

# Ventilation and Heart Rate

In this experiment, you will investigate the effect of altering the levels of oxygen and carbon dioxide on the rate at which the heart beats. Two different methods of ventilation will be used to investigate this phenomenon. The first method, *hyperventilation*, is when the breathing rate of an organism is greater than what is necessary for proper exchange of oxygen and carbon dioxide. This will be achieved by a period of rapid breathing by the test subject. The second method, *hypoventilation*, occurs when there is a decrease in ventilation without a decrease in oxygen consumption or carbon dioxide production by the body. True hypoventilation is usually the result of a disease. The test subject will simulate this condition by holding his or her breath for a period of time. The test subject's heart rate will be monitored using the Exercise Heart Rate Monitor.

## OBJECTIVES

In this experiment, you will

- Monitor the heart rate of the test subject using the Exercise Heart Rate Monitor.
- Evaluate the effects of hyperventilation and hypoventilation on heart rate.

## MATERIALS

computer  
Vernier computer interface  
LoggerPro

Vernier Exercise Heart Rate Monitor  
saline solution in dropper bottle

## PROCEDURE

Each person in a lab group will take turns being the subject and the tester. When it is your turn to be the subject, your partner will be responsible for recording the data on your lab sheet.

1. Elastic straps, for securing the transmitter belt, come in two different sizes. Select the size of elastic strap that best fits the subject being tested. It is important that the strap provide a snug fit of the transmitter belt.
2. Wet each of the electrodes (the two grooved rectangular areas on the underside of the transmitter belt) with 3 drops of saline solution.
3. Secure the transmitter belt against the skin directly over the base of the rib cage. The POLAR logo on the front of the belt should be in line with the chest center as shown in Figure 1. Adjust the elastic strap to ensure a tight fit.
4. Connect the receiver module of the Exercise Heart Rate Monitor to the Vernier computer interface.
5. Have the subject hold the receiver in his or her right hand as shown in Figure 2. Remember, the receiver must be within 80 cm of the transmitter belt while data is being collected.

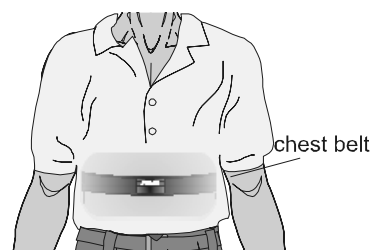


Figure 1

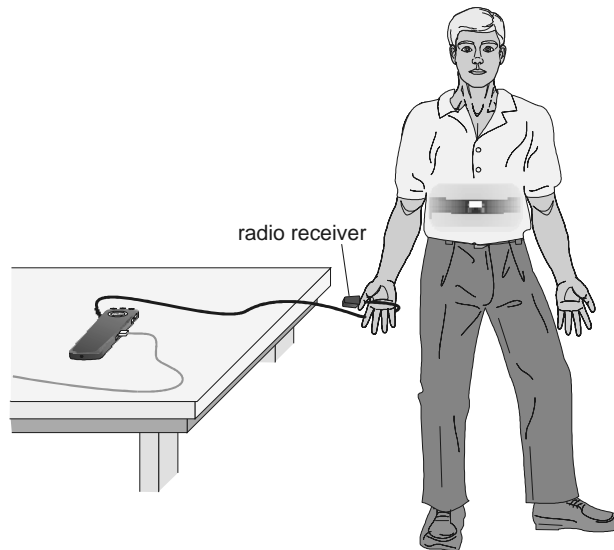


Figure 2

6. Prepare the computer for data collection by opening the file “29 Ventilation Heart Rate” from the *Biology with Vernier* folder of *LoggerPro*.
7. Click  to begin monitoring heart rate.
8. Determine that the sensor is functioning correctly. The readings should be consistent and within the normal range of the individual, usually between 55 and 80 beats per minute. Click  when you have determined that the equipment is operating properly.

#### Part I Hyperventilation

9. Instruct the test subject to breathe normally while sitting still. Click  to begin monitoring heart rate. After collecting data for 60 seconds, have the test subject make rapid shallow breaths for the next 30 seconds. The test subject should breathe normally during the remainder of the data collection. Data collection will stop after 120 seconds.
10. Click the Examine button, , to examine the heart rate values plotted on the graph. Record the test subject’s heart rate in Table 1 for every 10 second interval.
11. Click anywhere on the graph. Type **Hyperventilation** as the title of the graph and then press ENTER.
12. Print a copy of the graph. Enter your name(s) and the number of copies of the graph you want.

#### Part II Hypoventilation (simulated)

13. Click  to begin monitoring heart rate. After collecting data for 60 seconds, have the test subject take a large breath and hold it as long as possible. The test subject should not hold his or her breath longer than 60 seconds. The test subject should breathe normally during the remainder of the data collection after releasing his or her breath. Data collection will stop after 120 seconds.
14. Click the Examine button, , to examine the heart rate values plotted on the graph. Record the test subject’s heart rate in Table 1 for every 10 second interval.

- Click anywhere on the graph. Type “Hypoventilation” as the title of the graph and then press ENTER.
- Print a copy of the graph. Enter your name(s) and the number of copies of the graph you want.

### **PROCESSING THE DATA**

Table 1										
Time (sec)	30	40	50	60	70	80	90	100	110	120
Hyperventilation										
Hypoventilation										

### **QUESTIONS**

- What happens to the heart rate during hyperventilation?
- What happens to the heart rate during hypoventilation?
- List several factors that you think may have caused the test subject’s heart rate to change in each of the trials.
- What happens to the oxygen levels in your lungs during hyperventilation? Carbon dioxide levels?
- In what way would the change in heart rate that corresponds with holding your breath be advantageous in other types of organisms? What organisms might commonly exhibit such an adaptation?

# 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 *Biology with Vernier* lab manual includes 31 labs and essential teacher information. The full lab book is available for purchase at:

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



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