

Elephant Toothpaste

| Required Training | Required PPE |
|--------------------------------|--|
| UC Lab Safety Fundamentals | Lab coat, safety glasses/goggles, nitrile gloves |
| | |
| Equipment | Chemicals |
| 500ml glass graduated cylinder | Hydrogen peroxide (H ₂ O ₂), 30% solution |
| Clear plastic tub | Potassium iodide (KI), solid powder or sat. solution |
| | Dish soap |
| | Food coloring (optional) |

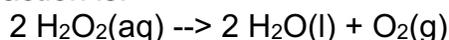
Procedure:

- 1.) Place the clear plastic tub on the ground, and then place the graduated cylinder in middle of the tub.
- 2.) Pour ~50 mL H₂O₂ into the graduated cylinder.
- 3.) Pour ~3 mL of dish soap into the cylinder and agitate slightly to mix.
- 4.) (optional) Run a few drops of food coloring down the sides of the cylinder for a striping effect.
- 5.) There are two methods for performing this demonstration:
 - Method 1) Quickly pour ~10 mL of the potassium iodide solution into the cylinder and step back, as a large volume of soap suds will very quickly erupt from the top of the cylinder and land in the plastic tub.
 - Method 2) Add 0.5 g of solid KI powder to the cylinder and step back. As the solid must dissolve and diffuse through the solution, this reaction is much slower and produces a stream of foam from the cylinder that may continue for up to a minute.
- 6.) This reaction produces a significant quantity of heat, and the graduated cylinder will be hot to the touch. Allow it to cool sufficiently before moving the demonstration.

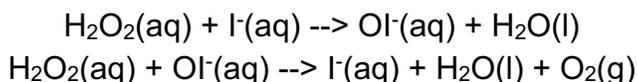
Clean-up: Once everything has cooled to room temperature, all waste can be safely rinsed down the drain.

Hazards: 30% H₂O₂ is corrosive and strongly oxidizing, causing immediate chemical burns on contact with skin. Always wear nitrile gloves when preparing, performing, or cleaning up this demo. Furthermore, the catalytic decomposition of H₂O₂ is strongly exothermic, and the graduated cylinder may become warm enough to cause thermal burns during the demonstration.

Principle: This demonstration involves the catalytic decomposition of H₂O₂ into water (H₂O) and oxygen gas (O₂(g)). The overall reaction is:



This reaction is slow, but may be catalyzed by the iodide ion (I⁻). One proposed mechanism for this reaction is:



A significant quantity of heat is also generated ($\Delta_r H^\circ = -196 \text{ kJ/mol}$), which vaporizes some of the H_2O into steam. The soap catches the evolved steam and oxygen, forming many small bubbles that coalesce into a foam.

Notes: More is going on in solution than just the reactions given in the mechanism listed above. Upon the addition of KI, the solution becomes a red-brown color that slowly clears, evidence for the formation and subsequent consumption of iodine (I_2) and the triiodide (I_3^-) anions that form upon reaction with excess I^- . Research on the reaction mechanisms and kinetics of this system is still ongoing. This demonstration is nearly identical to Genie in a Bottle, which does not use soap to catch the evolved gases.