

Body Building

Activity 3: Grades 5-8 **One-Way Valves**



Blood is sent by the heart through the vessels of the circulatory system in one direction only. This unidirectional movement insures that a continual supply of oxygen and nutrients travels toward the cells. At the same time, carbon dioxide and wastes travel away from the cells. One-way valves found within the heart and veins prevent any backward blood flow, insuring the efficiency of this one-way movement.

In [Search for an Artificial Heart](#), you observed the testing of artificial valves in the Abiomed mechanical heart. As in a real heart, these valves permit the flow of fluid in only one direction. If the flow reverses, the valve flaps "lock down" preventing any backward flow. In this activity you will get to see for yourself the way in which a valve works.

This activity page will offer:

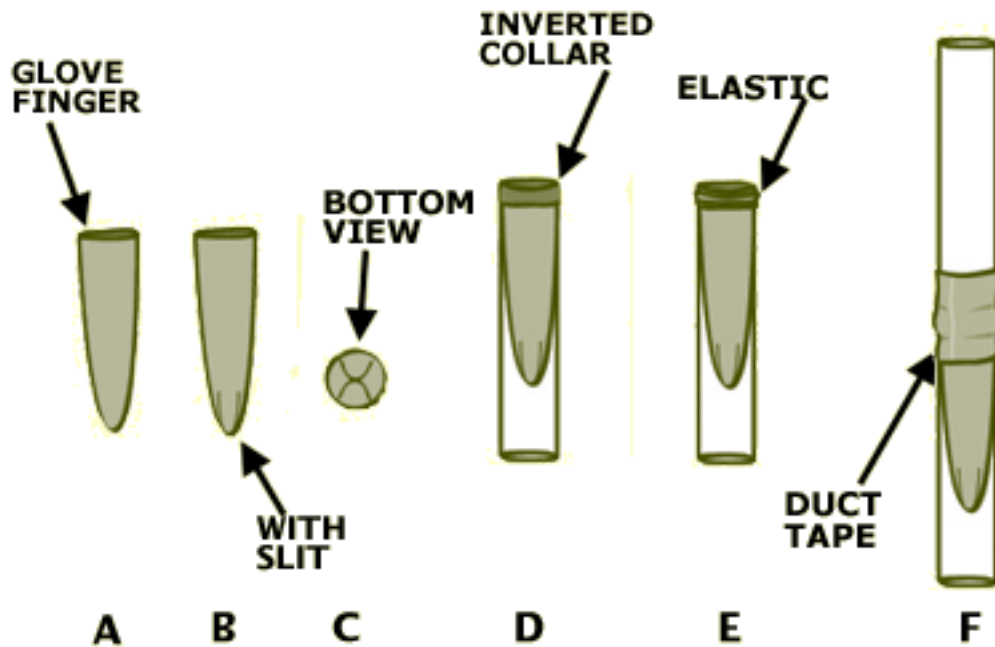
- A chance to observe fluid moving through a one-way valve
- An opportunity to build a model of a valve.
- An opportunity to learn more about biotechnology design.

MATERIALS

- Two 8-inch sections of clear plastic tubing, 1-2 inches in diameter*
- Small elastic band
- Scissors
- Rubber glove (such as those used for dishwashing)
- Duct tape
- Cup
- Water

*This type of tubing may be found at hardware, car care, small engine,

and marine supply stores.



PROCEDURE

1. Use a scissors to cut off one of the fingers from the glove.
2. Cut an "X" in the tip, with each slit about one-inch in length. SEE DIAGRAM B & C.
3. Insert the glove finger into one section of wide, clear plastic tubing. Invert and roll a small section of the fabric of the glove back over the tube to form a collar.
4. Secure the exposed collar to the plastic tube with either duct tape or an elastic band. SEE DIAGRAM E.
5. Place the other tube section on top of the balloon end of this tube.
6. Use duct tape to secure and form a waterproof seal around the joined edges of the two tubes. SEE DIAGRAM F.
7. Fill a small cup with water. Over a sink, carefully pour the water into the tube assembly so that it flows into the inside of the glove finger (Labeled "TOP" in diagram). Observe what happens as the fluid impacts the glove finger.
8. Turn the tube assembly upside down and again pour a cup of water into the tube. What happens this time? Write down your observations.

Questions

1. What did the glove represent?
2. What did the plastic tubing represent?
3. Why did you invert the glove in step 9?
4. Describe the mechanical action of the valve.

EXTENSIONS

Veins Only

Although there are valves in veins to prevent the backward ebb of blood, no such parts are found in arteries. Why?

HINT: Consider the difference in pressure found within an artery and a vein.

Who Gets the Heart?

There are not enough hearts or other transplant organs to meet the needs of the critically ill. Unfortunately, some people die while they wait for an available organ. Suppose you were in charge of deciding who was going to get the organ and who must continue to wait. What would you base this decision on? Would factors such as age, family, gender, finances, race, health issues, or role in society enter into this critical choice? If so, how?

eBay Debate

Perhaps you've heard of eBay? It's an online auction in which items that range from dinettes to dinosaur skulls are offered for sale. A while back, individuals began to post "organs for transplant" on this site. One kidney went as high as \$5.7 million dollars before eBay stopped the bidding. The sale of kidneys or any other body parts is illegal -- yet the marketing of body parts for profit is a potential source of organs. What do you think? Should people be able to sell one of their organs? Why or why not? Suppose the money was needed to finance a lifesaving operation? Would this make a difference?

Presumed Consent?

In the US, the current organ transplantation process depends mostly upon voluntarism. You have to "sign-up" in order to release your organs for transplantation. In contrast, in some foreign countries, including France, the medical establishment assumes "presumed consent." In other words, they can access the organs of a deceased individual without written consent. If you do not want your organs donated, you need to file legal paperwork stating so. Do you think that presumed consent should replace the voluntarism policy now in place in the United States? Why or why not? In the absence of a written statement granting permission here in the US, surviving family members can grant access to the deceased's organs. Often donated organs must be harvested immediately following the death of the donor. How might grief affect access to such organs?

WEB CONNECTION

[Interview with Dr. Mehmet Oz](http://www.accessexcellence.org/WN/NM/ozpage1.html)

<http://www.accessexcellence.org/WN/NM/ozpage1.html>

An informative interview on heart-assist devices that includes a virtual heart transplant lab.

[Heart Valve Information Page](#)

<http://www.csmc.edu/cvs/md/valve/default.htm>

This site includes images about a variety of artificial heart valves.

[Heart Transplant Program: Temple University](http://www.temple.edu/heartfailure/html/heart_transplant.html)

http://www.temple.edu/heartfailure/html/heart_transplant.html

Information on one hospital's heart failure and transplant programs.

The activities in this guide were contributed by Michael DiSpezio, a Massachusetts-based science writer and author of "Critical Thinking Puzzles" and "Awesome Experiments in Light & Sound" (Sterling Publishing Co., NY).

Academic Advisors for this Guide:

Corrine Lowen, Science Department, Wayland Public Schools, Wayland, MA

Suzanne Panico, Science Teacher Mentor, Cambridge Public Schools, Cambridge, MA

Anne E. Jones, Science Department, Wayland Middle School, Wayland, MA

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Answers

Questions

1. What did the glove represent?
(A one-way valve found within the heart or veins.)
2. What did the plastic tubing represent?
(A blood vessel or a section of the heart in which blood was confined.)
3. Why did you invert the glove in step 9?
(To simulate the backward flow of blood)
4. Describe the mechanical action of the valve.
(Water flowing in one direction kept the slits of the valve spread apart. When the direction of flow was reversed, the slits pressed in against each other. This clogged the valve and prevented any

reasonable back flow.)

EXTENSIONS

Veins Only

Although there are valves in veins to prevent the backward ebb of blood, no such parts are found in arteries. Why?

HINT: Consider the difference in pressure found within an artery and a vein.

(Because arteries extend from the heart, the high pressure within these vessels prevents any backward movement. Because veins return to the heart, the pressure is much lower and back flow can exist.)

CURRICULUM LINKS

General Science:

Observation and Inference

Life Science:

Respiratory System

Technology:

Artificial Organs

NATIONAL SCIENCE STANDARDS (Grades 5-8)

Science as Inquiry- Content Standard A

Students think critically and logically to make the relationships between evidence and explanations by deciding what evidence should be used and forming logical arguments.

Life Science - Content Standard C

The student gains familiarity of the structure and function in living systems by working with the respiratory system of the body.