Chapter 11 The Cardiovascular System—Heart and Vessels

OVERVIEW

The purpose of this chapter is to teach the anatomy and physiology of the cardiovascular system concerning the heart and vessels. The latter part of this chapter discusses the pathophysiology as it relates to the heart and vessels.

The cardiovascular system has been divided into two chapters: Chapter 10 on blood and Chapter 11 on the heart and vessels. The functions for this system are explained in Chapter 10 as they relate to blood. The Putting the Pieces Together feature is placed in this chapter.

Group activities for this chapter focus on blood flow through the heart and atherosclerosis. They can be found under Individual Outcomes 11.5 and 11.21, respectively.

Chapter figures can be found in the Online Learning Center (OLC). Discussion points, group activities, and quizzes listed in the summary table below are explained under their individual outcomes following the table. Answer keys to the text chapter review questions, workbook concept maps, and workbook review questions are located at the end of the chapter.

A review guide is also available on the OLC. This guide lists all of the learning outcomes for the chapter and gives space for students to take notes and make sketches. This can be an important tool to encourage students to pay attention to what they are learning and to use to either take initial notes or to organize their existing notes before exams.

Learning Outcome	CAAHEP Competencies	ABHES Competencies
11.1 Use medical terminology related to the cardiovascular system.	I.C.1. Describe structural organization of the human body	3.a. Define and use entire basic structure of medical words and be able to accurately identify in the correct context, i.e., root, prefix, suffix, combinations, spelling and definitions
11.2 Identify the chambers, valves, and features of the heart.	I.C.2. Identify body systems	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.3 Relate the structure of cardiac muscle to its function.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.4 Explain why the heart does not fatigue.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

11.5 Trace blood flow through the heart.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.6 Describe the heart's electrical conduction system.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.7 Describe the events that produce the heart's cycle of contraction and relaxation.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.8 Interpret a normal EKG, explaining what is happening electrically in the heart.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.9 Calculate cardiac output given heart rate and stroke volume.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.10 Explain the factors that govern cardiac output.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.11 Summarize nervous and chemical factors that alter heart rate, stroke volume, and cardiac output.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.12 Locate and identify the major arteries and veins of the body.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.13 Compare the anatomy of the three types of blood vessels.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.14 Describe coronary and systemic circulatory routes.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.15 Explain how blood in veins is returned to the heart.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.16 Explain the relationship between blood pressure, resistance, and flow.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.17 Describe how blood pressure is expressed and how mean arterial pressure and pulse pressure are	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

calculated.		
11.18 Explain how blood pressure and flow are regulated.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.19 Explain the effect of exercise on cardiac output.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.20 Summarize the effects of aging on the cardiovascular system.	I.C.10. Compare body structure and function of the human body across the life span	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.21 Describe common diagnostic tests used to diagnose heart and vessel disorders.	I.C.6. Identify common pathology related to each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
11.22 Describe heart and vessel disorders and relate abnormal function to pathology.	I.C	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

SUMMARY TABLE 11

LEARNING OUTCOME	LECTURE OUTLINE	ACTIVITIES – TALKING POINTS	ASSESSMENTS
11.1 Use medical terminology related to the cardiovascular system.		***WkBk Word Roots and Combining Forms***	***WkBk Chapter Review Questions:*** • Word Deconstruction: 1-5
11.2 Identify the chambers, valves, and features of the heart.	I. Overview II. Heart anatomy A. Pericardium B. Heart wall 1. epicardium 2. myocardium 3. endocardium	***WkBk Coloring Book:*** Figures: 11.1 (External anatomy of the heart) 11.2 (Pericardial sac) 11.3 (Internal anatomy of the heart and associated structures)	***Spot Check:*** *1, 2* **Quiz:** 1 (Covers LO 11.2. See Individual Outcome 11.2) Figure IMQ11.1

	C. Chambers and valves 1. right atrium 2. tricuspid valve 3. right ventricle 4. pulmonary valve 5. left atrium 6. bicuspid valve 7. left ventricle 8. aortic valve **Chapter Figures:** 11.2 (The position of the heart in the thorax) 11.3 (The pericardium and the heart wall) 11.4 (Spiral arrangement of cardiac muscle in the heart) 11.5 (Surface anatomy of the heart) 11.6 (Internal anatomy of the heart) 11.7 (Fetal heart)	**Talking Point:** It is easy to tell if you are looking at an anterior view of the heart. The anterior interventricular artery angles to the right of the apex of the heart. **Talking Point:** You can remember that the tricuspid valve is on the right side of the heart by thinking of this: "tri" and "righ." **Talking Point:** The bicuspid valve is also called the Mitral valve because anatomists thought the bicuspid valve too on the shape of a Mitre --- a Bishop's hat.	
11.3 Relate the structure of cardiac muscle to its function.	D. Cardiac muscle tissue 1. intercalated discs **Chapter Figure:** 11.8 (Cardiac muscle tissue)	**Talking Point:** This is a continuation of material discussed during histology in Chapter 2 and continued in a comparison of muscle tissues in Chapter 6.	***WkBk Chapter Review Questions:*** • MS: 1

11.4 Explain why the heart does not fatigue.		**Talking Point:** A quick review of aerobic versus anaerobic respiration and fatigue (covered in Chapter 6) may be helpful.	***Spot Check:*** *3* ***WkBk Chapter Review Questions:*** • Completion:1, 2
11.5 Trace blood flow through the heart.	III. Heart Physiology A. Blood flow through the heart **Chapter Figures:** 11.9 (The pathway of blood flow through the heart) 11.10 (General diagram of the pulmonary and systemic circuits)	**Group Activity:** Blood flow through the heart. (See Individual Outcome 11.5) ***WkBk Lab Exercises and Activities:*** • Blood flow through the heart	***Spot Check:*** *4,5*
11.6 Describe the heart's electrical conduction system.	B. Cardiac conduction system 1. SA node 2. AV node 3. AV bundle 4. Bundle branches 5. Purkinje fibers **Chapter Figure:** 11.11 (The cardiac conduction system)	**Talking Point:** It is important to stress that it is cardiac muscle cells that carry the electrical signals in the heart's conduction system, not nerve cells. Any patch of cardiac muscle cells is capable initiating the signal to start a cardiac cycle. The nervous system can modify the heart rate but is not necessary to initiate a cardiac cycle. **Talking Point:** The ECG (EKG) is a recording the electrical pathway from the SA node to the Purkinje fibers. ***WkBk Concept Maps:*** Figure 11.6 (Cardiac conduction system concept	***Spot Check:*** *6*

		map)	
11.7 Describe the events that produce the heart's cycle of contraction and relaxation.	C. Cardiac cycle 1. Phases of the cardiac cycle a. atrial systole b. atrial diastole c. ventricular systole d. ventricular diastole 2. Heart sounds during the cardiac cycle 3. Cardiac rhythm **Chapter Figures:** 11.12 (Concepts of volume, pressure, and flow) 11.13 (The action of heart valves on the left side of the heart)	**Talking Point:** Have each student take his/her own pulse. Poll the class as to over 100, 90-100, 80-89, 70-79, 60-69, under 60 beats per minute, so that students can see the range in a class. **Talking Point:** Many students believe that in a cardiac cycle: atria contract, ventricles contract, and it starts all over. It is important to stress that there is a rest between ventricular contractions and the next atrial contractions of the heart. This rest allows time for the heart to fill. This is further reinforced with the EKGs in the next LO. ***WkBk Concept Maps:*** Figure 11.7 (Cardiac cycle concept map)	***WkBk Chapter Review Questions:*** • MS: 8 • Completion: 3, 4
11.8 Interpret a normal EKG, explaining what is happening electrically in the heart.	D. Electrocardiogram 1. P wave 2. QRS wave 3. T wave **Chapter Figures:** 11.14 (Normal electrocardiogram) 11.15 (The relationship of an ECG	***WkBk Concept Maps:*** Figure 11.8 (Electrocardiogram concept map)	***Spot Check:*** *8* ***WkBk Chapter Review Questions:*** • MS: 9

	and contraction of the myocardium)		
11.9 Calculate cardiac output given heart rate and stroke volume.	E. Cardiac output 1. Heart rate 2. Stroke volume a. preload b. contractility c. afterload	***WkBk Concept Maps:*** Figure 11.9 (Stroke volume concept map)	***Spot Check:*** *9* ***WkBk Chapter Review Questions:*** • Completion:5
11.10 Explain the factors that govern cardiac output.	**Chapter Figure:** 11.16 (Arterial pressure points)		***Spot Check:*** *11* ***WkBk Chapter Review Questions:*** • MS: 3
11.11 Summarize nervous and chemical factors that alter heart rate, stroke volume, and cardiac output.	F. Heart regulation 1. Chronotropic factors of the autonomic nervous system a. proprioceptors b. baroreceptors c. chemoreceptors 2. Chronotropic effects of chemicals **Chapter Figure:** 11.17 (Baroreceptors and chemoreceptors in arteries superior to		***Spot Check:*** *10* ***WkBk Chapter Review Questions:*** • MS: 2 • Critical Thinking: 2

	the heart)		
11.12 Locate and identify the major arteries and veins of the body.	IV. Vessel anatomy A. Arteries B. Capillaries C. Veins D. Tunica externa E. Tunica media F. Tunica externa **Chapter Figures:** 11.18 (The major systemic arteries) 11.19 (The major systemic veins) 11.20 (The structural differences of arteries and veins)	***WkBk La bExercises and Activities:*** • Labeling vessels Figures: 11.4 (Major arteries) 11.5 (Major veins) **Talking Point:** Tunica is a Latin word that means "coat." Hence, inner coat, middle coat, and outer coat.	
11.13 Compare the anatomy of the three types of blood vessels.	A. Arteries 1. Conducting arteries 2. Distributing arteries 3. Resistance arteries B. Capillaries C. Veins 1. Venules 2. Medium veins 3. Large veins	***WkBk Concept Maps:*** Figures 11.10 (Types of vessels concept map) 11.11 (Vessel walls concept map)	***WkBk Chapter Review Questions:*** • Matching: 1-5

	Chapter Figure: 11.21 (Blood flow to a capillary bed)		
11.14 Describe coronary and systemic circulatory routes.	V. Vessel Physiology A. Circulatory routes 1. Coronary route 2. Systemic routes 3. Alternative routes a. Portal routes b. Anastomoses i. arteriovenous anastomoses ii. arterial anastomoses iii. venous anastomoses **Chapter Figures:** 11.22 (Coronary circulation) 11.23 (Superior view of the aortic valve with a section of the aorta removed) 11.24 (Pulmonary circulation – pulmonary circuit) 11.25 (Hepatic portal route)		**Quiz:** 2 (Covers LOs 11.12-11.14 See under Individual Outcome 11.14) Figure IMQ11.2 ***WkBk Chapter Review Questions:*** • Critical Thinking: 1

11.15 Explain how blood in veins is returned to the heart.	B. Venous return 1. Pressure gradient 2. Gravity 3. Thoracic pump 4. Cardiac suction 5. Skeletal muscle pump **Chapter Figure:** 11.26 (The skeletal muscle pump)	**Discussion Point:** Venous return. (See Individual Outcome 11.15)	***WkBk Chapter Review Questions:*** • MS: 7
11.16 Explain the relationship between blood pressure, resistance, and flow.	C. Blood pressure, resistance, and flow 1. Cardiac output 2. Blood volume 3. Resistance a. Blood viscosity b. Vessel length c. Vessel radius		***Spot Check:*** *12* ***WkBk Chapter Review Questions:*** • MS: 6 • Critical Thinking: 2
11.17 Describe how blood pressure is expressed and how mean arterial pressure and pulse pressure are calculated.	4. Sphygmomanometer 5. Stethoscope 6. Pulse pressure 7. Mean arterial pressure	***WkBk Lab Exercises and Activities:*** • Blood pressures Tables 11.1 (Blood pressures for students 1 to 3 at rest) 11.2 (Blood pressures for students 1 to 3 after exercise) 11.3 (Blood pressures for students 4 and 5 while supine) 11.4 (Blood pressures for students 4 and 5	***Spot Check:*** *13* **Quiz:** 3 (Covers LOs 10.7, 11.9, 11.10, 11.17. See Individual Outcome 11.17) ***WkBk Chapter Review Questions:*** • Matching: 6-10

		immediately upon standing) 11.5 (Blood pressures for students 4 and 5 after standing two minutes) **Talking Point:** Discuss the reason behind using a stethoscope when taking blood pressure.	
11.18 Explain how blood pressure and flow are regulated.	D. Regulation of blood pressure and flow 1. Local control a. precapullary sphincters b. inflammation c. reacton hyperemia d. angiogenesis 2. Hormonal control a. ADH b. Aldosterone c. Angiotesnin II 3. Neural control a. baroreflex b. chemoreflex c. medullary ischemic relfex	***WkBk Lab Exercises and Activities:*** • Blood pressures Tables 11.1 (Blood pressures for students 1 to 3 at rest) 11.2 (Blood pressures for students 1 to 3 after exercise) 11.3 (Blood pressures for students 4 and 5 while supine) 11.4 (Blood pressures for students 4 and 5 immediately upon standing) 11.5 (Blood pressures for students 4 and 5 after standing two minutes)	***WkBk Chapter Review Questions:*** • MS: 5
11.19 Explain the effect of exercise on cardiac output.	E. Effects of exercise on cardiac output	***WkBk Lab Exercises and Activities:*** • Blood pressures Tables	***WkBk Chapter Review Questions:*** • MS: 4

	Chapter Figure: 11.27 (Nick and Kate on a morning run)	11.1 (Blood pressures for students 1 to 3 at rest) 11.2 (Blood pressures for students 1 to 3 after exercise) 11.3 (Blood pressures for students 4 and 5 while supine) 11.4 (Blood pressures for students 4 and 5 immediately upon standing) 11.5 (Blood pressures for students 4 and 5 after standing two minutes)	
11.20 Summarize the effects of aging on the cardiovascular system.	VI. Effects of aging on the cardiovascular system		***WkBk Chapter Review Questions:*** • MS: 10
11.21 Describe common diagnostic tests used to diagnose heart and vessel disorders.	VII. Diagnostic tests for heart and vessel disorders A. Echocardiography B. ECG (EKG) C. Heart CT scan D. Nuclear heart scan E. Holter monitor F. Stress test G. Cardiac catheterization H. CT angiography I. Ultrasound J. Venography		***Spot check:*** 14 ***WkBk Chapter Review Questions:*** • Critical Thinking: 3 ***WkBk Case Study:*** 3, 4

	Table: 11.1 (Diagnostic tests used for heart and vessel disorders)		
11.22 Describe heart and vessel disorders and relate abnormal function to pathology.	VIII. Disorders of the heart and vessels A. Valve disorders 1. murmur 2. prolapsed valve B. Vessel disorders 1. Atherosclerosis 2. Thrombophlebitis 3. Varicose veins C. Myocardial disorders 1. Myocardial infarction 2. Angina pectoris 3. Congestive heart failure D. Congenital heart defects 1. Atrial septal defect 2. Ventricular septal defect 3. Valve defect 4. Tetralogy of Fallot **Chapter Figures:** 11.28 (Prolapsed valve) 11.29 (Atherosclerosis) 11.30 (Thrombophlebitis) 11.31 (Varicose)	**Group Activity:** Atherosclerosis. See Individual Outcome 11.21.	***Spot check:*** 15 ***WkBk Chapter Review Questions:*** • Critical Thinking: 3 ***WkBk Case Study:*** 1, 2

	11.32 (Congestive heart failure) 11.33 (Congenital heart defects) 11.34 (Tetralogy of Fallot) **Table:** 11.2 (Summary of diseases and disorders of the cardiovascular system)		

INDIVIDUAL OUTCOMES

OUTCOME 11.2

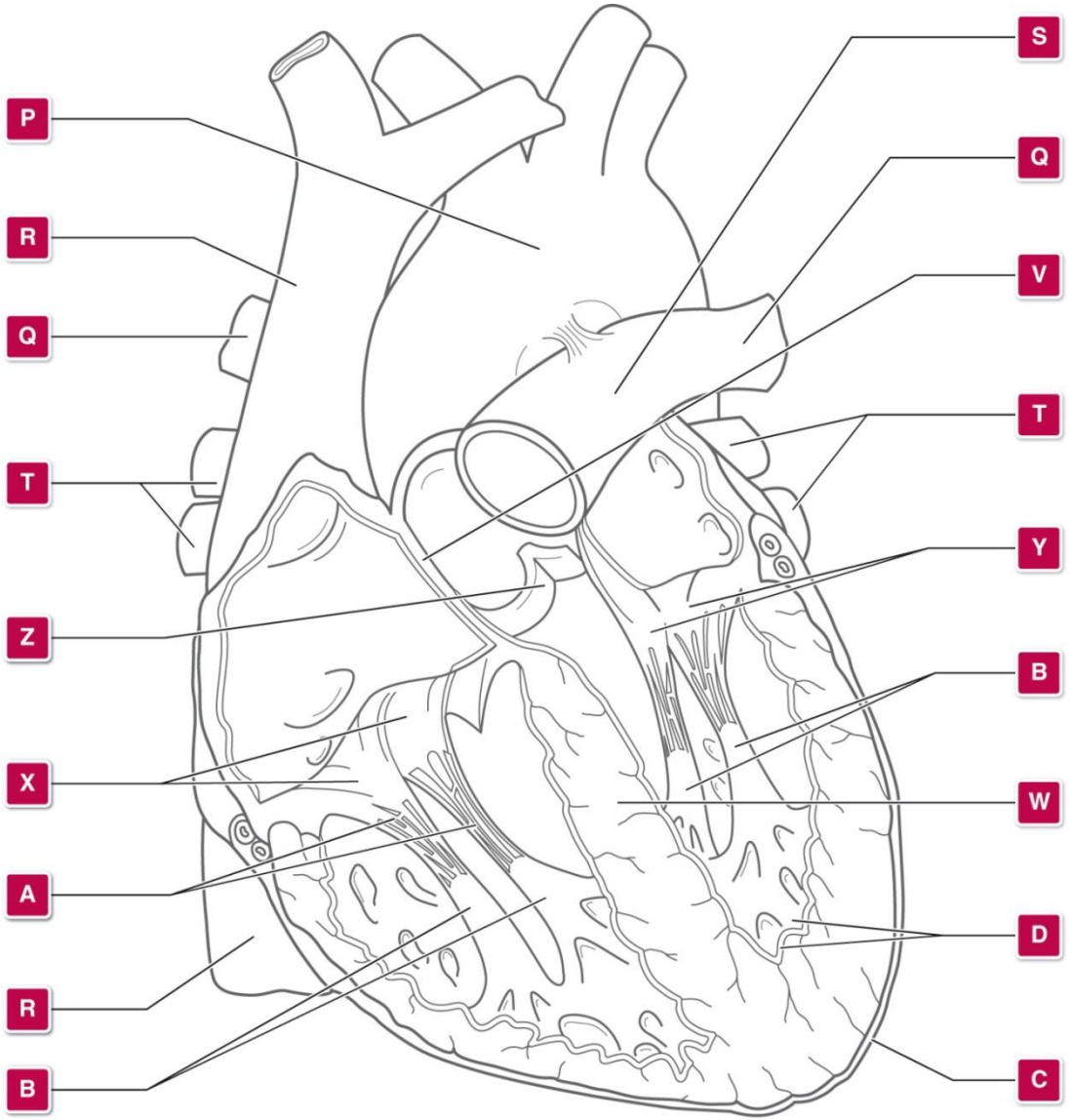
Spot Check 1: Which is more inferior, the base of the heart or the apex of the heart?

Answer: The apex of the heart

Spot Check 2: How can you determine the right ventricle from the left ventricle?

Answer: The left ventricle has a thicker outer wall because it has a larger workload.

Quiz: 1



Use the figure to answer the following questions.

1. Identify layer D. *Endocardium*
2. Identify valve X. *Tricuspid valve*
3. Identify valve Z. *Aortic semilunar valve*
4. Identify B. *Papillary muscle*
5. Identify A. *Tendinous cords*
6. Identify layer C *Epicardium*
7. Identify V. *Interatrial septum*
8. Identify W. *Interventricular septum*

OUTCOME 11.4

Spot Check 3: How does myoglobin help to prevent the heart from fatiguing?

Answer: Myoglobin stores oxygen so cardiac muscle can continue to perform aerobic respiration.

OUTCOME 11.5

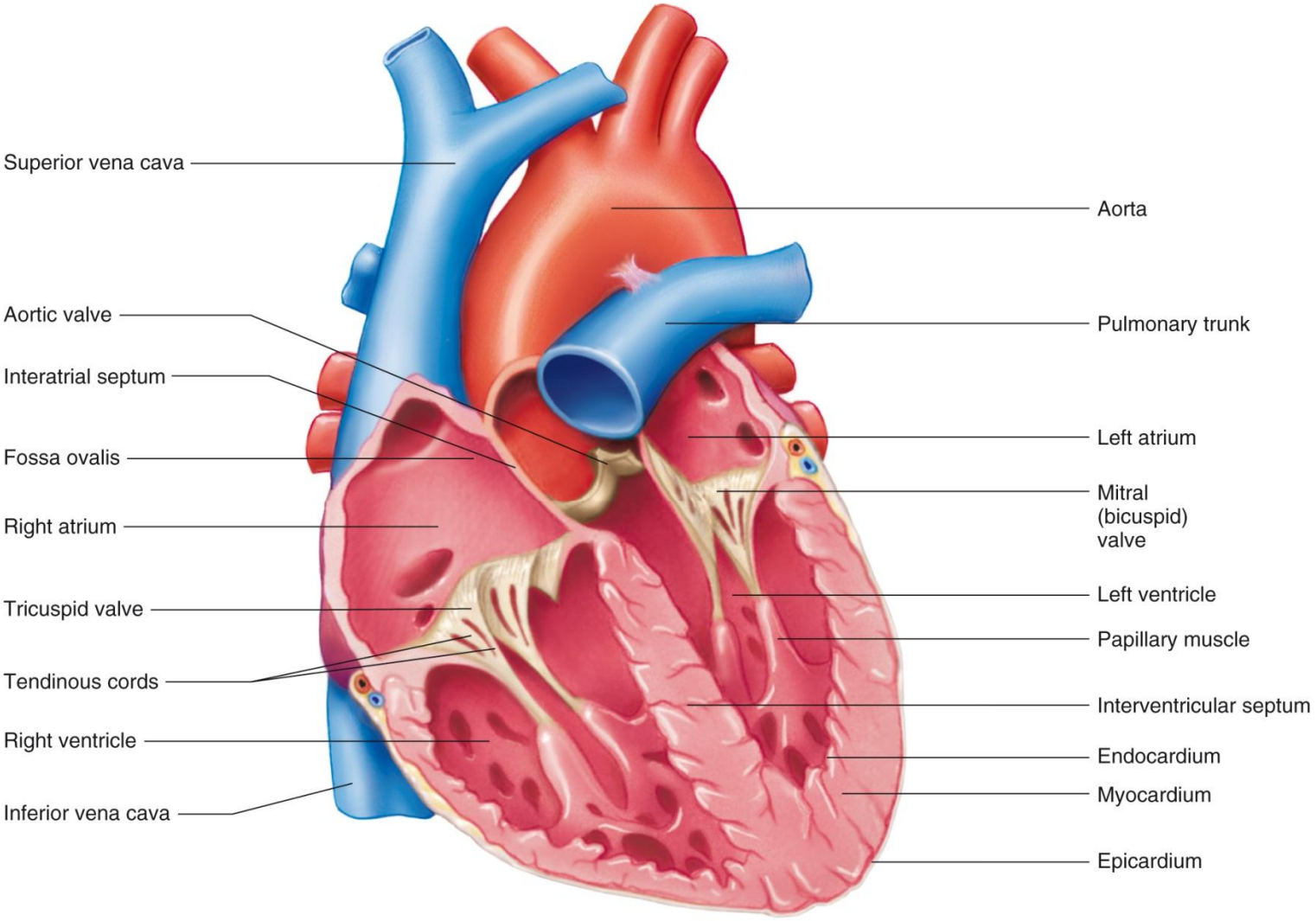
Spot Check 4: Where will blood be immediately after passing through the tricuspid valve?

Answer: The right ventricle

Spot Check 5: Through what valve will blood pass next after the left ventricle?

Answer: Aortic valve

Group Activity: Blood flow through the heart



This cooperative learning activity works well to teach blood flow through the heart. Divide the class into groups of 3 to 4. Each group's assignment is to make sure everyone in the group can describe blood flow through the heart and identify all of the relevant structures involved. The group is to work with their text and practice until they think they are capable of testing out with the instructor. To test out: the group comes to the instructor who selects one person to start. Each member of the group states one part of the blood flow in order. The instructor stops the progression at any time and asks the group member to show the structure just named on Figure 11.6. Any mistakes or even hesitation means the group goes back to study some more. On subsequent test outs the instructor picks a different member of the group to start. This works well if the instructor sets high standards and follows through with making the entire group responsible because every member of the group then has a stake in making sure the entire group knows the material.

OUTCOME 11.6

Spot Check 6: List in order the parts of the electrical conduction system used to stimulate ventricular contractions.

Answer: SA node, AV node, AV bundle, AV bundle branches, Purkinje fibers

OUTCOME 11.7

Spot Check 7: What heart sounds would be produced by a leaky aortic or pulmonary semilunar valve?

Answer: Lubb duppssh, lubb duppssh.

OUTCOME 11.8

Spot Check 8: What is happening in the atria and ventricles in the interval between the T wave and the next P wave?

Answer: All the chambers are filling with blood. The heart is at rest.

OUTCOME 11.9

Spot Check 9: What is the cardiac output if the heart rate is 100 beats/min and the stroke volume is 80 mL/beat?

Answer: 8 liters per minute

OUTCOME 11.10

Spot Check 11: What is the term for the pressure of blood filling the cups of the valve as it is trying to return to the heart during ventricular diastole?

Answer: Afterload

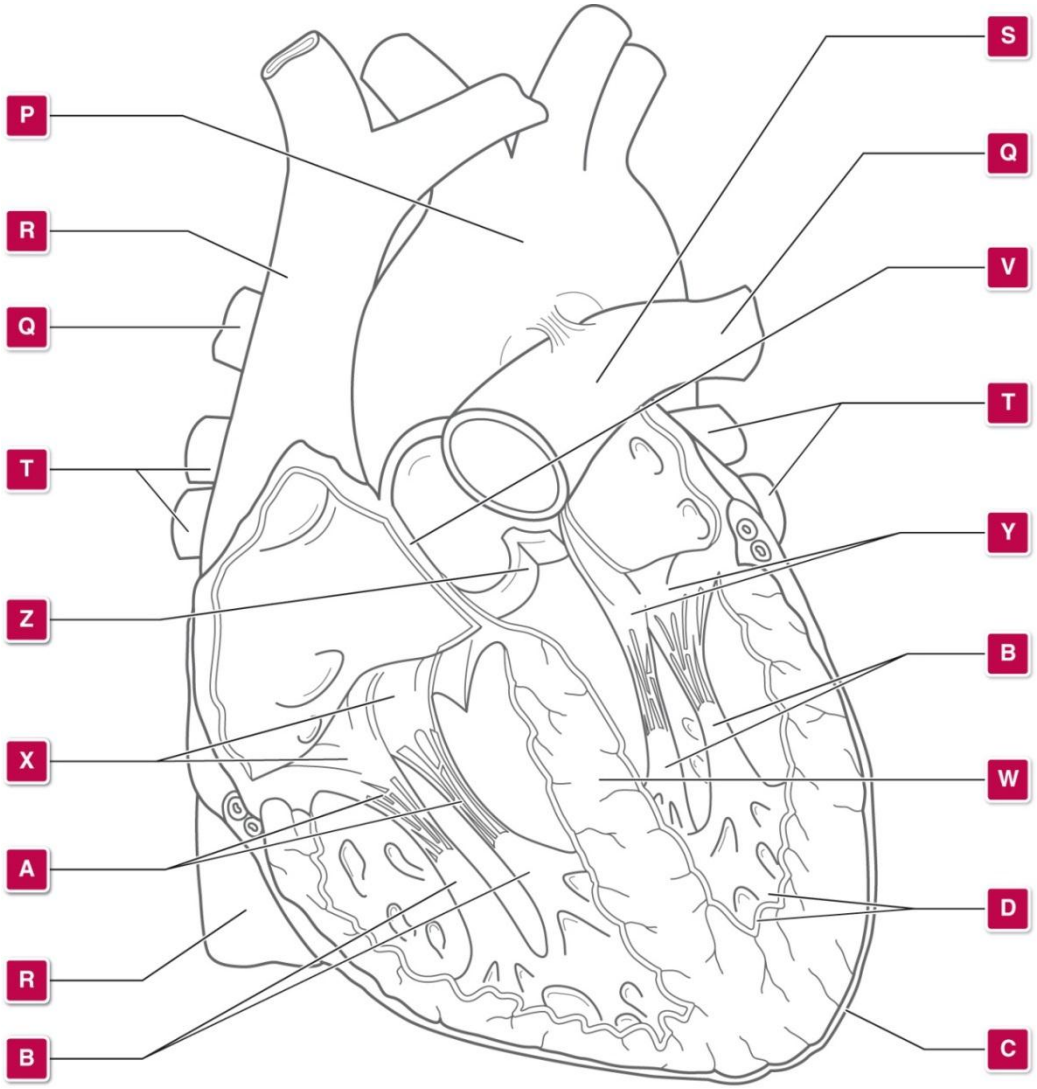
OUTCOME 11.11

Spot Check 10: What would be the effect on heart rate of two cups of coffee and a cigarette for breakfast? Explain.

Answer: The heart rate would likely increase because of the caffeine and nicotine.

OUTCOME 11.14

Quiz: 2



Use the figure to answer the following questions.

1. Identify P. *Aorta, arch of the aorta*
2. What type of vessel is P? *Artery*
3. Identify the two Rs. *Superior and inferior vena cavae*
4. What type of vessels are the two Rs? *Veins*
5. How does the number of tunics compare between P and the two Rs? *They are the same, 3.*
6. How does the anatomy differ between P and the two Rs? *P has more smooth muscle and elastic fibers in the tunica media*
7. What type of vessel is not shown in this figure? *Capillaries*
8. How many tunics does that vessel contain? *1*
9. How does blood get from P to the coronary arteries? *Through openings to the coronary arteries on the aorta side of the aortic semilunar valve*
10. What type of circulatory route insures that cardiac muscle is fed by more than one artery? *Arterial anastomosis*

OUTCOME 11.15

Discussion Point: Venous return. Ask the question: How would blood be returned to the heart in a grocery store checkout person four hours into her shift?

Skeletal muscle pump will not be active for the lower extremities in a person who is standing in place for long hours.

OUTCOME 11.16

Spot Check 12: Would blood flow be faster in the aorta or the femoral artery? Explain in terms of resistance.

Answer: It would be greater in the aorta because the aorta has a greater diameter than the femoral artery and it is closer to the heart.

OUTCOME 11.17

Spot Check 13: What are the pulse pressure and mean arterial pressure for a 25-year-old individual whose blood pressure is 150/96 mmHg?

Answer: Pulse pressure= 54 mmHg, MAP = 96+1/3(54)=114 mmHg.

Quiz:3

Given the following female patient values: Heart rate=72 beats/minute, Stroke volume=80 mL/beat, Blood pressure=138/84 mmHg, heart sounds= lubssh dup

1. What is her pulse pressure? *54 mmHg*
2. What is her diastolic pressure? What does diastolic mean? *84 mmHg, pressure produced when atria contract*
3. What is her mean arterial pulse pressure? *102 mmHg*
4. What is the definition of mean arterial pulse pressure? *The average pressure arteries must be able to withstand*
5. What is the pressure when the ventricles contract (give number)? *134 mmHg*
6. What is her cardiac output? *5,760mL/minute*
7. What is causing the heart sounds and what do the heart sounds indicate? *A murmur, possible leaky AV valve*
8. Does she have hypertension? *No, she is prehypertensive*
9. If her pulse was taken at her wrist, what vessel was likely used? *Radial artery*
10. What device was used to measure her blood pressure? *Sphygmomanometer*

OUTCOME: 11.21

Spot Check 14: Compare and contrast a stress test and the Holter monitor.

Answer: Comparisons: Stress test – monitors the heart rate *Contrasts: Stress test – monitors electrical activity and blood pressure*

Holter monitor – monitors heart rhythms *Holter monitor – does not monitor blood pressure or electrical activity*

Group Activity: Atherosclerosis.

Divide the class into groups. Each group is to research atherosclerosis in connection to heart disease in their state. They are to find the prevalence in the state, possible causes, how the disease thwarts the normal anatomy and physiology of the cardiovascular system, treatment options, prognosis based on various treatment options; hospitals or clinics that specialize in heart disease in the local area or state.

OUTCOME 11.22

Spot Check 15: Describe the relationship between atherosclerosis CAD, myocardial infarction, and angina pectoris.

Answer: Atherosclerosis is the buildup of fatty deposits with the vessel walls. CAD is the buildup of fatty deposits within the coronary vessels. This buildup of fatty deposits within the walls of any vessel can impede the flow of blood. Myocardial infarction and angina pectoris can be the result of impeded blood flow due to atherosclerosis.

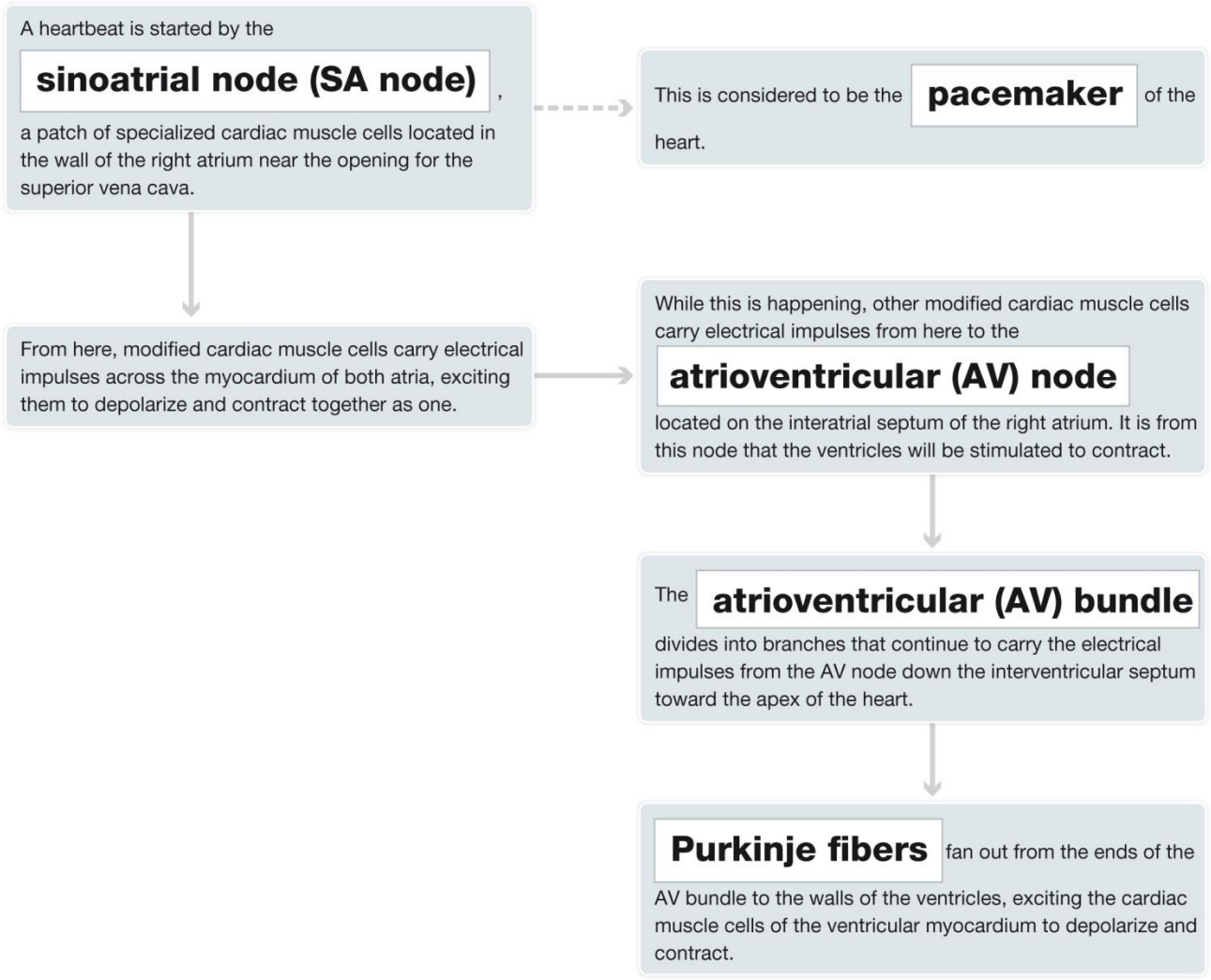
ANSWER KEYS

Chapter Review Questions

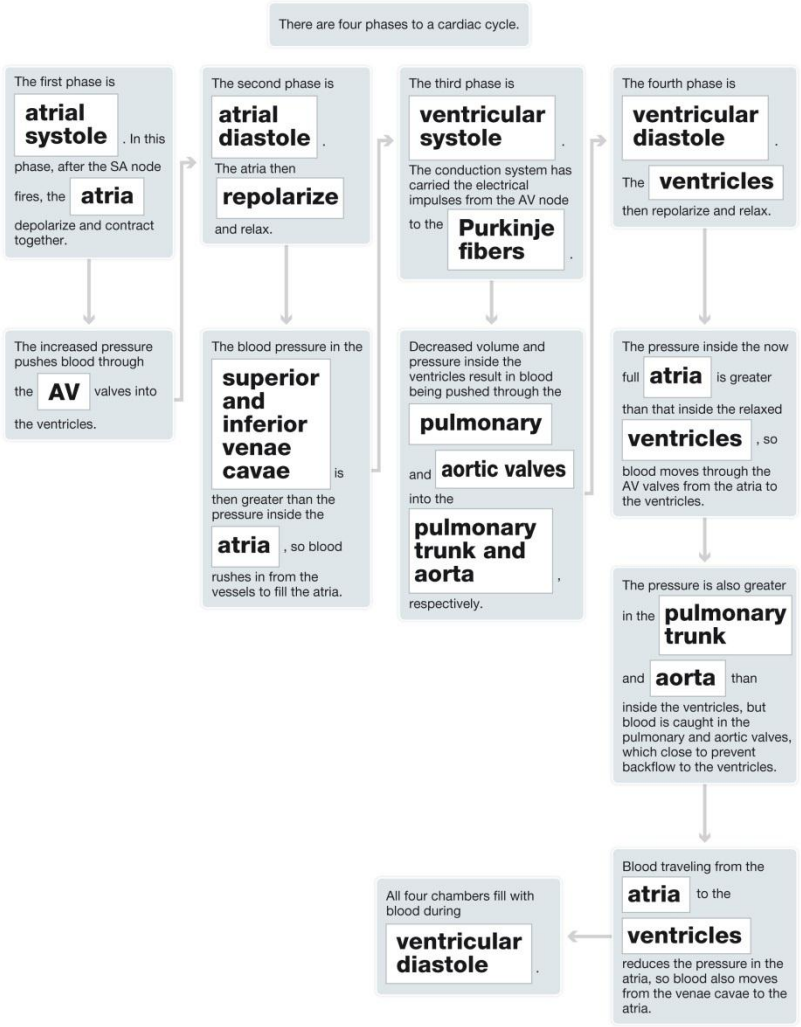
1. A
2. A
3. A
4. D
5. B
6. B
7. A
8. D
9. A
10. A
11. B
12. D
13. A
14. B
15. A
16. A
17. D
18. D
19. C
20. D
21. A
22. A

Workbook Concept Maps

Cardiac conduction system



Cardiac cycle



Electrocardiogram

A(n) **electrocardiogram (ECG or EKG)** is a graph showing the electrical activity in the heart.

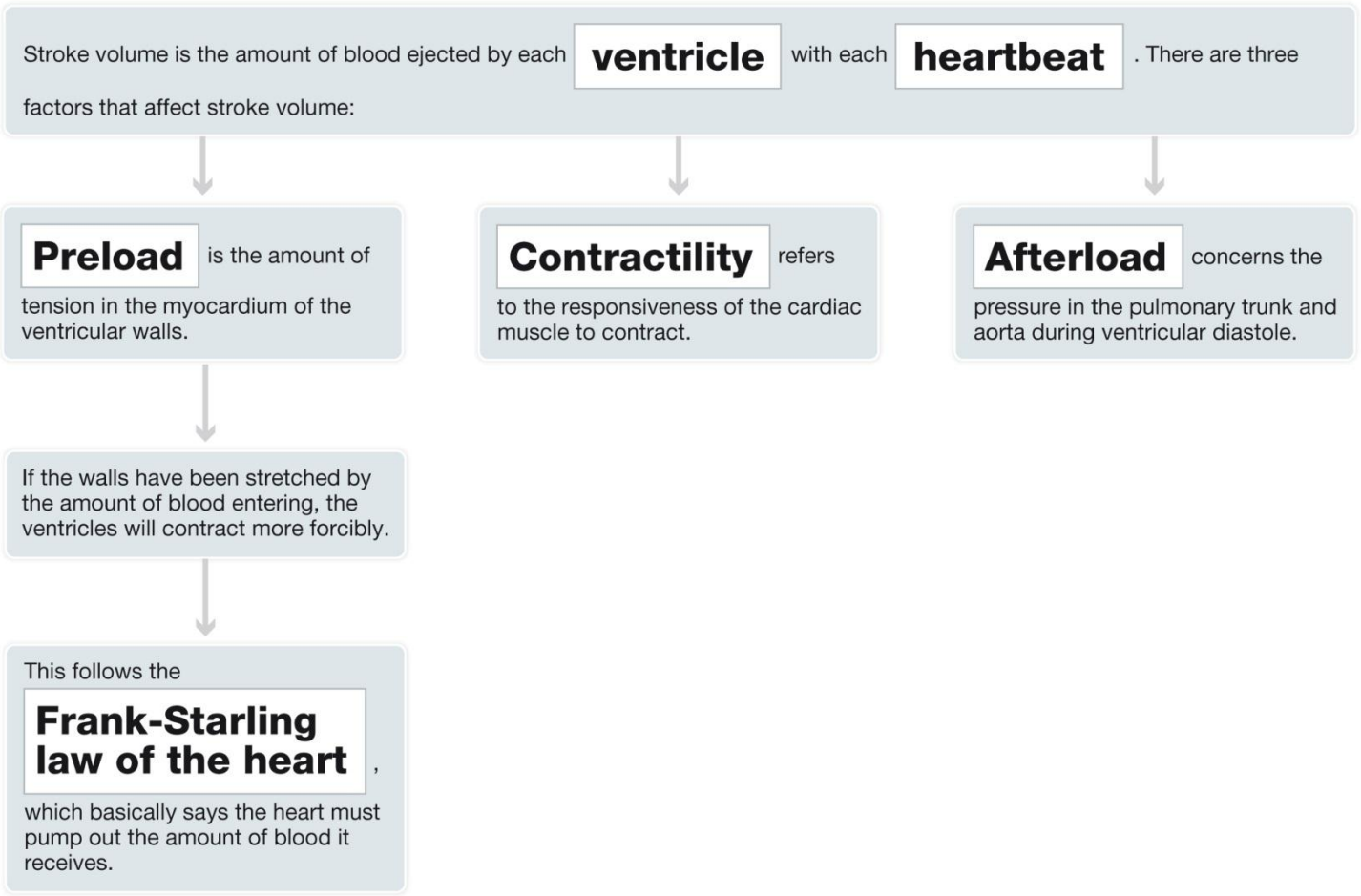
The **P wave** shows the depolarization of the atria.

The **Q, R, and S waves** together represent the ventricles depolarizing.

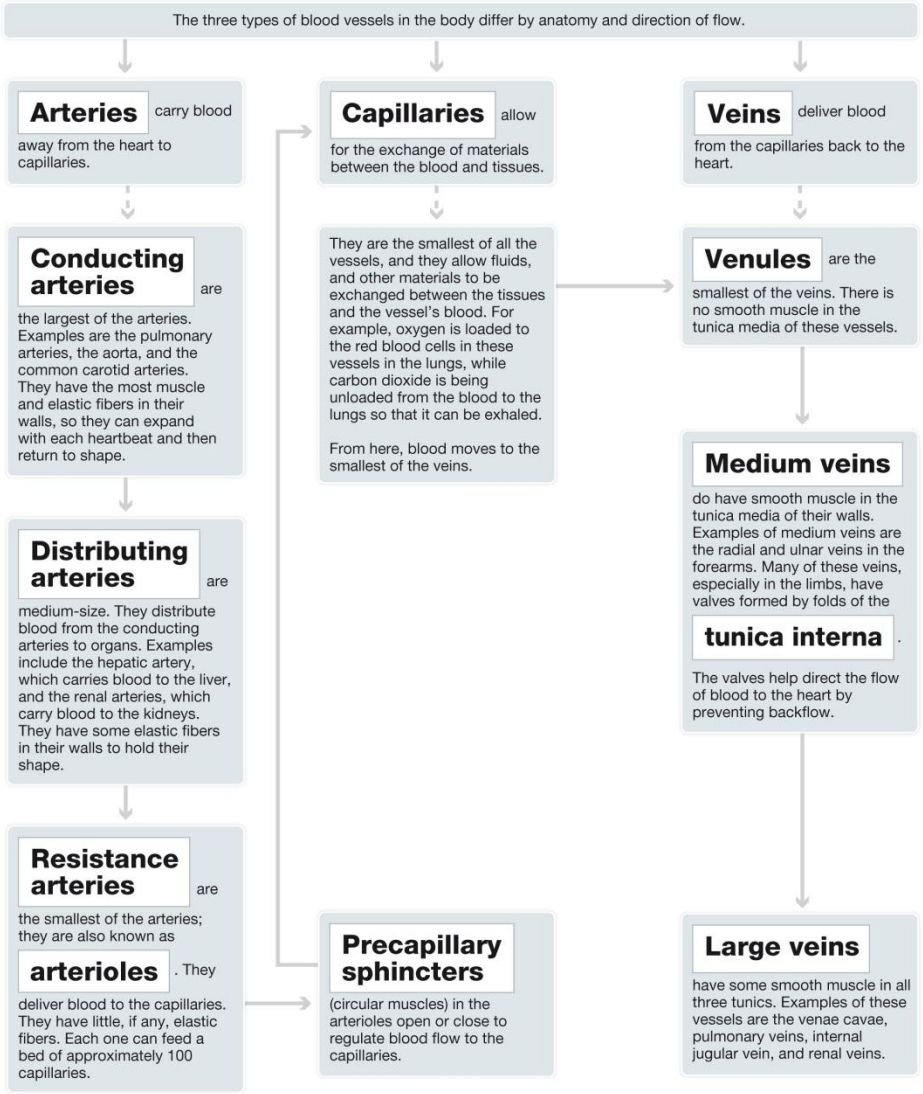
The **T wave** represents the ventricles repolarizing.

The **repolarization** of the atria occurs at the same time the ventricles are **depolarizing**.

Stroke volume



Types of vessels



Vessel walls

Along with direction of blood flow and location, the histology of the walls of arteries and veins differs. Arteries and veins have three basic layers to their walls, called tunics.

Tunica externa

is the outermost layer of the vessel wall. It is composed of loose connective tissue, which anchors the vessel to surrounding tissue and provides passage for nerves and small vessels supplying blood to the external wall.

Tunica media

is the middle layer of the vessel wall. It is the thickest layer, composed mostly of smooth muscle. This layer is more muscular in arteries than veins of comparable size. There may be elastic fibers in this layer, depending upon the vessel.

Tunica interna

is the lining of the vessel wall. It is composed of

endothelium

(simple squamous epithelial tissue and fibrous tissue). This layer secretes a chemical to repel platelets so that blood can easily flow through the vessel.

Workbook Chapter Review Questions

Word Deconstruction:

In the textbook, you built words to fit a definition using combining forms, prefixes, and suffixes. Here you are to break down the term into its parts (prefixes, roots, and suffixes) and give a definition. Prefixes and suffixes can be found inside the back cover of the textbook.

FOR EXAMPLE Dermatitis: dermat/itis—inflammation of the skin

1. Cardiomyopathy: _____*Cardio/myo/pathy, disease of the heart muscle*_____

2. Vascular: _____*Vascul/ar, pertaining to a vessel*_____

3. Coronaritis: _____*Coron/ar/itis, pertaining to inflammation of the heart*_____

4. Atheroma: _____*Ather/oma, mass made up of a fatty substance*_____

5. Pericardiostomy: _____*Pericardio/stomy, an opening in the pericardium*_____

Multiple Select:

Select the correct choices for each statement. The choices may be all correct, all incorrect, or any combination of correct and incorrect.

1. Which of the following statements is (are) accurate concerning cardiac muscle?

a. Cardiac muscle has specialized junctions to aid in electrical conduction.

b. Cardiac muscle is specially adapted to use anaerobic respiration.

c. Cardiac muscle is more excitable with calcium.

d. Cardiac muscle can be found in the myocardium.

e. Cardiac muscle has an absolute refractory period.

2. What is the role of the medulla oblongata in the cardiovascular system?

a. The medulla oblongata is responsible for initiating a heartbeat.

b. The medulla oblongata sends messages along the vagus nerve to slow the heart.

c. The medulla oblongata receives signals from proprioceptors in the aortic arch and carotid arteries during exercise.

d. The medulla oblongata receives information from baroreceptors and chemoreceptors.

e. The medulla oblongata is responsible for speeding up and slowing down the heart.

3. Which of the following statements is (are) accurate concerning cardiac output?

a. Cardiac output is expressed in mm/minute.

b. Cardiac output is expressed in mL/beat.

c. Cardiac output is increased if the heart rate is increased.

d. Cardiac output is increased if the stroke volume is decreased.

e. Cardiac output is dependent on heart rate and stroke volume.

4. Emily has decided to start off the new year with a resolution to become more fit. She has joined the local gym and will start each morning with water aerobics. What will happen to her cardiovascular system if she sticks with the program?

a. Her proprioceptors in her joints and muscles will alert her hypothalamus each morning on the increased activity levels.

b. The cardiac accelerator center will send messages along parasympathetic fibers to speed up the heart each morning.

c. If she sticks with her routine, angiogenesis should happen in the heart.

d. Her venous return should decrease while she is in the pool exercising.

e. Her stroke volume will decrease while she is exercising.

5. How can blood pressure and flow be regulated locally?

a. The buildup of wastes promotes the opening of precapillary sphincters.

b. The buildup of wastes increases angiogenesis.

c. The temporary lack of blood flow can cause reactive hyperemia.

d. Basophils can release vasodilators.

e. Damaged tissue can initiate an inflammatory response.

6. What is the relationship between blood pressure, resistance, and flow?

a. Blood pressure is dependent on cardiac output, blood volume, and resistance.

b. Resistance is dependent on blood viscosity, vessel length, and blood pressure.

c. Vessel length can be changed by the vasomotor center.

d. Blood flow is the amount of blood flowing to an area in a given amount of time.

e. A hematocrit is a good indicator of blood viscosity.

7. How is blood returned to the heart?

a. Through cardiac suction

b. Through gravity

c. Through the skeletal muscle pump

d. From pressure generated in the heart

e. Through the thoracic pump

8. What happens during a cardiac cycle?

a. AV valves close, causing afterload

b. All chambers fill during ventricular diastole

c. Papillary muscles contract to keep AV valves closed

d. Atrial systole comes before atrial diastole

e. The heart rests just before atrial diastole

9. Which of the following statements is (are) accurate concerning an electrocardiogram.

a. It can also be called an EEG.

b. It measures the force of heart contractions.

c. It shows the electrical activity of the heart.

d. A normal electrocardiogram shows three electrical events and a rest.

e. An atrial depolarization is not shown on a normal electrocardiogram.

10. Bill is an 80-year-old who has not exercised much in the last 20 years and does not watch his diet. What would you expect concerning his cardiovascular health?

a. His vessels have stiffened.

b. He has more collateral circulation in his heart.

c. His vascular resistance has decreased.

d. He is probably hypertensive if he has a lot of sodium in his diet.

e. His stroke volume has increased.

Matching:

Match each description with the type of vessel. Some answers may be used more than once.

__*d*__ 1. Receive blood from capillaries	a. Large veins
__*b*__ 2. Deliver blood to capillaries	b. Arterioles
abde 3. Have three tunics	c. Capillaries
__*c*__ 4. Allow for the exchange of materials	d. Venules
__*e*__ 5. Have large amounts of elastic fibers to expand and contract with each heartbeat	e. Conducting arteries

Matching:

Match the value with its unit. Some answers may be used more than once.

__*d*__ 6. Cardiac output	a. beats/min
__*c*__ 7. MAP	b. mL/beat
__*c*__ 8. Pulse pressure	c. mmHg
__*b*__ 9. Stroke volume	d. mL/min

__*a*___ 10. Heart rate

Completion:

Fill in the blanks to complete the following statements.

1. Cardiac muscle tissue contains _*myoglobin*_____ to store oxygen.

2. Cardiac muscle tissue contains ___*glycogen*_____, a storage molecule for glucose.

3. A __*sinus*_____ rhythm is produced if the SA node is the pacemaker.

4. A __*nodal*_____ rhythm is produced if the AV node is the ectopic focus.

5. The cardiac output for someone with a heart rate of 68 beats/min and a stroke volume of 75 mL/beat is _____*5100 ml/min or 5.1 L/min*_____.

Critical Thinking

1. Compare the composition of the blood (as far as oxygen and nutrients) and the direction of blood flow (in regard to the liver) for the hepatic artery, the hepatic vein, and the hepatic portal vein.

_*Hepatic artery: O_2 rich, nutrient rich, to the liver. Hepatic vein: O_2 depleted, nutrient depleted, away from the liver. Hepatic portal vein: O_2 depleted, nutrient rich, to the liver.*

2. Paramedics arrived on the scene of a car accident involving a driver with a deep cut on his leg that was bleeding a great deal. A preliminary assessment determined that the driver's blood pressure was falling and his heart rate was above normal. Explain the mechanisms that produce this result from severe bleeding. How did the body know what to do?

_*Bleeding caused a drop in blood volume and therefore blood pressure. Baroreceptors recognize the decreased blood pressure and sends signals to the medulla oblongata, whose cardiac accelerator center increases heart rate.*

3. Atherosclerosis can happen in arteries other than coronary arteries. What could be the possible consequences of atherosclerosis in the carotid arteries? Explain.

_*Carotid arteries feed the brain, so atherosclerosis may result in decreased blood flow to the brain that in turn could lead to a CVA.*

Case Study:

1. Atherosclerosis results in the buildup of fatty deposits within arterial walls, which causes the walls to roughen and project to the lumen within the vessel. When atherosclerosis obstructs the coronary arteries that supply blood to the heart, coronary artery disease or CAD results.
2. Answers may vary but can include angina pectoris and myocardial infarction. Both conditions result in myocardial ischemia which may cause death of myocardial tissue.
3. Echocardiography, electrocardiography, heart CT scan, nuclear heart scan, holter monitor, stress test, and ultrasound.
4. Blocked coronary arteries can be treated through angioplasty or coronary bypass surgery.