Teacher Page
LaCuKnoS Investigation – Spreading Infectious Diseases

Lesson Description
Students will explore two simulations of how disease spreads -- one computer simulation and one hands-on simulation -- as well as play the role of epidemiologists trying to figure out who the first person was who had the disease (patient zero).

Developers: Cory Buxton, OSU, and May Dartez, Cedar Shoals High School. Computer simulation developed by EPIC learning project at the University of North Carolina.

NGSS Connections:

SEPs: Using Mathematics and Computational Thinking; Developing and Using Models; Analyzing and Interpreting Data; Engaging in Argument from Evidence

CCCs: Scale, proportion, and quantity; Systems and systems modeling; Cause and effect: Mechanism and explanation

LaCuKnoS Practice(s) being highlighted

L1: Choosing language based on topic, purpose & audience

K1: Shared experiences with relevant phenomena as basis for how science knowledge is built and accepted

LaCuKnoS Tools used in lesson

In this lesson we use five LaCuKnoS tools:
- Language Booster (tool L1-1)
- Investigation Summary Template (tool L1-2)
- Multilingual Concept Cards (tool L1-3)
- Shared Anchoring Event (tool K1-1)

Language Boosters (tool L1-1) - LaCuKnoS Language Boosters are short (1-2 page), high interest science readings that provide a "hook" to engage students, a conceptual overview of the investigation topic, introduce some key concepts that will be fundamental to the investigation, and make a connection between the ideas to be learned and related experiences that students may have had in some context outside of the classroom. The Language Booster closes with 2 or 3 questions or prompts to guide students' oral and written reflections with a partner.

Investigation Summary Template (tool L1-2) - LaCuKnoS investigation guides end with an investigation summary template that encourages students to think, talk, and write with a partner about how they used science and engineering practices in the investigation. They practice using multiple registers to explain what they learned to two different audiences (e.g., Explain the main idea you learned in language that your 2nd grade cousin would understand; Explain the main idea you learned in language that your science teacher might use to describe it.)

Multilingual concept cards (tool L1-3) – LaCuKnoS concept cards define and explain a limited number (3 to 6) of important concepts, which are mentioned and highlighted in bold in the investigation -- often in the *Language Booster*. These cards provide the name, a brief "student friendly" definition and a picture of the concept, using both English and Spanish. The cards can be used flexibly, such as at the start of the lesson, as part of a word wall, to review in lab groups, or introduced as needed when working with the investigation.

Shared anchoring event (with community relevance) (tool K1-1) – LaCuKnoS anchoring events are events or processes that require students to bring together multiple ideas to explain. These events help students see the relationships between *natural phenomena* and *causal explanations.* Anchoring event should be context-rich, meaning that it is about a *specific* event that happens in a *specific* place and time under *specific* conditions (place based). When possible, there should be direct community relevance.

Concepts for Concept Cards

- Epidemiology
- Disease
- Outbreak
- Patient Zero
- Infectious disease

Materials needed

- Test tube and dropper for each participant
- Distilled water
- 0.1 molar NaOH
- pH 7.0 buffer solution
- Universal Indicator (phenolphthalein solution)

Advance Preparation

Before you teach this kit, you will need to provide the materials listed as not included in the kit. We recommend you familiarize yourself with all sections in this document before teaching this investigation.

In advance, prepare the test tubes one per student by filling each tube less than halfway with distilled water. In one cup only, add 10 drops of 0.1 molar NaOH to the water.

Other Teacher Notes:

- Do not tell the students that one tube is different but you should pay attention to which tube contains the dilute NaOH and which student receives this cup (this student is patient zero).
- Remind students not to actually drink their water sample.
- It is important for students to mingle and move around each time before they share their sample with others. If the students mostly stay in the same part of the room, then the disease will not spread well.
- When you test each student sample with the universal indicator, if the student is infected the water will turn pink. The final number of "infected," test tubes will vary depending on (1) the number of exchanges (equivalent to the number of rounds of spread in the computer simulation) and (2) how many trades occur between two already infected tubes.
- One possible method to find, "patient zero," is to have each participant write his or her name on the board, and underneath it the names of participants with whom he or she exchanged fluids in the order in which the exchanges occurred. Then as a group, highlight the names of people who end up infected. The visual representation can help clarify which participants may have infected one another, and in what order. Participants who, "test positive," and find that everyone with whom they traded also tested positive may be the original carriers of the disease. It is likely that there will be several candidates for, "patient zero." Cross-checking the history of each contact can narrow the field, but probably not to less than two candidates. *If you have a large group (30 or more) you may want to begin with two test tubes containing NaOH.
- Teacher should lead a full class discussion using the strategies the students come up with to try to determine who in the class was Patient Zero. Extend the discussion if desired with the following prompts:
    - Why is it important to find out who Patient Zero is in an outbreak of a disease?
    - How could organizations such as the World Health Organization and Doctors without Borders use similar strategies to contain a modern disease outbreak?

Safety Recommendations

* *Safety Note— Sodium hydroxide (NaOH) can irritate the eyes and skin. Make sure students know to NEVER drink chemicals in a lab.*

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do so. Continue rinsing.

Other Recommendations

Teacher Directions Extension : Immunity

Teachers will add the buffer solution to an, “infected,” cup. The solution will turn back to clear. Ask students to complete the part of their packet where it asks them to interpret what has been simulated by the addition of the buffer simulation. Discuss and then give students a couple minutes to add to their answers if they need to.

Immunity –

Vaccines provide immunity for an individual against a disease, even after exposure. Vaccines featured in the exhibit include smallpox, polio, tetanus, hepatitis B, influenza, and measles. Using the test tube with the buffer solution, add a couple of drops of the phenolphthalein indicator, followed by a couple of drops of the NaOH solution. While there might be a quick flash of pink when the drops of NaOH hit the test tube solution, the color should quickly return to clear. The buffer is acting to neutralize (figuratively and literally) the NaOH/disease.

Therapeutic drugs--Drugs can be an effective means for treating a disease after exposure. Therapeutic drugs featured in the exhibit include antibiotics, anti-malarial drugs, and antiretroviral drugs for HIV/AIDS. Drugs can be effective in preventing the spread of disease by eliminating the pathogen from the body, or by preventing the agent from functioning properly.

Alternative Versions:

- Other chemicals can be used for simulation #2. The goal is to use a difference in pH that will spread as students mix their liquids together.