Energy Under Brine

Trace how bacteria make ATP without oxygen.

7.2.a "Ask questions and construct an explanation of how anaerobic bacteria produce energy in environments with no oxygen."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the sentence that tells where ATP is made, and circle the food the bacteria use. Write 1 beside the step that makes ATP and 2 beside the step that lets ATP production continue without oxygen.

What Happens Beneath the Brine?

1. A cook presses shredded cabbage beneath salty water in a covered jar. At first, a little oxygen is trapped in the water, but it is soon used up. Deep beneath the surface, little or no oxygen remains. Lactic acid bacteria living on the cabbage can still grow there. They use sugars from the cabbage to obtain energy. Days later, the cabbage tastes sour because the bacteria release lactic acid. The sour taste is evidence of a chemical change, but it does not by itself show exactly how the bacteria obtained energy.

2. Inside each bacterium, a series of reactions called glycolysis splits a sugar molecule into smaller molecules. This step makes a small amount of ATP, the molecule cells use to power their activities. Glycolysis does not need oxygen, so it can keep working under the salty water. Yet it also depends on a helper molecule that must be reused. If the cell cannot restore that helper, glycolysis stops. Without glycolysis, the bacterium cannot keep making ATP from the cabbage sugar by this route.

3. Fermentation solves that problem. The bacteria change the smaller molecules from glycolysis into lactic acid, restoring the helper molecule for another round of glycolysis. Fermentation itself does not make extra ATP in this case. Instead, it allows glycolysis to keep supplying ATP when oxygen is absent. That is why these bacteria can use cabbage sugar and grow beneath the brine. If the sugar ran out, this route to ATP would stop even if the jar stayed free of oxygen. The food supplies the fuel; oxygen is not required for this route.

2 ANSWER WITH EVIDENCE

Use the passage

1. How can the bacteria make ATP beneath the brine when oxygen is absent? Name the step that makes ATP.

2. Why would glycolysis eventually stop without fermentation, even if sugar remained?

3. A student claims that fermentation itself makes extra ATP for these bacteria. How does the passage correct that claim?

4. Ask a question about what would happen to ATP production if the cabbage sugar ran out. Explain why your question matters.

3 YOUR TURN

Your own words

Imagine two identical oxygen-free containers holding the same lactic acid bacteria. Write four sentences that ask a testable question, describe what you would compare, predict the ATP result, and explain how fermentation supports your prediction.

ANSWER KEY

Energy Under Brine

GRADE 7 · 7.2.a

PART 1 · READ AND MARK

Underline the sentence that tells where ATP is made, and circle the food the bacteria use. Write 1 beside the step that makes ATP and 2 beside the step that lets ATP production continue without oxygen. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How can the bacteria make ATP beneath the brine when oxygen is absent? Name the step that makes ATP.	**Glycolysis makes ATP from cabbage sugar and does not need oxygen.**
2	Why would glycolysis eventually stop without fermentation, even if sugar remained?	**Glycolysis needs a helper molecule that can be reused. Fermentation restores it, so without fermentation glycolysis would stop.**
3	A student claims that fermentation itself makes extra ATP for these bacteria. How does the passage correct that claim?	**Fermentation does not make extra ATP in this case. It restores the helper molecule so glycolysis can keep making ATP.**
4	Ask a question about what would happen to ATP production if the cabbage sugar ran out. Explain why your question matters.	**For example: Would the bacteria stop making ATP from cabbage sugar if the sugar ran out? The passage says sugar fuels glycolysis, so ATP production by this route would stop.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Does adding sugar help these bacteria keep making ATP without oxygen? I would compare ATP production over the same period, adding sugar to only one container. I predict the bacteria given sugar would make more ATP through glycolysis. Fermentation restores the helper molecule that lets glycolysis continue without oxygen.

Accept questions that connect sugar availability to ATP production by this route. In Part 3, the comparison should change sugar availability while keeping oxygen absent, and the explanation should identify glycolysis as the ATP-making step.