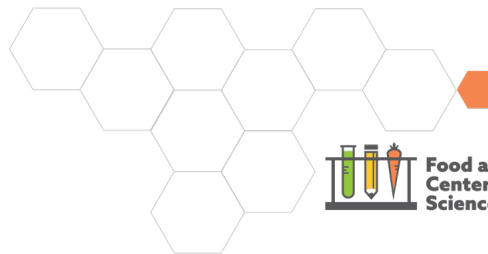


STUDENT GUIDE

EVALUATE LESSON 25



Food and Agriculture
Center for
Science Education



Part 1: Our Motivation

Record the next steps you want to take in the engineering design process.

I would like to communicate my design to relevant stakeholders who are involved with this problem and/or with the dairy system.



Part 2: Revising Solutions Presentations

Review the feedback provided by your peers and implement any suggestions you choose into your solution presentation.

Problem: Fertilizers pollute nearby waterways

Potential Solution: Building farms closer to consumers and incorporating rotational grazing practices on pastures

This solution reduces the amount of synthetic fertilizer required for crops which means less fertilizer will pollute nearby waterways. This solution also increases soil fertility.



Changing farming practices to incorporate grazing cattle can somewhat negate the biodiversity impacts of growing monoculture crops; we learned this during Biodiversity and Other Environmental Impacts Module. It can sequester carbon in the soil, which eliminates it from the atmosphere. This information comes from our Greenhouse Effect and Carbon Cycling Module that shows how carbon cycles between the dairy food system and the atmosphere.



The potential downsides of the solution include:

- Requires farmers to grow specific crops that sequester nitrogen into the soil like soybeans or alfalfa
- Higher initial costs for some of these nitrogen fixing plants.
- Tradeoffs for other desirable plant traits such as drought tolerance or yield.
- Need more space to graze cattle
- More labor is needed to move cattle from pasture to pasture



How the Solution Maintains System Benefits

- Cattle that graze on grass from rotational grazing can still produce milk for consumers.
- Farms closer to consumers can get dairy products to local consumers faster.

How the Solution Improves on System Costs and Risks

- Pastures require less fertilizer because cattle manure is dropped on the pasture as cattle graze, which can enhance soil fertility
- This will also reduce the amount of synthetic fertilizer that is used which could reduce fertilizer pollution in waterways
- Perennial grass growth sequesters more carbon in the soil root system than do annual plants like corn.
- Less transportation distance means less greenhouse gases like carbon dioxide added to the atmosphere due to transit.

Solution Benefits	Explanation
Environmental	Requires less synthetic inputs, reduces runoff, sequesters carbon and nitrogen
Economic	More jobs for farmers to manage cattle, more jobs on more local farms
Social & Ethical	More people to connect with local farmers if they are closer to where the food is consumed
Scientific	Meets standards in the industry, fits what we know about the greenhouse effect





Part 3: Local Stakeholder Presentation

Record the stakeholders that you choose to present to in the space below.

I shared this Solutions Presentation with a local Dairy Farmer.

Present your solution to your chosen stakeholders and observe the presentations of your peers. Record a summary of the problems and solutions presented by each group.

Group	Summary of Problem	Summary of Solution
1	The problem identified is that CH ₄ is produced by dairy animals.	The solution proposed is to selectively breed cattle for traits that reduce the amount of CH ₄ produced by the animal. This solution would require careful trait selection and breeding considerations. It changes the system because there would be less CH ₄ production which means the impact of the system as a whole is reduced.
2	The problem identified is that fertilizer runoff is polluting nearby waterways.	The solution proposed is to use plants that require less fertilizer to reduce the amount of synthetic fertilizer used on crops. This solution would presume that farmers would be willing to grow specific crops that sequester nitrogen into the soil, like soybeans or alfalfa.
3	Additional responses will vary	Additional responses will vary
4	Additional responses will vary	Additional responses will vary
5	Additional responses will vary	Additional responses will vary
6	Additional responses will vary	Additional responses will vary



Part 4: Reflections

After each group has shared their presentation, choose a presentation group you want to share a reflection with. Prepare a short, 2- to 3-minute video or written note addressing the following:

- Give a shout-out to something you think your peers did well in their presentations.
- Describe why this presentation resonated with you or changed your thinking.

*Reflections will vary.