Where Life Begins

Use cell theory and evidence to examine the boundaries of life.

BIO.1A "Students will demonstrate an understanding of the characteristics of life and biological organization. Develop criteria to differentiate between living and non-living things..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline three statements of cell theory, number the levels of organization from cell to organ system, and circle evidence for and against calling a virus living. Use your marks to compare the evidence in the questions.

Cells, Systems, and a Boundary Case

1. In 1665, Robert Hooke looked at thin cork with a microscope and named the empty compartments he saw "cells." Cork was once living tissue, but the compartments Hooke saw were the walls of dead cells. Later, Matthias Schleiden concluded that plants are made of cells, and Theodor Schwann reached the same conclusion for animals. Rudolf Virchow argued that new cells arise from existing cells. Together, these findings support cell theory: living things are made of one or more cells, cells are the basic units of life, and cells come from other cells. An empty cell wall alone does not carry out life processes.

2. To judge whether something is alive, ask whether it is cellular and carries out processes such as using energy, maintaining internal balance, and responding to changes. A single cardiac muscle cell uses energy to contract. Many such cells work together as cardiac muscle tissue. Muscle tissue joins nerve and connective tissues to form the heart, an organ. The heart works with blood vessels in the circulatory organ system, moving blood so cells receive oxygen and nutrients. This movement helps the body maintain internal balance. A heartbeat is not proof that every part of the system is independently alive: the system depends on its living cells.

3. An influenza virus carries genetic instructions inside a protein coat, but it is not a cell. Outside a host cell, it cannot use energy or make copies on its own. Inside a host cell, its instructions redirect the cell's machinery to produce new viruses. Recent ICTV taxonomy papers in *Archives of Virology* document viral genomes and replication patterns. Those findings show that viruses have inherited information and can evolve, traits linked to life. Yet a virus fails the cellular and independent energy-use criteria. By the cell theory criteria used here, it is classified as nonliving, although scientists debate where to draw the boundary.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why does Hooke's observation of cork not prove that the compartments he saw were living?

2. How did Schleiden, Schwann, and Virchow each contribute to cell theory?

3. Trace the path from one cardiac muscle cell to an organ system. Explain how the levels work together.

4. Use one finding reported in the scientific papers and two life criteria from the passage to explain why classifying a virus is difficult.

3 YOUR TURN

Your own words

Imagine a newly discovered multicellular seabird that drinks seawater and removes excess salt. In four sentences, propose a cell-to-organ-system pathway for salt removal, then describe two observations that would help show the bird is living.

ANSWER KEY

Where Life Begins

HIGH SCHOOL · BIO.1A

PART 1 · READ AND MARK

Underline three statements of cell theory, number the levels of organization from cell to organ system, and circle evidence for and against calling a virus living. Use your marks to compare the evidence in the questions. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why does Hooke's observation of cork not prove that the compartments he saw were living?	**He saw the walls of dead cells. Empty cell walls do not carry out life processes.**
2	How did Schleiden, Schwann, and Virchow each contribute to cell theory?	**Schleiden concluded that plants are made of cells, Schwann concluded that animals are made of cells, and Virchow argued that new cells come from existing cells.**
3	Trace the path from one cardiac muscle cell to an organ system. Explain how the levels work together.	**Cardiac muscle cells form cardiac muscle tissue. That tissue joins other tissues in the heart, which works with blood vessels in the circulatory organ system to move blood.**
4	Use one finding reported in the scientific papers and two life criteria from the passage to explain why classifying a virus is difficult.	**The papers document viral genomes and replication patterns, supporting the finding that viruses have inherited information and can evolve. However, viruses are not cells and cannot use energy independently, so they fail two criteria for life.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Salt-pumping cells could form a tissue that lines a salt gland. The gland could work with ducts and other salt-removing organs in an excretory organ system. I would observe whether its cells use energy to move salt. I would also check whether the bird keeps its internal salt level stable when the salt level of its water changes.

Accept other plausible cell-to-tissue-to-organ-to-system pathways that explain how the parts work together. For the open task, observations must address two characteristics of life, not merely name them.