

# BOUNCING SMOKE BUBBLES

There's something magical about a bubble. It's just a little puff of air trapped in a thin film of soap and water, but its precise spherical shape and beautiful swirling colors make it a true wonder of science. Bubbles are cool, but bubbles filled with fog are even cooler. Just imagine the cool factor going up tenfold if you could bounce and play with these bubbles. "Boo Bubbles" are what you get when you fill a bubble with a ghostly carbon dioxide cloud. But Boo Bubbles are truly magical because you can roll them on your hands, bounce them off your sleeve, and pop them to release the burst of fog. It's the combination of science and performance art that will have everyone (even you) oohing and ahhing.

## WHAT YOU NEED

Boo Bubbles™ Kit (available at [www.SteveSpanglerScience.com](http://www.SteveSpanglerScience.com))

Or

Safety glasses

Knit gloves

Gallon-sized plastic jar

3-foot piece of rubber tubing

Liquid soap (Dawn works best.)

Small plastic container

Dry ice

Thick gloves

Bath towel

## Making the Dry Ice Bubble Generator

The Dry Ice Bubble Generator pictured below is available as a kit (called the Boo Bubbles Kit) from [www.SteveSpanglerScience.com](http://www.SteveSpanglerScience.com). It's a no-hassle option for the person who wants to get started immediately. It's also possible to make your own Dry Ice Bubble Generator using items that are commonly found at a department store or the plumbing aisle of your favorite hardware store.

You'll need a gallon-sized plastic jar with a 3-foot long piece of rubber tubing attached to the side. The goal is to attach the tubing to the top part of the jar so that the fog created by mixing dry ice and water blows out of the tube when you cover the top of the jar with the lid. The free end of the rubber tubing is attached to a small funnel or something similar to help blow bubbles when it's dipped into a soapy water solution. The best approach is to start with the plastic jar and spend some time walking through the plumbing aisle of your local hardware store to consider all of the ways to attach a piece of plastic tubing to the jar. It could be as simple as drilling a hole in the jar and attaching the hose with a piece of tape or a dab of caulking or glue. The design is up to you, but be sure to take this book with you so you're prepared when someone asks, "How can I help you?"





### WARNING!

Never trap dry ice in a jar without a vent. In other words, there **MUST** be a hole in the jar to allow the pressure to escape. Otherwise, the pressure will build up and the jar will explode! This could cause serious harm to you or to someone else.

**NOTE:** You'll need some thick gloves to handle the dry ice. The knit gloves used later in the activity do not provide enough protection for your hands. Find a good pair of leather gloves to protect your hands against the cold temperature of the dry ice and you're set.

### LET'S TRY IT!

1. Start by putting on your attractive safety glasses and thick leather gloves. You might need to use a hammer to break up the dry ice into pieces that will easily fit into the jar.
2. Fill the jar one-half full with warm water. Dry ice produces the best fog when you use warm water. Attach the rubber hose to the side of the jar (if it's not already attached).
3. Drop a few good-sized pieces of dry ice into the jar. Immediately, the fog will roll out of the jar. Practice covering the top of the jar with the lid to control the flow of fog out of the tube. You don't have to screw the lid onto the jar. Just hold it on top of the jar to force more or less fog through the rubber tubing.
4. Make a soapy solution by mixing a squirt (that's a *very* technical term!) of liquid soap with about 4 ounces of water in the small plastic container.
5. Dip the free end of the rubber tubing (either the "naked" tubing or the end of the tube "dressed up" with a small plastic cup, funnel, or fitting from the hardware store) into the bubble solution to wet the end of the tube. Remove the tube from the bubble solution with one hand while covering the jar with the lid in the other hand. This will take a little practice, but it's easy once you get the hang of it. The goal is to blow a bubble filled with fog.
6. When the bubble reaches the perfect size, gently shake it off of the tubing and it will quickly fall to the ground (it's heavier than a normal bubble because it's filled with carbon dioxide gas and water vapor). When the bubble hits the ground, it bursts, and the cloud of fog erupts from the bubble. Very cool!





## TAKE IT FURTHER

### Bouncing Boo Bubbles

This Boo Bubble variation happened accidentally and now it's a must-do whenever you play with Boo Bubbles. A bath towel was stretched out on the table in an effort to make the soapy cleanup just a little easier. To everyone's amazement, some of the fog-filled bubbles bounced on the towel and didn't pop! It just goes to show you that what some people call "play time" is actually high-level research (okay, maybe it's not real *research*, but it is play with a purpose). It's important to mention that not all types of fabric behave the same way. Ponder that for a few minutes before reading about the science of the bouncing bubble in the following pages.

### Touchable Boo Bubbles

If fog-filled bubbles will bounce off of a towel, what would happen if you wrapped your hands in fabric and tried to touch or play with the bubbles? You can easily find out by purchasing a pair of inexpensive children's winter gloves. Blow a bubble about the size of a baseball with the Dry Ice Bubble Generator. Bounce the bubble off of your gloves. Try bouncing the bubble off of your shirt or pants. Again, some fabrics work better than others. Try bouncing bubbles on

a hand towel or start up a game of volleyball bubbles with another friend who has too much time on her hands.

### Giant Boo Bubbles

Regular-sized Boo Bubbles are awesome, but Giant Boo Bubbles are even more awesome! All you need are a few parts and pieces from around the house and you'll be making these giant, fog-filled bubbles in no time. Cover a clean table surface with a thin layer of soap bubble solution and spread it around. Fill the large water bottle with warm water and drop in a few big pieces of dry ice. Again, ***NEVER put any type of lid on the bottle or do anything that would seal the bottle closed. The rapidly expanding gas could result in an explosion.***

Hold the large plastic hose (similar to the kind you'd find on a shop vacuum) over the top of the large water bottle. The carbon dioxide cloud will start flowing out of the hose. Make sure you don't plug the hose so the gas can't escape. That never ends well . . . trust us.

Dip the open end of the hose into the bubble solution and put it down on the soap-covered table. A giant Boo Bubble will start forming on the surface of the table! Keep the nozzle down and your bubble will just get bigger and bigger and bigger. When the bubble finally pops, all of that carbon dioxide gas will escape, leaving a ghostly fog behind.



## WHAT'S GOING ON HERE?

While blowing bubbles indoors, you might have noticed the occasional bubble that fell to the carpet but didn't pop. Regular bubbles burst when they come in contact with just about anything. Why? A bubble's worst enemies are oil and dirt. Soap bubbles will bounce off of a surface if it is free of oil or dirt particles that would normally puncture the soap film. They break when they hit the ground, but they don't break if they land on a softer fabric like gloves or a towel.

Dry ice is frozen carbon dioxide ( $\text{CO}_2$ ). Under normal atmospheric conditions,  $\text{CO}_2$  is a gas. Only about 0.035% of our atmosphere is made up of carbon dioxide. Most of the air we breathe is nitrogen (79%) and oxygen (20%). Instead of melting, dry ice turns directly into  $\text{CO}_2$  gas. It does not melt like real ice because it skips the liquid stage and goes straight from solid to gas. When you drop a piece of dry ice in a bucket of water, the gas that you see is a combination of carbon dioxide and water vapor. So, the gas is actually a cloud of tiny water droplets.

Dry ice must be handled with care because it is  $-109.3^\circ\text{F}$  ( $-78.5^\circ\text{C}$ ). It must be handled using gloves or tongs—otherwise, it will cause severe burns if it comes in contact with your skin. Never put dry ice into your mouth!

Grocery stores use dry ice to keep food cold during shipping. Some grocery stores and ice cream shops will sell dry ice to the public (especially around Halloween) for approximately \$1 per pound. Dry ice comes in flat square slabs a few inches thick or as cylinders that are about 3 inches long and about half an inch in diameter. Either size will work fine for your dry ice experiments. Remember the science . . . dry ice turns directly from a solid into a gas—a process called **sublimation**. In other words, the dry ice in the grocery bag will literally vanish in about a day! The experts tell us that dry ice will sublimate (turn from a solid into a gas) at a rate of 5 to 10 pounds every 24 hours in a typical vented ice chest. It's best to purchase the dry ice as close to the time you need it as possible. This is the one time when last-minute shopping is necessary.

