



Exploring Contamination in the Produce Supply Chain

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Background

Estimated Time: 1 hour

Historically, contamination in produce samples has been tested with time-intensive laboratory procedures, such as culturing for multiple days, or with costly analytical instruments. This activity will safely introduce youth to emerging research on cost-effective point-of-care testing that can detect contamination of produce throughout the food supply chain. The proposed activity is structured to include an introduction to food safety, an activity to visualize the food supply chain and where contamination can occur, a hands-on simulation of point-of-care testing for bacterial contamination of lettuce, and a guided reflection that will empower youth to prevent bacterial contamination at home.

After completing this activity, youth will

- 1) Have an increased understanding of the food supply chain
- 2) Recognize that bacterial contamination of produce can be introduced at any step in the food supply chain
- 3) Have an increased awareness of emerging methods for rapid, inexpensive point-of-care detection of food contamination

Materials

- 3 mini black light flashlights
- 3 heads of lettuce or any other type of produce that is available
- 15 cotton swabs
- String or yarn
- 15 non-sterile microcentrifuge tubes [recommended: 1.5 mL]
- Liquid vitamin B12
- Printed materials, including pictures of stages of the food supply chain, bacteria notes, and decision tree graphic

Ahead of the activity:

- Fill centrifuge tube with water, leaving enough room for the end of a cotton swab to be submerged in the centrifuge tube without spilling.
- Add liquid vitamin B12 to 1-4 centrifuge tubes to create “positive” signals for *E. coli*. Participants should not be told which samples have the added Vitamin B12. Try to distribute the “positive” signals to only 1-2 groups.

Introduction (5 minutes):

- Briefly introduce types, causes, and impacts of produce contamination [see *Supplemental Information* below].
- In this example, we will explore contamination of fresh produce with pathogenic strains of *E. coli*. Leafy greens, such as lettuce, accounted for 25% of outbreaks from produce contamination between 1996-2014 according to the Food and Drug Administration.

Food Supply Chain Visualization (15 minutes):

- Distribute sets of food supply chain picture and yarn to groups of 3-5 youth. Prompt youth to organize the supply chain pictures and make connections with yarn along different distribution networks (~ 10 minutes).
- Once groups have constructed their food supply chains, distribute paper cut-outs of illustrated bacteria and ask youth to place their bacteria to vote on where in the supply chain contamination is introduced.
- Share with the youth that bacterial contamination can occur at any of the stages in the food supply chain. Food scientists, biochemists, and biological engineers are working to create rapid, inexpensive point-of-care testing to enable on-site detection of contamination through the supply chain. A familiar example of rapid, point-of-care are at-home COVID-19 tests.

Point-of-Care Testing (20 minutes):

- Assign teams to role-play as farmers who are testing on their farms, United States Department of Agriculture regulators who are testing at packaging facilities, and consumers who are testing at home.
- Distribute multiple testing swabs and lettuce samples. Encourage groups to think about the importance of replication and representative sampling in agriscience when deciding how to swab the lettuce to determine if the sample is contaminated*.
- Youth will place each swab in a centrifuge tube that is filled with a “testing reagent” and wait 3 minutes for the reaction to occur.
- Groups will use black light flashlights to see if their samples are contaminated and make a recommendation for the batch of lettuce based on an illustrated decision tree (Figure 1).
- Once all groups have tested their samples, prompt each group to present their findings from testing and recommendations on what to do with their batch of lettuce to other stakeholder groups.

*Lettuce can be thoroughly washed and consumed after the activity.

Guided Reflection and Action Steps (10 minutes):

- Ask youth to think about how food contamination might be prevented throughout the food supply chain.
- Empower youth by sharing how they can play an active role in preventing foodborne illness as consumers of produce, such as thoroughly washing produce before preparing and washing their hands thoroughly when handling food.
- Optional demonstration: coating a melon or apple with colored drink powder and showing how colored powder is spread to the fruit when the fruit is sliced without washing.

Supplemental Information

- The Center for Disease Control and Prevention estimated that foodborne diseases are responsible for 3,000 deaths and 48 million illnesses in the United States annually. Globally, the World Health Organization estimates that contaminated food causes 600 million illnesses and 420,000 deaths each year.
- According to the World Health Organization, 40% of all foodborne illnesses occur in children under 5 years old.
- The four types of food contamination are physical, biological, chemical, and allergenic.
- Physical contaminants are foreign objects that are introduced into food products, such as pieces of plastic, metal, or glass, that may cause choking, cuts, or broken teeth.

- Biological contaminants include pathogenic (i.e., disease-causing) bacteria, viruses, prions, fungi, protozoa, and worms.
 - Examples of pathogenic bacteria in food: *E. coli*, *Salmonella*, *Listeria*, *Campylobacter*
 - Examples of viruses in food: Norovirus, Hepatitis A
 - Example of parasitic protozoa: *Giardia*
 - Examples of parasitic flatworm: tapeworms (*Echinococcus* spp., *Taenia* spp)
- Chemical contaminants include naturally occurring toxins, persistent organic pollutants, and heavy metals.
 - Examples of heavy metals that contaminate foods: lead, cadmium, mercury
 - Examples of naturally occurring toxins: aflatoxins, marine biotoxins
 - Examples of organic pollutants: dioxins, polychlorinated biphenyls (PCBs), pesticides
- While most strains of *E. coli* are harmless, certain strains, such as O157:H7, can cause diarrhea, stomach cramps, vomiting, and fever.
- Contamination by pathogenic *E. coli* is generally incited by food or water coming into contact with human or animal fecal waste.
- Examples of how bacterial contamination might be introduced: produce is rinsed with contaminated water at a processing facility; food service workers transfer bacteria from unwashed hands to food; or there could be cross contamination from preparing produce with cutting boards and utensils that were not properly sanitized after use with contaminated products.

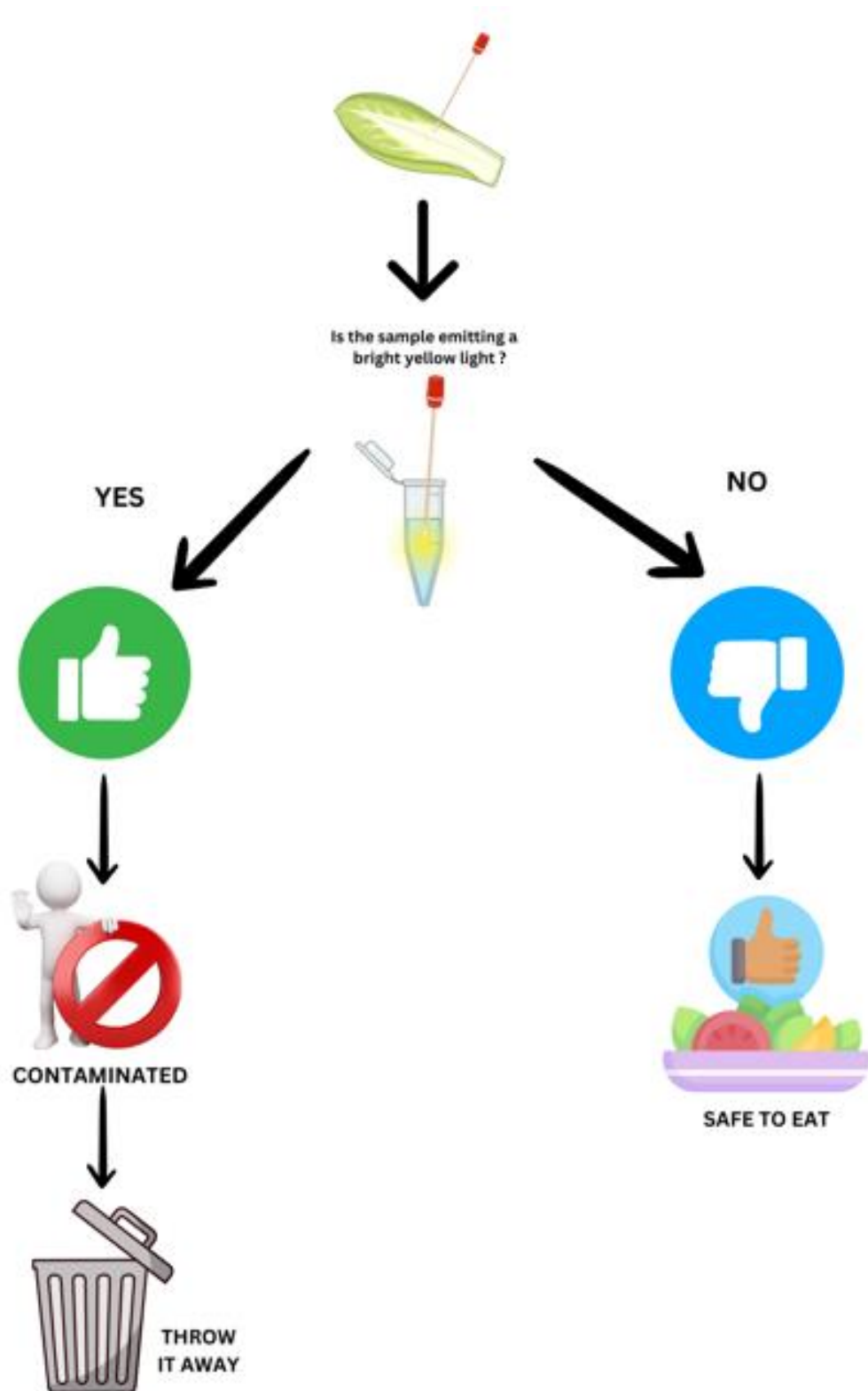


Figure 1: Decision tree graphic to guide testing and action steps

Additional Resources

[Centers for Disease Control and Prevention | How Food Gets Contaminated](#)

[World Health Organization | Food Safety Fact Sheet](#)