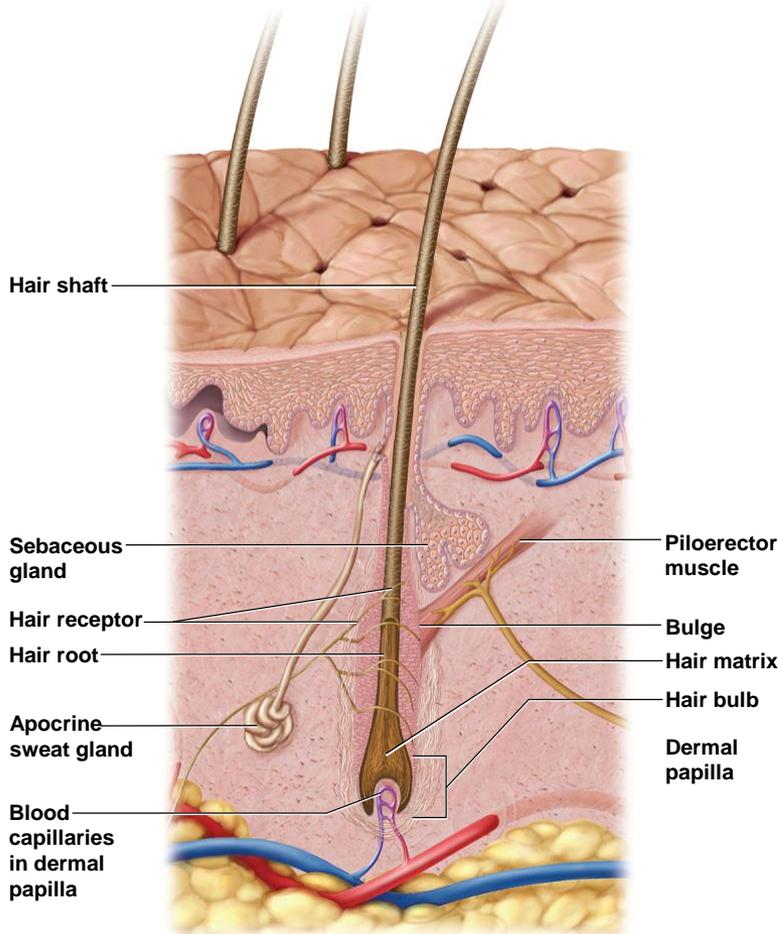
- **Pilus**—another name for a hair; **pili**—plural of *pilus*
- **Hair**—a slender filament of keratinized cells growing from a tube in the skin called a **hair follicle**
- **Hair covers most of the body**
 - Hair does not cover: palms, soles; palmar, plantar, and lateral surfaces and distal segments of fingers and toes; lips, nipples, and parts of genitals
 - Limbs and trunk have 55 to 70 hairs per cm²
 - Face has about 10 times as many
 - 100,000 hairs on an average person's scalp
 - Differences in hairiness across individuals is mainly due to differences in texture and pigment of hair

Hair

- **Three types of hair**
 - **Lanugo:** fine, downy, unpigmented hair that appears on the fetus in the last 3 months of development
 - **Vellus:** fine, pale hair that replaces lanugo by time of birth
 - Two-thirds of the hair of women
 - One-tenth of the hair of men
 - All of hair of children except eyebrows, eyelashes, and hair of the scalp
 - **Terminal:** longer, coarser, and more heavily pigmented
 - Forms eyebrows, eyelashes, and the hair of the scalp
 - After puberty, forms the axillary and pubic hair
 - Male facial hair and some of the hair on the trunk and limbs

Structure of the Hair and Follicle

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(a)

Figure 6.7a

- **Hair is divisible into three zones along its length**
 - **Bulb:** a swelling at the base where hair originates in dermis or hypodermis
 - Only living hair cells are in or near bulb
 - **Root:** the remainder of the hair in the follicle
 - **Shaft:** the portion above the skin surface

Structure of the Hair and Follicle

- **Dermal papilla**—bud of vascular connective tissue encased by bulb
 - Only source of nutrition for hair
- **Hair matrix**—region of mitotically active cells immediately above papilla
 - Hair's **growth center**

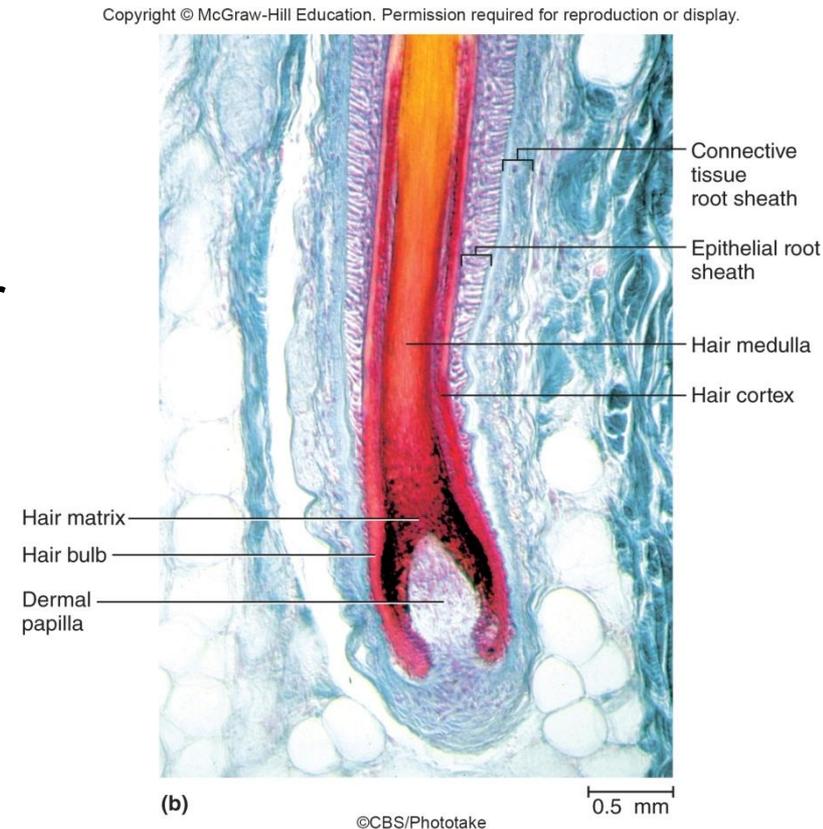


Figure 6.7b

Structure of the Hair and Follicle

- **Three layers of the hair in cross section**
 - **Medulla**
 - Core of loosely arranged cells and air spaces
 - **Cortex**
 - Constitutes bulk of the hair
 - Consists of several layers of elongated keratinized cells
 - **Cuticle**
 - Composed of multiple layers of very thin, scaly cells that overlap each other
 - Free edges directed upward

Structure of the Hair and Follicle

- **Follicle**—diagonal tube that extends into dermis and possibly hypodermis
 - **Epithelial root sheath**
 - Extension of the epidermis lying adjacent to hair root
 - Widens at deep end into **bulge**—source of stem cells for follicle growth
 - **Connective tissue root sheath**
 - Derived from dermis but a bit denser
 - Surrounds epithelial root sheath
- **Hair receptors**—sensory nerve fibers entwining follicles
- **Piloerector muscle** (arrector pili)—smooth muscle attaching follicle to dermis
 - Contracts to make hair stand on end (goose bumps)

Hair Texture and Color

- **Texture**—related to cross-sectional shape of hair
 - **Straight hair** is round
 - **Wavy hair** is oval
 - **Curly hair** is relatively flat
- **Color**—due to pigment granules in the cells of the cortex
 - **Brown and black hair** is rich in eumelanin
 - **Red hair** has high concentration of pheomelanin
 - **Blond hair** has an intermediate amount of pheomelanin and very little eumelanin
 - **Gray and white hair** have little or no melanin
 - Air present in medulla

Hair Texture and Color

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a-d: © McGraw-Hill Education/ Joe DeGrandis

Figure 6.8

Hair Growth and Loss

- **Three stages of hair cycle**

- **Anagen:** growth stage

- 90% of scalp follicles at a given time
 - Stem cells multiply
 - Root sheath cells above papilla form hair cells of hair matrix
 - Hair cells make keratin and die as they are pushed upward

- **Catagen:** degeneration stage

- Mitosis in hair matrix ceases and sheath cells below bulge die
 - Base of hair keratinizes into a hard club—**club hair**
 - Easily pulled out by brushing

- **Telogen:** resting stage

- When papilla reaches the bulge

Hair Growth and Loss

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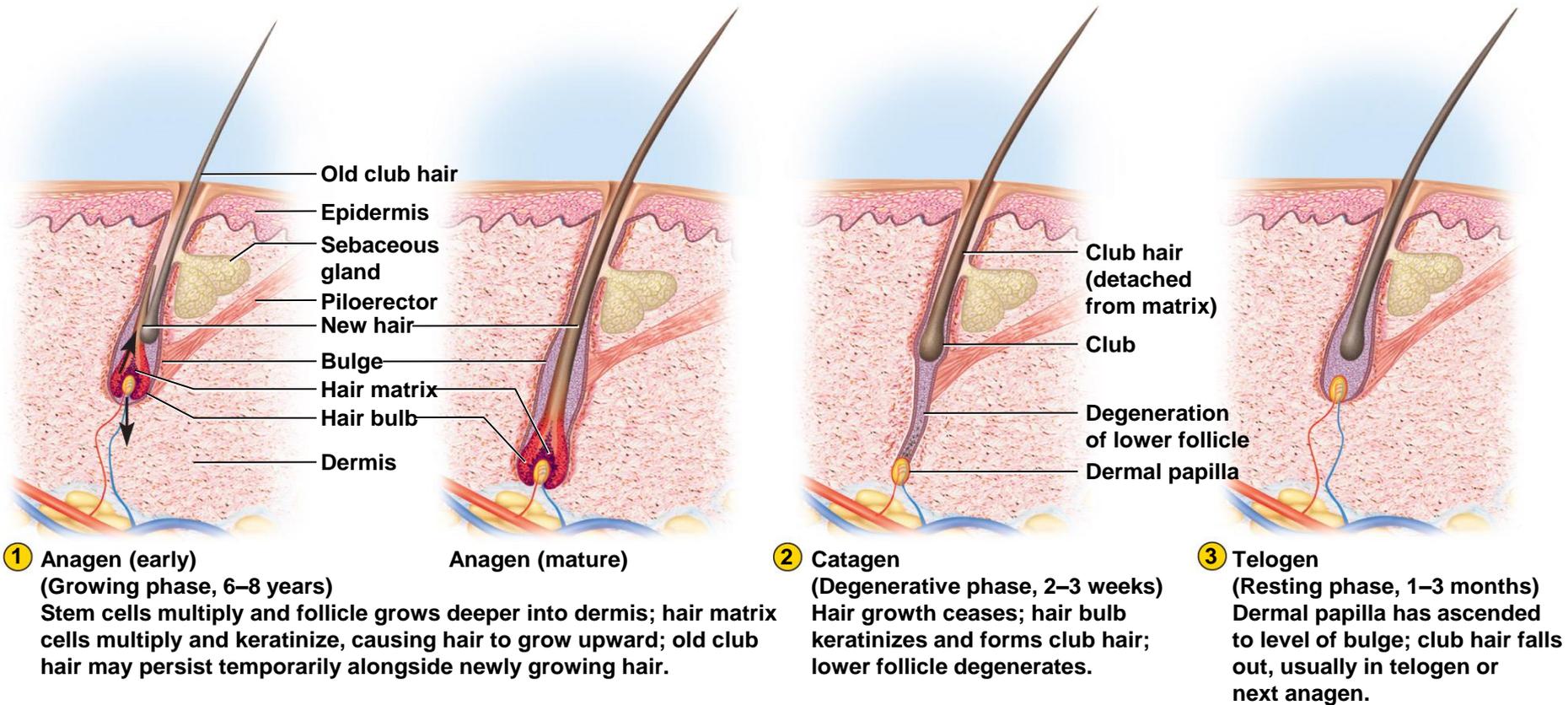


Figure 6.9

Hair Growth and Loss

- **We lose about 50-100 hairs daily**
 - A club hair may fall out during catagen or telogen or be pushed out in the next anagen phase
 - In young adults, scalp follicles spend 6–8 years in anagen, 2–3 weeks in catagen, 1–2 months in telogen
- **Hair growth—scalp hairs grow 1 mm per 3 days**
- **Alopecia**—thinning of the hair or baldness
- **Pattern baldness**—hair lost from select regions
 - Baldness allele is dominant in males and expressed when testosterone levels are high
 - Testosterone causes terminal hair on top of scalp to be replaced by vellus hair
- **Hirsutism**—excessive or undesirable hairiness in areas that are not usually hairy

Functions of Hair

- **Most hair on trunk and limbs is vestigial**
 - Has little present function but kept ancestors warm
- **Hair receptors alert us of parasites crawling on skin**
- **Scalp retains heat and protects against sunburn**
- **Pubic and axillary hair signify sexual maturity and aid in transmission of sexual scents**
- **Guard hairs (vibrissae)**
 - Guard nostrils and ear canals
- **Eyelashes and eyebrows**
 - Nonverbal communication

Nails

- **Fingernails and toenails**—clear, hard derivatives of stratum corneum
 - Composed of thin, dead cells packed with **hard keratin**
- **Functions:**
 - Improve grooming, picking apart food, other manipulations
 - Provide a counterforce to enhance sensitivity of fleshy fingertips to tiny objects
- **Nail plate**—hard part of the nail
 - **Free edge:** overhangs the fingertip
 - **Nail body:** visible attached part of nail
 - **Nail root:** extends proximally under overlying skin

Nails

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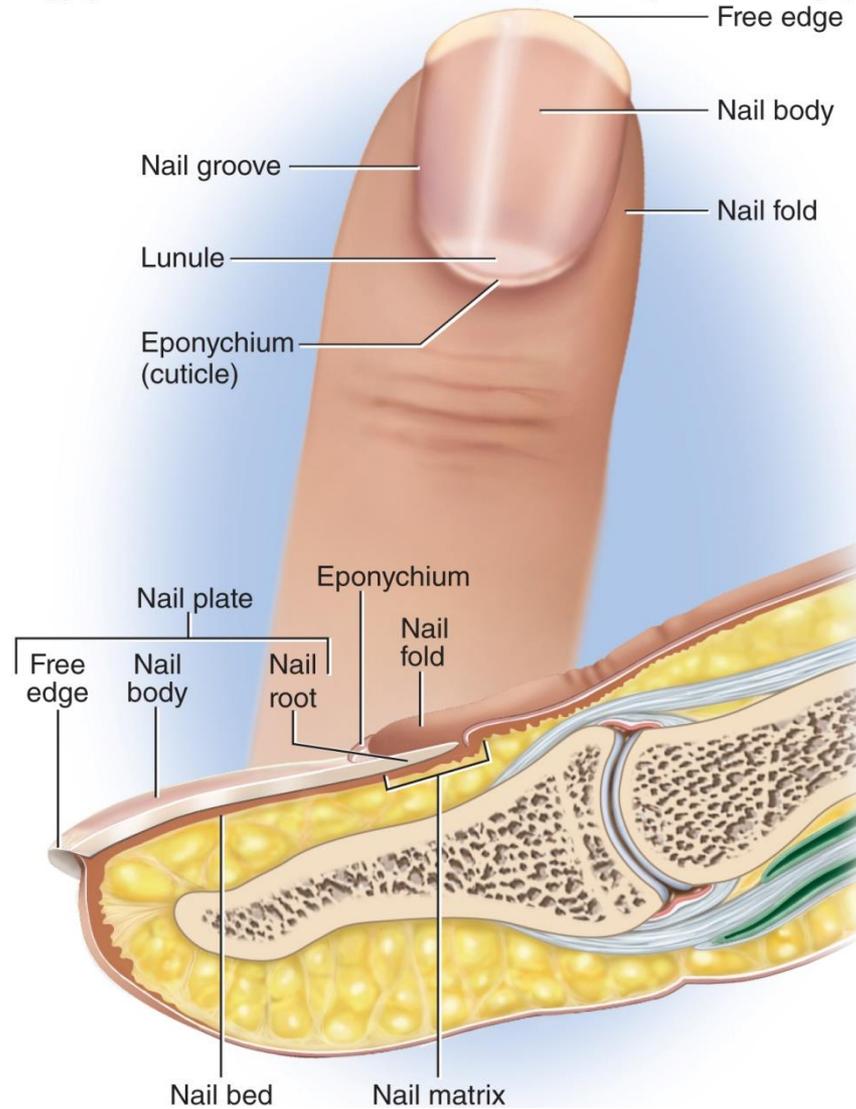


Figure 6.10

Nails

- **Nail fold**—surrounding skin rising above nail
- **Nail groove**—separates nail fold from nail plate
- **Nail bed**—skin underlying the nail plate
 - **Hyponychium**—epidermis of the nail bed
- **Nail matrix**—growth zone (mitotic) of thickened stratum basale at proximal end of nail
 - 1 mm per week in fingernails, slightly slower in toenails
 - **Lunule**—opaque white crescent at proximal end of nail due to thickness of matrix
- **Eponychium (cuticle)**—narrow zone of dead skin overhanging proximal end of nail

Cutaneous Glands

- **Expected Learning Outcomes**

- Name two types of sweat glands, and describe the structure and function of each.
- Describe the location, structure, and function of sebaceous and ceruminous glands.
- Discuss the distinction between breasts and mammary glands, and explain their respective functions.

Cutaneous Glands

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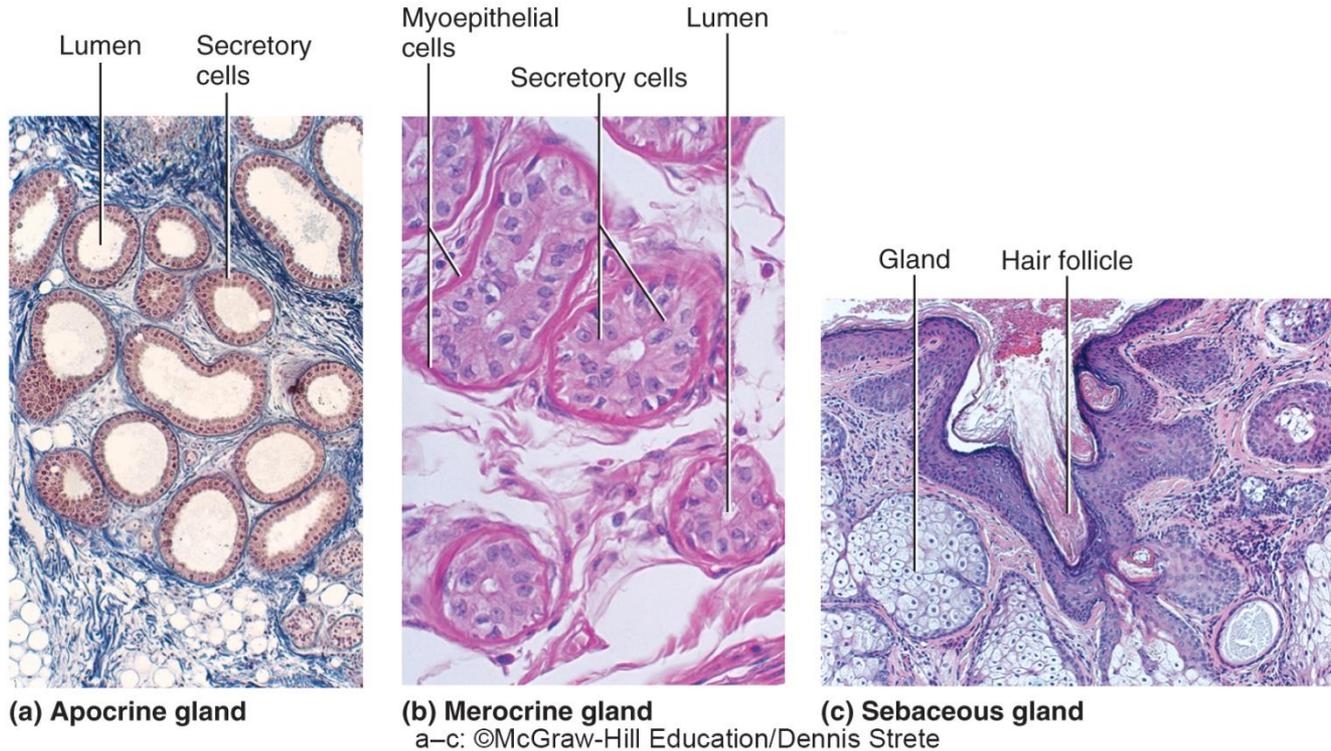


Figure 6.11a

Figure 6.11b

Figure 6.11c

- **The skin has five types of glands: merocrine sweat glands, apocrine sweat glands, sebaceous glands, ceruminous glands, and mammary glands**

Sweat Glands

- **Two kinds of sweat (sudoriferous) glands: apocrine and merocrine**
 - **Apocrine sweat glands**
 - Locations: groin, anal region, axilla, areola, beard area in men
 - Inactive until puberty
 - Ducts lead to nearby hair follicles
 - Produce sweat that is milky and contains fatty acids
 - Respond to stress and sexual stimulation
 - Believed to secrete **pheromones**—chemicals that can influence behavior of others
 - **Bromhidrosis**—disagreeable body odor produced by bacterial action on sweat from apocrine glands

Sweat Glands

(Continued)

– **Merocrine (eccrine) sweat glands**

- Most numerous skin glands—3 to 4 million in adult skin
 - Especially dense on palms, soles, and forehead
- Simple tubular glands
- Watery perspiration that helps cool the body

– **Myoepithelial cells**—contract in response to stimulation by sympathetic nervous system and squeeze perspiration up the duct

- Found in both apocrine and merocrine glands

Sweat Glands

- **Sweat**—begins as a protein-free filtrate of blood plasma produced by deep secretory portion of gland
 - Some sodium chloride and other small solutes remain in the sweat
 - Some sodium chloride reabsorbed by duct
 - Some drugs are excreted in sweat
 - On average, 99% water, with pH range of 4 to 6
 - **Acid mantle**—inhibits bacterial growth
 - **Insensible perspiration**—500 mL/day
 - Does not produce visible wetness of skin
 - **Diaphoresis**—sweating with wetness of the skin
 - Exercise—may lose 1 L sweat per hour

Sebaceous Glands

- **Sebaceous glands are flask-shaped and have short ducts opening into hair follicles**
- **Holocrine secretion style**
- **Sebum**—oily secretion of sebaceous glands
 - Keeps skin and hair from becoming dry, brittle, and cracked
 - Lanolin—sheep sebum

Ceruminous Glands

- Ceruminous glands are simple, coiled, tubular glands in **external ear canal**
- Their secretion combines with sebum and dead epithelial cells to form **earwax (cerumen)**
 - Keeps eardrum pliable
 - Waterproofs the canal
 - Kills bacteria
 - Makes guard hairs of ear sticky to help block foreign particles from entering auditory canal

Mammary Glands

- **Mammary glands**—milk-producing glands that develop only during pregnancy and lactation
 - Modified apocrine sweat glands
 - Rich secretion released through ducts opening at nipple
- **Mammary ridges or milk lines**
 - Two rows of mammary glands in most mammals
 - Primates kept only two glands, but a few people have additional nipples along the milk line (polythelia)

Cutaneous Glands

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TABLE 6.2	Cutaneous Glands
Gland Type	Definition
Sudoriferous glands	Sweat glands
Merocrine glands	Sweat glands that function in evaporative cooling; widely distributed over the body surface; open by ducts onto the skin surface
Apocrine glands	Sweat glands that function as scent glands; found in the regions covered by the pubic, axillary, and male facial hair; open by ducts into hair follicles
Sebaceous glands	Oil glands associated with hair follicles
Ceruminous glands	Glands of the ear canal that contribute to the cerumen (earwax)
Mammary glands	Milk-producing glands located in the breasts

Skin Disorders

- **Expected Learning Outcomes**
 - Describe the three most common forms of skin cancer.
 - Describe the three classes of burns and the priorities in burn treatment.

Skin Cancer

- **Skin cancer**—most cases caused by UV rays of the sun damaging skin cell DNA
 - Most often on the head, neck, and hands
 - Most common in fair-skinned people and the elderly
 - One of the most common, easily treated cancers
 - 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**

Skin Cancer

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(a) Basal cell carcinoma

a: ©NMSB/Custom Medical Stock Photo, Inc.

Figure 6.12a

- **Basal cell carcinoma**

- Most common type
- Least dangerous because it seldom metastasizes
- Forms from cells in stratum basale
- Lesion is small, shiny bump with central depression and beaded edges

Skin Cancer

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(b) Squamous cell carcinoma

b: ©Biophoto Associates/Science Source

Figure 6.12b

- **Squamous cell carcinoma**

- Arises from keratinocytes of stratum spinosum
- Lesions usually on scalp, ears, lower lip, or back of the hand
- Have raised, reddened, scaly appearance later forming a concave ulcer
- Chance of recovery good with early detection and surgical removal
- Tends to metastasize to lymph nodes and may become lethal

Skin Cancer

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Figure 6.12c

(c) Melanoma

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- **Malignant melanoma**

- Skin cancer that arises from melanocytes
- Less than 5% of skin cancers, but most deadly form
- Can be successfully removed if caught early, but if it metastasizes it is usually fatal
- Greatest risk factor: familial history of malignant melanoma
- Highest incidence in men, redheads, and people who had severe sunburn as a child

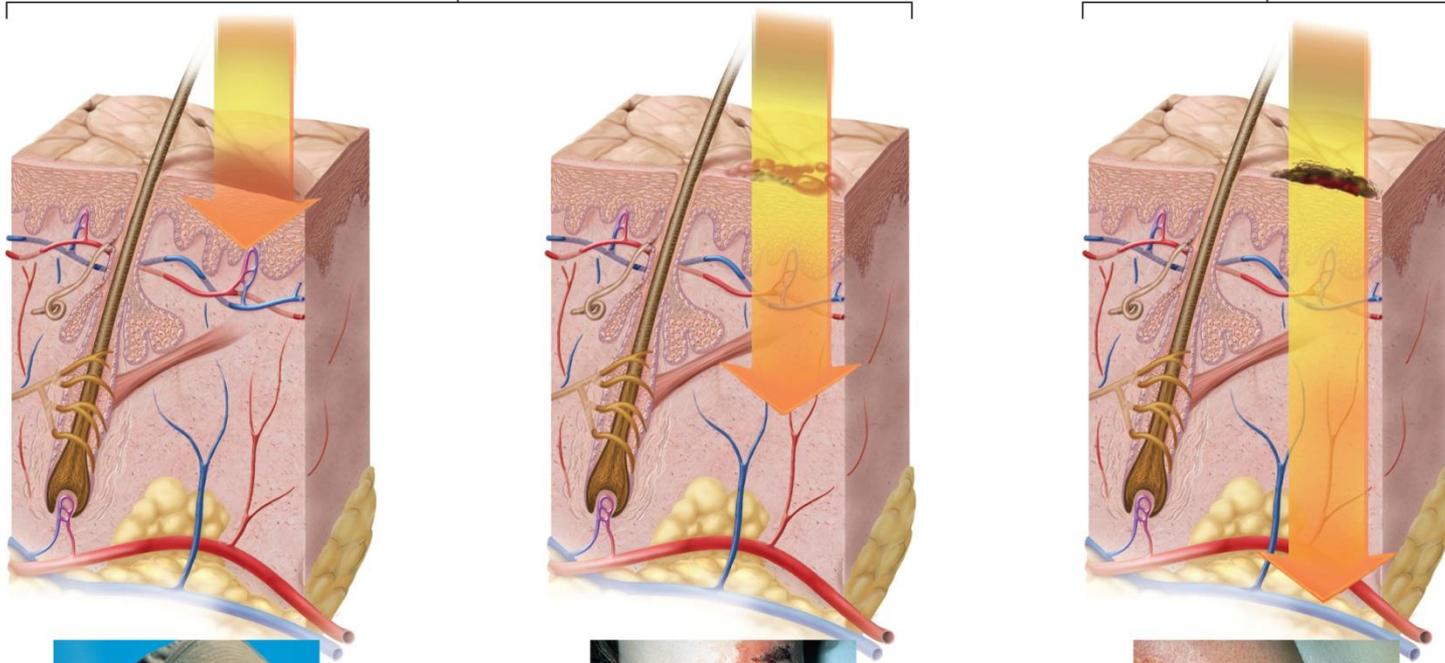
Burns

- **Burns**—leading cause of accidental death
 - Fires, kitchen spills, sunlight, ionizing radiation, strong acids or bases, or electrical shock
 - Deaths result primarily from fluid loss, infection, and toxic effects of **eschar** (burned, dead tissue)
 - **Debridement**: removal of eschar
- **Classified according to depth of tissue involvement**
 - **First-degree burn**: involves only epidermis
 - Redness, slight edema, and pain
 - Heals in days
 - **Second-degree burn**: partial-thickness burn; involves part of dermis
 - May appear red, tan, or white; blistered and painful
 - Two weeks to several months to heal and may leave scars
 - **Third-degree burn**: full-thickness burn; involves epidermis, all of dermis, and often some deeper tissues
 - Often requires skin grafts
 - Needs fluid replacement, infection control, supplemental nutrition

Degrees of Burn Injuries

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Partial-thickness burns

Full-thickness burns



(a) First degree



(b) Second degree



(c) Third degree

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Figure 6.13

UV Rays and Sunscreen

- **UVA and UVB** are improperly called “tanning rays” and “burning rays”
 - Both thought to initiate skin cancer
 - No such thing as a “healthy tan”
- **Sunscreens** protect you from sunburn but unsure if they provide protection against cancer
 - High SPF numbers can give false sense of security
 - Chemical in sunscreen damage DNA and generate harmful free radicals

Skin Grafts and Artificial Skin

- **Third-degree burns often require skin grafts**
- **Graft options**
 - **Autograft:** tissue taken from another location on the same person's body
 - **Split-skin graft**—taking epidermis and part of the dermis from an undamaged area such as the thigh or buttocks and grafting it into the burned area
 - **Isograft:** skin from identical twin
- **Temporary grafts (immune system rejection)**
 - **Homograft (allograft):** from unrelated person
 - **Heterograft (xenograft):** from another species
 - Amnion from afterbirth
 - Artificial skin from silicone and collagen