Integumentary System

LEARNING OBJECTIVES

- Define at least 10 terms relating to the integumentary system.
- Describe the function of the integumentary system.
- Identify at least five integumentary system structures and the function of each.
- Identify at least three methods used to assess the function of the integumentary system.
- Describe at least five disorders of the integumentary system.
- Describe three methods that can be used to maintain healthy skin.
- Identify three types of skin cancer and at least five methods for prevention.

KEY TERMS

- Adipose (AD-i-pose) Of a fatty nature, fat
- Biopsy (BI-op-see) Removal and examination of living tissue
- Ceruminous (se-ROO-min-us) Pertaining to earwax
- Dermatitis (der-muh-TI-tis) Inflammation of the skin
- Dermis (DER-mis) Corium, or layer of skin beneath the epidermis
- Epidermis (ep-uh-DER-mis) Outermost and nonvascular layer of skin
- Follicle (FOH-lihkl) Sac or pouchlike depression or cavity
- Lunula (LOO-nuh-lah) General term for a small crescent- or moon-shaped area of fingernail
- Melanin (MEL-uh-nin) Dark, shapeless pigment of the skin
- Papilla (puh-PIL-uh) Small, nipple-shaped projection or elevation
- Pilus (PIH-lus) Hair
- Sebaceous (se-BAY-shus) Pertaining to sebum or a greasy lubricating substance
- Subcutaneous (sub-koo-TAY-nee-us) Beneath the skin
- Sudoriferous (soo-do-RIF-er-us) Conveying sweat
Kaposi sarcoma is the most common type of cancerous lesions in people with acquired immunodeficiency disease (AIDS). (From Damjanov I. Pathology for the Health Professions, ed 3, St Louis, 2006, Saunders.)

### Abbreviations of the Integumentary System

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
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<tbody>
<tr>
<td>Bx</td>
<td>Biopsy</td>
</tr>
<tr>
<td>CA</td>
<td>Cancer</td>
</tr>
<tr>
<td>CAS</td>
<td>Culture and sensitivity</td>
</tr>
<tr>
<td>Etiol</td>
<td>Etiology</td>
</tr>
<tr>
<td>LE</td>
<td>Lupus erythematosus</td>
</tr>
<tr>
<td>mm</td>
<td>Millimeter</td>
</tr>
<tr>
<td>Oint</td>
<td>Ointment</td>
</tr>
<tr>
<td>PABA</td>
<td>Para-aminobenzoic acid</td>
</tr>
<tr>
<td>sc</td>
<td>Subcutaneous</td>
</tr>
<tr>
<td>SLE</td>
<td>Systemic lupus erythematosus</td>
</tr>
</tbody>
</table>

### Structure and Function

The integumentary system is composed of the skin and accessory structures (Fig. 10-1). Accessory structures of the system include the hair, nails, specialized glands, and nerves. The main function of the integumentary system is to protect the other body systems from injury and infection. A second function is to help the body maintain homeostasis by regulating temperature, retaining body fluids, and eliminating wastes. The skin also helps to perceive the environment with sensory receptors. The skin stores energy and vitamins and produces vitamin D from sunlight. Some hormones, fat-soluble vitamins, and drugs may be absorbed through the skin.

#### Skin

The skin, covering 17 to 20 square feet (1.6 to 1.9 m²), is the largest organ in the body. It varies in thickness from 1/6 inch (0.5 mm) in the eyelids to 3/6 inch (6.3 mm) in the soles of the feet. Changes in the skin often indicate the presence of other body system disorders, including anemia, respiratory disorders, liver disorders, cancer, and shock (Fig. 10-2).

The epidermis, or cuticle, is the outermost layer of the skin and is composed of a surface of dead cells with an underlying layer of living cells. Water-repellent cells made of protein (keratinocytes) make up 90% of the epidermis. Oil (sebaceous) and sweat (sudoriferous) glands and hair follicles lie in the epidermis. Melanocytes, which produce melanin, are located in this layer. Melanin is the pigment that gives skin its color (Fig. 10-3). The surface of the epidermis is covered with a film composed of sweat, oil, and epithelial cells that lubricates, hydrates, provides antibacterial protection, and blocks toxic agents from entering the body.

The dermis, or corium, is called the "true" skin. The dermis contains the blood vessels and nerves.

Each inch of skin contains 15 square feet of blood vessels. The innermost layer of the skin is called the subcutaneous layer. Fatty (adipose) tissue of the subcutaneous layer cushions and insulates the body’s organs. The nerve endings in the skin allow it to be sensitive to environmental stimuli. Skin senses pain, pressure, touch, and changes in temperature.
Hair and Hair Follicles

Skin normally has hair (plum) in all areas except the soles of the feet and palms of the hands. Some hair blocks foreign particles from entering the body through structures such as the nose and ears.

Each hair root originates in the dermis. The visible portion is called the shaft. The hair follicle is the root with its covering. One or two sebaceous glands are attached to each hair follicle. A tiny muscle (arrector pili) is attached to the hair shaft and causes "goose bumps" or the hair to "stand on end" in response to cold or fear (Fig. 10-4). Hair color and texture are inherited. The color depends on the amount of melanin in the cells.

Glands

The three types of glands in the skin are the sebaceous glands (oil), sudoriferous glands (sweat), and the ceruminous glands of the ear canal.

Sebaceous glands are located everywhere in the skin except the palms of the hands and the soles of the feet. Each square inch of skin has about 2000 sebaceous glands. Sebum, or oil, causes the skin to be soft and waterproof.

Sudoriferous glands originate in the subcutaneous layer of the skin. Some of these glands (apocrine) are attached to hair follicles, and others (eccrine) empty directly onto the skin. Apocrine glands are located in areas such as under the arms (axilla), the breasts, and pubic area. In some areas of the skin, each square inch contains about two million sudoriferous glands.

Sudoriferous glands help regulate body temperature and excrete body wastes. The skin loses at least 500 mL of water each day; more water is lost through sweating caused by exercise or heat.

Ceruminous glands are located only in the auditory canal of the ear. These sebaceous glands secrete wax that helps to protect the ear from infection and prevents entry of foreign bodies.

Nails

The function of the nails is to protect fingers and toes from injury. Finger nails and toenails are formed from dead, keratinized epidermal cells. The root or area of nail growth is covered by skin at the area of attachment to finger or toe. The crescent-shaped white area near the root is the lunula (Fig. 10-5).

Assessment Techniques

Dermatology is the study of skin. Dermatitis is the general term for inflammation of the skin. Skin disorders are usually uncomfortable and unattractive but not life threatening.

Assessment of the skin, hair, and nails includes palpation, olfactory (smell), and visual inspection. The color, temperature, texture, turgor (fullness or tension), and any moisture should be noted. The color of skin is genetically determined. Any change—such as paleness (pallor), redness (erythema), yellowishness (jaundice), or blueness (cyanosis)—may indicate a problem. Normal skin is warm, dry, and without open sores (intact). When a pinch or fold of skin on the forearm is lifted, it should rise easily and return to place quickly when released.

Skin lesions can usually be seen with visual inspection. The size, shape, texture, and color of a lesion often help reveal its cause. A biopsy or culture may be used to identify the causative organism.

The uppermost part of the dermis is composed of papillae, or ridges. The papillae form regular patterns in the fingers, palms of the hands, and soles of the feet, where the skin is thick. Fingertip and toe prints are unique to each person. In addition to forming a surface that permits gripping, the fingerprints allow the identification of each individual. The patterns of ridges in fingerprints and toe prints may also be linked to disorders such as Down syndrome.

DISORDERS OF THE Integumentary System

Acne vulgaris (AK-see vul-GAY-ri-us) usually appears in adolescence and may continue into adulthood. Acne is often caused by the increased secretion of oil (sebum) related to increased hormones during puberty. Bacterial growth and blockage of the hair follicles cause papules, pustules, and blackheads. Acne primarily affects the face, chest, and back. Acne tends to run in families. Contrary to popular belief, diet does not cause or affect the severity of acne. Treatment may include exposure to ultraviolet light, oral or topical antibiotics, or removal of the top layers of skin that has loosed (dermabrasion).

Albinism (AL-bin-izm) is a rare inherited disorder in which the melanocytes do not produce enough or any melanin. Lack of melanin leads to pale skin, white hair, and pink eyes. People with albinism are prone to severe sunburn, and light may damage unprotected structures of the eyes. Although no cure for albinism exists, wearing sunglasses, applying sunscreen, and avoiding exposure to the sun may help avoid skin cancer and eye damage.

Alopecia (al-pee-see-uh), or baldness, is the inherited tendency to lose hair from the head. Production of androgenic (an-dro-JEN-ik) hormones beginning at puberty initiates the loss. Baldness is more common in men, but it may occur in women and may begin at any age. Drugs, radiation, pregnancy, high fever, anorexia, and cosmetics may cause temporary hair loss.

Athlete's foot, or epidermophytosis (ep-i-DER-mo-fi-TOE-sis) is a common fungal infection. The skin may itch, blister, and crack, especially between the toes. Athlete's foot most often occurs during warm weather and is contagious. It can be transmitted on wet floors, such as in gym showers. Treatment includes application of antifungal medication and keeping the area clean, ventilated, and dry. More serious infections may be treated with an oral antifungal medication.

Cellulitis (s33-LOE-tis) is a bacterial infection of the dermis and subcutaneous layer of the skin. Cellulitis may be caused by many different bacteria but is commonly caused by Streptococcus organisms. It occurs in people with low resistance to infection, such as older patients, children, and chronically ill patients. The infected person may experience fever, chills, and vesicles (VES-i-kul) on a reddened, warm area of the skin. It most commonly occurs on legs and may cause impaired circulation and permanent lymphedema (lin-fee-DEE-uh-muh). Treatment includes rest, immobilization and elevation of the infected area, and antibiotics.

Chiliasma (klo-AZ-muh), or melaena, is a patchy discoloration of the face caused by high hormone levels that occur during pregnancy and by prolonged use of oral contraceptives. It may disappear at the end of the pregnancy or with stopping birth control pills. Chiliasma may also be a sign of liver problems. Treatment is often unnecessary, but the use of skin-lightening cosmetic products can minimize the discoloration.

Cleft lip or cleft palate (KLEFT PAL-ayt) occurs in 1 of 1000 (keeflt lip) and 1 in 2000 (keeft palate) infants. In this condition the upper lip has a cleft or space where the nasal processes or palate does not meet properly. Heredity appears to be the direct cause in 25% of the cases, and environmental factors and premature birth may also cause the condition. Treatment includes surgical and dental correction, speech therapy, and psychological counseling.
**Contact dermatitis** is an allergic reaction that may occur after initial contact or as an acquired response. Some substances commonly cause acquired contact dermatitis include poison ivy, nickel in jewelry, and preservatives in cosmetics. Latex in gloves may be an allergen for some health care workers. Redness, itching, swelling, and blisters may result from contact with the irritating substance. Treatment may include washing the affected area, applying anti-inflammatory creams, and avoiding exposure to the irritating substance.

**Dandruff** (DA-N-druff), characterized by itching of the scalp, produces white flakes of dead skin cells. Massaging the scalp and brushing and shampooing the hair can control dandruff. Medicated shampoos designed to control dandruff often help.

**Decubitus ulcers** (de-KYO-b-us UL-seers), or decubiti, are sores or areas of inflammation that occur over bony prominences of the body as a result of prolonged pressure and hypoxia to the affected tissues. These “bedsores” are seen most often in older patients and in patients who cannot move themselves (immobilized). Frequent changes in position, good nutrition, and massage to the area help to prevent decubiti. Prevention of decubiti is easier than treatment of them. Decubiti, as described in four stages by the Department of Health and Human Services, can be life-threatening. Decubiti are often resistant to treatment, which may include application of antibiotics, removal of necrotic tissue, and frequent cleaning of open sores. Larvae (maggots) of blowflies, which feed on dead tissue, have been used in some severe cases to clean sores. In addition to removing the dead tissue, the maggot larvae provide stimulation of the affected area with their movement and produce compounds that are lethal to bacteria that cause sores and similar infections. Deep pressure sores may require skin grafting. Negative pressure wound therapy (vacuum-assisted closure), as well as hyperbaric chamber therapy, may be used in some cases.

**Eczema** (EK-ze-muh), a form of dermatitis, is a group of disorders caused by allergic or irritant reactions. Eczema is characterized by swelling; redness; and itching, weeping, crusty skin lesions. Although it is not contagious, it seems to run in families. Eczema is chronic but may disappear as affected children become older. Treatment of eczema includes removing the irritant and keeping the affected skin clean and well moisturized. It is also helpful to avoid sudden changes in temperature and overheating. Outbreaks may disappear by avoiding harsh soaps and environmental factors or food that trigger outbreaks, as well as reducing stress.

**Fungal** (FUN-gul) skin infections live only on the dead, outer surface or epidermis. Some may cause no symptoms. Others may produce irritation, scaling, redness, swelling, or blisters. Most fungal infections occur in areas of the body that provide moisture and are named by the area in which they appear. Examples include athlete’s foot (see earlier) jock itch; and scalp, nail, body, and beard ringworm. Fungal infections of the scalp or beard can cause hair loss. Treatment by the use of antifungal creams usually cures these skin conditions. In severe cases, oral antifungal medication may be necessary. Infections of the skin may be prevented by keeping the skin dry; wearing loose, clean clothing; and avoiding shared use of towels, combs, and hairbrushes.

**Furuncle** (FUHR-un-kuhl), commonly called a boil, is a bacterial infection of a hair follicle. Although it is usually caused by Staphylococcus aureus (S. aureus), it may result from other bacteria or fungi. A carbuncle is several boils that join together. Recurring boils may indicate diabetes or an immune disorder. Boils are infectious, but the spread can be controlled with careful cleanliness and handwashing. Treatment includes hot compresses, antibiotics, and sometimes drainage by lancing. Boils may also be caused by methicillin-resistant Staphylococcus aureus (MRSA). More information about MRSA is found in Chapter 3.

**Hirsutism** (HER-ih-koz-izm), or hypertrichosis (hy- per-tri-KO-siz), is an abnormal amount of hair growth in unusual places. In women hair may appear on the face, back, and chest. Hirsutism may be caused by hormone supplements or may be a hereditary condition. Unwanted hair may be removed temporarily by shaving, waxing, or using depilatories, or it may be removed permanently by electrolysis. The disorder causing the hair growth, if any, should be treated when possible.

**Impetigo** (im-pih-TI-go) is a contagious bacterial skin infection that occurs most often in children. Impetigo is most often caused by S. aureus. It begins with small vesicles, which become pustules and form a crust. Itching and burning may occur. Ecthyma is a form of impetigo that creates open sores (ulcers) on the skin. Impetigo may lead to kidney infection, but lesions usually clear without causing lasting damage. It can be fatal in infants. Treatment includes antibiotics and isolation to prevent spread of the infection.

**Kaposi sarcoma (KS)** (kuh-FOH-see sahr-KOH- mahl) (Fig. 10-6) is a form of cancer that originates in blood vessels and spreads to the skin. KS may be a round or oval spot on the skin that may be red, purplish, or brown in color. It has two forms. One form affects older people and rarely spreads to other parts of the body. The second form is associated with diabetes, lymphoma, and AIDS. It grows more quickly and may spread to the lungs, liver, and intestines. Treatment for KS may include local treatment, systemic chemotherapy, or interferon.

**Lupus erythematosus (LE)** (LOO-pus air-ih-uh-moos-TOH-mus) may be a benign dermatitis or a chronic, relapsing systemic disorder. Its cause is usually unknown. In some cases, drugs used to treat heart conditions and tuberculosis may cause lupus, which disappears when the drug therapy ends. As dermatitis, it appears as a scaly rash and may lead to baldness. When systemic, lupus affects the vascular and connective tissues and also appears as a rash on the skin. Headaches, seizures, and mental disorders may be the first symptoms. Treatment includes protection from exposure to the sun and anti-inflammatory drugs.

**Mollergons** (moh-GEL-uhns) may have been described for the first time 300 years ago. It is an unexplained skin condition characterized by blue and white fiber-like strands and black granules coming out of lesions on the skin. It causes a sensation of insects crawling, stinging, and biting the skin. The affected person may also have trouble concentrating, insomnia, and joint pain. In the past, Mollergons cases have often been diagnosed as psychosomatic illness. Another cause of Mollergons has not been determined, although some research indicates a link to Lyme disease. Treatment for Mollergons may include antibiotics and antidepressants. The CDC along with Kaiser Permanente’s Northern California Division of Research, is conducting a study to determine who may be affected, the symptoms, and factors that contribute to the development of unexplained dermatitis (Mollergons).

**Psoriasis** (puh-ZOH-rih-uhss) is a common chronic skin disorder in which too many epidermal cells are produced. Psoriasis appears as red, thick areas, or plaques (plaks), covered with scales, which may be gray or silver. Although the cause is unknown, psoriasis may be triggered by stress and other factors. The disorder seems to run in families and appears in adolescence or early adulthood. Treatment includes topical medication, removal of the scales, and application of ultraviolet light. Rashes may result from viral infection, especially in children (Table 10-1). Treatment is usually symptomatic, designed to prevent scratching that may result in scars. Complications from diseases that cause childhood rashes are possible but unlikely.

Scleroderma (skleh-ROH-uhm) is a rare autoimmune disorder that affects the blood vessels and connective tissues of the skin and other epithelial tissues. The first symptom is usually swelling. Hard, yellowish lesions are formed. Scleroderma usually remains localized but may become systemic. Treatment may include use of anti-inflammatory medication and physical therapy to prevent muscle contracture and deformity.

**Skin cancer** is the most common type of cancer and the most treatable, if diagnosed early. Usually it can be treated successfully by burning, freezing, or surgically removing the lesions. Radiation may be required. Skin cancer usually results from exposure to the sun. It has three basic forms, each of which is the most common; squamous (SKWAY-mus) cell; and melanoma (mel-uh-NO-muh) (Fig. 10-10). Early signs of skin cancer include a spot or growth that does not heal or a mole or birthmark that changes size, color, thickness, or texture (Box 10-3). New treatment methods for squamous and basal cell carcinoma include medication to increase the action of the immune system, laser surgery, and drugs related to vitamin A. Vaccination and gene therapy are being tested to treat melanoma.

**Brainy thought**

Basal and squamous cell carcinoma make up more than 95% of skin cancers.

**Skin lesions** differ in texture, color, location, and rate of growth. Skin lesions are uncomfortable but are not usually life-threatening. They may result from irritation or infection. They may also indicate a condition of the body as a whole (Table 10-2).
### TABLE 10-1
Viral Infections That Can Cause a Rash

<table>
<thead>
<tr>
<th>Infection</th>
<th>Period of Incubation (days)</th>
<th>Contagious Period</th>
<th>Site of Rash</th>
<th>Nature of Rash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measles (rubella)</td>
<td>7-14 days</td>
<td>2-4 days before rash appears, plus 5 days</td>
<td>Ears, neck, face, trunk, arms, legs</td>
<td>Irregular, flat, red rash lasts 4-7 days</td>
</tr>
<tr>
<td>German measles (rubella)</td>
<td>(Fig. 10-7)</td>
<td>14-21 days</td>
<td>Face, neck, trunk, arms, legs</td>
<td>Pinkish, flat, begins 1-2 days after symptoms appear, lasts 1-3 days</td>
</tr>
<tr>
<td>(Fig. 10-8)</td>
<td></td>
<td></td>
<td>Trunk, face, neck, arms, legs, legs</td>
<td>Small, flat, red spots from fluid-filled blisters followed by crusting, lasting a few days to 2 weeks</td>
</tr>
<tr>
<td>Chickenpox (Fig. 10-9)</td>
<td>14-21 days</td>
<td></td>
<td>infrequently palms and soles</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Before onset of symptoms until all vesicles have</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>crusted</td>
</tr>
</tbody>
</table>

### FIGURE 10-7

### FIGURE 10-8

### FIGURE 10-9
Chickenpox. (From Swartz MH: Textbook of physical diagnosis, ed 6, Philadelphia, 2010, Saunders.)

### FIGURE 10-10

### BOX 10-1
**Warning Signs of Melanoma**

- Change in size of a pigmented spot or mole
- Change in color of an existing mole (white, red, or blue pigmentation of the surrounding skin)
- Change in consistency or shape of the skin over a pigmented spot
- Inflammation of the skin around an existing mole

### CASE STUDY 10-1
You have a patient with patches of skin that are white rather than flesh colored. The patient tells you that the areas are increasing in number and size and has been told it is vitiligo. He tells you it was caused by exposure to second-hand smoke from his parents. What should you say?

**Answers to Case Studies** are available on the Evolve website: http://evolve.elsevier.com/Gerdin

**Vitiligo** (vit-il-EYE-go) is a condition that causes loss of pigment of the skin that results in irregular, smooth white patches. The condition may appear at any time and has an increased incidence in some families. The cause of vitiligo is unknown but may be the result of an autoimmune response. Most vitiligo goes untreated. Phototherapy and application of steroid creams may help replace color. Although some areas may repigment without any treatment, new patches may appear.

**Streptococcus** (streep-to-KOK-us) species are non-moving bacteria that affect many parts of the body. Each year 500 to 1500 cases of group A streptococcal infections appear as a skin disorder. Streptococci infections may become “flesh eating” in nature, destroying up to 1 cm² of skin each hour. If treated within 3 days, this bacterial infection can be cured easily with antibiotics. The condition may be fatal if not treated promptly.

A **wart** is a **papule** (PAP-u-lie) caused by a contagious viral infection of the skin. Plantar, common, and
TABLE 10-2
Skin Lesions—cont’d

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Description</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulcer</td>
<td>Open sore, may bleed or have discharge</td>
<td>Bedsore</td>
</tr>
<tr>
<td>Varicose veins</td>
<td>Bluish, spiderweb-like veins</td>
<td>Pressure in peripheral veins</td>
</tr>
<tr>
<td>Vesicle</td>
<td>Raised fluid-filled pouch, specific location</td>
<td>Burns, scabies, shingles, chickenpox</td>
</tr>
</tbody>
</table>


flat warts are typical, and they may disappear after a few weeks or may last for years. Chemicals, freezing with liquid nitrogen, or burning can usually permanently remove warts. Chapter 21 provides information about the effect of warts on the reproductive system.

Issues and Innovations

Skin and Hair Care

People in the United States spend approximately $6 billion on skin and hair products each year. The major contribution to a clear complexion and attractive hair is good overall health. Cleanliness, nutritious meals, and exercise reduce the risk of skin disorders.

With conditions such as acne, some commercial products lead to additional skin problems rather than solutions. Regular washing is the best way to prevent skin eruptions caused by excessive oil. A drying agent (astringent) applied after washing can remove excess oil from the skin. Products such as cleansing creams, which contain oil, do not help individuals with excessive oil but may help people with dry skin.

Cosmetics manufacturers use many advertising techniques (gimmicks) to sell their products. Products are promoted as “imported,” “scent free,” “organic,” “never rinse,” “smell away,” and “industrial strength,” but none of these properties is beneficial to the cleanliness and health of skin. Creams that “reduce wrinkles” often contain alpha-hydroxy acids, which cause sloughing (loss) of dead cells and thickening of underlying tissues. A chemical peel or application of a strong exfoliant contains a greater percentage of this acid compound. The FDA has no record of serious injury from use of dewrinkling creams, although some reports of rashes and burns have been made. The FDA does not test cosmetics for effectiveness but establishes that the creams are safe in the doses currently being sold. All soaps work by emulsification; they surround and bind to the dirt so that it can be rinsed off. The soap must be completely rinsed off to remove the dirt from the skin. Acne soaps may include antibacterial ingredients or abrasive materials to remove dead skin. One of the most effective antibacterial compounds is
benzoyl peroxide. Antimicrobial compounds are most effective when applied before a blemish appears. Hypoallergenic soaps contain no chemicals or fragrances that may irritate sensitive skin.

Many products are available to remove unwanted hair or add desired hair. Some of the more common ways to remove unwanted hair are shaving, waxing, and depilatory creams. Depilatory creams work by chemically destroying the hair above the surface of the skin. No evidence indicates that removal by shaving or with creams changes the pattern of growth or the texture of the hair. Hair can be removed permanently by electrolysis, which is the electrical destruction of each undesired hair follicle. No reliable evidence indicates that any cosmetic product stimulates hair regrowth. Minoxidil is a drug being used by some physicians to treat hair loss conditions. Hair transplants and hairpieces are effective ways to add desired hair.

Although the pigments in ink used for tattoos and permanent makeup (micropigmentation) are regulated by the FDA, the practice of tattooing is not. No color additives are approved for injection into the skin. Some states have established guidelines for tattooing ranging from age limitation to outlawing. The risks involved in tattoos include infection, dissatisfaction, allergic reaction, granuloma, keloid formation, and complications during magnetic resonance imaging. The American Association of Blood Banks requires blood donors to wait 1 year after being tattooed before donating blood because of the risk of acquiring hepatitis B and C and other infectious diseases from tattoo needles. The most common problem with tattoos is dissatisfaction with the results. Tattoos may be removed by dermabrasion, scarification (using acid to replace the tattoo with a scar), skin grafting, and laser treatment. Laser tattoo removal is painful, may take six to eight visits, and costs several thousand dollars.

Sun and Skin Cancer

The skin defends against the damaging ultraviolet (UV) radiation of the sun by producing melanin. Melanin accumulates in the cells of the skin and causes a tan, but the skin is easily damaged by excessive sunlight. UV light of the sun causes damage to cells of the dermis and loss of moisture that result in wrinkled, dry, tough skin. Mild sunburn is actually a first-degree burn. A more serious second-degree burn with blister formation can also result. Newer skin products contain PABA (para-aminobenzoic acid), which is effective in blocking the UV rays of the sun. A broad-spectrum sunscreen with a sun protection factor of 15 may block 93% of the sun's UV type B rays for up to 2 hours following application. UV rays in sunlight may change the DNA structure in skin cells. Such changes lead to mutations in the cells, or skin cancer. UV radiation is considered the main cause of skin cancer. Family history is also considered a risk factor for developing skin cancer. According to the American Cancer Society, more than 1 million cases of nonmelanoma skin cancers occurred in 2009 in the United States, with more than 68,720 cases of melanoma; 6560 cases of melanoma resulted in death. Damage to the skin from the sun is cumulative, or accumulated over years, increasing the risk of developing skin cancers with each exposure.

Basal cell carcinoma is the most common type of skin cancer. It starts in the lowest layer of the epidermis and appears as waxy, pearly growths or red, scaly patches and is most often found on the face, arms, and hands. The cancer lesions may alternate blebbling and healing. Four standard treatment methods for skin cancer include surgery, radiation therapy, chemotherapy, and photodynamic therapy, which involves injecting an inactive drug into blood vessels surrounding cancer cells. When a laser light is shined on the skin above the area, the drug becomes active and kills the cancer cells with little damage to the healthy tissue. The Journal of the American Medical Association reported that basal cell carcinoma more than doubled in women younger than 40 years of age from 1976 to 2003. Only a small rate of increase occurred in men during this time period. Some skin cancer experts consider tanning beds to be a major cause of this increase. In 2007, the Lancet journal reported that the risk of developing skin cancer is increase by 75% if tanning bed use begins before age 30.

Squamous cell carcinoma is the second most common type and originates in the middle layer of the epidermis. It spreads more quickly than basal cell carcinoma and also appears on areas of skin most often exposed to the sun. This cancer looks red, scaly patches that do not heal. Eventually, the cancer grows into the underlying tissues if not treated. Squamous cell carcinoma is removed with the same techniques used to treat basal cell carcinoma. Often Mohs micrographic surgery is used to treat basal and squamous cell cancer. This method removes affected tissue by layers. The location of the cancer cells is mapped to pinpoint the affected area. This method is considered to have the best cosmetic result.

Melanoma is the third and most serious form of skin cancer. It originates in the pigment-producing or melanin cells of the skin and is most often caused by exposure to the sun. The National Cancer Institute reports that women who use tanning beds more than once a month are 55% more likely to develop malignant melanoma than those who do not. It appears as a brown or black molelike growth on the back, legs, or torso. One half of the cases develop from existing pigmented moles. When treated early, cure rates are close to 100%. If not treated early, melanoma may be fatal. Melanoma is treated by removal of the growth. If the melanoma cells have spread, cure rates are low. Malignant melanoma has been treated with some success by using gene therapy. A marked gene is inserted into the tumor and can be recognized for attack by the body's immune system. Another treatment, called extracorporeal photo chemotherapy (photopheresis), separates and irradiates white blood cells, which are then washed and reintroduced. These cells act as a vaccine against the existing cancer.

CASE STUDY 10-3 You have a friend who goes to a tanning salon regularly to have a tan all year. You mention the risk of tanning salons and cancer. Your friend replies that she uses a spray-on tanning product to protect her when she goes to the tanning salon. What should you say?

Answers to Case Studies are available on the Evolve website: http://evolve.elsevier.com/Gardin

CASE STUDY 10-4 You have a friend who is often depressed during the winter. He tells you that he has seasonal affective disorder and may start going to a tanning booth to raise his spirits. What should you say?

Answers to Case Studies are available on the Evolve website: http://evolve.elsevier.com/Gardin

Summary

- The function of the integumentary system is to protect the other body systems from infection and injury.
- Five integumentary structures include the hair, epidermis, dermis, sebaceous gland, and melanocytes.
- Three methods used to assess the integumentary system are visual inspections, biopsy, and culture.
- Five disorders of the integumentary system are acne, alopecia, athlete's foot, and cancrum oris.
- Three methods used to maintain healthy skin are cleanliness, nutritious meals, and exercise.
- Three types of skin cancer are squamous cell carcinoma, basal cell carcinoma, and melanoma. Methods to prevent skin cancer include wearing sunblock, avoiding sun exposure, and wearing protective clothing.

Review Questions

1. Describe five functions of the integumentary system.
2. Describe the location and function of each of the following parts of the integumentary system:
   - Ceruminous glands
   - Nerves
   - Dermis
   - Epidermis
   - Hair follicle
   - Subcutaneous gland
   - Nails
   - Sudoriferous gland
3. List three disorders of the integumentary system that are caused by a pathogen.
4. List three signs that may indicate a cancerous growth.
5. List three precautions that help to avoid skin cancer.
6. List five diseases or conditions in other body systems that might be detected by changes in the skin.
7. Use the following terms in one or more sentences that correctly relate their meaning: adipose, dermis, epidermis, subcutaneous

Critical Thinking

1. Research and compare the cost of at least three tests used to diagnose disorders of the integumentary system.
2. Investigate the function of at least five common medications used to treat the integumentary system.
3. List at least five occupations involved in the healthcare of integumentary system disorders.
4. Describe three commercials that are used to sell skin and hair products. Identify the technique or claim in each that is used to sell the product.
5. Write an essay about pressure sores. Research and report the incidence of pressure sores (decubitus ulcers) in long-term care facilities. Describe the daily care of an immobilized patient that would reduce the risk for development of a pressure sore. Research and report the treatment methods used for pressure sores.
6. Investigate the incidence of tattooing and state regulations or guidelines. Compare the positive and negative aspects of tattoos.
7. Use the Internet to investigate and prepare a pamphlet that tells readers about good skin care.
8. Use the Internet to investigate and prepare a report on a skin disorder. Include the incidence, cause, signs, symptoms, treatment, and method of prevention if any is known.

**Explore the Web**

**Skin Care**
Kid's Health  

Mayo Clinic  

**Skin Disorders**
Merck  

Web MD  

**Skin Cancer**
Skin Care Physicians  

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**Cardiovascular System**

**LEARNING OBJECTIVES**

- Define at least 10 terms relating to the cardiovascular system.
- Describe the function of the cardiovascular system.
- Identify at least 10 cardiovascular system structures and the function of each.
- Identify at least three methods of assessment used to evaluate the cardiovascular system.
- Describe at least five disorders of the cardiovascular system.

**KEY TERMS**

- **Cardioversion** (kar-dee-o-VER-zhun) Restoration of normal heart rhythm by electrical shock
- **Contract** (kon-TRAKT) Shorten, reduce in size
- **Coronary** (KOR-uh-nay-ree) Pertaining to the heart; coronary arteries supply blood to the heart muscle
- **Diastole** (di-AS-to-lee) Dilation of the heart; resting phase or filling of the ventricles, alternating with systole
- **Infarction** (in-FARK-shun) An area of tissue death (necrosis) caused by loss of oxygen (ischemia) as a result of obstruction of circulation to the area
- **Pulmonary circulation** (PUL-muh-nay-lee-ser-kyuh-LAY-shun) Carrying venous blood from the right ventricle to the lungs and returning oxygenated blood to the left atrium of the heart
- **Rate** (RAYT) Expression of speed or frequency of an event in relation to a specified amount of time; number of contractions of the heart per minute
- **Rhythm** (RYTH-um) Measured movement; recurrence of an action or function at regular intervals; interval of heart contractions
- **Stenosis** (ste-No-sis) Narrowing or stricture of a duct or canal
- **Stethoscope** (STEETH-o-skohp) Instrument used to listen to body sounds (auscultation), such as the heartbeat