



Activity #6:

The Invisible Fire Extinguisher

Chemistry Experiment, Experiential, Critical Thinking, Questioning

(Preparation: 5 minutes / Activity Time: 10-20 minutes)

***** **REQUIRES ADULT SUPERVISION!** *****

What Will You Need?

- Non-Plastic drinking glass/cup (made of glass or metal - glass is preferable)
- Candle (of any size - scented or unscented, whichever!) - *The candle must be able to stand on its own without being held upright, so be sure that it has either a flat bottom, or is placed securely in a candle holder*
- Matches or a lighter
- Large plate or serving dish with a flat center
- ¼ cup of Vinegar
- 1 Tbsp Baking Soda

Instructions: (Please Note - For extra safety, only adults should handle the candle and matches/lighter)

1. SHORT SLEEVES ONLY! (Please roll up any long sleeves or remove long-sleeved outer layers)
2. LONG HAIR - please pull-back, tie back, or place under a hat
3. Set the unlit candle in the center of the plate or dish (do not light it yet!)
4. Scoop 1 Tbsp of Baking Soda into the drinking glass
5. Light the candle - for extra safety, only adults should handle the candle, match, and/or lighter (and please be sure to safely put out the match, if using!)
6. Pour ¼ cup of vinegar into cups to start bubbling reaction
7. As soon as the bubbling starts, carefully tilt the glass over the flame (2-3 inches above the top of the flame) as if to pour out the bubbling liquid, but STOP tilting before any liquid pours out. (Your student may need some guidance or support with this step)
8. Wow! Even though no liquid touched the flame, it extinguished!
9. What was produced during the chemical reaction in the cup that could have put out the candle flame? You know that you “poured out” something non-liquid and invisible... What else did you notice?

A helpful tip for your student if they get stuck: “Think about the bubbles in the reaction - what fills the inside of bubbles?” Answer - air or gas

Check out this video of the experiment, courtesy of the “Sick Science!” YouTube channel (our instructions are just a tiny bit different, but the experiment will turn out the same!):

https://www.youtube.com/watch?time_continue=2&v=kycY6iA_cF0&feature=emb_logo

So Why Does This All Happen?

When baking soda (sodium bicarbonate) and vinegar (acetic acid) mix together, a chemical reaction happens in two parts, almost instantaneously! In **Part One** of the reaction, a “double displacement” happens - that is, the baking soda and the vinegar *trade* some of their chemical parts with each other and become two new, different chemicals inside the cup, sodium acetate and carbonic acid. But, carbonic acid is very unstable, and its chemical parts aren’t attached together very well. In **Part Two** of the reaction, the carbonic acid “decomposes”, or breaks apart in the cup into two more chemicals, liquid water and carbon dioxide gas.

If you thought this was cool already, just wait until you hear this! Remember how we left the liquid in the cup, but something put out the candle flame anyways? That was the invisible carbon dioxide gas “pouring” out of the cup! Flame needs oxygen to stay lit - it feeds the flame - but carbon dioxide is a dense gas, way more dense than oxygen. So, when we “pour” out the carbon dioxide into the oxygen-filled air, it starts to sink instead of mixing in with the other gases in the air. As it sinks towards the flame and the carbon dioxide gas surrounds the burning candle wick, it pushes the oxygen-filled air out of its way, suffocating the flame and putting it out.

This is the same concept that real fire extinguishers use to put out flames - they cover the fire in foam or powder, which stops oxygen from getting through to the flames, putting them out. That’s so neat!