NATURE Sunday Academy 2013-2014

Food Safety and Farms

Lesson Plan

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Activities

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Introduction

Foodborne illnesses are diseases that people acquire by eating foods. Food safety is the scientific field that deals with preventing and responding to foodborne illness problems. In our complex food system, foodborne illness can be caused by accidental contamination of food with pathogenic (disease-causing) microorganisms anywhere from the farm where the food is produced to the kitchen or restaurant where the food is eaten.

Since contamination can happen anywhere along the farm-to-fork food system, everyone working in food production and processing, from field hands on farms and quality-assurance specialists in packing plants to the floor managers at your grocery store, is working to ensure that food reaches your kitchen in as safe a condition as possible. That way, you can enjoy a healthy meal that won't leave you running to the bathroom, or worse the doctor, a few days later.

In spite of our efforts, about 1 in 6 people (48 million people) become sick from foodborne illnesses every year in the US. A new law, called the Food Safety Modernization Act of 2011, is changing the way companies approach food safety. As a result there is a huge demand for food safety managers at food companies big and small. In this project, you will work through the story of an outbreak investigation that changed the food safety culture in the US.

Activity 1: Identification of Contaminated Foods

Many consumers believe that they can tell unsafe food from safe food. Can you? With your group, examine the provided basket of fruits and vegetables. Some of it is contaminated heavily, some lightly, some not at all. Which items in the basket are safe to eat, which are not?

Step 1 – Get into your groups.

Step 2 – Examine your produce basket. Using any rules you can think of, decide which of the foods is contaminated.

Question 1.1 - Which produce items do you think are contaminated? Why?

Step 3 – The foods are "contaminated" with GloGerm™ powder. This fine powder is invisible to the eye and spreads around much like bacteria. It also,

thankfully, glows under a blacklight. Use the blacklight to examine your foods and identify which are contaminated.

Question 1.2 - Which food is contaminated? Did you guess correctly? Why do you think it is a challenge to identify contaminated foods? Do you think that contamination spread from food item to food item in the basket?

Step 4 – Carry your produce to a sink. Wash it until you think it is clean. Go back to the UV light and check your produce.

Question 1.3 - Were you able to get all of the contamination off of your produce? Do you think some food is harder to wash than others? Why or why not?

Activity 2: Outbreak!

Bacteria and viruses are, by far, the largest cause of foodborne illnesses in the US. Most of these illnesses are "sporadic" which means they are isolated, random incidents with a single person - or a few people in a family - getting sick. Sporadic illnesses usually result from accidental food contamination in farms or in home kitchens due to cross-contamination or failure to wash hands thoroughly. A few times a year in the US, something goes very wrong in the food production system, and large batches of food are contaminated before they ever get to consumers. Usually such contamination is caught and food is recalled before people get sick. However, when this contaminated food makes it to market undetected, outbreaks occur. An outbreak is defined as an above-normal rate of disease in a population. For example, if North Dakota historically sees 5 to 6 cases of salmonellosis per month then public health authorities would consider 10 or more cases in a month to be an outbreak. With fruits and vegetables, as with ready-to-eat meat and seafood, outbreaks are frequently much larger, because consumers frequently consume these foods out of the package. Typically, hundreds to thousands of reported illnesses occur in outbreaks linked to fruits and vegetables.

In this scenario, your local hospital has seen three patients who had to be treated for vomiting, diarrhea and dehydration. Samples from each patient were sent to a diagnostic lab. The results indicate that all three were infected with *Salmonella enterica* Saintpaul, a specific variety of the *Salmonella* pathogen. Upon reporting your local outbreak to the Centers for Disease Control and Prevention (CDC), you hear that your hospital's problem is part of a larger national outbreak in which 39 cases were linked to *Salmonella* Saintpaul this week. Hoping for a chance to join the CDC's elite Epidemic Intelligence Service, you want to use the CDC's information to solve the outbreak first. You have access to information about every patient that has been diagnosed with *Salmonella* Saintpaul in the outbreak. What questions should you answer in order to solve the outbreak?

Complete your investigation before time runs out!

Step 1 – Get into your groups.

Step 2 – In your group, decide on a plan of attack to solve the outbreak? You know that a lot of people have gotten sick with the same bacteria and that the bacteria probably came from food. What do you need to know next?

Question 2.1 - How can you get more information about which foods made people sick?

Step 3 – Phone survey data indicate that patients ate a lot of different foods that have historically been linked to *Salmonella* outbreaks. Which one actually caused the outbreak? Epidemiologists use attack tables to figure out whether foods are associated with illness in interviewees. Using the formulas below the table, complete the below attack table by filling in the missing data on the number of ill and well interviewees. Higher risk ratio means more likely cause of illness. For example, a risk ratio of 5.0 indicates that interviewees who ate the food were five times more likely to become ill than interviewees who did not eat the food.

	Ate the Food				Did Not Eat the Food				
Food	Total	Well	Ill	Attack Rate	Total	Well	Ill	Attack Rate	Risk Ratio
Eggs	79	64	15	19%	21	20	1	5%	3.8
Chicken		52		18%	37	35	3		
Pork	51	45				22	3	14%	
Tomatoes (salsa, salad, tacos, and fresh)	82			40%	18	17		6%	
Onion (salsa, salad, tacos)	45	33	12		55	51	4		
Cilantro (salsa, tacos)	77		49		36	32			
Peppers (salsa, salad)	124			66%		36	3		
Peanut butter	86		12		28	25	3	11%	
Almonds	48	36		25%	24	22			
Spinach	40	36	4		30	26	4		

Number of well = (1-(Attack rate/100)) x Total Interviewed
Number of ill = (Attack rate/100) x Total Interviewed

Attack Rate = (Number Ill/Total Interviewed) x 100%

Risk Ratio = Attack Rate$_{\text{Ate the Food}}$/Attack Rate$_{\text{Did Not Eat the Food}}$

Step 3 – DNA fingerprinting is used to link bacteria in food to bacteria from clinical patients in hospitals. To finally establish the epidemiological link between *Salmonella* in the food and *Salmonella* in the patients, match the DNA fingerprint from the sick patients to a DNA fingerprint from a food.

Question 2.2 - What food was the most likely cause of the outbreak?

Activity 3: How did the contamination happen on the farm?

Once investigators have determined what food is linked to the outbreak and pulled it from the shelves, their job still isn't done. Prevention of future outbreaks usually hinges on the ability of outbreak investigators to reconstruct what happened. Investigation of the outbreak can rule out contamination in consumer homes or grocery stores, because the number of households with illnesses was too large and the homes too geographically widespread for that. Testing for *Salmonella* Saintpaul yielded negative results in packing houses and in warehouses that stored the food. Therefore, contamination likely happened on the farm where the food was grown. Working together with Big Produce Company, Inc., you easily obtain permission to conduct sampling for *Salmonella* Saintpaul on the farm that supplied the contaminated food. However, the farm is a 6,000 acre operation that grows tomatoes, hot peppers and cilantro. Sources of the contamination could be wildlife intrusion, runoff from a nearby livestock operation, or contaminated irrigation water. How can you distinguish between these different sources of contamination?

Step 1 – Go to your groups.

Question 3.1 - Think about how contamination plays out on farms. As a group, how do you think the pattern of contamination is different when water, fecal runoff, or wildlife is the source? Explain your answers with words and/or diagrams on the next page.

Step 2 – Using the diorama material, create your contamination model. Place produce (filter paper), water sources, animals, and fecal material (cocoa), in or around the crop field.

Step 3 – Discuss the diorama with a teacher.

Step 4 – Put the diorama in motion! Spread the contamination with the appropriate water source.

Question 3.2 – Which form of contamination spread the most?

Step 5 - Harvest the peppers! Collect the "food" and mix it in a bag with uncontaminated "food" from other farms. This simulates the packing process. Did the contamination spread? What would happen if this mixed batch of peppers were split into shipping containers bound for grocery stores around the country?

Step 6 – In traceback investigation, as with epidemiologic investigations, the final conclusive link is made by comparing DNA fingerprints of bacteria from clinical patients to DNA fingerprints of DNA from food production environments.

Question 3.3 – What was the most likely source of the *Salmonella* Saintpaul bacteria associated with this outbreak?