Fluid Mechanics

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Research Host:

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Grade Level:

High School

Fluid Mechanics

Purpose:
Our health and vitality depend upon the delivery of nutrients and oxygen to the tissues of our bodies. For many people the delivery of nutrients and oxygen has been compromised. This is especially true for people who have atherosclerosis and asthma. The activities that I have put together show just how dramatically the flow of fluid can be reduced. Using concepts borrowed from the earth and physical science classes, the data the students gather will show that fluid volume will be reduced exponentially as a result of a decrease in the diameter of a vessel. Other activities will show how the friction between the walls of the vessel and the fluid contribute to frictional resistance.

Time-frame:
Three to four class periods

Objectives:
Students will be able to:

- use scientific methods to design experiments to solve problems.
- gather, organize and interpret data.
- compare living and nonliving systems.
- list factors that influence fluid flow.
- explain how a decrease in fluid flow contributes to a decline in the vitality of a person's health.

Materials:

- ring stands and rings
- tube clamps
- tygon tubing
- funnels tubs
- stopwatch
- balloons
- spoon candy materials
- Stream table or stream

Safety Materials:

- goggles
- oven Mitts

Teacher's note: Activities one and two can be done as teacher demonstrations or as stand alone activities as time and your curriculum will allow.

Activity 1
Students are to determine which area of a stream has the greatest velocity. A stream table borrowed from the earth science teacher may be used instead of a stream. Velocity may be found by floating objects next to the stream's bank as well as in the middle or the stream.

Use the Formula:

Speed - Distance ÷ time to calculate the velocity of water in the middle of the stream and along the shore.

Oral Assessment:

- Which area of the stream has the greatest velocity?
- What factors affect the velocity of the water?
- How would the velocity of water on the surface compare with the water at the bottom?

Homework:

- Research the term **atherosclerosis**. Find the causes and effects.

Activity 2
Combine the ingredients of spoon candy (see below) in a large saucepan. Heat to a boil stirring constantly. Cook to 245° F, or until the mixture reaches the softball stage. (The candy will hold together when a drop is placed in cold water.) Pour into a pan and let cool. Peanuts can be placed on the candy in a row along one edge of the pan. The pan is to be placed on the table with the end containing the peanuts raised. Observations will need to be taken throughout the day. In order to save time the candy may be made at home and brought to school. If the candy is to be eaten by the students it should be kept covered.

Spoon Candy Ingredients:

- 2 cups of sugar
- 3/4 cup light corn syrup
- **1/i** cup butter
- 2 cups table cream

Safety:

- Be sure to wear goggles.
- Use oven mitts to handle the hot pans.

Oral Assessment:

- Which area of the pan had the fastest flow?
- The slowest flow?
- List the differences in the two fluids. List the similarities of the two activities.

Oral Assessment:

- How does atherosclerosis limit the flow of blood?
- Compare and contrast the factors that cause atheroscierosis to the two previous activities?

Teacher's Note: For the next two activities, discuss with class, the different solutions by which these problems could be accomplished.

Before the Activity Explain to the Class:

- the need to begin with practice runs.
- to run some trials that an average can be calculated.
- the difference between qualitative and quantitative analysis.
- the difference between an independent and dependent variable.

Using a random method divide the class into groups of three or four. Each student in the group must be responsible for an assigned task
The groups will need to:

- identify the problem addressed in the activity.
- address the problem in the form of a question.
- identify the procedure they'll use.
- list the materials they plan to use.
- record any data with the correct units. build any graphs that may be used.

Activity 3

Students will build a system in which in which they will be required to measure a specific volume of water per time through tubing of different diameter. The system will be gravity powered. Quantitative measurements will be taken and recorded in the lab notebook. After the activity each student will examine the data gathered by the group and write a conclusion based on the observed data. Each student should assume responsibility for his or her own lab report.

Teacher's Note: For this activity plan on making available four diameters of Tygon tubing of equal length. This will provide for four data points as students measure volume/tube diameter as well as three data points when you compare the amount of the increase from one size to the next.

Safety:

No special consideration

Portfolio Assessment:

Lab report

Homework:

Research the condition asthma. Find out how asthma is caused and how it affects people who have it.

Activity 4:
In the year 1808 John Colter, a member of the Lewis and Clark expedition, who was exploring and trapping in the Yellowstone Park area, was captured by the Blackfeet. Given a chance to flee for his life Colter outran his Blackfoot captors and hid beneath a pile of driftwood in a river. Some reports have Colter breathing through a hollow reed in order to stay completely hidden.

Have the students experiment to find out how much Colter's breathing was impaired.

Teachers' Note: Supply the students with balloons, different sizes of tygon tubing, tubs, funnels and a stopwatch.

Safety:
Goggles

Homework: Research the condition **hypoxia**. What is the cause? What are the effects?

Oral Assessment:

- Compare and contrast the way that fluids and gases move through tubes.
- What happens to tissues that are repeatedly oxygen deficient?
- How do people with asthma remedy their condition?

Portfolio Assessment:

- Lab report

Grading:

- Use a lab report rubric

Extension:

- Research the reasons why asthma is more prevalent today than it was a generation ago.
- Write a description of a lifestyle that promotes a healthy cardiovascular system.

References:
The Elvis Experiment Papers, a classroom unit developed by the San Diego Ca. Local Outreach Team. The American Physiology Society / Frontiers In Physiology

Resources:
Stream Tables are available in most scientific supply companies. Prices begin at about $50.00.

Laboratory Assessment Guide:
In order to receive a grade on your lab assignment, your paper must have the following components:

Scientific Method:

The "problem" the lab is presenting must be clearly stated at the top of the page.

Score 1, 2, 3, or 4

Include a hypothesis

Based on what you may already know or what you may have researched, suggest an answer to your problem.

Score 1, 2, 3, or 4

Procedure

Describe the methods and list the materials that you will need to solve the problem.

Score 1, 2, 3, or 4

Observations including qualitative (what kind) and quantitative (how much) data must be listed.

Measurements must be labeled

Use tables and graphs when applicable to show data.

Score 1, 2, 3, or 4

Each paper must end with a conclusion. Be sure to include:

a statement consisting of what you learned related to your hypothesis.

a question you would ask for further study.

any source of error you might have encountered.

Score 1, 2, 3, or 4

Writing: All written work must:

contain correct punctuation and capitalization.

contain correct grammar.

show an understanding of the topic

be neat with no fringes, tears, wrinkles, or doodles.

Score 1, 2, 3, or 4

Math

Math problems must be set up in the proper form (as related to the equation).

Show how you derived the answer:

Computation must be correct.

Score 1, 2, 3, or 4

Time

Paper will be handed in on time.

You will not waste time in class.

Score 1, 2, 3, or 4

Scoring Guide

A 100-94%
B 93-86%
C 85-77%
D 76-70%
E ___/___X 100 = ___%