

Nutrition of the Beef Animal

Learning Objectives

Requirements for Completion of Project

Introduction

Digestive System of Beef Cattle

Some Sources of Feed Nutrients

Feeding Management

Heifer Feeding Management

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Objectives

In this 4-H Project, Nutrition of the Beef Animal members will learn about:

- * the digestive system of beef cattle.
- * some sources of feed nutrients.
- * feed nutrients.
- * nutrient requirements of cattle.
- * balancing rations.
- * feeding management.
- * feed preparation.

Requirements to Complete This Project

- * Enroll as a 4-H member in the beef project.
- * Read and study Unit 3.
- * Review Unit 1 & 2.
- * Complete the exercises and activities at the end of this publication.
- * Finish the records and activities as indicated by either your 4-H agent or leader.

Nutrition of the Beef Animal

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The beef animal is an amazing animal. It belongs to the group of animals called "ruminants". Ruminants have more than one compartment in their stomachs. The very specialized stomach allows the beef animal to take coarse feeds (roughages) such as hay and pasture and turn them into beef. Understanding how the animal uses these feeds to produce beef is part of the science of animal nutrition. To help you learn about beef cattle nutrition, we are going to study the beef animal's digestive system, feeds, and how to determine the amount and kind of feed needed.

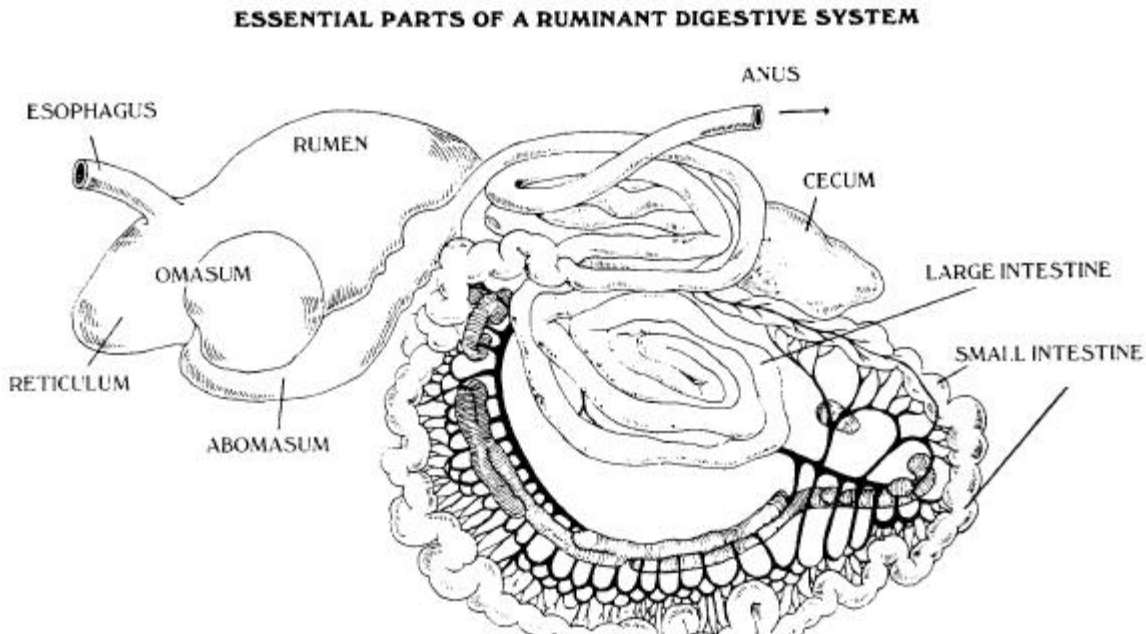
Let's Learn About the Digestive System of Beef Cattle

The digestive system of the beef animal has many parts that make it possible for roughage feeds such as hay to be used.

The first part of the digestive tract is the mouth. This is the place where feed given to the animal enters the digestive system and is broken into small pieces by the teeth. The second part is the esophagus (food tube) which carries the food from the mouth to the stomach. Swallowing is the term used to describe how muscles in the esophagus push feed from the mouth to the stomach.

The stomach is the next segment of the digestive tract. The function of the stomach is to digest the feed eaten by the animal. The animal may have a simple or a compound (ruminant) stomach. Animals such as the dog, cat, chicken, pig and man have a simple stomach. Cattle, sheep and goats have a ruminant stomach.

The simple stomach animal can digest only food that is low in fiber. High fiber feeds can be digested by the animal with a ruminant stomach.



Each of the four compartments of the ruminant's stomach play a role in the digestion of the high fiber feeds (roughages). The first compartment is the reticulum, then the rumen. There is no division between the rumen and reticulum. They are usually thought of as one compartment. In the mature animal the rumen and reticulum may hold 40 to 60 gallons of water and/or feed. The rumen and reticulum are sometimes called a "vat" because food is stored, stirred, and digested here. The feed stored in this vat is regurgitated (moved back up the esophagus to the mouth) and rechewed. After the feed is rechewed it is swallowed again and goes back into the rumen. This process is called rumination or sometimes "cud chewing". Bacteria, enzymes, etc. found in the "vat" help the animal break up or digest the feed eaten by the animal. Also, the muscles in these two compartments move the feed around and break it into smaller pieces.

The third compartment is the omasum or "manypies" It helps grind some of the food after it comes out of the reticulum. It also squeezes some water out of the feed.

The fourth compartment is the abomasum or "true" stomach. Here the feed is

digested by digestive juices. The abomasum works similar to the stomach of the pig and man.

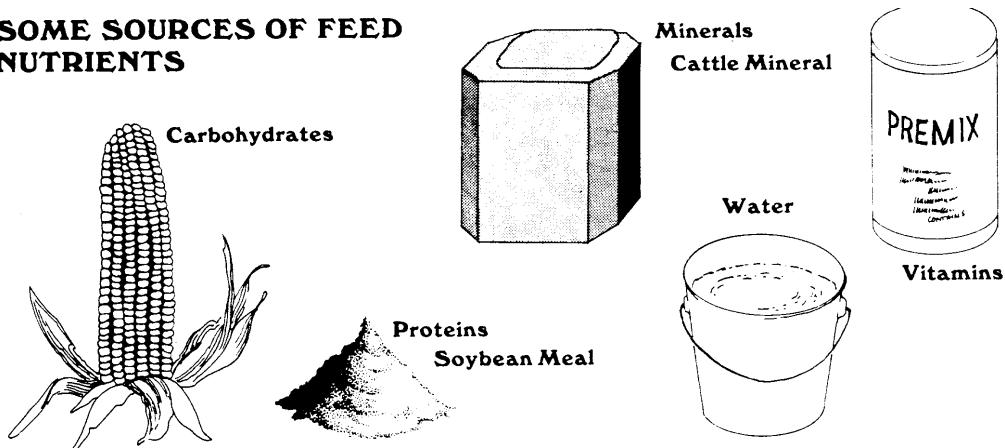
From the abomasum the food goes into the small intestine where the nutrients in the feeds are absorbed. The food nutrients not absorbed in the small intestine move on to the large intestine. At this junction is the "blind gut" or cecum. It has little function in the ruminant. In the horse and rabbit it is the place where roughages are digested. In the large intestine much of the water in the remaining food is absorbed. From the large intestine the unused feed is passed through the anus and is removed from the body.

With all the many processes that are required to make a feed usable by the animal, it takes up to 4 days from the time the feed enters the mouth until the unused feed passes through the anus and is eliminated. This compares to 1 day for the pig, a simple stomach animal.

Let's Learn About Feed Nutrients

Nutrients are elements in feeds that are used by the animal to grow, produce milk, etc. Some of the nutrients are needed in large amounts while others are needed in only tiny amounts.

SOME SOURCES OF FEED NUTRIENTS



Feeds contain five main types of nutrients. Each type of nutrient is used to do different jobs in the animal's body. The five major nutrients are (1) Carbohydrates (energy), (2) Proteins, (3) Vitamins, (4) Minerals and (5) Water. The animal must have some of each of the nutrients if it is to be healthy and productive. Carbohydrates furnish more of the energy needed by the animal. This energy is used to walk, breathe, produce heat to keep warm, etc.

Proteins are considered the building blocks of the body. Proteins are very complex chemicals that are used to build muscle, blood, internal organs, skin and many other parts of the body.

Vitamins are needed in small amounts by the animal's body. Although vitamins are needed in small amounts they are necessary for the normal functioning of the body. There are several different vitamins, each with a specific job in the body. The vitamins used by the body are Vitamins A, B, C, D, F and K.

Minerals are also needed in small amounts. Minerals are used in the animal's body in the chemical reactions that are necessary for many life processes. Minerals are also necessary for bone and teeth growth and their maintenance. Most feeds used in rations for ruminants usually contain all the minerals the animal needs except salt (sodium and chlorine) and calcium and phosphorus.

Water is the last nutrient on the list. Water is usually not thought of as a nutrient; however, it is extremely important since water makes up about 3/4 of the animal's weight. Water is used to carry other nutrients into and through the body and to carry wastes out of the body. Water is also used in chemical reactions and many other functions of the body.

Most feeds contain all of the nutrients listed; however, 100 percent of each of these nutrients cannot be used by the animal. A term used to describe how much of the feed that is digestible or usable by the animal is Total Digestible Nutrients (TDN).

It is impossible to look at a feed and tell what nutrients are in it. To determine what nutrients and how much of each is found in a feed, the feed is sent to a laboratory to be tested. If a feed is not tested it is possible to get an estimate of the nutrients by looking at the average nutrient contents of specific feeds in Feed Tables such as "Feed Composition Tables" published by the National Research Council.

By using the nutrient content figures from the tested sample or from the tables it is possible to balance rations after determining what the animal needs.

Let's Learn About the Nutrient Requirements of Cattle

Each animal must have certain nutrients in specific amounts if it is to stay healthy and grow properly. By studying what cattle eat, research workers have determined what nutrients an animal needs. These researchers have found that the kind of nutrients and the amounts required by an animal depend on its stage of production. Of course, a baby calf needs its mother's milk but when it gets older a different kind of food is needed. Also the level of performance will determine how much and what kinds of feeds are needed. The nutrient requirements of beef cattle are presented in Table 1.

Let's Learn About Balancing Rations

A balanced ration is one that will furnish the nutrients in the proportion and amount needed to properly nourish an animal for 24 hours.

The way to balance a ration is to take the requirements of the animal and try to find the kinds and amounts of feeds needed to meet the requirements. To balance rations a table giving the nutrient requirements of various classes of beef cattle is needed (Table 1). Table 2 gives the nutrient content of some feeds used to feed beef cattle.

Balancing rations is not hard if it is done one step at a time. Use the following procedure to balance a ration or to determine if the ration being fed is adequate:

STEP 1: Select the animal for which the ration is to be balanced. Find the nutrient requirements in Table 1. Fill in the information requested in Step 1 of Exercise 1.

STEP 2: Next, list the feed(s) and the nutrient content of the feed as requested in Step 2 in Exercise 1.

STEP 3: Next, write down the amount of feed required by the animal and multiply this figure by the percent of each nutrient found in the feed. This gives the amount of nutrients that the feed can furnish the animal.

STEP 4: Now check to see if the amount of nutrients found in Step 3 is equal to the amounts given in Step 1. If the amount of nutrients in the feed is greater than the requirements then the animal's needs will be met using the selected feed. If the requirement is greater than the pounds of nutrients in the feed then a different feed or an additional feed is needed. Select a feed that has a larger amount of the nutrient that was low. Go back and figure the ration again to see if the new feed will meet the animal's requirement.

Remember that the figures used are averages. If it is suspected that the feeds are of a lower than average quality, have a sample analyzed at the State Forage Testing Laboratory. Use these figures to balance the ration. Remember that the performance of the animal gives the best evaluation of how well the ration is balanced.

TABLE 1Nutrient Requirements of Beef Cattle¹

Body Weight (lbs.)	Average Daily Gain (lbs.)	Feed Intake² (lbs.)	Crude Protein² (lbs.)	Digestible Protein² (lbs.)	TDN² (lbs.)
Growing-Finishing Steer Calves and Yearlings					
400	2.0	9.9	1.27	.85	7.6
600	2.0	15.6	1.63	1.05	10.7
800	2.0	17.9	1.78	1.09	13.0
1000	2.0	22.5	1.94	1.15	15.5
Growing-Finishing Heifer Calves and Yearlings					
400	1.5	11.6	1.25	.81	7.6
600	1.5	13.6	1.41	.85	9.7
800	1.5	17.9	1.63	.92	12.2
1000	1.5	20.1	1.79	1.05	14.2
Pregnant Yearling Heifers (Last third of Pregnancy)					
700	1.5	19.6	1.75	1.00	10.8
800	1.5	21.5	1.88	1.08	11.6
900	1.5	25.4	2.05	1.18	12.5
Dry Pregnant Mature Cows (Middle Third of Pregnancy)					
800	—	12.5	.75	.54	6.8
900	—	13.6	.79	.57	7.0
1000	—	14.8	.87	.40	7.6
1100	—	15.9	.94	.44	8.1
1200	—	17.0	.99	.47	8.7
Dry Pregnant Mature Cows (Last Third of Pregnancy)					
800	.9	14.3	.94	.45	8.2
900	.9	15.5	1.08	.46	8.8
1000	.9	16.7	1.10	.50	9.4
1100	.9	17.9	1.12	.53	10.0
1200	.9	19.2	1.18	.56	10.6
Cows Nursing Calves, Superior Milking Ability (First 3-4 mos. after Calving)					
800	—	22.8	2.48	1.45	13.0
900	—	25.8	2.60	1.52	13.6
1000	—	24.9	2.72	1.59	14.2
1100	—	26.0	2.84	1.67	14.8
1200	—	27.0	2.95	1.74	15.4

¹From Nutrient Requirements of Beef Cattle, Fifth Revised Edition, National Research Council, 1976 as adopted by James E. Ross and Homer B. Sewell in Southern Regional Beef Cow-Calf Handbook SR 2000.1.

²Expressed on a Dry Matter Basis.

TABLE 2NUTRIENT CONTENT OF FEEDSTUFFS¹

Feed	Dry Matter %	Crude ² Protein %	Digestible ² Protein %	TDN ² (%)
<u>Roughages</u>				
Fescue Hay	88.5	10.5	6.0	62
Bermudagrass Hay	91.1	8.9	4.8	43
Alfalfa Hay	89.2	17.1	12.1	58
Orchardgrass Hay	88.5	9.7	5.8	57
<u>Concentrates</u>				
Corn Shelled	86.5	9.9	7.4	91
Corn (ear)	87.0	9.3	4.6	90
Barley	88.1	13.3	10.0	81
Oats	89.5	13.5	10.1	77
<u>Protein Supplements</u>				
Cottonseed Meal	92.5	44.3	35.9	74
44% Soybean Meal	89.0	51.5	43.8	81
48% Soybean Meal	89.8	56.7	51.0	84
Linseed Oil Meal	91.0	58.6	54.0	76

¹From United States-Canadian Tables of Feed Composition, Second Rev., 1972, National Academy of Sciences²Expressed on a Dry Matter Basis

Let's Learn About Feeding Management

Feeding a beef animal is more complicated than just balancing a ration and pouring the feed in the bunk. Animals are fed for different purposes (growth, finishing, lactation, etc.) and must be managed properly to accomplish this purpose. Since a beef heifer or steer is used as the 4-H project animal, a short discussion on feeding management will be presented for the beef heifer and beef steer.

Feeding the Beef Heifer

Keep in mind that you are feeding your heifer for the purpose of growing and developing her into a productive brood cow.

You must give her enough feed (nutrients) to keep her growing and developing rapidly. However, do not be too eager! Do not overfeed her.

Overfeeding can be harmful to her future production as a brood cow. An overfat heifer is usually a slow breeder, a poor milker, and is more likely to have calving trouble.

If you intend to show your heifer, enough extra feed will be needed to give her some extra finish or "bloom" so that she can look her best. Again, avoid getting her too fat. Work closely with your 4-H leader for recommended feed changes. Weigh your heifer weekly or monthly to check her progress.

A good average daily gain for a young heifer after weaning is 1.3 to 1.5 pounds per day. When the heifer is within two months from show, a daily gain of 1.3 to 1.8 pounds per day will assure a good "bloomy" heifer. If your heifer gains over 2.00 pounds per day, she will usually be getting too fat. Weigh your calf often so you can determine the average daily gain.

Feed your heifer what you grow on your farm. If you need extra nutrients to balance your ration, you will need to buy feed.

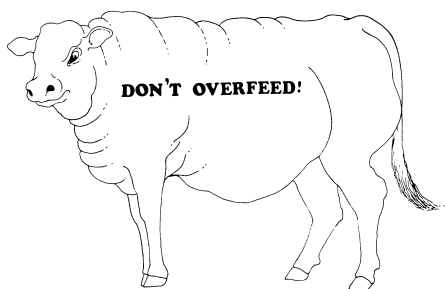
Provide pasture when possible. When more gain is needed, add an extra amount of grain.

Extra protein will be necessary in winter or when pasture is short or limited. A good guide on how much to feed is one pound of concentrates per 100 pounds of body weight, plus one pound of protein supplement for each animal. Information given earlier in this booklet may be used to make a completely balanced ration. Pasture or hay should be available at all times.

Example: Heifer weight is 700 pounds.

7 X 1 = 7 pounds cracked corn plus 1 pound of protein supplement and all the pasture or medium quality hay she wants.

Visit with your 4-H leader frequently about your feeding program.



Let's Learn About Heifer Feeding Management

Feeding management is the art of using animal nutrition (a science) to make your animal function for a specific purpose. You will become a better feeder as you gain more experience. Here are some guidelines to help you do a better job:

1. Feed only what is required - a balanced ration .
2. Prevent waste - Feed bunks 2 1/2 feet wide, 2 feet of bunk space for each animal, 12 inches from bottom of feed bunk to ground, 8-inch sides on feed bunk.
3. Feed at the same time each day. Do not skip a feeding.
4. Keep feed fresh. Don't let stale feed accumulate in bunk.
5. Talk softly, work quietly, avoid sudden movements and above all, be patient.
6. Provide free access to salt and mineral mix. Provide clean, fresh water at all times.
7. When mixing more than one kind of feed, mix thoroughly. Don't get feed too fine or dusty. A coarse grind is best.
8. Molasses will help settle dusty feed and makes feed more palatable. It is not necessary to add molasses to your ration.
9. Feed only the amount of hay your calf will clean up in one day.

10. Make feed changes slowly and increase slowly the amount of feed your calf receives

Young animals will make gain at less cost. As they grow older, gain will cost more. Keeping good records will help you plan future feeding programs.

Feeding The Beef Steer

The same scientific nutrition principles apply to feeding your steer as apply to growing and developing a heifer. In addition, you will need to feed a greater amount of nutrients in the form of energy to fatten your steer to the desired market finish.

This will involve feeding a greater amount of grain or concentrates. These extra energy nutrients must be supplied in a small enough volume of feed so the steer will eat them. You may utilize pasture and roughage to grow and develop your steer, but shortly before the yearling stage, and on until market time, he needs enough extra nutrients to begin to "finish".

You should use those feeds that are grown on your farm. Buy feeds that give you the most nutrients for the lowest price. (Ask your parents or project leader about this.) Keep your ration simple. A choice steer selected at the right age does not require a complicated feeding program.

Frequently check your feed cost for each pound of gain. This means that you should keep a simple record on the amount of feed you give your steer and the cost of this feed.

Weighing your steer each week or each month will allow you to figure the cost of each pound of gain.

Figure Cost per Pound of Gain:

$$\frac{\text{Amount of feed X cost of feed}}{\text{Total pounds gain}} = \text{Cost/lb of gain}$$

Example:

$$\frac{480 \text{ lbs feed X } 6 \text{ cents/lb.}}{60 \text{ pounds gain}} = \frac{\$28.80}{60}$$

48 cents/lb.

Nurse cows are not recommended for practical feeding programs. You cannot feed two animals as cheaply as one. Also, high-priced supplemental feeds may run your feed costs too high to make a profit. On the other hand, if you use poor quality, cheap feeds - and keep your gains too low - your steer will fail to reach an acceptable quality grade. Your goal should be to finish your steer to a choice grade and make some money. Your 4-H leader can help you figure your cost of gains, and show you how to cheapen feed costs if necessary.

Amount of Feed to Use

Steers should be on "full feed" of concentrates and low roughage the last 100 to 150 days. Their daily gains should average 2.0 to 2.5 pounds per day for this period. Before this, gains from 1.5 to 2.0 pounds per day is sufficient.

These lower gains may be achieved on one-half full feed, as described under the heifer feeding guide.

A steer is considered on full feed when he consumes about 2.0 to 2.5 pounds of concentrates per 100 pounds body weight. A very good performing steer may consume more than this. Two to four pounds of hay per day should be fed in addition. Turning your steer on a limited pasture area a short time each day may take the place of hay.

Rations

A number of different combinations of feed ingredients may be used for the steer's ration.

However, a simple ration may be best and economy should be considered.

Ration No. 1

First 60 days on feed

- 1 part cracked or rolled shelled corn
- 1 part crushed ear corn or rolled oats

Ration No. 2

Next 60 days on feed

- 2 parts cracked shelled corn
- 1 part crushed ear corn or rolled oats

Ration No. 3

After 120 days on feed

- 3 parts cracked shelled corn
- 1 part crushed ear corn or rolled oats

In addition, one part barley or grain may be added to any one of the above mixtures. Other rations may be developed using the information on ration balancing that was presented earlier.

Add Protein Supplement

The following may be used as a guide for adding a 36 to 40 percent protein supplement to the grain rations. (If a higher percent supplement is used, make adjustments according to protein content.)

1. If steer weighs 400 to 600 pounds, use 1 pound 36 to 40 percent supplement for each 6 pounds of grain mixture.
2. If steer weighs 400 to 600 pounds, use 1 pound 36 to 40 percent supplement for each 8 pounds of grain mixture.
3. If steer weighs 800 to 1000 pounds, use 1 pound 36 to 40 percent supplement for each 10 pounds of grain mixture.

Starting The Steer on Feed

Start your steer on full feed with daily ration of one pound per 100 pounds of body weight. Increase ration by 1/4 to 1/2 pound per day until he is on full feed (2 to 2.5 pounds per 100 pounds body weight). Increase feed as your steer grows.

In the beginning, give the steer all the pasture or hay he wants. Gradually decrease hay and pasture as a "full feed" is approached. Do not allow your steer on pasture the last 8 to 10 weeks before the show. Your 4-H leader will help outline a feeding program for your steer, using the feed that you have available on your farm.

Your feeding program will vary, depending on:

1. Age and size of steer
2. Feeds available
3. Degree of finish on steer
4. Final weight and finish expected

Steer Feeding Management

The same feeding management guides will apply to steers as to heifers. In addition, the following suggestions are given for steers:

1. If hand-feeding, allow the steer the amount of feed he will clean up in 45 to 60 minutes, twice each day. You may want to feed three times daily during the last 60 to 90 days on feed. Once on full feed, the steer may be self-fed, providing there is fresh feed before him at all times. Take out any stale feed.
2. Clean out bunk before each feeding.
3. When hand-feeding, if your steer leaves feed or has a poor appetite, cut back on feed for one or two feedings until he regains his appetite for the feed.

4. During the early part of the feeding period (until the animal gets on full feed), hay may be given free choice. When the animal is on full feed, hay should be limited 2 to 4 pounds daily.
5. Feed should be increased gradually. After your animal is on full feed, do not increase his feed any more than 1/4 pound per day. A change from one ration to another should also be over a period of 5 to 7 days.
6. Watch your steer's droppings for signs of trouble -- scouring indicates he is getting too much grain and not enough hay, or that he is getting moldy grain or other feeds that cause digestive disturbances. When loose droppings occur, increase hay and decrease grain according to severity of the case.
7. Feeding more than one animal, or having other animals nearby, helps to gentle the steer and increase his appetite.

Feed Preparation

A medium-to-coarse grind is best for feeds to be ground. Avoid a dusty feed. Shelled corn may be cracked or rolled, and oats and barley should be ground or rolled. Feeds should be thoroughly mixed. If molasses are added each day, use about 1/4 pound mixed with 1 pint of water. Mix thoroughly in the feed for steers weighing up to about 600 pounds. Give larger animals 1/2 pound molasses mixed the same way. Changes to molasses feeding should be made gradually.

GLOSSARY

Average Daily Gain (ADG) The amount of weight gain made each day. It is figured by the following formula: $ADG = \frac{\text{Weight now minus last weight}}{\text{No. days between weights}}$

Carbohydrates These are the elements in a feed that provide energy for the animal.

Concentrates These are the feeds that are high in energy. Grains such as corn, wheat and barley are good examples of concentrates.

Minerals These are the feeds that are needed to build bones and teeth and are necessary for many chemical reactions to take place in the body. Some examples of minerals are limestone, calcium phosphate and bone meal.

Nutrient Any group of food components or parts that have the same general chemical composition and aid in the support of life.

Proteins That part of feeds used to build muscles and hair and provide for necessary body processes.

Protein Supplement A feed that contains a large amount of protein. Cottonseed meal and soybean meal are high in proteins.

Ration Daily feed or amount of feed an animal eats in 24 hours.

Roughage A feed that is low in energy. Examples are hay and silage.

TDN (Total Digestible Nutrients) The part of the feed that is digestible or usable by the animal.

Vitamins Food substances that are necessary in small amounts to assist in metabolic processes in the animal's body.

Project Record
Nutrition of the Beef Animal
4-H Beef Project
Unit 3

NAME _____ ADDRESS _____

COUNTY _____ CLUB _____

AGE _____

1. Exercise 1 completed Date _____

2. Exercise 2 completed Date _____

3. Exercise 3 completed Date _____

4. Exercise 4 completed Date _____

5. The title of this unit is "Nutrition of the Beef Animal". Why must different classes of beef cattle be fed differently?

Extension Agent or Leader Signature

Exercise 1

Balancing The Ration

Balance a ration for your 4-H Project Animal. If you can't have an animal, balance a ration for an 800 lb. steer to gain 2 pounds/day.

Step 1:

	Dry Matter	Crude Protein	Digestible Protein	TDN
Requirements of Animal		Lbs.	Lbs.	Lbs.

Step 2:

Nutrient Content of Feed		%	%	%
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Step 3:

Amount of Nutrients in Feed		Lbs.	Lbs.	Lbs.
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(Use Dry Matter Requirements in Step 1 on this line.)

(Use Figures of Nutrient Content from Step 2 on this line.)

	x_____	x_____	x_____
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Pounds of Nutrients in Feed:

Step 4:
Does each of these meet requirements listed in Step 1?

Exercise 2

Learning More About Nutrition

1. List the five main types of nutrients found in feeds:
2. List the four compartments of the ruminant stomach.
3. List the feeds on your farm that can be fed to beef cattle.
4. List the names of Feed Stores in your country.

EXTRA CREDIT:

5. Visit a beef cattle feedlot. Answer the following questions:

Number cattle on feed _____.

Kind of feed used (commercial or home grown) _____.

List items in ration.

How much feed is fed per head per day?

What is the physical form of the feed (ground, pellets, etc.)?

Exercise 3

Things to Learn on Feed Store Visit

1. List feed items for sale at feed store.

2. Select one feed and check prices. List price of one ton of feed in bags.

In bulk.

3. Compare the price of protein in two protein supplements:

(_____ % Protein X 2000 lbs. = Lbs. Protein in One Ton)

(Price per ton / Lbs. Protein per ton = Price per Pound of Protein)

Protein Supplement	Price per Ton	Price per lb. of Protein
_____	_____	_____
_____	_____	_____
_____	_____	_____

4. Attach two different feed tags here:

Exercise 4

More Things To Do

(You must complete at least three of these activities to finish the project.)

	Date Completed
1. Feed a beef animal as a 4-H project.	_____
2. Visit a feed processing plant.	_____
3. Visit cow-calf producer to see what feed is being used.	_____
4. Visit a slaughter plant and observe a ruminant stomach.	_____
5. Attend 4-H Beef Leadership Conference.	_____
6. Attend 4-H Beef Project meeting.	_____
7. Take part in 4-H Livestock Project Tour.	_____
8. Give a demonstration of feeding the beef animal.	_____
9. Prepare an exhibit showing the different types of feed.	_____
10. Give a demonstration on feeding the beef animal.	_____

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