BIOLOGICAL HAZARDS

CONTENTS

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 and suggests ways of reducing associated risks.

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 chemical hazards present. General steps for reducing risks include:

- Choosing the safest chemicals possible.
- Being aware of potential hazards.
- Instructing students on proper handling procedures and ensuring they are followed.
- Using appropriate personal protective equipment, and
- Having appropriate safety equipment available.

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 animal contact. 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.

Oral pipetting is a prohibited practice.

Use of human tissue and fluid specimens

All activities involving the extraction and analysis of human fluid or tissue samples are to be conducted with due care to avoid cross contamination and exposure. This practice 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 (risk group 3 microorganism), and pneumonia (risk group 2 microorganism).
        - 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 curriculum needs.
- At the elementary level, use only print and digital images of microorganisms, not live specimens.
- In middle years classrooms, 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 mildewy objects, and
- In secondary classrooms, use micro-organisms that occur naturally on bread, cheese or mildewy objects as much as possible, and use other organisms with appropriate precautions. If swabs taken from door knobs or desks are 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 safely 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.

- To avoid contamination from other sources, either purchase culture medium from a supplier or use a culture medium that is properly sterilized by autoclaving 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.
    - ❖ **Note**: if there is potential for pathogenic bacteria to grow (at a risk group 2 or higher), the petri dishes must be autoclaved prior to regular garbage disposal. If autoclaving is not possible, the garbage must be labelled as biohazardous waste and follow biohazardous waste disposal methods.
- 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 (preferably non-latex).
    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.

Owls

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 organs for dissection come in either fresh or preserved form. Three potential hazards that exist with dissections are infections and accidental cuts from sharp scalpels and exposure to preservation fluid. Refer to the MSDS for the hazards associated with the preservation fluid, safe handling instructions, and any personal protective equipment that may be required. Teachers should also give careful consideration if curricular needs can be met through dissection alternatives.

Preserved specimens

Specimens sold for dissection commonly come in an alcohol-based solution which avoids the need to use formaldehyde or formalin (see the Chemical Hazard Information Table link 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. When using specimens preserved with formalin or formaldehyde, ensure that adequate ventilation is available. This work will require local exhaust ventilation such as a fume hood.

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 methods such as the trash or local landfill. Formalin-based specimens, on the other hand, must be sent to a government approved waste facility.

Fresh Tissue

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 federally 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 Saskatchewan 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.
  - Ensure adequate ventilation is available when using specimens preserved in formalin or formaldehyde.
- Use dissecting gloves.
- Discard fresh specimens or alcohol-based preserved specimen remains in double bags or double-strength bags in regular trash, and
- Clean equipment, wipe lab benches and wash hands after a dissection.

Be a safety role model: When in the lab, limit hand-to-face contact and never chew gum or put food or drink in your mouth. Leading by example will instill safety in your students.

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:

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

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. Ensure all sharps are disposed of properly in a sharps waste container. NEVER place syringes in the regular garbage.

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 and that the flame is colourless; students may not notice the ethanol is on fire resulting in burn risks and increasing the probability of a fire hazard), 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.

Animal and plant hazards

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

- Be very selective about the organisms brought into the school. Check for student and staff 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, and
- 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 Saskatchewan native poisonous plants to be aware of include:

Note: omission from this table does not indicate the plant is safe. It is the responsibility of the teacher and the school division to ensure plants have been researched appropriately for hazard identification whether for in class or laboratory purposes or possible exposure during field trips.

Plant Name	Scientific Family Name	Poison Symptoms
Wild calla	Araceae	Mouth irritation
Blueweed	Boraginaceae	Itchiness
Spatulate-leaved heliotrope	Boraginaceae	Abdominal pains, anorexia, ascities, death, diarrhea, cirrhosis of liver, nausea, vomitting
European buckthorn	Rhamnaceae	Abdominal pains, diarrhea, gastroenteritis, hemorrhage, muscle spasms, vomiting
Poison ivy	Anacardiaceaae	Blistering, weeping blisters, erythema, edema of face, itchiness, pneumonitis, elevated temperature, tracheitis
Cocklebur	Compositae	Erythema
Common groundsel	Compositae	Cirrhosis of liver
False ragweed	Compositae	Erythema
Spreading dogbane	Apocynaceae	Convulsions, deather, sweating, frequent urination, vomiting
Common hop	Cannabinaceae	Blistering, conjunctivitis, erythema
Thin-leaved snowberry	Caprifoliaceae	Dizziness, vomiting
Blue flag iris	Iridaceae	Abdominal pains, nausea, vomiting
Death camas	Liliaceae	Low blood pressure, shallow breathing, coma, death, diarrhea, drowsiness, pupil dilation, vomiting
White camas	Liliaceae	Low blood pressure, coma, dizziness, slow heart rate
Stinging nettle	Urticaceae	Erythema
Black henbane	Solanaceae	Coma, confusion, deather, hallucination, mouth dry, nausea, pupil dilation, skin, flushed, vomiting
Black nightshade	Solanaceae	Abdominal pains, death, diarrhea, dizziness, elevated temperature, unconsciousness, vomiting
Climbing nightshade	Solanaceae	Abdominal pain, labored breathing, death, dyspnea, gastroenteritis, lethargy, thirsty, vomiting

Plant Name	Scientific Family Name	Poison Symptoms
Jimsonweed	Solanaceae	Agitation, Babinski reflex, choreiform movement, confusion, death, dizziness, drowsiness, faintness, unsteady gait, hallucination, elevated heart rate, inebriation, memory loss, mouth dry, nausea, pupil dilation, reflex excitability, dry skin, skin flushed, slurred speech, elevated temperature, thirsty, unconsciousness, absent urination, vision impaired
Pink lady's-slipper	Orchidacaea	Weeping blisters
Yellow lady's-slipper	Orchidacaea	Weeping blisters
Canada nettle	Urticaceae	Erythema, itchiness, pain, flushed skin
Poison-hemlock	Umbelliferae	Coma, convulsions, death by asphyxiation, dizziness, headache, incoordination, pupil dilation, thirst, vomiting
Spotted water-hemlock	Umbelliferae	Abdominal pains, cardiac arrest, coma, confusion, convulsions, cyanosis, death, dizziness, protruding eyeballs, eyes rolling, faintness, elevated heart rate, inebriation, metabolic acidosis, frothing of mouth, muscle contractions, muscle spasms, muscle twitching, nausea, rigid neck, opisthtonos, pupil dilation, pinpoint pupils, reflex excitability, salivation, teeth grinding, unconsciousness, involuntary voiding, vomiting
Alfalfa	Leguminosae	Infertility
Purple cockle	Caryophyllaceae	Breathing, shallow, diarrhea, dizziness, stomach, cramps, vomiting, weakness
Red chokecherry	Rosaceae	Abdominal pains, Babinski reflex, coma, convulsions, cyanosis, death by asphyxiation, vomiting
Petty spurge	Euphorbiaceae	Discharge of eye, mouth irritation

More information on plants can be found at: http://www.npss.sk.ca or http://www.greenerthinking.ca.

Field trip hazards

Planning for biological field studies need to include considerations 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 or poisonous 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.
- West nile virus can be transmitted through mosquito bites. Ensure students wear protective clothing and use repellant.
- 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, consideration must be given to the 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 in **Chapter 4**.

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 after each activity. Ensure appropriate contact time is obtained to achieve disinfection. 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), and
- 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.