



**COURSE 2:**

# Food Production, Nutrition and Health

## TRACKING THE SOURCE



**food and  
nutrition sciences**

PREPARATION FOR TOMORROW





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# Project Overview



## CONCEPT/DESCRIPTION

- 1-2** Students determine the prevalence of bacteria. Students define GAPS and good manufacturing practices (GMPs).
- 3** Students define epidemiology. Students determine the scope and meaning of the project.
- 4** Students will distinguish the difference between foodborne intoxication and foodborne infection. Students identify toxin, viral, and parasitic forms of foodborne illness.
- 5** Students will interpret existing data related to foodborne illness and display data in a variety of formats.
- 6-7** Students develop interview questions for a specific audience and investigate a foodborne illness outbreak. Students explain the impact of sampling methods, bias, and the phrasing of questions asked during data collection and the conclusions that can rightfully be made. Students will conduct an interview.
- 8** Students analyze data and draw conclusions. Students display data in a variety of formats.
- 9** Students describe the difference between cleaning and sanitation.



## CONCEPT/DESCRIPTION

- 10** Students make predictions based on a specific data set. Students analyze the relationship between new and existing cases of foodborne illness.
- 11** Students calculate odds ratios from a given data set. Students will determine which foods/events are positively associated with the E. coli O157:H7 outbreak.
- 12** Students analyze food substances for pathogens.
- 13** Students will interpret gel electrophoresis results.
- 14** Students explain how food becomes contaminated. Students describe the consequences of a foodborne illness outbreak.
- 15-17** Students synthesize the findings of the case study. Students explain the cause of the foodborne illness outbreak. Students describe ways to prevent future outbreaks.
- 18** Students present findings of the case study.
- 19-20** Students define coliform. Students describe the relationship between coliform and food safety.



## Key Question of the Day:

*What is the relationship between bacteria and food safety?*

*(Each day the key question should be prominently displayed and used to open the lesson.)*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Determine the prevalence of bacteria.
- Define GAPS.
- Define good manufacturing practices (GMPs).



### Required Materials

- Weekly Bell-Work journal – [Appendix 1](#) – One for each student
- Daily Exit Ticket – [Appendix 2](#) – One for each student
- Flip chart
- Markers
- Lab Data Table adapted from *Bacteria Everywhere* - Lab adapted from *Science and our Food Supply*, page 18, by NSTA and FDA – [Appendix 3](#) – One for each student
- Lab materials:
  - › Dissecting microscope or hand lenses to view microbial colonies
  - › Additional petri dishes with nutrient agar and covers for expanded tests
  - › Disinfecting solution to disinfect lab surfaces (20 mL of liquid household bleach in 1 L of water)
  - › For each team:
    - » 3 sterile Petri dishes with nutrient agar and covers
    - » 2 cups sterile water
    - » Sterile cotton swabs
    - » Parafilm or masking tape to seal the dishes
    - » Permanent marker
    - » Safety gloves



### Bell-Work

*(Each day the Bell-Work question should be prominently displayed and used to open the lesson)*

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“List as many things as you can remember about bacteria.”**

## OPENING

*(Designed to **prepare** students for learning. Students are prepared for learning by activating an **overview** of the **upcoming** learning experience, their **prior knowledge**, and the **necessary vocabulary**.)*

- Read the Bell-Work question and solicit responses from the students.
- After students share their responses, remind the class that bacteria are microbes that are diverse and highly adaptive. They can encapsulate to survive in harsh environments, and some are motile and move around using filaments. Others are heterotrophic and use a variety of sources for nutrients, which allows them to thrive just about anywhere.
- Ask the class, **“How does this relate to food safety?”**
- Write student responses on a flip chart.
- Explain that if bacteria are everywhere, it’s likely in our food supply.

## MIDDLE

*(Designed to provide a **structure** for learning that actively promotes the **comprehension and retention** of knowledge through the use of **engaging strategies** that acknowledge the brain’s limitations of **capacity and processing**.)*

- Assign students to teams of 3.
- Each team should select 4 to 6 areas to examine. They should try for as many different areas as possible.
  - › Possible options include: hands, under fingernails, cell phone surface, computer keyboard, etc.
  - › Hands and under fingernails should be tested by at least one team.

- Next, each team should determine a hypothesis about which areas will have the most bacteria. Which will have the least? Why? How fast will the bacteria grow? Why?
- Each team should design an experiment to test their hypothesis.
  - › For example, if the team decides to test the classroom doorknob, under a desk, computer keyboard, and hands, and they hypothesize that the computer keyboard will have the most bacteria and the doorknob will have the least amount of bacteria, then they should come up with a way to test this. One way students could create the experimental design is by determining the length of time (hours/days) they think it will take bacteria to grow.
- Teams will report out their hypothesis and lab design to the rest of the class.
- Ask the class, “How can you be sure that your agar isn’t contaminated?”
  - › They should always have a control plate.
- Remind students how to swab a surface (on a dry surface using a moist swab) and inoculate a Petri dish.
- Before students begin, quickly review the lab safety for the handling of bacteria.
  - › Unless they are the team swabbing their hands and fingernails, students should wash their hands thoroughly before starting the lab.
- Give each team 3 Petri dishes.
  - › Students should label the dishes on the bottom (agar side).
  - › Divide the control dish into thirds. Label the control plate: agar, wet swab, and dry swab.
  - › Divide and label the other two dishes with the areas they want to test.
  - › Label the dishes with the date, their team members, and class period (along the side on the Parafilm or tape).
- Give the class 10 to 15 minutes to gather their samples and inoculate their dishes.
  - › Tape the dishes closed.
  - › Place dishes in an incubator at 35°C (95°F) or let the dishes sit at room temperature for the appropriate amount of time.
  - › Ask students to establish time parameters such as the number of hours or days it will take the bacteria to grow.

## CLOSING

(Designed to promote the **retention of knowledge** through the use of engaging strategies designed to **rehearse and practice skills** for the purpose of **moving knowledge into long-term memory**.)

- Provide each student with the weekly Exit Ticket handout [Appendix 2](#).
- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“Where do you expect to find the most bacteria?”**
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

(Continuation of Day 1)

*What is the relationship between bacteria and food safety?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Determine the prevalence of bacteria.
- Define good agricultural practices (GAPs).
- Define good manufacturing practices (GMPs).



### Required Materials

- Computers
- Internet
- Flip chart paper
- Markers
- Microscopes
- Post-It notes
- Lab Data Table – [Appendix 3](#) – *Bacteria Everywhere* - Lab adapted from *Science and our Food Supply*, page 18, by NSTA and FDA



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“What do you expect to see in your Petri dishes today?”**

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- After students share their responses, remind them of the importance of not opening the Petri dishes for safety reasons.

## MIDDLE

40 minutes

- Have students observe the bacterial growth and record the results. Students can use the data table in [Appendix 3](#) to record their data.
  - › The petri dishes should never be opened due to the fact that the microbes growing are unidentified and could be potentially very dangerous if exposed to the air.
  - › Check with your local school district for instructions on how to properly dispose of the contaminated petri dishes. They should not be thrown in the trash.
- Students should draw their Petri dish on the back of the Data Table and illustrate the organisms that are growing.
- Students should analyze the results based on their observations, and respond to the following questions:
  - › What do you see?
  - › What do you notice about the colonies?
  - › Why do they look different?
  - › How can the different strains of bacteria be identified?
- As a class, discuss the responses to the questions. Explain that what they are seeing is colony morphology, which is recorded by size, color, edge, shape, and description of the colony height. This is unique to each organism. For example, molds are fuzzy and colorful. Yeast colonies cannot easily be distinguished from bacterial colonies.

- Each team should report out to the class:
  - › The areas they sampled
  - › The number of organisms they observed
  - › The characteristics of the organisms (size, shape, and color)
- Debrief the lab by discussing the following question with the class, ***“Were there any differences in your results compared to the other teams? How did your results support or reject your hypothesis?”***
- Transition by explaining, ***“The point of this lab was to demonstrate that bacteria are everywhere. Bacteria are just one type of microbe that can sneak into our food supply and wreak havoc. As you learned in Course 1, there are all types of pathogens that can cause foodborne illness and impact food safety. There are two types of practices in place to help keep our food supply safe.”***
- Post the acronym GAPs on a sheet of flip chart paper on one side of the room.
- Post the acronym GMPs on a sheet of flip chart paper on the other side of the room.
- Give each student three Post-It notes.
- Divide the class in half.
  - › Half of the class will research GAPs and the other half will research GMPs.
- Students should determine what each acronym stands for, a brief summary of the purpose, and how it helps the food supply.
- The research part should take 5 to 10 minutes.
- Answers should be written on the Post-It notes, and when students are finished, they should stick their Post-It’s on the corresponding flip chart.
- Bring the class back together for a brief discussion of each term.
- The point to be made, “Even though we have producers such as GAPs and GMPs, we know that microbes are everywhere, and we know that nothing is perfect, sometimes contamination occurs. We’re about to learn more about what happens when food safety is compromised.”

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“Describe the difference between GAPs and GMPs.”***
- Collect the Exit Ticket for the day as students leave the classroom



## Key Question of the Day:

(Project Roll-out)  
*Do you understand the project?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Define epidemiology.
- Describe the purpose of the project.
- List the tasks and products related to the project.



### Required Materials

- Computer
- Projector
- Internet
- Video - <http://www.youtube.com/watch?v=YnC7Fbx5uSM> (E. coli Outbreak Spurs Major Ground Beef Recall)
- Project Description – [Appendix 4](#) – One for each student
- Project Management Log – [Appendix 5](#) - One for each student
- Venn Diagram – [Appendix 6](#)



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- “*What is epidemiology?*”

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Students may not be familiar with this term. They can use cell phones or any Internet device to look up the definition.
- Explain that, “**According to Webster’s dictionary, epidemiology is a branch of medical science that deals with the incidence, distribution, and control of disease in a population.**”
  - ✓ **TEACHER TIP!** Students will create a portfolio at the end of the project (on the last day) where they will compile the bodies of evidence they have created throughout the project. Remind students to save important artifacts as they complete different tasks throughout the project. Feel free to determine the best way for students to create their portfolios based upon your particular situation (e.g., if your school/district has any specific requirements, etc.).

## MIDDLE

40 minutes

- Show the video - <http://www.youtube.com/watch?v=YnC7Fbx5uSM>
- Ask the class, “**What is the connection between the definition of epidemiology and this news report, which focuses on E. coli?**”
- Distribute a copy of [Appendix 6](#) to each student. They should fill in the diagram to compare and contrast epidemiology and E. coli.
- Have the class share their responses.
- Give each student a copy of the project description ([Appendix 4](#)).
  - › Students should take about five minutes to read the project description.

- Discuss the project components and answer any questions.
- You can assign teams or allow students to select their teams, but the students will work with the same team for the duration of the project.
  - › The size of the team will depend on the number of students in the class. Teams of 2-3 would be ideal.
- Teams should determine a team name.
- Give each student a copy of the project management log ([Appendix 5](#)) and explain that students will keep track of work during the project using the log.
- Share the following information about the case investigation with the class once the teams are established, “Eleven patients are showing signs of recovery; however, 8 individuals are in reportedly in poor medical condition and another has since died due to kidney failure. Additional cases of severe gastroenteritis have been reported in the region. More people may become sick if you cannot identify the source quickly and recommend actions necessary to stop the outbreak. The public is counting on you to solve this case.”
  - › This information is part of the project and is necessary for students to have the full understanding of the investigation.
- Ask students to recall what they recall about E. coli from Course 1.
- Have a discussion and remind students about the basics of E. coli, “Escherichia coli O157:H7 is an enterohemorrhagic human pathogen that is estimated to cause tens of thousands of cases of gastroenteritis in the U.S. per year and is the leading cause of hemolytic uremic syndrome (HUS). It can colonize the gastrointestinal tracts of ruminant animals including cattle, sheep, deer, and goats without adverse health response in the animals. Outbreaks of E. coli O157:H7 in

humans have been associated with consumption of contaminated undercooked beef, raw milk, and produce including leafy greens and unpasteurized apple cider, despite its acidity. Infections have been acquired by direct contact, as in petting zoos, with animals shedding the bacteria in feces. Person-to-person transmission occurs through the fecal-oral route. E. coli O157:H7 produces shiga-like toxin(s) and is not to be confused with nonpathogenic E. coli which is part of the natural gastrointestinal microbiota of healthy individuals.” – from the case study background

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“What questions do you have about the project?”**
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

*What is the difference between food intoxication and food infection?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Distinguish the difference between foodborne intoxication and foodborne infection.
- Identify toxin, viral, and parasitic forms of foodborne illness.



### Required Materials

- Computers
- Internet
- Flip chart
- Markers
- Article 1 – [Appendix 7.1](#)
- Article 2 – [Appendix 7.2](#)
- Article 3 – [Appendix 7.3](#)



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“Think back to the last time you were sick from something you ate. How did you know that your illness was caused by the food? What were your symptoms?”**

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- As students share their experiences, have a discussion about foodborne illness and the causes.
- Explain that, **“We know that foodborne illness stems from improper handling and/or storage. But there are categories of foodborne illness and we’re going to explore those today to help us gain some background information about the current case we are investigating.”**

## MIDDLE

40 minutes

- Begin by having students research the definition of foodborne intoxication and foodborne infection. They can use textbooks and/or the Internet to complete this research.
  - › In addition to the definition, they should also find examples of each.
- When they are finished, bring the class back together for a brief discussion by having them share their findings.
- Record their findings on a sheet of flip chart paper.
  - ✓ **TEACHER TIP!** Use the following information to guide the discussion if students are off base with their findings:
    - › Foodborne intoxication – Occurs when consuming foods that contain poisonous toxins produced by a microorganism. It’s usually a toxin that causes illness. The microbe that produces the toxin is NOT the cause of the illness. Examples include: Staphylococcus aureus, Clostridium botulinum (botulism), mold toxins (mycotixins), and aflatoxin.

- › Foodborne infection – occurs when a food source that is infected by the living pathogen is consumed. Examples include Salmonella, Listeria, and Campylobacter.
- Next, divide the class into three groups.
- Each group will read one of the three articles.
- Each article covers a different type of foodborne infection (toxin-mediated, viral, and parasitic).
- The students can read independently or they can read as a team where each student reads an assigned part of the article.
- When students are finished reading, they should use a sheet of flip chart paper to summarize the article, including the 5 W's plus How (who, what, when, where, how, why).
- When the teams are finished creating their summaries, each team will share with the rest of the class.
- Have a brief discussion about the articles. As you discuss the articles, ask students if they can identify if the issue in the article is caused by foodborne intoxication or foodborne infection, and if it's a foodborne infection, what type (toxin, viral, parasitic).
  - ✓ **TEACHER TIP!** Use the following content as a reference to explain the types of foodborne infections during your discussion:
    - › Toxin-mediated – Similar to foodborne intoxications because they are also caused by a microbe that produces toxins. The difference is that in this case, the toxins grow and produce toxins in the intestine of the infected person, not the carrier of the microbe. So, the toxin isn't actually passed from the food source to the human, just the microbe which produces the toxin. Examples include Shigella, Clostridium perfringens, E. coli.
    - › Viral – Food is usually contaminated with viruses when they come in contact with polluted water or through improper personal hygiene of food handlers. The virus will reproduce inside the living cells of the person consuming the food. Examples include Hepatitis A, norovirus, and rotavirus.
    - › Parasitic – Parasites typically live inside animals that humans consume. Foodborne parasites include protozoa, roundworms, and flatworms. Examples include toxoplasma gondii and cyclospora.
- Create a project word wall and add the terms foodborne intoxication and foodborne infection.
  - › For the remainder of the project, build the word wall by adding key terminology.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“We are investigating an E. coli O157:H7 outbreak. Based on what you learned today, what type of foodborne illness is E. coli O157:H7?”***
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

*What is the prevalence of foodborne illness outbreaks in our state?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Interpret existing data related to foodborne illness.
- Display data in a variety of formats.



### Required Materials

- Computers
- Internet
- Microsoft Excel or other graphing tool
- Projector
- <http://wwwn.cdc.gov/foodborneoutbreaks/Default.aspx> - This is not available in a downloadable text form. If you attempt to use this link and it is no longer active, this exercise can be modified.



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- *“When is the last time you heard of a foodborne illness outbreak in our state?”*

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Students will share stories they may have heard about related to recent foodborne illness outbreaks.
- *“As we prepare to investigate an E. coli O157:H7 outbreak, let’s explore foodborne illness in general. How prevalent are foodborne illness outbreaks?”*

## MIDDLE

40 minutes

- Each student should visit the website <http://wwwn.cdc.gov/foodborneoutbreaks/Default.aspx>
- Use the following search criteria:
  - › Year: All
  - › State: Kansas or Nebraska (or whatever state you live in)
  - › Location of Consumption: All
  - › Etiology (Origin): All
- The search will display a large data table with all kinds of information about the reported foodborne illnesses.
- The goal of this exercise is not only for students to learn about the prevalence of foodborne illness outbreaks, but to practice reading and interpreting data. So within their teams, students should determine how to graph the data.
  - › As a team, students should review the available data and determine what trends they want to compare or what question(s) they want to answer as the basis for the graphs they create.
  - › Microsoft Excel will be used to create the graphs (if available)

- When they are finished, each team should have a total of three different data sets to share with the class.
  - › Students should list their task on the project management log ([Appendix 5](#)).
  - › Data can be displayed using a projector.
- After each team shares their data, debrief by asking the following questions:
  - › Which foodborne illness was the most common?
  - › What was the location of most of the reported cases?
  - › What was the source of most of the reported cases?
  - › How many reported cases resulted in death?
  - › What does this information tell us about food safety and foodborne illness?

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:  
***“How prevalent are foodborne illness outbreaks? Summarize what you learned today.”***
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

*How are foodborne illness outbreaks investigated?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Develop interview questions for a specific audience.
- Investigate a foodborne illness outbreak.
- Explain the impact of sampling methods, bias, and the phrasing of questions asked during data collection and the conclusions that can rightfully be made.



### Required Materials

- Interview Data – [Appendix 8](#) – One per team



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“What methods are used to gather information for research and analysis?”**

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Possible responses may include:
  - › Interviews
  - › Surveys
  - › Communication records
- **“Depending on the type of investigation, any of these methods could be used. To investigate a foodborne illness, interviews are a great starting point. Our goal is to determine a possible source of infection. How do we proceed with interviews?”**

## MIDDLE

40 minutes

- **“Before we determine how to proceed with the interviews, let’s unpack a bit more information about the outbreak.”**
- Share the following information with the class:
  - › **“Preliminary results of the investigation revealed one commonality: all patients had visited the local farm during elementary school field trips within 1 to 5 days prior to the onset of symptoms. Were their illnesses the result of consumption of one type of contaminated food or beverage, several different contaminated foods or beverages, environmental exposure, and/or exposure to an infected individual? Or is the farm a purely coincidental commonality and not the point of infection?”**
- Each team will be charged with the following tasks:
  - › Determine whom to interview.
  - ✓ **TEACHER TIP!** This should include people such as farm employees, patrons who were at the farm at the same time but did not contract E. coli O157:H7 (they would be the negative controls)

- › Develop interview questions based on what is known about the outbreak.
- › Develop interview questions to help uncover what is not known about the outbreak.
- › Sample questions (Do NOT share these with the students, but use to help guide the students in the right direction):
  - » *Describe health condition and symptoms, if any.*
  - » *When did symptoms begin?*
  - » *Have you recently been exposed to someone diagnosed with or exhibiting symptoms of gastroenteritis?*
  - » *Food/beverage intake history in past 5 days?*
  - » *With whom did you share meals in the past 5 days? Anyone report illness to your knowledge?*
  - » *Prior health conditions?*
  - » *Did you visit the local farm?*
  - » *Have you traveled in the past 5 days?*
- There is no limit to the number of questions the students should have in their interview guides. Teams should have enough questions to get the information they are seeking.
- Review what makes a good interview:
  - › Yes/no questions only when appropriate
  - › Open-ended questions so the interviewee can be descriptive
  - › Be prepared to ask follow-up questions to gain additional information
- Explain researcher bias and how that can impact the analysis of the data and overall conclusions.
  - › Discuss the meaning of bias and how personal biases can influence how questions are worded
- Give teams time to work on this before giving them [Appendix 8](#) so that they have time to brainstorm ideas without too many hints.
  - › Conduct a progress check with each team to determine when they are ready to receive [Appendix 8](#). Explain that this data came from the interviews conducted by the epidemiologists at the local health department.
  - › Teams will use this to help with the development of their interview guide.
- Teams will have the rest of the class period to create their interview guides.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“What are the characteristics of a good interview question?”***
- Collect the Exit Ticket for the day as students leave the classroom



## Key Question of the Day:

(Continuation of Day 6)

*How are foodborne illness outbreaks investigated?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Develop interview questions for a specific audience.
- Investigate a foodborne illness outbreak.
- Conduct an interview.



### Required Materials

- Interview Data – [Appendix 8](#) - One per team
- Guests to serve as interviewees
- ✓ **TEACHER TIP!** These can be anyone, despite the characteristics listed in the case study, since it will just be a role-play. These actors can be parents, teachers, other students, or anyone willing to volunteer their time. This is also a good opportunity to invite local healthcare workers or food/agriculture employees. Seven are recommended and outlined in the case study, but for larger classes, consider inviting more people for time efficiency.
- Possible Responses – [Appendix 9](#)



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“What questions do you have about your interview guides?”**

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Address any outstanding questions the students might have. This is also a good opportunity to do a status check and determine if teams need additional time to finish their guides.

## MIDDLE

40 minutes

- Explain that, **“Today you will have an opportunity to interview individuals who might be able to help us get one step closer to identifying how the outbreak began.”**
- Each team will rotate to each guest and will have up to five minutes to ask the questions on the interview guide they created.
  - › Use music or a timer to cue the teams when they should rotate.
- The guests will have [Appendix 9](#) to use as reference material for their responses.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“What initial conclusions can you make from the interviews you conducted today?”**
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

*How do you report and analyze data?*



### Estimated Time

Two 50-minute class periods



### Learning Objectives

As a result of this lesson, students will be able to:

- Analyze data and draw conclusions.
- Display data in a variety of formats.



### Required Materials

- Computers
- Microsoft Excel or other graphing tool
- Interview Data – [Appendix 8](#) - One per team



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“What is the best way to analyze the data from our interviews?”**

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Possible responses may include:
  - › Graphs
  - › Charts
  - › Tables
  - › Infographic
- Explain to students, **“There are a number of ways to display data. The method you select should be based on the questions you are trying to answer. In this case, we are looking for patterns, so how should we analyze our data?”**
- The answer is by creating charts/graphs/tables

## MIDDLE

40 minutes

- Teams had practice on Day 5 doing a similar exercise. They will apply knowledge from that lesson and determine the best way to display their data. They will also have to use data from [Appendix 8](#).
  - › Options include a bar graph of the number of patients who developed symptoms and the dates of symptom onset; the same graph by adding a plot for the number of patients who developed symptoms and the dates they visited the farm; a table with data on the foods consumed by all individuals and whether the foods were positively or negatively associated with the illness.
- Each team should have more than one display of data, so each team member should be responsible for creating a data output.
  - › Students should list their task on the project management log ([Appendix 5](#)).
- Students can use Microsoft Excel (if available) to create graphs/charts.



- For this exercise, teams will not present their data because it will be revealed at the end of the project when they present their case reports. So, each team will keep this information to be added to their final reports.
- After each team completes their data analysis, they should discuss their findings and begin to draw some initial conclusions.

## CLOSING

*5 minutes*

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:  
***“What has your data revealed about the E. coli O157:H7 outbreak?”***
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

*What is the difference between cleaning and sanitation?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Describe the difference between cleaning and sanitation



### Required Materials

- Student Lab Sheet – [Appendix 10](#) - Adapted from *Science and our Food Supply* by NSTA and FDA page 66-68
- Lab materials:
  - › .25 pound (113 grams) of raw hamburger (pre-packaged in serving size by grocery store, if possible, to avoid any unnecessary contamination)
  - › Sharp knife to open hamburger package
  - › 3 individually packaged slices of cheese
  - › 2 cutting boards
  - › 5 pre-poured, sterile nutrient agar petri dishes and covers
  - › 5 sterile swabs
  - › Paper towels
  - › Alcohol wipes
  - › Safety gloves, apron
  - › Sterile water to moisten swabs
  - › Parafilm or masking tape to seal plates



### Bell-Work

- Provide students with the weekly Bell-Work sheet – [Appendix 1](#)
- ***“So far, a review of farm employee health and absentee records and interviews with select individuals were conducted. Could the ill farm employee listed in Table 1 have been the original source of contamination in this outbreak? Why or why not?”***

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Explain to students, ***“Those of you who said no are correct. This employee can’t be the source of contamination because the onset of illness for affected employees was after the onset date of the first case, considering the full presumed incubation period and potential for overlap.”***
- Transition by explaining that one of the individuals whose stool sample tested positive for E. coli O157:H7 is a food handler in a restaurant.
- Ask the class, ***“What additional measures should be taken to protect the public?”***
  - › Clean the kitchen
  - › Sanitize the kitchen
  - › Wash hands after using the restroom
  - › Refrain from preparing food for others
- Ask the class, ***“What’s the difference between cleaning and sanitation? Aren’t they the same?”***

## MIDDLE

40 minutes

- Lead a discussion by explaining that cleaning is the removal of visible grime, dirt, or grease, and sanitation involves placing an antimicrobial barrier on a clean surface to delay surface contamination by microbes.
  - › Just because something is clean, doesn’t mean it is safe or free of microbes.
  - › Use of sanitizers is also risky because they can leave behind residue, which can then become a chemical hazard.

- Also, explain that cleaning and sanitizing each play a different role in food safety.
  - › When trying to minimize food safety risks due to food allergies, cleaning is more effective than sanitizing because allergens are generally not microbial, such as peanut residue, so cleaning a surface typically is enough to reduce the risk.
  - › When trying to minimize food safety risks due to microbes, sanitizing is more effective than cleaning because sanitizing actually kills the microbes, whereas cleaning doesn't.
- Transition by explaining that, ***“To learn more about this concept, we’re going to conduct an experiment with ground beef. We know that ground beef is a common carrier of E. coli O157:H7, and we also know that contaminated surfaces are food safety hazards.”***
- Students will complete the lab in their project teams using instructions from [Appendix 10](#) or as written below. Be sure teams create a hypothesis prior to starting the lab.
- Wash two cutting boards with hot, soapy water and air dry.
- Label cutting boards “A” and “B.”
- Label Petri dishes “A,” “B,” “Control Cheese,” “Control Agar Plate.”
- Divide the remaining dish in half and label “Control Board A” and “Control Board B.”
- Swab the clean cutting boards A and B and inoculate the cutting-board control dish.
- Partially unwrap, then swab one slice of cheese. Inoculate the cheese control dish – don't touch the cheese with your fingers.
- Seal the cutting board, cheese, and agar control plates.
- Put on safety gloves, then use an alcohol wipe to sanitize the outside wrap of the hamburger.
- Use an alcohol wipe to sanitize the knife.
- Carefully remove the wrap from the hamburger by slitting the wrap along 3 sides of the package, being careful not to touch the meat with the knife. Then, peel the wrap away from the meat. This technique helps ensure that you haven't cross-contaminated the hamburger with the knife or the wrap. This is important for a scientific experiment but not necessary at home. Divide the hamburger in half.
- Make one hamburger patty on cutting board A and another on board B. Make sure you press the patties into the boards as you are forming them. Let the patties sit on the boards for several minutes.
  - › Board A
    - › Remove the hamburger patty and safely dispose of it. Then, remove your gloves and throw them away.
    - › Thoroughly wash board A in hot, soapy water. Air dry to ensure that you don't contaminate the board with bacteria that might be on the paper towel.
    - › Unwrap a slice of cheese and put it on cutting board A. Make sure you place the cheese in the same place as the hamburger was placed. Let it sit there for several minutes.
    - › Swab the side of the cheese that was in contact with the board and inoculate Petri dish A.
    - › Remove gloves and wash your hands.
  - › Board B
    - › Remove the hamburger patty and safely dispose of it, but DO NOT wash the cutting board B. Remove your gloves and throw them away. Wash your hands and put on new gloves.
    - › Unwrap a slice of cheese and put it on cutting board B. Make sure you place the cheese in the same place as the hamburger was placed. Let it sit there for several minutes.

» *Swab the area of cheese that was in contact with the board and inoculate Petri dish B.*

- Tape all inoculated Petri dishes to seal.
- Place the Petri dishes in the incubator at 35°C (95°F) for 1 to 2 days.
- This will take about 18 to 24 hours to see results in an incubator or several days at room temperature. The cultures may be “pinpoint” cultures, but look closely to observe any bacterial growth.

## CLOSING

*5 minutes*

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“What do you expect to see for cutting board A vs. cutting board B?”***
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

*How do you know if new cases are related to the current outbreak?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Make predictions based on a specific data set.
- Analyze the relationship between new and existing cases of foodborne illness.



### Required Materials

- New Cases Report – [Appendix 11](#) - One per team
- Flip charts
- Markers



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- ***“Let’s check our Petri dishes from yesterday.”***

## OPENING

5 minutes

- Read the Bell-Work question.
- Instruct students to check make observations of the Petri dishes from the previous class period.
  - ✓ **TEACHER TIP!** The time for analyzing the results of this lab may have to be adjusted depending on the results you’re seeing. If results are noticeable, proceed with discussing the observations and discussion of the conclusion. If results are not visible and more time is needed, instruct students to leave their Petri dishes for another day and continue to check daily until results can be seen.
- Transition by explaining that the local health department has sent an update on the E. coli O157:H7 outbreak case.

## MIDDLE

40 minutes

- Share the following information with the class:
  - › ***“News of the outbreak and the association to the farm has hit news sources including newspapers, radio, television, and the Internet. As a result, numerous individuals other than those sought during the interviews have contacted their doctors, public health professionals, and/or attorneys with concerns they may also be victims in this foodborne illness outbreak.”***
- In teams, students will analyze the data in [Appendix 11](#) to determine if the new cases are associated with this specific E. coli O157:H7 outbreak.
- For each suspected case, using a sheet of flip chart paper and markers, each team should analyze the data and determine the reasons why the new case may or may not be related to the current outbreak of E. coli O157:H7, for each individual. This should include an explanation of what could be done to further determine if the reported case is related to this outbreak.

- › For example, if it is suspected that the individual is a victim of this outbreak based on this initial data, an interview could help uncover more information. Possible responses include:
  - » *Individual 1: Time period not consistent with this particular outbreak. Symptoms and incubation period not typical.*
  - » *Individual 2: Possibly victim of this outbreak. Should be tested and interviewed.*
  - » *Individual 3: Could be extremely mild case. Individual could be interviewed.*
  - » *Individual 4: Symptoms, time period, and exposure consistent with possible secondary case of outbreak (possibly contracted from close contact with sick family member).*
  - » *Individual 5: Symptoms consistent with E. coli O157:H7 infection and timing consistent with other cases. Route of exposure not clear. Individual should be tested and interviewed further. Other illnesses with similar symptoms should not be overlooked.*
- › Teams will likely have to reference the data from earlier in the project in order to make comparisons and draw conclusions.
- Teams will present their theories to the class as a large group brainstorming session.
- As teams finish, they can post their documents around the room to reference during the class discussion.
- As you debrief the discussion, pose the following questions for teams to discuss within their groups:
  - › How do you feel about the predictions from the other teams?
  - › Do you agree or disagree with their findings?
  - › How do their findings compare to your team?

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“How many new cases of E. coli O157:H7 do you suspect are related to the current outbreak?”***
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

What foods and/or events are positively associated with the *E. coli* O157:H7 outbreak?



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Calculate odds ratios from a given data set.
- Determine which foods/ events are positively associated with the *E. coli* O157:H7 outbreak.



### Required Materials

- Activity and Consumption Data - [Appendix 12](#) - One per student
- Computers
- Internet



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- “What is an odds ratio?”

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Possible responses may include:
  - › A probability
  - › Likelihood of something
- Explain the meaning of odds ratio. **“An odds ratio is a way to quantify (show with numbers) how strongly the presence of something is associated with something else. For example, in this case we are investigating if foods or events are positively associated with the *E. coli* O157:H7 illness outbreak.”**

## MIDDLE

40 minutes

- Demonstrate how to calculate the odds ratio by providing the class with the equation:
 
$$\text{Odds Ratio} = \frac{[(\# \text{ Consumed and Sick}) / (\# \text{ Not Consumed and Sick})]}{[(\# \text{ Consumed and Not Sick}) / (\# \text{ Not Consumed and Not Sick})]}$$
- Students can work with their teams but each student will complete this exercise independently in order to practice the math skills.
- Give each student a copy of [Appendix 12](#). They will use this data to for the calculations.
  - › They should complete the graph by filling in their answers in the last column.
- As students finish, they should compare their answers with their teammates as a form of peer review.
- Once the whole class is finished with the calculations and peer review, bring the class back together to interpret the results.

- Explain how to interpret the results of the odds ratio:
  - › The control group is the group who ate the same food and/or participated and did not get sick.
  - › When the odds ratio is less than 1, it is not likely that the incidence is related to the E. coli O157:H7 outbreak.
  - › If the odds ratio is greater than 1, then it is possible the incidence related to the outbreak.
- Answers for [Appendix 12](#) – Do NOT share this with students until you are ready to check their work.
  - › Unpasteurized apple juice – 3.16
  - › Bottled water – 0.15
  - › Lemonade – 0.25
  - › Hamburger – 0.31
  - › Salad – 0.07
  - › Ice cream – 2.48
  - › Petting zoo – 0.60
  - › Orchard picking – 0.33
- Add the definition and equation for “odds ratio” to the word wall.
- To prepare for tomorrow’s lab, if there is time left at the end of the class, students can research different type of testing that is done to foods to identify the presence of foodborne illness, specifically E. coli.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“What is an odds ratio and why is it an important step of our investigation?”**
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

*How are pathogens detected in foods?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Analyze food substances for pathogens.



### Required Materials

- Lab Instructions – [Appendix 13](#) - One for each student
- Test tube diagram – [Appendix 13.1](#)
- Lab materials:
  - Gloves
  - 10 g of the food product (unpasteurized apple juice – if available, hamburger, salad)
  - 2 Liter of water
  - Ziploc Bags
  - Forceps or tongs
  - Water
  - 90 mL sterile peptone water (PW)
  - Pipette
  - Pipette tips
  - Aerobic Plate Counts Petrifilms
  - E. coli Petrifilms
  - 24 test tubes per sample to hold 10 mL each
- Flip chart
- Markers



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- “What should the health department have tested for E. coli O157:H7?”**

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Possible responses may include:
  - Empty containers
  - Unopened foods
  - Foods positively associated with the illness (unpasteurized apple juice)
  - Anything that is still available from that day
- Explain that, **“All of these options are true and should undergo testing. Testing the foods for pathogens is a key step in tracking down the source of the outbreak. Today we are going to send the foods to the lab for further testing.”**

## MIDDLE

40 minutes

- Students will complete the lab with their project teams.
- First, each team should develop a hypothesis based on whether they expect to find the E. coli O157:H7 pathogen present in the food items.
- Then, they will follow this procedure using [Appendix 13](#):
  - ✓ **TEACHER TIP!** Refer to [Appendix 13.1](#) for a diagram of how to follow these directions for dilution.
  - Put your gloves on and wear them for the entire lab. Do not touch your face, eyes, or mouth. Do not eat during this lab. Wash your hands thoroughly after the lab.
  - Place 10 g samples of your food product in four different Ziploc – each labeled as “Food Item 1, 2, etc.” - bags using forceps or tongs.
  - Add 90mL of sterile peptone water (PW) to each sample bag and seal the bags.

- › Stomach the samples in the sealed bags manually, or use the stomacher. Manual stomaching is done by “squishing” the sample in the water and swirling gently. This creates the 4 rinsates for your food product.
  - › Prepare 24 test tubes per sample with 9ml of peptone water
  - › Pipette 1 mL of the rinsate from sample “Food Item 1” into first test tube.
  - › Mix for 30 seconds by drawing and emptying the rinsate into/out of the pipette.
  - › Withdraw 1 mL from each rinsate + blank test tube and place into another blank. Repeat five more times to create a dilution of 10<sup>-6</sup>.
  - › Transfer 1 mL of the sample to an E. coli Petrifilm and 1 mL of the sample to an Aerobic Petrifilm. Label them with the same label as the Ziploc containing the sample.
  - › Change pipette tips.
  - › Repeat for each “food item” rinsate.
  - › You will have 8 Aerobic and 8 E. coli Petrifilms for each food item.
  - › Incubate the films at room temperature:
    - » 24 hours for *E. coli*
    - » 48 hours for Aerobic
  - › Look for colonies on the films. If any exist on your E. coli Petrifilm, the food product is contaminated with a strain of E. coli. If any exists on your Aerobic Petrifilm, your product contains another pathogen such as Salmonella.
  - › Photograph your Petrifilms to include in your reports and explain the absence or presence of pathogens.
- To debrief from the lab, ask the class, ***“In the case of an outbreak, when there are multiple foods associated with illness, what could be the reasons for several foods being implicated?”***
    - › Open the floor for discussion.
    - › Record student responses on the flip chart.
  - Guide the discussion so that the students eventually get to the correct answers:
    - › Common ingredient in each of the menu items
    - › Common production settings for different companies’ products
    - › Cross contamination between foods
    - › Infected food handler contaminating multiple foods
    - › Secondary case of illness from close contact with infected individual rather than ingestion of contaminated food at original source
  - Conclude by explaining that these are the reasons why we have to conduct tests on any food items that we suspect could be potential sources of infection.
    - ✓ **TEACHER TIP!** Dispose of petri films/dishes properly – locate a biohazardous disposal location at your school (check with school nurse and/or science teachers)

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“What are you hoping to discover from this lab?”***
- Collect the Exit Ticket for the day as students leave the class.



## Key Question of the Day:

*What do the lab results tell us about the outbreak?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Interpret gel electrophoresis results.



### Required Materials

- Lab Data – [Appendix 14](#) - One per student
- Computers
- Internet
- Flip chart
- Markers



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- *“Let’s check the status of the specimens from our lab yesterday.”*

## OPENING

5 minutes

- Read the Bell-Work question and answer any questions from the class.
- Allow students time to check the results of the lab, which would be the end of the 24-hour period for *E. coli*.
- Students should record the data, which will be discussed the following day after the observations can be made at the end of the 48-hour period for Aerobic.

## MIDDLE

40 minutes

- Transition by posting the following question for the class, ***“What is pulsed field gel electrophoresis?” Use a flip chart and hang the question somewhere in the room.***
- Give students about 10 to 15 minutes to search the web and find the definition of pulsed field gel electrophoresis. Instruct students to keep the definition as basic as possible.
- Once students have a definition, bring the class back together for a discussion.
- Give students an opportunity to share the information they found with the class.
  - › Explain that, ***“While it isn’t necessary for us to know how to conduct the PFGE procedure, it’s important for us to understand how it is used to test for the DNA of these different pathogens. When investigating a foodborne illness such as *E. coli* O157:H7, pulsed field gel electrophoresis (PFGE) is one way to evaluate the data collected from various sources. In this case, the health department has provided us with the image of a gel they ran in their labs that shows data from food products, environmental swabs, and patient stool specimens. Bacteria isolates from growth media are treated with enzymes that cut the genetic material***

*at specific sequences. The pieces of DNA of different sizes react with a dye and can then be visualized on a gel. So, the banding patterns you're about to see are the isolates from the different sources. The goal is to compare these banding patterns so that we can get one step closer to our goal of identifying the source of the outbreak."*

- Give each student a copy of [Appendix 14](#). Each student should complete the task independently but can consult with their project teams for discussion and assistance.
- After students had a few minutes to review the lab results, have them think back to their hypothesis and start to determine if they know what caused the outbreak.
- Within their teams, students should discuss if the lab results support their hypothesis about which food(s) were associated with the outbreak.

## CLOSING

*5 minutes*

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:  
***"Based on your research, what are other uses of gel electrophoresis"***
- Collect the Exit Ticket for the day as students leave the class.



## Key Questions of the Day:

*How do outbreaks happen?*

*How could outbreaks be prevented?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Provide students with the weekly Bell-Work sheet – [Appendix 1](#)
- “What do the results of the lab from Day Twelve tell us about contaminants in food?”



### Required Materials

- Explain how food becomes contaminated.
- Describe the consequences of a foodborne illness outbreak.



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- “*What is the purpose of a sensory evaluation?*”

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Use this opportunity to review the purpose of a sensory evaluation.
- Explain that, “*The purpose of the sensory evaluation today is to confirm the attributes that you selected for your sensory evaluation form. Based on today’s sensory evaluation, you’ll be able to determine if any additional revisions are needed before sampling the preserved food you prepared.*”

## MIDDLE

40 minutes

- Post the following questions for the teams to respond to:
  - › Why did the lab call for you to use four samples of the same item?
  - › Why did you use two blanks for each sample?
  - › If your food product has pathogens, how might they have gotten there?
  - › What if some samples are contaminated and others are not?
  - › If we can test food for pathogens, how do outbreaks happen?
- Teams should answer the questions together. As teams finish, bring the class back together for a debrief discussion.
  - › Ask teams to share their responses to the questions.
- Explain that, “*With this information in mind, how do these concepts relate back to the case we’ve been investigating?*”
- Post the following questions for the class:
  - › If it turns out that a product grown and processed at two separate locations, but distributed at the same farm location is the vehicle for the outbreak, who is responsible for the potential contamination?

- › In your opinion, who should be held financially accountable for outbreak-related expenses (e.g., patient medical expenses and/or lost wages, costs associated with determining the source of the outbreak such as epidemiologist wages, lab tests, etc., and expenses associated with any potential recall and destruction of the food source)?
- Teams should have the rest of the period to discuss these questions and write out a response, as this information will be added to the final case report.
- While teams are working, answer any questions and check on their progress.
- Explain to the class that if anyone finishes the

task early, they should begin looking back over their work from this project in order to begin compiling the final case report.

- Share the rubric ([Appendix 15](#)) with the class so that they understand what will be evaluated in the final case report.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“What questions do you have at this point about the project?”***
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

*What are the results of the investigation?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Synthesize the findings of the case study.
- Explain the cause of the foodborne illness outbreak.
- Describe ways to prevent future outbreaks.



### Required Materials

- Computers
- Internet
- Flip chart
- Markers



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- ***“Are you ready to create your final case report?”***

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Ask the class if they have any questions before getting started. Now would be an opportunity to ensure that teams are prepared for this next step and have all of their documentation from the previous days available.

## MIDDLE

40 minutes

- Explain that, ***“This is it! Today is the day we begin to piece together the all of the data we have collected during our investigation. Your teams are officially charged with the task of creating your final case report, which will be shared with the epidemiologists at the local health department. Your job is to take all of the data you have compiled over the past few weeks and synthesize the information into a final case report.”***
- In addition to reporting all of the data they have collected, students should also answer the following questions in their reports, based on information and questions from the local health department:
  - › As a result of this outbreak, various groups with stake in this issue met to discuss appropriate actions for consumer protection. Two alternatives were discussed. Which of the alternatives does your team favor? State the reasons for your opinions.
    - » *Label the product that caused the outbreak with a warning that it might contain microorganisms that can cause illness.*
    - » *Require treatment to kill pathogenic bacteria prior to distribution to the consumer.*
  - › If a vaccine could be developed to minimize or even prevent the shed of E. coli O157:H7 by cattle, do you think administration should be required? Do you think immunizations would be sufficient enough to decrease the risk of E. coli O157:H7 in human foods and beverages? Explain your thoughts on this.

- Students will use computers to type up their final case reports, which should be written in an essay-style format. Headings should be used to separate the different topics and sections.
  - › Students should be able to add any data tables that were created earlier in the project directly to this document where applicable.
  - › Students should also have access to the Internet if they need additional background information to help state their case for their findings.
  - › Within teams, students should divide responsibilities for writing the final case report and this should be documented on the project management log ([Appendix 5](#)).
  - › Create a checklist including the following information to post in the room for students to refer to as they work on their final case reports:
    - » *Interview guide*
    - » *All data from labs and the case investigation*
    - » *Conclusion (team findings of the investigation)*
    - » *Responses to the following questions:*
- As a result of this outbreak, various groups with stake in this issue met to discuss appropriate actions for consumer protection. Two alternatives were discussed. Which of the alternatives does your team favor? State the reasons for your opinions.
  - › Label the product that caused the outbreak with a warning that it might contain microorganisms that can cause illness.
  - › Require treatment to kill pathogenic bacteria prior to distribution to the consumer.
- If a vaccine could be developed to minimize or even prevent the shed of E. coli O157:H7 by cattle, do you think administration should be required? Do you think immunizations would be sufficient enough to decrease the risk of E. coli O157:H7 in human foods and beverages? Explain your thoughts on this.
- The final product should be a Word document.
- When teams are finished with the written report, they should be ready to speak to the class about their findings by presenting a summary of their report.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“Summarize the requirements for the final case report.”***
- Collect the Exit Ticket for the day as students leave the classroom



## Key Question of the Day:

(Continuation of Day 15)

*What are the results of the investigation?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Synthesize the findings of the case study.
- Explain the cause of the foodborne illness outbreak.
- Describe ways to prevent future outbreaks.



### Required Materials

- Computers
- Internet



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- ***“What questions do you have about the final case report?”***

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Answer any questions the students might have.

## MIDDLE

40 minutes

- Teams will continue to work on their final case reports.
- As teams are working, visit with the students to see how their progress is coming along and address any questions.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: ***“What are you most excited to share about your case report?”***
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

(Continuation of Day 16)

*What are the results of the investigation?*



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Synthesize the findings of the case study.
- Explain the cause of the foodborne illness outbreak.
- Describe ways to prevent future outbreaks.



### Required Materials

- Computers
- Internet



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- **“Progress check! How are your reports coming along?”**

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Answer any questions the students might have.

## MIDDLE

40 minutes

- At this stage, teams should be close to completing their final case reports.
- They should combine the parts each person completed into a single Word document.
- When they submit the final report, they should indicate who completed which section.
  - ✓ **TEACHER TIP!** The time to complete the final report will vary depending on class size and the students. So, this stage can continue until students are finished. Another option is to have students continue working on their pieces for homework. Feel free to adjust the time for this as needed.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt: **“Are you ready for your final presentations?”**
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

*What can we conclude about the E. coli O157:H7 outbreak?*



### Estimated Time

Two 50-minute class periods



### Learning Objectives

As a result of this lesson, students will be able to:

- Present findings of the case study.



### Required Materials

- Project Rubric – [Appendix 15](#) – One per team
- Collaboration Rubric – [Appendix 16](#) – One for the teacher
- Project Presentation Audience Feedback – [Appendix 17](#) – One per student per presentation
- Guests to serve as the epidemiologists from the local health department



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- *“Remind the class of tips for being a good audience and good presenters.”*

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Possible responses may include:
  - › Listen
  - › Good eye contact
  - › Ask questions following presentations
  - › Quiet during presentations
- Explain that students should remember these tips for being good presenters and audience members.

## MIDDLE

40 minutes

- ✓ **TEACHER TIP!** Consider inviting the guests from the local health department/health care workers/food service workers to view the presentations. Since the teams are presenting their final case reports, it would be interesting and exciting to be able to share the results with the people they helped with the investigation. It would also take this to the next level by having professionals present who can ask real world questions and engage in relevant industry conversations.
- The rubric will be used to evaluate the case report, but the section for the presentation will be relevant for this part of the project.
- [Appendix 16](#) is for the teacher to use to assess team collaboration.
- Students will complete [Appendix 17](#) for one presentation of their choice.

- After each team completes their presentations, have a brief discussion with the class to debrief the results.
  - › It will be interesting to see the different perspectives of the teams on how the outbreak occurred.
  - ✓ **TEACHER TIP!** Presentations could take one to two class periods depending on class size. Continue with Day Nineteen once all presentations are completed.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:  
***“What did you learn from the class presentations?”***
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

How does the presence of a food pathogen affect the quality of the food?



### Estimated Time

One 50-minute class period



### Learning Objectives

As a result of this lesson, students will be able to:

- Define coliform.
- Describe the relationship between coliform and food safety.



### Required Materials

- Student Lab Sheet – [Appendix 18](#) – from *Science and our Food Supply* by FDA and NSTA, page 75
- Lab materials:
  - › For the class:
    - › 0.25 pound (113 grams) of ground beef (ground chuck or other inexpensive cut of beef)
    - › Safety gloves
    - › Safety glasses
    - › 1.5 or 2 L flask
    - › Violet red bile agar (VRBA)
    - › Sterile spatula or tongue depressor
    - › Sterile aluminum foil for weighing the samples
    - › Burner to heat agar
    - › 99 mL of sterile saline solution
    - › Blender (sterilize the bowl, if possible)
  - › For each team:
    - › 5 sterile Petri dishes with violet red bile agar and covers – 4 for the hamburger, 1 for the control
    - › 3 sterile test tubes
    - › 27 mL of sterile saline solution
    - › Test tube rack
    - › Permanent marker
    - › 4 sterile, disposable 1 mL pipets with pipette bulb or 4 sterile 1 mL tuberculin syringes
    - › Thermal gloves or hot pads to handle hot flasks



### Bell-Work

- Provide students with the weekly Bell-Work sheet ([Appendix 1](#))
- “What is coliform and how does it relate to food safety?”

## OPENING

5 minutes

- Read the Bell-Work question and solicit responses from the students.
- Students may not know the answer to this question. Allow them to share their responses and then explain the following:
  - Background from *Science and our Food Supply*: **“Coliforms are bacteria of great concern because they indicate the potential presence of pathogenic microorganisms such as *Cryptosporidium*, *Salmonella*, or *Giardia*. They can be found in untreated water and find their way into food from fecal contamination, resulting from unsanitary processing conditions, or human food handlers. Coliforms are not disease producers themselves, but they indicate that food may have been contaminated with fecal contamination, which may contain pathogens. They are also normal constituents of plant products. Sometimes there are as many as 104 to 106 coliforms in 1 gram of hamburger.”**
  - Explain that, **“Despite this, we have all consumed food containing coliforms and we are just fine because in most cases, the foods are carefully cooked and safe to eat.”**
  - Explain key terms for the lab, **“Bile salts inhibit the growth of gram-positive bacteria. This reduces competition and allows the gram-negative bacteria, which are the coliforms, to grow more rapidly. Neutral red is a dye that acts as a pH indicator. Crystal violet allows coliforms to grow by inhibiting gram-positive bacteria.”**

## MIDDLE

40 minutes

- Explain that, **“Now that we have completed our case investigation and are experts in *E. coli*, we’re going to explore a different aspect of food safety by learning about coliforms as a way to detect a potential foodborne illness. This lab will also allow us to practice dilutions.”**

- Teacher Prep (students can assist if this is done as a demonstration):
  - › Prepare the VRBA following the package instructions
  - › In a flask, add 41.5 grams of agar to 1 L of water (distilled water, if possible)
    - » *A general rule is that it takes about 20 mL per Petri dish. This will tell you how many mL of agar to prepare.*
    - » *VRBA should not be sterilized in an autoclave.*
    - » *VRBA can be prepared using a microwave.*
  - › Once you have the VRBA agar in the flask, bring it to a slow boil. Make sure the agar is at a rolling boil. Be very careful, as it will boil over the top very quickly.
    - » *The agar should be translucent and completely dissolved with no granules of agar on the sides of the flask.*
  - › Cool the agar slightly because it will harden if cooled too long.
    - » *The plates for this lab will be made when the agar is liquid, not by streaking the plates*
  - › Monitor the agar temperature as it cools. The best temperature for pouring is 44° to 46 °C. A water bath set at this temperature would be ideal.
  - › Next, prepare the hamburger solution.
    - » *Add 99 mL of sterile saline solution to the blender.*
    - » *Weigh out about 11 grams of hamburger on sterile aluminum foil (wear safety gloves).*
    - » *Add the hamburger to the sterile saline solution in the blender. Blend for about 1 minute on high. The concentration of the hamburger is 1 in 10.*
- 99 mL of saline solution and 11g of hamburger a ratio since the solution will be used for the dilution.
- Students will work with their same project teams using [Appendix 16](#).
- Students will begin by preparing the test tubes and Petri dishes.
  - › Label 5 Petri dishes: 10, 100, 1,000, 10,000 and control
  - › Label 3 test tubes: 1000, 1,000, and 10,000
  - › Add 9 mL of sterile saline solution to each of the three test tubes.
- Next, inoculate the Petri dishes:
  - › 1-in-10 Dilution
    - » *Pipette 1 mL of the 1-in-10 hamburger solution directly into the Petri dish marked "10." Carefully swirl the dish to cover the surface, then cover the Petri dish.*
  - › 1-in-100 Dilution
    - » *Pipette 1 mL of the 1-in-10 hamburger solution (from the classroom demonstration) into the test tube marked "100." Now the concentration of the hamburger is 1 in 100.*
    - » *Thoroughly mix the solution by holding the test tube by the top and gently shaking the bottom with the finger on the other hand for about 5 strikes.*
    - » *Pipette 1 mL of this solution into the Petri dish marked "100." Cover the dish.*
  - › 1-in-1000 Dilution
    - » *Pipette 1 mL of the 1-in-100 hamburger solution into the test tube marked "1,000." This will make the concentration of the hamburger 1-in-1,000.*
    - » *Pipette 1 mL of this solution into the Petri dish marked "1,000." Cover the dish.*
  - › 1-in-10,000 Dilution
    - » *Pipette 1 mL of the 1-in-1,000 hamburger solution into the test tube marked "10,000." The concentration of the hamburger will be 1-in-10,000.*
    - » *Pipette 1 mL of this solution into the Petri dish marked "10,000." Cover the dish.*
- Add the agar:
  - › Pour about 10 mL of agar into each Petri dish containing the hamburger solution. Swirl the dish to mix and evenly cover the bottom of the dish.
  - › As soon as the agar is solidified, pour another 4 to 6 mL of agar and swirl again to spread evenly.

- › Pour a control plate to make sure the agar is not contaminated.
- › Store the dishes upright until the agar is solid. Then, invert the dishes, tape them, and place in the incubator at 35°C overnight.
  - » *If an incubator is not available, the plates can be left at room temperature, but it will take longer to see the results.*
- Observations and data will be collected the next day.

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:  
***“List one new fact you have learned about coliforms.”***
- Collect the Exit Ticket for the day as students leave the classroom.



## Key Question of the Day:

(Continuation of Day 19) How does the presence of a food pathogen affect the quality of the food?



### Estimated Time

Two 50-minute class periods



### Learning Objectives

As a result of this lesson, students will be able to:

- Define coliform.
- Describe the relationship between coliform and food safety.



### Required Materials

- Project Reflection – [Appendix 19](#) – One per student
- Flip chart
- Markers



### Bell-Work

- Provide students with the weekly Bell-Work sheet (Appendix 1)
- *“Let’s check on our samples from yesterday.”*

## OPENING

5 minutes

- Read the Bell-Work question.
- Address any questions the students might have.
- In their teams, students should make observations of the samples they prepared the previous day.

## MIDDLE

40 minutes

- Have each of the following questions written on a sheet of flip chart paper (one question per sheet of paper) and hang them around the room:
  - › Which concentration of the hamburger plates was the easiest to count? Why?
  - › How does the experiment relate to reducing foodborne illness?
  - › What should be done to ensure that hamburger is safe to eat?
  - › What do you think is the source of the coliform bacteria in the meat?
  - › Do you think that pathogens make you sick every time you eat them? Why or why not?
  - › List other foods that you would like to test for coliform bacteria. Briefly explain why.
- Have each team rotate to each question. During the rotations, teams should discuss the questions and decide upon a response.
  - › Teams should write their responses on the flip charts.
- Use a timer or music as a cue for when to rotate.
- Teams should spend about 1-2 minutes at each question.



- When the class has rotated to each question, come back as a class and debrief by having a group discussion about the results of the lab, and the student responses to the questions.
- Conclude by having students complete the project reflection ([Appendix 19](#)).

## CLOSING

5 minutes

- Students will turn in their Exit Ticket for that day. They will respond to the following prompt:  
***“Now that you are experts on foodborne illness, what can you do on a personal level to prevent future outbreaks?”***
- Collect the Exit Ticket for the day as students leave the classroom.

# Daily Bell-Work Journal

---

MONDAY

DATE \_\_\_\_\_

---

TUESDAY

DATE \_\_\_\_\_

---

WEDNESDAY

DATE \_\_\_\_\_

---

THURSDAY

DATE \_\_\_\_\_

---

FRIDAY

DATE \_\_\_\_\_

# Daily Exit Tickets



-----

DAY      EXIT TICKET      Name: (First, Last) \_\_\_\_\_  
 Date: \_\_\_\_\_ Period: \_\_\_\_\_

Topic: \_\_\_\_\_



*Continue your answer on the back if necessary*

-----

DAY      EXIT TICKET      Name: (First, Last) \_\_\_\_\_  
 Date: \_\_\_\_\_ Period: \_\_\_\_\_

Topic: \_\_\_\_\_



*Continue your answer on the back if necessary*

-----

DAY      EXIT TICKET      Name: (First, Last) \_\_\_\_\_  
 Date: \_\_\_\_\_ Period: \_\_\_\_\_

Topic: \_\_\_\_\_



*Continue your answer on the back if necessary*

-----

DAY      EXIT TICKET      Name: (First, Last) \_\_\_\_\_  
 Date: \_\_\_\_\_ Period: \_\_\_\_\_

Topic: \_\_\_\_\_



*Continue your answer on the back if necessary*

-----

DAY      EXIT TICKET      Name: (First, Last) \_\_\_\_\_  
 Date: \_\_\_\_\_ Period: \_\_\_\_\_

Topic: \_\_\_\_\_



*Continue your answer on the back if necessary*

# Bacteria Everywhere Data Table

Name \_\_\_\_\_ Date \_\_\_\_\_ Class Period \_\_\_\_\_

LAB 1: Find the Bacteria	
Choose the Areas to Be Examined	Hypothesize the Least/Most Abundant Areas

LAB 2: Observe and Record the Results	
Rank the Amount of Microorganisms 5 (most) 0 (least)	Describe the Size, Shape, and Colors of Organisms

## Essential Question:

What causes foodborne illness outbreaks? How can they be prevented?

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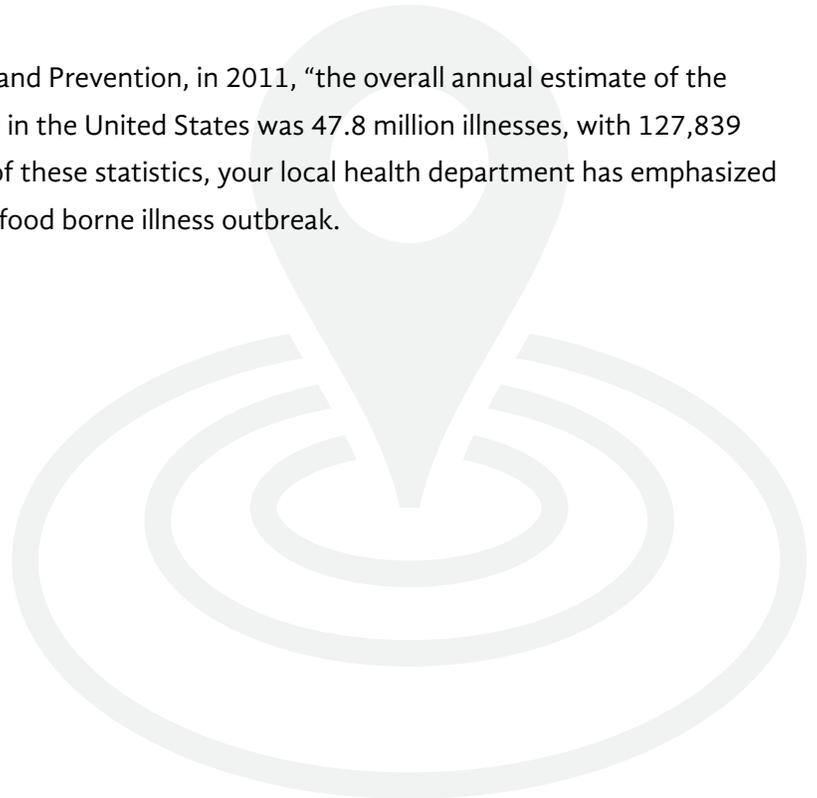
### Engagement Scenario:

Physicians from bordering counties in the states of Nebraska and Kansas report to their respective State Departments of Health a total of 20 individuals with severe gastroenteritis and stool samples positive for E. coli O157:H7. The Departments of Health from both states notified the United States Centers for Disease Control and Prevention (CDC). The CDC launched an investigation into the cluster of illnesses.

The epidemiology specialists from your local health department have requested your help in investigating the severity of the outbreak including the prevalence, the source of infection, and means to end the outbreak. Your team will assist the local health department with the investigation and prepare a final case report to share with the epidemiology specialists.

To gather information about the outbreak, your team will develop a questionnaire that will be used to interview food borne illness victims. Your team will research various aspects of food safety including GAPS, HACCP, and cleaning versus sanitation. For the final report, your team will describe common exposures, potential causes (food, individuals, environmental samples, other) that should be tested, interpretations of laboratory results, necessary actions to stop the outbreak, and necessary actions to take to prevent future outbreaks.

According to the Centers for Disease Control and Prevention, in 2011, “the overall annual estimate of the total burden of disease due to food consumed in the United States was 47.8 million illnesses, with 127,839 hospitalizations, and 3,037 deaths.” Because of these statistics, your local health department has emphasized the importance of solving the mystery of this food borne illness outbreak.

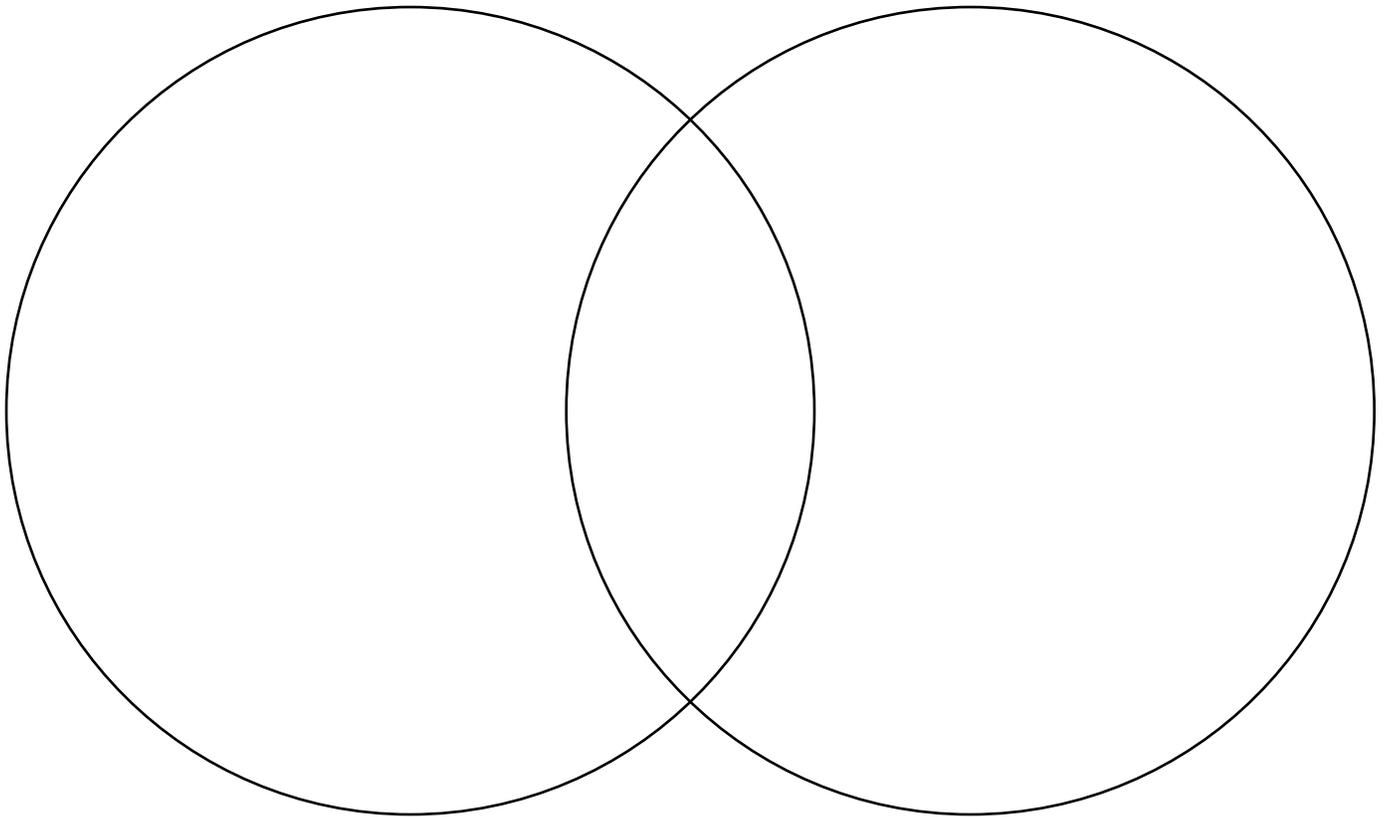




# Venn Diagram

Epidemiology

E. coli





# Thousands may have been exposed to hepatitis A at Missouri restaurant

by Matthew Stucker and Steve Almasy, CNN  
updated 11:01 AM EDT, Thu May 22, 2014 CNN.com

## DO YOU WANT HEPATITIS A WITH THAT BURGER?

**(CNN)** -- As many as 5,000 people may have passed recently through a Missouri restaurant where an employee with hepatitis A worked while possibly contagious, health officials said Wednesday.

Red Robin said the employee last worked on May 16 and that the restaurant has been deemed safe after an inspection by the Springfield-Greene County Health Department.

The New Jersey-based restaurant chain didn't say in what area of the restaurant the employee worked but told diners who ate there between May 8 and 16 to call the health department for information about what to do next.

"It scared me because my husband has been sick," Andrea Hall, a Red Robin customer, told CNN affiliate KOLR. "And a lot of his symptoms of his matched. A red flag just went off and I was like what do I do from here."

Hepatitis A is usually transmitted via contaminated food or water, or by someone who's infected, according to the Mayo Clinic. Frequent handwashing is recommended to limit the spread.

The highly contagious infection inflames the liver, limiting its ability to function.

While mild cases don't require treatment and the Mayo Clinic says most of those infected recover completely with no permanent liver damage, severe cases can lead to liver failure and death, according to the World Health Organization.

Health officials in Springfield said symptoms include fever, nausea, abdominal pain, dark urine and clay-colored bowel movements.

## Vaccination center set up

All workers at the Red Robin have since been inoculated with a immune globulin prophylaxis shot, the restaurant chain said.

The health department will run a two-day vaccination clinic at Remington's, a venue that hosts concerts and trade shows. On its Facebook page, the entertainment complex said 4,000 doses of a vaccine were being shipped there.

According to the Centers for Disease Control and Prevention, the incubation period for hepatitis A is between 15 and 50 days. The CDC says on its website that immune globulin offers protection for about three months for people who get the shot pre- or post-exposure. But the shot needs to be given within two weeks of exposure for maximum protection.

Many people already have been given a two-step vaccine, which was introduced in the United States in 1995. The CDC estimates that 17,000 people contract hepatitis A each year.

CNN affiliate KYTV reported that thousands more customers might have been exposed to the virus because the infected employee worked for Red Robin for several months.

They should watch for symptoms, the station said.

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<http://www.cnn.com/2014/05/21/health/missouri-hepatitis-a/index.html>

# Stores may have received tainted beef

by CNN Staff

updated 9:36 PM EDT, Thu May 22, 2014

**(CNN)** -- Check your ground beef before you grill out this Memorial Day weekend. The USDA's Food Safety and Inspection Service says stores in nine states may have received beef contaminated with E. coli O157:H7.

The service announced this week that 1.8 million pounds of ground beef products were being recalled because they could be contaminated. The federal agency has since named retailers that may have received the tainted products.

Some are as follows:

- Gordon Food Service Marketplace stores in Florida, Illinois, Indiana, Kentucky, Michigan, Ohio, Pennsylvania, Tennessee and Wisconsin
- Giorgio's Italian Delicatessen in Stuart, Florida
- M Sixty Six General Store in Orleans, Michigan
- Buchtel Food Mart in Buchtel, Ohio

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## What government tests found in your meat

A representative for the U.S. Department of Agriculture said the meat is being removed from store shelves. But consumers should return or throw out meat that has the code EST.2574B and a production date between March 31 and April 18, 2014.

The ground beef is sold under a variety of labels, according to the USDA, but comes from Wolverine Packing Co. in Detroit.

"While none of the Wolverine Packing product has tested positive for the pathogen implicated in this outbreak, the company felt it was prudent to take this voluntary recall action in response to the illnesses and initial outbreak investigation findings," Chuck Sanger, a spokesman for Wolverine Packing, said in a statement.

Eleven people across four states are suspected to have been sickened by the product, according to the USDA. Ten of those people were sickened after eating at restaurants that received contaminated meat. But federal officials say regulations prohibit them from naming those restaurants.

"People who were exposed were already exposed, so it doesn't help the public to tell them now that a certain restaurant was associated with these illnesses," said David Goldman, assistant administrator for the Office of Public Health Science at the USDA. "Our job really is to identify product that may still be available."

According to what officials received from the company, he said, the meat went to many states. "The number changes. Yesterday, it was on the order of nearly 40 states, but we don't -- that number changes. That's part of the process too, is to identify where the food -- the meat in this case -- was actually distributed," Goldman said.

A list of stores released Wednesday is not final, a Food Safety and Inspection Service representative said. More establishments will be added as the USDA continues its investigation.

The recall was categorized by the Food Safety and Inspection Service as "Class I": a health hazard situation in which there is a reasonable probability that the use of the product will cause serious, adverse health consequences or death.

E. coli is a large group of bacteria that live in the intestines of people and animals, according to the Centers for Disease Control and Prevention. Certain strains cause gastrointestinal illness in humans, with symptoms such as abdominal pain and diarrhea. An estimated 265,000 infections occur in the United States each year, the CDC says.

People usually get sick three to four days after ingesting the bacteria and recover on their own. Young children, pregnant women, the elderly and people who have weakened immune systems (like

cancer or HIV patients) are at greater risk for severe illness and death.

The best way to avoid getting sick is by washing hands frequently when preparing food and avoiding cross-contamination by washing cutting boards, counters and utensils with hot, soapy water.

Properly washing hands after using the bathroom and after coming into contact with animals or being in their environments -- anywhere there may be traces of feces -- also helps.

Cooking meats thoroughly to at least 160°F or 70C kills the bacteria and prevents infection as well. Using a meat thermometer will most accurately help you determine that the food is thoroughly cooked.

Food Safety and Inspection Service officials said in a news release that the agency is continuing to work with state and federal public health partners on the investigation and provide updated information as it becomes available.

*CNN's Chris Frates, David Fitzpatrick, Jacque Wilson, Miriam Falco, Elizabeth Cohen, William Hudson and Stephanie Smith contributed to this report.*

<http://www.cnn.com/2014/05/21/health/beef-recall/index.html>

# E. coli outbreak linked to sprouts; hummus, dips, walnuts recalled

By Elizabeth Landau, CNN

updated 11:42 AM EDT, Sun May 25, 2014

**(CNN)** -- This has been a big week for food product recalls and the risk of food borne illness.

Seven confirmed and three likely cases of E. coli infection linked to raw clover sprouts have been reported, the Centers for Disease Control and Prevention said Thursday.

The patients are all in either Idaho or Washington. Half the people who have fallen ill have been hospitalized.

Preliminary investigations indicate the likely source of this outbreak are raw clover sprouts produced by Evergreen Fresh Sprouts LLC of Idaho, the CDC said. The state departments of health in Washington and Idaho are telling consumers not to eat raw clover sprouts produced by Evergreen Fresh Sprouts.

Meanwhile, hummus and dip products totaling about 14,860 pounds are being voluntarily recalled by Lansal Inc. amid concerns about possible bacterial contamination.

At the same time, Sherman Produce is recalling some bulk and packaged walnuts sold to retailers in Missouri and Illinois.

These two recalls are precautionary measures against possible *Listeria monocytogenes*, which may cause serious and even fatal infections in people with weakened immune systems, such as the elderly.

No illnesses have been reported in connection with either recall, the respective companies said.

Both companies advise consumers who bought the recalled products to throw them out or return them for a full refund. The products should not be eaten.

Also this week, the USDA's Food Safety and Inspection Service said 1.8 million pounds of ground beef products were being recalled because they could be contaminated with a strain of E.coli.

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## Consequences of food-borne bacteria

*Escherichia coli* is a large group of bacteria; most are harmless, while some can cause serious illness. The strain involved in the sprout-linked outbreak is Shiga toxin-producing *Escherichia coli* O121.

E. coli infection can lead to severe diarrhea, abdominal pain and vomiting, according to the U.S. Food and Drug Administration. Most people recover within seven days, but some have severe complications, the CDC said. A type of kidney failure called hemolytic-uremic syndrome may result; the elderly and children under 5 are most at risk.

Most listeria infections may not be noticed because the symptoms are mild, according to the Mayo Clinic.

Symptoms of a listeria infection in an otherwise healthy person include fever, muscle aches, stiff neck, headache, loss of balance and convulsions, according to the Centers for Disease Control and Prevention. Diarrhea or other gastrointestinal problems may occur before these symptoms.

Pregnant women infected with listeria may suffer miscarriages, premature delivery or stillbirths. The newborn may have a serious infection if the mother has been sick with it.

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## Why sprouts?

Evergreen Fresh Sprouts was also involved in a 2011 salmonella outbreak. Consumers then were discouraged from eating the brand's alfalfa sprouts and spicy sprouts.

Sprouts have a history of being involved in bacterial infection outbreaks.

According to a study commissioned by the Canadian Broadcasting Corporation, the warm, moist conditions that are conducive to growing bumper crops of sprouts are also an ideal breeding ground for bacteria.

In the study, Kevin Allen, a microbiology professor at the University of British Columbia, tested 44 samples of prepackaged sprouts (as well as 48 samples of leafy greens and 58 samples of various herbs) and found, "Over 78% of sprouts had levels of microorganisms too numerous to count."

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### **Hummus and dips**

In the case of Lansal, the Texas Department of Health identified the potential for listeria contamination while routinely testing a Target Archer Farms Traditional Hummus product.

"Lansal Inc. is voluntarily recalling all products manufactured at the same facility and distributed to both wholesalers and retailers during the same time," the company said.

Included in this recall are some Target Archer Farms hummus products nationwide. Certain Giant Eagle hummus products in Pennsylvania, West Virginia, Ohio and Maryland are also affected.

Trader Joe's 5 Layered Dip, both large and small, with a use-by date of April 15 is being recalled in Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan,

Minnesota, Missouri, Nebraska, Ohio and Wisconsin. The 8-ounce container of Trader Joe's Edamame Hummus is recalled in 17 states with use-by dates of April 28, April 29 and May 9.

Some plastic containers of Tryst Yellow Lentil Hummus with Sunflower Seeds & Apricots are also affected.

"Lansal Inc. has contacted all impacted retail customers and distributors instructing them to remove all affected product from sale and is working with the appropriate agencies including state departments of health, the Food and Drug Administration and local authorities," the company said.

The Lansal consumer question line is 877-550-0694.

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### **Walnuts**

Sherman Produce said it was recalling "241 cases of bulk walnuts packaged in 25 lb bulk cardboard boxes and Schnucks brand 10 oz trays with UPC 00338390032 with best by dates 03/15 and 04/15."

An FDA sampling detected *Listeria monocytogenes* in walnuts at the facility.

Sherman Produce can be reached for questions at 314-231-2896.

<http://www.cnn.com/2014/05/22/health/>

# Interview Data

## DATA FROM INTERVIEWS WITH INDIVIDUALS

INDIVIDUAL	GENDER	AGE (YRS)	SYMPTOMS	DATE SYMPTOM ONSET	DATE VISITED FARM	EMPLOYEE, PATRON, CLOSE CONTACT	CONSUMED	PARTICIPATED	SPECIAL HEALTH CONCERNS	CURRENT HEALTH STATUS
1	Female	7	BD, HUS, A, KF	Oct 2	Oct 1	Patron	H, J, I	O	NK	Deceased
2	Female	8	BD, HUS	Oct 2	Oct 1	Patron	H, J, I	O	NK	Poor, Hospitalized
3	Male	7	BD, HUS	Oct 2	Oct 1	Patron	H, J, I	O, PZ	NK	Poor, Hospitalized
4	Female	8	BD	Oct 3	Oct 1	Patron	H, J, I	O, PZ	NK	Recovering
5	Male	7	BD	Oct 3	Oct 1	Patron	H, J, I	PZ	NK	Recovering
6	Male	7	BD	Oct 2	Oct 1	Patron	J, I	PZ	NK	Recovering
7	Male	7	BD	Oct 2	Oct 1	Patron	J, L, I	PZ	NK	Recovering, Hospitalized
8	Male	35	BD	Oct 4	Oct 1	Patron	H, J, W, L	O, PZ	NK	Recovering
9	Female	6	BD	Oct 3	Oct 2	Patron	S, J, I	PZ	NK	Recovering
10	Female	7	BD, HUS	Oct 3	Oct 2	Patron	J, I	NA	NK	Poor, Hospitalized
11	Male	7	BD	Oct 4	Oct 2	Patron	H, J, I	O, PZ	NK	Recovering
12	Female	29	BD	Oct 4	Oct 2	Patron	S, J	NA	NK	Recovering
13	Male	7	BD	Oct 5	Oct 4	Patron	H, J, I	NA	NK	Poor
14	Male	7	BD	Oct 5	Oct 4	Patron	H, J	O, PZ	NK	Poor
15	Male	8	BD, F	Oct 5	Oct 4	Patron	H, J, L	PZ	NK	Recovering
16	Female	8	BD, HUS	Oct 7	Oct 6	Patron	J, L, I	NA	NK	Poor, hospitalized
17	Female	8	BD	Oct 8	Oct 6	Patron	H, J, W	O	NK	Poor
18	Female	8	BD, V	Oct 8	Oct 6	Patron	H, J	O, PZ	NK	Recovering
19	Female	25	BD	Oct 10	Oct 6	Employee	S, J	NA	NK	Recovering
20	Male	23	BD	Oct 11	Oct 6	Employee	H, L, I	PZ	NK	Poor
21*	Male	33	None	NA	Oct 3	Patron	S, H, L, I	O, PZ	NK	Good
22*	Female	32	None	NA	Oct 6	Patron	S, H, L	O, PZ	NK	Good
23*	Female	29	None	NA	Oct 6	Patron	S, H, W	O, PZ	NK	Good
24*	Male	19	None	NA	Oct 5	Employee	H, I	PZ	NK	Good
25*	Female	17	None	NA	Oct 4	Employee	H, J, W, L	NA	NK	Good
26*	Female	30	None	NA	Oct 4	Patron	S, H, W	O	NK	Good
27*	Male	35	None	NA	Oct 3	Patron	S, L, I	O, PZ	NK	Good

\* Data gathered by students through mock interviews

- **Symptoms Key:** BD, bloody diarrhea; V, vomiting; F, fever; HUS, hemolytic uremic syndrome; KF, kidney failure; A, anemia
- All sick individuals visited their physicians.
- **Food Key:** S, salad; H, hamburger; J, fresh-pressed apple juice; L, fresh lemonade; W, water; I, ice cream,
- **Event Key:** PZ, petting zoo; O, orchard picking
- **Other:** NA, Not applicable; NK, None known

# Actor Responses for Interviewees # 21- 27 to Complete Table 1

*Note: Only provide answers if questions asked. Do not offer unsolicited information.*

---

**Actor 1:**

Male, age 33 years.  
Not sick, health currently good. No known health problems.  
Patron of farm on October 3.  
Consumed salad, hamburger, lemonade, and ice cream.  
Participated in orchard picking and petting zoo.

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**Actor 2:**

Female, age 32 years.  
Not sick, health currently good. No known health problems.  
Patron of farm on October 6.  
Consumed salad, hamburger, and lemonade.  
Participated in orchard picking and petting zoo.

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**Actor 3:**

Female, age 19.  
Not sick, health currently good. No known health problems.  
Patron of farm on October 6.  
Consumed salad, hamburger, and water. Participated in orchard picking and petting zoo.

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**Actor 4:**

Male, age 19 years.  
Not sick, health currently good. No known health problems.  
Employee of farm. Worked on October 5.  
Consumed hamburger and ice cream. Participated in petting zoo.

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**Actor 5:**

Female, age 17 years. Not sick, health currently good.  
No known health problems.  
Employee of farm. Worked October 4.  
Consumed hamburger, juice, water, and lemonade.  
Did not participate in orchard picking or petting zoo.

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**Actor 6:**

Female, age 30 years.  
Not sick, health currently good. No known health problems.  
Patron of farm on October 4.  
Consumed salad, hamburger, and water. Participated in orchard picking.

---

**Actor 7:**

Male, age 35 years.  
Not sick, health currently good. No known health problems.  
Patron of farm on October 3.  
Consumed salad, lemonade, and ice cream.  
Participated in orchard picking and petting zoo.



# Student Lab Sheet: Don't Cross Me

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## Getting Ready

- Wash 2 cutting boards with hot, soapy water and air dry.
- Label cutting boards "A," "B."
- Label Petri dishes: "A," "B," "control cheese," "control agar plate."
- Divide the remaining dish in half and label "Control Board A," "Control Board B."

---

## Conduct the Experiment

1. Swab the clean cutting boards A and B and inoculate the cutting-board control dish.
2. Partially unwrap, then swab one slice of cheese. Inoculate the cheese control dish – don't touch the cheese with your fingers.
3. Seal the cutting board, cheese, and agar control plates.
4. Put on safety gloves, then use an alcohol wipe to sanitize the outside wrap of the hamburger.
5. Use an alcohol wipe to sanitize the knife.
6. Carefully remove the wrap from the hamburger by slitting the wrap along 3 sides of the package, being careful not to touch the meat with the knife. Then peel the wrap away from the meat. This technique helps ensure that you haven't cross-contaminated the hamburger with the knife or the wrap. This is important for a scientific experiment, but not necessary at home. Divide the hamburger in half.
7. Make one hamburger patty on cutting board A and another on board B. Make sure you press the patties into the boards as you are forming them. Let the patties sit on the boards for several minutes.

### BOARD A

1. Remove the hamburger patty and safely dispose of it. Then remove your gloves and throw them away.
2. Thoroughly wash board A in hot, soapy water. Air dry to ensure that you don't contaminate the board with bacteria that might be on the paper towel. Put on clean gloves.
3. Unwrap a slice of cheese and put it on cutting board A. Make sure you place the cheese in the same place as the hamburger was placed. Let it set there for several minutes.
4. Swap the side of the cheese that was in contact with the board and inoculate Petri dish A.
5. Remove gloves and wash your hands.

### BOARD B

1. Remove the hamburger patty and safely dispose of it, **do not wash cutting board B**. remove your gloves and throw them away. Wash your hands and put on new gloves.
2. Unwrap a slice of cheese and put it on cutting board B. make sure you place the cheese in the same place as the hamburger was placed. Let it sit there for several minutes.
3. Swab the area of cheese that was in contact with the board and elite Petri dish B.

---

## Incubate Petri Dishes

- Tape all inoculated Petri dishes to seal.
- Place the Petri dishes in the incubator at 35° C for 1 to 2 days.
- You need 18 to 24 hours to see results in an incubator or several days at room temperature. The cultures you see may be "pinpoint" cultures. Look closely to observe any bacteria growth.

**Observe daily, record results, and state conclusions.**

# New Cases

## ARE THEY RELATED TO THE OUTBREAK?

INDIVIDUAL	SYMPTOMS	DATE SYMPTOM ONSET	SYMPTOM DURATION	DATE VISITED FARM	CURRENT HEALTH STATUS
1	Nausea, headache	July 30	1 day	July 30	Good
2	Severe diarrhea, abdominal pain	October 6	Nearly gone	October 4	Recovering
3	Mild diarrhea	October 5	2 hours	October 5	Good
4	Abdominal pain, diarrhea	October 7	Ongoing	NA, mother of child who visited farm on Oct 2	Poor
5	Bloody diarrhea, abdominal pain	October 8	Ongoing	NA, no known contact with sick patron, employee	Poor

# Activity and Consumption Data

## ACTIVITY/CONSUMPTION AT FARM AND ASSOCIATION WITH ILLNESS

FOOD OR ACTIVITY	# CONSUMED OR PARTICIPATED AND SICK	# CONSUMED OR PARTICIPATED NOT SICK	# NOT CONSUMED OR PARTICIPATED AND SICK	# NOT CONSUMED OR PARTICIPATED AND NOT SICK	ODDS RATIO
Unpasteurized Apple Juice	19	1	1	6	3.16
Bottled Water	2	3	18	4	0.15
Lemonade	5	4	15	3	0.25
Hamburger	13	6	7	1	0.31
Salad	3	5	17	2	0.07
Ice Cream	13	3	7	4	2.48
Petting Zoo	12	5	8	2	0.60
Orchard Picking	9	5	11	2	0.33

$$\text{Odds Ratio} = \frac{[(\# \text{ Consumed and Sick}) \div (\# \text{ Not Consumed and Sick})]}{[(\# \text{ Consumed Not Sick}) \div (\# \text{ Not Consumed and Not Sick})]}$$



# How are Pathogens Detected in Foods?

---

## Materials

- Gloves
- 10 g your food product(s)
- 10 g of the commercially available alternative
- 2 Liter of water
- Ziploc Bags
- Forceps or tongs
- Water
- 90 mL sterile peptone water (PW)
- Pipette
- Pipette tips
- Aerobic Plate Counts Petrifilms
- E. coli Petrifilms
- 24 test tubes per sample to hold 10 mL each

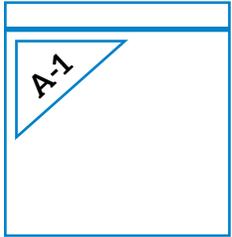
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## Procedure

1. Put your gloves on and wear them for the entire lab. Do not touch your face, eyes, or mouth. Do not eat during this lab. Wash your hands thoroughly after the lab.
2. Label all test tubes and bags as illustrated such as A-1, etc. (see picture in [Appendix 13.1](#))
3. Place 10 g samples of your food product in four different Ziploc – each labeled as “Food Item 1, 2, etc.” - bags using forceps or tongs.
4. Add 90mL of sterile peptone water (PW) to each sample bag and seal the bags.
5. Stomach the samples in the sealed bags manually, or use the stomacher. Manual stomaching is done by “squishing” the sample in the water and swirling gently. This creates the 4 rinsates for your food product.
6. Prepare 24 test tubes per sample with 9mL of peptone water. Change pipette tips.
7. Pipette 1 mL of the rinsate from sample “Food Item 1” into first test tube.
8. Mix for 30 seconds by drawing and emptying the rinsate into/out of the pipette.
9. Withdraw 1 mL from each rinsate + blank test tube and place into another blank. Repeat five more times to create a dilution of 10<sup>-6</sup>.
10. Transfer 1 mL of the sample to an E. coli Petrifilm and 1 mL of the sample to an Aerobic Petrifilm. Label them with the same label as the Ziploc containing the sample.
11. Change pipette tips.
12. Repeat for each “food item” rinsate.
13. You will have 8 Aerobic and 8 E. coli Petrifilms for each food item.
14. Incubate the films at room temperature:
  - » 24 hours for *E. coli*
  - » 48 hours for Aerobic
15. Look for colonies on the films. If any exist on your E. coli Petrifilm, the food product is contaminated with a strain of E. coli. If any exists on your Aerobic Petrifilm, your product contains another pathogen such as Salmonella.
16. Photograph your Petrifilms to include in your reports and explain the absence or presence of pathogens.

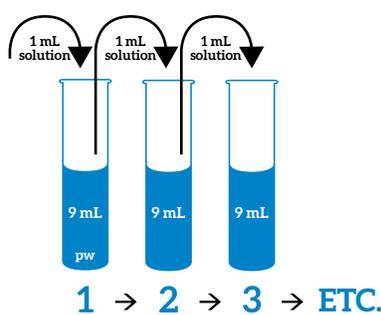
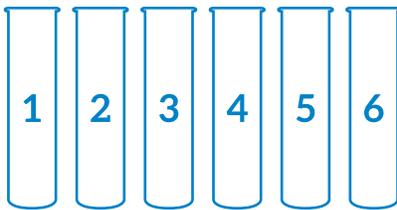
# Detecting Pathogens Diagram

## Label Bags



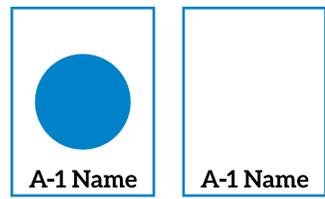
- Patty: A-1
- A-2
- A-3
- A-4
  
- Bulk: B-1
- B-2
- B-3
- B-4

## Label Test Tubes



- 1-1    2-1    3-1
- 1-2    2-2    3-2
- 1-3    2-3    3-3
- 1-4    2-4    3-4
- 1-5    2-5    3-5
- 1-6    2-6    3-6

## Label Petri Films



ECC                  Aerobic

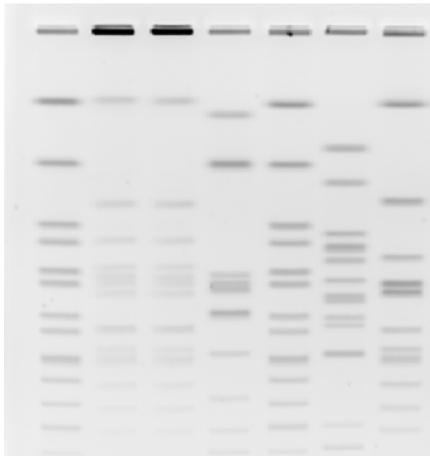
- Patty: A-1 - name
- A-2 - name
- A-3 - name
- A-4 - name
  
- Bulk: B-1 - name
- B-2 - name
- B-3 - name
- B-4 - name

# Lab Data

## Laboratory Data from Food Products, Environmental Swabs, and Patient Stool Specimen from the Farm-Associated Illness Outbreak

Pulsed field gel electrophoresis results. Bacterial isolates from growth media are treated with enzymes to cut the genetic material at specific sequences. Pieces of DNA of different sizes react with a dye and are visualized on a gel. Isolates from different sources are compared to determine relatedness based on banding patterns.

Lane    1    2    3    4    5    6    7



LANE	ISOLATE
1	Size reference
2	Patient #1 stool specimen
3	Unpasteurized cider
4	Ice cream
5	Petting zoo environmental swab
6	Orchard environmental swab
7	Hamburger

*Image Source: Delaware Public Health Laboratory*

# Case Report Final Rubric

Name \_\_\_\_\_ Date \_\_\_\_\_ Class Period \_\_\_\_\_

Total Points for Project \_\_\_\_\_ /100

CASE REPORT (50 POINTS)	
<ul style="list-style-type: none"> <li>• Synthesis of the data analyzed during the project and how it relates to the investigation, including an introduction and background of the investigation (0-60 points)               <ul style="list-style-type: none"> <li>› Include copies of:                   <ul style="list-style-type: none"> <li>» <i>All data tables</i></li> <li>» <i>Interview guide created by teams</i></li> </ul> </li> <li>› Summary should include responses from all questions related to the case investigation</li> </ul> </li> <li>• Clearly states the investigation conclusion and names the source of the outbreak (0-10 points)</li> <li>• Case report is typed and neatly formatted (0-10 points)</li> <li>• Case report is free of spelling/grammatical errors (0-10 points)</li> </ul>	
FINAL PRESENTATION (50 POINTS)	
<ul style="list-style-type: none"> <li>• Team was able to explain:               <ul style="list-style-type: none"> <li>› A summary of the investigation (0-10 points)</li> <li>› Rationale for their conclusion (0-10 points)</li> </ul> </li> </ul>	
<b>Final Presentation Total</b>	



# Collaboration Rubric

	BELOW STANDARD	APPROACHING STANDARD	AT STANDARD	ABOVE STANDARD
<b>RESPONSIBILITY FOR ONESELF</b>	<ul style="list-style-type: none"> <li>is not prepared and ready to work with the team</li> <li>does not do project tasks</li> <li>does not complete tasks on time</li> <li>does not use feedback from others to improve his/her work</li> </ul>	<ul style="list-style-type: none"> <li>is sometimes prepared and ready to work with the team</li> <li>does some project tasks, but needs to be reminded</li> <li>competes some tasks on time</li> <li>sometimes uses feedback from others</li> </ul>	<ul style="list-style-type: none"> <li>is prepared and ready to work with the team; is available for meetings and uses the team's communication system</li> <li>does what he or she is supposed to do without having to be reminded</li> <li>completes tasks on time</li> <li>uses feedback from others to improve his or her work</li> </ul>	<p><i>In addition to At Standard criteria:</i></p> <ul style="list-style-type: none"> <li>does more than what he or she has to do</li> <li>asks for additional feedback to improve his or her work, beyond what everyone has been given</li> </ul>
<b>HELPING THE TEAM</b>	<ul style="list-style-type: none"> <li>does not help the team solve problems; may cause problems</li> <li>does not share ideas with other team members</li> <li>does not give useful feedback to others</li> <li>does not offer to help others</li> </ul>	<ul style="list-style-type: none"> <li>cooperates with the team but does not actively help it</li> <li>makes some effort to share ideas with the team</li> <li>sometimes gives useful feedback to others</li> <li>sometimes offers to help others</li> </ul>	<ul style="list-style-type: none"> <li>helps the team solve problems, manage conflicts, and stay focused and organized</li> <li>shares ideas that help the team improve its work</li> <li>gives useful feedback (specific and supportive) to others so they can improve their work</li> <li>offers to help others do their work if they need it</li> </ul>	<p><i>In addition to At Standard criteria:</i></p> <ul style="list-style-type: none"> <li>steps in to help the team when another member is absent</li> <li>encourages others to share ideas, helps to make them clear, and connects them to the team's work</li> <li>notices if a team member does not understand something and takes action to help</li> </ul>
<b>RESPECT FOR OTHERS</b>	<ul style="list-style-type: none"> <li>does not pay attention to what teammates are talking about</li> <li>does not show respect for teammates (may interrupt, ignore ideas, hurt feelings)</li> </ul>	<ul style="list-style-type: none"> <li>usually listens to teammates, but not always</li> <li>is polite and kind to teammates most of the time, but not always</li> </ul>	<ul style="list-style-type: none"> <li>listens carefully to teammates</li> <li>is polite and kind to teammates</li> </ul>	<p><i>In addition to At Standard criteria:</i></p> <ul style="list-style-type: none"> <li>encourages the team to be respectful to each other</li> <li>recognizes everyone's strengths and encourages the team to use them</li> </ul>

# Project Presentation Audience Feedback

Student Team \_\_\_\_\_

Project Name \_\_\_\_\_ Date \_\_\_\_\_

Thank you for attending our project presentations and taking the time to write thoughtful answers to the following questions:

1. What did you learn from this presentation, or what did it make you think about?

2. What did you like about this presentation?

3. Do you have any questions about the topic or about how the project was done?

4. Any other comments about this presentation?



# Student Lab Sheet: Coliform Counts

## Prepare Test Tubes and Petri Dishes

1. Label 5 Petri dishes: "10," "100," "1,000," "10,000," and "control."
2. Label 3 test tubes: "100," "1,000," and "10,000." Place in test-tube rack.
3. Add 9 ml of sterile saline solution to each of the 3 test tubes.

## Innoculate Petri Dishes

### 1-in-10 Dilution

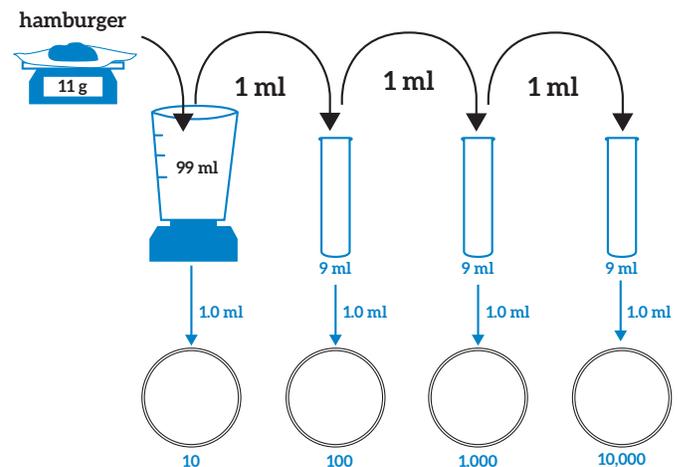
- Pipette 1 ml of the 1-in-10 hamburger solution (from classroom demonstration) directly into the Petri dish marked "10." Carefully swirl the dish to cover the surface. Cover the Petri dish.

### 1-in-100 Dilution

- Pipette 1 ml of the 1-in-10 hamburger solution (from classroom demonstration) directly into the test tube marked "100." Now the concentration of the hamburger is 1 in "100."
- Thoroughly mix the solution by holding the test tube by the top and gently striking the bottom with the finger on the other hand for about 5 strikes.
- Pipette 1 ml of this solution into the Petri dish marked "100." Cover the dish.

### 1-in-1,000 Dilution

- Pipette 1 ml of the 1-in-100 hamburger solution directly into the test tube marked "1,000." Now the concentration of the hamburger is 1-in-1,000.
- Pipette 1 ml of this solution into the Petri dish marked "1,000." Cover the dish.



### 1-in-10,000 Dilution

- Pipette 1 ml of the 1-in-1,000 hamburger solution (from classroom demonstration) directly into the test tube marked "10,000." Now the concentration of the hamburger is 1-in-10,000.
- Pipette 1 ml of this solution into the Petri dish marked "10,000." Cover the dish.

## Adding the Agar

1. Pour about 10 ml of agar into each Petri dish containing the hamburger solution. Swirl the dish to mix and evenly cover the bottom of the dish.
2. As soon as the agar is solidified, pour in another 4 to 6 ml of agar and swirl again to spread evenly.
3. Pour a control plate to make sure the agar is not contaminated.
4. Store the dishes upright until the agar is solid. Then invert the dishes, tape them, and place in the incubator at 35° C overnight.
5. Examine the Petri dishes for growth the next day and record your observations.

# Self-Reflection on Project Work

Think about what you did in this project and how well the project went. Write your comments in the right column.

<b>Student Name:</b>	
<b>Project Name:</b>	
<b>Driving Question:</b>	
<b>List the major steps of the project:</b>	
<b>ABOUT YOURSELF:</b>	
<b>What is the most important thing you learned in this project:</b>	
<b>What do you wish you had spent more time on or done differently:</b>	
<b>What part of the project did you do your best work on:</b>	
<b>ABOUT THE PROJECT:</b>	
<b>What was the most enjoyable part of this project:</b>	
<b>What was the least enjoyable part of this project:</b>	
<b>How could your teacher(s) change this project to make it better next time:</b>	