SCHOOLYARD ECOSYSTEMS

TEACHERS' GUIDE

Example Assessment & Instructional Strategies
For Science 7 Unit A: Interactions & Ecosystems

Photo Credit: Sue Arlidge ~ Exshaw School Grounds

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&

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INTRODUCTION

"*Ecosystems are maintained by natural processes and are affected by human action. To foster an understanding of ecosystems, this unit develops student awareness of ecosystem components and interactions, as well as cycles and processes of change. Building on this knowledge, students investigate human impacts and engage in studies that involve environmental monitoring and research. By reflecting on their findings, students become aware of the intended and unintended consequences of human activity, and recognize the need for responsible decision-making and action.*"
Adapted from: Alberta Learning Program of Studies for Junior High Science (2001).

By investigating schoolyards, students will gain an understanding that schoolyards, backyards, and other urban settings are functioning ecosystems with processes transferring energy and cycling matter. This understanding will help students make informed decisions regarding urban ecosystems. In this case, the primary organism of study is the common dandelion; its abundance and distribution, related food webs, monitoring of population change, and management in schoolyards. As such, this unit of study explores the role of science in informing community and personal decision-making.

Focus Questions

The ***Unit Planning Template*** developed for this project (www.ucalgary.ca/UofC/research/KFS/schoolyard.htm) and this ***Teachers' Guide*** use four focusing questions to guide assessment and instruction:

1. **Focus Question:** *Ecosystem Impact ~ How do we impact schoolyard ecosystems?*
   Assessment Outcome: Schoolyard Map.
   Activities: Schoolyard Scavenger Hunt, Schoolyard Mapping
   Enduring Ideas: Human impact is connected to differing needs, wants and values of schoolyards, and has an impact on living things in the schoolyard.

2. **Focus Question:** *Ecosystem Processes ~ What is our schoolyard food web?*
   Assessment Outcome: Schoolyard Food Web.
   Activities: Schoolyard Interactions and Animal Game
   Enduring Ideas: Patterns of living things in schoolyard ecosystems are connected to abiotic resources, and processes of energy flow and cycling of matter.

3. **Focus Question:** *Ecosystem Monitoring ~ How do we monitor our impact on schoolyard ecosystems?*
   Assessment Outcome: Schoolyard Ecosystem Monitoring Program
   Activities: Change in the Schoolyard, Schoolyard Ecosystem Monitoring
   Enduring Ideas: Ecosystems change over time and this change can be assessed by monitoring specific organisms and abiotic resources (e.g., water).

4. **Focus Question:** *Ecosystem Management ~ How do we manage schoolyard ecosystems?*
   Assessment Outcome: Schoolyard Ecosystem Management Plan
   Activities: Investigating Schoolyard Management and Issues
   Enduring Ideas: Management plans change over time and are not only based on science, but also other forms of information (e.g., economic, social, public safety).

Example Assessment & Instructional Strategies

The assessment and instructional strategies for the first three focus questions are based on classroom and workshop tested lessons provided by the CRCSSD Lead Teachers: K. Mah, S. Mattie, and J. Poleschuk. The lessons have been expanded upon to include alternative assessment strategies and teaching resources. The instructional strategy developed for the fourth focus question is based on a game entitled *Landopoly: A Decision-Making Game* developed by Michigan State University Extension for their *This Land is **Your** Land* education program: http://web4.msue.msu.edu/msuewc/kent/yourland/. This activity is based on *Hydropoly* (pp. 260-265) from *WOW! The Wonders of Wetlands* and is adapted with permission from Environmental Concern Inc. For further information contact Environmental Concern Inc. at (410) 745-9620 or visit: http://www.wetland.org.

The intent of this Teachers' Guide is to provide Science 7 teachers with example assessment and instructional strategies based on the Schoolyard Ecosystems Unit Planning Template developed by the CRCSSD Schoolyard Ecosystems Professional Development Team. We encourage teachers to provide us with feedback on these lessons and to contribute assessment and instructional strategies to the Schoolyard Ecosystems Website: http://www.ucalgary.ca/UofC/research/KFS/schoolyard.html.

Children's Perceptions of the Ecosystem Concept

By the time a child reaches grade nine, they have spent the equivalent of about 350 days in the schoolyard (Cheskey 1993). Schoolyards present us with some of the most intriguing questions and dilemmas of ecosystem function and management in an urban setting. When you ask students what does 'ecosystem' mean or what is an 'ecosystem' you invariably receive mixed responses from parks to wilderness areas. Very few students consider the schoolyard as a functioning ecosystem. According to the Leeds National Curriculum Science Support Project (Leach *et al.* 1991a, 1991b), where students' understanding of ecosystems was assessed, a number of misconceptions about ecosystems are common. Relevant insights from this research note that many students:

- Believe that plants take their food from the soil.
- Do not understand the significance of the sun as the source of energy.
- Think that soil, water and foods are factors required for animal growth; they do not consider these factors as sources of matter.
- Tend to think of food chains as linear. They have difficulty grasping the interdependence of organisms.
- Do not grasp the significance of green plants in a food web; they also believe that green plants exist solely for other organisms to eat.
- Think that predators can feed on all organisms at lower tropic levels.
- Are unaware of the role of microorganisms as decomposers and recyclers of nutrients within a food web.
- Many students conceptualize decomposition as the total or partial disappearance of matter. Have poor understanding of conservation of matter.

For teachers, an understanding of these common student misconceptions about ecosystems is critical. One way of determining student prior knowledge about ecosystems is to begin the unit by asking students to sketch an ecosystem. Specifically, ask students to draw their idea of what would be necessary for ten generations of dandelions (or any other schoolyard organism) to survive in the schoolyard over time.

Their diagrams will likely depict a collection of objects (animals, plants, rocks, etc.) with little illustration of relationships between them, changes over time, or processes underlying those relationships and changes. This activity works as a starting point for discussing ecosystem components and processes. Revisit this sketching activity at the end of the unit to determine how student understanding of relationships, change, and processes has changed.

"The most important single factor influencing learning is what the learner already knows; ascertain this and teach him accordingly." (Ausubel 1968).

Safety and Animal Welfare Issues

This symbol indicates a need to pay attention to possible safety hazards or animal welfare issues. A teacher may wish to eliminate activities that may cause stress to schoolyard organisms, or pose potential hazard to students. We have tried to ensure that the activities in this guide are safe in normal teaching situations; it remains the responsibility of the classroom teacher to work within policy statements of their school and school board, to conduct a risk assessment, and decide on whether activities are safe in their given schoolyard or situation.

References

Ausubel, D.P. (1968) *Educational Psychology: A Cognitive View*. New York: Holt, Rinehart, and Winston.

Cheskey, E.D. (1993) *Habitat Restoration: A Guide for Pro-Active Schools.* Waterloo Country Board of Education. Waterloo, Ontario.

Leach, J., Driver, R., Scott, P., and Wood-Robinson, C. (1991a) *Conceptual Progression in Science: Progression in Conceptual Understanding in Pupils from Age 5 to 16: Cycling of Matter, Flows of Energy and Interdependency and Classification of Organisms in Ecosystems*. Report to the National Curriculum Council for England and Wales. [Also published in: International Journal of Science Education, 1996, Vol. 18, No. 1, 19-34.]

Leach, J., Driver, R., Scott, P., and Wood-Robinson, C. (1991b) *Conceptual Progression in Science: Progression in Conceptual Understanding in Pupils from Age 5 to 16: Interdependency of Organisms*: Report to the National Curriculum Council for England and Wales. [Also published in the International Journal of Science Education, 1996, Vol. 18, No. 2, 129-141.]

FOCUS QUESTION 1: ECOSYSTEM IMPACTS

Curriculum Connection

Focusing Question: **How do we impact schoolyard ecosystems?**
Time Required: Two 45-minute class periods.
General Learner Outcome:

- Students will investigate and describe the relationships between humans and their environments, and identify related issues and scientific questions (Alberta Learning 2001).

Specific Learner Expectations:

- Investigate and describe different human uses or values (needs and wants) and resulting impacts on schoolyard ecosystems.
- Identify issues arising from those differing uses, value and impacts; and related scientific knowledge and questions required to address those issues.

Materials Required:

- class set of student attitude assessment
- class set of schoolyard scavenger hunt
- a compass
- 20 meter long lengths of string
- 5 trundle wheels (from Phys. Ed.)
- 5 tape measures (from Phys. Ed.)
- graph paper, pencils, markers, rulers
- student journals

Assessment Strategy

Students tend to equate natural and wilderness areas with fully functioning ecosystems. Some students might have difficulty perceiving schoolyards as ecosystems, but in fact, the schoolyard can be a window on ecosystems. The school site provides a place to regularly observe and monitor a local ecosystem, while studying how people interact with these ecosystems.

In this lesson plan:

- ❑ Students complete a student attitude assessment.
- ❑ Students participate in a schoolyard scavenger hunt.
- ❑ Students create a base map of the schoolyard.

- The Student Attitude Assessment is used to assess student background and preconceptions about their schoolyard.
- The Schoolyard Scavenger Hunt serves as an introduction to initiating, planning and recording inventories of schoolyard ecosystems. It is also used to introduce the class to outdoor boundaries, procedures, and safety protocol for schoolyard investigations.
- The Schoolyard Map activity serves as a central reference document for further investigations in this unit.

Instructional Strategy

A. Student Attitude Assessment

- Ask the students to complete ***Handout 1.1 – Our Schoolyard*** (p. 9), in order to assess prior understanding of ecosystems, discuss some of the responses to the attitude assessment questions. End the discussion with questions such as: *What is an ecosystem? Can our schoolyard be considered an ecosystem? Why or why not?*

> Ecosystem – a biological community consisting of living and non-living parts, and their interactions (specifically, the cycling of matter and the transfer of energy).

B. Schoolyard Scavenger Hunt

- Distribute copies of ***Handout 1.2 – Schoolyard Scavenger Hunt*** (pp. 10-11) to students and ask them to explore the schoolyard in pairs as they complete the scavenger hunt. Tell students that the idea is not to collect items on the list, but rather to find the items, agree with a partner that it meets the item criteria and check it off the list. Ask students to develop a protocol for working with living things; for example:
    - Disturb an area as little as possible.
    - Treat both plants and animals with respect. YOU are a visitor in THEIR home.
    - If you move something, replace it carefully the way you found it. Return living creatures to their natural habitat after you have observed them.

- Ask each pair to also record evidence of human use and impact on the bottom of Page 2 of the Scavenger Hunt handout, as they explore the schoolyard searching for items on the list.

- Point out the boundaries for the search and where to meet as a class upon completion of the scavenger hunt. After the search is complete, ask groups to pair up, and have them compare items they found for each criterion. Ask: *What was the most interesting item you found on the list. Why? Which item was the hardest to find? Why?*

- Back in the classroom, ask students to compile a class list of human uses and impacts they observed in the schoolyard and what affect each impact might have on living things in the schoolyard. Explain that in the next activity, they will develop a more detailed map of living things and evidence of human impact.

C. Schoolyard Map

1. Introduction to Maps

- Before conducting an investigation at a site, it is a good idea to become familiar with the whole site. Mapping is one way to help expand students' perception of the schoolyard as they identify the major

features of the site. Discuss how maps are useful as 'baseline' data. If available, show students large-scale maps of local features. Display a variety of maps in the class. As a quick warm up activity, challenge the students to spend five minutes drawing in their journals a map of their neighbourhood, or a map from their house to the school.

- Ask students: *What features should we include on a schoolyard map?* (All maps should include: a key, a north arrow, map scale, date of creation, and a white border around the map.)

- Take the time to introduce concepts of accuracy and scale at the beginning of the activity. Discuss types of human impact, at different scales, prior to searching for evidence in the schoolyard. Ask students: *What types of human impacts do you think we will see in the schoolyard?* (e.g., fencing, litter, walkways, mowing, watering, playground activities, introduced trees, etc.)

2. Guided Exploration

- Ask pairs of students from the Scavenger Hunt to join with two other pairs and go on a 'guided walkabout' in the schoolyard pointing out some of their discoveries of living things and human impact. Students should take notes in their journals as they walk, beginning to keep track of their discoveries for reference in later activities.

- Bring the groups back together and point out buildings, trees and other features to include on the map. As you explore, challenge students to make some predictions. For example, ask students to predict areas of highest human impact, or greatest number of different plants or animals; e.g., along edge of school, fences, playing fields. Ask students to record their predictions.

3. Map Making

- Demonstrate various methods of obtaining measurements, such as how to hold a tape measure to get distances and how to measure with a trundle wheel. Discuss methods of finding the area of irregular shapes, such as: laying out string along the edges and measuring the string; marking the boundaries with bone meal and measuring distance with a trundle wheel, etc.

- Also demonstrate the use of a compass; face towards the north. Tell the students that most maps are oriented with north at the top. Help them to find any features that run roughly north/south, and have them orient their maps accordingly. Also, use graph paper to create simple, scale drawings of the objects that they measured. The scale of 1 meter = 1 centimeter is easiest.

- Divide the schoolyard into areas for smaller groups of students to measure. With students working in groups of four or five, distribute measuring devices, and have them complete their measurements. Remind them to show buildings, roads, fences, paths, playground areas, existing vegetation and type, water sources, and other significant features. Ask the students to also estimate the heights of the trees and shrubs found on the grounds, by comparing their height to the heights of the plants. Ask the students how accurate their earlier predictions were.

- Once back in class, distribute large sheets of paper for groups to compile their data into one large schoolyard map. Ask each group to indicate on the map areas of greatest human impact and to predict what impact this might have on living things. Inform them that they will use this information to help guide them in the next lesson when they find out what is living in the schoolyard.

4. Assessment

- Distribute ***Handout 1.3 - Schoolyard Map Rubric*** (p. 12), and ask the students to fill it out for their own map. Also ask each student to record their plans for improving the map on the back of the Rubric.

D. Extension Activities

Map Site Use On a base map of the school, have students map the types of play that occurs. Have different students watch and map while different grades play. Why are some areas used differently than others? What happens in the site in off-hours?

Map Attitudes Challenge the students to produce different styles of maps, such as a map that shows how they feel about different places in the site. The map could include: Where do you like to sit? Where do you like to run? Which areas are noisy? Which area is the most fun to play in? What changes would you like to see in the school ground?

Watershed Maps If you extend mapping beyond the schoolyard level to assess where the water comes from for the school then you will create a regional watershed map. Students could extend this to also show where the water goes, after its use. Which watershed is the school part of at the local, regional, or national scales?

Historic Maps Research and produce a map that reveals the site's natural history before it was made into a schoolyard. Interview seniors to see if they can remember features of the site, before it was developed.

E. Teaching Resources

Alberta Program of Studies Recommended Texts:

Science in Focus

- Related Reading: Topic 1 Interactions Within Ecosystems: pp. 6-17.
  Topic 2 Human Impacts on Ecosystems: pp. 18-28.
- Related Activities: Just the Basics: p. 9 & Mapping Home: p. 36.
- Science Log Book: Pause & Reflect: pp. 7, 13, 16 (Research Assignment).

Science in Action

- Related Reading: Topic 1 Relationships Between Living Things & Environment: pp 8-28.
- Related Activities: Your schoolyard: p. 10.
- Science Log Book: Check & Reflect: p. 15.

Other Resources:

- *Schoolyard Ecology for Elementary Teachers* (SYEFEST): Schoolyard Ecology Treasure Hunt: and Schoolyard Wonders: www.ecostudies.org/syefest/.
- Hare, R. (1996). *Geography in the School Grounds*. Exmouth, Devon; Learning Through Landscapes Trust, Southgate Publishers Ltd.
- Harrington, S., Ed. (1995). *Giving the Land a Voice: Mapping Our Home Places*. Salt Spring Island; LTA Land Trust Alliance of British Columbia. A useful book about creating bioregional maps. www.islandnet/~1tabc/ .
- *OBIS* – Sensory Hi-Lo Hunt (focus on abiotic factors); Envirolopes (challenges students to looks for evidence of organisms); Terrestrial Hi-Lo Hunt (explores microclimates); Mapping a Study Site (orients students to the major features of a site)

Handout 1.1: Our Schoolyard

Name _____ Date _____

Circle the number that matches your thoughts about each statement, indicating whether you agree, disagree or are note sure. There is no right or wrong answer.

	AGREE		NOT SURE		DISAGREE
It would be interesting to investigate living things in our schoolyard.	1	2	3	4	5
Our schoolyard is home to a wide variety of plants and animals.	1	2	3	4	5
An ecosystem is only found in the wild.	1	2	3	4	5
There are a variety of ecosystems in our schoolyard.	1	2	3	4	5
Kids playing on the schoolyard do not affect wildlife living there.	1	2	3	4	5
Worms, dandelions and ants are not really important to me.	1	2	3	4	5
Nothing eats the weeds on our schoolyard.	1	2	3	4	5
The dead needles and grass in our schoolyard need to be raked up.	1	2	3	4	5
We should let weeds grow anywhere.	1	2	3	4	5
Dandelions in the yard look ugly.	1	2	3	4	5
Weed killer and other herbicides only affect weeds.	1	2	3	4	5

Adapted from samples on SYEFEST site: www.ecostudies.org/syefest/ap1res11.htm

Handout 1.2: Schoolyard Scavenger Hunt

Name _____ Date _____

- **Follow our classroom guidelines for outdoor behaviour and working with living things.**
- **Please complete this scavenger hunt. Do not collect the items! Observe, check off item, and describe where required.**

- ❑ Find a shady area – note the time. Describe the place.
  _____
  _____
- ❑ Find something in a place that is always shady.
- ❑ Find a tree (or a tree part) that was used as an animal home.
- ❑ Find a place where plants grow poorly. Why do you think the plants are struggling here?
  _____
  _____
- ❑ Find an animal home attached to a building or a structure.
- ❑ Find a creature living under something.
- ❑ Find the windiest spot on the schoolyard. Describe the site.
  _____
  _____
- ❑ Find something living in a crack in the sidewalk or pavement.
- ❑ Find a place where ants have set up a home.
- ❑ Find something living in an area that is always sunny.
- ❑ Find the rockiest location on the schoolyard. Find a creature living in this area.
- ❑ Look for something that has been planted by humans. What is it? Where is it?
  _____
  _____

- Find something that has never been alive. Describe.
  _____
  _____

- Find a non-living thing left by humans. Describe.
  _____
  _____

- Find three different kinds of seeds.

- Find a leaf that has been chewed by an insect.

- Find a flower or flowers visited by insects.

- Find a worm. Describe where you found it.
  _____
  _____

- Find a tree that you can put your arms around.

- Find the spot with the greatest variety of plants. Describe the amount of sunlight, moisture and temperature at this site.

- Look for a plant with a gall (bumpy growth) on it.

- Find a spider web.

Fill in the chart with evidence of human impact you observed during the scavenger hunt:

Evidence of Human Impact	**Possible Impact on Living Things**

Handout 1.3 - SCHOOLYARD MAP Scoring Rubric

WHAT TO DO:

- STUDY EACH OF THE EXPECTATIONS LISTED IN THE FIRST COLUMN, AND DECIDE WHICH LEVEL MATCHES YOUR SCHOOLYARD MAP. CIRCLE YOUR LEVEL IN EACH FOR EACH EXPECTATION.
- ON THE BACK OF THIS HANDOUT, LIST YOUR PLANS FOR IMPROVING YOUR SCHOOLYARD MAP.

Expectations	Level 1	Level 2	Level 3	Level 4
Map-Making • Map large enough to be clear • Scale is indicated • Map includes a key, a north arrow & date of creation • Map has a white border • Title is printed neatly below the map.	One of the following: • My map is too small or too large • I did not set up my page as required	My page is okay, but the labels are not complete or as neat as they could be.	My page layout follows requirements, but my printing could be clearer and my labels more complete.	My page is laid out as required and provides an attractive presentation.
Accuracy • Is 2- dimensional • Is complete and accurate • Is to scale	My map is not always accurate.	My map is fairly accurate but could include more information.	I used clear, continuous lines to draw what I observe, but sometimes shading isn't clear.	I made a clear, accurate, map of the schoolyard.
Completeness • Map has all of the required elements • Key is complete • Includes: trees, shrubs, mosses, flowering plants	One of the following: • My map lacks some of the elements or details • My labels are incomplete	I did not include all of the relevant details.	I included most details and most labels.	All details are included; all labels are clear and complete.

FOCUS QUESTION 2: ECOSYSTEM PROCESSES

Curriculum Connection

Focusing Question: **What is our schoolyard food web?**
Time Required: Four 45 minute class periods.
General Learner Outcome:

- Trace and interpret the flow of energy and materials within an ecosystem (Alberta Learning 2001).

Specific Learner Expectations:

- Identify biotic (organisms) and abiotic (resources: light, water, nutrients) components within the schoolyard and describe the interactions between these components.
- Identify organisms and their function (producers, consumers, decomposers) within schoolyard food webs.
- Describe processes controlling energy flow within food webs.
- Describe the carbon and water cycles present in schoolyard ecosystems.
- Relate this learning back to what effect the identified human impacts (and management) may have on these resources and consequent changes in food webs over time.

Materials Required:

- Overhead of Schoolyard Map
- overhead markers
- class set of baseline maps
- pencils, permanent markers
- graph/map paper
- whistle
- bug boxes (with magnifiers)
- insect nets / large fish aquarium nets
- Schoolyard Organism ID Cards
- laminated character cards on coloured paper with holes punched and thick elastics inserted into cards (see lesson for cards and numbers)
- cardboard construction paper for game
- example of Snakes and Ladders game
- Snakes and Ladders Scoring Rubric

Assessment Strategy

Using the background information acquired in the scavenger hunt and schoolyard mapping activity the next two activities further define what makes up an ecosystem in general, and provides the background for students to develop a schoolyard food web. In this lesson plan:

- ❑ Students produce an schoolyard food web
- ❑ Students help to create a schoolyard food web game
- ❑ Students create a schoolyard Snakes & Ladders board game.

- Developing a Schoolyard Food Web will gauge students' understanding of schoolyard ecosystem processes of energy flow and cycling of matter.
- Creating and participating in the Schoolyard Food Web Game illustrates understanding of connections between organisms in the schoolyard.
- The Schoolyard Snakes and Ladders board game indicates their understanding of human impact on the Schoolyard Food Web. Their games are assessed using the Snakes and Ladders Scoring Rubric and the Snakes and Ladders Game Design Rubric.

Instructional Strategy

A. Schoolyard Food Web

1. Making the Connections

- Ask students to brainstorm a list of all components of a schoolyard ecosystem they encountered on the scavenger hunt. Use a chart on the whiteboard similar to ***Table 2.1: Schoolyard Components & Processes (Things & Stuff)*** (p. 19) to record responses. List both abiotic and biotic components on the left hand column of the table.

- Ask students how the abiotic (non-living) components might determine what biotic (living) things will be found in a schoolyard ecosystem and how we might be able to measure the relationship between the abiotic and biotic components.

- Discuss the functions carried out by the biotic components of the ecosystem: producers – consumers – decomposers. [Producer – plants that use energy from the sun to make nutrients they need to survive; includes some bacteria that transfer energy from particles; Consumer – organisms that eat the food made by producers; can be herbivores, carnivores or omnivores; Decomposer – organisms that break down the cells of dead or waste materials and absorb their nutrients. Many bacteria and fungi are decomposers.] Go through the biotic components column, and determine primary function of each organism – producer, consumer, or decomposer.

- Ask students to brainstorm what processes transfer energy and cycle matter in a Schoolyard Ecosystem. You may choose to refer to the ***Overhead 2.1: Schoolyard Food Web*** (p. 20) and prompt with questions such as: *How do plants get their energy? What function does bacteria have in an ecosystem? What processes does a water droplet go through in a schoolyard?* Record responses in the right hand columns of Table 1.

- Discuss how food webs that connect organisms ('who eats it', and 'who it eats'), actually illustrates the transfer of energy and cycling of matter between the organisms within an ecosystem. For example, trace the flow of 'sun's energy, through photosynthesis in producers, to consumers, to decomposers in the schoolyard.

2. *Identifying Schoolyard Organisms*

- Take students into the schoolyard and search for organisms that could make up a schoolyard food web. Ask students to complete ***Handout 2.1 – Schoolyard Organism ID Card*** (p. 21), with at least four examples each of producers, herbivores, predators, and decomposers.

- Demonstrate how to record specific features, such as leaf shape, number of body parts, legs, etc. Also demonstrate use of bug boxes and/or small nets for capturing organisms, such as ants or spiders, for investigation. Remind students that their task is to collect, observe, sketch and release the organisms unharmed.

- Upon return to the classroom, ask students to record where the organisms were found on their master copy of the schoolyard map. Also ask students to conduct further research on how the organisms they identified interact with other organisms found in the schoolyard (i.e., 'who it eats' and 'who eats it'), by searching the library and Internet. Instruct students that they will need this information in order to construct a 'Schoolyard Food Web Game'.

B. Schoolyard Food Web Game

1. *Game Set-up*

- Instruct students that they are now going to take on the roles of some of the organisms they found through a Schoolyard Food Web Game to be played in the schoolyard. Ask them to identify the organisms that should be listed in the left hand column of ***Handout 2.2: Food Web Game Framework*** (p. 22) and to share information on what that organism eats.

- Assign groups to make the appropriate number of cards based on your class size using the % of students noted in Handout 2.2. Add enough cards for about 10 extra organisms. This is so that during play, the teacher can play the role of the sun (energy resources). If students run out of cards during the game (and die), the sun can give the students new cards.

- After describing the roles, and constructing the game cards, assign students a role. Hand out a zip-lock bag of the necessary cards per student. Assign appropriate colored 'pinnies' (from Phys. Ed. teacher) to be worn by each type of organism (e.g., Producer – Green; Herbivore – Brown; Carnivore – Red; Decomposer – Black), or colored bandanas/cloth that can be tied to their arm, above the elbow.

- Explain that to succeed in this game; the producers need to collect at least 10 each of energy and water cards from stations (e.g., milk cartons with cards) located throughout the game area. The herbivores and carnivores need to collect as many cards as possible by tagging their identified food source. Once tagged, a student needs to give their own coloured card to the person that tagged them. If they run out of cards, they need to check in with the teacher at a central location in the game area.

- When in the schoolyard, walk students around the game boundaries before the game starts, pointing out any hazards if required and where to meet if they run out of cards. Also indicate that there will be a number of rounds (15 minutes) with different environmental conditions or impacts coming into play for each successive round. Indicate the end of rounds by blowing a whistle and ask them to gather around you after each round to receive the next set of instructions about environmental or human impacts on the system.

- Provide the producers a fifteen second head start in each round to gather energy and water cards and then send out the herbivores, carnivores and decomposers. At the end of each round, add a new element to the game, such as drought (removal of all water stations), unusually cold spring (removal of all energy stations), or addition of tennis courts to the area (removal of part of playing area).

2. ***Assessment***

- After each round, ask the students to count their cards and to comment if they were successful or not, and why or why not. For example, if herbivores captured less than five lives, they do not have enough energy to reproduce, or they lose an additional card of their own due to starvation, etc. Ask the students: *What strategies did you use to avoid being caught? What strategies do the schoolyard organisms use? What strategies did you use to catch your prey? Do other plants or animals in the schoolyard use these strategies?*

- At the end of the game, ask: *What effects would humans have on this game? What if humans changed parts of the schoolyard – i.e., adding a flower garden, baseball diamond, playing field, etc.? What would happen to the food web? Explain.*

C. Snakes & Ladders – Schoolyard Impacts

1. ***Connecting Food Web to Human Impact***

- Explain that the aim of this activity will be to create a game of 'Snakes & Ladders' showing possible relationships between the human impact on the schoolyard and the schoolyard food web or ecosystem processes. Discuss examples of human activity and possible impacts (e.g., flower garden may increase number of flies (pollinators); regular watering may increase number of earthworms found; drought decreasing number of insects found; etc.).

- Ask students to spend the next two classes conducting further research on possible positive and negative impacts of human activity on different components of the food web and ecosystem processes and to create their 'Snakes & Ladders' game showing those relationships. Use ***Handout 2.3: Snakes and Ladders Game Instructions*** (pp. 23-24) as a guideline to build the game.

2. ***Playing the Game***

- Invite each group to join another group and play each other's versions of the game. Ask each group to assess each other's games based on ***Handout 2.4: Snakes & Ladders Game Student Assessment*** (p. 25) while playing the game.

- Randomly choose one or two groups to present their game to the whole class; explaining the relationships between human activity and the food web or ecosystem processes that they identified in their research.

3. ***Assessment***

- Ask each group how they might be able to actually measure the impact of a particular human activity on food webs or ecosystem processes. Response will vary, but this will help frame the next set of lessons on 'Ecosystem Monitoring'. This discussion will lead into the question: *What should we actually count and measure, or monitor, in the schoolyard to assess human impact in the schoolyard ecosystem?*

- Assess each group's game using the ***'Snakes & Ladders' Scoring Rubric*** (p. 26).

D. Extension Activities

Micro Hike Create a micro trail from the trunk of a tree outward to the base of its shaded area. Follow the trail, centimeter by centimeter, observing and recording every tiny object along the route. Draw a profile of the route of the trail. Complete a soil and leaf litter survey for invertebrates along the profile.

Flower Power Observe and identify native flowers. Monitor pollinator populations in natural area and/or flower garden.

Belief in a Leaf Collect and sort leaf samples to determine the plants growing in the natural area. Use the wind to race leaves along a line. Classify leaf shapes according to maximum speed.

What Gall! Search for and investigate galls on plants to see who lives where.

Sort Seeds In September, put wool socks over your shoes, and walk through a natural area, collecting seeds. Sort, identify, and try to grow the different seeds.

E. Teaching Resources

Alberta Program of Studies Recommended Texts:

Science in Focus

- Related Reading: Topic 4 How Organisms Interact: pp. 38-48.
  Topic 5 Cycles in the Environment: pp. 49-55.
- Related Activities: Investigation 1-F: Don't Waste It (using schoolyard soil) p. 46.
  Activity: Checking the pH (using schoolyard water): p. 52.
- Science Log Book: Topic Reviews (put into schoolyard context): pp. 48, 54.

Science in Action

- Related Reading: Topic 2 - The flow of energy and cycling of matter: pp. 26-49.
  Topic 3 -1 Investigating distribution of living things: pp. 51-54.
- Related Activities: Inquiry Activity – Energy Pathway (of a schoolyard): p. 37.
  Inquiry Activity – Food Web (schoolyard) Chain Reaction: p. 40.
  Inquiry Activity – Human Impact on a Schoolyard: pp. 53-54.
- Science Log Book: Research (Earthworms): p. 42 & Focus On (Impacts): p. 48.

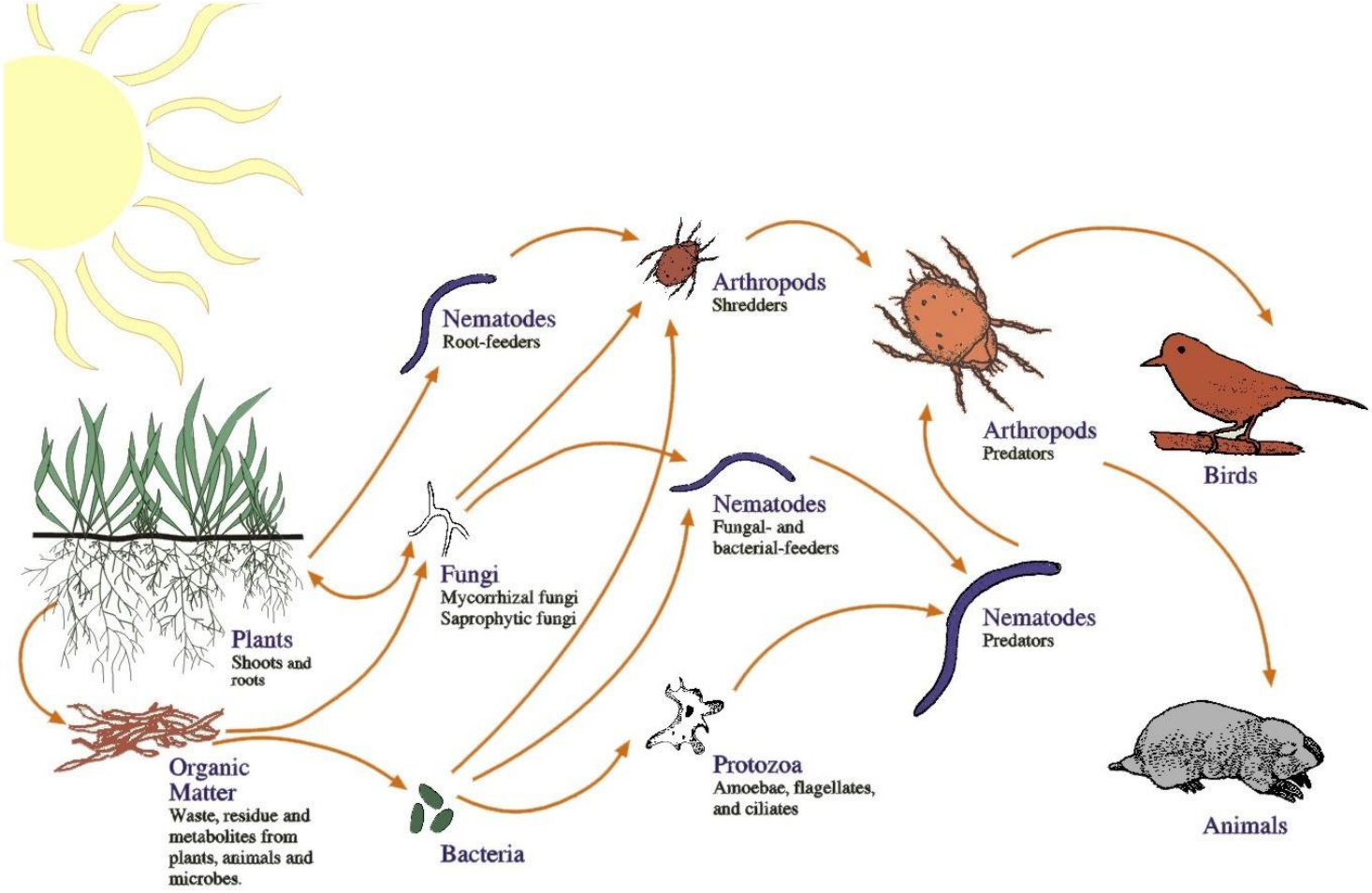
Other Resources:

- *IES – Eco-Inquiry.* Hogan, K. 1994. Kendall/Hunt Pub. Co. Module 1: Who Eats What? Pp. 46-168.
- *Green Teacher Magazine: Issue 71* – Investigating Ants, *Issue 62* – Biosphere Challenge, *Issue 62* - Sidewalk Botany, *Issue 64* – Galls
- *Schoolyard Ecology for Elementary Teachers* (SYEFEST) http://www.ecostudies.org/syefest Quadrat Questions; Schoolyard for Worms? Tree Transects; Percolation Protocol; Beat Sampling; Density; Litter Bags
- *OBIS* Plant Patterns; Super Soil; Food Chain Game

Table 2.1: Schoolyard Components & Processes (Things & Stuff)

COMPONENTS		PROCESSES	
ABIOTIC	**BIOTIC**	**CYCLING OF MATTER**	**TRANSFER OF ENERGY**
Examples: *Soil* *Water* *Gases – oxygen, nitrogen, inert, carbon dioxide, etc.* *Sunlight* *Climate factors: wind, temperature, humidity, etc.*	*Invertebrates: ants, worms, butterflies, hoverflies, caterpillars, moths, bees, wasps, mites, millipedes, sow bugs, spiders, beetles, flies, larvae, etc.* *Rodents – mice, squirrels, voles, etc.* *Other mammals – bats, cats, dogs* *Birds – robins, sparrows, crows, ravens, swallows, chickadees, etc.* *Ground plants – dandelions, grass, moss, ornamental plants, nectar plants, etc.* *Shrubs – roses, dogwoods, willows, lilac, etc.* *Trees – ornamental, conifers (pine, spruce, fir, larch), deciduous (aspen, poplar, etc.)* *Fungi, Bacteria, Organic Matter*	*Water cycle* *Carbon cycle* *Reproduction* *Decomposition* *Nitrogen cycle* *Phosphorus cycle* *Erosion/deposition*	*Predator prey relationships* *Photosynthesis* *Cellular respiration*

Overhead 2.1: Schoolyard Food Web



Adapted From: ***http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html***

Handout 2.1: Schoolyard Organism Identification Cards

Schoolyard Organism ID	**Sketch of Organism**
1. Type or name of organism? 2. Where found? 3. Research: This organism obtains energy from (or eats): 4. Research: This organism is eaten by: 5. Research: They protect themselves from being eaten by:	Identify any special features of the organism; for example, shape or texture of leaf, number of body parts, legs, wings, etc.
Schoolyard Organism ID	**Sketch of Organism**
1. Type or name of organism? 2. Where found? 3. Research: This organism obtains energy from (or eats): 4. Research: This organism is eaten by: 5. Research: They protect themselves from being eaten by:	Identify any special features of the organism; for example, shape or texture of leaf, number of body parts, legs, wings, etc.

Handout 2.2: Foodweb Game Framework

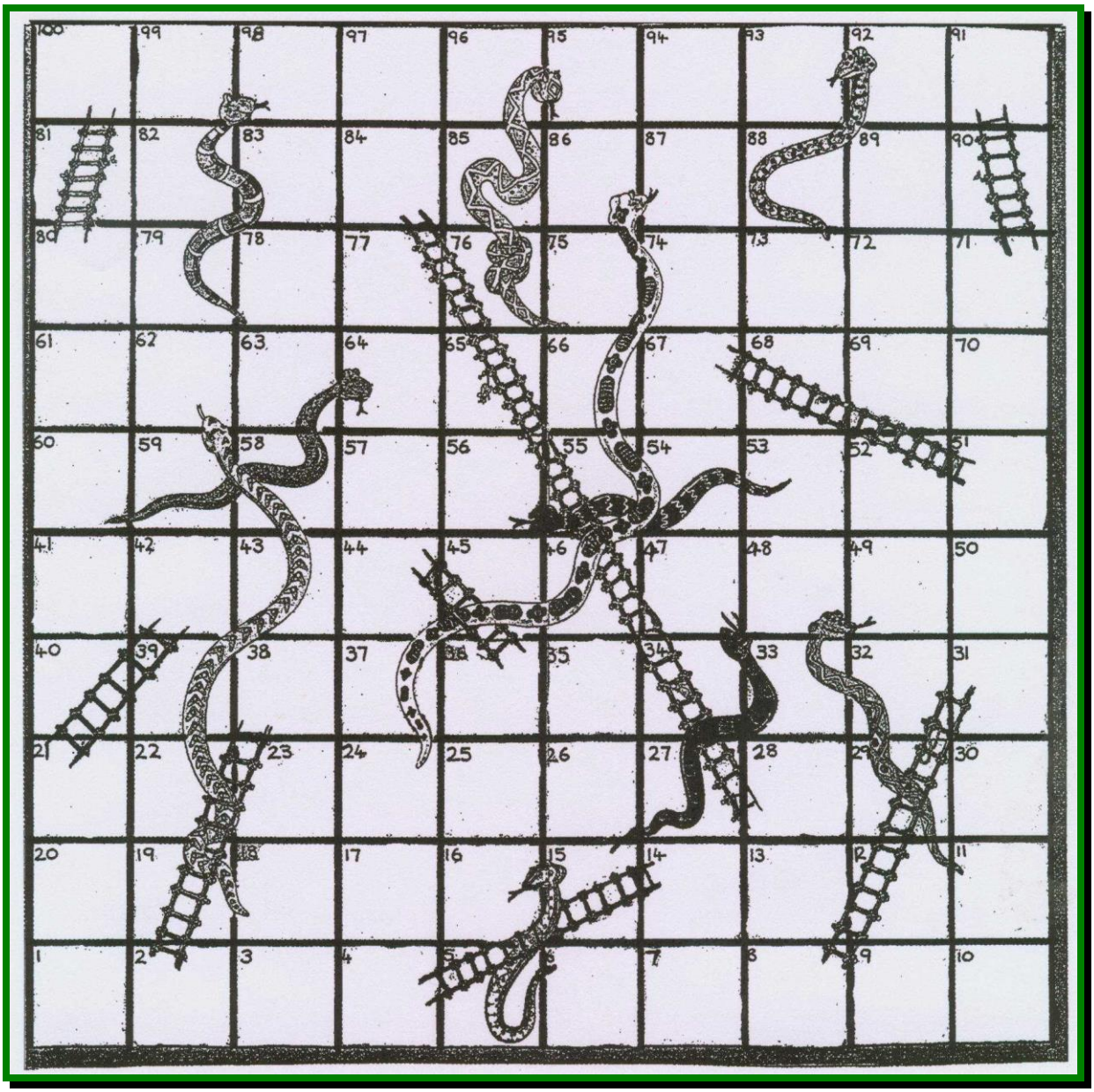
ORGANISM	Number of CARDS	COLLECTS FROM	CHASES WHOM?	CHASED BY
Carnivores (5% of students)	2 Red Cards per organism	Herbivore (Brown) Cards	Herbivores	Decomposers
Herbivores (20% of students)	4 Brown Cards per organism	Producer (Green) Cards	Producers	Carnivores and Decomposers
Producers (70% of students)	8 Green Cards per organism	Energy (Yellow) & Water (Blue) Cards	Collects from Card Stations	Herbivores and Decomposers
Decomposers (5% of students)	No Cards	All Organism Cards (Green, Brown, Red)	All	No one

Handout 2.3: Snakes and Ladders Game Instructions

- **You are working with your team to create a Snakes and Ladders game, based on what is happening in the schoolyard.**
- **You will have one class to research and design the game. Use your text, the library, or the Internet for your research.**
- **You must create a complete rough draft before creating the final game. You will have another class to create your final game board.**
- **Clip art, magazine pictures, or coloured sketches will make your final game board more interesting.**
- **Use the checklist below as you create your game board. Every game must include examples of:**
  - ❑ **Producers**
  - ❑ **Herbivores**
  - ❑ **Carnivores**
  - ❑ **Decomposers**
  - ❑ **Abiotic elements**
  - ❑ **Energy flow**
  - ❑ **Water cycle**
  - ❑ **Carbon cycle**
  - ❑ **Human impacts**
- **Each game should have at least ten different *snakes* and ten different *ladders*. Consider the *snakes* as challenges and the *ladders* as opportunities.**
- **On a separate sheet of paper from the game board, create a key to understanding the meaning of each snake or ladder on your game board. For example:**

SPACE	Challenges (SNAKES)	Opportunities (LADDERS)
4		A small fir tree is trying to grow through a bed of weedy vines. The weeds are hand picked, making more water and sunlight available. Move forward 5 spaces.
23	A woodpecker finds an anthill. Many ants are eaten. Go back 14 spaces.	

Example Schoolyard Ecosystem Snakes and Ladders Game Board



Handout 2.4: SNAKES & LADDERS GAME Student Assessment

Your name: _____

As you play other students games, please fill out this chart:

Whose game are you playing? Students' names: _____
_____

Check off the elements included in the game. Record one example of each element. If an element is missing, mark it with an X.

- ❑ **Producer** **Example: _____**
- ❑ **Herbivore** **Example: _____**
- ❑ **Carnivore** **Example: _____**
- ❑ **Decomposer** **Example: _____**
- ❑ **Biotic components** **Example: _____**
- ❑ **Energy flow** **Example: _____**
- ❑ **Water cycle** **Example: _____**
- ❑ **Carbon cycle** **Example: _____**
- ❑ **Human impacts** **Example: _____**

In your opinion, did the game make sense? In other words, did the 'snakes' represent 'negative' relationships, while the 'ladders' represented 'positive' relationships? Give a score out of ten, and justify it by describing at least two specific examples. Score: _____

The reason I gave this score:

_____
_____
_____
_____
_____

SNAKES & LADDERS GAME DESIGN Scoring Rubric (For Teacher)

Performance Criteria	Level 1	Level 2	Level 3 Acceptable Standard	Level 4 Standard of Excellence
Design Relevance • aware of needs to be met by design	Students need assistance to create design.	Students offer good ideas with some assistance.	Students create a good, functional design.	Students create an exceptional design with both form and function.
Feasibility • develops original design realistic in scope	Students create a design that is not feasible.	Students create a design that is feasible with modifications.	Students understand feasibility in design.	Students create a feasible board game with all design elements.
Rough Draft • makes a working draft with all elements	Students create a rough draft with constant help. Some elements are missing.	Students make a rough draft with frequent help, and a reminder to add all required elements.	Students make a workable rough draft with some help.	Students make a detailed rough draft with all design elements.
Design Process • takes orderly, efficient steps to move from rough to good copy	Students fail to note design limitations, and need constant assistance.	Students need some assistance and may note design limitations.	Students are methodical in creating a final project.	Students use an orderly method to create a complete final project with added touches.
Timing • meets deadline and keeps orderly pace throughout project	Students use time poorly and do not complete on time.	Students meet final timeline, but required pushing.	Students meet deadlines and pace work well.	Students meet deadlines and go the extra mile.

FOCUS QUESTION 3: Ecosystem Monitoring

Curriculum Connection

Focusing Question: **How do we monitor our impact on schoolyard ecosystems?**
Time Required: One 45 minute class period to set up monitoring protocol; on-going class time to collect data; approximately 1 hour/month.

General Learner Outcome:

- Students will monitor local ecosystems and assess impacts of environmental factors on the abundance, distribution, growth, and reproduction of organisms within those environments.

Specific Learner Expectations:

- Investigate and interpret distribution patterns of living things (e.g., dandelions) and evidence of change over time in the schoolyard.
- Design and implement a long-term physical or biological monitoring project to assess rate of change due to human impact in the schoolyard.

Materials Required:

- pencils/permanent markers
- graph/map paper
- class set of copies of Master Schoolyard Map
- meter sticks or hoola-hoops
- spray paint
- a camera to assist in data collection and comparison over time
- trowels for hand-digging dandelions
- 10 copies of *Weed Identification in Alberta*, available free from AB Environment call toll free: 310-0000 (780) 944-0313
- 10 copies of Pesticide Education Program *Weed Kit* and *Vegetation Management Study*, and the *Integrated Pest Management* Plan, available free from AB Environment call toll free: 310-0000 (780) 944-0313

Assessment Strategy

The possibilities for a schoolyard-monitoring program are endless. This lesson focuses on the dandelion, as it is present in almost every schoolyard, and dandelions bring up interesting management issues. In this lesson plan students develop a:

- Schoolyard Dandelion Distribution Map
- Schoolyard Monitoring Program

- A Schoolyard Dandelion Distribution Map will develop skills in estimating abundance and identifying patterns of distribution of dandelions in the schoolyard.
- A Schoolyard Monitoring Program will help students construct an understanding of basic methods to assess change over time in the schoolyard due to changing environmental conditions, human impact, or management.

Instructional Strategy

A. Background Information

Environmental Monitoring is the routine collection, analysis and interpretation of ecosystem variables (what), employing recognized protocol (how), at defined sites (where) over defined times (when), to monitor change in an ecosystem (why). Before initiating a specific monitoring program, the teacher should ask:

- *Why is the data useful? Who is going to use it?*
- *Will our data contribute to a project? Can the data serve as a base for management decisions?*
- *If a protocol for monitoring exists, how was it determined? If there is no protocol, can the students design methods for collecting reliable, replicable data that is useful?*

Baseline data is the information that scientists gather to be used as a starting point for monitoring an ecosystem. Baseline data can also be used to compare changes in an unmanaged versus managed site. For example: dandelion growth, abundance, and distribution over time in a managed area of the schoolyard with an unmanaged area, or nearby natural area.

B. Object of Study: Dandelions

1. A Weed or Not?

- Begin the lesson by writing the word *dandelion* on the board. Ask the students to brainstorm what they know about dandelions and what they want to know about dandelions (i.e., what they do not know). Save the discussion about what *weeds* are until later. Give students time to research information about identification and life cycles of dandelions. A good web site with line drawings is found at: http://www.ipm.ucdavis.edu. All might be very surprised to learn that the common species of dandelion found in schoolyards and backyards are an introduced species to the area.

- Ask students: *What is a weed?* (Weeds are plants that grow where humans don't want them.)Ask: *Why do weeds thrive in areas where lawns, gardens and crops may have a hard time growing?* (Weed species, especially introduced species, like the dandelion, are well-suited to the environmental conditions of an area and have the extra advantage of having no natural controls such as insects and disease which exists in their native areas.) Ask: *What adaptations do dandelions have that help them survive in most areas?*

> Dandelions have deep perennial taproots to reach water and little parachutes in the seeds to catch the wind, ensuring widespread dispersal.

- Discuss basic aspects of Alberta's Weed Control Act; i.e., what weeds are; types of weeds; classification of weeds (e.g., nuisance, noxious). Dandelion is classified as a nuisance weed.

Nuisance weeds are widespread and will likely never be eradicated. Herein lies further discussion in the next lesson on how to manage dandelions (or not).

2. ***Dandelion Monitoring***

- Ask students how they might be able to count and measure abundance and distribution of dandelions in the schoolyard, without having to count every dandelion in the schoolyard. Provide them with time to develop a number of strategies or methods, discuss as a class, and choose one method that will provide repeatable, replicable data from year to year. [Note: Students will develop methods very similar to 'quadrats', 'transects', random plots, etc., as they discuss alternative methods.]

- Introduce the concept of monitoring. Discuss with students that they are going to design a dandelion-monitoring project to monitor population change in a managed and unmanaged area. For example, students can hand-dig the dandelions from one of the schoolyard sites; to see what impact this type of human management has on dandelion populations. Ask: *How long do we need to collect data before we can see an impact on the human management of the hand-dug plot?*

- Make three one-meter square quadrats using meter sticks or string and stakes. Choose suitable locations for your study – at least ten meters from a building. Mark the sites with spray paint, so they are easy to re-locate. Tell the students to randomly toss a pebble or pencil into the study area, placing a corner of the quadrat where the pencil lands. Ask the students: *Why did we choose our plots by randomly throwing a pencil?*

- Ask students to create a chart in their notebook to record not only dandelions, but other plant species as well. For example:

Species	**Quadrat**					**Average number of individuals per m²**
	1	**2**	**3**	**4**	**5**	
Dandelion	*7*	*6*	*7*	*6*	*10*	*7.2*
Plantain	*5*	*2*	*6*	*8*	*12*	*6.6*
Clover	*2*	*0*	*3*	*2*	*0*	*1.4*

- Use plant identification keys to fill in the chart, adding plant names as required. See *Science in Focus* text for further plant identification resources.

- Use a camera as another tool for data collection. Ensure the photos are developed and stored with each appropriate data set.

3. Assessment

- Ask students to address the following questions using their field data:
    - *Does dandelion density vary from place to place within the study plots? What might account for these differences?*
    - *How do the dandelion populations in each study plot change over time?*
    - *What impact did the cultural control (digging up the dandelions) have on that population?*
    - *What other variables could you change to monitor human impact on dandelions? What happens if you create a shade barrier near the dandelions? What happens if a tarp is placed over the plots? Etc.*

C. Extension Activities

Here are more resources and ideas for local monitoring projects:

International Centre for Conservation Education has produced an excellent resource for making and using low cost equipment for investigating and monitoring schoolyard ecosystems. The title of the publication is: International Centre for Conservation Education. (No Year). *Environmental Education Activities for Primary Schools: Suggestions for Making and Using Low Cost Equipment.* Environmental Education Series 21. UNESCO-UNEP International Environmental Education Programme (IEEP) *http://portal.unesco.org/education/*.

Plantwatch is a monitoring program that uses phenology, the study of the seasonal timing of life cycle events, to link students as the "eyes of science", tracking the green wave of spring moving north. Students monitor the flowering of up to eight plants and report the bloom times to scientists over the Internet. Resulting maps are posted weekly to the Internet. Teacher manuals illustrate the plants, their distributions, and describe the program and curriculum connections. Schools can establish 'Plantwatch Gardens', planting some of the key indicator species. The "How to Plantwatch" manual is available for teachers: *www.discoveredmonton.com/devonian/research*. PlantWatch is also part of the Canadian Nature Federation's Nature Watch series of volunteer monitoring programs: *http://www.cnf.ca/plantwatch/dande.html* or *http://www.web.net/~cnf*.

Moth and Butterfly Survey Canadian Wildlife Federation, 2740 Queensview Drive, Ottawa, ON K2B 1A2 1-800-563-2286 or e-mail: info@cwf-fcf.org or web: www.cwf-fcf.org

Lady Beetle Survey This Nature Canada program surveys the abundance of native ladybird beetles, as compared with invasive species. Contact: *www.cnf.ca*.

Journey North An online program that gathers information about spring's journey northward. Students contribute by reporting local signs of spring, such as first butterflies and blooming flowers. Contact them through: *http://www.learner.org/jnorth*.

Ecowatch Affiliated with Environment Canada's Ecological Monitoring and Assessment Network, Ecowatch ensures that volunteer programs collect scientifically valid data with reliable protocols. For more information, check: *www.cciw.ca/eman-temp/ecowatch/*.

BIT Challenge The Bird Identification and Tally (BIT) Challenge is a bird tally that takes place the last weekend in May. Contact the SEEDS Foundation at: www.greenschools.ca/seeds.

Frog Watch! For more information about frog monitoring in your area, click on the National Frogwatch Web site at: *http://www.cciw.ca.emanops/*. To learn more about the amphibians of Canada, check out the Web site of the Canadian Amphibians and Reptile Conservation Network at *http://www.cciw.ca/ecowatch/dapcan*.

Project FeederWatch Participants collect and submit data on the birds visiting their feeders between November and March. Curriculum package and identification tips and visuals are available. To learn more, contact *www.bsc-eoc.org*.

E. Teaching Resources

Alberta Program of Studies Recommended Textbooks:

Science in Focus

- Related Reading: Topic 6 Succession and Change in Ecosystems: pp. 56-57.
  Topic 7 Environmental Monitoring: pp. 61-81.
- Related Activities: What is the Change: p. 71
  Monitoring Amphibians: p. 72.
  Comparing Ecosystems: p. 76.
- Science Log Book: Topic 6 & 7 Review (in a schoolyard context): p. 67.

Science in Action

- Related Reading: Topic 3 – Changes in ecosystems: pp. 50-65.
- Related Activities: Inquiry Activity – The Schoolyard: p. 52.
- Science Log Book: Check & Reflect: pg 54, 60; Research: Non-native species, p. 57.
  Focus On (Designing monitoring project): p. 65.

Other Resources:

- Pesticide Education Program *Weed Kit* and *Vegetation Management Study*, and the *Integrated Pest Management* Plan, available free from AB Environment call toll free: 310-0000 (780) 944-0313 or *www.gov.ab.ca/env/*
- *Schoolyard Ecology for Elementary Teachers* (*www.ecostudies.org/syefest/ap1res6.htm*): Impacts of schoolyard Traffic: Mapping a Daily Path through the Schoolyard; Quadrat Questions; Schoolyard for Worms? Tree Transects; Percolation Protocol; Dandelion Determinations
- *OBIS* – Out of Control (succession study of lawn); Impacts of Schoolyard Traffic
- *Dandelion* Barrie Watts, Silver Burdett Press, New Jersey. 1987 ISBN # 0-382-24016-2
- *Backyard Nature* is a website full of good resources. Please see: *http://www,backyardnature.net/index.html*
- *Prairie Restoration for Wisconsin Schools* – See What Transpires (p. 40); Prairie Invertebrate Survey (appendix 7)
- *Urban Weed Watch* –a database about weed distribution and management practices *http://www.gardenmosaics.cornell.edu/pgs/edmanual/invest/weedmenu.htm*
- *Choosing and Environmental Monitoring Program: a survey of the types of monitoring programs available to school and community groups.* Green Teacher 55: 6-10
- *Pest Notes – Dandelions* University of California, *http://www.ipm.ucdavis.edu*.

FOCUS QUESTION 4: Ecosystem Management

Curriculum Connections

Focusing Question: **How do we manage schoolyard ecosystems?**
Time Required: Three 45 minute periods.
General Learner Outcome:

- Students will describe the relationships among knowledge, decisions and actions in maintaining life-supporting environments.

Specific Learner Expectations:

- Identify the intended and unintended consequences of human activity and management of schoolyard ecosystems.
- Describe and interpret science investigations, research and policy used to inform schoolyard management plans.
- Analyze issues arising from and consequences of actions such as: introduced species, paved schoolyards, schoolyard restoration projects, or pesticide use from scientific and ethical perspectives.

Materials Required:

- pencils/permanent markers
- Pesticide Education Unit – Student Materials www.gov.ab.ca/env/
- reference resources – access to Internet
- *Decisions & Consequences* Game Board (Black Line Master 1)
- game pieces, dice
- decision cards (Black Line Master 2)
- chance cards (Black Line Master 3)
- class set of copies of Master Schoolyard Map
- overlays of dandelion distribution

Assessment Strategy

Schoolyards present students with some of the most intriguing questions and dilemmas of ecosystem function and management in an urban setting. *How are schoolyards used? Are all schoolyards the same? How are schoolyards managed, for whom, and for what purpose? What are the advantages and disadvantages of various management strategies? Has schoolyard management changed over time?* In this lesson students will develop:

- ❑ Management Definitions and Examples
- ❑ *Decisions & Consequences* Game Rubric
- ❑ Schoolyard Management Plan

- Management Definitions and Examples will illustrate students' awareness of the different management approaches.

- The *Decisions & Consequences* Game Rubric assesses their ability to analyse management options in a board game format.
- The Schoolyard Management Plan indicates that students are aware of possible management scenarios, and can choose appropriate options for the school site.

Prior to this class, it is recommended that the teacher obtain free student and teacher materials from student materials from the Alberta Environment *Pesticide Education Program*. The Pesticide Education Program *Weed Kit* and *Vegetation Management Study,* and the *Integrated Pest Management* Plan, are available free of cost from AB Environment call toll free: 310-0000 (780) 944-0313 or order on line at: www.gov.ab.ca/env/.

Instructional Strategy

A. Developing a Management Plan

1. Exploring Student Ideas

- Using the information gathered in the monitoring project, work with the students to create a graph showing population change at each site over time. Ask: *At which of the three sites, did the population change the most? What are possible reasons for the population change?*

- Brainstorm possible ways of managing schoolyard dandelions. Next to each possible management method, record student ideas for possible pros and cons.

2. Management Plan Research

- Distribute student materials from Alberta Environment Pesticide Education Program (Pesticide Education Program *Weed Kit* and *Vegetation Management Study,* and the *Integrated Pest Management* Plan, available free from AB Environment call toll free: 310-0000 (780) 944-0313 or www.gov.ab.ca/env/). These materials will provide students background information on management practices.

- Discuss objectives of Integrated Pest Management (IPM), the current 'best practice' in maximizing the control of a pest while keeping impact to other species at a minimum. An IPM uses physical, cultural, biological and chemical practices by choosing the best combination of options with the least environmental impact.

- Using their texts and reference materials from the Pesticide Education Program ask students to define: *introduced species, herbicide, pesticide, integrated pest management plan, physical controls, cultural controls, biological controls and chemical controls.* Ask them to include a specific example for each term.

Physical controls include: screening, netting, removing nests and sites, hand digging weeds, picking seed heads, high pressure water spray, boiling water, flame weeding, etc.
Cultural controls include management practices such as: companion planting, native plant gardening, crop rotation, mulching, using tarps to shade out weeds, aeration, etc.
Biological controls include: predators, such as lady bird beetles; pathogens, which are disease causing organisms, such as *Bacillus thuringiensis* (Bt) that produce a toxin to kill caterpillars; and parasites, which live within the body of other organisms, such as types of flesh flies that lay their eggs inside caterpillar cocoons.
Chemical controls include every chemical practice from 'natural products' such as pyrethrum (a highly toxic insecticide that comes from chrysanthemums), to dish soap sprays, low toxicity fatty herbicides and persistent chemicals such as DDT.

3. Asking the Experts

- Divide the students into three 'expert' groups to research possible management practices: physical and cultural controls; chemical controls; biological controls.

- Refer them to municipal resources such as the City of Calgary website at: *http://content.calgary.ca/CCA/City+Hall/Business+Unites/Parks/Integrated+Pest+Management/Integrated+Pest+Management* or the City of Edmonton's website at: *www.edmonton.ca/portal/server.pt/gateway/PTARGS_*. The Calgary Zoo's horticulturist at: *www.calgaryzoo.org* will also be of assistance. Another good website is: *www.pestinfo.ca*. It may be possible to obtain information on your specific site management policy from your school maintenance team.

- Each expert group's research should include: a definition of the management practice; reasons for its use; examples of how it is used; negative and positive results of the practice if used on school sites.

- After each expert group has completed their research, have each group summarize their findings on a fact sheet. Photocopy the fact sheets so that each member of the expert group has this information.

- Now rearrange students so that new groups consist of an expert from each 'school' of management. Ask each expert to present their findings to their new group.

- After every expert has had a chance to present, ask each group to vote on the management practice they deem most appropriate for schoolyard dandelions. Have a spokesperson from each group present their findings, with justification to the class.

B. Exploring Decisions & Consequences

1. *Decisions & Consequences Game*

- Divide the class into groups of four students and play ***Decisions & Consequences***[1]**.** The game is played as follows:
    - Photocopy one set of ***Black Line Master 1: Game Board*** (p. 37) per instructions for preparing the game board, decision, and chance cards.
    - Students place their game pieces on the start square and roll the dice. Whoever rolls the highest number begins the play. Play continues in a clockwise direction.
    - The first player rolls the dice and moves the appropriate number of spaces.
    - When a player lands on a Decision Card space, the player to their right reads the left hand side of the decision card out loud. The player chooses an option and the student to the right, reads the whole consequence card. The player then moves the appropriate number of spaces.
    - If the player lands on a Chance Card, they pick it up, read it aloud, and move the number of spaces indicated on the card. As an option, have each student record the web site on any Chance Cards, visit the site and report on site contents to the class, or do this as homework.
    - If a player lands on a square with no cards, his/her turn is over and the play proceeds to the player on his/her left.
    - The first player to reach the Winner Square wins the game.

2. *Assessment*

- Using all of the acquired information about ecosystems, and specifically dandelion populations, have each student use the Master Schoolyard Map, and Dandelion Distribution overlay to create a Schoolyard Management Plan. Stress that any plan may be acceptable, as long as the information is justified by evidence.

E. Teaching Resources

Alberta Program of Studies Recommended Texts:
Science in Focus

- Related Reading: Topic 3 Environmental Choices: pp. 29-37.
- Related Activities: Find Out Activity: Mapping Home (using schoolyard) pg. 36.
  Unit 1 Issue – A Debate (adapt to schoolyard) pp. 82-83.
- Science Log Book: Pause and Reflect (in a schoolyard context): pg. 87.
-

[1] ***Decisions and Consequences*** is based on a game entitled *Landopoly: A Decision-Making Game* developed by Michigan State University Extension for their *This Land is **Your** Land* education program: http://web4.msue.msu.edu/msuewc/kent/yourland/. This activity is based on *Hydropoly* (pp. 260-265) from *WOW! The Wonders of Wetlands* and is adapted with permission from Environmental Concern Inc. For further information contact Environmental Concern Inc. at (410) 745-9620 or visit: http://www.wetland.org.

Science in Action

- Related Reading: Topic 4 – Maintaining Sustainable Environments: pp. 67-87.
- Related Activities: Project – Design a Land Use Plan (for a schoolyard): pp. 86-87.
- Science Log Book: Check & Reflect: pp 75, 77.
  Focus On (Planning): pg. 83.

Other Resources:

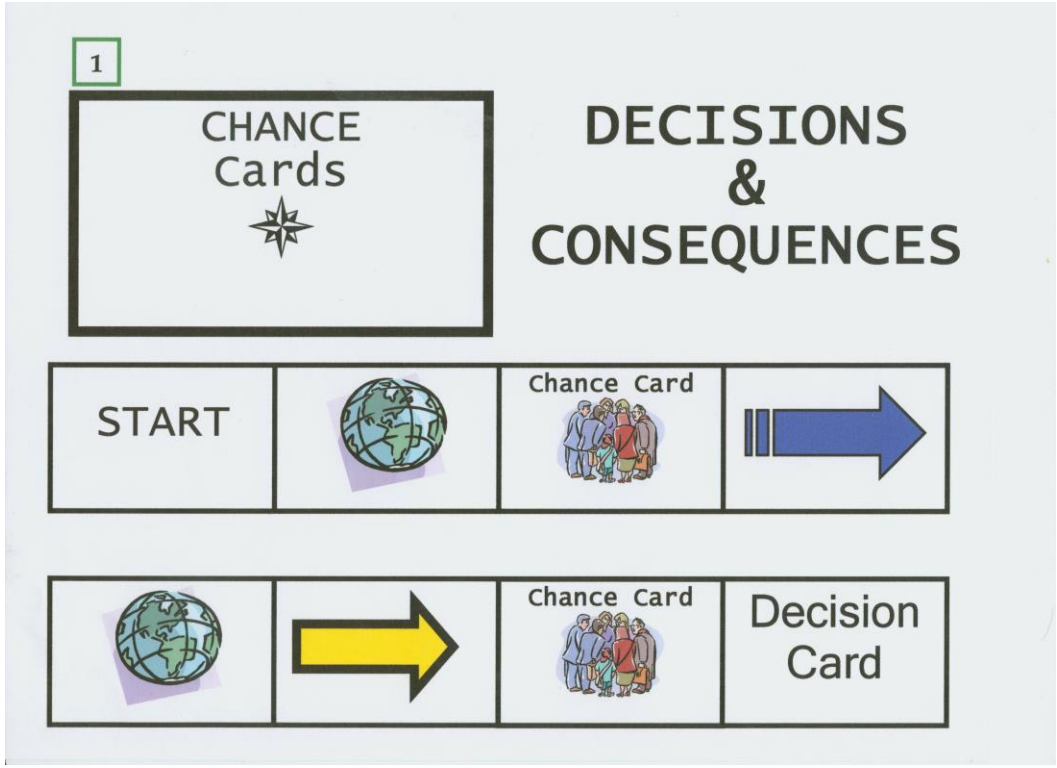
- Pesticide Education Program *Weed Kit* and *Vegetation Management Study*, and the *Integrated Pest Management* Plan, available free from AB Environment call toll free: 310-0000 (780) 944-0313 or *www.gov.ab.ca/env/*
- *Schoolyard Ecology for Elementary Teachers* (SYEFEST) Nature Preserves: Is Bigger Better? *http://www.ecostudies.org/syefest/ap1hunt.htm*.
- *IES – Eco-Inquiry*. Hogan, K. 1994. Kendall/Hunt Pub. Co. Module 1.9: Environmental Impact Statement: pp. 156-162.
- City of Calgary website integrated pest management plan: *http://content.calgary.ca/CCA/City+Hall/Business+Unites/Parks/Integrated+Pest+Management/Integrated+Pest+Management*
- City of Edmonton integrated pest management plan: *http://www.edmonton.ca/portal/server.pt/gateway/PTARGS*

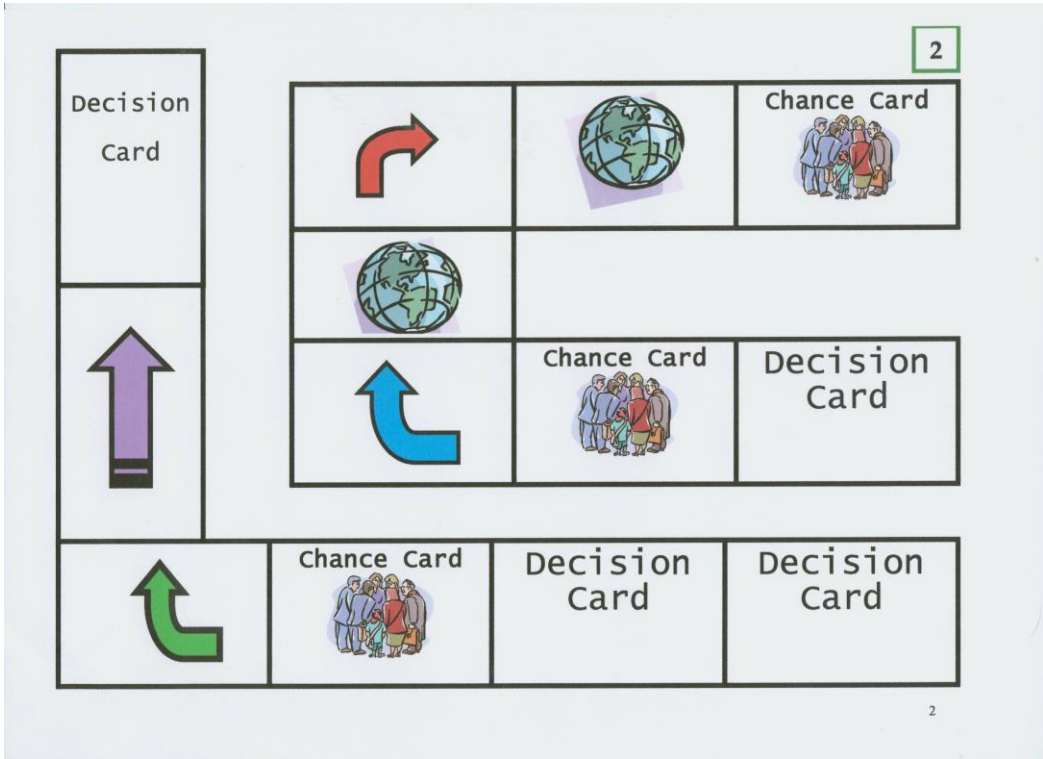
Black Line Masters 4.1: *Decisions & Consequences* Game

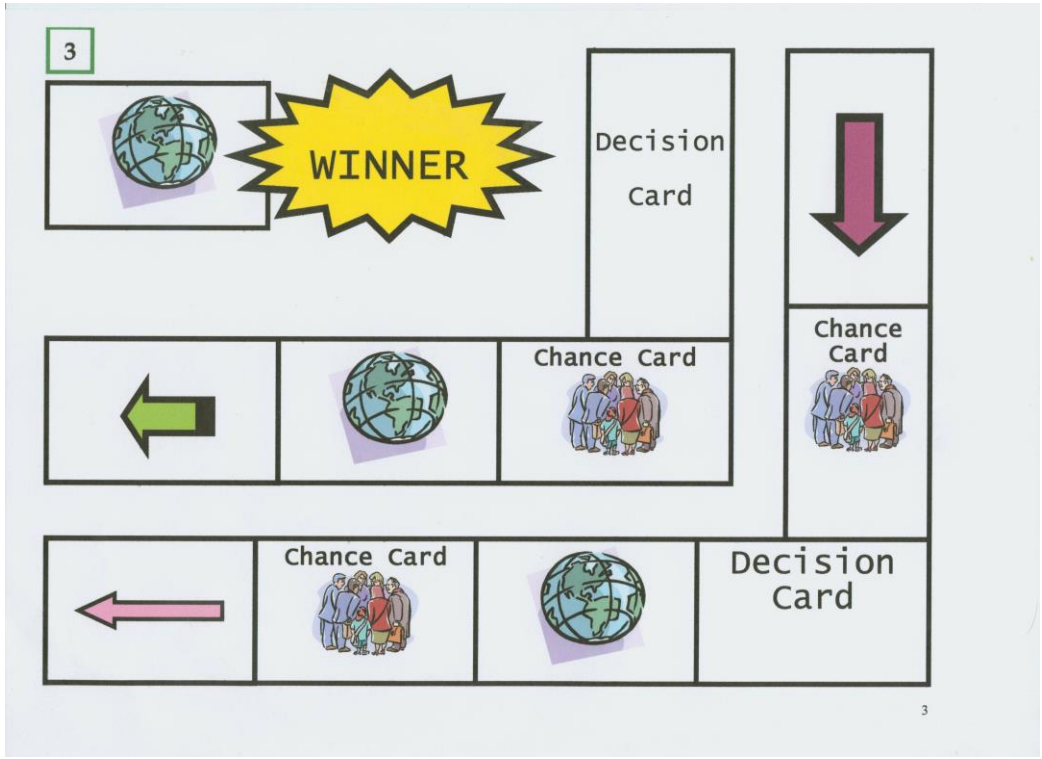
- Photocopy the Game Board Quadrants (pp. 38-41); trim the edges and paste together as shown:

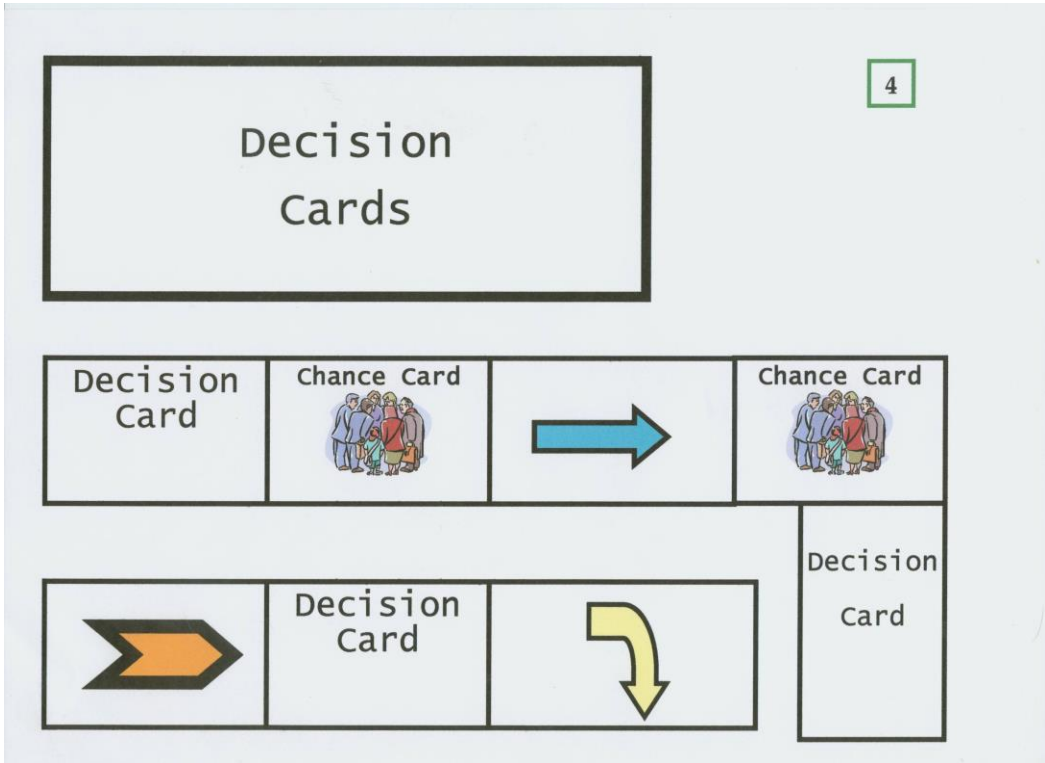
Quadrant 1	Quadrant 4
Quadrant 2	Quadrant 3

- Photocopy and cut out a set of ***Black Line Master 2: Decision Cards*** (p. 42-52) and a set of ***Black Line Master 3: Chance Cards*** (pp. 53-56) for each game table. Fold the Decision Cards in half and place the cards Decision side up on the game board. Place the Chance Cards face down on the Chance Card space on the Game Board.









Black Line Master 4.2: Decision Cards

Now You Decide… There is a proposal to add a soccer field to the schoolyard. You get to decide if the soccer field should be built: a) In an area that is currently paved. b) In an area that currently is left 'wild' and uncut.	**Consequences**: a) If you decide to put a soccer pitch in an area that is currently paved, you haven't removed any natural habitat. Move ahead three spaces. b) If you put the soccer field in the wild area, you remove diverse habitat for birds, rodents and insects and replace it with a single species of grass that will be hard packed after use. Go back two spaces.

Now You Decide… The parent council has a surplus this year and has decided to donate part of the money for schoolyard enhancement. As a member, you get to decide if it will be spent on: a) Tulip bulbs and other exotic ornamental gardens for the school entrance. b) An area for native trees and shrubs. Both options will cost the same. Which one will you support?	**Consequences**: a) If you decide to plant tulips and other exotic plants, you beautify the schoolyard but this type of garden requires inputs of fertilizer, herbicides, and on going watering to support it. Miss a turn. b) Native trees and shrubs provide habitat (including food) for native birds and insects. Once established, this type of planting requires little maintenance. Move ahead two spaces.

Now You Decide… The student council has decided to put a temporary ice rink on the grass this year. Give two examples of how this might have an impact on the current schoolyard ecosystem (the impacts can be both positive and negative)..	**Consequences:** • A temporary rink will compact the grass under the rink, reducing the soil percolation and changing the drainage of the area. • Snowdrifts, created by snow removal, may provide habitat for rodents. In addition, the snow piles may provide a moisture source later in the spring, as they take longer to melt than snow that's not piled. • Increased winter use of the site (it will probably be used on weekends and evenings) may reduce wildlife use in off school times. • Increased use of the site may increase litter. If the other players agree that you were able to determine two realistic impacts, move ahead two spaces. If you didn't provide examples, stay where you are.

Now You Decide… Your school is next to an off-leash area. Some people think the school should erect a sign indicating that no dogs or pets should enter the schoolyard. Looking at the schoolyard ecosystem, give two reasons how dogs can impact this ecosystem. (The impacts can be positive or negative.)	**Consequences:** Any of these two ideas (and probably more) are possible impacts: • Domestic pet waste is a hazard for humans. Humans are part of the schoolyard ecosystem. • Domestic pets can scare other wildlife from the school site. For instance: cats scare birds away. • Pet urine may kill soil organisms. • Pet waste breaks down, eventually, providing organic matter for soil. If the other players agree that you were able to determine two realistic impacts, move ahead two spaces. If you didn't provide examples, stay where you are.

Now You Decide…

Neighbours have complained about the spreading dandelions on school property. You are part of a team that will decide on a course of management. What should you do?

a) Determine what solution will work within an integrated pest management (IPM) plan.

b) Arrange for an application of a pesticide.

c) Wait until it really rains, and organize a crew to hand dig the dandelions. Plan on repeating this activity often.

Consequences:

a) An integrated pest management (IPM) plan uses an ecological approach to vegetation management that strives to reduce reliance on pesticides. Using cultural practices, such as deep watering, allowing the grass to grow up to two inches, and flame weeding, to improve long-term vegetation health can reduce pesticide use. Healthy grass can compete successfully with weeds, such as dandelions. If you chose this option, move ahead three spaces.

b) Pesticides are an effective means of controlling dandelions, but they should be used only if chemical controls are necessary. Pesticides are poisons. Fatty herbicides are of low toxicity and are most effective if applied while weeds are in an active growing phase before seeds are produced. If you chose this option as your only choice, stay where you are.

c) Hand digging dandelions is a lot of work, and must be repeated frequently for success. This approach, together with other cultural practices can work to remove dandelions, but requires a commitment of volunteers. Move forward one space.

Now You Decide… The community association that owns the land around your school wants to erect a large fence around the schoolyard. Your school is next to a large natural area. What type of fence will have the least impact on the current schoolyard ecosystem? a) A chain-link fence that doesn't shade the area, with two open gates on each side. b) A three-meter high, solid wooden fence with swing gates. c) Planting dense shrubs around the perimeter of the site.	**Consequences:** a) A chain link fence shouldn't change the sun and shade patterns very much. Frequent gates will provide access for wildlife already using the schoolyard. Move ahead three spaces. b) A solid fence will reduce the sunlight reaching the schoolyard site, and alter vegetation and snow drift patterns. Swing gates will prevent wild mammals from entering the schoolyard. Go back two spaces. c) Dense shrubs will attract wildlife, such as birds and insects. This will likely alter the schoolyard ecosystem. Although the impact of this choice is probably beneficial for wildlife, it's not a 'no impact' choice. Go ahead one space.

Now You Decide… The lunchroom supervisors have been keeping a worm bin for dealing with organic waste. It's been a huge success! Now the bin needs to be cleaned and the worms need to be divided into three new bins. What should happen to the extra worms? a) They should be put into new bins with bedding and keep decomposing food waste as before. b) They should be put into the school garden so they can aerate the soil.	**Consequences:** a) If you decided to keep the worms in new bins and have them do the job of indoor composting, you've made the right choice. The compost from a worm bin can be added to gardens later. Move ahead three spaces. b) Worm composters use red wriggler worms. They're not native to Alberta. Putting them in the garden may displace native decomposers and permanently introduce a new invasive species into the ecosystem. Go back three spaces.

Now You Decide…

The trees in your schoolyard are infested with insects that threaten to kill them. Some people think that using a biological control is the only way to solve this problem. What is a biological control? What are two possible long-term issues that the use of a biological control could create?

Consequences:

A biological control is the use of living organisms (use as parasites, predators or pathogens) to reduce or maintain pest populations to an acceptable level. If you answered this question correctly, move ahead three spaces. If not, stay where you are. Possible long-term effects of biological controls are:

- Introducing a new living organism into the ecosystem may alter ecosystem relationships.
- Introducing a pathogen as a biological control may have unintended consequences.
- Introducing predators as biological control agents may reduce prey populations to unsustainable numbers.
- Humans have little control over biological controls once they have been introduced.

If the other players agree that you were able to determine two long-term effects, go ahead two spaces. If you couldn't, stay where you are.

Now You Decide… Your school is moving to a brand new building that is being constructed at the edge of town. When preparing the site for construction, the contractors have a number of choices to make; for example: a) Remove all existing vegetation to level and landscape the area; b) Build around existing vegetation; although this is more expensive. Which choice would have the least impact on the ecosystem. Give two arguments for your choice.	**Consequences:** • If you chose leveling the area, stay where are. This option will have the most impact on the current site. • If you chose to build around the existing vegetation, go ahead 1 space. If you can provide 2 good arguments to do so, move ahead 2 more spaces.

Now You Decide…

The school needs money for a student exchange to Australia! What a great adventure it will be for you and your best friends! Parent council suggests one way to save the money would be to reduce the area of the schoolyard that needs to be maintained to half its size by paving it. The paved area could become tennis and basketball courts. But wait a minute. What kinds of impact will this have on the whole schoolyard? Your job is to report back to the committee on three possible impacts of paving half of the schoolyard.

Consequences:

Some of the possible impacts include:

- Loss of habitat for wild communities.
- Change in drainage for the site, with possible long-term implications.
- The recreation courts will attract more human use and change human use patterns, such as current pathways.
- Possible use of lighting on the courts will alter wildlife use patterns.

If the other players agree that you were able to explain three possible impacts of this action, move ahead three spaces. If you provide two arguments, move ahead two spaces. If you provide just one argument, go ahead one space. If you have no idea how this might impact the schoolyard, go back five spaces.

Now You Decide… Student council has decided to hold a fundraiser. You can either vote to: a) Host a dance for the three nearby junior high schools in your gym. b) Have a celebrity birdhouse-building contest. Local celebrities are invited to build and paint birdhouses that will be auctioned off to the highest bidder and placed around the school site.	**Consequences:** a) This event will likely have no consequences for the schoolyard. Move forward one space. b) This event will add birdhouses to the site, perhaps enticing nesting birds. Move ahead three spaces.

Now You Decide…
The school baseball field is full of weeds. What is one possible solution to this problem? If you apply this solution, what are the consequences for the nearby ecosystem?

Consequences:
Solution: apply pesticides.
Possible Consequence: kill weeds, kill other soil organisms, human health impacts, possible long term changes

Solution: till inner field, water and hand weed, apply ten centimeters red shale chips, monitor and prepare to repeat
Possible Consequence: remove weeds, (thereby removing some habitat), volunteer fatigue

Solution: flame weed with a drip torch, apply ten centimeters of red shale, monitor and prepare to repeat
Possible Consequence: kill weeds and soil organisms, safety concerns
If the other players agree that you were able to provide a good solution for improving the ball diamond, move ahead two spaces. If you didn't provide these arguments, go back one space.

Black Line Master 4.3: Chance Cards

Chance Card
You notice a ladybug larva on the school building. Want to learn more? Go to: Lady Beetle Survey. The Canadian Nature Federation surveys the abundance of native ladybird beetles, as compared with invasive species. Contact: www.web.net/~cnf Move forward two spaces.

Chance Card
It snowed light, fluffy snow last night, and it was cold outside! The snow provides insulated habitat for mice and voles. If you can state one thing that might eat one of these creatures, move ahead two spaces. If you can't, miss a turn.

Chance Card
Name three of the processes within the water cycle. Move ahead three spaces.

Chance Card
It's been raining for weeks! This is great news for all of the mosquitoes that require stagnant water for their eggs. Move ahead two spaces.

Chance Card
Describe what happens to a leaf when it dies and falls on the ground. What type of decomposers might go to work on a leaf? Move ahead one space.

Chance Card
It's spring! Name one of the signs of spring that you can see in the schoolyard. Want to know more? Visit Journey North, an online program that gathers information about spring's journey northward. Students contribute by reporting local signs of spring, such as first butterflies and blooming flowers. Contact them at: http://www.learner.org/jnorth Move ahead two spaces.

Chance Card
It's August in your school garden. Last year you planted native flowers, such as hairy aster and purple fleabane. Now your garden is alive with zebra butterflies. They love these flowers. Want to learn more? Go to the Moth and Butterfly Survey Canadian Wildlife Federation - e-mail: info@cwf-fcf.org or web: www.cwf-fcf.org Move ahead two spaces.

Chance Card
What evidence is there that photosynthesis takes place in the schoolyard? Want to know more? Go to: PlantWatch. It is part of the Canadian Nature Federation's Nature Watch series of volunteer monitoring programs. Learn more at: http://www.cnf.ca/plantwatch/dande.html

Chance Card
Quick! Where is the nearest wetland ecosystem to the school? Do frogs live there? What kind of habitat do you think that frogs like? Want to know more? Go to: Frog Watch! For more information about frog monitoring in your area, click on the National Frogwatch Web site at: http://www.cciw.ca.emanops/. To learn more about the amphibians of Canada, check out the Web site of the Canadian Amphibians and Reptile Conservation Network at http://www.cciw.ca/ecowatch/dapcan. Hop ahead two spaces.

Chance Card
Name two birds that frequently visit your schoolyard. Want to know more? Go to: BIT Challenge The Bird Identification and Tally (BIT) Challenge is a bird tally that takes place the last weekend in May. Contact the SEEDS Foundation at: www.greenschools.ca/seeds Fly ahead two spaces.

Chance Card
What are two different animals that migrate through (or near) your schoolyard? Want to know more? Go to: Journey North. It is an online program that gathers information about spring's journey northward. Students contribute by reporting local signs of spring, such as first butterflies and blooming flowers. Contact them through: http://www.learner.org/jnorth Move forward one space.

Chance Card
It's a hot day in June and some kids just poured their cola on the ground. The ants living there are using a lot of energy trying to move their eggs. Go back two spaces.

Chance Card
It's a cold and blustery day in February, and some kids just pulled down two large branches from a schoolyard spruce tree. Now the small birds will have to use up extra energy for protection against the wind. Move back two spaces.

Chance Card
Some kids think that the only reason worms exist is for fishing. Give three ways that worms might be connected to other creatures in the schoolyard. Want to know more? Go to: Worm Watch at Agriculture and Agri-Food Canada in the Lethbridge Research Centre. If you can give the connections move forward two spaces. If you can't move back two spaces.

Chance Card
Your school has set up bird feeders and you're amazed at the variety of birds that come to visit. Want to know more? Go to: Project FeederWatch. Participants collect and submit data on the birds visiting their feeders between November and March. Curriculum package and identification tips and visuals are available. To learn more, contact www.bsc-eoc.org Move ahead two spaces.

Decisions & Consequences Game Rubric (For Teacher)

Performance Criteria	Level One	Level Two	Level Three Acceptable Standard	Level Four Standard of Excellence
Motivation Participates in the game, include the reading of cards to other students	Does not participate fully in the game.	Participates in the game, but does not read cards aloud.	Participates fully in the game.	Participates fully in the game. Takes into account ecological, social and economic benefits and consequences.
Reasoning Able to explain reasoning behind decisions made	Makes decisions without thinking through possible effects.	Able to explain reasoning behind decisions.	Doesn't always take into account ecological, social and economic benefits and consequences	Makes decisions based on sound ecosystem management reasoning.
Ability to Analyze Able to explain why consequences to decisions are sound	Unable to explain why the consequences to decisions are appropriate with regard to schoolyard ecosystems.	Unable to make connections between management decisions and consequences.	Able to explain why decisions were made, and can explain why the consequences of decisions are appropriate.	Makes the connection between decisions and appropriate consequences. Recognizes the connections between ecological, social and economic choices in decision-making.

EXTENDING THE FOCUS QUESTIONS

Integrating Other Topics

The following includes further inquiries to integrate and extend the Science 7 Unit A: Interactions & Ecosystems Focus Questions with other subject areas:

Biology: What are the most abundant life forms on the school site? List introduced vs. native species. Does the site look the same, as it would have 200 years ago? 50 years ago? 10 years ago? What types of ecosystems are found at the schoolyard?

Geology: What type of bedrock is under the school site? How old is the bedrock? Are there signs of glaciation or other processes of erosion nearby? What type of soil is on the site? Is the soil more compacted in some areas than others? What formed the soil? Is the soil the same through the whole schoolyard?

Paleontology: What lived here in ancient times? How can we determine the processes that a site has undergone since ancient times? Are we likely to find fossils in these types of rock or sediments?

Hydrology: Where does the school's water come from? What watershed is it a part of? Where does the rainwater gather on the school site? Where is the highest spot on the schoolyard? Where does the school's water go after going down the drain? Are there any major groundwater features under the school site?

Meteorology: What is the dominant wind direction at the school site? Where are the coldest, warmest and shadiest spots on the site? How much annual precipitation does the schoolyard receive? What month has the highest precipitation? Describe the differences between things growing on the north vs. south side of the buildings.

Social Studies: Where do people live around the school site and why? What features in the school neighbourhood make it an attractive place for people to live? Who goes to the school? Does the school cater to a special population? How many students live within a kilometer of the school? How do people earn their living at the school site?

Human History: What is the history of land use or land management at this site? How long have people lived on the site? Is there any archaeological evidence to prove this? Why was the site chosen for a school? Have students' families attended the school for generations?

Beyond the Curriculum

The following list provides opportunity for extended projects in the schoolyard:

Schoolyard Eco-Calendar: What happens when in your schoolyard? After a year of collecting data, you can custom design a calendar to highlight the natural events in your very schoolyard. You calendar could include: average temperature; bloom dates of flowers such as dandelions; moon phases; expected date of returning birds and insects…The sky is truly the limit!

Birdhouse Bee: Could a local habitat improvement project use a kick-start? How about a bat or birdhouse bee? Some communities invite local celebrities to make the birdhouses, and then auction them off in a fundraiser. Research the native plants required by local wildlife, especially birds and insects. Create a native plant community garden. Monitor the bird populations frequently. See: Schiff, Paul and Smith-Walters, Cindy. *Wild School Sites: A Guide to Preparing for Habitat Improvement Projects on School Grounds.* (Bethesda, MD; Project WILD, 1993)

Schoolyard Naturalization & Habitat Enhancement Projects: Create a natural area right on your school site! There is community support for naturalization projects, no matter what the scale. Habitat improvement projects can have various goals. For schools, meeting curricular goals must drive the project from the beginning. Brainstorm the potential curricular links for each subject area, through the various stages of the project. From project vision and site inventory to design, fund-raising, ordering plants and media support, there are a number of interrelated tasks to complete. See: *www.calgaryzoo.ab.ca* for more information on support for these projects.

Green School Program: Over 4,500 schools across Canada have registered in the SEEDS Foundations' Green School Program, also called Learners in Action. Check out their web site for information about this, and their monthly National Challenge Programs. *http://greenschools.ca/seeds/* or phone (780) 458-2411.

Green Map Making: Through research, surveys and physical scouting, seek out the *green* in your community. Look for things like: green businesses, eco friendly transportation, compost piles, recycling centre, organic gardens and natural areas in your community. Compile the information on a large, bright map and displays it where many people will see it. Get global. Register with the Green Map System (GMS) to discover what other communities around the world are doing to make their communities greener. Two excellent resources to get going on any type of green mapping project are: *www.greenmap.org/grmaps/gmkids.html* and *Green Teacher Magazine* # 58, which is dedicated to green mapping.

Appendix 1: Glossary

Abiotic – a term applied to non-living things in the environment (e.g., soil, air, water).

Adaptation – an inherited characteristic that helps an organism survive in its environment.

Biotic – a term applied to living things in the environment (e.g., plants, animals).

Consumer – organisms that eat the food made by producers; can be herbivores, carnivores or omnivores.

Cycling of matter – a cyclical movement of matter through the environment (e.g., decomposition, water cycle).

Ecosystem – a biological community consisting of living and non-living parts, and their interactions.

Energy – the ability of a system to do work and to cause a chemical or physical change.

Energy Flow – the movement of energy, which originally comes from the sun, from one organism to another (e.g., photosynthesis, predation).

Environmental Monitoring - the routine collection, analysis and interpretation of ecosystem variables (what), employing recognized protocol (how), at defined sites (where) over defined times (when), to address a specific concept, issue, cause or hypothesis (why).

Decomposer – organisms that break down the cells of dead or waste materials and absorbing, or releasing their nutrients; many bacteria and fungi are decomposers.

Hypothesis – an idea or concept that can be tested through experimentation.

Integrated Pest Management (IPM) – control of a pest using a program that combines physical, cultural, biological and chemical control methods and has the least negative environmental impact.

Matter – anything that takes up space, has a mass and is made up of particles.

Noxious Weeds - within the Alberta Weed Control Act, these are weeds that can spread rapidly and can cause economic loss.

Nuisance Weeds - are common in Alberta. They are so well suited biologically to most sites that they cannot be eradicated.

Pesticide – any chemical used to control unwanted species.

Problem question – a specific question posed that will be answered through scientific investigation.

Producer – plants that use energy from the sun to make nutrients they need to survive; includes some bacteria that transfer energy from particles.

Restricted Weeds – within the Alberta Weed Control Act, these are weeds that pose a serious threat, due to rapid spread or superior competition. These weeds are to be eradicated.

Appendix 2: Further Resources

Clark, Rosemary and Walters, Peter. *Trees in the School Grounds.* (Crediton, Devon; Learning Through Landscapes Trust, 1991)

Feltwell, John. *Butterflies: A Practical Guided to their Study in the School Grounds.* (National Curriculum Series, Great Britain; Learning Through Landscapes Trust, 1991)

Feltwell, John. *Slugs, Snails and Earthworms: A Practical Guided to their Study in the School Grounds.* (National Curriculum Series, Great Britain; Learning Through Landscapes Trust, 1991)

Green Teacher Magazine. School habitat issues: volumes 47, 49, 50, 51, 53. 95 Robert Street, Toronto, ON, M5S 2K5. [www.greenteacher.com]

MacGreenler, Robin. *Prairie Restoration for Wisconsin Schools.* (Madison, Wisconsin; University of Wisconsin Press, 1988)

Pearce, Tony. *Butterflies: A Practical Guide to their Study in School Grounds.* (Willowdale, ON Permagon Press Canada Ltd., 1990)

Pearce, Tony. *Exploring Woodlands: A Cross-Curricular Approach to Investigations of the Woodland Environment.* (Willowdale, Ont; Permagon Press Canada Ltd., 1990)

Rowe, Sue. *Seasons in the School Grounds*. (Exmouth, Devon; Learning Through Landscapes Trust, Southgate Publishers Ltd., 1992)

Stoner, Darlene. *TAKING ACTION: An Educator's Guide to Involving Students in Environmental Action Projects.* (Bethesda, MD: Council for Environmental Education, 1991)

The Royal Society for the Protection of Birds. *Wildlife and the School Environment*. (Exmouth, Devon; Learning Through Landscapes Trust, Southgate Publishers Ltd., 1992)

Thomas, Gill. *Science in the School Grounds*. (Crediton, Devon; Learning Through Landscapes Trust, Southgate Publishers Ltd., 1992)

Appendix 3: Lesson Plan Evaluation and Feedback

This guide has been developed by the Schoolyard Ecosystems Professional Development Team and the University of Calgary Kananaskis Field Stations as part of the Environmental & Ecology Education Programs for schools. The programs undergo continual revision based on feedback provided by teachers. Please take a moment to evaluate this guide. Your comments will help us improve our service to you.

How did you hear about this guide (check one of the following)?

_____ KFS Website _____ Workshop

_____ Fellow Teacher _____ Other _____

How would you rate this guide (indicate on a scale of 1 to 5: 1 Poor & 5 Excellent)?

_____ Curriculum Match _____ Clear Instructions

_____ Sequence of Lessons _____ Time Allotted for Activities

_____ Appropriate for my Class _____ Appropriate for my Schoolyard

Please provide any other comments that would help to improve this guide, or let us know what worked well for your schoolyard or class, or any adaptations of lessons you found very useful:

_____
_____
_____
_____
_____
_____
_____

Please forward this form to:

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Environmental & Ecology Education Programs for Schools
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Calgary, Alberta, Canada T2N 1N4
E-mail: *mmappin@ucalgary.ca* **Fax: (403) 673-3671**