An Egg-cellent Opportunity To Study the Affects of Liquid Nitrogen

Objective: The students will be able to understand the affects of liquid nitrogen on an uncooked egg

Materials Needed: eggs, wooden spoon, frying pan, forceps, liquid nitrogen, safety goggles, gloves, hammer, large styrofoam coffee cup, and an insulated container

Set: "Eggs!" By Jack Prelutsky in The New Kids on the Block (copyright 1984), "EGGS RATED" By Shel Silverstein in Falling Up (copyright 1996), Egg-Drop Blues by Jacqueline Turner Banks, Green Eggs and Ham by Dr. Seuss, Humpty Dumpty Nursery Rhyme by Mother Goose

Procedure 1:

1. Place safety goggles securely on your face. Crack open egg and pour into frying pan.
2. Using the cup, pour liquid nitrogen over the egg. *It turns into a "fried egg"!*
3. Record your findings.
4. Discuss with the audience the fact that although it looks like a "fried egg" it is truly a frozen egg and that when it warms up again, it will become an uncooked egg once more.

Procedure 2:

1. Place safety goggles securely on your face. Place an egg (raw & in shell) into container with liquid nitrogen. The liquid nitrogen will seem to be "boiling" the egg.
2. After the nitrogen has stops boiling so rapidly, take the egg out using the wooden spoon and a glove.
3. Smash it with a hammer until it cracks open, it appears to be "hard boiled". As it cools it returns to white and yolk.

Explanation 1: As the liquid nitrogen begins to boil it begins to turn back into a gas thus causing it to sound as if the egg is frying. At the same time, the oxygen in the egg evaporates and freezes the egg giving it the cooked egg appearance. As the egg starts to thaw out and oxygen replenishes the surface of the egg, the egg reverts back to it's liquefied state.

Explanation 2: As the liquid nitrogen begins to boil it is freezing the egg in it's shell. When hammered, it cracks open and appears to be a hard boiled egg, however it is just in a frozen state and as it begins to thaw, it will return to a liquefied state.

Ping-Pong Anyone?

Objective: The students will be able to understand the affects of liquid nitrogen on air

Materials Needed: Ping-Pong balls, red, green, and blue permanent markers,
pin, forceps, wooden spoon, liquid nitrogen, safety goggles, gloves, and an insulated container

Procedure:

1. Prepare a Ping-Pong ball with a small pin-hole on the side of the ball. Place safety goggles securely on and keep gloves near by. Immerse it in liquid nitrogen (-196 °C). The nitrogen starts to boil more rapidly than it already did. After a while the fluid comes to rest again and it just boils gently as before the immersion.
2. *Ask the audience what will happen and why, when the ball is placed on the table.* (Don't tell yet that the ball is slightly prepared).
3. With forceps or wooden spoon the ball is taken out of the nitrogen and placed on the table. Almost immediately the ball begins to spin, initially slowly and later amazingly fast.
4. Record your findings.
5. To see the effect of spinning more clearly, repeat the experiment but first decorate the ball with colorful stripes. As the ball spins the stripes will vanish and the surface of the ball will seem whitish.

Explanation 1:

Liquid nitrogen was sucked into the ball. Placed on the table, the nitrogen warms up and the vapor (gas) leaves the ball through a pinhole with high speed.

Explanation 2:

Nearly invisible there is made a pinhole in the surface of the ball. At first air (at room-temperature) fills the inner side of the ball. Immersed in the liquid nitrogen, the air inside the ball cools down and the pressure of the air is lowering. Through the pinhole liquid nitrogen is sucked into the ball. (The liquid is boiling fiercely now because of the heat that is given off by the ball). As soon as the ball reaches the same temperature as the liquid, the fluid boils gently again.

When the ball is put on the table, heat from the surroundings is absorbed. The liquid nitrogen in the ball starts to boil more fiercely. Vapors and gasses can only escape through the pinhole (drilled not perpendicular to the surface of the ball). This acts as a jet-engine and makes the ball spin. If the right types of colors red, green and blue were used, the human eye would interpret a mixture of these colors as white.

Got Air?

Objective: The students will be able to understand the affects of liquid nitrogen on air

Materials Needed: latex gloves, balloons, test tubes, forceps, wooden spoon, liquid nitrogen, helium, safety goggles, gloves, and an insulated container

Set: "I Am Shrinking" by Jack Prelutsky in It's Raining Pigs & Noodles (copyright 1993), "Human Balloon" by Shel Silverstein in Falling Up (copyright 1996), Where Do Balloons Go?-An Uplifting Mystery by Jamie Lee Curtis

Procedure 1:

1. Place safety goggles securely on your face. Place an inflated glove into the container of liquid nitrogen. *As the glove starts to deflate, observe what is happening inside the glove. As the glove deflates the liquid nitrogen is making the air trapped inside liquefy. If you move the glove around, you can see the liquefied air inside the balloon move around.*
2. Take the glove out of the liquid nitrogen. When it is warmed up, the balloon regains its original volume and shape.
3. Record your findings.
4. Repeat the experiment with a balloon and record your findings.
5. A helium-filled glove or balloon can also be used in this experiment. When cooled by liquid nitrogen, the glove or balloon shrinks (not as much as the air-filled balloon). When heating up, the balloon slowly rises and flies up in the air again. When heating up, the glove slowly re-inflates. The weight of the latex glove keeps it from floating.

Extension 1: Blow up a balloon and slip the end of the balloon over the open end of a test tube, and place the closed end in a dewar full of liquid nitrogen. Your breath in the balloon will slowly liquify (10-15 minutes). When the balloon is completely deflated, lift the test tube out of the dewar and the audience can see your liquified breath in the test tube. The tube will frost up, but you can wipe the frost off with your

fingers. Rest the test tube in a beaker, and as time passes, the balloon will inflate again.

Extension 2: Throw a polystyrene coffee cup full of liquid nitrogen high into the air. Don't throw the cup! A cloud will temporarily be formed. This shows that if you cool the air enough, the water vapor in it condenses.

Explanation: The volume of the balloon decreases by the low temperature, because the gas inside is cooled down. At room-temperature the helium balloon is lighter than air with the same volume of the air, which makes it go up. At low temperatures its volume is too small, so it is heavier than the same volume of air. In the balloon there is an isolated amount of air or helium. By the low temperature the pressure of the gas inside the balloon tends to decrease. The atmospheric pressure, however, forces the balloon to a smaller volume until the pressure inside and outside the balloon are equal (neglecting the surface tension of the skin of the balloon). At these temperatures air can be compressed more than helium, because it contains components than can be liquified or frozen (nitrogen, oxygen, carbon-dioxide, water). At these temperatures helium always will be a gas. When heated up, the pressure in the balloon rises, the balloon expands, and will reach to its original shape. The helium-filled balloon flies up in the air, because the average density of the balloon and helium together is lower than the density of air. Just like a piece of wood, held under water, tends to rise to the surface of the water. When the balloon is cooled, the volume of the balloon is greater, resulting in a greater average density of the balloon and helium. This makes the balloon come down.

Falling to Pieces

Objective:

The students will be able to understand the affects of liquid nitrogen; the students will know that liquid nitrogen has a temperature of -196 °C and when organic materials are immersed in liquid nitrogen, it becomes extremely deep frozen; the students will understand that the properties of materials can change

Materials Needed:

flowers, banana, green pepper, marshmallows, tomatoe, forceps, rubber tubing, wooden spoon, hammer, liquid nitrogen, safety goggles, gloves, and an insulated container

Set: "Nine Mice" and "Forty Performing Bananas" by Jack Prelutsky in The New Kid on the Block (copyright 1984), "I'm Building a Bridge of Bananas" by Jack Prelutsky in It's Raining Pigs & Noodles (copyright 1993), "When Daddy Sat on the Tomatoes" by Jack Prelutsky in a PIZZA the size of the SUN (copyright 1996), "Why Do I Water My Flowers?" by Jack Prelutsky in Something Big Has Been Here (copyright 1990), Ice Cream by Elisha Cooper, Chrysanthemum by Kevin Henkes

Procedure:

1. Place safety goggles securely on your face.
2. Place different objects into the liquid nitrogen. Use the wooden spoon, forceps, and/or gloves to remove from the liquid nitrogen.
3. Once removed from the liquid nitrogen, take the hammer and smach the items. *Observe how flowers and rubber tubing, normally lean and soft, can be crushed to pieces and how 'slimy' bananas, peppers, and marshmellows can be shattered into pieces by a blow of a hammer.*
4. Record your findings.

Explanation: The structure of matter changes under the influence of low temperatures. The structure becomes harder and more brittle (it will break rather than bend). Moreover, biological material contains a lot of water, that turns to ice, which is also very hard at such low temperatures. The

structure of the rubber is changed by the low temperature. The material is much harder; the atoms are more tight together. This makes the material also easier to break into pieces.