

Pre-Harvest Food Safety in 4-H Animal Science

Part 1: Assessing Critical Control Points Associated with Disease Transmission

Overview and Background Information

The goal of pre-harvest food safety efforts is to protect the human food supply from pathogens, parasites, and other harmful agents. This requires vigilance and the application of specific knowledge and skills throughout the entire production process.

Animals are susceptible to a variety of diseases that can pass from one animal to another through direct and indirect transmission. **Direct transmission** occurs when a previously uninfected animal contracts a disease after a physical interaction with an infected animal. **Indirect transmission** occurs when an uninfected animal comes into contact with some contaminated surface (e.g., the floor of a transport trailer) or object (e.g., a food or water trough) or a **vector** (e.g., a disease-carrying insect or vermin) that transmits a **pathogen** (a disease-causing agent).

To help prevent disease transmission among food animals, it is important to carry out an assessment of potential hazards based on **Hazard Analysis and Critical Control Points** (HACCP). Critical control points are places or situations that present a high risk of disease transmission (e.g., risks during production and transport). The HACCP assessment identifies potential critical control points that occur during production and implements practices or conditions that will prevent, eliminate, or reduce these risks.

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Activity Concepts and Vocabulary

- **Hazard Analysis and Critical Control Points (HACCP):** A systematic approach to identifying, evaluating, and controlling food safety hazards.
- **Critical control point (CCP):** A point, step, or procedure in the process of growing food where humans can introduce a process that can help prevent, eliminate, or reduce a food safety hazard.
- **Direct transmission:** Physical contact between an ill person or animal and a healthy person or animal that leads to the transmission of a disease.
- **Indirect transmission:** The transfer of pathogens to an uninfected person or animal through contact with the contaminated surface of an inanimate object (e.g., a food dish; the floor of a transport trailer).
- **Pathogen:** A disease-causing organism.
- **Pre-Harvest Food Safety:** The protection of human health through the reduction of pathogens associated with livestock or poultry that enter the food supply.
- **Vector:** An organism, such as an insect or vermin, that carries disease-causing microorganisms from one animal to another.

Life Skills

- **Head:** Critical thinking, problem solving, decision making
- **Heart:** Communication, sharing, cooperation
- **Hands:** Contributions to a group effort, teamwork
- **Health:** Disease prevention

Subject Links

Science, language arts

Next-Generation Science Standards (NGSS) Crosscutting Concepts

- **Patterns:** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
- **Cause and Effect:** Mechanism and explanation. Events have causes, sometimes simple, sometimes multi-faceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
- **Stability and Change:** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Purpose of Activity

The purpose of this activity is to have youth learn to identify critical control points in food animal production and understand the importance of those points as related to the spread of disease. Knowledge of critical control points can help youth who raise food-producing animals determine what measures they can take to prevent and control the spread of disease among animals.

Overview of Activity

This activity focuses on various components that are necessary to maintaining the health of food animals from the time of their initial acquisition up to the point of sale or harvest, including reducing the risk of disease transmission through the identification, evaluation, and control of food safety hazards. Through learning activities that simulate livestock management situations, youth will learn to identify critical control points and determine how and when their hypothetical animals may be at risk of contracting a disease.

Time Required

45–75 minutes

Suggested Grouping

Small groups of 3 to 4

Materials Needed

(* = *Materials provided in curriculum*)

- * *Animal Situation Cards*
- * *Disease Descriptions*
- * *Critical Control Point Pictures*
- Construction paper
- Glue
- Flipchart paper
- Pens or pencils; markers

Getting Ready

- Make enough *Animal Situation Cards* so each group gets at least one card.
- Make enough *Disease Descriptions* so each group gets a complete set.
- Make enough copies of the *Critical Control Point Pictures* so each group gets a complete set. Cut out the *Critical Control Point Pictures*.
- Make sure each group gets a piece of construction paper, some glue, some flipchart paper, and pens, pencils, or markers.

Opening Questions

1. Why do you think it is important to keep animals healthy, especially when they are being raised to provide food for human consumption? Please share your ideas verbally or write them down on the flipchart paper.
2. What do you think are some potential ways for a food animal to contract an illness? Please share your ideas verbally or write them down on the flipchart paper.
3. How do you think you can prevent a food animal from getting sick? Please share your ideas verbally or write them down on the flipchart paper.

Procedure (Experiencing)

1. Give each group an *Animal Situation Card*. Each card contains information on one animal (beef cow, poultry, swine, sheep, or dairy cow) and includes a list of symptoms the animal is exhibiting.

2. Pass out the *Disease Descriptions* and ask each group to do research to determine what disease their animal may have contracted.
3. Have a volunteer pretend to be a veterinarian. Once a group has determined what disease their animal might have, have them go to the veterinarian to see if their determination is accurate. If it is, the veterinarian will give them a set of *Critical Control Point Pictures*. If their diagnosis is wrong, the veterinarian will ask the group to try again until they come up with an accurate diagnosis. Once they have diagnosed their animal correctly, the veterinarian will give the group a set of *Critical Control Point Pictures*.
 - » **Volunteer Tip:** Here are the correct diagnoses for each *Animal Situation Card*:
 - Chicken: Salmonella
 - Dairy cow: Bovine tuberculosis
 - Lamb: *E. coli* scours
 - Swine: Campylobacter
 - Beef: Foot and mouth disease
4. When the groups get the *Critical Control Point Pictures*, say “As your veterinarian, I wanted to let you know that there are steps you can take to prevent or minimize the spread of the disease your animal has acquired. I would like you to evaluate the location where the animal is housed and your daily animal care practices.”
5. Looking at their *Critical Control Point Pictures*, ask the groups to choose which pictures show situations that they think either contributed to their animal’s illness or have the potential to affect the health of their animal. Have them glue the pictures they chose onto the construction paper.

Sharing, Processing, and Generalizing

Follow the lines of thinking developed by the youth as they share and compare their ideas and observations; if necessary, use more targeted questions as prompts to get to particular points. Specific questions might include

1. How do you think your animal contracted the disease?
2. Which pictures do you think apply to your animal and its diagnosed disease? Why?
3. What could you have done to prevent your animal from catching this disease?
4. What can you do in the future to prevent your animal from getting sick?

Concept and Term Introduction/Discovery

At this point, volunteers need to ensure that the concepts and terms **critical control point, direct transmission, HACCP, indirect transmission, pathogen, pre-harvest food safety, and vector** have been introduced. (**Note:** The goal is to have the youth develop these concepts through their own exploration and define the terms using their own words.)

Concept Application

For those youth who raise food-producing animals:

- Using the *Critical Control Point Pictures* as a reference, do an assessment of your food-producing animal’s living area and make a list of all the potential critical control points your animal may encounter.
- Then think of ways to try to reduce those risks. Make a list of your ideas.

For those youth who do not raise food-producing animals:

- Ask a friend, neighbor, or relative if you can observe their food-producing animal's primary living area. Using the *Critical Control Point Pictures* as a reference, do an assessment of the food-producing animal's living area and make a list of all the potential critical control points the animal may encounter.
- Then think of ways to try to reduce those risks. Make a list of your ideas.

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ANIMAL SITUATION CARDS**Animal:** Chicken

Scenario: After a few days of watching your chicken, you notice that it is losing weight. You monitor its food and water bowl, and it doesn't look like it eats or drinks much. Your chicken is usually very active, but lately it seems tired and lethargic, closing its eyes for long periods of time. While cleaning its cage, you notice watery feces throughout the cage. You get really worried, so you start researching possible diseases your chicken might have.

Animal: Lamb

Scenario: It is lambing season and your lamb is out and about. One day when cleaning its pen, you notice diarrhea scattered throughout the bedding. Worried, you start looking for your lamb and find it lying next to a tree outside. You try to pick your lamb up but it cries out in pain. You notice that its stomach is very bloated. The lamb also looks really dehydrated, even though its water bowl was empty when you changed it earlier. You get really worried so you start researching possible diseases your lamb might have.

Animal: Dairy Cow

Scenario: One day you notice your dairy cow looking very thin. You observe her for a couple of days and notice that she is not eating. Overall, she is not very active and looks depressed. When you milk your cow during the early morning hours, you notice that she is producing a wet, harsh cough, but the cough seems to get less intense as the day goes on. You get really worried, so you start researching possible diseases your dairy cow might have.


Animal: Swine

Scenario: Your piglet is usually very active, eats well, and is in good overall health. Lately, however, you have noticed some very watery feces around your piglet's bedding. As the days pass, you notice that the piglet's feces change to a creamy diarrhea. You get really worried so you start researching possible diseases your piglet might have.



Animal: Beef

Scenario: You are getting ready for a big show for your steer. In the days leading up to the show, you notice that your steer is acting oddly. You see him laying down for long periods of time and not eating much. When doing a physical exam on your steer, you notice he has a couple of blisters in his mouth surrounded by eroded areas and foamy saliva. You also notice blisters on your animal's hooves. You get really worried so you start researching possible diseases your steer might have.



DISEASE DESCRIPTIONS

Campylobacter

- Campylobacter is a bacterial infection that can infect a variety of animals, including swine, cattle, dogs, and birds.
- In swine, campylobacter is naturally found in the animal's intestinal tract and, rarely, it is found in the bloodstream.
- There are a variety of ways for campylobacter to be passed from one animal to another. It is passed in the feces and can spread and infect when a second animal consumes the bacterium in infected food or water, or when an animal has direct contact with an infected animal.
- Animals that naturally carry campylobacter can easily spread the bacteria through feces left in poorly cleaned pens, through poor hygiene in farrowing pens, on wet, insufficiently cleaned floor surfaces, or from housing that is in continual use without being properly disinfected between animals.
- Piglets with the infection will either develop diarrhea with blood or mucous in it or a creamy diarrhea. They can also become dehydrated and lose body condition.
- Since campylobacter can infect humans, humans have to be very careful about the foods they eat and the animals they touch.
- Humans can catch campylobacter by eating raw, uncooked food products that have come into contact either with animal feces that have the bacteria or with infected humans or animals.
- Humans who touch or interact with animals or animal products that have the potential to carry the campylobacter bacteria should wash their hands to prevent ingestion or passing of the bacteria.
- If humans do catch the disease, they may experience symptoms such as mild or severe diarrhea, often with a fever, and traces of blood in the stool.

***Escherichia coli* (*E. coli*) scours**

- *E. coli* scours come from the bacterium *Escherichia coli* (or *E. coli*), which can infect a variety of animals, including cattle, sheep, goats, pigs, deer, dogs, poultry, and even humans.
- In sheep, *E. coli* can be found in the intestines and the bloodstream.
- There are a number of ways to pass *E. coli* scours from one sheep to another. Usually a sheep becomes infected if it ingests contaminated fleece or bedding.
- Sheep that are infected with the bacteria may develop diarrhea and start to salivate excessively. They may also become painfully bloated and dehydrated.
- Animals that have *E. coli* scours can easily spread the bacteria through their feces.
- There are several ways to minimize the spread of *E. coli*. These include the implementation of proper sanitation protocols, the use of clean bedding, relocation of lambing pens, use of adequate colostrums for lambs, decreased crowding, and improved ventilation to decrease moisture in the animals' area.
- Since *E. coli* can infect humans, humans have to be very careful with the foods they eat and the animals they touch.
- Humans can catch *E. coli* by the fecal-oral route. Humans can be infected by direct contact with diseased animals or by contact with human carriers.
- Humans who touch or interact with animals or animal products that have the potential to carry the *E. coli* bacterium should wash their hands to prevent ingestion or passing of the bacteria.
- If humans do catch the disease, they may experience symptoms such as cramps, pain in the abdomen, and watery feces followed by bloody diarrhea.

Foot and Mouth Disease (FMD)

- Foot and Mouth Disease (FMD) is an extremely contagious disease that has devastating effects on infected animals as well as on the farm economy.
- Currently, the United States is free of FMD.
- This disease is a virus that affects cloven-hoofed animals (e.g., cattle, swine, sheep, goats, and deer).
- The most obvious symptoms include a fever and blisters that form around the mouth and/or feet. As a result of the blisters, infected animals might start salivating excessively, have a hard time walking, develop eroded areas where blisters have ruptured, and lose weight. Some animals with the disease might show no symptoms at all, but still be able to spread the virus to other animals.
- FMD can be transmitted in a number of ways, including close contact animal-to-animal spread, long-distance aerosol spread, and spread via fomites (inanimate objects), typically fodder or motor vehicles.
- The clothes and skin of farmers and other animal handlers, standing water, and uncooked food scraps and feed supplements that contain infected animal products can harbor the virus as well.
- Humans contaminated with the disease can spread it to susceptible animals through the clothing that they wear or the things that they touch.
- Humans can be infected with foot-and-mouth disease through contact with an infected animal, but this is extremely rare. For the few humans who have been infected, symptoms have included fever, vomiting, lesions in the mouth, and blisters on the skin.
- The virus can survive in the environment for up to a month.
- Vaccination is possible, but it is not always effective because the virus mutates quickly.

Salmonella

- *Salmonella* is a bacterial genus that can infect a variety of animals, including poultry, vermin (mice and other rodents), reptiles, and even humans.
- *Salmonella* bacteria are naturally present in the intestines and reproductive tract of poultry.
- Poultry that are infected with *Salmonella* may exhibit diarrhea, loss of appetite and thirst, and a lack of energy. Poultry will generally look depressed, with their eyes closed and their feathers fluffed.
- *Salmonella* can be passed from one animal to another in a variety of ways. Wildlife and pest animals such as flies, rodents, and birds can pass the bacteria through their fecal matter.
- *Salmonella* can collect and flourish in the moisture in animal litter and cages, and can then spread easily to animals that traffic through it.
- Animals that have naturally present *Salmonella* can easily spread the bacteria through their secretions, feces, and feather dust. Wind and air currents can then pick up the bacteria and circulate them throughout the living area.
- Since *Salmonella* can infect humans, humans have to be very careful with the foods they eat and the animals they touch.
- Humans can become infected with *Salmonella* when they eat food products contaminated with animal feces that carry the bacteria or, through cross-contamination, when contaminated food comes into contact with uncontaminated food. Some possible sources are meat (beef or poultry) that is eaten raw, contaminated chicken eggs, and contaminated milk.
- Raw or undercooked foods, dairy products, and even vegetables can also carry *Salmonella*, which is only killed by cooking or pasteurization.
- People who touch or interact with animals and/or animal products that have the potential to carry *Salmonella* bacteria should wash their hands well to prevent ingestion or passing of the bacteria.
- If humans do catch the disease, they may experience symptoms such as cramps in the stomach, fever, watery feces, headache, and nausea. Most of the time, people recover from the infection without help from a doctor.

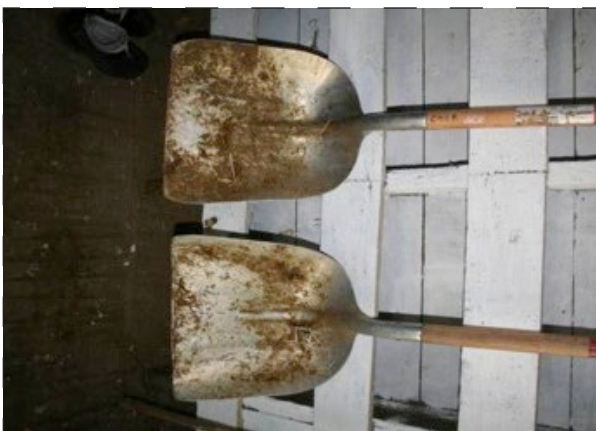
Tuberculosis (TB)

- Tuberculosis is caused by the bacterium *Mycobacterium*. Different strains of the bacteria can infect humans, birds, and cattle.
- *Mycobacterium bovis* primarily infects cattle, but can also infect deer, goats, elk, and swine, as well as humans.
- Many cattle infected with bovine TB do not show symptoms. However, some infected cattle may not eat and may become emaciated and weak and develop a fever.
- There are a variety of ways bovine TB can be passed from one animal to another, depending on where the infection occurs in the body. If the infection is in the digestive tract, cattle will develop diarrhea and constipation and can spread the disease through their feces. If the respiratory tract is infected, cattle will have a wet cough in cold weather and can potentially develop respiratory distress. Infected animals can spread the disease through aerosol droplets when they cough.
- Bovine TB can also infect other cows indirectly through contaminated equipment or even a milking parlor that is not disinfected.
- It is possible for contaminated feces of an infected cow to be the source of fecal contamination in milk.
- Since TB can infect humans, humans have to be very careful with the foods they eat and the animals they touch.
- Humans are not natural hosts for bovine TB but they can catch the disease by drinking infected (usually unpasteurized) milk.
- Humans who drink infected milk may develop TB in the mouth, neck lymph nodes, and/or the intestine, but bovine TB does not infect human lungs. Lung infections come from the bacterium that usually causes human TB, *Mycobacterium tuberculosis*.
- Workers or farmers who work closely with infected cattle or infected carcasses have an increased chance of catching bovine TB, particularly from inhaling small aerosol droplets that contain the TB bacteria.
- Humans who touch or interact with animals and/or animal products that have the potential to carry *M. bovis* bacteria should wash their hands to prevent ingestion or passing of the bacteria.
- Humans who are around infected animals should wear masks to decrease the chance that they will inhale contaminated droplets in the air.

CRITICAL CONTROL POINT PICTURES

The Critical Control Point (CCP) pictures provided in this activity will include all the CCPs for all the diseases that are covered here. Youth will then have to search through the pictures and find the ones that best match the disease they have.





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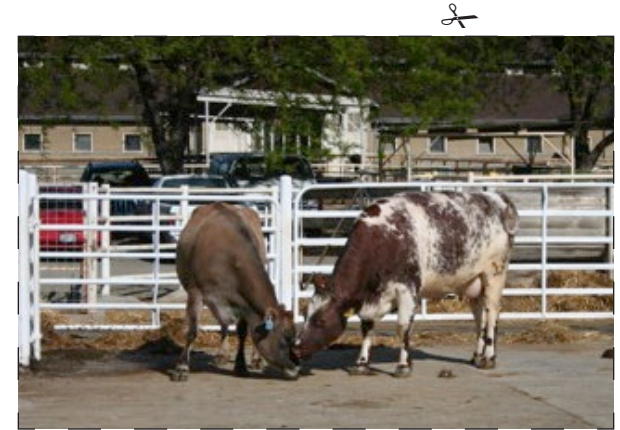
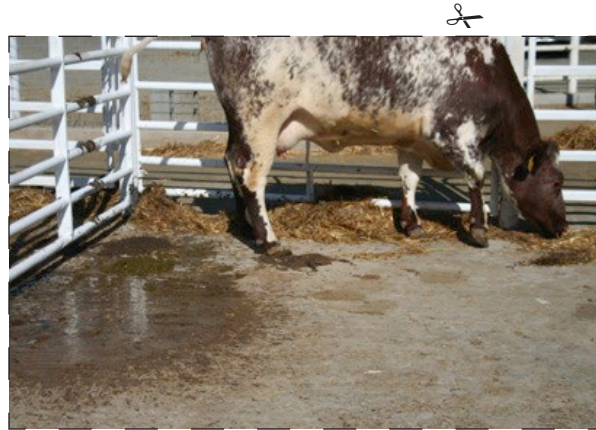


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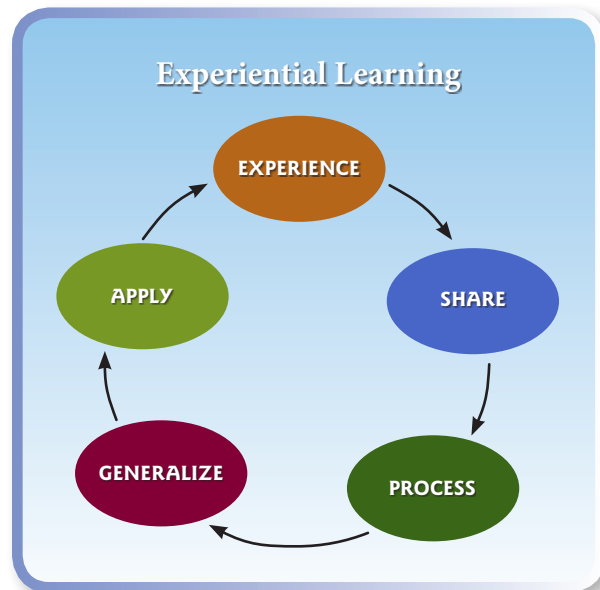
EAMON CURRY

Volunteers: Examples of Critical Control Points in Photographs

- Transportation
- Rakes, shovels
- Wheel barrels
- Water
- Ventilation
- Boots and clothing
- Flies
- Birds
- Feces
- Vermin
- High stocking density
- Run-off
- Food scraps
- Direct/indirect contact with like species
- Direct/indirect contact with unlike species

APPENDIX

The activities in this curriculum were designed around inquiry and experiential learning. Inquiry is a learner-centered approach in which individuals are problem solvers investigating questions through active engagement, observing and manipulating objects and phenomena, and acquiring or discovering knowledge. Experiential learning (EL) is a foundational educational strategy used in 4-H. In it, the learner has an experience phase of engagement in an activity, a reflection phase in which observations and reactions are shared and discussed, and an application phase in which new knowledge and skills are applied to a real-life setting. In 4-H, an EL model that uses a five-step learning cycle is most commonly used. These five steps—Experiencing, Sharing, Processing, Generalizing, and Applying—are part of a recurring process that helps build learner understanding over time.



For more information on inquiry, EL, and the five-step learning cycle, please visit the University of California Science, Technology, and Environmental Literacy Workgroup's Experiential Learning website, <http://www.experientiallearning.ucdavis.edu/default.shtml>.

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