AGsploration
The Science of Maryland Agriculture

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

Milk in Motion
A Dynamic Dairy Experiment

STATE SCIENCE STANDARDS:

6th, 7th, and 8th Grade Skills and Processes:

1.0 A.1	Design, analyze, or carry out simple investigations and formulate appropriate conclusions based on data obtained or provided.
1.0 A.1.b	Develop the ability to clarify questions and direct them toward objects and phenomena that can be described, explained, or predicted by scientific investigations.
1.0 A.1.c	Explain and provide examples that all hypotheses are valuable, even if they turn out not to be true, if they lead to fruitful investigations.
1.0.A.1.e	Explain that if more than one variable changes at the same time in an investigation, the outcome of the investigation may not be clearly attributable to any one of the variables.
1.0 B.1	Review data from a simple experiment, summarize the data, and construct a logical argument about the cause-and-effect relationships in the experiment.
1.0 B.1	Verify the idea that there is no fixed set of steps all scientists follow, scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence.
1.0 B.1.d	Describe the reasoning that leads to the interpretation of data and conclusions drawn.

8th Grade Science:

4.0 D.1	Compare compounds and mixtures based on data from investigations and research.
4.0D.2	Cite evidence and give examples of chemical properties of substances.
4.0 D 3	Provide evidence to support the fact that common substances have the ability to change into new substances.

GOAL STATEMENT:

Youth will learn about the dairy industry and products as well as learn about dynamic properties of milk by conducting several simple experiments.

OBJECTIVES:

- Students will learn about the dairy industry and dairy products.
- Students will conduct an experiment and explore what occurs when milk, food coloring, and a drop of soap are mixed.
- Students will increase their knowledge about chemical bonds.
- Students will compare different milk fat percentages to learn about chemical bonds and observe reactions.

Milk in Motion
A Dynamic Dairy Experiment

REQUIRED MATERIALS:

- 1/2 gallon fat-free milk
- 1/2 gallon 2% milk
- 1/2 gallon whole milk
- Water-based food coloring (4 different colors such as: red, yellow, blue and green)
- Dawn® dishwashing liquid soap (classic, non-concentrated, original scent)
- Cotton swabs
- Heavy duty coated soak proof paper plates—dessert size
- "Milk in Motion Nutrition Facts Comparison Chart" worksheet (1 per student)
- "Milk in Motion Milk Fat Experiment" worksheet (1 per student)
- "Milk in Motion Data Sheet" worksheet (1 per student)

AMOUNT OF TIME TO ALLOW:

45 minutes. Extension activities will take additional time.

Background Information

Today's dairy cow is one of the most efficient animals when it comes to converting feed energy into milk. Through selective breeding and improved management on the farm, the dairy cow has drastically increased milk production. In the early years of the United States, many families owned a cow to supply dairy products to the family. Today, dairy cattle are typically milked two to three times daily and produce on average 22,000 pounds of milk annually (the world record holder produced over 70,000 pounds of milk in one year). Milk is typically sold in the grocery store in half gallon and gallon containers. One gallon of milk equals 8.6 pounds so the average cow produces around 2,560 gallon containers of milk annually. The record holder produced 8,140 gallon containers of milk in one year.

According to the most recent agriculture statistics from 2007, Maryland has 57,172 dairy cows that produce over 1 billion pounds of milk annually. Maryland ranks 27th overall for milk and milk product production in the United States. While this is the "middle of the pack" for the country, dairy is the third leading agricultural commodity in Maryland. Dairy farms are most heavily located in Washington, Frederick and Carroll counties. There are seven recognized breeds of dairy cows, and Maryland is home to world class examples of all seven breeds, a unique situation of which our farmers are very proud. (The average dairy farm in Maryland has 160 acres, which is equivalent to 176 football fields.) Current Maryland Agriculture Statistics can be found at <www.nass.usda.gov/Statistics_by_State/Maryland/index.asp>

Milk is produced under sanitary conditions as dairy farmers take pride in producing wholesome, quality milk. Prior to processing milk, a variety of tests are performed on the raw milk to make sure it is of the highest quality. On average, a dairy cow's milk is composed of 87.4 % water, 3.7% fat, 4.8% lactose (milk sugar), 3.4% protein, and 0.7% minerals. Calcium and phosphorus are two important minerals that are needed in our diets that are important for bone growth. Today's consumers prefer dairy products that are low in fat and provide both nutritional and health benefits.

There are a variety of processes that occur at the milk plant before the milk or other dairy products end up on the grocery store shelves in one of its many forms, including fluid milk, yogurt, cheese, or ice cream. Clarification removes impurities from milk, pasteurization destroys disease-producing bacteria that might be present in raw milk, standardization assures that milk and dairy products are uniform in nutrient content, homogenization breaks up the fat particles in milk, and fortification adds vitamin D and Vitamin A to milk. Fluid milk is processed into different fat percentages: whole or 3.5%, 2%, 1%, and skim or 0%. The fat percentage accounts for an increase in calories. Fat-free milk has 0 grams of fat per cup and contains 80 calories while whole milk contains for 8 grams of fat and 150 calories per cup.

There are a variety of products that can be made from milk including butter, cheese, half and half, sour cream, whipping cream, ice cream, and yogurt. It takes 21.2 pounds of whole milk to make one pound of butter. Butter must contain a minimum of 80% fat. There are a variety of frozen dairy products including ice cream, frozen yogurt, frozen custard, and sherbet. It takes 12 pounds of whole milk to make one gallon of regular ice cream. Cultured dairy products are produced when a good-bacteria is added to milk. Examples include buttermilk, cheese, and yogurt. It takes 10 pounds of whole milk to make one pound of cheese. The main component in cheese is protein. Rennet is an enzyme use to coagulate milk when making cheese.

Most people have heard the nursery rhyme about Little Miss Muffett who was eating her curds and whey. Curds are cheese, and whey is the fluid by-product of cheese making. Cheese is

classified according to its consistency. Some cheeses are soft like cream cheese where others are very hard like parmesan. Due to the popularity of pizza, mozzarella is the most popular variety of cheese in the United States. Cheese can be made from milk other than cow's milk; for instance, Feta cheese is traditionally made from goat's milk. So, how does the fat in milk impact the product, other than just changing the calorie content? Let's find out! Start by having students look at the nutrition labels of various dairy products (attached) and fill out the Nutrition Facts Comparison Data Sheet to get a better understanding of nutritional values of dairy products.

Additional dairy product information can be found in the Extension activities.

Engagement

15 - 20 minutes

Ask the class where milk comes from and why it is important to humans. Allow students to discuss their ideas about the source of milk and its nutritional content. Next, share a video clip which answers these questions (video clips are available online at <www.realcaliforniamilk.com/kid-documentaries> Then share the following information below.

Milk is considered "nature's most nearly perfect food" as it is 96-98% digestible. All female mammals have the ability to produce milk from their mammary glands or udder. In order to produce milk, female mammals must give birth to an offspring. Typically, most mammals produce only enough milk to feed their young; however, some mammals, through selection and improved genetics, are able to produce larger quantities of milk for an extended period of time. One such animal is the dairy cow, who is considered the foster mother of the human race. Other mammals that produce milk for human consumption are goats, sheep, camels, water buffalo, reindeer, horses, and yaks.

You may also want to share additional information found in the Background Information section.

Exploration

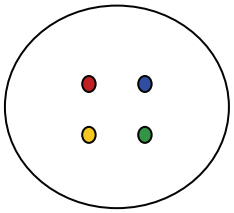
15 - 20 minutes

Directions:

During this experiment, students will explore what occurs when milk, food coloring and a drop of soap are mixed. Students will conduct this experiment in groups using fat-free, 2%, and whole milk and observe the reactions. They will compare and contrast their observations of each kind of milk. Have the class divide in groups of three and use the worksheet attached to complete the experiment (also listed here).

Steps to follow:

1. Ask students to make a prediction of what will happen when a clean plain cotton swab and a clean cotton swab covered in dish soap are dipped in milk of each type.
2. Hand out three plates and 10 cotton swabs to each trio.
3. Onto one plate have students pour fat-free milk, on another plate pour the 2% milk, and on the third plate pour the whole milk. Milk should completely cover the bottom of each plate. Allow two minutes for the milk to settle.
4. Have students add one drop of each of the four different food colors to each plate. The drops should be close together, but not touching in the center of each plate. See diagram on page 5.



5. Have one student in each group take a clean cotton swab and touch the tip to the center of the liquid between the colored dots. Students can take turns with the cotton swabs. First do the fat-free milk, then the 2% milk, and then the whole milk. Don't stir: just touch with the cotton swab, observe each reaction, and record your observations.
6. Squirt a small amount of dish soap onto another paper plate and dip the dry side of the cotton swab into the dish soap. One at a time, have students place the soapy end of the cotton swab in the middle of each plate and hold it there for 10 to 15 seconds. Have students observe each reaction and record their observations.
7. Have students add a second drop of soap to the tip of the cotton swab that had the soap on it before and try it again with each substance. Observe the reaction and record observations as before.
8. Have students experiment with placing the cotton swab at different places in each substance, observing the reaction, and recording observations. They may also try adding another drop of soap to see if there is any more movement.

Have students discuss what kind of milk produces the best swirling of colors. fat free, 2%, or whole milk, and why? Take the discussion further and have students think about and discuss how the reactions would occur in water, half and half (approximately 12.5% fat), or heavy whipping cream (minimum of 36% fat) and why?

Explanation

10 minutes

Milk is mostly water, but it also contains vitamins, minerals, proteins, and tiny droplets of fat suspended in solution. Fats and proteins are sensitive to changes in the surrounding solution (the milk).

The secret of the bursting colors is the chemistry of that tiny drop of soap. The same reaction is seen when washing dishes. Dish soap is typically used to wash grease off of pots and pans because it breaks the grease down. Dish soap, because of its bipolar characteristics (non-polar on one end and polar on the other), weakens the chemical bonds that hold the proteins and fats in the solution. The polar or hydrophilic (water-loving) end dissolves in water, and the non-polar or hydrophobic (water-fearing) end attaches to a fat globule in the milk.

The molecules of fat bend, roll, twist, and contort in all directions as the soap molecules race around to join up with the fat molecules. During all of this fat molecule movement, the food coloring molecules are bumped and shoved everywhere, providing an easy way to observe the otherwise invisible activity. As the soap becomes evenly mixed with the milk, the action slows down and eventually stops. Milk with a higher fat content produces a better explosion of color because there is more fat to combine with all of those soap molecules.

Try adding another drop of soap to see if there is any more movement. If you add another drop of soap and you see movement, you discover there are still more fat molecules that haven't found a partner to bond with.

The Science of Making Dairy Products:

Cheese (over 2 days—15 minutes each day)

Making cheese is an art and science. The earliest records of cheese date to 4,000 BC on stone tablets. Stories say that the first cheese was accidently made when milk was carried in pouches made from the lining of a cow's stomach which contained rennet, thus forming cheese. Today, cheese is made by removing most of the fat from milk, then coagulating (clotting or joining) the protein in milk with rennet, a bacterial culture or both. The curd is then separated from the whey by heating, draining, and pressing.

The distinctive flavor, body and texture of different cheeses are determined by the kind of milk used; the methods used for coagulating the milk and cutting, cooking, and forming the curd; the type of culture used; the salting method; flavorings added; and ripening conditions.

Cheese is then formed into a shape and coated with wax or wrapped before it is aged. Some cheese can be eaten right away and typically have a milk flavor while other cheese is aged for several months or even years, giving it a sharp flavor.

Cheese contains many nutrients, especially protein (casein), calcium, and vitamin A. One and one-half ounces of cheddar cheese contains nearly the same calcium as one cup of milk or 1 ½ cups of ice cream and the same protein as 1 ½ large eggs or 1 ½ ounces of cooked chicken or beef.

Cottage Cheese Making (From MAEF Take Me Out to the Corn Field Teacher's Guide)

Crush ¼ rennet tablet and add 1 tablespoon of water. Stir to dissolve. Pour 1 cup of warmed milk into a bowl. Stir in the rennet mixture. Add 1 tablespoon of lemon juice to the mixture. Stir as it curdles. Add an additional tablespoon of lemon juice, if necessary. Pour off the liquid whey. Rinse the curds and press out excess moisture. Serve with a salted cracker.

Mozzarella Cheese Making (From Acres of Adventures)

Day 1: Crush ¼ rennet tablet and put into a 16-ounce microwavable cup. Add ¼ teaspoon of salt. Add 6 ounces of skim milk heated to 100 degrees F and stir well. Refrigerate and the milk will coagulate in the cup overnight.

Day 2: Microwave for 1 minute. Pour the microwaved, coagulated mixture through a strainer held over a pan. Put the coagulated milk back into a cup and microwave for 10 more second, shrinking the cheese tighter and tighter. Repeat 2 more times, microwaving and straining until the cheese becomes soft mozzarella. Dry the cheese using a paper towel.

Ice Cream (15 minutes)

Ice cream is made from cream, milk, sugar or sweeteners, and flavoring. Ice cream contains at least 10 percent milk fat.

Ice Cream in a Bag Making (From MAEF Take Me Out to the Corn Field Teacher's Guide)

Place ½ cup of whole milk into a pint size zipper seal plastic bag along with 3 teaspoons of sugar and ¼ teaspoon of vanilla. Seal the bag tightly. In a one-gallon zipper seal bag, place 1-2 cups of ice and 2 tablespoons of rock salt. Add the pint bag with the milk ingredients and seal the gallon bag.

Shake well for about 10 minutes. Remove the small bag carefully, wipe off the salt on the outside of the bags, and enjoy your treat.

Butter (10 minutes)

Butter is made by churning pasteurized cream. Butter contains at least 80% milk fat. One tablespoon of butter contains 12 grams of fat and 100 calories. Salt is added to butter to give it flavor. Some butter is whipped, which means that it has had air mixed into it for easier spreading.

Butter Making in a Jar (From MAEF Take Me Out to the Corn Field Teacher's Guide)

Measure 2 tablespoons of heavy cream into a small baby food jar or 3 ounce plastic portion cup with a lid. Screw on the lid on tightly. Shake the container until butter forms (5-10 minutes). Serve with a cracker or pretzel stick.

Yogurt (20 minutes, then 4 hours to incubate)

Milk is cultured with special bacteria, normally *Lactobacillus bulgarius* and *Streptococcus thermophilus,* to make yogurt. It is normally made with low-fat milk and may be enriched with nonfat dry milk to increase nutrient content. Many times sugar/sweetener and fruit or flavorings are added to give it a better taste.

Yogurt Making (From University of Missouri Extension: Making Yogurt at Home: Country Living Series)

Measure 8 cups of whole or 2 % milk in top of a double boiler saucepan. Add 1/3 cup of nonfat dry milk powder. Add 2 to 4 tablespoons of sugar or honey. Heat milk to 200 degrees F, stirring gently for 10 minutes. Do not boil. Place pan in cold water to cool rapidly to 112-115 degrees F. Remove 1 cup of warm milk and blend with 1/4 cup of plain yogurt with active bacteria culture, then add to the rest of the warm milk. Incubate in a warm place for about 4 hours. Milk will start to thicken. The longer it sits, the more tart it becomes. Refrigerate immediately after 4 hours to stop the bacteria from continuing to ferment.

Career Connections

- **Dairy Farmer** — This person manages the health, husbandry, feeding, and milking of cows as well as crops, labor and finances associated with a dairy operation.
- **Milk Inspector** — This person is an employee of the USDA or milk company who inspects the dairy farm or milk plant to make sure that the milk is produced and handled in a clean and healthy environment.
- **Microbiologist** — This scientist who studies microbes including bacteria, viruses, fungi, and protozoa.
- **Lab Technician** — This is a skilled person who is trained to perform tests in a specific area in a laboratory. An example would be testing for the amount of bacteria found in raw milk.
- **Dairy Scientist** — This is a food scientist who studies, experiments with, and develops new dairy products.
- **Dietician** — This person understands and educates consumers about the proper diet that people need to eat in order to promote good health.
- **Food Scientist/Product Developer** — This scientist might study food with the harvesting of milk to the end products of preparing and consuming food products. They might experiment with dairy products and come up with new products and by-products of milk to market to consumers.

- **Dairy Plant Worker** — This is a person who works at the dairy plant helping to process raw milk and produce, package, and distribute dairy products.
- **Dairy Product Marketer** — This person writes articles and ads that advertise current and new dairy products. They also market the nutritional value of dairy products.
- **Dairy Nutritionist** — This person understands a cow's digestive systems and helps to develop the proper diets that cows should be consuming to be both healthy and productive.

Evaluation

A pre/post test should be completed with the 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.

References

"Virginia 4-H Dairy Bowl Study Manual." Virginia 4-H Dairy Youth Program. <www2.dasc.vt.edu/youth/bowlmat.pdf>

"Dairy Resource Handbook." The Ohio State University Extension.

NASS Maryland Dairy Statistics. <www.nass.usda.gov/Statistics_by_State/Maryland/index.asp>

"Color Changing Milk." Steve Spangler Science. <www.Steve Spangler.com>

"Acres of Adventures." National 4-H Program.

"Take Me Out to the Corn Field." Maryland Agricultural Education Foundation.

"Making Yogurt at Home: Country Living Series." University of Missouri Extension. <www.extension.missouri.edu/p/GH1183>

Milk in Motion

Nutrition Facts Comparison Chart

Name: _____

Date:_____ Period: _____

Use the pictures of nutrition labels from various items to complete the chart of their nutritional value.

	Serving Size	Calories	Total Fat	Sodium	Carbo-hydrates	Protein
Skim Milk						
2% Milk						
Whole Milk						
Half and Half						
Sour Cream						
Yogurt						
Stick Butter						
American Cheese						

Milk in Motion

Milk Fat Experiment

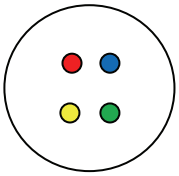
Name: _____

Date:_____ Period: _____

1. Make a prediction of what will happen when a clean plain cotton swab and a clean cotton swab covered in dish soap are dipped in fat free milk, 2% milk, and whole milk. Record it in the data chart.

2. Pour fat free milk on one plate, 2% milk on another plate, and whole milk on the last plate. Make sure to completely cover the bottom of each plate! Wait two minutes for the milk to settle.

3. Add one drop of each of the four different food colors to each plate. The drops should be close together but not touching in the middle of the plate. You should have three plates that look like this:



4. Have ONE group member take a clean cotton swab and touch the tip to the middle of the liquid between the dots on the fat-free milk plate. Have another group member do the same to the 2% plate, and have a third group member do the same to the whole milk plate. Record what happens in the data chart.

5. Place one drop of dish soap on the dry end of each cotton swab. One at a time, hold a soapy cotton swab in each plate for 10-15 seconds and observe what happens. Record what happens.

6. Add a second drop of soap to the soapy ends of the cotton swabs and repeat step 5. Record your observations in the data chart.

7. Place the cotton swabs in various places on each plate and record what happens.

8. Add another drop of soap to the end of each cotton swab and touch it to the milk on each plate. Observe to see if there is any more movement. Record what happens.

Milk in Motion
Data Sheet

Name: _____

Date:_____ Period: _____

	Fat-Free Milk	2% Milk	Whole Milk
Hypothesis			
Clean cotton swab			
1 drop of dish soap on cotton swab			
2 drops of dish soap on cotton swab			
Soapy cotton swab in various places of plate			
Additional drop of dish soap on cotton swab			

Analysis:

What kind of milk produced the best swirling of colors? Why?

_____

_____

What kind of things do you think would happen if we did this with water? Half and half? (Use the fact that it has 12.5% fat to help you). Heavy whipping cream? (Whipping cream is at least 36% fat). Why?

_____

_____

_____

2% Reduced-Fat Milk

2% REDUCED-FAT MILK Nutrition Facts	
Serving Size 1 cup (240 ml) Servings Per Container 8	
Amount Per Serving	
Calories 120	Calories from Fat 45
	% Daily Value
Total Fat 5g	8%
Saturated Fat 3 g	15%
Cholesterol 50 mg	17%
Sodium 125mg	5%
Total Carbohydrate 12 g	4%
Dietary Fiber0g	0%
Sugars 11g	
Protein 8g	

http://health.mo.gov/living/families/wic/wicfamilies/education/foodlabels.php

Whole Milk

Whole Milk
Serving Size 8 fl oz (240mL)
Servings Per Container 2

Amount Per Serving	
Calories 150	Calories from Fat 70
	% Daily Value*
Total Fat 8g	12%
Saturated Fat 5g	25%
Cholesterol 35mg	12%
Sodium 125mg	5%
Total Carbohydrate 12g	4%
Dietary Fiber 0g	0%
Sugars 11g	
Protein 8g	

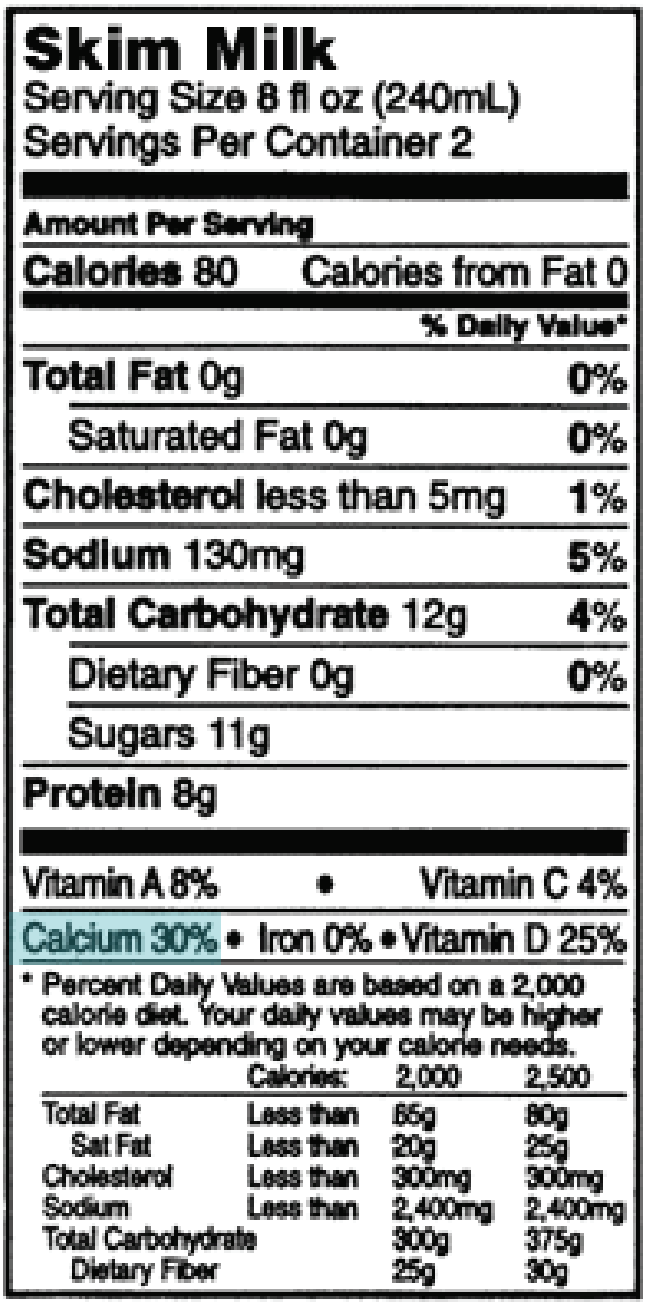
Vitamin A 6% • Vitamin C 4%
Calcium 30% • Iron 0% • Vitamin D 25%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

<www.vaughns-1-pagers.com/food/label-milk.gif

Skim Milk



Skim Milk
Serving Size 8 fl oz (240mL)
Servings Per Container 2

Amount Per Serving	
Calories 80	Calories from Fat 0
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol less than 5mg	1%
Sodium 130mg	5%
Total Carbohydrate 12g	4%
Dietary Fiber 0g	0%
Sugars 11g	
Protein 8g	

Vitamin A 8% • Vitamin C 4%
Calcium 30% • Iron 0% • Vitamin D 25%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

<ag.arizona.edu/maricopa/fcs/bb/Images/label-skimmilk.gif>

Fat Free Half and Half

Nutrition Facts

Serving Size 2 Tbsp (30 mL)
Servings Per Container 32

Amount Per Serving	
Calories 20	Calories from Fat 0
	% Daily Value*
Total Fat 0 g	0%
Saturated Fat 0 g	0%
Trans Fat 0 g	
Cholesterol 0 mg	0%
Sodium 30 mg	1%
Total Carbohydrate 3 g	1%
Dietary Fiber 0 g	0%
Sugars 2 g	
Protein 1 g	

Vitamin A 2% • Vitamin C 0%
Calcium 4% • Iron 0%

<ask-dj-lyons.hubpages.com/hub/Ask-DJ-Lyons-How-to-make-Vegetable-Quiche>

Sour Cream

Nutrition Facts

Serv. Size 2 Tbsp. (30g)
Servings about 8
Calories 60
Fat Cal. 45
* Percent Daily Values (DV) are based on a 2,000 calorie diet.

Amount/serving	%DV*	Amount/serving	%DV*
Total Fat 5g	8%	**Total Carb** 1g	1%
Sat Fat 3.5g	18%	Fiber 0g	0%
Trans Fat 0g		Sugars 1g	
Cholest 20mg	7%	**Protein** 1g	
Sodium 15mg	1%		

Vitamin A 4% • Vitamin C 0% • Calcium 2% • Iron 0%

Ingredients: Grade A cultured cream

<www.drgourmet.com/askdrgourmet/foods/smartbalance.shtml>

Plain Yogurt

Plain Yogurt Nonfat Serving Size 1 cup (227g)	
Amount Per Serving	**5**
Calories 127	
	% Daily Value
Total Fat 0 g	0%
Cholesterol 4mg	1%
Sodium 174 mg	7%
Total Carbohydrate 17 g	6%
Protein 13 g	26%
Vitamin C	3%
Calcium	45%
Thiamin	7%
Riboflavin	31%
Not a significant source of calories from fat, saturated fat, vitamin A, iron and niacin. Values are not available for fiber and sugars.	
*Percent Daily Values are based on a 2,000 calorie diet.	

<health.mo.gov/living/families/wic/wicfamilies/education/img/YogurtNutritionFacts.gif>

American Cheese

<hes.ucfsd.org/gclaypo/nutri/foodlabels/americancheese.jpg>

Stick Butter

Serving Size: 1 tbsp (14g)
Servings Per Container: Will depend on package size

Amount Per Serving

Calories 100
Calories from Fat 100

Saturated Fat 7 g	**37%**
Trans Fat 0 g	
Cholesterol 30 mg	**10%**
Sodium 95 mg	**4%**
Total Carbohydrate 0 g	**0%**
Dietary Fiber 0 g	**0%**
Sugars 0 g	
Protein 0 g	

Vitamin A 8 %	Calcium 0 %
Vitamin C 0 %	Iron 0 %

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

http://www.landolakes.com/product/15136/salted-butter

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PRE-Evaluation: Milk in Motion - A Dynamic Dairy Experiment

1. How old are you? _____

2. Are you….(Select one.)
☐ A Boy ☐ A Girl

3. Are you….(Select ALL that apply.)
☐ African American/Black
☐ Asian
☐ Hispanic/Latino
☐ Native American/Alaskan Native
☐ Native Hawaiian/Other Pacific Islander
☐ White
☐ Other

4. What type of school do you go to? (Select one.)
☐ Public school ☐ Private school ☐ Religious school (Catholic, etc.) ☐ Home school

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Your Science and Agriculture Opinions and Knowledge

5. ***BEFORE going through the AGsploration Program***, please **circle** the degree to which you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Agree	Strongly Agree
I like science.	1	2	3	4
I feel that Maryland agriculture is a part of science.	1	2	3	4
Science is useful for solving everyday problems.	1	2	3	4
Maryland agriculture is beneficial to me, my family, and my community.	1	2	3	4
When I graduate from high school, I would like to have a job in agricultural science.	1	2	3	4
I can name three jobs in the agriculture industry.	1	2	3	4

6. ***BEFORE going through the AGsploration Program***, please **circle** your knowledge level about the topics listed below.

	None	Low	Medium	High	Very High
Maryland agriculture	1	2	3	4	5
Dairy products	1	2	3	4	5
Dairy industry	1	2	3	4	5
Properties of milk	1	2	3	4	5
Nutrients found in milk	1	2	3	4	5

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

AGsploration
The Science of Maryland Agriculture

POST-Evaluation: Milk in Motion - A Dynamic Dairy Experiment

Your Science and Agriculture Opinions and Knowledge

5. ***AFTER going through the AGsploration Program***, please **circle** the degree to which you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Agree	Strongly Agree
I like science.	1	2	3	4
I feel that Maryland agriculture is a part of science.	1	2	3	4
Science is useful for solving everyday problems.	1	2	3	4
Maryland agriculture is beneficial to me, my family, and my community.	1	2	3	4
When I graduate from high school, I would like to have a job in agricultural science.	1	2	3	4
I can name three jobs in the agriculture industry.	1	2	3	4

6. ***AFTER going through the AGsploration Program***, please **circle** your knowledge level about the topics listed below.

	None	Low	Medium	High	Very High
Maryland agriculture	1	2	3	4	5
Dairy products	1	2	3	4	5
Dairy industry	1	2	3	4	5
Properties of milk	1	2	3	4	5
Nutrients found in milk	1	2	3	4	5

7. As a result of participating in this activity, tell one new thing you will try or one thing you will find information about.

UNIVERSITY OF MARYLAND EXTENSION
Solutions in your community

AGsploration
The Science of Maryland Agriculture

SUPPLEMENTAL - Evaluation: Milk in Motion - A Dynamic Dairy Experiment

Directions: If you are teaching more than one lesson plan in one day, you may attach this to the pre/post evaluation form for the other lesson you are teaching. Please have the student fill out these during the pre and post evaluation times. In addition, only have the student fill out the post evaluation questions Q5 – Q7 at the completion of all lessons.

PRE-Evaluation

BEFORE going through the AGsploration Program, please **circle** your knowledge level about the topics listed below.

	None	Low	Medium	High	Very High
Maryland agriculture	1	2	3	4	5
Dairy products	1	2	3	4	5
Dairy industry	1	2	3	4	5
Properties of milk	1	2	3	4	5
Nutrients found in milk	1	2	3	4	5

POST-Evaluation

AFTER going through the AGsploration Program, please **circle** your knowledge level about the topics listed below.

	None	Low	Medium	High	Very High
Maryland agriculture	1	2	3	4	5
Dairy products	1	2	3	4	5
Dairy industry	1	2	3	4	5
Properties of milk	1	2	3	4	5
Nutrients found in milk	1	2	3	4	5