# Teacher's Guide

Welcome to Topic 1 of the *Exploring the Path of Beef Sustainability* Reader Series! This guide is here to help teachers like you make the most of this educational resource. We've divided it into sections and have some suggestions to make learning more enjoyable for your students.

**Reader QR Code Links:**
If your students are unable to use QR codes in the classroom here are the links to share in alternative ways.

- Cattle By-Products: bit.ly/3PAdOkT
- Gimkit: bit.ly/3Lmpfdf
- Help Wanted Career Paths: bit.ly/3Rqxjhf
- UC Davis Explainer - The Biogenic Carbon Cycle: bit.ly/3EBTFV9
- Cattle and Carbon Videos: bit.ly/467wsG8
- Learn More Classroom Debate: bit.ly/44MGXh2

**Vocabulary Words**
There are seven vocabulary words to be found throughout the reader. They are bold with a small explanation to help define the word. Other ways to learn more:

- Have your students find the definitions of the words on their own before reading.
- Draw pictures of the words which will help them make meaningful connections.

**Page 2**
Learn more about cattle and how they're connected to our everyday lives. Students will:

- Discover products made from beef by-products.
- What's a cow-calf operation? Have students learn more about the beef lifecycle at bit.ly/3t1f9lo
- Understand that cattle's stomachs are different from humans' because they are ruminant animals.
- Test their knowledge with a 12-question quiz about cattle and their impact on the environment using Gimkit. You can play this quiz together in different game modes or assign it as homework. If you don't have an educator Gimkit account yet, don't worry! You can create one for free and enjoy the game.

**Page 3**
This page is all about beef sustainability, the biogenic carbon cycle, and the methane produced by animals.

- Discover various careers in the beef industry. Your students can pick a career they're interested in and share what they find with the class.
- Use the included worksheet to have a debate about the cattle industry and greenhouse gas emissions. The worksheet has resources they can use. By completing this worksheet, students will also practice their writing skills using the Claim, Evidence, and Reasoning (C.E.R) format.

**Page 4**
The Carbon Cycle Investigation is a simple lab that dives into the Carbon Cycle itself.

- Understand how carbon works, how it's made, and the role cattle play in the carbon cycle.
- Use visuals, reader information, and resources to write an explanation, similar to C.E.R.
- Connecting the lab to beef sustainability for a better understanding of the concept.

Enjoy the journey through the Beef Sustainability Reader Series and have fun teaching your students!

**Suggested Uses:**
This reader can be used as a stand-alone activity, or you can pair it with other Kansas Beef Council offerings – bit.ly/46ao8p3

- Ideal for substitute teacher activities
- A valuable addition to science or STEM curriculum
- Suitable for small reading groups or reading centers
- Promotes the integration of science and reading
- Encourages career exploration
- Provides engaging content for filling time after quizzes and tests
- A valuable after-school resource for extended learning opportunities

**Reader Citations**


**Page 2. Cattle are Important.**

- Marti, D. L., R. J. Johnson, and K. H. Mathews, Jr. 2011. Where's the (not) meat? Byproducts from beef and pork production. US Department of Agriculture Economic Research Service. LDP-M-209-01.

**Page 2. Gimkit.**

- EPA. 2021. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019. U.S. Environmental Protection Agency, Washington, D.C.
- US Department of Agriculture. 2017. Census of Agriculture. https://www.nass.usda.gov/ Publications/AgCensus/2017/index.php List of Reports and Publications | 2017 Census of Agriculture | USDA/NASS.)
- Broocks, Ashley et al. 2017a. Carbon Footprint Comparison between Grass- and Grain-finished beef. OSU Extension, AFS-3292.
- NASS. 2021. Steers and Heifers Commercial Slaughter GE 500, 2019/2020. Found on USDA/NASS QuickStats Ad-hoc Query Tool.
- USDA NASS. 2021. Crop Production 2020 Summary. Found on: Crop Production 2020 Summary 01/12/2021 (cornell.edu)
- Asem-Hiablie, Senorpe et al. 2018. A life cycle assessment of the environmental impacts of a beef system in the USA. The International Journal of Life Cycle Assessment

**Page 3. Beef Sustainability: Understanding and Visualizing Its Impact**

- UC Davis. 2020a. Clear Center. The Biogenic Carbon Cycle and Cattle. https://clear.ucdavis.edu/ explainers/biogenic-carbon-cycle-and-cattle
- EPA. 2021a. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019. U.S. Environmental Protection Agency, Washington, D.C.
- Silveira, et al. 2012. Carbon sequestration in grazing land ecosystems. University of Florida Extension. https://edis.ifas.ufl.edu/pdles/SS/SS57400.pdf



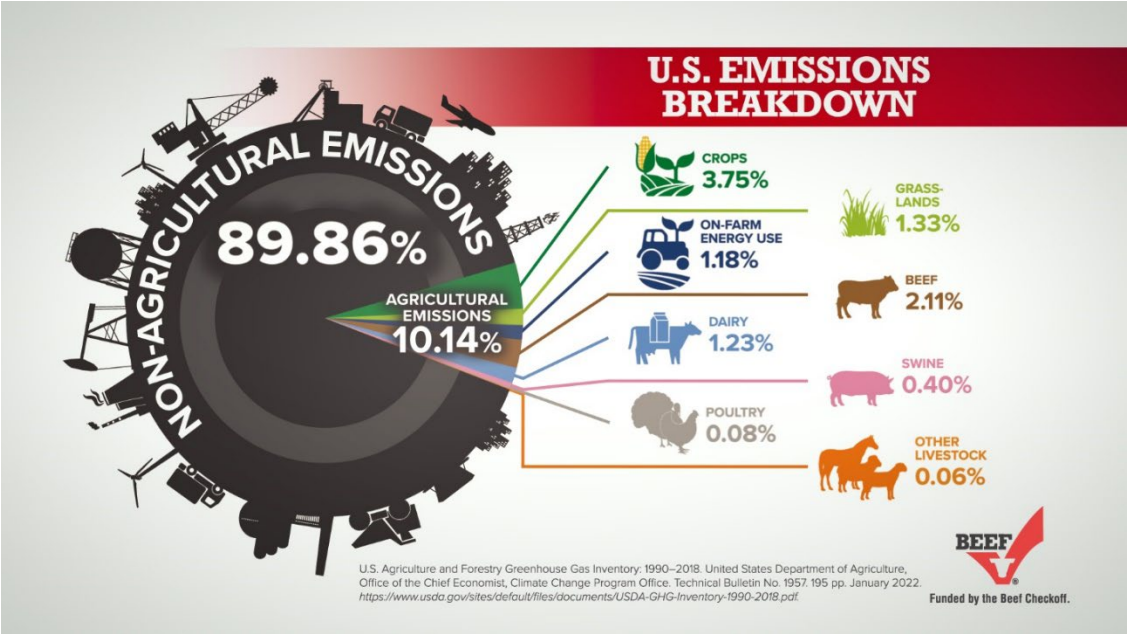
*Series written by Jessica Sadler, Science Educator and STEAM Facilitator*


*Series brought to you by beef farmers and ranchers from across the U.S.*

Name: **Answer Key** _____

## ACTIVITY: Cattle Carbon Cycling C.E.R and Debate

**Please review the figure below and answer the questions that follow:**



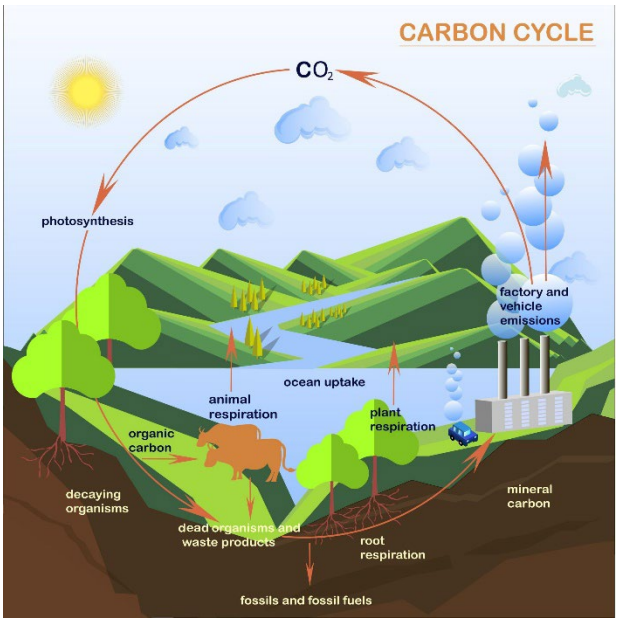

1. What do all the images circling the pie chart have in common? Sources of greenhouse gas emissions
2. Name three things, not related to farming, that produce greenhouse gas emissions. eg. industry, transportation, electricity, etc…
3. What is the total percentage of the agriculture-related emissions? 10.14%
4. What percentage of the agricultural emissions is labeled as “beef”? 2.11%
5. If people stop eating beef, would it significantly slow down climate change?
6. Are cows the main contributors to climate change?
7. What are some other factors that contribute to climate change?

Responses to 5, 6, and 7: Encourage students to critically evaluate these perspectives and consider the complexities of the issue. Climate change is a multifaceted problem, and addressing it requires a comprehensive approach that considers not only diet but also broader societal and environmental factors.

8. How can people help reduce carbon emissions? student examples: turn off lights when not in use; use energy-efficient light bulbs, use public transportation, walk, bike or carpool to school; drink from re-usable water bottles; minimize food waste by planning meals; buy secondhand or vintage clothing and goods

Name: Answer Key

# Inside the Lab: The Carbon Cycle




**Background:** Carbon, a chemical element, is an important part of nearly all living things. It can be found in cells and is present in all organisms. Organisms need carbon for energy, and they obtain it from their surroundings. Plants get carbon through a process called photosynthesis, while animals get carbon by eating plants or other organisms that have consumed plants.

So, what do organisms do with carbon compounds? Most organisms use a process called cellular respiration to release energy from food. This process requires oxygen. However, fungi use a different process called fermentation, which doesn't need oxygen. When food is broken down during these processes, energy is released. Organisms then use carbon and other elements to build their own molecules. As a result, waste products are produced.

One of the waste products of respiration and fermentation is carbon dioxide. Photosynthetic organisms, like plants, absorb this carbon dioxide and use it in photosynthesis. The carbon becomes part of the plant's structure and may eventually be consumed by an animal. The continuous movement of carbon through organisms, the atmosphere, and back is called the carbon cycle.

**Pre Lab-Questions:**

1. Why do organisms need carbon? Carbon is fundamental to life: structural backbone of biomolecules, provides energy, supports formation of structures, and plays a role in the functioning of ecosystems

2. How do plants, animals, and fungi obtain carbon? (What are the three processes?) Photosynthesis, consumption, fermentation (decomposition)

**Procedure:**

In this experiment, you will be working with yeast, which is a type of single-celled organism called a fungus. Yeast gets energy from food through a process called fermentation. By giving yeast different types of food, we will find out what it uses as its source of energy.

a. Label the three beakers: "1", "2", and "3"
b. Add 1 gram of yeast into each beaker
c. Add 1 gram of sugar to beaker 2 and 1 gram of salt to beaker 3
d. Add 100 mL of warm water to each beaker and stir gently
e. Observe what happens in each beaker over the next 10-15 minutes and record your observations in the table. Look for bubbles rising to form a foamy layer; this is evidence of carbon dioxide production.

| Reaction of Yeast to Different Food Sources | |
|---|---|
| **Beaker** | **Observations** |
| **1 (yeast only = control)** | Might have some bubbles; warm water can activate the yeast a little |
| **2 (yeast & sugar)** | Mixture doubles in size, bubbles; warmer temperature of mixture |
| **3 (yeast & salt)** | No bubbles |

**Analysis:**

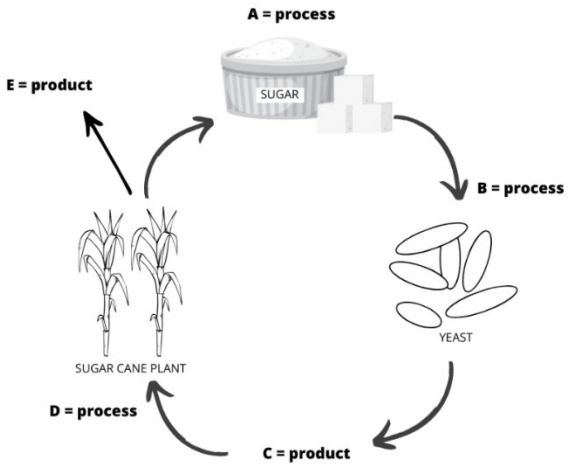
3. In which of the beakers did you observe bubbling? What does this indicate? #2, minimal in #1

4. Did you detect any specific odors from any of the beakers? What might be causing these smells? Gas production = carbon dioxide, some ethanol

5. Why do you think fermentation didn't occur in all of the beakers? Salt slows down or kills yeast

6. In the experiment described above, what was the source of carbon dioxide released by yeast? sugar

7. In the diagram below, fill in the blanks to explain what is occurring during each step.




A - Consumption

B - Fermentation

C - Carbon dioxide

D - Photosynthesis

E - Carbon dioxide/ethanol

8. Where do humans fit into the cycle depicted above? A

9. How is burning gas in a car similar to the digestion process in living organisms? Use gas as energy

10. Sugar acts as a fuel for living organisms, while gasoline, derived from the remains of deceased organisms, serves as fuel for cars. Why is there so much stored energy in these fuels?
Fossil fuels like coal, oil, and natural gas formed over a very, very long time - millions and millions of years under unique conditions. The large amount of carbon in fossil fuels is because of this very slow and natural process.