



Exploring Exercise Physiology Through Computer Simulation

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1999

Grade Level:
High School

Exploring Exercise Physiology through Computer Simulation

Purpose: The purpose of this activity is to expose students to computer simulations of basic physiological functions that potentially could cover a variety of topics. This is the same simulation that is used of the University Medical Center School in Jackson, MS.

The lesson will be based upon an application of the gas laws. The students will begin with the Elvis experiments, which was located on the APS web page. The APS web page is located at: <http://www.the-aps.org>. Biological Simulators has a website at <http://www.biosim.com>. All of the software is available for purchase online. The instruction manual is available for downloading on this website. Then, as a follow-up, the students begin the exercise program, naming their patient "Elvis." Simple exercise causes an increase in blood pressure.

Using the **Quantitative Circulatory Physiology** program, a subject is going to ride a bike for five minutes. The blood pressure is recorded. Flow rate is also recorded. Then the student will calculate the resistance. Determinations will provide approximate answers to the original stated hypothesis.

Simulation times will be extended to ten minutes, thirty minutes, and one hour. Data gathered will allow the student to extrapolate varied ideas. Data should be graphed with flow rate vs. pressure. Also, an integral part of this is for students to create a written report. This report will be presented to the English department.

Suggestions for Teachers

Purpose:

The purpose of this activity is to allow students to explore biological changes through computer simulation. The activity does not limit any exploration. Instead, it opens the human body for exploration of any topic.

Grade Level:

Chemistry, Biology II, Anatomy and Physiology

Objectives:

Students will be able to:

- investigate the responses of the human body to various exercise stimuli
- develop a hypothesis and experiment based upon set goals
- draw a conclusion based upon experimental data
- graph conclusion on graph paper

Materials:

- Quantitative Circulatory Physiology Program - This is available from the Biological Simulators Inc. Their website is <http://www.biosim.com>. The program developer is Dr. Tom Coleman, professor at University Medical Center School in Jackson, MS.
- computers with the program installed: one per two students

- data sheet provided. Have students title each section.
- graph paper
- ruler

Preparation and Procedure:

The teacher should be familiar with the program. Make sure that you have run all the options to completion so that you will be aware of any potential problems that may arise. The class should have an accurate understanding of computers and human physiology.

Questions to Ask:

1. What events would increase heart rate?
2. What effects on body functions do you expect to occur during exercise?
3. From the Elvis experiment, explain if you could increase flow rate without heart rate. If so, how?

Where to go from Here:

Invite a physiologist to answer questions on why certain organs and organ systems have reacted the way they have.

Assessment:

The math department will provide a basis for the grading of the graph. Visual representation of data is a must. Look for a title of the graph. Also, look for proper labeling of the graph.

The English department can assist with the grading of the paper. Proper English is required.

MLA format will be checked on the paper. The lost part of the assessment comes from a presentation. The recommendation is for this presentation to occur in front of the English and Math departmental classes that helped grade the individual parts.

Safety:

This experiment is completely safe as long as the computer is properly turned on and off.

References:

1. Dr. Thomas Coleman
2. American Physiological Society www.the-aps.org **Elvis Experiment**
3. Note: The **Elvis Experiment** is one component of the unit **Physiology of Exercise**, an exploration of cardiovascular and respiratory function for high school students. The entire unit is available on the APS website at:
<http://www.the-aps.org>

Set Up:

The teacher needs to make sure that the clinical buttons, basic Physiology and organ details buttons are active. To do so, click the view button and drag over the appropriate list. Also make sure the skeletal muscle has its metabolism active.

Introduction:

It is imperative that you give specific directions only about the operation of the computer program. After the student becomes familiar with the program, she or he will play a lot. We want to encourage this exploration; however, stress that all data be collected on the following data table. The students should be able to graph data prior to this activity. This activity would fit nicely into your gas laws chapters and diffusion discussions.

The student should first take a baseline reading of the subject's oxygen level. To do this, first use the mouse and find the "Go" button. Then slide down to "ten minutes" and activate it by letting go of the mouse. This allows the baseline figures to be established. Then, simply click on the O₂ button from the toolbar. Then, when the screen changes, have the students press the "I" button. The values should fill-in. While you may elect to demonstrate this first to their students, it is recommended that they actually push the buttons and you simply observe them in action.

There will be two groups that can occur at one time. The first is making the subject exercise on a treadmill. The second group has the subject exercise on a bike. **It is important that you have a good working knowledge of how these two activities work. Play around with it. That is what the students will be doing.**

Split the class into groups. It is recommended that you have groups with a maximum of four people. Ideally, two people would make a great group. Let them collaborate on how long to exercise their individual. They will need at least five different data points to graph. The graph is a must. Statistical data that is presented in an easy-to-understand format is a tool that all students need. A simple poster session would be an easy way to compare ideas that each group extrapolated and open discussion for questions raised during the simulation. As an extension of this project, you could have the English department grade their lab folders for grammatical correctness and have your students do their poster presentations in front of the English students.

It is imperative that you watch the initial groups work on the computer. They are going to play with the parameters. This is a great teaching point, simply ask the question, "Does changing the parameters, such as how much he eats/drinks, affect the data or can you change the parameters during the experiment?" This will provide them with the opportunity to discuss how you set up experimental control and the importance of restricting as many variables as possible.

You do want to stress that changing parameters is ok if it is done consistently throughout the experiment. If they change it during the experiment, the program is easy to restart. Simply click the restart the button on the tool bar.

Scenario 1

Your best friend's dad, Mr. Norm Subject, has volunteered to participate in the school's new physical fitness testing. You are asked to put him through a series of exercise activities that will determine the increase of his blood's oxygen concentration during exercises. Your job is to pick at least five different time periods and allow him to exercise.

If you are using the exercise bike, set his speed fairly low. He is old after all. If you are using the treadmill, you might want to go easy on the old fellow. Don't make him climb Mt. Everest. Well, if you think that it is necessary, then send him up a steep inline.

While you are exercising our friend, make sure you record the oxygen concentration, as well as the pH levels of the blood. Develop some questions that you want to answer. A second group should attempt the same experiment, except look at the relationship between CO₂ and pH. An in depth study of pH vs. pOH should be performed by another group. Also, from your graphed data, develop some questions to ask your audience to see if they easily understood your findings.

Hypothesis:

Need to describe method! (Parameters set)

Experimental Data: (Use attached sheet)

Conclusion:

Scenario 2

Your best friend's dad, Mr. Norm Subject, has volunteered to participate in the school's new physical fitness testing. You are asked to put him through a series of exercise activities that will determine if his arterial oxygen level is higher in the arterial blood versus venous side. Also, you will examine the carbon dioxide levels in arterial blood and compare these values to those in venous blood. Your job is to pick at least five different time periods and allow him to exercise.

If you are using the exercise bike, set his speed fairly low. He is old, after all. If you are using the treadmill, you might want to go easy on the old fellow. Don't make him climb Mt. Everest. Well, if you think it is necessary, then send him up a steep incline.

While you are exercising our friend, make sure you record the oxygen levels, as well as the carbon dioxide levels of arterial and venous blood. Develop some questions that you want to answer. Also, from your graphed data, develop some questions to ask your audience to see if they easily understand your findings.

Hypothesis:

Need to describe method! (Parameters set)

Experimental Data: (Use attached sheet)

Conclusion:

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