

TEACHER GUIDE

EXPLORE LESSON 3



Module Question: *How does the dairy system produce dairy products and get them to our table?*

What We Figure Out:

We realize there are several components in the dairy food system, and each component/step includes several inputs and outputs, as well as boundaries. Each of these components plays an important role in allowing the system to produce dairy foods. We realize the components include more than just agriculture systems but expand to other systems, such as transportation and manufacturing.

3D Learning Objective:

Students **integrate information in multiple media formats** to **determine central ideas** about the **inputs, outputs, and boundaries** included in the **dairy foods system**.

Time estimate:

50 minutes

Materials:

Lesson 3 Student Guide
Lesson 3 Student Handout Dairy System Component Cards
Chart Paper

Targeted Elements

SEP:

INFO-H2:

Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.

DCI:

ETS2.B-H1:

Modern civilization depends on major technological systems, including those related to agriculture, health, water energy, transportation, manufacturing, construction, and communications.

CCC:

SYS-H1:

Systems can be designed to do specific tasks.

SYS-H2:

When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.



Directions



Part 1: Our Motivation

USE OF PHENOMENA

Between Lessons 8 and 13, students will focus on the Module Phenomenon. In Lesson 14, they will return to evaluating the media claims from the Anchor Phenomenon using the knowledge they gain from this module.

Choose 2-4 student models from Lesson 2 that show different components of the dairy system. Ask students to share what they notice about how the different models represent how dairy products are made.

In student responses, listen for the following ideas:

- We all showed different steps in the process of producing dairy products.
- Most models show a cow, but the rest of the parts of the system are different.

Build off student responses to share that we will now gather evidence from a series of media to help us figure out what the parts of the dairy system are and what they do. Ask students how figuring this out will help us make progress on figuring out the Module Phenomenon.

In student responses, listen for the following ideas:

- If we figure out what the parts of the dairy system are, we can better understand their impact on the environment.

Finally, point to the Dairy Industry category of questions on the Driving Question Board. Share a few selected questions that align with what students will investigate in the upcoming lesson.

Example student questions or ideas could include:

- What steps are there involved in producing dairy products?
- What happens at each step in the process?
- How does the dairy get from the cow to the store?

Students can record these questions in their 3 Student Guide Part 1: Our Motivation. This will help students understand how this lesson connects to what they were trying to figure out about the module and Anchor Phenomena.

TEACHER SUPPORT

Remember that the sample questions are just examples when returning to the Driving Question Board. Use the questions that your students have asked instead of the sample questions.

**Part 2: Summarize Information About Parts of the Dairy System**

Students will record their thoughts on the steps in the system they want to know about. Allow students to answer the question individually before sharing using the following routine.

STUDENT SUPPORT

For multilingual students or students who are internal processors, it's helpful to allow time or opportunity for students to process information individually or by using non-linguistic processing modes before group share-outs.

Use a Think-Pair-Share to have students share what they think is needed to determine the impact of the dairy system on the environment.

1. Students are given time to think independently about their responses.
2. Students find an elbow partner.
3. Students take turns sharing their thoughts with their partner. Each student should be given time to respond.

As students share, use a Domino Share Routine to have them build off each other's contributions.

1. Each group nominates a spokesperson.
2. As a student from group 1 shares, all other students serve in a "listener" role, noting patterns or ideas that emerge as the group continues to share.
3. Spokespersons from each group continue to share ideas until all groups have shared.
4. The facilitator holds a whole class discussion and invites the remaining students to share what they heard that was similar across all the responses or a unique response they want to elevate.

In student responses, look for the following ideas that students want to know more about:

- If students have represented all the steps in the system.
- If students have shown the impacts of the system on the environment.

If students need additional support in generating what information they need, consider:

- Ask students to refer to their model and start asking questions from there.

- Direct students to think in the context of what these steps impact.

As students share their lists, write them on the board. Circle the important factors that align with the steps of dairy production, what is put into each step, and what is generated from each step.

Place students in groups of 5 and pass out the Lesson 3 Student Handout Dairy System Component Cards (total 10) to each group. Each student will get two cards. In the groups, students will divide the cards between group members so each person has at least two cards. Each card gives information about the inputs, outputs, and functions of the different components of the dairy system. Each card has content and links to more information or videos about the dairy system component.

Use the following steps with students as they engage with the cards:

1. Students will read the literature, view the additional resources by going to websites or watching videos linked on their cards.
 - a. Remind students of the definitions of input, output, and boundaries:
 - i. An input is some form of matter, energy, information, or an activity that moves into a component.
 - ii. An output is some form of matter, energy, information, or human activity that is produced by a component.
 - iii. A boundary is something that is excluded from the focus of the system being analyzed.
 - b. If students need additional support in reading/watching the card content:
 - i. Allow them to work together in their groups by asking questions like, “What do you think this means?” or “Tell me more about what you saw in the video?”
 - ii. If students need more teacher-led support, use pressing questions to elicit student observations like, “Why do you think that?”, “Why is this step important?”, or “What can you infer from this reading/video?”
2. Students will individually write a 2-3 sentence summary that paraphrases the inputs/outputs and function/purpose of each component of the dairy system, as well as the boundaries of each component of the system. Students can record their thoughts in the graphic organizer on their Lesson 3 Student Guide Part 2: Summarize Information About Parts of the Dairy System.
 - a. In student responses, look for:
 - i. A synthesis of information from the sources in each column (inputs, outputs, and boundaries)
 - ii. A short description of the part of the system. For the next parts of the lesson, this description will help them to know where the steps belong in the sequence of the dairy system model.
 - b. If students need additional support:
 - i. If students need support understanding inputs, outputs, and boundaries, provide an analogy of a more common situation. For example, a garden needs inputs like soil, seeds, fertilizer, sunlight, human labor, and water to produce

outputs of fruits/vegetables/flowers at the end of the season. At the same time, if the system boundaries include only the garden, then things beyond its boundaries that the garden interacts with include local wildlife and local weather.

STUDENT SUPPORT

When using analogies, be sure to consider what kind of analogy will be most relevant to the lives of your students. You may choose a garden example or another in this case.

- ii. If students need support in writing their part summary, ask them to ponder, “How would you describe this to a friend who knows nothing about dairy production?”
3. Once complete, students will find a partner with the same cards as them to reach a consensus on the inputs, outputs, functions, and boundaries of the components of the system they are working with.
4. Once each student has shared their cards, the pair will complete a consensus graphic organizer in Lesson 3 Student Guide Part 2: Summarize Information About Parts of the Dairy System.
5. Reflect on why boundaries were necessary in the model. Ask students to identify what they were focusing on in their system analysis, what was outside of the analysis, and how those components might interact. Students can record their thoughts in the graphic organizer, the Lesson 3 Student Guide Part 2: Summarize Information about Parts of the Dairy System.

FORMATIVE ASSESSMENT OPPORTUNITY

Students **integrate information in multiple media formats to determine central ideas** about the **inputs, outputs, and boundaries** included in the **dairy foods system**.

Assessment Artifacts:

- Students’ summaries of information obtained from video and text resources (Lesson 3 Student Guide Part 2 Summarize Information About Parts of the Dairy System).
- Students’ reflections of why boundaries of the system are helpful to analyze the function of components of the system (Lesson 3 Student Guide Part 2 Summarize Information About Parts of the Dairy System).

Look Fors:

- Student responses should include an integration of the information they viewed (INFO-H2).
- Student responses focus on components of the dairy food system and describe their function in producing dairy foods (ETS2.B-H1)(SYS-H1).
- The inputs, outputs, and boundaries of the component of the dairy system are defined (SYS-H2).

Assessment Rubric:

	Emerging	Developing	Proficient
Sample Student Response	My component of the dairy system produces milk. It uses a machine to do so.	<p>Inputs:</p> <ul style="list-style-type: none"> • Machinery is used to milk the cows. • Cattle are milked 2-3 times per day. • Humans help milk the cows. <p>Outputs:</p> <ul style="list-style-type: none"> • Milk is produced. 	<p>Inputs</p> <ul style="list-style-type: none"> • Machinery: Large machines are used to milk cows. Some are automatic. Some are carousels. Milking units have rubber that attaches to the cow's udder and vacuums milk out. • Humans: Look for concerns as cows are milked. Some dairies manually put on and take off milking units. Sanitize the udder before milking. • Cattle: Cows must be milked 2/3 times a day because of the amount of milk they produce. It takes 5-7 minutes to milk each cow. <p>Outputs</p> <ul style="list-style-type: none"> • Milk is vacuumed out of cattle using milking units before it moves to steel pipes to be chilled. <p>Boundaries</p> <ul style="list-style-type: none"> • This component starts when cattle get milked and ends when the milk is put into tanks. Factors that are outside of the boundaries include what happens to the milk after extraction, what happens before cows start producing milk, and where the machines used to milk cows are from.
How to Achieve This Level	Student completes 0 out of 3 Look Fors	Student completes 1-2 out of 3 Look Fors	Student completes 3 out of 3 Look Fors

To Provide Additional Support for Students: If students are struggling to determine the inputs, outputs, and boundaries of their assigned components of the system, have them revisit the definitions they created earlier. Consider providing the following prompts:

- How did you synthesize information from multiple sources?
- How do you determine what information is an input?
- How do you know what information is an output?
- What is the purpose of this part of the dairy system?
- What do you think interacts with this part of the system?
- What is outside of the boundaries of this part of the system?

CCSS SUPPORT

WHST 9-10.9: Draw evidence from informational texts to support analysis, reflection, and research.

As students engage with the component cards, they should gather evidence to demonstrate their understanding of the dairy system inputs, outputs, and boundaries. Using the information presented in the text, students can develop an understanding of the system as a whole vs. individual aspects of the system. Engaging in this standard will support students in making sense of the Module Question: *“How does the dairy system produce dairy products and get them to our table?”*

After students have analyzed their component of the dairy system, ask them to reflect on why thinking about the boundaries of the component helped them understand what we are focusing on and not focusing on in this analysis of the system. Use a Think-Pair-Share routine for students to share their responses. Listen for student responses that indicate:

- Many things contribute to the system component that we are not focusing on, including entirely different systems (e.g., manufacturing of trucks, machinery) or things that each system component creates and gets discarded (e.g., waste, pollution).



Part 3: Navigate to the Next Lesson

Ask students what they think they can do next to help them progress in figuring out the Module Question: *“How does the dairy system produce dairy products and get them to our table?”*

Listen for student responses that indicate that students are interested in seeing how all the different parts of the dairy system work together to make dairy products and how the whole system impacts the environment. Build off student responses to confirm that students will next assemble a full model of the dairy food production system using the information they gathered in this lesson.