Name: _____ Period: _____ Date: _____

Exercise, Energy Needs, and the Burning Reaction

Purpose.

- To observe the effects of exercise on production on one of our outputs, carbon dioxide.
- To explore the relationships of carbon dioxide production, breathing rate, and heart rate.

Background Information.

We think a reaction like burning is the way we get energy from our food. In burning, a fuel source made of carbon reacts with oxygen to produce the lower energy products carbon dioxide and water. As such, it releases a lot of energy.

$$\text{Fuel} + O_2 \rightarrow H_2O + CO_2 + \text{energy}$$

This simple lab will address how increased energy demand during exercise (increased muscle activity) affects the rate of carbon dioxide production. On the flip side of the reaction, you would expect increased demand for oxygen, which enters our body through the lungs and is carried to our muscles by the blood. You will measure 3 different indicators of an increase in the rate of our suspected chemical reaction: breathing rate, heart rate, and carbon dioxide production. The first two are indicators of demand for oxygen. Why? And the last is a direct measure of carbon dioxide production. You will measure these indicators at rest (with no exercise) and after 2 minutes of exercise. Breathing rate is measured in breaths per minute, heart rate in beats per minute, and carbon dioxide in the time it takes the sodium carbonate solution to change color. Carbon dioxide production can be measured by breathing through a straw into a solution of sodium carbonate combined with an indicator dye. (Ask your teacher which dye your class is using.)

Materials:

-Paper cup
-Straw
-Sodium carbonate solution
-Stopwatch/timer

Procedure: PART A: Resting (no exercise)

Measuring Carbon Dioxide Production:

Using a straw, ***exhale*** into the solution. (CAUTION: Do not inhale the solution!)
Record the time in your data table.

Measuring Breathing Rate:

Count the number of breaths (1 breath = inhale + exhale) you take in 1 minute.
Record this in your data table.

Measuring Heart Rate:

1. While you calculate your breathing rate, have your partner take your pulse.
2. Count the number of beats in 30 seconds and multiply that number by 2.
   Record this in your data table

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PART B: Increased Muscle Activity (Exercise)

1. Exercise for exactly 2 minutes by doing jumping jacks.
2. After 2 minutes of exercise, ***immediately*** exhale through the straw into the solution. Time how long it takes for the solution to turn clear. *Record this in your data table.*
   (Note: catching your breath before you start to exhale defeats the purpose).
3. Quickly calculate your breathing and heart rates as you did before. You only need to do this once.
4. *Record this in your data table.*
5. If there is time, get more of the sodium carbonate solution from me and repeat the entire procedure for your lab partner. Record data from 2 OR 3 other subjects in the class to get more data depending on if you partner was able to go or not.

Results:

	Student 1	Student 2
Heart Rate		
Resting		
Two Minutes		
Breathing		
Resting		
Two Minutes		
Time to Change		
Resting		
Two Minutes		

Analysis & Conclusions: Answer the questions below using your BACKGROUND information in the lab, as well as your lab data. ANSWER THE QUESTIONS IN COMPLETE SENTENCES

1. How did exercise affect the time needed for the solution to change color? Explain why the color change occurred
2. What can you conclude about the effect of exercise on the amount of carbon dioxide that is present in your exhaled breath? Why is this so?
3. What can you conclude about the effect of exercise on breathing rate? Why is this so?
4. What can you conclude about the effect of exercise on heart rate? Why is this so? What do your muscles need during exercise that the blood brings?
5. State whether your hypothesis was correct or incorrect and why. In doing so, discuss what you think is going on in the muscles of the body as muscle activity is increased. Address the need to get oxygen to the muscles and get rid of carbon dioxide, as well as how the muscles cells get the energy needed to continue contracting.