Name_____Period_____Assignment #_____

Lab 6 Cellular Respiration: What factors affect the rate of cellular respiration in multicellular organisms?

See lecture questions 3b, 4, 5, 6, 7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24

Pre-lab: Annotate and answer questions 1-25

_____Teacher initials procedures_____Teacher initials data collection

Annotating Text
☐ **UNDERLINE** concepts you think might be useful for understanding or solving the problem
☐ **Box** information you think might be helpful for designing your investigation
☐ ← Write **notes** in the left margin
☐ → Write **questions and answers** in the right margin
Each paragraph (including each step of the procedures) must have something underlined or boxed, **AND** have something written in the margins (a question and/or note).

Introduction:

Living systems require free energy and matter to maintain order, grow, and to reproduce. Energy deficiencies are not only detrimental to individual organisms, but they cause disruptions at the population and ecosystem levels as well. Organisms employ various strategies that have been conserved through evolution to capture, use, and store free energy. Autotrophic organisms capture free energy from the environment through photosynthesis and chemosynthesis, whereas heterotrophic organisms harvest free energy from carbon compounds produced by other organisms. The process of cellular respiration harvests the energy in carbon compounds to produce ATP that powers most of the vital cellular processes. In eukaryotes. Most of the ATP production in eukaryotic cell occurs in the mitochondria.

If sufficient oxygen is available, glucose may be oxidized completely in a series of enzyme mediated steps, as summarized by the following reaction:

$C_6H_{12}O_6$ X $6O_2(g)$ $6CO_2(g) + 6H_2O$ + energy (about 32 ATP)

The chemical oxidation of glucose has important implications to the measurement of respiration. From the equation, if glucose is the energy source, then for every molecule of oxygen consumed, one molecule of carbon dioxide is produced.

Suppose you wanted to measure the overall rate of cellular respiration.

1) What specific things could you measure?

2) Which of these might be easier or harder to measure?

3) What factors can affect the rate of cellular respiration?

4) If pressure and temperature remain constant, will the volume of gas in the respirometers increase or decrease? Illustrate your answer. Go to https://phet.colorado.edu/en/simulation/gas-properties for a general gas law tutorial.

5) What happens to the volume of the gas being measured (O_2 consumption or CO_2 production) when the temperatures or pressure changes during the experiment? Illustrate your answer.

6) Why is it necessary to correct the readings of the respirometers containing organisms with the readings taken from respirometers containing only glass beads? Your answer MUST refer to the concepts derived from the general gas law:

$$PV = nRT$$

P = pressure of the gas
V = Volume of the gas
N = Number of moles of the gas
R = The gas constant
T = Temperature of the gas

Because respirometers are sensitive to changes in gas volume, they are also sensitive to changes in temperature and air pressure; thus, you need to use a control respirometer.

7) What would be a good control for the Vernier biochamber?

8) Imagine that you are told to measure the rate of respiration for a 25g reptile and a 25g mammal at 10°C. Predict how the results would compare using a graph.

9) Imagine that you are asked to repeat the reptile/mammal comparison of oxygen consumption, but as a temperature of 22°C. Use a graph to predict how these results would differ from the measurements made at 10°C.

10) Justify your prediction. A justification has 3 components: 1) Scientific knowledge and/or theory; 2) data from your analysis related to the knowledge; and 3) an explanation of HOW the data supports the knowledge.

Your task:

Determine what affects the rate of cellular respiration.

You will have a variety of model organisms to choose from: seeds of various species, plants at various ages, beetle larva, earthworms, small crickets, large crickets, fruit flies, and possibly others are available upon request.

11) What biotic factors affect respiration?

12) What abiotic factors affect respiration?

Come up with a question about cellular respiration you would like to answer or choose from one of the following:

- Are there any situations when living cells are not respiring?
- Why might some living cells respire more than others?
- Do seeds that store energy as oil respire at a different rate from seeds that store energy as starch?
- Do monocot plants respire at different rates from dicot plants?
- Do available nutrients affect the rate of respiration in germinating seeds?
- What is the optimal temperature for respiration?

This investigation also provides an opportunity for you to apply and review concepts that you have studied previously, including the relationship between cell structure and function, enzymatic activity, strategies for capture store, and use of free energy, diffusion of gases across cell membranes, and the physical laws pertaining to the properties and behaviors of gases.

To determine *what type of data* you will need to collect, think about the following questions:

13) What will serve as your independent variable during your experiment?

14) What will serve as your dependent variable during each of your experiments?

15) What type of measurements or observations will you need to record during your experiment?

To determine *how you will collect your data*, think about the following question:

16) What will serve as your control condition?

17) What will you do to ensure conditions are same if it takes more than one class period to collect data?

18) What types of treatment conditions will you need to set up and how will you do it?

19) How many trials will you need to conduct?

20) How often will you collect data and how will you do it?

21) How will you make sure that your data are of high quality (how will you reduce measurement error?)

22) How will you keep track of the data you collect and how will you organize the data?

To determine *how you will analyze your data*, think about the following:

23) How will you determine if there is a difference between the treatment condition and the control condition? What statistics will you use?

24) What type of calculations will you need to make?

25) How will you present your data?

Connections to Crosscutting Concepts and the Nature of Science

As you work through your investigation, be sure to think about the following:

1) The importance of identifying the underlying cause for observations
2) How energy and matter move within or through a system
3) How structure is related to function in living things
4) The nature and role of experiments in science
5) How scientific knowledge develops over time

ADI Investigation Proposal TGB Version

Guiding Question:

Claim:

Alternative claims:

Method:	What data will you collect? How will this data help you answer the guiding question?

Data table(s) and chart(s)

Guiding Question:

Our Claim:

Our Evidence:

Analysis: break it down (Illustrate and describe your data)

Interpretation: What does the analysis mean?

Our Justification of the Evidence:

Use your scientific knowledge and analysis to support your interpretation