SCSU CRISP CCSA Teacher Module 2016

Title of Module: VirEx Delivery

Subject or Unit of Study: Biotechnology, Synthetic Biology

GRADE LEVEL: _____5-12+_____ **LENGTH OF DEMO/LESSON**: _____

STUDENT OBJECTIVES:
Students will learn the following concepts:
1) Synthetic biologists solve problems by applying engineering principles to the life sciences.
2) Researchers in the field of synthetic biology are engineering viruses to help treat diseases.
3) Synthetic biology benefits from many voices.

NEXT GENERATION SCIENCE STANDARDS

NGSS Performance Tasks	**MS-LS1-1: From Molecules to Organisms: Structures and Processes** • Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. **MS-ETS1-1 Engineering Design** • Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **HS-LS1-1. From Molecules to Organisms: Structures and Processes** • Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. **HS-ETS1-1 Engineering Design** • Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
NGSS Disciplinary Core Ideas (DSI)	**MS - LS1.A: Structure and Function** • All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). **MS - ETS1.A: Defining and Delimiting Engineering Problems** • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. **HS - LS1.A: Structure and Function** • Systems of specialized cells within organisms help them perform the essential functions of life. • All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. **HS - ETS1.A: Defining and Delimiting Engineering Problems** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.

	• Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
NGSS Cross-Cutting Concepts (CCC)	**CCC 3 - Scale, Proportion, and Quantity** • Phenomena that can be observed at one scale may not be observable at another scale. **CCC 6 - Structure and Function** • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. **Interdependence of Science, Engineering, and Technology** • All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS) • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS) • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS)
NGSS Science and Engineering Practices (SEP)	**SEP 1 - Asking Questions and Defining Problems** • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.(MS) • Analyze complex real-world problems by specifying criteria and constraints for successful solutions.(HS) **SEP 5 - Constructing explanations (for science) and designing solutions (for engineering)** • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

COMMON CORE STANDARDS

CC-ELA/Literacy Standards	**RST.6-8.1** • Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1) **WHST.6-8.8** • Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1) **WHST.9-12.2** • Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1)

	WHST.9-12.9 • Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-1) **RST.11-12.7** • Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1) **RST.11-12.8** • Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-1) **RST.11-12.9** • Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-1)
CC-Math	**MP.2** • Reason abstractly and quantitatively. (MS-ETS1-1) (HS-ETS1-1) **MP.4** • Model with mathematics. (HS-ETS1-1) **7.EE.3** • Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1) **6.EE.C.9** • Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-1)

MATERIALS

- Activity and facilitator guides
- Activity sign and holder
- Index cards
- Purple and orange yarn
- Scissors
- Tape
- Small cardboard takeout boxes
- Sticky notes
- Markers
- Reference sheets: Synthetic biology, Genes and DNA, and Structure of a Virus

SAFETY

Use caution when handling scissors

LEARNER BACKGROUND
Students should have an understanding of what a virus is – what makes a virus, how it works etc.

LEARNING ACTIVITY OR PROCEDURE:
Please see the Building with Biology facilitators guide for activity instructions

ASSESSMENT:
Provide an assessment to measure student progress of objectives.

STEM CAREERS:
Biomedical Engineer
Bioengineer
Geneticist
Medical Device Designer
Quality Control/Quality Assurance Technician
Research Scientist
Synthetic Biologist

ADDITIONAL RESOURCES:
Apply any links or additional information for students or teacher including videos, websites, etc.

TEACHER NOTES:
Things to talk about:

- How did you choose which disease you wanted to cure?
- Is it surprising to think about using a virus to treat a disease? How could you test your cure to be sure it was as safe as possible?
- Can you imagine other uses for "re-programming" viruses, beyond fighting disease?