

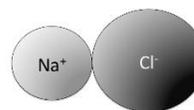


Making Ice Cream

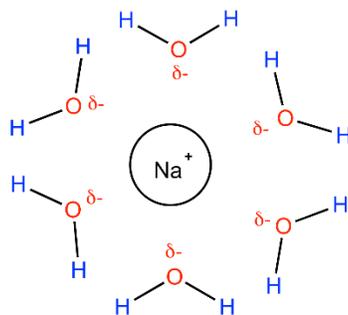
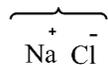
Introduction:

When it comes to food preparation, humans have developed many techniques to alter the temperature of foods and beverages to optimize the eating and drinking experience. This sometimes comes in simply heating or cooling foods directly and other times comes in using temperature changes to alter the properties of the food or beverage. When doing so, we frequently take advantage of the physical properties of particles in solution, colligative properties, to facilitate temperature changes.

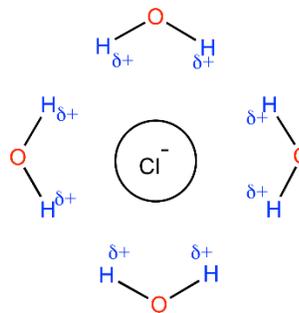
If you live in a cold weather climate your daily life is enhanced by an understanding of colligative properties. During icy road conditions, highway crews treat the roads with salts (NaCl or CaCl₂) or brine solutions made of these salt to reduce ice build-up. Adding NaCl brine to highways helps to melt the existing ice and prevents the formation of new ice. In a similar fashion, to keep the engine coolant in vehicles from freezing during severe cold, people use antifreeze. Most common antifreeze solutions contain ethylene glycol which when mixed with water lowers the freezing point. Having an understanding of the colligative properties of solutions enhances our lives in many practical ways, and also in less practical and more enjoyable ways, like making ice cream.



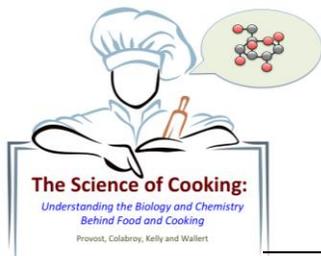
sodium chloride (i.e. table salt) is an ionic compound. It is made of 2 different types of atoms that are held together by a positive-to-negative attraction called an *ionic bond*



The sodium cation (Na⁺) is surrounded by a cloud of water molecules that are oriented to present their *slightly* negative oxygens toward the positively charged sodium



The chloride anion (Cl⁻) is surrounded by a cloud of water molecules that are oriented to present their *slightly* positive hydrogens toward the negatively charged chloride.



Laboratory Exercise – Ice Cream

Solutions are homogenous mixtures of two or more substances. The solvent is the major component of the solution and the majority of the physical properties of the solution are due to the solvent. The minor component or components of a solution are called solutes. Some of the physical properties of a solution are independent of the type of solute present and are only dependent upon the concentration of dissolved particles. These properties are referred to colligative properties. Colligative properties include boiling point elevation and freezing point depression. Properties that we take advantage of in preparation of foods such as homemade ice cream.

In this exercise we will take advantage of one of the colligative properties of solutions, freezing point depression, to make homemade ice cream. Then we will evaluate another property of ice cream, taste, to evaluate how changes to the ingredients used to make ice cream impact flavor.

Background:

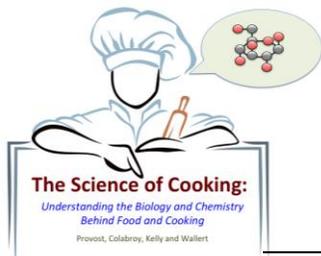
Colligative Properties

As you have learned several times, pure water freezes at 0 °C (32 °F) and boils at 100 °C (212 °F). We also know that these values can be altered by the addition of different solutes to the water. Using two examples from the introduction, we know that NaCl brines can be prepared to decrease the freezing point of water. A 23.3% solution of NaCl freezes at -51°C or -60°F, dramatically colder than the freezing point of pure water. The use of antifreeze in vehicles provides a similar impact. A 50/50 (v/v) mixture of antifreeze and water has a freezing point of -34°C or -29°F. Using a 70/30 mixture of antifreeze to water extends the freezing point to -84°C or -119°F.

How does understanding colligative properties help us with making ice cream? When you make ice cream whether in an old-fashioned, hand-cranked, ice cream maker or in a sealable plastic bag the temperature of the cream mixture needs to be maintained at temperatures below 0°C (32°F). Since ice water only reaches a minimum temperature of 0°C, we take advantage of colligative properties to reduce the temperature of the ice bath around the ice cream maker to accelerate the freezing.

Ice Cream Making and Tasting

As we have learned throughout this course, the perception of taste and flavor is a personal characteristic. Your preferences for spicy or salty food is a personal characteristic similar to your choice of chocolate, vanilla, or cookies and cream ice cream. The challenge with doing a taste test is endeavoring to place on objective measurement on a very subjective topic. To help



Laboratory Exercise – Ice Cream

in this process, we will need to define a series of terms that will be used to address flavor, body, and texture characteristics of ice cream. In this experiment we will taste test a series of vanilla ice cream products that vary both in price and the nature of the ingredients.

Flavor Characteristics

- **Flavoring or Sweetness:** Is the flavor or sweetness lacking or too strong. We will evaluate both flavor and sweetness. For the vanilla ice cream we will be tasting we will ask is the vanilla too weak, too strong, exactly what you like. We will also ask whether the ice cream is too sweet, not sweet enough or exactly what you like.
- **Syrup Flavor:** The syrup flavor is a measure of the presence of corn syrup sweetener present in the ice cream. Liquid corn syrup is the common reference point for this characteristic. Most people prefer their ice cream to be sweet without being syrupy.
- **Whey Flavor and Texture:** Whey is the common form of non-fat milk solids (NMS) added to ice cream that contribute to both flavor and texture. High levels of whey protein or the use of low quality whey protein lead to a flavor described as earthy, grassy or alfalfa-like in the ice cream that most people do not like.
- **Bloom / Bouquet:** These terms are used (often interchangeably) to describe the emergence of flavors as odorants are volatilized as the ice cream melts in your mouth and enter rear of the nasal cavity (retronasal). The bloom of ice cream is describe using terms such as insufficient, delicate, light, full, rich, overpowering.

Process of Science:

You will be evaluating the various properties of ice cream and how they relate to the ingredient list. To get ready to write the introduction to your report next week, you should answer the following question (*note: this handout will not be collected, this is merely to help you in the preparation of your report*).

1. A key question being investigated in each of the exercises below.
2. A hypothesis or proposed answer to the question asked.
3. A prediction for the outcome of the experiment based upon your hypotheses you developed. The prediction should written as an if/then statement and be specific to the measurements being made.
4. An explanation of your reasoning for each of your hypotheses and predictions.



Procedures:

Exercise 1: Making Vanilla Ice Cream

In this exercise we will be making vanilla ice cream. The recipe makes about 1 cup of ice cream.

A. Ingredient Preparation

1. Obtain a 1 quart zip seal plastic freezer bag.
2. To this bag add:
 - a. $\frac{1}{2}$ cup whole milk
 - b. $\frac{1}{2}$ cup heavy whipping cream
 - c. $\frac{1}{4}$ cup table sugar (sucrose)
 - d. $\frac{1}{4}$ teaspoon vanilla or vanilla flavoring
3. Seal the bag.
4. Mix the contents gently by squeezing and rocking the bag.
5. Place this bag in the freezer or on ice while preparing for part C.

B. Ice Bath Preparation

1. Obtain a 1 gallon zip seal plastic freezer bag.
2. To this bag add:
 - a. 3 cups crushed ice.
 - b. $\frac{1}{2}$ cup cold water.
 - c. $\frac{3}{4}$ cup table salt (NaCl)
3. Seal the bag.
4. Mix the contents gently by squeezing and rocking the bag.

C. Ice Cream Making

1. Open the 1 gallon zip seal plastic freezer bag.
2. Carefully place the 1 quart zip seal plastic freezer bag with the ice cream ingredients into the 1 gallon bag.
3. Seal the 1 gallon bag.
4. Gently rock the 1 gallon bag from side to side gently squeezing the contents occasionally. (You may want to wear a pair of winter gloves since the bag will get quite cold.)
5. Continue to rock and squeeze the bag for 10 to 20 minutes until the contents of the quart bag harden to form ice cream.
6. Remove the quart bag from the gallon bag and dry the outside of the quart bag.
7. Taste your ice cream!



Laboratory Exercise – Ice Cream

Exercise 2: Ice Cream Taste Test

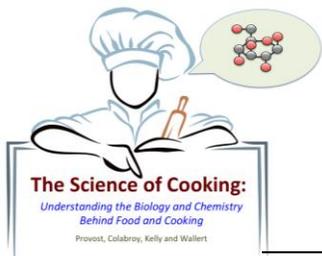
In this exercise you will be taste testing different brands and qualities of ice creams.

A. Preparation

1. By Thursday at 11:59pm, in the discussion forum you should decide as a group who is responsible for obtaining and rating which ice cream brands.

B. Tasting

1. Take a small amount of each the store-bought ice cream and rate it on a scale of 1 (poor) to 5 (exceptional) for each of the following:
 - a. Sweetness
Self-explanatory and very much a personal preference
 - b. Flavor
Self-explanatory and very much a personal preference
 - c. Syrup
Syrupiness is associated with the addition of corn syrup as a sweetener.
 - d. Bloom
Describes the emergence of the flavor as the ice cream melts in your mouth. Typically described as delicate, full, rich, or powerful. Include both a description and a score.
 - e. Body
The substance or structure of the ice cream. Typically described as weak, gummy, fluffy or chewy. Include both a description and a score.
 - f. Texture
Refers to the relative smoothness of the ice cream. Can be describes as coarse, thin, or greasy. Include both a description and a score.
2. Record the results of the taste test in Data Table 1.
3. Repeat for your homemade ice cream.



Laboratory Exercise – Ice Cream

Results (to be posted in the Discussion forum by Sunday night):

Data Table 1. Ice Cream Taste Comparison. Rank your homemade and store-bought ice creams 1 to 5 for each category. Average the total scores for each ice cream.

Characteristic	Ice Cream Brand	
	1. Homemade	2.
Sweetness		
Flavor		
Syrup		
Bloom		
Body		
Texture		
Average		

Results and Conclusions (to be completed after all data is collected from your peers):

Use the following questions to help you to write your Results and Conclusions sections of your laboratory report. Again, this handout will not be collected and scored, but use these questions to guide you.

Exercise 2: Ice Cream Taste Test

1. Recreate Data Table 1, now with at least 4 store-bought brands represented from yourself and your peers (along with your homemade ice cream):

Characteristic	Ice Cream Brand				
	1. Homemade	2.	3.	4.	5.
Sweetness					
Flavor					
Syrup					
Bloom					
Body					
Texture					
Average					



Laboratory Exercise – Ice Cream

2. Rank the ice cream brands you and your peers tasted highest to lowest based on average score. If several of your classmates used the same ice cream brand, you may either select the data from one peer, or average all of the scores (more accurate). Which ice cream brand scored the highest on the taste test? Which was the lowest?
3. Was there a correlation between the cost of the ice cream and the taste rankings? Was the correlation what you expected?
4. Compare the ingredients list for each of the ice creams tasted. Do the ingredients give you an indication why certain ice creams rated higher or lower in the scale?

Process of Science Questions and Conclusions:

Earlier you created a key questions, hypotheses, predictions, and explanations for this prediction for each of the experiments in this laboratory exercise.

Based upon your data and the questions you have answered related to this exercise you should be able to complete the process of science questions and conclusions.

Answer the following questions.

1. Did your data support or falsify your hypothesis?
2. How did you come to this conclusion?
3. Did these results change your thinking about this topic? How?
4. What changes would you make to your hypothesis based on this new data?
5. What changes would you make to the experiments to better clarify your results?