

# 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 a heart rate monitor while breathing patterns are measured using a respiration belt.

## OBJECTIVES

- Monitor the heart rate of the test subject using a heart rate monitor.
- Monitor the breathing pattern of the test subject using a respiration belt.
- Evaluate the effects of hyperventilation and hypoventilation on heart rate.

## MATERIALS

Chromebook, computer, **or** mobile device  
Graphical Analysis 4 app  
Go Direct Respiration Belt  
Go Wireless Hand-Grip Heart Rate **or** Go Wireless Exercise Heart Rate  
saline solution in dropper bottle (only for use with Go Wireless Exercise Heart Rate)

## PROCEDURE

1. Launch Graphical Analysis. Connect Go Direct Respiration Belt to your Chromebook, computer, or mobile device.
2. Select a member of your lab group as the test subject. Place the respiration belt around the subject's chest just below the sternum.
3. Tighten the belt until the tension indicator light, located in the bottom-left corner of the sensor label, just below the check mark, turns green. **Note:** If the light is not on, tighten the strap until the light turns green. Loosen the strap if the light turns red; a red light indicates too much tension.
4. Connect your 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.
5. Click or tap Mode to open Data Collection Settings. Change End Collection to 120 s. Click or tap Done.

### **Part I Hyperventilation**

6. Instruct the subject to sit still in a chair and breathe normally. The heart rate sensor should be in the correct position for data collection (in the hands for Go Wireless Heart Rate or around the chest in contact with the skin for Go Wireless Exercise Heart Rate). The subject should be sitting and facing away from the device screen.
7. Click or tap Collect to start data collection.
8. After collecting data for 60 seconds, have the subject make rapid shallow breaths for the next 30 seconds. The test subject should breathe normally during the remainder of the data-collection period. Data collection will stop after 120 seconds.
9. Click or tap the graph to examine the data. Record the heart rate and respiration rate in Table 1 for every 10-second interval. **Note:** You can also adjust the Examine line by dragging the line.

### **Part II Hypoventilation (simulated)**

10. Instruct the subject to sit still in a chair and breathe normally. Check that the sensors are in the correct positions and start data collection.
11. After collecting data for 60 seconds, have the subject take a large breath and hold it as long as possible. The 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 period after releasing his or her breath. Data collection will stop after 120 seconds.
12. Click or tap the graph to examine the data. Record the heart rate and respiration rate in Table 1 for every 10 second interval.
13. To display both data sets on a single graph, click or tap the y-axis label and select the data sets you want to display. Dismiss the box to view the graph.

**DATA**

**Note:** In the software, the unit "bpm" stands for both beats per minute (heart rate) and breaths per minute (respiration rate), depending on which sensor is connected.

Table 1				
Time (s)	Hyperventilation		Hypoventilation	
	Heart rate (bpm)	Respiration rate (breaths/min)	Heart rate (bpm)	Respiration rate (breaths/min)
10				
20				
30				
40				
50				
60				
70				
80				
90				
100				
110				
120				

**QUESTIONS**

1. What happens to the heart rate during hyperventilation? What happens during the recovery period?
2. What happens to the heart rate during hypoventilation? What happens during the recovery period?
3. List several factors that you think may have caused the test subject's heart rate to change in each of the trials.
4. What happens to the oxygen levels in your blood during hyperventilation? Carbon dioxide levels?
5. 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?

