Chapter 2: Implementing Safety in the Science Classroom or Laboratory

Overview

This chapter provides general guidelines for promoting safety in Early, Middle, and Senior Years schools. 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 these 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 members have the proper safety education and training, including teaching safe attitudes and behaviours to students.

Early Years

All students enjoy hands-on activities. This is especially true in the Early Years. 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 lessons, taking care to ensure student safety. Steps taken to ensure student safety involve all stages of planning, preparation, supervision, and activity follow-up. Sample 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 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 their involvement in science activities.
- Select activities and materials, taking into account the following:
  - Potential hazards
  - Student allergies and health conditions
  - Students' knowledge, skills, maturity, and disabilities
  - 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.

Getting Ready

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

Guiding Students

- Involve students in preparing the classroom for safe activity by clearing work surfaces and aisles.
- Introduce equipment and supplies to be used, and demonstrate 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 the 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 A for a sample contract for Early Years students. These contracts can be developed with students.

Following up

- 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.

Middle and Senior Years Schools

As in earlier grades, activities with real materials in Middle and Senior Years schools provide starting points for concept and skill development and can be powerful motivators for learning. In the Middle and Senior Years, 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 those manipulated in Early Years, creating new challenges for ensuring student safety.

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 or even remove them completely.

Science teachers 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.

> Accident prevention depends on forethought, identification of hazards, and careful instruction. The onus is on the teacher to be aware of potential dangers and convey this information to students. Teachers instruct students in proper handling procedures and expend every effort to ensure that procedures are followed consistently.

The selection of materials can help minimize risks. Inherent risks increase dramatically with the use of materials that are highly toxic, corrosive, or flammable. 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 common alternative is to use videos, animations, or simulations. Although these media may diminish the drama of a live demonstration, they effectively communicate what students need to know and understand. In addition, many of the approaches described in *Strategies for Minimizing Hazardous Waste Production* (see Chapter 9) are excellent ways to reduce safety risks. These strategies include microscale experiments, dispensing pre-measured quantities of chemicals, and using laboratory stations.

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

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 their involvement in science activities.
- Select activities and materials, taking into account
  - potential hazards
  - student allergies and health conditions
  - the students' knowledge, skills, and maturity

    - the equipment and facilities available to carry out the activity 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.

Getting Ready

- Obtain and prepare safety supplies (e.g., obtain personal equipment, such as goggles, aprons, and gloves). (See Chapter 4 for more information on safety equipment.)
- Prepare materials for safe use (e.g., prepare solutions in advance, organize materials to facilitate safe distribution). Follow the laboratory teacher guide for safe, effective organization of a laboratory experiment or investigation.
- Prepare for clean-up and disposal of chemicals and other waste products (e.g., label waste containers, identify solutions that may be safely disposed of down the sink). (See Chapter 9 for more information on disposal of chemicals.)
- Consult MSDS.
- Ensure that workspaces are adequately sized and well organized.

Guiding Students

- Set standards for safety preparation and behaviour in laboratories. Appendix B provides examples of science safety rules and procedures that could be used with students.
- Introduce WHMIS and MSDS 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 accidents
    - handling chemical wastes and spills
    - reporting defective equipment and potential hazards
    - reporting accidents
- 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. Review MSDS.
- 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 the 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 A for a sample contract for Middle Years or Senior Years students. Students can participate in the development of the safety contract.

Following up

- 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.

Safety and the Student

An important 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 modelled by example. In this way, science teachers are role models—advocates and practitioners of safety. Increasing students' awareness of safety issues in general (and knowledge of safety practices specifically) is one of the most important ways to reduce accidents.

Student Safety Training

Safety training is an integral part of learning laboratory techniques. 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 are addressed at the beginning of each course. These are posted and periodically reviewed. See Appendix B for a sample of science safety rules and procedures for students. More specific safety issues inherent in the activities can be discussed as part of the pre-activity instruction.

Safety expectations can be developed with students in a number of ways:

General Safety Practices

- Encouraging students to recognize that good laboratory technique produces more consistent and reliable results, and is time-efficient.
- Handing out written copies of good laboratory practices and reviewing these with students throughout the term.
- Posting lists of safe practices in appropriate areas and reminding students of them on a regular basis.
- Modelling safe behaviour during all activities.

Specific Safety Concerns

- Reviewing specific safety issues and procedures before each activity, including relevant WHMIS information, required personal protection equipment, and emergency response procedures in case of accidents, and posting MSDSs for each activity.

Development of common expectations for student behaviours and procedures can be a helpful starting point in planning for safety training. By planning as a team of science teachers 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 C for Suggested Science Department Safety Policies and Procedures.

Making safety an integral part of every course helps to reinforce its importance. It also 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 the following three time periods.

Before entering the laboratory

- Confine long hair and loose clothing.
- Wear only closed-toe shoes.
- Put on eye protection.
- Wear lab coats or aprons when necessary.
- Wear protective gloves when necessary.

- Know the hazards of the chemicals to be used.
- Understand response procedures in case of an accident.

While in the lab

- 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 a substance as hazardous unless it is definitely known as safe—read the WHMIS label to be sure.

Prior to leaving the lab

- Dispose of hazardous wastes in specified containers or as instructed by the teacher.
- Turn off and put away all equipment, and clean all glassware.
- If gas has been used during the activity, ensure that the gas valve is off and the cold Bunsen burner has been put away.
- 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 B for a more comprehensive list of *Dos* and *Don'ts*.

Outside the Classroom

Field Trips

Field trips are a valuable addition to any science course, 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 accidents can be reduced if the field trip is well planned and organized. Field trip planning should be guided by divisional field trip policies, 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 kinds of hazards present at the site, and the types of activities to be carried out. Supervisors prepare for any potential onsite hazards. If any such hazards exist, teachers and supervisors decide if the hazards are too great of a risk to continue the activity. First aid preparation should also take into account a Manitoba Workplace Safety and

Health standard that specifies that a schedule B first aid kit must be on hand for 24 persons or fewer and two kits for every 25-50 students. Most divisions now mandate that a manifest of students participating in the trip, complete with contact information and medical alerts, be in the teacher's possession, with copies supplied to the school office and the bus driver.

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

Outdoor Environments

Field trips to outside environment sites 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. Always visit the site prior to the field trip.
- 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.
- Ensure that there will be adequate adult supervision.
- Specify the clothing and footwear to be worn.
- Have a supply of clean water for drinking and cleaning.
- Provide special requirements such as insect repellent.
- Use appropriate precautions and equipment if working on or near water (e.g., whistles, lifejackets, throw line, "buddy" system).
- Most school divisions have regulations that require supervisors and students to take pre-field trip training when water activities are planned. Teachers and supervisors should refer to local divisional guidelines.
- Maintain access to a vehicle at all times in case of an emergency.
- Carry a cell phone to access emergency services and information. If coverage is not available, a satellite phone should be rented.

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

- Allergic reactions, toxic effects, or accidental 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 venomous snakes, 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 (e.g., deer mice can carry hantavirus and bats often carry rabies).
- Water-borne diseases such as Giardiasis (Beaver Fever).

If specimens are collected on a field trip and maintained at school for a period of time, consideration must be given to MSDSs, proper storage and labelling of fertilizers, special foods, or other chemicals required to support these organisms.