Borrowed Machinery

How a virus uses a cell to make more viruses

BIO.1C.3 "Contrast the structure of viruses with that of cells and explain why viruses must use living cells to reproduce."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB In paragraph 1, circle the phage's genetic material and coat, and underline two cell structures the phage lacks; in paragraph 2, number three ways the cell helps build new phages.

A Phage in a Pond

1. A bacteriophage, a virus that infects bacteria, lands on a living bacterial cell in a drop of pond water. The phage has genetic instructions, in this case DNA, packed inside a protein coat called a capsid. Its shape helps it attach to the bacterium. The bacterial cell is much more than a package of DNA: a cell membrane encloses cytoplasm, DNA, and ribosomes that build proteins. It also takes in materials and releases energy from food. The phage has no cytoplasm or ribosomes, so its DNA cannot direct protein production on its own.

2. When the phage attaches, it delivers its DNA into the bacterial cell. The viral DNA gives instructions that redirect the cell's activity. The bacterium's ribosomes read messages made from those instructions and assemble viral proteins from amino acids. The cell also supplies energy and raw materials to copy the viral DNA. New capsids form, and copies of the DNA are packaged inside them. This process builds new phages from parts inside an infected cell. A phage left in pond water without a living host cannot carry out these steps, even if nutrients surround it.

3. After many new phages have assembled, the infected bacterium may break open, releasing them into the pond. Nearby bacteria can then become hosts. By contrast, an uninfected bacterium can grow and divide when conditions provide water and nutrients; it uses its own ribosomes and other cellular machinery. Viruses do not grow into larger viruses or split into two. They are assembled from new parts made with a host cell's machinery. Other viruses may carry RNA instead of DNA, and some have an outer envelope, but none has the complete cellular machinery needed to make copies without a living cell.

2 ANSWER WITH EVIDENCE

Use the passage

1. Both the phage and the bacterium have DNA. Which two structures does the bacterium have that the phage lacks, and why does one of them matter for making proteins?

2. Once phage DNA enters a bacterium, how do the phage's instructions and the bacterium's structures work together to make capsid proteins?

3. Why can a phage surrounded by nutrients in pond water not produce new phages without a bacterium?

4. How is the production of new phages different from the way an uninfected bacterium produces another bacterium?

3 YOUR TURN

Your own words

A newly discovered virus has RNA inside a protein coat and an outer envelope. A student claims that its envelope makes it a cell that can reproduce on its own. In four or five sentences, correct the claim by comparing it with a cell and explaining what a living host must provide.

ANSWER KEY

Borrowed Machinery

PART 1 · READ AND MARK

In paragraph 1, circle the phage's genetic material and coat, and underline two cell structures the phage lacks; in paragraph 2, number three ways the cell helps build new phages. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Both the phage and the bacterium have DNA. Which two structures does the bacterium have that the phage lacks, and why does one of them matter for making proteins?	**The bacterium has cytoplasm and ribosomes, which the phage lacks. Ribosomes build proteins.**
2	Once phage DNA enters a bacterium, how do the phage's instructions and the bacterium's structures work together to make capsid proteins?	**The phage DNA supplies instructions, and the bacterium's ribosomes use messages from those instructions to assemble viral proteins, including capsid proteins.**
3	Why can a phage surrounded by nutrients in pond water not produce new phages without a bacterium?	**The phage lacks ribosomes and other cellular machinery needed to make proteins and copy its DNA. Nutrients alone cannot carry out those steps.**
4	How is the production of new phages different from the way an uninfected bacterium produces another bacterium?	**New phages are assembled from parts made inside a host cell. An uninfected bacterium uses its own machinery to grow and divide.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

An outer envelope does not make the virus a cell. Its RNA carries instructions, but the virus lacks the ribosomes and cytoplasm found in cells. Inside a living host, the host's machinery can use viral instructions to make viral parts. The host also supplies energy and raw materials needed to produce new viruses.

For marking, accept DNA and capsid or protein coat circled, cytoplasm and ribosomes underlined, and three numbered host contributions such as assembling proteins, supplying energy and materials, and copying viral DNA. For Part 3, accept an explanation that distinguishes an envelope from a cell and identifies the living host's role.