

Name: _____ Period: _____ Date: _____

Open **peebedu.com** and navigate to **Powerhouse (Mitochondria Simulator)**. Click the **Start Game!** button to begin. Read the instructions popup, which describes how to use the Eat button to spawn glucose, the Breathe button to spawn O_2 and clear CO_2 , and how to drag and drop molecules into reaction zones to trigger each stage of cellular respiration.

Free Response Questions

Question 1 – Conceptual Analysis

Simulation Task: Click "Eat" to spawn glucose. Drag one glucose molecule into the Glycolysis zone and click the zone to trigger the reaction. Observe the products that appear and note the ATP counter. Continue dragging products through Pyruvate Oxidation and the Krebs Cycle, triggering each reaction. Record the number of NADH, $FADH_2$, CO_2 , and ATP produced at each stage.

(A) (1 pt) **Describe** the molecules that carry electrons from the earlier stages of cellular respiration to the electron transport chain.

(B) (1 pt) **Explain** how the reactions of glycolysis and the Krebs cycle make the energy stored in glucose available to the electron transport chain.

(C) (1 pt) **Predict** what would happen to the total ATP produced from one glucose molecule if NADH could no longer deliver its electrons to the electron transport chain.

(D) (1 pt) **Justify** your prediction.

Question 2 — Analyze Model / Visual Representation

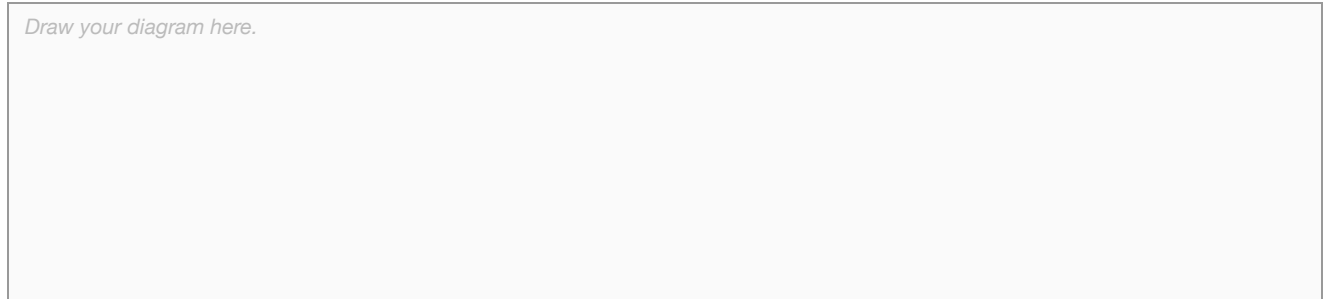
Simulation Task: After completing glycolysis, pyruvate oxidation, and the Krebs cycle for one glucose molecule, observe the NADH and FADH₂ molecules that have accumulated in the Oxidative Phosphorylation zone. Note the electron progress bar reading. Then click "Breathe" to spawn O₂, drag one O₂ molecule into the OxPhos zone, and trigger the reaction. Observe the product and the ATP counter change.

(A) (1 pt) **Describe** what happens to molecular oxygen at the final step of the electron transport chain in the mitochondria.

(B) (1 pt) **Explain** why the electron transport chain cannot continue to accept electrons from NADH and FADH₂ when oxygen is unavailable, even though the protein complexes of the chain are intact.

(C) (1 pt) **Represent** the four stages of aerobic cellular respiration by drawing a labeled diagram that traces the path of electrons from glucose through glycolysis, pyruvate oxidation, the Krebs cycle, and the electron transport chain, showing where ATP is produced at each stage and where oxygen is consumed.

Draw your diagram here.



(D) (1 pt) **Explain** how the compartments created by the mitochondrion's two membranes allow the stages of cellular respiration to occur in the separate locations shown in the simulation.

3.5.A.3