Lesson Plan:

Beef Sustainability, Nutrition & Quality (Neutral Version)

Grade Level: High School (Ag Education, Animal Science, Environmental Science, FCS)
Duration: 50 minutes
Unit Placement: Animal System – Beef Production OR Environmental Systems - Sustainability
Topic: Comparing sustainability, nutrition, and consumer perceptions of grass-fed vs. grain-fed beef

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Teacher Prep (Before Class)

1. Purchase both grass fed, and grain fed beef samples.
2. Cook and portion grass-fed and grain fed beef and label them as Sample A & B
3. Arrange a taste test station for both samples
4. Review difference in production systems, nutrition and sustainability; focus on tradeoffs, not “better”
5. Copy Student Worksheets (1 per student)

Learning Objectives

Students will be able to:

1. Describe grass-fed and grain-fed beef production systems.
2. Compare beef’s nutritional profiles from both systems.
3. Analyze sustainability factors: land use, water use, feed efficiency, and GHG emissions.
4. Conduct a guided taste test and evaluate differences in tenderness, juiciness, and flavor.
5. Identify trade-offs between production systems and connect them to consumer preferences.

ODE Agricultural Standards

- Animal Systems 2.2 – Evaluate management practices for efficiency, animal health, and environmental stewardship.
- AN.2.3 – Analyze factors affecting animal growth, feed efficiency, and production output.
- Environmental Systems 2.1 – Analyze agricultural practices that impact sustainability of natural resources.
- ES.2.2 – Evaluate strategies to reduce environmental impact while maintaining productivity.
- Food Science & Nutrition 3.4 – Evaluate the impact of production systems and processing on nutrient content and quality of food products.
- FS.3.5 – Analyze how food characteristics, sustainability, and marketing affect consumer choices.

Materials Needed

- Cooked beef samples: Grass-fed and grain-fed (equal portions, labeled “Sample A” and “Sample B”).
- Plates, forks, napkins, gloves, food-safe prep area.
- Student worksheets.

Lesson Procedures:

1. Bell Ringer / Engagement (5 minutes)

- Ask: *"When you hear 'sustainable beef,' what comes to mind? Grass-fed or grain-fed? Why?"*
- Students write 2–3 bullet points individually (worksheet Part 1).
- Discuss common themes; record under two columns: Grass-fed vs. Grain-fed on the white board for a group discussion.
- Ask: *"What factors influence your choice when eating beef?"* (taste, nutrition, sustainability, price).

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2. Taste Test – Required Component (10 minutes)

- Distribute samples labeled "A" and "B."
- Students taste both and **rate differences** (not "better") on tenderness, juiciness, flavor, and overall experience.
- Record class averages on the board.
- Reveal which is grass-fed vs. grain-fed.
- **Discussion Prompt:**
  - How do the tastes differ?
  - Would consumer preference always match sustainability data or nutrition?

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3. Beef Nutrition Comparison (10 minutes)

Students will compare the nutritional profiles of grass-fed and grain-fed beef. The goal is to highlight differences and trade-offs, not to promote one system as healthier.

Key Nutrients in the Example Table:

Nutrient	Units	Explanation	Source / Notes
Calories	kcal per 3-oz cooked ribeye	Total energy from protein, fat, and carbohydrates (negligible in beef). Grass-fed tends to be leaner → slightly lower calories.	USDA FoodData Central, 2023; Daley et al., 2010 (peer-reviewed study).
Protein	g per 3-oz	Essential for muscle growth, repair, and overall nutrition. Protein content is very similar in both systems (~22g per 3-oz).	USDA FoodData Central; NCBA educational resources.
Total Fat	g per 3-oz	Includes saturated, monounsaturated, and polyunsaturated fat. Grass-fed is leaner (~8g vs. 13g).	USDA FoodData Central; Daley et al., 2010.
Omega-3 Fatty Acids	mg per 3-oz	Grass-fed beef tends to have higher omega-3s due to pasture grazing. These are beneficial polyunsaturated fats.	Daley et al., 2010; Duckett et al., 2009.
Vitamin B12	mcg per 3-oz	Important for nerve function and red blood cell production. Slightly higher in grass-fed due to differences in feed and metabolism.	USDA FoodData Central; NCBA resources.

Teacher Notes

- Emphasize that both grass-fed and grain-fed beef are highly nutritious, providing high-quality protein, iron, zinc, and B12.
- Highlight differences, not "better/worse":
- Grass-fed: leaner, more omega-3s.
- Grain-fed: slightly higher fat content, slightly higher calories, same protein.
- Encourage students to think about consumer priorities: taste, nutrition, and dietary needs.

Discussion Prompts:

- How do these nutritional differences reflect production methods?
- Could these differences influence a consumer's choice? Why or why not?
- Are these differences large enough to make one "healthier," or are they just different?

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4. Sustainability Data Analysis (10 minutes)

Students will compare grass-fed and grain-fed beef production systems using measurable sustainability metrics. The goal is to highlight differences and trade-offs, not to judge one system as "better."

Metric	Units	Explanation	Source / Notes
Land Use	acres per pound of beef	Total land required to produce 1 pound of edible beef	Derived from life-cycle assessments (LCAs) such as Pelletier et al., 2010; Dalgaard et al., 2008. Grass-fed beef uses more pasture, grain-fed uses more feedlot and cropland for feed.
Water Use	gallons per pound of beef	Includes green water (rainfall on pasture), blue water (irrigation for feed crops), and gray water (water to dilute pollutants).	Sources: Mekonnen & Hoekstra, 2012; USDA LCA data. Calculated by summing pasture irrigation and feed crop water use.
Feed Conversion Ratio (FCR)	lbs feed per lb beef	Amount of feed required for 1 lb of live weight gain. Grass-fed systems often have higher FCR because cattle grow slower on pasture.	USDA & peer-reviewed studies (e.g., Duckett et al., 2009). FCR = Total feed consumed ÷ weight gained.
GHG Emissions	kg CO_2e per pound of beef	Includes methane from enteric fermentation, manure management, and feed production.	Sources: NASEM, 2016; FAO 2013. Calculated using LCA models summing all emission sources per pound of finished beef.

Teacher Notes

- Explain that these numbers are averages from multiple studies. Actual values vary by region, breed, feed, and management practices.
- Emphasize trade-offs rather than "better/worse." For example:
  - Grass-fed uses more land but may have other benefits (perceived animal welfare, taste).
  - Grain-fed is more efficient per pound but relies on concentrated feed crops.
- Encourage students to think critically about what each number represents and how it might affect producers and consumers.

Discussion Prompts:

- How do these numbers reflect the trade-offs in beef production?
- Would these numbers look different if cattle were raised in another region?
- How might consumer priorities (taste, sustainability, price) influence production decisions?

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4. Reflection & Class Discussion (10 minutes)

- Allow students to complete the reflection questions, discussing the differences between the two systems.

Notes:

About the Ohio Beef Council

The Ohio Beef Council (OBC) is a non-profit 501(c)(5) organization charged with the promotion and marketing of beef and beef products in Ohio. Checkoff dollars are used to increase beef demand through programs of promotion, research and education. The organization is directed by a 15-member Operating Committee of cattlemen appointed by the Ohio Director of Agriculture, representing the state's beef and veal producers.