STUDENT GUIDE
EXPLAIN LESSON 4

Food and Agriculture Center for Science Education

Part 1: Our Motivation

Record what we are now trying to explain about the module phenomenon.

- We have made models of the dairy system, but what parts are we missing?
- I think we need to know more about the order of the steps in the dairy system
- What steps are we missing?

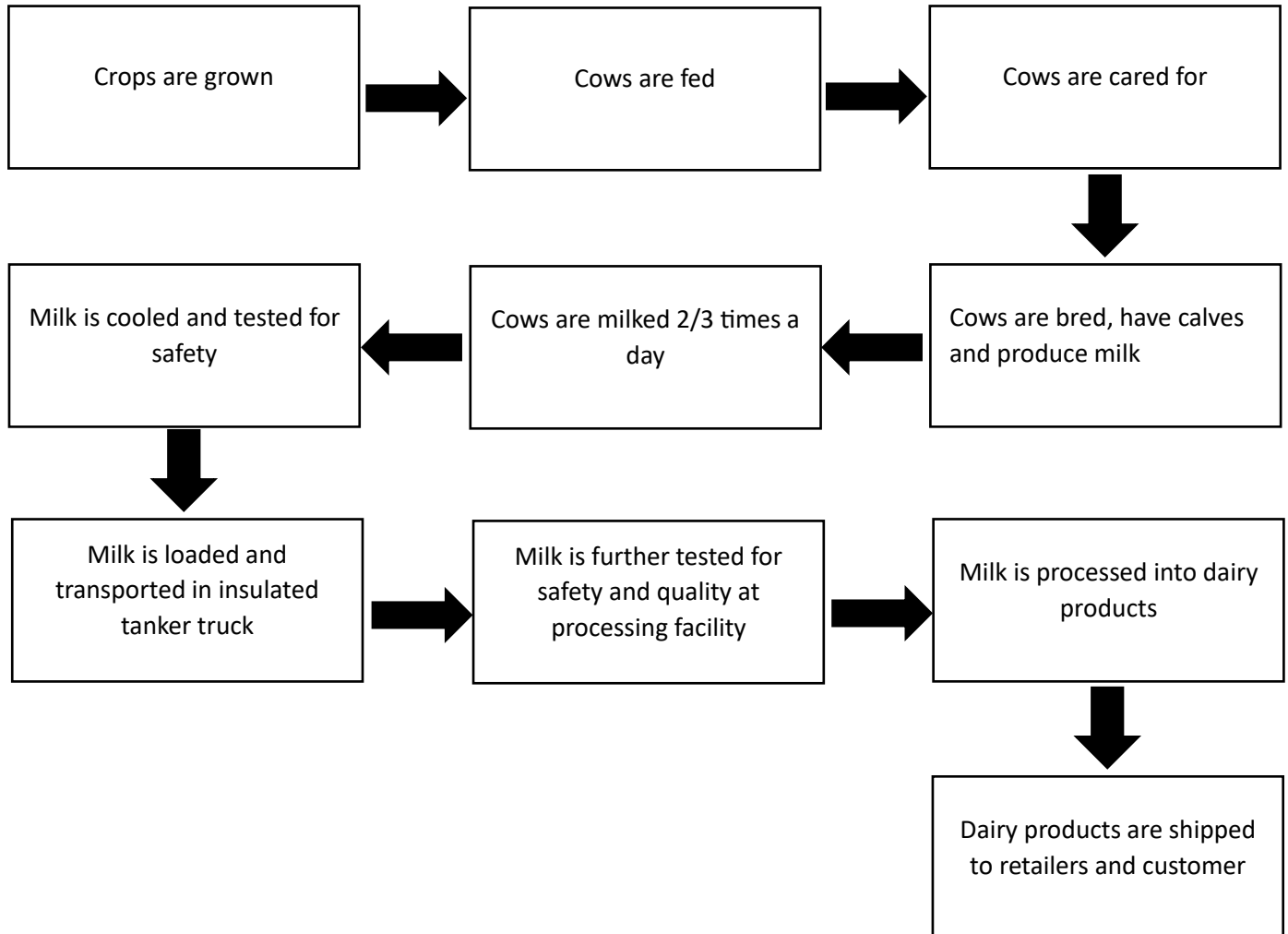### Part 2: Review Initial Dairy System Model

Review our Class Consensus Model of how dairy products get to your table. Identify specific components of your model that you think are supported by the evidence we have gathered or that you think we should revise.

Components of the model I support	Components of the model I would like to revise
Some parts of my model align with the new information we learned. I have the step about cows feeding and being milked. I think I accurately showed the last two steps (transportation to the products we have on our shelves).	I am missing steps about how the milking process happens and steps related to processing and testing of milk. I am also missing the stores/restaurants/schools that we get the products from.

👓 Part 3: Sequencing the Dairy System Components

With your group, take the dairy system cards you received and work together to arrange them in the order that you think represents the sequence of steps involved in creating a dairy product and transporting it to the consumer, then copy your answers below.

Crops are grown	Cows are fed	Cows are cared for

Milk is cooled and tested for safety	Cows are milked 2/3 times a day	Cows are bred, have calves and produce milk

Milk is loaded and transported in insulated tanker truck	Milk is further tested for safety and quality at processing facility	Milk is processed into dairy products

Dairy products are shipped to retailers and customer

| ⚛ | **Part 4: Create a Class Consensus Model** |

Use this space to copy the Class Consensus Model built by the class.

In your model, be sure to:
- Add additional steps of the dairy product journey into your model.
- Add inputs and outputs based on the information cards you have studied.
- Define the boundaries of the overall system, including examples of other components or systems outside the boundaries.
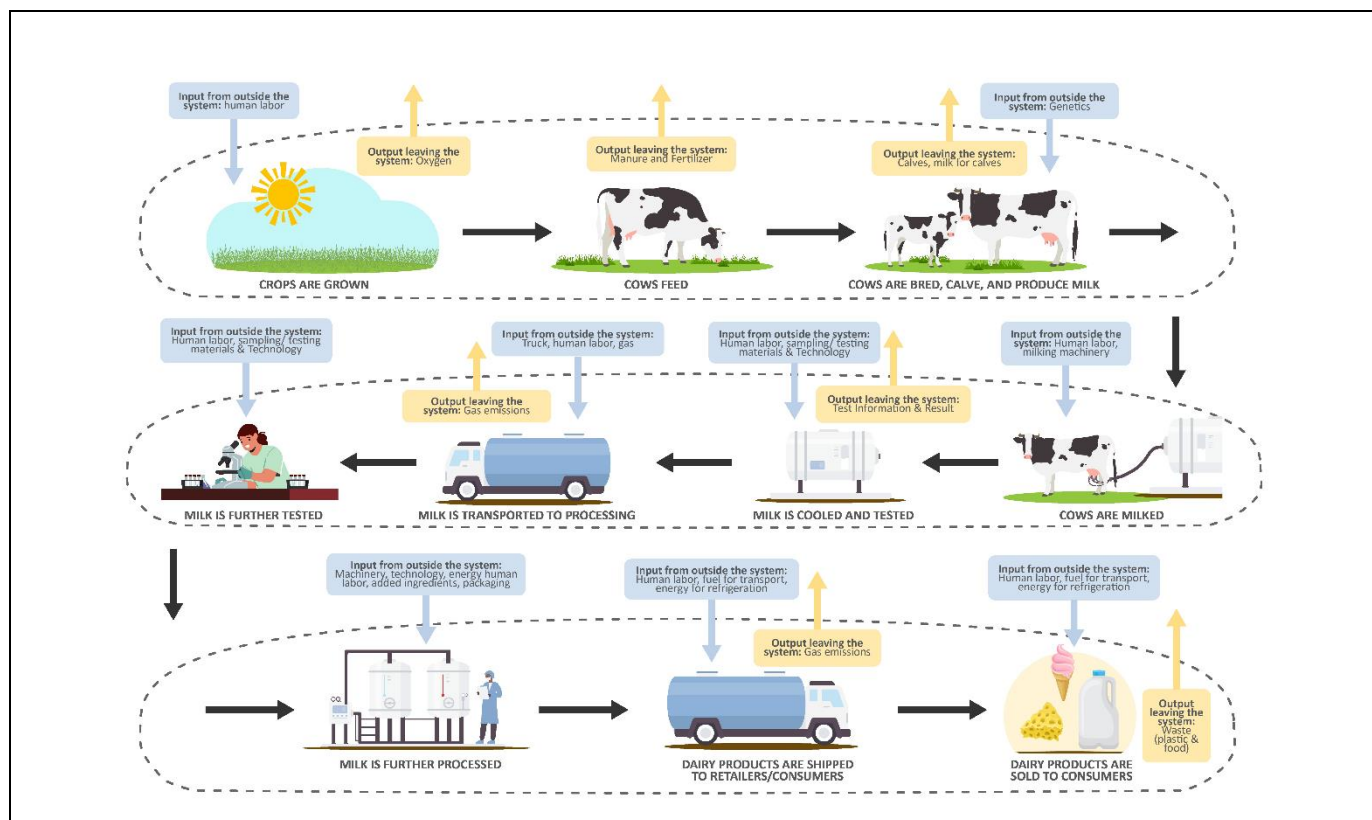
Reflect on the overall model of the dairy system.
- What do you think the model shows is the end goal of the design of the system?
- How do the system boundaries you made help you understand how parts of the system interact with things outside of the system?

The system was designed to produce dairy products efficiently for consumers. The boundaries help us define what is included in our system and what is not. We can use these boundaries to determine what components of the system are directly involved in the production of dairy products. The boundaries can also help us see that the system produces some impacts that extend to other systems or objects outside of the boundaries of the system.

⚛ Part 5: Construct an Explanation About a Dairy Product Journey

Select one dairy product that you like or know about and construct a detailed explanation of how this product gets to your table. In your explanation, be sure to:

- Describe each of the components of the dairy system and how they contribute to making a dairy product.
- Identify the inputs and outputs associated with each component of the process.
- The boundaries of the system, including what interacting systems, objects, impacts, or processes are outside the dairy system.
- The purpose of the dairy system and how the design of the system influences its purpose.

Dairy systems have been designed to produce large quantities of dairy to be widely distributed to people who cannot produce their own milk. Society as a whole depends on these systems so they can get dairy products to their table. Certain parts of the system are outside of the boundaries related to how my yogurt gets to my house for breakfast. They are still important overall, but I want to focus on what is more directly influenced by the system. Time, energy used to run machines, and manufacturing and production of machinery, are outside of the boundaries of this explanation. To get the yogurt I eat every morning requires a lot of parts of the system. It all begins with farmers growing crops to feed cows. This requires plants, probably water, and time to create the crops needed. The farmers must harvest those crops and transport them to the dairy farms. Next, the cows eat. They produce poop in this step. Female cows are bred and have calves before they can produce milk. Once they have their calves they are milked 2-3 times a day. Milking takes lots of technology and labor from workers running the milking machines. Once milk is collected, it is put into a large cooling tank on the farm. An insulated tanker truck comes to the farm to get the milk. The milk is tested before it is put in the tanker truck. If the milk has contaminants, it is discarded. If the milk is good, it is transported in the truck. This truck uses a driver and fuel to get to the processing plant. The milk is tested again by a worker before it is allowed in the processing facility. Then it goes through multiple processes to make it into the milk we have at home. The processes take larger equipment that can heat, cool, and bottle the milk. Fluid milk is either sent off to retailers or consumers or is sent for further processing to make my daily yogurt. Once the yogurt is processed, it is put onto another truck to be taken to grocery stores, restaurants, and schools. That is how I end up with the yogurt I eat each morning.

❓ Part 6: Asking New Questions

Record new questions you have that might help you:

- Find additional information about how the dairy system impacts the environment.
- "Fill in a gap" in your model or our class model.
- Settle an area of disagreement that we've identified in our models.

- I wonder if we have accurately captured all the inputs and outputs of the system.
- I wonder how the parts of the system can impact the environment outside the boundaries of the system.
- I wonder what the environmental impacts are of the system overall.