Effect of Exercise on Heart Rate

The adaptability of the heart can be observed during exercise, when the metabolic activity of skeletal 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.

OBJECTIVES

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

MATERIALS

Chromebook, computer, **or** mobile device
Graphical Analysis 4 app
Go Wireless Heart Rate **or** Go Wireless Exercise Heart Rate
saline solution in dropper bottle (only necessary for Go Wireless Exercise Heart Rate)

PROCEDURE

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

1. Launch Graphical Analysis. Connect the Go Wireless Heart Rate or Go Wireless Exercise Heart Rate to your Chromebook, computer, or mobile device. **Note**: The sensor will only be seen by the application when it is in contact with the subject's skin.

2. Click or tap Mode to open Data-Collection Settings. Change End collection to 200 s. Click or tap Done.

3. Have the subject stand quietly with the sensor in the correct position (in the hands for Go Wireless Heart Rate or around the chest in contact with the skin for Go Wireless Exercise Heart Rate). Click or tap Collect to start 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.

4. At approximately 100 s, instruct the subject to stop running and stand in place. Data will be collected for a total of 200 s.

5. Determine the maximum heart rate.
   a. Click or tap Graph Tools, , and choose View Statistics.
   b. Record the maximum heart rate in Table 1.
   c. Dismiss the Statistics box.

6. Determine the resting heart rate.
   a. Select 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.
   b. Click or tap Graph Tools, , and choose View Statistics.
   c. Record the mean resting heart rate, to the nearest whole number, in Table 1.
   d. Dismiss the Statistics box.

7. Determine the recovery time.
   a. Examine the region 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).
   b. Determine the recovery time, Δx, by subtracting the initial time for this region from the final time for this region. Record this value in Table 1.

DATA

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

DATA ANALYSIS

1. Typical 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. Certain medications are prescribed by medical professionals to slow a patient's heart or speed it up. If a patient complains of feeling poorly and has a heart rate of 120 beats/min, should a doctor administer a medicine to slow the rate?

EXTENSIONS

1. Design an experiment to test whether duration of exercise affects recovery rate. You might have subjects exercise for 5, 10, or 15 minutes at a time and compare the time it takes for heart rate to return to baseline.

2. 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.