



Activity 1: OutBreak!: A Simulation

Through this simulation, students will experience tracing the spread of a pathogen through a population.

Background

Epidemiology works to uncover and explain the factors that determine disease frequency and distribution. In the field of infectious disease, epidemiologists identify infectious agents, determine how they are spread, who gets infected, and the results of infection. This is a difficult task because not only are there different infectious agents, but there are also different environments in which they live, methods by which they spread, methods of invasion into the host, and different host abilities to fight the infectious agent. The possibilities are endless.

In order to answer these questions, scientists, physicians, public health care workers, and countless others combine their skills to accurately and methodically study the spread of a disease through a population. This is important because it helps to prevent the spread of future infectious diseases and limits the emergence of mutations of the disease.

This activity simulates how a pathogen can spread among a population. Students will exchange paper with one another to simulate the epidemiology of tracking an infectious agent. After this activity, the students should have a better understanding of how infectious agents spread from person to person and ways to prevent outbreaks. It can be adapted to a variety of scenarios. For example, the infectious agent could be smallpox or HIV or another pathogen that is spread by human contact.

Outbreak!: A Simulation

Learning Objectives

The student will:

1. learn the importance of epidemiology.
2. trace the spread of a pathogen through a population

Teacher Preparation

Paper strips

1. Count the number of students in the class. Cut up enough filter paper into strips approximately 1 inch by 3 inches so that each student gets five strips of paper. Coffee filters purchased at the grocery store work fine as the filter paper. Ironing helps to flatten them out.
2. Group five strips together using a paper clip, staple, or some other method to keep the five strips together.
3. Randomly select one group of five strips and dip them into the saturated baking soda solution (directions below) for a few seconds. (The student who gets these strips will be “infected” and the agent of transmission.) For a really large class, (over 25) you may want to have more than one student receive the “infected strips.”
4. Allow the wet strips to dry on a clean surface. This should take about an hour or so.
5. Regroup the five “infected” strips and assemble in the same way as you did the other packets of five strips so that all the groups of five look alike.
6. If you want to know ahead of time which student picks the infected group of strips, then you can personally pass out the strips, taking note of who gets the “infected” packet.

Saturated baking soda solution for “infected” strips

1. Add a couple of tablespoons of baking soda to one cup of water.
2. Stir the baking soda so that it dissolves.
3. Keep adding baking soda until it does not fully dissolve and collects at the bottom of the cup. At that point the solution is saturated. Now dip five strips into the solution for a few seconds.

Red cabbage pH indicator

1. Cut a head of red cabbage in half. Cut half the cabbage into small pieces.
2. Place pieces of cabbage into a large pot and add enough water to cover the cabbage. 3. Bring the water to a boil and boil for 30 minutes (or less).
4. Drain off the cabbage pieces and allow the cabbage juice to cool. (You can store this solution in the refrigerator for a number of weeks.)
5. On the day of the simulation, place the cabbage juice in a jar in a central location to serve as the “microbe testing station.” Alternatively, you can pour small amounts of the cabbage juice into plastic test tubes or paper cups, so that student groups have their own testing station.

Note: The cabbage juice acts as an indicator solution that will turn green in the presence of a base (baking soda).

Material

A. Before class

1. filter paper (a coffee filters from the grocery will work just fine)
2. scissors
3. paperclips or stapler
4. baking soda
5. water
6. measuring cup
7. red cabbage
8. pot
9. jar or test tubes or paper cups

B. During class

1. *Distribution Record Sheet* and *Data Analysis Questions*
2. strips of paper
3. pen *or* pencil
4. indicator solution (cabbage juice)

Methods/Procedure

1. Discuss the concept of epidemiology and how epidemiologists track the spread of disease.
2. Invite the students to think of questions they need to answer in order to identify the source of an unknown infectious disease.
3. Explain the purpose of the Center for Disease Control and Prevention and local public health agencies and their efforts to determine how diseases spread.
4. Tell the students that they will be receiving five strips of paper that may represent an unknown pathogen (germ) that can be passed from person to person through methods such as touch or the exchange of bodily fluids.
5. Distribute the *Distribution Record Sheet*, *Data Analysis Questions*, and the strips of paper.
6. Instruct the students to write their initials or names on each of their five strips.
7. Begin the simulation by telling students to trade one strip with another student. On their *Distribution Record Sheet*, they should write down who they traded with, the name on the strip they gave away and the name of the strip they received.
8. **On the first trade, they have to give away one of their own strips.**
9. **On the following trades, they can give away any of the strips they have (their own or that of someone who has traded with them before), but give away only ONE strip per trade.**
10. As the teacher you decide how many trades or how long you want the trading to continue. There is enough space for eight trades on the *Distribution Record Sheet*, but you can have them trade as few as five times.
11. Once all trading has stopped, ask them to use the indicator solution (red cabbage juice to see who is holding the “infected” strips. **They should dip each strip one at a time because the color may bleed onto another strip. If the strip turns GREEN, it is one of the infected strips (i.e., it has been soaked in baking soda solution).**
12. Using their *Distribution Record Sheet*, they should be able to determine the path of transmission.

Extension Activities

- *Health*: Determine what characteristics can increase the likelihood of contracting an infectious disease.
- *Health*: Discuss what environmental factors can affect the spread of an infectious disease.
- *Language Arts*: Interview a scientist or physician working in the field of epidemiology. Ask them questions about the diseases they study, what they do at work, and what infectious diseases concern them.
- *Mathematics*: Calculate the morbidity rate of the epidemic in the class by dividing the number of cases of the disease (assuming it was fatal) by the total number of students (population at risk).

Standards

1. Science Content Standard A: All students should develop abilities necessary to do science.
2. Science Content Standard C: All students should develop understanding of the structure and function of living systems.
3. Science Content Standard F: All students should develop understanding of personal health.
4. Science Content Standard F: All students should develop understanding of science and technology in society.

Books

- DeSalle, R. (1999) Epidemic! New York: The New Press.
- Hoff, B.H. and Smith, C., III (2000) Mapping Epidemics: A Historical Atlas of Disease. New York: Franklin Watts.
- Stephen, B.H., et al. (2001) Designing Clinical Research: An Epidemiologic Approach. New York: Lippincott Williams & Wilkins Publishers.

Web sites

- Epidemiology Lessons for Middle and High School Students
<http://www.montclair.edu/detectives/index.shtml>
- Critical Thinking
<http://www.criticalthinking.com/>
- Historical Infectious Diseases
<http://www.rlc.dcccd.edu/MATHSCI/reynolds/history/history.htm/>
- History of Epidemics and Plagues
<http://uhavax.hartford.edu/BUGL/histepi.htm/>
- CDC-Teaching Material
<http://www.cdc.gov/excite/index.htm>
- Emerging Infectious Disease Journal
<http://www.cdc.gov/ncidod/EID/index.htm>

Name _____ Class _____ Date _____

OutBreak!: A Simulation

Data Analysis Questions

1. Who was the original source of the outbreak?

Answer should lead to the person whose filter paper strip turned green.

2. Were some people exposed to the infectious disease (pathogen) but not infected? Would this happen in an actual pathogen exposure?

Yes. Sometimes people can contract an infectious disease, but display no symptoms of the disease. They can still pass the disease to others (example- “Typhoid Mary”). Also in an actual exposure case, the health of a person’s immune system can affect if they get symptoms of the disease or not.

3. How many people in the class were exposed to the pathogen?

Answers will vary.

4. What factors might have increased the chance of exposure to the pathogen?

Location – closer to the “outbreak” pathogen.

Repeated exposure – you got more than one infected

Quantity of pathogen – all five infected strips were being traded

5. If you were an epidemiologist, and this was an actual pathogen, what kinds of things would you do to trace back the source of the disease?

- **Verify that the pathogen that is involved is causing the disease.**
- **Create a “case definition” to define what is included as a case.**
- **Describe the outbreak with respect to time, place, and people.**
- **Develop a hypothesis**
- **Study and test the hypothesis (collect data)**
- **Develop and implement control and prevention systems**
- **Release the findings to the community**

***MISSION DEBRIEFING:* Student Activity Sheet**

Name _____ Class _____ Date _____

OutBreak!: A Simulation Distribution Record Sheet

| Exchange Number | Name of person you exchanged with | Name on strip of paper you <u>received</u> | Name on strip of paper you <u>gave away</u> |
|------------------------|--|---|--|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |

List below the names on the strips of paper that you ended up with after your final trade.

| |
|--|
| |
| |
| |
| |
| |

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