

Origins of Cell Compartmentalization

Learning objective 2.10.A Describe similarities and/or differences in compartmentalization between prokaryotic and eukaryotic cells.

Name: _____ Date: _____ Period: _____

Use the tool **The Endosymbiosis Case**. Work on the **Examine an organelle** tab for Parts 1 and 2, **Judge the evidence** for Part 3, Order the steps for Part 4, and **Build the argument** for Part 5. The exam skill here is supporting a claim with evidence, so every answer needs reasoning as well as a fact. Predicting: wherever a Part asks you to predict, write a specific number or word and one reason before you touch the tool, in the form “I think ... because ...”. A wrong prediction costs nothing; a prediction made after looking is not a prediction.

switch tab

scroll down

predict first

record from the tool

score yourself

The purple bar in the margin names the AP science practice a question uses.

Part 1 • Two explanations, two sets of predictions

Examine an organelle

Judge the evidence

Order the steps

Build the argument

- Use the **Examine an organelle** tab. It is the one showing when the tool opens.
- Open both explanations at the top of the tool and read what each one predicts you would see.

	Engulfed a whole cell	Folded in from the plasma membrane
How many membranes? <i>circle one</i>	one / two	one / two
Its own DNA? <i>circle one</i>	yes / no	yes / no
Its own ribosomes? <i>circle one</i>	yes / no	yes / no
How does it divide? <i>circle one</i>	on its own, like a bacterium / only with the rest of the cell	on its own, like a bacterium / only with the rest of the cell

1. State the endosymbiotic theory in your own words.

Part 2 · Collect the evidence



Stay on the **Examine an organelle** tab.



Click through all five organelles and record how many observations point each way. Open each observation to read the reasoning.

Organelle	Points to engulfing	Points to infolding	Best supported by <i>circle one</i>
Mitochondrion			engulfing / infolding
Chloroplast			engulfing / infolding
Lysosome			engulfing / infolding
Golgi complex			engulfing / infolding
Endoplasmic reticulum			engulfing / infolding

2. Which two organelles are supported by the endosymbiotic explanation? Name them and state how many lines of evidence each carries.

3. No organelle had evidence pointing both ways. Explain why that makes the conclusion stronger than if the evidence had been mixed.

Part 3 · What counts as evidence

Examine an organelle

Judge the evidence

Order the steps

Build the argument



Click the **Judge the evidence** tab at the top of the tool.

Work all ten cards. Each one gives you an observation and nothing else; two of them are not evidence for either explanation.

4. Complete this rule: an observation is evidence for a hypothesis only if ...

5. “Mitochondria are surrounded by membranes.” Explain why this is a true statement but not evidence for endosymbiosis.

6. Choose the line of evidence you think is strongest and justify your choice. Then choose the weakest and justify that.

Part 4 · Put the steps in order

Examine an organelle

Judge the evidence

Order the steps

Build the argument



Click the **Order the steps** tab at the top of the tool.



Move the five steps into order with the arrows and match each step to its evidence (A to E), then check. Record your final order and letters here, then do the **How do we know mitochondria came first?** check below it.

Step (shuffled, as in the tool)	Order (1 to 5) <i>circle one</i>	Evidence (A to E) <i>circle one</i>
Over many generations the engulfed cell becomes the mitochondrion. It still carries its own circular DNA and prokaryote-like ribosomes, and still divides by fission.	1 / 2 / 3 / 4 / 5	A / B / C / D / E
A prokaryote's plasma membrane folds inward. The infolded membrane becomes the nuclear envelope and the ER: the first internal compartments.	1 / 2 / 3 / 4 / 5	A / B / C / D / E
The cyanobacterium becomes the chloroplast. The cells that carry it are the ancestors of the algae and plants.	1 / 2 / 3 / 4 / 5	A / B / C / D / E
The cell engulfs a smaller, oxygen-using prokaryote and does not digest it. The two live together: the host shelters it and takes the ATP it releases.	1 / 2 / 3 / 4 / 5	A / B / C / D / E
A cell that already has mitochondria engulfs a photosynthetic prokaryote, a cyanobacterium.	1 / 2 / 3 / 4 / 5	A / B / C / D / E

Part 5 · Build the argument

Examine an organelle

Judge the evidence

Order the steps

Build the argument



Click the **Build the argument** tab at the top of the tool.

Then write your own version below, without copying the tool's wording.

8. Explain why the double membrane of a mitochondrion is evidence for the theory. Say where each of the two membranes came from.

9. Explain why the lysosome is not thought to have arisen in the same way as a mitochondrion.

10. Explain how we know the mitochondrion was acquired before the chloroplast.

Part 6 · Learning check self-report

  Scroll down to the **Learning check** at the bottom of the tool. Type each answer in your own words, check it, and tick the points you earned. Then record your score here and, for every point you did not earn, write what the rubric asked for that your answer left out.

Question	Points possible	Points I earned	Missed opportunities (what the rubric wanted that I left out)
1	2		
2	3		
3	2		
4	2		
Total	9		

What the model simplifies

The two hypotheses are presented as a clean pair. The real history is messier: there is active research on how many engulfing events there were, in what order, and how much of the original genome moved to the nucleus.

Evidence is scored by counting lines. Real scientific arguments weigh evidence rather than counting it, which is why the tool and this handout also ask which line is strongest and which is weakest.

The infolding account for the endomembrane system is well supported but less directly than endosymbiosis, because there is no surviving free-living relative to compare against.

The tool draws a mitochondrion and a chloroplast at similar sizes for clarity. A chloroplast is usually considerably larger.