Tie-dye! - An engaging activity to introduce polymers and polymerization to beginning chemistry students

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Abstract

Polymers are ubiquitous in modern society. Natural (wool and silk) and synthetic styrofoam and plastic polymers are familiar to people worldwide. Although an estimated 50% of all professional chemists in the USA work in the polymer industry, beginninglevel chemistry textbooks rarely cover polymer chemistry. This scenario represents a missed opportunity to teach polymer chemistry to a larger group of students from a broad range of majors. Given the high attrition as students move through the chemistry curriculum, the small group of students exposed to polymer chemistry in their later years in the university, results in an inadequate population equipped to support the chemical industry. In 1983, the core chemistry committee in general chemistry suggested that polymer related topics be integrated into the beginning chemistry curriculum. The 2015 American Chemical Society (ACS) undergraduate professional education in chemistry guidelines require that exposure to aspects of macromolecular, supramolecular, and nanoscale (MSN) chemistry be included in the undergraduate curriculum. Polymers are perfect candidates for introducing macromolecules. I will present a stand-alone polymer unit that is centered on a tie-dye activity, which engaged the imagination of beginning-level university students. This polymer unit consists of three parts. The first uses molecular model kits to investigate bond formation/ breakage during the polymerization process when the β-D-glucose monomer becomes the cellulose polymer. In the second part, students made tie-dyed t-shirts. The final part uses primary literature to help students investigate the chemical reactions that bind the cellulose fibers to the dye molecules permanently, producing a colorfast, tie-dyed, t-shirt.Tie-dye is a modern term invented in the mid-1960s in the United States (but recorded in writing in an earlier form in 1941 as "tied-and-dyed", and 1909 as "tied and dyed" by Charles E. Pellew, referenced below)[1] for a set of ancient resist-dyeing techniques, and for the products of these processes. The process of tie-dye typically consists of folding, twisting, pleating, or crumpling fabric or a garment and binding with string or rubber bands, followed by application of dye(s).[2] The manipulations of the fabric prior to the application of dye are called resists, as they partially or completely prevent the applied dye from coloring the fabric. More sophisticated tie-dyes involve additional steps, including an initial application of dye prior to the resist, multiple sequential dye and resist steps, and the use of other types of resists (stitching, stencils) and discharge.

Unlike regular resist-dyeing techniques, tie-dye is characterized by the use of bright, saturated primary colors and bold patterns. These patterns, including the spiral, mandala, and peace sign, and the use of multiple bold colors, have become clichéd since the peak popularity of tie-dye in the 1960s and 1970s. The vast majority of currently produced tie-dyes use these designs, and many are mass-produced for wholesale distribution. However, a new interest in more 'sophisticated' tie-dye is emerging in the fashion industry, characterized by simple motifs, monochromatic color schemes, and a focus on fashionable garments and fabrics other than cotton.[3] A few artists[4][5][6] continue to pursue tie-dye as an art form rather than a commodity

Biography :

Dharshi Bopegedera has served as a professor of chemistry at The Evergreen State College since 1991 where she received two teaching awards: The burlington northern faculty achievement award (1993) and the president's faculty achievement award (2014). Her PhD degree (physical chemistry) is from the University of Arizona. Her interests include gas phase spectroscopy and developing problem-based chemistry laboratory exercises. She is a reviewer for the journal of chemical education, serves on the executive committee of the puget sound section of the ACS and is the faculty advisor to the evergreen chemistry club. She has served on multiple school boards.