

The Cardiac Cycle

Graphics are used with permission of:
adam.com (<http://www.adam.com/>)
Benjamin Cummings Publishing Co (<http://www.awl.com/bc>)

Page 1. Introduction

- The cardiac cycle includes all the events related to the flow of blood through the heart during one complete heartbeat.

Page 2. Goals

- To list the phases of the cardiac cycle in consecutive order.
- To recognize that the pressure changes determine valve action and direction of blood flow through the heart.
- To relate an ECG and heart sounds to events of the cardiac cycle.

Page 3. Heart Valves

- During the cardiac cycle, heart valves open and close in response to differences in blood pressure on their two sides.
- The Heart Valves:
 - Pulmonary semilunar valve
 - Aortic Semilunar Valve
 - Left AV valve or Bicuspid valve or Mitral valve
 - Right AV valve or Tricuspid valve

Page 4. Overview of Cardiac Cycle

- Phases of the Cardiac Cycle
 1. Ventricular Filling - Occurs during mid to late diastole.
 2. Ventricular Systole - Includes isovolumetric contraction and ventricular ejection.
 3. Isovolumetric Relaxation - Occurs during early diastole.

Page 5. Ventricular Filling: Passive

- Occurs during mid to late diastole, when the heart chambers are relaxed.
- Blood flows passively into the atria, through open AV valves, and into the ventricles, where the pressure is lower.

Page 6. Ventricular Filling: Atrial Contraction

- Atria contract, forcing the remaining blood into the ventricles.
- Blood flows through both sides of the heart at the same time.

Page 7. Ventricular Systole: Contraction

- Isovolumetric contraction: Ventricles contract and intraventricular pressure rises, closing the AV valves. Briefly, ventricles are completely closed chambers.

Page 8. Ventricular Systole: Ejection

- Ventricular ejection: Rising ventricular pressure forces semilunar valves open. Blood is ejected from the heart into the aorta and pulmonary trunk.

Page 9. Isovolumetric Relaxation

- Ventricles relax and ventricular pressure drops. Blood backflows, closing semilunar valves. Ventricles are totally closed off again.

Page 10. Atrial Filling

- Meanwhile, the atria have been filling with blood. When atrial pressure exceeds ventricular pressure, AV valves open and ventricular filling, phase 1 begins again.

Page 11. Ventricular and Atrial Contraction

- Although we have been highlighting the flow of blood on the right side of the heart, remember that both atria contract at the same time and both ventricles contract at the same time.

Page 12. Control of Blood Flow by Pressure

- Pressure changes reflect the alternating contraction and relaxation of the heart.
- Blood moves along a pressure gradient (from higher to lower pressure) through any available opening.
- Pressure changes cause the heart valves to open and close, which keeps the blood flowing in the forward direction.

** Now is a good time to go to quiz questions 1 and 2:

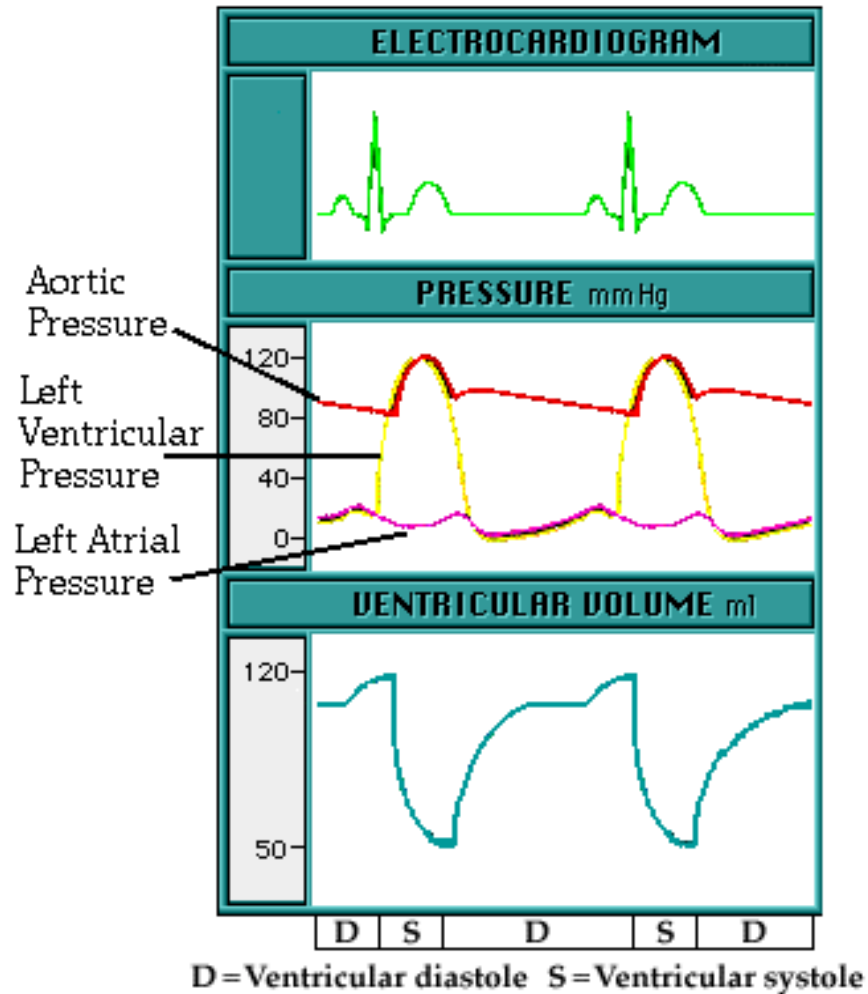
- Click the Quiz button on the left side of the screen.
- After answering question 2, click the Back to Topic button on the left side of the screen.
- To get back to where you left off, click on the scrolling page list at the top of the screen and choose "Page 13. Overview: Graphs and Heart".

Page 13. Overview: Graphs and Heart

- During ventricular ejection phase, ventricular pressure rises higher than aortic pressure. This is necessary to open the semilunar valve.
- Only a little more than half of the blood is ejected during ventricular ejection.

Page 14. Left Atrial Pressure

- As you go through pages 14-19, you may take notes on this diagram:



Page 15. Left Ventricular Pressure

Page 16. Aortic Pressure

Page 17. Ventricular Volume

Page 18. ECG

Page 19. All Graphs

Page 20. Summary

** Now is a good time to go to quiz questions 3-6:

- Click the Quiz button on the left side of the screen.
- Click on the scrolling page list at the top of the screen and choose "3. Cardiac Cycle Phase".
- Work through quiz questions 3-6.

Notes on Quiz Questions:

Quiz Question #1: Blood Flow through Heart

- This question asks you to trace the blood through the right side of the heart.

Quiz Question #2: Valves

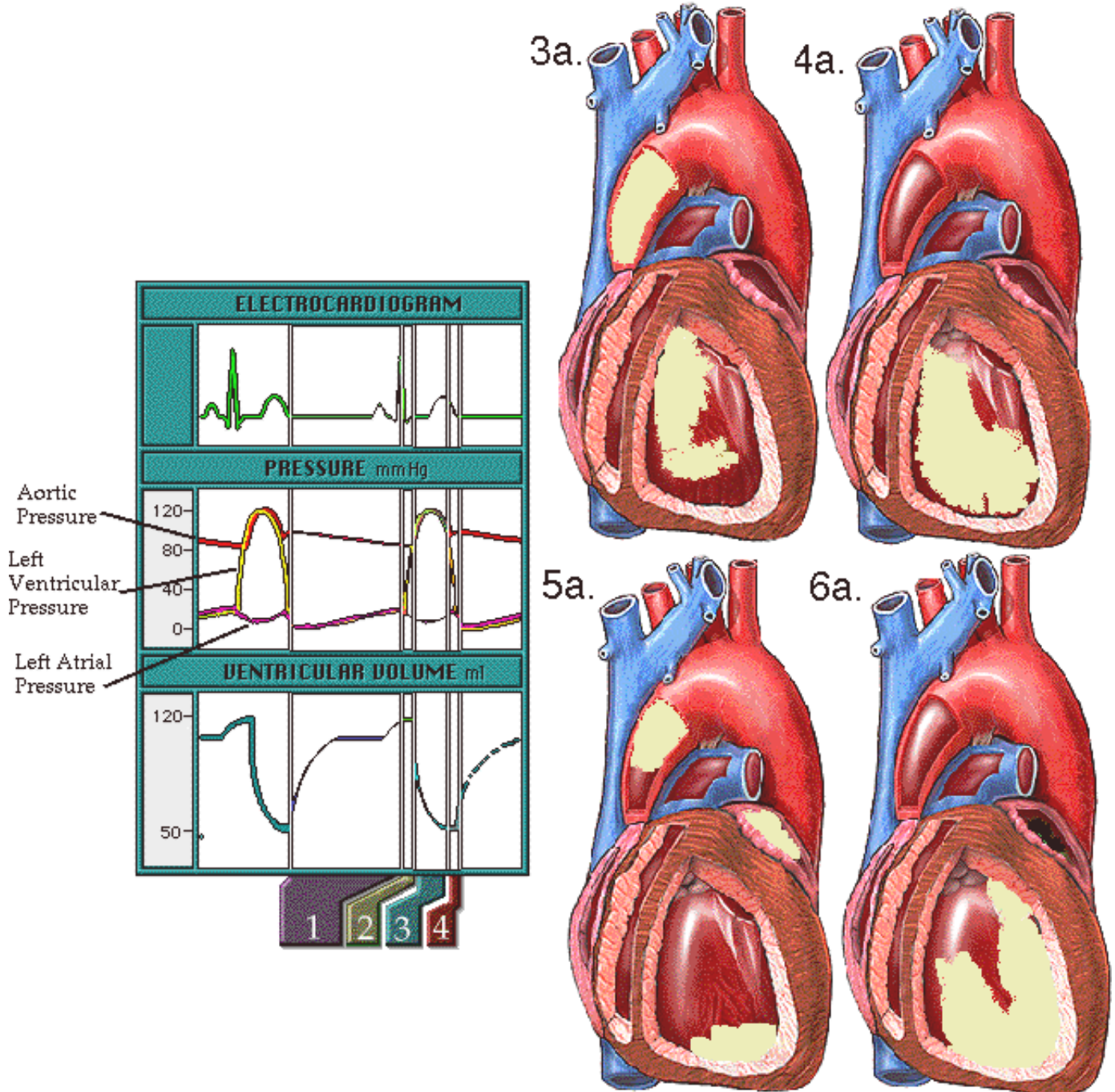
- This question asks you to predict when the valves are open or closed during the various stages of the cardiac cycle.

Quiz Questions #3a, 4a, 5a, 6a: Cardiac Cycle Phase

- These question asks you to view a diagram of the heart and predict what stage of the cell cycle it's in. You may take notes on the diagrams below. The dye-labeled blood has been colored light here to make it more visible.

Quiz Question #3b, 4b, 5b, 6b: Cardiac Cycle Graphs

- These questions asks you to predict the correct phase of the cardiac cycle by viewing an ECG, graph of ventricular volume, and a graph of pressures. You may want to take notes on this diagram:



Study Questions on the Cardiac Cycle:

1. (Page 1.) What is a cardiac cycle?
2. (Page 3.) What opens and closes the heart valves?

3. (Page 4.) List the three phases of the Cardiac Cycle.
4. (Pages 5-10.) Match the stages of the cardiac cycle to their description.
- | | |
|--|--|
| 1a. Ventricular Filling: Passive | v. Ventricles contract and intraventricular pressure rises, closing the AV valves. |
| 1b. Ventricular Filling: Atrial Contraction | w. Ventricles relax and ventricular pressure drops. Blood backflows, closing semilunar valves. |
| 2a. Ventricular Systole: Isovolumetric Contraction | x. Blood flows passively into the atria, through open AV valves, and into the ventricles. |
| 2b. Ventricular Systole: Ejection | y. Rising ventricular pressure forces semilunar valves open. Blood is ejected from the heart. |
| 3. Isovolumetric Relaxation | z. Atria contract, forcing the remaining blood into the ventricles. |
5. (Page 6.) True or false: Blood passes through the bicuspid valve at the same time blood is also passing through the tricuspid valve.
6. (Page 7.) What closes the AV valves?
7. (Page 8.) What opens the semilunar valves?
8. (Page 9.) What closes the semilunar valves?
9. (Page 10.) What opens the AV valves?
10. (Page 11.) True or false: The right side of the heart contracts, then the left side of the heart contract.
11. (Page 12.) What is the relationship between pressure inside a chamber of the heart and the state of the heart muscle (relaxed or contracted)?
12. (Page 12.) Blood always moves from ____ pressure to ____ pressure.
13. (Page 12.) What causes heart valves to open and close?
14. (Page 12.) Predict if the AV and semilunar valves are open or closed during the following phases of the cardiac cycle by circling the appropriate answer on this chart:

	State of AV Valves	State of Semilunar Valves
Isovolumetric Contraction	Open Closed	Open Closed

Isovolumetric Relaxation	Open Closed	Open Closed
Ventricular Ejection	Open Closed	Open Closed
Ventricular Filling	Open Closed	Open Closed

15. (Pages 14-19.) What is happening to the volume of blood inside the ventricles during each labeled part of the graph below?
16. (Pages 14-19.) What is happening to the pressure inside the ventricles during each labeled part of the graph below? Explain.
17. (Pages 14-19.) What is happening to the depolarization, repolarization and contraction of the atria and ventricles during each labeled part of the graph below?
18. (Pages 14-19.) On the graph below, which number corresponds to:
 ventricular ejection isovolumetric relaxation ventricular filling isovolumetric contraction

