Hacking Viruses

Overview

Using articles, questions, and a design challenge, you will learn about a scientific process by which viruses are reprogrammed, given new materials into their capsids – or bodies – and can be used to do a number of tasks quickly and safely. Then, you will read an article about how scientists are using viruses and their assembly methods to solve problems. Finally, you will design your own solution that uses current technology to solve a scientific problem. This can include climate change and problems related to it, energy production, food and agriculture, or other ideas. This will help with your upcoming project as well as learn about recent scientific developments in hacking viruses.

By the time you complete this assignment, you should know and understand the following:

- The “life” cycle of the virus
- How scientists program it
- What scientists can do when they reprogram it
- Identify ways in which programmed viruses can make your lives easier

Part 1. Virus life cycle Research Review

After you complete this section, you should be able to do the following

1. Describe how the structure of a virus enables it to function within a host
2. Describe the life cycle of a virus as it infects a host

Instructions

Use only this link and answer the questions below.

You will not have to read the entire contents of the link unless you want to know more. Refer to the table below to help you figure out which specific heading titles you should read. I color coded the boxes for your convenience:

Have you completed Are Viruses Alive?	**Then do this**
Yes!	OK! Read these headings and answer the questions in the blue boxes: **Virus genomes, What is a viral infection?**
No! These sections are a general review of the science of viruses	OK! Then read and answer the questions in the blue boxes: **Key points, Introduction, What is a virus?**
What if I completed Are Viruses Alive and want to know more? ***These sections are not required for the lesson, but contain interesting information about viruses***	Then the questions in the yellow boxes are for you. ***How are viruses different from bacteria? The structure of a virus, Virus capsids, Virus envelopes***

Article Prompts

Section	As you read this section, answer the following prompts
Virus genomes	What are the four different types of genetic material found in the viral genome?
What is a viral infection?	Describe what happens in the viral life cycle in each of these five parts: 1. Attachment 2. Entry 3. Genome replication and gene expression 4. Assembly 5. Release
Key points	Define: ● Virus ● Capsid ● Envelope ● Infection
Introduction	1. How big are viruses? 2. How plentiful are viruses?
What is a virus?	1. What is meant by the “commandeer” when used in this context? 2. Why are viruses not considered living things? 3. What makes viruses exist in the “in the questionable zone” between living and nonliving?
How are viruses different from bacteria?	List three differences between bacteria and viruses
The structure of a virus	What key features do all types of viruses possess?

Virus capsids	1. What comprises the capsid? 2. What are the different shapes of viruses?
Virus envelopes	1. How does the viral envelope enable the virus to attach to a host cell?

Part 2: Reprogramming Viruses Resource Review

After you complete this section, you should able to:

1. Relate how scientists use the viral cycle to perform tasks
2. Describe how viruses are able to help solve scientific and medical problems

In Part 1, you learned about the viral life cycle and some of the physical attributes of a virus. You learned about how they use a host to replicate themselves and spread. You also learned that they are simple. In this section, you will learn how scientists can reprogram their rudimentary genomes to assign viruses to do tasks.

1. Below are three different articles about different ways that reprogramming viruses can aid in solving human problems. Decide which articles would be most interesting for you to read. As you read the articles, use the organizer below to collect key points and ideas from the text.

Article Summary	Recommended for those interested in…
Viruses Can be Used to Make Batteries	Technology, Engineering
Viruses may be able to be programmed to regulate marine ecosystems	Environmental science, ecology, marine biology
Viruses reprogrammed to attack cancer	Biology, Medicine, Oncology

Article Organizer v2.0	
Prompt	Answer
What is the problem that viruses are solving?	
Why is that problem important to solve?	
How are viruses being used to solve a problem?	
What is the mechanism by which the virus works?	
What are additional ways NOT discussed in the article that could benefit people and their environment?	

Part 3: What Problem Would You Solve with a Reprogrammed virus?

In part 2, you read about one way that viruses are reprogrammed to solve medical and scientific problems. In this section, you will investigate other ways that reprogrammed viruses are used in science and design a solution to a problem of your choosing that involves reprogrammed viruses.

You will present your design, as well as an explanation of how this design is likely to have a positive impact on a problem of your choosing. Your audience for this presentation will be someone with the resources and power needed to help you build and test a prototype of your design. For example, this may be your school principal or another leader in your community. Unfortunately, since we do not have any boxes of reprogrammed viruses on hand, this idea will remain theoretical but your use of viruses must be realistic and comparable in scale to the problems solved in the articles.

The format of your presentation may be a written report, a poster, or slides. You should also use images and/or 3D models to support your presentation.

Your final product must include each of the following components. Everything on this list must be included, but you may decide to change the order:

1. Determine an audience for your design idea and explanation of why you choose that audience. Create your product with this audience in mind.
2. Describe the problem you are trying to solve:
    - Describe the problem that you want to solve
    - Describe how the article you chose uses reprogrammed viruses to solve a problem
    - Explain how the effects of your problem are disrupting something that matters to you. Be sure to explain the impact of the problem on you or other living organisms.
    - Explain why viruses can be applied to reduce the impacts of your problem.
    - Provide a model to illustrate the process of the virus as it is introduced and continues its life cycle making its product. Be sure to explain what is happening to the virus at each stage of its life cycle.
    - Explain the connection between the process of the viral life cycle and the problem you are solving.

3. Describe how you will know that the solution is successful.
    - Which part of the problem are you trying to solve? Why?
    - How will your solution affect the ecosystem? Explain how the solution will cause a change or maintain stability so that you get the desired effect.
    - What amount of impact will your solution have on the problem? In what timeframe?
    - What evidence will show that you have solved the problem? How will you collect this evidence?
    - What perspectives do different stakeholders have on the solution to this problem? Identify at least three stakeholders with different perspectives, and describe how their perspectives on success vary.
4. Identify the constraints of this design:
    - What materials are available to you for the design?
    - What is the budget for your design?
    - What are risks of the design, especially risks to safety?
    - What are any potential negative impacts on the environment?
    - What ethical constraints did you consider?
5. Identify trade-offs involved in your design:
    - What trade-offs are necessary to make the design successful while working within the limits of the constraints?
    - Which success criteria are you prioritizing? Why?
6. Provide references for your research.
7. Include a personal reflection:
    - Identify one skill you demonstrated at a high level of proficiency during this experiment. Provide an example of the skill.
    - Identify one skill you will work to improve. Explain how you identified this skill as a growth area, using an example from this investigation.

Guidelines

This box can be ***one*** of or a ***mix*** of:

- An essay
- Expanded and print outed to draw.
- A picture of a drawing or chart

Go here to see a suggested slide show format

Teacher Facing Guide

NGSS S&E Practices

Standard	Where the students do this	How the students are asked
• Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.	Part 2, Article organizer, last 2 boxes	As a direction
• Analyze complex real-world problems by specifying criteria and constraints for successful solutions	Part 3.4	4. Identify the constraints of this design:
• Ask questions to clarify and refine a model, an explanation, or an engineering problem.	During feedback sessions	Via a rubric they will use to give each other feedback
Constructing Explanations and Designing Solutions	Part 3.1, 2, 4, 5	As prompts in the project guidelines

Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.		
Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	Part 3.3	