When Oxygen Runs Low

Compare respiration pathways using a computer model

BIO.2.4 "Conduct scientific investigations or computer simulations to compare aerobic and anaerobic cellular respiration in plants and animals, using real world examples."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline what the model holds constant, circle what it changes, and number two comparisons you can make from its results.

Flooded Seeds and Sprinting Muscles

1. After heavy rain, pea seeds in a flooded field receive little oxygen. During a hard sprint, muscles may need ATP faster than oxygen-dependent pathways can supply it. A computer model compares these cells by tracking the ATP made from one glucose molecule. It runs each cell type twice, once with oxygen available and once without it.

2. The model holds glucose at one molecule per run and leaves other settings unchanged. Only cell type and oxygen availability change. The table shows estimated ATP yield and end products. A yield is the ATP made from one glucose molecule, not ATP made per minute. Oxygen-free conditions are simulated for cells, not for an entire person or plant.

MODEL RESULTS FOR ONE GLUCOSE MOLECULE

Cell type	Oxygen	ATP yield	End products
Pea seed	Available	About 30	Carbon dioxide and water
Pea seed	Unavailable	2	Ethanol and carbon dioxide
Human muscle	Available	About 30	Carbon dioxide and water
Human muscle	Unavailable	2	Lactate

3. In both cell types, aerobic respiration with oxygen yields far more ATP than pathways without oxygen. When oxygen is unavailable, glycolysis still makes some ATP, but fermentation products differ. To check the model, a lab could change oxygen availability for samples of one cell type while measuring glucose used and ATP made. Measuring ethanol or lactate could test the model's predicted pathways.

2 ANSWER WITH EVIDENCE

Use the passage

1. Compare ATP yield with and without oxygen in each cell type. What changed between the two runs for each type?

2. When oxygen is unavailable, how are the pea seed and muscle results alike, and how do their end products differ?

3. With oxygen available, what does the model predict for ATP yield and end products in pea seed cells compared with muscle cells?

4. How could a lab test the model's ATP yield comparison within one cell type? Name the condition to change and two things to measure.

3 YOUR TURN

Your own words

Design a four-run computer simulation for corn root cells in flooded soil and fish muscle cells during a fast escape. State what you would hold constant and change, then predict how ATP yield and end products would compare across the runs.

ANSWER KEY

When Oxygen Runs Low

HIGH SCHOOL · BIO.2.4

PART 1 · READ AND MARK

Underline what the model holds constant, circle what it changes, and number two comparisons you can make from its results. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Compare ATP yield with and without oxygen in each cell type. What changed between the two runs for each type?	**For both pea seed and muscle cells, yield drops from about 30 ATP to 2 ATP per glucose when oxygen changes from available to unavailable.**
2	When oxygen is unavailable, how are the pea seed and muscle results alike, and how do their end products differ?	**Both yield 2 ATP per glucose. Pea seed cells produce ethanol and carbon dioxide, while muscle cells produce lactate.**
3	With oxygen available, what does the model predict for ATP yield and end products in pea seed cells compared with muscle cells?	**Both yield about 30 ATP per glucose and produce carbon dioxide and water.**
4	How could a lab test the model's ATP yield comparison within one cell type? Name the condition to change and two things to measure.	**Change oxygen availability between samples of the same cell type. Measure glucose used and ATP made in each sample to compare ATP per glucose.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would run corn root cells and fish muscle cells with oxygen available and unavailable, holding glucose at one molecule per run. I predict both cell types would make about 30 ATP per glucose with oxygen and 2 without it. Without oxygen, corn roots would produce ethanol and carbon dioxide, while fish muscles would produce lactate. With oxygen, both would produce carbon dioxide and water.

Accept approximate aerobic ATP yields and equivalent descriptions of oxygen availability. For the open task, look for four runs, a constant glucose amount, and predictions that compare both ATP yield and end products.