

# 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.

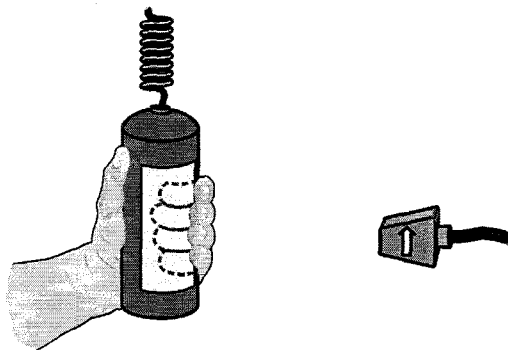


Figure 1

## 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)

## Experiment 4

### 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. Grasp the handles of the Hand-Grip Heart Rate Monitor. Place the fingertips of each hand on the reference areas of the handles (see Figure 1).
- b. The left hand grip and the receiver are both marked with an alignment arrow. When collecting data, be sure that the arrow labels on each of these devices are in alignment (see Figure 2) and that they are not too far apart. The reception range of the plug-in receiver is 80–100 cm, or about 3 feet.

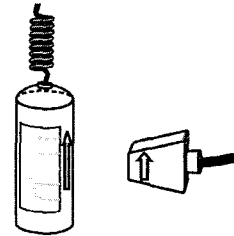


Figure 2

#### 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 3). 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.

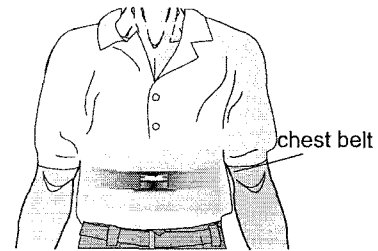



Figure 3

4. Stand quietly facing your table or lab bench.
5. Click  to begin data collection. There will be a 15 s delay while data are collected before the first point is plotted on the upper graph. Thereafter, a point will be plotted every 5 s.
6. Determine that the sensor is functioning correctly. The readings should be consistent and within the normal range of the individual, usually between 55 and 90 beats per minute. If readings are stable, click  and continue to the next step.
7. Click  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.
8. 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.

9. 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.
10. Click the Statistics button, . Record the mean resting heart rate in Table 1.
11. 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.
12. 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  $\Delta x$  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?

### ***Experiment 4***

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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.