Oxidation and Reduction—Preface

Oxidation and reduction represent an important class of chemical reactions. Oxidation of organic "fuels," whether in our bodies or in our cars, supplies energy for both life and living. The reduction of metallic ores requires great expenditures of energy, but gives us the materials necessary to "build" our civilization and our society. The purpose of *Oxidation and Reduction,* Volume 16 in the *Flinn ChemTopic™ Labs* series, is to provide high school chemistry teachers with laboratory activities that will help students identify and analyze oxidation and reduction reactions. Four experiments and six demonstrations allow students to investigate the role of electron transfer in oxidation and reduction and to determine how these processes are related. The conversion of chemical "redox" energy into electrical energy and the applications of redox reactions in electrochemistry will be investigated in *Electrochemistry,* Volume 17 in the *Flinn ChemTopic™ Labs* series.

Oxidation and Reduction

Studying the activity of metals offers a simple introduction to oxidation and reduction. The usefulness of metals depends not only on their physical properties, but also on their relative reactivity or ease of oxidation. In "Metal Activity and Reactivity," students carry out a series of possible single replacement reactions of metals with metal ions and observe which combinations of metals and metal cations will undergo a chemical reaction. Students determine the more active metal in each pair and rank the metals from most to least active. Two demonstrations also illustrate the ease of oxidation and activity of metals. "The Can Ripper," in particular, is a real attention-getter. Rip apart an aluminum can with just a firm twist of your hands? Yes, assuming you let chemistry do the work for you! In the "Floating Tin Sponge," two competing redox reactions produce hydrogen gas and tin metal, giving "rise" to a metal that floats in water.

Oxidation States and Oxidizing and Reducing Agents

When metals combine with nonmetals to form ionic compounds, the oxidation of the metal and reduction of the nonmetal are obvious from the charges on the ions. For many oxidizing and reducing agents, however, the only "real" way to recognize the changes taking place is to assign "imaginary" charges! These imaginary charges, called oxidation states, are especially helpful in understanding the chemistry of transition metal compounds. In the demonstration "Oxidation States of Vanadium," students observe bright color changes corresponding to four different oxidation states of vanadium and appreciate firsthand why the element was named after the mythological Norse goddess of beauty. In another demonstration, the multicolored oxidation states of cerium and iron work behind the scenes to create the "Fantastic Four-Color Oscillator." The microscale experiment "Oxidation–Reduction Survey" allows students to investigate the reactions of iron(II) and iron(III) ions with oxidizing and reducing agents, respectively. What factors influence whether a particular compound will be an oxidizing agent or a reducing agent? By determining the changes in oxidation state for each reagent and breaking down the reactions into oxidation and reduction half-reactions, students learn to balance redox equations and to describe the characteristics of oxidizing and reducing agents.

Applications and Analysis

Oxidation and reduction are real phenomena with real applications—and real problems. Consider, for example, the billions of dollars spent every year in the fight against corrosion. In the "Corrosion of Iron," a guided inquiry activity, students study the logic and evidence for the electrochemical model of corrosion and then use their imagination and creativity to design solutions to this problem. "UV-Sensitive Paper" and the "Silver Mirror Award" in the *Demonstrations* section of this book provide a showcase for additional applications of oxidation–reduction reactions. Finally, the principles and concepts of oxidation–reduction come together in "Analysis of Hydrogen Peroxide," a great culminating activity that also integrates prior learning of molar relationships and stoichiometry.

Safety, Flexibility, and Choice

Chemistry is an experimental science! Depend on Flinn Scientific to give you the information and confidence you need to work safely with your students and to 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. The selection of experiments and demonstrations in *Oxidation and Reduction* gives you the ability to design an effective lab curriculum that will work with your students and your resources in your classroom. Best of all, no matter which activities you choose, your students are assured of success. All of the activities in *Oxidation and Reduction* 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.