11 The Cardiovascular System
Study Guide

I. Concepts: Fill in the following sections with information from the text and lecture.

1. Heart Anatomy:

2. Heart Physiology:
4. Physiology of Circulation:
The major structures of the cardiovascular system, the heart and blood vessels, play a vital role in human physiology. The major function of the cardiovascular system is transportation. Using blood as the transport vehicle, the system carries nutrients, gases, wastes, antibodies, electrolytes, and many other substances to and from body cells. Its propulsive force is the contracting heart.

The anatomy and location of the heart and blood vessels and the important understandings of cardiovascular physiology (for example, cardiac cycle, ECG, and regulation of blood pressure) are the major topics of this chapter.

1. Complete the following statements by inserting your answers in the answer blanks.

   The heart is a cone-shaped muscular organ located within the a. __________________________. Its apex rests on the b. __________________________, and its base is at the level of the c. __________________________ rib. The coronary arteries that nourish the myocardium arise from the d. __________________________. The coronary sinus empties into the e. __________________________. Relative to the roles of the heart chambers, the f. __________________________ are receiving chambers, whereas the g. __________________________ are discharging chambers. The membrane that lines the heart and also forms the valve flaps is called the h. __________________________. The outermost layer of the heart is called the i. __________________________.

   The fluid that fills the pericardial sac acts to decrease j. __________________________ during heart activity. The heart muscle, or myocardium, is composed of a specialized type of muscle tissue called k. __________________________.

2. The heart is called a double pump because it serves two circulations. Trace the flow of blood through the pulmonary and systemic circulations by writing the missing terms in the answer blanks. Then, color regions transporting $O_2$ poor blood blue and regions transporting $O_2$ rich blood red on Figure 11-1. Finally, identify the various regions of the circulation shown in Figure 11-1 by labeling them using the key choices.

   From the right atrium through the tricuspid valve to the a. __________________________, through the b. __________________________ valve to the pulmonary trunk to the right and left c. __________________________ to the capillary beds of the d. __________________________ to the e. __________________________, to the f. __________________________ of the heart through the g. __________________________ valve, to the h. __________________________ through the i. __________________________ semilunar valve, to the j. __________________________, to the systemic arteries, to the k. __________________________ of the body tissues, to the systemic veins, to the l. __________________________ and m. __________________________, which enter the right atrium of the heart.
Key Choices

A. Vessels serving head and upper limbs
B. Vessels serving body trunk and lower limbs
C. Vessels serving the viscera
D. Pulmonary circulation
E. Pulmonary “pump”
F. Systemic “pump”
3. Figure 11-2 is an anterior view of the heart. Identify each numbered structure and write its name in the corresponding numbered answer blank.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>6.</td>
<td>11.</td>
</tr>
<tr>
<td>2.</td>
<td>7.</td>
<td>12.</td>
</tr>
<tr>
<td>3.</td>
<td>8.</td>
<td>13.</td>
</tr>
<tr>
<td>5.</td>
<td>10.</td>
<td>15.</td>
</tr>
</tbody>
</table>

*Figure 11-2*
4. Figure 11-3 is a schematic drawing of the microscopic structure of cardiac muscle. Using different colors, color the coding circles of the structures listed below and the corresponding structures on the figure.

Nuclei (with nucleoli)  Intercalated discs  Muscle fibers  Striations

![Figure 11-3]

5. Figure 11-4 is a diagram of the frontal section of the heart. Follow the instructions below to complete this exercise.

First, draw arrows to indicate the direction of blood flow through the heart. Draw the pathway of the oxygen-rich blood with red arrows, and trace the pathway of oxygen-poor blood with blue arrows.

Second, identify each of the elements of the intrinsic conduction system (numbers 1-5 on the figure) by inserting the appropriate terms in the blanks left of the figure. Then, indicate with green arrows the pathway that impulses take through this system.

Third, correctly identify each of the heart valves (numbers 6-9 on the figure) by inserting the appropriate terms in the blanks left of the figure, and draw in and identify by name the cordlike structures that anchor the flaps of the atrioventricular (AV) valves.

Fourth, use the numbers from the figure to identify the structures described below. Place the numbers in the lettered answer blanks.

A. ___ B. ___ Prevent backflow into the ventricles when the heart is relaxed

C. ___ D. ___ Prevent backflow into the atria when the ventricles are contracting

E. ___ AV valve with three flaps

F. ___ AV valve with two flaps

G. ___ The pacemaker of the intrinsic conduction system

H. ___ The point in the intrinsic conduction system where the impulse is temporarily delayed

Miss School, Miss Out!
6. A portion of an electrocardiogram is shown in Figure 11-5. On the figure identify the QRS complex, the P wave, and the T wave. Then, using a red pencil, bracket a portion of the recording equivalent to the length of one cardiac cycle. Using a blue pencil, bracket a portion of the recording in which the ventricles would be in diastole.
7. In Figure 11-6, fill in the blanks beneath the illustrations correctly identify each vessel type. In the additional spaces provided, list the structural details that allowed you to make the identifications. Then, using the key choices, identify the blood vessel tunics described in each of the following descriptions. Insert the term or letter of the key choice in the answer blanks.

**Key Choices**

<table>
<thead>
<tr>
<th>Tunica intima</th>
<th>Tunica media</th>
<th>Tunica externa</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ______</td>
<td>Single thin layer of endothelium</td>
<td></td>
</tr>
<tr>
<td>b. ______</td>
<td>Bulky middle coat, containing smooth muscle and elastin</td>
<td></td>
</tr>
<tr>
<td>c. ______</td>
<td>Provides a smooth surface to decrease resistance to blood flow</td>
<td></td>
</tr>
<tr>
<td>d. ______</td>
<td>The only tunic of capillaries</td>
<td></td>
</tr>
<tr>
<td>e. ______</td>
<td>Also called the adventitia</td>
<td></td>
</tr>
<tr>
<td>f. ______</td>
<td>The only tunic that plays an active role in blood pressure regulation</td>
<td></td>
</tr>
<tr>
<td>g. ______</td>
<td>Supporting, protective coat</td>
<td></td>
</tr>
</tbody>
</table>

Figure 11-6

A. ____________________  
   ____________________  
   ____________________

B. ____________________  
   ____________________  
   ____________________

C. ____________________  
   ____________________  
   ____________________
8. Figures 11-7 and 11-8 illustrate the location of the most important arteries and veins of the body. The veins are shown in Figure 11-7. Color the veins blue and then identify each vein provided with a leader line on the figure. The arteries are shown in Figure 11-8. Color them red and then identify those indicated by leader lines on the figure. NOTE: If desired, the vessels identified may be colored differently to aid you in their later identification.
Figure 11-8 Arteries

10
Miss School, Miss Out!
9. Figure 11-9 is a diagram of the hepatic portal circulation. Label the structures listed below.

- Hepatic portal vein
- Splenic vein
- Inferior mesenteric vein
- Superior mesenteric vein
- Gastric vein

Figure 11-9
10. Figure 11-10 illustrates the special fetal structures listed below. Select different colors for each and use them to color coding circles and corresponding structures in the diagram.

**Foramen ovale**  
**Ductus arteriosus**  
**Ductus venosus**

**Umbilical arteries**  
**Umbilical cord**  
**Umbilical vein**

*Figure 11-10*
11. Figure 11-11 is a diagram of a capillary bed. Arrows indicate the direction of blood flow. Label the structures listed below on the figure. Then answer the questions that follow by referring to Figure 11-11. Notice that questions 1-9 concern fluid flows at capillary beds and the forces (hydrostatic and osmotic pressures) that promote such fluid shifts.

- Arteriole
- Precapillary sphincters
- True capillaries
- Postcapillary venule
- Thoroughfare channel

![Figure 11-11](image)

a. If the precapillary sphincters are contracted, by which route will the blood flow?

b. Under normal conditions, in which area does hydrostatic pressure predominate: A, B, or C?

c. Which area has the highest osmotic pressure?

d. Which pressure is in excess and causes fluids to move from A to C? (Be specific as to whether the force exists in the capillary or the interstitial space.)

e. Which pressure causes fluid to move from A to B?

f. Which pressure causes fluid to move from C to B?

g. Which blood protein is most responsible for osmotic pressure?

h. Where does the greater net flow of water out of the capillary occur?

i. If excess fluid does not return to the capillary, where does it go?
12. Indicate what effect the following factors have on blood pressure. Indicate an increase in pressure by I and a decrease in pressure by D. Place the correct letter response in the answer blanks.

a. ___ Increased diameter of the arterioles
b. ___ Increased blood viscosity
c. ___ Increased cardiac output
d. ___ Increased pulse rate
e. ___ Anxiety, fear
f. ___ Increased urine output
g. ___ Sudden change in position from reclining to standing
h. ___ Physical exercise
i. ___ Physical training
j. ___ Alcohol
k. ___ Hemorrhage
l. ___ Nicotine
m. ___ Arteriosclerosis

DEVELOPMENTAL ASPECTS OF THE CARDIOVASCULAR SYSTEM

13. Complete the following statements by inserting your responses in the answer blanks.

The cardiovascular system forms early, and the heart is acting as a functional pump by the a. __________________ week of development. The ductus arteriosus and foramen ovale allow the blood to bypass the nonfunctioning fetal b. __________________. Another fetal structure, the c. __________________, allows most of the blood to bypass the liver. The fetus is supplied with oxygen and nutrients via the d. __________________, which carries blood from the e. __________________ to the f. __________________. Metabolic wastes and carbon dioxide are removed from the fetus in blood carried by the g. __________________. These special bypass structures that exist to bypass the fetal lungs and liver become h. __________________ shortly after birth. Congenital heart defects (some resulting from the failure of the bypass structures to close) account for half of all infant i. __________________ resulting from congenital defects. j. __________________ is a degenerative process that begins in youth but may take its toll in later life by promoting a myocardial infarct or stroke. Generally women have less of this degenerative process than men until after k. __________________, when estrogen production ends. Regular l. __________________ increases the efficiency of the cardiovascular system and helps to slow the progress of m. __________________. A vascular problem that affects many in “standing professions” is n. __________________. In this condition, the valves become incompetent, and the veins become twisted and enlarged, particularly in the o. __________________ and p. __________________.
11 The Cardiovascular System
Crossword Puzzle

Instructions: Use the vocabulary from this chapter to complete this crossword puzzle.

Across
2. Amount of blood pumped out of a ventricle in one minute.
7. System of blood vessels that carry blood to and from the lungs for gas exchange.
8. Layer of the heart wall composed of cardiac muscle.
10. A heart rate over 100 beats per minute.
13. Modified cardiac muscle fibers of the conduction system of the heart.
14. Blood vessels that return blood toward the heart from the circulation.
15. Period of the cardiac cycle when either the ventricles or the atria are relaxing.
16. A measure of the amount of friction encountered by blood as it flows through the blood vessels.
17. System of blood vessels that carries nutrient and oxygen-rich blood to all body organs.

Down
1. A heart rate below 60 beats per minute.
3. Double-layered serosa enclosing the heart and forming its superficial layer.
4. Specialized myocardial cells in the wall of the right atrium; pacemaker of the heart.
5. Amount of blood pumped out of a ventricle during one contraction.
9. Vessels that carry blood away from the heart.
11. The smallest of the blood vessels and the sites of exchange between the blood and tissue cells.
12. Substance released by the kidneys that is involved with raising blood pressure.