Name: Per: Date:

# Exercise & Cellular Respiration (H) /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).

**Safety:**

Goggles must be worn for Bromothymol Blue portion of experiment.

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.

## Respiration PRE-LAB

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

Glucose is gotten from what storage areas in the body (2): _____ & _____

The importance of oxygen is that it serves as the _____ _____ _____

The function of oxygen in cellular respiration results in the production of the byproduct _____

| 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 in mammals? | |
| 3. What is produced in cellular respiration? Which products are kept by the organism, and which are byproducts and removed or released? | |
| 4. I what ways 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)

_____

**Purpose of the experiment:** _____

_____

_____

**Prediction** *(remember to write in the proper format…):*
What do you think will happen in the experiment? _____

_____

_____

Results: 15 pts

**Table 1: <u>Carbon Dioxide Production</u>**

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

## Table 2: Breathing Rate

| Breathing rate (in breaths per minute) at rest and post Exercise | | |
|---|---|---|
| Resting | Student Data | Class Data (average) |
| | | |
| | | |
| Exercise: 1 Minute | | |
| Exercise: 2 Minutes | | |

## Table 3: Heart Rate

| Heart Rate (in beats per minute) at rest and post Exercise | | |
|---|---|---|
| Resting | Student Data | Class Data (average) |
| | | |
| | | |
| Exercise: 1 Minute | | |
| Exercise: 2 Minutes | | |

**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 (how the data was gathered)* | Impact on Results *(how would they alter your data, up/down?)* |
|---|---|
| | |
| | |
| | |

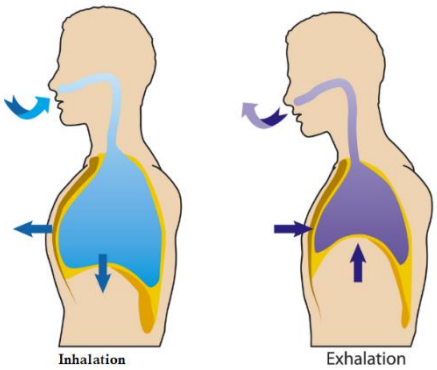
6. How might the data differ in a marathon vs. a sprinter athlete? Consider the following in your response and why their levels would be at the level you mention: target heart rates, muscle types and their ATP requirements (ie. glycolytic vs. aerobic muscles), $CO_2$ production, and breathing rate.

7. In 3 to five sentences, make a final statement about how this activity helped you see cellular respiration more clearly in mammals. Conversely, is there anything in this process you are still unsure about (be honest!)?

# 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.