Exploring the Elasticity of Blood Vessels

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Lesson
#11

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Suggestions for Teachers

Purpose:
The two main blood vessels of the body are arteries and veins. The heart pumps blood out to the body by way of arteries with veins carrying the blood back to the heart. Blood within these vessels is under pressure. Students will explore the differences in elasticity and whether this in turn affects the pressure within these vessels. As an optional extension to this activity students will explore the effects of arteriosclerosis and blood clots on blood flow.

Objectives:
- The students will be able to demonstrate an understanding of the relationship between applied force and distance traveled.
- The students will be able to take ONLY available materials to construct a sample vessel and measure pressure methods.
- The student will explain the role of elasticity of vessels in determining the pressure within a vessel.
- Students will be able to model the difference in pressure when blockages may occur using materials provided.

Preliminary Information and Activities:
I use these activities to introduce and cover the circulatory system. I begin by using a brainstorming activity having students give terms about the circulatory system that they are familiar with. This gives me a starting point in discussing what they know and what they would like to know. It also is a good method for revealing misconceptions. The following vocabulary sheet has terms that are important in mastering the following activities. I usually have the students work in their lab groups to define the terms and then we discuss them as an entire class.

I have also had students do full body circulatory system diagrams. One student per group lays on a large piece of butcher paper and has his/her body traced. The lab group then uses red and blue crayons to draw the circulatory system including the lungs. This is one of the fun activities they will remember for years. The other simple activity I use to introduce the topic is the bailing water from dishpan to dishpan to simulate the heart working to pump blood. Have the students take their pulse for 15 seconds. Multiple that number by four to get the number of beats per minute, by 60 for beats per hour, and by 24 for beats per day. This often amazes the junior high student. I ask for a volunteer to bail water for one minute using their pulse rate. Moving water from a full dishpan to an empty one at 70-80 cups per minute is no easy task and it gives the students a feel for how hard their heart works.

Introduction to Activity One:

Students must have an understanding of pressure as a force before they can make the leap to why the elasticity of vessels has a role in blood pressure. This first activity is designed to lay the groundwork for the knowledge necessary to carry out the main portion of this lab. Activity One is designed to be done with the entire class group. As a portion of this initial activity a graphing exercise is included to review graphing skills to be used in the second activity.

Activity One Materials:

- Straw
- Water
- Meter stick
- Tin Can with holes punched out vertically along the side at 1" intervals
- Student Volunteer
- Graph paper and pencil for each student

Activity One Procedure:

1. Begin the lesson with a brainstorming activity on pressure. This can be as simple as a webbing activity on the board or having students drawing diagrams to illustrate concepts. Leave this information on the board for students to reference during the rest of this activity.

2. Next, have the students look at the straw and hypothesize about how pressure could effect the distance water could be blown from the end of the straw.

3. Write several ideas on the board and have a student volunteer come and model the ideas. Record relevant information to having the students sees pressure as a force.

4. Have the students graph the data they have recorded on the board in the form they think best illustrates their data. All the students should be doing this graph independently of each other even though they are using the same data.

5. Once the students have completed the graphing activity discuss the methods they used. Have them identify independent and dependent variables, units of measurement used to label the graph, and style of graph used. This is all meant as a review of basic concepts that they will be graded on in the main activity.

6. **Optional**: The tin can be used to demonstrate the pressure concept as well. The hole in the side of the can needs a stopper of some kind so that you are opening just one hole at a time. Fill the can with water. Ask students what will happen if you remove the stopper from the hole closest to the top of the can. Will the same thing happen when the stopper in the bottom of the can is removed? Why is there a difference? What could be causing this? Can it be compared to blood vessels?

Teacher's note: This can be a difficult leap for some students but let them try to work through it or have classmates try to help but limit your input to only the necessary information to keep the students on track.

Introduction to Activity Two:

This activity is the main component of this unit. The students should now have the basic knowledge necessary to carry out this part of the lab in their lab groups. Remember that you are trying to guide the students into exploring elasticity and the role it plays in blood vessels. The tubing can be the same diameter but different composition or the same composition in different gauges. If possible try to control the internal diameter of the tubing so they are as close as possible.

Activity Two Materials:

- Two pieces of tubing of the same composition but different gauges
- Bucket
- Water
- Graduated cylinder
- Four clamps for each group
- Two funnels for each group
- Measuring tape
- Ring Stands
- Meter Stick
- Stop watch
- Connectors for tubing and funnel if there is not a snug fit
- Duct tape

Procedure:

1. The student should be instructed that they are to construct an experimental design to test the pressure differences in the two pieces of tubing they have been given. The rest of the materials should be made available to them but the tubing should be given to them directly to insure they have a section of each type. Allow them to work using the materials to design but with the freedom to return something or to ask for additional materials from the supply you have.

2. Explain that grading will be done on experimental design, presentation of data in graphs, conclusions, and each member of the groups' participation in the class presentation. Try to establish as much structure as you think necessary before the lab groups begin. I usually have them assign job titles for the lab, i.e. recorder, gopher, etc. I also let them know that each member of the group needs to be involved in their group's presentation so they can plan ahead before grading occurs.

3. Monitor student progress and watch for signs of frustration or dissention within a group that will bog them down. When students ask for answers or advice, and they will, try to lead them back through ***Activity One*** to draw their own conclusions. The students will need to make the link between the two activities in order for them to draw conclusions about vessels and pressure.

4. Questions that might help lead the students include the following:
    a. The higher the pressure in the tube, the farther the water will travel. Is this statement true or false?
    b. If veins are soft and flexible and arteries are less flexible and stiff, which of your tubes correspond to each vessel?
    c. Can you apply your findings to the blood pressure in veins and arteries?

Introduction to Activity Three:

Students are probably very familiar with the concepts of cholesterol, eating fried foods, and fast food diets effects on their blood pressure. It is something they hear a lot about but do they have an understanding of why? The following activity will allow them to see fatty deposits in arteries and the effect on blood pressure.

See Appendix C for information on the *Women Life Sciencetists: Past, Present, and Future* Book. Matyas, M. L. and Haley-Oliphant, A. (1997). Bethesda, MD: American Physiological Society.

Lab Group #_____
Class_____

STUDENT INSTRUCTION SHEET

ACTIVITY TWO

We have been exploring your cardiovascular system over the past few days. You should have your vocabulary sheets completed as well as your lab sheets from the first two activities. PLEASE, use all of this information as you set off on your own exploration of how your blood vessels work to control flow and pressure.

You will have available to you the following materials:

1. Two pieces of tubing, with different size walls
2. Bucket
3. Water
4. Clamps, up to four for each group
5. Two funnels per group
6. Meter sticks and measuring tapes
7. Ring stand
8. Duct tape

You will need to work on the following question:

You are to construct an experimental design to test the pressure differences in the two pieces of tubing you have been given. You will need to determine the significance of the two different types of tubing before you begin. Work together in your groups! Listen to everyone's opinions and be a team! I am available to answer questions, but I will not set up your design. REMEMBER, your design must be approved before you begin. GOOD LUCK!

OUR LAB DESIGN:

LAB GROUP #:_____

STUDENT VOCABULARY PAGE

In your lab groups work together to define the following terms. Use your own textbook or any other sources available in the classroom. It will be important for you to have a working understanding of these terms in developing your lab activity. Ask me for help if you have any difficulty locating the definitions.

1. Cardiovascular system-

2. heart-

3. atrium-

4. ventricle-

5. valve-

6. artery-

7. capillary-

8. vein-

9. aorta-

10. force-

11. blood pressure-

12. diffusion-

13. pulse-

14. hypertension-

15. atherosclerosis-

STUDENT GRADE SHEET

CIRCULATORY SYSTEM ACTIVITY

Student name:_____

Lab Group #:_____

25 point rubric

_____Experimental design and use of the scientific method

_____Testable hypothesis

_____Presentation of data in graph form

_____ Stated conclusion

_____ Participation in class presentation