# Grain Science

KANSAS STATE UNIVERSITY
Grain Science and Industry

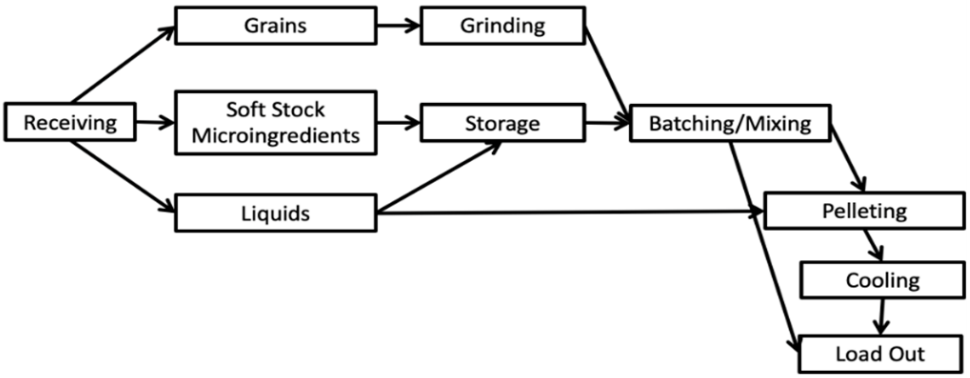
## Lesson 5: Livestock Feed

| | |
|---|---|
| **Unit:** | Grain Science |
| **Estimated Time:** | 50 Minutes |
| **Age of Learners:** | 9th-12th Grade |

**Equipment, Supplies, References, and Other Resources:**

- Three types of cereal
- 1 quart container (per group)
- Feed production PowerPoint
- Feed production flow chart worksheet
- Interactive feed mill video: https://www.youtube.com/watch?v=3pwmgErmm4M
- Livestock feed samples

| Instructor Directions & Estimated Time | Content Outline and/or Procedures |
|---|---|
| **Objectives** | 1. Explain the concept of grinding feed ingredients and its significance in preventing selective feeding behavior in animals, by conducting an experiment to compare the ease of separation between whole and ground cereals.<br>2. Summarize the feed production process, identifying the key steps involved from receiving bulk ingredients to the final loading of finished feeds, and understanding the role of milling in this process.<br>3. Analyze the impact of grinding grains through hammermill or roller mill on nutrient utilization and feed efficiency in livestock diets, by exploring the effects of increased surface area on enzymatic digestion.<br>4. Evaluate the importance of feed milling in enhancing digestibility and nutrient absorption in livestock, by examining a sample livestock ration to identify milled feedstuffs and discussing the potential implications on animal health and productivity. |
| **Feed the Sourdough**<br><br>~3 minutes<br><br>*Only one student needs to feed the class starter.* | • Start feeding by removing the starter from the container.<br>• In a bowl, mix 1 cup (115 grams) flour and 1/2 cup (115 grams) water with the starter, mixing by hand until smooth.<br>• Clean original container before replacing the starter. Cover and store. |
| **Interest Approach: Cereal Feed Mill**<br><br>~ 10 minutes<br><br>*When purchasing cereal for this activity, one variety could be Corn Flakes to show an example of steam flaking.*<br><br>*When students finish this activity, ask the discussion questions to the class and allow students to reflect and respond.*<br><br>*This is on a worksheet. You can display the instruction on a screen or give them the worksheet to conduct this activity* | The nutrition in feed like corn can be better utilized if it is ground. If ingredients are fed to livestock whole, animals might even pick out what they like best. Grinding corn or other ingredients through a hammer mill or roller mill can prevent the animal from picking their favorite feed out of the ration.<br><br>**Materials** (per group)<br><br>• 3 cups of 3 varieties of cereal<br>• 1 quart container with lid<br><br>**Directions**<br><br>1. Add 3 cups of 3 varieties of cereal to the container<br>2. Mix the cereal by shaking the container for 15 seconds<br>3. After the cereals are mixed, sort the cereals back into the original separate cereals. Note how easy the cereals are to separate. This is what animals do if allowed to pick and choose what they want to eat.<br>4. Place each separated cereal into a plastic bag and smash each with your fist or a book.<br>5. Once smashed, mix the cereals together again in the container.<br>6. Try to separate each cereal again.<br><br>**Discussion Questions**<br><br>1. How does grinding the cereals simulate the effect of processing feed through a hammer mill or roller mill in preventing this selective feeding behavior?<br>2. What are the potential benefits of grinding feed ingredients compared to feeding them whole, considering factors like nutrient utilization and feed efficiency? |

| Instructor Directions & Estimated Time | Content Outline and/or Procedures |
|---|---|
| **Process of Feed Production Graphic Organizer**<br><br>~ 15 minutes<br><br>*Students will use one or two words to summarize each step of the feed production process on the flow chart while they follow along with the slides. Students can take turns reading each slide.*<br><br>*Key words in the PowerPoint are underlined to help students complete their flow chart.* | Follow along with the slideshow and use one or two words to summarize each step of the feed production process on the flow chart below.<br><br>1. First, bulk or bagged ingredients are received from trains or trucks.<br>2. Ingredients come in three major groups – cereal grains that must be ground prior to use, those that are ready-to-use, such as microingredients and soft stock like DDGS, soybean meal, and wheat middlings, and liquids, such as liquid amino acids, liquid phytase, and fat sources.<br>3. Grains are ground with a hammermill or roller mill and are batched into the mixer. Sometimes they are stored for a short time before being used, but usually only a few hours.<br>4. Meanwhile, soft stock, microingredients, and liquids are received and stored before they are batched into the mixer. Soft stock are usually stored in bulk bins or totes. Microingredients are stored in the warehouse as bags or totes and then added to the mixer by hand or through the use of a set of small bins called a microtable. Liquids are stored in tanks that may be heated depending upon the ingredient.<br>5. Feeds are mixed for a set amount of time depending upon the types of ingredients and size and type of mixer. After mixing, feeds in mash form are sent to final feed bins.<br>6. Depending on the mill, some diets may be pelleted and cooled prior to load out.<br>7. In the case of pelleted feeds, sometimes liquids may be applied to the outside of the pellet instead of inside the mixer.<br>8. Regardless of the form, finished feeds are then loaded into bulk trucks or bagged and then exit the facility.<br><br>  <br> |

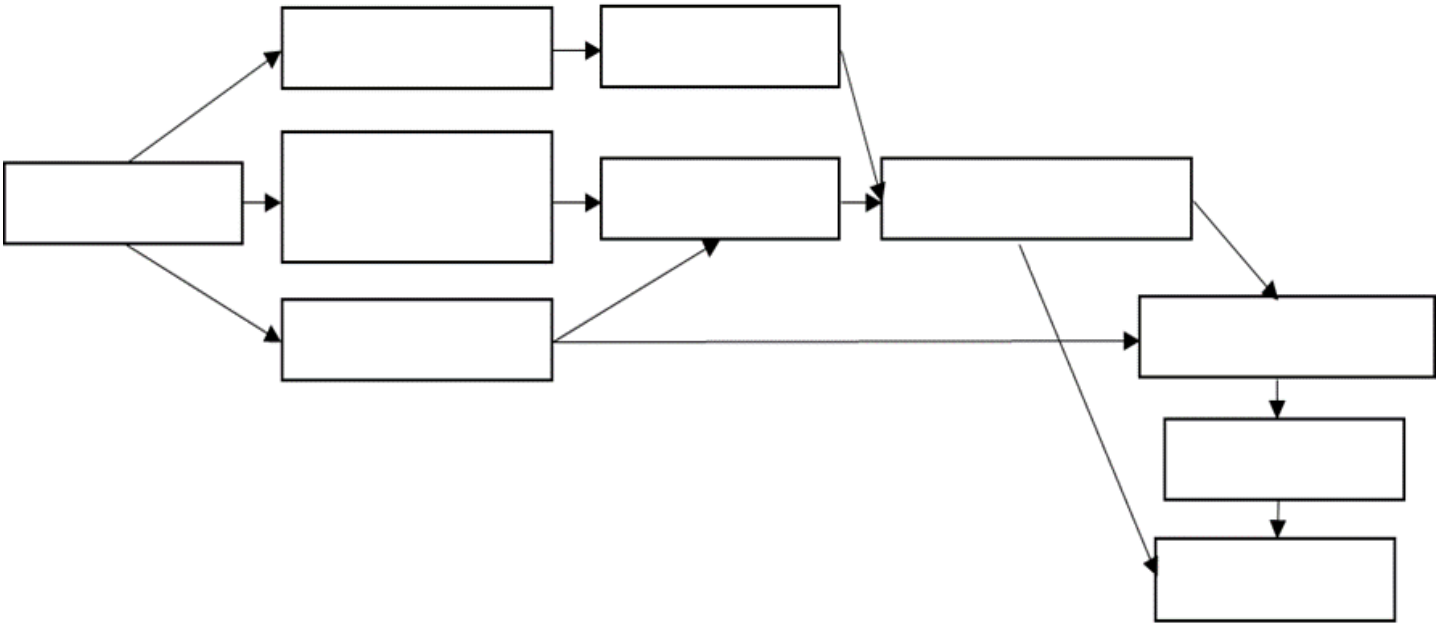
<table>
<tr><th>Instructor Directions & Estimated Time</th><th>Content Outline and/or Procedures</th></tr>
<tr><td>Particle Size<br><br>~ 5 minutes<br><br>Students will read about particle size on their lab sheet. Before discussing, students will record their initial thoughts. When they finish, discuss this as a class and allow them to fill in the blanks on the chart that is on the slide and answer then analysis question.</td><td>Grinding grains by hammermill (grinds by impact) or roller mill (grinds by shearing) reduces their particle size, which increases the available surface area for enzymatic digestion.<br><br>*If more of the starchy endosperm is exposed, the animal's digestive enzymes can be more effective in digesting the nutrients from the grain.<br><br>In feed for dairy, beef, sheep, and goats, grains are sometimes steam-flaked. In most diets for swine, poultry, aquaculture, and pet foods though, they are ground through either a hammermill or roller mill.<br><br>
<table>
<tr><th>Animal Species for Which the Ingredient is Intended</th><th>Hammer Mill or Roller Mill</th><th>Steam Flaker</th></tr>
<tr><td>Swine</td><td>X</td><td></td></tr>
<tr><td>Poultry</td><td>X</td><td></td></tr>
<tr><td>Aquaculture</td><td>X</td><td></td></tr>
<tr><td>Pet</td><td>X</td><td></td></tr>
<tr><td>Dairy</td><td>X</td><td>X</td></tr>
<tr><td>Beef</td><td>X</td><td>X</td></tr>
<tr><td>Sheep</td><td>X</td><td>X</td></tr>
<tr><td>Goat</td><td>X</td><td>X</td></tr>
</table>
</td></tr>
<tr><td>Interactive Feed Mill Video<br><br>~ 10 minutes<br><br>Students will use their personal device to watch this video. They can interact with the video to see different angles of the mill. This can also be conducted as a whole class.<br><br>Discuss and debrief when the video is complete and students have finished the worksheet.</td><td>Watch and interact with this 360-degree tour of a Canadian mill. As you watch and interact with the video, listen for the components of the Feed Production Flow Chart that you recorded earlier, and the type of mill being used. You will record your observations on the worksheet.<br>https://www.youtube.com/watch?v=3pwmgErmm4M<br><br>Conclusion Questions<br><br>1. What components from the Feed Production Flow Chart did you observe in the Interactive Video?<br>2. What kind of milling process did this feed mill use?<br>3. How does the feed mill test their product to ensure quality and safety?<br><br>(Another example of a feed mill to show is Hill's Pet Food in Emporia<br>https://www.youtube.com/watch?v=4X0QuaSeEz4&t=258s)</td></tr>
</table>

| Instructor Directions & Estimated Time | Content Outline and/or Procedures |
|---|---|
| **Samples of Feed**<br><br>~7 minutes<br><br>*Give pairs or small groups of students a sample of a livestock ration.*<br><br>*After one minute, review with the class all the ingredients. You can record the correct answers on the board or in a place where they can see them.*<br><br>*Contact a local co-op, feed store, area cattle producer for samples.* | Now you will analyze a sample of a livestock ration to identify feedstuffs that have been milled.<br><br>1. You have one minute to identify the ingredients or feedstuffs in the ration.<br>2. Next, identify which ingredients in the ration have been milled.<br>3. Just like grain is milled for flour and other food products for humans, feed is milled for livestock and animals.<br><br>**Discussion Questions**<br><br>1. What role does milling play in breaking down feedstuffs for better digestion and absorption?<br>2. What is the potential impact of using milled versus unmilled feed ingredients on animal health and productivity.<br>3. How does the milling process influence factors such as feed intake, nutrient utilization, and overall feed efficiency in livestock production systems? |

| | State Standards |
|---|---|
| **Language Arts** | • **SL.9-10.1.** Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 9-10 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively.<br>• **W.9-10.2.d.** Use precise language and domain specific vocabulary to manage the complexity of the topic.<br>• **W.9-10.3.e.** Provide a conclusion that follows from and reflects on what is experienced, observed or resolved over the course of the narrative. |
| **Math** | • **N.Q.1. (all).** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.<br>• **N.Q.2. (all).** Define appropriate quantities for the purpose of descriptive modeling.<br>• **N.Q.3. (all).** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. |
| **Science** | • **ETS1.B.** Developing Possible Solutions: When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to **HSLS2-7**), (secondary to **HS-LS4-6**)<br>• **HS-LS1-1.** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.<br>• **HS-LS1-2.** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. |

## Lesson 5: Feed Production Worksheet

Use one or two words to summarize each step of the feed production process on the flow chart below.



## *Grinding*

Grinding grains by hammermill (grinds by impact) or roller mill (grinds by shearing) reduces their particle size, which increases the available surface area for enzymatic digestion. Hammermilled grains have a greater variation in size compared to grains milled by roller mills.

Consider the species below and the two different types of grinding. Indicate in the "Initial Thoughts" column which species you think consume feed that is Hammer Milled or Roller Milled or Steam Flaked by writing "Hammer" or "Steam".

| Animal Species for Which the Ingredient is Intended | Initial Thoughts | Hammer Mill or Roller Mill | Steam Flake |
|---|---|---|---|
| Swine | | | |
| Poultry | | | |
| Aquaculture | | | |
| Pet | | | |
| Dairy | | | |
| Beef | | | |
| Sheep | | | |
| Goat | | | |
| | | | |

### Analysis Questions

1. How does crushing grains with a hammermill or flattening them with a roller mill affect how well animals can digest them?

2. Why might different animals, like cows or chickens, need their feed processed in different ways, such as grinding with a hammermill or rolling with a roller mill?

## *Interactive Feed Mill Video*

1. What components from the Feed Production Flow Chart did you observe in the Interactive Video?

2. What kind of milling process did this feed mill use?

3. How does the feed mill test their product to ensure quality and safety?

## *Milling and Mixing Feed*

The nutrition in feed like corn can be better utilized if it is ground. If ingredients are fed to livestock whole, animals might even pick out what they like best. Grinding corn or other ingredients through a hammer mill or roller mill can prevent the animal from picking their favorite feed out of the ration.

**Materials** (per group)

- 3 cups of 3 varieties of cereal
- 1 quart container with lid

**Directions**

1. Add 3 cups of 3 varieties of cereal to the container
2. Mix the cereal by shaking the container for 15 seconds
3. After the cereals are mixed, sort the cereals back into the original the original separate cereals. Note how easy the cereals are to separate. This is what animals do if allowed to pick and choose what they want to eat.
4. Place each separated cereal into a plastic bag and smash each with your fist or a book.
5. Once smashed, mix the cereals together again in the container.
6. Try to separate each cereal again.

**Discussion Questions**

1. How does grinding the cereals simulate the effect of processing feed through a hammer mill or roller mill in preventing this selective feeding behavior?

2. What are the potential benefits of grinding feed ingredients compared to feeding them whole, considering factors like nutrient utilization and feed efficiency?

## *Authors*

**Elisa Karkle,** *Ph.D., assistant professor, Department of Grain Science and Industry*

**KaCee James,** *doctoral student, Department of Communications and Agricultural Education*

**Brandie Disberger,** *Ph.D., teaching associate professor, Department of Communications and Agricultural Education*



KANSAS STATE UNIVERSITY | Grain Science and Industry

Grain Science lessons are posted at:
*https://www.grains.k-state.edu/educator-resources/untitled.html*





**July 2024**