



Lesson Five: Balanced Eating

Level: High School

Source: Nebraska Farm Bureau Foundation

PURPOSE

Students will analyze the nutritional needs of animals by creating a model of a balanced diet for a pig to explore the organization of their monogastric digestive system.

SCIENCE: FROM MOLECULES TO ORGANISMS: STRUCTURES AND PROCESSES

HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Science and Engineering Practices: Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.

Disciplinary Core Ideas: Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.

Crosscutting Concepts: Models can be used to simulate systems and interactions – including energy, matter, and information flows – within and between systems at different scales.

ESTIMATED TIME

50 minutes

MATERIALS NEEDED

- » Ration Building Worksheet – 1 per student
- » Feed Mill Introduction Reading – 1 per student
- » One of These Things is Not Like the Other PDF
- » Gram Scale – 1 per 4 students
- » Edible Food Ingredients for Ration Mixing Lab
 - Corn Flakes, Frosted Mini Wheats, Fruity Pebbles, Cocoa Pebbles, Chocolate Chips, M&M's, Peanuts, Almonds, Raisins, Dried Cranberries (If these ingredients are unavailable, pose student allergy concerns, or there are more feasible options, substitute using ingredients of similar texture.)
- » Sandwich Ziplock Bags – 1 per student
- » Small Paper Cup – Scooping Tool

VOCABULARY

Carbohydrate: A nutrient found in grains that is a primary source of energy in pig diets. They provide many calories per pound of food. Examples of carbohydrates include corn, wheat, oats, and barley.



Essential Amino Acids: Amino acids that cannot be synthesized by the body and must be supplemented in a diet.

Fat: A nutrient high in energy density that is also helpful in improving feed efficiency. Examples of fat sources include poultry fat, beef fat, and vegetable oils.

Feed Mill: An agricultural business that stores, mixes, and delivers feed for various livestock species, including pigs.

Guaranteed Analysis: Required to be printed on feed labels to tell the customer about the feed's nutrient content.

Limiting Amino Acids: Amino acids that, if deficient in the diet, will limit the body's ability to utilize other amino acids in a feed ration. A pig's limiting amino acids are lysine and tryptophan.

Minerals: Nutrients that help pigs grow efficiently and can be purchased in individual bags or premixed bags. Examples of minerals include salt, calcium, and phosphorus.

Palatable: (Of food or drink) pleasant to taste.

Protein: Made up amino acids, which are important builders of muscle. Examples of protein include soybean meal, fish meal, dried milk, and blood meal.

Ration: A portion of various feeds mixed together to meet an animal's nutritional needs.

Swine Nutritionist: A person who is responsible for knowing pigs' nutritional needs and putting together pig diets to meet those needs.

Vitamins: Nutrients that are dissolved by either fat or water in the body that help to keep pigs healthy. Vitamins can be purchased in individual bags or premixed bags. Examples of vitamins include A, D, E, K, B-complex, and C.

Water: An important nutrient for body temperature regulation and transport of nutrients and waste.

BACKGROUND INFORMATION

Read or summarize the following information for students prior to the lesson:

All throughout a pig's life, pig farmers work closely with feed mills and swine nutritionists to ensure their pigs are well cared for and all their nutritional needs are being met. As pigs grow from birth to market weight (approximately 280 pounds), their nutritional needs vary greatly. At various points in their life depending on age and gender, pigs utilize their feed for growth, maintenance, reproduction, milk production, and fattening.

General rations can be put together for pig farms, but it's important to know that genetic variation, environment, the availability of nutrients in various feeds, disease levels, and other stressors may increase the needed level of some nutrients for maximum performance.

Pig diets, similar to human diets, are made up of 6 major nutrients: carbohydrates, protein, water, fat, minerals, and vitamins.



Feed mills are agricultural businesses that store, mix, and deliver rations containing each of these 6 major nutrients to customers. Feed mills can be independent businesses, or they may be a part of a swine operation. In other words, some pig farms make and mix their own feed, rather than buying it. Feed mills are all about logistics; they use science and technology to ensure their rations are nutritionally sound and accurate.

Part One: Learning Activity

INTEREST APPROACH

1. Show the One of These Things is Not Like the Other PDF and ask students to pick which one is different. Have them present rationales.
2. Explain that today's lesson discusses pig nutrition and feed mills. On the slide, the cow is not like the others because it has a ruminant digestive system, which means it has 4 compartments. Pigs are similar to horses, humans, rabbits, and dogs in that they have monogastric digestive systems, meaning they have one main stomach compartment.

CONDUCT ACTIVITY

Part One

1. Distribute the *Feed Mill Introduction Reading*. Read together as a class.
2. Set up stations around the room with gram scales ready for use.
 - Students can be assigned a specific gram scale to share with other students.
3. In the center or the front of the room, set up a station with the edible feed lab ingredients easily accessible for students to collect food from.
4. Distribute a *Ration Building Worksheet* and ZipLock bag to each student.
5. Explain that today, students will get to practice their skills as swine nutritionists. Each student will select from 2 options of feeds for each major nutrient category.
6. Once they have completed their selections on their worksheets, they will measure the listed amount of each feed and combine them into their bags.
7. After students complete their measurements, they will sample their rations and complete part two of the *Ration Building Worksheet*, the evaluation portion.
 - Instruct students to take note of the protein selection on their ration building worksheets. Because pigs not only need **adequate** protein, but specific kinds of protein building blocks, students must pay attention to the colors of the protein representative they choose.
8. If desired, the instructor can bring a blender into the classroom and take the activity one step further by grinding up a sample ration. This demonstrates what feed mills do and helps make the feed more palatable for pigs.



FOLLOW UP QUESTIONS

Discuss as a class using the following guiding questions:

1. How does a pig's digestive organization into a monogastric (one-chambered stomach) system influence its diet?
 - The simpler digestive system, as compared to animals with multiple chambers (ruminants), necessitates that pigs eat simpler carbohydrates lower in cellulose and fiber content.
2. Compare and contrast essential and limiting amino acids.
 - Essential amino acids are those that must be supplemented in the diet. Limiting amino acids are those that, if not present in great enough quantity will limit the body's ability to use other amino acids.
3. How did you make your feed decisions?
 - Answers will vary
4. What do you think swine nutritionists think about when making decisions about rations?
 - Nutrient content, availability of feeds, how palatable it will be for the pigs, costs of feeds
5. Which of the nutrient categories gives the pigs energy?
 - Carbohydrates
6. Which of the major nutrients helps the pigs build muscle?
 - Protein
7. Do you think you would enjoy being a swine nutritionist? Why or why not?
 - Answers will vary

Part 2 (Optional): Attend a Virtual Field Trip

Biosecurity is a procedure to protect animals against disease. Farmers limit travel to their pig barns by practicing biosecurity. This ensures they can raise their pigs in a safe and healthy environment.

Virtual Field Trips allow farmers to open their barn doors to show students what happens inside. The farmer uses a tablet to connect with classrooms to be a part of a live, video-chat allowing students to have their questions answered in real time.

Visit the Nebraska Farm Bureau Foundation website, www.nefbfoundation.org/educators/get-involved/virtual-field-trips, to see a list of upcoming Virtual Field Trips and to sign up for a time to attend. If you have questions, please contact Nebraska Farm Bureau Foundation at foundationforag@nefb.org or (402) 421-4747.



SOURCES UTILIZED

Iowa Agricultural Literacy Foundation

www.iowaagliteracy.org/resources/lesson-plans/lesson-plans.aspx

Merck Veterinary Manual

www.merckvetmanual.com/management-and-nutrition/nutrition-pigs/nutritional-requirements-of-pigs

Nutrena

www.horsefeedblog.com/tag/limiting-amino-acids

Penn State Extension

extension.psu.edu/courses/swine/nutrition/swine-nutrients

Purdue University

www.ansc.purdue.edu/courses/ansc221v/protein.htm

Suwannee River Fair

mysrf.org/?page_id=3952/#swinehb

University of Missouri Extension

swine.missouri.edu/nutrition/pigfatsource.htm

U.S. Pork Center of Excellence

porkgateway.org/resource/nursery-swine-nutrient-recommendations-and-feeding-management

NATIONAL AGRICULTURAL LITERACY OUTCOMES

Science, Technology, Engineering & Mathematics

T4.9-12.f Predict the types of careers and skills agricultural scientists will need in the future to support agricultural production and meet the needs of a growing population.

RATION BUILDING

Part One: Mix the Ration

Instructions: Congratulations! You have just become a swine nutritionist, which means you're the person who puts together rations, or diets of what pigs should eat.

First, take a look at the "real-life sample mixed ration" to see what pigs would actually eat. Second, move on to the "my swine diet" chart and select one feed option for each major nutrient category and write it down. Next, following your instructor's guidelines, carefully measure out the specific amount of each ingredient you selected into your feed bag.

Real-Life Sample Mixed Ration		
Nutrient Category	Ingredient	Amount (lbs)
Carbohydrate	Mixed yellow corn & oats	1,200
Protein	Mixed soybean meal & dried whey	750
Fat	Added fats	50
Minerals	Premixed vitamin and mineral pack	50
Vitamins	Premixed vitamin and mineral pack	50
Water	Water	Always available
TOTAL		2100 pounds

My Swine Diet

Nutrient Category	Option #1	Option #2	My Choice	Amount (g)
Carbohydrate	Corn Flakes	Frosted Mini Wheats	Will vary	120 g
Protein (made up of amino acids)	Fruity pebbles	M & M's	Will vary	76 g
Amino Acids				
lysine & tryptophan (limiting)	Blue			At least 15 blue pieces within total protein sample
phenylalanine/valine	Yellow			Any amount within the total protein sample
threonine/isoleucine	Green			Any amount within the total protein sample
methionine/histidine	Red			Any amount within the total protein sample
arginine/leucine	Orange			Any amount within the total protein sample
Fat	Chocolate Chips	Cocoa pebbles	Will vary	4 g
Minerals	Peanuts	Almonds	Will vary	5 g
Vitamins	Raisins	Dried cranberries	Will vary	5 g
Water	Water	Water	Will vary	Always available
TOTAL				210 grams

Part Two: Evaluate the Ration

Instructions: Sample your feed ration as well as another person's feed ration to answer the questions below.

1. . Sample your ration. Describe the flavor and texture.
 - Answers will vary.
2. Sample another person's ration. List here whose ration you sampled and explain how it compares to yours in terms of being palatable.
 - Answers will vary.
3. How did you make the decision of which feed to pick for each nutrient category?
 - Answers will vary.
4. What do you think swine nutritionists think about when making decisions about rations?
 - Nutrient content, availability of feeds, how palatable it will be for the pigs, costs of feeds
5. Why do you think the greatest portion of the ration was carbohydrates?
 - It gives the pigs energy, it is relatively inexpensive, it also contains vitamins and minerals
6. Look back to the protein section. Why was it necessary to have 15 of a specific-colored protein particle?
 - The 15 pieces represented limiting amino acids. Without adequate amount of these specific amino acids, pigs are unable to digest the remaining amino acids present in the ration.

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PORK PRODUCTION 5: FEED MILL INTRODUCTION READING

All throughout a pig's life, pig farmers work closely with feed mills and swine nutritionists to ensure their pigs are well cared for and all their nutritional needs are being met. Feed mills are businesses that store, mix, and deliver pig diets containing the correct nutrients to customers. These diets are called rations. Feed mills can be independent businesses or they may be a part of a swine operation. In other words, some pig farms make and mix their own feed, rather than buying it. Swine nutritionists are people that are responsible for knowing pigs' nutritional needs and putting together pig diets.

As pigs grow from birth to market weight (about 280 pounds), their nutritional needs vary greatly. At various points in their life depending on age and gender, pigs use their feed for growth, maintenance, reproduction, milk production, and fattening.

Pig diets, similar to human diets, are made up of 6 major nutrients: carbohydrates, protein, water, fat, minerals, and vitamins. Carbohydrates are nutrients found in grains and are the main source of energy in swine diets. Examples of energy sources include corn, wheat, oats, barley. Protein is made up of amino acids, which are important builders of muscle. Pigs get protein from soybean meal, fish meal, and dried milk. For pigs, there are 10 essential amino acids, which means the pig cannot synthesize them in the body, but **must** get them in their diet. Furthermore, of these 10 amino acids, some are limiting, which means that if the pig runs out of these specific amino acids, they cannot use the rest of the amino acids present in the feed. The 10 essential amino acids for pigs are: phenylalanine, valine, threonine, tryptophan, isoleucine, methionine, histidine, arginine, lysine and leucine. These can be remembered with the acronym, PVT. TIM HALL. The limiting amino acids are lysine and tryptophan.

Fat is a nutrient high in energy density and also helpful in improving a pig's ability to use feed. Examples of fat sources include poultry fat, beef fat, and vegetable oils. Minerals are nutrients that help pigs grow efficiently; they can be purchased in individual bags or premixed bags. Some important minerals are salt, calcium, and phosphorous. Vitamins are nutrients that are dissolved by either fat or water in the body and help keep the pig healthy. Like minerals, they can be purchased in individual bags or premixed bags. Examples of vitamins are A, D, E, K, B-complex, and C. Finally, water is an important nutrient for body temperature regulation and transport of nutrients and waste. Depending on their growth stage, pigs drink up to 6 gallons of water per day.

It is important to know that single foods may contain multiple nutrients. For example, corn is not only a great source of carbohydrates, but also contains minerals like iron, zinc, and potassium. When pig farmers buy pig feed, it comes with a guaranteed analysis, which tells the customer about the feed's exact nutrient content. It is important that rations are high in nutrition and also palatable, which means pleasant to taste.

Feed mills use science and technology to make sure they get each ration correct. Every order a customer places is like a giant recipe, often containing hundreds to thousands of pounds of feed. Before pigs can feed us, we must feed them. After all, safe pork comes from healthy pigs!



One of These Things is not Like the Other

