**The relationship between agriculture and food, fiber, and energy**

**Pillar 2 D. Discover how regulatory agencies oversee food, fiber, and energy production in America and those commodities imported to America**

 (9th – 12th Grade)

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| **Website**: <http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=539&grade=9&author_state=0&search_term_lp=Discover%20how%20regulatory%20agencies%20oversee%20food,%20fiber,%20and%20energy%20production%20in%20America%20and%20those%20commodities%20imported%20to%20America>**Hands On**: <http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=479&grade=9&author_state=0>**Game:** <https://www.fda.gov/Food/FoodScienceResearch/ToolsMaterials/ucm212706.htm> |

**Outbreak Investigation- Salmonella**

**Purpose**

Students will be challenged to uncover a real-life foodborne illness outbreak. They will take on the role of FBI (FoodBorne Illness) investigators, working together in teams to plan the steps and identify the questions needed to get to the source of the outbreak. This activity will help students develop an awareness of how public health officials approach an actual foodborne outbreak investigation. Regulatory agencies are key in preventing this type of outbreak.

**Materials**

* Telephone or student messenger to give the update for the Introduction
* *Dr. X and the Quest for Food Safety* video Module 5 — Outbreak and Future Technology
* 4 to 8 large sheets of paper for presentations (or a flip chart)
* Assorted materials for conducting presentations

**Advance Preparation**

Make copies of the following for each student who will serve as a “Public Health Official” (PHO):

* *Outbreak Case Sheet*
* *Updates and Clues*
* *Update Background*
* *The 5 “Ws” and the “How” of the Case*

**Essential Files (maps, charts, pictures, or documents)**

* [The 5 "Ws" and the "How" of the Case](http://naitc-api.usu.edu/media/uploads/2016/07/06/5_Ws_and_the_How_of_the_Case.pdf)
* [Update Background](http://naitc-api.usu.edu/media/uploads/2016/07/06/Update_Background.pdf)
* [Updates and Clues](http://naitc-api.usu.edu/media/uploads/2016/07/06/Updates_and_Clues.pdf)
* [Outbreak Case Sheet](http://naitc-api.usu.edu/media/uploads/2016/07/06/Outbreak_Case_Sheet.pdf)

**Vocabulary**

**Salmonella:** a genus of rod-shaped gram-negative bacterium

Background Agricultural Connections

Even though our food supply is the safest in the world, we face new challenges as we import food from all over the world, as new pathogens emerge, and as familiar ones grow resistant to treatment. Foods reaching your table today are produced, processed and distributed very differently from even a decade ago. Food from a single source may be rapidly distributed to communities across the nation, making it more difficult to detect a disease outbreak caused by contaminated food. Just as food can now be rapidly distributed, technology is allowing us to keep track of foodborne outbreaks across the United States.

**Outbreak**

Even though our food supply is the safest in the world, we face new challenges as we import food from all over the world, as new pathogens emerge, and as familiar ones grow resistant to treatment. Foods reaching your table today are produced, processed, and distributed very differently than they were just a decade ago. Food from a single source may be rapidly distributed to communities across the nation, which could make it more difficult to detect a disease outbreak caused by contaminated food … but just as food can now be rapidly distributed, developments in technology are allowing us to keep track of foodborne outbreaks across the United States more quickly and easily.

**PulseNet**

Using molecular technology and a sophisticated computer system, epidemiologists can now rapidly assess whether a widespread food incident is underway, and they can trace the source of the problem by identifying distinctive fingerprint patterns of pathogens like *E. coli* O157:H7.

PulseNet is a way scientists are able to link microorganisms from different places associated with an outbreak to see if they have a common origin. Local laboratories participating in PulseNet perform DNA fingerprinting on bacteria that have caused illness. Microbiologists extract DNA from the microorganism and then pulse an electrical current through that material. The pattern, or fingerprints, received by the currents is then transmitted through a networked computer system to the Centers for Disease Control and Prevention (CDC).

If patterns submitted by laboratories in different locations match, CDC computers will alert PulseNet participants of a possible multi-state outbreak. An investigation can begin immediately to trace the source of the problem and stop the outbreak. If the source is found, the food will be taken off the market and measures will be taken to prevent future outbreaks.

**Science and our Food Supply**

This lesson was developed as a portion of an entire unit of lessons focusing on food safety from farm to table. Use the following links to see the remaining lessons:

**Module 1: Bacteria**

* + [Understanding Bacteria](http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=471&author_state=0&search_term_lp=understanding%20bacteria)
	+ [The 12 Most Unwanted Bacteria](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=609&search_term_cr_lp=science%20and%20our%20food%20supply)

**Module 2: Farm**

* + [Chain of Food](http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=472&search_term_lp=chain)

**Module 3: Processing and Transportation**

* + [Blue's the Clue: Souring Milk for Science](http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=473&author_state=0&search_term_lp=blue)
	+ [Mystery Juice](http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=474&author_state=0&search_term_lp=mystery)
	+ [Irradiation Web Quest](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=615&search_term_cr=web%20quest)
	+ [Ultra High Pressure Treatment](http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=475&author_state=0&search_term_lp=ultra%20high)

**Module 4: Retail and Home**

* + [Fast-Food Footwork](http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=476&author_state=0&search_term_lp=fast)
	+ [Cooking Right: The Science of Cooking a Hamburger](http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=477&author_state=0&search_term_lp=hamburger)
	+ [Coliform Counts](http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=478&author_state=0&search_term_lp=coliform)

**Module 5: Outbreak and Future Technology**

* + Outbreak Investigation- Salmonella
	+ [Beef Blasters](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=612&search_term_cr=science%20and%20our%20food%20supply)

**Interest Approach – Engagement**

1. Begin the lesson by welcoming students, but before you finish your sentence, have a phone ring on your desk, or have a student messenger deliver information on a piece of paper. Answer the phone (or respond to the message) with urgency and repeat the information you receive:
	* *An outbreak! Where? In Seattle and Portland? How many people? Oh, no! And what are the symptoms? This is serious. I’ll put my FBI team on it immediately. Please contact me with any updates.*
2. After you hang up the phone (or when the messenger leaves), continue to engage the students by telling them: *I need your help. You are going to be* FBI *(****F****ood****B****orne* ***I****llness) investigators for this very important mission.*

**Procedures**

**Day 1: Investigate the Case**

1. Ask 2 to 4 volunteers to serve as state Public Health Officials (PHOs).
	* Give each PHO an *Outbreak Case Sheet*. Have them begin planning an innovative way to present the “Case Background” to the rest of the class.
2. Divide the remaining students into 4 teams of FBI (**F**ood**B**orne **I**llness) investigators. It’s their job to discover the source of the outbreak and why it occurred.
3. Ask the PHOs to brief all the FBI teams on what has happened up to this point by presenting the “Case Background.”
4. Challenge each FBI team to develop a list of questions they’ll need to answer in order to develop a step-by-step strategy for solving the case.
	* **For lower level classes**, consider writing the 5 “Ws”: “Who,” “What,” “Where,” “When,” and “Why,” plus “How” on the board as a guide for students in developing their questions.
	* **For advanced classes**, let the students come up with their questions first. Midway through this process, write the 5 “Ws” and “How” on the board as a checkpoint for the students.
5. Distribute the remaining copies to the PHOs:
	* *Updates and Clues*
	* *Update Background*
	* *The 5 “Ws” and the “How” of the Case*
6. PHOs should get ready to answer questions from the FBI teams.
7. After about 5 to 10 minutes, have one of the PHOs deliver the following message: “We have an outbreak update. We’ve just learned some very important information that will help you solve this case!” (Give Update #1 from the *Updates and Clues*. When necessary, also give the Clue.)
8. Have the FBI teams continue working on their strategies. They can revise their strategies anytime during their investigations.



1. Now, have each FBI team outline their final step-by-step strategy on large presentation paper. Also ask them to list the following:
	* Their strategies
	* The 4 to 6 questions they asked the PHOs that were most helpful to them in “solving” the case. (Have them explain why the questions were helpful.)
	* 2 to 3 recommendations for preventing this type of outbreak in the future.
		+ Note: It’s important for students to understand that 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, well persons, food establishments, and test results.

**Day 2: Present the Strategies**

1. Have each FBI team present its investigation strategy, questions, and recommendations to the class.
2. After all the FBI teams have completed their presentations, have the class discuss what was similar about their strategies and what was different. The PHOs should interject information from the *Update Background*.
	* For lower level classes, have the PHOs, together with the teacher, lead the discussion.
	* For advanced classes, have the PHOs take the lead for the discussion.
3. Introduce the video clip to students by explaining that now it’s time to meet scientists who will share some of the tools they have for investigating FBI outbreaks. Watch for what they have to say about:
	* PulseNet
	* The connection between PulseNet and DNA
	* Pulse-Field Gel Electrophoresis (PFGE)
	* How the Internet aides in outbreak investigations
4. Show video [Module 5 — Outbreak and Future Technology](https://youtu.be/j8YfUEzBQ20?t=31m19s), but stop the video right after Dr. Paul’s segment (Time: 3 minutes). The rest of the video Module will be shown at the end of the Beef Blasters activity.

**Concept Elaboration and Evaluation**

Use the following questions to review and summarize the concepts taught:

1. How could this outbreak have been prevented? *(The food establishments in Seattle and Portland could have purchased pasteurized juice — unpasteurized products can contain harmful bacteria. Food establishments could mandate use of only pasteurized juice in their purchasing policies.)*
2. What can you do to assure the safety of the juice you buy? *(You may want to buy only pasteurized or otherwise treated juices. Any juice that does not have a warning label has been safely processed and is safe to drink. Unpasteurized or untreated juice may contain harmful bacteria and must have a warning label. This label is intended to inform at-risk consumers — i.e., the elderly, young children, and persons with weakened immune systems — that there may be a risk for developing foodborne illness from drinking this product. See page 69 of the Food Safety A to Z Reference Guide.)*
3. What have you learned about Salmonella? *(Most types of Salmonella live in the intestinal tracts of animals and birds and are transmitted to humans by contaminated foods of animal origin. It can be found in raw and undercooked eggs, meat, poultry, seafood, raw milk and dairy products, and even fruits.)*
4. Why were the scientists surprised that orange juice was the cause? *(The Salmonella Muenchen outbreak was an unusual case because Salmonella is not usually found in orange juice. It was thought that the acidic nature of orange juice would inhibit bacterial growth.)*
5. Why was a traceback necessary in this case? *(Once it was determined that a point-of-service [POS] violation was not the cause, the investigators had to focus on a source of contamination before the food or beverage reached the food establishment.)*
	* Through their interviews, investigators knew that orange juice was consumed by the sick people. The investigators also knew that orange juice was not consumed by the well persons who were at the restaurant at the same time.
	* Fortunately, in this case, there were unopened packages of the orange juice available for testing. Investigators knew the manufacturer of the orange juice and determined that the orange juice was unpasteurized; therefore, the traceback could stop there.
	* If the source of contamination could not be determined at the manufacturer, the traceback would have gone to the processor and even to the farm, if necessary.)

Summarize that one manufacturer, improperly processing unpasteurized orange juice by not following safe food handling procedures, caused a foodborne illness in the people who consumed that juice in different drinks and in different restaurants, even across state lines. It is the responsibility of all food manufacturers to make sure they always follow all safe food handling procedures in preparing the foods that we all consume. In addition, it is the responsibility of all others involved in handling that food to keep that food safe from harmful bacteria.

**Essential Links**

* [Science and Our Food Supply website](http://www.fda.gov/Food/FoodScienceResearch/ToolsMaterials/ScienceandTheFoodSupply/default.htm)
* [Dr. X and the Quest for Food Safety Video](https://youtu.be/j8YfUEzBQ20?t=31m19s)

**Enriching Activities**

* Check out [CDC’s Food Safety](http://www.cdc.gov/foodsafety/) website at (click on “Multistate Foodborne Outbreaks”) to see if any familiar foodborne pathogens have been involved in a recent foodborne illness outbreak. Include this information in your food safety portfolio.
* Write your own outbreak case and solution. Then act out the case and have the class investigate and solve it.
* In the *Dr. X and the Quest for Food Safety* video, you learned about PulseNet, a national network of local laboratories that performs DNA “fingerprinting” to detect a foodborne outbreak in multiple states. Using the [PulseNet website](http://www.cdc.gov/pulsenet/), prepare a report or presentation that includes 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?

**Suggested Companion Resources**

* [Beef Blasters](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=612) (Activity)
* [Imported Food Safety](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=638) (Activity)
* [Irradiation Web Quest](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=615) (Activity)
* [Lose a Million Bacteria The Game](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=613) (Activity)
* [The 12 Most Unwanted Bacteria](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=609) (Activity)
* [How Safe is Your Salad?](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=772) (Multimedia)
* [Virtual Food Safety Labs](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=673) (Multimedia)
* [Fight Bac! Food Safety Education](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=312) (Website)
* [Food Safety A to Z Reference Guide](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=35) (Website)

**Sources/Credits**

The *Science and Our Food Supply* Curriculum was brought to you by the Food and Drug Administration Center for Food Safety and Applied Nutrition and the National Science Teachers Association.

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