CODE
Council of Ontario Directors of Education

CODE HEALTH AND SAFETY COMMITTEE

Student Safety in Secondary Science Education Grades 9-12

A Resource for School Administrators

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About this guide

This resource is designed to help principals, vice-principals and supervisory officers promote and address health and safety provisions and requirements in schools. Developed by a team of educators and health and safety professionals as a support to the Student Injury Prevention Initiative, this document will help school leaders to know, recognize and respond to their responsibilities and duties regarding student health and safety in school science labs *(Ontario Ministry of Education, Memorandum, George Zegarac, Deputy Minister, January 30, 2013)*. The information contained in this resource was compiled through a series of consultations with school board educators and school board health and safety representatives, and with partner organizations that offer health and safety services to the education sector.

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Table of Contents

Background

Hands-on activities are an integral part of any science program, linking the real world with the abstract concepts being studied. They promote critical thinking, collaboration and problem solving – skills identified as essential for 21st-century learners.

These activities also introduce an element of risk to any science program. However, most of these risks can be avoided with appropriate training and careful planning. The result will be a safe and engaging activity-based science program.

According to the Science Teachers' Association of Ontario/L'Association des professeurs de sciences de l'Ontario (STAO/APSO):

> "the intent of a safe science program is not to put rigid restrictions on what teachers and students can experience; rather, a safe science program minimizes unnecessary risk in the delivery of an engaging hands-on experience for students." *(Safe On Science. Science Teachers' Association of Ontario/L'Association des professeurs de sciences de l'Ontario, 2010)*

It is crucial for everyone – administrators, teachers and students – to be actively engaged in promoting a positive attitude toward safety. This ensures a safe environment for all while teaching important lifelong skills. The significance of the teacher's role in modelling and promoting safety is clearly outlined in the science curriculum documents:

> "Teachers are responsible for ensuring the safety of students during classroom activities and for encouraging and motivating students to assume responsibility for their own safety and the safety of others. They must also ensure that students acquire the knowledge and skills needed for safe participation in science activities." *(Ontario Ministry of Education, Science Education -Grades 11-12, 2008)*

Purpose of this Resource

(Note: throughout this document, the word "principal" will be used to refer to both principals and vice-principals.)

The Science curriculum is diverse and complex, and classroom activities conducted on any given day raise a broad range of safety concerns. For a school administrator with limited science experience it may be difficult to assess whether or not appropriate safety precautions are in place.

With these important considerations in mind, this resource provides a set of markers, called "look fors," that are characteristic of a safe learning environment. These markers are not intended to be a comprehensive checklist of science safety; rather, they can be used to initiate an open and collaborative dialogue between principal and teacher for the purpose of enhancing safety. As a result, the principal is reassured that safety is sufficiently addressed, and that the teacher has conducted an objective assessment of the safety practices in his or her courses.

Examples of changes in practice that could result from this assessment include:

- Revising an experiment to use a few drops of chemicals rather than test-tube quantities;
- Selecting a safer source of microorganisms to culture (e.g., purchasing microorganisms from approved vendors instead of culturing unknown, and potentially unsafe, microorganisms that have been swabbed off cafeteria tables).

The use of this resource is not intended to replace regular inspections by experts trained to assess the degree to which observed practices comply with current health and safety legislation and best practices.

Hazard Awareness and Training in Secondary Schools

Working with hazardous substances and equipment requires specific knowledge and skills. Having this background allows the experienced science teacher to use these materials safely and to respond appropriately if/when something goes wrong.

It cannot be assumed, however, that science teachers acquire this background as part of their undergraduate training. Instead, specific, on-site training is required to ensure that the science teacher has the prior experience required before using hazardous substances in classroom demonstrations or student experiments.

Shared Understanding and Sample Discussion Questions

This guide provides sample discussion questions intended to initiate an open and collaborative discussion between the teacher and the principal. In this conversation, the principal is not expected to be an expert. Instead, the questions are designed to enhance his or her knowledge of classroom safety precautions currently in place. At the same time, the discussion allows teachers to objectively assess the health and safety practices in their programs, and assure the principal that health and safety issues are being sufficiently addressed.

Sample discussion questions include the following:

1. What is your process for assessing and minimizing the hazards (e.g., selecting safer alternatives) in the activity?
2. What is your process for demonstrating the proper and safe use of the materials and equipment used in the lesson?
3. How do you model best practices with regard to health and safety?
4. What procedures do you follow to assist a student involved in an accident while maintaining the safety of the other students?
5. What is your procedure for the handling and disposal of waste?
6. Is there any additional training that you require?

Science Safety Checklist

The Science Safety Checklist is intended to offer principals, vice-principals and supervisory officers an overview of health and safety requirements in science facilities, and to provide an opportunity for ongoing discussion with teachers. This checklist is not intended to provide a comprehensive assessment of science safety; rather, it can be used to initiate an open and collaborative dialogue between principals and teachers to enhance safety in science facilities.

Note: The following checklist for science activities, facilities and instruction has been compiled using a range of resources, including health and safety publications, advice from boards and professional organizations, and consultation with science educators and health and safety professionals.

For the purposes of this document:

(i) "Lab" refers to a science classroom in which experiments are conducted

(ii) "Activity" refers to both teacher demonstrations and student experiments.

Safety Instruction	Comments
• A consistent set of safety rules is used in all science courses. • Science safety rules are posted in the classroom and provided to students (e.g., as a safety contract). • Each student has successfully completed safety training early in the course. • Safety is included in pre-activity instructions to students (e.g., proper use of dissection tools). • The teacher models appropriate use of personal protective equipment (PPE) and other safety routines. • Teacher maintains a record of individual student safety training.	
Safety During Activities	**Comments**
• Activities are conducted only in the presence of a trained staff member (i.e., not a supply teacher). • Activities are appropriate for the maturity and skill level of the students. • Staff and students are using appropriate personal protective equipment, as outlined in the MSDS when doing experiments and lab activities (e.g., nitrile gloves, plastic aprons and splash goggles when using an acid).	

Safety During Activities *(continued)*	Comments
• Chemical splash goggles are worn when working with chemicals or heat. Impact goggles are appropriate when working with glass or rapidly moving small objects. • Appropriate accommodations are in place for students with special needs (e.g., providing a lower working surface for a student in a wheelchair). • Equipment is undamaged and in good working order. • Procedures for student-designed experiments are approved by the teacher before they are undertaken. • Activities that involve the production of a significant volume of vapours/smoke/fumes should be conducted in a fume hood. • Dispensed chemicals (e.g., dropper bottles) have appropriate WHMIS workplace labels. • The quantity of chemicals in the room is kept to a minimum. • Only chemicals supplied by the school/board should be used in the classroom. Teachers and students should not bring in chemicals (e.g., drain cleaner, camp fuel). • Sufficient time is allotted for clean-up and waste disposal after each experiment. • All chemicals should be put away into their appropriate storage location at the end of class. Chemicals should not be left out after instruction has ended, (e.g., overnight).	
Safer Alternatives	**Comments**
• Chemical solutions are as dilute as possible. • Smallest possible quantities of chemicals are used. • Safer chemicals are substituted wherever possible. • Hot plates are used instead of open flames whenever possible. • Low-voltage power sources are used for experiments involving electricity. • Microorganisms being cultured are safe (see Biosafety Level 1 organisms in STAO's Safe ON Science, p. 44). • Sharp dissection scissors are used instead of scalpels whenever possible. • Mercury thermometers are not used. (Mercury thermometers should be safely disposed of as per board procedures).	

Housekeeping	Comments
• Lab and chemical storage/prep rooms are clean and free of clutter and have: – No food and drink. – Visible safety signage and labels appropriate for the hazards present. – Visible broken glassware container and a general purpose spill kit capable of containing all the types of spills that could occur in the room. – Unobstructed aisles and doors. • Chemicals/lab apparatus are put away immediately after all sections of the course have completed the experiment. • Unsupervised labs are free of chemicals/lab apparatus.	
Personal Protection	**Comments**
(a) Personal Protective Equipment (PPE): • Appropriate PPE (e.g., goggles, face shields, apron, gloves) is available and in use. • Goggles are sanitized before use if they are shared, as per board protocol. *(b) Other:* • At least one portable safety shield is available in the department. • Carts with raised lips are used to transport chemicals/ apparatus. • Carriers are available for transporting large chemical bottles. • Chemicals, including compressed gases, are transported by qualified teachers only. • Eye wash stations are properly drained to prevent slip hazards. • A board-approved first aid kit is readily available.	
Emergency Procedures	**Comments**
(a) Eye Wash Stations are: • Present in each lab and chemical storage/prep room. • Accessible within 10 seconds of injury. • Clearly marked and unobstructed. • Capable of gently supplying water to both eyes for 15 minutes. • Tested regularly, as per board protocol.	

Emergency Procedures *(continued)*	Comments
(b) Safety Shower (deluge or hand-held) is: • Present in each lab and chemical storage/prep room where strong corrosives are stored and used. • Clearly marked and unobstructed. • Properly drained. • Tested regularly, as per board protocol. *(c) Plan and Procedures:* • A plan to deal with injuries is in place. • Procedures and equipment to deal with different spills (e.g., flammable liquids, corrosive liquids, and solids) are in place.	
Electrical Hazards	**Comments**
• Electrical outlets near water sources are GFCI protected. • Electrical power cords are in good condition (e.g., insulation and ground pin are intact). • Extension cords are used on a temporary basis only to avoid creating a trip hazard. • The location of circuit breakers is labelled and is known to teachers, custodians and administration. • All electrical equipment is in good working order and has an accessible shut-off switch. • The use of high voltage equipment (e.g., Van der Graaf generator) is restricted to trained staff only.	
Biological Hazards	**Comments**
• Only microorganisms purchased from board-approved suppliers are used for cultures. • Old cultures are disinfected prior to disposal. • Safety spectacles, protective gloves and a lab coat or apron are worn when handling or dissecting specimens. • Students are questioned about allergies before using food or biological specimens in an experiment. • Fresh biological specimens are used and disposed of as quickly as possible. • All surfaces are washed and disinfected after having been in contact with fresh biological specimens. • Dissection instruments are washed in a disinfectant solution immediately after use. • Local environmental regulations and procedures are followed when disposing biological specimens, preservatives and sharps.	

Heating Hazards	Comments
• Hot plates are used instead of open flames whenever possible. • When heating substances over an open flame, chemical splash goggles are worn, long hair is tied back and loose clothing and jewellery is secured. The type of eye protection required depends on the substance being heated. • Open flames are never used in the presence of flammable liquid. • Portable bottled gas burners are not used. • Solid or liquid fuel burners are not used.	
Waste Disposal	**Comments**
• Disposal procedures for waste chemicals are consistent with board and local environmental protocols. • Lab waste (e.g., chemical, biological, sharps, glass) is separated into properly labelled containers, as per board protocol.	
Fire Prevention and Control	**Comments**
(a) Dry chemical fire extinguishers are: • Located in each lab and chemical storage/prep room. • Checked regularly to ensure they are fully charged, as per board protocol. *(b) Sand* • A class D fire extinguisher or pail of silica free sand is available in the department (for class D fires resulting from burning metals, e.g., magnesium). *(c) Fire Exits* • Each lab and chemical/storage prep room has two clearly-marked and unobstructed exits.	
Master Shut-offs	**Comments**
• The locations of master shut-offs for gas, water and electricity are clearly labelled and are known to all science teachers, custodians and administrators. • All lab gas valves are checked to ensure they are closed at the end of each day under the supervision of the teacher. • The master shut-off for gas is closed when gas is not in use.	

Chemical Storage	Comments
(a) General • The chemical storeroom is: – Accessible by authorized personal using a specific key. – Well vented. – Away from sources of direct light and heat. – Not used as a teacher workroom. • Chemical storage/prep rooms are well vented and are off limits to students. • Chemical shelving is firmly secured to the floor or wall. • Large or heavy containers are stored below eye level. *(b) Chemicals* • The handling and use of hazardous chemicals and compressed gases is restricted to trained staff. • Chemicals are organized by compatibility. • All new chemicals are labelled with the date received, the date first opened and the shelf life (if applicable). • The quantity of chemicals on hand is not excessive (e.g., one-year supply or less). • Concentrated acids and bases are stored in their own dedicated vented corrosives cabinet (often blue in colour). • Chemicals are not stored or used in an area where food or drink is consumed. • Nitric acid should be segregated from the other acids. • Flammable organic liquids are stored separately in an approved cabinet. • The flammables cabinet is closed when not being accessed. • The shelves of both the corrosives cabinet and the flammables cabinet have trays to contain spills. • Water reactive chemicals (e.g., alkali metals) are stored separately in their own watertight container in a cool, dry location. • Flammable liquids are not stored in a domestic refrigerator. • Large compressed gas cylinders are stored in an upright position, either clamped in place or chained to a trolley.	

Chemical Storage *(continued)*	Comments
• Small lecture bottle gas cylinders are stored secured in an upright position. • Compressed gases are not recommended in science labs. *(c) Containers and Labelling* • All chemicals are stored in appropriate, sealed storage bottles (no food containers). • Chemical labels contain the purchase date or date of preparation. • Chemical labels comply with current WHMIS requirements. *(d) Fume Hoods* • Fume hoods are uncluttered and free of stored chemicals. • Fume hoods are regularly checked for proper airflow, as per board protocol. • Exhausted air vents directly outside and cannot be drawn back into the building.	

Documentation	Comments
• A complete set of current material safety data sheets (MSDSs) is readily available. • A current chemical inventory is readily available. • Chemical spill response guidelines are in place. • The record of equipment testing is readily available (e.g., fire extinguishers, fume hoods, showers) • The list of staff with WHMIS training is current. • The list of staff with First Aid training is current and posted.