Kinetics—Preface

Many chemical reactions that students see in the lab—indicator color changes, formation of a precipitate, evolution of a gas—occur immediately upon mixing. The rate of the reaction appears to be controlled by diffusion. Other reactions, however, occur at a slower rate and students can follow the progress of the reactions over time. What factors determine how fast a chemical reaction will occur? The answer to this important question has applications not just in chemistry, but also in engineering, food science, and human physiology. Kinetics is the study of the rates of chemical reactions. Chemists must be able to measure and control reaction rates in order to make compounds both safely and economically. The purpose of *Kinetics,* Volume 14 in the Flinn ChemTopic™ Labs series, is to provide high school chemistry teachers with laboratory activities that will help students understand and apply the principles of kinetics. Five experiments and five demonstrations allow students to measure reaction rates and identify how and why reaction conditions affect reaction rates.

Introducing Kinetics

How can the rate of a chemical reaction be measured? What effect does changing the concentration of reactants or their temperature have on the rate of a chemical reaction? Two experiments offer ifferent approaches to these fundamental questions. In "Introduction to Reaction Rates," students measure the time required for the "blue bottle" reaction of dextrose and methylene blue. The procedure is simple and easy-to-do, perfect for a hands-on introduction to a difficult topic. In "Temperature and Reaction Rates," an inquiry-based experiment, students must design and carry out a procedure to analyze the rate of reaction of magnesium with hydrochloric acid at different temperatures. Comprehensive teacher notes include suggestions for extending the activity to investigate how the nature of the reactants, their concentration, or the addition of a catalyst influences the reaction rate. Alternatively, teachers may choose to introduce the study of kinetics with a demonstration. Both the "Iodine Clock Reaction" and the "Sudsy Kinetics" demonstrations can be used to lay the foundation for higher level experiments dealing with reaction orders and rate laws.

Reaction Orders and the Rate Law

The mathematical relationship between the rate of a reaction and the concentration of reactants is expressed in the order of reaction for each reactant and the overall rate law for the reaction. In "The Order of Reaction," students determine the order of reaction for a microscale iodine clock reaction by measuring the rate of the reaction starting with different concentrations of a reactant. Teachers who have avoided traditional iodine clock experiments because of their complexity will love the simplicity of this microscale version. In this high-tech age, however, it is also important to demonstrate to students how scientists use technology in the real world to study these topics. In "Kinetics of Dye Fading," students use colorimetry and graphical analysis to investigate how the rate of fading of a familiar indicator depends on its concentration. Finally, "Determining a Rate Law" is a culminating-type activity—students apply what they have learned about reaction rates to evaluate the overall rate law for a reaction.

Catalysts and Reaction Pathways

As mentioned above, studying reaction rates is very important from a practical point of view. After all, if a reaction is too slow, it may not be practical. Too fast, however, and the reaction may not be safe! Kinetics is also important from a theoretical point of view in terms of understanding how reactions occur at the molecular level. Models of how reactions occur are called reaction pathways. In most textbooks, the reaction pathway is presented as an abstract concept and there are few suggestions for making it seem real to students. The demonstration "Now You See It, Now You Don't" gives teachers a springboard for introducing this abstract concept using the unusual, rhythmic color changes of an oscillating chemical reaction. The activity of catalysts in speeding up chemical reactions reflects their role in reaction pathways. Two demonstrations, "The Pink Catalyst" and "The Floating Catalyst," illustrate what catalysts do and how they work.

Safety, flexibility, and choice

Depend on Flinn ChemTopic™ Labs to give you the information and confidence you need to work safely with your students and help them succeed. As your safer source for science supplies, Flinn Scientific promises you the most complete, reliable, and practical safety information for every potential lab hazard. Each experiment and demonstration in *Kinetics* has been thoroughly tested and retested. You know they will work! At Flinn Scientific, we also know that no two classrooms are alike—the broad selection of experiments and demonstrations in *Kinetics* gives you the ability to design an effective lab curriculum for your students, with your resources, and to meet your local and state standards. Use the experiment summaries and concepts on the following pages to locate the concepts you want to teach and to choose activities that will help you meet your goals.