

INTRODUCTION

If science were merely a collection of facts, you would need only an encyclopedia to study science. You could simply research, read, and memorize information that someone else had collected. But science is much more than just a collection of facts. It is a working process, a method of thinking, and a way to solve problems. Science is what scientists do; memorizing a textbook full of facts could not teach you true science.

When it comes to learning, nothing can compare to hands-on experience. The investigations and demonstrations in this book were developed so that you will become genuinely interested in science. Through attention to detail, hard work, and good old-fashioned persistence, you will earn a great appreciation for scientific research and how valuable it is to our present understanding of the physical world.

Purposes

This laboratory manual was developed for the following purposes:

- *To help you understand how science works.* Science is a method of gathering information and solving problems that relate to the physical universe. You will not *imitate* scientists in this course; you will actually *be* a scientist. You will see firsthand how science works, what it can do, and what it cannot do.
- *To help you remember the information in your textbook.* You can remember information more easily when you use it than when you simply memorize it. The applications, investigations, and demonstrations in this laboratory manual allow you to review, apply, and observe the ideas you have encountered in your textbook.
- *To help you develop scientific attitudes.* Are you curious? Do you make decisions based on facts? How do you react when some fact seems to contradict one of your beliefs? A scientific attitude will help you make reasonable decisions in areas as different as buying clothes, forming opinions about ecology, and choosing which courses to take in school.
- *To help you build problem-solving skills.* All your life you will be solving some sort of problem. This laboratory manual will guide you in making accurate observations and sound judgments as you investigate scientific problems.
- *To help you learn laboratory skills.* The activities in this manual will teach you to make accurate measurements and to use common laboratory equipment safely.

1A INVESTIGATION

Laboratory Safety

Name _____

Date _____ Hour _____

Objectives

The purpose of this exercise is to

1. Familiarize you with the basic rules for laboratory safety.
2. Point out safety equipment in the laboratory.
3. Review basic first aid for common accidents.
4. Identify information on warning labels of common products.
5. Discuss the personal protection and hazard index.

Materials List

Suggested household products

Bleach
Hair spray
Household cleaner
Shaving cream
Paint

Suggested laboratory chemicals

Sodium fluoride
Ammonium nitrate
Mercuric chloride
Lead metal

Introduction

The laboratories that you will perform in this course have been designed with the maximum safety possible. However, even household items can become dangerous if they are not used properly. Before you begin a laboratory investigation, you are expected to have read and understood the procedures. You may not begin the in-class portion of the investigation until directed to do so by your teacher. These rules are for your safety, so follow them at all times.

Introduction

This investigation will include the class period and a homework assignment. The purpose of the investigation is to impress upon the students a serious laboratory attitude and to introduce safety practices that will be used in the remainder of the course. The information for the investigation is primarily found on the bottle label of the chemicals being used in the investigation. By law, the hazard index and personal protection information should be on every bottle stored or used in a laboratory. This information can be obtained from the Material Safety Data Sheet (MSDS), which is available upon request from your chemical supplier. Fully equipped classroom laboratories may have fire extinguishers, eyewash stations, fire blankets, and a shower. These items should be discussed. A suggested list of chemicals for this activity is provided in the materials list. You should plan to use three household products and four lab chemicals. Other substances may be substituted.

Note: Additional chemicals can be evaluated using the blank MSDS information form in the back of the lab manual.

Answers to Pre-Laboratory Questions

1. The overall purpose of this investigation is to become aware of laboratory safety.

2. The eye(s) should be flushed with plenty of water for fifteen minutes, and you should seek medical attention.

3. Yes. The label on the container provides warnings and precautions.

4. Container labels should contain a list of specific hazards, first aid procedures, personal protection information, and a hazard index.

5. Chemicals should be stored only in their designated containers
- so that someone knows the contents of the container.
 - so that proper warnings are on the container.

General Comments

1. Discuss the safety information for bleach. This demonstrates to the students what is expected to complete the safety information for each chemical.

2. Requiring the students to work individually further emphasizes a serious rather than a social attitude.

3. You should prepare grading keys for the chemicals you present in class and grade only those answers objectively in this exercise.

4. Giving a comprehensive safety quiz the following day documents that the students have been provided safety training. Each student should pass the quiz before participating in any future laboratory investigations.

5. Save the safety quizzes in your permanent records for at least one calendar year.

Pre-Laboratory Questions

Read the entire investigation. Answer the following questions prior to class on a separate sheet of paper. Use complete sentences.

- What is the purpose of this investigation?
- What should you do if a chemical splashes in your eye?
- Can household products be dangerous? How can you tell?
- Give the four items that a label on a container should contain.
- Give two reasons that household and laboratory chemicals should be stored only in their designated containers.

Basic Laboratory Rules

- Never perform any experiment without the teacher's permission.
- Avoid playful, distracting, or boisterous behavior.
- Work at your own station and do not "visit" with other groups.
- Never have food or drink in a laboratory.
- Never taste any chemicals or drink out of any chemical glassware.
- Place solid trash in the wastebasket and liquid wastes in designated containers.
- Notify the teacher of any injuries, spills, or breakages.
- Never leave a flame or heater unattended.

Laboratory Safety Features

- Eyewash stations (if equipped)
 - The purpose of the eyewash station is to remove any chemical that gets into your eyes.
 - Locate the eyewash stations in the room and turn on the water to see how the stations work.
- Showers (if equipped)
 - The purpose of the showers is to wash any dangerous chemicals off your clothes or skin.
 - Locate the shower in the laboratory and observe how it works. Do not test the shower.
- Fire blanket (if equipped)
 - The purpose of the fire blanket is to wrap up a person if his clothes catch fire.
 - Locate the fire blanket in the room.

D. Fire extinguishers

1. There may be several different types of fire extinguishers available that are made for different types of fires.
2. Locate the fire extinguishers and determine their specific use.

	Location	Use
a.	_____	_____
b.	_____	_____

Basic First Aid for Minor Injuries (Notify the lab instructor of all accidents.)

1. Eyes—If any chemical gets into your eyes, remove contact lenses and flush the area with plenty of water for fifteen minutes. Seek medical attention.
2. Minor heat burns—Apply cold water to the affected area.
3. Acid or alkali burns—Flush the area with plenty of water. If irritation persists, seek medical attention.
4. Cuts—Wash the area thoroughly with soap and water.
5. Inhalation of chemical dust or vapors—Remove to fresh air and observe for ten to fifteen minutes. Seek medical attention if breathing distress continues.

Warning Labels

Laboratory chemicals and common household products can be dangerous if they are not used properly. Labels on the containers should specify the hazards, first aid procedures, personal protection information, and the hazard index. Complete the following information about the following chemicals. It may not be possible to complete the information on every product since the labels may not contain all of the information. This investigation can be completed by using products found at home.

1. Hazard index
 - Health (e.g., 3—serious hazard)
 - Flammability
 - Reactivity
2. Personal protection index (e.g., D—face shield, gloves, synthetic apron)
3. Warnings—Warnings may include the following:
 - Target organs
 - Combustible or explosive
 - Strong oxidizer or corrosive
 - Storage and disposal instructions
4. First aid
5. Use

NFPA diamond symbol Copyright © 1995, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 495 and NFPA 325M which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 system to classify chemicals does so at their own risk.

Safety Marking Information

The following material is provided as a reference for helping students to understand the hazard codes they may find on various household and laboratory chemicals. It is not intended to be exhaustive, and the information may change over time. To obtain the most current safety marking information, you should contact the National Fire Protection Association (NFPA) office or visit their web site on the Internet at <http://www.nfpa.org>.

A common symbol found on many commercial chemicals is the NFPA "hazard diamond" shown below. This information relates to how the substance responds to fires. For a given chemical, the diamond will have a number between 0 (least severe hazard) to 4 (most severe hazard) in each of the spaces named (Health), (Flammability), and (Reactivity).



The codes for health hazards vary from 0—"Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials"—to 4—"Very short exposure could cause death or serious residual injury even though prompt medical attention was given."