

## 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.

### Safety First:

The presenter indicates the need for eye and skin protection when using liquid nitrogen. The extremely low temperature liquid is very dangerous.

### Introduction:

The presenter discusses the meaning of *cryogenics* with students and discusses what they know. *Cryogenics* is a branch of physics that deals with the production and effects of very low temperatures. The derivation of the word cryogens is from the Greek “kyros”, meaning “icy cold.”

### Demonstration of Liquid Nitrogen:

The presenter pours some liquid nitrogen into a clear cup and holds it high enough for students to see and to make observation.

### Fog Breath:

The presenter gently blows air over the surface of liquid nitrogen. Fog appears because water in the air condenses to form droplets.

### Banana Hammer:

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.*

### Shrinking Balloons:

Have students blow up 5-7 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:

A racquetball is placed 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:**

A small piece of rubber hose is placed in liquid nitrogen. Use tongs to remove the hose from the liquid nitrogen. The frozen hose can now be shattered with a hammer.

**Ping-Pong Ball Fun:**

According to Newton's Third Law of Motion, when two objects collide with one another, both objects experience forces which are equal in magnitude but opposite in direction. What if one object is the ping-pong ball and the other object is the liquid nitrogen vapor?

**Air Conditioner:**

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."

**Condensing Carbon Dioxide:**

Dry Ice is placed in water in a plastic pop bottle. A balloon is placed over the top of the bottle and allowed to fill with carbon dioxide gas. Next, the balloon, tied off, is placed in a bowl and liquid nitrogen is poured over the top of it. After it is deflated, the balloon is cut open and the pieces of Dry Ice are removed and placed in a plastic cup. Students once again look at the thermometer drawing showing where Dry ice becomes solid compared to where liquid nitrogen boils.

**Frozen Petals:**

Submerge a flower in liquid nitrogen until the liquid nitrogen no longer boils rapidly. Remove the flower and crush it in your hand.

**Superconductivity:**

Cut off the bottom 2 cm of a Styrofoam cup. Place a super conducting ceramic disc in the cup and place a small magnet on top of the disc. Pour liquid nitrogen in the bottom of the cup, and the magnet will levitate. Touching lightly with a wood splint will make the magnet rotate.

**Making Ice Cream**

Liquid nitrogen is used to freeze milk, cream, sugar, and flavoring to create yummy ice cream.

**Standards Met:**

**4.1.3, 4.1.7, 4.2.4, 4.2.5, 4.6.1, 4.6.4, 5.6.1**

**5.1.7, 5.3.8, 5.3.9**

**8.1.8, 8.2.7, 8.3.8, 8.3.10**

**CP.1.5, CP.1.11, CP.1.16**

**C.1.26, C.1.38, C.1.41**

**P.1.3, P.1.27**