SCIENCE LABORATORY MANUAL

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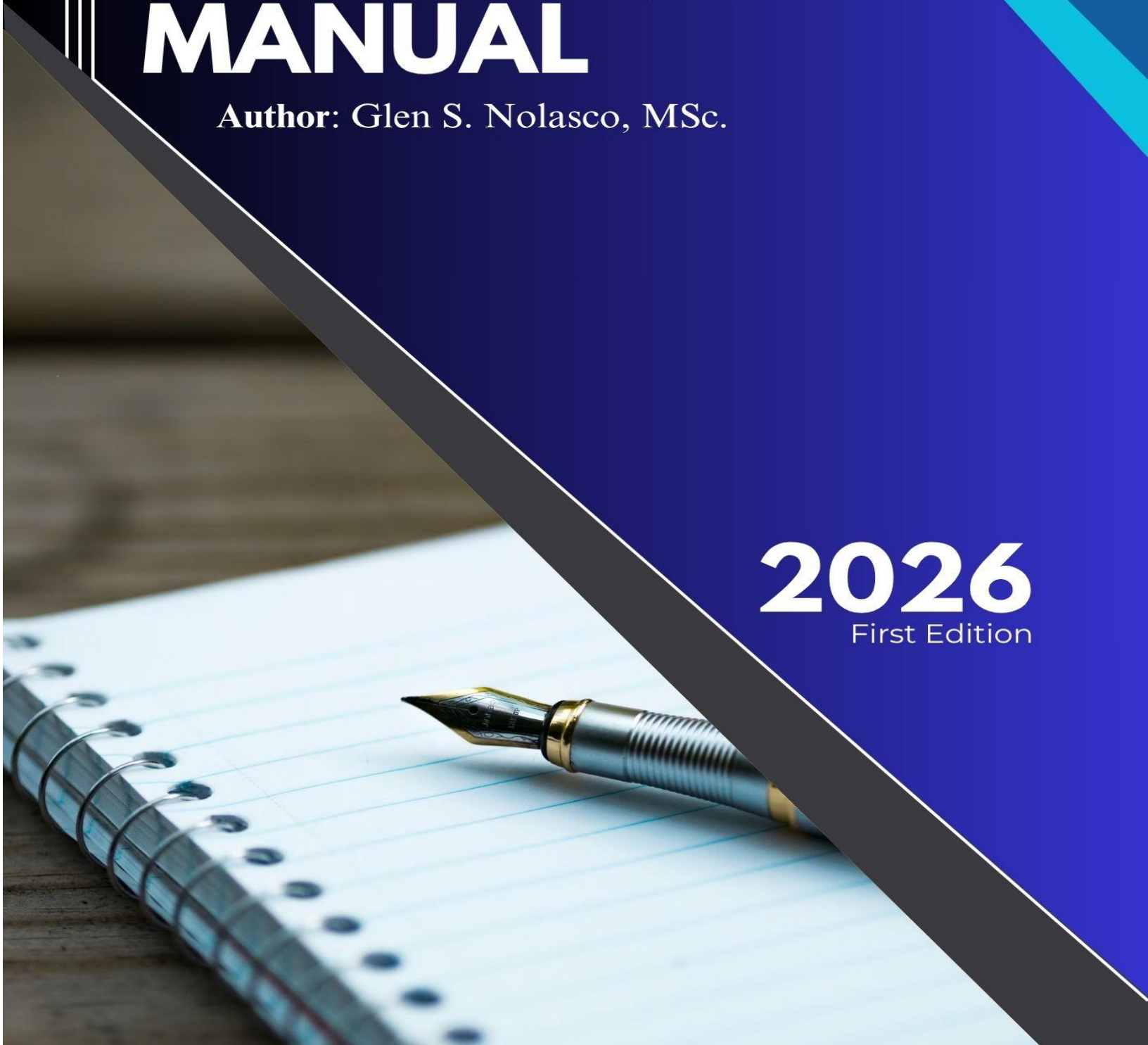

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First Edition

Science Laboratory Manual

The Science Laboratory Manual

1st Edition

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Copyright Page

This Science Laboratory Manual is the official laboratory safety and operations for courses under the science laboratory program. It is intended for use by faculty members, laboratory personnel, and students in laboratory-based science courses.

The policies, procedures, and safety guidelines contained in this manual are designed to promote responsible laboratory practices and ensure the safety of all laboratory users. The college reserves the right to revise, amend, or update the contents of this manual whenever necessary.

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Dedication

This Science Laboratory Manual is dedicated to the students, faculty members, and laboratory personnel, whose commitment to learning, scientific inquiry, and safe laboratory practices continues to inspire academic excellence.

It is also dedicated to the educators and mentors who tirelessly guide students in developing curiosity, discipline, and responsibility in the pursuit of scientific knowledge.

May this manual serve as a valuable guide in promoting safe, responsible, and meaningful laboratory experiences for all who use it.

Foreword

The laboratory is an essential component of science education, providing students with the opportunity to apply theoretical knowledge through practical experimentation and observation. It is within the laboratory environment that students develop critical thinking skills, scientific discipline, and a deeper appreciation for the principles of science.

This Science Laboratory Manual was developed to serve as a comprehensive guide for students and instructors engaged in laboratory-based courses. It outlines important laboratory policies, safety guidelines, proper handling of equipment and materials, and procedures necessary to maintain a safe and productive learning environment.

The preparation of this manual reflects the institution's commitment to promoting responsible laboratory practices and ensuring the safety of all laboratory users. By following the guidelines and procedures outlined in this manual, students and faculty members can conduct laboratory activities with confidence, responsibility, and respect for scientific standards.

It is our hope that this manual will serve as a valuable resource in fostering a culture of safety, discipline, and academic excellence in all science laboratory activities.

Acknowledgment

The preparation and completion of this Science Laboratory Manual would not have been possible without the valuable support and contributions of several individuals and groups.

The authors would like to express their sincere gratitude to the administration of Mabalacat City College for their continuous support in promoting quality education and safe laboratory practices. Their commitment to academic excellence has made the development of this manual possible.

Special appreciation is extended to the faculty members and laboratory personnel whose expertise, guidance, and dedication greatly contributed to the preparation and review of the contents of this manual. Their insights and recommendations have helped ensure that the procedures and guidelines presented are accurate, practical, and beneficial for students.

The authors also acknowledge the students whose enthusiasm for learning and participation in laboratory activities continue to inspire improvements in instructional materials such as this manual.

Above all, gratitude is extended to everyone who, in one way or another, contributed to the completion of this manual and to the advancement of science education.

About the Author

Professor Glen S. Nolasco, is a science educator and researcher with a strong commitment to advancing science education and promoting responsible laboratory practices. He has eight (8) years of teaching experience in laboratory-based science courses, where he has guided students in developing scientific inquiry, analytical skills, and a deeper understanding of biological concepts through hands-on experimentation.

Prof. Nolasco earned his Bachelor's Degree from Mabalacat City College, graduating Magna Cum Laude, and later obtained his Master of Science in Biology from Pampanga State Agricultural University. His academic and professional experiences have strengthened his dedication to integrating theory and practice in science education.

His research interests focus on experimental research and transdisciplinarity, emphasizing the integration of scientific knowledge across multiple disciplines to address complex real-world problems.

He is also an alumnus of the TERRA+ School of Transdisciplinarity, organized by the Research Institute for Humanity and Nature (RIHN) in Kyoto, Japan, where he engaged in collaborative learning and research initiatives centered on sustainability and transdisciplinary approaches.

Through the development of this Science Laboratory Manual, Prof. Nolasco aims to support students and educators by providing a practical guide that promotes laboratory safety, scientific discipline, and meaningful laboratory learning experiences.

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INTRODUCTION

Pursuant to the mandate of the Occupational Safety and Health Act of 1970, Mabalacat City College seeks to ensure the health and safety of its employees and students in the institution's premises through the adoption and implementation of occupational safety and health plans. The science laboratories present significant occupational safety and health risks associated with the performance of various scientific research experiments that may involve hazardous chemicals and pathogenic organisms.

Thus, this laboratory manual presents to the instructors and students a unique approach to Chemistry and Biology related courses that will foster innovative science education relative to the courses that they intend to study without compromising their safety and health. The science laboratories by their very nature give the students the opportunity to conduct experiments to explore various science concepts in accordance with proper laboratory techniques and safety principles. Since laboratory workers can be exposed to different potential hazards, including physical, chemical, biological, mechanical and radioactive, the science laboratory staff and Heads of the Institute of Arts and Sciences recognize the necessity of generating a Manual that will serve as a guide for the students and instructors in the conduct of their laboratory experiments and researches.

SEC. 1. GENERAL OBJECTIVES

This Manual seeks to achieve the following objectives:

- Ensure the safety and health of all science laboratory users, including instructors, students and staff;
- Heighten the students' appreciation of the role of the science laboratories in the creative pursuit of human knowledge;
- Instill discipline and proper behavior in the laboratory and during the performance of lab activities;
- Support hands-on practice of biological experiments using live samples;
- Facilitate the conduct of scientific research pursued by students, faculty and staff;
- Encourage scientific creativity, curiosity, and innovativeness; and
- Foster scientific literacy.

SEC. 2. SCIENCE Laboratory Safety Rules

2.1 General Safety Rules

- No laboratory work, activity or experiment can be conducted by a student without the supervision of a facilitator or instructor. Under no circumstances shall any student be allowed to work alone or unsupervised in the laboratory. [Any staff or instructor violating this rule shall be dealt with administratively.]
- When dealing with noxious chemicals in the laboratories, all students must wear safety laboratory suit or industrial quality safety spectacles. [Violation of this rule shall result in discontinuation of the activity and suspension of lab privileges for the next meeting.]
- Instructors must inform their students, at the beginning of the laboratory period, of any potential dangers that may be encountered in the course of the experiment in order to observe proper precautions necessary to lessen or avoid such hazards.
- Students should thoroughly understand the instruction or laboratory procedure prior to the conduct of any laboratory activity. It is recommended that students should **read all directions for the experiment at least two times**. Deviation from the instructions or

procedure shall be allowed without permission from the instructor or facilitator. [Violation of this rule shall result in suspension of laboratory privileges for a period of 1 meeting.]

- No activities can be performed in the laboratory without the authority or permission granted by the instructor or facilitator. [Violation of this rule shall result in suspension of lab privileges for a minimum of 1 meeting.]
- Students shall not operate any equipment (e.g., centrifuge or Bunsen burner) without knowing the specific instructions from, or being supervised by, the instructor. [Violation of this rule shall result in suspension of lab privileges for 1 meeting. Furthermore, in case of irreparable damage to the equipment, the student shall be liable to payment of the full cost of the equipment or replacement of the same.]
- Drinking, eating, playing of music, application of cosmetics, and/or any similar acts are strictly prohibited inside the laboratory. The instructors and laboratory staff shall implement this rule upon discovery of any violation. [Violation of this rule shall result in suspension of lab privileges for 1 meeting.]
- Always wash hands after handling chemicals, plants, and animals including their carcass or dissecting tools. [Non-observance of this rule shall result in demerits in laboratory performance grade given by the instructor.]
- Careless behavior in the laboratory can inevitably cause accidents. Horse playing, teasing, loud talking or tossing objects is strictly prohibited inside the laboratory rooms. [Non-observance of this rule shall result in suspension of laboratory privileges for 2 consecutive meetings.]
- All personal possessions such as books, coats and papers, which are not related to the laboratory activity, shall not be placed on the working table. [Non-observance of this rule shall result in confiscation of the aforementioned personal belongings.]
- Every student must be aware of the use and location of all safety equipment (i.e., goggles, gloves, apron or lab coat, eyewash, etc.). All students with laboratory privileges shall attend the mandatory Lab Orientation to be given by the staff. [Absent students shall be required to attend a special orientation. Failure to attend such orientation shall result in suspension of lab privileges for 1 meeting period.]

- Never reach over materials to avoid causing accidents. [Violations of this rule shall result in demerits in lab performance.]
- Bags, gadgets or any unrelated belongings should be placed inside the laboratory locker. [Three accumulated violations of this rule shall result in suspension of lab privileges for 1 meeting.]
- When the laboratory activity is done, tools and equipment must be cleaned and returned to their proper storage. The work area must be cleaned using appropriate cleaning materials. [Every violation shall result in demerits in lab performance. Three accumulated violations shall result in suspension of lab privileges for 1 meeting.]
- The disciplinary penalties for the violations of the foregoing rules shall be implemented by the instructor in the case of demerits in lab performance, and by the teacher and staff in the case of suspension of laboratory privileges. Demerits in lab performance shall mean deduction from the earned points for lab performance at the discretion of the instructor. Suspension of laboratory privileges shall mean that the student shall not be admitted into the laboratory during lab period but instead be directed to stay in the library for an alternative activity.

2.2 Hygiene Practices

- Keep hands away from your face, eyes, mouth, and body while using chemicals.
- Food and drinks sealed or not, shall not be brought inside the laboratory or chemical storage area.
- Do not apply cosmetics while inside the laboratory or storage area.
- Wash hands thoroughly after removing gloves, and before leaving the laboratory.
- Remove any protective equipment (i.e., gloves, lab coat or apron, chemical splash goggles) prior to leaving the laboratory.

  Note: Non-observance of the above practices shall result in demerits in lab performance at the discretion of the instructor and/or suspension of lab privileges upon recommendation of the lab staff.

2.3 Dress code

- The suggested school uniform is required to be worn inside the laboratory.
- Proper lab gown shall be worn when performing an experiment.

- Loose fitting clothing and long hair may create a potential fire hazard when burners or alcohol lamps are in use. Long hair should be secured with a tie, pins or barrette.
- Sandals and open-toed shoes should not be worn inside the laboratory rooms.
- Clothing such as ties, or long jewelry which could dangle in chemicals or flame should be removed or tied back.
- Wearing of rings, bracelets, or watches with high absorbent property are discouraged in the laboratory as they can trap chemicals under the jewelry and can cause irritation to the skin or damage the jewelry itself.
- Hair spray, alcohol spray, perfume and hair mousse are highly flammable and should not be used in the laboratory rooms.
- Synthetic fingernails are highly flammable and should not be worn during laboratory class. Organic solvents will also dissolve these synthetic fingernails.

  Note: Non-observance of the above dress code shall result in demerits in lab performance at the discretion of the instructor and/or suspension of lab privileges upon recommendation of the lab staff.

2.4 Emergency Procedures

- Every laboratory student shall attend the mandatory general orientation given at the start of the semester on emergency procedures, such as:
  - Fire drill exits and procedures;
  - Severe weather procedures;
  - First aid kit location or location of school nurse;
  - Location and proper use of fire extinguisher, alarm system, eye wash stations, chemical spill absorbents, chemical showers, etc.; and
  - Procedure for summoning help in the event of an emergency injury or fire.

  A special orientation shall be given to students who were absent during the regular orientation. [*Students who failed to attend any orientation shall not be allowed to avail of the laboratory services*.]
- Spills are to be cleaned-up as soon as possible. Students should ask the teacher or instructor for proper clean-up procedures for spilled chemicals. Unless specific permission is given, chemicals should not be disposed by pouring or dumping into the

sink or general trash container. [*Non-observance of this rule shall mean demerits in laboratory performance and suspension of laboratory privileges for at least 1 meeting*.]

- The plan for stopping work including the extinction of burners, securing chemicals, and/or instruments (sharp objects) shall be observed in the event of an emergency.

2.5 First Aid

- All accidents shall be reported to the instructor immediately. Only the instructor should administer first aid or should refer the student to the school nurse.
- Students should know what to do in an emergency such as splashing acid on one's skin or eyes. The affected area should be rinsed with clean water for a period of 15 minutes).

2.6 Personal Protective Equipment

- Protective eye goggles and/or clothing will be required during certain laboratory procedures. Goggles must be worn during all laboratory procedures that involve the use of chemicals, heated materials or dissection. Lab coats should be worn when working with chemicals, heated materials and dissection. [*Non-observance of this rule shall mean demerits in laboratory performance and suspension of laboratory privileges for at least 1 meeting*.]

2.7 Sharps

- All dissecting tools should be considered dangerous.
- A student who accidentally lacerates her/himself shall immediately notify the instructor.
- Razor blades and scalpels should be handled with extreme caution. Students should observe the rule "Always cut away from you, never toward yourself or another person".
- Used sharp blades should be discarded in designated containers.
- Specimens should be properly mounted on the dissection pan before necropsy is initiated.

2.8 SCIENCE LABORATORY REQUISITION REGULATIONS

- The borrower should be officially enrolled in science laboratory related courses. A non-enrolled student who intends to avail of the laboratory services shall first obtain the written approval of the Dean upon endorsement of the Program Head of Science and Mathematics.

Such request may be accommodated only subject to the availability of the lab upon determination of the Science Laboratory Head.

- The borrower must fill up the requisition slip indicating the item and quantity needed as well as the class schedule. The availability of requisitioned equipment and consumable materials (reagents, etc.) and the number of borrowers shall be considered in granting the borrower's request. [*Non-observance of this rule shall result in disapproval of the request.*]
- The requesting party shall submit the requisition slip duly approved by the instructor at least a day before the scheduled use/class. [*Non-observance of this rule for two instances shall result in suspension of laboratory privileges for one meeting*.]
- The borrower must return the borrowed item/instrument/equipment in good condition at the end of the period. The assigned lab staff shall immediately record glassware breakages and/or equipment/instrument damages and the accountable student. Replacement/restitution shall immediately be agreed upon for approval by the Laboratory Supervisor. Instructor concerned shall also be notified.
- The end-of-semester clearance shall be signed by the Laboratory supervisor or laboratory custodian designated by him clearing the student from any laboratory liabilities.
- Broken glassware or damaged equipment should be replaced by the responsible student as soon as possible so as not to deprive other students of the right to use the same. [*Failure to replace the lab item at the agreed time shall result in suspension of laboratory privileges until compliance is made*.]
- Non-students of Mabalacat City College shall secure prior approval from the Vice President for Academic Affairs by submitting a formal letter of request before conducting any science experiments within the college laboratory facilities.

SEC. 3. CHEMICAL HANDLING SAFETY

Everyone, especially students, working in the science lab should observe the following chemical handling safety reminders:

- Never touch or taste any chemical. Smelling of any chemicals should be performed only by gently waving your hand over the opening of the container, directing the fumes toward your nose. Do not inhale directly from the container.
- When removing the stopper from a bottle, do not lay the stopper on the desk or work area. Hold the stopper between your fingers. Hold the bottle so that the label is in the palm of your hand, protected from drips and runs. Both the stopper and the bottle can be held in one hand. Wipe any residue from the exterior of the bottle using absorbent pads prior to its storage location.
- Immediately replace all stoppers or lids when you are finished. Return the proper stopper or lid to the container. Be careful not to interchange lids or stoppers from two similar containers.
- Use only those chemicals stored away when not in use.
- Read the chemical name at least twice before using it. Many chemical names are similar and cannot be substituted for one another.
- Pipetting bulbs will be used to draw liquids into the pipette for transfer to another container. Mouth pipetting is not allowed under any circumstances. Air must not be bubbled through a pipette. This may cause the liquid to splatter.
- Pipettes should only be utilized for one chemical solution. Using the pipette in different solutions causes cross contamination or unwanted chemical reactions.
- Spatulas should be used to transfer only one chemical. Never use the same spatula for more than one solid chemical as cross contamination or unwanted reactions will occur.
- Remove from the stock container only that quantity of chemical or reagent necessary for the experiment. Never return the excess to the stock container as this practice may cause cross contamination.
- Extra precaution is needed when working with acids and bases. Pour neither chemical over a sink or basin.
- Always pour acids or bases into water – never the reverse.

- Spills or acids or bases on the skin should be rinsed immediately in cool running water. Acids or bases in the eyes should be rinsed for 15 minutes under cool running water. Hold the lids of the eyes open to allow for adequate rinsing of the eye surface.
- Notify your instructor immediately in the event of a chemical spill. He or she will instruct you as to the proper clean-up procedures.
- Mercury spills must be cleaned up immediately by the responsible instructor. Mercury will flow to the lowest point possible, and can easily become trapped in the small opening between the floor and the wall.
- Check the label to verify the correct substance before utilizing it.
- If the students transfer chemicals from their original containers, duplicate the label of the original containers, chemical equation, date, hazard, and concentration.
- Use a hot water bath to heat flammable liquids. Note: Never heat directly with a flame.
- Provide distance when holding containers from the body and when transferring a chemical or solution from one container to another.
- Weigh out or remove only the amount of chemical that will be needed in the experiment and do not return the excess to its original container, but properly dispose of it in the appropriate waste container.
- Strictly follow the instruction of the facilitator for chemical disposal.
- Never carry bottles that are wet or too heavy.
- Use equipment (glassware, Bunsen burner, etc.) in the correct way, as indicated by the teacher

SEC. 4. PROPER CHEMICAL LABELING

No unlabeled substance should be presented or used on the laboratory at any time! Everyone should observe strictly the following rules:

3.1. Basic Labeling of Chemicals

- Use labels with good/strong adhesive.
- Use permanent marker or laser printer.
- Print labels visibly and clearly.
- Replace damage, faded or detached labels.

3.2. Commercially Packaged Chemicals

Verify and double check the following information labeled on the container:

- Chemical name;
- Manufacturer; and
- Necessary handling and hazard information (NFPA guidelines).

Additional Information to be noted:

- Date Received
- Date First opened/used
- Expiration date

3.3. Secondary Containers and Prepared/Stock Solutions

Students should take note of the following:

- Chemical Name
- Person who prepared the solution
- Necessary handling and hazard information
- Concentration and purity (Note: Include if Analytical or Technical grade)
- Date prepared
- Expiration/Half-life

3.4. Chemical Waste

Note that all containers that are subjected for chemical waste collection and treatment are labeled correctly according to the following information:

- Conventional waste or Hazardous waste
- Chemical Name
- Accumulation start date

3.5. Peroxide-Forming Substances

Note that peroxide generating substances are labeled with the following:

- Date received
- Date first open
- Date to be disposed of

SEC. 5. GENERAL RULES FOR CHEMICAL STORAGE

4.1. Criteria for Storage Area

- Chemicals are stored inside a closeable cabinet or on a sturdy shelf with a front-edge lip to prevent accidents and chemical spills. A ¾-inch front edge lip is recommended/observed.
- Cabinets or shelves are secured to the wall or floor.
- Chemical storages are provided with doors with locks.
- The chemical stock room is kept away from all students or other non-laboratory staff.
- Storage areas are ventilated adequately.

4.2. Organization of the Chemicals

- Chemicals are organized by their compatibility (Note: These are not alphabetically arranged.)
- Chemicals are stored alphabetically within compatible groups.

4.3. Chemical Segregation

- Store all acids inside a dedicated acid cabinet. (Note: Place or keep nitric acid separately inside a nitric acid cabinet).
- Atrocious toxic chemicals are stored inside the poison cabinet with clearly visible sign.
- Volatile and odoriferous chemicals are stored inside a cabinet with proper ventilation or near at ventilated area.

4.4. Storage Don`ts

- Do not place heavy materials, liquids and large container on top of the shelf.
- Do not store chemicals on tops of cabinets.
- Do not store chemicals on the floor.
- Do not store chemicals with food and drinks.
- Do not store chemicals on shelf above eye level.
- Do not expose stored chemicals to direct heat or sunlight.

SEC. 6. INFORMATION GUIDE ON CHEMICAL STORAGE

Chemical storage is a foremost priority. Some guidelines followed in storing chemicals are:

- Chemicals are not being arranged in alphabetical order which is the most frequent method of storage. Incompatible materials may be brought close one another by this method. Thus, storing chemicals in alphabetical order is not applicable. It can be potentially dangerous and increases the possibility for unplanned, hazardous fusion of chemicals. Many who persist in this practice have been accustomed to it and are not been fully aware of all the implications and dangers besides the method poses. Safety and security concerns should take precedence over ease of retrieval.
- To lessen the potential for accidents, chemicals are preferably stored in multiple locations within the building. When this is not possible, the distance between classes of chemical compounds within the storage area is maximized.
- In all cases, acids and bases are stored with the greatest multiple locations within the building. Separate storage rooms for acids and bases represent ideal situations.
- General storage areas are not exposed to extreme heat or direct sunlight. Either one may result in a rapid deterioration or possible decomposition of many compounds.
- The recommended storage design of any chemical storage area is built around the utilization of six distinctly different compartments with each area storing substances belonging to a specific class of chemicals. Within each area separate shelves are designated for families of compound to put maximum distance between incompatible substances. Each compartment serves a specific need.
- Dry inorganic substances are stored in designated compartment **A**. Any possible contact of cyanides with acids is avoided as it may cause generation of highly poisonous HCN. Cyanides are stored above not below acids.
- Cyanides are inventoried only after careful re-evaluation of the need for them.
- Storing oxidizing agents (chlorates, dichromates, hydrogen peroxide, and nitrates) poses special problems. These substances are kept away from combustibles materials, organic solvents, metal hydrides, phosphorus, and metal powders like iron filling.

- Inorganic acids, except nitric acid, are stored together in area **B** (no more than 1 gallon is stored on lower shelf). These are not being kept on the floor where they could be accidentally kicked that could lead to chemical spill.
- Basic solutions are housed in areas away from dry chemicals and stockroom shelves near the floor. Inorganic hydroxides are best stored in polyethylene containers. As with acids, shelf life, date of receipts is recorded on the label.
- Flammable chemicals are maintained in an approved, vented cabinet that meets OSHA and NFTA standards. Where possible these chemicals are physically separated from each other and stored away from potential sources of sparks or heat. Materials which are flammable are stored in their original shipping containers or in containers specifically approved for their storage. Otherwise, the quantity stored should be limited to 100g.
- Nitric acids are stored with the miscellaneous materials rather than with the other acids. Nitric acid leads to a chemical explosion with the combination of acetic acid.
- Alkali metals, if kept in inventory, are maintained in glass stoppered containers using the most restrictive measures. **Na** and **K** are submerged in kerosene. **Li** is better stored in a container of mineral oil. As an added precaution, in the event of explosion, vessels containing **Na** and **K** must be embedded in an outer container of sand. User should be aware that **K** metal frequently forms a peroxide in the crust which, when cut, oxidizes quickly and reacts with traces of kerosene, creating the potential for an explosion.
- Sodium peroxide and calcium carbide are stored in airtight containers that eliminate even the most remote possibility of contact with water. Penetration of even the smallest amount of water may produce a violent reaction. The use of peroxides, in general, is discouraged.
- White or yellow phosphorus is stored under water tightly stoppered glass container. This is then placed in a metal container as an added precaution. When **P** is kept in inventory (which is discouraged), it is stored in a location that minimizes even the most remote chance of being knocked off accidentally from the shelf.
- Gas cylinders are stored in upright position, not their sides, to minimize the chance of their nozzles being sheared off. They then become projectiles that can penetrate a brick wall. Large cylinders are chained both when used and when in storage. They are housed in a cool, dry place, away from potential sources of heat and sparks or flammable or corrosive

materials. Empty cylinders are labeled as such and stored away from full ones until removed.

- Only 3% hydrogen peroxide is kept in stock, not the 30% solution which becomes unstable after a period of time. The 3% hydrogen peroxide can be safely stored on the shelf along with other inorganic #9 chemicals. The 30% solution must be stored in in an explosion-proof refrigerator, if kept in the chemical inventory.
- Ether is purchased only in small quantities and the unused portion is disposed one month after opening its bottle. Ether, once, opened starts to form peroxide giving it a shelf life of but a few months. The friction resulting from as little as twisting the cap of an old can of ether has been known to cause an explosion, if peroxides have formed.
- Chemical which have been particularly identified as carcinogen are totally excluded from the school stockroom. Others are made available only in very small quantities or when specific needs require their use.
- Hazardous chemicals are separated into four groups.
    - Chemicals which should be absolutely prohibited from the science facility.
    - Chemicals which may be present only when a legitimate need justifies their inventory.
    - Chemicals which should be maintained in only restricted quantities, good only for one- or two-years use.
    - Chemicals which present very little hazard and may be stored in unrestricted quantities. Proper chemical storage even though difficult must be faced squarely by teachers and critical issues resolved.

SEC. 7. FIRE/HEAT SAFETY

6.1. General Rules for Fire or Heat Safety

- Goggles should always be worn when working with heated materials.
- Know how to properly light your heat source such as candle, alcohol lamp or Bunsen burner.
- Keep the work area clear of clutter. Work materials should be put on a safe distance away from a heat source.
- Never leave a flame or heat source unattended. Always extinguish a burner or turn off a heat source when not in use.
- At the end of the class period or experiment, be sure to check that gas line to the Bunsen burner is off or the hot plate has been unplugged.
- Whenever heating test tubes or other glassware, be sure the mouth or base is not pointed toward a person. The contents of the tube or container may spew out or the glass itself may break. NOTE: Only Pyrex brand glassware should ~~only~~ be utilized for this purpose.
- Never reach over an open flame or any other heat source such as a hot plate.
- Never heat a liquid or a solid which emits a noxious gas when heated.
- Use clamps, tongs or heat resistant mitts when doing with heated glassware or other solid materials. Before handling heated glassware, hold the back side of the hand close to the glassware to check the temperature. If you can feel heat coming from the glassware, it is probably too not to handle.
- Bunsen burner hoses should be checked frequently for cracks and holes.
- Electric heat is a safer source of heat and is preferred over an open flame. Open flame should not be used when working with volatile liquids such as ether, carbon disulfide, alcohol, benzene, etc.
- Electric fan should not be utilized when heat source is involved in the experiment.

6.2. Lighting the Bunsen burner

1. Keep all flammable materials away from the alcohol lamp.
2. Connect the Bunsen burner to the gas line by inserting its rubber tube. Be sure that these are securely linked.
3. Turn on gas line regulator slowly. This is done by positioning the knob parallel with the gas line.
4. Light the burner by slowly opening the gas inlet as a lighted paper strip or a stick of matches is placed about 2.5 cm above the barrel. When flame is produced, keep it to a height of 5 cm.
5. Change the flame by manipulating the barrel. On the other hand, turn off the flame by closing the gas line regulator cautiously.

SEC. 8. PROPER WASTE DISPOSAL OF CHEMICALS

7.1. General Rule for Chemical Waste

- Put solid wastes in the trash can, not in the sink. [*Non-observance of this rule shall result in demerits in lap performance and suspension of lab privileges.*]
- Follow the directions precisely. Use reduced quantities whenever possible, to reduce waste.
- Check the toxicity of chemicals you will handle. The instructor will usually give prior precautions.
- Toxic and corrosive chemicals should be disposed of using standard containers. [*Non-observance of this rule shall result in demerits in lap performance and suspension of lab privileges.*]
- Concentrated base solutions are disposed of by diluting it with water, then pouring it down the sink, followed by plenty of water. [*Non-observance of this rule shall result in demerits in lap performance and suspension of lab privileges.*]

7.2. DISPOSAL OF CHEMICALS

Getting rid of chemicals is an integral part of the operation and management of a school laboratory. Some guidelines for chemical disposal are:

- Check the shelves and the stores at regular intervals for the presence of unlabeled containers or chemicals known to be dangerously unstable e.g., old samples of diethyl ether.
- Old samples of ether may be explosive because of the formation of peroxides. Never attempt to distill these samples. Test for the presence of peroxides with a starch/iodide paper which will be discolored if peroxides are present. (Perform a blank)
- Dispose of old stocks of potassium by adding small pieces at a time of the metal to t-butyl alcohol. Allow 100 mL of the alcohol to 2 g of **K**. Old stock of **K** may also explode even when stored under mineral oil.
- Get rid of excess stocks of flammables, known carcinogens, contaminated chemicals or product from practical work.
- The small amounts of materials produced daily in school such as test tube and beaker quantities and washings from glassware of acids, alkalis, oxidizing and reducing agents

and chemicals of relatively low toxicity may be allowed to be released into the drainage system with plenty of water under normal circumstances.

- Small quantities of liquids or solutions can be rendered harmless by drawing them into large bottle where these are diluted or neutralized by a large volume of suitable liquid. The capillary tube restricts the flow of chemical into the large bottle and screw clip is adjusted to ensure that the flow rate is sufficiently low to bring about effective dilution or neutralization. Larger quantities from stock bottle (up to 2.5 dm^3), liter and kilogram quantities should be released in small quantities over a period of time (little and often techniques)
- Particularly toxic or harmful chemicals, less easily degraded materials such as halogenated alkanes or potentially explosive substances should be disposed of only by methods stated at the Material Safety Data Sheet (MSDS). One possibility is to allow slow evaporation, if the solvent is left in a place not accessible to unauthorized persons, animals, etc.
- Disposal by burial is not recommended nor is the burning of flammables unless this is allowed by the laboratory staff or instructor.
- A teacher is responsible not only to the students but also to the cleaners, refuse collectors, and others who may be involved in the subsequent handling of garbage and carelessly discarded waste. It is unacceptable to put materials out for disposal by people who are unaware of the hazards to cope with the consequential problems.

SEC. 9. SPECIAL SAFETY DUTY: IMPLICATIONS FOR THE CHEMISTRY TEACHER

The chemistry teacher will be able to fulfill his/her accident prevention responsibilities if he/she will conduct the same type of safety program expected of every supervisor in industry. The following are some guidelines.

- Have a thorough understanding of the potential hazards of all the materials, processes and equipment that will be in the school laboratory.
- Fully instruct every pupil in the necessary laboratory safety requirements established as a condition of participation. Check students understanding of these requirements with carefully developed written test, signed by the pupil and kept on file; near perfect score should be considered for students` participation in laboratories activities.
- Supervise closely the daily activities of pupils in the laboratories to be reasonably sure of good compliance with safety requirements. Take (and keep a record of) disciplinary action for any willful violation of safety rules. Reinstruct as necessary to ensure complete understanding.

SEC. 10. LABORATORY TOOLS AND TECHNIQUES

The efficiency and safety of performance of an experimenter in the laboratory are seriously affected by the way he/she handles his/her experimental tools and employs correct experimental techniques.

Proper handling of laboratory ware/instrument and correct procedural techniques lead to more accurate experimental results and reduced possibility of accidents.

9.1. COMMON MEASURING TECHNIQUES

The invention of suitable devices for measuring different quantities such as distance, area, mass, volume, temperature, pressure and time ushered in what is called “modern science”. These devices enabled man to report quantitative data giving real meaning to observations. It is also enabled scientists to determine relationships. In chemistry, for example, the invention of the balance gave way to the relationships between substances involved in chemical reactions. These relationships led to the concepts of mass conservation and law of definite composition. *Note*: The unit of measurement preferred now is the metric system.

9.1.1. Measuring Volume

The graduated cylinder, volumetric flask, burette, and pipette are used to measure liquid volumes in the laboratory.

When measuring volume, read the lower meniscus in the case of transparent liquids and higher meniscus in the case of opaque liquids to generate accurate data. Read the same point meniscus consistently for a given liquid. Make sure that the apparatus is held vertically straight and the eye is at the same level as the meniscus. Your line of vision should be truly perpendicular to the scale to avoid false reading caused by parallax.

9.1.1.1. Graduated Cylinder

A graduated cylinder is generally used for approximate measurements with accuracy not greater than 0.5%. It is not resistant to heat and should not be used for measuring hot or boiling liquids.

Graduated cylinders of different capacities are available. It is recommended that the volume of the cylinder should not be more than ten times the volume to be measured for better accuracy.

9.1.1.2. Burette

Burettes are used to accurately measure volume. It is especially useful when measuring the volume of a liquid to be delivered into a reaction flask.

There are two kinds of burettes (a) an acid burette with a glass stopcock, and (b) a base burette with a rubber connection bearing a glass delivery tip and pinchcock. This rubber connection is used to prevent the freezing of the glass stopcock by the alkali. The technique in using a burette is discussed in titration.

9.1.1.3. Pipette

Pipettes are used for accurate measurements of volumes to be transferred from one vessel to another.

There are two types of pipettes: the transfer (volumetric) pipette marked T_d (to deliver) and the, measuring (Mohr) marked T_c (to contain) pipette.

9.1.1.4. Volumetric Flasks

Volumetric flasks are flat-bottomed flasks with long narrow neck. A line etched on the neck of the flask marks its precise volume content. The volume content is marked on the flask as well the temperature at which the calibration was made.

Volumetric flask is strictly for volume measurement at room temperature. Do not put hot liquid into it. The glass is not heat resistant.

Use a glass rod to transfer a liquid into the volumetric flask. When the liquid rises quite close to the mark on the neck of the flask, use a medicine dropper to add the liquid, drop by drop, until the lower meniscus of the liquid column coincides with the mark.

9.1.1.5. TECHNIQUES AND HANDLING

- When using a pipette, always use a rubber suction bulb. The bulb will protect you from the chemical and the liquid from contamination. Before attaching the bulb to the pipette, squeeze the bulb to remove the air inside, then release. Any contaminant will be forced out into the air and not into the pipette.
- Rinse the pipette with the liquid to be measured before use. Put a small amount of the liquid to be measured into a clean and dry beaker. Without attaching the bulb to the stem, hold it firmly against the end of the pipette stem, as you squeeze. (This will make removal of the bulb easier.) Dip the tip of the pipette into the liquid and gradually release the bulb to draw only 1 to 2 mL of the liquid into the pipette. Set the bulb aside. Rotate or move the pipette near horizontal position so that the whole inner surface comes in contact with the liquid. Drain the liquid and repeat the rinsing.
- After rinsing, add enough liquid to the beaker to fill the pipette above the mark. Avoid sucking air into the pipette. Dip the tip of the pipette to the liquid. Using the technique in no.2 draw the liquid after squeezing the air out of the bulb. Gradually release the

bulb so that the liquid rises slowly in the pipette. (If you release the bulb abruptly, bubbles will form in the liquid or the liquid might enter the rubber bulb. In both cases you will have to discard the liquid and start all over again.) Let the liquid rise 1 to 2 cm above the calibration mark. Quickly remove the bulb and close the end of the stem with your index finger.

- Remove the excess liquid. Hold the pipette vertically. Let the air enter the stem by manipulating your index finger to allow the liquid to flow out slowly into the beaker or container. Do this until the liquid meniscus coincides with calibration mark. Touch the tip of the pipette to the glass wall of the beaker to remove any adhering drop.
- Insert the tip of the pipette well inside the receiver. Hold the pipette vertically and tilt the receiver so that the pipette's tip touches the wall of the receiver. Allow the liquid to flow freely down the wall of the receiver. When free flow stops, keep the pipette in contact with wall for 15 seconds more, so that the pipette will have a chance to drain. Remove the pipette without shaking or blowing out the small amount of liquid left at its tip. This volume of liquid is taken care of in the calibration of the pipette.
- If you do not have rubber bulb, use mouth suction for nontoxic liquids but always keep the pipette tip below the liquid level. If not, air will enter the pipette and may push up the liquid into your mouth. If liquid enters your mouth, spit it out and rinse with plenty of water immediately. Suction by mouth should never be done with corrosive or volatile liquids such as concentrated acids, ammonia, water, solution or arsenic, etc. Such liquids should be put in tall narrow container, so that when the pipette is inserted, the liquid level is above the mark on the pipette. Cover the tip of the pipette with the index finger then remove from the liquid. The liquid is then delivered into the receiver following the same instructions as with the use of the rubber suction bulb.

9.2. DETERMINING MASS

- A balance is a device used to determine the mass of a material. Different types of balances have different ranges of accuracy. An equal arm balance is used to measure the mass of a material by comparing its weight force or gravity with the weight of standard masses. When the pans are balanced the weight of the material and the standard masses are the same.

- The single beam is graduated for 10 g in 0.1 g-divisions. The balance is sensitive to 0.1 g and can therefore read to 10 g without additional masses. Its maximum capacity is 2000 g. Analytical masses should never be used with this rough sets of masses for this purpose.

9.2.1. Triple Beam Single Pan Balance

This balance is used for semi micro masses and has a maximum capacity of 111 g. The middle scale reads up to 100 g in 10 g notched steps, the rear scale to 10 g in 1 g notched steps and the front scale to 1 g with the rider sliding over a scale graduated into 0.01 g unit

SEC. 11. SAFETY GUIDE IN THE BIOLOGICAL LABORATORY

10.1. GENERAL SAFETY IN THE BIOLAB

When in the BIOLAB, strictly adhere to the following safety rules:

- *Do not eat, drink, nor smoke inside the laboratory room.
- *Turn off all electronic devices while inside the laboratory room.
- **Perform only the assigned activities and never do laboratory investigations without the supervision of the instructor.
- *Wear safety goggles and suitable clothing during laboratory periods.
- *Keep the work space orderly. Store books and purses in the designated area.
- *Live specimens in containers/cages and preservation jars.
- *Glassware and chemicals should be placed away from the edges of the working table.
- *Do not directly touch a hot object with bare hands. Utilize clamps, tongs or mitts when handling hot objects.
- **Dispose wastes properly by using the provided waste cans. Water and toxic materials should be placed in the waste jars supplied for this purpose.
- *Always wash hands thoroughly after every activity.
- *Be sure that the gas and water outlets are turned off.
- **Return all equipment to the stockroom.
- Know the location of the safety equipment, such as safety showers and first aid cabinet.
- Know the location of the safety equipment, such as safety showers and first aid cabinet.
- **If not used, the safety pin of the fire extinguisher should be kept intact. Likewise, the proper way of using it should be observed.

*Non-observance of these rules shall result in demerits in lab performance.

**Non-observance of these rules shall result in suspension of lab privileges.

10.2. SAFETY GUIDE FOR ELECTRIC HAZARDS

In a laboratory setup, the chance of potential electrical hazards including electric shock, electrocutions, fires and explosions is high. Broken or lacerated electrical cords can lead to electrocutions or electric shocks. An electrical cord with standard

rubberized cover may be damaged by door or window edges, via fastenings and staple, equipment rolling over it, or simply by aging.

The potential for possible electric shock or electrocution or contact with electrical hazards can result from a number of variables, which include the following:

- Electrical equipment/instrumentation or conventional laboratory wiring;
- Damaged connectors and receptacles; and
- Improper work practices.

SEC. 12. PROPER USAGE OF BIOLOGICAL LABORATORY EQUIPMENT

11.1. USING THE CENTRIFUGES

Centrifuges use high speed revolution to generate the desire pellet and supernatant, but when improper usage is performed, potential accidents may happen. Unbalanced centrifuge rotors can result in injury, even death upon exposure to noxious chemicals subjected in the equipment. Sample container breakage can generate aerosols that may be hazardous if inhaled when an incompetent person operates a centrifuge. The majority of all centrifuge accidents are the result of misuse. Proper training and workshop can lessen the potential threats of accidents related to centrifuge operation.

When centrifuging infectious agents, the equipment should be stopped for at least 10 minutes before opening the lid. Proper decontamination protocol should be done when chemical or infectious spills occur in/on the centrifuge. The instructor or facilitator will instruct the student on the proper decontamination.

11.2. USING THE MICROSCOPE

Strictly observe the following when using the microscope:

- *Always carry the microscope in an upright position. This is done by holding its arm using one hand and supporting its base with the other.
- *Place the microscope away from the edge of the working table. It should be positioned at an area where the observer can conveniently and safely use it.
- **Never play with the microscope. It is a valuable science instrument, not a toy.
- *Keep the microscope clean and dry. Wipe any liquid that wets the stage and objectives with cotton or absorbent pad.
- *Use xylene in cleaning and removing oil and dirt from the objectives.
- *Return the microscope properly in its designated cabinet after use.

*Non-observance of these rules may result in demerits in lab performance.

**Non-observance of these rules may result in suspension of lab privileges.

SEC. 13. SAFETY GUIDE FOR BIOLOGICAL MODELS

All procedures involving animal models should be performed by properly trained personnel under the supervision of the instructor. Animal handling protocol recommended by the Philippine Association for Laboratory Animal Science (PALAS) seeks to minimize the likelihood that the experimenter will be bitten, scratched, or exposed to animal body fluids and tissues. Importantly, the PALAS instructions will minimize the animal model's exposure to unnecessary stress.

12.1. *Possible Injuries/Illnesses*

The most common work-related health complaints reported when dealing with animal models are the following:

- Sprains;
- Strains;
- Bites; and
- Allergies.

Allergies to fur, feather or proteins in small animals' urine, saliva, and dander can trigger allergic reaction that may lead to potential health risk. Because mice and rats are the animals most frequently utilized in research experiments or laboratory activity, they have the most reported cases of allergy. Most workers who develop allergies to laboratory animals have frequent direct exposure to specific animals.

12.2. Conventional Practices to Reduce Allergic Reactions

• Lessen or minimize exposure to the proteins found in animal urine, saliva and dander using protective laboratory dress code.

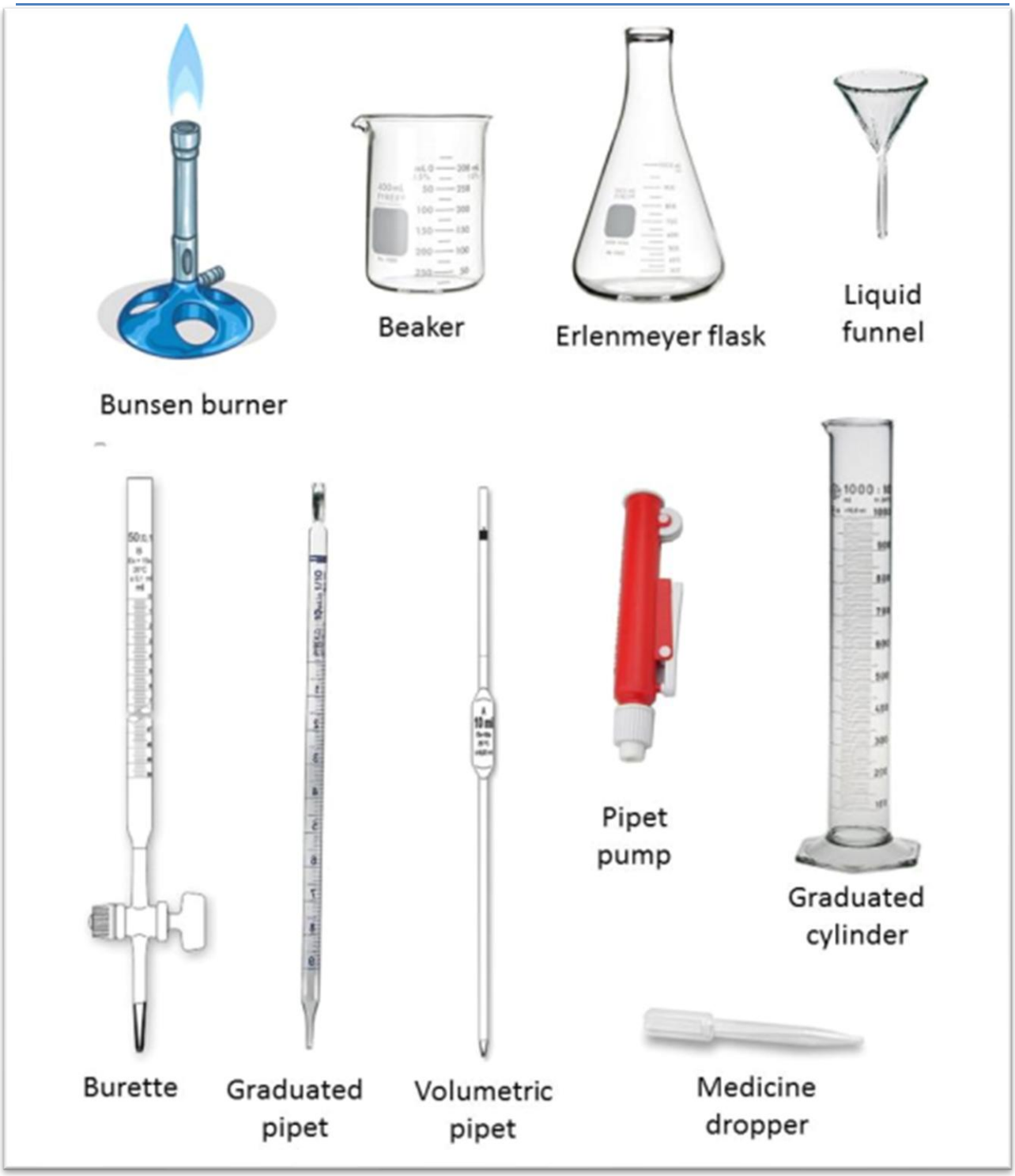
• Limit the chance of inhalation or contact with animal fur. This can be done by proper waste disposal of the carcass.

• Use appropriate dress code (i.e., gowns, gloves, hair covers, face mask).

12.3. ZOONOTIC DISEASES CAUSED BY ANIMAL MODELS

There are a host of possible infectious agents that can be transferred from animals to humans which are known as zoonotic diseases. The conventional routes of exposure to infectious agents are inoculation, inhalation, ingestion and contamination of skin and mucous membranes. Inhalation of biological hazards can happen during work practices that can generate aerosols. These include the following: mixing of chemicals, centrifugation, pouring/decanting and spilling/splashing of culture animal fluids. Inoculation hazards can occur via accidental laceration using infected sharps. Since, animal models (rats, mice, frogs, snail, danio, brine shrimp, roaches, etc.) are widely used in laboratory experiments, prior knowledge of zoonotic diseases can minimize allergic reaction that students may experience during laboratory activity.

APPENDIX A
Common Laboratory Apparatuses



Test tube rack

Test tube

Test tube holder

Crucible and cover

Evaporating dish

Watch glass

Crucible tongs

Stirring rods

Wash bottle

Spatula

Weighing paper

Ring stand

Utility clamp

Thermometer clamp

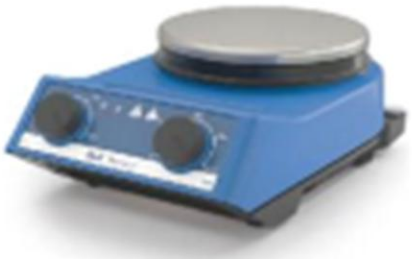
Double burette clamp

Thermometrer

Safety goggles

Safety glasses

Centrifuge

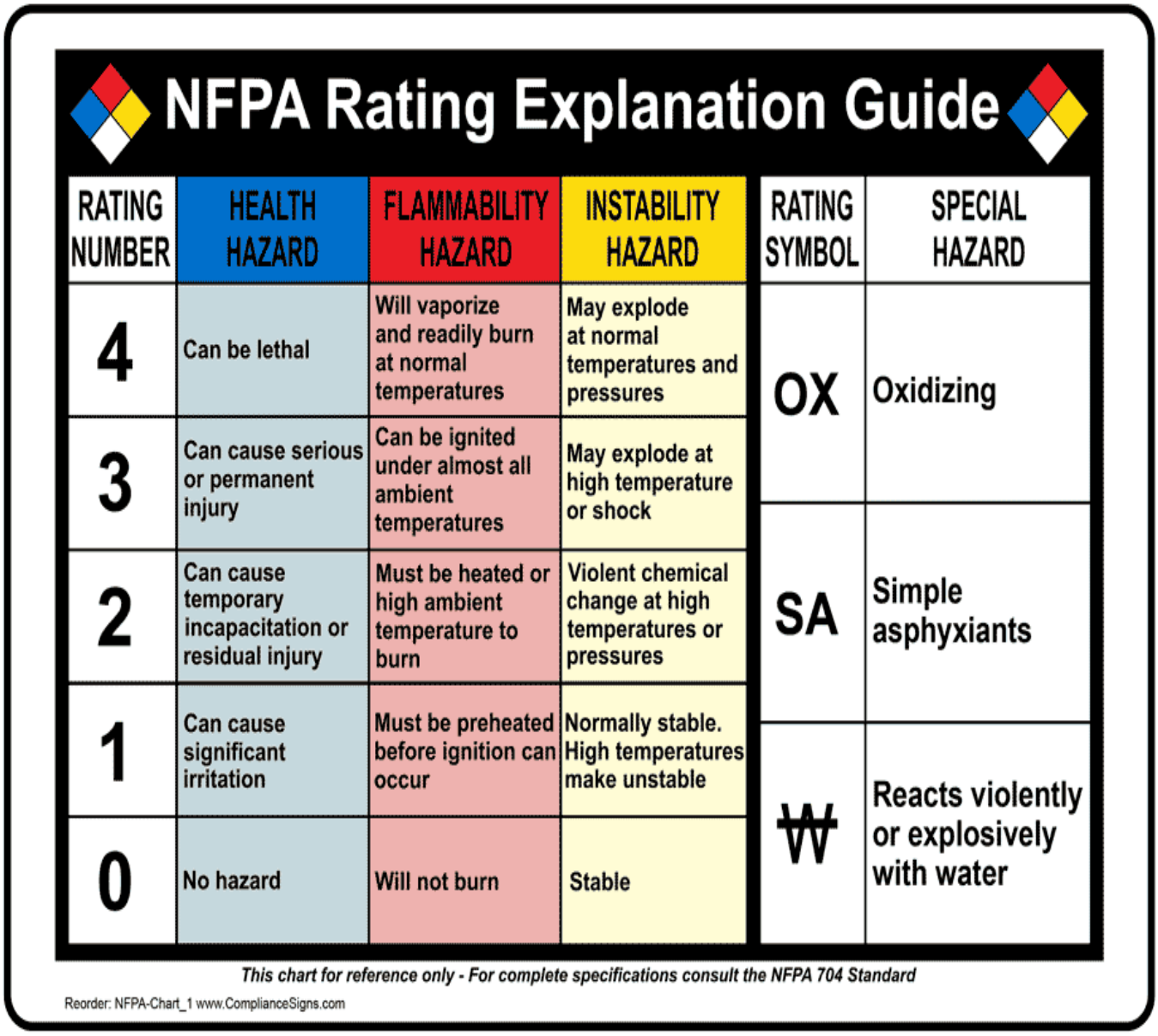


Stirring hot plate

Balance

Vortex mixer

APPENDIX B
National Fire Protection Association (NFPA) Chemical Rating Guide



NFPA Rating Explanation Guide

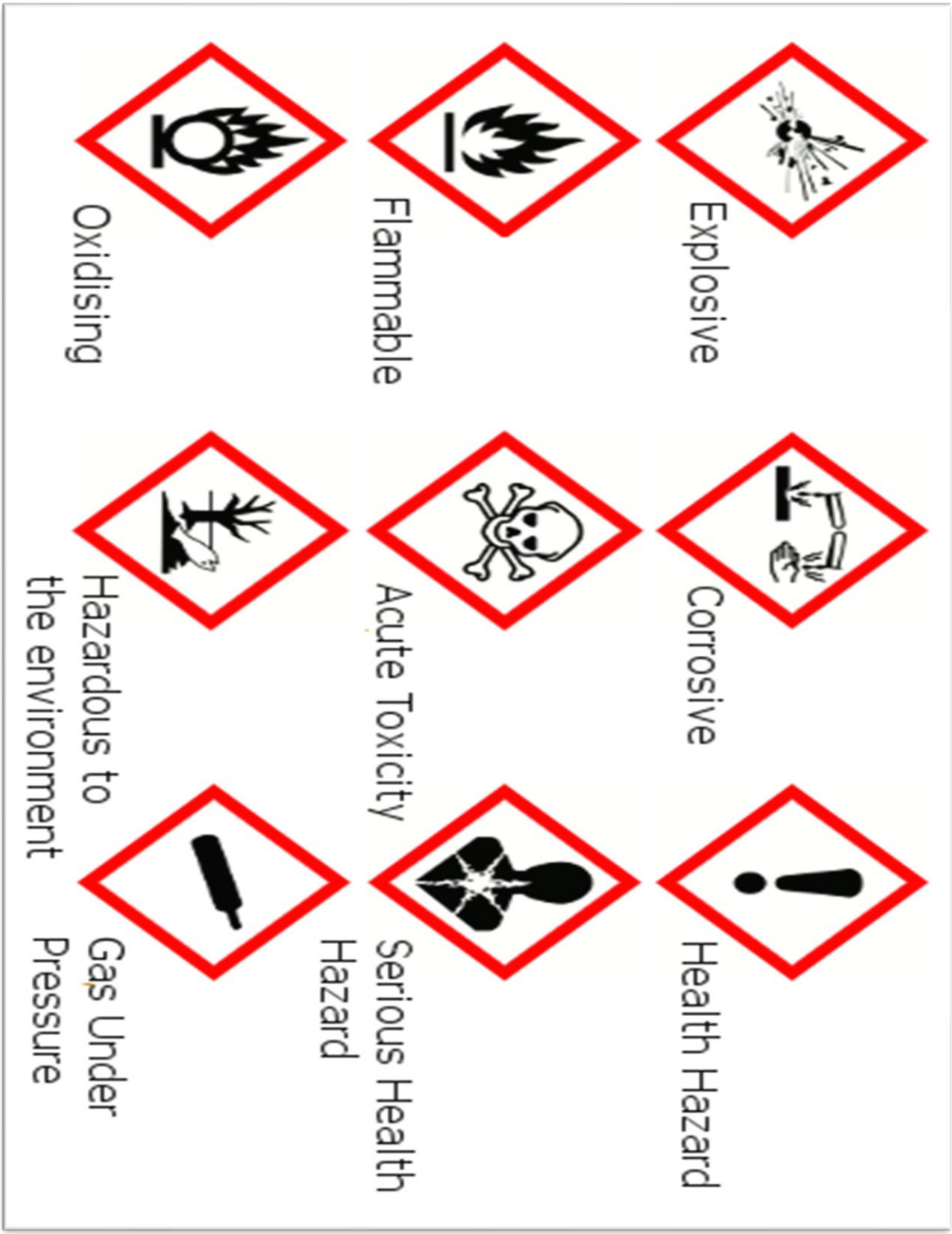
RATING NUMBER	HEALTH HAZARD	FLAMMABILITY HAZARD	INSTABILITY HAZARD
4	Can be lethal	Will vaporize and readily burn at normal temperatures	May explode at normal temperatures and pressures
3	Can cause serious or permanent injury	Can be ignited under almost all ambient temperatures	May explode at high temperature or shock
2	Can cause temporary incapacitation or residual injury	Must be heated or high ambient temperature to burn	Violent chemical change at high temperatures or pressures
1	Can cause significant irritation	Must be preheated before ignition can occur	Normally stable. High temperatures make unstable
0	No hazard	Will not burn	Stable

RATING SYMBOL	SPECIAL HAZARD
OX	Oxidizing
SA	Simple asphyxiants
₩	Reacts violently or explosively with water

This chart for reference only - For complete specifications consult the NFPA 704 Standard

Reorder: NFPA-Chart_1 www.ComplianceSigns.com

APPENDIX C.
Signage Used By NFPA



APPENDIX D
Sample List of Inorganic (Dry) and Organic Chemicals

AREA A. INORGANIC (DRY)	AREA C. ORGANIC
#1, Sulfur, phosphorus, arsenic, phosphorus peroxide	#1, alcohol, glycols
#2, halides, sulfates, sulfites, thiosulfates, phosphates	#2, hydrocarbons, esters.
#3, amides, nitrates (not ammonium nitrate), nitrites	#3, ethers, ketones.
4#, metals and hydrides,(store away from any water)	#4, epoxy compounds, isocyanates
#5, Hydroxides, oxides silicates	#5, sulfides, polysulfides
#6, arsenates, cyanides (store above acids)	#6, phenols, cresols
#7, sulfides, selenides, phosphides carbides, nitrides	#7, peroxides, azides
#8, borates, chromates, manganates, permanganates.	#8, acids, anhydrides, peracids
#9, chlorates, perchlorates, chlorites, peroxides.	

APPENDIX E
Sample List of Dangerous Chemicals

Chemical	Keep out of contact with:
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, glycol, perchloric acid, peroxides, permanganates.
Alkaline metal, such as powdered aluminum or magnesium, sodium, potassium.	Water, carbon tetrachloride or other chlorinated by hydrocarbon, carbon dioxide, the halogens
Ammonia, anhydrous	Mercury (in manometer, for instance), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Carbon, activated	Calcium hypochlorite, all oxidizing agents
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials.
Chromic acid	Acetic acid, naphthalene, camphor, glycerin, turpentine, alcohol, flammable liquids in general.

Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, the halogen.
Hydrocarbons (butane, propane, benzene, gasoline, turpentine, etc.)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide.
Hydrogen peroxide	Copper, chromium, iron, most metals and their salts, alcohols, acetone, organic materials, aniline, nitro-methane, flammable liquids, combustibles materials.
Mercury	Acetylene, fulminic acid, ammonia.
Nitric acid	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases
Potassium chlorate	Sulfuric acid and other acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium)
Ammonium nitrate	Acids, flammable liquids, metal powders, sulfur, chlorates, any finely divided organic or combustible substance

Bromine, chlorine	Ammonia, petroleum gases, hydrogen, sodium, benzene, finely divided metals
Iodine	Acetylene, ammonia, hydrogen
Hydrogen sulfide	Oxidizing gases, fuming nitric acid
Potassium permanganate	Sulfuric acid, glycerol, ethylene glycol
Sodium peroxide	Ethanol, methanol, glacial acetic acid, carbon disulfide, glycerol, ethylene, ethyl acetate.

APPENDIX F
Sample List of Explosion Hazards

Avoid the following combinations among chemicals commonly found in the school science laboratory.

- Na or K with water
- NH_4NO_3 , Zn Powder and small amount of water
- KNO_3 with CH_3COONa (sodium acetate)
- Nitrate and ester
- Peroxides with magnesium, zinc or aluminum.
- Chlorate and sulfuric acid
- Nitric acid with zinc, magnesium or other metals
- Halogen and ammonia
- Phosphorus with nitric acid, a nitrate or chlorate.
- Mercury(II) oxide with sulfur

APPENDIX G
Sample List of Hygroscopic and Deliquescent Substances

$AgNO_3 \cdot H_2O$ (silver nitrate mono hydrate)	$MgC1_2 \cdot 6H2O$ (magnesium chloride hexahydrate)
$AlCl_3 \cdot 6H_20$ (aluminum chloride hexahydrate)	$M(NO_3) \cdot 6H_2O$ (magnesium nitrate hexahydrate)
$Al(NO_3)_3 \cdot 9H_2O$ (aluminum nitrate nonahydrate)	$MgSO_4$ (magnesium sulfate)
$Bi(NO_3)_2$ (bismuth nitrate tetrahydrate)	$MnCl_2 \cdot 4H_2O$ (manganese chloride tetrahydrate)
$CaCl_2 \cdot 2H_2O$ (calcium chloride dehydrate)	$NiCl_2 \cdot 6H_2O$ (nickel chloride hexahydrate)
$Co(NO_3)_2 \cdot 6H_2O$ (cobalt nitrate hexahydrate)	NaOH (sodium hydroxide)
$CrCl_3$ (chromium (III) chloride)	Na_2O (sodium oxide)
$Cu(NO_3)_2 \cdot 3H_2O$ (copper (II) nitrate trihydrate)	$NaC_2H_3O_2 \cdot 3H_2O$ (sodium acetate trihydrate)
$FeCl_3 \cdot 6H_2O$ (iron (III) chloride hexahydrate)	$ZnCl_2$ (zinc chloride)

$Fe(NO_3)_3 \bullet 9H_2O$ (iron (III) nitrate nonahydrate $Fe(CNS)_3 \bullet 3H_2O$ (iron (III) thiocyanate trihydrate KOH (potassium hydroxide)	C_6H_5OH (phenol) $CH_3COO)_2O$ (acetic acid anhydride)

APPENDIX H
Sample List of Chemicals which Burn or Stain Skin; Volatile Substances; and Fire Hazards

Concentrated acids Strong bases Phenol $AsC1_3$ (arsenic (III) Chloride) $AgNO_3$ (silver nitrate)	PCl_3 (phosphorus (III) chloride) Liquor Br_2 (bromine) $C_6H_5NH_2$ (aniline)

APPENDIX I
Sample List of Volatile Substances

$CH_3CH_2OCH_2CH_3$ (diethyl ether)	CH_3CH_2OH (ethanol)
CS_2 (carbon disulfide)	CCl_4 (carbon tetrachloride)
CH_3COCH_3 (acetone)	$CH_3COOCH_2CH_3$ (ethyl acetate)
$CHCl_3$ (chloroform)	CH_3OH (methanol)

APPENDIX J
Sample List of Fire Hazard Chemicals

White and yellow **P** Phosphorus	CH_3CH_2OH (ethanol)
$C_2H_5OC_2H_5$ (diethyl ether)	C_6H_6 (benzene)
CH_3COCH_3 (acetone)	

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