Demonstration Risk Assessment
"Elephant's Toothpaste"

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Demonstration Statement

A slightly yellow solution is created in a 1 L cylinder with hydrogen peroxide (H_2O_2) is mixed with Joy dish soap.[1] When a scoop of potassium iodide (KI) is added to the cylinder, a foam resembling toothpaste rises out of the opening. As KI catalyses the rapid decomposition of (H_2O_2) and in the presence of soap the rapidly generated oxygen from the decomposition will create mounds of fine suds filled with oxygen gas.

The Chemistry

The reaction proceeds nearly immediately once the KI is added. The reactions for the decomposition are shown here.

$$H_2O_2 + \cancel{I^-(aq)} \rightarrow H_2O\ (l) + \cancel{OI^-(aq)}$$
$$H_2O_2\ (aq) + \cancel{OI^-(aq)} \rightarrow H_2O\ (l) + O_2\ (g) + \cancel{I^-(aq)}$$

$$2\ H_2O_2\ (aq) \rightarrow 2\ H_2O\ (l) + O_2\ (g) + \text{heat}$$

Reactivity Hazards

Known Incompatibilities

- hydrogen peroxide (SA SDS): zinc, powdered metals, copper, nickel, brass, iron and iron salts.
- potassium iodide (BDH SDS) strong reducing agents, Nickel, Strong acids, and its alloys, Steel (all types and surface treatments), Aluminum, Alkali metals, Brass, Magnesium, Zinc, cadmium, Copper

Information Sources Used and/or Reviewed

- Potassium Iodide: Sigma Aldrich SDS, product #221945, Version 4.10 Revision Date 12/02/2015.
- Potassium Iodide: Fisher Scientific SDS, product #'s P410-10; P410-100; P410-3; P410-500, Creation Date 14-Sep-2009.
- Potassium Iodide: VWR, product C6459 (27.02.2016), 74210 (27.02.2016), and BDH product # BDH9264 SDS.
- eChemPortal GHS J
- Hydrogen Peroxide Solution: Sigma Aldrich SDS for product # 216763, Version 4.13 Revision Date 05/24/2016
- Dr. XXX, personal communication
- Eldridge, D. Using Elephant's Toothpaste as an Engaging and Flexible Curriculum Alignment Project. *J. Chem. Educ*. **2015**, 92, 1406−1408. DOI: 10.1021/acs.jchemed.5b00037

[1] Any dish soap can be used, but Joy works the best for generating the desired size of bubbles. The hazards are not affected.

- Porcja, B. Catalytic Decomposition of Hydrogen Peroxide by Potassium Iodide. Rutgers Chemistry Lecture Demonstration (CLD) Facility. http://cldfacility.rutgers.edu/content/catalytic-decomposition-hydrogen-peroxide-potassium-iodide (accessed July 17, 2016).
- Catalytic Decomposition of H_2O_2 – Elephant's Toothpaste. NCSU Dept. of Chemistry Lecture Demonstrations, Kinetics. https://ncsu.edu/project/chemistrydemos/Kinetics/Elephants%20Toothpaste.pdf accessed July 17, 2016).

Equipment Required with Known Hazards

Spill tray, 1 L cylinder (sharps), scoopula

Safety and Emergency Response Equipment

For ER:

No unusual ER equipment is needed. Standard laboratory ER equipment should be available. If demo is performed as outreach or in the classroom, include portable bottle of eyewash solution.

For Spills:

- H_2O_2 can be cleaned up with wet paper towels using gloves. Rinse prior to placing in the trash can. Avoid inhalation.
- KI spills should be gathered up with a small broom and dust pan and dissolved in a beaker of water. Solutions with pH between 5 and 9 can be drained disposed in most areas. Check local regulations.

PPE

Chemical splash goggles, nitrile gloves, lab coat (optional)

Preparation Instructions with Associated Hazards & Controls

Gather chemicals and equipment. There are no known hazards other than breaking glass or spilling reagents while gathering equipment. See demonstration procedure for those controls.

Table 1: Information for Reagent Preparation

Chemical (Add rows as needed)	MW g/mol	Concentration Required for Demo	Amount Required for Demo	Amount of Chemical Needed for Preparation	Amount Recipe will Prepare
hydrogen peroxide (H_2O_2) CAS 7722-84-1	34.0	30% (~9 M)	150 mL	Buy at required concentration	N/A
potassium iodide (KI) CAS 7681-11-0	166	Solid (99+)	~10 g (scoop)	Buy at required concentration	N/A
Joy dish soap	-------	As purchased	~25 mL	Buy at required concentration	N/A
Food Coloring (Optional)	-------	As purchased	drops	Buy at required concentration	N/A

Demonstration Instructions with Associated Hazards & Controls

1. Don chemical splash goggles and nitrile gloves
2. Add ~150 mL of 30% H_2O_2 to the cylinder
   Hazards: splash, spill, sharps
   Controls: Ensure audience is back 10 ft; review spill response procedures prior to demo, wear eyewear and recommended gloves, ensure eyewash is functioning and available (alternate is eyewash solution in a bottle), clean up broken class using broom and dustpan
3. Add ~25 mL of dish soap to the cylinder and swirl to mix
4. Place cylinder on tray
5. If desired, add 4 drops of food color of choice at 4 points around the cylinder opening. Do not add to the H_2O_2/soap unless you want the "toothpaste" to be a uniform color rather than striped.
6. All at once add the scoopful of solid KI and swirl slightly.
   Hazards: splash, spill, dermal contact, heat, sharps
   Controls: Ensure audience is back 10 ft and do not allow observers to touch foam, review spill response procedures prior to demo, review ER for dermal contact of KI, continue to wear eyewear and gloves, have running water available, allow cylinder to cool prior to disposal, clean up broken class using broom and dustpan

Waste Disposal

Unused reagents (if any) should be returned to storage.

This demo does not generate any known hazardous waste and may be flushed down the sink with water. However, since local ordinances may vary, it is always advisable to check local ordinances.

General Information

Conflicting hazard information was found on the hazards of potassium iodide. Sigma Aldrich lists KI with an exclamation point and warning signal word. Fisher Scientific lists it not requiring GHS elements. At VWR, I saw skull and crossbones for KI granules (product 74210) and none for KI (product # C6459, and exclamation point for a BDH product. Assume that it is a target organ hazard (fetus).

There are some known incompatibilities

☑ I have read the required information on the hazards of this demonstration and understand the risks to the demonstrator and audience

Signed:

Date:

Ventilation Requirements:

- ☐ hoods for preparation
- ☐ hoods for demonstration
- ☐ demonstration must be performed outside
- ☑ normal room ventilation

Emergency Equipment Requirements:

- ☐ standard lab ER equipment
- ☑ eyewash/shower
- ☑ spill kit

  running water
- ☐ fire extinguisher

Waste Requirements:

- ☐ labeled waste container(s) needed
- ☐ neutralize and dispose
- ☑ flush down drain with water

PPE Requirements (Demonstrator):

- ☑ gloves

  nitrile (all chemicals)
  Type
  Type
- ☑ eyewear

  chemical splash goggles (demonstrator)
  eyewear for audience (no)
- ☐ lab coat

  not required

Reactivity Precautions:

- ☐ flammable solvents
- ☑ corrosives
- ☑ oxidizers
- ☐ incompatible wastes