# TEACHER GUIDE ENGAGE LESSON 7



# Module Question: How could cow burps be influencing climate change?

## What We Figure Out:

We observe the Module Phenomenon, which shows a farmer that claims that cow burps may be related to climate change. We create an initial model that shows how we think this happens. We think the methane emissions from cow burps go into the atmosphere and then have something to do with climate change. We generate additional questions to help us figure out how this happens.

Targeted Elements	<b>3D Learning Objective:</b> Students develop a model to illustrate the interactions between the Earth's system and greenhouse gas emissions released from the dairy food system, resulting in changes in the atmosphere.		<b>Time estimate:</b> 50 minutes	Materials: Lesson 7 Student Guide <u>Cow Burps Video</u> (Play 0:00 to 1:03)	
	Targeted Elements				
SEP: DCI: CCC:	SEP:	DCI:		CCC:	
Pre-Assessment 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.Pre-Assessment ESS2.D-H3: Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.Pre-Assessment EM-H2: Changes of energy and matter a system can be described in terms of energy and matter flows into, out of, a within that system.	Pre-Assessment 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.	Pre-Assessment ESS2.D-H3: Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.		Pre-Assessment EM-H2: Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.	

# Directions



# Part 1: Our Motivation

#### **USE OF PHENOMENA**

Students ended the previous lesson by asking what questions need further investigation to understand the Anchor Phenomenon and revisiting the Driving Question Board. The next set of media claims from the Anchor Phenomenon that students will investigate are Claims 2, 5, 6, 7, 9, and 10. These claims also correspond to the Greenhouse Gas and Climate category from the Driving Question Board. Therefore, in this module, students will start by observing a Module Phenomenon that asks students to figure out how cow burps could be influencing climate change. Figuring out this Module Phenomenon will help students progress on their questions about the overall Anchor Phenomenon for the unit: how the dairy system impacts the environment.

To introduce this module to students, return to the class list of media claims. Ask students what media claims seem the most pressing to investigate next. Build off student responses to point out the claims related to climate and greenhouse gases. Then, return to the Driving Question Board and revisit the questions in the Greenhouse Gas and Climate category. Have students read off selected questions to highlight student questions about how dairy impacts the climate, how emissions from the dairy industry compare to other industries, or any other question that has to do with greenhouse gases and climate.

Students can record these questions, or the media claims they are investigating, on their Lesson 7 Student Guide Part 1: Our Motivation. This will help students understand how this lesson connects to what they were trying to figure out about the Anchor Phenomenon. In student responses, listen for the following ideas:

- How does the dairy industry influence climate?
- Do cows contribute to climate change?
- What are greenhouse gases? How do they impact climate change?
- What do cows have to do with climate change?

Build off student questions and the selected media claims to confirm that students will next set out to figure out the impact of the dairy industry on climate.

## Part 2: Observing the Investigative Phenomena

Introduce the Cow Burps Video by telling students, "We noticed a lot of confusing claims about the dairy industry's impact on climate from Lesson 1. We had a lot of questions on our Driving Question Board about how climate change was related to the dairy industry. Let's look at this connection in a short video and see what we observe."

Play the <u>Cow Burps Video</u> (play 0:00 to 1:03). As students watch, ask them to record their observations about cows and climate on their Lesson 7 Student Guide Part 2: Observing the Investigative Phenomena.

#### STUDENT SUPPORT

To increase access for all learners, especially multilingual students, utilize the closed captioning feature while playing the video.

Use a Think-Pair-Share Strategy to have students share what they noticed from 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.

In student responses, look for the following ideas:

- The farmer said that the cows impact the climate more than the factory.
- The cow burps release methane.
- They wanted to reduce the greenhouse gas emissions from milk production.

#### STUDENT SUPPORT

If students need additional support finding observations from the video, consider replaying the video at specific moments when the narrator discusses cow burps and asking students to make observations at this time.

#### **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 considering the evidence and reasoning presented. The goal of this standard is to challenge students to respond to diverse perspectives. At this point in the lesson, students may have different reactions to the video. Remind students to share their perspective respectfully and connect their opinion to any evidence that can be gathered from the video and class discussion.

After this conversation, introduce the term **greenhouse gases** to refer to gases in the atmosphere, such as methane, linked to climate change. Share with students that methane is a gas molecule that has the chemical formula CH<sub>4</sub>, which we will sometimes use as a shorthand to refer to it.

After agreeing on their observations from the video, introduce the Module Question, "*How could cow burps be influencing climate change*?"

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## Part 3: Creating an Initial Model

## **STUDENT SUPPORT**

To help connect the Module Phenomenon to students, you may facilitate a conversation to connect the topic of greenhouse gases and climate to students. Use this opportunity to connect this topic to students' homes, neighborhoods, communities, and cultures as appropriate. Seek out and use students' current funds of knowledge from their own experiences. Consider asking questions such as:

- Why does climate change matter to us?
- What do we already know about greenhouse gases and climate change?
- How have we heard this topic discussed in our community?
- Why do we think this is an important topic for us to learn?

Use a Think-Pair-Share to ask students how their understanding of the dairy industry from the previous module could help them figure out how cow burps impact climate. Allow students to share their responses and build off student responses to share that knowing the parts of the dairy system that produce greenhouse gases, such as the cow burps and the transportation, will help us understand the impacts of the dairy system on the climate.

Students will create an initial model that shows how they would currently answer the Module Question on their Lesson 7 Student Guide Part 3: Creating an Initial Model. Allow students time to create a model to show how they think cow burps influence the climate. As students start to work on their models, hold a class discussion to determine how students will define the system, the components of the system, and the boundaries of the system they are considering for this model. Share that just like in their models of the dairy system from module one, students can define the system and system boundaries here. Build on student responses to confirm that the components of the system can include the Earth, dairy cows, and transportation trucks.

Ask students what other components outside the system they should represent when considering climate change and Earth's temperature. Confirm that students should also represent the Sun and the light and heat that comes from the Sun that influences Earth's temperature. Finally, share with students that they should distinguish between the matter (methane, CO<sub>2</sub>) and energy (radiation from the Sun in their models and that the class can use common conventions, such as differently colored arrows, to show this difference.

#### **CCC SUPPORT**

EM-H2: Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

In middle school, students tracked the transfer of energy through a system and how the transfer of energy drives the motion of matter. This unit builds on this middle school knowledge by asking students to carefully track the movement of energy and matter into and out of a system and use that to track how the energy within a system changes. This lesson serves as a pre-assessment of students' proficiency with this understanding.

As students work, circulate the room to elicit and probe student thinking. Ask questions such as:

- Can you tell me more about what you drew there?
- What I see in your model is...Can you say more about that?
- How do you think cow burps and climate change are related?
- What are you defining as the system in this model? What are the boundaries?

#### **STUDENT SUPPORT**

Remind students that they can use images, icons, and pictures to visually represent what is happening to methane in the air after a cow burps.

#### PRE-ASSESSMENT OPPORTUNITY

Students develop a model to illustrate the interactions between the Earth's system and greenhouse gas emissions released from the dairy food system, resulting in changes in the atmosphere.

#### Assessment Artifacts:

Students' initial models of how cow burps influence climate change (Lesson 7 Student Gudie Part 3 Creating an Initial Model). •

#### Look Fors:

- Models show the movement of matter as it moves between components of the model and into and out of the system. (MOD-H3) (EM-• H2)
- Models show the movement of energy as it moves between components of the model and into and out of the system. (MOD-H3) (EM-• H2)
- Models include changes in the atmosphere due emissions from the dairy food system. (ESS2.D-H3) •

	Emerging	Developing	Proficient	
Sample	Student model shows	Student model shows:	Student model shows:	
Student Response	the components of the system under consideration, including components such as the Earth, the cattle, and the atmosphere.	<ul> <li>Movement of matter (methane) from the cattle to the atmosphere.</li> <li>Movement of light energy from the Sun to the Earth.</li> </ul>	<ul> <li>Movement of matter (methane) from the cattle to the atmosphere.</li> <li>An accumulation of methane in the atmosphere.</li> <li>A system boundary that includes the cattle, the Earth, and the atmosphere.</li> <li>Movement of light energy from the Sun to the Earth.</li> </ul>	
How to Achieve This Level To Provide Addit	Student completes 0 out of 3 Look Fors tional Support for Student	Student completes 1-2 out of 3 Look Fors ts:	Student completes 3 out of 3 Look Fors	

#### **Assessment Rubric:**

Consider the following supports for students as they create their models:

- Ask students to pick two components that they think interact with each other and ask, "What are some ways you can show this interaction in your model using pictures and/or words?"
- How does your model show changes in the atmosphere due to human activity?
- Ask students what their breath is made of and what happens to it after they exhale when they are outside. Where does it go?
- Ask students to recall any prior knowledge they have about how climate change is occurring. What have they heard previously?
- Ask students to identify each component as representing energy or matter, and label it accordingly.

#### **DCI SUPPORT**

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ESS2.D-H3: Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.

In middle school, students learned that greenhouse gases are major factors in the rise of Earth's mean surface temperature. In this unit, students build on this middle school understanding by establishing the mechanism by which excess production of greenhouse gases by the agricultural and other industries can contribute to changes in changes in average atmospheric temperature. This initial model can serve as a pre-assessment of students' proficiency with this DCI knowledge.

## Part 4: Sharing Initial Models

Use the Stay and Stray Strategy to have students share their models with their peers.

- 1. After small group models are complete, ask groups to have one person "stay" at their table with the model they created to explain the model to classmates from other groups.
- 2. The rest of the team members "stray" to the other groups to learn about the other group's models, allot about 2 to 5 minutes per rotation.
- 3. During the rotation time, students can ask questions to help gain clarity on the decisions they made. Students can ask questions such as, "What parts of the models do we seem to agree on?"
- 4. At every signal to rotate to a new group, 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.
- 5. After visiting all groups, initial small groups regroup and share new information gathered.
- 6. Groups discuss new ideas and decide whether they will integrate them into their work.

As students share, they should record the parts of those models they agree with and those they disagree with in their Lesson 7 Student Guide Part 4: Sharing Initial Models.

After all students have had time to share, hold a whole-class share-out to have students work together to make a Class Consensus Model. The aim is for students to look across their models and represent the most common areas of agreement on a class model.

Deliberately pick a few student models to share with the whole class. Have the first student share their model.

During the share-out, ask questions and share reminders to help establish what consensus ideas to add to the class model, such as:

- What parts of the models do we seem to agree on?
- Can anyone suggest a feature of the model we should add to the class model?
- Remember, we can add any part to the model an arrow, a component, or any other single part, that we all must agree on.

#### **STUDENT SUPPORT**

If students need additional support in the class consensus discussion, consider:

- Asking pressing questions such as, "Why do you think that?" or "What does everyone think about what \_\_\_\_\_ said?"
- Pointing out a specific feature in the models chosen for sharing and asking students what they see in common among the models and if they agree that this feature should be added to the consensus model.

As parts are agreed upon, begin creating a Class Consensus Model on the board. As the model is being built, have students copy it into their Lesson 7 Student Guide Part 4: Sharing Initial Models.

#### **TEACHER SUPPORT**

As you build the class model, if you find disagreements, follow these steps to help resolve the disagreement.

- Summarize the two sides of the disagreement.
- Ask the students to pause and reflect on their reasonings to be on that side.
- Prompt students to again re-discuss the area of disagreement.
- If students still disagree, suggest that we can represent areas of disagreement on the class model with question marks or other annotations of uncertainty.

#### **STUDENT SUPPORT**

If students need additional support in the class consensus discussion, consider:

• Asking pressing questions such as, "Why do you think that?" or "What does everyone think about what \_\_\_\_\_ said?"

• Pointing out a specific feature in the models chosen for sharing and asking students what they see in common among the models and if they agree that this feature should be added to the consensus model.

Continue adding to the Class Consensus Model such that every group shares at least one component or relationship to add to the model. The class consensus model should show the following:

- Components should include a cow, the grass on the Earth it is feeding from, and the atmosphere.
- Movement of matter can be shown by feed being eaten by the cow and then the cow burping methane into the atmosphere.
  - This could be shown as a cow grazing on grass or being fed in stalls.
  - Students may or may not identify what cows are eating just that they are ingesting some feed.
- Movement of energy can be shown by showing the radiation energy from the Sun moving towards the Earth.



#### Sample Class Consensus Model

#### **SEP SUPPORT**

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.

To develop student proficiency in the targeted SEP for this lesson, students need to understand that the phenomenon in question, how cow burps contribute to climate change, can be thought of in terms of multiple interacting systems: the Earth system and a human-designed dairy production system. This lesson allows students to create a model and use sharing strategies to explain the relationships between the two systems while also asking questions of other student models.

After a Class Consensus Model has been built, students will reflect on gaps in understanding present in the model. At this point, there will be gaps to the model, and this is okay at this stage because these will be addressed throughout the rest of this module. Provide guidance for students to find the gaps in their model by asking questions like "Take a closer look at the class model. What seems to be missing from the model to help us explain how cow burps can lead to climate change?"

In student responses, look for the following ideas:

- What do greenhouse gases in the atmosphere have to do with climate change?
- What does the methane do when it goes into the atmosphere?
- How is methane similar to or different than other greenhouse gases?

## **STUDENT SUPPORT**

If students need additional support in finding gaps in the models, consider:

- Having students verbally describe the system and, as they do so, consider if any component might logically be missing. Say, "Talk me through how cow burps end up in the atmosphere without looking at the model." This allows them to visualize the system and see if there are gaps present.
- Reminding them that we are in the beginning stages of the module, and they will learn more and have time to edit their model later in the module.

## **Part 5: Asking New Questions**

As a final step in this lesson, students will create a new list of questions to help them determine what additional information they need to know to help them figure out how cow burps affect climate change. They can write these questions on their Lesson 7 Student Guide Part 5:

Asking New Questions. Add these questions to the Greenhouse Gas and Climate category of the Driving Question Board so they can continue to be referenced in the coming lessons.

To facilitate students asking questions, use the Question Formulation Technique.

- 1. With their group, students take 5 minutes to brainstorm questions about what they need to know about how dairy foods are created and distributed.
- 2. Students then look at all their questions and choose the 3-5 questions they think are most important to be answered to help them figure out the Module Question.
- 3. A representative from each group will then share their prioritized questions with the whole class. As students share their prioritized questions, they will add them to the Driving Question Board.

#### LOOK FOR

In student questions, listen for the following ideas:

- What does a greenhouse gas do to cause climate change? Why do we care about them?
- Is methane the only greenhouse gas that impacts climate?
- Are the claims about greenhouse gas emissions from the dairy food system accurate?
- Are there additional greenhouse gas emissions from other components in the dairy food system that contribute to climate change?
- Where do the greenhouse gas emissions go once released from the cow burps?
- What other man-made production systems emit greenhouse gases?
- How do emissions from the dairy food system compare to emissions from other industries? How does their impact compare?

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