Produce Safety

BEGINNING FARMERS

# What Am I Going to Do About Produce Safety?

*Participants will learn about food safety planning and how to put it into action. They will also find out where to get more information and help.*

## TEACHING OBJECTIVES: WHY DO THIS?

- Farm safety risks can be lowered by simple actions, such as washing hands and keeping things clean.
- Planning for food safety might seem scary, but it doesn't have to be hard. New farmers should know that there are lots of resources to help them keep their farm produce safe.

## LEARNING OBJECTIVES: WHAT CAN PARTICIPANTS LEARN?

- Explain the difference between cleaning, sanitizing and disinfecting
- Describe when and where cleaning, sanitizing and disinfecting may be used on a farm to reduce produce safety risks
- Construct or purchase scale-appropriate handwashing facilities
- Safely use compost and manure
- Discuss how to keep records of farm food safety tasks and why a farm may want to do this
- Recall how to contact a Michigan Produce Safety Technician and what services they offer

## IMPORTANCE FOR BEGINNING FARMERS

Even new farmers can take steps to make their produce safer. Adding food safety planning to the early stages of starting a farm can help avoid having to fix things later. Getting help with food safety resources early in their career can also save farmers time, money and frustration.

## UNIQUE ASPECTS OF THE CURRICULUM

Most food safety guides start by focusing on creating a written food safety plan and training workers. They usually talk about rules like GAP Certification or FSMA compliance. But this guide takes a different approach. It begins by teaching basic food safety practices and shows you where to get free help with assessing and planning food safety on your farm.

# Facilitator Planning & Preparation

| Activity | Estimated Instructional Time |
|---|---|
| **Primary Activity 1:** Constructing a Portable Handwashing Station | 30 minutes |
| **Primary Activity 2:** Meet Your Local Produce Safety Techician | One hour |
| **Primary Activity 3:** Food Safe Composting | 30+ minutes |

# Primary Activities

*Overview of the main activities in this module*

## Activity 1

### Constructing a Portable Handwashing Station

Participants will build a low-cost, portable handwashing station to take back to their farm. The station is designed to be used anywhere on the farm that handwashing may be needed.

## Activity 2

### Meet Your Local Produce Safety Technician

Participants will be introduced to their local produce safety technician who can provide free and confidential on-farm food safety planning assistance. Technicians will talk through some of the most common scenarios they encounter on farms and how to incorporate these learnings into their planning.

## Activity 3

### Food Safe Composting

Participants will practice measuring the temperature of a compost pile and keeping records to make sure the compost gets hot enough to kill harmful germs that could make people sick.

# Technical Content

## KEY WORDS

**Cleaning**
The process of getting rid of dirt or soil from a surface. It usually means scrubbing with soap or cleaning solution and then rinsing with clean water.

**Detergent**

A cleaning product that helps lift dirt, dust or other messes off a surface so you can wipe, scrub or rinse it away. An example is dish soap.

**Disinfecting**

Treatment of a surface to kill germs; usually done on non-food contact surfaces.

**Food Contact Surfaces**

Surfaces that directly contact human food. This includes surfaces of equipment and tools as well as the hands of food handlers.

**Food Safety Modernization Act (FSMA) Produce Safety Rule**

Federal regulations for those who grow, harvest, pack and hold produce. Many beginning farmers will not need to comply with the full set of regulations; however, it is important for growers to be aware of the laws, know their coverage status and understand how it could change in the future.

**Farm Food Safety Plan or Manual**

A written document that outlines the farm's policies and procedures for food safety; it may also include recordkeeping logs or other supporting documents.

**Food Safety Policy**

A statement that explains what the farm will do to achieve a desired food safety outcome. For example, a farm may have a policy that prohibits employees from working if they are sick to prevent the spread of foodborne illness.

## KEY WORDS (continued)

**Good Agricultural Practices (GAPs)**

Agricultural practices that reduce microbial risks to fruits and vegetables.

**Good Agricultural Practices Certification (GAP Certification)**

Certification by the USDA or another organization that a farm is meeting a set of guidelines based on Good Agricultural Practices.

**Recordkeeping**

Noting when things occur for the purpose of verifying they happened and collecting useful data. Examples include harvest records, cleaning logs, wildlife scouting logs, etc.

**Risk Assessment**

A process of analyzing the farm's environment and practices to identify potential hazards and how likely they are to impact produce safety.

**Sanitary Design**

Selecting materials and equipment for your farm that are easy to clean and sanitize.

**Sanitizer**

A substance (e.g., bleach or peroxyacetic acid) that significantly reduces the amount of microorganisms on a surface. Sanitizing will only work on surfaces that have been cleaned first.

**Sanitizing**

Treating a cleaned surface in order to reduce microorganisms present; sanitizing follows cleaning and is often done on food contact surfaces.

**SOP or Standard Operating Procedure**

Step-by-step instructions for carrying out a task in a standardized way.

## FACILITATOR BACKGROUND INFORMATION:

- All types of produce are susceptible to contamination that can cause foodborne illness.
- Foodborne illness makes people very sick and can result in hospitalization, long-term health problems and death. Those who are more vulnerable to severe illness include young children, older adults and immunocompromised individuals.
- All farms, regardless of scale, location or type of produce grown, can reduce risks to produce safety.
- Following good handwashing practices is an effective way to reduce the risk of pathogens contaminating fresh produce that comes into contact with workers' hands or surfaces that hands have touched.
- For good handwashing practices to be followed, handwashing stations need to be readily available to all workers. There are numerous types of handwashing stations available at all price points to serve any farmer's need:
    - Permanent, plumbed handwashing sinks
    - Portable sinks with a foot pump (often the option provided by port-a-jon companies)
    - DIY portable handwashing stations. Note that many different designs exist, including those that do not require tools or construction skills.

## FACILITATOR BACKGROUND INFORMATION:

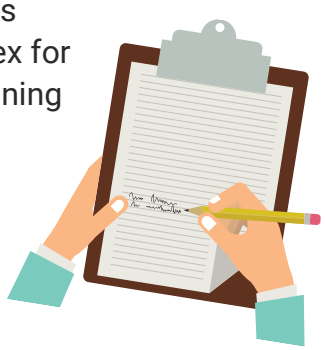
- Cleaning, sanitizing and disinfecting are three distinct tactics for maintaining a food-safe farm environment.

  - Cleaning is the physical removal of visible dirt from a surface. The process of cleaning involves removal of the dirt with a brush or spraying with water, scrubbing with a detergent, rinsing with clean water and allowing to air dry.
  - Sanitizing is the treatment of a cleaned surface in order to reduce microorganisms present. Sanitizing always follows cleaning and is often done on food contact surfaces.
  - Disinfecting is the treatment of a surface to destroy pathogens. Usually only non-food contact surfaces are disinfected.

- Food safety planning and record keeping are important components of maintaining a food-safe farm environment:

  - Making a habit of planning for food safety and recording actions taken is a recommended practice for beginning farmers. Food safety planning and recordkeeping does not need to be complicated or time consuming, and should be incorporated into day-to-day farm tasks.

  - There are many food safety plan and recordkeeping templates available for farms. Some of these may be needlessly complex for beginning farmers. Recommendations of templates for beginning farmers are included in this curriculum on pages 27-29.



## FACILITATOR BACKGROUND INFORMATION:

- Michigan Produce Safety Technicians offer **free, voluntary and confidential assistance to farms**, including:
  - Farm visits
  - Michigan Produce Safety Risk Assessments
  - On-Farm Readiness Reviews for Food Safety Modernization Act (FSMA) compliance readiness
  - Action plan development
  - Food safety plans and more

Michigan On-Farm Produce Safety

- Doing an on-farm risk assessment such as the **Michigan Produce Safety Risk Assessment** is a good first step to help farmers understand how a food safety plan can address risks present on their farms.

- Once farmers are more familiar with food safety planning and recordkeeping, reviewing food safety plan templates and thinking about how a farm might customize them can help them prepare to write their own farm plans.

- Farm food safety plans should reflect only the practices a farm is doing currently on their farm. If the plan doesn't match what is actually happening, it needs to be revised. It is recommended that farms review and revise food safety plans at least annually.

- Farms may decide to participate in food safety certification programs that require them to have a written food safety plan and an implemented food safety program. These certification programs are voluntary and typically initiated by a produce buyer's request.

# KWL Process

*Know, Want to Know, Learn*

## Suggested discussion questions for farmers to share from their experience:

- What seems most daunting to you when it comes to addressing food safety on your farm?
- What are you most worried about?
- What infrastructure do you have on your farm that can support food safety? What infrastructure may you need to add?

## Suggested discussion questions to find out what participants want to learn:

- What, if anything, have you done to address food safety on your farm? Why did you choose to do that?
- If you have not yet done anything, are you facing barriers (e.g., mental, financial, resource, lack of information, etc.) to start?

# 1. Constructing a Portable Handwashing Station

## OVERVIEW

Participants will build a low-cost, portable solution for handwashing anywhere on the farm.

## MATERIALS NEEDED

One per participant and one set for the facilitator:

- Water container with an open/close valve
- Soap dispenser
- Paper towel holder and adhesive or bungee cord
- Paper towel roll
- Dishpan or five-gallon bucket
- Trash can or bucket with lid

## BEST LOCATION

Classroom or farm

## BEST TIME OF YEAR

Any time of the year

## FACILITATOR BACKGROUND INFORMATION

Handwashing is an effective way of removing germs from a common food contact surface (hands) to prevent contamination of produce by pathogens that can cause foodborne illness. While some farms may have plumbed handwashing sinks in restrooms or packing areas, others may not. This is a low-cost option for a handwashing station that can be located anywhere handwashing is needed:

- On a folding table in the wash/pack
- On a trailer in the field
- On a table in a break area

# 1. Constructing a Portable Handwashing Station (continued)

## PROCEDURE

- Prior to the lesson or at the beginning of the lesson, set up a demonstration handwashing station as pictured.
- Explain the purpose of the various components of the handwashing station:
  - Water container with an open/close valve
    - Use this to hold potable water for handwashing.
    - Warm water is ideal if you have access. The water will also warm up in the container if it's in a sunny location.
    - Treat the open/close valve like a sink tap: use a paper towel to turn it off after washing to avoid recontaminating hands.
  - Soap dispenser
    - Soap is necessary to remove germs from hands. Water alone does not remove germs, nor does hand sanitizer. (This is a tie-in to the Handwashing Activity from the "What are the Risks?" module.)
  - Paper towel roll
  - Paper towel holder and adhesive or bungee cord to keep paper towels in place
  - Dishpan or five-gallon bucket for collecting wastewater.
    - Ask: Where would you dispose of this wastewater on your farm?
  - Trash can or bucket with lid for used paper towels
- Distribute a set of materials to each participant. Participants may choose to fully assemble the handwashing station on-site or take components back to their farms.

# 1. Constructing a Portable Handwashing Station (continued)

## DIVE DEEPER

- As a group, review other handwashing station setup options in the handout or presentation from North Carolina Cooperative Extension.
    - Discuss the advantages and disadvantages of each setup.
    - Discuss why they could be a good choice for various types and scales of farm operations.

## VARIATIONS

Build a wooden base for the handwashing station with these instructions and/or video from University of Minnesota Extension.

# 2. Meet Your Local Produce Safety Technician

## OVERVIEW

Participants will be introduced to their local Produce Safety Technician in a casual environment and learn about the various free and confidential services offered through the Michigan On-Farm Produce Safety program. Technicians will talk through some of the most common scenarios they encounter on farms and how to incorporate these learnings into participants' food safety planning.

## MATERIALS NEEDED

**Refer to participant packet for handouts**

- Virtual or printed copies of Produce Safety Technician Interview Questions (included in the participant packet)
- Computers, projector or other A/V equipment as needed

## FACILITATOR BACKGROUND INFORMATION

Michigan has a free and confidential produce safety assistance program for farmers. A team of Produce Safety Technicians are located regionally to work one-on-one with farms across the state. These individuals offer a variety of services, which farmers can access through a form on the Michigan On-Farm Produce Safety website.

For some farms, the idea of inviting a stranger on to their farm may be unsettling. Through this activity, farmers can get to know their local technician and begin to build a relationship with them.

# 2. Meet Your Local Produce Safety Technician (continued)

## PROCEDURE

- Facilitator reaches out to the nearest Produce Safety Technician to schedule the visit.
  - Technician contact information may be found on the Michigan On-Farm Produce Safety website **Contact page**.
  - Brief the technician on the purpose of their visit:
    - Meet local beginning farmers
    - Introduce their services
    - Talk about some common issues they see on farms and how beginning farmers can incorporate preventative measures into their produce safety planning
- Arrange chairs in a circle if some or all of the participants are joining in person.
- On the day of the visit, prepare participants by sharing some sample interview questions for the technician and encouraging them to think of others.
- Ask the technician to introduce themselves, what they do for work, and what they like to do outside of work.
- Ask the participants to introduce themselves.
- Facilitator initiates question and answer conversation by inviting participants to ask questions from the sheet of provided questions or others that they have come up with. From there the conversation can be free-flowing. If needed, the facilitator can prompt additional questions.

# 2. Meet Your Local Produce Safety Technician (continued)

## DIVE DEEPER

- View the video Michigan's Produce Safety Risk Assessment to learn more about the risk assessment program from a technician and a participating farm.

- After the technician leaves, allow space for participants to process together as a group.
  - What was their biggest takeaway?
  - What concerns do they have about the program and services?
  - How might these concerns be addressed?

## VARIATIONS

If an educational farm is available, request that the technician conduct a Produce Safety Risk Assessment for the farm and invite participants to observe and ask questions throughout the assessment process.

## CONNECTIONS TO OTHER MODULES

In addition to Produce Safety Technicians, Michigan Conservation Districts also offer Michigan Agriculture Environmental Assurance Program (MAEAP) Technicians. A similar activity could be conducted with the local MAEAP Technician.

# 3. Food Safe Composting

## OVERVIEW

Participants will practice taking temperatures of a compost pile and keeping compost records to monitor that compost is heating up enough to destroy microorganisms that can be harmful to human health.

## MATERIALS NEEDED

- Compost pile or instructions and materials to build two can bioreactor (see pages 20-22) or soda bottle bioreactor (see pages 23-25)
- 1 long probe thermometer
- 1 small probe thermometer per student if making soda bottle bioreactors
- Printed or electronic copies of compost production record

## BEST LOCATION

Classroom or farm at any time of year

## FACILITATOR BACKGROUND INFORMATION

Aside from vermicomposting (worm composting), most composting systems use thermophilic (high temperature) systems to achieve high-quality, safe compost. High temperatures result in a compost pile or bin when microbes feed on the contents of the pile. Heat is released as the microbes' bodies decompose the material into finished compost.

Different kinds of microbes thrive under different temperature conditions, and the microbes who thrive in the hottest temperatures of 115-160 degrees Fahrenheit are called thermophilic microorganisms. They have friends called mesophiles (mid-temperature loving microbes) that are active from about 50-100 degrees Fahrenheit. These microbes actually do the bulk of the decomposing. However, those hot temperatures in the pile are needed to finish the decomposition process, kill weed seeds and destroy pathogens that can make people sick.

# 3. Food Safe Composting (continued)

## FACILITATOR BACKGROUND INFORMATION, CONTINUED

Compost temperature should be measured and recorded daily to demonstrate that the necessary time and temperature has been achieved. Introducing oxygen to the pile through turning the pile speeds up the decomposition process, in turn producing more heat. To kill pathogens and weed seeds:

- If the pile is not turned, the pile must maintain a temperature of at least 131 degrees Fahrenheit for three days in a row (sometimes called contiguous days).
- If the pile is turned a minimum of five times, the pile must reach a temperature of at least 131 degrees Fahrenheit for 15 days total. These do not need to be contiguous days.

Manure or vegetative waste that has been left to age in a pile without temperatures being recorded needs to be treated as raw manure and applied at least 120 days before harvest.

For more instructor background on composting, review **"The Science of Composting"** and instructor background information provided in the soil health curriculum.

# 3. Food Safe Composting (continued)

## PROCEDURE

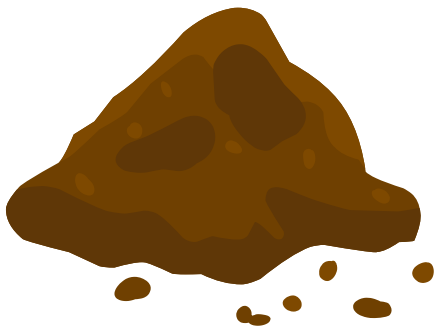
- Facilitator explains the composting process and why measuring temperature is important to ensure that compost is food safe (some concepts may be review if participants have completed the soil health module).
- Facilitator introduces the probe thermometer to participants and asks if anyone has used a similar kind of thermometer before. It's possible that some participants may have used a smaller version for food preparation.
- Facilitator models the basic procedure for using a probe thermometer to measure and record compost pile temperatures:
  - Insert probe deep into the pile.
  - Leave in place long enough for temperature reading to stabilize.
  - Record the temperature reading in the compost production record.
  - Move the probe to a new location in the pile and repeat until four temperature readings have been taken and recorded.
- Each participant is given the opportunity to use the probe thermometer to measure compost temperature.

# 3. Food Safe Composting (continued)

## CONNECTIONS TO OTHER MODULES

If you teach this activity along with the soil health curiculum, you can connect the concepts for participants.

Compost production factors are just as important to human health as they are to plant health. Properly making compost ensures a balanced fertilizer that will not harm your crops or those who eat them. By following simple guidelines for making compost, a farmer will be rewarded with a nutrient rich soil amendment that is food safe.



## DIVE DEEPER

- Encourage participants to think through how they will organize and store compost and soil amendment application records.
  - Will they keep virtual records? Paper?
  - What kind of reminders or triggers will help them remember to take records?

## VARIATIONS

- Build a two can bioreactor to use for the activity instead of an outdoor compost pile (see pages 20-22). This would allow the activity to be done in winter or when no outdoor compost pile is available.
- Have each student build a soda bottle bioreactor to take home to practice the habit of taking and recording daily temperature readings (see pages 23-25).

These variations are adapted from "Composting in the Classroom" by Nancy M. Trautmann and Marianne E. Krasny.

# Variation: Two-Can Bioreactors



## TWO-CAN BIOREACTORS

### PURPOSE

Two-can composters consist of a 20-gallon garbage can containing organic wastes placed inside a 32-gallon garbage can. Although many classrooms have successfully composted with a single container, placing the can that holds wastes inside another container helps alleviate any odor and fly problems that may arise. The outside container can also be used to collect leachate.

Two-can units are designed to be used for small-scale indoor composting, and as an educational tool in the classroom. A 20-gallon can holds only about 10% of the cubic meter volume commonly recommended for thermophilic composting. Thermophilic composting is possible in these smaller systems, but careful attention needs to be paid to C:N ratios, moisture content, and aeration.

A system using a 10-gallon plastic garbage can inside a 20-gallon can may be substituted if space is a problem. The smaller system may operate at lower temperatures, thereby lengthening the time for decomposition. Or students may want to experiment with various aeration and insulation systems to see if they can come up with a 10-gallon system that achieves temperatures as high as those in a larger system.

### MATERIALS

- 32-gal plastic garbage can
- 20-gal plastic garbage can
- drill
- brick
- spigot (optional—see Step 3, below)
- insulation (optional—see Step 5, below)
- duct tape (optional—see Step 5, below)
- 6 pieces of nylon window screen (each about 5 $cm^2$)
- dial thermometer with stem at least 60 cm long
- peat moss or finished compost to make 5-cm layer in outer can
- compost ingredients, including high-carbon materials such as wood chips and high-nitrogen materials such as food scraps (see Step 8, below)

### CONSTRUCTION

1. Using a drill, make 15 to 20 holes (1–2.5 cm diameter) through the bottom of the 20-gal can.
2. Drill five 1–2.5 cm holes just below the rim of the larger garbage can, and cover them on the inside with pieces of nylon window screen.
3. Design and build a spigot at the bottom of the larger can for draining leachate. One way to do this is to fit a piece of pipe into a hole at the bottom edge of the outer can, sealing around the edges with waterproof tape or sealant. Close the outer end of the pipe with a tight-fitting cork or stopper that can be removed to drain the accumu-



Excerpt of "Composting in the Classroom" by Nancy M. Trautmann and Marianne E. Krasny.

# Variation: Two-Can Bioreactors, continued



lated leachate, and cover the inner end with a piece of nylon screening to block the flow of solid particles.

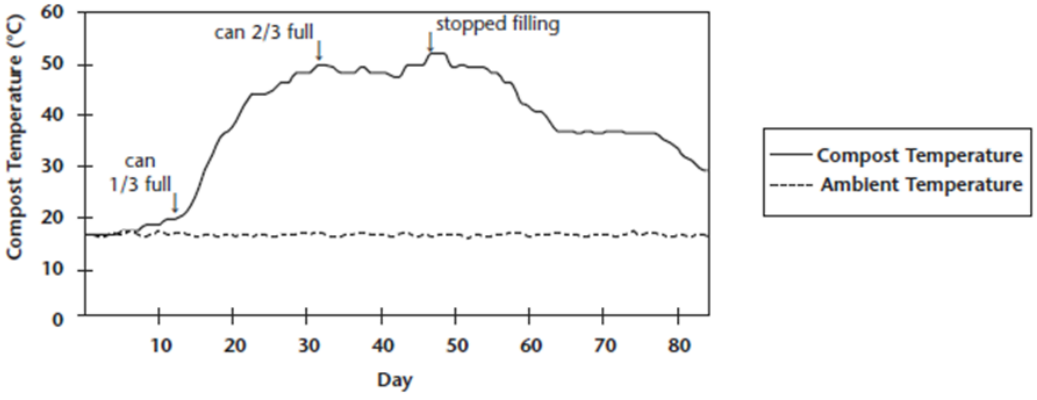
4. Place a brick or some other object in the bottom of the 32-gal can. This is to separate the two cans, leaving space for leachate to collect. (Students may want to measure the leachate and add it back into the compost.)

5. If you are composting in a cold area, you may want to attach insulation to the outer barrel and lid with duct tape, making sure not to block aeration holes.

6. To reduce potential odors, line the bottom of the outer can with several centimeters of absorbent material such as peat moss or finished compost. Periodically drain the leachate to avoid anaerobic conditions that may cause odors. The leachate can be poured back in the top if the compost appears to be drying out. Otherwise, dispose of it outside or down the drain, but do not use it for watering plants. (This leachate is not the "compost tea" prized by gardeners, and it could harm vegetation unless diluted. Compost tea is made by soaking mature compost, after decomposition is completed.)

7. Fill the reactor, starting with a 5–10 cm layer of "brown" material such as wood chips, finished compost, or twigs and branches. Loading can take place all at once (called "batch composting") or in periodic increments. With batch composting, you are more likely to achieve high temperatures quickly, but you will need to have all organic material ready to add at one time. If you are going to add layers of materials over a period of time rather than all at once, the material probably won't begin to get hot until the can is at least 1/3 full (Figure 2–1).

*Figure 2–1. A Typical Temperature Profile for Two-Can Composting with Continuous Loading.*




Excerpt of "Composting in the Classroom" by Nancy M. Trautmann and Marianne E. Krasny.

# Variation: Two-Can Bioreactors, continued



Whether you fill the reactor all at once or in batches, remember to keep the ingredients loose and fluffy. Although they will become more compact during composting, never pack them down yourself because the air spaces are needed for maintaining aerobic conditions. Another important rule is to keep the mixture in the inner can covered at all times with a layer of high-carbon material such as finished compost, sawdust, straw, or wood shavings. This minimizes the chance of odor or insect problems.

8. To achieve thermophilic composting, you will need to provide the ingredients within the target ranges for moisture, carbon, and nitrogen. For moisture, the ideal mixture is 50–60% water by weight. You can calculate this by using the procedure described in Chapter 3 (pp. 47–48), or use the rule of thumb that the ingredient mix should feel about as damp as a wrung-out sponge. For carbon and nitrogen, the mixture should contain approximately 30 times as much available carbon as nitrogen (or a C:N ratio of 30:1). Using a specified quantity of one ingredient, you can calculate how much of the other you will need to achieve this ratio (see Chapter 3, pp. 48–50). Or, you can simply make a mixture of high-carbon and high-nitrogen materials. Organic materials that are high in carbon include wood chips or shavings, shredded newspaper, paper egg cartons, and brown leaves. Those high in nitrogen include food scraps, green grass or yard trimmings, coffee grounds, and manure. (Do not use feces from cats or meat-eating animals because of the potential for spreading disease organisms.)

You are now ready to begin monitoring the composting process using the methods outlined in Chapter 4. The composting process should take two to three months after the can is filled. At the end of this period, you can either leave the compost in the can or transfer it into other containers or an outdoor pile for the curing phase.

Excerpt of "Composting in the Classroom" by Nancy M. Trautmann and Marianne E. Krasny.

# Variation: Soda Bottle Bioreactors



## SODA BOTTLE BIOREACTORS

### PURPOSE

Soda bottle bioreactors are designed to be used as tools for composting research rather than as a means to dispose of organic waste. They are small and inexpensive, enabling students to design and carry out individualized research projects comparing the effect of variables such as moisture content or nutrient ratios on compost temperatures.

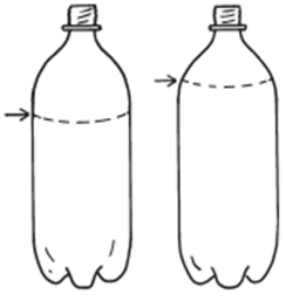
Use the instructions below as a starting point. Challenge students to design their own soda bottle reactors and to monitor the temperatures that their reactors achieve.

### MATERIALS

- two 2-liter or 3-liter soda bottles
- Styrofoam plate or tray
- one smaller plastic container such as a margarine tub that fits inside the bottom of the soda bottle (optional—see Step 3, below)
- drill or nail for making holes
- duct tape or clear packaging tape
- utility knife or sharp-pointed scissors
- insulation materials such as sheets of foam rubber or fiberglass
- fine-meshed screen or fabric (such as a piece of nylon stocking) large enough to cover ventilation holes to keep flies out
- dial thermometer with stem at least 20 cm long
- chopped vegetable scraps such as lettuce leaves, carrot or potato peelings, and apple cores, or garden wastes such as weeds or grass clippings
- bulking agent such as wood shavings or 1-cm pieces of paper egg cartons, cardboard, or wood
- hollow flexible tubing to provide ventilation out the top (optional—see Step 8, below)

### CONSTRUCTION

1. Using a utility knife or sharp-pointed scissors, cut the top off one soda bottle just below the shoulder and the other just above the shoulder. Using the larger pieces of the two bottles, you will now have a top from one that fits snugly over the bottom of the other.



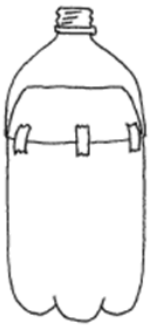
2. The next step is to make a Styrofoam circle. Trace a circle the diameter of the soda bottle on a Styrofoam plate and cut it out, forming a piece that fits snugly inside the soda bottle. Use a nail to punch holes through the Styrofoam for aeration. The circle will form a tray to hold up the compost in the bioreactor. Beneath this tray, there will be air space for ventilation and leachate collection.

3. If your soda bottle is indented at the bottom, the indentations may provide sufficient support for the Styrofoam circle. Otherwise, you will need to fashion a support. One technique is to place a smaller plastic

Excerpt of "Composting in the Classroom" by Nancy M. Trautmann and Marianne E. Krasny. 31

# Variation: Soda Bottle Bioreactors, continued





container upside down into the bottom of the soda bottle. Other possibilities include wiring or taping the tray in place.

4. Fit the Styrofoam circle into the soda bottle, roughly 4–5 cm from the bottom. Below this tray, make air holes in the sides of the soda bottle. This can be done with a drill or by carefully heating a nail and using it to melt holes through the plastic. If you are using a plastic container to hold up the Styrofoam tray, you may need to drill holes through the container as well. The object is to make sure that air will be able to enter the bioreactor, diffuse through the compost, and exit through the holes or tubing at the top.

   Avoid making holes in the very bottom of the bottle unless you plan to use a pan underneath it to collect whatever leachate may be generated during composting.

5. Next, determine what you will compost. A variety of ingredients will work, but in general you will want a mixture that is 50–60% water by weight and has approximately 30 times as much available carbon as nitrogen (a C:N ratio of 30:1). You can estimate moisture by using the rule of thumb that the mixture should feel as damp as a wrung-out sponge, or you can calculate optimal mixtures using the procedures in Chapter 3 (pp. 47–48).

   Similarly, mixtures that will achieve optimal C:N ratios can be either estimated or calculated. Materials that are high in carbon include wood chips or shavings, shredded newspaper, and brown leaves. High-nitrogen materials include food scraps, green grass or yard trimmings, and coffee grounds. By mixing materials from the high-carbon and high-nitrogen groups, you can achieve a successful mixture for thermophilic composting. Try to include more than just a couple of ingredients; mixtures containing a variety of materials are more likely than homogeneous ones to achieve hot temperatures in soda bottle bioreactors. To calculate rather than estimate the amounts needed, use the equations in Chapter 3 (pp. 48–50).

   The particle size of compost materials needs to be smaller in soda bottle bioreactors than in larger composting systems. In soda bottles, composting will proceed best if the materials are no larger than 1–2 cm.

6. Loosely fill your bioreactor. Remember that you want air to be able to diffuse through the pores in the compost, so keep your mix light and fluffy and do not pack it down.

7. Put the top piece of the soda bottle on and seal it in place with tape.

8. Cover the top hole with a piece of screen or nylon stocking held in place with a rubber band. Alternatively, if you are worried about potential odors, you can ventilate your bioreactor by running rubber tubing out the top. In this case, drill a hole through the screw-on soda bottle lid, insert tubing through the hole, and lead the tubing either out the window or into a ventilation hood.

 Excerpt of "Composting in the Classroom" by Nancy M. Trautmann and Marianne E. Krasny.

# Variation: Soda Bottle Bioreactors, continued

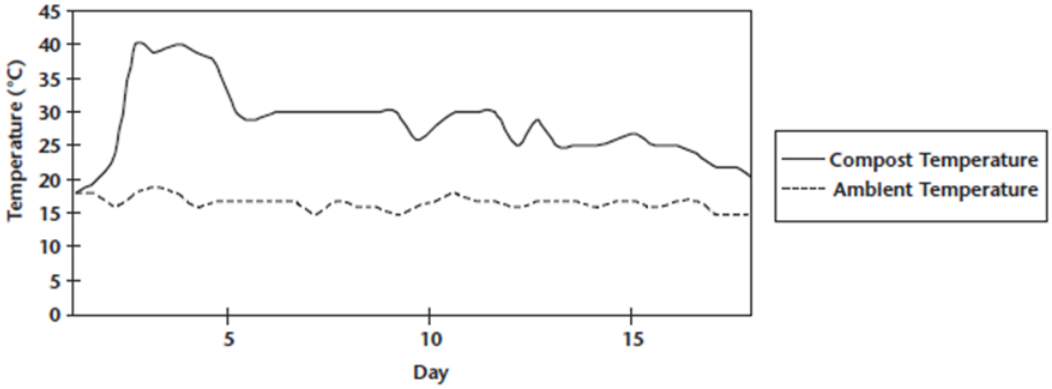


9. If you think flies may become a problem, cover all air holes with a piece of nylon stocking or other fine-meshed fabric.
10. Insulate the bioreactor, making sure not to block the ventilation holes. (Because soda bottle bioreactors are much smaller than the typical compost pile, they will work best if insulated to retain the heat that is generated during decomposition.) You can experiment with various types and amounts of insulation.

Now you are ready to watch the composting process at work! You can chart the progress of your compost by taking temperature readings. Insert a thermometer down into the compost through the top of the soda bottle. For the first few days, the temperature readings should be taken at least daily, preferably more often. In these small systems, it is possible that temperatures will reach their peak in less than 24 hours. To avoid missing a possible early peak, use a max/min thermometer or a continuously recording temperature sensor, or have the students measure the temperatures frequently during the first few days.

Soda bottle reactors generally reach temperatures of 40–45°C, somewhat lower than temperatures achieved in larger composting systems (Figure 2–2). If conditions are not right, no noticeable heating will occur. Challenge your students to design systems that show temperature increases, and use their results as a starting point for a discussion of the various factors that affect microbial growth and decomposition (C:N ratios, moisture levels, air flow, size, and insulation).

*Figure 2–2. A Typical Temperature Profile for Soda Bottle Composting.*




***Research Possibility:*** *How do different soda bottle reactor designs affect the temperature profile during composting? How do different mixtures of organic materials affect the temperature profile in soda bottle reactors?*

Excerpt of "Composting in the Classroom" by Nancy M. Trautmann and Marianne E. Krasny.

# Additional Resources/Activities

## Resource 1

### Cleaning, Sanitizing and Disinfecting Video

This short animated video defines cleaning, sanitizing and disinfecting within the context of a farm and covers the steps involved with cleaning and disinfecting farm surfaces.

## Resource 2

### Building a Low-cost Wash Station Video

This video walks farmers through the steps to building a food-safe wash station from simple, low-cost, easy-to-find materials. Two farmers are interviewed about their choice to build a wash station: Remi Harrington of Zoo City Food and Farm Network, an urban farm in Kalamazoo, MI and Laura Brosius of Full Plate Farm, a rural farm in Skandia, MI.

## Resource 3

### Farm Produce Safety Roadmap Video

This video presents a guide for beginning farmers to navigate the various produce safety programs available to them throughout their farming journey.

## Resource 4

### Farm Produce Safety Roadmap Handout

This handout on pages 31-32 is a complement to the Farm Safety Roadmap video.

# Additional Resources/Activities

## Resource 5

### Michigan's Produce Safety Risk Assessment Video

This video provides an introduction to the free and confidential Michigan Produce Safety Risk Assessment Program from a Produce Safety Technician and farmer perspective. It also details the benefits of this program to farmers and produce buyers.

## Resource 6

### Handwashing Stations Handout

This handout from University of Minnesota Extension provides an overview of different types of handwashing stations for farms of all scales. Estimated costs and capacity are noted, in addition to step-by-step building instructions for one design. The resource is a PDF copy of a slideset; it could be used by the instructor as a presentation or given to students as a handout.

## Resource 7

### Recordkeeping Log Templates

This Excel-based template from the UP Food Exchange that includes various farm food safety logs, such as harvest, injury/illness, animal monitoring, compost production, cleaning, manure application and others.

# Additional Resources/Activities

## Resource 8

### Produce Packshed Design for Safety and Efficiency Video

This **video** from University of Vermont Center for Sustainable Agriculture showcases how beginning farmers Ansel Ploog and Justin Cote of Flywheel Farm designed a small-scale open packshed on leased farmland.

## Resource 9

### Crop Storage Plan Template

Storing produce at an appropriate temperature and location is important for both produce safety and quality. This **template** from the Michigan State University Organic Farmer Training Program can be modified to create a crop storage plan for one's individual farm. It was designed in Google Docs but can easily be downloaded as a Word document. It could also be converted to an Excel spreadsheet with some copy/paste effort.

## Resource 10

### Food Safety Plan Template

Once beginning farmers have a good background in produce safety concepts, a recommended next step is to put their practices in writing. This **template** is from the Michigan On-Farm Produce Safety Team. Michigan Produce Safety Technicians are available to assist farms in writing a food safety plan.

# Additional Resources/Activities

## Resource 11

### Food Safety Plan Template for Produce Farms

Another **template** for beginning farmers to consider for their food safety plan, from the Michigan State University Organic Farmer Training Program.

## Resource 12

### Cleaning and Sanitizing Equipment Video

This **video** is recommended for farmers who have a foundation of produce safety and have been introduced to the FSMA Produce Safety Rule. It is recommended for beginning farmers who have machinery that needs to be taken apart to clean and sanitize, such as produce washers and sorters with rollers, conveyor belts, nozzles or brushes.

## Resource 13

### Hygenic Design Video

This **video** is recommended for farmers who have a foundation of produce safety and have been introduced to the FSMA Produce Safety Rule. It is recommended for beginning farmers who are considering the purchase of machinery such as produce washers and sorters. Viewers are introduced to the concept of hygienic design and learn the five principles of applying this concept.

# Review and Encouraging Further Learning

### Activities for review:

Reading Detergent, Sanitizer and Disinfectant Labels:

- Working in small groups, give participants the actual bottles or copies of the labels of various detergents, sanitizers and disinfectants and ask them to read the labels with an eye toward whether it can be used on produce, produce contact surface or non-food surfaces; how much should be used and how it should be applies; and what, if any personal protective equipment is needed to use.

Bring in a panel of farmers who are at various “stops” along the food safety roadmap to discuss their experiences and decisions. Make space for participants to ask questions and engage in dialogue.

### Taking your knowledge back to the farm:

- Follow up with your Produce Safety Technician and invite them out to your farm.
- Identify which food safety records would be useful to keep on your farm:
  - How will you take records (e.g., clipboard, Google forms, etc.)?
  - When will records be taken?
  - Who is responsible for taking records?

# Michigan Farm Produce Safety ROADMAP

This roadmap is designed to help farms navigate the different produce safety programs and services available in Michigan.

## PRODUCE SAFETY EDUCATION

If you are new to farming or have never attended a farm food safety training, a good first step is to take some time to learn about produce safety, Good Agricultural Practices (GAPs) and the Food Safety Modernization Act (FSMA) Produce Safety Rule (PSR). The MSU Extension Agrifood Safety website has videos and other training materials to get you started: https://www.canr.msu.edu/agrifood_safety/produce-safety-education/.

## RISK ASSESSMENT

Now that you have a background in farm produce safety concepts, the next step is to apply them to your farm. The Michigan Produce Safety Risk Assessment is a free and confidential program delivered by trained Food Safety Technicians across the state.

To find a technician near you, visit:
https://www.michigan.gov/documents/mdard/Conservation_District_Food_Safety _Technician_Coverage_Map_626467_7.pdf.

## WRITTEN FOOD SAFETY PLAN

Once you have identified your farm's food safety risks, the next step is to write policies and procedures for how you will address these risks. There are templates and resources available to guide you on the MSU Extension Agrifood Safety website: https://www.canr.msu.edu/agrifood_safety/produce-safety-education/food-safety-plan.

## FSMA PRODUCE RULE TRAINING

The FSMA PSR includes a set of regulations that apply to fresh produce growers. If you are covered under the rule, at least one individual from your farm must complete a Grower Produce Safety Course, such as those offered by Michigan State University Extension: https://www.canr.msu.edu/produce_safety_rule_training_and_cer/.

## ON-FARM READINESS REVIEW

On-Farm Readiness Reviews (OFRR) are designed to help fresh produce growers feel prepared and ready for meeting the FSMA PSR requirements by walking through their operations with a small team of produce safety experts. Learn more about OFRRs and how to request one at https://www.canr.msu.edu/agrifood_safety/on-farm-readiness-reviews.

## FOOD SAFETY CERTIFICATION

Some buyers may require you to obtain a third party food safety certification. If your buyer requires USDA GAP certification, the Michigan GroupGAP Network is an option to achieve USDA GAP certification in a supportive, educational environment. Learn more at https://www.migroupgap.com/.

Published by Michigan State University Extension in partnership with the Michigan Food Safety Work Group.

https://www.canr.msu.edu/outreach/

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