Patterns
Plants and Playgrounds

Educational Activities for School Grounds
“If a child is to keep alive his inborn sense of wonder... he needs the companionship of at least one adult who can share it, rediscovering with him the joy, excitement and mystery of the world we live in...”

Rachel Carson, 1956
Patterns
Plants
and
Playgrounds

Educational Activities for School Grounds

INTERMEDIATE GRADES 4 TO 7

written and compiled by Steven D. Lott
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Introductions

In a survey done by Evergreen in 1998, a number of teachers requested assistance in making connections between the provincially prescribed IRP curriculum and outdoor school ground activities. All school grounds have the potential to involve students in educationally valuable outdoor experiences regardless of whether they are amply endowed with lush forests, a vibrant pond and uncut grassy meadows, or reduced to lifeless rectangular parcels of asphalt and gravel. Patterns, Plants and Playgrounds is designed to assist teachers by providing PLO connections to activities that make the best possible use of the school ground as a teaching resource.

Where and how we choose to teach has a profound effect on how students interpret and experience knowledge. Many environmental educators, philosophers and ecologists argue that experiential learning is critical in fostering a land ethic. In 1949, American ecologist Aldo Leopold described in A Sand County Almanac, the importance of educating for a land ethic. “A land ethic… reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land.” Exploring and conducting experiments on the school ground as well as enhancing its ecological diversity promotes ethical understandings and a compassionate attachment to the natural world. By recognizing the fundamental importance of safeguarding the health of the land base, schools help to maintain the ecological vitality of their communities.
Introduction

It is from this perspective that *Patterns, Plants, and Playgrounds* has been developed. This curriculum guide aims to aid in the development of:

- an appreciation and understanding of processes and patterns in the environment
- an awareness around how human actions impact environmental health
- knowledge and skills to evaluate both historical and cultural perceptions of the environment as well as to foster values of respect
- hands-on experiential learning for students and other alternative teaching methods that respond to different learning styles
- activities on the school ground that move children beyond mere talk about environmental issues to projects that empower them to bring about change and involve them in the care-taking or stewardship of local lands

**Teaching Outdoors**

The lands on which our schools are built are inherently connected to every ecosystem in the world and are a place of constant change. Outside of the controlled environment of the classroom, changes in weather, seasons, biological blooms and declines, colours and even human activity occur on a frequent basis. This makes school grounds an obvious place for engaging students in activities that explore the physical and relational patterns of natural ecology. The recurring changes in the outdoor environment expand the contents, contexts and outcomes of school learning into new domains. Students who conduct experiments, record observations, illustrate their impressions, reflect on personal thoughts and experiences, as well as participate in school ground improvement projects, develop interests and understandings that are vital to a development of environmental awareness, literacy and citizenship.

Students develop understandings of human/environment relations through a familiarity with patterns found in the outdoors. Examining the outdoor environment through the constructivist lens of pattern recognition invites students to become newly acquainted with their surroundings, as well as to build a more personal perspective of the abstract facts and issues presented in indoor classroom teachings.

In primary grades, teachers develop basic literacy and numeracy skills through connections to personal experiences and the application of many hands-on activities. However, in the intermediate grades, hands-on learning tends to be reduced as greater attention and focus is put on the use of notebooks, texts and media education in the indoor classroom. This curriculum guide will enable the teacher to develop intermediate curriculum beyond the indoor classroom level to include an outdoor experiential approach to learning. This process will provide a more holistic approach to school education, which further expands the objectives and outcomes of curriculum.
An increasing body of educational research and writings currently exists in support of outdoor activities and learning. Teachers interested in the theoretical and practical arguments for student participation in outdoor activities are recommended to read such authors as David Orr, Rachel Carson, Steven van Matre, Bill McKibben, Garret Hardin, Robert and Susanne Kaplan, Thom Henley and Joseph Cornell amongst many others. A bibliography of these and other educational writers is provided in Appendix B.

Learning through patterns

Today, many school children view the natural world as a strange, frightening and dangerous place. Creatures like slugs, bugs, beetles and bees threaten to bite, berries to poison, and contact with the soil to carry infection. Cut-off from connections with natural environments, many children simply lack the experience to construct alternate patterns of understanding that could help them overcome their fears of nature - their fears of the unknown.

Our universe is filled with patterns. From the mathematical models of sub-atomic physics, to the oral poetry, songs and stories of ancient cultures, people create and communicate understanding through the organization of perceptions and ideas into patterns. Through outdoor activities such as monitoring changes in the patterns of the season, the weather and the local ecology, students can begin to understand how their own life interconnects with all life on earth.

Linking to the BC Ministry curriculum

The goal of this curriculum guide is to provide a framework of activities that will support the development of diverse skills as well as foster an ethical relationship towards the natural environment. The IRP Learning Outcomes represent a method for validating and evaluating this process in relation to the prescribed Ministry curriculum.

The task of integrating provincially mandated curriculum objectives can become a considerable challenge for BC teachers. To assist in the organization of the many diverse learning outcomes prescribed in Ministry curriculum, this curriculum guide is constructed around four core themes. Each unit (or theme) has specific Ministry of Education learning outcomes that support the development of frequent and meaningful outdoor learning activities. Further, it provides an organizational structure to help teachers create educational programs that are both linked to educationally valuable features of the outdoor environment, and are potentially long term, cross-curricular and developmental in scope.
The four units that will be developed in separate sections in this booklet are:

**Unit 1: Patterns in Nature**

**Unit 2: Patterns in the Landscape**

**Unit 3: Patterns of Time and Change**

**Unit 4: Actions for Stewardship**

The first three units (Patterns in Nature, Patterns in the Landscape, and Patterns of Time and Change) provide a basis for developing skills and understandings appropriate for successful stewardship of the land and its ecosystems. Activities in the three “pattern” units work to develop a land ethic. Students increase their understanding of, as well as their connection to, the diversity of the schoolyard and community ecosystems.

The fourth unit, *Actions for Stewardship*, suggests several ways that students can take action in restoring, protecting and maintaining the health of their school ground and community ecosystems.

Objectives for each of the curriculum guide’s four sections can be summarized as follows:

**Unit 1: Patterns in Nature**

Students use their senses to observe plants and animals found on their school grounds. By observing, recording and describing the diverse patterns they discover, students develop an appreciation and understanding of the complexities of natural ecosystems. The content focus of this unit parallels the development of learning outcomes prescribed in the Science IRP. However, these activities can also include the development of concepts and skills in many other subject areas.

**Unit 2: Patterns in the Landscape**

Students develop practical skills in estimating, measuring, comparing and reconfiguring features found in the school landscape. Also through art projects, such as site-specific sculpture and installation pieces, students reflect upon and interpret their own responses to the landscape. The content focus for this unit is primarily drawn from the Math and Social Studies IRP’s. Additional outcomes in Language Arts, Performing Arts, and other subjects can also be developed.
Unit 3: Patterns of Time and Change

Students record, examine and analyse causes and effects of both natural and human processes that they experience first-hand. On the school ground students can observe patterns of time and change through seasonal changes, sun and moon cycles etc. They can then consider the methods (i.e. hours) which we use to interpret, organize, and regulate the natural processes we observe.

Unit 4: Actions for Stewardship

Through these hands-on projects, concepts of stewardship and sustainability move from being abstract ideas to ways students can directly contribute to the protection and maintenance of their school ground. Suggested student projects and activities include maintaining a soil composter, planning and constructing a butterfly garden, or keeping a vegetable patch.

As well as the content outcomes listed in each unit, there are also a significant number of skills-oriented learning outcomes that add to the educational potential of the activities. Many of these outcomes can be found in the Language Arts IRP which has a strong focus on presentation, research, communications, cooperation, and organization skills. These and other learning outcomes prescribed in other IRP’s can be developed in interesting and unique ways using activities that take place on the school grounds. Other outcomes are particularly relevant to the methods teachers construct for evaluating student learning and development. (See pages 6-7 for a list of PLO’s that activities in this curriculum guide meet.)
LEARNING OUTCOMES

Note: The following Learning Outcomes are quoted directly from BC Ministry of Education Integrated Learning Packages (IRP’s). This list of outcomes is intended to provide an overview of potential linkages between prescribed curriculum and outdoor activities.

LANGUAGE ARTS IRP

PRESENTATIONS SKILLS

It is expected the student will:

Grade 5 • identify what they know about topics selected by the class or by groups of students.
        • formulate questions that are relevant to specific audiences and purposes.
        • select and shape information appropriately for specific audiences and purposes.

Grades 6 & 7 • adjust the degree of formality in their language to suit the form and purpose of their presentations.
        • demonstrate their knowledge of the conventions of public speaking and informal oral presentations.

Grade 6 • identify the purpose, audience, and form for each of their communications.

Grade 7 • apply the rules and conventions of formal presentations, including speeches, news reporting, and dramatic monologues.

RESEARCH SKILLS

It is expected the student will use information they have read, heard or viewed:

Grade 5 • to develop questions and activities that will extend their understanding.

Grade 6 • in a variety of written or graphic forms, including written notes and charts.

It is expected the student will locate and interpret details to:

Grade 5 • answer specific questions or complete tasks

Grade 6 • gather information and build understanding.
        • describe the purposes and key features of what they read, hear, and view.

Grade 7 • explain how works of communication relate to the broader context of community and world issues.

Grades 6 & 7 • locate, gather, select, and record information for specific purposes from various human, print, and electronic sources.

Grades 5, 6 & 7 • apply various strategies to generate and shape ideas.

COMMUNICATIONS SKILLS

It is expected the student will:

Grade 5 • create various communications for their own satisfaction, including journals and diaries
        • create a variety of personal and informational communications, including written and oral stories, poems, or lyrics; explanations and descriptions; informal oral reports and dramatics; and brief factual reports

Grade 6 • create a variety of oral and written communications to express their feelings and concerns
        • create various personal and transactional communications, including real and invented narratives, poems or lyrics, summaries of retellings, descriptions, letters, informal oral presentations, charts, and posters

Grade 7 • create a variety of personal and informational communications, including fiction and non-fiction; written summaries, instructions, and reports; oral and visual presentations; oral and written opinions; poems; or lyrics
        • create a variety of written and oral communications to record their views, opinions, values, and beliefs

COOPERATION AND INTERACTION SKILLS

It is expected the student will:

Grades 5, 6 & 7 • use language to acknowledge people, commemorate special events, and honour accomplishments within the community
        • demonstrate confidence in their abilities to communicate effectively in various classroom situations

Grade 5 • demonstrate an awareness of how to use language to develop and maintain friendships and relationships in
        • assume a variety of roles when interacting in groups
        • use the language of praise and constructive feedback when working with others
        • listen to and express interest in the ideas of others
Grade 6
• describe the diverse ideas, opinions, cultures and contributions of their peers
• demonstrate a willingness to assume a variety of roles in group interactions

Grade 6 & 7
• demonstrate a willingness to interact with others in a variety of classroom and school activities involving communication

Grade 7
• form opinions and modify viewpoints to gain further understanding of self
• share responsibility for the effective functioning of groups
• encourage others to participate
• use pre-established criteria to evaluate group processes and their own contributions to the group
• use appropriate language to celebrate special events and accomplishments

**VISUAL ARTS IRP**

It is expected the student will:

Grades 5, 6 & 7
• make 2-D and 3-D images:
  • using a variety of design strategies, including selection
  • in various styles
  • to communicate ideas
  • to engage more than one of the senses
  • using a variety of sources
  • using a variety of image-development strategies including juxtaposition, and metamorphosis
  • demonstrate the ability to collaborate to develop a group display for the school or community
  • demonstrate a willingness to work experiment with a variety of materials, tools, equipment, and processes
  • select materials, tools, equipment, and processes to make images

Grade 5
• identify aspects of selected images that indicate the social, historical, or cultural context in which they were created
• describe individual opportunities for visual arts in the local community
• express personal identity

Grade 7
• incorporate the styles of selected artists from a variety of social, historical, and cultural contexts

**DRAMA IRP**

It is expected the student will:

Grades 5, 6 & 7
• apply audience skills appropriate to a variety of presentations
  • use the creative process to develop dance sequences alone and with others
  • perform more complex movement sequences using elements of body awareness, space awareness, qualities, and relationships

Grade 7
• represent abstract concepts through dramatic work
• demonstrate an understanding of how social values are communicated in dramatic presentations
• participate safely in an outdoor experience
• demonstrate activity-specific motor skills from activities in a variety of alternative environments

**DANCE IRP**

It is expected the student will:

Grade 5
• apply the creative process to revise dance compositions

Grade 6
• perform dance, reflecting the sense of feeling and mood in the choreography
• interpret and move in response to a variety of sounds, images, feelings, and music
• alter dance sequences by transforming movements

Grade 7
• apply appropriate performance skills in a range of presentations
• transform given dance sequences
• create movement in response to the expressive elements of music and sound
• create movement sequences using pattern and narrative choreographic forms, individually and with others

**MUSIC IRP**

It is expected the student will:

Grades 5 & 6
• identify a variety of purposes for creating music

Grades 5 & 7
• create music for a given purpose

Grades 5, 6 & 7
• demonstrate respect for music from various historical and cultural contexts
Preparing for outdoor activities

Just as the school ground is connected to the global environment, so the development of a school ground’s educational potential is best supported by the broader educational community. Support of school boards and school administrators, as well as outdoor grounds keepers, parents, and teachers are valuable in the development of a school environmental legacy program. Unfortunately, this support may not always be available in all school situations.

Regardless of whether you start alone or as a part of a coordinated school ground project, certain practical information-gathering steps should be taken before commencing activities outdoors. Begin by surveying your students in order to gain insights into their background understandings and experiences outdoors. Ask them questions. Do they have gardens at home? If so, do they help with the planting and upkeep? Do they enjoy this work? How many outdoor experiences do they have? How frequently do they go camping, or fishing, or hiking? What are their thoughts and feelings about local parks, natural areas and their school grounds? Try to find out how familiar they are about environmental and ecological topics, from both a conceptual as well as an experiential perspective. Gathering this background information will help give you a starting point for making your school ground activities relevant to your students.

With your student’s perceptions in mind, consider carefully the physical characteristics and educational potentials of the school grounds. Take walks through the grounds at different times of the day, while students are at play and when the grounds are quiet. What constructive ideas come to mind; what concerns do you have? Take note of your own thoughts and feelings, remembering that you may soon be asking your students to do likewise. Examine your curriculum expectations and consider your own teaching strengths. Consult activities manuals such as this curriculum guide and others (see Appendix, Bibliography, page 137), for ideas that suit your personal interests and the characteristics of the school. Think of other school grounds you have seen or heard about. What potentials can you envision for short and long term student involvement?
An initial outdoor activity

There are three characteristic types of school grounds. It is important for teachers to appreciate which type the students will be working with, in order to develop activities and evaluate outcomes. Different types of school ground environments develop different learning outcomes. Each one has a different function in developing student understandings of human/environment interrelationships. Ideally, a school ground will allocate space for all three categories and provide students with opportunities to interact in the different possible ways.

School grounds may be classified into three general categories:

1. **MANICURED AND/OR PRIMARILY ABIOTIC (NON-LIVING) GROUNDS:** These school grounds support a limited diversity of living organisms. They often consist of large areas of blacktop and concrete, gravel, or cut-grass fields and are typical of many urban schools. Their educational function is primarily for competitive sports and recreational play for which they are designed and built to withstand the high impact of large numbers of students at play. Small green spaces and lawns are generally maintained and manicured by professional grounds keepers. The use of inorganic herbicides and fuel burning maintenance machinery is commonplace.

2. **CULTIVATED GROUNDS AND GARDENS:** These grounds include areas that support a limited selection of annual or perennial plant varieties and require a fair amount of ongoing upkeep. Maintenance is usually the responsibility of grounds keepers. The use of these gardens for educational purposes may range from relatively low (e.g. gardens constructed for architectural landscaping purposes and held off-limits to children) to very high, (e.g. classroom flower and vegetable gardens which demand a high degree of ongoing student care and maintenance).

3. **INDIGENOUS ECOSYSTEM ENVIRONMENTS:** These school grounds include areas of land in a natural or semi-natural state. These areas may support a wide range of educational activities depending on their size, age, biological complexity and the health of their many natural components (such as soils, plants, insect and bird populations). Care and maintenance requirements can vary depending on the size and extent of the use of the area.

**Before you go…**

With up to 30 students in a class, activities must be adaptable to varying group dynamics. Participation in outdoor activities may require alternative class management strategies from those applied in indoor settings. The potential for reduced supervision in outdoor areas can be a concern for teachers wary of behavioral issues in their classrooms. Students who have had little previous experience in outdoor settings may require reinforcement of appropriate rules of behavior.
Suggestions to teachers

- Assess previous development of critical thinking skills including background knowledge and vocabulary terms such as classification, observation, comparison, evaluation, analysis, sequence. Also assess student’s experience in group and cooperative work.
- Develop conceptual and behavioral skills before heading outdoors. School grounds may often be better used as a site for direct experience rather than a site for direct instruction.
- Start with simple whole-class activities and build up to more complex and individualized challenges, as children become more comfortable and responsible when learning in the outdoors.
- Establish the need for class cooperation by reinforcing basic “ground rules” through role-playing and “dry run” activities. Be prepared to cancel outdoor activities immediately.
- Develop productive “study buddy” group relations by recognizing, rewarding and building on positive interpersonal dynamics. Know who works well with whom and reward students by letting them choose their partners. Be attentive and inclusive, however, of students with special needs.
- Partner behaviorally challenged students with an adult, if possible. Many behavior problems stem from student desires for attention. Additional adult assistance is crucial if behaviorally challenged students are to be included in outdoor activities. The rewards, however, can be tremendous, and with increased familiarity in outdoor environments, student behaviors will often improve dramatically.
- Get help. Invite community workers, parents and specialists to join in your activities.

Note: student skills and behaviors will generally improve with increased contact and familiarity with the procedures and expectations that accompany outdoor learning activities. School programs that provide school ground activities from K to 7 will develop a continuity of appropriate school ground learning behavior.
Making a school ground activity kit

In order to be prepared for activities outdoors, every child should be prepared with a few basic essentials. Most of the outdoor activities in this curriculum guide can be done with these few basic items. Where additional equipment is required, a list of extra materials is included with the specific activity.

It is very helpful to have each student make up their own school ground kit with their name labeled on it so that they are ready to head outdoors at a moments notice. Because weather can play such an important factor in many school ground activities, it is always best to plan ahead, but be ready to move spontaneously. The following section provides suggestions on how your students can be ready to go outside anytime – in a flash!

KIT A: BASIC PERSONAL KIT  One kit for every student (recommended)

• 1 personal water-proof Kit bag to store personal equipment in (a small knapsack, extra large zip-lock back, small garbage bag)
• 1 waterproof ‘wedgie-board’ or ‘sit-upon’ (instructions on how to make one below)
• 1 personal journal (unlined is best) inside its own zip-lock bag
• 1 fat primary pencil (for drawing)
• 1 regular HB pencil and/or pen (for note-taking)
• 1 clipboard (instructions on how to make one below)
• Pack of coloured pencils
• Large bandana (for blindfold games and in case of spills or accidents)

If you plan on doing several activities from one particular unit of this booklet, it will help to prepare supplementary materials beforehand. The following unit lists itemize equipment that can be used for a variety of activities related to the theme. It may not be necessary to provide every student with a full supplementary kit; one kit per two or even three students is generally adequate.

KIT B: NATURE STUDIES KIT  One kit per 2–3 students (supplementary)

• 1 or 2 transparent collecting boxes or jars for small insects and spiders
• Several small plastic bags for collecting plants, fungus, rocks
• String
• Hand lens or jeweler’s loop (one per student is ideal)
• Assorted Field guides (Birds, Trees, Plants, Insects, Mushrooms)
• 1 Pooter jar or suck-a-bug (a special jar with two straws to facilitate collecting small insects)
• 1 meter measuring tape (sewing)
Kit C: LANDSCAPE STUDIES KIT  One kit per 3–5 students (supplementary)
  • Magnetic compasses (one per 2 students)
  • Long tape-measure (15 meters) or trundlewheel (2 or 3 per class is sufficient)
  • Spools of coloured string
  • Coloured flagging tape
  • Graph paper (various sizes)
  • Base maps (cadastral) of school grounds and community

Kit D: TIME AND CHANGE STUDIES KIT  One kit per class (supplementary)
  • Weather instruments (thermometers, rain gauge, barometer, wind gauges)
  • Stop watch(es)
  • Cloud charts

Kit E: STEWARDSHIP ACTIVITIES KIT  One kit per class (supplementary)
  • Gardening tools
  • Gardening resource books
  • Plans
  • Large plastic bin (worm composting)
  • Water testing kit (pH test, dissolved O2, test beakers, aquatic invertebrate field guide)
How to make your own ‘Wedgie board’

Also known as a ‘sit-upon’, a Wedgie Board is a waterproof cushion used for sitting on grass, logs, or anywhere outside. Having a Wedgie Board keeps children’s bottoms dry and comfortable while writing in journals, drawing, quiet listening and rest times. There are many designs of wedgie boards, but the cheapest and simplest is made of one section of the daily newspaper, folded in half, tightly wrapped with a large plastic bag and taped shut. Another option is to use a piece of soft cushion foam instead of newspaper. They should be kept small enough to fit neatly into the student’s Basic Kit bag.

How to make your own light-weight clipboard

An inexpensive, lightweight, versatile and durable clipboard can be made from rigid Styrofoam poster backing board (foamcore). This rigid foam board is easy to cut with a sharp utility knife. Cut to 8 1/2 x 11 size. It is relatively water-resistant and will not go soft when wet. It weighs very little, but has a hard surface that is excellent to write on. Use butterfly clips to hold down paper work. Fit the clipboard inside an extra large zip-lock bag when working outside in damp and wet weather.
UNIT 1

Patterns in Nature
UNIT 1: Patterns in Nature

Introduction

All schoolyards are host to a variety of living organisms. From visiting birds and insects, to resident plants, mosses, lichens, and microorganisms, life goes on in fascinating, mysterious, yet often unnoticed ways. This section, Patterns in Nature, engages students in exploring the many types of flora and fauna that inhabit every outdoor environment.

Exactly what types of living organisms students might expect to find on their school grounds depends primarily on the environmental qualities of their schoolyard. Examining relationships between soils, plants and animals on their school grounds is one way students can begin to recognize and evaluate patterns in the ecosystems around them. By exploring and explaining patterns that they discover, students construct their own unique understandings of their community and the world.

Discovering patterns in the living world can be done using any and all of our senses. From smelling different flowers, mushrooms and trees, to looking at the vein patterns of different leaves, or learning to distinguish the songs of different birds, students use their senses to construct explanations of why things look, smell, taste, feel and sound as they do. In these outdoor activities, it is not necessary that students find “correct” or “right” answers to questions, but that they become engaged in exploring the natural world close up and in new ways. Simply by asking questions of their diverse senses, students will discover new features and facts about the world and gradually dispel personal inhibitions and fears about interacting with the natural environment. This is an important step for more active and involved projects that may follow.
### Prescribed Learning Outcomes

**UNIT 1: Patterns in Nature**

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<tr>
<th>GRADE</th>
<th>SUBJECT</th>
<th>LEARNING OUTCOMES</th>
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<tbody>
<tr>
<td><strong>GRADE 4 Science</strong></td>
<td>a) Discuss how changes in an organism's habitat can affect the survival of individual organisms and entire species</td>
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<td>b) Relate the structure and behavior of local organisms to their survival in local environments</td>
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<td></td>
<td>c) Relate the structure and behavior of local organisms to their survival in local environments</td>
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<td></td>
<td>d) Describe the changing requirements of organisms as they grow</td>
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<td>e) Relate the growth and survival of organisms to a variety of conditions</td>
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<td>f) Relate dietary habits and behaviors to an organism's health</td>
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<td>g) Give examples of how differences in individuals of the same species may give an advantage in surviving and reproducing</td>
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<td><strong>GRADE 5 Science</strong></td>
<td>a) Distinguish between natural and synthetic materials</td>
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<td>b) Identify living resources in the local environment</td>
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<td>c) Compare and contrast sensory systems of humans and animals</td>
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<tr>
<td><strong>GRADE 6 Science</strong></td>
<td>a) Develop common classification systems for organisms</td>
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<td>b) Describe how living things belong to one of five kingdoms</td>
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<td>c) Describe all living things as being composed of cells</td>
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<td>d) Identify the characteristics of various single-celled micro-organisms</td>
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<td>e) Describe the similarities and differences in plant and animal cells</td>
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<td></td>
<td>f) Describe the body's defenses against micro-organisms</td>
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<tr>
<td><strong>GRADE 7 Science</strong></td>
<td>a) Describe all living organisms in terms of their roles as part of interconnected food webs</td>
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<td></td>
<td>b) Describe ways in which species interact with each other</td>
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<td></td>
<td>c) Determine limiting factors for local ecosystems</td>
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<td></td>
<td>d) Compare and contrast the major biogeoclimatic regions of BC</td>
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<td>e) Compare and contrast asexual and sexual reproduction in both plants and animals</td>
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<tr>
<td><strong>Math</strong></td>
<td>a) Develop and implement a plan for the collection, display, and analysis of data, using measures of variability and central tendency.</td>
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</tbody>
</table>

*Though each of the above IRP’s have been broken down into grade-specific themes, all the following activities may be adapted to any single or multi-grade classroom setting. The outcomes listed above can be linked to specific activities, but can also be used as a guide for the unit as a whole.*
### Activity-specific Learning Outcomes

**UNIT 1: Patterns in Nature**

<table>
<thead>
<tr>
<th>Pg.</th>
<th>ACTIVITY # AND TITLE</th>
<th>RELATED LEARNING OUTCOMES</th>
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<tr>
<td>21</td>
<td>#1. Seeing-eye “buddies”</td>
<td>Science a,b,d, Science a,b, Social Studies a</td>
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<tr>
<td>21</td>
<td>#2. Sound portraits</td>
<td>Science f Science c</td>
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<tr>
<td>22</td>
<td>#3. The human camera</td>
<td>Science f Science c</td>
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<td>22</td>
<td>#4. Simile search</td>
<td>Science c</td>
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<tr>
<td>22</td>
<td>#5. Wild imagination</td>
<td>Science a,b,c,d Science a,b Science a</td>
</tr>
<tr>
<td>22</td>
<td>#6. Leaf colours</td>
<td>Science a Science b</td>
</tr>
<tr>
<td>23</td>
<td>#7. The sensitive scavenger</td>
<td>Science c</td>
</tr>
<tr>
<td>22</td>
<td>#8. Scavenger camouflage game</td>
<td>Science a,b,d,f Science c</td>
</tr>
<tr>
<td>24</td>
<td>#9. Create a collage</td>
<td>Science a</td>
</tr>
<tr>
<td>25</td>
<td>#10. Where do pigeons perch?</td>
<td>Science a,b Science b Science b,c</td>
</tr>
<tr>
<td>25</td>
<td>#11. Oshibana leaf collage</td>
<td>Visual Arts 5,6,7</td>
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<th>THEME 2: ENVIRONMENTAL PERSPECTIVES</th>
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<th>THEME 3: CLASSIFICATION</th>
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<th>THEME 4: ECOLOGY</th>
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Please use this table in conjunction with page 18. BC Ministry Prescribed Learning Outcomes in other grades and other subjects may also apply to each activity. See the Learning Outcomes Tables provided in the Introduction for additional curriculum connections.
ACTIVITIES

UNIT 1 THEME 1: Observing living organisms

By observing, recording and evaluating populations of trees, shrubs, grasses, flowers, birds and so on, students can construct an overview of the biodiversity of their school grounds. By performing the same assessments on nearby areas in a more preserved condition, students can evaluate changes to the ecology of their school grounds and begin to envision ways to regenerate it.

SUGGESTED ACTIVITIES

1. Seeing-eye “buddies”

   Find a partner - your “buddy.” Select an area of the school grounds that has trees or other interesting items to look at. Try to look for something unusual, something that you haven’t really noticed much before, like the shape of a branch, a collection of plants, or the shape of a flower. Sit back to back with your buddy. Describe what you are looking at in your best detail. Your partner draws while you describe what you see. Change roles so that your buddy can describe something you can’t see. (Don’t peek, it ruins the fun.) Then compare your pictures with what was really there. What things did you miss, what things did you communicate best?

2. Sound portraits

   Find a peaceful, comfortable spot where you are far enough away from your friends so as not to be disrupted, but within hearing distance of the teacher. Close your eyes for one minute and listen carefully to all the sounds you can hear then open your eyes and begin to draw the sounds that you hear as you listen. Be creative in your drawing. After five minutes, share your drawing with others and talk about the things you heard. What did you hear and draw first? What sounds came to you only after you had been listening for a while?
3. **The human camera**

Find a partner. Name one person “the camera,” the other person is “the photographer.” Begin with the “photographer” gently, but carefully blindfolding the “camera.” Next, the photographer leads the camera gently and carefully to a place close by where a good “close-up photo” can be made. “Click” on a scene, allowing “the camera’s” eyes to open for 10 seconds only. Return to where you started. Allow the cameraperson 2 minutes to quickly draw what they saw. Then, see if they can find what it was that they “photographed.” Change partners and repeat the activity.

4. **Simile search**

Discuss what a simile is. Find objects you can describe with the phrase, “the — is as — as a —.” (E.g., the dandelion is as yellow as the sun, a fern leaf is as flat as a feather). Create similes using the five different senses. Can you make similes for one object using all five senses? Record your findings and share them with the class.

5. **Wild imagination**

Look closely and carefully at the plants growing in a playing field. Imagine yourself as a blade of grass or a dandelion in a field:

- Describe the types of changes that occur throughout the day and throughout the year in your living environment.
- Describe extremes of cold, wet, heat, and dryness that you must be able to survive.
- Describe ways your leaves and flowers are adapted to survive these difficult conditions.

6. **Leaf colours**

In early October, ask each student to select one deciduous tree. Students should choose different trees. Choose one leaf each day that represents how the tree looks on that day. Record the date it was picked. Immediately draw, laminate or iron the leaf between two sheets of wax paper. Collect leaf samples from this tree for as long as the leaves keep falling from the tree. Examine the leaves carefully to see how they have changed. Make a colour timeline to show how the colours changed. Summarize the changes in a written or artistic form.
7. **The sensitive scavenger**

Have students create their own multi-sensory scavenger hunt worksheet for making a collection of things using all of their five senses. (*See worksheet, Appendix A, page 117.*)

Draw a large outline of a head including eyes, ears, nose, mouth and blank spaces that will be used for recording items of touch. Leave lots of blank space for filling in the things that they find outdoors. Prepare a scavenger hunt sheet with a set of instructions similar to these:

- Find three sounds that you enjoy, and three sounds that aren’t so pleasant.
- Record the smells of the following: grass, air, soil, water, your skin, a plant, and two other objects of your own choice.
- Find something that feels: rough, smooth, squishy, hard, fuzzy, cold, wet, warm
- Find things that look good enough to eat (but don’t eat them!) 
- Record how being in this spot that makes you feel (happy, sad, excited, bored, curious, etc.)
- The students then find a quiet place to observe their surroundings and complete their scavenger hunt of the senses.
- Conclude by discussing: what new things were discovered and in what ways the different senses of animals help them to understand the world.
8. **Scavenger camouflage game**

**Materials**
- Toothpicks in a variety of colours
- Timer/Watch

**The Game**
Hide the toothpicks in easy- and hard-to-find places. Place them so that some toothpicks match the background while others contrast against the background. Allow 5-10 minutes for students to find the toothpicks and bring them back to home base.

**Debrief**
- Discuss which toothpicks were easy or hard to find. Why?
- Make connections to animal camouflage techniques and discuss how predators overcome the problem of finding camouflaged prey (i.e., they use other senses like smell, or they wait patiently until the prey moves).

9. **Create a collage**

Gather a varied collection of leaves. Make an artistic collage, drawing, or rubbing with them. Examine finished collages for patterns of leaf veins, edges and leaf shapes. Some vocabulary for development includes:
- veins: branching, symmetry, radiating, alternating, parallel
- edges: serrated, smooth, pointed, rounded
- shapes: oval, elongated, uniform.
10. **Where do pigeons perch?**

Observe birds on your school grounds. Notice that most birds have areas that they prefer to “hang-out.” Seagulls never sit in trees or on wires, but they like grass fields, roof tops and telephone poles. Starlings, on the other hand are happy almost anywhere. Pigeons like roofs, wires and fields, but you won’t find them in trees, either. Why not? Make up a chart of the various types of places birds might prefer. Then, observe different species of birds and record where they go. Graph and analyse your observations. Draw hypotheses and conclusions by making a simple chart. (This activity focuses on habitat and adaptation.)

11. **Oshibana leaf collage**

Oshibana is the Japanese art of making pictures with pressed plants. Take your students outdoors and collect specimens of monocot and dicot seeds — flowers, leaves, whole tiny plants, and press them. Place specimens between pieces of plain bond paper or waxed paper and place them between the pages of telephone books or science catalogs. Make your pictures after the specimens are nicely pressed and before they lose their color.

**Materials**
- Pressed plant flowers, stems, leaves and other small articles of interest such as tiny shells
- Colored construction paper or colored bond paper
- Japanese rice paper (or thin tissue paper/thin paper towels) or self-laminating sheets
- Glue mixture: 1 part white glue to one part water (add a little more water if too thick)
- Small brush

**Procedure**

a) Cut construction paper to size and form desired.

b) Arrange plant parts artistically on construction paper; add shells, sparkles, glitter, writing, etc. if desired.

c) Place rice paper on top of plant parts.

d) Brush glue mixture lightly on top until rice paper is thoroughly wet but not soaking.

e) Let dry.
UNIT 1 THEME 2: Environmental perspectives

Understanding different perspectives on the environment is an important skill that requires development. The grade five curriculum introduces the topics of “living” and “natural” resources. The idea of a resource implies the use of something for a purpose. The use of living and natural resources involves human choices that inherently effect living organisms and ecosystems. The consequences and effects of human actions on the environment are a critical topic that goes beyond the Ministry curriculum objectives. In constructing activities respecting the processes of obtaining and using natural resources teachers should include critical thinking questions that inquire into potentially adverse consequences of over exploitation of environmental resources. These activities are a starting point for activities in the Stewardship unit of this document.

SUGGESTED ACTIVITIES

1. Free verse
   Sit in a quiet place. Draw a picture of what you see, or write a free verse poem about this place and what it means to you. Write a poem about what this place means to the animals and plants that live here. Contrast the different perspectives that different living things might have about this place.

2. Animal senses
   Start by showing pictures of animals that have pronounced sensory apparatus such as a fox’s nose, an owl’s eyes, a butterfly’s antennae, or a rabbit’s ears. Have the students look at their their results from The Sensitive Scavenger (Activity 7, page 23). Now ask them to imagine themselves as one of the animals in the pictures. How might their observations help to explain the importance of the special senses of these animals? What things might these animals be more aware of than we humans are?
3. Deer ears

How are a deer or a rabbit’s ears shaped? Cup your hands. Is that shape like a deer’s ears? Hold your cupped hands behind your ears; does the shape look like your own ears? Make sounds or speak softly from different directions, moving around the listening students. Have students move their cupped hands to point in different directions. How well do cupped hands help improve hearing? What is the best way to cup hands for the best hearing?

The Game

One student volunteers to be the “Big Buck” deer. Blindfold this student carefully, making sure that the ears are not covered. Tuck a second piece of cloth in the Buck’s back pocket so that at least 6 inches is hanging out. This is the Buck’s “tail.”

Gather all of the other students in a wide circle (over 10 meters wide) around the blindfolded “Buck.” These students are the predators (wolves, cougars, lynx, humans), and it is their task to sneak up on the buck and grab its tail without being heard.

When the teacher gives the signal to “eat,” the predator animals begin to silently move towards the centre of the circle. When danger is sensed, or a sound is heard, the buck shouts out “STARVE” and points in the direction the sound came from. Everyone must immediately freeze. Any predator within a couple of degrees of the buck’s pointed hoof is caught and has to leave the game.

The Buck is allowed to shout “starve” only as many times as there are predators, plus two extra (twenty predators = twenty-two guesses). The first predator to snatch the deer’s tail without being caught becomes the next buck.

Debrief

Discuss what it was like to be a buck. How good was your hearing sense? Why did some bucks live longer than others? What was it like to be a predator? What made some predators more successful than others? How was this game like the real world of deer and predators? How was it not like the real world? What other animals need good hearing to survive? Could you change the game to represent other animals?

4. A Litter Bug

Most school grounds have a perpetual litter problem. This activity will challenge students’ perceptions of their surroundings and the role they take in maintaining it. It asks them to examine their own thoughts and actions in relation to the problem of school litter.

Ask students to imagine a “litter bug” in its habitat. What does a litter bug eat? Where does it like to sleep? Does the litter bug share its home with other organisms?

Students then draw a picture of their litter bug and its environment.

Discussion

Ask students to discuss reasons why other organisms could or could not survive in the litter bug’s environment. As students begin to understand the relationships of living organisms to their environments, they should also be questioned on their own relationship to the environment.
5. **Eagle eyes**

Eagles can see objects 10 times as clearly as humans can from long distances. This activity will help students to see how acutely sensitive eagle eyes are.

**Preparation**

Make up several license plate sized cards with 6 random letters or numbers (about 10 cm high) on each card. Make the letters bold and easy to read up close. Make identical cards that are only 1/10 the size (with letters only 1 cm high).

Take the students outdoors to an open field. Start with all the students at one end of the field. Hold up the first card so that all the students can see it. With a small notepaper and a pencil in hand, instruct the students to walk slowly backwards until they can not read the card clearly any more. Tell them to count their steps as they walk backwards. When they can not see the card clearly, they must stop and wait for the next instruction. Have each student mark the location where they stopped with a marker or a line. Once everyone has stopped, hold up a second card and ask the students to write down the new numbers on their notepaper. If they can not read the new letters clearly, they may walk back slowly until they can (when everyone has come to a point where they can read the new card, put it away where they can't see it.) Have each student mark their second location, then count their steps as they walk back to the starting point. Check their recorded letters with the large card. Repeat again as many times as it takes to get an accurate point of the students’ vision horizons.

Gather the students together. Discuss why some people can see further than others. Then hold up the little cards and ask them to repeat the exercise. Compare the results of the first activity with the results of the second. Were the distances 10 times less? What other factors might have made a difference?

**Extension**

Make paper role 'binoculars.' Even without magnifying lenses, these help students focus on individual objects more clearly. Have students wear these ‘binoculars’ around for awhile and record different things they see and how the world looks differently. In what ways would this type of vision help animals? How would it hinder them?
UNIT 1 THEME 3: Classifying living organisms

As a means for observing and evaluating patterns, classification is a basic skill that has limitless applications. Classifying living organisms may involve the pre-set patterns of taxonomy, or it may involve characteristics discovered and defined by the students.

SUGGESTED ACTIVITIES

1. **Examine different organisms**
   Observe and record differences in colour, size, and shape of the different organisms you collect. Draw a picture, describe where it was found, measure how big it is, write a story or a poem about one or several of the living things you examine. Be careful not to hurt or damage living things and return them carefully to where you found them if you pick them up. Practice feelings of care and compassion when observing living creatures and plants.

2. **Classify insects and spiders**
   Observe and examine closely (a hand magnifier is helpful) a variety of insects and spiders. Draw pictures of them highlighting special distinguishing features such as coloured spots, design patterns, extra long legs or antennae and so on. Put each animal on a separate card and collect them. Identify them in a guidebook and add extra information on the back of your cards. When several different insects have been drawn and described, form a group with other students and determine a method of organizing and classifying your “bugs.” Consider the following topics to help with organization and classification: habitat, food, colour, shape, size, special features. Be prepared to explain your classification method.

3. **Conduct a stimulus-response experiment**
   Design an experiment to observe how organisms respond differently to stimuli such as light, moisture and movement. Example experiments include:
   a) place a large rock for shade inside a shoe box. Place several different types of insects inside the box. Shine a flashlight into the box and observe which bugs run for cover. What happens when you put the box in a dark place? Why do some creatures like light while others don’t?
   b) conduct a similar experiment but use wet and dry soils as the variable. Or, choose an over-ripe and an unripe piece of fruit to see which attracts insects more and which types of insects each attracts.
4. Collecting seeds

The following activities are best started in middle to late spring and early fall after plants have flowered and before their seeds have been fully dispersed. Several different types of activities can be done when collecting seeds:

a) collect a variety of seeds and identify the types of plants they come from.

b) classify seeds in different ways (shape, colour, size, number to a flower)

c) estimate how many seeds come from one flower of a particular species (dandelion, sunflower, ear of corn)

d) make seed necklaces by threading new seeds onto a piece of fishing line or coloured thread and then leaving them to dry and harden. Make interesting patterns with different colours, sizes, and shapes of seeds.

e) if enough seeds are collected, students can make seed collages by drawing a pattern onto a board or piece of cardboard then painting white glue into selected areas before sprinkling seeds onto the wet glue. Interesting textures can be created using this art technique.

f) (advanced) record when different types of flowers mature. Chart them by name and date. Do some research on how to prepare the seeds for germination, propagation and planting in the following year.

5. Observing plants

a) Draw pictures of plant leaves, needles, flowers and/or bark; or, do a pencil rubbing of a leaf, or, take close-up photographs. Display for other students to compare their samples.

b) Group drawings of leaves according to different patterns. Outline their shape, edge smoothness, veins, leaf-tip points. Enlarge small drawings and label them with appropriate terms to describe their parts, shapes or textures.

c) Do leaf and bark rubbings in different colours of pastel, crayon or charcoal. Cut out individual rubbings before arranging them and gluing them onto a sheet of backing paper. Use leaf rubbings for borders around poetry or other writings placed on display.

d) Describe plants in terms of their symmetry such as leaf vein patterns, branching, and flower shapes. Create schematic diagrams to describe the different types of plant symmetry.
6. **Identifying differences in plants**

In the field, look for major groups of plants such as mosses, lichens, shrubs, weeds, grasses, flowers, trees (deciduous, coniferous, coniferous evergreens).

Examine a variety of plants for their basic structural features (roots, stems, leaves, flowers, seeds).

Find plants that do not have all of these features; ask, how are these plants different?

Provide students with a blank classification table. *(See worksheet, Appendix A, page 118)*

<table>
<thead>
<tr>
<th>Plant “family” name</th>
<th>Characteristic Features</th>
<th>Simplified Drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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Instruct students to examine a variety of plants closely and see how many common groups they can identify. Advise them that plants in a common group may look different, but will have similar structural features. For example, the common dandelion and chicory have different shaped leaves and the flowers are different colours; however, both have ray shaped flowers and stems that contain a milky juice. This is typical of many flowers in the Aster (Sunflower) family.

On their classification table, have students draw a simple picture of each family of plant and label the important features that it has.

Ask students to give each family group its own name based on the common characteristics they discovered (correct taxonomic names are not needed).

7. **Comparing leaves by texture**

Groups of three students gather 9 different leaves and keep them hidden from other students. Leaves should come from many types of plants including grasses, shrubs, trees and so on. When all the leaves are gathered, have the students spread out their leaves under a large sheet of newspaper where other students still can not see them. Each group designates a “player.” Players close their eyes and are led to the table of another group. Keeping their eyes closed, players feel the leaves and group (classify) them according to their textures (not their shapes). When finished, players open their eyes, record their observations and share comments.

Discuss the technique of classifying plants by texture. What words did the students need to describe the leaf textures? Can the class agree on a texture classification system?
8. The five kingdoms (monera, protista, fungi, plant, animal)

Use textbooks and natural resource guidebooks to find examples from each kingdom of organism. Prepare the students by researching and discussing major characteristics that differentiate organisms in the five major kingdoms.

Provide students with special equipment such as field microscopes and collecting jars for carrying samples back to classrooms. Explore selected areas of the school ground where organisms from each kingdom are likely to be found. Provide pairs of students with the record sheet provided below. (See worksheet, Appendix A, page 119.) Instruct students to include a simple sketch and record identifying characteristics for each type of organism. Review results in class and discuss common characteristics for organisms in each kingdom.

<table>
<thead>
<tr>
<th>Name (if known) &amp; KINGDOM</th>
<th>How it moves</th>
<th>Where it was found</th>
<th>What it eats</th>
<th>What eats it</th>
<th>Coloured sketch drawing (name if known)</th>
</tr>
</thead>
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</table>
UNIT 1 THEME 4: Ecosystems

The topic of ecosystems is not introduced until grade 7 in the Science IRP. However, students should ideally begin to explore the interconnections of living things and the natural environment well before this grade. Many of the outdoor activities described previously will help prepare students for more complex experiments and observations in the upper intermediate grades. Developing familiarity with the individual characteristics of organisms at earlier grades will help students understand ecological processes and interconnections in greater depth at higher grades.

SUGGESTED ACTIVITIES

1. Comparing biotic (living) and abiotic (non-living) objects

   Take a walk through the school grounds looking at the trees, plants, playground toys, rocks, and animals (birds, insects, etc.). Then sit in a quiet spot and make a complete list of as many biotic (living) and abiotic (non-living) things you can find. Further classify each living thing as either a plant or an animal and abiotic things as either natural or made by people. Number each thing you can find. (See worksheet, Appendix A, page 120.)

   Discuss

   Which are most numerous, biotic or abiotic things? Which have the most variety? Which did they find easiest to see? What makes a biotic thing different from an abiotic thing?

   Have the students describe in their own words what makes a living thing different from a non-living thing. Ask them to be as specific as they can and to think of characteristics that living things share, that non-living things don’t have or can’t do.

<table>
<thead>
<tr>
<th>BIOTIC (Living things)</th>
<th>ABIOTIC (Non-living things)</th>
</tr>
</thead>
<tbody>
<tr>
<td>plants</td>
<td>natural</td>
</tr>
<tr>
<td>animals</td>
<td>1</td>
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<tr>
<td>1</td>
<td>2</td>
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<td>3</td>
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2. **Food web activities**

**Materials**
- library catalogue cards (about 30)
- large dark felt pen
- long roll of string

a) Think of, or look for, all the animals and plants that live in, or visit the school ground. Write the name of each organism you can think of and draw lines to connect it to every other organism that it shares some connection to (that it eats, that eats it, that provides shelter for it, that carries its seeds, etc.) Continue making branches of the food web in order to include as many organisms as possible. (NB: large sheets of paper can be useful for knowledgeable students.)

b) When this activity is finished, ask the students to name all of the organisms they could think of that live in or visit the school grounds. As they are calling out names one by one, select organisms to write on catalogue cards in heavy felt pen. Stop when you have enough names to provide each student with one card. (Be sure that you obtain a wide variety of both plants and animals of different types). Add one extra card labeled “SUN.”

c) In a large open area, ask the students to sit in a big, but tight circle. Choose one student to hold the card labeled “SUN.” Give one card to each other student.

d) Begin by asking the students “What is the source of all life on Earth?” When they have answered “the Sun” give one end of a large ball of string to the student wearing the card so labeled. Continue asking the students to make connections (such as “what eats this?” or “what does this eat?”) between the different organisms in the circle and connect them together with the string as you go. Continue until all of the organisms are connected.

e) Ask the students to pull the string gently, but firmly to take up any slack. Begin a series of questions such as “What would happen if insecticide was sprayed on the blackberry bush?” at which point any bug connected to the blackberry bush would have to leave the circle. Each time an organism is destroyed, the circular web will get a bit more uneven and disconnected. Continue the activity until the web is completely unravelled, or the students get too restless (which often happens amongst those who have to leave the game).

f) Conclude with a discussion about the interconnectivity of food webs and whether the students think the activity was a realistic illustration of the way that the world of nature works. Ask how they might improve the game and act out their suggestions if warranted.
Extensions

Tape the organism name cards on the students backs before they have a chance to see them. Play the game “Who am I,” in which students can ask only one question of each other classmate as they try to discover the name taped to their back.

Instead of a single card labeled “SUN”, stick a strong pole into the ground at the centre of the circle with the words “SUN,” “CLEAN AIR” and “CLEAN WATER” taped to it. Play the Web Game in the same way as above with the following modification.

Start the game at the centre of the circle and explain that all living things require sunlight and water to survive. To reinforce this idea, pass the string around the pole in the middle of the circle every time one organism is connected to another. (This activity consumes a lot more string.) When the Web is complete, all organisms will be connected first to the pole at the centre and then to all the other organisms gathered around. Ask the students “what would happen if there was no more sun, or clean air or water to support all of our organisms?” Tell them to pull firmly but gently on their string, then quickly pull the pole out of the ground, or cut all the strings with a sharp knife to send the kids scattering across the ground. (Note: this is a good way to get short pieces of string to perform quadrat experiments as described in Section 2.)
3. **Exploring habitat niches**

Search carefully through trees and grasses to uncover clues that will help you to find and describe the niche of local indigenous animals and plants such as:

a) a squirrel  
b) a mushroom  
c) a spider  
d) a maple tree  
e) a woodpecker

Draw a picture (or ‘key visual’) of the organism including all the key elements of its habitat in the drawing.

4. **Habitats, biomes and niches**

Students examine differences in the growing conditions required by different plants on their school grounds. Biomes are named for the environmental conditions that best support particular types of plants. Different areas on school grounds can be defined by the different types of plants growing on them. These plants are in turn influenced by the environmental conditions which the plants themselves create as well as by human actions.

Students choose one type of plant. Find several examples of this plant species. For each location, describe with as much detail as possible, the habitat where the plant is found. (*See worksheet, Appendix A, page 121*)

<table>
<thead>
<tr>
<th>% SHADE (how much shade/day)</th>
<th>SOIL TYPE/QUALITY</th>
<th>MOISTURE</th>
<th>NEIGHBOURING PLANTS</th>
<th>HUMAN IMPACTS (foot traffic, gravel, concrete, gardening, cutting)</th>
</tr>
</thead>
</table>
5. **Seed production: lawn versus meadow**

**Materials**
- coat hangers
- plastic collecting bags
- weigh scales

Students working in groups toss a coat hanger, bent open in the shape of a square, onto a) a cut lawn and b) an uncut grassy meadow. Have them carefully collect all the seeds they can find inside the coat hanger square from both locations and place them in labeled plastic bags. Bring the bags of seeds back to the classroom to be examined and weighed.

**Observation and Discussion Questions**
- In which of the two habitats were the greatest mass of seeds found?
- In which habitat did they find the greatest variety of seeds? Why?
- How might the amount and variety of seeds found in each location be important to wildlife?
- What kinds of organisms might feed on these seeds in each location?
- How do you think the seed samples might change if we collected the seeds at different times of the year?
- At what time of the year would we find the most seeds?

**Challenge**
Calculate the total mass of seeds in the whole lawn and/or in the meadow areas.
6. **How much does a tree drink? (advanced)**

**Materials**
- leaves, include petioles (or stalks) – mulberry and cottonwood work well.
- small beakers (50 - 75 ml)
- spring water
- mineral oil
- graph paper

a) Teams of students go outdoors and randomly collect five leaves from a selected tree.

b) Returning to the classroom, they carefully trace the outline of each leaf onto a piece of graph paper. Count squares to find the area of each leaf (Determine area of square and multiply by number of squares). Add the areas of each of the five leaves together to determine a total area measurement in square centimeters \( A_T \).

c) The team now places its five leaves into a small beaker and fills it about half full with the spring water so that the petioles are entirely submersed. Pour a thin layer of oil on the surface of the water, so it is completely covered (carefully avoid getting oil on the leaves). The purpose of the oil is to prevent any water loss due to evaporation from the surface of the water. Mark the top edge of the oil with an erasable marker on the side of the beaker. Set up an identical beaker without leaves to act as a control. Let the beakers sit for 24 hours by a window or grow light.

d) After 24 hours, estimate, or measure, how many milliliters of water has been lost overnight from each of the beakers. Subtract the amount lost from the control beaker from the leaf beaker. Divide the net amount lost from the leaf beaker (the number of milliliters “transpired”) by the total area of the five leaves to obtain the amount of water transpired (measured in milliliters per square centimeter of leaf in 24 hours \( y \)).

e) Send student teams back outdoors to estimate the number of leaves on their trees in the following manner. Count the number of leaves on a branchlet, the number of branchlets on a branch, the number of branches on a big branch, and so on. Then multiply each number together to arrive at an estimate of the total number of leaves on the tree \( x \).
f) Calculate the size of one average leaf by taking the previously calculated total area of the five leaves and dividing it by five to reach an average. Multiply this average by the estimated number of leaves on the tree to arrive at the total leaf area of the tree. Now, multiply this by the milliliters of water transpired per square centimeter in 24 hours to obtain the number of milliliters transpired by the tree in one day. \((A_T \div 5) \times (y) =\)

**Even More Advanced Calculations**

Determine liters of water transpired per day (also pounds, etc. - there are 2.2 pounds per liter of water.)

Calculate yearly water loss of the tree through transpiration (if deciduous, use number of months the tree has leaves.)

If the average number of trees per acre in a temperate rainforest is about 40, how much water is being transpired from trees per acre on a daily or yearly basis? (The calculation is definitely a “guesstimate”)

If there are about 300 trees per acre in a tropical rain forest, make an estimate of how much water is transpired by trees from an acre of tropical rain forest. Then consider the commonly reported statistic that one acre of the Earth’s tropical rain forests is lost every minute (some figures range as high as one per second...). Determine how much water transpiring “potential” is lost after a year of cutting down rain forests. Then, consider that trees give off 1.8 times more oxygen than they transpire water. Multiply all your figures by 1.8, and don’t forget that the missing trees cannot pull carbon dioxide out of the atmosphere. Describe some of the effects that cutting down trees may have on the global atmosphere.
Additional patterns for curriculum exploration

The following pattern themes are provided as suggestions for developing additional activities related to living organisms and natural ecosystems in the outdoor environment. These additional patterns illustrate the many diverse ways student explorations, inquiries and experiments can be structured for school ground activities.

Patterns of Behavior

Ants and other insects move more slowly in cold weather. Pigeons prefer buildings and telephone wires over tree branches. Squirrels hide seeds, only to dig them up and hide them again. By observing animals and plants under varying conditions, students can begin to see that all living things are controlled in part by environmental factors and in part by natural instincts for self protection, finding food, procreating and so on.

Patterns of Growth

All organisms grow in unique ways. Immature seagulls go through many changes in plumage (and are not just “dirty birds” as some children believe); deciduous trees bud, blossom and loose their leaves at different times and in different ways; mushrooms sprout in different seasons. Students can see that all different species grow in different ways, but within the species, changes during growth are consistent between individual organisms.

Patterns of Behavioral Adaptation

Students often confuse behavioral and evolutionary adaptations. Organisms must constantly adapt to environmental changes in temperature, humidity, food supply, and so on. These adaptations may involve finding new sources of food, seeking shelter from the cold or the heat, shedding leaves, or growing new fur. Severe or unexpected changes in the environment may mean that some organisms can not adapt and will not survive. Very serious changes to the environment (such as destruction of the forest canopy, a prolonged drought or flood) can wipe out entire species and indigenous ecosystems.
Patterns of Migratory Adaptation

Large mammals, many species of birds, some insects and even some fish have evolved highly regulated patterns of long distance travel in order to remain within climatically and ecologically favorable ecosystems. Birds and insects (such as butterflies) migrating through the school ground and surrounding region, do so in their ongoing search for seasonal food and suitable climatic conditions. Urbanization and development of lands favourable to seasonal food supplies can threaten species dependent on migratory patterns of adaptation. School projects aimed at protecting or enhancing indigenous food supplies can play an important role in the survival of migratory species.

Patterns of Evolutionary Adaptation

Students also confuse species evolution from genetic variations. Individual organisms within a particular species may show differences in their appearance or character that are not related to evolutionary adaptation. Students may falsely believe that changes and mutations in individual organisms bring about immediate changes in the evolution of a species. Such events rarely, if ever, occur as the genetic evolution of a species depends on genetic characteristics being found in a majority of the species, not only in single organisms.

Students can discover through classification and comparison activities that certain species are closely related to other species. Differences in closely related species are generally caused by evolutionary changes in their physical structures and appearances. Evolutionary adaptations allow members of a species to thrive in the environments that they are best suited for. Evolutionary change, however, takes many generations and does not happen overnight. Confronted with drastic changes to their natural habitat, individual members of a species will rarely, (if ever), evolve fast enough to adapt to environmental change and will often perish.
UNIT 2: Patterns in the Landscape

INTRODUCTION

One of the most rewarding aspects of outdoor activities is the limitless range of individual interpretations and impressions that are possible. For students interested in art, writing, numbers, history, animals, and many other topics, possibilities for discovery and expression can always be found through examination of the landscapes we live in. Recognizing landscape features provides a beginning for understanding the patterns in landscapes that give meaning to the places we inhabit and our relations with and within them.

We say people are “lost” when they do not recognize features of the landscape they are in. Lost persons tend to wander aimlessly, confused about their direction, their location and their objectives. Today, entire communities and cities appear to have lost the connection to their natural landscapes, sadly, often without even seeming to realize it. Recognizing patterns in landscapes not only helps us to understand and appreciate the places we live in, but aids in future decisions and actions which affect the health and well-being of the land.

This section will introduce techniques for exploring school and community landscapes. Students develop their abilities in mathematics, making observations, and recording information by estimating and measuring sizes and distances, as well as, reading and drawing charts, maps and other graphic forms of representation.

To understand a landscape, its features, patterns and processes of change, we use a variety of tools and techniques ranging from simple sketches to highly sophisticated maps, satellite images and so on. Each of these tools uses and reinforces a variety of skills that have applications in other areas.

This section invites students to examine the geography and geometry of natural and human-built features of the land and the systems we use to describe their locations. The prescribed curriculum outcomes that support examination of these patterns are found primarily in the Social Studies and Mathematics IRP’s. In general, the learning outcomes selected for this section introduce and develop skills of measurement, as well as various interpretations of landscapes using illustrations, maps, charts, and other graphic representations.


### Prescribed Learning Outcomes

**UNIT 2: Patterns in the Landscape**

<table>
<thead>
<tr>
<th>GRADE</th>
<th>SUBJECT</th>
<th>LEARNING OUTCOMES</th>
</tr>
</thead>
</table>
| **GRADE 4** | Math | a) Estimate, measure and compare quantities  
b) Use decimal and standard units of measure  
c) Select appropriate units to measure length (mm, cm, m, km)  
d) Solve problems involving grams and kilograms  
e) Estimate, measure, record, compare and order shapes by areas  
f) Use standard units (cm², m²)  
g) Select appropriate units to measure area |
| | Language Arts | a) Use a variety of written and graphic forms including charts, webs, and maps  
b) Describe information contained in simple and direct illustrations, maps, charts |
| | Social Studies | a) Use topographic and thematic maps  
b) Use latitude and longitude  
c) Locate and describe major physical features  
d) Describe the diverse distribution of natural resources |
| **GRADE 5** | Math | a) Use measurement concepts and appropriate tools  
b) Solve problems in real-life contexts (measure width, height, depth, thickness, perimeter, circumference, etc.)  
c) Measure the area of irregular shapes |
| | Language Arts | a) Use a variety of written and graphic forms including charts, webs, and maps  
b) Describe information contained in simple and direct illustrations, maps, charts |
| **GRADE 6** | Math | a) Be able to solve problems involving perimeter, area, surface area, volume, and angle measurement |
| | Social Studies | a) Interpret and use graphs, tables, aerial photos, scales, legends, and various maps  
b) Describe information contained in simple and direct illustrations, maps, charts |
| **GRADE 7** | Math | a) Solve problems involving the properties of circles and their relationships to angles and time zones |
| | Social Studies | a) Construct, interpret, and use graphs, tables, scales, legends and various types of maps  
b) Interpret details in simple and direct illustrations, maps, charts, and other graphic representations.  
c) Locate and describe current and historical events |

*Though each of the above IRP’s have been broken down into grade-specific themes, all the following activities may be adapted to any single or multi-grade classroom setting. The outcomes listed above can be linked to specific activities, but can also be used as a guide for the unit as a whole.*
## Activity-specific Learning Outcomes

### Unit 2: Patterns in the Landscape

<table>
<thead>
<tr>
<th>Pg.</th>
<th>ACTIVITY # AND TITLE</th>
<th>RELATED LEARNING OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>THEME 1: MEASUREMENT</strong></td>
<td><strong>GRADE 4</strong></td>
</tr>
<tr>
<td>49</td>
<td>#1. Measuring school ground shapes</td>
<td>Math b,c,e,f,g</td>
</tr>
<tr>
<td>49</td>
<td>#2. Drawing to scale</td>
<td>Math a,b,c,e,f,g</td>
</tr>
<tr>
<td>50</td>
<td>#3. Measuring and calculating volume</td>
<td>Math b</td>
</tr>
<tr>
<td>50</td>
<td>#4. Calculating height of tall objects</td>
<td>Math a</td>
</tr>
<tr>
<td>51</td>
<td>#5. There's a whale on the field!</td>
<td>Math a</td>
</tr>
<tr>
<td>52</td>
<td>#6. Compass reading: &quot;Put red to bed&quot;</td>
<td>Math b</td>
</tr>
<tr>
<td>53</td>
<td>#7. Orienteering – basic skills</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>#8. Orienteering – estimating distances</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>#9. Orienteering – intermediate skills</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>#10. Measuring distances by triangulation using a protractor and baseline</td>
<td>Math a</td>
</tr>
<tr>
<td></td>
<td><strong>THEME 2: GRAPHIC REPRESENTATIONS AND MAPPING</strong></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>#1. Classifying outdoor objects by shape</td>
<td>Language Arts b</td>
</tr>
<tr>
<td>61</td>
<td>#2. Scavenger hunt mapping</td>
<td>Social Studies d</td>
</tr>
<tr>
<td>61</td>
<td>#3. Basic maps of school grounds</td>
<td>Language Arts b</td>
</tr>
<tr>
<td>61</td>
<td>#4. Making a thematic school ground inventory map</td>
<td>Social Studies a,d</td>
</tr>
<tr>
<td>62</td>
<td>#5. Grid mapping</td>
<td>Language Arts b</td>
</tr>
<tr>
<td>63</td>
<td>#6. Quadrat surveying</td>
<td>Social Studies a,d</td>
</tr>
<tr>
<td>65</td>
<td>#7. Estimating school ground plant populations</td>
<td>Math b</td>
</tr>
<tr>
<td></td>
<td><strong>THEME 3: SENSE OF PLACE</strong></td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>#1. Sentimental mapping: mapping our feelings</td>
<td>Social Studies a</td>
</tr>
<tr>
<td>67</td>
<td>#2. Historical mapping</td>
<td>Language Arts a</td>
</tr>
<tr>
<td>68</td>
<td>#3. Creative mapping</td>
<td>Social Studies a</td>
</tr>
<tr>
<td>68</td>
<td>#4. Mapping frequencies and types of school ground activities</td>
<td>Language Arts a</td>
</tr>
<tr>
<td>68</td>
<td>#5. Finding longitude and latitude of your neighborhood</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>#6. Symbols in the landscape</td>
<td>Social Studies c,d</td>
</tr>
<tr>
<td>73</td>
<td>#7. Site-specific sculpture and installation pieces (advanced or enrichment)</td>
<td>Social Studies c,d</td>
</tr>
</tbody>
</table>

Please use in conjunction with page 46. BC Ministry Prescribed Learning Outcomes in other grades and other subjects may also apply to each activity. See the Learning Outcomes Tables provided in the Introduction for additional curriculum connections.
SUGGESTED ACTIVITIES

1. **Measuring school ground shapes**

   Look for various regular and irregular shapes on the school grounds such as tennis, basketball, hopscotch and foursquare courts. Use different tools for making measurements such as: pre-measured one meter or longer lengths of string or rope, trundle wheels, tape measures or foot steps. Try using different types of measuring tools for each different type of measurement (as in a stations approach). Compare the accuracy of the different tools used. Discuss benefits and difficulties of using each different type of measuring technique.

   Try estimating distances before measuring them, such as the space between two large trees, or the length of a path or a walkway. How accurate are student’s guesses?

   Have student’s design their own methods and tools for measuring distances. If they are accurate, have them used for measuring other things in later outdoor mapping activities. Reward solutions that are creative and imaginative as well as those that are practical and accurate.

2. **Drawing to scale**

   Use graph paper to make simple scale drawings and sketches of objects measured on the school grounds. Practice techniques for converting actual measurements to scale measurements. Keep scaling calculations simple (for example: 1 meter = 1 centimeter). Reinforce powers of ten and place value skills in Math while doing metric measurements and scaled drawings.
3. **Measuring and calculating volume**

This activity measures and calculates the area or the volume of large regular shapes. Square and rectangular shapes are easiest to begin with. Some common large regular-shaped objects often found on school grounds are: ball courts, parking stalls, planter boxes, storage containers, garbage bins, portable classrooms, a gymnasium or other building extension. Areas can be measured and drawn to scale first and then area and volume calculations computed.

Remember:  
\[
\text{Area} = \text{length} \times \text{width} \\
\text{Volume} = \text{length} \times \text{width} \times \text{height}
\]

4. **Calculating the height of tall objects (2 person pencil technique)**

Try to figure out how tall a tree, a building, a flagpole or other tall object is. Begin by giving the students the problem before telling them how to solve it. Tell them the only tools they need are a long pencil (or a ruler) and their feet. Let them puzzle over this for a few minutes, or a few days, and then give them the following instructions:

**Materials**
- 1 pencil or other small straight object (a ruler, a straw, even a blade of grass)

Form students into pairs. One student holds a pencil out at arms length pointing up and down in line with the selected tall object. Line up the bottom of the pencil with the bottom of the object. Keeping the pencil held straight in front with the bottom of the pencil in line with the bottom of the tall object, move directly towards, or away from the object until the top of the pencil lines up with the top of the object and the bottom lines up with the bottom. Standing at this point with arm outstretched, the pencil and the object now look to be the same height to the student viewer.

Now, tilt the pencil over so that it is horizontal to the ground and with the bottom of the pencil still in line with the bottom of the object. Send the second student off to stand beside the base of the object. This second student then walks away from the object until the end of the pencil held by the viewer is reached. The place where the second student stops will be the same distance away from the base of the object as the top of the object. Together the two students can now pace off this distance, or use a measuring tape to calculate the height in meters, or feet.
5. **There’s a whale on the field!**

In this activity, students will use their skills of pacing, or measuring distances to construct a grid for drawing a full sized outline of a whale or a dinosaur on a school field or paved area.

**Materials**

- Sidewalk chalk for drawing on paved areas
- 1 meter long sticks for drawing on gravel fields, plus field chalk for outlining shapes

a) Start with a side view drawing of a very large animal, such as a baleen whale or a large dinosaur. Be sure that the real life dimensions of length and height are also given. (Provide a sample page.)

b) Calculate an appropriate grid size so that each grid on the drawing represents one meter in actual size

c) Have students draw the grid lines over top of the drawing.

d) Take the drawing out to a large field.

e) On the field, construct a grid of one meter squares, large enough to cover the length and height of the large animal.

f) Divide the class into teams with different members responsible for one side, or one section of the animal. Draw the outline of the animal onto the field using chalk or by scratching a stick into gravel.

When the outline is finished, gather around the perimeter of the animal shape and try to hold hands. How big is this animal? Try drawing other animals to scale on the field to get a comparison of sizes.
6. **“Put Red to Bed:” a primer on compass reading**

Reading a compass demands many skills in measurement, math and geometry. Learning how to read a compass accurately requires practice, patience and attention to detail. Once the basics of compass reading have been taught a variety of schoolyard activities can be introduced to expand student skills into other areas.

Reading a compass can be a daunting experience for many elementary students. Here is a way to simplify the task.

Give the parts of the compass the following names:

- “Ted”: a distant object in the direction that you heading. (The name “Ted” goes with every distant object that you will be orienting towards.)
- “Red”: the north pointing end of the magnetic compass (it is usually coloured red)
- The “Bed”: two white lines on the Compass dial between which the red North arrow fits. The red North arrow must always be “put to bed” when reading the compass.

Now memorize the following verse:

> “Point to Ted and Put Red to Bed
  (When all is said, that’s where you’ll head)”

**How To Do It**

a) Hold the compass at stomach level with the direction arrow pointing toward “Ted” in the distance.

b) Be sure the compass is flat and level (most compasses have an air bubble to help level them). Note which way North is by looking at the red arrow.

c) With the direction arrow pointing at Ted, turn the compass dial slowly until “Red”, the North arrow, is framed by the two white posts of the “Bed.”

d) With Red in the Bed, and the direction arrow pointing at Ted, you can now read the direction to Ted using the direction arrow on the compass. (Reinforce how to read degrees on a circle as you are reading the compass.)

e) Walk to Ted, keeping Red in the Bed.

For practicing compass reading, set up the simple orienteering activity following.
7. **Orienteering—basic skills**

The challenge and skill of orienteering has many levels. Orienteering can be a simple direction-finding activity, or a physically demanding cross-country race. Start students out with the basic skills of direction finding and compass reading before progressing to more active and energetic activities. With practice, students can make up their own orienteering courses and challenge one another.

**Simple orienteering**

A simple orienteering course can be made by posting large letters in easy-to-see locations around a school field. For the letters, choose a word that the students are learning, such as the word “orienteering.” Post the letters in a random order, (but be sure that the students know the correct spelling of the chosen word). Instruct the students to move from letter to letter in the correct sequence, reading the direction of the following letter from their magnetic compass as they move through the course. In large groups, divide the students into pairs and start them at different letters, making sure that they move sequentially through the spelling of the key word.

**Figure: Example Student Worksheet** *(See worksheet, Appendix A, page 122.)*

<table>
<thead>
<tr>
<th>Letter station</th>
<th>Direction to next letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>25° N</td>
</tr>
<tr>
<td>R</td>
<td>100° E</td>
</tr>
<tr>
<td>I</td>
<td>220° SW</td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
</tr>
</tbody>
</table>
8. **Orienteering: estimating distances (by walking, running and on changing slopes)**

An important skill for orienteering as well as other land mapping activities is the ability to estimate or reasonably accurately measure distances by stepping them off. When running through a challenging orienteering course, students must be able to calculate distances using only their running steps as measurement. Knowing the length of your stride and being able to adjust for an upward or downward slope takes a fair amount of skill. Developing an awareness of distance measurements and the ability to estimate and calculate distances using only the student’s steps are useful skills in many situations. Whether giving or receiving directions near to their own home, or in a faraway location, familiarity with relative distance is a useful basic skill for students to develop.

**Materials**

- trundle wheel or long tape measure

**Location**

- a large open field

**A. Walking Measurements**

a) Delineate a starting line with chalk, string, or other method.

b) Measure a distance of 50 or 100 meters away from the starting line and create a second parallel finishing line.

c) Line-up students along the starting line. Instruct them to walk carefully to the finish line, keeping each step even and natural, and counting their steps as they go.

d) When they reach the finish line, write down the number of steps they took.

e) Repeat the walk two times in both directions counting steps and recording them.

f) When finished, compare the number of steps taken in each walk. If a large variation is found, the student must try to make more even steps; stress the importance of this for later activities.

g) If a minimal variation is found, calculate the average number of steps taken by adding up all the steps and dividing by the number of separate walks taken.

h) Then divide the total number of steps by the distance taken to find the average distance of each individual step.

Example: 140 walking steps ÷ 100 meters = 1.4 steps/meter

*Note: The answer to this and following exercises are personal answers that the students must remember when doing orienteering and outdoor activities that require steps for measurements. Students should write down and memorize their personal measurements.*
B. Running Measurements

Repeat Activity A above, but have students run the distance this time. Instruct students not to sprint, but to try to maintain an even running pace. (It is a good idea to have students run around the field first in order for them to establish their average running pace and speed.)

Repeat the activity and average the number of running steps.

Divide the average number of steps by the distance run.

Example: 120 running steps ÷ 100 meters = 1.2 steps/meter

C. Slope Measurements

This variation requires a slope or hill of at least 10 meters in length. Students can walk and run, up and down the slope, counting and recording the number of footsteps they take each time over a measured distance. They will observe that running and walking uphill will shorten their stride considerably, whereas travelling downhill may tend to lengthen their pace. Record these individual measurements on the student’s personal footstep chart. These measurements can be used in many activities outdoors involving the measurements of distance for orienteering races and mapping exercises.

Using Personal Measurements

Using personal distance measurements requires a great deal of estimating. Students must make judgments about the speed they travel, the slope they are traveling on and how consistent their pace is. All of these judgments require that the student pay close attention to their surroundings as well as their own physical condition as they carry out a measurement exercise. (See worksheet, Appendix A, page 123.)

Figure: Student Footstep Measurement Record

<table>
<thead>
<tr>
<th></th>
<th>Distance Traveled</th>
<th># of steps</th>
<th>Average steps/meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Walking</td>
<td>100 meters</td>
<td>140</td>
<td>1.4</td>
</tr>
<tr>
<td>B. Running</td>
<td>100 meters</td>
<td>120</td>
<td>1.2</td>
</tr>
<tr>
<td>C i. Walking uphill</td>
<td>10 meters</td>
<td>25</td>
<td>2.5</td>
</tr>
<tr>
<td>C ii Running uphill</td>
<td>10 meters</td>
<td>20</td>
<td>2.0</td>
</tr>
<tr>
<td>C iii. Walking Downhill</td>
<td>10 meters</td>
<td>15</td>
<td>1.5</td>
</tr>
<tr>
<td>C iv. Running Downhill</td>
<td>10 meters</td>
<td>12</td>
<td>1.2</td>
</tr>
</tbody>
</table>
9. **Orienteering: intermediate skills**

Orienteering can be a very physically challenging activity that requires a variety of skills. The following activity brings the skills of compass direction finding and distance measuring together. There are many possible variations of orienteering that can be done on a school ground. With practice, students can even set up their own courses and challenge their classmates.

**Materials**
- compasses
- base map of activity site, or directions sheet

**Course Set-up**

Locate and post at least 10 station signs around the activity site that will be clearly visible to students approaching from several directions. Stations should be at least 10 meters away from one another and fairly easily accessible. Be mindful of student damage to foliage and keep an eye out for possible dangers such as insect nests, irritating plants (nettles, poison ivy, etc.) and other obstacles. Keep the course simple, but add challenges by posting station signs on the backs of tree trunks, goal posts and backstops. Try to post signs near to eye level and do not hide them under things.

Once all the signs are posted, proceed around the course, taking compass readings and stepping off measurements between each station. Record all measurements and check for accuracy. Make up a master course list.

For an added challenge, provide clues, or math challenge questions that must be decoded in order for the students to figure out the direction of the next station. Mix up letters found at each station that the students must unscramble to complete the activity.

**Optional extension**

Provide a base map of the activity site for students to record their progress and the location of each station site as they go.

**Figure: Example Orienteering Course Sheet** *(See worksheet, Appendix A, page 124.)*

<table>
<thead>
<tr>
<th>Station #</th>
<th>Station Letter</th>
<th>Direction to next Station</th>
<th>Distance to next Station</th>
<th>Clues Found:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>45° NE</td>
<td>65 meters</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>180° S</td>
<td>20 meters</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>275° NW</td>
<td>56 meters</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>etc.</td>
<td>27 meters</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>etc.</td>
<td></td>
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10. **Measuring distances by triangulation using a protractor and a baseline**

The following activity is suited to advanced grade 6 or grade 7 students. The principles of geometry and angle measurement may be too difficult for younger students. To measure distances with triangulation requires a protractor or a compass to measure angles. Familiarity with angles, angle measurements and the use of a protractor is essential to this activity. A large protractor is also useful for making outdoor measurements. This may be constructed from an enlarged photocopy, or constructed by the students. Activity A, below, describes how students can make a large protractor.

**A. Making a Protractor**

When measuring angles outdoors, a large protractor will help to increase accuracy. Accuracy of angle measurement is important for accuracy of distance calculation. Students learn to make their own protractors in the following activity:

**Materials**

- blank paper 8” x 14”
- small plastic protractor
- straight edge
- piece of string
- pin or tack

The enlarged protractor should be at least the size of an 8 x 14 inch piece of legal paper. Larger protractors are possible, but can be unwieldy for children (see diagram A, Appendix A, page 125).

**Procedure**

a) Start by drawing a baseline the length of the paper.
b) Mark the centre point.
c) Draw a line perpendicular to the centre point.
d) Construct a large semi-circle using a length of string pinned down at the centre point and with a pencil tied at the appropriate diameter length. (Make the diameter to cover as much of the paper as possible.)
e) Place a standard plastic protractor on the baseline and centred on the centre point. Mark all degree points of five-degree increments.
f) Extend degree lines to the outside arc and label them.
g) Check for accuracy by comparing each “slice” of five degrees in the enlarged protractor. All slices should be the same size and width.
h) Mount the completed protractor on stiff cardboard for outdoor handling.

Practice reading the protractor with students. Make sure they understand why a protractor has two sets of increasing and decreasing numbers, and how to read them accurately. Now you are ready to go outside.
B. Measuring by Triangulation

Groups of two or three students

Materials

- enlarged protractor (see construction activity above)
- standard sized clear plastic protractor
- a piece of string approximately 1.5 meters in length
- graph paper and clip board

a) Start by drawing a baseline approximately 10 meters in length from which to begin measuring. Select an object (or objects) located within 50 meters of this baseline that is approximately centred on the baseline. Identify the object(s) clearly for the students using a large letter card, a strip of coloured tape or something easily recognizable. Have the students locate a point on the baseline that they feel is perpendicular to the distant object. Check for accuracy. Mark the centre point clearly (see diagram, Appendix A, page 125).

b) Now have the students pace off a distance of five to ten paces on each side of the centre point along the baseline. (Practice making equal sized steps to improve accuracy beforehand.) Have students mark their endpoints on each side of centre line clearly, so that they can be identified from other student’s measurement points. (Note: due to the individual sizes of student paces different endpoints will help to spread out the class along the baseline. To further spread out students assign the number of paces to step off from five to ten paces.) On their graph paper, have the students draw a baseline, find the centre point and measure the number of steps they have taken by making one square on the graph paper equal to one step. Mark the endpoints on the graphed baseline.

c) Have students prepare their large protractor by finding the mid point of their piece of string and pinning it to the centre (vertex) of the enlarged protractor (which has been mounted on a piece of stiff cardboard). Place the protractor flat on the ground and directly above the endpoint marked on the ground. Align the protractor’s baseline with the baseline marked on the ground and stretch one end of the string along the baseline to ensure that the two baselines are accurately in line. Check to make sure all endpoints, vertexes and baselines are properly aligned.

d) With the protractor properly and firmly held in place, stretch the other end of the string so that it points directly at the distant object. Sight along the string to ensure accuracy. While holding the string taught, measure the interior angle from the baseline to the extended string. Record the measurement and reconstruct it on the graph diagram using the smaller protractor. When completed, the students may proceed to their second endpoint and repeat Steps 3 and 4.
e) Now that the baseline and two angles are completed, the students have the basic geometric elements of a Side-Angle-Side triangle. To complete their measurement to the object of study, simply complete the graph paper drawing by extending the sides of the two measured angles until they intersect. Then draw a line between this intersecting point and the centre point on the baseline. This line is a scaled representation of the distance to the object. By counting the number of squares covered by this line and multiplying this number by the length of one of their paces, the students can calculate the distance to the object with relative ease.

Extensions

Rather than using a protractor, this same activity can be done using magnetic compasses. In this version, it is important that students develop strong skills in compass reading first, as the added component can compound the difficulty of the activity (see 7. Orienteering - basic skills, pg. 53).

Historically, this technique was used to map most of the world prior to the development of aerial photographs, satellites and laser beams. Students studying history of land settlement (Grade 5 and 7 Social Studies) can learn a lot about the use of triangulation, the original tools (rod and chain) involved in it, and many amazing feats of engineering (e.g., measuring the Himalayan mountains: mapping the first transcontinental Canadian Railroad; building the Cariboo Wagon Road through the lower Fraser River Canyon, etc.).

Triangulation mapping can be extended to cover the entire area of the school grounds or further. To extend map making beyond the measurement of a single object, simply repeat the steps in the activity above using each measured object as the vertex of the next angle. To do this extended activity will require a much larger piece of paper and strong competency in triangulation skills. However, by measuring and recreating a variety of prominent objects scattered around a given area, students can construct a very accurate triangulation map of their school grounds. With the triangulation map completed, shapes of objects and important details can be added in layout form or as pictorial representations.
UNIT 2 THEME 2: Graphic representation & mapping

The different measurement skills developed in Unit 2 Theme 1 can be applied to the activities in Unit 2 Theme 2. Through the following activities, students will learn a variety of mapping skills and produce several different varieties of maps.

SUGGESTED ACTIVITIES

1. **Classifying outdoor objects by general shape (round, square, conical)**
   
   In constructing graphic drawings and maps outdoors, students learn to see and represent things as general shapes and patterns. In this activity, students look for simple shapes in trees, buildings, and areas of the landscape.

   **Materials**
   
   • notebook or journal and pencil

   Have students brainstorm a list of simple regular shapes that they might find in things outdoors. Instruct them to think big and general, such as the shapes of trees, buildings, gardens and other large things outdoors. What shapes do they think might be the most common they will find?

   Copy the following list into notebooks:
   
   • circular shapes
   • cylindrical shapes
   • conical shapes
   • square shapes
   • rectangular shapes
   • other interesting shapes

   Proceed outside to find all the objects they can that fit into these general shapes.

   **Debrief**

   What objects did students find for each shape? Does everyone agree with one another? If not why not? What shapes are most common? Are there differences in the general shapes of objects made in nature and objects made by people? If so, what causes these differences?

   Have students draw a sketch map of the school ground using general shapes for the different objects they found.
2. **Scavenger hunt mapping**

Scavenger Hunts are an excellent way to start children exploring patterns in the outdoors. As students hunt for different things they can record their findings on a simple grounds map. Several easy to prepare scavenger hunts that help students discover and record different aspects of their surroundings include:

- finding objects that match coloured pieces of paper or sample paint swatches
- “biggest, tallest, smoothest, roughest.” Find examples of descriptive adjectives.
- habitat hunts: places where bugs, birds, animals, live or feed.
- hidden things: place coloured objects in foreign places (camouflage).
- diversity hunts (different objects within a single category, such as different plant leaves, flower petals, seeds, bark samples, cones, shades of yellow, red or green, etc.).

3. **Basic maps of school grounds**

Describe the three basic elements of Point, Line and Area used in making maps. Start with an existing map and locate features according to each of the three characteristics. What types of objects can students find that might be represented by Point, Line and Area? Examples include:

**Point:** a bench, a fire hydrant, a favorite tree, a play swing, a large rock, a big stump, and a bridge

**Line:** a pathway, road, stream, fence, pipeline or boundary

**Area:** a type of vegetation, a field, a parking lot, a building, a swamp, a tennis court.

Use community cadastral maps and superimpose information.

Draw site plans to scale.
4. **Making a thematic school ground site inventory map**

Thematic maps are made by locating borders around areas defined by a set of common characteristics. Thematic characteristics can include types of vegetation, locations of buildings, predominant types of human activity or use such as sports and games, areas that receive a lot of sun or shade, garden areas that are well maintained or left natural, play areas for different grade groups and/or that are used primarily by boys or girls, garbage hot spots.

The following activity is used for constructing an inventory of important features of the school ground prior to discussions and planning activities related to school ground naturalization or redevelopment projects.

**Student Challenge**

Make a basemap of important features found on the school ground.

Begin with a large scaled basemap of the school ground obtained from the school principal or district office.

Using the following colours locate the following areas:

- **GREEN** existing vegetation
- **RED** active play areas
- **ORANGE** passive play areas (gathering spots)
- **YELLOW** proposed planting areas
- **BLUE** any areas with standing or running water
- **BLACK PENCIL** pathways (including where people walk, trails, sidewalks, shortcuts)
- **LEAVE WHITE** all buildings, parking lots and paved areas where no plants grow
5. **Grid mapping**

Constructing a large-scale quadrat (e.g., 40 to 100 meters squared) makes an interesting class activity that requires careful group coordination and cooperation from the students. Every student has a role in this activity and classroom groups must work together for the final result to be good. However, even if the large-scale grid does not work out accurately, students will learn a lot about measurement, direction finding and the importance of teamwork. This activity provides an excellent opportunity to build student cooperation and communication skills.

A. **Establish Mapping Criteria**
   a) Determine size of area to be surveyed and scale of map to be drawn
   b) Determine what is being mapped before beginning.
   c) Choose key symbols for the legend

B. **Site-Survey Procedures**
   a) Using a compass: “Point to Ted and put Red to Bed” *(see activity, pg. 52)*
   b) Stepping off distances: find your own personal stepping measurements
   c) Laying out the ground baseline: lay out the ground baseline end points. Then divide the space between into even increments for transect lines. (Check your map scale to determine increment spacing.)
   d) Laying out transects: establish grid lines perpendicular to the baseline for each baseline transect point. Walk grid lines stepping off or measuring transect points and flagging them with tape or pegs.
   e) Check transect grid lines: from an outside perpendicular edge, sight transect markers parallel to the base line. Check alignment for accuracy. Correct where needed.
C. Building the Base Map

a) Survey the field: coordinate the mapping grid to the baseline and transect markers. Systematically cover the mapping area, recording information on the rough map and in notes as you go (check your location frequently).

b) Hand sketching: sketch interesting details that can be added to the finished map for interest and aesthetic appeal.

c) Edit symbols: review your initial symbols and delete and add new ones where appropriate. Add relevant details and facts.

### LAYING OUT THE GRID

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walk & mark

- check transects for parallel
- transect points
6. **Quadrat surveying**

A **quadrat** is an area divided up by a square-shaped grid. A **quadrat study** is a formal way of measuring, mapping and recording objects and information found within the quadrat area. A **quadrat area** can be many sizes from a very small area examined by a hand-lens or a microscope, to a much larger area examined through aerial photographs and satellite images. The size of the area depends entirely on the purpose of the study and the type of information that is sought.

For school studies, the most common quadrat studies are done on an area one-meter square in size. These quadrats are easy to construct and provide a rich source of information about local habitats and ecosystems. Below are instructions on how to construct a quadrat, and several examples of their use.

**How To Construct a Quadrat Frame:**

a) There are many ways to construct a one-metre square quadrat grid. The simplest quadrat frame consists of a four meter long piece of string or rope tied together to make a loop and draped on the ground in a square shape. Felt pen marks at 10 centimeter intervals along the rope or string act as a guide for a second piece of string, (a transect), that is stretched across the area. Students must be careful to place their strings accurately, especially if the ground is uneven and bumpy. Although this type of Quadrat is easy to make and transport, it is more difficult to use due to its flexible construction.

b) More sturdy and accurate quadrat frames make for more accurate observations and records. An ideal frame can be constructed of lightweight wood or plastic pipe joined at the corners with 90 angles. A grid of strings stretched across this frame at 10-centimeter intervals facilitates the task of accurately reconstructing the area of study.

c) For very small-scale studies, provide students with a hand-lens or jewelers scope.

d) For repeat studies in different seasons, or in later years, place a permanent marker at two corners of the quadrat (a metal spike or a wooden stake driven deep into the ground works well). Record which corners of the quadrat frame were used so that the same area of ground is covered. Also record identifying landmarks on a base map, so that the markers can be found at a later date.

**Recording Quadrat Observations:**

(See recording template, Appendix A, page 127.)

Observations and information gathered from a quadrat can be recorded in several ways. The quadrat frame lends itself to accurate scale drawings of the study site. Students can examine for plant species, insects and small animal nests, mushrooms and lichens and other items of interest.
Analysing Data

By comparing their observations, the students will learn about the diversity of ground cover on a small scale. They will also see relationships between companion plants, insects and the non-living environment. In larger classes or multiple class projects, larger quadrats can be constructed with individual students gathering more refined data from selected study areas within the larger field. (Add things students can look for in quadrats.)

7. **Estimating a schoolground plant population**
   a) Walk around a large field looking for a representative sample of dandelions, or other small plant mixed in with the grass.
   b) Measure a 1-meter by 1-meter square (a tied piece of string four meters in length works well).
   c) Outline your representative sample square.
   d) Count the dandelions (or other plant) inside this square.
   e) Estimate the total area of the field by walking the length and width of the park, counting paces.
   f) Estimate the number of dandelions inside the park by multiplying the number of dandelions counted inside the sample area by the total area of the park.
   E.g. 50 dandelions x 3000 square meters = 15000 dandelions in the field
UNIT 2 THEME 3: Sense of place

Developing a sense of place has many meanings and connotations. Increasing a child’s awareness of the local surroundings helps to identify areas of concern, fear and, conversely, comfort and security that the child perceives.

This section focuses on teaching children that they can be creators of their spaces. Look at the school ground or school ground plan and find places that cannot be changed. Look for places where electrical and gas lines, water and sewer pipes and automobiles enter and leave the schoolyard. These are areas that are probably too expensive to change. There are, however, many other areas ripe for creative re-designing.

SUGGESTED ACTIVITIES

1. **Sentimental mapping: mapping our feelings**
   
   Ask: “What areas of the school do you like best? Where do you like to sit? Where do you like to run? Are there unsafe places or areas where bullying takes place? Which areas are noisy or quiet? Which areas are dry during rain, or cool during the hot suns?”
   
   Provide students with a base map of the school grounds and have them shade in areas that make them feel differently. Have them select colours to suit their feelings and make a legend.
   
   When finished, have students compare maps and suggest ways to improve the general sentiment of specific areas and the whole school in general.
   
   Ask: “What changes would you like to make to the school environment?”
   
   Discuss whether the things they would like to add to the environment are practical or costly.

2. **Historical mapping**

   Interview people in the neighbourhood, or consult archival photographs and other sources for information about the past local history. Construct historical maps showing where features in the landscape once were, such as: buried streams, tall trees, a filled in swamp or lake, an old homestead or farm, a replaced school house. Decorate the map using old pictures or quotations taken from interviews.
3. **Creative mapping**

Use coloured and textured papers or pieces of cloth to make a collage of the school grounds or a selected area. Capture moods and feelings and uses as well as shapes of objects in the area. Include drawings of birds or animals seen on the grounds, or patterns made from leaf collages to decorate areas where those leaves represent the dominant foliage.

4. **Mapping frequencies and types of school ground activities**

Map the types of play activity that take place on the school grounds, or identify “Garbage Hot Spots” and garbage-free zones. Interview students to find out why they prefer some areas to other areas. Map which grades use which areas of the school ground during their free time. Analyze why areas are used differently. Plan a project to improve the use of one area.

5. **Finding longitude and latitude of your neighbourhood**

Many hydro power poles in British Columbia have a small metal plate mounted near to eye level. A series of coded numbers on these plates gives the exact location in latitude and longitude of each pole. By deciphering this code, students can make geographically accurate maps of their school grounds and neighbouring community. Accompanied by triangulation skills described above, student maps have the potential to be accurate enough to become legal documents. With practice, your students can find the precise geographic location of any object in their area.
How to Read a Power-pole Location Marker.

The numbers on a Hydro Pole marker are organized into columns and rows. The first column represents longitude, the middle column represents latitude, and the third column provides additional information on existing survey maps. The first number (e.g., 2311) records in degrees and minutes the longitude nearest to this location. In British Columbia all measurements of longitude are greater than 110 West so the initial “1” has been left off. The number 2311, therefore, gives the location “123 degrees, 11 minutes west of Greenwich”.

Below it is a number (e.g., 250) that tells the distance (in feet x 10) that this particular telephone pole is located west of the longitude above it. Again, this number has been abridged by leaving off a final “0”, so the number (250) must be multiplied by 10 to give the exact distance. Thus, the exact longitudinal location of this power pole is: “2500 feet west of longitude 123 degrees, 11 minutes west of Greenwich.”

The second column represents similar information for latitudes North of the Equator. The measurements “4920” and “232” in our example above mean “2320 feet north of 49 degrees 20 minutes north of the equator.” Taken altogether, our pole marker tells us that this pole is located “2500 ft. west of 123˚ 11’ West longitude, and 2320 ft. north of 49˚ 15’ North latitude.”

Discovering that this level of sophisticated information is easily available to them is empowering for children. Including geographical coordinates in maps of school grounds and other areas, helps students to find their location on maps of different scales from local cadastral maps (city zoning and property maps), to much smaller scale maps of their country, the continent and the globe.

A Standard Hydro Pole Location Marker

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<td>0226</td>
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6. **Symbols in the landscape**

This activity invites students to examine city rules and laws by examining commonplace signs and symbols found in the landscape. Without venturing far past the street intersections close to their school grounds students can begin to discover and interpret the often subtle meanings and instructions of the many signs and symbols encountered in their everyday movements.

**Materials**
- clipboard
- paper (worksheet or journal)
- pencil

**Procedure 1: Signs and Symbols in Urban Landscapes**

Find a safe location with a good view of a busy location; a place where students can gather in a group without obstructing pedestrians, or traffic. Begin with a discussion of the signs and symbols they can find in the immediate landscape.

**Identify** three levels of signs and symbols that can be perceived.

**Level 1 Signs:** Signs with words, or instructions that clearly tell you what to do, how to act, or where a product or service can be found. Examples of 1st level signs include: stop signs, street signs, bus stops, shop signs, advertisements, logos, billboards and so on. Have students look carefully for further examples and write them on the worksheet or in their journal. Answers may be restricted to fixed signs and objects, or expanded to include things that people are wearing and signs on moving cars and buses (including name plates, license plates, etc.).

**Level 2 Signs and Symbols:** When they have gathered a good number of Level 1 signs, instruct students to look more closely for signs and symbols that don't have words on them, or aren't associated with stores and product names. These second level signs give information about how people are to act, move, or behave. Examples may include, crosswalks, stop lights, parking lines, and street addresses. Less obvious examples include, street curbs (a line that separates pedestrian from vehicle traffic), building entrances, parking meters, fire hydrants, garbage cans and so on. All of these objects instruct us on appropriate actions and patterns of behavior.

**Level 3 Signs and Symbols:** Third level signs and symbols are the most difficult to see, but cities are full of them. Street trees, for example, represent shade, nature, greenery and add softness to otherwise harsh urban settings. Fountains likewise add sounds and feelings of nature even in the most barren and concrete settings. Open areas and benches indicate places where people are welcome to stop and rest, whereas, narrow sidewalks induce people to keep on moving. Tall buildings, gas stations, corner malls, street lamps and overhead wires, can all be looked at symbolically. In this activity, it is hoped that students will formulate their own creative interpretations.
Debrief
Conclude the first part of the activity by asking students what they were able to see. Ask them to collect all observations in journals or on a worksheet such as is provided in the Appendix. Discuss the quantity of signs and symbols that they were able to find and what the function of each one is. Important functions include, ensuring safety, maintaining order, advertising products and services, identifying things and locations and so on. Ask the students if this amount of organization and information makes them feel good or uncomfortable. Does it make them feel secure, or are does it restrict their freedom in some ways? How? Can there be more signs and symbols, in the landscape or should there be less, Why? (See worksheet, Appendix A, page 128.)

Signs and symbols in an urban landscape

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<td>SIGNS WITH WORDS</td>
<td>SIGNS WITHOUT WORDS</td>
<td>LESS OBVIOUS SYMBOLS</td>
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Procedure 2: Signs and Symbols in Natural Landscapes

This second activity takes place in a natural setting where people visit only on occasion and mostly for reasons of relaxation or exercise such as a park, a forest, a stream or an open field. (The two parts of the activity can be done on separate days, as long as the students keep records of their experiences.)

Begin by reviewing first, second and third level signs and symbols found in Procedure 1. In the new naturalized location ask students to again look for examples of each and write them down. If no examples can be found, ask the students why there is so much difference between the two landscapes. Have them consider how the natural world can operate without some system of order. What is this system of order and control in a naturalized landscape? Why do humans need so many symbols and signs when the natural world appears to have so few? Can human landscapes do with fewer symbols?

Extension

Survey the schoolyard for symbols in the landscape. Are there any unnecessary signs or symbols, or signs from an earlier time (such as a “BOYS” and “GIRLS” entrance)? Are there any places where additional signs or symbols might be useful, such as anti-litter reminders, cleaning up doggy-litter, or taking care of young trees? (See worksheet, Appendix A, page 129.)

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7. **Site-specific sculpture and installation pieces: (advanced or enrichment)**

**Student Challenge:** Build a temporary outdoor sculpture or structure that invites people to experience in new ways the many meanings a particular place conveys.

Site-specific installations are works of art that invite viewers to participate in the art piece by walking through it, touching it, smelling it, or however the artist chooses to present the interactive component. The goal of an installation is to create a unique experience for the viewer or participant. Site-specific installation pieces reflect the student’s awareness and understandings of a particular place on the school ground through a 3-dimensional sculpting of the thoughts, feelings, ideas and questions they choose to express. Although this may all sound rather academic for intermediate grade students, the possibilities and creative potentials can be endlessly exciting. The challenge for the teacher is to structure the activity carefully, so that students can allow their imaginations to flow freely.

The following procedures suggest how this can be done.

**A. Selecting a “Special Place”**

a) Instruct the students to choose a special place on the school grounds which they feel has an interesting quality, or symbolic meaning to it. (Refer to Activity 6 above for development of symbolic meaning.) This special place should be a private place for reflection and thought. The initial stages of this activity are personal and private and students should be separated by enough distance so as not to distract one another.

This special place will become the site of the students installation piece after they have spent some time examining, reflecting and getting to know the surroundings through a variety of short activities. The students will return to this same place several times before they will be asked to begin imagining what they might create, or add to the space to bring out a special quality that they have perceived.

b) Over a period of several days, or even weeks, have the students return to their special place with a journal, or sketch pad and undertake several short reflective activities such as the following:

1. **Listen:** spend five minutes listening carefully to the surrounding sounds. Illustrate what is heard, or hum a short song that captures some of the sounds.
2. **Daydream:** simply do nothing for five minutes, then draw or write a quick sketch of some thing you thought about.
3. **Reflect:** on a topic such as being a student in this school, what happiness means, this changing world, or any other topic that seems important at the time. Summarize your thoughts in a sketch or journal writing.
4. **Look:** for things new and not seen before, for all types of movements, for changes under way.

C) As the students become more familiar and comfortable in their special place, ask them to observe and think about other things, animals, plants and people that also inhabit this place. What lives here, visits here and for what reasons? To find food? For play? For quiet time or safety? When you feel the students are comfortable enough with their place, assign them to write a poem or a short story, produce a series of drawings, make up a song, that describes their special place in a creative way.
B. Constructing a Site-specific Installation Piece

Constructing a site-specific installation piece requires imagination, creativity and a sense of what ‘serious fun’ means. Once a student has explored and expressed his or her personal understandings of a ‘special place’ it is time to offer the challenge of doing something to this space that will invite others to become aware of this space in a new way. The creative potentials for this activity are limited only by the student’s creativity, the materials they can find, and the limitations on bad taste and excess that the teacher imposes.

Students should be responsible for finding their own construction materials such as: photographs, recycled containers, string and rope for hanging things, sticks, old furniture, pots, paintings, coloured paper, old LP album covers and so on. There need be no restrictions on what students use or how they are displayed aside from a few cautionary rules:
1. displays be in good taste and not offensive to other people or potentially harmful to animals.
2. the environment is not damaged and is returned to its original condition when the installation is finished.
3. no dangerous items are left lying around (knives, broken glass).

C. Evaluating a Site-specific Installation Piece

Site-specific installation pieces are symbolic in nature. Uniquely reflective of a particular space and time, these art works might not make sense if they were created in a different location or context. Keeping clear goals in mind while creating the work is a key challenge for students. Moreover, because there are limitless variables for the student to focus on, evaluation becomes relatively subjective. Key criteria to evaluate include:
1. attention to detail – how carefully is the work put together and how much detail is applied.
2. symbolism – how deeply has the student thought about the project and how much meaning does it display.
3. creativity and use of materials – how much variety and creative use of materials is shown. Has the student made unique and interesting uses of ordinary materials?
4. suitability – how well does the work suit the space where it is installed? If it clashes with the environment, is this done intentionally to create effect?
5. explanations – how well can the student explain what the goal and message of the piece are. Do they have a clear idea, or is it really just a collection of junk?
D. Summary Comments

Site-specific installations are uniquely engaging and are a creative activity which allows the students an opportunity to focus their impressions and feelings into a personal art statement. Although initial reluctance may be met, many students are capable of coming up with exciting ideas provided they are given the time to internalize and reflect on the special places they choose. In other words, this is not an activity that can be rushed and students should be given plenty of advanced discussion and preparation so that they can use their time outdoors effectively and productively. It is also recommended that installation pieces be dismantled at night to prevent vandalism.
UNIT 3

Patterns of Time and Change
UNIT 3: Patterns of Time and Change

INTRODUCTION

To many people the modern world appears more unpredictable than ever. As ever-faster technologies accelerate communication, travel and the powers of computation to hitherto unimaginable levels, time itself is said to be moving at a quicker and quicker pace. But in the midst of all this acceleration and change are regular patterns of time that we see, feel and depend upon absolutely, even if often unconsciously. The cycles of nature – day and night, the ebbs of ocean tides, seasons of rain, seasons of snow and seasons of harvest – have been with us since before humans began to record them. It is essential that in this era of omnipresent change, we not lose sight of these essential patterns of the natural world that support us.

Schoolyards are ideal places for observing and monitoring patterns of time and change. Of course, not all school grounds will provide suitable conditions for observing every type of change in the environment. Some fortunate schools may have access to streams, lakes, beaches and forests where more diverse and unique observations can be made. However, in any school ground, there are many different natural patterns of time and change for students to examine.

Opportunities for examining time and change are not restricted to natural cycles, processes and events. To understand the relationships of human cultures to their environments, it is also important for students to analyze influences and impacts of human induced changes to the landscape. Urbanization is an excellent example of a significant change over time. Students can interview long term residents, go through archival photographs and research other records to discover how the lands around their schools have been changed over time. A timeline of major projects in the past, such as the year of initial forest cutting, first road construction, first houses built and lots cleared, and the year when the school was built, will give students a reasonable understanding of the pace at which human-induced changes can occur.
## Prescribed Learning Outcomes

### UNIT 3: Patterns of Time and Change

#### GRADE 4

- **Science**
  - a) Use the physical properties of water to describe or illustrate the water cycle.
  - b) Compare the uses of simple machines with those in the past.

- **Social Studies**
  - a) Relate years, decades, centuries and milleniums.
  - b) Analyse how people interact with their environment, in the past and in the present .
  - c) Identify economic and technological exchanges between explorers and aboriginal people.
  - d) Describe traditional technologies used by aboriginal people in Canada.
  - e) Describe technologies used in exploration.
  - f) Operate simple machines to demonstrate their usefulness in every day society.
  - g) Manipulate simple machines to determine their characteristics and uses.

- **Tech. Ed.**
  - a) Express personal thoughts and feelings about the effects of technology in their lives, at home, and in the classroom.

#### GRADE 5

- **Math**
  - a) Predict outcomes, conduct experiments, and communicate the probability of single events.
  - b) Develop and implement a plan for the collection, display and analysis of data gathered from appropriate samples.

- **Science**
  - a) Describe the key features of a variety of weather conditions.
  - b) Use instruments to identify and measure factors that influence weather.
  - c) Describe consequences of extreme weather conditions.
  - d) Identity factors responsible for weather systems both locally and globally.

#### GRADE 6

- **Math**
  - a) Communicate the probability of single events from experiments and models.
  - b) Demonstrate that different outcomes may occur when the same experiment is repeated.
  - c) Compare experimental results and theoretical results.

- **Science**
  - a) Classify changes to matter as either chemical or physical.
  - b) Identify factors affecting chemical and physical changes.
  - c) Relate the movement of the sun, movement and earth to the seasons, tides, eclipses and the phases of the moon.

#### GRADE 7

- **Math**
  - a) Create and solve problems using probability.

- **Science/ S. Studies**
  - a) Gather and record a body of information from primary archaeological and historical evidence.

- **Science**
  - a) Locate and describe current and historical events
  - b) Use the pH scale to classify a variety of substances.
  - c) Identify chemical reactions that are important in the environment.
  - d) Assess the impact of chemical pollution on the local environment.
  - e) Collect, analyse and interpret data on environmental quality.
  - f) Analyse ways that people's interactions with their physical environments change over time.
  - g) Collect, analyse and interpret data on environmental quality.
  - h) Illustrate the seasonal position of various constellations.

*Though each of the above IRP's have been broken down into grade-specific themes, all of the following activities may be adapted to any single or multi-grade classroom setting. The outcomes listed above can be linked to specific activities, but can also be used as a guide for the unit as a whole.*
## Activity-specific Learning Outcomes

### UNIT 3: Patterns of Time and Change

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Please use in conjunction with page 80. BC Ministry Prescribed Learning Outcomes in other grades and other subjects may also apply to each activity. See the Learning Outcomes Tables provided in the Introduction and the Four Units of this guidebook for additional curriculum connections.
ACTIVITIES

UNIT 3 THEME 1: The schoolyard eco-calendar

SUGGESTED ACTIVITIES

1. The customized schoolyard eco-calendar

An eco-calendar should be an essential tool for every student who studies the outdoor world. In the elementary school curriculum there are opportunities to examine changes in nature at every grade. In grade 5, for example, a focus on weather makes a calendar an essential tool for gathering information. However, imagine the additional opportunities for understanding seasonal changes, if a calendar has been kept and passed on from the students’ previous grades! Likewise, the Grade 6 BC Science IRP recommends that students “relate the movement of the sun, moon, and earth to the seasons, tides, eclipses, and the phases of the moon.” Again, the potential for students to understand these relationships is significantly enhanced if a calendar has been kept and passed on from their younger grades. As students become more understanding of the changes and processes that take place, their ability to analyse and evaluate consistencies and anomalies will also increase.

Equipped with records that they themselves have created in previous years, the students will not only be familiar with the patient techniques and routines required for recording long term information, but they will have their own unique data upon which to construct further understandings! A customized eco-calendar is a very useful tool for gathering information of events and information observed throughout the year. The classroom calendar the students create in the following activities becomes an important record of daily and seasonal changes in their local community.

(For larger-scale example of one complete calendar month see Appendix A, pages 130-131)
A. The Schoolyard Calendar: Getting Started

Divide the class into 10 groups, each group representing one month of the school year (12 groups if the students can be expected to continue their records over the summer months). Assign each group one-month out of the school year.

Brainstorm with the students the topic “Seasonal Changes in Nature.” Discuss annual cycles of change and elicit background understandings of the processes and changes which occur in nature (e.g., salmon spawning, birds migrating, leaves falling, winter snows, fall rains, spring floods and so on). Continue brainstorming until a list that has at least one major change identified for each month has been created.

Summarize the brainstorm with the students by examining their list of changes for seasonal characteristics. Classify seasonal changes according to the time of year they occur in (e.g., flowers bloom = spring; snow falls = winter, etc.). If possible, suggest a month in which the seasonal changes might normally take place. Make a list of the months. Attach key words from the brainstorm that characterize changes and conditions in each month. Later, these key words can be used in the calendar designs of each month on the class calendar.

B. Calendar Construction

Create a template, or have students create their own calendar template from scratch. Instruct the students to leave some white space around their table if you wish them to decorate the borders with symbols and pictures suited to their particular month.

Using a current calendar, almanac or other source have the students locate the first day of each month and number the consecutive dates on the calendar. Include any special information such as moon phases, special dates and holidays, special theme weeks, etc. (The UN, for example, puts out a list of all international theme days at the beginning of the school year.) Students who have a special day or week within their calendar month can organize a presentation, a celebration, or a classroom activity to commemorate its significance. Try to ensure that every student group has a special date or event to remember.

The annual Farmer’s Almanac is a great source of information to include in the class calendar. If your school has a garden, the Farmer’s Almanac is an excellent reference for information on everything from when to plant seeds, times to harvest, tide and weather charts, and even celestial occurrences. Students can examine these and other patterns of change to see if, and how, they may be interconnected. This is where the true learning potential of the classroom calendar comes in.
There are different ways to complete the student calendar. One way is to have them finished initially as black line masters, with lots of white areas left inside the student’s line drawings. Collect each group’s calendar and photocopy a class set; one copy of each month for each student. Individual students can then add their own personal touches of colour, shading and design. If your class is ‘buddied’ with another younger class, this blackline class calendar can also make a useful gift for them to decorate and keep, as well.

Another way to complete the class calendar is to enlarge it, colour it and laminate it. This large master copy should be given a prominent place in your classrooms where it is easy for students to add personal observations and keep their own desk copies up-to-date. Laminating is not essential, but it does make the calendar more durable. Erasable pens can be convenient if students are adding information of their own.

C. Recording Information on Classroom Calendars

As the list provided below shows, there are many different patterns of time and change for students to examine and record on their Schoolyard Eco-calendar.

- Plant growth cycles – first buds, blossoms, leaves of different plants and trees; first leaf fall, last leaf fall; mushroom blooms.
- Animal growth and seasonal behavior patterns – first insects (ladybugs, beetles, spiders, bumblebees, wasps, etc.); bird migrations, nesting, rearing young; squirrel activities; salmon spawning; metamorphoses of insects and amphibians.
- Weather observations – In conjunction with school weather monitoring stations (see below) record daily weather events. Weather may be recorded accurately or simply depending on the skill level of the students (for a simple weather recording chart see worksheet, Appendix A, page 130).
- The water cycle – seasonal climate changes; barometric pressure changes for forecasting clear and rainy spells; seasonal winds and storms; cloud types and making weather predictions.
- Major geophysical events – earthquakes, hurricanes, ice storms and other large weather events in other parts of the world. (See the Vancouver Sun for weekly Weather Events column.)
- Celestial movements – phases of the moon; changing azimuth of the sun at noon; shifting point where the sun sets on the horizon; equinoxes and solstices; solar and lunar eclipses; movements of planets, stars and constellations of the zodiac; tidal flows.
UNIT 3 THEME 2:
Recording seasonal cycles and climate changes

Most regions of British Columbia are fortunate to have well-differentiated seasons and climatic cycles. Using the student’s personal Calendar, Journal, or other means of recording observations, a wide variety of changes can be followed as they take place over time. Records can be started at anytime of year and can be maintained for varying lengths of time. Asking students what things they might wish to record provides an initial assessment of their general awareness of seasonal cycles. As students become more familiar with characteristic events and changes in their environment, they should begin to notice more refined changes occurring.
Changes can be divided into two categories: 1) climate/weather, and 2) biological/ecological.

SUGGESTED ACTIVITIES

1. **Seasonal Changes in Climate and Weather**

Weather and climate change can be observed and recorded in a number of ways depending on the amount of time and the quality of the weather recording equipment available. The use of sophisticated monitoring equipment may provide more accurate scientific information, but it is not necessarily the most valuable for students in the elementary grades. Constructing their own weather measuring instruments is a worthwhile challenge for students. If quality equipment is available, students can compare results from their own instruments and explain differences and causes for error.

Students can also record information in other ways such as simple drawings of their daily impressions of the weather and other things they observe on a daily basis. Records kept for the entire school year can provide valuable information for classes in later years. Comparisons of data recorded in subsequent years can reveal recurring patterns, as well as significant environmental anomalies caused by major events like El Nino and La Nina.

Weather changes frequently in many parts of British Columbia and may often seem to lack any patterns of recurrence. Recording daily weather changes is a first step in observing cycles and patterns in both local and more global weather systems. Include television and radio news reports to help students understand larger scale influences on the weather such as the Jet Stream, High and Low pressure fronts, prevailing winds and so on. Keep a classroom scrap book of local newspaper weather reports to compare with your own local class observations.
Some of the many outdoor weather collecting activities students can perform include:

A. Creating Recording Instruments
Students can design and construct their own weather recording instruments. Some examples of instruments include: maximum/minimum temperature thermometers, barometers, rain gauges, wind direction gauges, wind speed odometers, hygrometers, and sunlight recorders. For ideas and examples of how instruments can be constructed, look at the Gander Academy website. http://www.stemnet.nf.ca/CITE/weather.htm#Tools

B. Recording Cloud Formations

C. Recording Precipitation
Record rainfall and/or snow accumulation over one day, one week, one month. Students can use pie plates or buckets to catch the rainfall. Amounts should be measured and emptied daily. Make graphs of the results.

D. Recording Pressure
Observe and record barometric pressure changes and predict changes in the weather.

E. Recording Climate Events
On your eco calendar (see 1. The customized schoolyard eco-calendar, page 83) record significant climate events such as large storms, first frost, and full moons.

F. Making a School Weather Chart
Make a school weather chart to provide information to all students. Students in other grades can use information generated by one class for other activities of their own such as: when to plant a garden, comparing weather from one year to another, calculating long-term monthly and seasonal averages of rainfall, sunlight, temperature.
2. **Time-lapse film making**

**Student challenge**

Devise a technique for capturing and re-creating time-lapse motion or change. This activity requires careful coordination and persistence on the part of the film-makers. When making time-lapse films of such events as flowers or buds opening, the sun or clouds moving across the sky, or even longer-term events such as changes in the seasons or a garden growing, students must be prepared to maintain a very regular routine of picture taking. This activity can be done using many formats of image making including still cameras, video cameras, digital cameras, or even pencil sketches for longer term and simplified recordings.

Time-lapse film making consists of individual pictures taken at regular and consistent intervals. The length of the interval between each camera shot varies depending on the time-lapse subject and the length of time within the complete event. An average quality film must change pictures at least 16 times per second in order to create smooth movements. Student quality films do not need to be this rapid, but a frame speed of at least 3-4 pictures per second is desirable to create an impression of continuous motion. Determining the frame speed and the length of the film will tell how many individual pictures are needed to make a complete film.

**For example**

Film length (10 seconds) x frame speed (3 frames/second) = 30 individual frames

Once the number of frames has been determined, students can then calculate the interval between each photograph by estimating the length of time (the duration) of their chosen event. Two examples of this calculation:

**Example 1**

Clouds and the sun moving across the sky. Duration = 2 hours (or longer)

2 hours x 60 minutes = 120 minutes
30 frames = 1 frame / 4 minutes

**Example 2**

A garden growing. Duration = 2 months (or longer)

2 months x 30 days = 60 days
30 frames = 1 frame / 2 days

In both of the above examples, a minimal number of 30 frames has been selected. Using more frames will either increase the length of the finished film, or improve its smoothness and quality. The challenge for the students, however, is to keep the interval between each picture constant and not to miss any recordings. There are many ways for students to accomplish this goal and it is an excellent problem for them to solve alone or in groups, mechanically or manually.

**Time-lapse Subjects**

- flowers opening, or moving with the sun (dandelions, sunflowers, tulips, anenomes, etc)
- flow of pedestrians and cars on a street
- tidal movements
- movement of the sun and/or clouds across the sky
- clouds forming
- leaves sprouting, or changing colour and falling
- seasonally changing landscape (include the horizon to show where the sun sets)
3. **Seasonal changes in biology/ecology**

Along with changes in seasonal weather, resident and migrating animals and plants also display a wide variety of changes. Observing and recording these changes helps to establish connections between the living and non-living elements of the environment. It is very helpful for students to observe how incremental changes in weather, such as a first frost, a prolonged rainfall, or a hot spell, can result in sudden changes within the local biota.

**SEASONAL CHANGES TO OBSERVE**

**A. Plant Changes**

Look for first buds on trees, first shoots sprouting from the ground, first flowers of different species and varieties (i.e; bulb plants, trees, perennials, annuals). First changes in leaf colour; first species of tree to lose all its leaves.

**B. Seed Dispersal**

Collect different seeds and use observation and deduction to find out how they are dispersed (a Fall activity). Examples of dispersal techniques include: parachutes – dandelions, milkweed seeds; helicopter – maple, ash, elm; slingshot pods – jewelweed; burs – burdock, thistle, cocklebur; fruits – apples, plums, cherries; berries – blackberry, Oregon grape, mountain ash; floating berries – cranberry, coconuts, some beans; burying – acorn, filbert, walnut (by squirrels).

**C. Migrations**

Identify birds flying north and/or south; over-wintering species of birds; butterflies.

**D. Bird Nesting and Rearing**

Watch for nest-building, mating dances, eggs in nests (don’t disturb them), first young born. Count the number of successive broods hatched from one nest of small birds like sparrows or chickadees.

**E. Insects**

Look for first flying insects of spring, such as first bumblebees, ladybugs, and butterflies; last insects of Fall; insect swarms such as Mayflies, bees, flying ants (usually in the heat of Summer).

**F. Mammal Movements**

Ask students if they have seen squirrel, raccoon and other small animal sightings around the school or community at night. Tell them to listen for reports of bear, deer, elk and other larger mammals in the community.

**G. Signature Trees**

Identify a “signature tree” that is representative of the trees in your area, or plant your own class tree that will be observed for years to come. Each year, have students measure the circumference of the trunk at chest height and determine its diameter, the diameter of the canopy and the height of the tree. Measure the length and width of randomly selected leaves and determine their average size. Compare the data from year to year. What patterns of growth can be observed?

Each year, have students draw pictures of the tree from a variety of angles, label them carefully and save them. When students display their finished drawings, show them drawings from past years. What changes do they see? Take pictures with students next to the tree.
UNIT 3 THEME 3: Changes to global climate

Changes to the global climate present significantly more complex challenges of observation and analysis than measuring the local weather. Although there is at present no absolute consensus amongst scientists on all the causes and consequences of newsworthy trends in global climate change, students should understand some of the potential effects of global warming and atmospheric ozone depletion.

SUGGESTED ACTIVITIES

1. **Describe solar warming and the greenhouse effect**
   
   Begin this activity by discussing how the sun warms the earth and the role of CO\textsubscript{2} in absorbing and retaining heat in the atmosphere. To illustrate the greenhouse effect try these two activities.

   a) Take two clear jars and place a thermometer in each. Cover one with a lid and leave the other open. Place both in direct sunlight. Record the temperatures of each every 30 seconds for 10 minutes (see worksheet, Appendix A, page 132). Graph the results and compare them. What examples of this principle of heat retention can the students find in their world?

   b) This time take 3 jars again with a thermometer and lid for each. Tape a sheet of black paper to the back of each jar. Fill the first jar with clear water. In the second jar, put nothing by air. In the third jar, burn a candle, or try to capture exhaust from the tailpipe of a running car engine (To prevent inhalation of exhaust fumes or other injury, an adult should supervise this latter activity). Place all of the jars in the direct sun, again recording temperature increases for 10 minutes (see worksheet, Appendix A, page 133). After this time, both gas filled jars should have reached their maximum, but the water jar will still be warming up. Leave them for a period of time until the temperature of the water jar stops rising.

   With all the jars at, or near their maximum greenhouse temperature, place them in a well-shaded location. Measure, record and graph the rate of temperature decline for each jar. Explain the results by thinking about the greenhouse effect, the mass of the substances in the jars and what has been discussed about CO\textsubscript{2}.
2. **Build a solar green house**

Having a solar green house on the school grounds provides opportunities for a wide variety of activities and experiments. Testing the effects of climate warming on different types of plants is one type of activity that is possible with a greenhouse. These effects can be positive, such as increasing the length of the growing season and assisting in the early germination of seeds. But they can also be negative, such as creating conditions too hot for some indigenous plants, increasing the season for insects to multiply, increasing evaporation from soils and so on. Using a green house and the outdoor environment, students can compare differences in the rate of growth of plants, differences in temperature on sunny and cloudy days and rates of evaporation and transpiration from soils and plants.

Plans for greenhouses can be obtained from building supply and gardening stores. They can be made inexpensively from a roll of heavy polyurethane plastic stretched over a wood or 2-inch plastic pipe frame. Plastic pipe frames have the advantage of snapping together and apart for storage. Rigid transparent plastic panels can also be purchased that are used in industrial greenhouses. Get students to fundraise for the money, or grow seedlings and pay off any loans with the income.

3. **The great energy grab**

Capturing and re-using energy is possibly the most important technological achievement in human history, and it may again be the most important in years to come. From the first successful attempts to control fire, human societies have sought ways to obtain energy for their own uses. In more recent times, the discovery of the power of coal, oil and gas, the invention of the internal combustion engine, and the harnessing of nuclear power have all brought about huge changes to the ways people lived and worked. Begin this activity by discussing with children what they know about energy, where we get it from, how we take extract it or harness it from the environment, and what some of the consequences of current magnitudes of use are. This is also a practical way to conclude the activity, with an in-depth research project into one type of energy, its uses, origins and environmental effects.
Student Challenge

Design and build a working solar collector, a waterwheel, or a windmill. Measure and explain the effects of changes in the energy source on your energy collector.

Comments

Students can be responsible for finding and collecting their own materials, or you can provide them with the materials listed below so that they can get started with their designs and construction sooner. Some of the items they may use include:

Solar Collectors

• metal pie plates, or aluminum foil
• clear plastic food wrap
• rubber bands
• thermometers
• measuring cups

Waterwheels

• corks, cans, cups, spoons,
• nails, pins, tacks
• a tall milk carton or box
• empty thread spools
• string, wire, elastics, straw, glue

Windmills

• toilet paper tubes, straws
• coat hanger wire, empty thread spools
4. **Global climate monitoring**

Now, with the possibility of linking students to global Internet monitoring and information exchange programs a far more sophisticated global climate picture can be constructed in the classroom. Today, students can actually participate in international weather monitoring projects and exchange information with scientists and students in other countries around the world. Construction of an accurate weather recording station with scientific quality equipment is essential for participation in these global programs.

One example of these projects is the GLOBE Environmental Monitoring Web Site [http://globe.ngdc.noaa.gov/](http://globe.ngdc.noaa.gov/), which is currently gathering environmental data, gathered from schools on at least four continents. Schoolyard data can be recorded and analyzed by students as well as being passed on to scientific databases through the Internet. Selecting and compiling environmental data is a first step in familiarizing students with the patterns and fluctuations in their own environment as well as in a broader global or regional context. Connected to a larger world audience, student projects take on a much deeper and richer meaning for participating students.

5. **Counting contour rings in evaporated puddles**

This simple activity allows students to explore geo-chemical change by inviting students to determine what causes the rings found around large puddles as they dry up. Are they caused by changes in temperature, or are they a daily change occurring only in the day, or at night? By watching and counting the growth of puddle rings over a period of hours, or days, students may be able to determine what causes them to develop.

6. **Where does all the water go?**

Begin with a base map of the school ground area. Prepare students with materials to collect and measure rainfall. Collect and measure the amount of rain that falls during a very heavy rainfall period (November is good in BC). Calculate how much rain fell on the entire school ground.

Proceed onto the school ground and look for places where the water goes. Look for areas where water pools, or where small temporary streams are formed. What impacts does high rainfall have on the soil and the land? Can students find areas of erosion, or undercutting of plants? What areas are most protected from erosion? What effect does slope have on water flow and erosion? Estimate how much of the water was absorbed into the soil by observing how much water flows off the school grounds in streams, culverts and ditches. How do tree roots help to stem erosion? What influences do people-made pathways have on water flow and erosion?

Return to the area in a drier period. What impacts of the rain are still visible?
UNIT 4
Actions for Stewardship
UNIT 4: Actions for Stewardship

INTRODUCTION

Every schoolyard has the potential to support curriculum objectives from virtually every subject and every grade. Many schools, however, face some considerable challenges in providing and maintaining environmental diversity on their outdoor grounds. This final unit will present activities that engage students in revitalizing and maintaining diverse ecological and educational features on the school ground.

School grounds can play an integral role in their regional ecology. By providing food and nesting habitat for birds, butterflies, certain small animals and insects, school grounds can serve a useful and productive function in preserving ecosystem, or bioregional integrity. Suitably preserved naturalized school ground environments assist in the movement and migration of plant and animal species and can act as nodes in the ecological corridors which link distinct bioregions together. Such an important ecological function has the added benefit of providing opportunities for students to observe, monitor and assess ecosystem dynamics occurring right in the students immediate neighbourhood; natural processes that they witness on a daily basis, but may often scarcely be aware of.

Opportunities for students to develop projects such as building and planting a school garden or growing trees from seedlings may involve periods of months, or even years. Student projects that have a duration greater than one school year are rare in most school programs, but their value is significant. Building a legacy of environmental stewardship on school grounds requires an ongoing commitment to preserving the health of the land. Developing a sequential K-7 environmental legacy program can result in the development of projects and long term goals that carry over from one year to another. Students gain not only from direct contact and appreciation of the land around them, but from the opportunity to contribute directly to something that is passed on from one generation of students to another.

Teaching students patience, perseverance and an ability to apply long term strategies to personal and citizenship goals are fundamental yet often undervalued skills. Engaging students in all stages of schoolyard rehabilitation projects, from planning and design, to revitalizing and maintaining the long-range health of the landscape has incalculable educational benefits for all children. The development of personal planning, critical thinking and related academic skills, as well as developments in social behaviors and both fine and gross motor skills are readily included in many types of outdoor schoolyard activities. This final chapter in the curriculum guide will present a selection of activities that will engage students in taking active responsibility for the well being and stewardship of the world around them.
## Prescribed Learning Outcomes

### UNIT 4: Actions for Stewardship

<table>
<thead>
<tr>
<th>GRADE 4</th>
<th>SUBJECT</th>
<th>LEARNING OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Planning</strong></td>
<td>a) Set short-term goals.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) Demonstrate an appreciation of the reasons for school and community safety rules.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Identify a variety of job and volunteer situations in the community, including paid and unpaid work.</td>
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<tr>
<td></td>
<td>d) Point out the possible impact of their decisions on themselves, on others, and on the environment.</td>
<td></td>
</tr>
<tr>
<td><strong>Tech. Ed.</strong></td>
<td>a) Express personal thoughts and feelings about the effects of technology in their lives, home, and in the classroom.</td>
<td></td>
</tr>
</tbody>
</table>

| GRADE 5 | **Personal Planning** | a) Distinguish between short- and long-term goals. |
| | b) Demonstrate a commitment to participate in the development of a healthy school and community. |
| **Science** | a) Compare the environmental impacts of using natural and synthetic materials. |
| | b) Describe how technology has affected human health. |
| | c) Describe the environmental impacts of using non-living resources. |
| | d) Identify ways science is used responsibly in their communities. |
| | e) Describe technologies that allow humans to extend their natural abilities. |
| | f) Design a strategy for sustaining a living resource. |
| **Social Studies** | a) Assess effects of lifestyles and industries on local and global environments. |
| | b) Demonstrate an understanding of sustainability, stewardship, and renewable versus non-renewable natural resources. |

| GRADE 6 | **Language Arts** | a) Create various personal and transactional communications, including real and invented narratives, lyrics, summaries of retellings, descriptions, letters, informal presentations, charts, and posters. |
| | b) Describe the diverse ideas, opinions, cultures, and contributions of their peers. |
| | c) Use appropriate language to celebrate special events and accomplishments. |
| **Personal Planning** | a) Take steps needed to carry out their short and long term goals. |
| | b) Demonstrate a commitment to participate in the development of a healthy school and community. |
| **Science** | a) Discuss the contributions Canadians have made to science. |
| **Social Studies** | a) Compare use of resources and conservation practices. |

| GRADE 7 | **Personal Planning** | a) Take steps needed to carry out their short and long term goals. |
| **Science** | a) Outline factors that influence the length and quality of life. |
| | b) Describe how technology and science are related. |
| | c) Evaluate energy options for particular purposes in the community. |
| | d) Outline stages of recovery of a damaged local ecosystem. |
| | e) Evaluate the impact of natural processes and human-induced changes on communities. |
| | f) Analyse ways that people's interactions with their physical environments change over time. |
| **Social Studies** | a) Evaluate how ancient cultures were influenced by their environment. |

Though each of the above IRP’s have been broken down into grade-specific themes, all of the following activities may be adapted to any single or multi-grade classroom setting. The outcomes listed above can be linked to specific activities, but can also be used as a guide for the unit as a whole.
# Activity-specific Learning Outcomes

## Unit 4: Actions for Stewardship

### RELATED LEARNING OUTCOMES

<table>
<thead>
<tr>
<th>Pg.</th>
<th>ACTIVITY # AND TITLE</th>
<th>GRADE 4</th>
<th>GRADE 5</th>
<th>GRADE 6</th>
<th>GRADE 7</th>
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<tr>
<td></td>
<td></td>
<td>个人规划 a,b,c,d</td>
<td>个人规划 a,b</td>
<td>个人规划 a,b</td>
<td>个人规划 a</td>
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<tr>
<td>101</td>
<td>#1. 选择种植一个原生或栽培的花园</td>
<td>Science f</td>
<td>Science f</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social Studies b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>#2. 年生球茎和春季花</td>
<td>个人规划 a,b,c,d</td>
<td>个人规划 b</td>
<td>个人规划 a,b</td>
<td>个人规划 a</td>
</tr>
<tr>
<td></td>
<td>花园</td>
<td>Science f</td>
<td>Science f</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Social Studies b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>#3. 韧性蔬菜: 豌豆, 土豆和其他早季节品种</td>
<td>个人规划 a,b,c,d</td>
<td>个人规划 a,b</td>
<td>个人规划 a,b</td>
<td>个人规划 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science f</td>
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<td></td>
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</tr>
<tr>
<td>103</td>
<td>#4. 蝴蝶花园</td>
<td>个人规划 a,b,c,d</td>
<td>个人规划 b</td>
<td>个人规划 a,b</td>
<td>个人规划 a</td>
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<tr>
<td></td>
<td></td>
<td>Science f</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>103</td>
<td>#5. 园林准备和维护</td>
<td>个人规划 a,b,c,d</td>
<td>个人规划 a,b</td>
<td>个人规划 a,b</td>
<td>个人规划 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>#6. 选择植物和种子</td>
<td>个人规划 a,b,c,d</td>
<td>个人规划 b</td>
<td>个人规划 a,b</td>
<td>个人规划 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>#7. 培育植物和种子</td>
<td>个人规划 a,b,c,d</td>
<td>个人规划 a,b</td>
<td>个人规划 a,b</td>
<td>个人规划 a</td>
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<tr>
<td></td>
<td></td>
<td>Science f</td>
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<tr>
<td>106</td>
<td>#1. 几个简单的土壤测试</td>
<td>Science d</td>
<td>Personal Planning a,b</td>
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<tr>
<td>106</td>
<td>#2. pH测试</td>
<td>Personal Planning a,b</td>
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<tr>
<td>107</td>
<td>#3. 有机土壤质量实验</td>
<td>Personal Planning a,b</td>
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<td></td>
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<tr>
<td>109</td>
<td>#4. 土壤渗透性测试</td>
<td>Personal Planning a,b</td>
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<td></td>
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<tr>
<td>110</td>
<td>#5. 蚯蚓堆肥</td>
<td>Personal Planning d</td>
<td>Science f</td>
<td>个人规划 a,b</td>
<td>个人规划 a</td>
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<tr>
<td></td>
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<td>Social Studies a,b</td>
<td>Social Studies a</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>#6. 计算你的花园中的蚯蚓</td>
<td>Personal Planning a,b</td>
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</tr>
<tr>
<td>111</td>
<td>#1. 找/映射覆盖的溪流</td>
<td>Social Studies a</td>
<td></td>
<td>Science e,f,g,d</td>
<td></td>
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<tr>
<td>112</td>
<td>#2. 暴雨下水道标记</td>
<td>Science c</td>
<td>Social Studies a</td>
<td>Science a,d,e</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Personal Planning b</td>
<td></td>
<td></td>
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</tbody>
</table>

*Please use in conjunction with page 98. BC Ministry Prescribed Learning Outcomes in other grades and other subjects may also apply to each activity. See the Learning Outcomes Tables provided in the Introduction for additional curriculum connections.*
ACTIVITIES

UNIT 4 THEME 1: Gardens

Gardens are possibly the most valuable outdoor learning resource for a school ground. Gardens involve students in a great many ways from their initial design and construction, to their ongoing maintenance and upkeep. As discussed in the opening sections of this guidebook, gardens also represent important symbolic and practical connections between human industry and the natural world. Different types of gardens, from vegetable, to ornamental flowering, to indigenous flora each provide a unique outdoor environment for students to learn in.

So many varieties of gardens are possible that a different type of garden could be provided for every grade in a particular school. Selecting the type of garden or gardens best suited to a school depends on a number of factors including the interests of both teachers and students, the amount of available space, the availability of community assistance and connections to the school curriculum. Although each type of school garden will require different schedules of care and maintenance, some general activities can be described. Because a comprehensive discussion of the many individual specifics of gardening are well beyond the scope of this activity guidebook, it is valuable to introduce a selection of activities to illustrate the potential educational benefits of school ground gardens.

SUGGESTED ACTIVITIES

1. Choosing to grow an indigenous or cultivated garden

(See Activities 2 - 5 for more garden-specific activities.)

The choice of what garden to make depends on a wide variety of factors. There are also many ways to mix garden types through integrated plantings.

A. Cultivated Gardens: Vegetables

Choosing to grow a vegetable garden provides wonderful opportunities for students to engage in the challenges of growing healthy plants and later tasting the fruits of their labors. A problem with cultivated gardens is the need for ongoing maintenance during the growing season, including the summer months when students are on vacation. Some early yielding varieties of plants may produce crops before students leave for summer vacation. Crops such as lettuces, radishes, early carrots, peas and potatoes, arugula, or chard can be started in a greenhouse or cold frame and may produce enough growth for students to taste their harvest before the summer months.
Other hardy vegetables such as squash and pumpkin, beets, and turnips can be kept with little summer time maintenance other than weekly watering and an occasional weeding. Brussels sprouts, kale and parsnips have the added advantage of being late fall or winter crops that show their best growth when students are back in school after the summer holidays. Growing a cultivated vegetable garden demands a relatively high degree of ongoing care and maintenance that may be beyond the scope of school communities to support.

B. Cultivated Gardens: Perennials

Perennial flowering plants make excellent and relatively low-maintenance school ground gardening projects. Started from seeds or shoots, most perennial flowers are easy to grow and can produce beautiful flora displays throughout the year. Like any managed garden, maintenance of soil quality is essential for the healthy flourishing of plants. Students can be involved in all aspects of perennial garden care from designing the layout of the garden, propagating seedlings and young plants, enriching soils and controlling pests, weeds and disease organically. The wide range of flowers and leaves in a perennial garden make possible many other activities including sketching and drawing, flower arranging, and observing many other patterns of life introduced in Unit 1 of this guidebook.

It is also possible to include varieties of indigenous flowers, shrubs and trees in perennial gardens, or to make the garden exclusively representative of locally indigenous plant species. The amount of school time students can devote to maintaining their garden is probably the most important decision in selecting the type of gardens suitable to a schoolyard. Other factors, including the amount of space, potentials for vandalism, length of the growing season and so on, are also important. But providing students with the time they need to explore, experiment, and expand their knowledge about how plants grow and the techniques of gardening is the most important factor.

C. Indigenous Gardens

The indigenous species garden is different from other types of gardens because it is inherently connected to its natural bioregional ecosystem. The design, construction and maintenance of an indigenous garden, therefore serves a much broader purpose than other types of cultivated gardens. A primary objective of the indigenous garden is to optimize ecological habitat for transient birds, insects and small animals that may use this land as they migrate from one area to another. In order to support the indigenous ecosystem in this optimal way, it becomes necessary for students to become aware of the many ebbs and flows occurring in the natural world around them. The selection of plant species, layout and design, and ongoing long-term maintenance of indigenous school ground gardens requires a very different set of objectives and procedures from those applied to annually reconstructed cultivated gardens. This is where the opportunity for constructing a legacy garden is most pronounced. By recording observations of changes in the garden and looking beyond the physical boundaries of the schoolyard to connections to the bioregion and beyond, students become involved in making their school a part of a healthy global ecology. In the final analysis, this is a goal well worth striving for in every space that humans inhabit.
2. **Annual bulbs and spring flower gardens**

   These annual gardens are suitable for young gardeners and school with limited time and space for gardening projects. Plant bulbs in fall for sprouting and flowering in springtime. Watch and record first sprouting, blooming, and the length of time flowers stay open. Try planting bulbs in different parts of the school ground – shaded areas, sunny areas, weedy areas and so on. Observe which come out first and which flower the best. Dig-up bulbs and store them in late spring for planting next year. If you live in southern British Columbia, you can leave the bulbs in the ground as long as they are planted with sand above and below. Protect bulbs from rodents and small mammals in the winter by covering them with small rocks or chicken wire.

3. **Hardy vegetables: peas, potatoes and other early season varieties**

   Early fruiting vegetables can be grown at any grade level. Having a place to germinate and start young seedlings allows earlier plantings and much earlier harvests.

   Germinate seeds in early spring under a cold frame, on classroom windowsills or in a greenhouse. This is also an opportune time to do experiments by varying conditions of seed crowding, light supply, soils quality and watering. Prepare soils with compost in the fall and turn over again in early spring. Plant young seedlings when soils have warmed, (consult the Farmers Almanac or Web site for planting dates of different varieties and locations). Protect young seedlings (such as lettuce) from slugs and birds during nesting periods. Pest and disease identification and control may be less of a problem with early fruiting varieties, as many problem pests do not become serious until the warmer summer months.

4. **Butterfly gardens**

   If the school has a garden that attracts butterflies, bees and other bugs and birds, students should practice identifying different species. Ongoing research into other types of local species of birds and insects to attract can lead to decisions on new varieties of flowering plants or trees to grow. By doing research into indigenous plant, insect and bird life, students can plan for landscaping projects when they reach later grades.

5. **Garden preparation and maintenance**

   Every garden requires some degree of maintenance and regular attention. Typically district staff workers do this work. However, where specialized garden projects are implemented, ongoing garden work can provide an opportunity for teaching a wide range of practical and intellectual skills. Students will participate in many ongoing routines and tasks such as regular composting throughout the year.
6. Selecting plants and seeds

Seeds are produced by different plants at varying times of the year from late March until November. In order to collect a full range of the plant seeds in a particular area, it is necessary to collect seeds every month or so. The best time to collect flowering and vegetable plant seeds is when the flowers are brown and beginning to dry. At this stage, some seeds will still be encased inside the seed ovule before being dispersed. The other advantage of collecting seeds while they are still inside the flower is in identifying them. Seeds that are scattered about on the ground, carried by wind or other means may be hard to identify, let alone to find.

Selecting plants for propagation requires some thought regarding the intended purpose and location where the next year’s seedlings will be planted. If seedlings are to be grown for sale, a greenhouse will provide an ideal climate for starting large numbers. If only a small number are to be grown and transplanted onto the school grounds, it is important to consider carefully where they will be planted including: amount of shade or sunlight received, compaction of the soil, amount of water, exposure to traffic, wind, frost and snowfall. It is also important to consider the full mature size of plants such as Douglas fir and cedar seedlings. A thorough plan for school ground reforestation or naturalization projects is a must before planting. It is possible, however, to begin selecting seeds and propagating seedlings early on in a large scale school project. Just remember to transplant them before they get too big!

7. Propagating plants and seeds

When planting seeds in pots, it is important to read any instructions provided with seed packages. Like all living things, all seeds have a preference for how deep they are planted, and how moist and warm they are kept while germinating. Students can perform many experiments to determine what the best conditions for starting seeds are. Any good gardening store will provide information on starting domestic seeds. Germinating native indigenous plant species, however, can be much more complicated. Some seeds require special treatment, such as exposure to cold, or high heat in order to prepare them for germination. Consult a specialty guidebook (see appendix B, bibliography), contact a local indigenous plant nursery, or seek the advise and assistance of a qualified university or college specialist for help.
UNIT 4 THEME 2: Building healthy soils

The effects of flooding and soil erosion on soil quality have had a major impact on human cultures since long before the beginning of recorded time. Many of the great early civilizations such as the Mesopotamians and the Egyptians thrived from the silt-laden floods of their mighty rivers that regularly replenished the soils of their fields. Today, the opposite phenomenon is occurring around the world as rivers are diked and dammed cutting off the flow of organic nutrients into the soil. Instead, irrigation and fertilization leach the soils of their organic material leaving residues of salt that make soils unproductive.

The following activities help students to understand the importance of maintaining organic material in the soil. This is a basic principle of organic gardening.

An obvious way to test the quality of different soils is to grow something in it. Different plants grow best in different types of soil, however, so it is important to use only one type of plant when testing soil quality. You can also test how well different types of plants grow in a particular type of soil, but it is important not to mix too many variables in soil experiments.

To test the quality of different soils, you can start with seeds or young plants. Testing soils with older plants is not recommended for two reasons:

1. They suffer more from the stress of transplanting.
2. They have soil on their roots already which will skew results.
SUGGESTED ACTIVITIES

1. Several simple soil tests
   a) Pick up a pinch of soil. Rub it across a piece of soft cloth or paper. Did it leave a smudge mark? A dark brown to black smudge is one indicator of the quantity of organic material in the soil.
   b) Is there air in soil? Fill a bucket half full of soil. Pour water onto the soil until the earth is covered. Watch as the soil settles for bubbles to appear. How long do the bubbles keep coming? Compare soils taken from several different locations for different amounts of air. When all bubbles have stopped, gently stir the soil with a stick. Why do more bubbles appear? (If any small creatures appear, collect them and take them outside)
   c) Tip out a several small buckets of soil taken from different locations onto a large plastic sheet. Start by looking for bugs, worms and other interesting critters in your soil sample. Remove them carefully and return them unharmed. Take a pinch of soil and rub it between your thumb and fingers. Describe its feel. Pick up a handful of soil. Press it together in your hand. Does it hold its shape? Does it have a smell? Does it stain your hands? Count the number of small pebbles in your handful. Look for small twigs, leaves and other organic material. Record observations and compare the different soils.
   d) Collect a variety of different soil samples including some from children’s homes. Fill small jars 1/3 full of soil. Add water to fill the jars 1/2 full. Shake the jars vigorously, then leave them to stand. Ask children to record what they notice:
      • after 30 seconds, 1 minute, 5 minutes, 1 hour, 3 hours, 24 hours and after 48 hours. Ask them to carefully draw what they see after 48 hours. The different soil layers will have settled out and each soils sample will form its own unique pattern of layers (see worksheet, appendix A, page 134).

2. PH testing
   Testing the acidity of soils helps in the determination of suitable plants to grow, or whether steps need to be taken to change the soil acidity. Most plants have a preferred range of soil acidity. Many gardening books will provide information on optimal acidity levels for plants in your area. Soil test kits are available in gardening stores as well as school science equipment suppliers. Testing dissolved hydrogen, or pH, in soils is a practical exercise related to both chemistry and biology. It is also an essential piece of information for maintaining healthy plant growth.
3. **Organic soil quality experiment**

   **A. Preparation**

   a) Fill a bucket 1/3 full with soil from an area that grows lots of plants. Examine it carefully using a magnifying glass, a smudge test and/or a pH test. What qualities can be observed?

   b) Overfill 3 medium plant pots to overflowing and pour them into a bucket.

   c) Fill one more pot and put it aside. Label this “Pot #1 Control” sample.

   d) Add two to three liters of water into the bucket of soil. Swirl the soil and water around in the bucket. Carefully pour the water along with any brown sludge into another bucket. Keep the water.

   e) Examine the soil left in the bottom of the first bucket. How has it changed? Add more water and wash the soil again. Pour off the water again, this time you may discard the water. Repeat if necessary until the wash water looks fairly clean and the soil is mostly pebbles and sand.

   f) Fill plant pot #2 with this washed soil and set it aside. Label this sample “Pot #2 Washed Soil”.

   g) Fill plant pot #3 with an equal amount of the ‘washed soil’ from step two above and good fresh organic compost (or well-rotted manure). Label this pot “Pot #3 Compost Added” and set it aside.

   h) For plant pot #4, fill the pot 1/2 full with the washed soil from the bucket. Now, slowly and carefully pour all of the water from step (d). onto the washed soil in pot #4. This may be a bit messy, as the excess water should flow out the bottom of the pot. Keep pouring until all the water has been used up and all the brown sludge in the bottom of the bucket has been poured into pot #4. Label this pot “Sludge added” and set aside.

   Now you are ready to test your soils.

   **Optional Experiment**

   Start with a base of pure clean sand. Add organic compost or well-rotted manure in varying amounts. Grow plants in the different soil mixtures and record the results.
B. Testing Soils by Planting Seeds

a) In each pot of different soils, plant 3 or four seeds at the suggested depth for the species selected (see seed package for recommendations). Keep the seeds warm and well watered as they germinate.

b) After germination, allow the plants to grow to their first or second set of leaves and then select the one that looks healthy and strongest. Pinch off the others at the base. (Do not pull extra plants out at the roots as you may disturb the soil). Continue to water regularly.

c) Measure rates of growth every two or three days for several weeks on a table or chart. Record observations such as new leaf buds, etc.

d) Graph observations and draw conclusions.

Note: When working with a full class of 20 to 30 students it is possible to carry on several different experiments simultaneously. Have 5 to 10 students test different soils; 5 to 10 students test different types of plants; and, 5 to 10 students test the effects of plant crowding, fertilization, water or light deprivation and other factors. Students may be clustered into groups in order to share results and to put together a final report on all the results.

<table>
<thead>
<tr>
<th>Plant Pot #</th>
<th>March</th>
<th>April</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
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<td></td>
<td></td>
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<tr>
<td>#1 Control</td>
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<tr>
<td>#2 Washed soil</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>#3 Compost added</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4# Sludge added</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(For worksheet see Appendix A, page 135)
4. **Soil permeability tests**

Soil permeability is a measurement of the ability of the soil to allow water to pass through it. Water retention is the ability of the soil to hold or store water. Higher soil permeability and water retention levels are important in areas where rainfall is severe or infrequent. Exposed soils on school grounds are often compacted by the daily footsteps of playing children.

1. Pour a litre of water on different types of surface found around the school grounds. Record observations and then discuss what happened to the water at each site. Discuss “permeability” (the ability of a substance to let water pass through it).

2. Place a tin can with both ends removed upright on the surface. Pour the litre of water into the tin can as quickly as possible without letting the tin can overflow. Measure the time it takes for all of the water to flow out of the bottom of the can. (Take care not to allow water to leak out the sides at the bottom. To make a better seal on the bottom of the can, push the can slightly into the surface, or line the rim with moist clay.)

3. Record time measurements for each surface type in a table. Arrange them from shortest time to longest time and make a bar graph. Discuss permeability as above.

Which parts of the school ground had the highest and lowest soil permeability? What is the relationship of permeability to plant growth? How do people affect soil permeability?

**Evaluating results**

Make a list of all the criteria you have found that is necessary for plants to grow. What factors prevent plants from growing in the soil? What are the causes of the factors that prevent plants from growing?

**Soil Permeability Table:**

<table>
<thead>
<tr>
<th>Site #</th>
<th>Surface Description: (Colour, Hardness)</th>
<th>Amount of time for water infiltration</th>
<th>Relative Permeability (high, Medium, Low)</th>
<th>Amount and types of Greenery present</th>
<th>Smudge test.</th>
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(For worksheet see Appendix A, page 136)
5. **Worm composting**

What wonderful pets worms make. In contrast to the shrieks and shudders uttered by many students when they first set eyes on a bucket filled with wriggling red worms, these slithery creatures can quickly earn a respected place in the classrooms and gardens of our schools. Keeping earthworms is a natural way to link the production of garbage waste to processes of recycling and the maintenance of healthy soils.

Students can work with worms inside or outside of the classroom. Indoors, worms can be raised in plastic tote containers (see “worm composting” below). Outdoors, vermiculture composters can be set up in conjunction with a school garden project or waste reduction program. Understanding the important role played by earthworms in building healthy soils provides students with a living example of organisms at work in their ecosystem. Classroom studies in the life cycle, physiology and behaviours of earthworms will further help students appreciate the importance of worms in the processes of nature.

Worms are among the best composters of soil for our gardens. Red Wriggler worms have voracious appetites and multiply quickly in the right conditions. They love fresh food scraps and can be kept indoors in rubber tote containers during cold weather seasons. Vermiculture compost should be added to gardens to fortify the soil at least twice a year, in early spring and in the fall. Red Wrigglers will eat virtually any type of vegetable matter other than bread and cereal products; they love coffee grounds. Never compost meat, as it will smell awful and attract undesirable pests.

There are many excellent resource manuals for worm composting including *Worms Eat My Garbage*, and Ministry of Environment *Eco Education Program Teachers Manual*. For help setting up a worm composting program in your school contact the BC Green Team, or, in Vancouver, The Greater Vancouver Regional District Waste Education Program coordinators, or City Farmer.

**Extension:** Collect waste lunches from other classrooms, sort biodegradable waste and add to classroom composters.

6. **Counting worms in your garden**

Do a comparative density survey of earthworms in different parts of the schoolyard and estimate how many worms live on the school grounds. Make a thin mixture of hot mustard powder and water. Mark out a one-meter square area using a 4-meter long string loop. Spread the mixture over the ground and wait and watch as the worms wriggle to the surface. Count the number of worms in this area. Check for different varieties of worms. Record the types of worms and the quality of the soil. Compare results with other student’s results in other areas of the school grounds. Consult your map of the school and estimate the amount of area that is made up of soils similar to your area. Calculate the populations of worms living in the different soils of the school and on the whole school grounds. More advanced students can identify the different types of earthworms and attempt to estimate populations of the different species. Studying worm biology, anatomy and reproduction are natural project extensions to a vermiculture composting program.
UNIT 4 THEME 3: Water

Water is a transient, but essential part of every school ground. The flow of water through the school ground connects it to the local and global marine ecosystem. Students undertake a variety of projects observing, measuring, recording and enhancing water systems located on or near to the school grounds. Although many city schools have little access to exposed streams or other open water, students should become aware of things they can and should do to protect the quality of water in their community. Because there are many excellent resource books already written about water resource use, stream stewardship, waste treatment and disposal, insect invertebrate monitoring and wetland habitat care and rehabilitation, educators are recommended to consult the appended resource bibliography for contact suggestions.

For stream rehabilitation activities, consult educational manuals such as the Streamkeepers Program, the Aquatic Invertebrate Monitoring Guidebook, Project Wet, the DFO’s Fish Habitat Enhancement Guide, The Stream Stewardship Program and others for information and activities related to protecting and enhancing the quality of local streams.

SUGGESTED ACTIVITIES

1. Finding/mapping covered streams

In communities where streams have been covered over by development, students can research their past and present locations through old waterworks maps and interviews with local citizens. The Greater Vancouver Regional District has published an excellent map of Lost Streams of Greater Vancouver. Students can often locate these lost streams by finding culverts which connect to underground storm sewers. Knowing where rainwater goes to helps students appreciate the interconnectedness of watershed drainage systems.
2. **Storm drain marking**

This popular community education program involves students in protecting the quality of run-off water entering storm sewers. By painting bright coloured fish on the pavement beside street sewers, students help to remind local citizens not to pour toxic or polluting chemicals into storm drains. This helps to keep local streams, rivers, lakes and other elements of river watersheds healthy. Storm drain marking kits can be obtained from many city and district waterworks offices, but students can easily make their own templates. Here’s how.

1. Make a single fish-shaped template (a salmon shape works well) about 30 cm x 15 cm.
2. Transfer the template onto a half dozen or so pieces of rigid cardboard. Cut out the cardboard to make painting patterns.
3. Ask students to look for storm drains around the community that are in need of fish marking. Locate and mark these drain sites on a street map. Plan a route that will take the class past the unmarked drains. Plan additional activities for students to undertake on the class outing (activities could include a scavenger hunt for different leaves, bugs, or seeds, a survey of local community architecture, or a tally and density analysis of cars parked on city streets).
4. Divide students into painting crew groups and provide them with the tools of the trade; a medium paintbrush, a fish-painting pattern, and some bright yellow durable marine enamel paint (a few rags might be useful, too).
UNIT 4 THEME 4: Human technologies and environmental impacts

SUGGESTED ACTIVITIES

1. **Studying human impacts on ecosystems**
   
   Study areas that have been damaged by human actions. Record the type of human action and the damage that has occurred. Students need look no further than their own schoolyards for obvious signs of ecological damage. By making a list of indigenous plants, animals and birds that may at one time have visited the area that is now the school grounds, students will begin to appreciate the serious ecological impacts of many human developments. Envisioning ways to bring these indigenous species back to the school ground becomes a project that may take years to accomplish, but has valuable meaning and uncountable rewards for students.

2. **Using simple tools**
   
   Simple tools such as the shovel, hoe and rake changed the fundamental ways in which early human cultures related to the natural world. The shift from nomadic hunter/gathering to agriculture based societies made possible permanent settlements that led to the eventual development of modern civilizations and cities. Practical experience with these basic tools can be augmented by studies in the physics of their operation (leverage), the archeological record of their development, and the history of their use in early industries such as farming and mining.

3. **Examine technological advancements to a simple tool**
   
   An extension to the use of simple tools is an examination of modern day development in the technologies that perform their original functions. For example, what modern day machines make use of the function of a shovel, i.e., moving soil or rock? What machines make use of the function of a rake, i.e., leveling the earth? How have these original functions of an early technology and its tools changed over time, and how has this affected the land and human uses of the land?
Appendices
The sensitive scavenger
Identifying differences in plants

<table>
<thead>
<tr>
<th>Plant “family” name</th>
<th>Characteristic Features</th>
<th>Simplified Drawings</th>
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</table>
The five kingdoms (monera, protista, fungi, plant, animal)

<table>
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<tr>
<th>Name (if known) &amp; KINGDOM</th>
<th>How it moves</th>
<th>Where it was found</th>
<th>What it eats</th>
<th>What eats it</th>
<th>Coloured sketch drawing (name if known)</th>
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Comparing biotic and abiotic objects

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<tr>
<th>BIOTIC (Living things)</th>
<th>ABIOTIC (Non-living things)</th>
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<tr>
<td>plants</td>
<td>animals</td>
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<tr>
<td>natural</td>
<td>human-made</td>
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Habitats, biomes and niches

<table>
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<tr>
<th>% SHADE (how much shade/day)</th>
<th>SOIL TYPE/QUALITY</th>
<th>MOISTURE</th>
<th>NEIGHBOURING PLANTS</th>
<th>HUMAN IMPACTS (foot traffic, gravel, concrete, gardening, cutting)</th>
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## Orienteering—basic skills

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<th>Letter station</th>
<th>Direction to next letter</th>
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<td>R</td>
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## Orienteering: estimating distances

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<th>Distance Traveled</th>
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<th>Average steps/meter</th>
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<td>A. Walking</td>
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<td>C. iv. Running Downhill</td>
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<tr>
<td>C. iii. Walking Downhill</td>
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<tr>
<td>C. ii. Running uphill</td>
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<tr>
<td>C. i. Walking uphill</td>
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<tr>
<td>B. Running</td>
<td>100 meters</td>
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Orienteering: intermediate skills

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Measuring distances by triangulation using a protractor and a baseline

A. Making a protractor

B. Measuring by triangulation

Graph Paper
Quadrat surveying  Recording Quadrat Observations:
Signs and symbols in an urban landscape

<table>
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<tr>
<th>1st level</th>
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<th>3rd level</th>
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<tr>
<td>SIGNS WITH WORDS</td>
<td>SIGNS WITHOUT WORDS</td>
<td>LESS OBVIOUS SYMBOLS</td>
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Signs and symbols in a natural landscape

<table>
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<th>WITHOUT WORDS</th>
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The customized schoolyard eco-calendar (example)
The customized schoolyard eco-calendar (example)
## Solar warming and the greenhouse effect

<table>
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<tr>
<th>Time</th>
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Solar warming and the greenhouse effect

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<td>10 min.</td>
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Soil tests

Soil sample ______________________

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<th>TIME</th>
<th>DESCRIBE WHAT YOU SEE</th>
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<td>30 seconds</td>
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<td>1 minute</td>
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<td>1 hour</td>
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<td>3 hours</td>
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<td>24 hours</td>
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<td>48 hours</td>
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After 48 hours, draw the pattern of layers that you see.
## Organic soil quality experiment

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<tr>
<th>Plant Pot #</th>
<th>Description</th>
<th>#1 Control</th>
<th>#2 Washed soil</th>
<th>#3 Compost added</th>
<th>#4 Sludge added</th>
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<td>May</td>
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## Soil permeability table

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<th>Site #</th>
<th>Surface Description: (Colour, Hardness)</th>
<th>Amount of time for water infiltration</th>
<th>Relative Permeability (high, Medium, Low)</th>
<th>Amount and types of Greenery present</th>
<th>Smudge test</th>
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Appendix B

Resources Bibliography

**SCHOOL GROUND CURRICULUM & ACTIVITIES**


Appendix B


Raham, Gary. *Explorations in Backyard Ecology: Drawing on Nature in the Classroom Grades 4-6*. Englewood CO: Teacher Ideas Press,


**SCHOOL GARDENS**


Jurenka, and Blass, *Cultivating a Child’s Imagination through Gardening*. Teacher Ideas Press, PO Box 6633, Englewood


Appendix B


*Worm Worlds,* North America Association of Environmental Education Publications


**MAPPING RESOURCES**


Harrington, Sheila ed. *Giving the Land a Voice: Mapping Our Home Places.* Salt Spring Island Community Services


*The Outdoor Classroom: Educational Use, Landscape Design and Management of School Grounds.*


Wysga, Marilyn. *Homes for Wildlife.* Concord: New Hampshire Fish and Game Department.

**HANDICRAFTS**

Adrosko, R. *Natural Dyes and Home Dying.* New York: Dover, 1971


**ENVIRONMENTAL EDUCATION**


Appendix B


FIELD GUIDES AND HABITAT REFERENCES


Internet Web Sites

*BCTV Sky Watchers School Program*
http://weatheroffice.com/sky/

*Classroom Bird Watch*
http://birdsource.cornell.edu/cfw/curriculum.htm
In this exploration you introduce your students to the excitement of participating in Classroom FeederWatch. Together you examine the articles, stories, and pictures produced by the previous year’s students for a national newsletter called Classroom Birdscope.

*Environment Magazine*: List of links to many educational topics
http://www.emagazine.com/links/alph_links.html

*Environment Canada Web Site*
http://www.ec.gc.ca/
http://www.pnr-rpn.ec.gc.ca/air/cloudchart/
**Evergreen Web Sites**
http://www.evergreen.ca/
http://www.evergreen.ca/resnsncuschoolyardprimer.html

**Gander Academy: Weather Theme**
http://stemnet.nf.ca/CITE/weather.htm#Tools

**Globe Environmental Monitoring Program**
http://globe.ngdc.noaa.gov/

**Grandview/ ?uuqinak’uuh Gardens**
http://www.cityfarmer.org/grandview.html

**The Green Brick Road**
http://gbr.org/home.htm
(GBR) is a non-profit organization which specializes in resources and information for students and teachers of global and environmental education. Our most highly-recommended resources have recently been made available for purchase. Browse through our Guide to Environmental and Global Education Resources - for detailed descriptions of these normally hard-to-find titles.

**Greening Schoolgrounds**
http://www.greengrounds.org/
Our vision is to have every school community in Canada practicing stewardship on their school grounds by creating educational and shaded areas on their grounds.

**Green Teacher**
http://www.web.ca/~greentea/

**International School Peace Gardens**
International School Peace Gardens, which officially began in 1994 as a UN 50th Anniversary program, is an initiative of the International Holistic Tourism Education Centre (IHTEC). IHTEC is dedicated to developing programs that educate young people through “Tourism as a vital force for peace”.

**International School Grounds Day**
http://gbr.org/school

**Learning For a Sustainable Future**
http://www.schoolnet.ca/vp-pv/learning/e/
Learning for a Sustainable Future is a Canadian nonprofit organization whose mandate is to work with educators from across Canada to integrate the concepts and principles of sustainable development into the curricula at all grade levels.

**Project WILD- Environmental Education**
http://eelink.umich.edu/wild/guides.html#wss


**NASA S’COOL Online Cloud Chart**  

**The Nature Mapping Program Educational Website**  
http://www.fish.washington.edu/naturemapping/modindex.html  
The NatureMapping Program’s vision is to create a national network that links natural resource agencies, academia and land planners with local communities primarily through schools. Our goal is to keep common animals common and to maintain our quality of life. Our approach is to train individuals to become aware of their natural resources and to provide the tools to inventory and monitor their resources.

**National Wildlife Federation**  
http://www.nwf.org/nwf/habitats/schoolyard/index.html

**Old Farmers Almanac**  
http://www.almanac.com

**Tree Canada Foundation**  
http://www.treecanada.ca/  
The Tree Canada Foundation is a not-for-profit, charitable organization established in 1992. The Foundation provides education, technical assistance, resources and financial support through working partnerships to encourage Canadians to plant and care for trees in our urban and rural environment in an effort to help reduce the harmful effects of carbon dioxide emissions.

**Weather Reporters**  
http://www.enoreo.on.ca/students/weatherindex.htm  
A series of activities related to the topic of weather are being developed to encourage students to take an active role in the monitoring of scientific data. Activities will range from the collection of weather data, to more sophisticated analysis of this information. Students will be introduced to satellite imagery and the role it plays in meteorology.

**Links for Educators and Students To Educational Resources**  

**Weather the Final Front**  
http://www.scdsb.edu.on.ca/csg/homepage.html  
Visit our weather pages and be amazed at the resources available on this exciting topic. El Nino, hurricanes, satellite images, classroom activities, “everything you ever wanted to know but were afraid to ask”. The Canadian Science Gateway is THE connection to automated weather stations positioned throughout the United States and Canada.

**School Nature Area Project (SNAP)**  
http://www.stolaf.edu/other/snap/
SEEDS - Environmental Green Schools Program
http://greenschools.ca/seeds/

Students in a Project-based Learning Approach to Schoolyard Habitat Development
http://www.stclair.k12.il.us/services/scilit/schlyrd.htm
Creating and Sustaining Schoolyard Habitats Instructional Unit
This engaged learning unit is designed for teachers who would like to provide students with both problem and project-based instructional experiences while carrying out an investigation to address the issues of schoolyard wildlife habitat development. The end result of the teacher’s and students’ efforts will be an action plan that can be presented to administrators, school boards, community groups, and others to gain approval for wildlife habitat restoration.