Beef Barriers

Middle School, Life Sciences

Task Overview

In this task, students will evaluate existing beef cattle production / industry practices and determine their impacts on water quality and biodiversity. Using scientific evidence for support, students will identify a potential solution that could improve key biodiversity variables among water ecosystems.

Students will evaluate data regarding harmful algal blooms in NY waterways and determine that livestock allowed to drink directly from waterways can have a negative impact on water quality. For this reason, physical barriers are often observed on cattle farms. Through their work, students will be able to identify the characteristics of healthy and unhealthy water ecosystems. Next, students will evaluate 4 common conservation management practices - managing beef lifecycle, filter strips / forested buffers, managing grazing, and fenced farm dams. After learning about these practices, students identify the solution that most improves water quality of NY water ecosystems.

Background Information

There are a variety of solutions being implemented by beef cattle production that include industry practices aimed toward improvement of the causes of pollution in NY water ecosystems. Scientific evidence shows that best practices include any of the following solutions to mitigate the effects of pollution due to production. Each has a unique impact on the biodiversity of a water ecosystem. Using cover crops helps soil hold onto nutrients so they are not released into the ecosystem. Managing the life cycle of beef cattle and grazing practices by using a feedlot for a portion of cattle's life cycle and reducing overgrazing helps maintain the local ecosystem. Buffers or filter strips can be used to help trap nutrients that would otherwise end up in the local water ecosystem. Fencing is a physical barrier that keeps water sources clean by blocking livestock access.

Note:
There are many solutions, but the background information is limited to those discussed in this transfer task.

Next Generation Science Standards

Three-Dimensional Claim

Students will identify potential causes of pollution among NY water ecosystems of existing beef cattle production / industry practices and their effects on water quality and biodiversity to explain a solution (or combinations of solutions) that could lead to improvement in key variables by using scientific evidence to support their explanation.

This task is intended to elicit student learning of the following **NGSS elements** for each of the three dimensions:

Disciplinary Core Ideas

LS2.D: Social Interactions and Group Behavior (MS)

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on – for example, water purification and recycling (secondary to MS-LS2-5)

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

ETS1.B: Developing Possible Solutions (MS)

- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors (MS-ETS1-3)

Science and Engineering Practices

Constructing Explanations and Designing Solutions (MS)

- Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.
- Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.

Crosscutting Concepts

Patterns (MS)

- Patterns can be used to identify cause and effect relationships.
- Graphs, charts, and images can be used to identify patterns in data.

Suggestions for Use

This task is intended to be used for formative assessment purposes - to identify students' strengths and needs with the above dimensions to provide feedback to students and guide shifts in instruction.

Assumptions

Students should have engaged with instructional experiences that ask them to read and analyze information from graphs and data tables to evaluate potential pros and cons of possible solutions to environmental concerns. Students should also understand the role that humans play in maintaining biodiversity of ecosystems and that responsible management of natural resources is a necessity for sustainability.

Materials Needed

- Beef Barriers Student Task
- Pencil and/or pen
- Prompt 3, Table 2 enlarged images (1 set per group)

Assessment Guidance

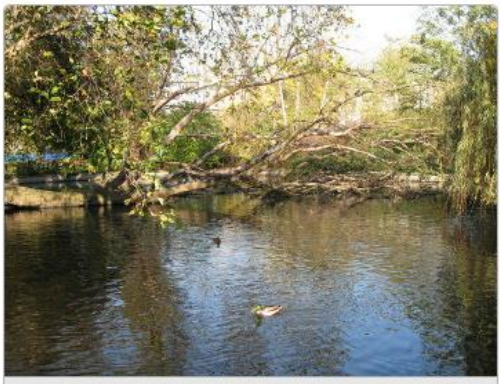
Introduction:

Historically on livestock farms, such as beef cattle farms, animals were given access to open water sources. A concern that farmers have is the management of nutrients and manure that are applied to crops or created by livestock and the ways in which these might affect the ecosystem at and near their farm. As manure is produced by cattle in an area, there is the potential for algae to develop in a water source. When large amounts of algae appearing rapidly together in a group, it is known as an algal bloom. While there are many natural causes, runoff from farms and other sources can

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

cause algae issues in local waterways as fertilizers spread on field crops can be washed away by rain and irrigation.

Algal blooms can have short- or long-lasting impacts on water ecosystems. Figure 1 below shows Brookmill Park Lake in Britain. Over 11 months, the lake experienced an explosive growth of algae.



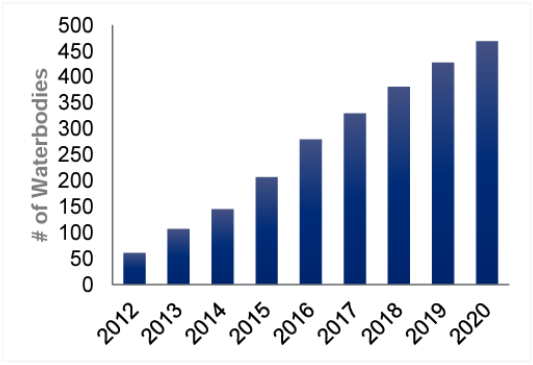
Brookmill Park Lake, Britain, when there was no algal problem.
Sources/Usage: Public Domain.
Credit: Mike Quinn via Geograph U.K.

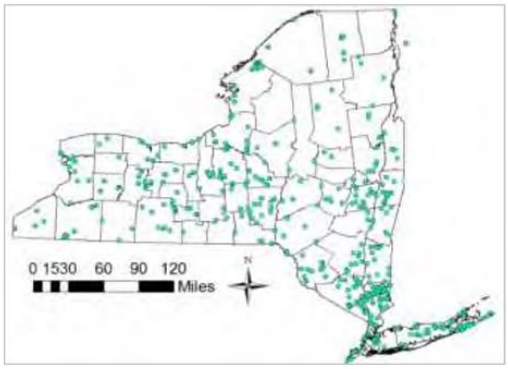
Brookmill Park Lake, Britain, when there was a severe algal problem.
Sources/Usage: Public Domain.
Credit: Mike Quinn via Geograph U.K.

Figure 1. Brookmill Park Lake[1]

Prompt 1:

There are similar environmental issues in waterways throughout New York. Graph 1 below shows the number of waterbodies affected by harmful algal blooms (HABs) from 2012-2020.





Graph 1. (at left) Cumulative number of waterbodies in NYS with documented HABs
Graph 2. (at right) Cumulative map of locations of waterbodies in NYS with documented HABs, 2012-2020
From: https://www.dec.ny.gov/docs/water_pdf/researchguide.pdf

[1] From: Water Q&A, Lab Exchange
https://www.labxchange.org/library/pathway/lx-pathway:69980a09-42bf-418d-9679-f8756f2bcc6a/items/lx-pb:69980a09-42bf-418d-9679-f8756f2bcc6a:html:7bcac1df

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

Q1.
Using Graph 1 from above, describe how waterbodies in New York have been impacted by algae since 2012.

Q2.
Using Graph 2 from above, describe any observations you notice about the locations of algal blooms in waterbodies in New York.

Algal blooms can be a problem on beef cattle farms and the open water that livestock drink from, which can have a negative impact on many connected waterways. For this reason, many beef cattle farms have fencing around open water sources. When a physical fence is not possible, farmers will often block access to water for their livestock with a barrier, grass buffer, or line of trees. Examples are shown in Figures 2 and 3.

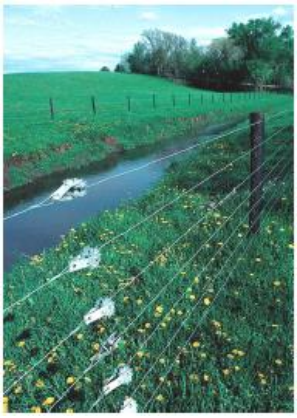


Figure 2. (at left) Fencing around stream. (Photo courtesy of USDA NRCS)
Figure 3. (at right) Trees lining a farm stream
From: https://www.morningagclips.com/wp-content/uploads/2019/04/28774453358_37389bee19_z.jpg

Sources of water that do not have fencing and allow beef cattle free access to the water can easily develop algae, shown below in Figure 4.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

Figure 4. Algae covered farm pond.

Q3. In what ways might a physical barrier help to prevent algal blooms in water sources on beef cattle farms?

Beef cattle farmers can help to improve water quality in their communities by managing their farms effectively.

Watch the video, Water Supply for Over 9 Million - YouTube[2].

Q4. Why is it important for beef cattle farmers to help protect the quality of the water supply?

Prompt 1 Performance Outcome:
Evaluate sources of information to determine the causes of pollution that threaten biodiversity of natural resources.

SEP	• evaluate sources of information to determine
DCI	• of pollution that threaten biodiversity of natural resources
CCC	• the causes

[2] Video Link: https://www.youtube.com/embed/HSoHkG7bbJE?feature=oembed

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

Prompt 1 Rubric			
	Emerging	Developing	Proficient
Sample Student Response	Q1. Harmful algal blooms have increased. OR Harmful algal blooms have decreased. Q2. There are harmful algal blooms occurring in most parts of the state. OR Harmful algal blooms are not happening in NY. Q3. A physical barrier will not prevent harmful materials from getting into the water source. Q4. Beef cattle farmers need to protect the quality of the water supply.	Q1. Graph 1 shows that harmful algal blooms have reached 500 since 2012. Q2. Graph 2 shows that there are harmful algal blooms occurring in most parts of the state. Q3. A physical barrier might prevent harmful materials from getting into the water source. Q4. After watching the video, beef cattle farmers need to protect the quality of the water supply so that it doesn't impact others negatively. By improving water quality, they produce a better product and prevent harmful pollutants from getting into the water ecosystem.	Q1. Graph 1 shows that in 2012 there were 50 harmful algal blooms. By 2020, this number reached 500. This data shows that harmful algal blooms are significantly increasing. Q2. Graph 2 shows that there are harmful algal blooms occurring in most parts of the state. The southern area of New York, near New York City and Long Island appear to have the greatest concentration of harmful algal blooms in their waterbodies. Q3. A physical barrier might prevent harmful materials from getting into the water source. Beef cattle cannot access it to make it dirty or contaminate it in any way. Q4. After watching the video, beef cattle farmers need to protect the quality of the water supply so that it doesn't impact others negatively. By improving water quality, they produce a better product and prevent harmful pollutants from getting into the water ecosystem and traveling to other locations in the water.
Look-Fors	• Students do not identify the source they obtained their evidence from. • Students do not use numerical evidence to demonstrate	• Students may or may not identify the source they obtained their evidence from. • Students will use numerical evidence to demonstrate	• Students will identify the source they obtained their evidence from. • Students will use numerical evidence to demonstrate scientific understandings.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

	scientific understandings OR when it is used it is incorrect. ● Students fail to make connections of multiple lines of evidence regarding patterns and causes of negative impacts to quality of water ecosystems. ● Students may or may not demonstrate that humans contribute to water quality and biodiversity. ● Student understanding of movement of water in an ecosystem is incredibly limited or not clearly expressed.	scientific understandings, but it may be incomplete or unclear. ● Students will make connections of multiple lines of evidence regarding patterns and causes of negative impacts to quality of water ecosystems, but the depth to which they explain is limited. ● Students may or may not demonstrate that humans contribute to water quality and biodiversity in locations near and far. ○ Water travels to other locations and so do the pollutants.	● Students will make strong connections of multiple lines of evidence regarding patterns and causes of negative impacts to quality of water ecosystems. ● Students should demonstrate that humans contribute to water quality and biodiversity in locations near and far. ○ Water travels to other locations and so do the pollutants.

Prompt 2A:

Before we explore what beef cattle farmers do on their land, we need to understand why clean water is important. Use Figure 5 to answer the questions that follow.

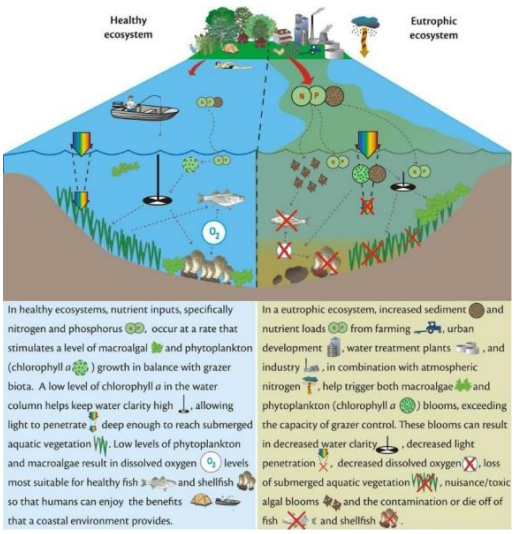


Figure 5. Conceptual diagram comparing a balanced ecosystem with one receiving excess nutrients.
From: Phosphorous in aquatic ecosystems, Chapter 1[3]

[3] https://www.canada.ca/en/environment-climate-change/services/freshwater-quality-monitoring/publications/phosphorus-aquatic-ecosystems/chapter-1.html

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

Q5.
What are some visible indicators of a healthy water ecosystem?

Q6.
A eutrophic water ecosystem is unhealthy. What makes a water ecosystem unhealthy?

Q7.
How can beef cattle farming impact the health of a water ecosystem?

Prompt 2B:

High amounts of nutrients like nitrogen, phosphorous, and potassium can cause algal bloom in a water ecosystem[4]. In Data Set 1, shown below, are the results of an experiment that a student did comparing different amounts of fertilizer and seeing how much algae grew over 4 days.

Average Algae Growth Counts			
Day	Control	Low Amount of Fertilizer	High Amount of Fertilizer
1	1.3	4	4
2	3.3	5.6	6.6
3	5	15	18.7
4	8.7	16	24.3

Data Set 1. Average Algae Growth Compared to Amount of Fertilizer[5]
Adapted from:
Water Quality Ag in the Classroom Activity 1
Miller & Levine Biology: The Effect of Fertilizer on Algae Inquiry Lab

[4] https://newyork.agclassroom.org/matrix/lesson/802/

[5] https://assets.savvas.com/asset_mgr/current/202131/LabSamp_MLBio.pdf

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

Observations from experiment:
After 4 days, the test tube that had the high amount of fertilizer was the darkest shade of green.

Q8. Using evidence from the experiment, explain the impact of nutrients on the growth of algae.

Extension idea: Create a graph of the data as Q7, then explain impact in Q8

Figure 6 below shows how nutrients are related to beef cattle.

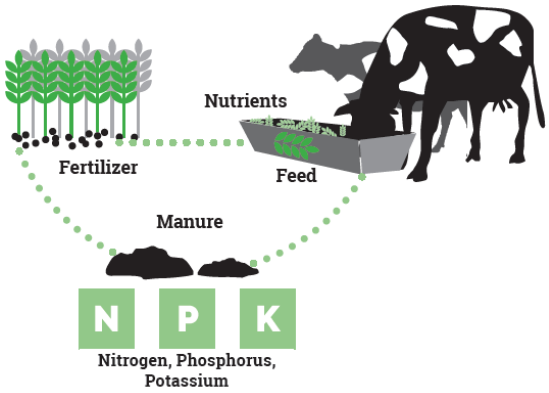


Figure 6. Manure nutrients[6]

Q9. What is the connection of beef cattle to algae growth in open water sources on farms?

Prompt 2 Performance Outcome: Evaluate sources of information to determine the causes of pollution that threaten biodiversity of natural resources using data to determine patterns that exist within ecosystems.	
SEP	• Evaluate sources of information to determine

[6] From: Michigan EnviroImpact Tool
https://lpelc.org/the-michigan-enviroimpact-tool-a-supporting-tool-to-help-farmers-in-forecasting-manure-nutrient-runoff-risk/

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

DCI	• of pollution that threaten biodiversity of natural resources • within ecosystems
CCC	• the causes • using data to determine patterns that exist

Prompt 2 Rubric			
	Emerging	Developing	Proficient
Sample Student Response	Q5. A healthy water ecosystem has a balance of nitrogen and phosphorous, high light penetration into the water, lower levels of algae and Chlorophyll a, dissolved oxygen to support fish, shellfish, and aquatic vegetation. BUT Most elements of the response are missing. Q6. An unhealthy water ecosystem has high levels of sediment and algal blooms, high levels of Chlorophyll a, nitrogen and phosphorus, low light penetration into the water, and less dissolved oxygen to support fish, shellfish, and aquatic vegetation. BUT Some elements of the response are missing. Q7. Farming practices do not contribute to an unhealthy balance of nutrients in a water ecosystem. Q8. When there is more fertilizer present in water, it contributes to higher growth of algae over time. OR Fertilizer does not contribute to	Q5. According to Figure 5, a healthy water ecosystem has a balance of nitrogen and phosphorous, high light penetration into the water, lower levels of algae and Chlorophyll a, dissolved oxygen to support fish, shellfish, and aquatic vegetation. BUT Some elements of the response are missing. Q6. According to Figure 5, an unhealthy water ecosystem has high levels of sediment and algal blooms, high levels of Chlorophyll a, nitrogen and phosphorus, low light penetration into the water, and less dissolved oxygen to support fish, shellfish, and aquatic vegetation. BUT Some elements of the response are missing. Q7. According to Figure 5, farming practices can contribute to an unhealthy balance of nutrients in a water ecosystem, having negative impacts on biodiversity. Q8. According to Data Set 1, when there is more fertilizer present in water, it	Q5. According to Figure 5, a healthy water ecosystem has a balance of nitrogen and phosphorous, high light penetration into the water, lower levels of algae and Chlorophyll a, dissolved oxygen to support fish, shellfish, and aquatic vegetation. All of these are key factors that support ecosystem biodiversity. Q6. According to Figure 5, an unhealthy water ecosystem has high levels of sediment and algal blooms, high levels of Chlorophyll a, nitrogen and phosphorus, low light penetration into the water, and less dissolved oxygen to support fish, shellfish, and aquatic vegetation. All of these are key factors that support ecosystem biodiversity and lead to unhealthy environments when they are out of balance. Q7. According to Figure 5, farming practices can contribute to an unhealthy balance of nutrients in a water ecosystem, having negative impacts on the key factors of healthy biodiversity of the ecosystem. Q8. According to Data Set 1, when there

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

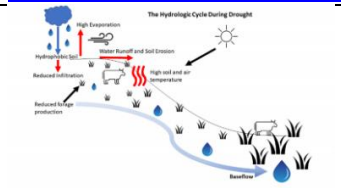
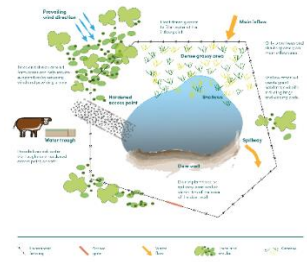
	algae growth over time. Q9. Cattle manure contains nitrogen, phosphorous, and potassium. BUT some elements are missing. OR Cattle manure does not have harmful effects for the ecosystem.	contributes to higher growth of algae over time. From day 1 to day 4, the growth of algae in the high fertilizer system went from 4 - 24.3. Q9. According to Figure 6, cattle manure contains nitrogen, phosphorous, and potassium. Manure can also be absorbed into the groundwater, causing potentially harmful effects for the ecosystem.	is more fertilizer present in water, it contributes to higher growth of algae over time. From day 1 to day 4, the growth of algae in the low fertilizer system went from 4 – 16. From day 1 to day 4, the growth of algae in the high fertilizer system went from 4 - 24.3. It was reported it was also the darkest shade of green. Q9. According to Figure 6, cattle manure contains nitrogen, phosphorous, and potassium. Manure can be used as fertilizer to make plants grow, but it can also be absorbed into the groundwater, causing potentially harmful effects for the ecosystem and biodiversity.
Look-Fors	• Students do not identify the source they obtained their evidence from. • Students do not use numerical evidence to demonstrate scientific understandings OR when it is used it is incorrect. • Students fail to make connections of multiple lines of evidence regarding patterns and causes of negative impacts to quality of water ecosystems. • Students may or may not demonstrate a clear understanding of the unique factors present in healthy vs. unhealthy water ecosystems. • Students should explain the connection between harmful ecosystem effects and high manure concentrations in groundwater, but there is limited understanding, or it is not clearly expressed.	• Students may or may not identify the source they obtained their evidence from. • Students will use numerical evidence to demonstrate scientific understandings, but it may be incomplete or unclear. • Students will make connections of multiple lines of evidence regarding patterns and causes of negative impacts to quality of water ecosystems, but the depth to which they explain is limited. • Students may or may not demonstrate a clear understanding of the unique factors present in healthy vs. unhealthy water ecosystems. • Students should explain the connection between harmful ecosystem effects and high manure concentrations in groundwater, but the depth to which they explain is limited.	• Students will identify the source they obtained their evidence from. • Students will use numerical evidence to demonstrate scientific understandings. • Students will make strong connections of multiple lines of evidence regarding patterns and causes of negative impacts to quality of water ecosystems. • Students should demonstrate a clear understanding of the unique factors present in healthy vs. unhealthy water ecosystems. • Students should clearly explain the connection between harmful ecosystem effects and high manure concentrations in groundwater.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

Prompt 3:

Solutions that limit the growth of algae in open water sources on the farm can impact the biodiversity of a water ecosystem for any water connected to it. Farmers throughout New York are part of conservation efforts to help make a positive impact. In the Chesapeake Bay region, conservation practices used by farmers in 2011 reduce the total nitrogen to rivers and streams by 44%. Phosphorous entering streams was reduced by 75% (Creech, 2021)[7].

Table 2 below explains some potential solutions that beef cattle farmers are using.

Conservation Practice	**What is it? What does it do?**	**What does it look like?**
Managing the beef lifecycle	Diet grazing in the pasture consists primarily of grass forages and crop residue from grain production. Cattle may spend 4-6 months in a feedlot, where 50-85% of their diet is grain from corn and by-products. This means that it takes less time to get from birth to harvest which decreases their environmental impact	 Image source: https://www.canr.msu.edu/news/2022-msu-feedlot-educational-series
Filter strips or vegetated / forested buffers	Buffers of trees or vegetation can mitigate nutrient pollution; remove sediment, organic matter, and pollutants from runoff and wastewater	 Image source: https://extension.wsu.edu/animalag/content/protecting-the-water-on-your-small-farm/
Managing grazing	Overgrazing can impact soil moisture, temperature, and evaporation rates. When there is little water in the soil, there is less water infiltration. This can lead to surface water runoff and increased soil loss.	 Image source: https://extension.sdstate.edu/impacts-drought-soil-water-forage-and-livestock-grazing-systems
Fenced farm dams	Improves water quality for livestock consumption, provides habitat for wildlife, and secures water during droughts; draws down greenhouse gases to mitigate effects of climate change	 Image source: https://www.sustainablefarms.org.au/news/ben

[7] From: https://www.usda.gov/media/blog/2017/12/13/farmers-keeping-nutrients-field-out-streams

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

		efit-cost-analysis-lends-support-for-improved-farm-dam-management/

Table 2. Beef Cattle Farm Water Quality Solutions

Suggestion to educators: print enlarged versions of the table images for student groups when working on the task.

Q10. Based on the evidence provided, which of the practices listed above has the greatest positive impact on biodiversity and water quality? Explain your answer.

Prompt 3 Performance Outcome: Analyze data from competing design systems to support claims about the effects of natural resource management on sustainable biodiversity.	
SEP	• analyze data from competing design systems
DCI	• of natural resource management on sustainable biodiversity
CCC	• to support claims about the effects

Prompt 3 Rubric			
	Emerging	Developing	Proficient
Sample Student Response	Q10. According to Table 2, ___ practice will have the greatest positive impact on biodiversity and water quality.	Q10. According to Table 2, ___ practice will have the greatest positive impact on biodiversity and water quality. This is because of (data from table 2 and provides justification).	Q10. According to Table 2, ___ practice will have the greatest positive impact on biodiversity and water quality. This is because of (data from table 2 and provides justification).
Look-Fors	• Student responses will need to be evaluated based on their justification and use of evidence. • There is no "right answer" that identifies a specific practice as better than another, as all beef cattle	• Student responses will need to be evaluated based on their justification and use of evidence. • There is no "right answer" that identifies a specific practice as better than another, as all beef cattle	• Student responses will need to be evaluated based on their justification and use of evidence. • There is no "right answer" that identifies a specific practice as better than another, as all beef cattle

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

	production systems have unique requirements. ● Student responses may or may not identify a specific practice (or combination of practices) as a proposed solution. ● Students do not directly connect that this practice / these practices have a positive impact on biodiversity by providing limited or inaccurate evidence. ● Students do not directly connect this practice / these practices to key healthy water quality indicators by providing limited or inaccurate evidence. ● The justification of evidence is minimal, highly inaccurate, or not provided.	production systems have unique requirements. ● Student responses should identify a specific practice (or combination of practices) as a proposed solution. ● Students should connect that this practice / these practices have a positive impact on biodiversity but could elaborate more on specific evidence. ● Students should connect this practice / these practices to key healthy water quality indicators but could elaborate more on specific evidence. ● Student justification of evidence should be specific and complete. The POV of the student demonstrates understanding but is somewhat unclear. OR The justification of evidence is minimally provided.	production systems have unique requirements. ● Student responses should identify a specific practice (or combination of practices) as a proposed solution. ● Students should clearly connect that this practice / these practices have a positive impact on biodiversity. ● Students should clearly connect this practice / these practices to key healthy water quality indicators. ● Student justification of evidence should be specific, complete, and clear. The POV of the student demonstrates accurate understanding.

Prompt 4:

Consider what practices (or combinations of practices) should be implemented to improve water quality among New York water ecosystems.

Q11.

Develop a potential solution by creating a land management plan that is economically sound and considers the environmental impacts of the beef cattle industry.

Your answer should include:

A potential solution

3 pieces of evidence from the task for why this solution is best for biodiversity of the environment and water ecosystems.

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

For additional consideration:
Complete a self-assessment or propose some other type of evaluation in conjunction with a land planning model.

Prompt 4 Performance Outcome: Evaluate competing design system's responsible resource management strategies based on what they effect in the environment.	
SEP	• evaluate competing design system's
DCI	• responsible resource management strategies • in the environment
CCC	• based on what they effect

Prompt 4 Rubric			
	Emerging	Developing	Proficient
Sample Student Response	Q11. The most effective practice(s) are ___. They will have (this specific impact) on biodiversity and water quality. May or may not include justification from 1 or more prompts.	Q11. The most effective practice(s) are ___. They will have (this specific impact) on biodiversity and water quality. This is because of (data from most of the prompts including justification).	Q11. The most effective practice(s) are ___. They will have (this specific impact) on biodiversity and water quality. This is because of (data from all prompts including justification). **Example student response:** The solution that would have the greatest impact to the environment would be incorporating fenced farm dams and managing grazing for beef cattle. In Prompt 1, we learned that sources of water that do not have fencing and allow beef cattle free access to the water can easily develop algae. In prompt 2B, we learned that beef cattle manure has nitrogen, phosphorous, and potassium. These nutrients can end up in the water when beef cattle are allowed access to it. However, when regulated, these nutrients are essential in fertilizer for plant growth. In high amounts, they cannot be absorbed and end up in

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

			farm runoff in groundwater. These nutrients make it difficult for plants to grow when amounts are not properly balanced. In Prompt 3, we learned that surface water runoff can lead to increased soil loss. Managing grazing practices of cattle can help to maintain proper soil moisture. We also learned that farm fences can improve water quality for livestock. It also secures water during droughts and provides habitat for wildlife, which increases local biodiversity.
Look-Fors	• Student responses will need to be evaluated based on their justification and use of evidence from some of the prompts in the task. • There is no "right answer" that identifies a specific practice as better than another, as all beef cattle production systems have unique requirements. • Student responses may or may not identify a specific practice (or combination of practices) as a proposed solution. • Students do not include 3 pieces of evidence and/or there is limited connection to biodiversity and key healthy water quality indicators. • Student responses do not demonstrate a solid understanding of beef cattle production systems and/or are unclear.	• Student responses will need to be evaluated based on their justification and use of evidence from most of the prompts in the task. • There is no "right answer" that identifies a specific practice as better than another, as all beef cattle production systems have unique requirements. • Student responses should identify a specific practice (or combination of practices) as a proposed solution. • Students may include 3 pieces of evidence, but there is limited connection to biodiversity and key healthy water quality indicators. • Student responses are clear, but not cohesive or do not demonstrate a solid understanding of beef cattle production systems.	• Student responses will need to be evaluated based on their justification and use of evidence from all prompts in the task. • There is no "right answer" that identifies a specific practice as better than another, as all beef cattle production systems have unique requirements. • Student responses should identify a specific practice (or combination of practices) as a proposed solution. • Students should include 3 pieces of accurate and convincing evidence that are directly connected to biodiversity and key healthy water quality indicators. • Student responses are clear, cohesive, and demonstrate solid understanding of beef cattle production systems.

Resources

- https://www.labxchange.org/library/pathway/lx-pathway:69980a09-42bf-418d-9679-f8756f2bcc6a/items/lx-

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}

pb:69980a09-42bf-418d-9679-f8756f2bcc6a:html:7bcac1df
- https://www.dec.ny.gov/docs/water_pdf/researchguide.pdf
- https://www.morningagclips.com/wp-content/uploads/2019/04/28774453358_37389bee19_z.jpg
- https://www.youtube.com/embed/HSoHkG7bbJE?feature=oembed
- https://www.canada.ca/en/environment-climate-change/services/freshwater-quality-monitoring/publications/phosphorus-aquatic-ecosystems/chapter-1.html
- https://newyork.agclassroom.org/matrix/lesson/802/
- https://assets.savvas.com/asset_mgr/current/202131/LabSamp_MLBio.pdf
- https://lpelc.org/the-michigan-enviroimpact-tool-a-supporting-tool-to-help-farmers-in-forecasting-manure-nutrient-runoff-risk/
- https://www.usda.gov/media/blog/2017/12/13/farmers-keeping-nutrients-field-out-streams
- https://www.canr.msu.edu/news/2022-msu-feedlot-educational-series
- https://extension.wsu.edu/animalag/content/protecting-the-water-on-your-small-farm/
- https://extension.sdstate.edu/impacts-drought-soil-water-forage-and-livestock-grazing-systems
- https://www.sustainablefarms.org.au/news/benefit-cost-analysis-lends-support-for-improved-farm-dam-management/
- https://www.usda.gov/media/blog/2017/12/13/farmers-keeping-nutrients-field-out-streams
- https://extension.missouri.edu/publications/eq681
- https://extension.sdstate.edu/impacts-drought-soil-water-forage-and-livestock-grazing-systems
- https://www.sustainablefarms.org.au/news/fencing-farm-dams-halves-methane-emissions/
- https://extension.wsu.edu/animalag/content/protecting-the-water-on-your-small-farm/
0-how-clean-is-the-water-student.pdf (nourishthefuture.org)

These materials are made freely available by the American Farm Bureau Foundation for Agriculture, a 501(c)3 nonprofit organization through generous support from {funder name will be inserted based on task content}