Name: _____

Partner(s): _____

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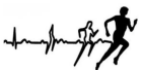

Monday, November 27th, 2017
ST 306-08
Centennial Regional High School

THE EFFECT OF EXERCISE ON CELLULAR RESPIRATION LAB

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

Hypothesis: From this purpose, form a hypothesis:

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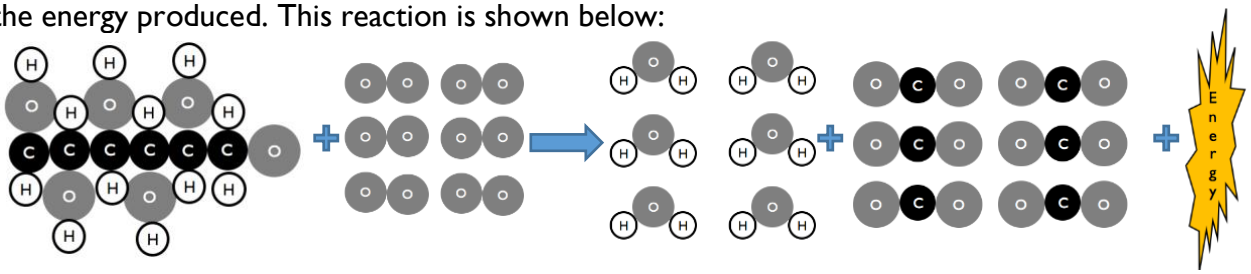
Lab Theory: The mitochondria in your cells burn glucose ($C_6H_{12}O_6$) in the presence of oxygen (O_2) to produce energy that is stored within the chemical bonds of a complicated molecule called **adenosine triphosphate (ATP)**. It also produces two waste products: carbon dioxide (CO_2) and water (H_2O).

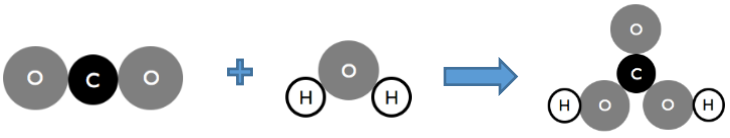
This chemical reaction is called **cellular respiration**. Each molecule of glucose requires 6 oxygen molecules to react. The result is 6 carbon dioxide molecules and 6 water molecules, in addition to the energy produced. This reaction is shown below:



$C_6H_{12}O_6$ (glucose) + 6 O_2 (oxygen) ⟶ 6 H_2O (water) + 6 CO_2 (carbon dioxide) + Energy

The glucose comes from the food you eat, and the oxygen is from the air you breathe. It comes into the body at the lungs and travels to your cells' mitochondria via the blood stream. The waste products are put back into the blood stream, brought back to the lungs, and exhaled.

When the carbon dioxide produced during cellular respiration reacts with water in your blood, it produces a new substance called **carbonic acid (H_2CO_3)** according to the following chemical reaction:



CO_2 (carbon dioxide) + H_2O (water) ⟶ H_2CO_3 (carbonic acid)

When you are exhaling, you are emitting CO_2, which will react with H_2O to form H_2CO_3. Because this process is invisible, we will use a special indicator called **bromothymol blue**. This solution changes colour depending on whether it's an acid, base, or neutral.

- Bromothymol blue is _____ in colour in the presence of a **base**.
- Bromothymol blue is _____ in colour in the presence of a **neutral substance**.
- Bromothymol blue is _____ in colour in the presence of an **acid**.

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The more CO_2 you breathe into the bromothymol blue, the more acidic the solution becomes, and it will change to yellow faster.

In this lab, you will time how long it will take for the solution to change colour with you breathing, and then see if exercise has an effect on this timing.

Procedure: To verify the effect that exercise has on cellular respiration, you will measure the extent of cellular respiration in 3 ways:

- Counting the number of breaths you take in a minute, before and after exercising.
- Counting how many times your heart beats in a minute, before and after exercising.
- Timing how long it takes a bromothymol blue solution to change colours, before and after exercising.

Part 1 – Breathing Rate (measured in breaths per minute)

1. Count how many breaths you take in one minute (a single breath involves inhaling and exhaling). Record the number of breaths in Table 1, for yourself and your partner(s). This will be trial 1.
2. Repeat this step 2 more times, for yourself and your partners, and record the number of breaths in Table 1. These are trials 2 and 3.
3. Calculate the average number of breaths for you and your partner(s). This will be each of your average breathing rates before exercising.
4. Exercise vigourously for exactly one minute.
5. As soon as you stop exercising, immediately begin counting the number of breaths in one minute. You will only do one trial of this. Record the values in Table 1.
6. Repeat the previous two steps, but this time after exercising for 2 minutes. Record your results in Table 1.

Table 1 – ***Number of breaths per minute, before and after exercise***

		Student 1: _____	**Student 2:** _____	**Student 3:** _____
Breathing at rest	Trial 1			
	Trial 2			
	Trial 3			
	Average			
Breathing after exercise	1 minute exercise			
	2 minutes exercise			

Part 2 – Heart Rate (measured in beats per minute).

1. Count how many times your heart beats in 30 seconds, while resting. Multiply this value by 2 to obtain the number of beats per minute. Record this number in Table 2, for yourself and your partner(s). This will be trial 1.
2. Repeat this step 2 more times, for yourself and your partner(s) and record the number of beats per minute in Table 2. These are trials 2 and 3.
3. Calculate the average number of beats per minute for yourself and your partner(s). Record the values in Table 2.
4. Exercise vigourously for one minute.
5. As soon as you are done exercising, immediately count how many times your heart beats in one minute. Record this value for you and your partner(s) in Table 2.
6. Repeat the previous two steps, but this time after exercising for 2 minutes. Record your values in Table 2.

Tip :

You can feel your pulse (heartbeat) by placing two fingers on the side of your neck or the inside of your wrist.

Table 2 – *Number of heartbeats per minute, before and after exercise*

		Student 1: _____	**Student 2:** _____	**Student 3:** _____
Breathing at rest	Trial 1			
	Trial 2			
	Trial 3			
	Average			
Breathing after exercise	1 minute exercise			
	2 minutes exercise			

Part 3 – Carbon Dioxide Production (measured in seconds required for colour change)

1. Using a straw, blow gently into a test tube with bromothymol blue solution.
2. Time how long it takes for the solution to turn yellow in colour. Record this amount of time in Table 3. We will only do one trial of this portion of the experiment. Repeat this for your partner(s).
3. Exercise vigourously for 1 minute.
4. Using the same straw, repeat steps 1 and 2 with a new test tube, for yourself and your partner(s). Record your values in Table 3.
5. Exercise vigourously for 2 minutes.
6. Using the same straw, repeat steps 1 and 2 with a new test tube, for yourself and your partner(s). Record your values in Table 3.

Table 3 – *CO_2 production according to amount of time required for colour change*

		Student 1: _____	**Student 2:** _____	**Student 3:** _____
Breathing at rest	Single trial			
Breathing after exercise	1 minute exercise			
	2 minutes exercise			

Conclusion: Write a sentence summarizing your results. Do your results confirm your hypothesis? Why or why not?

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Follow-up: Of the three tests you performed, which is the most reliable at determining the effect of exercise on cellular respiration? Explain why.

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Whether or not you were successful at confirming your hypothesis, suggest at least **two sources of error** that may have influenced your results.

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Fill in the following blanks:

Cellular respiration occurs when _____ from our food and _____ from respiration undergo a chemical reaction, emitting _____ and _____ as waste products.

This chemical reaction occurs in the _____ of our cells, and also produces energy that is stored in the chemical bonds of a molecule called _____.

When the waste products combine, it forms _____. We can test for this acid using an indicator called _____.

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