

Describe the Distinguishing Features of the Integumentary System

I**NTEGUMENT** is a Latin word that means covering. The covering to which it refers is the largest single organ in the human body: skin. The skin of an average adult measures 17 to 20 square feet and weighs 9 to 15 pounds. The three layers of skin (epidermis, dermis, and hypodermis) perform different functions, but they work together to cover and protect the internal body.



Objective:



Explain the characteristics and functions of skin.

Key Terms:



dermis
epidermis
hypodermis
integument
vitamin D

Skin

There are close to 1,000 organs in your body, and your skin is the largest. It is divided into three layers: the epidermis, the dermis, and the hypodermis. Skin covers your body, protecting you from injury, sunlight, heat, and water loss. It produces **vitamin D** (a fat-soluble prohormone that helps with bone growth and the absorption of calcium); prevents dehydration; regulates body temperature; and acts as a barrier to bacteria, parasites, and other organ-

isms. Equally as important, your skin has the sense of touch (the capacity to feel pain, pressure, and vibration).

EPIDERMIS

The **epidermis** is the outer layer of skin and is composed of dead skin cells (the cells making up the skin). The epidermis is flexible and thin. Skin ranges in thickness from $\frac{1}{50}$ of an inch on the eyelid to $\frac{1}{6}$ of an inch thick on the sole of your foot where you need more protection. Living cells are constantly pushing outward to the surface and flaking off the dead surface cells. As a result, people lose from 30,000 to 40,000 skin cells every minute and from 40 to 60 million skin cells every day. At this rate, people have a complete new outer layer of skin each month. (A lifetime of flaking is said to remove about 105 pounds of old skin and creates a thousand new outer layers.)

The constant flaking of dead cells is a person's first defense against infection and abrasion and is the largest cause of dust in a home. As the dead cells push upward away from their source of nourishment, they flatten and shrink, turning into lifeless keratin protein. The epidermis has no blood vessels and few nerve endings.

New cells are produced by the division of living cells at the base of the epidermis. The lower living cells are nourished by your blood; they provide replacement cells to your outer epidermis and contain pigment that gives skin its color. Color in the skin acts as a sunblock and screens ultraviolet radiation (invisible rays that are part of the energy from the sun) to prevent damage to the DNA in underlying tissue. Though skin uses ultraviolet (UV) light to produce vitamin D, it needs only about an hour of exposure a week to absorb calcium to create strong bones and teeth.

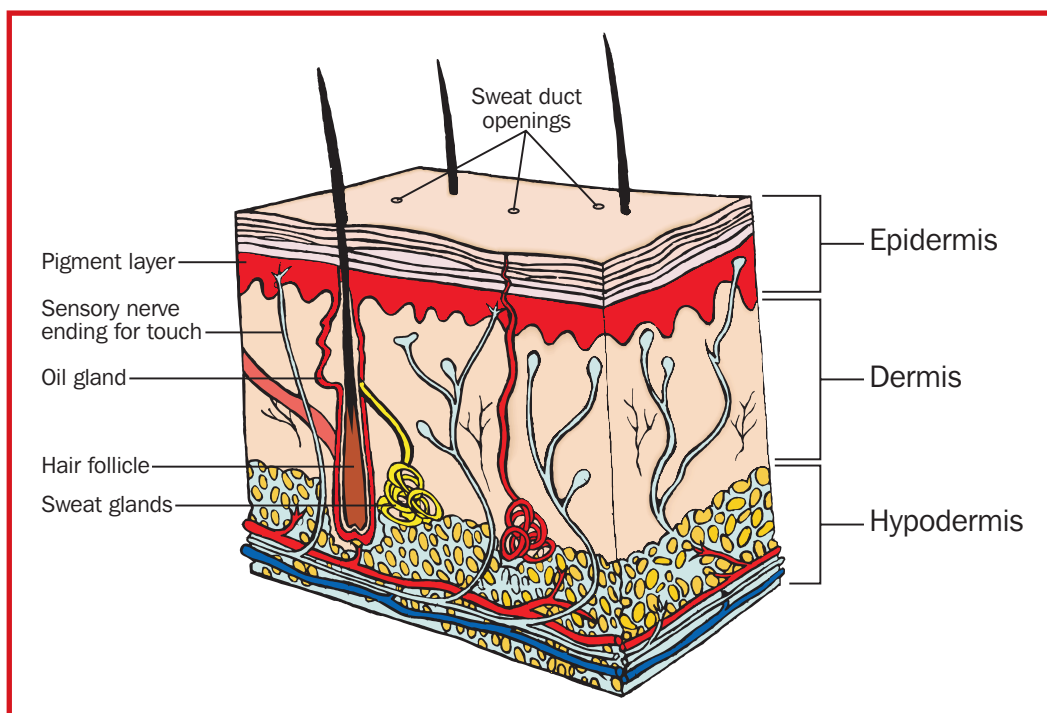


FIGURE 1. The three layers of your skin are constantly active.

DERMIS

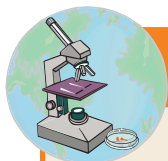
The **dermis** (second or inner layer of skin) is made up of connective tissue (a type of tissue made up of fibers forming a framework and support structure for body tissues and organs), blood vessels, nerves, sweat glands, and oil glands that intersect throughout the dermal layer. Within the dermis are hair roots and nails, which are additional structures that push upward to the surface of the epidermis. Hair covers your entire body, except the palms of your hands and the soles of your feet. Hair in your nose, in your ears, and around your eyes protects these organs from dust, insects, and other foreign objects. The hairless surfaces on your feet and palms help prevent you from slipping and make it easier for you to grasp.

Your skin's elasticity (flexibility) is due to the fibers in the connective tissue of the dermis.

Blood Vessels

Blood vessels (elastic, tubular channels that transport blood throughout the body) located in the dermis help regulate body temperature (the level of heat produced and sustained by the body processes) by dilating when the temperature outside the body is hot; this brings more blood to your body surface to cool you. When the outside temperature is cold, blood vessels constrict, bringing less blood to the surface to prevent heat loss. The average adult has 19 feet of intricately woven blood vessels running throughout the body.

When you get a paper cut, though it hurts, there is no blood if the cut penetrates only the epidermis. However, a deeper cut into the dermal layer bleeds because the blood vessels are located in the dermis. A scab forms while new epidermal cells are being made.



EXPLORING OUR WORLD...

SCIENCE CONNECTION: Skin Shows Signs of Aging

With age, the skin loses elasticity and strength as collagen fibers in the dermis stiffen and break resulting in wrinkles, crow's feet, and baggy skin. Skin thins and sags. In addition, dry skin occurs when oil and sweat secretions decrease. Skin becomes fragile and can be easily injured because blood vessels decrease in number.

Brown spots, called "age spots" or "liver spots," appear on the wrists and hands. The skin has fewer nerve endings, which lessens the ability to sense heat, cold, and pain. The loss of fatty tissue also makes a person more sensitive to cold. So an older person must be protected from drafts and cold with sweaters, lap blankets, socks, extra blankets, and higher thermostat settings.

Mild soap, lotions, oils, and creams may help prevent dry skin and itching. In addition, sweat secretions decrease. Therefore, a full bath may be necessary only twice a week.

Fingernails and toenails become thick and tough. Also, feet generally have poor circulation.

White or gray hair is common when pigment granules in the dead hair cells of the cortex contain mostly air. Men experience more hair loss. Hair grows thinner on men and women under the arms and in the pubic area. Women may grow facial hair on their chins. In addition, hair becomes drier from decreased scalp oils. Yet brushing promotes circulation and oil production.

Nerve Endings

Nerve endings in the skin sense pleasant and unpleasant stimulation. They protect you by sensing cold, pain, touch, pressure, and vibration. You have approximately 19,000 nerve cells.

Sweat Glands

Sweat glands help the body regulate temperature. Sweat consists of water, salt, and small amounts of waste. When your body overheats, sweat glands release water through your pores to cool your skin. An inactive person perspires at a rate of $\frac{1}{12}$ ounce per hour; an extremely active person perspires at a rate of a quart or more sweat per hour.

Oil Glands

Oil glands in your skin prevent dehydration by regulating the amount of water you secrete. Oil glands lie near hair shafts (the non-growing portion of hair that protrudes from the skin) and secrete an oily substance that helps keep hair and skin soft and shiny.

Fingerprints

Fingerprints are produced by the unique swirls and ridges on the surface of your fingers. (Genes determine your unique fingerprints at birth, and they never change. They just get larger.) Even identical twins have different fingerprints. A combination of oil and sweat make your fingerprints visible on a smooth surface.

When you have your hands and toes in water for an extended time, as when you spend too much time in the bathtub or in a swimming pool, your fingertips and toes look wrinkled. When this happens, the oil has been washed off your skin, and you have taken in too much water.

Extensions of Your Skin

Like sweat glands, oil glands, hair, and fingernails are extensions of your skin. The surface hair and fingernails that we see are dead. Hair (fine, threadlike outgrowths from the skin) insulates the body and is formed in tiny elongated pits in the dermal layer of skin in living follicle (small sacs, cavities, or glands for excretion or secretion) cells. The living cells divide to form hair and push it upward. Like other skin cells, they fill with keratin protein (tough, fibrous, and insoluble protein that forms the principal matter of hair, fingernails, etc.) and die before they reach the surface. Because hair cells are dead, cutting hair is painless.

Keratin molecules, which contain sulfur, coil around each other like a telephone cord, rigidifying with each twist. Hair grows thickest and most rapidly on your head, which is covered by 100,000 hairs. Each hair lives for four to six years, falls out, and is replaced with a new hair that grows about $\frac{1}{2}$ inch per month. You lose between 70 and 100 hairs every day. There are three layers in your hair: the outer cuticle, the cortex, and the inner medulla. The cortex is the largest part and contains long cells that make dark hair when filled with pigment (coloring matter) granules, but white hair contains mostly air in the dead cells.

Have you ever wondered why you sometimes get goose bumps? Goose bumps are simply a condition of the skin that results in erect papillae due to cold, fear, or some other cause.

Fingernails are made of a horn-like substance that grows on the upper part of the end joint of a finger. Like hair, fingernails are dead and are tightly packed keratinized cells. The white crescent at the base is where epidermal cells divide and push the fingernail forward at the rate of 1 mm or 0.04 inches per week. Fingernails and toenails protect the small, fragile bones of fingers and toes. They also make it easier to grasp objects, adding support to the fingertips. They grow faster in warm weather. Also, fingernails grow 300 to 400 percent faster than toenails.



FIGURE 2. People often get goose bumps when they are cold.

HYPODERMIS

The **hypodermis** (subcutaneous) is the third layer of skin, just below the dermis, where fat layers store nutrients and protect internal organs from injury. Men and women's exteriors function the same way, except in the production of skin oils and the distribution of body fat. Men tend to store body fat in the abdomen, and women tend to store fat in the lower body.

Summary:



Your integumentary system is your skin covering, which is the largest organ in your body. It is divided into three segments: the epidermis, the dermis, and the hypodermis. It covers your body and protects you from injury, sunlight, heat, and water loss. Skin also produces vitamin D; prevents dehydration; regulates body temperature; and acts as a barrier to bacteria, parasites, and other organisms. This organ senses pain, pressure, touch, and vibration.

Checking Your Knowledge:



1. What are the three layers of skin?
2. How big is the largest organ in your body?
3. Where do you find dead skin cells?

4. From which layer of skin does your hair grow?
5. How does skin show signs of aging?

Expanding Your Knowledge:



Examine your skin under a microscope. Then compare with a classmate the differences in your fingerprints, a strand of hair, and your fingernails. Discuss what causes the differences.

Web Links:



The Integumentary System

<http://library.thinkquest.org/3007/integumentary.html>

The Integumentary, Skeletal, and Muscular Systems

http://www.sparknotes.com/101/index.php/biology/the_integumentary_skeletal_and_muscular_systems/the_integumentary_system.html

Integumentary System

<http://www.fi.edu/learn/heart/systems/integumentary.html>