A Circulatory System Relay

Grade Level: **5 - 8**

Module: **Cardiovascular**

Overview

The heart is the main pump that forces the blood through the blood vessels of the body. There are four cavities or open spaces inside the heart that fill with blood. The two upper cavities are the atria and the two lower cavities are the ventricles. The blood coming from the lungs travels to the heart and to all the cells in the body. Once having removed the cells' carbon dioxide and wastes the blood returns to the heart and lungs to pick up a fresh supply of oxygen.

The left ventricle pumps blood that has received oxygen (in the lungs) to the brain and all the organs and extremities of the body. Weakening of the left ventricle is a serious cardiovascular problem that affects many thousands of patients. Heart transplants are the solution for some, but many will die before a transplant is available. Combining NASA's research interest in cardiovascular physiology with NASA's expertise in fluid dynamics, mechanical and electrical engineering has helped to address this problem. Partnerships between NASA and cardiovascular specialists have led to significant advancements in left ventricular assist devices. These devices are most simply described as auxiliary pumps that take a portion of the "pumping" burden from the left ventricle. These devices can pump up to 5 liters of blood per minute, with minimal damage to the blood cells and no clotting of the blood. Such devices may one day save many lives.

Key Question

- How do blood cells travel through the body?

Time Frame:

1 class period

Materials

For each team of 5 students:

- 5 inflated red balloons
- 5 inflated blue balloons
- poster or drawing of the lungs
- playground chalk or masking tape

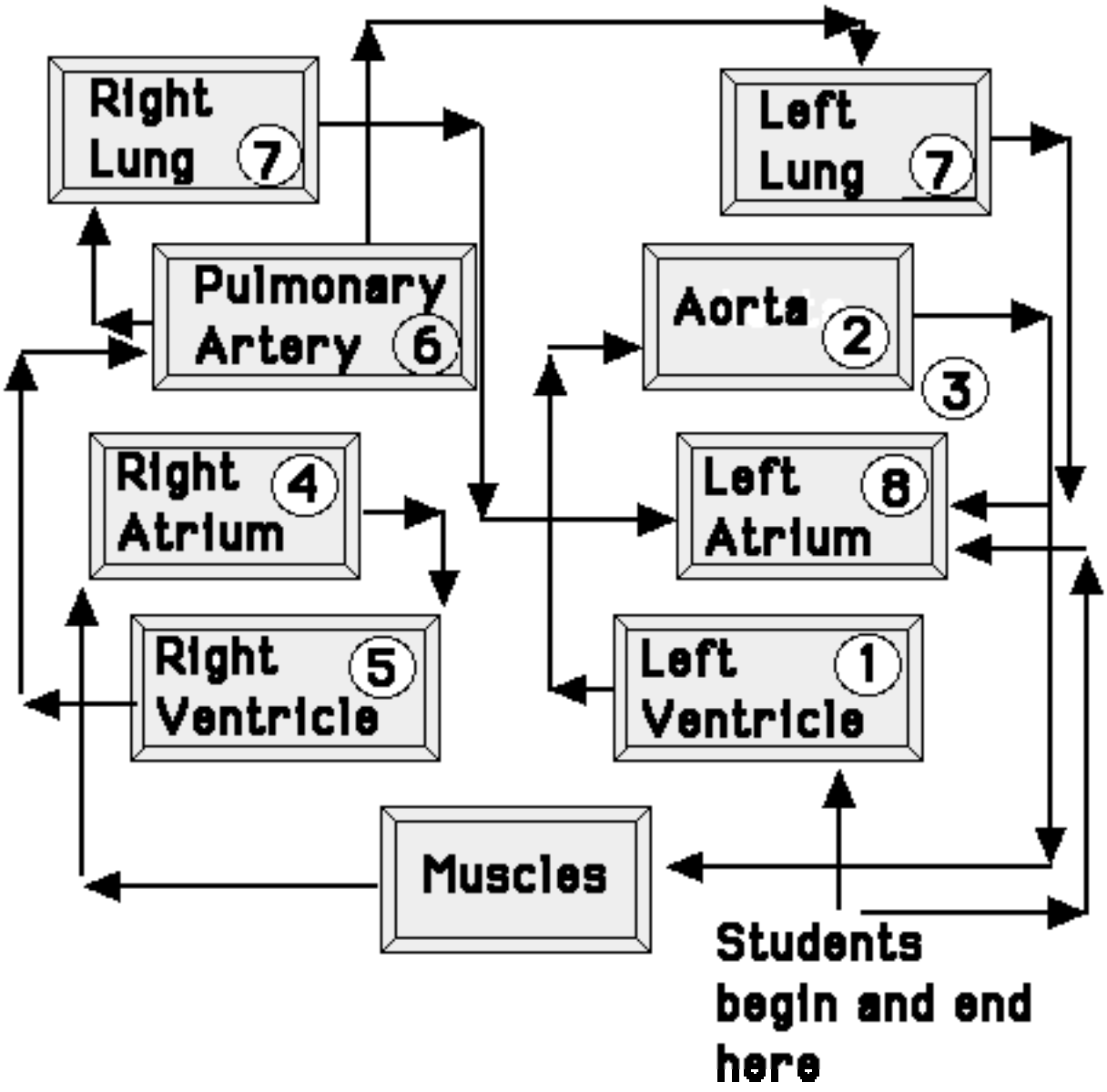
For the class:

- (optional) transparency of "Circulatory System Relay Simulation"

Getting Ready

Set up the relay course ahead of time in a gymnasium or on the playground (see the diagram on next page). If a gymnasium or hallway is used, mark off the parts of the circulatory system with squares of
masking tape. If the playground is used, mark off the squares with playground chalk.

Circulatory System Relay Simulation



1. Students begin in the Left Ventricle as an oxygenated blood cell.
2. They travel through the Aorta.
3. After passing through the aorta students carry their oxygenated blood to the muscles.
4. From the muscles students carry carbon dioxide loaded blood to the Right Atrium.
5. From the Right Atrium students travel into the Right Ventricle.
6. Students travel through the Pulmonary Artery.
7. From the Pulmonary Artery students travel into the lungs where they exchange their carbon dioxide for oxygen.
8. Now carrying oxygenated blood students enter the Left Atrium and are ready to begin the circulatory cycle again.

Classroom Activity

1. Prior to beginning the activity, review the parts of the circulatory system with the students.

2. Show the students the relay course and review the circulatory pathway. You may wish to use a transparency of the relay to help in explaining.

3. Divide the students into teams. Explain to students that the red balloons will represent oxygenated blood cells. Meanwhile, the blue balloons will represent carbon dioxide loaded blood cells that have given away their oxygen and are now carrying away the cells' waste.

4. Demonstrate the path with one student. Walk the student slowly through this pathway:
   a. Students begin in the Left Ventricle as an oxygenated blood cell.
   b. They travel through the Aorta.
   c. After passing through the aorta students carry their oxygenated blood to the muscles.
   d. From the muscles, students carry carbon dioxide loaded blood to the Right Atrium.
   e. From the Right Atrium students travel into the Right Ventricle.
   f. Students travel through the Pulmonary Artery.
   g. From the Pulmonary Artery students travel into the lungs where they exchange their carbon dioxide for oxygen.
   h. Now carrying oxygenated blood students enter the Left Atrium and are ready to begin the circulatory cycle again.

1. Once everyone seems to have the idea, tell the students they are going to have a relay race to see which group can complete the relay in the shortest amount of time. Explain that from the moment the heart begins beating until it stops, the heart works tirelessly, without ever pausing to rest. The average heart muscle will contract and relax about 70 to 80 times a minute. It takes

one blood cell approximately 20 seconds to complete the journey through the circulatory system.

2. Blood cells go exactly where they are needed most in the body without ever stopping. Students should be prepared to take on the role of a blood cell and know exactly where to travel in the circulatory system. Have one group of 5 students demonstrate. One student must go through the entire circulatory system before the next blood cell may continue. Begin timing with a stop watch with the first student starting from the left ventricle, and end timing when the last student reenters the left atrium from the heart. If each blood cell only takes 20 seconds to complete the circuit a group should be able to complete the process in about 1 minute and 20 seconds. Keep a record of group times to see which group circulates through the system most time efficiently.

3. Have some students link together to form a blood clot and traverse the course. What are the health impacts of blood clots? What happens if the left ventricle pushes blood cells out inefficiently (i.e., too slow)? if the valves between the heart chambers allow back flow, rather than control flow in one direction? if the vessels or valves collect deposits that narrow or restrict them?

Wrap-up Session

Ask the students, "What factors do you think might affect the efficiency of circulation in real bodies?"

"What do you think might be the effect of zero gravity (as experienced in space flight) on the circulatory system?"

More Activity Ideas

1. Follow up this activity by assigning students to write a creative story following a red blood cell though the circulatory system. Encourage students to include the major parts of the circulatory system as characters in the story. Students must be sure not to deviate from the true path a blood cell travels.

2. Additional follow up activities may include viewing movies such as Walt Disney's "Hemo the Magnificent" or using a CD-ROM program such as *A.D.A.M.*

3. Construct a heart model out of milk cartons and straws.

4. Make a poster showing the parts of the heart.

5. Make a video depicting the life of a blood cell as it travels through the circulatory system.

Background for Teachers

Prerequisites:

- Knowledge of the circulatory system
- Be familiar with terms associated with the heart

Vocabulary:

- Circulation - movement in a cycle; specifically, movement of blood throughout the body
- Right atrium - the upper right chamber of the heart
- Left atrium - the upper left chamber of the heart
- Right ventricle - the lower right chamber of the heart
- Left ventricle - the lower left chamber of the heart
- Lungs - the organ of the body where where blood cells become enriched with oxygen
- Oxygen - element 16 in the periodic table; essential for respiration
- Carbon dioxide - compound with molecules consisting of one carbon atom bound to two oxygen atoms
- Carbon - element 14 in the perdiodic table; essential for "carbon-based lifeforms" like ourselves

Skills:

- Timing an event
- Recording data

Concepts:

- The path of blood through the circulatory system

Keywords: Circulatory System, Heart, Lungs