MIND TREKKERS
Dry Ice Bubble Lesson Plan

Amount of time Demo takes: 3-4 min
# per hour: 20

Materials:
1. Dry ice (small chunk)
2. Glass pie plate
3. Bubble solution (1/2 cup) or enough to fill bottom of pie plate
4. Glass bowl
5. Tongs or thick gloves for handling dry ice (1)
6. Paper towels (1 roll/day)
7. Bucket for fresh water, bucket for waste

Set up instructions:
1. Pour some warm water into the bowl.
2. Add a piece of dry ice, using tongs or wearing gloves. The dry ice will make bubbles in the liquid.
3. Use a paper towel that has been soaked with bubble solution to smear bubble solution across the top of the container. The bubble should form and grow for a time. Eventually, it will pop (or you may pop it), causing a little cloud of CO\(_2\) to spill out over the table. Check out [this video](#) to see what the demo should look like.
4. Explain sublimation: the transition from a solid (dry ice) directly to a gas (CO\(_2\)), and how this differs from a normal ice cube melting into a liquid.

SAFETY!
1. Do not store dry ice in an air-tight container - it will explode! Instead, store it in a Styrofoam cooler, with easy-to-remove lid.
2. Handle dry ice only when wearing thick gloves or using tongs. Do not touch with bare hands, as it will cause frostbite. Similarly, do not give dry ice to students to handle.
3. Use and store the dry ice in a well-ventilated area.

Lesson’s big idea bullet points
Dry ice is made of frozen carbon dioxide, the gas we exhale. When warmed, the dry ice sublimates, meaning the solid makes the transition directly to carbon dioxide gas rather than melting into a liquid. This process occurs much more quickly in water than in air. As the dry ice sublimates, the carbon dioxide vapor is caught inside the bubble solution. The bubble expands!
Sometimes conditions are right for the bubble to stabilize at a given size. This happens because carbon dioxide is able to diffuse across the bubble surface. Sublimating carbon dioxide expands the bubble, but when the bubble expands its walls become thinner and leak more. Since more carbon dioxide can escape, the pressure is reduced and the bubble has a tendency to shrink back again. As long as the solution doesn't evaporate too quickly, the bubble may remain relatively stable until the dry ice is nearly gone. At that point the bubble will become smaller.

Clean Up
Replace the water in the small bowl from time to time. As the water cools down from the dry ice, the reactions will go more slowly. Also, the water will get filled with bubble solution, which is messier. Clean up the bowl and surrounding area, since they will soon be covered in bubble soap.

National Standards
K-4 Content Standard B, Physical Science, Properties of objects and materials
5-8 Content Standard B, Physical Science, Properties and changes of properties in matter
9-12 Content Standard B, Physical Science, Chemical Reactions

References:
http://chemistry.about.com/od/dryiceprojects/a/dryicebubble.htm
http://www.youtube.com/watch?v=r8ch4n_d-YA&feature=channel_page