



Elephant toothpaste

Objective:

This is a demonstration showing that chemical reactions can occur faster when a catalyst is added. A catalyst reduces the amount of energy needed for the reaction. Chemical reactions occur in our body all the time and are often sped up with a catalyst.

Introduction:

“Let’s imagine: I want to visit [name], but there’s a big hill in between us. If I want to visit him/her, I have to climb all the way up the big hill (pretend to be struggling to walk up a steep hill as you cross in front of the students). This takes a lot of energy and it’s slow (return to the other side of the classroom). But, if we made a tunnel through the hill (walk easily across in front of the students) it’s a lot easier, uses a lot less energy, and it’s faster! Adding a catalyst to the reaction is like blasting a tunnel through the hill – it suddenly makes the reaction go faster and uses less energy.

Have you heard of hydrogen peroxide before? Your parents might have used it to clean and disinfect cuts or scrapes. What happens when you put hydrogen peroxide on a cut? (Audience members might suggest that it bubbles, sizzles, etc.) “Yes, hydrogen peroxide will react by bubbling and fizzing when it goes on a cut. The hydrogen peroxide I have here is even more concentrated than the stuff you have at home, so it would actually be dangerous to put on your skin!”

When hydrogen peroxide bubbles, it’s because it’s slowly degrading (‘degrades’ means that the molecule breaks down into smaller pieces). Hydrogen peroxide breaks down into water and oxygen; that’s what the little bubbles are: oxygen gas that’s escaping! Hydrogen peroxide normally degrades very slowly, so it doesn’t make a lot of bubbles very quickly. Are there lots of bubbles inside the cylinders right now?”

(Hold up one of the cylinders for the audience to see. Invite someone from the front row to come closer and look inside the cylinders for any bubbles forming.)

“There might be some bubbles sitting on the surface, but these liquids aren’t actively making lots and lots of new bubbles. If we want the bubbles to form faster, we’re going to have to add something... a catalyst.

The catalyst will generate heat, water, and oxygen.

Ask the students about what will happen with heat and water (steam).

Materials:

- 1 L Erlenmeyer flask or graduated cylinder
- Cooking sheets or aluminum bins to collect the overflow from the beaker (to minimize the mess)
- Hydrogen Peroxide (29% solution)
 - Can be purchased at a pool or hydroponics store
- Dish soap
- Food coloring (optional)
- Potassium iodide
 - Saturated potassium iodide is best and can be made ahead of time
 - Potassium iodide crystals can be purchased at Amazon.com (\$16.00/100g)

Protocol & Expected Results:

1. Fill a 1 L Erlenmeyer flask $\sim \frac{1}{4}$ - $\frac{1}{2}$ with hydrogen peroxide
 - Same stuff you have at home, only more concentrated
 - Reaction will produce oxygen (ask the kids if oxygen is solid, liquid, or gas)
 - Because it produces gas, we wouldn’t be able to see it as the reaction is happening, so we add soap to trap the oxygen in bubbles
2. Add a few drops of dish soap
3. Add a few drops of food coloring for fun (optional)
 - We can wait for the reaction to occur
 - Alternatively, we can add a catalyst to make the chemical reaction occur much faster
 - Catalyst: potassium iodide (can be used as a dietary supplement, so it’s safe)
4. Add 0.5-1 mL of saturated potassium iodide
 - Point out the steam formed from heat, water, and oxygen trapped in the bubbles
 - Looks like something you would use to brush an elephant’s tooth so it’s called “elephant toothpaste”