

Thermochemistry—Preface

There is an old saying that the only thing constant in life is change. This is certainly true in chemistry, where physical changes, chemical changes, and energy changes are all intertwined. The purpose of *Thermochemistry*, Volume 10 in the Flinn ChemTopic™ Labs series, is to provide high school chemistry teachers with laboratory activities that will lead students to a successful understanding of the role of heat and energy changes in chemistry.

How are processes characterized as exothermic or endothermic? What happens to the heat energy that is absorbed in an endothermic reaction? Can the amount of heat energy be measured? How much energy is released when food “burns” in the body? *Thermochemistry*—a collection of five experiments and five demonstrations—will help students answer these questions and appreciate the significant applications of thermochemistry in their daily lives.

Energy, heat, and temperature

Two demonstrations look at the relationship among these related but distinct concepts. “Colorful Heat” provides an effective visual aid to observe the difference between heat and temperature, while “Specific Heat” explores the definition of specific heat and how different substances can be used to store energy. Use the “Specific Heat” demonstration to introduce the factors involved in heat energy calculations.

Exothermic and endothermic reactions

Some reactions absorb heat as they proceed, while others release heat as they take place. In “Exploring Energy Changes,” students observe the heat changes in physical and chemical reactions and then use technology to measure temperature changes over time in an endothermic or exothermic reaction. Two demonstrations—“The Cool Reaction” and “Flameless Ration Heaters”—also provide dramatic evidence of endothermic and exothermic reactions, respectively.

Calorimetry

Three experiments provide a range of choices for measuring heat transfer in physical and chemical processes. In “Measuring Energy Changes,” students measure a heating curve for ice and water, and then use calorimetry to determine the amount of energy needed to melt ice. In “Discovering Instant Cold Packs,” students design a calorimetry experiment to determine the enthalpy change that occurs when a “cold pack solid” dissolves in water. Finally, in “Measuring Calories,” students use calorimetry to compare the amount of energy released when different snack foods burn.

Heats of reaction

“Heats of Reaction and Hess’s Law” is an advanced microscale experiment that allows students to integrate their understanding of experi-

ment and theory. Students determine the heats of reaction for reactions of magnesium metal and magnesium oxide and then apply Hess’s law to calculate the heat of combustion of magnesium. Finally, the “Whoosh Bottle” provides a powerful demonstration of how much energy is released when fuels burn. Use this demonstration to introduce heat of reaction calculations and to illustrate the products formed in combustion reactions.

Incorporating technology

The use of technology for data collection and analysis is tailor-made for thermochemistry. “Exploring Energy Changes,” the first experiment in this book, has been written as a technology-based lab activity. Specific instructions for adapting each activity to the use of calculator- or computer-based technology have also been included in the Supplementary Information of each experiment. In all cases, the use of technology should be viewed as an option, not a requirement.

Safety, flexibility and choice

The overlapping selection of experiments and demonstrations in *Thermochemistry* gives you the ability to cover the topics you feel are important in the safest, most effective manner possible. Beginning-level students will appreciate the opportunity to learn essential definitions not by memorizing them, but by seeing and feeling them, literally, in “Exploring Energy Changes.” Students of all skill levels will benefit from the opportunity to discover calorimetry and connect it to their lives in the inquiry-based experiment, “Discovering Instant Cold Packs.” Alternatively, the real-world application in “Measuring Calories” provides an effective learning exercise to make even the most resistant students sit up and take notice of what thermochemistry is all about. Finally, ambitious students will be challenged to put their knowledge of theory into practice in “Heats of Reaction and Hess’s Law.” Best of all, no matter what experiments and demonstrations you choose, your students are assured of success. Each experiment in *Thermochemistry* has been extensively tested and retested to make sure students will achieve meaningful results. 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.

