Name: _____ **Date:** _____

Section: _____

Powerhouse Activity

Tracking Energy Flow Through Cellular Respiration

Background: _____

Cellular respiration is the metabolic process that releases energy from glucose and other organic molecules. This simulation allows you to trace molecules through each stage and quantify ATP production.

Phase 1: ENGAGE (10 minutes)

Getting Started: Open peebedu.com and navigate to Powerhouse - Cellular Respiration

Initial Exploration: Identify the four reaction zones in the simulation

Click '`Eat`' to spawn glucose and observe its appearance Click '`Breathe`' to spawn oxygen molecules Watch molecules move through the process

Pre-Assessment Questions: What are the inputs and outputs of cellular respiration? _____

Why do cells need both glucose AND oxygen? _____

What happens to the energy in glucose? _____

Phase 2: EXPLORE (30 minutes)

Investigation 1: Glycolysis

Drag glucose to the glycolysis zone and observe.

Observations:

- Where does glycolysis occur? _____

- What products appear? _____

Investigation 2: Pyruvate Oxidation

Move pyruvate molecules to the pyruvate oxidation zone.

Key Questions:

- Where do pyruvates go after glycolysis? _____

- What happens to the remaining carbon atoms? _____

Investigation 3: Krebs Cycle

Place acetyl-CoA molecules in the Krebs cycle zone.

Observations:

- What shape does the cycle make? _____

- What electron carriers are produced? _____

Investigation 4: Oxidative Phosphorylation

Transfer NADH and $FADH_2$ to the oxidative phosphorylation zone.

Key Observations:

- Where do the electrons go? _____

- When is ATP produced? _____

Phase 3: EXPLAIN (25 minutes)

Energy Flow Through Respiration

Tracing the Path:

Complete the energy flow diagram: _____ Glucose → _____ → _____ → Krebs → _____ → ATP

Key Relationships:

- Why must glycolysis happen before Krebs cycle? _____

- What role does oxygen play at the end? _____

Process Connections:

Explain the relationship between:

- Food and breathing: _____

- Mitochondria and energy: _____

Regulation Concept:

Why would a cell need to control respiration rate? _____

Phase 4: ELABORATE (20 minutes)

Real-World Applications

Without Oxygen:

Run simulation without oxygen:

- What happens to the process? _____

- What happens during intense exercise? _____

Different Fuels:

Besides glucose, cells can use:

- Fats: More or less energy per molecule? _____

- Which fuel is '`cleanest`' (least waste)? _____

Temperature Effects:

How might temperature affect respiration? _____

- Cold conditions: _____

Poisons and Medicine:

Cyanide blocks the electron transport chain:

- What would happen to a poisoned cell? _____

- How might you treat it? _____

Phase 5: EVALUATE (15 minutes)

Assessment Questions

Process Understanding:

Put these in order: ___ ATP synthase makes ATP ___ Glucose enters glycolysis ___ Oxygen accepts electrons ___ Krebs cycle produces CO_2 ___ Electron transport creates gradient

Concept Application:

Why do you breathe harder during exercise? _____

What would happen without mitochondria? _____

Critical Thinking:

Why do organisms use such a complex process instead of just burning glucose? _____

Model Evaluation:

What does this simulation show well? _____

What important aspects are simplified? _____

Synthesis Question:

Explain why the phrase '`food is fuel`' is both accurate and oversimplified: _____