

# TEACHER GUIDE

## ELABORATE LESSON 5



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

### What We Figure Out:

We figure out that each component of the dairy production system has costs, risks, and benefits that are both within the system boundaries and extend beyond the system boundaries. These impacts include economic, social, environmental, and geopolitical impacts, some of which are positive and some of which are negative.

### 3D Learning Objective:

Students **use evidence from scientific literature to revise their dairy system model** to include **economic, social, environmental, and geopolitical costs, risks, and benefits** that **extend beyond the boundaries of the dairy system**.

### Time estimate:

50 minutes

### Materials:

Lesson 5 Student Guide  
Lesson 5 Student Handout Dairy System Module Reading  
Chart Paper (optional)

### Targeted Elements

#### SEP:

#### MOD-H3:

Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.

#### DCI:

#### ETS2.B-H1:

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

#### ESS3.A-H2:

All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs

#### 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.



	<p><b>and risks as well as benefits.</b> New technologies and social regulations can change the balance of these factors.</p>	
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## Directions



### Part 1: Our Motivation

Display the Class Consensus Model from Lesson 4, and ask students to reflect on why they set out to make the models of the dairy system. Listen for student responses such as:

- To figure out how dairy products are made and get to our tables.
- To understand the dairy industry's impact on the environment

Ask students what they think these models show and do not yet show. Listen for student responses such as:

- We have shown how the system produces dairy products but haven't figured out how the system impacts the environment.

Have students review their questions from the Dairy Industry category of the Driving Question Board. Ask students which of these questions correspond to the gaps in the model that we need to figure out more about.

Example student questions or ideas could include:

- How does [component of the system] impact the environment?
- What are the downsides of [component of the system]?

Build off student responses to share that students will now explore the economic, social, environmental, and geopolitical impacts of the dairy system, as well as their costs, risks, and benefits.



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

Students will start by sharing their initial ideas about the benefits and downsides of the dairy production system. Students can draw on the understandings they have built so far in this module, as well as their background knowledge. Students can record these on their Lesson 5 Student Guide Part 2: Summarize Information About Parts of the Dairy System.

**STUDENT SUPPORT**

Depending on students' personal, cultural, or local experience, they may not see a direct impact from the dairy food system. Honor students' personal experiences by encouraging them to see how the dairy food system might provide benefits to other people, cultures, or communities.

Allow students to share their thoughts with a shoulder partner, then come back together as a group to share.

**STUDENT SUPPORT**

Allowing students space to reflect individually and share their thoughts in small groups increases access for all learners who are not comfortable speaking in front of large groups. For their thoughts and opinions to get elevated to large group discussions, you can alter this whole-group share-out by instructing speakers to share what they heard their partners share instead of repeating their own thoughts and questions.

Record student responses on chart paper or the board to refer to throughout the lesson. Build on student responses to share that students will now gather more information on the benefits and downsides of the dairy system to help confirm or refine their initial thinking.

**Part 3: Obtaining Information from Texts**

Students will be reading an adapted scientific text from the Lesson 5 Student Handout Dairy System Module Reading that describes the economic, social, environmental, and geopolitical impacts of the dairy system, as well as their costs, risks, and benefits. Before they begin, aligning with students on what these words mean is important. Follow these steps to define the terms economic, social, environmental, geopolitical, cost, risk, and benefit.

Share the terms with students and allow student groups to choose one of the terms. Each group will complete a Frayer Model to share what they think the definition of the term is. Allow students time to complete the Frayer Model, and then have a reporter for each group share the definition with the class. Agree on the definitions shown below:

- Economic: Transactions of goods, services, and money
- Social: The interactions between people and the organization of society
- Environmental: The impacts on the natural world, including plants, animals, and their habitats
- Geopolitical: The interactions between states, nations, or other groups.

**TEACHER SUPPORT**

These terms will be used throughout the remainder of the unit, especially in module four, when students are figuring out how to design solutions for the downsides of the dairy system. Accordingly, ensure students agree on the definitions here so they are prepared to use them throughout the unit.

Students will next engage in a Jigsaw routine to read one of the six sections of the text and share their findings with their peers. First, have students choose one section to read and annotate the text to determine the costs, risks, and benefits they find. Students will do so in a group that has chosen the same part of the text.

**STUDENT SUPPORT**

If students need additional support reading the passages, ask questions such as:

- What do you think this means?
- Tell me more. What did you see in the reading?
- What benefits are in this part of the text? What costs or risks?
- Why is this part of the reading important?
- What can you infer from this reading?
- What evidence is the text providing?

Then, students can move to Jigsaw groups where each person has one of the six parts of the article. Students will share with their group of six what they found in their portion of the text. As they do so, they will fill out the graphic organizer on the Lesson 5 Student Guide Part 3: Obtaining Information from Texts. Their goal is to summarize the central ideas of the text, including noting the economic, social, environmental, and geopolitical costs, risks, and benefits of the dairy production system.

**TEACHER SUPPORT**

Use a relatable analogy if students need support with understanding cost, risks, and benefits, for example, buying a new video game. When you purchase a video game, there is a cost that you pay for the game, and there is the benefit of having a game to play and share with friends. However, there's also the risk that you spend so much time on the game you forget to do chores or homework, which impacts other areas of your life.

Share with students that they will next use the costs and benefits they found to revise their models of how the dairy system produces products for consumers.



## Part 4: Revise Your Dairy System Model

Students will now use the evidence gathered throughout this lesson to revise the Class Consensus Model from Lesson 4 Part 4: Create a Class Consensus Model to help us better understand our Driving Question: ***“What is the impact of the dairy system on the environment?”***

Prompt students to use their graphic organizer from Lesson 5 Part 3: Obtaining Information from Texts to edit their model. The model must include all of the identified social, economic, environmental, and geopolitical costs and benefits of the system. Costs and risks should be written in red and benefits in green.

Groups can add to their existing models from Lesson 4 or draw a new dairy system model in the Lesson 5 Student Guide Part 4: Revise Your Dairy System Model.

### CCSS SUPPORT

**RST 9-10.4:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics. Students will engage in this standard as they add to and revise their existing lesson models. From the text at the start of the lesson, they will identify new scientific words or ideas that need to be incorporated into their model updates. Students should draw in any new symbols on their model and include vocabulary related to the costs and benefits of the dairy system.

Once they complete their models, students will reflect on the overall tasks the dairy system was designed for and the unintended consequences of the design. Allow students time to reflect on the tasks the dairy system accomplishes and its unintended consequences. Students will focus their reflection on how the system was created to optimize production and what impacts that optimization has on components outside of the system. In their reflection, students should describe why it would be important for us to consider the economic, social, environmental, and geopolitical costs and risks as well as benefits to the model and explain why we need to consider the boundaries of the dairy system. Prior to having students begin, engage in a short discussion about why it is important to identify these costs and benefits and the boundaries of the dairy system. Listen for responses that include:

- We can use these costs and benefits to evaluate the environmental impacts of the dairy industry.
- The system boundaries can help us better understand environmental impacts that extend beyond the design of the system itself.

### CCC SUPPORT

**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.**

Here, students engage in both of these CCC elements by considering the task the dairy system was designed for and then considering how a model of the dairy system can help reveal what impacts it is having on the external environment that were not considered in its intended design.

Assist students in completing this reflection using Lesson 5 Student Guide Part 5: Revise Your Dairy System Model.

### FORMATIVE ASSESSMENT OPPORTUNITY

Students use evidence from scientific literature to revise their dairy system model to include economic, social, environmental, and geopolitical costs, risks, and benefits that extend beyond the boundaries of the dairy system.

#### Assessment Artifacts:

- Students' revised dairy system models (Lesson 5 Student Guide Part 4 Revise Your Dairy System Model).
- Students' reflection on their models and what they show about the dairy system' impact on the environment (Lesson 5 Student Guide Part 4 Revise Your Dairy System Model).

#### Look Fors:

- Students include inputs, outputs, and boundaries in their models. (MOD-H3) (SYS-H2)
- Students include the costs, risks, and benefits that are associated with social, economic, environmental, and geopolitical systems. (MOD-H3) (ESS3.A-H2)
- Models show the dairy technological system and how it influences humans and modern civilization. (MOD-H3) (ETS2.B-H1)

#### Assessment Rubric:

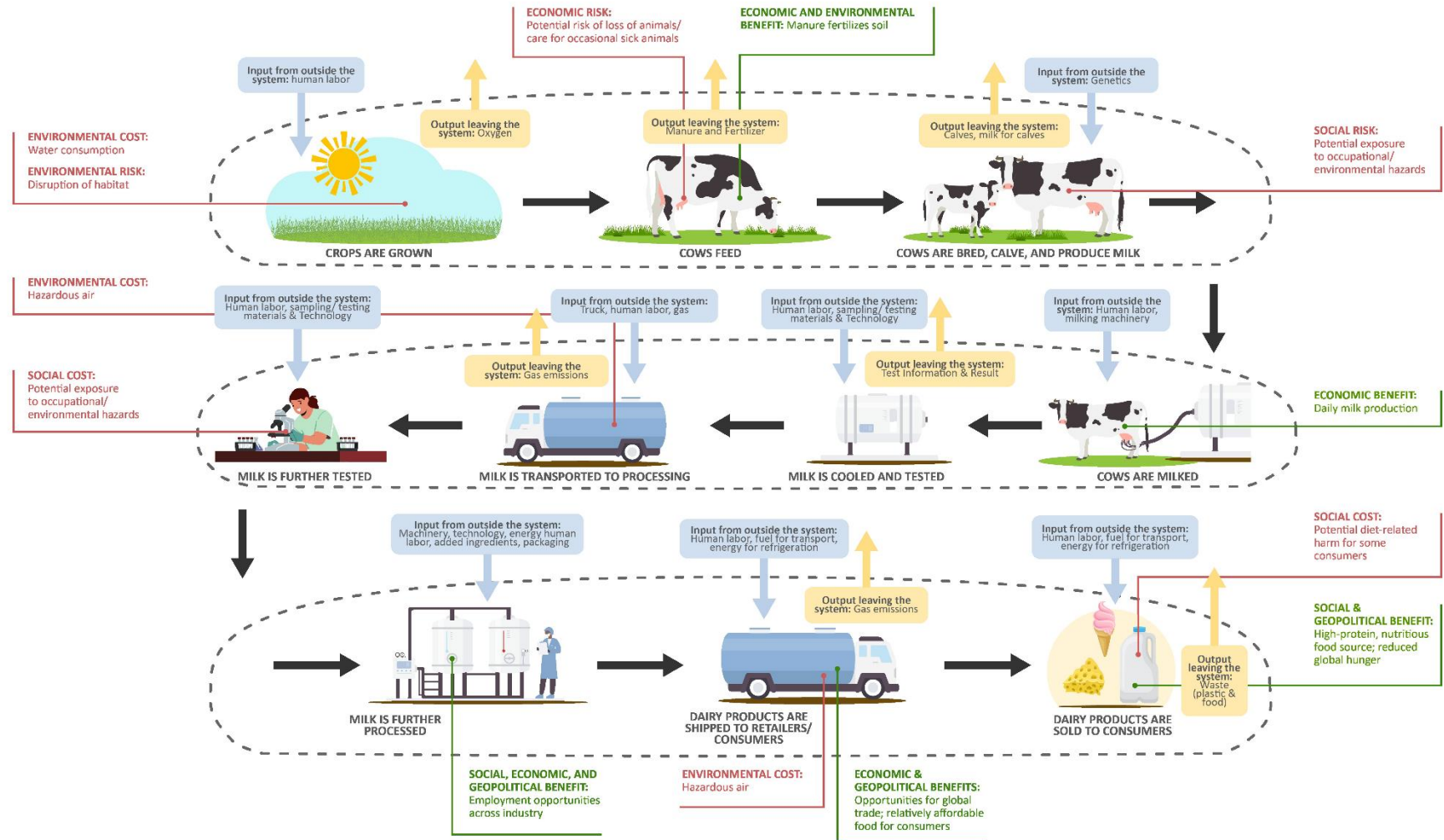
	Emerging	Developing	Proficient
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<b>Sample Student Response</b>	Any student artifact describes a cost, risk, or benefit of a component of the dairy system.	<p>Student model includes:</p> <ul style="list-style-type: none"> <li>Some components of the model are labeled with costs, risks, or benefits.</li> <li>Some costs, risks, and benefits are labeled as social, economic, environmental, or geopolitical.</li> </ul> <p>Student reflection describes:</p> <ul style="list-style-type: none"> <li>How one or more components of the dairy system impact the environment.</li> </ul>	<p>Student model includes:</p> <ul style="list-style-type: none"> <li>At least one label of a cost, risk, or benefit for each component of the model.</li> <li>Each cost, risk, and benefit is labeled as social, economic, environmental, or geopolitical.</li> </ul> <p>Student reflection describes:</p> <ul style="list-style-type: none"> <li>How one or more components of the dairy system impact the environment.</li> <li>How showing the system boundaries can help understand the unintended consequences of the design of the system on people and on the environment.</li> </ul>
<b>How to Achieve This Level</b>	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 with identifying the costs, benefits, or risks of each part of the system, consider:

- Ask questions such as:
  - What new ideas did you find in the text about how the dairy process impacts people?
  - How do the different parts of your model impact people?
  - Why is it important for people to understand the costs, risks, and benefits of a designed system?
  - How is your model communicating the costs, risks, and benefits of this designed system?
- Asking students to return to the text and focus their attention on factors they may have missed. Then ask students to incorporate that factor into their model.

### Example Student Model and Reflection



The dairy system was created because humans needed to get milk, and they couldn't do it like they previously did when many people owned cows. Now, the system is set up so, if they want, everyone can easily and reliably get dairy products at school, restaurants, or stores. Unfortunately, I see that this system has bigger impacts outside of the system. There are economic, social, and environmental risks and not just benefits. For example, transportation is required for milk to travel from farm to processing and then to customers. This releases a lot of greenhouse gases into the atmosphere. This doesn't just



impact the system; it impacts the health of people, animals, plants, and the earth as a whole. It is important to consider the impacts that extend beyond the boundaries of the system to identify ways that it can be improved. The changes that have a direct impact on the system we are analyzing could be implemented first to make a big impact.



### Part 5: Navigate to the Next Lesson

Ask students to recall the media claims about the environmental impacts of the dairy industry that they started evaluating at the beginning of the unit. Ask students if they think they have gathered enough new information to evaluate these media claims in a new way. Listen for student responses that indicate that students can think differently about the claims and would like to return to their evaluation of these claims. Build off student responses to share that students will do so in the next lesson.

#### USE OF PHENOMENA

In the next lesson, students will shift their focus from the Module Phenomenon, how dairy products get to our tables, and return to focusing on the Anchor Phenomenon: evaluating the impact of the dairy production system on the environment.