Evaluating Solutions for Sustainable Ranching in the Southwest

Description
Students will evaluate one of three solutions that hold promise for creating more sustainable beef production in the southwest: (1) the use of a heritage breed, the **Rarámuri Criollo**, or Criollo crossbreeds, rather than traditional cattle breeds; (2) the use of **precision tools** (such as GPS collars and water sensors); (3) the production of **grass-fed beef** as an alternative to the traditional beef supply chain. These topics stem from a large research project at New Mexico State University from 2019-2025. The module is designed to be completed as an in-class project, with some out-of-class work time for students. FFA students may also choose to expand upon their presentation and participate in the FFA Agricultural Issues Forum event.

Grade Level
9^{th} – 12^{th} grades

Objectives
Students will:

- choose one of three potential solutions to promote sustainable beef production in the southwestern United States.
- analyze the strengths and weaknesses of the solution.
- create an oral presentation that showcases both strengths and weaknesses of the solution.
- present information and provide peer review of other students' presentations.

Next Generation Science Standard
HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Science & Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information	ETS1.B Developing possible solutions	Cause and Effect

Common Core State Standards
English Language Arts
CCSS.ELA-LITERACY.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
CCSS.ELA-LITERACY.RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

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Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards

CRP.07.CCTC Standard: Employ valid and reliable research strategies. Career ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use a reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices. The use an informed process to test new ideas, information and practices in their workplace situation.

CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them.

Depending on which of the three research topics students choose for their presentations, they may also be addressing the following AFNR Standards:

Rarámuri Criollo

AS.01. Analyze historic and current trends impacting the animal systems industry.

AS.05. Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.

AS.06. Classify, evaluate and select animals based on anatomical and physiological characteristics.

AS.08. Analyze environmental factors associated with animal production.

Precision Tools

BS.01. NCAE Standard: Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., historical events, societal trends, ethical and legal implications, etc.).

BS.03. NCAE Standard: Demonstrate the application of biotechnology to solve problems in Agriculture, Food and Natural Resources (AFNR) systems (e.g., bioengineering, food processing, waste management, horticulture, forestry, livestock, crops, etc.).

Grass-Fed Beef

AS.01. Analyze historic and current trends impacting the animal systems industry.

FPP.04. Explain the scope of the food industry and the historical and current developments of food product and processing.

Research Question

Is your solution (Rarámuri Criollo cattle, precision tools, or grass-fed beef) an effective way to improve the sustainability of beef production and ranching in the southwestern United States?

Time

Two (or three) 45-minute lessons

Background

This lesson was inspired by the Agricultural Issues Forum developed by the FFA to help students learn about agricultural issues in their local region. In the Forum, students research a local agricultural topic, create a presentation that showcases both sides of the issue, and then present their work at local forums and at state and national competitions. Students present all sides of an issue without advocating for a particular solution. The FFA Agricultural Issues Forum prepares students to become future leaders in agriculture.

Through this lesson, students will learn about the Sustainable Southwest Beef Project, a five-year USDA-NIFA funded project that promotes ranch and rangeland sustainability in the southwestern

United States. The diverse team studies the following solutions as possible means to help keep ranching and rangelands ecologically and economically healthy as climate, markets, and policies change:

1. Rarámuri Criollo: Rarámuri Criollo cattle have undergone natural selection for generations to thrive in the harsh environments of Mexico's Copper Canyon. Preliminary research suggests that, compared to common cattle breeds, Rarámuri Criollo travel greater distances from water, spend more time traveling, and appear to experience less heat stress, while maintaining weight and body condition. Ranchers have observed, and research also suggests, that smaller framed and more mobile Rarámuri Criollo may have a lower impact on sensitive soils and vegetation and exhibit desirable reproductive and mothering characteristics.
2. Precision Tools: Precision tools include sensors for automated monitoring of livestock location and health and other components of ranching such as stock tanks, drinkers, rainfall, and forage growth. Precision tool systems are fairly common in croplands and in intensive animal agriculture but are rare in ranching operations. A well-calibrated, user-friendly precision ranching system could aid ranchers in making rapid decisions to address issues of animal health and forage shortage.
3. Grass-Fed Beef: From grazing lands to feed yards, traditional U.S. beef production systems involve the movement of cattle, feed, and money between multiple regions of the United States. The Sustainable Southwest Beef Project investigates multiple opportunities and challenges in traditional and alternative supply chains. In this lesson, students will learn more about one alternative supply chain: the production of grass-fed beef on southwestern rangelands.

Both the FFA program and the Sustainable Southwest Beef project are working toward the sustainability of agriculture for future generations. The goal is to meet all of society's food needs while maintaining the ability for future generations to be able to do the same.

Lesson 1: Introduction to the Project and Planning a Presentation

Materials all available at https://asombro.org/**solutions**/

- PowerPoint presentation
- Computer and projector for teacher
- Student Worksheet Packet; 1 per student
- Solutions pages PDFs: Rarámuri Criollo, Precision Tools, and Grass-fed Beef

Preparation

1. Download, print double-sided copies, and staple the worksheet packets (1 per student).
2. Download and print double-sided copies of the each of the solution pages (1 per student).
3. Set up a computer and projector and be ready to display the PowerPoint presentation.

Procedures

An Introduction to the Problem: The Need for Sustainable Beef Production (15 minutes)

- Slide 1: Today we will learn about a real-world problem in the southwestern United States: the production of beef in a way that is sustainable for ranchers, consumers, and the environment.

You'll learn about three potential solutions, research one of them, and then create a presentation that teaches about the strengths and weaknesses of these possible solutions.

- Slide 2: Why study beef production?
    - The global demand for beef is continually increasing.
    - The United States is top beef producer worldwide.
    - There are 25,000 ranches in the southwestern U.S.
    - Cattle are an important part of the social fabric of rural America: most beef cattle operations are small (<50 head) and family owned.
- Slide 3: Economic importance of cattle
    - Beef and dairy production are important areas of research since they are the largest forms of income in agriculture for the southwestern states including California, New Mexico, Arizona, Utah, Oklahoma, and Texas.
        - With these six states combined, agricultural income from beef and dairy is 48% of the annual agricultural income (source: 2017 agricultural reports).
        - [Click to advance slide.] Dairy and cattle contribute 3.3 billion dollars in annual income for these states combined.
- Slide 4: Challenges for ranchers in the southwest
    - Cattle ranchers are facing a lot of challenges in the current beef market such as:
        - Consumer concerns about beef production and their desire for environmentally friendly beef
        - Small profits for ranchers
        - Warming and drying climate
        - Reliant on other regions for finishing, marketing, distribution
- Slide 5: Sustainable Southwest Beef Project
    - These sustainability concerns (climate stressors, low profit margins, and environmental impacts associated on vegetation changes and water issues) are the foundation of the Sustainable Southwest Beef Project.
    - This project is funded through a grant from the United States Department of Agriculture through the National Institute of Food and Agriculture's Sustainable Agricultural Systems program.
    - The project includes ranchers, scientists, educators, and extension specialists.
    - They are investigating three possible solutions to help produce beef more sustainably.
- Slide 6: Steps to completing your presentation
    - You have five steps to complete:
        - First, you will choose one of the three solutions to focus on for your project.
        - Second, you will carefully read a two-page summary paper on that solution.
        - Third, you will create a presentation about the strengths and weaknesses (or pros and cons) of your solution.
        - Fourth, you will give your presentation.
        - Finally, you will provide feedback to your classmates on their presentations.
- Slide 7: Three possible solutions
    - These novel solutions, that you will be choosing from are part of the Sustainable Southwest Beef project:
        - Rarámuri Criollo (räh-räh-mur-ē krē-ō-yō)
        - Precision Tools
        - Grass-Fed Beef as a Supply Chain Option

- Slide 8: Rarámuri Criollo
    - This type of cattle has been adapting to the desert environment of Copper Canyon, in northern Mexico, for 400 years and can survive where other cattle cannot, especially in arid and semi-arid landscapes.
    - Missionaries introduced these cattle to the Tarahumara Indians, and they gave the cattle this name, which means "light-footed ones."
    - Since they have not left the area, these cattle have become well adapted to dry, hot regions.
    - Many studies of this breed of cattle have shown that they have different grazing behaviors when compared to other cattle. Researchers believe these grazing behaviors may be key, especially when there is less food available.
- Slide 9: Precision Tools
    - Using technology like precision tools is rare on ranches but fairly common in croplands.
    - These ranching tools include smart sensors for monitoring livestock (e.g., GPS animal sensors on collars), water tanks, and rainfall within a rangeland.
    - This research is not only looking into how this technology will help ranchers but also examining the cost, durability, and maintenance of such equipment.
    - The study is creating a precision tools system to log, transmit, and analyze animal, weather, and drinker sensor data in close-to-real time.
- Slide 10: Grass-Fed Beef
    - This portion or the Sustainable Southwest Beef Project is looking at alternative ways to take cattle from birth to beef production, such as grass-fed beef.
    - **Grain-finished** beef is currently more common. It requires more water and transportation. Cattle are moved to feedlots in other parts of the country.
    - **Grass-fed and grass-finished** beef
        - Only eat grass and other forage, no grain
        - Must have continuous access to rangelands or pastures
        - Viability is heavily dependent on consumers being willing to pay more for beef
- Slide 11: Step 1 – Choose your solution
    - *Suggestion: put students into five groups so that you have time to watch all presentations in one class period.*
    - You and your group will read about one of these three solutions. Please choose that solution now and mark it on page 1 of your worksheet.

An Introduction to the Student Project (10 minutes)

- Slide 12: What do you think is needed for these solutions to be successful in making beef production sustainable? Think about what we, as a society, use to determine success of a company or project. For example, we may think of profits or the environment as ways to measure success or as criteria for success. What criteria of success would you use to determine if a solution is successful? Brainstorm criteria for success in sustainability.
- Slide 13: Five Domains of Sustainability - The Sustainable Southwest Beef Project is looking at achieving sustainability through five domains that have been defined in the Sustainable Intensification Assessment Framework.
    - Productivity –maintaining or increasing current levels of productivity.
    - Economic – the profitability of beef production.

    - Environmental – looking at the natural resources that support beef production (e.g., water, soil), the environment affected by this production (e.g., habitat), and the pollution resulting from it (e.g., pesticides and greenhouse gas emissions).
    - Human – keeping consumer choices for beef at the individual or household level under consideration.
    - Social – creating equitable relationships within the community or landscape where beef production is taking place (e.g., resolving conflicts between agriculture and natural resource management).
- Slide 14: Our criteria for success
    - You will evaluate your possible solution against two domains of sustainability: environmental and economic.
    - What are the strengths and weaknesses of the solution related to environmental sustainability?
    - What are the strengths and weaknesses of the solution related to economic sustainability?
- Slide 15: Step 2 – Read about your solution from the two-page information sheet and look for strengths and weaknesses based on the criteria for success.
    - The objective of your research is to find effective solutions to keep ranching and rangelands ecologically and economically healthy as climate and markets change.
    - Take notes on the strengths and weaknesses you find.
    - List at least one strength and weakness for environmental sustainability and economic sustainability.
- Slide 16: Step 3 – Plan a presentation
    - Think about how you will present the strengths and weaknesses of the solution.
    - Create an attention-grabbing opening.
    - Possible presentation ideas: newscast, talk-show, skit or play, game show, commercial, song
- Slide 17: Step 4 - Present
    - You will have five minutes for your presentation, which needs to include:
        - An attention-grabbing introduction
            - The introduction should explain the solution and give a statement about why this solution is important.
        - Strengths of the solution
        - Weaknesses of the solution
        - Information about whether or not this solution is sustainable environmentally and economically.
        - It needs to be a creative and informative presentation.

- Slide 18: Step 5 – Provide feedback
    - All of these presentations will be evaluated by your peers.
    - Each of you will be completing a scorecard for the other groups in the class.
        - You can use this scorecard to help you plan and write your presentation.
        - Page two of your worksheet has a checklist of these items from the scorecard to help you make sure all of the components are in your presentation.
- Slide 19: Today's tasks
    - For today we will focus on steps one through three.

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Work Time to Choose Solution and Begin to Read and Evaluate (15 minutes or more)
**Students who work quickly will be able to complete the front of the worksheet in 12-15 minutes; other students may need 20 minutes.*

- Slide 20: Choose a solution and begin to read and evaluate
    - You have the rest of class to work.
    - *After about 15 minutes, encourage students to finish their reading and worksheet and move on to planning their presentation.*

**Students who work quickly may be ready for presenting on the second day. Other students may need another class period to create and prepare for their presentations. Modify the number of days for the lesson based on student needs.*

Lesson 2: Presentations and Peer Feedback

Materials all available at https://asombro.org/solutions/
- PowerPoint presentation (from lesson 1)
- Computer and projector for teacher
- Worksheets as completed in previous lesson
- Presentation scorecards

Preparation
1. Provide students with adequate time between lessons for them to complete their presentation.
2. Download, print single-sided and staple copies of presentation scorecards (1 packet per student).
3. Ensure all students have their worksheet packet from the previous lesson to turn in.
4. Download the PowerPoint presentation to the computer or a thumb-drive.
5. Set up a computer and projector and display the PowerPoint presentation.
6. Have timer set for five minutes and ready for presentations.

Procedures
Reminder of the Goals of the Project and Presentations
- Slide 21: Today we will make presentations to evaluate three possible solutions for sustainable ranching the southwest.
- Slide 22: Presentation time … almost!
    - You will have time *(we suggest ten to fifteen minutes)* to finish and practice your presentation.
- Slide 23: Presentation scorecard
    - All of these presentations will be peer-scored.
    - Each of you will be completing a peer scorecard for the other groups in the class.
    - You will answer "yes" or "no" for each statement on the score card by placing a tally in the appropriate column.
    - You will then total the columns at the bottom of each table for each group.
    - Your time starts now. (*Start a timer for the time you allotted*.)

Time to Present
- Slide 24: Time to present

- Each group will have five minutes to present.
- Remember to state your group or presentation name before presenting.
- You will be informed when time is up.
- If you're not presenting, make sure to fill in a peer review.

Wrap-up

- Slide 25: In the last two minutes of class:
  - We've now come to the end of this lesson.
    - Please finish your scorecards and turn in your work.
  - These are the Science and Engineering Practices we covered in this lesson:
    - Obtaining, Evaluating, and Communicating Information
    - Engaging in an Argument from Evidence
  - Great job today!

Literature Cited and Additional Resources

Agricultural Issues Forum - 90th National FFA Convention & Expo YouTube Video: https://www.youtube.com/watch?v=z5QyBX05hZo

Agricultural Issues Forum: Leadership Development Events - WATCH: More about the Agricultural Issues CDE Video: https://www.ffa.org/participate/cde-lde/agricultural-issues-forum/

FFA Agricultural Issues Forum: https://www.ffa.org/participate/cde-lde/agricultural-issues-forum/

Southwest Beef Project Overview and Fact Sheets: https://southwestbeef.org/resources/fact-sheets/

Walthall, C.L., J. Hatfield, P. Backlund, L. Lengnick, E. Marshall, et. al. 2012. *Climate Change and Agriculture in the United States: Effects and Adaptation.* USDA Technical Bulletin 1935. Washington, DC. Accessed 26, Apr. 2021 Web: https://www.usda.gov/sites/default/files/documents/CC%20and%20Agriculture%20Report%20(02-04-2013)b.pdf

What is Sustainable Agriculture: https://sarep.ucdavis.edu/sustainable-ag