Lesson 1 - Upper Level
Animal Health - Part 1

DISCOVER DAIRY — Beyond the Refrigerator

Standards:

These lesson tools meet the following Common CORE and PA educational standards.

Science: (PA Standards) S8.B.2.1, S8.B.2.1.4, S8.B.2.2, S8.B.1.1; **(Common CORE):** MS-LS1-5, MS-LS4-4, MS-LS4-5, MS-LS1-5, MS-LS4-4, MS-LS4-5, MS-LS1-5, MS-LS4-4, MS-LA4-5,

Reading: (PA Standards) R8 1.1.8. A, R8 1.6.8. A, R8 1.8.8. A; **(Common CORE):** CCSS.ELA-LITERACY.RI.6.4, CCSS.ELA-LITERACY.RI.6.10, CCSS.ELA-LITERACY.W.6.1, CCSS.ELA-LITERACY.W.6.1, CCSS.ELA-LITERACY.L.6.4, CCSS.ELA-LITERACY.RI.7.10, CCSS.ELA-LITERACY.W.7.1, CCSS.ELA-LITERACY.W.7.2.D, CCSS.ELA-LITERACY.SL.7.1, CCSS.ELA-LITERACY.L.6.4, CCSS.ELA-LITERACY.RI.8.10, CCSS.ELA-LITERACY.W.8.1, CCSS.ELA-LITERACY.SL.8.1, CCSS.ELA-LITERACY.L.8.4, CCSS.ELA-LITERACY.8.6

Math: (Common CORE): CCSS.MATH.CONTENT.RP.6.1

Essential Question:

How has genetic selection played a role in the amount of milk today's dairy cows give?

Approximate Length:

This lesson has two parts. Teacher can choose to teach one or both parts of lesson. Lessons and parts can be taught during one block or divided into periods over 2 - 4 days. Each part should take about 60 - 70 minutes of class time, with these segments:

Segment	Responsible	Segment	Responsible
1) Lesson Overview — 5 min	Teacher	4) Lab Exercise — 20 min	Students
2) Reading Passage — 10 min	Students	5) Lesson Review — 10 min	Class
3) Classroom Discussion — 10 min	Teacher/Class	6) Lesson Evaluation — 10 min	Teacher

Material List:

To complete the lesson and lab activities, you will need the following items:

- Animal Health Reading Passage (Copy for Each Student)
- 1.1 & 1.2 Lab Handouts (Copy for Each Student)
- "Discover Dairy … And Animal Health" Video - available at www.discoverdairy.com
- Animal Health transparencies or graphics to project
- Projector or Smart Board to show video and graphics
- 1 cup of spinach, 2 carrots, 1 cheese stick and 1 12-oz. cup of orange juice, and weight scale and/or measuring cups for Part 2 Lab Exercise
- Pencil or pen for each student

Activating Strategy:

The activating strategy should take about 10 minutes of classroom, with four minute video included, to set the stage for the lesson. Teachers should remind students that milk is an essential part of a balanced diet. The "MyPlate Food Diagram" encourages teens and pre-teens to get at least three servings of dairy a day. Milk comes from the cows that live on dairy farms. As the world's population has grown, dairy farmers have needed to supply more milk for a growing population. This lesson demonstrates some of the ways dairy farmers have been able to increase the amount of milk their cows can produce to feed a growing population, without compromising the high quality of care their cows receive. ***Show video motivator.***

PART 1 — SELECTIVE BREEDING IN DAIRY CATTLE

Essential question:

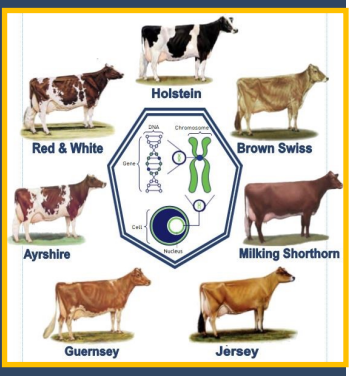
"How has genetic selection played a role in the amount of milk today's dairy cow produces?"

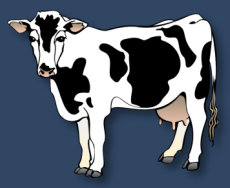
Key to answering essential question:

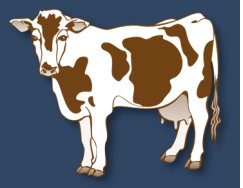
- Discuss genetic traits of dairy cow and how they play a role in milk production.
- Practice the process of trait mating
- Recognize the purpose of artificial insemination.
- Describe how farmers select bulls that improve upon cow's genetic traits.

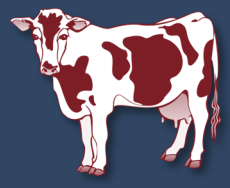
Reading Passage: Give students 10 minutes to read over Page 1 of the Reading Passage.

Lesson 1 - Upper Level
Animal Health - Part 1









Food for Thought:

Ask Students what other species, either on the farm or in the wild, may use selective breeding to improve the genetics of the breed or species.

Classroom Discussion:

Use these discussion points and questions to walk through the Reading Passage.

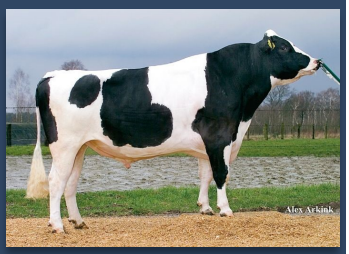
- 7 different breeds — each breed descends from a different region of the world, and each breed has its own unique characteristics and qualities.
  - *Ask students:* ***"What breed are you most familiar with?"***
- Dairy farmers have built on those unique characteristics to improve the cow's productivity and longevity through selective breeding.
  - *Ask students:* ***"Why do you think greater longevity and productivity would be important to the farmer?"***
- Selective breeding has played an important role in enabling cows to increase the amount of milk they can produce.
  - *Ask students:* ***"How much more milk do cows produce today compared to when they did in 1940?"***
- Most dairy farmers use artificial insemination to impregnate their cows. Farmers select the bulls to breed their cows based on how well their genetic traits compliment the cow.
  - *Ask students:* ***What has artificial insemination done to the genetic pool in dairy? (increased/decreased).***
- Using artificial insemination and selective breeding gives the farmer the ability to influence the genetic traits inherited by an offspring from a cow.
  - *Ask students:* ***What traits do dairy farmers want in a bull when choosing a mate for their cow?***
- Many of the genetic traits used to select mates relate to how the animal appears – such as size and scale. Animals are also bred for traits relating to the cow's milk production.
  - *Ask students:* ***Why do you think farmers breed their cows to increase milk production?***
- Some traits relate specifically to the longevity of the animal. For example, a cow that has difficultly walking could be mated to a bull that corrects her feet and leg problems.
  - *Ask students:* ***Other than production and longevity, what other traits can the farmer breed for?***

Part 1 Lab Exercise:

Teacher should prepare copies of the **"Lab 1.1: Selective Breeding in Dairy Cattle"** Worksheet to distribute to the class to prepare for this exercise. Students can complete the exercise in groups of two or as individuals. Teachers should explain lab after handing out materials.

Part 1 Lab Explanation:

Farmers work with artificial insemination companies that have semen collected from a vast selection of bulls. Dairy Farmers work with a professional who helps to find a perfect match for their cows. Through using this process of genetic selection, farmers have been able to dramatically improve both the productivity and longevity of cows in the past 50 years.



Part 1 Lab Explanation ~ Continued:

In this lab exercise, students should compare and contrast traits of three dairy cows and evaluate a list of dairy bulls to identify the right mate to balance each dairy cow's traits.

Students should explain their bull choice for each cow to demonstrate that they understand the principles of selective breeding and how it relates to dairy cows.

The ideal Holstein cow should be tall and strong, with a deep body, a level back (or rump), and legs that have the appropriate angle from both the side and back view. Her udder, which holds the milk, should have a strong fore udder attachment, a high and wide rear udder, a strong udder cleft, close rear and front teat placements and average sized teats. She should also be positive in milk, fat and protein.

Students should use this description of the ideal cow to identify which bull they could select to improve upon each cow's traits the most.

Give the students 10 - 15 minutes to evaluate the information and fill out Part I of the Lab Component. The teacher should facilitate classroom discussion around which bulls were selected and why.

Ask students: ***"How does selecting a bull with a negative milk production score affect the offspring? What about a bull with poor feet and legs?"***

Part 1 Lesson Review:

Teachers, ask the following questions to evaluate students' understanding of selective breeding and dominant/recessive genes applied to dairy cows.

1. What are the two advancements that have played a key role in enabling dairy cows to quadruple their milk production in the past 70 years?
   Artificial Insemination & Selective Breeding
2. How does selective breeding work?
   It allows the farmer to use the principles of genetics — dominant and recessive genes — to breed for offspring that can produce more milk and live longer.
3. What are some traits that dairy farmers can use selective breeding to influence
   The cow's feet and legs and her mobility, her size and scale, her appearance, the amount of milk she gives, component levels in the milk, the quality of her udder, and many more things can be influenced.
4. If having horns is a dominant trait in dairy cows, and the farmer breeds a cow with horns to a bull that was polled (doesn't have horns), will the offspring have horns or not?
   Yes, the offspring will have horns.
5. What if the farmer breeds the offspring to another polled bull (with no horns)?
   That offspring will not have horns.

Part 1 Lesson Evaluation:

Teachers can use the Lesson 1 Part 1 section to evaluate students' ability to grasp lesson concepts. *This test can also be used at unit end.*

Lesson 1 - Upper Level
Animal Health - Part 2

Essential Question:

How has nutrition and technology played a role in the amount of milk today's dairy cows can produce?

PART TWO — THE LIFE CYCLE OF THE DAIRY COW

Essential question:

"How have nutrition and technology played a role in the amount of milk today's dairy cow can give?"

Keys to answering essential question:

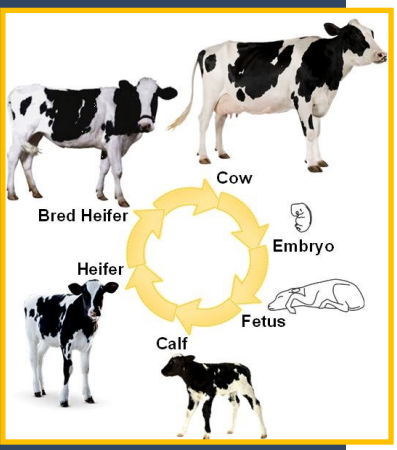
- Understand the life cycle of a dairy cow.
- Understand how a cow's nutrient needs and requirements change throughout her life.
- Understand how the farmer plays a role in providing the proper nutrition and care for the cow.

Reading Passage: Give students 10 minutes to read over Page 2 of the Reading Passage.

Classroom Discussion:

Use the "Life Cycle of A Dairy Cow" worksheet to review the reading passage

Teachers should review the different stages of a cow's life and how the farmer plays a role in each stage.



- **Embryo –** the first step in the life cycle of a cow is the embryo, which is the organism that results from a successful mating of a male sperm and a female ovary.
  - *Ask students:* ***"How does a cow's gestation period compare to the gestation period of a human?"***
- **Fetus –** A fetus is what the offspring is called in between the embryonic stage and when it is born.
  - *Ask students:* ***"Why is the fetal stage important to the cow's development?"***
- **Calf –** A baby cow is called a calf. A calf weighs about 100 pounds when it is born. Female calves will grow into cows someday. Male calves become bulls.
  - *Ask students:* ***"Why is it important to feed the calf colostrum right after it is born?"***
- **Heifer –** A heifer is a cow that hasn't given birth yet.
  - *Ask students:* ***"Why can a heifer eat more grass-based foods than a baby calf can?"***
- **Bred Heifer –** When the heifer is 14 months old, she is mated with a bull and becomes pregnant. Around 2 years old, she has her first calf and becomes a cow.
  - *Ask students:* ***"Why it is important that a heifer has a calf?"***
- **Mature Cow –** Cows typically give milk for 10 months out of the year, with a two month break before each time she has a baby. They typically produce offspring once every year.
  - *Ask students:* ***"Why do you think it's important for a cow to have a two-month break before she has her calf?***

Lesson 1 - Upper Level
Animal Health - Part 2

Follow-up Questions:

- *What role do you think the farmer plays in taking care of the calves, heifers and cows?*
- *What are some basic needs the cow has in each stage of her life?*
  - *How do those needs compare to the needs of a human?*

Part 2 Lab Exercise:

The following items are needed for this exercise (per student or group):

- 1 cup of spinach, 2 carrots, 1 cheese stick, 1 12-oz. cup of orange juice, and weight scale and/or measuring cups

Teacher should prepare copies of the **"Lab 1.2: Feeding a Dairy Cow's Lifestyle"** Worksheet to distribute to the class to prepare for this exercise. Students can complete the exercise in groups of two or as individuals. Teachers should explain lab after handing out materials.

Part 2 Lab Explanation:

Teachers should explain that a healthy, well-cared-for cow will give more milk. The way farmers care for their cows and how they feed them has helped to increase the amount of milk cows give over the past 50 years.

- Just like our diets, a cow's diet must be balanced based on her stage of life. For instance, a baby calf requires higher energy foods to fuel her rapid growth.
- A cow that has just given birth requires higher levels of certain nutrients to replenish her body. Farmers must adjust rations to accommodate those needs.
- Farmers work closely with an animal nutritionist and use a variety of feed products to balance cows' diets to meet their precise nutrient needs using a variety of feed products.
- Farmers use a large feeding scale to make sure each cow gets the right amount of each feed. Those feeds are blended together to provide a balanced diet called a Total Mixed Ration (TMR).

During the lab, students should use the carrots, celery, cheese and orange juice to balance a diet to meet the required nutrients listed on the lab worksheet. They should use a weight scale to measure the right amount of each feed. If they don't have a weight scale, they can use measuring cups to determine the amount. Complete the ratios in the worksheet.

Lesson Review:

Teachers can asked the following questions to evaluate the students' understanding of the cow's life cycle in comparison to ours and why a balanced diet is needed to support growth and development.

1a. Name three of the six stages a cow passes through during her life cycle:
Embryo, Fetus, Calf, Heifer, Bred Heifer, and Mature Cow

1b. How does that compare to the stages in our life cycle?
Humans also start out as embryos and become fetuses. Discuss the different stages in human life.

Food for Thought:

Dairy farmers feed their cows a balanced feed called a "***Total Mixed Ration***." A TMR is like a salad for a cow that has all of the feeds they need blended together to meet their exact nutrient needs. Farmers will work with nutritionists to create to perfectly balanced diet for their cows. Their diet will change seasonally due to the moisture levels found in the feed types that are used in the TMR.

90

The pounds of feed a dairy cow producing milk eats every day.

2. What role does colostrum play in a calf's development?
   It is the first milk produced by the mother after she has given birth and provides essential antibodies needed to aid the calf's immune system

3. How long does a cow carry her calf before giving birth?
   About 9 months, the same length of time that a human carries her baby

4. Why it is important that a calf or cow gets a balanced diet of food?
   To provide the right amount of nutrients to aid in her growth and development and to meet her nutrient needs for her current stage of life.

5a. How much feed does a mature cow eat every day?
   About 90 pounds of feed.

5b. How much water does she drink?
   About 40 gallons of water.

Summarizing Lesson:

Remind students that milk is an important part of good nutrition. As the global population continues to grow, dairy farmers will have to find ways to increase milk production to meet the growing demand. Two ways farmers have increased production is through genetic selection and proper nutrition.

Summarize concepts identified in labs:

- Farmers work with artificial insemination companies that have a vast array of bulls they can choose from, and they often work with someone who trait mates their cows to find the perfect match for their genetic make-up. ***Through using this process of genetic selection, farmers have been able to dramatically improve both the productivity and longevity of cows in the past 50 years.***
- A healthy, well-cared-for cow will give more milk. The way farmers care for their cows and how they feed them has helped to increase the amount of milk cows give over the past 50 years. Just like our diets, a cow's diet must be balanced based to meet her current stage in life. Farmers must adjust feed rations to accommodate those needs. ***To balance cows' diets to meet their precise nutrient needs, farmers work closely with a nutritionist and use a variety of feed products.***

Evaluation:

To test comprehension of lesson content, use the "***Discover Dairy Upper Level Post Assessment"*** available online at www.discoverdairy.com. For a writing assessment, have the students research an article on the Internet that identifies one way dairy farmers provide good care of their cows and have them summarize that article.

Food for Thought:

Ask Students what other species, either on the farm or in the wild, may use selective breeding to improve the genetics of the breed or species.

Evaluate Comprehension!

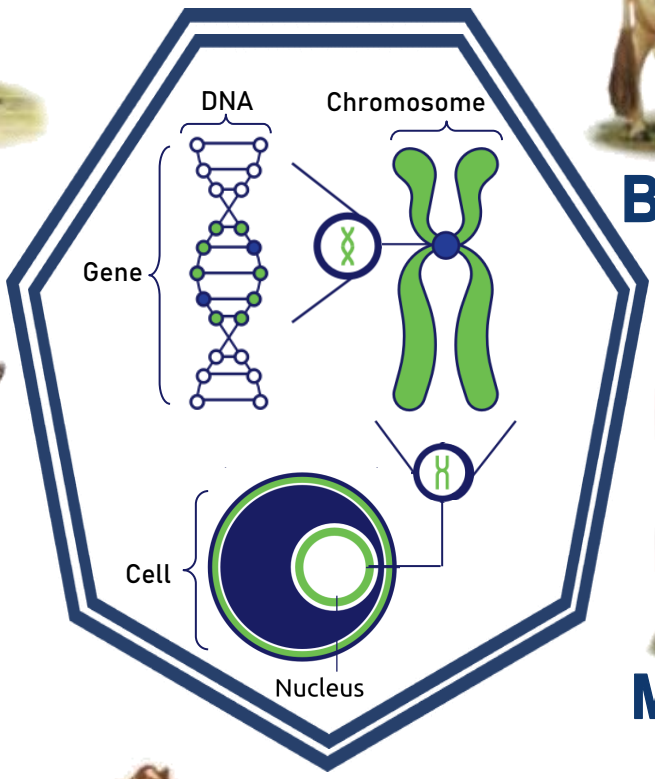
Lesson 1 - Upper Level

The 7 Breeds of Dairy Cattle

Holstein

Red & White

Brown Swiss



Ayrshire

Milking Shorthorn

Guernsey

Jersey

Lesson 1 - Upper Level

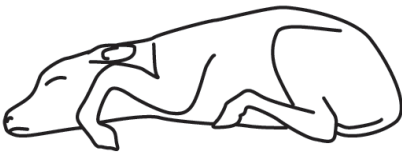
The Life Cycle of A Dairy Cow

Cow

Bred Heifer

Embryo

Heifer



Fetus

Calf

Part 1 — Selective Breeding

Farmers work with artificial insemination companies that have a vast array of bulls they can choose from, and they often work with someone who mates their cows by traits to find the perfect match for their genetic make-up. Through using this process of genetic selection, farmers have been able to dramatically improve both the productivity and longevity of cows in the past 50 years.

In this lab exercise, students should compare and contrast traits of three dairy cows and evaluate the list of six bulls on page 2 of this exercise. Identify the best dairy bull to balance each dairy cow's traits. Each cow and each bull has a "PTA Score" for milk, fat, protein, production life (a measurement of longevity), type (a measurement of their overall appearance), udder score, and feet and legs. The "PTA Score" compares the bull or cow's evaluation to the breed average for that trait.

Look for the traits that are negative in the cow and try to improve upon those with bulls that are positive in those traits. Make sure negative traits in the bull do not pull the cows' positive traits down. Try to choose the bull that balances all the cow's traits the best. The individual cows are listed below, and descriptions of the bulls are listed on Page 2. You may only use each bull once.

Cow No. 1 Gracistate Rubens Tessie

PTA Scores: **-320 Milk** **- 9 Fat** **+4 Protein** **+1.3 Production Life**
+1.93 Type **+2.22 Udder Composite** **+.95 Feet & Leg Composite**

First Bull Choice for Tessie: _____

Explain Bull Choice: _____

_____

Cow No. 2 R-S-F Prestar Revlon

PTA Scores: **-2351 Milk** **- 59 Fat** **- 52 Protein** **+.1 Production Life**
- .13 Type **+.03 Udder Composite** **-.30 Feet & Leg Composite**

First Bull Choice for Revlon: _____

Explain Bull Choice: _____

_____

Cow No. 3 Richdale Igniter Deanna

PTA Scores: **+148 Milk** **+10 Fat** **+2 Protein** **+0.0 Production Life**
+1.28 Type **+1.2 Udder Composite** **+.14 Feet & Leg Composite**

First Bull Choice for Deanna: _____

Explain Bull Choice: _____

_____

RE DESIGN

PGAC

7HO7514 REGANCREST DESIGN-ET EX (93)
USA60540176 100% RHA-NA TR TV TL TD
Eland x Encore x Mark

USDA PTA Score:

-26 Milk	-.04 Protein
+.07 Fat	+1.8 Productive Life
+2.23 Type	+1.61 Udder Composite
+1.63 Foot & Leg Composite	

RELIABLE

PGA

7HO7901 SILMARILLION DN RELIABLE-ET VG (88)
USA60641700 100% RHA-NA TR TV TL TD
Dane x Terry x Barlo

USDA PTA Score:

+1,166 Milk	-.03 Protein
-.01 Fat	+1.7 Productive Life
+0.68 Type	+0.72 Udder Composite
+0.86 Foot & Leg Composite	

BUTCH

PGA

7HO8625 MR SCHULTZ OMAN BUTCH-ET VG (88)
USA135872035 100% RHA-NA TV TL TD
O Man x BW Marshall x Addison

USDA PTA Score:

+746 Milk	-.09 Protein
-.05 Fat	+1.6 Productive Life
+0.08 Type	+0.94 Udder Composite
+1.21 Foot & Leg Composite	

SILVA

PGA

7HO8659 GLEN-D-HAVEN OMAN SILVA-ET EX (93)
USA52323649 100% RHA-NA TR TV TL TD
O Man x Aaron x Elton

USDA PTA Score:

+1,556 Milk	-.03 Protein
-.10 Fat	+0.7 Productive Life
+1.06 Type	+0.37 Udder Composite
+1.81 Foot & Leg Composite	

MR SAM

PGA

7HO6758 REGANCREST-MR DRHAM SAM-ET GM
USA207184639 100% RHA-NA TR TV TL
Durham x Emory x Prelude

USDA PTA Score:

+146 Milk	+.01 Protein
+.10 Fat	+1.2 Productive Life
+1.61 Type	+1.52 Udder Composite
+1.85 Foot & Leg Composite	

MUFFIN

PGA

7HO8398 FAR-O-LA FIN MUFFIN-ET
USA61196049 100% RHA-NA TV TL TD
Finley x Convincer x Bellwood

USDA PTA Score:

+442 Milk	+.04 Protein
+.00 Fat	+1.2 Productive Life
+1.89 Type	+2.22 Udder Composite
+0.61 Foot & Leg Composite	

Additional Lab Questions:

1. Which bulls did you not use? _____
   Why not? _____
2. Name one other species in which selective breeding may be used? _____
3. As selective breeding improves the genetics of dairy cows, do you think the scores of existing bulls get higher or lower? _____ Why? _____
   _____

Part 2 Lab Component:

Needed for exercise (per student or group)

- **1 cup spinach**
- **1 cheese stick**
- **Baby or whole carrots**
- **One 12 oz. cup of orange juice**

A healthy, well-cared-for cow will give more milk. The way farmers care for their cows and how they feed them has helped to increase the amount of milk cows give over the past 50 years.

- Just like our diets, a cow's diet must be balanced based on her stage of life. For instance, a baby calf requires higher energy foods to fuel her rapid growth.
- A cow that has just given birth requires higher levels of certain nutrients to replenish her body. Farmers must adjust feed rations to accommodate those needs.
- To balance cows' diets to meet their precise nutrient needs, farmers work closely with a nutritionist and use a variety of feed products.
- Farmers ensure cows have a fresh, clean supply of water throughout their life cycle. Cows have constant access to fresh, clean water.

Students should use **carrots, spinach, cheese and orange juice** to make a snack of a spinach salad and orange juice that meets the required nutrients listed on the page. They should use a weight scale to measure the right amount of each feed. Measuring cups can be used in place of the scale if necessary. This exercise is designed to simulate how farmers use a large feeding scale to balance and weigh each feed to meet the cow's precise nutrient needs.

Steps to Lab Exercise:

1. Weigh each of the foods and record. If you are using measuring cups, here are translations:
   - 1 cup of **spinach** weighs 30 grams.
   - 2 **baby carrots** weigh about 15 grams.
   - 1 stick of **string cheese** weighs about 24 grams.
2. Divide carrots, spinach and orange juice into serving sizes. A serving size for each is as follows:
   - **Carrots** — 15 grams
   - **Spinach** — 30 grams
   - **Orange Juice** — 8 ounces
3. Use the table on the back of this page to balance the four foods to make a snack of spinach salad and orange juice with the following total nutrient content:
   - 299 total calories
   - 13 grams of protein
   - 370 mg of Calcium
   - 2.65 mg of Iron
4. Use the table on page 2 of this exercise to determine what percentage of the total salad each food represents in weight.

Use a piece of scrap paper to balance the four foods to meet the nutrient requirements for the snack. Blend the ingredients together once you have determined the right amounts of each. Write the correct answers below and include the amount of each nutrient provided by the corresponding food. Calculate what percentage of the salad's total weight each food type is.

	Weight (in grams)	Calories	Protein (grams)	Calcium (mgs)	Iron (mgs)	Percent of Total Weight
Spinach						
String Cheese						
Carrots						
Orange Juice						

Total Amount Required for Snack: 299 calories, 13 g Protein, 370 mg Calcium & 2.65 mg Iron.
Nutrients found in one serving size of each food are listed below.

String Cheese	Spinach	Carrots	Orange Juice
1 stick (24 grams)	30 grams	15 grams	8 ounces (226 grams)
100 calories	7 calories	5 calories	112 calories
7.2 grams protein	1 grams protein	0 grams protein	2 grams protein
214 mg Calcium	39 mg calcium	0 mg calcium	26 mg calcium
0 mg Iron	½ mg iron	½ mg iron	0.1 mg iron

Review Lab Exercise

1. What nutrient was the hardest to balance? Why? _____
   _____
2. What happened if you tried to add more than one serving of string cheese? _____
   _____
   _____
3. What happened when you added too much orange juice? _____
   _____
4. Our bodies need 18 essential nutrients for good health. How do you think adding 10 more nutrients to the equation would change this exercise? _____
   _____
   _____

Lesson 1 - Upper Level

Animal Health Reading Passage

Dairy Overview

In the United States there are more than 40,000 dairy farms total, covering every single state in the nation. On these farms, there are a total of 9.3 million cows who produce 215 billion pounds of milk every year.

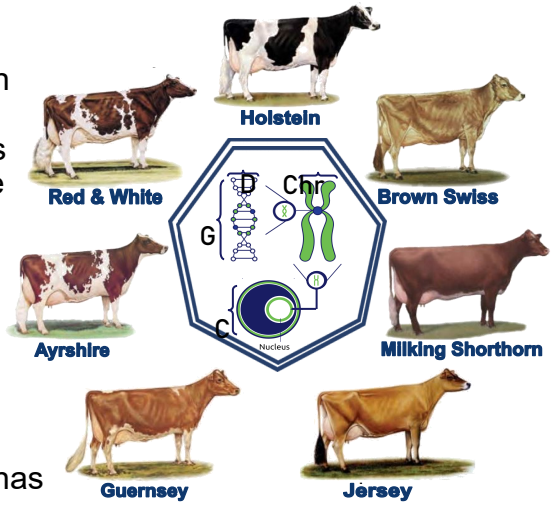
As the number of people in the U.S. and in the world continues to expand, dairy farmers who care for these cows have needed to supply more milk for a growing population.

These dairy farmers have used selective breeding, nutrition, technology and constant care to increase the amount of milk a cow can produce. This has resulted in the U.S. dairy industry producing 50 percent more milk than in the 1940s, with *62 percent fewer cows.*

Selective Breeding in Dairy Cows

How do you think genetic selection played a role in the amount of milk today's dairy cow produces?

Just like in dogs and cats, there are different breeds of dairy cows. The seven different breeds are the Holstein, Brown Swiss, Jersey, Guernsey, Ayrshire, Milking Shorthorn and Red and White Holstein. Each breed descends from a different region of the world, and each breed has its own unique characteristics and qualities.



Dairy farmers have built on those unique characteristics to improve the cow's productivity and longevity (or length of life) through selective breeding.

This process has played an important role in enabling cows to increase the amount of milk they can give. In 1940, the average cow gave about 4,600 pounds (or about 537 gallons) of milk.

Today, the average cow gives about 21,800 pounds (or about 2,534 gallons) of milk. Much of that advancement has occurred through the process of genetic selection.

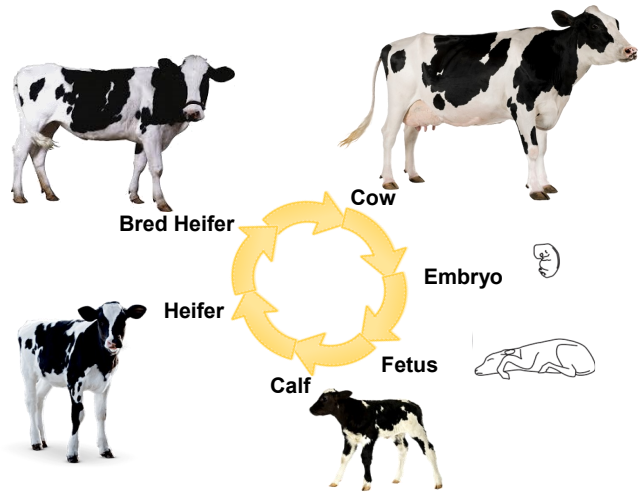
Average Cow's Annual Production	1940	2017
In Pounds	4,600 lbs.	22,941 lbs.
In Gallons	537 gal.	2,668 gal.

Most dairy farmers use artificial insemination to impregnate their cows. Artificial insemination is the process by which sperm is placed into the reproductive tract of a female for the purpose of impregnating the female by artificial means. Sperm from genetically superior bulls in each breed is collected. The semen is evaluated for specific genetic traits, and farmers select the bulls to breed their cows based on how well their genetic traits compliment the cow.

Using artificial insemination and selective breeding gives the farmer the ability to influence the genetic traits inherited by an offspring from a cow. Farmers look at a variety of genetic traits to make their breeding selections. They apply the basic principles of genetics, with dominant and recessive genes, to breed for offspring that can produce more milk and live longer than their ancestors could.

Many of the genetic traits used to select mates relate to how the animal appears – such as size and scale, strength, and cleanness of bone (which is an indicator of how fat the cow is). They can also breed for traits relating to the cow's milk production – how much milk she gives, how high the fat and protein of the milk is, and high of quality the milk is.

Some of the traits relate specifically to the longevity of the animal. For example, a cow that has difficultly walking could be mated to a bull that corrects her feet and leg problems. Other traits relate to physical characteristics, such as whether the cow has horns or not or whether a Holstein will be black and white or red and white.



The Lifecycle of a Dairy Cow

How do you think nutrition and technology have played a role in the amount of milk cow's can give today?

Just like humans, dairy cows pass through different stages in life as they grow. Dairy farmers play an important role in each stage of the dairy cow's life, ensuring that she grows into a healthy and productive mature cow.

- **Embryo:** Like humans, the first step in the life cycle of a cow is the embryo, which is the organism that results from a successful mating of a male sperm and a female ovary. A cow's gestation cycle, the length of time a cow carries her offspring in her reproductive system, is about 9 months, the same length as a human's. After about eight weeks of development, the embryo becomes a fetus.
- **Fetus:** A fetus is what the offspring is called in between the embryonic stage and when it is born. Much of the development and growth of an unborn calf occurs in the fetus stage.
- **Calf:** A baby cow is called a calf. When a calf is first born, it is fed colostrum, the first milk the mother produces after the calf is born, that is filled with important antibodies for the calf. This colostrum plays an important role in strengthening the calf's immune system. A calf weighs about 80-100 pounds when it is born. Female calves will grow into cows someday. Male calves become bulls.
  - They typically produce offspring once every year.
- **Heifer:** Dairy cows are part of the bovine family and are considered ruminant animals. Ruminant animals have four stomach compartments that allow them to more readily digest plant-based foods than monogastric (simple stomached) animals like humans can. A calf is fed milk for the first two months of her life until her stomach fully develops. As she grows into a heifer, which is a cow that hasn't given birth yet, she is fed more plant-based foods, like hay and grass, to supply her nutrient needs.
- **Bred Heifer:** When the heifer is 14 months old, she is mated with a bull and becomes pregnant. At about two years of age, she has her first calf and becomes a cow.
- **Mature Cow:** Cows typically give milk for 10 months out of the year, with a two month break before each time she has a baby. Cows eat about 90 pounds of feed a day and drink about 40 gallons of water. An average cow weighs about 1,500 pounds and gives about 60 pounds of milk a day.

Lesson Vocabulary Definitions:

- **Selective breeding:** the process of breeding plants and animals for particular genetic traits.
- **Artificial insemination:** the process by which sperm is placed into the reproductive tract of a female for the purpose of impregnating the female by artificial means.
- **Semen:** an organic fluid secreted by the male containing sperm.
- **Genetic Trait**: a specific trait or physical characteristic that is inherited by the offspring from the parents.
- **Embryo:** the organism that results from a successful mating of a male sperm and a female ovary.
- **Fetus:** the stage between an embryo and birth when much of the development and growth occurs.
- **Calf:** a baby cow.
- **Colostrum**: the first milk a mother produces after giving birth that is filled with important antibodies.
- **Heifer:** a young cow before she gives birth.
- **Ruminant:** a hoof-footed mammal with multiple stomachs or stomach compartments.