saturday academy

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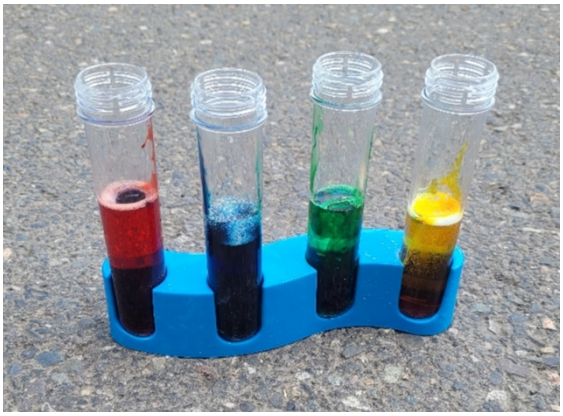
Did you know that chemical reactions can occur at different speeds? There are special classes of molecules called catalysts that can greatly accelerate a reaction into something extraordinary! This handout will provide you with instructions on how to make your very own elephant toothpaste reaction, an experiment that will delight learners of all ages.

## Objectives

- Create and enjoy an elephant toothpaste reaction.
- Understand the concept of a catalyst, and how it applies to the reaction.

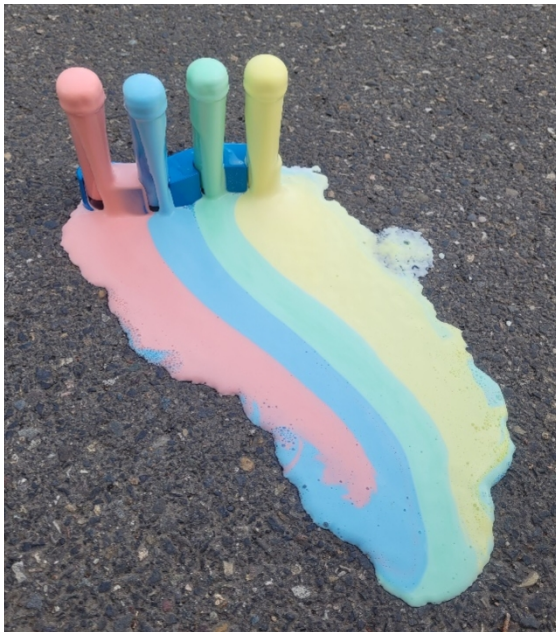


## Materials

- Empty plastic bottle, or other container with a narrow opening
- 3% hydrogen peroxide solution (available at pharmacies and grocery stores)
- Packet of active yeast
- Liquid dishwashing detergent
- Warm water
- Food coloring

## Creating the Elephant Toothpaste

1. Pour 1/4 cup hydrogen peroxide solution, a generous squirt of dish soap and a few drops of food coloring into the bottle. Swish the bottle gently around to mix the ingredients, but do not agitate so much that you create bubbles.
2. Set the bottle in a sink or outdoors or some other place where you won't mind getting wet foam everywhere.
3. In a separate container, mix a packet of active yeast with a 3 tablespoons of warm water. Give the yeast about five minutes to activate before proceeding to the next step.
4. When you are ready to do the demo, pour the yeast mixture into the bottle. The reaction occurs immediately upon the addition of the yeast!
5. Cleanup – wash all of the foam and solutions down the drain.



## What's going on?

Hydrogen peroxide, also known as $H_2O_2$, is a reactive molecule that readily decomposes into water ($H_2O$) and oxygen:

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

In the elephant toothpaste demonstration, yeast acts as a ***catalyst***, a molecular that helps to dramatically speed up a reaction. Yeast makes the decomposition of hydrogen peroxide much more rapid than normal. Yeast needs warm water to reproduce, so the reaction won't work as well if you use cold water or very hot water (which kills the yeast).

The dishwashing detergent captures the oxygen that is released in the reaction, making foam. The reaction continues as long as there is some hydrogen peroxide and yeast left. Once one of them runs out it stops making new foam. Food coloring adds color to the bubbles. After the reaction has completed, feel the side of the container. Is it warm? In addition to being an excellent example of a catalyzed reaction, the elephant toothpaste demo is exothermic, which means that heat is produced.

**Research Questions**

1. What temperature is best for the yeast to act as a catalyst?
2. What happens if there is no dish soap to capture the released oxygen?
3. What happens with different concentrations of hydrogen peroxide? (Note: 30% hydrogen peroxide can be found at salon supply stores; however, if using 30% solutions, please take extra care as the heat released could cause burns).
4. Why is hydrogen peroxide stored in brown or opaque bottles?
5. Try the reaction in different shaped bottles. How does the resulting toothpaste behave?

**Terms and Concepts to Start Background Research**

- **Catalyst** – Energy stored in an object at rest.
- **Exothermic** – Energy of an object in motion

**Bibliography**

1. ThoughtCo: Kid Friendly Elephant Toothpaste: www.thoughtco.com/kid-friendly-elephant-toothpaste-demo-604164
2. Scientific American: Make Elephant Toothpaste: www.scientificamerican.com/article/make-elephant-toothpaste/