

# Polymers—Preface

**P**olymers are an indispensable part of life. Natural polymers include a wide range of biological molecules and materials, such as DNA, proteins, starch, cellulose, and wood. Synthetic polymers or plastics are incredibly useful modern materials. Examples of polymer “products” that could only be imagined more than 50 years ago include disposable diapers and nylon running shoes, contact lenses and artificial joints, bike helmets and bulletproof vests. The enormous size of polymer molecules and the flexibility of polymer chains give polymers unique and interesting properties. The purpose of *Polymers*, Volume 21 in the Flinn ChemTopic™ Labs series, is to provide high school chemistry teachers with meaningful, easy-to-do laboratory activities that will help students understand the basic principles of polymer structure and function. Six experiments and five demonstrations allow students to prepare a variety of common polymers, investigate their properties, and discover the fascinating uses and applications of these “giant” compounds.

## Introduction to Polymers

There is a lot of wisdom in the old saying, “Learning is child’s play.” Introduce students to the basic structure of polymer molecules and their unusual properties with two fun activities. In “Let’s Make Slime,” students learn how interactions between polymer molecules give polymers their interesting properties. In “Designer Gluep,” a guided-inquiry activity, students “play” with the ratio of ingredients in a cross-linked polymer gel to make a “glue ball” bounce! Popular polymer demonstrations include “Polyurethane Foam,” “Preparation of Nylon,” and “Polymethyl Methacrylate.” Students love seeing how these familiar materials are made, and teachers love being able to showcase the connections and contributions of chemistry to everyday life.

## Preparation and Properties of Polymers

Compare and contrast different methods for preparing polymers in “Small-Scale Synthesis of Polymers.” Students investigate the principles of addition and condensation reactions for the synthesis of polymers as they make polystyrene and a polyester in the lab. The activity-stations lab “Structures and Properties of Polymers” includes four self-contained activities, each with a different polymer: Students (1) explore the properties of a natural polymer obtained from seaweed that is used as a thickening agent in foods, (2) see how an amorphous polymer can be molded into new shapes by heating, (3) observe the amazing birefringence pattern of a

plastic to “see” how the polymer molecules are arranged, and (4) study the properties of the crystalline polymer in Teflon® tape. In “Properties of a Natural Polymer,”

students investigate the elastic properties of natural rubber by measuring the stress and strain behavior of a rubber band. The unique properties of large polymer molecules that make them very different from non-polymer materials are also highlighted in a pair of demonstrations, “Properties of a Superabsorbent Polymer” and “Oh, the Memories—Polystyrene Returns to Form.”



## Applications and Uses of Polymers

The United States produces almost 100 billion pounds of plastics every year, yet only about 4% of this amount is recycled. Recycling plastics is a special challenge because of the amount and variety of plastics in everyday use. In “Sorting Plastics by Density,” students investigate the composition and properties of plastics and their recycling codes. Students determine the densities of unknown plastics, identify the unknowns, and learn why sorting and separating discarded plastics helps make recycling more effective and valuable.

## Science in Personal and Social Perspectives

Building connections between the sciences and integrating social and personal perspectives are important goals of science education, and indeed these goals are formally embedded in the National Science Education Standards. The activities in *Polymers* offer an excellent opportunity to help students see chemistry not just in a textbook, but in the world around them. All of the experiments and demonstrations have been optimized to adapt them to the knowledge and skill level of the high school chemistry curriculum. The use of hazardous reagents has been critically evaluated, preparations have been scaled down, and procedures have been reviewed and simplified to make sure they are as safe as possible yet still produce satisfying outcomes. All of the activities have been thoroughly tested and retested. You know they will work! Use the experiment summaries and concepts on the following pages to locate the concepts you want to teach and to choose experiments and demonstrations that will help you meet your goals.