# Appendices

Manitoba Education and Training
1999

# APPENDIX A: GENERAL LEARNING OUTCOMES*

The purpose of Manitoba science curricula is to help students gain a measure of scientific literacy that will assist them in becoming informed, productive, and fulfilled members of society. As a result of their Early, Middle, and Senior Years science education Manitoba students will be able to:

## Nature of Science and Technology

A1. recognize both the power and limitations of science as a way of answering questions about the world and explaining natural phenomena

A2. recognize that scientific knowledge is based on evidence, models, and explanations, and evolves as new evidence appears and new conceptualizations develop

A3. distinguish critically between science and technology in terms of their respective contexts, goals, methods, products, and values

A4. identify and appreciate contributions made by women and men from many societies and cultural backgrounds towards increasing our understanding of the world and in bringing about technological innovations

A5. recognize that science and technology interact with and advance one another

## Science, Technology, Society, and the Environment (STSE)

B1. describe scientific and technological developments, past and present, and appreciate their impact on individuals, societies, and the environment, both locally and globally

B2. recognize that scientific and technological endeavours have been and continue to be influenced by human needs and the societal context of the time

B3. identify the factors that affect health and explain the relationships among personal habits, lifestyle choices, and human health, both individual and social

B4. demonstrate a knowledge of, and personal consideration for, a range of possible science- and technology-related interests, hobbies, and careers

B5. identify and demonstrate actions that promote a sustainable environment, society, and economy, both locally and globally

## Scientific and Technological Skills and Attitudes

C1. recognize safety symbols and practices related to scientific and technological activities and to their daily lives, and apply this knowledge in appropriate situations

C2. demonstrate appropriate scientific inquiry skills when seeking answers to questions

C3. demonstrate appropriate problem-solving skills while seeking solutions to technological challenges

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*Source: The general learning outcomes are identified in Manitoba Education and Training. *Kindergarten to Grade 4 Science: Manitoba Curriculum Framework of Outcomes.* Renewing Education: New Directions series. Winnipeg, MB: Manitoba Education and Training, 1999.

C4. demonstrate appropriate critical thinking and decision-making skills when choosing a course of action based on scientific and technological information

C5. demonstrate curiosity, skepticism, creativity, open-mindedness, accuracy, precision, honesty, and persistence, and appreciate their importance as scientific and technological habits of mind

C6. employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data

C7. work cooperatively and value the ideas and contributions of others while carrying out scientific and technological activities

C8. evaluate, from a scientific perspective, information and ideas encountered during investigations and in daily life

## Essential Science Knowledge

D1. understand essential life structures and processes pertaining to a wide variety of organisms, including humans

D2. understand various biotic and abiotic components of ecosystems, as well as their interaction and interdependence within ecosystems and within the biosphere as a whole

D3. understand the properties and structures of matter, as well as various common manifestations and applications of the actions and interactions of matter

D4. understand how stability, motion, forces, and energy transfers and transformations play a role in a wide range of natural and constructed contexts

D5. understand the composition of the Earth's atmosphere, hydrosphere, and lithosphere, as well as the processes involved within and among them

D6. understand the composition of the universe, the interactions within it, and the impacts of humankind's continued attempts to understand and explore it

## Unifying Concepts

E1. describe and appreciate the similarity and diversity of forms, functions, and patterns within the natural and constructed world

E2. describe and appreciate how the natural and constructed world is made up of systems and how interactions take place within and among these systems

E3. recognize that characteristics of materials and systems can remain constant or change over time, and describe the conditions and processes involved

E4. recognize that energy, whether transmitted or transformed, is the driving force of both movement and change, and is inherent within materials and in the interactions among them

# APPENDIX B: SELECTING SCIENCE-BASED LITERATURE

## Science-Based Factual Literature (Non-Fiction Resources)

Science-based factual literature (also referred to as non-fiction or information trade books) provides an extensive range and variety of science learning resources. The selection and use of high-quality, science-based factual literature enhances students' interest in and enjoyment of science. Teachers can use non-fiction resources for exploring science concepts and gaining ideas for instructional strategies.

The attractive and interesting formats and dynamic use of visual information in effective science-based non-fiction books appeals to students. There are two common formats. One involves the presentation of information in a narrative or "story" style. The other organizes and structures information for ease of research, using headings and sub-headings.

Science-based factual literature should

- present science concepts accurately
- contain current information
- use correct scientific vocabulary that is age-appropriate for the intended audience
- have a variety of visual cues, such as charts, images, labelled diagrams, captioned pictures
- capture students' interest and spark their curiosity

## Science-Based Narrative Literature (Fiction Resources)

The use of a variety of forms and genres of narrative texts is a key element in the development of literacy in Early Years classrooms. Science-based narrative texts support the development of literacy skills and knowledge of science concepts.

Learning resources that successfully integrate science with children's narrative literature include

- a strong and obvious science concept or theme flowing throughout the story
- relevant science vocabulary
- a motivational approach that stimulates discussion and arouses curiosity
- illustrations that complement and enhance the textual information

The use of the above criteria for the selection of science-focussed narrative literature will maximize the effectiveness of teaching science through an interdisciplinary approach. This integration can enhance both literacy and science learning.

The use of a variety of genres of narrative texts accommodates student diversity in prior knowledge, experience, and learning approaches. Several literary sources focussing on the same scientific concept or theme should be used, including rhymes, picture books, poetry, songs, and short stories.

The use of science-based narrative literature should lend itself to follow-up, hands-on learning experiences that focus on skills and strategies connected to science-concept development.

# APPENDIX C: THE MANITOBA CLEAN WATER GUIDE WHAT YOU CAN DO*

**In General**

- ❑ Turn taps off tightly so they do not drip.
- ❑ Repair tap, faucet, pipe, and hose leaks promptly.
- ❑ Use low-flow faucet aerators.

**In the Kitchen**

- ❑ Only use a dishwasher when full; use the cycle that requires the least water.
- ❑ Hand wash dishes in a partly filled sink. Instead of using running water to rinse dishes, fill a separate sink or use the faucet spray attachment.
- ❑ Keep a container of drinking water in the refrigerator instead of running tap water until it is cold.

**In the Bathroom**

- ❑ Use a partially filled sink rather than running water continuously while washing your hands.
- ❑ Check for toilet tank leaks and repair them promptly.
- ❑ Short showers use less water than baths; use a low-flow showerhead.
- ❑ For bathing, fill only half the tub with water.
- ❑ Toilets use the largest proportion of household water—about 40%. Use toilets only for their intended purpose—do not flush paper towels, cotton swabs, or cigarette butts. Never flush paints, solvents, pesticides, or other chemicals, since these are hazardous to the aquatic environment.
- ❑ A toilet dam or weighted plastic bottle in the toilet tank can reduce water use.
- ❑ Low-flush toilets are available and are practical for home and cottage use.

**Laundry**

- ❑ Only use the washing machine when full; use the cycle that requires the least water.
- ❑ Adjust the water level if smaller washes are necessary.
- ❑ If you have a septic system, limit the number of loads per day to avoid overloading it.

(continued)

*Source: *The Manitoba Clean Water Guide,* p. 14. Reproduced with permission of Manitoba Environment, 1999. This document is available on Manitoba Environment's website at <http://www.gov.mb.ca/environ/pages/publs97/cwgtext/cover.html>

**Outdoors**

- ❑ Water your lawn only when it needs it. Lawns require only 2-3 centimetres of water per week. Some sprinklers have an attached measuring well to determine the volume of water used. You can determine it yourself by collecting water in a pan.
- ❑ To reduce water evaporation, water in early morning or late afternoon and avoid watering on windy days.
- ❑ Drip irrigation or soaker hoses are the best methods for conserving water while watering plants.
- ❑ A low-level sprinkler is the best type to use for watering the lawn; an oscillating sprinkler loses up to 50% of the water to evaporation.
- ❑ Cut your grass to a height of 5-8 centimetres and leave the grass clippings on the lawn. This shades their roots during hot weather, and will help retain moisture.
- ❑ Shrubs and young trees usually require watering only once a week.
- ❑ Transplanted or young garden plants should be watered more often with small quantities of water until they become well established.
- ❑ Use organic mulch around plants and trees and incorporate compost into your garden soil to help retain moisture.
- ❑ Washing your car with running water can use up to 400 litres of water. Use a bucket, a sponge, and a trigger nozzle on the hose to reduce water consumption.
- ❑ Instead of washing leaves, soil, and debris off a driveway or sidewalk, use a rake and broom.

# APPENDIX D: PETS IN THE CLASSROOM*

When we think of classroom pets, we often imagine small mammals such as gerbils, hamsters, or guinea pigs. While these are interesting creatures to observe, hamsters and gerbils are nocturnal animals and, as such, tend to be rather sleepy during the day. In fact, one group of Grade 1 students once questioned whether or not there was a real animal in the hamster cage. The children would occasionally annoy the hamster into activity, but for the most part, he remained an unseen fixture of the classroom.

Generally speaking, most animals in the classroom are best left as visitors, rather than residents. It is expected that students will have opportunities to observe living creatures, but this can be accomplished by having animals as special visitors for a period of time. Of course, teachers should outline strict guidelines for the safety of the animals, ensuring that they undergo as little stress as possible. Teachers must also be aware of allergies the students might have, especially to fur-bearing animals.

Teachers who are planing to maintain a "classroom pet" for any period of time need to recognize that all vertebrate animals have important dietary and housing concerns that require time, expertise, and care to address.

Birds, for the most part, do not make good classroom pets. Some, like the budgie or any member of the parrot family, can be carriers of parrot fever and should not be housed in a school or classroom. Other birds, such as finches, canaries, or pin quail, are sensitive to temperature changes and require large flight pens to move around comfortably.

Reptiles and amphibians require very specific environments and carefully designed diets. Being cold-blooded, these animals will endure a slow death of starvation if their dietary needs are not met. Turtles, of course, must be avoided in classrooms, due to concerns regarding salmonella. Amphibians, such as frogs, are sensitive to temperature and humidity changes and require large environments so that they have suitable ranges for movement.

Exotic pets of all types need not be resident in schools or classrooms. Large and small snakes, tropical birds, monkeys, and reptiles are interesting creatures for students to observe. However, with the availability of media today, there is no reason for these animals to be long-term "classroom pets."

Wild animals may carry potentially dangerous pathogens, and must not be brought into classrooms unless under the care of a knowledgeable expert. Animals found by students and brought into school (such as raccoon babies, injured squirrels, small snakes, and other creatures) should be directed to a local humane shelter or wildlife rescue organization.

Small fish make good classroom pets. With proper housing, feeding schedules, and cleaning, an aquarium can house a collection of small fish, readily available from most pet stores. Teachers should avoid keeping fancy tropical fish in their classrooms. Fish can be sensitive to light and temperature changes — some schools turn down their heating over the weekends in wintertime, making heaters essential for aquaria. Feeding schedules must be maintained. While it may seem that classroom fish can make it through a holiday weekend without being fed such fasting periods put undue stress on the fish and make them far more susceptible to diseases.

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*Source: "Keeping Animals in the Classroom—A Guide." Implementation Planning Workshop for *The Ontario Curriculum, Grades 1-8: Science and Technology.* © Queen's Printer for Ontario, 1998. Adapted with permission.

Invertebrates can make good classroom pets. These pets are relatively easy to maintain. They require minimal amounts of space and small quantities of food. Of course, teachers have to be aware of their environmental and dietary needs.

The following guide provides some general classroom care information regarding the needs of a variety of living things. This guide should be used PRIOR to having an animal in the classroom. It is, by no means, comprehensive, but rather gives teachers some information about the dietary and environmental needs of a number of animals they may wish to have as classroom visitors.

| Organism | Housing | Temperature Range | Food | Causes of Failure | Remarks |
|---|---|---|---|---|---|
| **Aquatic Snails** | aquaria | 24 °– 29 °C | lettuce | lack of food, drastic temperature changes | include in culture with guppies |
| **Brine Shrimp** | 8 litre container or aquaria | 21° - 27° C | diluted yeast solution | overfeeding, lack of oxygen, overcrowding | raise in a 3-5% solution of non-iodized salt |
| **Chameleons-Anoles** | large aquarium with screened lid | 27° - 32° C | live crickets, occasional mealworm | overcrowding or lack of water/food | spray droplets or water on sides of container daily |
| **Earthworms** | organic soil in wooden or plastic box | 13° - 18° C | mashed potatoes, lettuce, coffee grounds | too much heat, too much or not enough moisture, overcrowding | buss bedding works well in place of soil, keep covered |
| **Guppies** | aquaria, 8 litre container | 24° - 29° C | prepared fish food, brine shrimp | excessive food | change water occasionally, include numerous aquatic plants |
| **Mealworms** | 8 litre container or larger, plastic shoe box | 16° - 27° C | bran, dog food, occasional apple or potato slice | mould growth from too much water | cover top of bran with cotton, sprinkle water on cotton |
| **Newts** | 8 litre container, terrarium | 17° - 28° C | live food, daphnia, brine shrimp or liver bits | lack of food, escape easily, no dry place | move liver when feeding (looks alive), provide dry resting place |
| **Butterflies (painted lady)** | large box with sides cut out; openings covered with screen | 21° - 27° C | larvae-artificial media, adult –5% sugar water | humidity not correct | add containers of moist sand to adult container |
| **Milkweed Bug** | plastic shoe boxes or similar containers | 10° - 35° C | milkweed seeds, shelled unsalted sunflower seeds | excessive mould on food, too much moisture | easily raised, good example of incomplete metamorphosis |

# APPENDIX E: USING LEARNING CENTRES IN THE SCIENCE CLASSROOM

Learning centres are generally small, designated sections of the classroom that may range from a temporary table set-up to a more developed permanent area or space. Successful learning centres are dynamic and inviting. Their purpose should be clearly expressed to students and be developmentally appropriate for all students in the class, providing a range of learning experiences and investigations. Centres include a variety of materials and well-organized sets of basic supplies to be manipulated and explored by small groups of students at a time. Science centres are essential components of Early Years classrooms.

Learning centres promote self-directed learning. They motivate, guide, and support students, providing them with repeated opportunities to test ideas, take risks, and work at their own pace to complete the task at hand. Learning centres also allow students to work together, share, and develop skills in cooperation and leadership. As they manipulate materials, students take ownership of their learning and contribute to the learning of others. Centres allow students to gain confidence in their own abilities and develop collaboration, communication, and mutual respect. The teacher serves as the facilitator and not the expositor of knowledge during centre time. The use of centres requires that some time be spent teaching cooperative and collaborative learning skills.

Centres can be used to promote inter-disciplinary investigations around a central science-focussed theme. Language is used throughout for sharing materials, solving problems, clarifying learning, and recording information. For example, if centres are established around the theme of "plants," they might have specific disciplinary emphases.

**Sample: Centres for a Plant Theme**

| Disciplinary Focus | How Learning Centres Address Science Themes |
|---|---|
| **Mathematics** | Measuring and recording changes as plants grow; graphing results |
| **Reading** | Reading fiction and non-fiction texts related to plants; researching to determine which plants begin as seeds, bulbs, cuttings, etc. |
| **Writing** | Writing stories, poems, raps, or songs about plants |
| **Science** | Carrying out investigations related to sorting and classifying plants, objects made from plants, and/or foods that come from plants; planning and recording plant experiments |
| **Art** | Observing and drawing different plants; making recycled paper; experimenting with colour, shape, texture, and pattern |
| **Social Studies** | Determining the types of plants that grow in the community; describing the location for each; investigating global products made from plants |

Effective use of learning centres enables teachers to circulate and ask questions to develop student thinking. Teachers should assist students who are experiencing difficulty. At times, teachers may select a particular centre for assessment purposes and remain there until all students cycle through. Some form of recording and/or debriefing should follow centre investigations/tasks.

Learning centres allow teachers to integrate many curricular areas, thus enabling students to meet learning outcomes from several subject areas. Centre work can be assessed through observational checklists/notes, peer- and self-assessment, journal/learning log entries, and marking of finished products.

*Kindergarten to Grade 4 Science: A Foundation for Implementation* provides ideas for learning centres in the Suggestions for Instruction column. These ideas are meant as suggestions only and are not the only places where centres can be used to achieve student learning outcomes. Teachers are encouraged to make their own decisions as to the most appropriate time and place to use centres.

## NOTES