Vasodilation and Vasoconstriction

STUDENT INVESTIGATION

1 BACKGROUND

Many organisms, including humans, use the process of vasodilation and vasoconstriction to regulate core body temperature within a narrow range despite drastic fluctuations in environmental conditions. Vasodilation is the process by which blood vessels in the extremities (arms and legs) are dilated, allowing a greater volume of blood to flow to these tissues. Vasoconstriction is the exact opposite. Blood vessels in the extremities are constricted, preventing blood flow to certain tissues. The regulation of body temperature by the central nervous system is controlled by a number of physiological mechanisms, two of which are vasodilation and vasoconstriction.

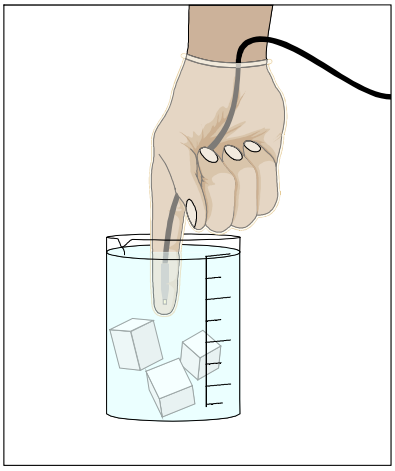
Have you ever noticed that on cold days your fingers seem thinner and any rings you normally wear tend to feel loose? On warm days, the exact opposite happens, your fingers tend to swell and any rings you normally wear often feel tight. Both of these situations are caused by vasoconstriction and vasodilation, respectively. On those cold days, your nervous system constricts blood flow to your extremities, and in so doing prevents cold blood from returning to your core which would cause a rapid drop in body temperature. On hot days, your nervous system dilates the vessels in your extremities, allowing the blood to be cooled much like your radiator keeps the temperature of your cars engine cool. In fact, you may have noticed that when you walk outside on a cold day, you often need to urinate. Believe it or not, this is a side effect of vasoconstriction in your extremities and is called cold induced dieresis. As soon as the vessels in your extremities are constricted, a large amount of blood is forced into your core, causing a rapid increase in blood pressure. To compensate, your kidneys quickly remove fluid from your blood stream so that your blood pressure stays within a certain range.

In this experiment you will explore the processes of vasodilation and vasoconstriction. You will submerge one of your fingers in an ice bath and monitor your fingers change in skin temperature as it cycles through vasodilation and vasoconstriction over the course of 20 minutes.

2 MATERIALS

Standard Temperature Probe
Latex/surgical glove
Ice
Medium-size beaker/container

3 EXPERIMENT SETUP



Insert finger into ice bath with Standard Temperature Probe held in place with a piece of tape and a latex glove.

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4 EXPERIMENT PROCEDURE

Check boxes as you go

☐ **1)** First, open the Excelerator workbook called *Vasodilation and Vasoconstriction*. Attach the Standard Temperature Probe to the Interface.

☐ **2)** Next, prepare an ice bath by filling a medium-size beaker/container ¾ of the way with equal amounts of ice and water. You will use this ice bath for the entire period, so continually add ice as necessary. You are trying to keep the water as close to 0 degrees Celsius as possible.

☐ **3)** Attach the Standard Temperature Probe to one of your fingertips using the tape and latex glove to hold it in place. (See Experiment Setup)

☐ **4)** At this point, you are ready to submerse your finger in the ice bath and start recording measurements with Excelerator. To do so, click on the *Go* button and then insert your finger. The experiment will run for 20 minutes, so keep your finger as still as possible the entire time. If necessary, lengthen the experiment duration.

 ← **Go button**

☐ **5)** After Excelerator has stopped recording data, remove your finger from the ice bath. Rescale the Fast Graph to determine whether or not your finger cycled through vasodilation and vasoconstriction. Fill in the data table below.

5 DATA ANALYSIS

STUDENTS NAME	DURATION	WARMEST TEMP. (C)	COOLEST TEMP. (C)	AVERAGE TEMP. (C)	# OF CYCLES

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6 CONCLUSIONS

Label the significant points on your graph and include a description of what is happening within the blood vessels of your finger at each of these points.

As a class, create a single data table that contains the above information for everyone in the class and discuss the following questions:

1) Was the cycling between vasodilation and vasoconstriction apparent in every group members graph?
2) If not, why do you think it was absent for some people?

7 EXTENSIONS

1) Perform the same experiment on a broader group of individuals and see if there are any trends between boys and girls, younger and older people, smokers and non-smokers.
2) Shorten the experiment to ten or fifteen minutes (ask your intructor how to do this). Complete it and then use the same finger again. Determine if there was any difference from the first to the second trial.
3) Complete a trial with one finger, then a different one (or use the same digit from the opposite hand). Do the appendages behave the same?