32.3 Skin—The Integumentary System

THINK ABOUT IT What's the largest organ in your body? No, it is not your ears or stomach, or even your lungs or heart. By far the largest human organ is the skin. If that sounds a little strange, it's probably because you're used to taking your skin for granted—it's just the outside of your body, right? Well, the skin has a lot of roles that go beyond just covering your body.

Integumentary System Functions

What are the principal functions of the integumentary system?

The integumentary system includes the skin, hair, and nails. The skin—the major organ of the system—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 wastes from the body, gathers information, and produces vitamin D.**

Protection The skin forms a barrier that blocks out pathogens and debris and prevents the body from drying out. The skin also provides protection from the sun's ultraviolet radiation. Nails, which protect the tips of fingers and toes, are also produced by the skin.

Body Temperature Regulation The skin helps to regulate body temperature by releasing excess heat generated by working cells, while keeping in enough heat to maintain normal body temperature. Hair also helps to prevent heat loss from the head.

Excretion Small amounts of sweat are constantly released from your sweat glands. Sweat contains waste products such as urea and salts that need to be excreted from the body.

Information Gathering 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 from the outside environment to the nervous system.

Vitamin D Production One of the skin's most important functions is the production of vitamin D, which is needed for absorption of calcium and phosphorus from the small intestine. Sunlight is needed for one of the chemical reactions that produce vitamin D in skin cells.

Key Concepts

- ***What are the principal functions of the integumentary system?***
- ***What are the structures of the integumentary system?***
- ***What are some problems that affect the skin?***

Vocabulary

epidermis • keratin • melanocyte • melanin • dermis • sebaceous gland • hair follicle

Taking Notes

Preview Visuals Before you read, preview **Figure 32–12.** Make a two-column table. In the first column, list all of the structures labeled in the figure. As you read, fill in the function of each structure in the second column.

MYSTERY CLUE

How do you think the knowledge of the effect of sunlight on skin could have helped scientists unravel the rickets mystery?

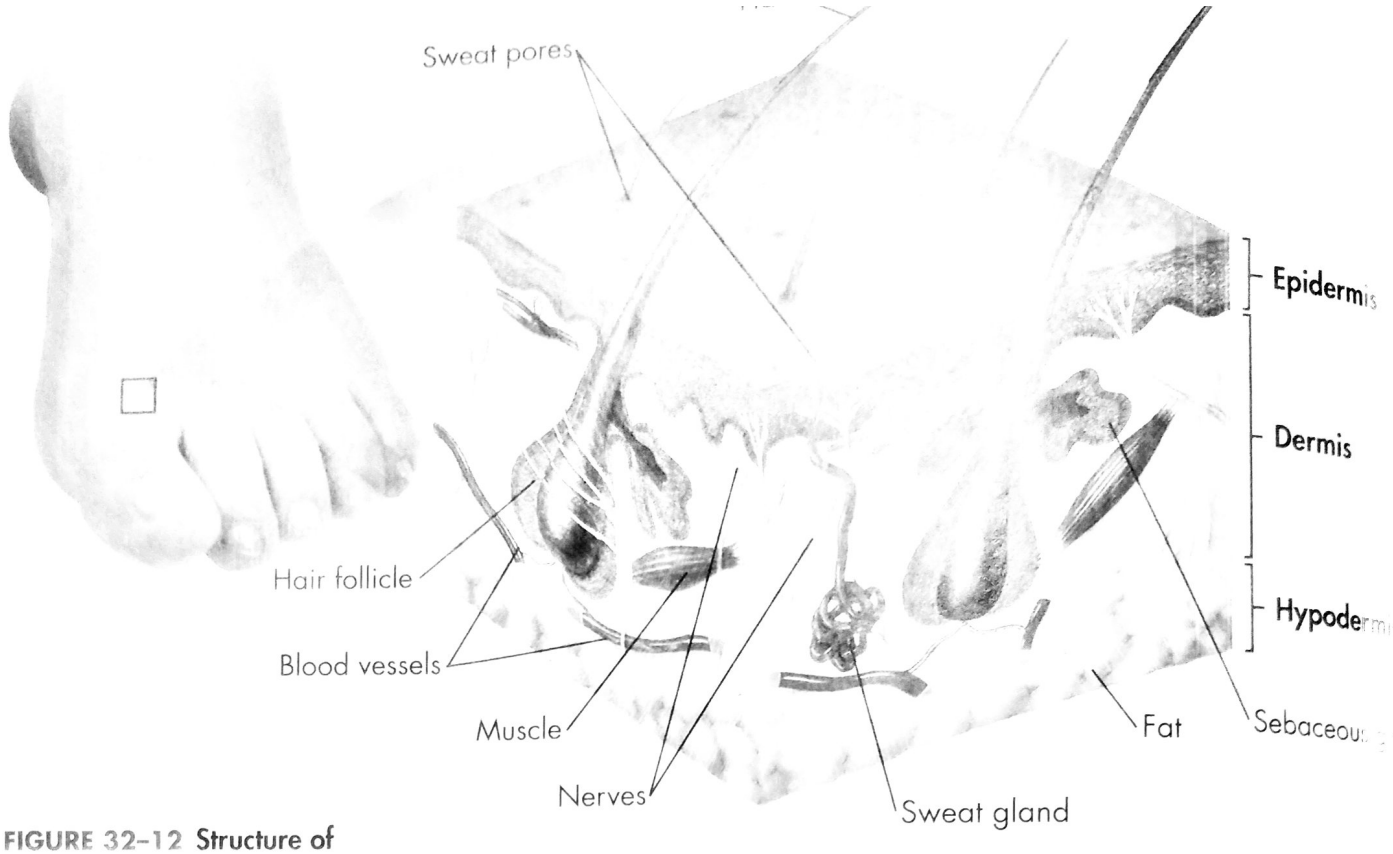


FIGURE 32–12 Structure of the Skin The skin has an outer layer called the epidermis and an inner layer called the dermis. **Infer** *Why do you think a slight scratch on the surface of the skin does not bleed?*

BUILD Vocabulary

WORD ORIGINS The prefix *epi-* in **epidermis** comes from the Greek word meaning "on" or "upon." *Dermis* derives from the Greek *derma*, meaning "skin."

Integumentary System Structures

What are the structures of the integumentary system?

Many structures are required to fulfill all the functions you just read about. **Skin and its related structures—the hair, nails, and several types of glands—make up the integumentary system.** The skin is made up of two main layers—the epidermis and the dermis. Beneath the dermis is a layer of fat (the hypodermis) and loose connective tissue that helps insulate the body. **Figure 32–12** shows many of the structures that make up the skin.

Epidermis The outer layer of the skin is the **epidermis.** The epidermis has two layers. The outer layer of the epidermis—the layer that you see—is made up of dead cells. The inner layer of the epidermis is made up of living cells, including stem cells. These cells divide rapidly, producing new skin cells that push older cells to the surface of the skin. As the older cells move upward, they flatten, and their organelles disintegrate. They also begin making **keratin,** a tough, fibrous protein.

Eventually, the older 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 six weeks, a new layer of dead cells replaces an old layer.

The epidermis also contains **melanocytes** (MEL uh noh cytes), which are cells that produce a dark brown pigment called **melanin.** Melanin helps protect the skin by absorbing ultraviolet rays from the sun. Skin color is directly related to the production of melanin. The melanocytes of people with darker skin produce more melanin than the melanocytes of people with lighter skin produce.

Dermis The **dermis** lies beneath the epidermis and contains the protein collagen, blood vessels, nerve endings, glands, sensory receptors, smooth muscles, and hair follicles. Structures in the dermis interact 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. This brings blood closer to the body's core and prevents heat from escaping through the skin. On hot days, the blood vessels widen, bringing heat from the body's core to the skin.

Sweat glands in the dermis also aid temperature regulation. Excess heat is released when sweat glands produce perspiration, or sweat. When sweat evaporates, it takes heat away from your body.

The skin also contains **sebaceous** (suh BAY shus) **glands,** which secrete an oily substance called sebum that is released at the surface of the skin. Sebum helps to keep the keratin-rich epidermis flexible and waterproof. Because it is acidic, it can kill bacteria on the surface of the skin.

In Your Notebook *Explain whether the epidermis, the dermis, or both layers are involved in protection and temperature regulation.*

Hair The basic component 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 covers almost every exposed surface of the human body and has some 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 (in the form of 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. New research has shown that hair follicles contain stem cells that help to renew the skin and heal wounds. The hairs shown in **Figure 32–13** are actually large columns 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 hairs stay soft and flexible.

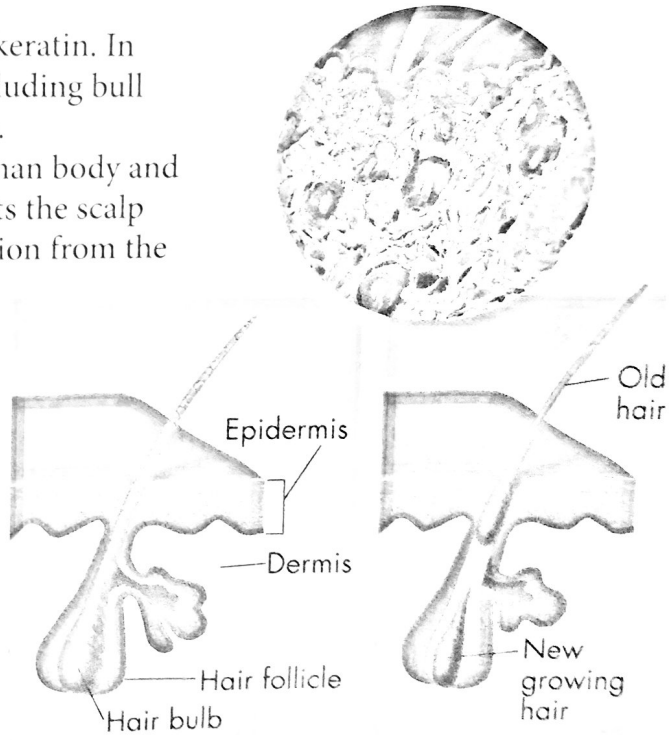


FIGURE 32–13 Hair As a new h grows, it pushes the old hair out the follicle. The micrograph show individual hairs in their follicles.

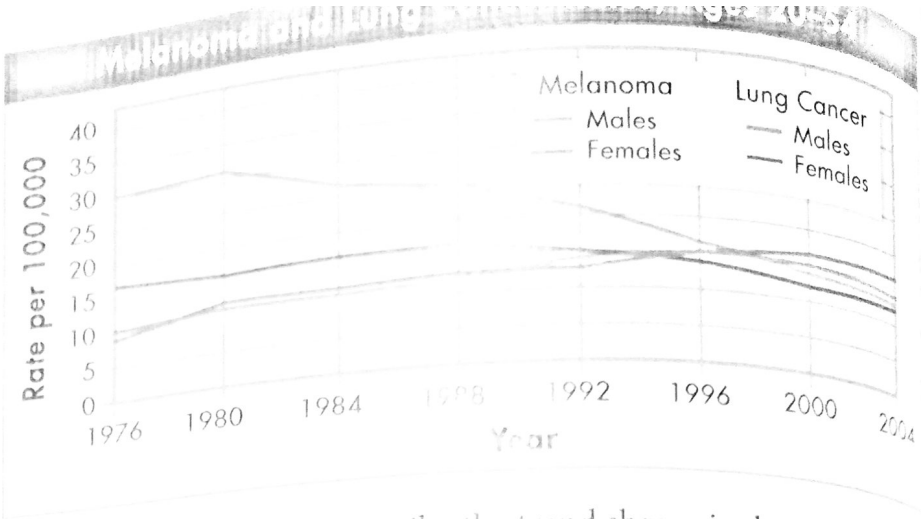
Nails Nails grow from an area of rapidly dividing cells known as the nail root. The nail roots are located near the tips of the fingers and toes. During cell division, the cells of the nail root fill with keratin and produce a tough, platelike nail that covers and protects the tips of the fingers and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

Analyzing Data

The Rising Rate of Melanoma

Over the past several decades, the incidence of some deadly cancers, such as lung cancer, has decreased among people aged 20–54. Some people attribute this to decreasing smoking rates. During the same time period, the incidence of melanoma increased for the same age group. The incidence of both lung cancer and melanoma increases with age. But melanoma is one of the most common cancers in young adults.

What are some possible reasons for this increase? Despite public health efforts, many people still consider tanned skin a sign of health. Also, many people do not use enough sunscreen for it to be effective.



1. Interpret Graphs Describe the trend shown in this graph for the incidence of lung cancer and melanoma from 1976 to 2004.

2. Infer In what year does the rate of melanoma surpass the rate of lung cancer in men? In women?

3. Predict The data are only for a specific age group. If you were to look at similar data for the whole population, how do you think the graph would differ? Explain.

Skin Problems

What are some problems that affect the skin?

More than any other organ, the skin is constantly bombarded by internal and external factors that affect its health. **The skin's constant interaction with the environment can lead to problems of varying degrees of severity. Such problems include acne, hives, and skin cancer.**

Acne Acne develops when sebum and dead skin cells form plugs in hair follicles. Bacteria are often trapped in the plug, which leads to infection and inflammation. Up to 85 percent of people experience acne to some degree during adolescence and young adulthood. One hypothesis about acne suggests that high hormone levels during puberty lead to increased sebum production. There are many treatments for acne that can be purchased over the counter. But if the acne is severe and scarring is likely, a dermatologist—a doctor who specializes in skin care—should be consulted.

Hives Allergic reactions to food or medicine often display themselves as red welts commonly called hives. When the body experiences an allergic reaction, a chemical called histamine may be released. Histamine causes small blood vessels to widen. Fluid can ooze from the vessels into surrounding tissues, which causes the swelling that leads to hives.

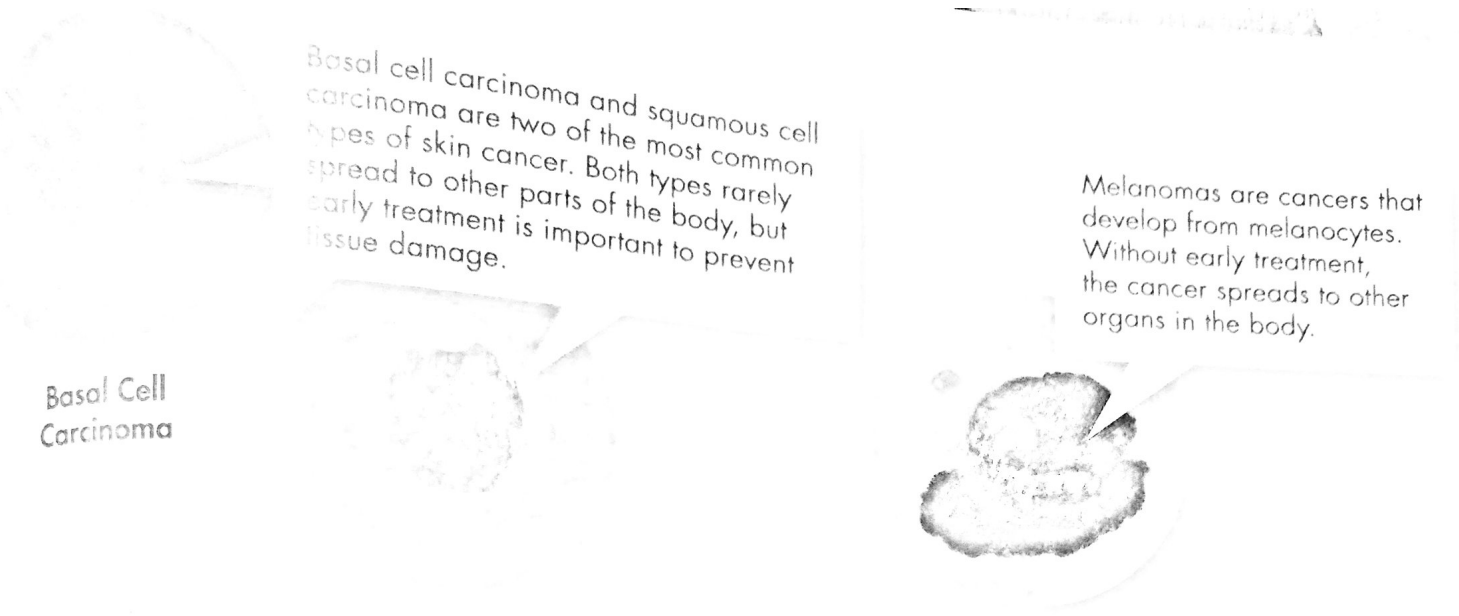


FIGURE 32–14 Skin Cancer Early detection is important in treating skin cancer. Signs of skin cancer may include a sore that does not heal or a sudden change in a mole's appearance. You should also see a doctor if you notice a new mole that is larger than 6 mm, has irregular borders, or is an odd color.

Skin Cancer Excessive exposure to the ultraviolet radiation in sunlight and artificial radiation from tanning beds can produce skin cancer, an abnormal growth of cells in the skin. **Figure 32–14** shows examples of the three most common types of skin cancer, including melanoma, the most dangerous form. Over 60,000 people are diagnosed with melanoma every year in the United States, and as many as 8000 people die from it.

You can help protect yourself from this dangerous disease by avoiding tanning salons and wearing a hat, sunglasses, and protective clothing whenever you plan to spend time outside. In addition, you should always use a sunscreen that protects against both UV-A rays and UV-B rays and that has a sun protection factor (SPF) of at least 15.

In Your Notebook *Summarize the steps you can take to protect your skin from sun damage.*

32.3 Assessment

Review Key Concepts

1. a. **Review** List the functions of the integumentary system.
   b. **Classify** What organs and tissues make up the integumentary system?
2. a. **Review** What structures are found in the epidermis? What structures are found in the dermis?
   b. **Apply Concepts** Explain two ways that the skin can help remove excess heat from the body.
3. a. **Review** What are some ways to reduce your risk of developing skin cancer?
   b. **Sequence** Explain the events that lead to acne.

Apply the Big Idea

Structure and Function

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