2017 National 4-H Volunteer e-Forum

Activity: Hay Storage Facility

Instructions: In teams of 3 or 4, use the various materials on your table to build a structure that will hold as much hay as possible while minimizing losses due to weather and/or pests.

2017 National 4-H Volunteer e-Forum

Activity: Hay Storage Facility

Instructions: In teams of 3 or 4, use the various materials on your table to build a structure that will hold as much hay as possible while minimizing losses due to weather and/or pests.

A Stomach At Work

Skill Level:
- Beginner to intermediate

Life Skills:
- Critical thinking, decision-making and problem-solving

Setting:
- An outdoor or indoor space with a supply station and an easy to clean floor; seating is optional.

Time:
- 20–30 minutes

Materials:
- ❑ Resealable plastic sandwich bags (one per participant plus one for demonstration)
- ❑ Sliced white bread (one piece per participant plus one for demonstration)
- ❑ 2-liter bottles of orange juice or cola (about one bottle per 15 participants)
- ❑ 3-ounce disposable cups (one per participant)
- ❑ Paper towels (one sheet per participant and enough for clean-up)
- ❑ Flipchart or other large paper
- ❑ Markers
- ❑ Easel or display space
- ❑ Masking tape
- ❑ Clock or stopwatch
- ❑ Large trash bag (one or more depending on the size of your group)
- ❑ "The Basics of the Ruminant Digestive System" resource sheet (one per participant, optional)

Overview:
The *Animal Digestion – A Stomach At Work* lesson is designed to teach young people about animal digestion. Participants will complete an activity in which they "digest" a slice of bread the way their stomachs would. They'll also discuss the basic differences in how various species of livestock digest feed. In the interactive lesson, they'll also learn the importance of acids to the process of digestion.

Objectives:
After completing this activity, participants will be able to:
- Discuss how digestive acids break down carbohydrates.
- Explain the difference between monogastric and ruminant animals.

PROCEDURE:

Before the meeting:

1. Review the lesson and gather any supplies you will need. Make one copy of "The Basics of the Ruminant Digestive System" resource sheet per person (optional).

2. Place one piece of white bread in a resealable plastic sandwich bag and fill one 3-ounce cup with orange juice or cola for each participant. Set the sandwich bags and filled cups out on the supply station.

3. Write the following definition of the word "digestion" on a sheet of flipchart paper and display it where everyone can see it, but keep it covered until the appropriate point in the lesson.

   Digestion is the process of breaking down food in the mouth, stomach, intestines and other organs so that it can be used by the body.

4. (Optional) On a sheet of flipchart paper, sketch a sandwich bag, a slice of bread and a bottle of juice or cola. Label them "stomach," "food" and "stomach acid," respectively, then hang the paper up where the group can see it.

5. Recruit one or more teen or adult volunteers to help with the activity.

During the meeting:

1. Introduce the activity by pointing out to the group the [optional] flipchart paper with the labeled sketches of the sandwich bag, slice of bread and bottle of juice or cola on it, then reading aloud or paraphrasing the following:

Today we're going to make model stomachs and "digest" slices of bread in them so we can observe the digestion process. A little later we'll also learn about the two main digestive systems of livestock animals: the monogastric or simple digestive system and the ruminant or complex digestive system.

2. Ask for volunteers to explain what the word "digestion" means. Record the answers on flipchart paper, then display the paper where everyone can see it. After everyone has had a chance to answer who wants to, uncover and discuss with the group the definition of "digestion" that you wrote on the flipchart sheet before the meeting.

3. Now ask the group why the digestion process is important to animals. *(So they can absorb and use the nutrients in the food they eat to build blood, bone, muscles, organs, nerves and other cell types. So they can maintain or increase their weight. So they can use the nutrients for energy to move and think and perform other tasks.)* Discuss and record their answers on flipchart paper and display the sheet where everyone can see it.

4. Give each person one of the bags with a piece of white bread in it. Explain to the group that in this activity, the bag will act like a stomach – a muscle that contains and squeezes the food (in this case, the bread) to break it down.

5. Now have them take turns bringing their plastic bag stomachs to the supply station to pick up a cup of orange juice or cola to pour into their bags. Explain that the liquid will play the part of the digestive juices in their model stomachs – that is, the stomach acid and enzymes that react chemically with the food in the stomach.

6. Once they've all combined the bread and the fluid in their plastic bag stomachs, tell them to carefully observe what is starting to happen to the bread.

7. Have the adult or teen volunteers you recruited earlier work with the participants to ensure that all of the plastic bag stomachs are tightly sealed. If the seal on any bag seems questionable, or if a bag has a hole in it, have them seal the entire bag (with its contents still inside) into another plastic bag.

8. Now ask the group the following questions:
   - What is happening inside of your model stomach? *(The bread is absorbing the liquid, turning color and getting mushy. It may be breaking apart.)*
   - What do you think might happen if you squeezed your model stomach for a little while? *(The bread will break into smaller pieces. The bread will be squished.)*

9. Give one piece of paper towel to every participant. Tell them to wrap the paper towel around their model stomachs so that they cannot see what is happening inside.

10. Now tell them that on your signal, they will act as the muscles for their model stomachs by gently squeezing their towel-covered bags for 2 minutes. Emphasize that they need to keep the towels wrapped around their bags and be gentle to avoid poking holes in them. Have a volunteer keep track of the time.

11. While the participants are using their model stomach muscles, ask them the following questions:
    - **Do humans have monogastric or ruminant digestive systems? *(Monogastric or simple.)***
    - **What does monogastric mean? *("Mono" means "one" or "single," and "gastric" means "stomach" or "related to the stomach," so "monogastric" means "one stomach" or "one stomach compartment.")***
    - **Name one livestock species that has a stomach that is similar to the human stomach. *(Swine and rabbits.)***
    - **Do sheep have monogastric or ruminant digestive systems? Cows? *(Ruminant.)***
    - **What does "ruminant" mean? *("To chew over again.")***
    - **What is the biggest difference between the ruminant and monogastric digestive systems? *(Ruminant stomachs have four compartments, and monogastric stomachs have only one compartment. Ruminants are able to digest grasses and other fibrous feeds better than animals with monogastric systems can. Ruminant animals are able to do this because they chew their food several times through a process of regurgitation and rumination that is more familiarly called "chewing their cud.")***

12. When the timekeeper indicates that the participants have been squeezing their model stomachs for 2

minutes, tell them to remove the paper towels and – without opening the bags! – observe the changes to the contents. After they've had a moment to observe and think about the changes, ask the group the following questions:

- What caused the changes to the bread? *(The mechanical action of squeezing and the chemical breakdown of the bread fibers by the acids in the liquid.)*
- Would the change have been different if the liquid we added was just water? Why or why not? *(Yes, because it is the acids in the orange juice or cola that accelerate the breakdown process.)*
- How is animal digestion similar to what we did with our model stomachs? *(An animal's stomach churns and squeezes and breaks down its contents in nearly the same way that we churned and squeezed and broke down the bread in our model stomachs. The acidic fluid – the orange juice or cola – we added to our model stomachs reacted chemically with the bread in them, just as real stomach acid reacts chemically with the contents of the stomach.)*

13. Now have a volunteer collect the sealed model stomachs in a trash bag. Have other volunteers clean up any other messes.

14. Next have the group stand in a straight line facing you. Tell them they're going to review the basic steps in the digestion process in monogastric animals. Ask them to imagine that a pig has just eaten a mouthful of grain, then ask the first person in the line "What happens to the food next?" (**Note:** You may want to record their answers for each step on flipchart paper to help the group keep track of where they are in the process.)

15. Move down the line, asking each person in turn "What happens to the food next?" (**Note:** The rough outline of the digestion process that follows will help you prompt any participant who isn't sure.)

a. The animal takes a bite of food.

b. The food mixes with saliva in the animal's mouth and is chewed by the teeth until is in small enough bits to be swallowed.

c. The food then moves down the esophagus to the stomach, where it is churned and digestive acids begin to break it down.

d. Then the food travels to the small intestine, which absorbs most of the nutrients in it.

e. Next the food enters the cecum, a sac between the small and large intestines that contains enzymes that help break down plant material. (**Note:** Younger and less experienced groups probably won't be familiar with the cecum, so you'll most likely have to tell them about this step.)

f. Next stop is the large intestine, which absorbs most of the water in the food.

g. Finally, what's left of the food moves through the rectum and exits through the anus.

16. Once the group has reached the end of the line, so to speak, read aloud or paraphrase the following:

The process of digestion in ruminants is similar to the process in monogastric animals. As we learned before, though, ruminant stomachs have four compartments, which helps ruminants digest plant material much more efficiently than monogastric animals can.

Another interesting difference is that ruminants chew their cuds. Does anyone know what it means when someone says a ruminant like a cow is "chewing its cud"? **(It means the cow has belched up a clump of food called a "bolus," from the first stomach compartment, the rumen, and is chewing it again to break apart the plant fibers some more.)**

After the food leaves the rumen, it moves to the other chambers, which are, in order, the reticulum, the omasum and the abomasum.

17. Refer to the "Basics of the Ruminant Digestive System" resource sheet for explanations of the functions of each of the ruminant stomach compartments. Share the level of information from the resource sheet that you feel is appropriate for the ages and experience levels of your group.

18. Next divide the group into four equal teams, then assign each team a compartment of the ruminant stomach. Tell the teams they'll have 30 seconds to come up with the word or phrase that is most representative of the stomach compartment they were assigned.

19. After 30 seconds, or when the teams seem to have settled on their descriptive words, tell them you're

going to point to each team in the order of where their assigned stomach compartment falls in the digestion process. Explain that when you point to a team, you want them to yell the name of their stomach compartment and the word or phrase they chose to describe it. For example:

- Rumen = fermentation
- Reticulum = honeycomb
- Omasum = many folds
- Abomasum = mixes

20. Rotate through the teams three times to help everyone remember the information.

21. Finally, challenge the group to think about how their own livestock animals digest food. Ask for volunteers to name an animal species they're raising and a type of food that is relatively easy for that species to digest. Do the same for food types that are harder for their animals to digest.

ADAPTATIONS & EXTENSIONS:

- **Older or More Advanced Participants:** If your group includes a mix of ages and experience levels, have the older or more experienced members partner with the younger or less experienced participants.
- **Older or More Advanced Participants:** Challenge the group to write out each stage of the ruminant digestion process from the perspective of a piece of grass being eaten by a cow.
- **Younger or Less Experienced Participants:** Make a card to represent each organ or step in the digestive system of a monogastric animal. Have each participant choose a card and then have the group work together to arrange themselves and their cards in the correct spots in line in the digestive system.
- Use an app such as Nearpod to create brief interactive mobile presentations that participants could use anywhere they have Internet access. You could tailor presentations to supplement the work the group is doing during meetings or to prepare background information on specific topics for the group to review before a meeting. (**Note:** "Apps" are small computer programs that are usually optimized for use on mobile devices such as smart phones and tablets that have relatively small screens.)
- Distribute copies of "The Basics of the Ruminant Digestive System" resource sheet for participants to take home with them.
- Adapt the lesson to focus on other types of animal digestive systems, such as hindgut fermenters (horses and guinea pigs) and avian (poultry) digestive systems. You could use many of the same steps with only limited adjustments.
- Have the stomach compartment teams build models of their compartment using only objects they can find in the room or area. Give them 1 minute to plan, 2 minutes to find materials and build their models, and 30 seconds per team to present their models and explain to the whole group what their stomach compartment does.
- Adjust how quickly the digestive process happens in the participants' model stomachs by altering the bread that is being "digested."
  - To speed up the process, remove the bread crust from the white bread before placing it in the plastic bag.
  - To slow down the process and give yourself an opening to talk about the food types that are harder to digest, such as roughages, consider using whole wheat or other whole grain bread.
  - Divide the larger group into three teams of equal sizes and give the members of each team one type of bread. That is, one team would have white bread with crusts, another white bread without crusts and another whole wheat or other whole grain bread. After the 2 minutes of "digesting" (squeezing) the bread, lead a discussion comparing the results of the action on the different types of bread.
- Arrange a group field trip to the Michigan State University Dairy Teaching and Research Center to examine the rumen of a fistulated cow. (A fistulated cow has had a "window" surgically implanted in its side to allow researchers to reach in and remove some of the contents of its rumen for study.)

REFERENCES & RESOURCES:

Canadian Museum of Nature (2011). *Ruminant GI tract* [3-D video]. Retrieved from youtube.com/watch?v=SVNNJf_28KE&feature=context&context=C3639844ADOEgsToPDskI2WscWco3nbNz1EQVG6dAv

Oklahoma Department of Career and Technology Education, Curriculum and Instructional Materials Center. (n.d.). *Agriscience principles and applications: Unit 1: Animal nutrition and digestion,* (p. 15). Retrieved from www.okcimc.com

Petersen, K. E. (2014). *Biology 453 mammalian digestive system photos.* Seattle: University of Washington, Department of Biology. Retrieved from courses.washington.edu/chordate/453photos/gut_photos/mammal_digestive_photos.htm

Radunz, A. (2012). *Back to basics: Ruminant digestive system* [blog post]. Madison: University of Wisconsin–Extension, Wisconsin Beef Information Center. Retrieved from fyi.uwex.edu/wbic/2012/01/18/back-to-basics-ruminant-digestive-system

ACKNOWLEDGMENTS:

Author

Julie Thelen, 4-H Livestock and Veterinary Science Educator, Michigan State University Extension

Thank You

Thank you to Dr. Karen E. Petersen, Senior Lecturer, Department of Biology, University of Washington, for permission to reprint the stomach compartment photos in the resource sheet.

Thank you to the Oklahoma Department of Career and Technology Education, Curriculum and Instructional Materials Center, for permission to reprint the hog and calf digestive system diagrams from *Agriscience Principles and Applications, Unit 1: Animal Nutrition and Digestion*.

This bulletin was produced by ANR Communications (*anrcom.msu.edu*).

MICHIGAN STATE UNIVERSITY | Extension

The Basics of the Ruminant Digestive System

Digestion

The process of breaking down food in the mouth, stomach, intestines and other organs so that it can be used by the body.

Introduction

In general, livestock animals have one of two major types of digestive systems: monogastric or simple (see fig. 1) and ruminant or complex (see fig. 2). Monogastric animals include swine, horses, chickens and other poultry. Ruminant animals include cattle, sheep and goats. Table 1 lists a few of the major differences between monogastric and ruminant digestive systems.

Table 1. Major differences between monogastric and ruminant digestive systems

Difference	Monogastric digestive system	Ruminant digestive system
Number of stomach compartments	1	4
Number of times food is chewed	Once	Several times
Efficiency in digesting plants and plant byproducts	Limited	Highly developed

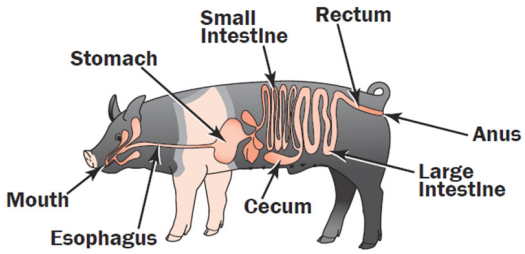


Figure 1. A diagram of the monogastric digestive system of swine. *(Courtesy of the Oklahoma Department of Career and Technology Education, Curriculum and Instructional Materials Center)*

Ruminant animals chew their food several times through a process called "rumination" or "chewing the cud." When a ruminant animal such as a cow takes a bite of grass or other food, the animal chews the food just enough so it can be swallowed. The food then travels from the mouth down the esophagus to the rumen (the first and largest stomach compartment). From there, it moves to the second compartment, the reticulum. Later, the cow can regurgitate the food (now called a "bolus" or "cud") to chew it again to continue breaking down the plant fibers.

The stomach compartments of a ruminant animal are much larger than the stomach of a monogastric animal because it takes ruminants longer to ferment, mix and digest the roughage they've eaten. They need plenty of room in their stomachs for all of that to happen.

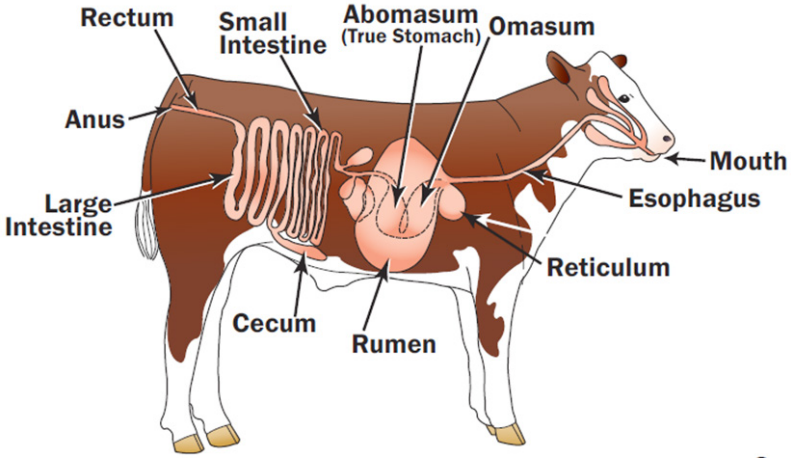


Figure 2. A diagram of the ruminant digestive system of cattle. *(Courtesy of the Oklahoma Department of Career and Technology Education, Curriculum and Instructional Materials Center)*

Four Stomach Compartments

The stomach of a ruminant animal has four compartments. In the order that food travels through them, they are the rumen, reticulum, omasum and abomasum. Each compartment has a distinct function and appearance. They're described here.

The Rumen

The rumen (see fig. 3) is the largest compartment of the ruminant stomach – it can store up to 50 gallons of digested materials. Food is fermented in the rumen, because the environment is anaerobic (has no oxygen). That allows for increased microbial action and high concentrations of bacteria ("rumen bugs"). The rumen is capable of changing poor-quality protein (such as the nitrogen in grass) to a good-quality microbial protein. To aid in this process, the rumen is very selective about how quickly particles can move from one stomach compartment to another. If a roughage is difficult to digest, the rumen will extend fermentation time to allow for further mechanical breakdown through the process of cud chewing. The rumen has fingerlike projections called "papillae" that increase the surface area on which microorganisms do their work. When a cow eructates (belches), it's releasing fermentation gas (mostly carbon dioxide and methane).

The Reticulum (Honeycomb)

The reticulum (see fig. 4) is attached to the rumen and consists of bands of smooth muscle. The walls of the reticulum look like honeycombs, which give it the nickname "the honeycomb." Its main functions are to first detect large feed particles that need to be broken down further, and second to regurgitate or force those particles back up the esophagus to the mouth so they can be chewed and then swallowed again. Cows have an unfortunate habit of accidentally ingesting hardware such as nails and bailing wire. These foreign objects usually wind up in the reticulum and sometimes have to be surgically removed.

The Omasum

Many folds or layers of muscle (called "plies") make up the omasum (see fig. 5). These folds increase the compartment's surface area, which helps it absorb nutrients from feed and water. The omasum squeezes water from the feed particles and continues to break them down into smaller particles.

The Abomasum (True Stomach)

The abomasum (see fig. 6) is called the "true stomach" because it's the equivalent of the stomach of a monogastric animal. This is where acids and enzymes (digestive juices) mix with and prepare feed for enzyme breakdown and absorption in the small intestine. It has a very low (acidic) pH. This is the feed's last stop before entering the small intestine where most nutrient absorption will take place.

Figure 3. A close-up of a rumen. *(Photo: Dr. Karen E. Petersen, Department. of Biology, University of Washington.)*

Figure 4. A close-up of a reticulum. *(Photo: Dr. Karen E. Petersen, Department. of Biology, University of Washington.)*

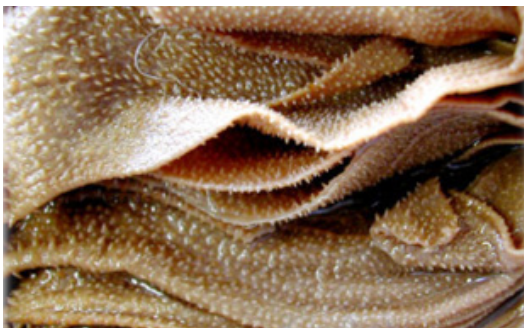


Figure 5. A close-up of an omasum. *(Photo: Dr. Karen E. Petersen, Department. of Biology, University of Washington.)*

Figure 6. A close-up of an abomasum. *(Photo: Dr. Karen E. Petersen, Department. of Biology, University of Washington.)*

The animal takes a bite of food.	The food mixes with saliva in the animal's mouth and is chewed by the teeth.	The food is swallowed.	The food moves down the esophagus.
The food is broken down by digestive acids and the churning action of the stomach.	The food travels to the small intestine.	The food works its way through this organ where most of the nutrients are absorbed.	The food enters the cecum, a sac between the small and large intestines.
The enzymes found in this organ help break down plant material.	The food moves to the large intestine.	The food moves through this organ where most of the water is absorbed.	What is left of the food moves through the rectum.
Waste exits the body through the anus.			

Monogastric Digestive System

The animal takes a bite of food.	The food mixes with saliva in the animal's mouth and is chewed by the teeth.	The food is swallowed.	The food moves down the esophagus.
The food enters the rumen, the largest ruminant's stomach compartment.	The food is fermented due to the lack of oxygen.	Microbial action and rumen bugs assist in the digestion process.	The food enters the reticulum, bands of smooth muscles that look like honeycombs.
Large particles are detected and regurgitated for additional chewing (cud chewing).	The food moves to the omasum which is made of many folds of muscles called plies.	Nutrients are absorbed from the food and water is squeezed out of the food particles.	The food moves to the abomasum which is also called the "true stomach".
Digestive juices mix with and prepares the food for absorption.	The food moves to the small intestine where nutrients are absorbed.	The food moves through the cecum and into the large intestines where water is absorbed.	The "left overs" move through the rectum and exit the body through the anus.

ig

Undressing the Mystery of Meat

GOAL STATEMENT:

Students will learn about the types of beef, pork, and lamb meat cuts and products and the role that these important agricultual commodities play in one's diet and in Maryland's economy.

OBJECTIVES:

- Students will learn the importance that livestock animals and meat products play in Maryland's economy.
- Students will name major products we get from beef, pork, and lamb carcasses and how they fit into people's diets.
- Students will learn about dressing percentages of different animals used for meat.

REQUIRED MATERIALS:

- "Beef Cuts Made Easy" (Cattleman's Beef Board and National Cattlemen's Beef Association)
- "Retail Cuts of Pork" (National Livestock and Meat Board)
- "Retail Cuts of Lamb" (National Livestock and Meat Board)
- Fruit* (1 piece per group)
- Paring knife, safety knife, or peeler (1 per group)
- Plate (1 per group)
- Scale (1 per group)
- Calculator (1 per group)
- Protractor (1 per student)
- "Undressing the Mystery of Meat" worksheet (1 per student)

*Any type of fruit may be used; apples, pears, and oranges work well. If you are working with younger students, consider using a fruit like an orange that can be easily pulled apart without using a knife.

AMOUNT OF TIME TO ALLOW:

Approximately 60-75 minutes. Extension activities will take additional time.

Background Information

Teacher's Note: Realize that not all people consume meat products in their diets for various health, religious, political, environmental, cultural, ethical, aesthetic, or economic reasons. However, livestock is still an important part of agriculture. Students who don't eat meat can still learn the importance they play in the economy and agriculture.

Maryland ranks 34th in the Nation for the value of livestock, poultry, and animal products produced. That amount earns Maryland farmers $1.2 billion annually. Each year Maryland farmers sell about 90,000 cattle, 123,000 hogs, and 12,000 sheep. Most of these cattle, hogs, and sheep are sold for meat. (To see the current number and economic value of livestock sold by Maryland farmers consult the Agriculture Census data for Maryland available from the National Agricultural Statistics Service of the USDA.)

Meat is the muscle and fat (and sometimes bone) from a livestock animal which has been raised and processed for food as part of our diets. The processing of an animal is referred to as **harvesting** the animal, just as we harvest corn or wheat. A **carcass** is the body of an animal after skinning and removing the internal organs. Meat is part of many people's diets because it provides important nutrients for our bodies and people like the taste. Meat is a protein source that contains B vitamins, vitamin E, iron, zinc, and magnesium. Protein is important in a diet for muscle growth and repair.

Industry Overview and Facts

Beef

Meat that comes from cattle is called beef. Some of the common beef meat cuts or products are steaks, roasts, and hamburgers. Cattle that are grown for meat typically take about 14-18 months to grow to market weight. Market weight is the weight of a livestock animal when it is harvested for meat. The market weight of beef animals is 1,000 to 1,300 pounds. A 1,000-pound beef animal will yield about 600 pounds of meat.

- Beef is the number one selling protein in the United States. In 2010, consumer spending on beef totaled $74.3 billion.
- According to industry research firm CattleFax, the average American consumes 59.6 pounds of beef a year and spends $240 a year on beef.

Pork

Meat from pigs (also called hogs or swine) is called pork. Some of the common pork cuts that you may know are pork chops, ribs, bacon, sausage, and ham. Pigs grown for meat typically take about 5-6 months to reach market weight. The market weight of a market hog is 230-270 pounds. A 250-pound hog will yield about 175 pounds of meat.

- In 2015, the average American consumed 49.9 pounds of pork a year (Economic Research Service, USDA).
- Pork is known as "the other white meat" because even though many people don't realize it, many pork cuts are as lean as skinless chicken.

Lamb

Meat that comes from sheep under a year of age is called lamb. Meat from older sheep is called mutton. Some common lamb cuts you may know are rack of lamb, leg of lamb, lamb chops, or lamb kabobs. Sheep that are grown for meat typically take 5-6 months to reach market weight. Market weight for a lamb is 100 to 140 pounds. A 100-pound lamb will yield about

50 pounds of meat.

- A 3-ounce serving of lamb provides 43 percent of an adult's recommended daily allowance of protein.
- Lamb consumption in the United States is smaller than other meats. Americans consume just 0.8 pounds of lamb a year (www.sheep101.info/lamb.html, 2015).

Engagement

25 minutes

Begin by writing Beef (Cattle), Pork (Swine), and Lamb (Sheep) on the board. Ask students to provide names of meat products that they eat or have tried and which animal they think it comes from. Record the students' ideas on the board to create a list under each heading (i.e. bacon comes from pork, hamburger is beef, hot dogs typically come from both pork and beef). You can use the attached meat charts to check different cuts. (You will most likely have to help them get a good list for lamb.)

Divide the students into groups (by tables or by counting off) of beef, pork, and lamb. Have students talk about the types of meat they have tried out of their animal. Provide the meat chart that corresponds to each of the groups and ask each to pick a cut from the list on the board. Then have them use the sheets to find where their cut comes from on the animal. Next ask each group to arrange themselves by their cut in order of the way they would come front to back in the animal. Each group can share with the class.

Exploration

20 minutes

Activity 1: Picture Sort

1. Divide students into groups of about four.
2. Hand out the Meat ID Pictures.
3. Ask the students to go through the pictures and say whether they think the cut comes from beef, pork, or lamb. Ask why they think that and where on the animal they think it comes from.
4. Go through and review the slides with the class.
5. You can also let students know that in most animals the best, most tender meat comes from the loin (steaks, pork chops, lamb chops, etc.) and usually costs the most.

Activity 2: You Be the Butcher

Butcher – a person who harvests animals and processes them for meat products.
Carcass – the body of an animal after skinning and removing the internal organs.
Live weight – the original weight of the animal before it is harvested.

This activity will simulate what the butcher does to process the animal into meat that ends up in the store.

1. Divide the class into small groups or use the groups they are already in.
2. Provide each group with a type of fruit and a peeler and/or paring knife. (Apples, oranges, and pears work well. You may also consider using safety knives. If using oranges, no knives are needed.)
3. Have the students being by weighing and recording the weight of their fruit.
4. Have students peel off the skin of the fruit and weigh just the skin on the scale.
5. Have students cut the fruit open and take out the core, seeds, and anything inedible. Weigh all the contents they take out.
6. Have students finish by weighing the remaining edible fruit they have.
7. Have students create a pie chart of the peel, inedible parts, and fruit they have left.
   a. Record the values for each of the layers in the chart provided in the weight column.
   b. Find the total weight of the fruit and record.
   c. Find the percentage for each portion of the fruit by dividing its weight by the weight of the whole fruit. (The answer should be a decimal like .45 which is equal to 45%.)
   d. Find the angle for each pie section. Multiply the percentage for each section by 360. (Following with our example above, 45 x 360 = 162 degrees.) If you have done it correctly, all the numbers should add up to 360.
   e. Draw a line to make the radius of the circle. To do this, start in the exact center of the circle and draw a straight line to the outside of the circle.
   f. Draw each section division. To do this, lay the protractor against the radius of the circle and draw a line at the angle you calculated in the earlier step. Each time you add a section, adjust the protractor so it is against the new radius line you just drew. Color each segment a different color to match your key color.
8. Have students find the dressing percentage of their fruit. Dressing percentage in an animal is the amount of the live weight that will enter the cooler in the form of a carcass. Dressing percentage can be calculated as carcass weight (weight of the animal after it has been skinned and had the internal organs taken out) divided by the live weight and multiplied by 100. Dressing percentage for the fruit is the weight of the edible fruit divided by the weight of the whole fruit multiplied by 100.

Explanation

20 minutes

Most animals are sold on a live weight basis so it is important for buyers to know that the actual amount of animal they end up with is less. The dressing percentage of the animal is what is left after the skin and internal organs are removed. Factors like if the animal had horns, if a sheep had wool, or if an animal is extremely fat will affect dressing percentage. The average dressing percentage for livestock animals is usually around:

- Pork - 70%
- Beef - 60%
- Sheep - 50%

After dressing, more processing is done to make cuts like steaks, roasts, chops and ground meat so the total edible product is even less then the dressing percentage.

Allow students time to fill out the worksheet questions within their groups. Use these questions to guide the class discussion. Talk about how much of the actual animal becomes edible product. Talk about what the discarded parts like skin, fat, bone and other things can be used for.

Worksheet answers:

- *Pig dressing percentage - 70%*
- *Steer carcass weight - 750 lbs.*
- *Lamb's live weight - 130 lbs.*
- *You can make 600 Big Macs*

Extension

An easy extension would be to use the "Food Fiber and More" lesson plan in the AGsploration curriculum to talk about and make animal byproducts.

Have an adult help students to pan-broil one pound of ground beef. Separate and weigh the cooked meat and the grease (fat and other fluids). Determine the percentage of each in the pound of uncooked ground beef. Repeat the activity with ground pork or sausage and one pound of ground lamb and compare the results.

Foods are often associated with special events or holidays. Ask students to discuss the association of meat with different events they enjoy and holidays they celebrate. For example, people eat hot dogs at ball games, have corned beef on St. Patrick's Day, or serve lamb on Easter.

Keep a record of the meat products from beef, pork, or lamb that your family eats in a one-week period. Visit a grocery store or local restaurant and find all the meat products your family ate in that week and determine the total cost for your family to have meat in your diet that week. Compare the cost of your favorite steak or other cut of meat at your local store to the restaurant cost.

Evaluation

A pre/post test may be completed with this lesson plan. Student understanding of concepts can also be evaluated through class discussion as well as through evaluation of completed activity data sheets. Analysis/conclusion questions that are answered incorrectly by a large number of students should be addressed in a follow-up discussion.

Career Connections

There are many careers related to the science and business of providing wholesome, nutritious, quality, and convenient meats and meat products to consumers. Opportunities in the meat industry involve all the sciences and is one of the fastest changing of the food industries. Many fields of study can lead to careers in the meat industry including microbiology, chemistry, biochemistry, engineering, sales, management, and marketing. Today, the emphasis being placed on food safety is creating many new jobs in this industry. Careers can be found in several segments of the meat industry including production, fresh meats, manufacturing or processing, and industry support.

Production – Includes raising livestock animals to be used for meat and meat products. Example jobs include:

- **Production Manager** – This person oversees the daily operations of a livestock farm that raises animals for meat.
- **Marketing and Sales** – This person secures buyers for live animals at the best possible prices.
- **Quality Assurance** – This person makes sure that the safest possible livestock production practices are used to raise animals for meat.

Fresh Meats – Includes harvesting and processing fresh meat. Example jobs include:

- **Harvest and Fresh Meat Processor** – This person is responsible for cutting large carcasses into smaller cuts of meat like steaks, chops, roasts, and hamburger for grocers, restaurants, and consumers.
- **Carcass Grader** – This person performs an evaluation of the meat characteristics of beef, pork, and lamb that affect the meat products consumers like most and are willing to buy.
- **Food Safety Inspector** – This person is a federal inspector that makes sure only safe animals are used for meat and that they are processed in clean, safe facilities.

Manufacture – Includes manufacture of processed meat products like beef jerky, smoked hams, pepperoni, bacon, bologna, and much more. Example jobs include:

- **New Product Developer** – This person works to find safer ways to freeze, dehydrate, cook, and store meat products or applies new technologies to create new convenient ways for consumers to transport, serve, store, or prepare meat products.
- **Food Scientist** – This is a scientist who creates new recipes for lunch meats, hams, bratwursts, and much more or improves the nutritional value of meat products.

Support Industry – Includes equipment, ingredients, chemicals, packaging materials, and services. Example jobs include:

- **Food Service Worker or Retailer** – This person might be running a meat department at a grocery store or working as a chef or manager at your favorite restaurant.
- **Research and Consulting** – This person studies meat industry problems in processing, producing, storing, and preparing meat and meat products.
- **Engineer** – This person designs equipment that processes or packages meat and meat products and might also design meat processing or manufacturing plants.

References

2010 Maryland Agriculture Overview. USDA National Agricultural Statistics Service. <www.nass.usda.gov/Statistics_by_State/Maryland/index.asp>

Maryland at a Glance. Maryland State Archives. <www.mdarchives.state.md.us>

"Beef Prices Soar." Parija Kavilanz. <money.cnn.com/2011/03/31/markets/beef_price_increasing/index.htm>

U.S. Meat and Poultry Production & Consumption: An Overview. American Meat Institute. <www.meatami.com/ht/a/GetDocumentAction/i/48781>

Pork Nutritional Information. National Pork Board. <www.porkbeinspired.com/NutritionArticle_MyPyramid.aspx>

USDA Dietary Guidelines. United States Department of Agriculture. <www.choosemyplate.gov>

"The Consumer's Choice - Lean Meat." United States Department of Agriculture.

"The Guide to Identifying Meat Cuts." Cattleman's Beef Board and National Cattlemen's Association.

Cal-Poly Department of Animal Science Department of Animal Science. <animalscience.calpoly.edu/AboutUs/AreasOfStudy/meat_science>

University of Nebraska Department of Animal Science Requirements. <animalscience.unl.edu/anscmeatscience-courses>

Meat Group - Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts Group. West Virginia University Extension. <www.wvu.edu/~exten/infores/pubs/fypubs/ne300_99.pdf>

Undressing the Mystery of Meat

Name: _____

Date: _____ Period: _____

Goal:
Simulate processing an animal into edible meat products.

Materials:

- Fruit (apple, orange, pear, etc.)
- Plate
- Peeler, paring knife, or safety knife
- Scale
- Calculator

Background:
Livestock are grown and harvested in many parts of the world to serve as a high-quality source of protein and essential vitamins and minerals in our diets. The three main livestock species harvested for meat in the United States include beef, sheep, and swine. The process of getting them from live form to what you get in the store is done by a butcher. The butcher is responsible for getting all of the edible products from that animal to our plates.

Directions:

1. Get into your lab group.
2. Listen carefully as the teacher explains the activity.
3. Weigh your fruit on the scale and record the weight.
4. Carefully take your paring knife or peeler and remove all of the skin from your fruit, weigh it on the scale, and record the weight in the table.
5. Cut your fruit in half and remove the seeds, pits, and any inedible parts you find inside. Weigh this amount on the scale and record the weight in the table.
6. Take the remaining edible fruit, weigh it, and record the weight in the table.
7. Create a pie chart with three sections: skin, inedible parts, and edible fruit.
    a. Find the percentage for each portion for peel, inedible parts, and edible parts by taking their amount and dividing by the whole then multiplying by 100.
    b. Find the angle for the both sides of the pie section. Take the percentage and multiply it by 360.
    c. If you have done it correctly, all the numbers should add back up to 360.
    d. Draw a line to make the radius of the circle. Start in the exact center of the circle and draw a straight line to the outside of the circle.
    e. Draw each section division. Draw the sections by marking the first division against the edge of the protractor at the correct angle, using the angle formulations you got in the earlier step. Each time you add a section, the radius changes to the line you just drew; rotate your protractor accordingly.
    f. Color each segment a different color to match your key color.

Undressing the Mystery of Meat

Name: _____

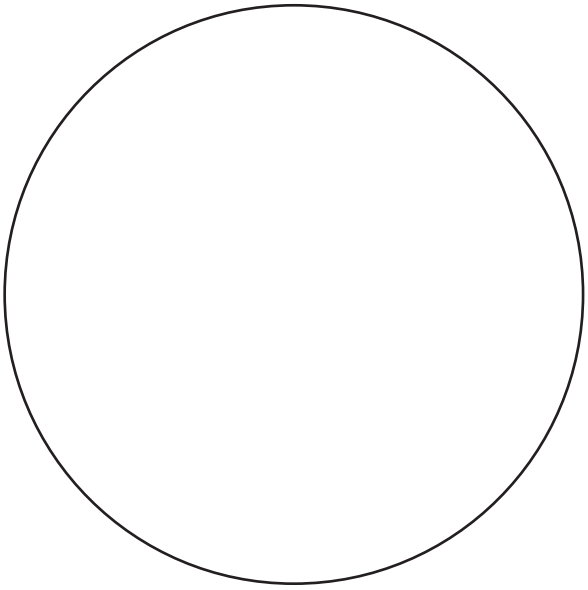
Date: _____ Period: _____

Hypothesis:

What percentage of your fruit will you have left after you take off the skin and the inedible inside?

Part of Fruit	Weight
Whole Fruit	
Skin	
Inedible parts (seeds, core, etc.)	
Edible fruit	

Fruit Dissection Pie Chart



Pie Chart Color Key

- ☐ Skin
- ☐ Inedible
- ☐ Edible Fruit

1. Record the values for each of the layers in the chart provided in the weight column.
2. Find the total weight of the fruit and record.
3. Find the percentage for each portion of the fruit by dividing its weight by the weight of the whole fruit. (The answer should be a decimal like .45 which is equal to 45%.)
4. Find the angle for each pie section. Multiply the percentage for each section by 360. (For example, 0.45 x 360 = 162 degrees.) If you have done it correctly, all the numbers should add up to 360.
5. Draw a line to make the radius of the circle. To do this, start in the exact center of the circle and draw a straight line to the outside of the circle.
6. Draw each section division. To do this, lay the protractor against the radius and draw a line at the angle you calculated in the earlier step. Each time you add a section, adjust your protractor so it is against the new radius line you just drew.
7. Color each segment a different color to match your key color.

Undressing the Mystery of Meat

Name: _____

Date: _____ Period: _____

Dressing percentage is the amount of the live weight of the animal that will enter the cooler in the form of a carcass (the processed animal that has been skinned and had the internal organs removed). Find the dressing percentage of your fruit.

(weight of edible fruit / weight of the whole fruit) x 100 = dressing percentage

---

To find the dressing percentage of an animal:

(carcass weight / live weight) x 100 = dressing percentage

You sold a pig that weighed 250 pounds and his carcass weight is 175 pounds. What is his dressing percentage?

The dressing percentage of your steer is 60% and his live weight is 1250 lbs. What is his carcass weight?

Your market lamb's carcass weighed 65 pounds and has a dressing percentage of 50%. What was the lambs live weight?

Once an animal is dressed, more processing takes place to get meat into the final form that consumers buy it in.

An average 1200 pound steer has about 490 pounds of trim beef. Of that about 150 pounds ends up as ground beef. If we were to make this ground beef into hamburgers, how many McDonald's Big Macs could we make? (Hint: a Big Mac is two 1/8th pound patties.)

S.T.E.M. Definition and Examples

Science	Technology	Engineering	Math
The intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experimentation.	***Technology is the use of scientific knowledge for practical purposes or applications, whether in industry or in our everyday lives.***	***The application of science and mathematics by which the properties of matter and the sources of energy in nature are made useful to people.***	***The abstract science of number, quantity and space. It may be studied in its own right or as it is applied to other disciplines such as physics and engineering.***
Anatomy- the study of organisms and their parts.	**Agricultural**- uses machines and systems to raise and process food.	**Aerospace**-develop and design jets, helicopters, space shuttles, satellites and rockets.	**Algebra-** letters representing numbers are combined according to the rules of arithmetic.
Bacteriology- the study of bacteria, especially in relation to medicine and agriculture.	**Assistive**- uses various types of services and devices designed to help people with disabilities function in an environment.	**Agricultural**- develop ways to improve farms and our food supply.	**Analysis**- concerned with limits, continuity and infinite series.
Biochemistry- the study of the chemical substances and processes in living organisms.	**Biotechnology**- use of living systems and organisms to develop or make products.	**Automotive**-develop engines that improve fuel efficiency and reduce emissions.	**Basic/Arithmetic-** deals with nonnegative real numbers and application of operations (+,-,x, /).
Biology- the study of life and living organisms.	**Construction**- uses machines and systems to erect buildings and other structures.		
Cardiology- the medical study of the heart	**Communication**- uses machines and systems to collect, process and exchange information.		
			Charts- a sheet giving information in a tabular form.
			Computation/Calculate- determine the amount or number of something.
Ecology- the study of organisms and their environment.		**Chemical**-use chemistry, math and physics to design industrial equipment and methods of manufacturing products such as paints, plastics and soaps.	**Cryptology-** the study of codes, the art of writing and solving them.
Embryology- the student of the formation, early growth and development of living organisms.		**Civil**-design highways, municipal infrastructure and ensure availability of water and sewage	**Economics-** concerned with the production, consumption and transfer of wealth.

S.T.E.M. Definition and Examples

		treatment facilities.	
Endocrinology- the study of the glands and hormones of the body.	**Energy**- uses machines to convert, transmit and apply energy.	**Communication**- design, create and manage communications systems and networks such as the internet.	**Estimation-** rough calculation of the value, number, quantity or extent of something.
Genetics- the study of heredity and inherited traits.		**Computer**-design, analyze and manufacturing of electronic circuits and devices.	**Fractions-** a numerical quantity that is not a whole number.
Hematology- the student of the blood and blood-producing organs.		**Electrical**-involved with generation, production, transmission and distribution of electrical energy.	**Game Theory-** analysis of strategies for dealing with competitive situations.
Histology- the study of the microscopic structure of animal and plant tissues.	**Food-** deals with the production processes that make food and includes such pasteurization, freeze drying and canning.	**Environmental**-work to prevent pollution and solve problems affecting the welfare of humans and nature.	**Geometry-** concerned with the properties and relations of points, lines, surfaces, solids and higher dimensional analogs.
Immunology- the study of the immune system of the body.			
Medicine- the science of diagnosing and treating disease and damage to the body.			
Metrology- the science of measurement.			
Microbiology- the study of microorganisms and their effects on other living organisms.			
Neurology- the study of the nervous system and disorders affecting it.		**Gas**-explore, recover and process natural gas reserves.	**Measurement-** the size, length or amount of something.
Nutrition- the study of food and nourishment.		**Geological-**use geological data to determine suitable locations for buildings and structures.	**Modeling-** art or activity of making three-dimensional models.
Oncology- the study of the development, diagnosis, treatment and prevention of tumors.	**Information-** use of computers to store, study, retrieve, transmit and manipulate data or information in business or other enterprise.	**Industrial/Manufacturing** -work to improve efficiency, effectiveness and productivity.	**Number Theory-** deals with the properties and relationships of numbers.
Optics- the study of light	**Mechanical**- uses wheels,	**Materials**-study the	**Number Systems-** a way of

S.T.E.M. Definition and Examples

and vision.	cams, levers, gears, belts and engines to allow motion in one direction to cause a different kind of motion.	properties of existing and find new ways to work with and develop new materials.	representing (expressing or writing) numbers of a certain type. Ex. Base 10, decimals and roman.
Pathology- the study of disease and its causes, processes, development and consequences.	**Medical**- uses machines and systems to treat diseases and maintain the health of living beings	**Mechanical**-design, manufacture and maintain mechanical equipment from appliances to vehicles.	**Percentages-** a rate, number or amount in each hundred.
Physics- the science of matter and energy and interactions between the two.	**Nano**-the manipulation of matter on an atomic, molecular or supramolecular scale.	**Metallurgical-** develop processes for extracting metals, develop new alloys and metals and produces metal products.	**Probability-** the likelihood of occurrence, measured by the ration of the favorable cases to the whole number of cases possible.
Physiology- the study of functions of living organisms.	**Robotics**- create a programmable mechanical device that can perform tasks and interact with its environment without the aid of human interaction.	**Mining**- discover, extract and prepare minerals from the earth's crust to be used by manufacturing and energy industries.	**Proportions-** a part, share or number considered in comparison with a whole
Systematics- the science of systematic classification.	**Space**-used in spaceflight, satellites and space exploration and may include equipment, support infrastructure, procedures, spacecraft, stations and satellites.	**Oil**- explore, recover, development and processing of oil reserves.	**Set Theory-** deals with the formal properties of sets as units and the expression of other branches of math in terms of sets.
Thermodynamics- the study of relationships and conversions between heat and other forms of energy.	**Transportation**- uses machines and systems to move people and cargo.	**Plastics**-study the properties of polymer materials and design machine used to manipulate and shape plastics.	**Statistics-** collecting and analyzing numerical data in large quantities, especially for inferring proportions in a whole.
Toxicology- the study of poisons and the treatment of poisoning.		**Production**-design, control and improvement of integrated systems of personnel, materials, machinery and money that produce goods and services.	**Trigonometry-**dealing with the relations of the sides and angles of triangles and with the relevant functions of angles.
Virology- the study of viruses and viral diseases.		**Software**-design, develop and maintain software systems and products.	
Zoology- the study of the structure, physiology, development and classification of animals.		**Systems**- assist and support policy-making, planning, decision-making and associated resource allocation or action deployment.	
		Water Resource- protect water supplies and ensure	

S.T.E.M. Definition and Examples

		that development of new resources does not disrupt natural processes and water tables.	

https://www.merriam-webster.com/dictionary/

http://mistupid.com/science/fields.htm- science areas

http://mistupid.com/science/fields.htm- engineering areas

http://www.aboriginalaccess.ca/adults/types-of-engineering- engineering areas

https://prezi.com/mh8nvw6t3qy4/7-major-areas-of-technology/- technology areas

http://curriculum.vexrobotics.com/curriculum/intro-to-robotics/what-is-robotics

http://study.com/academy/lesson/what-is-technology-definition-types.html

http://tam.uky.edu/basics/techtypes.html

https://en.wikipedia.org/wiki/Areas_of_mathematics

https://www.physicsforums.com/threads/complete-list-of-math-branches.466170/

2017 National 4-H Volunteer e-Forum
STEMming into Animal Science, Growing True Leaders
Resource List

Resource	Type	Species	Topics Included	Website	Cost
***Agsploration: The Science of Maryland Agriculture University of Maryland Extension**	**Digital Download**	**Multiple**	**Meat Science, Digestive System, Nutrition, Careers**	**https://extension.umd.edu/agsploration**	**$ -**
***Livestock-Maker Science Experiments Purdue Extension**	**Digital Download**	**Multiple**	**Animal by-products, Forages, Working Facilities, Biosecurity**		**$ -**
4-H AgriScience	Digital Download		AgriScience, Biotechnology, Teens Teach	http://4-h.org/parents/curriculum/agriscience/	$ -
4-H Animal Science Anywhere Michigan State University	Digital Download	Multiple	Meat Science, Digestive System, Reproduction	http://msue.anr.msu.edu/resources/4_h_animal_science_anywhere	$ -
4-H Science Toolkit: Animal Science Cornell University	Digital Download	Multiple	Body Temperature, Immunity, Animal Behavior	https://extension.purdue.edu/4h/Documents/Volunteer%20Resources/Livestock%20Volunteers/Animal%20Science.pdf	$ -
4-H SET: Animal Science University of California	Digital Download	Multiple	Management, Meat Science, Animal Behavior, Anatomy	http://4h.ucanr.edu/Resources/Curriculum/FREE/	$ -
Afterschool Agriculture Acres of Adventure	Digital Download or Online Instruction	Multiple	Beginning/ cloverbud Ag. activities, agriculture in the classroom	http://4-h.org/parents/curriculum/afterschool-agriculture/	Varies
Beef Quality Assurance Manuals National Cattlemen's Beef Board	Digital Download	Beef Cattle Dairy Cattle	Beef Quality Assurance	http://www.bqa.org/resources/manuals	$ -
Beef Resource Handbook Ohio State University	Manual	Beef Cattle	Management, Reproduction and Genetics, Meat Science	http://estore.osu-extension.org/Beef-Resource-Handbook-P147.aspx	$18.50
Discover 4-H Clubs Curriculum Utah State University Extension	Digital Download	Multiple	Management, Production, Showmanship	http://utah4h.org/discover/	Varies

*Highlighted activities were used during session.

2017 National 4-H Volunteer e-Forum
STEMming into Animal Science, Growing True Leaders
Resource List

Resource	Type	Species	Topics Included	Website	Cost
Fertis the Fistulated Steer: Revealing the Rumen at Open House	Digital Download	Cattle	ruminant digestion	http://www.youtube.com/watch?v=-ban6fHArBU	$ -
Goat Resource Handbook Ohio State University	Manual	Meat Goat Dairy Goat	Management, Reproduction, Nutrition, Diseases	http://estore.osu-extension.org/Goat-Resource-Handbook-P32.aspx	$21.25
Grow For it Curriculum NC State University	Digital Download	Gardening	Plant Science, soil, composting, etc.	http://www.growforit.org/curriculum	$ -
Iowa Livestock Resources Iowa State University	Digital Download	Multiple	Production, Management, Veterinary Science	http://www.extension.iastate.edu/4h/projects/livestock	$ -
National 4-H Counci Dairy Goat Curriculum	Printed Curriculum (set of 4)	Dairy Goats	Selection, Feeding, Showmanship, Health	http://www.4-hmall.org/Category/4-hcurriculum-dairy-goat.aspx	$19.50
National 4-H Council Beef Curriculum	Printed Curriculum (set of 4)	Beef Cattle	Breeds, Parts, Meat Science, Health Management	http://www.4-hmall.org/Category/4-hcurriculum-beef.aspx	$19.50
National 4-H Council Dairy Cattle Curriculum	Printed Curriculum (set of 4)	Dairy Cattle	Breeds, Calving and Care, Ration Balancing, Products	http://www.4-hmall.org/Category/4-hcurriculum-dairy-cattle.aspx	$19.50
National 4-H Council Meat Goat Curriculum	Printed Curriculum (set of 4)	Meat Goat	Selection, Feeding, Parasite Control, Reproduction	http://www.4-hmall.org/Category/4-hcurriculum-meat-goat.aspx	$19.50
National 4-H Council Sheep Curriculum	Printed Curriculum (set of 4)	Sheep	Selection, Feeding, Health Management, Products	http://www.4-hmall.org/Category/sheep.aspx	$19.50
National 4-H Council Swine Curriculum	Printed Curriculum (set of 4)	Swine	Breeds, Parts, Meat Science, Breeding	http://www.4-hmall.org/Category/swine.aspx	$19.50

*Highlighted activities were used during session.

2017 National 4-H Volunteer e-Forum
STEMming into Animal Science, Growing True Leaders
Resource List

Resource	Type	Species	Topics Included	Website	Cost
National 4-H Council Veterinary Science Curriculum	Digital Download (set of 5)	Multiple	Animal Care, Biomedical Research, Food Safety	http://www.4-hmall.org/Category/veterinary-science.aspx	$34.99
National Pork Board	Digital Download	Swine	Animal Care, Breeding, Reproduction, Biosecurity	http://www.pork.org/youth-and-education/youth-production-resources/	Varies
Noble Academy Noble Research Institute	Digital Download		Chemistry, Biochemistry, Biology, Genetics	https://www.noble.org/education/noble-academy/lessons/	$ -
Quality Counts Texas AgriLife Extension	Digital Download	Multiple	Pillars of Character, Quality Assurance, Meat Science	http://anr.ext.wvu.edu/r/download/180164	$ -
Sheep Resource Handbook Ohio State University	Manual	Sheep	Management, Nutrition, Diseases, Meat Science	http://estore.osu-extension.org/Sheep-Resource-Handbook-for-Market-and-Breeding-Projects-P71.aspx	$27.50
Swine Resource Handbook Ohio State University	Manual	Swine	Management, Digestive System, Nutrition, Diseases	http://estore.osu-extension.org/Swine-Resource-Handbook-for-Market-and-Breeding-Projects-P148.aspx	$19.50
Youth Beef Quality Assurance (Pacific Northwest) University of Idaho	Digital Download	Beef Cattle	Management, Ethics and Animal Welfare, Health	https://extension.usu.edu/cache/files/Youth_Beef_Quality_Assurance.pdf	$ -
Youth Beef Quality Assurance (Oklahoma)	Digital Download	Beef Cattle	Beef Quality Assurance	http://4h.okstate.edu/literature-links/lit-online/animal-science-companion-animals/copy_of_YBQAforleaders.pdf	$ -
Youth for the Quality Care of Animals	Online Training Modules	Multiple	Food Safety, Animal Well-being, Character Awareness	http://yqca.org/	$12.00
Youth PQA Plus Manual National Pork Board	Manual Digital Download	Swine	Pork Quality Assurance	http://www.pork.org/youth-pqa-plus/program-materials/	$ -

*Highlighted activities were used during session.

PURDUE EXTENSION

Livestock-Maker Science Experiments

Makerspaces are zones of self-directed learning. Their hands-on character, coupled with the tools and raw materials that support invention, provide the ultimate workshop for the tinkerer and the perfect educational space for individuals who learn best by doing. There are no set instructions, just materials to have fun, invent and create something new while learning about Science! This Livestock-Maker packet is meant to introduce the Maker Movement to the livestock project areas while also highlighting the idea that youth need to make discoveries on their own.

Included in this packet are 6 lesson plans would be perfect to use as the basis for a STEM in Livestock SPARK Club as it provides educational content to meet the 6-hour requirement. This is a great way to engage non-traditional audiences that are interested in animals but do not have access to live animals. But they are also great to use with traditional animal youth in 4-H club meetings and livestock workshops individually or as a series. In each lesson, the leader is encouraged to not give too much instructions or directions. The goal is for youth to make discoveries for themselves without being told the right answer or the right way to accomplish a certain task. Their idea might fail the first time, and that is okay. They learn through these failures how to improve their ideas and make it better the next time. Think of this as the Trial and Error method. Additionally, do not feel constrained by the species used as the example in each lesson. Feel free to tailor each activity to fit the species of interest of the targeted audience.

Livestock-Maker lessons include:

- Animal By-Products
- Animal Roundup
- Hay Storage Facility
- Livestock Working Facility
- Preventing Disease
- Transporting Corn

Have fun incorporating more STEM related topics in your 4-H Livestock Programming!

Livestock-Makers Science Experiment: Animal By-Products

Scenario:
There are many by-products of animal production that many people would consider to be wastes. These products are not really wastes, they are resources that have a use somewhere else. This includes manure (fertilizer, feed for chickens), by-product feeds (corn gluten feed, soybean hulls, cottonseed hulls) and animal organs/bones/hooves (medicine, soap, camera film). All of these by-products are an important part of the livestock industry and even everyday life.

Supplies: (These materials are suggestions, almost anything could be used.)

- **Empty Plastic Bottles**
- **Paper Towel and Toilet Paper Tubes**
- **Disposable Pie Tins**
- **Newspapers and Magazines**
- **Empty Egg Cartons**
- **Glue**
- **Masking and Scotch Tape**
- **Scissors**

Expected Time: 30 minutes

What to Do:

1. Split the youth into groups of 3-4 and explain that they will be creating new uses for these by-products. Allow the youth time to discuss the items with each other, including what the items were initially intended for and how they think they can use these materials for another use.
2. Give youth approximately 20-25 minutes to experiment with creating new uses and products for the recycled materials. *(Very little instruction is given by the instructor during this time. The goal is for participants to work together and be creative using their own skills and background knowledge.)*
3. Give each group time to share how they created their new products and how they can be used in the future.

Reflect:

1. How did your group work together to create your new product?
2. Did you have difficulties getting your group to agree on a new product or use for your materials?
3. What do inventors need to do in order to create a product that will be used by consumers?
4. What did you learn about the process of inventing a new product?

Apply:
Are you surprised that there are animal products in camera film? What about chewing gum? The famous saying "One Person's Trash is Another Person's Treasure" can be very true. Think about times in your life when you have thrown something away. *How could you have used the product in a different way? What other products can you think of that are reused or recycled for a different purpose? How does using these animal by-products affect a farmer's production costs?*

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Livestock-Makers Science Experiment: Animal Round-up

Scenario:
Animals see their surroundings much different than people. For example, cattle have an almost 300-degree field of vision. Because of this, they have poor depth perception (will not walk over a shadow). It is important to understand their point of balance (shoulder) and flight zone (personal space) to move cattle in a stress-free way. Narrow alleys, solid panels and avoiding loud noises, sudden movements and sharp turns are also important.

Supplies: (These materials are suggestions, almost anything could be used.)

- **HEXBUG Nano Robots** (https://www.hexbug.com/nano/hexbug-nano-nitro-five-pack.html)
- **Cardboard**
- **Paper Straws**
- **PVC Pipe**
- **Craft Sticks**
- **Index Cards**
- **Tape**
- **Scissors**

Expected Time: 30 – 45 minutes

What to Do:

1. Split the youth into groups of 3-4 and explain to them that they will be designing a system to get weaned calves from a pasture to the barn with 3-4 HEXBUGS as the calves. The distance from pasture to the designated barn area should be at least 2 feet. Allow youth time to discuss cattle movement and what they know about it, then they should sketch out their plan.
2. Give youth approximately 20-25 minutes to design their system. *(Very little instruction is given by the instructor during this time. The goal is for participants to work together and be creative using their own skills and background knowledge.)*
3. After the design session, it is time for the competition! Each group will explain their design, and then turn the calves loose. Record the number of calves and the time it takes for the calves to reach the barn. The group with the most calves in the barn in the least time will be declared the winner.

Reflect:

1. Did the number of turns in your system impact the time it took for the calves to make it to the barn?
2. Did you have to add anything to your design to keep the calves contained?
3. What worked the best at keeping the calves moving forward?
4. Why do you think farmers put up fences on their farms?

Apply:
Have you ever moved a group of calves? Was it difficult? Did you learn anything in this activity that will help you do it better in the future? Robots and computer systems are commonly used on farms. Did you know that robots are being used to milk dairy cows? *In what ways do you think robots and computer systems can be used in the future of animal agriculture? Is it possible to use robots to round-up animals?*

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Facilitator Note: This activity can easily be modified to include examples of goats, sheep, swine, llamas, horses, dogs and cats.

Livestock-Makers Science Experiment:
Hay Storage Facility

Scenario:
Hay is the predominant winter feed for beef cattle, sheep and goats. Losses due to weather damage can range from 10-30% for hay not stored in a barn. Storing hay in a barn can significantly decrease the production costs for livestock producers. Important considerations for hay barns include complete protection from the weather, minimizing access to pests, storage capacity and a firm foundation.

Supplies: (These materials are suggestions, almost anything could be used.)

- **Cotton Swabs**
- **Paper Plates**
- **Straws**
- **Index Cards**
- **Craft Sticks**
- **Masking Tape**

Expected Time: 30 minutes

What to Do:

1. Explain to the youth that they will be designing a hay barn that will hold as much hay as possible, minimizes losses due to weather/pests and has a firm foundation. Allow youth time to discuss hay barns and what they know about them, then they should sketch out their plan.
2. Split the youth into groups of 3-4 of various age and ability levels and explain the various materials they can use to build a structure.
3. Give youth approximately 20-25 minutes to build a hay barn using the materials on hand. *(Very little instruction is given by the instructor during this time. The goal is for participants to work together and be creative using their own skills and background knowledge.)*
4. At the end of the design session, it is time for the competition! Each group will explain their hay barn design. You should apply a little pressure to the top with your to make sure it will has a firm foundation. The biggest barn that does not collapse will be declared the winner.

Reflect:

1. How did your group work together to create your barn?
2. Did you have difficulties getting your barn to stand up?
3. What does a building need in order to stand? (a firm foundation)

Apply:
What did you know about hay barns before this activity? What did you learn about hay barns and buildings in general through this activity? Even though buildings can look very different, they can have very similar purposes and the good ones have a firm foundation. As you go out into the world, take the time to look at the buildings around you. *How long do you think it takes to plan and build a hay barn in real life?*

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Livestock-Makers Science Experiment: Livestock Working Facility

Scenario:
Proper animal restraint is one of the most important parts of the humane care of animals. Large animals like beef and dairy cattle, require a working facility consisting of panels and gates that form holding pens and alleyways that allow for the low stress movement through the facility. Important considerations include solid panels, narrow alleyways to prevent turning around and gates that work to funnel the animals from the holding pens to the alleyway.

Supplies:

- **3D Printing Pens**
  - Recommended Pens: Intelligent 3D Pen, Amazing Pagreberya V3 3D Drawing Pen for Kids
- **3D Printing Pen Filament**
- **Cardboard or plastic sheets**

Expected Time: 30 – 45 minutes

What to Do:

1. Explain to the youth that they will be designing a livestock working facility that should include at least 1 holding pen, an alleyway and a head gate. Allow youth time to discuss livestock working facilities and what they know about them, then they should sketch out their plan.
2. Split the youth into groups of 3-4. Give youth approximately 20-25 minutes to experiment with the 3D Printing Pens. They can complete their designs on the cardboard or plastic sheets. The designs easily peel off of most surfaces in a few seconds after hardening. *(Very little instruction is given by the instructor during this time. The goal is for participants to experiment with the pens and make discoveries on their own.)*
3. Give each group time to share about their livestock working facility.
4. **Variation on the Experiment:** If you do not have access to 3D Printing Pens, you can replicate this experiment by having children create 3D objects using a variety of materials.

Reflect:

1. What is the biggest difference between using a 3D Printing Pen and a regular pen?
2. Was it difficult to get the pen to work as you were creating your design?
3. What did this experiment teach you about using patience and perseverance?

Apply:
What did you know about livestock working facilities before this activity? What did you learn through this activity? 3D Printers are being used to help move the world forward in a variety of ways. Did you know 3D Printers are currently being used to replicate organs for the human body and for prototyping in the auto industry? *In what ways do you think 3D Printers can be used in the future of animal agriculture? Is it possible to 3D print a livestock working facility?*

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Livestock-Makers Science Experiment: Preventing Disease

Scenario:
Vaccines are one of the main ways that farmers prevent disease in their livestock. They expose an animal to a form of a disease that causes the animal to build immunity to a certain disease. Generally, this results in reducing the severity of a disease or decreasing the percentage of the herd that gets sick. Many vaccines (and other medications) require storage in a refrigerator to remain effective and also have expiration dates.

Supplies:

- **Cardboard Box** (smaller, shoebox size; one per group)
- **Wax Paper**
- **Aluminum Foil**
- **Masking Tape**
- **Newspaper**
- **Rubber Bands**
- **Ice Cubes** (2 per group)

Expected Time: 30 – 45 minutes

What to Do:

1. Split the youth into groups of 3-4 and explain to them that they will be designing a refrigerator to store vaccines. Give each group a cardboard box and the remaining supplies (except the ice cubes). You can decide if you want to give each group an unlimited amount of supplies or a set amount of supplies.
2. Give youth approximately 20-30 minutes to design their own refrigerator. The goal is for their ice cube to melt slower than a control ice cube outside of the box. *(Very little instruction is given by the instructor during this time. The goal is for participants to work together and be creative using their own skills and background knowledge.)*
3. After the design session, it is time for the competition! Each group will explain their design, and then place one cube in their refrigerator and one outside of the container (control ice cube). After 90 seconds, remove the ice cube from the refrigerator and measure the difference in melting between it and the control ice cube. If the 2 ice cubes are similar (same loss of water), the refrigerator did not work well. The group with the least amount of water loss (melting) will be declared the winner.
4. For more "scientific results", try weighing or measuring the volume of each ice cube prior to testing it. Measure it again after testing to find the true amount of water/mass lost compared to the control.

Reflect:

1. What materials did you use? Were there any that you did not use? Why?
2. Which materials worked best? Which worked the least? Why?
3. Which design worked the best? What is it about that design that seemed to make the difference?

Apply:
Have you ever given a vaccine to an animal? If so, did you check the expiration date? Do you know if it was properly stored? *How would you check to makes sure a refrigerator is working properly? What other animal products have special storage requirements?*

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Source: PBS ZOOM Activities "Keep-A-Cube"
www.pbskids.org/zoom/activities/sci/keepacube.html

Livestock-Makers Science Experiment: Transporting Corn

Scenario:
Many agricultural products are transported by water to marketplaces all over the world. This might include transporting grain on a river from one state to another, or exporting meat across an ocean to another country. The goal is to transport the products as efficiently as possible.

Supplies:

- **Aluminum Foil (be sure to give each group the same amount)**
- **Tape**
- **Scissors**
- **Several Pennies (to represent "corn")**
- **Bucket of Water**
- **Other materials that can be used for building a boat**

Expected Time: 30 – 40 minutes

What to Do:

1. Explain to the youth that they will be designing a boat that will need to be sturdy enough to transport corn down the river to be used in a neighboring state (pennies represent corn). It is important to transport as much as possible to keep transportation costs low, while also not over-loading the boat.
2. Split the youth into groups of 3-4. Give the groups approximately 15-20 minutes to design a boat that will float on water and transport as much corn as possible. The goal of the competition is to design a boat that will hold the most corn without sinking the boat. *Give very little instruction during this time. Encourage youth to experiment with the boats and test out how much cargo it can hold.*
3. At the end of the design session, it is time for the competition! Each group will explain their boat design and then count the number of pennies (amount of corn) that their boat can hold without sinking.
4. The group whose boat can hold the most pennies was able to transport the most corn and will be declared the winner of the challenge.

Reflect:

1. Think about the boat that held the most pennies. What was the shape of that boat?
2. Do you think the shape of the boat makes a difference in how many pennies it can hold?

Apply:
Ask the group why you need to know the correct amount of corn to have on the boat. *How do you know when you have the correct amount? What is wrong with having too little corn? What might happen if there is too much corn?* Depending on the age of the youth, consider teaching them about volume, buoyancy and density.

Additional Resource for Teaching Volume, Buoyancy, and Density: http://www.sciencebuddies.org/ (How Much Weight Can Your Boat Float?)

PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS