



Lesson 2.1

Avenues for Contamination

Estimated time: Two 50 min periods

Instructional overview

Lesson 2.1 serves as an introduction to the second module of *Food Safety Investigation: Applying Food Safety Practices from Farm to Table*. This module applies information from module one and examines farm management and food safety practices. In this lesson, students will explore how different types of food move from farm to table. Students will determine how different physical, chemical, and biological hazards can contaminate food within each highlighted sector of the food system including produce, meat, milk, and grain.

Instructional objectives

1. Identify several paths food could take as it moves from farm to table.
2. Determine points at which physical, chemical, and biological hazards could contaminate food.

Assessment

Teachers should assess students on their understanding of the food system, as students work on their assignments to determine how food moves from farm to table as well as the hazards that exist and present their ideas through the JIGSAW activity. Student experiences with farming and the food system will vary, thus some groups will require more guidance than others.

Relevant learning standards – NSES-A, NSES-C, NHES-1

Equipment, supplies, and materials

1. PowerPoint Presentation – PPT 2.1.
2. Case Notes 2.1 “Avenues for Contamination” – one per student or use ppt template.
3. Supplemental Career Introduction Activity 2.1 “Windows of Opportunity” - one per student or use ppt template.

References and background information

1. “Jigsaw Classroom: Jigsaw in 10 Easy Steps” Social Psychology Network, 2006. Internet Access at <http://www.jigsaw.org/steps.htm>
2. GAPsNET www.gaps.cornell.edu

Interest approach

Choose a commodity and ask the students to define the steps that move this commodity from farm to table. Food production pictures would help students understand the various steps. Some images have been provided in the PPT 2.1 but additional images can be gathered from other sources to highlight the commodity that has been selected for use in the interest approach. Once students have identified the steps, ask students to briefly predict potential ways food could be contaminated for a few of the steps in the process. Use this discussion to highlight the complexity of the food system, risks that exist, and how food safety practices are built in to prevent contamination.

Classroom procedures

Teaching procedures	Content
<p>Lead discussion to briefly review the previous module and introduce module two.</p> <p>Focus discussion on the Thought Questions as it is important to get students thinking about the complexity of the food systems and where the hazards exist. Record student responses on the board.</p>	<p>Review from module one:</p> <ul style="list-style-type: none"> • Name the three types of food safety hazards? • Which one was responsible for the foodborne outbreak with green onions? • What was the specific microorganism of concern? <p>Thought Questions:</p> <ul style="list-style-type: none"> • How did Hepatitis A virus get on the green onions? • What should be the next step in our investigation?
<p>State expectations for today's lesson.</p>	<p>By the end of this class you should be able to:</p> <ol style="list-style-type: none"> 1. Identify the paths food takes as it moves from farm to table. 2. Determine points at which physical, chemical, and biological hazards could contaminate food.
<p>Introduce Farm to Table.</p>	<p>The American food system is complex, with food traveling many miles within this country or imported from another country before it arrives on our tables. It is important to identify the paths our food takes as it travels from the farm to table when investigating the sources of contamination in a foodborne illness outbreak.</p> <p>The food industry does its best to assure quality and safety but contamination can occur naturally as in the case of toxic plants or animals or when errors occur. This is why attention to detail is important at every step in the process, from farm to table.</p>

<p>Handout Case Notes 2.1 or show the ppt template to help students organize their notes.</p> <p>Have students identify the steps it takes to get lettuce from the field, to the bag, then to the consumer.</p> <p>Once the students have identified the steps, have them determine what type of hazard may be present and describe it.</p> <p>Review types of food safety hazards</p> <p>P = Physical</p> <p>C = Chemical</p> <p>B = Biological</p> <p>Remind students to record their notes on Case Notes 2.1 Lettuce.</p> <p>Have students repeat this process for meat (hamburger), dairy (milk), and wheat (bread). Flowcharts and keys are provided as a reference.</p> <p>Note: For this portion of the lesson, students can be divided into either their Investigative Teams or into three groups to finish the remaining commodities or the class can work through the flowcharts as one large group. For the Jigsaw exercise that comes next, the students will need to be in their Investigative Teams to start.</p>	<p>Steps from Farm to Table – Developing a flowchart for lettuce</p> <ol style="list-style-type: none"> 1. Lettuce is grown in a field 2. Lettuce is harvested and cored by hand 3. Lettuce is sanitized and often treated with an anti-browning agent 4. Lettuce is placed in bags that are stored in bins and transported to packinghouse 5. Lettuce is pre-cooled (commonly in hydro vacuum tube) 6. Lettuce is chopped into small pieces and flumed to packaging area in water containing a sanitizer 7. Lettuce is centrifuged to remove excess water 8. Lettuce is packaged into bags 9. Lettuce is transported to distributor, retail or storage 10. Lettuce is purchased by Consumer <p>Possible contamination in Lettuce</p> <p>Step 1: B- contaminated by wild animal feces or contaminated irrigation water C- improper application of topical sprays (either timing, amount, or use of poor quality water for mixing) Should we add topical sprays to the definitions?</p> <p>Step 2: B- poor worker hygiene leads to contamination</p> <p>Step 3: B- Improper water disinfection C- Too much disinfectant or anti-browning agent leads to chemical contamination of product</p> <p>Step 4: B/C- dirty truck contaminated product with microbial pathogens or chemicals B- storage bins are not cleaned properly</p>
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	<p>Step 5: B- improper water disinfection in hydro vacuum tube</p> <p>Step 6: B- water not properly disinfected in packinghouse C- packinghouse water contains too much disinfectant or other contaminant B- improper equipment sanitation</p> <p>Step 7: B- improper equipment sanitation</p> <p>Step 8: P- foreign objects are accidentally packaged in bags of lettuce (stones, equipment parts, animal parts, etc.)</p> <p>Step 9: B- improper cooling in truck B/C- dirty truck B- improper storage temperature</p> <p>Step 10: B- improper refrigerator temperature B- storage for time beyond use-by date leads to growth of bacteria, molds, etc. B- cross contamination with raw meat in the home</p>
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<p>Hamburger Production Flowchart key:</p> <ol style="list-style-type: none"> 1. Beef animal is raised on farm and/or feedlot 2. Live animal is transported to slaughter facility and inspected 3. Animal is slaughtered 4. Carcass is inspected for meat quality 5. Carcass is cooled 6. Carcass is fabricated into primals, sub-primals, cuts, and trimmings 7. Cuts and/or trimmings are ground (may be held – chilled – before grinding) 8. Meat is packaged and stored 9. Meat is transported to retail store (meat may be repackaged at retail store into smaller units) 10. Meat is purchased by consumer 	<p>Possible contamination in Hamburger</p> <p>Step 1: B- feed contains banned animal products C- animal is treated with antibiotics or other medications without proper holding time P- animal contains broken needles, buckshot, etc.</p> <p>Step 2: B- animal is not healthy at time of slaughter C- animal is treated with antibiotics or other medications without proper holding time P- animal contains broken needles, buckshot, etc.</p> <p>Step 3: B- contamination of carcass with pathogenic bacteria during slaughter</p> <p>Step 4: B- visible feces, ingesta, and milk are not removed during final inspection P- carcass contains broken needles, buckshot, etc.</p> <p>Step 5: B- contamination with pathogenic bacteria during cooling; growth of pathogenic bacteria due to insufficient cooling</p> <p>Step 6: B- contamination with pathogenic bacteria during fabrication; growth of pathogenic bacteria due to insufficient cooling</p> <p>Step 7: C- improperly applied cleaning chemicals from processing environment contaminate meat P- metal fragments from grinder contaminate hamburger meat B- improperly cleaned grinder leads to contamination of meat with pathogenic bacteria</p> <p>Step 8: B- storage temperatures are too warm resulting in growth of pathogenic bacteria</p>
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	<p>Step 9: B- storage temperatures are too warm resulting in growth of pathogenic bacteria</p> <p>Step 10: B- consumer preparation practices lead to cross contamination or pathogen growth; meat not cooked to proper temperatures before consumption</p>
<p>Milk Production Flowchart key:</p> <ol style="list-style-type: none"> 1. Cow is milked on farm 2. Milk is stored in bulk tank 3. Milk is transferred to tanker 4. Milk is transported to processing plant 5. Milk is stored at processing plant 6. Milk is pasteurized and homogenized at processing plant 7. Milk is packaged at processing plant 8. Milk is transported to retail or distributor 9. Milk is stored and sold at retail store 10. Milk is purchased by consumer 	<p>Possible contamination in Milk</p> <p>Step 1: C- milk from sick cows treated with medications not kept separate C- teat sanitizer not properly removed and contaminates milk B- fecal/soil/feed contamination from dirty teat P- filters not maintained properly and particulates contaminates milk</p> <p>Step 2: P/B/C- bulk tank lid left open and milk is contaminated with physical, biological or chemical contaminants B/C- intentional contamination of milk B/C- milk not properly refrigerated (e.g., <i>Staphylococcus</i> toxin production)</p> <p>Step 3: B/C- tanker truck not properly cleaned and sanitized</p> <p>Step 4: B/C- intentional contamination of milk</p> <p>Step 5: B/C- milk not properly stored/refrigerated (e.g., <i>Staphylococcus</i> toxin production) B/C- intentional contamination of milk</p> <p>Step 6: B/C- milk not properly pasteurized or cross contamination occurs B/C- intentional contamination of milk</p>

	<p>Step 7: B/C- post pasteurization contamination e.g., dirty equipment, personnel B/C- intentional contamination of milk P- bottles, containers, packages contain a physical hazard/filler parts</p> <p>Step 8: B- refrigeration in truck or store does not work properly</p> <p>Step 9: B- milk temperature is not kept below 40 degrees Fahrenheit, poor product rotation B/C- intentional contamination of milk</p> <p>Step 10: B- milk temperature is not kept below 40 degrees Fahrenheit B/C- intentional contamination of milk B/C/P- accidental contamination of milk</p>
<p>Bread Production Flowchart key:</p> <ol style="list-style-type: none"> 1. Field is prepared (plowed, limed, fertilized, drilled) 2. Wheat is grown in field 3. Wheat is combined 4. Grain is transported to storage facility and stored 5. Grain is transported to mill 6. Grain is ground, cleaned, scoured, milled into flour, and packaged 7. Flour is transported to bakery 8. Flour is mixed with other ingredients and baked into bread and other products 9. Bread is packaged in bags and boxes 10. Bread is transported to retailer or distributor 11. Bread is purchased by consumer 	<p>Possible contamination in Bread</p> <p>Step 1: B- manure is applied less than 120 days prior to harvest</p> <p>Step 2: C- improper application of topical sprays (either timing or amount)</p> <p>Step 3: P- stones, sticks, or other physical hazards from the field are harvested with the grain</p> <p>Step 4: B- storage facility either has pest problems or does not maintain appropriate environment allowing for the growth of molds</p>

	<p>Step 5: P/C/B- dirty truck used in transportation</p> <p>Step 6: P- metal parts from milling and screening process break off into flour B/C– Processing equipment improperly cleaned leaving biological or chemical residues</p> <p>Step 7: P/C/B- dirty truck used in transportation</p> <p>Step 8: C- accidental addition of ingredient that is toxic or other contaminant B- uncontrolled pest problems lead to contamination of bread with pest parts or feces</p> <p>Step 9: P/C/B– bags and boxes are not stored in clean area prior to use and become contaminated with physical hazards, chemical, or biological contaminants such as rodent feces</p> <p>Step 10: P/C/B- dirty truck used in transportation or rodents may contaminate product</p> <p>Step 11: B- improper storage allows growth of microorganisms such as mold</p>
<p>Focus on Fresh Produce</p> <p>It is important for students to understand the following:</p> <p>Eating fresh produce has many health benefits including maintaining a healthy weight, obtaining daily requirements for vitamin and minerals, and preventing certain cancers.</p>	<p>What do all of these food systems have in common?</p> <p>What makes fresh produce production different from most other foods?</p> <p>Review the steps that fresh produce, such as packaged salads, takes before it is eaten. (Notice: There is not a heat treatment or other process to reduce or eliminate harmful bacteria).</p> <p>Compare this to the processing of most other foods.</p>

<p>Fresh Produce is a food safety concern because it is not cooked or processed prior to consumption to eliminate harmful microorganisms.</p> <p>Are the benefits of eating fresh produce greater than the risks?</p>	<p>Why is preventing contamination by microorganisms at the farm as well as every other stage of fruit and vegetable production important? Prevention is important because there is no heat treatment (kill step) to destroy pathogens that may be present.</p>
<p>Classroom Activity suggestion based on JIGSAW</p>	<p>After reviewing the possible points of contamination for the different foods the students will form their Investigative Teams. In the groups, each student will choose one of the four food products reviewed. They will then break away from their small groups and join into a new group with other students who chose the same product. For example, in a small group of four people, Susan chooses the lettuce production system. When Susan’s group breaks up, she will then join a group made up of the other lettuce representatives. This should result in four large groups one for each food.</p> <p>In the large groups, the students should focus on creating a story about how their food is produced. The story should hit all of the major points reviewed in the materials. To help the students really remember each of the points, the story should tell how the food became contaminated at each point. The stories should represent a worst-case scenario. The contamination should reflect real possibilities, but can be as drastic or compounded as the students like. The more creative, the better.</p> <p>When each group has developed their story, the large groups break up, and the students return to their original Investigative Teams. The students will then take turns telling the stories about their food. In the end, all students will get to hear each of the stories.</p> <p>After the groups have finished sharing stories, ask students about them. To check for understanding, ask students questions about the stories they did not help to develop. You may have a vote at the end to see which story was the favorite.</p>

<p>Supplemental Career Introduction Activity 2.1 Windows of Opportunity. Explain Assignment. Write due date on the board.</p>	<p>Take a moment and think about all of the people producing the foods we eat. The food industry includes people who work on farms, in processing plants, for distributors and wholesalers, in grocery stores and all types of restaurants. Every person in each sector of the food system needs to be properly educated and trained so they can understand, manage, and implement food safety practices as food moves from farm to table. Attention to details is very important in assuring the safety of foods.</p> <p>Directions: For this assignment you will investigate one of the careers listed below that interest you. Using the paper provided by your teacher develop a poster by locating pictures of people “on the job” in magazines, newspapers, and other sources. Cut them out and attach them to your poster along with the following information:</p> <ul style="list-style-type: none"> a). Job Title b). Approximate salary range c). Education required d). Working Conditions e). Career Growth/Outlook for the future f). Advantages/Disadvantages <p>Once you have created your poster, write a half page summary that discusses what interests you most about this position and how this career relates to keeping the food supply safe. This portion of the assignment will be included in your Case File.</p>
<p>Reflections for future use.</p>	



Avenues for Contamination

Case Notes 2.1: Fruits and Vegetables

Name: _____ Date: _____

Bagged lettuce flow chart

Please list the types of hazards that could occur at each step and an example for each.

B = Biological, **C** = Chemical, **P** = Physical

1. Lettuce is grown in a field _____

2. Lettuce is harvested and cored by hand _____

3. Lettuce is sanitized and often treated with an anti-browning agent _____

4. Lettuce is placed in bags that are stored in bins and transported to packinghouse _____

5. Lettuce is pre-cooled (commonly in hydro vacuum tube) _____

6. Lettuce is chopped into small pieces and flumed to packaging area in water containing a sanitizer _____

7. Lettuce is centrifuged to remove excess water _____

8. Lettuce is packaged into bags _____

9. Lettuce is transported to distributor, retail or storage _____

10. Lettuce is purchased by consumer _____



Avenues for Contamination

Case Notes 2.1: Meat

Name: _____ Date: _____

Hamburger Production Flowchart

Please list the types of hazards that could occur at each step and an example for each.

B = Biological, **C** = Chemical, **P** = Physical

1. Beef animal is raised on farm and/or feedlot _____

2. Live animal is transported to slaughter facility and inspected _____

3. Animal is slaughtered _____

4. Carcass is inspected for health and meat quality _____

5. Carcass is cooled _____

6. Carcass is fabricated into primals, sub-primals, cuts, and trimmings _____

7. Cuts and/or trimmings are ground (may be held – chilled – before grinding) _____

8. Meat is packaged and stored _____

9. Meat is transported to retail store (meat may be repackaged at retail store into smaller units)

10. Meat is purchased by consumer _____



Avenues for Contamination

Case Notes 2.1: Milk

Name: _____ Date: _____

Milk Production Flowchart

Please list the types of hazards that could occur at each step and an example for each.
B = Biological, C = Chemical, P = Physical

1. Cow is milked on farm _____

2. Milk is stored in bulk tank _____

3. Milk is transferred to tanker _____

4. Milk is transported to processing plant _____

5. Milk is stored at processing plant _____

6. Milk is pasteurized and homogenized at processing plant _____

7. Milk is packaged at processing plant _____

8. Milk is transported to retail or distributor _____

9. Milk is stored at retail store _____

10. Milk is purchased by consumer _____



Avenues for Contamination

Case Notes 2.1: Grain

Name: _____ Date: _____

Bread Production Flowchart

Please list the types of hazards that could occur at each step and an example for each
B = Biological, **C** = Chemical, **P** = Physical

1. Field is prepared (plowed, limed, fertilized, drilled) _____

2. Wheat is grown in field _____

3. Wheat is combined _____

4. Grain is transported to storage facility and stored _____

5. Grain is transported to mill _____

6. Grain is ground, cleaned, scoured, milled into flour, and packaged _____

7. Flour is transported to bakery _____

8. Flour is mixed with other ingredients and baked into bread and other products _____

9. Bread is packaged in bags and boxes _____

10. Bread is transported to retailer or distributor _____

11. Bread is purchased by consumer _____



This lesson will be graded using the following Grading Rubric:

Assessment Criteria	Maximum Points	Points Scored
Students were active in creating the production path for a particular commodity.	8	
Students were active in assigning the risks for each step of the production path and in teaching their Investigative Team members on a specific commodity.	10	
The student completed their Case Notes.	5	
The assignment was neat, organized, and handed in on time.	2	
TOTAL	/25 =	%



Supplemental Career Introduction: Windows of Opportunity

Assignment 2.1

This assignment is due: _____

Take a moment and think about all of the people involved in producing the foods we eat. The food industry includes everything from producers, farm workers, processors, distributors, wholesalers, retailers, fast-food workers and restaurant personnel. Each one of these people need to be trained to manage, operate, and implement food safety steps as food moves from farm to table.

Directions: For this assignment you will investigate one of the listed careers that interest you. Using the paper provided by your teacher develop a poster by locating pictures of people “on the job” in magazines, newspapers, and other sources. Cut them out and attach them to your poster along with the following information:

- a). Job Title
- b). Approximate salary range
- c). Education required
- d). Working Conditions
- e). Career Growth/Outlook for the future
- f). Advantages/Disadvantages

Once you have created your poster, write a half page summary that discusses what interests you most about this position and how this career relates to keeping the food supply safe. This portion of the assignment will be included in your Case File.

Choose One of the Following Food Industry Career Opportunities¹

BUSINESS Accountant Buyer Distributor Financial Analyst Loan Officer Food Marketing Specialist Salesperson Statistician Human Resource Personnel	PROCESSING Butcher Efficiency Expert Engineer Plant Line Worker Plant Supervisor Refrigeration Specialist Safety Specialist Quality Specialist	RETAILING/FOOD SERVICE Baker Cook/Pizza Maker Counter Salesperson Deli Operator Meat Cutter Nutritionist Produce Specialist Restaurant Owner/Operator Waiter/Waitress
COMMUNICATIONS Advertising Specialist Broadcaster Media Specialist TV Producer Writer	QUALITY ASSURANCE Food Analyst Grader Inspector Lab Technician Quality-Control Supervisor Quarantine Officer	TRANSPORTATION Dispatcher Trucker Rail Operator Merchant Marine Route Supervisor
EDUCATION College Professor Extension Specialist Industry Educator Teacher	RESEARCH & DEVELOPMENT Distribution Analyst Biochemist Microbiologist Packaging Specialist Process Engineer Research Scientist Laboratory Technician Food Technologist Sensory Evaluation Spec.	HEALTH & NUTRITION Sanitarian Epidemiologist Doctor Nurse Dietician

1. Career List adapted from *Agriscience Fundamentals & Applications*, 3rd Edition by E.L. Cooper and L. DeVere Burton (2004)



The supplemental activity can be graded using the following Grading Rubric:

Category	10	8	5	1
Poster	Poster is neat and extremely organized with well-constructed and clear headings for each of the 6 categories. All pictures have captions	Poster is neat and organized with well-constructed and clear headings for each of the categories.	Poster is not well organized or does not address all of the 6 categories.	The poster and information presented is inaccurate and disorganized.
Summary	Summary is a half page in length and clearly shows student's interest in the career. The summary includes details/examples of how the career relates to food safety.	Summary is a half page in length and shows student's interest in the career.	Summary is less than a half page but shows the student interest in the career.	Summary is less than a paragraph and does not show student interest or include details/examples of how the career relates to food safety.
Grammar and Spelling	Writer makes fewer than 5 errors in grammar and/or spelling.	Writer makes 5-8 errors in grammar and/or spelling.	Writer makes 9-10 errors in grammar and/or spelling.	Writer makes more than 10 errors in grammar and/or spelling.
Sources	All sources (information and photos) are accurately documented in the desired format.	All sources (information and photos) are accurately documented, but a few are not in the desired format.	All sources (information and photos) are accurately documented, but none are not in the desired format.	Sources are not documented.

CATEGORY WEIGHT:

Poster: _____ x 5 = _____
 Summary: _____ x 3 = _____
 Grammar and Spelling: _____ x 1 = _____
 Sources _____ x 1 = _____
 TOTAL POINTS: _____ out of 100 = _____