They Don't Just Eat Grass

Grades 6-8

Math, Science, Health, Agriscience, Family and Consumer Sciences

Objectives

Students will read about healthy feeding programs for farm animals. Students determine the best graphing method for information about animal nutrition and plot numbers provided. Students will relate information about balance in animal diets to balance in their own diets and mix their own balanced "rations."

Vocabulary

dormant—having growth or other biological activity much reduced or suspended
energy—power or ability to be active
enzymes—proteins that act as biological catalysts by speeding up chemical reactions in organisms, such as helping to break down nutrients in the digestive process
fiber—indigestible substance (cellulose, lignin, etc.) found in the cell walls of plants
forage—herbaceous plant material
hormones—chemicals made in one part of the body that act on a different part of the body (e.g., pituitary gland secretes hormones that act on reproductive organs); regulate metabolism, growth, etc.
lactating—producing milk
megacalories—1 megacalorie = 1000 kilocalories; 1 kilocalorie = 1 Calorie, which is what food energy is measured in (e.g., soda has 140 Calories a can); 1 Calorie is the amount of energy it takes to heat one kilogram of water 1 degree Celsius; large animal energy needs are measured in megacalories (mcal)
maintenance—the act of keeping in good condition
minerals—inorganic elements needed by livestock that must be provided in the diet since they cannot be synthesized by the animal or their microbes
monogastric—having one stomach
nutrient—a substance or ingredient that furnishes nourishment
protein—substance made of amino acids that makes up a large portion of the body—muscles, organs, skin, etc.
roughage—a feed with more than 18 percent indigestible fiber on a dry-matter basis
ruminant—a cud-chewing mammal having a complex stomach with three or four chambers
silage—fermented forage used as animal feed
supplement—something that supplies what is needed or makes an addition
vitamins—a group of dissimilar organic substances necessary for growth and maintenance that cannot be synthesized by most animals and that are only needed in small amounts

Background

Grass, a type of **forage**, is one of our most plentiful resources in Oklahoma, and most beef producers take advantage of this by grazing their cattle on pasture whenever possible. Beef cattle graze many areas in Oklahoma that are unsuitable for growing crops. They transform grass, which people cannot digest, into protein (meat) that people can eat. Cattle are even allowed to graze on winter wheat in the fall and early spring. When the wheat is **dormant** or covered with snow, supplementary feed is provided. The cattle are removed from the wheat before it reaches its jointing stage to allow it to mature and ripen for harvest in late spring/early summer.

Cattle eat food for **energy** and **nutrients**. Just as humans need variety and balance in their diets, animals need more than just grass to stay healthy. Food eaten by animals is called "feed." Animal feed provides energy, fat, and **fiber**; **protein** for the development and maintenance of muscles and the synthesis of **hormones** and **enzymes**; **vitamins** and **minerals**, important for the growth and maintenance of bones and other body systems and **roughage,** like hay, **silage** and grain hulls, which provides energy and helps animals feel full. .

The type and amount of feed necessary depends on the species, size, and "job" of the animal (plow horse, milk cow, beef steer, etc.). Nutritional needs are different for animals that are **monogastric** (horses) than they are for those that are **ruminant** (cattle). Larger animals or animals that are working, bred, **lactating**, or growing usually have higher nutrient requirements than those animals that are just being **maintained** at their current condition.

There are many tables and books of research data that help beef producers determine the nutrient and energy requirements of their animals. Energy needs for large animals are expressed as **megacalories**. Once the nutrient and energy requirements are determined, the producer may have feed custom-mixed or may buy commercial feed.

Animal feeds usually consist of grain, a protein source and plant byproducts. A byproduct is what remains after the part of the plant used for human food has been removed. Wheat middlings (mids) are a byproduct of the wheat seed that remains after the part used in making flour has been removed. Brewer's grains are a byproduct of the brewing industry that result from drying mash solids. Soybean hulls are a byproduct of processing soybeans for soybean meal.

Some feed mixes, called sweet feed, are lightly sweetened with molasses. Just like humans, animals like foods that are sweet, so one purpose of the molasses is to make the food taste better. Another purpose for the molasses is to catch all the fine bits of grain that otherwise would end up as dust. Sometimes molasses also masks poor quality feed.

There are two basic kinds of commercially-available animal feed: **supplements**, which are designed to be fed along with hay or other forage materials, and complete feeds, which are designed to be the only source of food for the animal. Commercial feeds are labeled with the species for which they are intended, a guaranteed analysis of the nutrients, the feed ingredients, and directions for use (how much to feed per unit of weight, etc.).

Even when a feeding routine is in place, other factors come into play. Extreme heat or cold, wind chill, moisture, illness, stress, parasite infestation and other factors affect nutritional and energy requirements. Monitoring feed requirements and intake is just one of the many responsibilities of raising livestock.

Background sources:
Damron, Stephen W., "*Introduction to Animal Science: Global, Biological, Social and Industry Perspectives"*, 3rd ed., 2006.
Freeman, David W., *"Feed Tag Information for Commercial Feeds for Horses,"* OSU Extension Fact Sheet F-3919. *"Ration Formulation for Horses,"* OSU Extension Fact Sheet F-3997, *"Use of By-Product and Nontraditional Feeds for Horses."*
Dumler, Troy, *"Winter Wheat Grazing,"* Kansas State University Fact Sheet MF-1009.

Additional Reading

Damerow, Gail, *Barnyard in your Backyard: A Beginner's Guide to Raising Chickens, Ducks, Geese, Rabbits, Goats, Sheep, and Cows*, Storey, 2002.
King, Hazel, *Carbohydrates for a Healthy Body*, Heinemann, 2009.
Macaulay, David, *The Way We Work*: *Getting to Know the Amazing Human Body*, Houghton Mifflin, 2008.
Miller, Edward, *The Monster Health Book: A Guide to Eating Healthy, Being Active and Feeling Great for Monsters & Kids*, Holiday House, 2008.
Patrick, Jean LS, and Alvis Upitis, *Cows, Cats and Kids: A Veterinarian's Family at Work*, Boyd's Mills, 2003.
Powell, Jillian, *Fats for a Healthy Body*, Heinemann, 2009.
Royston, Angela, *Proteins for a Healthy Body*, San Val, 2003.
Wilson, Janet, *Raising chickens: Beginners Guide to Raising Healthy and Happy Backyard Chickens*, Drip Digital, 2020

Websites

https://extensionpublications.unl.edu/assets/pdf/g1892.pdf
https://www.myplate.gov/life-stages/kids

Activity 1: Feed Efficiency, (Math, Agriscience) 1 50 minute class period

Students will perform calculations and evaluate different feed categories and determine their value in maintenance and growth of an animal.

Oklahoma Academic Standards

Activity 1: Feed Efficiency (Math, Agriscience)

6.N.1.3	Explain that a percent represents parts "out of 100" and ratios "to 100."
6.D.1.1	Calculate the mean, median, and mode for a set of real-world data.
6.D.1.2	Explain and justify which measure of central tendency (mean, median, or mode) would provide the most descriptive information for a given set of data
7.N.2.5	Solve real-world and mathematical problems involving calculations with rational numbers and positive integer exponents.
7.A.2.1	Represent proportional relationships with tables, verbal descriptions, symbols, and graphs; translate from one representation to another. Determine and compare the unit rate (constant of proportionality, slope, or rate of change) given any of these representations.
7.D.1.1	Design simple experiments, collect data and calculate measures of central tendency (mean, median, and mode) and spread (range). Use these quantities to draw conclusions about the data collected and make predictions.
PA.A.2.2	Identify, describe, and analyze linear relationships between two variables.
PA.D.1.2	Explain how outliers affect measures of central tendency.
PA.D.1.3	Collect, display and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit, make statements about average rate of change, and make predictions about values not in the original data set. Use appropriate titles, labels and units.
AS.04.01.01.a	Compare and contrast common types of feedstuffs and the roles they play in the diets of animals.
AS.04.01.02.b	Appraise the adequacy of feed rations using data from the analysis of feedstuffs, animal requirements and performance.

Materials:

- Activity 1 Reading Page 1 **"Net Energy for Maintenance (NEm)"**
- Activity 1 Worksheet 1 **"Graphing Feed Data"**
- Activity 1 Worksheet 2 **"Livestock Feed Decisions"**

Procedures

1. Read and discuss background and vocabulary.
2. Hand out copies of Activity 1 Reading Page 1 **"Net Energy for Maintenance (NEM)"**.
   —Randomly assign to each student one category of feed type from the table (roughages, grazed forages, etc.)
   —Students will find the measures of central tendency for the numbers in the assigned categories.
   —Students will explain and justify which measure of central tendency would provide the most descriptive information for the data.
3. Students will use two different colors to plot the net energy for maintenance (NEm) and percentage fat of each feed on Activity 1 Worksheet 1 **"Graphing Feed Data"** .
4. After completing their graphs, students will complete "Activity 1 Worksheet 1 **"Livestock Feed Decisions"**.
   —Students may work in groups or individually.
   —Discuss answers as a class.
5. If students are familiar correlation coefficients, data can be posted on a scatterplot graph and students can calculate whether the relationship between NEm and % fat is a positive or negative correlation.

Choose one of the categories of feed from the table below. Use two different colors to plot the net energy maintenance (NEm) and percentage fat of each feed on the same graph.

NEm = Net energy for maintenance, expressed in megacalories (mcal) per 100 pounds (cwt) of feed; energy used to work muscles, maintain and repair tissue, keep a steady temperature, maintain homeostasis (a steady internal environment) but not grow or produce milk.

Roughage		
Type of Feed	**NEm (Mcal/cwt)**	**% fat in feed**
Alfalfa hay, early bloom	59	2.9
Alfalfa hay, full bloom	52	2.3
Alfalfa cubes	55	2.0
Bermuda hay, early bloom	49	1.9
Bermuda hay, full bloom	39	1.8
Corn silage	77	3.1
Cotton seed hulls	45	1.9
Fescue hay, early bloom	55	3.5
Peanut hulls	36	1.5
Prairie hay	40	2.0
Rice hulls	35	3.9
Sorghum silage	58	2.7
Sunflower seed hulls	42	2.2
Wheat straw	43	1.8

Source: Lalman, David, "Nutritive Value of Feeds for Beef Cattle", OSU Extension Fact Sheet F-3018

Grazed Forage		
Type of Feed	**NEm (Mcal/cwt)**	**% fat in feed**
Native range, Jan-March	42	1.7
Native range, April-June	74	3.2
Native range, July-Aug	65	3.0
Native range, Sept-Oct	58	2.5
By-Product Feeds		
Distillers grain w/soluble corn	104	10.6
Soybean hulls	84	2.6
Wheat bran	74	4.5
Feed Grains		
Corn grain, whole	99	4.3
Corn grain, steam flaked	106	4.1
Milo, cracked, rolled or ground	74	4.5
Milo, steam flaked	102	3.1
High Protein Meals/Seeds		
Cottonseed, whole	108	17.8
Soybean meal, 48%	98	1.2
Soybeans, whole	106	18.8
Sunflower seeds, high oil	142	42.0

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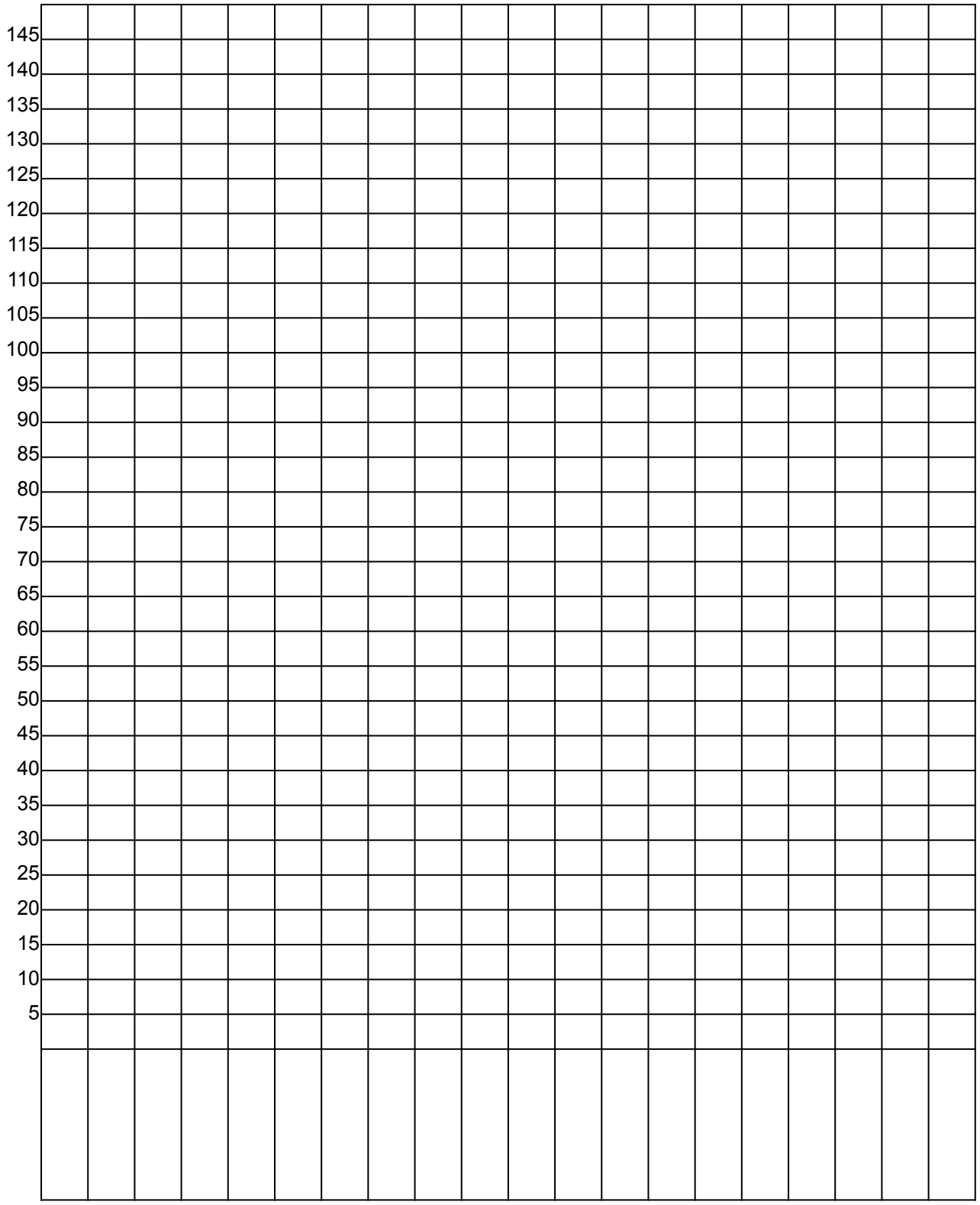
Activity 1 Worksheet 1: Graphing Feed Data

Name: _____ Date: _____

Using the information from Activity 1 Reading Page 1 **"Net Energy for Maintenance"**, write the name of each feed at the bottom of the table. Use two different colors to plot the NEm and % fat for each type of feed.



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Activity 1 Worksheet 2: Livestock Feed Decisions

Name: _____ Date: _____

Use the "Net Energy for Maintenance (NEm) Table to answer the following questions:

1. Which category of feedstuffs (roughage, feed grains, etc.) have the highest NEm?

   _____

2. Which category of feedstuffs have the highest percentage of fat?

   _____

3. For the hays and forages, does the season or cutting (early versus late bloom) affect the amount of energy and fat available?

   _____

4. Should it take more energy to produce meat, milk, etc., than to maintain weight?

   _____

   What is a possible reason for your answer? Discuss your thoughts with your partner.

   _____

   _____

5. How might this feed information be used by a producer?

   _____

   _____

6. If hay costs were the same and you had a herd of horses that were in good condition and didn't need to gain weight, which hay would you buy? Why?

   _____

7. The NEM is calculated on a "dry matter" basis. In other words, the samples are dehydrated first and then the megacalories are determined. Why do you suppose it is done that way?

   _____

8. Is there a direct correlation between the amount of NEm in a feed and the percentage of fat in the feed? Why or why not?

   _____

   _____

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Activity 1 Worksheet 2: Livestock Feed Decisions

ANSWER KEY

Name: _____ Date: _____

Use the "Net Energy for Maintenance (NEM) Table to answer the following questions:

1. Which category of feedstuffs (roughage, feed grains, etc.) have the highest NEM?

   High protein meals/seeds

2. Which category of feedstuffs have the highest percentage of fat?

   High protein meals/seeds

3. For the hays and forages, does the season or cutting (early versus late bloom) affect the amount of energy and fat available?

   Hay - the early bloom has more net energy and fat; grazed forage - April-June is highest

4. Should it take more energy to produce meat, milk, etc., than to maintain weight?

   Yes - active growth or lactation requires more energy

   What is a possible reason for your answer? Discuss your thoughts with your partner.

   It takes a certain amount of energy to maintain weight. To produce more muscle (meat) or milk there must be energy available above what is required for maintenance.

5. How might this feed information be used by a producer?

   Knowing the time of year, energy and fat content in the feed could help a producer adjust feed To meet specific needs (maintenance, growth, milk production, etc.)

6. If hay costs were the same and you had a herd of horses that were in good condition and didn't need to gain weight, which hay would you buy? Why?

   Bermuda hay because it has the lowest fat content

7. The NEM is calculated on a "dry matter" basis. In other words, the samples are dehydrated first and then the megacalories are determined. Why do you suppose it is done that way?

   Water is important for body functions but has no nutrient or energy value

8. Is there a direct correlation between the amount of NEm in a feed and the percentage of fat in the feed? Why or why not?

   No. Examples: early bloom alfalfa 59 X .029 = 1.711; early bloom Bermuda 49 X .019 = .931 early bloom fescue 55 X .035 = 1.925; milo, steam flaked 102 X .031 = 3.162

Activity 2: Human Feed Rations, (Science, Health, Family and Consumer Sciences)

1 50 minute class period

Students will use the guidelines in MyPlate to create a healthy snack mix that meets one-third of the dietary need for one day.

Oklahoma Academic Standards

Activity 2: Title (Science, Health, Family and Consumer Sciences)

6.LS1.3	Use an argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
7.LS1.7	Develop a model to describe how food molecules in plants and animals are broken down and rearranged through chemical reactions to form new molecules that support growth and/or release energy as matter moves through an organism.
7.LS2.1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
8.LS4.2	Apply scientific ideas to construct an explanation for the patterns of anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer ancestral relationships.
Health 5.8.2	Determine when health-related situations require the application of decision-making skills.
Health 5.8.4	Distinguish between healthy and unhealthy alternatives of health-related decisions.
Health 5.8.5	Predict the potential short-term impact of healthy and unhealthy alternatives to a health-related decision.
FACS 9.3.1	Analyze nutrient requirements across the life span addressing the diversity of people, culture, and religions.

Materials:

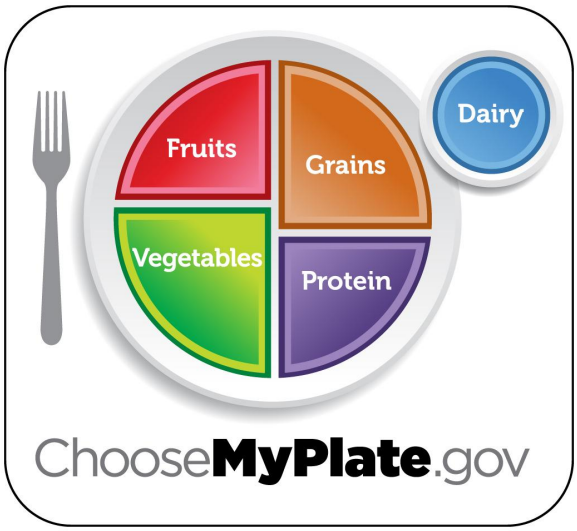
- Activity 2 Reading Page 1 **"Using MyPlate"**
- Activity 2 Worksheet 1 **"Human Feed Rations"**
- food scale or other weight measure
- measuring cups
- measuring spoons
- gallon-sized plastic bag or large clear bowl
- quart-sized plastic bags
- assorted dry cereals such as squares, "O"'s, clusters, etc. (grain group)
- assorted dried fruit such as cranberries, blueberries, raisins, apricots (fruit group)
- assorted nuts and seeds, such as sunflower seeds, pumpkin seeds, pecans, walnuts, almonds, etc. (meat and bean group)
- yogurt
- raw vegetables

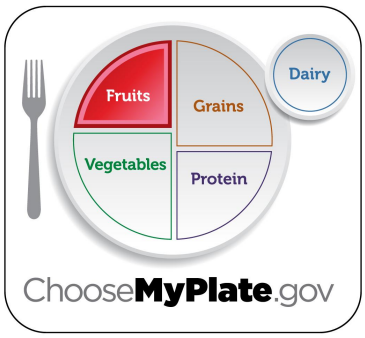
Procedures

1. Distribute Activity 2 Reading Page 1 **"Using MyPlate"**
2. Lead a class discussion about balanced nutrition for animals and humans.
   —Students will list components of a balanced diet for middle school students.
   —Students will brainstorm to develop a list of ingredients for a balanced feed mix for humans.
3. Explain to students that you will be mixing a human feed mix which includes USDA daily recommended portions of grain, fruit and nuts for middle school-aged students (9-13).
   —Provide students with copies of Activity 2 Worksheet 1 **"Human Feed Ration"**.
   —Students will read from the chart as the teacher or student volunteers mix the correct portions of dry cereal, dried fruit and nuts in a clear bowl or gallon sized plastic bag to create a daily ration.
   —Show students the completed ration, and lead a discussion about student diets compared with the USDA recommendations. What has been left out? (milk and vegetables)
   —Weigh the completed ration.
4. Students will follow the directions on the worksheet to create their own feed mix.
   —Students will calculate the amount needed of each ingredient for 1/3 of the daily recommendation.
   —Students will measure each ingredient to make their own ration.
   —Students will weigh their own rations. Are individual rations 1/3 the weight of the daily ration prepared in Activity 3? If not, why not?
   —Provide raw veggies and yogurt to complete USDA recommendations for a balanced ration.
5. Students will develop a recipe for granola that is nutritionally balanced, based on the USDA daily recommendations. Possible ingredients include oats, dried fruit, wheat germ, dry milk solids, nuts, seeds, etc.

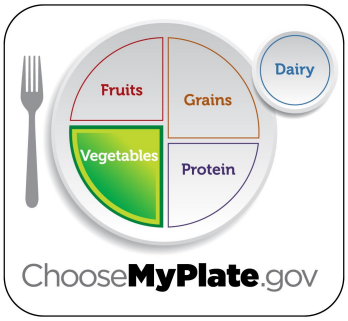
MyPlate is an eating plan that helps everyone get the nutrients they need without consuming too many calories. Think of MyPlate as the human equivalent of Net Energy for Maintenance (NEM) with tastier options.

In humans, like livestock, calorie and nutrient needs increase and decrease based on activity and growth. That is why the number of servings recommended from most food groups changes during the life cycle.

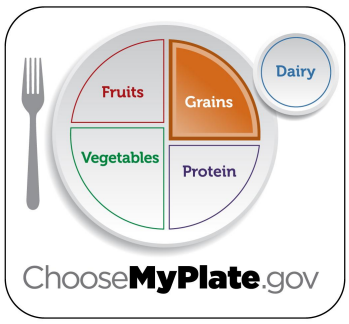




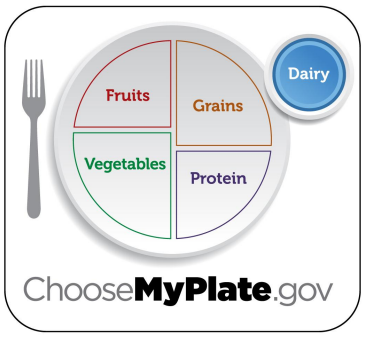
A serving of **fruit** is one cup of fruit or 100% fruit juice, ½ cup of dried fruit or a whole apple, banana, peach, pear, orange, etc.
Most girls and women need 1½ to 2 servings/day.
Most boys and men need 2-2 ½ servings/day

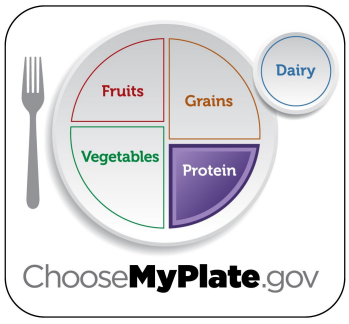


A serving of **vegetables** can be one cup of raw or cooked vegetables or vegetable juice or 2 cups of raw, leafy salad greens.
Most girls and women need 2-3 servings/day.
Most boys and men need 2-4 servings/day.



At least half of the grain you eat should be whole grain. A serving of **grain** includes:
1 slice of bread,
1 cup of ready to eat cereal,
½ cup of cooked rice, pasta or cereal.
Most girls and women need 5-7 servings/day
Most boys and men need 6-10 servings/day





A serving of **protein** can include:
1 ounce of meat, poultry or fish
¼ cup cooked beans
1 egg
1 tablespoon peanut butter
½ ounce nuts
Most girls and women need 4-6½ ounces per day
Most boys and men need 5-7 ounces per day

A serving of **dairy** includes:
1 cup of milk, yogurt or soy milk
1 ½ ounces natural cheese
USDA recommends that everyone age 9 and older get 3 servings of dairy per day.
About 90% of Americans do not get enough dairy.

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Activity 2 Worksheet 1: Human Feed Ration

Name: _____ Date: _____

Livestock producers watch the calorie intake of their animals to promote the correct amount of weight gain without producing meat that is too fat. Animals also need energy from calories to stay warm and healthy.

Humans also need calories for energy, but people usually don't have someone controlling their calorie intake as closely as farmers regulate the diets of their animals. People must make their own choices. Calories provide the fuel we need to keep going, but eating too many calories—and not burning enough of them off through activity—can lead to weight gain.

Young people, aged 9-13, need between 1600 and 2500 calories per day. If you eat more calories than your body needs, the leftover calories are stored as fat. By eating a diet that includes the right amount of fruits, vegetables, grains, protein and dairy along with avoiding empty calorie foods like soda, candy, chips and sweets, most people can achieve and maintain a healthy weight. Everyone should try to get 30 minutes of exercise at least 5 days a week (150 minutes a week) to tone muscles and maintain weight.

The US Department of Agriculture (USDA) recommends eating foods from all the food groups every day.

USDA Daily Recommendations

Source: USDA MyPlate https://www.myplate.gov/

	Fruit	Vegetable	Grain	Dairy	Protein
Girls 9-13	1 ½ - 2 cups	1 ½ - 3 cups	5-7 oz.	3 cups	4-6 oz.
Boys 9-13	1 ½ - 2 cups	2 - 3½ cups	5-9 oz.	3 cups	5-6 ½ oz.
One serving for snack mix	½ cup dried fruit (raisins, cranberries, blueberries, apricots, etc.)		1 cup flakes, puffs, squares or discs ¼ cup granola		½ oz seeds/nuts (about 10 almonds, walnut or pecan halves or cashews)

Use the ingredients provided to create a snack mix with ingredients from the Grain, Fruit and Protein Groups. (Nuts and seeds are included in the "Protein" group.) Use the chart above to calculate how much you need of each ingredient. Your snack mix should provide ⅓ of the daily recommendation from these three groups.

	Fruit	Grain	Protein
Food Used			
Amount of food needed (⅓ of daily recommendation)			