Name_____

Mrs. Caro Period _____

Human Body Systems Notes

Levels of Organization

cells ⟶ tissues ⟶ organs ⟶ organ systems ⟶ body (organism)

Cells are specialized into tissues. Tissues are groups of cells specialized to do certain jobs.

Specialization or differentiation occurs because only some genes in the nucleus of a cell are "turned on". Almost every cell has a complete set of genes, but only those needed for the cell's particular job are active. So while red blood cells have all the genetic information needed to make nerve cells, bone cells, and skin cells, all those genes are turned off and only the red blood cell genes are turned on.

There are 11 human body systems. They are:

Digestive	**M**uscular	**U**rinary/Excretoy
Reproductive	**C**irculatory	**R**espiratory
Integumentary	**S**keletal	**E**ndocrine
Lymphatic	**N**ervous	

Body Systems:

Digestive System

Major Function – breakdown and absorb nutrients that are necessary for growth and maintenance

Major Organs – mouth, teeth, salivary glands, esophagus, large intestine, small intestine, rectum

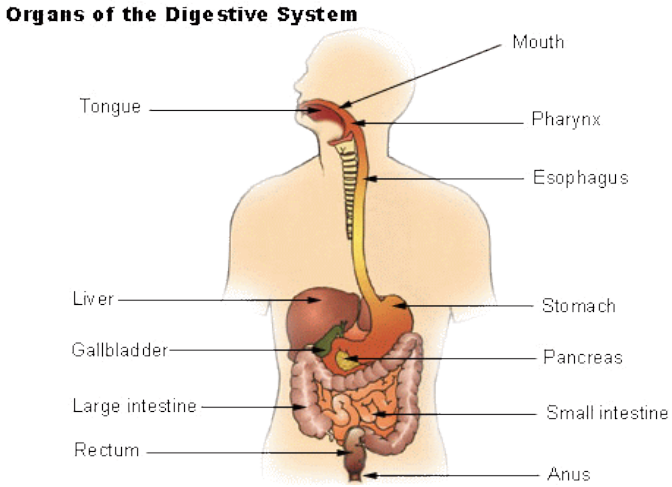
The digestive system is responsible for the breakdown and absorption of nutrients that are necessary for growth and maintenance. Food needs to be broken down so it is small enough to enter the body tissues and cells.

The body needs energy from food, but it cannot use food in its original form. The body first must break down the food into simpler substances.

Food is broken down both mechanically and chemically as it moves through the digestive system.

Some organs of the digestive system are tongue, teeth, mouth, throat, salivary glands, esophagus, stomach, pancreas, liver, gall bladder, large intestine, small intestine, rectum and anus.

When stretched out end to end, the digestive system of an adult can reach the height of a four story building. It fits inside of the body because it is folded around itself.



Digestion begins in the mouth. The teeth then break the food down into smaller pieces (mechanical). Enzymes in the saliva break starches down into sugar (chemical). The food then travels to the stomach by moving through the esophagus. Circular muscles in the esophagus contract and move the food forward in a process called **peristalsis**. Once the food reaches the stomach gastric juices (enzymes) continue to break down the food. Food then moves into the small intestine where most digestion takes place. More enzymes are secreted into the small intestine where they digest the food more. These enzymes are produced by the pancreas and the liver. The pancreas secretes pancreatic juice, which digest starch, fat and protein. The liver produces bile, which breaks down fat. Digested food enters the bloodstream through the walls of the small intestine. Undigested food goes into the large intestine. Eventually the undigested food is carried out of the body through the anus.

Diseases/Problems of the Digestive System:

- Diabetes – a chronic disease marked by high blood sugar levels. Insulin is created in the pancreas that controls blood sugar levels. Diabetes can be caused by too little insulin, resistance to insulin or both.
- Colitis – inflammation of the colon (large intestine)

- Colorrectal cancer – cancer that starts in the colon (large intestine) or the rectum (the end of the large intestine)
- Heartburn – irritation of the esophagus that is caused by stomach acid
- Ulcers – sores that form in the lining of the stomach
- Gallstones – hard, pebble-like deposits that form inside of the gallbladder. The gallbladder stores bile secreted from the liver.

Respiratory System

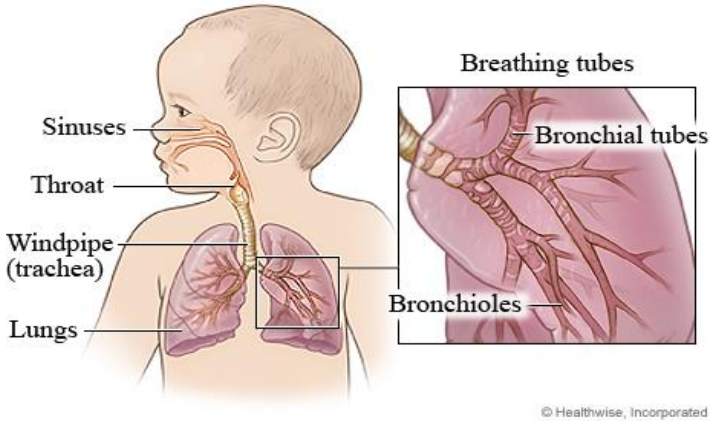
Major Function - provide gas exchange between the blood and the environment. Oxygen is absorbed from the atmosphere into the body and carbon dioxide is expelled from the body.

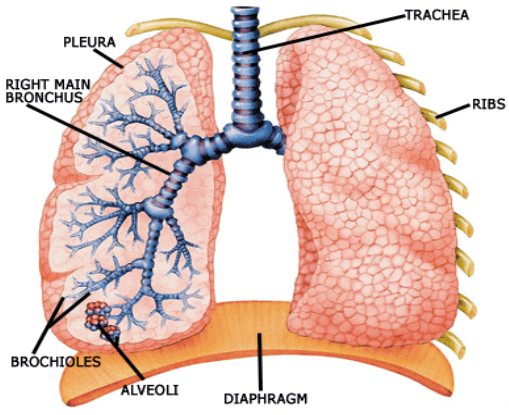
Major Organs – nose, trachea, lungs, alveoli, larynx

The respiratory system provides gas exchange between the blood and the environment. Physical respiration (breathing) provided oxygen needed for chemical respiration (which releases energy from sugar). Oxygen is absorbed from the atmosphere into the body and carbon dioxide is expelled from the body.

The major parts of the respiratory system are the mouth, nose, trachea, lungs, alveoli and larynx.

Breathing is the movement of air in and out of the respiratory system. The **diaphragm** and rib cage control breathing. During inhalation, the diaphragm moves down and ribs move up and out. This increases the size of the chest, and air is forced into the lungs. During exhalation, the diaphragm moves up and air is forced out of the lungs. You breathe faster when CO_2 builds up in the blood (when you need more oxygen). The alveoli are very important because this is where the oxygen enters the blood and CO2 leaves. The alveoli look like microscopic sacs surrounded by capillaries.





Diseases/Problems of the Respiratory System:

- Pneumonia – an infection of the lungs
- Emphysema – lung disease that involves damage to the air (alveoli) sacs in the lungs
- Asthma – an inflammatory disorder of the airways, which causes attacks of wheezing, shortness of breath, chest tightness and coughing
- Cystic fibrosis – abnormally thick mucus in the lungs and intestines

Integumentary System

Major Function – to protect body from internal damage, to waterproof our bodies and to control body temperature

Major Organs – skin, hair, nails and sweat glands

The integumentary system is the largest organ system in the human body. It accounts for about 15% of the actual weight of an adult.

The integumentary system has a variety of functions.

- It waterproofs, cushions and protects the deeper tissues.
- It excretes wastes.
- It regulates temperature.
- It is the attachment site for sensory receptors to detect pain, sensation, pressure and temperature.

The major parts of the integumentary system are the skin, hair, nails and sweat glands.

The top layer is called the epidermis. The epidermis is the outer layer of the skin. This layer contains epithelial cells. Epithelial cells are flat and connected like bricks in a wall. It usually takes about 27 days to replace all of the outer skin cells. There are specialized cells called melanocytes within the epidermis. They produce melanin, a brownish pigment. All people have about the same number of melanocytes, however they differ in the amount of melanin produced. This is why there are so many different skin tones. There are no blood vessels in the epidermis. The lower layer is called the dermis.

Skin also contains hair, nails, oil gland and sweat glands. The hair and nails are forms of dead skin cells.

Diseases/Problems of the integumentary System:

- Acne (pimples) – disorder where the hair follicle gets clogged and infected.
- Athlete's Foot – common fungus infection in which the skin between the toes becomes itchy and sore, cracking and peeling away.
- Warts – small growths caused by a viral infection of the skin

Lymphatic System (Immune System)

Major Function – to destroy and remove invading microbes from the body. It also removes fat and excess fluids from the blood.

Major Organs – lymph, lymph nodes and vessels, white blood cells, T- and B- cells

The job of the lymphatic system is to destroy and remove invading microbes from the body. This protects the body against **pathogens** (organisms that invade the body causing disease). It also removes fat and excess fluids from the body.

The major parts of the lymphatic system are the lymph, lymph nodes and vessels, white blood cells, bone marrow, T-cells and B-cells

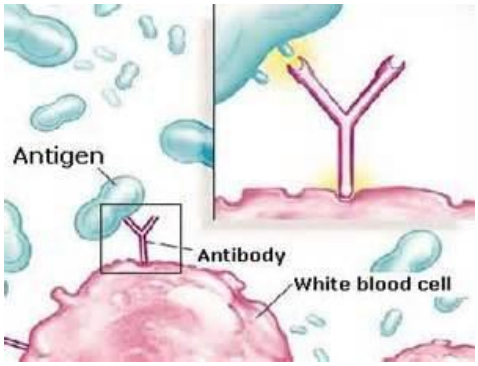
Fluid and Protein Balance

As blood moves through the arteries and veins, 10% of the fluid filtered by the capillaries, along with vital proteins, becomes trapped in the tissues of the body. This loss of this fluid (called lymph) would rapidly become life threatening if the lymphatic system did not properly function. The lymphatic system collects this fluid and returns it to the circulatory system.

Immunity and Spread of Infection

The lymphatic system plays an integral role in the immune functions of the body. It is the first line of defense against disease. This network of vessels and nodes transports and filters lymph fluid containing antibodies and lymphocytes (good) and bacteria (bad). The body's first contact with these invaders signals the lymphatics, calling upon this system to orchestrate the way the infection-fighting cells prevent illness and diseases from invading microorganisms.

White blood cells are the main components of the immune system. Different white blood cells have different roles. Antigens cause an immune response. Antibodies are proteins made by white blood cells to attack antigens. Each antibody attacks a specific antigen determined by its shape.



A **vaccine** is an injection of a dead or weakened pathogen. This causes the body to make antibodies against that pathogen. Vaccines only prevent diseases. They are not cures.

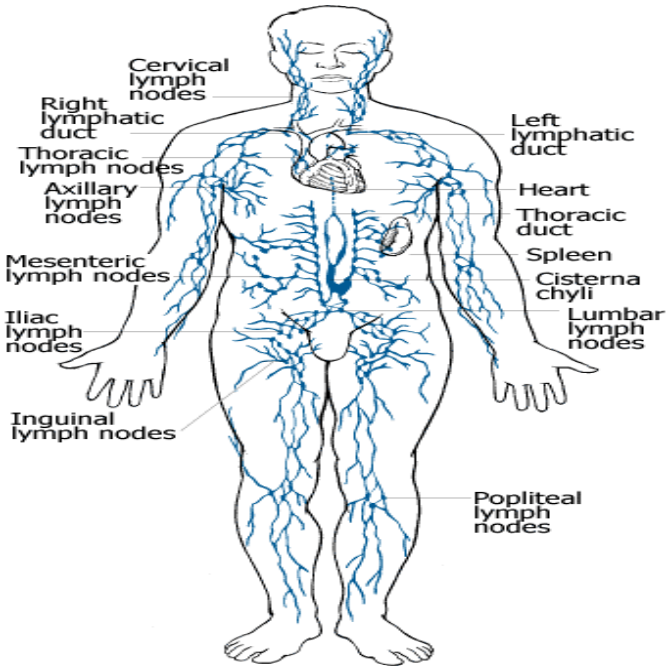
Antibiotics are drugs used to stop infections by **bacteria**. Antibiotics will not work against viruses.

When a person gets an organ transplant many times that organ is rejected. This is because the body views the transplanted organ as a foreign object that it must kill or get rid of.

Digestion

Lymph vessels in the lining of the gastrointestinal tract absorb fats from food. A malfunction of this part of the lymphatic system can result in serious malnutrition. The lymphatic system also impacts diseases such as excessive obesity caused by abnormal fat and carbohydrate metabolism.

Spleen – blood is filtered here, also damaged red blood cells are removed as well as antigens



Diseases/Problems of the Lymphatic System:

- Hodgkin's Disease – a type of cancer of the lymphatic system
- Glandular Fever – tender lymph nodes
- Tonsillitis – infection of the tonsils and throat
- Oedema – swelling caused by too much fluid in the tissue

Muscular System

Major Function – provide movement of the body, muscles also control movement of materials through some organs (stomach, intestines, heart)
Major Organs – skeletal and smooth muscles

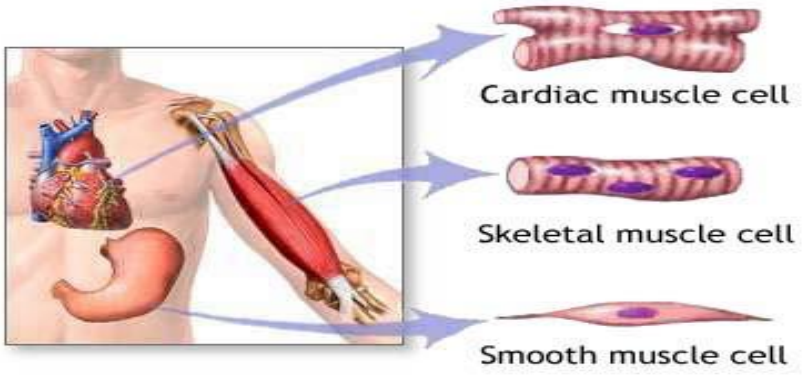
The muscular system provides movement of the body. Muscles also control movement of materials through some organs (stomach, intestines, heart). Muscles only pull and must work in pairs.

The major organs of the muscular system are the smooth, cardiac and skeletal muscles.

Cardiac muscle – involuntary (automatic) muscle made up of a network of striped cells. Found only in the heart.

Smooth muscle – involuntary muscle made of short, non-striped cells. They have smooth, slow contractions, and they can stay contracted for long periods of time. Found lining the digestive tract and blood vessels.

Skeletal muscle – voluntary muscles made of bundles of long, striped cells. Skeletal muscles move the bones of the body.



Diseases/Problems of the Muscular System:

- Myopathy – Myopathies are diseases of the skeletal muscle which are not caused by nerve disorders. This causes the skeletal muscles to become weak. Myopathies are usually degenerative.
- Muscular Dystrophy – genetic disorder of the muscles. It causes the muscles in the body to become very weak. Muscles break down and are replaced by fatty deposits over time.

Circulatory System

Major Function – transport nutrients, gases (oxygen, carbon dioxide), hormones and wastes

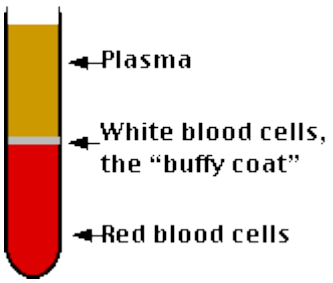
Major Organs – heart, blood vessels and blood

The circulatory system is made up of the vessels and the muscles that help and control the flow of the blood around the body. This process is called circulation. The main parts of the system are the heart, arteries, capillaries and veins. The circulatory system moves water, nutrients, hormones, and wastes through the body.

Arteries are tough, elastic tubes that carry blood **away** from the heart. As the arteries move away from the heart, they divide into smaller vessels. The largest arteries are about as thick as a thumb. The smallest arteries are thinner than hair.

Veins carry the blood to the heart. The smallest veins, also called venules, are very thin. They join larger veins that open into the heart. The veins carry dark red blood that doesn't have much oxygen. Veins have thin walls. They don't need to be as strong as the arteries because as blood is returned to the heart, it is under less pressure.

Blood is thicker than water and has a little bit salty taste. In an adults body there is 5 litersh of blood circulating around. In their blood there is billions of living blood cells floating in a liquid called plasma. If you took a small sample of this blood and poured it into a test tube and then put it in a machine called a centrifuge, you would be able to see the layers of this blood. This machine spins the blood around so fast



that it separates the red blood cells, from the white blood cells, from the platelets. The red blood cells sink to the bottom because they are the heavier, more solid parts, but the plasma remains at the top because it is lighter. The plasma is 95% water and the other 5% is made up of dissolved substances including salts.

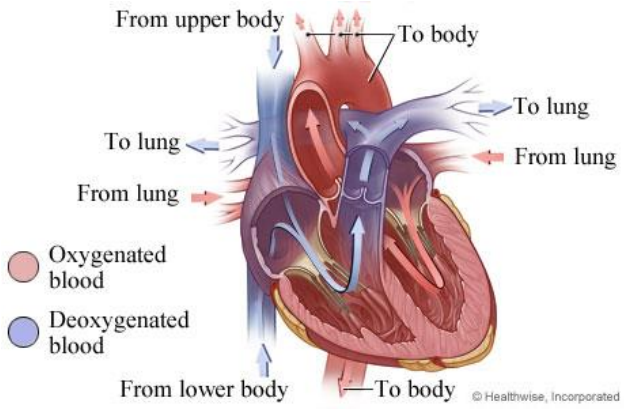
Red blood cells carry oxygen. **White blood cells** fight disease. **Plasma** transports everything except oxygen. **Platelets** clot the blood.

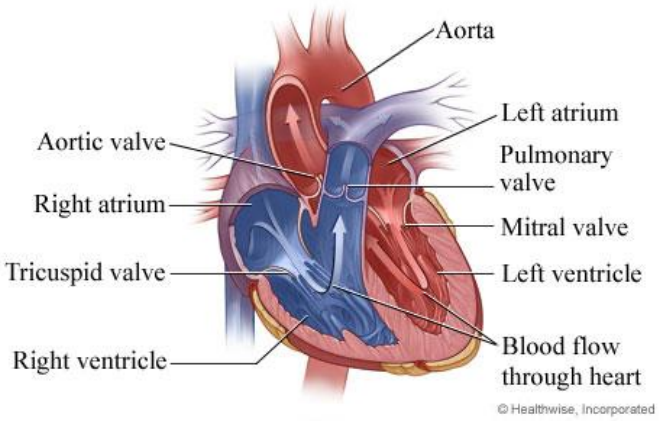
Blood type O is a universal donor; type AB is the universal acceptor.

Heart - Did you know that your heart is the strongest muscle? Your heart is divided into two sides. The right side pumps blood to your lungs where it picks up oxygen. The left side pumps oxygen-soaked blood out to your body. They do not work on their own, but together as a team. The body's blood is circulated through the heart more than 1,000 times per day. Between five and six thousand quarts of blood are pumped each day. Your heart is about the same size as your fist.

As blood begins to circulate, it leaves the heart from the left ventricle and goes into the aorta. The aorta is the largest artery in the body. The blood leaving the aorta is full of oxygen. This is important for the cells in the brain and the body to do their work. The oxygen rich blood travels throughout the body in its system of arteries into the smallest arterioles. On its way back to the heart, the blood travels through a system of veins. As it reaches the lungs, the carbon dioxide (a waste product) is removed from the blood and replace with fresh oxygen that we have inhaled through the lungs.

Your heart's job is to pump blood around your body. Its muscles contract and squeeze out blood. The left-hand side pumps blood from the lungs to the rest of your body. The right-hand side pumps stale blood from your body back to your lungs





for a fresh supply of oxygen.

Diseases/Problems of the Circulatory System:

- Anemia – a condition in which the body does not have enough healthy red blood cells.
- Leukemia – cancer of the blood or bone marrow, this causes the person with leukemia to produce abnormal white blood cells.
- Hemophilia – a condition where the blood clots slowly or not at all, genetic disorder
- Heart Attack – when low blood flow causes the heart to "starve" for oxygen
- Aneurysm – a balloon like bulge in an artery
- High Blood Pressure – Blood pressure is the force of blood against the walls of the arteries. Blood pressure rises and falls during the day. When blood pressure stays elevated (high) over time it is called high blood pressure or hypertension.
- Sickle Cell Anemia – red blood cells are abnormally shaped

Skeletal System

Major Function – provide support for the body, to protect delicate organs and to provide attachment sites for the organism

Major Organs – bones, bone marrow, joints and teeth

The skeletal system gives structure and supports the body. It also protects vital organs. The bones are also attachment sites for muscles.

There are 206 bones in an adult human (some people consider it 208, they count the sternum being made up of 3 bones). Babies have more bones than an adult, this is because some of their bones fuse together as they grow.

Besides bones, the skeleton also contains connective tissue called cartilage. Cartilage is flexible and tough. This type of rubbery tissue can be found in the top of the nose, the outer ear and wherever two bones meet.

The major organs of the skeletal system are bones, bone marrow, joints and teeth.

Other parts of the skeletal system:

- tendons – connect muscle to bones (made of tough, white tissue)
- ligaments – link bones together
- marrow – soft fatty tissue that produces red blood cells, white blood cells and other immune system cells (found inside of bones)

Types Joints:

- fixed joints – do not move, found in the skull
- partially moveable joints – allow for some movement of bones, found between the vertebrae of the back
- moveable joints – allow for full movement of the bone
  - gliding – formed when two bones that move separately meet (wrist)
  - pivot – form when one bone rests and rotate from a certain point (neck)
  - hinge – allow movement in one direction (elbow, knee)
  - ball and socket – allow the bones to swing and move in almost any direction (shoulder)

Diseases/Problems of the Skeletal System:

- Leukemia - It is a kind of cancer in which abnormal white blood cells multiply in an uncontrolled manner. they interfere with the production of normal white blood cells. Leukemia affects the production of red blood cells.
- Osteoporosis - Osteoporosis is a disease resulting in the loss of bone tissue.
- Sprains - A sprain is an injury to a ligament or to the tissue that covers a joint.
- Fractures - A fracture is a broken bone.
- Spina bifida - Spina bifida is a spinal defect that is present at birth. In spina bifida, the spinal cord does not form properly and the vertebrae and skin cannot form around it. Spina bifida results from an error in the development of the embryo that occurs about a month after a woman becomes pregnant. This error may have various causes, including the use of alcohol or certain medications by the pregnant woman or exposure to extreme heat. Genetic factors appear to be very important.
- Scurvy - Scurvy is a disease caused by lack of ascorbic acid (vitamin C) in the diet. If a person does not get enough vitamin C, any wound he or she might have heals poorly. The person also bruises easily. The mouth and gums become sore. The gums bleed, and the teeth may become loose. Patients lose their appetite, their joints become sore, and they become restless.
- Arthritis - There are more than 100 diseases of the joints referred to as arthritis. Victims of arthritis suffer pain, stiffness, and swelling in their joints.
- Scoliosis - Scoliosis is a side-to-side curve of the spine. This condition becomes apparent during adolescence. It is unknown why Scoliosis affects more girls than boys.
- Tendinitis - Tendinitis is a disorder involving stiffness or pain in the muscles or joints. It is often called rheumatism.

Nervous System
Major Function – to relay electrical signals through the body, directs behavior and movement and along with the endocrine system controls processes like digestion, circulation etc.
Major Organs – brain, spinal cord and peripheral nerves

The job of the nervous system is to relay electrical signals through the body, directs behavior and movement and along with the endocrine system controls processes like digestion, circulation etc. The nervous system regulates your body along with the endocrine system.

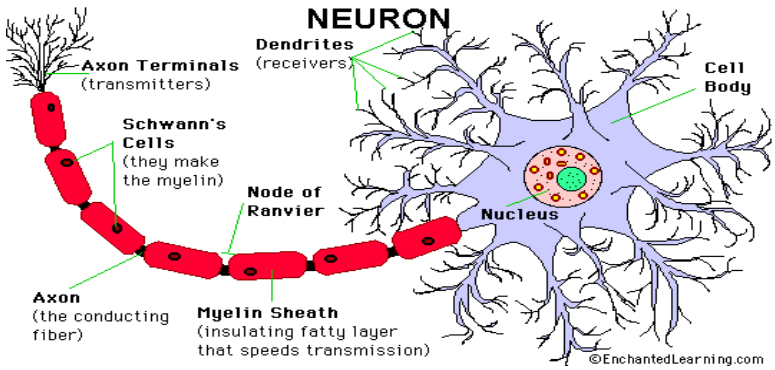
Major Organs – brain, spinal cord and peripheral nerves

The **Central Nervous System** consists of your brain and spinal cord.

The spinal cord controls reflexes and brings impulses from the nerves to the brain.

The **Peripheral Nervous System** all of the nerves outside of your brain and spinal cord.

Neuron – a nerve cell, the cells of the nervous system.



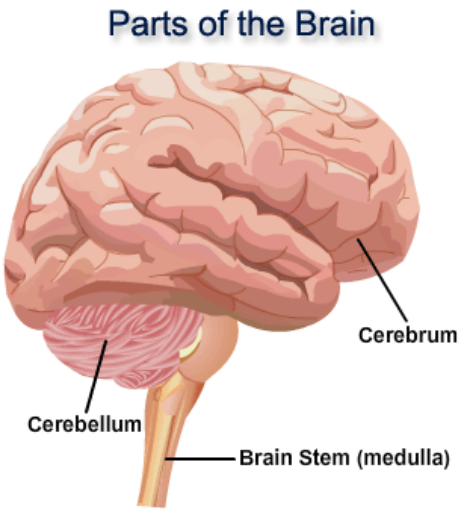
There are three types of neurons in the nervous system:
Sensory Neurons – these neurons send messages from your senses TOWARDS the central nervous system (part of the peripheral nervous system)
Motor Neurons – send messages AWAY from your central nervous system to muscles of glands (part of the peripheral nervous system)
Association Neurons – (also called interneurons) – send messages between sensory and motor neurons (located in the central nervous system)

Sending Messages:
Neurons have specialized projections called **dendrites** and **axons**. Dendrites bring information to the cell body and axons take information away from the cell body

Information from one neuron flows to another neuron across a **synapse**. The synapse contains a small gap separating neurons.

Dendrites – receive nerve impulses from other neurons

Axons – sends nerve impulses AWAY from the neuron (the long "tail" part of the neuron)



Your brain is your most powerful organ, yet weighs only about three pounds. It has a texture similar to firm jelly. It has three main parts:

1. The cerebrum fills up most of your skull. It is involved in remembering, problem solving, thinking, and feeling. It also controls movement.
2. The cerebellum sits at the back of your head, under the cerebrum. It controls coordination and balance.
3. The brain stem (medulla) sits beneath your cerebrum in front of your cerebellum. It connects the brain to the spinal cord and controls automatic functions such as breathing, digestion, heart rate and blood pressure.

Diseases/Problems of the nervous System:

- Meningitis – an infection that causes inflammation of the membranes covering the brain and spinal cord
- Encephalitis – inflammation of the brain, can be caused by bacteria or virus
- Parkinson's Disease – a disorder of the brain that leads to shaking (tremors) and difficulty with walking movement, and coordination
- Bell's Palsy – temporary facial paralysis that usually affects only one side of the face, but in rare cases can affect both. Mostly caused by damage or trauma to one of the two facial nerves

Urinary/Excretory System
Major Function – filter out cellular waste, toxins and excess water or nutrients from the circulatory system
Major Organs - kidney, ureters, bladder and urethra

The job of the urinary/excretory system is to filter out metabolic waste, toxins and excess water or nutrients from the circulatory system. Your body excretes salt, water, urea, and CO_2.

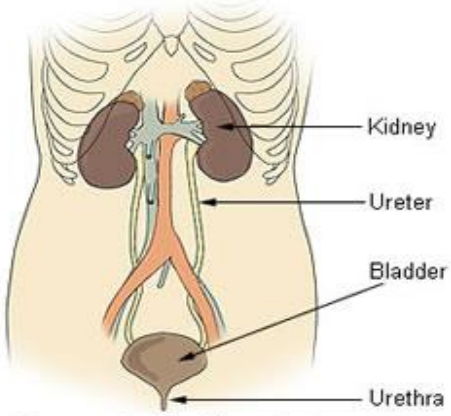
The major parts of the urinary/excretory system are the lungs, kidney, ureter, urethra and bladder.

The lungs can be considered part of the excretory system because carbon dioxide and water waste are given off every time you exhale.

The liver filters toxins and dead red blood cells from the blood, so sometimes it is considered part of the excretory system.

Sometimes the skin is also considered part of the excretory system. This is because waste can also leave through the skin. We will get into more details of the skin when we discuss the integumentary system.

The urinary system contains the kidneys, ureter, urethra and the bladder. Blood is filtered in the kidneys, where it forms waste liquid called urine. It then travels through the ureter to the bladder. Once the bladder collects enough urine it leaves the body through the urethra.



Components of The Urinary System

Diseases/Problems of the Urinary/Excretory System:
- Urinary Tract Infection (UTI) – an infection of the urinary tract (this can occur anywhere in the urinary tract).

- Kidney Stones – hard solid pellets that form in the urinary tract. A small stone can that blocks the flow of urine can cause extreme pain. Most of the time kidney stones can pass through the urinary system and do not require surgery.

Reproductive System

Major Function – manufacture cells that allow reproduction (male-sperm, female-egg)
Major Organs – female – ovaries, oviduct, uterus, vagina and mammary glands
male – testes, seminal vesicles and penis

The function of the reproductive system is to manufacture cells that allow reproduction to take place. Humans undergo sexual reproduction. Sexual reproduction is reproduction involving two parents and results in offspring that are genetically different from their parents. This is because the offspring get half of their DNA from the mother and half from the father.

Human sex cells

Female sex cells are called eggs. Male sex cells are called sperm. Both male and female sex cells have half the number of chromosomes as a normal human body cell. Sex cells have 23 chromosomes where body cells have 46 chromosomes. This is so when fertilization (the joining of sperm and egg) occurs there is the proper number of chromosomes.

Organs

The organs of the reproductive system are gender specific. The male reproductive organs are the testes, seminal vesicles and the penis. The female reproductive organs are the ovaries, oviduct, uterus, vagina and mammary glands. Sexual organs are sometimes called gonads. Human gonads become activated by hormones that are secreted from glands in the body.

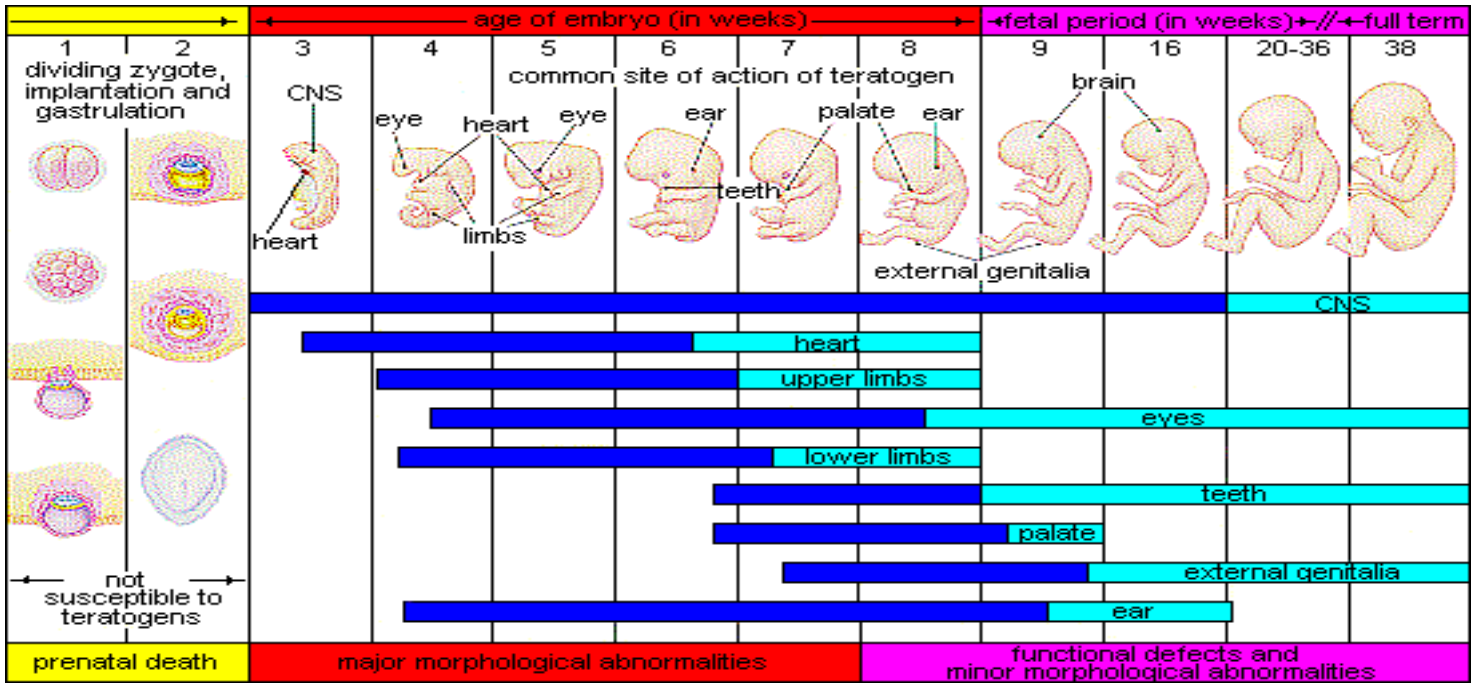
Puberty

Puberty is the time during teenage years when males start to produce sperm, and females start to release eggs. Puberty occurs a couple of years earlier for females than males usually. When a female reaches puberty she begins menstruation. Menstruation is regulated by the female sex hormones, estrogen and progesterone. Menstruation or 'periods' is the release of the blood-filled lining of the uterus if a woman is not pregnant. It lasts about 5 days. During pregnancy, menstruation ceases.

Fertilization and Development

Once an egg is fertilized an embryo begins to form. This fertilized egg immediately divides into two cells, these cells then divide again and again over the next couple of

days as the cluster of cells makes its way to the uterus (womb). Here it plants itself in the lining of the uterus and continues dividing its cells to make billions of new cells. The embryo grows into a fetus and develops for a period of nine months. This nine month period is called the gestation period (the time between conception and birth). This period is not the same for all animals. In humans it is nine months, for cats it's 63 days, and for elephants it is 22 months. After the fetus has developed for nine months a baby is born.



Endocrine System

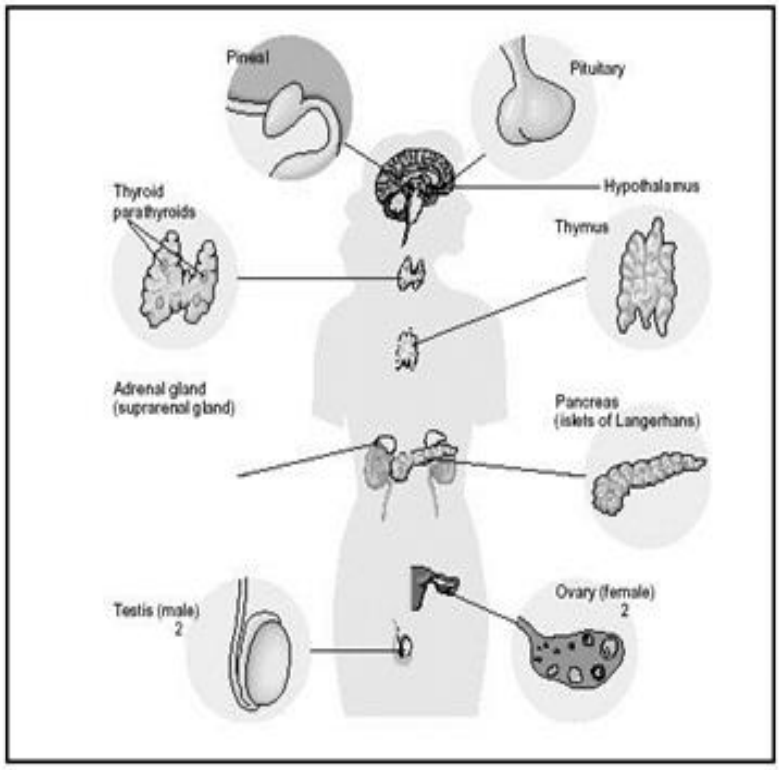
Major Function – relay chemical messages through the body (these chemical messages help to control physiological processes such as nutrient absorption and growth)
Major Organs – many glands (hypothalamus, pituitary, pancreas and adrenal)

The job of the endocrine system is to relay chemical messages through the body (these chemical messages help to control physiological processes such as nutrient absorption and growth). The endocrine system regulates the body along with the nervous system. The endocrine system acts slower, but has longer effects.

The glands in the body that make and secrete hormones make up the endocrine system. All endocrine glands secrete hormones directly into the bloodstream. These glands control many activities in the body such as growth, sexual development, and regulation of blood levels.Glands in the body and their functions:

- pineal – produces melatonin, a hormone that affects awake/sleep patterns in a person, controls the onset of puberty in humans

- pituitary - "master gland", stimulates growth and stimulates secretions of hormones from other glands
- hypothalamus – the major area where the nervous and the endocrine systems interact
- thymus – promotes production and maturation of white blood cells
- pancreas (islets of Langerhans) – produces insulin which controls blood sugar levels
- adrenal gland – produces adrenaline - initiates stress responses, increases heart rate, blood pressure, and metabolic rate, dilates blood vessels, mobilizes fat and raises blood sugar levels
- testis/ovary – stimulates development of secondary sex characteristics (estrogen and progesterone female sex hormones, testosterone male sex hormone)



Hormone levels are controlled by negative feedback.

Diseases/Problems of the Endocrine System:

- Diabetes – a disorder that occurs when the body cannot process sugar properly
- Growth Disorders – caused by having not enough or too much of the growth hormones
- Hyperthyroidism – excessive production of thyroid hormones