

Electrochemistry—Preface

Principles of electricity and chemistry overlap in electrochemistry, the study of the interconversion of chemical and electrical energy in chemical reactions. What are the basic features of an electrochemical cell? What chemical reactions will take place when an external voltage is applied to an electrolytic cell? What factors determine the ability of a voltaic cell to produce electricity? What is the relationship between the amount of electricity that flows through a solution and the extent of the chemical reaction that takes place? The purpose of *Electrochemistry*, Volume 17 in the Flinn ChemTopic™ Labs series, is to provide high school chemistry teachers with laboratory activities that will help students understand the basic principles of electrochemistry and its applications. Four experiments and six demonstrations allow students to build simple electrochemical cells and to investigate the production and utilization of electricity. Please see *Oxidation and Reduction*, Volume 16 in the Flinn ChemTopic™ Labs series, for activities dealing with the fundamental role of electron transfer in oxidation and reduction reactions.

Basic Principles

The basic features of an electrochemical cell are explored for both electrolytic and voltaic cells. In the experiment “Introduction to Electrochemistry,” students study the electrolysis of water in a simple U-tube using mechanical pencil “lead” electrodes and a 9-V battery. Indicator color changes reveal the oxidation and reduction reactions that take place at each electrode and the properties of the anode and the cathode. In “Measuring Cell Potentials,” students build unique micro-voltaic cells using metals and metal ion solutions and measure the resulting cell voltages. Complementary demonstrations that may be used to teach students about electrolytic and voltaic cells include “Hoffman Electrolysis” and the “Lemon Battery Contest,” respectively. In the demonstration “Basic Electrophoresis,” the separation of charged dye molecules in an electric field illustrates the central role of ion migration in electrochemical cells.

Oxidation and Reduction Reactions

While the electrical principles at work in electrochemistry certainly command attention, they should not obscure the chemical reactions that take place. In the experiment “Electrolysis Reactions,” students use a simple and inexpensive Petri dish electrolysis set-up to observe the oxidation

and reduction reactions of potassium iodide, copper(II) bromide, and sodium chloride in aqueous solution. In “The Tin Man” demonstration, tin(II) ions in a solution of tin(II)

chloride are oxidized to tin(IV) ions at the anode and are reduced to tin(0) metal at the cathode. The result is a stunning “tin-man” crystal tree that grows before your eyes!



Quantitative Applications

Electrolysis has many industrial and commercial applications, and the amount of electricity used in electrolysis represents a significant portion of the nation's energy consumption. In the experiment “Quantitative Electrochemistry,” students study the relationship between the quantity of electricity used and the amount of product obtained in a copper-electroplating reaction. “Microscale Electrolysis” is a wonderful companion or follow-up demonstration for the “Introduction to Electrochemistry” experiment. The gas mixture generated in the electrolysis of water is collected in a pipet bulb and then ignited with a spark. The resulting “rocket reaction” offers convincing proof that the gas mixture contains the 2:1 stoichiometric ratio of hydrogen and oxygen. Finally, the “Hoffman Electrolysis” demonstration also has an optional quantitative component.

Learning in the Lab

Chemistry is an experimental science! Don't let budget constraints limit what students learn in the lab—electrochemistry does not have to bust the budget. Use the safe, simple, and economical activities in *Electrochemistry* to help you make the most of your resources. The selection of experiments and demonstrations, combined with complete sample data and extensive teacher notes, gives you the ability to design an effective lab curriculum for your students. Best of all, no matter which activities you choose, your students are assured of success. All of the activities in *Electrochemistry* 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.