

5 Basic Nutrients

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Goal (learning objective)

Youth will learn about the five major types of feed nutrients. In addition, youth will learn how much water livestock drink per day, on average.

Supplies

- Handout 1 “BEEF Nutrition and Feeding: The Essential Nutrients Handout” make enough copies for your group
- Handout 2 “SHEEP Nutrition Handout” make enough copies for your group
- Handout 3 “SWINE Nutrition Handout” make enough copies for your group
- Handout 4 “Feed Word Bank Worksheet” make enough copies for your group
- 8oz. drinking glass/cups (enough for your group)
- 1-1gal. container (milk jug, etc.)
- 1-5gal. bucket
- Water

Pre-lesson preparation

- Make copies of the handouts
- Read the handouts to familiarize yourself with the content
- Practice the activities

Lesson directions and outline

Share the following information with the youth:

All feeds are made up of nutrients. Just like people, livestock must have certain nutrients in their daily feed to remain healthy and continue to grow.

The essential nutrients for beef, sheep, and swine are:

- Water
- Energy
- Protein
- Minerals
- Vitamins

Water is the most important nutrient and should be available free choice to your steer, lamb, or hog. It should be clean, of normal temperature, and accessible at all times. Water is necessary for digestion, carry food nutrients and waste products, cooling the body, and lubricating the joints.

Energy from carbohydrates and fats enhance movement and produce heat to keep the body warm. Excess energy feeds are stored as fat.

Protein supplies the materials to make body tissues like muscle, internal organs, bones, blood, and skin.

Minerals help build bones and teeth.

Vitamins are required for healthy eyes, nasal passages, lungs, blood and strong bones.

Conducting the activity (DO)

Activity 1

1. Distribute Handout 4, every member should have a copy.
2. Have each member name feed sources that they feed their animals. Have them write these feed sources on their Feed Word Bank Worksheet (if not already listed).
3. For each feed ingredient, check whether it is primarily used as a source of protein, energy, mineral, or vitamin. Discuss options.

Activity 2

1. Discuss/share the following:
 - Knowing how much clean drinking water an animal requires each day will help members determine if they are able to provide for their animal's needs
 - Water is the basis of all life and is the most important part of an animal's diet. The average child drinks about six glasses of water per day. Ask the child if this is more or less than the average beef animal drinks?
 - To give members perspective, a 350 pound animal needs between one and five gallons of drinking water a day; a 500 pound animal needs between two and six gallons of drinking water a day; a 750 pound animal needs 10-15 gallons per day; a steer weighing 1000 pounds or more needs 20 gallons or more of cool, clean drinking water a day
2. Have a volunteer distribute the cups to members
3. Have members fill their glass with water and pour into the 1-gallon container and have members count how many glasses it takes to fill the 1-gallon container.
4. Have members fill the 5-gallon bucket with a 1-gallon container and have members count how many 1-gallon containers it takes to fill the 5-gallon bucket.

What did we learn? (REFLECT)

- Ask: Were you surprised at how much water it took to fill the 1-gallon container and the bucket?
- Ask: Do you think your animal would drink more water if it was available?
- Ask: What nutrient group is the most important to animal health? Why?
- Ask: How much water does a 1000lb steer need?
- Ask: How much water does a 200lb hog need?
- Ask: How much water does a 100lb lamb need?
- Ask: What happens if your animal goes off feed?

Why is that important? (APPLY)

- Ask: What could happen if your animal does not get enough water? How do you feel if you don't have water?
- Ask: How does nutrition impact your life?
- Ask: Why is it important to observe and record your animal's daily eating habits?

Resources

- Kuhl, G., Adams, J.P., and Astroth, K. (n.d.). How Much Water? –Kansas 4-H Beef Leader Notebook (S100). (pages 66-69). Kansas State University.
- National 4-H Council. (2005). Bite Into Beef. BU-08143 (pages 16-17).
- Ohio State University Extension. (2011). Nutrition and Feeding. *Beef resource handbook* (pages 7-1 through 7-7).
- Ohio State University Extension. (2008). Nutrition. *Goat resource handbook* (pages 51-55).
- Ohio State University Extension. (2011). Nutrition. *Sheep resource handbook for market and breeding projects* (pages 49-50).
- Ohio State University Extension. (2000). Nutrition. *Swine resource handbook for market and breeding projects* (pages 8-1 through 8-3).

BEEF Nutrition and Feeding: The Essential Nutrients Handout

Source: Beef Resource Handbook 4-H 117R. (2001). The Ohio State University Extension. Chapter 7. Pages 7-1 through 7-7.

Water

Water is an extremely important part of an animal's diet. It is found in every cell in the body. It helps keep the body cool and carries other nutrients throughout the body. Water also helps the body form waste materials.

Be sure cattle have plenty of fresh water every day. Limitations on water intake depress animal performance more quickly and more drastically than any other nutrient deficiency. Domesticated animals can live about sixty days without food but only seven days without water. Hearing and sight are impaired without water.

Cattle will drink up to 20 gallons or more of water in one day, depending on their weight and the environmental temperature. For example, a calf that drinks three gallons a day in the winter, will drink nine gallons a day in the summer.

Water should be at a comfortable temperature. Drinkable water is usually between 40°F and 65°F. Steers that have access to cool drinking water will gain between 0.3 to 0.4 pounds more per day than those drinking warm water.

Therefore, you may want to occasionally check water temperature. Dip a thermometer into the water. Do not allow the thermometer to rest on the bottom. Touching the heated bottom of the pan can result in higher temperatures. Check the temperature over several cold days. Water temperatures of at least 40°F should minimize mechanical water system problems and maintain animal performance.

Energy

Energy is used for growing and also for producing a calf. Carbohydrates and fats give beef cattle most of the energy they need. Examples of carbohydrates that you eat are bread and potatoes. Grains cattle eat which are high in energy include corn, barley, wheat, and oats. Other feeds, like hay, are intermediate in energy while corn stalks are low in energy.

There are several different ways to measure energy levels. The two most common methods are Total Digestible Nutrients (TDN) and the Net Energy (NE) systems. The Net Energy system is becoming more common. While you may still use the older TDB system, some labs are now only reporting feed energy in Net Energy values.

Protein

Beef cattle use protein to build muscles, hair, hooves, and tissues inside their bodies. Protein works with carbohydrates so the animal will grow properly. Proteins are made up of small building blocks called "amino acids". We eat meat and eggs, which are high in protein. Soybean oil meal and alfalfa hay (legumes) are examples of livestock feeds that are high in protein.

Cattle protein supplements may be composed of a natural protein source or may contain some Non-Protein Nitrogen (NPN). For example, a common natural protein supplement is soybean meal, and a common NPN source is urea. Urea is better suited for older cattle on higher energy diets.

Note: Urea cannot be given to calves until their rumens are developed, so calves must be older than four months. Animals under 450 pounds generally gain more efficiently on natural protein sources. The amount of urea fed in the rations should not exceed one percent of the total ration or three percent of the concentrate mixture.

Minerals

Minerals are needed to build strong bones and teeth and to make blood, muscle, and nerves. Some minerals may need to be supplemented directly in the ration. Salt, calcium, and phosphorus are minerals needed in larger amounts than other minerals. (*Table 7.01*) Cattle should have a salt-mineral box to supply them with the extra minerals they do not get from their feed. This box should be accessible to cattle at all times. Minerals needed in smaller amounts are called trace minerals. Examples of trace minerals are calcium and phosphorus. We eat cheese and drink milk to get calcium and phosphorus. For beef cattle, grass and hay can be a source of calcium, while grains are high in phosphorus. Beef is an excellent source of many trace minerals for us.

Salt

Feeds generally do not contain adequate amounts of salt, the main source of sodium. Sodium can be supplemented as sodium chloride or sodium bicarbonate, and both forms are easily absorbed by the animal. Iodized salt should always be used to avoid an iodine deficiency. Cattle fed maintenance rations while confined in a dry lot often consumer high levels of mineral mixtures, perhaps from boredom.

Calcium and Phosphorus

A calcium to phosphorus ratio of less than 1:1 or more than 8:1 may reduce performance. The typical calcium to phosphorus ratio is 1.5 to 2.0:1 for beef cattle. However, high levels of calcium from legumes do not appear to depress gains in growing rations. Calcium supplementation will probably be needed for growing steers and heifers receiving some grain.

Phosphorus

Phosphorus is often deficient in forage diets. Around calving time, cows should have free-choice access to 10-12% phosphorus mineral. An example would be ½ dicalcium phosphate. At other times of the year, cows and stockers would need a mineral consisting of 25-35% dicalcium phosphate or 7-8% phosphorus.

Magnesium

A mineral that may be deficient in feed is magnesium. The result of such a deficiency is called grass tetany, grass staggers, or magnesium tetany.

Magnesium tetany results when cattle, particularly cows that are milking and grazing on lush pastures, use up their existing body supplies of magnesium without a steady replacement from their diet. Another likely group to get magnesium tetany is cows in late gestation because of the nutritional requirements of the growing fetus. However, any animal that is grazing lush, green pastures of either grass or small

grain is running the risk of magnesium tetany. A high level of calcium will also tie up the availability of magnesium. Therefore, you should use dolomitic lime if magnesium is deficient in your area.

Symptoms of magnesium tetany include nervousness and irritability. Often, muscle twitching, usually in the face, eyelids, ears or flanks, will occur. Animals may bellow loudly while in the pasture or do some frenzied galloping. Later, animals will exhibit a staggering gait and fall down. After falling, they go into convulsions and eventually die. Mineral supplements containing magnesium and grain should be readily available to encourage consumption.

Vitamins

There are two categories of vitamins, water-soluble and fat-soluble. Produced in the rumen of the animal. Produced in the rumen of the animal, B complex vitamins are soluble. Fat-soluble vitamins of importance to cattle are A, D, E, and K. Cattle usually receive enough vitamin D from sunlight or from sun-cured hay. Vitamin E is usually received through feed, while vitamin K is produced in the rumen.

Vitamin A may need to be supplemented if green, leafy forages are not available. Vitamin A can be supplemented in the diet or by an injection. One million International Units of vitamin A palmitate injected intramuscularly (for example, when cows are palpated for pregnancy) will meet their vitamin A needs for two to four months. In the mineral mix, add 10,000 to 50,000 International Units per 0.1 to 0.2 lbs. of mineral mix. Be very cautious if you are mixing your own vitamin-mineral mix. Only a very small amount of vitamin A pre-mix is needed and mistakes in mixing can lead to toxicity situations. Vitamin A will not remain stable very long in homemade mineral mixes (approximately 2-3 weeks). Utilize or request protected forms of vitamin A for your vitamin-mineral mix.

SHEEP Nutrition Handout

Source: Sheep Resource Handbook 4-H 194R. (2000). The Ohio State University Extension. Chapter 4. Pages 49 through 50.

Nutrients are elements in feed that are used by the animal for growth and production. Nutrients are normally divided into five categories: Water, protein, carbohydrates, minerals, and vitamins.

Water

Water is the main constituent of the body. Two-thirds of the body is water, thus, an animal can live much longer without feed than water. Water helps the body digest food and carries nutrients to body tissues. It also helps get rid of wastes and keeps the body regulated. Sheep should always have access to a supply of clean, fresh water.

Protein

Proteins are the building blocks of the body. They are very complex chemicals, made up of amino acids that are used to build muscle, blood, internal organs, and skin. They also help form parts of the nervous system and the skeleton. Proteins can be used as energy too. When feed contains too much protein, the extra protein is used as energy. Soybean oil meal and fish meal are high in protein. Corn and barley are lower in protein.

Energy

Carbohydrates and fats are used to supply energy for lambs. The main use of energy is to make chemical reactions, resulting in conversion of feed to meat. Energy nutrients that are not used are stored as fat until needed. Sugar, starch, and fiber are carbohydrates. Corn oil and tallow are fats. Fat furnishes two and one-fourth times more energy than equal amounts of carbohydrates.

Minerals

Minerals are needed in small amounts and are used to build bones and teeth and in chemical reactions necessary for many life processes. Salt (NaCl) is a regulator in the body and sheep need 7-11 grams daily. Salt should only be fed in loose form to ensure that sheep can get enough to eat. Calcium is essential for bone growth and maintenance. Legumes (alfalfa) are high in calcium. Calcium can be supplemented by adding limestone to the ration. Phosphorus is needed in bone growth also. Phosphorus deficiencies can be overcome by feeding dicalcium phosphate. Iodine is another important mineral and is best supplied by feeding. There are minor minerals that are important such as copper and selenium. Feeding a trace mineral salt will help avoid deficiencies or toxicities.

Vitamins

Vitamins are needed in small amounts by sheep. All the necessary vitamins except for Vitamin A, D, and E are produced in the rumen of the mature sheep. Vitamin A is available from green feeds, such as hay, and stored in the liver for 3-4 months. Vitamin D is made available from the sun shining on the skin. Vitamin E and the mineral selenium are important for the prevention of white muscle disease. Selenium should be supplied in the diet in areas that are selenium deficient, like some parts of Idaho. Vitamin E is important for maintaining the healthiness of body cells, and thus, is important for reproduction because it maintains the cells of the reproductive organs. Wheat germ meal, dehydrated alfalfa meal, and some green feeds are good sources of Vitamin E.

SWINE Nutrition Handout

Source: Swine Resource Handbook 4-H 134R. (2001). The Ohio State University Extension. Chapter 8. Pages 8-1 through 8-3.

In general, nutrients are divided into five categories: Water, protein, carbohydrates, minerals, and vitamins. Except for water, which is largely supplied separately, nutrients are supplied to animals in the food materials we provide them (known as feedstuffs).

Water

Water is so common that we seldom think of it as a true nutrient, but it is the most essential and the cheapest of all nutrients. Water is the largest single component of a pig's body. It also passes through the body, transporting nutrients and removing wastes. Depriving pigs of water reduces feed consumption and limits growth and feed efficiency. Therefore, ample water should be provided continuously. A pig needs to drink two to three pounds of water for every pound of feed it eats.

Water is usually taken into the body at a lower temperature than the body itself, therefore, a portion of the body's heat or energy must be used in the warming of the water. In hot weather, this can be a comforting advantage, but in the winter, it can be a serious disadvantage. If the water is ice cold, the pig will drink less. Reduced water consumption will limit performance as significantly as a lack of any other nutrient.

It is important that you make certain your animals always have all the fresh, clean water they need and that it is relatively cool in the summer and warmer in the winter.

Protein

Proteins are composed of 20 simpler building blocks called amino acids, and it is actually the amino acids that are the essential nutrients. Pigs, in fact, do not specifically need protein, but rather require amino acids for the formation of muscle and other body proteins.

Ten of the amino acids are called essential, because these cannot be produced within the pig's body. The pig's growth or performance can be limited by a lack of even one of the essential amino acids, even if the other nine are adequately supplied. The ten essential amino acids that must be provided in swine diets are: lysine, threonine, tryptophan, methionine, cysteine, isoleucine, histidine, valine, arginine, and phenylalanine. Most cereal grains are limiting in lysine, threonine, tryptophan, and methionine. Therefore, when one evaluates feed ingredients, these amino acids are most important in determining protein quality.

Energy

Energy is technically not a nutrient, but is a result of metabolism of carbohydrates (starch) and fats that are in a pig's diet. Carbohydrates and fats are the main source of energy in the diet. They are the primary fuels that are used in maintaining body temperature and producing muscular movement.

Energy must be provided in large amounts over what is needed for maintenance to achieve optimum growth and reproduction responses. Energy is needed in many chemical changes that occur within the body. Because energy is needed constantly by a growing pig, the body stores some energy in the form of fat. The major source of dietary energy for the growing pig is from the carbohydrate component of grains in their feed.

Minerals

Minerals are needed in body tissues and to assist in some of the body's chemical reactions. In particular, calcium, phosphorus, and salt (often referred to as macro-minerals) are major needs. Calcium is important in bone formation. Phosphorus is also involved in bone building and assists in energy utilization. Salt is important for maintaining good appetites and water consumption in hogs.

Other minerals are needed in small amounts and are called trace minerals (or micro-minerals). These include iron, copper, zinc, magnesium, manganese, iodine, and selenium.

Of all farm animals, the pig is the most likely to suffer from mineral deficiencies. This is due to the following:

1. Hogs are primarily fed cereal grains which are low in minerals (except calcium).
2. The skeleton of a pig, in contrast to those of other animals, supports greater weight in proportion to its size, which means it needs more mineral content than most animals.
3. Hogs do not consume great amounts of roughages, which would balance the mineral deficiencies of grain.
4. Hogs are fed to grow at a maximum rate and are marketed before they reach full maturity. Emphasis on rapid growth and lean meat production requires adequate mineral concentrations, yet under these conditions, minerals are often overlooked in diet formulations. Most minerals are supplied in purchased supplements.

Vitamins

Vitamins are compounds that assist the body in the assimilation and use of the other nutrients. They are described in two classes, fat soluble (A, D, E, K), and water soluble (the B vitamins). The body can keep reserves of the fat soluble vitamins for a time, but the water soluble vitamins must be supplied in the diet daily.

Fat Soluble Vitamins:

- Vitamin A (carotene) is found in feedstuffs like alfalfa and corn. Converted by the body from carotene, it assists in maintaining the surface or epithelial cells. Such cells make up the outer skin as well as the lining of the digestive and respiratory tracts.
- Vitamin D is in compounds that have been exposed to sunlight. Some Vitamin D is fixed in the animal itself during exposure to sunlight. This vitamin assists in the utilization of calcium.
- Vitamin E's function is for normal muscle activity and reproduction. It helps to prevent the membrane surrounding individual cells from deteriorating, influences the production of various hormones, and defends against infection.
- Vitamin K's function is to help calcium and Vitamin D metabolism. The blood requires Vitamin K to form clots.

Water Soluble Vitamins:

- These vitamins occur or are supplied as chemical compounds in feeds. They assist particularly in the changes of nutrients into energy for growth. They may also assist in maintaining the health and soundness of the lining of the digestive organs. This group is also called the B-complex group. The B Vitamins generally added to swine diets include thiamine, riboflavin, niacin, pantothenic acid, B₁₂, and pyridoxine.

Feed Word Bank

Feed Ingredient	Nutrient Category				
	Energy	Protein	Mineral	Vitamin	Water
<input type="checkbox"/> Alfalfa Hay					
<input type="checkbox"/> Barley					
<input type="checkbox"/> Beet Pulp					
<input type="checkbox"/> Calcium					
<input type="checkbox"/> Cobalt					
<input type="checkbox"/> Copper					
<input type="checkbox"/> Corn					
<input type="checkbox"/> Cottonseed Meal					
<input type="checkbox"/> Dicalcium Phosphate					
<input type="checkbox"/> Grass Hay					
<input type="checkbox"/> Grass/Pasture					
<input type="checkbox"/> Iodine					
<input type="checkbox"/> Milo					
<input type="checkbox"/> Molasses					
<input type="checkbox"/> Oats					
<input type="checkbox"/> Salt					
<input type="checkbox"/> Soybean Meal					
<input type="checkbox"/> Straw					
<input type="checkbox"/> Wheat					
<input type="checkbox"/> Water					

Instructions:

1. Check the box next to each feed ingredient that you feed to your animal.
2. List any additional feed ingredients you feed your steer that are not listed in the black rows at the bottom of the Ingredient list.
3. Place an X in the column to represent which nutrient category your feed ingredient is.