Carolina Quick Tips®

Elephant Toothpaste

Demonstrate the use of a catalyst in the decomposition of hydrogen peroxide.

- **TEKS HS**
  C.c.13.C: Classify processes as exothermic or endothermic and represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis.
- **TEKS MS**
  6.b.6.E: Identify the formation of a new substance by using the evidence of a possible chemical change, including production of a gas, change in thermal energy, production of a precipitate, and color change.

  7.b.6.C: Distinguish between physical and chemical changes in matter.

Materials Required

Dishwashing Liquid

Hydrogen Peroxide, 30%

Potassium Iodide

Food Coloring (optional)

Graduated Cylinder, 100 mL

Spatula

Safety Goggles

Gloves

Large Garbage Bag or Large Tray

Plastic Bottle or Large Graduated Cylinder (250 to 500 mL)



Safety

Hydrogen peroxide, at 30%, is a very strong oxidizer. It is corrosive to clothing and will cause burns if spilled on the skin. Use appropriate personal protective equipment (PPE)—such as gloves, chemical splash goggles, and lab coats or aprons—to avoid contact. Know and follow all federal, state, and local regulations as well as school district guidelines for the disposal of laboratory wastes. Upon completion of this demo, the bottle can be rinsed; keep PPE on in case the bottle contains any leftover hydrogen peroxide. Unless otherwise prohibited, the foam and catalyst on the trash bag can be carefully rolled up and discarded in the trash.

Activity Procedure

1. Put on gloves and safety goggles.
2. Crush any lumps of potassium iodide (KI) into fine crystals with a spatula, then weigh 1.5 g of it onto a weighing boat or filter paper.
3. Lay a large garbage bag flat on a desk, table, or lab bench to protect the demo area. A large tray can also be used for this purpose.
4. Place the plastic bottle or large graduated cylinder in the middle of the demo area.
5. Measure 15 mL of 30% hydrogen peroxide into the bottle or cylinder.
6. Add 25 drops of dishwashing liquid to the hydrogen peroxide.

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7. Swirl the bottle or cylinder to mix the liquid soap and peroxide.
8. Optional: Hold the bottle or cylinder at a 45º angle and add a few drops of red food coloring so that the coloring runs down the inside. Repeat with blue food coloring on the opposite side.
9. Quickly add the KI crystals to the bottle or cylinder and observe the oxygen gas as it forms bubbles in the soap, creating a plume of foam that is quickly expelled.

Results/Summary

Hydrogen peroxide (H_2O_2) is stable for at least a year if stored in an airtight opaque container at room temperature. Common in first aid kits, a 3% H_2O_2 solution can be applied to minor cuts and abrasions. When the solution contacts tissue and blood, it rapidly decomposes into water (H_2O) and oxygen gas (O_2).

$$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$$

The oxygen gas creates a foam that lifts and washes contaminants out of the wound. This rapid decomposition can only happen in the presence of a catalyst. In the human body, that catalyst is catalase, a biological catalyst in blood and tissue. In this demo, solid potassium iodide (KI) dissolves in aqueous H_2O_2, forming an aqueous iodide ion (I-) and catalyzing the reaction of aqueous H_2O_2. The steps of the reaction mechanism are as follows:

Step 1	$H_2O_2(aq) + I^-(aq) \rightarrow H_2O(l) + IO^-(aq)$	Slow Reaction
Step 2	$IO^-(aq) + H_2O_2(aq) \rightarrow H_2O(l) + O_2(g) + I^-(aq)$	Fast Reaction
	$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$	Overall Net Reaction

In this demo, as the rapidly produced oxygen gas is released into liquid soap, it forms foam that quickly emerges from the bottle in a manner reminiscent of toothpaste squeezed from a tube.

Additional Information

View more information, content links, and products related to this activity at www.carolina.com/takeaways.

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