TEACHER GUIDE
ANCHOR LESSON 1

Food and Agriculture Center for Science Education

Driving Question: *What is the impact of dairy production on the environment?*

What We Figure Out:

We observe the Anchor Phenomenon to see that people are upset by the dairy industry's impact on the environment. While there are many claims about the dairy industry being a problem for the environment, there are also conflicting claims that it can benefit the environment and people. We acknowledge that dairy plays an important role in many of our lives and nutrition, and we notice that the claims often lack evidence or cite conflicting evidence. We wonder what is true – is dairy production helpful or harmful for the environment? We consider the different perspectives and make our initial arguments about what we think is the impact of the dairy food system on the environment.

3D Learning Objective:	**Time estimate:**	**Materials:**
Students evaluate the validity of multiple media claims about whether the dairy food production system causes positive or negative impacts on the environment. Students respectfully provide critiques on arguments about whether the dairy food production system causes positive or negative impacts on the environment.	100 min. (two class periods)	Lesson 1 Student Guide Students Protesting the Environmental Impacts of Dairy Production Video, Alternative Link Media Claims Handout (1 packet per group) Initial Argument Graphic Organizer (as needed for differentiation)

Targeted Elements

SEP:	DCI:	CCC:
(Pre-Assessment) INFO-H4: **Evaluate the validity and reliability of** and/or synthesize **multiple claims**, methods, and/or designs **that appear in** scientific and	**(Pre-Assessment) ETS1.A-H2**: **Humanity faces major global challenges today, such as the need for** supplies of clean water and **food** or for energy sources that	**(Pre-Assessment) SYS-H1:** **Systems can be designed to do specific tasks.**

technical texts or media reports, verifying the data when possible. **(Pre-Assessment) ARG-H3: Respectfully provide and/or receive critiques on scientific arguments by** probing reasoning and evidence and **challenging ideas and conclusions, responding thoughtfully to diverse perspectives,** and determining what additional information is required to resolve contradictions.	minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.	

Directions

Part 1: Observing the Anchor Phenomenon

Ask students what kinds of natural resources they depend on in their lives. Listen for student responses such as food, water, materials for building, materials for making things, landscapes and wildlife for natural beauty, and clean air. Student responses may vary. Follow up by asking students if they think all people have access to these resources or if they're difficult for people in their community or any global community to obtain. Build off student responses to indicate that some resources are not easy to obtain for all people and that providing enough resources for everyone in the future is a challenge humanity faces.

Introduce the unit by saying that we will now focus on one specific kind of natural resource and how sustainable its production is now and into the future. Ask students, "What do you know about where your food comes from?" Wait for student responses, which will vary.

Then, share that some types of food production are controversial, such as dairy products like milk, cheese, butter, and ice cream. Ask students why they think the dairy industry might be a controversial topic. Allow students to share their responses and welcome any ideas they have. Build off student responses to share that in this unit, students will focus on a particular controversy in the dairy industry. Share that to get started trying to observe this controversy, students will look at what some people are saying about how the production of dairy foods impacts the environment.

Direct students to record what they notice the people in the video doing as they watch the Students Protesting the Environmental Impacts of Dairy Production Video.

USE OF PHENOMENA

This video shows part of the Anchor Phenomenon for this unit: a claim that protesters have against the harmful impacts of the dairy industry. Students will later see an additional variety of media claims that are being made about the dairy industry. Together, these different claims comprise the anchor phenomenon for this unit. While claims are not phenomena in the strict sense, in the unit we aim to have students investigate the broad impacts of the production of dairy on the environment, which is a series of different phenomena all together. To elicit students' ideas about this broad range of phenomena, we felt that using a range of media claims to anchor the unit was an effective and succinct way for students to share their thinking and to motivate looking closer at different Module Phenomena and at the various investigations across the unit.

In the unit overall, we aim for students to assess if the dairy industry as a whole has positive, negative, or mixed impacts on the environment. In each of the upcoming modules, students will engage with Module Phenomena that highlight specific impacts of the dairy system on the environment. Students then use the information they gather about the different specific impacts to assess the overall environmental impact of the dairy industry.

STUDENT SUPPORT

Consider watching the video with closed captioning because the recording is quiet, and it is tough to hear what they are saying.

Use a Think-Pair-Share to facilitate a whole-class discussion to identify what students think was the main argument of the people in the video.

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.

As students share their observations, make sure they come to a consensus that the people are pouring milk on the floor in protest because they think that the dairy industry contributes to greenhouse gases in the atmosphere and that they harm and abuse cows for profit.

Next, ask students to record on their Lesson 1 Student Guide Part 1: Observing the Anchor Phenomenon if they agree or disagree with what the people in the video are saying. Allow a handful of students to share their ideas. Students will share a variety of opinions and have strong beliefs, and that is okay. You want to hear both sides and do not need a uniform class opinion. For this Anchor Phenomenon, we intend for students to have differing opinions, reactions, or feelings toward the video. Students will likely not agree with their peers. We hope to elevate these disagreements across this lesson to help students see that, based on their background understanding, there are conflicting viewpoints on this issue.

STUDENT SUPPORT

If you haven't done so previously in the academic year, consider starting a list of norms for how students engage in productive and respectful classroom discussions. Ask students how they think they can have respectful conversations with each other. Create a class list with the norms your class generates, and hold students accountable for participating in these norms throughout the unit. Some examples are shown below, but be sure to co-create your list with your students.

- Be Respectful: We can discuss and disagree on ideas, but we do not look down or talk down to people.
- Listen, Then Talk: Show that you are listening to your partner by repeating what they say or asking a question.
- Find Common Ground: When disagreeing, find at least one thing you agree with before discussing what you disagree with.

SEP SUPPORT

ARG-H3: Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and **challenging ideas and conclusions, responding thoughtfully to diverse perspectives,** and determining what additional information is required to resolve contradictions.

In middle school, students engaged in argumentation by respectfully providing critiques of peers' explanations, models, or questions by citing relevant evidence or by posing questions that elicit elaboration from peers. In this unit, we aim to build on this middle school SEP and progress students' proficiency toward the above high school SEP. In this lesson, we are providing a pre-assessment opportunity to assess

how students engage in respectful argumentation. Students will likely have differing opinions, and we will ask them to challenge each other's differing opinions with evidence throughout the unit.

Part 2: Evaluating Media Claims

To help students make sense of whether the claims being made by the milk pourers are true, tell students they will now look more closely at what other claims are being made about the dairy industry to see if these claims are similar or different. Provide students access to the Media Claims Handout, which can be a physical copy or a digital copy. Working in small groups, students will begin discussing if they think the media claims are accurate or inaccurate or if they are unsure. The purpose of this activity is to expose students to the variety of seemingly contradictory claims that are being made about the dairy production industry. By sorting the claims, students share their current thinking about whether they think the dairy industry is helpful or harmful to the environment. This process will also expose students to some of the Module Phenomena they will explore in each module.

To help facilitate this process, remind students to start with Media Claim #1 and work as a group to decide upon its accuracy. If a group cannot decide on placing the claim in the accurate or inaccurate column, it should go in the undecided column. Instruct students to write the claim number in the appropriate column on their Lesson 1 Student Guide Part 2: Evaluating Media Claims and move on to the discussion about the next claim. Students will repeat this process for all media claims. As students discuss the claims with one another, circulate the room and listen to students' thinking.

STUDENT SUPPORT

Depending on a student's personal, cultural, or local experience with the dairy industry, they might have personal views of the industry. It's important to validate their experience while at the same time helping them to focus their attention on the claims and topics for discussion.

PRE-ASSESSMENT OPPORTUNITY

Students evaluate the validity of multiple media claims about whether the dairy food production system causes positive or negative impacts on the environment.

Assessment Artifacts:

- Students' sorting of claims (Lesson 1 Student Guide Part 2 Evaluating Media Claims).
- Students' reasoning for why they sorted claims into different categories (Lesson 1 Student Guide Part 2 Evaluating Media Claims).

Look Fors:

- Students categorize each of the claims provided as accurate, undecided, or inaccurate (INFO-H4).
- Students provide plausible reasoning for how they assessed the validity of the three claims (INFO-H4).
- Students' reasoning about how they chose to categorize the claims involves discussion of the impact of the dairy system on the environment (ETS1.A-H2, SYS-H1).

Assessment Rubric:

	Emerging	Developing	Proficient
Sample Student Response	I think media claim 1 is accurate because it is something I have heard before.	I think media claim 1 is accurate because it says that the dairy industry contaminates water.	I think media claim 1 is accurate because it says that the dairy industry contaminates water. The cows in the dairy industry create pollution, which can contaminate the water.
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:

- Ask students probing questions such as:
  - Can you tell me more about why you put this claim here?
  - What was it about this claim that made you place it here?
  - In your own words, what do you think this media claim is saying?
  - Wait, claim ___ and ___ seem to be contradicting each other. What do you think about that?
  - Claims ___ and ___ seem to say the same thing: dairy production is good/bad for the environment, yet you put them in different places. Why?
  - What evidence do you have for your claim?

After student groups have sorted all the media claims, they will work individually to select one from each category and provide reasoning for organizing the claim into the category. Each student will record this on their Lesson 1 Student Guide Part 2: Evaluating Media Claims. Encourage students to make sure their reasoning is based on anything they read in the Media Claims Handout or on their own background knowledge.

STUDENT SUPPORT

For some students, explaining their reasoning might be challenging. They may be unsure of the science concepts at this point in their learning, and that is okay. Assure students that the idea is simply to capture their initial ideas about the media claims as they relate to the impact of dairy production on the environment.

Additionally, to support multilingual learners or other learners, here and throughout the unit, allow students to express their ideas in a written, verbal, or drawn format as needed. This can support students who may struggle with one form of expression and still take part in the classroom community.

SEP SUPPORT
INFO-H4: Evaluate the validity and reliability of and/or synthesize **multiple claims**, methods, and/or designs **that appear in** scientific and technical texts or **media reports, verifying the data when possible.**

In middle school, students evaluated competing information in texts. This unit builds on this middle school practice by asking students to evaluate the validity of multiple claims in media reports and to use their knowledge from this unit to verify the claims being made. This lesson provides a pre-assessment opportunity to evaluate students' proficiency with the high school-level SEP.

Part 3: Sharing with Our Peers

Students will share the claims' organization with the class using a Stay and Stray Strategy. Explain the process if this is the first time you have used this strategy with students.

Implementing the Stay and Stray Strategy:

1. When instructed, ask groups to have one person "stay" at their home base to explain their work to visitors.
2. The rest of the group members "stray" to the home bases of other groups to hear the other group share the organization of their claims, allot about 2 to 5 minutes per rotation.
3. Note: At every signal to rotate to a new home base, a different team member goes back to stay with the group's work, and everyone else (including the person who first stayed) moves on to view the next product. This allows everyone to see all but one product.

Encourage students to record areas of agreement and disagreement to enrich group discussion. This activity aims for students to see the variety of ways the class organized the media claims, which may stimulate further discussion and argumentation as to which claims are most accurate.

CCSS SUPPORT

SL 9-10.1(d): Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
The goal of this standard is to challenge students to respond to diverse perspectives. At this point in the unit, students will not have gathered evidence to support their claims and argue against the claims of their peers. Students will later do so again at the end of each module after they have gathered evidence in each module.

As student groups rejoin after the protocol, allow students time to begin discussing the various ways other groups organized the media claims. In their Lesson 1 Student Guide Part 3: Sharing with Our Peers, they should record the positioning of claims they agreed with and disagreed with based on the work shared by their peers.

Facilitate a whole-class discussion to have students share the areas of agreement and disagreement they noticed in each other's claim organization charts. The purpose of this conversation is for students to realize that even though they have some areas of agreement, they organized the claims in many ways across the class. Accordingly, students should see that there is a wide variety of opinions on whether they think the dairy industry is or is not harmful to the environment.

Facilitate students to share what they noticed and to think through it with each other. This might sound like:

- Why do you think that?
- Where did you notice that groups put claim ___? Why did you put it there?
- What does everyone think about what ____ said?
- Does anyone agree with what ____ said about claim __?
- Does anyone disagree?

As a class, build a class consensus list for how to organize the media claims. At this point, it is okay to follow the thinking of your class. Any of the claims can be categorized as accurate, inaccurate, or undecided. If students have any level of disagreement, it is okay to categorize the claim as undecided. It is also okay at this point to have many claims categorized as undecided. Going forward in the unit, students will revisit this list and recategorize claims after gathering additional evidence about their validity.

CCSS SUPPORT

SL 9-10.1: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. Students will have different opinions as to how to sort these claims. Giving students time to engage in a small group and then in a larger group to contribute to whole class discussion is a way to build confidence with their own ideas and develop their thoughts clearly before sharing with diverse partners.

Building off the disagreements and uncertainties in this conversation, introduce the Driving Question for this unit, "***What is the impact of dairy production on the environment?"*** to students. You can say, "It seems like there are many ideas out there about the impact that dairy production has on the environment, so we should continue to investigate it." Students might still be unsure of an answer but should be reminded that throughout the unit, we will explore evidence for making an argument about our thoughts.
Ask students to share what kinds of environmental impacts they think the dairy system is having. Students can base their responses on their own background knowledge and the claims they read. Facilitate the class conversation to agree that the dairy industry seems to be impacting the climate, impacting plants and animals, potentially causing pollution, and impacting the lives of people. Share with students that they will investigate the extent of each of these different kinds of impacts throughout the unit.

USE OF PHENOMENA

This conversation helps students see that there are multiple possible kinds of impacts of the dairy industry on the environment. Each of these types of impacts will be centered as a Module Phenomenon in each of the upcoming modules within the unit. Students will return to the Anchor Phenomenon at the end of each module and evaluate specific media claims again to see how their thinking has changed.

Part 4: Writing an Initial Argument About Dairy's Impact on the Environment

Now that students have been exposed to the variety of ideas that the class has, they will take a stand and share their own position and reasoning by writing an initial argument about the effect they think dairy production has on the environment. They can write this initial argument in their Lesson 1 Student Guide Part 4: Writing an Initial Argument About Dairy's Impact on the Environment.

Provide students some individual thinking time to come up with their initial ideas in response to the Driving Question. Share with students that they will be writing an initial argument about dairy's impact on the environment. To help students draft their responses, share that, at this point, there is no right or wrong answer to this question, and their argument is demonstrating what they think as an individual.

STUDENT SUPPORT

- Remind students that these arguments can be based on the claims they viewed, their own opinion, or both.
- Explain that their claim should be supported by two pieces of evidence they gathered from the media claims or their own background knowledge.

Part 5: Sharing Initial Arguments

Use a Mingle-Pair-Share routine to have students share their initial argument with a peer and to hear the arguments of their peers. As students share, encourage them to keep in mind elements they agree and disagree on and record those on their Lesson 1 Student Guide Part 5: Sharing Initial Arguments. Once again, the purpose here is not for students to agree with each other or establish a consensus, but, instead, students are meant to engage in respectful argumentation with their peers who may hold differing opinions.

PRE-ASSESSMENT OPPORTUNITY

Students respectfully provide critiques on arguments about whether the dairy food production system causes positive or negative impacts on the environment.

Assessment Artifacts:

- Students' written responses about if they think the dairy production system helps or harms the environment (Lesson 1 Student Guide Part 4 Writing an Initial Argument About Dairy's Impact on the Environment).
- Students' verbal discussions with peers.

Look Fors:

- How respectfully students are providing and receiving critiques on each other's arguments. (ARG-H3)
- How students use questions to probe peers' evidence, reasoning, and conclusions about if dairy production is helpful or harmful to the environment. (ARG-H3)

- Students argue that the dairy system has a positive or negative impact on the environment. (SYS-H1)
- Students focus their discussions on the specific impacts of the dairy food system. (ETS1.A-H2)

Assessment Rubric:

	Emerging	Developing	Proficient
Sample Student Response	Written Response: Dairy production helps the environment. Peer Discussion: I think you are wrong about what you are saying.	Written Response: Dairy production is helpful to the environment. I think this is true because the cattle can help promote biodiversity, like was stated in Claim 12. Peer Discussion: I think what you said about cows being harmful to the environment maybe is true. But I really think I'm right and you are not.	Written Response: Dairy production is helpful to the environment. This is because, if Claim 2 is to be believed, there are solutions that exist to reduce enteric methane emissions. We also don't know if we are hearing the entire story about what dairy is or is not doing to the environment. Claim 7 stated that not all claims in the media are true – Oatly claimed, "dairy and meat industries emit more CO_2 than all of the world's planes, trains, cars, boats, etc. combined." It was investigated and they were found to be "overstating" emissions because they did not account for emissions related to transportation, only when vehicles were driven. So, overall, maybe the media claims are only telling part of the story. Peer Discussion: I hear what you are saying that you think that dairy production harms the environment because of its pollution. You raise a valid point. One question I have is about how much it would impact the environment compared to other food production industries?
How to Achieve This Level	Student completes 0-1 out of 4 Look Fors	Student completes 2-3 out of 4 Look Fors	Student completes 4 out of 4 Look Fors

To Provide Additional Support for Students:

- Briefly model a respectful argumentation conversation.
- Provide students with sentence starters, which might be displayed for students on the board if it is their first time engaging in a discussion that requires argumentation. Sentence starters include, but are not limited to:
    - I agree with…but…

- I disagree with your reasoning because…
- I know where you are coming from, but I have a different idea…
- I appreciate your idea, but I respectfully disagree because…
- Thanks for sharing your perspective, but have you considered this idea…
- I'm not sure your reasoning makes sense to me. Could you please explain it a bit further?
- That's an interesting idea. The evidence says…

- Ask students probing questions such as:
  - Can you tell me more about why you put this claim here?
  - What was it about this claim that made you place it here?
  - In your own words, what do you think this media claim is saying?
  - Wait, claim ___ and ___ seem to be contradicting each other. What do you think about that?
  - Claims ___ and ___ seem to say the same thing: dairy production is good/bad for the environment, yet you put them in different places. Why?
  - What evidence do you have for your claim?

SEP SUPPORT

ARG-H3: Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and **challenging ideas and conclusions, responding thoughtfully to diverse perspectives,** and determining what additional information is required to resolve contradictions.

Here, students are engaged in the below argumentation SEP and will be receiving critiques on their scientific arguments. To begin supporting students in developing respectful argumentation, define and establish norms for discussion based on the level of support your students need. Here are a few things to remind students of as they begin discussing their different views.

- Students should responsibly and respectfully discuss with their peers.
- All students in the group should be given time to think, respond, and ask questions.
- Feedback should be about the ideas presented and not about the individual.
- Differences in opinion do not equal deficits or inadequacies.

Students will continue to improve upon this practice throughout the unit.

STUDENT SUPPORT

Another activity you may choose to do is to have students brainstorm and record phenomena from their own lives they believe are related to the anchor phenomenon. This may look like students describing other industries that they know of and how they impact the environment, how students think their actions impact the environment, or other things they have heard about how the dairy industry impacts the environment. Giving students an opportunity to connect to phenomena from their own lives can help strengthen their connection to and interest in figuring out more about this anchor phenomenon.

Part 6: Asking Questions

As a final step in this lesson, students will create a list of questions to help them determine what additional information they need to know to help them figure out how milk production impacts the environment. They can write these questions in their Lesson 1 Student Guide Part 6: Asking Questions.

To facilitate students asking questions, use the Questions Only Routine.

1. Individually, students brainstorm a list of six questions about what they need to know about the dairy industry and its impact on the environment.
2. Students will get into pairs and take turns sharing their list of six questions. One will speak first, and the second will listen, then they will switch roles.
3. The pairs will review their lists and star the question that seems the most interesting/relevant to helping them get closer to making sense of the phenomenon.
4. Pairs will then share their starred questions with the whole class.
5. As students share their starred questions, they will add them to the Driving Question Board.

As students share their questions, ask them to create categories to group similar questions. As these question groups start to form, give the categories a name. The goal is that the emerging categories correspond to the upcoming unit modules so students can see that those questions motivate and drive the instruction of the following lessons.

CCSS SUPPORT

SL 9-10.1(c): Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.

As students begin to develop questions for the Driving Question Board and begin to categorize them based on similarities, remind them to incorporate the ideas they shared as they sorted the media claims and considered them for their initial written argument. Example student questions could include:

- **Dairy Industry**
  - Where do dairy foods come from?
  - How are dairy foods made, and how does this process impact the environment?
  - Is drinking dairy bad for your health?
  - Does drinking dairy produce asthma?
  - Does dairy production pollute the water or air?
  - Are there parts of the dairy system that impact the environment more than others?
  - What does animal waste do to the environment?

- **Greenhouse Gas and Climate**
  - How does the dairy industry impact the climate?
  - What do greenhouse gasses do to the environment?
  - How does the dairy industry climate impact compare to other industries?
  - How do nitrous oxide and carbon dioxide in the atmosphere lead to climate change?
  - What is the role of the dairy industry in methane emissions?
  - How is enteric methane different from other forms of methane in the atmosphere?
  - How does the dairy industry increase greenhouse gases?
  - What makes the meat and dairy industries such a huge contributor to climate change?
  - What is the actual amount of CO_2 that the dairy industry emits?
  - What is the carbon footprint of the dairy industry?

- **Biodiversity and Environment**
  - What impact does the dairy industry have on the environment?
  - Can dairy ever help improve biodiversity, land use, and the environment?
  - Are dairies using monoculture or polyculture farming practices?
  - Why would they use a practice if it is not more environmentally friendly?

- Are there any other species that are being helped by the dairy industry?

- **Dairy Industry Solutions**
  - What solutions exist for reducing methane emissions?
  - What are farmers doing to improve sustainability?
  - What does the dairy industry have in place to help the environment?
  - What is being done about reducing waste/manure on factory farms?
  - Are dairy farmers looking to make environmental improvements to their practices?
  - What are dairies doing to protect nature and set aside land?

USE OF PHENOMENA

Each of these suggested groupings of questions corresponds to each module in the unit. By grouping questions in this way, students can see how the Module Phenomena they observe in each module are introduced based on the questions students have raised.

Wrap up the lesson by sharing how the ideas students shared will be used going forward. This may sound like, "Your questions and ideas are the most important part of our classroom work together, so we will use them to decide on what our upcoming investigations will be. We will use your questions to help us investigate the accuracy of each of these different media claims across the whole unit."