

Heart Rate and Exercise

The adaptability of the heart can be observed during exercise, when the metabolic activity of muscle tissue increases. The cardiovascular system, consisting of the heart and blood vessels, responds to exercise with an increase in heart rate and strength of contraction with each beat, resulting in a higher *cardiac output* (quantity of blood pumped through the heart per unit of time). Physically fit people can deliver a greater volume of blood in a single heartbeat than unfit individuals and can sustain a greater work level before reaching a maximum heart rate. Being more physically fit also leads to a more rapid recovery of resting heart rate.

In this experiment, you will observe how the heart responds to the increased metabolic demand of muscles during exercise.

Important: Do not attempt this experiment if physical exertion will aggravate a health problem. Inform your instructor of any possible health problems that might be exacerbated if you participate in this exercise.

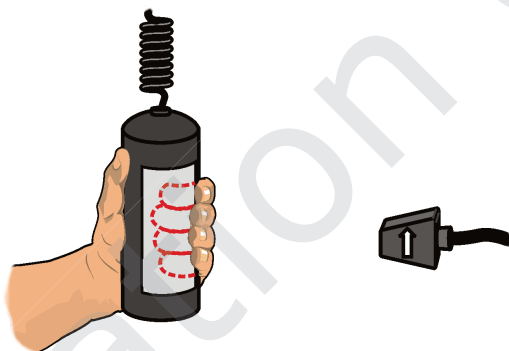


Figure 1

OBJECTIVES

In this experiment, you will

- Determine the effect of exercise on heart rate.
- Correlate the fitness level of individual with amount of daily exercise.

MATERIALS

computer
Vernier computer interface
Logger Pro

Vernier Hand-Grip Heart Rate Monitor **or**
Vernier Exercise Heart Rate Monitor
saline solution in dropper bottle
(only for use with the Exercise HR Monitor)

PROCEDURE

Select one or more persons from your lab group to be the subject(s).

1. Connect the receiver module of the Heart Rate Monitor to the Vernier computer interface.
2. Open the file “04 Heart Rate and Exercise” from the *Human Physiology with Vernier* folder.
3. Set up the Heart Rate Monitor. Follow the directions for your type of Heart Rate Monitor.

Using a Hand-Grip Heart Rate Monitor

- a. The receiver and one of the handles are marked with a white alignment arrow as shown in Figure 2. Locate these two arrows.
- b. Have the subject grasp the handles of the Hand-Grip Heart Rate Monitor so that their fingers are in the reference areas indicated in Figure 3. Hold the handles vertically.
- c. Have someone else hold the receiver near the handles so that the two alignment arrows are pointing in the same direction and are at approximately the same height as shown in Figure 2. **Note:** The receiver must stay within 60 cm of the handles during data collection.



Figure 2



Figure 3

Using an Exercise Heart Rate Monitor

- a. Depending upon your size, select a small or large size elastic strap. Secure one of the plastic ends of the elastic strap to the transmitter belt. It is important that the strap provide a snug fit of the transmitter belt.
- b. Wet each of the electrodes (the two textured oval areas on the underside of the transmitter belt) with 3 drops of saline solution.
- c. Secure the transmitter belt against the skin directly over the base of the rib cage (see Figure 4). The POLAR logo on the front of the belt should be centered. Adjust the elastic strap to ensure a tight fit.
- d. Take the receiver module of the Heart Rate Monitor in your right hand. Remember that the receiver must be within 80 cm of the transmitter in the Heart Rate Monitor belt.

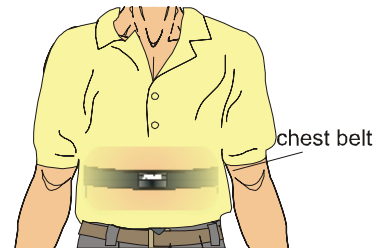



Figure 4

4. Stand quietly facing your table or lab bench.
5. To determine that everything is set up correctly, click **▶ Collect** to begin monitoring heart rate. Note that there may be up to a 30 second delay before data are seen. The readings should be within the normal range of the individual, usually between 55 and 80 beats per minute. Click **■ Stop** when you have determined that the equipment is operating properly, and proceed to Step 6.
6. Click **▶ Collect** to begin data collection. If the baseline appears stable, begin to run in place at 40 s. Continue data collection while running in place for the next 60 s.
7. At approximately 100 s, stop running and stand in place while your heart rate slows toward its resting pre-exercise value. Data will be collected for 200 s.

8. Click and drag over the area of the graph where the resting heart rate is displayed (from 0 to approximately 40 s). This will highlight the region of interest.
9. Click the Statistics button, . Record the mean resting heart rate in Table 1.
10. Drag the right hand bracket to the right edge of the graph, until all the data points are highlighted. The values in the Statistics box will be adjusted based on the data within the brackets. Record the maximum heart rate in Table 1.
11. Move the statistics brackets to highlight the area of the graph beginning with the maximum heart rate and ending with the first data point that matches the initial baseline value (or the last point graphed, if baseline is not achieved). Record the Δx value displayed at the lower left corner of the graph as the recovery time in Table 1.

DATA

Table 1	
Condition	
Resting heart rate (bpm)	
Maximum heart rate (bpm)	
Recovery time (s)	

DATA ANALYSIS

1. Normal resting heart rates range from 55–100 beats per minute. What was the subject's resting heart rate? How much did the subject's heart rate increase above resting rate with exercise? What percent increase was this?
2. How does the subject's maximum heart rate compare with other students in the group or class? Is this what you expected?
3. Recovery time has been shown to correlate with degree of physical fitness. How does the subject's recovery rate compare to that of your classmates? Is this what you expected?

4. Congestive heart failure is a condition in which the strength of contraction with each beat may be significantly reduced. For example, the ventricle may pump only half the usual volume of blood with each beat. Would you expect a person with congestive heart failure to have a faster or slower heart rate at rest? With exercise?

5. Medications are available which can slow the heart or speed it up. If a patient complains of feeling poorly and has a heart rate of 120 beats/min, should you administer a medicine to slow the rate?

EXTENSION

Design an anonymous survey to be taken by each member of your class. In the survey, ask questions that you think might influence the test results (examples might include: gender, age, exercise regimen, coffee drinking within 2 hours of the experiment, and smoking status). Compare and contrast resting heart rates and recovery rates after exercise within and among these groups.

Vernier Lab Safety Instructions Disclaimer

THIS IS AN EVALUATION COPY OF THE VERNIER STUDENT LAB.

This copy does not include:

- Safety information
- Essential instructor background information
- Directions for preparing solutions
- Important tips for successfully doing these labs

The complete *Human Physiology with Vernier* lab manual includes 24 labs and essential teacher information. The full lab book is available for purchase at:

<http://www.vernier.com/cmat/hpa.html>



Vernier Software & Technology

Vernier Software & Technology
13979 S.W. Millikan Way • Beaverton, OR 97005-2886
Toll Free (888) 837-6437 • (503) 277-2299 • FAX (503) 277-2440
info@vernier.com • www.vernier.com