



# **The Effects of Various Exercises on the Cardiovascular System**

Kevin L. Menzel  
Round Rock High School  
Round Rock, Texas  
Summer 1997

Research Host:  
Dr. Edward F. Coyle  
The University of Texas at Austin

# **The Effects of Various Exercises on the Cardiovascular System**

## **Suggestions for Teachers**

### **Introduction:**

In many exercise and fitness magazines, the idea is established that heart rate alone is a good predictor of the aerobic benefits of exercise. This idea greatly oversimplifies the complexity and grand design of the cardiovascular system. The integrative approach set forth here and in a paper by Edward Coyle (see References and Resources below) helps students understand how dynamic the body is and the importance of a holistic approach to human physiology.

The teacher should review this article. The main emphasis of the lab is that the effects of exercise on the heart changes with type of exercise. There are two main effects: 1) increases in ventricular chamber size, 2) increase in wall thickness

Chamber size increase is a result of an increased filling rate during prolonged endurance training exercise. An increase in ventricular wall thickness occurs from high intensity strength training. The total peripheral resistance to blood flow increases due to muscle contraction. More pressure must be generated by the heart to move blood. This seems to be why the wall thickens. Details concerning the above issues and other areas to explore are found in the noted article.

Finally, the teacher should become familiar with the graphs in Figure 2. Explore questions focus on these graphs. Their primary importance is that the student can use heart rate measurements to extrapolate oxygen consumption. Oxygen consumption is a much better measure of cardiovascular benefit. Direct measurement would only be possible by measuring  $VO_{2max}$ .

### **Purpose:**

The purpose of this activity is to determine the effects of different exercises on the cardiovascular system.

### **Objectives:**

#### **Students will be able to:**

- appreciate the importance of science and research in validating physiological claims made by individuals and the media.
- understand the difference between endurance training and strength training exercises and their effects on the human body.
- collect data and apply systematically in order to solve a problem.
- use graphs and discussion to clearly present the results of research.

### **Materials:**

- phymomanometer and stethoscope
- stopwatch
- access to steps
- student lab sheet

*Note:* This lab may be performed without blood pressure measurements if you don't have access to the equipment. The necessary data is heart rate. It's nice to demonstrate the blood pressure response, but it's not necessary for the lab to be successful.

### **Preparation:**

Students should be familiar with taking blood pressure and heart rate measurements. Students should read the articles cited for background on the problem and to provide motivation for discovery.

### **Procedures:**

1. Students may be divided into research groups of 4 or more, depending on the number of available materials.
2. Students will measure the blood pressure and heart rate changes of a subject during endurance training (step test) and strength training (pushups).
3. Data will be collected and results compared to the graph from Coyle's paper to determine the effects on the cardiovascular system.

### **Safety:**

Follow standard safety protocol for exercising students.

### **Questions to Ask:**

1. If we change the rest time during the strength training, will that change anything?
2. Would a different type of strength training exercise give us different results?
3. Based on the graphs, at the maximum heart rate for the step test what was the oxygen consumption? For pushups?
4. What was the caloric expenditure for both?
5. Based on the discussion of oxygen consumption, which exercise provided the greatest cardiovascular benefit.

### **Where to Go From Here:**

- This lab should be used during cardiovascular system discussions. Coyle's paper is also excellent to tie the nervous system in with cardiovascular function. Students could do research in popular fitness magazines. Many articles will claim that weight lifting at a faster rate will provide aerobic benefits. Ask them to critique this position based on their research and Coyle's paper (see References and Resources below). The Gatorade Sports Science Institute also has a Web page at <http://www.gssiweb.com>. This site is an excellent resource for human physiology information.
- [Editor's note: See also the activity "[Getting A-Round Scientific Inquiry](#)" for an excellent way to get students involved in a structured discussion about research papers such as the one cited here.]

### **References and Resources:**

1. Coyle E. F. (1991, September). Cardiovascular function during exercise: neural control factors. *Sports Science Exchange*, Vol. 4, p. 34.
2. Gatorade Sports Science Institute, P.O. Box 9005, Chicago, IL 60604

**Suggestion for Assessment:**

I suggest you have students create their own data table and graph. They should then prepare the results of their research in “publishable” form. Have the students turn in a lab report similar to a research journal paper. Background information can come from their text, the paper from Dr. Coyle, and research suggested in where to go from here.

## **The Effects of Various Exercises on the Cardiovascular System**

### **Student Activity Sheet**

#### **Purpose**

To determine the effects of different exercises on the cardiovascular system.

#### **Materials:**

- sphygmomanometer and stethoscope
- stopwatch
- access to steps
- student lab sheet

#### **Procedure:**

1. Make a data table to record time, heart rate, and blood pressure for pushups and the step test.
2. In your lab group assign one person to be the first subject.
3. Find the resting heart rate and blood pressure. Record.
4. Perform Strength Training Test: a) Subject will do 10 pushups. b) Have subject sit and immediately determine heart rate and blood pressure. Record. c) When subject is ready, repeat steps a-b) 5 times. Record the time interval between the stop and start of exercise.
5. Allow the subject to return to resting heart rate and blood pressure values.
6. Perform Endurance Training Step Test: a) The subject will step up and down onto a step, alternating legs for 10 minutes. b) Record heart rate values at 2 minute intervals. c) Have subject sit and immediately determine heart rate and blood pressure. Record.
7. Graph your results, (strength training heart rate vs. time and endurance training heart rate vs. time).
8. Using Graph B from Coyle's paper find the oxygen consumption for each exercise at peak heart rate values.
9. Use your values for predicted oxygen consumption to predict cardiac output and stroke volume for each exercise.
10. Answer conclusion questions provided by your teacher.

#### **Experiment Design:**

1. With your lab members you will now modify the above investigation. If you change certain variables will you get different results? Try different exercises, or different work loads. Change time intervals, or anything which seems interesting to your group.
2. You are performing human performance research. Write your investigation protocol as a human research scientist would. Be very detailed and indicate the effects you believe your changes will have on performance.
3. Present your results in the form of a journal article. Include graphs and a detailed discussion of your procedures and results.