Section 34.1 Skin: The Body's Protection

Before You Read

Your entire body is covered by skin. Skin is an important organ. What are the functions of your skin? List your ideas on the lines below. After you have read this section, add other functions to your list.

Read to Learn

Structure and Functions of the Integumentary System

Skin is your body's largest organ. It is also the main organ of the integumentary (inTH TE gyuH MEN uh ree) system. Hair, nails, and some glands are also part of the system. Skin covers our bodies. It is composed of layers of the four types of body tissues. The four types of tissues are epithelial, connective, muscle, and nervous. Epithelial tissue is found in the outer layer of the skin. It covers body surfaces. Connective tissue consists of both tough and flexible protein fibers. Connective tissue holds your body together. Muscle tissues interact with hairs on the skin to respond to stimuli, such as cold and fright. Nervous tissue helps humans sense external stimuli, such as pain or pressure.

What is the epidermis?

The epidermis is the outermost layer of the skin. It has two parts—the exterior, or outside, part and the interior, or inside, part. The exterior layer of the epidermis consists of 25 to 30 layers of dead, flattened cells. These cells are continually shed. Although the cells are dead, they serve an important function. They contain a protein called keratin (KER uH tin). Keratin helps protect the living cell layers underneath from exposure to bacteria, heat, and chemicals.

The interior layer of the epidermis contains living cells. The living cells continually divide so that they can replace the dead cells. As new cells are pushed toward the skin's surface, the nuclei

ANNOTATE!

STUDY COACH

Specific Ideas As you read through this section, highlight the text each time that you read about ways in which the skin helps to protect the body.

What are the four types of body tissues that make up the skin?

Reading Check
in the cells degenerate, and the cells die. Then these cells are shed. This process takes about 28 days. So, every four weeks, all of the cells of the epidermis are replaced by new cells.

Some of these cells in the interior layer contain melanin. Melanin is a pigment that colors the skin. Differences in skin color are due to the amount of melanin produced by the cells. Melanin helps protect the underlying body cells from solar radiation, or sun damage, by absorbing ultraviolet light. If ultraviolet light damages cells, skin cancer could develop.

The epidermis on the fingers and palms of your hands and on the toes and soles of your feet contains ridges and grooves that are formed before birth. These ridges increase friction, which improves the skin’s grip. Each person has a unique pattern of ridges and grooves. Because these patterns are unique, footprints and fingerprints can be used to identify individuals.

**What is the dermis?**

The second principal layer of the skin is the dermis. The dermis is the inner, thicker portion of the skin. The thickness of the dermis changes from body part to body part. The thickness depends on how that body part is used.

As shown in the illustration on page 411, the dermis contains structures such as blood vessels, nerves, nerve endings, hair follicles, sweat glands, and oil glands. Underneath the dermis, the skin is attached to the underlying tissues by the subcutaneous layer. This layer consists of fat and connective tissue. Fat deposits help the body absorb impacts, retain heat, and store food.

Hair is another structure of the integumentary system. It grows out of hair follicles, narrow, hollow openings in the dermis. The primary function of hair is to protect the skin from injury and damage from the sun. Hair also provides an insulating layer of air just above the surface of the skin. As hair follicles develop, they are supplied with blood vessels and nerves. These follicles become attached to muscle tissue. Most hair follicles have an oil gland. Oil prevents hair from drying out and keeps the skin soft. Oil also helps prevent the growth of certain bacteria. When oil and dead cells block the opening of the hair follicle, pimples may form.

**What are the functions of the integumentary system?**

One function of skin is to help maintain homeostasis. Homeostasis is the regulation of an organism’s internal environment to maintain conditions suitable for its survival. Skin helps...
regulate your internal body temperature. When your temperature rises, blood vessels in the dermis dilate. This dilation causes increased blood flow. Body heat is transferred from the blood vessels to the surface of the skin. From the skin, the heat is lost by radiation. When you are cold, the blood vessels in the skin contract, and the body conserves heat.

Glands in the integumentary system help cool the body. When the body heats up, glands in the dermis produce sweat. The wet skin helps reduce body temperature. As the sweat evaporates, the water changes from liquid to vapor. Heat is lost, and the body cools itself.

The skin also is a sense organ. Nerve cells in the dermis receive stimuli from outside the body. Nerve cells provide information about pressure, pain, and temperature to the brain.

Skin helps produce essential vitamins. When exposed to ultraviolet light, or sunlight, skin cells produce vitamin D. Vitamin D helps the body absorb calcium into the bloodstream. Because too much sunlight can damage the skin, people may need to take vitamin D supplements or eat foods that are enriched with this vitamin.
Skin serves as a protective layer for the tissues beneath it. It protects the body from physical and chemical damage. It also protects the body from invasion by bacteria. Cuts or other openings in the skin need to be repaired quickly or bacteria will enter the body.

**Skin Injury and Healing**

It does not take the skin long to heal after a minor injury or wound. If the skin receives a minor scrape, cells in the deepest layer of the epidermis divide. The cells quickly fill in the gap on the skin. If the injury to the skin extends into the dermis, bleeding usually occurs. The skin then goes through a series of stages to heal the damaged tissue. The body's first reaction is to close the break in the skin. Blood flows out onto the skin until a clot forms. A scab develops on the skin to close the wound. The scab creates a barrier that prevents bacteria on the skin from reaching the underlying tissues. Dilated blood vessels allow white blood cells to move to the wound site. White blood cells fight infections. New skin cells begin to form beneath the scab. These cells eventually push the scab off, and new skin can be seen. If a wound to the skin is large, dense connective tissue used to close the wound may leave a scar.

**How are burns rated?**

Burns result from exposure to the sun, contact with chemicals, or contact with hot objects. Burns are rated according to how severe they are.

A first-degree burn, such as a mild sunburn, results in the death of epidermal cells. When the skin receives a first-degree burn, the skin turns red, and you feel mild pain. A first-degree burn heals in about a week. It will not leave a scar. A second-degree burn damages the skin cells of both the epidermis and the dermis. A second-degree burn can result in blisters and scars. The most severe burn is a third-degree burn. A third-degree burn destroys both the epidermis and the dermis. With a third-degree burn, the skin loses its function. The cells will not be replaced by new cells. Skin grafts may be required to replace the lost skin.
Skeletal System Structure

The adult human skeleton contains about 206 bones as shown in the illustration on page 415. The skeleton has two main parts. The **axial skeleton** includes the skull and the bones that support it. These bones include the vertebral column, the ribs, and the sternum. The sternum is the breastbone. The other main part of the human skeleton is the **appendicular** (a pen DI kyuh lur) **skeleton**. It includes the bones of the arms and legs, the shoulder and hip bones, wrists, ankles, fingers, and toes.

**How are bones joined together?**

In vertebrates, **joints** are found where two or more bones meet. Most joints help bones move in relation to each other, and in several different directions. For example, ball-and-socket joints allow legs to swing freely from the hip and arms to move freely from the shoulders. Hinge joints allow back-and-forth movement from knees, elbows, and fingers. The joints in the skull, however, are fixed. The bones of the skull do not move. Skull joints are held together by bone that has grown together, or by fibrous cartilage. Recall that cartilage is not bone. It is a tough, flexible material that makes up portions of the skeletons of bony animals.
Section 34.2 Bones: The Body’s Support, continued

Joints are often held together by ligaments. A ligament is a tough band of connective tissue that attaches one bone to another. Joints with large ranges of motion, such as the knee, usually have more ligaments surrounding them. In movable joints, the ends of the bones are covered in cartilage. This layer of cartilage allows for smooth movement between the bones. In some joints,
34.2 Bones: The Body’s Support, continued

Think it Over

90. Compare/Contrast What is the difference between a ligament and a tendon?

including the shoulder and the knee, there are fluid-filled sacs located on the outside of joints. These sacs are called bursae. The bursae decrease friction and keep bones and tendons from rubbing against each other. Tendons are thick bands of connective tissue that attach muscles to bones.

When a joint is twisted with force, an injury called a sprain can result. Sprains usually occur in joints that have a wide range of motion, such as the wrist, ankle, and knee.

Diseases also can harm joints. One common joint disease is arthritis. Arthritis is an inflammation, or serious irritation, of the joint that causes swelling or deformity. One kind of arthritis causes bony growths inside the joints. These growths, or bone spurs, make it painful to move because bone is rubbing on bone.

What are the two types of bone tissue?

Notice that bones are made of two different types of bone tissue: compact bone and spongy bone. Every bone is covered in a layer of hard bone called compact bone. Tubular structures known as osteon or Haversian (ha VER zhun) systems run down the entire length of compact bone. Osteocytes (ah STH see oh sitz) are living bone cells that receive oxygen and other nutrients from small blood vessels running within the osteon systems. Nerves in the canals of the osteon system conduct impulses to and from each bone cell.

Compact bone surrounds spongy bone. Spongy bone gets its name from its appearance. Like a sponge, it has many holes and spaces.

Formation of Bone

The skeleton of a vertebrate embryo is made of cartilage. In the human embryo, bone begins to replace cartilage by the ninth week of development. Blood vessels penetrate the membrane covering the embryo’s cartilage. The blood vessels stimulate the
embryonic cartilage cells to become potential bone cells. These potential bone cells are called osteoblasts (AHS tee oh blastz). Osteoblasts secrete a protein called collagen. Minerals from the bloodstream begin to deposit themselves in the collagen. Calcium salts and other ions harden the newly formed bone cells. These new living bone cells are osteocytes.

The skeleton of an adult human is almost all bone. Cartilage is found only where flexibility is needed. Regions with cartilage include the nose tip, the external ear, discs between individual vertebrae, and movable joint linings.

How do bones grow?

Bones grow in both length and in diameter. In bones that end in cartilage, bone growth occurs at both ends of the bones. During the teen years, increased production of sex hormones causes the osteoblasts, the cells that form bone, to divide more rapidly. This results in a growth spurt. These hormones also cause the growth centers at the ends of the bones to slow production. As these cells begin to die, growth slows. After growth stops, bone-forming cells repair and maintain the bones.

Skeletal System Functions

The primary function of the skeleton is to provide a framework for the body tissues. The skeleton also protects internal organs, such as the heart, the lungs, and the brain.

The human skeleton allows for efficient movement. Muscles that move body parts need to be firmly attached to a strong structure that the muscles can pull against. The skeleton provides these attachment points.

Bones also produce blood cells. Red blood cells, white blood cells, and cell fragments that are needed for blood clotting are produced in the red marrow of a bone. Red marrow is found in the humerus, the femur, the sternum, the ribs, the vertebrae, and the pelvis. Yellow marrow is found in many other bones. Yellow marrow consists of stored fat. The stored fat can be used in times of need.

What other functions do bones have?

Your bones store minerals. Minerals stored in bones include calcium and phosphate. Calcium is needed to form strong, healthy bones. It is important to eat foods that are rich in calcium. These foods include milk, yogurt, cheese, lettuce, spinach, and other leafy vegetables.

READING ESSENTIALS

Chapter 34 417
Section 34.3 Muscles for Locomotion, continued

Skeletal muscle is the third type of muscle tissue. Skeletal muscle is attached to and moves your bones. Most of the muscles in your body are skeletal muscles. You can control their contractions. When you want to move your arm or your leg, the muscles are under your control. A muscle that contracts under conscious control is called a voluntary muscle. Skeletal muscles are voluntary muscles.

Skeletal Muscle Contraction

Movement occurs because muscles can contract and relax. Most of your skeletal muscles work in opposing pairs. When one muscle contracts, another relaxes. When you bend your arm, the biceps muscle, which is located on the front of your arm, contracts. The muscle on the back of your arm, the triceps, relaxes. When you straighten your arm, the biceps relaxes, and the triceps contracts.

Muscle tissue is made up of muscle fibers. Muscle fibers are long muscle cells that are connected. Each fiber is made up of smaller units called myofibrils (mi oh FI brulz). Myofibrils consist of even smaller protein filaments that can be either thick or thin. The thicker filaments are made of the protein myosin. The thinner filaments are made of the protein actin. Each myofibril can be divided into sections called sarcomeres (SAR kuh meerz). Sarcomeres are the functional units of muscles.

One of the best explanations for how muscle contraction occurs is called the sliding filament theory. The sliding filament theory states that when a muscle receives a signal from a nerve, the actin filaments in each sarcomere slide toward each other. This shortens the sarcomeres in a fiber. This shortening causes the muscle to contract. The myosin filaments do not move.

Muscle Strength and Exercise

Muscle strength does not depend upon the number of fibers in a muscle. The number of fibers in each muscle was fixed before
34.3 Muscles for Locomotion

Before You Read

Most humans can control how they run, walk, jump, wave their arms, and touch their toes. During all these activities, the human heart keeps beating without any prompting. On the lines below, explain the ways in which you keep your heart and other muscles strong.

Read to Learn

Three Types of Muscles

Almost half of your body mass is muscle. A muscle is groups of fibers, or cells, that are bound together. Almost all the muscle fibers you will ever have were present at birth. There are three main types of muscle tissue in your body.

Smooth muscle is found in the walls of your internal organs and in blood vessels. Smooth muscle is made of sheets of cells that line organs, such as the digestive tract and the reproductive tract. The most common job of smooth muscle is to squeeze. A smooth muscle applies pressure on the space inside the tube or organ it surrounds. This pressure moves material through the organ. For example, food moves through the digestive tract because smooth muscles squeeze the material as it moves through the tract. Gametes move through the reproductive system because they are squeezed by smooth muscle. You do not consciously control a smooth muscle and its contractions. Therefore, smooth muscle is considered an involuntary muscle. It contracts by itself.

Cardiac muscle is also an involuntary muscle. Cardiac muscle makes up your heart muscle. Cardiac muscle fibers are connected, forming a network that helps the heart muscle contract efficiently. Cardiac muscle can generate and conduct electrical impulses. These impulses are necessary for the regular, rhythmic contractions of the heart—your heartbeat. Cardiac muscle is found only in the heart.