Have an ice cream social—chemistry style! Ice cream is fast and fun to make when you freeze it using liquid nitrogen. Clubs could have a social to welcome new members, or could sell ice cream as a fundraiser at a school event or school sport concession stand.

LIQUID NITROGEN ICE CREAM

SUBMITTED BY ACS OFFICE OF HIGH SCHOOL CHEMISTRY, WASHINGTON, DC

INGREDIENTS

4 cups milk
6 cups heavy cream (half-and-half is an acceptable substitute for the milk and heavy cream)
1 cup sugar
2 tbsp vanilla extract

Optional:
Egg Beaters® egg substitute.
For chocolate ice cream: Add 1 cup cocoa powder and 1/2 cup additional sugar.
For chocolate chip ice cream: Add 12 oz chocolate chips, mini chocolate chips, or chocolate flakes.
For fruit flavors: Add 1 to 2 cups chopped fruit or fruit preserves.

EQUIPMENT

Liquid nitrogen, at least 4 liters and Dewar flask to hold it
Stainless steel mixing bowl, 5 quart or larger (Do not use plastic, glass, or ceramic bowls as they may crack due to the temperature of the liquid nitrogen.)
Large wooden spoon
Large spoon or scoop for serving the ice cream
Plastic spoons, cups/bowls/cones for serving

SAFETY

Wear heavy insulated or cryogenic gloves when working with liquid nitrogen. Any helpers should also wear gloves. Keep all spectators at a safe distance.

Wear goggles while preparing the ice cream.

All materials used must be reserved for food use only. The materials must be stored in an area where there is no possibility of contamination from laboratory chemicals.
INSTRUCTIONS

1. Combine all ice cream ingredients in a large stainless steel bowl. Stir to dissolve all the sugar. If desired, add one 4 oz container from a standard 3-pack of Egg Beaters® to the ice cream mix. This acts as an emulsifier to prevent separation of components. Other optional ingredients can be added at this time. If making chocolate ice cream, mix the cocoa with some milk or cream by shaking it in a separate, sealed plastic container before adding it to the ice cream mix.

2. Slowly add some liquid nitrogen to the ice cream mixture. Wait briefly, then stir with a wooden spoon. Stir until you have a consistent mixture (all parts equally liquid/frozen). CAUTION: A fog will be formed and some liquid nitrogen may splatter from the container.

3. Continue to stir while adding additional liquid nitrogen in small quantities. It will take approximately two liters of liquid nitrogen to freeze a single batch of the mixture.

TO THINK ABOUT

Describe the states of matter for the nitrogen used in this recipe. How is the nitrogen able to freeze the ice cream?

References

TIPS

Liquid nitrogen ice cream does not keep well and should be served immediately. If it does start to turn back into a liquid, you can add more liquid nitrogen to refreeze it.
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DID YOU KNOW?

The liquid nitrogen, at –196 °C, is able to quickly cool and freeze the liquid ice cream mixture, with any remaining nitrogen leaving as a gas. The secret to the creamy ice cream is all in the rapid freezing of the mixture and the use of fats (from the cream) in the mixture. The liquid nitrogen causes the fat and the water particles to stay very small, giving the ice cream its creamy consistency. The goal is to avoid large ice crystals in the structure.

SAFETY

Liquid nitrogen is extremely cold, –196 °C (–320 °F). It should be stored in a large Dewar flask. Under no circumstances should the liquid nitrogen container be tightly sealed. Vented tops or covers must be used.