Alive or Not?

Weigh research evidence about what makes something living.

BIO.1A.4 "Use evidence from current scientific literature to support whether a virus is living or non-living"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline evidence that viruses depend on host cells, circle evidence that viruses evolve, and number the two studies cited. Use your marks to weigh both sides of the question.

The Case of the Huge Phage

1 A drop of pond water may contain phages, viruses that infect bacteria. Are these tiny particles alive? Scientists do not settle that question by size or by whether a virus can cause illness. Instead, they compare observations with traits often used to describe life, such as making new copies, using energy, and changing across generations. A virus carries genetic instructions inside a protein coat, but it has no cell of its own. When a phage enters a bacterium, the bacterium's machinery can make viral parts. Outside a host cell, the phage does not make new copies.

2 In a 2020 *Nature* study, Al-Shayeb and colleagues examined genetic material from huge phages found in many environments. Some carried genes related to protein production, a process usually associated with cells. That finding complicates the idea that all viruses have only a few genes. Yet the study did not show these phages making proteins or reproducing on their own. Even a phage with useful genes must rely on a host cell's working machinery to assemble new phages. This evidence supports a non-living classification if independent metabolism and reproduction are required, but a gene count alone cannot settle the question.

3 Other evidence points in a different direction. In a 2022 *Science* study, Zayed and colleagues analyzed ocean RNA sequences and identified thousands of previously unknown RNA virus groups. Their comparisons revealed patterns of viral diversity shaped by evolutionary change over time. Evolution is a trait often linked to life, even though individual virus particles do not grow or reproduce by themselves. The ocean study identifies viruses through genetic evidence; it does not show a single particle carrying out metabolism. A reasoned conclusion must therefore name the criterion being used, cite evidence from the studies, and explain why evidence for evolution does not automatically prove independent cellular activity.

2 ANSWER WITH EVIDENCE

Use the passage

1. What finding from the Al-Shayeb study might make someone question a simple non-living classification of viruses? Explain why.

2. Why does the Al-Shayeb finding not show that huge phages can reproduce independently?

3. How does the Zayed study support a living classification, and what does it leave unproven?

4. If you require independent reproduction for something to be living, which classification does the passage support? Use evidence from both studies.

3 YOUR TURN

Your own words

Researchers find a new virus that makes no new particles in a nutrient-rich container but makes particles inside host cells. Its descendants also show inherited genetic changes. In four or five sentences, decide whether to call it living or non-living, using this finding and one result from each study in the passage. Explain how a different criterion could lead to a different decision.

Alive or Not?

PART 1 · READ AND MARK

Underline evidence that viruses depend on host cells, circle evidence that viruses evolve, and number the two studies cited. Use your marks to weigh both sides of the question. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What finding from the Al-Shayeb study might make someone question a simple non-living classification of viruses? Explain why.	**Some huge phages carry genes related to protein production, a process usually associated with cells.**
2	Why does the Al-Shayeb finding not show that huge phages can reproduce independently?	**The study did not show them making proteins or reproducing on their own. They still rely on a host cell's machinery to assemble new phages.**
3	How does the Zayed study support a living classification, and what does it leave unproven?	**Its genetic comparisons provide evidence of viral evolution, a trait linked to life. They do not show an individual virus particle carrying out metabolism.**
4	If you require independent reproduction for something to be living, which classification does the passage support? Use evidence from both studies.	**Non-living. The huge phages studied by Al-Shayeb still depend on host machinery, and the evolution shown by Zayed's genetic comparisons does not demonstrate independent reproduction.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would call the new virus non-living because it makes new particles only inside host cells, not in the nutrient-rich container. Al-Shayeb's study found that even huge phages with genes related to protein production still depend on host machinery. The inherited changes resemble the evolutionary patterns supported by Zayed's study of ocean viruses. Someone who treats evolution, rather than independent reproduction, as the deciding trait could call the new virus living.

Accept either classification in Part 3 if the student applies a stated criterion consistently, uses accurate evidence from both studies and the new finding, and explains the other position. Genes related to protein production are not evidence that a phage makes proteins independently.