Levon Khachigian, PhD

I am of Armenian descent. My parents, who were Christian missionaries working in the Middle East, migrated to Australia in 1965 with me in tow at 18 months old. I attended Naremburn Public School, on Sydney's lower north shore, until Year 6 and then went onto Crow's Nest Boys' High School till Year 12. I studied Science at the University of New South Wales majoring in Biochemistry and Microbiology, and graduated with First Class Honours in 1986. I was awarded a PhD in medical biochemistry by the University in 1993. I then studied at Harvard Medical School for three years before returning to the University in 1996 and completing my studies in 2004.

As a molecular biologist, my research has helped increase our understanding of the processes that lead to the appearance of harmful genes in cells of the artery wall. This has led to the generation of novel DNA-based drugs that block arterial re-narrowing after some forms of arterial surgery. More recently, I have been unravelling the mechanisms behind tumour growth control by inhibiting the growth of blood vessels supplying the tumour.

I am a National Health and Medical Research Council Principal Research Fellow and Head of the Signalling and Transcription Laboratory at the Centre for Vascular Research at the University of New South Wales. I am also an Associate Professor of Pathology at the University.

Artery Health

The process in which plaque builds up in the wall of an artery is known as atherosclerosis. Plaque is made up of fats, cholesterol and other substances and deposits can grow large enough to significantly reduce the blood's flow through an artery.

INVESTIGATION ONE

Demonstration of a siphon

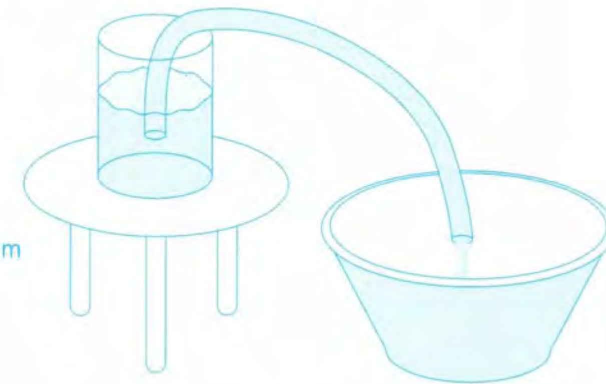
You will need

A length of clear plastic hose

A beaker or 2 litre plastic milk bottle

A bucket

A chair or lab stool



This investigation is best done with the whole class.

The aim of this investigation is to demonstrate a siphon and solve the problem of why it works.

Procedure

1. Place the stool on a bench.
2. Fill the beaker with water, place it on the stool.
3. Fill the hose with water and hold it in with a finger on each end.
4. Place one end of the hose in the beaker; make sure the other end is always over the bucket, which should be on the bench.
5. Vary the height of the end of the hose not in the beaker and by removing the finger at various heights, show that water runs out faster the lower the open end is.
6. By keeping the open end of the hose at the same level as the water in the beaker, show that water won't flow out unless the end of the hose (more accurately the lower surface of the water in the hose) is below the water level in the beaker.
7. Show that if the hose is empty the siphon doesn't work.

Brainstorm with the class:

Question 1: What makes the water run up the hose, out of the beaker and down the hose into the beaker?

Question 2: Why won't the siphon work if the hose is empty?

Question 3: Why won't the siphon work if the open end of the hose is level with the water in the beaker?

Everybody should draw the circumstances where the siphon will and won't work. Make sure that students show the water in the hose appropriately.

INVESTIGATION TWO

As arteries clog up, flow rate diminishes

You will need

Three clear lengths of plastic hose with different internal diameters, small, medium and large. The large should not be greater in diameter than about 1.5cms.

A beaker or 2 litre plastic milk bottle

A bucket

A stopwatch

A chair or lab stool

Pen and pad to record results.

This investigation is best done with the whole class.

The aim of this investigation is to demonstrate that for constant pressure, less liquid flows through a small pipe than a large pipe.

Procedure

1. Cut the three pieces of plastic hose so that they are all as close as possible to the same length. A longer length will be needed if a stool is used rather than a chair, but aim for 1-1½ metres long.
2. Place a mark on each hose to identify it.
3. Place the stool on a bench or table.
4. Fill one of the beakers with water and place it on the stool with the other empty beaker (or bucket) on the bench close to the stool.
5. Fill one of the plastic hoses with water and hold a finger on each end to keep it full.
6. Place one end of the hose in the beaker of water; push that end close to the bottom but not close enough to obstruct the flow.
7. Hold the other end over the bucket, close to but inside the rim of the bucket.
8. Remove the finger from that end of the hose and start the stopwatch. When the beaker is empty stop the stopwatch.
9. Have an appointed student record the time on the board along with the hose identifier.
10. Repeat with the other two hoses, emptying the bucket between each recording.

Have the class examine the results.

Question 1: Does the time to drain the beaker diminish, as the hoses get larger in diameter?

Question 2: Is the pressure drawing the water out of the beaker constant for the three different hoses?

Draw the analogy between this investigation and the heart pumping blood through our bodies. If the heart pumps at constant pressure, the more clogged our arteries become, the less blood will flow through them. This can lead to oxygen starvation of our muscles and brain. It can also cause our heart to pump harder to boost the pressure and make more blood flow leading to heart problems.

INVESTIGATION THREE

Presenting the results of Investigation Two

You will need

Pen and paper for plotting a graph

This investigation is best done with the mathematically able students in the class.

The aim of this investigation is to demonstrate a better way of looking at the results of investigation two.

Background

Flow rate was measured in investigation two by having a constant volume of water (a full beaker) pass through the hose in a measured time. Flow rate is then calculated by using the formula:

Flow rate = Volume of water/time to empty beaker

= k1/time

Therefore, as long as volume is constant, time is inversely related to flow rate (k1 is a constant).

Flow rate through the plastic hose is proportional to the cross-sectional area of the hose, the pressure difference between its ends and its length.

The formula connecting these four variables is:

Flow rate = k2*cross-sectional area*pressure/length

where k2 is a constant.

In investigation two we did a scientific experiment by varying only one of these parameters and measuring the effect on flow rate. We held the pressure difference and the length of the hose constant. This allows us to rewrite the last equation as:

Flow rate = k3*cross-sectional area

where k3 is another constant.

Combining the first and last equation, we end up with:

1/time = k4*cross-section

where k4 is another constant.

This equation tells us that if we plot 1/time on the y-axis and cross-section on the x-axis, we should get a straight line.

Procedure

We have three data points from investigation two that we can plot on a piece of graph paper to test this idea. Set up a table as follows:

Results	Time	1/Time	Hose internal diameter	Cross-section
Small hose				
Medium hose				
Large hose				

Artery Health

1. Insert the times measured in the Time column and the hose internal diameters in that column.

2. Calculate 1/Time using a calculator.

3. To calculate the cross-section, divide the hose internal diameter by two, square the result and multiply by π (3.14159).

4. Plot the three numbers in column 3 on the y-axis against those in column 5 on the x-axis.

5. Test for straightness by trying to rule a straight line through the points.

Question 1: Is the graph a straight line? If not, why not?

FURTHER WORK

Make a list of the likely errors in Investigation Two that caused your line in Investigation Three not to be straight.

Make an artificial heart from a plastic petrol siphon bought from a local car accessories shop. By connecting this artificial heart to plastic hoses of different diameters, you should be able to demonstrate that you need to squeeze the plastic bulb harder for smaller pipes to maintain the same flow rate, just as a heart has to work harder in people with atherosclerosis.

Research the causes of artery clogging using the Internet and your school library. Use your research to make a poster advising people about ways to avoid atherosclerosis. Can you see any difficulties in having your advice heeded?

People in some countries eat a lot of animal fat, e.g. the Inuit of Northern Canada, the Masai of Africa and many people in Mongolia. Compare and contrast death rates or average life span in one of these populations with that in Australia. What could be done to help these people live longer? Do you think comparing death rates or life span is a fair measure of the effects of dietary differences between these two groups. Why or why not?