

Activity 4.1.1: Path of Blood in the Heart

Introduction

At the time of her death, Anna’s heart stopped beating. The body’s pump was no longer able to propel oxygen-rich blood to her tissues and cells. As you continue to piece together the circumstances of her untimely death, examine any evidence housed in Anna’s *cardiovascular system*, the system of the heart and the associated blood vessels, for additional clues.

The human heart is an amazing pump. Each beat correlates with the pumping action of the heart as it moves blood through the entire body. On average, a person’s heart beats 100,000 times each day. That is over 35 million beats a year and over 2.5 billion beats during an average lifetime. The human heart has to pump 5.6 liters (about six quarts) of blood every 20 seconds. In an average lifetime the heart pumps over 55 million gallons of blood. That is a lot of pumping!

The blood pumped by the heart carries many of the resources necessary for life, including nutrients, oxygen, and water, to your cells. The body’s cells must carry out many reactions in order to survive, grow, repair, or replicate. All of these processes require energy, and oxygen is required for cells to obtain energy. Therefore, all cells need a constant supply of oxygenated blood.

To understand the design of the heart, it is important to examine the structures of this incredible organ and trace the path of blood flow. In this activity you will investigate the basic structure of the heart as well as identify the major blood vessels that bring blood in and out of the heart’s main chambers. You will create a graphic organizer to help you remember the basic traffic pattern of blood flow to and from the heart and lungs .The diagrams you draw in this activity will help you to identify the actual structures of the heart when you dissect a four-chambered sheep’s heart in the next activity.

Equipment

* Computer with Internet access
* 8.5 x 11 inch paper, chart paper, or poster board
* Colored pencils or markers
* An Illustrated Dissection Guide to the Mammalian Heart by David Hall or other anatomy atlas of the heart
* Laboratory journal

Procedure

1. Open the NOVA *Map of the Human Heart* Interactive available at <http://www.pbs.org/wgbh/nova/body/map-human-heart.html>.
2. Click on the *Launch Interactive* button to the right of the heart drawing.
3. Click the *Track* button to track the liters of blood your heart pumps while completing this interactive.
4. Click on the *Anatomy* tab to view the basic structures of the heart. Pay special attention to the information regarding the convention in naming the right and left sides of the heart. Return to this drawing as needed throughout the activity.
5. Click on the *Step Thru* tab and follow the main steps as blood moves through the heart, lungs, and body. List these six steps in your laboratory journal. Note which side of the heart takes oxygen to the lungs and which side of the heart is responsible for delivering oxygen to the body.
6. Note the amount of blood (in liters) your blood has pumped before exiting the animation. Remember that a traditional soda bottle holds two liters.
7. Follow the directions below to create a simplified drawing of the heart showing the basic flow of blood through the organ. This “heart box” will be a general reference for you as you further explore the main blood vessels that serve the body and the heart. It is not designed to show you an anatomical drawing of the heart, but to help you remember key structures as well as the general flow of blood.
8. Use any of the following websites or a reference textbook to view the structure of the human heart and complete the remaining steps of the activity.

* Human Anatomy Online – Heart <http://www.innerbody.com/image/card02.html>
* Get Body Smart: An Online Examination of Human Anatomy and Physiology <http://www.getbodysmart.com/ap/circulatorysystem/heart/menu/menu.html>
* Texas Heart Institute – Heart Anatomy <http://www.texasheartinstitute.org/HIC/Anatomy/anatomy2.cfm>
* John Wiley and Sons, Inc. Blood Flow Through the Heart animation <http://www.sumanasinc.com/webcontent/animations/content/human_heart.html>
* Yale University; Cardiothoracic Imaging: Gross Anatomy of the Heart at: <http://www.yale.edu/imaging/anatomy/ant_heart_2/>

1. Open to a new page in your notebook and turn your page landscape.
2. Use a ruler to create a large table in the center of the paper as shown below. This doesn’t have to be that large, because you are going to add one box on either side of this table.

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1. Remember that there are four chambers in the human heart. Think about each square in the box as a chamber of the heart. Label the right and left atria in the correct boxes and do so in the upper corner as “RA” and “LA.” Label the right and left ventricle as “RV” and “LV” in the bottom corners of the appropriate box. **Remember** that you are looking at an illustration of someone else’s heart. Make sure you are clear as to which side is labeled as the right and which side is labeled as the left. (Put the notebook up to your chest and see if you have the sides labeled properly.
2. Review circulation in the body. *Pulmonary circulation* moves blood to the lungs to pick up oxygen and back to the heart so that oxygenated blood can be delivered. *Systemic circulation* pumps oxygen rich blood to the body and returns deoxygenated blood back to the heart to be sent out for refueling. **Add these two definitions to your notebook.**
3. Use a ruler to create a smaller box on either side of the main 2x2.

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1. With your partner, determine which side of the heart is responsible for pulmonary circulation and which side is dedicated to systemic circulation. Label the appropriate side box “lungs” and the other box “body.” If you want you can add a little drawings to represent the lungs and the body.
2. Answer Conclusion question 1 and 2.
3. Note that a series of tubes, or vessels, serve as the highways for the transportation of blood. *Arteries* are responsible for carrying blood away from the heart and *veins* are responsible for returning blood back to the heart. **Add definition to notebook.**
4. Add the major blood vessels to your diagram. Refer to the resources in Step 11 for guidance. Draw arrows running from one box to another (outside the boxes) to show the path of the vessels listed below. Think about where each vessel starts and ends. For example, the pulmonary arteries move blood from the heart (the right ventricle) to the lungs to pick up oxygen. In this case you would draw an arrow from the box representing your right ventricle to the box representing the lungs. **Define these in your notebook as well.**

* Pulmonary Artery
* Pulmonary Vein
* Aorta
* Superior and Inferior Vena Cava

1. Label each major blood vessel. Make sure the path you show on your diagram is accurate. Note that blood that is moving out of the ventricles actually moves up through the top of the heart. Major vessels do not leave the bottom of the heart as shown in their heart box. The diagram will simply help you remember the order of flow.
2. Add color to your diagram. **Red** is traditionally used to show oxygenated blood, and **blue** is used to show blood that is oxygen deficient. Color chambers and vessels according to the type of blood they carry. But remember, this coloring scheme is used to help you visualize differences. Your blood is never blue! Deoxygenated blood is dark red which appears blue when viewed through the skin.
3. Answer Conclusion question 3.
4. Note that throughout the heart there is a system of valves. Review the structure and function of heart valves using the websites listed in Step 11 or other reliable sources. **Write down your definition in your notebook**.
5. Add the following valves to the appropriate places on your diagram. Use small lines to show flaps or *cusps* of the valve. Label each valve in your boxes. **Add the definitions to your notebook. See my valve.**

* Tricuspid Valve
* Mitral (Bicuspid) Valve
* Pulmonary Valve
* Aortic Valve

1. Imagine you are a red blood cell sitting in the right atria of the heart. In your laboratory journal, write a paragraph that describes what happens to this red blood cell as it moves through the body. What structures will it pass through? How will it interact with oxygen? Think back to Unit 3 and make sure to include the word *hemoglobin* in your response.
2. Print out a diagram of the human heart (from one of the websites listed in Step 11). Label the structures and vessels listed on your heart box. Find a blank space on your poster board and attach this image. Keep this picture handy to remind yourself of how the heart actually looks in your chest. Use this diagram as a reference in Activity 4.1.2.
3. Answer the remaining Conclusion questions.

Conclusion

1. Which chamber of the heart do you think is the most muscular? Explain your reasoning.
2. A growing fetus has a vessel, the ductus arteriosus, in the heart that connects the pulmonary artery with the aorta and conducts blood directly from the right ventricle to the aorta. Why do you think this vessel closes soon after birth?
3. In most of the body, the arteries carry oxygenated blood and the veins carry deoxygenated blood. The exception to this pattern is the heart. Explain how and why specific arteries and veins of the heart are different from the pattern seen in the rest of the body.
4. Describe the mechanisms in place to prevent the blood from flowing in the wrong direction through the heart.
5. Explain what happens to tissues, such as the heart, or the brain, if oxygenated blood is not delivered in a timely manner.