Mito Mission Worksheet

Cellular respiration · Logical Home Schooling

Name: _____ **Date:** _____ **Period:** _____

In this lab you will follow one glucose molecule through cellular respiration in the Mito Mission game. You will track where its carbons go and how much energy the cell gets from it, with and without oxygen.

Game link: www.logicalhomeschooling.com/mito-mission.html

Objectives

By the end of this lab you will be able to:

- Name the stages of cellular respiration and where each one happens in the cell.
- Track the ATP, NADH, and $FADH_2$ made at each stage, and the total for one glucose.
- Explain where the carbon atoms of glucose go, and where the oxygen you breathe ends up.
- Compare aerobic respiration with fermentation.
- Explain the role of oxygen, H^+ ions, and ATP synthase in the electron transport chain.

Materials: a computer or tablet with the game open, a pencil, this worksheet. Time: about 50 minutes.
Honors: turn on Honors mode in the game and complete the boxes marked Honors.

Part 1: Pre-lab (before you open the game)

1. Fill in the coefficients of the overall equation for aerobic cellular respiration.

   $C_6H_{12}O_6 + ___ O_2 \rightarrow ___ CO_2 + ___ H_2O + ATP$

2. In your own words, what is ATP, and why does a cell need it?

   _____

   _____

3. Predict. Fill in the first two columns now, before you play. Fix any wrong predictions in the last column after you play.

Stage	My prediction: where in the cell?	Needs oxygen? (Y/N)	Correct answer (after the game)
Glycolysis			
Fermentation			
Pyruvate oxidation			
Krebs cycle			
Electron transport chain			

Part 2: Stage 1, Glycolysis

Open the game. Make sure the **Stages** tab is selected and play Stage 1. Watch the **Energy ledger** on the right side of the screen.

1. Partway through glycolysis, the ATP ledger showed a negative number. What number did it show, and why?

2. Record the ledger at the end of Stage 1.

ATP (net)	NADH	$FADH_2$	CO_2 out	Carbons still in fuel

3. Glucose has 6 carbons. What molecule does it become at the end of glycolysis, and how many carbons does each one have?

4. Glucose ($C_6H_{12}O_6$) has 12 hydrogen atoms, but the two pyruvate molecules have only 8. Where did the other hydrogens go, and what did they form?

Part 3: Stage 2, No oxygen (fermentation)

1. Complete the table.

Organism	Products of fermentation	Releases CO_2? (Y/N)
Yeast		
Your muscle cells		

2. How much ATP does a cell get from one glucose with no oxygen? How much of that comes from fermentation itself?

3. If fermentation makes no ATP, why does the cell do it?

Part 4: Stage 3, Pyruvate oxidation

1. Where does pyruvate go when oxygen is available?

2. The carbon tracker dropped from 6 to 4. Where did those 2 carbons go?

3. What is acetyl-CoA, and how many carbons are in its acetyl group?

Part 5: Stage 4, The Krebs cycle

1. As you play, record each step of the first turn of the cycle.

Step	Molecule formed	Carbons	Released (CO_2, NADH, $FADH_2$, ATP, or nothing)
1			
2			
3			
4			
5 (Honors)			
6 (Honors)			
7 (Honors)			
8 (Honors)			

Honors: turn on Honors mode before Stage 4. The cycle then has 8 steps, and you name every intermediate. Everyone else fills in steps 1 to 4 only.

2. How many times does the Krebs cycle turn for one glucose? Why?

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3. Record the ledger at the end of Stage 4.

ATP	NADH	$FADH_2$	CO_2 out	Carbons still in fuel

4. Only 4 ATP have been made so far. Where is most of glucose's energy stored at this point?

Part 6: Stage 5, The electron transport chain

1. Where in the mitochondrion is the electron transport chain? Why do its folds matter?

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2. What do the proteins of the chain pump across the membrane, and where do those particles flow back through?

3. What is the final electron acceptor, and what does it form?

4. Record the final ledger.

ATP	NADH	$FADH_2$	CO_2 out	H_2O made

Part 7: The energy summary

Use your ledger records to complete the summary for one glucose with oxygen.

Stage	Location	ATP made	NADH made	$FADH_2$ made	CO_2 released
Glycolysis					
Pyruvate oxidation					
Krebs cycle					
Electron transport chain					
Total					

Part 8: Build the map and rapid round

1. Play Stage 6, *Build the map*. How many stars did you earn? _____ How many wrong placements? _____

2. Click the **Rapid round** tab and play twice.

Trial	Correct answers	Score
1		
2		

3. Which rapid round question did you miss most often? Write the question and the correct answer.

Part 9: Comprehension and analysis

Answer these **without** the game.

1. Cyanide is a poison that blocks the last protein of the electron transport chain, so electrons cannot reach oxygen. Predict what happens to ATP production, and explain why cyanide is deadly.

2. Aerobic respiration makes about 36 ATP per glucose. Fermentation makes 2. How many times more ATP does a cell get with oxygen? Show your work.

3. Trace one carbon atom from a glucose molecule in your muscle cell to the air you breathe out. Name each molecule it is part of along the way.

4. The oxygen you breathe in does not become the CO_2 you breathe out. Where does it end up?

5. During a hard sprint your muscles start to burn and you breathe faster. Use what you learned about fermentation and the electron transport chain to explain both.

6. Compare the products of cellular respiration with the reactants of photosynthesis. What do you notice?

Conclusion

Write 3 to 5 sentences describing the journey of one glucose molecule through cellular respiration. Use the words **glycolysis**, **mitochondria**, **oxygen**, and **ATP**.

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