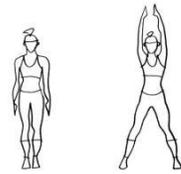


Name: _____ Per: _____ Date: _____

Exercise & Cellular Respiration (A)

/35



Background:

Cellular respiration is a chemical reaction that occurs in your cells to create energy; when you are exercising your muscles, cells are creating ATP (energy currency of the cell) to contract. Cellular respiration requires oxygen (which is breathed in) and creates carbon dioxide (which is breathed out).

The purpose of this lab will address how exercise (increased muscle activity) affects the rate of cellular respiration in three ways: heart rate, breathing rate and carbon dioxide production. Carbon dioxide production can be measured by breathing through a straw into a solution of bromothymol blue (BTB). BTB is an acid indicator; when it reacts with acid it turns from blue to 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 yellow.

Safety:

Goggles must be worn for Bromothymol Blue portion of experiment.

Respiration PRE-LAB

Write out the formula for Cellular Respiration (Check with partner, then table, then notes).

QUESTION	Response (from reading above or previous work)
1. What reactants and/or storage molecules are needed for cellular respiration to occur?	
2. What factors could affect the rate of cellular respiration?	
3. What is produced in cellular respiration?	
4. How could rate of cellular respiration be measured directly and indirectly?	

Investigate **how exercise could affect cellular respiration rate.**

These are your supplies:

- 250 mL Erlenmeyer flask to hold BTB solution
- Straw with cut-out hole to exhale into the BTB solution
- BTB (0.04% Bromthymol Blue Solution – a non-toxic acid/base indicator)
- Graduated Cylinder to



Experimental Design:

Independent Variable (what the scientist varies between experimental groups)

Dependent Variables (what the scientist measures, counts, or weighs in response to the IV)

Constants (List at least three – conditions kept constant in every trial)

Control Group (group with the absence of the experimental variable ~ used to compare)

Prediction:

What do you think will happen in the experiment? _____

Results: 15 pts

Table 1: Carbon Dioxide Production

Time for BTB Solution to change color (in seconds) at rest and post Exercise		
<u>Resting</u>	Student Data	Class Data (average)
<u>Exercise: 1 Minute</u>		
<u>Exercise: 2 Minutes</u>		

Table 2: Breathing Rate

Breathing rate (in breaths per minute) at rest and post Exercise		
<u>Resting</u>	Student Data	Class Data (average)
<u>Exercise: 1 Minute</u>		
<u>Exercise: 2 Minutes</u>		

Table 3: Heart Rate

Heart Rate (in beats per minute) at rest and post Exercise		
Resting	Student Data	Class Data (average)
<u>Exercise: 1 Minute</u>		
<u>Exercise: 2 Minutes</u>		

Analysis & Conclusions: 20 pts

1. How did exercise affect the time needed for the solution to change color? Support with data. 4 pts

2. Explain why the color change occurred. Use the background information for assistance. 3 pts

3. What can you conclude about the effect of exercise on breathing rate and heart rate? Support statements with data. 6 pts

4. How did your group's data compare with the class average? Why is this comparison important? 3 pts

5. What validity issues may have occurred in the experiment (List at least three)? How might these errors have impacted results? 4 pts

Errors in procedure	Impact on Results

6. How might the data differ in a marathon vs. a sprinter athlete? Consider target heart rates.

Procedure: PART A - RESTING (NO EXERCISE)

Measuring Carbon Dioxide Production:

1. Use a graduated cylinder to measure out 20 mL of tap water and pour it into a small beaker.
2. Use a dropper to add 8 drops of 0.04% bromothymol blue to make a BTB solution.
3. Put stopwatch on. Using a straw, exhale a lung-full of air into the BTB solution. Remove lips from straw, inhale air and exhale into straw again. Repeat until a color change is noticed.

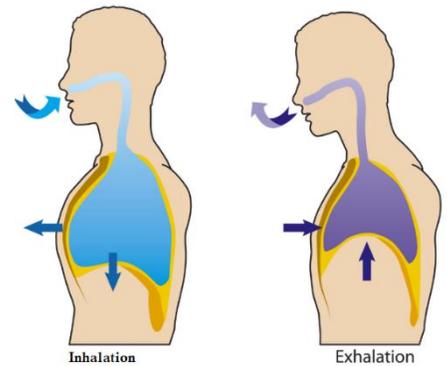


(CAUTION: Do not inhale the solution!)

4. Record how long it takes for the blue solution to turn yellow in seconds. Fill-in the time in Table 1.
5. Wash out the beaker.

Measuring Breathing Rate:

1. Count the number of breaths (1 breath = inhale + exhale) taken in 1 minute.
2. Record this in Table 2.



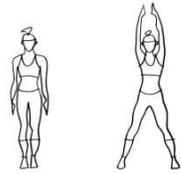
Measuring Heart Rate:

1. Take your pulse by palpating (feeling) an artery at the wrist (Radial Artery) or the neck (Carotid Artery) as seen to the right.
2. Count the number of beats in 30 seconds and multiply that number by two.
3. Record this in Table 3.



Procedure: PART B

EXERCISE ONE MINUTE



1. Use a graduated cylinder to measure out 20 mL of tap water and pour it into a small beaker.
2. Use a dropper to add 8 drops of 0.04% bromothymol blue to make a BTB solution.
3. Exercise for exactly 1 minute by doing jumping jacks.
4. Put stopwatch on. Using a straw, exhale a lung-full of air into the BTB solution. Remove lips from straw, inhale air and exhale into straw again. Repeat until a color change is noticed. (CAUTION: Do not inhale the solution!)
5. Record how long it takes for the blue solution to turn yellow in seconds. Fill-in the time in Table 1.
6. Quickly calculate your breathing and heart rates as you did before. You only need to do this once.
Record these values in Tables 2 & 3.
7. Rest for 5 minutes.

EXERCISE TWO MINUTES

8. Use a graduated cylinder to measure out 20 mL of tap water and pour it into a small beaker.
9. Use a dropper to add 8 drops of 0.04% bromothymol blue to make a BTB solution.
10. Exercise for exactly 2 minutes by doing jumping jacks.
11. Put stopwatch on. Using a straw, exhale a lung-full of air into the BTB solution. Remove lips from straw, inhale air and exhale into straw again. Repeat until a color change is noticed. (CAUTION: Do not inhale the solution!)
12. Record how long it takes for the blue solution to turn yellow in seconds. Fill-in the time in Table 1.
13. Quickly calculate your breathing and heart rates as you did before. You only need to do this once.
Record these values in Tables 2 & 3.