

Name: \_\_\_\_\_ Period: \_\_\_\_\_ Date: \_\_\_\_\_

Open **peebedu.com** and navigate to **Redox Challenge**. Click **Launch Interactive** to begin. The simulation presents the OIL RIG mnemonic: **Oxidation Is Loss** of electrons, **Reduction Is Gain** of electrons. You will progress through 8 redox reactions in photosynthesis and cellular respiration, choosing whether each molecule is oxidized or reduced. Hover over each molecule to see where the reaction occurs in the cell.

**Part 1 – Model Evaluation (MAPP Framework)**

*Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Redox Challenge as a scientific model.*

**M – Mode**

What type of model is the OIL RIG Redox Challenge? Describe how this computational simulation represents oxidation and reduction reactions in photosynthesis and cellular respiration. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about electron transfer in metabolic pathways.

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## A – Accuracy

(a) Identify two things this simulation represents **accurately** about redox reactions in photosynthesis and cellular respiration. For each, name the specific simulation feature and explain what biological concept it demonstrates.

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(b) Identify two things this simulation **oversimplifies or leaves out** about electron transfer in metabolic pathways. Consider what you cannot observe in the simulation that would be important for a complete understanding of how electrons flow through photosynthesis and cellular respiration.

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## P – Purpose

What is the learning goal of this simulation? Explain how the Redox Challenge is designed to help you understand how electrons are transferred between molecules during photosynthesis and cellular respiration, and how the location of each reaction within the cell relates to its function. In your answer, connect at least one specific simulation feature to the biological significance of electron transfer in energy conversion.

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## P – Permanency

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

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## Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for redox reactions in metabolic pathways?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the simulation help you connect the concept of electron transfer to the flow of energy from photosynthesis to cellular respiration?

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## Part 2 – Free Response Questions

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### Conceptual Analysis

#### Question 1 – Electron Transfer in Photosynthesis

*Simulation Task: In the Redox Challenge, progress through all 8 reactions. For each reaction, note whether the molecule is oxidized or reduced and the cellular location shown in the tooltip. Pay particular attention to Reaction 1 ( $H_2O \rightarrow O_2$ ) and Reaction 2 ( $NADP^+ \rightarrow NADPH$ ) and the role each plays in its respective pathway.*

**(A)** (1 pt) **Describe** the role of water in the light-dependent reactions of photosynthesis, including the type of redox reaction it undergoes and where this reaction occurs within the chloroplast.

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**(B)** (1 pt) **Explain** how the electrons removed from water during the light reactions are ultimately used to reduce  $NADP^+$  to  $NADPH$ .

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**(C)** (1 pt) **Predict** what would happen to the production of  $NADPH$  and the fixation of carbon in the Calvin cycle if the oxidation of water at Photosystem II were blocked by a chemical inhibitor.

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**(D)** (1 pt) **Justify** your prediction by explaining the relationship between the oxidation of water as an electron source and the subsequent reduction reactions that depend on those electrons in the light reactions and Calvin cycle.

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## Analyze Model / Visual Representation

### Question 2 – Compartmentalization of Redox Reactions in Cellular Respiration

*Simulation Task: In the Redox Challenge, complete Reactions 5 through 8 and use the hover tooltips to identify the cellular location of each reaction. Note the progression from cytoplasm to mitochondrial matrix to inner mitochondrial membrane.*

**(A)** (1 pt) **Describe** the sequence of redox reactions that occur during cellular respiration, identifying the molecule that is oxidized or reduced at each stage (glycolysis, pyruvate oxidation, Krebs cycle, and the electron transport chain) and the cellular compartment where each stage occurs.

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**(B)** (1 pt) **Explain** why the compartmentalization of cellular respiration into different locations within the cell is important for the efficiency of ATP production.

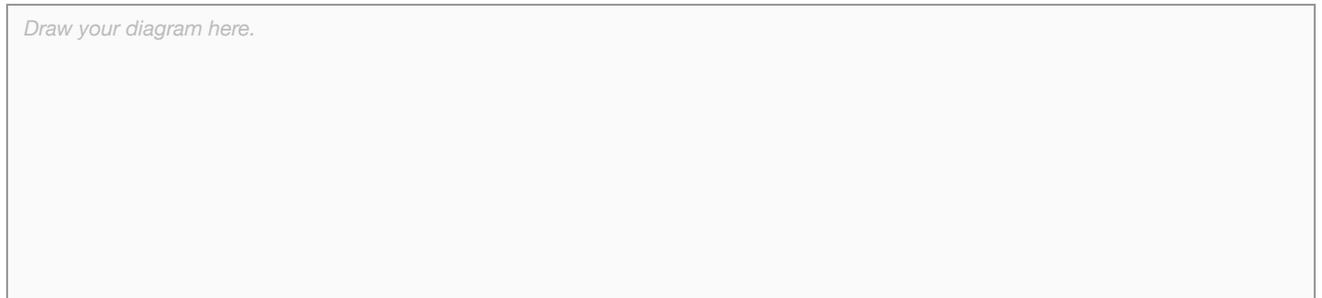
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**(C)** (1 pt) **Represent** the flow of electrons through cellular respiration.

*Draw your diagram here.*



**(D)** (1 pt) **Explain** how the transfer of electrons through the electron transport chain drives the flow of energy through an ecosystem.

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