OVERVIEW

In this lesson, students continue their investigations of systems and interactions. The lesson starts with a review of the Lesson 4 homework, which you can use as an opportunity to check for student understanding of systems. Students share their ideas about the home-to-school transportation system that they participate in each day. This discussion is followed by a class demonstration that introduces students to interactions and feedback. In introducing the Unit 2 Question, *What is the system that gets food from farm to table?*, students review what they have learned and then brainstorm the parts of a food system that get food from the farm to the store. As students ponder systems and interacting parts, encourage them to think about the energy that is used in our food system. With this activity, students begin in earnest their exploration of the Module Question: *What is the system that gets food from farm to table, and how does this system affect the environment?*

AIM

To begin to investigate the system that gets food from field to store.

SCIENTIFIC PROCESSES
• question, investigate, build theories

OBJECTIVES
Students will be able to:
• explain what a system is;
• identify parts of a system and describe how they interact;
• discuss the steps a type of food goes through from field to store;
• identify processing, packaging, and transportation as steps in the food system.

MATERIALS
For the teacher:
• *Why Do We Need a Food System?* sample conversation
• *Student Understandings of Systems* teacher note
• *Apples to Applesauce Concept Map* lesson resource
• *Modeling Interactions* experiment sheet
• Chart paper
• Markers

For each student:
• *Exploring Our Food System* student reading
• *Thinking about Systems* student reading (pp. 64–65)
• *Thinking about Systems Review* activity sheet (pp. 66–68)
• LiFE Log

For the class:
• Materials from the *From Field to Store Supply List* lesson resource
PROCEDURE

Before You Begin:

- Review the Why Do We Need a Food System? sample conversation, Student Understandings of Systems teacher note, and the Apples to Applesauce Concept Map lesson resource.

- Remind students to bring in their homework from Lesson 4. Review the Thinking about Systems student reading and the Thinking about Systems Review activity sheet.

- Review the Modeling Interactions experiment sheet.

- Gather the materials listed on the From Field to Store Supply List lesson resource and set up the Modeling Interactions demonstration.

- Make copies of the Exploring Our Food System student reading to distribute to students.

- If you have not already done so, post the Module Question and the Unit 2 Question at the front of the classroom.

MODULE QUESTION

What is the system that gets food from farm to table, and how does this system affect the environment?

UNIT QUESTION

What is the system that gets food from farm to table?

QUESTIONING

1. Review Student Understandings of Systems

Ask students to take out their completed Thinking about Systems Review activity sheet, their homework from Lesson 4. In a whole-class discussion, elicit students’ ideas about systems. You may wish to use the Student Understandings of Systems teacher note and the guiding questions from the student reading to direct the discussion. What does the word “system” describe? (Something made up of parts that interact to make a whole.) Can a system be different from its parts? What is an example of a whole system that is different from its parts? Can part of a system also be a system? What are some examples of parts of a system that also are systems? Use this homework review as a way to gauge student understanding of systems and interactions. Pay particular attention to student understanding and discussion of the interconnections. Urge them to think beyond naming the parts of the system to how these systems interrelate and what the connections are.

Invite students to share their ideas about the home-to-school transportation system that they are part of. List the parts on chart paper. Accept all answers. Ask student volunteers to describe or draw on the chart paper different interactions that take place between the parts. For example, if students ride a bus to school, the bus, a mechanical system, and human systems interact when students get on the bus and ride it to school. Another human, the bus driver, interacts with the bus by applying the brake system to stop the bus to pick up the students; the bus driver takes the students to school, part of the school system, which also includes the students, teachers, administration, and other staff. The bus runs on fuel, which can be traced back to the environment. The bus also travels along a network of highways and is part of the school system’s transportation system, and so forth.
2. Discuss Interactions

Use the Modeling Interactions experiment sheet to conduct the water level demonstration. If you have not already done so, gather the materials listed on the From Field to Store Supply List lesson resource and set up the Modeling Interactions demonstration.

Explain that interactions are an important source of information in studying systems. Tell students that you are going to model a system with interactions and feedback. The feedback is the information that you will get based on the action you take. The feedback will tell you how the system is working. Students may be familiar with feedback from their own experiences, such as feedback from their teachers on their schoolwork, or feedback from coaches. Invite students to talk about what they do when they get feedback. Tell them that feedback in a system is similar. Information from the system is passed back through the system. Follow this discussion with the demonstration.

Do the first demonstration. Pour the water into the cup at a steady rate to maintain the water level. What is the action that is taking place? (Pouring water into the cup as water flows out of the bottom of the cup.) What information do we get back from this action? (We pour water in at the same rate that it flows out the bottom.) What can we do to reduce the water level? (Pour water in at a slower rate than it flows out.) Repeat the demonstration, pouring the water at a slower rate. What information did we get this time? (We did not pour fast enough.) What changed? (The water level dropped.)

Do the demonstration again, this time pouring water faster so that the cup overflows. What happened? (We poured water into the cup faster than it flowed out of the cup.)

3. Discuss Systems

Encourage students to think through what they observed in the demonstration. Imagine this model represents a food system. If the cup represents a farmer’s stand at a market, and the water is a crop, like raspberries, the water in the cup would represent the raspberries that the farmer is selling. What would the water flowing out represent? (Customers buying raspberries.) What would the water flowing into the cup represent? (The berries the farmer grows for the market.) Continue the discussion. Point out that if there aren’t as many customers, it’s like more water flowing in than water flowing out. There are berries left at the end of the day. If there are more customers than there are berries, some customers go away empty-handed. With this feedback (not enough berries for the customers), the farmer might bring more berries the next week. If the customers don’t buy them all, the farmer might sell them at a reduced price at the end of the day or might have to throw them away or compost them. Can you see why the farmer might want the system to be balanced? Bring the discussion to a close.

4. Introduce the Unit 2 Question

Remind students that in their Farm to Table & Beyond studies, they have been investigating the Module Question. In Unit 2, the class will be investigating the system that gets food from farm to table.

Invite students to reflect on what they have learned about systems and to brainstorm the parts of a food system that get food from the farm to the store. Consider referring to a food that most students are familiar with, such as applesauce. Record their answers on chart paper. The Why Do We Need a Food System? sample conversation and Apples to Applesauce Concept Map lesson resource can help you guide your students through this discussion of
the parts of the food system. You may wish to prompt student thinking with questions such as: What ingredients are in applesauce? Where are apples grown? (Orchard, farm, trees.) What happens when the apples are ripe? (Someone picks them.) What happens after the apples are picked? How do they become applesauce? (Someone makes the applesauce; apples are made into applesauce in a factory.) How does the applesauce get to a place where you can buy it? (It’s put in jars or cans and then into boxes, shipped, a truck takes it to a store.) What happens when the applesauce gets to the store? (Someone puts it out for people to buy.) Can you think of any feedback that someone might get in this food system? (People want more applesauce than the store has and the store sells out; the apples are not the right ones to use for applesauce and it doesn’t turn out well; there are not enough apples to make applesauce.)

5. Make Connections

Review student responses. Point out that by describing all these parts, students have started to describe a food system. Ask if anyone would like to change any of the answers or add to them. Record any changes or additions. Next, elicit student ideas about the connections between the parts of the whole food system that they outlined. Is the natural environment connected in any way? Where do you see connections to the natural environment? (Water, trees, soil, air.) Are humans connected to this food system? Where do you see the connections? Can you think of any points in this food system where energy is used? (Fuel for tractors, human energy to pick the apples, energy to run the machines in the factory, energy for lights in the factory, fuel for the truck, energy in the stores.)

Discuss how the parts of the applesauce system interact. What would happen if half of the apple harvesters were out sick one day? Do you think that the harvesters being out sick would affect the total number of apples that were picked and placed on the truck that day? (If there weren’t as many people picking the apples, there would be fewer apples on the truck.) If a factory bought machines that could make twice the amount of applesauce, do you think that would affect the rest of the apples-to-applesauce system? What kind of changes do you predict would take place? (It would create a demand for more apples. There would be more applesauce available in the marketplace.) Do you think it would have an affect on you, the applesauce consumer? (There might be a change in the price of applesauce.)

6. LiFe Logs

Ask students to describe the farm-to-table system in their own words. Tell them to include where they think there may be interactions that would provide feedback. Have students record any questions they still have about food systems, including interactions and feedback. Invite students to share their descriptions with the class. Engage students in a discussion of why we need a food system. Use the sample conversation as a guide. As you close the lesson, record the questions students still have about food systems on chart paper and post it at the front of the classroom.

7. Homework

Give each student a copy of the Exploring Our Food System student reading to read after he or she completes this lesson.
**Why Do We Need a Food System?**

This sample conversation in the Questioning phase of the QuESTA cycle will help you guide your students through a conversation that will allow them to think deeply and thoughtfully about food systems. During the conversation, students may ask questions, think about what they already know, speculate on answers to questions, and wonder about what they are going to learn. This is a guide. Feel free to adjust your questioning to the needs of the class.

**MS. R:** Does anyone have any ideas about what we mean when we say “food system”? Think about what you have learned about systems and interactions and tell me why you think the process of getting food from the field to the store is called a food system.

**MAX:** Food has to get from the field to the store. Sometimes I see trucks that deliver food to the store near my home. The trucks are part of the transportation system we just talked about from our homework.

**LENNY:** Maybe it’s called a food system because there are parts, like transportation, and the farm, that make up the system.

**MS. R:** Good thinking, Max and Lenny. There are lots of different parts that are connected to make up the whole food system. Why do you think we need a food system?

**SOFIA:** My grandmother told me that she grew up on a farm in California and that back then there were lots of people who were farmers. But I don’t think there are as many farmers now. I don’t know anyone who is a farmer.

**MS. R:** You’re right, Sofia. There are not as many farmers today as there were when your grandmother was a little girl. So, if we have fewer farmers, what does that mean? How do we get our food?

**SOFIA:** It means that most people don’t grow their own food, so we have to get it from the store.

**MS. R:** Right. What if we did all grow our own food? Would our lives be different?

**OLIVIA:** I don’t think we would come to school every day. I think we would have to help our families on the farm. I saw something on television about a girl who lived on a dairy farm and she had to help her dad milk cows every day. That’s a lot of work.

**MS. R:** It sure is. We would spend a lot of time doing work related to growing our food if we didn’t have a food system that got our food to the store for us. What are some of the steps in the food system besides transportation?

**OLIVIA:** Last night we had spaghetti for dinner and my dad made it using a jar of sauce and a box of spaghetti. I don’t know how the noodles were made but I know the sauce is made from tomatoes and it must have been made in a factory somewhere.

**MS. R:** You bring up an important idea, Olivia. In the food system we have today, we can buy foods that are already prepared in some way. This is called processing. Tomatoes from a farm were processed into sauce. It is convenient for us to buy foods that already are prepared, like the tomato sauce. The sauce is convenient because we don’t have to spend time making it from scratch. So we have more time to spend doing other things.

Continue the conversation to include a discussion of packaging as part of the food system.
Student Understandings of Systems

In this module, we focus on the highly technological, complex system we have for getting food from the farm to the table. When we began developing this curriculum we interviewed students about their understanding of the food system. Although they had some ideas about how food is grown and some ideas about what food does in our body, they had very little understanding about our farm-to-table food system. Some students had very creative ideas about parts of the food system. For example, one student told an intricate story about the way the colorful little Os in Froot Loops cereal are cooked in an oven similar to a dryer, then dipped into a barrel of dye, and next are returned to the dryer-like oven so that the color does not rub off on the consumer’s hands. After completing the student interviews, we termed the farm-to-table part of our food system “the black hole” — students are interested in the topic and have their own ideas about it, but have little scientific understanding of how it actually works.

The term “system” is part of our daily vocabulary — from computer systems to sound systems to transportation systems to ecosystems. Your students may be very familiar with the word, yet not understand its meaning. Researchers have found that students have difficulty recognizing differences between parts and whole systems and tend to view them as similar. The National Science Education Standards urge teachers of science to help students recognize the properties of objects, as emphasized in grade-level content standards, while helping students understand systems.\(^1\) For example, in studying packaging and transportation as subsystems of the global food system, encourage students to consider the weight of materials used in packaging and how that might influence the mode of transportation.

Understanding our global food system, how the parts interact, and how our food choices can affect the environment is challenging. It is also important. The impact of human beings on the natural environment is expected to increase as populations grow and science and technology develop more sophisticated ways to change the natural world to suit human demands. What skills and knowledge will help prepare students to be able to participate in public debate about issues that involve the impact of human activities on the natural environment? Help students hone their scientific-reasoning skills and introduce the dimension of time. Encourage students to think about the parts of the food system today, and the food system in the past. What caused changes in our food system from the past to the present? What changes might there be from the present into the future?

Consider using reflective writing to uncover students’ thinking about systems and interactions. Encourage them to use diagrams to demonstrate the flow of information and feedback loops. Use the time-line resources included in the module to help students develop a historical perspective and to spur them on to think of creative solutions for the future. After all, your students will be the scientists, engineers, designers, and consumers who will be making the decisions that influence the food system in years to come.

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\(^1\) National Science Education Standards, 1996, p. 116
List the terms and phrases that students suggest during the brainstorming session. Terms might include: apples (or food); orchard, farm, trees; someone picks the apples; trucks take the apples to the factory; someone makes applesauce, applesauce is made at a factory; it’s put in jars or cans and then into boxes; it gets shipped, trucks take it to the store; someone puts the applesauce on the shelf.
From Field to Store Supply List

MODELING INTERACTIONS (pp. 78–79)

Supplies

For the class
• 3 cups of water
• Pitcher (1 quart or larger)
• (Optional) Food coloring
• (Optional) Spoon to stir food coloring in water
• 1 clear plastic cup, no larger than 8 ounces
• 1 nail (to punch a hole in the bottom of the cup)
• 1 two-cup measuring cup or small plastic container to catch the water
• Plastic dishpan or basin
• Paper towels (to clean up any spills)
Modeling Interactions

In this demonstration, students observe what happens when water is poured into a cup with a hole in the bottom. They ponder what needs to change to reduce the water level, maintain the level, and cause an overflow. They then apply what they have learned from this model to a discussion of the food system.

Setup

1. Gather the materials. Pour the water into the pitcher.
2. If you choose to dye the water, add the food coloring. This makes it easier to see the water in the cup.
3. With a dark marker, draw a line 1–2 inches from the rim of the cup. This line marks the water level.
4. Use the nail to punch a small hole in the bottom of the cup with the water level line.

Procedure

1. Place the measuring cup or small plastic container in the plastic dishpan or basin.
2. Place a finger over the hole in the bottom of the cup. Pour water into the cup until you reach the line marking the water level. You may wish to have a student volunteer help.
3. Remove your finger from the bottom of the cup. Slowly pour more water into the cup. Pour at a rate such that water flows out of the hole at about the same rate as you are pouring water into the cup.
4. Pour the water back into the pitcher and set up to repeat the demonstration. Pour water up to the level mark to begin. Remove your finger from the bottom of the cup.
5. This time, pour more water in as slowly as you can. Pour at a rate such that water flows out of the hole at a faster rate than you are pouring it into the cup. The water will drop below the mark on the cup.
6. Pour the water back into the pitcher and set up to repeat the demonstration. Pour water up to the level mark to begin. Remove your finger from the bottom of the cup.
7. This time, pour more water in as fast as you can. Pour at a rate such that water flows into the cup at a faster rate than it flows out of the hole. The cup will overflow.

Questions

1. What action is taking place? What happened the first time we poured water into the cup? What information did we get?
2. What action can we take to reduce the water level while still pouring water into the cup?
3. What evidence do you have to support your views?
4. Based on this feedback, if we don’t want the water level to drop, what should we do?
5. What evidence do you have to support your views?
6. What action can we take to have the water overflow as we pour water into the cup?
7. What evidence do you have to support your views?
Exploring Our Food System

Guiding Questions

• What are the parts of a food system?
• Who produces food?
• Why do we package food?
• How does processing change food?
• How is food transported?

The next time you sit down to eat spaghetti with tomato sauce, stop for a minute and think about how this food gets to your table. The sauce’s journey begins in a field where the summer sun is hot and the tomato plants are covered with tomatoes. A farmer grows these tomatoes for others to eat. This step of the food system is called food production. As soon as the tomatoes are ripe, someone picks them, puts them in boxes, and prepares them to ship from the farm to the next step in the food system. People load the boxes onto trucks and the truck drivers drive off. During the trip to the factory, the drivers stop to buy fuel and eat a meal. After resting, they continue the drive along highways and across bridges until they reach a factory. This step of the food system includes transportation.

At the factory, people sort the tomatoes and keep all the ones that are perfect for sauce. The damaged and rotting tomatoes are thrown away. The tomatoes for sauce are moved from one part of the factory to another, where they are processed into sauce. They are washed and heated, and the skins are removed and thrown away. They are cooked at high temperatures. Water, salt, and herbs are added to the tomatoes. Food processing means that food, like the tomato, is changed in some way.

When the sauce is ready, it goes to the next step of the food system, called packaging. The can that tomato sauce comes in is one kind of packaging. Sometimes packaging is made from cardboard, plastic, or glass. Packaging protects the food. It keeps food from drying out, getting moist, breaking into small pieces, and spilling. It can also protect food from microorganisms. The packaging usually includes a label, so you know what kind of food is inside. Making the labels and attaching them is another step in the food system. It can include taking a photograph of the food, or drawing it, designing a label, printing the label, and pasting it onto the package. Packaging also helps advertise the food, which can increase the sales of the food product. Once the packaging is complete,
Exploring Our Food System

during the transportation process, the tomato-sauce cans are put into boxes or crates and are sealed, ready to be shipped to the next stop on this journey.

The transportation system connects with the food system again. People load the boxes of tomato sauce onto trucks, or into railroad cars, or onto boats, or even onto planes. The tomato sauce is on the move and heading to its next destination. Once the tomato sauce arrives, it might be stored in a warehouse. From the warehouse, boxes of tomato sauce are moved directly to your neighborhood market. At your market, workers unload the trucks, open the cases, and put the cans of tomato sauce on the shelves.

The next time you enjoy spaghetti with tomato sauce, think about all the steps that it takes to bring those farm-fresh tomatoes to your table.