

Welcome to Chemistry! Thank you for volunteering your time and sharing your talents.

Goal: In this module, the students will perform a polyurethane foam experiment and observe two other experiments that demonstrate chemical reactions and adhesion/cohesion. Feel free to offer your perspective, real-life examples, and experiences as you go through the experiments with them.

Before sitting down, each student should put on a protective garment.

Introduce yourself and briefly share your career/education background.

Activity # 1: POLYURETHANE FOAM EXPERIMENT

Tell the students they will mix two liquids together and watch closely as the foam expands to 30 times its original size! They should not be fooled by the looks of the foam - it will turn into a solid material called polyurethane. Ask the students if they can think of some examples of polyurethane foam (life preservers, injection molding, pool noodles, etc.)

Have students put on safety goggles and two vinyl gloves. If a student needs larger gloves, there are XL gloves available. If a student wears glasses, they do not need to put on the safety goggles. Using a sharpie, have students write their name on the third glove.

Start by showing the students the laminated card with the names of the chemicals they will be mixing. Have them try to pronounce the chemical names (the pronunciation is on the back).

Part A is *POLYMERIC DIPHENYLMETHANE DIISOCYANATE* (C_8H_5NO)_n

Part B is *PENTAFLUOROPROPANE* $C_3H_3F_5$

Before doing the actual experiment, it is important to follow these guidelines:

- Have one side of the table go through the entire experiment before allowing the other side of the table to start.
- Students should work with the student sitting directly across from them. If needed, you can also help hold the gloves open.
- Have students roll up sleeves or remove any jewelry that could possibly get ruined. They should also make sure their cell phones are put in a safe place.
- All students should be wearing protective garments and goggles (or glasses) before proceeding.

THE EXPERIMENT

- Have students pass the glove with their name on it to the person sitting across from them.
- Measure 1 tablespoon (scoop) of Part A into a disposable cup. *Note:* We have plastic scoops marked with Part A and Part B for the students to use.
- Add 2 to 3 drops of food coloring to the liquid. ***It is very important to tell the students to use no more than 2 to 3 drops since it could negatively affect the chemical reaction.***
- Add 1 tablespoon (scoop) of Part B into the same disposable cup. Explain that Part B is considered the ***catalyst*** in this experiment. *The catalyst is what increases the rate of a chemical reaction without itself undergoing any permanent chemical change.*
- Each student should then use the wooden stick to stir the two liquids (about 30 seconds). Be careful not to drip any of the liquid onto the floor, table, clothes, or anything else of value.
- Carefully and quickly pour the mixture inside the vinyl glove. The student who is not doing the experiment should hold the other student's glove open. Have the student "work" the liquid into the fingers. The less manipulating the better.
- Put hand on the table to "rest" and WAIT!
- The foam will expand to 30 times its original volume. The gloves will feel warm - this indicates an ***exothermic*** reaction.

How does it work? Polyurethanes are formed by mixing a polyol (an alcohol with more than two reactive hydroxyl groups per molecule) with a diisocyanate in the presence of suitable catalysts and additives. This lightweight foam expands to about thirty times its original liquid volume and will become rigid in about five to ten minutes.

Activity #2: BREATHLESS BALLOON (Time-filler only)

Please make sure students keep on safety goggles or glasses for this experiment also! Get a bottle from the supply table. There should be about $\frac{1}{4}$ cup of vinegar already in the bottle. Also collect a balloon, baking soda, teaspoon, and small funnel. The students can help with this experiment. Have one student use the funnel to put 2 teaspoons of baking soda in the balloon. The place the balloon over top of the bottle to seal it off. When ready, lift the balloon dumping the baking soda into the bottle with the vinegar. Instantly there will be a reaction and it will bubble, expand and the balloon will start to blow up.

How does it work? When the baking soda (base) and vinegar (acid) mix it creates a chemical reaction. Initially it makes carbonic acid, but then breaks down creating carbon dioxide (a gas) and water. The gas cannot escape so the pressure builds, and the carbon dioxide fills the balloon blowing it up.

Discuss with the students what they just learned through this activity.

Activity #3: ELEPHANT TOOTHPASTE EXPERIMENT

This will be done with about 5 minutes left in the rotation. When the volunteer doing the experiment is ready, they will call the students to the front. Students should still be wearing their protective garment and safety glasses.

How does it work? Elephant toothpaste is formed of tiny foam bubbles filled with oxygen. The potassium iodide acts as a catalyst to make the hydrogen peroxide decompose very quickly. Hydrogen peroxide breaks down into oxygen and water. As a small amount of hydrogen peroxide generates a large volume of oxygen, the oxygen quickly pushes out of the tube. The soapy water traps the oxygen, creating bubbles and turns into foam. This reaction is called an Exothermic Reaction, which means it not only created the foam...it also created heat!

Have the students remove their protective garments and throw them in the container provided. Goggles should be placed in the small blue plastic bin on the table. ***Please clean the goggles after each rotation with a disinfecting wipe.***

End of the Day:

- **Clean goggles with a disinfecting wipe and bring to the supply table.**
- **JA staff and student volunteers will restock and pack the bins.**

Thank you for making a difference today!