Elephant Toothpaste
Lesson Plan

**Amount of time Demo takes:** 2-5 mins.
**Don't try this at home!**

**Materials**
- 2000 mL Erlenmeyer flask
- 2 smaller flasks or styrofoam cups
- 30/35% Hydrogen peroxide
- Potassium iodide
- Water
- Food coloring (1 bottle/day)
- Funnel
- Foil cake pan with 2-inch sides (8x8 or larger)
- Safety glasses
- Paper towels
- Graduated cylinder
- Dish soap

**Set-up Instructions/Instructional Procedure**
1. *(Only do 3-4 times per hour.) Chemicals are expensive for this demo.*
2. Premix ~5 tablespoons (70 mL) of solid Potassium Iodide dissolved in adequate water in a small flask or styrofoam cup.
3. Add ~110 mL of 30-35% hydrogen peroxide in a small flask.
4. Premix ~110 mL of dish soap in a small flask with adequate food colouring dye.
5. Stand the large Erlenmeyer flask up in the center of the foil cake pan. Add the funnel.
6. Add the Hydrogen Peroxide into the large flask.
7. Add the dish soap/dye mixture.
8. Remove the funnel and add the dissolved Potassium Iodide mixture (stand back!)
9. The students can touch the bottle to feel any changes that take place. Heat will be released (it’s exothermic).

**SAFETY!**
- Safety goggles, have public stand back!
• Wear disposable gloves. Oxygen is evolved in this reaction, so **do not** perform this demonstration near an open flame.
• Reaction is exothermic, producing a fair amount of heat, so do not lean over the graduated cylinder when the solutions are mixed. Leave your gloves on following the demonstration to aid with cleanup. The solution and foam may be rinsed down the drain with water.

**Lesson’s Big Idea**

• The reaction creates foam that shoots up out of the bottle and pools in the pan. After a minute or so, it begins to come out in a moving stream that looks like toothpaste being squeezed out of a tube.
• The students can play with the foam as it is just soap and water with oxygen bubbles. Oxygen is released from the peroxide when it interacts with the yeast.
• The bottle will feel warm to the touch as this is an exothermic reaction.
• The Dawn dish detergent acts as a catalyst, releasing the extra oxygen from the hydrogen peroxide (H2O2), producing foam, and leaving H2O as a byproduct.

**How does it work?**

• You might remember Mom treating your scraped knee or a cut with hydrogen peroxide. H2O2 is the formula for hydrogen peroxide. H2O2 looks like ordinary water (H2O), but the addition of that extra oxygen atom turns the molecule into an extremely powerful oxidizer. The hydrogen peroxide found at the grocery store is a low grade 3% solution which is safe to touch, but powerful enough to kill bacteria, viruses, and fungi on surfaces.
• The hydrogen peroxide used in this demo is ten times stronger what you can find at the store. Low grade hydrogen peroxide (3%) will not produce the massive amount of foam seen in the Elephant's Toothpaste demo. The secret ingredient is actually sodium iodide which acts as a catalyst - something that speeds up the decomposition of hydrogen peroxide. When hydrogen peroxide decomposes, it breaks down to form water (H2O) and oxygen (O2). The soap bubbles that erupt from the cylinder are actually filled with oxygen. As the reaction takes place, you'll also see steam rising from the erupting foam. This shows that the reaction is exothermic (gives off heat).
• Hydrogen peroxide (30% strength) will act as an oxidizing agent with
practically any substance. This substance is severely corrosive to the skin, eyes, and respiratory tract. Sodium iodide is slightly toxic by ingestion. Given these safety precautions, it's best to leave this one to the experts.

- The overall equation for this reaction is:
  - \( 2 \text{H}_2\text{O}_2(aq) \rightarrow 2 \text{H}_2\text{O}(l) + \text{O}_2(g) \)

- However, the decomposition of the hydrogen peroxide into water and oxygen is catalyzed by the iodide ion.
  - \( \text{H}_2\text{O}_2(aq) + \text{I}^-(aq) \rightarrow \text{OI}^-(aq) + \text{H}_2\text{O}(l) \)
  - \( \text{H}_2\text{O}_2(aq) + \text{OI}^-(aq) \rightarrow \text{I}^-(aq) + \text{H}_2\text{O}(l) + \text{O}_2(g) \)

- The dishwashing detergent captures the oxygen as bubbles. The heat from this exothermic reaction is such that the foam may steam. If the demo is performed using a plastic bottle, you can expect slight distortion of the bottle from the heat.

**Clean Up**

- Clean up between demos if needed. When completely finished gather all materials listed for this demo and make sure everything is accounted for. If something was used up, broken or damaged, let someone know so it can get replaced or fixed.

**References**

- [http://chemistry.about.com/od/chemistrydemonstrations/a/elephanttoothpaste.htm](http://chemistry.about.com/od/chemistrydemonstrations/a/elephanttoothpaste.htm) (explains reaction)
- [http://www.stevespanglerscience.com/experiment/elephants-toothpaste](http://www.stevespanglerscience.com/experiment/elephants-toothpaste) (Videos and additional explanation)
- [http://chemistry.about.com/od/chemistrydemonstrations/a/elephanttoothpaste.htm](http://chemistry.about.com/od/chemistrydemonstrations/a/elephanttoothpaste.htm)

**Next Generation Science Standards**

- **K-5**
  - 2-PS1-4
  - 4-PS3-2
  - 5-PS1-4

- **6-8**
  - MS-PS1-2/6
  - MS-PS3-4

- **9-12**
  - HS-PS1-4/5
Alternate instructions:

Materials
- 50-100 ml of 30% hydrogen peroxide (H2O2) solution
- saturated potassium iodide (KI) solution
- liquid dishwashing detergent
- food coloring
- 500 mL graduated cylinder
- splint (optional)

Procedure
1. Put on gloves and safety glasses. The iodine from the reaction may stain surfaces so you might want to cover your workspace with an open garbage bag or a layer of paper towels.
2. Pour ~50 mL of 30% hydrogen peroxide solution into the graduated cylinder.
3. Squirt in a little dishwashing detergent and swirl it around.
4. You can place 5-10 drops of food coloring along the wall of the cylinder to make the foam resemble striped toothpaste.
5. Add ~10 mL of potassium iodide solution. Do not lean over the cylinder when you do this, as the reaction is very vigorous and you may get splashed or possibly burned by steam.
6. You may touch a glowing splint to the foam to relight it, indicating the presence of oxygen.