

Cellular Respiration Worksheet

Name _____

Section A: Intro to Cellular Respiration

Once energy from the sunlight is transformed into glucose by photosynthesis, organisms have to convert the glucose (chemical energy) into a usable form. Cellular respiration breaks down glucose ($C_6H_{12}O_6$) and transfers the energy to make ATP. ATP is used to provide energy for cellular processes. Cellular Respiration can be divided into three metabolic processes: glycolysis, the Krebs cycle and electron transport chain (oxidative phosphorylation). Glycolysis reaction occurs in the cytosol and begins the process of breaking down glucose without the use of O_2 . Products from the first reaction enter the mitochondria where O_2 is needed for the Krebs cycle and the ETC to occur. A net of 36 ATPs are formed from the enzymatic breakdown of one glucose molecule.

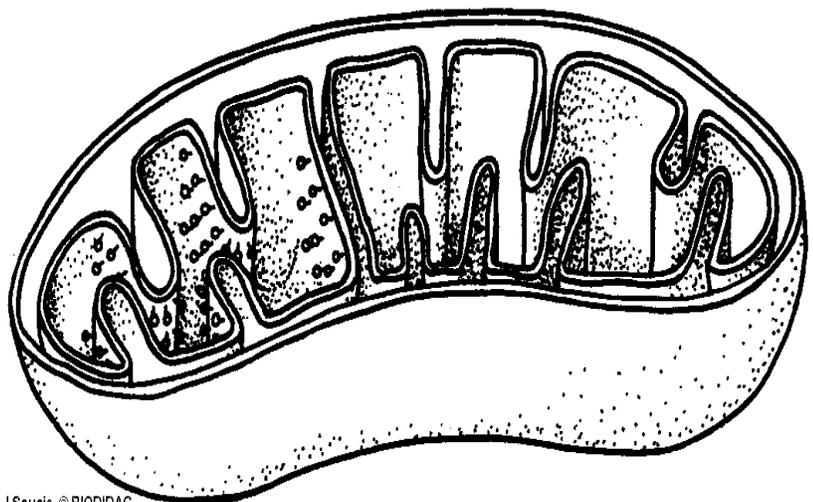
If all glucose supplies are depleted, then other substances in the body are converted into glucose or intermediate products that can enter the processes. The conversion of fatty acids (lipids) or amino acids (proteins) into glucose or intermediate products is called gluconeogenesis. Fats are only being used as a primary energy source during starvation, fasting or untreated diabetes. Proteins are only used if protein intake is high or if glucose and fat sources are depleted.

1. Why is the breakdown of glucose from photosynthesis important? _____
2. Which process of cell respiration is anaerobic? _____
3. Which processes of cell respiration are aerobic? _____
4. When one glucose molecule enters cellular respiration, how many ATPs are formed? _____
5. When are fatty acids used instead of glucose? _____
6. When are amino acids used instead of glucose? _____

Section B: Mitochondria

Mitochondria are the powerhouse of the cell. Glucose made by plants during photosynthesis is broken down to release energy for the production of ATP by cellular respiration. The more active a cell, the more mitochondria it will have. Mitochondria have a double-membrane: the outer membrane is smooth; the inner membrane is convoluted into folds called cristae. These folds greatly increase the surface area of the membrane so that carbohydrates can combine with oxygen to produce ATP. The electron transport chain takes place across the membranes of the cristae. Inside the cristae (folds) is a space called the matrix that contains enzymes needed for the Krebs cycle.

1. Color the cristae orange and the matrix blue.
2. What organisms undergo cellular respiration? _____
3. Why is the mitochondria called the powerhouse of the cell? _____
4. Why do some cells have more mitochondria? _____
5. What are the inner folds called? _____
6. What is the fluid called? _____
7. What is cellular respiration? _____



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Section C: Reactions

Glycolysis

Location: _____

Anaerobic or aerobic? _____

What happens? _____

NET YIELD: _____



Krebs Cycle

Location: _____

Anaerobic or aerobic? _____

What happens? _____

NET YIELD: _____



Electron Transport Chain

Location: _____

Anaerobic or aerobic? _____

What happens? _____

NET YIELD: _____

Section D: Concept Check

- Cellular respiration is the process by which cells convert the energy available in food to which energy-rich compound? _____
- What molecule is represented by A? _____
- What molecule is represented by B? _____
- What is the function of the NADH/FADH molecules?

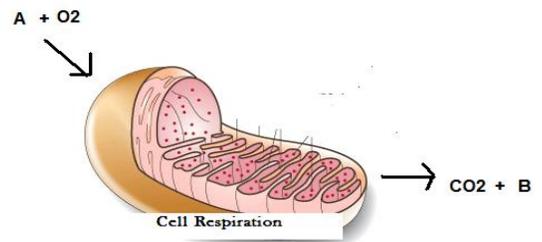
- What molecule is the electron acceptor in the ETC?

- What is the equation for cell respiration? _____
- How many ATPs are produced during anaerobic respiration? _____
- How many ATPs are produced during aerobic respiration? _____
- Where does anaerobic respiration occur?

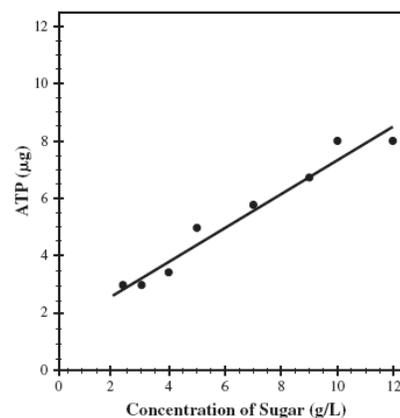
- Where does aerobic respiration occur?

- What process is illustrated by the graph?

- What happens to the ATP as the sugar is increasing? _____



Effect of Sugar on ATP Production in Muscle Cells



Section E: Cell Respiration in PEAS

Living things need energy to carry on most of their processes. The germinating seeds contain cells that breakdown glucose to form ATP during the process of cellular respiration. In this process, carbon dioxide is released as a byproduct.

The increasing concentration of carbon dioxide, in a closed environment, can be observed using a pH indicator solution. As carbon dioxide dissolves in water, it produces carbonic acid. As the carbonic acid concentration increases, the pH lowers. "Bromthymol Blue" is used for observing respiratory indicators.

Part 1: Demo

1. Fill a jar $\frac{1}{2}$ full of H₂O. Place 5 drops of Bromthymol Blue in the vial. What color is it? _____
2. Use a straw and gently blow bubbles into the water. What color is it? _____ What gas did you blow out? _____

Part 2: Germinating Peas

1. Get two glass vials and fill about $\frac{1}{3}$ full of water. Add 5 drops of Bromthymol Blue to each vial.
2. Place 3 germinating peas into one vial and 3 beads into the second vial. Put the lids on the vials and sit aside until tomorrow.

	Color Before	Color After
Peas (vial 1)		
Beads (vial 2)		

Post-lab questions:

1. Was there a color change in the pea vial? Explain your response. _____
2. Was there a color change in the bead vial? Explain your response. _____
3. Why is it necessary to have a control for this experiment? _____
4. Do you think there would be a difference in the color change if the peas were placed in the dark? Why or why not? _____

Section F: Challenge Yourself

1. Study the diagram of an experimental set up below. The class sets up an experiment with the four flasks. Bromthymol Blue is a chemical indicator that changes color from blue to yellow in the presence of CO₂ (and vice versa when levels of CO₂ decrease). All four flasks are stoppered and placed under the floodlight. What color would the solutions be after a few hours? Explain the processes that have occurred in each flask.

Flask 1 – 100 mL H₂O, 1 mL bromthymol blue, plant

Flask 2 – 100 mL H₂O, 1 mL bromthymol blue, 2 small fish

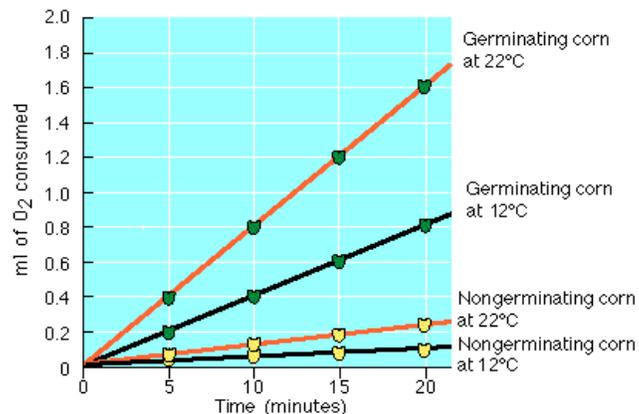
Flask 3 – 100 mL H₂O, 1 mL bromthymol blue, plant, 2 small fish

Flask 4 – 100 mL H₂O, 1 mL bromthymol blue



Flask 1:	
Color –	_____
Process –	_____
Flask 2:	
Color –	_____
Process –	_____
Flask 3:	
Color –	_____
Process –	_____
Flask 4:	
Color –	_____
Process –	_____

2. Describe the relationship between temperature and consumption of oxygen.
- _____
- _____
- _____
3. Based on the graph, would you conclude that non-germinating seeds respire? _____



Section G: Fermentation

- After glycolysis, if no O₂ is available, what happens next? _____
- When does lactic acid fermentation occur in humans? _____
- Anaerobic respiration can be observed in yeast. As fungi breakdown the glucose by cellular respiration, carbon dioxide is given off. Let's see this in action. Pour 100 mL of juice and 5 g of yeast in one flask. Pour 100 mL of water and 5 g of yeast into a second flask. Put a balloon on top of each flask and let it sit overnight.
 - What gas was released into the balloon? _____
 - Where does fermentation occur in the cell? _____
 - How many ATPs could the yeast produce per glucose molecule? _____
 - What this process aerobic or anaerobic? _____
 - Why was the water tested? _____

Section H: Photosynthesis vs. Cellular Respiration

- Bacteria are considered prokaryotes, because they do not contain a nucleus or membrane-bound organelles. However, they are still capable of performing photosynthesis and respiration without the chloroplast and mitochondrion. How is this possible? _____
- _____
2. Compare photosynthesis and respiration.

Photosynthesis	Cellular Respiration

Quizzes:

- <http://www.sciencegeek.net/Biology/review/U2Respiration.htm>
- http://edhsgreensea.net/Biology/taters/respiration_mc.htm