

# The Chemical World

# 1

## Chapter Overview

This chapter presents an understanding of the history of chemical investigation. It is hoped that this will help the student understand the history of experimentation and scientific inquiry so that he or she feels a real-world association with the material to be covered later in the course. A few examples that the student may be familiar with are presented.

## Lecture Outline

### 1.1 Sand and Water

- A. All things are made of atoms
- B. How atoms are arranged dictates properties of substances
- C. What is chemistry?

### 1.2 Chemicals Compose Ordinary Things

Learning Objective: Recognize that chemicals make up virtually everything we come into contact with in our world.

- A. Everything we can hold or touch is made of chemicals
- B. Molecules interact all around you all the time
- C. Understanding how the universe works means understanding how molecules interact.

### 1.3 The Scientific Method: How Chemists Think

Learning Objective: Identify and understand the key characteristics of the scientific method: observation, the formulation of hypotheses, the testing of hypotheses by experiment, and the formulation of laws and theories.

- A. Observation – hypothesis – law – theory – experiment
- B. Scientific law (e.g., law of conservation of mass)
- C. Dalton's atomic theory

### 1.4 Analyzing and Interpreting Data

Learning Objective: Identify patterns in data and interpret graphs.

- A. Sets of measurements constitute data
- B. Identifying patterns in data
- C. Interpreting graphs

### 1.5 A Beginning Chemist: How to Succeed

- A. Curiosity and imagination
- B. Calculation
- C. Commitment

## Chemical Principle Teaching Ideas

### Matter and Molecules

Go around the room and point out how everything around the students, including the room and their notebooks, are made of matter. Emphasizing the real-world association with what is covered in lecture is always a good idea.

### The Scientific Method

Using the scientific method to cover a simple concept such as putting together a children's puzzle or baking a cake will help them understand the method, which is most important here.

### Success as a Beginning Chemist

If the students are to do well in this course, they must be willing to expand their horizons outside the classroom and try to use everyday interactions with their world to help understand the concepts to be covered.

## Skill Builder Solutions

- 1.1. According to the graph, the concentration of carbon dioxide in 1880 was 290 ppm. In 1920, the concentration of carbon dioxide was 304 ppm. The change in concentration was  $304 \text{ ppm} - 290 \text{ ppm} = 14 \text{ ppm}$ , over a change in time of 40 years. The average rate of increase was then  $14 \text{ ppm} / 40 \text{ years} = 0.35 \text{ ppm/year}$ . The increase is likely due to increased burning of fossil fuels.

## Suggested Demonstrations

Open a can of soda in the students' presence and talk about the myriad of reactions and interactions taking place. The more often students associate chemical principles with real-life events, the better.

Burning of Magnesium, *Chemical Demonstrations* 1:38, Shakhshiri, B. Z. University of Wisconsin Press, 1983.

Use the scientific method to analyze an everyday occurrence in students' lives. Suggestions are a jigsaw puzzle, the burning of a combustible material, or some aspect of body chemistry.

## Guided Inquiry Ideas

Below are a few example questions that students answer in the guided inquiry activities provided in the Guided Activity Workbook.

In a grammatically correct sentence, describe the relationship between laws and theories.

Considering the way the terms are used in science, are laws more certain than theories? Explain.

In a grammatically correct sentence, describe the difference between atoms and molecules.

How many hydrogen atoms are there in one molecule of water? What do all the atoms have in common?

What famous law might be explained with the kinetic theory of gases?