uBEATS Teacher's Guide:

Viruses: Are They Living?

(Grades 9-10)

This teacher guide is a supplementary text to support the use of the uBEATS "Viruses: Are They Living?" module for grades 9-10.

To help students develop the knowledge necessary for an incredible future in health care, we created UNMC Building Excellence in Academics Through STEM (uBEATS), an online health science resource for Nebraska students.

UNMC uBEATS modules are short (15 minutes or less), interactive online health science modules to supplement curriculum taught in grades 6 – 12. These do not replace curriculum but are a supplement for teachers and students incorporating evidence-based information and UNMC expert guided material. Each module is chunked into sections with formative and summative assessments with immediate feedback provided.

Tips on how to utilize uBEATS modules:

- Internet access is required to view uBEATS modules.
- For those who have access to one-to-one technology, modules can be used in or outside of the classroom as a topic introduction, extension, or review.
- For classrooms without individual student devices modules can be used in whole group instruction. Formative assessment questions can use the teacher's preferred call and response method and summative assessment questions can be displayed on the board and answered individually by students or printed and distributed to students after viewing the module.

Objectives

- Describe the structure of a virus
- Identify reasons that viruses are not considered to be living organisms.
- Explain why viruses can be described as living.

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Introduction

Viruses come in a variety of shapes. However, no matter what they look like, the question of the day is: Are viruses alive? Scientists sometimes present conflicting responses to that question. Let's begin by finding out a few things about what viruses are made of and what they do.

Prior Knowledge

Before beginning this module, the student should understand the Next Generation Science Standards (NGSS) featuring Three-Dimensional Learning.

Core Idea LS1: From Molecules to Organisms: Structures and Processes A Framework for K-12 Education

- Life sciences focus on patterns, processes, and relationships of living organisms. Life is self-contained, self-sustaining, self-replicating, and evolving, operating according to laws of the physical world, as well as genetic programming. Life scientists use observations, experiments, hypotheses, tests, models, theory, and technology to explore how life works. The study of life ranges over scales from single molecules, through organisms and ecosystems, to the entire biosphere, that is all life on Earth. It examines processes that occur on time scales from the blink of an eye to those that happen over billions of years. Living systems are interconnected and interactive. Although living organisms respond to the physical environment or geosphere, they have also fundamentally changed Earth over evolutionary time. Rapid advances in life sciences are helping to provide biological solutions to societal problems related to food, energy, health, and environment.
- From viruses and bacteria to plants to fungi to animals, the diversity of the millions of life forms on Earth is astonishing. Without unifying principles, it would be difficult to make sense of the living world and apply those understandings to solving problems. A core principle of the life sciences is that all organisms are related by evolution and that evolutionary processes have led to the tremendous diversity of the biosphere. There is diversity within species as well as between species. Yet what is learned about the function of a gene or a cell or a process in one organism is relevant to other organisms because of their ecological interactions and evolutionary relatedness.

Science and Engineering Practices NGSS

- Constructing explanations and designing solutions

Crosscutting Concepts NGSS

- Cause and Effect

Key Terms/Vocabulary

Virus, virion, rhinovirus, rotavirus, Ebola, HPV, Zika, genome, single-stranded RNA, double-stranded RNA, double-stranded DNA, icosahedral, capsid, viral envelope, glycoprotein, lipid, hemorrhagic fever, protein, nucleic acid, energy, metabolism, homeostasis, stimulus, organism, organ.

Science Standards

This module is related to the content of **UNMC High School Alliance: Introduction to Pathology and Microbiology**

Pathology is the study of disease processes. The field lays the foundation for all clinical medicine and medical research. All diseases begin at the cellular level and changes in the structure and function of tissues ultimately lead to symptoms that health care providers see daily. This course will introduce students to medical terminology, normal histology and gross/microscopic pathology, allowing students to correlate the findings they see into basic clinical concepts.

Nebraska's College and Career Ready Standards for Science 2017 Nebraska Science Standards

Engineering in Health Sciences: SC.HSP.17.1.C

- Evaluate a solution to a complex real-world human health problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. Solutions could include the effects on the human body or solutions for environmental public health issues.

Extensions of the Lesson

- To help students become more familiar with the Key Terms of this module, the teacher can use the vocabulary list for a classroom Word Wall or integrate the vocabulary into classroom word games during review sessions.
- To help the students see personal relevance, suggest that they have a **private** conversation at home regarding viruses they have encountered.
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
  - The understanding of viruses is controversial and confusing. Some scientists talk about viruses not being living organisms, while other scientists talk about viruses as being alive. The distinction is all about whether the virus can carry out its own life cycle and replicate without depending on a host organism. In some ways, a virus is like a living heart. A heart cannot replicate on its own, and therefore is not a living organism. However, a heart is certainly a living organ, capable of staying alive even outside of the body.
  - The concept of "Life"—when it begins and when it ends—is hard to define. Some people say that life begins at the moment a sperm and an egg fuse together, while other people suggest that a sperm and an egg each are alive before they

ever encounter one another. Likewise, it is difficult to identify the moment of death. At one time, people considered the cessation of breathing as the point of death. Others believed that a non-breathing body was still alive until the heart stopped beating. Still others make the decision based on brain activity, which is itself difficult to detect for final determination.

- When judging whether something is a living organism, the key is in its nucleic acids (RNA, DNA). Nucleic acids are molecules of life that direct the life processes within an organism, as well as reproducing additional individuals of that species. Automobiles and drones can perform many activities, but they have no nucleic acids in a genome that can identify them or control their functions. Most importantly, they have no genome to reproduce babies of their kind.
- Viruses do contain their own genome, capable of communicating with cell parts of other species to replicate themselves. In fact, many scientists classify unique virus genomes as unique species—assigning to them positions in the tree of life.
- Outside of a host organism, a virus exists as an inert particle called a virion. The virion shows no signs of life. Only when the virus is inside a host cell does it become active and replicate.

Enrichment

- For information about career opportunities, see UNMC's Careers in Healthcare.
- Students should be watchful in current events for recent stories about viral infections.
- PBS *Eons* offers an 8-minute video Where Did Viruses Come From?
- A quick (1:43) discussion from *Life's Little Mysteries* is available at Are Viruses Alive?
- A 5-minute presentation from *Virus Watch* is Are Viruses Alive?
- An example of a classroom activity about viruses would be an in-class exploration of ViralZone.
- To make connections in your community, contact the American Red Cross, local hospitals, healthcare clinics, nurses, doctors.