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Green Teacher

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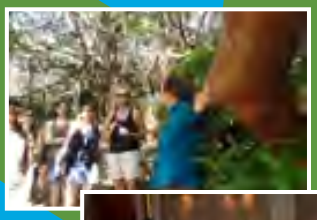

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Editorial

Editorial & Notes

WHAT EDUCATIONAL EXPERIENCES do kids need to thrive in this world? This is the underlying question addressed by the articles and activities found in this issue. If kids are going to thrive, they'll need enhanced outdoor learning programs that employ all of their intelligences — and ones that accommodate those with special learning needs. If they are to appreciate the cycle of life from a young age, teaching about decomposition is a good place to start. Learning about solar energy and sustainable home design can help young people think of their own futures in a positive way. Similarly, creating leadership and interdisciplinary learning programs can enable teenagers to more comprehensively understand the world around them and what role they might each play in creating that positive future.

Last but not least, this issue includes an article about how teachers and students at a small town high school developed a collection program for unused prescription drugs in their community. Their goal: to find a way to reduce contamination of local water bodies. Their success has inspired dozens of similar programs around the world, and demonstrated once again that students truly will thrive when given opportunities to improve the world around them.

We hope you enjoy this issue of *Green Teacher* and find it useful in your own programs.

Now I'd like to share some news...

New design. We hope you like Lisa Rebnord's new cover design as much as we do. After publishing our 100th issue this Summer, we felt it was time for a new look. Lisa has been laying out the magazine for several years now, and we were thankful to be able to tap her considerable expertise.

New subscriber benefits. Less obviously, we've recently also made some behind the scenes improvements. Subscribers can now freely access — via our website — the 25 most recent issues of the magazine, in addition to enjoying full access to our more than 40 webinars. Instead of having to keep track of separate passwords for each issue, now a single password will do the trick.

Expect more changes soon. In a few weeks, we'll be releasing a full colour version of the digital edition of this Winter issue. In a few months, we'll be unveiling an index of the contents of our 25 most recent issues. This will enable everyone to more readily identify which *Green Teacher* articles and activities are appropriate for each age group and which topics are covered by them.

Fall issue? Those paying close attention will have noticed that we did not publish a Fall issue. Our work on the issue alongside that of an upcoming book, delayed the former so much that it eventually became the Winter issue now before you. As a result, we'll be extending all subscriptions by one issue.

New book. Late this Winter, we'll be releasing *"Teaching about Invasive Species"*, our first new book in 4 years. It will be full of innovative strategies for engaging young people in how best to enhance biodiversity in local ecosystems, while addressing the threats posed by invasive species. Stay tuned.

—Tim Grant

Accommodating Those with Special Learning Needs

Students with special learning needs can be a challenge inside the classroom. But with the proper accommodations they can thrive in outdoor learning environments.

Photo credit (this page and cover photo): Janet Main, www.saugeenartists.ca

By **Carol A. McMullen**

WHETHER 6 TO 16 YEARS OLD, Danny is always in the wrong place at the wrong time. He never follows instructions and seems to forget what you just asked him to do. He is in trouble all the time. You want to reprimand, punish, give consequences and time-outs, (or maybe just lose him in the woods), but you sense there is more behind this.

It sure seems as if he has Attention Deficit Disorder (ADD), or maybe he has family problems. But… if his brain is unable to efficiently process what he hears, he does not absorb what is being said, even if he can physically hear it. This is a Central Auditory Processing Disorder (CAP) – a Learning Disability, not ADD.

Danny's parents and instructors are simply unaware because of his superficial ability to hear and high IQ.

As instructors, you can become familiar with the symptoms and implications of these disorders – and the accommodations you can make are similar to those for a more obvious hearing impairment – these are listed on the next page.

Green Teacher readers are likely familiar with mounting evidence that outdoor education provides enhanced learning experiences for all students. But when those with special learning needs − who need this alternative approach the most − are sidelined, or miss significant portions of the experience, it becomes urgent that instructors become better informed about how to create greater accessibility and involvement. You can do so much to help!

You will find below a "toolkit" of hands-on strategies you can use to help these kids better engage in the wonderful outdoor programs you have planned.

When you picture a student with "special learning needs", you may be imagining someone with a lower intellectual capacity (like Down's syndrome) or a seeming inability to meet the goals of your program. These students do indeed need a revised instructional approach and a lot of extra support.

But kids who are not able to focus, who seem disinterested, overactive, or just uncooperative may also have special learning needs that are masked by high intelligence levels. During the last decade, many of these students were mislabeled under the general ADHD category. In this decade, there is a huge increase in young people being diagnosed with Asperger's-ASD. Many of them may also have undiagnosed or untreated Learning Disabilities, which confounds the challenges for instructors with no special training in this field.

It is precisely *because they look the same as others* and are often very bright that no one can believe the extent and impact of their disabilities. Both parents and instructors can feel very frustrated and be very hard on these kids. Without

proper identification and help, students drop out, get in trouble with the law, and do serious self-harm. (Adam Lanza, the Sandy Hook Elementary School shooter from Dec 2012 in Connecticut was reported to have had untreated Asperger's Syndrome.) Fortunately, these tragedies are preventable.

Bright students with special learning needs can now graduate from all programs at college and university. But they may not be able to read higher than a grade 9 level, like a student of mine in Veterinary Medicine. This student also had an arithmetic reasoning score in the 16th percentile. Yet he achieved 85% in honours math and science – with the needed accommodations. Some can't find their way from the gym to their parking spot, or understand the simplest joke or sarcasm. They are "lost" in our world, misunderstood, and often bullied.

A wide range of accommodations have recently become established as legal rights across most of North America and the Western world. These include having note-takers or teacher notes, a classroom FM system for students with CAP, computer text reader and voice recognition programs (for writing essays), reference sheets and scribes for exams, various options for multiple choice questions, literally dozens of creative options.

These accommodations parallel Braille, mobility access, and extra time for exams – which have been common-sense options for many decades before these developments.

So we ask: which of these can be best applied to outdoor education programs?

Students with all special learning needs require more structure, which can be a challenge in an outdoor setting. But if you are able and willing to share your teaching or activity plan ahead with parents for preview the night before, this can facilitate better student understanding about what will be happening and how s/he will be connecting to the various activities.

Here are some ways to accommodate students with special learning needs:

- Instructions need to be repeated or presented in a couple of different ways, and *chunked* into smaller steps.
- Use visual aids with bright colours, and hands-on practice examples.
- Simplify your goals – avoid an overload of information.
- Help these students to use all their senses – especially touch. Some may never have experienced the feel of swamp water, moss, or milkweed fluff.
- A small visual guide or checklist for the student to follow during the actual program will further assist focus and motivation.
- Pair the student with a partner who is strong in organization and performance skills.
- Close proximity to an instructor is also required. Or consider enlisting an education assistant, an older student in another program, a parent, or an active senior volunteer with good skills in engaging various kinds of kids.
- By assigning various real or "creative" jobs (water carrier, butterfly net holder, trail marker, look-out climber etc.) to students with special needs, it helps them maintain focus and motivation. As well, this practice can increase their status within the group, which can sometimes be an issue.

Where there is any academic component to the program, sight reading may be a problem for many of these kids, as it was the case with the veterinary medicine student mentioned above. Never embarrass a student in a group reading exercise – ask only for volunteers who wish to read aloud. As with the previewing suggestion above, have material

What Are These Special Learning Needs?

Attention Deficit Disorder, with or without hyperactivity (ADHD) – a condition characterized by poor attention or focus, sometimes with excessive talking, activity levels, propensity for disruption and conflict

Asperger's Syndrome – a high-functioning **Autism Spectrum Disorder (ASD)** – students have significant social interaction problems, and restrictive or repetitive patterns of behaviour and interests

Learning Disabilities (LD) – auditory or visual processing problems that affect learning, despite high intelligence – can affect listening speaking, memory, all academic areas

read to this student ahead of the program, provide a scribe for written work or pair the student with a strong writer. Math accommodations are more complex and need to be based on a very specific academic program, similar to the JumpMath.org approach.[1]

Finally, a word about the social and perceptual difficulties for students on the Autistic Spectrum (including Asperger's). Unstructured outdoor settings may be highly distressing for some of these kids. On the other hand, others like 10-year-old Tracy may love being out of their constricted and noisy classrooms. Tracy becomes overwhelmed by the extra stimuli of electric lights, chairs scraping, too many voices, images, charts, and flashy classroom decor. She doesn't like being touched by others and seldom makes direct eye contact. But in your outdoor setting, she becomes completely absorbed in the hyper focus of the cloud patterns or certain leaf formations. She could be mentally composing a song for the insects rather than listening to your lesson.

This seeming distractibility (i.e. little regard for you, but much for her personal focus points) may appear to be disinterest, disrespect, or an "ADHD" issue. You can see how complex these various pieces may be.

Not relating to others, or relating intensely to certain others who provoke a negative response, may be a challenge for you as an instructor. You will likely need to modify and simplify your activities for certain of these kids to provide a comfort zone of functioning so as not to take your entire time and energy away from the others. Confining the student's parameters and providing the structure outlined above will hopefully allow a "parallel" participation mode without forcing a level of interaction that will result in a melt-down or blow-up.

You have the opportunity to make a profound impact on the lives of the students you work with. Helping to develop their knowledge and love of nature will have lasting results on how they protect our environment, seek refreshment and renewal as adults, and teach their own children perhaps. For your students with special learning needs, you may observe things about them and connect in ways not possible in the regular classroom. Your insights may provide some added contribution for their parents and other teachers who are trying to cope with the ongoing challenges.

You may form a special connection with them that others cannot make in a more restricted setting. They may remember these pieces more than anything else from their school experience. This connection and encouragement may be the influence that keeps them from taking a destructive path in later years. Your position of privilege and responsibility can be an inspiration on many levels – may it be so.

Carol A. McMullen is specialist who works with children, youth, and adults with a wide range of learning issues. She is the author of a comprehensive manual for both families and professionals: *Saving Your Child, Saving Yourself: Navigating Roadblocks in Managing ADHD, Asperger's and Learning Disabilities*. Learn more about her work at www.carolmcmullen.ca.

Endnotes

1. I have devoted an entire chapter to this program aspect in a handbook I have just published: *Saving your Child, Saving Yourself: Navigating roadblock in the Management of ADHD, Asperger's and Learning Disabilities.*

Tomorrow's Leaders for Sustainability

Fostering Leadership for Sustainability

Ten basic principles for getting students aged 11-18 engaged and active in bringing about change for a more sustainable future

By **Patricia Armstrong**

I MET AN AMAZING young leader this year. He was only 14 years old, but already has taken on a project to install solar panels on the roof of his school, because, as he sees it, the school should be a model to the community in using renewable energy. It has not been an easy project. The school has said that they don't have the money, but he has persisted, producing convincing arguments to any objections raised and generating numerous fundraising ideas. Giving in is not an option. He told, me "If I don't do this, who will?" His goal is to have the panels on the school by the time he finishes his final year.

During this time, he has demonstrated entrepreneurship, resilience, excellent communication skills, courage, determination, strategic planning, futures thinking on multiple occasions. We are only now beginning to realize such qualities are the hallmarks of young leaders for sustainability.

Since I met this driven young man, I've observed many students that shared similar leadership skills and passion for sustainability. More and more schools are successfully introducing and maintaining sustainability initiatives that have similar students actively engaged and encouraged to take leadership.

A recent study of schools in Victoria, Australia has provided evidence that supports the idea that student engagement and empowerment is key to success in sustainability initiatives. The authors concluded:

> "Motivating students to identify and take charge of their own projects and also making the work they do visible to the wider school community (through

T-shirts or badges) helps keep them motivated and elevate sustainability work as 'mainstream' or 'cool' from the perspective of other students."[1]

These observations and research results raised a number of important questions about young people ages 11-18. What does the literature tell us about leadership for sustainability in young people? How can teachers and educators motivate young people to become leaders in sustainability? To what extent can young leaders contribute to their school's achievements or outcomes in sustainability?

In 2008, with these questions, observations and reflections in mind, Jane Stewart and I co-founded Tomorrow's Leaders for Sustainability (TLfS), with the broad aim of helping primary (elementary) and secondary (high) school teachers to engage and empower their students in sustainability initiatives. Since then, we have developed training courses for students, run workshops to train teachers in the approach, licensed other organizations to work with schools, conducted one and three-day forums for students in hundreds of schools in Victoria, as well as community leadership courses.

What is youth leadership for sustainability?

There has been very little research on youth leadership for sustainability and what it may mean to young people. One recent study of the Australian Sustainable Schools Initiative identified that "students defined leadership in terms of communicating clearly and simply; making new tasks fun and easy; and being positive role models."[2]

Taylor[3] defined adult leadership for sustainability as:

> … a process of influence that occurs within the context of relationships between leaders and their collaborators, and involves establishing direction, aligning resources, generating motivation and providing inspiration to achieve mutual interests. This definition can accommodate leaders and collaborators swapping roles during the process, strong individual leadership as well as distributed leadership (e.g. within a team, where all or some of the members contribute to the leadership process at some time).[4]

At TLfS we have incorporated Taylor's "process of influence" in the following working definition of youth leadership for sustainability:

> Leadership for sustainability with young people is the ability to have ideas, take initiatives, influence and motivate others and complete actions that will bring about change for a more sustainable future.

A 17-year-old student in a Victoria-area school has come up with an even more succinct and profound definition of leadership for sustainability. When asked what she understood by the two terms leadership and leadership for sustainability, the student defined the first as "service for the community" and the second as "service for the environment."

Ten principles for fostering leadership for sustainability in students

From a search of the relevant literature and our observations and experiences with many schools, the following are what I believe to be the 10 key principles in nurturing leadership skills and attitudes in school age students towards sustainability:

1. Theories, models and styles of adult leadership are not necessarily applicable to young people.

While there are numerous theories, models and styles of adult leadership, there are far fewer on the subject of youth leadership. We cannot assume that what applies to adults will also apply to young people. There are at least two reasons for this. Firstly, the theories, models and styles adult leadership were developed from research on adult leaders of other adults in a range of situations, such as the workplace, the military, sport, churches and community organizations. These are quite different situations to schools, which are places where children learn under the guidance of teachers. In schools, there has been some research[5 6], but little work regarding youth or adolescent leadership for sustainability. More research is needed in this important area.

Approaches to adult leadership are based on the cognitive capacity of the adult brain, but brains of children and adolescents are different. We don't understand yet how these differences may impact on their leadership capacity. What we do know is that during mid-adolescence—about 14-16 years in age—a young person's brain undergoes rapid changes and this leads to greater cognitive and social abilities compared with younger children.[7] Often this development is not complete until a young person is in his or her late teens or even early adulthood.

One theory of adult leadership which seems to work for young people is that of *collaborative leadership*, in which people from different groups work collaboratively to achieve outcomes. A good example of this took place at Melbourne Girls College in Richmond, Victoria, where they formed a Sustainability Collective to run sustainability projects. The Collective, made up of students, teachers, parents and people from businesses and the local community, has undertaken many interesting projects including tree planting and a solar powered, open-air theatre night.[8]

While it is tempting to just provide a simplified version of adult leadership training programs for young people, this may not be appropriate. Teachers and educators who conduct training for young people in leadership skills should look for programs that are based on research with young people and are appropriate to their students' cognitive and social capacities at the time.

2. Young people seem to be more interested in developing leadership through involvement in groups, rather than as individuals.

This important principle, which is based on a 10 year longitudinal study of youth-based organizations in the United States[9], is about *leadership within a group and for the group*. The principle can also be extended to embrace the practice of older students mentoring younger students.

This doesn't mean that schools should not have environmental captains, as long as these leaders are working in a collaborative way with other students, staff and parents. In my research, several young leaders told me that one of the things that motivates them to be leaders is recognition; having a position as an environmental leader helps give them that recognition. On the other hand, we have observed schools where a whole class took on the role of environmental leaders collectively, with individuals having clear responsibilities, but working together on significant projects. Having environmental clubs or committees is another way of fostering leadership in a group situation.

This principle is consistent with the work of the US psychiatrist, Daniel Siegel, who argued that we need to help young people to have a well-balanced approach to life that integrates personal insight, empathy for others and moral awareness; "behaviours for the greater social good."[10] Leadership in groups helps young people move from the "me" to the "we."

3. Leadership for sustainability is about working towards positive environmental or social change.

As with adults, young people's leadership for sustainability should be directed towards taking actions that bring about change. There is not much point to being an environmental captain or part of an environmental club or committee unless change happens. TLfS resources were designed with this principle in mind. Teachers use the resources to guide students to choose, implement and report back on their projects, and finally, when the projects are completed, to celebrate their success.

4. All young people have the potential to be leaders for sustainability.

Leadership for sustainability is about influencing others to take positive actions to achieve a more sustainable future. Taylor believed that "anyone in a sustainability-focused organization could potentially be a leader at some point in time if they are involved in a process of influence that involves encouraging sustainable practices."[11]

The key words here are "sustainability-based organization." In a school culture where sustainability is valued, a student has the potential to take on leadership, whether this means as a school environmental captain or organizing their own campaign. Either way, the student is influencing others to adopt sustainable practices.

This does not mean that every student will want to be a leader for sustainability. As young people lead busy lives and many have other interests; sustainability may not be the most important thing for them at this stage in their life. Some may feel that, at present, they just don't have the confidence, knowledge, skills and experience to be an effective leader. Perhaps we should be helping students to look at this from a different perspective: by taking initiative and actions, a young person will develop their confidence, knowledge, skills and experience and become better leaders. One student told me that it's like a cycle, "The more you do, the better off you are."

5. Many leadership skills can be learnt.

There is evidence to show that students can learn and improve their leadership skills.[12] [13] Young people can learn skills such as communication, teamwork, planning, running meetings, giving presentations, planning projects, solving problems and making ethical decisions. These basic skills provide the framework for our TLfS leadership courses.

Nonetheless, leadership for sustainability is not just about developing skills; it is also about gaining knowledge, having good ideas, being able to inspire others and bring out their ideas and strengths, working collaboratively, taking actions, and eventually completing projects and delivering outcomes for sustainability. Some of this can be taught, some of it can learnt from other students or adults, while some can only be learnt through practical experience and developed over time. Teachers can best help their students to develop their leadership capacity by giving them opportunities for leadership through meaningful projects, recognizing their efforts and achievements, encouraging and guiding them when things become difficult or uncertain, i.e. to not just be their leadership trainer, but their trusted coach or mentor.

6. Young people can be motivated to take environmental actions through positive people and experiences

Research suggests that the best way to motivate young people to take environmental actions is by helping them to learn through *positive people* (teachers, family, friends and role models) and *positive experiences* (outdoor natural experiences and youth groups, events and conferences). [14] As many of us are now coming to realise, focusing on "doom and gloom" scenarios does not work in motivating young people to take environmental actions. Instead, motivate them through inspiring experiences and personal examples of all the little things that you do to live a more sustainable

life; riding a bicycle to school, bringing your own low garbage lunch, turning off lights when you leave a classroom, and growing vegetables at home.

7. The key elements for promoting youth leadership are based on empowering young people.

Researchers Des Marias, Yang and Farzanehkia listed a number of essential elements that they believe are critical to the development of youth leaders. These are: "youth / adult partnerships; granting young people decision-making power and responsibility for consequences; a broad context for learning and service; and recognition of young people's experience, knowledge, and skills."[15]

This means entering into real partnerships with young people, where the relationships are not power-based and not rescuing students every time something goes wrong (of course, adults must step in when safety is at stake).

8. Youth leadership is best developed through challenging and meaningful projects.

One of the cornerstones of our programs has been fostering leadership through significant projects. This principle is based, in part, on the major US study of youth leadership by Roach et al. discussed earlier. The authors believed that one of the best ways to promote youth leadership is by "… finding ways for young people to commit to work that will benefit others and be judged by tough criteria."[16] In our programs, students are encouraged to work in groups on projects of their choice, guided by the class teacher. We have seen some unbelievable group projects, during which the young people underwent quite astonishing transformations in their leadership and personal development.

At one secondary school in western Victoria, groups of students were expected to undertake a significant community project and were allowed to work out of the school on their project for one day a week. At the end of the semester, the groups gave presentations on their projects to all the Year 9 classes. Each project had a social enterprise component in which students were expected to raise money for a local charity. The projects included making recycled paper stationery, helping to rehabilitate a golf course that had been burnt out in bushfires, environmental photography and environmental odd jobs at a local primary school (digging vegetable gardens, fixing leaky taps etc).

9. Encouraging students to undertake environmental and social actions can help students to feel more connected to their school.

This principle is based on research that has showed that connectedness to school is an important factor in helping young people to develop into successful adults.[17] It then can be argued that students who are undertaking projects at school feel more connected to their school and may go on to become more successful adults.

10. Training for leadership should start when a person is young and continue throughout life.

Many authors advocate starting leadership training when young[18]. Teachers and educators who are running youth leadership programs in schools are not only helping their students to become better leaders in their school, but are also helping them to become better leaders and adults, starting the lifelong journey of leadership development.

Pat Armstrong has worked as a sustainability educator for many years, and now specializes in youth leadership for sustainability and professional development programs and other approaches that bring about lasting change. She is also a doctoral candidate at RMIT University, Victoria, Australia, undertaking research into adolescent leadership for sustainability. Pat would like to thank Jane Stewart (her co-founder of Tomorrow's Leaders for Sustainability) and Dr. Colin Hocking for their contributions to this paper. Teachers and educators can purchase TLfS resources from www.leadersforsustainability.com/. She would welcome feedback on the ten principles described in the article, and can be reached at pat@leadersforsustainability.com.

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Visioning a Green School

Suitability: upper primary (elementary) and secondary (high) school students.

Teacher Background

Teaching ideas

Introduction

1. One of the characteristics of good leaders is that they can create clear "visions" or "ideas" for the future.
2. Many top athletes use this process to imagine achieving their personal or team goals.
3. In sustainability, many "experts" paint scenarios of the future which are "doom and gloom". There seem to be so many problems and barriers that it is often hard to see a positive future. This can be very upsetting for many people in the community.
4. Many people are now arguing that we need create positive futures by focusing on achieving goals and on solving problems, not dwelling on the problems themselves.
5. This activity will help a person to envision a positive future, to overcome barriers to achieve a dream.

Discuss with students:

1. What are some of the features of your school that you would describe as demonstrating or modelling sustainability – Environmental (e.g. the energy saving features of the school, the water tanks) Social /Cultural (Fair Trade events), Economic (saving money on energy bills, saving fares by using bikes)
2. How do you learn about sustainability at school? (in many subjects, it is a strong part of science, integrated into the curriculum, etc.)
3. Show images of schools with sustainability programs (www.ceres.org.au has many cases studies of schools with outstanding sustainability programs.)

- Students are allocated into four groups and each group chooses one of the four schools listed below.
- Students prepare a model of their "school" and their presentation.
- Remind students about the tips for giving clear presentations.
- Students give presentations.
- Debrief activity: What did you learn from this activity?

Time required

15 minutes for introduction and outlining of activity, 30 minutes to build models of "schools", 20-30 minutes for students to give presentations and 5-10 minutes to debrief. Total time of 70-85 minutes.

Student Information

Purpose

To create a vision of a green school of the future that will be sensitive to the environmental conditions of a local area and the social and cultural needs of a local community.

Materials

- Natural materials – cones, nuts, seeds, twigs, branches, flowers, shells, pebbles
- Construction materials – blocks
- Plastic model animals and cars
- Sand tray

- Water
- Pipe cleaners
- Bamboo skewers
- Butcher's paper
- Labels, markers, tape
- Card
- Scissors

What to do

Imagine that it is 2018. Your group has just won a prestigious National Environmental Award for the category of Green Schools. Your group was involved in designing and building a new school that:

- made little impact on the natural environment
- helped to build a strong community
- respected the cultures of the local people
- paid for the extra costs of the sustainable features from savings in energy, water and waste disposal

The judges were very impressed by the leadership shown by your team and your exciting design. They also commented on how the team was able to come up with a design that cleverly integrated the environmental, economic and social/cultural sides of sustainable development.

Work in small groups. Each group has to imagine that it is 2018 and they have been asked to give a presentation after the announcement of the award, explaining their design, how it all came about and the benefits it has brought to the local community. The group can use any props they like in their presentation: e.g. butcher's paper, 3D models, etc.

In your presentation, your group will need to cover:

- How the project got started
- Your final design
- How you managed to meet the needs of the school and its community
- Who was involved in the planning and the design
- How you got all these people to work together
- How long it took
- The barriers you faced and how these were overcome
- Some of the benefits of the new school for the students and the community
- How you feel about it now

Each group can choose one of the following schools:

1. A primary (elementary) school in a small, isolated indigenous (i.e. Native American or Canadian) community
2. A primary (elementary) school in a small rural town. The old school was burnt down in a bushfire and replaced with a new building.
3. A new primary (elementary) school in a booming new suburb on a major city. The new suburb has special sustainability building requirements, such as compulsory solar water heaters on all new buildings and grey water recycling.
4. A large secondary (high) school in an inner city. The old school was demolished and replaced by the new buildings.

This activity is reprinted with permission and slightly adapted from Tomorrow's Leaders for Sustainability. To see the whole unit, visit www.leadersforsustainability.com.

Illustrations by Tom Goldsmith

Using multiple intelligences to promote nature education

A compilation of activities which let students – young and old – explore their environment by using the eight forms of intelligence.

By **Christophe Vermonden**
Translated by **Patrick Alcock**

BEFORE LEADING A guided nature excursion, you must first know the trail inside and out, have an understanding of ecosystems, and know your audience. It is key to always have the participants in mind. If you want to engage each student, the trick is to create links and make connections between humans and nature.

The theoretical framework of multiple intelligences, developed by Howard Gardner, gives educators a broader scope and a more general understanding of learners at every age. This theory, rising out of cognitive psychology, allows nature guides to develop nature excursions based on the multiple intelligences of the participants, not simply based on the environment itself.

The eight forms of intelligence as identified by Howard Gardner are:

- Verbal-linguistic intelligence
- Logical-mathematical intelligence
- Bodily-kinesthetic intelligence
- Visual-spatial intelligence
- Musical intelligence
- Interpersonal intelligence
- Intrapersonal intelligence
- Naturalistic intelligence

To understand these variances is useful in preparing activities which support all of the intelligences, and allow everyone to connect with nature—especially those with limited awareness.

I have prepared twelve activities to help raise nature awareness incorporating all eight multiple intelligences (naturalistic intelligence is weaved into every activity). I carried out the activities with a variety of participants including children, teenagers, working-class and privileged adults, families, and people with mental health issues.

These activities are founded on three assumptions:

- Humans are a part of nature; we therefore have an impact on nature and nature has an impact on us;
- Nature is all around us and is beautiful;
- We learn by doing, interacting and working together

Incorporating 8 Types of Intelligence

Verbal-Linguistic Intelligence: Word Lovers

Beyond simply enjoying the company and conversation of others, people with this type of intelligence have a gift for description and telling stories. Here are two example activities:

Description chart

Have members of the group work in pairs and ask them to observe either a flower or an insect and create a chart which includes the following elements:

- A first name and a family name (this helps to introduce the learner to the common names of animals or plants and their origins)
- A description of shapes and colours, with as much detail as possible (you can supply a list of descriptive adjectives for describing colour; for inspiration look in a guidebook)
- Way of life: food, habitat, reproduction, seed dispersal, protection against predators, etc. This section of the chart will lead to discussion of the countless ways by which living things adapt to their environment.

Each part of the chart will relate to a characteristic of the living thing.

When finished, ask each team to share their findings with the others.

Cooperative story writing

Libraries are filled with the many stories and legends inspired by nature. During a nature walk, talk about the landscape or creatures as though they are part of a tale rather than simply describing them: the alder's red heart, the daffodil's flower, birch trees etc. Read a passage from Zola's *Germinal* for maximum effect.

At the end of the excursion, ask the group to create a story or a poem based on some of the elements found in nature. Ask them to form a circle, and have the first person begin the story by choosing an element of nature. Every two minutes, the person on his or her left continues the story. Variation: form groups of three to four people and ask them to write a story and share it with the rest of the group.

For optimum results, it is best to carry this activity out over several sessions; This activity presupposes both a specific context (such as a school trip, an environmental class, a family weekend, etc.) and a written component.

Logical-Mathematical Intelligence: Number Lovers

People who have this form of intelligence make use of identification keys as they help in the development of logical thinking. Measuring, recording experiences and analysing numerical data are all elements of logical-mathematical intelligence. These learners can understand any given environment, whether it be a forest, a field, or a simple trail, using measurement.

Fill up a bag with boards, twine, measuring tape, a thermometer, a stop-watch, a square, a few crayons, and grid paper. Ask participants to count everything in their surroundings:

- Count the number of trees and categorize them by species, height, and circumference and estimate how old they are
- Measure the temperatures in different areas and at different altitudes
- Calculate a stream's flow rate, width, and depth, etc
- Count the number of plants per square metre (foot)
- Find the longest piece of mycelium

By recording all of these measurements using graphs and tables, the student's analysis and determination of variables will help them make sense of these numbers and foster a sense of enjoyment of nature.

Bodily-Kinesthetic Intelligence: The Movers

Here are two activities that activate this form of intelligence.

Working with clay

Clay is a wonderful natural material. It is inexpensive and fun to work with at any age, in any environment. For example, you can create sculptures of animal shadows.

Here is how it's done:

- Photocopy animal shadows from a book (or print them from pictures online) and cut them out.
- Create a rectangular plate out of clay, about one centimetre thick, and place the animal shadow of your choice on it.
- Go over the outside and inside edges with a pencil and remove the paper.
- Using toothpicks, wooden sticks, knives or a similar tool, carve a cavity into the animal shadow.
- Let it dry and paint it or varnish it.

By making these clay animals, the participants can note their differences and distinguish between the various characteristics of each animal, particularly if the shadows are quite similar to one another.

Group co-operation is encouraged through the sharing of the different animal shadows according to the levels of difficulty: it's easier to trace the shadow of a wild boar than that of a hedgehog!

The Bird Song dance

Recognizing and mimicking the songs of birds isn't an easy task for most, even though we hear more perching birds than we actually see. Instead, attribute a dance or movement to each birdsong. The rhythm of the great titmouse could be interpreted by the movement of flowing water, the excitement of a yellow warbler might become a lively swing of the hip. During the nature walk, as soon as a participant hears the sound of this bird, they will be asked to reproduce this movement.

This activity works particularly well with children and families, promoting group dynamics wherein each group creates its own culture, and fosters a happy, friendly environment where laughter can be shared.

Visual-Spatial Intelligence: The Image Makers

Plans, mental maps, drawings and photos are all helpful tools that can lead us to better understand nature. Visual intelligence allows us to understand the notion of interdependence, for example, differentiating the leaves on trees.

The leaf chart

This activity helps us recognize different types of trees based on their leaves using symbols and charts, rather than dictionaries or logical thinking.

Give the participants eight plates: three participants will describe the edge of the leaf, five will describe its shape. Have them search for as many leaves as possible that are different based on two characteristics. Afterwards, have the students arrange their findings in a double entry format in the boxes on the board (a large panel or even the ground will do), this activity will help them understand the concept of classification. Challenge them to fill up all of the boxes on the board. Many leaves will belong in the same box, which will help raise awareness about biodiversity.

Food webs

Give each of the participants a card with the drawing of an animal and what it eats. Give the participants some string and ask them to link their animal to the animals they eat. You can then play out scenarios like the extinction of plants due to herbicides, the decrease in the numbers of insects, or the growing fox population.

Musical Intelligence: The Sound Searchers

Naturalists who are particularly adept at recognizing the sounds of birds possess musical intelligence.

Another way to learn about nature is through "environmental music": creating musical instruments and using them to make rhythms, sounds, entire symphonies. These "musical plants" are their own indicators of biodiversity. Try it yourself:

- Rub a teasel-head against a spoon or a plank of wood
- Blow into the seed capsule of a rhododendron
- Play a xylophone made of flat stones laid out on logs
- Rub a blade of grass in between your thumbs and fore fingers
- Shake beechnut acorn cups inside a plastic container

Using some of these examples, create an orchestra where everyone listens to one another to make a tuneful symphony.

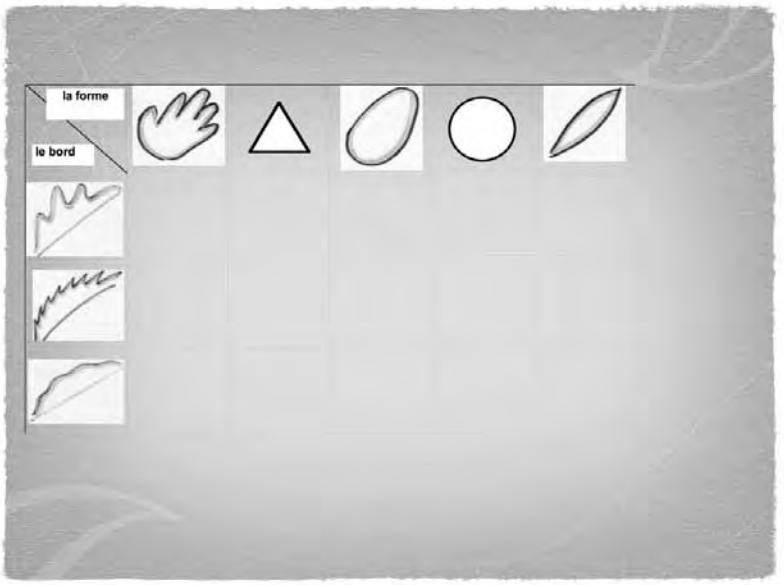
Interpersonal Intelligence: The Social Links

Any activities that require the participant to take into consideration other points of view foster interpersonal intelligence; for example role play and dramatic play.

A quasi-natural environment such as a brownfield or an empty lot is the perfect setting for the following immersive activity.

Here is how to go about it:

- Give the participants a scenario: "This land is the subject of a conflict involving several interest groups. Each of you will represent one of the interested parties and you will participate in a meeting with the others where you will defend your point of view."
- Assign different roles to the participants: the city developers who would like to turn the space into a commuter parking lot, youth groups who use it as a play area, naturalists who see it as a corridor for biodiversity, a contractor who would like to use the land for a commercial business.
- Provide each group with documents, such as maps, lists of the various species of wildlife, the rate of attendance of the site, photos, resource people, etc., which vary depending on the group,



Leaf chart

Night Walk
Night time is the perfect setting for getting in touch with our emotions in the great outdoors. The dark puts us in touch with four of our five senses, and helps us confront some of our deepest emotions, fears and insecurities. The trick of a night walk is to slowly bring the participants from their initial state of excitement to an inward journey of self-discovery. This can only take place if the participants do not try to scare one another. The activity should be held in an area that is well known; it can be of a long or short duration and carried out as a group, in pairs, or alone. You can take the activity one step further and spend the night under the stars: a powerful experience wherein the group can take on the facilitator role.

- Set aside some time to visit the site to further define the possible arguments.
- Hold meetings with all of the interested parties. Members of the different groups meet with one another and each participant has the opportunity to defend his or her point of view and to listen to the other viewpoints. Each group consolidates the various arguments of its members and offers a solution to present to the entire group of participants.
- Set aside time for debriefing the way participants handled the activity: their feelings, challenges, and strategies they used.

This activity encourages a systematic and multi-factor approach to learning about the environment. It requires dynamic and strong leadership, regular follow-ups with each group, as well as careful preparation of resource documents. The intensity of the exercise may necessitate more than one facilitator.

Shorter activities can also help in the development of interpersonal intelligence For example:

Animal on your back.
Each participant has the drawing of an animal stuck on his or her back. Participants must then guess what animal they are solely by asking the others questions.

Intrapersonal Intelligence: The Internalizers

Activities in nature are ideal for the development of the highly delicate intrapersonal intelligence, as they foster personal and emotional development.

Land Art
This activity consists of creating a work of art by using repeating patterns found in nature and natural landscapes. Participants will choose a location that will serve as a stand or a backdrop for exhibiting their work: tree trunk, path, stump, rock, puddle, row of pine trees, etc. Here, participants will display one or two natural elements, based on a number, rhythm, or shape of their choice … to create a piece of abstract art. The activity ends with a visit to an "outdoor art gallery."

Implementation

By taking into account the different intelligences, nature guides must change their way of thinking. It's no longer about knowing nature, or being able to describe its wonders to captivate your audience: the goal is to put the participants smack in the middle of the action, so each may interact on their own terms.

These activities help to transform the facilitator: he/she is no longer person who simply passes on knowledge of the environment. Rather, the facilitator becomes a gateway to discovery, ensuring rich interactions are maintained within the group and between the group and nature.

Intelligence is the result of the interaction between heredity, the environment, and experience. It's our job to promote these kinds of activities so that we may demystify nature.

Christophe Vermonden is a Belgian teacher, activity leader in nature and trainer in environmental education for over 20 years. He has a M.Sc. of Education at the University of Louvain in Belgium. He is currently a pedagogical adviser for schools and NGOs.

Patrick Alcock is a freelance translator who resides in Toronto, Ontario, but is originally from Montreal, Quebec. He has just completed his Bachelor of Education degree at University of Toronto.

A longer French version of this article appeared in L'erable, the magazine of the Belgian Naturalists Association (i.e. Cercles des Naturalistes de Belgique) in 2010.

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Turning Rotten into Right

How a year-long study of decomposition turned a class of Kindergarten students into unlikely environmental stewards.

Photographs: Jyoti Gopal

By **Jyoti Gopal**

DECOMPOSITION IS A RATHER unsightly natural process, but it is an essential one. At its core, decomposition enables dying organisms to return their nutrients to the earth for re-use; a truly beautiful part of the life cycle. Children know from experience that fruits rot and garbage stinks. My colleagues and I aimed to harness the powerful sensory experiences children have towards decomposition into learning by creating a year-long curriculum that took the "eew" factor into the "Aha!" zone.

My colleagues and I wanted to create a hands-on interdisciplinary Kindergarten curriculum by weaving important scientific concepts with language arts, social studies, art, music, and technology. We also wanted to entwine the curriculum into the daily life of Kindergarten so that children could revisit the same practices and concepts throughout the year. By studying natural and managed decomposition as a part of everyday life, we encouraged young children to reflect on their own relationship to waste and its impact on their environment in a very personal way.

Classroom Routines

In September, as the children enter Kindergarten, they become familiar with the rhythms and routines of our classroom. One of the first things they learn is that there are four receptacles for their waste: a paper recycling bin for paper, a co-mingles bin for glass, metal and recyclable plastic, a food scraps bucket for certain types of food and paper towels and a garbage can for what can't be put in the first three. Our goal, I tell them, is to keep the garbage can as empty as possible.

Jobs are assigned on a weekly basis and two Environmental Stewards are responsible for taking the food scraps bucket out to the garden and emptying the contents into the outdoor composter. Most children know that food "goes bad," so I tell them that putting it into the composter is a way of helping the food recycle back into the earth. The words compost, composter, recycle and environmental steward become a part of their daily language. I show the students a rap about composting sung by some wiggly worms, which quickly becomes a favorite YouTube video at lunch!

Our Class Pets, the Red Wigglers

We soon introduce the children to our class pets; *Eisinia Fetida*, or red wiggler worms. Our worm bin is brought into the classroom in the mornings so that children can dig into the bedding and investigate the worms and their home. The children help with cutting fruit and vegetable leftovers from our snacks and lunches and feeding it to the worms, and tear newspaper strips to refresh the bedding. They learn that the worms are recycling the food by eating it and that what looks like soil in the bin is actually worm poop, or as they learn to call it, castings.

In addition to seeing worms in the worm bin at different stages of growth, my students also come across other living organisms, like snails, nematodes and mites. I introduce the word 'decomposers,' explaining that all these organisms are

helping to break down the food we are putting in the bin.

Later in the year, I present a formal lesson on worm anatomy and a worm's role in enriching the soil. The children use their experience with the worms to express what they have observed and use this to build their conceptual understanding. We give them the accurate scientific terminology and they use it with great enjoyment. We provide them with opportunities to investigate the worms more closely with magnifying glasses and powerful microscopes, which they use to identify body parts and observe the worm's movements. Students are asked to figure out "Do worms like water?," "Do worms like light?," and "Do worms move forwards or backwards or both?"

Garden Work

While the children familiarize themselves with the worms, they are also introduced to outdoor garden beds. In the garden, the students' senses are excited by herbs, pumpkins and other plants that they can smell, touch, pick and taste. They learn how to weed and mulch. Later in the year, they harvest compost from the outdoor composter and the worm bin to mix into the beds and indoor plantings.

The garden is a great place to dig for earthworms —comparisons with the red wigglers' anatomy are inevitable— and I point out they can see some other fascinating creatures by turning over a log.

Nature Walks and Log Hotels

We start our nature walks in September, in the woodlands adjacent to our campus. One of my favorite walks to go on is the one with our 4th grade buddy class. The 4th graders share what they have been studying about "log hotels": a decaying log that can house many different species. Immediately, the kindergartners start comparing what they see in the woods with what is under the log in our garden.

In the classroom, I set up a temporary log hotel for observation and exploration. Students start to identify and name the different creatures they see, looking for invertebrates, arachnids, insects and gastropods. We read books on log hotels and discuss the life cycle of a tree. Even a dead tree that has fallen down continues to be a source of life for other living things. Decomposition comes up again as we discuss how the living organisms that live in this tree eventually break the tree down back into the soil.

The children belt out the FBI song (Fungi, Bacteria and Invertebrates) by the Banana Slug String Band; a fun musical tool for learning about nature's recyclers.

Through the seasons, nature walks continue to be an excellent avenue for children to observe natural decomposition. As we trudge through fall leaves and investigate fallen trees, the evidence of decomposition is all around us.

Organic and Inorganic Litter Study

Around mid-October, we add on another layer of our decomposition curriculum. All of the trash from the day's lunch — apple cores, banana peels, Ziploc bags, juice boxes, napkins and some added leaves and twigs from the playground — is put on a tray.

We play "What's the Rule?": as I place the litter in two

different trays, the children try to figure out what rule I am using to separate the litter. It's always fun to listen to how they start narrowing it down, starting with "things we can eat/things we cannot eat" to "made in a factory/grown in the garden" and so on. At the end of the exercise, I introduce the words organic and inorganic and we clarify the difference. I bring out two glass bowls filled with soil — mini-Earths. I fill each bowl with a different type of litter and the children predict what they think will happen to the litter. Some examples of predictions include:

- "they both will stay the same"
- "they both will sink into the soil"

- "the organic litter will get rotten"
- "the inorganic litter will get smaller"

For the rest of the year, the children observe the organic and the inorganic litter, confirming or refuting what was predicted. Inevitably, we keep adding to the mini-earth with the organic litter as the litter decomposes. The mini-Earth with the inorganic litter, however, gets full very quickly and for the rest of the year remains exactly the same: a small but powerful visual.

Throughout the year, we continue to provide opportunities for children to practice sorting our litter and identifying organic vs inorganic, whether we are out in the woods, in the classroom or in our garden.

Bottle Cap Recycling

The Kindergarten classrooms also partner with Aveda, a company that recycles bottle caps. Starting in September, the children bring in bottle caps from home and throughout the year, they sort, count, and collect. As each collection box gets full, we finally mail them off to Aveda. I put some caps into the mini-earth with the inorganic litter and with each passing month, the children note that the caps not only do not decompose but in fact stay exactly the same, crowding the space. They can literally see the difference they are making every time we ship off a box of 2000 caps (yes, we count them!) to Aveda for recycling instead of throwing them in our garbage and sending them off to landfills.

Pumpkin Study

Our Halloween pumpkin study is another fun activity in our decomposition curriculum. After Halloween, the pumpkin is placed in the dirt outside our classroom doors. Everyday as they run out to recess, the children check on the pumpkin to see the state it is in. Photographs are taken and kept in their science journals. We compare the pumpkin's changes to what we have seen happening to the organic litter and to the food in the worm bin. 'Decomposing' becomes a regular addition to our daily vocabulary. During this observation, we go back to the list of predictions they had made before we put the pumpkin out and we check off those that we see are coming true. We note what observations did not pan out, such as "it is going to get bigger." We also note that many of the predictions yet to occur —"it will turn into soil and make more pumpkins"—are part of the lengthy process of decomposition.

The observation of the pumpkin becomes child driven, as each day, at least one child comes running to a teacher to update us on the status of the pumpkin, or to remind us to take a picture of the pumpkin to add to our timeline.

On cold winter days, we bring the decomposing pumpkin inside so children can take a closer look at some of the decomposers at work. Fungi, of different variety, usually abound. A centipede or a beetle will hurriedly crawl out. The children are immediately assailed with the smell of decomposition as well as the sight of rotting food. Despite the few "gross" and "eew" remarks, the children continue to exhibit scientific behavior in the way they investigate the pumpkin, using magnifying glasses from the science center to take a closer look.

My students are always amazed at how long the stem takes to decompose — long after the rest of the pumpkin is already part of the soil, the stem hangs around stubbornly refusing to go anywhere. When it finally does, one spring day, it is a cause for celebration and an opportunity to count how many days it has taken the stem to finally become a part of the soil.

Making Connections

Once, as we prepare to add some red pepper leftovers to our "organic" mini-earth, one of my kindergartners said, "Ms. Gopal, I think the stem of the pepper is going to take longer to decompose than the soft part." I pointed out to the class that Savannah had made a hypothesis and asked for her reasoning. She immediately replied, "Do you remember how long it took the stem of our pumpkin to decompose?" Here was scientific thinking based on extrapolation from previous data!

Along with such anecdotal evidence, we also use journal

entries and representational drawings to encourage children to document and share their understandings or observations. One day, we tasted brussel sprouts (as part of our weekly taste tests connected to our letter study). We place the left-over chopped brussel sprouts from a taste test into the organic mini-Earth. I decide to add a whole one as well and ask my students to predict if one or the other would decompose faster and why. They record their predictions into their science journals and in the process, I was able to see that most of the children immediately picked up on one of two attributes to explain their reasoning; either the size of the sprouts or the consistency of the sprouts. A couple of children were not sure what would happen - they needed more experiences with decomposition and more time to make the connection.

For documentation and assessment, we use a website called Voice Thread that enables users to add images or videos that other users can comment on by either audio or text. It is especially effective for young learners whose expressive language exceeds their writing abilities. "I See, I Think, I Wonder," a Visible Thinking strategy tool developed by Harvard's Project Zero, is another excellent tool to help determine what connections and conceptual understandings students are developing.

Art projects set up throughout the year (mixed media collages, tempera painting, cray pas murals, botanical sketches and work with clay) provide opportunities for artistic representations of the children's experiences and knowledge. Making a life-size replica of the Giant Gippsland worm out of play dough brings it to life as does becoming a Giant Gippsland worm when making a line to go to Music.

Environmental Stewards

Through this year-long study, the children start to learn that they can make an impact on their environment, in both positive and negative ways. They begin to make the connection between the kind of litter they throw away and the possible impact it may have on their surroundings. They learn that they can make a difference whether in recycling bottle caps, composting or being on litter patrol. They are more aware of using containers that can be reused or recycled. They learn that even the smallest creature has a deeply important role to play in the health of our planet. Some of my students internalize this, others develop a beginning understanding and still others may need more experiences to continue them on this journey. Regardless, it is a journey that is well worth it at this early developmental stage and which I hope, sets them on a path of both scientific inquiry and respect for the environment.

Jyoti Gopal is a Kindergarten teacher at Riverdale Country School in the Bronx, New York.

Resources

Worms Eat My Garbage by Mary Appelhof

NYC Compost Project – www.nyccompost.org

The compost rap sung by worm puppets:
www.youtube.com/watch?v=kq3yfKCC9ok

Banana Slug String Band - The FBI is on the Scene
www.youtube.com/watch?v=cBzXhOO-MEc

Wild Harvesting and Traditional Ecological Knowledge

Introduce grade 4-7 students to Indigenous knowledge and local ecosystems by sustainably harvesting wild products

Sierra Club of British Columbia

By **Kieran Dowling**

THE RESOURCES AND BEAUTY of nature are shared amongst all of us on this planet. What we take from nature not only impacts our ability to return for more, but is also tied to the survival of other organisms sharing those resources. Berries, mushrooms, flowers and roots are examples of wild products we can sustainably harvest to support human life. But nature can provide more than just products; nature's diverse landscapes, plants, and animals inspire many stories, legends, practices, and skills. Learning to appreciate nature, while also sharing its resources and building cultural narratives, can be a rewarding experience for all learners, young and old.

Indigenous peoples (i.e. Native Americans) across North America have wisdom and knowledge that comes from many generations of living within the complexity of their local ecosystems. Transmitted from one generation to the next through stories, songs, legends, and practices, Traditional Ecological Knowledge (TEK) influences skills, culture, connection to place, and the ability to provide basic necessities. Nature is in constant flux and as a result, the way that people relate to nature is also constantly changing. Sustainable harvesting is an active way in which everyone can engage with nature. Drawing from traditional knowledge and practices, wild harvesting provides us with an opportunity to learn from cultures and nature simultaneously.

Many organisms – plants, animals, fungi – are the focus of the stories we hear. The Ojibway People of eastern Canada folded cattail leaves to make simple toys; big sagebrush leaves are used in medicinal teas by indigenous peoples of the Great Basin, while the bark can make ropes and baskets; butternut root was used in the Civil War as a way to make the dye for confederate soldiers' uniforms. Cattail of the Atlantic Northeast provides shoots for food, pollen for medicine, and leaf fibres to make string. It is also a plant species that helps remove pollutants from marshes and wetlands. The western red cedar tree in the Pacific Northwest provides bark for hats and baskets, and timber for forest shelters. Cedar has been called the tree of life by Indigenous peoples of the western coast. Each of these stories adds to our knowledge of the complexity in ecosystems, adding layers of wisdom to our relationship with nature.

The resourcefulness of humans and our ability to appreciate nature's complexity can provide awe and wonder for learners. Providing learners with wild harvesting opportunities can widen their relationship with nature.

One could start by asking some essential questions: What types of plants did our ancestors collect and use? How do people use these plants now? How can they be used in a sustainable way to strengthen our community?

This approach for understanding human-nature interconnectedness is enriched with Indigenous peoples' perspectives and knowledge. The activities presented below assist grade 4-7 educators with delivering this inquiry through TEK. Learners will benefit from the sequential delivery of all three activities, although each activity can be taught on its own. Extensions to these activities would enable them to engage students in grades 9-12.

Geographical Adaptations

The activities below are taken from the Going Wild! Guidebook and were designed using TEK from the First Nations communities of coastal British Columbia. For those living in other geographical regions, use the links at the end of this article to find lists of plant species in your region. Although these regions are quite broad across North America, they can be used as a guide to help teachers adapt lesson plans that reflect local ecosystems and cultures of relevance to them.

Prepare a Species Backgrounder with information

Regional North American Plants

Choose the one listed for your region, or substitute it with another that is or has been harvested.

Northwest Coast: Devil's Club (Oplopanax horridus)
http://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=221

California: Saguaro (Carnegiea gigantean)
http://plants.usda.gov/plantguide/pdf/cs_cagi7.pdf

Great Basin: Western Chokecherry (Prunus virginiana)
http://plants.usda.gov/factsheet/pdf/fs_prvi.pdf

Plateau: Big Sagebrush (Artemisia tridentate)
http://plants.usda.gov/factsheet/pdf/fs_artr2.pdf

Plains and Prairies: Sunflower (Helianthus annuus)
http://plants.usda.gov/plantguide/pdf/cs_hean3.pdf

Southeast: Bloodroot (Sanguinaria canadensis)

Northeast: Cattail (TyphaLatifolia);
http://plants.usda.gov/plantguide/pdf/cs_tyla.pdf

Northeast: Butternut (Juglans cinerea)
http://plants.usda.gov/plantguide/pdf/pg_juci.pdf

Aude Ray Houle

obtained from one of these sites or from field guides or other sources. This will help you consider the ecological, historical and cultural contexts in which each species can be presented. Each year, add to the Backgrounder new information that is gathered as part of the activities below.

Before You Start

The concepts of interconnectedness, wild harvesting, and traditional techniques require research and preparation. Each plant or wild product you learn about may have multiple uses and origin stories, and be connected to valuable ecological processes. Work towards answering questions such as: How do other organisms connect to the plant or product you are focusing on? How has the plant or product been used by Indigenous peoples, past and present?

If you do not already know, learn about the First Peoples who call home the land you live on. How do they refer to themselves? A good place to start would be to investigate Indigenous influences present in your community. Are there names of towns, cities, and places of interest that reflect the First Peoples? For example, Mississauga (Ontario) – is named after the Mississauga people who live in the area, and describes the mouth of a river. Michi or missi means "many," and saki, "outlet" a river having several outlets[1]. There are also numerous states, cities and towns in the US that come from the Algonquian language group of native peoples. The word Connecticut is derived from the Algonquian word quinatucquet: meaning "upon the long river"[2]. Once you have done some preliminary investigation it is helpful to ask more specific questions, such as: how do local Indigenous people refer to the plant or product in their language? Are there any members of Indigenous communities that are willing and able to assist you? If none are available to easily visit your classroom, you might like to try and find someone with anthropological expertise. There may be resources in your community that can help, such as an aboriginal friendship centre[3].

It is also important that you locate a safe, accessible, and acceptable place to harvest the plant/s you wish to use for the activities. Asking local Indigenous and environmental organizations will enable you to learn about appropriate locations in your area.

Finally, when working with traditional knowledge, it is important to consider the generations of understanding and the spiritual significance that underlies this knowledge. While some traditional knowledge is general and openly shared, some information is sensitive and can only be shared when permission is given.

Kieran Dowling is the Education Program Manager with Sierra Club British Columbia. With 15 years of experience as an environmental educator working in Australia, Asia, and now Canada, he has an underlying passion for widening perspectives and appreciative inquiry.

Notes

1. (www.aadnc-aandc.gc.ca/eng/1100100016346/1100100016350)

2. Connecticut, A Guide to Its Roads, Lore, and People by Federal Writers' Project of the Works Progress Administration for the State of Connecticut, The New England Quarterly , Vol. 11, No. 4 (Dec., 1938), p. 875 www.jstor.org.ezproxy.royalroads.ca/stable/360666

3. National Association of Friendship Centres (Canada): http://www.nafc.ca/

Going Wild! & Other Sierra Club BC Publications

The activities in this article have been adapted from the Going Wild! Guidebook for Educators, a Sierra Club BC publication. While many contributed their time and expertise, a special thanks is owed to authors Nick Stanger, Robin June Hood, Nadine Lefort and Susan Gage. The community members and board of the Great Bear Turning Point Initiative are also acknowledged for their encouragement to develop the guidebook.

In 2013, Sierra Club BC's Education Program is celebrating its 15th year of delivering in-class, curriculum-linked, environmental education programs throughout British Columbia, Canada. All are welcome to download any of their free educational resources from www.sierraclub.ca/bc/programs/education

Activity 1: Learning about Wild Products

Learning Objectives:
- Formulate questions about medicinal and spiritual uses of a specific plant species
- Describe the medicinal and spiritual uses of a plant species and their cultural importance

Time: 2 hours

Materials
- Plant specimens or images of plant/s being presented
- Copies of the Species Backgrounder, prepared in advance by the educator.
- Copies of Student Handout, How "Plant species" is used in Our Community. See example below.

Before you start: Select plant species which are appropriate for your community, and look for resource people you can ask to help with this activity. Decide how you will structure the work. Some options are:
- Students, either independently or in pairs, interview community members with a knowledge of past and present uses of plant species
- Students prepare questions for a community visitor whom you invite to the classroom to speak and respond to questions about the plant species

Process:
1. Introduce the plant. Hold up a specimen or a picture of the plant; ask students where it grows and what they know about it.
2. Distribute copies of the relevant Species Backgrounder. Read through it together.
3. Explain that students are going to have the opportunity to learn more about how this plant is used in their community, and outline how they're going to do this (interviews, class visitor, etc).
4. Distribute copies of the student handout entitled "How "plant species" is used in Our Community". (See sidebar.) Go through it with your students. You may find it helpful to brainstorm one set of questions, as a way of encouraging students to formulate their own.
5. When students have had a chance to ask their questions and take notes (either through separate interviews or through a class visit), ask each of them to report a separate fact or story that most impressed them (ensuring it's different from those that earlier students have recounted).

Evaluation: Ask students to write a mini-report or story on what interested them, and arrange these on a bulletin board, surrounding a picture of the plant. Invite them to include their questions, answers, and mini-reports in their portfolios.

Extension Suggestion: Have students gather the recorded information about the plant species and prepare a Species Backgrounder with pictures, comments and information suitable as a submission for a guidebook publication.

Activity 2: The Seasonal Harvest Calendar

Learning Objectives:
- Identify the season for harvesting various wild products in the territory
- Describe traditional harvesting methods and uses of wild products in the area

Time: 1 hour

Materials:
- Large sheet of chart paper and felt markers
- Large stickies, or sheets of paper and tape

Before you start: Invite an Elder or other community resource person with knowledge of past and present practices to speak about the wild products traditionally gathered for food in your area. Ideally, the resource person you invite to work with your class will be able to speak to some or all of these topics:
- Different foods that are harvested at different times of year.
- Moving around to follow the plant harvest season.
- Methods of preserving wild products.
- Traditional practices for harvesting plants, eg. How did they make sure the harvest was sustainable?
- Obtaining some wild products through trade with other people.
- Stories from their own childhood. What do they remember about gathering and preparing wild foods as a child?

Tell your students about the visitor who will be coming, and invite them to make a list of questions they would like to ask him or her. Identify a student to thank the visitor at the end of the presentation.

Process:
1. Introduce your community resource person, and explain to the class that they will be helping you learn about the wild products traditionally used for food in your area.
2. On a large sheet of paper draw a large circle with an "X" in it.
3. Mark each season (winter, spring, summer, fall) in the four quadrants of the circle, with winter on top.
4. Before the speaker begins, ask the students if they know what time of year any important plants or animals are harvested. Write these on your large stickies or separate pieces of paper and stick them to the seasonal wheel.
5. Invite your visitor to speak and encourage them to make additions or changes to the seasonal wheel, building on the students' brainstorming. Ask your students to take notes of anything that stands out for them, and of any questions that they would like to ask at the end. Add more onto the seasonal harvesting chart after listening to the speaker.
6. Ask the designated student to thank the visitor.

Evaluation: Invite students to write a thank-you letter to the visitor, identifying at least one new thing they learned and one thing they really enjoyed about the presentation.

Extension Suggestion: Transform your Seasonal Harvest Calendar from rough copy to final copy by inviting students to make pictures of the different wild products, and pasting them onto the calendar next to the name of the product.

Activity 3: Making Wreaths

Learning Objectives:
- Identify and sustainably harvest wild products suitable for floral greenery
- Create a work of art using local materials

Time: 1.5 hours

Materials:
- Copies of Student Handout 12: Greenery Harvesting Guide
- Tape measures or rulers (a few to share)
- Bags to carry the branches
- Shears (gardener's scissors)
- Camera
- Bendable wire – precut to 1m (3') length – one length for each student (you can use straightened old wire coat hangers but they're not as easy to work with)
- Green twist-ties

Before you start:
- Locate an appropriate place to harvest plant materials.
- Invite a local community member to help you.

Process:
1. If you have invited a local resources person, introduce him or her.
2. Explain to your students that they are going to be collecting branches, using sustainable harvesting methods, and making wreaths.
3. Distribute copies of Student Handout 12: Greenery Harvesting Guide. Go through it together.
4. Distribute collection bags.
5. Divide students into groups of 3 to 4, giving each group a tape measure.
6. Go out and collect your boughs.
7. Return to the classroom to make the wreaths.

Evaluation: Create a Photo-Essay. Take pictures of each stage of wreath-making: welcoming your visitor, preparing to go out, collecting, making the wreaths, and holding the completed wreaths. Post these along the bulletin board, and invite students to choose one stage of the process to write a paragraph about. Post these paragraphs under the related photo. (Note: This photo-essay may be the basis of an article you send to your local newspaper or community newsletter).

Extension suggestion: Use these wreaths as a fundraiser to finance a field-trip later in the year. Support the students developing a business plan to sell the wreaths or have a holiday gathering where the wreaths are up for auction. Develop a list of the costs involved in making the wreaths, and determine an appropriate selling price.

Pathways to Possibility

How a small team of dedicated educators successfully developed an interdisciplinary model within the confines of the traditional subject-bound timetable.

Photographs: Graeme Mitchell

By **Graeme Mitchell**

"WHAT'S THE POINT?" This was a statement made by one of my brightest grade 11 students at the beginning of a current events unit on increasing human consumption and declining resources. This question resonated with me for days afterwards. Apathetic comments from 15 year-old boys are nothing new, but this particular statement was different. The more I thought about it, the more I realized that this student, like so many others, was simply bewildered by the gloom and doom surrounding our present ecological state. When I spoke to the class a few days later, they confirmed my realization. While it was obvious they were concerned about receding ice caps and increasing levels of greenhouse gases in our atmosphere, many of them appeared overwhelmed by the thought and scale of so many seemingly unsolvable problems. They were not indifferent to environmental degradation. They were afraid.

There is little question that we have to educate students about the world's most pressing problems, especially at a time when we face a convergence of unprecedented ecological, economic and social challenges. However, it can be argued that preparing students to be aware of their environment and act on its behalf depends on how we present the challenges. Terrible news catches our attention, but it is not especially good at changing our minds or motivating us. In fact, it might do the exact opposite. The way to enact positive change is to show what is possible.

Through my teaching experiences and interaction with other educators in British Columbia, I came to the realization that while we have certain courses that touch on issues of sustainability (Social Studies, Geography, Earth Science, Biology, Chemistry, Civics, and Law etc.), we do not have a comprehensive course that seeks to educate students on the three interdependent pillars of sustainability: environmental protection, economic prosperity, and social well-being/equity. Since the world has accumulated a growing number of unresolved problems over the past few decades by ignoring the links between these three areas, it has become clear to me that we need curriculum that connects the dots and prompts students to look ahead toward a more positive vision.

In the fall of 2007, I began to design a course that would serve as a road map towards a more sustainable future. Sustainability 11 launched in September 2008 at Stelly's Secondary School in Saanich, BC. Eighty-seven students took part in the initial course offering. The goal of the curriculum is to develop sustainable solutions that will preserve our planet for future generations. Essentially, the course is about thinking big even if we have to act small, and about approaching challenges with a bias for action.

While the course proved extremely popular, I began to realize that as a stand-alone elective program it was not accomplishing two fundamental objectives. First of all, the course was still only accessing 20% of enrolled senior students. Secondly, the interdisciplinary scope of the program was limited. After conducting a qualitative review of the program, I was convinced that in order to maximize the efficacy of the curriculum, it needed to be delivered not as an isolated course, but as part of a comprehensive, interdisciplinary model.

A growing body of research reveals that learners engaged in interdisciplinary programs are more likely to acquire integrated perspectives and solution-focused strategies, rather than content-specific knowledge derived from a single discipline. While colleges and universities across North America increasingly offer interdisciplinary programs as markers of their ability to prepare a new generation of leaders, there are very few models which connect learning outcomes at the secondary school level. Motivated by the idea of transforming Sustainability 11 into a truly interdisciplinary offering capable of reaching a greater percentage of students, I joined three colleagues at another school in our district, Claremont Secondary, to research how such a model could exist within the rigid, subject-bound confines of the traditional 4-block timetable. Our goal was to build upon the popular Global Studies course that had been inspiring Claremont students for nearly a decade. After months of planning, we approached our administration with our vision – the Institute for Global Solutions (IGS). We proposed moving forward with a project-based curriculum designed to equip students with tools and experiences to address the unprecedented environmental and humanitarian challenges of the 21st century. We argued that since the complex issues at the heart of the program would transcend traditional disciplines like science, math, and social studies, the educational platform of the IGS needed to bring previously distinct subjects together. Fortunately, our team was given the full support of our administration, superintendent, and later the school board to proceed.

Pushing Ahead

The logistics of running an interdisciplinary program within the limits of a system defined by single discipline offerings proved complex. The vast majority of secondary schools in British Columbia are timetabled into single discipline blocks. A typical senior level student might divide her mornings between English and Biology and her afternoons between Calculus and Social Studies. There is usually little to no overlap in the curriculum content between classes. From Shakespeare to synapses and scalars to self-government, there is rarely a contextual theme binding the learning together. Yet while most educational policymakers realize that the current model is in need of reform, there is little chance of systemic overhaul in the near future. Thus, for the IGS model to be successful and replicable, we needed to find a way for it to co-exist within this current framework.

After spending a great deal of time meeting with educational practitioners from both secondary and post-secondary institutions as well as from the Ministry of Education, we put together a comprehensive model. The classes would be taught by an interdisciplinary team of teachers, including myself, sharing our expertise and differing perspectives. The program would eventually combine the prescribed learning outcomes of four previously distinct Grade 11 courses (Social Studies 11, Biology 11, Environmental Math 11, and Sustainability 11) and four Grade 12 courses (Geography 12, Global Studies 12, BC First Nations 12, and a first year Political Science college transfer course) into a so-called "super-course" over a two-year period.

The IGS would meet daily in Periods 2 & 3, giving students ample opportunity to complete additional core courses and electives in Periods 1 & 4. Classroom learning would be complemented by seminars and an ambitious array of distinguished speakers who would share their progressive ideas as part of a weekly IGS Speaker Series. Learning would also extend beyond the classroom. Our goal was to get IGS students out of the classroom at least once a week to immerse themselves in meaningful work on the campus and in the surrounding community.

Delivery Model

Our model began with four instructors, each with their own area of expertise ranging from the humanities to the sciences. Blending the prescribed learning outcomes from previously distinct subjects together required a great deal of flexibility, balance, and compromise. Since the size of the interdisciplinary class was large enough to justify staffing two teachers, we were able to team teach the IGS curriculum over two blocks each day (180 minutes) and expose the students to the unique perspectives of four educators on a regular basis.

In an attempt to shift the emphasis from direct instruction towards facilitation, the team combined the methods of Socratic Inquiry and the Flipped Classroom. In the traditional model, class time is consumed primarily with the instructor's lecture followed by a Q&A session and worksheets. Most often, students work on assigned activities outside of the classroom. In our partially flipped model, students viewed many of the lectures online as well as read the necessary materials before they arrived in the classroom. As a result, learners were immediately ready to discuss the topic and delve into related individual or small-group activities. This model used multiple technologies for instruction, including lecture video and podcasts, content access, and social networking. Delivering much of our content through this method increased classroom time to discuss complex topics in greater depth. To make sure that the students grasped the content essentials, we began most lessons with a Socratic seminar. These seminars were formal discussions, based on the material, in which the teacher(s) asked open-ended questions. Within the context of the discussion, students were expected to listen closely to the comments of others, think critically for themselves, and articulate their own thoughts and responses to the thoughts of others. Most seminars lasted about thirty minutes in length and were often followed by writing activities whereby students were asked to reflect upon their own participation, salient points that piqued their interest, and to write down any additional questions they may have had.

One of our primary goals from the beginning was to build bridges between IGS learners and the larger community. We have always strived to combine teaching, research and community service in every single project.

Meaningful Work

We are fortunate enough to have our students for 180 minutes every day. This has given us the time to take part in a number of projects around our community. The students are working closely with scientists to help restore a previously degraded wetland on the property. As our students help return the area to a functioning vernal pond suitable for native species of amphibians, this has become an amazing educational experience for them. Meanwhile, every Wednesday our senior level IGS students walk over to Haliburton Farm and work with a fantastic group of organic farmers on a number of different tasks, such as seed propagation and composting. Their work on the farm has also prompted them to undertake on our own campus an ambitious permaculture project based on the ideas of water, food, energy, and waste. We are currently in the midst of transforming an underused courtyard into a space that will produce food for our cafeteria and provide an inviting outdoor learning space which can be used year-round.

In addition to the work at the organic farm, our students have also played a large role in bringing the community together to support action on climate change. Every year our students host the CC350 – a climate change awareness campaign that involves teams of students riding their bikes around our school track 350 times. This event now includes students and community members from across the region.

Most recently our Grade 11 cohort embarked upon an eleven-day adventure we called Rails to Relevance in order to become more engaged with our democratic process. We boarded a train in Vancouver and travelled all the way to Ottawa, our nation's capital. Along the way students interviewed fellow passengers about what it meant to be a Canadian citizen and what should Canada's responsibility be to the rest of the world. Our provincial and federal Members of Parliament accompanied us and taught classes on governance and civic engagement, helping to turn us into our moving classroom. In Ottawa, students were granted full access to Parliament Hill which included a tour of the Senate and House of Commons, meetings with the NDP Caucus and the leader of the Liberal Party. Once we returned to Vancouver, the students transformed their footage into short documentaries which were shared with our community in the first ever IGS 'Citizen Can' Film Festival.

Speaker Series

The teaching team behind the IGS model believes passionately in the power of ideas to change attitudes, lives and ultimately, the world. So as part of the program, we offer a weekly lecture series that exposes students to many of the region's most prominent leaders and innovators, from academics and politicians to entrepreneurs and activists. This interactive format provides students with opportunities to engage with a number of inspirational individuals. During the first year, we brought in an impressive array of speakers including environmentalist David Suzuki, Green MP Leader Elizabeth May, Liberal Leader Justin Trudeau, Massey Lecturer Ronald Wright, journalist Gwynne Dyer, scientist Andrew Weaver, education expert John Abbott, and author Thomas Homer-Dixon. We were amazed at how often our invitees accepted our requests to present to our students. While a few of them charged small appearance fees, most took the time out of their busy schedules to come and talk with our learners for free. Time and again our guest

Recommendations for Starting an IGS Program

Develop an interdisciplinary team with expert teachers who are flexible and comfortable working as part of a team.
Build the program around courses with natural connections.
Coordinate the delivery model in explicit detail.
Schedule the program carefully so as to allow for multiple teachers to take part.
Consult with administration and other staff members early and often. The more inclusive the model, the better.
Develop and nurture partnerships with local post-secondary institutions.
Foster relationships with not for profit educational organizations.
Search for sustainable sources of funding.

speakers remarked at how much they enjoyed presenting to a younger audience. While most speak regularly at universities and conferences, the majority of them had never been invited to present in front of high school students.

In their exit interviews, a number of our students remarked upon how special it was to have had the opportunity to interact with so many influential individuals in such an informal setting.

Partnerships

In addition to the incredible support we received from our administration and district, the IGS team developed a number of rewarding partnerships with organizations from around the region. The program heads at the University of Victoria's Faculty of Education and the Environment and Sustainability Program at Royal Roads University were invaluable both in terms of helping us develop and refine our model and in promoting it within the community. We have also taken on student teachers interested in teaching within an interdisciplinary approach. In addition to the collaboration with local universities, we have also been very fortunate to team up with three non-profit organizations whose mandates revolve around the promotion of innovative educational programs that seek to address societal challenges. These partners have helped us raise funds for our program and connected our students to a wide range of philanthropic initiatives. All three partners have helped the program gain exposure and work hard to attract potential funders and additional support.

Obstacles

While our team has been overwhelmed with the level of support for our program, a few notable obstacles have emerged. As a school district facing declining enrolment, the introduction of a new class or program inherently causes more competition for learners in the school building. This zero-sum scenario generated resentment from a few staff members, especially those whose offerings stood to lose the most. While this tension subsided after a few weeks, if given the chance again our team would have spent more time consulting with other staff members in the initial development and roll-out stages.

Securing funding proved to be another significant challenge. In order to offset the costs incurred from our weekly field studies and guest speakers, we needed to charge a tuition fee for the program. We managed to cut the costs down to $350.00 per student per semester. While our school is situated in an affluent area, having to ask the students to pay for this type of educational experience was still challenging. Moreover, since our goal is to make this program replicable, we realized that this price tag could become a significant road block to many potential students and their families. In order to address this issue we managed to secure a number of private donations from supporters within the community. These donations were then matched up to $10,000 by our partner Innovation Expedition through the Charitable Impact Foundation (CHIMP) giving platform. This allowed us to provide bursaries and scholarships for students who found the price prohibitive. With schools now increasingly expected to do more with less, we have come to the realization that fundraising will be an ongoing component of the IGS model.

The final complication revolves around assessment. While the Ministry of Education is promoting educational experiences that are more flexible, dynamic, and relevant, it still mandates that each student write exams in most core subject areas. These exams emphasize memorization instead of assessing key competencies such as critical thinking, inquiry, and technological literacy. This disconnect continues to prevent us from offering a truly interdisciplinary approach. As it stands, we still need to set aside time near the end of every semester to review the content using conventional stand and deliver techniques. The team have come to realize that this is simply a reality of merging two seemingly inconsistent models together. In the meantime, the IGS team is now in the midst of developing an empirically grounded framework for interdisciplinary assessment to serve as a foundational tool for our program and beyond.

To date, the journey I have shared with my IGS colleagues and students has been incredibly rewarding. The opportunity to collaborate with such an amazingly close-knit team and deliver an interdisciplinary model that inspires our learners to examine and take action on today's most urgent global issues is proving to be the most satisfying and meaningful experience of my career.

Graeme Mitchell is a teacher at Claremont Secondary in Saanich, B.C. and co-founder of the Institute of Global Solutions. He is set to start his Doctoral Studies in the spring. He wants to thank the following: his school's ever-supportive administration, his forward-thinking School District and especially his IGS colleagues Mark Neufeld and Dave Gardner for their inspiration, dedication, and professionalism.

Photographs: Nelson Lebo

Active Students, Passive Solar

A renovated passive solar home serves as a unique backdrop for teaching elementary science and math

By **Nelson Lebo**

ONCE UPON A TIME, in a small country at the edge of the world, a couple bought a run-down house and renovated it into an eco-home using passive solar design. They opened up their home and shared their passion with the local community by holding workshops, welcoming school visits, and giving presentations. They also started a blog chronicling their everyday trials and triumphs called Eco-Thrifty Renovation.[1] Word of the project traveled far and wide, up the Whanganui River and out across the Parapara Range to a number of rural schools in New Zealand that formed a cooperative network called a "cluster." Teachers from three schools in the cluster decided they wanted the theme of their final term to be sustainable energy use. They contacted the couple and arranged a *hui* – Maori for gathering or assembly – to talk about working together.

At the *hui*, the teachers decided together to take a cross-curricular approach, integrating science, mathematics, English and the arts. The isolated locations of the schools across the rugged New Zealand countryside offered both challenges and opportunities. The couple would not be able to visit the schools during the term. However, they could communicate online as part of an innovative unit plan that could be shared not only across the Parapara, but also across the world. Additionally, the rural schools had enrollments of 5 to 25 students, so mixed-age classrooms were the norm. Therefore, the lessons would need to be adaptable for different ages and abilities. The couple returned home and developed a series of multi-disciplinary lessons on energy that became The Little House That Could (TLHTC).

This article describes a number of the lessons in the 10-week unit on passive solar design for primary school students – aged 5 to 12 – and the ways in which holistic approaches to teaching and learning were incorporated. This diverse unit includes online components, hands-on activities, maths and writing exercises, drawing, and a field trip.

Overview

The design of TLHTC consists of three consecutive stages. The first stage is a series of combined science/mathematics lessons engaging students in the basic elements of passive solar design: sunlight energy, thermal mass, and insulation. Each element is introduced with a special blog post written for children, which is followed by hands-on activities aimed at developing science and mathematics skills for students in

a mixed-age classroom. The teachers found that the older students could understand the content of the blog posts while the younger students liked looking at the pictures. For the younger ones, simply learning that the sun can heat a home is an important early lesson. For the older ones, learning how it works can lay the foundations of an eco-designing mind, while providing a relevant context for standard science and mathematics skill-building.

The next stage consists of a series of mathematics exercises engaging students in designing their own eco-homes by practicing addition, subtraction, multiplication, division, fractions, and percents. The lesson, "Adding Savings, Subtracting Costs," is written for teachers to adapt for their classrooms. It is not a handout, but a document that leads teachers through the elements of an eco-home in order to increase their confidence in eco-design before sharing the lesson with their students. There is also a graphic drawing exercise and a writing exercise at the end of the lesson, as well as science review questions sprinkled throughout. The teachers found that the students enjoyed designing their own homes, and that drawing pictures of them was a good 'reward' for working through the math exercises.

The final stage of the curriculum is a field trip to visit the passive solar home. For the students in the Parapara rural cluster, this meant coming down the river to experience firsthand the house they had learned so much about. Teachers interested in teaching TLHTC curriculum, should coordinate a visit to a passive solar home in their area: many eco-home owners are happy to share their homes with local students. The Parapara teachers found that the end-of-term field trip was a continual source of motivation for students, and the site visit helped answer some of their lingering questions about our renovation. The site visit was mostly student directed exploration, along with a lunch of solar-cooked pizza and sausages.

Below is a sampling of some of the activities that can be used to encourage eco-learning. They have been designed to be adapted by teachers for students of different ages and abilities, but are focused around the upper primary (elementary) and lower intermediate (middle) years. The moral of this story is that students can engage in relevant sustainability lessons while learning the maths, science, and writing skills that teachers are required to deliver. This win-win-win situation is good for learners, good for teachers, and good for the planet.

Dr. Nelson Lebo is an eco-design and education consultant living in Whanganui, New Zealand. For more pictures and information on The Little House That Could curriculum, visit the Facebook page listed in the Notes section below.[2]

Stage One Lessons: Science and Maths

Lesson: Sunlight Energy

This lesson has five mini-lessons, or activities, from which each teacher could pick and choose, although the first activity – on sun angles and movement – is more-or-less essential for encouraging students' excitement for the big field trip at the end of the term.

Activity #1: The Sun Moves

For younger students, this is an easy way to let them "discover" that the sun "moves" across the sky and to practice their numeracy skills.

Find a pole at the school that casts a shadow. Use chalk to draw a line on the shadow 1 metre from the base of the pole. Go off and do some other activities for 20 to 40 minutes and then come back and look at the chalk line and shadow. Measure 1 metre from the base of the pole along the shadow and make a mark. Then measure from the new mark to the old mark and see how much the sun "moved."

For older students, you can explain that the sun appears to move 15 degrees per hour, but actually the earth is spinning on an axis. 15 degrees per hour times 24 hours equals 360 degrees (15 x 24 = 360). In the same way, stars track across the sky at 15 degrees per hour.

(See the blog post: "Sunrise, Sunset." (http://ecothrifty-doup.blogspot.co.nz/2011/10/sunrise-sunset.html)

Activity #2: Catch the Sun and Warm Your Home

(based on the book *Hot Water and Warm Homes from Sunlight* by Alan Gould)

Build the Model: Have students cut out and tape together their model homes.[3] Tape a piece of clear plastic in the window and make sure that all seams are sealed, but leave a small hole to insert a thermometer.

A Fair Test: Run a side-by-side test for two identical model homes with identical thermometers. Lightly tape a piece of paper over the window in one home but leave the other one clear. Place outside with a student standing to block the sun while the models and thermometers are placed.

Take the temperature in each model in the shadow of the student. This is Time 0. (The temperatures should be the same.) Take the temperature every minute for 10 minutes in direct sunlight and fill in a data table like this.

Older students can make line graphs of the data.

Time	Temperature House A	Temperature House B
0		
1		
2		
3		
Etc.		

Activity #3: Solar Hot Water
Put three or four folded tea towels in a cardboard box. Fill a glass bottle with cold tap water and take the temperature. Place the bottle in the box and cover with a piece of glass, plexiglass, or clear plastic. Try to seal out drafts. Set in direct sunlight. Take the temperature every hour for a full school day. Angle the box toward the sun and move it every hour to track the sun.

Extension: See next lesson on thermal mass.

Lesson: Thermal Mass

A passive solar home that does not have enough thermal mass inside the walls will overheat during the day and get cold at night. Thermal mass stores excess heat during the day and releases it slowly at night.

Activity: Prevent Overheating and Hold Heat for Nighttime[4]
Refer to the Solar Hot Water activity in the previous section. Find an identical box to the one used in that activity, but without a bottle inside. Place the two boxes in the sun for 3 hours. Take the temperature only at the 3-hour mark and then immediately move them into the shade or bring them into the classroom. Then take the temperature of both boxes every 10 minutes for an hour. Make a data table like this:

Older students can make line graphs of the data.

Time	Temperature Box A	Temperature Box B
0		
10		
20		
Etc.		

Lesson: Insulation

Activity: Hold That Heat
Use the same two boxes from the thermal mass activity. This time, line one with bath towels or wool blankets, leaving one to lay on top. Fill two identical bottles (plastic, glass or hot water bottles) with hot water and take the temperature to make sure they are the same. Place one bottle in the box with towels/blankets and the other in the empty box. Put the extra blanket on top of the insulated box. You'll need a hole in each box for thermometers or use a digital indoor/outdoor thermometers with an outdoor probe on a wire. Then take the temperature every 10 minutes for an hour of both boxes and make a data table like this.

Older students can make line graphs of the data.

(See The Little House That Could blog post: "Warm and Fuzzy": http://ecothriftydoup.blogspot.co.nz/2011/11/warm-and-fuzzy.html)

Time	Temperature Box A	Temperature Box B
0		
10		
20		
Etc.		

New Zealand students warm up to solar energy whilst testing their model homes.

Stage Two Lessons: Maths, English and the Arts.

Activity: Adding Savings, Subtracting Costs

The following is not intended as a handout, but a document that leads teachers through the elements of an eco-home in order to increase their confidence in eco-design before sharing the lesson with their students. The purpose of these activities is to build numeracy skills incrementally. They are meant to flow one to the next, but teachers should feel free to use any by themselves.

1. What shape should a passive solar home be, and where should the glass go?

In cold and temperate climates, the best passive solar home to build for warm winters and cool summers is a rectangle with the long sides facing north and south.

The long sides should be 1.5 to 2 times longer than the short sides. If a passive solar home is 10 metres (30 feet) wide, how long could it be?

Science review: Which side should have the most windows? Why?

When deciding where to put windows, the most should go on the north (facing the equator) and the least on the south, if you live in the Southern Hemisphere. The east and west are in between. But if you live in the Northern Hemisphere, such as in Europe, Canada or the United States, most windows should go on the south side (facing the equator). The following example assumes that you live in the southern half of our planet. Simply reverse "north" and "south" if you live in the northern half:

The north wall could have 25% to 50% windows. The east and west walls could have 10% to 25% windows. The south wall could have 0% up to 10% windows. Choose one of the percentages for each wall depending on how many windows you'd like to have in your eco-home. Circle that number and use it for the rest of the questions.

If the north and south walls are 20 metres (60 feet) long and 2.5 metres (75 feet) high, how much glass should each one have?

Step 1: 20 m (60') X 2.5 m (75') = _____ m^2
Step 2: Answer in step one times the percent of windows chosen for north.
Step 3: Answer in step one times the percent of windows chosen for south.

If the east and west walls are 10 metres (30') long and 2.5 metres high (75'), how much glass should each one have?

Step 1: 10 m (30') X 2.5 (75') m = _____ m^2
Step 2: Answer in step one times the percent of windows for east.
Step 3: Answer in step one times the percent of windows for west.

2. Add up the sizes of all the windows you need to buy for your eco-home. How much total glass is there? _____ m^2

   If windows cost $300 per square metre, how much will all of the windows cost?

3. When planning for insulation, you'll want to insulate the ceiling first. How do you know how much ceiling insulation you'll need to buy?

   Hint: Size of eco-home: 20 metres (60') long and 10 metres (30') wide.

4. How do you know how much under floor insulation to buy?

   Hint: Same as above.

5. How much wall insulation do you need?

   First, calculate the total area of your exterior walls.

   (20 X 2.5) + (10 X 2.5) + (20 X 2.5) + (10 X 2.5) = _____

   Then take that number and subtract your total area of windows. Hint: see #3 above.

6. If insulation costs $15 per square metre (yard), how much will all of that insulation cost?

   Science review: What is the purpose of insulation?

   The Arts: Draw a picture of the four sides of your eco-home. Make sure you have the right size of the length and height. Make sure you have the right amount of window glass. Where would you put your windows? Would you have glass french doors or a ranch slider? Add colour to your house along with some trees and flowers.

7. If your eco-home saves $600 per year in power bills compared with an uninsulated home, how much money will you save in 4 years? How long will it take you to save as much money as the cost of the insulation?

   This amount of time is called "Payback Period." It is the period of time needed to pay you back for your investment in insulation.

Writing: Pretend that you have just built your eco-home. Write a letter to your Aunt and Uncle, who live in another town, to explain what you love about your new home. Tell them what you would buy with all the money you saved.
Science extension: Besides saving money, what is another reason to save energy?

Notes

1. www.ecothriftydoup.blogspot.com

2. www.facebook.com/pages/The-Little-House-That-Could/205750306163061?fref=ts

3. You will find detailed instructions, including photos, of how to make a model solar home from a single sheet of 8 ½" x 11" or A4 paper at http://greenteacher.com/model-solar-home/

4. Introduce this activity with The Little House That Could blog post: "Keep it Comfortable" http://ecothriftydoup.blogspot.co.nz/2011/10/keep-it-comfortable.html

References

Gould, Alan, *Hot Water and Warm Homes from Sunlight* 0-912511-24-9, 80 pp, Grades 4-8, $20 from Lawrence Hall of Science, http://lhsgems.org, (510) 642-7771

Just Add Water

The Prescription Pill and Drug Disposal Program: driving conservation and curriculum

Photographs: Paul Ritter

By **Michael Soares**

SURROUNDED BY BIG BUILDINGS representing even bigger ideas, the students from Pontiac Township High School made their way into the boardroom of the American Medical Association in downtown Chicago and prepared to address the adults poised with notebooks and laptops. On this occasion, the group was taking their groundbreaking program to new heights by addressing the question, "What does one do with unused medication?" Dazzled by the cityscape and excited by the invitation, the students proceeded to their microphones and presented the Prescription Pill and Drug Disposal Program (P2D2), a collaborative effort between communities, local pharmacies, police departments, hospitals, city officials, students, and more. By demonstrating their concern about the integrity of the water supply, the student-created P2D2 program has gained international attention for its curricular innovations and eco-conscious applications, inspiring dozens of similar programs in Illinois, twenty-six other U.S. states, and other countries.

Research studies have uncovered startling statistics about the variety of drugs in our water supply (see sidebar). A simple drink of tap water can contain trace amounts of chemicals found in everything from to birth control pills to cholesterol-lowering medication. Armed with research, Pontiac students set out in 2007 to make a difference. Though they realized that prescription drugs would continue to find their way into the water supply through human waste, the students hoped to make a major dent in the problem by changing the way people dispose of ingestible chemicals.

The following years demonstrated phenomenal results. Not only have they changed the way Illinois and other states now dispose of unused and unwanted prescription medication and controlled substances, our students have created public awareness about contaminated drinking water. In the process, they have also showcased ways that students everywhere can be galvanized to unexpected levels of achievement. The scene in Chicago was far from the peak of their success. As more and more teachers and communities adopt the program, the full potential for this eco-curriculum has yet to be realized.

Developing a successful P2D2 program hinges on student investment. Unless the students buy into the program, the curriculum becomes merely another assignment. However, as our school's experience has shown, a grassroots passion for conservation can achieve international results. In what follows, I'll explain how P2D2 works, include some advice on starting a P2D2 program in your community, and share a few examples of the curriculum we developed as part of our project at Pontiac.

How Does P2D2 Work?

At some point in their lives, most people have wondered exactly what to do with expired and unused pharmaceuticals. The answer can be elusive. Simply dumping drugs down the drain or flushing them down the toilet seems undesirable at best, and the suspicion that they would eventually make their way to the water supply is troubling. Seeking resolution, teachers at Pontiac Township High School took the problem to their classrooms and invited students to brainstorm solutions. With classroom time devoted to research and writing, the students eventually developed a system which coordinated efforts among themselves, law enforcement, city supervisors, and even elected government officials at the state level to collect and safely dispose of unwanted and unused drugs, preventing them from entering and contaminating the water supply.

The premise is simple and free of charge: people take their expired or unused prescription or non-prescription drugs to participating pharmacies and law enforcement stations with approved receptacles. Once the drugs have been securely dropped off, they will be collected community-wide and safely transported to an electric company which incinerates them as an energy source for their power plant.

Not satisfied with merely protecting the water supply, educators involved with the program have constructed curriculum to help students understand the severity of the contamination and underlying concerns, as to assist them in employing the resources needed for enacting change. Laying the groundwork for the success of this program was, in itself, a monumental task; however, both educators and students took the opportunity to develop innovative eco-conscious curriculum which took them out of the comfort zone of the classroom.

The first steps were considering which classes would be involved in the project and gauging the instructors' willingness to participate. At our high school, teachers representing Science, Social Studies, English, and Art formed a coalition, each designating a course or group of students to bring the program to fruition. Once these students were in place, the campaign to include the community began. Students wrote letters to local and state lawmakers, made personal visits to pharmacies, and invited city officials to the classroom to present the basic tenets of the program. Having succeeded in piquing interest with decision makers in the community, the students then branched out to the community at large by creating flyers, brochures, billboards, media presentations, and other attention-getting devices to promote the recycling of drugs. Eventually, students were talking into radio microphones and television cameras as news stations began to take notice of the program's success.

Starting a P2D2

The program's credibility among other students, teachers, and administrators will be directly proportionate to the enthusiasm and discipline of the students involved. To start off on the right foot, students conduct interdisciplinary research into the local water supply, the availability of drug recycling, and other information peripheral to the cause. As students begin their research, they can be instructed to use technology to locate and document reports on the status of their current water supply. As our students analyzed their findings, it was especially eye-opening to discover that trace amounts of controlled substances were present in the local water supply.

Once the students have completed their research, the next step is to educate partners − such as pharmacists, city officials and government agencies, legislators, researchers from local colleges and universities, and media outlets − about improperly disposed drugs and controlled substances and their harmful effects on the water supply. We had success partnering with city officials, and in particular the Street Superintendent and Public Works Director. Once students showed civic leaders how policy changes could improve the environment, it took little convincing to get them on board. If you decide to start a P2D2, we recommend forming a committee with at least one teacher, a school administrator, a city official (the public works director would be most effective here), a local pharmacist, a member of local law enforcement, and several students.

Developing a logo is another important element. Our "Pill Bottle Phil" was originally conceived as a Superman-like icon for recycling drugs and soon became the mascot for P2D2. As other schools incorporate the program into their communities, we encourage them to modify the logo to fit their needs, and include the names of sponsors in

Impacts of Drug Collection Programs

Water contamination is a world-wide phenomenon and it is likely that water quality studies in heavily populated areas would reveal similar issues. Pontiac students used a recent United States Geological Survey studies to demonstrate how scientists have found traces of painkillers, estrogen, antidepressants, blood-pressure medicines, and other drugs in water samples from thirty states. Studies have linked hormone exposure to reproductive defects in fish, and environmental exposure to antibiotics to the development of drug-resistant germs.[1] A recent study by the Associated Press found trace amounts of pharmaceuticals in over 46 million Americans.[2] A recent take-back program in San Francisco found the average household had 2.7 pounds of unwanted or expired drugs (Source: Teleosis Institute www.teleosis.org)

While it is impossible to know for sure the percentage of unused drugs collected in the Pontiac Township High School community, 1,000 to 1,200 pounds of medication has been collected and recycled every year since 2007. Nationwide, it is conservatively estimated that 900,000 pounds of drugs have been responsibly destroyed through the efforts of P2D2 programs.

To increase the participation rate, we'll need more students creating drug recycling programs in their communities and more teachers designing curriculum to support these students. We'll also need more government action to promote drug recycling and for pharmaceutical companies to take more responsibility for excess prescription drugs.

the design. While sponsors can provide funding and other resources, they also bring name recognition. For example, the name of a local hospital or respected civic organization will resonate with community members and lend legitimacy to the endeavor.

A well-designed logo helps put students in a positive light during their community outreach. Over time, Pill Bottle Phil has been featured on the website and links, as well as on student-printed t-shirts and student-designed billboards placed at high visibility locations.

The success or failure of students' outreach to their community rests on planning. A lesson plan designed to help Environmental Science students give effective presentations can be found in a nearby sidebar.

Curriculum

The job of a teacher is to facilitate the curriculum and keep it aligned with standards. In the United States, many areas have adopted the national Common Core State Standards which requires more multidisciplinary and real world applications in the classroom, an initiative which intersects well with P2D2. At our high school, research undertaken in Science classrooms found its way into Social Science topics, such as understanding the role of elected officials and writing letters to them. As the program progressed, students learned how to write proclamations and were eventually involved in lobbying and working with legislators to write bills that were later voted upon by the State House and Senate.

We've found that teachers of other subjects can also take advantage of the program and design lessons that address standards for their courses. In music classes, students can compose music to accompany media presentations of P2D2 to neighboring schools. Spanish and French classes can create multilingual documents and other media to reach new audiences. Even Physical Education can get on board by discussing the harmful effects of consuming medications which are not prescribed and how students can make sure that unwanted drugs are safely disposed.

P2D2 has had a profound effect on the English classroom, providing opportunities for reading across the curriculum and writing in multiple genres. For example, to meet the needs of the poetry curriculum, one lesson plan created stretched students' imaginations to new limits as they incorporated eco-conscious elements to the concept of the haiku. (See the sidebar entitled "Writing an Eco-ku".)

Legacy

Working in conjunction with a staff member from an Illinois state senator's office, our students drafted legislation in 2010 that increased existing fines for illegal drug possession in the state by $20. The legislation directed the funds to be used to pay the full cost of shipping unused prescription drugs to incineration facilities. The P2D2 bill passed unanimously through the Illinois House and was signed by Governor next to the Chicago River in August 2011 in the presence of the teachers and students whose small town program had become a statewide success story.

As Pontiac's homegrown program advances, it continues to attract high profile media coverage. Five students and P2D2's Director Paul Ritter traveled to Sweden in early June 2012 to compete in the Volvo Adventure Awards. The competition, in conjunction with the United Nations Environmental Programme (UNEP), invited twelve groups from among many nations to present their innovative and groundbreaking eco-conscious programs for a "greener future." Already having won first place in the USA, the P2D2 team returned home having won the third place award.

As of this writing, communities in more than half of US states, plus those in countries such as Brazil, Mexico, and even locations in the Caribbean, have incorporated some version of the P2D2. For our own teachers and students, adding a study of community water quality, transformed ordinary curriculum into an extraordinary community program with international results.

Michael Soares is a doctoral student in English Education at Illinois State University and an English teacher at Pontiac Township High School in Illinois. He is the editor for the P2D2 program and can be reached at soaresm@pontiac.k12.il.us. **Paul Ritter** is the Director of the National Prescription Pill and Drug Disposal Program and teaches Science at Pontiac Township High School. He can be reached at ritterp@pontiac.k12.il.us. Please contact either to discuss how to incorporate P2D2 into your educational programs.

Resources

Common Core State Standards Initiative. www.corestandards.org/

The Medicine Chest: A collection of safe disposal curriculum activities and service-learning resources. www.iisgcp.org/education/safe_disposal_curriculum.html

"Prescription Pill and Drug Disposal Program." P2D2Program.org. September 20, 2011. p2d2program.org/index_return.html or p2d2program.net/

"Prescription Pill and Drug Disposal Program Grants for Law Enforcement Agencies." The Illinois Criminal Justice Information Authority. www.icjia.org/public/index.cfm?metastory=10100

Water is Life: Developing Eco-conscious Curriculum. www.livebinders.com/play/play/293152

Notes

1. http://p2d2program.net/facts.html.

2. http://hosted.ap.org/specials/interactives/pharmawater_site/sept14a.html

Creating an Effective Presentation to Inform the Public

By Paul Ritter

Objectives

Students will:

1. Understand the effects of unused pharmaceuticals on the environment, and the hazards of people ingesting medicine that was not meant for them.
2. Learn the proper methods of pharmaceutical disposal.
3. Serve as an important agent for change to help protect and improve local water quality.
4. Learn how to defend their research findings to an audience.
5. Learn how to make PowerPoint presentations, posters, and billboards or other large displays that will deliver messages that help people understand how medicines can be harmful to people, pets, and the environment.

Procedure

Day 1 – Establish student teams. Direct the students to research problems associated with pharmaceuticals in the water. Have them use computers, books, magazines, and contact leading researchers to gather any and all information about the issues related to pharmaceuticals in the water.

Days 2-3 – As they continue investigating the problem, ask them to create a list of pharmacies in the area and research current accepted disposal methods of pharmaceuticals. Have the students keep their records in a binder.

Day 4 – As they continue their research, direct students to contact all area pharmacists and local officials to ask if they would be willing to collaborate in determining possible solutions that prevent the improper disposal of pharmaceuticals in the environment. Send out formal invitations to participate in this community stewardship project.

Days 5-7 – Instruct the students on creating effective media presentations using PowerPoint, Prezis, LibGuides, etc. Ask students to develop their information into a media presentation for distribution. Depending on the students' abilities, this can take several days to complete.

Day 8 – Students will give formal presentations of their research to area pharmacists and local officials that inform them of the best disposal practices that are available in your area.

Day 9-10 – Students will develop an informational brochure/poster to display at local businesses. This should include contact information for the public to learn about how and where they can bring their unwanted medicine. Participating sponsors should be acknowledged. In addition, students will create a flyer with this information that can easily be stapled to small paper bags for public distribution.

Day 11 – Students will contact local media outlets (print and broadcast) to inform them of this program and its benefits. In addition, students can create informational videos that will be linked on the P2D2 website and on YouTube™ for broader dissemination.

Day 12 – Students will develop a billboard display that could be put up near an interstate highway, or another high-traffic roadway. Ask local billboard companies if they will donate a billboard. In our experience, they often say yes or will produce one at minimal cost.

Day 13 – Share this project with other schools, corporations, etc. and share your program/curriculum unit(s). Identify community medicine collection events or other local festivals and events where students can distribute information to educate the public about safe disposal practices.

Writing an Eco-ku

By Michael Soares

Objectives
Students will:
1. Work in a cooperative learning environment to employ figurative language, written in haiku format, to express a message of ecological importance to a greater audience.
2. Confer with classmates regarding format, message, and editing issues.
3. Present their "eco-ku" orally to the class along with appropriate illustrations, graphics, and explanations.

Materials
Notebook paper, pen, magazines, construction/printer paper, markers or other drawing/writing utensils, tape or glue, scissors, stapler

Procedure
Background and Overview of the Lesson: Eco-kus are a hybrid of ancient Japanese poetry and a contemporary awareness of environmental needs in our community. Written in haiku form, eco-ku are created to convey ecology-oriented messages to the public. The eco-ku lesson plan was conceived as a device to interest P2D2 students who were not ordinarily high achievers in language arts courses, but were heavily invested in local ecology projects.

Although this lesson plan was designed primarily for high school sophomores and keyed accordingly to the appropriate Illinois Learning Standards, modifications can easily be made for different age levels.

1. Begin with a teacher led-discussion of the haiku format's 3 rules:
   - Has three lines
   - Has 17 syllables total
   - Has five syllables in the first line, seven in the second, and five in the third

2. Next, analyze an original composition that you have written. Here is one that I wrote:
   Sitting in the sand.
   Wave touches foot and pulls back.
   Old sand trades for new.

3. Discuss content and count syllables, as you explore haikus that are found at http://www.haikusociety.com.

4. Explain that "Haiku-writing is an ancient Japanese practice that tries to capture a 'moment in time,' much like a snapshot. For this project, you will consider what you have learned about our environment and programs such as P2D2, and create an 'eco-ku' based on those concepts. You will either cut out or create three pictures and write an eco-ku poem for each. These three poems need to be turned in as a book with your name on the cover."

5. In groups of two or three, have students discuss both haiku and ecology, and then create their own individual eco-ku. Then they should search magazines for pictures that can illustrate their eco-ku, create their own images on a computer or by hand-drawing them. For verification, the students should confer with each other on format and syllable count. When a student has created three eco-ku, he or she should use available materials to construct a "book", which includes a cover onto which their name is incorporated into a title.

6. Before students submit their eco-ku books, they will have their work reviewed by those in their groups, so that corrections can be made.

7. Finally, students will give an oral presentation of their eco-ku books to their fellow students, replete with any necessary explanations, and be prepared to answer any questions.

Rubric
Timely Completion: Was it done on time? Yes / No
Basic Criteria Met: Did it follow the prescribed pattern? Yes / No
Creativity: Is it imaginative? Eye-catching? Colorful? Neat?
Correctness: Are there errors in spelling? Grammar? Syllables?
(Total)

Stormwater Stewards

Stormwater science lab and field activities for middle and high school students

Photographs: Kirk Ordway

By **Steve Braun**, **Ted Hart** and **Kirk Ordway**

STORMWATER IS QUICKLY becoming one of the greatest sources of urban pollution. Yet most of the public are unaware of this growing threat. Stormwater is part of the hydrological cycle wherein most rainwater and snowmelt infiltrates the ground. Within urban areas, an increasing percentage of it becomes surface runoff, which mobilizes contaminants that either flow directly into surface waterways or is channeled into sewers.

Storm Water Green Streets (SGSs), a type of Low Impact Development (LID), are now being used by municipalities and developers to mitigate water quality (i.e. contaminants) and quantity (i.e. runoff) threats. These are small excavated areas backfilled with a topsoil mixture of highly-permeable sandy soil with organic matter and are designed to maximize infiltration, pollutant retention, and vegetative growth. They perform similar functions as mitigation ponds, rain gardens, planter boxes, eco-roofs and swales. Portland, Oregon is among the cities with the greatest number and density of SGSs. But even here, public education and the maintenance of these facilities have proved challenges to their successful use.

In this article, we present in-depth and hands-on stormwater curricula which has been used successfully by many Portland teachers. It is our hope that educators interested in hydrology, urban ecology and engineering solutions to environmental problems will replicate or modify it for their use. It may be particularly useful for educators with stormwater mitigation sites on or near their school site.

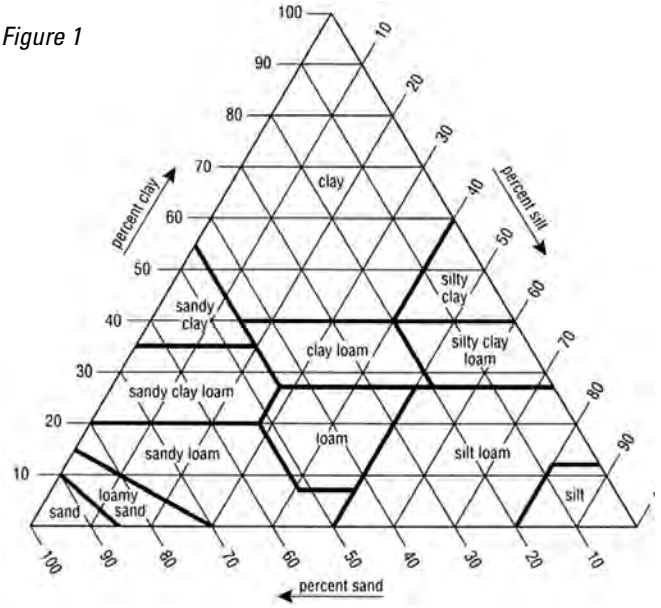
Our ten-week inquiry aims to increase students' environmental literacy, specifically their knowledge, dispositions and skills, and to teach students relevant ecological principles to urban and natural hydrology. It also provides students with engineering and field research skills, while developing a personal sense of stewardship. In what follows, you will find the key questions, along with a detailed description of the main activities of the inquiry.

Question: Why is stormwater becoming one of the greatest sources of pollution in urban areas?

Students use their own words to describe the big picture of how urbanization has decreased stormwater quality and why field work, such as testing water quality and habitat restoration, are effective mitigation tools.

Students should tour their own schoolyard and make observations about the structure and possible functions of existing SGSs. (If none exist there, visit the nearest example in the local community.) Have them compare and contrast the soil and plants found in the SGS to those found in wetland and forested

Figure 1



areas. Then discuss why these facilities are being used instead of pipes (i.e. they are usually more cost effective). Students can then identify the primary functions of these facilities—lowering runoff and pollutant retention—and how their maintenance will help maintain these functions.

In a jigsaw activity, separate students into three groups entitled habitat (SGS soil and vegetation), field work (SGS maintenance), and stormwater (from pollutant to resource). These themes represent the stewardship (field work) necessary to maintaining a well-functioning watershed (habitat) which effectively removes pollutants from runoff (stormwater). Give ten pictures to each group and ask them to arrange them from good to bad (i.e. picture of pristine stream to picture of polluted storm water). Students will quickly get into discussions—sometimes arguments—over which pictures are good or bad. Have a representative from each of the three groups form a discussion group to answer questions such as "What makes this stormwater polluted?" or "What makes good habitat?" At the end students should ideally be able to answer the question "How does good field work result in good habitat and stormwater?" and to define "good stormwater stewardship".

Question: How do water, soil and plant properties relate to stormwater processes?

Water: Students can learn about the water cycle by drawing the larger urban area in which they live, school grounds with SGS's, or a nearby forested area on large butcher paper. They then identify the stormwater segment of this cycle, and where it starts and ends. They also note the differences between natural and urbanized water pathways and how this distinction relates to their lives. They also learn about water cohesion and adhesion, through the exercise of determining how many water drops they can place on a penny and nickel, and how this relates to how stormwater transports pollution.

Soil: Students learn about soil texture, bulk density and horizons as they relate to stormwater infiltration. Allow students to use the feel method to determine the texture of samples of sand, topsoil, and clay. Have them draw the soil triangle (see Fig. 1) on butcher paper, and place the identified samples on their given textures. Students can then calculate the bulk density (mass of soil/volume of container). One of the easiest methods is to excavate a small hole in the ground (1 gal), weigh the soil to attain mass, place a plastic bag over the hole, fill hole with water till level with grade, pour plastic bag of water into measuring device to attain volume. Students can hypothesize how a change in bulk density might affect porosity (% voids in soil) and thus infiltration (next paragraph). Similarly, students can determine horizon A depths in the school yard and SGSs, and hypothesize how the greater A depth may affect stormwater flow. This can easily be done by inserting a soil auger into the soil, extracting the core, and then examining the soil core visually (i.e. color change from dark brown topsoil to light brown subsoil) and through the feel method of forming soil ribbons in one's hand.

Hydrology: Students learn how to calculate rain volume through the following simulation. Pour water through a small bin with holes onto a surface with many cups that catch the rain. After the "rainfall" ends, have students average the height of water found in the cups and extrapolate this amount to the entire area to get the total volume of rain fallen. This is an effective way to teach how replication can increase the accuracy of measuring rain volume.

Plants: Ask students to discuss how large plants provide an environment which cleans storm water more than small plants. They can also learn how to estimate plant percent using a simulated random sampling activity in class. Lay down a map (or anything with patchily distributed shapes), lay down a ruler parallel to the map (either N-S or E-W, 0 in value on map corner), cast a die, locate number on ruler, lay another ruler perpendicular to the one already on the map on this number (0 in value of second ruler on die cast number), cast die again, locate number on second ruler (your now on the map), lay a white square transect (1 in x 1 in) on that second number, and record percent cover of vegetation.

Question: How do SGSs mitigate harmful effects of stormwater in urban areas?

Differences Among Field Sites:

In order for students to understand how the ecology and hydrology of different systems can affect stormwater quality, have students visit natural areas and record:

1. Plant diversity and percent cover
2. Soil texture
3. Bulk density
4. Horizon A depth
5. Infiltration rate
6. Water quality (pH, temperature, dissolved oxygen, and turbidity)

Ideally data from a forest, an urban wetland site and an on-site SGS should be compared. This allows students to investigate how local ecology affects stormwater across natural and urban settings and evaluate if SGS sites are affecting the stormwater.

Ted Hart

Split the class into four different sampling groups: water quality, infiltration, plants and soil. The water quality group gathers temperature, dissolved oxygen, turbidity and pH data using a Hach water quality kit. The infiltration group uses a single ring infiltrometer (a 3-gallon metal paint bucket with the bottom cut out can work in most soils), pours 1-gallon of water into the ring, measures the time it takes for water to completely infiltrate the soil and repeat until a steady infiltration rate is reached .

The soil group digs a small hole (about 2 fists deep and wide), dries soil in the classroom and uses a balance scale to determine weight of the removed soil. Prior to returning the soil to the hole, students lay a plastic bag in the hole, pour water from a graduated cylinder into the hole and record volume of water. Soil weight is divided by volume to get bulk density. Extending this, students can also calculate porosity (ϕ=1-(bulk density/2.65g/cm3). Both of these metrics can be a good measure of soil compaction which greatly affects infiltration rates and runoff. Soil horizons and texture should be measured with the use of a soil auger and 'feel method', respectively. Students can determine what soil texture existed at their sites to a good degree of accuracy with minimal training and supporting feel method guides which are abundant online. Soil augers cost less than $100.

Plant diversity is measured along a transect with students laying out a 100 meter measuring tape, randomly selecting a number between 1-100, laying down a 1 meter square quadrat on that selected number, identifying plant species and calculating percent cover for each species. The quadrat is constructed of 1 inch diameter PVC pipe and 4 plastic elbow fittings. Vegetation types could include: shrubs, herbs, grasses and trees.

Combine data from all of these groups for individual and whole class analysis, with groups of 5-6 students making posters that display their findings. Students compare data between urban and natural sites and qualify parameters such as water quality or infiltration rates as good, okay or poor. Students can also make conclusions regarding the efficacy of the school's on-site SGS and whether it is functioning more like a natural or urban system, using the same rating scale in their evaluation.

School Storm Water Budget

In order for students to evaluate how water moves through an urban landscape, students can perform a superficial water budget of the school property. The water budget is superficial in that it does not address groundwater in or out, evapotranspiration or change in storage, but it is still a useful exercise. In order to estimate this volume, students should multiply nearby online rain gauge data times the area of the school. Next, students measure how much of the school's property surface is impervious and pervious. From these totals, students can make hypotheses regarding how much rain water runoff entered the city's stormwater infrastructure and how much water infiltrated into the soil. Students may then revise their hypotheses based on further explorations. For example, they might determine that much of the impervious surfaces on the school's campus direct stormwater into on-site SGSs. From this, new water budgets can be created which reflect actual runoff rates from the school's property. Have students translate these water volume values (ft^3) into tangible representations such as number of basketballs or automobiles so that they and others will better appreciate the water volumes involved. Students can then see how much water moves through the school's property and estimate how much water is being removed from the municipal storm water system by the presence of the SGSs.

Home Water Budget and SGS Design

This final activity allows students to plan for ways that they and their families can be 'stormwater stewards.' Students print out two copies of an aerial photo of where they live, including apartment buildings, typical urban residential settings and large urban lots. Using the first copy, have students perform a water budget for the most recent month on their property, similar to the school storm water budget. They will indicate where impervious areas are located, and how water moves from the roofs to different surfaces. They will note any gutters, whether downspouts directly flow into the municipal stormwater system, and where water from the driveway flows. Using the second copy of the aerial image, ask students to redesign their properties to include LIDs such as eco-roofs, rain gardens, pervious pavement and bioswales. After completing their new designs, ask them to recalculate their home water budgets and again translate water volume values into tangible representations.

Prior to this lesson, it would be helpful to invite local storm water educators to provide a lesson that teaches students how LIDs function to soak up storm water in a cost-effective manner. A possible extension activity could include having students calculate the cost to redesign their residence, or collect data on their property, such as infiltration rates or vegetation diversity.

Assessment

Learning Gains and Changes in Attitude: Before and after participating in the program, students' interest in science and their attitudes towards the environment should be assessed against a control group not participating in the program. No formal formative assessment of knowledge need be used. Instead, have students each complete a workbook throughout the unit.

Conclusion

The stormwater stewards curriculum teaches students about the strategies employed by municipalities, citizens and NGOs to address non-point sources of water pollution and improve watershed health. In the process students learn their own impacts and the science behind of these strategies, including soils, hydrology, plants and engineering. Inspired by the hands-on curriculum, we have seen students internalize new knowledge and become confident in their skills to improve watershed health. Many become stewards of their own watersheds and begin educating their parents.

Steven M. Braun and **Ted Hart** are students in the School of the Environment at Portland State University, where they are both pursuing PhDs in Earth, Environment and Society. Steve's research involves restoration ecology and environmental education, whereas Ted's interests involve storm water bio-retention facility functions and education. **Kirk Ordway** is a science educator at Mt. Tabor Middle School in Portland Public Schools.

The authors would like to thanks the following for assisting with the creation and implementation of this curriculum: National Science Foundation GK-12 program, Portland Public Schools, Portland's Bureau of Environmental Services and several dedicated individuals. To view the curriculum, which will be available in early 2014, visit www.pdx.edu/soe-gk12/curriculum

Notes

See http://www.pdx.edu/soe-gk12/videos-and-mini-documentaries and view Bioswales at Mt Tabor Middle School, Portland for a video describing this project.

Photographs: Paul Hackl

Let's Build a Home

While learning the basics of sustainable home design, high school students are empowered to think of their own futures

By **Paul Hackl**

HOUSING IS, FOR MANY, the largest financial and most environmentally significant investment they will ever make. When designing a house, thoughtful consideration of heating, electrical and water efficiency, building materials and site orientation can transform a house from an energy consumer to an energy producer. Energy efficient buildings have lower operating costs and a smaller carbon footprint over their life cycle.

For the past six years, I have been facilitating "The Sustainable House Project" with groups of 17-18 year olds as part of an Ontario curriculum course entitled "The Environment and Resource Management". The basic concept is to have groups of students design and build a scale model of a sustainable house from recycled or recyclable materials over a period of 4 to 6 weeks. Their sustainable house must fit into the local neighbourhood and retain the original design and flavour of the area. In other words, it should not stand out too dramatically. To get them started, I usually select a house from the neighbourhood and have the students decide whether it should be renovated or rebuilt on the site. But with group consensus, students can select another house to focus on for their project.

Students must reduce the overall ecological footprint of the house by considering energy consumption (including renewable and nonrenewable sources), waste production, water consumption and the use of the sewage system. Overall, the house must be as close to a zero net energy structure and preferably a net energy producer.

While teaching this course I have found that giving young people the tools to create a model of their potential future can be transformative and empowering.

Getting Ready

Before students are tasked with building their energy efficient house, they need some background information on both sustainability and building construction. Here are five foundation activities/lessons that I recommend/use to get the students ready for the upcoming project:

1. Introduce the concepts of energy conservation, defining LEED architecture, alternative energy production, and biomimicry.
2. Lead a discussion of environmentally-friendly house building materials and design choices (materials such as insulation bats made from steel slag and concepts like daylighting).
3. Introduce and demonstrate two dimensional drawing techniques.

4. Watch videos such as *Build Green* and *Earth Energy* (available from CBC at iTunes), the Grand Designs Australia video series and the Empowerhouse Solar Decathlon series from the USA. Introduce students to magazines and websites such as those listed in the Resources section below.
5. If possible find local experts such as an urban planner and/or architect to speak to your class about what they do before starting the drawing and design phase.
6. At the start of the school year I take my class to the Evergreen Brickworks in Toronto to see for themselves a Platinum LEED standard building. Track down similar structures in your area and use this as a local model of what a sustainable house can be.

Pedagogy

We are hearing more about 'flipping the classroom' where students listen to lecture materials outside of class time and spend their in-class time being guided by the teacher and assisted by peers. In this vein, I have students do research at home, reading articles online or from magazines about green home design. This will provide the inspiration that they can use to get started in the classroom.

Because they are actually executing the project, students are often the best critics when it comes to evaluating the various aspects of an activity. They are actually the ones who suggested I require the project models be built out of recycled materials. Listening to your students' commentary about what they like and dislike about the assignment and their comments will help guide the evolution of the activity.

Teamwork and personal responsibility are critical components of the project. Experience has shown that three to four students are an optimal group size. I leave open the option for solo work as a social safety valve. It is reflective of reality and allows students to express their own needs and take on personal responsibility.

Materials & Safety

I outline very specific rules about what may be used to build the house. The most important is that no virgin materials may be used. Collect old poster projects from your students - many are quite happy to donate their old assignments for the cause. Get friendly with the custodial staff at your school and let them know about the project so they can save used materials for your class. Let other instructors know what you are planning; many will be eager to donate unwanted projects that can be used as building materials. At the end of the project, the whole works must go back into the recycling bin with no sorting of materials.

This project can get messy so train your class to clean up properly long before the class is over. Ask for a broom and spare recycling bags from the custodial staff at your school. Never expect them to clean up after the students.

The issue of equipment safety in the classroom must be dealt with in a formal session with all the students. Since hot glue guns, scissors and box cutters will be used daily, it is important to train your class to handle them properly to prevent injury. Take the time needed to demonstrate safe and proper techniques.

Project Steps

Before the students start building, they need a solid plan. I require them to submit three design drawings detailing of the house model, and all of the energy efficient systems contained within. Each student will hand in drawings of the South elevation (an elevation is a view of the outside wall), the floor plan from above at ground level and the elevation section from the west (a view of the side of the house with the outside wall removed to show the interior). Drafting the house design before the building begins mirrors how architects work, and ensures students have a solid understanding of how energy efficient systems work before they begin to build. The drawings help keep students focused on the task at hand. They also ensure that the models will be realistic.

I also require students to select and research a device or system that will be part of the house they are building. Students can choose from:

- Active and/or passive heating systems
- Lighting and daylighting systems
- Water supply (hot and cold water and rain water collection)
- Building materials
- Onsite sewage treatment and surrounding vegetation.

Each device or system must be accompanied by a brief explanation that describes its operation and its environmental benefits. The device or system must be constructed to scale, installed in the house, and labeled for easy identification.

Now for the fun part—the construction of the model. Students always enjoy this because it allows them to be creative and apply their imagination while solving real-life problems. As I already mentioned, recyclable materials must be used for the construction. The model should be built to a scale of 1 to 20 (in reality, 1 meter – or 1 foot – of the model is 20 meters – or 20 feet). Smaller is fine but bigger is not. You will be amazed by the accuracy and professionalism of some of these models.

Changing Lives

I enjoy this project as much as my students and love watching the creative juices flow, the problem solving process evolve and the pride of workmanship that the students take in their work. The results go far beyond the classroom. I have had students come back to visit me years after graduating to let me know that they are now working as construction contractors, house designers, renovators and engineers. They point their finger at the house project and claim it was their career inspiration. As young people come to understand a home's environmental impact, they gain the power to make informed decisions.

Every year the students sell this course to their peers because of this single activity. You will never hear them ask "Why are we learning this?", because the rationale is self-evident. This is student directed learning at its best.

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You can find Paul's complete Sustainable House Project Assignment and evaluation rubric available at http://greenteacher.com/sustainable-house-project/.)

Resources

Both you and your students can find inspiration for sustainable house design via both traditional media and online. To provide a starting point, here are a few of the resources we use.

- *Fine Homebuilding* magazine is an excellent resource for learning about important structural details. Available in print and online, it provides clear explanations of how everything from solar panels work to why LED light bulbs use so little electrical power.
- *Dwell* magazine includes inspirational design concepts from all over the world.
- Websites of sustainable design architects, like Paul Dowsett, principle of Sustainable.to or Martin Leifhebber, principle of Breathe Architects. Their websites contain real world examples of successful design and use of energy saving concepts.
- The Martin Davis Ecohousing website contains some good information about a new housing development in Fredericton, on the East coast of Canada.

Have your students Google "passive house plans-images" for great visuals. The possibilities are vast. I also ensure that a number of related magazines and books are available in class for use during my students' planning sessions.

Additional Online Resources

http://www.naturallifemagazine.com

http://www.nrel.gov/docs/fy00osti/27835.pdf

http://www.taunton.com/finehomebuilding/pages/fh_feat_energyeff.asp

http://oikos.com/esb/44/advancedhome.html

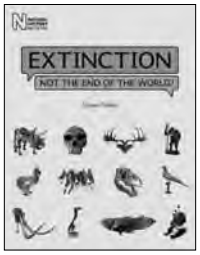
http://inhabitat.com/bedzed-beddington-zero-energy-development-london/

https://www.greenhomesforsale.com

http://savehomeenergy.ca/pages/solar.php

Resources

Reviewers in this issue: Kristen Bergsman, Alan Crook, Jon Hayes, Barbara McMillan, Phyllis McKenzie, and Deborah Roe.



Extinction: Not the End of the World?

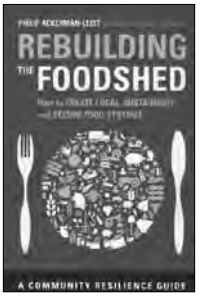
As I read *Extinction: Not the End of the World?* I was reminded of *Dr. Strangelove*. Should we stop worrying and love extinction? After all, since 999 of every 1000 species to inhabit the earth are now extinct, the process is certainly "not the end of the world." Or is it? This book is a brief but clear exploration of a very complex issue. After looking at the causes and benefits of extinctions throughout prehistory, author Steve Parker spends almost two-thirds of the book on the current (according to UNEP) mass extinction and its drivers—most notably humans. It's large format, liberally illustrated with numerous interesting examples, makes for an easy read. The tone is cautiously hopeful, with enough 'back from the brink' stories to indicate that perhaps we can maintain enough biodiversity to remain part of the .1% rather than the 99.9%. This is a very useful resource for both teachers and students (advanced Grade 7's and up), as well as anyone wanting some excellent information on extinctions, and extinction as a process.*–(AC)*

Natural History Museum, 2013, ISBN 978-0-56509321-1 (hc), 96 pp., US $15.95/ CD $17.95 from nternational Publisher's Group, , (800) 888-4741, <www.ipgbooks.com>

Explore Weather and Climate!

Whether it's tornadoes in Oklahoma, flooding in southern Alberta, a rain-free July in Vancouver, or heat waves in the southwestern United States, the extreme weather events in the Northern Hemisphere have never seemed so frequent. Kathleen Reilly's *Explore Weather and Climate!* helps readers aged 6-9 to understand what weather is, the atmospheric conditions that result in every day weather, and the meteorological conditions associated with extreme weather events such as thunderstorms, tornadoes, and hurricanes. The 92 pages are filled with age-appropriate scientific information in charts, lists, and text boxes; definitions of "Words to Know", intriguing "Did You Know" word balloons, and Brian Stone's cartoon-like illustrations. In addition, there are 25 "Make Your Own" activities that engage children in first-hand observations, data collection, or design projects to make abstract concepts like air pressure, fog, lightning, the Doppler Effect, and weather forecasting more meaningful. There is also information on climate change, preparing a "weather safety kit", creating a weather station using hand-made instruments, and short lists of books and internet resources appropriate for children.*–(BM)*

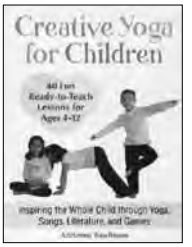
Nomad Press, 2011, ISBN 978-1-936313-84-6 (pkb), 92 pp., CDN$13.95/US$12.95 from Press (802) 649-1995, <www.nomadpress.net>



Rebuilding the Foodshed

Sustainability and security are the buzzwords these days and food systems is where they intersect. The book *Rebuilding the Foodshed: How to Create Local, Sustainable and Secure Food Systems* looks at how people can create, or recreate systems that are more sustainable than the agribusiness system on which we currently rely. Being both a professor and a farmer, author Philip Ackerman-Leist includes the hard facts – such as the fact that the U.S. continues to lose 1.7 billion tons of agricultural topsoil each year – but also practical advice on everything from "wildcrafting" to the creation of local food policy councils. For him, one benefit of working at the local level is the "rekindling [of] community and cultural connections". He urges us to be "food citizens" rather than food consumers. Ackerman-Leist also wants us to use a variety of tools to decrease waste, energy use, and environmental destruction while at the same time improving nutrition, biodiversity, pride of place, and addressing other concerns. For example, how can we make quality food available to people at all income levels? He describes innovative projects across the US such as Seattle's "Beacon Food Forest" and agricultural studies at Green Mountain College. This book would be valuable for any individual or group interested in these issues and wanting to make a positive change within their own community.*–(DR)*

Chelsea Green Publishing, 2013, ISBN 978-1-60358-423-4 (pb), 360 pp., US$19.95 from Chelsea Green Publishing, (802) 295-6300, <www.chelseagreen.com>



Creative Yoga for Children

The practice of yoga from a young age can lead to a lifetime of positive benefits from stress reduction to flexibility and to an increased ability to concentrate. Adrienne Rawlinson's book, *Creative Yoga for Children*, offers forty ready-to-teach lessons for children aged four to twelve. These lessons provide a balanced program by incorporating songs, literature, awareness of the natural world as well as many opportunities for cooperation and group sharing. It may be just the thing for teachers and homeschoolers who have wanted to introduce yoga but have been hesitant due to their unfamiliarity. One particularly admirable quality of the lessons is they all emphasize the process rather than aim to have children produce perfect stances. Not all teachers and students will be comfortable with all activities (the rubbing of scented oil on students' toes comes to mind) but the activities and lessons may be modified as needed with effective results.*–(DR)*

North Atlantic Books, 2013, ISBN 978-1-58394-554-4, 233 pp., US$16.95 from (800) 733-3000, <www.northatlanticbooks.com>

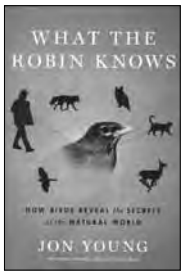
Birding for Everyone

After decades of hearing "I've never met a black birdwatcher before," John C. Robinson began his work on the

book *Birding for Everyone: Encouraging People of Color to Become Birdwatchers*. His purpose was to introduce people to his passion and to investigate why more people of color do not go birding. Robinson describes his own experiences on the road to becoming an accomplished birdwatcher. He invites us into the birder's world by letting us in on his ten secrets of identifying birds. In addition, he weighs the merits of field guides and binoculars. The main thrust of the book is how birding can and should become a more accessible hobbywith to those with more diverse ethnic and racial backgrounds. Robinson's most valuable research is gleaned from interviews with American bird watchers of diverse ages and ethnic backgrounds. Through these interviews we begin to see a route forward: getting school children outside to participate in birding programs, developing community programs with a focus on nature, and communicating about birding through the media to a wider ethnic audience. Ultimately, *Birding for Everyone* is a call to increase the ethnic diversity of people enjoying nature, so that we can collectively conserve our environment for generations to come. *–(JH)*

Wings-on-Disk, 2008, ISBN 978-0-9679-338-3-2, 143 pp., $20.00 US from (707) 688-2848, <www.onmymountain.com>

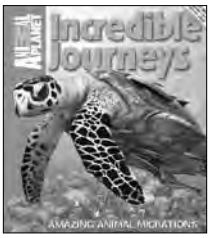
What the Robin Knows



I have always considered myself a reasonable observer of the landscape. Not even close. There is a whole other world out there, both aural and visual. What opened my eyes and ears was *What the Robin Knows: How Birds Reveal Secrets of the Natural World.* This book is part memoir, part homage, part how-to, part storytelling, part personal exploration, and, more than anything, a journey from our (however unintended) collision with the natural world, to a more respectful connection with it. It is based on the richness of author Jon Young's 30 years of experience in the wild, pulling us into the world of (mostly) songbirds and their habitats and ecosystems. The title is a bit of a misnomer, as many different birds—not just Robins— are used to illustrate bird language and how it can inform our understanding of what is happening out there in nature. First the normal, unstressed activity, or baseline, is explored through four key vocalizations. Then much the book is devoted to alarms—what happens when the baseline is disturbed by a predator or a person. The remainder and one appendix explains how you can unravel this puzzle without unduly disturbing the birds, and in the process become more respectful of them and their natural community. Other appendices connect this admittedly personal experience and deep, native intelligence with behavioural and ecological research, and in-situ vocalization references to excellent, online recordings. I highly recommend this book to anyone from advanced Grade 7's and up, and I intend to try it out in my backyard. Outdoor centres take note!*–(AC)*

Houghton Mifflin Harcourt, 2012, ISBN 978-0-547-45125-1 (hc), 241 pp., US$22.00 from <www.hmhco.com>

Incredible Journeys

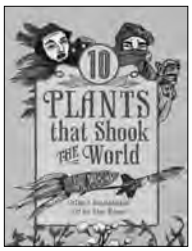


Global animal migration occurs at such an awesome scale, it can be hard to capture it in a written book. But Dwight Holing's *Incredible Journeys: Amazing Animal Migrations* manages to educate, entertain and provoke without relying on sensationalism. The concept of migration is divided between the land animals like elephants, air-like Monarch butterflies or Arctic Terns, and water-like krill or salmon. Each mode of migration features about a dozen species, showing their migratory routes, special adaptations, and means of survival. Besides gleaning a greater understanding of the migration, students will develop an understanding of food chains, habitats, human impacts on the environment, adaptations for survival and global geography. Artful photographic illustrations and seamless design no doubt add to the overall quality of the book. Precise, relevant information is laid out to engage readers young and old. This easily readable text falls somewhere between coffee-table book, science textbook and field guide. *Incredible Journeys* seems most relevant for grades 2-8, though it will enlighten people of any age.*–(JH)*

Kingfisher, 2011, ISBN 978-0-7534-6726-8, 128 pp., US$19.95 from (646) 307-5151, <http://us.macmillan.com>

10 Plants that Shook the World

How can a humble little plant cure disease, spark a war, cause a mass human migration, or play a role in forced labor? *10 Plants that Shook the World* by Gillian Richardson provides profiles of useful plants that changed the course of human history. The stories of these plants speak of the human drama of exploration, acquisition, and invention. Cacao, cinchona, corn, cotton, papyrus, pepper, potato, rubber, sugarcane, and tea – these plants are forever entwined with the course of human history. This non-fiction resource is at a reading level appropriate for ages 9-12, but with its surprising facts is a fascinating read for adults too. Each plant profile offers stylized illustrations, basic botanical information, a fictional narrative to introduce the plant, and 6-10 pages of stories and facts explaining the plant's effect on civilization. A map of plant origins and an index are also provided. 10 Plants that Shook the World could be used as a student reader or as a resource to complement the study of ethnobotany, human history, and human/plant migrations around the world.*–(KB)*



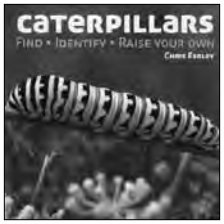
Annick Press, 2013, ISBN: 978-1-55451-444-1 (pb), ISBN: 978-1-55451-445-8 (hb), 132 pp., CDN/US $14.95(pb), <www.fireflybooks.com>

Sneaky Art

Are you sneaky? Are your kids or students motivated by sneakiness? The furtive crafts described by Marthe Jocelyn in *Sneaky Art* are subversive, fun, thoughtful, playful and…well….sneaky. The idea is simple: make simple, clever crafts using easy-to-find materials and sneak them into surprising places. For instance: float boats made of recycled

corks and stir sticks in a public fountain or bathroom sink; surprise your family with paper plate peekers made with old magazines that can hide in a drawer; make a flock of paper birds you can attach to tree plants or wire fences using clothespins; wrap colourful yarn around a rock until vibrant and place it among other rocks. Marthe Jocelyn's simple craft ideas intends to inspire people to pause and smile as they go about their daily lives. Most crafts involve re-used materials such as corks, tin foil, magazines or juice boxes. The instructions are simply described, including a list of materials and eye-catching photographs. This book is aimed toward kids aged 8 and up, but adults will enjoy these unusual crafts as well.*–(JH)*

Candlewick Press, 2013, ISBN 978-0-7636-5648-5 (pb), 54 pp., CDN$15.00/US$12.99 from (800) 733-3000, <www.candlewick.com>



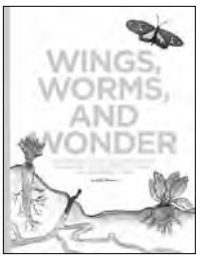
Caterpillars

With over three dozen descriptions and photographs of caterpillars and the moths or butterflies they become, *Caterpillars: Find, Identify, Raise Your Own* serves as a great introduction to the world of these variable insects. In 32 colorful pages, author Chris Earley describes the life cycle stages of a monarch butterfly and a polyphemous moth, how to safely collect and raise caterpillars, and how to know when to let them go. This cheerful book is a great guide for encouraging budding naturalists ages 8 and older.*–(PM)*

Firefly Books Ltd., 2013, ISBN 978-1-77085-183-2 (pb), 32 pp., CDN/US $6.95 from (800) 387-5085, <www.fireflybooks.com>

Worms, Wings and Wonder

Elementary school teachers who are interested but uncertain how to green their school grounds and move their classrooms out of doors should start with Kelly Johnson's *Wings, Worms, and Wonder*. Subtitled *A Guide for Creatively Integrating Gardening and Outdoor Learning into Children's Lives*, Johnson's book is informed by the exemplary Nature Study movement of the early 1900s. Another strength is that her pedagogical approach and her ideas for students' experiential learning are well-grounded in education literature. Each topic is thoroughly researched and she presents 36 lesson plans that are creative, interdisciplinary, learner-centred, and well-illustrated. These lessons include nature journaling, composting, studying insect mouths and bird beaks, comparing different honeys, reestablishing May 4th as Bird Day, creating a wormery, weaving with natural objects, and preparing a flower salad with a dressing of honey 'dew'. For each lesson, she provides a materials list, preparation steps, procedures, and extension activities. Johnson's goal is obvious: to nurture wonder and ecological literacy in children and adults alike.*–(BM)*



Kelly Johnson (self published), 2012, ISBN 978-0-615-64435-6 (pb), 184 pp., CDN$47.95/US$44.95 from <http://www.etsy.com>

What's for Lunch?

In her dedication to *What's for Lunch?: How School Children Eat Around the World* author Andrea Curtis writes, "To the good people everywhere working to make school lunch equitable, healthy and gentle on the earth." This single sentence informs astute readers, eight years of age and older, that the book is about much more than what school children eat for lunch in the thirteen nations represented. Interspersed with Yvonne Duivenvoorden's beautifully clear photographs of what a lunch serving looks like for students from Russia to Peru, and Sophie Cassen's colourful illustrations, are the author's descriptions of those lunches and short statements exploring food justice, risks to food security and sustainable well-being. As a result of farm to urban migration, agribusiness, global transportation networks and the influx of subsidized Western foods, traditional diets are changing and the cost of food staples have risen. This in turn has led to malnourishment, obesity, and serious health problems. But communities and student groups and individuals like Curtis are fighting back. Public schools are offering free midday meals, vending machines selling soda and snacks are being banned, and students are starting to demand fresh foods from local sustainable food producers and the gardens and orchards they help to cultivate on school grounds.*–(BM)*

Red Deer Press, 2012, ISBN 978-0-88995-482-3 (pb), 40 pp., CDN$12.95 from (800) 387-9776 ext. 225, <www.reddeerpress.com>

Schools that Change Communities DVD

Teachers, administrators and educational stakeholders looking to engage students in school-community based social learning projects will want to watch Bob Gliner's *Schools that Change Communities*. The film chronicles five communities in Maryland, Massachusetts, South Dakota, Oregon and California where a public school has become "the glue that holds a community together" and gives each community hope. In all cases, whether improving the health of a polluted creek, restoring a native wetland, reviving a dying farm community, or learning about the lives of migrant farm workers, the end result is the empowerment of students as citizens. Whether in elementary or high school, students identified a local problem, were helped to do something about it, and positively impacted the larger community in which they lived. Rather than educating children to leave, schools and communities, as one interviewee states, "became a team in search of a common goal…to make the community and the school the most wonderful place to live and to learn and to be a part of." Achieving such a goal helped students to see that they have a voice and "can make an enormous difference in the world." *–(BM)*

The Video Project, 2012, 53 minutes, US$195 (colleges/universities) or $79 (K-12), from (800) 475-2638, <www.videoproject.com>

Chameleons

There is no question that chameleons are a fascinating reptile, instantly compelling due to their ability to change colours. In their book *Chameleons*, Chris Mattison and Nick Garbutt explore the world of this complex crea-

ture with chapters on evolution and classification, size and shape and color, enemies and defense, food, reproduction and development, relationships to humans, and chameleon genera. There is an astounding amount of detail, right down to the common parasites of these animals. The small text size is hard on the eyes but the diligent reader will rewarded with a plethora of interesting facts. For example, one species of leaf chameleon, *Brookesia micra*, was recently discovered in Madagascar and measures only an inch in length making it, most likely, the world's smallest lizard! The full color photos on nearly every page illuminate the striking appearance of chameleons. This very thorough effort will appeal to older youth (i.e. Grades 7 and up) and adults with a love of herpetology.*–(DR)*

Firefly Books Ltd., 2012, ISBN 978-1-77085-121-4, 112 pp., US$29.95 from (800) 387-5085, <www.fireflybooks.com>

The Otesha Book

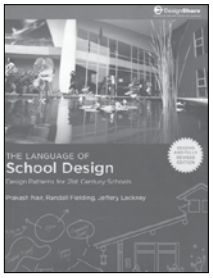
The choices students make each day about what to wear, what to eat, and how to get from place to place greatly impact the health of our environment. Through young adult voices *The Otesha Book: From Junk to Funk* provides a youthful point of view toward creating a sustainable future. The book is the combined effort of 18 members of The Otesha Project, "Otesha" being an eastern African word that means "to cause to dream". These youth present reflective, heartfelt stories that share dreams and visions of a healthy future for all. Topics including water, clothing, media, transportation, food, and coffee are presented in a variety of engaging ways. First, the realities of a simple choice are revealed; then, myths are debunked. An author provides a personal story related to the topic and finally suggestions for becoming empowered to make change are provided. The Otesha Book is a fine example of peer-to-peer education for young adults. High school teachers working to cultivate the habits needed for a sustainable future will find this book very helpful.*–(PM)*

The Otesha Project, 2005, Licensed under the Creative Commons Attribution-Non-Commercial-ShareAlike License (pb), 160 pp., CDN/US $10.00 - 20.00, from (613) 237-6065, <www.otesha.ca>

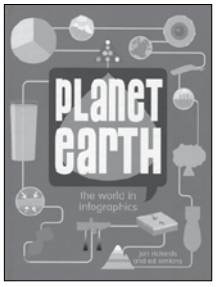
The Language of School Design

Did you redecorate your classroom at the beginning of the school year? Do you wish for more space, bigger windows, or better lighting? Perhaps a messy space for doing science or

art projects is on your wish list. If you're ready to take learning spaces into the now, *The Language of School Design: Design Patterns for 21st Century Schools* will be a stimulating resource. In this well-illustrated volume, architects Prakash Nair, Randall Fielding and Jeffery Lackney show a variety of schools and designs from around the world. These examples are not your 20th century boxes, and the ideas go far beyond green building materials or energy efficiency to really look at the culture of learning. Creating small learning communities through design is a major emphasis in this work, yet the authors also discuss designing for individual work, group work, independent learning and passive supervision. *The Language of School Design* addresses the learning environment holistically and from diverse stakeholder's points-of-view. Whether you are on the verge of building something new or simply trying to make the most of the space you already have, this book offers many new ways of thinking based in both research and real world experience. *–(PM)*



DesignShare.com, 2009, ISBN 0-9762670-0-4 (pb), 214 pp., CDN/US $45 from <www.designshare.com>



The World in Infographics

One of the challenges of teaching children about the natural world is distilling complex information into digestible formats. Both subtitled "*The World in Infographics*", *The Natural World* and *Planet Earth* are the first two books in a series by Jon Richards and Ed Simkins that presents statistics and data in graphical form for children ages 8-12. What is the largest spider by mass? *The Natural World* features infographics on basic biology topics such as classification and cell division as well as ecological topics like food webs and endangered species. Young readers will especially enjoy the colorful graphics on record-breaking organisms, from the fastest-slowest to the biggest-smallest. Which continent experiences the fewest earthquakes? *Planet Earth* offers a visually stunning look at basic earth science facts, including information related to the atmosphere, biosphere, hydrosphere, and lithosphere. Each book includes a pictorial glossary, internet resources, and an index. These hardcover books would be a great addition to an elementary school library or classroom collection. Serving as reference materials, they could inspire a class assignment challenging students to visually present data using infographics of their own design.*–(KB)*

Owlkids Books, 2013, ISBN 978-1-926973-75-3 (hb), 32 pp., CDN$16.95/US$15.95 from (416) 340-2700 x227, <www.owlkids-books.com>

Adalyn's Clare

Sometimes, school is difficult. Not because students don't know the answers, but because people and situations can be overwhelming. In *Adalyn's Clare*, a novel for grade 3-6 readers, we meet Adalyn, a spunky fourth-grader who is learning to breathe deeply, talk softly, and deal with crowds, all with the help of a young Labrador retriever named Clare. When Clare first arrives at school, she has to learn from other animals in the science classroom how to take care of her charge, Adalyn. Through the interactions of a puppy, a motmot bird, a ferret, a rat, and others, author Kari Dunn Buron shows how social situations can bring about strong reactions for some people. With Clare at her side, Adalyn finally finds some friends who have similar interests. She also learns that she is able to manage her emotions and fears and that she can succeed in school. *Adalyn's Clare* will be a great tool for teaching the respect, self-assuredness, and kindness needed to help students with social anxiety, and their friends, thrive.*–(PM)*

AAPC Publishing, 2012, ISBN 978-1-937473-22-8 (pb), 122 pp., CDN/US $12.00 from (913) 897-1004, <www.aapcpublishing.net>

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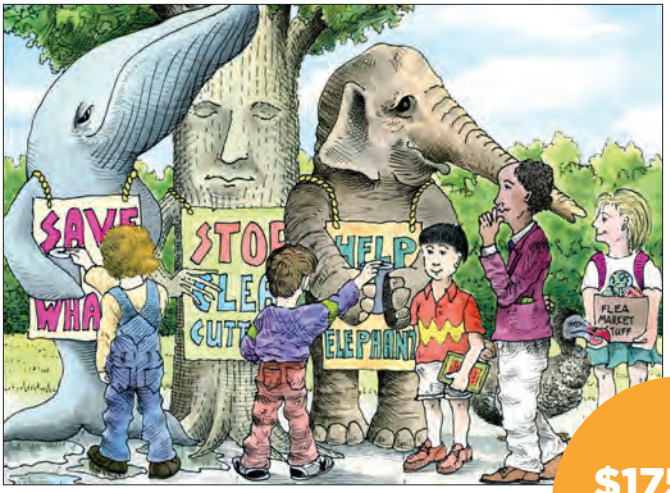

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