

Most Important

You should know:

- The main structures of each of the major organ systems, including how to recognize these structures from a picture.

You should understand:

- The main functions of each of the major organ systems.
- The concept of specialization, how it relates to the importance of biological diversity, and how it enables our bodies to do complex functions.
- Why communication is important in the body, how this relates to the concept of specialization, and the main mechanisms that our bodies use to communicate among cells.
- The concepts of homeostasis, temporary change, and permanent change, including examples of each and why each is important to life.
- That structure gives rise to function, including some examples of this.

The Human Body

You should understand:

- That all living things (people included) are made of cells, which are ultimately responsible for all of the functions of that organism.
- That cells form tissues, which form organs, which form organ systems, which form organisms.
- That the cells of the body have specialized functions that contribute to the overall functioning of the body, and these cells have specialized structures that give them those specialized functions.
- That **diversity** is important in biology: We need different cell types to do different jobs (to **specialize**), so they can work together to make something better rather than competing.
- The two main things we need to accomplish in order to stay alive are *staying the same* (**homeostasis**) and *changing* (temporarily or permanently)

The Nervous System

You should understand:

- That, because the cells in our bodies are so specialized, we need advanced communication systems to keep everything working together.
- That the **nervous system** is responsible for *fast, immediate* communication (often less than a second), which we need to respond to quick changes in the environment or string together complex thoughts.
- That the **central nervous system** is like the boss of our bodies. It knows just about everything that needs to happen and is responsible for making sure those things get done.

- That the **peripheral nervous system** is like the nerve highway system of the body, sending and receiving signals from all over the body.
 - This includes **autonomic** control for automatic body functions, like breathing, and **somatic** control for voluntary body functions, like movement.
- That neural communication relies on fast communication through electrical signals down a neuron and chemical signals between neurons: Nerves receive an input, which causes them to fire an **action potential** (electrical signal), which causes them to release a **neurotransmitter** (chemical signal), which determines what effect that action potential will have on the next cell.
- The simplest pathway that demonstrates the main idea of the nervous system is the reflex arc: we have some sort of sensory input which travels up a **sensory neuron**, which tells something in the **CNS** what's going on, which tells a **motor neuron** what to do to fix that thing (like moving your hand away from a hot stove).
- The role of the brain in coordinating body processes generally, and temperature regulation specifically.

The Endocrine System

You should know:

- The basic roles of the following hormones:
 - Insulin: raises blood sugar
 - Glucagon: lowers blood sugar
 - Thyroid: increases basal metabolism
 - Epinephrine and norepinephrine: short-term stress and the fight-or-flight response
 - Cortisol: long-term stress and potentially negative health consequences
 - Aldosterone and vasopressin: increase in blood pressure
 - Growth hormone: causes growth (in height)

You should understand:

- The **endocrine system** is for slow, prolonged communication, which we need for processes that take place over a longer period of time. This can range from a period of minutes to years.
- That the endocrine system uses **hormones**, which are produced by **glands** and are chemical signals that have certain set specific functions.
- That endocrine control is slower than nervous system control and can do fewer things, but it can be sustained over the long term and requires less energy input to carry out a certain set of important tasks on a regular basis.
- How insulin and glucagon are important for blood sugar homeostasis, including the specific role of each.
- How **type I diabetes** and **type II diabetes** affect blood glucose and insulin levels.
 - In type I diabetes, the pancreas stops making insulin, so blood glucose stays really high until that person gets treated. Insulin levels are also low.

- In type II diabetes, the pancreas still makes insulin, but cells no longer respond to it. Blood glucose stays really high even though insulin levels are also high.
- How **feedback inhibition** or **negative feedback** maintains homeostasis, while **positive feedback** causes change.
- That **estrogen** and **progesterone** are found in high levels in those with female anatomy and **testosterone** is found in high levels in those with male anatomy.
- That, during female sexual development, eggs start to be released from the ovaries, the **menstrual cycle** begins (the uterus thickening in preparation for a baby and then shedding that lining each month), the hips widen, and the breasts develop.
- That, during male sexual development, **sperm** production begins in the **testes**. The testes are located on the external part of the body so that temperature regulation of sperm can occur.
- How the concept of **homeostasis** is important in blood sugar, metabolism, salt, and blood pressure regulation.
- How the concept of change is important in stress, puberty, and reproduction.

The Integumentary System

You should understand:

- That the skin is a complex, living organ with many important functions in your body.
- The role of the skin in protecting the body from the outside world, especially acting as a barrier, waterproofing the body (keeping bad water out and good water in), providing padding, healing wounds, and protecting us from the sun.
- The role of the skin in sensing the environment, including that it has touch, temperature, and pain receptors.
- The role of the skin in temperature regulation, including the importance of hair and subcutaneous fat in keeping you warm and sweat in keeping you cool.
- The role of the skin in vitamin D production.
- That the skin's structure enables it to do its functions.

The Musculoskeletal System

You should know:

- The names and locations of each of these bones and muscles:
 - Skull
 - Jaw
 - Clavicle
 - Sternum
 - Scapula
 - Ribs
 - Spine
 - Pelvis
 - Femur
 - Deltoid

- Pectoral muscles (“Pecs”)
- Biceps
- Triceps
- Lateral muscles (“Lats”)
- Abdominal muscles
- Gluteal muscles (“Glutes”)
- Quadriceps (“Quads”)
- Hamstrings

You should understand:

- That bones provide leverage for muscles to move.
- That **joints** are anywhere two bones meet. Moveable (**synovial**) joints allow for muscle movement/bending.
- That **flat bones**, such as the ribs and skull, protect structures underneath.
- That bones store calcium and phosphorus, which is regulated by hormones.
- That **bone marrow**, found inside of **long bones**, is responsible for producing all of your blood cells.
- That muscles **contract** when the protein filaments that make them up slide past each other, shortening the muscle.
- The difference between **contraction** and **relaxation** of a muscle.
- That muscles come in **antagonistic pairs**, like biceps and triceps, or quadriceps and hamstrings: when one contracts, the other relaxes.
- That there are three muscle types: **skeletal**, **cardiac**, and **smooth**. You should understand which of these is voluntary and where each can be found.

Cardiovascular System

You should understand:

- That blood transports many things throughout the body, including oxygen, carbon dioxide, nutrients, wastes, hormones, and immune cells.
- That **arteries** carry blood to the body from the heart.
- That **veins** carry blood to the heart from the body.
- That **capillaries** are the site of exchange between blood and tissues. They are very thin, only one cell thick, so that diffusion can occur easily.
- That capillary exchange sometimes happens through regular membrane transport, especially at tightly regulated barriers like the blood-brain barrier, and often happens through **bulk flow** through gaps in the capillary walls. Bulk flow relies on blood pressure to push fluids out of capillaries and proteins to pull fluids back in.
- That blood flows through **dual circulation**, which separates **deoxygenated** blood from **oxygenated** blood.
- That the heart pumps **deoxygenated** blood first to the lungs for gas exchange, then **oxygenated** blood returns to the heart so that it can be pumped to the body.

- That the **sinoatrial node** or **pacemaker** is responsible for maintaining the heartbeat. It is separate from the brain.
- That the **liver** detoxifies blood, the **kidneys** excrete wastes, and the **spleen** recycles blood cells.

Respiratory System

You should understand:

- That the **respiratory system** is made up of the lungs and all of the tubes that connect the lungs to the outside air.
- How carbon dioxide and oxygen are exchanged at the alveolus by **simple diffusion**.
- How the structure of alveoli contributes to its function, including the role of the thin membrane, the surrounding net of capillaries, and the high surface area.
- The mechanics of **negative pressure breathing**, and how the structure of the diaphragm contributes to this.

The Digestive System

You should understand:

- That food is first **digested** and then **absorbed**. After that, water is reabsorbed from what's left and the waste is eliminated as feces.
- That digestion involves **mechanical digestion** plus some **chemical digestion** in the mouth and stomach (carbs for the mouth and proteins for the stomach, because acid is needed), but that most digestion occurs in the **small intestine**.
- That digestion is carried out by **enzymes** made by **accessory structures**. The **pancreas** makes the majority of digestive enzymes.
- That absorption occurs in the small intestine. The small intestine has specialized structures called **villi** and **microvilli** that give it a lot of surface area for absorption.
- That the large intestine reabsorbs water from your feces, which then exits the body through the rectum.
- Which foods pretty much everyone agrees are healthy, which foods some people disagree on, and which people most people agree are unhealthy if eaten in excess.

The Excretory System

You should understand:

- That the **excretory system** is responsible for eliminating wastes from the body, as urine.
- That the excretory system consists of your **kidneys**, which are responsible for cleaning your blood (and some other functions related to maintaining blood homeostasis), as well as ureters, which connect the kidneys to the bladder; the bladder, which stores urine; and the urethra, which connects your bladder to the outside world.
- That the functional unit of the kidney is the **nephron**, which consists of the **glomerulus**, which filters all small solutes out of your blood (including nutrients and wastes), and the

tubules, which selectively reabsorbs nutrients and actively gets rid of any wastes remaining in the blood.

- That **dialysis** is a life-saving treatment that filters the blood outside of the body using a special machine. It is required by people who have kidney disease, which is pretty common. Kidney disease is caused by other common diseases, including diabetes and high blood pressure.
- That some organs outside of the excretory system also have important excretory functions.

The Immune System

You should understand:

- That the immune system is involved in protecting against both infectious and some non-infectious diseases, like cancer.
- The main similarities and differences among the 4 main types of pathogens: viruses, bacteria, fungi, and protozoa and parasites.
- That the less complex a pathogen is, the faster it can evolve new defenses against the immune system.
- That the more similar a pathogen is to human cells, the harder it is for your immune system or medicine to target specifically and kill.
- That the **first line of defense** provides passive defense against pathogens getting into the body in the first place, like the skin, which provides a barrier.
- That the **second line of defense** involves non-specific cellular attacks that recognize the general features of bacteria and then do **phagocytosis** (eating) to destroy them. The second line of defense also includes fever, which tries to destroy invaders through heat, and inflammation, which is the swelling of blood vessels to get more phagocytotic cells to a damaged tissue.
- That the **third line of defense** is super-specific and is made up of lymphocytes that specifically identify a single **antigen** and then, through **clonal selection**, expand to create a massive army of lymphocytes specifically designed to attack that antigen.
- That **B cells** attack viruses and bacteria before they get into cells, and **T cells** attack infected and cancerous cells.
- That **memory cells** persist after an infection and attack a specific antigen again immediately the next time your body sees it, so that you don't get sick from the exact two things twice.