Name _____ Date _____

Human Body Systems

"Keep You Alive"

Learn more about this topic! Each section gives more detail on one of the lyrics from the song. Read each section, and then respond by answering the question or taking notes on key ideas.

Lyric: Whatever you're doing, wherever, whenever, 12 systems working together. 24/7, 365, Your body systems keep you alive

Your body systems are always working to keep you in motion!

Even when you're doing something as simple as sitting on the bus, your body systems are hard at work. Your brain in the nervous system is interpreting the sights and sounds sent to it by your senses. You're breathing in, and your circulatory system is picking up the oxygen from the respiratory system and exchanging it for carbon dioxide. Suddenly you feel hungry, thanks to your endocrine system. So, your nervous system sends signals to the muscles in your arm, which are connected to your bones, to let you reach into your lunch bag and pull out a sandwich. You eat the sandwich, and your digestive system starts breaking it down so that your cells can use the nutrients. Someone sneezes on you — your immune system protects you, with help from the lymph nodes in your lymphatic system. Meanwhile, your excretory system has been filtering out waste, and now you have to go to the bathroom! The bus is hot, and you're sweating through the pores in the skin from your integumentary system.

Notes

Lyric: Unless your body maintains its homeostasis

Your body systems are always working to keep you alive.

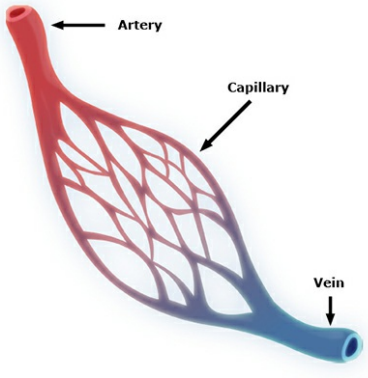
Throughout the day, your body is exposed to all kinds of different conditions. You might walk out under the hot sun at the beach or into an chilly, air-conditioned room. You might run several miles or eat a very sugary doughnut. Why doesn't your body change drastically whenever external conditions change? Thanks to **homeostasis**: the tendency of organisms to keep their internal environments stable, or constant, despite changes in external conditions. This includes keeping things like our body temperature, amount of water in our body and level of sugar in our blood fairly stable. Maintaining this balance is critical for survival.

How does your body maintain homeostasis in the beach scenario above? When you go to a hot beach, your body temperature rises. Normal human body temperature is 98.6 degrees Fahrenheit, and negative effects occur if the body temperature rises much higher or falls much lower. Your body has an "internal thermometer" in the hypothalamus, a part of the brain. When the hypothalamus detects that your temperature has risen too much, it send signals to your sweat glands, telling them to start producing sweat. When the sweat droplets evaporate, your body cools down.

As you can see, multiple body systems, including the nervous, endocrine and circulatory, work together to maintain your body's inner balance. So the next time you're sweaty and red-faced, just smile and enjoy your homeostasis!

Notes

Lyric: The circulatory system

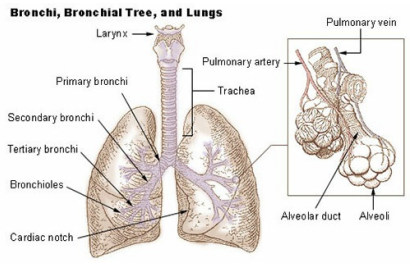


Capillaries connect your veins and arteries.

The purpose of the circulatory system, or the cardiovascular system, is to carry oxygen, water and nutrients to each cell in the body and to carry away carbon dioxide and other wastes. It does this by circulating a fluid called **blood**, which carries the molecules of water, nutrients and waste. To "circulate" means "to move through a closed system." The main organ of the circulatory system is the **heart**, a muscle that beats a little more than once per second and pumps blood throughout the body. Blood travels through the body through tubes called blood vessels. There are three different kinds of blood vessels: **arteries**, **veins**, and **capillaries**. Arteries carry blood *away* from the heart. The most important artery is the aorta, which pumps blood full of oxygen out to smaller arteries from the heart. Veins carry blood back to the heart. **Capillaries** are the tiniest blood vessels. They connect arteries to veins. Capillaries are where the materials like nutrients and waste are exchanged between the blood and the body's cells.

Notes

Lyric: Now, we got the respiratory



In alveoli, carbon dioxide is exchanged for oxygen.

The purpose of the respiratory system is to transfer oxygen to the blood from the air and to remove carbon dioxide from the blood. This process is called **respiration**, and breathing is part of it. Our cells need oxygen to release the energy from food. When they do this, they create carbon dioxide as a waste product. This waste is eliminated by the respiratory system.

How does it work? There's a large, sheet-like muscle at the bottom of the ribcage called the **diaphragm**. When you breathe in, the diaphragm gets smaller and moves down. This lets your **lungs**, the main organ of the respiratory system, fill with air. Air first enters your body through the mouth and nose and moves through the **pharynx** (throat) and **trachea** (windpipe) into branching tubes in your lungs. These tubes divide into smaller and smaller branches until they become tiny sacs called **alveoli**. Remember the capillaries? They surround the alveoli. This lets the respiratory system exchange oxygen and carbon dioxide with the circulatory system. In the alveoli, blood in the capillaries picks up the oxygen from the air. In exchange, the alveoli receive the carbon dioxide waste product from the blood. When you breathe out, the diaphragm gets larger and moves upward, forcing air filled with carbon dioxide out of your lungs, through the trachea and throat and out of your mouth and nose.

Notes

Lyric: digestive

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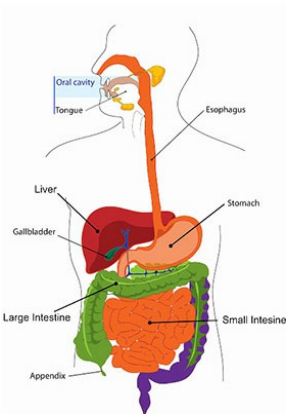

From the moment you start chewing, digestion is at work!

Your lunch of a tuna sandwich, an apple and some carrot sticks is great for your body — but your cells can't use the food in that form! What we eat and drink must be broken down into smaller molecules before our cells can use them for energy, growth and healing. This process is called **digestion**. Digestion starts in our mouths when our teeth chew food into a soft pulp. This is called **mechanical digestion** because the food is physically broken down into smaller pieces, but its chemical composition remains the same. A bit of **chemical digestion**, or the breakdown of nutrients into smaller molecules by proteins called enzymes, also starts in the mouth. The chewed up food then moves through your **esophagus**, a muscular tube that connects the throat to the **stomach**. The stomach is an organ with thick, muscular walls that produce strong digestive juices filled with enzymes. The stomach churns up the food into a soupy substance called **chyme**, and the enzymes continue chemical digestion.

Lyric: Into nutrients that your cells need

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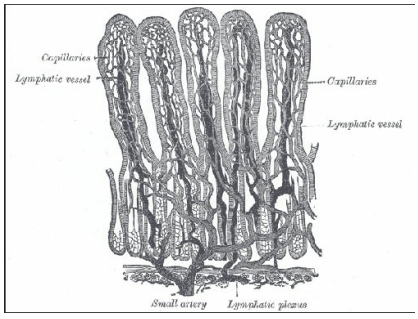

The lining of your small intestine is folded into projections call villi.

The chyme moves to the **small intestine**, which actually isn't so small! It's about 20 feet long, but it's called "small" because its diameter is smaller than the **large intestine**'s diameter. The small intestine is where most of the nutrients from the food are absorbed into the bloodstream to be delivered to the rest of the body. The lining of the small intestine is made up of small, fingerlike projections called **villi**. The villi absorb food molecules, which are then passed into the blood. Whatever is left over after the small intestine moves on to the large intestine, which is shorter but wider. At this point, what's left over is mostly water and material that can't be digested. The extra water and minerals are absorbed through the walls of the large intestine. What's left is finally squeezed down to the **rectum** at the end of the large intestine and expelled through the **anus** as waste material called **feces**.

Lyric: nervous system

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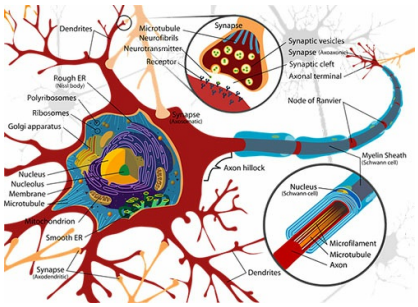

Neurons send signals within your body.

The nervous system is responsible for the body's muscle movement, coordination and control. It interprets information about our surroundings that's provided by our senses. The nervous system is divided into the **central nervous system** and the **peripheral nervous system**. The central nervous system is composed of the **brain** and the **spinal cord**. The brain is the major control center. It gives us the power to think, move, write, solve problems and imagine. It interprets all the information sent to it from outside and inside the body, and it controls our body temperature, heart rate and breathing. The **spinal cord** is a bundle of nerve fibers that runs along the back and connects the brain to all of the other nerves in the body. These nerves that extend throughout the body are called the **peripheral nervous system**. They transfer messages to and from the brain via the spinal cord. Your peripheral nervous system is divided into the **somatic** and **autonomic nervous systems**. The **somatic nervous system** controls your voluntary actions — for example, when you decide to pick up your phone to text your friend or to kick a soccer ball. The **autonomic nervous system** controls the bodily functions that happen on their own, like breathing or the heart beating. Cells of the nervous system, or nerves, are called **neurons**.

Lyric: muscular system

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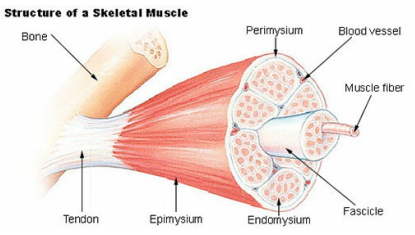
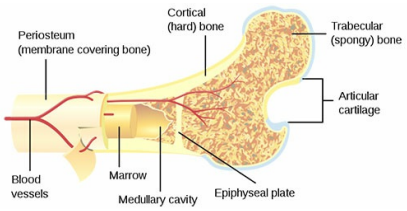


Muscles help you move your skeleton!

The muscular system helps the body move and gives it shape. Muscles work in pairs: one muscle in the pair **expands**, or gets longer, while the other one **contracts**, or gets shorter. Muscles can be **voluntary** (you consciously control their movement) or **involuntary** (you don't). **Skeletal muscle** is the muscle attached to your skeletal system that allows your bones to move up and down. Skeletal muscle is voluntary because it is controlled by conscious thought. **Cardiac muscle** is the muscle in the heart that pumps blood throughout the body. Cardiac muscle is involuntary because you don't control your heart beating. **Smooth muscle**, muscle found in sheets or layers, is also involuntary. Smooth muscle is found in places like the stomach, esophagus, bladder and blood vessels.

Lyric: skeletal system

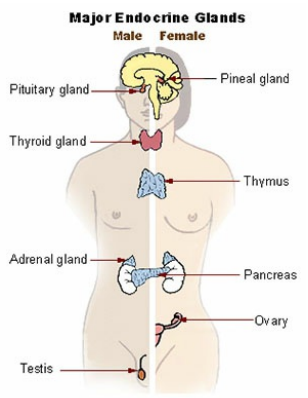


Bones have multiple layers.

The skeletal system works with the muscular system to help you move. It also provides structure and support to the body, stores minerals, creates blood cells and protects your internal organs. For example, the **cranium**, or skull, protects the brain, and the **ribcage** protects the heart and lungs. There are about 206 bones in the skeletal system, as well as flexible connective tissue called **cartilage**. You can feel cartilage on the sides of your nose and the tops of your ears. **Joints** are the places where two bones meet. Without joints, we wouldn't be able to move. Different kinds of joints allow bones to move in different ways. For example, hinge joints, like those in your elbows and knees, allow back and forth movement. Bones are made up of an outer layer called **compact bone**, which is heavy and hard. The compact bone protects layers of **spongy bone**, which is filled with spaces and looks like a honeycomb. Deep inside the bone is **bone marrow**, a jelly-like substance where blood cells are made.

Notes

Lyric: endocrine



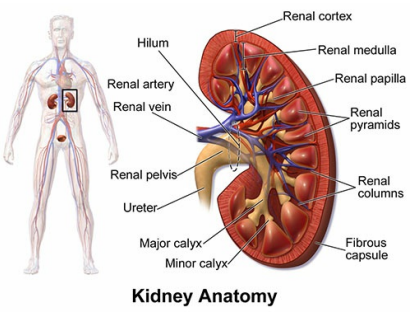
Males and females have many of the same endocrine glands.

The endocrine system works closely with the nervous system and helps regulate the body's growth and development, mood, tissue function, metabolism and reproductive processes. It's made up of **glands**, groupings of cells that secrete chemical messengers called **hormones**. Each hormone communicates with and affects a certain type of cells, called its target cells. Target cells have receptors that attach to the hormones that affect them. Important organs and glands of the endocrine system include the hypothalamus, a collection of specialized cells in your brain; the pituitary gland; adrenal glands; thyroid gland; pineal gland; thymus gland; and the pancreas. In the video, we mention the hormone that "helps indicate hunger," which is called **ghrelin**. Ghrelin is a hormone produced primarily by the stomach but also the pancreas. Before you've eaten, ghrelin levels increase. It's thought that the hormone stimulates your appetite and makes you feel hungry. After you eat, ghrelin levels go down.

Other hormones include growth hormone, which is produced by the pituitary gland and causes bone and body tissue to grow. The pineal gland produces a hormone called melatonin, which helps regulate the cycle for sleeping and waking. The adrenal glands produce a hormone called epinephrine, or adrenaline, that controls the body's response when it experiences stress. Have you ever felt your heart beat fast when you're stressed or nervous about something? You can thank your endocrine system for that!

Notes

Lyric: excretory system



Kidney Anatomy

Waste is filtered out of your blood in the kidneys.

The excretory system disposes of waste material, like excess liquid and heat energy, from the body. When we talk about the excretory system, we're usually referring to the **urinary system**, which gets rid of liquid waste, or urine. However, the lungs and the skin are also part of the excretory system because they also dispose of bodily wastes. The respiratory system excretes carbon dioxide, and sweat is excreted through the skin. The process of sweating gets rid of excess heat from the body since the body cools down as the sweat evaporates.

The main organs involved in the creation of urine are the **kidneys**. There are two bean-shaped kidneys in the body, one on each side. Each kidney contains about 1 million tiny filtering units called **nephrons**. Blood containing waste materials collected from cells enters the kidneys through arteries. The nephrons filter out the waste, which combines with water to make urine. The urine then moves from the kidneys through two **ureters**, thin tubes of muscle, to the **bladder**, a muscular sac that stores it. When the bladder gets filled up...well, you know what happens then! Circular muscles keep the urine from leaving your bladder until you're able to use the bathroom. Then, urine moves out through another tube called the **urethra**.

Notes

Lyric: integumentary System

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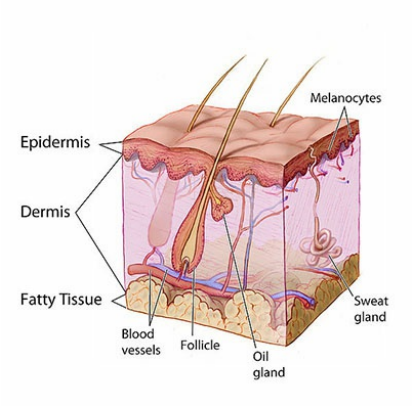
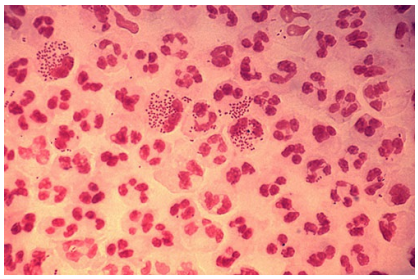


Your skin acts as a barrier that protects your body.

Imagine if all the muscles and organs of your systems didn't have anything covering them — they'd be exposed to a lot of disease-causing microorganisms and injury. A major function of the integumentary system is to protect the body. The integumentary system is made up of the skin, related glands that produce sweat and oil, hair and nails. The skin provides a barrier to keep microorganisms that can make us sick, like viruses and bacteria, from entering. It also helps regulate body temperature, guards the body against the sun's rays and contains sensory receptors that let the body feel touch, temperature and pain. The skin is divided into layers: the **epidermis** is the top layer and is where new skin cells are made. The **dermis** is below the epidermis; this is where sweat glands and the roots of your hair are found. Below the dermis is **subcutaneous fat**, and its functions include controlling temperature. The skin is your body's largest organ with a surface area of about 18 square feet!

Lyric: immune system

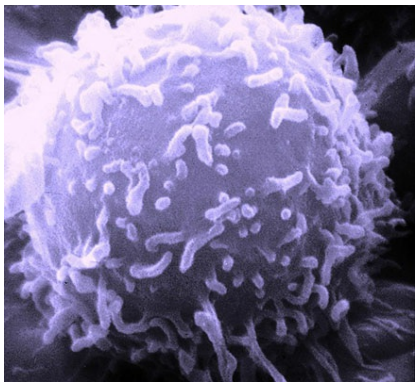
Notes



An image from a microscope of bacteria inside phagocytes.

The immune system protects the body against disease-causing organisms called **pathogens**. Examples of pathogens include viruses, bacteria, fungi and parasites. There are different stages of the immune system's response. The first line of defense is your skin and the mucus in your respiratory tract and the acid in your stomach, which can kill pathogens. If pathogens make it past these, the immune system activates the second line of defense. This is a general response, not specific to the kind of pathogen that's invading. During this response, white blood cells called **phagocytes** swallow and break down invaders. The site of an infection may become **inflamed**: red, swollen, hot and painful. You might get a fever. These are signs that your immune system is in the midst of a fight against pathogens.

Lyric: White blood cells break 'em down



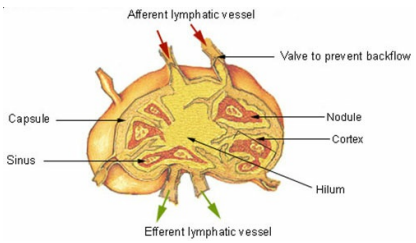
An image of a lymphocyte from a scanning electron microscope

Pathogens that make it past these general barriers then face the third stage of the immune response. This response is specialized; the body uses a specific weapon to target the exact pathogen that's invading. The white blood cells involved in this response are called **lymphocytes**. Lymphocytes tell the difference between invaders based on markers on their surfaces called **antigens**. **B lymphocytes** produce **antibodies**, specialized proteins that target specific antigens. An antibody binds to an antigen like a lock in a key. Then, **T lymphocytes** arrive on the scene. Some T lymphocytes destroy the invaders that have been tagged by antibodies. Others help direct the immune response by stimulating B cells, phagocytes and other T cells.

Once antibodies have been produced for a specific antigen, they continue to exist in your body. If the same antigen tries to attack your body again, the antibodies are already there to get rid of it, and it won't make you sick. We call this being **immune** to a disease. That's why if you ever had the virus mononucleosis ("mono"), you probably won't get it again. On the other hand, you've probably come down with a common cold many times in your life. This is because there are over 200 different viruses that cause the common cold. Even if you build up immunity to one, chances are you'll get one of the other 199 next time, and your antibodies won't be effective!

Notes

Lyric: lymphatic



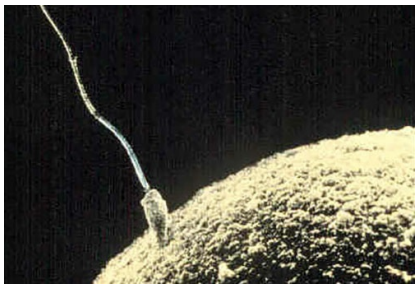
The structure of a lymph node

The lymphatic system is a network of vessels that helps keep the level of fluid in the body balanced. It absorbs excess fluid called **lymph** from body tissues and returns it to the bloodstream. **Lymph** is a clearish white fluid that contains substances like protein molecules, salt and sugar, as well as white blood cells.

The lymphatic system also plays a huge role in defending the body against germs. B and T lymphocytes are created and fight infection inside small organs of the lymphatic system called **lymph nodes**. Lymph nodes filter lymph fluid, and most are found in clusters in the neck, armpit and groin. When they detect foreign invaders during the filtering process, they manufacture more lymphocytes, causing the nodes to swell. This is why you might feel swollen lumps in your neck, for example, when you're sick. The lymphatic system is also composed of **vessels** that drain lymph fluid from all over the body. Lymph fluid only moves in one direction — upward, toward the veins at the base of your neck — where it rejoins the circulatory system. The **spleen** is another major organ in the lymphatic system and filters blood.

Notes

Lyric: reproductive



A sperm cell and and egg cell must meet to create life.

Reproduction is the process by which organisms make more organisms, and the reproductive system is what makes it possible. The organs of the female reproductive system include the **vagina**; the **uterus**, the organ where babies grow before birth; and the **ovaries**, the organs that produce hormones and female sex cells called **eggs**. The male reproductive system includes the **penis**; the **testes**, which produce hormones and male sex cells called **sperm**; and the **vas deferens** and **epididymis**, tubes that transport sperm. In the human reproductive process, both a sperm cell and an egg cell, also called **gametes**, are necessary to create a new organism.

The development of the reproductive system depends on the endocrine system. When people reach puberty, the time when they develop from children to sexually mature adults, the pituitary gland releases hormones. These hormones tell the testes in males to start producing the hormone testosterone and the ovaries in females to start producing the hormone estrogen. Testosterone and estrogen then cause the changes that transform boys and girls into men and women.

Notes