# Demonstration: Fish Tank CO₂

## Summary
In this demonstration, students watch as a reaction between baking soda and vinegar produces carbon dioxide, which then causes lit candles to extinguish. They answer a series of questions about the densities of the two gases to explain their observations.

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## Objectives
By the end of this lesson, students should be able to
- explain that carbon dioxide has a higher density than air.
- explain their observations using the concept of density.

## Chemistry Topics
This lesson supports students’ understanding of
- Density
- Observations

## Time
**Teacher Preparation:** 10 minutes  
**Lesson:** 20 minutes

## Materials
For each group:
- 20-gallon fish tank
- 4 candles of different heights
- Vinegar
- 500-mL plastic beaker
- Bubbles

## Safety
- Always use caution around open flames. Keep flames away from flammable substances.
- Always wear safety goggles when handling chemicals in the lab.
- Vinegar vapors can be irritating. Work in a well-ventilated area. In the event of eye contact, flush with water. The concentration of acetic acid in this experiment does not present any significant hazards.

## Teacher Notes
- Watch time carefully during this demonstration – over time the carbon dioxide will escape from the tank and the later steps of the demonstration will not work properly.

## FOR THE STUDENT
Lesson

Explore

1. Place a 20-gallon fish tank at the front of the classroom. Line 3 candles (of varying heights) along the front inside of the tank. Place one candle on the outside of the tank.

   *As you are doing this, begin a discussion with the students about making good observations and safe handling of all chemicals.*

2. Light all candles. Spread baking soda on the floor of the tank.

   *Ask the students what they know about baking soda. Encourage discussion about chemical properties and the chemical formula for baking soda.*

3. Slowly pour 600 mL of vinegar into the tank to cover the baking soda.

   *What do you know about vinegar?*

4. Write the chemical equation on the board so that the students know what reaction is taking place. \[\text{NaHCO}_3 + \text{HC}_2\text{H}_3\text{O}_2 \rightarrow \text{NaC}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O} + \text{CO}_2\]

   *Note that one of the products of this chemical reaction is carbon dioxide (CO}_2).*

5. Have the students make observations (the candles go out sequentially short to tall and there will be fizzing which indicates a reaction has taken place).

   *Why do you think the candles went out at different times? [Because CO}_2 is building up at the bottom of the tank, replacing the oxygen required for combustion.]*

6. With a 500-mL plastic beaker slowly scoop out some gas from the back of the fish tank. Cover the beaker with your hand and transfer the gas outside of the tank and slowly pour it onto the outside candle (it will extinguish). If the students think it is a coincidence, relight the candle and do it again.

   *Ask the students why the flame went out. [Because CO}_2 is replacing the oxygen]*
**Why did the CO₂ stay in the tank?**  [Because CO₂ has a higher density than air, so it got “trapped” at the bottom of the fish tank.]

7. Get a good bubble solution and blow a bubble into the tank. It will bounce off the interface between the gases in the tank illustrating that CO₂ has a higher density than air.

**What was the bubble bouncing off of?**  [CO₂]

8. [Optional] Give the students an article about Lake Nyos (disaster in the 80’s) in Camaroon where 1200 people died because a CO₂ cloud settled on their village.