

Elephant Toothpaste Instructor's Demonstration Notes



Overview

This lab is an introduction to chemical reactions, an excellent demonstration of how catalysts accelerate those chemical reactions and a clear demonstration of an exothermic reaction that also produces a dramatic change of state. In a nutshell a solution of potassium iodide and detergent (the catalyst) is dropped into 30% hydrogen peroxide. The reaction takes a couple of seconds to get going but in short order a stream of bubbles shoot up and out of the mouth of the bottle eerily resembling a giant tube of toothpaste that is being squeezed. Steam is released, the foam curls around the base of the bottle and your introduction to exothermic reactions is met with enthusiastic applause and pleas for an encore.

Instructional Video Links

Teacher Tube: <http://www1.teachertube.com/viewProfile.php?user=Looseinthelab>

You Tube: <http://www.youtube.com/user/looseinthelab>

Content Correlations and Vocabulary

Chemistry Ideas

- Chemical Change
- Chemical Reaction
- Change of State
- Decomposition
- Exothermic Reactions
- Catalyst

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Objectives

1. The student will investigate how evidence of chemical reactions indicate that new substances with different properties are formed. They will identify the release of heat and the change of state from liquid to gas as of the indicators in this chemical reaction.
2. The student will observe the role of a catalyst in a chemical reaction and will be able to describe how Potassium iodide acts on hydrogen peroxide.

Time Line

10-15 Minutes

Lab Safety and Clean-up Concerns

1. *Potassium iodide* is an inorganic salt that has many human applications. In short, you can touch, eat, and snort (not recommended) potassium iodide without too much of a health concern.

2. *Hydrogen Peroxide* is very corrosive to skin, eyes, and your respiratory tract. Avoid all contact. It is also a very strong oxidizer, as well as a fire and explosion risk. Fun stuff, pay attention.

3. Heat is going to be released during the reaction which produces steam so wear your goggles and avoid holding your face directly over the opening of the bottle no matter how much a steam facial appeals to your sense of outer beauty.

Let the reaction cool for a bit before you grab the bottle, which will also be buried in hot foamy soap. It is fun to wash the bottle off and pass it around the classroom so that the kids can see how the plastic reacts to the heat by shrinking.

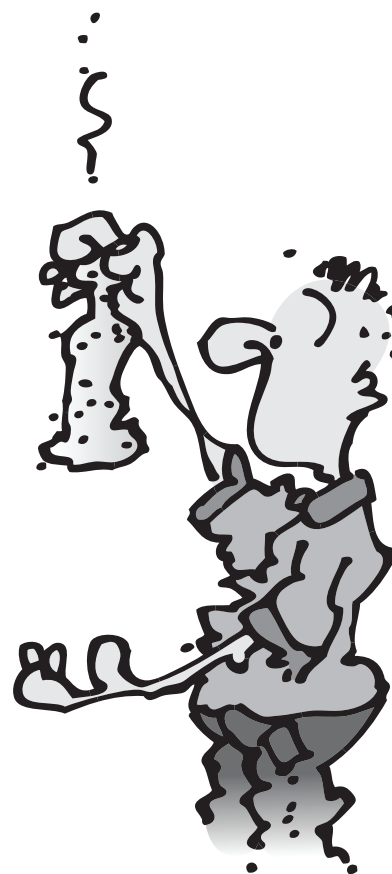
4. When you are done with the demonstration you can rinse the contents of the bottle in the sink and then toss everything in the recycling bin. Which we are sure that you have at your school.

Lab Prep

1. Photocopy the cartoon of the elephant brushing his teeth that is included with this lab. Cut it out and tape it to the outside of the pop bottle. This is your giant tube of elephant toothpaste.

2. Pre-measure 10 grams of potassium iodide and place the salt in a portion cup.

3. Set your demo table so that you can begin as soon as the kids walk in the room.



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The Lab Experience

If heat is released and the reaction gets warm or hot it is classified as an exothermic reaction. Exo meaning exiting or leaving and thermic having to do with measuring temperature or heat. So, an exothermic reaction is a chemical reaction where the heat stored in the chemical bonds is released and goes into the environment. These are two indicators of a chemical reaction with this demo. The first is the release of heat and the second is a change of state. Hydrogen peroxide is quickly decomposed into steam (water) and oxygen. These two gases rise out of the bottle and create the illusion of a spirit or genie coming from the inside.

Vocabulary

Catalyst: A chemical that dramatically changes the rate of reaction of other chemicals.

Catalytic Reaction: Certain chemicals decompose over time. A catalyst is a chemical that speeds this process up. In this lab hydrogen peroxide decomposes to release oxygen and produce water, about 10% per year by volume. By adding a catalyst the reaction takes seconds to complete rather than the majority of a decade.

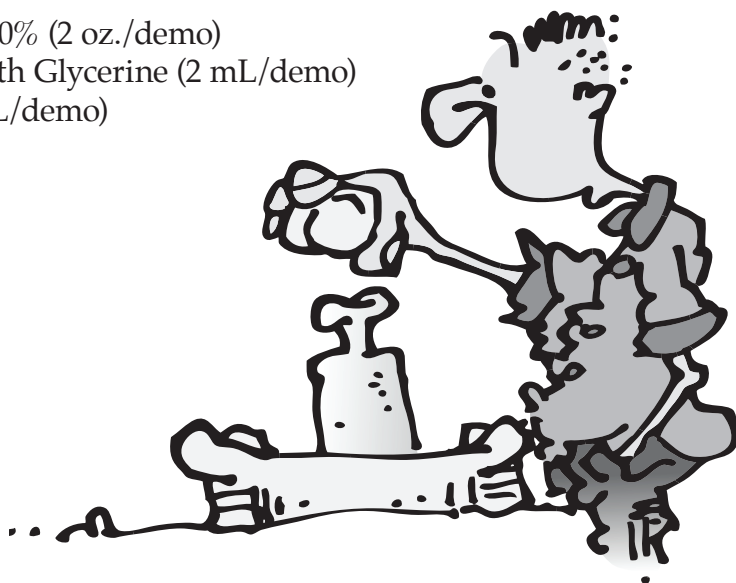
Chemical Change: This is the result of the chemical reaction. When the atoms in the reaction get rearranged and it produces a new material this results in a change of physical properties as well. Outward indicators include a new color, odor, emission of light, a temperature gain or loss, change of state, and an increase or decrease in the pH. In this lab liquid changes to gas and heat is released.

Exothermic Reaction: A chemical reaction that produces or release heat.

Foam: Gas trapped in a liquid or solid chemical.

Materials

- 1 7/8 oz. Vial of Iodide (10 g/demo)
- 1 16 oz. Bottle of Hydrogen Peroxide, 30% (2 oz./demo)
- 1 1 oz. Bottle of Blue Food Coloring with Glycerine (2 mL/demo)
- 1 1 oz. Bottle of Liquid Detergent (3 mL/demo)
- 10 mL water/demo
- 1 Loose in the Lab Toobe, 12" tall
or
- 1 Graduated cylinder, 100-250 mL
or
- 1 Bottle, empty, 2 liter, plastic
- 1 Beaker, 100 mL
- 1 Portion Cup, 4 oz.
- 1 Craft Stick, wooden
- 1 Pipette, disposable, 1 mL
- 1 Tub, plastic, 3-5 gallons
- Goggles & gloves



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Procedure

1. Put on your goggles and gloves. It is important to set a good example and, in this case, hydrogen peroxide is not a fun party guest.

2. Have a couple of the kids feel the side of the container (pop bottle, graduated cylinder, or Toobe) and describe it for the other kids. Ask them to enter this observation into their data table. Place the container in the center of the overflow tub.

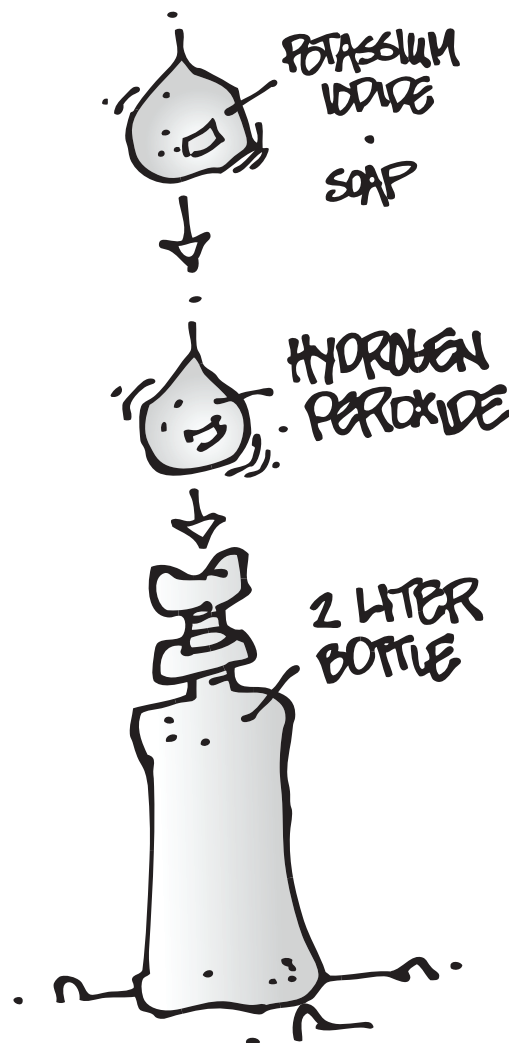
3. Measure 60 mL (2 ounces, for those of you who still prefer ye olde English measurements) of hydrogen peroxide from your source bottle into the beaker. Pour the entire 60 mL into the bottom of your container.

4. Place 10 grams of potassium iodide in the plastic portion cup. Add 10 mL of water and a squirt (about 3 mL) of liquid detergent. Stir all three chemicals together using the wooden craft stick.

5. Open the bottle of food coloring mixed half and half with glycerine or corn syrup and extract 2mL of the dye. Dribble it down one side of the container that you are using.

6. Add the mixture of soap, water and potassium iodide to the hydrogen peroxide in the container. The potassium iodide will separate into potassium and iodine ions. Iodine is naturally dark yellow-brownish in color which you will see forming at the bottom of the container. This ionization causes two things to happen very quickly. One, the hydrogen peroxide is going to now decompose into water and oxygen and two, a lot of heat is also going to be released changing the water to steam. The reaction starts slowly, like a big boulder starting to roll down a hill and then quickly picks up speed. Once it gets going, the colloidal soap (aka elephant tooth paste) will erupt out of the bottle and at the same time the plastic bottle will get very hot and the sides of the bottle will warp and shrink a bit.

7. The reaction produces a yellowish, white foam with a band of red or blue where you added the food coloring. The foam shoots into the air, like a tube of toothpaste squished too hard and then winds around the base of the container looking like a giant, foamy dog poop.



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8. Once the reaction is complete ask a couple of the students to come up and carefully touch the sides of the bottle and describe the temperature for all of the other kids in the class.

9. When you are done you can empty the leftover solution inside the bottle down the drain with water and toss the bottle in the recycling bin. Another great demonstration, another empty tube of elephant toothpaste.

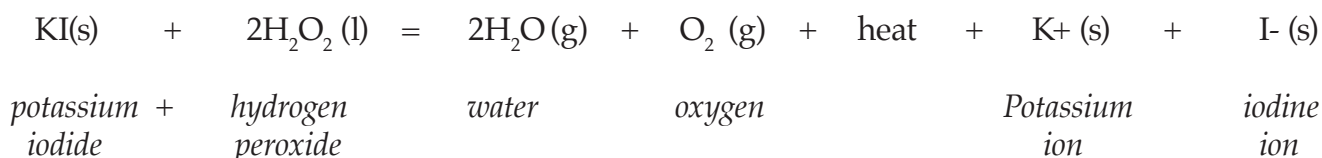
How Come, Huh?

A catalyst is a chemical that is introduced to other chemicals specifically to speed up a slow moving reaction. In this case the potassium iodide was the catalysts. When you plopped it into the hydrogen peroxide the whole decomposition process ratched it up a notch and not only was water and oxygen in abundance but some of the water was converted to steam. The steam, being a hot, expanding gas is trapped in the liquid detergent and shoved out of the bottle as a foam by the pressure inside the bottle.

The reaction also created a fair amount of heat which reacted with the "mers" (groups or clusters of atoms, collectively known as polymers) in the plastic bottle. Things usually expand when they are heated, however, in this case, the heat causes the long bonds of the plastic to collapse. The end produce is a hot, wrinkly pop bottle.

The Chemistry Behind It ...

The potassium iodide catalyzes (speeds up) the decomposition of hydrogen peroxide into water and oxygen with the release of heat as a by-product.



Chemical Applications

Hydrogen peroxide (H₂O₂) is an oxidizer commonly used as a bleach. It is the simplest peroxide (a compound with an oxygen-oxygen single bond). Hydrogen peroxide is a clear liquid, slightly more viscous than water, that appears colorless in dilute solution. It is used as a disinfectant, antiseptic, oxidizer, and in rocketry as a propellant.

Hydrogen peroxide is naturally produced in organisms as a by-product of oxidative metabolism. Nearly all living things possess enzymes known as peroxidases, which harmlessly and catalytically decompose low concentrations of hydrogen peroxide to water and oxygen.

Potassium iodide is an inorganic salt that has many human applications. It is added to salt to prevent thyroid problems, used as a topical antiseptic, given as a solution to help clear lungs that are congested and can be used to protect your thyroid glands in the event that you happen to have a nuclear emergency in your neighborhood.

Elephant Toothpaste

Instructor's Demonstration Notes

Answers to Questions

1. What happens to the reaction when you drop the potassium iodide into the hydrogen peroxide? THERE IS A LARGE AMOUNT OF HEAT RELEASED AND THE HYDROGEN PEROXIDE DECOMPOSES INTO STEAM AND OXYGEN. THE POTASSIUM IODIDE REMAINS AS A SOLID IN THE BOTTOM OF THE BOTTLE.

A/2. Based on your observations is this a chemical change.

D/3. The two main indicators of a chemical reaction are a change of heat and change of state.

4. Hydrogen peroxide naturally decomposes to WATER and OXYGEN.

5. By adding potassium iodide to the hydrogen peroxide you SPEED UP the rate of the decomposition.

6. Describe the temperature of the bottle *before* the reaction. COOL.

7. Describe the temperature of the bottle *after* the reaction. HOT.

8. Is heat released in this reaction? YES

9. Describe the appearance of the bottle after the reaction is complete. IT WAS WRINKLY.

10. A gas trapped in a liquid is called a COLLOID.

Extra Credit and Extension Ideas

1. Release the Genie from the Bottle, another silly chemistry demonstration.

2. Find out what other kinds of chemicals act as catalysts on hydrogen peroxide. One good hint would be to look at other transition metals. Another good hint would be find out what chemical is given to thyroid patients to help them assimilate iodine.

3. Create foams using Poly A and Poly B and the instructions in Foam Gnomes. You can also create a very nice, permanent foam using the instructions in Orange Sorbet, aluminum sulfate and sodium bicarbonate.

Congruent Labs

Rotten Egg Gas

Hot Hands, Cold Pack

Frozen Fertilizer

Genie in a Bottle

Baking Soda Balloons

Foam Gnomes

Sizzling Sunset

Surprise Fire

Cornstarch Fireball

Genie in a Bottle

Elephant Toothpaste Data & Observations

Name : _____

Date: _____

Teacher: _____

Period: _____

Data Tables & Questions

1. What happens to the reaction when you drop the potassium iodide into the hydrogen peroxide?

_____ 2. Based on your observations is this a _____ change.

- A. Chemical
- C. Gassy

- B. Physical
- D. Periodic

_____ 3. The two main indicators of a chemical reaction are a change of _____.

- A. Heat and Smell
- C. Heat and Mass

- B. Heat and Opacity
- D. Heat and Change of State

4. Hydrogen peroxide naturally decomposes to _____ and _____.

5. By adding potassium iodide to the hydrogen peroxide you SPEED UP/SLOW DOWN the rate of the decomposition.

6. Describe the temperature of the bottle *before* the reaction. _____.

7. Describe the temperature of the bottle *after* the reaction. _____.

8. Is heat released in this reaction? YES NO

9. Describe the appearance of the bottle after the reaction is complete.

10. A gas trapped in a liquid is called a _____.

Elephant Toothpaste Label for 2 Liter Soda Bottle



ELEPHANT TOOTHPASTE

**FUN, FOAMY,
& A LITTLE NUTTY**

