Teacher's Guide

Welcome to Topic 3 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.

- Page 2. Interactive Maps: bit.ly/beefinteractive
- Page 2. Why Do Ranchers Burn Their Pastures: bit.ly/3Hrrt8M
- Page 3. AgCareers: https://biwfd.com/3RvdoMf
- Page 3. Water Footprint Assessment Tool: bit.ly/waterinteractivetool

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:

- The Vocabulary Words "Smoke Drift" and "Routine Burn" are located within the "Why Do Some Ranchers Burn Their Pastures" section on Page 2 and the words are not bold.
- 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
This page covers how cattle help ecosystems thrive on different land spaces. If you are a teacher in Kansas or Oklahoma, this is an excellent opportunity to encourage students to explore more about the Flint Hills and how landscape would be impacted if cattle and prescribed burns weren't utilized to control invasive species. This understanding can be applied to lessons on habitats if desired.

Completing the worksheet will help students make connections to language arts skills by comparing and contrasting acres of pastureland with acres of land used for cattle. They will also practice reading interactive maps and data. You could organize students into three different groups, each focusing on one aspect of the Venn diagram. Then, they can share their findings in a three-part jigsaw activity.

Page 3
The focus of this page is ecosystems and water, particularly in relation to cattle. Students will learn about different types of water, specifically: green, blue, and gray. They will utilize an interactive water tool to make observations of these different water types. Allocate approximately 10 minutes for students to explore and take notes on their observations before beginning a discussion.

Below are some questions to help facilitate the discussion, but feel free to add to the list. Note the tool includes features for students to examine different countries worldwide, compare water usage by commodities, compare countries, etc. However, the questions below primarily focus on the United States.

1. Which regions of the United States have the highest usage of each type of water? Remember, the darker the color, the more usage in that area.
2. If you examine domestic water usage and select the green category, why does nothing show up? Students should suggest something along the lines of green water being rainwater and not having the need for human impact to be used.
3. When you click the bar graph icon on the right, which country has the highest total water footprint? China
4. Using the same graph, what is the highest water usage type for the United States? Gray Water
5. What is that type of water primarily used for in the cattle industry? Gray water is water that has already been used but isn't contaminated with feces allowing it to be used for cleaning animal facilities and such.
6. What surprising aspects are you discovering from the information provided in this interactive tool? Answers will vary.

Utilize the AgCareer cards and resume template to engage students in exploring potential STEM career paths.

Page 4

This lab from TeachEngineering.org will require students to collect data and engineer and design possible solutions for improving water quality and management. It requires minimal supplies and access to the "Teach Engineering" lab instructions. Not only does this lab facilitate discussion about water, cattle, and sustainability, but it also integrates Engineering and Design Standards as part of NGSS. Plan for a minimum of two class periods to complete this lab, with the option to extend as needed based on class sizes and timing. **Lab procedures and handouts available via open access at:** https://www.teachengineering.org/activities/view/cub_humanwatercycle_lesson01_activity1

Optional video on sustainability practices in agriculture in other countries: https://www.youtube.com/watch?time_continue=200&v=59KvzvWkaVM&embeds_euri=https%3A%2F%2Fagclassroom.org%2F&source_ve_path=Mjg2NjM&feature=emb_logo

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

Next Generation Science Standards (NGSS)

Middle School Science

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

High School Science

- HS-LS2-6. Evaluate the effects of resource availability on ecosystems and the relationships between ecosystem dynamics and population dynamics.
- HS-LS2-8. Evaluate the evidence for the role of biodiversity in the stability of ecosystems and the impact of human activities on these ecosystems.
- HS-ESS2-4. Use a model to describe the cycling of water through Earth's systems, including the influence of the water cycle on weather patterns and climate.
- HS-ESS3-6. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems, taking into account the sustainability of the solution.

Reader Citations

Page 2. United States Dept of Agriculture.

- Broocks et. al. 2017b. Corn as Cattle Feed vs. Human Food. Oklahoma State University. https://extension.okstate.edu/fact-sheets/corn-as-cattle-feed-vs-human-food.html
- USDA-ERS. 2021a. Economic Research Service using data from the Major Land Use data series. Available at: https://www.ers.usda.gov/data-products/major-land-uses.aspx

Page 2. Carbon storage.

- Pendall, E., D. Bachelet, R.T. Conant, B. El Masri, L.B. Flanagan, A.K. Knapp, J. Liu, S. Liu and S.M. Schaeffer, 2018: Chapter 10: Grasslands. In Second State of the Carbon Cycle Report (SOCCR2): A Sustained Assessment Report [Cavallaro, N., G. Shrestha, R. Birdsey, M.A. Mayes, R.G. Najjar,S.C. Reed, P. Romero-Lankao, and Z. Zhu (eds.)]. U.S. Global Change Research Program, Washington, D.C., pp. 399-427. Using EPA's GHG Equivalency Calculator and this study for the carbon stocks estimates: Total grassland carbon stocks in the conterminous U.S., estimated to be about 7.4 petagrams of carbon (Pg C) in 2005, are projected to increase to about 8.2 Pg C by 2050.
- EPA. 2021a. Greenhouse Gas Equivalencies Calculator. Updated March, 2021. Greenhouse Gas Equivalencies Calculator | Energy and the Environment | US EPA.

Page 3. Cattle Ecosystem Services.

- Broocks, Ashley et al. 2017a. Carbon Footprint Comparison between Grass- and Grain-finished beef. OSU Extension, AFS-3292.
- Scott, Dave. 2018. Livestock as a Tool: Improving Soil Health, Boosting Crops. NCAT. Found on https://attra.ncat.org/product/livestock-as-a-tool-improving-soil-health-boosting-crops/
- Maher et al. 2020. National and State Economic Values of Cattle Ranching and Farming-Based Ecosystem Services on Federal and Private Lands in the U.S. Sustainable Rangelands Roundtable Publication
- Baber, J.R. et al., 2018. Estimation of human-edible protein conversion efficiency, net protein contribution, and enteric methane production from beef production in the United States. Trans. Anim. Sci. 2(4): 439-450.

Page 3. Cattle industry water use.

- **Gerbens-Leens et al. 2013. The water footprint of poultry, pork and beef: A comparative study in different countries and production systems. Water Resources and Industry 1-2: 25-36.**

Page 4. Cattle industry water use.

- Rotz CA, S Asem-Hiablie, S Place, G Thoma., 2019. Environmental footprints of beef cattle production in the United States. Agricultural Systems 169:1-13.
- Klopatek, S.C., Oltjen, J.W., 2022. How advances in animal efficiency and management have affected beef cattle's water intensity in the United States: 1991 compared to 2019. Journal of Animal Science 100.
- Dissmeyer, G.E. 2000. Drinking Water from Forests and Grasslands: A synthesis of the scientific literature. USDA Forest Service. SRS-39. Found on https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs039/gtr_srs039.pdf

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

Name:_____

Maximizing Marginal Land Through Grazing
Venn Diagram Activity

Directions: Complete the Venn diagram by using map data from, https://bit.ly/beefinteractive. Follow these directions to get to the correct maps.

1. Click the red Maps rectangle. Ex: 

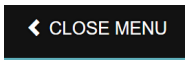
2. Click the Agricultural Option. Ex: 

3. Choose the Acres-Pastureland Ex: 

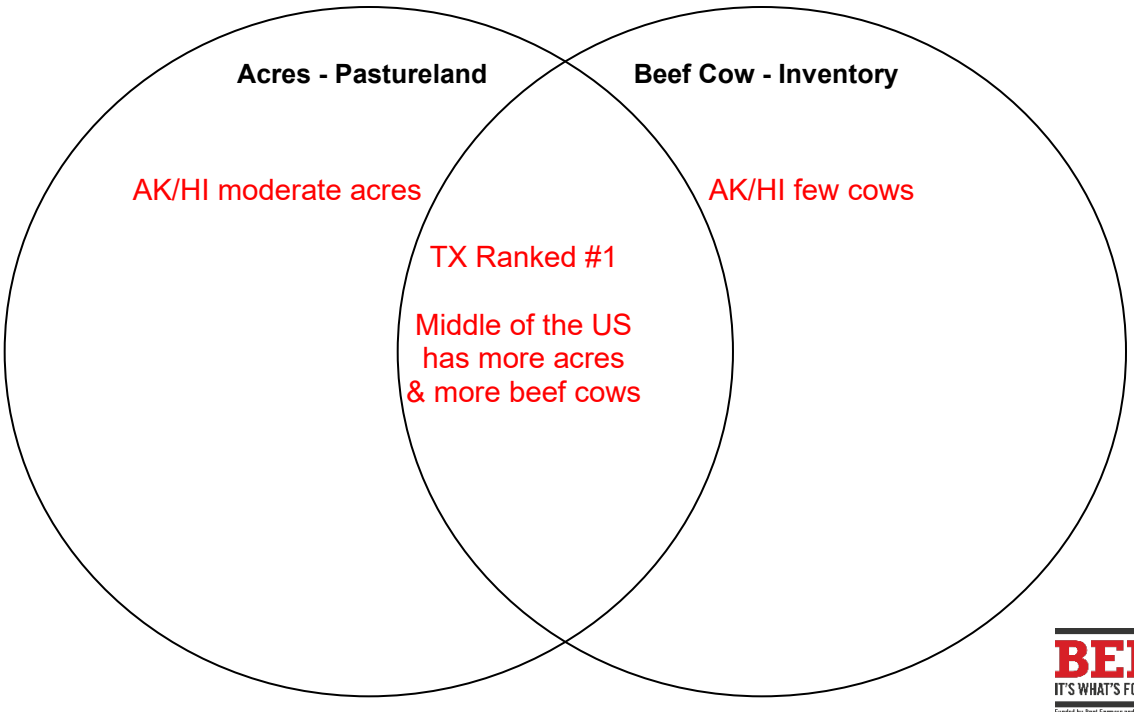
4. Click the mirror rectangle Ex: 

5. Click the red Maps Rectangle Ex: 

6. Scroll to the Beef Cow- Inventory and select Ex: 

7. Click the Close Menu Option Ex: 

8. Now you can compare the two Maps side by side and fill in the diagram below
   Hint: Focus on rankings, head of cattle, amount of land, “Legend” info, etc.



BEEF. IT'S WHAT'S FOR DINNER.
Funded by Beef Farmers and Ranchers

Name:_____

DID YOU KNOW? Why Do Some Ranchers Burn Their Pastures? Answer Key

Directions: Use the QR Code or bitly (**http://bit.ly/3Hrrt8M**) found on page 2 of the reader to complete the questions below.

1. How would you describe the Flint Hills? E.g. region of tallgrass prairie in Kansas, known for its rugged terrain and unique ecosystem

2. Name three main reasons that this area of land is used for cattle? E.g. nutrient-rich soil, abundant native grasses, and minimal trees

3. What are some of the benefits of **routine burns** in the Flint Hills? E.g. help maintain the health of the prairie, control invasive species, and improve the quality of forage for cattle

4. If routine burns were not conducted, how long would it take for the Flint Hills to become a forest? 10 to 15 years

5. How do ranchers reduce **smoke drift**? E.g. by conducting burns under favorable weather conditions and using firebreaks to control the spread of smoke

6. How much weight can cattle gain per day eating the fresh grasses after a burn? Up to 3 pounds per day