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.

CHEMICAL HAZARDS IN BIOLOGY ACTIVITIES

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

- choosing the safest chemicals possible
- being aware of potential dangers
- instructing students in proper handling procedures and insisting that they are followed
- 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 infection 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.

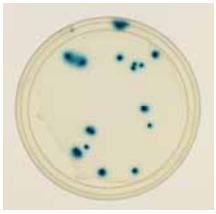
Use of Human Tissue and Fluid Specimens

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 *A 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 Web site 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
  - 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 moldy bread, cheese or mildewed objects.
  - At the senior high school level, use micro-organisms that occur naturally on bread, cheese or mildewed objects as much as possible, and use other organisms with appropriate precautions. If swabs are taken (e.g., from door knobs or desks) and cultured, use precautions that allow for the possibility that some organisms might be pathenogenic. Culture the plates for a minimum time period, view within a sealed container, and dispose of as soon as possible.
- 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 by autoclaving to avoid contamination from other sources and 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.
- Clean up any spills using proper procedures:
  1. Put on disposable gloves.
  2. Place paper towels over spill.
  3. Pour disinfectant such as 10% bleach solution on top of the towels and leave for 10 to 15 minutes.
  4. Wipe up the spill with the towels and discard into an airtight plastic bag or other appropriate container.
  5. Autoclave if possible.

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 accidental 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 nontoxic product, eliminating exposure to the formaldehyde and its fumes.

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 Health of Animal Regulations. For example, these regulations have recently 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 noninfectious. 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 regular trash.
- Clean equipment, wipe lab benches and wash hands after a dissection.

Activities Requiring Mouth Use

Some activities that involve the mouth include swabs in taste testing, PTC paper, 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 accidental 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, 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 in a secured double-strength plastic bag and dispose of in a regular garbage.

Bulbed pipette

Syringes

The most serious hazards associated with syringe use are accidental inoculation 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 causing atmospheric contamination and subsequent inhalation. To minimize this risk:

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

inoculating loop

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, that latter caused by a bacterium transmitted by birds.

rat

- 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.
- 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:

- plants poisonous to touch due to exuded oils:
  Poison ivy (*T. radicans; R. diversiloba*)
  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.)
  Hyacinth (*Hyacinthus orientalis, Scilla nonscriptus, and Agraphis mutans*)
- other plants that are poisonous when eaten:
  Tansy (genus *Tanacetum*)
  Foxglove (*D. purpurea*)
  Rhubarb leaves (*R. rhabarbarum*)
  Baneberry (*Actaea pachypoda; Actaea rubra*)
  Marsh marigold (*Caltha palustris*).

More information on toxic and nontoxic plants can be found at http://www.citysoup.ca. In the Search area, enter "Toxic and Nontoxic Plant Information."

FIELD TRIP HAZARDS

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 nettles, 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
- 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, consideration must be given to MSDSs, proper storage, and labelling of fertilizers, special foods or other chemicals required to support these organisms. Further guidelines for planning field trip activities can be found on page 53.

CLEANLINESS IN BIOLOGY

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

- Do not store or consume food in these areas.
- Wash all used surfaces with a disinfectant (e.g., bleach) after each activity. Contact 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 weekly intervals using an appropriate disinfectant.
- Wash hands after handling any kind of organism(s).

- If an autoclave is not available, sterilize equipment used in microbiology by boiling in a pressure cooker for 10 to 15 minutes. The heat provided by a microwave, on the other hand, is not uniform enough for this purpose. An ultraviolet light cabinet can be used to sterilize external surfaces. Liquid disinfectants and germicidal agents generally will not provide complete sterilization.

autoclave