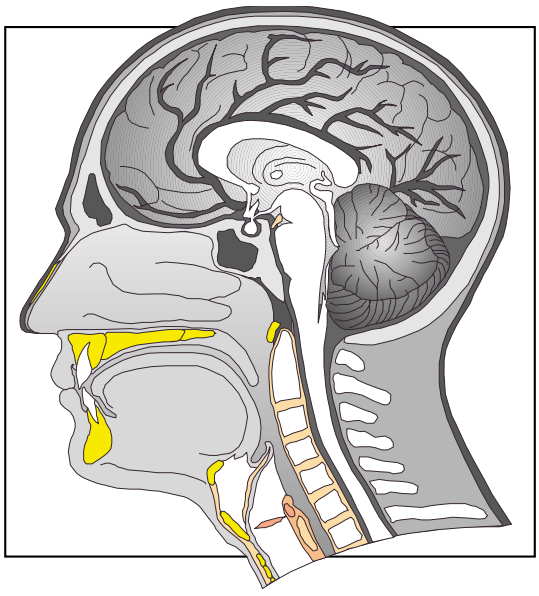
Unit 9: More Human Body Systems



Vocabulary

Study the vocabulary words and definitions below.

antibodies ..... proteins that stick to pathogens and make them harmless

auditory nerve ..... the nerve that sends information from the ear to the brain

cerebellum ..... the middle part of the brain; coordinates motor impulses

cerebrum ..... the uppermost and largest part of the brain; responsible for complex thought processes

cervix ..... the opening of the uterus

cochlea ..... a spiral-shaped tube deep inside the ear whose neurons react to sound wave patterns

embryo ..... the developing individual inside the uterus

Fallopian tubes ..... tubes that connect the ovaries to the uterus

glands ..... structures in the endocrine system that produce hormones

hormones ..... biochemical messengers in the endocrine system

immunization ..... a small amount of a dead or weakened pathogen that is introduced to the body so that lymph cells can produce specific antibodies to disable the pathogen in its stronger, more dangerous form

lymph nodes ..... special structures in the body that produce antibodies

medulla ..... the lowermost part of the brain; maintains the involuntary function of vital organs, such as the heart, the intestines, and endocrine glands

menstruation ..... a monthly discharge released from the uterus when the lining decays after the egg is not fertilized

neurons ..... long, thin cells that make up the nervous system

olfactory nerve ..... the nerve that sends information from the nose to the brain

optic nerve ..... the nerve that sends information from the eye to the brain

ovaries ..... female sex organs that produce female sex hormones and female sex cells, or eggs

pathogens ..... disease-causing agents that invade the body

penis ..... the sex organ by which the male ejects sperm into the female reproductive system

phagocytes ..... white blood cells that surround and swallow pathogens

placenta ..... a special organ that provides the embryo with oxygen and nutrients and disposes of its waste products

retina ..... a surface at the back of the eye that contains neurons that pass on information about the light patterns it receives

scrotum ..... the sack of skin that houses the testes

semen ..... a mixture of sperm and other fluids that help the sperm survive

taste buds ..... little, flask-shaped structures in the tongue containing neurons that react to different tastes

testes ..... male sex organs that produce male hormones and male sex cells known as sperm (*sing.* testis)

uterus ..... the sex organ in which the fertilized egg will develop

vagina ..... a muscle-lined canal connecting the opening of the uterus to the outside of the body

Introduction

In Unit 8, we began our inspection of the human body and the many biological systems that make it work. With Unit 9, we will finish that inspection by looking at the *nervous* system, the *endocrine* system, the *reproductive* system, and the *immune* system. We will also consider the many different types of disease that disrupt or slow down a particular body system or perhaps bring all of the interacting systems to a grinding halt. Once again, it's important to keep in mind how each system overlaps and contributes to the others.

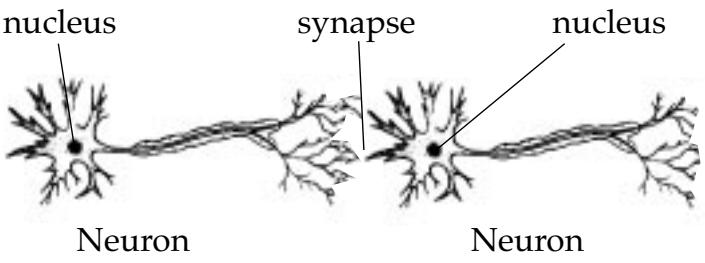
The Nervous System

The nervous system is involved in every movement of every muscle. Nerves are a part of voluntary movements, such as seeing a luscious brownie and reaching for it. They also cause the motion of involuntary muscles, such as the heart's beating or the intestines' pulsing.

The cells that make up the nervous system are called **neurons**. Neurons are like parts of an electrical wiring system that carry messages from the sense organs—for example, the eyes, ears, or nose—to the "master control center," the brain. The brain analyzes all of the information it receives and determines what action the body should take. Thus the nervous system can bring about anything from a tiny quiver to a great thought.

Neuron Structure

Like any other cell in the body, the neuron has a nucleus and organelles. Yet the neuron is special in that it has a long, thin shape with branching ends. This shape helps the neuron act as a message pathway—a sort of telephone wire—for the body. Neurons are often bunched together like a cable of wires. These bunches of neurons are known as *nerves*.



Messages travel along neurons as tiny surges of electricity. Electrically charged atoms of sodium and potassium, called *ions*, are concentrated on opposite sides of the cell membrane of the long neuron fiber. As an electrical impulse moves along the neuron, the cell membrane suddenly allows these ions to change sides—sodium ions rush inside the fiber and potassium ions rush out. Thus the nerve impulse moves down the fiber like a wave. It is a wave of chemicals that produce electricity. After the impulse passes a given spot, the concentration of ions returns to its pre-impulse condition. All of this happens in less than one millisecond (one-thousandth of a second)!

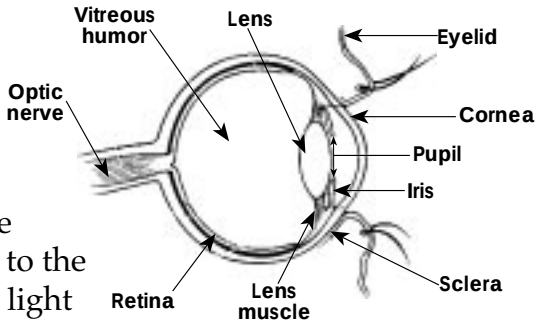
The Sense Organs

When we think of senses, we usually think of the big five: sight, hearing, smell, taste, and touch. Sense organs take in information from the world around us through neurons and send it to the brain to be processed. The brain then sends back a message along a separate nerve pathway to tell the sense organs what to do next.

The Human Senses

Sense	Sense Organs	Function
sight	**eyes**	pick up patterns of light; lens forms image on *retina*; impulses from *optic nerve* go to the brain; the brain interprets and decodes the image
hearing	**ears**	the outer ear directs sound waves through ear canal; sound waves vibrate through the middle and inner ear systems; information travels via the *auditory nerve* to the brain where it is interpreted and decoded
smell	**nose and nasal cavities**	chemicals in the form of a gas are detected by *neurons*; neurons line the top of the nasal chamber; the *olfactory nerve* carries the message of smell to the brain where it is interpreted as smoke, perfume, or some other odor
taste	**tongue and nose**	small bumps on the surface of the tongue called *taste buds* cause sense of taste; special nerve cells detect chemicals and send signals to the brain; taste buds sense only sour, sweet, salty, and bitter; our nose and the smell of food helps our appreciation
touch	**skin**	five types of nerve cells detect pain, pressure, touch, heat, and cold; signals sent to the brain for decoding; most nerve cells found in the *dermis* (thick inner layer); only nerve cells which detect pain found in the dermis and *epidermis* (thin outer layer)

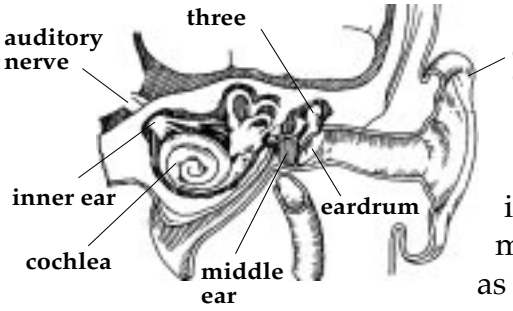
The Eyes



The eye allows us to see by picking up patterns of light, which pass through the lens of the eye to form an image on the **retina,** which lies at the back of the eye. The neurons of the retina send impulses to the **optic nerve** according to how much light they take in. From there, the nerve impulses go to the brain, which interprets the signals from the optic nerve and, finally, shows us what we perceive as a vision of the outside world.

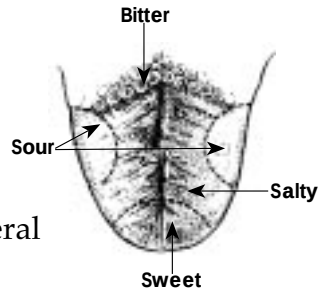
The Ears

The ears perceive sound as air molecules that are set in motion. We call these vibrating air molecules *sound waves*. Sound waves hit the whole body, thus people can sometimes "feel" sounds even if their ears don't work. In healthy working ears, the outer ear structure channels the sound wave down the ear canal to the eardrum. The eardrum picks up the vibration and passes it on to tiny bones inside the ear. These bones pass the vibration on to another membrane that causes fluid inside the spiral-shaped **cochlea** to move. Neurons inside the cochlea react as fluid moves past them. The **auditory nerve** gathers this information and sends it to the brain, which interprets the specific patterns of the vibrations as specific sounds. The inner ear also contains tiny hairs that detect gravity and help us keep our balance.



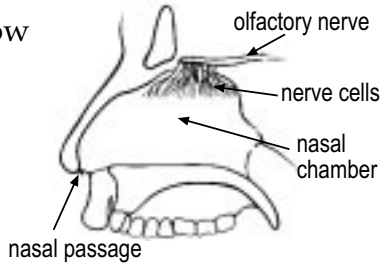
The Tongue

The tongue gives us the sense of taste through its tiny **taste buds**. These are little, flask-shaped structures with pores in the top. Food dissolved in saliva enters these pores. Then hairlike nerve endings inside react, sending signals to the brain. Research shows taste buds can sense only four general flavors: sour, sweet, salty, and bitter. Much of our appreciation of food stems from its smell.



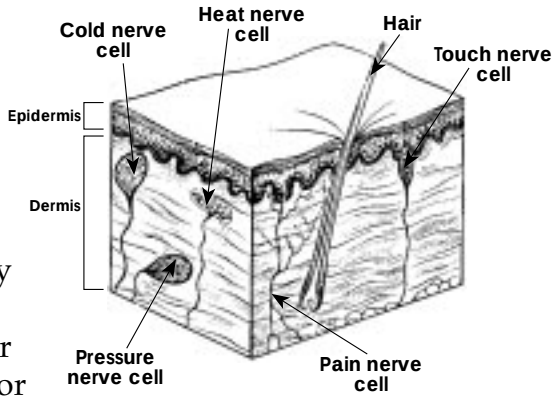
The Nose and Nasal Cavities

Neurons inside the nose and nasal cavities allow us to smell. Smells enter the nose as chemicals floating in the air. Different groups of nasal neurons are sensitive to particular types of chemicals. They send signals that travel through the **olfactory nerve** to the brain where they are interpreted as odors.



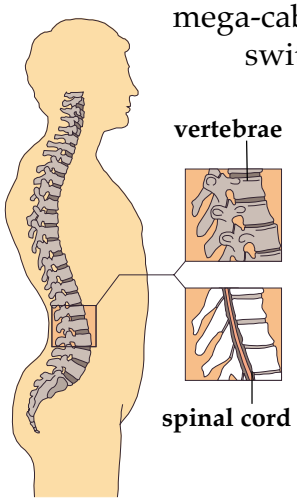
The Skin

Besides the sense of touch, the skin can feel several other conditions: pain, pressure, heat, and cold. Different neurons in the skin are responsible for sensing each of these conditions. According to their job, the neurons are either very close to the skin surface, as with neurons for pain or touch, or deeper in the skin tissue, as with neurons for pressure.



The Spinal Cord

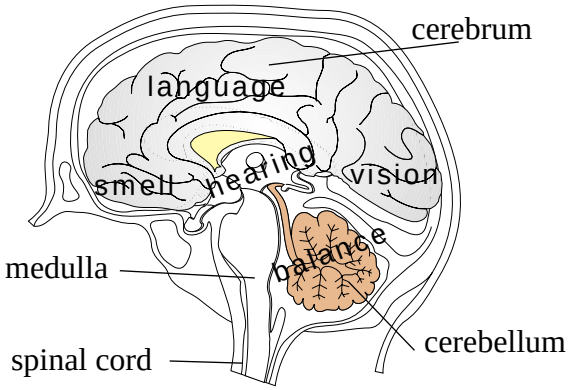
If you think of a nerve—a bundle of neurons—as a telephone cable filled with telephone wires, then you can think of the spinal cord as the mega-cable for the body's nervous system, leading to the main switchboard, the brain. The spinal cord carries sensory messages from the body to the brain, and motor impulses from the brain to the body.



The spinal cord leads directly from the brain and descends about two-thirds of the way down the back. It is protected by the bones of the spinal column, called *vertebrae*. The inner part of the spinal cord is made up of "gray matter," the same tissue of densely packed neurons of which the brain is made. The outer part is made of nerve fibers. Many spinal nerves branch off from the spinal cord between the bones of the spine.

The Brain

The brain is divided into three major parts: the **cerebrum**, the **cerebellum**, and the **medulla**. Nerves carry electrical impulses which may have been caused by external or internal factors to the brain. For example, we respond by eating the food that smells good to us. However, pain in our stomach caused by eating spoiled food may cause us to vomit. As we examine how the three parts of the brain function, we will see how the different organs and parts of the body communicate.



brain

The upper part of the brain, the cerebrum, is the largest part of the brain. It's the cerebrum most people picture when they think of the brain—gray and ridged with deep wrinkles and furrows. The cerebrum is responsible for *complex thought processes* such as language, reasoning, and artistic efforts. It stores information as memories. It also receives and interprets information from the sense organs and sends impulses to the muscles for voluntary motions. The cerebrum is made up of two halves: the right half controls the left side of the body and the left half controls the right side.

The cerebellum helps the cerebrum to control *muscular activity*. It coordinates impulses sent to the muscles so that motion is smooth, not jerky. The operation of the cerebellum is involuntary. The cerebellum lies beneath the cerebrum.

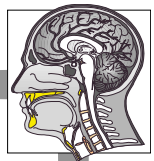
The medulla is the bottom part of the brain, lying at the base of the skull and at the top of the spinal cord. The medulla controls *vital involuntary motions*, such as the activities of all internal organs. These activities include respiration and the actions of the heart and digestive organs. The medulla also controls the actions of **glands** that release the biochemical messengers of the endocrine system, which we'll look at next.

The Endocrine System

The nervous system isn't the only means by which our bodies can send messages from one part to another. The endocrine system is a network of organs that produce chemical messengers known as **hormones**. These organs are known as glands and are located in many different places in the body. They travel from place to place in the bloodstream. Some hormones are complex proteins, and others are not. Specific hormones cause specific changes to take place in certain body parts or organs.

Glands: Their Location and Function

	Location	Function
Pituitary	brain	controls growth and regulates sex organs
Thyroid	throat	regulates use of food in body cells
Parathyroid	throat	controls calcium levels in body
Adrenal	near kidney in central back	produces adrenaline which allows bursts of energy; controls salt levels
Pancreas	near kidney in central back	produces insulin, which controls the amount of sugar in the blood and helps sugar enter cells
Ovary	lower abdomen	controls female sex characteristics in females
Testis	testicles	controls male sex characteristics in males



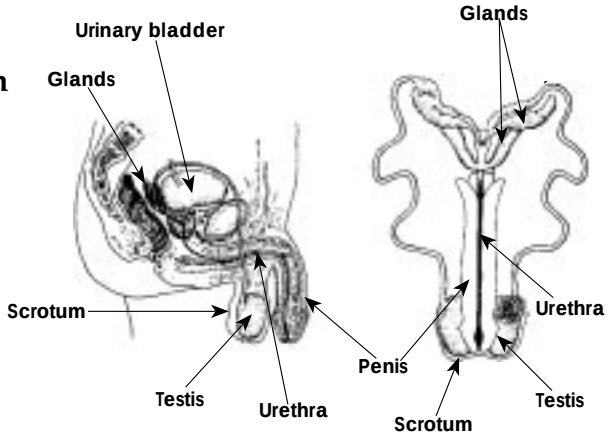
All of these glands, and the hormones they produce, play important roles in the body. No doubt you've heard of some of them. For example, the pancreas produces insulin. Insulin acts as a gatekeeper for cells, allowing sugar to move from the bloodstream into the cell, where it is used as food. A lack of insulin or the body's inability to use insulin properly causes *diabetes*. People with diabetes do not have or cannot use their own insulin to let sugar into their body cells. Thus there's a high level of sugar in the blood and urine, yet the cells are starving. This condition can now be corrected by injecting insulin produced from pigs, cows, or sheep.

The Reproductive System

Hormones play a big part in bringing the sexual organs of men and women to maturity. Hormones also play a big part in making the reproductive system work. One of their main functions is to make males and females attractive to each other so that they will mate and bear offspring. As we've seen through our study of other body systems, each system is designed to achieve its goal as efficiently as possible, and the goal of the reproductive system is to reproduce. Humans, however, unlike most other animals, have the ability to rise above the hormonal urges of their reproductive systems. Humans are able to think about what they want for themselves.

In some ways it seems odd to discuss the structure and operation of the human reproductive system as just another biological topic. For most of us, the reproductive system is associated with ideas of love, romance, desire, and commitment. In many ways, however, it is especially important to be objective and knowledgeable about how the reproductive system works. Knowing the facts means that you can control when or if you have children and whether or not you become infected with serious or even deadly diseases.

The Male Reproductive System



The **testes** (*sing.* testis) are the male sex organs that produce male sex cells, known as *sperm*. The testes also produce testosterone, a hormone that helps create and maintain male sex characteristics. These characteristics include the sex

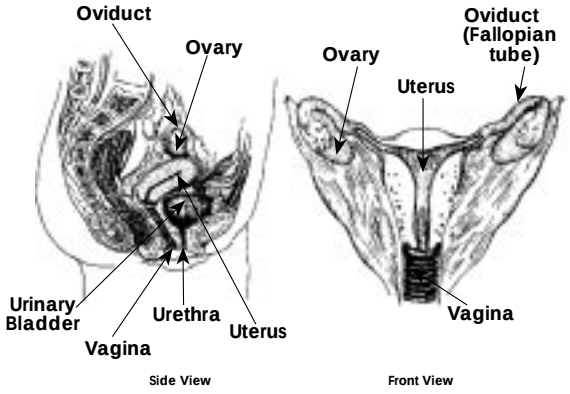
organs themselves as well as other traits such as body hair, muscular development, and a deeper voice. The testes are housed in a sack of skin called the **scrotum**.

Sperm develop from special cells in the testes. These cells divide by meiosis. If you'll recall the cell division described in Unit 4, meiosis gives each sex cell only half the number of chromosomes as the parent cell. When the male sex cell unites with the female sex cell, the egg, the offspring has the same number of chromosomes as the parents.

After the sperm leave the testes, they mix with several fluids from other glands. This gives them energy and more resistance to acidity. The resulting mixture is called **semen**. During sexual intercourse, semen is ejected into the female reproductive system through a sex organ called the **penis**. As many as 130 million sperm may be ejected at a time.

The Female Reproductive System

The **ovaries** are the female sex organs that produce female sex hormones and female sex cells, or eggs. Like sperm, eggs are produced through meiosis and contain only half the chromosome number of the parent.



In humans, the ovaries usually release one egg each month. The egg moves from the ovaries into the **Fallopian tubes**, which are tubes that connect the ovaries to the **uterus**. The uterus is the sex organ in which the egg will develop if it is fertilized. Each month, hormones in the body prepare the uterus for the possibility of nurturing a fertilized egg as it develops into another individual. These hormones give the uterus a soft, spongy lining with lots of blood vessels to deliver nutrients. If the egg is not fertilized, this lining decays and drains out of the uterus at the end of the monthly cycle. This discharge is known as **menstruation**. It leaves the uterus through an opening called the **cervix** and exits the body through a canal called the **vagina**. The vagina serves as an entry point for sperm during sexual intercourse and also as the birth canal.