

An anatomical model of a human torso, showing muscles and internal organs, is the background of the cover. A blue grid pattern is overlaid on the model. The title text is centered within this grid.

 **The
Human
Body**
Owner's Manual

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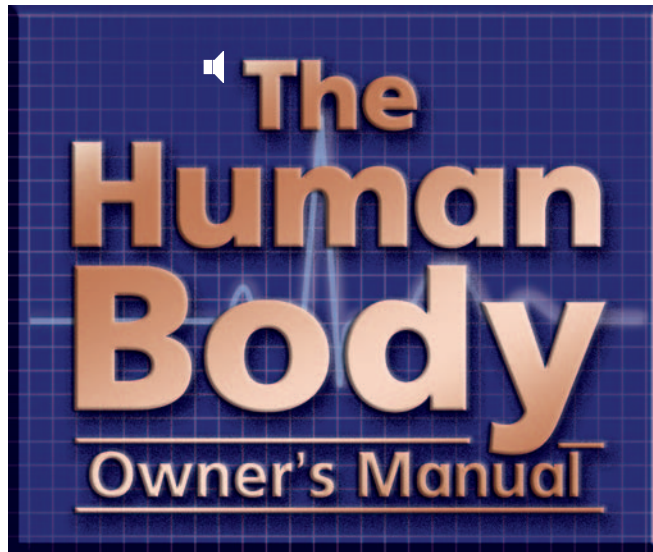
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by Sharon Kahkonen



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Introduction

The human body is an amazing machine. Your body has the same basic design as everybody else's: two eyes, two ears, a nose, a mouth, a chest, an abdomen, two arms, two legs, and several internal organ systems that keep everything running smoothly. However, the design of your particular body is also unique. There is incredible variation in human body shapes, sizes, and colors. No two bodies are alike.

 This human body owner's manual has three parts. Part 1 offers a brief overview of some important features of your body. Part 2 is a troubleshooting guide to some of the malfunctions (diseases) of the human body and their symptoms, causes, and treatments. Part 3 offers some helpful tips for care and maintenance of the human body.

Part 1: Some Human Body Features

The basic unit of design in the construction of your body is the cell. Each of your cells is a micromachine in itself, capable of carrying out all important life functions. Each cell has a nucleus—the control center that contains the blueprint for the cell's design and for all of its functions. Each cell has energy production equipment, raw materials, and information needed to carry on millions of chemical reactions.

 There are trillions of individual cells in your body. These cells work together in a highly complex way to produce a functioning human body. Different kinds of body cells have different functions. For example, muscle cells are designed to contract, thereby causing movement. Red blood cells are designed to pick up oxygen and carry it to other body cells. When a number of similar cells work together, they're called a tissue. For example, a group of muscle cells is a type of tissue. An organ is made up of a collection of tissues. The heart, for example, is an organ that is made up of several different tissues, including muscle tissue and connective tissue. Organs are organized into organ systems, including the nervous, skeletal-muscle, digestive, excretory, respiratory, circulatory, and immune systems. Information on three important body systems—the respiratory system, the circulatory system, and the immune system—is included in this manual.

The human body is composed of several body systems that work together.

Systems

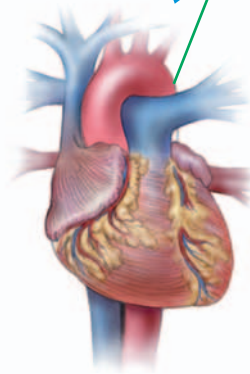
The circulatory system consists of blood, blood vessels, and the heart.

Human body



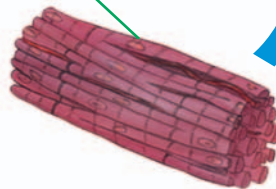
Organs

The heart is an organ made of muscle tissue and connective tissue.



Tissue

Muscle tissue in the heart is composed of a group of muscle cells.



Cell

A heart muscle cell is the basic building block of heart muscle tissue.

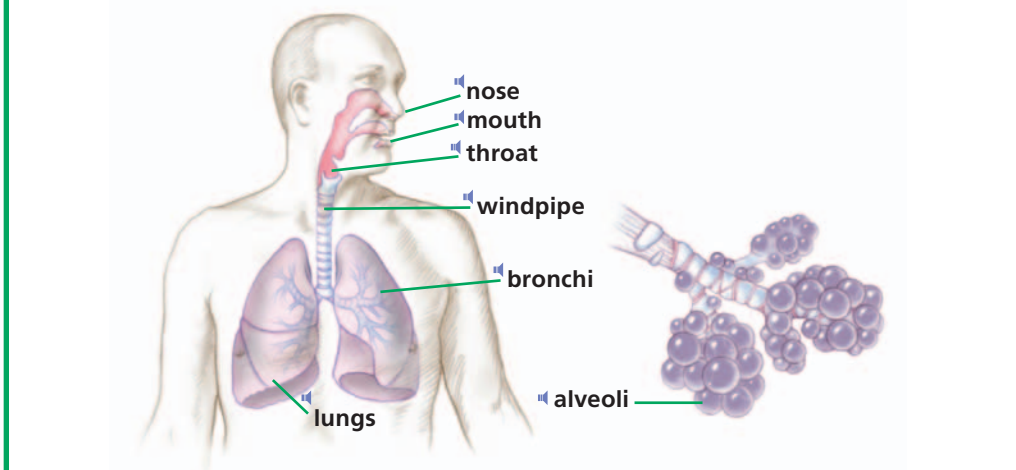


The Respiratory System

Machines need energy to make them work. Many machines get the energy they need by burning fuel. For example, a car burns gasoline for energy. Burning gasoline requires oxygen. The carburetor mixes together just the right amount of oxygen and gasoline. This mix enters the piston, where it contacts the spark plugs and ignites, producing the kinetic energy that moves the car's wheels. Waste products—carbon dioxide and water—produced by the burning process leave the car through the tail pipe.

 Your body also “burns” fuel to get energy. The fuel your body burns is glucose, a sugar. Like a car, your body needs a supply of oxygen to make its fuel burn. Also like a car, your body produces waste products—carbon dioxide and water—that it has to expel. Your respiratory system takes oxygen into your body and gets rid of the waste carbon dioxide and water. When you breathe in, fresh oxygen enters your body. When you breathe out, carbon dioxide and water are expelled. The center of the respiratory system is the lungs. The path that air follows in and out of the lungs includes the nose or mouth, throat, windpipe, bronchi, and lungs. Inside the lungs are alveoli—tiny air sacs through which inhaled oxygen is transferred to your bloodstream and carbon dioxide is passed back to your lungs to be exhaled.

The human respiratory system

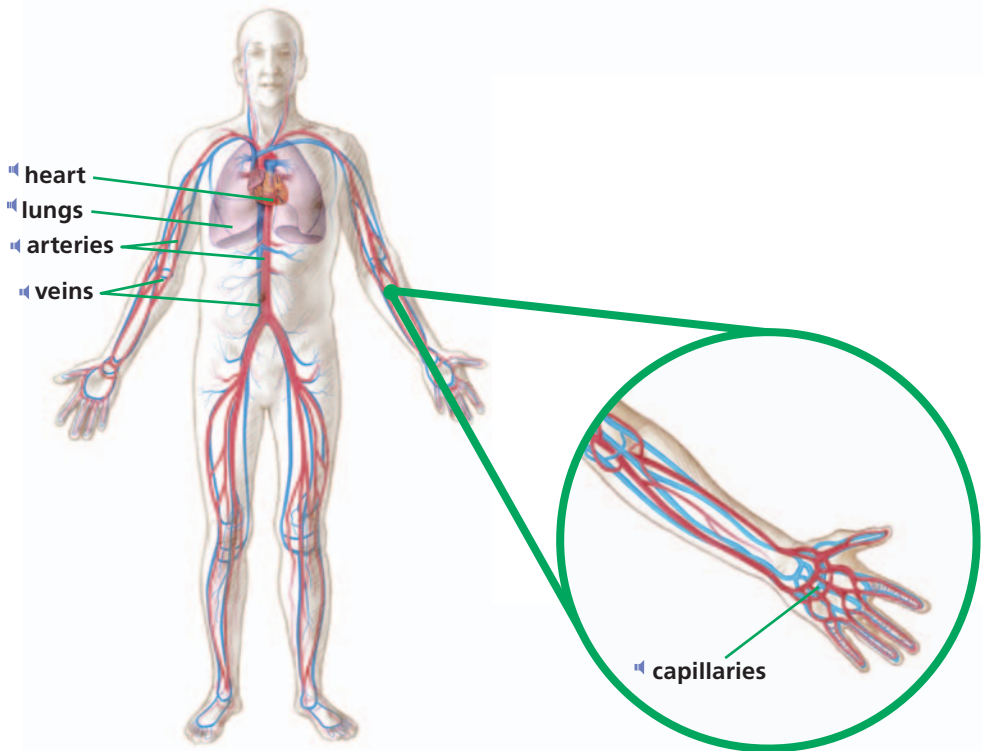


The Circulatory System

Unlike a car, which burns fuel only in the pistons, your body burns fuel in every one of your cells. Each body cell needs glucose to burn and oxygen to burn it. Each body cell also needs to get rid of the waste products—carbon dioxide and water—produced when it burns glucose. Your cells don't burn glucose quickly, as a car burns gasoline in an explosive fire. Rather, glucose is burned very slowly in a controlled reaction, and the energy is shunted off to fuel the cells' many activities.

 Oxygen and food energy get to every body cell through your circulatory system. Your circulatory system also takes waste products away from your body cells. Composed of the heart, blood, and many miles of blood vessels, your circulatory system is much more complex than a car's circulatory system. The three kinds of blood vessels are arteries, veins, and capillaries.

The human circulatory system



Arteries carry blood away from the heart and out to your body cells, and veins bring blood back. Capillaries are the tiniest blood vessels. They link arteries to veins. The complex web of capillaries is where oxygen enters body cells and where carbon dioxide leaves body cells. If all the arteries, veins, and capillaries of your circulatory system were laid end to end, the total length would be about 96,500 km (60,000 mi). That's nearly two and one-half times around Earth!

When blood from the body cells travels through veins back to the heart, it is pumped first to the lungs. Here, the blood releases carbon dioxide into the lungs and picks up fresh oxygen. Then the blood is pumped to the heart, and the heart pumps the oxygen-rich blood back out to the body cells.

The Immune System

When a car breaks down, it cannot fix itself. A mechanic has to figure out what's wrong and then do whatever is needed to fix it. Your body is different. Your body can actually fix itself! When you get a cut or burn, new skin cells grow to replace the damaged skin. When you get an infection, your body can usually fight it off. Fighting infection is the job of the immune system.

Each day, you're exposed to thousands of germs (bacteria and viruses) that can cause infections and diseases. They're floating in the air, they're on food, and they're on surfaces that you touch. Viral and bacterial infections are by far the most common causes of illness for people. They cause illnesses like colds, influenza, measles, mumps, malaria, and AIDS. When a virus or bacterium invades your body and reproduces, it can produce side effects that make you sick. However, some bacteria are beneficial. For example, you have millions of bacteria in your intestines that help you digest food. These beneficial bacteria also help your body get rid of harmful bacteria.

Your immune system prevents most germs from multiplying and causing an infection that harms your body. When enough germs get past the immune system, however, you can catch a cold, the flu, or worse. Your immune system reacts to the invading germs by producing antibodies.

Your immune system has several lines of defense against bacteria and viruses.

 Your nose, mouth, and eyes are potential entry points for germs. Tears and mucus contain an enzyme that breaks down the cell walls of many kinds of bacteria.

 Saliva in your mouth is also antibacterial. Because the nasal passage and lungs are coated in mucus, many germs not killed immediately are trapped in the mucus.

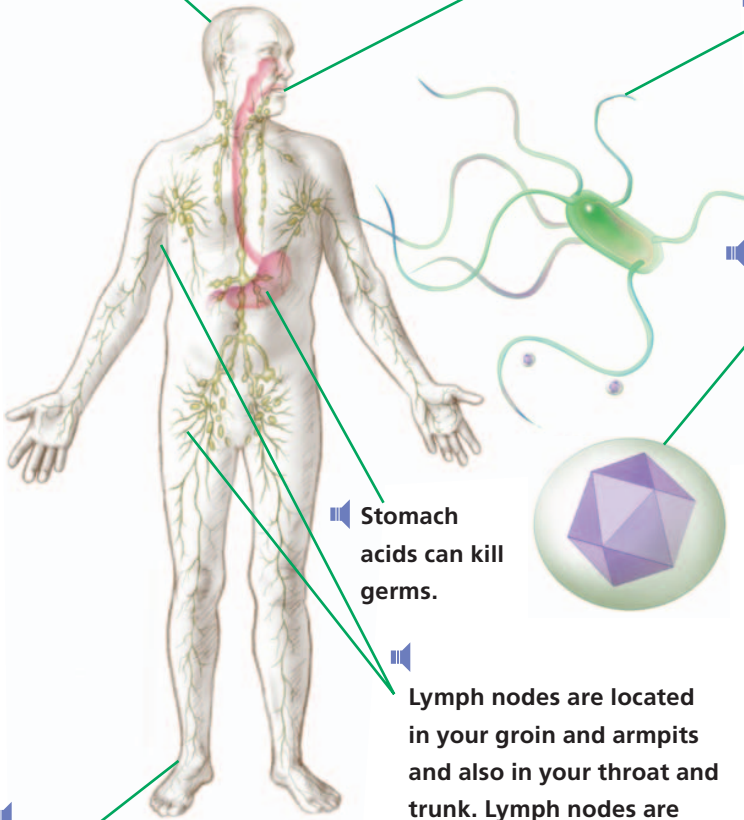
 Bacteria are one-celled organisms that are able to live and reproduce in your body.

 A virus particle is nothing but a fragment of DNA in a protective coat. When a virus comes in contact with a cell, it attaches itself to the cell and injects its DNA into the cell. The DNA uses the machinery inside your cells to reproduce new virus particles. Eventually the new virus particles are released from the hijacked cell.

 Stomach acids can kill germs.

 Lymph nodes are located in your groin and armpits and also in your throat and trunk. Lymph nodes are connected to one another by lymph vessels. The lymph system includes your white blood cells, which attack and destroy invading bacteria and viruses.

 Your skin acts as a barrier between germs and your body. The skin also secretes antibacterial substances. Most bacteria and fungal spores that land on the skin die quickly.



These antibodies fight the disease and help you get over the illness. Each different kind of germ causes the body to produce a different kind of antibody. Antibodies usually stay in your system, even after the disease has gone, and protect you from getting the same disease again. This is called immunity.

A vaccine stimulates your immune system to produce antibodies against a disease before you get the disease. Dead or weakened germs that cause a disease are made into a vaccine. You can take a vaccine as a shot or as drops to be swallowed or inhaled. Vaccines fool your immune system into thinking that it's under attack by disease, and the immune system reacts by producing antibodies. These antibodies stay in the body. Then if you are exposed to the actual disease, you are protected.

Part 2: Troubleshooting Guide

In this section of the manual, you will find information about some of the disorders of the circulatory and respiratory systems. First, the **symptoms** for each disease are given. In order to diagnose a disorder, you need to know the symptoms. Next, there is a brief explanation of the **cause** of the illness. This information may help you do things that will keep you from getting the disease. Then, some **treatment** options are provided. You can diagnose and treat some common diseases, such as the common cold, at home. However, for other diseases, doctors are needed to diagnose the problem and prescribe treatment.

Respiratory System Diseases

The Common Cold

Symptoms Your throat is scratchy and you have a runny nose. Your eyes are watery and itchy. You feel tired and congested, and you sneeze and cough frequently.

Cause There are about 200 cold viruses that can cause the common cold. You get a cold by touching virus-contaminated people or things and then touching your eyes or nose. You can also get a cold by breathing air

that contains virus-contaminated droplets. To help prevent catching cold, wash your hands often and keep your hands away from your eyes and nose.

🔊 **Treatment** Rest, drink plenty of fluids, keep warm, and use over-the-counter medicines to relieve symptoms.

🔊 The Flu

Symptoms Your head aches, and so does every muscle and bone in your body. You are cold one minute and hot the next. Your throat is sore, and you have a cough—you may have the flu! The illness usually begins suddenly, and symptoms can last for several days.

🔊 **Cause** The flu is a disease caused by a virus. It is highly contagious and tends to spread in epidemics. It affects the upper respiratory tract and may spread to the lungs. You get it mainly by breathing virus-contaminated droplets and also by hand contact.

🔊 **Treatment** Rest, drink plenty of fluids, and take over-the-counter medicine to relieve symptoms. If the symptoms are severe, you may need to go to the doctor.

🔊 Asthma

Symptoms Wheezing and coughing are the most obvious symptoms of asthma. When air tries to get through narrow airways, it makes a whistling sound. Extra mucus produced in the airways may cause coughing. Shortness of breath and chest tightness are other signs of asthma.

🔊 **People with asthma often use inhalers to help open their breathing passages.**



🔊 **Cause** Asthma is a condition in which parts of the airways become narrow, making it hard for air to get through. Scientists are not sure exactly what causes asthma, but they have identified several contributing factors. People with allergies are more likely to get asthma than people without allergies. People who had serious respiratory infections when they were very young and people exposed to air pollution and cigarette smoke are also more likely to get asthma. In asthma, airways exposed to pollutants like smoke or dust become irritated. This causes the muscles that wrap around the airways to tighten and prevent the particles from getting farther into the lungs. At the same time, the bronchial tubes become inflamed and swollen, making it even harder for air to flow through them.

🔊 **Treatment** There is no cure for asthma, but it can be controlled. Asthma medicine comes in many forms, including pills, liquids, and injections. People with asthma often use a hand-held inhaler that sprays a mist of medicine into the person's bronchial tubes. The drug works to open up the airways and relieve symptoms.

🔊 Pneumonia

Symptoms High fever, chills, pain in the chest, difficulty in breathing, and coughing are some of the symptoms of pneumonia. People with pneumonia also may cough up mucus that is pinkish or rust-colored.

🔊 **Cause** Pneumonia is an acute infection of one or both lungs. It can be caused by a bacterium, a virus, a fungus, or another organism. Usually a person gets pneumonia after another respiratory infection, like the flu or a bad cold. People who do not have a strong immune system, such as very young children or the elderly, are the most susceptible.

🔊 **Treatment** Penicillin or other antibiotics are usually effective in treating pneumonia caused by bacteria. Complete bed rest is important. Oxygen helps relieve difficulty with breathing.

🔊 Tuberculosis (TB)

Symptoms TB in the lungs may cause a bad cough that lasts longer than two weeks, pain in the chest, and coughing up blood or phlegm. Other symptoms of TB are weakness or fatigue, weight loss, loss of appetite, chills, and fever.

■ **Cause** TB is caused by bacteria. The disease mainly affects and damages the lungs, but the bacteria may spread to any other organ system. TB is spread through the air from one person to another. When a person with TB of the lungs or throat coughs or sneezes, the bacteria go into the air. People nearby may breathe in these bacteria and become infected.

■ **Treatment** If you have TB, you need to take several different drugs. This is because there are many bacteria to be killed. Taking several drugs will do a better job of killing all of the bacteria and preventing them from becoming resistant to individual drugs. It's very important to take the drugs on time, every time.

■ Emphysema

Symptoms Emphysema usually starts with shortness of breath. Eventually, every breath may require a major effort. When this happens, a person with emphysema has trouble carrying on normal activities.

■ **Cause** Cigarette smoking is the cause of most cases of emphysema. Tobacco smoke damages the lungs' alveoli. The lungs lose their normal elasticity, or stretchiness, and breathing becomes more and more difficult. Elasticity helps hold your airways open when you breathe. Loss of elasticity causes the small airways to collapse when you breathe out. This makes it impossible for you to get rid of stale air and take in enough fresh air.

■ **Treatment** Lung damage from emphysema is irreversible. Giving up smoking can slow its progression. Treatment is aimed at increasing the functional capacity of the lungs and may include using a respirator to get oxygen or having a lung transplant.

■ People with advanced emphysema need a respirator to get enough oxygen.



🔊 Lung Cancer

Symptoms The symptoms of lung cancer are coughing, shortness of breath, hoarseness, coughing up bloody mucus, and pain.

🔊 **Cause** Smoking causes about 85 percent of the deaths in the United States from lung cancer. Lung cancer is a disease of the tissues of the lungs. From the lungs, it can spread elsewhere, such as to the brain, bone, liver, or bone marrow. Lung cancer is the leading cause of cancer death in the United States in both men and women.

🔊 **Treatment** Surgery to remove tumors, radiation treatment, and chemotherapy are used to treat lung cancer.

🔊 Circulatory System Diseases

Heart Disease

Symptoms Usually heart disease is accompanied by severe or prolonged chest pain, or pain that spreads to the neck, arms, or shoulders. Shortness of breath, nausea, fainting, or sweating are other symptoms. Unexplained fatigue, weakness, or anxiety can also be symptoms of heart disease.

🔊 **Cause** Heart disease occurs when arteries that supply blood to the heart become clogged, usually because of a deposit called plaque that coats the arterial walls. Blood then clots around the plaque, blocking the blood flow through the arteries. If the blockage is moderate, there may not be enough blood flowing when the body is under stress, such as during exercise. This can lead to discomfort or pressure in the chest. If an artery is completely blocked, the part of the heart muscle connected to that artery will die, causing a heart attack. The way you live, beginning in childhood, helps determine whether you get heart disease. Eating high-fat foods, not exercising, and smoking may all increase the chances of heart disease. People with high blood pressure and high cholesterol levels run a higher risk of getting heart disease. Heredity and stress may be other factors in causing heart disease.

🔊 **Treatment** There are many ways to treat heart disease. A person having a heart attack must be taken quickly to a hospital for treatment. If the patient's heart stops beating, it must be restarted as quickly as

possible. Once the patient is stable and not at risk of dying, the doctors need to figure out what kind of treatment is needed. If the heart attack was not severe, the patient may need only rest. Medicines like nitroglycerin tablets may be prescribed to make it easier for the heart to work. A change of health habits may also be prescribed. If the heart disease is severe, drugs may not be enough. The heart may be too seriously damaged or the blood vessels too blocked. Then either the blood vessels must be opened or a bypass operation must be performed to create a new route for blood to get to the heart muscles.

Sickle-Cell Anemia

Symptoms People with sickle-cell anemia may have pain in the chest, stomach, arms, legs, or other parts of the body. This is caused by sickle cells blocking blood flow through the blood vessels. Feeling tired and having trouble fighting infections are also common symptoms.

Cause Sickle-cell anemia occurs when a person inherits two abnormal genes (one from each parent) that cause the red blood cells to change shape. Instead of being flexible and round, these cells are more rigid and curved in the shape of a sickle. Rather than moving through the bloodstream easily, these sickle cells can clog blood vessels and deprive the body's tissues and organs of the oxygen they need to stay healthy.

 **Normal red blood cells are round. The sickle-shaped cells are typical of sickle-cell anemia.**



■ **Treatment** There is no cure for sickle-cell anemia. Doctors can provide treatments that help prevent complications from the disease, however. Folic acid, a vitamin that helps the body produce new red blood cells, is often prescribed. Pain medications help relieve severe pain. Transfusions of healthy red blood cells may help carry oxygen more effectively to the tissues of patients' bodies.

■ Leukemia

■ **Symptoms** Many of the symptoms of acute leukemia are caused by a low number of functioning blood cells. A low number of functioning white blood cells can result in frequent infections. Bleeding may develop when platelets are scarce. Immature white blood cells may collect in the lymph nodes, spleen, and liver, causing enlargement and pain, or they may invade the central nervous system, causing dizziness, headache, or fever.

■ **Cause** Leukemia is a cancer of the blood-forming tissues, including the bone marrow, lymph nodes, liver, and spleen. These tissues begin to make too many white blood cells, which crowd out the red blood cells and platelets. Possible causes of leukemia include exposure to certain chemicals, such as benzene, exposure to radiation, exposure to certain drugs used in cancer treatment, or infection with a virus.

■ **Treatment** Treatment depends on the type of leukemia, the progression of the disease, and the age of the patient. Treatment may include chemotherapy with anticancer drugs, radiation therapy, blood and plasma transfusions, and bone marrow transplants. In bone marrow transplants, healthy bone marrow (either marrow donated by a closely matched donor or treated marrow from the patient) is infused into the patient after the patient has undergone a course of very high dose chemotherapy to destroy the cancerous bone marrow.



Part 3: Human Body Care and Maintenance

Like all other machines, the human body needs regular maintenance to keep it in tip-top shape. Here are some maintenance tips that will help keep diseases away and give you lots of energy. Follow these tips to keep your body performing and looking its best.

-  **1 Drink plenty of water.** Your body is 50–70 percent water. Water is necessary to keep all your body cells lubricated and working properly.
-  **2 Eat a variety of nutritious foods that are low in fat and sugar.** Your body needs calories, proteins, minerals, vitamins, and water to function properly. The Dietary Guidelines for Americans are a good general guide for a balanced diet. Breakfast is especially important to get your body going in the morning.
-  **3 Stay active.** Some machines wear out with use, but the human body actually gets stronger and functions better with use. Exercise every day. Limit the time you spend in front of the television or computer to one or two hours per day.
-  **4 Get plenty of rest.** Both your mind and body need sleep to function at their best.
-  **5 Learn how to manage stress.** Stress makes your body more susceptible to disease. Participate in activities that you find relaxing, such as hobbies, music, yoga, or meditation.
-  **6 Maintain a healthy weight.** Extra weight puts a strain on all of the body systems.
-  **7 Don't smoke.** Smoking is bad for you and bad for others, too. Smoking is the leading cause of emphysema and lung cancer, and it also causes heart disease.
-  **8 Keep your hands clean.** Wash with soap and water after you go to the bathroom, before you eat, and after you play outside. Washing your hands will prevent many disease-causing germs from entering your body.

Follow the Human Body Care and Maintenance tips to keep your body performing and looking its best.



Think and Write

-  1. Explain how food and oxygen get to a muscle cell in your big toe.
-  2. What are some health habits you can follow to prevent heart disease, emphysema, and lung cancer?
-  3. When a family member has a cold, what are the lines of defense in your immune system that might prevent you from catching the cold?
-  4. **Persuasive Writing** It is very difficult to persuade young people to change their health habits. Write a convincing brochure for youth your own age about important health habits they should follow and reasons for doing so.

Hands-On Activity

You will need an adult volunteer to help you with this experiment. Ask the adult to let one hand hang low for a minute, so that its veins stand out, and then place the hand on a table, palm down. Find a vein on the back of the hand, and press a finger on it, firmly but gently. Place a second finger on the same vein, very close to the first finger, and closer to the wrist. With your second finger, stroke the vein toward the heart. This empties the vein of blood. Lift the second finger. The vein does not refill because a valve stops the blood from flowing backward. Lift the first finger to allow more blood to flow into the vein. The English scientist William Harvey did this experiment in the early 1600s to show how blood flows along veins back to the heart and how valves in the veins stop blood from flowing the wrong way.

School-Home Connection

Share this reader with a family member. Discuss diseases of the circulatory and respiratory system. Talk about what the symptoms, causes, and treatments of these diseases are. Discuss what measures your family members have taken to prevent these diseases and what prevention measures you can take in the future.