The Effects of Exercise on Cellular Respiration

Class Copy

**Background Information**: Bromothymol blue is a chemical indicator that changes color as the pH of a solution changes. It is yellow in acidic solutions and blue in basic and neutral solutions. When carbon dioxide (CO2) is dissolved in water, it creates carbonic acid (H2CO3) with a pH of about 5.7. This reaction occurs as rainwater absorbs carbon dioxide. One of the products of Cellular Respiration is carbon dioxide. As cells produce CO2 in cellular respiration, it is carried by our blood cells to our lungs where it is exhaled. You can measure the rate your cells carry out cellular respiration by measuring how quickly you produce carbon dioxide. You will first determine your resting rate or cellular respiration, and then you will determine your rate after exercise.

6 CO2 + 6 H2O 🡪 6 H2CO3  + 6 H+

**PreLab Questions**:

1. How is breathing related to cellular respiration?

2. How will exercise affect the rate of cellular respiration?

3. How can bromothymol blue pH help you measure your rate of cellular respiration?

**Materials**:

Stopwatch drinking straw bromothymol blue solution beaker graduated cylinder SAFETY GOGGLES

**Procedure**:

1. Fill the beaker with 40 mL water and 10 mL bromothymol blue solution.

2. Assign one person to be the timer and one person to perform the experiment.

3. When the timer says, “START,” the experimenter will exhale through the straw into the bromothymol blue solution until the color changes from blue (basic) to green (more acidic). **Do not inhale the solution! Exhale from your lungs!**

4. Your partner will stop the time as soon as the color changes.

5. Record the time it took for the color change in the observation table below. This is the control group.

6. Rinse out the beaker and refill with 40 mL water and 10 mL bromothymol blue solution.

7. Now have the experimenter do jumping jacks or a similar exercise for **1** minute. You should feel a little winded when you are finished!

8. Using the same straw, exhale into the solution the same way as in the control and record how long it takes for the solution to change color.

Table 1. THE EFFECT OF EXERCISE ON THE RATE OF CELLULAR RESPIRATION

|  |  |
| --- | --- |
| Time spent exercising (seconds) | Time it takes for color to change (seconds) |
| 0 |  |
| 30 |  |
| 60 |  |
| 90 |  |

**Analyze and Apply**: (Answer #2 – 5 in complete sentences).

1. Make a graph of your results. Carefully decide which variables belong on the X axis and Y axis. **Remember to label the X and Y axes and provide a title that relates the 2.**

2. Compare the time it took the bromothymol blue solution to change color before exercise and after exercise. Explain why there was a difference.

3. Using your graph, predict the time it would take the color to change if the experimenter exercised for 2 minutes.

4. In this investigation, we measured the amount of carbon dioxide produced to find the rate of cellular respiration. What else could we measure to find out the rate of respiration?

5. Explain why it is so important to exhale completely when doing exercise.

6. What chemical equation explains how you produce CO2?

7. In what organelle is this activity happening?