Biology: Unit 2

Name: _____ Date: _____ Period: _____

Cellular Respiration: Energy in Exercise

Purpose:

1. Explain how exercise affects the rate of cellular respiration by measuring the time it takes for the Bromothymol blue solution (BTB) to turn green.
2. Analyze data collected to form logical conclusions and predictions about the rate of exercise and energy production.

Background:

While performing various activities, muscles in your body contract. Muscle contraction requires energy, which is obtained through the process of cellular respiration. Carbon dioxide is produced as a waste product and by diffusion enters the bloodstream and moves to the lungs where it is exhaled. As there is an increase in muscular activity, such as running, increased demand is placed on the muscles and more energy (ATP) is required in order to maintain that activity level. This means that there is also a corresponding increase in the amount of carbon dioxide (CO_2) produced and exhaled. For the first 15 minutes of prolonged activity, your body uses energy stored in glycogen. Glycogen is a complex carbohydrate that can be broken down into glucose, a simple carbohydrate. Glucose is broken down through glycolysis, the first step in cellular respiration. After using the available glycogen, the body begins to burn energy stored as fat. This is one reason why aerobic exercise is so beneficial to weight control – it helps you burn the fat!

Materials:

- 3 Test Tubes
- Bromothymol blue solution (BTB)
- Straws
- Stopwatch
- Graduated cylinder

Pre-Lab Questions:

Use your background information and your cellular respiration packet to answer the following questions.

1. What is the equation for cellular respiration?

   In symbols: _____ $\longrightarrow$ _____

   In words: _____ $\longrightarrow$ _____

2. Which cell organelle is responsible for the process of cellular respiration? _____
3. Which body tissue is likely to have a high concentration (amount) of this organelle? Explain your answer.

   _____

   _____
4. What are the three steps of cellular respiration in sequence?

   1. _____ 2. _____ 3. _____
5. In a complete sentence, explain in terms of the amount of ATP produced, why our body utilizes cellular respiration as the duration of exercise increases as opposed to only glycolysis.

   _____

Set up Procedure:

1. Label the test tubes (1) Control (2) Resting (3) Exercise
2. Use a graduated cylinder to place 15mL of water into each test tube.
3. Add 5 drops of Bromothymol Blue (BTB) into each beaker. Swirl to mix solution.

NOTE Carbon Dioxide causes Bromothymol Blue to turn Green!***

Part 1: Your partner should time you on the stopwatch for the following steps:

1. When your partner says "GO", SLOWLY exhale through the straw into the solution.
   ***CAUTION* DO NOT INHALE THROUGH THE STRAW!!!!!!!!! TURN YOUR HEAD AWAY FOR EACH BREATH. COVER THE TEST TUBE WITH YOUR HAND TO PREVENT SPLASHING.**
2. When your solution turns completely green, your partner should say "STOP".
3. Record how long it took for the *BTB to change from blue → green*. Write your results in the tables.
4. Switch roles and record your partner's time. Each person should have both of your data recorded on the table.
5. Repeat Steps 1-4. Add your data to the board when complete.

Part 2: Exercise—partner is responsible for time.

1. Do the selected exercise for 1 minute. Be mindful of people around you please!
2. Immediately after you finish, (and when your partner says "GO"), exhale through the straw into the solution.
   ***CAUTION* DO NOT INHALE THROUGH THE STRAW!!!!!!!!! TURN YOUR HEAD AWAY FOR EACH BREATH. COVER THE TEST TUBE WITH YOUR HAND TO PREVENT SPLASHING.**
3. Record how long it took for the *BTB to change from blue → green*. Write your results in the tables.
4. Switch roles and record your partner's time. Each person should have both sets of data recorded on the table.
5. Add your data to the board when complete.

Data:

		Student 1	Student 2
Resting	Trial 1		
	Average of Student 1 and 2		
	Class Average		
Exercise	1 minute		
	Average of Student 1 and 2		
	Class Average		

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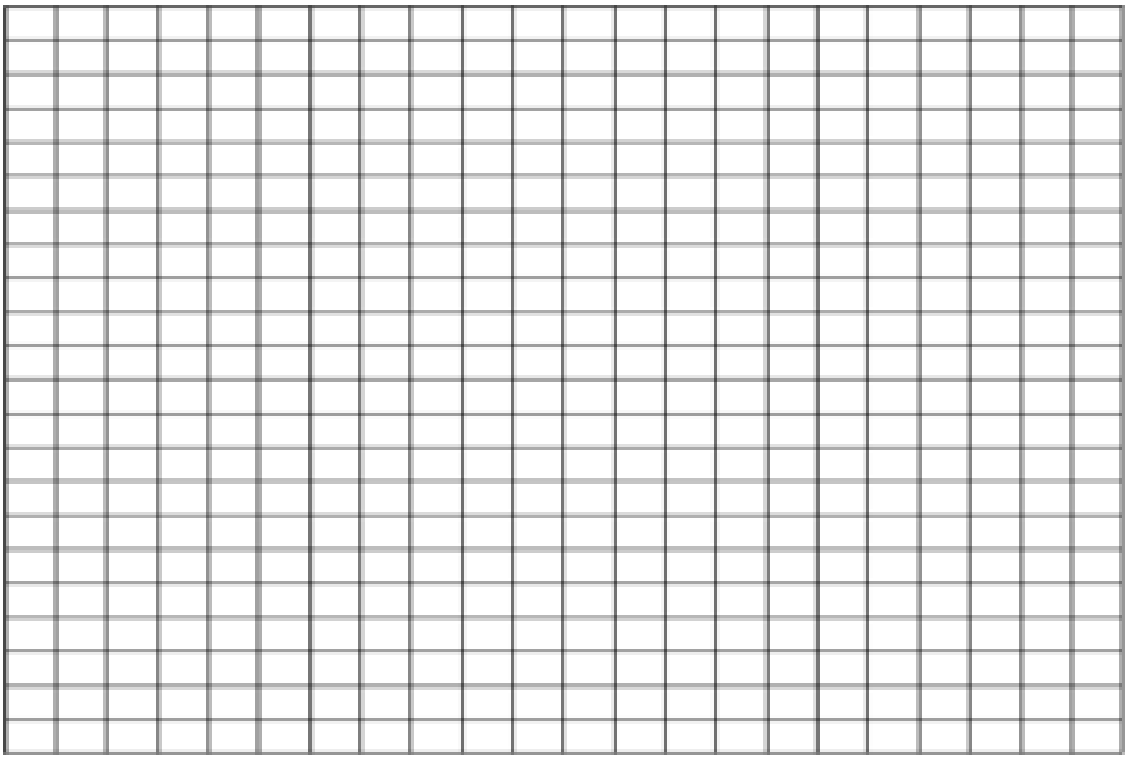
Graph.

Create a double bar graph representing the activity state (rest or exercise) and the time it took for BTB to change. Be sure to make different colored bars for your group and the class. This will also require a legend (key). Remember a title and labels must be included. Use your graphing tip sheet to help you.



Analysis and Conclusion: Answer in complete sentences.

1. What was the relationship between the *exercise* amount, and the *time* it took for the BTB to change color?
   _____
   _____
2. Explain ***why*** the BTB changes color. (How does BTB work?)
   _____
   _____
3. How could you tell whether ***resting*** or ***exercising*** produced more carbon dioxide in your body? _____
   _____
   _____
4. What can you conclude about the amount of carbon dioxide that is present in your exhaled breath? How does **exercising** affect how much carbon dioxide is in your breath? _____
   _____
5. Predict how we could change BTB back to its original color. (How could we remove the CO_2 that was added?)
   _____
   _____