

TO THE STUDENT

Chemistry is exciting! Each day in the laboratory you are given the opportunity to confront the unknown, and to understand it. Each experiment holds many secrets. Look hard and you may uncover them. Work hard and you will understand them.

The word *science* comes from the Latin word *scire*, which means “to know.” The goal of all science is knowledge. Scientists are men and women who devote their lives to the pursuit of knowledge.

In this class, you are given the opportunity to do what scientists do. You can wonder how things work, ask why and how, and then think of ways to answer your own questions. You are given the chance to understand what is unknown to you and to many other people.

It is a great opportunity. Do not waste it by being lazy or careless. Work hard. Master the scientist’s skills of observation and experiment. These skills are tools for understanding the secrets of the unknown.

SAFETY

Chemistry is a laboratory science. As part of your laboratory experience you will handle many chemical substances and manipulate specialized laboratory equipment. Many of these substances pose a health risk if handled improperly, and some of the laboratory equipment can cause severe injury if used improperly. This section is a guide to the safe laboratory practices you will use throughout this course.

Preparation and Safety

To get the most out of your laboratory experience, you must be well prepared for each experiment. This means that you must read the experiment thoroughly before coming to the laboratory. Make sure you have a clear idea of what the experiment is about. Be sure that you understand each step of the procedure. If you are unsure of any part of the experiment, ask your teacher for help before the laboratory begins.

Preparation is important not only to understanding, but also to safety. If you are well prepared for the laboratory, it is much less likely that an accident will occur. In the laboratory, you are responsible not only for your safety, but also for the safety of your classmates. If an accident happens because you are not prepared, it can also affect your friends. This is all the more reason for you to take the time and make the effort to prepare for the laboratory.

Be sure to note the safety warnings listed in the Safety section of each experiment. Note that these warnings are emphasized by symbols appearing in the margins. The symbols mark those parts of the procedure that may be hazardous. In addition, be sure to observe the general safety precautions described in the safety section at the beginning of the manual. Finally, remember the most important safety advice of all: *Always wear safety goggles in the chemistry laboratory!*

Safety in the Chemistry Laboratory

Everyone who works in a chemistry laboratory should follow these safety precautions:

1. Wear safety goggles and a laboratory apron in the laboratory at all times.
2. Shoes must be worn in the laboratory. Avoid wearing overly bulky or loose-fitting clothing. Remove any dangling jewelry.
3. Conduct only assigned experiments, and do them only when your teacher is present.
4. Know the locations of safety equipment such as eyewash fountains, fire extinguishers, emergency shower, and fire blanket. Be sure you know how to use the equipment.
5. Do not chew gum, eat, or drink in the laboratory. Never taste any chemicals. Keep your hands away from your face when working with chemicals.
6. Wash your hands with soap and water at the end of each laboratory exercise.
7. Read all of the directions for a laboratory procedure before proceeding with the first part. Reread each instruction before you do it.
8. Notify your teacher immediately if any chemicals, especially concentrated acid or base, are spilled.
9. Report all accidents, no matter how slight, to the teacher immediately.
10. Pin or tie back long hair and roll up loose sleeves when working with flames.
11. Do not leave a lighted burner unattended.
12. Use a hot plate instead of an open flame whenever a flammable liquid is present.
13. Read the label on a reagent bottle carefully *before* using the chemical. After removing the chemical from the bottle, check to make sure that it is the correct chemical for that procedure.
14. To avoid contamination, do not return unused chemicals to a reagent bottle. Similarly, never put a pipet, spatula, or dropper into a reagent bottle. Instead, pour some of the reagent into a small clean beaker and use that as your supply.
15. Do not use chipped or cracked glassware. Discard it according to your teacher's instructions.
16. When diluting an acid, *always* pour the acid slowly into water, stirring to dissipate the heat generated. **CAUTION:** *Never pour water into a concentrated acid.*
17. When heating a liquid in a test tube, turn the mouth of the test tube away from yourself and others.
18. Clean up spills and broken glass immediately. Leave your work area clean at the end of the laboratory period.

Laboratory Hazards

You should be aware of possible hazards in the laboratory and take the appropriate safety precautions. By doing so, you can minimize the risks of doing chemistry. This safety section is intended to acquaint you with the hazards that exist in the laboratory and to indicate how you can avoid these hazards. In addition, information is provided on what to do if an accident should occur.

Thermal Burns

A thermal burn can occur if you touch hot equipment or come too close to an open flame. You can prevent thermal burns by being aware that hot and cold equipment look the same. If a gas burner or hot plate has been used, some of the equipment nearby may be hot. Hold your hand near an item to feel for heat before touching it. Treat a thermal burn by *immediately* running cold water over the burned area. Continue applying the cold water until the pain is reduced. This usually takes several minutes. In addition to reducing pain, cooling the burned area also serves to speed the healing process. Greases and oils should not be used to treat burns because they tend to trap heat. Medical assistance should be sought for any serious burn. *Notify your teacher immediately if you are burned.*

Chemical Burns

A chemical burn occurs when the skin or a mucous membrane is damaged by contact with a substance. The Materials section of each exercise indicates which substances can cause chemical burns. **C** stands for **corrosive**. It indicates that the chemical can cause severe burns. **I** stands for **irritant**. It indicates that the chemical can irritate the skin and the membranes of the eye, nose, throat, and lungs. Chemicals that are marked **C** or **I** should be treated with special care. Chemical burns can be severe. Permanent damage to mucous membranes can occur despite the best efforts to rinse a chemical from the affected area.

The best defense against chemical burns is prevention. *Without exception, wear safety goggles during all phases of the laboratory period—even during cleanup.* Should any chemical splash in your eye, immediately use a continuous flow of running water to flush your eye for a period of 20 minutes. Call for help. If you wear contact lenses, remove them immediately. This is especially crucial if the chemical involved is an acid or base. It can concentrate under the lens and cause extensive damage. Wear a laboratory apron and close-toed shoes (no sandals) to protect other areas of your body. If corrosive chemicals should contact your exposed skin, wash the affected area with water for several minutes.

An additional burn hazard exists when concentrated acids or bases are mixed with water. The heat released in mixing these chemicals with water can cause the mixture to boil, spattering corrosive chemical. The heat can also cause non-Pyrex containers to break, spilling corrosive chemical.

To avoid these hazards, follow these instructions: Always add acid or base to water, very slowly while stirring; never the reverse. One way to remember this critical advice is to think of the phrase “Pouring acid into water is doing what you ought-er.”

Cuts from Glass

Cuts occur most often when thermometers or pieces of glass tubing are forced into rubber stoppers. Prevent cuts by using the correct technique for this procedure. The hole should be lubricated with glycerol or water to facilitate the movement of the glass tubing. The glass should not be gripped directly with the hands, but rather by means of cloth towels. The towels will protect your hands if the glass should break. Use a gentle twisting motion to move the tube smoothly into the stopper.

Avoid cuts from other sources by discarding chipped and cracked glassware according to your teacher's instructions. If you should receive a minor cut, allow it to bleed for a short time. Wash the injured area under cold running water, and notify your teacher. Serious cuts and deep puncture wounds require immediate medical help. Notify your teacher immediately. While waiting for assistance, control the bleeding by applying pressure with the fingertips or by firmly pressing with a clean towel or sterile gauze.

Fire

A fire may occur if chemicals are mixed improperly or if flammable materials come too close to a burner flame or hot plate. When using lab equipment, prevent fires by tying back long hair and loose-fitting clothing. Do not use a burner when flammable chemicals are present. **Flammable chemicals are designated with the symbol \boxed{F}** in the Materials section for each exercise. Use a hot plate as a heat source instead of a burner when flammable chemicals are present.

If hair or clothing should catch fire, *do not* run, because running fans a fire. Drop to the floor and roll slowly to smother the flames. Shout for help. If another person is the victim, get a fire blanket to smother the flames. If a shower is nearby, help the victim to use it.

In case of a fire on a laboratory bench, turn off all accessible gas outlets and unplug all accessible appliances. A fire in a container may be put out by covering the container with a nonflammable object. It could also be smothered by covering the burning object with a damp cloth. If not, call for a fire extinguisher. Spray the base of the fire with foam from the extinguisher. **CAUTION: Never direct the jet of a fire extinguisher into a person's face.** Use a fire blanket instead. If a fire is not extinguished quickly, leave the laboratory. Crawl to the door if necessary to avoid the smoke. Do not return to the laboratory.

Poisoning

Many of the chemicals used in this manual are toxic. **Toxic chemicals are identified in the Materials sections with the symbol \boxed{T}** .

You should do several things to prevent poisoning. Never eat, chew gum, or drink in the laboratory. Do not touch chemicals. Clean up spills. Keep your hands away from your face. In this way you will prevent chemicals from reaching your hands, mouth, nose, or eyes.

In some cases, the detection of an odor is used to indicate that a chemical reaction has taken place. It is important to note, however, that many gases are toxic when inhaled. If you must detect an odor, use your hand to waft some of the gas toward your nose. Sniff the gas instead of taking a deep breath. This will minimize the amount of gas sampled.

Safety Symbols

Take appropriate precautions whenever any of the following safety symbols appear in an experiment.



Eye Safety

Wear safety goggles.



Clothing Protection

Wear a lab coat or apron when using corrosive chemicals or chemicals that can stain clothing.



Skin Protection

Wear plastic gloves when using chemicals that can irritate or stain your skin.



Broken Glass

Do not use chipped or cracked glassware. Do not heat the bottom of a test tube.



Open Flame

Tie back hair and loose clothing. Never reach across a lit burner.



Flammable Substance

Do not have a flame near flammable materials.



Corrosive Substance

Wear safety goggles, an apron, and gloves when working with corrosive chemicals.



Poison

Don't chew gum, drink, or eat in the laboratory. Never taste a chemical in the laboratory.



Fume

Avoid inhaling substances that can irritate your respiratory system.



Thermal Burn

Do not touch hot glassware or equipment.



Electrical Equipment

Keep electrical equipment away from water or other liquids.



Sharp Object

To avoid a puncture wound, use scissors or other sharp objects only as intended.



Disposal

Dispose chemicals only as directed.



Hand Washing

Wash your hands thoroughly with soap and water.



Corrosive



Irritant



Flammable



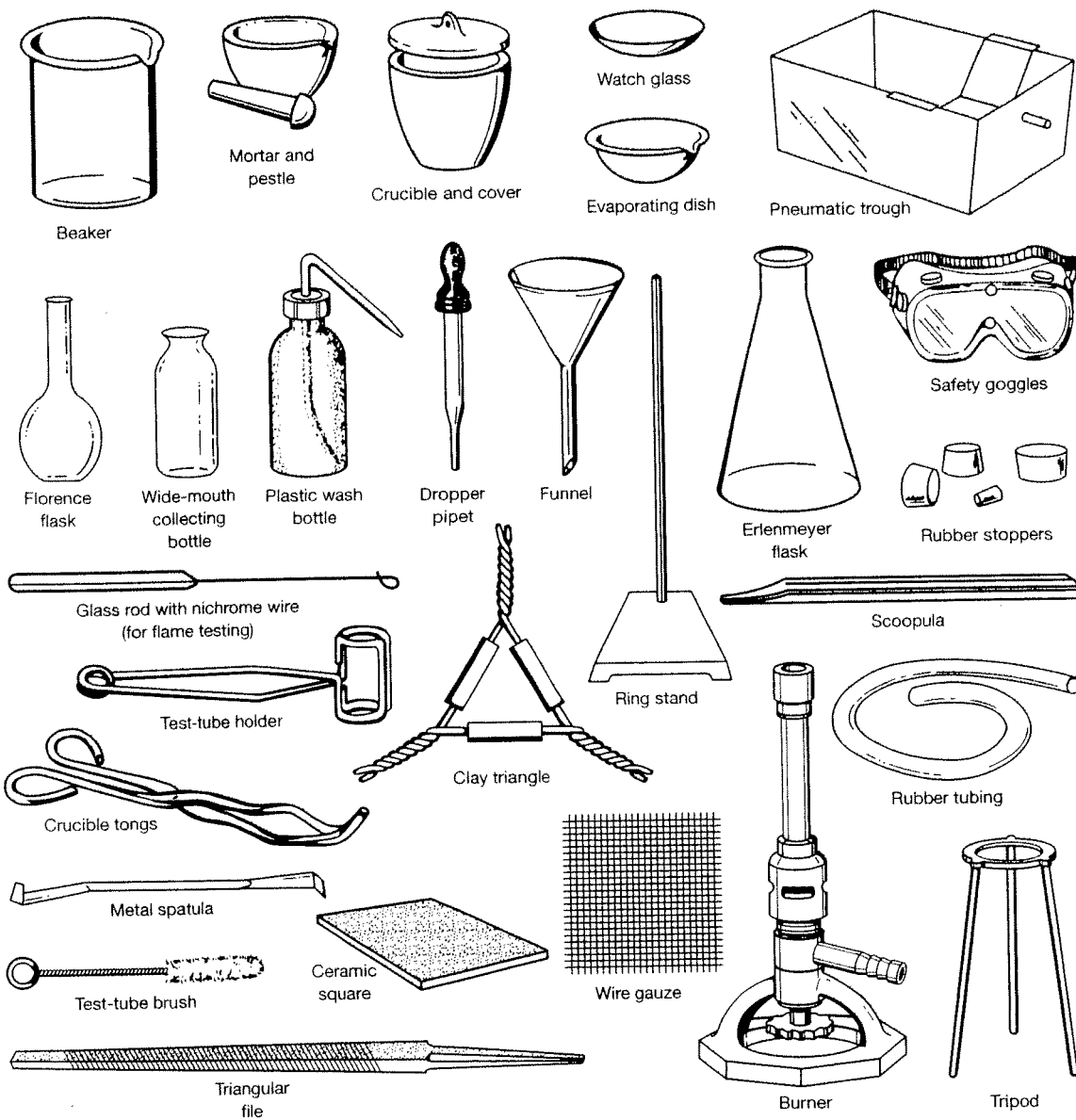
Toxic

Emergency Procedures

Report any injury, accident, or spill to your teacher immediately. Know the location of the closest eyewash fountain, fire blanket, fire extinguisher, and shower.

SITUATION	SAFE RESPONSE
burns	Immediately flush with cold water until the burning sensation subsides.
fainting	Provide fresh air (for instance, open a window). Move the person so that the head is lower than the rest of the body. If breathing stops, use CPR
fire	Turn off all gas outlets. Unplug all appliances. Use a fire blanket or fire extinguisher to smother the fire. CAUTION: <i>Do not cut off a person's air supply.</i>
eye injury	Immediately flush the eye with running water. Remove contact lenses. Do not allow eye to be rubbed if a foreign object is present in the eye.
minor cuts	Allow to bleed briefly. Wash with soap and water.
poisoning	Note what substance was responsible. Alert teacher immediately.
spills on skin	Flush with water.

Laboratory Equipment



Beaker: glass or plastic; common sizes are 50 mL, 100 mL, 250 mL, 400 mL; glass beakers may be heated.

Buret: glass; common sizes are 25 mL and 50 mL; used to measure volumes of solutions in titrations.

Ceramic square: used under hot apparatus or glassware.

Clamps: the following types of clamps may be fastened to support apparatus: buret/test-tube clamp, clamp holder, double buret clamp, ring clamp, 3-pronged jaw clamp.

Clay triangle: wire frame with porcelain supports; used to support a crucible.

Condenser: glass; used in distillation procedures.

Crucible and cover: porcelain; used to heat small amounts of solid substances at high temperatures.

Crucible tongs: iron or nickel; used to pick up and hold small items.

Dropper pipet: glass tip with rubber bulb; used to transfer small volumes of liquid.

Erlenmeyer flask: glass; common sizes are 100 mL, 250 mL; may be heated; used in titrations.

Evaporating dish: porcelain; used to contain small volumes of liquid being evaporated.

Florence flask: glass; common sizes are 125 mL, 250 mL, 500 mL; may be heated; used in making and for storing solutions.

Forceps: metal; used to hold or pick up small objects.

Funnel: glass or plastic; common size holds 12.5-cm diameter filter paper.

Gas burner: constructed of metal; connected to a gas supply with rubber tubing; used to heat chemicals (dry or in solution) in beakers, test tubes, and crucibles.

Gas collecting tube: glass; marked in mL intervals; used to measure gas volumes.

Glass rod with nichrome wire: used in flame tests.

Graduated cylinder: glass or plastic; common sizes are 10 mL, 50 mL, 100 mL; used to measure approximate volumes; must not be heated.

Graduated pipet: glass; common sizes are 10 mL, 25 mL; used to measure solution volumes; less accurate than a volumetric pipet.

Mortar and pestle: porcelain; may be used to grind crystals and lumpy chemicals to a powder.

Pipet bulb: rubber; used in filling a pipet with a solution; a pipet must never be filled by mouth.

LABORATORY SAFETY AGREEMENT

MATERIAL

DATE

Review of First Aid in the Laboratory.

Review of Laboratory Techniques

In-class review of laboratory regulations,
procedures, safety symbols, and safety equipment

I, _____, have read and understand the material entitled First Aid in the Laboratory and Laboratory Techniques. I agree to abide by the regulations and procedures outlined in this material. Furthermore, I agree to abide by any additional printed or verbal instructions provided by my teacher or school district during the school year.

student's signature

date

FIRST AID IN THE LABORATORY

REPORT ALL ACCIDENTS, INJURIES, AND SPILLS TO YOUR TEACHER IMMEDIATELY.
YOU MUST KNOW: safe laboratory techniques
where and how to report an accident, injury, or spill
location of first aid equipment, fire alarm, phone, school nurse's office
evacuation procedure

Injury	Safe Response
burns	Flush with water. Call your teacher immediately.
cuts and bruises	Follow the instructions on the first aid kit. Report to the school nurse.
fainting or collapse	Provide the person with fresh air. Have the person recline so that their head is lower than their body. Call your teacher. A nurse or doctor may be needed to provide artificial respiration.
fire	Wrap the person in fire blanket. Extinguish all flames.
foreign matter in eye	Flush with plenty of water. Use eyewash bottle or fountain.
poisoning	Note the suspected poisoning agent and call your teacher.
severe bleeding	Apply pressure or a compress directly to the wound and get medical attention.
spills on skin	Flush with water or use safety shower.
acid spills	Apply baking soda, NaHCO_3 , and call your teacher.
base spills	Apply boric acid, H_3BO_3 , and call your teacher.

