


36-3 The Integumentary System

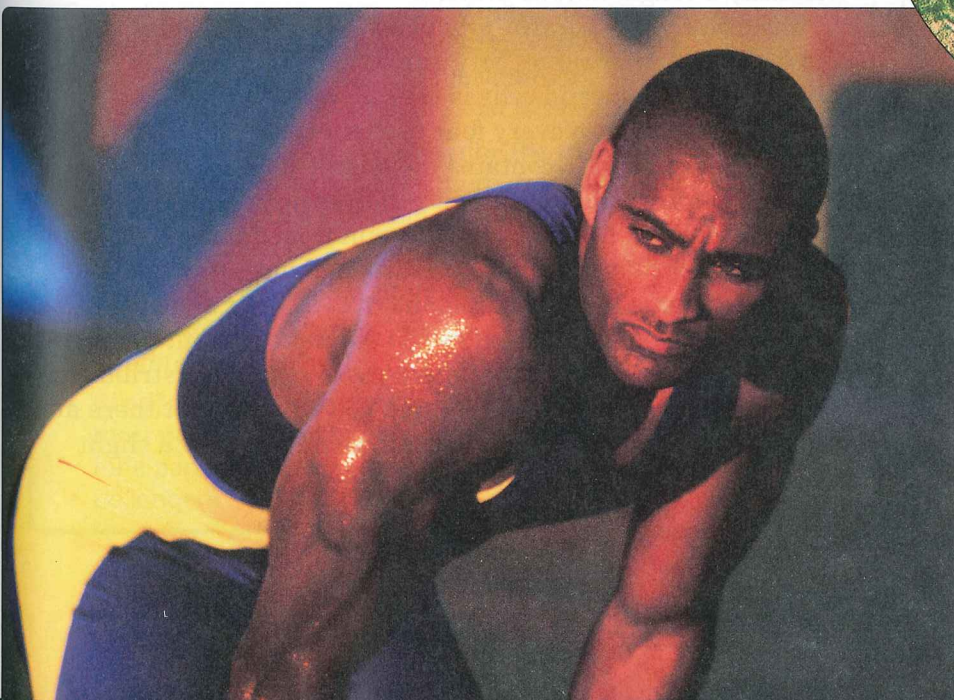
“Good fences make good neighbors,” wrote the American poet Robert Frost as he explained the importance of property boundaries. Living things have their own “fences,” and none is as important as the skin—the boundary that separates the human body from the outside world.

The skin, the single largest organ of the body, is part of the integumentary (in-teg-yoo-MEN-tuh-ree) system. The word *integument* comes from a Latin word that means “to cover,” reflecting the fact that the skin and its related structures form a covering over the entire body. Skin and its related structures—the hair, nails, and a variety of glands—make up the integumentary system.

The Skin

The skin has many different functions, but its most important function is protection.  **The integumentary system serves as a barrier against infection and injury, helps to regulate body temperature, removes waste products from the body, and provides protection against ultraviolet radiation from the sun.** Because the largest component of the integumentary system—the skin—contains several types of sensory receptors, it serves as the gateway through which sensations such as pressure, heat, cold, and pain are transmitted to the nervous system.

The skin is made up of two main layers—the epidermis and the dermis. Beneath the dermis is a subcutaneous layer of fat (the hypodermis) and loose connective tissue that help insulate the body.



Guide for Reading



Key Concept

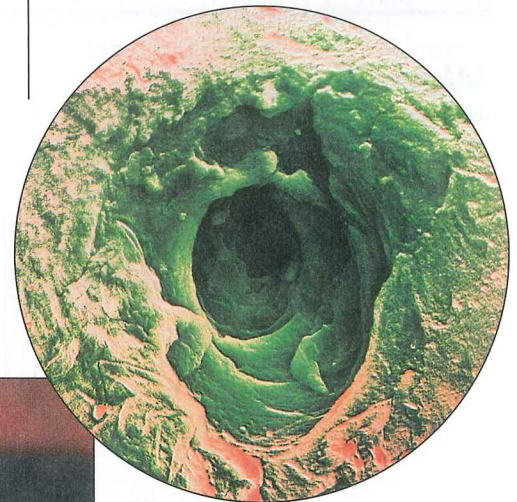
- What are the functions of the integumentary system?

Vocabulary

epidermis
keratin
melanin
dermis
hair follicle

Reading Strategy: Building Vocabulary

Before you read, preview **Figure 36-13** to identify vocabulary with which you are unfamiliar. As you read, look for the meaning of these terms.



(magnification: 340×)


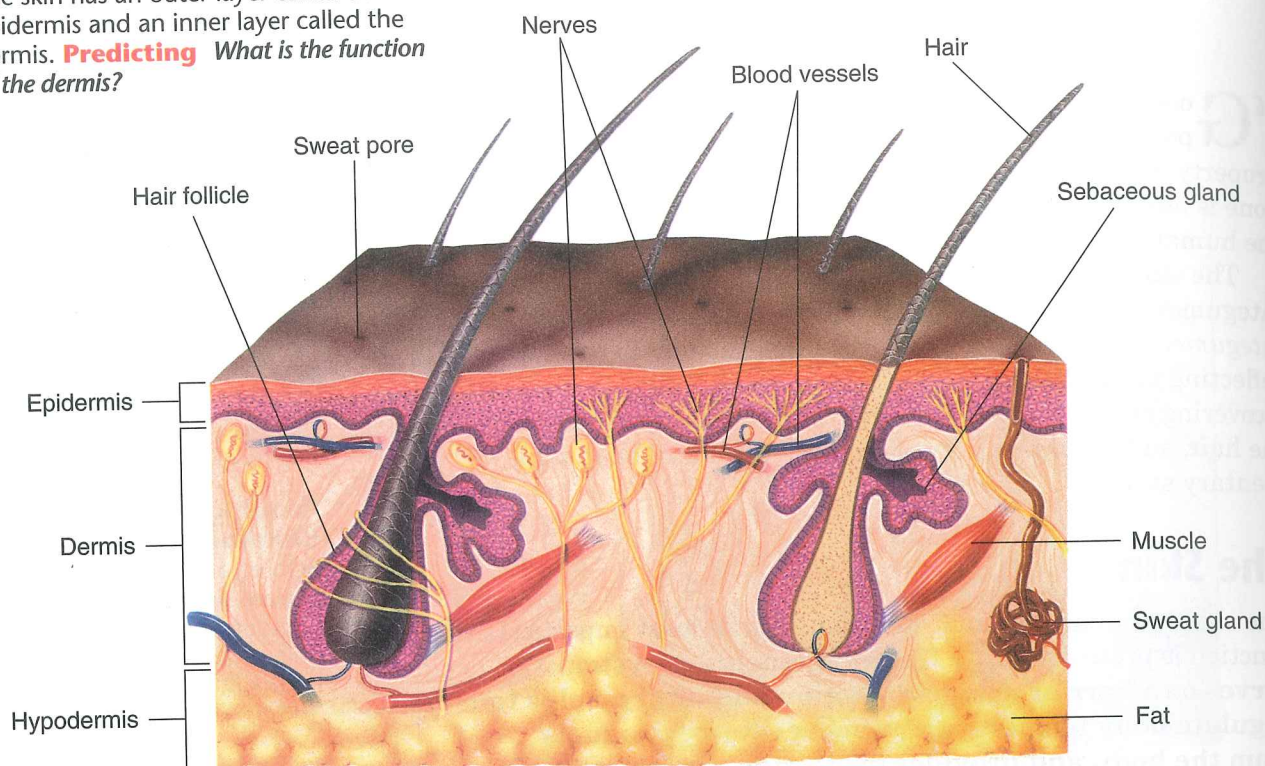
Figure 36-12  After strenuous exercise, the skin produces sweat, which decreases the temperature of the body and rids the body of wastes. Sweat is secreted by sweat glands and leaves the body through sweat pores.

FIGURE 36-13 STRUCTURE OF THE SKIN

The skin has an outer layer called the epidermis and an inner layer called the dermis. **Predicting** What is the function of the dermis?



Word Origins

Epidermis comes from two Greek words: *epi*, meaning "on the outside," and *derma*, meaning "skin." If the Greek word *phyton* means "plant," what does the term *epiphyte* mean?

Epidermis The outer layer of the skin is the **epidermis**. The epidermis has two layers. The outside of the epidermis—the part that comes in contact with the environment—is made up of dead cells. The inner layer of the epidermis is made up of living cells.

Cells in the inner layer of the epidermis undergo rapid cell division, producing new cells that push older cells to the surface of the skin. As they move upward, the older cells become flattened and their organelles disintegrate. They also begin making **keratin**, a tough, fibrous protein.

Eventually, the keratin-producing cells die and form a tough, flexible, waterproof covering on the surface of the skin. This outer layer of dead cells is shed or washed away at a surprising rate—once every four to five weeks.

The epidermis also contains melanocytes (MEL-uh-noh-syts). Melanocytes are cells that produce **melanin**, a dark brown pigment. Melanin helps protect the skin from damage by absorbing ultraviolet rays from the sun. Although most people have roughly the same number of melanocytes in their skin, differences in skin color are caused by the different amount of melanin the melanocytes produce and where these cells are distributed.

Look closely at **Figure 36-13** and you will see that there are no blood vessels in the epidermis. This explains why a slight scratch will not cause bleeding.

CHECKPOINT What is melanin?

Dermis The inner layer of the skin is the **dermis**. The dermis lies beneath the epidermis and contains collagen fibers, blood vessels, nerve endings, glands, sensory receptors, smooth muscles, and hair follicles.

The skin interacts with other body systems to maintain homeostasis by helping to regulate body temperature. When the body needs to conserve heat on a cold day, the blood vessels in the dermis narrow, helping to limit heat loss. On hot days, the blood vessels widen, bringing heat from the body's core to the skin and increasing heat loss.

The dermis contains two major types of glands: sweat glands and sebaceous (suh-BAY-shus), or oil, glands. If your body gets too hot, sweat glands produce perspiration, or sweat. Sweat contains water, salts, and other compounds. When sweat evaporates, it takes heat away from your body. Sweat also gets rid of wastes from the blood, along with water. In this way, the skin acts as an organ of excretion. Sebaceous glands produce an oily secretion called sebum. Sebum spreads out along the surface of the skin and helps to keep the keratin-rich epidermis flexible and waterproof.

CHECKPOINT What structures are found in the dermis?

Analyzing Data

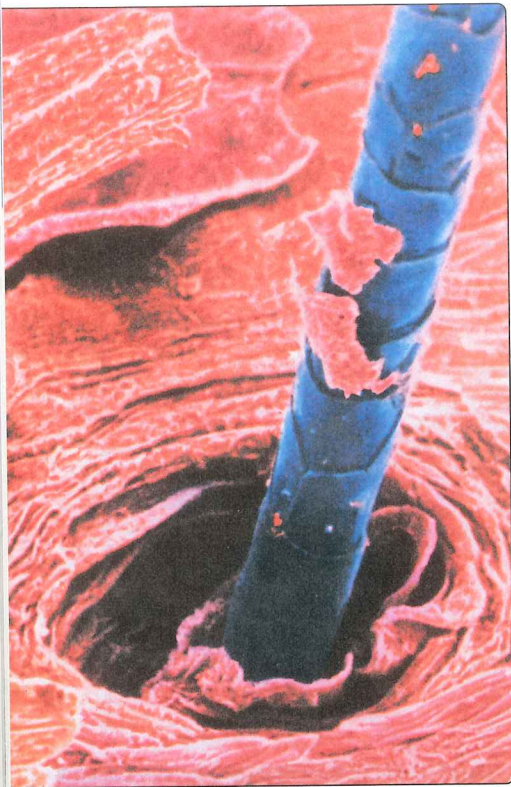
The UV Index and Sunburn

Ultraviolet (UV) radiation is one type of energy from the sun. UV rays cause sunburn, some cataracts, and skin cancer. There are many factors that affect the amount of UV radiation to which you are exposed. These include the time of day, the season, the weather conditions, and your location. Recently, the National Weather Service, the Environmental Protection Agency, and the Centers for Disease Control agreed upon a national UV index. The UV index is issued daily to advise you of conditions in your region of the country. Use the information in the chart to answer the questions that follow.

- Interpreting Graphics** Describe the trend in the amount of time it takes to sunburn, from a minimal UV index level to a very high UV index level.
- Applying Concepts** Why do you think applying sunscreen is always recommended?
- Drawing Conclusions** Why should a hat worn as protection against UV rays have a brim?
- Predicting** The minutes-to-burn data apply to most people. What variable could cause the time for a particular person to burn to be shorter or to be longer?
- Using Tables and Graphs** Use the data in the table to construct a bar graph. Place the UV index levels on the x-axis and the minutes to burn on the y-axis.

Protection From Sunburn

UV Index Level	How to Protect Yourself	Minutes to Burn
Minimal (0–2)	Apply sunscreen Wear sunglasses near snow and water	60
Low (3–4)	Apply sunscreen Wear sunglasses and hat	45
Moderate (5–6)	Apply sunscreen Wear sunglasses and hat Apply lip balm	30
High (7–9)	Apply sunscreen Wear sunglasses and hat Seek shade from 10 AM to 4 PM	15
Very High (10+)	Apply sunscreen Wear sunglasses and hat Avoid sun from 10 AM to 4 PM	10



▲ **Figure 36-14** In this color-enhanced scanning electron micrograph of a hair shaft, the scalelike structures are layers of skin cells. The part of the hair that is above the skin is made up of dead cells that become filled with keratin. **Observing** *What layer of the skin contains the hair follicle?*

Skin Cancer Excessive exposure to the ultraviolet radiation in sunlight can produce skin cancer, an abnormal growth of cells in the skin. You can help protect yourself from this dangerous disease by wearing a hat, sunglasses, and protective clothing whenever you plan to spend time outside. In addition, you should always use a sunscreen with a sun protection factor (SPF) of at least 15.

Hair and Nails

The basic structure of human hair and nails is keratin. In other animals, keratin forms a variety of structures, including bull horns, reptile scales, bird feathers, and porcupine quills.

Hair Hair covers almost every exposed surface of the body and has important functions. Hair on the head protects the scalp from ultraviolet light from the sun and provides insulation from the cold. Hairs in the nostrils, external ear canals, and around the eyes (eyelashes) prevent dirt and other particles from entering the body.

Hair is produced by cells at the base of structures called hair follicles. **Hair follicles** are tubelike pockets of epidermal cells that extend into the dermis. The individual hair shown in **Figure 36-14** is actually a large column of cells that have filled with keratin and then died. Rapid cell growth at the base of the hair follicle causes the hair to grow longer. Hair follicles are in close contact with sebaceous glands. The oily secretions of these glands help maintain the condition of each individual hair.

Nails Nails grow from an area of rapidly dividing cells known as the nail root. The nail root is located near the tips of the fingers and toes. During cell division, the cells of the nail root fill with keratin and produce a tough, platelike nail that covers and protects the tips of the fingers and toes. Nails grow at an average rate of 3 millimeters per month, with fingernails growing more rapidly than toenails—about four times as fast.

36-3 Section Assessment

- Key Concept** List the functions of the integumentary system.
- What organs and tissues make up the integumentary system?
- Compare the structures of the epidermis and dermis.
- How does the skin help maintain body temperature?
- In what way is the growth of hair and nails similar?
- Critical Thinking Applying Concepts** Why does cutting your skin hurt, but cutting your hair or nails does not hurt?

Focus on the BIG Idea

Structure and Function

Compare and contrast the structure and function of the dermal tissue in plants discussed in Chapter 23 with the structures in human skin. In what ways are they similar? *Hint:* You may wish to organize your ideas in a Venn diagram.