# **Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Elephant’s Toothpaste**

# **Background:** Hydrogen peroxide (H2O2) is a chemical compound found in most households. It is available in 3 forms, 3%, 10% and 30%. Hydrogen peroxide is useful because it is a naturally unstable compound, and spontaneously undergoes a decomposition reaction, which is triggered by the presence of sunlight. The sunlight provides the **activation energy** necessary to start the forward reaction. 3% hydrogen peroxide is a first aid staple, routinely used to disinfect small wounds, as an antiseptic gargle, and an aid to ear wax removal. 10% Hydrogen peroxide is often used as a hair lightening oxidizing dye. 30% is not available for purchase by the general public. It is only used for laboratory purposes, and direct contact with skin is to be avoided. The decomposition of hydrogen peroxide in aqueous solution proceeds very slowly- so slowly that a bottle can remain stable on a grocery store shelf for a very long time. This decomposition of aqueous hydrogen peroxide produces liquid water and gaseous oxygen. The normal decomposition will be a little too slow for experimental purposes, so today we will be using a **catalyst** called potassium iodide to speed up this reaction. Invisible gas will be released, but we’ll trap it by adding liquid soap bubbles so we can “see” the gas. The soap bubbles will contain oxygen- a product of the reaction. **Collision theory** states that for a reaction to occur, atoms or molecules must come together or collide with one another. Not all collisions, however, bring about chemical change. According to the collision theory, the rate at which a [chemical reaction](http://www.britannica.com/EBchecked/topic/108802/chemical-reaction) proceeds is equal to the *frequency of effective collisions*. The presence of a catalyst, the concentration of the reactants, and the temperature of the reactants are all factors that may alter the rate of reaction.

**Reading Questions:**

1. Why is hydrogen peroxide packaged in dark brown opaque containers as opposed to clear containers?
2. Why is a catalyst being used in the reaction?
3. Define activation energy.

**Predictions:**

1. In the boxes below, draw particle models for the two hydrogen peroxide solutions. There are 100 molecules in each box. Box on the left should be 3% and the box on the right should be 30%

 

1. What concentration 3% or 30% hydrogen peroxide would have the faster reaction rate? Explain your prediction by citing information from the diagram above.

**Safety Precautions:** *Hydrogen peroxide solution*, 30% is severely corrosive to the skin, eyes, and respiratory tract: very strong oxidant. Dangerous fire and explosion risk. Do not heat this substance. Gloves, safety goggles, and aprons are **REQUIRED** for this lab. *Potassium iodide* is slightly toxic by ingestion. Potassium Iodide may stain your hands or clothing, so use appropriate caution.

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# **Procedure:**

1. Place two 100ml graduated cylinders in a large, plastic demonstration tray.
2. Add 20 mL of 3% hydrogen peroxide to the first graduated cylinder and 20 mL of 30% hydrogen peroxide to the second graduated cylinder.
3. Add 5 squirts of dish soap to each cylinder and swirl to dissolve the detergent.
4. Measure out 5 mL of 2M potassium iodide (KI) solution for each of the graduated cylinders.
5. Pour the potassium iodide solution into the two graduated cylinders containing the differing concentrations of hydrogen peroxide and watch the reaction.
6. Write down all your observations in the space provided in the data table below.

|  | **Cylinder # 1** | **Cylinder #2** |
| --- | --- | --- |
| **Concentration of hydrogen peroxide** |  |  |
| **Observations** |  |  |

**Analysis Questions:**

1. The reaction that you performed was hydrogen peroxide → water + gaseous oxygen. Write the chemical reaction and balance it.
2. Draw Lewis structures for the reaction above.



1. Was the reaction endothermic or exothermic? Explain how were you able to tell?
2. Explain, using collision theory, why one of the reactions proceeded faster than the other.

