

Polyurethane Foam



FYI...

Two teaspoons of each liquid will usually form enough foam to expand 1–2 inches above the top of the cup.

Polyurethane is a synthetic polymer found in many types of athletic clothing and sports equipment. As an impact-resistant foam, it is used to line the inside of athletic helmets and to make the outer sole of many types of footwear, including athletic shoes. Polyurethane also makes up the inflatable bladder of professional footballs and the strings and grips of pro tennis rackets. In this activity, you'll investigate the properties of polyurethane foam.

Stuff You'll Use: ▶polyurethane foam system (Polyurethane foam systems are available in craft and hobby stores. One brand name is Mountains in Minutes. The system comes in two parts; be sure to purchase parts A and B.) ▶clear plastic cup (9- to 10-oz) ▶plastic spoon ▶paper towels ▶newspapers or extra paper towels ▶(optional) food coloring ▶(optional) balance capable of measuring 0.1 g ▶(optional) paring knife

What to Do:

- ⚠ *Perform this activity only in a well ventilated area. Avoid breathing the vapors produced. Wear gloves and goggles to prevent contact with skin and eyes.*
- 1 Pour about 2 teaspoons of Part A of the foam system into a cup. Add a few drops of food coloring if you wish.
- 2 Add about 2 teaspoons of Part B to the cup and stir until the mixture is a uniform color throughout. Wipe spoon with a paper towel.
- 3 Place the cup on the newspaper or paper towel. (If you wish, you can place the paper towel and cup on a balance and record the initial and final weight.) Observe the cup for about 5 minutes. *What happens to the foam? Feel the outside of the cup. Do you notice a change in temperature? What type of reaction is taking place in the cup?*
- 4 Tap the foam with the spoon. *What property of the material changed during the reaction? What has happened to the volume of the material in the cup? Has the weight changed?*
- ⚠ *Since the foam may contain unreacted isocyanate, do not handle it until it has ample time to cure (approximately 24 hours).*
- 5 *What do you think the foam would look like if you cut it open? (If desired, cut the foam open with a paring knife.)*
- 6 *What properties of this polymer make it useful for sports?*

How It Works:

The foam is produced by a polymerization reaction between a polyether polyol (Part A) and a diisocyanate (Part B). The reaction is exothermic. Part A also contains a catalyst. During the reaction, water reacts with some of the diisocyanate to produce carbon dioxide gas, which forms bubbles and causes the foam to expand, much like baking bread. The weight before and after should be nearly the same, but the volume increases about 30 times, producing a corresponding decrease in density.



More Fun?

Learn how to make a variety of polymers, such as Gluep and slime. Terrific Science Press (www.terrificscience.org/sciencestore) offers the following books that include activities about polymers:

- ▶▶ [*Polymers All Around You, 2nd Edition*](#)
- ▶▶ [*Teaching Chemistry with TOYS*](#)
- ▶▶ [*Classroom Science from A to Z*](#)
- ▶▶ [*Science Night Family Fun from A to Z*](#)
- ▶▶ [*Exploring Matter with TOYS: Using and Understanding the Senses*](#)

