HEALTH and SAFETY in the Science Classroom

Kindergarten to Grade 12

2019

Alberta

Health and Safety in the Science Classroom: Kindergarten to Grade 12

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Note: All website addresses were confirmed as accurate at the time of publication but are subject to change.

The primary intended audience for this document is:

Administrators	✓
Counsellors	✓
General Audience	✓
Parents	
Students	
Teachers	✓

TABLE OF CONTENTS

INTRODUCTION

Hands-on activities are a fundamental part of science learning. In early grades, student's exploratory activities with materials provide the starting point for their concept and skill development. In later grades, students learn the techniques of controlled investigation and experimentation and, through practice, develop the skills of science inquiry and problem solving. Laboratory activities provide the starting point for understanding the nature of science and the interplay of evidence and theory.

The challenge for schools is to offer science activities that are both educationally rewarding and safe. This result can only be achieved through a team effort, involving all of those who set and administer school policies, design and maintain the learning environment, plan and deliver science programs, and select and prepare the materials used.

The goal of this K–12 science health and safety resource is to bring together information needed by administrators, planners, teachers, and support staff to help them make sound decisions regarding science safety. The document identifies areas for decision making and action at a variety of levels. It supports planning and action by providing information on safety legislation and standards, health and safety hazards, and example procedures for eliminating or minimizing hazards.

The materials in this health and safety resource have been compiled from sources believed to be reliable and accurate and to represent the best of current thinking on the subject. This resource is intended to serve as a starting point for planning good practices, but does not purport to specify the level of technical detail that some users may require or to have anticipated every circumstance where health and safety may be a factor.

Alberta Education thus cannot assume responsibility for the validity or completeness of the information provided or for the consequences of its use. It can neither be assured that all necessary warnings and precautionary measures are contained herein, nor that additional information or measures may not be required due to particular exceptional circumstances.

PART A: GENERAL SAFETY MANAGEMENT

Chapter 1: Starting Points for Planning and Policy Setting

Overview

This chapter sets the stage for safety planning for science classrooms. The chapter outlines the roles of key stakeholders and lists sample actions that are appropriate to these roles. It also summarizes legislated requirements that have an impact on planning for science safety. Finally, it provides general guidelines for promoting safety.

Due Diligence: An Approach to Science Safety

A first step in planning for science safety is to become aware of the potential hazards that science activities may present. Further steps focus on minimizing risks by taking reasonable safety precautions—in other words, by acting with due diligence.

In a legal context, due diligence means taking all reasonable steps to prevent incidents and injuries, thus avoiding the assumption of legal liability. However, due diligence is more than just a legal concept; it is a positive approach to avoiding incidents and injuries by identifying possible hazards, planning precautionary actions, and fulfilling one's responsibilities. This more general definition provides a common sense starting point for safety planning.

Principals, administrators, teachers, and other staff can demonstrate due diligence by taking action in the following three key areas:

- ensuring awareness of potential risks and the related safety regulations;
- ensuring staff competency in meeting legislated requirements, thereby avoiding unnecessary risk; and
- implementing monitoring and compliance strategies to ensure that regulations are met.

Awareness of Legislated Safety Requirements

Principals, administrators, teachers, and other personnel need to know about the legislated requirements that apply to science programs offered in their schools. It is important to know about these regulations not only because they are legal obligations, but also because they help educators to better understand potential risks and the preventative measures that can be taken. Relevant legislation and requirements are summarized in this chapter inasmuch as they relate to safe practices in the science classroom. For access to the actual legislation, regulation, code, or bylaw itself, see Appendix I for the website addresses.

Staff Competency

As outlined in Section 8 of the Alberta Teachers' Association Code of Professional Conduct and Section 13(1) of the Occupational Health and Safety Regulation, Alberta Regulation 62/2003 (with amendments up to and including Alberta Regulation 51/2018), it is essential that teachers and other staff who perform potentially dangerous tasks are competent to handle these tasks. Competency means being aware of risks and being properly trained in relevant procedures to safely perform the task by controlling hazards. One of the legal responsibilities of administrators is to develop and implement plans to provide staff with this knowledge and training.

Evidence of staff competency may be required by provincial inspectors or investigators. For example, if a teacher was burned while handling chemicals in a science preparation area, a provincial investigator would determine whether the teacher

- had received Workplace Hazardous Materials Information System (WHMIS) 2015 training;
- knew where information on the chemicals was available;
- had assessed the hazards of the task before engaging in it;
- knew how to use the appropriate safety equipment; and
- had access to the appropriate safety equipment.

If the investigator found that the teacher was not competent to handle the chemicals, the teacher's employer could be held liable and charged under Alberta Occupational Health and Safety legislation. Should the investigator find that the teacher had been appropriately trained, yet chose not to execute appropriate hazard control practices, the teacher may be held liable and charged under Alberta Occupational Health and Safety legislation.

Monitoring and Compliance

The third area of due diligence involves monitoring work environments and activities to ensure compliance with health and safety legislation. For principals and administrators, this means monitoring their schools or work sites to make sure that staff comply with legislation and work in a safe and healthy manner. For teachers and other staff, it means identifying and following safe procedures and reporting situations that create potential risks.

Monitoring and compliance can be supported by

- discussing safety at staff meetings regularly;
- reviewing plans, practices, and responsibilities related to science safety periodically;
- developing processes to keep staff aware of changes in legislation;
- communicating regularly and sharing information on safety issues (for example, if an individual encounters a problem with a piece of equipment, they remove the equipment from service and make others in the school and district aware of the problem);
- evaluating unusual activities or those activities that have not been previously assessed for safety considerations, and dealing with any health and safety issues before the activity begins;
- reporting any violations of legislated requirements or district policy, using appropriate procedures; and
- giving regular attention to the following areas in planning:
  - emergency preparedness: Are plans updated as required to reflect changes? Are students' home telephone numbers current? Are drills conducted regularly?
  - hazard identification and control: Are hazards identified, evaluated, and dealt with appropriately? Are inspections conducted regularly? Are recommendations dealt with promptly?
  - incident reporting and investigation: Are all incidents reported to appropriate authorities as required? Has a near-miss incident-reporting system been set up and is it working effectively? Have incident statistics been analyzed and are appropriate actions being taken in response?
  - environmental protection: Are appropriate spill kits in place and are staff trained on how to use them? Are all releases (leaks or spills) being reported? Is hazardous waste being properly identified, stored, and disposed of from the school?

- safe work practices: Are safe operating procedures in place or being developed for hazardous activities? Are staff trained in these procedures? Are Safety Data Sheets accessible to staff in electronic or hard copy format?

- training: Are all new staff given safety orientation training? Are existing staff members trained as necessary? Are training records kept?

Key Players: Roles and Recommended Actions

Responsibility for ensuring safety in the science classroom is shared by many members of the educational system, including

- Alberta Education;
- universities and colleges;
- school authorities and superintendents;
- school administrators;
- science teachers;
- science technicians;
- science students;
- parents;
- educational assistants; and
- volunteers.

Individuals in each of these groups have roles to play in promoting safety in the science classroom. Example role statements and recommended actions to fulfill each role are described below. Roles frequently overlap and need to be aligned with local circumstances.

For example, some schools employ science technicians to help teachers prepare materials for laboratory activities, whereas in other schools, materials preparation is done directly by the teacher. Whatever the staffing pattern may be, it is up to everyone involved to work together as a team to ensure that responsibilities are determined, understood, and fulfilled.

Alberta Education

Role: Make safety information available to Alberta schools.

Recommended Actions

- Develop and/or authorize resources that offer information and guidelines on safety in science classrooms and laboratories.
- Periodically update authorized science safety resources.
- Provide information sessions to highlight safety roles, strategies, and resources.

Universities and Colleges

Role: Make safety information available to education students who take courses in science curriculum and instruction.

Recommended Actions

- Include safety knowledge and skills in curriculum and instruction courses delivered to students prior to their participation in classroom practicums.

School Authorities and Superintendents

Role: Provide leadership and resources to support science safety.

Recommended Actions

- Develop safety policies and procedures consistent with current legislated requirements, and facilitate the implementation of these policies and procedures.
- Ensure that school and school authority staff carry out their safety responsibilities.
- Provide training and support to ensure staff competency.
  - Ensure that each school has staff trained in first aid and emergency care.
  - Ensure that staff are trained in WHMIS 2015 and in Transportation of Dangerous Goods (TDG), as required.
- Make staff assignments that support safe operation of science facilities on an ongoing basis; e.g., by assignment of science department heads or science technicians.
- Establish a system to monitor the effectiveness of safety policies and practices in their schools.
- Establish a system to periodically assess the adequacy of science facilities and safety equipment in each school, and provide for their ongoing maintenance.

- Make provisions for the safety of students with special needs or language difficulties.

- Request and/or direct safety and health investigations.

School Administrators

Role: Ensure safe policies and practices are in place at the school level, and support teachers in providing a safe working environment.

Recommended Actions

- Ensure that staff have required safety training and expertise.

- Ensure that teachers and substitute/supply teachers of science have the expertise to teach the assigned curriculum safely.

- Ensure that staff who handle hazardous materials and prepare laboratories have the expertise to do so safely.

- Enable teachers and technicians to obtain training in science safety—in particular, to become familiar with the Alberta Occupational Health and Safety Act, Regulation, and Code to meet the requirements of WHMIS 2015 and the TDG Act.

- Ensure proper disposal of chemical and organic wastes in accordance with the Environmental Protection and Enhancement Act, RSA 2000, c. E-12 and associated regulations; Canada Water Act, RSC 1985, c. C-11; and local bylaws.

- In setting policies and practices for school organization, give consideration to
  - the numbers of students per science class;
  - classroom size and facilities; and
  - curricular requirements.

- Ensure that facilities used for science activities are safe and appropriate for the activities carried out in them and that necessary safety equipment is available. (See the Safety Equipment and Supplies section in Chapter 3 for further information.)

- Implement and maintain safe storage and waste disposal systems for hazardous substances used or produced in the school.

- Ensure that procedures are in place for hazard reporting and that all safety concerns regarding facilities, equipment, and procedures are addressed.

- Ensure that schools have effective policies and practices to follow in case of incidents and emergencies.

- Maintain accurate records of incidents and first aid treatments provided; report incidents as required by the Occupational Health and Safety Act, Regulation, and Code and Workers' Compensation Act; and document near-misses.

- Cooperate with outside personnel and agencies in promoting science safety (e.g., local fire marshal, Occupational Health and Safety, Alberta Environment and Parks).

- Stop any practices that jeopardize student or staff safety.

- Provide for the safety of students with special needs or language difficulties.

- Support disciplinary measures that the teacher may take to ensure safety in science classes.

- Ensure the school follows safety regulations and procedures.

Science Teachers

Role: Plan and prepare learning activities with a view to safety, and model and supervise safe practices in the science classroom/laboratory.

Recommended Actions

- Make prudent decisions regarding the selection of laboratory activities, taking into account the learning environment; the knowledge and skills of the students; and their own knowledge, expertise, and training to conduct activities in a safe and effective manner.

- Provide safety guidelines or lessons to students at the beginning of each year, term, or course. Outline the roles and actions of students, assistants, and adult volunteers in maintaining classroom safety; identify the location and describe the use of safety equipment; and, where appropriate, obtain written confirmation from students that their responsibilities are understood and accepted. (See Appendix B for a sample safety contract for elementary students and Appendix C for a sample safety contract for secondary students.)

- Explain and model safety procedures for each learning activity.

- Monitor students and correct behaviour that jeopardizes safety.

- Maintain a confidential list of students with any physiological conditions (e.g., allergies, asthma) or physical disabilities. Use a buddy system or other system for those with special needs.

- Implement safety rules specified by school authority policy and relevant legislation.

- Contribute to developing and implementing school laboratory safety policy and procedures.

- Be familiar with the location and use of safety equipment and the location of main gas valves and electrical breakers.

- Report any defects in science equipment, facilities, or practices to the school administrator responsible for safety. Remove defective equipment from service, as applicable.

- Verbally report any injuries or incidents to the school principal immediately, followed by a written report. Written reports of incidents are required under the Occupational Health and Safety Act and Workers' Compensation Act. Also document near-misses so that colleagues can avoid similar situations (this is a recommended but not legal requirement).

- Participate in health and safety training provided by the employer.

- Be WHMIS 2015 trained if handling hazardous products. If responsibilities include shipping and/or receiving chemicals, TDG training is required.

- Inform administration when work conditions or responsibilities have changed and additional training is required.

- Complete regular inspections of the workspace and laboratories to identify any safety concerns or hazards.

- Take on roles and responsibilities of a science technician (as defined in the next section) that have not been designated to someone else.

Science Technicians

This section applies to staff that may have a variety of related titles, such as laboratory aide, laboratory assistant, laboratory technician, or science technologist.

Role: In general terms, their responsibility is to assist in the preparation of science laboratory materials as requested by teachers for specific laboratory activities. However, their role may also include promoting and maintaining safety standards in laboratory and classroom activities, managing chemical inventories in accordance with WHMIS and other regulations, and ensuring that all science and safety equipment is in good condition.

Recommended Actions

- Maintain laboratory safety equipment and ensure it is both sufficient and accessible.

- Ensure all science equipment is in good working condition.

- Identify, document, and inform teachers of safety problems related to specific laboratory activities, and adapt activities when necessary to eliminate problems while still meeting curriculum goals.

- Follow WHMIS 2015 and TDG regulations when dealing with hazardous products and dangerous goods.

- Conduct a yearly chemical inventory, ensuring Safety Data Sheets (SDSs) are current, and submit the inventory to the school's designated person responsible for hazardous materials.

- Ensure proper disposal of chemical/organic wastes in accordance with the Environmental Protection and Enhancement Act, Canada Water Act, and local bylaws.

- Work with the science curriculum leader to promote safe procedures, and maintain safety standards in all science activities.

- Keep safety in the forefront within the science department through meetings, articles, posters, and other methods.

- Complete regular inspections of the workspace and laboratories to identify any safety concerns or hazards.

Science Students

Role: Support safety in the science classroom by acting responsibly and knowing how to respond to unsafe situations and emergencies.

Recommended Actions

- Inform the teacher of health concerns and circumstances that could affect personal safety; e.g., allergies, medications, use of contact lenses.

- Come to the laboratory appropriately dressed for lab work; e.g., closed shoes, long hair tied back, secured clothing or jewellery.

- Wear goggles and an apron or use other safety equipment as required and/or as directed by the teacher.

- Learn about the hazards posed by materials and equipment to be used in each activity and about procedures to be followed.

- Learn about the location and use of safety equipment.

- Follow all safety procedures and instructions, and act in a way that shows concern for everyone's safety.

- Begin activities only with the teacher's permission and never perform unauthorized activities.
- Report unsafe situations, hazards, or incidents to the teacher immediately.
- Dispose of all chemicals, specimens, and other materials as instructed by the teacher.
- Wash hands thoroughly after each experiment.

Parents

Role: Support the school's efforts to provide safety in the classroom or laboratory.

Recommended Action

- Inform the school about relevant student medical problems.

Educational Assistants and Volunteers

Role: Support the classroom teacher in maintaining safety.

Recommended Actions

- Find out about the hazards posed by materials and equipment to be used in science activities and about procedures to be used and avoided.
- Understand and model safe behaviour.
- Monitor equipment and student behaviour, and report any unsafe conditions to the teacher.

Legislated Requirements

Legislated requirements relevant to science safety are found in the following sources (listed by category). **Note:** The information provided in this section was current as of the date of publishing.

Fire and Building Codes

- Alberta Fire Code, 2014
- Alberta Building Code, 2014

Occupational Requirements

- Labour Relations Code, RSA 2000, c. L-1
- Occupational Health and Safety Act, SA 2017, c. O-2.1
- Occupational Health and Safety Regulation, AR 62/2003 (with amendments up to and including Alberta Regulation 51/2018)
- Administrative Penalty (Occupational Health and Safety Act) Regulation, AR 165/2013
- Occupational Health and Safety Code, AR 87/2009 (with amendments in force as of June 1, 2018) (Refer to https://www.alberta.ca/occupational-health-safety.aspx for the current Occupational Health and Safety Code.)
  - Hazard Assessment, Elimination and Control, Part 2
  - Chemical Hazards, Biological Hazards and Harmful Substances, Part 4
  - Emergency Preparedness and Response, Part 7
  - First Aid, Part 11
  - Workplace Hazardous Materials Information System (WHMIS), Part 29
- School Act, RSA 2000, c. S-3
- Teaching Profession Act, RSA 2000, c. T-2

Environmental Requirements

- Environmental Protection and Enhancement Act, RSA 2000, c. E-12
  - Release Reporting Regulation, AR 117/1993
  - Waste Control Regulation, AR 192/1996
- Canadian Environmental Protection Act, 1999, SC 1999, c. 33
- Canada Water Act, RSC 1985, c. C-11
- Transportation of Dangerous Goods Act, 1992, SC 1992, c. 34, and regulations
- local bylaws

Other Legislated Requirements

- Hazardous Products Act, RSC 1985, c. H-3

Many aspects of school safety are governed by more than one piece of legislation. For example:

- The "maximum permissible occupancy load" of science laboratories and classrooms is regulated by the Alberta Fire Code, 2014, which refers back to the Alberta Building Code, 2014, for base figures on "occupancy load."

- The use of chemicals is regulated under the Occupational Health and Safety Code, the Hazardous Products Act, the Transportation of Dangerous Goods Act and Regulations, and the Environmental Protection and Enhancement Act. Additional aspects of chemical safety are regulated by the Waste Control Regulation and the Canada Water Act, and may be further regulated by municipal sewer and solid waste bylaws.

The following sections highlight some important elements of key legislation as they relate to science safety, and outline how teachers, administrators, and other staff can meet these requirements.

Fire and Building Codes

Alberta Fire Code, 2014

The Alberta Fire Code, 2014, outlines standards for building designs, equipment, and procedures required to minimize risk of fire and enable safe exit of occupants when fire occurs. Particular sections of the code provide standards for

- storage of combustible or dangerous substances (including combustible and flammable liquids with regard to their storage, arrangement, labelling, and venting);
- chemical spill control;
- fire safety plans;
- emergency procedures, fire drills, and fire department access;
- fire protection equipment, including extinguishing systems, extinguishers, water supply systems, fire alarm systems, and emergency power installations;
- required fire doors and separations;
- ventilation systems and strategies; and
- maximum permissible occupant load.

Factors used in determining the maximum permissible occupant load of a science room or laboratory include the type of use of the room, the room layout, the number and location of exits, and the size and location of furnishings. For advice on the maximum permissible occupant (student) load of a particular science facility, please request an evaluation by your local fire marshal.

Alberta Building Code, 2014
The Alberta Building Code, 2014, outlines standards for the design, construction, and alteration of buildings in order to ensure the "life safety" of future occupants. Standards set by the Alberta Building Code, 2014, include electrical wiring, fire alarm systems, fire extinguisher requirements, emergency routes, and lighting and ventilation (including the venting of chemical storage areas).

Occupational Requirements

Labour Relations Code, RSA 2000, c. L-1
In cases of a Labour Board inquiry into employment conditions, this code gives the board or an officer of the board the right to inspect the school premises, question employees, and examine school records relating to safety inspections, fire drills, and staff training programs.

Occupational Health and Safety Act, Regulation, and Code
The Occupational Health and Safety Act, Regulation, and Code were established to ensure reasonable levels of health and safety in the workplace. These pieces of legislation deal with chemical hazards and harmful substances, hazard assessment, first aid, emergency preparedness, fire and explosion hazards, personal protective equipment, ventilation, and other important occupational health and safety issues.

The Occupational Health and Safety Act has extensive implications for both employers and employees (referred to as "workers" in the act). Note that Alberta Justice does not consider students to be workers under this legislation except for those in registered apprenticeship or off-campus work experience programs. For more information, refer to Workplace Health and Safety Bulletin LI022 (https://ohs-pubstore.labour.alberta.ca/li022).

According to the act

- employers are responsible for
  - ensuring the health, safety, and welfare of workers;
  - ensuring that workers are aware of their rights and duties under the law and are aware of any health and safety issues;
  - providing competent supervisors, training workers, and preventing violence and harassment; and
  - ensuring public safety at or in the vicinity of work sites;

- supervisors must be competent, protect the health and safety of workers, advise workers of all health and safety hazards, report all health and safety concerns to the employer, and prevent violence and harassment;

- workers are responsible for ensuring the health and safety of themselves and others, reporting unsafe or unhealthy conditions, and refraining from causing or participating in violence or harassment; and

- workers have rights to
  - know about potential hazards and have access to basic health and safety information on site;
  - participate in health and safety discussions, including participation in health and safety committees; and
  - refuse dangerous work.

The following parts of the Occupational Health and Safety Code are particularly relevant for science classrooms. The information below should not, however, be considered an exhaustive list of all relevant aspects of the Occupational Health and Safety Code.

Part 2: Hazard Assessment, Elimination and Control outlines the employer's responsibility to regularly assess a work site, prepare reports, and involve workers in performing regular hazard assessments and controlling or eliminating hazards.

Part 4: Chemical Hazards, Biological Hazards and Harmful Substances

- provides 8-hour, 15-minute, or ceiling occupational limits (OELs) for a variety of chemical substances. For further information on OELs, see Schedule 1, Table 2 of the Occupational Health and Safety Code;

- provides specific employer obligations and procedures for ensuring treatment after overexposure;

- prohibits eating, drinking, and smoking in areas contaminated by a harmful substance; and

- includes the requirement for a code of practice that governs the storage, handling, use, and disposal of a number of specific chemicals and groups of chemicals used at work sites. (See Chapter 7 for a complete list of these substances.) The code of practice applies only in instances where the amounts of these chemicals exceed 10 kg when in pure form or, if in a mixture, 10 kg at a concentration of 0.1% or more.

Part 7: Emergency Preparedness and Response

- states that an employer must establish an emergency response plan; and
- outlines the minimum requirements of such a plan, the need for updating the plan, and the importance of employee training.

Part 11: First Aid

- requires the employer to maintain first aid equipment and supplies and a first aid room. For further information about first aid room requirements, see tables 3 to 7 of Schedule 2 of the Occupational Health and Safety Code;
- specifies contents of first aid kits for low-, medium-, and high-hazard sites;
- states that kits must be clearly labelled so that every worker knows their location;
- states requirements for the number of first aiders on a job site;
- states requirements for an emergency transportation plan;
- states requirements for the recording of injury or illness occurring at a work site; and
- states requirements for access to first aid records.

Part 29: Workplace Hazardous Materials Information System (WHMIS)

- outlines a system to inform people of the hazards of materials they might be handling in the workplace and to minimize risks;
- provides information for hazardous products with higher inherent risks; and
- specifies standards for
  - labelling of chemicals: Labels alerting the user to hazards of the product and precautions for safe use are mandatory for hazardous products;
  - Safety Data Sheets (SDSs): Employers must ensure that the SDS for a hazardous product received at the time of purchase from the supplier is the most current version. The employer must also ensure that the SDS is readily available at a work site to workers who may be exposed to the hazardous product; and
  - WHMIS training and education: Knowledge about potential hazards and safety procedures is mandatory for teachers, laboratory technicians, or any other person working with or near hazardous products.

See chapters 4 and 8 of this document for additional details on WHMIS and SDSs and Chapter 8 for details on labelling of chemicals.

For more information, visit https://www.alberta.ca/ministry-labour.aspx or access an approved computer learning package for in-school training and/or review.

Note that there are numerous other sections of the code that may be applicable (such as parts 16, 18, 22, 28); these sections may be reviewed online by visiting https://www.alberta.ca/occupational-health-safety.aspx.

School Act, RSA 2000, c. S-3
The School Act (Section 45.1(1)) indicates that boards have a responsibility to ensure that students and staff members are provided with a welcoming, caring, respectful, and safe learning environment.

Teaching Profession Act, RSA 2000, c. T-2
The Teaching Profession Act indicates that teacher conduct is considered unprofessional if it "is detrimental to the best interests of students."

Environmental Requirements

Environmental Protection and Enhancement Act (EPEA), RSA 2000, c. E-12
The EPEA was established to help protect and improve the environment. The act is essentially preventative in nature: it ensures that potentially damaging activities can proceed only if their impact has been closely examined and provisions have been made to adequately protect the environment against damage. Authorizations typically stipulate requirements for ongoing reporting on groundwater quality and air emissions.

The act also states that all polluters—including schools—are expected to pay for the cost of their actions. If any potentially damaging substance is released into the environment

- immediate steps must be taken to confine, clean up, and dispose of the substance;
- the release must be reported immediately in accordance with the Release Reporting Regulation, AR 117/1993; and
- the environment must be returned to a condition that is satisfactory to the Government of Alberta.

Waste Control Regulation, AR 192/1996
This regulation sets out requirements for handling, storing, and disposing of hazardous wastes generated by industry or institutions, including schools or school authorities, and stipulates how to deal with hazardous waste spills. Although specific waste products are not identified by name, the regulation describes the properties that determine whether waste materials can be disposed of in landfills.

Canadian Environmental Protection Act, 1999, SC 1999, c. 33
The Canadian Environmental Protection Act is the federal equivalent of the EPEA. The act and its regulations describe procedures for storage, transport, and disposal of hazardous wastes produced by industries, as well as schools or school authorities, and outline how to deal with spills. Like the EPEA, this act states that all polluters are expected to pay for the cost of their actions.

Canada Water Act, RSC 1985, c. C-11
This act defines *waste* as substances that alter water quality to the extent that its use would be detrimental to humans, animals, and fish or to plants that are useful to humans. It prohibits pollution of water in areas designated for restoring, maintaining, or improving water quality and specifies the penalties for doing so.

Transportation of Dangerous Goods (TDG) Act, 1992, SC 1992, c. 34 and Regulations
The TDG Act and Regulations protect the general public and the environment during the transport of hazardous goods, including regulated chemicals ordered or disposed of by schools. TDG provides a complementary system to WHMIS: during transportation, these products are called dangerous goods and are governed by the regulations of TDG. The TDG Act states that during transport, dangerous goods must be identified by

- labels on containers;
- placards on trucks; and
- shipping documents.

These TDG regulations terminate with the reception of the regulated chemicals by a receiver at the point of delivery. For this reason, the receiver must be TDG trained to receive the chemicals at a school or school authority site.

This person must also undergo TDG recertification every three years. Refer to Receiving Chemicals in Chapter 8 for more information on steps to follow when receiving chemicals. Once the regulated goods have been unloaded from the transport vehicle and received, they become hazardous products and fall under WHMIS regulations.

This information is important to staff and others in emergencies, as well as in routine activities. The TDG chemical classifications used on labels and in documents are international in scope, and as a result, they are rigidly specified.

Local Bylaws
Large cities such as Calgary and Edmonton have established bylaws related to waste management and disposal. In such cases, wastes may have additional definitions that may vary by jurisdiction, such as hazardous, prohibited, or restricted.

Smaller centres, such as Red Deer, Lethbridge, Medicine Hat, and Grande Prairie, are following the lead of these larger centres in the development of documented bylaws restricting the limits of waste materials disposed of via the sewage system, and possibly, via the local landfill site(s).

In most cases, local bylaws support and reinforce the regulations of federal and provincial legislation, but they may also provide more specific disposal limits or other details. For example, in the City of Edmonton, Bylaw 16200, Drainage Bylaw (January 1, 2017) states that no person shall release or permit the release of any matter containing a hazardous waste into a sanitary sewer. It also states that a small quantity of waste water containing a prohibited or restricted waste may be released with prior permission of the city manager, but only if it is determined to have a minimal adverse effect on the sewage system. The bylaw also lists wastes that cannot be disposed of via the drain.

The City of Calgary and other Alberta municipalities have similar bylaws to prohibit or limit waste disposal through drains.

Check with your municipal office or town/city council for relevant bylaws in your area.

Other Legislated Requirements

Hazardous Products Act, RSC 1985, c. H-3
This act defines what materials are designated as hazardous products (formerly controlled products) in Canada. Designation of hazardous products has the following significance for schools:

- The WHMIS requirements apply to all materials designated as hazardous products. Suppliers of hazardous products are required to provide a Safety Data Sheet (SDS, formerly MSDS) for each product and ensure the product or its container is labelled with required information and hazard symbols.

- The advertising, sale, and importation of hazardous products for use in the workplace, including Canadian schools, is regulated under the act.

Implementing Safety in the Science Classroom or Laboratory

The following general procedures are recommended to use in day-to-day routines of planning, preparation, guiding, and follow-up to science activities. Two sets of guidelines are provided—a basic set of procedures for elementary schools, and a more extensive set of guidelines for junior and senior high schools. The more extensive guidelines reflect the increased complexity of science activities at the upper grade levels.

Elementary Schools

Elementary students thrive on hands-on activities. The opportunity to explore and investigate real materials is a powerful motivator for learning and provides starting points for concept and skill development. The benefits of hands-on activities are well-known to teachers, who regularly incorporate them into their programs, taking care to ensure student safety. Steps taken to ensure student safety involve all stages of planning,

preparation, supervision, and activity follow-up. Example strategies for ensuring safety in elementary science activities are described below, beginning with the early stages of planning.

Selecting Activities and Materials

- Consult teacher guides and safety resources to become familiar with risks posed by the activities and materials under consideration.
- Access and review information on student allergies and health conditions that could limit students' involvement in science activities.
- Select activities and materials, taking into account
  - potential hazards;
  - student allergies and health conditions;
  - the knowledge, skills, maturity, and disabilities of students; and
  - the equipment and facilities available to safely carry out the activities.
- Avoid bringing poisonous plants or wild animals—dead or alive—into the classroom, and do not engage in direct investigations of human body tissues and fluids.

Preparing Activities

- Obtain and prepare safety supplies; e.g., obtain personal protective equipment, such as goggles and gloves.
- Prepare materials for safe use; e.g., organize materials to facilitate safe distribution.
- Prepare for cleanup and disposal of chemicals and other waste products; e.g., label waste containers.

Introducing and Guiding Activities

- Involve students in preparing the classroom for safe activity by clearing work surfaces and aisles.
- Introduce equipment and supplies to be used and how they can be used safely by identifying procedures to follow and actions to avoid.
- Ensure that all students are aware of risks inherent in the materials to be used.
- Ensure that students use personal protective equipment as required for the activity.
- Initiate short, simple tasks that provide opportunity for students to practise safe procedures before moving on to more complex tasks.
- Model safety at all times.

- Consider having students sign a safety contract as a commitment to safety. See Appendix B for a sample contract.

Follow-up Procedures

- Have students clean up their workspace, following safe and environmentally responsible procedures.

- Have students wash their hands after taking part in activities that involve chemical or biological materials.

Junior and Senior High Schools

As in earlier grades, activities with real materials in junior and senior high schools can be powerful motivators for learning and provide starting points for concept and skill development. At the junior and senior high school levels, experience with materials also provides opportunities to learn about the nature of science investigation and to critically examine the link between evidence and theory. With the increasing complexity of concepts studied, investigations may involve more complex equipment and a broader range of materials than studied at the elementary level, creating new challenges for ensuring student safety.

The general strategies for ensuring science safety nevertheless have much in common with earlier levels, involving all stages of planning, preparation, supervision, and activity follow-up. The following general strategies are thus recommended. It is further recommended that secondary schools refine and extend these practices to reflect the program, student characteristics, facilities, and staff roles within the particular school.

Selecting Activities and Materials

- Consult teacher guides and safety resources to become familiar with risks posed by the activities and materials under consideration.

- Access and review information on student allergies and health conditions that could limit students' involvement in science activities.

- Select activities and materials, taking into account
  - potential hazards;
  - student allergies and health conditions;
  - the knowledge, skills, and maturity of the students; and
  - the equipment and facilities available to carry out the activities safely.

- Avoid bringing poisonous plants or wild animals—dead or alive—into the classroom, and do not engage in direct investigations of human body tissues and fluids.

Preparing Activities

- Obtain and prepare safety supplies; e.g., obtain personal protective equipment, such as goggles, aprons, and gloves.
- Prepare materials for safe use; e.g., prepare dilute solutions in advance, organize materials to facilitate safe distribution.
- Prepare for cleanup and disposal of chemicals and other waste products; e.g., label waste containers.

Introducing and Guiding Activities

- Set standards for safety preparation and behaviour in laboratories. See Appendix A for example science safety rules and procedures that could be used with students.
- Introduce WHMIS and SDS symbols, data sheets, and safety procedures, and ensure that students understand the need for and application of these standards.
- Provide a general introduction to risks and safety procedures at the outset of the course. In this introduction, review procedures for
  - handling medical emergencies and incidents;
  - handling chemical wastes and spills; and
  - reporting defective equipment and potential hazards.
- Familiarize students with the location and use of safety equipment; e.g., eyewash stations.
- Introduce equipment and supplies to be used in each activity, and describe how they can be used safely by identifying procedures to follow and actions to avoid.
- Ensure that all students are aware of risks inherent in the materials to be used.
- Ensure that students use personal protective equipment as required for the activity.
- Provide opportunity for students to practise safe procedures.
- Model safety at all times.
- Consider having students sign a safety contract as a commitment to safety. Retain the contract, but recognize that this is not a legal document. See Appendix C for a sample contract.

Follow-up Procedures

- Have students clean up their workspace, following safe and environmentally responsible procedures.
- Have students wash their hands after taking part in activities that involve the use of chemical or biological materials.

Chapter 2: Emergency Preparedness and Response

Overview

This chapter provides information and strategies to prepare for contingencies in the science classroom, laboratory, and science preparation areas. The chapter includes sections on planning emergency responses, responding to incidents and medical emergencies, and preparing incident reports.

General Safety Audit

A general safety inspection can be a good starting point for preparing to deal with emergencies that are more likely to occur in or impact science classrooms. Typically, this inspection would be done as part of the larger school emergency planning process and would include a thorough evaluation of general safety concerns, such as fire prevention and response, as well as response to medical emergencies, gas leaks, and other situations. In addition, special attention would be given to areas where chemicals are stored and used, since extra precautions and equipment are involved in these locations. An inspection checklist could be developed to assist in this process and to ensure that nothing is overlooked. See Appendix D for a sample inspection checklist devised for use in assessing safety in the chemical laboratory area.

Emergency Preparedness Planning

Part 7 of the Occupational Health and Safety Code specifies that every workplace must develop and implement an on-site emergency response plan. This requirement is applicable to schools. Such a plan establishes procedures to deal with different kinds of emergencies and is tailored to the specific design, circumstances, and nature of the hazards of the school. Procedures must also take into account the needs of diverse students.

Any emergency that threatened the safety of students or staff would then be dealt with according to this plan. Before engaging in the development of such a plan, review Part 7 of the Occupational Health and Safety Code for the broad outline of what must be addressed by the plan, and reference Part 7, Sections 115–118, of the Occupational Health and Safety Code Explanation Guide for more detail (see https://www.alberta.ca/ohs-act-regulation-code.aspx). Topics to be covered as identified in the code are

- identification of potential emergencies;
- procedures for dealing with the identified emergencies;
- identification of, location of, and operational procedures for emergency equipment;
- emergency response training requirements;
- location and use of emergency facilities;
- fire protection requirements;
- alarm and emergency communication requirements;
- first aid services required;
- procedures for rescue and evacuation; and
- designated rescue and evacuation workers.

Considerations in Emergency Preparedness Planning

Emergency plans address a number of different safety hazards and emergency situations. At a minimum, the plan would include

- safety measures for fire, including prevention measures specified in the Alberta Building Code, 2014, the Alberta Fire Code, 2014, district regulations, or elsewhere, and procedures to follow in the event of a fire in a science laboratory or elsewhere;
- a building floor plan showing where all hazardous substances are located, as well as key control items such as first aid kits, eyewash stations, and fire extinguishers;
- procedures for dealing with the release or spill of hazardous substances;
- procedures for responding to a natural gas or propane leak;
- procedures for responding to incidents and medical emergencies; and
- plans to ensure staff receive adequate orientation and training.

Creating Your Own Emergency Plan

A model plan should contain the following elements:

Statement of Purpose. A brief description of what the plan is intending to achieve is necessary to set planning parameters and to establish a benchmark against which all subsequent action is taken. In other words, if an event can be handled with day-to-day resources and procedures, it does not belong in the plan.

Concept of Operations. An overview of how the plan functions and its relationship to other activities helps rearrange the organizational framework needed for managing the situation. A classroom emergency plan could provide direction for a problem to be handled by an individual teacher within certain parameters. When conditions exceed

those parameters, a school team of officials could establish control and provide direction and support to the affected area. If the problem affects the school at large, then the plan is interfaced with the school authority and the community emergency or crisis management plan.

Risk Assessment. To assist in developing adequate arrangements, a thorough risk assessment should be completed. Minimize the assessment process to those hazards/threats that actually warrant activation of the plan, and include them in the document.

Authority. A reference to specific legislation/regulation/policy gives legal expression to the plan.

Activation. The conditions that must exist for the plan to be activated should be clearly stated. Care is required to avoid ambiguity often inherent in such statements. This can be overcome by stating routine conditions that do not justify activation of the plan along with the crisis conditions that mandate activation.

Notification. A means of alerting key officials about the onset of a crisis situation is highly recommended as a routine for quickly assembling a predesignated crisis management team once the plan is activated. This may be part of a larger communications plan but still must be included separately.

Centralized Control. A location for the crisis management team(s) to work from should be designated and prepared in advance, and there should be consideration for an alternate location. People in crisis like to know where the leadership team is at all times and how to contact them.

De-activation. Provide a clear guideline describing how and when the event has ended and it is safe to return to normal activities, particularly who has the authority to make such decisions (e.g., principal, fire department).

Self-assessing. The plan should be self-assessing. This means there should be a checklist of questions by which you can determine if the plan meets your needs or requires updating.

Check Sheets. These sheets outline the actions that should be taken when the plan is activated. Actions are listed in order of priority and can be used to assign key roles to individuals.

Appendices. The appendices contain the working documents that supplement the procedures defined in the check sheets.

References. This section provides a list of other resources that would be useful in designing an emergency plan.

Sources of Emergency Plans

As they develop or review their plans, schools may find it useful to consult the various models available on the Internet. These models follow the generally accepted planning design principles and are recommended only as a guideline to help school disaster planners develop, implement, assess, and revise their emergency plans.

In Alberta, the Alberta Emergency Management Agency is often available to assist with interpreting and applying planning strategies, taking into account each school and school authority's unique resources and the community emergency response support mechanism.

Staff can also assist with reviewing drafts and evaluating existing plans.

Emergency planning and policy requirements can be found on the Alberta Education website at https://education.alberta.ca/ using the search phrase "health and safety."

Resources for the development of emergency management plans are available online from the federal government at https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/mrgnc-prprdnss/index-en.aspx.

Evaluating Your Emergency Planning

To evaluate whether your emergency preparedness planning is adequate, consider whether your plan is realistic, comprehensive, and appropriate for the workplace and includes measures for implementation. Effective emergency planning should include the following:

- All potential emergencies are mentioned in the plan, but it is the most probable events as determined by the hazard analysis and risk assessment that are developed into contingency arrangements.
- The required supplies and equipment (e.g., fire extinguishers, respirators, and first aid kits) are available and in good condition.
- There is an effective process to announce the emergency to all staff members, students, and visitors.
- Drills are carried out periodically, testing response to incidents.
- Records and evaluation of drills indicate that the plan is feasible.
- Staff members understand the plan.
- Staff members are aware of their roles if there is an incident or if an evacuation is necessary; staff and their back-ups are sufficiently trained to carry out these roles.

- The required number of staff are trained in emergency and standard-level first aid.
- All staff members are trained and prepared so that they know how to declare an emergency and initiate the alarm and how to determine the required level of response; e.g., standby, escalation, evacuation, or take cover.
- Key staff members are trained on how to determine when the incident is over.

Responding to Fire

A response procedure for a school fire would address the following elements:

- When to sound the local fire alarm.
- When and how to evacuate the school. (For example, would an appointed person take the building's emergency services kit with them to the command centre?)
- Who is responsible for notifying the fire department and school superintendent.
- Under what circumstances staff members may attempt to extinguish the fire, and procedures for doing so.
- When and how to permit people to re-enter the building or to carry out further evacuation procedures if staff and/or students will be unable to return.
- Procedures for securing utilities.
- Responsibilities and procedures for filing written reports with the supervisor of schools and the fire marshal.

Responding to Leaks and Spills

The response plan should include procedures for emergency response to leaks and spills of hazardous substances, particularly those that pose an immediate danger due to the quantity and location of the spill. The emergency plan should include the following:

- When and how staff should (and should not) attempt to contain a leak or spill.
- When and how to evacuate.
- Who is responsible for requesting emergency services and informing appropriate school officials.
- Procedures and responsibilities for providing the appropriate SDS to the emergency responder, hospital, or physician.

- Procedures and responsibilities for reporting the leak or spill and completing any follow-up investigation.

For spills of small quantities of less dangerous substances, a full emergency response may not be required. See Chapter 7 for cleanup procedures.

Responding to a Natural Gas or Propane Leak

Natural gas and propane are flammable gases that are used as fuels in science laboratories. Both are delivered under pressure. Any leakage of gas from pipes or fittings creates a risk of fire and/or explosion, particularly if the leakage is in a confined area, and especially if it remains undetected for some time.

A slow continuous leak can lead to migration of gas through a room or building until it reaches a source of ignition, resulting in an explosive flash back to the source. A fire near the source of a leak may also cause the gas container or pipe to explode.

Emergency planning should address the following elements for natural gas or propane leaks that cannot be immediately stopped:

- When and how to evacuate the area.
- Who is responsible to alert the fire department and school authority officials.
- Under what circumstances staff members may attempt to localize and/or dissipate the leaking gas, and procedures for doing so.

Responding to Incidents and Medical Emergencies

To handle medical emergencies and serious injuries, each school is required by Occupational Health and Safety Legislation to have staff with emergency or standard-level first aid training. These individuals would have the expertise to administer relevant first aid procedures, which may include abdominal thrusts, mouth-to-mouth breathing, and cardiopulmonary resuscitation (CPR).

This section outlines first aid for both minor and major injuries that are most likely to occur in the science laboratory or classroom. Included are the first steps to alleviate damage and to treat the injury, as well as when to engage local emergency services. School authorities may have additional procedures or regulations for responding to medical emergencies. Additional items related to notification, reporting, control of the classroom, etc., may be required. The following are guidelines only. Also, first aid practices change periodically. Always follow the practices taught in first aid courses by first aid trainers and providers.

Corrosive Chemical on the Skin

Be familiar with the first aid measures given in the SDS for chemicals used. The general rule is to wash the area immediately and thoroughly with cool water or soap and water. The recommended time for this washing is 15–20 minutes. Remove contaminated clothing. If significant harm is detected or suspected, seek medical assistance.

Splashes into the Eyes

Immediately flood the eye(s) with a gentle stream of cool water for 15–20 minutes, holding the eye(s) open if necessary. Close the eyelid and cover with a loose, moist dressing. Proceed to get medical help to assess the condition of the eye(s) and ensure no further damage occurs. Alkalis produce more serious burns than acids, but flushing should be done immediately regardless of the substance.

Foreign Object in the Eye

If no help is available, try to flush the eye clear on your own. Position an eyecup or small clean glass of water with its rim resting on the bone at the base of the eye socket, and pour the water in, keeping the eye open. If you cannot clear your eye, seek emergency medical help.

To help a person with a foreign object in their eye:

Keep the person from rubbing their eye. Wash your hands. Seat the person in a well-lit area. Try to locate the object in the eye visually. Examine the eye by gently pulling the lower lid downward and instructing the person to look upward. Reverse the procedure for the upper lid. Hold the upper lid and examine the eye while the person looks downward.

If the object is on the surface of the eye, you may be able to flush it out or remove it manually. While holding the upper or lower lid open, use a moistened tissue or the corner of a clean cloth to remove the object by lightly touching it. Once removed, flush the eye with a saline solution or lukewarm water. If you cannot remove the object easily, cover the eye with a soft cloth and seek emergency medical assistance.

If the object is embedded in the eye, do not remove the object. Apply a dressing over the eye in such a way that it does not make direct contact with the eye surface. Cover the dressing with a cup or ring pad, and seek emergency medical assistance.

If pain, vision problems, or redness persists, seek emergency medical help.

Cuts

Put on disposable gloves to minimize risk of infection from the blood. If necessary, wash minor cuts with cool water to remove any foreign material, dry the area, and cover with a bandage.

In the case of major cuts with severe blood loss, apply a large compress, and then apply direct pressure with the heel of your hand and transport the victim to the hospital. For major cuts with minor bleeding, cover with a gauze pad, and then transport the victim to hospital for further medical help.

If glass or any other sharp object may still be in the wound, do not attempt to remove it. Instead, tent dress the area and add padding around the injury until it is higher than the imbedded object. Secure padding with a wrapping of gauze and seek medical help. Be careful not to put undue pressure on the gauze while transporting the victim, since circulation may be cut off completely.

Ingestion of Chemicals

The primary source of information in Alberta on prescribed treatment for ingested chemicals is the Alberta Health Services Poison and Drug Information Service; telephone

1–800–332–1414

Specialists are on 24-hour call every day of the year. They should be called immediately if ingestion of a chemical occurs—before proceeding with any treatment.

Another source of information on treatment would be found on the SDS on file for the chemical. However, inconsistency in the treatment prescribed does occur depending upon the source of the SDS. As well, the treatment prescribed may not be consistent with that prescribed by the Poison and Drug Information Service. Note that the former standard procedure to have the victim drink plenty of milk or water is no longer recommended.

Burns

Treatment of minor burns is basically a three-step process. Cool the burned area for about 15 minutes by running cool water over it, immersing it in cool water, or cooling with a cold compress. Do not use ice for this time period as this may freeze the area of treatment. Loosely wrap the burned area with a sterile gauze bandage, avoiding excess pressure on the burned skin. If the burn is severe, cool the area as described above, wrap loosely with a moist dressing, and transport the person to a hospital for medical assistance. If in doubt, seek medical assessment and/or treatment.

Burning Clothing

Rapid action in extinguishing burning clothing is critical to minimizing exposure and minimizing harm that may result.

Several approaches are used, and your local fire department or school authority policy may recommend one of these as the preferred response. The “Stop, Drop, and Roll” method is commonly recommended by fire departments.

In conjunction with this technique, other heavy clothing or a fire blanket may be used to smother the flames. Fire blankets are not a Fire Code requirement and are not recommended by all fire departments. If a blanket is used, it must be removed immediately after the fire is out to minimize trapping of heat and sparks against the victim’s skin.

Other options for extinguishing burning clothes include using an ABC dry-chemical fire extinguisher, spraying the victim with water, or using an emergency shower, if available.

Selection of any one of these options may be circumstantial; the use of the fire extinguisher, for example, may not be practical from a safety perspective if the fire is near the facial area and chemical spray will get into the victim’s eyes.

Once the fire is extinguished, loose clothing can be removed, if necessary, but any clothing adhering to the burned skin should not be removed. After the fire is out, follow the procedures for responding to burns.

Shock and Fainting

Lay the person down if they are in shock, and elevate the feet higher than the head. Loosen tight clothing, cover the person with a blanket, assess or monitor the person, and talk to them reassuringly. Do not give them anything to drink.

If the person has fainted, place them in the recovery position; i.e., on their side with the head tilted back to keep the airway open. Ensure that the airway is clear and that the person is breathing.

Make the head comfortable, cover the person with a blanket, and leave them lying down.

If there is a chance of injury due to the collapse, avoid moving the person if they are breathing until you can communicate with the person to confirm no injury was sustained.

On the other hand, if the airway is blocked and/or the victim is not breathing, the head may have to be tilted back or the victim may have to be laid on their back to begin artificial resuscitation or CPR. If other injuries are present or any symptoms persist, seek emergency medical assessment and/or treatment.

If the casualty must be left alone, always place the victim in the recovery position, and ensure the airway is open.

Inhalation of Toxic Fumes

Move the victim into fresh air and contact the Alberta Health Services Poison and Drug Information Service at 1–800–332–1414 for information on treatment of the victim.

If available on site, summon trained personnel who can administer oxygen and other medical procedures, as necessary. In severe cases, seek further medical treatment at a hospital.

Other Medical Emergencies

Being prepared to deal effectively with emergencies involving serious existing medical conditions such as asthma, anaphylactic shock, diabetes, or epilepsy requires open communication between school administration, counsellors, and parents. Teachers need to know if students have these conditions, as well as what to look for and what to do if the student becomes symptomatic. Basic training could be provided to assist teachers in dealing with, for example, seizures or insulin shock. If in doubt, seek medical assessment and/or treatment.

Incident Reporting

An *incident* is an undesired event that results in or may have resulted in harm to individuals, property, or the environment. The term *incident* is preferable to *accident* because *accident* comes with the connotation that an event could not have been predicted or prevented. An *incident* acknowledges that something "happened," which may have been prevented. Even though some legislation still uses the term *accident*, for the purposes of this document the term *incident* will be used.

For more information about incidents and broader information related to health and safety, see the Occupational Health and Safety Resource Portal at https://ohs-pubstore.labour.alberta.ca/#educators.

When an incident occurs, the first concern is the injured. Priority can then be placed on systematic investigation and proper reporting of the incident.

By law, certain work-related injuries and incidents must be reported as soon as possible to Alberta Occupational Health and Safety. Section 40 of the Occupational Health and Safety Act, SA 2017, c. O-2.1 requires employers to

- report certain incidents, including any injury or incident that results in a fatality or in a worker being admitted to hospital;
- report any unplanned or uncontrolled explosion, fire, or flood that causes (or could cause) a serious injury; and
- conduct an investigation whenever a serious injury or incident occurs, and prepare a report that is available for inspection.

Incidents involving workers that fall under the jurisdiction of the Workers' Compensation Act must also be reported to the Workers' Compensation Board within 72 hours of the incident. The Workers' Compensation Act applies to laboratory aides and technicians but not science teachers. (The act does, however, apply to some teachers in other subject areas, such as Career and Technology Studies courses. Principals and assistant principals also fall under the act if injured while involved in non-teaching activities.)

Students do not fall under the Workers' Compensation Act in the science classroom. (Again, there are exceptions for some students, including those taking off-campus education programs.) The Workers' Compensation Act requires both the employer and the employee to report injuries that result in the loss of at least one full day's work and all injuries that require medical aid.

Both Occupational Health and Safety and the Workers' Compensation Board may choose to investigate the incident.

Schools can improve safety and show compliance with incident reporting requirements by ensuring that

- all incidents and injuries are recorded, reported, and investigated, as appropriate;
- staff know when and how to report incidents, including where to access reporting forms and instructions;
- staff know what kinds of incidents will be investigated;
- staff receive appropriate orientation and training and understand their responsibilities;
- all required information is gathered and provided by supervisors for staff compensation claims;
- general pre-planning has been done regarding incident investigation and reporting;

- the underlying causes of incidents are determined; and
- measures are taken to prevent incidents from reoccurring.

See Appendix E for a sample Incident Report Form. This sample shows the type of information that is required in an incident report, as well as who is required to complete the report.

Near-miss Reporting

A near-miss is an event that could, but does not, result in an incident.

Like incidents, near-misses are caused by unsafe acts or conditions. Examples of unsafe acts include handling of materials by someone without proper training and failure to use personal protective equipment, such as safety goggles. Examples of unsafe conditions include poor lighting, excessive noise, and poor housekeeping.

Documentation of near-miss situations, although not required by law, should be done internally and the information on the situations should be shared with colleagues. In this way, near-miss reporting is a proactive means of improving safety awareness, identifying and tracking potential hazards, and ultimately preventing incidents.

Whenever a near-miss is recorded, it is important to identify, as far as possible, the unsafe acts and conditions that contributed to the near-miss. Actions can then be taken to reduce the risk of a similar event occurring in the future.

Additionally, the collection of such information can help senior staff evaluate the safety program because incident control theory states that as near-misses increase, the risk of a major incident also increases.

Chapter 3: Facility Design and Safety Equipment

Overview

As the previous chapters have shown, many laws and regulations govern safety in science classrooms. Some of these relate to how we do things—the plans we put in place and the procedures we use. Others relate to the physical environment—the design of the facility and the safety supplies kept in that facility. This chapter outlines guidelines and rules surrounding facility design and safety equipment.

Assessing the Suitability of Facilities for Science

The selection and planning of science activities must take into account the strengths and limitations of available facilities. Although some introductory activities do not impose any facility requirements, many others—particularly at the secondary level—require some minimal facility characteristics; e.g., flat-topped surfaces are needed for activities with containers of liquids. For some activities, the use of purpose-built laboratory facilities is a practical necessity.

When deciding whether a given facility is adequate to the needs, consider the following factors:

- Does the facility have flat-topped surfaces? How much flat-topped surface will the class need?
- Does the facility have sinks? How many will the class need? Is the number sufficient for cleanup and emergency flushing?
- How many students are in the class, and how much space does the activity require? Keep in mind that overcrowding increases risks.
- How is the facility configured? Does it allow the teacher to see all the students? Does it provide easy passage from one area to another without risk of bumping into one another?
- Does the facility have appropriate emergency-response equipment; e.g., an eyewash station, a shower, a first aid kit, a fire extinguisher?
- Does the facility have sufficient storage and/or adjacent preparation areas that minimize the need to transport equipment and supplies through the school? Are the storage and preparation areas lockable?

- Does the facility have adequate ventilation?
- Does the facility have a functioning fume hood that can be used in teacher demonstrations?

In planning for science activities, teachers should also be aware of any local standards that may have been established. For example, in some cases, a school or school authority may determine the maximum number of students for a given facility and/or the number of students under the guidance of one teacher in that facility.

Facility Checklist

The following checklist is adapted from *Science and Safety, Making the Connection* (Council of State Science Supervisors, 2000). This is not an exhaustive checklist and is only intended to address the needs of science laboratories for grades 7 to 12.

Layout and Space

- ❒ The room has adequate space. See pages 14–15 of Chapter 1 for specific details of the Alberta Fire Code, 2014, requirements.
- ❒ Aisle width is adequate to accommodate equipment and students with physical disabilities (1.2 to 1.5 m).
- ❒ Workspace per student is adequate (1.5 to 2.0 m width of workspace per student, depending on the activity) and, where necessary, meets the design requirements of Section 3.8.3.14 of the Alberta Building Code, 2014.
- ❒ The teacher can see students in all locations of the room.
- ❒ The general light level is sufficient (538.2 to 1076.4 lm/m^2, with diffuse lighting preferred).

Safety Equipment

- ❒ A telephone or intercom is available in case of emergencies.

- ❒ Fire detectors and heat detectors are installed in laboratories, science preparation rooms, chemical storage areas, waste disposal areas, and any other high-risk areas.

- ❒ At least one emergency eyewash station must be located in areas where corrosive chemicals are used, according to Occupational Health and Safety requirements for workers. The Alberta Occupational Health and Safety Code does not reference any particular standard for the design or placement of emergency eyewash stations; however, the ISEA/ANSI Standard Z358.1-2004 is referenced within the published Explanation Guide to the Code.

  An emergency eyewash station is defined as one that provides a continuous flushing fluid to both eyes at a minimum of 1.5 L/min for 15 min. It can be plumbed in or portable. Portable bottles (squeeze bottles) do not meet this standard. Squeeze bottles, however, are also to be made available for all activities where there is risk of materials entering the eye.

  See the Safety Equipment and Supplies section in this chapter for information on maintenance of eyewash stations.

Exits

- ❒ The room has two exits, both with doors that open outward and have reinforced glass viewing windows or peepholes.

- ❒ Doors open easily and do not require a key to exit.

- ❒ Doorway widths are sufficient to accommodate students with physical disabilities, allow movement of equipment carts, and serve as emergency exits.

Construction Materials

- ❒ Ceilings are constructed out of a material with a low flame-spread rating; e.g., drywall.

- ❒ Floors are even, free of cracks, and have a non-skid surface (sheet flooring is preferable to tiles or carpets; tile floors should be covered with a non-skid wax).

- ❒ Laboratory bench surfaces are made of material resistant to acids, alkalis, solvents, and heat. Measures should be taken to prevent mechanical damage to laboratory bench surfaces that contain asbestos.

Ventilation

- ❒ Air in the room is recycled and mixed with outside air at a rate of 4 to 12 complete laboratory air changes per hour, depending on the type or amount of chemicals used, or a minimum of 15 L/s per occupant.

- ❒ The exhaust ventilation system is separate from that of the chemical fume hood.

- ❒ The hood(s) of the exhaust ventilation system is/are located away from doorways, windows, high-traffic areas, or areas with disrupted airflow.

- ❒ Installation of chemical fume hoods in science rooms, although not required by the Alberta Building Code, 2014, is recommended for senior high school chemistry laboratories and rooms where chemicals are prepared. Where fume hoods exist, the functional and maintenance standards that apply are those of the American National Standards Institute (ANSI/AIHA Z9.5-2012 Standard for Laboratory Ventilation; ANSI/ASHRAE 110-1995 Method of Testing Performance of Laboratory Fume Hoods). These include an average face velocity of at least 0.5 m/s and all individual face velocity readings above 0.43 m/s. Exhaust is vented to the outside wall or roof vent. For more details on fume hoods, see the Safety Equipment and Supplies section that appears later in this chapter.

Electrical

- ❒ There are sufficient electrical outlets (i.e., located at intervals of 2 to 2.5 m) to make extension cords unnecessary, and all power outlets meet Alberta Building Code, 2014, standards. Where hot plates will typically be in use, it is recommended that each 15 A circuit be restricted to two double plug-in outlets to prevent overload and tripping of breakers during times of maximum usage.

- ❒ Outlets within 1.5 m of water are equipped with ground-fault interrupters.

- ❒ Fume hood controls are located outside the fume hood in an immediately accessible area.

Plumbing

- ❒ Plumbing is free of leaks or cracks, and drains are made of chemical-resistant material.

- ❒ Countertops are lipped toward the sink.

- ❒ A plumbed-in emergency eyewash station and/or shower is/are provided in laboratories where corrosive chemicals are used. The preferred location of the shower is in an adjacent nook that is equipped with a wastewater holding receptacle rather than direct drainage into a sewage system.

- ❒ Water taps may be located inside the fume hood cabinet if there is a main shut-off valve in another area of the laboratory.

Storage and Preparation Facilities

- ❒ The chemical storage and waste area is adequate in size, well ventilated, secured from student access, and built with material having a low flame-spread rating, and it has an adequate drain at the lowest point. See Chapter 8 for more specific guidelines.

- ❒ There is adequate area for the long-term storage of laboratory equipment, supplies, and safety equipment.

- ❒ There is a preparation area, including bench space, sink, and fume hood, for making solutions and other materials for class use. It should also allow for storage of SDSs as well as WHMIS and TDG information.

- ❒ There is an area for temporary storage of materials for later use, leftover materials from laboratory activities, and chemical waste storage for year-end disposal.

- ❒ Adequate refrigeration is available for storing fresh tissue/organs, enzymes, specific chemicals, agar plates, and perishables.

Other Resources

Additional equipment, as indicated below, may in some situations help ensure that safe and efficient procedures are followed:

- ❒ computer to track school equipment and chemical inventories and to access Internet information; e.g., regulations, SDSs;

- ❒ microwave to prepare materials such as gelatin and agar; and

- ❒ dishwasher to clean equipment, reducing the risk of injuries from broken glass and chemical exposure.

Safety Equipment and Supplies

Having the proper safety equipment and supplies in place in science areas of a school is critical to managing risks and dealing with emergencies that may arise. This section discusses essential safety equipment and some basic procedures for using these resources.

General Safety Equipment for Science Classrooms

With the exception of the fire blanket, this list identifies general safety equipment that is either essential or highly recommended in the science area of the school. Safety can be further enhanced by making sure teachers, students, and technicians are familiar with the location and use of this equipment, that the equipment is easily accessible, and that safety posters are displayed.

Equipment	Comments
ABC-type dry chemical fire extinguisher	A 2.5 kg to 5 kg (5 lb to 10 lb) Type 2, ABC extinguisher is recommended by the Alberta Fire Code, 2014, for laboratories. A Type 4, ABC extinguisher is recommended for chemical storage areas. Note that the number in the extinguisher type refers to its volume capacity and the letters identify the class of fire(s) that can be put out. Refer to the Fire Extinguishers section later in this chapter for Fire Code specifications regarding the location of extinguishers. After use, the extinguisher will require service. Demonstrations should not be done with this extinguisher; a spare extinguisher may be reserved for that purpose.
First aid kit	The Occupational Health and Safety Code, AR 87/2009 (with amendments in force as of June 1, 2018) specifies content requirements for first aid kits, based on the number of workers at a site, the hazard level of the work, and the location of the work site relative to a first aid location (Occupational Health and Safety Code, Schedule 2, Table 3).
First aid rooms	While not specific to the science classroom, requirements for a first aid room that meet the needs of Schedule 2, Table 4 of the Alberta Occupational Health and Safety Code must be reviewed to ensure compliance.

Equipment	Comments
Eyewash station, emergency and personal (squeeze bottle)	Eyewash stations should meet American National Standards Institute (ANSI) ISEA/ANSI Standard Z358.1-2004. An emergency eyewash station is required in areas where corrosive chemicals are used. See the Facility Checklist section in this chapter for more detail. The water supply must be tempered by mixing hot and cold water (20–25°C), and once activated must run hands-free. All emergency eyewash stations, whether fixed or portable, require routine maintenance to ensure proper functioning and cleanliness. This requires that they be tested regularly to verify that they are operating properly. Such testing also prevents growth of microbes in stagnant residual water and flushes out any dirt, rust, or pipe scale that may be present. In areas with hard water, keeping a plumbed-in system operable is a major challenge. Two options that should be investigated to reduce rapid and frequent corrosion of the system is the use of a water softener or the attachment of the system to its own supply of distilled or buffered water, which can be replenished as required. In some situations, the most practical solution may be to purchase a portable emergency eyewash unit with its own water supply. Where portable eyewash squeeze bottles are provided, the bottles are filled with a buffered solution supplied by the manufacturer and changed regularly as per the manufacturer's instructions. Also available for purchase is a buffered saline solution preserved with a suitable antibacterial agent. The antibacterial agent prolongs the shelf life of the bottle contents, and the buffered saline solution is less irritating to the eyes than water out of the tap.
Handwashing facilities	Handwashing facilities should be available in or near each science classroom.
Emergency shower (if certain chemicals are used)	If large amounts of caustic or flammable stock are used, a deluge shower is required, as specified on the chemical's SDS. If diluted caustics or small amounts of flammable stock are used, a hand-held, telephone-style shower is sufficient.

Equipment	Comments
Fume hood (if chemicals are used)	A fume hood is strongly recommended for science preparation rooms in junior and senior high schools. The inclusion of a fume hood in senior high school chemistry laboratories is also recommended. In junior high, science programs and textbook resources do not call for chemicals requiring the use of a fume hood. Fume hoods should meet ANSI specifications (ANSI/AIHA Z9.5-2012 Standard for Laboratory Ventilation; ANSI/ASHRAE 110-1995 Method of Testing Performance of Laboratory Fume Hoods) and must be inspected at least once a year by a qualified person. Fume hoods are invaluable to minimize inhalation of vapour and airborne powder when dispensing volatile liquids and more toxic powdered chemicals. In senior high school chemistry, they also become useful when performing reactions that generate toxic vapours.
Ultraviolet goggle sterilizing cabinet	A sterilizing cabinet is recommended in junior and senior high schools (one cabinet can serve several classrooms). The cabinet should have interlocking doors. A cabinet is not needed if each student has their own goggles or if other methods of sterilization, e.g., disinfectant solution, are used.
Discretionary ★ Fire blankets (Not a Fire Code requirement)	★ Fire blankets are not recommended by all fire inspectors and require proper usage to avoid further damage to burned skin. Check with your local fire marshal for more details. Blankets containing asbestos must be removed from the school.

Personal Protective Equipment

The following list identifies personal protective equipment that should be present in every classroom that is used as a science laboratory. If injuries to students result from the failure to have or use personal protective equipment, negligence may be claimed. Appropriate safety equipment should be identified by the teacher for use during each laboratory activity as part of a routine with students prior to doing the laboratory activity. Refer to Student Safety Training in Chapter 4 for more information on the use of personal protective equipment.

Equipment	Comments
Protective eyewear	Eye protection should be CSA approved (CSA Standard Z94.3-07 R2014) and must be worn whenever there is the risk of eye injury beyond what would be protected by safety glasses or normal prescription glasses. Goggles should be designed to completely enclose the eye area (CSA Class 2B). If glasses are normally worn, goggles should fit over them. Protective equipment should be splash proof if used for chemistry. Some facility or procedure for sterilizing goggles after use is strongly recommended if goggles are shared. Face shields should be able to be adequately fitted to the user's head and must meet the requirements of CSA Class 6A. Information on the selection of appropriate safety goggles or face protectors can be accessed from the Government of Canada, Canadian Centre for Occupational Health and Safety (CCOHS) website at http://www.ccohs.ca/oshanswers/prevention/ppe/.
Laboratory coats or aprons	Laboratory coats and aprons should be made of approved material only, and should be worn when working with chemicals and when appropriate in other science activities; e.g., biology. Coats are preferable to aprons.
Sleeve protectors	Sleeve protectors should be worn when required.
Non-latex disposable gloves (neoprene, nitrile, or tactylon)	Gloves should be worn when handling hazardous chemicals and in biological experiments. Gloves should be used in combination with other measures because gloves may only slow down transmission of some materials, not completely prevent it. Note that some students and staff may have latex allergies; the use of latex gloves is not recommended.
Heat-/Cold-resistant gloves	Gloves for heat should be made of treated texture silica or woven fabric. Do not use asbestos gloves. Cryogenic gloves should be used if handling liquid nitrogen.

Equipment	Comments
Beaker tongs	Use tongs with heat-resistant gloves when handling very hot equipment.
UV-filtering glasses	Eye protection should be worn when UV sources are in use; e.g., discharge tubes, mercury or ion arcs, lamps for fluorescent "black light" experiments. Appropriate glasses include Shields sunglasses or any glasses labelled "Blocks 99% or 100% of UV rays," "UV absorption up to 400 mm," "Special Purpose," "BS," or "Meets ANSI UV requirements."

Fire Extinguishers

The Alberta Fire Code indicates that the number and location of fire extinguishers should be governed by factors such as floor space, hazard levels, and the physical design of the building. The Alberta Fire Code requires that a fire extinguisher be located in strategic sites along corridors. It also requires that a fire extinguisher be placed in either the chemical storage room or just outside this room, and recommends one in both locations, given the increased hazard level in the area. Extinguishers are also required to be placed so as to be accessible without the user being put at undue risk (i.e., the user must not have to cross through the fire to reach the extinguisher). Although not compulsory, placement of a fire extinguisher in every laboratory is recommended.

In general, the initial selection and placement of fire extinguishers in schools is determined by design engineers prior to construction of a school. This is done in accordance with the Alberta Fire Code as well as the National Fire Protection Association (NFPA10) regulations. Schools contemplating renovations, placing additional extinguishers, or changing placement of existing units can contact Alberta Municipal Affairs, Safety Services Branch for more information: 1–866–421–6929.

The following chart shows fire extinguisher types that may be appropriate for use in schools (the type will be identified on an inspection label on the unit). ABC extinguishers are recommended (an Alberta Fire Code recommendation) for all school locations because they do not require the user to classify the fire and select the appropriate extinguisher, and only one operational procedure must be learned and remembered.

Type	Extinguishing agent	Use
Class A	Water	Fires involving ordinary combustible materials such as wood, cloths, or paper.
Class B	Dry chemical foam, carbon dioxide	Fires involving flammable liquids, such as solvents, grease, gasoline, or oil, and fires involving ordinary combustible materials.
Class C	Dry chemical and carbon dioxide	Fires involving electrical equipment.
Class D	Special dry powder medium or dry sand	Fires involving combustible metals, magnesium, sodium, lithium, or powdered zinc.
Class ABC	Dry chemical	All materials and fire types.
Class K	Alkaline mixture type	Fires involving combustible cooking materials (animal or vegetable fats), generally in kitchens.

Schools can maximize the value of fire extinguishers by

- placing extinguishers near an escape route, not in a “dead end” location;
- ensuring all teachers and support staff working in the science area know the location of all fire extinguishers and understand when and how to use the kinds of fire extinguishers installed on site;
- having fire extinguishers inspected once a year by the local fire department or an approved agency, with inspection records kept by the principal or school authority administrator;
- placing fire extinguishers in such a way as to be easily reached if a fire occurs (i.e., not being blocked by the fire); and
- having fire extinguishers inspected by staff (at a minimum once per month) to ensure that the pressure is still in the green and there are no signs of corrosion and ensuring the inspection is recorded (there is typically a tag on the extinguisher that can be marked).

There are also specific requirements for mounting height and identification under NFPA 10 that must take into account a barrier-free environment.

First Aid Kits

First aid kits are required by schools under the Occupational Health and Safety Code. The contents of first aid kits are standardized and referred to by the number "1," "2," or "3" or "Type P." Schools occupied by 100 persons or more are required to have a Number 3 first aid kit on hand at a central location that is designated as an access point for first aid services. In addition to maintaining a Number 3 first aid kit in one central location, schools will normally maintain additional kits at or near facilities where activities may pose particular risks. To meet the needs of science laboratories, the recommended approach is to stock a Number 1 kit in each laboratory or at a location readily accessible to several laboratories.

For further information on Code requirements and guidelines, see Part 11 of the Occupational Health and Safety Code Explanation Guide at http://work.alberta.ca/occupational-health-safety/ohs-code-explanation-guide.html. Note that the guide designates schools as "medium" hazard sites.

Kits are available from St. John Ambulance, Canadian Red Cross, and most safety or science supply companies. Number 1 kits are available as fanny packs that are suitable for use on field trips.

For field trips, the Occupational Health and Safety Code specifies a Number 1 first aid kit (fanny pack) along with one certified first aider. The first aider does not necessarily have to be a field trip supervisor, but can be a trained employee at the field trip site. However, as part of their safety policy, school authorities may require that a risk assessment be done prior to the field trip to determine what first aid equipment should be taken and what number of first aiders should go along if there are increased levels of risk. For example, for groups above 9 in total, a Number 2 first aid kit will likely be more appropriate (even if not required by Code as students are not workers) based on needed supplies.

The contents of first aid kits should be checked and replenished regularly. The kit container should be clearly marked and readily accessible, and should keep the contents dry and free of dust.

The contents of a Number 1 kit include the following:

10	antiseptic cleansing towelettes, individually packaged
25	sterile adhesive dressings, individually packaged
10	10 cm x 10 cm sterile gauze pads, individually packaged
2	10 cm x 10 cm sterile compress dressings, with ties, individually packaged
2	15 cm x 15 cm sterile compress dressings, with ties, individually packaged
2	7.5 cm conform gauze bandages
1	7.5 cm crepe tension bandage
3	cotton triangular bandages, minimum length of base 1.25 m
1	2.5 cm x 4.5 m adhesive tape
5	safety pins, assorted sizes

1 pair of scissors
1 pair of tweezers
1 artificial resuscitation barrier device with a one-way valve
4 pairs of disposable non-latex gloves (nitrile recommended)
1 first aid instruction manual (condensed)
1 inventory of kit
1 waterproof waste bag

Equipment for Cleanup and Disposal of Chemical Spills

The following list identifies items to keep in the laboratory in a clearly identified and accessible location for cleanup and disposal of spills. See Chapter 7 for cleanup and disposal procedures for different kinds of chemical spills.

Equipment	Comments
Acid, base, and solvent spill kits	Spill kits are used for absorbing spills or diluting solutions of chemicals. Use these kits for cleanup of small spills (follow manufacturer's instructions).
Hazorb spill control pillows	Pillows are used to absorb spilled liquids (follow manufacturer's instructions).
Several litres of asbestos-free vermiculite, bentonite, or diatomaceous earth in container with scoop	These materials can be used for spills of solid chemicals, especially powders, and viscous or sticky liquids. Containers should be clearly labelled and contents disposed of safely.
Containers suitable for waste chemicals and solvents	Each chemical must be collected separately and labelled according to WHMIS specifications. Waste solvents should be collected only in a safety disposal can with an automatic pressure-release closure.
Waste container for glass and sharp objects	A separate container for these items reduces the chance of injury to maintenance and janitorial staff responsible for normal garbage disposal.
Large container of dry $NaHCO_3$ (baking soda)	Baking soda can be used to neutralize strong acids before disposal.
Plastic dustpan and brush	Use the dustpan and brush for sweeping up used sand, vermiculite, or broken glass. Wash and dry both thoroughly after use.

Equipment	Comments
45-cm long chemical-resistant gloves	Gloves should be worn whenever dealing with spills, especially when broken glass is involved. Gloves are usually included with spill kits.
Heavy-duty garbage bags	For disposal of all solid waste, including used sand, vermiculite, and contaminated broken glass. Dispose of each spill separately. Tie bags very securely, double bag if necessary, and label for disposal.
Biohazard bags or extra thick garbage bags	For disposal of biological specimens and cultures.
Respirator	For pickup of certain spilled chemicals, as noted on SDS sheets. Schools offering science programs in grades 9 to 12 should have at least one respirator per preparation room or department. The use of respiratory protection must be accompanied by a respiratory protection program, including fit testing and training, among other provisions. Reference CSA standard Z94.4 for more details.

Generic Spill Kit

A simple, generic spill-kit mixture can be made by mixing equal volumes of sodium carbonate, bentonite (clay cat litter), and dry sand in a plastic container with a lid. Shake the container until the components are mixed. The contents can be mixed again just prior to use when cleaning up a chemical spill. This mixture is effective in the cleanup of the majority of spills. See Managing the Release or Spill of Toxic or Corrosive Substances in Chapter 7 for more information on use.

Monitoring and Assessment

Ongoing monitoring and assessment are important steps in maintaining and improving the condition of science facilities, equipment, and materials. Regular performance of these activities supports a proactive approach to repairs and maintenance, which in turn reduces risks for incidents. Monitoring and assessment activities can take place through periodic inventory of equipment and materials and the completion of laboratory checklists such as the one provided in Appendix D.

Chapter 4: Risk Management

Overview

All activities involve potential risks. In order to manage risks, teachers need to evaluate the risks involved in each potential activity and make prudent choices in the selection and development of those activities. The selection of an experiment or demonstration should take into account what that activity will achieve, what potential hazards it involves, and how to control or minimize these hazards. Risk management also means ensuring that staff have the proper safety education and training, including WHMIS and TDG training, and teach safe attitudes and behaviours to students.

Risks

Inherent Risks

Inherent risks arise as the direct consequence of the particular materials and activities used. Most science activities involve some inherent risks. For example, an activity aimed at helping students learn about heat might require use of heat sources and heat-resistant containers, creating an underlying risk of burns and minor cuts. More serious risks are inherent in the use of particular chemicals, equipment, or procedures.

Before selecting materials and activities, it is important to consider ways to minimize inherent risks. For example, in planning an activity that requires elementary students to transfer liquids from one container to another, teachers can avoid the inherent risk of cuts caused by broken glassware by opting instead to use plastic containers. Similarly, a teacher could minimize inherent risks in an activity involving the handling of acid solutions by preparing the solutions in advance, rather than having students prepare them as part of the activity. Decisions such as these should also take into account the learning outcomes, the grade level, and the skill level of students.

Situational Risks

Situational risks arise from the context in which the materials and procedures are used. For example, if heat sources are used in a crowded workspace, the situation of crowding creates an additional risk of burns. If situational risks are not considered, an activity that has low inherent risk can grow into a high-risk situation. Risk assessment and hazard evaluation can be aided by using various commercial applications or online programs.

Situational risks can be minimized by ensuring that

- hazards are assessed prior to commencement of laboratory activities;
- teacher and students are aware of inherent risks involved in an activity;
- teacher and students understand and are able to carry out appropriate procedures;
- steps are taken to minimize potential distractions or disruptions;
- workspaces are adequately sized and well organized; and
- sufficient supervision and guidance are provided at all times.

The most effective way to minimize situational risks is through a collaborative effort among teachers, aides, and students. Teachers thus need to enlist students in planning for safety and in establishing safe classroom procedures. This strategy for risk minimization can be supported by involving students in activities such as the following:

- identifying risks;
- developing class lists of required and prohibited laboratory activities;
- creating posters that show appropriate and inappropriate activities; and
- developing a safety contract for students to sign at the beginning of the school year.

Choosing Science Activities

Safety is a primary concern in selecting activities for science classes. Factors to consider before proceeding with a science activity include

- potential hazards (both inherent and situational risks);
- the knowledge, skills, and maturity of the students;
- the experience and expertise of the teacher; and
- the equipment and facilities available to safely carry out the activity.

Inherent risks increase dramatically with the use of materials that are highly toxic, corrosive, or flammable. The selection of materials can thus help minimize risks. Even highly qualified teachers need to assess the risks of different alternatives and select the one that presents the fewest hazards for students—even though another choice might produce a more spectacular result. Alternatively, an activity might be carried out as a demonstration by a teacher with appropriate safety precautions in place. A further alternative may be to access videos online. Although this may take away from the drama of a live demonstration, it effectively communicates what students need to know and understand.

In addition, many of the approaches described in Chapter 8, under the heading Strategies for Minimizing Hazardous Waste Production, are excellent ways to reduce safety risks. These strategies include microscale experiments, dispensing premeasured quantities of chemicals, and using laboratory stations.

Teachers should also be aware of Part 1, Section 14(1) of the Occupational Health and Safety Regulation, AR 62/2003 (with amendments up to and including Alberta Regulation 51/2018), which specifies that "A worker who is not competent to perform work that may endanger the worker or others must not perform the work except under the direct supervision of a worker who is competent to perform the work." This clause places an onus on teachers to evaluate their own competence in choosing activities that they will carry out. The clause could also be the basis for a substitute or regular teacher to refuse an assignment that requires them to carry out specific tasks in which they are not competent, and it could be a consideration in tasks that are assigned to, and accepted by, a science aide or science technician.

Field Trips

Field trips are a valuable addition to any science program, giving students the opportunity to explore applications of science and to investigate living things in their environment. Potential hazards associated with off-site excursions depend on the nature of the trip and the site visited, but in general the possibility of incidents can be reduced if the field trip is well planned and organized. Field trip planning should be guided by the school authority's field trip policy, which will often identify standards in such areas as supervision and first aid preparation. Planning for adequate supervision should take into account the age and number of students, the number and capabilities of staff and aides, the kinds of hazards present at the site, and the types of activities to be carried out.

Transportation is a further element of field trip planning. Local policy should be reviewed to determine what modes of transportation are considered acceptable and what guidelines apply. For example, there may be local guidelines on the use of parent-supplied transport.

Preparations for field trip safety should also include briefing students on safe and unsafe activities.

Museum, Zoo, or Industrial Site

The two primary concerns for these kinds of trips are safe transportation and adequate supervision. Be aware of any on-site hazards, if these exist, and make students and supervisors aware of them prior to the trip. Also ensure that a first aid kit and someone who can provide first aid (certified first aider) is available on site at all times. In many cases, this may be available at the site to be visited, but if in doubt this should be included in trip preparation. Note that there may be additional safety requirements in order to gain access to industrial sites.

Nature Site

Field trips outdoors present their own set of challenges because students are exposed to the weather, physical hazards, and local organisms. Taking the following precautions can reduce risks.

- Be thoroughly familiar with the site and any potential hazards. Visit the site prior to the field trip if necessary.
- Provide students with a map of the site, identifying the specific locations to be visited, the routes by which they will get there, and the potential hazards.
- Specify the clothing and footwear to be worn. Requirements for long sleeves and pants should be made if there is a potential for exposure to ticks.
- Indicate special requirements, such as insect repellant during breeding of biting insects like mosquitoes.
- Use appropriate precautions and equipment if working on or near water; e.g., whistles, life jackets, throw line, “buddy” system.
- Ensure supervisors are located so that all students have an adult relatively nearby at all times.
- Have a first aid kit and someone who can provide first aid on site at all times.
- Maintain access to a vehicle at all times in case of an emergency.
- Carry a cellphone to access emergency services and information.

For more information on biology field trips, see Chapter 5.

Safety Awareness and Education

Safety awareness and education is a responsibility at all levels of educational planning. All staff should be aware of hazardous materials and procedures used in their working environment, and have the knowledge and skill needed to eliminate or minimize risks to themselves and to others. As employers, school authorities have responsibility to ensure that school staff have this knowledge and skill—a responsibility that also falls on each employee. As overseers of school programs and school environments, school authorities also have responsibility for ensuring that students develop the knowledge, skills, and attitudes they need to support their own safety and the safety of others. With appropriate safety education, all staff and students will be able to act responsibly, follow appropriate safety procedures to avoid hazards and injury, and deal appropriately with injury or incidents if they occur.

WHMIS

As described in Chapter 1, the Workplace Hazardous Materials Information System (WHMIS) is designed to identify and minimize risks for human health and safety. Under federal and provincial legislation, people in every workplace have the right and responsibility to know whether materials they are working with are hazardous, the nature of the hazard, and what safety measures to take. Although students are not specifically referred to in WHMIS, except in the case of registered apprenticeship or work experience programs, their presence in the school workplace suggests that a level of care be provided consistent with WHMIS standards. This implies making students aware of any potentially hazardous materials in areas accessible to them and providing training in the safety skills needed to use these materials. The safest and most practical approach is to manage the environment so that student access to these materials is limited to times of teacher supervision.

Science teachers and other school staff who work with potentially hazardous materials must be WHMIS trained. According to the Alberta Occupational Health and Safety Code, AR 87/2009 (with amendments in force as of June 1, 2018), Part 29, Section 397, the employer must provide training to the worker in

- the content required to be on a supplier label and a work site label and the purpose and significance of the information on the label;
- the content required to be on a Safety Data Sheet and the purpose and significance of the information on the Safety Data Sheet;
- procedures for safely storing, using, and handling the hazardous product;
- if applicable, the procedures for safely manufacturing the hazardous product;
- if applicable, the methods of identification referred to in section 402;

- the procedures to be followed if there are fugitive emissions; and
- the procedures to be followed in case of an emergency involving the hazardous product.

This training must be generic, as well as product- and site-specific, so that staff know, among other things, what hazardous materials they will encounter in their work location, where the hazardous materials and safety equipment are located, and where the SDSs are located. Since the site-specific component of WHMIS training differs from school to school, science teachers who move to a new school should go through a safety orientation that covers such detail without having to repeat the generic WHMIS training.

For more details on WHMIS training requirements and resources, refer to Part 29 of the Occupational Health and Safety Code and to other resources available through the Government of Alberta's Occupational Health and Safety Resource Portal (https://ohs-pubstore.labour.alberta.ca).

Another source of valuable information on WHMIS is WHMIS.org, Canada's National WHMIS Portal at http://whmis.org. Not only does the site provide information on changes to WHMIS legislation and the transition from WHMIS 1988 to WHMIS 2015, but it provides links to provincial and territorial information, as well as training and education materials from the Canadian Centre for Occupational Health and Safety (CCOHS) (http://www.ccohs.ca), such as free e-courses for workers and fact sheets. The fact sheets summarize key requirements of WHMIS 2015, including new hazard classes and categories, new pictograms, requirements for supplier labels and work site labels, and standards for Safety Data Sheets.

Staff Training

Considered in broader context, basic staff training should cover

- legislation that regulates or defines safety standards in the school, particularly Occupational Health and Safety, Environmental Protection, WHMIS, and TDG regulations;
- due diligence and staff responsibilities;
- school and/or school authority safety policies for science classrooms, laboratories, and field trips;
- safety equipment, location, and use;
- management of chemicals and control of chemical hazards: location and safe storage, classes, specific risks, safe use of hazardous products, and disposal of chemicals;

- location of SDSs and how to read them;
- response to spills and spill cleanup;
- response to incidents, including first aid procedures;
- incident and near-miss reporting procedures; and
- review of basic laboratory techniques and identification of inherent hazards. See Appendix H for examples of such techniques and their hazards.

Transportation of Dangerous Goods (TDG) Act and Regulations

The purpose of the TDG Act and Regulations is to protect the general public and the environment during the transportation of dangerous goods. The act and regulations require that anyone transporting, shipping, or receiving dangerous goods be trained and have their training certificate available for inspection. A training certificate is valid only for three years; after that time, the individual must be retrained and issued a new certificate. These requirements apply to anyone who

- offers dangerous goods for transport, such as a shipper at a chemical supply company;
- receives dangerous goods, such as the individual at a school who accepts delivery and signs the delivery docket or manifest;
- handles dangerous goods by loading or unloading materials; and
- drives a vehicle carrying dangerous goods.

Principals and administrators are responsible for ensuring that staff members who receive or ship dangerous goods are TDG trained and certified. Certified staff will know

- the classes of dangerous goods and associated hazards;
- the information that is required on shipping documents;
- what labels and markings are required on packages and containers;
- what placards must be shown on vehicles;
- what protective measures to adopt during transport;
- what responsibilities they have if they are the shipper, receiver, or transporter of the dangerous goods; and

- how and when to report incidents involving dangerous goods, especially those releases deemed dangerous occurrences.

Refer to Chapter 1 for more information on TDG regulations.

Environmental Protection and Enhancement Act and Local Bylaws

The Environmental Protection and Enhancement Act, RSA 2000, c. E-12 (EPEA) and its regulations outline a system to protect, improve, and ensure wise use of the environment. This provincial statute sets the standard on a broader regulatory level with regard to human environmental impact, whereas municipalities take responsibility for establishing specific guidelines and standards for waste management. Such standards are embedded in local bylaws, identifying prohibited or restricted materials and regulating where and what wastes may be disposed of via local landfill sites and the sewage system. For specific details about bylaws in your area, see the section on Bylaws in Chapter 1.

One way that principals and administrators can ensure compliance with EPEA regulations and local bylaws is by educating staff about these regulations and bylaws. With proper training, staff who handle chemicals will know

- how to ensure that chemicals are used, handled, and disposed of in an environmentally safe manner;
- what emergency and reporting procedures to follow if there is a major leak or spill requiring evacuation;
- how to confine the release and ensure prompt cleanup takes place to restore the environment to a satisfactory condition;
- what preventive and protective measures to use; and
- how to implement measures to minimize and/or recycle hazardous waste.

Refer to Chapter 1 for more information on the EPEA and local bylaws.

Use of Safety Equipment

Science teachers and support staff need to be familiar with the location, use, and limitations of all safety equipment in the science area. Such familiarity may require initial training and periodic refresher sessions if the teacher cannot demonstrate existing competence. Sharing this information with students will help them take appropriate action if the teacher is not immediately available in an emergency situation.

Safety and the Student

Part of the role of science educators is not only to ensure a safe learning environment but to instill in students an understanding of their own responsibilities in the science classroom. Learning about science includes learning to respect the materials being used, and this respect can be taught only by example. In this way, science teachers are role models, advocates, and practitioners of safety. Increasing students' awareness of safety issues in general, and their knowledge of safety practices specifically, is one of the most important ways to reduce situational risks.

Student Safety Training

Safety training is an integral part of learning laboratory techniques. Though infrequently put to the test, safety training is an excellent way of encouraging students to make safety a lifelong practice at home and in the workplace. As part of such training, general safety issues and student expectations would be addressed at the beginning of each course. These would be posted and periodically reviewed. See Appendix A for example science safety rules and procedures for students. More specific safety issues inherent in the activities would be discussed as part of the pre-activity instruction.

Safety expectations can be taught in a number of ways:

General Safety Practices

- Hand out written copies of good laboratory practices and review these with students throughout the term.
- Post lists of safe practices in appropriate areas and remind students of them on a regular basis.
- Model safe behaviour during all activities.

Specific Safety Concerns

- Review specific safety issues and procedures before each activity, including relevant WHMIS information, required personal protective equipment, and emergency response procedures in case of incidents.

Development of common expectations for student behaviours and procedures can be a helpful starting point in planning for safety training. By planning as a science team, and by sharing common lists of expectations and procedures, the science staff in a school can ensure consistency in their messages and avoid student confusion about what they may and may not do. See Appendix G for Suggested Science Department Safety Policies and Procedures.

Making safety an integral part of every course helps to reinforce its importance and conditions students to think about safety whenever they undertake any activity in the laboratory.

Developing Safety Awareness and Responsible Habits

One of the most important ways to promote safety in science classrooms is to increase students' awareness of safe practices and to help them develop responsible attitudes. Good laboratory practices can be broken down into three time periods.

Before Entering the Laboratory

- Confine long hair and loose clothing.
- Put on enclosed footwear.

While in the Laboratory

- Know the hazards of chemicals to be used.
- Understand response procedures in case of an incident; if unsure, ask the teacher or check the SDS information.
- Put on eye protection.
- Be aware of the location of emergency safety equipment, including, but not limited to, emergency eyewash stations, deluge showers, and fire extinguishers.
- Cover exposed areas of the body with chemical-resistant clothing (protective gloves, aprons or laboratory coats, and face shields) when using hazardous products.
- Behave responsibly and respect the safety of others at all times.
- Never work alone or unsupervised.
- Do not eat, drink, or keep food in the laboratory.
- Never pipette by mouth.
- Replace stoppers and caps of chemical containers immediately after use.
- Treat all substances as potentially hazardous.
- Work under a fume hood if using substances that produce a hazardous vapour or dust.
- Control for hazards by using personal protective equipment and following operating procedures.
- Where possible, use products that have the least amount of hazards (physical, biological, or chemical).

Prior to Leaving the Laboratory

- Dispose of hazardous wastes in specified containers or as instructed by the teacher.
- Turn off and put away all equipment, and clean all glassware.
- Wash hands thoroughly.

The more awareness students have of these issues, the greater chance they will develop safe and responsible habits of mind. See Appendix A: Example Science Safety Rules and Procedures for a more comprehensive list of Dos and Don'ts.

PART B: SPECIFIC HAZARDS

Chapter 5: Biological Hazards

Overview

While chemical hazards may be the most obvious safety concern in the science classroom, biology-related activities present their own risks. Potential biological hazards include pathogens in specimens or cultures and allergens in plants, animals, or the chemicals used to store specimens. This section discusses common biological hazards, suggests ways of reducing associated risks, and identifies official restrictions on biological materials in Alberta schools. For a more thorough overview of biosafety in schools, see *Biosafety in the Classroom*, developed by the Centre for Biosecurity, Public Health Agency of Canada, at https://training-formation.phac-aspc.gc.ca/course/index.php?categoryid=31.

Chemical Hazards in Biology Activities

Many activities in biology classes require the use of chemicals. As with any use of chemicals, incident prevention depends on assessing and minimizing risks related to the specific chemicals used. General steps for managing risks include

- choosing the chemicals with the least inherent hazards;
- being aware of potential dangers;
- instructing students in proper handling procedures and insisting that these procedures are followed; and
- using appropriate protective equipment.

See chapters 7 and 8 for more information on selecting, storing, and using chemicals.

Accidental Infections: Specimens and Cultures

The most frequent known causes of laboratory-acquired infections are oral aspiration through pipettes, animal bites or scratches, and contact with an animal. Other common causes include cuts or scratches from contaminated glassware, cuts from dissecting instruments, spilling or dropping cultures, and airborne contaminants entering the body through the respiratory tract.

Use of Human Tissue and Fluid Specimens

In September 1987, following a review of the potential means of transmitting hepatitis or HIV (human immunodeficiency virus), Alberta Education issued a directive prohibiting activities deemed to cause unwarranted risks. This directive continues to be in force. **All activities involving the extraction and analysis of samples of human fluid or tissue are prohibited in Alberta schools.** This directive is noted in Alberta Education's *Guide to Education* and is further described in the document *Clarification of Statements Prohibiting the Use of Human Body Substances in the Alberta Science Curriculum,* 1988.

This prohibition applies to all activities involving extraction of human tissue and fluid samples, including *cheek cells*, *blood*, *saliva*, and *urine*. Alternative materials that schools may want to consider in place of these samples include prepared slides and simulated urine and blood. These materials are available from scientific and educational suppliers. In some instances, other mammalian, amphibian, or reptilian sources may be substituted. There are also excellent videos, computer software, and website resources available on these topics.

Cultures

Most micro-organisms are not harmful to humans and can be safely cultured. However, culturing harmless micro-organisms still has the potential risk of unintended contamination by pathogenic forms that may be simultaneously introduced to the culture plate. Although the body can routinely destroy small numbers of these pathogenic forms, it may be overwhelmed by large numbers.

Teachers can reduce this risk by being aware of the hazards presented by infectious agents and their possible sources and by using proper handling, storage, and disposal techniques when working with cultures.

Some general practices to consider when culturing micro-organisms include the following:

- Do not intentionally culture anaerobic bacteria or pathogenic organisms. Pathogenic organisms can be bacteria, viruses, fungi, or protozoa. Examples of these include
  - bacteria that cause tuberculosis and pneumonia;
  - fungi that cause athlete's foot and ringworm; and
  - protozoa that cause giardiasis and amoebic dysentery.

- Select materials for study that reflect student and teacher skills and the needs of the curriculum.
  - At the elementary level, use only print and digital images of micro-organisms, not live specimens.

- At the junior high school level, use print and digital images, and where live specimens are to be used, select only micro-organisms that occur naturally on mouldy bread, cheese, or mildewed objects.

- At the senior high school level, use micro-organisms that occur naturally on yogurt, sour cream, baker's yeast, bread, cheese, or mildewed objects as much as possible, and use other organisms with appropriate precautions. If swabs are taken from fomite surfaces (e.g., from door knobs or desks) and cultured, use precautions that allow for the possibility that some organisms might be pathogenic. Culture the plates for a minimum time period, view within a sealed container, and dispose of the culture as soon as possible.

    - For mixed cultures from fomite sources, consider the following:

        - Grow cultures only at room temperature or in the range of 25°C to 32°C. Incubation at 37°C encourages growth of micro-organisms capable of living in the human body.

        - Use a culture medium that is properly sterilized to avoid contamination from other sources, and do not use a selective medium to minimize the chance of culturing pathogenic forms of bacteria.

        - Use disposable Petri dishes rather than glass ones. When no longer needed, the cultures and plates can be disposed of in the regular garbage in a double-strength or double plastic bag.

        - After inoculating the medium with micro-organisms, replace the cover and tape the plates shut. Subsequent observations can be made through the cover.

    - For pure cultures from regulated sources, consider the following:

        - Secondary education kits available through educational supply houses contain certified non-pathogenic pure cultures.

        - Growth of these cultures will require that the plates are NOT sealed to allow for manipulations (e.g., transformation, antibiotic testing) and will have a restricted incubation temperature (i.e., 37°C).

        - When no longer needed, these cultures and plates should be treated with an appropriate disinfectant or autoclaved before disposal in the regular garbage in a double-strength or double plastic bag.

- Clean up any spills containing biologic materials using proper procedures:

  Step 1: Put on disposable gloves.

  Step 2: Place paper towels over spill.

  Step 3: Pour a suitable disinfectant (e.g., commercial disinfectants containing hydrogen peroxide or quaternary ammonium) on top of the towels and leave for 10 to 15 minutes.

  Step 4: Wipe up the spill with the towels and discard into an airtight plastic bag or other appropriate container.

  Step 5: Clean and disinfect any reusable items before next use (use an autoclave if available).

Owl Pellets

Commercially purchased owl pellets are sterilized and do not pose any infectious hazards. This will not be the case with specimens that are personally collected in the wild by the teacher or any other individual.

Dissection

Animals and/or organs for dissection come in either preserved or fresh form. Two potential hazards that exist with dissections are infections and cuts from sharp scalpels.

Preserved Specimens

Specimens sold for dissection now commonly come in an alcohol-based solution, thus avoiding the need to use formaldehyde or formalin (see the Chemical Hazard Information Table in Chapter 9 for hazards associated with formalin and formaldehyde). If specimens are injected with formalin or preserved in a formalin solution, a chemical called *infutrace* can be used to convert the formaldehyde into a non-toxic product, eliminating exposure to the formaldehyde and its vapours.

Specimens should be removed from the shipping solution using gloves and tongs and rinsed thoroughly before proceeding. If smaller numbers of specimens are required, vacuum-packed specimens may be a good alternative.

Disposal of alcohol-based preserved specimens can be done via routine solid waste disposal, i.e., trash/local landfill. Formalin-based specimens, on the other hand, must be sent to a government-approved waste facility.

Fresh Tissues

Fresh beef, pork, and lamb organs and tissues are commonly used for dissection. Chicken, on the other hand, often carries salmonella and is not a good option for dissection work except if well-cooked or boiled.

Organs and tissues obtained from slaughterhouses or store meat departments will have been inspected for infectious agents. If kept refrigerated, they should be stable for 10 to 14 days. Handle as you would fresh meat.

High-risk materials, such as animal tissues that potentially carry infectious agents, are controlled by the Animal Health Act and regulations. For example, these regulations have placed restrictions on the availability of tissues and organs, such as eyes, from the heads of Alberta cattle because of bovine spongiform encephalopathy (BSE). Currently, all head tissues and organs from cattle over 30 months of age are to be removed and condemned; cattle under 30 months old are considered non-infectious.

Check with a local slaughterhouse at any time to determine what materials are available for dissection and what safety precautions may be necessary.

General Hazards of Equipment and Techniques

Dissection

Dissection is an integral part of biology that attracts much student curiosity and interest. To minimize risks during such activities, consider the following safety precautions:

- Use preserved specimens or inspected animals or animal parts. Avoid using specimens in formalin- or formaldehyde-based preservative.
- Use dissecting gloves.
- Discard remains of fresh specimens or alcohol-based preserved specimens in double bags or double-strength bags in the regular trash.
- Clean and disinfect equipment, wipe laboratory benches, and wash hands after a dissection.

Activities Requiring Mouth Use

Some activities that involve the mouth include swabs in taste testing, PTC paper use, spirometer mouthpieces, and plastic-wrapped thermometers. To minimize risks during these activities, consider the following guidelines:

- Avoid mouth pipetting (even if pipetting bulbs are not available), as it can result in ingestion of fluid.
- Consider using tympanic thermometers, which avoids insertion into the mouth.
- Ensure that any components that are placed in the mouth are used only once and then sterilized or discarded.
- Check that students do not have bleeding gums or open wounds in the mouth, which increases risks greatly.
- Ensure that students wash their hands thoroughly before and after each activity.
- After use, place the used item in a secured double-strength plastic bag and dispose of the bag in the regular garbage.

Syringes

The most serious hazards associated with syringe use are unintended inoculation (i.e., needle sticks) and aerosol production. The best way to eliminate these hazards is to avoid the use of needled syringes in science classes.

Inoculating Loops

Inoculating loops pose one potential hazard: the film held by a loop may break, producing an aerosol that causes atmospheric contamination and subsequent inhalation. To minimize this risk

- avoid making jerky motions, shaking the loop, or agitating the liquids;
- dip inoculating loops into ethanol before flaming (bearing in mind the flammability of ethanol); and
- allow the hot loop to cool after flame sterilization to avoid spattering when the loop is subsequently inserted into a micro-organism sample.

Centrifuging

Centrifuges require close monitoring to ensure the careful balancing of inserted tubes and their contents. The centrifuge lid should remain in place during the time of operation. After use, centrifuges can be cleaned with ethanol under a fume hood to kill any bacteria present.

Plant and Animal Hazards

The study of live plants and animals in the classroom poses potential risks of injury, infection, and allergic reaction. To minimize these risks, consider the following common-sense precautions:

- Be very selective about the organisms brought into the school. Check for student allergies and any diseases the animal may carry. Two common diseases that can be carried by wild animals are rabies and psittacosis, the latter caused by a bacterium transmitted by birds.
- Consider how you will dispose of the animal before acquiring it.
- Use domesticated animals or those available through reputable, licensed pet stores.
- Know and use proper handling techniques.
- Wear gloves to protect against biting and scratching.
- Explain to students the importance of acting respectfully and responsibly around the animals. Ensure that students do not tease the animals or put their fingers or other objects into the cages.
- Maintain animals in a clean, healthy environment.
- Have a plan to care for plants and animals when school is closed.
- Discourage students from bringing sick animals into the laboratory, and do not allow students to bring in any animals that have died from unknown causes.

When selecting plants, be aware that many plants are poisonous or contain irritants, including a number that are often used as house plants. Make a point of checking for toxic properties of plants before using them in the classroom, and ensure that students wash their hands after handling plants or plant parts.

Some common poisonous plants to be aware of include the following:

- plants poisonous to touch due to exuded oils:
  - poison ivy (T. radicans; R. diversiloba); and
  - oleander (N. oleander).

- toxic house or garden plants:
  - poinsettia (*E. pulcherrima*);
  - dieffenbachia (*D. maculata*);
  - castor bean (*R. communis*);
  - mistletoe (*V. album*);
  - lantana (*L. camara*, etc.); and
  - hyacinth (*H. orientalis*, *S. nonscriptus*, and *A. mutans*).

- other plants that are poisonous when eaten:
  - tansy (genus *Tanacetum*);
  - foxglove (*D. purpurea*);
  - rhubarb leaves (*R. rhabarbarum*);
  - baneberry (genus *Actaea*); and
  - marsh marigold (*Caltha palustris*).

More information on toxic and non-toxic plants can be found at http://poison.org/articles/plant, part of the Poison Control website.

Field Trip Biological Hazards

Planning for biological studies in the field needs to include consideration of the following specific hazards:

- allergic reactions, toxic effects, or infections. Be aware of any student allergies to plants, animals, pesticides, herbicides, or other materials. Also be aware of dangerous plants or animals that may exist in the area, such as stinging nettle, poison ivy, or rattlesnakes, and bring appropriate first aid materials;
- disease-carrying parasites, such as ticks carrying Lyme disease. Students should check their clothing and other belongings for these organisms before returning to school;
- diseases associated with handling animals. For example, deer mice can carry hantavirus and bats often carry rabies; and
- water-borne diseases such as giardiasis (beaver fever) or those that may be released through fecal waste, particularly human waste.

If specimens are collected on a field trip and maintained at school for a period of time, use proper storage and labels, both for the specimen and for any fertilizers, special foods, or chemicals (including SDSs as appropriate) to support these specimens. Further guidelines for planning field trip activities can be found in Chapter 4.

Cleanliness in Biology

Areas where organisms are kept or cultured must be given special attention with regard to cleanliness. General safety guidelines to consider include the following:

- Do not store or consume food in these areas.
- Wash all used surfaces with an appropriate disinfectant after each activity. Consult Health Canada, your local health authority, or a science supply catalogue for appropriate disinfectants.
- Clean shelves, cupboards, animal cages, autoclaves, fridges, and other items at regular intervals using an appropriate disinfectant.
- Wash hands after handling any kind of organism(s).
- If an autoclave is not available, sterilize reusable microbiology equipment by boiling in a pressure cooker for 10 to 15 minutes. The heat provided by a microwave is not uniform enough for this purpose, and a microwave cannot be used for metal components. An ultraviolet light cabinet can be used to sterilize external surfaces. Liquid disinfectants and germicidal agents generally will not provide complete sterilization.

Chapter 6: Physical Hazards

Overview

Physical hazards include mechanical, electrical, heat, sound, and radiation hazards that may occur in physics laboratory activities as well as a variety of other science activities. Hazards in each of these categories have the potential to cause injuries (or, in some cases, death), but by taking general precautions, such as using appropriate protective equipment and emphasizing routine safety, physical hazards can be easily minimized.

Mechanical Hazards

Mechanical hazards rarely exist in a well-maintained laboratory where equipment is commercially produced, approved, and in good working order. In general, safety can be increased by ensuring that equipment is well maintained, that all equipment is turned off before leaving the area for any reason, and that students use equipment only with teacher supervision. In addition, there are some risks and safety measures to keep in mind when using specific kinds of equipment or performing specific kinds of activities.

Rotating Machinery

Machinery with rotating parts can catch loose clothing, hands, or hair, potentially causing serious injuries. Uncovered parts may also fly off, creating additional risk, especially for eye injuries. To minimize risks

- ensure rotating shafts, belts, and pulleys are covered by guards, lids, or covers;
- check devices attached to a rotor before use to ensure that they are tightly fastened;
- wear (and have students wear) eye protection when using uncovered, rapidly rotating parts, as in the demonstration of centripetal force and circular or periodic motion; and
- have students stand back as much as possible.

Tools

Use of tools or use of tools in poor condition can cause injuries to the hands, eyes, head, and limbs. To minimize risks

- regularly check tools for defects or damage; and
- provide students with clear instructions on safe use before they have access to tools.

Cutting Tools (Scalpels, Razor Blades)

These instruments tend to be very sharp; improper use can quickly result in deep cuts on the fingers and hands. To minimize risks

- use extreme caution in handling cutting tools, and ensure that students do the same (provide training on proper cutting technique);
- ensure that replacement of blades is only done by teachers or technicians; and
- wear eye protection when using cutting tools in case a blade breaks.

Magnets

Large, powerful magnets or electromagnets can attract other magnets or iron/nickel objects with surprising force, which can cause pinching or crushing of fingers or hands if caught between the two. To minimize risks

- inform students of this hazard before such magnets are used, and limit use of strong magnets.

Glassware

Any kind of glassware has the potential to break, thus creating the risk for cuts, spilled materials, or the entry of foreign objects into eyes. To minimize risks

- wear goggles for eye protection;
- use heat-resistant glassware, which is less likely to crack when heated;
- do not use glass containers that are cracked or chipped, since they may crack further during the experiment; and
- clean up any broken glass immediately and dispose of it in a special waste bin.

Projectile Launchers

Projectile launchers are often used in the study of motion—sometimes as demonstration devices and sometimes as equipment for student laboratories. Equipment used includes such devices as ballistic pendulums, commercially available devices that launch plastic and steel balls, and teacher-constructed devices that launch a variety of materials. Decisions about devices to be used for this purpose (and who will use them and how) need to recognize factors that can affect potential risk. These factors include the power of the launcher, the nature of the projectile, and the maturity, skill, and safety awareness of the user. Risk is also critically affected by the location and orientation of the launcher when the device is operated, relative to the location of students. These devices should never be oriented in a way that puts anyone in the line of fire.

Use of such equipment, where potential injury is a concern, should only be allowed under the direct supervision of a teacher. To minimize risk

- wear goggles for eye protection;
- ensure no one is in the line of fire;
- never launch projectiles with sharp points;
- ensure that misfiring does not place participants or spectators at risk; and
- control the risk posed by loading launching equipment with force that could cause the equipment to collapse or break (such as over-tensioning).

Testing Structural Design to Failure

Studies of the physics of design technology frequently include activities in designing, constructing, and testing models for strength and/or efficiency of performance. Such testing, particularly for strength, often requires stress to failure determination, which may require some precautions.

To minimize risks

- assess all inherent risks of testing to determine necessary precautionary measures;
- wear goggles for eye protection;
- minimize the height at which testing is done on collapsing structures; and
- closely supervise the use of heavy weights.

Electrical Hazards

The two major risks related to electricity are electrical shock and fire. Some specific hazards and precautions are described below.

Faulty Wiring

Loose or broken connections or frayed connecting cords may create a short circuit. This can result from contact of the lead-in wires or internal connections in the equipment. Fire, electrical shock, or equipment damage may result. The use of such damaged equipment is a violation of the Occupational Health and Safety Regulation. To minimize risks

- check external wiring of equipment before use; and
- verify normal function before making equipment available for student use.

Heavy-duty Usage of Lightweight Electrically Powered Equipment

Equipment damage and overheating, and therefore fire, are always possible if electrically powered equipment is in prolonged use, particularly if under load (such as motors powering pulleys with weights). To minimize risks

- use equipment only as intended; and
- limit prolonged use of any electrically powered equipment.

Electrical Equipment Near Water

Use of electrical equipment near water creates the potential for a shock hazard or fire if water gets into the electrical system and/or if a person makes contact with the water conducting current from the equipment. As well, this creates potential for malfunction or failure of the equipment. To minimize risks

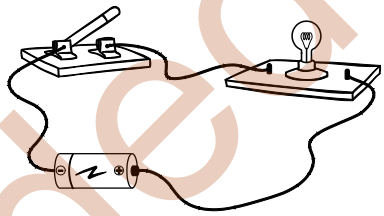
- ensure equipment used near sinks or other water sources is properly insulated and grounded;
- use ground-fault interrupter plugs where available; and
- switch off the current at the wall outlet or unplug immediately if water gets into the electrical equipment, and do not use the equipment again until completely dry.

Electrical Equipment Near Flammable Liquids

Use of equipment that creates heat or sparks, can cause flammable vapours to ignite and cause fire or explosion under certain conditions. For example, the rotor of an electric motor generates sparks as it rotates past the brushes, which can ignite flammable vapours under poorly-ventilated conditions. To minimize risks

- ensure that electrical equipment is used only in properly ventilated areas, and away from flammable liquids.

Shorting Dry Cell Circuits



Short circuits in devices not protected by a fuse can lead to overheating and to risk of fire or injury. Completing a circuit between terminals of a dry cell or dry cells without adding any resistance in the form of a bulb or other electrical device, will create such risks.

Contact with overheated wires can lead to skin burns or cause a fire if the wires are near flammable materials. Severe shorts can also cause dry cells to melt, give off toxic fumes, and possibly explode. To minimize risks

- ensure a circuit has at least one source of resistance, e.g., bulb, electric motor, within the circuit; and
- connect the battery/batteries last into a circuit if an open switch is not included.

Spark Timers

Spark timers are sometimes used in the study of motion in senior high school physics. This equipment uses a low voltage surge to transfer carbon dots onto a ticker tape or paper sheet to mark the location of an object at preset time intervals. Spark timers attached to air tables are hazardous because they use large sheets of carbon paper that can transmit a minor electric shock (static discharge) to anyone who touches them. The shock itself is not the danger, but reaction to the shock can create unwanted hazards such as an elbow to the face of a bystander or knocking over nearby materials. To minimize risk, warn students of the potential hazard.

High Voltage Equipment

Some student-wired laboratory set-ups and teacher-made demonstration equipment have the potential to deliver a high voltage discharge. Common risks include the following:

- Capacitors that build up and store current can discharge on contact, generating a powerful shock in the process.

- Polarized capacitors can explode if incorrectly connected into a circuit.
- Tesla coils can cause severe skin burns.
- Electrostatic generators, particularly the Van de Graaff, can cause serious shocks.
- Isolation transformers that use 120V AC current can be fatal since only one wire needs to be touched.

To minimize risks

- ensure high voltage equipment is handled with extreme care;
- ensure any use of such equipment is under the direct supervision and guidance of a qualified person; and
- ensure the equipment is in good working order before using it in the classroom.

Heat Hazards

Heating devices create hazards of fire and injury. The potential risks posed by these devices vary with the heating device used and the way in which it is used. The analysis below identifies the pros and cons of using different devices and suggests procedures for minimizing risk.

In general, to reduce the risk of burns, students should

- wear heat-resistant gloves when handling heated objects or containers;
- where possible, use test tube holders or tongs to handle hot equipment and containers;
- never reach over an exposed flame or heat source;
- ensure hair is tied back and long and loose clothing does not have an opportunity to connect with an exposed flame or heat source;
- use heat-resistant glassware for heating substances to prevent cracking and spilling of hot contents; and
- allow ample time for heated objects to cool before touching them.

Additional precautions for specific heat sources are listed in the following sections.

Bunsen Burners

Bunsen burners provide a direct and very efficient source of heat for laboratory purposes. However, there is a risk of burns particularly to student fingers and hands. As well, if the burner is used to heat water or a solution, the rapid heating can cause hot liquid to spurt out as it reaches its boiling point. To minimize risks

- use Bunsen burners only if the activity requires high heat and only if the maturity of the students is sufficient (in general, Bunsen burners would not be the preferred source of heat in elementary school and might also be avoided in junior high school);
- provide students with training on the use of Bunsen burners, particularly the routine of lighting and regulating flame intensity;
- point the tube mouth away from anyone nearby when using Bunsen burners to heat a solution or water in a test tube;
- do not use Bunsen burners or alcohol burners if flammable liquids are being used anywhere in the laboratory; and
- supervise students closely at all times during use.

Alcohol Burners

Use of alcohol burners creates a significant burn hazard especially if there is any risk of the burner falling and breaking while it is lit or if it is turned upside down. The use of hot plates in place of alcohol burners is thus recommended as they create a lower risk for students. Given the risks associated with use of alcohol burners, the National Science Teachers Association (NSTA) has taken a similar position with a recommendation that they should no longer be used in the science classroom or laboratory.

If alcohol burners are used, the following steps can be taken to minimize risks:

- Use burners that are leak proof; i.e., do not leak if turned upside down.
- Supervise students closely during use.
- Avoid moving alcohol burners while lit.
- Never place burners on sloping surfaces.
- Place the burner well away from the edge of the table or counter on which it is set.

Hot Plates

Electric hot plates with thermostatic controls provide a safer, controllable, and reliable source of heat that meets the needs of science courses. However, they can still cause burns to skin. In addition, coiled hot plates, which might still be in use in some schools, have greater potential to cause burns because of the exposed coils. To minimize risks

- ensure hot plates, as well as the heated materials and containers, are handled with care, using proper techniques; and
- avoid coiled hot plates if possible, and take extra care if they must be used.

Butane Burners

These burners are relatively easy to use and function much like a Bunsen burner. Ensure the model of burner used has separate adjustments for both gas and air. (Avoid butane burners where air supply cannot be regulated as heat intensity cannot be easily controlled.) One drawback to the use of butane burners is that the gas cartridges are not refillable and must be replaced once the gas is used up, making them more expensive to use than Bunsen burners.

Candles

Candles provide low intensity heat and thus are limited in their usefulness. However, they can be a good source of heat for activities where low intensity is required. The main problem with candles is their instability that can lead to tipping. To minimize risk

- secure the candle firmly to a base to prevent tipping. For example, impaling the bottom of the candle onto a nail protruding from a board base is effective. Setting the candle into a small amount of melted wax that then solidifies is generally not adequate.

Rocketry Hazards

Rockets are devices containing combustible propellants that produce thrust by expelling hot gases. Depending on their physical size and the size of the motor(s), two categories of devices are described, according to Canadian Aviation Regulations: model rockets and rockets (non-model, high powered rockets). The guidelines and regulatory requirements that must be met for each of these are quite different.

Model Rockets

A model rocket means a rocket that

- is equipped with model rocket motors that will not generate a total impulse exceeding 160 N•s;
- has a gross weight, including motors, not exceeding 1500 g (3.3 lb); and
- is equipped with a parachute or other device capable of retarding its descent.

No special training or certification is required for building, installing, and firing model rockets made of lightweight materials weighing 1.5 kg or less. Model rockets are restricted to types A to G motors producing up to a maximum of 160 N•s impulse. For less powerful A to F motors, the person must be over the age of 12 years and be supervised by an adult. However, to purchase "G" level motors, a person must be 18 years old or older. Model rockets use premanufactured solid propellant rocket motors with black powder or composites as propellants.

According to Canadian Aviation Regulation 602.45, "No person shall fly a model aircraft or a kite or launch a model rocket or a rocket of a type used in a fireworks display into cloud or in a manner that is or is likely to be hazardous to aviation safety."

Flying of model rockets should be done in accordance with the Canadian Association of Rocketry model rocketry safety code. This can be found at http://www.canadianrocketry.org/. Check also with local authorities for bylaws regulating the firing of model rockets. Currently, in Calgary, for example, Bylaw 36/74 prohibits firing of model rockets from city-owned properties such as park lands, which includes green spaces, school and park reserves, city parks, as well as school yards. In Edmonton, a permit is required to launch model rockets from public-owned or controlled land, including any local park. Launching on private land does not require a permit as long as the rocket lands on the same private land.

Some Alberta model rocketry clubs are listed at https://www.rocketreviews.com/rocketry-clubs.html. These clubs can be contacted through their websites for more information about model rocketry in Alberta.

Rockets (Non-model, High Powered Rockets)

Rockets in this category are equipped with authorized motors with an impulse over 160 N•s, but not exceeding 40 960 N•s, and include rockets that weigh more than 1.5 kg. Installing and firing such rockets is restricted to individuals over the age of 18, requires Canadian Association of Rocketry High Power certification, and is restricted to approved launches. The Canadian Launch Safety Office created guidelines for these rockets. The guidelines are contained in the Canadian Association of Rocketry CAR High Power Rocketry Safety Code located on the Canadian Association of Rocketry website at http://www.canadianrocketry.org/.

The major inherent risks associated with firing rockets include possible burns and the potentially lethal impact of misguided rockets.

Sound Hazards

Cumulative damage to inner ear hair cells, which results in permanent loss of hearing at the specific frequencies to which the lost hair cells were sensitive, can be caused by exposure to noise over certain durations and decibels (dBA★). Such volumes might be created, for example, by loud music at school dances or by large generators in mechanical rooms. By contrast, high impact noise can cause eardrum perforation or damage to the bones of the middle ear. Such noise is generated by pneumatic tools such as jack hammers, or in some cases, high voltage discharge. The eardrum perforations will heal, but each time this happens, scar tissue builds up on the eardrum and makes it less sensitive to sound waves. Any equipment or instruments generating significant sound should be monitored for loudness to ensure they do not exceed allowable occupational exposure limits (time and dBA) set out in the Occupational Health and Safety Code, Schedule 3. As a general rule of thumb, if it is felt that the voice needs to be raised to be heard at a distance of 1 metre, then the noise levels are likely over 85 dBA and hearing protection may be warranted.

★**Note:** A dBA is a measure of sound level in decibels using a reference sound pressure of 20 micropascals when measured on the “A” weighting network of a sound level meter.

Radiation Hazards

Radiation is a hazard associated with the decay of radioactive materials, such as isotopes of uranium and thorium, as well as emissions from electronic equipment or other sources. Radiation is the emission of energy in either particulate or electromagnetic form and is generally classified into two distinct categories, ionizing and non-ionizing.

Ionizing Radiation

Ionizing radiation has the potential to damage human tissue by breaking chemical bonds, removing electrons from atoms, or even breaking up the nucleus of atoms. It can affect the cells of the body, increasing risk of harmful genetic mutations, cancer, or, at worst, massive tissue damage leading to death within a few weeks. For this reason, possession and use of materials that emit such radiation is tightly controlled by the Canadian Nuclear Safety Commission (CNSC) through the enforcement of several sets of regulations.

It should be noted that while there are standards set out for safe exposure to different types of ionizing radiation, public perceptions range from zero tolerance to those acceptable exemption levels set out in Schedule 1 of the Nuclear Substances and Radiation Devices Regulations. These exemption levels, given in becquerels, do not require licensing as long as the possession limit of such sealed sources does not exceed 10 in any one calendar year.

In general, the level of radioactivity in materials considered acceptable for senior high school activities is so small that it approaches the level of normal background radiation. Such low levels do not require special licensing from the CNSC, since potential health risks are minimal. These low-level sources are readily available through science supply companies. They have radioactivity levels measured in microcuries and can generally be disposed of via the local landfill. One should check with the school authority office to ensure this is the case. Furthermore, no elaborate safety equipment or protective measures are necessary.

> Radioactive decay rates are given in curies or in the International System of Units in becquerels. A curie (Ci) is defined as 37 billion disintegrations per second as measured in 1 gram of radium. A becquerel equals one disintegration per second.

Special handling and shielding of radioactive materials is required in instances where activity levels exceed the exemption quantities set out in Schedule 1 of the Nuclear Substances and Radiation Devices Regulations. Materials that have such high levels of radioactivity are not recommended for school use. See http://laws-lois.justice.gc.ca/eng/regulations/SOR-2000-207/ for more information on these regulations and exemption limits in Schedule 1.

Radioactive materials available for purchase come in both sealed and unsealed containers. Sealed containers have the radioactive material permanently embedded within a metal, plastic, or other medium. Such sources are easier to handle and are generally safer to use than the unsealed sources of the same material. Sealed sources in license-exempt quantities are also readily disposable.

The term “ionizing” radiation refers to radiation in several forms:

- alpha particles;
- beta particles; and
- gamma rays.

Each of these forms of radiation has sufficient energy to break chemical bonds and damage human tissue. Potential harm is proportional to the energy absorbed, which in turn is affected by the amount of exposure.

Although alpha particles can be stopped by a sheet of paper and beta particles by a layer of clothing, both are much more hazardous if ingested or inhaled. On the other hand, both gamma and x-rays easily pass through the human body. Lead shielding is necessary to protect against such rays.

Cathode ray tubes (CRTs) do not normally pose a radiation risk but can emit x-rays when a current is present and there is a potential of at least 5000 volts. To produce an appreciable x-ray beam requires 10 000 volts or more.

Protection from Ionizing Radiation

To minimize the potential hazards of ionizing radiation, consider the following precautions that limit exposure to the radioactive material:

- Use low-level radioactive material with emissions in millicuries.
- Keep the time for potential exposure to a minimum.
- Stay as far from the radiation source as possible. As a rule, if the distance is doubled, exposure is reduced by a factor of four.
- Monitor radiation levels throughout time of exposure with the use of a Geiger counter.
- Store the material in a suitably shielded container; e.g., a lead storage pot in a properly marked cabinet not frequently used by people.

Non-ionizing Radiation

Radiation that has enough energy to move atoms in a molecule around or cause them to vibrate, but not enough to change them structurally, is referred to as non-ionizing radiation. Examples of this kind of radiation are sound waves, visible light rays, ultraviolet rays, and microwaves.

Non-ionizing radiation increases kinetic energy of molecules in body tissue, which leads to heat production. When short wavelength radiation, such as ultraviolet rays, is absorbed by the skin or eyes at a high enough intensity or for a long enough time, the result can be sunburn and painful "welder's flash" burns of the eye. Prolonged or chronic exposure to ultraviolet radiation may also lead to premature skin aging. At sufficiently high intensities, non-ionizing radiation can disrupt essential physiological processes. However, in normal school laboratory practices, where low intensity radiation sources are used and exposure is minimized, levels will be well below specified limits and it is generally not necessary to measure actual field strengths.

Protection from Non-ionizing Radiation

The best way to minimize the potential hazards of non-ionizing radiation is to limit exposure to radiation sources by taking precautions such as the following:

- Keep the time for potential exposure to a minimum.
- Stay as far from the radiation source as possible (note that this is not the case with laser beams, which do not significantly change in intensity within the space of a typical school laboratory).
- Use appropriate shielding or protection, such as UV goggles or protective gloves.
- Never look directly into a laser beam, ultraviolet radiation source, or bright light.
- Instruct students in proper operating and handling procedures, and ensure that they follow these procedures.

Potentially Hazardous Sources of Non-ionizing Radiation

Ultraviolet radiation

Ultraviolet rays are high-energy rays that can produce skin burns and "welder's flash" burns of the eye with enough exposure and light intensity. To reduce these risks

- minimize skin exposure; and
- never look directly at a source of ultraviolet rays without appropriate eye protection.

Potential sources of ultraviolet rays include lasers, stethoscopes, microwave ovens, UV bulbs, welders, fluorescent bulbs, gas discharge tubes, and burning magnesium ribbon.

Visible light and lasers
The direct or reflected viewing of any intense visible light source—electric arcs, burning magnesium ribbon, the Sun, or even collimated or focused beams from ordinary tungsten lights—can cause retinal damage. For example, looking at the Sun requires the use of a solar filter equivalent to that of a welding mask.

Under the International Electrotechnical Commission (IEC) Standard 60825-1, laser products are classified in the following order, from the lowest to highest potential risk: Class 1, 1M, 2, 2M, 3R, 3B, and 4. According to the Canada Consumer Product Safety Act, hand-held Class 3B and 4 laser pointers are considered a danger to human health and safety and are, therefore, prohibited in Canada.

Whenever possible, use lasers possessing a lower risk classification and/or a lower output power. The visible light from any classification of laser entering the eye will become focused by the lens of the eye, which could result in severe retinal damage, even if only from brief exposure.

Battery-powered hand-held lasers used with students must be no higher than Class 3R visible lasers (US FDA Class IIIa), which usually have a power output of 5 mW or less. For safety reasons, non-visible 3R lasers should be avoided. The passage of laser light through magnifying optics should also be avoided.

To further reduce risks

- do not allow students to use lasers without close supervision;
- choose a laser that stays on only when the button is pressed;
- use lasers in a well-lit room so that the pupils of the eye are small; and
- position lasers so that the beam cannot enter the eyes directly or by reflection.

Stroboscopes
Rhythmical pulses of light, especially in the range of 3 to 7 hertz, can cause unpleasant or dangerous physiological effects in some people, including nausea and epileptic seizures. To minimize these risks

- avoid the range of 3 to 7 hertz;
- warn students of potential effects and monitor them closely for unusual behaviour or onset of nausea during use of stroboscopes; and
- excuse students who know that flashing light has a negative effect on them.

Microwaves
All microwave ovens produced since 1971 are covered by a federal radiation standard that assures such ovens are safe. This standard limits leakage of microwaves to values well below the level at which heating or burning of human tissue would occur, even at distances as close as 5 cm.

Chapter 7: Chemical Hazards

Overview

Chemical hazards come in a variety of forms. Some chemicals are toxic or corrosive in nature; others are unstable when exposed to certain compounds or conditions; still others are carcinogenic or mutagenic. Most of the chemicals used in schools do not pose serious dangers. However, there are some chemicals that require more careful handling and others that should be avoided altogether. It is also important to know proper cleanup procedures, in case a spill occurs.

Before working with any chemical, particularly regulated or hazardous substances, staff and students should be thoroughly familiar with its chemical and physical properties. Where possible, control risks by limiting chemical concentration and exposure. Keep in mind that, as per Paracelsus (the father of toxicology), "*The dose makes the poison*"; in other words, the higher the concentration of, or exposure time to, a chemical, the higher the hazard.

General Safety Measures

The following general guidelines can be followed to increase the margin of safety when working with chemicals:

- Ensure that the chemical is appropriately labelled and that the SDS is readily available.
- Minimize exposure.
- Ensure that the acquisition, use, and storage of toxic materials are based on real needs: if safer alternatives exist, use them.
- Do not handle or use hazardous chemicals unless you are WHMIS trained.
- Do not engage other staff in handling and using hazardous chemicals if they are not WHMIS trained.
- Before using any chemical, review its SDS to determine potential hazards.
- Inform students of hazards and the necessary safety precautions. Never underestimate risks when mixing chemicals.
- Be prepared for incidents.

- Ensure chemicals and chemical wastes are stored with proper hazard identification.
- Do not keep stock bottles in the laboratory.
- Store chemicals in minimum quantities and in lower concentrations.
- Do not use materials unless you have identified hazard control strategies, and ensure you have the appropriate tools and procedures to control the hazard (e.g., personal protective equipment).

Code of Practice

Schools that stock any of the following substances should note that there is a specific Occupational Health and Safety Code requirement (a code of practice) that applies for pure substances in amounts greater than 10 kg and for mixtures in which the amount of the substance is more than 10 kg and at a concentration of 0.1% by weight or more. More information can be found in the Alberta Occupational Health and Safety Code, Section 26. Note that there are exposure control requirements for hundreds of other chemicals, but the following list has special requirements:

arsenic and compounds	1,2-dibromomethane	methyl bromide
asbestos	ethylene oxide	methyl hydrazine
benzene	hexachlorobutadiene	perchlorates
beryllium	hydrazines	silica-crystalline, respirable
1,3-butadiene	hydrogen sulphide	styrene
cadmium	isocyanates	vinyl chloride
coal tar pitch volatiles	lead and lead compounds	zinc chromate

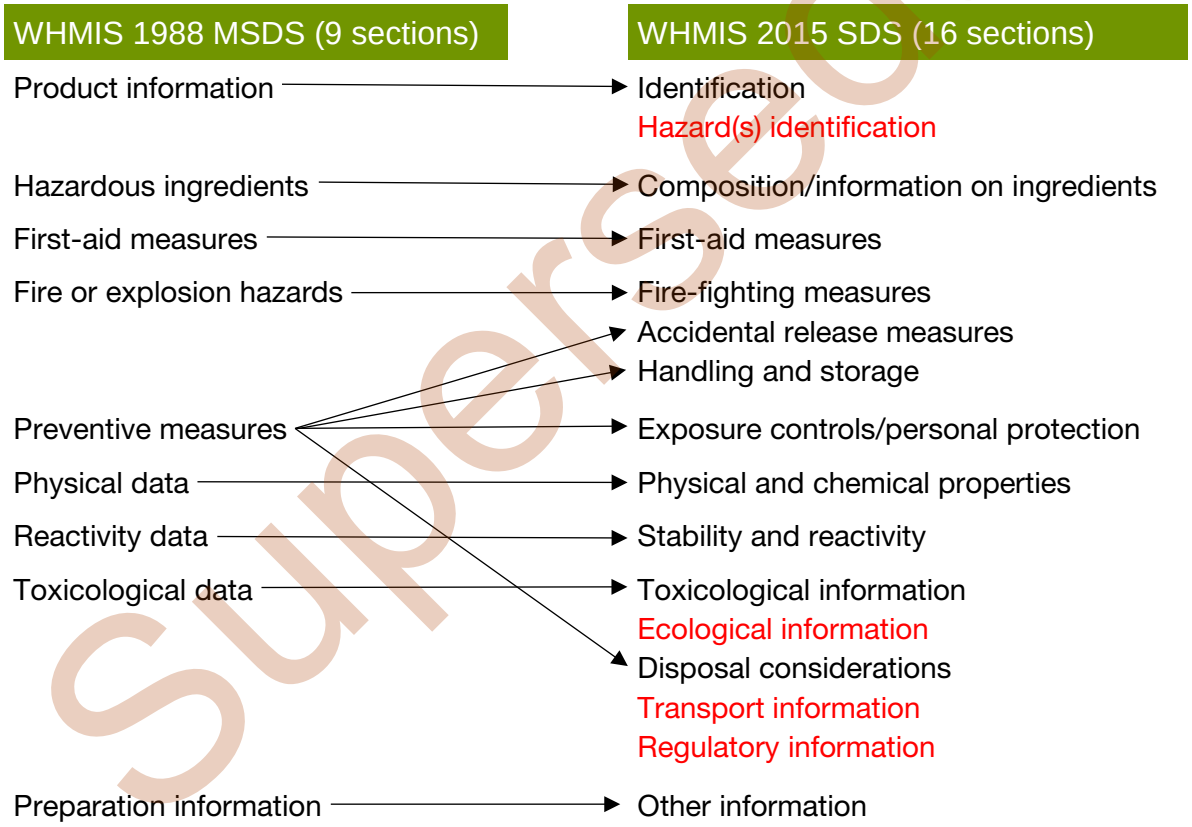
The code of practice must include measures to be used to prevent any uncontrolled release of the substance and include the procedures to be followed if there is an uncontrolled release.

For more information on this requirement, see the Occupational Health and Safety Code, Part 4, Section 26(1), and the corresponding section of the Occupational Health and Safety Code Explanation Guide, which can both be accessed through the Government of Alberta website at https://www.alberta.ca/occupational-health-safety.aspx.

Safety Data Sheets

Safety Data Sheets (SDSs – formerly Material Safety Data Sheets) give detailed information about a chemical's composition, reactivity, and health effects, as well as which protective equipment, safety procedures, and emergency procedures to use. These sheets must be prepared by the product supplier and provided to the user (in this case the school) for all hazardous chemicals. Suppliers may also be asked for SDSs for other chemicals they supply. The SDSs supplied by a chemical supply company are the legal source of information for those chemicals in case of an incident.

SDSs are an essential source of information about chemical hazards, so it is important that teachers and students be able to understand the sheets from a variety of suppliers. Although the numbering of sections and the order of appearance may differ from supplier to supplier, the following information must be on each SDS (a comparison of the old WHMIS 1988 MSDS and the WHMIS 2015 SDS is provided):



(Pinchin West Ltd.)

Toxic and Corrosive Chemicals

Toxic or corrosive properties are the most common hazards posed by chemicals in schools (see the Chemical Hazard Information Table in Chapter 9 for information about specific chemicals). A toxic substance is any substance that may cause damage by its chemical action when ingested, inhaled, absorbed, or injected into the body in relatively small amounts. While all compounds are toxic (depending on dose), significant concern in school laboratories focuses on damage that can occur when materials

- directly destroy tissue through corrosive action; e.g., NaOH reacts with moisture in the skin;
- interfere with chemical reactions of the body; e.g., CO replaces O_2 in hemoglobin; and
- disrupt the biological processes of the body; e.g., NO_2 causes pulmonary edema and allergic responses.

Exposure to Toxic Materials

Toxic materials can enter the body by

- inhalation—breathing in poisonous or corrosive vapours and dust (most common route by which toxic materials enter the body);
- ingestion—swallowing liquid or solid toxic materials;
- injection—chemicals directly injected through punctures, allowing chemicals access to the bloodstream; and
- absorption—while penetration through cut or damaged skin can occur rapidly, toxic materials can be absorbed through intact skin, mucous membranes, or eyes.

Every effort should be made to avoid circumstances that allow for overexposure to toxic materials. Any activities that involve use of significant volumes of highly toxic materials in liquid, gaseous, vapour, or dust form should be carried out under a fume hood wherever possible.

Effects of Toxic Chemicals

Toxic effects can be local or systemic, acute or chronic. Local effects are confined to the area of the body that has come in contact with toxic materials; systemic effects occur throughout the body affecting organ systems after absorption into the bloodstream. Acute effects are immediate and usually extremely serious or painful. With chemicals that can produce acute effects, poisoning may be suspected when any of the following are evident:

- strange odour on the breath;
- discolouration of lips and mouth;
- pain or burning sensation in the throat; and
- unconsciousness, confusion, or sudden illness.

By comparison, chronic effects are long lasting and may take many years before becoming evident. Many substances, such as arsenic and mercury, have cumulative effects, meaning that poisoning may occur at lower concentrations through repeated exposures over a period of time. Such substances are sometimes known as insidious hazards.

Insidious substances include carcinogens, teratogens, and mutagens. Carcinogens cause cancer in cells. Teratogens interrupt or alter the normal development of a fetus (with no observable effect on the mother). These include chemicals such as ethanol and mercury compounds, viruses such as rubella, and ionizing radiation. Mutagens increase the rate of mutation of cells or organisms, and include chemicals such as nitrous acid, peroxides and dichromates, as well as certain viruses and radiation.

Insidious Hazards

The most obvious source of insidious chemical hazards is from substances known to have dangerous long-term effects, such as mercury and carcinogens, which are discussed in the following sections. These substances can cause damage through direct exposure or through leakage of gases or vapours from chemical containers. However, even if such chemicals are not intentionally ordered and stored in the school, insidious hazards can still exist and be easily overlooked. These hazards include

- leaking gas cylinders;
- formaldehyde (formalin) from biological specimens (if still around);
- mixed chemicals that slowly react to form toxic products, particularly mixtures of waste materials;
- neglected containers of dried solutions and residues of chemical products from past demonstrations and activities (e.g., formation of crystals sensitive to shock); and

- residue from chemicals improperly disposed of in the sink drain, resulting in subsequent interactions that cause the formation and release of toxic or other hazardous materials into the laboratory air (for chemicals that can be safely disposed of down the drain, see the Chemical Hazard Information Table in Chapter 9).

Mercury

One relatively well-known hazardous substance is mercury, which can have serious and cumulative effects on the gastrointestinal and central nervous systems. Open mercury evaporates and readily absorbs through the skin and respiratory system. Disposal of mercury and mercury compounds is, therefore, a major concern.

Given the hazards of mercury, it is not recommended for use in Alberta schools. Mercury thermometers should no longer be used in schools because of potential breakages and spills. If mercury is still in stock, the following steps need to be taken to manage it more safely:

- Store mercury in plastic bottles under a layer of water or oil.
- Keep the container sealed in a cool, well-ventilated area.
- Avoid opening the container and allowing vapours to escape.
- Wear gloves when handling containers.

Mercury spills from thermometers, thermostats, or any other source must be cleaned up immediately and thoroughly, regardless of the size of the spill. Unless spills are promptly and thoroughly cleaned up and the area decontaminated, dangerous exposure to vapours will continue. In the past, the common practice for cleanup was to aspirate or sweep up any visible drops. Often, however, small droplets hidden in cracks and crevices were inadvertently left behind to evaporate into the atmosphere; and aspiration not done with extreme care simply aerosolized the material further.

Mercury droplets from 10 to 1000 micrometres in diameter stick to vertical surfaces and penetrate into porous flooring. In some cases, relatively large amounts of mercury may be left undiscovered after spills. Prompt and thorough cleanup of mercury spills is essential or cumulative exposure to mercury vapours can cause irreparable harm to those working in the area.

In Alberta, the cleanup procedures for mercury spills in schools are determined by local school authorities. Some school authorities may permit school staff to clean up spills using commercial spill kits, while others specifically restrict cleanup to hazmat cleanup professionals. Check your school authority's policy on mercury spill cleanup before proceeding with the actual process. If school authority policy allows staff cleanup, use a commercial spill kit that includes components to control vapours; i.e., aspirator, mercury absorbent, and vapour absorbent. More likely, cleanup will require the use of specialized remediation services. A useful resource for cleanup methods and procedures is the United States Environmental Protection Agency site on low-level mercury contamination at https://www.epa.gov/mercury/what-do-if-mercury-thermometer-breaks.

Carcinogens

A carcinogen is a chemical, physical, or biological substance that is capable of causing cancer. The damaging effects are subtle and imperceptible in the short term, thus carcinogenic substances are another insidious hazard that may be present in the laboratory and chemical storage area. A substance is considered to be carcinogenic if it has been evaluated and rated as a human carcinogen, an animal carcinogen, or a potential carcinogen by the American Conference of Governmental Industrial Hygienists (ACGIH) or the International Agency for Research on Cancer (IARC).

Those compounds that are designated as ACGIH A1 (known human carcinogens) or A2 (suspected human carcinogens) are now listed in Table 2 of Schedule 1 of the Alberta Occupational Health and Safety Code (https://www.alberta.ca/occupational-health-safety.aspx). Carcinogenic properties are also indicated in the Chemical Hazard Information Table in Chapter 9.

Actual manifestation of cancer or tumours for most carcinogenic chemicals requires prolonged and often relatively constant exposure. Proper storage of such chemicals in airtight containers reduces this hazard by limiting exposure only to periods of chemical usage. However, the more frequent the use, the greater the exposure, particularly for powdered forms of these chemicals, which can be absorbed through the skin and lungs.

Fewer chemicals have carcinogenic properties compared to other risks, and those that do should be avoided, if possible. Whether to stock and use chemicals with carcinogenic properties will depend on curricular requirements, adequacy of facilities, and the ability to safely handle and dispose of these chemicals with the frequency required. Serious consideration should be given to using alternative chemicals wherever possible.

Corrosive Substances

Corrosive chemicals cause visible, usually rapid damage to human tissue at the site of contact. Often this corrosive quality is due to the reaction of the substance with water or moisture in the tissue. This is the case with strong acids and bases of 1 molar mass (1 M) or greater concentration, non-metal halides, dehydrating agents, halogens, and oxidizing agents. The most serious corrosion hazards come with substances that are in a mist or gaseous state, since they can be readily absorbed through the skin or inhaled into the lungs.

The corrosive properties of chemicals commonly found in schools are identified and discussed in the Chemical Hazard Information Table in Chapter 9.

Minimizing Risks of Toxic and Corrosive Chemicals

Whenever chemicals are used, the onus is on the teacher to assess risks, determine proper handling procedures, and convey this information to students before beginning the activity. Handling procedures used for all chemicals, and especially those with greater hazards, should aim to minimize exposure. This can be accomplished through strategies such as the following:

- Do not handle highly toxic materials in open containers, as gas, vapours, dust, and liquids can easily escape during normal handling.
- Do not heat highly toxic materials, as smoke, gas, and vapour may be released in much greater quantity when material is hot.
- Avoid crushing or grinding solids or unnecessarily transferring powders, which creates dust.
- Use and store highly toxic materials only in areas with adequate ventilation. Toxic gases and vapours can rapidly accumulate to dangerous levels in a room, or part of a room, that does not have a constant replacement of fresh air.
- Do not lean over open bottles, as toxic gases or vapours can be concentrated directly above the bottle even in well-ventilated rooms.
- Ensure chemicals are clearly labelled and check these labels every time a substance is used. Odour and appearance are not reliable guides to the toxicity of substances: numerous highly toxic liquids can be clear and odourless, and numerous highly toxic gases or vapours may have little or no odour, even at dangerous concentration levels.
- Use proper personal protective equipment, such as correct clothing, face protection, or respirators, to prevent skin contact with hazardous materials and inhalation of toxic vapours.
- Use proper engineering controls, like fume hoods, when appropriate.
- Do not chew gum, smoke, or store or consume food or beverages in an area where highly toxic materials are used. Food, beverages, and cigarettes can easily absorb hazardous vapours or be contaminated with unseen toxic dust. Poisons may also be transferred from hands to food or cigarettes.
- Follow proper cleanup procedures after each lab activity is finished. Substances left on benches or in beakers and bottles may expose others to these toxic materials.
- Ensure students wash their hands thoroughly after activities to avoid transferring toxic materials to food they eat.

Insidious hazards could be easily overlooked or ignored, even during routine safety inspections, because they do not have immediately obvious effects. To avoid or reduce these kinds of hazards, consider the following measures:

- Give specific attention to possible sources of insidious hazards during the safety inspection process.
- Prepare an inventory of insidious hazards that must be tended to regularly.
- Provide adequate ventilation in the form of hoods and forced air, as stated in current standards and codes.
- Avoid stock build-up of toxic, flammable, or corrosive materials.
- Keep appropriate cleanup agents accessible in case of spills.
- Collect waste materials in separate containers and do not mix them.
- Perform diligent and regular housekeeping.

Other Chemical Hazards

Cryogenic Substances (liquefied/solidified gases)

Cryogenic substances are compounds that are maintained in liquid or solid form at extremely low temperatures. The most common cryogens that are readily available to schools are solid carbon dioxide (dry ice) and liquid forms of hydrogen, oxygen, methane, and nitrogen.

Cryogens pose several serious hazards. These include the following:

- *Explosive Pressure*. Cryogenic gas generates enormous pressure when it vaporizes within the container and when released through the valve. In the case of methane gas, for example, the expansion is 630 times that of the equivalent liquid volume.
- *Fire*. Flammable cryogenic substances present the same flammability hazard as their gaseous forms.
- *Embrittlement* of structural materials and human tissues. Most materials experience some degree of embrittlement at temperatures below –50°C. Contact with cryogenic liquids, their gases, or the surfaces of their containers can lead to frostbite or more extensive freezing of tissue that can be very destructive. Living tissue can become completely frozen and so brittle that it will shatter on impact.

- *Asphyxiation*. Except for liquid oxygen, expansion of cryogens may displace a sufficient volume of air to cause asphyxiation. This is particularly true of dry ice, which sublimes into carbon dioxide gas and readily displaces normal air, since it is heavier than other atmospheric gases.

The use of cryogenic compounds is not required to meet any specific learner outcomes in Alberta science curricula. Instead, teachers sometimes use these substances to create special effects. Use of cryogens may require submission of a written "Safe Work Procedure" proposal to the Safety Services Department or an equivalent department. Before proceeding with ordering and using these substances, check the regulation requirements with your school authority office.

Only personnel with the necessary expertise and appropriate administrative approval should handle cryogenic substances, including dry ice. Use by students is not recommended. Anyone choosing to use cryogens should have a thorough knowledge of the characteristics of the substance at the temperatures and pressures being used and a thorough knowledge of the appropriate safety precautions for handling. They should also know how to recognize and eliminate leaks and know the requirements for short- and long-term storage.

To minimize risks, it is important to take every possible precaution, including the following:

- Use cryogens only in a properly ventilated space to avoid a build-up of gas/vapour that may cause fire, explosion, or asphyxiation. Adequate ventilation is particularly important to prevent asphyxiation with the use of dry ice.

- Store containers of cryogenics in a cool, well-ventilated space, in an upright secured position, and vent containers properly to avoid explosion. Prolonged storage in a poorly ventilated area will cause metal valves to undergo chemical corrosion. If this occurs, store in a separate cool, dry room away from direct sunlight and sources of sparks or flames.

- Ensure warning signs and the name of the cryogen are posted in locations where the substance is stored or used.

- Ensure vessels are appropriately labelled and filled only with the liquids that they were designed to hold.

- Perform operations slowly to minimize boiling and splashing.

- If liquid nitrogen is heavily contaminated with oxygen, handle it with precautions suitable for liquid oxygen. The appearance of a blue tint in liquid nitrogen is a direct indication of oxygen contamination.

- Take appropriate precautions when releasing cryogenic gases. If oxygen is used, remember that it does not burn but it does enhance burning of flammable materials; thus, open flames or sources of sparks should be removed from the area.

- Ensure that all eyes are protected and all skin is covered by wearing goggles, a face shield, pants and boots, a laboratory coat or apron without pockets or cuffs, and loose-fitting insulating gloves that can be easily removed.

- Remove watches, rings, bracelets, and other jewellery.

Compressed Gases

Cylinders of compressed gases should be handled and stored in a similar fashion to cryogenic substances.

Containers used to store gases should meet the National Fire Protection Association (NFPA) standard prescribed for both Canada and the United States.

Flammable Substances

Generally, substances that are highly flammable, particularly those that are also highly volatile, should not be used by students. If minute amounts are provided for student use, make sure the area is well-ventilated and far from open flames or sparks. Identify and eliminate any unwanted ignition sources that may exist, such as sparks that come with unplugging electrical cords and static electricity. Teacher demonstrations using flammable substances can be done under similar conditions or under the fume hood.

Again, cabinets and containers used to store gases should meet the National Fire Protection Association (NFPA) standard, which is relevant both in Canada and the United States.

Explosive Substances

Concentrated forms of unstable substances that have the potential to explode pose too great a risk to warrant use and should not be kept in schools. Some explosive substances in lower concentrations, such as hydrogen peroxide, are relatively safe. For more information on explosive substances, refer to this group in the “Reactive Nature of Chemicals” table in Chapter 9.

Managing the Release or Spill of Toxic or Corrosive Substances

Deciding how to handle a spill first requires understanding the health hazards associated with the substance. There are three immediate questions that must be answered:

- Is this substance highly toxic or corrosive?
- Does it give off toxic or corrosive fumes?
- Are the fumes potentially explosive?

Answers to these questions can be found in the pertinent SDS that should be accessible to users at all times and that should be reviewed before commencing activities with the substance. For substances that are highly toxic or corrosive (see Use in School Category in Chapter 9), any spills and releases of these substances must be handled by specially trained professionals who are equipped to deal with such emergencies. This may require evacuation of the school, particularly if highly toxic gases or vapours are associated with the substance. See Chapter 2 for emergency procedures.

In the case of spills of acids and bases, local action by knowledgeable staff can be taken to neutralize the spill using materials prepared for that purpose. Once neutralized, the products can then be cleaned up and disposed of.

Prompt cleanup is also the appropriate measure to deal with manageable quantities of other materials that are not highly toxic or corrosive. All wastes resulting from these cleanups should be contained separately. Placing all spilled or waste chemicals in a general waste bin may result in reactions with other chemicals or wastes placed in the container.

Corrosive Liquids

Less serious spills of corrosive liquids can be handled using the following steps:

1. Put on protective clothing/equipment (face shield, rubber gloves, rubber boots, and laboratory coat) if the spill is concentrated.

2. Contain the spill with asbestos-free vermiculite, clay cat litter (bentonite), or diatomaceous earth.

3. Neutralize the substance. For acids, liberally apply sodium bicarbonate (baking soda) or sodium carbonate (soda ash), or apply a spill kit pillow. For bases, sprinkle boric acid or citric acid on the spill, or apply a spill kit pillow. Test with pH paper to ensure the substance is completely neutralized.

4. Dilute with plenty of water and mop up using an absorbent cloth.

5. Wash contents down the sink and clean the spill area with water. Wipe dry with paper towels.

Note: Municipal bylaws and waste regulations may permit some substances to be disposed of through drains. If permitted in your area, wash the material down with plenty of water. Alternatively, absorbent materials (asbestos-free vermiculite or diatomaceous earth) may be used to soak up the solution. The resulting mixture can then be bagged, labelled, and sent for disposal.

Flammable Liquids

Small amounts of flammable liquids, such as solvents, can be cleaned up as follows:

1. Immediately shut off all ignition sources (if not already the case), and open windows and vents leading directly to the outside for ventilation.

2. Contain and cover the spill with a mineral absorbent such as asbestos-free vermiculite, bentonite, or diatomaceous earth.

3. Scoop the contaminated absorbent into a heavy gauge garbage bag or plastic bucket with lid.

4. Wash the spill area with soap and water, using a disposable cloth.

5. Dispose of the contaminated cloth in the same garbage bag.

6. Allow for evaporation under the fume hood.

Other Liquids (excluding mercury)

Water-soluble Liquids

1. If necessary, contain with towels, asbestos-free vermiculite, bentonite, or diatomaceous earth.

2. Dilute with water.

3. Mop up using paper towels or cloths. Very small spills can be swabbed directly into a sink and flushed with large volumes of water.

4. Check the Chemical Hazard Information Table in Chapter 9 or the SDS for final disposal details.

Water-insoluble Liquids

1. If necessary, contain with towels, asbestos-free vermiculite, bentonite, or diatomaceous earth.

2. Cover the spill with mineral absorbent and scoop the contaminated material into a suitable container for disposal.

3. Wash the spill area with water and soap and wipe dry with paper towels.

4. Discard contaminated towels or cloths. Check the Chemical Hazard Information Table in Chapter 9 or the SDS for final disposal details.

Solids

The critical factor in cleaning up solid chemicals is to avoid raising particles into the air and inhaling them.

1. Slowly sweep up granules or powder into a dustpan.

2. Mop up smaller amounts with a damp disposable cloth.

3. Wipe the area clean.

4. Determine appropriate disposal procedures from the Chemical Hazard Information Table in Chapter 9 or the SDS.

Chapter 8: Chemical Hazard Control

Overview

While all types of hazards (e.g., chemical, physical, and biological) must be adequately controlled, chemical hazards represent the greatest risk to staff and students based on historical experience. As such, a detailed section on controlling chemical hazards is provided.

Many chemicals can be managed safely by schools, depending on staff expertise and the facilities available. Chemicals designated as hazardous, however, require special attention through the full cycle of procurement, storage, use, and disposal. Hazard control of such chemicals requires a thorough understanding of their chemical properties and their potential hazards and knowing what to do in case of an incident.

Chemical hazard control can be achieved by implementing a sound and comprehensive chemical hazard control plan that addresses chemical purchasing, storage, and inventory, as well as strategies for minimizing and managing chemical wastes. To ensure such a plan is working effectively requires auditing (and revising if necessary) processes for

- ordering and receiving chemicals;
- storing and handling chemicals; and
- disposing of chemicals.

Chemical Acquisition

Choice of Chemicals

The selection of chemicals for use in school laboratories should be based on several considerations:

- curriculum needs;
- value of the laboratory experiences provided to students;
- chemical hazards;
- likelihood of chemicals being used in multiple activities or classrooms;
- maturity, knowledge, and skills of the students;
- availability of alternative activities and materials;
- storage facilities and laboratory equipment available; and
- environmental considerations and costs related to disposal.

In many cases, non-regulated chemicals that can be bought at the local store can be used as substitutes for more hazardous chemicals. Choosing these less hazardous chemicals often reduces cost of purchase and disposal as well as the hazards associated with use.

However, there are many chemicals required in science courses, particularly those in senior high school, that must be ordered from chemical supply houses. Choose safer substitutes if a chemical, no matter how beneficial, poses significant risks.

If an activity that is being attempted for the first time calls for chemicals not on the shelf, a school may wish to borrow rather than purchase the chemicals, particularly if it is uncertain that these chemicals will be used again in the future. If borrowing requires transport between locations, follow Transportation of Dangerous Goods (TDG) regulations.

Quantity Ordered

When determining how much of a specific chemical to order, consider the following factors:

- consumption rate;
- stability of the chemical (e.g., most inorganic salts and dilute acids and bases stocked in schools do not deteriorate with time);
- future use of the chemical;
- available storage space; and
- financial resources.

As a general rule, a "less is better" approach to chemical purchasing lowers inherent risks. Buying only what is needed, based on the factors above, also leads to better organization and less costly waste disposal at the end of the year. For less-stable compounds, particularly those that decompose over time, keeping amounts ordered to a minimum will greatly improve safety and reduce storage concerns and disposal costs. A reasonable shelf life for such substances would be a maximum of three years.

Suppliers sometimes sell large quantities of chemicals at considerable savings. Bulk purchase may be an option with frequently used chemicals, particularly those that are not considered hazardous or are not regulated. However, there are several reasons why such bulk orders may not be advisable:

- Adequate storage space may be limited.
- Curricular changes may occur or teachers may choose different experiments, eliminating the need for the chemical.
- Initial cost savings from bulk purchasing may be eliminated by added disposal costs if a large amount of the chemical is no longer needed and requires disposal.

Receiving Chemicals

Only TDG-trained personnel can receive incoming chemicals. Whenever an order of chemicals arrives, these individuals may follow the steps below or other similar school or school authority procedures.

1. Check the integrity of each chemical and chemical container.
2. Check for WHMIS labelling and the presence of SDSs.
3. Write on each container the date received and the name of the school.
4. Enter information into a chemical inventory.
5. Store chemicals (apply colour-coding, if that is the school's practice) and file paperwork.

Storage of Chemicals and Other Products

Storage of chemicals and other products requires thoughtful planning and appropriate facilities. Chemicals purchased from supply companies demand special attention with regard to safe storage.

However, in addition to these chemicals, chemical storage areas in schools often contain consumer products, perishables, ice, and frozen goods required by school science programs. Vitamins, antacids, detergents, yeast, soda drinks, vegetable oils, meats, dairy products, fruits, vegetables, and baking products are a few of the materials that may be found in school science areas. Some of these products fit into a chemical storage category; others require additional storage space, often in a refrigerator or freezer.

Consumer products classified as hazardous products should be integrated into the storage scheme used for all other chemicals.

Materials for activities involving eating or tasting should not be used or stored in any areas used for hazardous chemicals and, therefore, will also require an additional storage space outside of the chemical preparation and science laboratory areas. A refrigerator used for storing chemicals cannot be used for refrigeration of "eating" or "tasting" products. Once edible products are stored with chemicals in a refrigerator, they are considered contaminated and can no longer be consumed.

Storage Facilities for Chemicals

The hazards associated with chemical use can be greatly reduced by storing all chemicals in suitable storage facilities.

An ideal chemical storage area

- is a separate area outside of the classroom;
- can be accessed only by authorized personnel;
- has locking doors with a key separate from those used to enter classrooms or preparation areas;
- is adequately vented with a continuously running fan to prevent build-up of gases or vapours;
- protects chemicals from direct sunlight and extreme temperatures;
- has explosion-proof lights, switches, and fan motor housing to prevent fires caused by electrical shorts or sparks in faulty switches (required in locations defined as a “hazardous location” described in Part 1 of the Canadian Electrical Code);
- has ground-fault interrupter (GFI) circuits installed, especially near sinks;
- has ceilings and walls made of gypsum boards or a similar non-combustible material;
- has adequate cupboard space for each category of chemicals, as determined by the quantity on hand and school requirements;
- has sturdy, non-metallic shelves that are securely fastened to the wall or are part of a securely fastened or supported cupboard; and
- has storage cupboards that are not airtight.

Flammables and concentrated acids may be stored in special cabinets purchased for these types of hazardous materials. Such cabinets are available in metal, plastic, or wood. Cabinets made of wood are suitable for bases.

Since wood is not suitable for nitric acid, acids should be stored in plastic cabinets.

Cabinets for flammables are generally metallic, but the wood ones are suitable for corrosive flammables such as organic acids; e.g., acetic, butyric, formic.

Venting of these cabinets is not considered necessary but depends on air circulation or venting of the room in which they are stored.

The chemical storage area(s) in a school should be large enough to house all of the chemical stock used in the science program as well as the waste chemicals generated through use.

A typical senior high school of 800 to 1000 students will require a room with approximately 100 linear metres of shelf space. A junior high school may require 50 metres of shelf space. The space requirements should reflect the science programs offered throughout the year. Schools offering advanced placement or international baccalaureate courses will require additional space. If a school is unable to accommodate its chemical stores in a facility similar to the one described in this section, the school may need to reassess or reconsider the amount of material necessary to have in storage.

The chemical storage area must be equipped with appropriate safety equipment and supplies, including a first aid kit. See Chapter 3 for more information.

Chemical Storage Schemes

In the past, chemicals in schools may have been stored using a non-classified system, with products placed on shelves in alphabetical order. Although this arrangement of chemicals appeared to be orderly, it resulted in highly reactive substances, such as oxidizing agents and reducing agents, being stored together, creating the risk of spontaneous reactions between incompatible chemicals. In some cases, flammable storage cabinets were used to store a variety of hazardous materials without consideration for their compatibility.

The risk of incidents can be greatly reduced by replacing this kind of non-classified storage system with a scheme that separates incompatible groups and isolates chemicals that present special hazards.

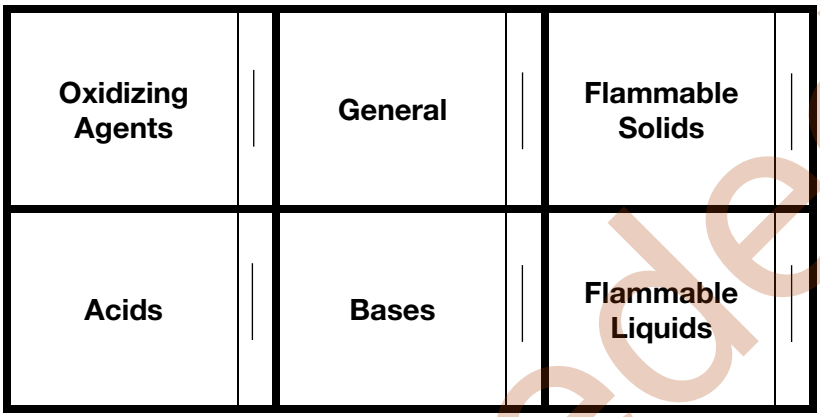
The storage schemes that follow can be used as a guideline for safe storage of chemicals in schools. They reflect the 2014 Alberta Fire Code (Table 3.2.7.6), which requires separation of certain chemicals based on TDG regulation classification.

By separating flammable solvents from reactive chemicals, and corrosive liquids from toxicants, these schemes eliminate the risk of spontaneous fire or the release of poisonous fumes.

These schemes are adaptable to facilities of various designs and to various chemical inventories. Schools may or may not have all of the hazard categories, and some schools may establish other categories to meet their particular needs.

Scheme 1: Grades 1–8 (storage scheme for limited quantities of low-hazard chemicals)

Scheme 1 provides for adequate separation of chemicals for most elementary and junior high schools up to Grade 8 where *small quantities of low-hazard* chemicals and dilute solutions are kept on hand. This scheme could also be adapted for Grade 9, but is not adequate for senior high schools. Scheme 2 provides a better model for senior high school use.



Scheme 1 is based on six cupboards but may be expanded to seven or more to provide sufficient space for general storage items. The shelves in these cupboards need to be secure and strong enough to support the weight of all containers placed on them. These cupboards must **not** be airtight.

In addition to the cupboards shown, a refrigerator may also be needed to store perishables and frozen products. If the refrigerator is used for storing materials for tasting or eating, it should be placed away from the chemical storage area and not be used for storing chemical and biological specimens.

Further information on safe storage of chemicals is included in the following storage category notes:

1. *Acids*
   Keep organic acids (e.g., acetic acid) and mineral acids (e.g., hydrochloric acid and sulfuric acid) on separate shelves. The acid cupboard should not contain any metal fixtures or objects.

2. *Bases*
   This cupboard would shelve household ammonia, sodium hydroxide, and other hydroxides. It should not contain any metal fixtures or objects.

3. *Oxidizing agents*
   Peroxides, bleach, and nitrates are examples of oxidizing agents. Most peroxides are not recommended for elementary and junior high schools, but hydrogen peroxide would be shelved here. These materials must be kept away from any flammable

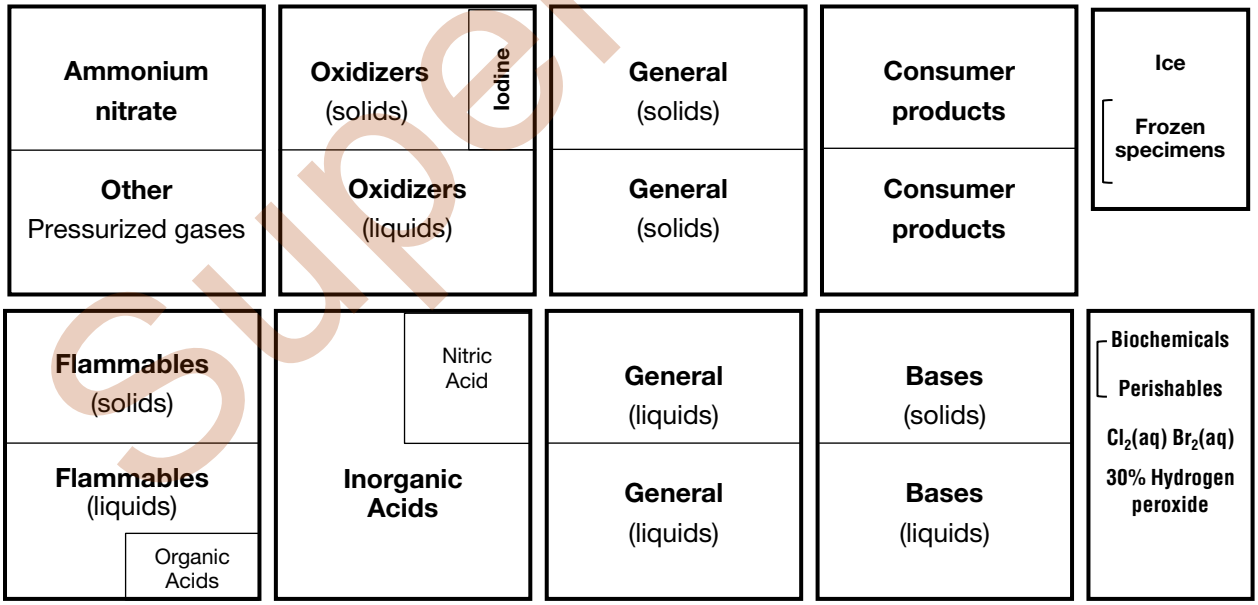
liquids or solids, as well as materials such as paper or cloth. Ammonium nitrate, if purchased, should be stored by itself, as it is a very strong oxidizing agent and is incompatible with most other chemicals.

4. *Flammable solids*
   Flammable solids include metal powders, carbon, charcoal, and similar materials. These materials must be kept away from oxidizing agents.

5. *Flammable liquids*
   Flammable liquids such as methanol and ethanol should be stored in a clearly labelled, cool, and well-ventilated cupboard, separated from other cupboards by at least a partition. Refer to the Alberta Fire Code for regulations governing type, location, labelling, allowable quantities, and other requirements for these storage areas. Avoid storing flammable liquids in a fridge where lights, switches, or thermostats can serve as ignition sources.

6. *General*
   This category includes any materials not covered in the other categories, such as Epsom salts, baking soda, starch, glycerin, and vitamins.

Scheme 2: Grades 9–12 (scheme for senior high schools)
Scheme 2 provides for adequate separation of chemicals in schools that offer science programs from grades 9 to 12. The scheme is based on a greater number of chemical categories than shown in Scheme 1 and includes provision for refrigerated storage of some chemicals.



Provide space between chemicals to facilitate access. Avoid storing chemicals more than three deep. If the height of the cupboards requires the use of a step ladder or stool, use a ladder or a stool with a non-slip surface.

1. Acids

Store organic acids, such as vinegar, above or separated from mineral acids. Store acid anhydrides with this group. Nitric acid is a strong oxidizing agent and should be isolated as well. It will build pressure over time and should be vented periodically. Parafilm or plastic electrical tape can be placed around lids for storage to help prevent the escape of fumes. Plastic lids will deteriorate with time and should be replaced when this occurs. This cupboard should not contain any metal fixtures or objects unless coated with special paint.

2. Bases

Store any solid sodium hydroxide above or separated from dilute solutions of sodium hydroxide and household ammonia. Some bases will react with glass containers to form a filmy precipitate and are best stored in base-resistant plastic bottles. Those that emit fumes should be sealed with parafilm or electrical tape. This cupboard should not contain any metal fixtures or objects.

3. Oxidizing agents

Store nitrates, potassium permanganate, and iodine solids above or separated from their oxidizing solutions. Lids on bottles of iodine should be sealed with parafilm or electrical tape. These materials must be kept away from any flammable liquids or solids and materials such as paper or cloth.

Ammonium nitrate is an extremely strong oxidizing agent and is incompatible with most other chemicals. It should be stored away from other materials.

4. General

Inorganic substances, such as baking soda, salt, and copper sulfate, would be found here, as well as organic compounds such as glucose, indicators, and starch. This category includes any materials not in any of the other categories. Some further separation may be desirable if available storage facilities allow.

5. Flammable liquids

Rubbing alcohol, ethanol, petroleum ether, and indicators dissolved in ethanol would be in this area. These materials should be stored in a clearly labelled, cool, and well-ventilated cupboard, separate from other cupboards by at least a partition. Ideally, flammables should be stored in a special cabinet manufactured for this purpose.

6. Flammable solids

Flammable solids include metal powders, carbon, and charcoal. These materials must be kept away from oxidizing agents. Refer to the Alberta Fire Code, 2014, for regulations governing type, location, labelling, allowable quantities, and other requirements.

Setting Up a Chemical Inventory

A chemical inventory serves as an effective way of tracking chemical supplies. It is also an excellent opportunity for schools to improve safety by recording and organizing information about hazardous materials in the school.

A chemical inventory provides a consolidated information base for monitoring chemical usage, completing insurance claims, and tracking WHMIS requirements for SDSs. It also allows for an integration of computer support systems and encourages sharing of information through computer networking. Finally, by establishing a system for monitoring chemical supplies on an ongoing basis, an inventory ensures program and support continuity when staff changes.

A computerized or electronic inventory is ideal because it is easy to update as chemicals come in or are removed from stock. The inventory can be stored centrally for easy access, with a copy supplied to the head caretaker and the individual(s) responsible for chemicals and hazardous materials in the school.

An effective chemical inventory will include the following information:

- name of chemical;
- CAS number;
- quantity of chemical;
- supplier;
- verification and date of SDS;
- date of purchase;
- inventory review date;
- WHMIS signal word and hazard statements;
- storage location;
- date container was opened; and
- disposal date (empties).

For those choosing to track chemicals using a traditional paper-based inventory, a blank template of the following sample inventory is included as Appendix F of this document.

Chemical Inventory – Example

Completed by _____ Review Date _____

Chemical	CAS Number	Quantity	Supplier	SDS Mo/Yr	Purchase Date	WHMIS 2015 Signal Word and Hazard Statement(s)	Storage Location	Container Opened Date	Disposal Date (Empties)
Acetic acid (glacial)	64-19-7	4 L	Westlab	Nov-18	Dec-18	*Danger* • Flammable liquid and vapour • Harmful if swallowed • Causes severe skin burns and eye damage • Causes serious eye damage	Acid cabinet	Dec-18	Feb-19
Ethanol	64-17-5	2 L	Westlab	Jan-18	Jan-18	*Danger* • Harmful if swallowed • Highly flammable liquid and vapour • Causes serious eye irritation • Causes damage to organs	Flammables cabinet	Feb-18	March-20

Inventory Control

Inventories should be updated annually to reflect product use and curriculum changes. The decision regarding the quantity ordered and stocked needs to take into account consumption rate, as well as the stability of the chemical. See the section Quantity Ordered earlier in this chapter for factors that have an impact on chemical inventory. As chemicals are used or disposed of from the school site, they should be deleted from the inventory.

An annual check of chemicals on the shelves is a chance to

- remove chemicals unsuited for the program(s);
- remove excess supplies, including chemicals no longer used because of program changes or activities selected;
- remove contaminated, deteriorated, and unidentified chemicals;
- ensure a current SDS is available for each chemical (SDSs are updated as new information is known; it may be necessary to contact the supplier to confirm that no changes have been made.);
- ensure a WHMIS label is on every chemical container;
- confirm chemicals are in their proper location on the storage shelf;
- ensure that opened containers are being used before new stock is opened; and
- visually inspect chemicals on the shelf to ensure they have not deteriorated or been contaminated by moisture or other substances.

Labelling

Proper labelling is one of the most important aspects of an effective and safe laboratory. Labels alert the user to the hazards of the product and provide precautions for its safe use. Therefore, they must present the required information clearly and legibly.

WHMIS Pictograms and Labelling Conventions

Purchased and prepared stock chemicals kept in the storeroom, as well as materials that are generated by staff and students, require proper labelling according to WHMIS regulations.

In terms of labelling and SDS requirements, the WHMIS definition of hazardous product does not include radioactive materials, pesticides, traditional explosives, consumer products, or materials covered under food and drug legislation. A sufficient amount of information is provided to workers through other means to ensure the safe use of these products. Wood and tobacco products and manufactured articles are also excluded from all aspects of WHMIS. Other provincial health and safety laws and regulations cover the hazards of these materials. The following are examples of WHMIS 1988 and WHMIS 2015 pictograms used to indicate hazards:

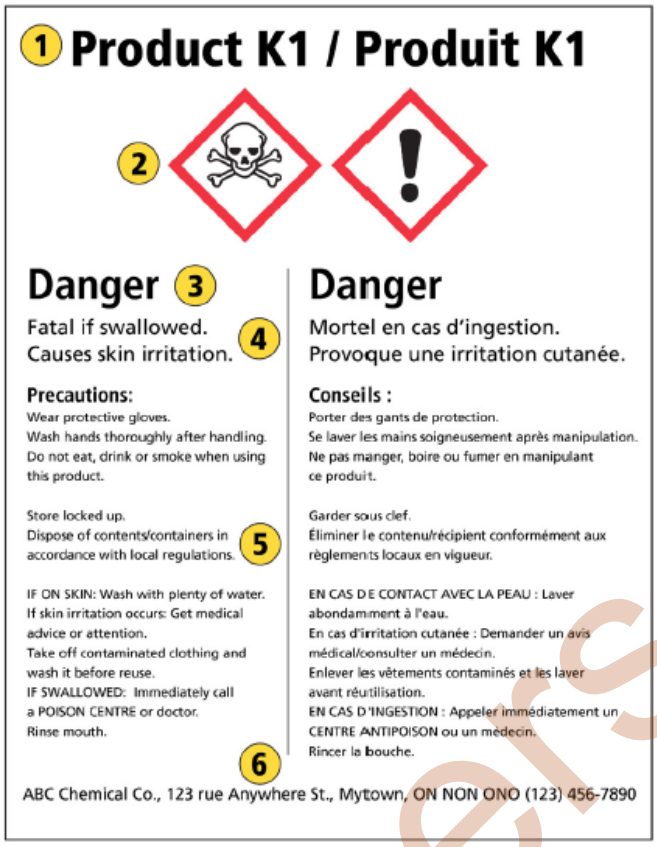
WHMIS Chemical Hazards Pictograms 2015

WHMIS 1988 Hazard Class	WHMIS 1988 Symbols	WHMIS 2015 Symbols	WHMIS 2015 Hazard Class
A			Gases Under Pressure
B1 to B6			Flammables, Self-Heating, Emit Flammable Gases, Pyrophoric Gases, Liquids & Solids Organic Peroxides
C			Oxidizing Gases, Liquids, Solids
D1			Acute Toxicity - Oral, Dermal, Inhalation
D2			Eye Irritation, Skin Irritation Skin/Respiratory Sensitization, Carcinogenicity Mutagenicity Reproductive Hazards
D3			Biohazardous Infectious Materials
E			Skin/Eye Corrosion Corrosive to Metals
F			Self-Reactive Substances Organic Peroxides
N/A	N/A		Explosive Substances (Explosives are still covered under WHMIS exclusions for now)
N/A	N/A		Aspiration, STOT (Single Exposure, Repeated Exposure)

(Government of Canada, Health Canada)

Supplier Labels

These labels come with the chemicals from the chemical supply company. The following is an example supplier label with six information elements under WHMIS 2015:



(Canadian Centre for Occupational Health and Safety (CCOHS), 2016)

1. Product Identifier – The product name exactly as it appears on the container and on the Safety Data Sheet (SDS).
2. Hazard Pictograms – Determined by the hazard classification of the product, these symbols convey specific hazard information visually.
3. Signal Word – "Danger" or "Warning" is used to emphasize hazards and indicate the severity of the hazard.
4. Hazard Statements – Brief standardized statements of all hazards based on the hazard classification of the product.
5. Precautionary Statements – These statements describe recommended measures to minimize or prevent adverse effects from exposure to the product.
6. Supplier Identifier – The company that made, packaged, sold, or imported the product and is responsible for the label and SDS.

Supplier labels must be bilingual (English and French). All chemical containers, including the original container, must be labelled in such a way as to clearly identify the contents. There are a few situations where the supplier label may be slightly different from the basic model. This may be the case for hazardous products in volumes less than 100 mL and for compressed gas cylinders having curved labels on their necks.

Work Site Labels

These labels are applied at the work site. They are used on hazardous products that are transferred from the supplier's containers to work site containers. In the laboratory, for example, transfer containers and reaction vessels containing mixtures, solutions, or reaction products must have a work site label. Work site labels are also used to replace supplier labels that have been damaged.

This form of label has three components as shown below.

Chemical Name (matching the SDS product name)
Safe handling precautions (may include pictograms or other supplier label information)
Statement to refer to *Safety Data Sheet* for further information

Work site labels for small quantities of 100 mL or less are exempt from the requirement to include safe handling precautions. In such cases it is recommended the label include the following:

- chemical name (matching the SDS product name);
- hazard pictogram(s) and signal word; and
- statement to refer to the SDS.

The tray or box, however, used to keep the aggregate total (e.g., a box containing 10 35 mL dropper bottles) must have a standard work site label attached.

Consumer-restricted Products and Other Hazardous Materials

Other legislation in Canada requires precautionary labelling on containers of hazardous materials not covered under WHMIS, such as consumer-restricted products, explosives, pesticides, or radioactive substances.

Consumer-restricted products are chemicals that are packaged for consumer use at home or for recreational purposes. Such products include bleach, hydrogen peroxide, mineral spirits, drain cleaners, and turpentine. These are not regulated as closely as hazardous products. Accordingly, the supplier does not need to supply an SDS with these products, but will nevertheless provide one on request. As with other consumer products, consumer-restricted products have to be clearly labelled and indicate any hazards inherent in the product. When used in the workplace, these products are subject to regulatory requirements, such that

- they are correctly labelled; and
- workers know how to use, store, handle, and dispose of them safely.

In some jurisdictions, liability suits have identified lack of proper labelling as a contributing cause of an incident. Careful labelling practices help prevent incidents and protect the teacher and school authority from assuming unnecessary liability.

WASTE STORAGE AND DISPOSAL

Storage of Wastes and Surplus Chemicals

Surplus chemicals and chemical wastes created in experiments present the same kinds of hazards as stock chemicals ordered from supply companies. Chemical waste from individual experiments should be collected in clearly labelled containers. With solutions, the water can be allowed to evaporate to leave a solid waste residue. Until each surplus chemical or waste material can be safely removed, it should be carefully stored in the cupboard normally used for that WHMIS classification. Proper waste storage includes

- attaching appropriate identification and WHMIS labels;
- categorizing and arranging waste by WHMIS class and ensuring that waste products of incompatible chemicals are not stored in the same container;
- using a separate section or sections of the storage area, designated with a label stating “For disposal. Do not use!”; and
- avoiding physical contact between waste groups when wastes are stored.

Chemical wastes should be combined for storage according to the categories used by disposal companies. Common categories are shown in the table below, but it would be prudent to consult with your school's selected waste disposal company before beginning your sorting system.

Flammable	– liquids	
	– solids	
Corrosive	– liquids	– acids
		– bases
	– solids	– acids
		– bases
Oxidizers	– liquids	
	– solids	
Substances that react with water emitting flammable gas		
Mercury compounds	– liquid	
Polychlorinated biphenyls		
Aerosols		
Bulk paint		
Oil (waste type 201)		
Glycol (waste type 202)		

Disposal of Wastes and Surplus Chemicals

Surplus chemicals and wastes generated in school activities will both require disposal. Selection of the best method for disposal of each waste will require consideration of the kind of hazard each presents, the severity of the hazard, the material's concentration, and whether the material is in pure form or part of an inseparable mixture.

The disposal method also depends on local waste disposal regulations, provincial and federal regulations, and the expertise of school staff. Legislation that applies to waste disposal includes the Waste Control Regulation, AR 192/1996 (with amendments up to and including Alberta Regulation 62/2013), as well as local or municipal regulations, bylaws, or policies regarding sewers, landfills, and the environment.

To avoid safety risks, periodically review the school's chemical inventory and remove chemicals that are not being used, have expired, or that have a container that shows evidence of a breach (such as crystals forming on the outside of the container or staining on the label).

Also remove any chemicals that may have been used in the past but are no longer considered appropriate for use. For example, containers of dissection preservative containing formaldehyde should be safely disposed of. The vapours from such containers can combine with those of hydrochloric acid to form bischloromethyl ether, a strong carcinogen at concentrations as low as 0.001 ppm.

Conducting a chemical inventory can help you identify and dispose of unneeded or dangerous chemicals such as the following:

- any chemicals or containers that have deteriorated or become contaminated;
- chemicals not utilized in current teaching lessons and unlikely to be used in the future;
- chemicals for which updated SDSs are no longer available;
- any seldom-used chemical in excess amounts (several containers of the same chemical or unnecessarily large bulk quantities);
- chemicals without a WHMIS label;
- chemicals that have exceeded their shelf life; and
- old solutions of formaldehyde or other dissection material preservatives.

The following materials require special disposal procedures:

- substances that are designated as dangerous (i.e., regulated) within the Transportation of Dangerous Goods (TDG) Act; and

- all hazardous wastes, if the school produces a total of 5 kg or more of solid or 5 L or more of liquid hazardous wastes per month.

Unknown Substances
Provincial programs have been initiated over the years to safely deal with unknown substances in schools. Labelling something as "unknown chemical waste" is neither possible nor an acceptable category under the TDG Act. Unknown chemicals should be avoided on a go-forward basis. In the unlikely event that unknown chemical waste is generated, teachers and laboratory technicians should segregate the unknown chemical waste and contact a waste carrier to perform some simple tests and obtain a primary hazard classification so that waste materials can be safely transported away from the school. In some cases, school personnel with the proper credentials who are familiar with these simple tests may be able to perform some of these tests on-site themselves.

Waste Carrier and Hazardous Waste Provincial Identification Number
The two categories of materials listed above that require special disposal procedures must be removed from the school by a qualified waste carrier and disposed of by a licensed receiver. A qualified waste carrier is able to pick up and transport hazardous substances to a licensed receiver for proper disposal at a waste disposal facility. Disposal of waste from a school must be initiated through the school authority office, also known as the *waste generator*, and the contract for removal will be between the school authority and the carrier.

School authorities may want to investigate a number of carriers in order to select one that best meets their particular needs. A list of Alberta hazardous waste carriers with approval to collect and transport hazardous wastes can be accessed from the Alberta Environment and Parks website at http://aep.alberta.ca/waste/hazardous-waste/industry/default.aspx.

Before hazardous waste can be disposed of, school authorities are required by the Environmental Protection and Enhancement Act, RSA 2000, c. E-12 to obtain a **hazardous waste provincial identification number**, which must be provided to their waste carrier. Application forms to obtain an identification number can be accessed from the Alberta Environment and Parks website at http://aep.alberta.ca/waste/hazardous-waste/industry/default.aspx or by calling 780-427-3081.

Ecostations and sites designed for drop-off and disposal of household wastes are not appropriate for disposal of school chemical wastes.

Waste Management and Environmental Responsibility
Proper storage and disposal of surplus chemicals and hazardous waste is not only part of science safety, but also an environmental issue.

By being environmentally conscious in the day-to-day management of school laboratories and materials, teachers and other school personnel can prevent unnecessary damage to the environment and instill responsible attitudes in students.

Chemical disposal regulations prevent indiscriminate dumping of chemical waste in the trash or down the drain where to do so would create environmental risks.

Landfills, once thought of as the dumping place for all manner of materials, are now designated by classes based on their design. These class designations indicate the scope of wastes that a landfill of that design can safely accept. Municipal authorities can provide information on the class of local landfills and the types of chemicals that can be disposed of through regular trash.

Similarly, local sewer bylaws identify restrictions on materials that can be disposed of via the drain.

The disposal column of the Chemical Hazard Information Table in Chapter 9 provides basic information on what chemicals can be disposed of via the drain or trash.

For all other chemicals, it is best to strive for a “no chemicals down the drain” philosophy, whereby chemical waste is disposed of by an alternative means that avoids environmental impact. This approach to waste management may require that students and/or teachers place chemical wastes into labelled waste containers on completion of their use.

Teacher caution in categorizing waste is needed to avoid placement of incompatible waste together. The waste is then managed in accordance with accepted best practices. In larger schools, the pooling of wastes for disposal through a waste carrier may be the best strategy for ensuring safe disposal of many hazardous materials.

Strategies for Minimizing Hazardous Waste Production

There are several straightforward and practical ways to reduce the volume of chemical waste generated by science classes. Most of the strategies discussed here involve students using fewer chemicals, which results in less waste generated, less environmental impact, and lower waste disposal costs. Other strategies suggest ways to recover chemicals for reuse or to make multiple uses of the chemical.

Microscale Experiments

Traditional practice in school laboratories is for students to perform experiments using gram quantities of chemicals. An alternative approach is to have students carry out microscale experiments in which chemical quantities are reduced to no more than 100 mg (0.1 g).

Chemical experiments can be carried out successfully using these small quantities of materials, and many students enjoy the challenge of performing experiments on a miniature scale. When students are planning an experiment to investigate a particular question, they can be encouraged to think about using smaller volumes.

Microscale experiments may require the use of different glassware and equipment or the use of existing equipment in new ways. Instead of beakers and Erlenmeyer flasks, teachers may use small test tubes or drop plates. Disposable pipettes calibrated to allow delivery of 0.5 mL or 1 mL can be used to deliver chemical solutions. Reaction plates with a series of wells can be used in performing qualitative analysis of inorganic ions. Disposable pipettes in which the stem has been cut short and a small wad of glass wool inserted can be substituted for filter funnels to collect a few crystals by filtration.

Dispensing Chemicals

Teachers will sometimes find it necessary to weigh the relative merits of dispensing premeasured quantities of chemicals to students versus teaching students to measure quantities for themselves. The decision on which approach is best will usually hinge on an assessment of the hazards associated with the chemical.

If it is a chemical that is of relatively low hazard or toxicity, such as sodium carbonate, then waste generated by students during measurement is not a major concern.

If, on the other hand, the substance is magnesium ribbon, it may be more prudent to pre-cut the appropriate length of ribbon for each student to avoid pieces longer than necessary. Advance measurement by the teacher may also help to minimize waste and limit the possibility of spillage when more hazardous solutions are used.

Use of Lab Stations

Setting up activities at specific sites or stations, equipped with appropriate chemicals and supplies, makes it easier to control and manage chemical use by students.

This approach helps avoid students having to carry chemicals from one place to another and reduces the chance of spills or other incidents. This approach is particularly beneficial in activities where the chemicals can be reused, as it eliminates the need for providing a separate set of chemicals for each group of students.

In activities where probes are used for specific measurements or readings, solutions provided at a station could be used repeatedly as each group progresses through the station.

Since students also leave everything behind once they are done at each station, there is less likelihood of chemicals being intentionally mixed by students out of curiosity. This reduces the generation of unknown and unnecessary wastes that are costly to identify and dispose of via chemical treatment plants.

Use of Demonstrations

Although there is educational value in having students perform experiments on their own, demonstrating a chemical reaction to an entire class can be an effective means of achieving an instructional goal and reducing resulting wastes, particularly in cases where the chemicals involved are more hazardous.

Use of Videos and Computer Simulations

These resources can demonstrate reactions or experiments that otherwise would not be possible due to equipment limitations or because they are too dangerous to perform in class. Such visual presentations or simulations of more dangerous reactions avoids associated risks and provides a near first-hand experience for students. These resources can be used either as part of a class presentation or individually, at stations, by students.

Recovery and Recycling

One aspect of good chemical management is to recycle materials whenever possible. Before discarding uncontaminated chemicals or their solutions, consider other activities where these substances might be used. For example, copper sulfate solution produced when teaching students how to make solutions can be used for growing crystals, for copper plating, or in replacement reactions in the same course or other courses. Similarly, crystals grown in one class may be re-dissolved for use in another when these solutions do not require great purity.

Chemical recovery requires some upfront planning and a space in the lab or chemical storage room where reconstitution can be done. Since most substances used are in solution form, reclaiming the material simply requires evaporating the water.

If a recovered substance is stored in a container other than the original, then proper WHMIS labelling is required on the new container.

Chemical Treatment of Hazardous Waste

There are several chemical methods for processing hazardous waste to reduce volume and/or toxicity in preparation for disposal. Chemical treatments, however, may require the purchase of additional chemicals, be labour intensive, and expose staff to unnecessary risks.

Chemical treatments for hazardous waste should only be carried out by staff who have knowledge of the chemistry involved and who are experienced in working with chemicals. Normally, waste chemicals—in their original form—should be disposed of through a qualified waste carrier.

Evaporation of Aqueous Solutions

When solutions contain chemicals not suitable for recovery, the volume of hazardous materials can be greatly reduced by allowing the solution to evaporate under a fume hood or in another well-ventilated area. Transfer the solution to a wide-mouthed container such as an evaporating basin or large beaker for maximum evaporation surface and allow to stand until a sludge remains. This sludge can be transferred to an appropriate labelled container for off-site disposal.

There may be cases where regulations restrict disposal down the drain but allow disposal via local landfill. In such cases, evaporate to dryness and dispose of in solid trash.

Chapter 9: Chemical Hazard Information

Overview

Many chemicals have minimal hazards, making them relatively safe to use. Others pose inherent risks and require specific precautions. Still other chemicals must be handled with such extreme care that they are not practical or safe for use in schools. This chapter provides information on hazards for nearly 600 chemicals to help teachers, schools, and school authorities select and use chemicals safely. Schools and school authorities may use this information as a starting point for reviewing chemicals currently on their shelves (particularly where chemicals have accumulated over the years) and reassessing the scope and contents of their chemical inventories.

The information in this chapter includes WHMIS hazard classifications, signal words, and hazard statements; use in school categories and storage classes; as well as disposal methods. This information has been compiled from the most reliable and accurate sources available at the time of writing. It remains the responsibility of school authorities and individual teachers to use this information carefully and cautiously and assume responsibility for the consequences of using this information.

Inclusion of a chemical in this listing does not signal appropriateness for school use, but is provided as preliminary information on potential concerns. Given the nature and severity of hazards involved, some of the chemicals listed are designated as not appropriate for use in schools due to safety considerations. Readers are advised to consult SDSs and other current sources of more detailed information before using any of the chemicals listed here. Omission from this list is also not an indication of a non-hazardous chemical.

Reactive Nature of Chemicals

Chemicals can be grouped according to their chemical properties and general behaviour on exposure to other substances or environmental conditions. The following table provides information on types of reactive chemicals, which can be useful when designing a chemical storage scheme or deciding whether or not a chemical should be stocked for classroom use.

Reactive Nature of Chemical	Substances	Notable Characteristics	Handling and Storing
Explosive	• Fulminates* • Nitroglycerin* • Peroxides* • Picric acid* • Azides* • Perchlorates (Na, K)* • Hydrazines* • Dioxane* • Ether* (excluding petroleum ether)	• Substances that decompose with such speed that they cause a rapid expansion of air, sometimes accompanied by burning gases and flying objects. • Explosion may be caused by shock, friction, or heat. • May form explosive by-products on slow decomposition during storage; e.g., ether and dioxane may form explosive peroxides with varying storage time. These appear as grey-green precipitates.	★ Do not order, use, or store **concentrates** of this group of chemicals in schools. • Lower concentrations of some explosive substances (e.g., hydrogen peroxide at 3 to 7%) are safe.
Acid sensitive	• Alkali metals • Alkaline hydroxides • Carbonates • Carbides • Nitrides • Metals • Sulfides • Cyanides* (excluding $K_4Fe(CN)_6 \bullet 3H_2O(l)$)	• Substances that react with acids to release heat, hydrogen, and/or other explosive gas and toxicants.	• Isolate from reactive substances. • Wear and use adequate protection.
Water sensitive	• Strong acids and bases • Acid anhydrides • Alkali metals • Alkali metal hydrides • Carbides* • Aluminium chloride (anhydrous)	• Substances that react with water, releasing heat and/or flammable gases. • Ignition in moist air can cause explosions. • May produce acetylene or methane. • Spontaneous decomposition during extended storage may cause container to explode upon opening.	• Isolate from other reactive substances. • Store in cool, waterproof area. • Wear protective gear.

* These chemicals are not recommended for schools because of their **reactive** nature.

Reactive Nature of Chemical	Substances	Notable Characteristics	Handling and Storing
Oxidation-reduction sensitive (oxidizers only)	• Oxygen • Mineral acids • Perchlorates* • Peroxides* (excluding H_2O_2) • Chromates and dichromates* (excluding $(NH_4)_2CrO_4$(s) and $(NH_4)_2Cr_2O_7$(s)) • Permanganates • Halogens* (excluding I_2(s)) • Chlorates • Iodates	• Substances that undergo rapid oxidation or reduction, releasing heat in the process. • Some are explosive.	• Isolate from each other and other potentially reactive substances. • Use adequate protection.
Special-case organic substances	• Acrolein* • Benzene* • Diethyl ether*	• Organic substances that are flammable may polymerize violently or form explosive peroxides. • May explode when exposed to many oxidants. • May be carcinogenic (benzene, ethylbenzene).	• Store in an airtight container in a cool place. • Isolate from oxidants.
Pyrophors	• Phosphorous (white or yellow)*	• Substances that burn spontaneously when exposed to air.	• Protect from air.

* These chemicals are not recommended for schools because of their **reactive** nature.

Organization of the Chemical Hazard Information Table

The Chemical Hazard Information Table in this chapter provides information to assist teachers and schools in deciding what chemicals to stock and use. The table lists hazard ratings for almost 600 chemicals, including a number of substances that have been used in schools in the past but that have serious risks associated with their use. As well, it provides additional information necessary for safe storage and disposal of the chemicals.

The absence of chemicals from this table does not imply that they are safe. Other sources should be consulted for information on these chemicals.

The Chemical Hazard Information Table is organized with the following column headings:

1. CAS Number
2. Chemical Name(s), State, and Formula
3. Use in School Category
4. WHMIS 2015 Hazard Classification: Class (Category)
5. WHMIS 2015 *Signal Word* and Hazard Statement(s)
6. Storage Class
7. Disposal Methods

The content of each section, as well as the codes and conventions used in the table, is briefly explained below.

CAS Number

A CAS Registry Number is a unique numerical identifier assigned by Chemical Abstract Service (CAS) to every chemical substance described in the open scientific literature.

Chemical Name(s), State, and Formula

The table lists chemicals alphabetically using names conforming to those of IUPAC and the Merck Index. Where an alternative name is acceptable, the substance will appear in the table under both names. The state or form of the substance is included since it implies concentration—a factor that must be known if the hazard levels are to be meaningful. The formula is provided as a means to cross-reference the names of substances, ensuring that the name used for a specific substance actually correlates with the correct substance by formula.

Use in School Category

To assist teachers, schools, and school authorities in making safe choices, the chemicals listed in the table have been grouped into one of four categories, based on their relative safety. The hazards of a chemical tend to increase with its concentration. Keeping this in mind, it should be noted that some chemicals in the table are rated in the "B" or "C" category in concentrated form, but may be rated in the "A" or "B" category in the diluted form. Many acids and bases are rated in this way; e.g., hydrochloric acid [HCl(aq)].

Concentration	Category
0.1 mol/L or less	A
0.1 mol/L to 6.0 mol/L	B

Category A – Chemicals appropriate for use in schools under controlled conditions of use.
Chemicals in this category are ones for which the risks can be managed if used in limited quantities and concentrations, in controlled situations, and following safe procedures. Use of these chemicals should take into account the maturity and skills of the students, the knowledge and skills of the teacher, and the needs of the curriculum.

Category B – Chemicals not appropriate for student use in schools, except in junior and senior high school science courses under highly controlled conditions of use.
This category of chemicals is not appropriate for use by students in elementary science, but may be appropriate for use in junior and senior high school science courses when used in limited quantities under close supervision by well-qualified staff in appropriate facilities. If these chemicals are used, keep quantities and concentrations to a minimum, instruct students in safe use procedures, and ensure waste storage and disposal have been addressed. These chemicals may be appropriate for demonstration purposes in elementary schools by teachers with appropriate knowledge and skills.

Category C – Chemicals not appropriate for student use.
Chemicals placed in this category pose significant safety risks in one or more hazard categories (health, flammability, or reactivity), making them dangerous to use unless major precautions are taken. Conditions required for safe use by students exceed what can be consistently and reliably provided by schools. Some chemicals in this category may be used for demonstration purposes by well-qualified senior high school teachers following a thorough risk assessment.

Category D – Chemicals not recommended for school use by teachers or students because of excessive hazard levels.
For quick reference, category D chemicals have been itemized in alphabetical order in Appendix J at the back of this document. **It is important to note that Category D chemicals identified in the Chemical Hazard Information Table (and in Appendix J) do not represent an exhaustive list of all chemicals not recommended for use by teachers or students.**

WHMIS 2015 Hazard Classification: Class (Category)

Hazard classes are a way of grouping together products that have similar properties. Most of the hazard classes are common to WHMIS 2015. Hazard classes are grouped as physical hazards (flammable gases, oxidizing agents, corrosive to metals, etc.), health hazards (acute toxicity, germ cell mutagenicity, carcinogenicity, etc.), and environmental hazards (not mandatory).

Each hazard class contains at least one category. The hazard categories are assigned a number (e.g., 1, 2). Categories may also be called "types." Types are assigned an alphabetical letter (e.g., A, B). In a few cases, subcategories are also specified. Subcategories are identified with a number and a letter (e.g., 1A and 1B).

Some hazard classes have only one category (e.g., corrosive to metals); others may have two categories (e.g., carcinogenicity [cancer]) or three categories (e.g., oxidizing liquids). There are a few hazard classes with five or more categories (e.g., organic peroxides).

The category indicates how hazardous the product is. Category 1 is always the greatest level of hazard. If Category 1 is further divided, Category 1A within the same hazard class is a greater hazard than category 1B. Category 2 within the same hazard class is more hazardous than Category 3, and so on.

Note that the information in the chart is provided primarily to assist schools in determining what chemicals are appropriate for use. After the chemicals have been acquired, school staff should consult the SDSs for more detailed information before using any of the chemicals.

WHMIS 2015 *Signal Word* and Hazard Statement(s)

A signal word is a prompt that signifies the degree of hazard of the product. There are only two signal words used: "Danger" and "Warning." "Danger" is used for high-risk hazards, while "Warning" is used for less severe hazards. If a signal word is assigned to a hazard class and category, it must be shown on the label and listed in Section 2 (Hazards Identification) of the Safety Data Sheet (SDS).

Each hazard class and category has an assigned "hazard statement." Hazard statements are brief, standardized phrases that describe the most significant hazard of the product. The wording of the hazard statement helps to describe the degree of the hazard. For example, a hazard statement that says "May cause cancer" indicates a more significant hazard than the wording "Suspected of causing cancer."

Storage Class

The chemical classes assigned in this section of the table and outlined below are useful in devising a scheme for the safe storage of chemical groups in laboratories or chemical storage rooms. In some cases, a chemical may fall into more than one class. In such instances, flammability is the primary overriding property for storage classification.

Class #	Chemical Category and Symbol
1	Inorganic Acids (IA)
2	Strong Bases (SB)
3	Organic Acids (OA)
4	Flammable Solids (FS)
5	Flammable Liquids (FL)
6	Oxidizing Agents (OX)
7	Halogens (element form) (H)
8	Miscellaneous (M)

Chemical storage classes were discussed in some detail in Chapter 8 as an important aspect of chemical management.

Disposal Methods

The appropriate methods for disposing of various chemicals depend on a number of factors, and must meet federal, provincial, and local regulations. The Chemical Hazard Information Table uses the following symbols to indicate disposal options for each chemical.

Symbol	Disposal Method	Comments
WF/I	Chemical Waste Facility/Incinerator (government-approved)	Substances identified as hazardous products must be disposed of through a waste facility by federal/provincial law. Non-hazardous chemical waste may be disposed of via a waste facility.
A	Dissipate into Air	Atmospheric gases only.
D	Drain	Dilute acids and bases containing no regulated constituents (pH of 5.5 to 10) and non-hazardous salts can be disposed of this way.
R	Recycle	Local metal and plastic recycle depots.
RS	Return to Supplier	Containers with remaining substance can be returned to supplier.
T	Trash (Landfill)	Dry, non-hazardous wastes.

"Hazardous products" are substances that fall into one or more of the WHMIS hazard classes. These include compressed gases, oxidizing materials, and substances that are poisonous, infectious, flammable, combustible, corrosive, or dangerously reactive.

CHEMICAL HAZARD INFORMATION TABLE

Note: One should become familiar with the background information to the Chemical Hazard Information Table in the introductory portion of this chapter before proceeding to the table for details on specific chemicals.

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
75-07-0	acetaldehyde (liquid) (*ethanal, acetic aldehyde*) $CH_3CHO(l)$ or $C_2H_4O(l)$	D	• Flammable liquids (Category 1) • Skin corrosion/irritation (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Carcinogenicity (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Extremely flammable liquid and vapour • Causes mild skin irritation • Causes serious eye irritation • Suspected of causing cancer • May cause respiratory irritation	5	WF/I
60-35-5	acetamide (crystals) (*acetic acid amide*) $CH_3CONH_2(s)$	C	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2B) • Carcinogenicity (Category 2)	*Warning* • Causes skin irritation • Causes eye irritation • Suspected of causing cancer	8	WF/I
64-19-7	acetic acid, glacial (liquid) (*ethanoic acid*) $CH_3COOH(l)$ or $C_2H_4O_2(l)$	B – dilute C – concentrated	• Flammable liquids (Category 3) • Acute toxicity (oral) (Category 4) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Flammable liquid and vapour • Harmful if swallowed • Causes severe skin burns and eye damage • Causes serious eye damage	3, 5	WF/I
64-19-7	acetic acid (solution) (*vinegar*) mixture: CH_3COOH 5–7% H_2O 93–95% $CH_3COOH(aq)$	A	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes skin irritation • Causes serious eye irritation	3	D

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
108-24-7	acetic anhydride (liquid) (*acetic oxide*, *ethanoic anhydride*) $C_4H_6O_3(l)$	C	• Flammable liquids (Category 3) • Acute toxicity (oral) (Category 4) • Acute toxicity (inhalation) (Category 2) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Flammable liquid and vapour • Harmful if swallowed • Fatal if inhaled • Causes severe skin burns and eye damage • Causes serious eye damage	5	WF/I
67-64-1	acetone (liquid) (*propan-2-one*) $CH_3COCH_3(l)$	B	• Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Highly flammable liquid and vapour • Causes serious eye irritation • May cause drowsiness or dizziness	5	WF/I
Not applicable	aceto-carmine stain (solution) mixture: carmine 0.5% acetic acid 45.0% water 54.5%	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Flammable liquids (Category 3)	*Danger* • Causes serious eye damage • Flammable liquid and vapour	5	WF/I
Not applicable	aceto-orcein stain (solution) mixture: acetic acid 45% orcein 2% water 53%	B	• Flammable liquids (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Flammable liquid and vapour • Causes serious eye damage • Causes severe skin burns and eye damage	5	WF/I
75-36-5	acetyl chloride (liquid) (*ethanoyl chloride*) $CH_3COCl(l)$	D	• Flammable liquids (Category 2) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Highly flammable liquid and vapour • Causes severe skin burns and eye damage • Causes serious eye damage	5	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
50-78-2	acetylsalicylic acid (solid) (*Aspirin*) $C_9H_8O_4$(s)	B	• Acute toxicity (oral) (Category 4) • Combustible Dusts (Category 1)	*Warning* • Harmful if swallowed • May form combustible dust concentrations in air	4	WF/I
107-02-8	acrolein (liquid) (*prop-2-enal, acrylaldehyde*) C_3H_4O(l)	D	• Flammable liquids (Category 2) • Acute toxicity (oral) (Category 2) • Acute toxicity (inhalation) (Category 1) • Acute toxicity (dermal) (Category 2) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Carcinogenicity (Category 2)	*Danger* • Highly flammable liquid and vapour • Fatal if swallowed • Fatal if inhaled • Fatal in contact with skin • Causes severe skin burns and eye damage • Causes serious eye damage • May cause an allergic skin reaction • Suspected of causing cancer	5	WF/I
79-10-7	acrylic acid (liquid) (*prop-2-enoic acid*) $C_3H_4O_2$(l) or $CH_2CHCOOH$(l)	D	• Flammable liquids (Category 3) • Acute toxicity (oral) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (dermal) (Category 4) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Flammable liquid and vapour • Harmful if swallowed • Harmful if inhaled • Harmful in contact with skin • Causes severe skin burns and eye damage • Causes serious eye damage • May cause respiratory irritation	5	WF/I
124-04-9	adipic acid (powder) (*hexanedioic acid*, *1,4-butandicarboxylic acid*) $C_6H_{10}O_4$(s) or $HOCO(CH_2)_4COOH$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	3	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
111-50-2	adipoyl chloride (liquid) (*hexanedioyl dichloride*) $C_6H_8Cl_2O_2$(l)	B	• Flammable liquids (Category 4) • Acute toxicity (oral) (Category 4) • Acute toxicity (dermal) (Category 4) • Skin corrosion/irritation – Skin corrosion (Category 1) • Acute toxicity (inhalation) (Category 4)	*Danger* • Combustible liquid • Harmful if swallowed • Harmful in contact with skin • Causes severe skin burns and eye damage • Harmful if inhaled	5	WF/I
51-43-4	adrenaline (powder) (*epinephrine*) $C_9H_{13}NO_3$(s)	D	• Acute toxicity (oral) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (dermal) (Category 2)	*Danger* • Toxic if swallowed • Toxic if inhaled • Fatal in contact with skin	8	WF/I
9009-18-0	agar, all culture (powder) mixture: agarose variable agaropectin variable glucose variable ascorbic acid variable other variable	A	Not a hazardous substance or mixture	None	8	T
56-41-7	L-alanine (crystals) (*L-2 aminopropanoic acid*) $C_3H_7NO_3$(s) or $CH_3CH(NH_2)COH$(s)	B	Not a hazardous substance or mixture	None	8	T or D(aq)
72-48-0	alizarin (crystals) (*alizarin B* or *red*, *mordant red 11*, *turkey red*) $C_{14}H_8O_4$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I
130-22-3	alizarin red S (solution) mixture: alizarin 1.0% water 99.0%	B	Not a hazardous substance or mixture	None	8	D

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
130-22-3	alizarin red S (powder) (*mordant red 3*) $C_{14}H_7NaO_7S$(s)	B	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Combustible Dusts (Category 1)	*Warning* • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation • May form combustible dust concentrations in air	8	WF/I
2243-76-7	alizarin yellow R (powder) $C_{13}H_8NaO_5N_3$(s)	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Harmful if swallowed • Causes serious eye irritation	8	WF/I
7784-24-9	alum (powder) (*aluminium potassium-sulfate dodecahydrate*) $AlK(SO_4)_2 \bullet 12H_2O$(s)	A	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2B)	*Warning* • Causes skin irritation • Causes eye irritation	8	WF/I
7429-90-5	aluminium (foil or strips) Al(s)	A	Not a hazardous substance or mixture	None	8	R or T
7429-90-5	aluminium (powder) Al(s)	B	• Flammable solids (Category 2)	*Warning* • Flammable solid	8	R/RS
142-03-0	aluminium acetate (basic) (powder) $Al(C_2H_3O_2)_2OH \bullet 1H_2O$(s)	A	Not a hazardous substance or mixture	None	8	T or D
7784-26-1	aluminium ammonium-sulfate dodecahydrate (powder) (*ammonium alum*) $AlNH_4(SO_4)_2 \bullet 12H_2O$(s)	A	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
1299-86-1	aluminium carbide (powder) Al_4C_3(s)	D	• Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 2) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • In contact with water releases flammable gases • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	4	WF/I
14455-29-9	aluminium carbonate (powder) $Al_2(CO_3)_3$(s)	A	• Acute toxicity (oral) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (dermal) (Category 4)	*Warning* • Harmful if swallowed • Harmful if inhaled • Harmful in contact with skin	8	WF/I
7446-70-0	aluminium chloride, anhydrous (powder) $AlCl_3$(s)	C	• Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Causes severe skin burns and eye damage • Causes serious eye damage	8	WF/I
21645-51-2	aluminium hydroxide (powder) (*aluminium hydrate*) H_3AlO_3(s)	A	Not a hazardous substance or mixture	None	8	WF/I
7784-27-2	aluminium nitrate nonahydrate (crystals) $Al(NO_3)_3•9H_2O$(s)	B – solution C – crystals	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Oxidizing solids (Category 2)	*Danger* • Causes skin irritation • Causes serious eye irritation • May intensify fire; oxidizer	6	WF/I
1344-28-1	aluminium oxide (powder) $Al_2O(s)_3$(s)	A	Not a hazardous substance or mixture	None	8	T

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
7784-30-7	aluminium phosphate (powder) $AlPO_4$(s)	B – solution C – powder	• Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Causes severe skin burns and eye damage • Causes serious eye damage	8	WF/I
7784-24-9	aluminium potassium sulfate dodecahydrate (crystals) (*alum*) $AlK(SO_4)_2 \bullet 12H_2O$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
10102-71-3	aluminium sodium sulfate (powder) $NaAl(SO_4)_2$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
10043-01-3	aluminium sulfate (powder) $Al_2(SO_4)_3$(s)	A	• Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • May be corrosive to metals • Causes serious eye damage	8	WF/I
1302-81-4	aluminium sulfide (granules) Al_2S_3(s)	C	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	8	WF/I
569-58-4	aluminon (crystals) (*ammonium aurintricarboxylate*) $C_{22}H_{23}N_3O_9$(s)	B	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes skin irritation • Causes serious eye irritation	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
7664-41-7	ammonia, anhydrous (gas, liquid under pressure) $NH_3(g)$ and $NH_3(l)$	C	• Flammable gases (Category 2) • Gases under pressure (Compressed Gas) • Acute toxicity (inhalation) (Category 3) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Flammable gas • Contains gas under pressure; may explode if heated • Toxic if inhaled • Causes severe skin burns and eye damage • Causes serious eye damage	5	WF/I
1336-21-6	ammonia water (solution) (*household ammonia*) mixture: NH_3 10% H_2O 90% $NH_3(aq)$	A – 1% or less B – 10%	• Corrosive to Metals (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May be corrosive to metals • Causes severe skin burns and eye damage • Causes serious eye damage • May cause respiratory irritation	2	WF/I
1336-21-6	ammonia water (solution) (*ammonium hydroxide*) mixture: NH_3 25–30% H_2O 70–75% $NH_3(aq)$	B	• Corrosive to Metals (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May be corrosive to metals • Causes severe skin burns and eye damage • Causes serious eye damage • May cause respiratory irritation	2	WF/I
631-61-8	ammonium acetate (crystals) $CH_3COONH_4(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
12124-97-9	ammonium bromide (crystals) $NH_4Br(s)$	A	• Serious eye damage/eye irritation – Eye irritation (Category 2B)	*Warning* • Causes eye irritation	8	WF/I
506-87-6	ammonium carbonate (powder) $(NH_4)_2CO_3(s)$	B	• Acute toxicity, oral (Category 4)	*Warning* • Harmful if swallowed	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
12125-02-9	ammonium chloride (powder) $NH_4Cl(s)$	B	• Acute toxicity (oral) (Category 4) • Combustible Dusts (Category 1)	*Warning* • Harmful if swallowed • May form combustible dust concentrations in air	8	WF/I
7788-98-9	ammonium chromate (crystals) $(NH_4)_2CrO_4(s)$	B – solution C – crystals	• Oxidizing solids (Category 2) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Carcinogenicity (Category 1A)	*Danger* • May intensify fire; oxidizer • Causes severe skin burns and eye damage • Causes serious eye damage • May cause an allergic skin reaction • May cause cancer	6	WF/I
3012-65-5	ammonium citrate (powder) $(NH_4)_2HC_6H_5O_7(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
7789-09-5	ammonium dichromate (crystals) $(NH_4)_2Cr_2O_7$(s)	B – solution C – crystals	• Oxidizing solids (Category 2) • Acute toxicity (oral) (Category 3) • Acute toxicity (inhalation) (Category 2) • Acute toxicity (dermal) (Category 4) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Germ cell mutagenicity (Category 1B) • Carcinogenicity (Category 1B) • Reproductive Toxicity (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • May intensify fire; oxidizer • Toxic if swallowed • Fatal if inhaled • Harmful in contact with skin • Causes severe skin burns and eye damage • Causes serious eye damage • May cause an allergic skin reaction • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause genetic defects • May cause cancer • May damage fertility or the unborn child • Causes damage to organs through prolonged or repeated exposure	6	WF/I
7722-76-1	ammonium dihydrogen-phosphate (crystals) (*ammonium phosphate monobasic*) $NH_4H_2PO_4$(s)	A	Not a hazardous substance or mixture	None	8	R/RS
7783-85-9	ammonium ferrous sulfate hexahydrate (crystals) (*Mohr's salt*, *ammonium iron(II)sulfate hexahydrate*) $(NH_4)_2FeSO_4 \bullet 6H_2O$(s)	A	Not a hazardous substance or mixture	None	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
12125-01-8	ammonium fluoride (crystals) $NH_4F(s)$	D	• Acute toxicity (oral) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (dermal) (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Toxic if swallowed • Toxic if inhaled • Toxic in contact with skin • Causes serious eye damage	8	WF/I
1066-33-7	ammonium hydrogen carbonate (powder) (*ammonium bicarbonate*) $NH_4HCO_3(s)$	A	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
7783-28-0	ammonium hydrogen phosphate (crystals) (*ammonium phosphate dibasic*) $(NH_4)_2HPO_4(s)$	B	Not a hazardous substance or mixture	None	8	WF/I
1336-21-6	ammonium hydroxide (solution) (*ammonia water*) mixture: NH_4OH 57% H_2O 43%	B – solution C – crystals	• Acute toxicity (oral) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Causes skin irritation • Causes serious eye damage	2	WF/I
12054-85-2	ammonium molybdate tetrahydrate (crystals) $(NH_4)_6Mo_7O_{24}•4H_2O(s)$	B	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	8	WF/I
6484-52-2	ammonium nitrate (crystals) $NH_4NO_3(s)$	B	• Oxidizing solids (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • May intensify fire; oxidizer • Causes serious eye irritation	6	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
6009-70-7	ammonium oxalate monohydrate (granules) $(NH_4)_2C_2O_4 \bullet H_2O(s)$	D	• Acute toxicity (oral) (Category 4) • Acute toxicity (dermal) (Category 4)	*Warning* • Harmful if swallowed • Harmful in contact with skin	8	WF/I
7727-54-0	ammonium persulfate (crystals) $(NH_4)_2S_2O_8(s)$	C	• Oxidizing solids (Category 3) • Acute toxicity (oral) (Category 4) • Acute toxicity (dermal) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May intensify fire; oxidizer • Harmful if swallowed • Harmful in contact with skin • Causes skin irritation • Causes serious eye irritation • May cause an allergic skin reaction • May cause respiratory irritation	6	WF/I
7722-76-1	ammonium phosphate, monobasic (crystals) (*ammonium dihydrogen phosphate*) $NH_4H_2PO_4(s)$	A	Not a hazardous substance or mixture	None	8	R/RS
7783-20-2	ammonium sulfate (crystals) $(NH_4)_2SO_4(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
12135-76-1	ammonium sulfide (liquid) $(NH_4)_2S(l)$	D	• Flammable liquids (Category 3) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Flammable liquid and vapour • Causes severe skin burns and eye damage • Causes serious eye damage	5	WF/I
7783-11-1	ammonium sulfite monohydrate (crystals) $(NH_4)_2SO_3 \bullet H_2O(s)$	B	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes skin irritation • Causes serious eye irritation	8	WF/I

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1762-95-4	ammonium thiocyanate (crystals) $NH_4SCN(s)$	B	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4)	*Warning* • Harmful in contact with skin • Harmful if inhaled • Harmful if swallowed	8	WF/I
7783-18-8	ammonium thiosulfate (powder) $(NH_4)_2S_2O_3(s)$	B	Not a hazardous substance or mixture	None	8	T or D(aq)
7803-55-6	ammonium vanadate (granules) $NH_4VO_3(s)$	D	• Acute toxicity (oral) (Category 3) • Acute toxicity (inhalation) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Repeated exposure (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Toxic if swallowed • Harmful if inhaled • Causes serious eye irritation • Causes damage to organs through prolonged or repeated exposure • May cause respiratory irritation	8	WF/I
628-63-7	amyl acetate (liquid) (*n-amyl acetate*) $CH_3COOC_5H_{11}(l)$	C	• Flammable liquids (Category 3)	*Warning* • Flammable liquid and vapour	5	WF/I
123-51-3	*iso*-amyl alcohol (liquid) (*3-Methylbutan-1-ol*) $C_4H_{10}O(l)$ or $(CH_3)_2CHCH_2CH_2OH(l)$	B	• Flammable liquids (Category 3) • Acute toxicity (inhalation) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Flammable liquid and vapour • Harmful if inhaled • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	5	WF/I

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71-41-0	*n-amyl* alcohol (liquid) (*pentan-1-ol*, *n-pentyl alcohol*) $C_5H_{11}OH(l)$	B	• Flammable liquids (Category 3) • Acute toxicity (inhalation) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Flammable liquid and vapour • Harmful if inhaled • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	5	WF/I
9000-90-2	amylase (powder) composition variable	B	• Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • May cause an allergic skin reaction	8	WF/I
62-53-3	aniline (liquid) (*amino benzene, benzenamine*) $C_6H_5NH_2(l)$	B – solution C – pure liquid	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 2) • Flammable liquids (Category 4) • Germ cell mutagenicity (Category 2) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • Suspected of causing cancer • Combustible liquid • Suspected of causing genetic defects • May cause an allergic skin reaction • Causes serious eye damage • Causes damage to organs (blood) through prolonged or repeated exposure	5	WF/I
118-92-3	anthranilic acid (*2-aminobenzoic acid*) $C_7H_7NO_2(s)$	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Danger* • Causes serious eye damage • Causes serious eye irritation	3	R/RS
7440-36-0	antimony (solid) Sb(s)	B	Not a hazardous substance or mixture	None	8	WF/I

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7647-18-9	antimony pentachloride (liquid) (*antimony perchloride*) $SbCl_5(l)$	D	• Acute toxicity (oral) (Category 4) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if swallowed • Causes severe skin burns and eye damage • Causes serious eye damage • May cause respiratory irritation	8	WF/I
7446-32-4	antimony sulfate (powder) (*diantimony trisulfate*) $Sb_2(SO_4)_3(s)$	B	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4)	*Warning* • Harmful if inhaled • Harmful if swallowed	8	WF/I
1345-04-6	antimony sulfide (powder) (*diantimony trisulfide*) $Sb_2S_3(s)$	B – solution C – powder	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4)	*Warning* • Harmful if inhaled • Harmful if swallowed	8	WF/I
10025-91-9	antimony trichloride (crystals) (*trichlorostibine*) $SbCl_3(s)$	D	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
1309-64-4	antimony trioxide (crystals) (*diantimony trioxide*) $Sb_2O_3(s)$	B – solution C – crystals	• Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2B)	*Warning* • Suspected of causing cancer • Causes eye irritation	8	WF/I
1306-05-4	apatite (crystalline) (*fluorapatite*, *chlorapatite*, *hydroxlapatite*) $Ca_5(PO_4)_3(F,Cl,OH)(s)$	A	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I

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5328-37-0	L-arabinose (crystals) (*pectin sugar*) $C_5H_{10}O_5$(s)	A	Not a hazardous substance or mixture	None	8	T
74-79-3	L-arginine (powder) $C_6H_{14}N_4O_2$(s)	A	Not a hazardous substance or mixture	None	8	T
7440-37-1	argon (gas) Ar(g)	B	• Gases under pressure (Compressed Gas)	*Warning* • Contains gas under pressure; may explode if heated	8	A
7440-38-2	arsenic (powder or lump) As(s)	D	• Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 4)	*Danger* • Toxic if inhaled • Harmful if swallowed	8	WF/I
1303-28-2	arsenic pentoxide (powder) (*diarsenic pentaoxide*) As_2O_5(s)	D	• Acute toxicity (oral) (Category 2) • Acute toxicity (inhalation) (Category 3) • Carcinogenicity (Category 1A)	*Danger* • Fatal if swallowed • Toxic if inhaled • May cause cancer	8	WF/I
7784-34-1	arsenic trichloride (liquid) (*trichloroarsine*) $AsCl_3$(l)	D	• Acute toxicity (oral) (Category 2) • Acute toxicity (dermal) (Category 2) • Acute toxicity (inhalation) (Category 3)	*Danger* • Fatal if swallowed • Fatal in contact with skin • Toxic if inhaled	8	WF/I
1327-53-3	arsenic trioxide (powder) (*diarsenic trioxide*) As_2O_3(s)	D	• Acute toxicity (oral) (Category 2) • Carcinogenicity (Category 1A) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Fatal if swallowed • May cause cancer • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I

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12001-29-5	asbestos (fibrous solid) mixture: silicates of Na, Mg, and Ca; most commonly chrysotile $Mg_3(Si_2O_5)(OH)_4$ amosite $(MgFe)_7(Si_8O_{22})(OH)_2$(s)	D	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Carcinogenicity (Category 1A)	*Danger* • Causes serious eye damage • May cause cancer	8	WF/I
50-81-7	ascorbic acid (crystals) (*vitamin C*) $C_6H_8O_6$(s)	A	Not a hazardous substance or mixture	None	3	T or D(aq)
5794-13-8	L-asparagine monohydrate (crystals) $C_4H_8O_3N_2 \bullet H_2O$(s)	A	Not a hazardous substance or mixture	None	8	T
56-84-8	L-aspartic acid (crystals) $C_4H_7NO_4$(s)	A	Not a hazardous substance or mixture	None	3	T
531-53-3	azure A (powder) $C_{14}H_{14}ClN_3S$(s)	B	Not a hazardous substance or mixture	None	8	T
531-55-5	azure B (powder) $C_{15}H_{16}ClN_3S$(s)	B	• Germ cell mutagenicity (Category 2)	*Warning* • Suspected of causing genetic defects	8	WF/I
144-55-8	baking soda (powder) (*sodium hydrogen carbonate or bicarbonate*) $NaHCO_3$(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7440-39-3	barium (powder or solid) Ba(s)	C – solid D – powder	• Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 2)	*Danger* • In contact with water releases flammable gases	4	WF/I

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513-77-9	barium carbonate (powder) $BaCO_3$(s)	B	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
10326-27-9	barium chloride dihydrate (solid) $BaCl_2 \bullet 2H_2O$(s)	B – solution C – solid	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 3)	*Danger* • Harmful if inhaled • Toxic if swallowed	8	WF/I
17194-00-2	barium hydroxide (crystals) (*barium hydrate*) $Ba(OH)_2$(s)	B – solution C – crystals	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Harmful if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	2	WF/I
13718-50-8	barium iodide (beads or crystals) BaI_2(s)	B	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4)	*Warning* • Harmful if inhaled • Harmful if swallowed	8	WF/I
10022-31-8	barium nitrate (crystals) (*black ash*) $Ba(NO_3)_2$(s)	B	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Harmful if inhaled • Harmful if swallowed • May intensify fire; oxidizer • Causes serious eye irritation	6	WF/I
1304-29-6	barium(IV) oxide (powder) (*barium peroxide*) BaO_2(s)	B – solution C – powder	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 2)	*Danger* • Harmful if inhaled • Harmful if swallowed • May intensify fire; oxidizer	6	WF/I
7727-43-7	barium sulfate (powder) $BaSO_4$(s)	B	• Acute toxicity (oral) (Category 4) • Acute toxicity (inhalation) (Category 4) • Specific target organ toxicity – Repeated exposure (Category 2)	*Warning* • Harmful if swallowed • Harmful if inhaled • May cause damage to organs through prolonged or repeated exposure	8	WF/I

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21109-95-5	barium sulfide (crystals) BaS(s)	B – solution C – crystals	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 3) • Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Harmful if inhaled • Toxic if swallowed • May be corrosive to metals • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
Not applicable	bauxite (chunks/granules) mixture: aluminium silicates and oxides of Al, Si, Ti, and Fe	A	Not a hazardous substance or mixture	None	8	T
Not applicable	Benedict's qualitative reagent (solution) mixture of: H_2O 73.5% $NaCO_3$ 10.0% $CuSO_4•5H_2O$ 1.5% $C_6H_5Na_3O_7•2H_2O$ 15.0%	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes serious eye irritation • Causes skin irritation	8	WF/I
Not applicable	Benedict's quantitative reagent (solution) mixture of: H_2O 58.21% $NaCO_3$ 7.41% $CuSO_4•5H_2O$ 1.8% $C_6H_5Na_3O_7•2H_2O$ 20.04% KSCN 12.52% $C_6H_6FeK_4N_6O_3$ 0.02%	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes serious eye irritation • Causes skin irritation	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
100-52-7	benzaldehyde (liquid) (*benzoic aldehyde*) $C_6H_5CHO(l)$	B	• Acute toxicity (dermal) (Category 4) • Acute toxicity (oral) (Category 4) • Flammable liquids (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Harmful in contact with skin • Harmful if swallowed • Combustible liquid • Causes skin irritation	5	WF/I
569-64-2	benzaldehyde green (crystals) (*malachite green*) $C_{23}H_{25}ClN_2(s)$ or $C_{23}H_{26}N_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Reproductive Toxicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Suspected of damaging fertility or the unborn child • Causes serious eye damage	8	WF/I
71-43-2	benzene (liquid) $C_6H_6(l)$	D	• Carcinogenicity (Category 1A) • Flammable liquids (Category 2) • Germ cell mutagenicity (Category 1B) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • May cause cancer • Highly flammable liquid and vapour • May cause genetic defects • Causes serious eye irritation • Causes skin irritation • Causes damage to organs (blood) through prolonged or repeated exposure	5	WF/I
26158-00-9	benzenesulfonic acid hydrate (*phenylsulfonic acid*) $C_6H_5SO_3H•H_2O$	D	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful in contact with skin • Harmful if inhaled • Harmful if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	3	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
65-85-0	benzoic acid (crystals) (*benzenecarboxylic acid*, *phenylformic acid*) $C_7H_6O_2$(s)	B – solution C – crystals	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 1)	*Danger* • Causes serious eye damage • Causes skin irritation • Causes damage to organs	3	WF/I
94-36-0	benzoyl peroxide (crystals) (*dibenzoyl peroxide*, *acetoxyl*, *nericur*) $(C_6H_5CO)_2O_2$(s)	D	• Organic Peroxides (Type B) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Danger* • Heating may cause a fire or explosion • May cause an allergic skin reaction • Causes serious eye irritation	4, 6	WF/I
7440-41-7	beryllium metal (lump) Be(s)	C	• Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1B) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Fatal if inhaled • Toxic if swallowed • May cause cancer • May cause an allergic skin reaction • Causes serious eye irritation • Causes skin irritation • Causes damage to organs • May cause respiratory irritation	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
7787-47-5	beryllium salts (crystals) $BeCl_2$(s)	D	• Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1B) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Fatal if inhaled • Toxic if swallowed • May cause cancer • May cause an allergic skin reaction • Causes serious eye irritation • Causes skin irritation • Causes damage to organs • May cause respiratory irritation	8	WF/I
Not applicable	bile salts (powder) (*oxgall*) $C_{24}H_{40}O_5$(s)	A	Not a hazardous substance or mixture	None	8	T
7440-69-9	bismuth (powder or lump) Bi(s)	B – lump C – powder	• Flammable solids (Category 2)	*Warning* • Flammable solid	4	WF/I
7787-60-2	bismuth chloride pentahydrate (crystals) (*bismuth trichloride*) $BiCl_3 \bullet 5H_2O$(s)	B – solution C – crystals	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
10361-44-1	bismuth nitrate (crystals) (*bismuth ternitrate*) $Bi(NO_3)_3$(s)	B – solution C – crystals	• Oxidizing solids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May intensify fire; oxidizer • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	6	WF/I

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1304-76-3	bismuth oxide (powder) (*dibismuth trioxide*, *bismuth yellow*) Bi_2O_3(s)	A	Not a hazardous substance or mixture	None	8	T
Not applicable	Biuret reagent (solution) mixture: NaOH 28.00% $CuSO_4$ 0.12% H_2O 71.88%	B	• Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Causes severe skin burns and eye damage	2	D
7681-52-9	bleach (solution) (*sodium hypochlorite*) mixture: H_2O 80–99% NaClO 1–20% NaClO(aq)	B – diluted C – full strength	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Warning* • Causes serious eye damage • Causes severe skin burns and eye damage	8	D
7778-54-3	bleaching powder (granules) (*calcium hypochlorite*) $Ca(ClO)_2$(s)	C	• Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • May intensify fire; oxidizer • Causes serious eye damage • Causes severe skin burns and eye damage	6	WF/I
6104-58-1	brilliant blue G (solid) (*acid blue 90*) $C_{47}H_{48}N_3NaO_7S_2$(s)	B	Not a hazardous substance or mixture	None	8	WF/I
1303-96-4	borax (powder) (*sodium borate decahydrate*) $Na_2B_4O_7 \cdot 10H_2O$(s)	B – solution C – powder	• Reproductive Toxicity (Category 2)	*Danger* • Suspected of damaging fertility or the unborn child	8	T or D(aq)

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10043-35-3	boric acid (crystals) H_3BO_3(s)	B – solution C – crystals	• Reproductive Toxicity (Category 2)	*Danger* • Suspected of damaging fertility or the unborn child	1	WF/I
7440-42-8	boron (powder or chunks) B(s)	C	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
Not applicable	brass (solid) mixture: copper variable (2 parts) zinc variable (1 part) other metals variable	A – solid C – fume	Brass (solid) – not a hazardous substance Brass dust or fume: • Acute toxicity (inhalation) (Category 4) • Carcinogenicity (Category 1A) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1)	Brass dust or fume: *Danger* • Harmful if inhaled • May cause cancer • May cause allergy or asthma symptoms or breathing difficulties if inhaled	8	R
7726-95-6	bromine (liquid and gas) Br_2(l) or Br_2(g)	D	• Acute toxicity (inhalation) (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Fatal if inhaled • Causes serious eye damage • Causes skin irritation	7	WF/I
7726-95-6	bromine water (solution) Br(aq)	B	• Acute toxicity (inhalation) (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Fatal if inhaled • Causes serious eye damage • Causes skin irritation	7	WF/I
76-60-8	bromocresol green (powder) $C_{21}H_{14}Br_4O_5S$(s)	A – solution C – powder	Not a hazardous substance or mixture	None	8	T or D
115-40-2	bromocresol purple (powder) $C_{21}H_{16}Br_2O_5S$(s)	A – solution C – powder	Not a hazardous substance or mixture	None	8	T or D

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74-96-4	bromoethane (liquid) (*ethyl bromide*) $C_2H_5Br(l)$	C	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Flammable liquids (Category 2)	*Danger* • Harmful if inhaled • Harmful if swallowed • Suspected of causing cancer • Highly flammable liquid and vapour	5	WF/I
115-39-9	bromophenol blue (powder) $C_{19}H_{10}Br_4O_5S(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
115-39-9	bromophenol blue (solution) mixture: water 79.0% methyl alcohol 20.0% bromophenol blue < 1.0%	A	Not a hazardous substance or mixture	None	8	D
75-59-5	bromothymol blue (solution) mixture: water 99.9% bromothymol blue 0.1%	A	Not a hazardous substance or mixture	None	8	D
75-59-5	bromothymol blue (crystals) $C_{27}H_{28}Br_2O_5S(s)$	A	Not a hazardous substance or mixture	None	8	T
106-97-8	butane (liquefied gas) $C_4H_{10}(l)$ and $C_4H_{10}(g)$	B	• Flammable gases (Category 1) • Gases under pressure (Liquefied Gas)	*Danger* • Extremely flammable gas • Contains gas under pressure; may explode if heated	5	WF/I

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71-36-3	butan-1-ol (liquid) (*butyl alcohol*, *propyl carbinol*, *n-butyl alcohol*) $C_4H_{10}O(l)$ or $CH_3(CH_2)_2CH_2OH(l)$	B	• Acute toxicity (oral) (Category 4) • Flammable liquids (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Harmful if swallowed • Flammable liquid and vapour • Causes serious eye damage • Causes skin irritation • May cause respiratory irritation • May cause drowsiness or dizziness	5	WF/I
78-93-3	butan-2-one (liquid) (*methyl ethyl ketone*) $C_4H_8O(l)$ or $CH_3COCH_2CH_3(l)$	B	• Flammable liquids (Category 2) • Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Specific target organ toxicity – Single exposure (Category 1)	*Danger* • Highly flammable liquid and vapour • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • Causes damage to organs	5	WF/I
78-83-1	iso-butyl alcohol (liquid) (*2-methyl-propan-1-ol*) $C_4H_{10}O(l)$ or $(CH_3)_2CHCH_2OH(l)$	B	• Flammable liquids (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Highly flammable liquid and vapour • Causes serious eye damage • Causes skin irritation • May cause respiratory irritation	5	WF/I
78-92-2	sec-butyl alcohol (liquid) (*butan-2-ol*, *1-methyl propanol*) $C_4H_{10}O(l)$ or $CH_3CHOHCH_2CH_3(l)$	B	• Flammable liquids (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Flammable liquid and vapour • Causes serious eye irritation • May cause respiratory irritation	5	WF/I

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75-65-0	butyl alcohol-tert (liquid) (*tert-butanol*, *2-methyl-propan-2-ol*) $C_4H_{10}O(l)$ or $(CH_3)_3COH(l)$	B	• Acute toxicity (inhalation) (Category 4) • Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if inhaled • Highly flammable liquid and vapour • Causes serious eye irritation • May cause respiratory irritation	5	WF/I
84-74-2	n-butyl phthalate (liquid) (*butyl phthalate*) $C_6H_4(CO_2C_4H_9)_2(l)$	B	• Reproductive Toxicity (Category 1B)	*Danger* • May damage fertility or the unborn child	8	WF/I
107-92-6	n-butyric acid (liquid) (*butanoic acid*, *ethyacetic acid*, *propylformic acid*) $C_4H_8O_2(l)$ or $CH_3CH_2CH_2COOH(l)$	B	• Acute toxicity (oral) (Category 4) • Flammable liquids (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • Combustible liquid • Causes serious eye damage • Causes severe skin burns and eye damage	3, 5	WF/I
7440-43-9	cadmium metal (solid bar) Cd(s)	A	• Acute toxicity (inhalation) (Category 2) • Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 2) • Reproductive Toxicity (Category 2) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Fatal if inhaled • May cause cancer • Suspected of causing genetic defects • Suspected of damaging fertility or the unborn child • Causes damage to organs through prolonged or repeated exposure	8	R

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
7440-43-9	cadmium metal (powder or chunks) Cd(s)	C – chunks D – powder	• Acute toxicity (inhalation) (Category 2) • Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 2) • Reproductive Toxicity (Category 2) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Fatal if inhaled • May cause cancer • Suspected of causing genetic defects • Suspected of damaging fertility or the unborn child • Causes damage to organs through prolonged or repeated exposure	8	WF/I
513-78-0	cadmium salts (powder) $CdCO_3$(s)	D	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 2) • Reproductive Toxicity (Category 2) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Harmful in contact with skin • Fatal if inhaled • Harmful if swallowed • May cause cancer • Suspected of causing genetic defects • Suspected of damaging fertility or the unborn child • Causes damage to organs through prolonged or repeated exposure	8	WF/I
58-08-2	caffeine (powder) (*1,3,7-trimethylxanthine*) $C_8H_{10}N_4O_2$(s)	A – solution C – powder	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
471-34-1	calcite (crystalline) (*calcium carbonate*) $CaCO_3$(s)	A	Not a hazardous substance or mixture	None	8	T
7440-70-2	calcium metal (solid) Ca(s)	B	• Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 2)	*Danger* • In contact with water releases flammable gases	4	WF/I

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62-54-4	calcium acetate (powder) $Ca(CH_3COO)_2(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
75-20-7	calcium carbide (granules) $CaC_2(s)$	D	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 1)	*Danger* • Causes serious eye damage • May cause respiratory irritation • In contact with water releases flammable gases which may ignite spontaneously	4	WF/I
471-34-1	calcium carbonate (powder) (*calcite*, *aragonite*, *limestone*) $CaCO_3(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
10043-52-4	calcium chloride (granules) (*dowflake*) $CaCl_2(s)$	A	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I
10031-30-8	calcium dihydrogenphosphate monohydrate (crystals) (*calcium phosphate, monobasic, monohydrate*) $Ca(H_2PO_4)_2•H_2O(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
7789-75-5	calcium fluoride (powder) (*fluorite*, *acid spar*) $CaF_2(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7789-78-8	calcium hydride (granules) $CaH_2(s)$	C	• Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 1)	*Danger* • In contact with water releases flammable gases which may ignite spontaneously	4	WF/I

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1305-62-0	calcium hydroxide (crystals) (*slake lime*, *calcium hydrate*) $Ca(OH)_2(s)$	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes serious eye damage • Causes skin irritation • May cause respiratory irritation	2	WF/I
1305-62-0	calcium hydroxide (solution) (*lime water, quicklime*)	A	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes serious eye damage • Causes skin irritation • May cause respiratory irritation	2	D
7778-54-3	calcium hypochlorite (crystals) (*bleaching powder*) $Ca(ClO)_2(s)$	B	• Oxidizing solids (Category 2) • Acute toxicity (oral) (Category 4) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • May intensify fire; oxidizer • Harmful if swallowed • Causes severe skin burns and eye damage	6	WF/I
13477-34-4	calcium nitrate tetrahydrate (crystals) $Ca(NO_3)_2 \bullet 4H_2O(s)$	B – solution C – crystals	• Oxidizing solids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May intensify fire; oxidizer • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	6	WF/I
5794-28-5	calcium oxalate monohydrate (powder) $CaC_2O_4 \bullet H_2O(s)$	B	• Acute toxicity (dermal) (Category 4) • Acute toxicity (oral) (Category 4)	*Warning* • Harmful in contact with skin • Harmful if swallowed	8	WF/I

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1305-78-8	calcium oxide (powder) CaO(s)	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes serious eye damage • Causes skin irritation • May cause respiratory irritation	8	WF/I
7758-23-8	calcium phosphate, monobasic (powder) (*calcium biphosphate*) $Ca(H_2PO_4)_2(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
7789-77-7	calcium phosphate dibasic dihydrate (crystals) $CaHPO_4 \bullet 2H_2O(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7758-87-4	calcium phosphate (tribasic) (crystals) $Ca_3(PO_4)_2(s)$ or $Ca_5(OH)(PO_4)_3(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
4075-81-4	calcium propionate (granules) $Ca(CH_3CH_2COO)_2(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7778-18-9	calcium sulfate (granules) (*anhydrous gypsum*) $CaSO_4(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)

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20548-54-3	calcium sulfide (powder) CaS(s)	D	• Flammable solids (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Flammable solid • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	4	WF/I
76-22-2	camphor (crystals) (*bornan-2-one*) $C_{10}H_{16}O$(s)	B	• Flammable solids (Category 2) • Acute toxicity (oral) (Category 4) • Acute toxicity (inhalation) (Category 4) • Specific target organ toxicity – Single exposure (Category 2)	*Warning* • Flammable solid • Harmful if swallowed • Harmful if inhaled • May cause damage to organs (lungs) if inhaled	4	WF/I
111-87-5	caprylic alcohol (liquid) (*n-octanol*) $C_8H_{18}O$(l) or $CH_3(CH_2)_6CH_2OH$(l)	B	• Flammable liquids (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Combustible liquid • Causes serious eye irritation	5	WF/I
57-13-6	carbamide (powder) (*urea*) CH_4N_2O(s) or NH_2CONH_2(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)

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108-95-2	carbolic acid (liquid or crystals) (*phenol*, *phenic acid*, *phenylic acid*) C_6H_6O(s)	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Germ cell mutagenicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • Suspected of causing genetic defects • Causes serious eye damage • Causes severe skin burns and eye damage • May cause damage to organs through prolonged or repeated exposure	3	WF/I
7782-42-5	carbon (powder or rods) (*graphite*) C(s)	A – rods B – powder	• Flammable solids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Flammable solid • Causes serious eye irritation • May cause respiratory irritation	4	T
124-38-9	carbon dioxide (gas) CO_2(g)	B	• Gases under pressure (Liquefied Gas)	*Warning* • Contains gas under pressure; may explode if heated	8	A
124-38-9	carbon dioxide (solid/gas) (*dry ice*) CO_2(s) and CO_2(g)	C	Not a hazardous substance or mixture	None	8	A

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75-15-0	carbon disulfide (liquid) (*carbon bisulfide*) $CS_2(l)$	D	• Flammable liquids (Category 2) • Acute toxicity (oral) (Category 4) • Reproductive Toxicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Highly flammable liquid and vapour • Harmful if swallowed • Suspected of damaging fertility or the unborn child • Causes serious eye irritation • Causes skin irritation • Causes damage to organs through prolonged or repeated exposure if inhaled	5	WF/I
56-23-5	carbon tetrachloride (liquid) $CCl_4(l)$	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 2) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • Suspected of causing cancer • May cause allergy or asthma symptoms or breathing difficulties if inhaled • Causes damage to organs through prolonged or repeated exposure if inhaled	8	WF/I
409-21-2	carborundum (solid) (*silicon carbide*) SiC(s)	A	Not a hazardous substance or mixture	None	8	T
1390-65-4	carmine (powder) $C_{22}H_{20}O_{13}(s)$	A – solution C – powder	Not a hazardous substance or mixture	None	8	T

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Not applicable	Carnoy's fluid (liquid) mixture: ethanol 98.0% acetic acid (glacial) 1.0% chloroform 1.0%	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Flammable liquids (Category 2) • Carcinogenicity (Category 2) • Reproductive Toxicity (Category 2) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • Highly flammable liquid and vapour • Suspected of causing cancer • Suspected of damaging fertility or the unborn child • Causes skin irritation • Causes serious eye irritation • Causes damage to organs through prolonged or repeated exposure	5	WF/I
9000-71-9	casein (granules) (*milk protein*)	A	Not a hazardous substance or mixture	None	8	T
1310-58-3	caustic potash (pellets) (*potassium hydroxide*) KOH(s)	B	• Acute toxicity (oral) (Category 4) • Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • May be corrosive to metals • Causes serious eye damage • Causes severe skin burns and eye damage	2	WF/I
1310-73-2	caustic soda (pellets) (*sodium hydroxide*) NaOH(s)	B	• Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • May be corrosive to metals • Causes serious eye damage • Causes severe skin burns and eye damage	2	WF/I
9004-35-7	cellulose acetate (powder) (variable formula)	A	Not a hazardous substance or mixture	None	8	T or D(aq)

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9004-67-5	cellulose methyl ether (granules) (*methyl cellulose*) $C_7H_{14}O_5X$(s)	A	Not a hazardous substance or mixture	None	8	T
7440-46-2	cesium metal (solid) Cs(s)	C	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 1)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage • In contact with water releases flammable gases which may ignite spontaneously	4	WF/I
7647-17-8	cesium chloride (crystals) CsCl(s)	B	• Reproductive toxicity (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2)	*Warning* • Suspected of damaging fertility or the unborn child • May cause damage to organs (kidney, liver) through prolonged or repeated exposure	8	WF/I
36653-82-4	cetyl alcohol (powder) (*hexadecane-1-ol*, *palmityl alcohol*) $C_{16}H_{34}O$(s) or $CH_3(CH_2)_{14}CH_2OH$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
7440-44-0	charcoal (solid) (*carbon*) C(s)	A	Not a hazardous substance or mixture	None	8	T

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7782-50-5	chlorine (gas) $Cl_2(g)$	D	• Acute toxicity (inhalation) (Category 3) • Gases under pressure (Compressed Gas) • Oxidizing Gases (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Toxic if inhaled • Contains gas under pressure; may explode if heated • May cause or intensify fire; oxidizer • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	6, 7	WF/I
Not applicable	chlorine (water) $Cl_2(aq)$	B	Not a hazardous substance or mixture	None	6, 7	D
67-66-3	chloroform (liquid) (*trichloromethane*) $CHCl_3(l)$	D	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Reproductive Toxicity (Category 2) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful if inhaled • Harmful if swallowed • Suspected of causing cancer • Suspected of damaging fertility or the unborn child • Causes skin irritation • May cause damage to organs through prolonged or repeated exposure • May cause respiratory irritation	8	WF/I
95-57-8	2-chlorophenol (liquid) (*o-chlorophenol*, *2-hydroxychlorobenzene*) $C_6H_5ClO(l)$	D	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Flammable liquids (Category 4)	*Warning* • Harmful in contact with skin • Harmful if inhaled • Harmful if swallowed • Combustible liquid	5	WF/I

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4430-20-0	chlorophenol red (powder) (*3',3'-dichlorophenolsulfunaphthalein*) $C_{19}H_{12}Cl_2O_5S$(s)	B	Not a hazardous substance or mixture	None	8	WF/I
1333-82-0	chromic acid (solution) (*chromium(VI) oxide solution*) mixture: H_2O 90% CrO_3 10% CrO_3(aq)	D	• Oxidizing solids (Category 1) • Acute toxicity (oral) (Category 3) • Acute toxicity (inhalation) (Category 2) • Acute toxicity (dermal) (Category 3) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Germ cell mutagenicity (Category 1B) • Carcinogenicity (Category 1A) • Reproductive toxicity (Category 2) • Specific target organ toxicity - Repeated exposure (Category 1)	*Danger* • May cause fire or explosion; strong oxidizer • Toxic if swallowed • Fatal if inhaled • Toxic in contact with skin • Causes severe skin burns and eye damage • Causes serious eye damage • May cause an allergic skin reaction • May cause genetic defects • May cause cancer • Suspected of damaging fertility or the unborn child • Causes damage to organs (kidneys, liver, respiratory system, skin, eyes) through prolonged or repeated exposure	1	WF/I
7440-47-3	chromium metal (solid) Cr(s)	A	Not a hazardous substance or mixture	None	8	R
7440-47-3	chromium metal (powder) Cr(s)	B	• Flammable solids (Category 2) • Carcinogenicity (Category 2)	*Warning* • Flammable solid • Suspected of causing cancer	8	R

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1066-30-4	chromium(III) acetate (powder) (*chromic acetate*) $C_6H_9CrO_6$(s) or $Cr(CH_3COO)_3$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2B) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes eye irritation • Causes skin irritation	8	WF/I
10060-12-5	chromium(III) chloride hexahydrate (crystals) $CrCl_3 \bullet 6H_2O$(s)	B	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
10060-12-5	chromium(III) chloride hexahydrate (powder) $CrCl_3 \bullet 6H_2O$(s)	B	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
7789-02-8	chromium(III) nitrate nonahydrate (solid) $Cr(NO_3)_3 \bullet 9H_2O$(s)	B	• Oxidizing solids (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • May intensify fire; oxidizer • Causes serious eye irritation • Causes skin irritation	6	WF/I
7789-02-8	chromium(III) nitrate nonahydrate (crystals) $Cr(NO_3)_3 \bullet 9H_2O$(s)	B	• Oxidizing solids (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • May intensify fire; oxidizer • Causes serious eye irritation • Causes skin irritation	6	WF/I

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1333-82-0	chromium(VI) oxide (powder) CrO_3(s)	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1A) • Germ cell mutagenicity (Category 1B) • Oxidizing solids (Category 1) • Reproductive Toxicity (Category 2) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Toxic in contact with skin • Fatal if inhaled • Toxic if swallowed • May cause cancer • May cause genetic defects • May cause fire or explosion; strong oxidizer • Suspected of damaging fertility or the unborn child • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction • Causes serious eye damage • Causes severe skin burns and eye damage • Causes damage to organs through prolonged or repeated exposure	6	WF/I
11104-59-9	chromium(VI) salts (powder) (*chromates*) CrO_4^{-2}	D	• Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 1B) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1)	*Danger* • May cause cancer • May cause genetic defects • May cause allergy or asthma symptoms or breathing difficulties if inhaled	8	WF/I
7788-99-0	chromium potassium sulfate dodecahydrate (granules) $CrK(SO_4)_2 \cdot 12H_2O$(s)	B	Not a hazardous substance or mixture	None	8	WF/I
77-92-9	citric acid (powder) $C_6H_8O_7$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	3	WF/I

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1829-00-1	Clayton yellow (powder) (*thiazole yellow G*) $C_{28}H_{19}N_5Na_2O_6S_4$(s)	B	Not a hazardous substance or mixture	None	8	T
7440-48-4	cobalt (powder or solid) Co(s)	B – solid D – powder	• Flammable solids (Category 1) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • Flammable solid • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction	4	R or WF/I
71-48-7	cobalt(II) acetate (crystals) $Co(C_2H_3O_2)_2 \bullet 4H_2O$(s)	B	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 2) • Reproductive Toxicity (Category 1B) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Danger* • Harmful if swallowed • May cause cancer • Suspected of causing genetic defects • May damage fertility or the unborn child • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction • Causes serious eye irritation	8	WF/I

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513-79-1	cobalt(II) carbonate (powder) $CoCO_3(s)$	D	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 2) • Reproductive Toxicity (Category 1A) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • Harmful if swallowed • May cause cancer • Suspected of causing genetic defects • May damage fertility or the unborn child • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction	8	WF/I
7646-79-9 7791-13-1	cobalt(II) chloride, anhydrous and hexahydrate (powder) $CoCl_2(s)$ and $CoCl_2•6H_2O(s)$	D – anhydrous powder B – hydrate crystals	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 2) • Reproductive Toxicity (Category 1B) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • Harmful if swallowed • May cause cancer • Suspected of causing genetic defects • May damage fertility or the unborn child • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction	8	WF/I
10026-22-9	cobalt(II) nitrate hexahydrate (crystals) $Co(NO_3)_2•6H_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Oxidizing solids (Category 2) • Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • Harmful if swallowed • Suspected of causing cancer • May intensify fire; oxidizer • May cause an allergic skin reaction	6	WF/I

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10026-24-1	cobalt(II) sulfate heptahydrate (crystals) $CoSO_4 \bullet 7H_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 1B) • Reproductive Toxicity (Category 1B) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • Harmful if swallowed • May cause cancer • May damage fertility or the unborn child • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction	8	WF/I
64-86-8	colchicine (powder) $C_{22}H_{25}NO_6(s)$	D	• Acute toxicity (inhalation) (Category 1) • Acute toxicity (oral) (Category 2) • Germ cell mutagenicity (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Fatal if inhaled • Fatal if swallowed • May cause genetic defects • Causes serious eye damage	8	WF/I
9004-70-0	collodion solution (liquid) (pyroxylin solution) mixture: ethyl ether 60–70% ethyl alcohol 22–26% nitrocellulose ~5.2%	D	• Flammable liquids (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Extremely flammable liquid and vapour • Causes serious eye irritation • May cause drowsiness or dizziness	5	WF/I
573-58-0	congo red (solution) mixture: water 99.0% congo red 0.1% $C_{32}H_{22}N_6Na_2O_6S_2(aq)$	B	• Carcinogenicity (Category 1B) • Reproductive Toxicity (Category 2)	*Danger* • May cause cancer • Suspected of damaging fertility or the unborn child	8	WF/I
573-58-0	congo red (powder) $C_{32}H_{22}N_6Na_2O_6S_2(s)$	C	• Carcinogenicity (Category 1B) • Reproductive Toxicity (Category 2)	*Danger* • May cause cancer • Suspected of damaging fertility or the unborn child	8	WF/I

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7440-50-8	copper metal (powder) Cu(s)	B	• Flammable solids (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Flammable solid • Causes serious eye irritation • May cause respiratory irritation	8	R
7440-50-8	copper metal (strip or wire) Cu(s)	A	Not a hazardous substance or mixture	None	8	R
7758-89-6	copper (I) chloride (anhydrous crystals) CuCl(s)	B	• Acute toxicity (oral) (Category 4) • Acute toxicity (dermal) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Harmful in contact with skin • Causes skin irritation • Causes serious eye damage	8	WF/I
142-71-2	copper(II) acetate monohydrate (powder) $Cu(CH_3COO)_2 \bullet H_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
7789-45-9	copper(II) bromide (crystals) $CuBr_2(s)$	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I

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12069-69-1	copper(II) carbonate basic (powder) $CuCO_3 \bullet Cu(OH)_2(s)$	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
7447-39-4	copper (II) chloride (anhydrous crystals) $CuCl_2(s)$	B	• Acute toxicity (oral) (Category 4) • Acute toxicity (dermal) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Harmful in contact with skin • Causes skin irritation • Causes serious eye damage	8	WF/I
19004-19-4	copper(II) nitrate hemihydrate (crystals) $Cu(NO_3)_2 \bullet 2.5H_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • May intensify fire; oxidizer • Causes serious eye damage • Causes severe skin burns and eye damage	6	WF/I
1317-38-0	copper(II) oxide (powder) $CuO(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2B)	*Warning* • Causes eye irritation	8	WF/I
7758-98-7	copper(II) sulfate anhydrous and pentahydrate (powder) $CuSO_4(s)$ and $CuSO_4 \bullet 5H_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation	8	WF/I
1317-40-4	copper(II) sulfide (powder) $CuS(s)$	A	Not a hazardous substance or mixture	None	8	WF/I

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868-14-4	cream of tartar (powder) (*potassium hydrogen tartrate*) $KHC_4H_4O_6(s)$	A	Not a hazardous substance or mixture	None	8	T
95-48-7	cresol (liquid) (*cresylic acid*) $C_7H_8O(l)$	B	• Acute toxicity (dermal) (Category 3) • Acute toxicity (oral) (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Toxic in contact with skin • Toxic if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
2303-01-7	cresol purple (powder) (*m-cresol purple, m-cresolsulfonphthalein*) $C_{21}H_{18}O_5S(s)$	B	Not a hazardous substance or mixture	None	8	WF/I
1733-12-6	cresol red (powder) (*o-cresolsulfonaphthalein*) $C_{21}H_{18}O_5S(s)$	B	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	8	WF/I
15096-52-3	cryolite (chunk) (*sodium aluminium fluoride*) $Na_3AlF_6(s)$	C	• Acute toxicity (inhalation) (Category 4) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Harmful if inhaled • Causes damage to organs through prolonged or repeated exposure	8	WF/I
548-62-9	crystal violet (powder) (*gentian violet*) $C_{25}H_{30}N_3Cl(s)$	C	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Suspected of causing cancer • Causes serious eye damage	8	WF/I

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548-62-9	crystal violet stain (solution) mixture: ethanol <12.0% methyl alcohol <1.0% phenol <1.0% crystal violet <0.4% water balance	B	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Suspected of causing cancer • Causes serious eye damage	8	WF/I
98-82-8	cumene (liquid) (*isopropylbenzene*) $C_6H_5CH(CH_3)_2(l)$	C	• Flammable liquids (Category 3) • Acute toxicity (oral) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2B) • Carcinogenicity (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Flammable liquid and vapour • Harmful if swallowed • Causes skin irritation • Causes eye irritation • Suspected of causing cancer • May cause respiratory irritation	5	WF/I
110-82-7	cyclohexane (liquid) (*hexamethylene*) $C_6H_{12}(l)$	B	• Aspiration Hazard (Category 1) • Flammable liquids (Category 2) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May be fatal if swallowed and enters airways • Highly flammable liquid and vapour • Causes skin irritation • May cause respiratory irritation	5	WF/I

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108-93-0	cyclohexanol (liquid) (*hexalin*, *cyclohexyl alcohol*) $C_6H_{12}O(l)$	B	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Flammable liquids (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful in contact with skin • Harmful if inhaled • Harmful if swallowed • Combustible liquid • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	5	WF/I
110-83-8	cyclohexene (liquid) (*tetrahydrobenzene*) $C_6H_{10}(l)$	B	• Acute toxicity (dermal) (Category 3) • Acute toxicity (oral) (Category 4) • Aspiration Hazard (Category 1) • Flammable liquids (Category 2)	*Danger* • Toxic in contact with skin • Harmful if swallowed • May be fatal if swallowed and enters airways • Highly flammable liquid and vapour	5	WF/I
52-90-4	cysteine (crystals) $HSCH_2CH(NH_2)COOH(s)$	B	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
923-32-0	cystine (crystals) (*L-cystine*) $C_6H_{12}N_2O_4S_2(s)$	A	Not a hazardous substance or mixture	None	8	T
50-99-7	dextrose (crystals) (*glucose*) $C_6H_{12}O_6(s)$	A	Not a hazardous substance or mixture	None	8	T

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124-09-4	1,6-diaminohexane (crystals) (*hexamethylenediamine*) $C_6H_{16}N_2$(s)	C	• Acute toxicity (oral) (Category 4) • Acute toxicity (dermal) (Category 4) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Harmful in contact with skin • Causes severe skin burns and eye damage • May cause respiratory irritation • Causes serious eye damage	5	WF/I
9000-92-4	diastase (powder) (*amylolytic enzymes*)	B	• Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction	8	WF/I
106-37-6	1,4-dibromobenzene (crystals) (*p-dibromobenzene*) $C_6H_4Br_2$(s)	C	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
84-74-2	dibutyl phthalate (liquid) (*n-butyl phthalate*) $C_6H_4(CO_2C_4H_9)_2$(l)	B	• Reproductive Toxicity (Category 1B)	*Danger* • May damage fertility or the unborn child	8	WF/I
106-46-7	p-dichlorobenzene (crystals) (*1,4-dichlorobenzene*) $C_6H_4Cl_2$(s)	C	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Harmful if swallowed • Suspected of causing cancer • Causes serious eye irritation	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
107-06-2	1,2-dichloroethane (liquid) $ClCH_2CH_2Cl(l)$	D	• Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 1B) • Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Toxic if inhaled • Harmful if swallowed • May cause cancer • Highly flammable liquid and vapour • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	5	WF/I
956-48-9	2,6-dichloroindophenol (solid) $C_{12}H_7Cl_2NO_2(s)$	B	• Acute toxicity (oral) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful if swallowed • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	8	WF/I
75-09-2	dichloromethane (liquid) (*methylene chloride*) $CH_2Cl_2(l)$	D	• Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Suspected of causing cancer • Causes serious eye irritation • Causes skin irritation • May cause damage to organs (liver, blood) through prolonged or repeated exposure if swallowed • May cause damage to organs (central nervous system) through prolonged or repeated exposure if inhaled • May cause respiratory irritation • May cause drowsiness or dizziness	8	WF/I

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94-75-7	2,4-dichlorophenoxyacetic acid (powder) (*2,4-D*) $C_8H_6Cl_2O_3$(s)	D	• Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Suspected of causing cancer • Causes serious eye irritation • Causes skin irritation • May cause damage to organs (liver, blood) through prolonged or repeated exposure if swallowed • May cause damage to organs (central nervous system) through prolonged or repeated exposure if inhaled • May cause drowsiness or dizziness	8	WF/I
79-14-2	1,2-dichlorotetrafluoroethane (gas) (*freon 114*) $CClF_2CClF_2$(g) or $C_2Cl_2F_4$(g)	D	• Gases under pressure (Liquefied Gas)	*Warning* • Contains gas under pressure; may explode if heated	8	WF/I
60-29-7	diethyl ether (liquid) (*ethyl ether, Quick Start*) $C_4H_{10}O$(l) or $C_2H_5OC_2H_5$(l)	D	• Flammable liquids (Category 1) • Acute toxicity (oral) (Category 4) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Extremely flammable liquid and vapour • Harmful if swallowed • May cause drowsiness or dizziness	5	WF/I
95-45-4	dimethylglyoxime (powder) (*diacetlyldioxime*) $C_4H_8N_2O_2$(s)	B	• Flammable solids (Category 2)	*Warning* • Flammable solid	4	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
77-78-1	dimethyl sulfate (liquid) $(CH_3)_2SO_4(l)$	D	• Acute toxicity (inhalation) (Category 1) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1B) • Flammable liquids (Category 4) • Germ cell mutagenicity (Category 2) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Fatal if inhaled • Toxic if swallowed • May cause cancer • Combustible liquid • Suspected of causing genetic defects • May cause an allergic skin reaction • Causes serious eye damage • Causes severe skin burns and eye damage	5	WF/I
10024-97-2	dinitrogen monoxide (liquefied gas) (*nitrous oxide*, laughing gas) $N_2O(l)$ and $N_2O(g)$	C	• Oxidizing Gases (Category 1) • Gases under pressure (Liquefied Gas) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects) • Simple asphyxiants (Category 1)	*Danger* • May cause or intensify fire; oxidizer • Contains gas under pressure; may explode if heated • May cause drowsiness or dizziness • May displace oxygen and cause rapid suffocation	8	WF/I
51-28-5	2,4-dinitrophenol (powder) (*aldefin*) $C_6H_4N_2O_5(s)$	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • May cause damage to organs through prolonged or repeated exposure	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
123-91-1	1,4-dioxane (liquid) (*1,4-diethylene dioxide*) $C_4H_8O_2$(l)	D	• Carcinogenicity (Category 2) • Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Suspected of causing cancer • Highly flammable liquid and vapour • Causes serious eye irritation • May cause respiratory irritation	5	WF/I
122-39-4	diphenylamine (crystals) (*n-phenylbenzeneamine*) $C_{12}H_{10}NH$(s)	C	• Acute toxicity (inhalation) (Category 2) • Acute toxicity (dermal) (Category 3) • Acute toxicity (oral) (Category 4)	*Danger* • Fatal if inhaled • Toxic in contact with skin • Harmful if swallowed	8	WF/I
Not applicable	Drano (crystals) contains sodium hydroxide, sodium nitrate, sodium chloride, and aluminium	B	• Acute toxicity (oral) (Category 4) • Acute toxicity (inhalation) (Category 4) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • Harmful if inhaled • Causes severe skin burns and eye damage	8	WF/I
124-38-9	dry ice (solid/gas) (*carbon dioxide*) CO_2(s) and CO_2(g)	C	Not a hazardous substance or mixture	None	8	A
60-00-4	EDTA (powder) (*ethylenedinitrilotetraacetic acid*, *edetic acid*) $C_{10}H_{16}N_2O_8$(s) or the dihydrate $C_{10}H_{12}N_2Na_4O_8 \bullet 2H_2O$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I
548-24-3	eosin B (powder) $C_{20}H_6Br_2N_2Na_2O_9$(s)	B	Not a hazardous substance or mixture	None	8	WF/I

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15086-94-9	eosin Y (solution) mixture: water 99.8% eosin Y 0.2% $C_{20}H_6Br_4Na_2O_5$(aq)	A	Not a hazardous substance or mixture	None	8	D
15086-94-9	eosin Y (powder) $C_{20}H_6Br_4Na_2O_5$(s)	B	Not a hazardous substance or mixture	None	8	WF/I
51-43-4	epinephrine 99% (powder) (*adrenalin*) $C_9H_{13}NO_3$(s)	D	• Acute toxicity (dermal) (Category 2) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3)	*Danger* • Fatal in contact with skin • Toxic if inhaled • Toxic if swallowed	8	WF/I
10034-99-8	epsom salts (*magnesium sulfate heptahydrate*) $MgSO_4 \bullet 7H_2O$(s)	A	Not a hazardous substance or mixture	None	8	T
1787-61-7	eriochrome black T (liquid) mixture: water 0.8% methyl alcohol 98.5% ammonium hydroxide 0.3% eriochrome black T 0.4%	B	• Acute toxicity (dermal) (Category 3) • Acute toxicity (oral) (Category 3) • Flammable liquids (Category 2) • Reproductive Toxicity (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1) • Specific target organ toxicity – Single exposure (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Toxic in contact with skin • Toxic if swallowed • Highly flammable liquid and vapour • May damage fertility or the unborn child • Causes damage to organs through prolonged or repeated exposure • Causes damage to organs • May cause drowsiness or dizziness	5	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
1787-61-7	eriochrome black T (powder) $C_{20}H_{12}N_3NaO_7S$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects) • Combustible Dusts (Category 1)	*Warning* • Causes serious eye irritation • May cause drowsiness or dizziness • May form combustible dust concentrations in air	4	WF/I
64-19-7	ethanoic acid, glacial (liquid) (*glacial acetic acid*) CH_3COOH(l)	B – dilute C – concentrated	• Flammable liquids (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Flammable liquid and vapour • Causes serious eye damage • Causes severe skin burns and eye damage	5	WF/I
64-19-7	ethanoic acid (solution) (*acetic acid*, *vinegar*) mixture: CH_3COOH 7% H_2O 93% CH_3COOH(aq)	A	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes serious eye irritation • Causes skin irritation	3	D
141-78-6	ethyl acetate (liquid) $CH_3COOC_2H_5$(l) or $C_4H_8O_2$(l)	B	• Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Highly flammable liquid and vapour • Causes serious eye irritation • May cause drowsiness or dizziness	5	WF/I
64-17-5	ethyl alcohol (liquid) (*ethanol*) C_2H_5OH(l)	B	• Acute toxicity (oral) (Category 4) • Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 1)	*Danger* • Harmful if swallowed • Highly flammable liquid and vapour • Causes serious eye irritation • Causes damage to organs	5	WF/I

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75-04-7	ethylamine (liquid and gas) (*monoethylamine*) $C_2H_7N(l)$ and $C_2H_7N(g)$	D	• Acute toxicity (inhalation) (Category 4) • Flammable gases (Category 1) • Gases under pressure (Liquefied Gas) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if inhaled • Extremely flammable gas • Contains gas under pressure; may explode if heated • Causes serious eye irritation • May cause respiratory irritation	5	WF/I or RS (gas in cylinder)
100-41-4	ethylbenzene (liquid) (*ethylbenzol, phenylethane*) $C_6H_5C_2H_5(l)$	D	• Flammable liquids (Category 2) • Aspiration Hazard (Category 1) • Acute toxicity (inhalation) (Category 4) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Highly flammable liquid and vapour • May be fatal if swallowed and enters airways • Harmful if inhaled • May cause respiratory irritation • May cause drowsiness or dizziness	5	WF/I
74-96-4	ethyl bromide (liquid) (*bromoethane*) $C_2H_5Br(l)$ or $CH_3CH_2Br(l)$	D	• Flammable liquids (Category 2) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2)	*Danger* • Highly flammable liquid and vapour • Harmful if inhaled • Harmful if swallowed • Suspected of causing cancer	5	WF/I
105-54-4	ethyl butyrate (liquid) $C_6H_{12}O_2(l)$	B	• Flammable liquids (Category 3)	*Warning* • Flammable liquid and vapour	5	WF/I

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107-06-2	ethylene dichloride (liquid) (*1,2-dichloroethane*) $ClCH_2CH_2Cl(l)$	D	• Flammable liquids (Category 2) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 1B) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Highly flammable liquid and vapour • Toxic if inhaled • Harmful if swallowed • May cause cancer • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	5	WF/I
107-21-1	ethylene glycol (liquid) (*ethane-1,2-diol*) $C_2H_6O_2(l)$	B	• Acute toxicity (oral) (Category 4) • Specific target organ toxicity – Repeated exposure (Category 2)	*Warning* • Harmful if swallowed • May cause damage to organs (kidney) through prolonged or repeated exposure if swallowed	8	WF/I
107-15-3	ethylenediamine (liquid) (*ethane-1,2-diamine*) $C_2H_8N_2(l)$	D	• Acute toxicity (dermal) (Category 4) • Acute toxicity (oral) (Category 4) • Flammable liquids (Category 3) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Harmful in contact with skin • Harmful if swallowed • Flammable liquid and vapour • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction • Causes serious eye damage • Causes severe skin burns and eye damage	5	WF/I
60-00-4	ethylenediaminetetraacetic acid (EDTA) (powder) (*edetic acid*) $C_{10}H_{16}N_2O_8(s)$ or $C_{10}H_{12}N_2Na_4O_8 \bullet 2H_2O(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I

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60-29-7	ethyl ether (liquid) (*diethyl ether*) $C_4H_{10}O(l)$	D	• Acute toxicity (oral) (Category 4) • Flammable liquids (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Harmful if swallowed • Extremely flammable liquid and vapour • May cause drowsiness or dizziness	5	WF/I
75-03-6	ethyl iodide (liquid) (*iodoethane*) $C_2H_5I(l)$	C	• Acute toxicity (oral) (Category 4) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if swallowed • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
Not applicable	Fehling's reagent A (solution) mixture: copper(II) sulfate 4.43% water 95.57% $CuSO_4(aq)$	B	Not a hazardous substance or mixture	None	8	WF/I
Not applicable	Fehling's reagent B (solution) mixture: sodium potassium tartrate 24% potassium hydroxide 7% water 69%	B	• Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Corrosive to Metals (Category 1)	*Danger* • Suspected of causing cancer • Causes serious eye damage • Causes severe skin burns and eye damage • May be corrosive to metals	8	D
68476-25-5	feldspar (chunks) (*kaolinite*) $H_4Al_2Si_2O_9 \bullet SiO_2(s)$	A	Not a hazardous substance or mixture	None	8	T

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1343-88-0	florisil (solid) (*magnesia-silica gel*) MgO_3Si(s)	A	Not a hazardous substance or mixture	None	8	T
2321-07-5	fluorescein (powder) (*acid yellow 73, uranine*) $C_{20}H_{12}O_5$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I
7782-41-4	fluorine (gas) F_2(g)	D	• Acute toxicity (inhalation) (Category 1) • Gases under pressure (Compressed Gas) • Oxidizing Gases (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Specific target organ toxicity – Single exposure (Category 1)	*Danger* • Fatal if inhaled • Contains gas under pressure; may explode if heated • May cause or intensify fire; oxidizer • Causes serious eye damage • Causes severe skin burns and eye damage • Causes damage to organs	6, 7	RS
7789-75-5	fluorite (solid) (*calcium fluoride*, *fluorspar*) CaF_2(s)	A	Not a hazardous substance or mixture	None	8	T

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50-00-0	formaldehyde (solution) (*formalin*, *methanal*) mixture: HCHO 37% CH_3OH 12–15% H_2O 48–53%	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1B) • Flammable liquids (Category 4) • Germ cell mutagenicity (Category 2) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Single exposure (Category 1)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • May cause cancer • Combustible liquid • Suspected of causing genetic defects • May cause an allergic skin reaction • Causes serious eye damage • Causes severe skin burns and eye damage • Causes damage to organs	5	WF/I
50-00-0	formalin (solution) mixture: HCHO 3–4% CH_3OH 1–1.5% H_2O 94–96%	C	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 1B) • Flammable liquids (Category 4) • Germ cell mutagenicity (Category 2) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Specific target organ toxicity – Single exposure (Category 1)	*Danger* • Harmful if swallowed • May cause cancer • Combustible liquid • Suspected of causing genetic defects • May cause an allergic skin reaction • Causes serious eye damage • Causes severe skin burns and eye damage • Causes damage to organs	5	WF/I
64-18-6	formic acid (solution) (*methanoic acid*) mixture: formic acid 85–98% water 2–15% HCOOH(aq)	B	• Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 4) • Flammable liquids (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Toxic if inhaled • Harmful if swallowed • Flammable liquid and vapour • Causes serious eye damage • Causes severe skin burns and eye damage	3, 5	WF/I

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57-48-7	d-fructose (powder) $C_6H_{12}O_6$(s)	A	Not a hazardous substance or mixture	None	8	T
3244-88-0	fuchsin, acid (powder)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	3	T
110-17-8	fumaric acid (powder) (*but-2-enedioic acid*) $C_4H_4O_4$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	3	WF/I
59-23-4	galactose (powder) $C_6H_{12}O_6$(s)	A	Not a hazardous substance or mixture	None	8	T
1314-87-0	galena (solid) (*lead(II) sulphide*) PbS(s)	C	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Reproductive Toxicity (Category 1A) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Harmful if inhaled • Harmful if swallowed • May damage fertility or the unborn child • May cause damage to organs through prolonged or repeated exposure	8	WF/I
7440-55-3	gallium (powder) Ga(s)	A	• Corrosive to Metals (Category 1)	*Warning* • May be corrosive to metals	8	WF/I
9000-70-8	gelatin (powder)	B	Not a hazardous substance or mixture	None	8	T

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548-62-9	gentian violet (solution) mixture: methyl alcohol 20.0% water 78.5% ammonium oxalate 1.0% gentian violet 0.5%	B	• Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Suspected of causing cancer • Causes serious eye irritation • Causes skin irritation	8	WF/I
548-62-9	gentian violet (powder) (*crystal violet*) $C_{25}H_{30}N_3Cl$(s)	B	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Suspected of causing cancer • Causes serious eye damage	8	WF/I
7440-56-4	germanium (powder) Ge(s)	A – solid B – powder	• Flammable solids (Category 1)	*Danger* • Flammable solid	4	WF/I
77-06-5	gibberellic acid (powder) $C_{19}H_{22}O_6$(s)	A	Not a hazardous substance or mixture	None	3	T
50-99-7	glucose (powder) (*dextrose*) $C_6H_{12}O_6$(s)	A	Not a hazardous substance or mixture	None	8	T
56-86-0	glutamic acid (crystals) $C_5H_9NO_4$(s)	A	Not a hazardous substance or mixture	None	3	WF/I
56-85-9	glutamine (powder) $C_5H_{10}N_2O_3$(s)	A	Not a hazardous substance or mixture	None	8	T
56-81-5	glycerin (viscous liquid) (*glycerol*, *propane-1,2,3-triol*) $C_3H_8O_3$(l)	A	Not a hazardous substance or mixture	None	8	D
56-40-6	glycine (crystals) $C_2H_5NO_2$(s)	A	Not a hazardous substance or mixture	None	8	T

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9005-79-2	D-glycogen (powder) (*animal starch*) $(C_6H_{10}O_5)_n$(s)	A	Not a hazardous substance or mixture	None	8	T
7440-57-5	gold (powder or pieces) Au(s)	A	Not a hazardous substance or mixture	None	8	R
7782-42-5	graphite (powder) (*activated charcoal*) C(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Carcinogenicity (Category 1A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Causes serious eye irritation • May cause cancer • May cause respiratory irritation • May cause damage to organs through prolonged or repeated exposure	8	RS
90-05-1	guaiacol (crystals or liquid) (*2-methoxyphenol*) $C_7H_8O_2$(s)	C	• Flammable liquids (Category 2) • Acute toxicity (oral) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Highly flammable liquid and vapour • Harmful if swallowed • Causes skin irritation • Causes serious eye irritation	5	WF/I
7647-14-5	halite (crystalline) (*sodium chloride*) NaCl(s)	A	Not a hazardous substance or mixture	None	8	T
1309-37-1	hematite (chunks) (*iron(III) oxide*) Fe_2O_3(s)	A	Not a hazardous substance or mixture	None	8	T

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142-82-5	n-heptane (liquid) $C_7H_{16}(l)$	B	• Aspiration Hazard (Category 1) • Flammable liquids (Category 2) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • May be fatal if swallowed and enters airways • Highly flammable liquid and vapour • Causes skin irritation • May cause drowsiness or dizziness	5	WF/I
1100-54-3	n-hexane (liquid) $C_6H_{14}(l)$	B	• Aspiration Hazard (Category 1) • Flammable liquids (Category 2) • Reproductive Toxicity (Category 2) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2B) • Specific target organ toxicity – Repeated exposure (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • May be fatal if swallowed and enters airways • Highly flammable liquid and vapour • Suspected of damaging fertility or the unborn child • Causes skin irritation • Causes eye irritation • May cause damage to organs through prolonged or repeated exposure • May cause drowsiness or dizziness	5	WF/I
124-09-4	hexane-1,6-diamine (solid) (*hexamethylenediamine*) $C_6H_{16}N_2(s)$	C	• Acute toxicity (dermal) (Category 4) • Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful in contact with skin • Harmful if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage • May cause respiratory irritation	8	WF/I
71-00-1	L-histidine (crystals) $C_6H_9N_3O_2(s)$	A	Not a hazardous substance or mixture	None	8	T

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7647-01-0	hydrochloric acid (solution) (*muriatic acid*) mixture: HCl 36.5% H_2O 63.5% HCl(aq)	A – 0.1 mol/L or less B – dilute C – concentrated	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage • May cause respiratory irritation	1	WF/I
7664-39-3	hydrofluoric acid (solution) mixture: HF 48–52% H_2O 48–52% HF(aq)	D	• Acute toxicity (dermal) (Category 1) • Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Fatal in contact with skin • Fatal if inhaled • Fatal if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	1	WF/I
1333-74-0	hydrogen (gas) H_2(g)	B	• Flammable gases (Category 1) • Gases under pressure (Compressed Gas)	*Danger* • Extremely flammable gas • Contains gas under pressure; may explode if heated	8	RS
74-90-8	hydrogen cyanide (liquid or gas) (*hydrocyanic acid* or *prussic acid* if aqueous) HCN(l) or HCN(g)	D	• Acute toxicity (dermal) (Category 1) • Acute toxicity (inhalation) (Category 1) • Acute toxicity (oral) (Category 1)	*Danger* • Fatal in contact with skin • Fatal if inhaled • Fatal if swallowed	1	WF/I
7722-84-1	hydrogen peroxide (solution) mixture: hydrogen peroxide 30% water 70% H_2O_2(aq)	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage • May cause respiratory irritation	8	WF/I

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7722-84-1	hydrogen peroxide (solution) mixture: hydrogen peroxide 2–4% water 96–98% H_2O_2(aq)	A	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage	8	D
7783-06-4	hydrogen sulfide (gas) H_2S(g)	D	• Acute toxicity (inhalation) (Category 2) • Flammable gases (Category 1) • Gases under pressure (Liquefied Gas)	*Danger* • Fatal if inhaled • Extremely flammable gas • Contains gas under pressure; may explode if heated	8	RS
123-31-9	hydroquinone (crystals) (*benzene-1,4-diol*) $C_6H_6O_2$(s)	C	• Acute toxicity (oral) (Category 4) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Germ cell mutagenicity (Category 2) • Carcinogenicity (Category 2)	*Danger* • Harmful if swallowed • May cause allergy or asthma symptoms or breathing difficulties if inhaled • Causes serious eye damage • Suspected of causing genetic defects • Suspected of causing cancer	8	WF/I
860-22-0	indigo carmine (powder or solution) $C_{16}H_8N_2Na_2O_8S_2$(s)	B – solution C – powder	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
7440-74-6	indium (solid) In(s)	B	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful in contact with skin • Harmful if inhaled • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I

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87-51-4	indole-3-acetic acid (solid) (*heteroauxin*, *IAA*) $C_{10}H_9NO_2$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
5418-32-6	indophenol sodium salt (crystals) $C_{12}H_8NaNO$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
87-89-8	*myo*-inositol (crystals) (*hexahydroxycyclohexane*) $C_6H_{12}O_6$(s)	B	Not a hazardous substance or mixture	None	8	T
7553-56-2	iodine (crystals or solution) I_2(s)	B – solution C – solid	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful in contact with skin • Harmful if inhaled • Causes serious eye irritation • Causes skin irritation • Causes damage to organs (thyroid) through prolonged or repeated exposure if swallowed • May cause respiratory irritation	7	WF/I
75-03-6	iodoethane (liquid) (*ethyl iodide*) C_2H_5I(l)	B	• Acute toxicity (oral) (Category 4) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if swallowed • May cause an allergic skin reaction • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I

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7439-89-6	iron (powder) Fe(s)	C	• Flammable solids (Category 1) • Self-heating substances and mixtures (Category 1)	*Danger* • Flammable solid • Self-heating; may catch fire	4	WF/I
7439-89-6	iron (filings) Fe(s)	A	Not a hazardous substance or mixture	None	8	R
1185-57-5	iron(III) ammonium citrate (powder) $xFe•xNH_3•C_6H_8O_7(s)$	A	Not a hazardous substance or mixture	None	8	WF/I
7783-83-7	iron(III) ammonium sulfate dodecahydrate $FeNH_4SO_4(s) •12H_2O(s)$	A	Not a hazardous substance or mixture	None	8	WF/I
7783-85-9	iron(II) ammonium sulfate hexahydrate (crystals) (*Mohr's salt*) $Fe(NH_4)_2(SO_4)_2•6H_2O(s)$	A	Not a hazardous substance or mixture	None	8	WF/I
10025-77-1	iron(III) chloride hexahydrate (crystals) $FeCl_3•6H_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Harmful if swallowed • May be corrosive to metals • Causes serious eye damage • Causes skin irritation	8	WF/I
13478-10-9	iron(II) chloride tetrahydrate (crystals) $FeCl_2•4H_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
7782-61-8	iron(III) nitrate nonahydrate (crystals) $Fe(NO_3)_3•9H_2O(s)$	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I

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1309-37-1	iron(III) oxide (powder) Fe_2O_3(s)	A	Not a hazardous substance or mixture	None	8	WF/I
7782-63-0	iron(II) sulfate heptahydrate (crystals) (*ferrous sulfate 7-hydrate*) $FeSO_4 \bullet 7H_2O$(s)	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation	8	WF/I
7782-63-0	iron(II) sulfate heptahydrate (powder) $FeSO_4 \bullet 7H_2O$(s)	A	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation	8	WF/I
10028-22-5	iron(III) sulfate, hydrated (powder) $Fe_2(SO_4)_3 \bullet xH_2O$(s)	B	• Acute toxicity (oral) (Category 4) • Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Harmful if swallowed • May be corrosive to metals • Causes serious eye damage • Causes skin irritation	8	WF/I
1317-37-9	iron(II) sulfide (powder) FeS(s)	A	Not a hazardous substance or mixture	None	8	WF/I
123-51-3	isoamyl alcohol (liquid) (*isopentyl alcohol*) $C_4H_{10}O$(l) or $(CH_3)_2CHCH_2CH_2OH$(l)	B	• Acute toxicity (inhalation) (Category 4) • Flammable liquids (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful if inhaled • Flammable liquid and vapour • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	5	WF/I

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443-79-8	isoleucine (powder) (*DL-isoleucine*) $C_6H_{13}NO_2$(s)	B	Not a hazardous substance or mixture	None	8	T or D(aq)
8008-20-6	kerosene (liquid) (*kerosine*) mixture: aromatics 15.9% cycloparaffins 52.8% paraffins 30.8% alkenes 0.5%	B	• Aspiration Hazard (Category 1) • Flammable liquids (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • May be fatal if swallowed and enters airways • Combustible liquid • Causes skin irritation • May cause drowsiness or dizziness	5	WF/I
525-79-1	kinetin (solid) $C_{10}H_9N_5O$(s)	A	Not a hazardous substance or mixture	None	8	T
Not applicable	Knop's reagent (solution) mixture: $MgSO_4 \bullet 7H_2O$ 1.0 g KH_2PO_4 0.2 g KNO_3 1.0 g $Ca(NO_3) \bullet 4H_2O$ 1.0 g $FeCl_3$ (1% soln.) 1.0 drop H_2O 1.0 L	A	Not a hazardous substance or mixture	None	8	D
79-33-4	lactic acid (crystals or liquid) (*hydroxyl-2-propanoic acid*) $C_3H_6O_3$(s) or $CH_3CHOHCOOH$(s)	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Causes serious eye damage • Causes skin irritation	3	WF/I
64044-51-5	lactose (crystals or powder) $C_{12}H_{22}O_{11}$(s)	A	Not a hazardous substance or mixture	None	8	T

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143-07-7	lauric acid (crystals) (*dodecanoic acid*) $C_{12}H_{24}O_2$(s) or $CH_3(CH_2)_{10}COOH$(s)	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Causes serious eye damage	3	WF/I
7439-92-1	lead metal (strips) Pb(s)	C – strips D – powder	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Reproductive Toxicity (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2)	*Warning* • Harmful if swallowed • Suspected of causing cancer • Suspected of damaging fertility or the unborn child • May cause damage to organs through prolonged or repeated exposure	8	R
Not applicable	lead compounds	D – solutions and powders	• Acute toxicity (oral) (Category 4) • Acute toxicity (inhalation) (Category 4) • Oxidizing solids (Category 2) • Reproductive Toxicity (Category 1A) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Harmful if swallowed • Harmful if inhaled • May intensify fire; oxidizer • May damage fertility or the unborn child • Causes serious eye damage • May cause damage to organs through prolonged or repeated exposure	8	WF/I
Not applicable	lime water (solution) mixture: $Ca(OH)_2$ 0.16% H_2O 99.84% $Ca(OH)_2$(aq)	A	Not a hazardous substance or mixture	None	8	D

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7439-93-2	lithium (solid) Li(s)	C	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 1)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage • In contact with water releases flammable gases which may ignite spontaneously	4	WF/I
6108-17-4	lithium acetate dihydrate (crystals) $LiCH_3COO \bullet 2H_2O$(s)	A	Not a hazardous substance or mixture	None	8	T
7550-35-8	lithium bromide (anhydrous) (crystals) LiBr(s)	B	• Acute toxicity (oral) (Category 4) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Harmful if swallowed • May cause an allergic skin reaction • Causes serious eye irritation • Causes skin irritation	8	WF/I
554-13-2	lithium carbonate (powder) Li_2CO_3(s)	A	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Danger* • Harmful if swallowed • Causes serious eye irritation	8	WF/I
7447-41-8	lithium chloride (crystals) LiCl(s)	A	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation	8	WF/I

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7789-24-4	lithium fluoride (crystals) LiF(s)	B	• Acute toxicity (oral) (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Toxic if swallowed • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
1310-66-3	lithium hydroxide monohydrate (crystals) $LiOH•H_2O(s)$	B	• Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Toxic if inhaled • Toxic if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	2	WF/I
10377-51-2	lithium iodide (powder) LiI(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes serious eye irritation • Causes skin irritation	8	WF/I
7790-69-4	lithium nitrate (granular) $LiNO_3(s)$	B – solution C – granule	• Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Danger* • Harmful if swallowed • May intensify fire; oxidizer • Causes serious eye irritation	6	WF/I
10377-48-7	lithium sulfate (crystals) $Li_2SO_4•H_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Harmful if swallowed • Causes serious eye irritation	8	WF/I
1393-92-6	litmus blue (powder) (*lichenblue*) formula (variable)	A – solution B – powder	Not a hazardous substance or mixture	None	8	T or D(aq)

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Not applicable	Lugol's iodine stain (solution) (*Bouchardat reagent*) mixture: I_2 1% KI 1% H_2O 98%	A	Not a hazardous substance or mixture	None	8	WF/I
521-31-3	luminol (solid) (*5-amino-2,3-dihydrophthalazine-1,4-dione, 3-aminophthalhydrazide*) $C_8H_7N_3O_2$(s)	B	Not a hazardous substance or mixture	None	8	T or D(aq)
8023-70-9	lycopodium (powder) (*club moss spores*, *vegetable sulfur*)	B	• Flammable solids (Category 1)	*Danger* • Flammable solid	8	WF/I
56-87-1	lysine (solid) (*L-lysine*) $C_6H_{14}N_2O_2$(s)	B	Not a hazardous substance or mixture	None	8	T or D(aq)
7439-95-4	magnesium (powder) Mg(s)	C	• Self-heating substances and mixtures (Category 1) • Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 1)	*Danger* • Self-heating; may catch fire • In contact with water releases flammable gases which may ignite spontaneously	4	WF/I
7439-95-4	magnesium (strips) Mg(s)	A	• Self-heating substances and mixtures (Category 1) • Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 1)	*Danger* • Self-heating; may catch fire • In contact with water releases flammable gases which may ignite spontaneously	4	R

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16674-78-5	magnesium acetate tetrahydrate (powder) $Mg(CH_3COO)_2 \bullet 4H_2O(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7789-48-2	magnesium bromide (granular) $MgBr_2(s)$	A	Not a hazardous substance or mixture	None	8	T
546-93-0	magnesium carbonate (powder) $MgCO_3(s)$	A	Not a hazardous substance or mixture	None	8	T
7791-18-6	magnesium chloride hexahydrate (crystals) $MgCl_2 \bullet 6H_2O(s)$	A	Not a hazardous substance or mixture	None	8	T
1309-42-8	magnesium hydroxide (powder) $Mg(OH)_2(s)$	A	Not a hazardous substance or mixture	None	2	WF/I
13446-18-9	magnesium nitrate hexahydrate (crystals) $Mg(NO_3)_2 \bullet 6H_2O(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2B)	*Warning* • Causes eye irritation	6	WF/I
1309-48-4	magnesium oxide (powder) $MgO(s)$	A	Not a hazardous substance or mixture	None	8	T
1335-26-8	magnesium(IV) oxide (powder) (*magnesium peroxide*) $MgO_2(s)$	B	• Oxidizing solids (Category 2)	*Danger* • May intensify fire; oxidizer	6	WF/I
14807-96-6	magnesium silicate hydrous (powder) (*talc, talcum powder*) $H_2Mg_3O_{12}Si_4(s)$	A	Not a hazardous substance or mixture	None	8	T
7487-88-9	magnesium sulfate (powder) $MgSO_4(s)$	B	Not a hazardous substance or mixture	None	8	WF/I

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1317-61-9	magnetite (powder) (*iron oxide*) Fe_3O_4(s)	A	Not a hazardous substance or mixture	None	8	T
569-64-2	malachite green (solution) mixture: water 55% malachite green 45%	B	• Acute toxicity (oral) (Category 4) • Reproductive Toxicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Suspected of damaging fertility or the unborn child • Causes serious eye damage	8	WF/I
569-64-2	malachite green (crystals) (*aniline green*, *china green*, *benzaldehyde green*) $C_{23}H_{25}N_2Cl$(s) or $C_{23}H_{26}N_2O$(s)	B	• Acute toxicity (oral) (Category 4) • Reproductive Toxicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Suspected of damaging fertility or the unborn child • Causes serious eye damage	8	WF/I
2437-29-8	malachite green oxalate (crystals) $C_{23}H_{25}N_2Cl•C_2HO_4•0.5C_2H_2O_4$(s)	B	• Acute toxicity (oral) (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Reproductive Toxicity (Category 2)	*Danger* • Toxic if swallowed • Causes serious eye damage • Suspected of damaging fertility or the unborn child	1, 6, 8	WF/I
110-16-7	maleic acid (solid) (*butenedioic acid*, *toxilic acid*) $C_4H_4O_4$(s)	B – solution C – solid	• Acute toxicity (dermal) (Category 4) • Acute toxicity (oral) (Category 4) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful in contact with skin • Harmful if swallowed • May cause an allergic skin reaction • Causes serious eye damage • Causes skin irritation • May cause respiratory irritation	3	WF/I

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108-31-6	maleic anhydride (lumps) (*2,5-furandione*) $C_4H_2O_3$(s)	B – solution C – lump	• Acute toxicity (oral) (Category 4) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Harmful if swallowed • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction • Causes serious eye damage • Causes severe skin burns and eye damage • Causes damage to organs (respiratory system) through prolonged or repeated exposure if inhaled • May cause damage to organs (kidneys) through prolonged or repeated exposure if swallowed	8	WF/I
6915-15-7	malic acid (crystals) (*hydroxybutanedioic acid*) $C_4H_6O_5$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	3	WF/I
141-82-2	malonic acid (crystals) (*propanedioic acid*) $CH_2(COOH)_2$(s)	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Causes serious eye damage	3	WF/I
6363-53-7	maltose (granules) $C_{12}H_{22}O_{11}$(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7439-96-5	manganese (powder or solid) Mn(s)	B – solid C – powder	• Serious eye damage/eye irritation – Eye irritation (Category 2B) • Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 1)	*Danger* • Causes eye irritation • In contact with water releases flammable gases which may ignite spontaneously	4	WF/I

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598-62-9	manganese(II) carbonate hydrate (powder) $MnCO_3•XH_2O(s)$	A	Not a hazardous substance or mixture	None	8	WF/I
13446-34-9	manganese(II) chloride tetrahydrate (crystals) $MnCl_2•4H_2O(s)$	A	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	T or D(aq)
1313-13-9	manganese(IV) oxide (powder) (*manganese dioxide*) $MnO_2(s)$	A	• Acute toxicity (oral) (Category 4) • Acute toxicity (inhalation) (Category 4)	*Warning* • Harmful if swallowed • Harmful if inhaled	8	WF/I
10034-96-5	manganese sulfate monohydrate (granular) $MnSO_4•H_2O(s)$	A	• Specific target organ toxicity – Repeated exposure (Category 2)	*Warning* • May cause damage to organs through prolonged or repeated exposure	8	WF/I
3458-28-4	D-mannose (crystals) (*seminose*, *carubinose*) $C_6H_{12}O_6(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
471-34-1	marble (chips) (*calcium carbonate*) $CaCO_3(s)$	A	Not a hazardous substance or mixture	None	8	T
2216-51-5	menthol (solid) (*hexahydrothymol*) $C_{10}H_{20}O(s)$	A	• Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes skin irritation	8	WF/I
7439-97-6	mercury (liquid) (*quicksilver*) Hg(l)	D	• Acute toxicity (inhalation) (Category 2) • Reproductive Toxicity (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Fatal if inhaled • May damage fertility or the unborn child • Causes damage to organs through prolonged or repeated exposure	8	WF/I

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7439-97-6	mercury compounds	D	• Acute toxicity (inhalation) (Category 2) • Reproductive Toxicity (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Fatal if inhaled • May damage fertility or the unborn child • Causes damage to organs through prolonged or repeated exposure	8	R or WF/I
74-82-8	methane (gas or liquid) (*natural gas*) CH_4(g) and CH_4(l)	B	• Flammable gases (Category 1) • Gases under pressure (Compressed Gas)	*Danger* • Extremely flammable gas • Contains gas under pressure; may explode if heated	5	WF/I or RS (cylinder)
63-68-3	L-methionine (crystals) (*acimethin*) $C_5H_{11}NO_2S$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
67-56-1	methyl alcohol (99%) (liquid)	B	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Flammable liquids (Category 2) • Specific target organ toxicity – Single exposure (Category 1)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • Highly flammable liquid and vapour • Causes damage to organs	5	WF/I

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108-88-3	methylbenzene (liquid) (*toluene*, *phenylmethane*) $C_7H_8(l)$	C	• Aspiration Hazard (Category 1) • Flammable liquids (Category 2) • Reproductive Toxicity (Category 2) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • May be fatal if swallowed and enters airways • Highly flammable liquid and vapour • Suspected of damaging fertility or the unborn child • Causes skin irritation • May cause damage to organs through prolonged or repeated exposure • May cause drowsiness or dizziness	5	WF/I
123-51-3	3-methylbutan-1-ol (liquid) (*isoamyl alcohol*) $C_4H_{10}O(l)$ or $(CH_3)_2CHCH_2CH_2OH(l)$	B	• Acute toxicity (inhalation) (Category 4) • Flammable liquids (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful if inhaled • Flammable liquid and vapour • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	5	WF/I
9004-67-5	methyl cellulose (solid) (*cellulose methyl ether*) $C_7H_{14}O_5$ X(s)	A	Not a hazardous substance or mixture	None	8	T
122965-43-9	methylene blue hydrate (crystals) (*basic blue 9*) $C_{16}H_{18}ClN_3S•3H_2O(s)$	A	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
61-73-4	methylene blue (solution) mixture: water 99.0% methylene blue <1.0% $C_{16}H_{18}ClN_3S$(aq)	A	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
75-09-2	methylene chloride (liquid) (*dichloromethane*) CH_2Cl_2(l)	D	• Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Suspected of causing cancer • Causes serious eye irritation • Causes skin irritation • May cause damage to organs (liver, blood) through prolonged or repeated exposure if swallowed • May cause damage to organs (central nervous system) through prolonged or repeated exposure if inhaled • May cause respiratory irritation • May cause drowsiness or dizziness	8	WF/I
2679-01-8	methylene green (powder) (*basic green 5*) $C_{16}H_{17}ClN_4O_2S$(s)	B	• Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes skin irritation	8	WF/I
2679-01-8	methylene green (solution) (*basic green 5*) $C_{16}H_{17}ClN_4O_2S$(aq)	B	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
79-93-3	methyl ethyl ketone (liquid) (*butan-2-one*) C_4H_8O(l) or $CH_3COCH_2CH_3$(l)	C	• Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Highly flammable liquid and vapour • Causes serious eye irritation • May cause drowsiness or dizziness	5	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
82-94-0	methyl green (solid) (*double green*, *light green*) $C_{26}H_{33}Cl_2N_3$(s)	B	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	8	WF/I
547-58-0	methyl orange (solid) (*C.I. acid orange 52*) $C_{14}H_{14}N_3NaO_3S$(s)	B	• Acute toxicity (oral) (Category 3)	*Danger* • Toxic if swallowed	8	WF/I
547-58-0	methyl orange (solution) mixture: water 99.9% methyl orange 0.1% $C_{14}H_{14}N_3NaO_3S$(aq)	A	Not a hazardous substance or mixture	None	8	WF/I
98-06-6	2-methyl-2-phenylpropane (liquid) (*t-butylbenzene*, *tert-butylbenzene*) $C_{10}H_{14}$(l)	B	• Flammable liquids (Category 3) • Acute toxicity (inhalation) (Category 4) • Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Flammable liquid and vapour • Harmful if inhaled • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	5	WF/I
75-65-0	2-methyl propan-2-ol (liquid) (*isobutanol*, *tert-butanol*) $C_4H_{10}O$(l)	C	• Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Acute toxicity (inhalation) (Category 4) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Highly flammable liquid and vapour • Causes serious eye irritation • Harmful if inhaled • May cause respiratory irritation • May cause drowsiness or dizziness	5	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
1340-02-9	methyl purple (solution) (*tetrasodium*) mixture: water 99.8% methyl red sodium 0.1% fast green 0.1% $C_{67}H_{62}N_8Na_4O_{14}S_3$(aq)	B	Not a hazardous substance or mixture	None	8	WF/I
493-52-7	methyl red (solid) (*C.I. acid red*) $C_{15}H_{15}N_3O_2$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
493-52-7	methyl red (solution) mixture: methyl alcohol 99.98% methyl red 0.02% $C_{15}H_{15}N_3O_2$(aq)	A	Not a hazardous substance or mixture	None	8	WF/I
119-36-8	methyl salicylate (liquid) (*wintergreen oil*) $C_8H_8O_3$(l)	A	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
548-62-9	methyl violet (solution) mixture: water 99.98% methyl violet 0.02% $C_{24}H_{28}N_3Cl$(aq)	B	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Suspected of causing cancer • Causes serious eye damage	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
548-62-9	methyl violet (crystals) (*C.I. basic violet 1*) $C_{24}H_{28}N_3Cl$(s)	B	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Suspected of causing cancer • Causes serious eye damage	8	WF/I
78-83-1	2-methylpropan-1-ol (liquid) (*isobutyl alcohol*) $C_4H_{10}O$(l) or $(CH_3)_2CHCH_2OH$(l)	B	• Flammable liquids (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Flammable liquid and vapour • Causes serious eye damage • Causes skin irritation • May cause drowsiness or dizziness • May cause respiratory irritation	5	WF/I
12001-26-2	mica (sheets) (*muscovite*, *micro*, *dry ground*, *wet ground mica*) $KAl_2Si_3O_{10}(OH)_25H_2O$(s)	A	Not a hazardous substance or mixture	None	8	R or T
Not applicable	Millon's reagent (solution) mixture: mercury 25% nitric acid 50% water 25%	D	• Acute toxicity (dermal) (Category 1) • Acute toxicity (inhalation) (Category 1) • Acute toxicity (oral) (Category 2) • Oxidizing liquids (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Fatal in contact with skin • Fatal if inhaled • Fatal if swallowed • May intensify fire; oxidizer • Causes serious eye damage • Causes severe skin burns and eye damage • May cause damage to organs through prolonged or repeated exposure	1, 6	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
7783-85-9	Mohr's salt (crystals) (*ammonium ferrous sulfate hexahydrate*) $(NH_4)_2Fe(SO_4)_2 \bullet 6H_2O(s)$	A	Not a hazardous substance or mixture	None	8	WF/I
7439-98-7	molybdenum metal (powder) Mo(s)	A	Not a hazardous substance or mixture	None	8	WF/I
91-20-3	naphthalene (crystals) (*moth balls*, *tar camphor*) $C_{10}H_8(s)$	C	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Flammable solids (Category 2)	*Warning* • Harmful if swallowed • Suspected of causing cancer • Flammable solid	4	WF/I
Not applicable	nichrome wire (solid) mixture (alloy): nickel 80–90% chromium 10–20%	A	Not a hazardous substance or mixture	None	8	R
7440-02-0	nickel (powder) Ni(s)	D	• Carcinogenicity (Category 2) • Flammable solids (Category 2) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Suspected of causing cancer • Flammable solid • May cause an allergic skin reaction • Causes damage to organs through prolonged or repeated exposure if inhaled	4	WF/I
7440-02-0	nickel (strip) Ni(s)	B	• Carcinogenicity (Category 2) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Suspected of causing cancer • May cause an allergic skin reaction • Causes damage to organs through prolonged or repeated exposure	8	R

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
Not applicable	nickel compounds	D	• Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1A) • Germ cell mutagenicity (Category 2) • Reproductive Toxicity (Category 1B) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • Toxic if inhaled • Toxic if swallowed • May cause cancer • Suspected of causing genetic defects • May damage fertility or the unborn child • Causes skin irritation • Causes damage to organs through prolonged or repeated exposure • May cause an allergic skin reaction	8	WF/I
485-47-2	ninhydrin monohydrate (powder) $C_9H_6O_4$(s)	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation	8	WF/I
7697-37-2	nitric acid (solution) mixture: HNO_3 62–75% H_2O 25–38% HNO_3(aq)	B – dilute C – concentrated	• Corrosive to Metals (Category 1) • Oxidizing liquids (Category 3) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • May be corrosive to metals • May intensify fire; oxidizer • Causes serious eye damage • Causes severe skin burns and eye damage	1, 6	WF/I

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98-95-3	nitrobenzene (oily liquid) (*nitrobenzol*, *oil of mirbane*) $C_6H_5NO_2(l)$	C	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 2) • Flammable liquids (Category 4) • Reproductive Toxicity (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • Suspected of causing cancer • Combustible liquid • May damage fertility or the unborn child • Causes damage to organs (blood) through prolonged or repeated exposure if inhaled	5	WF/I
7727-37-9	nitrogen (gas) $N_2(l)$ and $N_2(g)$	C	• Gases under pressure (Compressed Gas)	*Warning* • Contains gas under pressure; may explode if heated	8	A
10102-44-0	nitrogen dioxide (liquefied gas) $NO_2(l)$ and $NO_2(g)$	D (commercial cylinders)	• Acute toxicity (inhalation) (Category 2) • Oxidizing Gases (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Fatal if inhaled • May cause or intensify fire; oxidizer • Causes serious eye damage • Causes severe skin burns and eye damage	6	WF/I
112-14-1	octyl acetate (liquid) (*2-ethylhexyl acetate*) $C_{10}H_{20}O_2(l)$	A	• Flammable liquids (Category 4)	*Warning* • Combustible liquid	5	WF/I or RS (cylinder)
111-87-5	octyl alcohol (liquid) (*n-octanol*, *caprylic alcohol*) $C_8H_{18}O(l)$	B	• Flammable liquids (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Combustible liquid • Causes serious eye irritation	5	WF/I
1320-06-5	Oil red O (*solvent red 27*) $C_{26}H_{24}N_4O(l)$	B	Not a hazardous substance or mixture	None	8	WF/I

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112-80-1	oleic acid (oily liquid) (*(z)-9-octadecenoic acid*) $C_{18}H_{34}O_2$(l)	A	Not a hazardous substance or mixture	None	3	WF/I
554-73-4	orange IV (powder) (*tropaeolin O*, *C.I. 13080*) $C_{18}H_{14}N_3NaO_3S$(s)	B	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation	8	WF/I
554-73-4	orange IV (solution) mixture: water 99.9% orangeIV 0.1% $C_{18}H_{14}N_3NaO_3S$(aq)	A	Not a hazardous substance or mixture	None	8	D
1400-62-0	orcein (powder) $C_{28}H_{24}N_2O_7$(s)	B	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
144-62-7	oxalic acid (crystals) (*ethanedioic acid*) $C_2H_2O_4$(s)	C	• Acute toxicity (dermal) (Category 4) • Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful in contact with skin • Harmful if swallowed • Causes serious eye damage	3	WF/I
7782-44-7	oxygen (gas) O_2(g)	A	• Gases under pressure (Compressed Gas) • Oxidizing Gases (Category 1)	*Danger* • Contains gas under pressure; may explode if heated • May cause or intensify fire; oxidizer	6	A
57-10-3	palmitic acid (crystals) (*hexadecanoic acid*) $C_{16}H_{32}O_2$(s)	A	Not a hazardous substance or mixture	None	3	WF/I

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8049-47-6	pancreatin (powder) (*diastase vera*) (variable composition)	B	• Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May cause allergy or asthma symptoms or breathing difficulties if inhaled • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
106-46-7	paradichlorobenzene (crystals) (*1,4-dichlorobenzene*) $C_6H_4Cl_2$(s)	C	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Harmful if swallowed • Suspected of causing cancer • Causes serious eye irritation	8	WF/I
8002-74-2	paraffin (solid) C_nH_{2n+2}(s)	A	Not a hazardous substance or mixture	None	8	T
30525-89-4	paraformaldehyde (powder) $(CH_2O)_n$(s)	D	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Flammable solids (Category 2) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if inhaled • Harmful if swallowed • Suspected of causing cancer • Flammable solid • May cause an allergic skin reaction • Causes serious eye damage • Causes skin irritation • May cause respiratory irritation	4	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
109-66-0	pentane (gas) $C_5H_{12}(g)$	C	• Aspiration Hazard (Category 1) • Flammable liquids (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • May be fatal if swallowed and enters airways • Extremely flammable liquid and vapour • May cause drowsiness or dizziness	5	WF/I
71-41-0	n-pentyl alcohol (liquid) (*n-amyl alcohol*, *pentan-1-ol*) $C_5H_{11}OH(l)$	B	• Acute toxicity (inhalation) (Category 4) • Flammable liquids (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful if inhaled • Flammable liquid and vapour • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	5	WF/I
9001-75-6	pepsin (powder) (variable composition)	B	• Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
7601-90-3	perchloric acid (solution) mixture: $HClO_4$ 70% H_2O 30% $HClO_4(aq)$	D	• Acute toxicity (oral) (Category 4) • Corrosive to Metals (Category 1) • Oxidizing liquids (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Harmful if swallowed • May be corrosive to metals • May cause fire or explosion; strong oxidizer • Causes serious eye damage • Causes severe skin burns and eye damage • Causes damage to organs (thyroid) through prolonged or repeated exposure	1, 6	WF/I
8032-32-4	petroleum ether (liquid) mixture: n-pentane 85+% methylpentane small % cyclopentane small % dimethylbutane small % other hydrocarbons variable	C	• Aspiration Hazard (Category 1) • Flammable liquids (Category 2) • Germ cell mutagenicity (Category 1B) • Carcinogenicity (Category 1B)	*Danger* • May be fatal if swallowed and enters airways • Highly flammable liquid and vapour • May cause genetic defects • May cause cancer	5	WF/I
108-95-2	phenol (liquid) (*carbolic acid*, *phenic acid*) $C_6H_6O(s)$	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Germ cell mutagenicity (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • Suspected of causing genetic defects • Causes serious eye damage • Causes severe skin burns and eye damage • May cause damage to organs through prolonged or repeated exposure	3	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
77-09-8	phenolphthalein (crystals) $C_{20}H_{14}O_4$(s)	C	• Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 2) • Reproductive Toxicity (Category 2)	*Warning* • May cause cancer • Suspected of causing genetic defects • Suspected of damaging fertility or the unborn child	8	WF/I
77-09-8	phenolphthalein (solution) mixture: phenolphthalein 0.5–1.0% ethyl alcohol 50–95% methyl alcohol 1–2% isopropyl alcohol 1–2%	B	• Carcinogenicity (Category 1B) • Flammable liquids (Category 3) • Reproductive Toxicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • May cause cancer • Flammable liquid and vapour • Suspected of damaging fertility or the unborn child • Causes serious eye irritation	5	WF/I
143-74-8	phenol red (solution) mixture: water 73–75% ethanol 24–26% phenol red < 1.0%	B	• Acute toxicity (oral) (Category 4) • Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 1)	*Danger* • Harmful if swallowed • Highly flammable liquid and vapour • Causes serious eye irritation • Causes damage to organs	5	WF/I
63-91-2	L-phenylalanine (crystals) $C_9H_{11}NO_2$(s)	A	Not a hazardous substance or mixture	None	8	T
100-41-4	phenylethane (liquid) (*ethylbenzol*, *ethylbenzene*) C_8H_{10}(s)	D	• Flammable liquids (Category 2) • Aspiration Hazard (Category 1) • Acute toxicity (inhalation) (Category 4) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Highly flammable liquid and vapour • May be fatal if swallowed and enters airways • Harmful if inhaled • May cause respiratory irritation • May cause drowsiness or dizziness	5	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
100-63-0	phenylhydrazine (liquid) (*hydrozinobenezene*) $C_6H_8N_2$(l)	C	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1B) • Flammable liquids (Category 4) • Germ cell mutagenicity (Category 2) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • May cause cancer • Combustible liquid • Suspected of causing genetic defects • May cause an allergic skin reaction • Causes serious eye irritation • Causes skin irritation	5	WF/I
118-55-8	phenyl salicylate (crystals) (*hydroxy-2-benzoic acid*, *phenyl ester*) $C_{13}H_{10}O_3$(s) or $C_6H_4(OH)COC_6H_5$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
103-85-5	phenylthiocarbamide (*PTC paper, phenylthiourea*) $C_7H_8N_2S$(s)	B	• Acute toxicity (oral) (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • Fatal if swallowed • May cause an allergic skin reaction *Note: recommend use of sodium benzoate strips as a safer alternative*	8	T
7664-38-2	phosphoric acid (solution) mixture: H_3PO_4 74–95% H_2O 5–26% H_2PO_4(aq)	B – dilute C – concentrated	• Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • May be corrosive to metals • Causes serious eye damage • Causes severe skin burns and eye damage	1	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
7723-14-0	phosphorus, amorphous red (powder) P(s)	C	• Flammable solids (Category 2)	*Warning* • Flammable solid	4	WF/I
7723-14-0	phosphorus, purified yellow (waxy solid) (*white phosphorus*) P_4(s)	D	• Pyrophoric solids (Category 1) • Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 2) • Acute toxicity (dermal) (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Catches fire spontaneously if exposed to air • Fatal if inhaled • Fatal if swallowed • Fatal in contact with skin • Causes serious eye damage • Causes severe skin burns and eye damage	4	WF/I
1314-56-3	phosphorus pentoxide (powder) (*phosphoric anhydride*) P_2O_5(s)	C	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
7719-12-2	phosphorus trichloride (fuming liquid) PCl_3(l)	D	• Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Fatal if inhaled • Fatal if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage • May cause damage to organs through prolonged or repeated exposure if inhaled	8	WF/I
88-99-3	phthalic acid (powder) (*benzene-1,2-dicarboxylic acid*) $C_8H_6O_4$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	3	WF/I

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88-89-1	picric acid (crystals) (*trinitro-2,4,6-phenol*) $C_6H_3N_3O_7(s)$	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 4) • Flammable solids (Category 1)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Harmful if swallowed • Flammable solid	3, 4	WF/I
7440-06-4	platinum metal (solid) Pt(s)	A	Not a hazardous substance or mixture	None	8	R
9002-88-4	polyethylene (solid) $[C_2H_4]_n(s)$	A	Not a hazardous substance or mixture	None	8	R
9003-07-0	polypropylene (solid) $[C_3H_6]_n(s)$	A	Not a hazardous substance or mixture	None	8	R
9003-53-6	polypropylene (solid) (*dylene*) $[C_8H_8]_n(s)$	A	Not a hazardous substance or mixture	None	8	R
9003-20-7	polyvinyl acetate (solid) (*PVA*) $[C_4H_6O_2]_n(s)$	A	Not a hazardous substance or mixture	None	8	R
9002-89-5	polyvinyl alcohol (granules) $[CH_2CHOH]_n(s)$	A	Not a hazardous substance or mixture	None	8	R
7440-09-7	potassium metal (solid) K(s)	C	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A) • Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 1)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage • In contact with water releases flammable gases which may ignite spontaneously	4	WF/I

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127-08-2	potassium acetate (powder) $KCH_3COO(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
127-95-7	potassium binoxalate (powder) (*potassium hydrogen oxalate*) $C_2HKO_4(s)$	B	• Acute toxicity (oral) (Category 4) • Acute toxicity (dermal) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Harmful if swallowed • Harmful in contact with skin • Causes serious eye irritation	8	WF/I
7646-93-7	potassium bisulfite (solution) (*potassium hydrogen sulfite*) $KHSO_3(aq)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes serious eye irritation • May cause respiratory irritation	8	WF/I
7758-01-2	potassium bromate (powder) $KBrO_3(s)$	B – solution C – powder	• Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1A) • Oxidizing solids (Category 1)	*Danger* • Toxic if swallowed • May cause cancer • May cause fire or explosion; strong oxidizer	6	WF/I
7758-02-3	potassium bromide (crystals) $KBr(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I
584-08-7	potassium carbonate (powder) $K_2CO_3(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
3811-04-9	potassium chlorate (powder) $KClO_3(s)$	D	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 1)	*Danger* • Harmful if inhaled • Harmful if swallowed • May cause fire or explosion; strong oxidizer	6	WF/I

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7447-40-7	potassium chloride (crystals) KCl(s)	A	Not a hazardous substance or mixture	None	8	T
7789-00-6	potassium chromate (crystals) K_2CrO_4(s)	D	• Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 1B) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Toxic if swallowed • May cause cancer • May cause genetic defects • May cause an allergic skin reaction • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I

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7778-50-9	potassium dichromate (powder) $K_2Cr_2O_7(s)$	D	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 1B) • Oxidizing solids (Category 2) • Reproductive Toxicity (Category 1B) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Harmful in contact with skin • Fatal if inhaled • Toxic if swallowed • May cause cancer • May cause genetic defects • May intensify fire; oxidizer • May damage fertility or the unborn child • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction • Causes serious eye damage • Causes severe skin burns and eye damage • Causes damage to organs (cardiovascular system) through prolonged or repeated exposure if inhaled	6	WF/I
7778-77-0	potassium dihydrogen phosphate (crystals) (*potassium phosphate, monobasic*) $KH_2PO_4(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes serious eye irritation • Causes skin irritation	8	T
14459-95-1	potassium ferrocyanide trihydrate (liquid) $K_4Fe(CN)_6•3H_2O(l)$	A	Not a hazardous substance or mixture	None	8	WF/I
298-14-6	potassium hydrogen carbonate (crystals) (*potassium bicarbonate*) $KHCO_3(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)

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7778-11-4	potassium hydrogen phosphate (powder) (*potassium phosphate dibasic*) K_2HPO_4(s)	A	Not a hazardous substance or mixture	None	8	WF/I
877-24-7	potassium hydrogen phthalate (powder) $KH_5C_8O_4$(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7646-93-7	potassium hydrogen sulfate (powder) (*potassium bisulfate*) $KHSO_4$(s)	B – solution C – powder	• Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes severe skin burns and eye damage • Causes serious eye damage • May cause respiratory irritation	8	WF/I
868-14-4	potassium hydrogen tartrate (powder) (*potassium bitartrate*, *cream of tartar*) $KHC_4H_4O_6$(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)
1310-58-3	potassium hydroxide (pellets) (*caustic potash*) KOH(s)	B	• Acute toxicity (oral) (Category 4) • Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Harmful if swallowed • May be corrosive to metals • Causes serious eye damage • Causes severe skin burns and eye damage	2	WF/I

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7758-05-6	potassium iodate (powder) $KIO_3(s)$	B – solution C – powder	• Oxidizing solids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May intensify fire; oxidizer • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	6	WF/I
7681-11-0	potassium iodide (crystals) KI(s)	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation	8	WF/I
7757-79-1	potassium nitrate (crystals) $KNO_3(s)$	B	• Oxidizing solids (Category 3)	*Warning* • May intensify fire; oxidizer	6	WF/I
7758-09-0	potassium nitrite (granules) $KNO_2(s)$	B	• Acute toxicity (oral) (Category 3) • Oxidizing solids (Category 2)	*Danger* • Toxic if swallowed • May intensify fire; oxidizer	6	WF/I
583-52-8	potassium oxalate (crystals) $K_2C_2O_4 \bullet H_2O(s)$	B – solution C – crystals	• Acute toxicity (dermal) (Category 4) • Acute toxicity (oral) (Category 4)	*Warning* • Harmful in contact with skin • Harmful if swallowed	8	WF/I
7722-64-7	potassium permanganate (crystals) (*Condy's crystals*) $KMnO_4(s)$	B	• Oxidizing solids (Category 2) • Acute toxicity (oral) (Category 4)	*Danger* • May intensify fire; oxidizer • Harmful if swallowed	6	WF/I
7778-77-0	potassium phosphate, monobasic (powder) $KH_2PO_4(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes serious eye irritation • Causes skin irritation	8	WF/I

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7758-11-4	potassium phosphate, dibasic (powder) $K_2HPO_4(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I
7778-53-2	potassium phosphate, tribasic (powder) $K_2HPO_4(s)•XH_2O(s)$	C	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes serious eye damage • May cause respiratory irritation	8	WF/I
6381-59-5	potassium sodium tartrate (powder) (*Rochelle salt*) $KNaC_4H_4O_6•4H_2O(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7778-80-5	potassium sulfate (powder) $K_2SO_4(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
39365-88-3	potassium sulfide (powder) $K_2S(s)$	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
10117-38-1	potassium sulfite (crystals) $K_2SO_3(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
333-20-0	potassium thiocyanate (crystals) KSCN(s)	B	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4)	*Warning* • Harmful in contact with skin • Harmful if inhaled • Harmful if swallowed	8	WF/I
147-85-3	L-proline (powder) $C_5H_9NO_2(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)

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74-98-6	propane (liquid or gas) $C_3H_8(l)$ or $C_3H_8(g)$	B	• Flammable gases (Category 1) • Gases under pressure (Compressed Gas) • Simple asphyxiants (Category 1)	*Danger* • Extremely flammable gas • Contains gas under pressure; may explode if heated • May displace oxygen and cause rapid suffocation	5	RS or WF/I
71-23-8	propan-1-ol (liquid) (*propyl alcohol*) $C_3H_8O(l)$ or $CH_3(CH_2)_2OH(l)$	B – small volume	• Flammable liquids (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Highly flammable liquid and vapour • Causes serious eye damage • May cause drowsiness or dizziness	5	WF/I
67-63-0	propan-2-ol (liquid) (*isopropyl alcohol, rubbing alcohol*) $C_3H_8O(l)$ or $(CH_3)_2CHOH(l)$	B	• Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Highly flammable liquid and vapour • Causes serious eye irritation • May cause drowsiness or dizziness	5	WF/I
79-09-4	propionic acid (oily liquid) (*propanoic acid*, *methyl acetic acid*) $C_3H_6O_2(l)$ or $CH_3CH_2COOH(l)$	B – dilute C – concentrated	• Flammable liquids (Category 3) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Flammable liquid and vapour • Causes severe skin burns and eye damage	3, 5	WF/I
57-55-6	propylene glycol (oily liquid) (*propane-1,2-diol*) $C_3H_8O_2(l)$ or $CH_3CHOHCH_2OH(l)$	A	Not a hazardous substance or mixture	None	8	WF/I
74-90-8	prussic acid (liquid) (*hydrogen cyanide anhydrous*, *hydrocyanic acid*) HCN(l)	D	• Acute toxicity (dermal) (Category 1) • Acute toxicity (inhalation) (Category 1) • Acute toxicity (oral) (Category 1)	*Danger* • Fatal in contact with skin • Fatal if inhaled • Fatal if swallowed	1	WF/I

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103-85-5	PTC (paper) (*phenylthiocarbamide, phenylthiourea*) $C_7H_8N_2S$(s)	B	• Acute toxicity (oral) (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1)	*Danger* • Fatal if swallowed • May cause an allergic skin reaction *Note: recommend use of sodium benzoate strips as a safer alternative*	8	T
110-86-1	pyridine (liquid) (*azabenzene*) C_5H_5N(l)	C	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Flammable liquids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Harmful in contact with skin • Harmful if inhaled • Harmful if swallowed • Highly flammable liquid and vapour • Causes serious eye irritation • Causes skin irritation	5	WF/I
139-36-0	pyrite (chunks) (*iron disulfide*) FeS_2(s)	A	Not a hazardous substance or mixture	None	8	R or T
87-66-1	pyrogallol (powder) (*pyrogallic acid, benzene-1,2,3-triol*) $C_6H_6O_3$(s)	B	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Germ cell mutagenicity (Category 2)	*Warning* • Harmful in contact with skin • Harmful if inhaled • Harmful if swallowed • Suspected of causing genetic defects	3	WF/I
14808-60-7	quartz (chunk) (*silica*) SiO_2(s)	A	• Carcinogenicity (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • May cause cancer (by inhalation) • May cause damage to organs (lungs, spleen, blood, and endocrine system) through prolonged or repeated exposure (inhalation)	8	R or T

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117-92-0	quinaldine red (powder) $C_{21}H_{23}IN_2$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
6119-70-6	quinine sulfate (powder) (*quinine sulfate dihydrate*) $(C_{20}H_{24}N_2O_2)_2\ H_2SO_4 \bullet 2H_2O$(s)	B	• Combustible Dusts (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • May form combustible dust concentrations in air • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
25956-17-6	red dye 40 (powder) (*allura red AC*) $C_{18}H_{14}N_2Na_2O_8S_2$(s)	B	Not a hazardous substance or mixture	None	8	RS
9073-79-4	Rennet tablets (solid) (*rennin*) (variable composition)	A	Not a hazardous substance or mixture	None	8	T
108-46-3	resorcinol (powder) (*benzene-1,3-diol*) $C_6H_6O_2$(s)	B – solution C – powder	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation	8	WF/I
141-84-4	rhodanine (crystals) (*rhodanic acid*) $C_3H_3NOS_2$(s)	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Causes serious eye damage	3	WF/I
6381-59-5	Rochelle salt (powder) (*potassium sodium tartrate*) $KNaC_4H_4O_6 \bullet 4H_2O$(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)

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603-45-2	rosolic acid (powder) (*aurin*) $C_{19}H_{14}O_3$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	3	WF/I
71-23-8	rubbing alcohol (liquid) (*isopropyl alcohol, propan-2-ol*) C_3H_8O(l) or $CH_3(CH_2)_2OH$(l)	B	• Flammable liquids (Category 2) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Highly flammable liquid and vapour • Causes serious eye damage • May cause drowsiness or dizziness	5	WF/I
477-73-6	safranin O (solution) mixture: water 98.8% sodium benzoate 0.2% safranin O 1.0%	A	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I
477-73-6	safranin O (powder) $C_{20}H_{19}N_4Cl$(s)	A	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
69-72-7	salicylic acid (crystals) (*hydroxy-2-benzoic acid*) $C_7H_6O_3$(l) or HOC_6H_4COOH(l)	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Causes serious eye damage	3	WF/I

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111-19-3	sebacoyl chloride (powder) (*decanedioyl dichloride*) $C_{10}H_{16}Cl_2O_2$(s)	C	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category1A)	*Danger* • Harmful if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
7782-49-2	selenium (shot) Se(s)	B	• Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Toxic if inhaled • Toxic if swallowed • May cause damage to organs (liver and reproductive system) through prolonged or repeated exposure (oral)	8	WF/I
56-45-1	serine (powder) $C_3H_7NO_3$(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)
1343-98-2	silicic acid (granules) (*silica gel*) H_2SiO_3(s)	B	• Specific target organ toxicity – Repeated exposure (Category 2)	*Warning* • May cause damage to organs (lungs and immune system) through prolonged or repeated exposure	1	WF/I
7440-21-3	silicon (crystals/powder) Si(s)	B – crystal C – powder	• Flammable solids (Category 2)	*Warning* • Flammable solid	4	WF/I
7631-86-9	silicon dioxide amorphous (granules) (*silica*, *quartz*, *sand*) SiO_2(s)	A	Not a hazardous substance or mixture	None	8	T
7440-22-4	silver metal (solid and foil) Ag(s)	A	Not a hazardous substance or mixture	None	8	R
563-63-3	silver acetate (powder) $AgC_2H_3CO_2$(s)	A	• Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes skin irritation	8	WF/I

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7785-23-1	silver bromide (powder) AgBr(s)	A	Not a hazardous substance or mixture	None	8	WF/I
7783-90-6	silver chloride (powder) AgCl(s)	A	• Corrosive to Metals (Category 1)	*Warning* • May be corrosive to metals	8	WF/I
7761-88-8	silver nitrate (crystals) $AgNO_3$(s)	B	• Corrosive to Metals (Category 1) • Oxidizing solids (Category 2) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • May be corrosive to metals • May intensify fire; oxidizer • Causes severe skin burns and eye damage	6	WF/I
20667-12-3	silver oxide (powder) Ag_2O(s)	D	• Oxidizing solids (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May cause fire or explosion; strong oxidizer • Causes serious eye damage • May cause respiratory irritation	6	WF/I
10294-26-5	silver sulfate (crystals) Ag_2SO_4(s)	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Causes serious eye damage	8	WF/I
8006-28-8	soda lime (pellets) mixture: ethyl violet < 1% NaOH < 2% KOH < 3% $Ca(OH)_2$ > 80%	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage	2	WF/I

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7440-23-5	sodium metal (solid) Na(s)	C	• Aspiration Hazard (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 1)	*Danger* • May be fatal if swallowed and enters airways • Causes severe skin burns and eye damage • In contact with water releases flammable gases which may ignite spontaneously	4	WF/I
6131-90-4	sodium acetate anhydrous and trihydrate (crystals) CH_3COONa(s) and $CH_3COONa•3H_2O$(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7784-46-5	sodium arsenite (powder) $NaAsO_2$(s)	D	• Acute toxicity (dermal) (Category 2) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 2) • Carcinogenicity (Category 1A) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Fatal in contact with skin • Toxic if inhaled • Fatal if swallowed • May cause cancer • May cause damage to organs through prolonged or repeated exposure	8	WF/I
532-32-1	sodium benzoate (powder) C_6H_5COONa(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Acute toxicity (oral) (Category 4)	*Warning* • Causes serious eye irritation • Harmful if swallowed	8	WF/I
1303-96-4	sodium borate decahydrate (powder) (*borax*) $Na_2B_4O_7•10H_2O$(s)	B – solution C – powder	• Reproductive Toxicity (Category 2)	*Danger* • Suspected of damaging fertility or the unborn child	8	T or D(aq)

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
7789-38-0	sodium bromate (powder) $NaBrO_3(s)$	B	• Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Harmful if swallowed • May intensify fire; oxidizer • Causes serious eye irritation • Causes skin irritation	6	WF/I
7647-15-6	sodium bromide (granules) NaBr(s)	A	Not a hazardous substance or mixture	None	8	T
497-19-8	sodium carbonate anhydrous (granular) $Na_2CO_3(s)$	A	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	T or D(aq)
7775-09-9	sodium chlorate (crystals) $NaClO_3(s)$	D	• Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 1)	*Danger* • Harmful if swallowed • May cause fire or explosion; strong oxidizer	6	WF/I
7647-14-5	sodium chloride (granules) NaCl(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)

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10034-82-9	sodium chromate tetrahydrate (powder) $Na_2CrO_4 \bullet 4H_2O(s)$	D	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 1) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1A) • Germ cell mutagenicity (Category 1A) • Reproductive Toxicity (Category 1A) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Harmful in contact with skin • Fatal if inhaled • Toxic if swallowed • May cause cancer • May cause genetic defects • May damage fertility or the unborn child • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction • Causes serious eye damage • Causes severe skin burns and eye damage • Causes damage to organs (central nervous system, lungs, and blood) through prolonged or repeated exposure	8	WF/I
6132-04-3	sodium citrate dihydrate (powder) $Na_3C_6H_5O_7 \bullet 2H_2O(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)

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7789-12-0	sodium dichromate dihydrate (powder) $Na_2Cr_2O_7 \bullet 2H_2O(s)$	D	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 3) • Carcinogenicity (Category 1B) • Germ cell mutagenicity (Category 1B) • Oxidizing solids (Category 2) • Reproductive Toxicity (Category 1B) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Harmful in contact with skin • Fatal if inhaled • Toxic if swallowed • May cause cancer • May cause genetic defects • May intensify fire; oxidizer • May damage fertility or the unborn child • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause an allergic skin reaction • Causes severe skin burns and eye damage • Causes damage to organs (lungs, liver, digestive system, and blood) through prolonged or repeated exposure	6	WF/I
13472-35-0	sodium dihydrogen phosphate (crystals) (*sodium phosphate monobasic dihydrate*) $NaH_2PO_4 \bullet 2H_2O(s)$	A	Not a hazardous substance or mixture	None	8	WF/I
127-09-3	sodium ethanoate (crystals) (*sodium acetate*) $CH_3COONa(s)$ and $CH_3COONa \bullet 3H_2O(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)

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7681-49-4	sodium fluoride (crystals) NaF(s)	B – solution C – crystals	• Acute toxicity (oral) (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Toxic if swallowed • Causes serious eye irritation • Causes skin irritation	8	WF/I
144-55-8	sodium hydrogen carbonate (powder) (*sodium bicarbonate*, *baking soda*) $NaHCO_3$(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)
7558-79-4	sodium hydrogen phosphate anhydrous (granules) (*sodium hydrogen phosphate dibasic*) Na_2HPO_4(s)	A	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
7681-38-1	sodium hydrogen sulfate monohydrate (crystals) (*sodium bisulfate*) $NaHSO_4 \bullet H_2O$(s)	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Causes serious eye damage	8	WF/I
7631-90-5	sodium hydrogen sulfite (granules) (*sodium bisulfite*) mixture: $NaHSO_3$(s) 58–99% Na_2SO_5(s) 1–42%	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Causes serious eye damage	8	WF/I

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1310-73-2	sodium hydroxide (pellets) (*caustic soda*) NaOH(s)	B	• Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • May be corrosive to metals • Causes serious eye damage • Causes severe skin burns and eye damage	2	WF/I
1310-73-2	sodium hydroxide (solution) (*caustic soda*) mixture: H_2O 80–90% NaOH 10–20% NaOH(aq)	A – 5% or less B – > 5%	• Corrosive to Metals (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • May be corrosive to metals • Causes serious eye damage • Causes severe skin burns and eye damage	2	WF/I
7681-52-9	sodium hypochlorite (solution) (*bleach*) mixture: H_2O 80–99% NaClO 1–20% NaOCl(aq)	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Warning* • Causes serious eye damage • Causes severe skin burns and eye damage	8	D
7681-55-2	sodium iodate (powder) $NaIO_3$(s)	B – solution C – powder	• Oxidizing solids (Category 2)	*Danger* • May intensify fire; oxidizer	6	WF/I
7681-82-5	sodium iodide (crystals) NaI(s)	B	• Specific target organ toxicity – Repeated exposure (Category 1)	*Danger* • Causes damage to organs (thyroid) through prolonged or repeated exposure if swallowed	8	WF/I
7681-57-4	sodium metabisulfite (granules) $Na_2S_2O_5$(s)	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Causes serious eye damage	8	WF/I

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10213-79-3	sodium metasilicate pentahydrate (powder) $Na_2SiO_3 \bullet 5H_2O(s)$	C	• Corrosive to Metals (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Acute toxicity (oral) (Category 4)	*Danger* • May be corrosive to metals • Causes severe skin burns and eye damage • Causes serious eye damage • May cause respiratory irritation • Harmful if swallowed	8	WF/I
7631-99-4	sodium nitrate (crystals) $NaNO_3(s)$	B	• Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 2)	*Warning* • Harmful if swallowed • May intensify fire; oxidizer	6	WF/I
7632-00-0	sodium nitrite (granules) $NaNO_2(s)$	B	• Acute toxicity (oral) (Category 3) • Oxidizing solids (Category 3) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Repeated exposure (Category 2)	*Warning* • Toxic if swallowed • May intensify fire; oxidizer • Causes serious eye irritation • May cause damage to organs through prolonged or repeated exposure	6	WF/I
62-76-0	sodium oxalate (powder) $Na_2C_2O_4(s)$	B	• Acute toxicity (dermal) (Category 4) • Acute toxicity (oral) (Category 4)	*Warning* • Harmful in contact with skin • Harmful if swallowed	8	WF/I
1313-60-6	sodium peroxide (granules) $Na_2O_2(s)$	C	• Oxidizing solids (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • May cause fire or explosion; strong oxidizer • Causes severe skin burns and eye damage	6	WF/I
10101-89-0	sodium phosphate tribasic dodecahydrate (crystals) $Na_3PO_4 \bullet 12H_2O(s)$	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1C)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I

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137-40-6	sodium propionate (powder) $NaC_3H_5O_2(s)$ or $CH_3CH_2COONa(s)$	B	• Acute toxicity (dermal) (Category 4)	*Warning* • Harmful in contact with skin	8	WF/I
6834-92-0	sodium silicate (powder) (*water glass, sodium metasilicate*) $Na_2SiO_3(s)$	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage • May cause respiratory irritation	8	WF/I
13517-24-3	sodium silicate nonahydrate (powder) $Na_2SiO_3•9H_2O(s)$	B	• Corrosive to Metals (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • May be corrosive to metals • Causes severe skin burns and eye damage • May cause respiratory irritation	8	WF/I
7757-82-6	sodium sulfate (powder) $Na_2SO_4(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
1313-84-4	sodium sulfide nonahydrate (crystals) $Na_2S•9H_2O(s)$	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Toxic in contact with skin • Harmful if swallowed • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I
7757-83-7	sodium sulfite (crystals) $Na_2SO_3(s)$	A	Not a hazardous substance or mixture	None	8	WF/I
1303-96-4	sodium tetraborate decahydrate (crystals) (*sodium borate*, *borax*) $Na_2B_4O_7•10H_2O(s)$	B – solution C – powder	• Reproductive Toxicity (Category 2)	*Danger* • Suspected of damaging fertility or the unborn child	8	T or D(aq)

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540-72-7	sodium thiocyanate (crystals) NaSCN(s)	B	• Acute toxicity (dermal) (Category 4) • Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4)	*Warning* • Harmful in contact with skin • Harmful if inhaled • Harmful if swallowed	8	WF/I
7772-98-7	sodium thiosulfate (crystals) $Na_2S_2O_3(s)$	A	Not a hazardous substance or mixture	None	8	T or D(aq)
9005-25-8	starch (powder) $(CH_2O)_n(s)$	A	Not a hazardous substance or mixture	None	8	T
57-11-4	stearic acid (powder) (*octadecanoic acid*) $C_{18}H_{36}O_2(s)$ or $CH_3(CH_2)_{16}COOH(s)$	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	3	WF/I
7440-24-6	strontium (solid) Sr(s)	C	• Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Category 2)	*Danger* • In contact with water releases flammable gases	4	WF/I
14692-29-6	strontium acetate hemihydrate (crystals) $SrC_4H_6O_4•0.5H_2O(s)$	A	Not a hazardous substance or mixture	None	8	T
1633-05-2	strontium carbonate (solid) (*strontianite*) $SrCO_3(s)$	B	Not a hazardous substance or mixture	None	8	RS
10025-70-4	strontium chloride hexahydrate (powder) $SrCl_2•6H_2O(s)$	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Causes serious eye damage	8	WF/I

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10476-86-5	strontium iodide (anhydrous) (*diiodostrontium*) $SrI_2(s)$	B	• Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Corrosive to Metals (Category 1)	*Danger* • Causes severe skin burns and eye damage • Causes serious eye damage • May cause respiratory irritation • May be corrosive to metals	8	WF/I
10042-76-9	strontium nitrate (powder) $Sr(NO_3)_2(s)$	B	• Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful if swallowed • May intensify fire; oxidizer • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	6	WF/I
7759-02-6	strontium sulfate (solid) $SrSO_4(s)$	B	Not a hazardous substance or mixture	None	8	WF/I
100-42-5	styrene (oily liquid) (*ethenylbenzene*) $C_8H_8(l)$	C	• Acute toxicity (inhalation) (Category 4) • Aspiration Hazard (Category 1) • Flammable liquids (Category 3) • Reproductive Toxicity (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if inhaled • May be fatal if swallowed and enters airways • Flammable liquid and vapour • Suspected of damaging fertility or the unborn child • Causes serious eye irritation • Causes skin irritation • Causes damage to organs (central nervous system, liver, respiratory system, and the hearing organs) through prolonged or repeated exposure • May cause respiratory irritation	5	WF/I

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110-15-6	succinic acid (crystals) (*butanedioic acid*) $C_4H_6O_4$(s) or $HOOCCH_2CH_2COOH$(s)	B	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes serious eye damage • Causes skin irritation • May cause respiratory irritation	3	WF/I
57-50-1	sucrose (crystals) $C_{12}H_{22}O_{11}$(s)	A	Not a hazardous substance or mixture	None	8	T or D(aq)
85-86-9	sudan III (powder) $C_{22}H_{16}N_4O$(s)	B – solution C – powder	Not a hazardous substance or mixture	None	8	WF/I
85-83-6	sudan IV (powder) $C_{24}H_{20}N_4O$(s)	D	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
5329-14-6	sulfamic acid (crystals) (*amidosulfonic acid*) H_3NO_3S(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Warning* • Causes serious eye irritation • Causes skin irritation	3	WF/I
7704-34-9	sulfur (solid) S_8(s)	B	• Flammable solids (Category 1) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Flammable solid • Causes skin irritation	4	WF/I
7664-93-9	sulfuric acid (solution) mixture: H_2SO_4 52–100% H_2O 0–48% H_2SO_4(aq)	B – dilute C – concentrated	• Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1A)	*Danger* • Causes serious eye damage • Causes severe skin burns and eye damage	1	WF/I

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7782-99-2	sulfurous acid (solution) (*hydrogen sulfite*) mixture: H_2SO_3 6–12% H_2O 88–94% H_2SO_3(aq)	B – dilute C – concentrated	• Acute toxicity (inhalation) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if inhaled • Causes serious eye damage • Causes severe skin burns and eye damage	1	WF/I
1401-55-4	tannic acid (powder) (*tannin*) $C_{76}H_{52}O_{46}$(s)	A	Not a hazardous substance or mixture	None	3	WF/I
87-69-4	L-tartaric acid (crystals) (*2,3-dihydroxybutanedioic acid*) $C_4H_6O_6$(s)	A	• Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Causes serious eye damage	3	WF/I
1934-21-0	tartrazine (powder) (*Yellow 5*, *trisodium salt*) $C_{16}H_9N_4Na_3O_9S_2$(s)	C	• Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1B)	*Danger* • May cause an allergic skin reaction • May cause allergy or asthma symptoms or breathing difficulties if inhaled	8	R/RS
127-18-4	tetrachloroethylene (liquid) (*ethylene tetrachloride*) Cl_2CCCl_2(l)	D	• Carcinogenicity (Category 2)	*Warning* • Suspected of causing cancer	8	WF/I
7440-28-0	thallium metal (solid) Tl(s)	C	• Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2)	*Danger* • Fatal if inhaled • Fatal if swallowed • May cause damage to organs through prolonged or repeated exposure	8	WF/I

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62-55-5	thioacetamide (crystals) (*ethanethioamide*) C_2H_5NS(s)	C	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 1B) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Harmful if swallowed • May cause cancer • Causes serious eye irritation • Causes skin irritation	8	WF/I
7440-29-1	thorium (solid) Th(s)	D	• Acute toxicity (inhalation) (Category 2) • Acute toxicity (oral) (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2) • Pyrophoric solids (Category 1)	*Danger* • Fatal if inhaled • Fatal if swallowed • May cause damage to organs through prolonged or repeated exposure • Catches fire spontaneously if exposed to air	8	WF/I
76-61-9	thymol blue (powder) (*thymolsulfonephthalein*) $C_{27}H_{30}O_5S$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
125-20-2	thymolphthalein (crystals) $C_{28}H_{30}O_4$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
7440-31-5	tin metal (granules or mossy flakes) Sn(s)	A	Not a hazardous substance or mixture	None	8	T
7772-98-8	tin(II) chloride (crystals) $SnCl_2$(s)	B	• Acute toxicity (oral) (Category 4) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Serious eye damage (Category 1) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • May cause an allergic skin reaction • Causes serious eye damage • Causes severe skin burns and eye damage	8	WF/I

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21651-19-4	tin(II) oxide (powder) SnO(s)	A	• Acute toxicity (oral) (Category 4)	*Warning* • Harmful if swallowed	8	WF/I
18282-10-5	tin(IV) oxide (powder) SnO_2(s)	A	Not a hazardous substance or mixture	None	8	T
7488-55-3	tin(II) sulfate (powder) $SnSO_4$(s)	A	Not a hazardous substance or mixture	None	8	T
7440-32-6	titanium metal (solid) Ti(s)	A	Not a hazardous substance or mixture	None	8	R or T
7550-45-0	titanium(IV) chloride (powder) $TiCl_4$(s)	C	• Skin corrosion/irritation – Skin corrosion (Category 1B) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Causes severe skin burns and eye damage • Causes serious eye damage	8	WF/I
13463-67-7	titanium(IV) oxide (powder) TiO_2(s)	B	• Carcinogenicity (Category 2)	*Warning* • Suspected of causing cancer	8	WF/I
108-88-3	toluene (liquid) (*methylbenzene*) C_7H_8(l)	C	• Aspiration Hazard (Category 1) • Flammable liquids (Category 2) • Reproductive Toxicity (Category 2) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Repeated exposure (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • May be fatal if swallowed and enters airways • Highly flammable liquid and vapour • Suspected of damaging fertility or the unborn child • Causes skin irritation • May cause damage to organs through prolonged or repeated exposure • May cause drowsiness or dizziness	5	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
71-55-6	1,1,1-trichloroethane (liquid) (*methylchloroform*) $C_2H_3Cl_3$(l) or CH_3CCl_3(l)	D	• Acute toxicity (dermal) (Category 3) • Acute toxicity (inhalation) (Category 3) • Acute toxicity (oral) (Category 3) • Flammable liquids (Category 2) • Specific target organ toxicity – Single exposure (Category 1)	*Danger* • Toxic in contact with skin • Toxic if inhaled • Toxic if swallowed • Highly flammable liquid and vapour • Causes damage to organs	5	WF/I
76-13-1	1,1,2-trichloro-1,2,2-trifluoroethane (liquid) (*freon*) CCl_2FCClF_2(l)	D	• Gases under pressure (Liquefied Gas) • Health Hazards Not Otherwise Classified (Category 1)	*Warning* • Contains gas under pressure; may explode if heated • Harms public health and the environment by destroying ozone in the upper atmosphere	8	WF/I
102-71-6	triethanolamine (liquid) (*trolamine*) $C_6H_{15}NO_3$(l) or $(HOCH_2CH_2)3N$(l)	B	• Skin corrosion/irritation – Skin corrosion (Category 1B) • Specific target organ toxicity – Repeated exposure (Category 2)	*Warning* • Causes severe skin burns and eye damage • May cause damage to organs through prolonged or repeated exposure	8	WF/I
7601-54-9	trisodium phosphate (crystals) (*sodium phosphate tribasic*) Na_3PO_4(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
9002-07-7	trypsin (powder) $C_{35}H_{47}N_7O_{10}$(s)	B – solution C – powder	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Respiratory or skin sensitization – Respiratory Sensitizer (Category 1) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Causes skin irritation • Causes serious eye irritation • May cause allergy or asthma symptoms or breathing difficulties if inhaled • May cause respiratory irritation	8	WF/I
73-22-3	tryptophan (crystals) $C_{11}H_{12}N_2O_2$(s)	A	Not a hazardous substance or mixture	None	8	T
7440-33-7	tungsten (solid) W(s)	A	Not a hazardous substance or mixture	None	8	R or T
7783-03-1	tungstic acid (powder) H_2WO_4(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	1	WF/I
8006-64-2	turpentine (liquid) $C_{10}H_{16}$(l)	B	• Acute toxicity (inhalation) (Category 4) • Aspiration Hazard (Category 1) • Flammable liquids (Category 3) • Respiratory or skin sensitization – Skin Sensitizer (Category 1) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Narcotic effects)	*Danger* • Harmful if inhaled • May be fatal if swallowed and enters airways • Flammable liquid and vapour • May cause an allergic skin reaction • Causes serious eye irritation • Causes skin irritation • May cause damage to organs • May cause drowsiness or dizziness	5	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
60-18-4	tyrosine (L and DL) (crystals) $C_9H_{11}NO_3$(s)	B	• Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	T
Not applicable	universal indicator (solution) mixture: methyl alcohol 10–20% ethyl alcohol 60–100% methyl ethyl ketone <0.5% ethyl acetate <0.2% phenolphthalein <1.0% methyl red <1.0% bromothymol blue <0.2% thymol blue <0.5% butter yellow <0.1% water balance	B	• Flammable liquids (Category 4) • Acute toxicity (oral) (Category 4)	*Danger* • Combustible liquid • Harmful if swallowed	5	WF/I
57-13-6	urea (powder) (*carbamide*) CH_4N_2O(s)	A	Not a hazardous substance or mixture	None	8	T
51-79-6	urethane (crystals, powder) (*carbamic acid*, *ethyl ester*) $C_3H_7NO_2$(s)	B	• Carcinogenicity (Category 1A)	*Danger* • May cause cancer	8	WF/I
109-52-4	valeric acid (liquid) (*n-pentanoic acid*) $C_5H_{10}O_2$(l)	B	• Acute toxicity (oral) (Category 4) • Flammable liquids (Category 4) • Skin corrosion/irritation – Skin corrosion (Category 1B)	*Danger* • Harmful if swallowed • Combustible liquid • Causes severe skin burns and eye damage	3, 5	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
72-18-4	L-valine (crystals) $C_5H_{11}NO_2$(s)	A	Not a hazardous substance or mixture	None	8	T
7440-62-2	vanadium (powder) V(s)	B	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation) • Flammable solids (Category 1)	*Danger* • Causes skin irritation • Causes serious eye irritation • May cause respiratory irritation • Flammable solid	8	R/RS
64-19-7	vinegar (solution) (*acetic acid*) mixture: CH_3COOH 5–7% H_2O 93–95% CH_3COOH(aq)	A	• Skin corrosion/irritation – Skin irritation (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes skin irritation • Causes serious eye irritation	3	D
108-05-4	vinyl acetate (liquid) $C_4H_6O_2$(l)	C	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Flammable liquids (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if swallowed • Suspected of causing cancer • Highly flammable liquid and vapour • May cause respiratory irritation	5	WF/I
50-81-7	vitamin C (crystals) (*ascorbic acid*) $C_6H_8O_6$(s)	A	Not a hazardous substance or mixture	None	3	T or D(aq)

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
119-36-8	wintergreen oil (liquid) (*methyl salicylate*) $C_8H_8O_3$(l)	A	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Warning* • Harmful if swallowed • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	8	WF/I
1330-20-7	xylene (1,2- and 1,4- forms) (liquid) (*dimethylbenzene*) C_8H_{10}(l)	C	• Acute toxicity (inhalation) (Category 4) • Acute toxicity (oral) (Category 4) • Flammable liquids (Category 3) • Skin corrosion/irritation – Skin irritation (Category 2)	*Danger* • Harmful if inhaled • Harmful if swallowed • Flammable liquid and vapour • Causes skin irritation	5	WF/I
7440-66-6	zinc metal (mossy chunks) Zn(s)	A	Not a hazardous substance or mixture	None	8	R or T
557-34-6	zinc acetate (powder) $ZnC_4H_6O_4$(s)	A	• Serious eye damage/eye irritation – Eye irritation (Category 2A)	*Warning* • Causes serious eye irritation	8	WF/I
3486-35-9	zinc carbonate (powder) $ZnCO_3$(s)	A	Not a hazardous substance or mixture	None	8	WF/I
7646-85-7	zinc chloride (granules) $ZnCl_2$(s)	B – solution C – granules	• Acute toxicity (oral) (Category 4) • Carcinogenicity (Category 2) • Flammable liquids (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if swallowed • Suspected of causing cancer • Highly flammable liquid and vapour • May cause respiratory irritation	8	WF/I

CAS Number	Chemical Name(s), State, and Formula	Use in School Category	WHMIS 2015 Hazard Classification: Class (Category)	WHMIS 2015 *Signal Word* and Hazard Statement(s) Note: Consult supplier SDS before use.	Storage Class	Disposal Methods
10196-18-6	zinc nitrate hexahydrate (crystals) $Zn(NO_3)_2 \bullet 6H_2O(s)$	C	• Acute toxicity (oral) (Category 4) • Oxidizing solids (Category 2) • Serious eye damage/eye irritation – Eye irritation (Category 2A) • Skin corrosion/irritation – Skin irritation (Category 2) • Specific target organ toxicity – Single exposure (Category 3, Respiratory tract irritation)	*Danger* • Harmful if swallowed • May intensify fire; oxidizer • Causes serious eye irritation • Causes skin irritation • May cause respiratory irritation	6	WF/I
1314-13-2	zinc oxide (powder) ZnO(s)	A	Not a hazardous substance or mixture	None	8	T
7446-20-0	zinc sulfate heptahydrate (crystals) $ZnSO_4 \bullet 7H_2O(s)$	B	• Acute toxicity (oral) (Category 4) • Serious eye damage/eye irritation – Serious eye damage (Category 1)	*Danger* • Harmful if swallowed • Causes serious eye damage	8	WF/I
1314-98-3	zinc sulfide (powder) ZnS(s)	A	Not a hazardous substance or mixture	None	8	T
7440-67-7	zirconium (chunks) Zr(s)	A	Not a hazardous substance or mixture	None	8	R or WF/I
7440-67-7	zirconium (powder) Zr(s)	C	• Flammable solids (Category 1)	*Danger* • Flammable solid	4	WF/I

APPENDICES

Appendix A: Example Science Safety Rules and Procedures

Referenced on pages 23, 58, and 60 of this document.

1. Learn about safe and unsafe practices before beginning science activities.
    - Pay attention to safety notes provided by the teacher or textbook.
    - Find out what procedures are safe and which ones are unsafe.
    - Learn the location, purpose, and use of safety equipment.
    - Speak out if you have a safety concern or question.

2. Use protective devices and clothing to ensure safety of eyes, face, hands, and body.
    - When instructed, wear safety goggles and protective clothing.
    - Wear closed shoes during laboratory sessions.
    - Tie your hair back if it is long.

3. If you wear contact lenses, notify the teacher. Some activities may require you to remove contact lenses.

4. Behave responsibly at all times during science activities.

5. Use chemicals safely and responsibly.
    - Take only as much chemical as instructed and never return excess chemicals to the original container.
    - Handle chemical containers safely; e.g., hold bottles by the base, not by the neck.
    - Use chemicals in the laboratory only.
    - Dispose of chemicals as directed by your teacher.

6. Alert the teacher immediately if an incident or spill occurs.

7. Clean up your work area after science activities.

8. Wash your hands thoroughly with warm water and soap at the end of each activity.

9. Do not use equipment if it appears to be in an unsafe condition. For example, do not use cracked or chipped glassware.

10. Do not eat or drink in the science classroom. Do not taste anything unless you are instructed to do so.

Appendix B: Sample Student Safety Contract/Agreement—Elementary

Referenced on pages 9 and 22 of this document.

Class: _____ Student's Name: _____

Teacher's Name: _____

Room: _____

I am learning to be a good scientist. I know that to learn science safely I must be responsible, aware of my environment and the hazards in it, organized, and prepared to follow safe work practices.

I promise to

- be prepared for science activities;
- listen to directions and make sure that I understand them before I start;
- follow directions;
- observe carefully;
- be calm and quiet so that I can learn more;
- handle equipment carefully and put it away when I am done;
- wash and return all things to their proper places, then wash my workspace and my hands; and
- follow all safety rules.

Student's Signature: _____ Date: _____

Parent's Signature: _____ Date: _____

Appendix C: Sample Student Safety Contract/Agreement—Secondary

Referenced on pages 9 and 23 of this document.

Class: _____ Student's Name: _____

Teacher's Name: _____

I understand that incidents can be caused by being unprepared, careless, or in a hurry. I will come to class prepared to be responsible so that my safety and welfare, as well as that of others, is not jeopardized.

I will

- follow all written and oral instructions given by the teacher;
- ask any questions or state any concerns I have before beginning a laboratory procedure;
- behave in a manner that will ensure the health and safety of myself and others in the laboratory or classroom at all times;
- use protective devices for my eyes, face, hands, body, and clothing during laboratory activities;
- know the location and use of first aid and fire extinguishing equipment;
- refrain from eating, drinking, chewing gum, or applying cosmetics in the laboratory; and
- keep my work area clean and free of clutter during laboratory class.

I have read the written science safety rules prepared by my teacher and agree to follow these and any other rules.

Student's Signature: _____ Date: _____

Parent's Signature: _____ Date: _____

Teacher's Signature: _____ Date: _____

Please list any known allergies or health problems, such as asthma, epilepsy, or heart condition, that may affect participation in science activities.

_____

_____

_____

_____

Do you wear contact lenses? ❒ YES ❒ NO

Students wearing contact lenses need to be identified in case of incidents that might require contact lens removal. Removal of contact lenses will be done by trained personnel in cases where the student cannot remove them on their own. All students will be required to wear safety goggles for certain activities, even if they wear contact lenses or prescription glasses.

Parent/Guardian Signature: _____ Date: _____

Appendix D: Chemical Laboratory Safety Inspection Checklist

Referenced on pages 24 and 49 of this document.

Inspected By: _____ Date: _____

Building and Room: _____

A. Documentation	Yes	No	N/A	Comments
Science safety rules and procedures are posted?				
Emergency procedures are posted?				
Chemical spill response guidelines are available?				
Chemical inventory is available and up to date?				
SDSs are available for all hazardous products?				
WHMIS and other training records are available?				

B. Housekeeping

Benches and sinks are clean and tidy?				
Exit doors are unobstructed?				
Aisles are unobstructed?				
No tripping hazards are present (e.g., cords, hoses, equipment)?				
Separate disposal bin is available for broken glass?				
No food or drink is present in the laboratory?				

C. Emergency and Safety Equipment	Yes	No	N/A	Comments
Appropriate fire extinguisher(s) is available?				
First aid kit is accessible and fully stocked?				
Safety goggles are available and in use?				
Laboratory coats or aprons and gloves are available and properly used?				
Eyewash is available and accessible?				
Emergency shower is available and accessible?				
Spill kit is accessible and fully stocked?				

D. Chemical Storage

All chemicals have WHMIS compliant labels?				
Chemicals are segregated by storage class?				
Chemicals are dated upon receipt?				
Chemicals are labelled with container opening date?				
All gas cylinders are upright and secured in cool storage?				
Chemical waste is properly stored and labelled?				

Appendix E: Incident Report Form

Referenced on page 35 of this document.

Part A – To be completed by the individual(s) directly involved or injured in the incident

❒ Medical Aid ❒ Lost Time ❒ Spill/Contamination/Environmental Release

❒ Near-Miss ❒ Property Damage

IDENTIFY – Person(s) involved

_____

First Name Last Name

Date and Time of Incident

_____/_____/_____ _____ AM / PM

YR MO DD HH:min

Date and Time of **Medical Evaluation**

_____/_____/_____ _____ AM / PM

YR MO DD HH:min

❒ School Nurse
❒ Hospital
❒ Clinic or Family Physician

Exact details of injury/illness and treatment (e.g., body part involved, cut, strain, bruise, illness, symptoms, and date of onset, etc.)

_____

_____

_____

_____

WCB Form: (Please check)

❒ Has been prepared and forwarded
❒ Is not required (list reason)

Description of Incident (add additional pages if necessary)
State exactly the sequence of events leading to the incident, where it occurred, what the person was doing, the size, weight, and type of equipment or materials involved, etc.

_____

_____

_____

_____

_____

WITNESSES (If any)

Name	Department	Telephone Number

PROPERTY DAMAGE

Identify property involved. Give machine name, tool name, etc.	Description of damage or loss	Estimated value of loss

Parent/Guardian to Notify: _____ Telephone: _____

Completed By: _____ Date: _____
Print Name

_____
Signature

Forward to Supervisor Immediately

Part B – To be completed by Supervisor within 24 hours

Why did it happen? (conditions and/or actions contributing to injury/incident)

_____

_____

_____

_____

_____

_____

_____

_____

Parent/Guardian Notification:

Name: _____

Date: _____Time: _____

Corrective Actions to Prevent Reoccurrence	Action By Whom and Date to Be Completed

Investigated By: _____ Title: _____

_____ Telephone: _____ Date: _____
Signature

Appendix F: Chemical Inventory Template

Referenced on page 106 of this document.

Chemical Inventory

Completed by _____ Review date _____

Chemical	CAS Number	Quantity	Supplier	SDS Mo/Yr	Purchase Date	WHMIS 2015 Signal Word and Hazard Statement(s)	Storage Location	Container Opened Date	Disposal Date (Empties)

Appendix G: Suggested Science Department Safety Policies and Procedures

Referenced on page 58 of this document.

Teacher classroom practice should be a good example of safety in action and be consistent with laboratory procedures set out for students. Example policies and procedures for science teachers may include the following:

Policies

1. Safety always precedes other priorities in planning for laboratory activities. If the design of an investigation compromises safety, it should be modified or avoided.

2. Materials to be used in student activities are prepared and the classroom environment is set up in ways that minimize safety risks.

3. Teachers model safe behaviour and provide guidance, direction, and supervision to support student safety.

4. In preparation for science activities, students are made aware of potential risks, appropriate procedures, procedures to avoid, and procedures to follow in case of an incident.

5. Open-ended investigations proposed by students are not to be approved until a complete risk assessment has been done and precautions can be identified before any hazards are encountered.

6. In general, if the regular classroom teacher is absent, practical laboratory activities should not be done. Special concessions may be made if the supply or substitute teacher is an experienced science teacher.

Procedures

1. Teachers hand out, discuss, and post laboratory rules and procedures for students.

2. Teachers diligently enforce laboratory rules.

3. Teachers require students to report all incidents.

4. Teachers do not leave students unsupervised in laboratories.

5. Teachers are aware of the location of all emergency equipment, such as fire extinguishers, first aid kits, and eyewash facilities, and know how to use them.

6. Teachers educate their students about the emergency procedures of the school and the fire exits in their area.

7. Teachers inform students of any hazards that may be associated with specific activities and inform them of the precautions they should take to minimize risks.

8. Teachers lock science laboratories when they are not in use.

9. Teachers ensure gas taps and main valve are turned off at the end of each class/day and 110-volt electrical apparatus are put away when they are not required for classroom use.

Appendix H: Basic Laboratory Techniques

Referenced on page 56 of this document.

Lighting a Bunsen Burner

Follow these steps to light a Bunsen burner:

1. Check that all gas valves at the laboratory benches are shut off, then open the main gas valve.

2. Attach the rubber intake hose of the Bunsen burner to the nearest gas nozzle.

3. Close off air intake ports at the base of the barrel so as to produce a cool red flame upon lighting. This is done either by rotating the barrel clockwise until it stops or rotating a sleeve at the base of the barrel to cover intake ports.

4. If there is a gas valve at the base of the barrel, check that it is open about one-half to one revolution.

5. Fully open the valve attached to the intake hose. If there is no valve at the base of the barrel, then partially open the valve at the intake hose. Using a flint striker or a match, light the gas at the top of the barrel. If there is too much gas/air mixture coming through the barrel, it will create a strong current of gas that is difficult to light and that may blow out the match. If this happens, check the air intake ports to ensure they are closed. Once lit, you should have a cool red flame.

6. The air ports can then be opened by turning the barrel counter-clockwise or rotating the sleeve to get the desired intensity of flame (blue flame is hottest).

7. The gas valve can be opened further to get a bigger flame.

8. When finished, turn off the Bunsen burner using the gas tap.

Making the Alcohol Burner Flame More Visible

The alcohol burner flame tends to be pale blue in colour, making it somewhat difficult to see and increasing the probability of accidental burns. Add some salt to the burner fuel to colour the flame orange, making it more visible.

Pouring Solutions into a Funnel Filter

Pour the liquid along a glass stirring rod, the end of which is in line with the centre of the filter in the funnel. This will avoid splashing of solution or liquid.

Diluting Concentrated Acids and Bases

Working safely with concentrated acids or bases requires careful handling and an understanding of the hazards involved. The following steps help to reduce the inherent hazards associated with these concentrates:

1. Put on a long-sleeved laboratory coat, nitrile gloves, and full face protection.

2. Determine the volume ratio of water and acid/base required for the concentration intended and the total volume of dilute acid/base needed. Let's assume 1 L of 10% sulfuric acid is required and 50% sulfuric acid is on the shelf. To get a 10% concentration requires a ratio of 2 mL of 50% acid to 8 mL of distilled water. Therefore, to make 1 L of 10% acid, add 200 mL of the acid to 800 mL of water.

3. Measure the required amount of the concentrated acid or base in a graduated cylinder. This can be done under a fume hood to avoid inhaling fumes, particularly acid fumes that are very corrosive. Now add it slowly to the proportionate amount of water in another container. Using a glass stirring rod, stir the water as the acid or base is added to dissipate the heat. Never add the water to the concentrated acid or base, as this causes an excessive buildup of heat and spattering may result.

4. Avoid inhaling concentrated acid vapours.

Cutting Glass Tubing

Follow the procedure as outlined.

1. Etch the glass with a triangular file.

2. With the etch facing away from you, hold the tubing with both hands so that the thumbs are pressing on each side of the etch. Apply gentle pressure on the thumbs to snap the tubing.

3. Glazing or fire polishing the cut end of the tubing in a hot Bunsen burner flame will remove the rough edges.

Inserting Glass Tubing into a Stopper

Safe insertion of tubing or a thermometer into a rubber stopper can be done as follows:

1. Ensure there are no rough edges on the end being inserted. If necessary, glaze the end in a hot flame and let cool.

2. Lubricate the glass with glycerin, petroleum jelly, or stopcock grease.

3. Wrap a cloth around the tubing or thermometer, or put on thick gloves before starting the insertion.

4. Grasp the tubing close to the end to be inserted with the fingers of one hand and the stopper in the fingers of the other. Avoid grasping either with the palm of your hand.

5. Insert with a rotating motion while applying gentle pressure. Avoid excessive force that can snap the tubing. If excessive force is required, check to ensure the hole is large enough to accommodate the tubing.

Note: If glass tubing or thermometers remain in stoppers for prolonged periods of time, the stoppers will harden and the glass will bind to the stopper surface. Do not attempt to push or pull glass tubing or thermometers from rubber or cork stoppers that have hardened. It is best to cut away the stopper from the glass with a sharp knife or scalpel.

Boiling Liquids

Liquids often boil in an uneven fashion called “bumping” because bubbles of steam cannot form regularly on the smooth container walls. This leads to irregular flashes of superheating that results in large bubbles of steam erupting violently to the surface, causing splashing and spitting or, at worst, expulsion of contents from full containers.

Bumping can be prevented by adding a few boiling chips to the liquid before you start heating. These chips provide a rough surface upon which bubbles can form. Avoid adding the chips to liquids near boiling temperature because this can cause the liquid to immediately boil over. “Porous” boiling chips cannot be reused because the pores become filled with liquid on cooling. “Sharp” chips, like silicon carbide or coal, are reusable until they become coated with residues and become ineffective.

Heating Flammable Liquids

Heating flammable liquids should be done in a water bath heated by a hot plate. Test tubes of flammable liquid can be placed in a beaker of water large enough to immerse the test tube contents but small enough to keep the tubes upright. If the use of an open flame cannot be avoided in heating the water bath container, place the container on a wire gauze or alternative surface to ensure that the flame does not reach the flammable vapours. Alternatively, a larger metal tray of water placed on a stand plus a beaker of water set into the tray to hold test tubes of flammable liquid would be the safest arrangement when an open flame is used. If it is the beaker itself that holds the flammable liquid, then it may have to be weighed down to offset buoyancy while in the water bath.

Avoiding a Van de Graaff Discharge

Operating a Van de Graaff generator in a draft-free room with low humidity may result in a buildup of electric charge on your body if your shoes are non-conducting and prevent flow of current to the floor. Once electrified, you will get an electric discharge if you touch any grounded object, such as the metal switch to turn the machine off.

To avoid this unpleasant "zap," hold a small metal object in your hand while using the generator, then touch it against ground before turning off the generator switch with your other hand.

Removing Stuck Glass Stoppers

Follow the procedure outlined below.

1. Stand the bottle in a large sink.

2. Cover the stopper and the neck of the bottle with a cloth.

3. Gently tap the stopper. If the jammed stopper is glass, use another glass stopper to tap against it, since glass stoppers will set up a resonance that will often successfully loosen the stopper that is stuck in the bottle.

4. If possible, run the neck of the bottle under a stream of hot water to allow for expansion of the neck, and then repeat the tapping.

5. If these measures fail, it will be necessary to break the neck of the bottle to remove its contents. Score around the neck with a glass file, then apply a point of hot glass to the score mark. The neck should break cleanly along the score mark.

Weighing Chemicals

When handling chemicals, keep the following points in mind:

- Wear a protective apron and gloves.
- Check the chemical label before and after weighing.
- Avoid chemical contact with the metal pan of the balance through the use of weigh paper, a weigh boat, or a small beaker.
- Use a fume hood or respiratory protection when handling powders of more toxic or corrosive chemicals to avoid inhalation.
- Replace the cover or stopper on the chemical container as soon as possible, particularly for more volatile substances.
- If required to smell the chemical or solution, hold the container slightly in front of and beneath your nose and waft the fumes toward your nostrils with your hand. Never smell it directly.

Use of Scalpels

Remember the following points when using scalpels:

- Always cut away from fingers near the area being dissected.
- Never try to catch a scalpel that has been dropped.
- After completing a series of dissections, immerse scalpels in an appropriate non-corrosive disinfectant for at least 15 minutes.

Use of an Autoclave

Autoclaves are high-pressure steam or dry heat devices used to sterilize solutions and equipment. To operate an autoclave safely, remember the following points:

- Ensure the door is completely closed before starting the sterilization process.
- Use containment procedures when sterilizing known infected material. Wear full protection, including a long-sleeved laboratory coat or gown, protective gloves, and a face mask, as a minimum protection against infection.
- Always use a “hot hand” or glove to remove any article from the autoclave. It must never be presumed that the autoclave has cooled down.

- Carry out regular sterilization effectiveness testing using spore strips or an equivalent.
- Regularly check mechanical parts of the autoclave for normal functioning. Poorly maintained autoclaves can be lethal.

Pressure Cooker–Type Autoclave

- Ensure the safety valve is clear and operative.
- Tighten the wing nuts evenly by tightening two opposite nuts simultaneously.
- Do not allow the operational pressure (gauge reading) to exceed that specified in the operation manual. Generally, this will be between 101.3 kPa to 138 kPa (15–20 psi) pressure.
- Allow the autoclave to cool before opening the stopcock to equalize pressure.
- Remove the cover only when the pressure has been equalized.

Mixing a Test Tube Solution

The proper and safe technique for mixing the contents of a test tube is as follows:

1. Place a stopper into the tube.
2. Shake the tube by flicking it with your finger or by holding the stopper with your thumb and turning the tube over several times.

Appendix I: Websites for Acts, Regulations, Codes, and Bylaws (as of August 2018)

Referenced on page 4 of this document.

Canada Water Act (Canada)
http://laws-lois.justice.gc.ca/eng/acts/c-11/index.html

Canadian Environmental Protection Act (Canada)
http://laws-lois.justice.gc.ca/eng/acts/c-15.31/

Environmental Protection and Enhancement Act (Alberta)
http://www.qp.alberta.ca/1266.cfm?page=E12.cfm&leg_type=Acts&isbncln=9780779793709

Epcor Drainage Services Bylaw (City of Edmonton Bylaw 18100)
https://www.edmonton.ca/city_government/bylaws/bylaws-e.aspx

Hazardous Products Act (Canada)
http://laws-lois.justice.gc.ca/eng/acts/H-3/

Labour Relations Code (Alberta)
http://www.qp.alberta.ca/1266.cfm?page=L01.cfm&leg_type=Acts&isbncln=9780779791644

Occupational Health and Safety Act (Alberta)
https://www.alberta.ca/occupational-health-safety.aspx

Occupational Health and Safety Code (Alberta)
https://www.alberta.ca/occupational-health-safety.aspx

School Act (Alberta)
http://www.qp.alberta.ca/documents/Acts/s03.pdf

Teaching Profession Act (Alberta)
http://www.qp.alberta.ca/documents/Acts/T02.pdf

Transportation of Dangerous Goods Act (Canada)
https://www.tc.gc.ca/eng/acts-regulations/acts-1992c34.htm

Waste Control Regulation (Alberta)
http://www.qp.alberta.ca/1266.cfm?page=1996_192.cfm&leg_type=Regs&isbncln=9780779790579

Wastewater Bylaw (City of Calgary Bylaw 14M2012)
https://www.calgary.ca/CA/city-clerks/Documents/Legislative-services/Bylaws/14M2012-Wastewater.pdf?noredirect=1

Appendix J: Category D Chemicals

Referenced on page 124 of this document.

1. acetaldehyde
2. acetyl chloride
3. acrolein
4. acrylic acid
5. adrenaline
6. aluminium carbide
7. ammonium fluoride
8. ammonium oxalate monohydrate
9. ammonium sulfide
10. ammonium vanadate
11. antimony pentachloride
12. antimony trichloride
13. arsenic
14. arsenic pentoxide
15. arsenic trichloride
16. arsenic trioxide
17. asbestos
18. barium powder
19. benzene
20. benzenesulfonic acid hydrate
21. benzoyl peroxide
22. beryllium salts
23. bromine liquid/gas
24. cadmium metal powder
25. cadmium salts
26. calcium carbide
27. calcium sulfide
28. carbolic acid
29. carbon disulfide
30. carbon tetrachloride
31. Carnoy's fluid
32. chlorine gas
33. chloroform
34. 2-chlorophenol
35. chromic acid
36. chromium(VI) oxide
37. chromium(VI) salts
38. cobalt powder
39. cobalt(II) carbonate
40. cobalt(II) chloride anhydrous powder
41. colchicine
42. collodion solution
43. 1,2-dichloroethane
44. dichloromethane
45. 2,4-dichlorophenoxyacetic acid powder
46. 1,2-dichlorotetrafluoroethane
47. diethyl ether (ethyl ether)
48. dimethyl sulfate
49. 2,4-dinitrophenol
50. 1,4-dioxane
51. epinephrine 99%
52. ethylamine (liquid and gas)
53. ethylbenzene
54. ethyl bromide
55. ethylene dichloride
56. ethylenediamine
57. fluorine
58. formaldehyde
59. hydrofluoric acid
60. hydrogen cyanide (hydrocyanic acid)
61. hydrogen sulfide
62. lead metal powder
63. lead compounds
64. mercury and mercury compounds
65. methylene chloride
66. Millon's reagent
67. nickel powder
68. nickel compounds
69. nitrogen dioxide (commercial cylinders of gas)
70. paraformaldehyde
71. perchloric acid
72. phenol
73. phenylethane
74. phosphorus, purified yellow
75. phosphorus trichloride
76. picric acid
77. potassium chlorate
78. potassium chromate
79. potassium dichromate
80. prussic acid
81. silver oxide

82. sodium arsenite
83. sodium chlorate
84. sodium chromate tetrahydrate
85. sodium dichromate dihydrate
86. sodium sulfide nonahydrate
87. sudan IV
88. tetrachloroethylene
89. thorium
90. 1,1,1-trichloroethane
91. 1,1,2-trichloro-1,2,2-trifluoroethane

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