LIPID-FLAVOR INTERACTION

AT A GLANCE

Students will taste how fat can influence flavor perception, when they taste chocolate milk.

OBJECTIVES

Students will:

- Observe the visual effects of fat on white & chocolate milk.
- Understand how & why fat allows flavor to linger on the tongue, influencing taste.
- Participate in a tasting to compare the 4 different chocolate milk drinks with various levels of fat to a market product.
- Calculate the Nutrition label for the whipping cream, for a 1 cup serving size. Compare the 4 labels and note differences in fat, calories, and protein.

KEY WORDS

- Lipid
- Fat
- Flavor
- Solubility
- Mouthfeel
- Viscosity
- Partitioning
- Sedimentation
- Homogenization

GRADE LEVEL

Suggested Grade Levels:

- 9-12
- High School

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TIME FOR LESSON 30-45 min

BACKGROUND KNOWLEDGE *(can read with class)*

Fat has a major influence on the sensory perception of food products. "Fats enhance the taste and acceptability of foods, and lipid components largely determine the texture, flavor and aroma of foods" (Uauy & Castillo, 2003). Fat plays a major role in mouthfeel, flavor masking, aroma, flavor duration and flavor intensity perceived in a food or a beverage. Fat can also affect the release of sweetness in a product. This demonstration will show you some of these characteristics of fat.

Fats are vitally important to diets of humans. Studies show from the third trimester through the first few years of life, the need for dietary fats is essential for brain growth and development. "One of the fundamental and necessary events in the normal development of the central nervous system in vertebrates is the formation of a myelin sheath. It is becoming more evident that this process is influenced by dietary lipids. (*Salvatti, Attorri, Avellino, Di Biase & Sanchez, 2000*). Have you ever seen children eating butter or drinking coffee creamers straight out of the single-serve containers at restaurants? Their need for fat (and sugar) in their diet is inherent and they crave it. The Central Nervous System requires adequate amounts of dietary lipids to properly develop the brain, specifically, the myelin sheath. Approximately 70% of the myelin sheath is comprised of lipids, of which are supplied via the diet (Yehuda, Rabinovitz & Mostofsky, 2005). The myelin is made of layers of fat that surround the axon. If the myelin does not have adequate amounts of lipids or fats (as supplied by the diet), it does not form properly and can have negative affects on learning, motor skills and vision (*Salvatti, Attorri, Avellino, Di Biase & Sanchez, 2000*). Once the myelin sheath is formed, your brain uses little fat from your diet to maintain the brain function and structure. What does the myelin sheath actually do? It assists the information travelling along the nerves, its presence helps information move more quickly from nerve to nerve to transmit information to and from the body and the brain.

Fat is also necessary for the absorption of fat soluble vitamins: Vitamin A, D, E and K. Fat continues to play a vital role in health and wellness as humans age. Fat is the most concentrated nutrient, regarding energy. Fat contains 9 calories per grams (versus 4 calories per gram for carbohydrates & protein), making it more satiating than carbohydrates and protein.

Because of the characteristics of fat, having fat in food and beverage products helps deliver the flavor of the food we are consuming. Think of a delicious cut of Ribeye, with fat marbled into the fibers of the meat. Fat allows flavor to develop on the tongue and because fat 'sits' on the tongue it holds the flavor there with it. Fat makes the meat more moist and extends the flavor.

In this demonstration, you will witness how fat assists in the delivery of flavor in the chocolate milk. Alternately, it interferes with sweetness & the color. These are common challenges food scientists face when they are developing food products. If one attribute of food is altered (like reducing fat in a cookie) other attributes are affected, such as moisture, saltiness, sweetness, color of the finished product, baking time and storage/shelf life conditions.

References:

Salvati, S., Attorri, L., Avellino, C., DiBiase, A., & Sanchez, M. (2000). Diet, Lipids and Brain Development. Developmental Neuroscience, 22, 481-487.

Uauy, R., & Castillo, C. (2003). Lipid Requirements of Infants: Implications for the Nutrient Composition of Fortified Complementary Foods. The Journal of Nutrition, Supplement 2962S-2972S.

Yehuda, S., Rabinovits, S., & Mostofsky, D.I. (2005). Essential fatty acids and the brain: From infancy to aging. Neurobiology of Aging, 26S, S98-S102.

BELL RINGER

Have the students calculate the fat in "whipping cream" (see food label below).
Note it is based on a serving size of 1 cup).

16 tablespoons = 1 cup

Skim Milk

Nutrition Facts
Serving Size 1 cup (240mL)

Amount Per Serving	
Calories 90	Calories from Fat 0
	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	**0%**
Cholesterol <5mg	**1%**
Sodium 125mg	**5%**
Potassium 410mg	**12%**
Total Carbohydrate 13g	**4%**
Dietary Fiber 0g	
Sugars 13g	
Protein 8g	**17%**

Vitamin A 10% • Vitamin C 4%
Calcium 30% • Iron 0% • Vitamin D 25%
*Percent Daily Values are based on a 2000 calorie diet.

2% Milk

Nutrition Facts
Serving Size 1 cup (240mL)

Amount Per Serving	
Calories 120	Calories from Fat 45
	% Daily Value*
Total Fat 5g	**8%**
Saturated Fat 3g	**15%**
Trans Fat 0g	**0%**
Cholesterol 20mg	**7%**
Sodium 125mg	**5%**
Potassium 400mg	**11%**
Total Carbohydrate 12g	**4%**
Dietary Fiber 0g	
Sugars 12g	
Protein 8g	**16%**

Vitamin A 10% • Vitamin C 4%
Calcium 30% • Iron 0% • Vitamin D 25%
*Percent Daily Values are based on a 2000 calorie diet.

Whole Milk

Nutrition Facts
Serving Size 1 Cup (240mL)

Amount Per Serving	
Calories 150	Calories from Fat 70
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 5g	**25%**
Trans Fat 0g	**0%**
Cholesterol 35mg	**11%**
Sodium 125mg	**5%**
Potassium 400mg	**11%**
Total Carbohydrate 12g	**4%**
Dietary Fiber 0g	
Sugars 12g	
Protein 8g	**16%**

Vitamin A 6% • Vitamin C 4%
Calcium 30% • Iron 0% • Vitamin D 25%
*Percent Daily Values are based on a 2000 calorie diet.

Whipping Cream

Nutrition Facts
Serving Size 1 tbsp (15 mL)

Amount Per Serving	
Calories 50	Calories from Fat 50
	% Daily Value*
Total Fat 5g	**8%**
Saturated Fat 3.5g	**17%**
Trans Fat 0g	
Cholesterol 20mg	**7%**
Sodium 5mg	**0%**
Total Carbohydrate 0g	**0%**
Dietary Fiber 0g	**0%**
Sugars 0g	
Protein 0g	

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

*Percentage 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
Saturated 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
Protein		50g	65g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

INGREDIENTS: HEAVY CREAM, LESS THAN 1% OF EACH OF THE FOLLOWING INGREDIENTS: MONO & DIGLYCERIDES, POLYSORBATE 80, CARRAGEENAN.
CONTAINS: MILK

PREPARATION

1. Make overhead of the Bell Ringer.
2. Make copies of the handout.
3. Purchase:
   - Hershey's Syrup
   - Skim Milk
   - 2% Milk
   - Whole Milk
   - Whipping Cream
   - Nesquick - Chocolate Fat-Free (or Low-Fat) Ready to drink (not powder) in a bottle (***Only if you want to compare it to a market product.*)
   - Tasting cups (5 per student) - label each cup (A, B, C, D, E)

MATERIALS NEEDED

Per Group (of 4):

- 1 cup each (skim, 2%, Whole and Whipping Cream)
- 1 tablespoon of Hershey's syrup for each milk
- 1 cup of Nesquick Market Product
- Permanent Marker
- *Optional: Calculator*

Per Student:

"Flavor Lipid Interaction" student activity sheet

ACTIVITY

1. Each group of students will measure out 1 cups of each milk product.
2. They will stir in 1 Tablespoon of Hershey's Syrup (according to the directions) to each cup of milk. Preferably mix into a clear food grade beaker, or clear container, or have clear tasting cups for visual purposes.
3. Pour evenly into tasting cups.
4. They will taste from least fat (skim, 2%, whole, half & half) to most fat product.
    - While tasting, complete the observation portion of the worksheet.
    - Fill in the flavor intensity/time chart. For each beverage tasted, create a graph of how intense the chocolate flavor is and how long that flavor lasts on your tongue.
    - Note** If you are tasting the Nesquick (R) ready to drink product, too. Please compare the ingredients and understand that adding the gums help hold the chocolate in solution, increase the mouthfeel in this low-fat milk product and the wrap around the bottle prevents the consumer from seeing the settled chocolate on the bottom of the bottle (cut the package off, if you can without shaking the product).

CHECK FOR UNDERSTANDING

Discuss with students the results from their taste test.

- What were the noticeable differences between the samples you tasted (viscosity, color, flavor impact, texture, mouthfeel, sweetness, etc)?
- Why is the sweetness of the chocolate milk made with skim milk so much greater than the chocolate milk made with whipping cream? (Even though the same amount of Hershey's syrup was added to all samples)
- How did the characteristics of the chocolate flavor change as the fat content increased?
- Was the solubility of the chocolate syrup affected by the fat content of the milk? Was there sedimentation in any of the samples? What does the ingredient statement look like for the whipping cream, compared to the milk?
- Compare the chocolate milk solutions made in class, to the Nesquick product. What are the differences?

WHAT'S HAPPENING?

The Lipids hold the chocolate flavor on the tongue longer. The fat also binds with the sugars in the milk products to reduce the sweetness.

When tasting the different chocolate milk samples, the lower the fat content, the darker the color and more intense the sweetness is (even though the same amount of chocolate was added to each type of milk). However, as the fat content increases, the intensity of sweetness and flavor is reduced. But, did you notice that the flavor (although reduced in intensity) was present on the tongue for a greater amount of time? The fat is keeping the flavor on the tongue longer, even though the intensity of the flavor is reduced.

Have the students look at how much chocolate syrup has fallen out of the solution.

- Which milk solution has the most fall out?

  The skim milk should have the most sedimentation and the "whipping cream" should have the least amount of sedimentation because the fat is increasing the viscosity or density, therefore holding the cocoa solids in place longer than the skim milk. Cocoa solids, if alkalized, should also stay in solution longer than non-alkalized. The process of alkalinization will also help increase the solubility of the cocoa in a solution. *(You can read more about the process on Hershey's website for Nutrition Professionals at http://www.hersheys.com/nutrition-professionals/)*

- In chocolate milk bought at the grocery store, have you ever seen so much sedimentation?

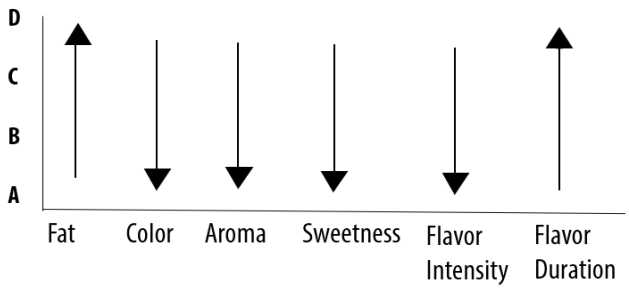
  Probably not, because the milk is homogenized. The process of homogenization breaks the fats into very small particles, therefore keeping all the chocolate, fat and milk in a more uniform solution. The cocoa solids are what is falling out of the milk solution. In addition to homogenization, the milk sold in the grocery store either has fat or 'thickeners' to increase the viscosity and help keep the cocoa solids in solution. The milk fat is increasing the density of the product, just as gums/gels/carrageenan can increase the density, making the cocoa solids more buoyant in solution.

- Look at the Nesquick milk product, is there sedimentation in this product even with it being marketed as a "fat-free" or "low-fat" product?

- Why do you think the cocoa solids can be suspended in the Nesquick product, even though there is little to no fat present in the finished product?

  Look at the ingredient label of the Nesquick product. Do you see anything that would be used to increase the viscosity? The gums, gels and carrageenan all act as 'thickeners' to increase the viscosity of the chocolate milk, therefore giving it more mouthfeel. The 'thickeners' also hold the cocoa solids in solution.

Lipid-Flavor Interaction



LEARNING EXTENSIONS

Language Arts	Have the students look at the descriptors for Chocolate (see attached) and discuss whether or not the flavor displayed the descriptors. The descriptor discussion will happen on a group level. In the case of an unknown word, the teacher can facilitate the teaching of a new word.
Math	• Students can calculate the Nutrition Label for the Whippign Cream, but also add the chocolate syrup nutrition facts to each type of milk and compare the 'finished chocolate milk samples' to the Nesquik 'ready-to-drink' product bought at the grocery. • Allow the students to double the recipe or change the metric to grams or ounces instead of cups. Conversions & percents can be confusing for students, so allow them time to practice. • Compare the time intensity charts of all students in the group to determine which chocolate milk had the most intense flavor over time.
Chemistry	Have the students write a paragraph "lab summary" how lipids affect the sweetness and flavor delivery in a food/beverage product, using chemistry related terms: density, neutral buoyance, viscosity, viscositier, solutions, reagents and interactions.
Technical Writing	Identify a food item you have eaten both the higher fat and lower fat product. Describe the difference of fat and how it affects your perception of the food. How do the differences you taste relate to this lesson or lab? Support your hypothesis/ideas with a nutritional label and ingredient statement.

FOR MORE INFORMATION PLEASE GO TO WWW.FONA.COM

This lesson plan was written by Katie Sudler, for FONA International, Inc.
***This lesson plan has been peer reviewed by:**
Robert Sobel, M.A.E.L.& Ph.D. - Vice President, Research, Quality & Innovation, FONA International
Wende Dallain, Food Science Career Pathway, Chicago High School for Agricultural Sciences

CHOCOLATE DESCRIPTORS

Descriptive Terms

Alkalized
Astringent
Acidic, Harsh
Beany
Bitter
Black Cocoa
Botanical
Caramellic
Cocoa Powder
Coffee, Burnt
Dairy, Buttery
Dark Chocolate
Dirty
Dutched
Earthy
Ethyl Vanillin
Fatty
Floral
Fruity
Fudgey
Green
Hot Chocolate
Ice Cream
Liqueur
Malted Milk Balls
Malty
Marshmallow
Medicinal, Phenolic
Milky
Musty
Nutty
Oily
Perfumey
Pyrazine
Resinous
Roasted
Rosy
Rubbery
Semi-sweet
Skunky
Sour
Spicy
Stale
Sulfitic
Sweet
Tea
Tobacco
Vanillin
White Chocolate
Woody

Descriptive Types

Devil's Food Cake
Hershey Bar
Hershey Syrup
Milk Shake
Morsels, Semi-sweet
Nestlé Quik
Oreo® Cookie

Notes

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Worksheet Lipid-Flavor Interaction (ANSWER KEY)

Name: TEACHER'S COPY

BELL RINGER

Skim Milk

Nutrition Facts
Serving Size 1 cup (240mL)

Amount Per Serving	
Calories 90	Calories from Fat 0
	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	**0%**
Cholesterol <5mg	**1%**
Sodium 125mg	**5%**
Potassium 410mg	**12%**
Total Carbohydrate 13g	**4%**
Dietary Fiber 0g	
Sugars 13g	
Protein 8g	**17%**

Vitamin A 10% • Vitamin C 4%
Calcium 30% • Iron 0% • Vitamin D 25%
*Percent Daily Values are based on a 2000 calorie diet.

2% Milk

Nutrition Facts
Serving Size 1 cup (240mL)

Amount Per Serving	
Calories 120	Calories from Fat 45
	% Daily Value*
Total Fat 5g	**8%**
Saturated Fat 3g	**15%**
Trans Fat 0g	**0%**
Cholesterol 20mg	**7%**
Sodium 125mg	**5%**
Potassium 400mg	**11%**
Total Carbohydrate 12g	**4%**
Dietary Fiber 0g	
Sugars 12g	
Protein 8g	**16%**

Vitamin A 10% • Vitamin C 4%
Calcium 30% • Iron 0% • Vitamin D 25%
*Percent Daily Values are based on a 2000 calorie diet.

Whole Milk

Nutrition Facts
Serving Size 1 Cup (240mL)

Amount Per Serving	
Calories 150	Calories from Fat 70
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 5g	**25%**
Trans Fat 0g	**0%**
Cholesterol 35mg	**11%**
Sodium 125mg	**5%**
Potassium 400mg	**11%**
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Sugars 12g	
Protein 8g	**16%**

Vitamin A 6% • Vitamin C 4%
Calcium 30% • Iron 0% • Vitamin D 25%
*Percent Daily Values are based on a 2000 calorie diet.

Whipping Cream

Nutrition Facts
Serving Size 1 tbsp (15 mL)

Amount Per Serving	
Calories 50	Calories from Fat 50
	% Daily Value*
Total Fat 5g	**8%**
Saturated Fat 3.5g	**17%**
Trans Fat 0g	
Cholesterol 20mg	**7%**
Sodium 5mg	**0%**
Total Carbohydrate 0g	**0%**
Dietary Fiber 0g	**0%**
Sugars 0g	
Protein 0g	

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

*Percentage 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
Saturated 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
Protein		50g	65g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Calculate the Nutrition label for the Whipping cream, for a 1-cup serving size.

***Let the students figure out the conversion of tablespoon to cup. Set out various sizes of cups and tablespoons and let them figure it out.*

***Regarding the '% Daily Value', the student can figure out the 'Daily Value' by using a mathematical equation to find it by solving for (x).*

**At the bottom of the nutritional labels, it says the % DV is based on a 2000 calorie diet.

	1 cup Whipping Cream	*% Daily Value*
Calories	280 calories	14%
Fat	28 g	40%
Saturated Fat	16 g	80%
Carbohydrates	8 g	2.7%
Sugars	8 g	
Protein **assume 0.75 grams Protein per 2 T for the Whipping Cream*	6 g	12%

WORKSHEET Lipid-Flavor Interaction (ANSWER KEY)

PROCEDURE:

1. Measure out 1 C. of each type of milk (Whole, 2%, skim and Whipping Cream) into a clear plastic class. Label each glass with a permanent marker.
2. Stir in 1T. of Hershey's syrup using a plastic spoon.
3. Taste the milk in this order reserving about half of the milk in the original cup for a later observation: Skim, 2%, Whole, ½ & ½
4. While tasting, leave the milk sample in your mouth for about 30 seconds and record the time it takes to reach the highest intensity, how high that intensity is, and how long it lasts. Graph that time (approximately) on the graph given.
5. While tasting complete the observation portion of the worksheet.
6. After you have completed tasting all 4 samples, look to see if the chocolate has settled out of any of the milks. Record this under sedimentation.
7. Prepare a sample of Nesquick using skim milk. How is this sample different than the skim chocolate milk that we made with Hershey's syrup?

RECORD PERSONAL OBSERVATIONS

COLOR	*The color should change between samples. As the fat content increases, the color will become lighter, even though the same amount of chocolate syrup is added to all of the samples.*
SWEETNESS	*The sweetness of each product also diminishes as the fat content is increased. The 'half & half' has very little sweetness, whereas the skim sample has an intense sweetness.*
FLAVOR INTENSITY	*The lower the fat content the more intense the flavor is. Flavor is most noticeable in the skim milk sample and muted in the 'half & half' sample.*
MOUTHFEEL	*Mouthfeel increases with fat content and viscosity. Even though all of the milk products are homogenized, there are more fat particles distributed throughout the higher fat products. You can feel them in your mouth.*
FLAVOR DURATION	*The flavor should last longer in the 'half & half' sample, than any other sample. It will be very apparent that the fat is helping the flavor 'hang out' on the tongue and the release of the flavor is distributed over a longer period of time.*
SEDIMENTATION	*The skim milk should have the most sedimentation and the "half & half" should have the least amount of sedimentation because the fat is increasing the viscosity or density, therefore holding the cocoa solids in place longer than the skim milk. Cocoa solids, if alkalized, should also stay in solution longer than non-alkalized. The process of alkalinization will also help increase the solubility of the cocoa in a solution.*

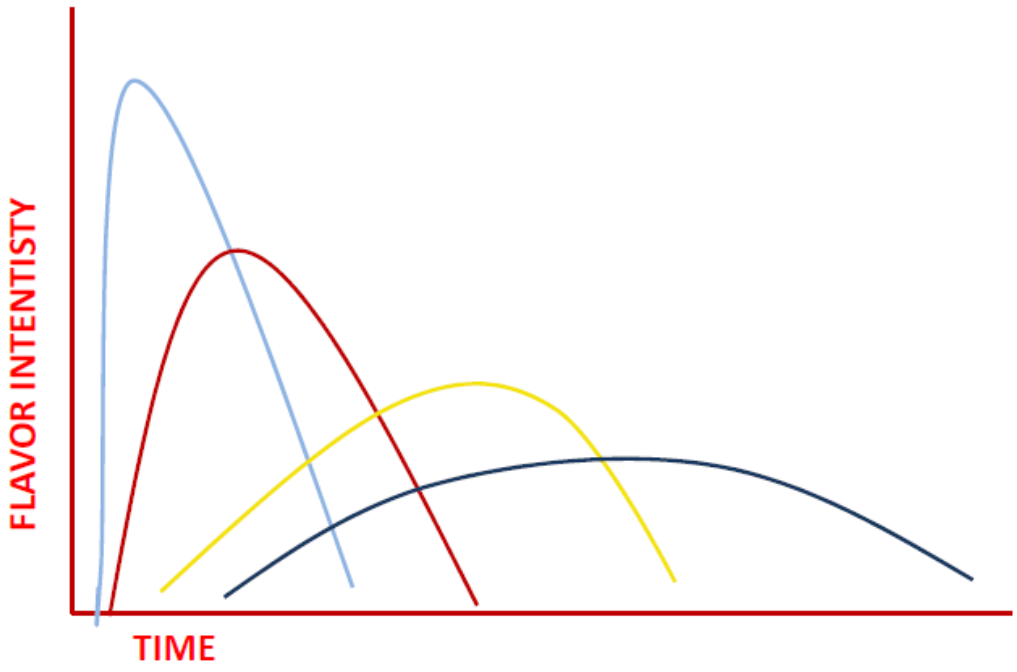
Worksheet Lipid-Flavor Interaction (ANSWER KEY)

Please READ for the graphing exercise:
The graphing your students are about to do, is something they have likely never been exposed to. It is more of an estimation rather than an exact graphing exercise they are used to (with numbers on the x- and y- axis that form a point, connecting the points become a line or a bell curve).

In this exercise, as the intensity of flavor increases and decreases with each sample, draw what that increase & decrease in flavor intensity in your mouth would look like. Please be aware that some of your student may have a difficult time grasping this concept.

*****As an example on the board, graph the sweetness of a sugar vs sugar free chewing gum. Your students will not be familiar with this type of graphing, so doing an example for them on the board will help them when they start graphing for this exercise (do the example on the board before they taste the chocolate milks)***

DIRECTIONS: With 4 different color pens/markers make a time intensity chart for flavor intensity, starting with the skim milk sample. **Put the milk in your mouth, record intensity over time (it should only*



LABELS

**indicate colors used on chart*

- **Skim Milk**
- **2% Milk**
- **Whole Milk**
- **Half & Half**
- **Nesquick**

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Worksheet Lipid-Flavor Interaction (ANSWER KEY)

DISCUSSION QUESTIONS -

1. What were the noticeable differences between the samples you tasted (skim, 2%, whole and whipping cream)?

2. How did the samples differ, in taste, to the Nesquik product?

3. Why is the sweetness of the chocolate milk made with skim milk so much greater than the chocolate milk made with whipping cream?

4. How did the characteristics of the chocolate flavor change as the fat content increased?

5. Which milk solution had the most cocoa solid sedimentation? Why?

6. What is a major challenge that food scientists have to deal with (as you observed in this lab)?

WORKSHEET Lipid-Flavor Interaction

Name: _____

BELL RINGER

Skim Milk

Nutrition Facts
Serving Size 1 cup (240mL)

Amount Per Serving	
Calories 90	Calories from Fat 0
	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	**0%**
Cholesterol <5mg	**1%**
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Nutrition Facts
Serving Size 1 cup (240mL)

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Whipping Cream

Nutrition Facts
Serving Size 1 tbsp (15 mL)

Amount Per Serving	
Calories 50	Calories from Fat 50
	% Daily Value*
Total Fat 5g	**8%**
Saturated Fat 3.5g	**17%**
Trans Fat 0g	
Cholesterol 20mg	**7%**
Sodium 5mg	**0%**
Total Carbohydrate 0g	**0%**
Dietary Fiber 0g	**0%**
Sugars 0g	
Protein 0g	

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

Calculate the Nutrition label for the whipping cream, for a 1-cup serving size.

	1 cup whipping cream	*%Daily Value*
Calories		
Fat		
Saturated Fat		
Carbohydrates		
Sugar		
Protein **assume 0.75 grams Protein per 2 T for the Half & Half*		

Compare the 4 labels and note the major differences in fat, calories, and protein.

WORKSHEET Lipid-Flavor Interaction *(continued)*

PROCEDURE:

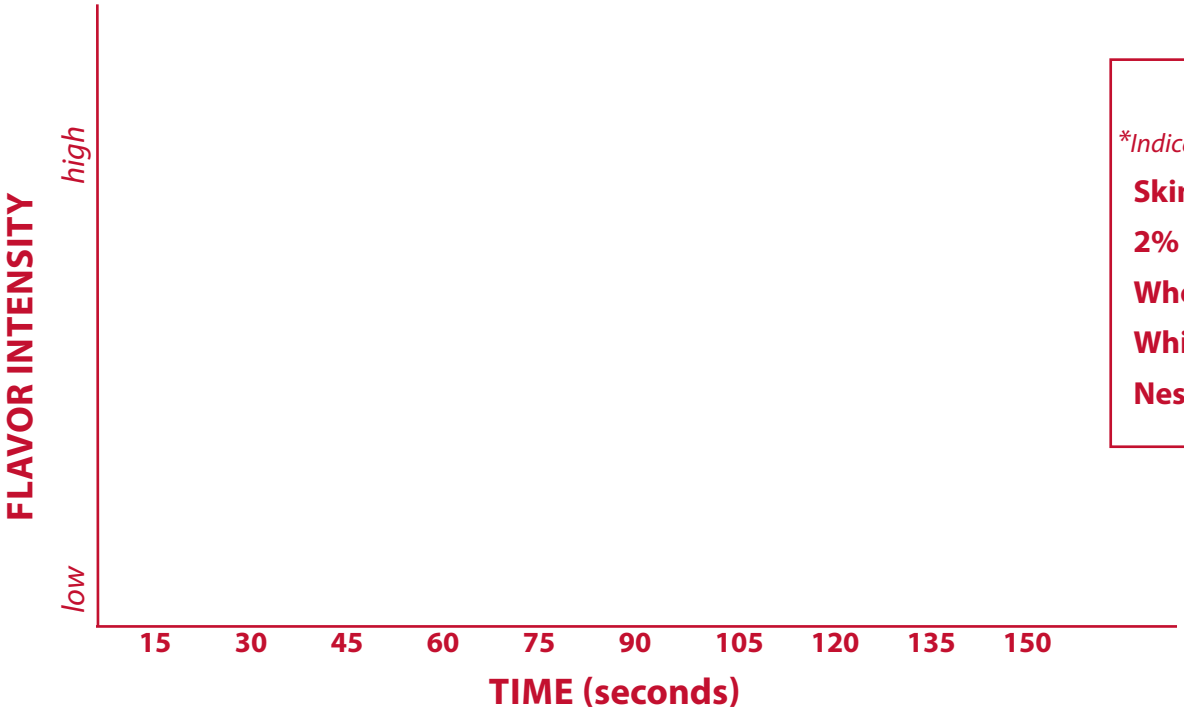
1. Measure out 1 C. of each type of milk (Whole, 2%, skim and whipping cream)into a clear plastic class. Label each glass with a permanent marker.
2. Stir in 1T. of Hershey's syrup using a plastic spoon.
3. Visually observe the differences in the milk samples. Write down some observations.
4. Smell the differences in the milk samples. Write down your observations.
5. Taste the milk in this order reserving about half of the milk in the original cup for a later observation: skim, 2%, whole, whipping cream.
6. While tasting, leave the milk sample in your mouth for about 30 seconds and record the time it takes to reach the highest intensity, how high that intensity is, and how long it lasts. Graph that time (approximately) on the graph given.
7. While tasting complete the observation portion of the worksheet.
8. After you have completed tasting all 4 samples, look to see if the chocolate has settled out of any of the milks. Record this under sedimentation.
9. Prepare a sample of Nesquick using skim milk. How is this sample different than the skim chocolate milk that we made with Hershey's syrup?

WORKSHEET Lipid-Flavor Interaction *(continued)*

RECORD PERSONAL OBSERVATIONS

COLOR	
SWEETNESS	
FLAVOR INTENSITY	
MOUTHFEEL	
FLAVOR DURATION	
SEDIMENTATION	

DIRECTIONS: With 4 different color pens/markers make a time intensity chart for flavor intensity, starting with the skim milk sample. **Put the milk in your mouth, record intensity over time (it should only take about 30 seconds for the flavor to loose intensity on your tongue)*



LABELS

**Indicate colors used on chart*

Skim Milk

2% Milk

Whole Milk

Whipping Cream

Nesquick

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1900 Averill Road, Geneva, IL 60134
630.578.8600 | www.fona.com

WORKSHEET Lipid-Flavor Interaction *(continued)*

DISCUSSION QUESTIONS

1. What were the noticeable differences between the samples you tasted (skim, 2%, whole and shipping cream)?

2. How did the samples differ, in taste, to the Nesquik product?

3. Why is the sweetness of the chocolate milk made with skim milk so much greater than the chocolate milk made with half & half?

4. How did the characteristics of the chocolate flavor change as the fat content increased?

5. Which milk solution had the most cocoa solid sedimentation? Why?

6. What is a major challenge that food scientists have to deal with (as you observed in this lab)?