

Liquid Nitrogen Demos

Liquid nitrogen is a cryogenic liquid (of or related to low temperatures) and is stored at 77 Kelvin (-199°C). The liquid boils at -196°C. Since liquid nitrogen is so cold it has many uses as a refrigerant (including keeping some electronic equipment cool and preserving simple living organisms for long periods of time) and is also used to form inner atmospheres for the preservation of other materials. Because of its cryogenic properties, the interaction of liquid nitrogen with other materials can lead to reactions which are scientifically interesting, some of which will be described in the following procedures.

Shrinking Balloons:

- Small balloons
- Tongs

Have students blow up 7-10 balloons to a size slightly smaller than the opening of the Dewar containing liquid nitrogen. Place a balloon in liquid nitrogen. The balloon flattens as the air condenses, allowing many more balloons to be placed into a small Dewar.

Shattering Ball:

- Racquetball
- Tongs

Hold a racquetball with tongs and place it in a Dewar of liquid nitrogen. After several minutes, the ball is hard enough to shatter when “bounced.” If the ball is removed from the liquid nitrogen too early, it will bounce like a billiard ball. *Note: Be sure to hold the ball with a cryo-glove.*

Rubber Hose:

- Tygon tubing
- Tongs

Tell students that the tubing resembles their finger in the way that it moves. Hold a small piece of Tygon tubing is placed in liquid nitrogen. Count to 5 and remove the tubing from the nitrogen. The frozen hose can be shattered with a hammer.

Banana Hammer:

- Banana
- Nail
- Board

This demo can illustrate what would happen to your finger if it was placed in the liquid nitrogen. Bananas are composed of mostly water, and when water is cooled it expands. This expansion causes the cells to break. When the banana thaws it will turn brown, just as your finger will turn brown from frostbite.

Place a ripe banana in liquid nitrogen. The nitrogen will boil rapidly, and then slow down. At this point the banana is hard enough to hammer a nail into a small piece of wood. If removed too

early, the banana will be too soft to pound the nail, but if left in the liquid nitrogen too long, it will be too brittle and will break. *Note: Be sure to hold the frozen banana with a cryo-glove.*

Air Conditioner:

- Insulated cup
- Water

Put a small amount of water in an insulated cup. Add liquid nitrogen to the cup, and put the lid in place. Water vapor pours out of the hole in the top of the lid, creating an "inexpensive air-conditioner." The most expensive part of the air conditioner is the insulated cup. Liquid nitrogen is about as expensive as milk.

Liquid Oxygen:

- Balloon
- Oxygen gas

Carefully hold an oxygen-filled balloon (without tying) and pour liquid nitrogen onto the balloon. The oxygen condenses inside the balloon. Quickly pour the liquid oxygen into a small Styrofoam cup.

Methane Torch:

- Methane tank
- Pyrex test tube
- Rubber hose
- Styrofoam cup

Fit a rubber hose to either a methane tank (fitted with a regulator) or a gas jet supplying methane. Pour liquid nitrogen into a styrofoam cup. Place the hose attached to the methane supply into the test tube. Start the flow of methane to evacuate the test tube of oxygen and place the Pyrex test tube into the liquid nitrogen. The methane gas will be condensed in the test tube. Continue to condense methane until a few milliliters of methane are collected. Turn off the methane gas supply. Remove test tube from the styrofoam cup with either a test tube holder or a cryo-glove. As the liquid methane begins to vaporize, ignite the top of the test tube with a match or lighter. This will result in a small blue flame at the top of the test tube. As more methane is vaporized the flame will get bigger. The vaporization process can be sped up by warming the bottom of the test tube with your hand. Do not heat the test tube over an open flame. The flame will extinguish when all of the liquid methane has vaporized or it can be extinguished by placing the tube back into the styrofoam cup of liquid nitrogen. (CAUTION: Be sure to begin the flow of methane before placing tube into the test tube. Failure to do so may result in the air inside the tube being condensed and mixing with the methane. This will introduce liquid oxygen into the system which can cause explosive results.)