

## **Extension 8.3.1/8.3.2**

# **Lab: Exercise & Cellular Respiration**

**Purpose:** The purpose of this lab activity is to analyze the effect of exercise on cellular respiration.

**Background:** You will measure 3 different indicators of cellular respiration: breathing rate, heart rate, and carbon dioxide production. You will measure these indicators at rest (with no exercise) and after 1 and 2 minutes of exercise. Breathing rate is measured in breaths per minute, heart rate in beats per minute, and carbon dioxide in the time it takes bromthymol blue to change color.



Carbon dioxide production can be measured by breathing through a straw into a solution of bromthymol blue (BTB). BTB is an acid indicator; *when it reacts with acid it turns from blue to green/yellow*. When carbon dioxide reacts with water, a weak acid (carbonic acid) is formed. The more carbon dioxide you breathe into the BTB solution, the faster it will change color to green/yellow.

**Materials:** graduated cylinder, beaker, straw, stopwatch, bromothymol blue solution

### **Procedures:**

#### **Resting (before exercise)**

##### *Measuring Carbon Dioxide Production:*

1. Use a graduated cylinder to measure out 20 mL bromthymol blue solution into a beaker.
2. Using a straw, exhale into the BTB solution. (CAUTION: Do not inhale the solution!)
3. Time how long it takes for the blue solution to turn green/yellow. Record the time in the data table.
4. Wash out the beaker.

##### *Measuring Breathing Rate:*

1. Count the number of breaths (1 breath = inhale + exhale) you take in 1 minute. Record this in the data table.

##### *Measuring Heart Rate:*

1. Have your partner help take your pulse.
2. Count the number of beats in 30 seconds and multiply that number by 2. Record this in the data table.

#### **Increased Muscle Activity (Exercise)**

1. Repeat the above procedures after one minute of exercise, then repeat after 2 minutes of exercise.
2. Repeat this entire procedure for your lab partner.

Data:

**Student # 1:** \_\_\_\_\_

	<b>CO<sub>2</sub> Production</b> (time it takes BTB to change color)	<b>Breathing Rate</b> (Breaths/minute)	<b>Heart Rate</b> (pulse)
Before Exercise			
After 1 min. of exercise			
After 2 min. of exercise			

**Student #2:** \_\_\_\_\_

	<b>CO<sub>2</sub> Production</b> (time it takes BTB to change color)	<b>Breathing Rate</b> (Breaths/minute)	<b>Heart Rate</b> (pulse)
Before Exercise			
After 1 min. of exercise			
After 2 min. of exercise			

**Analysis & Conclusions:** Answer the questions below using your *BACKGROUND* information in the lab, as well as your lab data. ANSWER THE QUESTIONS IN COMPLETE SENTENCES

1. What is the equation for cellular respiration?
2. How did exercise affect the time needed for the solution to change color?
3. Explain why the color change occurred (How does BTB work?)
4. What can you conclude about the effect of exercise on the amount of carbon dioxide that is present in your exhaled breath? Why is this so?
5. What can you conclude about the effect of exercise on breathing rate? Why is this so?
6. What can you conclude about the effect of exercise on heart rate? Why is this so?
7. What do your muscles need during exercise that the blood brings?