Virus Outbreak

Task

Introduction of the Problem/Context: In this activity, students will simulate the uncontrolled spread of a disease through a population. Students will then conduct an epidemiological study to locate "patient zero."

Selected GPS:

Co-Requisite: Characteristics of Science

Habits of Mind

- **SCSh1**: Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.
  a. Exhibit the above traits in their own activities.

- **SCSh2**. Students will use standard safety practices for all classroom laboratory and field investigations.
  a. Follow correct procedures for use of scientific apparatus.
  b. Demonstrate appropriate technique in all laboratory situations.
  c. Follow correct protocol for identifying and reporting safety problems and violations.

- **SCSh3**: Students will identify and investigate problems scientifically.
  c. Collect, organize, and record appropriate data.
  e. Develop reasonable conclusions based on data collected.

Nature of Science

- **SCSh7**: Students will analyze how scientific knowledge is developed.
  d. Hypotheses often cause scientists to develop new experiments that produce additional data.

- **SCSh8**. Students will understand important features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:
  a. Scientific investigators control the conditions of their experiments in order to produce valuable data.

Co-Requsite: Charateristics of Science

Content

- **SB3**. Students will derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems.
  d. Compare and contrast viruses with living organisms.

Classroom Materials: Lesson Outlines

Virus Outbreak

Grade Level/Subject: Middle School Life Science or High School Biology

Overview: In this activity, students will simulate the uncontrolled spread of a disease through a population. Students will then conduct an epidemiological study to locate "patient zero."

Key Objectives:

- To investigate a problem scientifically (GPS: SCSh3 c, e).
- To keep detailed and accurate records of data collected (GPS: SCSh4 a).
- To develop reasonable conclusions based on data collected (GPS: SCHSH3 c).
- To understand how viruses spread (GPS: SB3 d).

Learning Outcomes:

- Students will know:
  - → that viruses spread quickly and can cause epidemics.
  - → that controlling the conditions of their experiments is important when conducting investigations.
- Students will be able to:
  - → investigate problems scientifically using the appropriate safety protocol.
  - → use data collected to develop reasonable conclusions.

Possible Materials:

- Safety Goggles
- Test Tubes
- Test Tube Racks
- Distilled Water
- Pipettes/Droppers
- dilute solution of HCl or other acid
- pH indicator, such as Phenolphthalein

* Please note, any indicator may be used in conjunction with the correct chemical as long as the positive color change is obvious to students. For example, a dilute solution of NaOH or ammonia may also be used and tested with the appropriate basic indicator.

Task: The fluid exchange activity is designed to simulate the uncontrolled spread of a disease through a population. Test tubes are prepared with distilled water, except 1 or 2 (depending on class size), which contain a dilute (0.1M) solution of NaOH. Tubes are randomly distributed throughout the class so that each student receives one. Students are then move about the room for 5 minutes, using pipettes/droppers to exchange fluids with at least 3 people and keeping record of who they swapped with. What follows is a test to determine who has been "infected," in which students line up and have pH indicator added to their test tubes. A pink color (bright or faint) indicates a positive result; the student is "infected." Students then conduct an investigation in order to determine who are the original carriers.

Sample Questions:

In words, explain your thinking to the following problems clearly.

- Explain what an indicator is and how it works.
- Did every person in the room become infected?
- If we did this experiment long enough, would everyone become infected?
- In a real virus infection, not every person in the city comes down with the disease.
- If you were infected, describe how you would figure out which contact gave you the virus.
- What method of disease transmission is not simulated by this activity?
- Discuss two ways that the spread of viruses can be prevented.
- What does a person with a virus look like?

Assessment Ideas:

- Assign each student or group of students a viral disease. Have them create a power point or poster presentation about their virus. Topics covered might include type of virus, how it reproduces and spreads, types of plants or animals in insects, symptoms caused, signs of the disease, prevention, etc.
- Relate the activity to sexually transmitted diseases, such as HIV/AIDS. Have students journal or discuss how this activity relates to sexually transmitted diseases and how the spread of such diseases can be prevented.
- What effect does abstinence have on the spread of the virus? What if only everyone mixes with only one person? Can anyone think of a method of "safe mixing"? Each new question should be tested with a new mixing run.

Sample Question Solutions:

- Explain what an indicator is and how it works.
  → Indicators are specialized chemicals that change color in the presence of certain chemicals or molecules.
  → Indicators are added to a solution and change color if the chemical of interest it present.
  → For example, in this activity, the indicator is an acid indicator called phenolphthalein. It turns pink in the presence of an acid but the solution will stay clear if no acid is present in the solution.
- Did every person in the room become infected? Why or why not?
  → No, everyone did not become infected.
  → In only three rounds of fluid swapping, it is not possible for everyone in the room to have contact with someone who is positive for the disease.
- If we did this experiment long enough, would everyone become infected?
  → Yes, because it would allow enough time for each person in the room to swap fluids with someone positive for the disease.

- In a real virus infection, not every person in the city comes down with the disease. Why?
  → In real life, not everyone will come down with a disease because certain people are immune to viral diseases. Although the majority of the population will become infected, a few will not.
- If you were infected, describe how you would figure out which contact gave you the virus.
  → Students can either figure this out as a class or they can guide their own investigations. In order to determine who started the virus spread, each student needs to list each of the three people he or she swapped fluids with and if each of the people were positive or negative for the virus. They also need to know whether or not they tested positive for the virus. By using deductive reasoning, it becomes clear that there are 1 or 2 students that tested positive, and that everyone they traded with also tested positive. These are usually the original carriers.
- What method of disease transmission is not simulated by this activity?
  Some sample answers include:
  → # one infected person sneezing into a room full of people
  → # a single water or food supply infecting a community
- Discuss two ways that the spread of viruses can be prevented.
  → Preventing the swapping of fluids, or covering out mouths and noses when we sneeze or cough are good ways to prevent the spread of viruses.
  → Some viruses are airborne and are difficult to control.
- What does a person with a virus look like?
  → The point here is that many people can be carriers without visible symptoms of the disease. Carriers, although appearing to be healthy or harmless, can transmit disease.

* Adapted from Randall Good's Fluid Exchange Activity. www.AccessExcellence.com