General Overview

Connecting with the Natural World
Junior Division Integrated Curriculum

The “Connecting with the Natural World” curriculum project has been designed to create engaging science and technology activities that increase elementary students' interests in the areas of sustainability and environmental stewardship. It provides teachers with suitable hands-on activities to foster this interest. The project demonstrates the effective strategies to encourage students and teachers to take better care of the environment by physically getting them back into the natural world. Integrating different disciplines helps students combine their mathematical, logical, scientific, linguistic, artistic, and social knowledge to make their lives and interactions with the world clearer. Integration with other subject disciplines has been provided throughout the lessons. Special consideration has been given to the Social Studies curriculum. Activities encourage the use of inquiry and critical thinking.

Vision for Environmental Education in Ontario

“Ontario’s education system will prepare students with the knowledge, skills, perspectives, and practices they need to be environmentally responsible citizens. Students will understand our fundamental

connections to each other and to the world around us through our relationship to food, water, energy, air, and land, and our interaction with all living things. The education system will provide opportunities within the classroom and the community for students to engage in actions that deepen this understanding." (*Shaping Our Schools, Shaping Our Future, p. 4)*

"Environmental education is defined as education about the environment, for the environment, and in the environment that promotes an understanding of, rich and active experience in, and an appreciation for the dynamic interactions of:

- The Earth's physical and biological systems
- The dependency of our social and economic systems on these natural systems
- The scientific and human dimensions of environmental issues
- The positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems." (Sh*aping Our Schools, Shaping Our Future*, p. 6)

The policy framework emphasizes the necessity of ensuring that young people become environmentally active and responsible citizens. Students need to have the knowledge and skills that will enable them to understand and deal with complex issues that affect the environment now and in the future. For example, students need to develop skills in problem solving, inquiry, decision making, action planning, higher-level thinking, systems thinking, and critical literacy. They also need to be able to identify issues and perspectives, carry out research, and communicate their ideas in meaningful ways. (*Environmental Education, Grades 1–8: Scope and Sequence of Expectations, 2011)*

To help achieve this goal, the Ministry of Education is working to embed environmental education expectations and opportunities in all grades and in all subjects of the Ontario curriculum, as appropriate, as part of the ongoing curriculum review process. A *Scope and Sequence* resource document was prepared in 2008 to assist teachers in bringing environmental education into the classroom in each subject area in grades 1 to 8. This resource is updated regularly as more curriculum documents are revised with the environmental education component. (*Environmental Education, Grades 1–8: Scope and Sequence of Expectations, 2011)*

Why Learn Outdoors?

In the ground-breaking book, "*Last Child in the Woods: Saving our Children from Nature Deficit Disorder"*, Richard Louv describes the new and growing body of research indicating that direct exposure to nature is essential for healthy childhood development, and for the physical and emotional health of students and adults.

Students learn through active exploration of the world around them and, for this reason, the hands-on, multi-sensory, multidisciplinary nature of environmental education is particularly well suited to meeting the developmental needs of students in the elementary school grades. Students should have opportunities to develop a personal connection with nature. If students are encouraged to explore the natural world — to learn about local plants and animals, to observe and anticipate seasonal patterns, to get their feet wet in local rivers — they are more likely to develop a lifelong love of nature that will translate into a lifelong commitment to environmental stewardship. The benefits of this type of hands-on learning are acknowledged among educators and supported by findings in brain research. Learning is a function of experience, and the best education is one that is sensory-rich, emotionally engaging, and

linked to the real world. High quality environmental education enhances student academic achievement and increases environmental literacy.

Expanding our idea of teaching environment to include the outdoors as a classroom has many benefits for students and teachers. Some student benefits include increased participation and enjoyment, opportunities for students to develop skills in problem solving, inquiry, decision making, action planning, higher-level thinking, systems thinking, and critical literacy. Learning with a hands-on, interactive approach in the outdoors also helps students to be able to identify issues and perspectives, carry out research, and communicate their ideas in meaningful ways. These advantages are identified in the Ministry document: *Environmental Education, Grades 1–8: Scope and Sequence of Expectations, 2011.*

The outdoors offer students a range of opportunities to use all of their senses and to learn through doing, as they explore the world around them. This is good for students' eyes, as they exercise focussing in the distance as well as the foreground, and gives them practice in observing, asking questions, and deducing. In addition, out of doors learning can provide numerous other benefits, such as:

- It provides many links to Aboriginal perspectives and ways of learning;
- It engages naturalistic learners;
- Learning outside lends itself naturally to inquiry-based learning;
- Regular time in the out of doors increases environmental stewardship in students;
- People have an intrinsic connection to the natural environment and out of doors education can foster that connection.

Supporting Critical Thinking in Elementary Environmental Education

While doing science, students have opportunities to think critically whenever they make decisions, such as:

- What hypothesis or design is best?
- Is this answer representative of reality?
- Do I have all the important data/information?
- Is a graph the best way to communicate these findings?
- Etc.

Each decision is an opportunity for teachers to support critical thinking. Some simple ways that are reflected in our lessons are as follows:

1. Overtly ask students to make decisions. E.g. – What is the biggest human impact on the environment? What is energy? To which taxonomic group does this organism you found belong?
2. Make criteria for basis of decision overt. E.g. - As a class, develop the criteria for a good tourist map of habitats; as a class, develop criteria for size of human impact.
3. Use a variety of thinking concepts to organize lessons and overtly teach these thinking concepts. E.g. - Interrelationships (Habitats and Communities), patterns and trends, significance (Conservation of Energy), cause and consequence; note there is a great parallel between thinking concepts in social studies and science.
4. Use a variety of tasks to exercise all different kinds of decisions students/scientists/science-savvy citizens need to make. (For more information on different kinds of activities to support critical thinking, see *The Critical Thinking Consortium*, www.tc2.ca). E.g. - Rework a product made from rocks and minerals to create a new product with a new purpose; convince a political party of a plan of

action for energy conservation; create a nature trail; design and carry out an inquiry into alternate energy; solve the mystery – what kind of rock is this?

5. Focus on specific aspects of inquiry or thinking in lesson. E.g. - Identification of rocks (Rocks and Minerals) focuses on observation skills; virtual collection (Biodiversity) focuses on interpreting evidence; what is my habitat? (Habitats and Communities) focuses on drawing conclusions.
6. Assess critical thinking! If you asked students to interpret evidence and draw plausible conclusions, then assess these learning goals. Include assessment of critical thinking throughout the achievement chart, including each of Knowledge/Understanding, Inquiry, Communication, and Application because:

    - You can't understand a concept without thinking critically (e.g., to know what an insect is, and is not, you need to have criteria and be able to make decisions about whether an organism is an insect or not).
    - You can't be proficient at inquiry without being able to make a myriad of decisions well - e.g., interpret evidence (choose most relevant evidence and assess between different interpretations) or draw plausible conclusions (assess between different conclusions).
    - You can't communicate effectively without being able to make decisions about what are the best methods to use for a particular purpose and audience, and without being able to assess between different options for what information to include and not to include and what text/visual/auditory elements to use.
    - You can't apply learning to new situations without being able to decide what aspects of learning can be applied, and to generate new ideas and choose most feasible between them.

What is Inquiry?

Simply put, inquiry is asking and answering questions. Science inquiry is asking and answering questions about our physical environment (in contrast to historical inquiry, for example, which asks and answers questions about past human events and people). Students may require some direct instruction and practice in formulating questions. Science inquiry includes solving problems about our physical world, for example the work of inventors. Science inquiry also involves all the different ways people have developed in order to get the best answers possible, such as fair tests and Traditional Knowledge.

As teachers, we ask and answer questions about the natural environment every day, without thinking about how we go about doing so. Teaching through inquiry is ~~quite simply~~ about providing and supporting students in asking and answering their questions about their natural environment, specifically, the questions and answers specified in the curriculum documents for your grade level.

Note that inquiry is not a circle or a flow chart. There are two reasons for this.

1. There are multiple entry points: students are inquiring when they ask a question and investigate; when they are given a question of interest to investigate; when they are given an investigation and asked to analyze it; or when they respond to the communication of a peer's investigation with new questions or ideas for applications. Students need practice with all components of inquiry, including asking questions. Teaching an entire curriculum solely through complete inquiry is not always feasible, though it is probably easier than you think (see *Natural Curiosity*).

2. There is a lot of interplay between the components; a question might be asked, an initial investigation leads to a new question, and the first question is dropped. Or the analysis of an investigation leads to more investigation as further problems arise. For example, imagine yourself asking and answering a question about your environment, such as fixing a jammed photocopier. First, you might ask yourself, what is wrong? Then you investigate, and do not successfully find an answer. The inquiry will change then, to another question – perhaps, who do I call to get it fixed? Or, how will I modify my lesson to teach without the planned photocopied resources?

The Elements of Scientific Inquiry

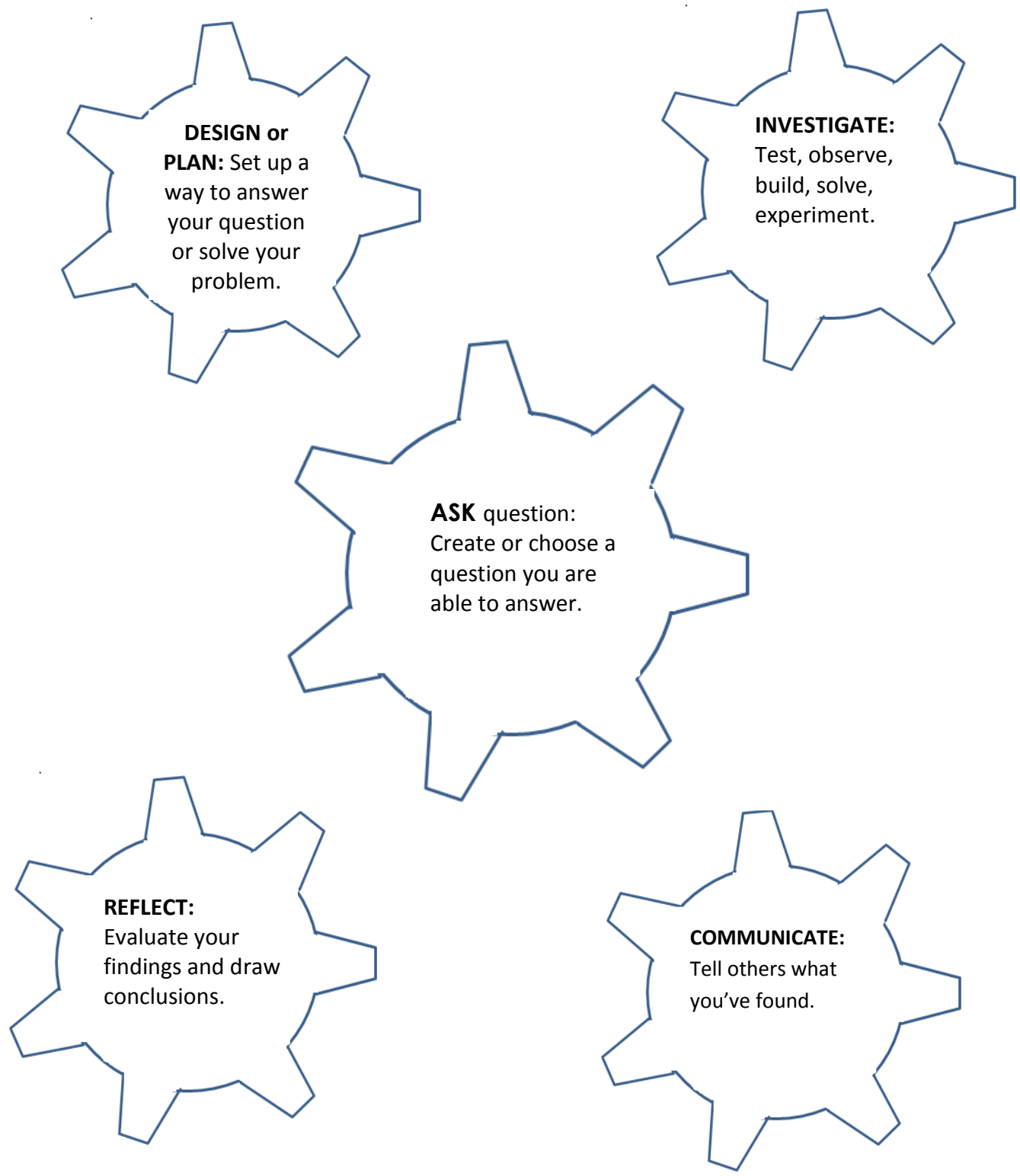
ASK: Create or choose a question you are able to answer or a problem you'd like to solve.
Do you know enough about the topic?
What can you observe?
Can you test this?
Where will you find existing answers?
What might the variables be?
What might the challenges to solving your problem be?

DESIGN or PLAN: Set up a way to answer your question or solve your problem.
What experiment will you do?
What observations will you make and how will you record them?
What steps will you take to solve the problem?
What variables will you consider and how?
How will you interpret your findings?
How will you overcome the challenges to solving your problem?
What do you need to build and how will you build?
What do you expect to happen?

INVESTIGATE: Test, observe, build, solve, experiment.
Are you being complete in your observations?
Are you paying attention to the unexpected?
Are you recording your findings carefully and completely?
Is there any factor influencing your findings? Can your findings be trusted? How much?
Is everything going as expected? Is it working?

REFLECT: Evaluate your findings and draw conclusions.
What do your findings tell you? Did you answer your question or solve your problem?
How does it compare to others' findings?
What conclusions can you draw?
What would you do differently?
What new questions arise from your findings?
How can your findings be applied?

COMMUNICATE: Tell others what you've found.
Who is your audience?
What are the best ways to report your findings and your reflections?
Is your communication clear, concise, comprehensive, and catchy?


DESIGN or PLAN: Set up a way to answer your question or solve your problem.
INVESTIGATE: Test, observe, build, solve, experiment.
ASK question: Create or choose a question you are able to answer.
REFLECT: Evaluate your findings and draw conclusions.
COMMUNICATE: Tell others what you've found.

Tips for Infusing Scientific Inquiry in Your Classroom

1. Give students opportunities to practice asking questions. Provide them with time outside to observe and write down questions that come to mind. Bring aspects of the natural world into the classroom (such as, insects in an aquarium) and give students lots of time to exercise their imagination and ask questions. Encourage different kinds of questions (e.g., use the five Ws) and discuss with students what makes a question a good science question (e.g., it is possible to answer it, or at least attempt to answer it).

2. Give students opportunities at all five components. Don't feel you need to do an entire inquiry from start to finish, all the time. Providing the results from another class's investigation and asking students to focus on the interpretation of those results, their communication, or their application, are all valid activities that teach students inquiry skills.

3. Give students the big idea of a strand, and let them ask questions, gather them, and post in the classroom. Cross reference and organize them around the curriculum learning expectations. You'll find they will greatly overlap. This will give students a sense of ownership and motivation to investigate and learn the curriculum, and get the answers to their questions.

4. DO NOT BE AFRAID of the unknown. Boldly go where you have not been before. If you don't know the answers to questions you or your students have, this is fabulous. Your students will be excited to be covering new ground with you, and you might just find that you get excited as well. How would you feel if your teacher said, "I don't know but let's find out"? Respect? Comradery? Curiosity?

5. Be okay with not ever getting all the answers. Science does not have all the answers. The curiosity that comes with unanswered questions is what has driven every scientist that ever lived to make discoveries. Many important questions, despite much effort by some very smart people, still go unanswered, such as the shape of our universe, the workings of the brain, the landscape and organisms of the deep sea floor. Leaving some questions unanswered is natural, even inevitable, and will only serve to encourage your science-inclined students to pursue the topic further.

6. Encourage mistakes. Students are often afraid of mistakes, afraid to do something incorrect or "wrong." Inquiry, indeed all of science and technology, relies heavily on mistakes. It is a crucial part of progress. Teaching students to feel comfortable making mistakes and responding by learning from them will provide them with attitudes that will aid them to succeed in all aspects of life, not just in the science classroom.

7. Citizen science initiatives provide an excellent way to engage students in actual research that is meaningful and provides you, the teacher, with support. See the web site resources and the grade 4 Ladybird beetle study lesson plan for further suggestions.

8. If you're science-shy, start small. Rome was not conquered in a day. Scientific inquiry is such an engaging process that we're confident you'll see results with even small steps as you activate and build on your students' curiosity. Engaged students learn!

9. Ask for help. Seek out science teachers in your community or online who have been successfully teaching science through inquiry, and ask questions! Contact non-profit community organizations that organize science students or scientists familiar with scientific inquiry and the topics in your curriculum. People are available to come into your classroom or to mentor you as you infuse inquiry into your current program. See the Resources section for some suggestions of who to contact.

Environmental Inquiry

An excellent presentation of successful strategies for teaching in the outdoors, described as Environmental Inquiry, can be found in the resource, "*Natural Curiosity",* produced by The Laboratory School at the Dr. Eric Jackman Institute of Child Study. Environmental Inquiry has four branches: Inquiry-based Learning, Integrated Learning, Experiential Learning, and Stewardship. Each of these branches involves valuable practices.

Inquiry-based Learning builds on students' natural curiosity and encourages students to ask and investigate their own questions. Taking students outside is a great way to stimulate questions. Students can explore and investigate in a ten-minute search in a schoolyard as well as in a two-hour hike through a forest. Any exposure to the wonders of nature will spark questions that can be fanned into a conversation with other students in a knowledge-building circle or become a foundation for a research or art project to develop a concept. Teachers can ask questions, such as "What do you notice?", "What does this make you wonder about?" or "Why do you think this happened?" to encourage students' own questions. Further expansion of planning for Inquiry-based Learning can be found on page 19 of *"Natural Curiosity", 2011.*

Experiential Learning is learning through direct experience. Bringing students outdoors and allowing them to interact with their environment using their senses is one major way to provide this. In order for students to make connections with the world around them and with living things, they need opportunities to interact with their environment and not simply read about or even interact on a computer. Examples of strategies for providing direct experiences are close observations of nature, allowing students to design experiments in the outdoors, open-ended exploration, five-senses exploration, journaling in the outdoors, expressing what they experience outside through artwork, field research or taking field trips.

Integrated Learning can be thought of as "Seeing the Big Picture" *(Natural Curiosity, p.43).* Teachers can integrate their students' questions into their planning and curriculum goals. Using students' interests and the wealth of natural material in the outdoors, teachers can address many curricular topics and integrate different subjects or strands of the curriculum. This is also a way to differentiate instruction as students will be introduced to material from different perspectives. Concept mapping of students' questions is one strategy to integrate subjects across different curricula or strands within a curriculum.

Fostering the desire in students to help the environment is at the core of *Stewardship*. Bringing students outside and letting them see the difference between a healthy and unhealthy environment can motivate students to action, as can an appreciation and enjoyment of natural surroundings or firsthand observations of human impacts on the environment. Local and/or community-based organizations are generally very open to partnerships with students. Providing opportunity for students to join a research project or community-based initiative, such as the invasive species examples in the Grade 6 Biodiversity and Grade 4 Habitats and Communities sections, will give students ownership of what they have learned and the satisfaction of making a positive difference in their world.

Getting Started - Science Walks and Techno Walks

Field trips, “science walks”, and “techno walks” allow students to make observations of their environment. They do not require months of preparation or planning. Taking your class outside is a wonderful opportunity to stretch your legs and breathe some fresh air! Each time you venture outside, you discover something new or a new perspective. Leave the classroom for an hour and see what you can find in your local community. Students will enjoy investigating, exploring, observing, and recording what they discover. Encourage the students to use all their senses! Most schools do not require a permission form to walk within a few blocks of the building.

On the way to and from the park or outdoor location, encourage students to make observations about the environment with their group. Look for natural and human-made examples. Consider patterns that are observed. Get students to make sketches using a variety of traditional media as well as digital technology, if available. Take pictures often to record the trip. Investigate different options for borrowing digital cameras from the school or parent volunteers.

Why Field Trips

- connection between reality and theory – hands-on
- introduction to a unit or a culminating activity
- provides an authentic learning experience
- exciting; students get to meet and interact with others
- experience all five senses
- students remember the field trips because they learn using different methodology

Field trips allow for opportunities to integrate a whole spectrum of subjects. For example:

Social Studies

- map routes using compass, local community landmarks
- Google Earth – map route before and after trip
- GPS – add pictures to Google maps using latitude and longitude from picture of field trip

Physical Education

- Pedometer – record movements
- outside games and activities, orienteering, geocaching

Art

- leaves, tree rubbings, mobiles, landscapes, Nature Art (Andy Goldsworthy)

Language

- poems, stories, recording, scientific literacy skills

Math

- data collection and manipulation

Technology

- how to use effectively

Preparation and Class Management

Just as we would set up our classroom rules and expectations in the beginning of the year, so must we set up our expectations and rules for learning out of doors. By ensuring students understand what is expected of them, and the consequences for not following set rules, the experience will be a positive one that is bursting with authentic learning opportunities. Here are some simple guidelines to think about.

- It is helpful to have a permission form signed at the beginning of the year for each student that allows the student to go outside, off school grounds, for activities and investigations. This would not necessarily cover long field trips or bus trips.
- If students are not accustomed to the wonderful opportunities of working out of doors, begin with short, teacher-directed visits to the outdoors. Once students are accustomed to the parameters of working out of doors, longer sessions can be planned. Students can be encouraged to make observations and record data all year long in this controlled environment, such as the schoolyard.
- Take a walk around the area where you would like to bring your class or group to look for teaching possibilities. Keep the area outside small to begin with; students should be able to see and hear you while outside, at least in the beginning. Decide on boundaries for the activities you have planned; for example, if you are going to have the students play a game, record the boundaries for off limits.
- Look for safety issues, both natural and human-made, such as barbed wire fences, poison ivy or other poisonous plants such as stinging nettles, broken glass, etc. Additional safety issues can be found in the Safety Section of this resource.
- Note the terrain and climate of the area you are going to explore so you can prepare your students to dress appropriately.
- Set expectations for behaviour while still in the classroom where students are already set in the routines of the classroom. Make certain that all students fully understand the boundaries, the expected behaviours, and how you will be getting their attention while outside.
- Take attendance before and after going outside. Students should be instructed to let the teacher know if their partner is not where they should be.
- Always ensure that the office knows where and how long the class will be out of doors.
- Bring adult volunteers, if appropriate. Ensure the volunteers understand what is expected of students and of the volunteers. Ensure adult volunteers have a recent Criminal Record Check on file with your school.
- Ensure students have a focus to complete while out of doors. If they are concentrating on completing a task that is engaging, they will only have time to be on task. Make sure the time allotted is just enough for students to complete the task.
- Provide organizers for students to complete while out of doors. If they are expected to return with a finished product, they will have to remain on task.
- Organize students into partnerships that are most likely to succeed. If partners are responsible for each other, the experience will be more successful. No student should be working alone outdoors.
- Bring a whistle or other tool that can get students' attention while outside. Sound travels differently in larger spaces. Students need to know what they are expected to do when hearing the sound of the whistle or other tool you select.
- Speak to the students about respecting the outdoor area they will be visiting by returning items to their homes after examining them, and having as little impact as possible.

Good resources to approach for help on outdoor excursions are:

- Supportive parents who have outdoor experience, like hiking, camping
- Other teachers who bring their students outdoors
- Organizations, like Ministry of Natural Resources http://www.mnr.gov.on.ca/en/ , Canadian Wildlife Federation http://www.cwf-fcf.org/en/educate/ and Let's Talk Science http://www.letstalkscience.ca/ may have volunteers that would come to your school and accompany your class for an activity. They also have curriculum ideas for taking your class outdoors.

Preparation: Instructions for Students

- Inform your teacher of any allergies.
- Dress appropriately for the weather.
- Bring water, if you will be outside for more than an hour, or if the weather is hot.
- Watch for poisonous plants that the teacher has noted.
- Stay with your group or partner.
- Follow all your teacher's instructions.

Tips for Outdoor Learning

- Take advantage of the "teachable moment" when students find things you didn't have planned.
- Encourage the sense of wonder.
- Use your five senses.
- Let exploration and questions happen.
- Enjoy yourself!

Tips for Follow Up after Your Outdoor Experience

- Debrief experience with students by using strategy such as think-pair-share.
- Provide time for students to ask questions and collaborate for ideas. An example, such as knowledge-building circles, can be found at www.naturalcuriosity.ca.
- Integrate questions into expression, such as an art or writing project.

Sample Activity to Get Started

Use the schoolyard or a nearby community park to do this type of activity several times during the school year so that students can record their observations and make connections to the cycles of nature.

Nature Scavenger Hunt –Sample Questions to Consider and Spark More Questions and Observations

1. How many different types of trees can you find; try and identify several. What did you use to identify them?
2. How many different types of plants/flowers can you find; try and identify several. What did you use to identify them?
3. How many kinds of seeds can you find? How can you tell where they came from? What mechanism do the seeds have for travelling?
4. What sights and sounds do you see or hear that tell you animals are here?
5. What proof can you find that animals have been here? (e.g., footprints, anthills, droppings, feathers, etc.)
6. Examine a tree where the leaves are changing colour. Look at the pattern of the colouration and try and explain the reason for the difference.
7. Where can we find the most insects? Why? What types can you find and where are they located?
8. What evidence is there of nature's effect on the terrain and landscape?
9. What species or plants live near the water?
10. What evidence is there of erosion?
11. Other questions our group wants to explore

Field Trip Roles

Giving students specific roles while on field trips helps them to focus and be responsible for certain activities. This encourages teamwork and collaboration. It also supports classroom management. Rotating the roles often ensures that each student has the opportunity to be the person "in charge" or responsible for the technology. Many opportunities are created for students to develop new skills. Students can be provided with "task cards" or badges that they can wear to indicate their role. Students enjoy the role playing components and will offer advice to each other based on their roles.

Sample Field Trip Roles

Chief Biologist

- Determines location for study
- Leads the group in all activities and ensures all work is completed
- In charge of the group

Cartographer, Recorder

- Maps route and final destination
- Records all group information

Materials Specialist, Reporter

- Collects all materials for trip
- Collects data and reports results
- Submits group work at end of class

Multimedia Specialist

- In charge of the iPod Touch, iPad, and digital camera
- Responsible for research activities related to technology
- Considers how to incorporate technology appropriately and effectively in group presentation

Communications Officer

- In charge of deciding most important aspects to be communicated
- Responsible for selecting the best mode(s) of communication
- Organizes who will submit what information and how
- Edits materials for submission

Other Suggested Roles – Set Two

Principal Investigator / Chief Navigator

- Responsible for safety of group members
- In charge of managing the group
- Leads the group by assigning duties to all members of the group
- PI is the Chief Navigator for all activities using GPS and compass

Multimedia Specialist

- Responsible for all digital images during and after activities
- Uploads all images and video
- Makes sure all group members get an opportunity to use digital technology
- Creates music for all presentations

Web Strategist

- Responsible for all website/blog components and uploading of images, video, and data
- Adds information to Citizen Scientists' websites
- Updates relevant project activities
- Designs graphics for website and presentations
- Uses appropriate technology as available within the group

Reporter / Cartographer

- Responsible for mapping routes and final destination locations
- In charge of recording all necessary information in variety of formats
- Adds information and images to Google Maps activities

Materials Specialist / Research Analyst

- Responsible for collecting and passing out all equipment
- In charge of clean-up;can involve others in this group responsibility
- Responsible for validating all scientific investigations and updating life lists
- Uses appropriate technology as available, depending on group

Other Suggested Roles – Set Three

Principal Investigator

- In charge of managing the group
- Checks the assignment
- Asks instructor any clarifying instructions
- Leads the group by conducting the activity or by assigning duties to the other members of the group
- PI is in charge of safety

Project Manager

- Facilitates team making sure everyone understands and performs their responsibilities on time
- Assists team in understanding the activities
- Manages all group work

Project Engineer

- Responsible for ensuring all technology activities are conducted accurately
- Reports technology findings

Materials Manager / Specialist

- In charge of picking up materials
- In charge of passing out all equipment and materials that are necessary
- Only one who has a real reason to be moving around classroom

Recorder

- In charge of collecting necessary information and recording it in the proper form: graph, table, tape recorder, etc.
- Works with Principal Investigator and Materials Manager to verify accuracy of the data

Maintenance Director

- In charge of clean-up; has power to involve others in this group responsibility
- Responsible for equipment being returned and consumables being cleaned up

Reporter / Timekeeper

- In charge of reporting results, orally or in writing, back to teacher or entire class
- Keep groups on task and on time

Scenario Approach

A very effective way of engaging students is through the use of scenarios or story lines as the "hook". Students really buy into it and it is a great way to integrate many different subjects and topics. Create the scenarios to take into account different subject areas as well as real-world examples so that students can make connections to what is happening in their local neighbourhood as well as the larger global community. The use of roles, as noted above, further engages the students. Sample scenarios have been included in each set of grade specific activities.

Rural and Urban Community Challenges

Challenge: Lack of Green Space

Some schools have a lack of green space in schoolyard and teachers may feel reluctant to try outdoor activities due to this apparent challenge. Possible solutions include:

- using the city block based on permission form allowing students to walk in the local community
- going to the local parks which are often close to schools in urban areas
- planning a class project to create a school garden
- bringing nature into the classroom

Challenge: Schoolyard Not a Rich Habitat

Schools in rural areas may have a lack of resources close by for small field trips or excursions to explore nature. Possible solutions include:

- work with what you've got; a tree is a rich habitat for a variety of creatures, so is soil and grass
- encourage students to explore around their own homes and bring discoveries or descriptions of their discoveries to class
- arrange for field trips to local conservation areas or parks
- bring nature into the classroom as much as possible
- when appropriate, encourage students to make observations, ask questions, and investigate in the green space you do have – and the surroundings in view beyond the schoolyard
- explore opportunities for students to do work outside that can be done inside as well

Challenge: Lack of Background Knowledge of Nature

Teachers may feel that they do not have the necessary background knowledge or skills to take their class outside. Possible solutions include:

- relax; appreciate the fact that students enjoy being outside and will be full of questions and enthusiasm. It is alright to let the students explore and investigate and become "field scientists" without the teacher having all the information. This is a very powerful learning opportunity for students.
- institute regular walks around the school yard initially and talk about basic observations of living things
- make regular recordings of observations seen on these short trips
- invite a naturalist or parents with knowledge to join the class, contact a local organization, e.g., a conservation authority, to elicit expertise, or a classroom visitor
- ask other teachers for suggestions or do as a joint project with another teacher who is more comfortable with outdoor activities
- bring books and visual resources into the classroom and make specific connections between the content of these resources and the world around you

Challenge: Fear of Nature
There may be situations where teachers and students have limited exposure to nature and are hesitant about using it in the program. Possible solutions include:

- start small
- bring nature into classroom to increase familiarity; encourage students to touch and feel organisms
- enlist help of local conservation authority or non-profit organization with an education mandate, or local naturalist, colleagues or parents
- show students the nature around them which is already familiar but perhaps overlooked, for example, ants, butterflies, grass, weeds and other plants, rocks, sparrows
- utilize students' curiosity to overcome their apprehensions; for example, take students out of doors and find something interesting, perhaps an ant hill, and express curiosity and wonder – chances are they'll rush over to see what you've found
- model a healthy relationship with nature

Outside All Year – Class and School-Wide Activities

Make the environment a focus for the school. Talk to your School Council about opportunities to conduct school-wide programs that will engage the community. Investigate the Ontario EcoSchools program http://www.ontarioecoschools.org/index.html and enrol your school. Plan outside activities that involve the whole school, such as a "school hike". Invite all the classes, administrative and support staff, and parents. Play a Nature Scavenger Hunt with everyone on this hike.

School programs work best if the community is actively involved in order to maintain the initiatives all year long. Some ideas include:

- a flower or peace garden
- a Monarch butterfly garden and way station – http://www.monarchwatch.org/waystations/
- a vegetable plot
- an outside classroom
- a natural playground
- a school birdfeeder
- tree planting activities
- restoration of native habitats in the school grounds and surrounding area
- recycling programs
- composting programs

When planning integrated programs for the school year, consider the best time of year to conduct the various topics and strands in the Science and Technology curriculum. Work with the whole school to coordinate projects and resources. Look at your local community to see what activities happen at certain times of the year so that you can take advantage of these events and the expertise of volunteers.

Consider "10 minute field trips" to the school yard on a regular basis. These observations can assist students in developing scientific inquiry and problem-solving skills. They will gain a sense of wonder for the natural world. Outdoor activities should be done all year long so that students get to experience nature in many different forms. Observations of a tree throughout the year can yield much data that can be incorporated into many lessons.

Suggestions for these short trips can include:

- observing and measuring a puddle after a rainfall and then 15 minutes later, on a rainy day and on a sunny day
- recording the number and types of birds that come to a bird feeder in the school garden
- tending to the school garden and noting its growth
- observing shadows at different times during a sunny day
- making note of the size of the shadow, shape of shadow, and orientation of where the shadow falls on the ground, etc.
- making note of colour of leaves and the appearance of buds, etc., on branches over the whole year. Even in winter, sometimes the buds of trees begin early! A whole inquiry or investigation could be fostered through these occurrences!
- examining plants in the fall before the frost, after the frost, and in the spring
- observing a sample of soil in the different seasons
- asking the students what they can observe and record!

Making Outside Observations All Year Round

Seasonal changes involve more than just the colour changes on leaves. It is the position of the sun, the temperature, the shadow formation, precipitation patterns, the presence or absence of different wildlife, types of garbage being discarded in the playground, and much more. Aboriginal ways of thinking are often organized into seasonal changes, including the observable differences in habitats and animal behaviours for different times of the year. For many students, seeing the whole picture of seasonal change is something they find abstract and hard to make connections with. When students are able to compare observations throughout the year, the connections become more obvious and less abstract. In order to help students make these important connections, there are many ways to record year long observations. Here are some examples of what teachers are using.

Science Logs

Students can take year-long observations, keeping these observations organized in a science log with different pages designated for that purpose. If students are recording the different birds they see year round at the class birdfeeder, they may need more pages. Pictures that can be glued directly into the log may be beneficial to record birds that change in appearance. If students are recording temperature for each day of each month, they may need a page for each month. OR - a specific log for each of the year-long observations can also be organized by month or week. Collection and safe keeping of these logs may be necessary for some students in order to avoid loss of important data.

Photo Journals

A class photo journal is an excellent way to collect regular observations of shadow shapes and sizes or the birds visiting the class birdfeeder all year. Summaries and descriptions can be added to the journal or album in the appropriate time to designate observations not noted directly in the photos. This can be kept in a central space where students can access it to add their new entries and to make periodic comparisons of observations over time. Programs such as Photostory and iMovie are powerful media tools to showcase student work.

Portfolio Folder

Students can keep their important science logs or recording sheets in their portfolios if they have a file. They should have some tool to keep the pages of one yearly project together. This may be a duo-tang or paper clip of some type. Periodic reflections and comparisons should be made from time to time in order for students to ask more questions or decide to look for more specific observations for the next data collection period.

Electronic Portfolio

Students can keep files within their electronic portfolio in order to keep their yearly observations safe and in one spot over the course of the year. There are a number of ways to keep electronic portfolios but, if it is through an electronic file system on a classroom computer, students should be reminded to backup their files from time to time in order to avoid losing any electronic files. More and more classrooms are moving to online electronic filing systems now, which is something you may want to consider. Periodic reflections and comparisons of the data taken should help students build an understanding of the data they are collecting, promote questioning and wondering in order to develop better observations for the next data collection session. Teachers will want to have access to student electronic portfolios, even if they are password protected.

Digital Books

As an extension to these activities, students can create digital books or graphic novels that highlight their study of nature and the environment over the course of the school year. Apps on the iPad, such as Strip Designer and ComicBook!, allow students to create engaging graphic novels using the photographs and art applications they have generated throughout the year. Other publishing programs, such as iAuthor, allow students to create digital books of their work that can be printed or kept as digital applications and sent to parents and classmates. These can be used as tools to integrate many subject areas.

Technology Enhancements

Students can use a variety of technologies to explore their environment and make informed decisions based on their research and field activities. Investigate options available to you within your school and board media resources. These tools and related applications will enable them to become "field scientists". Digital cameras allow students to document their findings and create multi-media productions that can then be broadcast to a global audience. Many cameras have the ability to include the GPS information so pictures can then be tagged and information added to worldwide global education projects. The grade 4 Habitats and Communities Lesson 2: Create a Habitat Map suggests strategies to incorporate GPS activities into the unit. This ability to participate in global projects is a great motivator for students when they see that their findings can be used by scientists and researchers around the world. Projects such as iNaturalist http://www.inaturalist.org/ and Project Noah http://www.projectnoah.org/ allow students to create their own projects, add information to global studies, and ask for input from others. Sites such as Journey North http://www.learner.org/jnorth/ and Monarch Watch http://www.monarchwatch.org/ are excellent examples of Citizen Science programs where students can observe, record, and report on scientific activities in their community.

Handheld devices, such as the iPod Touch and the iPad, can be used to collect and analyze data, and as a multimedia reference. There are many apps that can be used as portable field guides to assist students in identifying and classifying plants and animals in their community. Other applications allow students to step through the process of identifying what species they have "seen." A collection of simple web pages could be developed on insects, birds, and animals specific to your location in order to act as a multimedia reference. With this class-created guide installed on the electronic devices, teachers and students will have a field guide that not only shows pictures and words, but can play the vocalizations of birds and animals. Sensor-based data acquisition systems enable students to conduct authentic scientific investigations, much as research scientists do. Strategies for the inclusion of iPad technologies have been included in several lessons as starting points.

With the use of GPS units, iPads or smartphones, geocaching nature activities and orienteering can be introduced as another way of learning about the environment. Programs such as ArcGIS and Motion X are simple-to-use navigation programs with mapping capabilities. These programs can be integrated with Google Earth to allow students to map their activities on a larger scale and share their findings.

Out in the field, students have opportunities to communicate their activities through programs such as Skype and iMessage. Simple scavenger hunts can be turned into exciting adventures when digital technology is added. Apps for the iPad, such as Scavenger Hunt, Geohunt, and iSpy!, allow students the opportunity to create challenges for their classmates using the local environment. These programs can invigorate a class walk by encouraging students to look for the nature that is all around them.

Class wikis and blogs are exciting tools to showcase work and projects. Students can share their work on a regular basis to a wide audience and, therefore, give greater meaning to their studies. Many teachers are now using blogs as class portals, online filing cabinets to keep student work, e-portfolios, collaborative space, knowledge management, and class websites. Blogs can enhance and deepen learning; if used as a blog, they are true forms of constructivist learning. Weblogs can be used to organize and keep class data over a long period of time in order to make comparisons and connections to data over the period of the school year.

Files can be set up for each project and its observations over the period of the year. Students should make periodic comparisons of the data they are entering in order to build understanding of the changes over the period of time, but also to make note of what else they may want to focus on in their observations. Students can enter numbers, charts, graphs, visuals such as scanned pictures, electronic photos or video clips, and comments to support their observations and comparisons.

See **Grade 5 Unit, Lesson #3 - Conservation of Energy and Resources Blog** for an example of setting up a class blog.

Sites to help set up a blog for students:

www.blogger.com

http://kidblog.org/home/

http://www.hellokids.com/t_2856/blogs-for-kids

http://www.simplesite.com/pages/receive.aspx?partnerkey=ffgoogle:CA_Search_Blog_PM_Blogs&target=ftp3:crea

The Voices From the Land project http://www.sharingvoices.org/ encourages students to combine nature, art, writing, and technology. Students can upload their work to a global audience and also create posters and calendars of their work.

Nature Art is a wonderful way to involve students with the environment. Andy Goldsworthy is a British artist who uses a range of natural materials—snow, ice, leaves, bark, rock, clay, stones, feathers, petals, and twigs. He creates outdoor sculptures and records his work in colour photographs. Goldsworthy is not discouraged by changes in the weather which may occur while he is creating. Goldsworthy photographs the progress of his creations as he works, showing the changes over time. Students can easily replicate Goldsworthy's work. Encourage students to create a natural sculpture using materials found in the environment. Have them photograph the changes in their sculpture as they work. They can then create a slideshow to show the progression of their sculpture over time.

An extension of this Nature Art activity involves students creating maps of where their art is located and sending this information to another group of students. The second group must locate the art based on the GPS navigation or map, take a picture of the art, and send it back to the original group. Collaborative art projects can be created by having each group make modifications to the art and comparing the appearance over time. Art programs on the iPad can be incorporated by having the students take pictures of their art and then modifying and enhancing it with these applications. Suggested art apps for the iPad include:

- Sketch Book
- Brushes
- Art Studio
- Doodle Buddy

Evernote

Evernote is an organizational tool. It runs directly from the iPod, IPhone, iPad, and computer, and allows the user to create an online notebook from text, handwritten notes, audio clips, web pages, and snapshots. Pencast from Livescribe pens can be downloaded onto Evernote as well. It is very useful in boards that support hand-held devices in the classroom. There is a small fee but many schools are already using it.

Evernote allows students to keep their observations organized for comparison at a later date. The notes can be accessed through any computer to help students make comparisons and connections between the data collected. Students are not able to interact and add reflections directly onto the notes but must make a new file in order to include it.

Audio Recordings

There are several audio recording applications on the iPad and other similar devices that can assist students with their collection of data and sharing of information. Students can take these devices into the field and record their observations. Programs such as Dragon Dictation convert audio recordings into an email message. Other programs include Voice Memos, Voice Recorder, QuickVoice, and Recorder. These are wonderful applications to allow students to get the sense of being scientists in the field! It also provides excellent methods for differentiated instruction.

Email

Suggestions have been provided throughout the activities to create scenarios that will engage the class in relevant studies in their local environment. Part of this can involve sending special email or text messages to grab the attention of the class. In order to do this effectively, it is suggested that you create a separate email account for the project. This is easily done through a program such as Gmail where you can alter the name of the user. This will allow you to send messages to the class from the leader of the Detective Agency (Grade 4 Habitats and Communities), for example. If you are using iMessage or Skype, follow the same procedure so that there is a special identity for the communitarian.

Map and Globe Skills

Throughout the activities described in this resource, there are many opportunities for students to practice map and globe skills. As students travel to the site of their investigations, they can record the route taken and map this during their trip and on return to the class. Detailed maps can be created based on digital images and sketches. Pedometers can be used to record the distances travelled and this can then be compared to a route drawn on Google Earth. An example of this activity can be found in the Grade 4 Habitats and Communities – Lesson 2: Create a Habitat Map.

GPS activities can be incorporated into many outside lessons. When students are researching in their local habitats, they can create routes for their classmates to follow based on the GPS coordinates. In the Grade 4 Rocks and Minerals unit, students can hunt for “hidden rocks” based on the GPS coordinates. Once they find the treasure, students can send back the image of their find to confirm that they have located what they were looking for. New routes can then be sent to find the next treasure or geocache.

Safety

Venturing outdoors are the experiences students tend to remember when thinking back on science class. Whether your school is in an urban setting or surrounded by green space, there are many learning opportunities for students. Safety can be simple but must be considered prior to learning outside the classroom walls.

Just as the classroom management and safety rules within the classroom are discussed in depth with students, so must these details be fully understood before going outside. Here are some tips for you to consider:

For Playground and Short Community Excursions:

Inform the School Office

- Inform the school office of your planned outside activity, the anticipated duration and location of field activity

Know the Area

- A quick visit to the location ahead of time will allow you, the teacher, to prepare for any safety preparations (e.g., how fast is the stream flowing, is the field flooded, is there fallen debris, broken glass to be avoided, dog fouling to avoid?) This can change quickly depending on the time of year. A visit in early April and a visit to the same spot in June can be very different and may impact on the visit and planned activities.
- Be aware of any landmarks.

Establish Clear Boundaries

- Establish clear physical boundaries for each activity. You can use pylons, markers, skipping ropes or natural school or park boundaries.
- Begin by ensuring the entire study area is within your visual range.
- Have a predetermined signal (e.g., whistle) to bring students to your attention.
- Review outdoor behaviour rules so that all students understand what is expected of them.
- Practice having students gathering around you in a semi-circle to listen to directions.
- Begin small and work towards more freedom (e.g., begin by conducting a knowledge-building circle for a set time and move into more expansive explorations).

Activities

- Have a purpose set prior to going outside (why you are there and what are students expected to come back with?)
- Establish an expectation that students stay on task while outside

Touch or Not to Touch

- Gloves should be worn if students are collecting trash or examining waste
- The rules around student exploration will vary depending on the actual activity and location. "Look only" might be best for some students and situations.
- Students can "touch but not pick" if examining rocks or logs and should replace everything in the same location.
- Students can gather materials that have fallen to the ground for projects such as Nature Art . If collecting live harvest, students should be encouraged to use a sustainable approach and use good judgment.

General Considerations

- Appropriate clothing should be worn for the weather and activity
- Be aware of any allergies or health issues with students

Additional Considerations for More Extensive Excursions:

Inform the School Office and Volunteers

- Inform the school office of your planned outside activity, and ensure the school office has a route or plan and knows where you are in case of emergency
- Take attendance before, during, and after excursion
- Have students work with a buddy or in a small group to better monitor the class while in this location
- Consider having volunteers, depending on the site, the activities, and the ability for students to stay on task
- Ensure volunteers have a clear understanding of what the students are to be doing, and what your expectations for volunteers are. Ensure all volunteers have a valid Criminal record check.

Materials and Equipment

- Have an "outdoor" backpack that contains all the materials needed for any excursion outside of the school building
- Emergency supplies, such as a first aid kit that includes antiseptic, antibiotic cream, band-aids, as well as a cell phone complete with emergency numbers, should be included
- Bring along a container of sanitary wipes and tissues
- Allow for flexibility in your teaching schedule in order to allow for harsh weather, but be prepared for fluctuations in weather with appropriate footwear and clothing
- Proper clothing can be ensured by beginning a 'clothing collection' so that there are rubber boots, raincoats, winter boots, mittens, etc. OR send home a note reminding parents what appropriate outdoor clothing will be expected.
- Suggest hats and sunscreen when out in the sun in warmer weather
- Bring drinking water if going for an extended hike
- Think about the appropriate footwear students should wear for a hike or stream excursion
- Ensure students know how to use any equipment before going outside
- Safety rules for equipment use should be established prior to going outside
- Gloves should be worn if students are collecting trash or examining waste
- Washing of hands upon return is important after any outside activity. This is especially important if students are handling dirt or other organic matter.

Know the Area

- Investigate any poisonous plants (e.g., poison ivy or poison oak) in the area you wish to visit
- Ensure students know what they can touch and what they cannot touch and why
- Ensure students understand that they cannot collect or eat any berries, etc. they may find
- Be aware of allergies, health concerns, and possible hazards in the area you are visiting (e.g., has an area been recently sprayed with fertilizer, pesticides, etc.?)

Special Need Students

All students should have the opportunity to experience outdoor activities. Consider how to make modifications to the activities to ensure equitable access for all students. Bring parents or volunteers on field trips. Partner students during activities so that each student can complement the abilities of the pairings. Consider the use of devices, such as the iPad and Smartphones, to provide mechanisms for students to collect, record, and share information. Encourage all students to take leadership roles during outdoor field experience activities. Bring the natural world into the classroom wherever possible to further enhance the experience for all students.

References

Charles, C., Louv, R., Bodner, L., Guns, B., Stahl, D. (2009). Students and Nature: A Report on the Movement to Reconnect Students to the Natural World. Santa Fe: Students & Nature Network.

Last Child in the Woods: Saving our Children from Nature Deficit Disorder. Richard Louv. Algonquin Books , Chapel Hill, North Carolina, 2008.

Natural Curiosity: Building Children's Understanding of the World Through Environmental Inquiry / A Resource for Teachers. The Laboratory School at the Dr. Eric Jackman Institute of Child Studies, 2011.