CELL RESPIRATION LAB NAME \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In this experiment you will work with seeds that are living but DORMANT. A seed contains an embryo plant and a food supply surrounded by a seed coat. When the necessary conditions are met, germination occurs, and the rate of cellular respiration greatly increases. In this lab you will measure oxygen consumption during germination by measuring the change in gas volume in respirometers containing either germinating or non-germinating pea seeds at two different temperatures.

CELLULAR RESPIRATION is the release of energy from organic compounds by metabolic chemical oxidation in the mitochondria within each cell. Cellular respiration involves a series of enzyme-mediated reactions. The equation below shows the complete oxidation of glucose. Oxygen is required for this energy-releasing process to occur.  
  
 C6H12O6 + 6 O2 → 6CO2 + 6 H2O + 686 kilocalories of energy/mole of glucose oxidized

The equation above shows there are three ways cellular respiration could be measured:  
 1. Consumption of O2  
 2. Production of CO2  
 3. Release of energy

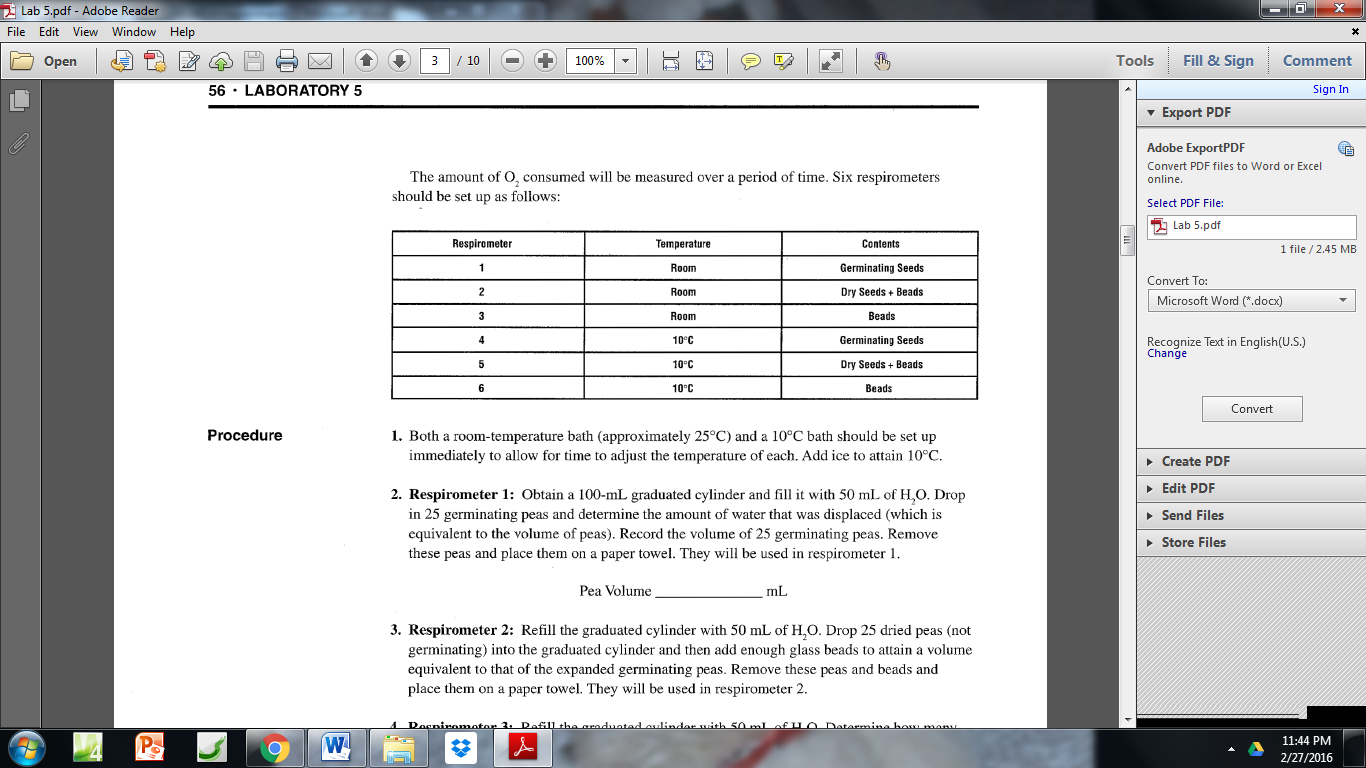
In this experiment, the relative volume of O2 consumed by germinating and non-germinating (dry) peas at two different temperatures will be measured.

RESPIROMETERS  
During cellular respiration, O2 is consumed and CO2 is released. In this experiment, CO2 produced will be removed by potassium hydroxide (KOH) and will form solid potassium carbonate (K2CO3).

CO2 + 2 KOH → K2CO3 + H2O

During respiration, the gas volume in the respirometer will be reduced because oxygen is being consumed and the CO2 produced is being converted to a solid. The net result is a decrease in gas volume and a related decrease in pressure in the tube. Since the CO2 is being removed, the change in the volume of gas in the respirometer is directly related to the amount of oxygen consumed. If water temperature is kept constant and the volume of gas inside the respirometer decreases, the water will move toward the region of lower pressure moving into the tube. The vial with glass beads alone will permit detection of any volume changes due to atmospheric pressure changes or temperature changes.

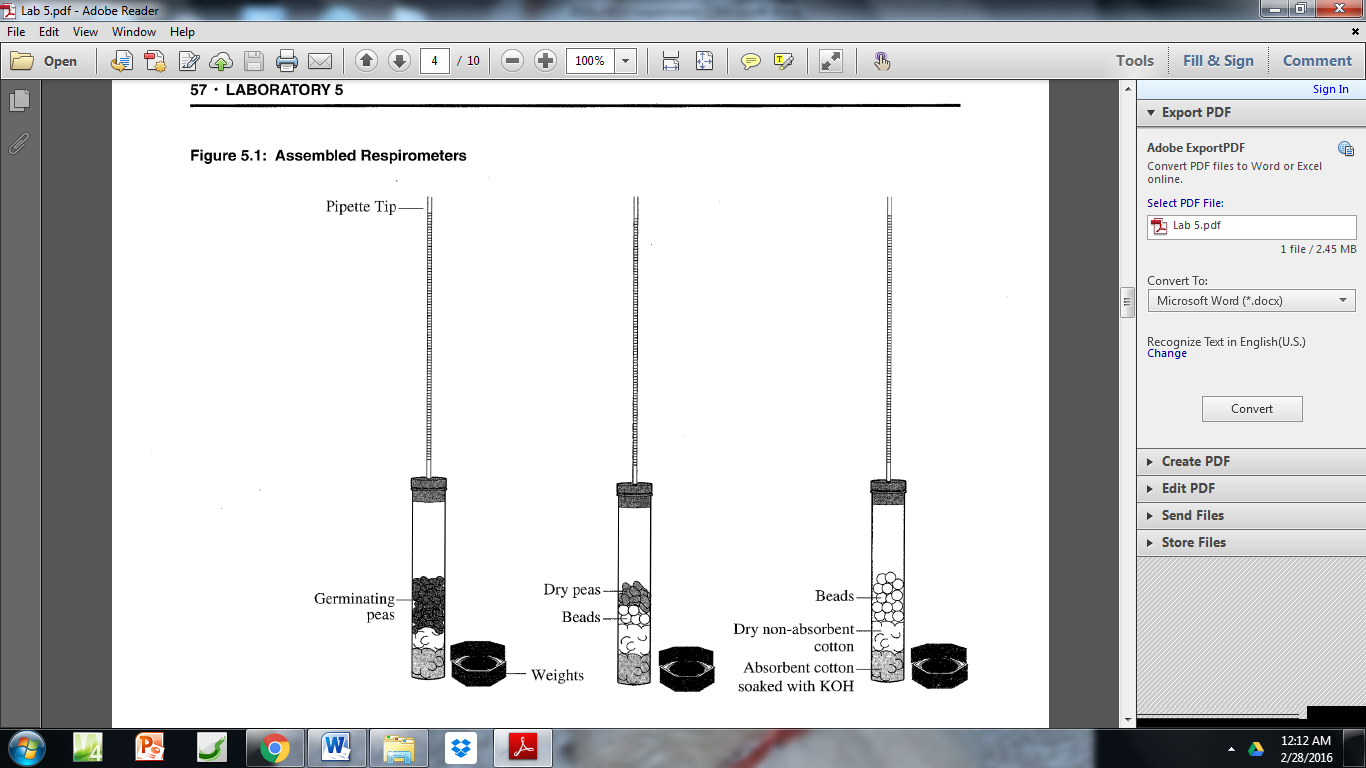
EXPERIMENTAL DESIGN  
The amount of O2 consumed will be measured over a period of time. SIX respirometers should be set up as follows:

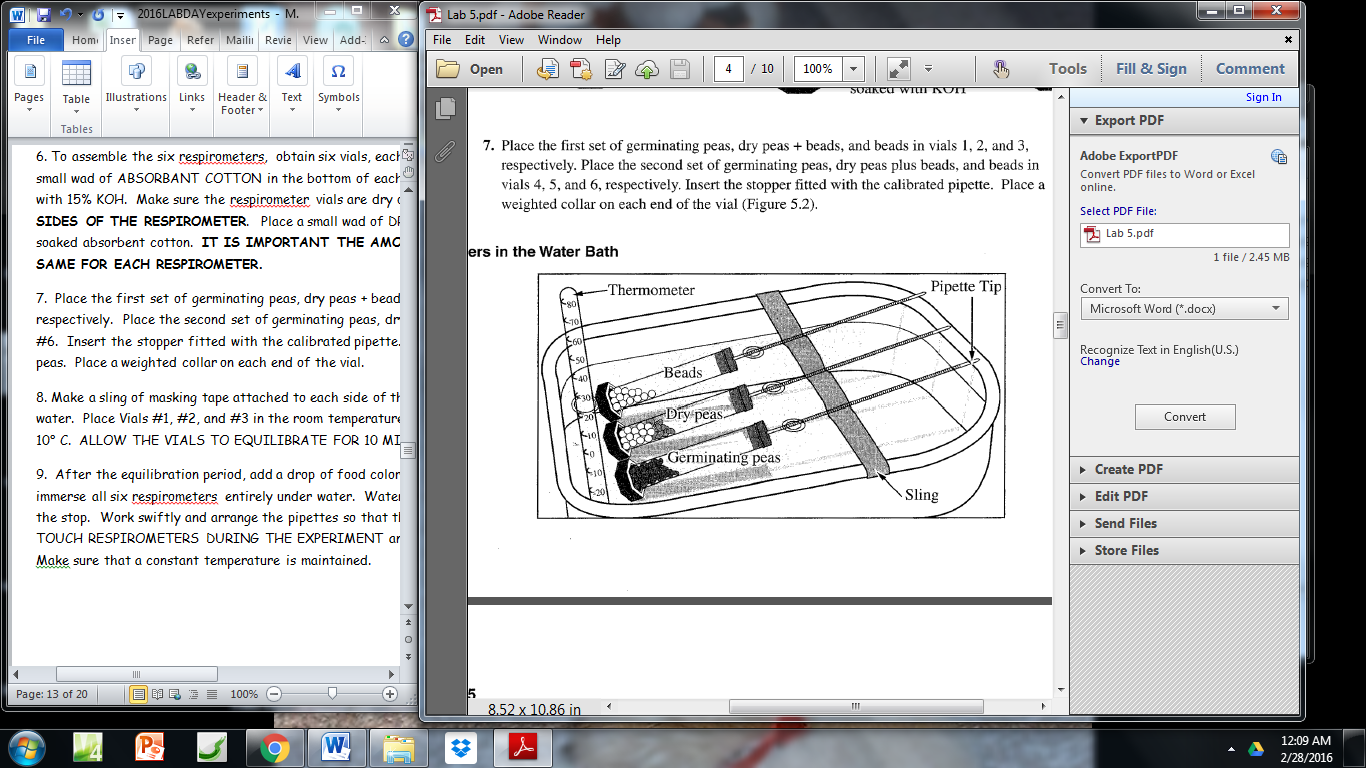


1. RESPIROMETER #1: Fill a 100-mL graduated cylinder with 50 mL of H2O. Drop in 20 germinating peas and determine the amount of water that was displaced. This is equivalent to the volume of peas. Record the volume. Remove the peas and place them on a paper towel.

PEA VOLUME = \_\_\_\_\_\_\_\_\_\_\_ mL

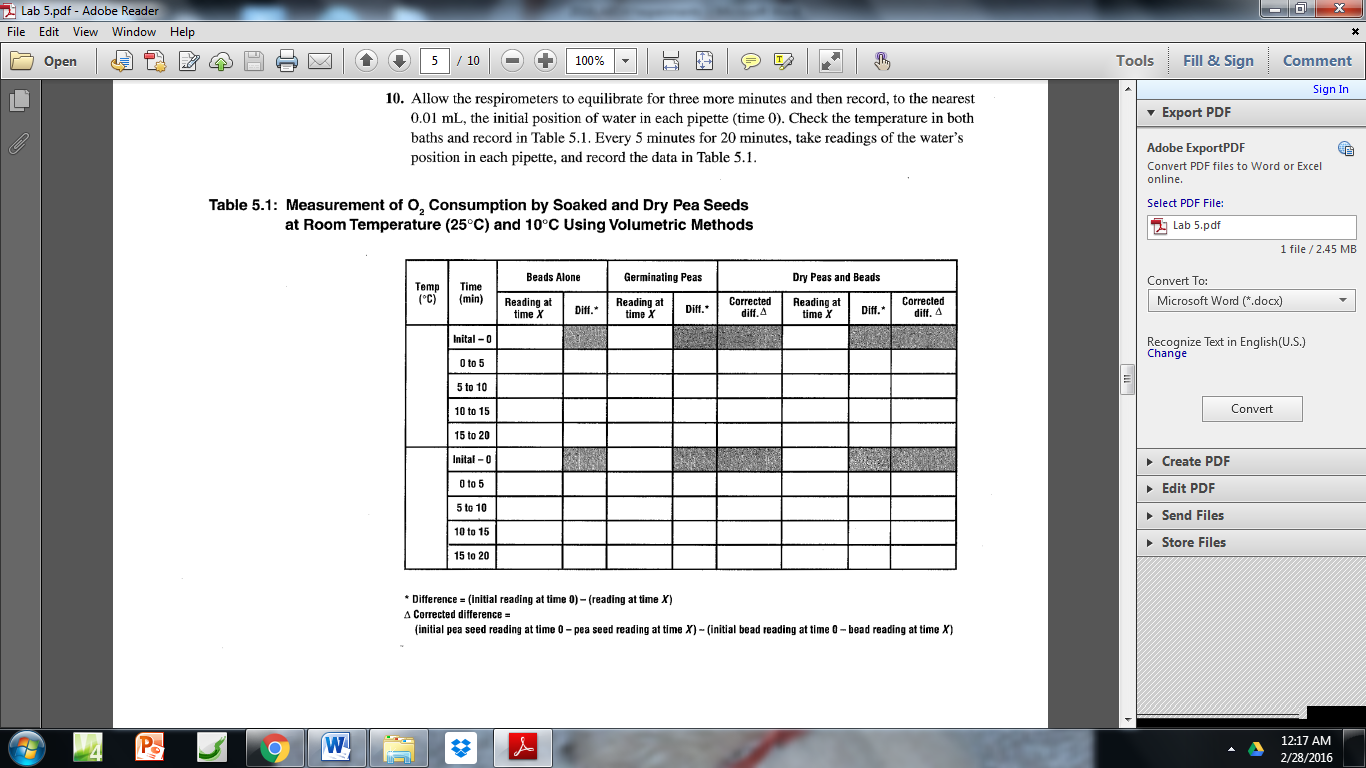
2. RESPIROMETER #2: Refill the graduated cylinder with 50 mL of H2O. Drop in 20 **DRY** peas. Add enough glass beads to attain a volume equivalent to the germinating peas. Remove these peas and beads and place them on a paper towel.

3. RESPIROMETER #3: Refill the graduated cylinder with 50 mL of H2O. Add glass beads to attain the volume equivalent to the germinating peas. Remove the beads and place them on a paper towel.   
  
4. REPEAT THE PROCEDURES ABOVE TO PREPARE A SECOND SET OF GERMINATING PEAS, DRY PEAS PLUS BEADS, AND BEADS FOR USE IN RESPIROMETERS #4, #5, AND #6.  
  
5. To assemble the six respirometers, obtain six vials, each with an attached stopper and pipette. Place a small wad of ABSORBANT COTTON in the bottom of each via. Using a dropper, saturated the cotton with 15% KOH. Make sure the respirometer vials are dry on the inside. **DO NOT GET KOH ON THE SIDES OF THE RESPIROMETER**. Place a small wad of DRY RAYON non-absorbant balls on top of the KOH-soaked absorbent cotton. **IT IS IMPORTANT THE AMOUNTS OF COTTON AND KOH BE THE SAME FOR EACH RESPIROMETER.**

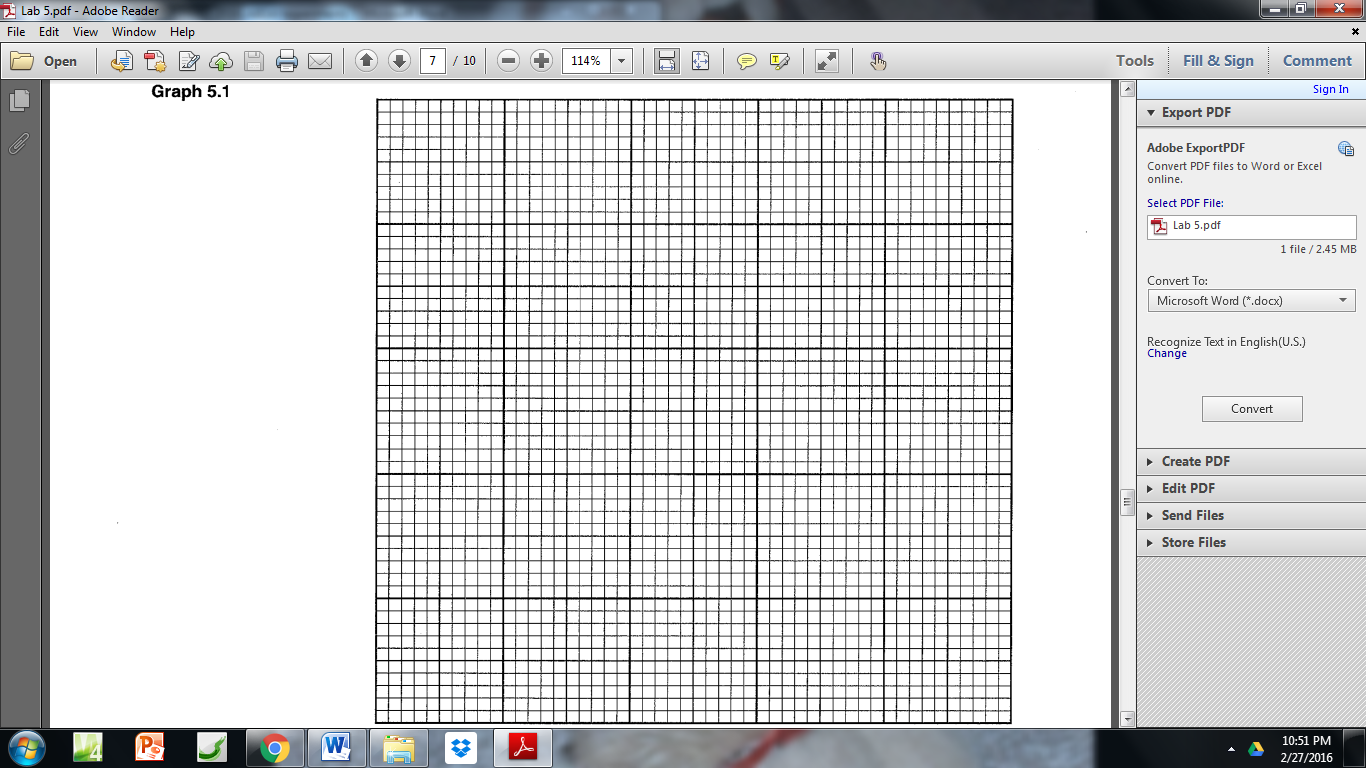
6. Place the first set of germinating peas, dry peas + beads, and beads in vials #1, #2, and #3, respectively. Place the second set of germinating peas, dry peas + beads, and beads in vials #4, #5, and #6. Insert the stopper fitted with the calibrated pipette, making sure the end of the pipette doesn’t poke into the peas. Place a weighted collar on each end of the vial.

7. Make a sling of masking tape attached to each side of the water baths to hold the pipettes out of the water. Place Vials #1, #2, and #3 in a room temperature water bath. Place vials #4, #5, and #6 in the 10° C water bath. ALLOW THE VIALS TO EQUILIBRATE FOR 15 MINUTES

9. After the equilibration period, add a drop of food coloring to the tip of each respirometer and immerse all six respirometers entirely under water. Water will enter the pipettes for a short distance the stop. Work swiftly and arrange the pipettes so that they can be read through the water. DON’T TOUCH RESPIROMETERS DURING THE EXPERIMENT and KEEP the TANKS AS STILL AS POSSIBLE> Make sure that a constant temperature is maintained.

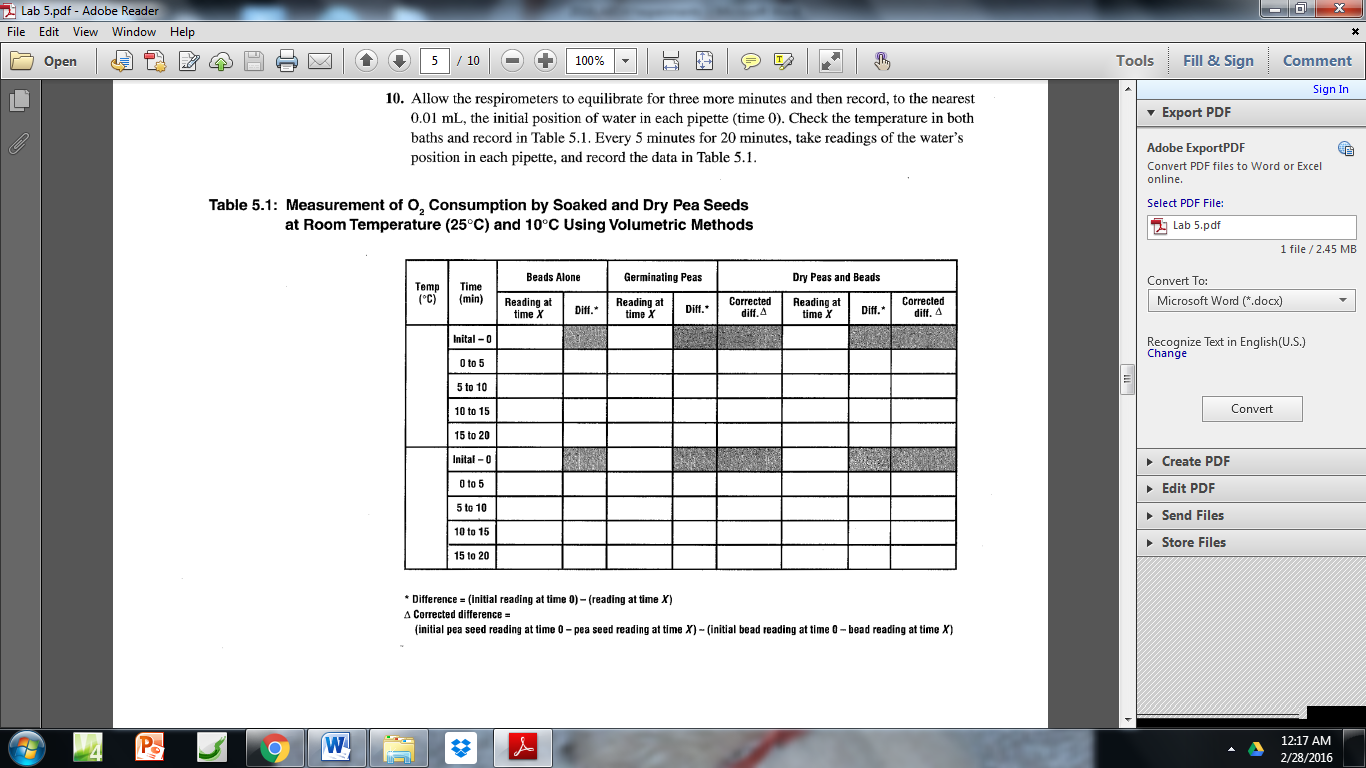
10. Allow the respirometers to equilibrate for 3 minutes, then record to the nearest 0.01 mL the initial position of the water in each pipette at TIME ZERO. Check the temperature in both baths and record in the table below. Every 5 minutes for 20 minutes, take readings of the water’s position in each pipette and record in the date table below.  
  
 O2 CONSUMPTION BY GERMINATING AND NON-GERMINATING DRY PEAS at 10° C and 25° C.

GRAPH the results from the CORRECTED DIFFERENCES column for the germinating peas and dry peas at both room temperature and at 10° C.

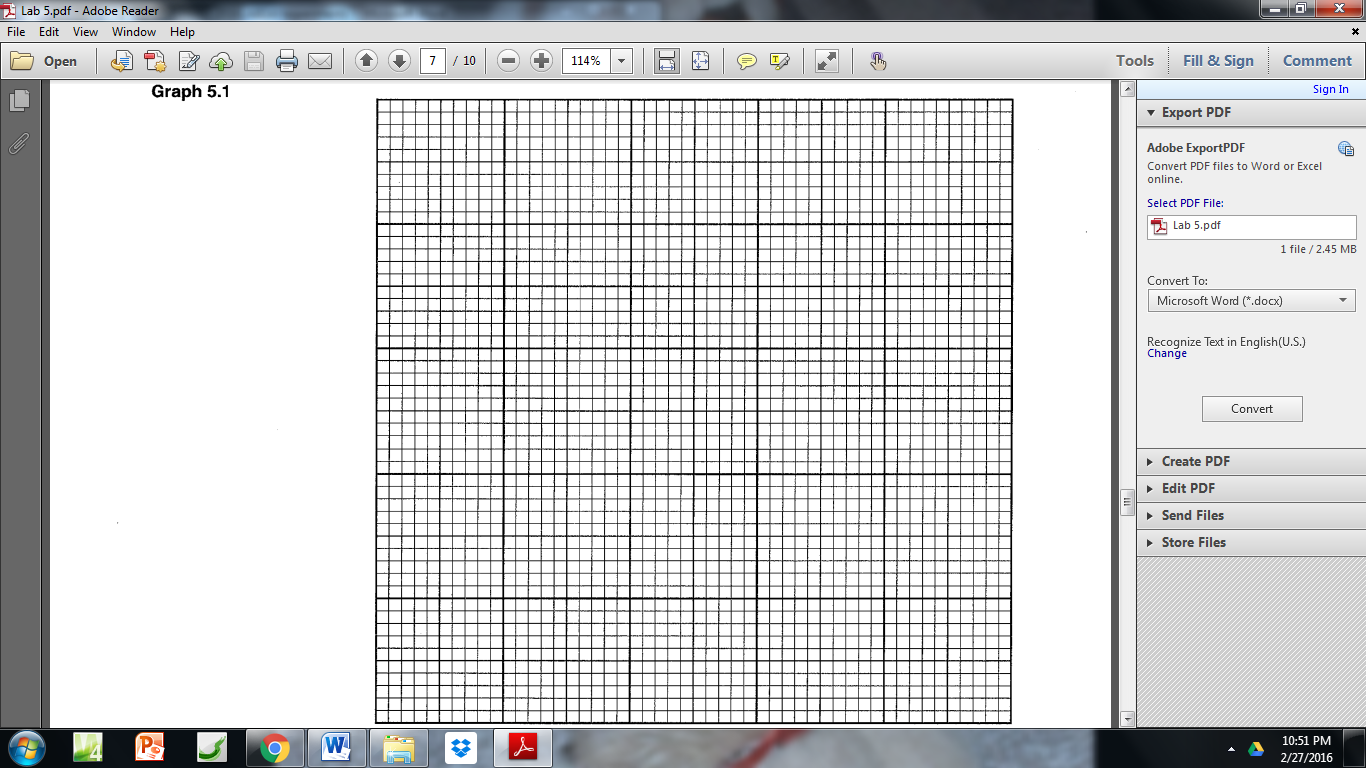


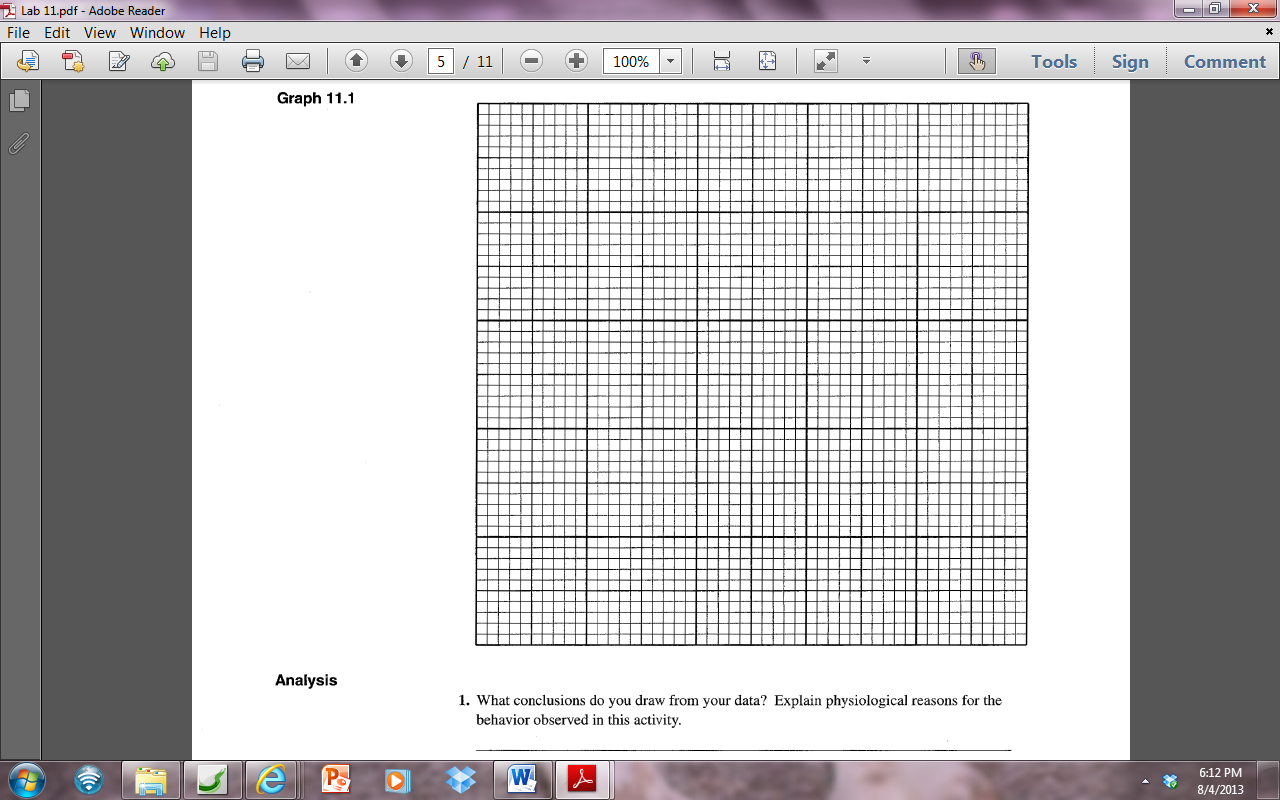
DESIGN YOUR OWN EXPERIMENT

|  |  |  |  |
| --- | --- | --- | --- |
| Title of Experiment: | | | |
| Hypothesis (place in the “If…, then…” format) | | | |
| Independent Variable | | | |
| Levels of Independent Variable |  |  |  |
| Dependent Variable | | | |
| Controlled Factors (List at least 5) | | | |
| Explanation of why this is a controlled experiment | | | |
| Show how you will record initial data | | | |
| How will you display data for your report | | | |

MODIFY THE DATA TABLE TO FIT YOUR EXPERIMENTAL DESIGN

GRAPH YOUR RESULTS



QUESTIONS

EXPERIMENTAL DESIGN: In this activity, you are investigating both the effect of germination versus non-germinating AND warm temperature versus cold temperature on respiration rate.

1. WRITE an H0 and HA for the experiment comparing room temperature germinating and non-  
 germinating peas.

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 2. What are the dependent and independent variables in the experiment to test effect of temperature?   
  
 Dependent variable \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Independent variable \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Does this experiment have an experimental CONTROL? EXPLAIN YOUR ANSWER.

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4. Identify and describe at least three controlled variables in this experiment.

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5. DESCRIBE and EXPLAIN the relationship between the amount of O2 used and time.

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4. EXPLAIN what would happen if you ran the experiment without adding KOH to the respirometers?

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5. Why were beads added to the respirometer containing the dry peas?

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6. Why is it necessary to correct the readings using the changes in the “beads only” vial?

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7. If you used the same experimental design to compare the rates of respiration of a 25 g reptile and a 25 g mammal at 10◦C, what results would you expect? EXPLAIN your reasoning.

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8. If respiration in a small mammal were studied at both room temp (21◦C) and 10◦C, what results would you predict? EXPLAIN your reasoning.

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9. EXPLAIN what caused the colored water to move into the respirometer pipettes.

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