

Respiration and Ventilation

Your respiratory system allows you to obtain oxygen, eliminate carbon dioxide, and regulate the blood's pH level. Ventilation refers to the movement of air between the lungs and the environment. The process of taking in air is known as *inspiration*, while the process of blowing out air is called *expiration*. A respiratory cycle consists of one inspiration and one expiration.

The rate at which your body performs a respiratory cycle is dependent upon the levels of oxygen and carbon dioxide in your blood, although the control of respiratory patterns by the brain is complex. The respiratory centers in the brain stem receive input from a variety of sources, including mechanoreceptors, chemoreceptors, the hypothalamus and the cerebral cortex. The respiratory centers can alter breathing to change both depth and rate of ventilation. While basic respiratory patterns fall under control of the autonomic nervous system (especially while sleeping), they can be overridden by cerebral cortex to allow activities such as speaking, singing, or playing a wind instrument.

You will learn how to use a respiration belt to monitor the respiratory patterns of one member of your group under different conditions. A respiration belt will be strapped around the test subject. Each respiratory cycle will be recorded, allowing you to calculate a respiratory rate for comparison at different conditions.

OBJECTIVES

- Use a respiration belt to monitor the respiratory rate of an individual.
- Evaluate the effect of holding of breath on the respiratory cycle.
- Evaluate the effect of rebreathing of air on the respiratory cycle.

MATERIALS

Chromebook, computer, **or** mobile device
Graphical Analysis 4 app
Go Direct Respiration Belt
small paper bag

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.

Experiment 10


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. Have the test subject sit upright in a chair and breath normally. The test subject should be sitting and facing away from the device screen.

Part I Holding of breath

5. Click or tap Collect to start data collection.
6. When data have been collected for 60 seconds, have the test subject hold his or her breath for 30 to 45 seconds. Once the breath has been released, the test subject should breathe normally for the remainder of the data-collection period.
7. Click or tap the graph to examine the data. **Note:** You can also adjust the Examine line by dragging the line.
8. Determine the respiration rate before and after the subject's breath was held. Record the values in Table 1.

Part II Rebreathing of air

Important: Anyone prone to dizziness or nausea should not be tested in this section of the experiment. If the test subject experiences dizziness, nausea, or a headache during data collection, testing should be stopped immediately.

9. Have the test subject cover his or her mouth with a small paper bag, tight enough to create an air-tight seal. The test subject should breathe normally into the bag throughout the course of the data collection process.
10. Click or tap Collect to start data collection. Again, the test subject should be sitting and facing away from the screen.
11. Collect respiration data for the full 300 seconds while the subject is breathing into the sack.
12. Once you have finished collecting data, calculate the maximum height of the respiration waveforms for the several time intervals.
 - a. Select the data from 0 to 30 seconds.
 - b. Click or tap Graph Tools, , and choose View Statistics.
 - c. Subtract the minimum force from the maximum force to calculate the amplitude. Record this value in Table 2.
 - d. Dismiss the Statistics box.
 - e. Repeat this process for two other time intervals: 120 to 150 seconds and 240 to 270 seconds.

DATA

Table 1: Holding of Breath	
	Rate (breaths/minute)
Before holding breath	
After holding breath	

Table 2: Rebreathing of Air	
Time interval (s)	Amplitudes of respiration waves (N)
0 to 30	
120 to 150	
240 to 270	

QUESTIONS

1. Did the respiratory rate of the test subject change after holding they stopped holding their breath? If so, describe how it changed.
2. What is different about the size (amplitude) or shape (frequency) of the respiratory waveforms following the release of the test subject's breath? Explain.
3. What would be the significance of an increase in the amplitude and frequency of the waveform while the test subject was breathing into the bag?
4. How did the respiratory waveforms change while the test subject was breathing into the bag? How would you interpret this result?
5. Explain how you think carbon dioxide affects your respiration rate.

