

LESSON 1.7

Facilities Design

COMPETENCY	STANDARDS
- Assess livestock facility needs by devising a plan. - Evaluate current issues in animal agriculture.	- AG3.AS1.C.i - AG3.AS2.C.j - AG3.AS3.C.k - AG3.AS4.C.l - AG3.AS5.C.m - AG3.AS6.C.n - ESS3.C.1 - ETS1.B.2 - SS.EC.4 - SS.G.4.2 - A-SSE.1 - S-ID.9 - ELA.WHST.9-12.2 - ELA.RST.11-12.9

LESSON OBJECTIVES

During the lesson, the student will...

1. Create a facilities plan that incorporates relevant equipment.

ENABLING OBJECTIVES

During the lesson, the student will...

1. Use principles of low-stress livestock facilities to design basic facilities for each production/enterprise's needs.
2. Estimate the financial demands to purchase a list of basic equipment required to start a beef enterprise.
3. Inspect environmental management concerns relevant to the beef industry.
4. Design a waste management plan for a beef enterprise considering best management practices.
5. Create a cleaning and sanitation practices list for a beef enterprise.

TIME

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160 minutes	OR	4 of 45-minute segments/class periods
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RESOURCES, TOOLS, EQUIPMENT, AND SUPPLIES

- PowerPoint Slides
- Printed handouts
- Pens/Pencils for students

REFERENCES

- **Regulatory & Environmental Management Sources:**
 - Local, state, and federal regulations on cattle facilities
 - Best Management Practices (BMPs) for waste and environmental control
 - Sustainable facility design guidelines
- **Educational Resources:**
 - Online virtual farm tours (e.g., FarmFood360)
 - Beef cattle industry standards for low-stress handling

KEY TERMS

- **Low-Stress Handling:** Facility and handling practices designed to minimize stress on cattle, improving health and productivity.
- **Quarantine Area:** A designated area for isolating new or sick cattle to prevent disease spread.
- **Manure Management:** Systems in place to properly collect, store, and utilize manure to minimize environmental impact.
- **Biosecurity Measures:** Protocols implemented to reduce the risk of disease transmission within livestock operations.
- **Rotational Grazing:** A pasture management technique that rotates cattle between different grazing areas to maintain pasture health.

LESSON OVERVIEW

INTEREST APPROACH

- Students consider how uncomfortable environments affect them and how cattle might be affected by uncomfortable or unfit environments.

OBJECTIVES

- Students will explore facility design principles to reduce cattle stress, including housing, feeding, and working facilities. They will estimate the financial costs required

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to start a beef enterprise and create budgeted expense plans. Environmental management will be discussed, focusing on manure handling, water conservation, and regulatory compliance. Lastly, students will develop a waste management plan and sanitation checklist tailored to their facility design.

REVIEW

- In the Review and Close section, students reflect on the connection between facility design, cattle handling, and management efficiency.

INTEREST APPROACH (5 MINUTES)

1. **Do:** Start class without chairs at student desks.
2. **Say:** How long would you be willing to stand at your table and take notes or do assignments before you got uncomfortable?
 - a. **Listen for:** Students giving different time estimates.
3. **Ask:** Did you know that cattle that are treated better and live in a comfortable environment actually taste better?
4. **Do:** Give students chairs back.
5. **Say:** Some poor cattle conditions may cause health hazards, while others may not be dangerous but may make them uncomfortable and/or stressed.
6. **Say:** Being uncomfortable can cause stress and general unhappiness for both people and cattle. We are going to discuss cattle needs for a safe, low-stress environment.

OBJECTIVE 1: USE PRINCIPLES OF LOW-STRESS LIVESTOCK FACILITIES TO DESIGN BASIC FACILITIES FOR EACH PRODUCTION/ENTERPRISE'S NEEDS. (45 MINUTES)

Teaching Strategies	Related Content
Ask: Consider different buildings and places you go and how they make you feel. Are there certain places that stress you out? What about the design of your home stresses you out? What about the design of the school? Other places you go to? Listen for: Students to describe places or features that stress them out (i.e., example: the mall, hallways at school, florescent lights, etc.)	

Say: Cattle are not all that different from us, as stress affects us both. Just like how some building designs can cause you stress, cattle facilities can do the same thing to them. When designing livestock facilities, it is important to know what designs are best suited to lower stress in beef cattle. Today, we will be discussing what low-stress facilities look like for beef cattle.

Say: Designing low-stress livestock facilities for a beef operation involves creating an environment that reduces stress and enhances the welfare and productivity of the cattle.

Do: Show **Slide 3: Cattle Handling and Facility Design** and play the video. If you have trouble with the embedded video in PowerPoint, the direct link is below.

Link to video: [Cattle Handling Facility Design](#)

After the video, discuss what the class saw. If you are not able to share the video, you may instead share various photos of cattle facilities and have the students discuss the elements they notice in each facility.

Do: Show **Slide 4: General Facility Design Principles**.

Say: Avoiding stress-inducing flow and movement allows cattle to move with less flight and overall makes for more efficient handling.

Ask: Why should shadows be avoided?

Listen for: Startling cows, they think something is there, etc.

Slide 3: Cattle Handling and Facility Design

Slide 4: General Facility Design Principles

Say: Designs can help reduce noise, like making sure there are not any large pieces of equipment around where the cattle handling facilities are built. Do: Show Slide 5: Shelter and Housing. Say: Extreme weather, like extreme temperatures, wind, rain, or snow, can provide hazards to herds of cattle. The overall goal for barns and sheds is to ensure the animal is comfortable, safe, and remains healthy. Do: Show Slide 6: Feeding and Watering Facilities. Say: Feed and water areas should eliminate the need for competition and ensure that all cattle have equal access to food. These areas can get pretty dirty, so cleaning them needs to be part of a health plan for the herd. Checking for frozen water and broken heated waterers in the winter months is important, as dehydration can cause fast problems in your herd. Do: Show Slide 7: Handling and Working Facilities. Ask: Which of these handling and working elements did we see shown in the video (or photos) we saw earlier? Listen for: Curved chutes, solid sides, gradual slopes, etc. Do: Show Slide 8: Breeding and Calving Facilities.	Slide 5: Shelter and Housing Slide 6: Feeding and Watering Facilities Slide 7: Handling and Working Facilities Slide 8: Breeding and Calving Facilities
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Say: Breeding pens should be made for easy monitoring and handling of breeding pairs. Calving sheds should be designed to ensure that the cows and calves are exposed to the least amount of stress as possible. Do: Show Slide 9: Quarantine and Isolation Areas. Ask: Why are quarantine and isolation pens important? Listen for: They stop transmission if a cow gets sick and stop new diseases from coming into the herd with new cattle. Do: Show Slide 10: Pasture and Grazing Management. Say: High-tensile wire, barbed wire, and electric fencing are all safe and durable fences options. Maintaining fencing regularly is important to ensure there aren't any holes in the fencing due to cattle getting out, deer, or other circumstances. Do: Give students Activity Sheet #1: Facility Plans & Management Project. Say: You will be designing a facility for each of the types of cattle enterprises listed below. Do: Answer any student questions and allow students time to work. You may choose to allow students to conduct outside research to design their facilities.	Slide 9: Quarantine and Isolation Areas Slide 10: Pasture and Grazing Management Activity Sheet #1: Facility Plans & Management Project (BeefLesson1.7_AS1)
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OBJECTIVE 2: ESTIMATE THE FINANCIAL DEMANDS TO PURCHASE A LIST OF BASIC EQUIPMENT REQUIRED TO START UP A BEEF ENTERPRISE. (30 MINUTES)

Teaching Strategies	Related Content
Ask: If you were to decide to start raising beef cattle, how much would it cost to get everything you need? Listen for: Students list different amounts of money. Say: Let's brainstorm a little further, with your table partners, get a scratch piece of paper out and list all of the items you would need to start a successful and fully operational cattle operation. Do: Give students time to brainstorm, about 5 minutes. After 5 minutes has passed, take time to share things and list them on the board. Ask: Do you think your original estimates for cost are still accurate? Do they need to be lower? Higher? Listen for: Various student answers. Say: Today we are going to be exploring what equipment meets needs for beef cattle operations as well as the costs of that equipment. Do: Pass out the Activity Sheet #2: Financial Demands of Cattle Enterprises Say: Starting a beef enterprise requires several key pieces of equipment to ensure the efficient and humane handling, feeding, and care of cattle. On page 2 of this sheet,	Activity Sheet #2: Financial Demands of Cattle Enterprises (BeefLesson1.7_AS2)

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there is a list of basic equipment needed. Find and research the cost of these items and compile an expenses list to see what your total for start-up would be with all of these supplies. Make sure you consider the quantity of the supplies you need (example: one automatic waterer may not be applicable in a production facility with 15 pastures being used for rotational grazing). Your goal is to spend the LEAST amount of money while making sure you have what you NEED.	
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OBJECTIVE 3: INSPECT ENVIRONMENTAL MANAGEMENT CONCERNS RELEVANT TO THE BEEF INDUSTRY. (20 MINUTES)

Teaching Strategies	Related Content
Ask: What environmental concerns might there be on a beef cattle operation? Listen for: Manure, smell, soil damage, etc. Do: Write on the board as students answer. Say: Environmental management in the beef industry in the United States involves addressing various concerns to minimize the environmental impact and ensure sustainable production practices. We are going to discuss key environmental management concerns relevant to the beef industry, like some of the ones you brainstormed. Here are the main areas we will be discussing. Do: Show Slide 11: Manure Management. Say: Proper storage for manure would include facilities like lagoons or pits. They prevent run off and help with smell. Regular collection should happen everywhere, but	Slide 11: Manure Management

specifically feedlots, barns, and grazing areas. When using manure as fertilizer, it's important to have a nutrient management plan to make sure you don't over fertilize. Do: Show Slide 12: Water Quality Protection. Say: The facilities used to prevent runoff from manure management help part of the runoff problem but runoff from rain can also cause damage. Putting in extra runoff control around feedlots, barns, and manure storage areas can help filter any runoff that does happen. Say: As far as protecting the water from contamination, keeping manure facilities away from water sources and regularly monitoring water quality to check for standards can help ensure your cattle have safe water to drink. Do: Show Slide 13: Air Quality Management. Ask: What air quality problems might arise with cattle? Listen for: Gas emissions, smell, etc. Say: While some smell and emissions are unavoidable, there are things that can be done to ensure that we aren't dealing with unnecessary emissions and excessive odor. Do: Show Slide 14: Nutrient Management. Say: The more nutrients that are optimized in the diets of cattle, the less nutrients are being excreted. The less being excreted, the	Slide 12: Water Quality Protection Slide 13: Air Quality Management Slide 14: Nutrient Management Slide 15: Energy Use and Efficiency
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less of a chance of causing nutrient build ups in soils. Do: Show Slide 15: Energy Use and Efficiency. Ask: What might be some renewable energy sources you could implement on a beef cattle operation? Listen for: Solar or wind power Do: Show Slide 16: Water Use and Conservation. Say: Conserving water is a growing agricultural issue. Regularly maintaining and monitoring watering equipment can help reduce leakage and overall water waste. Some non-potable, or non-consumable, ways we can reuse water is for irrigation and for dust control. Do: Show Slide 17: Land Use and Habitat Protection. Ask: Why would selection of sites be important when it comes to habitat protection? Listen for: To consider environmentally sensitive areas, home to wildlife, etc. Do: Show Slide 18: Chemical Use and Safety. Say: Some examples of implementing conservation practices to protect natural resources and wildlife would include maintaining riparian buffers and protecting wetlands.	Slide 16: Water Use and Conservation Slide 17: Land Use and Habitat Protection Slide 18: Chemical Use and Safety Slide 19: Waste Management
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Say: Having an IPM plan can help reduce the number of pests that you have issues with, lowering the need for unplanned pesticide use. Do: Show Slide 19: Waste Management. Say: Waste management is a large area of production agriculture, we will touch base on waste management a little more later on but reducing overall waste and making sure we are safely disposing of it are important factors in production. Do: Show Slide 20: Regulatory Compliance. Say: Following environmental regulations should always be number one priority when it comes to environmental management. Say: Now that we have a better understanding of environmental management, let's look deeper into waste management.	Slide 20: Regulatory Compliance
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OBJECTIVE 4: DESIGN A WASTE MANAGEMENT PLAN FOR A BEEF ENTERPRISE CONSIDERING BEST MANAGEMENT PRACTICES. (30 MINUTES)

Teaching Strategies	Related Content
Say: We are going to dive a little further into one specific environmental management practice: waste management. Say: Designing a waste management plan for a beef enterprise involves implementing best management practices (BMPs) to efficiently handle, store, utilize, and dispose of manure and other waste products.	

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Say: The goal is to minimize environmental impact, comply with regulations, and enhance the sustainability of the operation. You will be doing some planning for one of the facilities you designed to create a waste management plan for your herd. Do: Handout Activity Sheet #3: Waste Management Plan. Explain to students that they will be following the prompts to complete each section of the waste management plan.	Activity Sheet #3: Waste Management Plan (BeefLesson1.7_AS3)
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OBJECTIVE 5: CREATE A CLEANING AND SANITATION

PRACTICES LIST FOR A BEEF ENTERPRISE. (30 MINUTES)

Teaching Strategies	Related Content
Ask: From what we have learned already, what sanitation practices are important for beef cattle operations? Listen for: Cleaning and sanitizing, having quarantine areas, etc. Say: Maintaining cleanliness and proper sanitation in a beef enterprise is essential for ensuring the health and productivity of the cattle, as well as for preventing the spread of disease. Say: We are going to go create a list of cleaning and sanitation practices for a beef enterprise in the United States. Do: Hand out Activity Sheet #4: Cleaning and Sanitation Plan and explain to students that they will be creating checklists for their cattle operations.	Activity Sheet #4: Cleaning and Sanitation Plan (BeefLesson1.7_AS4)

Say: First, begin to add as many cleaning and sanitations practices as you can think of into whether they should be completed daily, weekly, or monthly. Write the items as if this were a checklist for you or someone else to use to keep your facilities clean and sanitized.

Do: Allow students time to work. Encourage that they work independently at this point and without using outside resources.

Say: Next, find a partner and compare your lists. What would you add or change to your list based on your partner's list? Take a few minutes to update together.

Say: Next, together, you may use outside resources, such as online research, to see if there are any items you have still missed. You'll have 10 minutes for this step.

Do: Allow students time to work in their pairs. Encourage students to not work with other students yet, as that will be the next step.

Say: Great job! Together as a class, let's use the knowledge we have all gained to create one comprehensive list. We'll start with daily. Each group can share one daily cleaning and sanitation item, and as a class, we'll decide if it should be added to our checklist. We'll do this for daily, weekly, and monthly until we have a complete checklist.

Do: You may use the teacher key to compare the comprehensive checklist your class has created with an example one and encourage students to think of any they have missed. Your comprehensive list will not exactly

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match the teacher key and that's okay; encourage student thinking and use answers in their own words. Do: Show the exit ticket on Slide 21: Lesson Exit Ticket . and have students complete.	Slide 21: Lesson Exit Ticket
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REVIEW ACTIVITY | (2 MINUTES)

Say: Cattle are similar to humans in that their homes should be low-stress and meet the general needs of the herd. A lot of planning goes into designing facilities, estimating costs, and planning for environmental management of a beef cattle herd. Best management practices (BMPs) should always be followed when running an operation.

ASSESSMENT

Consider using the following artifacts from the lesson to assess student learning:

- Formative Assessment
 - Review student **Activity Sheet #1** to assess student's ability to use principles of low-stress livestock facilities to design basic facilities for each production/enterprise needs.
 - Review student **Activity Sheet #2** to assess student's ability to estimate the financial demands to purchase a list of basic equipment required to start a beef enterprise.
 - Review student **Activity Sheet #3** to assess student's ability to design a waste management plan for a beef enterprise considering best management practices.
 - Review student **Activity Sheet #4** to assess student's ability to create a cleaning and sanitation practices list for a beef enterprise.
- Summative Assessment
 - Use **Lesson #1.7 Assessment** to test student knowledge on their ability to create a facilities plan that incorporates relevant equipment.

EXTENDED LEARNING OPPORTUNITIES

Extended Learning Opportunities allow for the primary acquisition of knowledge and skills through instruction or study outside of the traditional classroom, including, but not limited

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to: Independent study, SAEs, FFA CDEs/LDEs, Internships, guest speakers, and apprenticeships.

Classroom

- Have students physically build one of their designs. Provide supplies or have students bring them in: popsicle sticks, cardboard, hot glue, etc.
- Visit a large beef cattle operation and have students identify different parts of the facility or point out things they have in place that are part of waste or environmental management.
- Take a trip to a small cattle operation and a large cattle operation and have students compare facilities and their needs. If a trip is not possible, do a virtual field trip, like the one linked: <https://www.farmfood360.ca/en/beef/>

FFA

- Have students research and complete an agriscience fair project on the impact of the beef cattle industry on one of the areas touched on during the environmental management part of the lesson.
- Have students research and compare different waste management practices and collect data on their environmental impact.
- Students can work on a beef cattle operation.

SAE

- During Farm Safety Day, educate producers, students, and the public about the importance of different environmental management practices on the farm.
- During Food for America, educate students and staff about efforts to reduce the carbon footprint of the beef cattle industry.

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Cleaning and Sanitation Plan

Student Name _____ . Date _____

Example Teacher Key:

Note: These are example answers. Use this example key to fill in any gaps students may have missed. Students may also place different tasks in daily, weekly, or monthly, depending on their reasoning. Acknowledge and accept student responses if they still make sense for facility cleaning and sanitation.

Daily	Weekly	Monthly
☐ Remove manure and soiled bedding and replace with fresh bedding ☐ Clean and disinfect feeders and waters daily and check and repair any leaks ☐ Sweep and clean walkways and common areas ☐ Place footbaths at the entrance of each barn and pen area ☐ Monitor air quality ☐ Limit access to barns and pens ☐ Require visitors and workers to wear clean, protective clothing and footwear ☐ Clean and disinfect vehicles and equipment before they enter and leave the farm	☐ Periodically disinfect pens, barns, and other housing areas with appropriate disinfectants ☐ Change disinfectant in footbaths regularly ☐ Use traps, baits, and insecticides as needed while ensuring safety for the cattle ☐ Provide laundry facilities for protective clothing ☐ Properly store and compost manure and used bedding away from barns and pens ☐ Use covered storage to prevent runoff and odor issues ☐ Regularly clean and disinfect water troughs and buckets to prevent contamination	☐ Remove all manure, bedding, and feed residues from pens and barns ☐ Wash the entire facility with high-pressure water and detergent. Then allow the area to dry completely before applying disinfectants and apply disinfectants to all surfaces, ensuring complete coverage. Allow adequate contact time for the disinfectant to be effective. Rinse with clean water if necessary and allow the area to dry thoroughly before introducing new cattle ☐ Regularly clean and replace air filters in ventilation ☐ Clean ventilation ducts and fans to prevent dust and debris build up

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☐ Establish designated cleaning stations for vehicle and equipment ☐ Provide handwashing stations with soap and disinfectant near barns and pens and ensure that all personnel wash their hands before and after handling cattle ☐ Require personnel to wear clean overalls, boots, and gloves ☐ Dispose of deceased cattle promptly and in accordance with local regulations to prevent disease spread	☐ Monitor water quality to ensure it is safe and clean for cattle	☐ Implement an integrated pest management (IPM) program ☐ Store feed in clean, dry, and secure facilities to prevent contamination by pests or moisture ☐ Clean feed bins, carts, and other equipment regularly to prevent feed spoilage and contamination ☐ Maintain detailed records of all cleaning and disinfection activities. Include dates, procedures followed, and products used ☐ Provide regular training for all staff on proper cleaning, disinfection and biosecurity practices. Update training programs to reflect current best practices and any changes in regulations
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LESSON 1.7

Assessment

Student Name _____ Date _____

DIRECTIONS

Partner up with a classmate who has a facility design that is different from yours. Share your plans and designs with each other. Answer the following questions about their designs or compare the two.

1. Would you say that their design is low-stress? List three items included in their design that support your answer.

Answers will vary.

Possible Answer: Yes, my partner's design is low stress. There are solid curved sides to their chute system, tall walls to avoid scaring the animals, and it provides shelter for the animals in case of severe weather. All of these things will help prevent stress.

2. Comparing your design to your classmates, which is the most low stress? Explain your answer.

Answers will vary.

Possible Answer: My design provides the lowest stress because I went into more detail. My design has non-slick floors in all facilities, utilizes natural lighting as much as possible, and overall provides the animal with more accommodations for stress management.

3. Which design costs the most to start up, yours or your classmates'? What parts of design and planning made the difference?

Answers will vary.

Possible Answer: My partner's design was more expensive than mine. They had a Cow-calf operation for their design, so they needed more equipment than I did, causing their start-up cost to be very high.

4. Describe the environmental management practices your classmate uses in their plan. What problems are there related to what we discussed in class?

Answers will vary.

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5. What differences were there in the Waste Management plans based on facility designs?

Answers will vary.

6. Are there any cleaning and sanitation differences between the two based on facility type and design?

Answers will vary.