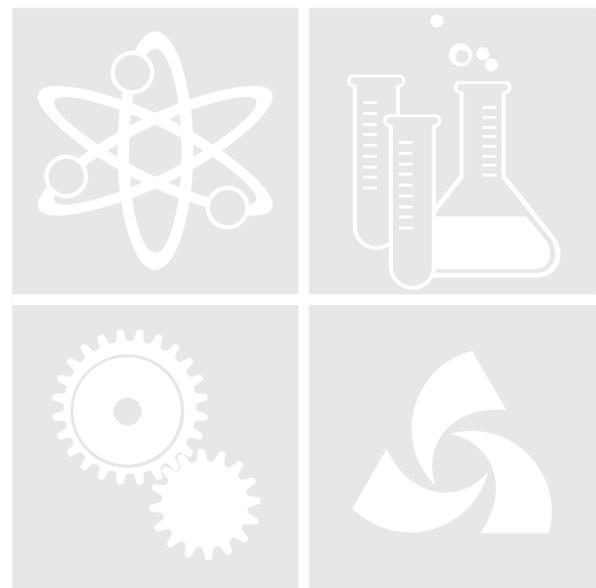
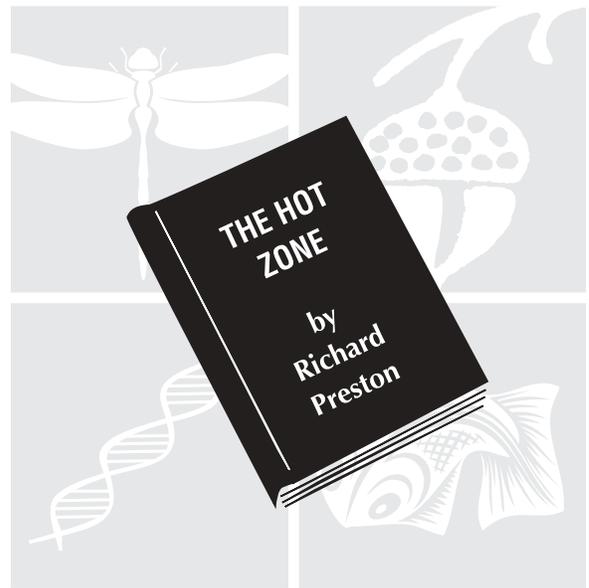
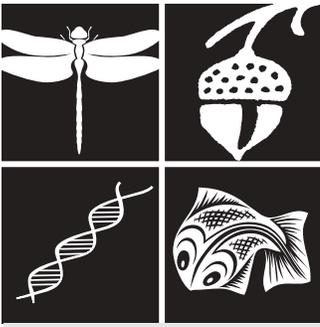


Grades

9-12

Strategic
Science
Teaching





Title of Lesson:

Virus Alert

Essential Question:

What are various types of pathogens and how do they affect organisms?



Conceptual Statement:

Viruses differ from prokaryotic and eukaryotic cells in complexity and general structure. The threats they pose are related to the nature of virus reproduction, human behavior and human defense systems.

Conceptual Learning Sequence:

This lesson is part of a conceptual unit on pathogens and their affects on organisms. It is appropriate after students have a general understanding of disease, human defenses (e.g., antigens/antibodies), and disease-causing agents including bacteria.

Student Outcomes:

- Students describe the structure and reproductive requirement of viruses.
- Students participate in a simulation to explore the relationship of human behavior to the spread of viruses.
- Students extract information about viruses from expository text.

Lesson Overview:

In this lesson, students participate in an activity that models the invisible and rapid spread of viruses. The students read and analyze sections of *The Hot Zone* using the learning strategy "Question-Answer Relationships" (QAR) to access information about the nature and reproductive requirements of viruses, and to better understand the human role in the spread of viruses. "QAR" helps students identify different kinds of questions and create strategies for finding the answers.



English Language Learning:

English Language Development standards are referenced in the lesson where appropriate. The hand icon appears throughout the lesson when learning strategies and lesson components are identified as pathways for academic success and reflect critical developmental difference for students who are English learners.

Literature in the Science Learning Cycle:



The literature selection, *The Hot Zone*, is used in the ENGAGE stage to create a graphic picture of the spread and the effects of a virus on humans. The literature is also used in the EXPLORE and ELABORATE stages to build understanding about the structure and reproductive requirements of viruses, and the relationship of human behavior to the spread of the viruses.



Learning Strategy:

This lesson uses the "Question-Answer Relationship" ("QAR") learning strategy which is based on the four-part system for classifying questions: Right There; Think and Search; Author and You; and On Your Own. (See Appendix pages 171-173.)

Literature Selection:

Title: *The Hot Zone*



Author: Preston, Richard

Publisher: Anchor Books, 1998 ISBN: 0385479565; (small format paper-back 4 1/4 inches x 6 1/2 inches)

Annotation: This is a dramatic, true account of the appearance of lethal viruses into the human population and the battle to contain them. The book is very graphic and fast-paced.

Genre: Narrative Nonfiction

California Science Content Standards:*

Biology/Life Science; Grades 9-12

Cell Biology

1. The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:

- c. Students know how prokaryotic cell, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.

Ecology

6. Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:

- b. Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.



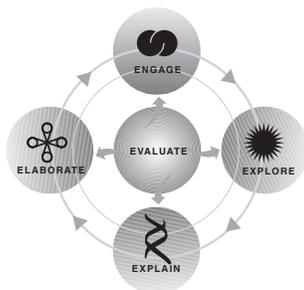
Investigation Experimentation

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:

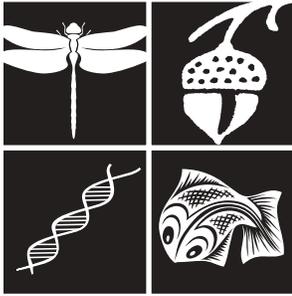
- d. Formulate explanations by using logic and evidence.
- g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
- l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.

*Specific standards addressed in this lesson.

Lesson at a Glance



Science Learning Cycle	Objective Learning Strategy, Science Process	Suggested Time
ENGAGE	Students engage in connecting their current understanding of viruses to new situations. By reading a powerful section of <i>The Hot Zone</i> and by using the “QAR” strategy to answer questions and generate their own, students prepare for the simulation. Communicating	50 minutes (one class period)
EXPLORE	Through a simulation, students explore how quickly a virus spreads. Students continue building and answering their questions by visiting appropriate web sites, using text material and doing further reading in <i>The Hot Zone</i> . Observing, Communicating, Ordering, Inferring	50-100 minutes (one to two class periods)
EXPLAIN	Students explain the content of the questions they investigate. The teacher facilitates the discussion to connect the aspects of engagement and exploration activities to student understanding of the content. Communicating, Comparing, Inferring	50 minutes (one class period)
ELABORATE	Through further reading and use of the “QAR” strategy, students expand and generalize their understanding of how filoviruses spread. Communicating, Comparing, Inferring, Applying	50 minutes (one class period)
EVALUATE	Students evaluate their understanding by constructing a poster that informs how to prevent the spread of viruses. Teacher evaluates student understanding of student outcomes in this activity as well throughout the lesson. Applying	50 minutes (one class period)



Virus Alert

Teacher Background:

Viruses consist of genetic material, either DNA or RNA, surrounded by a protein coat. Some viruses appear to be harmless to humans, while others cause important infectious diseases.

There is on-going controversy over whether or not viruses are living. Viruses depend on a host's cell for the virus's metabolic and reproductive needs. Viruses are typically transmitted through air or fluid, and do not respond to antibiotics.

The Ebola virus cited in *The Hot Zone* belongs to a family of viruses called filovirus. These viruses look like a strand of thread that may tangle or roll into loops. Some or all filoviruses are particularly contagious and lethal.

Related Standards:

English-Language Arts: Grades 9-10

Reading Comprehension (Focus on Informational Materials)

Students read and understand grade-level-appropriate material. They analyze the organizational patterns, arguments, and positions advanced.

Comprehension and Analysis of Grade-Level-Appropriate Text

2.5 Extend ideas presented in primary or secondary sources through original analysis, evaluation, and elaboration.

Listening and Speaking

Students formulate adroit judgments about oral communication. They deliver focused and coherent presentations of their own that convey clear and distinct perspectives and solid reasoning. They use gestures, tone, and vocabulary tailored to the audience and purpose.

Organization and Delivery of Oral Communication

1.8 Produce concise notes for extemporaneous delivery.

2.4 Deliver oral responses to literature:

Advance a judgment demonstrating comprehensive grasp of the significant ideas of works or passages (i.e., make and support warranted assertions about the text.)

Support important ideas and viewpoints through accurate and detailed references to the text or to other works.

Reading: Grades 11-12

Comprehension and Analysis of Grade-Level-Appropriate Text

2.4. Make warranted and reasonable assertions about the author's arguments by using elements of the text to defend and clarify interpretations.

English Language Development Standards

Reading Comprehension

Recognize a few specific facts in familiar expository texts such as consumer and workplace documents and content area texts.

Read and orally identify a few specific facts in simple expository text such as consumer and workplace documents and content area texts.

Orally identify main ideas and some details of familiar literature and informational materials/public documents (e.g., newspapers, brochures, etc.) using key words or phrases.

Apply knowledge of language to achieve meaning/comprehension from informational materials, literary texts, and texts in content areas.

Listening and Speaking

Actively participate and initiate more extended social conversations with peers and adults on unfamiliar topics by asking and answering questions and soliciting information.

Prepare and deliver short presentation on ideas, premises, or images from a variety of common sources.

Grouping:

Whole group, groups of 4, individual

For hands-on activities, mix the EL with the native speakers. For debriefing, include at least two EL with native speakers to form discussion groups.

Materials:

Per Class

Clear base indicator (phenolphthalein) in a dropper bottle or with a pipette

Base solution, 10 ml of 0.1 M NaOH or 20% solution of Liquid Drano™ for one student (see advanced preparation)

Per Student

Small clear cup, test tube or beaker (20 ml or more)

Dropper, or pipette

Water, 10 ml

Post-its™

Advanced Preparation:

1. Prepare the base solution of NaOH by placing 0.4 grams of NaOH dissolved in enough water to make 100 ml of solution OR place 20 ml of Drano in 80ml of water.
2. Put 10 ml of water in all of the students' cups but one; put 10 ml of the base solution in this one cup. There should be one student "infected" with the base solution for every 24 students participating.



Glove and Safety glasses required.

Teacher Resources:

Centers for Disease Control (U.S. Department of Health and Human Services)
<http://www.cdc.gov/>

The Biology Project (University of Arizona)
http://www.biology.arizona.edu/cell_bio/tutorials/pev/problems.html

Teacher Tips:

- Teach the "QAR" methodology to students before doing this lesson.
- Obtain a commercial kit that models the rapid spread of viruses (See Lab Quest) instead of doing your own preparation.
- Do not let the students know that one student has a different solution; the "infection" needs to be invisible.
- Make sure that the student-generated questions used in the class chart reflect the content that needs to be addressed in this lesson. If they do not, add the appropriate questions.
- In Step 10 and 11, decide how direct to be with the activity directions. For example, provide an overhead with the directions on it, or model the first exchange before having the class complete their exchanges.
- The page numbers in this lesson correspond with the small format (4 1/4 inches x 6 1/2 inches) paper-back version of *The Hot Zone*.

Related Student Resources:

Cook, Robin. *Outbreak*. Berkeley, 1991.

Garrett Laurie. *The Coming Plague*. Viking, 1995.

Horowitz, Leonard G. and Martin, W. John. *Emerging Viruses: AIDS and Ebola, Accident or Intentional*. Tetrahedron, 1996.

Roca, Núria Bosch and Serrano, Marta. *La Célula, El Origen do la Vida*. Norma SA, 1995.



VOCABULARY

eukaryotic – cells which contain a visibly evident nucleus and organelles. Eukaryotic cell structure is characteristic of all organisms except bacteria and blue-green algae

filovirus – a virus with an unusual thread or strand shape, very contagious and dangerous, e.g., Marburg and Ebola

pathogens – disease-causing agent, e.g., some viruses, bacteria, fungi

prokaryotic – cells which do not have a distinct nucleus. Prokaryotic cell structure is characteristic of organisms such as bacteria or blue-green algae (cyanobacteria)

virus – a microorganism that consists of a protein covering and either DNA or RNA inside the covering. Viruses reproduce only within the cells of their host

The Science Learning Cycle:

Virus Alert



ENGAGE:

1. Use a think-pair-share strategy to help students make connections between their current knowledge of viruses and what they will learn in this lesson. Ask students to think about what they already know about viruses. Allow one minute for thinking. Have students share what they know about viruses with a partner. Have partner groups share with the class. Record class responses about viruses.



2. Explain to students that they are going to read selections from *The Hot Zone* to add to their understanding of viruses.
3. Preview the book with the students: have students relate the picture on the cover to what they know about viruses; ask students to predict what the title might mean; have students read the table of contents to get an overview of the book; note the list of main characters and glossary found at the end of the book; have students look at the map to determine the setting for the story.
4. Have students read the first seven pages, beginning with “Infectious Area No Unauthorized Entry” to “Caution Biohazard.” Ask students to discuss what the author’s purpose is in beginning a book with these warning messages.



5. Using the “QAR” strategy, provide the students with the following four questions to answer as they read *The Hot Zone*, pages 14 -24. Partner EL students with native speakers for Step 5 and 6.
6. Right There: What is vomito Negro?
Think and Search: What is the pattern of the virus's effect on the human body?
Author and You: How does Monet’s experience in the emergency room relate to your own experiences in an emergency room or some other time when you needed swift attention?
On Your Own: If you were seated next to a passenger with these symptoms, what would you do?
7. While reading, ask students to write on post-its additional questions elicited by the reading on pages 14-24.
8. In groups of four, have students share their answers to the four questions and share their newly generated questions that were elicited by reading the text.
9. Ask students to set aside these questions as they prepare to participate in a simulation about the transmission of viruses. Explain that this activity might answer some of their questions.



EXPLORE:

Part A

10. Remind students to put on safety goggles and gloves. For every 24 students, give 23 a container with water and give one student a container with the base solution. Give one student 10 ml of base solution instead of the water. (All the students think that everyone's liquid is the same.)
- 
11. Have students walk around the classroom, find another student and ask that student to define a virus. After they exchange definitions, ask the students to exchange a small amount of liquid by inserting their own dropper into their own liquid and dropping the liquid into the other student’s container. Have students record the name of the person with whom they exchanged the fluid.
 12. Ask students to repeat step 10 with two other students and then return to their seats.
 13. Inform the students that one (or more) of their classmates was carrying a very contagious virus, a filovirus, like the one described in *The Hot Zone* reading. Identify the original carrier(s) by putting the indicator solution in that student’s container.
 14. Ask the students to review the list of students with whom they exchanged fluid. Ask, “Who thinks they may have been infected by the carrier?” Test their solution with the indicator. Continue using the indicator until all students have been tested.

The Science Learning Cycle: Virus Alert

15. Lead a discussion of the observations that the students made during this simulation. For example, some students may not have been directly infected by the identified carrier but were infected secondarily by someone who was infected by the carrier. Some students may have exchanged fluid with someone who was infected by the carrier, but before the infection. If there is more than one student with the base solution at the beginning of the activity, the students are able to see the complications in determining the “chain of infection.”
16. Ask students to return to their list of questions that they originally generated in the reading. Ask them if this activity helped to answer any of the questions. If so, have the students remove those questions from their list.
17. Ask students to generate, on post-its, new questions from the simulation.

Part B



18. In groups of four, have the students share their unanswered questions from the initial reading and the “infection” simulation. Ask them to use the “QAR” strategy to classify their questions into the four types.
19. Create a class question chart by having each group post their questions under the appropriate categories: (Right There; Think and Search; Author and You; and On Your Own). Scan the questions and clump in each category those that are similar.
20. Divide the questions among the groups so that all groups have some questions in common and some unique questions. Make sure that the following questions are among those to be answered: In Latin, what does “filovirus” mean? What do they look like? How are Ebola and Marburg viruses similar? How are they different? How do viruses like Ebola spread and die out? What can be done to prevent the spread of viruses?



21. Direct the students to find answers to their questions by using their textbook, *The Hot Zone* (pages 37-38; 62-67; 83-86; 98-100; 105-109; 117-118, and 197-198) and the internet. Search viruses, filoviruses, Ebola in addition to these sites:
<http://www.cdc.gov/ncidod/spb/mnpages/ebola.htm>
<http://www.biology.arizona.edu/cell-bio/tutorials/pev/problems.html>



EXPLAIN:

22. Facilitate student explanation of the content (i.e., the structure and reproductive requirements of viruses, and the relationship between human behavior and the spread of viruses) by having groups share their answers to the questions. For the questions that the groups had in common, are their explanations similar? What can each group learn from the questions they did not have to answer?



ELABORATE:

23. Have students respond to the prompt “What are some other ways filoviruses spread?” as they read *The Hot Zone* (pages 215 – 217, 360 – 371). Ask students to discuss the relationship between human behavior and the spread of viruses. Ask students what questions they still have and how they might research answers to those questions.



EVALUATE:

24. Have students select one question for each “QAR” category. The questions may be selected from their own question list or the class question list. Direct students to design a poster to prevent the spread of viruses. Have students use the *The Hot Zone* “QAR” questions as an outline for the poster. The poster should indicate student understanding of: 1) the structure and reproductive requirements of viruses, 2) the relationship between human behavior and the spread of viruses, and 3) the “QAR” strategy.



Teacher Reflection:

1. How does the student work provide evidence that they learned the structure and reproductive requirements of viruses, and the relationship of human behavior to the spread of the viruses?
2. What instructional strategies used in this lesson promote student understanding? How do you know?
3. How does the literature selection support student understanding of the science concepts?
4. How would you modify instruction to ensure understanding of student outcomes by all students?