

Sheep Project Area Guide

Intermediate



Chapter 4: Gastrointestinal Tract and Feedstuffs
By Layney Clarke, Laura Gilliard, Adara Gonzalez-Anleo

Chapter 4

Gastrointestinal Tract and Feedstuffs

Learning Outcomes:

- Define the following terms: carbohydrate, starch, fat, fiber, roughage, nonprotein nitrogen, forage quality, vitamins, minerals, creep feeding, rotational grazing
- Label the major sections of the gastrointestinal tract: mouth, esophagus, rumen, reticulum, omasum, abomasum, small intestine, large intestine
- Identify the following feedstuffs from samples: cracked corn, ground corn, distiller's grain, whole wheat, wheat middlings, whole barley, whole oats, rolled oats, sorghum (milo), beet pulp, limestone, urea, dried and liquid molasses
- Analyze a feed tag for ingredients, nutrient analysis, and medicated status

Key Terms:

- **Carbohydrate** - Primary energy source made up of sugars, starches, and fibers
- **Starch** - Primary way for plants to store carbohydrates
- **Fat** - Triglycerides split into fatty acids as a source of energy for metabolism and structure
- **Fiber** - Plant matter digested by the microbes in rumen
- **Roughage** - Feed ingredient that is low in digestible nutrients, but high in fiber
- **Nonprotein Nitrogen** - Form of nitrogen not contained within peptides or proteins
- **Forage Quality** - Describes how good sheep feed is for their health and growth
- **Vitamins** - Organic compounds found in plants and animals that are essential for growth and activity
- **Minerals** - Inorganic elements found in plants and animals that start chemical reactions and form many tissues
- **Creep Feeding** - Offering free-choice, high-quality feed to lambs away from their mothers to aid in weaning
- **Rotational Grazing** - Dividing a pasture into smaller areas, changing or rotating the primary pasture the sheep or goats graze in to promote animal and pasture health

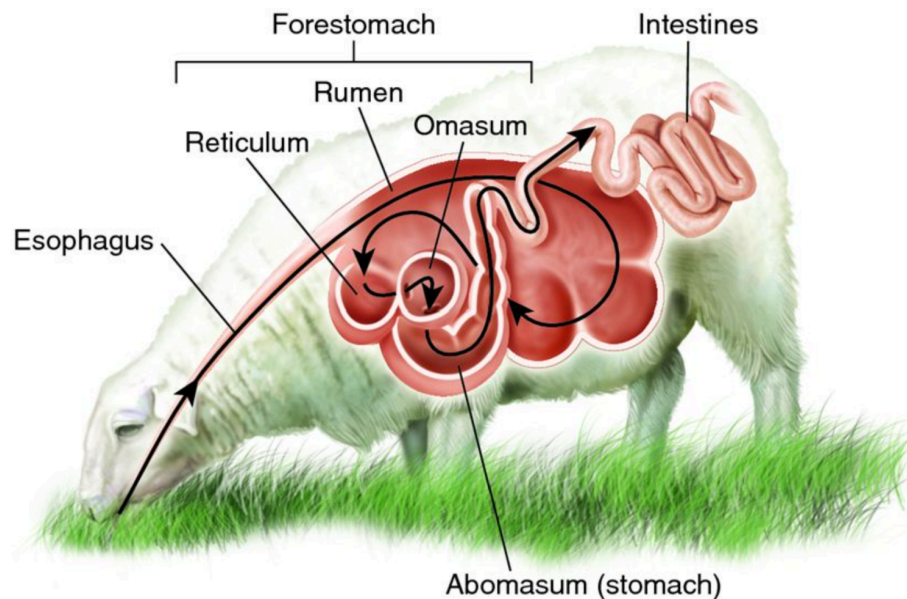
Introduction:

Nutrition is vital to the overall health and well-being of small ruminants. The digestive tract of sheep is designed to break down feedstuffs and forages to fuel the bodily functions of individual animals. Sheep are ruminant animals, and the ruminant digestive system includes four compartments: the rumen, reticulum, omasum, and abomasum. The rumen is where the food eaten by the sheep is fermented and broken down by microorganisms, including bacteria, fungi, and protozoa. These rumen microbes and the sheep are an example of a symbiotic relationship, as the microorganisms receive nutrients and an environment to live and the sheep can further digest the nutrients that are initially broken down by the organisms. The reticulum is the next compartment in the ruminant digestive tract. The reticulum catches large food particles that were not broken down in the rumen, and sends them back to the rumen to be further broken down by the rumen microorganisms. This is also where foreign objects, like hardware and twine, eaten by the sheep are typically caught and must be surgically removed. The omasum is the third compartment, and it is where water is absorbed from the feed into the sheep for bodily functions. The last compartment is the abomasum, which is also known as the “true stomach.” The abomasum is where digestive enzymes are secreted to break down food and to be digested by the body. Most of the nutrient absorption occurs in the small intestine, which follows the abomasum.

Feedstuffs, or feed, serve a variety of nutritional purposes. Examples of feedstuffs include ground and cracked corn, distiller’s grain, whole wheat and wheat middlings, whole barley, whole oats, sorghum (milo), beet pulp, limestone, urea, dried and liquid molasses. The nutrients from the feed that are broken down and absorbed by the sheep fall into six main categories: water, **carbohydrates**, **fats**, protein, **minerals**, and **vitamins**. Water can be consumed directly by drinking, as well as absorbed from feedstuffs and forages in the animal’s diet. **Carbohydrates** are the main source of energy for sheep and can be included in an animal’s diet through feedstuffs like corn, wheat, beet pulp, and milo. **Fats** include saturated and unsaturated fatty acids, depending on the chemical structure of the molecules that make up the fat. Proteins are the building blocks for the maintenance of bodily functions, growth, and reproduction in sheep. Feedstuffs can also serve to supplement **vitamins** and minerals. **Minerals** have a variety of functions and are split into two categories: macro and micro minerals. Macro minerals are needed in large amounts. Examples of macro minerals are calcium and magnesium, which are both important minerals for bone development and muscle movement. Micro minerals are needed by sheep in a significantly smaller quantity than macro minerals. Micro minerals include iron and zinc, which are both important micro minerals for sheep metabolism.

The nutritional requirements vary for each sheep, and factors such as age, parasite load, reproductive status, and daily activity all influence these requirements. Feed additives can also be included in feedstuff to maintain rumen pH, supplement rumen microorganisms, and provide medication. The feed tag is important in navigating the purpose of the feed and its nutritional breakdown of ingredients. The feed tag will also provide feeding instructions and warnings for that particular product.

Gastrointestinal Tract:



- **Mouth & Esophagus**

- Roof of mouth hard/soft palate without upper incisors, saliva helps break down fats and starches and creates bolus to move down esophagus
- Can regurgitate their food to re-chew, “chewing the cud”

- **4-compartment stomach (takes over left side of abdominal cavity)**

1. Reticulum

- Honeycomb lining. Separation/sifting of particles (small particles move to Omasum and large particles move to Rumen to break down).

2. Rumen

- Largest compartment, fermentation takes place here (solids), microbes break down plant cell walls and produce volatile fatty acids that are used for energy.

3. Omasum

- Looks like wet pages. Responsible for absorption of water and nutrients (liquids)

4. Abomasum

- True stomach, acidic digestion and enzymatic breakdown, for protein absorption in the intestines
- Chief cells - protect lining by secreting mucus

- **Intestines** - The small intestine is responsible for nutrient absorption. The large intestine is responsible for water absorption and excretes remaining solids from rectum as feces

Feedstuffs:

Cracked Corn

Dry Matter	88%	 University of Kentucky- Feedstuff Discovery
Crude Protein	9.4%	
Total Digestible Nutrients	90%	
Crude Fiber	2.6%	
Calcium	0.03%	
Phosphorus	0.31%	
• Corn mechanically processed through a mill • Coarser grind preferred for ruminants		

Ground Corn

Dry Matter	88%	 University of Kentucky- Feedstuff Discovery
Crude Protein	9.4%	
Total Digestible Nutrients	90%	
Crude Fiber	2.6%	
Calcium	0.03%	
Phosphorus	0.31%	
• Corn mechanically processed through a mill • Coarser grind preferred for ruminants		

Distiller's Grain

Dry Matter	88%	 University of Kentucky- Feedstuff Discovery
Crude Protein	30%	
Total Digestible Nutrients	82%	
Crude Fiber	8.5%	
Calcium	0.03%	
Phosphorus	0.83%	
• Produced from distilling after alcohol and yeast has been removed • Primarily used as a source of protein and energy		

Whole Wheat

Dry Matter	89.4%	 University of Kentucky- Feedstuff Discovery
Crude Protein	14.2%	
Total Digestible Nutrients	88%	
Crude Fiber	7.9%	
Calcium	0.05%	
Phosphorus	0.43%	
• Widely grown • Slightly lower in energy than corn • Usually processed to some extent before feeding		

Wheat Middlings

Dry Matter	89%	
Crude Protein	18.4%	
Total Digestible Nutrients	81%	
Crude Fiber	8.5%	
Calcium	0.13%	
Phosphorus	0.99%	
• Wheat by-product from processing • Very palatable, but has a slight laxative effect		University of Kentucky- Feedstuff Discovery

Whole Barley

Dry Matter	91%	
Crude Protein	12.4%	
Total Digestible Nutrients	88%	
Crude Fiber	5.4%	
Calcium	0.06%	
Phosphorus	0.39%	
• Not widely available in western US • Less energy than corn, but more protein, fiber, and lysine		University of Kentucky- Feedstuff Discovery

Whole Oats

Dry Matter	90%
Crude Protein	13.2%
Total Digestible Nutrients	77%
Crude Fiber	13.1%
Calcium	0.11%
Phosphorus	0.4%
• Widely grown in cool weather • Less energy than corn, but more protein • Used for starting young animals	



University of Kentucky- Feedstuff Discovery

Rolled Oats

Dry Matter	90%
Crude Protein	13.2%
Total Digestible Nutrients	77%
Crude Fiber	13.1%
Calcium	0.11%
Phosphorus	0.4%
• Processed with high steam and then rolling into flat flake • Increases surface area and digestibility	



University of Kentucky- Feedstuff Discovery

Sorghum (Milo)

Dry Matter	88.6%
Crude Protein	13.2%
Total Digestible Nutrients	82%
Crude Fiber	2.8%
Calcium	0.07%
Phosphorus	0.35%

- Comparable to corn, but generally processed because of hard shell
- Grown in areas with less rain



University of Kentucky- Feedstuff Discovery

Beet Pulp

Dry Matter	90%
Crude Protein	8%
Total Digestible Nutrients	68%
Crude Fiber	21%
Calcium	0.6%
Phosphorus	0.05%

- Extract sugar from beets and dry the pulp
- Good source of digestible fiber



University of Kentucky- Feedstuff Discovery

Limestone

Dry Matter	98%
Calcium	36%
Natural source of calcium	



University of Kentucky- Feedstuff Discovery

Urea

Nitrogen	42-45%	
• Non-protein nitrogen source that should only be fed to ruminants • Toxic if overfed- No more than ⅓ of the total nitrogen in diet		

University of Kentucky- Feedstuff Discovery

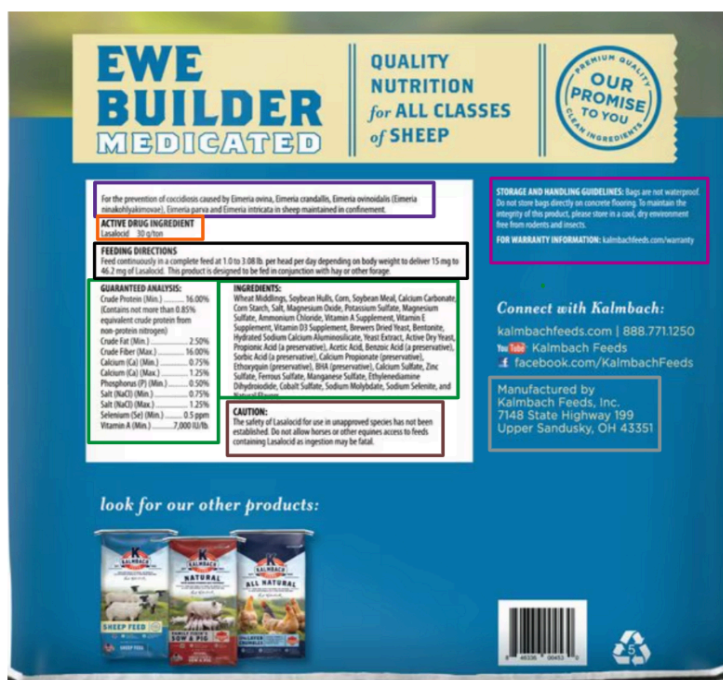
Dried or Liquid Molasses

Dry Matter	74.3%	
Crude Protein	5.8%	
Total Digestible Nutrients	80%	
Crude Fiber	0.0%	
Calcium	1%	
Phosphorus	0.1%	
• Dried or wet product of sugar cane or beet processing • Very palatable and a readily available energy source		University of Kentucky- Feedstuff Discovery

Feed Tag Analysis:

The feed tag is the label on the bag of feed that describes the nutrient content, ingredients, and usage of the feed. It must include specific information based on the Association of American Feed Control Officials (AAFCO). The required information includes:

Product Name	Purpose Statement	Medication Use Statement	Active Ingredient(s)
Guaranteed Analysis	Feed Ingredients	Manufacturer/Distributor Information	
Net Weight/Quantity	Directions for Use Feeding/Management Instructions		
Storage and Disposal	Precautionary Statements and Warnings		



Activity 1: Crossword Puzzle of Key Terms

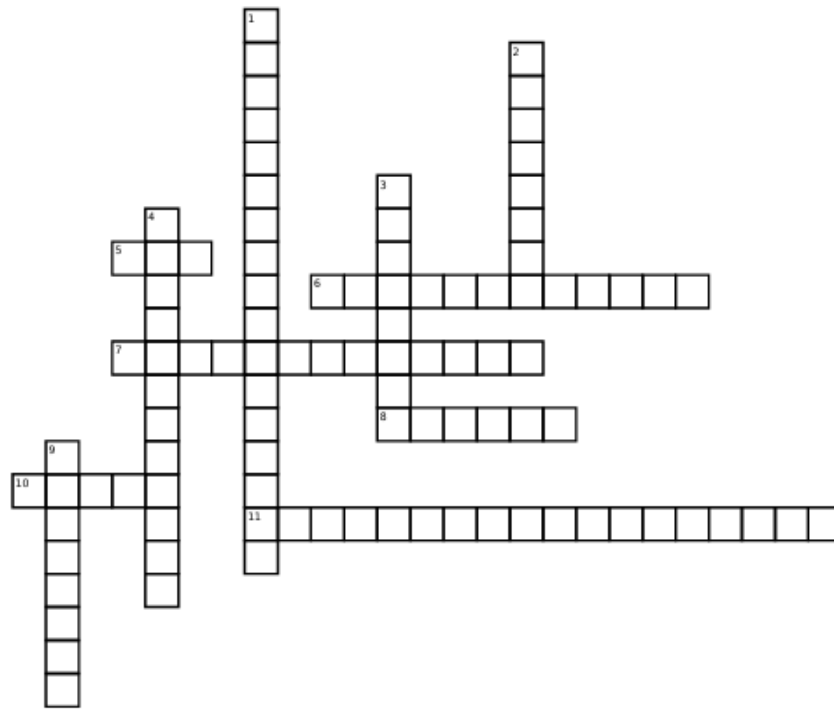
Author: Layney Clarke

Supplies:

- Crossword Puzzle
- Pen or pencil

Instructions:

1. Complete the crossword puzzle using the key terms introduced for this chapter

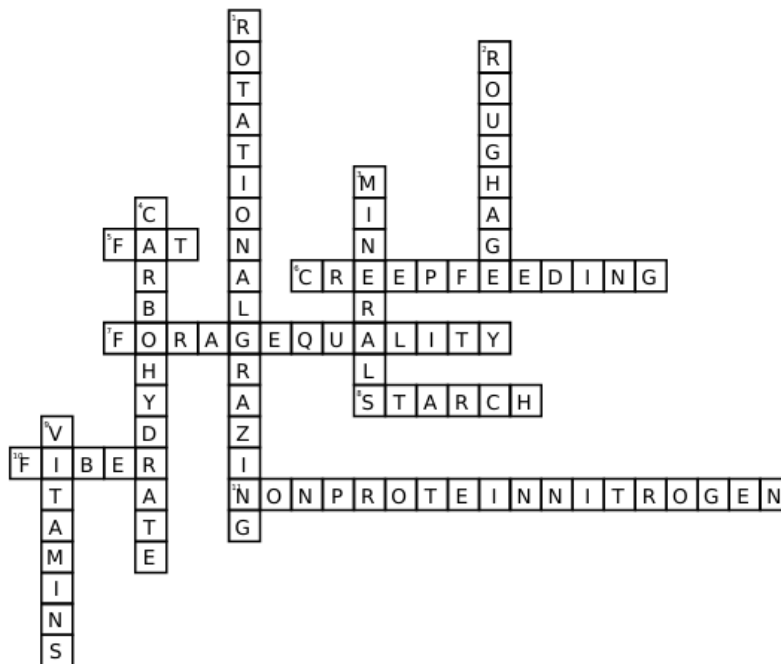


Down:

1. Dividing a pasture into smaller areas, changing or rotating the primary pasture the sheep or goats graze in to promote animal and pasture health
2. Feed ingredient that is low in digestible nutrients, but high in fiber
3. Inorganic elements found in plants and animals that start chemical reactions and form many tissues
4. Primary energy source made up of sugars, starches, and fibers
9. Organic compounds found in plants and animals that are essential for growth and activity

Across:

5. Triglycerides split into fatty acids as a source of energy for metabolism and structure
6. Offering free-choice, high-quality feed to lambs away from their mothers to aid in weaning
7. Describes how good sheep feed is for their health and growth
8. Primary way for plants to store carbohydrates
10. Plant matter digested by the microbes in rumen
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Activity 2: Ruminant Digestion Experiment

Author: Adara Gonzalez-Anleo

Students will replicate the fermentation process that takes place in the Rumen, while identifying what part each supply represents.

Supplies:

- Empty 20 oz bottle with cap (Rumen)
- Packet of dry quick-rise yeast (Micro-organisms)
- 9-inch latex balloon (shows methane and carbon dioxide produced)
- 3 tbsp of white granulated sugar (plants/forage eaten)
- Warm tap water (stomach acid)
- Funnel

Instructions:

1. Add the packet of yeast and sugar to the empty bottle.
2. Fill the bottle halfway with warm tap water and twist the cap on tight.
3. Shake the bottle a couple of times.
4. Remove the cap and place the balloon over the top of the bottle.
5. After a few minutes, the yeast will consume the sugar and produce gas to inflate the balloon.

Activity 3: Identifying Feedstuffs in a Mixture

Author: Adara Gonzalez-Anleo

Supplies:

- Ziplock bags
- Several samples of feedstuffs mentioned in this chapter- At least 10 or 15 samples

Instructions:

1. Pour small amounts of 2-3 types of feedstuffs into a ziplock bag to create a feedstuffs mixture.
 - a. Each ziplock bag should have 2-3 different types of feedstuff, and there should be approximately 5 bags with different mixtures.
2. Take turns looking at the ziplock bags and determine the different mixtures of feedstuffs in each bag
3. For each ziplock bag, identify characteristics of the feedstuffs that allow for its identification

Activity 4: Labeling the Ruminant Digestive System

Author: Adara Gonzalez-Anleo

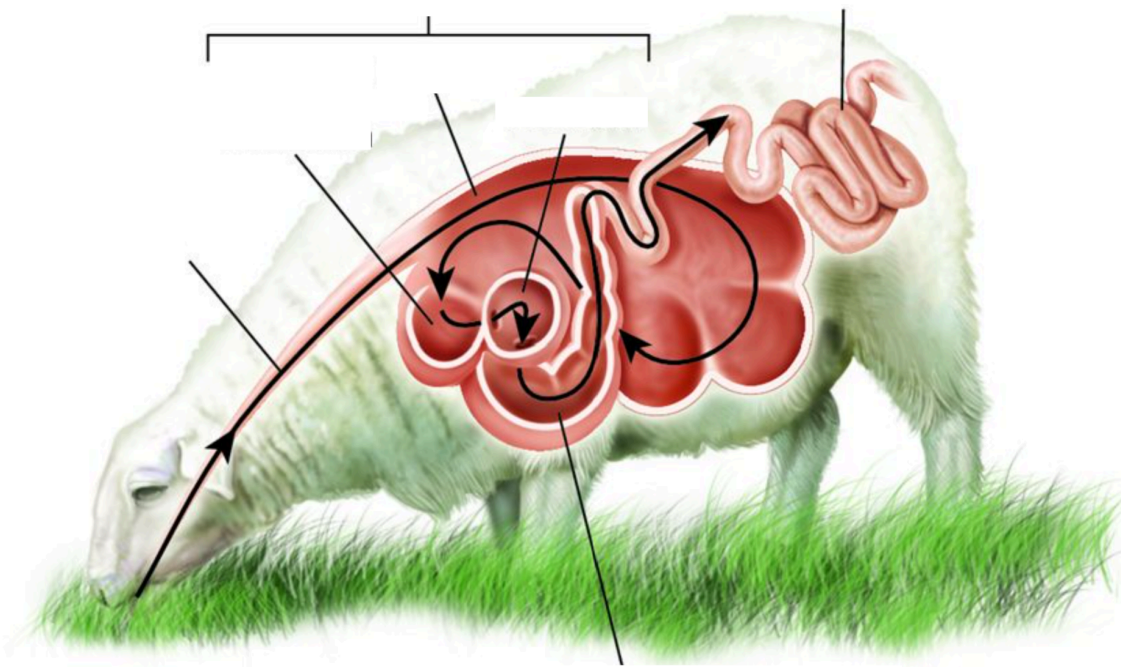
Students will test their recall on the locations of the different parts of the ruminant digestive system

Supplies:

- Print-out of unlabeled diagram
- pencils/pens for labeling

Instructions:

1. Correctly label the parts of the digestive system marked below.



Word Bank		
Omasum		Abomasum
Reticulum		Intestines
Rumen		Esophagus

Activity 5: Creating a Feed Tag

Author: Layney Clarke

This activity is intended to practice identifying different components of a Feed Tag. Some numbers, ingredients, instructions, etc. may not be completely accurate.

Supplies:

- Feed Tag Templates
- Pens or colored pencils
- Examples of feed tags (either real bags of feed or images)

Instructions:

1. Print out Feed Tag Templates.
2. Use example feed tags from real bags of feed to practice identifying the important aspects of the feed tag
3. Fill in the blanks to complete the Feed Tag template. Pay special attention to the important parts of the Feed Tag.

Template 1:

-----'S EWE FEED  FRESH & DELICIOUS FOR USE BY: PURPOSE: WEIGHT: ACTIVE DRUG:		MANUFACTURED BY: STORAGE: FEEDING INSTRUCTIONS: GUARANTEED ANALYSIS: <table><tr><td>Energy</td><td>3.4 kcal/g</td></tr><tr><td>Fat</td><td>2.5%</td></tr><tr><td>Calcium</td><td>1%</td></tr><tr><td>Phosphorus</td><td>0.5%</td></tr><tr><td>Protein</td><td>16%</td></tr><tr><td>Fiber</td><td>16%</td></tr></table> ACTIVE INGREDIENTS: 1. 2. WARNING:	Energy	3.4 kcal/g	Fat	2.5%	Calcium	1%	Phosphorus	0.5%	Protein	16%	Fiber	16%	INGREDIENTS: 1 2 3 4 5
Energy	3.4 kcal/g														
Fat	2.5%														
Calcium	1%														
Phosphorus	0.5%														
Protein	16%														
Fiber	16%														

Example:

LAYNEY'S

EWEE FEED



FRESH & DELICIOUS

FOR USE BY: BREEDING SHEEP
PURPOSE: MEDICATED FEED FOR EIMERIA

WEIGHT: 50LBS **ACTIVE DRUG: LASALOCID**

MANUFACTURED BY: LAYNEY'S SHEEP FEED CO.

STORAGE: KEEP IN COOL, DRY PLACE

FEEDING INSTRUCTIONS:

FEED IN CONJUNCTION WITH FORAGE OR HAY

GUARANTEED ANALYSIS:

Energy	3.4 kcal/g
Fat	2.5%
Calcium	1%
Phosphorus	0.5%
Protein	16%
Fiber	16%

ACTIVE INGREDIENTS:

1. WHEAT MIDLINGS
2. DISTILLER'S GRAIN

WARNING: NOT FOR USE WITH UNAPPROVED SPECIES

INGREDIENTS:

1 WHEAT MIDLINGS

2 DISTILLER'S GRAIN

3 OATS

4 CORN

5 LIMESTONE

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