

## *SciGuide Lesson Plan*

### *Theme: Outbreak and Future Technology*

**Title:** Outbreak Alert (Shigella)

**Author(s):** FDA/NSTA

**Grade Level:** 5-8

**Subject Area:**

Life Science/Health

#### **Standards Alignment-National Science Education Standards:**

- Science and Technology
  - Understandings about Science and Technology.
    - Scientists propose explanations for questions about the natural world, and engineers propose solutions relating to human problems, needs and aspirations.
- Science in the Personal and Social Perspective
  - Personal Health.
    - Natural environments may contain substances (for example, radon and lead) that are harmful to human beings. Maintaining environmental health means establishing or monitoring quality standards related to the use of soil, water and air.
- Science in the Personal and Social Perspective
  - Risks and Benefits.
    - Risk analysis considers the type of hazard and estimates the number of people that might be exposed and the number likely to suffer consequences. The results are used to determine the options for reducing or eliminating risks.
- Science in the Personal and Social Perspective
  - Science and Technology in Society.
    - Technology influences society through its products and processes.

#### **Time Required:**

One 45-minute class period

#### **Overall Lesson Goal:**

Students will analyze a real-life foodborne illness outbreak. They will assume the role of FBI (FoodBorne Illness) investigators to plot out the steps and identify the questions to ask in order to get to the source of the outbreak. Students will discuss and compare their investigative approaches to the actual public health investigation.

#### **Individual Learning Objectives:**

- Students will research and analyze data on outbreaks, specifically Shigella.

- Students will analyze their findings compared to actual public health investigation.

**Prerequisite Knowledge; Misconceptions/Preconceptions:**

- For background information on outbreaks, read about the following in the Food Safety A to Z Reference Guide:
  - Outbreak
  - Pulse-Field Gel Electrophoresis
  - PulseNet (also see the step-by-step process for tracing a food implicated in a foodborne illness outbreak)
  - Shigella
- Photocopy Here’s What the Public Health Officials Did (page 77) for each team.

**Procedures/Instructional Strategy:**

**Introduction**

Motivate your students with this scenario: You’re sitting in your office. All of a sudden, red lights are flashing! You hear, “ring,” “ring,” “ring” all around you. What’s going on? Then finally you realize that this flutter of red lights and constant ringing is your telephone — it’s ringing off the hook. Could it be . . . an outbreak?

Continue to engage the students by telling them that they are FBI (FoodBorne Illness) Investigators in Suffolk County, New York. They’ve just received notice that 21 people in the county have become ill with similar symptoms (nausea, vomiting, diarrhea, cramps, and fever). The illnesses occurred over a 1-month period — from November 8 to December 8. The sick persons have tested positive for the Shigella bacterium. Ask: How would you investigate this case to find out how the outbreak got started?

**Procedure**

1. Divide the students into 3 or 4 groups.
2. Inform students that as FBI (FoodBorne Illness) investigators, it’s their job to work with their colleagues to identify the steps they would take to investigate this outbreak.
  - a. Tip: It’s okay if the students do not come up with the exact steps or conclusions as the actual investigation on the “HERE’S WHAT THE PUBLIC HEALTH OFFICIALS DID . . .” page. The important thing is for them to arrive at a conclusion that’s based on logical, scientific questioning and a step-by-step process.
3. Ask students: What do you know about this case? Have them analyze the existing data and record it in their food-safety portfolio in the form of the 5 “Ws” (“Who,” “What,” “Where,” “When,” and “Why,” plus “How”). Note: 4 of the “Ws” were given in the teacher introduction.
  - a. Who — 21 people who became ill
  - b. What — Shigella bacterium

- c. Where — Suffolk County, New York
  - d. When — November 8 to December 8
  - e. Why — ?
4. Challenge each team to discover more details about the case. They should come up with more specifics on each “W,” then solve the “Why” and “How” of this case. For example:
    - What is Shigella?
    - How is Shigella transmitted?
    - Where in Suffolk County could this outbreak have occurred?
  5. Ask students: What do you need to find out first? To help them along the way, students can conduct research about outbreaks and Shigella (see the Internet Resources section). From time to time, you can also give them clues (see box at right for clues and the answers), but first allow the students to formulate their own strategies.
  6. Have the teams write up their steps. Make sure they number each step.
  7. Then have each group share their investigation steps and their conclusions with the class.
  8. Discuss and compile a class list of what would be the most probable conclusions as to where the outbreak occurred, who or what transmitted the Shigella bacterium, and why the outbreak occurred. Then ask: What would you do to correct the problem?
  9. After you have compiled the class list, review the real-life, step-by-step process that Public Health Officials in Suffolk County, New York, conducted (see “S WHAT THE PUBLIC HEALTH OFFICIALS DID . . .” page). Compare the class approach and conclusions with the actual investigation. Are there similarities? Differences?
  10. Then have students discuss the questions in the Instant Replay below.

### **Summary**

One person, working in a foodservice establishment, can infect multiple people if he or she doesn't follow safe food-handling practices, especially proper handwashing. Proper handwashing is one of the most important precautions in preventing bacteria from spreading from hands to foods. Everyone plays a role in keeping our food safe from harmful bacteria, including farmers, ranchers, distributors, manufacturers, foodservice managers, employees, and customers.

### **Outcome/Assessment:**

1. How could this outbreak have been prevented?  
(The restaurant manager should not have come to work if he was sick. The appropriate handwashing supplies should have been provided in the kitchen and employee and customer restrooms. The manager should have washed his hands properly.)
2. Why is it important for public health officials to investigate foodborne illness outbreaks?

(Early detection of an outbreak helps determine the possible source of that outbreak and prevents additional people from getting sick or dying from consuming harmful foodborne bacteria. Also, what public health officials learn from these outbreaks can help prevent future outbreaks.)

3. Why is it important to wash hands even when you don't feel sick?  
(Even though you may not feel sick, you could be a carrier of a foodborne bacterium without experiencing the symptoms. Therefore, if you don't properly wash your hands, you could spread the bacterium from your hands to foods. For example, the store manager in the Shigella outbreak was a carrier of the bacterium when the French fries were contaminated, but he didn't experience the symptoms until several days later. Proper handwashing is of extreme importance at all times.)
4. What can you do to make sure your food is safe when you eat at fast-food restaurants?  
(When you go out to eat, always wash your hands properly before eating food. Also, observe the restaurant's surroundings. If it's not up to your cleanliness standards, you might want to eat somewhere else.)

#### **Extensions:**

- In the Dr. X and the Quest for Food Safety video/DVD, you learned about PulseNet, a national network of local laboratories that performs DNA "fingerprinting" to better detect a foodborne outbreak in multiple states. Investigate the PulseNet Web site at: [www.cdc.gov/ncidod/dbmd/pulsenet/pulsenet.htm](http://www.cdc.gov/ncidod/dbmd/pulsenet/pulsenet.htm) and prepare a report, including the following:
  - What is PulseNet?
  - How does DNA "fingerprinting" by PFGE work?
  - How has DNA "fingerprinting" been used to prevent foodborne illness?
  - Is PulseNet currently tracking your foodborne pathogen?
  - How do you think PulseNet will change in the next 10 years? 20 years? 30 years?
- Write your own outbreak case and solution. Then act out the case and have the class investigate and solve it.
- Check out CDC's Food Safety Web site at: [www.cdc.gov/foodsafety](http://www.cdc.gov/foodsafety) (click on "outbreak investigations") to see if your foodborne pathogen was involved in any recent foodborne illness outbreaks. Include any discoveries in your food-safety portfolio.
- Relate your pathogen to this activity and record the information in your food-safety portfolio.

#### **Internet Resources:**

- Food Safety A to Z Reference Guide (See the following terms — Log Reduction, Outbreak, Phage Typing, Pulse-Field Gel Electrophoresis, PulseNet, Recall, Shigella, Serogroup, and Traceback.) <http://www.cfsan.fda.gov/~dms/a2z-toc.html>
- Alphabetical Listing of Bacterial Infectious Diseases and Links [www.cdc.gov/ncidod/dbmd/diseaseinfo/](http://www.cdc.gov/ncidod/dbmd/diseaseinfo/)
- CDC Food Safety Initiative [www.cdc.gov/foodsafety](http://www.cdc.gov/foodsafety)
- Excite — Excellence in Curriculum Integration through Teaching Epidemiology [www.cdc.gov/excite/index.htm](http://www.cdc.gov/excite/index.htm)
- FAQs About Foodborne Infections [www.cdc.gov/ncidod/dbmd/diseaseinfo/foodborneinfections\\_g.htm](http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodborneinfections_g.htm)
- FDA Recall Policies [www.cfsan.fda.gov/~lrd/recall2.html](http://www.cfsan.fda.gov/~lrd/recall2.html)
- Morbidity and Mortality Weekly Report [www.cdc.gov/epo/mmwr/preview/mmwrhtml/ss4901a1.htm](http://www.cdc.gov/epo/mmwr/preview/mmwrhtml/ss4901a1.htm)
- Outbreak!/National Biotechnology Information Facility <http://www.swbic.org/outbreak/top1.html>
- The Bad Bug Book/FDA [www.cfsan.fda.gov/~mow/intro.html](http://www.cfsan.fda.gov/~mow/intro.html)
- PulseNet — The National Molecular Subtyping Network for Foodborne Illness Surveillance [www.cdc.gov/ncidod/dbmd/pulsenet/pulsenet.htm](http://www.cdc.gov/ncidod/dbmd/pulsenet/pulsenet.htm)
- USDA Food Recalls [http://www.fsis.usda.gov/Fsis\\_Recalls/index.asp](http://www.fsis.usda.gov/Fsis_Recalls/index.asp)

**Classroom Resources:**

- Food-safety portfolios (for each student)
- Dr. X and the Quest for Food Safety video/DVD, Module 5 — Outbreak and Future Technology

## Clues

### Clue #1

- What do you know about Shigella? How is it transmitted? (Shigella outbreaks are usually caused by a sick food worker who, after using the bathroom, doesn't wash his or her hands and then handles food.)

### Clue #2

- Where does this information lead you?
- (A food worker probably caused the outbreak.)

### Clue #3

- Who would you talk to?
- (the 21 sick people)

### Clue #4

- What would you ask the sick people?
- (Where did you eat before you got sick?)
- (What did you eat?)
- (When did you first experience symptoms?)

### Clue #5

- Where would this information lead you?
- (It would tell you where the outbreak might have occurred and what food might be implicated in the outbreak.)

### Clue #6

- Who else would you talk to?
- (food workers at the implicated food establishment)

### Clue #7

- What would you ask the food workers?
- (Were you working on the days in question?)
- (What was your work schedule?)
- (Were you sick on those days?)
- (What are your restaurant's policies, particularly handwashing procedures?)

### Clue #8

- Where would this information lead you?
- (There was probably a food worker who was sick on the days in question and did not properly wash his or her hands.)

Clue #9

- What would you do next?
- Tip: Public Health Officials can test people and food to determine if they have been exposed to a particular bacterium.
- (Test the food worker for the Shigella bacterium to see if his or her test results match the results from the 21 sick people.)

Clue #10

- If the results match, where does this information lead you?
- (As a FoodBorne Illness investigator, you would suspect that the Shigella outbreak was caused by a food worker who did not properly wash his or her hands and handled food that was later eaten by the 21 people who became sick).

HERE'S WHAT THE PUBLIC HEALTH OFFICIALS DID . . .  
The Real-life Step-by-Step Investigation  
1994 Shigella Outbreak in Suffolk County, New York

**Pathogen Identified**

1. Between November 8 and December 8, 1994, 21 people experiencing symptoms (nausea, vomiting, diarrhea, cramps, and fever) go to the doctor.
2. Doctors make an initial diagnosis, and stool cultures from the patient are sent to a clinical laboratory.
3. At the lab, medical tests are done on the stool cultures. The lab determines the presence of the Shigella bacterium.
4. An isolate of the bacterial culture is sent to the state health department lab for further testing.
5. The health department sends the results to the Bureau of Infectious Disease Control in Suffolk County.

**Investigation Expanded**

6. Due to the unusual cluster of cases, the Bureau realizes that this is not an isolated case, but an outbreak. On December 12, 1994, the investigation begins.
7. Health officials interview the 21 sick people. They discover that 17 of the 21 people affected fell into one of three categories:
  - They ate at the same fast-food restaurant 1 or 2 days prior to the symptoms occurring;
  - They were members of a family who ate foods prepared at the restaurant 1 or 2 days before a family member became ill;
  - They had close personal contact with families who had eaten at the restaurant 1 or 2 days before a family member became ill, but they did not, personally, eat at the restaurant.

**Possible Location and Food Identified**

8. Officials give the affected families a questionnaire. Two of the 5 families return the questionnaire. The questionnaire reveals that 4 of the 5 families who had eaten at the restaurant developed symptoms within the 2-to-3 day incubation period. The fifth family had close personal contact with one of the families that had eaten at the restaurant. French fries were the only common food eaten by the sick people and their families.
9. Health officials interview the employees who worked in the afternoon, because the suspect meals were served in the afternoon.
10. Health officials take stool samples from the afternoon employees for bacteriological examination.
11. Health officials inspect the restaurant. During the inspection, they discover that the rear kitchen handwashing sink and the customer and employee restrooms lack sanitary hand towels.

**Location and Food Verified**

12. Health inspectors request that the restaurant's operators advise all employees who worked on the days in question to submit to a stool sample. Four employees quit rather than submit a sample.
13. Fifty-one stool samples were provided. All but 3 samples were negative. One was positive for Streptococcus, one was positive for Salmonella, and one was positive for Shigella. These 3 employees were restricted from work until 3 consecutive, negative stool samples were obtained. The one positive sample for Shigella was collected from the store manager who had first stated that he had not been ill. He later admitted that he had experienced gastrointestinal illness on December 8, 1994.
14. When a positive Shigella was obtained from the manager, a copy of his work schedule was obtained to determine if he worked on the dates and times of the suspect meal. It was found that his work schedule matched 2 of the 4 suspect meals.

### **Conclusion**

15. The health department makes a conclusion that the illnesses originated at the restaurant based on the following factors:
  - Shigella outbreaks are usually caused by sick food workers who, after using the bathroom, don't wash their hands and then handle food.
  - The sick food worker first said that he was not sick and later stated that he experienced symptoms on December 8, 1994. This was several days after the last customer in the outbreak became sick, indicating that he may have been spreading the bacterium before he actually experienced the symptoms. The food worker may also have been mildly sick, but didn't realize it.
  - French fries were the only product common to all the sick people. Normally, very little hand contact occurs in preparing and dispensing French fries, because the fries are scooped with a utensil. However, the product is handled by front-counter personnel who do not use disposable gloves as a barrier to hand contact with the food. It's not unusual for fries that fall out of the cardboard holders to be picked up with bare hands and tossed back into the French fry bin. Furthermore, the cardboard containers are stored flat and must be "opened" to accept fries. These containers are frequently opened and carried with bare hands that touch the outside and inside of the container.

**Note:** This investigation did not confirm the association between the restaurant and the Shigella bacterium. However, the bacteria test results and the presence of an employee in the restaurant who tested positive for the same type of Shigella that infected the families who ate at the restaurant, suggest that the outbreak was caused by foods eaten at the restaurant. Foodborne illness outbreaks are very difficult to track and public health officials can only draw conclusions based on the information they obtain from sick persons, food establishments, and test results.