



Dry Ice Bubble

Amount of time Demo takes: 3-4 minutes

Don't try this at home!

Lesson's Big Ideas

- **Sublimation:** when material is converted directly from a solid phase to gas phase
- A gas will expand to fit the space it is provided, since the bubble is expandable the gas expands until the bubble is too thin and carbon dioxide is able to escape.

Materials

- Dry ice (small chunk)
- Glass pie plate
- Water
- Bubble solution (1/2 cup) or enough to fill bottom of pie plate
- Glass bowl
- Tongs & thick gloves for handling dry ice (1)
- Paper towels (1 roll/day)
- Bucket for fresh water, bucket for waste
- Safety glasses

SAFETY!

- Do not store dry ice in an airtight container -as the material turns into a gas, it will build up pressure inside that container! Instead, store it in a Styrofoam cooler, with easy-to-remove lid.
- 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.
- Use and store the dry ice in a well-ventilated area.

Background Information

- 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.

Set-up Instructions

1. Pour some warm water into the glass bowl.
2. Add a piece of dry ice using tongs or wearing gloves. The dry ice will make bubbles in the liquid.

Instructional Procedure

1. Use a paper towel that has been soaked with bubble solution to smear bubble solution across the top of the glass bowl. The bubble should form and grow for some 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.
2. 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.

Tips and Tricks

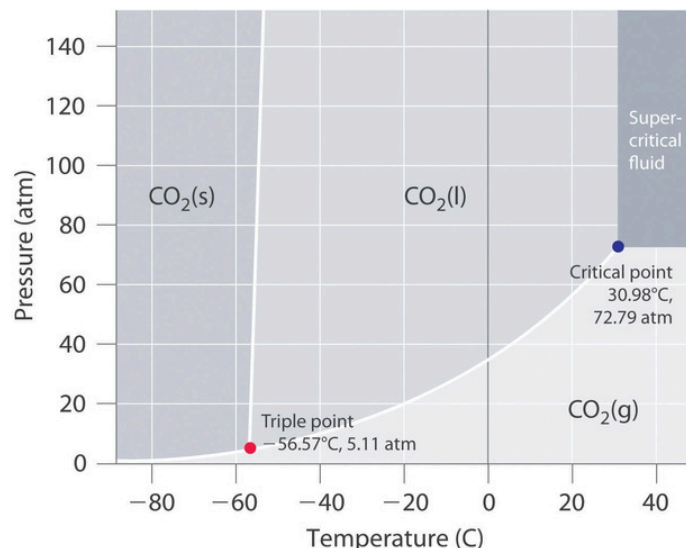
- Replace the water in the small bowl from time to time.
- As the water cools down from the dry ice, the reactions will go more slowly. Also the water will get filled with bubble solution, which is messier.
- Make sure you use a bowl that your entire hand can fit over so that the paper towel doesn't slip and break the bubble.

Careers & Real-World Applications

- Sublimation is sometimes used by chemists as a way of getting rid of impurities in order to purify compounds.
- Dry ice is often used to help preserve food that must stay cold or frozen. Since dry ice sublimates you also don't have to worry about the items getting wet.
- Environmental engineers: work to reduce the emission of carbon dioxide (CO₂) in order to mitigate the greenhouse effect and reduce climate change.

Assessment Questions

1. What is sublimation?
 - a. When material goes directly from solid phase to gas phase. Sublimation occurs as the phase diagram illustrates. The pressure is constant at ground level, which is 1 atmosphere and remains constant. Since the experiment is being conducted at one atmosphere, the phase of CO₂ changes from solid to gas as the temperature increases from left to right.



2. Why does the bubble expand?
 - a. Gas expands to fit the container it's in, the bubble expands as the gas expands.
3. Why does the bubble pop?
 - a. As the gas expands the bubble gets thinner and eventually the bubble pops resulting in escape of the carbon dioxide..

Clean Up

- On the last day of the event leave container open for awhile before the event ends so the dry ice sublimates quicker
 - If there is dry ice left at the end of the event either put it outside where it will not be disturbed or pour water over it until it evaporates
- Thoroughly clean up the bowl and surrounding area, since they will soon be covered in bubble soap.
- Make sure that everything is clean and dry and then return everything into the bin.

References

- <http://chemistry.about.com/od/dryiceprojects/a/dryicebubble.htm>
- http://www.youtube.com/watch?v=r8ch4n_d-YA&feature=channel_page
- [http://en.wikipedia.org/wiki/Sublimation_\(phase_transition\)](http://en.wikipedia.org/wiki/Sublimation_(phase_transition))
- [https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_\(Petrucci_et_al.\)/12%3A_Intermolecular_Forces%3A_Liquids_And_Solids/12.4%3A_Phase_Diagrams](https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_(Petrucci_et_al.)/12%3A_Intermolecular_Forces%3A_Liquids_And_Solids/12.4%3A_Phase_Diagrams)

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