Yeast at Work

Investigate fermentation conditions and their uses

BIO.2.5 "Enrichment: Investigate variables (e.g., nutrient availability, temperature) that affect anaerobic respiration and current real-world applications of fermentation."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle two factors that can change the rate of fermentation, underline two conditions kept the same in the flask test, and draw a box around one real-world use of fermentation.

From Sugar to Fuel

1. At a fuel plant, tanks of yeast turn sugars from corn into ethanol, which can be blended with gasoline. When oxygen is scarce, yeast breaks down sugar and uses alcoholic fermentation to keep glycolysis running. This process produces ethanol and carbon dioxide, but it releases much less usable energy per sugar molecule than aerobic respiration. Workers cannot simply demand faster output: yeast needs enough sugar to feed the process, and its cells must remain active. If sugar runs low, carbon dioxide production can slow. Tracking gas production over a set time gives workers a clue about fermentation rate, although gas alone does not measure ethanol directly.

2. A technician tests whether temperature changes the rate. She places equal amounts of yeast and sugar solution in three flasks fitted with gas-collection balloons. Each flask starts with the same solution volume, sugar concentration, yeast mass, and limited oxygen. She keeps the flasks at 15°C, 30°C, and 45°C for one hour, then measures the collected carbon dioxide after bringing the balloons to the same temperature. A larger gas volume suggests faster fermentation during that hour. Cold can slow yeast enzymes; excessive heat can damage yeast cells. Because she changed only temperature, differences in gas volume can be linked to that factor.

3. The plant can use these comparisons to choose a temperature that produces ethanol efficiently without overheating its tanks. It can also test sugar supply: batches that begin with too little sugar may stop producing fuel early, while adding more sugar than yeast can use wastes money. A sound test changes one factor at a time and keeps the yeast strain, starting volume, and test length the same. Fermentation also helps bakers make bread. In dough, yeast releases carbon dioxide that forms bubbles and makes the dough rise. The best conditions for fuel production need not be the best conditions for bread texture.

2 ANSWER WITH EVIDENCE

Use the passage

1. A fuel plant's yeast runs low on sugar. What change in carbon dioxide production would you expect, and why?

2. Why might the flask at 45°C collect less carbon dioxide than the flask at 30°C?

3. To test temperature fairly, name two starting conditions the technician kept the same and identify what she measured.

4. Why can the fuel plant use collected carbon dioxide to compare fermentation rates but not to state an exact ethanol yield?

3 YOUR TURN

Your own words

In winter, a bakery's dough rises slowly. Design a fair test of two dough-warming conditions: name the temperatures, what you would keep the same, what you would measure, and how the bakery would use the result.

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PART 1 · READ AND MARK

Circle two factors that can change the rate of fermentation, underline two conditions kept the same in the flask test, and draw a box around one real-world use of fermentation. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A fuel plant's yeast runs low on sugar. What change in carbon dioxide production would you expect, and why?	**Carbon dioxide production may slow because yeast needs sugar to continue fermentation.**
2	Why might the flask at 45°C collect less carbon dioxide than the flask at 30°C?	**Excessive heat can damage yeast cells, slowing fermentation and carbon dioxide production.**
3	To test temperature fairly, name two starting conditions the technician kept the same and identify what she measured.	**For example, she kept yeast mass and sugar concentration the same and measured the collected carbon dioxide.**
4	Why can the fuel plant use collected carbon dioxide to compare fermentation rates but not to state an exact ethanol yield?	**Gas volume provides a clue about fermentation rate, but it does not directly measure the ethanol produced.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would make two batches of dough with the same amounts of flour, water, sugar, and yeast. I would keep one batch at 18°C and the other at 28°C for the same length of time, then measure how much each dough's height increased. The bakery could use the temperature that gives a reliable rise without making the dough too warm.

For the marking job, accept sugar and temperature as factors, any two stated controls from the flask test, and either fuel or bread as an application. For Your Turn, accept other reasonable temperatures if only the temperature changes and the proposed measurement shows how much the dough rises.