LIFEPAC®

SCIENCE

STUDENT BOOK

10th Grade | Unit 6

Alpha Omega
PUBLICATIONS

SCIENCE 1006

Human Anatomy and Physiology

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Human Anatomy and Physiology

Introduction

When you study the human body you must do so with an appreciation for the wonderful design which God has given to us. In Genesis 1:26 we are told that man has been made in God's image, and in chapter 2 we are told that the raw material from which God created us was "dust." This creation is a long way from the evolutionary idea that man is merely an evolving ape, who came about by a chance chemical reaction.

In this LIFEPAC® you will learn about the physical structure of the human body. The structural branch of biology is called *anatomy* and deals with how God has made the body, both on the large scale and at the microscopic level. To study how the body parts are made without also learning their function and how they are able to perform their tasks would not be sufficient. The study of body functions and performance is called *physiology*. Both the anatomy and physiology of the human body will be studied at the same time. This LIFEPAC is divided into three sections dealing with body *systems*, which are groups of organs working together for a common function.

When you consider the fact that God is perfect, you may wonder why things are not always perfectly made in the body. Why are some people born with deformities and why do others catch terrible diseases that injure the body or even cause death to the person? In the last section you will see how the origin of disease is linked to the origin of sin in the garden of Eden.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC. Each section will list according to the numbers below what objectives will be met in that section.When you have finished this LIFEPAC, you should be able to:

1. Describe the anatomy of the various parts of the human body.
2. Describe the function of the various parts of the human body.
3. Group the organs of the body into their body systems.
4. Tell how body organs and systems can enable us to interact with our environment.
5. Describe the organs and systems that control and protect the body.
6. Explain the origin of disease.
7. Describe various types of human disease and their causes.
8. Identify many of the structures of the body as shown in diagrams.

Survey the LIFEPAC. Ask yourself some questions about this study and write your questions here.

1. SUPPLY OF NEEDED MATERIAL

In this section you will consider how four of the body systems work together to supply the materials that are needed for life. You will see how the digestive system breaks down food, how the excretory system gets rid of harmful wastes, how the respiratory system both takes in an essential gas and gets rid of gaseous waste products, and how the circulatory system transports needed materials throughout the body.

Section Objectives

Review these objectives. When you have completed this section, you should be able to:

1. Describe the anatomy of the various parts of the human body.
2. Describe the function of the various parts of the human body.
3. Group the organs of the body into their body systems.
8. Identify many of the structures of the body as shown in diagrams.

Vocabulary

Study these words to enhance your learning success in this section.

absorption
antibodies
Bowman's capsule
bronchioles
cortex
erythrocytes
fibrinogen
hemoglobin
inhalation
jaundice
leukocytes
lymph node
nephron
phagocytosis
platelets
respiration
thoracic cavity
urethra
ventricles
albumin
arteries (artery)
bronchi
capillaries (capillary)
edema
exhalation
filtration
hemophilia
insulin
larynx
loop of Henle
medulla
pelvis
pharynx
prothrombin
sickle cell anemia
thrombin
urinary bladder
alveoli (alveolus)
atria (atrium)
bronchial tubes
cilia
elephantiasis
fibrin
glomerulus
hormone
intestinal flora
leukemia
lymph
metabolism
pericardium
plasma
renal artery
spleen
thromboplastin
veins

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.*

DIGESTIVE SYSTEM

The word **digest** means to *break down* and that is why this system is called **digestive**. Digestion is responsible for changing the food we eat into simpler substances which can be used as nutrients for the body. As the various parts of the digestive system are described, refer to Figure 1 for the appearance and location of each structure mentioned.

Mouth. As we eat, food is taken into our mouth in a process called **ingestion**. After we ingest the food our body immediately begins to break the food down by digestion. The first step involves a liquid called **saliva**. This liquid is produced by structures within our mouth called **salivary glands** and is continually released into the mouth. Saliva contains chemicals called **enzymes**, which are responsible for breaking down food substances like starch. The purpose of chewing is to break down the solid food and mix it with the saliva before it is swallowed.

Esophagus and stomach. The ground food is then swallowed and passed into a long tube called the **esophagus**, which stretches to allow the food to pass through. Once inside the *stomach*, the food is mixed with **gastric juices**. These juices contain a strong acid called **hydrochloric acid**, which breaks the food down further. Sometimes under abnormal conditions, the acid may eat through the wall of the stomach or intestine. Excessive acid results in what is called an *ulcer*. Food will eventually pass out of the stomach and into the small intestine by way of a valve at the base of the stomach. The valve opens and closes to regulate the movement of the material through the digestive tract. After some time of being empty, the stomach will begin to contract again giving the person the sensation of being hungry.

Small intestine and digestive organs. Once the food is within the small intestine it encounters some other enzymes and juices. The function of this part of the digestive tract is both to digest and to absorb the food material by taking

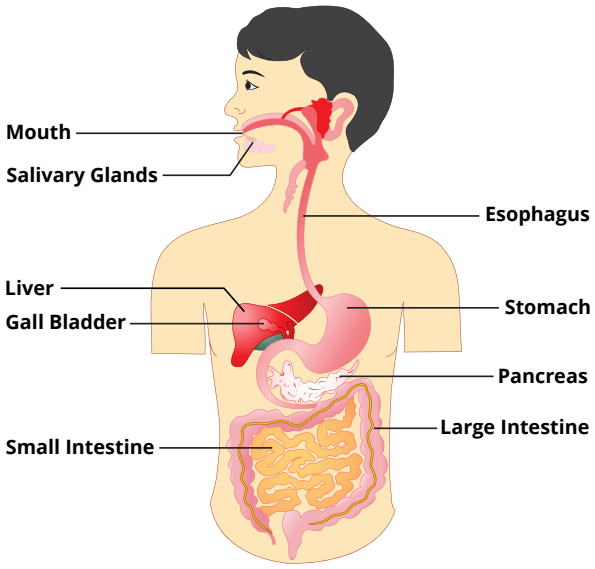

Figure 1 | Digestive System

the nutrients into the bloodstream. Two organs that are responsible for the production of the intestinal juices are the **liver** and the **pancreas**. The liver secretes a thick yellow-green fluid called **bile**. Bile aids digestion by causing the fats and fat-soluble vitamins to become soluble in water. Enzymes then break the fats down into simple chemicals for cellular use. The **gall bladder** is a sac that stores the bile until it is needed to help digest fatty food. Sometimes the gall bladder forms gall stones, which cause the blockage of the common bile duct coming from the gall bladder to the small intestine. When this blockage occurs, bile may enter the blood and cause **jaundice**, which turns the skin and eyes yellow. People can survive without their gall bladder but usually have some trouble digesting fatty meals.

Another organ that produces an important fluid for the intestine is a thin, long organ lying within the curved portion of the small intestine. This long organ is called the **pancreas**. The pancreas has two functions: (1) to secrete a **hormone** (a chemical messenger) called **insulin** to regulate blood sugar and (2) to produce enzymes that further break down food material in the small intestine. The first function will be discussed

later; the second function relates to the system we are now considering.

You should notice in Figure 2 a duct coming from the liver which brings bile into the gall bladder. Where the duct from the liver and the duct from the gall bladder join to enter the small intestine, there is a tube called the **common bile duct**. The duct from the pancreas also joins the common bile duct to empty its secretions.

These three basic food types must be digested: **carbohydrates**, **proteins**, and **fats**. Carbohydrates are substances like starch and sugar and are mainly digested in the mouth and small intestine. Proteins make up most of our body structure and are digested in the stomach and small intestine. Fats (like animal fat and oils) are digested mostly in the small intestine. The pancreas secretes enzymes into the small intestine for all three food types. Both the insulin and the bile contain the basic materials to neutralize the acid from the stomach. The lining of the small intestine also secretes enzymes to digest foods.

The digested food must now undergo a process called **absorption**. Absorption involves food entering into the blood stream to be used by the body. The small intestine has many finger-like projections called *villi* which serve to increase the inner surface area for absorption of food. Villi contain vessels from the circulatory system which receive the nutrients once they pass through the cells covering the villi.

Large intestine. The food finally passes into the **large intestin**e. By the time the food has reached the large intestine, most of the usable food has been absorbed by the small intestine. Where the small intestine enters the large intestine, there is a finger-like projection called the **appendix**. Sometimes this projection becomes inflamed and infected by bacteria. This inflamed condition is called **appendicitis**. If the appendix is not surgically removed soon after it is infected, it may burst and spill bacteria into the abdominal cavity.

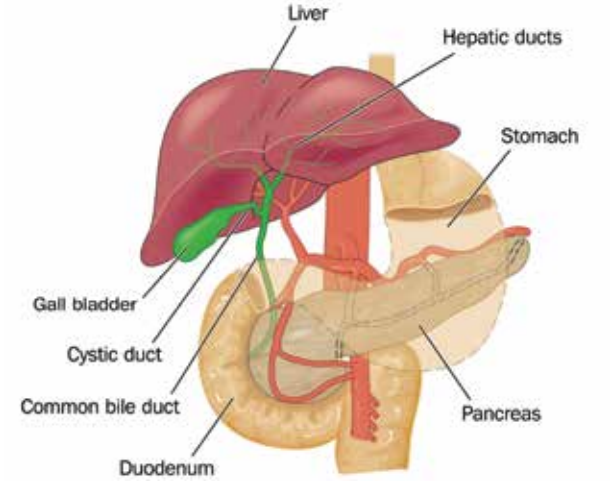

Figure 2 | Intestinal Secretions

The large intestine contains bacteria called **intestinal flora**. These bacteria affect the final breakdown of the remaining foods. The chemicals given off by these chemical processes have an unpleasant odor. A substance that originally came from bile is present in the final waste matter called **feces** and gives this waste a brown color. Contractions of the muscles throughout the entire digestive tract move the material to the lower part of the large intestine called the **rectum**. The feces is finally expelled from the body via the opening called the **anus**. This last process is called **excretion**. Sometimes veins may bulge from the pressure of the feces and form a quite painful condition known as **hemorrhoids**.

Two other conditions may interfere with the digestive system. One is constipation, a condition in which the feces are dry and hard and difficult to pass. Constipation can be lessened by eating more vegetables and foods grouped as roughage. The opposite condition is called **diarrhea**, a condition in which the feces is too fluid and flows out in liquid form. Much body water can be lost from diarrhea. Diarrhea is often treated using some sort of antacid material, but it will often stop without treatment. The entire digestive system secretes a mucus-type material which serves to lubricate the lining of the tract. Under normal conditions the bowels function on a quite regular basis.

Complete the following activities.

1.1 What is the difference between anatomy and physiology?

_____

_____

1.2 What happens to food during the following four processes: ingestion, digestion, absorption, and excretion?

a. _____

b. _____

c. _____

d. _____

1.3 Complete the following chart.

STRUCTURE	SECRETION	FUNCTION OF SECRETION
salivary glands	a.	b.
stomach	c.	d.
liver and gall bladder	e.	f.
pancreas	g.	h.

1.4 Describe the following conditions.

a. ulcer _____

b. gallstones _____

c. appendicitis _____

d. hemorrhoids _____

e. constipation_____

f. diarrhea _____

1.5 What do the following three structures do with respect to bile?

a. liver _____

b. gall bladder _____

c. common bile duct _____

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EXCRETORY SYSTEM

The word excretion refers to the removal of waste products from the body. Three types of wastes must be eliminated; solid, liquid, and gaseous. Several organs are involved in the excretory process. The solid waste is processed by the digestive system and has already been discussed. The solid waste excretion involves the digestive tract, rectum, and anus. The gaseous waste product is carbon dioxide, which is the end product of body **metabolism**. The lungs are responsible for ridding the body of this gas; they will be discussed under the respiratory system. The third type of waste, the liquid form, is excreted by both the skin and the **kidneys**. Sweat from the skin rids the body of liquid waste and cools the body at the same time. The discussion of the skin will be left until we examine the sense of touch. The kidneys are the primary organ responsible for liquid waste disposal, and they accomplish this disposal by filtering out impurities from the blood.

The overall urinary system will be presented first to show how the liquid waste called **urine** is processed. Refer to Figure 3 as the structures are being explained.

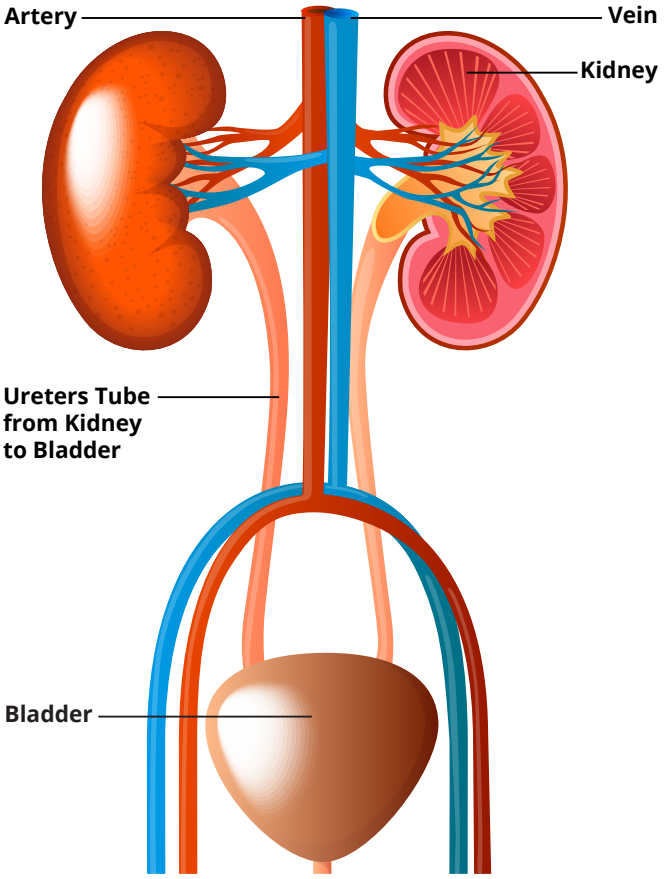

Figure 3 | Urine Production

Urine is produced by the bean-shaped kidneys located at the back of the abdominal cavity. When urine is produced, it flows down two tubes called **ureters**, which go from the inner side of each kidney to the **urinary bladder**. The bladder is a pear-shaped organ located in the lower abdominal cavity and serves to temporarily store the urine until the person urinates. When the bladder has approximately 300 ml of urine inside, the person will develop the desire to urinate. Urine will pass from the bladder into a tube called the **urethra**, which takes the urine to the outside of the body.

The basic structural unit of the kidney for producing urine is the **nephron**. The human kidney contains approximately 1 million of these tiny structures. Look at Figure 4 to better understand the explanation that follows.

Blood passes into the kidney via the **renal artery** and then through a series of smaller vessels until it reaches the **glomerulus**. The glomerulus is a ball of tiny blood vessels surrounded by a structure called the **Bowman's capsule**. This structure is where wastes dissolved in water pass from the glomerulus into the capsule and down into a descending tube of the nephron called a tubule. The **tubule** loops down sharply into the **loop of Henle** and comes back up to form an ascending tubule. Within the tubules, water and other important materials are taken back into the blood. Two processes are involved in the nephron: (1) **filtration**, which takes place in Bowman's capsule and involves the removal of many dissolved substances from the blood, and (2) **reabsorption**, which takes place in the tubules and is

responsible for replacing the important materials that left the blood. The only materials left in the urine are the dissolved waste materials. This liquid waste passes from the nephron into the collecting tubule and then to the center of the kidney called the **pelvis**. By the time the urine is in the pelvis, it has been changed into a concentrated liquid waste product. The nephrons are located in both the inner **medulla** and the outer **cortex** layers of the kidney.

We could not exist long if our kidneys stopped working, because our blood would be poisoned by the accumulating wastes. People who have had their kidneys removed are put on a **dialysis machine**. This machine serves as an artificial kidney by filtering the blood of the wastes. Medical advancement has made possible a kidney transplant from a close relative who has two healthy kidneys and is willing to give one up.

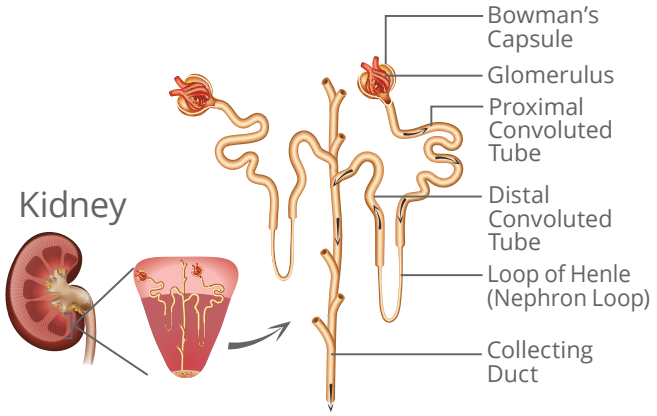

Figure 4 | The Kidney Nephron

Answer the following questions.

1.6 What can be done if somebody's kidney stops working? _____

_____

_____

1.7 What are the two steps involved in the production of urine by the kidneys?

a. _____

_____

b. _____

_____

Complete the following activities.

1.8 Define the following parts.

a. nephron _____

b. ureter _____

c. pelvis _____

d. glomerulus _____

e. urethra _____

1.9 Trace the path of the waste material from the time it leaves the glomerulus to the time it leaves the body. _____

_____

1.10 Complete the following chart.

WASTE TYPE	ORGAN(S) RESPONSIBLE FOR EXCRETION
solid	a.
liquid	b.
gaseous	c.

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RESPIRATORY SYSTEM

The process of **respiration** involves the exchange of two gases between your body and the environment. Oxygen is taken in from the air and carbon dioxide is released as a waste product of metabolism. Respiration has two aspects: (1) **external respiration**, which is the mechanical exhaling and inhaling that is needed to get the oxygen from the air into the lungs during breathing, and (2) **internal or cellular respiration**, which is the actual use of oxygen by the cells of the body and the release of carbon dioxide in exchange. Cellular respiration will not be covered in this section since it was discussed in previous LIFEPACs.

Nose and mouth. In normal breathing, air passes first into the nostrils of your nose. The lining of your nose contains both tiny hairs and mucus, which work together to filter out many of the solid particles from the air. The air is also moistened and warmed on its way through your nasal passages. From the nose, air passes through a muscular cavity at the back of your mouth called the **pharynx**. From the pharynx

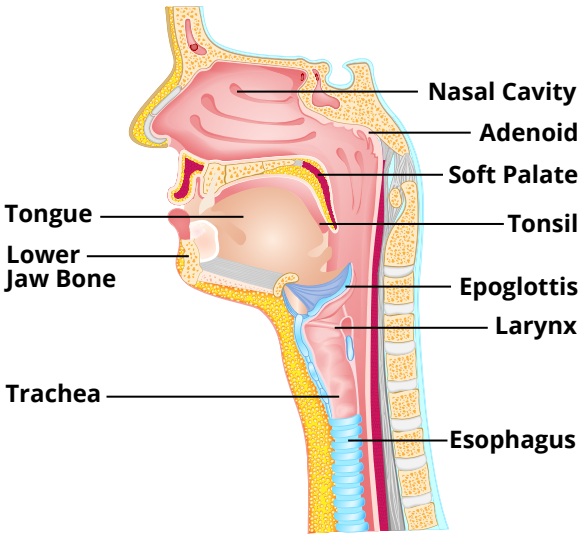


Figure 5 | Mouth and Throat Structures

the air enters the **trachea**, or windpipe as it is more commonly named.

Larynx. A flap of tissue called the **epiglottis** prevents the saliva or food from going down the trachea instead of the esophagus. The epiglottis flaps over the entrance of the trachea when you swallow. When food "went down the wrong way" and you choked and coughed, probably either you were not taking your time to eat properly or were speaking as you swallowed.

Part way down the trachea you have an enlargement called the **larynx** which is covered with cartilage. You can feel the larynx, sometimes called the Adam's Apple, on your neck. The larynx is commonly referred to as the "voice box" because it contains the vocal cords. The vocal cords are strips of cartilage that vibrate when air passes over them and make what you call your voice. The tongue enables us to shape into words the sounds from the larynx. If you put your finger in the middle of your lower neck and run it gently up and down, you will feel the ridges of cartilage that go around your trachea to keep it open for the passage of air.

Bronchial tubes and lungs. The trachea divides at its lower end into two **bronchi**, one going to each lung. **Cilia**, which are tiny hairs, within the tubes leading to the lungs beat upward to remove debris from the lungs and breathing tubes. The bronchi continue to divide, first becoming **bronchial tubes** and then **bronchioles**, which end in round air sacs called **alveoli** (singular = alveolus). See Figure 6. These tiny air sacs make up most of the lung tissue and give this tissue a soft and spongy texture. Gas exchange takes place by diffusion through the walls of the alveolus. Carbon dioxide leaves the tiny blood vessels that surround the air sacs and is exhaled. Oxygen is taken from the air in the alveolus and enters the blood stream to be taken to the cells of the body for cellular respiration. A moist film on the lining of the alveoli allows this gaseous diffusion to occur. A condition called **emphysema** results in the breakdown of the alveoli. This breakdown decreases the surface area of the lung, resulting in a greater difficulty in breathing. Cigarette smoking is a major cause in the development of emphysema in many people.

Our lungs have several lobes each, fill most of our chest cavity, and surround the heart. The process we call breathing involves two steps: (1) **inhalation**, in which air is drawn into the lungs, and (2) **exhalation**, in which air is forced out of the lungs. The lungs have no muscles to enable us to breath and depend upon a sheet of muscle called the **diaphragm** which stretches across the inside of the body below the lungs. This large, flat muscle separates the **thoracic**, or chest, **cavity** from the **abdominal cavity.** When the diaphragm contracts during inhalation, it works with muscles which pull the ribs back to enlarge the thoracic cavity. This enlargement of the thoracic cavity causes a partial vacuum inside the lungs, which causes air to rush into them. When we exhale, the muscles on the ribs and the diaphragm relax, and the elastic nature of the lung tissue forces the air out.

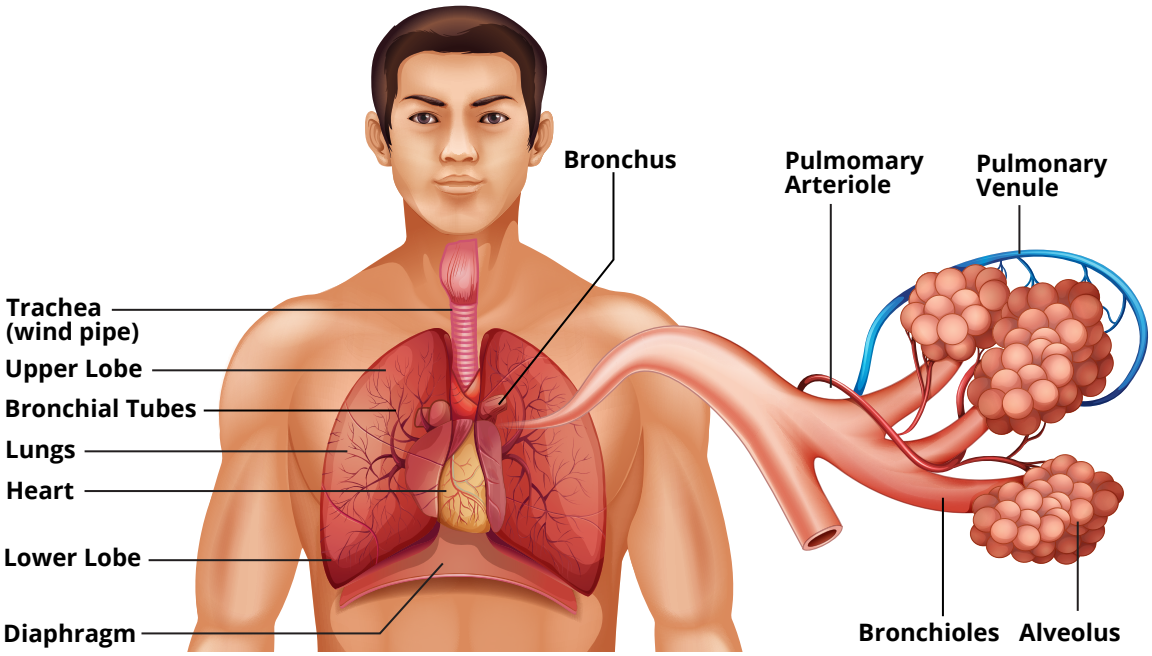


Figure 6 | The Respiratory System

Complete the following activities.

1.11 Name and describe the two aspects of respiration._____

_____

_____

1.12 Explain why food goes down our esophagus instead of the trachea when we chew and swallow our food properly. _____

_____

1.13 Explain how we are able to speak. _____

_____

1.14 Trace the path of air from the nose to the alveoli of the lungs. _____

_____

_____

1.15 Explain how we are able to exhale and inhale during breathing. _____

_____

_____

_____

CIRCULATORY SYSTEM

The primary functions of the circulatory system are to bring needed materials like food and oxygen to the cells of your body and to remove waste products. Since the primary fluid being circulated throughout the body is **blood**, a logical approach is to consider first the composition of this body tissue.

Blood. Blood can be broken down into two parts, solid and liquid. The liquid portion of the blood is a straw-colored fluid called **plasma** and is composed of water and dissolved materials. The dissolved materials fall into several groups: proteins, minerals, foods, and wastes. The proteins include such things as clotting factors, **antibodies**, and **albumin**, a protein that is identical to the one that takes up the white of an egg.

The solid portion of the blood can be broken into three groups: red blood cells, or **erythrocytes** (erythro = red, cyte = cell); white blood cells, or **leukocytes** (leuko = white, cyte = cell); and **platelets**. Erythrocytes are specialized red cells made to carry oxygen from the lungs to the cells of the body and to return carbon dioxide to be exhaled. Red blood cells are produced in the red bone marrow found at the ends of some of the bones in the body. When red cells are first produced they have a nucleus. This nucleus soon disintegrates causing the erythrocytes to be concave on each side. Since mature red blood cells do not contain a nucleus, more room is available for the red pigment called **hemoglobin**. Hemoglobin is composed of a protein with iron and is able to pick up oxygen because of the iron atom. The oxygen is released at the cells in exchange for the waste product carbon dioxide. God has designed hemoglobin for the purpose of carrying oxygen just as He created the pigment chlorophyll in plants for the specific purpose of carrying on photosynthesis. Sometimes people get a condition called **anemia** in which the amount of erythrocytes in their blood is decreased, thus

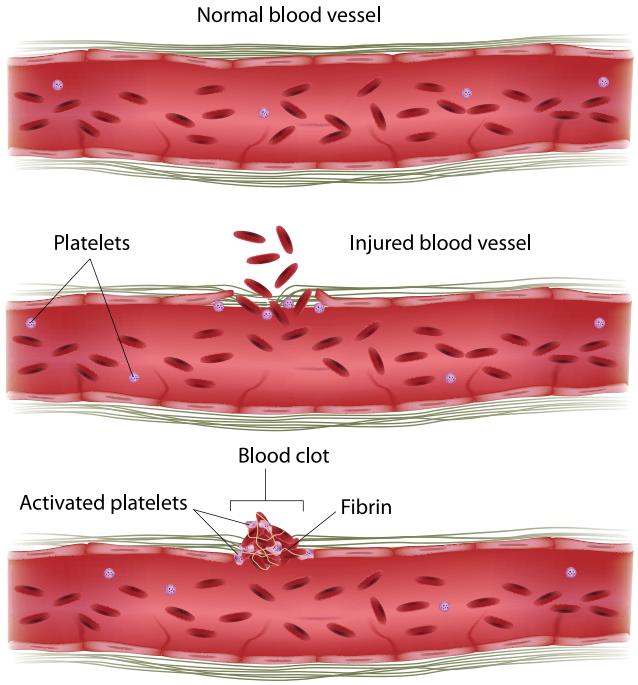


Figure 7 | Platelets

making it more difficult for the body to supply the cells with enough oxygen. Anemia is sometimes caused by an iron deficiency in the person's diet. Another condition which has this same effect is a genetic condition called **sickle cell anemia** and is found predominantly in African-Americans. With sickle cell anemia, the erythrocytes of the afflicted person can "sickle," or become curve-shaped, in such a way as to decrease the ability of the cell to carry oxygen to the body.

The second solid part of the blood is the leukocytes, or white blood cells. The primary function of these cells is to defend the body against disease. When a particle of material foreign to your body enters, the leukocytes can leave the capillaries and "eat" the bacteria or other particle by a process called **phagocytosis**. Sometimes so many bacteria are eaten that the leukocytes die. Many dead leukocytes mixed with plasma and bacteria form **pus**.
In two other ways, white blood cells differ from the red blood cells:(1) leukocytes have a nucleus, sometimes with several lobes, and (2)

leukocytes do not contain hemoglobin. Leukocytes are produced in the lymph glands and the red bone marrow. When cancer cells form in the tissues that grow the leukocytes, a condition called **leukemia** develops. Leukemia is most common in children.

The third solid component of the blood is the platelets, which contain materials responsible for blood clotting. See Figure 7 for the structures of these solid components of the blood. Platelets are bits of protoplasm broken from large cells made in the bone marrow.

The platelets burst open when a cut ruptures a blood vessel. When platelets burst, a substance called **thromboplastin** is released which, in the presence of calcium, reacts with another substance called **prothrombin** to form **thrombin**.

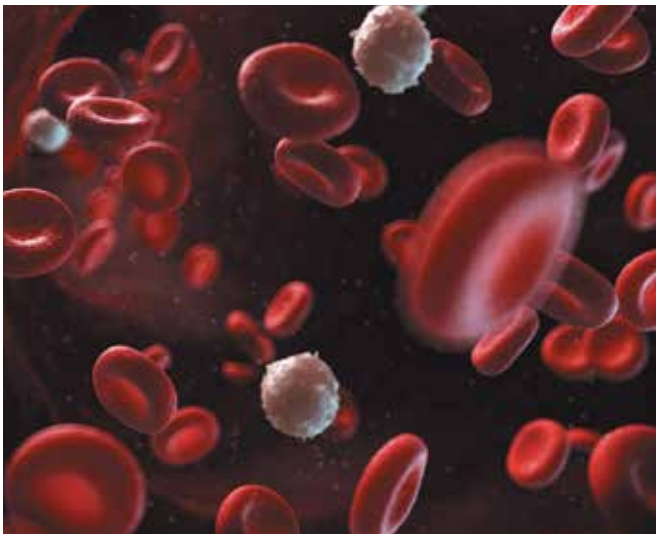
thromboplastin + prothrombin + calcium ——› thrombin

Thrombin then reacts with a protein called **fibrinogen**, already in the blood stream, and changes fibrinogen into **fibrin**, a substance which is made up of many tiny threads.

thrombin + fibrinogen ——› fibrin (which forms the clot)

Blood cells get caught in this maze of fibers formed by the fibrin and form what we call a "clot." A bruise is an example of a clot where blood vessels were broken from an impact against the tissue without cutting the skin. If blood did not clot, one could bleed to death when he was cut. A condition in which people are unable to form blood clots when cut is called **hemophilia**, or bleeder's disease. Hemophilia is inherited and was common in Queen Victoria's family in England.

Several kinds of blood groups are of great importance. The most common is the ABO blood group which includes four types of blood: A, B, AB, and O. A person with type A blood has protein A on their red blood cells. One with type B blood has protein B on their erythrocytes. The person having AB blood, which is less common, has both proteins on the red blood cells. Conversely, the one having type O blood, has neither protein A nor B.



| Blood Platelets

Another blood group is one involving a protein called the Rh factor. Anyone having this protein, Rh factor, on his erythrocytes, is Rh+ (Rh positive). Anyone not having this protein is Rh- (Rh negative). At one time this factor was a problem for pregnant mothers with Rh- blood. If an unborn child was Rh+ and its mother was Rh-, then the mother's blood might mistake the baby's blood for an invader and produce chemicals to destroy it. When proper medical precautions are taken, having this blood protein is no longer a major problem. You will examine the blood as a body defense in a later portion of this LIFEPAC.

Organs which serve as blood reservoirs or storage areas are the **liver** and the **spleen**. When one bleeds internally or exercises strenuously, these organs contribute more blood to the circulation system. The Bible tells us in Leviticus 17:11 and 14 that the "life of all flesh" is identified with its blood. Jesus had to shed His blood for our sins because sin brings forth death. If He had not died in our place, we would have to bear the penalty of death ourselves, and the penalty is eternal separation from God.

Complete the following sentences.

1.16 The primary functions of the circulatory system are to a. _____ , b. _____ , and c. _____ .

1.17 The primary fluid circulated throughout the body is _____.

1.18 The liquid portion of blood is called _____ .

1.19 The dissolved materials in blood are grouped as a. _____ , b. _____ , c. _____ , and d. _____ .

Complete the following chart of blood solids.

	SOLID	NAME	FUNCTION	BODY SOURCE
1.20	**red blood cells**	a.	b.	c.
1.21	**white blood cells**	a.	b.	c.
1.22	**platelets**	a.	b.	c.

Define the following terms.

1.23 hemoglobin _____

1.24 sickle cell anemia _____

1.25 phagocytosis _____

1.26 Rh protein _____

Answer the following questions.

1.27 What is the process God has designed for our blood to clot? _____

_____

_____

_____

1.28 Locate Leviticus 17:11 and 14. Read the verses carefully. What is the importance of the blood to life as described in Scriptures? _____

_____

_____

_____

1.29 As you read in Leviticus 17:11 and 14, "the life of the flesh is in the blood." Past medical practices included bleeding the patient, especially when other methods failed to cure the illness. Was this a sound practice based upon Scriptures? Defend your answer.

_____

_____

_____

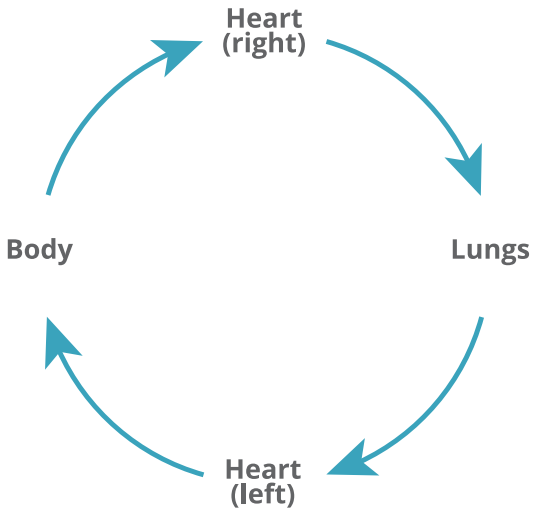
_____

_____

TEACHER CHECK _____ initials _____ date

Heart. Now that blood has been considered, the heart is located in the center of the chest despite the fact that it feels like it is on the left side. The reason for this feeling is because the pumping end is pointing downward and toward the left. The heart is surrounded by a sac called the **pericardium**. In humans the heart has four chambers, two thin-walled **atria**, which are responsible for receiving the blood back from the body, and two thick, muscular **ventricles**, which do the actual pumping of blood into the arteries. God gave our heart four chambers because this arrangement prevents the fresh blood coming from the lungs from being mixed with the blood low in oxygen that is coming back from the body. After blood leaves the blood vessels, it enters an atrium and flows through a valve into the ventricle. The left ventricle pumps blood to the upper and lower body; the right ventricle pumps blood to the lungs. If a one-way valve were not present between the atrium and ventricle, the blood would rush back into the atrium when the ventricle contracted rather than following the blood vessel leading from the heart. The valve between the right atrium and right ventricle is called the **tricuspid valve** because it has three cup-shaped flaps. The valve between the left atrium and left ventricle is the **bicuspid valve** because it has only two cup-shaped flaps. Valves also exist in the blood vessels coming from the ventricles. These valves prevent the blood from backing up after being pumped out of the heart in Figure 8. Look at the diagram of the heart on the next page. Study its parts and pathway of circulation carefully.

The general pattern of circulation is shown by the following diagram:



The blood gives up oxygen and takes on carbon dioxide in the body tissues. It then gives up the carbon dioxide and takes on the oxygen in the lungs.

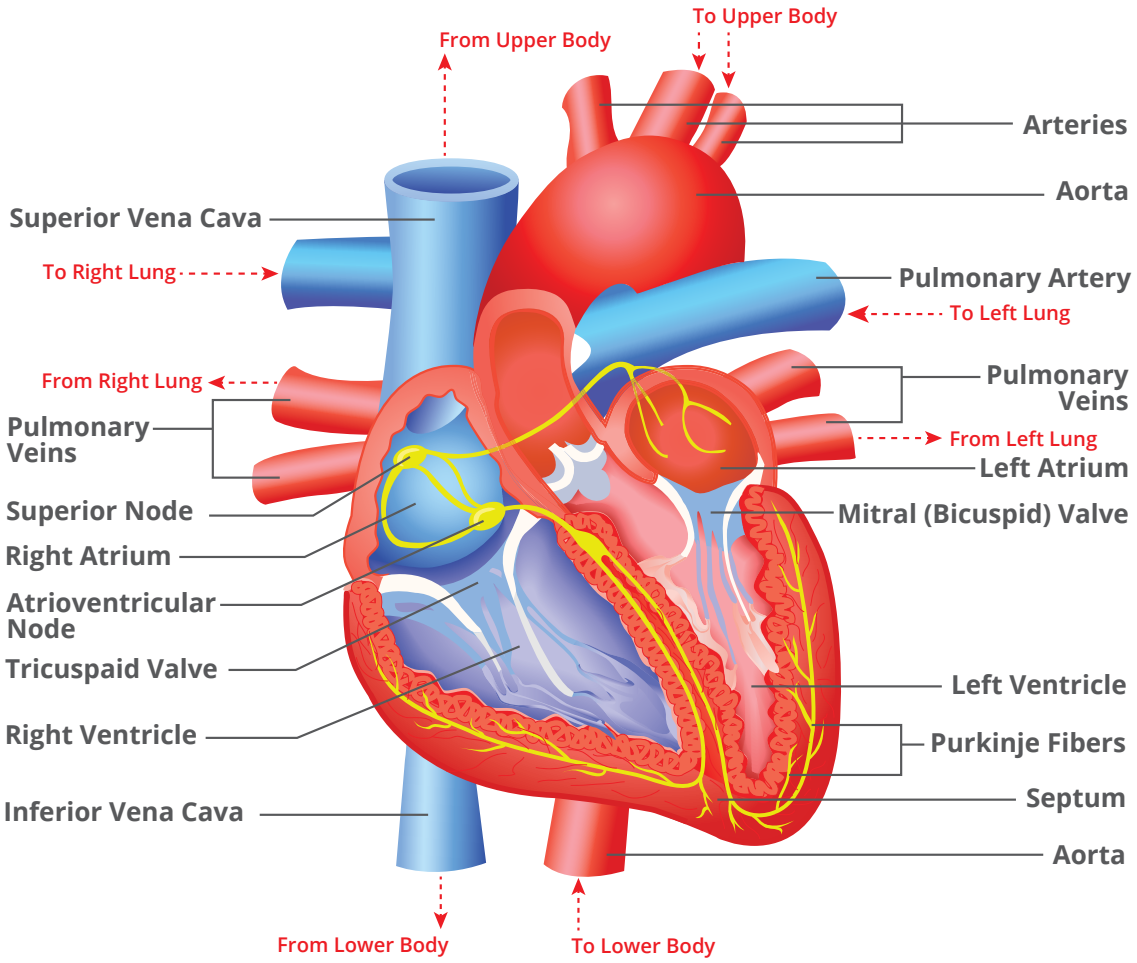


Figure 8 | The Heart

Blood vessels. There are many blood vessels that supply the heart itself with blood. When one of these vessels becomes clogged, the section of the heart which was supplied by that vessel could die. This clogging causes a heart attack. For these two reasons heart attack is the major cause of death in the United States: (1) the high fat content in the diet, and (2) the ill effects of cigarette smoking.

The average heart rate of an adult is about seventy beats per minute. This rate goes up whenever you exercise because your tissues have a greater need for oxygen at this time. The heart functions on a cycle that operates in two phases. The first phase, called **systole**, is when the heart ventricles are contracting. Systole is the point at which the pressure in your blood vessels is greatest. When the ventricles are relaxed and the atria are filling with blood, the pressure is lowest. This second phase is **diastole**. When a doctor or nurse takes your blood pressure, they record the upper systolic pressure and the lower diastolic pressure. The average blood pressure for a healthy adult is around 120/80. A common condition in the United States caused by diet and life style is **hypertension**, or more commonly called high blood pressure. Persons with hypertension need medical treatment to lower their blood pressure, otherwise they will risk having heart disease. The opposite condition, low blood pressure, can result in dizziness due to a lack of adequate oxygen in the brain. Low blood pressure is less common than high blood pressure.

Do this heart rate investigation.

Follow these directions. Put a check in each box when the step is completed.

- ☐ 1. Choose a partner and perform the following experiment. Do not do this experiment with any student who knows he or she has a heart condition or other medical problem.
- ☐ 2. Take your heart rates by placing your middle and pointer finger over the right side of the lower side of the wrist of your partner. Be sure to feel a distinct pulse before you proceed further.
- ☐ 3. Count the number of beats in 15 seconds and multiply this number by four to get the number of beats in one minute.
- ☐ 4. Take each other's pulse rate and record it in the appropriate boxes in the first half of the Heart Rate Chart.
- ☐ 5. Now take turns doing the following exercise: Do 50 jumping jacks as rapidly as you can. Be sure not to take short cuts in the way you do this exercise.
- ☐ 6. Have the partner who did not exercise take your pulse rate as soon as you finish.
- ☐ 7. Record the pulse rate in the correct space under the correct column.
- ☐ 8. Wait exactly one minute, take the pulse rate again, and record the data.
- ☐ 9. Repeat the pulse check after one more minute.
- ☐ 10. Now do the same thing to the partner who did not exercise the first time.
- ☐ 11. Have the resting partner record the same measurements in the second column of the chart.
- ☐ 12. Once you have completed the first half of the chart, calculate the change in pulse rate for yourself and your partner.

HEART RATE CHART	PARTNER 1: _____	PARTNER 2: _____
resting heart rate		
heart rate directly after exercise		
heart rate 1 min after exercise		
heart rate 2 min after exercise		
CHANGE IN PULSE RATE AFTER:		
0 minutes		
1 minute		
2 minutes		

1.30

Heart Rate Experiment

Answer this question.

1.31 Speculate on what some of the reasons might be for any differences observed between the response of your heart and the heart of your partner. _____

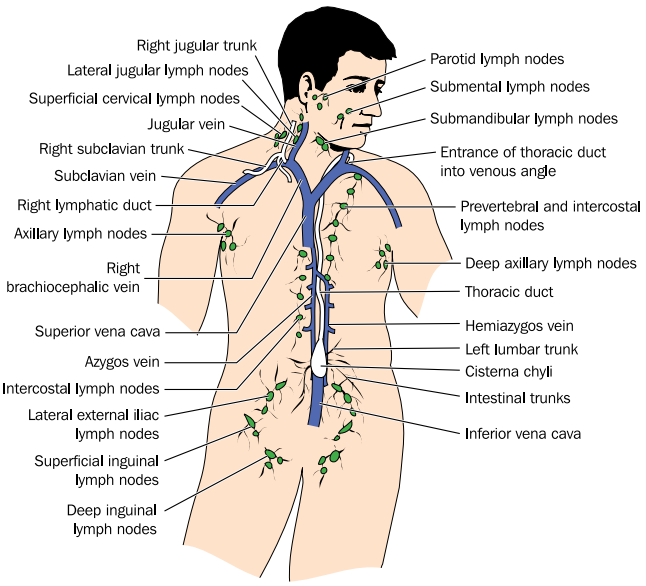
_____

_____

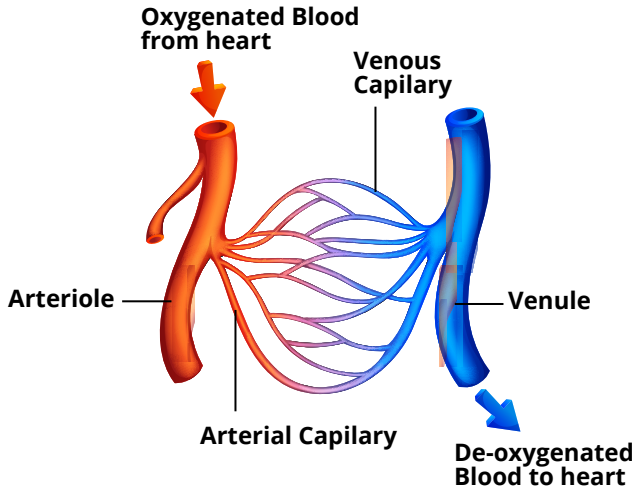
_____

The body has a series of tubes or vessels into which the heart can pump the blood to be taken to the body tissues. The vessels are divided into three types: **arteries**, **capillaries**, and **veins**. Arteries take blood from the heart toward the lungs or body. Because arteries receive the blood directly from the heart, they have thick walls which can withstand the high internal pressure. Arteries branch into smaller vessels called **arterioles**, and finally become so small that they cannot be seen by the eye. At the point when the vessels can not be seen by the unaided eye, they are called **capillaries**. In capillaries, oxygen and carbon dioxide are exchanged by diffusion into and out of the tissues. The capillaries begin to come together into larger vessels called **venuoles** and eventually form **veins**, the vessels that must bring the blood back to the heart. Veins have thinner walls than do arteries because the internal pressure is lower. Study Figure 9.

Lymph is the fluid that bathes the cells making up the tissues of the body. This fluid collects in small tubes which have a larger bead-like structure called a **lymph node**. Lymph nodes are dispersed throughout the body. The function of these nodes is to purify the lymph before it returns to the blood stream. A larger vessel called the **thoracic duct** collects lymph from the smaller vessels. The thoracic duct empties its contents into a vein in the left shoulder region. Another major duct, called the **right lymphatic duct**, returns lymph to a vein in the right shoulder region. This right duct drains the upper right portion of the body. The thoracic



| Figure10: The Lymphatic System



| Figure 9: The Blood Vessels

duct drains the whole left side and lower right side of the body. See Figure 10.

A condition called **edema** causes the accumula-tion of lymph in the tissues and results in the swelling of the body. Edema can be caused by blockage of the lymph vessels. A good example is **elephantiasis**, a condition caused by roundworms blocking the lymphatic vessels and causing the legs to swell. Other causes of edema are heart disease, poor diet, a hard blow to the body, or liver and kidney disease.

Answer this question.

1.32 Why does blood have the general pattern of heart to lungs to heart to body again?

_____

_____

_____

Complete the following activities.

1.33 Name and describe the three major types of blood vessels.

a. _____

b. _____

c. _____

1.34 Describe the following conditions.

a. anemia _____

b. sickle cell anemia _____

c. leukemia _____

d. hemophilia _____

e. heart attack _____

f. hypertension _____

g. edema _____

h. elephantiasis _____

1.35 Describe what a nurse or doctor is recording when they take your blood pressure.

_____

1.36 Describe the purpose and function of heart and blood vessel valves.

_____

_____

_____

TEACHER CHECK _____ initials _____ date

Review the material in this section in preparation for the Self Test. The Self Test will check your mastery of this particular section. The items missed on this Self Test will indicate specific areas where restudy is needed for mastery.

SELF TEST 1

Match the following items (each answer, 2 points).

1.01 _____ pancreas

1.02 _____ pericardium

1.03 _____ small intestine

1.04 _____ large intestine

1.05 _____ stomach

1.06 _____ villi

1.07 _____ gall bladder

1.08 _____ salivary glands

1.09 _____ tubules

1.010 _____ Bowman's capsule

a. secretion for digestion in mouth

b. stores bile

c. finger-like projections for absorption

d. intestinal flora

e. filtration of wastes from the blood

f. digestion and absorption of food

g. secretes digestive enzymes into the small intestine

h. the sac around the heart

i. hydrochloric acid to digest food

j. reabsorption of needed materials by the kidney

Write the letter of the correct answer on each line (each answer, 2 points).

1.011 Alveoli are structures that are _____ .

a. important in digestion within the stomach
b. used in the production of urine by the kidneys
c. important in respiration within the lungs
d. within the red bone marrow producing leukocytes

1.012 The function of the nephrons is to _____ .

a. regulate the rate of the heart during exercise
b. produce urine by filtering blood
c. reabsorb water from the feces within the rectum
d. produce insulin to regulate blood sugar

1.013 Hypertension is a condition involving _____ .

a. the back-up of lymph causing tissue swelling
b. the inability to form clots when cut
c. the adverse reaction of a mother's body to an unborn body with Rh+ blood
d. high blood pressure within the arteries of the body

1.014 The tube which drains lymph from the whole left side of the body and the lower rightside is the _____ .

a. thoracic duct
b. common bile duct
c. tricuspid valve
d. right lymphatic duct

1.015 The purpose of the left ventricle is to _____ .

a. pump blood to the upper and lower body
b. receive blood coming back from the lungs
c. pump blood toward the lungs to be oxygenated
d. receive blood back from the upper and lower body

1.016 Two basic processes exist in the kidney, filtration and reabsorption. Reabsorption occurs in which of the following kidney structures? _____ .

a. glomerulus b. pelvis c. Bowman's capsule d. tubules

1.017 The clotting of blood includes all of the following materials except _____ .

a. prothrombin
b. Rhesus factor (Rh factor)
c. calcium
d. fibrinogen

1.018 The vocal cords which make the sounds that enable us to speak are contained within the _____ .

a. bronchi b. larynx c. diaphragm d. trachea

1.019 The vessels in which blood is brought back to the heart are the _____ .

a. veins b. capillaries c. lymphatic vessels d. arteries

1.020 The disease caused by parasitic roundworms is _____ .

a. emphysema b. leukemia c. elephantiasis d. hemophilia

Complete these statements (each answer, 3 points).

1.021 The two parts of the blood consist of the liquid portion, called the _____ , and the solid components.

1.022 The solid part of the blood contains red blood cells called _____ .

1.023 The red blood cells contain a red pigment called _____ .

1.024 The solid component of the blood that is involved in the body's defense is the _____ .

1.025 When foreign particles like bacteria enter the body, certain types of white blood cells eat or engulf these particles by a process called _____ .

1.026 The solid part of the blood needed in the clotting mechanism is the _____ .

1.027 The upper pressure in the arteries when the heart is contracting is called the _____ .

1.028 The lower arterial pressure between heart contractions is called the _____ .

1.029 The average blood pressure for a human being is _____ / _____ .

1.030 The average heart rate for a healthy adult is _____ beats/minute.

Complete these items (each numbered item, 5 points).

1.031 Name and describe the two types of respiration and trace the path of a molecule of oxygen from the time it enters your nose to the time it is absorbed in the lungs.

a. _____

_____

b. _____

_____

c. _____

_____

1.032 Carefully describe the blood types found in the ABO blood groups and in Rh blood groups.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

64/80 **SCORE** _____ **TEACHER** _____ _____
initials date

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