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EDITORIAL

"The marvelous richness of human experience would lose something of rewarding joy if there were no limitations to overcome." —Helen Keller

"If you find a path with no obstacles, it probably doesn't lead anywhere."
—Frank A. Clark

It goes without saying that in trying to accomplish what we as educators hope to accomplish, we often face obstacles. Some are financial. Others are more logistical. Local politics and un-cooperative weather can also be limiting factors. Finding ways to overcome these barriers drives innovation, which in turn makes it easier for others to surmount them.

Overcoming obstacles might well be the underlying theme of this issue of *Green Teacher*. In their article on night hikes, Brad Daniel and Clifford Knapp remind us that people fear the unknown and many find darkness to be threatening. This fear may well date back to primordial fears about being attacked by wild animals, a common occurrence in times past.

To promote a sense of awe for the natural world, they describe how to organize nocturnal outings with the safety and comfort of participants in mind. Similarly, it is perhaps the fear of being stung that blinds us to the decline of native bees that Alison Stevens describes in her article.

After examining the obstacles to a sustainable future embedded in the Judeo-Christian narrative of Western culture and reinforced by the ideals of the Enlightenment, author John Gust's grade 5 students went on to develop more hopeful narratives of how we humans could live more harmoniously within the natural world. By becoming aware of the mental traps in our way of thinking, they were motivated both to re-write history, and develop their own visions of what a sustainable community would look like.

In our lead article, Elin Kelsey and Catherine O'Brien present a compelling alternative to doom and gloom: a call to educate for sustainable happiness. To overcome barriers to real happiness created by modern consumerism, they invite students to explore what makes some people happier than others. This reflection helps young people consider the value of their social relationships, and the impact of their consumption patterns on the planet.

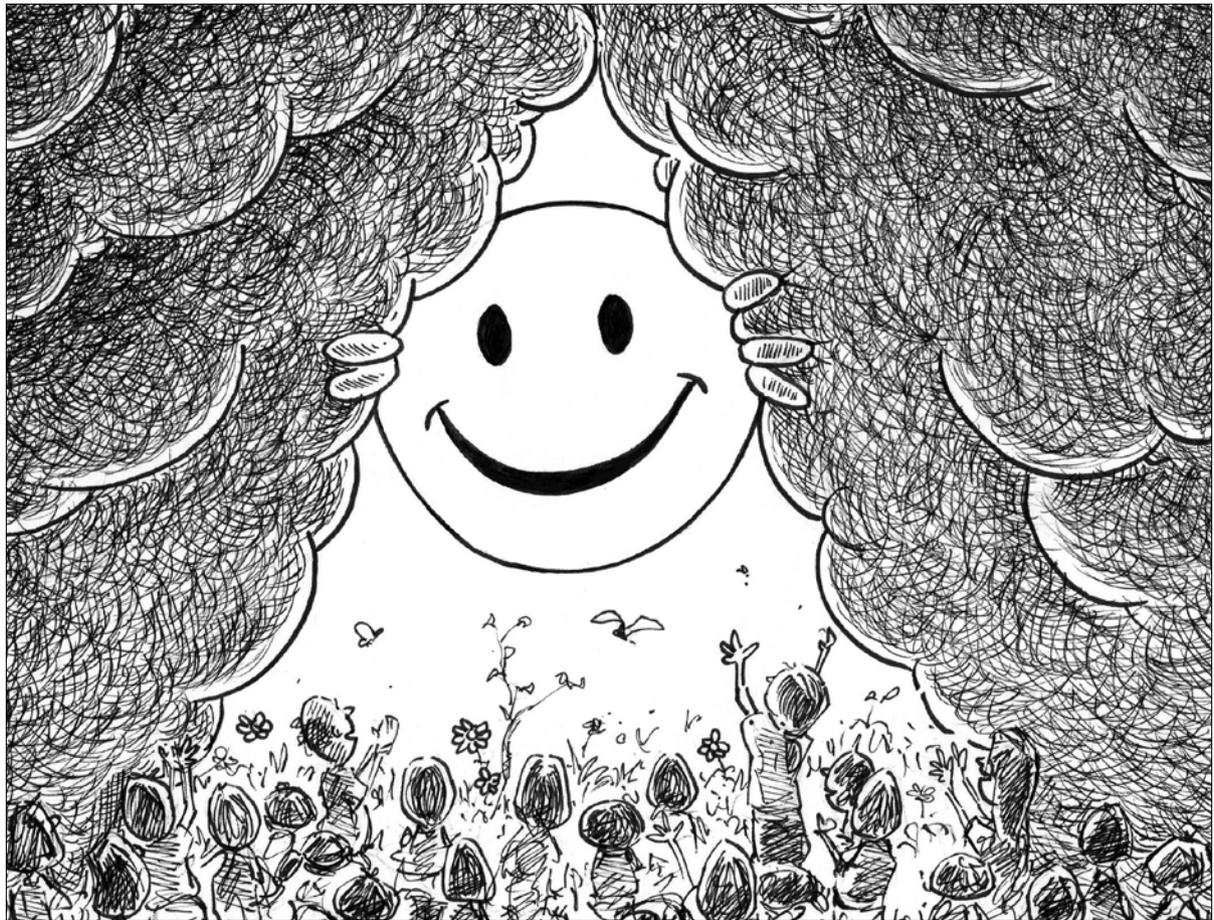
Young people face many educational and political obstacles to developing an understanding of the impact of climate change on their futures. Janice McDonnell and co-authors describe how bringing high school students onto university campuses to learn from faculty experts, motivates them to create action plans for their school communities. Francisco Sónora Luna describes another innovative solution to this problem: the remarkable Climántica project in Galicia, Spain, which engages large numbers of young people in climate change learning through online technologies.

To overcome the pedagogical barriers to developing an empathic relationship with other species, Edith Couchman describes active outdoor games whose dilemmas and conflicts ultimately promote compassion for amphibians. She argues persuasively that such games are more effective than being preachy with young people.

Ann Coffey has found a way to overcome the logistical barriers to involving all the students in an elementary school in a large art project. In her article, she describes how to organize an artist-led creation of a large outdoor mural.

We hope this issue of *Green Teacher* will equip you with some new tools to overcome any obstacles you are facing in your current and future educational endeavours.

—Tim Grant



Illustrations by Tom Goldsmith

Sustainable Happiness

New ways to nurture hope in a time of environmental despair

By **Elin Kelsey** and **Catherine O'Brien**

ENVIRONMENTAL EDUCATORS tend to be nice folks. We're the first to encourage a child to join us on a hike, and the last to leave a party when there are recyclables that need to be sorted from the garbage. A love of life drew many of us to this profession: a love for bugs and birds and early morning canoe trips or muscle-burning mountain hikes.

The irony, of course, is that much of what we teach is depressing. Global climate change, endangered species, habitat destruction, plastics pollution: our job is to chronicle the destruction of the very things we care most deeply about, and to raise the alarm to others. All too often, we end up being unwitting harbingers of doom and gloom. Is this the most effective way to inspire engagement? What if we could return to our jovial roots? What if exploring happiness and all those things that make our heart sing, rather than the threat of demise, turns out to be the best way to inspire greener lifestyles amongst our students and other educators?

We've been investigating these questions as new findings from environmental psychology, positive psychology and

resiliency research provide fresh understandings about the way we engage with sustainability issues. The result is an innovative field that links happiness with sustainability: Sustainable Happiness.

Happiness is at the heart of who we are and turns out to be an ideal entry point for underscoring the interdependence of all life on the planet. For the group of student teachers attending the first course in Sustainable Happiness at Cape Breton University last spring, spending class time exploring why some people are happier than others, or the links between happiness and health, was intriguing but unfamiliar territory. Who would you choose, for example, if asked to interview the happiest person you know?

Happiness is a universal desire. But in a consumer society, where consumption and happiness tend to be inextricably linked, it is easy to confuse the "path to the 'good life' as the 'goods life'." And in most industrialized countries, our pursuit of happiness is often at the expense of other people and the natural environment.

Here's the intriguing and optimistic news. Research suggests that "authentic happiness" is associated with positive health and well-being.² Authentic happiness is derived

through relationships with family, friends, meaningful work, and engagement in our community rather than relentless striving for material possessions. There is also evidence that once basic needs are met, substantial increases in income do not translate into substantial increases in happiness.³

We're discovering that over-consumption in consumer societies is neither the ultimate path to authentic happiness nor the path to sustainability.

The concept of sustainable happiness draws attention to the positive and negative consequences of how individuals, communities and nations pursue happiness. In a globalized world, everyone's actions have repercussions on distant lands and people. Some impacts are merely short-term while others have enduring effects. Sustainable happiness can guide the daily actions and decisions of individuals to account for far-reaching consequences; it reinforces the need to consider social, environmental and economic indicators of well-being so that community happiness and well-being are sustainable at the national and international level, for now and into the future.

You may be drinking a cup of coffee while reading this. It's a momentary pleasure familiar to many of us. Being mindful of such simple sensory delights is enjoyable and relaxing. Viewed through the lens of sustainable happiness, your daily coffee can be placed in a wider context. Is your pleasure enhanced when you drink fair trade coffee, knowing that workers in the coffee plantation have been paid fairly and that the coffee was grown with regard for the environment? Sustainable happiness reminds us to reflect on whether the positive emotion derived from the coffee (or anything else for that matter) has come at the expense of other people or the natural environment.

The importance of considering more hopeful approaches is underscored by the experiences of children. Nearly a decade ago, David Sobel, director of the teacher certification program at Antioch New England Graduate School in New Hampshire coined the phrase "eco-phobia" to describe what really happens when we lay the weight of the world's environmental problems on eight and nine year-olds already haunted with too many concerns and not enough real contact with nature. "Ecophobia," he writes, "[is] a fear of ecological problems and the natural world. Fear of oil spills, rainforest destruction, whale hunting, acid rain, the ozone hole, and Lyme disease. Fear of just being outside."⁴

Albert Zeyer of the University of Zurich demonstrates that many high school students today are fully aware of our looming environmental crises, yet feel powerless to change things.⁵ "They suffer latent environmental depression," Albert explains. The result of decades of "gloom and doom" messages is a generation of informed but disillusioned and depressed youth. As one teenager in the study puts it: "We don't have a chance."

Despite this, environmental education research is largely silent about dealing with the emotional implications of the environmental crisis on kids or teachers. Words like grief, despair, or anger rarely appear in our writings, and there is virtually nothing in the literature addressing appropriate

Sustainable Happiness is happiness that contributes to individual, community and/or global well-being, without exploiting other people, the environment or future generations.

ways to deal with the emotions associated with environmental degradation.

At first glance, it may seem odd for a researcher recording children's experiences of hopelessness and despair about the environment to team up with a researcher working on sustainable happiness. What we share is an

interest in exploring the emotional aspects of environmental education, and the need to acknowledge the feelings children and teachers experience, both positive and painful. Sustainable happiness reinforces the fact that our lives are inextricably linked with other people, other species and the natural environment. It serves as a vehicle to identify options for creating more hopeful, joyful, and sustainable legacies.

Elin Kelsey, PhD, lives in Pacific Grove, California where she works as a consultant with Stanford University, the Monterey Bay Aquarium and other institutions. She is spending the summer studying hope and resiliency as a Visiting Scholar at the Cairns Institute, in Queensland, Australia. **Catherine O'Brien, PhD**, is an Associate Professor of Education at Cape Breton University in Sydney, Nova Scotia. Both authors are eager to hear from readers and researchers who are working with these concepts. Contact them at Catherine_O'Brien@cbu.ca and elin@elinkelseyandcompany.com.

Notes

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3. Seligman, M.E.P., *Authentic Happiness: Using the New Positive Psychology to Realize Your Potential for Lasting Fulfillment*, Free Press, 2002.
4. Sobel, D., *Beyond Ecophobia: Reclaiming the Heart in Nature Education*, Orion Society, 1995.
5. Zeyer, A., and Roth, W.M., "A mirror of society: a discourse analytic study of 15- to 16-year-old Swiss students' talk about environment and environmental protection," *Public Understanding of Science* 4 (2009), pp. 961-998.

The activities below are drawn from the *Sustainable Happiness and Health - Teachers Guide* by Catherine O'Brien. This new resource offers curriculum-based activities and lesson plans for grades K to 6 that are linked to health education outcomes, with many cross-curricular applications. Available for free in both English and French, the Guides can be found at <www.sustainablehappiness.ca/for-educators>.

Elin Kelsey's newest children's book, *Not Your Typical Book About the Environment* (Owl Kids 2010), aims to allay children's fears about environmental doom by showing them what a remarkable time they live in. Smart technologies, innovative ideas, and a growing commitment to alternative lifestyles are exploding around the world. The book won both the 2011 Green Earth Book Award and the 2010 Moonbeam Children's Book Award and is short-listed for the 2011 Canadian Children's Book Awards. Learn more at <www.elinkelseyandcompany.com>.

Activities

Natural Happiness (all grades)

Objectives:

- 1) Students will identify the positive emotions related to simple, natural experiences.
- 2) Students will recognize that they can choose to experience natural happiness every day.
- 3) The activity should reinforce the empathetic experience of enjoying the natural happiness of other students.

Instructions: Introduce the concept of “natural happiness”: happy/positive experiences that come ‘naturally’ (i.e. other than those that come from material possessions, playing computer games, or watching television). Offer some examples of natural happiness such as:

Feeling the sun on your face

Snuggling under warm covers

Hugs

Smelling flowers

The cold side of a pillow

An unexpected high five

Finding something I didn't know I lost

Doing something that makes my best friend smile

Sun sparkling on snow (or water)

Jumping

Have students pair up and tell each other as many of their natural happiness points as they can. You may want to let groups have the class guess the natural happiness points they come up with by playing a game of charades, or simply ask each pair to give you a couple of their favourites. These can be collected by you and displayed on large chart paper.

Use the discussion to draw out the feelings associated with natural happiness and the positive experience of hearing about the natural happiness of other people. Guide students towards the awareness that they can choose to experience, create and share natural happiness. Alternately, ask students to draw one of their natural happiness points and use these to create a display in the classroom. You may want to reinforce the concept of natural happiness by asking students to share a natural happiness point they experienced each day.



Happy Feet, Happy Earth (Grades K-6)

Objective: Students will identify links between happiness and walking, and the benefits for the community and the earth when people choose to walk rather than use motorized vehicles. They will convey these benefits through at least one art form.

Instructions: Lead class on a walkabout around the schoolyard and/or neighbourhood (you may need parent volunteers or older students). Ensure that required permissions are obtained if students are leaving the school site. Before returning to class, ask students to name all the reasons they can think of why walking makes them happy; then how it makes their community happy; and how it makes the earth happy.

Back in the classroom, students work with a partner to determine how they want to convey the benefits of walking. They can create a poster, make up a song, write a story, create a skit, make a puppet show. Each team shares their work with the whole class and you may want to share this with other classes.

Happiness Interview (Grades 4-5)

Objective: Students will explore the concept of happiness and what it means to different people. They will discover that for most people, happiness comes from relationships with family and friends, doing meaningful work in the community, feeling connected to other people or the natural environment, or from spiritual beliefs. Sustained happiness is less often attained through material possessions.

Instructions: Explain that this activity is about discovering what contributes to lasting happiness and well-being. Instruct students to interview someone from home, school or the community – ideally the happiest person they know. In the interview, ask the following questions, plus any additional ones that they care to ask.

- What kinds of things make you happy?
- What lessons have you learned about happiness through the tough times in your life?
- What advice do you have for my generation about having a happy life? Once the students have completed their “happiness interview,” prepare a chart made of four large pieces of paper. Three of the pieces should include one of the above questions. The fourth sheet is for any other questions students asked. Students contribute to the four sheets by summarizing the answers they received for each question (this may be done in point form).

Once the chart is complete, review the answers with the class as a group. Ask the class to point out similarities and differences. What are some of the key lessons from this? Do students agree with the advice that has been given? How does the interview information compare with the information that the media gives us about happiness?

Follow this up with some key points about happiness and well-being from the list below:

The relationship between happiness and health:

Happy people tend to seek out and act on health information
 Happiness and well-being have been associated with reduced risk of cardiovascular disease
 Positive states of well-being tend to correlate with better physical health
 Happy people tend to live longer
 Positive moods can lower blood pressure
 Hope has been associated with increased chances of survival for cancer patients
 Immune systems are positively affected by high levels of positive emotions
 There is some evidence that happy people are less susceptible to cold and flu viruses

The relationship between happiness and social interaction:

Social relationships are essential to well-being
 Happy people tend to have healthy social relationships
 Interpersonal skills have a strong association with life satisfaction
 People who report high life satisfaction and happiness may have a greater tendency to volunteer in the community
 Social and community service has a strong association with life satisfaction



Happy Places (Grades K-3)

Objectives:

- 1) Students will identify places that make them feel happy.
- 2) Students will understand the qualities of that place and why these qualities make them feel happy.
- 3) Students will appreciate the people who may have created that place or the natural environment
- 4) Students will understand the value of respecting and protecting these happy places.

Instructions: Invite students to think of a place in their home, neighbourhood or nearby that they would call a happy place. This is a place that makes them feel happy. Ask students to share with the class what that happy place is, what it looks like and why it makes them feel happy. Use this discussion to guide students to understand that these kinds of places contribute to their health and well-being because positive emotions are very healthy for us.

The nature of the discussion will determine for you how to draw out some of the following points:

- places that are beautiful are often happy places – we can help to keep these kinds of places beautiful by not littering or breaking things
- happy places may be fun places to play – let’s appreciate the people who created those places and respect the places because it might be someone else’s happy place
- perhaps the happy place is in their backyard or inside their home – appreciate the people who have helped to make it a happy place
- the happy place may be a natural area such as a beach, forest, or lake – reinforce the value of protecting these areas because it is a happy place for others, animals, trees and plants
- perhaps they have helped to create a happy place – by planting a garden, creating an art piece that is on display at home, etc.

Conclude the lesson by having students paint a picture of their happy place. The picture could include a caption about the place.

Assessment Suggestions:

Teacher-student conference to provide feedback on student understanding.

(Objective 1&2) The place shared with the class & painting created by the student.

(Objective 3&4) On the back the students write a note of thanks "thank you: creator, Mother Earth, mom, dad, etc". "I promise to _____ to help protect the happy place you've provided me."

Walk with me (Grades K-3)

Objective: Students will initiate an activity that promotes walking.

Walking with parents and friends is an activity that is healthful for people, the community and the environment. The positive emotions that people experience while walking is an example of sustainable happiness. Students can encourage adults to engage in this activity with them. Perhaps they would like their parent/guardian/grandparent or an older sibling to walk with them to school, the playground or a friend's house.

Lead a discussion about the places that students enjoy walking, who they like to walk with and why they enjoy the trip. Assist students to create an invitation to someone with whom they would like to walk. Their picture may show where they want to walk or the person they would like to walk with. Some key words that they may need to create their invitation could be generated through class discussion. E.g. "Walk with me," "Let's go for a walk."

Students can give the invitation to the person they want to walk with and report back to the class once they have gone for the walk.

Assessment Suggestions:

- Observe individual student ability to articulate the benefits of walking.
- (Objective 1) The invitation, participation and response to their walk. The response could be oral, written, or both.



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Bear Beach Camping Trip

An overnight trip in September helps grade 8 city kids connect with the natural world



Photographs: Alan Barwin

By **Alan Barwin**

“Now I see the secret of the making of the best persons. It is to grow in the open air, and to eat and sleep with the earth.”
—Walt Whitman, *Leaves of Grass*

IT IS LATE SEPTEMBER, a week before the Bear Beach trip, my annual overnight camping trip on the west coast of Vancouver Island with my grade 8 Social Studies classes. I’m stressed, thinking about the weather and parent drivers and paperwork. A colleague asks me, “Is it worth it?” I pause and consider the question.

Jump forward a week. The class is gathered around the campfire. “Civilization” groups are dressed in seaweed and carry artifacts and food that they have spent the afternoon discussing and creating. We pass a feather and share what we appreciate about the day:

- Exploring the river.
- The sea-cave.
- Making the sundial.
- Seeing the whale.
- Getting to know my group better.
- Taking off the backpack after the hike down.
- Listening to the waves.
- Seeing the beach change as the tide goes out.
- Making our own supper on the stove.
- Looking up right now, and seeing millions of stars and the Milky Way. I have never seen so many stars.

This from a group of urban kids most of whom have never backpacked or camped out on a beach.

For four years I have started the first term of my grade 8 Social Studies classes with an integrated unit on Environment and Culture, with the Bear Beach trip as a summative experience. The premise of the unit is that, across time and place, natural environments affect cultures and cultures affect their environments. Throughout September, students learn about worldviews, geography, examine what is a civilization and create a timeline from the Big Bang to today. To consolidate and bring this learning to life, for two days students are immersed in a wild coastal environment, not always in the friendliest weather, and have to create a civilization that could exist there sustainably (see the assignment instructions at the end of this article). Their culture must include dwellings, a social structure and government, arts, technology, language, commerce, agriculture and a worldview. All of these must be based on the coastal environment, and students must consider the impact of this culture on the ecosystem.

The trip has three goals. First, students will better understand the interplay between environment and culture. This theme is reinforced throughout the year as we look at a variety of civilizations, from the Vikings to medieval Japan to Renaissance Europe. Second, students and staff will bond as a group through the experience. Weeks before we head out, I put together “civilization” groups of 5 or 6 students comprising boys and girls who come from different grade

7 classes and social groups. By planning, cooking and camping together, students develop positive relationships that endure beyond the trip. During the overnight there are separate tarps for boys and girls. The common experience of setting up shelters and sleeping like sardines underneath brings everyone together. I also get to know students in a way that is difficult in the classroom, through informal chats, sharing stories and experiences, and letting them see the “real” me in one of my favorite places. Finally, students get to spend time in nature. Richard Louv¹ and others have written extensively about the value of getting kids outside in both structured and unstructured settings. Perhaps the most important aspect of the Bear Beach trip is facilitating personal connections between city kids and the natural world. While creating an inventory of the plants, animals, geography and spiritual elements of the areas, as well as during free time, students have an opportunity to look closely at nature, to observe, to reflect, and to discover. They leave with a greater sense of place and a stronger bond with the coast. Research suggests that this will lead to more sustainable lifestyles² as well as happier people.³

Before we head out, there is much preparation. I send out a field trip letter with itinerary, supply list and permission form in the first week of school. Because I use parent chaperones and drivers, and because students provide their own food and gear, I can keep the cost to less than \$10 per person. This covers the provincial park camping fee as well as new group gear. Each year I add to our school collection of tarps, camp stoves, and emergency equipment. In class, students learn about nutrition for backcountry camping and plan their own meals under my supervision. I try to steer them away from over-packaged foods, heavy cans and junk food, but somehow it shows up. (Grade 8s are not known for their attention to detail, listening skills or refined palate.) We practice using camp stoves and hanging food to protect it (and us) from bears. I demonstrate how to and how not to pack a backpack. This is the notorious “exploding pack” lesson, in which I casually look for an item that should be handy, like a headlamp, and pull out everything imaginable, including a sleeping bag, tennis racket, ice axe, beach ball and textbook. Afterwards, I explain what is actually necessary and how to organize a pack. We discuss safety (cougars and wet rocks and bears, oh my!) and I introduce both the civilization project and a writing assignment about the trip.

A few days later we arrive at the trailhead and, after a safety talk, head down to the beach. The trail comprises logging road, mature forest and the legendary ‘hill of doom’, before opening onto the beach for lunch. From there we walk on the rocks, over logs and past waterfalls and cliffs (occasionally through the water if the tide is high) to the campsite. It is not a long trail, less than 2 km (1.2 mi.), but it is challenging.

The first task is shelter building. This is a classic endeavor



our where students work together to design and raise their tarps with no help from adults, and with very real consequences. It can take some time and often requires patience, humour and sometimes mediation. I ensure that the tarps are solid enough but I don't mind if students get a bit damp, as we are heading home the next day.

The bulk of the students' afternoon is spent in groups creating an inventory of the natural environment and designing their civilizations. Students have time to explore the beach, forest and river under adult supervision, as well as down time with friends. They eat in their groups when they choose.

At sunset, we gather around the fire to share our civilizations. There are introductions of chiefs and councils, myths of whale-gods and creation, sharing of delicacies (a word of warning: do not eat the salal [a native plant] wrapped in kelp!), songs, dances and demonstrations. Then it is my turn to tell a story and pass the feather before bed.

The next morning, a groggy, and sometimes soggy, bunch packs up, makes breakfast, and takes one last look around to ensure we have left no trace of our visit. Before we leave the beach, I ask them again to reflect on why this place is special, and whether or not life is more “real” here or in the city. This is a Social Studies class, but it is so much more than that. Bear Beach is a chance for students to strip back all of the trappings of our self-absorbed consumptive society and recognize themselves and each other for who they really are. It is an opportunity for them to see the value of wild places for more than their physical resources. Students learn experientially that they are connected to the natural environment, as every civilization throughout history has been, and that nature can invigorate the spirit.

Back at school, students spend a few days refining their civilizations, creating models and artifacts and writing poetry, fiction and personal reflections about Bear Beach. Groups formally present their cultures and submit their reports, full of grounded hands-on learning. The unit is over, but the personal growth and critical thinking has only just begun.



Hailey, a past student, sums up her experience: “At Bear Beach we didn’t need desks and textbooks to learn and understand concepts. The environment was really beautiful and interesting. [The trip] made us all have to work and think together.”

Yes, I tell my colleague, it absolutely is worth it.

Alan Barwin teaches Grade 8 French Immersion at Central Middle School in Victoria, British Columbia.

Notes

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2. Palmer, J.A., Suggate, J., Robottom, I., and Hart, P., “Significant life experiences and formative influences on the development of adults’ environmental awareness in the UK, Australia and Canada,” *Environmental Education Research*, 5(2), 1999, pp. 181-200.
3. Kelsey, E., “Removing our kids from the front lines of climate change,” 2007, <<http://www.worldchanging.com/archives/007636.html>>, Accessed December 13, 2010.

The Assignment

Imagine that your group has just arrived in this environment. You are alone here and have brought nothing from our modern North American culture - no conceptions of civilization, no beliefs, no notion of culture or community, and no worldview. You have all afternoon. Here are your tasks:

1. Take an inventory of everything that exists in this environment

| Plants (what is here— possible uses?) | Animals (what is here— possible uses?) | Climate, Weather, Seasons | Geography and geology (what do the land, rocks and coast look like?) | Spiritual elements (what places and things are powerful here?) |
|---|--|---------------------------------|---|---|
| | | | | |

2. Considering the natural environment, create a civilization. Your civilization must reflect where you are. Keep notes, create artifacts, discuss ideas with your group. You must provide evidence of the eight characteristics of a civilization discussed in class:

- belief system/religion
- government/social organization
- permanent dwellings
- knowledge of agriculture
- knowledge of science/technology
- commerce
- arts (music/dance/drama/visual arts)
- written language

3. At the campfire tonight, you will share your civilization. You may:

- introduce yourselves by your roles in your society (e.g. chief, warrior, shaman, etc.)
- tell a myth or share a tradition
- show something to eat, a work of art, your technology or goods to trade
- speak in your language
- be creative, entertaining, demonstrate higher order thinking
- BE your society - act according to your role and have fun



Amphibians and Two Game Structures

Learning about frogs through active, outdoor games.

By **Edith Couchman**

WHY SHOULD CHILDREN LISTEN when we offer to share information about nature? If we tell them clearly that we're trying to transmit TRUE stories about the world in which they live, will they gain interest and actually pay attention? If we explain to them that knowing about non-human beings is vital because, in fact, their own individual lives are linked in profound ways to the lives of all inhabitants of the planet, will they try to understand? If we urge them to listen because we are parentally-sanctioned 'Teachers' and their families and communities want them to learn what we're trying to teach, will this motivate them? Perhaps it will if we're lucky. More likely it will not.

Our rationales and appeals to youngsters' sense of wonder and connection with the natural world may go unheeded, depending on each child's emotional context and individual history of socialization. If we try to catch a child's attention by threatening negative consequences, the attention we'll

get will be sullen and resentful—not listening or learning of the best sort. However, if we invite students to play a genuinely engaging game with their friends that respects their developmental priorities, aren't they more likely to follow along? Won't a few more actually try to tune into the stream of words and distill these sounds into ideas and actions? I would wager that they will, and here are examples of two simple, almost archetypal games which together can be adapted to create opportunities for empathetic and enjoyable learning about animal life on earth.

Frog Fortunes

Following a field trip to a wetland or some class time spent studying various amphibians, give your students an opportunity to try this activity. It's best conducted outdoors but can easily be adapted to the confines of a classroom as needed. Students form teams that impersonate various species of frogs. Three or four frog teams work well, but if it's a small class, two will suffice (teams need not be evenly divided). The assortment that I enjoy includes: green frogs,



Genuinely engaging games create opportunities for empathetic and enjoyable learning about animal life on earth.

bullfrogs, wood frogs and spring peepers. Children have to choose which frog they'll pretend to be. Knowing this is an incentive for them to listen carefully as one introduces the characteristics of each species.

Once students have chosen their species, the newly minted 'frogs' assemble into species groups along a pre-arranged starting line. At this point, I usually teach an approximation of each frog's call: green frogs have a banjo-like "gunk"; bullfrogs sound like "jug-a-rum"; wood frogs "quack"; and spring peepers emit a high-pitched, sustained "peeeep".¹ After discussing the role of calls in frog communication, I explain that these calls can serve as each team's 'cheer'. I encourage the youngsters to use these sounds as they joke around and build team spirit.

Next, we explain that each group of frogs has just awakened from winter hibernation. The groggy frogs are about to begin their perilous journey towards a peaceful 'pond' (the designated finish line). There, the frogs will feast on various small invertebrates, find mates and eventually produce the next generation of froglets. Progress towards the breeding pond is determined by drawing from a set of randomly arranged Frog Fortune Cards (see the cards at the end of this article). These cards describe some of the helps and harms real frogs might face during such travels.

The moderator (the teacher, or better, a student who likes to read and be dramatic) draws a card for each team and team members hop forwards or backwards in unison according to the card's instructions. (The cards provided apply to all frog species—they present events which might befall any type of frog.) Continue to draw cards for each group of frogs, always in the same order, as the teams progress across the field. The first team to reach the pond is victorious.

Extension

Have students, independently or in teams, research the lives of frogs. Students can then compose their own event cards based on what they have learned. Youngsters could also create life-size frog illustrations for the cards before or after playing. This is a very effective way for them to assimilate and share new knowledge about all sorts of living creatures.

As an activity, Frog Fortunes tends to be rather controlled (except for the unpredictable sequence of event cards). The former quality can be an advantage, particularly when you are dealing with new students (such as a group visiting a nature center) or with youngsters who are being a bit obstreperous. One can, however, make the game more

enjoyable—and not merely didactic—by emphasizing its competitive, team-bonding dimensions and the imaginative possibilities of pretending to be a frog. Urge the various frog species to call proudly in chorus prior to the reading of their Fortune Cards. Read the cards themselves theatrically.

When the youngsters are actually playing, these directions have proved very helpful: Encourage the students to make astonishing (yet fair) leaps forward. Capture the interest of the more athletic individuals by allowing each team to move forward to the point that was reached by the team's very best hopper. This policy helps keep each species group together on the playing field and prevents the kids who don't jump particularly far from straggling behind and being singled out in a negative way. When one team finally arrives at the "pond of destiny", conclude the game with a multi-species celebration featuring supportive frog vocalizations—not just from the winners.

Traveling Frogs

After one or two rounds of Frog Fortunes, try a game with more opportunities for socializing, free choice, and exercise. Traveling Frogs is a game based on the traditional game of "tag". Describe to your students a scenario in which the various frogs travel to a wooded area, damp meadow or pond to feed and breed. Establish a finish line to represent this enchanting destination. As before, the frogs must compete to reach the finish. This time, however, they will have to reach their goal individually, and they must avoid being tagged by one or more "Dangers" who are moving across the grounds. The youngsters could brainstorm to determine who these dangers are. Perhaps they will decide on Great Blue Herons, Minks, River Otters, Marsh Hawks, Saw-whet Owls or even cars, lawnmowers or toxic chemicals.

Students who volunteer or are chosen for these roles should try, if possible, to imitate the enemies being portrayed. Can they imagine some sound or gait that would characterize their particular danger? How do you imitate a pesticide spray? Line up the designated Dangers and describing their frightening characteristics to the Frogs before you start the actual game. This is an opportunity to pass along additional knowledge, since students will be listening as they try to register which of their classmates they'll need to outrun. Select volunteers to serve as game monitors, who will observe the game to make sure proceedings go fairly. This is a perfect role for any student who cannot run.

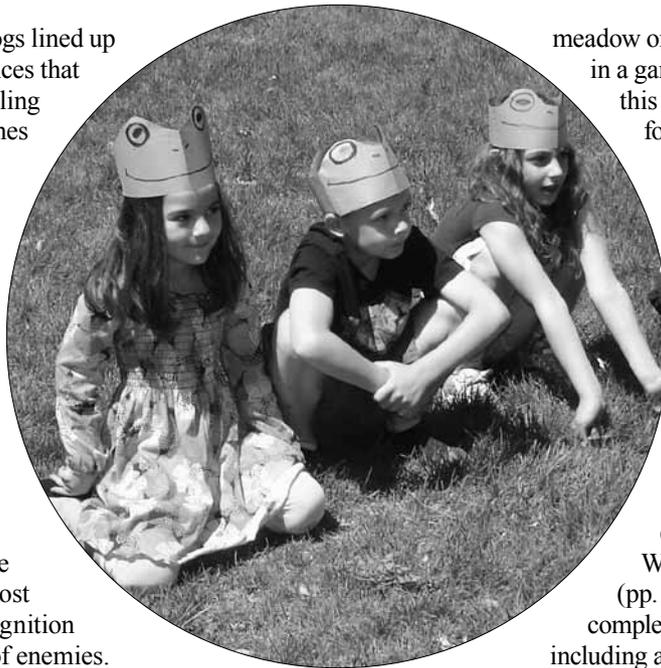
Frog Fortune Cards (Frog fortune cards apply to all species)

| |
|--|
| Warm, rainy day – forward 3 hops |
| Catch a fly – forward 2 hops |
| Encounter a skunk! – back 2 hops |
| Meet a hungry Garter Snake – back 3 hops |
| Devour several small slugs – forward 2 hops |
| Highway – back 5 hops |
| Find an earthworm – forward 3 hops |
| Blackflies for lunch – forward 3 hops |
| Cold weather. Since you're an ectotherm, your muscles (and your metabolism in general) won't work well if it's too cold outside – lose a turn |
| Find a nice clump of tall wildflowers. Hide among their leaves during the hottest part of the day. Because you've sheltered here, no enemy can find you and your skin will not dry out – forward 3 hops |
| Catch a dragonfly that wasn't paying attention – forward 2 hops |
| Munch on a crane fly – forward 2 hops |
| Nasty children tossing sticks – back 2 hops |
| Catch a mayfly – forward 1 hop |
| Cross a golf course during lawn mowing – back 3 hops |
| Find a tasty caterpillar – forward 3 hops |
| Encounter a menacing housecat – back 1 hop |
| Catch a slow Clouded Sulfur butterfly – forward 3 hops |
| Bulldozers have filled in a favorite pond that you used to visit. It's been replaced with a shopping mall – back 6 hops |
| Gobble up a Rove Beetle that you find in the weeds – forward 3 hops |

| |
|--|
| Hear other frogs calling – forward 4 hops |
| Bask in the sun for a while to improve your health (taking care not to dry out your skin!) – forward 2 hops |
| Catch a pillbug – forward 2 hops |
| Enjoy the morning dew. It keeps your skin moist and this is important because you breathe in oxygen through a thin layer of water on your skin – forward 3 hops |
| Race to escape from a dog – back 2 hops |
| Capture a small moth – forward 3 hops |
| Get toxic spray on your skin from pesticides applied to lawns or nearby fields. You become very sick for a while – back 5 hops |
| Encounter a large lawn with grass that's clipped short (exposing you to danger from hawks flying overhead, as well as the drying sun) – back 2 hops |
| Avoid a raccoon by jumping into a nearby stream – lose a turn |
| A lovely, rainy night for traveling – forward 5 hops |
| Catch several gnats – forward 2 hops |
| Capture a Lightning Beetle – forward 3 hops |
| Cross a field that has lately been treated with a variety of toxic chemicals (such as glyphosate) that are often used as weed killers (herbicides) in large, industrialized agricultural operations – back 4 hops |
| Gobble up a Wolf Spider – forward 3 hops |
| Find a Cabbage Looper Caterpillar – forward 2 hops |
| Avoid a person trying to capture you – back 2 hops |
| Capture a Red-Banded Leafhopper – forward 2 hops |
| Because of human-caused climate change, it's too hot and dry. You're having trouble keeping cool, moist, and fed. You don't feel like traveling. – back 2 hops |

Gameplay begins with all the frogs lined up at one point. The teacher announces that Spring has arrived and the travelling Frogs may “GO!” Like most games with a tag format, the point is essentially to avoid being tagged by the “Dangers” while dashing to the finish line.

The monitors must ensure that all Frogs play fair and ‘die’ (move to the sidelines) once tagged. Captured frogs must stay there until the game finishes. Play begins and continues until all the frogs have either reached the designated wetland or been tagged. At this point, the Danger who has captured the most frogs might receive special recognition for being the fiercest or fastest of enemies. Words of commiseration are offered to those frogs who have fallen and praise is awarded to those who have reached the forest, pond or meadow.



meadow or sprouting seeds trying to grow in a garden. During inclement weather, this kind of game can be adapted for use indoors (substitute steps for leaps, use symbolic checks on a blackboard or screen, or even use counters on a board to represent each team’s progress). The ‘tag’ format, with modifications, works beautifully in bird migration games, as described by Lingelbach and Purcell in “Migration Obstacle Course” (p. 144), yet is obviously well suited for any predator-prey or creature-danger dynamic. Project Wild’s “Quick Frozen Critters” (pp. 122-123) adds some interesting complexities to the basic game premise, including a requirement for players to gather

food tokens as they try to reach the goal. Once

children are accustomed to playing games with these general structures, they can easily invent their own versions. Students can share and viscerally reflect on research that they’ve done by transforming their findings into event cards for ‘prescribed movements towards a goal’ activities or perhaps complex variations of tag.

Reflections:

- As you can imagine, these two distinct games can easily be reconfigured to represent other natural scenarios. For my own classes, I’ve used the basic structure of ‘prescribed movements towards a goal’ to model the challenges confronting pollinators trying to gather food from a blossoming

- By challenging young people to create and dramatize real-life dilemmas and conflicts in a game, we give them the occasion to vividly empathize with the lives of other

Additional Cards for Older Students

Big Trouble: When you were a tadpole growing up, excess nitrogen fertilizer running off from carelessly treated farms, a nearby golf course and suburban lawns led to an increase in the quantity of algae in your pond. Because of the extra algae, more large snails came to live in your pond and feast on these small green plants. Some of the snails were carrying parasitic trematode larvae. The parasitic larvae infected you! Because your immune system was already stressed from various toxic pesticides that had also drained into the water, your immune system couldn’t fight off the trematodes very well. They invaded your leg bud and caused so much damage that you were only able to grow one hind leg instead of two. – **back 4 hops slowly**

Big Trouble: You’ve been exposed to the very deadly chytrid fungus. It was accidentally brought to the continent when non-native clawed toads (being kept for pharmaceutical research and as pets) were released into the wild. These toads are somewhat immune to the fungus, but most native amphibians (like you) are not. Luckily you have some helpful bacteria, called *Janthinobacterium lividum*, living on your skin. They will help you to fight the fungus, but even so you’re somewhat weakened. – **back 3 hops**

Big Trouble: You are easily tired because you received too much UVB radiation as a little egg in the pond. This happened, in part, because human-made chemicals such as CFCs thinned the ozone layer of the atmosphere. (This is the layer that usually filters out a lot of the damaging UVB rays in sunlight.) On the bright side—a poor choice of words—at least you survived; many of your siblings never even made it to the tadpole stage! – **back 5 hops**

Big Trouble: Herbicides (such as atrazine) used in industrial agriculture contaminated the water where you were living when you were a tadpole. The hormone levels in your body have been disrupted and now that you’re a grown up frog, you have both male and female characteristics. You may not be able to reproduce even if you make it to the pond. – **back 6 hops**

Big Trouble: Run-off from chlorothalonil, a fungicide used in industrial agriculture, entered the wetland where you were living as a tadpole. While most of your brothers and sisters died from contact with this fungicide, you survived in a weakened condition. – **back 3 hops**

Big Trouble: a card for older students: Estrogen-mimicking chemicals from inadequately treated city and suburban wastewater have washed into the water where you are living. This has affected your development in a very negative way. – **back 4 hops!**

beings. This can fortify their sense of compassion and connection with other forms of life.

- In each game's highly charged peer-to-peer interaction, children learn how to coordinate quick strategic decision-making with large motor movements – a good challenge for their brains' executive functions. Moreover, the games chasing format allows students to participate in significant physical exercise, especially when played outside. In both game formats, youngsters can build stronger interpersonal skills as they learn to compete and cooperate within a rule-governed social structure. And youngsters are reinforcing and expanding their real-life social networks during these games. By entwining awareness of natural history and science with enjoyable social and physical activity, instruction of this kind can promote the assimilation of new information both intellectually and emotionally. Additionally, games of this sort are more respectful of collectivized youngsters' developmental needs and proclivities than are other necessary but sometimes aversive techniques such as classroom reading, passive video presentation, or worse yet – lectures.
- When games of this kind are part of a teaching program, even if students forget many of the precise details of the natural history scenarios, at least they retain a pleasant memory of running across fields with their peers in the fresh air. They're not alienated from the educational enterprise, and by the end of class, they're a little more physically fit and healthy just from having fun in the sunshine or under the clouds.

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Endnotes

1. Recordings of frog vocalizations can be found on-line at sites such as the University of Michigan Museum of Zoology's Animal Diversity Web: <<http://animaldiversity.ummz.umich.edu/site/Topics/FrogCalls.html>> or in printed sources such as the book and compact disc combination *The Frogs and Toads of North America*—see the References section of this article.

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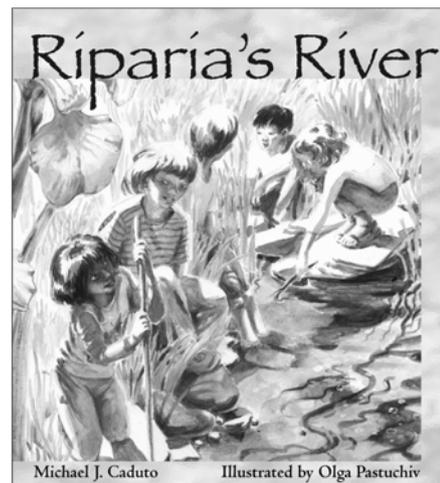
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Directed Outdoor Murals on Schools

A guide to engaging all children in painting a mural about endangered species or a schoolyard greening project.



By **Ann Coffey**

WHO WOULD HAVE IMAGINED that your students could all be great artists, completing a 4' x 24' "eco-mural" designed by a professional artist in as little as five days? Who would have thought that such a project could be undertaken with the involvement of pre-school, kindergarten, autistic, and behaviourally-challenged children?

Ontario artist Nicole Belanger has devised a "directed mural" approach to help elementary schools plan a successful mural painting project. The project has achieved spectacular results with young painters of all ages and abilities, but it requires a lot of preparation beforehand and during the activity to make sure the project is a success.

In Belanger's approach, a professional artist designs and sketches the outline of the mural on the first day, and groups of children and parent volunteers paint in the details over the next four days. Some have criticized this "directed" approach because they feel it limits students' freedom of expression. However, without direction, murals usually become a hodge-podge of peace symbols, happy faces, slogans and hand prints. In fact, murals where students are given free rein tend to look very similar. Painting a directed mural is certainly no

less enjoyable for the children, and in the process they learn a few painting techniques and observational skills, as well as the value of community cooperation and respect for fellow students' work (you don't paint over it!).

If the mural is intended to enhance a school grounds greening initiative, its subject matter can be largely determined by the lead artist, but specifics should be chosen through consultation with the school. For example, schools may want to draw attention to local ecological priorities such as species at risk, or focus on aspects of their projects such as butterflies, the four seasons, pollinators, vegetable gardens or composting. The topic, roughly sketched out beforehand, provides focus, and a short lesson on applying paint and choosing the right brush for the job gives children the basics to get started.

The following details will help schools prepare for and paint a directed mural:

Getting ready to create the mural

- For exterior murals where school administration does not permit painting on brick or other masonry, there are two types of plywood you can use. An advantage of painting on plywood is that the mural can be relocated if necessary, and can be painted indoors. Half inch marine

grade plywood has lots of glue between the plies to keep water out. It is more expensive than high grade exterior plywood, but a local building supplier might be willing to donate it or at least give you a discount. A cheaper alternative is high density overlay (HDO) plywood that is used for exterior signs. Both marine grade and HDO plywood are specialty items so not all building suppliers carry them.

- The top edges of the plywood should be protected from the weather with three-sided metal or vinyl strips (shelf edging) that snap onto the edges.
- Use a good primer to cover all sides and edges of the panels. Apply paintable caulking to the edges after you have primed the panels, and then apply a coat of primer to the caulking to protect it.
- Use high quality exterior matte latex acrylic paint to cover the primer with a background colour. Whatever colour you use for the background, make sure it will work well with the colours used to paint the mural. You can expect little spots of the background colour to remain unpainted where children are at work, so the background colour will show through in places. If you use white for the undercoat, it will have a flattening effect on the final colours. Impressionist painters often used ultramarine or another primary colour for the undercoat on their canvasses as a device to make topcoat colours even more vibrant in places where it the undercoat is not completely covered. Brilliant undercoat colours add intensity by “shining” through the top layers of paint.

Tip: You can use different undercoat colours for different parts of the mural depending on the colours you plan to use for your design. For example, if you were to paint an area of fallen dried leaves, you could use a reddish chestnut colour for the undercoat and blue-black paint for the sketch. The blue of the lines and the tiny reddish patches that remain unpainted will help to create an effect similar to the device used by the Impressionists.

Teachers might like to use this opportunity to teach children about the colour wheel and look at what happens at the margins of primary colours when they are placed next to each other. They could also have classes examine Pointillist paintings by Georges Seurat and Paul Signac to see how a colour that looks purple from a distance is actually composed of tiny red and blue dots or small isolated brush strokes, as an example of colour theory.

NOTE: You may wish to invite artists in the school com-



A preliminary sketch allows young students to add important details within a proper frame.”

munity to help out, particularly with the more detailed work on the last two days of the project.

Painting with kids

What group size is best?

Generally speaking, having groups of five to seven JK-4 kids (ages 5-10) work on the mural in turns works well. A kindergarten teacher will sometimes want to bring the entire class at once, which is fine as long as there are no more than about 12 children painting at once, due to space limitations. You might have to ask other teachers to bring some of their own aprons or smocks. Children in grades 5 and 6 (ages 11-12) often muck about and try to paint each other and put smiley faces on the mural, so, as with the younger grades, four or five older students at a time is best depending on the class. It's good to get the low down on this first from the teachers, and have them choose the combinations of children where behaviour problems are least likely.

The Cost of a Directed Mural

Creating a mural requires funding for materials, installation, and an artist to oversee the project. Grants are available through national, regional (state/provincial) and local organizations such as community foundations, arts councils and boards, artists in schools programmes, etc., and (in Canada) Multicultural Arts for Schools and Communities (MASC) <<http://www.masonline.ca>> and ArtsSmarts <<http://www.artssmarts.ca>>. If you can find an artist who is partially funded by an organization, the school's monetary contribution to the project is generally around \$1,500. Hiring an artist privately will generally cost \$20-30 per square foot depending upon the intricacy of the design, materials and installation extra. Finding a local artist willing to volunteer would obviously save money. Whichever option you choose, it is essential to find someone with good organizational skills who works well with children.



The five-day process

Monday: Preparation

Tuesday morning to Friday noon: Involving all of the children in painting the mural

Friday afternoon: Touch-ups and adding finer details

Monday

- Prepare surfaces if you haven't been able to do this ahead of time
- Sketch design
- Set up a table with paints, a range of brushes sizes, palettes, and paint rags
- Organize access to water and have two pails for washing brushes
- Make sure you have enough paint shirts
- For artistic inspiration, to help students paint detail, and to encourage the direct observation of nature, collections of plant parts, mulch, rocks, etc., can be brought put on display, as can photographs of any less-portable or intangible elements such as birds, insects, trees and clouds.
- Draw up a schedule for groups of children based on the number of children in the school, the size of each class, and the grade.

NOTE: It's a good idea to have groups of K-2 (ages 5-8) children paint areas of background in the lower half of the mural on the first day because they're not as tall as children in grades 3-6 (ages 9-12), and can be less adept at controlling paint. If they are unable to come on the first day, you can reserve the more easily reached lower part of the background for them to paint on the second day.

- Plan to include everyone – junior and senior kindergartens, behaviour classes, special needs, etc.

Tuesday morning to Friday noon

- Have ready a palette with several colours, a paintbrush, a water pot and a paint rag for each child
- Fetch the first group of children from their classroom
- Let children know that no talking will be allowed because you want all of their attention to be focused on painting
- Explain that the artist will start to describe the mural painting process while they are putting on their protective clothing
- Ask the group to remove long-sleeved sweaters and roll up long sleeves of dresses, shirts, etc.
- Dress the kids in coveralls such as old T-shirts, shirts, and aprons while the artist explains the project, and show children how to apply paint (described below)
- Give each child a brush, palette and spot to work on
- Supervise the application of paint
- Five minutes before the end of the first group's time, have a volunteer fetch another group
- Let the group know a couple of minutes before their time is up
- Have children remove paint shirts, wash their hands, and collect any clothing they may have removed
- Have the children, or volunteers, wash brushes in the pails of water, and replenish paint on the palettes, or clean them if necessary
- Dress the new group in paint shirts
- If the preceding group has to be accompanied back to the classroom, have a volunteer do this while the artist is explaining the process to the next group
- Write down the names and classes of particularly talented children in case you wish to have them participate in touching up the mural on the final afternoon of the project
- At the end of the day prepare for the following morning



The size of the group also depends upon the size of the class. If there are 24 kids, take four groups of six. If there are 20 kids, take four groups of five. Take two groups of six and one group of five from a class of 17, and two groups of seven from a class of 14, and so on. Behaviour and specials needs classes tend to be quite small and have teacher assistants, so you can take a whole class at once.

Working with autistic children: I have worked with several autistic children on mural projects. They were completely focused once dressed in painting clothes, equipped with a palette and brush, and given a specific area to paint. The autistic children I worked with are quite talented and painting had a remarkably calming effect on them.

How much painting time per child?

The amount of painting time allowed for each child depends on the number of children in the school and the size of the groups. Generally, it's feasible to allow each child 15 to 30 minutes of painting time. (The smaller the school population, the more time each child will have.) In large schools, you might consider working through the morning and afternoon recesses or increasing the size of the groups, particularly for the first two days of the project when there is more focus on painting large areas of colour rather than finer details. A lot of time can be saved, and thus children can have more time for painting, if one or two volunteers helps with organizing groups of children, dressing them in paint clothes, and clean-up.

Explaining the process

Teachers may have explained to their classes in advance about the mural painting project, but don't leave it to chance. Make sure all children in the school know, perhaps through a P.A. announcement, that everyone in the school is participating in painting the mural.

Most children will have used only the kind of one-size-fits-all bristle brushes and powder paints typically found in schools. They tend not to be familiar with paintbrushes with square, rounded, angled or pointed tips, or know how to choose brush shapes and sizes to make different strokes. They also tend to scrub with a brush, use far too much paint, and not know how to mix colours.

Since children often want to start by painting smaller details, you will have to explain that it is necessary to start with the background and end with the foreground because painting the background last could result in foreground details being unintentionally painted over.

Explaining the process of painting has to be done very quickly otherwise it will consume too much painting time. Some of the following points can be repeated as required while the children are painting:

- Show children a range of brush sizes and shapes
- Demonstrate the strokes different brushes can make
- Show children how much paint they should load onto the brush
- Show them how to remove any excess paint from the brush

- Demonstrate how to hold the paintbrush – many children hold the brush close too to the bristles and get covered with paint, or hold it too far from the bristles, which results in lack of control
- Show them how to apply the paint
- Show them how to keep within the lines sketched
- Explain that the paint is very expensive because it has to last for many years out of doors, so it is not to be fooled around with or wasted
- Make sure they understand that if the paint gets on their clothes or shoes it will not come off
- Explain that they will each receive a palette with a limited number of colours to avoid paint wastage
- Show them how to mix colours right on the mural and not on the palette
- Explain that they will each be given a particular spot to paint
- Choose brushes for each student that are appropriate for the spot they will be painting

Starting to paint

Children are each allocated an area to work on. Try to keep at least three feet between students for elbow room. Some classmates like to work with their heads practically touching and paint the on the same spot, which is acceptable as long as they don't get paint on themselves.

- The artist and volunteers take children to their painting spot and help them to get started, and circulate to monitor and give help as required

Tips:

Paint: For a good, durable exterior acrylic paint, Nicole uses Stevenson's paint, which Canadians can order at: <<http://www.dlstevenson.ca>>

Brushes: Watch for sales at art supply stores. Buy good quality 1/8" brushes with pointed end for fine detail, and brushes of various shapes and sizes up to 1/2" for the rest. Kids tend to be hard on brushes so the 1/2" size will end up wider after a few uses. You'll also need large brushes and/or rollers for priming.

Palettes: Try to avoid using disposable plates for palettes, and plastic spoons for scooping paint from pots. Metal spoons and old plates bought at a second-hand store are reusable. Dry acrylic paint can be peeled off metal and china surfaces.

Paint clothes: Buy cheap shirts at thrift stores and garage sales for overalls for the kids. Once dry, Stevenson's and other acrylic paints cannot be removed from clothing. One simply doesn't want a ton of parents complaining about irremovable paint on designer clothing! A call could also go out to parents asking that they send in old large-sized T-shirts, plates, spoons, and paint rags.

- Remind children not to paint over anyone else's work

Enlisting painters for the final afternoon of the project

Write down the names and classroom numbers of any particularly talented children you would like to help with putting the finishing touches to the mural. Depending upon how much finishing work remains, you could have four to eight children in the group. At the end of the day on Thursday or early on Friday morning, have a volunteer go to these children's teachers to ask whether you can borrow them for part or all of the afternoon.

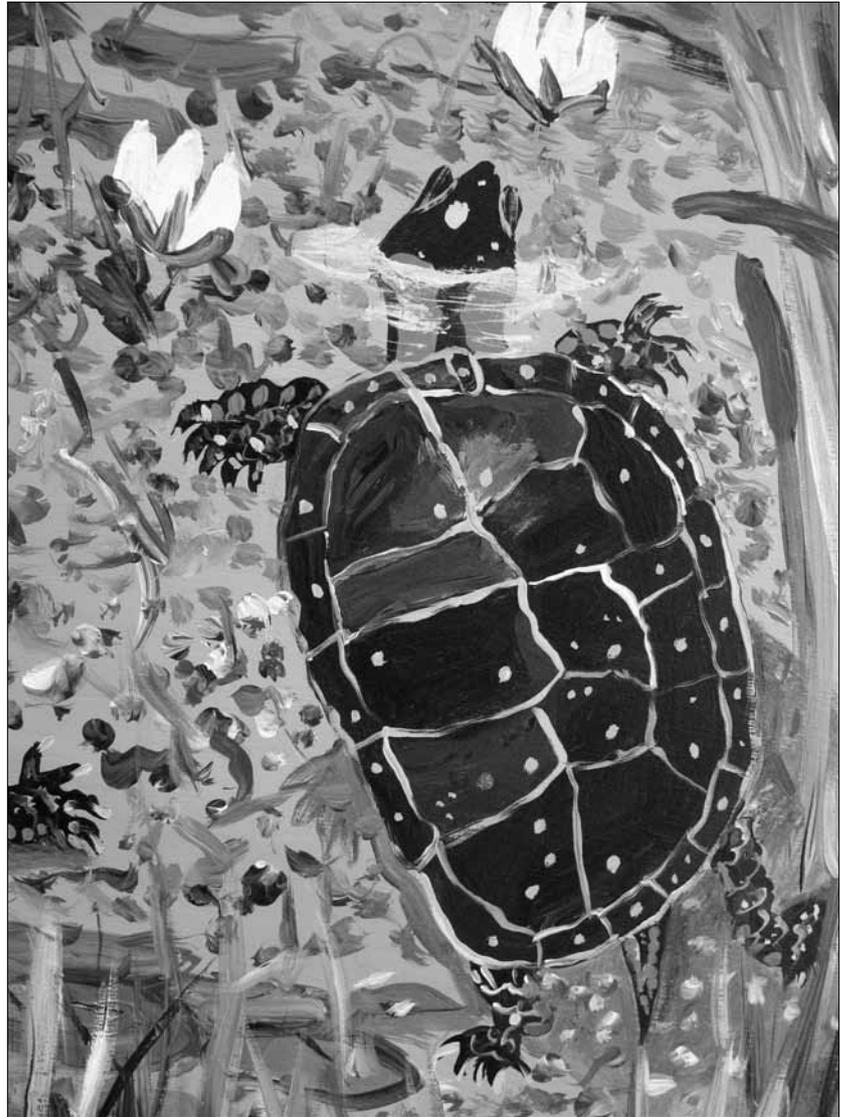
You may find you have more talented children on your list than you actually need, but bear in mind that some of your choices may be unable to come due to having special classes to attend, going on a school outing, or being away sick. If you have too many children for one group, you can split them into two groups and halve their time.

Adding details

By Wednesday afternoon, you should have the background and most of the larger areas painted, and may have already started on the more detailed work. This is the time when people tend to panic because two-thirds of the five-day project have been spent painting only half of the mural. Don't worry because the details usually go faster than the background. Now would be a good time to have any artists in the local community, or students from your local high school or art school come to help out.

When the subject material for the mural is carefully chosen to reflect a simple need, such as the addition of colour in an otherwise drab outdoor school environment, it will have more meaning for the children and the community, and will also provide a useful learning tool for teachers. Other needs/purposes for the mural may include outdoor educational activities such as composting, area biodiversity, local geography, the impacts of development on local species, and cultural and historical aspects of the community.

For example, the school community at Blessed Kateri Tekakwitha Elementary Catholic School chose to depict some of the 48 at-risk species in Ottawa. The school's research prior to starting the mural showed that a large number of amphibians, reptiles, insects and plants on the City of Ottawa's endangered, threatened and at-risk list all depend upon wetlands for their survival. They were horrified to discover that all six of Ottawa's turtles are at risk. A wetland habitat was subsequently chosen for the mural to help raise awareness on the plight of wetland species. Due to limited space and time, not all species could be included, but the mural now serves as a springboard for follow-up educational activities on, for example, the consequences to area species



of draining wetlands for residential development and roads.

No matter how small the patch painted by a child, everyone seems to remember having painted the entire mural single-handedly, perhaps because the mural was painted by all of the children working together as one body with a common goal. Whatever the reasons, participants become enormously proud of their artistic achievement. And perhaps this is the most satisfying aspect of all, because the more children gaze at their painting the more meaningful it becomes, and the more the educational activities surrounding it are reinforced.

Ann Coffey lives in Ottawa, Ontario, where she has been a school grounds greening designer and practitioner for 22 years. Currently an associate with Evergreen, she has enjoyed working with Nicole to create 10 murals in Ottawa schoolyards.

TO SEE COLOUR PHOTOS of completed and partially-completed murals, visit www.greenteacher.com and click the link to the table of contents for this issue (Green Teacher #93, Summer 2011).

Rewriting Our World

Moving from doom and salvation to hope and sustainability in the Western cultural narrative



By **John Gust**

THERE WE WERE, doing exactly as our language arts content standard dictated, “analyz[ing] media as sources for information, entertainment, persuasion, interpretation of events, and transmission of culture,” when the question dawned on me—What sort of tale is our media spinning? “Hey,” I asked, interrupting my fifth-graders’ morning perusal of the *Los Angeles Times*. “I was wondering: Given what you hear, see, and read in the media—you know... TV, newspapers, books, magazines, the Internet, radio, video games, movies, all that—what do you think is going to happen to the world? What is going to become of us?”

Everybody grabbed their pencils and started writing. I knew that a recent study released by the Kaiser Family Foundation had claimed today’s 8 to 18 year-olds devote a whopping 10 hours and 45 minutes to entertainment media across a typical day, so I really was dying to find out exactly what sort of culture the media was transmitting to these kids. With everything that had been going on in the world, I had my own ideas about what students would say, but I wanted to find out for sure. I desired to delve into my students’ lived experience to uncover what Paulo Freire called their “generative themes” or “thematic universe” (p. 77).

My students’ answers exposed a universal theme all right, but I’d hardly call it generative. Every one of them said our story was going to turn out badly. Their answers were incredibly disturbing and full of despair. Brian wrote:

“I think the world is going to be trashed by pollution and all the things that are being wasted since us humans don’t even care.” Christian declared: “I think the world will end up like the one in *Wall • E*.” April’s account was the worst: “I think everybody living on earth will soon die and the air will be filled with lots of carbon dioxide. The whole earth will be trashed with plastic bags, water bottles, garbage, etc.” Prior generations had weaved stories about a possible nuclear holocaust, but it was never anything like this. This is the first generation I can remember feeling so desperate about their future. And all of this, from just a brief review of the media.

Here’s how it all got started: First, I brought the *Los Angeles Times* into the classroom. We identified the sections of the paper, looked at all of the articles and advertisements, cut out those that were noteworthy and saved them in a folder. Then we listed and talked at length about all the movies, TV shows, books and videos that we had watched or read recently. Lots of them had seen the movies *Wall • E*, *I Am Legend*, *The Day After Tomorrow*, *Deep Impact*, *Armageddon*, or *2012*. Most had read articles about wars, polar bears and their diminishing environment, rising carbon emission levels, global warming, climate change, the Great Pacific Garbage Patch, and our planet’s new, sixth mass extinction. And many had read at least one of the growing number of lauded dystopian young adult novels out there, like Lois Lowry’s *The Giver* or even M.T. Anderson’s picture book, *Me, All Alone, at the End of the World*.

Since my students’ answers were indicative of our cur-

rent collective state of mind, I decided that we should explore how all this gloom and doom got started. How did we fall into this narrative that says our world is going to end in catastrophe, death and destruction? What sort of principles and ideals had generated this theme for our tale?

The Fatal Founding Principles

My next task was to take my students backward in history for a critical review of our story to discern the origin of their “thematic universe.” To accomplish this, I figured we’d have to identify the principles and ideals that formed the foundation and direction of our worldview, because I believed these to be the origin of my students’ generative theme. So, we set off to uncover the origin of the theme hidden in the narrative my students were living.

Fortunately, I didn’t have far to look. I found the source in our fifth-grade Social Studies curriculum. In California’s fifth-grade classrooms, educators were supposed to teach how the United States of America was “founded on Judeo-Christian principles,” and “the ideals of the Enlightenment.” There they were, our good old principles and ideals.

Now, to determine what those principles and ideals are, we would need to listen closely for evidence of that kind of discourse ‘humming’ through our story. We would need to hear “the voice of Mother Culture” as Daniel Quinn describes it in his book, *Ishmael*, because: “Once you learn to discern the voice of Mother Culture humming in the background, telling her story over and over again to the people of your culture, you’ll...be tempted to say to the people around you, ‘How can you listen to this stuff and not recognize it for what it is?’” (1992, p. 37).

Wanting my students to be able to recognize our dominant narrative for what it is, we started searching first for evidence of the Judeo-Christian principles that helped to form our culture. Once again, we didn’t have far to look: the chalkboard. On it, I had written the day’s date. “And where does this come from?” I asked. “None other than our Gregorian Calendar! It’s our world’s civic calendar that Pope Gregory XIII introduced to correct the inaccuracies of the Julian calendar. It’s based on the *Anno Domini system*, or the birth of Jesus. Therefore, our civic calendar is about as Judeo-Christian, or more specifically, as Christian as anyone can get.” And right there, I thought, with our entire world dated to the birth of Jesus, essentially, to one degree or another we were all living in accordance with certain Judeo-Christian principles.

In the United States, we citizens hear all kinds of Judeo-Christian principles humming away in the background. We even chime into the story’s mantra everyday in our public schools when reciting the words “under God” in our Pledge of Allegiance. Heck, our country’s official motto, written on our dollar bill, is “In God We Trust.” Likewise, I’ll bet that if you listen closely enough you can hear Judeo-Christian principles humming along in the dominant narrative of nearly every country in the Western world.

At this point, I presented a gallery walk of quotations

Redemptive Narrative

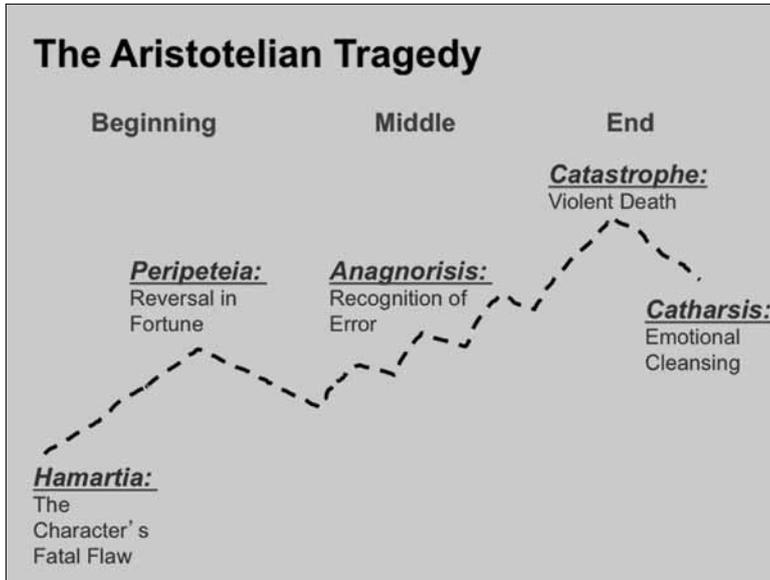


- The Fall
- Under God
- In God We Trust
- Made in the Image of God
- Be Fruitful and Multiply
- Soul of Man Only
- This Land is Your Land
- Hold Dominion
- For the Glory of God
- City on a Hill
- Revelations of the Apocalypse
- Savior
- Redemption (post apocalyptic earthly beatitude)

and illustrations from a few prominent “voices” heard in our Judeo-Christian discourse. For this, I glued specific quotes and illustrations on posters, and hung them on the wall for display. Students took turns reading, reflecting on and writing a response to each piece, and commenting on each other’s responses, thus turning the entire exercise into a discussion of sorts.

The last poster on our gallery walk included two images that I believe identified the true origin of my students’ “generative theme.” The first was a painting of the author of the *Book of Revelation*, John of Patmos, receiving from this God we trust, his two apocalyptic visions. The second was Michelangelo’s *The Last Judgment* from the Sistine Chapel. Surrounding these two images, I also included a variety of dreadful quotes from the *Book of Revelation*. Since those horrific revelations, it seems, we as a culture have been talking, writing, filming and dreaming about, and perhaps looking, waiting and even hoping for the end of the world, non-stop.

So, this is the narrative we had uncovered. It’s what Thomas Berry, the former Catholic priest and eco-theologian, called in his book *The Dream of the Earth* the “redemptive story.” As Berry states, “[t]his religion-based story originated in a revelatory experience some three thousand years ago.” First was the ‘fall’ of humanity described in Genesis: “[a]ccording to this story, the original harmony of the universe was broken by a primordial human fault.” Because we’re fatally flawed, Eve picked the fruit that got us expelled from the garden. Now we’re under God, in whom we trust, even it seems, to the exclusion of our own self-reliance. However, because we’ve been made in His image, we should be fruitful and multiply. And because human beings are the only creatures who possess a soul and the ability of self-reflection, this land is our land and we hold dominion over all the other creatures on our planet. Thus, for the glory of God, we’re supposed to create a great city on a hill, so that it can all end in a horrible apocalypse. But those who believe in the savior will be redeemed and “mov[e] infallibly toward [their] fulfillment in the peace of a reconstituted paradise” (p. 124).



With the Judeo-Christian principles and resulting narrative clearly identified, our next task was to search our discourse for evidence of the ideals of the Enlightenment. “But what exactly is the Enlightenment?” I asked. None of them knew, of course, so I first defined the term. “Immanuel Kant, one of the most influential thinkers of the time, described it as, ‘The freedom to use one’s own intelligence.’ So... instead of looking to the crown or the church for answers...”

“People started reading and thinking for themselves,” interrupted a student.

“Exactly,” I said. “And one of those people was Sir Isaac Newton, whose voice, more than any other, found a place of prominence in our story.” Thus began another gallery walk. I posted quotes from Locke’s *Two Treatises of Government*, but we focused mostly on Newton’s *Optics* and Descartes’ *Meditations*, because each quote from these works illustrated just how much these men were influenced by the Judeo-Christian principle of a transcendent, patriarchal Creator and His creation.

In this world, dead matter, particles, and solids—without purpose and devoid of spirit—were set in motion according to certain mechanical laws “the end for which...” Newton said, “God himself made one in the first creation.” And, according to Descartes, we represent nothing more than the mere “machine of the human body as having been formed by God for the sake of the motions which it usually manifests.”

Now, the story was complete. I felt confident that we had located the origin of our generative theme. For me, it was clear: Our Judeo-Christian principles provided us with a clear apocalyptic vision, and the ideals of the Enlightenment paved the path to help get us there. As characters in the story, we believe that with the proper use of the scientific method we have the means to manipulate the material world for almost anything we want. And because we’ve been made in God’s image, and are therefore superior to all other species in the Animal Kingdom, we have the complete arrogance to think that we have the right, even the responsibility, to do so. But from the looks of things, we seem to be failing in our efforts. The principles and ideals that had once propelled us to greatness are not working anymore. Because of our fatal

flaw, or *hamartia*, we are not living sustainably on our planet. Not by a long shot.

More and more, I realized, our media is transmitting a culture that seems destined to end up like an Aristotelian tragedy. Augusto Boal warned us about in his book *Theatre of the Oppressed*. “[Aristotle’s] system appears in disguised form on television, in the movies, in the circus, in the theatres. It appears in many and varied shapes and media. But its essence does not change: it is designed to bridle the individual, to adjust him to what pre-exists. If this is what we want, the Aristotelian system serves the purpose better than any other...” (p. 47). Realizing this, I decided it was time to transform my students from passive spectators in this unfolding apocalyptic narrative into bold “spec-actors” ready to rewrite the script. In short, we needed a whole new story.

The Rewrite

“So what are we going to do?” I asked, once our critical review of our dominant narrative was complete. “Can we change things? Should our story be rewritten?” “Yeah,” my students said. “We’ve got to try.”

First, we decided to make some personal changes by completing a carbon footprint survey. Right away students discovered that *all* of our footprints were *way* above our earth’s share! And because now everything seemed so incredibly urgent, at home students were immediately compelled to start making changes. Kids told their parents to take shorter showers, not to serve any more beef, to change their light bulbs, or to pedal to the store.

In spite of all our personal efforts, the question always loomed: “Will our small changes be enough to save the world?” “Personally,” I said, “I think we need to change *everything*.” We needed big changes. And to do that we still needed to transform our thinking about the world, our generative theme. “That means we’ll have to start over again. All over. Right from the beginning. Well, maybe not the beginning, but rather, sometime back in our country’s history.” My young fifth-graders were really great at suspending disbelief, so I next asked, “What do you say we travel back in time and go see the people we learn about in U.S. History to persuade them to change things? If you could, would you do that? Would you go back in time to make a few changes and then return to the present with the hope of finding a whole new world waiting for you? All because of you and your efforts?”

“Yeah!” they all shouted.

“Really?” I asked.

They all nodded. Some shouted “Yeah!” again.

“Okay,” I said. “Then let’s figure out a way to make a time machine, and go!”

Off we went, rewriting our world, each of us creating our own alternative history. We were going to change the world through our stories, one narrative at a time. In order to write our stories, we first had to look for places to break into our culture’s storyline. We had to determine where and when we would go, and who we would talk to when we arrived. First, we wrote research reports on various historical figures—

“We have to know who we’re going to go see, right?” And after our research reports were complete, I explained, “We better know what we’re going to try to convince them to do when we get there, right?” Thus the persuasive essays were born. It was our responsibility to have something pertinent to say. And we had to say it well, if we were to truly convince these people.

After that, students synthesized their thoughts to create three worlds. The first world in their collective story was the dystopian world they were leaving behind just in the nick of time. Exactly how would it end? What would it sound, feel, look, smell and even taste like? The second world was composed of the historical world settings to which students time traveled. If students were going to interrupt the Constitutional Convention, they had better know who was going to be there, what they looked like, and what the Philadelphia State House looked like, as well. And finally, in their new ending—which was really a new beginning—after convincing our historical figures to make a few major changes to our Constitution or Bill of Rights, or whatever, they had to return to a strange new ecotopian world their actions helped to create. Therefore, we had to create and articulate a vision for how to rebuild our world. What exactly would a sustainable community look, sound, feel, smell and taste like?

In order to envision this new world, we learned a variety of ecological literacy concepts—basically, a whole new set of principles and ideals. Aside from the usual study of non-renewable versus renewable forms of energy, for example, my students also learned the difference between democracy and biocracy, agriculture and permaculture, anthropocentric and

biocentric, mechamimicry and biomimicry, states and bioregions, and on-the-grid and off-the-grid, to name just a few.

When all was said and done, my students had completed more writing than they had ever done in all their lives. And they loved every minute and word of it. There was never an issue of motivation, because they felt as if they were doing something hopeful to actually save and transform their world. They were engaged from beginning to end. My reward came when all their stories and books were done, and when my student, Livier, proudly proclaimed: “I love writing because if you want to change something or the whole world, just write a story and the story might persuade people that read it to change their whole way of thinking.”

John Gust is a sixth-grade teacher at Environmental Charter Middle School in Inglewood, California and the author of books including *Adventures in Fantasy: Lessons and Activities in Narrative and Descriptive Writing* (Jossey-Bass). To learn more about John’s books or ECMS visit www.johngust.org or www.ecmsonline.org.

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Climate Change Summits for Teens

Increase global awareness by hosting a climate and environmental change summit with teenagers



By **Janice McDonnell, Laura Bovitz, Carrie Ferraro, Rachel Lyons, and David Robinson**

THE IMPACTS OF HUMAN-INDUCED global warming on the natural environment are drastically affecting, and will continue to drastically affect, every aspect of our economy and our daily lives. We now have a fundamental scientific understanding of global warming, and nearly universal acceptance in the scientific community that anthropogenic greenhouse gas emissions are affecting global climate and ocean properties (IPCC, 2007). Despite this, much of the general public is becoming more confused and less concerned about global warming amidst a barrage of frightening (and sometimes conflicting) data, and media spin. Public comprehension and acceptance of the authenticity of global warming is woefully lacking, hovering around 50% (Leiserowitz et al., 2009).

Global warming is the most publicized and broadly debated consequence of greenhouse gas emissions. Just as significant, but less well-known, are other adverse consequences ranging from sea level rise to biodiversity loss. With a huge portion of the world's population living in coastal areas, sea level rise alone will directly affect perhaps billions of people, not to mention its global economic consequences. For effective change to occur, the public urgently needs at least a basic grasp of the science behind climate change and global warming, and a realization of their present and future effects. This urgent need should be a clarion call for education and research communities to come together to transform how young people, and the general

public, are educated on these issues.

In an effort to contribute to climate education and literacy, we created the Climate and Environmental Change (CEC) Summit. CEC is a two day Science Technology Engineering & Mathematics (STEM) event for middle and high school students (ages 12-18), designed to increase knowledge and understanding of climate change science through interaction with climate scientists at Rutgers University. The event, which takes place on the university campus, begins with interactions with climate change scientists, and then uses an action planning process to help youth apply this knowledge to community-service projects. School teams create Action Plans for community involvement and present the results of their projects through group presentations and videos. Teams are recognized for their achievements and success in communicating with their communities. In this article we will describe how you can host a CEC Summit in your school or community to help support climate literacy.

Program Goal

The overall objective of the CEC Summit is to provide participants with both scientific knowledge about climate change and the decision-making skills needed to improve application of this knowledge as active citizens and in their personal lives. The project was also designed to enhance interdisciplinary collaborations between natural and social scientists involved in the Rutgers University Climate and Environmental Change Initiative, and between the participating teens and high school teachers.



Program Outline

Our first step was to create a planning team of educational, scientific, and logistical professionals who would oversee the program and curriculum development for the Summit. The team was led by education professionals from the New Jersey Department of 4-H¹ Youth Development at Rutgers University. 4-H county and state faculty focus on creating positive educational experiences for youth, geared towards building leadership skills. The scientist members of the planning team were from the Institute of Marine & Coastal Sciences at Rutgers, a world-class oceanographic research center. These research scientists focused on science content and on facilitating scientist participation in the project. Lastly, to assist with recruiting and registering school teams, we engaged an independent logistics coordinator.

The planning team chose to create a hands-on experiential program that culminated in a community service project. Learning that is experiential and engaging sets the stage for rewarding habits, accumulation of knowledge, and confident application of skills (Eccles and Gootman, 2002). We chose to focus the program towards grades 8-11 (ages 13-17); research has shown that students at these ages have the cognitive ability to engage in the interdisciplinary connections required to comprehend climate change science (Roseman and De Boer, 2007). Having the program on university campus afforded students the opportunity to feel like they were part of a college learning experience.

In the first workshop of the CEC Summit, *Climate Change 101*, students meet with Rutgers University faculty to enhance their understanding of climate and environmental science. This full-day program is offered in mid-January during the school day. In 45 minute workshops, faculty guide students through hands-on lessons that focus on the com-

plex nature of climate-ocean-land interactions. The workshops are designed to help students understand the interplay of biological, geological, physical, chemical, economic, and 'human dimension' factors and their effect on the climate (NOAA, 2009). Workshop topics include scientific uncertainty, weather and climate, and the impacts of climate change (sea level rise, human disease and vector biology, and extreme weather). In the second half of the day, we focus on providing students with skills in using video and other media to communicate scientific information, and on working in school teams to develop a community plan of action. The plans of action focus on how students can more broadly share what they have learned with their faculty mentors.

In the ensuing months back at school, students work on their plans of action and on developing their community education and outreach projects. Students work either in class or in an after-school club to implement their action plans. During this time, teachers email questions and ideas to university faculty.

In the final workshop, *Knowledge to Action*, conducted in the spring (May-June), students learn about ongoing environmental initiatives at Rutgers University—this includes

tours of the university solar farm and information on green purchasing and recycling programs. School teams then present the results of their Action Plans through group presentations and educational videos they produce. The student teams are recognized for their achievements and communication success within their communities. Student teams have exceeded our expectations with their projects. Examples of 2009 and 2010 projects include:

- **Behavior and Policy Changes in Schools and Communities:** Several of our collaborating schools focused on implementing behavioral and policy changes in their schools and communities. They led school-wide campaigns like “Ban the Bottle” to reduce the consumption of wasteful plastic water bottles by distributing reusable ones. One of our schools, Bergen Academies, was highlighted in the Nickelodeon program *Our Thirsty World*. And one underserved and underrepresented middle school group from Camden, NJ worked with local Cooperative Extension Specialists to install a rain garden and conducted education programs to help their community understand the importance of water consumption and conservation.
- **Environmental Education “Teach In” Events:** Many of our schools, including home school groups, have developed programs with nature centers, community centers and after-school program providers to raise climate change awareness and promote behavior change in students. Some groups concentrated on dispelling misconceptions about weather and climate by providing information on how rainfall patterns are predicted to change in the Northeast with a changing climate. Yet another group of high school students developed a

hands-on educational program for their school district's 4th grade students to learn about the importance of reducing, reusing and recycling. They continue to volunteer to teach this program in the district's elementary schools. All of these programs include information on the scientific basis of climate change and how scientists are researching and modeling its impacts.

Results: Fruits of Our Labor

Over two years, 104 youths attended the two-day Summit. A total of 15 Rutgers University scientists presented to the groups. We have evaluated our students' perception of climate change by asking them an open-ended question on how they feel about climate change and what they think they can do about it. In 2010, 80% of the students reported their fundamental perception of climate change changed as a result of the Summit, and 99% indicated that climate change was an important issue to address. 97% of participants indicated they improved their understanding of the science concepts. All students agreed in their follow-up survey that they could make a positive impact on the global climate by reducing their carbon footprint and encouraging others (family, school, and friends) to do the same. Students reported significant improvements in their ability to work as part of a team and in adult-youth partnerships, to plan and organize, be leaders, serve their community, and develop plans of action. Overall, scientists, teachers and students all report the experience as life-changing and enlightening.

Looking Ahead

While we develop a program guide for conducting climate change summits elsewhere, the New Jersey 4-H program is seeking to include more schools in the Climate and Environmental Teen Summit. Our hope is that many more *Climate Change Ambassadors* will soon be sharing their knowledge and experiences with other students as well as members of their communities. These young people surely will be among "the one million new scientists and one million new ideas" envisioned by the national 4-H program.

Janice McDonnell is the 4-H Science Engineering & Technology Agent and Associate Professor in the Department of 4-H Youth Development, School of Environmental and Biological Sciences/NJAES, Rutgers University in New Brunswick, New Jersey. She is also the Director of the National Science Foundation's Center for Ocean Science Education Excellence Networked Ocean World (COSEE NOW), where marine microbiologist, **Dr. Carrie Ferraro** is the Education Program Coordinator. Both **Laura Bovitz** and **Rachel Lyons** are county 4-H Agents in New Jersey, as well as Assistant Professors in the Department of 4-H Youth Development, School of Environmental and Biological Sciences/NJAES at Rutgers. **Dr. David Robinson** is a Professor of Geography Department, and the New Jersey State Climatologist, Center for Environmental Prediction, School of Environmental and Biological Sciences/NJAES at Rutgers. Please feel free to contact the authors via mcdonnel@marine.Rutgers.edu for sample copies of agendas and evaluation instruments.

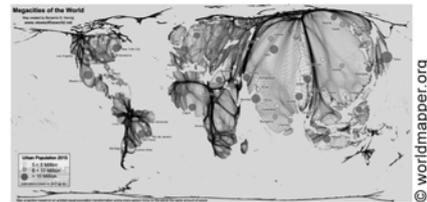
VISIT www.greenteacher.com/contents93 for an example of a Plan of Action developed by the environmental club of one high school. It includes the goals, timelines and resources needed to complete the project.

Notes

1. Nationally, 4-H serves 6 million children ages 8-18 in 3,150 counties across the United States, including at-risk youth, with a history of strengthening essential life skills. Our hope is to encourage and support a new generation of scientists through the 4-H *One Million New Scientists One Million New Ideas* campaign. Our CEC program focuses both on understanding the science of climate change and breaking through what can be perceived as insurmountable challenges of develop strategies for mitigation of, and adaptation to, the consequences of climate change.

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Climántica: A Web 2.0 Education Project

An innovative, trilingual project provides a model for climate change education



Climántica

by **Francisco Sónora Luna**

IN THE SPANISH REGION OF GALICIA, interest in environmental education rose dramatically after two major environmental disasters: a catastrophic oil spill which polluted thousands of kilometers of the Spanish coast in 2002, and the 2006 forest fires that affected more than 40% of Galicia's forested region. The oil spill remains the largest environmental disaster in Spain's history, and the forest fires resulted in severe erosion of topsoil that impacted shellfish beds in many of the region's estuaries. These disastrous events raised public awareness of environmental issues throughout the region.

Following the disasters, an increased public demand for environmental information, along with the emerging issue of climate change, prompted the Galician government in 2006 to establish the Climántica project. The project was initiated as an interdisciplinary educational component of the "Galician Action Plan Against Climate Change". It has been developed by four working groups of experts that collaborate via an intranet platform. From the beginning, these groups recognized that to achieve the scope of climate change education they desired, a fundamentally new approach was needed—one that included the use of online technology. Although the program was initially focused only on secondary school students in Galicia, the Climántica team soon

began to explore the educational aspects of global climate change for an online audience of diverse ages, nationalities and languages.

From its inception, Climántica has been committed to establishing a web presence that allows teachers and students to exchange, assess and publicize their ideas, experiences and initiatives. It has also sought to enrich school curricula to provide environmental education resources on a range of issues related to climate change.

The project was strongly influenced by the project-based learning methodology originally proposed by John Dewey and W. H. Kilpatrick, whose writings have been instrumental in the development of critical thinking and the ability to create opinions on contemporary scientific issues. It is also based on other educational concepts such as social-constructivism, communication and argumentation processes in the classroom.

Website organization

Climate change is the framework we use to introduce the eight environmental issues dealt with in Climántica – energy, waste, water resources, biodiversity, landscape and land use, rural and urban environments. This framework enables us to tackle these global issues through an interdisciplinary approach. The corresponding eight sections of the website are directly linked to the secondary school Biology

and Geology curriculum, although they are also used in Physics, Chemistry, Technology and Economy (economics). The structure of the units makes it possible for teachers to use entire stand-alone chapters, or to just extract the parts they consider most useful to their students.

Each of these sections was developed in two stages. First, the Climántica team published a secondary school teaching unit. Teachers played an active role in producing the unit's content by participating in pilot experiences. The most successful and active teachers were then invited to work together with the Climántica team to design and implement educational resources. This has led to the development of a body of material with potential for use by teachers in many different contexts, and since our website is available in Galician, Castillian and English, its reach is much greater than the Galician region alone.

In the second stage of project development, students and teachers play an active and ongoing role in growing the project. Through the Climántica website, students from 12-17 years old become climate change instructors, delivering lessons to other students on topics such as the Arctic and Antarctic effect, the development of hurricanes, the absorption of solar radiation, the greenhouse effect, the thermal regulation of the ocean, the evidence of carbon dioxide, ocean and atmosphere circulation, and so on. They also perform role play activities such as *Climate Change Dynamics*, *How Much Does Our Energetic Dependence Cost?*, *The Hidden Element Game*, and *Imaginative Workshop on Peak Oil*. At the same time, they produce papers for conferences, which may be published in the school journal and uploaded to the web.

Finally, secondary students are organized into an observation network that provides environmental data to the Galician meteorological and water services agencies. This network currently includes more than 140 secondary schools (about 30% of all such schools in Galicia).

While Galicia was not the first Spanish region to undertake an extensive environmental education project, Climántica has become a model for the entire country by using "Web 2.0" technology to address climate change. (Websites which follow the Web 2.0 protocol provide means to generate active participation and collaboration among users, such as blogs/forums, RSS feeds and social bookmarking.) As a result, Galicia has now joined Catalonia, the Basque region, Andalucia and Madrid as leaders in environmental education in Spain.

The development of the Climántica project has been



Up close and personal: students discuss what they just saw inside the base of a wind turbine.

chronicled in video lectures and seminars, interviews, documentaries and courses, all found on Climántica TV¹. It can also be seen in a short movie called "2101 Back To Climántica" which explains the project in English².

Results

In its first two years of the Project, there have been more than one million hits on the website from 111 different countries. An online community of 8,000 teachers and students has developed a number of related blogs. Approximately 1,000 Galician teachers have attended Climántica training courses, and more than 3,000 students have attended Climántica workshops in their schools. Two annual student conferences have attracted almost 1,000 students, whose papers have subsequently been published online and in print.

To date, we have distributed 12,000 copies of the interdisciplinary book *Climaeucambio*, which helps students develop basic skills to face the challenge of climate change. We also published 4,000 copies of our first teaching unit, which focuses on how our consumption and transportation habits have changed since our grandparents were young. We created and distributed 10,000 copies of a Climántica comic book for primary school children. Other entertaining and informative materials for primary schools such as 3D cartoon series, video games have been produced. For the general public, we have produced blogs, documentaries and magazines. Finally, we distributed 5,000 copies of a novel entitled *La Tormenta de C* ("The Storm of C"), which addresses various environmental issues related to climate change. Aimed at 10-15 year olds, some chapters are designed to be read in classroom and provoke discussion among students about how best to respond to the problems raised. Some of our

Climántica curriculum units

Stage 1

Does Climate Really Change?

Our first Global Teaching unit provides background on climate change. Each section includes classroom activities. Published in Spanish in February 2007, it has been translated into English and published online at <<http://Climántica.org/ClimánticaFront/en/page/unidad?u=01&c=01>>.

If We Burn We Warm

Published in March 2009, this second teaching unit uses an interdisciplinary approach to deal with the origins of climate change and the history of energy sources from the Industrial Revolution to the present. It then moves on to deal with nuclear energy, renewable energy sources and, finally, the potential of energy conservation and the use of alternative sources to power the future and reduce the risk of climate change.

Stage 2

Our newest teaching unit is the first of a five volume collection entitled “*Let’s learn with Climántica schools*”, aimed at students 10-12 years old. It contains student worksheets, guidelines and answer keys for teachers. In order to deal with climate change and its solutions in an intuitive and holistic way, two comics were produced for the two first units of the project. They are part of the collection entitled “*Palmira and Marcial*”, whose first issue is published in Spanish, Galician and English: <<http://biblioteca.Climántica.org/resources/308/comic-en.pdf>>. They are designed to address the complexity of the challenge through fantasy and fun.

Other characters which play key roles in this task are those included in the 24 chapters of the first novel of the project, “*La tormenta de C*” (“*The Storm of C*”), in the collection called “*Cuentos climánticos*” (Climántica Tales), which is published in Spanish and Galician. In addition, the first volume of “*Let’s learn with Climántica Schools*” includes our first videogame of the project, CLMNTK, which is linked to the core of the book. It is an online network game that consists of making decisions about land planning and energy management in the framework of the 21st century climate change society: <<http://xogo.Climántica.org/?locale=es>>.

Multidisciplinary online projects for 10-17 year-olds

Digital skills are developed through the following four activities:

- Setting up the first edublog and eduforo system was implemented by experiences with 12-17 year-old students: <<http://blogs.Climántica.org/>>
- Interactive activities for 10-13 year-old-students: <<http://eduprimaria.Climántica.org/>>
- E-Learning lessons for 14-17 year-old-students: <<http://biblioteca.Climántica.org/gl/formacion/didactica>>
- Wiki for 14-17 year-old-students: <<http://www.wiklimantica.com>>

educational materials are being translated into other languages like English. Already, our first comic book is available in English, along with the digital version of our first teaching unit.

Climántica has received considerable recognition. The Spanish Agency of Climate Change cited it as a model for good practice. UNESCO in Portugal is now supporting the training of teachers in that country to use the program. Project staff have been invited to speak at conferences around the world, and pilot projects have sprouted in Argentina, Cuba and Portugal.

In its first four years, the Climántica project has promoted an exchange of ideas and experiences about the problems and solutions presented by climate change. It has also led to numerous innovative teaching materials and an enrichment of our curriculum. In future years, we hope that project’s value to students will keep growing as we expand the content and geographical horizons. We will continue to use Climántica to promote teachers’ professional development and serve the general public. We hope that it will serve as a model for similar initiatives worldwide.

Francisco Sónora Luna is a biologist and teaching advisor. He is also the designer and project director of Climántica, a project of the General Directorate on Sustainability and Landscape, in the Department of Environment, Urban and Infrastructural Planning for the Xunta de Galicia (the autonomous government of Galicia), in Santiago de Compostela, Spain. He can be reached at fsluna@edu.xunta.es or via www.Climántica.org.

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List of English language resources

- <<http://Climántica.org/ClimánticaFront/en/page/Weblog>>
<<http://biblioteca.Climántica.org/resources/308/comic-en.pdf>>
<<http://xogo.Climántica.org>>
<<http://tv.Climántica.org/entradas/215>>

Notes

- <<http://tv.Climántica.org/?locale=es>>
- <<http://tv.Climántica.org/entradas/215>>



Photographs: Jennifer Haynes Photography

Nighttime Adventures

Exploring and appreciating the mysteries of the night by leading walks after dark

By **Brad Daniel** and **Clifford Knapp**

“In darkness I remember that it is not knowledge to which we most deeply belong but mystery, and I sense in the mystery of night a beauty that exceeds even the great and notable beauties of the daylight world.”¹

—John Daniel

POETS AND NATURALISTS have raved and written about the values of darkness and the night for centuries (see sidebar for selected quotations). The beauty and magic of nighttime walking emerges in ways seldom apparent during the day. The air smells different, nighttime sounds are strange and more varied, and the trails that may be familiar in daylight appear new and mysterious in the dark. The organized night walk is a way to minimize possible dangers and increase the pleasures for participants attending camps, environmental and nature centers, or those just taking a recreational walk in the woods and fields. This article explains some of the hows and whys of planning and leading a night hike. It describes the purposes of night hikes, some potential barriers, leadership guidelines, safety tips, and suggested activities.

We have been leading night walks for many years now and we know the impact they can have on adults and children. We

know that when a night experience is conducted with care and concern for positive outcomes, the participants go away with pleasant and powerful memories and want to go again. We want participants to learn to love the night and to feel comfortable in nature after the sun goes down. We want them to discover a sense of awe and mystery for the plants and nocturnal animals. We know that these goals don’t just happen—they must be facilitated with skill and knowledge of the land in a particular place. We hope that these ideas will help launch a series of night adventures for you and your students, and enable you to successfully lead others through the darkness.

Purpose

The purpose of leading an organized night hike is to guide an experience that increases participants’ appreciation for the outdoors while they learn about the nocturnal world. For example, they can discover bioluminescent organisms (perhaps foxfire fungus or firefly glow worms), animal behaviors and adaptations, how to identify star constellations, and many more wonders of the night. Although almost everyone has walked around at nighttime, relatively few have participated in a guided experience that promotes sensory awareness and mindfulness through a sequence of planned activities. Night hikes are exciting experiences for people of all ages because the outdoor darkness in natural settings is new to most.

Potential Barriers

People often fear the unknown. For many, being outdoors at night holds negative associations. Darkness can be threatening because we are very dependent on our sense of sight; we fear what we cannot see. Also, people have been taught to fear the night by negative associations with violent acts and other threatening creatures and situations. The media have promoted these fears in our culture through horror films and tales of nocturnal evil. Ask your group what they are nervous about and you are likely to hear about Jason from the movie *Friday the 13th*. Organized night hikes seek to reduce fears by providing positive experiences leading to greater appreciation of the outdoors.

Guidelines

We offer the following guidelines for planning and leading a night hike.

Leaders should:

1. Know the characteristics and background of the group including something about each individual's experience in the outdoors at night. Children from rural areas might respond differently than a group of kids raised in urban areas.
2. Provide an opportunity before the hike for participants to share feelings about night fears and how they were learned and perhaps overcome
3. Set the tone for the experience by helping participants understand the purpose of the hike. Participants need to feel secure in themselves, the leadership, and the natural setting in order to learn.
4. Acclimatize the group to the night by beginning with playful discovery activities.
5. Make ground rules to ensure that no one will scare others by promoting negative experiences. Reassure the group that there will be no practical jokes or horseplay during the hike! There is no place for such behavior on a night hike because it can scare people and cause accidents.
6. Explain how each activity during the hike contributes to the overall goal of learning to love the night.
7. Explain the benefits of walking quietly and slowly (i.e. to hear night sounds, see animals, and to have a relaxing time).
8. Explain how to walk safely in the dark by lifting one's feet higher than usual to avoid tripping hazards, and how people can help each other by alerting one another to tripping or eye level hazards.
9. Take time after the hike to discuss the meaning of the hike in order to help participants process the experience. A good night hike always includes time to reflect on what was learned. Sadly, it is a component that is often minimized or eliminated due to time constraints. It is better to do fewer activities and leave time to reflect on them in order to best develop a meaningful experience.
10. Inform participants that, prior to the hike, they are not to

use their flashlights in order to allow their pupils to dilate for optimal night vision (this may take about 20 minutes). There may be a few activities that require lights, however.

Safety Tips

A variety of factors should be taken into account when planning the hike including weather forecasts, the phase of the moon and the age of the group. These factors may play a role in determining what to wear. For example, the leader might choose to wear lighter-colored clothing while leading a hike during a new moon (the phase where the moon is invisible) to increase visibility and security. If thunderstorms are predicted it is best to stay away from potential lightning strikes.

Night hike leaders need to have clearly defined safety and emergency procedures that are communicated to the group before the hike begins.

Leaders should only use trails that can accommodate the size and type of group. Avoid trails that have drop-offs, stream crossings or other potential hazards. Be sure to scout the trail beforehand and to know it well.

A minimum of two leaders is recommended for any group. A leader in the front of the group and a "sweeper" in the back ensure the most safety. Leaders at the front and back often create security and a sense of well-being within the group. A third leader is sometimes required to monitor safety in the middle of the group if the participants are inexperienced and frightened. The safety monitor should move up and down the group line watching that the group stays intact and remains on the trail. The age and experience of the participants as well as the length and terrain of the hike should be taken into account. Generally, a group of 15 or more requires three leaders. When the group stops on the trail for an activity, the leader in back should have a way to let the front leader know that the group is together before the activity begins.

It is imperative that each participant feels connected to the group. A rope line is sometimes used for younger children. The rope extends from the front leader to the back leader. The children are spaced comfortably along the rope and are instructed to hold it with one hand during the hike. For teens and adults, the group line could be established by lining up and placing a hand on the shoulder of the person in front. This method permits easy walking if the participants are lined up according to their height. A participant is told to stop walking if they become disconnected from the rope or the group. The back leader can then promptly alert the head leader to stop the hike until everyone is in line and connected to the group.

It is important that there is no conversation during the hike. This reduces any chance of confusion or distraction, which are especially hazardous at night. Also, this procedure allows the focus to be on the sounds of the night. How do you make "no talk during the walk" work? One way is to use blindfolds. When the blindfolds go on, the mouths go closed. A second way is to stop walking when anyone is talking. Yet another way is to use non-verbal signals to inform the group members of any obstacle in the trail such as a root or rock. For example, thumping the ground a couple of times with the foot mimics the behavior many animals use to alert others to danger. Because the thumping is not meant to be loud, participants must listen carefully, encour-



The right way to walk at night."

aging an enhanced auditory experience. These methods can be effective and allow for a safe and educational experience.

A Sample Plan

There are many ways to facilitate a night hike. Below, we offer a sample plan. It is important to sequence the activities so they build toward a culminating activity. The activities can be thought of in four stages: pre-hike, stationary, transition, and closing activities.

Pre-hike activities:

The leader can prepare participants for the hike by doing some activities in the days or weeks before the actual trip. For example, students could practice identifying owls and other nocturnal animals by their sounds. Several excellent guides to wildlife sounds have been produced and are readily available (see the resource list at the end of this article).

Another example of a pre-hike activity would involve playing a simulation game such as Bat and Moth. In this game, one student is blindfolded (the bat) and one student is not (the moth). The group forms a circle around them to create a safety perimeter. The game simulates the echo location technique bats use to find their prey by sending high frequency sounds toward the prey. Every time the bat says "bat," the moth replies "moth" and the bat tries to locate and tag the moth by sound. An activity like this can be played at dusk to allow the eyes to adjust and the group to become more comfortable with being outside at dark.

Stationary and Transition Activities during the Hike:

Stationary activities are done at places along the trail where the group stops and gathers. Transition activities are ones where the group is given an assignment while walking. Upon reaching the next station, the leader asks the participants to describe what they discovered. For example, the leader might ask the group to be aware of temperature differences when under leafy shrubs compared to under more open canopy. Upon reaching the next station, the participants would describe what they noticed and discuss how animals might use that to their advantage.

After preparing the group, the hike begins. The leader should describe how to walk in the outdoors at night (by lifting one's feet higher than usual). Many of the following activities can be either stationary or transitional depending on how they are framed.

Station One: Sound

1. **Deer Ears.** Listen to sounds by cupping the hands behind the outer ears while standing still and rotating the upper body. The quality of sound is improved greatly by directing these "receivers" toward the source. The group can discuss how animals might use this to their advantage.
2. **Sound Inventory.** Stand perfectly still for 1-2 minutes and point in the direction of the different sounds heard. Share these with the group afterwards.

Transition: Mental Mapping: Ask the participants to construct a "mental map" of what the terrain is like along the length of the hike. Ask participants at each stop along the way what the terrain was like since the last station. For example, did the trail go up or down? Did it turn to the left or right? If you can spot the Big Dipper (or the Little Dipper), you can try to locate the North Star (Polaris)². This allows participants to determine the cardinal directions (N, S, E, W) which they could incorporate into their mental trail maps (i.e. the trail turns east, etc.). Mapping the terrain can help build towards a culminating activity such as a solo hike if the group returns on the same trail.

Station Two: Smell

Smelly Things. Smell the night air, soil, crushed plant parts or pass a scented marker around. Ask the group to identify the scents in the dark. Typically, you will hear a variety of answers. Sometimes, people think they are identifying things by smell alone when it is actually the combination of sight and smell being used. Removing the sight component often makes it more difficult to identify a smell.

Transition: Touch and Go. Along a safe section of the trail, ask the group to focus on feeling the trail with their feet. Then, ask them to step off the trail to one side (watch out for poison ivy or other hazards) and then back on the trail. Have them do this several times and then report any differences. Trails tend to be more compact and quieter whereas "off trail" is often softer and louder due to twigs, leaves, and other debris.

Station Three: Sight

1. **Night Light.** Look to the left or right of a distant star or planet to use the rod cells in your retinas to see faint light and contrast better. Try this by looking at objects on the trail. The rod cells in your eye help you see contrast. The next activity illustrates this.
2. **Headless Horseman.** Pair up the group members across from one another and have them stare at their partner's head without moving their eyes. Have them describe what happens when they do this. (Their partner's head should seem to 'disappear'. This only works in very low light.)
Explanation: The retina of the eye contains rods cells, which detect light contrast and cone cells, which detect color. Due to the placement of the rod cells, they are activated more by viewing peripherally rather than using direct focal vision. Therefore, looking to the left or right of a head or star enables the shape to be distinguished more clearly. Staring directly at the head does not activate the rod cells in the same manner, causing the head to seem to disappear.

3. Color in the Night. Distribute small pieces of differently colored paper or colored toothpicks to the group members. Ask them to guess what color(s) they have. Ask them to identify different colors of clothing. They can check their accuracy when they return to a lighted area. Cone cells allow the eye to detect color providing there is enough reflected light to see the object. When light is diminished, it is much harder to discern color.

4. After Image. Discuss original and reflected light sources (reflectors, matches, stars, planets, moons, electric lights, etc.). Then predict how much light will be cast from a single match, and light it from a distance away. Move the lighted match in a circular or linear pattern. Ask the people to quickly close their eyes to try to see an after image of the pattern. Next try this with a flashlight to compare what happens. The image created after the brain translated the light received via the optic nerve remains briefly after the source disappears.

Transition: Thermometer. Check the temperature of the air, trees.

Station Four: Night Vision and Solo Time

- 1. Night Sight Story.** Tell a story about exploring the outdoors at night while participants close/cover one eye. Have the participants stare at a lit candle or bright lantern with the open eye during the story. Extinguish the light and have participants look around with each eye to see if they notice a difference between the one that was covered/uncovered. The difference is dramatic because the light causes the uncovered pupil to contract while the covered pupil remains dilated.
- 2. Night Eyes.** After the story, ask the group to describe how night vision develops (pupil dilates to allow more light in). The story can serve a dual purpose. In addition to creating a dramatic difference in night vision, it can help create a metaphor for use in the solo hike described below. Explain this metaphor by giving an example.
- 3. Solo Hike/Sit.** Place people along the trail so they can experience the night alone. Tell them not to move and communicate with other people. Pick them up again after a short time. Another option (not for young children) is to have them do a solo hike alone back to where the hike started. You can send them out at longer or shorter intervals depending on the amount of ambient light, and other factors. Always allow those that do not want to do a solo hike to bring up the rear quietly. Remind the solo hikers to use what they have learned on the night hike up to that point.



To simulate echo location, a group plays "Bat and Moth".

Station Five: Taste

- 1. Sparky Party.** After returning from the solo hike, have a "sparky party" to celebrate. In pairs facing one another, instruct the group to chew wintergreen (WintOgreen) Lifesavers with an open mouth (trying not to wet the lifesaver with saliva because it flashes better when dry) while observing the mouth of their partner. Ask them what they think creates a blue-green glow when broken by the teeth or a pair of pliers (to save fragile teeth). This phenomenon, called triboluminescence, occurs when light is released in the visible spectrum after the chemical bonds of the granulated sugar molecules in the presence of wintergreen oil (methyl salicylate) nitrogen in the air are broken. Try scraping rock candy with a knife in the dark to see a glow. (Unless the candy is damp, it usually works.)

Closing Reflection Activities

Take time to reflect on the night hike experience.

1. Make a list of open-ended questions for the participants to complete verbally. This will help them reflect upon their night walk experience. Once the group is back together, have them form a circle and share a few of these. Some examples: What is one thing that you appreciated most about the walk? What new facts did you learn about the night? Did you have any surprises along the way?
2. Ask the participants to finish the following sentence stems:
 - a. The best thing along the way was . . .
 - b. Now I realize that darkness is . . .
 - c. One thing I'm still wondering is . . .

3. Have the participants say one word that best describes how they feel about the night after the walk.
4. Ask the participants to make up a round robin story about the night by saying a few sentences and then having the others, in turn, continue the story thread from where the last person ends. (Make a rule that the story cannot be a scary one because the purpose of the walk was to learn to love the night, not be afraid of it.)
5. As a final closing, you may choose to read one or two of the quotations included in this article. You can also find short poems about the night to read to the participants.

Conclusion

If the leaders follow some of these suggestions and participants were cooperative and open to trying something new, chances are that the night walk will be a positive experience. Keep in mind that one evening outside cannot completely change a lifetime of fears and negative associations with the dark. We often feel safer in the forest at night than we do in the city. It takes a gradual progression of non-threatening associations with the beauties and wonders of the night in order to learn to love it. We suggest that the initial experiences with the night be kept short and pleasant. Each successive night can be longer and introduce new activities. Additional activities, useful equipment and resources, and selected quotations about the night can be found at the end of this article. We wish you peaceful ramblings as you and those you lead become closer friends with the night.

Brad Daniel is Professor of Outdoor Education and Environmental Studies at Montreat College in North Carolina. He has been designing and leading outdoor activities for over 25 years. **Clifford E. Knapp** is a Professor Emeritus in the Teaching and Learning Department at Northern Illinois University and a consultant in outdoor and place-based education. He has been leading outdoor activities for over 50 years.

Notes

1. Daniel, J., "In praise of darkness", in P. Bogard, ed., *Let There Be Night: Testimony on Behalf of the Dark*, University of Nevada Press, 2008, p. 30.
2. A useful guide to explaining how to do this can be found at: <http://www.physics.ucla.edu/~huffman/finddip.html>.

Useful Resources

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Useful Equipment

Colored cards or paper, Candle, lighter or matches, Starfinders, Pieces of Quartz (Rock), Birdsong Identifier or Small Tape Recorder, Blindfold, Rope Flashlight with red lens or red covering of cellophane or red balloon (red light is less disruptive of animals), Scented markers or film canisters filled with essential oils like mint orange, etc., Wintergreen Lifesavers

Additional Activities, Equipment, and Resources

There are many other popular activities to do on a night hike. These include:

1. **Nocturnal Menagerie.** Locate animals such as frogs, toads, earthworms, spiders, bats, and owls. Discuss the definition of a nocturnal animal. Try to estimate the size of an animal based on its sound. As the sense of hearing becomes more acute, participants will often overestimate the size of animals making noises. Have the group listen to recorded night sounds before going outside.
2. **Rock On.** Strike or scratch quartz rocks together sharply. They will give off a flash of light and a faint smell. This happens because striking them causes the alignment of the crystalline molecules of the quartz to be interrupted, and an electric discharge results when they realign (an example of 'piezoelectricity'). The faint smell of sulfur is caused by a chemical reaction in the sulfur compounds in the rocks.
3. **Latitude.** In the Northern hemisphere, find the North Star (Polaris) and put a stick in the ground pointing directly to it. This stick forms an angle with the flat ground which is equal to the latitude of the location. It can be used on a sunny day as a sundial gnomon.
4. **Night Owl.** Play a recording of a common owl call or imitate it with your voice. An owl may respond to the call if the group is quiet. Do not over do this during nesting season because it will disrupt the mating habits of the owls.
5. **Bioluminescence.** Search for bioluminescence in fireflies, glow-worms (firefly larvae), decaying wood (containing foxfire fungi), and other natural objects. Find out what causes each form of light. To find foxfire more easily at night, walk the path in late afternoon and kick some of the decaying wood to expose the bioluminescent fungi in the wood.
6. **Spider Eyes.** Using a flashlight, search for the reflection of spiders' eyes by holding the base of the light on your forehead and projecting the beam into the vegetation where spiders hide.
7. **Legend of the Stars.** On a starry night, invent new symbols, shapes, and stories in the sky to correspond to the different star patterns. Then learn the traditional star patterns identified by different cultures, including your own.
8. **Insect ID.** Hang a white sheet outside and shine flashlights on it to attract night-flying insects. Try to identify them.
9. **What's up DOC?** Determine if the moon is waxing or waning, by looking at the side with the more pronounced curve. Think about the word DOC. D=Waxing (becoming more illuminated each night, represented by "D" because when waxing the left side of the moon is dark), O=Full (fully illuminated), C=Waning (becoming less illuminated each night, represented by "C" because when waning the right side of the moon is dark). Note: in the Southern Hemisphere, this mnemonic is reversed—"COD".

Discovering Native Bees

Why native pollinators matter and how children can learn about native bees in a classroom setting



By Alison Pearce Stevens

NATURAL SYSTEMS PROVIDE humans with a variety of services essential to our survival. Ecosystem services such as climate regulation, water purification, oxygen production, waste treatment and detoxification, flood prevention, and pollination are provided at no cost, yet their true value is immeasurable. In our economy-driven world, these systems are often taken for granted, and as a consequence many are in peril. Understanding their role is a critical first step towards ensuring that they endure.

Pollination, the process of moving pollen grains from one flower to another to stimulate fruit and seed production, is among the easiest of these services to understand. Pollination is important for successful reproduction of all flowering plant species, both wild and cultivated. It allows intact ecosystems to continue functioning efficiently, and it provides food and other products for human consumption. Despite its importance, pollinators have been declining in number over the past two decades.

Although some plants, including most major cereal crops (corn, rice, wheat, barley, and oats) rely on wind dispersal for pollination, 70 to 90 percent of flowering plants rely on animal pollinators. These plants include fruits and vegetables consumed by humans and other animals. Without pollinators to facilitate pollen transfer, these plants will cease to produce fruit altogether.

The best way to ensure that such ecosystem services remain intact and functional is to understand their value in economic terms. If we understand the costs associated with losing the services, we will be more likely to take steps to avoid paying those costs. Determining the economic value

of ecosystem services presents a challenge, but the best estimates use traditional economic models to establish a ballpark value. Researchers have estimated the global value of all ecosystem services at US\$33 trillion per year. The value of pollination alone is estimated between US\$20 and 40 billion for the United States, and up to US\$200 billion globally.

An economic perspective provides a useful framework for adults. An alternative approach—one that better illustrates the issue for children—is to examine the nutritional impact of a world that lacks animal pollinators. Approximately one-third of the food we eat comes from animal-pollinated plant crops. Pollinators affect not only the fruit and vegetable content of our diets (see the table below), but also availability of meat and dairy products (e.g., cattle are often fed alfalfa and clover, which are pollinated by bees).

The Role of Honey Bees

The best known animal pollinator is the honey bee (*Apis mellifera*). Honey bees are not native to North America; they were imported from Europe as early as the 1600s, to provide wax and honey. Their role in pollination went unrecognized for over 200 years, until native North American pollinators declined in the early 1900s and honey bees were used to replace them.

Honey bees are ideal from a management standpoint because they live in large, easy-to-manage colonies with thousands of foragers. In theory, such legions of pollinators would provide very efficient pollination of crops, particularly when a honey bee forager can spend 5-10 hours foraging in a day. In reality, although the honey bee can pollinate a wide variety of species, it is a sub-optimal pollinator for a number of plants. This is in contrast to native pollinators

that co-evolved with native plants and have adapted to collect and transfer pollen grains with each flower visit.

For example, honey bees visit alfalfa to collect nectar, but their bodies, which lack pollen-collection structures on the underside of the abdomen, fail to ‘trip’ the alfalfa flowers. As a consequence, the bees come away without pollen. Blueberries, cranberries, and tomatoes require buzz-pollination, in which the bee rapidly rotates its abdomen against the flowers’ pollen-loaded anthers, transferring pollen to its body in the process. Bumble bees (*Bombus spp.*) buzz-pollinate, making them ideal pollinators for such crops. In contrast, honey bees fail to pollinate these plants. Similarly, the flowers found on apple trees are not well pollinated by honey bees. These trees are better served by the hornfaced bee (*Osmia cornifrons*). As an additional drawback, honey bees often make long-distance foraging trips, visiting flowers well outside the crop field or orchard they are intended to pollinate.

Perhaps the biggest issue concerning the use of honey bees to pollinate crops is colony collapse disorder (CCD), which was first documented with a decline of 30 to 90 percent of honey bee colonies in the winter of 2006–2007. CCD is characterized by a sudden loss of foragers and other adult bees from the colony, a low adult-to-brood ratio, and a lack of dead bees in the vicinity of the hive.¹

The Need for Native Pollinators

In light of the extensive losses of managed honey bee colonies, recognition of, and efforts to encourage populations of, native pollinators are increasingly important. Globally, over 16,000 species of bee have been described — of which only seven are honey bees. Unlike honey bees, many of the remaining species are specialists, which co-evolved with native plant species and are best able to pollinate those plants. They have also evolved to emerge from their nests at the time of year when their host plants are in bloom. As a result, native bees are an essential component of plant-pollinator food webs throughout the world.

In addition, the sheer numbers of native pollinators boost pollination efforts when the availability of honey bees declines. Researchers have found that native bees account for over 50% of crop pollination in the United States, despite belief by farmers that their crops are entirely pollinated by managed honey bee colonies. Native bees are particularly abundant on small agricultural fields with nearby trees and a variety of flowering weedy species.

Such findings underscore the importance of habitat in promoting biodiversity. Loss of habitat is considered a major contributing factor to loss of native bee diversity in Europe. Suitable habitat may not be completely lost; however, researchers have found that ‘partial’ habitat loss—loss of either food resources or nesting sites—is sufficient to lead to a decline in the number of pollinators. All parts of the complete habitat must be present for individuals to complete their life cycles and perpetuate the species.

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VISIT www.greenteacher.com/contents93 for a list of common crop species and their animal pollinators (scroll down to the links for this article’s supplements). Also online, you will find tables showing the nesting habits, timing and distribution of native bees, and common bee genera (scroll down to the links for this article’s supplements); the following 5 activities for ages 9 and up: Pollination Exploration, Nest Search, Building a Nesting Block, Behavioral Observations and Busy Bees.

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Notes

1. Although researchers are still investigating the causes of CCD, bees in hives affected by the disorder have been shown to be infected with a higher number of pests and pathogens (tracheal mites, Varroa mites, hive beetles, and viruses). In addition, apiaries with at least one CCD-affected hive are more likely to have multiple CCD-affected hives, which suggests an element of transfer from one colony to another.

Star Power

A reading and 2 activities for 8-13 year olds on harnessing the Sun's energy



Joshua Strang, United States Air Force

by **Michael J. Caduto**

HOW CAN TEACHERS and environmental educators broach the overarching issue of global climate change in such a way that students are empowered to do something about it, rather than becoming despondent? What are the basic understandings that young people need in order to generate their own renewable energy and cut down on greenhouse gases?

Every day, the solution shines down upon us and blows in on the wind. Understanding how the immensely powerful forces of nature work, and knowing how to use them for generating renewable energy, are keys for unlocking young minds and energizing youth toward action. I developed the Kids' Power Program so that youth can have fun while generating and storing renewable energy that they can use in everyday life.

This subject is a natural entry point for getting kids excited about physical forces and electricity. After presenting my program to classes of 6th graders in Connecticut recently, the students started coming into class eager to power up

using their own original inventions for mini-wind turbines.

It's all about the *Power of One*: Every single environmental action taken by every single person adds up to have a powerful positive impact on the world. If all of the approximately 120 million households found in Canada and the United States lit just a single lightbulb with solar-powered electricity, instead of with electricity supplied by the power grid, it would save enough energy to power all of the lighting for 4 million households. This would also cut down on greenhouse gas emissions and shrink our carbon footprints.

The following article is adapted from my new book, *Catch the Wind, Harness the Sun: 22 Super-Charged Science Projects for Kids* (Storey Publishing). This excerpt shows that critical science concepts can be written and presented so that they are understandable, compelling, fun and useful tools for Earth stewardship. In essence: Earth is powered by a star, the Sun, whose energy comes from nuclear fusion. Solar power is a nearly boundless source of renewable energy that we can harness for heat and light, to generate electricity and to help fight global warming.

The Sun is Our Home Star

The Sun is our home star. This great ball of heat and light, this round mass of fire, was called Sol in ancient Rome and Helios in Greece. According to a legend from the Muskogee (Creek) peoples of the southeastern United States, the Sun was carried aloft on top of a vulture's head, inside a silken bag woven by Grandmother Spider. On bright, sunny days, when the light is just right, you can still see gossamer rays of Grandmother Spider's bag shining down.

Even though the Sun is more than 93 million miles (150 million km) away, we can feel its heat and light as though it were close by. Just how far away is the Sun? If there was a road that led from Earth to the Sun, your family could climb into the car and drive there. But get out your iPods and earbuds, then download a ton of songs, because a ride to the Sun is going to take awhile.

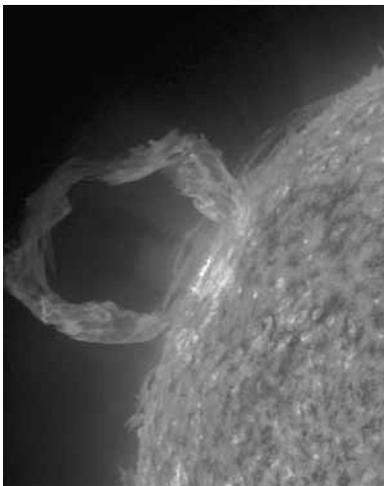
Let's say that, on the road to the Sun, the driver brought the car up to 70 miles per hour (113 kph) and set it on cruise control for the whole ride, 24/7. At that speed, if no one stopped to get a bite of food or to take a bathroom break and the drivers rotated so that you never had to slow down or stop, you would arrive at the Sun in 152 years! How long is that? If your family had begun such a journey back in 1861 — the first year of the U.S. Civil War — you would finally reach your destination in 2013.

Even from that great distance, it takes the Sun's energy only 8 minutes and 20 seconds to reach us on Earth while traveling at the speed of light — around 670,000,000 miles (1,078,231,000 km) per hour. Traveling at that speed, sunlight would get a hefty speeding ticket on the interplanetary highway, if only someone could catch it!

How big is the Sun? It would take 109 Earths, placed edge to edge, to reach across the face of the Sun. And if you had a bag as large as the Sun, you could fit 1 million Earths inside.

A Real Ball of Fire

At times, when a person is being very active, someone will say, "You're a regular ball of fire." But no one can hold a candle to the Sun. At its center or core, the Sun's temperature is 28 million°F (15.6 million°C). At this great heat the atoms of hydrogen join together to form helium, also from the Greek, Helios. Energy is created every time hydrogen joins to form helium. This reaction, called *nuclear fusion*, drives the Sun's energy. Even though 600 million tons (544,311,000 metric tons) of hydrogen change into helium every second, there is still enough hydrogen left for the Sun to last another 5 to 6 billion years.



When we catch a brief glimpse of the Sun, we see the 200-mile- (322 km) thick layer called the *photosphere*, which is about 10,000°F (5,500°C). *Sunspots* are about 2,700°F (1,500°C) cooler than the rest of the photosphere, so they appear darker. Some sunspots are wider than the diameter of Earth. They can last for anywhere from a few hours to a couple of months, and they can produce violent explosions called *solar flares*. A large solar flare can last for a few hours, interrupt satellite communications on Earth, and generate enough energy to power the entire United States for 100,000 years. Sunspot activity runs in cycles of about 11 years. A high point in the number of sunspots is expected from late 2011 through 2013.

Surrounding the photosphere is another, somewhat hotter layer of the Sun called the *chromosphere*, which is 1,000 to 2,000 miles (1,600 to 3,200 km) thick.

Finally, like a shimmering halo, comes the *corona*, in which the temperature shoots up to more than 1 million°F (555,500°C). Superheated gases from the corona rocket off into space as charged particles called the *solar wind*. We can only see the reddish chromosphere and the corona's whitish streamers during a *total solar eclipse*, a time when the moon passes directly between the Sun and Earth and the Sun is completely blocked out wherever the moon's shadow falls. But the Sun's energy can damage eyes and cause blindness, *so don't ever look directly at the Sun*, even during an eclipse.

Neon in the Sky

In the Northern Hemisphere, especially when sunspot activity is high, look for spectacular, shimmering displays of the *northern lights*, *Aurora Borealis*. In the Southern Hemisphere, catch the *southern lights*, *Aurora Australis*.

These dramatic nighttime spectacles are created when the solar wind sends charged electrons and protons racing toward Earth, where they slide along Earth's magnetic field toward the North and South poles. There the solar particles crash into the molecules of Earth's atmospheric gases, causing those electrons to jump out of their orbits.

The energy given off by the excited electrons shows up as brightly colored curtains and ribbons of light — green, red, pink, white, and lavender.

We've all experienced or seen in books the brightly colored neon lights that spell out the names of city restaurants and markets. The process that creates the northern and southern lights is similar to the way a neon light works: electricity passes through glass tubes filled with gas and causes it to glow. Each gas emits a different kind of color when it glows, such as neon (reddish orange), mercury (bright blue), argon (lavender), krypton (silver white), xenon (pale blue) and helium (gold).

A ReNEWable Day

Oil, coal, and natural gas, also called *fossil fuels*, were formed from the remains of prehistoric plants fed by sunlight, plus the animals that ate those plants. That means fossil fuel is solar power stored underground from sunlight that shone long ago. These kinds of energy took millions of years to form, and it will take another few million years to make more. So when we rely on fossil fuels to heat our houses and run our cars, we are counting on types of energy that will one day run out. Once fossil fuels are all taken out of the ground, there won't be any more for millions of years.

The Sun, however, shines every day, so its energy won't run out. Even on cloudy days when the Sun doesn't "come out," our home star is up there wrapping Earth in its powerful blanket of energy. That's why solar energy is called *renewable* — it sustains itself constantly, which means it will give us life and won't run out for at least another 5 billion years. Every single hour, enough of the Sun's energy reaches Earth to supply all humankind's energy needs for an entire year.

Even though the Sun has so much positive potential, we use solar energy for only a tiny amount of our energy supply. Just 7 percent of our energy comes from all renewable sources put together, including solar, wind, hydroelectric, tidal, geothermal, and biomass power. But only 1 percent of this 7 percent comes from solar power! That means less than 1/10 of 1 percent of our total energy supply comes from the Sun. That's a tiny amount!

The Sun doesn't care where it falls or on whom its rays shine. The Sun reaches all places — high and low; wet and dry; tropical, temperate, and covered with snow and ice. Despite this abundance of sunshine, there are about two billion people in the world who still don't have electricity. It would cost less to power these households with solar energy than it would to create new power plants and power lines. There is a lot of potential for solar power. How can you help?

Capture the Sun

Like a wild bronco, the Sun's energy is all over the place. But we can tame that energy and put it to work. There are several ways to do this.

Passive Solar

Simply catching the rays of the Sun is called passive solar. Passive solar is used in three ways: (1) to heat a house or other space; (2) to heat water; and (3) to bring light into dark spaces.

Passive Solar Heat. To heat spaces or water with passive solar, all you need is a sunny window or something dark to absorb solar heat. The darker the color, the more of the Sun's energy it absorbs. Spaces can be solar-heated by building them with large, south-facing insulated windows for catching and holding the heat. If the walls and floors are a dark color where the sun strikes, they will absorb solar heat during the day and radiate that same heat into

the house at night. Some people keep large, often dark-colored containers of water in the sunlight. Once water heats up, it radiates that heat for a long time.

Many solar water heaters consist of dark tubes that are enclosed in a glass-covered flat box, or panel, and exposed to the Sun. Fluid that runs through tubes is used to heat water. In some systems, the water is heated directly by the sun. These solar collectors can be placed on a roof or on a raised platform in a sunny place on the ground. There are a lot of solar water heaters already being used in North America, including those that are designed for heating pools.

Passive Solar Light. Some houses have interior rooms with no windows or dark rooms with small windows. Many times, with good planning, small daylight shafts, such as the Solatube, can be made to catch and direct light from a brightly lit part of a roof or wall down into the dark room. These shafts are either painted white or lined with a shiny metal surface to reflect the light down.

Sun-tricity

With the right kind of equipment, it's possible to use sunlight to generate electricity.

Photovoltaic, which means "electricity from light," comes from the Greek word for light (phot-) and the name of the Italian inventor, Alessandro Volta, who created the first battery.

Picture tiny electrons moving around the nucleus of an atom. When the Sun's energy strikes a photovoltaic solar panel, which is usually made from an element called silicon, the electrons become energized. They escape their atomic bonds and can only move from bottom to top through the photovoltaic (PV) cell's two thin layers of silicon. (The lower section, which has too few electrons, is called the *positive 'p-type' layer*, and the upper is the *negative 'n-type' layer*.) Opposing charges on the top and bottom cause electrons to flow through the circuit of wires attached to the PV cell to form a current.

The electrons moving along the wire from the PV cell form *direct current*, or *DC*. This current can be used to power things that run on electricity, or it can be stored in batteries for use later on. If someone wants to feed this power into a household electrical system, it is usually run through an inverter, which changes the DC current to *alternating current* or *AC* — which is what our household appliances are designed for.

Less than 1/2 of 1 percent of all the electricity that is generated in the world is made using photovoltaic panels. Isn't it high time that we put more of the Sun's colossal power to work?

Michael J. Caduto is an environmental educator, ecologist and the co-author of the landmark *Keepers of the Earth®* series. Apart from *Catch the Wind*, his recent other book is *Riparia's River* (Tilbury House). Learn more about his programs at www.p-e-a-c-e.net.

Activities

Sun Burns

If you ever wanted proof of the power of the Sun, these next two activities are for you. By gathering the Sun's energy that falls over a just a few inches of Earth's surface and focusing it with a magnifying glass, you can create a point of light-heat that is hot enough to light a fire with paper and even burn wood. The temperature at which something will burn is called the *flash point*. The flash point for paper is 451°F (233°C) and for wood is 572°F (300°C).

Activity: Writing with Sunlight

When writing with sunlight, you'll see how quickly the sun's energy burns a piece of wood, and use it to create a nameplate or sign. Then you can ponder how else to put the Sun's energy to use.

!Safety First!

- **Do this activity only with adult supervision.**
- Wear safety glasses and work carefully when sawing wood. When using the magnifying glass, don't point the light anywhere but at the exact spot where you need to focus it for your activity. The magnifying glass focuses the Sun's powerful radiation to a tiny point that is extremely hot and bright. Use that point of sunlight with the same safety measures you would use when handling a lighted match.
- Wear sunscreen that blocks UVA and UVB rays (SPF 30 minimum).
- Wear sunglasses when looking at the focused point of sunlight. Use sunglasses that protect your eyes from 100 percent of the Sun's harmful ultraviolet rays, including UVA and UVB. Just to be safe, work on your Writing with Sunlight project for only short periods of 10 to 15 minutes per day, to give your eyes a long rest from looking at the bright light. *If you do not wear sunglasses while doing this activity, or even while looking over the shoulder of someone else doing it, you can burn your eyes' retinas.*

Materials:

- UVA and UVB sunscreen (SPF 30 minimum)
- Flat piece of softwood such as white pine (a piece that is 1/2 inch [1.25 cm] thick by 4 inches [10 cm] wide will do); be sure it's long enough to fit the lettering you plan to use.
- Safety goggles
- Small handsaw
- Sandpaper (medium grit, #80)
- Pencil
- Sunglasses (100% UVA & UVB protective)
- Handheld magnifying glass
- Eraser

Do the Deed

All you need is a little patience and a steady hand to write with sunlight. Keep the point of the beam as small as possible, and use it like a hot pencil.

1. Decide what you want the sign to say. Perhaps you want to make a sign with your name or the name of a friend, a family member, or a pet. You could create a sign to hang on the door of your room. Or how about making a sign that says "Catch the Wind" or "Harness the Sun"?
2. Gather a piece of wood on which you want to make the sign. Any kind of wood will work, but softwoods, like white pine, are lightweight and easy to cut, sand, and burn. If you don't have a piece lying around the workshop in your house, try going to a hardware store or lumberyard and asking if they have a short piece of scrap wood that they'll sell or give to you.
3. Put on your safety glasses, and use the saw to cut the wood into the size and shape you want, being certain to allow enough room for some lettering. A single name would easily fit onto a piece that's about 12 inches (30 cm) long.
4. Sand the edges smooth so that the sign will look finished and you won't get splinters when handling the wood. Just rub the sandpaper over any rough edges until smooth.
5. Lightly write the lettering onto the sign in pencil, along with any simple designs that you want to go with it. Use simple block letters that are only a few inches high, and space them as you normally would when writing on paper.
6. Take the board outside on the next sunny day. Put sunglasses on to protect your eyes from the bright light. (See the !Safety First! message about sunglasses at the beginning of this activity.)
7. Use the magnifying glass to focus the sunbeam onto the first letter of your sign until it starts to smoke and turn black.
8. Gradually move the beam along the lines of the lettering and designs, allowing the light to linger just long enough to create a black line where the Sun is burning into the wood. You are writing with sunlight!
9. Erase any leftover pencil marks.

Follow the Lead

- Can you think of any other small-scale tasks you could do or things you could make by focusing sunlight in this way?
- What other safe, useful things could you do by focusing the Sun's energy with a magnifying glass?
- Now, think big. How could the Sun's energy be focused on a larger scale to create electricity? Keep in mind that enough heat would have to be gathered to boil water and turn the blades of a turbine that is connected to an electrical generator. Draw a diagram of how you could accomplish this by designing a solar electrical generator.
- Once you've drawn your design, go online and search under "solar power plant" to see if the designs of real power stations are anything like the one that you imagined.

Activity: Solar Heat by the Gallon

Water is the best common substance to use for storing heat. It takes a lot of heat to warm up water, but it loses that heat very slowly. A container of water that heats up in the sunlight continues to give off that heat well into the night. Follow the steps in this activity to create a small passive capture solar heater for your school or home.

Materials:

- Dish soap
- Dish drainer
- Four (or more) 2-liter-size beverage bottles with screw-on lids
- Drop cloth
- Paintbrush
- Can of flat black interior latex paint (any flat, dark color will do)
- Clean, quart-size (about a liter) can or plastic container full of water for cleaning the paintbrush
- Water for filling bottles
- Bookshelf

Do the Deed

Passive solar heat is easy to catch. All you need is something dark that absorbs the Sun's heat during the day and then radiates it back into the room at night.

1. Use the dish soap to thoroughly clean at least four 2-liter plastic beverage containers. Save the caps. Remove labels from the outside of the containers, and wash the outside well so the surface is clean and paint will stick to it. Rinse the inside of each container well, and put it upside down in the dish drain to dry.
2. Once the beverage containers are dry, place them on the drop cloth and use the brush to paint them with the flat black paint. It is best to do this outside or in an open garage or other space that is well ventilated.
3. Use the container of water for cleaning the paintbrush, then set the brush aside to dry.
4. Once the paint is dry, fill each container with water and cap it off snugly. Leave about an inch of air on top to allow space for the water to expand as it warms up. Be sure not to crush or bend the containers while handling them or the paint might crack off.
5. Place the black jugs full of water on the top of a bookshelf in a sunny window or on a windowsill to create a simple solar heat collector.

Follow the Lead

- Add more shelves and "Solar Heat by the Gallon" jugs to your homemade heat collector to increase its storage capacity.
- Experiment by placing other kinds of dark-colored containers full of water in the Sun to see which one holds the heat longest once the Sun goes down. Try using containers made from glass, ceramic, metal, or thicker plastic. Which kind of container works best? Why?
- On a sunny day: Open one of the bottles in the morning, and lower inside it the long, thin sensor end of a cooking thermometer or a science-class dial thermometer. If the bottle is deeper than the thermometer is long, you may need to tie a string around the top of the thermometer. Make a graph showing temperature along the left-hand side and time along the bottom. Read the thermometer every half hour, capping the container after each reading. Use a dot to record the temperature at each half-hour time mark. Once the Sun goes down, observe how the temperature rose and fell during the day. When was the "heat of the day?" Was it exactly in the middle of the day? Why, or why not?
- Try this same experiment by recording and graphing the water temperature on a cloudy day. How does that temperature pattern compare with the results from the sunny day?
- Repeat the previous experiment using two bottles: one that sits in direct sunlight, and one that rests in the shade. Using a different colored marker for each bottle, chart the temperature of both bottles on your graph throughout the day. Compare the temperature changes that occurred in each bottle. Why do you think you got that result? Is it what you expected?
- How does the temperature chart from the bottle that sat in the shade in this experiment compare with the graph you made earlier of the bottle kept exposed to the sky on a cloudy day?

RESOURCES

Reviewers this issue: Kelly Borkowski, John Cooper, Ariana Grindrod, Judy Halpern, Jon Hayes, Jen Johnson, Phyllis McKenzie, and Barbara McMillan



Buy, Use, Toss?

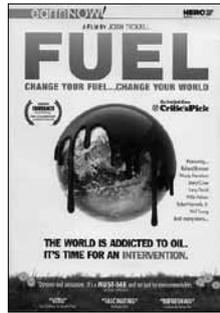
Designed to create thoughtful consumers, *Buy, Use, Toss? A Closer Look at the Things We Buy* is an interdisciplinary

2-week curriculum for grades 9-12 that focus on the impacts that the Western materials' economy has on the environment, society and our lives. After determining whether common consumer items are necessities or luxuries, students follow the life cycle of an item, from extraction of natural resources to production, distribution, consumption and disposal. Key lessons include analyzing advertisements and reflecting on the relationship between consumer goods and quality of life. Most lessons are designed to be completed in small groups, and include blackline master worksheets. The unit incorporates the free online video "The Story of Stuff," which explores the conventional production cycle in order to help students consider more sustainable alternatives. Included are links to up-to-date external resources for teacher background and student research and all lessons are linked to U.S. National Standards for science and social studies. — (PM)

Facing the Future, 2010, no ISBN (PDF), 105 pp., free download from Facing the Future, <www.facingthefuture.org>.

Change Your Fuel, Change Your World

Do you remember the guy who traveled across America in the late '90s fueling his modern 'flower power' van with used fryer oil from fast food restaurants? In the documentary *Fuel*, Josh Tickell now makes a compelling case for biodiesel's importance as a viable alternative to gasoline and petroleum-based diesel. The documentary offers



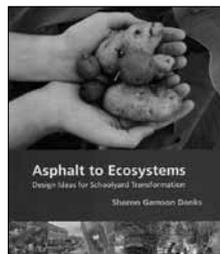
a fascinating history of the diesel engine (which originally ran on biodiesel!) and how the petroleum industry has quashed biodiesel as a major fuel

source for the last 100 years. Apart from the environment, Tickell shows us why alternative fuels are an imperative for reasons of economics and social justice as well—how the U.S.' dependence on oil has led to huge foreign debt as well as unnecessary wars. The film addresses objections to the sustainability of biodiesel production by offering alternatives to virgin oil production, such as promising new algae-based technologies and production from waste byproducts. Ideal for high school science, environmental and social studies classrooms. — (PM)
Cinema Libre Studio, 2010, ISBN 1-59587-130-6 (DVD), 112 minutes, US\$24.95 from Cinema Libre, (818) 349-8822, <www.cinematolibrestudio.com>.

Asphalt to Ecosystems

Asphalt to Ecosystems: Design Ideas for Schoolyard Transformation by Sharon Danks is a book for school administrators, teachers, parents, and school designers ready to change the environments in which we teach and learn.

The book features case studies of urban and rural schoolyards from around the world, accompanied by beautiful color photographs. It offers diverse solutions for greening schoolyards through incorporating wildlife habitats, organic



gardens and artistic elements. Examples of schoolyard elements profiled include forest, desert and wetland ecosystems, permaculture food gardens and renewable energy systems. The book evinces the benefits of such projects with links to curriculum spanning the humanities and sciences. Within the design process, we are guided to address practical issues

such as seating, microclimates and protection from the elements. Though most case studies are from California, the book addresses schoolyard greening solutions for many different climates and bioregions. This book is an important addition to the growing body of literature on green schoolyard transformation, and is a must-have for school district libraries as well as an asset for all schools. — (PM/JC)

New Village Press, 2010, ISBN 978-0-9766054-8-5 (pb), 276 pp., US\$39.95 from New Village Press, <www.newvillagepress.net>.

Get Growing!

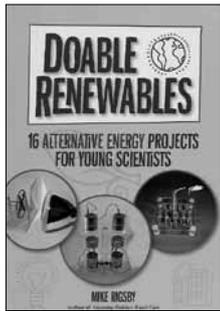
Edited by Jolie Mayer-Smith and Linda Peterat, *Get Growing! Activities for Food and Garden Learning, A Teacher Resource For Elementary and Middle Grades* will help educators connect grades K-7 students with



the natural world through food gardening. Over 300 interdisciplinary and inquiry-based activities encourage students to use their senses in experiencing

gardens first-hand. A comprehensive range of topics are covered, from plant identification, to soil and compost, nutrients, the plant cycle, spring planning, planting & tending, harvesting and winter gardens. Curriculum connections run the gamut of subjects (science, social studies, mathematics, language and visual arts, nutrition/health, home economics, drama, careers, and physical education). While the guide was developed in Vancouver, its lessons apply to many geographic locations. Each topic is laid out as a user-friendly lesson plan including learning outcomes, key vocabulary, curriculum connections, materials, preparations, guidance for volunteers and further extensions. Student handouts are provided for most activities to continue the learning in the classroom. To inspire students with real-life examples, profiles of farmers, gardeners and environmentalists are interspersed among the lessons. — (JHayes)

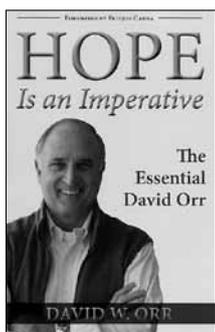
Really Small Vernon Press, 2010, ISBN 978-0-88865-672-8, 220 pp., C\$25 from InterGenerational Landed Learning on the Farm, jolie.mayer-smith@ubc.ca.



Doable Renewables
Curious, hands-on science lovers will enjoy the projects in *Doable Renewables: 16 Alternative Energy Projects For Young Scientists*

by electrical engineer Mike Rigsby. Each chapter contains a materials list (including ordering information) and simple instructions to construct a number of mechanisms which demonstrate the power of renewable energy, from solar to wind and wave energy. Most required materials are standard household items. Most projects are ideally suited for ages 12-15; students below grade 8 will most likely require the assistance of an adult, especially for safety reasons (some projects require soldering and power tools). The clear diagrams are helpful in understanding the construction process, but in some cases the black and white photographs of different stages of construction could be more clear. This book contains excellent ideas for science fair projects or independent study extensions, and may serve to help inspire future inventions which harvest sustainable energy. – (KB/JC)

Chicago Review Press, 2010, ISBN 978-1-56976-343-8 (pb/PDF/Kindle), 195pp., US\$16.95 (pb)/\$11.95 (Kindle/PDF) from Independent Publishers Group, (800) 888-4741, <www.ipgbook.com>.



HOPE
Hope Is an Imperative is a compilation of some of the most provocative and poignant essays of distinguished American environmental studies professor and writer David Orr.

In the essays, Orr examines myriad political, social, economic and psychological obstacles to sustainable living facing modern societies. While not providing a specific template for teaching

students about sustainability, the wisdom in this anthology can provide inspiration and ideas for how to apply sustainability principles into your teaching programs, community, and life. Ranging in topics from economic growth to religion and architecture, each chapter explains how these topics relate to sustainability. Moreover, it suggests ways to move beyond the detrimental constructs of our present education system, building practices, environmental policies, and ideologies. In the section on education, Orr is critical of current pedagogy which he says “emphasizes theories, not values; abstractions rather than consciousness; neat answers instead of questions; and technical efficiency over conscience.” Orr wants students not just to theorize but to participate, in a system where land, air and sea become the driving force of the curriculum and provide a context for why we learn what we learn. Advanced/enriched high school students may also enjoy this book. – (AG)

Island Press, 2011, ISBN 978-1-59726-700-7 (pb), 370 pp., US\$30 from Island Press, <www.islandpress.com>.



Garbage! DVD

Ever wonder what would happen if you kept every piece of garbage for three months? This was the basis of Andrew Nisker’s

feature film *Garbage! The Revolution Starts at Home*. With the help of the ordinary McDonald family, audiences everywhere can now discover how much garbage one family collects in a short amount of time. Nisker takes a deeper look at where the waste ends up. From the plastic bags to poop from their baby’s diapers, viewers can get an up close view of waste management plants, water treatment areas, and recycling programs in the United States and Canada. The McDonalds learn how to cut down by reusing, recycling, and most importantly reducing their need to buy. Insightful, energetic and eye opening, *Garbage!* is 75 minutes of trash-filled adventure everyone can enjoy. Nisker challenges viewers to keep their garbage for three months and start the revolution within in their own lives. This documentary would

be an excellent tool to jumpstart a school’s recycling program. – (JJ)

GarbageMan Productions, 2007, (76 minute DVD), US\$89 (K-12 schools, libraries & non-profits) from The Video Project, (800) 475-2638, <www.videoproject.com>; C\$19.99-\$295 (depending on use) from Take Action Films, <www.takeactionfilms.com>.



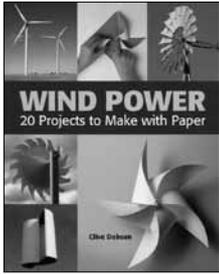
GRASP
GRASP: A Tool for Developing Ecological Literacy through Rich Performance Tasks is a resource designed to give K-12

teachers a framework for teaching ecological literacy based on systems thinking—“thinking in terms of relationships, connectedness and context”. Author Steve Bibla and editor Eleanor Dudar draw upon earlier research to apply “GRASP” elements—Goal, Role, Audience, Scenario, and Performance/product—in promoting ecological literacy. The “performance tasks” culminate in five projects for different grade levels. The grade 4-5 performance task, for example, is focused on environmental change in the Arctic: students take on the “Role” of Inuit president, learn about how climate change affects northern communities (“Scenario”), and write a letter (“Performance”) to the government (“Audience”) that lists the changes and their consequences. Written for schools in Toronto, some aspects are not applicable everywhere. Nonetheless, its value in establishing a simple framework for teaching a modern definition of ecological literacy make it very useful for any teacher looking to incorporate ecological literacy. – (BM/JC)

Toronto District School Board, 2007, 45 page PDF, free download from www.ecoschools.ca. (Click “Guides and other publications” and then “Guides”).

Wind Power

Author and artist Clive Dobson combines his creative talents in *Wind Power: 20 Projects to Make with Paper*, a book of simple paper projects for ages 10 and up. Included are 20 designs for windmills to be created using basic geometric principles. Styles include pinwheels, water-pumping windmills, modern wind turbines, and other less familiar designs. Instructions and diagrams are clear and accompanied



by color photographs. Most projects can be built with basic materials (paper, pencil, compass, ruler and scissors). Through building and experimenting

with different rotor designs and both vertical and horizontal axes, students gain hands-on experience while exploring the physics of wind power. *Wind Power* offers an accessible but thorough introduction to wind power and could be used to supplement studies in

physics, geometry, technology, and the environment. – (PM/JC)

Firefly Books, 2010, ISBN 978-1-55407-749-6 (pb), 96 pp., US/C\$12.95 (pb), US/C\$24.95 (hc) from Firefly Books, <www.fireflybooks.com>.

Green Careers

Jennifer Power Scott's *Green Careers: You Can Make Money And Save The Planet* is a lighthearted and inspirational read for teens and tweens. It provides interesting, if cursory glimpses into the careers of over 30 young 'eco-entrepreneurs' and professionals. From building a lucrative empire on worm poop fertilizer to eco-

fashion design to a tree farmer in Kenya, these 20- and 30-somethings have demonstrated that it is possible to be professionally and financially successful while saving the natural environment and attaining personal fulfillment. This would make a great classroom or school library book for those 14-18 years



old. The book includes a "Resources" section with listings of post-secondary institutions offering environmental

Books for Young Readers

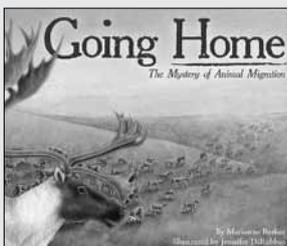


One Hen

by Katie Smith Milway, illustrated by Eugenie Fernandes *One Hen* offers a great springboard for introducing children to the concept of development in poor countries. After his father passes away, Kojo has to leave school to help his mother make ends meet. The twenty farm families in his village in Ghana work hard to save so that they

can increase their capital and obtain microloans from the bank. The purchases they make help increase their profits to the point where they can repay their loans and keep some profit for themselves. After plenty of forethought, Kojo uses his leftover money to buy a hen, hoping to have some eggs to eat and more to sell at the market. His idea is a success. Through careful planning and patience, he is able to go back to school, and support his own workers by growing his business. This book has a wonderfully interactive website which can be found at www.onehen.org and more learning materials which can be found at www.kidscanpress.ca. Ages 8-12. – (JHalpern)

Kids Can Press, 2008, ISBN 978-1-554453-028-1 (hc), 32 pp., US\$18.95/C\$19.95 from Kids Can Press, <www.kidscanpress.com>.



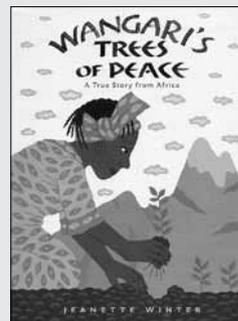
Going Home: The Mystery of Animal Migration

by Marianne Berkes, illustrated by Jennifer DiRubbio *Going Home* tells, in rhyme, the amazing migratory journeys of ten different North

American animal species, spoken from the animals' own voices. Each two-page spread features an eight line verse from the animal, vivid and realistic watercolour and pencil illustrations, and brief scientific information

about each species' migratory habits. The final pages of the book are filled with additional materials, including a map of all ten animals' migration routes, further detailed information on each species, teaching tips and extension activities from the author as well as a list of books and websites that will direct children who want to learn more. Ages 4-8. – (JHalpern)

Dawn Publications, 2010, ISBN 978-1584691273 (pb)/978-1584691266 (hc), 30 pp., US\$8.06 (pb)/\$15.26 (hc), from Dawn Publications, <www.dawnpub.com>.



Wangari's Trees of Peace: A True Story from Africa

written and illustrated by Jeanette Winter

Wangari's Trees of Peace tells the story of Wangari Maathai, a Kenyan woman who won the Nobel Peace Prize for her role in reforesting Kenya. Author/illustrator Jeanette Winter makes a story which touches on advanced

themes accessible to children of all ages, from the very young to the caring and action-minded pre-teen. As a child, Wangari marvels at the trees in her hometown—how they keep the land green, house animals and provide enough firewood for the nearby villages to cook with. Wangari leaves to study on a scholarship in the USA, but upon her return to Kenya, discovers that the most of the trees, have been cut down to make way for buildings, leaving a barrenness that greatly saddens her. She begins to plant seedlings, and convinces other village women to do the same. Against government opposition, she starts a movement which sweeps Kenya and is successful in reforesting the land. Colourful illustrations showing Wangari's tribulations and successes enrich the text on each page. Ages 4-12. – (JHalpern)

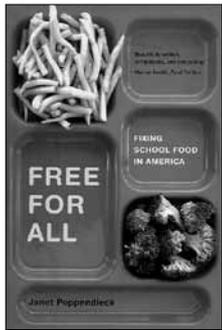
Harcourt Children's Books, 2008, ISBN 978-0152065454 (hc), 32 pp., US\$17 from Houghton Mifflin Harcourt, <www.hmhbooks.com>; C\$21.50 from Thomas Allen & Son, <www.thomasallen.ca>.

programs of study, green job websites, contests and awards, and green companies and organizations. — (KB)

Lobster Press, ISBN 978-1-897550-18-2 (pb), 240 pp., C\$16.95 from Lobster Press, <lobsterpress.com>, US\$16.95 from Orca Book Publishers, (800) 210-5277, orders@orcabook.com.

Free For All

Janet Poppendieck's *Free For All: Fixing School Food in America* is a comprehensive and remarkably readable investigation of the current state of school food in America. In addition to drawing upon scholarly work, the author undertakes extensive hands-on research, volunteering as a high school cafeteria worker for a week, attending local meetings and national conferences, and visiting scores of school cafeterias. The book explores school food through the lenses of politics,



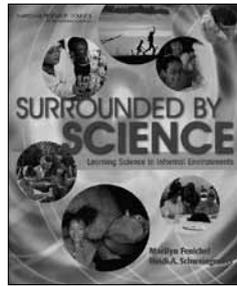
nutrition, the environment, policy, and, of course, taste. Drawing upon exemplary schools that have already made their food healthier, more accessible, educational and

economically feasible, the book calls for action to collectively rethink school food at a national level. Poppendieck presents her vision through a series of questions to start the conversation between educators, parents, administrators, activists and food service professionals. While it should be read by every school food administrator, teachers and concerned parents will find in this book arguments and inspiration for pressuring their local school or district to make reforms. — (JH)

University of California Press, 2010, ISBN 978-0-520-24370-5 (hc), 368 pp., US\$45.00 (hc)/ \$17.95 (pb) from University of California Press, (800) 777-4726, <www.ucpress.edu>.

Surrounded by Science

Surrounded by Science: Learning Science in Informal Environments by Marilyn Fenichel and Heidi A. Schwein-gruber explores the potential for student science learning in informal, non-classroom settings, from nature centers to museums to after school programs. Through case studies of specific venues, it evaluates the effectiveness of a

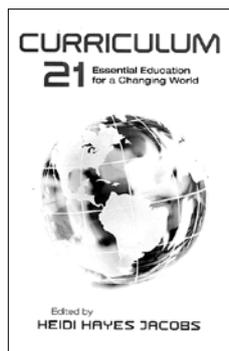


number of science learning programs informal settings, based on findings from current pedagogical theory. Each chapter provides suggestions for developing curriculum design and outlines salient considerations for successful programs in various situations. While additional pictures from the actual case studies instead of stock photography would be a welcome improvement, *Surrounded by Science* will refresh your thinking about what constitutes science learning and how to go about creating successful informal educational situations. This book is essential reading for educators and educational program designers who are working with learners of all ages outside of traditional classroom environments and for those interested in learning about learning. — (PM/JC)

National Academies Press, 2010, ISBN 978-0-309-13674-7 (pb), 220 pp., US\$24.95 from The National Academies Press, (800) 624-6242, <www.nap.edu>.

Curriculum 21

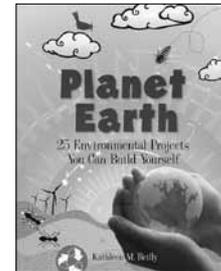
What type of learning does a student need to succeed in the 21st Century; moreover, what type of learning does the modern world need to succeed? What are the gaps between current school curricula, and curricula which reflect and address modern realities,



technologies, and global challenges? *Curriculum 21: Essential Education for a Changing World* is a collection of essays which provide basic guidelines for 'modernizing' the school curriculum, from upgrading basic content, to constructively incorporating new technologies, to dealing with globalization, media literacy and sustainability. An essay on Education for Sustainability (EfS) by Jaimie P. Cloud is particularly relevant to environmental educators and curriculum developers, providing case studies of how EfS has been successfully incorporated into the curricula of a num-

ber of schools and institutions. This book is a valuable resource for school administrators, curriculum developers and teachers alike. Includes an extensive list of references and resources. — (JJ/JC)

Association for Supervision & Curriculum Development, 2010, ISBN 978-1-4166-0940-752695 (pb), 251 pp., US\$26.95 from ASCD Publishers, (800) 933-2723, <www.ascd.org>.



Planet Earth projects

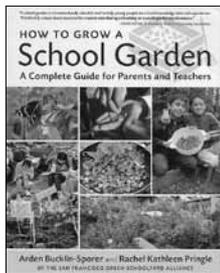
Planet Earth: 25 Environmental Projects You Can Build Yourself by Kathleen M. Reilly is a compact book

containing simple environmental projects for children nine and up. The projects are organized in topic chapters such as air, water, the sun, ozone depletion, the food chain, habitat, and more (unfortunately, the project titles themselves aren't listed in the table of contents). Most projects, such as the "solar powered oven," are simple to assemble, using common household materials, while others, such as the "garbage picker upper," (which uses PVC piping and a Dremel tool) require harder to find materials and adult assistance. The book is written in a child-friendly tone with bold print and fun typefaces. Each chapter includes background information and definitions of the key scientific concepts involved; the book also includes fun "did you know" and trivia questions. Also included is a helpful glossary and resource list. — (KB)

Nomad Press, 2008, ISBN 978-1-9346700-4-0 (pb), 128pp., US\$14.95 from Independent Publishers Group, <www.ipgbook.com>.

How to Grow a School Garden

Planting a garden at one's own home is often a relaxing and fairly simple activity, but developing a schoolyard garden can be a daunting task—in a multi-use yard, where will it go, who will plant it, and who will pay for it? *How to Grow a School Garden: A Complete Guide for Parents and Teachers*, by Arden Bucklin-Sporer and Rachael Kathleen Pringle of the San Francisco Green Schoolyard Alliance, helps one answer these questions in almost any school setting. Geared towards vegetable gardens, the book is designed



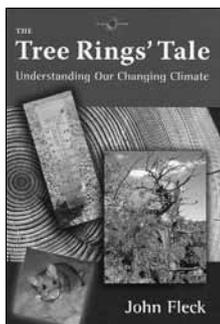
to be a comprehensive guide, from information on why school gardens are beneficial, to garden design, budgeting for the garden, maintenance,

year-round garden lessons, recipes and cooking ideas. With many colourful photographs of school gardens from the San Francisco area, this book will have you pitching your ideas to your principal, writing funding letters, making the most out of your space during planning, and connecting the garden to school curriculum. The suggested grade range for the included lessons is K-8. – (KB/JC)

Timber Press, 2010, ISBN 978-1-60469-000-2 (pb), 223 pp., US\$24.95 from Timber Press, <www.timberpress.com>; C\$31.50 from Thomas Allen & Son, <www.thomasallen.ca>.

Tree Rings and Our Climate

The Tree Rings' Tale: Understanding Our Changing Climate is a captivating and informative introduction to the discovery and continuing role of using tree rings to learn about historical climate variations, and predict future ones. Author John Fleck treads the line

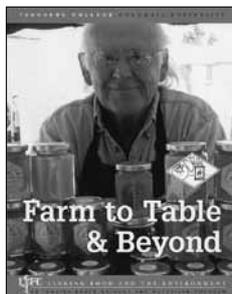


between science textbook and storybook, interspersing science with the story of John Wesley Powell, a 19th century Grand Canyon explorer who paved the way for contemporary

scientists to discover the importance of tree rings in climate science. The book then follows the intriguing research of five climate scientists, who are using tree rings, amongst other natural indicators, to increase our knowledge of climate variability to predict precipitation and droughts in future years. While this book is focused on the American Southwest and the importance of climate science to this arid region, the increasing importance of climate science everywhere make it universally applicable. Filled with colour photographs, explanatory sidebars and a glossary, this book would make good independent or research reading for readers ten and

above, who can increase their knowledge by carrying out the end of chapter experimental/investigative tasks. Alternatively, science teachers may find these tasks or individual chapters from the book useful as curriculum supplements. – (BM/JC)

University of New Mexico Press, 2009, ISBN 978-0-8263-4757-2 (hc), 91 pp., US\$21.95 from University of New Mexico Press, <www.unmpress.com>.



Systems Thinking and Food

Elementary school teachers teaching sustainability will often teach kids about the origins of

everyday material goods, and look at their impact on the environment. *Farm to Table & Beyond* follows this same process, but for the food we eat every day. This outstanding resource for grades 5-6 was produced by the Teachers College at Columbia University and the National Gardening Association. Using an inquiry-based approach, “QUESTA” (questioning, experimenting, searching, theorizing, and applying to life), the authors help students understand the interconnected subsystems of our enormous farm-to-table system. The six curriculum units in the book contain all teacher materials necessary for implementing thirty lessons including guiding questions, sample conversations, background information, lesson resources, and blackline masters for student readings and activity sheets. The first units address the questions: “What is a food scientist?”, “What is the system that gets food from farm to table?”, “What happens to food as it moves from farm to table?”, “What are the environmental effects of our farm-to-table system?”, and “How can we reduce the food-related waste that we produce?” The final unit helps teachers and students plan a “Farm to Table & Beyond Expo” to showcase what they’ve learned. – (BM)

Teachers College Columbia University and the National Gardening Association, 2008, ISBN 978-0-915873-50-0432 (sc), 432 pp., US\$34.95 from the National Gardening Association, (800) 538-7476, <www.gardenwithkids.org>.

Watershed Investigations

Using an inquiry-based approach, the 12 labs in *Watershed Investigations: 12 Labs for High School Science*



launch students into investigations of many aspects of our fragile and crucial watersheds. Lessons run the gamut of geology, chemistry, biology, physics and

earth science and include, amongst others, how glaciers have shaped our watersheds, watershed plant identification, stream channel morphology and groundwater contamination. An underlying theme throughout the lessons is how watersheds change, both naturally and as a result of urbanization. Due to their interdisciplinary nature, the lessons would be useful both in traditional science classrooms, and in any high school environmental science unit, though the labs are probably most appropriate for grades 11 and 12. Some, but not all, of the experiments require access to a waterway. Each lab provides teachers with material lists, detailed instructions, suggested preparations, procedures and sample data. Student handouts, worksheets and questions are also included. Lessons are tied to US national and state curricular standards, and external links are mostly to US sources, but the labs could be adapted for use in many regions. – (JH)

National Science Teachers Association, 2009, ISBN 978-1-933531-48-9 (sc), 175 pp., US\$27.95 from NSTA, <www.nsta.org>.



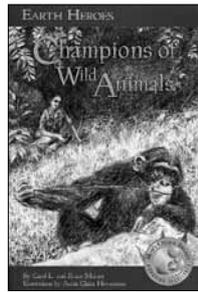
Building a Wildlife Garden

Gardens are often seen as aesthetically pleasing collections of plants, or as sources

of food, but perhaps less often as habitats for, and attractors of, wildlife. Elizabeth McCorquodale’s *Kids in the Wild Garden* is a guide to planting gardens that attract various animal and insect species, either in schoolyards or home settings. Filled with colour photographs, this book is attractive to children while providing detailed

guidelines for teachers and parents. Readers learn how to attract various kinds of wildlife to their gardens by learning what is good and bad for wildlife habitats, including plant and soil configurations and other garden features. They also learn how to build insect/animal shelters and how to observe the wildlife they see and conduct simple biology experiments. Interspersed with humour, interesting facts and extension project ideas, the book and its activities are made engaging for children ages 4-10. Project ideas include lists of needed materials and step by step instruction, though children will most likely require help from an adult. Note: this book is published in the UK, many of the projects are specific to local wildlife species, and may not be applicable for other areas; however, most of the plants, animals and insects mentioned are endemic to most of the Northern Hemisphere. – (KB/JC)

Ordering information: Black Dog Publishing, 2011, ISBN 9781907317200 (pb), 96pp., US\$15.95 from Black Dog Publishing, <www.blackdogonline.com>.



Champions of Wild Animals

What will inspire the next generation of naturalists and wildlife advocates? *Champions of Wild Animals*, a lively biography for ages 9-12,

attempts to do just this by focusing on the pioneers in conservation biology. Part of the *Earth Heroes* series of books, this book starts with William Temple Hornaday, a pioneer of the first bio-park in 1920 and ends with the Douglas-Hamilton Family, champions of elephant sanctuaries to the present day. Altogether, this anthology profiles

eight different animal rights activists and advocates. Authors Carol and Bruce Malnor include familiar names like Rachel Carson and Jane Goodall, and less well-known names like duck advocate “Ding” Darling and “Lord of the Ants” Edward O. Wilson. Each chapter is filled with nuggets of facts and insights. A brief afterword invites the reader to become a champion of wild animals, with links to citizen scientist projects young people can join. Teachers will appreciate that each section includes a detailed timeline, historical context, and additional readings. Young readers will be attracted by Anisa Claire Hovemann’s vivid animal illustrations and historical photographs. – (JJ)

Dawn Publications, 2010, ISBN 978584691235 (pb), 144 pp., US\$11.95 from Dawn Publications, <www.dawnpub.com>.

NAAEE 40th Annual Conference



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NORTH AMERICAN ASSOCIATION FOR
ENVIRONMENTAL EDUCATION

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October 12-15, 2011

October 11 & 12, 2011
The 8th Annual
NAAEE Research Symposium

Conference registration opens June 1.

Scholarship applications are due May 11 and are available on the NAAEE web site www.naaee.org/conference.

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