





THE HEART AND LUNGS AT WORK



ASSESSMENT CATEGORIES

-  Application
-  Communication
-  Knowledge and Understanding
-  Thinking

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Respiratory Anatomy and Physiology 89

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1

8.1 CARDIOVASCULAR ANATOMY AND PHYSIOLOGY
(Textbook pages 150-160)

8.1.1 Review Your Key Terms

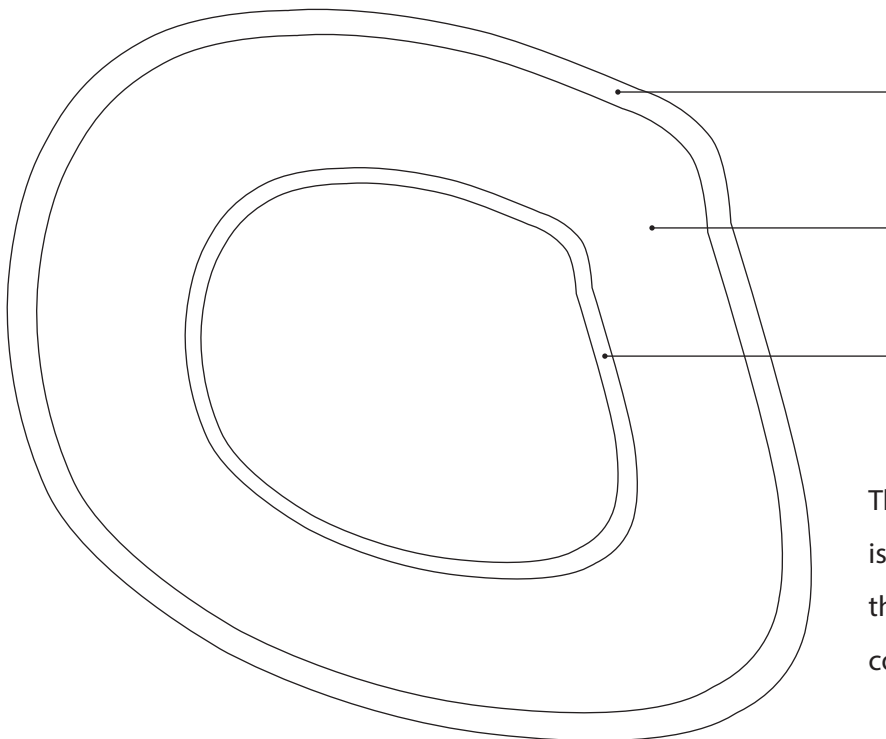
action potential
aorta
aortic valve
arterial-venous oxygen (a-v O₂) difference
arterioles
arteries
atrioventricular valves
bicuspid (mitral) valve
Bohr effect
capillaries
capillarization
cardiac output
carotid pulse
chloride shift
diastole
diastolic pressure
endocardium

epicardium
erythropoietin (EPO)
Haldane effect
heartbeat
heart rate
hematocrit
hemoglobin
hypertension
inferior vena cava
left atrium
left ventricle
maximal aerobic power (VO₂max)
myocardium
pericardium
plasma
platelets (thrombocytes)
pulmonary artery
pulmonary valve

pulmonary vein
radial pulse
red blood cells (erythrocytes)
reticulocytes
right atrium
right ventricle
semilunar valves
sinus node
stroke volume
superior vena cava
systole
systolic pressure
tricuspid valve
valves
veins
venules
white blood cells (leukocytes)

8.1.2 Layers of the Heart

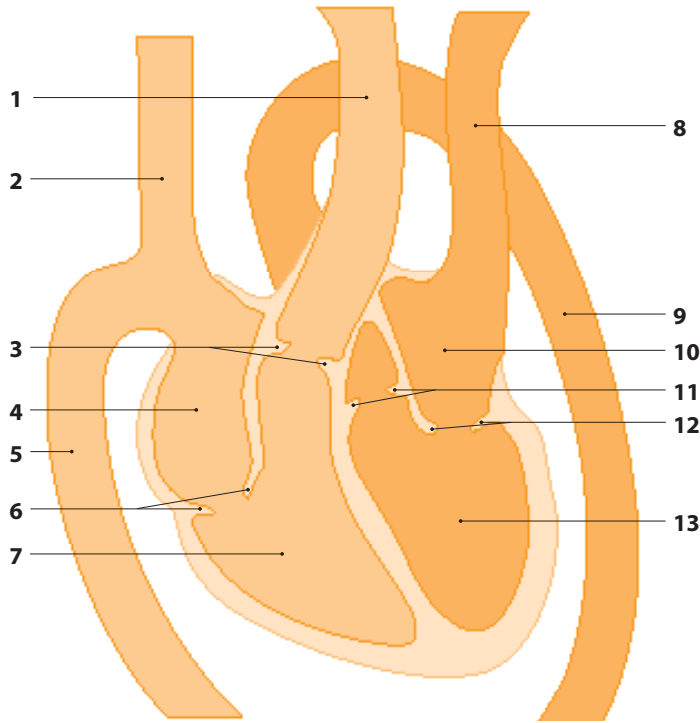
The specialized muscle cells of the heart form three distinct layers of tissue that perform very specific functions. Label these layers on the diagram below, and color in the layer that is primarily responsible for physically pumping the blood.



The _____ is the protective sac that loosely surrounds the entire heart, allowing it to expand and contract freely.

8.1.3 Circuitry of the Heart

Label the diagram of the heart below. Add arrows to the diagram to indicate the direction of blood flow, using red arrows for oxygenated blood and blue arrows for deoxygenated blood. Then in the space provided, describe the flow of blood through the entire heart starting with deoxygenated blood as it enters the first chamber of the heart. Include the names of all the major chambers, valves, arteries, organs, and veins involved.



- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____
- 9 _____
- 10 _____
- 11 _____
- 12 _____
- 13 _____

8.1.4 The "Silent Killer"

Your grandfather was recently diagnosed with high blood pressure, also known as _____, with a reading of 160/100 mm Hg. He calls you to get some answers about blood pressure.

A. Explain what blood pressure is and why high blood pressure is dangerous. Indicate what an average normal blood pressure reading should be. Be sure to include words such as *diastole*, *systole*, *atria*, *ventricles*, and so on.

B. Help your grandfather calculate his cardiac output (ml/min) given the following information: stroke volume = 45 ml; heart rate = 96 beats per min. Explain how cardiac output relates to blood pressure.

8.1.5 How Hard Am I Working?

This exercise is designed to help you measure your *resting heart rate (RHR)*, *exercise heart rate (EHR)*, and *training target heart rate (TTHR)*. The two most common and reliable points to measure your pulse are the carotid artery in the neck and the radial artery in the wrist (see Figure 8.3 in the textbook).

Counting the number of beats in one minute will give you an accurate heart rate in beats per minute (bpm). However, you can also establish your heart rate in beats per minute by multiplying your 10-second pulse count by 6, multiplying your 15-second pulse count by 4, or multiplying your 30-second pulse count by 2. Although a true resting heart rate can really only be established immediately upon waking up, this should give you a relatively accurate value. Try it and record your pulse in the table provided.

Measuring heart rate is also a very simple and practical way to estimate the intensity of work or exercise. Perform the following exercises: (1) 10 push-ups at a fast pace; (2) 20 full leg squats at a fast pace; and (3) climbing stairs for 70 seconds. For each exercise, determine your heart rate (bpm) by taking your pulse immediately after each exercise for 15 seconds. Record your results in the table. Allow yourself sufficient rest between the exercises (i.e., your RHR should return to normal levels as determined previously).

Exercise	Pulse (15 seconds)	Heart Rate (bpm)
Resting		My RHR is _____ bpm
10 push-ups		My EHR is _____ bpm
20 squats		My EHR is _____ bpm
Stair climbing		My EHR is _____ bpm

In order to obtain adequate cardiovascular development, you must train at an intensity that elevates your heart rate to at least 50 percent of its maximum rate. In other words, maintaining a heart rate between the 50 percent and 85 percent training intensities is necessary for improvement of the cardiovascular system.

Use the equations below to calculate your 50 percent, 70 percent, and 85 percent training target heart rates. This is the range you should try to maintain during aerobic exercise.

$$\text{50\% TTTHR} = \frac{\quad}{\text{RHR}} + (0.50 [\frac{\quad}{\text{MHR}} - \frac{\quad}{\text{RHR}}]) = \quad \text{bpm}$$

$$\text{70\% TTTHR} = \frac{\quad}{\text{RHR}} + (0.70 [\frac{\quad}{\text{MHR}} - \frac{\quad}{\text{RHR}}]) = \quad \text{bpm}$$

$$\text{85\% TTTHR} = \frac{\quad}{\text{RHR}} + (0.85 [\frac{\quad}{\text{MHR}} - \frac{\quad}{\text{RHR}}]) = \quad \text{bpm}$$

Do you remember how to calculate your maximum heart rate (MHR)? The value can be estimated by using the following equation:

$$\text{MHR} = 220 - \text{Age (in years)}$$

My minimum and maximum training target heart rates:

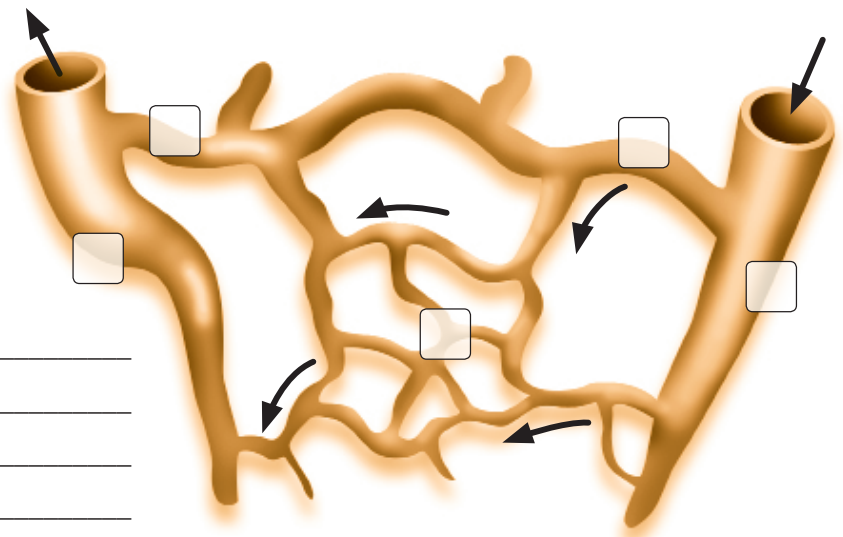
Min (50% TTTHR): _____ Max (85% TTTHR): _____

8.1.6 Arteries and Veins

Outline the major differences between veins and arteries. Be sure to discuss their structure, function, and color and the direction of blood flow. Fill in the labels below using the words provided (arrows indicate direction of blood flow). Then color the veins and arteries the color they appear in the human body.

1 arteriole 3 capillaries 5 venule

2 artery 4 vein



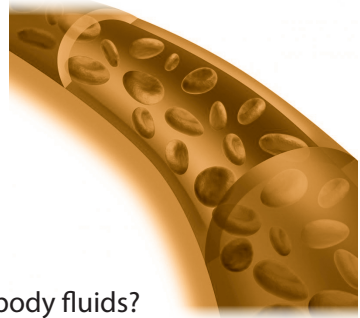
8.1.7 Transporting, Loading, and Unloading



(A) Carbon Dioxide Transport

Identify the three ways carbon dioxide is transported in the blood on its way to the lungs to be exhaled and removed from the body.

- ~10 percent _____
- ~20 percent _____
- ~70 percent _____



Which of the mechanisms listed above contributes to the regulation of pH levels in body fluids?



(B) Oxygen Loading and Unloading



Since oxygen and carbon dioxide compete for hemoglobin occupancy, there are mechanisms in place that facilitate the loading and unloading of both oxygen and carbon dioxide when needed. Briefly discuss how the *Haldane effect* and *Bohr effect* contribute to this vital balance of oxygen extraction and carbon dioxide removal.

