Heart

Answers to Workbook Activities

A. List the functions of the circulatory system.

The functions of the circulatory system are as follows:

1. The heart is the pump necessary to circulate blood to all parts of the body.

2. Arteries, veins, and capillaries are the structures that take blood from the heart to the cells and carry the waste products away and back to the heart.

3. Blood carries oxygen and nutrients to the cells and carries the waste products away.

4. The lymph system returns excess fluid from the tissue to the general circulation.

B. Select the letter of the choice that best completes the statement.

1. If the blood flow to the brain ceases for 5 to 10 seconds, the muscles will start to twitch convulsively within

b. 15 to 20 seconds.

2. The average heart rate is \_\_\_\_\_\_\_ beats per minute.

b. 70–80

3. The recommended rate of chest compressions in cardiopulmonary resuscitation (CPR) is \_\_\_ per minute.

d. 100

4. The heart is located in the thoracic cavity

a. posterior to the sternum and superior to the diaphragm.

5. The heart pumps 5 quarts per minute. The amount of blood pumped in 1.5 hours is \_\_\_\_ quarts.

b. 450

6. To listen to the heart sounds, place the stethoscope between the

a. fifth and sixth ribs, middle of left clavicle.

7. The S1 sound occurs when

d. both the tricuspid and bicuspid valves close.

8. The SA node sends an electrical impulse to the atria that causes them to

b. depolarize.

C. Follow the directions regarding each of the structures of the heart. Label the callouts according to the numbers.

1. Label and describe the layers of the heart.

The layers of the heart are:

1. endocardium—- is the inner lining of the heart

2. myocardium—is the middle layer of muscle tissue that makes up the major portion of the heart.

3. pericardium is the outer layer or visceral pericardium.

2. Describe the double layer of fibrous tissue surrounding the heart. What is the name of the fluid between the two layers? What is the function of this fluid?

The pericardium is a double layer of fibrous tissue surrounding the heart; the outer layer is the parietal pericardium, and the inner layer is the epicardium.

The fluid is called pericardial fluid. It is a lubricating fluid that prevents the two layers from rubbing against each other and creating friction.

3. Label the chambers of the heart.

The chambers of the heart are:

1. right atrium

2. right ventricle

3. left atrium

4. left ventricle

4. Label the structures leading to and from the heart. Place answers on the lines provided.

The structures leading to and from the heart are:

1. superior vena cava

2. inferior vena cava

3. right pulmonary artery

4. left pulmonary artery

5. right pulmonary vein

6. left pulmonary vein

7. aorta

5. Where do these structures go to or come from?

The superior and inferior vena cava return blood to the right atrium from all over the body. The pulmonary artery takes blood to the lungs from the right ventricle. The pulmonary veins take blood from the lungs to the left atrium. The aorta takes blood from the left ventricle to all parts of the body.

6. Label the four valves of the heart and their locations. Place your answers on the lines provided.

The four valves of the heart and their locations are:

1. tricuspid valve—between the right atrium and the right ventricle.

2. pulmonary semilunar valve—from the right ventricle leading to the lungs

3. bicuspid or mitral valve—between the left atrium and the left ventricle.

4. aortic semilunar valve—from the left ventricle leading to the aorta.

7. What is unique about the structures of the heart valves?

The structures of the valves permit the blood to flow in one direction only. These valves open and close during contraction of the heart, preventing blood from flowing backwards.

8. Name the structure that separates the heart into two halves. What is the major difference between the right heart and the left heart?

The structure that separates the right side of the heart from the left is the interventricular septum.

The major difference between the right heart and, left heart is that the right heart contains deoxygenated blood and pumps blood to the lungs for oxygen. The left heart has oxygenated blood that is pumped to all the organs of the body.

D. Using Figure 13-6 in your textbook as a guide, list the steps that take blood from the superior vena cava to the aorta.

The steps are as follows:

1. superior vena cava

2. right atrium

3. tricuspid valve

4. right ventricle

5. pulmonary semilunar valve

6. main pulmonary artery

7. left pulmonary artery and right pulmonary artery

8. to lungs—blood receives oxygen

9. lungs to pulmonary veins

10. left atrium

11. mitral valve (bicuspid valve)

12. left ventricle

13. aortic valve (semilunar valve)

14. aorta

E. Use the words in the following list to complete the story on circulation.

inferior vena cava

right atrium

tricuspid valve

lung

oxygen

left atrium

miter

aortic semilunar

descending aorta

right ventricle

pulmonary   
 semilunar valve

pulmonary artery

carbon dioxide

pulmonary veins

bicuspid valves

left ventricle

aorta

liver

Circulation of a Red Blood Cell

I am tired. I am a red blood cell that has journeyed through this maze of blood vessels for the past 100 days. I am on my way back to the PUMP factory, carrying with me carbon dioxide thrown out as waste by a muscle cell.

I will be glad to get there to unload this baggage, and then I will pick up oxygen for one of my last trips. The major road from the liver is called the inferior vena cava, which goes to the right upper room, or right atrium, at the factory. After getting dumped there, I feel the walls start to vibrate and close around me. I get pushed through a door marked tricuspid valve. I am now in the lower room called the right ventricle. Just as I get comfortable, I hear that same sound again, and these walls start to move from the other side, pushing me upward through another door, which looks like a half moon. This one is called the pulmonary semilunar valve. Now I find myself pushed through the pulmonary artery tunnel, which goes from the heart to a spongy looking building complex with lots of wings; this is known as the lung factory.

When I arrive I am sent to a small chamber and there I drop off my carbon dioxide. “Wait,” the supervisor calls out. “You have to take this little fellow oxygen back to the PUMP factory with you.” As I leave the buildings, I am pointed in the direction of a maze of four highways, also known as the pulmonary veins. I am told that any of those roads will get me back to the PUMP factory.

I choose the least-crowded lane and land back at the PUMP factory on the left side of the building. I am now in the left atrium chamber. OH NO! It is happening all over again. The room starts to shake, the walls start closing in, and my little friend Oxy and I are pushed out a door marked bicuspid valve. This one has a funny top to it; it looks like a bishop’s miter. Now, here I am, in the left ventricle, and before you know it the walls are pushing at me again. Up, up, and away through the aortic semilunar valve. Oxy and I are in a bigger tunnel this time; it is called the aorta. At the end of the road is a curve with three major arteries coming off it; we will take the road going south; it is marked descending aorta.

This is my route back to the liver, taking Oxy along. I am so tired of getting pushed and shoved, I think I will just drop oxy off and stay there and retire to the recycle plant.

Can you guess the name of the pump? The heart

F. 1. Label the figure that illustrates the conduction system of the heart.

The labels are as follows:

1. sinoatrial valve (SA node)
2. atrioventricular valve (AV node)
3. AV bundle/Bundle of His
4. Purkinje fibers

2. What is the cardiac cycle? The cardiac cycle comprises one complete heartbeat with both atrial and ventricular contractions.

The following sentences illustrate the actions that occur during the cardiac cycle. Complete the blanks using the words provided. Words may be used more than once.

atria contraction aorta pulmonary veins

open ventricles pulmonary artery relaxed

semilunar bicuspid tricuspid closed

Depolarization

1. The SA node stimulates the contraction of both atria. Blood flows from the atria into the ventricles. The ventricles are relaxed, the semilunar valves are closed, and blood cannot enter the pulmonary artery and aorta.

2. The AV node receives the impulse from the SA node and stimulates the contraction of both ventricles, which pumps blood into the pulmonary artery and aorta. The atria are relaxed and the tricuspid and bicuspid valves are closed.

Repolarization

3. The ventricles are relaxed and the semilunar valves are closed, which prevents blood from flowing back into the ventricles. The heart rests.

4. On an electrocardiogram:

A. What action of the heart does the P wave and QRS wave represent?

The P wave and QRS wave represent the depolarization of the heart.

B. What action of the heart does the T wave represent?

The T wave represents the repolarization of the heart.

C. What information does an EKG give the physician?

By observing the size, shape, and location of each wave, the physician can analyze and interpret the conduction of electricity through the cardiac cells, the heart’s rate, the heart’s rhythm, and the general health of the heart.

G. Match the statements in Column B with the terms in Column A.

Column A Column B

j. 1. arrhythmia a. gurgling or hissing sound made by the valves

g. 2. diuretic b. difficulty in breathing

d. 3. bradycardia c. balloon surgery

a. 4. murmur d. pulse rate below 60 beats per minute

l. 5. mitral valve prolapse e. inflammation of the heart muscle

c. 6. angioplasty f. normal sinus rhythm

k. 7. pericarditis g. drug that reduces amount of fluid

b. 8. dyspnea h. pulse rate over 100 beats per minute

i. 9. cardiotonic i. drug that strengthens the heart

h. 10. tachycardia j. change or deviation of the heart rate

k. inflammation of the outer layer of the heart

l. may be related to stress

H. Mark the underlined words in the following statements either true or false. Correct any false statements.

 T   1. Heart failure occurs when the ventricles of the heart are unable to contract effectively and blood pools in the heart.

 F   2. If the left ventricle fails in heart failure, edema occurs.

If the left ventricle fails in heart failure, dyspnea occurs.

 T   3. If the right ventricle fails in heart failure, an abnormal accumulation of serous fluid will occur in the abdominal cavity.

 F   4. In congestive heart failure, there is edema of the lower extremities and treatment is with anticoagulants.

In congestive heart failure, there is edema of the lower extremities, and treatment is with cardiotonics and diuretics.

 T   5. Mitral valve prolapse is due to the improper closing of the valve between the left atria and left ventricle.

 T   6. A heart block occurs when the conductive system between the SA node and the AV node is disrupted.

 F   7. First-degree heart block is characterized by a pattern of only every second, third, or fourth impulse being conducted to the ventricles.

Second degree heart block is characterized by a pattern of only every second, third,  or fourth impulse being conducted by the ventricles.

 T   8. One form of first-degree heart block is characterized by a momentary delay at the SA node before the impulse is transmitted to the ventricles.

 T   9. Third-degree heart block is characterized by no impulse carried over by the SA node.

 T   10. The atria beat 72 times per minute, while the ventricles contract independently, beating 72 beats per minute. This occurs in third-degree heart block.

I. Fill in the blanks in the following statements.

1. When an area of the heart other than the pacemaker sparks and stimulates a contraction of the myocardium, it is known as a premature contraction.

2. When abnormal impulses from the atria bombard the AV node, this condition is known as atrial fibrillation.

3. Premature ventricular contractions (PVCs) originate in the ventricles and cause contractions ahead of the next anticipated beat; they may be benign or deadly.

4. When the heart rhythm breaks down and the muscle fibers contract at random without coordination, a life-threatening condition known as fibrillation exists.

5. The device used to discharge strong electric current through a patient’s heart to shock the SA node to resume its normal rhythm is called a defibrillator.

J. Answer the following questions.

1. Describe the pain that occurs in angina pectoris and myocardial infarction. Are they the same?

The pain that occurs with angina and myocardial infarction is different. In angina the pain radiates from the pericardial area of the heart to the left shoulder, down the arm along the ulnar nerve. In myocardial infarction the pain is a crushing, severe chest pain radiating to the left shoulder, arm, neck, and jaw. Myocardial infarcts tend to affect women differently. Women frequently have no chest pain and are said to have “silent” MIs.

2. Name the types of drugs used in the treatment of myocardial infarct.

Analgesics, anticoagulants, and cardiotonics are used to treat MI.

3. Describe the two types of heart surgery.

Two types of heart surgery are angioplasty, known as balloon surgery, and coronary bypass. In angioplasty, a small deflated balloon is threaded into the coronary artery until it reaches the blocked area; then the balloon is inflated. The balloon is opened and closed a few times until the blockage is pushed against the arterial wall and the area is unblocked. The balloon is then deflated and removed.

Coronary bypass surgery involves provision of a detour or bypass to allow the blood supply to go around the blocked area. A healthy blood vessel—usually a vein—is used for this purpose. The vein is inserted before the blocked area and provides another route for the blood supply to the myocardium.

4. What is the major problem in heart transplants?

The major problem in heart transplants is that the recipient’s immune system rejects the donor heart.

5. What is the action of immunosuppressants?

Immunosuppressants are drugs that suppress the recipient’s immune system so it will not form antibodies to reject the donated heart.

6. What are the risks involved in taking immunosuppressants?

The person will be more susceptible to infection and disease.

K. Complete the following word puzzle using the clues given. The numbers in parentheses tell how many letters are necessary to complete each statement. Some statements require two words.

1. Abbreviated term for this condition M I             (2)

2. Dilates blood vessels        nitrogl y cerine      (14)

3. Count should be below 200            ch o lesterol    (11)

4. Loss of elasticity of arterial walls       arterios c lerosis      (16)

5. Cardiotonic          digit a lis           (9)

6. Another name for myocardial infarction           hea r t attack     (11)

7. Lack of this causes condition          bloo d supply       (11)

8. Tiredness            fat i gue           (7)

9. Bed rest, oxygen, and medication            tre a tment          (9)

10. Plaque buildup in arterial walls        atherosc l erosis         (15)

11. Therapy to dissolve clots           ant i coagulant (13)

12. Severe chest pain          angi n a pectoris (14)

13. Change this to prevent heart attacks (per NIH)             li f estyle        (9)

14. Blood vessel most involved in this condition      coronary a rtery     (14)

15. Alleviates pain         deme r ol            (7)

16. Heart muscle          myo c ardium     (10)

17. Classification of drugs to strengthen heart         cardio t onic         (11)

18. To reduce mortality, provide this type of care        immed i ate           (9)

19. Surgical treatment          angi o plasty       (11)

20. Maintain blood pressure and weight         preve n tion         (10)

L. This cryptogram is a message in substitution code. Each letter is substituted for another letter. For example, the letter *k* is substituted for the letter *t*. Decipher the message.

Cryptogram Cardiac Output

Cardiac output is the total volume of blood ejected from the heart per minute. If the heart rate is 80, all the blood in the body is pumped through the heart every minute.

Applying Theory to Practice

1. a. How many quarts of blood are pumped through the heart in a 24-hour period with a heart rate of 72 bpm? If the heart rate was 60 bpm, how much blood would be pumped?

Using the facts that there are 32 ounces in 1 quart and the heart pumps 2 ounces of blood per beat, at 72 bpm, 6,480 quarts per day would be pumped; at 60 bpm, 5,400 quarts per day would be pumped.

1. b. Describe cardiac output.

With each heartbeat, between 60 and 80 ml of blood are ejected from the ventricles; this is known as stroke volume. Cardiac output = stroke volume × heart rate per minute.

2. Aliya is a cardiac nurse educator and is requested to prepare a brochure on “How to Reduce the Risk of Heart Disease” for the annual Health Fair. What information will Aliya include in this brochure?

The information in the brochure will include the following:  
Risk factors for heart disease, including family history, high blood pressure, high cholesterol, diabetes, smoking, physical inactivity, and obesity.

Practices to lower risk include prevention and control of high blood cholesterol and triglycerides. Low-density lipoprotein (LDL) builds up fat in the arteries, but high-density lipoprotein (HDL) helps to counter the fat level. Desirable levels for these values are:

Total cholesterol: less than 150mg/dL  
 LDL: less than 100mg/dL

VLDL (very-low-density lipoprotein): 5–30 mg/dL  
 HDL: 40mg/dL or higher  
 Triglycerides: less than 150mg/dL

If necessary, a physician may prescribe statin drugs, which block the enzymes necessary for the liver to manufacture cholesterol.  
Other measures include: reducing stress and taking medication, if necessary, to prevent and control high blood pressure; prevent and control diabetes through weight loss and regular exercise; no smoking; regular physical exercise; eat lots of fresh fruits and vegetables; lower salt intake; and eat less foods high in saturated fats.

3. Keith is 80 years old and uses a cardiac resynchronization therapy, a specialized type of pacemaker. What instructions can you give him regarding risks from external devices, such as smartphones?

You would explain to Keith that proper operation of pacemakers may be affected by MRI machines and other medical devices, electrical surveillance systems, and possibly even iPods. It is recommended that people with pacemakers not place smartphones over the area of the pacemaker; they should also be sure to carry ID noting the use of a pacemaker.

4. A 70-year-old woman wants to know how nitroglycerin is going to help her heart. She had heard “nitro” was used as an explosive. Explain the difference to her.

The nitroglycerin in pill formation is in therapeutic amounts; it causes no damage. It dilates the blood vessels and allows more blood to flow, especially to the heart muscle.

5. Because you are employed at the Cardiac Care Center associated with your local hospital, you must be familiar with the diagnostic tests ordered for heart disease and circulatory problems. Describe the differences between the following pairs:

a. Angiography and cardiac MRI

Angiography is an X-ray that uses dye injected into the coronary arteries to study the circulation of blood through the coronary arteries.  
Cardiac MRI is the use of the MRI technique to allow for clear and detailed pictures of the size and thickness of the chambers of the heart. The images can determine the extent of damage caused by a heart attack or progressive heart disease. Persons with implanted pacemakers or defibrillators cannot have this procedure.

b. Cardiac catheterization and IVUS

Cardiac catheterization is the insertion of a catheter into the femoral artery or vein. The catheter is fed into the chambers of the heart. Dye is inserted and pictures are taken as the fluid moves through the chambers. This test determines the patency of the coronary blood vessels as well as the efficiency of the structures of the heart.  
IVUS is an intravascular coronary ultrasound, which is a combination of echocardiography and cardiac catheterization. IVUS uses sound waves to produce an image of the coronary artery. The sound waves are sent through a catheter, which is threaded through an artery and into the heart. This allows the physician to look inside the blood vessels.

Health care workers must be certain to ask patients undergoing tests that require any type of dye injection if they are allergic to any substance, especially fish.

c. Arterial blood gases and C-reactive protein

The arterial blood gases test measures the amounts of oxygen and carbon dioxide in the blood.

C-reactive protein is produced in the liver in response to infection and inflammation. If the level of C-reactive protein is over 3 mg/L, it may indicate heart disease in conjunction with other findings.

d. Lipid panel and BNP

The lipid panel measures blood levels of LDL, VLDL HDL, cholesterol, and triglycerides.  
 BNP measures the level of the hormone B-type natriuretic peptide, which has been shown to rise in heart failure.

e. Exercise stress test and Holter monitor

In an exercise stress test or treadmill test, the patient walks on a treadmill while being monitored by an EKG to see if changes occur.

The Holter monitor is a small portable EKG machine worn by the patient to record EKG results on tape over 24 to 48 hours. The monitor is returned to the physician’s office, and the tape is read and evaluated.

6. Fred Gander, age 75, complains of chest pain and dyspnea and has a fever. He goes to the ER and a diagnosis of pericarditis is made. Fred asks the doctor to explain pericarditis and how he got this illness. Describe pericarditis and its treatment.

Pericarditis is an inflammation of the lining around the heart. The cause is either a bacterial or viral infection. Treatment is with antibiotics.

7. Maureen Hague notices that her ankles are swollen. In addition, she is short of breath, has a cough, and seems tired most of the time. What heart condition may Maureen have? Describe the condition and its treatment.

Maureen may have congestive heart failure. The ventricles of the heart are unable to contract effectively, and blood pools in the heart. Blood backs up into the lungs, and there is edema of the lower extremities. Diuretics will help to reduce the fluid, and cardiotonics will slow and strengthen the heartbeat.

8. Anthony is interested in a career as an EMT. He knows he must be certified in CPR. What is CPR, and how is it performed?

CPR, or cardiopulmonary resuscitation, is a life-saving technique that can keep oxygenated blood flowing to the brain and other organs if someone has stopped breathing or the heart has stopped beating. The American Heart Association recommends that all CPR should begin with chest compressions, after first calling 911. Using upper-body strength, push straight down on the chest at least 2 inches. Push hard at the rate of 100 compressions   
per minute.

What are the requirements to become an EMT.

Refer to Career Profile in Chapter 13 of the text.

Surf the Net

For additional information and interactive exercises, use the following key words:

• structure and function of the heart

• conduction system of the heart

• prevention of heart disease

• diagnostic tests for heart disease

• disorders of the heart—arrhythmias, inflammation of the heart, coronary artery disease, angina, myocardial infarction, heart attack, heart failure, conduction defects of the heart

• women and heart disease—atypical symptoms

• pacemakers and defibrillators

• heart surgery