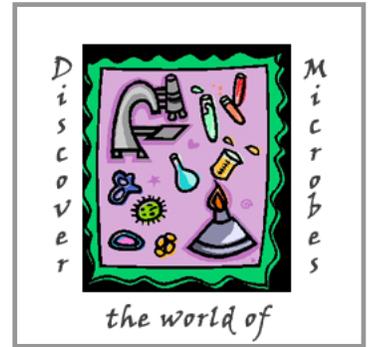


# Microbial Discovery Activity

## Outbreak!

## Investigating Epidemics



### Authors

**Liliana F. Rodriguez, MPH, RM(AAM), M(ASCP)**  
The University of Texas Health Science Center at Houston  
School of Public Health  
Houston, Texas 77030  
[Liliana.F.Rodriguez@uth.tmc.edu](mailto:Liliana.F.Rodriguez@uth.tmc.edu)

**Leslie Miller, PhD and the MedMyst Group**  
Center for Technology in Teaching and Learning  
Rice University  
Houston, Texas

### Intended Audience

K-4  
5-8        X  
9-12

### Activity Characteristics

Classroom setting	X
Uses hands-on manipulatives	X
Requires group work	X
Appropriate for special needs student	X



# Introduction

## Description

This activity simulates how a pathogen can spread among a population without the need to use any harmful material.

## Abstract

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 HIV or another pathogen that is spread by human contact. This activity can be used with ASM's Intimate Strangers Episode 6 video podcast.

## Core Themes Addressed

General Microscopy Concepts	
Microbial Cell Biology	
Microbial Genetics	
Microorganisms and Humans	X
Microorganisms and the Environment	X
Microbial Evolution and Diversity	
Other -Common properties of life; Cellular components	

## Keywords

Epidemic, Pathogens, Infectious agents, Transmission, Epidemiology, Prevention

## Learning Objectives

By completing this activity, the student will:

- Learn the concepts involved in epidemiology.
- Discuss the importance of epidemiology in disease prevention.
- Experience tracing the spread of a pathogen through a population.

## National Science Education Standards Addressed

Science Content Standard A: All students should develop abilities necessary to do science.

Science Content Standard C: All students should develop understanding of the structure and function of living systems.

Science Content Standard F: All students should develop understanding of personal health.

Science Content Standard F: All students should develop understanding of science and technology in society.



# ***Teacher Handout***

## ***Outbreak! Investigating Epidemics***

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### **Student Prior Knowledge**

None required.

### **Teacher Background Information**

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.

### **Videopodcast**

Episode 6 of ASM's *Intimate Strangers Unseen Life on Earth* videopodcast depicts scientists who seek to understand our most personal relationships with the microscopic world and follows a team from the Centers for Disease Control as they investigate an epidemic in the Four Corners area of the United States.

Viewers can access ASM's video podcast online at [www.microbeworld.org](http://www.microbeworld.org) or subscribe for free by entering ASM's URL feed address — <http://feeds.feedburner.com/asm> — into Apple's iTunes or another podcast receiver such as Juice or Doppler. Detailed instructions on how to subscribe to a podcast feed are available on ASM's MicrobeWorld website under the "Look & Listen" tab.

To directly download the corresponding episode of *Intimate Strangers: Unseen Life on Earth* for this exercise, enter [http://libsyn.com/media/flpradio/Episode\\_6\\_-\\_Dangerous\\_Friends\\_\\_Frie.mp4](http://libsyn.com/media/flpradio/Episode_6_-_Dangerous_Friends__Frie.mp4) into your browser's address field. For additional information about ASM's video and audio podcasts, please contact Chris Condayan, manager, public outreach, at 202-942-9302 or email [condayan@asmusa.org](mailto:condayan@asmusa.org).

### **Class Time**

Approximately one hour class time is required; 15 minutes to watch the videopodcast, and 45 min for the exercise.



## Teacher Preparation Time

About 1 hour to cut paper strips and prepare the baking soda and pH indicator solutions. Two additional hours are required for paper strips to dry.

### 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.
2. Group five strips together using a paper clip, small envelope, 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 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 the cabbage halves into small pieces with a kitchen knife.
2. Place pieces of cabbage into a large pot and add enough water to cover the shredded cabbage.
3. Bring the water to a boil and boil for 30 minutes.
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.



## Materials and Equipment

### A. Before class

1. filter paper (a coffee filters from the grocery will work just fine)
2. scissors
3. paperclips or small envelopes
4. baking soda
5. water
6. measuring cup
7. red cabbage
8. pot
9. kitchen knife
10. 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

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 [[www.cdc.gov/](http://www.cdc.gov/)]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 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 *Data Analysis Questions*, the *Distribution Record Sheet*, and the strips of paper.
6. Instruct the students to write their initials or names on each of their five strips. NOTE: Because some students may be sensitive that they had, or spread "disease," rather than using their real names, you may suggest that they choose and adopt a fictitious name of a character from Star Wars, Battlestar Galactica, or other popular and contemporary movies.
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).

- Using their *Distribution Record Sheet* as a "clues map," students should be able to determine who the first person infected was, and the path of transmission of the mysterious microbe.

## Safety Issues

Do not use glass tubes as containers to distribute the indicator solution. Cabbage juice may stain clothing.

## Suggestions for Assessment

Have the students answer the questions in the data analysis in small groups and report back to the larger group about their conclusions.

## Limitations

This exercise does not provide a mechanism to increase the number of infected people.



## Supplementary Materials

### Tips / Suggestions:

If the students have access to computers, they can play the MedMyst web adventure on cholera that employs some of the same type of epidemiological techniques. See <http://medmyst.rice.edu>.

This is a relatively simple exercise to introduce the concept of epidemics to young students. If you wish, you can make it more elaborated by selecting a particular infectious disease ahead of time. After the exchanges of strips you can discuss its transmission, symptoms, treatment, and prevention, or ask the students to investigate it on their own time and prepare a report.

### Answers to Data Analysis (Student Handout)

1. Who was the original source of the epidemic? **This is determined at the end of the exercise**
2. Did you get the infectious disease? **This is determined at the end of the exercise.**
3. Were some people exposed to the infectious disease (microbe) but not infected? **The answer will be affirmative if blank filter paper strips are given along with a few "contaminated" ones in the same envelope. Here you can discuss the concept of asymptomatic infections, and the role of immunity (natural or through vaccines).**
4. How many people in the class were exposed to the microbe? **It varies from group to group.**
5. What factors might have increased the chance of exposure to the microbe?  
**Here you can discuss proximity (higher probability), time of exposure, infective dose.**
6. It was possible to trade with the infected person but not get the disease. How do you think this relates to real life? **See answer to question 3**
7. What do you think would happen if two people were the original source? What about ten people?  
**Discuss how probabilities of an epidemic increase, as more people become infected.**
8. What factors affect the amount of exposure to a microbe in real life? Hint--- Does washing your hands affect your exposure? What other things may affect exposure?  
**Discuss natural immunity, how vaccines prevent infections, and the role of hygiene including hand washing.**

### Video Podcast

The videopodcast component can be eliminated if time is a constraint.

### Sample Lesson Planning Guide

A sample lesson planning guide is provided in the next 3 pages as an additional tool.



## Lesson Planning Guide

**Course/Subject:** Outbreak!

Dangerous Friends Friendly Enemies: What happens when our delicate relationship with microbes change.

### Anticipatory Set

**The Hook:**

The study of how an infectious disease spreads through a population can ultimately lead to the prevention of the disease. A outbreak is about to occur in your classroom. Become a disease detective and see if you can help in the search for the source of contamination.

**Review and Practice:**

Students will need a general understanding of the type of microorganisms and the different ways in which microbes cause diseases in humans. For students to learn about microbes in an interactive way, ask them to log into MedMyst, at: <http://medmyst.rice.edu> and play the Germ Blasters in Mission 1, or to visit the "Meet the Microbes" section at the Microbe World's website: <http://www.microbeworld.org/microbes/>

**Activate Prior Learning:**

Questioning  
 Individual work  
 Discussions  
 Home work  
 Group work  
 Reciprocal teaching

**Value of the Lesson:**

In this exercise students become disease detectives and solve an epidemiologic puzzle.

**Objective/Outcome:**

By the time students leave the classroom they will be able to learn the concepts involved in epidemiology, discuss the importance of epidemiology in disease prevention, and experience tracing the spread of a pathogenic microbe through a population.



## Instructional Delivery: Process

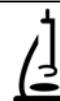
<p><b>Teacher Processes:</b> Learning will be facilitated using a podcast from the American Society for Microbiology, inexpensive hand-on activities, group discussions and individual use of the internet.</p>	<p><b>Activities:</b></p> <ul style="list-style-type: none"><li>• Discussion</li><li>• Thinking skills<ul style="list-style-type: none"><li>• Analyzing</li><li>• Synthesizing</li><li>• Evaluating</li><li>• Cause-effect</li><li>• Hypothesizing</li><li>• Decision Making</li></ul></li><li>• Performance (written)</li><li>• Graphic Organizers<ul style="list-style-type: none"><li>• Word web</li><li>• Podcast</li></ul></li></ul>
<p><b>Student Process/Procedures:</b> Before class, students will play with an internet-based program (MedMyst), or review basic information about the different types of microorganisms on a website from ASM. The MedMyst game consists of a futuristic setting designed for students to learn about pathogenic microbes. During class, students will exchange pieces of 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.</p>	
<p><b>Guided Practice (Check for understanding):</b> Using their <i>Distribution Record Sheet</i> as a "clues map," students should be able to determine who was the first person infected and the path of transmission of the mysterious microbe.</p>	

## Summary/Closure:

<p><b>Clearly articulate (student/teacher):</b> After this exercise, students would have gained an understanding of pathogenic microorganisms, how epidemics occur, and how outbreak investigations are</p>
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<p>conducted. The basic principles taught here can be applied to learn about many infectious diseases that affect populations and can be adapted to a variety of scenarios. For example, the infectious agent could be HIV or another pathogen that is spread by human contact.</p>	
<p><b>Assessment and Evaluation of Lesson:</b> Students will receive a Distribution Record Sheet to keep track of all their exchanges and help them trace their contacts during the epidemic. A Data Analysis sheet with 8 general questions is provided.</p>	<ul style="list-style-type: none"> <li>• Written exercise</li> <li>• Observation</li> <li>• Checklist</li> </ul>
<p><b>Homework:</b> None or students can be asked to complete the data analysis at home rather than in the classroom. An additional assignment could include the calculation of attack rates in a population.</p>	
<p><b>Technology-Utilization:</b> The use of technology in this exercise is optional. Students can access MedMyst (<a href="http://medmyst.rice.edu">http://medmyst.rice.edu</a>), an internet-based game designed for learning about pathogenic microbes, or MicroWorld.org, and informative website maintained by the American Society for Microbiology</p>	<p><b>Materials:</b></p> <ul style="list-style-type: none"> <li>• Worksheets</li> <li>• Handouts</li> <li>• Computers</li> <li>• Access to Internet (optional)</li> <li>• Calculators (optional)</li> </ul>



# Appendix

## 1. 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 mortality 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 in the classroom (population at risk).

## 2. Useful Books

- 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.
- National Research Council (1996) National Science Education Standards. Washington, DC: National Academy Press.

## 3. Useful 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-Epidemiology Teaching Material  
<http://www.cdc.gov/excite/index.htm>



# ***Student Handout***

## ***Outbreak! Investigating Epidemics***

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### **Introduction**

The study of how an infectious disease spreads through a population can ultimately lead to the prevention of the disease. An outbreak is about to occur in your classroom. See if you can help in this search for the source of contamination.

### **Terms and Definitions**

**Epidemiology** - It is the scientific method of problem solving used by "disease detectives" to get to the root of a health problem in the community.

**Epidemic** - An epidemic occurs when there are more cases of a particular disease than expected in a given area, or among a specific group of people, over a particular period of time.

**Outbreak** - Many epidemiologists use the term outbreak interchangeably with epidemic. Some restrict the use of epidemic when a large geographic area is affected.

**Vaccination** - The process of giving a vaccine to humans or animals.

**Vaccine** - Any preparation of attenuated or killed microorganisms (usually bacteria and some viruses) used to stimulate the immune system to produce antibodies and prevent infectious diseases.

**Quarantine** - To restrict the activities or movement of people who may have been exposed to a contagious disease in order to prevent spread to others.

**Hypothesis** - A tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation.

### **Materials Checklist**

1. *Distribution Record Sheet and Data Analysis Questions*
2. Strips of filter paper
3. Pen or pencil
4. Indicator solution



## Procedure

1. Pick up the *Distribution Record Sheet* and *Data Analysis Questions* and a group of 5 paper strips.
2. Write your name (real or adopted) or initials on each strip.
3. When the teacher says trading begins, trade one of your strips with another student. Write down whom you traded with, the name on the strip you gave away, and the name on the strip you received on the *Distribution Record Sheet*.
4. **On the first trade, you have to give away one of YOUR strips (one strip per trade).**
5. **On the following trades, you can give away any of the strips that you have (a strip with your name or someone else's who has traded with you).**
6. Your teacher will tell you when the trading period will begin and end.
7. At the conclusion of trading, you will have to place each strip ONE at a TIME in the indicator solution.
8. If one of your strips turns GREEN, it indicates that you have now contracted an infectious disease. The name on the strip is the original source of the infection.
9. Using your *Distribution Record Sheet* figure out the path of transmission.
10. Answer the *Data Analysis Questions* as indicated by your teacher.



Name: \_\_\_\_\_

***Distribution Record Sheet***

<b>Exchange Number</b>	<b>Name of person you exchanged with</b>	<b>Name on strip of paper you <u>received</u></b>	<b>Name on strip of paper you <u>gave away</u></b>
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.




## Data Analysis

1. Who was the original source of the epidemic?
2. Did you get infected?
3. Were some people exposed to the infectious disease (microbe) but not infected?
4. How many people in the class were exposed to the microbe?
5. What factors might have increased the chance of exposure to the microbe?
6. It was possible to trade with the infected person but not get the disease. How do you think this relates to real life?
7. What do you think would happen if two people were the original source? What about ten people?
8. What factors affect the amount of exposure to a microbe in real life? Hint--- Does washing your hands affect your exposure? What other things may affect exposure?

