

Name: _____ Period: _____ Date: _____

Open **peebedu.com** and navigate to **Endosymbiotic Theory Interactive**. Click the **Launch Interactive** button to begin. In Level 0, observe the different prokaryotes and their metabolic inputs and outputs. Click on the prokaryote that consumes glucose and O₂ to produce ATP. Progress through the educational slides and quizzes, then continue through all four levels by following the on-screen instructions.

Part 1 – Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Endosymbiotic Theory Interactive as a scientific model.

M – Mode

What type of model is the Endosymbiotic Theory Interactive? Describe how this game-based simulation represents the process of endosymbiosis. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about the origin of eukaryotic organelles.

A – Accuracy

(a) Identify two things this simulation represents **accurately** about the endosymbiotic theory. For each, name the specific simulation feature and explain what aspect of endosymbiosis it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about endosymbiosis. Consider what you cannot observe in the simulation that would be important for a complete understanding of how mitochondria and chloroplasts originated from free-living prokaryotes.

P – Purpose

What is the learning goal of this simulation? Explain how the Endosymbiotic Theory Interactive is designed to help you understand how membrane-bound organelles such as mitochondria and chloroplasts evolved from once free-living prokaryotic cells. In your answer, connect at least one specific simulation feature to the evidence that supports the endosymbiotic theory.

P – Permanency

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

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for endosymbiotic theory?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does progressing through the levels help you understand the sequence of evolutionary events that led to eukaryotic cells?

Part 2 – Free Response Questions

Conceptual Analysis

Question 1 – Evidence for the Endosymbiotic Origin of Mitochondria

Simulation Task: Complete Level 0 by clicking on the aerobic prokaryote (the one that consumes glucose and O₂ to produce ATP). Observe the phagocytosis animation in Level 1 as your cell engulfs the prokaryote. After engulfment, read the “Evidence for Endosymbiotic Theory” list that appears on the info screen.

(A) (1 pt) **Describe** the structural features of mitochondria that provide evidence that these organelles evolved from once free-living prokaryotic cells via endosymbiosis.

(B) (1 pt) **Explain** how the presence of circular DNA and the ability to replicate by binary fission in mitochondria support the claim that mitochondria were once independent prokaryotic organisms.

(C) (1 pt) **Predict** what would happen to a eukaryotic cell’s ability to produce ATP through aerobic respiration if its mitochondria lost their own DNA and could no longer replicate independently.

(D) (1 pt) **Justify** your prediction by explaining the relationship between the endosymbiotic origin of mitochondria and the compartmentalization of aerobic respiration within eukaryotic cells.

Analyze Model / Visual Representation

Question 2 — Prokaryotic vs. Eukaryotic Compartmentalization

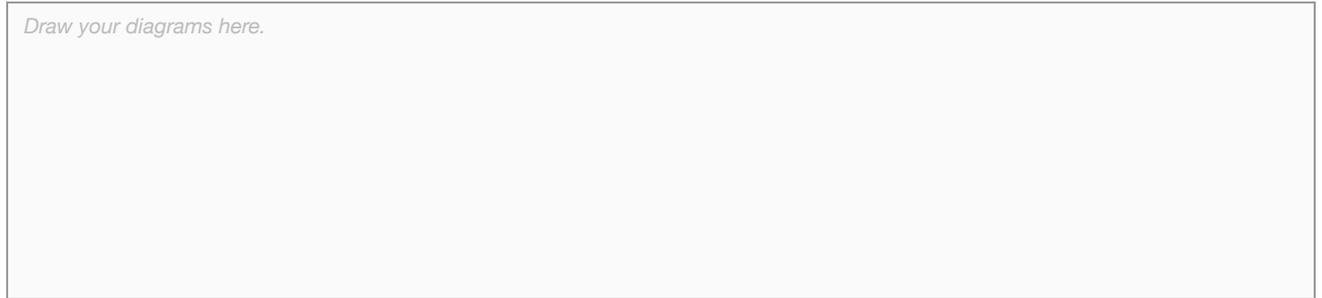
Simulation Task: In Level 0, observe how the prokaryotes (aerobic bacteria, anaerobic bacteria) perform their metabolic reactions without internal membrane-bound organelles. Then advance to Level 4, where your eukaryotic cell contains both mitochondria and chloroplasts. Observe how molecules are transported between these compartments along intracellular pathways.

(A) (1 pt) **Describe** the differences in internal organization between the prokaryotic cells observed in Level 0 and the eukaryotic cell in Level 4 of the simulation.

(B) (1 pt) **Explain** how the internal membranes and membrane-bound organelles in the Level 4 eukaryotic cell allow different metabolic processes to occur simultaneously in specialized regions.

(C) (1 pt) **Represent** the structural differences between a prokaryotic cell and a eukaryotic cell that resulted from endosymbiosis.

Draw your diagrams here.



(D) (1 pt) **Explain** how the endosymbiotic events that produced mitochondria and chloroplasts contributed to the evolution of eukaryotic diversity.

EK 2.10.A.1, 2.10.A.2, 2.10.A.3