Molar Relationships & Stoichiometry—Preface

The mole concept is fundamental to chemistry. It is the bridge that allows us to cross over from the macroscopic world in which we live to the submicroscopic world of atoms and molecules. Understanding the mole concept makes it possible to analyze compounds and determine their chemical formulas—to study the composition of matter. Applying the mole concept makes it possible to relate the amounts of chemicals consumed and produced in chemical reactions—to study the properties of matter. The purpose of *Molar Relationships and Stoichiometry*, Volume 7 in the Flinn ChemTopic™ Labs series, is to provide high school chemistry teachers with laboratory activities that will help students understand and apply the mole concept. Five experiments and five demonstrations allow students to explore molar relationships and discover the principles of stoichiometry.

Atoms, mass, and moles

We cannot see atoms or molecules. We cannot touch them or feel them to determine their size. But we can count them! In "Who's Counting?" students use rice grains and navy beans to discover how chemists count atoms and molecules—chemists count atoms by weighing them. As students learn how the "counting-by-weighing" strategy can be applied to real atoms, they face the almost impossible task of trying to imagine Avogadro's number of atoms. "How Big Is a Mole?" presents some analogies and mental math exercises that will help students visualize the magnitude of Avogadro's number. The relationship between atoms, mass, and moles comes full-circle in "Mole Samples and Molar Mass," where students view a variety of mole samples on display and identify elements and compounds based on their molar masses.

Moles and chemical formulas

Historically, one of the first advances made possible by the evolution of the mole concept was in analyzing compounds to determine their chemical formulas. In "Magnesium Oxide," students prepare a new chemical compound and calculate its percent composition. They then apply the mole concept to determine the empirical formula of the compound and its percent yield. "Magnesium Oxide" uses a direct approach to calculate the number of moles of atoms in a compound and determine its formula. The "Stoichiometry and Solubility" demonstration illustrates an indirect method for achieving the same goal. The purpose of this demonstration is to find the optimum mole ratio for the formation of a precipitate in a double replacement reaction and predict the formula of the product.

Mole ratios and chemical reactions

Stoichiometry is defined as the study of the quantitative relationships governing the disappearance of reactants and the appearance of products in a chemical reaction. In "Decomposition of Sodium Chlorate," students design and carry out an experiment to determine the product obtained in the thermal decomposition of sodium chlorate. In "Mole Ratios—Copper and Silver Nitrate," students determine the number of moles of silver produced in the reaction of copper with silver nitrate and use the mole ratio to write the balanced chemical equation for the reaction. Finally, in "Micro Mole Rockets," students generate microscale quantities of hydrogen and oxygen and test their combustion properties, first separately, then in mixtures of various mole ratios. Use this experiment as a fun, culminating-type activity to reward students for their perseverance in learning stoichiometry. The goal of this experiment is to find the most "explosive" gas mixture and use it to launch a micro mole rocket across the room. Be forewarned—once students get started, they will not want to stop!

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, from working with hot crucibles to handling strong oxidizing agents.

Stoichiometry calculations often inspire fear in chemistry students. Because many students struggle to understand the physical reality behind the calculations, they tend to view them only as formal, mathematical exercises. The selection of experiments and demonstrations in *Molar Relationships and Stoichiometry* will help you take the fear out of stoichiometry. These activities work because they match the way students think and learn. No matter which activities you choose, your students are assured of success. Each experiment and demonstration in *Molar Relationships and Stoichiometry* has been thoroughly tested and retested. 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.