Equilibrium—
Experiment Summaries and Concepts

Exploring Equilibrium—It Works Both Ways

Physical changes, such as melting ice or dissolving sugar, can easily be reversed. What about chemical reactions? Many chemical reactions are also reversible—the reactions occur in both the forward and reverse directions. In this introductory level experiment, students explore the nature of chemical equilibrium for two reversible reactions. Students identify the key properties of a system at equilibrium and the conditions that affect equilibrium as they follow the color changes for a complex-ion and acid–base indicator reaction.

Concepts
- Reversible reactions
- Chemical equilibrium
- Complex-ion reaction
- Acid–base indicator

Restoring Balance—LeChâtelier's Principle and Equilibrium

Chemical equilibrium is a balancing act. What happens when the balance between the forward and reverse reaction rates is disturbed? The purpose of this classic chemistry experiment is to examine how concentration and temperature changes affect the "pink-and-blue" equilibrium involving cobalt complex ions. Students gather evidence to see how equilibrium responds to different reaction conditions. LeChâtelier's principle is used to interpret the results and visualize how balance is restored.

- Chemical equilibrium
- LeChâtelier's principle
- Complex-ion reaction
- Exothemic vs. endothermic

The Equilibrium Constant—Complex-Ion Formation

For any reversible reaction in a closed system, the concentrations of all reactants and products will not change once equilibrium has been reached. The equilibrium constant provides a mathematical description of the position of equilibrium for any reversible chemical reaction. In this technology-based experiment, students use colorimetry to measure the equilibrium constant for a reaction and determine if the equilibrium constant is, indeed, a constant.

- Chemical equilibrium
- Equilibrium constant
- Complex-ion reaction
- Colorimetry

Gas Phase Equilibrium—Pressure and Temperature

Many important reactions that take place in the atmosphere involve equilibrium concentrations of gas-phase reactants and products. What variables affect the equilibrium for reactions in the gas phase? In this microscale experiment, students examine how the relative concentrations of nitrogen oxides in a sealed tube depend on temperature and pressure. The results highlight the gas-phase reactions that contribute to air pollution.

- Chemical equilibrium
- LeChâtelier's principle
- Gas-phase reactions
- Nitrogen oxides

Penny-Ante Equilibrium—A Cooperative Activity

What is equilibrium? What happens to the amount of reactants and products when equilibrium is reached? What if more reactants or products are added to a system already at equilibrium? Students use pennies as reactants and products in a reversible reaction to answer these questions and learn more about the fundamental nature of equilibrium. Use this cooperative group activity in the *Demonstrations* section to introduce equilibrium and to describe the properties of a system at equilibrium.

- Reversible reactions
- Equilibrium
- Equilibrium constant
- LeChâtelier's principle

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