**The Effects of Exercise on Cellular Respiration**

**QUESTION: How does exercise affect cellular respiration?**

**BACKGROUND INFORMATION**

Bromothymol blue, BTB, is an indicator of CO2—it turns yellow when CO2 is added to it. It starts out a green color; it turns blue when there is no CO2 and turns yellow when CO2 is added. When carbon dioxide is dissolved in water, it creates carbonic acid (pH~5.7). 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.** The more carbon dioxide you breathe into the BTB solution, the faster it will change color to yellow. You will first figure out your resting rate of cellular respiration, and then you will figure out your rate after exercise.

**PreLab Questions:**

1. What is the equation for cellular respiration? Label which items are the reactants (ingredients) and the products (what is made).

2. In what part of the cell does cellular respiration happen? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Write a hypothesis of how exercise will affect your body’s production of carbon dioxide (do you think your body will produce more or less carbon dioxide as you exercise). Make sure you EXPLAIN WHY you feel that way.

**If I exercise more, then my body will produce \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_CO2**.

 ***write "more or less"***

Why do you think this? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Materials:**

150 mL beaker

Bromothymol blue (BTB)

2 straws

Clock with second hand

beaker shield

**Control:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Independent Variable:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Dependent Variable: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**PROCEDURE**

1. Measure 40 mL of water in the small beaker.

2. With the eyedropper, put 10 drops of Bromothymol blue (BTB) into the beaker and stir with your

 straw. The solution will be green.

3. Place the cardboard shield on top and insert your straw through the hole—into the beaker.

4. You will take turns: one person will be the timer, and one person will perform the experiment.

5. When the timer says “START”, one person will exhale-**BLOW OUT** through the straw

 into the Bromothymol blue (BTB) solution until the color changes from green to YELLOW.

***Do NOT inhale the solution! Exhale—BLOW OUT from your lungs!***

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

7. Record the time it took for the color change in the observation table below.

 This is the control group.

8. Rinse out the beaker, and refill with 40 mL water and 10 drops of Bromothymol blue solution.

9. Now have the same person do jumping jacks or run fast in place for ONE (1) minute.

 You should feel a little tired when you are finished!

10. Using the **same** straw, exhale-**BLOW OUT**- into the solution the same way as in the control group.

***Do NOT inhale the solution! Exhale—BLOW OUT from your lungs!***

 Write down the time it took for the color to change to yellow in the observation table below.

11. Repeat the procedures above for your partner—using a **NEW** straw.

***Do NOT inhale the solution! Exhale—BLOW OUT from your lungs!***

**OBSERVATION TABLE**

**The effect of exercise on the rate of cellular respiration**

|  |  |  |  |
| --- | --- | --- | --- |
| **Time-length of activity** |  **Time for color change (seconds)** | **Time-length of activity for your PARTNER** | **Time for color change (seconds) for your PARTNER** |
| 0 minutes of exercise |  | 0 minutes of exercise |  |
| 1 minute of exercise |  | 1 minute of exercise |  |

1. Did you accept or reject your hypothesis? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. How did exercise affect the time needed for the BTB solution to **change to a yellow color**?

Time before exercise\_\_\_\_\_\_\_Time after exercise\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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3. Explain how the BTB works and why the color changed when you blew into the beaker of solution. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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4. What can you conclude about the effect of exercise on the amount of carbon dioxide that is present in your exhaled breath?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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5. Predict the time of a color change if you did exercise for 2 minutes. 3 minutes.

 \_\_\_\_\_\_\_ \_\_\_\_\_\_\_

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

(Think—What are the other reactants and products of cellular respiration?)

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

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8. Were there differences between you and your partner’s respiration times?\_\_\_\_\_\_\_\_\_

Explain possible reasons for this difference. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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