

Membranes and the Integumentary System



HOSA Event Prep

Pathophysiology is the study of diseases and abnormal health conditions or disorders. Understanding what causes diseases and disorders, and how to prevent them when possible, is important to people in most healthcare careers. Throughout this textbook, you will read about common diseases and disorders that occur in each body system.

If the study of diseases and disorders interests you, you may want to investigate HOSA's *Pathophysiology* event. This event exposes health science students to disease processes that affect various body systems, including the integumentary system.

Go to the HOSA website at <https://hosa.org/guidelines/> to find out more about HOSA's *Pathophysiology* event. What is involved in this event? Is it a written or practical (skills assessment) event, or both? What information presented in this chapter may help you prepare for this event? If you decide you want to participate in this event, check with your HOSA advisor for more information about guidelines and procedures.

What determines whether people have straight, wavy, or curly hair?

People tend to think about their skin mainly when they are interested in getting a tan or avoiding sunburn. Consider, however, that the skin is actually a body organ like the heart or lungs. In fact, this organ called *skin* makes up approximately 15 percent of your total body weight!

The skin is quite a remarkable organ. It is far more than just an outer layer of covering. The skin contains glands and sensory receptors that perform specialized functions; it also grows hair and nails. For these reasons, the skin and its contents are considered a body system—the *integumentary system*.

This chapter examines the anatomy and functions of the integumentary system, including associated structures and membranes. It also discusses some of the common injuries and disorders of the skin and membranes, along with their symptoms and current treatments.

Chapter 3 Outline

> Lesson 3.1 Body Membranes

- Epithelial Membranes
- Synovial Membranes

> Lesson 3.2 The Integumentary System

- Functions of the Integumentary System
- Anatomy of the Skin
- Appendages of the Skin

> Lesson 3.3 Injuries and Disorders of the Skin

- Skin Injuries
- Infections of the Skin and Membranes
- Inflammatory Conditions of the Skin and Membranes
- Cancers of the Skin

Building Your Portfolio

Take digital photographs of the models you create as you work through this chapter. Create a document called “The Integumentary System” and insert the photographs, along with written descriptions of what the models show and your reasons for creating them using the materials and forms you choose. Add this document to your personal portfolio.

Before You Read

Try to answer the following questions before you read this lesson.

- Do all membranes secrete some type of fluid?
- What is the common name for the cutaneous membrane?

Learning Outcomes

- 3.1-1 Identify the types of epithelial membranes and the differences among them.
- 3.1-2 Describe the structure and function of synovial membranes.

Key Terms

cutaneous membrane	serous fluid
epithelial membranes	serous membranes
membranes	synovial fluid
mucous membranes	synovial membrane
mucus	

The **membranes** in the human body surround and help protect the body's surfaces. These surfaces include cavities that open to the outside world, internal cavities that house body organs, capsules that surround ball-and-socket synovial joints, and the skin. This lesson explores the similarities and differences among the membranes that cover these different body surfaces.

3.1-1 Epithelial Membranes

The **epithelial** (ehp-i-THEE-lee-al) **membranes** provide a lining, or covering, for the internal and external surfaces of the body. These membranes include both a sheet of epithelial cells and an underlying layer of connective tissue. There are several categories of epithelial membranes.

Mucous Membranes

The **mucous membranes** line the body cavities that open to the outside world (**Figure 3.1**). These cavities include all the hollow organs of the respiratory, digestive, urinary, and reproductive tracts. The mouth, nose, lungs, digestive tract, and bladder are examples of hollow organs lined with mucous membranes.

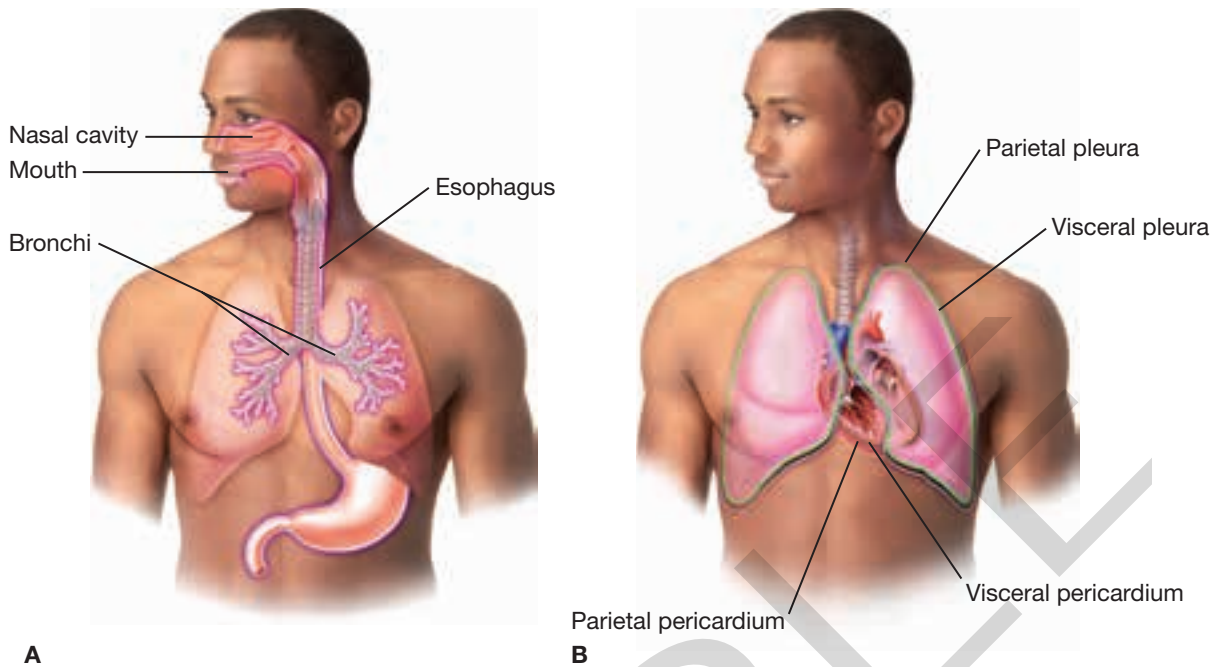
The structure of the mucous membranes comprises a layer of epithelium on top of loose connective tissue called *lamina propria*. The mucous membranes are all moist: the membranes of the digestive and respiratory tracts secrete mucus, and glands in the urinary tract add mucus there. **Mucus** is a slippery solution that protects the mucous membranes and aids in transporting substances.

Serous Membranes

Serous (SEER-us) **membranes** line body cavities that are closed to the outside world (**Figure 3.1**). Examples are the pleura (PLOO-ra), which encloses the lungs; the pericardium (per-i-KAR-dee-um), which surrounds the heart; and the peritoneum (per-i-toh-NEE-um), which lines the abdominal cavity.

The structure of serous membranes is an outer layer of simple squamous (flattened) epithelium on a thin layer of loose connective tissue. Each serous membrane forms a double lining with an outer lining and an inner lining. The outer lining of each body cavity is called the *parietal layer*. The inner lining that covers each organ within a body cavity is called the *visceral layer*.

Serous membranes secrete a thin, clear fluid called **serous fluid**. This fluid serves as a lubricant between the parietal and visceral membranes to minimize friction and “wear and tear” on organs that move within the linings, such as the beating heart.



© Body Scientific International

Figure 3.1 Two classes of epithelial membranes. A—Mucous membranes line body cavities that open to the outside world. B—Serosus membranes line body cavities that are closed to the outside world.

Cutaneous Membrane

The **cutaneous** (kyoo-TAY-nee-us) **membrane** is the anatomical name for the skin. The basic structure of skin is a keratinizing, stratified (layered) squamous epithelium over dense, fibrous connective tissue. Although the skin contains sweat glands, it is a dry membrane when sweat is not present. The integumentary system, which encompasses the skin and its related structures, is discussed in detail in the next lesson.

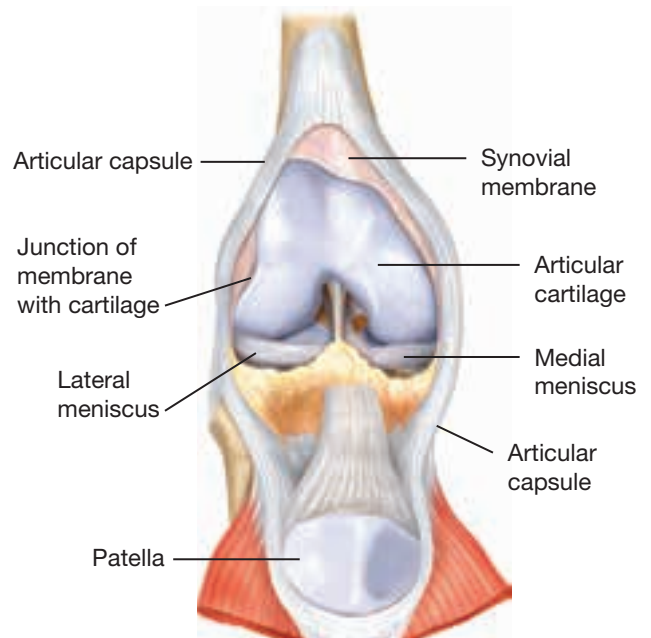
✓ Check Your Understanding

1. Which two tissues make up epithelial membranes?
2. Where are epithelial membranes located? Name at least three locations for mucous membranes and three for serous.
3. What is the difference between mucous membranes and serous membranes?

3.1-2 Synovial Membranes

Synovial (si-NOH-vee-al) **membranes** are the only type of membrane in the body that are composed solely of connective tissue and

include no epithelial cells. These membranes line the capsules that surround synovial joints, such as the shoulder and knee (**Figure 3.2**). They also line tendon sheaths (the connective tissue that surrounds tendons) as well as bursae,



© Body Scientific International

Figure 3.2 Anterior view of a synovial joint.

the small, connective tissue sacs that serve as cushions for tendons and ligaments surrounding the joints. Synovial membranes in all these locations secrete a clear **synovial fluid**, which provides cushioning and reduces friction and wear on moving structures.



Check Your Understanding

1. Which type of body membrane contains no epithelial cells?
2. Name the two purposes of synovial fluid.

LESSON 3.1 Review and Assessment

Mini Glossary

Make sure that you know the meaning of each key term.

- cutaneous membrane** another name for skin
- epithelial membranes** thin sheets of tissue lining the internal and external surfaces of the body
- membranes** thin sheets or layers of pliable tissue
- mucous membranes** thin sheets of tissue lining the body cavities that open to the outside world
- mucus** a slippery solution that protects the mucous membranes and aids in transporting substances
- serous fluid** a thin, clear liquid that serves as a lubricant between parietal and visceral membranes
- serous membranes** thin sheets of tissues that line body cavities closed to the outside world
- synovial fluid** a clear liquid secreted by synovial membranes that provides cushioning for and reduces friction in synovial joints
- synovial membrane** the lining of the synovial joint cavity that produces synovial fluid

Know and Understand

1. List the two main categories of body membranes. (LO 3.1-1)
2. List the subcategories of the epithelial membranes. (LO 3.1-1)
3. Describe the basic structure of skin. (LO 3.1-1)
4. Name three examples of serous membranes. (LO 3.1-1)
5. List the areas of the body in which mucous membranes are found. (LO 3.1-1)
6. What type of tissue makes up synovial membranes? (LO 3.1-2)

Analyze and Apply

1. What is the primary purpose of the fluid that is produced by serous membranes? (LO 3.1-1)
2. Of what condition would dry mucous membranes in the body be a symptom, and how could this symptom be treated? (LO 3.1-1)
3. Serous membranes line and enclose several body cavities, where they secrete a lubricating fluid that reduces friction from the movement of what body tissue? (LO 3.1-1)
4. What is the main purpose of the cutaneous membrane, and how does it achieve its goal? (LO 3.1-1)
5. If synovial fluid were not present, what would happen to the joints in the body? (LO 3.1-2)

IN THE LAB

1. Using the information that you have learned about membranes, use a magnifying mirror to examine your mouth and nose. What do you see? What color is the skin that lines your mouth? Is it moist or dry? How would you describe the skin around your nose? Write a detailed description of the skin in your mouth and nose. Do the characteristics that you noted match the information presented in this lesson? (LO 3.1-1)
2. Search online for pictures of laboratory slides of each type of tissue discussed in this chapter: epithelial, mucous, serous, cutaneous, and connective tissue. Print and paste the pictures to 3×5 cards to create flash cards. On the back of each card, write the name and function of the tissue. With a partner, use these cards to study the various types of tissue. Practice pronouncing any terms with which you are not familiar. (LO 3.1-1, LO 3.1-2)

Before You Read

Try to answer the following questions before you read this lesson.

- What causes differences in skin color, and what causes tanning?
- What causes people to have straight, wavy, or curly hair?

Learning Outcomes

- 3.2-1 Describe the functions of the integumentary system.
- 3.2-2 Identify the layers of the skin.
- 3.2-3 Explain the purpose and functions of the appendages of the human skin.

Key Terms

apocrine glands	Merkel cells
dermis	papillary layer
eccrine glands	reticular layer
epidermal dendritic cells	sebaceous glands
epidermis	sebum
hypodermis	stratum basale
integumentary system	stratum corneum
keratin	stratum granulosum
keratinocytes	stratum lucidum
lipocytes	stratum spinosum
melanin	subcutaneous fascia
melanocytes	sudoriferous glands

The skin is the major organ of the **integumentary** (in-tehg-yoo-MEHN-ta-ree) **system**. The term *integumentum*, which means “covering.” However, the integumentary system is not simply a membrane like those discussed in the previous lesson. It is an entire system that includes a cutaneous membrane, sweat and oil glands, and nails and hair. Working together, these structures perform critically important functions that are not only convenient but also essential for life.

3.2-1 Functions of the Integumentary System

The skin forms a protective cover that serves a variety of purposes. When you sustain a cut or an abrasion, your skin acts as the first line of defense in protecting the underlying tissues. The skin’s outermost layer contains **keratin** (KER-a-tin), a tough protein also found in hair and nails that adds structural strength. In addition, keratin helps to protect the skin against damage from harmful chemicals.

Keratin and naturally occurring oils in the skin also act as a water barrier. The skin substantially lessens the evaporation of water and the loss of essential molecules that the water carries from inside the body. Furthermore, keratin prevents water from entering the body during bathing or swimming.

The skin is also critically important in regulating body temperature, due to the extensive array of tiny capillaries and sweat glands that lie near the surface of the skin. When the body is overheated, the capillaries dilate (expand), enabling body heat to dissipate. Likewise, during hot conditions, the sweat glands become active, producing sweat that evaporates and has a cooling effect on the skin. When the environment is cold, the capillaries constrict (tighten), and blood flow moves to deeper vessels away from the skin to minimize heat loss.

Skin is also involved in certain chemical processes in the body. Specialized cells in the skin called **melanocytes** (MEHL-a-noh-sights) produce **melanin**, a pigment that helps protect the body against the harmful effects of ultraviolet ray damage from sunlight.

Melanin can be yellow, brown, or black. It is the amount and type of melanin in the skin that primarily determines skin color. Each child inherits a number of genes influencing melanin production from each parent, yielding significant variety in skin coloration. These genes govern production of the enzyme *tyrosinase*, which influences the number and distribution of melanocytes in the skin. Exposure to ultraviolet radiation from the sun also results in different degrees of skin darkening, commonly known as

tanning. With exercise, the tiny blood vessels in the skin dilate, creating a reddish coloration.

Exposure to the ultraviolet-B (UVB) rays from sunlight causes the conversion of modified cholesterol molecules called *provitamin D3* in the skin to vitamin D. Vitamin D is essential for bone health. In addition, during the process of sweating, the body eliminates chemical waste products, including urea, uric acid, and salts. And, because the fluid secreted by the sweat glands is acidic, it helps to protect the body against bacterial infections.

Finally, the skin contains specialized sensory receptors that are part of the nervous system. These receptors transmit nerve signals that contain information about the environment, including touch, pressure, vibration, pain, and temperature. The table in **Figure 3.3** summarizes the functions of the integumentary system.

✓ Check Your Understanding

1. What elements in the skin act as a water barrier?
2. How do sweat glands protect against bacterial infections?

3.2-2 Anatomy of the Skin

The skin has two layers—an outer **epidermis** (ehp-i-DERM-is) and an underlying **dermis** (**Figure 3.4**). A blister is produced when a burn or friction causes these two layers to separate, forming a fluid-filled pocket. The epidermis and dermis are thick over areas such as the soles of the feet and thin in delicate areas such as the eyelids.

MEMORY TIP

The word *dermis* means “true skin.” The prefix *epi-* means “upon” or “over.” The prefix *hypo-* means “below,” or “under.” Thus, the epidermis lies above the dermis, and the hypodermis lies below the dermis.

Beneath the dermis is the **hypodermis**, or **subcutaneous fascia**, which serves as a storage repository for fat. The hypodermis is not part of the skin, but it connects the skin to the underlying tissues. It also provides cushioning and insulation against extreme external temperatures.

Epidermis

The outer layer of skin, the epidermis, is the visible skin. The epidermis contains five layers of tissue (**Figure 3.5**). From superficial to deep (the outside going in), these are named the **stratum corneum**, **stratum lucidum**, **stratum granulosum**, **stratum spinosum**, and **stratum basale**.

All epidermal layers consist of cells, but they do not include a blood supply that provides nutrients to the skin. The innermost layer, the stratum basale, absorbs nutrients from the underlying dermis. The cells in the stratum basale are constantly producing new skin cells. As new cells germinate, they are pushed toward the surface and away from nutrients. Eventually, they die.

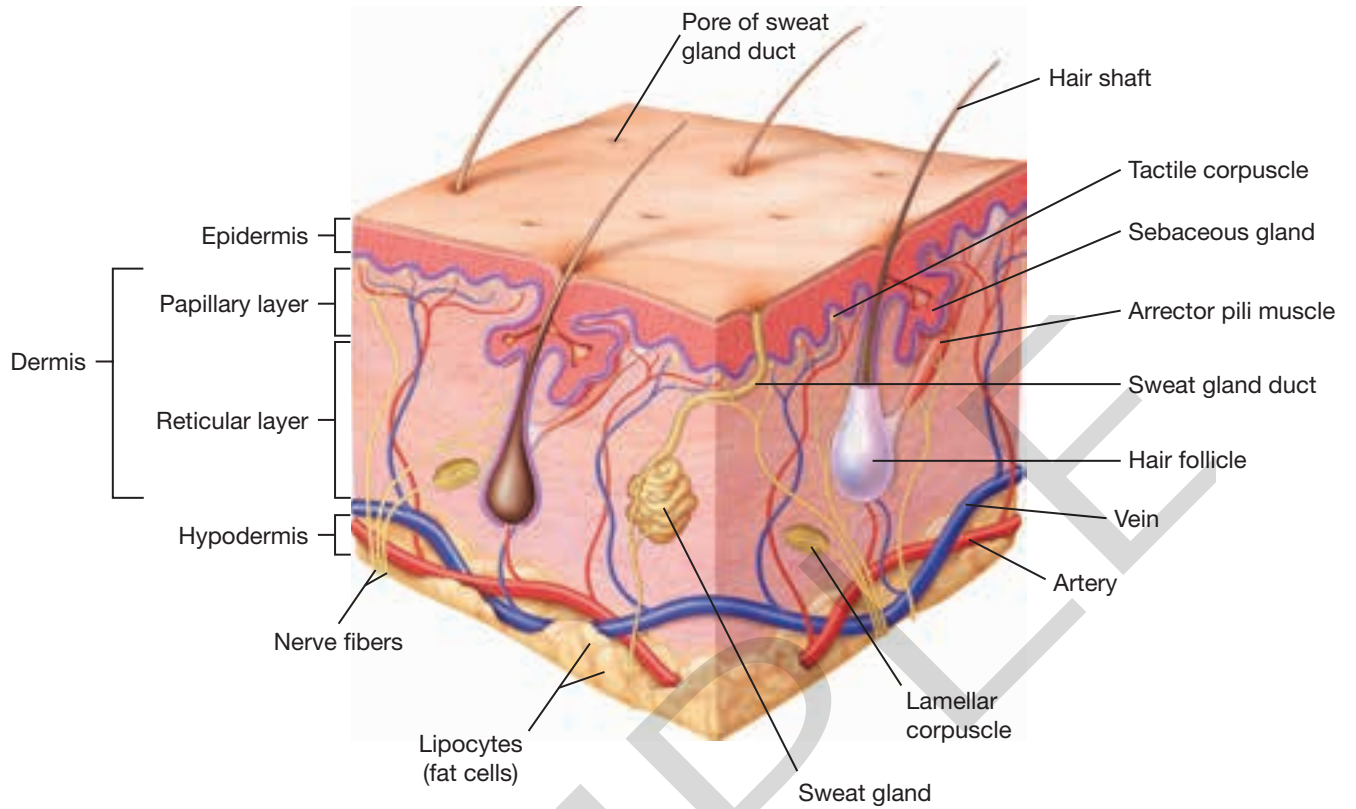
Most of the cells within the epidermis are **keratinocytes** (keh-RAT-i-noh-sights), which produce keratin. Moving up through the stratum

Functions of the Integumentary System

Function	Mechanisms
Protection	Tough keratin protects against mechanical injury and chemical damage. Melanocytes produce melanin to protect against UV ray damage. Acidic sweat protects against bacterial infections.
Water barrier	Keratin and oils in the skin reduce water loss through evaporation and form a barrier against water infusion.
Temperature regulation	Capillaries dilate to dissipate heat and constrict to conserve heat. Sweat evaporation provides a cooling effect.
Vitamin D production	Sunlight converts modified cholesterol molecules to vitamin D, which is essential for bone health.
Waste elimination	Urea and uric acid are eliminated in sweat.
Sensory perception	Receptor cells transmit information about touch, pressure, vibration, pain, and temperature to the nervous system.

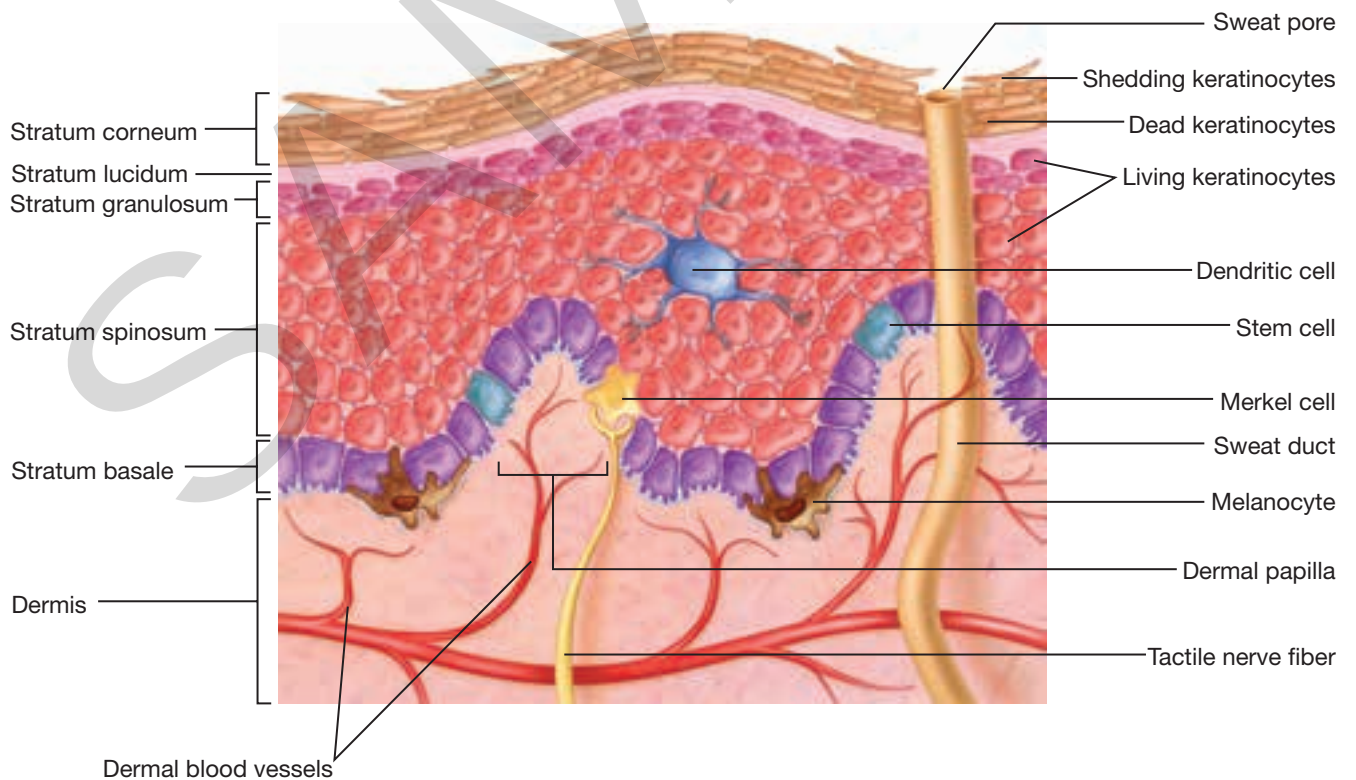
Figure 3.3

Goodheart-Willcox Publisher



© Body Scientific International

Figure 3.4 The layers and structures of the integumentary system.



© Body Scientific International

Figure 3.5 The layers of the epidermis. *Which layer continually produces new cells?*

spinosum and stratum granulosum, cells become progressively flatter and more filled with keratin, which makes them tough and water-resistant. The stratum lucidum is a clear layer of thick skin found only on the palms of the hands, fingers, soles of the feet, and toes.

The outer layer of the epidermis, the stratum corneum, consists of dead cells that are totally filled with keratin and are continually shedding. You might be surprised to learn that the epidermis completely replaces itself every 25 to 45 days.

The stratum basale contains melanocytes. As you may recall, these specialized cells produce the pigment melanin. Melanin, which ranges in color from reddish yellow to brown and black, is primarily responsible for human skin color. Exposure to sunlight causes melanocytes to produce more melanin. As melanin granules are pushed out into the neighboring skin cells, the result is tanning.

The presence of extra melanin in the skin functions as a sunscreen, which is why sunburn is more likely to affect individuals with light skin. Sunburn is also less likely once a light-skinned person has a tan.

An inherited condition called *albinism* (AL-bin-izm) prevents the normal production of melanin. Albinism produces very little pigment in the skin, hair, and eyes. Individuals with albinism have extremely pale skin and white hair.

The epidermis contains specialized cells associated with the immune and nervous systems. **Epidermal dendritic cells** respond to the presence of foreign bacteria or viruses by initiating an immune system response, which brings in other specialized cells to attack the foreign invaders. There are as many as 800 dendritic cells per square millimeter of skin to help ward off infections.

Merkel cells (also called *Merkel-Ranvier cells*), located in the stratum basale, function as touch receptors. These cells form junctions with sensory nerve endings that relay information about touch to the brain.

Dermis

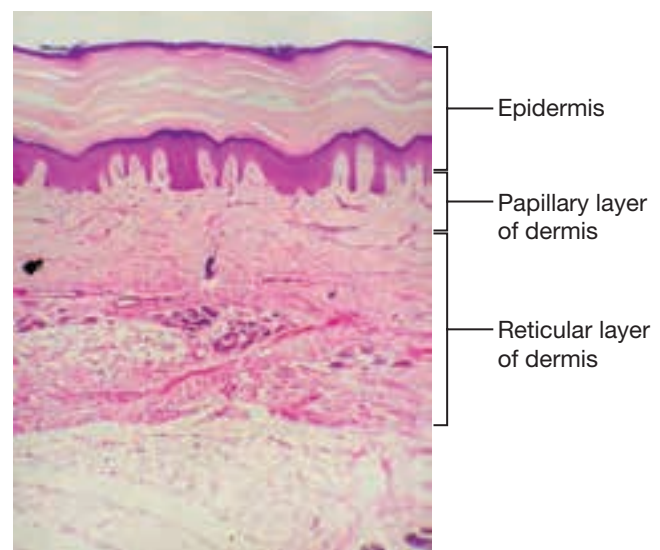
The dermis, or “true skin,” is a dense, fibrous connective tissue composed of collagen and elastic fibers. The collagen fibers provide toughness and also bind with water molecules to help keep the inner skin moist. The elastic fibers are what keep the skin looking young, without wrinkles or sagging.

The dermis has a rich supply of blood vessels, which, as previously discussed, dilate or constrict

to help dissipate or retain body heat, respectively. Also present throughout the dermis is a variety of specialized sensory receptors for touch, vibration, pain, and temperature. These receptors communicate with nerve endings to transmit information to the brain about what the body is sensing. Specialized white blood cells called *phagocytes* (FAG-oh-sights), which are distributed throughout the dermis, are responsible for ingesting foreign material, including bacteria as well as dead cells.

The outer layer of the dermis is the **papillary layer** (PAP-i-lar-ee) **layer**, after the *dermal papillae* (pa-PIL-ee) that protrude from its surface up into the epidermis (**Figure 3.6**). Some of the dermal papillae contain capillaries that supply nutrients to the epidermis. Other dermal papillae contain nerve endings involved in sensing touch and pain. These papillae form genetically determined, ridged patterns on the palms of the hands, fingers, toes, and soles of the feet. It is from the papillae patterns on the fingers that each person’s unique fingerprints are derived.

Underneath the papillary layer lies the **reticular layer** of the dermis. The collagen and elastic fibers in this region have an irregular arrangement. The reticular layer includes blood and lymphatic vessels, sweat and oil glands, involuntary muscles, hair follicles, and nerve endings.



Jubal Harshaw/Shutterstock.com

Figure 3.6 Light micrograph showing the two regions of the dermis below the epidermis. *Why do you think the dermis is called the “true skin”?*

Hypodermis

The hypodermis, or subcutaneous fascia, includes fibrous connective tissue and adipose (fatty) tissue. It is within the hypodermis that **lipocytes** (LIP-oh-sights), or fat cells, reside. Some amount of body fat is important for padding and insulating the interior of the body. Fat also serves as a source of energy.

✓ Check Your Understanding

1. What are the two layers of skin?
2. Where does the body store fat?
3. What specialized cells are responsible for human skin color?

3.2-3 Appendages of the Skin

The integumentary system includes several appendages, or accessory structures, that help the skin perform its functions. Structures considered to be appendages of the skin include the sudoriferous glands, sebaceous glands, hair, and nails.

Sudoriferous Glands

Sudoriferous (soo-doh-RIF-er-us) **glands** are sweat glands. They are distributed in the dermis

over the entire body, with larger concentrations in the axilla (under the arms), on the palms of the hands and soles of the feet, and on the forehead. Each person has approximately 2 to 3 million sweat glands. The two types of sweat glands are eccrine glands and apocrine glands (**Figure 3.7**).

The **eccrine** (EK-rin) **glands** are the major sweat glands of the body. They cover most of the body and open directly onto the skin. The sweat

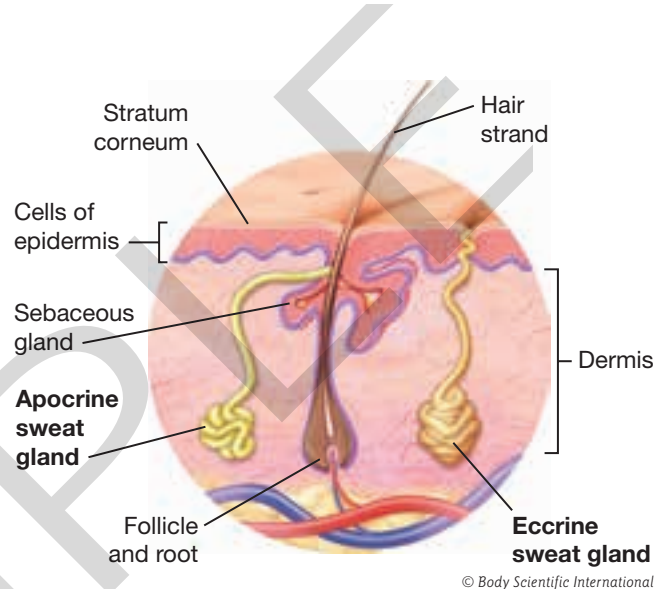


Figure 3.7 The eccrine and apocrine sweat glands. *What is the difference between the eccrine and the apocrine glands?*

LIFE SPAN DEVELOPMENT: *The Integumentary System*

The integumentary system develops through a series of events, beginning before birth and continuing throughout life. Following birth, these changes are brought about by the normal aging process and are influenced by genetic, environmental, and lifestyle-related factors.

In the developing fetus, the beginnings of the epidermis and dermis are present by the end of the first month. Keratinocytes start developing at 9 weeks, and at 13 weeks differentiation of the skin layers is noticeable. Hair follicles originate at 14 weeks, sebaceous glands at 18 weeks, and eccrine glands at 23 weeks. By 34 weeks, the keratinocytes are mature and flattened. During the third trimester, a protective covering called the *vernix caseosa* is secreted by the sebaceous glands. This white substance, composed of lipids, protein, and water, surrounds and protects the fetal skin.

At birth, a baby's skin transitions from continuous immersion in the mother's amniotic fluid to exposure to the

air. This causes an initial dehydration of the skin, followed by increasing hydration for up to three months as the skin adapts. The increased skin hydration lasts for approximately the first year of the baby's life. Although at birth, the skin in full-term infants includes all five layers, the skin continues to develop functional capabilities over the first year. Infant skin is in a constant state of flux with changes in hydration, lipid content, and skin acidity.

The next developmental period lasts from infancy to puberty. The skin of both males and females thickens continuously during this stage, although the epidermal and dermal layers of males thickens more than that of females.

With the onset of puberty, hormones exert significant influence on the glands in the skin. Androgens (steroids) stimulate the sebaceous glands, which increase the oiliness of the skin and hair and may cause acne (**Figure 3.8A**). Females accumulate a layer of subcutaneous fat, which is absent in

(continued)



A



B

Bangkoker/Shutterstock.com, Alex75/Shutterstock.com

Figure 3.8 Characteristic skin changes throughout the life span. A—In puberty, hormonal changes increase the oiliness of the skin, which may result in acne. B—As a person ages, wrinkling and sagging of the skin result from loss of subcutaneous fat, combined with lower collagen levels and decreased elasticity.

males. Males begin a gradual thinning of their thick epidermal and dermal layers. In females, these layers maintain a constant thickness throughout adolescence and adulthood until menopause. Beginning with puberty, both genders experience a decrease in skin collagen content that progresses with age.

Characteristic skin changes occur for both genders in older adulthood. Thinning of the skin with the loss of collagen eventually results in translucence, with the blood vessels clearly showing through (**Figure 3.8B**). Loss of subcutaneous fat, coupled with the decrease in collagen and elastic fibers, creates the wrinkling and sagging of the skin commonly seen in old age. Because females have lower collagen density than males, they appear to age earlier than males. The skin and hair become drier, and the skin's dermal blood vessels become fewer and more fragile. The remaining fragile vessels are easily damaged, so bruising becomes more frequent and more severe. These changes in the blood vessels and sweat glands, along with the loss of subcutaneous fat, combine to make body temperature regulation a challenge. Thus, elderly people are more prone to hypothermia in cold weather and heat stroke in hot weather.

The hair also undergoes characteristic changes with aging. Hair follicles produce less melanin, which results in the graying of hair. In some people, graying may begin as soon as the early 30s. The rate of hair color change is primarily determined by genetics. The hair strands also become finer, and fewer follicles produce new hairs. By the age of 50, most people have a reduction of approximately a third in functioning hair follicles. Male-pattern baldness is the common, large absence of hair on the top of the head. The less common female-

pattern baldness involves significant thinning of the hair to the point that the scalp readily shows through.

With aging, the nails grow more slowly and may become dull or yellowed and brittle. The nails, particularly the toenails, may become thicker and may develop lengthwise ridges.

Although many of these described changes to the integumentary system are a function of aging and genetic makeup, environment and lifestyle are also factors. The strongest accelerator of facial wrinkling is smoking. The nicotine in cigarettes causes narrowing of the blood vessels in the skin. With less blood flow, the skin receives less oxygen and important nutrients. Many of the chemicals in tobacco smoke also damage collagen in the skin, causing premature wrinkling and sagging. Skin damage from smoking becomes noticeable after about 10 years. The more cigarettes you smoke and the longer you smoke, the more skin wrinkling is accentuated.

Aging of the skin is also accelerated by exposure to the sun. Over time, exposure to the ultraviolet rays in sunlight can damage collagen, making the skin less elastic and leading to wrinkling. Skin may even become thickened and leathery. The more sun exposure you have, the earlier your skin ages. Wearing sunscreen, protective covering, and avoiding excessive sun exposure can slow the onset of the characteristic changes associated with aging skin.

Life Span Review

1. Why does a newborn's skin become dehydrated during the first three months after birth?
2. What factors, other than age, can contribute to the "aging" of the skin?

secreted by eccrine glands is a clear, acidic fluid that consists of approximately 99% water, but it also contains waste products such as urea, uric acid, salts, and vitamin C.

Sweat is odorless, but if it is left on the skin, bacteria can chemically change it to produce an unpleasant odor. Sweat glands contain nerve endings that cause sweat to form when body temperature or external temperature is elevated. Evaporation of sweat from the skin's surface is very effective in dissipating body heat. However, during periods of physical activity in a hot environment, the body can lose as much as a liter of liquid per hour in the process of sweating. In such circumstances, it is important to drink appropriate amounts of fluids to avoid serious, potentially life-threatening conditions.

The **apocrine** (AP-oh-krin) **glands**, which begin to function during puberty, are located in the genital and axilla (armpit) areas. The apocrine glands are larger than the eccrine glands. They secrete a milky fluid consisting of sweat, fatty acids, and proteins. Unlike the eccrine gland ducts, which open directly onto the skin, the apocrine gland ducts empty into hair follicles.

Sebaceous Glands

Sebaceous (seh-BAY-shus) **glands**, located all over the body except for the palms of the hands and soles of the feet, produce an oily substance called **sebum** (SEE-bum). Most sebaceous glands empty into a hair follicle, although some secrete directly to the skin. Sebum helps to keep the skin and hair soft and also contains chemicals that kill bacteria. Because the sebaceous glands are particularly active during adolescence, teenagers' skin tends to be oily.

Hair

Hair follicles (FAHL-i-kuhlz) are bulb-shaped structures in the dermis that produce hair (**Figure 3.9**). The base of the follicle is "invaded" by a papilla of connective tissue containing a rich capillary blood supply, which provides nourishment for hair cell formation. In the matrix, or growth zone, within the base of the follicle are specialized cells that divide and generate living hair cells. But, like the epithelial cells generated in the stratum basale, as these cells are pushed up toward the scalp, they become filled with keratin and die. Most of a shaft of hair is, therefore, nonliving material composed mainly of protein.

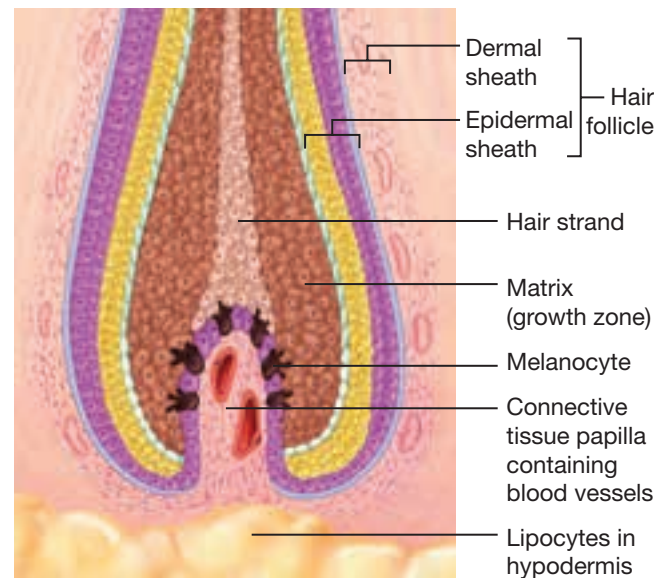
What gives a person's hair a particular color and texture (straight, wavy, or curly)? Melanocytes within the follicle produce the pigment melanin that gives hair its color. As a person ages, the melanocytes produce less pigment, resulting in gray or white hair.

The shape of the hair follicle is genetically determined. A round hair follicle produces straight hair; an oval follicle causes hair to be wavy; and a flat follicle produces curly hair.

What causes the familiar "goose bumps" that are part of an involuntary reaction when you are cold or frightened? Tiny muscles called *arrector pili* (ah-REHK-tor PIGH-light) connect both sides of the hair follicle to the epidermis. When stimulated, these muscles contract, pulling the hair upright and causing the appearance of goose bumps on the skin. The erect hair traps a layer of air close to the skin, which adds insulation and helps to warm the body.

Nails

Underlying each nail is a specialized region of the stratum basale known as the *nail bed*. The proximal end of the nail bed is a thickened region called the *nail matrix*, or growth zone. Nail growth occurs within the matrix, with new cells rapidly becoming keratinized and dying.



© Body Scientific International

Figure 3.9 The base of a hair follicle—longitudinal section view. *If you were to ask a stylist or barber to trim all the "dead ends" from your hair, you would be practically bald. Why?*

Nails are transparent, but they appear pinkish in color because of the capillary blood supply beneath the stratum basale. The white, crescent moon-shaped region at the base of the nail, which is positioned over the thickened nail matrix, is called the *lunule* (LOO-nyool). The word *lunule* gets its name from the Latin word *luna*, which means “moon.” The lunule has a curved shape like that of a crescent moon.

✓ Check Your Understanding

1. Name four body structures that are considered to be appendages of the skin.
2. What are the two main types of sudoriferous glands?
3. What is the purpose of sebum?

What Research Tells Us

...about Health in Skin Color

Changes in skin color can signal underlying changes in body function or patterns of food consumption. Among Caucasians, changes in coloration are relatively apparent. In people with darker skin coloration, the same color changes are masked, but can be observed to some extent in the mucous membranes and nail beds.

Capillaries in the dermis carry oxygenated hemoglobin, which is bright red. In people with less melanin and lighter complexions, the hemoglobin in the blood gives the skin a pinkish tone. Conditions that cause dilation of the blood vessels, such as elevated blood pressure or inflammation, can produce flushing of the skin. The blood vessels are also dilated during vigorous exercise and during exposure to hot conditions, both of which can result in reddening, especially of the face.

Alternatively, any condition that causes constriction of the blood vessels can result in paleness or pallor of the skin. Cold conditions and certain emotional responses, such as fear or anger, can do this. Low blood hemoglobin content,

called *anemia*, or low blood pressure can also cause paleness of the skin.

Poor oxygenation of the blood causes hemoglobin to lose its red color, turning bluish. This condition is known as *cyanosis*. Breathing disorders such as asthma, chronic obstructive pulmonary disease (COPD), and lung cancer can cause cyanosis, as can different forms of heart failure.

A yellowish hue to the skin and eyes is an indication of *jaundice*, a condition in which excess bile from the liver is deposited throughout the body. Jaundice can be a symptom of disease or damage to the liver.

Diet can also influence skin color, especially when there is large intake of beta-carotene. Beta-carotene is the orange-colored pigment that gives carrots, sweet potatoes, and acorn squash their color. It is also found in leafy green vegetables. Beta carotene is deposited in the stratum corneum layer of skin. Diets excessively rich in beta-carotene can produce an orange-yellow coloration of the skin, especially in the palms of the hands and soles of the feet.

LESSON 3.2 Review and Assessment

Mini Glossary

Make sure that you know the meaning of each key term.

apocrine glands sweat glands located in the genital and armpit areas that secrete a milky fluid consisting of sweat, fatty acids, and proteins

dermis layer of skin between the epidermis and hypodermis; includes nerve endings, glands, and hair follicles

eccrine glands sweat glands located over the majority of the body that produce a clear, acidic fluid that consists of approximately 99% water, but it also contains waste products such as urea, uric acid, salts, and vitamin C.

epidermal dendritic cells skin cells that initiate an immune system response to the presence of foreign bacteria or viruses

epidermis the outer layer of skin

hypodermis the layer of tissue beneath the dermis, which serves as a storage repository for fat

integumentary system enveloping organ of the body that includes the epidermis, dermis, sudoriferous and sebaceous glands, and nails and hair

keratin a tough protein found in the skin, hair, and nails

keratinocytes cells within the epidermis that produce keratin

lipocytes fat cells

melanin a pigment that protects the body against the harmful effects of ultraviolet ray damage from the sun

melanocytes specialized cells in the skin that produce melanin

Merkel cells touch receptors in the skin

papillary layer the outer layer of the dermis

reticular layer the layer of skin superficial to the papillary layer

sebaceous glands glands located all over the body that produce sebum

sebum an oily substance that helps to keep the skin and hair soft

stratum basale the deepest layer of the epidermis

stratum corneum the outer layer of the epidermis

stratum granulosum a layer of somewhat flattened cells lying just superficial to the stratum spinosum and inferior to the stratum lucidum

stratum lucidum the clear layer of thick skin found only on the palms of the hands, fingers, soles of the feet, and toes

stratum spinosum the layer of cells in the epidermis superior to the stratum basale and inferior to the stratum granulosum

subcutaneous fascia the tissue that connects the skin to underlying structures; the hypodermis

sudoriferous glands sweat glands that are distributed in the dermis over the entire body

Know and Understand

1. Describe two ways in which skin helps to protect the body. (LO 3.2-1)
2. List the important features of the epidermal dendritic cells and Merkel cells of the epidermis. (LO 3.2-2)
3. What is the purpose of collagen fibers? (LO 3.2-2)
4. Describe elastic fibers and list the areas of the body in which they are located. (LO 3.2-2)
5. What is the other name for sweat glands? (LO 3.2-3)
6. What are the two types of sweat glands? Describe them both. (LO 3.2-3)
7. Where does hair and nail growth occur? (LO 3.2-3)

Analyze and Apply

1. The skin is involved in chemical processes. Which vitamin is essential to bone health, and what role does the skin play in producing that vitamin? (LO 3.2-1)
2. The epidermis completely replaces itself every 25 to 45 days. Describe the process of skin shedding and how the body constantly supplies nutrients to the outer layers of the skin. (LO 3.2-2)
3. If a person has albinism, does the person's epidermis function normally? Explain. (LO 3.2-2)
4. In the summer months, exposure to extreme temperatures can be life threatening, but glands close to the surface of the skin help to keep the body cool. What are these glands and how do they help to regulate body temperature? (LO 3.2-1, LO 3.2-3)
5. In previous chapters, you read about homeostasis. Relate what you have previously read to the function of the skin in regard to regulating the body's temperature. (LO 3.2-1, LO 3.2-3)

IN THE LAB

1. Using the information that you have learned about the layers of skin, examine your hands, arms, and feet. Describe what the skin looks like on these areas. Does the skin of your hands and feet have a different color, thickness, or design than that of your arms? Describe in detail why this is or is not the case. (LO 3.2-2)
2. Assume that you are a forensic scientist who has been asked to help solve a murder using a few strands of hair that were caught in the victim's hand. Using a few strands of your own hair, follow this procedure: (LO 3.2-3)
 1. Place a drop of water on a clean microscope slide.
 2. Place several strands of hair on the drop of water.
 3. Use forceps to place a coverslip on top.
 4. Examine the slide under low and high power.
 5. In your lab notebook, record the color and structure of the hair. Be specific.

Before You Read

Try to answer the following questions before you read this lesson.

- Why are the worst skin burns not painful?
- Which common viral infection never completely goes away?

Learning Outcomes

- 3.3-1 Describe common injuries of the skin and how they are treated.
- 3.3-2 List common viral, fungal, and bacterial infections of the skin.
- 3.3-3 Describe common inflammatory conditions of the skin and membranes.
- 3.3-4 Describe the three most common forms of skin cancer.

Key Terms

ABCD rule	human papillomavirus (HPV)
basal cell carcinoma	impetigo
cellulitis	melanoma
decubitus ulcers	peritonitis
first-degree burns	plantar warts
fourth-degree burns	pleurisy
herpes simplex virus type 1 (HSV-1)	psoriasis
herpes simplex virus type 2 (HSV-2)	rule of nines
herpes varicella	second-degree burns
herpes zoster	squamous cell carcinoma
	third-degree burns
	tinea

As the first “line of defense” in protecting the body from the external environment, the skin is routinely subject to minor injuries and is exposed to a variety of common infections. Fortunately, the skin is a multilayered system with a remarkable capacity for self-healing.

CLINICAL CASE STUDY

Joe plays left wing on his school’s club ice hockey team. At a recent team practice, he realized that he had forgotten his uniform pants, so he borrowed a pair from a teammate who is about the same size. Two days later, Joe has developed a red, itchy rash on his upper, inner thighs. When questioned by his doctor about this, Joe reveals that he has not had recent sexual activity. As you read this section, try to determine which of the following conditions Joe most likely has.

- A. Herpes simplex type 2
- B. Genital warts
- C. Tinea cruris
- D. Impetigo

3.3-1 Skin Injuries

The skin commonly sustains minor cuts, abrasions, and blisters that tend to heal quickly. In the absence of injury, through normal homeostasis, the skin maintains a balance between cell proliferation and cell death to maintain tissue structure and function. Following injury, healing can occur through regeneration to restore normal tissue structure, or by repair, with deposition of collagen fibers and scar formation.

With all minor skin injuries, infection is a major concern. Injuries to the skin that penetrate the underlying tissues are more complicated, and infection is still the most significant concern.

Decubitus Ulcers

Decubitus (deh-KYOO-bi-tus) **ulcers** are pressure ulcers. Often inaccurately called *bedsores*, decubitus ulcers are skin injuries caused by an area of localized pressure that restricts blood flow to one or more areas of the body. Without the normal blood supply to provide nutrients and oxygen, the skin cells die. These skin injuries typically occur in people who undergo prolonged

bed rest. When a bedridden patient is not turned often enough, sustained pressure over an area can result in a decubitus ulcer. Decubitus ulcers can occur anywhere on the body, but most form over bony areas such as the lower back, coccyx (tailbone), hips, elbows, and ankles.

A decubitus ulcer begins as an area of reddened skin, but as cells start to die, small cracks or openings appear in the skin. As the condition progresses, the tissue continues to degenerate and an open ulcer forms. If not treated, tissue degeneration can progress all the way to the bone and eventually can be fatal.

Decubitus ulcers can develop in any situation in which the blood supply to the tissues is restricted. People who use wheelchairs, for example, can develop decubitus ulcers over pressure points. Individuals with numbness in parts of the body from a spinal injury or diabetes mellitus must be particularly careful to avoid remaining in the same position for prolonged periods.

Treatment for decubitus ulcers includes prescription of oral antibiotics to address or prevent infection. Removal of damaged tissues is another component of treatment. Because dead tissue prevents healing, it must be removed for proper healing to occur.

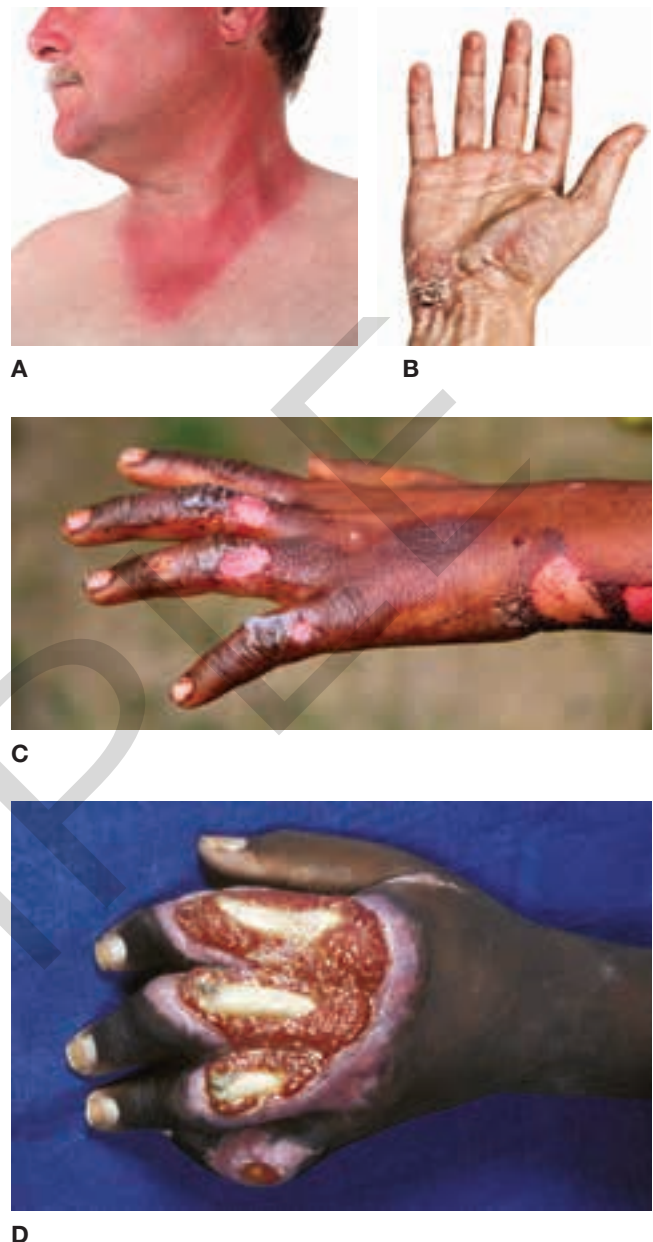
There are two approaches to removing ulcer-damaged tissues: debridement and vacuum-assisted closure. Debridement is the removal of dead tissue using a surgical or chemical procedure. In vacuum-assisted closure, a vacuum tube is attached to the wound. The vacuum draws moisture from the ulcer, thereby shortening the healing process and reducing the risk of infection.

Proper nutrition is an important factor in both the prevention and healing of decubitus ulcers. Vitamins A, B, C, and E and the minerals magnesium, manganese, selenium, and zinc all contribute to skin health. Sufficient amounts of dietary protein are also important.

Burns

Burns are injuries that can arise from exposure to excessive heat, corrosive chemicals, electricity, or ultraviolet radiation (from sunburn, for example). Burns, which vary considerably in severity, cause tissue damage and cell death.

First-degree burns affect only the epidermal layer of skin (**Figure 3.10A**). These burns involve reddening of the skin and mild pain, and they tend



Suzanne Tucker/Shutterstock.com, JTeffects/Shutterstock.com, Naiyyer/Shutterstock.com, Dr. M.A. Ansary/Science Source

Figure 3.10 Different types of burns.
A—First-degree burn. B—Second-degree burn.
C—Third-degree burn. D—Fourth-degree burn.

to heal in less than a week. Most types of sunburn are first-degree burns.

Second-degree burns involve damage to both the epidermis and the upper portion of the underlying dermis (**Figure 3.10B**). Second-degree burns are characterized by blisters, fluid-filled pockets that form between the epidermal and dermal layers. These burns are painful and take longer to heal than first-degree burns. An even longer period of healing is required for larger blisters.

Third-degree burns destroy the entire thickness of the skin (**Figure 3.10C**). For this reason, they are also called *full-thickness burns*. (First- and second-degree burns are called *partial-thickness burns*.) The area affected by a third-degree burn appears grayish-white or blackened. Although a third-degree burn is a serious injury, it is initially not painful because the nerve endings in the skin have been destroyed. Later, scarring and pain will occur. A third-degree burn cannot heal on its own because the stratum basale, which generates new skin cells, has been destroyed. Treatment involves grafting skin over the damaged area.

The most serious burns are **fourth-degree burns**, which destroy all layers of skin, and also some of the underlying tissues (**Figure 3.10D**). These may include nerve endings, muscle, tendon, ligament, and bone. Reconstruction of these underlying tissues may be required, as well as the grafting of new skin.

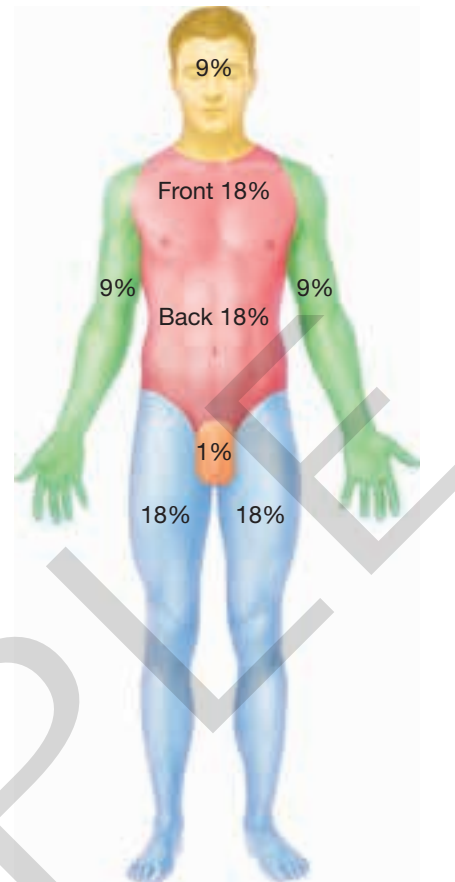
When a large region of skin has been burned, clinicians use the **rule of nines** to estimate the extent of burned tissue. **Figure 3.11** illustrates the rule of nines. According to this rule, the percentage of total body surface area covered by burns is approximated as follows:

- 9% for both the anterior (front) and posterior (back) of the head and neck;
- 18% for the anterior and 18% for the posterior of the torso;
- 9% for both the anterior and posterior of each arm;
- 18% for both the anterior and posterior of each leg; and
- 1% for the genital region.

Using this approach for both the anterior and posterior surface areas of the body, the total is 100%. For example, if the anterior of the torso and the anterior of one arm were burned, the affected surface area would be approximately 23% (4.5% for the anterior of the arm and 18 percent for the anterior of the torso).

The descriptions of the various diseases and disorders throughout this textbook include information about the following aspects of each:

- The etiology (cause) of the disease
- Strategies for prevention
- Pathology (clinical characteristics)
- Diagnosis (keys for identifying the condition)
- Common treatments



© Body Scientific International

Figure 3.11 The rule of nines. *How is the rule of nines useful in helping a physician determine how to treat a patient with burns on his body?*

Each type of skin injury is diagnosed and treated according to accepted, or standard, practices. The etiology, strategies for prevention, pathology, diagnosis, and common treatments for these injuries of the skin are summarized in **Figure 3.12**.

✓ Check Your Understanding

1. What causes decubitus ulcers?
2. Where on the body do decubitus ulcers commonly occur?
3. What is the difference between a first-degree and second-degree burn?

3.3-2 Infections of the Skin and Membranes

Skin infections can be caused by contact with an infectious agent that is present on another person or a surface. They can also be caused by

Injuries of the Skin

	Etiology	Prevention	Pathology	Diagnosis	Treatment
Decubitus ulcer	localized pressure that reduces blood flow to the skin	changing body position frequently, proper nutrition	reddened area of skin progresses to an open ulcer	visual observation and case history	oral antibiotics, removal of dead tissue
1st-degree burn	exposure to sun or heat source	avoidance of sun or heat	reddening of skin, mild pain	visual observation	topical analgesic
2nd-degree burn	prolonged exposure to sun or heat	avoidance of heat source	damage to epidermis, blisters	visual observation	topical analgesic
3rd- and 4th-degree burns	prolonged exposure to extreme heat	avoidance of heat source	destruction of all skin layers, including nerve endings; 4th-degree also damages underlying tissues	visual observation	skin grafting, antibiotics

Figure 3.12

Goodheart-Willcox Publisher

airborne particles such as viruses or bacteria or by contamination introduced by a foreign object into a penetrating wound. Strategies for preventing infections include frequent handwashing, as well as annual health screenings and examinations.

Viral Infections

Many people think of viruses as the cause for respiratory illnesses, such as flu or the common cold. However, viruses can also cause infections in many body systems, including the integumentary system.

Herpes

Herpes is a viral infection that produces small, painful, blister-like sores. Once a herpes infection is present, it lasts for the rest of a person's life. Fortunately, herpes infections tend to stay dormant most of the time, with no noticeable sign of infection. Occasional flare-ups do occur, however; the resurgence of symptoms usually accompanies periods of stress or sickness. Several different varieties of the herpes virus are known to exist.

Herpes varicella (vair-i-SEHL-a), better known as *chickenpox*, is a common childhood disease. Because chickenpox is highly contagious, it tends to spread quickly and widely. The fluid-filled blisters caused by chickenpox are extremely itchy. They can spread over most of the body, or they can be limited in scope. A vaccine is available for chickenpox that decreases the chance of infection or reduces the seriousness of the virus if infection does occur. Treatment is a topical ointment or spray to reduce itching.

Once a person infected with chickenpox has recovered, the virus lies dormant. In an adult, the virus can recur as **herpes zoster** (ZAHS-ter), commonly known as *shingles* (Figure 3.13A). Shingles involves an extremely painful, blistering rash accompanied by headache, fever, and a general feeling of unwellness. The shingles virus may trigger more serious symptoms, such as chronic nerve pain. In the United States, approximately 50% of people older than 80 years of age have had shingles at least once. A vaccine for shingles is recommended for adults older than 60 years of age. Treatments include an antiviral medication and analgesic.

Herpes simplex virus type 1 (HSV-1), sometimes associated with the common cold, generates “cold sores” or “fever blisters” around the mouth (Figure 3.13B). **Herpes simplex virus type 2 (HSV-2)** is the genital form of herpes. Both types of the herpes simplex virus are highly contagious and can be transmitted to the mouth or genital area through physical contact with an infected person. In the United States, about one in six people has genital herpes.

Transmission of the herpes simplex virus from an infected male to a female partner occurs with greater ease than from an infected female to a male partner. Thus, more women than men are infected with the virus.

During the first outbreak of genital herpes, a person may experience flu-like symptoms such as fever, body aches, and swollen glands. Repeat outbreaks are common, particularly during the first year of infection. Symptoms during repeat outbreaks are usually shorter in duration and



A



B

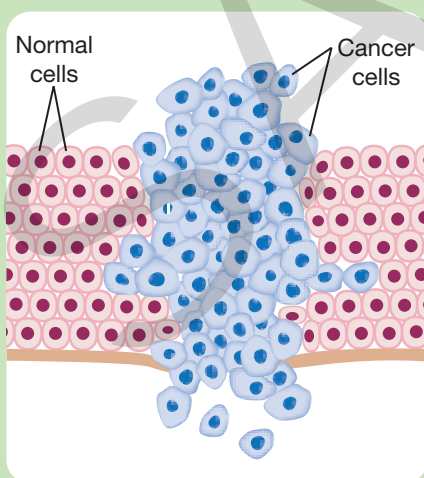
Mumemories/Shutterstock.com, Cherries/Shutterstock.com

Figure 3.13 Two different types of herpes infections. A—Herpes zoster (shingles) infection. B—Herpes simplex (cold sore) infection.

What Research Tells Us

...about High-Risk HPVs and Cancer

The human papillomavirus (HPV) infects epithelial cells on the skin and in the membranes that line areas such as the genital tract and anus. When an HPV enters an epithelial cell, the virus begins making specialized proteins. Two of these proteins initiate cancer by interfering with the cell's normal functions, enabling the cell to grow in an uncontrolled manner and resist cell death (**Figure 3.14**).



Alila Sao Mai/Shutterstock.com

Figure 3.14 Development of cancer cells. *Explain how HPV-infected cells can develop into a tumor.*

When the immune system recognizes HPV-infected cells, it attacks and attempts to destroy them. When the immune system fails, however, these infected cells continue to grow, and infection takes root. As the cells multiply, they can develop mutations that further promote cell growth, sometimes leading to tumor development.

Researchers believe that some 10 to 20 years can pass between the initial HPV infection and tumor formation. They estimate, however, that less than 50% of high-grade HPV infections lead to cancer. Fortunately, because HPVs do not enter the bloodstream, an HPV infection in one part of the body should not spread to other parts of the body.

Taking It Further

Working with a group of classmates, design a brochure to raise HPV awareness. Your brochure should address these questions: What is HPV? How do people become infected with this virus? How is HPV diagnosed? What treatments are available? What is the link between HPV and certain cancers? How can HPV be prevented? You might include separate discussions for HPV in women and HPV in men. Share your brochure with the rest of the class.

less severe than those in the first outbreak. As with all herpes infections, once a person has been infected by a herpes simplex virus, it remains dormant, with the potential to reactivate, throughout the remainder of the person's life. However, the number of outbreaks tends to decrease over time.

Human Papillomavirus (HPV)

Warts are raised, typically painless growths on the skin that vary in shape and size. Warts can spread from one part of the body to another. Less commonly, warts can spread from one person to another. All types of warts are caused by the **human papillomavirus (HPV)**.

HPVs are a group of more than 150 related viruses. Common warts typically appear on the hands or fingers and tend to disappear without treatment. It is important, however, to make sure that a wart-like growth on an adult is not a form of skin cancer. **Plantar warts**, which develop on the soles of the foot, grow inward and can become painful. When warranted, warts can be removed by surgery, cryotherapy (freezing), and topical medications such as salicylic acids (**Figure 3.15**).

Genital warts caused by HPV infections are the most common sexually transmitted infections in the United States. More than 40 of the HPVs can be easily spread through direct, skin-to-skin contact during vaginal, anal, and oral sex. More than 50% of all sexually active people are infected with an HPV at some point during their life.

There are two major categories of HPVs: low risk and high risk. Low-risk HPVs can cause warts on the skin around the genital area and



SURKED/Shutterstock.com

Figure 3.15 Salicylic acid is commonly used to treat plantar warts.

anus but are not known to cause cancer. High-risk HPV infections, however, do cause nearly all cervical cancers, which is why some healthcare professionals advocate the papillomavirus vaccine for teenage girls and boys. High-risk HPV infections also cause most anal cancers and about 50% of all vaginal, vulvar, and penile cancers. In addition, HPV infections cause cancer of the soft palate, the base of the tongue, and the tonsils. High-risk HPVs account for about 5% of all cancers. Information about the HPVs and other viral infections of the skin described in this chapter is summarized in **Figure 3.16**.

Fungal Infections

Fungal infections, or **tinea** (TIN-ee-a), tend to occur in areas of the body that are moist. They therefore tend to be more prevalent during warm weather, and they are more common in individuals whose work or sporting activities involve frequent periods of sweating.

Athlete's Foot

Tinea pedis (athlete's foot) is the most common fungal infection. It is characterized by cracked, flaky skin between the toes or on the side of the foot. The skin may also be red and itchy. Because *tinea pedis* is highly contagious, it spreads rapidly on locker room and shower floors. Treatment and prevention include keeping the feet clean and dry, especially between the toes, and using over-the-counter, antifungal powder or cream that contains clotrimazole, miconazole, or tolnaftate.

Jock Itch

Tinea cruris, or jock itch, is an itchy, red rash on the genitals, inner thighs, or buttocks that primarily affects males. It is caused by the combination of prolonged sweating and friction from clothes. It can be spread through direct contact with infected skin or unwashed clothing. *Tinea cruris* typically is treated by keeping the skin clean and dry, wearing loose clothing, and applying a topical antifungal or drying powder that contains clotrimazole, miconazole, or tolnaftate.

Ringworm

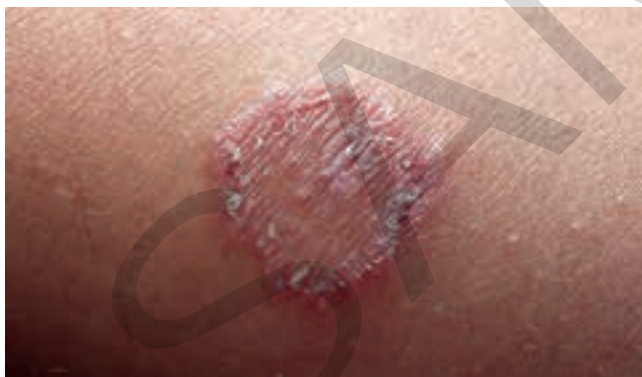
Tinea corporis, more commonly known as *ringworm*, does not actually involve any type of worm. However, the characteristically red, ring-shaped rash with a pale center somewhat resembles the shape of a worm (**Figure 3.17**).

Viral Infections of the Skin

	Etiology	Prevention	Pathology	Diagnosis	Treatment
Herpes varicella (Chickenpox)	spread by coughing, sneezing, and direct contact	vaccination	itchy, fluid-filled blisters over part or most of the body, fever	confirmed by visual observation	topical treatment for itching, (no aspirin)
Herpes zoster (Shingles)	herpes varicella lies dormant and reoccurs as herpes zoster	vaccination for adults over age 60	painful, blistering rash accompanied by headache and fever	visual observation can be confirmed with biopsy in lab	antiviral medication and analgesic
Herpes simplex (Type 1: oral herpes) (Type 2: genital herpes)	physical contact with the herpes infection on another person	avoid contact with an infected person	type 1: blister on lips type 2: blistering rash on genital area, flu-like symptoms	visual observation can be confirmed with biopsy in lab	medication to relieve pain and shorten duration
Human Papillomavirus (HPV): Low risk	physical contact with the HPV on another person or object	avoid contact or sharing objects with an infected person	small skin growths on the hands (common warts), on the soles of the feet (plantar warts), in the genital area (genital warts)	visual observation can be confirmed with biopsy in lab	if necessary, can be removed with surgery or topical treatments
Human Papillomavirus (HPV): High risk	vaginal, anal, or oral sexual contact with an infected person	vaccination prior to onset of sexual activity	can cause cancer of the cervix, vulva, vagina, penis, anus or back of the throat, including the tongue and tonsils	visual observation can be confirmed with biopsy in lab	topical treatments; cancer treatments if cancer occurs

Figure 3.16

Goodheart-Willcox Publisher



/frank60/Shutterstock.com

Figure 3.17 Tinea corporis, or ringworm.

Tinea corporis is especially common in children. It is highly contagious and can be spread through direct contact with the fungus on a person, pet, or contaminated items such as clothes or bedding. Treatment involves keeping the skin clean and dry and applying an over-the-counter, antifungal cream that contains clotrimazole, miconazole, ketoconazole, or oxiconazole.

Toenail Fungus

Tinea unguium is a fungal infection under the nails of the fingers or toes. It causes discoloration and thickening of the infected nail. In general, over-the-counter antifungal creams do not help this condition. A prescription antifungal medication must be taken orally for several weeks.

Bacterial Infections

Impetigo (im-peh-TIGH-goh) is a highly contagious staphylococcus infection common in elementary school children. Its symptoms are pink, blister-like bumps, usually on the face around the mouth and nose, that develop a yellowish crust before they rupture. Antibiotic ointment is used to treat impetigo.

Cellulitis (seh1-yoo-LIGH-tis), another staphylococcus infection, is characterized by an inflamed area of skin that is red, swollen, and painful. The origin of cellulitis often is an open wound or ulceration that most commonly occurs on the lower legs but can occur anywhere

on the body. Cellulitis is a serious condition that can become life threatening if not treated with antibiotics.

The etiology, strategies for prevention, pathology, diagnosis, and common treatments for fungal and bacterial infections of the skin are summarized in **Figure 3.18**.

✓ Check Your Understanding

1. Which type of herpes is responsible for “fever blisters”?
2. What causes warts?
3. What are the most common sexually transmitted infections in the United States?
4. What is impetigo?

3.3-3 Inflammatory Conditions of the Skin and Membranes

Inflammation is a general response of body tissue to any injury or disease that damages cells. It is a protective response that involves increased blood flow to the distressed area, along with

marshalling of specialized cells that attack infectious agents and destroy dead tissue. The increased blood flow causes redness; major inflammation also causes pain and swelling. Although most infections and disorders of the skin and membranes provoke an inflammatory response, those discussed in this section are specific inflammatory conditions that may have different causes. The etiology, strategies for prevention, pathology, diagnosis, and common treatments for these inflammatory conditions of the skin and membranes are summarized in **Figure 3.19**.

Pleurisy

Pleurisy (PLOOR-i-see) is an inflammation of the pleura, the membrane that lines the thoracic (chest) cavity and lungs. It can be caused by an infection, such as pneumonia or tuberculosis. It can also be caused by cancer, rheumatoid arthritis, lupus, injury to the chest, a blockage in the blood supply to the lungs, or the harmful presence of inhaled asbestos.

Pleurisy causes the normally smooth surfaces of the pleura to become rough. With

Fungal and Bacterial Infections of the Skin

	Etiology	Prevention	Pathology	Diagnosis	Treatment
Tinea pedis (athlete’s foot) Tinea cruris (jock itch) Tinea corporis (ringworm)	contact with the fungus on a person, clothing, or object	avoid contact with fungus; keep body area clean and dry	T. pedis: cracked, flaky skin on the feet T. cruris: itchy, red rash on the genitals, inner thighs, and buttocks T. corporis: ring-shaped, red rash that spreads outward from the center	observation with a black light, in which the fungus glows	antifungal powder or cream
Tinea unguium (toenail fungus)	contact with the fungus on a person or object	avoid contact with fungus; keep body area clean and dry	discoloration and thickening of the infected nail of the hand or foot	observation with a black light, in which the fungus glows	prescription oral medication
Impetigo	contact with a person or object infected with the impetigo staphylococcus bacteria	avoid contact with infected people; wash frequently	red sores that quickly rupture, ooze for a few days, and then form a yellowish-brown crust	confirmed by visual observation	antibiotic ointment
Cellulitis	staphylococcus bacteria invades an open wound, often in the lower leg	keep skin wounds clean and protected from infection	red, swollen, painful area; can be accompanied by a fever	visual observation can be confirmed with blood test	oral antibiotic

Figure 3.18

Goodheart-Willcox Publisher

Inflammatory Conditions of the Skin and Membranes

	Etiology	Prevention	Pathology	Diagnosis	Treatment
Pleurisy	inflammation of pleura caused by infection, cancer, or injury	no specific strategy	chest pain that worsens with inhalation or coughing	exam with stethoscope, X-ray	anti-inflammatory drugs; other treatment depends on cause
Peritonitis	inflammation of the peritoneum caused by infection	no specific strategy	abdominal pain and tenderness, fever, nausea, fatigue, shortness of breath, rapid heartbeat, decreased urine and stool output	physical exam, X-ray	surgery to repair abdominal damage; strong antibiotics
Psoriasis	skin condition possibly caused by an autoimmune disorder	no specific strategy	overproduction of skin cells, resulting in thick, red skin with silver-white scales that itch and burn	physical exam; can be confirmed with biopsy	topical treatments, light therapy, systemic medications

Figure 3.19

Goodheart-Willcox Publisher

each breath, the pleura lining the chest cavity and the pleura lining the lungs rub against each other, producing a grating sound called a “friction rub” that can readily be heard with a stethoscope (Figure 3.20).

The primary symptom of pleurisy is chest pain that sharpens with inhalation or coughing. The pain may radiate to one or both shoulders. Pleurisy can cause an accumulation of fluid in the thoracic cavity. This fluid accumulation can make breathing difficult and may cause a bluish

skin color (due to reduced oxygen circulation in the blood), shortness of breath, rapid breathing, and coughing.

The course of treatment for pleurisy depends on the cause. Bacterial infections are treated with antibiotics. When fluid has accumulated in the chest cavity, it can be drained through a surgical procedure. Anti-inflammatory drugs can help control the pain caused by pleurisy.

Peritonitis

Peritonitis (per-i-toh-NIGH-tis) is an inflammation of the peritoneum, the membrane that lines the inner wall of the abdomen and covers the abdominal organs. Peritonitis can result when a bacterial or fungal infection is introduced into the abdominal cavity through a rupture in the abdominal wall or a surgical procedure. Symptoms include abdominal pain and tenderness that may worsen with movement or touch. The abdomen may also be swollen. Other symptoms may include fever and chills, nausea and vomiting, fatigue, shortness of breath, rapid heartbeat, and decreased urine and stool output (Figure 3.21).

Peritonitis is a serious, potentially life-threatening condition. Medical treatment typically involves surgery to repair the internal damage that caused the condition, along with a course of strong antibiotics.

Psoriasis

Psoriasis (soh-RIGH-a-sis) is a common skin disorder that speeds up the life cycle of skin cells.



Marius Pirvu/Shutterstock.com

Figure 3.20 Doctor examining patient. *Why will the doctor be able to determine whether or not the patient has pleurisy?*



Shidiowski/Shutterstock.com

Figure 3.21 Peritonitis, like many other intestinal conditions, can result in painful swelling of the abdomen.

It causes cells to build up rapidly on the surface of the skin. The extra skin cells form regions of thick, red skin with flaky, silver-white patches called *scales* that itch, burn, crack, and sometimes bleed (**Figure 3.22**).

According to the prevailing hypothesis, psoriasis has its roots in an autoimmune disorder, an inappropriate immune response to a substance or tissue that is present in the body. In the case of psoriasis, the body's immune system causes skin cells to be produced too quickly. Psoriasis is not contagious and may be hereditary. It typically develops between 15 and 35 years of age and can progress quickly or slowly. It may disappear and return, or it may persist indefinitely. Outbreaks of psoriasis most commonly affect the elbows, knees, and trunk region, although they can occur anywhere on the body.

A variety of conditions can trigger or exacerbate psoriasis. These conditions include bacterial or viral infections, minor injuries to the skin, dry skin, stress, too little or too much sunlight, excessive alcohol consumption, and certain medications. Psoriasis is also worsened by a weakened immune system due to AIDS, chemotherapy, or autoimmune disorders such as rheumatoid arthritis.

The goal of psoriasis treatment is to control symptoms and prevent infection. Three treatment approaches are available: topical treatments, systemic treatments, and light therapy. Topical treatments include special skin lotions, ointments, creams, and shampoos that are applied to the affected area. Systemic treatments, which treat the whole body, include medications that can be injected or taken orally.

Light therapy, also called *phototherapy*, is a medical treatment in which the skin is carefully exposed to ultraviolet light. The UVB in natural sunlight is an effective treatment for psoriasis. It penetrates the skin and hinders the growth of skin cells affected by the condition. In light therapy, the skin is exposed at regular intervals to a source that delivers artificial UVB (**Figure 3.23**).



Lipowski Milan/Shutterstock.com

Figure 3.22 Psoriasis.



Eugeniy Kalinovskiy/Shutterstock.com

Figure 3.23 Phototherapy is a form of treatment that exposes psoriatic skin to UVB light in controlled doses.

✓ Check Your Understanding

1. What causes the redness associated with inflammation?
2. What is pleurisy?
3. What skin disorder is characterized by regions of thick, red skin with flaky, silver-white patches?

3.3-4 Cancers of the Skin

As described earlier in this lesson, many skin conditions involve bumps or small, noncancerous lesions. Common warts are an example. Thus far, the conditions described have been benign—that is, they involve tumors that do not *metastasize*, or spread, to remote regions of the body.

When a tumor is malignant, or cancerous, it tends to metastasize to other body parts. Skin cancer is the most common type of cancer in the United States; at some point, about one-fifth of the population experiences skin cancer. Overexposure to the sun is a major risk factor. The three most common forms of skin cancer are basal cell carcinoma, squamous cell carcinoma, and melanoma.

Basal cell carcinoma (kar-si-NOH-ma) is the most common form of skin cancer and, fortunately, is also the least malignant (**Figure 3.24**). It is caused by overproduction of cells in the stratum basale that push upward, forming dome-shaped bumps. These bumps most often appear on areas of the head or neck that have been exposed to the sun. Slow-growing basal cell carcinomas are usually noticed and surgically removed before they can spread and become dangerous.



jax10289/Shutterstock.com

Figure 3.24 Basal cell carcinoma. *How are slow-growing basal cell carcinomas often treated?*

Squamous cell carcinoma is caused by overproduction of cells in the stratum spinosum layer of the epidermis. These cancers appear as a scaly, reddened patch that progresses to an ulcer-like mass with a raised border (**Figure 3.25**). The most commonly affected locations are the scalp, ears, lower lip, and backs of the hands among fair-skinned people. Dark-skinned people typically develop this condition in areas not exposed to the sun, such as the legs or feet. Squamous cell carcinomas grow rapidly and can easily spread to nearby lymph nodes. With early removal by surgery or radiation treatment, these cancers can be completely cured.

The most serious form of skin cancer is **melanoma** (mehl-a-NOH-ma), so named because it is a cancer of the melanocytes (**Figure 3.26**). Melanoma can also form in the eyes and, rarely, in internal organs, such as the intestines.

Although typically dark colored and irregular in shape, a melanoma can appear pink, red, or “fleshy.” Change in the size, shape, color, or elevation of a mole are typical warning signs of a malignant melanoma.

The American Cancer Society advocates the **ABCD rule** for determining the presence of melanoma:

Asymmetry: The shape of the mole is irregular.

Border irregularity: The outside borders are not smooth.

Color: More than one color is present.

Melanomas may contain different shades of black and brown, blues, reds, or pinks.

Diameter: The mole size is larger than about one-quarter of an inch in diameter, or larger than the diameter of a pencil.



Sergei Primakov/Shutterstock.com

Figure 3.25 Squamous cell carcinoma.



Nasekomoel/Shutterstock.com

Figure 3.26 Melanoma. *What is the ABCD rule for determining the presence of a melanoma?*

It is important to see a healthcare provider immediately if melanoma is suspected. Although these cancers comprise only about 5% of all skin cancers, they can be deadly. Use of indoor tanning beds, booths, or sun lamps has been shown to increase the incidence of melanoma and all other skin cancers. For this reason, a number of states and other countries have banned all forms of indoor tanning. The etiology, strategies for prevention, pathology, diagnosis, and common treatments for cancers of the skin are summarized in **Figure 3.27**.

✓ Check Your Understanding

1. Squamous cell carcinoma is an overproduction of cells in which layer of the epidermis?
2. What is the ABCD rule for detecting melanoma?

Cancers of the Skin

	Etiology	Prevention	Pathology	Diagnosis	Treatment
Basal cell carcinoma	overproduction of cells in the stratum basale caused by overexposure to UV rays	avoid excessive sun exposure and tanning beds; use sunscreen and protective clothing	dome-shaped bumps appearing in areas of skin exposed to sun	physical exam, biopsy	surgical procedure or freezing
Squamous cell carcinoma	overproduction of cells in the stratum spinosum layer of the epidermis	avoid excessive sun exposure and tanning beds; use sunscreen and protective clothing	scaly, reddened patch that progresses to an ulcer-like mass with a raised border	physical exam, biopsy	surgical procedure or freezing
Melanoma	cancer in the melanocytes, which produce melanin	avoid excessive sun exposure and tanning beds; use sunscreen and protective clothing	a growth with asymmetry, border irregularity, more than one color present, and more than a quarter-inch in diameter	physical exam, biopsy	surgical removal followed by cancer treatments, as needed

Figure 3.27

Goodheart-Willcox Publisher

What Research Tells Us

...about the Danger of Indoor Tanning

Indoor tanning, through use of a bed, booth, or sunlamp, has been popular in the United States since the 1980s. Indoor tanning devices deliver high levels of UV radiation, including both UVA and UVB rays, in a short time. Although most of these operate on a timer, the amount of UV radiation varies based on the type and age of the lightbulbs. However, studies have shown that the newer tanning beds are not safer than older models.

Several federal and international agencies and organizations have issued warnings about the negative effects of indoor tanning on health. Among these are the US Food and Drug Administration, which has declared that the UV radiation in tanning devices poses serious health risks. A recent report by the International Agency for Research on Cancer, (IARC), part of the World Health Organization, also warns that indoor tanning is dangerous. The Healthy People 2020 initiative, which provides science-based, 10-year national objectives for improving the health of all Americans, includes goals for dramatically reducing the use of indoor tanning devices.

The problem is that exposure to UV radiation, whether from the sun or indoor tanning devices, can contribute to the development of skin cancer, skin burns, wrinkles, lax skin, brown spots, cataracts, and cancers of the eyes. Cancers

that can be caused by indoor tanning include melanoma, basal cell carcinoma, squamous cell carcinoma, and ocular melanoma. Numerous research studies have shown that the incidence of melanoma and other skin cancers is increased among indoor tanning users, with risk proportional to the number of tanning sessions.

You may have heard or read that exposure to UV rays is beneficial in elevating levels of vitamin D within the body. However, indoor tanning is not a safe way to get vitamin D. In fact, the best way to get adequate vitamin D is through diet.

EVENT PREP Taking It Further

Because of the known dangers associated with indoor tanning, the practice has been banned or restricted in many regions. Research indoor tanning practices, including local, state, national and even international laws and guidelines concerning indoor tanning. Launch a community awareness campaign or prepare a lesson for a targeted group of people. HOSA provides events directly related to these activities. Go to the HOSA website and review the *Community Awareness* and *Health Education* events for more information.

LESSON 3.3 Review and Assessment

Mini Glossary

Make sure that you know the meaning of each key term.

ABCD rule The American Cancer Society's rule for determining the presence of melanoma

basal cell carcinoma the most common form of skin cancer and the least malignant type

cellulitis a bacterial infection characterized by an inflamed area of skin that is red, swollen, and painful

decubitus ulcers ulcers caused by an area of localized pressure that restricts blood flow to one or more areas of the body

first-degree burns burns that affect only the epidermal layer of skin

fourth-degree burns full-thickness burns that destroy both the skin and underlying tissues including muscles, tendons, ligaments, and bone

herpes simplex virus type 1 (HSV-1) the form of herpes that generates cold sores or fever blisters around the mouth

herpes simplex virus type 2 (HSV-2) the genital form of herpes

herpes varicella (chickenpox) a highly contagious, common childhood disease that is characterized by extremely itchy, fluid-filled blisters

herpes zoster (shingles) a disease that involves a painful, blistering rash accompanied by headache, fever, and a general feeling of unwellness

human papillomavirus (HPV) a group of approximately 150 viruses that cause warts

impetigo a bacterial infection common in elementary school children that is characterized by pink, blister-like bumps, usually on the face

malignant melanoma cancer of the melanocytes; the most serious form of skin cancer

peritonitis inflammation of the peritoneum, the membrane lining the inner wall of the abdomen and covering the abdominal organs

plantar warts warts that develop on the soles of the foot, grow inward, and can become painful

pleurisy inflammation of the pleura, the membrane that encases the lungs

psoriasis a common skin disorder that involves redness, irritation, and scales (flaky, silver-white patches) that itch, burn, crack, and sometimes bleed

rule of nines a method used in calculating body surface area affected by burns

second-degree burns burns that involve damage to both the epidermis and the upper portion of the underlying dermis; characterized by blisters

squamous cell carcinoma a type of rapidly growing cancer that appears as a scaly, reddened patch of skin

third-degree burns burns that destroy the entire thickness of the skin

tinea a fungal infection that tends to occur in areas of the body that are moist

Know and Understand

1. Name two interventions that can help to reduce a bedridden patient's risk for developing decubitus ulcers. (LO 3.3-1)
2. Describe each of the four types of skin burns. (LO 3.3-1)
3. Name two types of skin infections common in school-age children. (LO 3.3-2)
4. List the medical treatments for warts. (LO 3.3-2)
5. Briefly describe four common fungal infections. (LO 3.3-2)

6. What is pleurisy, and what is its primary symptom? (LO 3.3-3)

7. Which form of skin cancer is caused by overproduction of cells in the stratum spinosum? (LO 3.3-4)

Analyze and Apply

1. Why are third-degree burns not painful? Why are they not able to heal on their own? (LO 3.3-1)
2. What is the connection between herpes varicella and herpes zoster? (LO 3.3-2)
3. Wrestlers tend to get ringworm at a higher rate than any other type of athlete. Why do you think this might be, and what would you suggest be done to prevent it? (LO 3.3-2)
4. Why might tanned or dark-skinned people tend to be diagnosed with skin cancer in later stages than people who have lighter skin? (LO 3.3-4)

IN THE LAB

1. Using the rule of nines, calculate the percentage of total body surface area covered by burns for each of the following burn victims: (LO 3.3-1)
 - A. burns on one leg: all of the front, half of the back
 - B. burns in the genital area and all of the lower limbs
 - C. burns to just the front of the body: the head, right arm, and torso
 - D. burns over the entire body except for the head
2. Go to the Centers for Disease Control (CDC) website and search *herpes varicella*, *herpes zoster*, *herpes simplex type 1*, and *herpes simplex type 2*. What characteristics are similar among all of these herpes viruses? What characteristics, if any, are different? Prepare a short written report of the differences and present your report to the class. (LO 3.3-2)

Anatomy & Physiology at Work

Dermatology is the field of medicine that deals with the anatomy, functions, and diseases of the skin. A career in dermatology can be challenging, profitable, and rewarding.

Dermatology Assistant/Technician

A dermatology assistant or dermatology technician usually provides patient support and performs specialized technical tasks for a licensed dermatology practice. Some dermatology technicians, however, choose to work independently in salons or spas, providing services such as hair removal, facials, and skin-care treatments. Because dermatology assistants and technicians work directly with patients or clients and handle a variety of duties, they must have strong communication skills and the ability to multitask.

In some states, the educational requirements for dermatology technicians is higher than those for dermatology assistants. In these areas, assistants may perform general office duties, while technicians perform basic client services. At a minimum, dermatology assistants and technicians must have a high school diploma or GED, although most businesses prefer candidates who have earned a certificate or associate's degree in medical assisting. Community colleges offer certificate and associate's degree programs in medical assisting accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP) or the Accrediting Bureau of Health Education Schools (ABHES). In addition, most college programs offer internships beyond traditional coursework.

Medical Assistant Certificate

A one-year medical assistant certificate program prepares students for clinical and administrative duties in a variety of healthcare settings. Coursework typically includes medical terminology, anatomy, dermatology, and pharmacology. Administrative subjects include clerical functions, basic accounting, and insurance billing.

Associate of Applied Science for Medical Assistants

An associate's degree program in medical assisting takes 18 to 24 months to complete. Most programs include externships in a clinical setting in which students are trained in drawing blood, giving injections, preparing and maintaining patients' medical records, and using appropriate telephone techniques. Coursework covers computer software applications, medical office procedures, biology, microbiology, and hematology.

Dermatologist

A dermatologist is a medical doctor (MD) who specializes in treating diseases and disorders of the skin through medicine and surgery (**Figure 3.28**). Many dermatologists also perform cosmetic procedures.

To become a dermatologist, one must earn a college degree and complete four years of medical school followed by a residency in dermatology. In the United States, residency training typically



Andrey_Popov/Shutterstock.com

Figure 3.28 A dermatologist evaluates a patient's skin for melanoma.

takes four years to complete. The first year of residency usually consists of a supervised internship in medicine or surgery. During the following three years, residents receive specialized training in dermatology. Further specialization can be acquired through an additional two-year fellowship.

The following specialized procedures are generally performed by dermatologists:

- Photodynamic therapy for treatment of skin cancer and precancerous growths
- Cryosurgery for treatment of warts and skin cancers
- Laser therapy for management of unwanted birthmarks or tattoos and for cosmetic resurfacing
- Hair removal
- Hair transplantation
- Injections of cosmetic filler substances
- Liposuction
- Allergy testing for allergies caused by skin contact
- Topical therapies for various skin conditions

Veterinary Dermatology Technician

Do you love animals? If so, you may be interested in becoming a veterinary dermatology technician (**Figure 3.29**). These technicians assist veterinarians in the care of domestic or wild animals with various skin conditions or diseases. They may be asked to provide medicated baths, apply various topical medications, and even assist in veterinary surgery.



ShutterDivision/Shutterstock.com

Figure 3.29 Veterinary dermatology technicians assist veterinarians in providing skin care to various animals.

The educational requirements are similar to those for a general dermatology technician. An employer may also require special courses in veterinary subjects or require on-the-job training.

Planning for a Health-Related Career

Do some research on the career of a dermatologist or dermatology technician. Alternatively, select a profession from the list of related career options. Using the Internet or resources at your local library, find answers to the following questions:

1. What are the main responsibilities of the career that you have chosen to research?
2. What is the outlook for this career? Are workers in demand, or are jobs dwindling? For complete information, consult the current edition of the *Occupational Outlook Handbook*, published by the US Department of Labor. This handbook is available online or at your local library.
3. What special skills or talents are required? For example, do you need to be good at biology and anatomy? Do you need to enjoy interacting with other people?
4. What personality traits do you think are needed to be successful in this job? For example, a dermatology career involving laboratory research requires collaboration with other people. Do you enjoy teamwork?
5. Does this career involve a great deal of routine, or do the day-to-day responsibilities vary?
6. Does the work require long hours, or is it a standard “9-to-5” job?
7. What is the salary range for this job?
8. What do you think you would like about this career? Is there anything about it that you might dislike?

Related Career Options

- Dermatology assistant
- Dermatology technician
- Medical assistant
- Dermatologist
- Immunodermatologist
- Medical aesthetician
- Pediatric dermatologist
- Teledermatologist
- Veterinary dermatologist

> LESSON 3.1

Body Membranes**Key Points**

- 3.1-1 Epithelial membranes, including the mucous, serous, and cutaneous membranes, line or cover the internal and external surfaces of the body.
- 3.1-2 Synovial membranes are the only membranes that do not include epithelial cells; they consist entirely of connective tissue.

Key Terms

cutaneous membrane	serous fluid
epithelial membranes	serous membranes
membranes	synovial fluid
mucous membranes	synovial membrane
mucus	

> LESSON 3.2

The Integumentary System**Key Points**

- 3.2-1 The integumentary system protects the body against damage from harmful chemicals and ultraviolet rays from sunlight, serves as a water barrier, and helps to regulate body temperature.
- 3.2-2 The two layers of the skin are the epidermis (outer layer) and the dermis (underlying layer).
- 3.2-3 The appendages of the skin include the sweat glands, the sebaceous glands, hair, and nails.

Key Terms

apocrine glands	Merkel cells
dermis	papillary layer
eccrine glands	reticular layer
epidermal dendritic cells	sebaceous glands
epidermis	sebum
hypodermis	stratum basale
integumentary system	stratum corneum
keratin	stratum granulosum
keratinocytes	stratum lucidum
lipocytes	stratum spinosum
melanin	subcutaneous fascia
melanocytes	sudoriferous glands

> LESSON 3.3

Injuries and Disorders of the Skin**Key Points**

- 3.3-1 Common injuries to the skin include decubitus, or pressure, ulcers and burns.
- 3.3-2 Infections of the skin and membranes may be caused by viruses, fungi, or bacteria.
- 3.3-3 Common inflammatory conditions of the skin and membranes include pleurisy, peritonitis, and psoriasis.
- 3.3-4 The three types of skin cancer are basal cell carcinoma, squamous cell carcinoma, and melanoma.

Key Terms

ABCD rule	human papillomavirus (HPV)
basal cell carcinoma	impetigo
cellulitis	melanoma
decubitus ulcers	peritonitis
first-degree burns	plantar warts
fourth-degree burns	pleurisy
herpes simplex	psoriasis
virus type 1 (HSV-1)	rule of nines
herpes simplex	second-degree burns
virus type 2 (HSV-2)	squamous cell carcinoma
herpes varicella	third-degree burns
herpes zoster	tinea

Assessment

➤ LESSON 3.1

Body Membranes

Learning Key Terms and Concepts

1. *True or False?* The body membranes surround and help to protect the body's surfaces. (LO 3.1-1)
2. Which of the following surfaces is *not* surrounded and protected by membranes? (LO 3.1-1)
 - A. ball-and-socket synovial joints
 - B. internal cavities housing organs
 - C. fingernails and toenails
 - D. cavities open to the outside world
3. _____ membranes line or cover the internal and external surfaces of the body. (LO 3.1-1)
4. *True or False?* The epithelial membranes line or cover the internal surfaces of the body only. (LO 3.1-1)
5. The _____ membranes line the body cavities that open to exterior surfaces. (LO 3.1-1)
6. The mucous membranes line which of the following body cavities? (LO 3.1-1)
 - A. digestive tract
 - B. heart
 - C. lungs
 - D. abdominal cavity
7. *True or False?* Mucous membranes tend to be dry. (LO 3.1-1)
8. The pleura, pericardium, and peritoneum are all examples of which type of membranes? (LO 3.1-1)
9. *True or False?* The visceral layer is the outer lining of each serous membrane. (LO 3.1-1)
10. *True or False?* Cutaneous membrane is another name for skin. (LO 3.1-1)
11. Which type of membrane is composed only of connective tissue and includes no epithelial cells? (LO 3.1-2)
12. What is the purpose of synovial fluid? (LO 3.1-2)

Thinking Critically

1. Compare and contrast the characteristics of a mucous membrane and a serous membrane. Give examples of both types of membranes in your answer. (LO 3.1-1)
2. Assume that someone challenges you when you tell them that skin is a membrane. Explain why the person might think that but why he or she would be wrong. (LO 3.1-1)
3. Describe what you would see if you looked at the visible mucous membranes of a person who is severely dehydrated. (LO 3.1-1)
4. The oral cavity is often referred to as the “mirror of the body” because the mucous membranes in the mouth change depending on many different diseases. What diseases or conditions might a dry mouth indicate? (LO 3.1-1, LO 3.3-2)

➤ LESSON 3.2

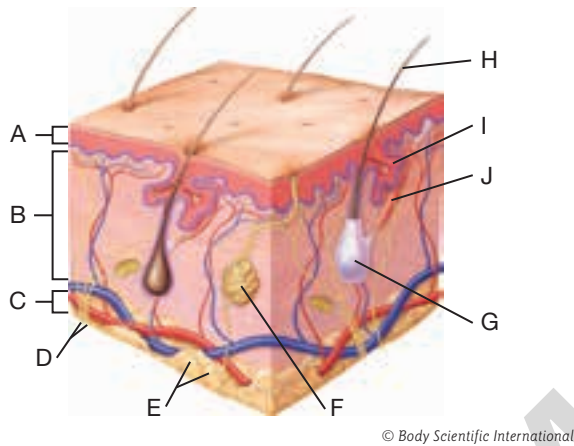
The Integumentary System

Learning Key Terms and Concepts

1. Which type of protein, found in the outermost layer of the skin, adds structural strength to the skin? (LO 3.2-1)
2. _____ receptors transmit nerve signals containing information from the skin about the environment, including touch, pressure, vibration, pain, and temperature. (LO 3.2-1)
3. The skin is made up of which two layers? (LO 3.2-2)
 - A. epidermis and hypodermis
 - B. epidermis and dermis
 - C. hypodermis and dermis
 - D. hypodermis and underlying tissues
4. *True or False?* The epidermis completely replaces itself every 25 to 45 days. (LO 3.2-2)
5. *True or False?* Keratin is primarily responsible for human skin color. (LO 3.2-2)
6. Collagen and elastic fibers make up the dense, fibrous connective tissue called _____. (LO 3.2-2)

7. Which of the following are considered to be appendages of the skin? (LO 3.2-3)
- eyes
 - nerves
 - hair
 - muscles
8. The ____ muscles are responsible for “goose bumps” on the skin. (LO 3.2-3)

Instructions: Choose the letter that best describes each integumentary system structure.



© Body Scientific International

- lipocytes ____ (LO 3.2-2)
- hypodermis ____ (LO 3.2-2)
- sebaceous gland ____ (LO 3.2-2)
- arrector pili muscle ____ (LO 3.2-2)
- dermis ____ (LO 3.2-2)
- hair follicle ____ (LO 3.2-2)
- epidermis ____ (LO 3.2-2)
- sweat gland ____ (LO 3.2-2)
- hair shaft ____ (LO 3.2-2)
- nerve fibers ____ (LO 3.2-2)

Thinking Critically

- Explain the skin's function in regulating body temperature. Compare and contrast the ways in which the skin helps the body become cooler and warmer. (LO 3.2-1)
- In what way does the skin protect the body from damage due to ultraviolet rays from the sun? What would happen to your body if you did not have this protection? (LO 3.2-1)
- The skin is described as keratinizing stratified squamous epithelial tissue. Describe what each of these terms means in relationship to the structure and function of the skin. (You may need to refer to the discussion in Chapter 2 on types of epithelial tissue.) (LO 3.2-2)

- Explain to an imaginary person why his or her hair color and texture (straight, wavy, or curly) have developed as they have. (LO 3.2-3)

LESSON 3.3

Injuries and Disorders of the Skin

Learning Key Terms and Concepts

- Decubitus ulcers may form on the body when ____ is restricted. (LO 3.3-1)
- True or False?* Burns can be caused by exposure to electricity. (LO 3.3-1)
- True or False?* First-degree burns damage the epidermis and parts of the underlying dermis. (LO 3.3-1)
- A(n) ____, also referred to as a full-thickness burn, destroys the entire skin, leaving underlying tissues intact. (LO 3.3-1)
- The most common fungal infection in humans is athlete's foot, also called _____. (LO 3.3-2)
- _____ is a highly contagious staphylococcus infection that is common in elementary school children. (LO 3.3-2)
- True or False?* Psoriasis is a highly contagious disease characterized by scaly skin patches that itch, burn, crack, and sometimes bleed. (LO 3.3-3)
- _____ is a common skin disorder characterized by regions of thick, red skin with flaky, silver-white patches. (LO 3.3-3)
- Which of the following is *not* a type of viral infection? (LO 3.3-3)
 - herpes
 - psoriasis
 - plantar warts
 - genital warts
- The most serious type of skin cancer is _____. (LO 3.3-4)

Thinking Critically

- What is the difference between chickenpox and shingles? (LO 3.3-2)
- Compare and contrast HSV-1 and HSV-2. (LO 3.3-2)
- Name the two major categories of HPVs and explain how they differ. (LO 3.3-2)
- Compare and contrast tinea and impetigo. Mention how they look, what causes them, and how they are treated. (LO 3.3-2)
- Name seven potential causes of pleurisy. (LO 3.3-3)

Building Skills and Connecting Concepts

Analyzing and Evaluating Data

Instructions: Using the information that you learned in this chapter about skin burns and the rule of nines, answer the following questions.

1. What percentage of burned tissue would you assign to a patient who suffered burns to the anterior and posterior portions of the head and the anterior portion of both arms? (LO 3.3-1)
2. What percentage would you assign to a patient who suffered burns to the anterior portion of the left leg and the anterior portion of the torso? (LO 3.3-1)
3. What percentage would you assign to a patient who suffered burns to the anterior and posterior right leg, the anterior portion of the torso, and the posterior portion of the right arm? (LO 3.3-1)

Communicating about Anatomy & Physiology

1. **Writing** Go to the Centers for Disease Control (CDC) website and research skin injuries and disorders that commonly occur in the work environment. List steps that you can take to prevent possible dermal exposure to yourself. Develop a plan that could be used to help people in the event of dermal exposure at work. Use key terms from this chapter to explain how the exposure could occur. Write your plan and present it to the class. If you do not have an actual workplace, specify a place you would like to work. (LO 3.3-1)
2. **Writing** Research the effects of chemicals on the skin. Then write a three-paragraph summary about how a worker in a chemical plant might be exposed to chemicals through the different layers of the skin. (LO 3.2-2, LO 3.3-1)

3. **Speaking** After researching a burn-related topic such as emergency first aid for burns or the importance of wearing sunscreen, prepare and deliver a mini-lesson to your peers on the topic. Use HOSA's *Health Education* event guidelines to develop your project. (LO 3.3-1)

Lab Investigations EVENT PREP

1. The tissue that lines the inside of the mouth is known as the basal mucosa and is composed of squamous epithelial cells. In this lab, view your own cells under a microscope. **Materials:** microscope, slides and coverslips, methyl blue stain, gloves, paper towels, cotton swab. **Procedure:** Put on gloves and gently scrape the inside of your mouth with the tip of the cotton swab. Smear the cotton swab on the center of the slide for 2 to 3 seconds. Add a drop of methylene blue solution and place a coverslip on the slide. Place the slide under the microscope and examine it under low and high power. Describe your observations in your lab book. (LO 3.1-1)
2. Working in a small group, design a laboratory experiment to test a hypothesis developed by your group. Specific procedures will vary depending on the hypothesis that you test, but your hypothesis should have something to do with a condition or disease that affects the membranes or skin. (LO 3.3-2).

Reminders:

- List the steps in your experiment.
- The experiment must be repeatable.
- Your directions must be very clear so that someone else could repeat the experiment exactly as your group did.
- The data collected must be measurable.

On a sheet of paper, summarize the procedure that your group used. Record your observations as accurately and in as much detail as possible. Then summarize the results of your experiment.

- Was your hypothesis supported?
- What problems did you encounter?
- What did you learn from this experiment?