Chemistry in the Environment—Preface

Earth, air, and water—these classical "elements" in ancient Greek philosophy were thought to be the basis of all living and nonliving things. Modern science has cast these "elements" in a new light. We know that the ultimate fate of our natural resources and the quality of the environment depend on physical, chemical, and biological principles and processes. Chemical reactions abound in the soil beneath our feet, the air we breathe, and the water we drink. Chemical principles provide a foundation for understanding how the soil binds nutrients, what happens to combustion gases in the atmosphere, and why lakes and streams are naturally buffered. The purpose of *Chemistry in the Environment,* Volume 22 in the Flinn ChemTopic™ Labs series, is to provide high school teachers with meaningful, easy-to-do laboratory activities that will help students apply the principles they have learned in general chemistry to chemical processes in the environment. The six experiments and five demonstrations in this book are an excellent foundation for an exciting and relevant capstone module in the science curriculum.

Chemistry and Soil Science

Soil is an essential natural resource. The physical and chemical properties of soil, including the capacity to store nutrients and the ability to protect against groundwater contamination, depend on the mixture of particles in the soil and its pH and nutrient content. In the "Physical and Chemical Properties of Soil" experiment, students analyze the composition of soil and determine soil texture, study the ability of soil to bind nutrients, and measure the pH and nutrient levels in soil. Soil is a vital component of the hydrologic (water) cycle, serving as a filter for many chemicals that may be incorporated into the soil. Chemicals that do not bind to the soil migrate through the soil and leach into the groundwater. "Cleaning Up with Iron" demonstrates a novel technological approach for removing organic pollutants from contaminated groundwater.

Chemistry and Water Quality

The amount of dissolved oxygen in water and pH are important indicators of water quality. Dissolved oxygen levels are critical in maintaining biological diversity. Use the "Dissolved Oxygen Testing" lab to organize a cooperative class project on the effect of environmental variables on the amount of oxygen dissolved in water. Students use the Winkler method to measure dissolved oxygen concentrations as a function of temperature, salinity, nutrient levels, etc. Many lakes and streams are naturally buffered due to the presence of dissolved minerals from rocks and soil. In "pH and the Alkalinity of Water," students determine the alkalinity or buffer capacity of water by acid–base titration. Alkalinity is also closely related to water hardness—see the microscale EDTA titration in "How Hard Is Your Water?" to measure water hardness. Water purification and water cleanup activities are the focus in two demonstrations, "Clearing Water with Alum" and "Oil Spill Cleanup."

Chemistry in the Atmosphere

Gases and particulate matter released into the atmosphere as a result of both natural processes and human activities undergo a variety of photochemical and other atmospheric reactions. These reactions have a significant impact on air pollution and air quality. In "Air Pollution Investigation," students measure the amount of particulate matter in air, study the chemistry of combustion products, and explore some of the consequences of acid rain. The "Acid Rain in a Bag" demonstration is a safe microscale simulation of the properties of nitrogen oxides and the production of acid rain. A zippered bag on the overhead projector provides a model atmosphere for the generation, dispersal, and reactions of nitrogen oxides. Update your curriculum with modern developments in solar energy technology using the "Build a Solar Cell" experiment. The lab has comprehensive background information and instructions for building and testing a dye-sensitized solar cell.

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 *Chemistry in the Environment* offer an excellent opportunity to help students see chemistry not just in a textbook, but in the world around them. The experiments and demonstrations have been optimized to adapt them to the knowledge and skill level of the high school science curriculum, and 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.

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