Yeast Respiration Lab

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

> Open **peebedu.com** and navigate to **Yeast Respiration Lab**. Read the introduction screen, which describes three yeast strains and explains how you will explore the switch between aerobic respiration and alcohol fermentation. Click **Begin Experiment** to enter the workspace.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Yeast Respiration Lab as a scientific model.

M — Mode

What type of model is the Yeast Respiration Lab? Describe how this computational simulation represents the metabolic processes of cellular respiration and fermentation in yeast. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about how cells obtain energy from organic molecules.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about how yeast cells switch between aerobic respiration and fermentation. For each, name the specific simulation feature and explain what concept of cellular energetics it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about cellular respiration and fermentation. Consider what you cannot observe in the simulation that would be important for a complete understanding of how cells produce ATP from glucose.

P — Purpose

What is the learning goal of this simulation? Explain how the Yeast Respiration Lab is designed to help you understand how cells use different metabolic pathways depending on oxygen availability. In your answer, connect at least one specific simulation feature to a biological example of why the ability to switch between aerobic and anaerobic metabolism matters for living organisms.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Yeast Respiration Lab. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- How does the vessel seal/unseal toggle help you understand the relationship between oxygen availability and metabolic pathway selection?
- What information about the intermediate steps of cellular respiration is missing from this simulation, and why might the designers have chosen to simplify those steps?
- How does the rate graph help you compare the relative ATP yields of aerobic respiration versus fermentation?
- If you could add one feature to this simulation to better represent how cells obtain energy, what would it be and why?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Alcoholic Fermentation in Yeast

> *Simulation Task: Select **Glucose** as your substrate and observe the rate graph for about 10 seconds with the vessel open. Then click the **Vessel Sealed** button and watch the O_2 Level meter, the rate graph, and the Ethanol Produced counter as oxygen depletes. Note the moment when the equation display switches from aerobic respiration to alcohol fermentation.*

(A) (1 pt) **Describe** the process of alcoholic fermentation in yeast.

(B) (1 pt) **Explain** why glycolysis continues during fermentation even though the Krebs cycle and oxidative phosphorylation have stopped.

(C) (1 pt) **Predict** what would happen to the yeast cells' ability to produce ATP if the fermentation pathway were blocked by a mutation while the vessel remained sealed and oxygen was unavailable.

(D) (1 pt) **Justify** your prediction by explaining why fermentation is essential for continued ATP production under anaerobic conditions, even though it yields far less ATP than aerobic respiration.

EK 3.5.B.6

Analyze Model / Visual Representation

Question 2 — Oxygen Availability and Metabolic Pathway Selection

> *Simulation Task: Click **Reset Experiment**, then select **Glucose** and let the simulation run for 15 seconds with the vessel **open**. Observe the three lines on the rate graph. Then click **Vessel Sealed** and watch until the O_2 Level drops below 15% and the fermentation line appears. After 15 more seconds, click **Vessel Open** again and observe how the rate lines change as oxygen returns. Note the overall pattern on the graph.*

(A) (1 pt) **Describe** how oxygen availability determines whether yeast cells use aerobic respiration or fermentation.

(B) (1 pt) **Explain** the relationship between the O_2 Level meter in the simulation and the activity of the KC/OxPhos and fermentation rate lines on the graph.

(C) (1 pt) **Represent** the metabolic switch between aerobic respiration and fermentation.

Draw your flowchart here.

(D) (1 pt) **Explain** how the metabolic flexibility demonstrated in this simulation — the ability of yeast to switch between aerobic respiration and fermentation — could be subject to natural selection in yeast populations living in environments with fluctuating oxygen levels.

EK 3.5.B.5