

# Unit Summary

The hands-on activities in Frey's Inquiry Investigations™ Chemistry Module link to core science concepts, making them an excellent complement to existing curricula. Students investigate atomic structure, molecular structure, the periodic table, matter, elements, mixtures, compounds, gases, chemical and physical reactions, endothermic and exothermic reactions, acids, bases, salts, oxidation/reduction reactions, conservation of mass, and water purification.

The Inquiry Investigations™ Chemistry Module consists of four investigative units featuring twenty-seven hands-on laboratory activities. Each unit begins with a thorough introduction of the science skills and concepts presented in the lab activities that follow. The lab investigations can be performed in sequence (see pacing chart) or separately based upon the time available.

Suggested *Going Further* investigations allow students to design and carry out their own investigations, expanding their knowledge and understanding of chemistry.

## Unit 1: Atom and Basic Molecular Structures

### Lab 1: Atomic Structures

In **Activity 1**, students construct models of atoms of different elements. They also learn about and model the formation of ions.

In **Activity 2**, students model the formation of molecules by covalent bonding.

In **Activity 3**, students demonstrate the formation of an ionic bond.

Suggested *Going Further* investigations prompt students to investigate the attraction between opposite charges and research the subatomic particles that make up protons and neutrons.

### Lab 2: Molecular Structures

In **Activity 1**, students model the structures of common acids and bases. They also illustrate the reaction of an acid and a base in water, demonstrating the gain or loss of a hydrogen ion.

In **Activity 2**, students model the formation of a salt and learn about its crystal structure.

In **Activity 3**, students learn about organic compounds and assemble models of various hydrocarbons.

In **Activity 4**, students learn about soaps and detergents and model the formation of a soap molecule.

Suggested *Going Further* investigations ask students to design an experiment to test the effect of salt on the freezing temperature of water.

## Unit 2: Physical Changes

### Lab 3: Matter

In **Activity 1**, students investigate the characteristics of the three states of matter: solids, liquids, and gases.

In **Activity 2**, students investigate chemical and physical changes in matter.

Suggested *Going Further* investigations ask students to design an experiment that would determine which brand of steel wool resists rusting the longest, and identify conditions that would speed the rusting process.

### Lab 4: Elements

In **Activity 1**, students learn about atoms and elements. They calculate the amount of various elements in the human body.

In **Activity 2**, students learn about the periodic table and its organization.

Suggested *Going Further* investigations ask students to investigate the idea of periodicity by examining weather data such as the high, low, and average temperatures.

### Lab 5: Mixtures

In **Activity 1**, students make homogeneous and heterogeneous mixtures and explore their properties.

Suggested *Going Further* investigations allow students to investigate polymers and how they can help clean up our environment.

### Lab 6: Compounds

In **Activity 1**, students use electrolysis to separate the elements hydrogen and oxygen from a common compound, water.

In **Activity 2**, students demonstrate a chemical reaction between aluminum and copper chloride. They also create a word statement describing the reaction and translate the word statement into a chemical equation.

Suggested *Going Further* investigations ask students to perform gas-producing and thermal reactions.

### Lab 7: Gases

In **Activity 1**, students investigate Boyle's Law by varying the pressure of air in a syringe and measuring the corresponding change in volume.

Suggested *Going Further* investigations prompt students to investigate how a change in temperature would affect the pressure of a gas.

## Unit 3: Chemical Changes

### Lab 8: Chemical Reactions

In **Activity 1**, students observe a chemical reaction that produces a change in temperature. They also identify the reaction as either exothermic or endothermic.

In **Activity 2**, students observe a color change produced during a chemical reaction.

In **Activity 3**, students observe the production of a gas during a chemical reaction between sodium bicarbonate and vinegar.

In **Activity 4**, students observe how respiration and photosynthesis cycle carbon dioxide ( $\text{CO}_2$ ) and affect the pH of a solution.

Suggested *Going Further* investigations ask students to investigate the rate of reactions in the lab and investigate the chemical reaction that takes place inside leaves during the autumnal season.

### Lab 9: Energy Changes in Chemical Reactions

In **Activity 1**, students investigate an exothermic chemical reaction.

In **Activity 2**, students observe an endothermic reaction.

Suggested *Going Further* investigations allow students to investigate the exothermic reaction between calcium chloride ( $\text{CaCl}_2$ ) and water.

### Lab 10: Acids, Bases, and Salts

In **Activity 1**, students use an indicator solution to determine the pH of three unknown solutions. They then identify each solution as an acid, base, or salt.

In **Activity 2**, students investigate how acids combine with metals to undergo a chemical change.

In **Activity 3**, students learn how salts are produced by performing a neutralization reaction.

Suggested *Going Further* investigations ask students to design experiments to compare and contrast the disintegrative properties of acids using soft drinks as an example.

### Lab 11: Oxidation/Reduction Reactions

In **Activity 1**, students demonstrate and observe a series of color changes that are due to oxidation/reduction reactions occurring within a solution.

Suggested *Going Further* investigations ask students to explore how electrolysis of certain metals is carried out and how the process is related to oxidation/reduction chemical reactions.

## Unit 4: Comprehensive Inquiry Investigation

### Lab 12: Culminating Lab

In **Activity 1**, students purify a polluted water sample by developing a water treatment process that yields a water sample with a purity rated value of  $\geq 75$  points.

In **Activity 2**, students design an experiment to test the law of conservation of mass by comparing the mass of a system before and after a chemical reaction involving sodium bicarbonate and acetic acid.

Suggested *Going Further* investigations ask students to explore a local water treatment facility near their home and learn about the chemical processes used to purify waste water.