

# Acids and Bases— Experiment Summaries and Concepts



## ***Properties of Acids and Bases—Identification and Classification***

Acids and bases are useful reagents in the laboratory and play an important role in biology and nature. What properties of substances can be used to distinguish acids and bases? The purpose of this microscale experiment is to explore the properties of aqueous solutions and classify them as acidic, basic, or neutral. The results of indicator, reactivity, and conductivity tests are used to develop working definitions of acids and bases and to analyze the pH scale for identifying acids and bases.



## ***Natural Indicators—Acids, Bases, and the pH Scale***

Roses are red, violets are blue—or are they? Red roses, as well as many other flowers and fruits, contain natural indicators that are sensitive to acids and bases. In this inquiry-based activity, students extract natural indicators from flowers and fruits and then design a procedure to investigate their color changes as a function of pH. The results are used to analyze the pH values of unknown solutions.



## ***Measuring Acid Strength— $K_a$ Values of Weak Acids***

Acids vary greatly in their strength—their ability to produce ions when dissolved in water. What factors determine the strength of an acid? The purpose of this experiment is to measure the equilibrium constant for ionization of an unknown weak acid. Solutions containing equal molar amounts of a weak acid and its conjugate base are prepared by half-neutralization of the acid. Their pH values are measured and used to calculate the  $K_a$  value of the acid and determine its identity.

## ***Classic Titration—pH Curves and an Unknown***

One of the most common questions chemists have to answer is how much of something is present in a sample or product. If the product contains an acid or base, this question is usually answered by titration. The purpose of this technology-based activity is to analyze the shape of the titration curve for neutralization of hydrochloric acid with sodium hydroxide and to determine the concentration of an unknown hydrochloric acid solution.



## ***Microscale Titration—Percent Acetic Acid in Vinegar***

Vinegar, aspirin, antacids—many common substances that we use every day are acids or bases. The composition or purity of these products is something we normally take for granted. In this experiment, students analyze the percent acetic acid in vinegar by microscale titration. Students prepare a standard sodium hydroxide solution of known molarity and then use this solution to titrate vinegar and determine the percent of acetic acid.



## ***Buffers Keep the Balance—Biological Buffers***

A buffer protects against changes in pH when acids and bases are added to it. Every living cell contains natural buffer systems that maintain the constant pH needed for proper cell function. Consumer products are often buffered to safeguard their activity. The purpose of this experiment is to explore the properties of model carbonate and phosphate buffers that mimic the biological buffers present in blood and cells, respectively.

## **Concepts**

- Acids and bases
- pH Scale
- Indicators
- Conductivity
  
- Indicators
- Extraction
- pH Scale
  
- Weak acid
- Conjugate base
- Equilibrium constant
- Neutralization reaction
  
- Titration
- Neutralization
- Equivalence point
- Titration curve
  
- Microscale titration
- Neutralization
- Equivalence point
- Molarity
  
- pH
- Buffer
- Weak acid
- Conjugate base