

Molar Relationships & Stoichiometry— Experiment Summaries and Concepts



Who's Counting?—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! How can that be? The purpose of this activity is to discover by analogy how chemists count atoms and molecules. Students count out and measure the mass of rice and bean “particles” and calculate their average mass. They then predict the mass of a much larger number of rice grains and navy beans and test the accuracy of the “counting-by-weighing” method.

Magnesium Oxide—Percent Composition and Empirical Formula

There are over 20 million known chemical compounds. Identifying and analyzing what compounds are made of is one of the most important jobs in chemistry. In this experiment, 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 in the synthesis reaction.

Decomposition of Sodium Chlorate—Mass, Moles, and the Chemical Equation

Sodium chlorate is used as a source of oxygen in emergency oxygen generators. Decomposition of sodium chlorate produces oxygen gas and a white solid. How much gas is evolved, and what is the formula of the white solid? In this inquiry-based experiment, students design a microscale experiment to answer these questions and determine the chemical equation for the decomposition of sodium chlorate. Students discover the principles of stoichiometry as they apply the mole concept to the relationship between reactants and products in a balanced chemical equation.



Mole Ratios—Copper and Silver Nitrate

The reaction of copper wire with silver nitrate in aqueous solution can be used to grow beautiful crystals of silver metal. When students see the silver forming in front of their eyes, their first question is usually “Can we make money this way?” The purpose of this experiment is to capitalize on this natural curiosity of students and learn about stoichiometry in the process. Students measure the mass of silver produced and calculate the mole ratio governing the disappearance of copper and the formation of silver metal. They then use this information to determine how much their silver is worth. Surprise—it's not as much as they think!

Micro Mole Rockets—Hydrogen and Oxygen Mole Ratio

The combustion reaction of hydrogen and oxygen has been used to send people to the moon and to design electric vehicles for the future. What factors determine the explosiveness of this reaction? In this microscale lab experiment, students generate hydrogen and oxygen gases and test their combustion properties, first separately, then in mixtures of various proportions. The goal—to find the most powerful gas mixture and use it to launch a micro mole rocket across the room!



Concepts

- Average atomic mass
- Molar mass
- Mole concept
- Avogadro's number
- Percent composition
- Empirical formula
- Molecular formula
- Percent yield
- Moles
- Balanced chemical equation
- Molecular formula
- Stoichiometry
- Mole ratio
- Balanced chemical equation
- Stoichiometry
- Single replacement reaction
- Mole ratio
- Stoichiometry
- Combustion
- Limiting reactants