

STUDENT GUIDE

EXPLAIN 2 LESSON 11



Part 1: Our Motivation

Record what we were trying to explain that led to this investigation.

At the end of Lesson 10, we realize that CO₂ and methane have different residence times in the atmosphere and different ways they flow from pool to pool in the carbon cycle. We're now going to update our models with this new information.

Questions that led to this investigation are:

- How does carbon move in the carbon cycle?
- Why do methane and carbon dioxide have different residence times in the atmosphere?





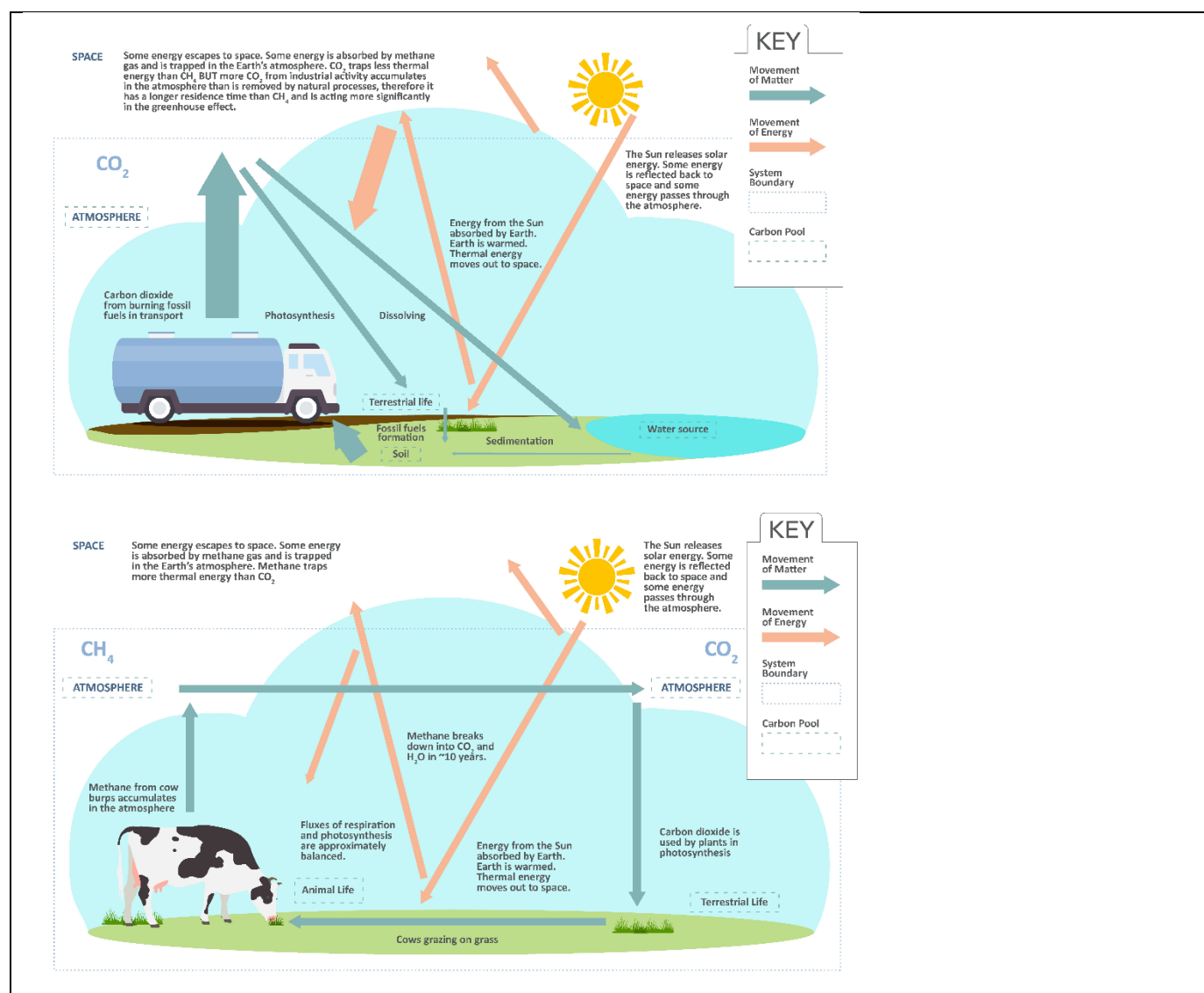
Part 2: Revising Models of How Cow Burps May Be Influencing Climate

Revise your model that shows how you would currently answer our Module Question, “How could cow burps be influencing climate change?” In your model, be sure to utilize images, icons, and pictures to visually represent what is happening in the atmosphere.

Be sure to describe:

- How you are defining your system and its boundaries.
- How you think greenhouse gases influence climate via the greenhouse effect.
- How the movement of matter (carbon dioxide and methane) differs from the movement of energy.
- How the carbon cycle moves carbon dioxide and methane in different ways.

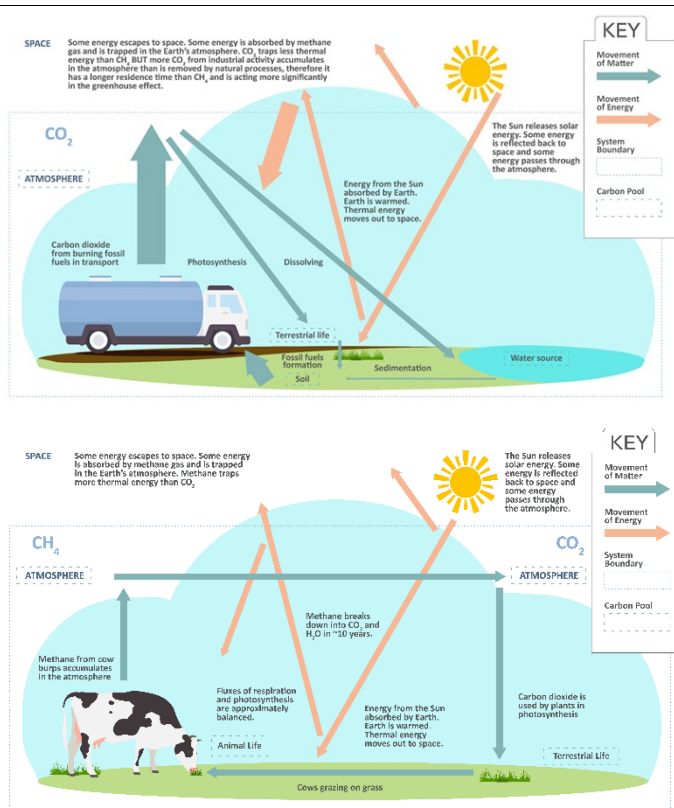
Draw a copy of your model in the space below.





Part 3: Creating a Class Consensus Model

In the space below, record new ideas you gained from the class discussion.



Cattle release methane through “burps” into the atmosphere. Methane is a type of greenhouse gas. When a greenhouse gas, including both methane and carbon dioxide, builds up in the atmosphere, it produces the greenhouse effect which acts to reduce the outputs of thermal energy in the Earth system that is leaving to space, resulting in an increase in average surface temperature. Methane and carbon dioxide are both a part of the carbon cycle. Through the carbon cycle, carbon is exchanged through carbon pools such as Earth’s oceans, plants and animals on both land and sea, soil sediments, ocean sediment, and fossil fuel deposits. The specific ways in which carbon is moved from one pool to another is called carbon flow or flux. These movements can include photosynthesis, making long carbon chains, carbon dioxide dissolving into water, carbon being trapped in layers of rock, among others. Carbon can be exchanged between the oceans, land, and atmosphere through the processes of photosynthesis and respiration.

These processes are particularly relevant to cow burps. In the carbon cycle, methane breaks down into carbon dioxide and water after about 12 years in the atmosphere. Photosynthesis then converts the carbon dioxide and water into energy (glucose) in the crops cattle eat, or the carbon dioxide is absorbed into the ocean to become carbonic acid. In contrast, the carbon dioxide emitted from burning of fossil fuels in transit results in carbon moving from Earth’s surface to the atmosphere, then to the oceans, where it very slowly moves back into other parts of Earth’ surface. This buildup prevents carbon dioxide from leaving the atmosphere quickly, resulting in its longer residence time in the atmosphere.

**Part 4: Asking New Questions**

Record new questions you have that might help you:

- Find additional information about how the dairy system impacts the environment.
 - “Fill in a gap” in your model or our class model.
 - Settle an area of disagreement that we’ve identified in our models.
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- Which contributes more to greenhouse gases in the atmosphere: human activities or cow burps?
 - How do the greenhouse gas contributions of the dairy system compare to other industries?
 - What happens to Earth's temperature when there gets to be too many greenhouse gases?
 - What will happen to Earth in the future if we keep generating methane and carbon dioxide?
 - Is there more carbon dioxide or methane in the atmosphere?
 - Is there any way to get rid of greenhouse gases in the atmosphere?