



The Science Behind Your Food

Virtual Field Trip Educator Guide

Watch the Virtual Field Trip: This activity accompanies the Science Behind Your Food virtual field trip and design to be completed while or immediately after watching the show. [Check it out here.](#)

Question: How does protein make it from the farm to our kitchen table? Who is working behind the scenes to make sure that the protein products that nourish us are raised responsibly, packaged safely, and sustainable?

Answer: Cargill is a food, agriculture and industrial products company that works with a vast network of professionals to supply us with delicious and nutritious protein products. This Virtual Field Trip at the Cargill Innovation Center in Wichita, Kansas gives students a behind-the-scenes look at protein from a variety of perspectives. We begin our journey by talking with a Cargill professional who works with farms in order to learn about advances in farming technology that help family farmers to be successful. Then, we chat with a food scientist in the Cargill chemistry labs who explains how science and technology inform everything behind the farm to table process. We round out the journey by chatting with the Cargill employees responsible for marketing and distributing protein products to learn about the skills needed to package, transport, and sell protein products to consumers across the country.

This Virtual Field Trip will highlight a variety of skills, competencies and careers necessary to the agriculture and food industries. These companion activities help extend the learning from the Virtual Field Trip to the classroom.

Students will:

- Trace the path of protein from farm to table.
- Identify strategies to mitigate the risk of foodborne pathogens.
- Use the engineering design process to provide a solution to a design challenge.
- Reflect on real-life examples of effective merchandising and packaging design.
- Investigate careers related to agriculture and food safety.

Activity Options

Activity 1: The Cold Chain²

Farmers, scientists, engineers, and vendors work against the forces of time and temperature to prevent foodborne pathogens. A single bacterium can multiply into millions of cells in mere hours! In this activity, students will simulate a variety of professional roles in order to identify each of the steps of the cold chain

that take protein from farm to table, as well as contamination risks at each step.

Time: 45-60 minutes

Materials:

- “The Cold Chain” worksheet, one per student
- Poster boards or large easel paper, one piece per student group
- Chalk/markers
- A computer with access to the internet
- A projector and screen

Instructor Notes:

1. Begin the class by handing each student a copy of “The Cold Chain” worksheet.
2. Provide context for the lesson: students will begin by watching a series of videos on food safety. After each video segment, students will answer the pertinent questions on their answer sheet. Then, explain that students will divide into groups and simulate the process of transporting a protein from the farm to the table while mitigating the risk of foodborne illness.
3. Show the following video excerpts, pausing after each one to have students record answers to the pertinent questions on their sheets. You may choose to discuss answers to the questions in order to ensure student understanding.
 - a. At the farm/competitive exclusion/composting (FDA Food Safety Video):
 - i. <https://www.fda.gov/Food/FoodScienceResearch/ToolsMaterials/ucm182117.htm> (17:26 to 19:34)
 1. How does competitive exclusion work in poultry farming?
 - a. Answer: Chickens are sprayed with good bacteria from a young age. Through normal actions like preening, the good bacteria is spread through a colony of chickens. Because there is only so much space where bacteria can thrive, the good bacteria takes away space from the pathogens, like salmonella.
 2. How does proper composting help to prevent the spread of bacteria?
 - a. Answer: The heat of the microbes digesting the organic material from the farm becomes hot enough to kill off harmful bacteria like e.coli that might make it onto the crops.
 - b. Portable Technology Quickly Identifies Bacteria for Food Safety
 - i. <https://news.science360.gov/obj/video/20110615/>
 1. What can this device detect to help us know more about the foods we

eat?

- a. Answer: E. coli, browning chemicals, fungicides
2. Who could use this device to detect food contaminants?
 - a. Answer: Everyone throughout the supply chain: production, shipping, and consumers
4. Divide students into groups of 4 and ask groups to refer to the activity prompt on their “The Cold Chain” worksheets.
5. Explain that students will be taking on the task of navigating a shipment of protein products from the farm to the consumer’s table and must mitigate contamination risks at each step along the cold chain. Students will work as a team to inhabit the mindsets of different professionals along the protein production supply chain and complete the farm-to-table cycle on their worksheets. Once they have completed their worksheets, they will work together as a team to display the steps of the cold chain on poster board, easel paper or a whiteboard. Students should capture evidence from the Virtual Field Trip (VFT) or additional research to support their responses.
6. Provide students with 20-25 minutes to complete the cold chain in groups.
7. Once student groups have completed their cold chains, ask each group to share how they used their knowledge from the VFT, and other research, to mitigate risk at each step along the farm to table cycle.

Activity 2: Pack and Stack

Protein packaging must be heat-resistant, freezable, leak-proof, easy to transport and attractive to consumers. In this activity, students will analyze the current protein package designs on the market and prototype an efficient and environmentally-friendly packaging design of their own.

Time: 60 minutes

Materials:

- Aluminum foil
- Plastic wrap
- Wax paper
- Quart-sized plastic bags
- Cardboard
- Tape
- Paper towels
- Markers
- Protein:
4 water balloons per group

16-20oz. of water per group

OR

1 egg per group

- “Pack and Stack” worksheet, one per student
- One scale per student group
- One funnel per student group

Instructor Notes:

1. Begin by dividing students into groups of 4.
2. Give each student group a copy of the “Pack and Stack” activity worksheet.
 - a. *Optional extension: the following web resource can be printed and handed out to student groups in order to extend learning about the benefits and drawbacks of different packaging designs: <https://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/safe-food-handling/packaging-materials/meat-protein-packaging-materials>.³*
3. Review the important points of the worksheet prompt: a company is looking for a packaging solution for a specific protein product—a pound of protein. This packaging concept must be lightweight, temperature-resistant, leak-proof and environmentally friendly (no Styrofoam). In addition, the packaging should be stackable in order to make it easily transportable. Furthermore, the company would like to use the space on the packaging in order to educate the consumer about good food safety practices for protein or beef.
4. Provide each student group with listed materials.
5. As a class, walk through the process of filling each of the four water balloons with 16-20oz of water. Utilize the balloons, water, funnel and scale. Once filled, the balloons should be tied. These balloons will be used to simulate one pound of protein. Alternatively, students can use an egg.
6. Provide student groups with 35-40 minutes to design a packaging solution that meets the requirements of the prompt.
7. Allow for 10 minutes for students to present their packaging prototypes to the class.
8. In the remaining 5 minutes, ask the class the following critical questions:
 - a. How has this activity made you think critically about protein packaging?
 - b. What important marketing messages do protein companies have the responsibility to communicate? As a consumer of these products, what catches your eye and makes you pay attention?

National Standards

Next Generation Science Standards

HS-ETS1-3 Engineering Design

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

National Health Education Standards

Standard 1

Students will comprehend concepts related to health promotion and disease prevention to enhance health.

Standard 4

Students will demonstrate the ability to use interpersonal communication skills to enhance health and avoid or reduce health risks.

Standard 8

Students will demonstrate the ability to advocate for personal, family, and community health.

Works Cited

¹ U.S. Food and Drug Administration. Dr. X and the Quest for Food Safety. January 14, 2015. <https://www.fda.gov/Food/FoodScienceResearch/ToolsMaterials/ucm182117.htm>.

² The Cold Chain. Global Cold Chain Alliance. 2017. <http://www.gcca.org/about-us/the-cold-chain/>.

³ United States Department of Agriculture. Meat and Protein Packaging Materials. March 24, 2015. <https://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/safe-food-handling/packaging-materials/meat-protein-packaging-materials>.

The Cold Chain: Activity Worksheet

What is the cold chain?

The cold chain is the process used to transport temperature-sensitive products from the farm to the table in a manner that maintains quality and safety and prevents the risk of foodborne illness.²

Critical Cold Chain Questions:

1. How does competitive exclusion work in poultry farming?
2. How does proper composting help to prevent the spread of bacteria?
3. What can this device detect to help us know more about the foods we eat?
4. Who could use this device to detect food contaminants?

Play the Part: Cold Chain Management

Imagine that you and your student colleagues are a group of professionals responsible for transporting a shipment of protein from a farm in Wichita, Kansas to a home in Cherry Hill, New Jersey. Your team must transport the protein from the farm to table as safely as possible. Using the chart below, transport the protein through the steps of the cold chain while maintaining the quality of the products and preventing the growth of bacteria. Once you have finished, draw your cold chain and present your solution to your class. You can use evidence from the virtual field trip or other resources to support your ideas.

Step of the Cold Chain	Responsibilities	Potential Risks	Solutions
Farmers			
Processors			
Transportation professionals			
Warehouse technicians			
Transportation professionals			
Retail and marketing professionals			
Consumers			

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Pack and Stack: Activity Worksheet

Imagine you're walking through a grocery store. As you walk through each aisle, you look at the different products available for purchase. From vegetables to yogurt and from cans to bags, food packaging looks many different ways. In large part, that's because food packaging has to accomplish many different goals.

In this activity, you and your student colleagues will step into the shoes of the packaging professionals who are responsible for packaging protein products safely, affordably, attractively and responsibly. Using the steps of the engineering design process, you will create a new packaging method for a protein that is lightweight, environmentally friendly and conveys to consumers the importance of preventing foodborne illness.

Play the Part: Pack and Stack

You and your group members work for a packaging design firm that has been called upon to perform a special task. A protein production company has installed a new CEO who wants to limit the company's impact on the environment by replacing the Styrofoam typically used in packaging their protein products with a more environmentally-friendly solution. This new packaging must accomplish the following goals:

- It must weigh less than 5oz.
- It must fit 16oz of protein (simulated by 4.4oz. water balloons or egg)
- It must include information about how to prevent the spread of foodborne illness
- It must be water resistant and leak-proof
- It must be stackable/easily transportable
- It must be recyclable

Activity Steps

1. If using a water balloon:
Using the funnel, fill the four balloons with 4oz of water each.
Tie the balloons.
2. Using the chart below, use the engineering design process to create a prototype that fits the above design constraints.

Engineering Design Process Step	Notes
Define the Problem	
Identify Constraints	
Brainstorm Solutions	
Select the Best Solution	
Construct the Prototype	
Test the Prototype	
Present the Solution	