Eveready Battery Company
P.O. Box 450777
Westlake, OH 44145

Dear Educator:

The Cleveland Section of the American Chemical Society and NASA Lewis Research Center are again sponsoring a contest for students in grades 9 - 12 as a part of their National Chemistry Week celebration. National Chemistry Week will be celebrated November 6-12 this year. There will be several other activities in addition to the contest this year. We have enclosed a calendar of events. Please share this information with your students. We hope both you and they will enjoy the activities we have planned.

Please encourage your students to enter the contest. We also encourage you to perform the experiments in your classroom and send entries in as a class. The questions were selected so that common items are used for the experiments; no special chemicals or equipment are needed. You can send one self-addressed stamped envelope for your entire class, but please use an envelope approximately 9 inches by 12 inches with 4 stamps so that we can fit into it the prizes for all the students in your class that entered the contest. Each individual entry must include the student's name and phone number, teacher's name, grade, and school.

Every student who enters will receive a prize. Correct answers will be entered into a random drawing and the winners of that drawing will receive savings bonds.

Please encourage your students to research these and related topics, such as "ice cream -- history", endothermic and exothermic reactions, and heats of solutions. Both NaCl and $CaCl_2$ are used in melting ice on roads in winter. After researching this topic, the students will know at what temperature NaCl is no longer effective. Water solutions of NaCl and $CaCl_2$ are common refrigeration brines used in skating rinks and in industrial machinery. A NaCl brine fog method is used to freeze fish and other foods. It is used as a spray to prevent frost formation on cooling coils. Ethylene glycol solutions are used in snow melting, ice rinks, and as antifreeze in cars. (Ashrae Handbook 1985 Fundamentals). Ice cream novelties and popsicles can be made in molds immersed in a $CaCl_2$ brine solution which in turn is cooled by ammonia coils.

Students who are interested in learning more about commercial ice cream making can be directed to the ice cream manufacturer Pierre's which is located in Cleveland. The Production Manager, Mike, at 432-1144 has agreed to answer calls about Pierre's process.

We hope you and your students enjoy the contest. We hope that this helps your students to experience the excitement of discovery and to see the relevance of science to their daily lives.

Sincerely,

Michael P. Setter and Marcia Schiele
National Chemistry Week Co-Chairs

A: Solutions are homogeneous mixtures where the particles of lesser quantity called the solute are dissolved in a solvent. These solute particles are generally molecules or ions and cannot be observed even with an ultramicroscope. They cannot be physically separated from the solvent by, for example, filtration or centrifugation. They do not settle on standing. The particles are thoroughly surrounded by solvent molecules. The particles seem to disappear when dissolved, and the resulting solution is clear although it may have a color. During the formation of a solution, solute molecules are separated from each other and sometimes molecules are broken into ions, and energy is used. Subsequently energy is released by the "bonding" of the solvent molecules to solute particles. This evnergy is adsorbed and released as heat; temperature change may or may not be readily observed.

B: Colloids bridge the difference between solutions and suspensions. They are stable two-phase dispersions. In such a mixtrue one substance (the dispersed phase)is divided into minute particles and dispersed and held throughout a second substance (called the dispersing medium) in which they are insoluble. The dispersed particles are not appreciably bound to solvent molecules but they do not settle on standing. They are small enough to remain dispersed indefinitlely. The particles, on the order of 10 to 10,000 angstroms (1 angstrom = 1 ten billionth of a meter)in diamter, are larger than those in solutions and smaller than those in suspensions. The particles may be aggregates (such as micelles) of molecules or very small particles, or single large molecules such as polymers or proteins. The mixture tends to pass through ordinary filter paper (try a coffee filter). Sometimes the mixture looks cloudy or milky. However, sometimes seemingly clear mixtrues are colloids. There is a method to differentiate the two. Colloids scatter light when a narrow beam of light is passed thhrough the (they Tyndall effect). In a completely darkened room, pass a narrow beam of light through the mixture (use a regular flashlight covered with aluminum foil with a pinprick in the center). You may have to try different angles of the flashlight in order to see the path of light.

C: Suspensions are mixtures where the particle are greater than about 10,000 angstroms in diameter, larger than those in colloids or solutions; they are visible under a microscope and some can be seen with the naked eye. The particles precipitate or settle out under the influence of gravity if left undistrubed. The particles can be easily filtered out.

Sources:

Basic Chemistry, 2nd Ed., by W.S. Seese and G.H. Daub, Prentice-Hall, inc., NJ, 1977.

Chemical Investigations for Changing Times. 5th Ed., by J.W. Hill, L.W. Scott, and P. Muto, Macmillan Publishing Company, NY, 1988.

Physical Chemistry, by G.M. Barrow, McGraw-Hill, Inc., NY, 1973.

What is Chemistry? A Chemical View of Nature, by J. Nordmann, Harper & Row, NY, 1974.

The New Columbia Encyclopedia, Columbia University Press, Ny, 1975.

THE AMERICAN CHEMICAL SOCIETY
CLEVELAND SECTION &
NASA LEWIS RESEARCH CENTER

As part of the celebration of National Chemistry Week
(November 6-12, 1994)
Ask students in the eighth grade or below

"WHAT ARE THE FOLLOWING MIXTURES?"

Prepare the following mixtures and identify each as a true solution, colloid, or temporary suspension.

1) 1/8 teaspoon of hot cocoa mix in 8 oz very hot water.
2) 1 teaspoon sodium bicarbonate (baking soda) in 8 oz water.
3) 1/2 teaspoon Knox Unflavored Gelatine® in 8 oz very hot water.
4) 1 teaspoon instant coffee in 8 oz water.
5) 2 drops red food coloring in 8 oz water.
6) 1/8 teaspoon all purpose flour in 8 oz water.
7) 1 teaspoon sugar in 8 oz water.
8) 1/8 teaspoon vegetable oil and 2 drops dish washing liquid in 8 oz very hot water.
9) 1/8 teaspoon pepper in 8 oz water.
10) 1/8 teaspoon 2 % milk in 8 oz water.

Stir each mixture thoroughly in a clear, clean drinking glass or jar. Observe immediately, after standing for several minutes, and again after about 10 minutes. Do not shake the mixtures. The very hot water can be boiled water stored in a thermos. Report the results in a table with the following columns, making a check mark in the proper column:

Mixture Number	True Solution	Colloid	Temporary Suspension

Include your name, phone number, school, and teacher's name on your entry. Send your answer and a self-addressed stamped envelope BY OCTOBER 31 to:

Grade/Middle School Chemistry Contest
c/o John Carroll University
Department of Chemistry
Cleveland, OH 44118-4581

All answers will be rewarded with a prize (so be sure to send your self-addressed stamped envelope)! All the correct answers will be entered into a random drawing. Winners of the drawing, their parents, and their teachers will be invited to be our guests at one of the Cleveland Section of the American Chemical Society's monthly meetings. At the meeting, the students will be recognized and presented with savings bonds.

This contest has been supported by area industries that help to make our lives better through chemistry.

Eveready Battery Company
P.O. Box 450777
Westlake, OH 44145

Dear Educator:

The Cleveland Section of the American Chemical Society and NASA Lewis Research Center are again sponsoring a contest for students in grades 8 and below as a part of their National Chemistry Week celebration. There will be several other activities in addition to the contest this year. We have enclosed a calendar of events that you can share with your students. We hope both you and they will enjoy the activities we have planned.

Please encourage your students to enter the contest. We encourage you to perform the experiments in your classroom and send entries in as a class. The questions were selected so that common items are used for the experiments; no special chemicals or equipment are needed. You can send one self-addressed stamped envelope for your entire class, but please use an envelope approximately 9 inches by 12 inches with 3 or 4 stamps so that we can fit the prizes for all the students in your class that entered the contest into it. Each individual entry must include the student's name and phone number, teacher's name, grade, and school.

Every student who enters will receive a prize. Correct answers will be entered into a random drawing and the winners of that drawing will receive savings bonds.

Feel free to help your students with the following definitions:

A: Solutions are homogeneous mixtures where the particles of lesser quantity, called the solute, are dissolved in a solvent (water in this case). The solute particles cannot be observed, even with an ultramicroscope. They cannot be separated from the solvent by filtration through coffee filters. They do not settle on standing. The particles seem to disappear when dissolved, and the resulting solution is clear although it may have a color. During the formation of a solution, solute molecules are separated from each other and sometimes are broken into ions. They then "bond" to the solvent molecules.

B: Colloids are in between solutions and suspensions. They can be aggregates of molecules, small particles, or single, large molecules. In such a mixture one substance is divided into minute particles and dispersed and held throughout a second substance. The dispersed particles do not settle on standing. The mixture tends to pass through ordinary filter paper (try a coffee filter). Sometimes the mixtures looks cloudy or milky. At other times they are clear. In a completely darkened room, pass a narrow beam of light through the mixture (use a regular flashlight covered with aluminum foil with a pinprick in the center). The light path can be seen in the colloid, but not in the solution. This is the Tyndall effect. You may have to try different angles of the flashlight in order to see the path of light.

C: Suspensions are mixtures where the particles are visible under a microscope and some can be seen with the naked eye. The particles precipitate or settle out under the influence of gravity if left undisturbed. The particles can be easily filtered out.

We hope you and your students enjoy the contest. We hope that this helps your students to experience the excitement of discovery and to see the relevance of science to their daily lives.

Sincerely,

Michael P. Setter and Marcia Schiele
National Chemistry Week Co-Chairs

Dear Educator,

Thank you for participating in our 1994 grade school contest. The theme we chose for activities during National Chemistry Week centers on Food and Kitchen Chemistry. We hope your students enjoyed making observations and conclusions about mixtures of common foods. We hope the students are more aware of the chemistry all around us. After participating, one student said he wished he had a sample of the pond water he went canoeing in, because it was cloudy and full of little particles suspended in it, just like a colloid!

All entrants are rewarded with a chemist Weepul wearing safety goggles and holding a banner proclaiming National Chemistry Week (NCW). Even the adults who saw these wanted one! Entries with correct answers will be placed in a drawing for savings bonds and dinner with ACS - Cleveland Section members. We were lenient "graders" because we felt everyone made good observations, and also because of the nature of the experiments -- there are many variables when dealing with food (and nonuniform ingredients). We wanted the experiments to be easy to do (with easy-to-find materials), safe, and fun!

We did some research about mixtures, and we tried the experiments several times; we thought you might find our results (below and next page) interesting. Thank you for your participation.

Sincerely,
Dr. Michael P. Setter & Marcia Schiele, NCW Co-Chairs
Richard Pachuta, Radiometer America

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In the following table, "T/L" refers to THEORY/LITERATURE and "O" to our OBSERVATIONS.

Mixture Number (& ingredient in 8 oz. water)	True Solution	Colloid	Temporary Suspension
1 (hot cocoa mix)	*	T/L, O	O
2 (Baking soda) **	T/L, O		
3 (gelatine) **		T/L, O	
4 (instant coffee)	T/L, O	O	
5 (red food coloring) **	T/L, O		
6 (flour) **			T/L, O
7 (sugar)	T/L, O	O	
8 (oil, dishwashing liquid)		T/L, O	
9 (pepper) **			T/L, O
10 (milk) **		T/L, O	

* The hot cocoa mix we used contained milk, so mixture #1 had properties of a colloid. The list of ingredients hopefully gave you a clue about the presence of milk; without it your mixture may have been observed as a solution.

** We based the "grades" on these mixtures (two of each type) where ingredients are fairly standardized. (#3 or #8 was acceptable)

According to examples given in the LITERATURE (see references listed below) and THEORY, mixture #s 1 (hot cocoa mix), 3 (gelatine), 8 (oil/dishwashing liquid), and 10 (milk) can be classed as colloids. The dispersed particles in a colloid are about 10 to 10,000 angstroms (1 angstrom = one ten-billionth of a meter) in diameter. The particles may be aggregates (such as micelles), as is the case when oil is dispersed in water (#8) - the oil is not floating on the top, but is dispersed by the action of the dishwashing liquid. Single large molecules, such as polymers or proteins, can also be in this size range.

There are many types of colloids. Both the dispered particles and dispersing medium can be gas, liquid, or solid and are classed as foams, aerosols, emul-

sions, gels, & sols. #8 and milk are examples of emulsions, where liquid particles are dispersed in a liquid. Butterfat in milk is dispersed in water. The scattering of a beam of light is observable through thin milk. (#s 1 and 10)

OUR OBSERVATIONS when we did the experiments, in general, supported theory. Mixture #1 (hot cocoa mix) looked cloudy and milky like a colloid, and it scattered a beam of light. We noticed if it was not initially thoroughly mixed, then particles settled out with time, making the mixture look like a temporary suspension. We suggested using very hot water, as do the manufacturers, to aid in the mixing (the faster the molecules move, the faster and better the mixing). It is also possible that our cocoa mix just simply contained large-sized particles that settled out. Mixture #3 was a good candidate for the Tyndall "test". After the gelatine was thoroughly mixed in, the mixture became very clear. To distinguish if it was a solution or colloid we used a covered flashlight with a pinhole opening in a dark room, as described in the contest letter. A thin beam of light was readily observable through the mixture. We had a similar experience with #8 (oil/dishwashing liquid). Mixture #10 (milk) was cloudy and "milky" and broadly scattered light.

According to the LITERATURE and THEORY, mixtures 2 (baking soda), 4 (instant coffee), 5 (red food coloring), and 7 (sugar) are solutions.

OUR OBSERVATIONS clearly agreed in the case of #s 2 and 5. The mixture of baking soda (#2) was very clear and, in a thin flashlight beam, in a dark room, no light could be seen in the jar (only spots of reflected light on opposite sides of the jar). We had the same results with the mixture with red food coloring (#5); the only difference was that although the solution was clear it had color. These results verified the presence of a solution.

Some teachers questioned why a mixture known as a solution looked like a colloid (specifically the sugar mixture, #7) when testing the Tyndall effect. We had a few ideas: If the mixtures are vigorously stirred or shaken (which we discouraged) small air bubbles become incorporated and may remain suspended for a long time. Table sugar is sucrose, a "double" sugar, but if powdered sugar were used the results become clouded, so to speak. Powdered sugar generally contains insoluble cornstarch (starch is made of chains of thousands of single sugar units) to prevent caking. (Flour, #6, has about 70% starch by weight and will eventually settle out of the water.) Table salt, NaCl, is soluble in water, but often contains insoluble additives like sodium silicoaluminate.

After all that, we had some questions about #s 4 and 7, also. Mixtures with instant coffee (various types) and sugar looked clear, but sometimes light scattering results indicated the mixtures were colloidal-like. We concluded that different coffees may have additives with particles in the "colloid" size range. The purity of sugar may vary depending on product filtering.

The LITERATURE and OUR OBSERVATIONS agreed that mixture #s 6 and 9 were temporary suspensions. Upon sitting, the "large" flour and pepper particles settled to the bottoms of the jars.

Our observations were not done in a lab, but in a kitchen with kitchen utensils and off-the-shelf products. Chemists in the lab often have sophisticated instrumentation to aid their senses in analyzing such things as particle size. It is interesting to note, however, that the Tyndall effect, a simple test, can be used to determine if mixtures such as pharmaceutical preparations are true solutions.

References: Basic Chemistry, 2nd Ed., by W.S. Seese and G.H. Daub, Prentice-Hall, Inc., NJ. 1977. Chemical Investigations for Changing Times, 5th Ed., by J.W. Hill, L.W. Scott, and P. Muto, Macmillan Publishing Company, NY, 1988. The First Year College Chemistry-College Outline Series #5, 7th Ed., by J.R. Lewis, Barnes & Noble, NY, 1964. Chemically Active! by Vicki Cobb, Lippincott, NY, 1985. Physical Chemistry, by G.M. Barrow, McGraw-Hill Inc., NY, 1973. What is Chemistry? A Chemical View of Nature, by J. Nordmann, Harper & Row, NY, 1974. The New Columbia Encyclopedia, Columbia University Press, NY, 1975.

THE AMERICAN CHEMICAL SOCIETY
CLEVELAND SECTION &
NASA LEWIS RESEARCH CENTER

As part of the celebration of National Chemistry Week
(November 6-12, 1994)
Ask students in grades 9 through 12

"WHY PUT SALT ON THE ICE SURROUNDING A HOMEMADE-ICE-CREAM MAKER?"

A 1. Make a 1/2 cup mixture of crushed ice and water. Put it in an insulated cup or thermos. Measure its temperature with a thermometer that measures below freezing.
2. Add 1/2 teaspoon of NaCl (table salt) to the ice/water mixture and stir it. Record the temperature between 30 seconds and 2 minutes after adding the salt.
3. Repeat step 2 six times.
4. Why doesn't the solution freeze as the temperature drops below 0°C, the freezing point of water?

B: 1. Weigh 1/2 cup of fresh tap water (W_1, in g) without ice. Put it in a clean insulated cup or thermos. Measure the temperature (T_1, in C).
2. Weigh 1 teaspoon of NaCl (W_2, in g). Thoroughly stir it into the water. Measure the temperature between 30 seconds and 2 minutes after stirring (T_2, in C).
3. Calculate and report the heat of solution, ΔH_{sol} of the NaCl in cal/g.

$$\Delta H_{sol} = (T_2 - T_1)\frac{W_1}{W_2}(1\frac{cal}{g^\circ C})$$

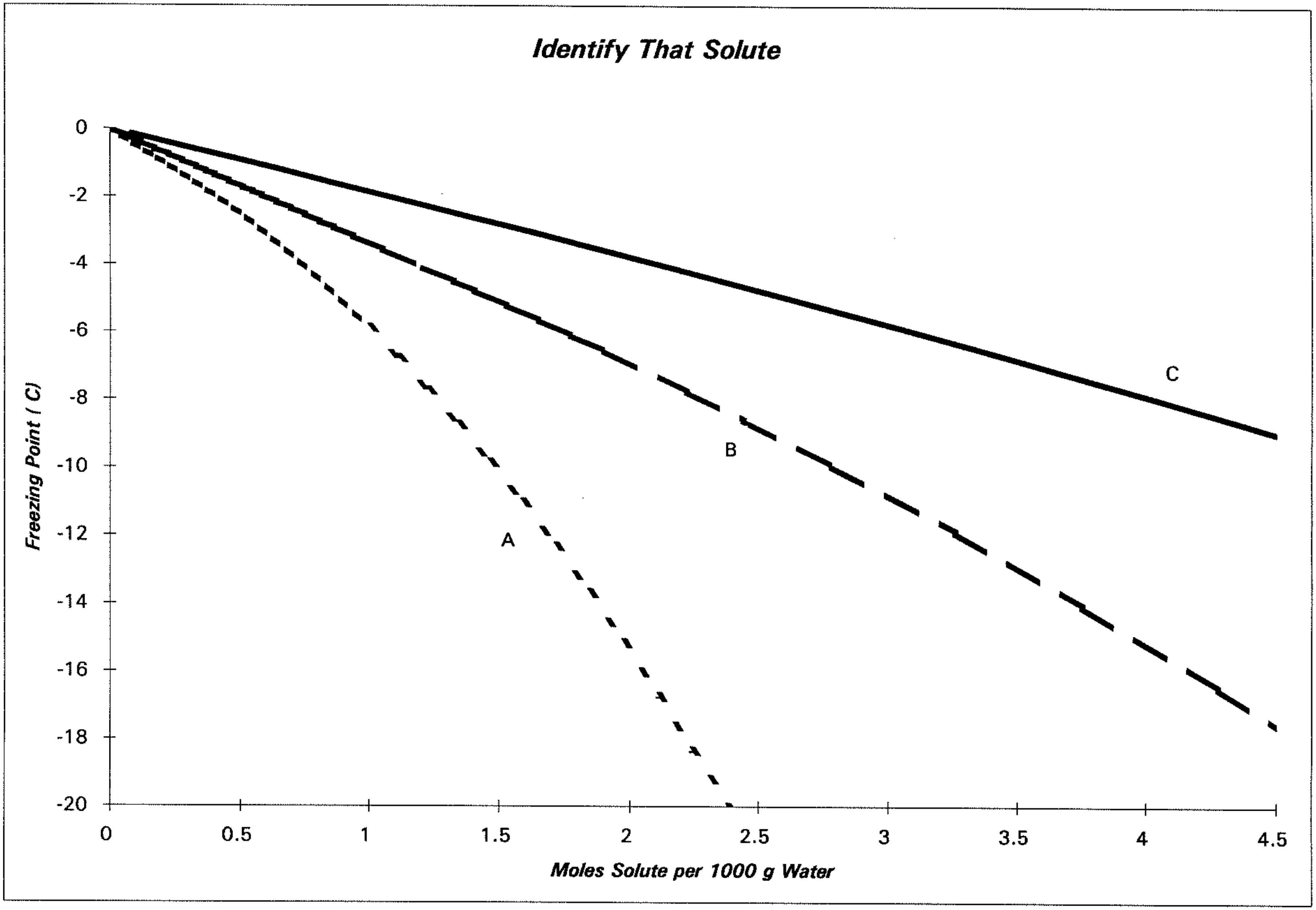
C: Determine and report which lines (A, B, and C) on the attached graph correspond to the following solutes: sodium chloride (NaCl), ethylene glycol ($C_2H_6O_2$), and calcium chloride ($CaCl_2$). Two solutes are ionic and the third is not. The definitions of heat of solution, colligative properties, van't Hoff i factors, molal freezing-point-depression constant, and Beckman method may be helpful.

Include your name, phone number, school, and teacher's name on your entry. Send your answer and a self-addressed stamped envelope BY OCTOBER 31 to:

High School Chemistry Contest
c/o John Carroll University
Department of Chemistry
Cleveland, OH 44118-4581

All answers will be rewarded with a prize (so be sure to send your self-addressed stamped envelope)! All the correct answers will be entered into a random drawing. Winners of the drawing, their parents, and their teachers will be invited to be our guests at one of the Cleveland Section of the American Chemical Society's monthly meetings. At the meeting, the students will be recognized and presented with savings bonds.

This contest has been supported by area industries that help to make our lives better through chemistry.


Identify That Solute
Freezing Point (C)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Moles Solute per 1000 g Water
A
B
C

THE AMERICAN CHEMICAL SOCIETY-CLEVELAND SECTION & NASA LEWIS RESEARCH CENTER
IN CELEBRATION OF NATIONAL CHEMISTRY WEEK, NOVEMBER 6-12, 1994
HIGH SCHOOL CHEMISTRY CONTEST

Dear Educator,

Thank you for participating in our 1994 high school chemistry contest. The theme we chose for activities during National Chemistry Week centers on Food and Kitchen Chemistry -- being aware of the chemistry all around us! We hope learning about the chemistry of ice cream and cooling materials was enjoyable for your students.

All entrants are rewarded with a chemist Weepul wearing safety goggles and holding a banner proclaiming National Chemistry Week (NCW). Even the adults who saw these wanted one!

Following are interesting facts on ice-cream making from ON FOOD AND COOKING - The Science and Lore of the Kitchen, by Harold McGee, Charles Scribner's Sons, NY, 1984, pp. 27-30:

Salt in the cooling bath acts like the sugar in the liquid ice cream mixture itself. Dissolved sugar gets in the way of water molecules that must bond together to form ice crystals; this lowers the freezing point of the mixture from 0 to about -3 degrees C. As the water starts crystallizing, the remaining sugar solution gets more concentrated and the freezing point is lowered more, ensuring that some liquid will always remain. At -12 degrees C, the serving temperature recommended for regular ice cream, there is about a cup of liquid per half gallon.

Freezing a homemade ice cream mixture is done with a bath of ice and salt. "Ice cream simply cannot be made without salt in the ice water." Since the sugar mix will not freeze above -3 degrees C, the surrounding cooling bath must be colder than this. Ice from the freezer is about -12 degrees C, however factors such as warm air and warm mix cause the ice water to warm up. So salt is added to lower the freezing point of the water, thus it is liquid at lower temperature. The salt water then absorbs heat from the ice cream mix, "the colder ice melts and keeps the brine cold, and salt crystals dissolve to keep the brine from being diluted. Theoretically, one part of salt added to three of ice (by weight) can produce a liquid brine of -21 degrees C. In practice, our ice is not that cold to begin with, salt isn't that cheap, and we really don't want that cold a brine anyway, at least not during the first stage of freezing....more often than not we just throw in a handful of salt for every few handfuls of ice."

According to Encyclopedia Americana, one of the most important innovations in ice-cream making came with the discovery that salt lowers the freezing point of water.

According to the Handbook of Chemistry and Physics, the heat of solution of sodium chloride in water at 18 degrees C is -21.92 cal/g, and at 25 degrees C -15.88 cal/g. When we did a series of experiments with a digital thermometer and starting temperatures ranging from 22.0 to 22.5 degrees C and final temperatures ranging from 21.1 to 21.7 degrees C, we obtained heats of solution between -15.8 and -17.7 cal/g. Using a mercury thermometer at about the same temperature our results were between -19.7 and -21.5 cal/g.

On the graph the top line is associated with ethylene glycol, the middle with sodium chloride, and the bottom line with calcium chloride which depresses the freezing point the most.

Thank you again for your participation.

Sincerely,
Dr. Michael Setter and Marcia Schiele
National Chemistry Week Co-Chairs
Richard Pachuta, Radiometer America