Green Teacher

EDUCATION FOR PLANET EARTH

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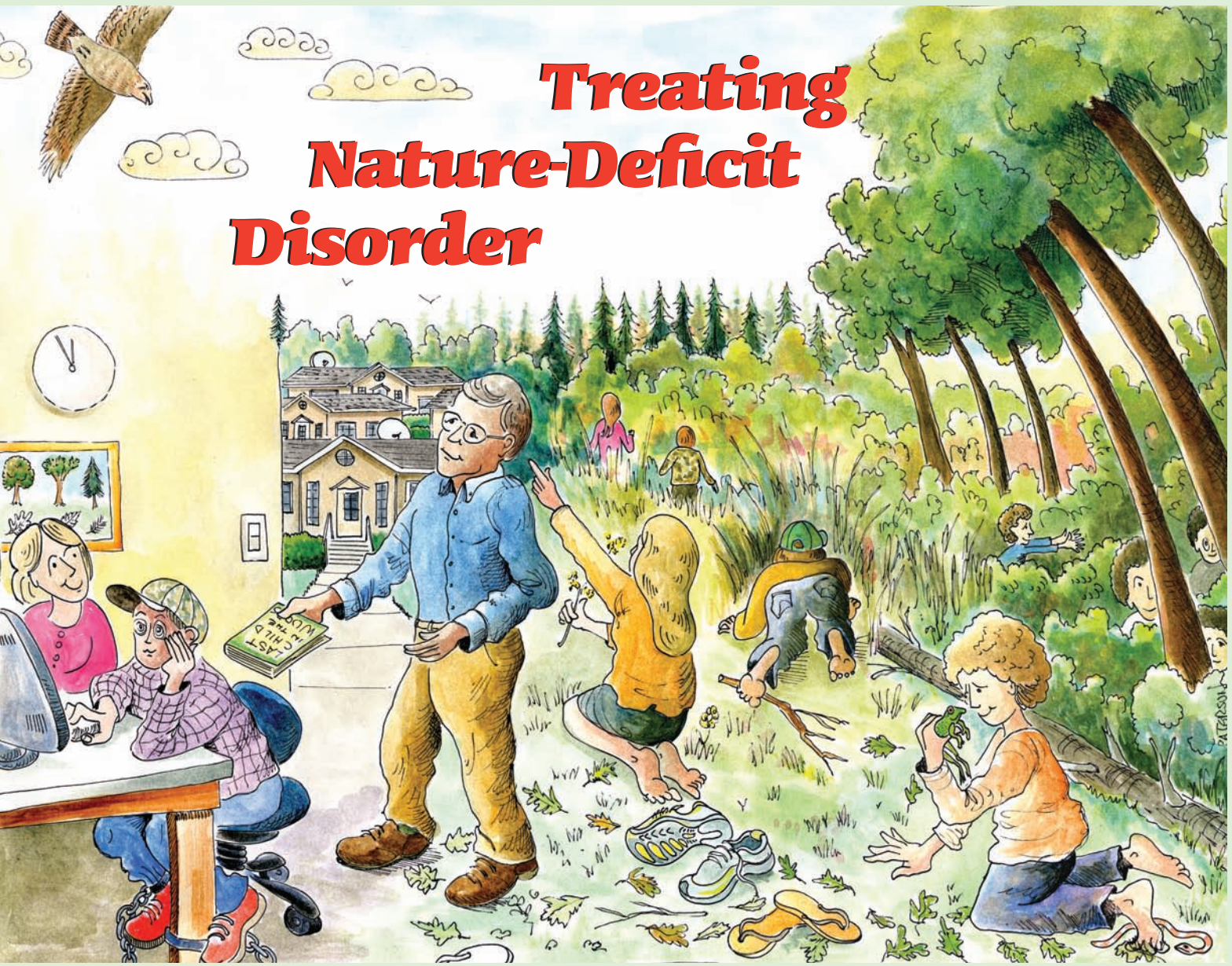
Issue 87

Treating Nature-Deficit Disorder



Habitat Studies with Google Earth

The Importance of Eelgrass

The Power of Enviro-Poetry in Education

Miming Forms of Energy

A Refuge for Slugs and Bugs

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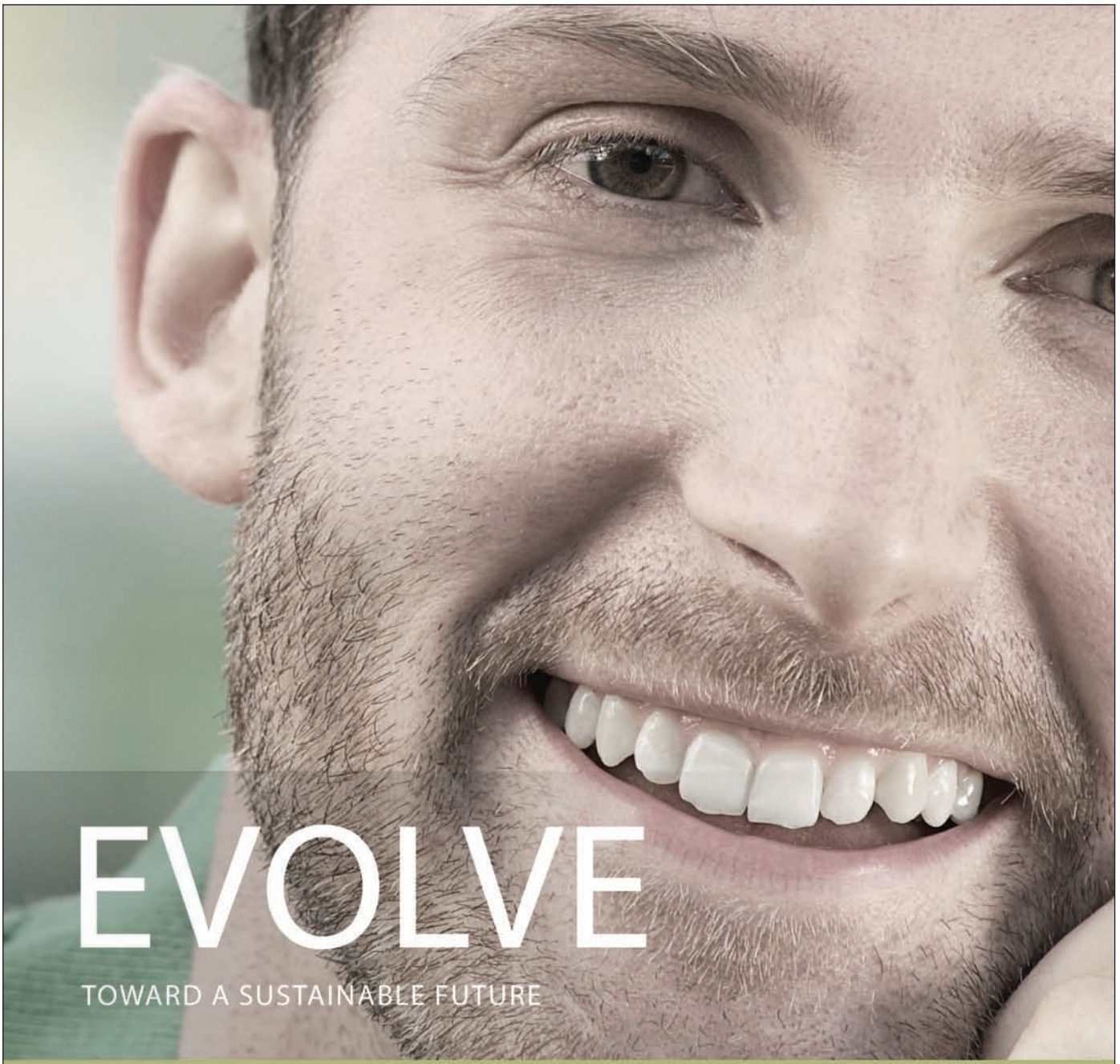

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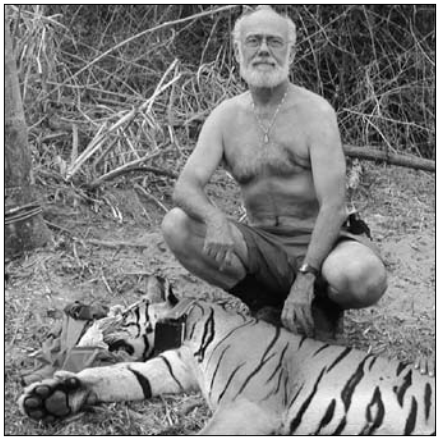

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Features

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Editorial

A NEW YEAR IS A TIME FOR new beginnings. And the beginning of a new decade is a time to look back at where we've been and ahead to where we need to go. So it is especially fitting that this issue opens with a critical appraisal of the enormous impact of Richard Louv's 2005 book *Last Child in the Woods: Saving our Children from Nature-Deficit Disorder*. In researching the article, Mike Weilbacher interviewed a great many educators inside and outside the growing child-and-nature movement that was spawned by Louv's book. The result is an encouraging assessment of the book's impact on both education and popular culture.

Of course, nothing tackles nature deficit better than actively learning about other species, especially ones that are largely loathed or ignored by humans. The articles "For Slugs' Sake" and "From Seals to Snails: Understanding Eelgrass" emphasize the important roles that invertebrates and coastal sea grasses play in the functioning of healthy ecosystems, and describe physically active, hands-on lessons for introducing these underappreciated species to elementary and middle school children. For even younger children, Edith Couchman's "The Hawk in the Nest" introduces the concept of trophic levels through a fun circle game that engages children physically, vocally and socially.

To involve older youth in the issues of the day, we'll need to make use of some new tools. Dawn Tanner's "Analyzing Wildlife Habitat with Google Earth" shows how this free and readily available remote-sensing software can help students learn to recognize the characteristics of good wildlife habitat, monitor changes in land use over time and develop a big-picture understanding of the need for effective conservation strategies. But sometimes the best tools are old tools. As Alison Flensburg reminds us, reading and writing poetry can open students' minds and hearts to things they otherwise might not notice or care about. She makes a strong case for the view that combining poetry with explorations in the natural world is a powerful way to promote ecological values. Finally, in an era of climate change, raising students' "energy literacy" is a critical challenge. So we're pleased to include in this issue Arianna Grindrod's activity "Acting out Energy Forms," demonstrating how "active learning can help students comprehend complex ideas".

During this decade, as during the last, introducing children to the wonders of the natural world and engaging older students in issues associated with our impact on the planet remains a compelling challenge. We hope you'll find in this and future issues of *Green Teacher* many useful tools, both new and old, to help you meet that challenge.

— Tim Grant and Gail Littlejohn, co-editors

We printed lots of extra copies of our special Fall theme issue on "Two-Eyed Seeing" in order to offer bulk copies cheaply. While copies last, 10 or more can be purchased for $3.50/copy, while 50-99 and 100+ copies cost $3.00 and $2.50/copy respectively (plus shipping and taxes, where applicable). Bulk copies of the digital edition cost $2.00/school, with a minimum of 15 schools.

Last Child in the Woods, First Book in the Field

Bob Bailie, Schlitz Audubon Nature Center

by **Mike Weilbacher**

IN 2005, A STRAIGHTFORWARD, tightly researched book with a powerful premise landed with a splash in environmental education's pond — and that splash has been rippling through the profession ever since. The book has forged a bona fide movement, and its author has become the biggest star in the environmental education firmament.

The book is *Last Child in the Woods*, and its author is journalist Richard Louv. Since 2005, the book has sold some 325,000 copies in 21 printings, including an expanded and updated 2008 edition, and has been — or will be — translated into nine languages in 13 countries. Not many books related to environmental education crack the coveted best-seller list of *The New York Times*, and not since Steve Van Matre's *Acclimatization* or Joseph Cornell's *Sharing Nature with Children*, both children of the 70s, has a book burned this hot within environmental education circles. The core message of *Last Child in the Woods* is startlingly simple: in an unprecedented development, 21st century children are growing up disconnected from the natural world, a disconnection with numerous consequences. Weaving research from a wide array of disciplines — education, psychology, medicine, sociology — with interviews of professors and parents, children and child experts, the book immediately resonated with educators and naturalists, and has struck a nerve in popular culture.

Louv coined a new phrase, nature-deficit disorder, to characterize "the human costs of alienation from nature, among them: diminished use of the senses, attention difficulties, and higher rates of physical and emotional illnesses." That phrase has taken on a life of its own, with 440,000 Google hits and its own Wikipedia definition. And both Louv and that phrase have grabbed the attention of the content-hungry media: *Orion* magazine, Good Morning America, The Today Show, National Public Radio and *The Washington Post* — to name just a few — have featured Louv and his theories. An essay of his was published in *The Times of London* last summer, introducing the UK to Louvian thought. Many magazines have run pieces similar to one in *Canadian Living* that offered an interactive "Is Your Family Suffering from Nature Deficit Disorder?" online quiz. Even Opus, the penguin star of Berkeley Breathed's long-running eponymous comic strip, was discovered OD'ing on video games, suffering from nature-deficit disorder.

For many authors, placing a new phrase in the cultural lexicon would be sufficient laurels upon which to rest. But that's just the beginning. In the few years since it hit the bookstands, *Last Child in the Woods* has unleashed a torrent of activity. Consider the following:

- Louv co-founded the Children & Nature Network, a nonprofit organization that fosters the movement started by the book. The web-based group provides leadership

training, maps the growing movement, has begun producing its own teaching resources, offers Louv's blog, and more.[1] The Child and Nature Alliance formed to guide the movement in Canada.

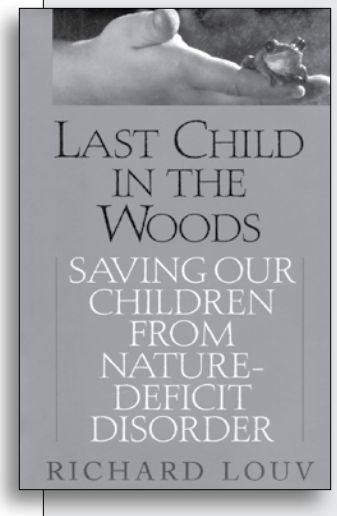
- Inspired by the book and armed by its alarming data, hundreds of small nonprofit organizations have formed, created coalitions or developed new programs and campaigns, many of which are linked to the Children & Nature Network and displayed on its web map. It's a worldwide explosion of activity — Super Natural Adventures in Costa Rica, Healthy by Nature in Alberta, the Maryland Partnership for Children and Nature, Ontario's Back to Nature campaign, London's Nature of Experience, Get Outdoors Anchorage!, Rhode Island Families in Nature, and on and on. Louv notes that at least "sixty urban regions in North America — and more coming in other countries — have created regional, state or provincial campaigns to get kids outside."
- Emboldened by the book, more than 1,500 organizations representing 50 million people, led by such groups as the Chesapeake Bay Foundation and the National Wildlife Federation, have orchestrated a No Child Left Inside Coalition to lobby for environmental education legislation in the United States. The coalition is backing a No Child Left Inside education bill in the US Congress that seems poised to pass in the spring of 2010 and will have profound consequences for environmental education. The bill authorizes $500 million in grants over five years to support environmental education and outdoor learning.
- The book has led directly to intriguing changes in environmental education programming, such as nature centers creating spaces for unstructured play with branches, rocks and dirt, and an increased interest in nature-based preschools. Even public television's Sesame Street, the urban street that millions of kids have visually strolled, now features open spaces and gardens to encourage preschool viewers to get outside and become "nature detectives."

How big is Louv? Woodward Bousquet, chair of the environmental studies department at Shenandoah University in Winchester, Virginia, places Louv's book alongside only a handful of writings with as wide an impact in the field of environmental education, including Anna Botsford Comstock's *Handbook of Nature Study*, David Orr's *Earth in Mind* and Mark Terry's underappreciated *Teaching for Survival*.[2] "This makes only the seventh work in a century that has had a broad and lasting impact on environmental education," he calculates.

In 2008, Louv was presented with the 50th Audubon Medal from the National Audubon Society, joining such conservation luminaries as Rachel Carson and Edward O. Wilson as recipients of the medal. This honor was bestowed upon him for "sounding the alarm about the health and societal costs of children's isolation from the natural world — and for sparking a growing movement to remedy the problem." Even today, nearly five years after the book's publication, "Nature-Deficit Disorder" and the "No Child Left Inside" slogan have become featured conference themes. Louv has become environmental education's James Brown, the hardest working man in the profession, speaking at conferences, special events and town meetings across the continent.

With Louv now the most prominent voice in environmental education, with the United States poised to pass No Child Left Inside legislation, and with the tide of activity inspired by the book still rising, this is an opportune moment to assess the legacy that both book and author are creating.

Last Child in the Woods: The Book in a Nutshell



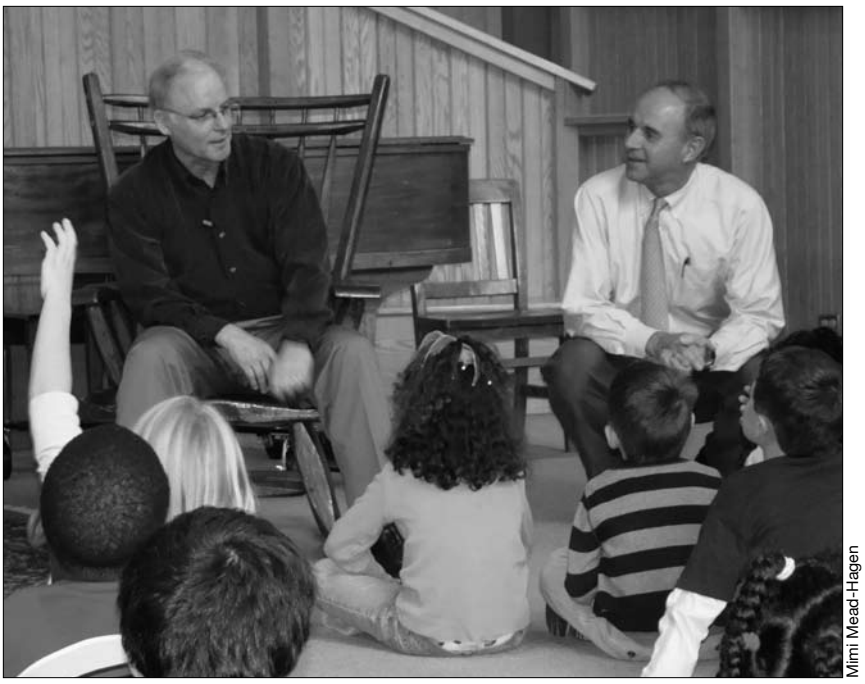
Not long ago, children spent the lion's share of free time outdoors, all pickup baseball games and flashlight tag, bike riding and fort building. City kids were no different, playing street games and just hanging out. But today, numerous trends have colluded to disconnect kids from the outdoors, says Richard Louv in *Last Child in the Woods*, coining "nature-deficit disorder" as the new name for this estrangement. Kids are time-stressed and time-managed, chauffeured from ballet to soccer to play dates. Technology is complicit: kids play inside "'cause that's where all the electrical outlets are," one child says memorably. Parents play a role, too, as fear of strangers, ticks and West Nile virus discourage them from allowing their children to play outdoors or walk to school. Urban development has uprooted natural areas, and liability issues keep kids away from the green spaces that remain. Visitation to national parks has dropped, and, adding insult to injury, schools have downsized recess, giving kids little time outdoors during the week. A child in the 1990s roamed over a territory only one-ninth the size of the territory typically explored by a child in 1970. Obesity is rampant among children, as are attention-deficit disorders, hyperactivity and even depression.

Louv weaves together what *Scientific American* called "acres of evidence" showing the need to connect kids to nature. To summarize, children who have access to nature and the outdoors learn better, are calmer, behave more appropriately, are more creative and are better at critical thinking. Time in nature fills their physical, emotional and spiritual deficits.

And nature needs children, too, but the John Muirs and Rachel Carsons of the next generation are locked indoors. Deprived in childhood of the inspiration that derives from exploring freely in the natural world, they are unlikely to seek nature as their life's work. The solution? What Louv calls a "nature-child reunion" that returns kids to the outdoors.

No Child Left Inside Act

In spring 2010, the US Congress will likely reauthorize The Elementary and Secondary Education Act, the statute that George W. Bush famously metamorphosed into the No Child Left Behind Act a decade ago (the legislation must be reauthorized every five years). Apart from how other educators might assess the impact of No Child Left Behind (NCLB), it has been widely reviled by environmental educators, who watched helplessly as the act chained kids to their desks, number 2 pencils at the ready. With NCLB's strong emphasis on testing and accountability, and with no environmental education content on the tests, school interest in that field plunged.[3] Nature centers were hit hard, downsizing as attendance withered because teachers have little time for outdoor learning.



Mimi Mead-Hagen

Headmaster Peter Rapelye (right) listens to Richard Louv address youngsters at Princeton Junior School in Princeton, New Jersey.

In June 2007, representatives of 33 educational, environmental and youth organizations, from the YMCA to the Sierra Club to the National Science Teachers Association, gathered at a press conference to announce a response to NCLB: the formation of the No Child Left Inside (NCLI) Coalition.[4] The coalition initiated a bill that was introduced in the 2008 Congress, and while it sailed through the House of Representatives with strong bipartisan support, it never cleared the Senate. In 2009, the group cleverly switched tactics even as it swelled in size (1,500 groups representing 15 million people have joined the coalition). Instead of a standalone bill, NCLI Coalition director Don Baugh recounts, the group decided that they "would infuse its major components onto the No Child Left Behind bill," the reauthorization of education funding. The bill now has 80 co-sponsors in the House of Representatives and 16 in the Senate, and is expected to pass in 2010."

Rather than mandate environmental education, the NCLI bill would make federal funding for environmental education available to those states that have environmental literacy plans approved by the federal Department of Education. And, amazingly, the coalition seems close to having secured the required funding through climate change legislation that is on a parallel track in Congress: one percent of the cap-and-trade money will go to "education for a green economy," including environmental education in public schools. The money has been "a big lift," says Baugh, who is also on staff at the Chesapeake Bay Foundation. "Already, over 30 states are at some level of developing their literacy plans."

The website of the North American Association for Environmental Education (NAAEE),[5] one of the key stakeholders in pushing the bill forward, provides information on writing literacy plans; and NAAEE will likely play a key role in approving plans for the Department of Education. "It's hard for the political system to ignore 50 million people," says NAAEE executive director Brian Day, who calls NCLI "a radical shift in K-12 education."

Could all this have happened without Louv's book? Possibly. But the book gave the NCLI Coalition a powerful case statement, and Baugh pressed the book into the hands of many legislators in the early days. At the first press conference announcing the coalition, Louv and his Nature and Child Network were right there.

The nature and child movement

As the ripples from his work spread, Louv "saw a need for an organization that could provide access to the best of the best resources and research," said Cheryl Charles, a veteran environmental educator and the guiding force for 20 years behind both Project Learning Tree and Project WILD. Together, Louv and Charles founded the Children & Nature Network (C&NN) in 2006. From an online compendium of research to an annual summit of its Natural Leaders Network for youth, C&NN's mission is nothing short of empowering a worldwide youth movement. The group has published a tool kit to help families create nature clubs, and partnered with ecoAmerica to create the Nature Rocks[6] program, which offers families online resources for getting children outdoors. They are considering creating a natural teachers network that would unite teachers from all disciplines who use the outdoors and nature as inspiration.

Just one example of C&NN's impact: Kids Outdoors in southeastern California started with three moms who read Louv's book and went on to create a free nature club that recently celebrated its one-year anniversary with 200 families and 500 kids. Most importantly, C&NN has become an online hub of activity for the literally thousands of groups like Kids Outdoors, and for events and campaigns blossoming across the globe. The map is sprinkled with nature clubs, special events, regional campaigns and awareness month activities. Coalitions of all shapes and sizes at all levels are forming to accomplish a wide range of tasks. At one end of the spectrum, the aforementioned Child and Nature Alliance

is organizing Canadian leadership on this issue, offering nationwide conferences and mapping the growing movement in Canada; at the other, a Toronto pocket park recently became the city's first natural playscape, an area of sand, stumps, boulders and a misting "cloud forest," all built by volunteers. Advocates of green schools have borrowed C&NN's research on the positive effects of sunlight, fresh air and greenery on children's learning, and envision school grounds as natural areas where kids can play after class.

Co-founder Cheryl Charles has deftly and quickly maneuvered the C&NN into prominence. At a recent International Union for the Conservation of Nature (IUCN) gathering in Barcelona, attended by 8,000 green leaders from 177 nations, Charles moderated a panel discussion, "Strategies for Solving Nature-Deficit Disorder," that included participants from India, the Netherlands, Mexico and Hungary. The group passed a resolution asking the IUCN to assist members in "reconnecting people, especially children, and nature as a priority in order to assure responsible stewardship of the environment for generations to come."

Bob Bailie, Schlitz Audubon Nature Center

In Canada, the Child and Nature Alliance is ramping up its efforts as the northern counterpart of C&NN. The alliance has hosted two large and successful forums in the last three years, the second attended by educators and concerned adults from across Canada, and is launching a new and enhanced website in January 2010. On its site, you can read and sign their Hatley Park Declaration on the rights of families to connect to nature. "We're building a movement across Canada," says Becs Hoskins, the group's executive director.

And as befits next-generation nonprofits, you can follow both organizations on Facebook and Twitter.

Impact on nature centers

Louv's work has had at least two — and likely more — quantifiable impacts on the nature center movement. For one, when Louv was asked to list *Last Child*'s lasting impacts, one that he cited was "the increasing popularity of nature preschools, where children learn about wildlife even as they learn to read." New Canaan Nature Center in Connecticut has been operating a certified preschool since 1967 — so certainly the idea has been in the air for a while. But Michigan's Chippewa Nature Center just dedicated a new building that includes Nature's Preschool, a full-time certified program like New Canaan's. Without question, *Last Child* has made more nature centers consider this possibility.

Marcie Oltman, director of early childhood education at the Schlitz Audubon Nature Center Preschool in Milwaukee, notes that there are now 20 or 25 preschools in nature centers. "One thing Richard's [Louv's] work has done for us," she said, "is legitimize our approach. The whole notion of play in nature and learning through play is now a genuine way to approach environmental education." She thinks the preschool approach is critical, calculating that "our children spend more time outside in only two years [at preschool] than they will during the rest of their K-12 traditional education." Ken Finch is taking nature preschools in a different, and bigger, direction. As the director and founder of Green Hearts Institute for Nature in Childhood, he plans on launching a network of licensed preschools in which nature and the environment are central to the curriculum. While Finch understands that Louv didn't invent nature preschools, "his book made it so much easier to get traction in my work."

In a move replicated across the environmental education landscape, Bob Mercer, director of Silver Lake Nature Center north of Philadelphia, has "tried to incorporate more play into our summer camps." An acre of land has been roped off to create "a crawl-through trail through bushes and blackberries, a 25-foot stream that wanders to a waterless pond, cut-up and notched sections of logs, a sand box with buried minerals, even grapevines so kids can swing." Children rearrange the logs into forts, dig, climb, crawl — in short, violate the cardinal rules of nature centers everywhere: don't pull, pluck, touch, don't get off trails and don't get dirty. This kind of natural playscape is catching on even more rapidly than nature preschools.

But wait! A curmudgeon's response

With a book as important as Louv's in a field as diverse and longstanding as environmental education, you'd expect a variety of voices to sing in the choir. While no one disagrees with anything in the book, there is an important segment of the environmental education community that is increasingly disgruntled with how the book is being manipulated within the profession. Ken Finch admits right away that he

Child and Nature Alliance

Left: *Members of the Natural Leaders Alliance at the launch of the Child and Nature Alliance in Victoria, British Columbia, in March 2009. This Canadian youth-led network will collaborate with the Natural Leaders Network, its counterpart in the U.S.* ***Right:*** *Child and Nature Alliance forum participants exploring the grounds of Royal Roads University in Victoria, British Columbia. Workshop presenters were encouraged to take people outside for experiential learning.*

is "a curmudgeon about traditional environmental education," says straight up that the movement has failed, and has been watching with keen interest as *Last Child in the Woods* ripples the pond. Finch reminds us that the book's core message is about frequent unstructured play in natural spaces. So while states will be writing cognitive concept-based curricula into their environmental literacy plans — filled with scopes, sequences and benchmarks — he worries that the book's message "is being bent, folded, spindled and mutilated to fit standard environmental education. EE has been desperate for resources for decades, so educators are thrilled at what is coming. EE is jumping on the kids-and-nature bandwagon, disregarding that the research points more strongly at play than at any school-based learning," he avers, and cites research about the most common influences on the development of personal conservation values. "Number one is an intense experience of place," Finch recounts. "Two is adult mentors like parents. Formal education is a distant fifth."

"I am increasingly thinking the book is more relevant to parents than to traditional environmental educators," he concludes, "for they are the gatekeepers of children's time. Parents have more impact on conservation values than anything kids learn in school."

David Sobel echoes many of Finch's comments. Sobel, whose ideas are featured extensively in *Last Child*, is professor of education at Antioch University New England and a leader in place-based education. His 1996 seminal writing, *Beyond Ecophobia*,[7] presented Louv's key premise years before the publication of *Last Child in the Woods* ("I'm only mildly jealous" of the book's success, Sobel confessed).

"Louv is skeptical about a lot of environmental education, in many of the same ways I am," notes Sobel, warning that much of traditional environmental education "imposes tragedy education on kids while imposing science constructs on kids too early." In other words, five-year-olds are learning about rainforest deforestation when they should be playing outside. For role models of how young people should be learning about nature, he turns to some giants: "Rachel Carson was right in her *Sense of Wonder*. E. O. Wilson got it right when he said kids 'need to be mucking about and catching stuff.'" Sobel is after giving kids "transcendent nature experiences." "One transcendent nature experience is worth a thousand facts," he concludes. This is not the sort of statement being written into state environmental literacy plans.

Another thinker in this vein is University of Florida professor of environmental education Martha C. Monroe. "One thing I like to remind folks," she says, "is that Louv's conclusions aren't brand new.[8] The Nature Study Movement said similar things back at the turn of the last century. It's like Liberty Hyde Bailey said, 'in the early years, we are not to teach nature as science, we are not to teach it primarily for method or for drill; we are to teach it for loving.'"

Then Monroe veers in a new direction. "My cynical side," she notes, "says that all the positive attention on nature-deficit disorder is because it's a 'safe' topic. It's easy to care about kids and nature, but much harder to build broad agreement or attract national attention on issues like population and over-consumption. But if we want to protect nature for our children, we can't neglect these challenges, even though EE programs for older youth are not as photogenic as kids playing in leaf piles." Still, she concludes, "We know nature is good for people, so we should ride this wave as long as we can. But kids and nature isn't ALL we should do."

Bearing up to the pressure

So the children and nature movement grows, and environmental education with it. For his part, Louv blushes at the book's success. "Although it's natural to have high expectations for a project you put years of your life into," he notes, "it's more practical to continue to do the best you can, cross your fingers, stay focused and learn from the experience." He's writing a sequel "with an entirely different flavor," while traveling the world spreading his green gospel and strategically placing essays in more and more publications.

"The swing to nature-balanced and enhanced education may be small today," he concludes, "but it is accelerating. I suspect we may be entering one of the most creative periods in human history — or at least I hope we are."

Soon after we talked, Louv left to take his sons to Alaska's Kodiak Island. In the midst of this whirlwind, "I have nature-deficit disorder, too. The bears will help."

Mike Weilbacher is executive director of the Lower Merion Conservancy outside Philadelphia, Pennsylvania, and travels the U.S performing environmental education theater. He blogs at <www.mikeweilbacher.blogspot.com>.

Chippewa Nature Center

Notes

1. Louv's work includes additional websites, <www.richardlouv.com> and <www.lastchildinthewoods.com>.

2. The other three are Liberty Hyde Bailey's *The Nature Study Idea*, Clay Schoenfeld's *What's New about Environmental Education* and Steve Van Matre's writings, including *Acclimatization*.

3. From the Chesapeake Bay Foundation website: "NCLB is contributing to an increasing environmental literacy gap by reducing the amount of environmental education taking place in K-12 classrooms." See <www.cbf.org>.

4. The clever "No Child Left Inside" moniker was invented (and trademarked) by the Connecticut Department of Parks and Recreation, which used it to market parks statewide. The state has happily lent the name to the burgeoning movement for environmental education legislation.

5. See the "No Child" icon on the bottom of the home page at <www.naaee.org>, the website of the North American Association for Environmental Education.

6. See the Nature Rocks website at <www.naturerocks.org>.

7. David Sobel, *Beyond Ecophobia: Reclaiming the Heart in Nature Education*, The Orion Society, Nature Literacy Series, Vol. 1, 1996. An adaptation of the book can be found on the website of *Yes!* magazine <www.yesmagazine.org/issues/education-for-life/803>. The promotional copy reads as follows: "'If we want children to flourish,' says educator David Sobel, 'we need to give them time to connect with nature and love the Earth before we ask them to save it.'" This is Louv's core message, written in 1996.

8. Louv agrees. "I always emphasize that there's nothing new about the message," he told me via email. "Many pioneers — teachers, researchers, writers, along with many educational and environmental organizations — have been working for decades to help connect children to nature. I write about many of them in the book. So the groundwork for a movement had already been laid."

For more information…

Children & Nature Network (United States)

7 Avenida Vista Grande B-7, #502, Santa Fe, NM 87508, <www.childrenandnature.org>.

Child and Nature Alliance (Canada)

Visit <www.childnature.ca> to learn about the developing national network. **Contact:** Becs Hoskin, (250) 920-6178, becs@childnature.ca.

Back to Nature (Ontario)

Visit <www.rbg.ca/pages/BacktoNature.html> for a report on the November 2008 forum at the Royal Botanical Gardens in Hamilton. **Contact:** Barb McKean, bmckean@rbg.ca, (905) 527-1158 x 247.

Analyzing Wildlife Habitat with Google Earth

Left: Sharon Lovell; Right: Dawn Tanner

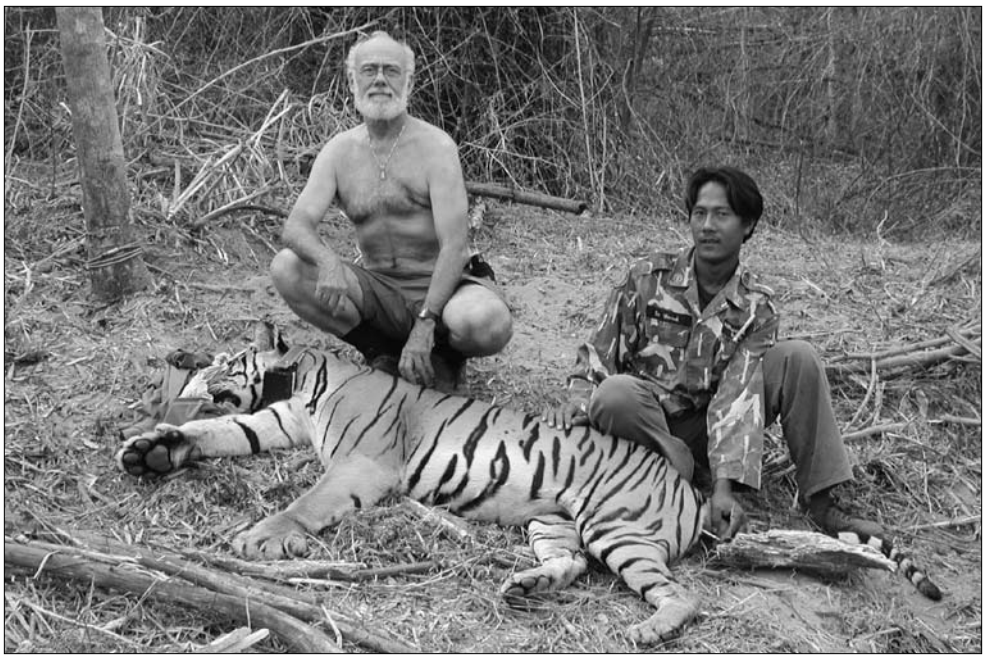
by **Dawn Tanner**

HABITAT LOSS IS THE MOST significant threat to wildlife around the world and a driving force behind the extinction of species. Most of the loss is due to the expansion of human activities into natural areas, such as the conversion of wetlands into agricultural fields, or the replacement of forests or grasslands with suburban development. Yet there is reason to be optimistic about the ability of individuals and communities to restore habitat for wildlife, especially in backyards, public green spaces and riparian areas along streams and lakes. Habitat loss and fragmentation are often the result of many small and seemingly disconnected decisions that, together, lead to major changes in landscape. By considering the larger ramifications of these small decisions and restoring native vegetation in schoolyards and local green spaces, we can increase the area of habitat available to local wildlife and create valuable links among remaining patches of natural habitat.

The imaging of landscapes by remote sensing, such as by satellite and aerial photography, is an important tool by which conservationists can monitor changes in landscape over time. Such images provide a wide-angle perspective as well as local detail for use in "analyses of water quality, ecosystem health, wildlife habitat, land-cover assessments and other land management issues."[1] For wildlife biologists, satellite images are useful in evaluating habitat quality and identifying key areas to target for the conservation of rare species. Satellite images can be obtained from a variety of government and non-governmental organizations; but Google Earth provides free access to satellite imagery. Students can virtually explore the world with Google Earth, as images are now available for most areas of the globe.

This article presents three classroom lessons for Grades 5-6 that help students understand conservation at a landscape scale. Part of a larger 12-week curriculum,[2] the lessons are a cohesive sequence that has students using Google Earth to analyze land cover, classify and quantify habitat types and suggest ways they might improve their schoolyard wildlife habitat. In the first lesson, students consider the habitat requirements of large cats (*Panthera*) and use a variety of Google Earth tools to explore habitats of large cats at sites around the world. Large cats are chosen because they are rare, charismatic species that excite students and stimulate imagination. In the next two lessons, students analyze and compare wildlife habitat in their schoolyard and in a nearby protected area, such as a state or provincial park. They learn the terminology of land-cover classes and determine which classes apply to their schoolyard and protected area. Each lesson is framed by a focus question and begins with prior-knowledge questions that allow students to express their ideas and begin thinking about the new material in the lesson.

These lessons are best conducted in a computer or media lab with students working in groups of two to three at one computer. Google Earth is often included in school software packages, and the program can be downloaded free. (Go to <http://earth.google.com/>, select "Download Google Earth 5" and follow the instructions.) Teachers unfamiliar with the program may wish to consult the many online resources that provide tips and lesson ideas for using Google Earth.[3]



Courtesy of Dave Smith, research archives

Tiger outfitted with a radio tracking collar by Dr. David Smith and assistant in Nepal's Royal Chitwan National Park.

Lesson 1: Exploring Large Cat Habitats

In this activity, students use Google Earth to visit the habitats of jaguars, lions and tigers in three locations in the world and to identify landscape characteristics that indicate good wildlife habitat. The exploration provides a chance for students to become comfortable using Google Earth, zooming to different scales, using the ruler to measure spatial characteristics and locating photographs embedded in maps.

Focus question: *What can we learn from satellite images about the habitats of jaguars, lions and tigers?*

Time: 1 hour

Materials: One computer with Google Earth installed for each group of two or three students, LCD projector, one copy of "Student Worksheet: Exploring Big Cat Habitats" for each student, sheet of paper or journal for each student for recording responses

Prior-knowledge questions:

1. Write a short definition of habitat.
2. List 3–5 characteristics of good wildlife habitat for a native species of cat found in your geographic area. When students have finished answering these questions individually, briefly discuss their definition of habitat and generate a list of characteristics of good wildlife habitat on the board.

Procedure:

1. Present the following introduction to students:

Professor Dave Smith is a scientist from the University of Minnesota who uses remote cameras and radio telemetry to study tigers and their habitat in Royal Chitwan National Park in Nepal. Dave and his students spend hours trekking through the forest searching for signs of tigers, such as tracks, claw marks and scat. They use large box traps to capture the animals so that they can put radio tracking collars on them. These collars allow the researchers to follow the tigers' movements and understand their habitat requirements. The forest habitat and the prey animals that tigers need to survive are rapidly disappearing. Many forests have already been cleared, tiger prey species are often hunted, and tigers themselves are often poached for illegal sale on the black market. Dave's research helps scientists learn about tiger habitat and work toward their conservation.[4]

Today you are a biologist preparing to embark on fieldwork collecting data on large cats. You are studying three species that are said to be of "conservation concern," which means we are concerned about how many individual animals of these species remain in their wild habitat and what we can do to improve their habitat. The cats we are studying are the jaguar (Panthera onca), the lion (Panthera leo) and the tiger (Panthera tigris). All three live in UNESCO World Heritage Natural Resource sites.

All scientists prepare for field work before they travel to a research site. We will use Google Earth to examine those sites so that we can prepare for our field season. Watch the steps that I take to arrive at a site, then type in the same commands to arrive at the site yourself. As you arrive at a site, click on photo links to see what that area looks like. You will have five to ten minutes to explore the site on your own and answer the questions on the worksheet. Then we will depart for our next field site. Let's go!

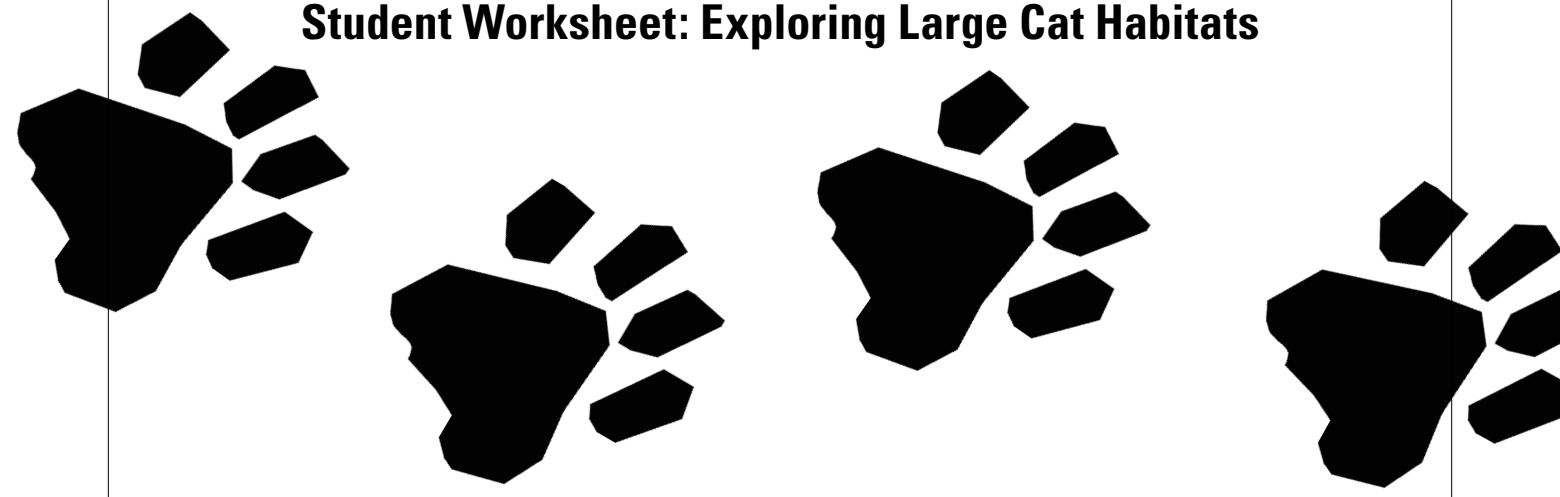
2. Hand out the student worksheet "Exploring Large Cat Habitats." As students begin to work through the lesson, demonstrate each step in Google Earth with a projector so that they can watch the execution of commands and then repeat those commands until they are ready to explore independently. Regroup the class before navigating to a new location, so that groups move through the lesson together and all are able to finish.
3. Discuss students' responses to the following worksheet questions at the end of the exercise and ask students to hand in their worksheet answers.

Site 1: Iguazu Falls, Argentina

- How wide is the river at its widest point? *(Approximately 1.4 km.)*
- Describe three things you can see that would make this good habitat for jaguars. *(Possible answers: Large uninterrupted forest patches; access to both fast water and shallow, slow-moving pools that support different aquatic*

(Continued on page 12)

Student Worksheet: Exploring Large Cat Habitats



Set your start location in Google Earth

1. Start Google Earth, click *View* and select *Scale Legend* to add scale to your map. You will notice *Eye alt* on the lower right-hand corner of the screen. *Eye alt* is the elevation of your viewpoint as you look at the screen. The *Scale Legend* tells the actual distance or scale of the map as you view it and zoom in and out. The *Scale Legend* is the same as a scale bar on a standard print map.

2. On the left side of the screen under *Search*, find the *Fly To* box. Enter your school's address in the box and click *Enter* on your keyboard. The Earth will spin and zoom in on your school. Click *View*. At the bottom of the list, select *Make this my start location*. A marker will be added on the screen. You are now ready to prepare for fieldwork.

Site 1: Iguazu Falls, Argentina, habitat of jaguars

3. Enter "Iguazu Falls, Argentina" in the *Fly To* box and click *Enter*. The Earth will spin to the location. Zoom in, and you will see a large bend in the river just south of the city of Iguazu Falls. Jaguars come to the river to drink, to hunt crocodiles called caiman and to swim in pools. Use the *Zoom* tool to explore this jaguar habitat.

Q: Describe three things you can see that would make this good habitat for jaguars.

4. In the *Layers* box on the left side of the screen, make sure *Places* is checked. This will allow display of small blue boxes that indicate that photographs are available. To look at a photograph, click on its box. The photograph and information about the image will open in a separate box over your map. Close the photograph by clicking on the "x" in the upper-right corner, and continue exploring.

5. Click *Tools* and then *Ruler* to measure the river.

Q: How wide is the river at its widest point?

Site 2: Serengeti National Park, Tanzania, habitat of lions

6. Enter "Serengeti National Park, Tanzania" in the *Fly To* box, and click *Enter*. Use the *Zoom* tool and view the photographs to explore this lion habitat.

Q: Describe three things in the lion habitat that differ from the jaguar habitat.

7. Zoom in and out and notice how the image clarity changes; this will acquaint you with scale (distance) on your map. Zoom in until you can no longer make out images clearly.

Q: What does the Scale Legend say?

Site 3: Royal Chitwan National Park, Nepal, habitat of tigers

8. Enter "Royal Chitwan National Park, Nepal" in the *Fly To* box and click *Enter*. Use the *Zoom* tool and view the photographs to explore tiger habitat.

Q: How far is it from the Chitwan marker to the main river channel?

9. You have arrived at one of Dave Smith's field sites. Today you are part of Dave's research team. Where will you set up camp to start collecting data on tiger movements and habitat requirements? Record a new placemark for your site by going to the drop-down menu at the top of the screen under *Add* and selecting *Placemark*. Create a unique name for your placemark. The latitude/longitude coordinates will be visible on your *Placemark* screen.

Record the coordinates of your campsite.

(Continued from page 10)

and terrestrial organisms; very little cleared land or human development.)

Site 2: Serengeti National Park, Tanzania

- Describe three things in the lion habitat that differ from the jaguar habitat. *(Possible answers: Wide open landscape with sparser tree cover, red soils instead of connected tree cover, drier landscape, less water, variety of large animals — bigger prey for lions.)*
- When you zoom in enough that you can no longer make out images clearly, what does the Scale Legend say? *(Approximately 1.5 km)*

Site 3: Royal Chitwan National Park, Nepal

- How far is it from the Chitwan marker to the main river channel? *(Approximately 6.25 km, and it is 0.17 km to the tributary nearest the Chitwan marker. There are two Chitwan markers, so the distance to the nearest tributary will depend on which marker the students use.)*

4. Lead a class discussion to compare the research sites chosen by the groups. Discuss characteristics of their chosen sites that provide especially good habitat for tigers. For example: What does the vegetation cover look like? How far is it to water? What kind of tiger prey do you think would be found at your location? How much human-dominated landscape can you find (e.g., homes, villages, cities)?

Reflection: Ask students to reflect on their experience by writing a field notebook entry about the habitats of large cats around the world: What one surprising discovery did you make about another country as you explored? List three things that you found among the Google Earth sites that seemed to indicate good wildlife habitat.

Lesson 2: Analyzing Land Cover in the Schoolyard

In this lesson, students define land-cover classes for the schoolyard, quantify each type of land cover on printouts of Google Earth images of the schoolyard, measure linear distance of roads on those printouts (if time permits), and build bar and pie graphs to represent land cover in the schoolyard.

The land-cover classification systems that are used for scientific research contain many more land classes than would be suitable in an elementary classroom setting. I recommend starting with the following classes and adding others as needed to represent the landscape in your region: trees and shrubs, pavement and buildings, mowed grass, natural grassland, bare soil, water, wetland, agricultural fields and pasture.

Focus question: *What can we learn from satellite images about wildlife habitat in our schoolyard?*

Time: 1 hour

Materials: One computer with Google Earth installed for each student group, printed Google Earth image of your schoolyard and a 10 x 10 grid printed on an overhead transparency for each group, dry-erase markers, tape, LCD projector for graphical analysis and discussion, clipboards, spreadsheet and graphing software such as Microsoft Excel.

Prior-knowledge questions:

1. Estimate the percentage of our schoolyard that you think is good wildlife habitat.
2. List three projects that we might be able to implement to improve wildlife habitat in our schoolyard.

Figure 1: *An image of the schoolyard was selected in Google Earth and overlaid with a 10x10 grid printed on an overhead.*

Preparation:

1. In Google Earth, select a view of your school that encompasses the buildings, parking area and schoolyard (see Figure 1 for an example). Make sure the Scale Legend is visible in the image. You can view a larger image by removing the Sidebar (Select *View* and remove the checkmark in front of *Sidebar*).
2. From Google Earth, save the screen image as a jpg by going to *File*, *Save* and choosing *Save Image*.
3. Open the image in a photo viewer and print one copy for each group of two or three students. (Note that landscape details will be more vivid if you print on photo paper.)

Helpful hints with Google Earth: To reorient the image, click on the compass in the upper right-hand corner. If you move the North portion westward, for example, you will change the orientation of the image. To return to a top-down view and remove the image perspective angle, hold Shift, left-click the mouse and move the mouse up or down.

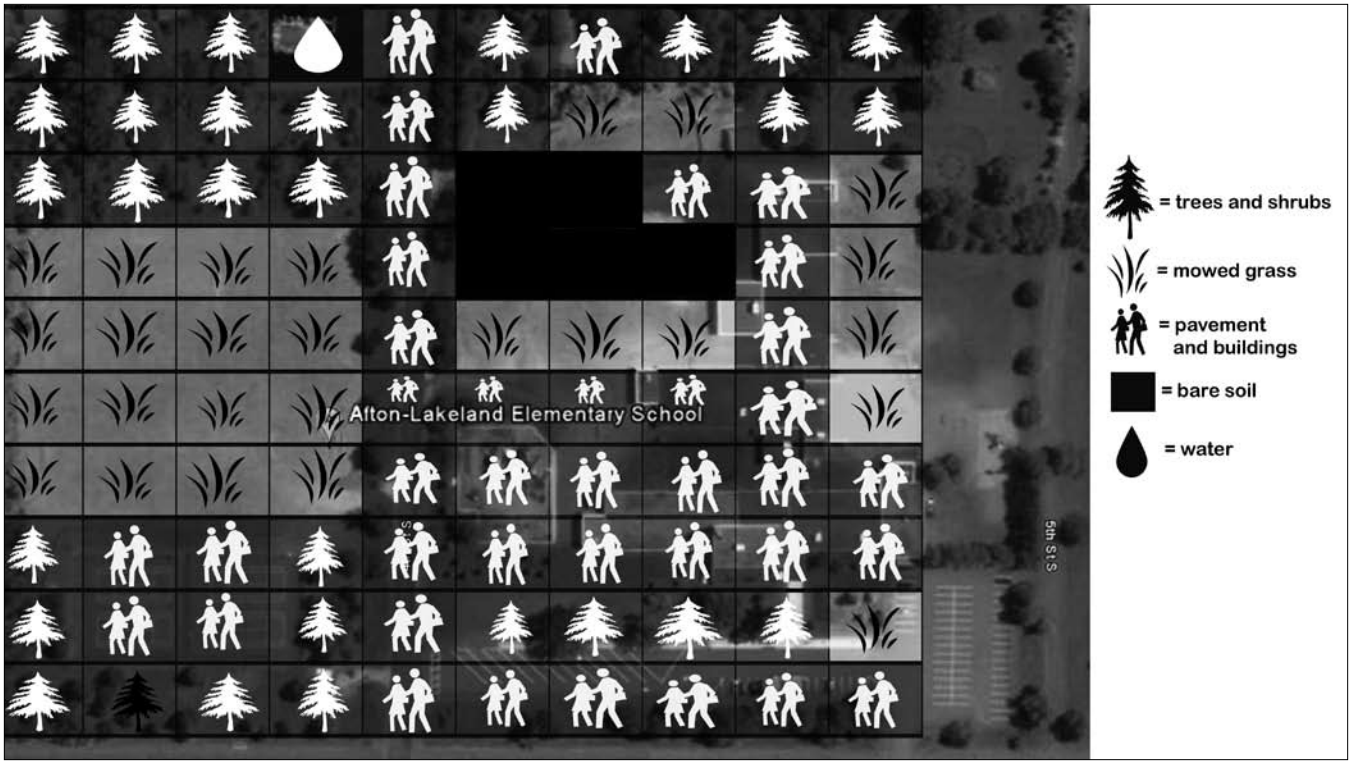
Procedure:

1. Introduce the lesson: *In Lesson One, we explored research sites in other parts of the world. Today we will work on a site we know well, our schoolyard. In our next lesson, we will use the same tools we use today to analyze a nearby protected area. We begin by defining land-cover classes that represent the variety of characteristics we observe in our schoolyard.*
2. List the land-cover classes on the board so that students can refer to them as they identify characteristics of the schoolyard.
3. Have each group navigate to your school address on Google Earth and choose a view showing the schoolyard in detail and decide on which land-cover classes are represented there.
4. Specify a color for each land-cover class. Hand out to each group a printed copy of the Google Earth image of your schoolyard, a grid and other materials. Ask students to place the transparent grid over the printout, tape it into place, and use markers to color each cell to represent its land-cover class. Each square must be only one color. This means that students must decide which land cover dominates in squares that are on an edge or have mixed types. (See Figure 2.)
5. Have students count and record the squares in each class. The number of squares is equal to the percentage of land cover (the 10 x 10 grid contains 100 cells). Collect and compile student data to create Excel graphs (see Figures 3 and 4). Referring to your land-cover classes, discuss and record the percentage of the schoolyard the class would consider excellent wildlife habitat.

Reflection: Think about the land-cover graphs created at the end of today's lesson. Write a paragraph describing how you think graphs for a protected area would be different.

Follow-up: Before the next lesson, have students spend 30 minutes in the schoolyard working in pairs to search for animal sign. Equip each pair with a clipboard and printout of the image of schoolyard. They should record on the printout each animal sign they find (including tracks, scat, fur/feathers, homes, animal sightings). Ask students to describe in one paragraph the characteristics of the places where they observed the most animal sign.

Figure 2: *A land-cover analysis of their schoolyard done by a student group using the following classes: trees and shrubs, mowed grass, pavement and buildings, bare soil and water.*



Schoolyard Land Cover Percentage

	Teacher Sample	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Class Average
trees and shrubs	21	30	10	33	16	20	40	29	25
pavement and buildings	36	32	35	24	31	51	28	34	34
mowed grass	38	26	49	34	42	6	14	25	29
natural grassland	2	6	3	0	7	12	15	4	6
water	0	1	0	0	0	0	0	0	0
bare soil	3	5	3	9	4	11	3	8	6

Figure 3: *The group counts are entered into a data program such as Microsoft Excel to obtain average percentages of different types of land cover in the schoolyard. Teachers may choose to do their own classification prior to the classroom exercise and share it with the students when they have finished their assessment.*

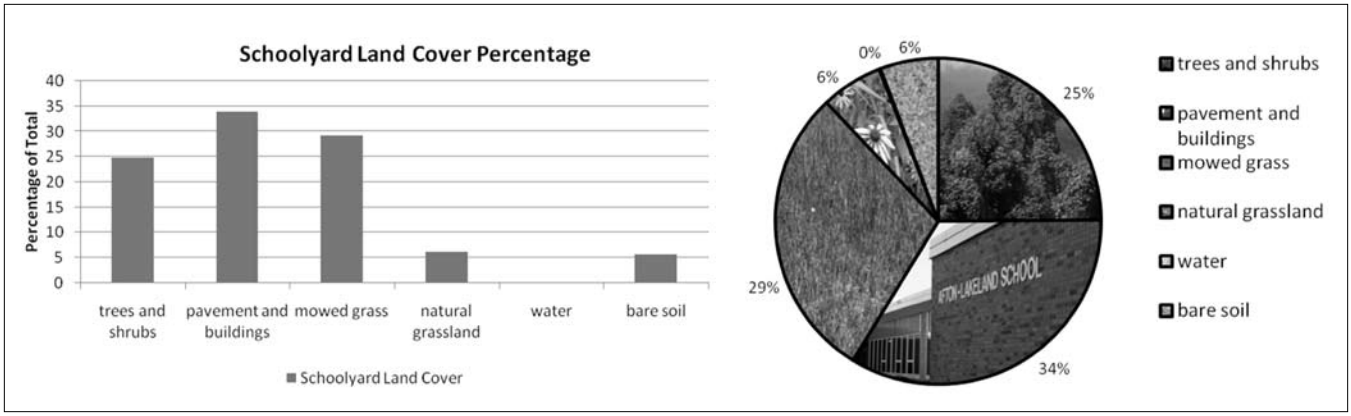


Figure 4: *Class averages of land-cover percentages are used for creating bar and pie graphs. In this example, the students determined that 31 percent of their schoolyard is high-quality wildlife habitat, consisting of trees, shrubs and natural grass.*

Lesson 3: Analyze a Protected Area

In this activity, students define land-cover classes in a protected area, quantify types of land cover on printouts of the protected area, measure linear distance of roads on printouts of the protected area (if time permits), build bar and pie graphs of protected area land cover, and compare them to graphs of the schoolyard land cover.

Focus question: *What can we learn from satellite images about wildlife habitat in our protected area?*

Time: 1 hour

Materials: One computer with Google Earth installed for each student group, the previous lesson's completed grids and graphs for comparison, printed Google Earth image of the protected area (see Preparation below), a 10x10 grid printed on a transparency for each student group, tape, dry-erase markers, LCD projector for graphical analysis and discussion.

Prior-knowledge questions:

1. Estimate the percentage of our protected area that you think is good wildlife habitat.
2. List 3 to 5 things about the wildlife habitat in our protected area that you think will be different from what you noticed in our schoolyard.

Preparation:

Choose a protected area near your school, such as a state or national park, local nature center with walking trails, or another natural area that provides high-quality wildlife habitat and limited density of roads and buildings. For this lesson, I used Afton State Park, a place many students visit with their families, and a landscape and ecosystem that the current schoolyard would have resembled in pre-European times.

On Google Earth, select a view of your protected area such that the scale is as close as possible to the one you used for the schoolyard. Make sure the scale bar is visible in the image. Print a copy of the image for each group of two or three students. Project or list on the board the land-cover classes and the bar and pie graphs from the schoolyard for reference.

Procedure:

1. Introduce the lesson as follows: *In our previous lesson, we determined the types of land cover in our schoolyard and reflected on how the land cover in a protected area might be different. Today we will analyze a protected area and re-examine our predictions. As we classify the land in our protected area, we may need to add land classes that are not in our schoolyard or delete some that are.*

2. Hand out a copy of the Google Earth image of the protected area to each group. Have students repeat the classification steps they performed for the schoolyard. Then compile the data and develop Excel graphs for the protected area. Figure 5 shows the classification done by a student group for Afton State Park, using the categories of trees and shrubs, water, pavement and buildings, and bare soil.
3. Compare the data and graphs for the schoolyard and the protected area, discussing the quantitative differences in land cover and what these differences would mean for plants and animals. How are these species affected by our decisions, such as how much land we mow, which plant and animal species we actively remove or encourage, where we allow trees and shrubs to grow, where we place our buildings and roads, and the size of our buildings?

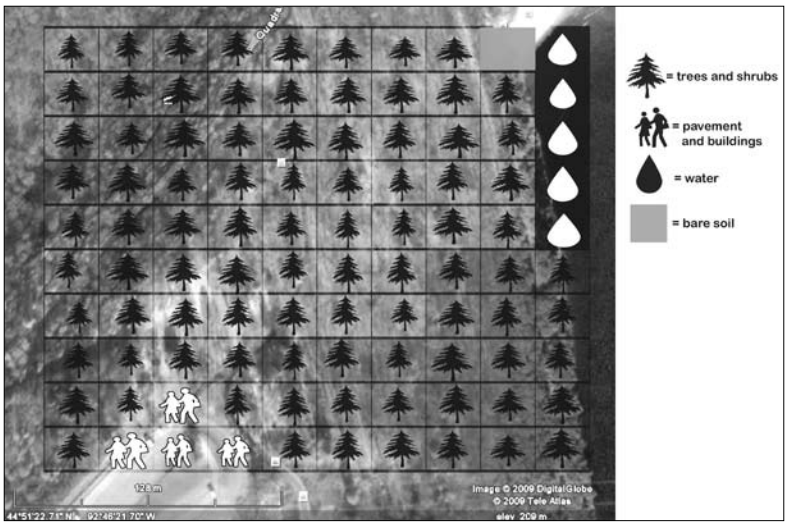


Figure 5: *Land cover classification of Afton State Park done by a student group.*

Especially informative contrasts may be seen by comparing the percent of land covered by pavement and buildings, and the difference in trees and shrubs or native grasses. Ask the students: Although it would be difficult to remove our buildings and roads, how might we increase the amount of land covered in native trees, shrubs and grasses that would provide food and cover for wildlife? As you compare the schoolyard to the protected area, can you identify gaps in the schoolyard where adding new plantings could connect existing patches of high-quality habitat such as native trees, shrubs and grasses? Are there places that are currently mowed in the schoolyard that could be restored so that they could provide habitat for wildlife and save money in maintenance costs? How would you research restoration projects being done in your protected area to find ideas that might be feasible in the schoolyard?

Reflection: Looking at the differences in land cover that you found between your schoolyard and protected area, which location do you think would be most similar to your home or neighborhood? Write one paragraph about similarities and differences that you would expect to see if you did this Google Earth exercise for your home.

Extensions: There are many ways to expand on these lessons. One exciting way is to look at changes in land cover over time. *Historical Imagery* is a new map display option in Google Earth 5.0. Click on *View* and select *Historical Imagery*. This opens a sliding bar that will allow you to view available images by date for your site. Choose an earlier date (for example 10 or 30 years prior to the current date) and repeat the analyses of your schoolyard and protected area. How has land cover changed over time? You could add even more historical perspective by using aerial photographs available from state or provincial natural resource agencies. These historical views help students understand landscape changes in recent history, and impacts on wildlife as habitat becomes fragmented and natural areas are converted to urban and agricultural areas.

Students can be encouraged to implement projects in their schoolyard to improve wildlife habitat and reduce effects of fragmentation. There are extensive resources to assist in such projects. Refer to the U.S. Fish & Wildlife Service's *Schoolyard Habitat Project Guide*[5] or Project WILD's *Wild School Sites*,[6] and consider implementing projects to work toward certification of your schoolyard for wildlife habitat through the National Wildlife Federation.[7] As a class, you might propose a habitat-improvement project to your school board or parent organization. At Afton-Lakeland Elementary, the parent organization provided funds for the students to plant native fruiting trees and shrubs in the schoolyard in the spring of 2009 and allocated funds for future student-proposed habitat projects.

Dawn Tanner is a PhD candidate in the Conservation Biology Program at the University of Minnesota. She created the *Taking Action Opportunities (TAO)* curriculum for environmental education with partnership and support from MN DNR/MN Project WILD, Cedar Creek Ecosystem Science Reserve, Afton-Lakeland Elementary School and Afton State Park.

Notes

1. J.E. Vogelman, S.M. Howard, L. Yang, C.R. Larson, B.K. Wylie, and N. Van Driel, "Completion of the 1990s National Land Cover Data set for the conterminous United States for Landsat Thematic Mapper data and ancillary data sources," *Photogrammetric Engineering and Remote Sensing*, 67, 2001, pp. 650-662.

2. D. Tanner, *Taking Action Opportunities (TAO): Connecting Kids to Wildlife with Trail Cameras*, Minnesota Department of Natural Resources, Minneapolis, MN, 2009.

3. See "Google Earth Lessons: An Educational Resource for Teachers," 2008, online December 8, 2009, <http://gelessons.com/lessons/>; and Glenn A. Richard, "Pedagogy in Action: Teaching with Google Earth," 2008, online December 8, 2009, <http://serc.carleton.edu/sp/library/google_earth/>.

4. D. Smith in *Lights, Camera, Capture*, DVD, MN Project WILD, Minneapolis, MN, 2009.

5. R. Mason, B. Slattery, K. Reshetiloff, and L. Hewitt, *Schoolyard Habitat Project Guide*, U.S. Fish & Wildlife Service, Chesapeake Bay Field Office, 2009, available online December 9, 2009, <http://www.fws.gov/ChesapeakeBay/pdf/habitatguide.pdf>.

6. Council for Environmental Education, *Project WILD Wild School Sites: A Guide to Preparing for Habitat Improvement Projects on School Grounds*, Houston, Texas, 2005.

7. National Wildlife Federation, "Create a Schoolyard Habitat," 2009, online December 9, 2009 from <www.nwf.org/schoolyard/>.

Illustrations: Tom Goldsmith

Poetry Power:
Using Poems in Environmental Education

by **Alison Flensburg**

POETS CAN BE ELOQUENT tour guides on the journey to sharpen our awareness of nature, connect with our planet and take action on its behalf. Poetry distills the essence of things, invites us to inspect the details of our lives and helps us see what we might not otherwise see. Combine environmental poetry with children's sense of wonder and natural delight in language and you have a powerful and joyful way to nurture ecological values in young people. Poetry can enrich many areas of the curriculum at any grade level, whether it be a kindergarten unit on winter, a Grade 4 lesson on sketching from nature, or a Grade 8 study of natural adaptation.

This article looks at how to use poetry in environmental education: finding the right poems, writing poems for your students, presenting poems to students, teaching them gratifying ways of playing with poems, and guiding them in performing and writing poetry.

Reading poems to students

Besides the obvious use of poetry in language arts, the bite-sized nature of poems makes it possible to weave poetry into spare moments throughout the school day. Reading a poem is a dramatic way to begin and end lessons, activities and themes; and poetry's portability makes it handy for those waiting times that often mar field trips. Poems can even be used to change the mood of a class. One year, when teaching a particularly challenging Grade 5 and 6 class, I kept books of poems by the students' favorite poets ready for times when scheduled activities ended before the bell. That way, even after a stressful period, the class ended with positive feelings.

Playing with poems

When reading poems with students, resist the temptation to be too analytical, since young people bond best to poetry if they become immersed in poems in a playful way. Students can read poems aloud, dramatize them, or add creative movement to the words. (Physical interpretations may work best when one group reads or recites and another group performs the action.)

Encourage students to experiment with a variety of choral reading techniques. For example, poems with more than one speaker, such as question/answer poems or conversation poems, work well with the call-and-response choral method. A list poem is effectively handled by having each student in turn read the line(s) pertaining to one item in the

list. An unusual technique is reading a poem cumulatively, starting with one voice and increasing the number of voices as the poem progresses. One especially intriguing strategy is the two-or-more-voices approach popularized by Paul Fleischman. Here the voices are choreographed, sometimes with a solo voice and sometimes with a combination of voices. (For an example, see Fleischman's poem "The Passenger Pigeon.") Challenge students to combine a variety of approaches to choral reading.

Going public: Students reading to an audience

Most poetry is meant to be heard, and reading environmental poetry aloud to an audience is a powerful way for a class or environmental club to spread its green message. Possibilities for poetry events include readings in school assemblies or during interactive hours with parents, presentations to younger classes, and dramatic poetry readings or poetry jams in public places such as bookstores or libraries. Besides participating in group presentations, students can be challenged to perform solo readings. For example, primary students may enjoy performing one at a time in front of parents. Encourage those who enjoy memorizing poems to do so, but don't make memorizing poems for individual performance a requirement. The pressure of having to remember the words when alone in front of an audience may sour students on poetry.

Whether presented by groups or by individual students, poetry readings can be enhanced with props, costumes, sound effects and background music. For example, a student might enjoy dressing as an alien for a lively rendition of the poem "The Alien's Auction." (See page 20.) Young people who use presentation software such as PowerPoint can scan in their prints, drawings, paintings or photographs and project them on a screen to illustrate the poems being read.

Finding the poems you need

Perhaps your Grade 3 students need poems to read at an assembly on the theme of endangered animals. Or perhaps you are seeking a poem to inspire Grade 8 students to write their own poems about their wilderness camping experience. The poem chart provided here (see page 19) is a good place to start. In addition, libraries often have poetry indexes in book form, which list poems by topic and give their sources. (The words "ecology" and "pollution" give the most fruitful results when searching these indexes for environmental poems.) Once you have titles, search to see if the poems are available on the Web. Otherwise, you may be able to track down the poems in their original sources — the books or magazines indicated in the indexes. The best website I have found for environmental poems written by both adults and children is "Morning Earth," created by the poet John Caddy. Teachers searching for poems for Grade 7 and up may also find the Poetry Tool provided at The Poetry Foundation site useful for finding nature poems. (See References section.)

Before using poems obtained from the Internet in your classroom, ensure that you have permission to do so. You or your school board may seek permission directly from the copyright owners or through a copyright collective such as Access Copyright.

Collaborating with poets

Can't find the perfect poem? With a bit of searching, you may find a poet willing to write poems on topics that you provide, in exchange for constructive feedback from you and your students. Your best bets are relatively unknown poets who appreciate both the stimulus to write and the exposure. (I write many of my best poems in response to such requests by teachers.) Public library staff in information services departments may be able to help you find writers' groups in your area. (Small local writers' groups aren't usually on the Web, so don't assume they don't exist because you can't find them using a search engine.) You may also find online writing groups willing to help you find poets to collaborate with.

Writing your own poems

Suppose you can't find the poems you need and you don't have the time to track down a poet. Write your own!

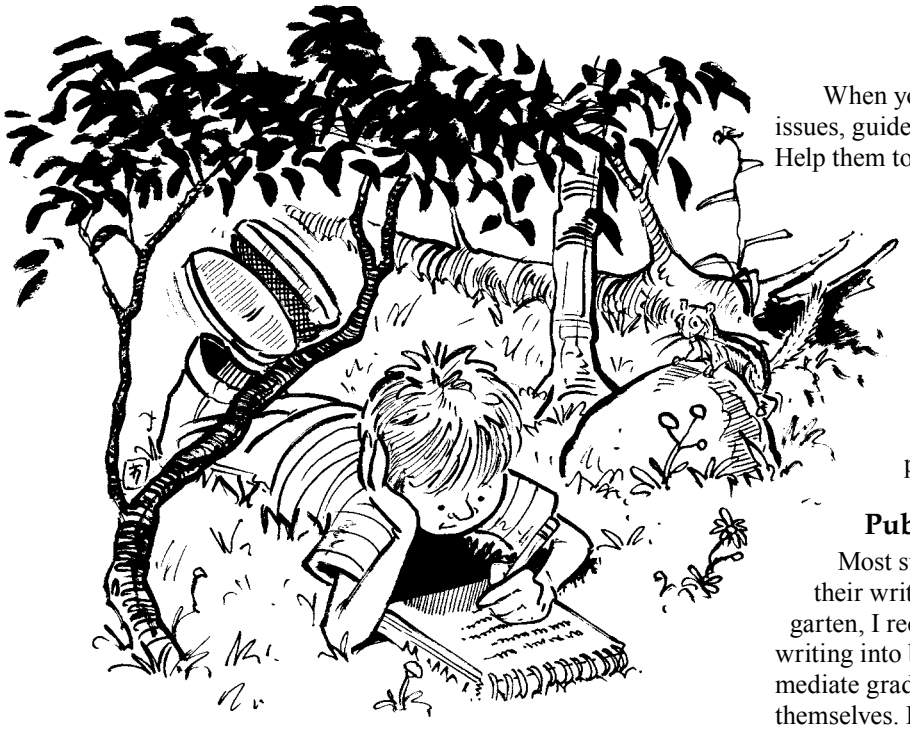
An important consideration when writing poetry is whether or not to use rhyme. If your poems will be used as models to inspire students' own poetry writing, they do not need to rhyme. The stretch to find rhyming words often distracts young poets from reaching for fresh images, evocative comparisons and genuine emotions. Rhyme also tends to create rigorous demands for regular meter and rhythm. Only pre-school and kindergarten children need a steady diet of rhyming poetry. From the time they are old enough to start writing their own poems, children need to read and hear some non-rhyming poems to inspire their own writing.

However, there are some situations in which you might want to write rhyming poetry: you may be writing for children who are too young to write; you may wish to create rhyming poems for rhythmic performance pieces; or you may simply want to tap into the element of delight that a well-written rhyming poem can bring. Valuable aids in writing rhyming poems are websites such as Rhymer and OneLook Dictionary Search that generate lists of rhyming words. (See References: Help writing poems.) Some of these websites also have other useful features; for example, you can find a two-syllable word that starts with "b" and ends with "n."

Students writing poems

Writing poems about environmental themes immerses students in a creative process that engages both mind and emotions, thus strengthening learning and deepening commitment. When students write poems that celebrate principles of ecology, express their connection to the Earth, or call for its stewardship, they reinforce environmental concepts they have learned and they clarify their own environmental values. This is also true of other forms of writing, such as journal writing, but the ability of poetry to compress emotions into a short format gives poetry extra punch.

Reading and listening to poetry are great motivators for students to write their own poems. If you use a variety of poems as examples, including poems written by young people, the students will sense the range of possibilities. In his book about poetry writing, *Rose, Where Did You Get That Red?* Kenneth Koch recommends teaching the reading and writing of poetry at the same time, identifying what he calls "poetry ideas"[1] that can serve as models for students'



poems. For example, in the poem "The Alien's Auction" (see page 20), the poetry idea could be the impression that an alien might have of nature when visiting Earth, or the idea of selling nature in order to bring attention to how priceless it really is. In selecting poems to read, Koch doesn't worry about whether students are familiar with all the words and allusions in a poem: "My students learned new words and new conceptions in order to play a new game, or enable them to understand science fiction in comics or on TV, so why not for poetry, which they liked just as much?" [2] Non-rhyming poems are ideal as models for writing. If using rhyming poems, focus on the "poetry idea" in the poems and make it clear that the students are not required to write in rhyme.

In addition to having students develop their "poetry idea," have them think about poetic vehicles to transport the "poetry idea" into readers' minds. For instance, "The Alien's Auction" uses a list to express the idea of an alien's impression of Earth. Examples of other vehicles are letters, requests, narratives, monologues, conversations, questions, and questions with answers. Refer to the poem chart (opposite) for titles of poems that use such vehicles. For example, Lew Sarrett uses a request as a poem vehicle in "Four Little Foxes," while Aileen Fisher uses question and answer in "Package of Seeds." The use of requests as a poetic vehicle lends itself particularly well to environmental topics, as it allows students to give a voice to creatures and other elements of the environment. For example, they could write from the point of view of a water bird, asking humans not to throw away the plastic can holders that birds can get their necks stuck in.

Other sources of inspiration abound for writing poetry on environmental topics. Immersion in nature during a field trip can inject great expressive power into student poetry. Students can also write in response to recorded nature sounds and evocative guided imagery of experiences in nature. Photographs, provided by the teacher or taken by students, can also spark poetry writing. For models of how photography can inspire poetry, go to the website "Morning Earth" for John Caddy's combinations of poetry and photography.

When your students are writing about environmental issues, guide them to avoid writing versified mini-sermons. Help them to understand the difference between verse that alienates by preaching and powerful poetry that persuades by engaging the emotions. Teach them to write the latter by showing instead of telling, by using a rich variety of sensory detail, and writing about the particular instead of the general. Encourage your students to rewrite until every word in their poems contributes to a vivid and concise effect. Inspire them to make their poems sparkle!

Publishing students' poems

Most students are tremendously motivated to write if their writing may be published. When I taught kindergarten, I recruited parents to type and bind the students' writing into beautiful hardcover books. When I taught intermediate grades, I showed the students how to bind the books themselves. Each of these books included an "About the Author" section, along with the child's photo. The students invited their families to their book launches: momentous events complete with cameras and camcorders. These child-authored books became treasures in each year's classroom library.

In addition to creating their own books, students may be able to publish their poems in the school newsletter. They might also like to enter their poetry in contests or send it to magazines and websites that publish student writing. How about an end-of-the-year trash-free family picnic with students writing their environmental poems in chalk on the sidewalk for their families to enjoy? Creative ways to feature student poems are limited only by imagination.

There is a wealth of project ideas that involve an entire class creating a final product, such as tape recordings of class poems, class anthologies of student poetry, and class photograph albums that combine images with poems. Producing an anthology can be as simple as collecting students' poems in a binder for the class library, or it can involve students in editing, proofreading, page design and desktop publishing. The final product can be produced in quantity and sold to raise money for an environmental project or organization. You could even invite a local reporter to the launch.

In *As If the Earth Matters*, Thom Henley and Kenny Peavy describe one elementary school teacher's daily homework assignment to her students to spend "enough quality time in Nature that they will experience that involuntary reflex moment and utter the word 'Wow!'"[3] Although there can be no substitute for time spent in nature, those "Wow!" moments do not have to be limited to time spent outdoors — we can also experience them through poetry.

Environmental poetry shakes the mind and prods the heart in ways that encourage the loving stewardship of Earth. Kenneth Koch wrote of his students that the experience of reading and writing poetry lifted them "… out of their ordinary selves…; the fresh power of their feelings and perceptions was … a real power in the world."[4] Give your students that power — give them poetry.

The poems listed here can be found online, with the exception of those by A. and M. Flensburg, which are on pages 20-21. Before using poems obtained from the Internet, ensure that you or your school board obtain permission directly from the copyright owners or through a copyright collective such as Access Copyright (Canada) or the Copyright Clearance Center (U.S.).

Legend: **K** - kindergarten; **P** - primary; **I** - intermediate; **H** - high school

	Sense of Wonder	Reverence for Life	Conservation/ Biodiversity	Poetic Vehicles
Berry, Wendell. "The Peace of Wild Things" **(I, H)**	•	•		
Bipes, Andy (Grade 5). "The Wild Dance" **(I)**	•	•	wilderness	
Brownjohn, Alan. "We Are Going to See the Rabbit" **(I, H)**		•	endangered species	narrative
Bruchac, Joseph. "Birdfoot's Grampa" **(P, I, H)**		•		narrative
Budde, Dee Dee (Grade 8). "A Mingling" **(I, H)**	•	•		narrative
Caddy, John. "Big bluestem grass still dances..." **(I, H)**	•	•		
Caddy, John. "The little myrtle warbler..." **(I, H)**	•	•		
Caddy, John. "A young heron in his first power..." **(I, H)**	•	•		
Crofoot, Irene. "Waking Up" **(K, P)**	•			
Field, Rachel. "The Little Rose Tree" **(K, P)**	•			
Fisher, Aileen. "Caterpillars" **(K, P)**	•	•		question/answer
Fisher, Aileen. "Package of Seeds" **(P)**	•	•		question/answer
Fisher, Aileen. "Pussy Willows" **(K, P)**	•			
Fleischman, Paul. "The Passenger Pigeon" **(I)**			extinction	
Flensburg, Alison and Mike. "Banana Peels Orange Peels Onion Skins" **(I)**			composting	
Flensburg, Alison and Mike. "Alien's Auction" **(K, P, I)**	•	•		list
Flensburg, Alison and Mike. "The Sidewalk Moth and Me" **(P, I)**		•		narrative
Frost, Frances. "Valentine for Earth" **(P, I)**	•			list
Frost, Robert. "Dust of Snow" **(P, I)**	•			
Frost, Robert. "The Pasture" **(P, I)**	•	•		request
George, Chief Dan. "And My Heart Soars" **(P, I)**	•	•		
Grimes, Nikki. "April Ala Carte" **(P, I)**	•			
Hardy, Thomas. "Throwing a Tree" **(I, H)**		•	trees	narrative
Harjo, Joy. "Eagle Poem" **(I, H)**	•	•		
Hendrickson, Kristoff (Grade 4). "The Forest" **(P, I)**		•	forest	questions
Hovey, Kate (Grade 4). "The Beauty" **(P, I)**	•	•		list
Hughes, Langston. "April Rain Song" **(P)**	•			
Hughes, Langston. "In Time of Silver Rain" **(P, I)**	•	•		
Johnson, Adam (Grade 7). "The Oceans" **(I)**		•	oceans	
Lawless, Gary. "When the animals come to us..." **(I, H)**		•	general	questions
Layton, Irving. "If Whales Could Think On Certain Happy Days" **(I, H)**		•		
Moffitt, John. "To Look at Anything" **(P, I, H)**	•	•		
Moore, Lillian. "If You Catch a Firefly" **(K, P)**	•	•		
Prosser, Jenny (Grade 10). "Oneness" **(P, I, H)**	•	•		
R., Sara. "Earth Dancer" **(P, I)**	•	•		
Rossetti, Christina. "Hurt No Living Thing" **(P, I)**	•	•		request, list
Rowell, Katie (Grade 5). "The Wind" **(I)**			air	request
Sandburg, Carl. "Flat Lands" **(I, H)**	•		land	
Sandburg, Carl. "Spring Grass" **(P, I)**	•	•		request
Sarett, Lew. "Four Little Foxes" **(I)**		•		request
Schmitz, Sarah (Grade 4). "Praise to the Pattern" **(P, I)**	•	•		list
Schmoll, Zach (Grade 2). "Speak to Me Spring" **(P, I)**	•	•		request
Smiley, Norene. "Winter Yard" **(P, I)**	•	•		narrative
Starhawk. "Earth Mother, Star Mother" **(I, H)**	•	•		
U.N. Environmental Sabbath Program. "A Prayer of Healing" **(I, H)**		•	general	
Wright, Kit. "The Song of the Whale" **(I, H)**		•	whales	

The Alien's Auction

On the block, we have the planet Earth.
Come on now! What's this planet worth?

Yes indeed, you see this awesome Earth?
Note its pansy faces, peacock tails,
quaking aspen, apples, quails, and snails,
roses, noses, tickly grass and feet,
hills that glimmer, shimmer in the heat...

Oh, this globe's unique, you know. You get:
merrymaking monkeys, mussel shells,
dolphins romping where the humpback dwells,
snow-drift sculptures, drifting desert sand,
cricket music from a moonlit band...

Yes, my friends, and here's what else it has...
black-tailed deer and flapping dapper drakes,
bubbly burbling brooks and glassy lakes,
foxes, fireflies, flamingos, frogs,
bitsy beetles, elephants, and dogs!

So... ladies, gents, what WILL you give?
Do I hear a worthy starting bid?
Earth's well worth
    your time,
        your love
            your trouble.
Ladies, gentlemen! Oh, on the double!

Yes, my earthly friends,
what will you give?
What will you bid?
    What
        will
            you
                give?

Using "The Alien's Auction"

Poetry idea to model: aspects of the Earth that would seem wonderful to a visiting alien. Before writing, provide the students with photographs of the Earth, lead a brainstorming session on the marvels observed on a nature field trip, or guide students through a creative visualization to imagine the wonders of the Earth.

Poetry vehicle to model: list

Poetic technique to model: alliteration. Help the students to realize how the liberal use of alliteration in this poem adds to the upbeat, energetic tone and intensifies the effect of its imagery. Encourage students to look at their own lists of natural wonders to see how they could work alliteration into their poems.

Performance use: performance by a single student. The fun of this activity could be enhanced by an alien costume; a sense of wonder could be stimulated by a PowerPoint illustrations.

Banana Peels, Orange Peels, Onion Skins

Hi! I'm your compost bin.
I'm where your garbage goes,
but only
your munchiest,
your crunchiest,
your yummiest
garbage.

    Banana peels?
Indeed!
    Orange peels?
Oh, yes!
    Onion skins?
Of course!
    Apple cores?
Absolutely!
And so much more:
fruit and veggies galore,
all seasoned with leaves —
tasty, brown, and crackly.

Ooooh,
I smell a mushy banana peel!
Scrumptious!
I thank you.
Mother Earth thanks you.
My pet worms thank you.
The veggies you'll feed
with my super-rich
supersoil
thank you too.

    Supersoil?

Oh, yes —
supersoil!
Your garden's most delicious
dinner of dirt!

Using "Banana Peels, Orange Peels, Onion Skins"

Poetic idea to model: what an object (or creature) would say if it could talk. Have the class brainstorm a list of objects and creatures that might have an environmental message for people.

Poetry vehicle to model: conversation. Challenge students to write a conversation between a human and an object or creature on an environmental topic the class is studying.

Poetic techniques to model: repetition, personification. Draw attention to these techniques in the poem, and encourage students to use them in their own poems.

Performance use: performance by an individual student. This is a fun poem for a student to perform, while the other students contribute the human's words. A student volunteer might enjoy the opportunity to dress up as a compost bin; or the whole class could take the role of the compost bin, and a single student take the part of the human.

The Sidewalk Moth and Me

I'm late for home again and rushing.
I see a small-spotted moth
on the sidewalk —
speckled white,
fluttering,
struggling.
I nudge it with my old-sneakered toe.
"Hey, moth. Go!"

The moth crawls
sooo sooooo slowly.
It doesn't
flitter off,
poor old moth.
With the next person's step
this bug may be smushed
squashed
crushed.

I rush off.
But
something winged and quivering
inside me
calls,
urges me
back,
bends
my knees,
makes me
ease the moth
onto my math sheets.
"Come on, this is no home
for moths.
Let's move you
onto that lawn."

When I straighten,
holding the moth on my math,
I spot her —
my teacher
watching,
grinning.
I shrug,
then grin back.
Well, why not?

— Poems by Alison and Mike Flensburg; lesson ideas by Alison Flensburg

Using "The Sidewalk Moth and Me"

Poetic idea to model: connection to another living being. Read "The Sidewalk Moth and Me" along with "Birdfoot's Grandpa" by Joseph Bruchac and "Winter Yard" by Norene Smiley. Prompt the students to write about times someone showed empathy for a living thing. You may wish to brainstorm examples of such incidents, such as helping a hurt pet, or rescuing animals after oil spills or natural disasters.

Poetry vehicle to model: narrative. To encourage creative thinking, you could mention that other vehicles could also be used to express the "poetry idea," such as a request or a conversation.

Poetic technique to model: assonance. Ask the students to listen for assonance and to become aware of its subtle effect in heightening the emotional tone of the poem; encourage them to use this technique in their own poems.

Performance use: choral reading or performance by an individual student.

Other use: introduction to an outdoor activity. Read this poem and "Birdfoot's Grandpa" to your students before taking them on an excursion into nature.

Alison Flensburg is a retired teacher, a children's writer and a performance poet living in Saskatoon, Saskatchewan. She and her husband, Mike Flensburg, are currently working on a number of picture books and two poetry collections for teachers, one on environmental education and another on peace and justice issues.

Alison is seeking to collaborate with teachers who require poems on particular themes. If you are interested in having her write poems for your class in exchange for feedback, please contact her at flensburgam@sasktel.net.

Notes

1. Kenneth Koch, *Rose, Where Did You Get That Red? Teaching Great Poems to Children*, Random House, 1972, pp. 13–17.

2. Koch, p. 10.

3. Thom Henley and Kenny Peavy, *As If the Earth Mattered: Recommitting to Environmental Education*, 2003, pp. 10–11.

4. Koch, p. 24.

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Nicholls, Judith (ed.), *Earthways, Earthwise: Poems on Conservation*. Oxford University Press, 1995, ISBN 0-19-272248-4.

Paladino, Catherine (ed.), *Land, Sea, and Sky: Poems to Celebrate the Earth*. Boston: Little, Brown and Company, 1993, ISBN 0-316-68892-4.

Poetry Foundation website: Provides the Poetry Tool for finding poems on nature (and many other themes) for Grade 7 up <www.poetryfoundation.org/archive/tool.poem.cat.html>.

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Swartz, Larry. *Classroom Events Through Poetry*. Pembroke Publishers, 1993, ISBN 1-55138-008-0.

Vardell, Sylvia M. *Poetry Aloud Here! Sharing Poetry with Children in the Library*. American Library Association, 2006, ISBN 0-8389-0916-7.

Help writing poems

OneLook Dictionary Search: Makes it possible to combine sound with meaning in your word search. (For example, if you want to find a word relating to flowers which begins with "d", you type in "d*:flower.") <www.onelook.com>.

Rhyme Zone: Gives rhymes, synonyms, definitions, and more. <www.rhymezone.com>.

Rhymer: Provides end rhymes, beginning rhymes, first syllable rhymes, last syllable rhymes, and double rhymes. <www.rhymer.com>.

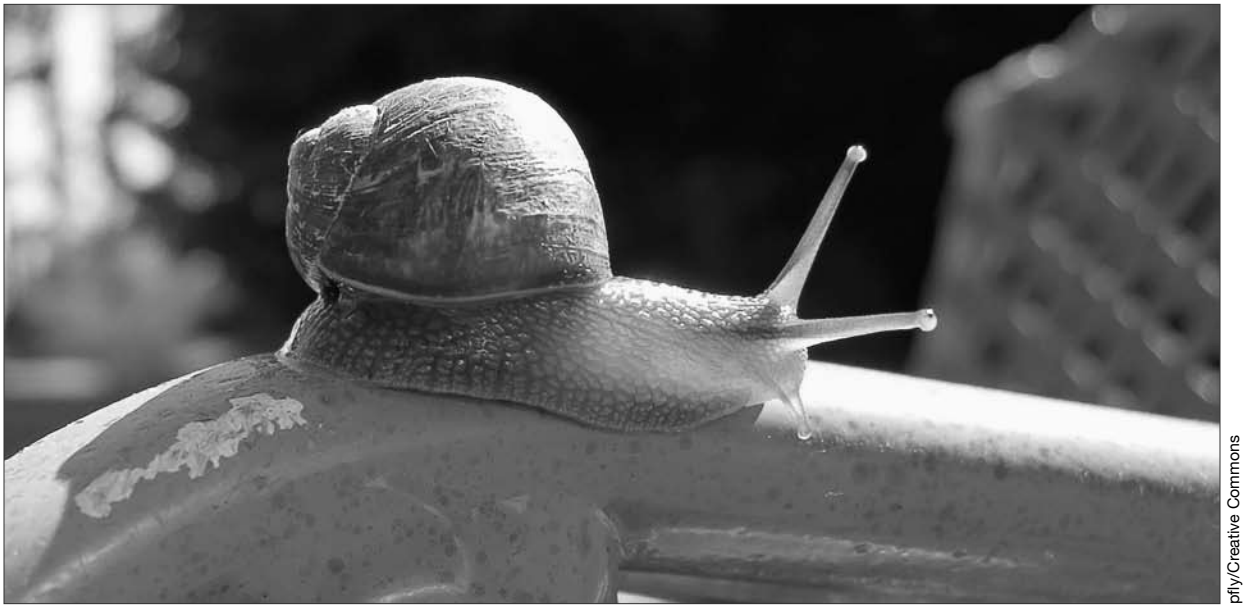
Publishing students' poems

Poetry4Kids: Includes lists of contests for student poets, magazines and websites that publish student poems. <http://poetry4kids.com/links.html>.

Young Poets, project of The League of Canadian Poets: Contains comprehensive listings of markets and contests for youth. <www.youngpoets.ca>.

For Slugs' Sake:

Making a Refuge for Slugs, Bugs and Other Invertebrates



pfly/Creative Commons

by **Angela Wilbers Luekenotto**
and **Janice Schnake Greene**

INVERTEBRATES ARE THE MOST abundant and diverse group of animals on Earth, and yet many students know little about these creatures. They may think that some invertebrates look slimy or may fear being stung or jumped at, and yet be unaware that invertebrates serve a major role in recycling nutrients by decomposing organic material. We tend to hear about the damage that invertebrates do to crops and trees, but we hear less about the good things they do, such as pollinating plants and serving as a food source for the higher animals that we do like.

A study of invertebrates provides excellent opportunities for students to improve their science skills and become more aware of the natural world around them. In this extended exercise, students learn about the characteristics and habitat requirements of invertebrates by making observations, creating a habitat for invertebrates, and designing and conducting investigations. Slugs were chosen as the focus of several of the activities because many people have negative attitudes towards slugs. However, students may choose to work with any invertebrates. While the activities are most suitable for middle school, they could be adapted to any level and have been used in cooperative lessons between a high school class and an elementary class.

The goals of the unit are for students to:

- develop an appreciation for nearby nature areas
- learn about a misunderstood organism (slugs)
- practice research, writing and presentation skills
- become "experts" on one invertebrate organism
- learn about habitat structure and construction

Lesson 1: Take a Closer Look!

Anita363/Creative Commons

In this activity, students develop their skills of observation and discover that small organisms exist all around us.

Materials: Field journals or clipboards, writing materials, string, tape measure or meter stick, hand shovels, magnifying glasses

Procedure: Locate a spot of nature nearby, where students can make observations and record them in journals. This can be the schoolyard, a park, a vacant lot or simply a patch of grass with a tree in it. Focus students' observations by providing specific instructions, such as: 1) describe the plants in the area; 2) describe the animals in the area; 3) describe the weather; 4) describe the terrain or lay of the land; and 5) close your eyes and note all the smells and sounds that you recognize. Students can write their description and make lists and/or sketches in their journals.

Next, have students work in pairs or groups to take a closer look. Have each group mark off a 50-centimeter (20-inch) square with string. Encourage them to use hand

shovels or sticks to dig in the soil, and to get down close and use magnifying glasses in order to see better. Ask them to answer the focus questions again from this closer vantage point and discuss their responses in their group. Follow with a class discussion comparing their first and second sets of observations.

Lesson 2: Slugs and snails, what do you know?

Randy/Creative Commons

This activity provides information about a specific group of organisms that many people do not like.

Procedure: Find out what students know about slugs, and then what they want to know about them. Depending upon the age of the students, you can discuss the relationship of slugs to mollusks, annelids and arthropods, especially with regard to body design. In addition, you can cover the anatomy, reproduction, habitat and behavior of slugs (see sidebar). At the end of class, have students write for two minutes in their journals about what they learned about slugs. Ask a few students to share what they learned.

Assignment: Have students create crossword puzzles using their new knowledge of slugs. (The Discovery Channel website has templates for creating word puzzles; see the Resources list). On another day, students can trade puzzles as a means of reviewing what they have learned.

Lessons 3–4: Slugs and Bugs, Learning Tolerance

In this activity, students role play in order to better understand the roles of invertebrates in the environment.

Procedure:

Tom Quine/Creative Commons

1. Have students, in their journals, create a list of invertebrates they consider pests. Some examples that students might give are spiders, beetles, wasps, silverfish and termites. Develop a top-ten list as a class. Discuss why they chose the organisms that they did and introduce the concept of bias against invertebrates. Anti-animal bias refers to the negative feelings that many people have toward certain animals, even if they have had little exposure to those animals. Using the slug as an example, discuss why people may not like them (e.g., they are slimy, they eat garden plants) and the things that people sometimes do to harm them (e.g., sprinkle salt on them, squash them).

2. Begin a role-playing exercise to address the topic of anti-animal bias. As an example, the scenario could be that the town council wants to rid the community of slugs and is encouraging citizens to kill them indiscriminately. Assign roles, such as grocery store owner, gardener, ecologist, botanist and historian. Some students could take the roles of different animals, those who want slugs around for prey (e.g., frogs, snakes) and others who want to get rid of them because they are competing for the same resources (e.g., herbivorous insects).

   For each role, provide a slip of paper with a brief description of the position. As examples, the gardener might want to kill the slugs because they eat plants, while the ecologist may want to spare the slugs because of the important roles they play as decomposers and prey animals. Have students conduct research so that they can defend their position. Tell them that they personally may disagree with their role, but they should go along with the premise.

Mélomane

Biology of Slugs

Slugs are very similar to snails, except they do not have an external shell. They are in the phylum *Mollusca*, class *Gastropoda*. Slugs have a mantle behind the head, and a radula (sandpaper-like grinding mouth parts) that they use for shredding food into little pieces. Their shorter sensory tentacles are used for smelling and possibly also for tasting. The longer tentacles are sensitive to light and smell. Slugs produce several kinds of mucus, which helps them move around and keeps them from drying out.

While many slugs are detrivores, some eat living plant tissue and a few species eat earthworms and insects. Slugs are nocturnal creatures; during the day, they hide under decaying logs, rocks and fallen leaves to take shelter from the sun and to keep from drying out. They are hermaphroditic, which means that they have both male and female reproductive organs. Eggs are laid in holes in the ground. Depending upon the species, slugs can lay up to 1,000 eggs in several batches. Some species take up to two years to become fully grown.

3. In the next class session, hold a simulated town meeting and give all of the characters an opportunity to explain their position on the issue of slug elimination. Emphasize good listening and questioning skills. Students can be evaluated on how well they are prepared and how well they argue their point. At the end of the period, do a wrap up and relate the discussion to the upcoming lessons on the importance of organisms in their environment. By role playing, students are forced to look at invertebrates from different perspectives. This can increase their understanding of the various niches or "jobs" that organisms have.

Janice Schnake Greene

Lesson 5: Making habitats

In this activity, students collect natural materials to make a terrarium habitat for invertebrates. In the next activity, they collect invertebrates and make any necessary alterations to the habitats to reflect that species' needs. Lessons 5 and 6 may be completed at the same time, depending on the time available and the ease of access to outdoor areas.

Materials: For each group, one terrarium container, such as an aquarium or a clear plastic box with a lid that has holes in it; a large clear jar with a lid, or any type of clear container with a tight fitting lid.

Procedure: Discuss the basic requirements of life (food, water and shelter) and the manner in which invertebrates that live in or on the ground meet these needs. Then take the class outside to gather materials for a mini-terrarium to house invertebrates. Some items to pick up are sticks, moss, leaves, rocks, soil and bark. Have each student group use the materials they collected to make a generic habitat that can later be altered, if necessary, for the specific organism they collect.

Assignment: Have the students brainstorm in their journals what sort of invertebrates might like to live in their habitat. They must justify their suggestions with some facts about the requirements of the organisms.

Lesson 6: Collecting invertebrates

Students will collect invertebrates to live in their terrarium habitats and conduct research on the specific invertebrate they chose.

Janice Schnake Greene

Materials: Hand shovels, small nets, plastic bags, scoops, and small plastic containers with lids (see Conservation Tips and Issues sidebar).

Procedure:

1. Take the students to a nearby nature area and have them examine microhabitats for invertebrates that they can collect for their terraria. Look in the soil for earthworms, pill bugs, mites, etc.; under fallen leaves and on vegetation for slugs, beetles, millipedes and other insects; and on trees or shrubs for preying mantis, walking sticks, etc. Be sure to take some soil that is rich in organic matter (e.g., rotting leaves), because it probably contains a variety of creatures.
2. As the students capture their creatures, tell them to collect some vegetation and other habitat materials if the

Conservation Tips and Issues

- Do not remove organisms from a protected area or nature reserve.
- Make sure to ask permission of the owner before going onto private land.
- Do not take any organism that you will be unable to care for.
- Pay close attention to the natural environment of the organism and try to replicate that in the constructed habitat.
- Watch the status of the organism and, if it is not thriving, immediately return it to its native habitat.
- When you are finished making observations and presentations, take the plants and animals back to where you collected them.
- Do not take any plants or animals that are endangered. If you are unsure, leave the organism in its habitat.

animals' microhabitats are different from the habitat they already made. They should think about the animals' needs for food, water and shelter.


Janice Schnake Greene

3. Back in the classroom, put the invertebrates into the habitats. As the organisms are settling in, students can plan experiments: e.g., what types of food do the organisms like best and how much moisture, heat and light do they prefer. To test for heat, moisture and light preferences, students can provide options within the habitat and observe what the organism chooses. For example, put a light on one end of the terrarium and have items providing cover (i.e., darkness) on the other end, or keep one end of the habitat moist and one end dry or have a gradient of moisture (i.e., one end very wet, the middle damp, and the other end dry).
4. Return the organisms to their natural habitats in a timely manner. We recommend keeping the organisms no longer than one week. This allows time for background research and experiments. However, as noted in "Conservation Tips and Issues," if an organism is not doing well, it should be released sooner.

Assignment: Have students research their chosen organism, using multiple sources, in order to gather information on its scientific name, habitat, life span, basic anatomy, reproduction processes, predators, prey, role in the food web, and other interesting facts. In addition, students should research how human activity affects their organism. Explain that they will be presenting the information to the class and should be prepared to answer questions about their creature.

Lesson 7: Presentation Day

Students can turn in a paper about their organism, or prepare a poster presentation or a PowerPoint presentation. Having students present their research on their invertebrate allows everyone in the class to learn about the organisms. Students should be prepared to ask and answer questions about their creature.

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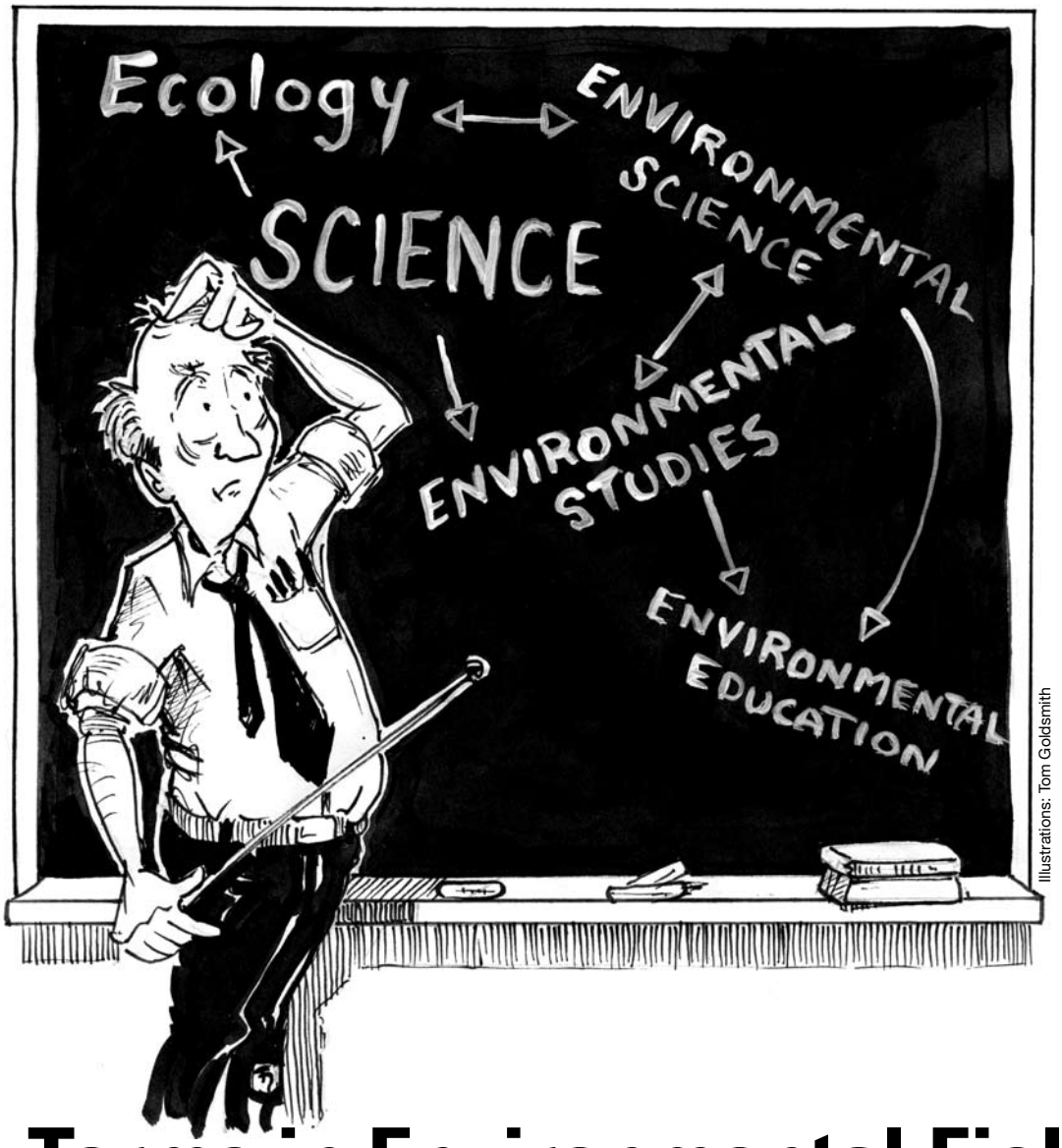

Illustrations: Tom Goldsmith

Key Terms in Environmental Fields: Establishing a Foundation

by **Fletcher Brown**

TERMINOLOGY COMMONLY confuses students when they are first introduced to new topics. Environmental science is no exception. Compounding this problem are the many misconceptions created by some in our society about the radical and left tendencies associated with the environmental fields. Given this backdrop, it is important to begin a high school or introductory college level class that has an environmental focus with a lesson that helps students clarify misconceptions associated with the key terms that stand as a foundation for the class content. The following activity engages, identifies and clarifies students' understanding of the basic definitions of the main fields in the environmental disciplines.

Activity 1: Exploring key Terms

Key terms: science, ecology, environmental science, environmental studies, environmental education

Overview: In this activity, the five key terms listed above are introduced one at a time. As students progress through the list, from science to environmental education, they work cooperatively in groups to construct a shared understanding of each term. The sequence of the terms provides two curriculum structures for the class and students. First, defining the terms in this order provides a historical perspective regarding the evolution of the disciplines one from each other. Second, this order of terms provides a sequence of topics the teacher can follow to guide the course of study.

Procedure:

1. Begin by reassuring the students that specialized terminology is rampant in most disciplinary fields and particularly in the sciences. It is therefore valuable to establish a base understanding of the key terms being used in the class so that everyone will have a similar foundation to build from.
2. Divide the class into groups of three to five. If the class is new, have students introduce themselves and, if time permits, do a simple get-to-know-you activity. Establishing a comfortable environment for discussion and sharing early on is very important because environmental studies involve both learning factual content and exploring feelings and beliefs related to environmental issues. A good activity is the one-on-one interview, in which pairs of students ask each other one or two questions and then introduce each other to the group. Interview questions about where they grew up are particularly effective because the answers provide information about the cultures students come from, which can provide perspective as the class progresses into environmental issues and debates.
3. Write the first term, "science," on the board and have students individually write down their definition of the term. Then have them share their definitions with a partner and their group. Once the groups have agreed on a definition, have each group report to the class by writing their definition on the board.

   Students' definitions will have some variability, but the most important thing to draw out of these definitions is that science is a process of inquiry — that science aims to explore the world by observing, asking questions and testing, in a way that allows others to replicate one's experiments. Through repeated exploration and testing, patterns develop that help answer questions, new questions may emerge, and knowledge is gained through an "objective" process.
4. Introduce the term "ecology," again having the groups discuss and define the term; then, as a whole class, come to an agreement on its definition. It is important to make several points while cooperatively defining this term. One is that the field of ecology is a relatively new branch of science housed in the discipline of biology. This establishes awareness in students of the historical development of these disciplines. Another point to emphasize is that ecology involves the scientific study of both the structural and functional components of the environment, and of the relationships between organisms and the environment. Since many teachers spend time in their environmental science classes having students study both ecosystem structure and function, including these terms in the initial definition is important.
5. Next, consider the term "environmental science." Prior to having students discuss the term in their groups, it may be useful to refer back to the definition of science. In addition, ask students to think about topics that involve the term "environment" to help guide them in this definition. When the term environment in introduced, students commonly think of such topics as acid rain or clear cutting, which characterize human-related problems in the environment. As the discussions progress, many students will continue to come up with a definition of environmental science that is essentially the same as the definition given for ecology. This is a useful starting point from which to say that as ecologists studied ecosystems it became obvious that one species — humans — has a significantly greater impact than others. In turn, the discipline of environmental science began, focused on the scientific study of human interaction with the environment and the associated problems that occur. This leads to the next term to explore.
6. Following the same procedure, introduce the term "environmental studies." Revisit the term "environmental science" and note that it introduced human impact into the discussion. The focus then turns to the term "studies." Students usually have a harder time with this term. One helpful strategy for guiding them is to refer to other programs or disciplines that have the term "studies" in their title. For example, in a women's studies program more than one discipline is involved in exploring, understanding and solving problems and issues. Similarly, in environmental studies one finds law, policy, science and literature, among other disciplines, used to explain and understand the human impact on the environment.
7. The last term to explore and clarify is "environmental education." The aim in defining this term is to introduce the most recent and the broadest approach to addressing the impact that humans have on the environment. One way to help students define this term is to have them think about what they are doing when they are engaged in an environmental education experience. Many will describe walking in the woods, looking at plants and animals, some will describe talking about issues and some will describe cleaning up trash.

   Revisit all of the terms and explain the historical evolution of the fields they refer to. The progression has been from inquiry and the use of the scientific method in the study of our world (science), to the discovery of and learning about the relationships of living and nonliving things (ecology), to humans' growth as a species with a unique and excessive impact on our ecology (environmental science), to trying to understand that these problems are complicated and that to solve them we will need many disciplines working together (environmental studies).

This leaves us with the question of what environmental education is. Here one can identify a commonalty among all environmental fields, which is an interest in having humans interact with the environment in a positive way. This means learning to live in a healthy and sustainable manner as part of the environment. In a broad sense, education environmental education aims to promote environmentally responsible behavior through a variety of different approaches with different age groups.

8. Have students, before the next class, revisit each of their initial definitions of the terms and compare them to the terms settled on in class. This forces students to clarify their misconceptions and rethink the new definitions in preparation for the next activity.

Activity 2: Application of Terms

Having clarified the terms, students now have an opportunity to apply them in a different context. Through reading and discussing articles, students clarify the definitions of each of the terms and see how they are reflected in a professional setting.

Preparation: Select three or four short articles, or excerpts of articles, that focus on the same central topic but reflect the interests of the different environmental fields by dealing with different aspects of the topic. For example, on the topic of birds, I have used a science article about the singing behavior of birds (science), a scientific study about the effect on bird populations of the destruction of forest habitat (ecology, environmental science), and a multidisciplinary report on issues related to the spotted owl in Oregon (environmental studies). For fun, I have also added "Far Side" cartoons, and have included a literature piece to give students different perspectives on dealing with humans' impacts on bird populations and bird habitat.

Procedure:

1. Divide the class into groups of four. Have students pair off and share their initial definitions of the terms and the definitions constructed in class. Give time for students to clarify among themselves what each of the terms means.
2. Hand out to each group the three or four articles selected for the activity (see Preparation, above). Ask students to read each article independently, trying to identify whether its focus is science, ecology, environmental science or environmental studies. Then ask the groups to discuss and try to come to an agreement on which article represents which field. At the end of the class period, have groups share their results with the whole class. Conclude with a summary of the terms and how they are represented in text. This activity helps student apply the terms discussed and gives them an opportunity to see how they are reflected in the professional community and our society.

Summary: By identifying their preconceptions of each term and, as a group, cooperatively constructing a base definition for each of them, students begin the course from the same starting point. This leads to clearer understanding as the semester progresses and gives students an historical perspective on what the environmental disciplines are and where they fit with regard to each other. Finally, by having the students begin the course discussing and sharing their thoughts, the instructor is creating a learning environment that encourages dialogue, sharing, group work and shared understanding, which will likely grow as the semester progresses.

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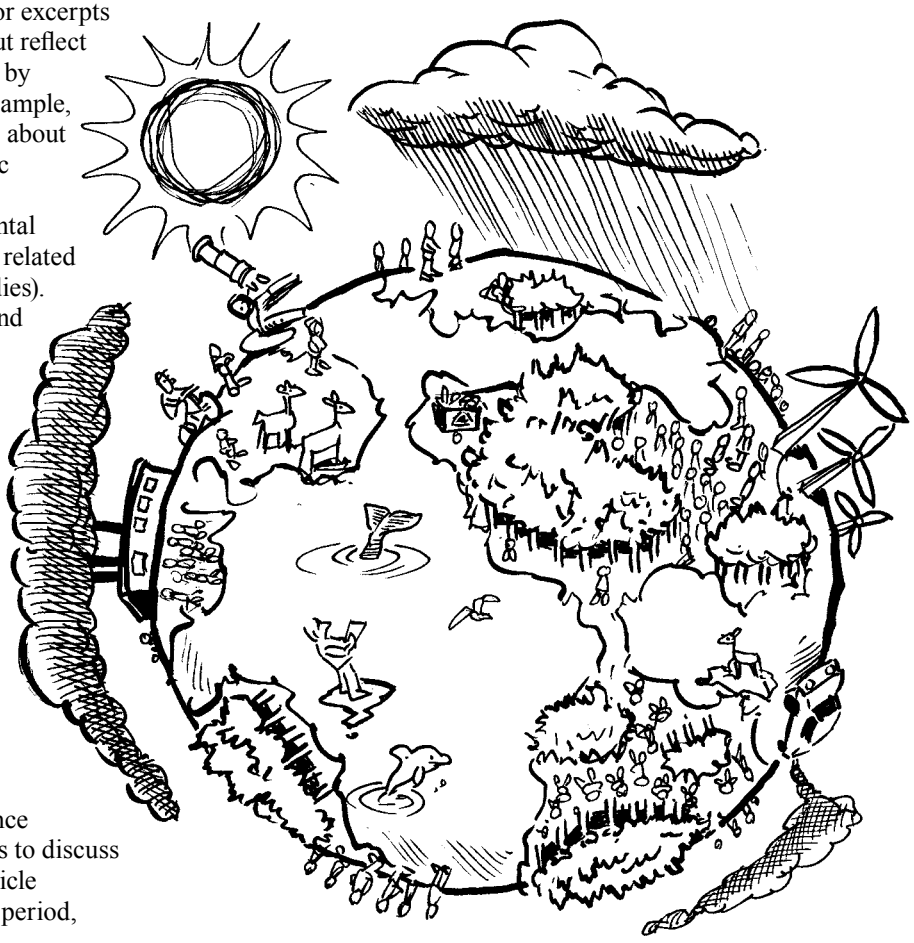


From Seals to Snails: Understanding Eelgrass

Paul Sokoloff

Michael Dufilho demonstrates the use of a dissolved-oxygen meter for determining whether the water is suitable as eelgrass habitat.

by **Nora Beem**, **Michael Dufilho** and **Frederick Short**

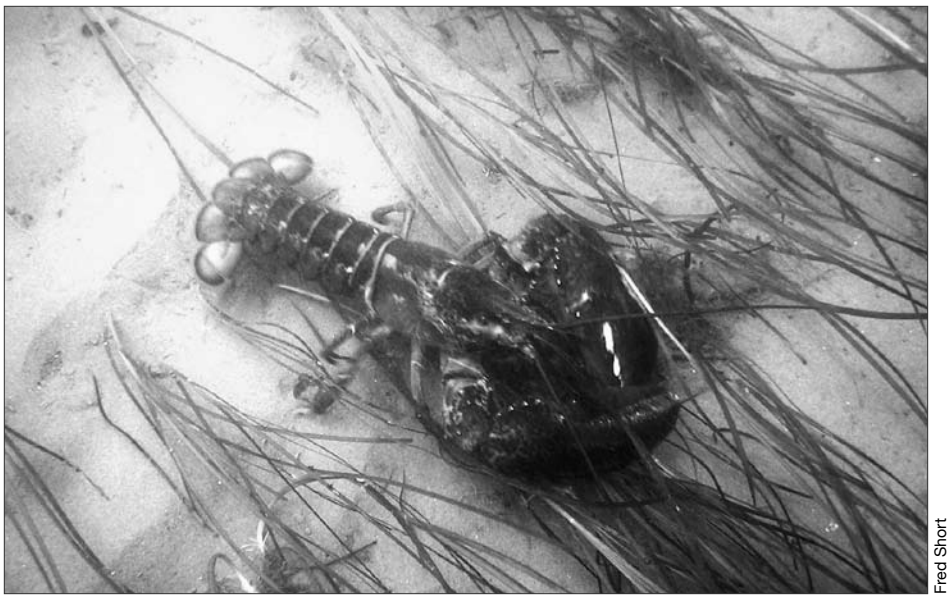
VISITS TO MUCH OF North America's coastline involve splashing in clear ocean waters, strolling along sheltered beaches and indulging in local seafood delicacies. While you are enjoying these offerings, clams slowly burrow downward in the wet sand beneath your toes. Near the mouth of a nearby stream flowing into the estuary a great blue heron methodically hunts. Farther out, by a distant rock, a harbor seal plays. And holding this moment together? Swaying unassumingly, just below the waterline, is eelgrass. A simple gaze at this innocuous plant does little justice to the important role that eelgrass has come to play in estuaries and coastal waters.

Along the coastlines from eastern Canada down to North Carolina, and from British Columbia to California,[1] eelgrass plays the critical role of supporting the tremendous weight of the coastal food web. The plant, ranging from only a few centimeters to over two meters tall, is responsible for improving and maintaining water clarity,[2] reducing wave energy and slowing water currents,[3] providing food for small invertebrates, and creating shelter for juvenile fish species, many of which are commercially important.[4]

Despite its important roles in coastal ecosystems, eelgrass is in decline throughout its distribution area. This decline is commonly attributed to nutrient and sediment loading[5] associated with shoreline development. The following background information and activities focus on the protective role of eelgrass (Predator Snapshot), the complexities involved in cleaning up polluted watersheds (Clean up the Bay!), the effects of environmental stressors on eelgrass function (Stressful Situation!) and the effects of declining eelgrass populations on fish (Habitat Hopscotch).

Well, what *is* eelgrass?

Eelgrass, one of approximately 60 species of aquatic plants known as seagrasses, can be found off the coast of every continent except Antarctica.[6] Seagrasses are not true grasses, but marine flowering plants that grow in shallow coastal waters. Except in some shallow intertidal beds, seagrasses are always submerged and do not possess a rigid leaf structure to provide support. However, they are the only group of marine plants with root systems,[7] enabling these plants to play a critical role in coastal ecosystems. *Zostera marina* is the dominant species of seagrass found in the temperate waters off both coasts of North America.



Fred Short

Juvenile lobsters and other invertebrates burrow in the mud beneath eelgrass beds for protection against predation.

Eelgrass: Cornerstone of the estuarine food web

In estuaries, as in most ecosystems, the energy from the sun fuels the primary producers, such as eelgrass, algae and phytoplankton. Isopods, small arthropods, feed on eelgrass leaves. In turn, the isopods are preyed on by small fish, which seek shelter in eelgrass beds. These fish are preyed on by larger fish, such as striped bass. Harbor seals also feed on the smaller schooling fish as part of their diet.[12] In tropical climates, turtles and manatees graze on seagrass leaves.

Some organisms rely on the physical structure of eelgrass for survival. Mud snails lay their eggs on eelgrass blades to prevent their desiccation,[13] and blue mussels settle on eelgrass leaves in their early stages before settling on the substrate.[14] Some juvenile invertebrates, such as lobsters, burrow in the mud beneath eelgrass beds for protection against predation.[15] Horseshoe crabs forage in eelgrass beds looking for mollusks and marine worms.[16] Even birds utilize eelgrass beds during low tide. Wading birds such as blue herons search eelgrass beds for crabs and fish, while Canada geese graze directly on the leaves.[17]

The dead leaves and other detritus that collect in the eelgrass root system also contribute greatly to the estuarine food web. Gastropods (e.g., snails), grass shrimp and polychetes (marine worms) all feed upon the detrital material in eelgrass beds, which can exceed the biomass of the living plant material.[18] The detritivores help convert nutrients in the plant material back into a form usable by the plants as well as serving as another link in the estuarine food web.

While eelgrass can grow in intertidal waters, it is important to recognize that seagrasses are not salt marsh plants. Plants growing in salt marshes, such as cordgrass (*Spartina alterniflora*) and salt hay (*Spartina patens*) are salt-tolerant terrestrial grasses, not aquatic grasses, even though they are partially submerged during high tide. Eelgrass is also not seaweed. Despite occupying the same waters, eelgrass is a marine plant, while seaweeds are not plants but protists, a kingdom of organisms with no tissue specialization and no root system, and that reproduce asexually.[8]

The importance of eelgrass

Seagrass ecosystems perform a number of ecologically important functions in coastal waters. The root system of eelgrass helps stabilize sediment while anchoring the plant. The leaves and shoots filter particulate matter out of the water column,[9] improving water clarity and light transmission, thus increasing the plant's capacity to photosynthesize. Above ground, seagrass reduces wave energy and slows water currents, allowing suspended material to collect within the seagrass bed.[10] The older leaves and poorly rooted plants are often uprooted in storms, creating floating islands of wrack in an estuary. This dead plant material eventually washes up on shore, where it is an important food source for detritivores (organisms that feed on dead material) such as amphipods.

Eelgrass grows in dense patches known as beds or meadows. The physical structure and camouflaging ability of the seagrass canopy protects juvenile fish and invertebrates from predation. Because juvenile fauna are regularly found in eelgrass beds, the beds are often referred to as "nursery habitats." Commercially important species, including flounder and bay scallops, have all been shown to use eelgrass meadows as critical nursery habitat.[11] Eelgrass habitat not only provides shelter, but also creates an important link between other estuarine habitats, such as salt marshes, oyster reefs and mussel beds.

If eelgrass is so important, why is it disappearing?

Eelgrass decline has been documented along both coastlines of North America and is primarily attributed to nutrient and sediment loading.[19] Shoreline development, characterized by impermeable ground cover such as asphalt and concrete, reduces an area's natural ability to absorb rain and runoff, promotes soil erosion, and leads to higher sediment and nutrient loads entering the estuary,[20] both of which ultimately impact eelgrass growth. Excess sediment in an estuary clouds the water, increasing turbidity and reducing the amount of light reaching the substrate. In declines caused by heavy nutrient loading, also known as eutrophication, eelgrass beds are replaced by algal blooms. Unfortunately, algae do not serve the same functions as eelgrass; areas where eelgrass has been replaced by algae have also experienced a loss in fish and decapod (crab) diversity.[21]

In addition to declines caused by nutrient and sediment additions, eelgrass is subject to direct physical damage from boat moorings and propellers, docks and dredging. Boat

docks reduce light levels, shading out plants and fragmenting eelgrass beds.[22] Dredging and dragging of the estuary bottom through moorings, channel widening and harvesting of mussels uproots plants and reduces water clarity by suspending sediment in the water column.[23]

Activity 1: Predator Snapshot

The Predator Snapshot activity focuses on the role of eelgrass in protecting juvenile and small organisms. The purpose of the activity is to compare the camouflaging ability of vegetated and bare sediment. While it requires significant preparation, Predator Snapshot is a useful and interactive way to address the structural role of eelgrass in an estuary.

Grade level: 5–8

Objectives:

- Compare the protective capability of vegetated and bare sediment.
- Understand the importance of eelgrass as a "nursery" habitat.
- Assess one's own predatory ability.

Materials: Two clear or white plastic containers of 15 liters (4 gallons) or more in volume (for large groups, additional tanks are desirable), green yarn or pipe cleaners, sand or fine sediment, fish cutouts made from foam, monofilament line, metal sinkers, blindfolds

Preparation:

1. Cover the bottom of the containers with an inch or so of sand or sediment and then fill them the rest of the way with water.
2. Set one (or half) of the containers aside — this will be the bare sediment model. "Plant" the other container by burying the ends of the pipe cleaners or yarn in the sediment until the container is covered with eelgrass plants approximately one inch apart.
3. Place the same number of foam cut-outs of fish in both tanks at varying heights — surface, mid-water column and substrate — by tying different lengths of monofilament (fishing line) to the fish and weighing them down with metal sinkers. To explore the concept of camouflage within an eelgrass bed, vary the color of the fish so that students can determine which are the easiest/hardest to spot.

Procedure:

1. Blindfold participants and line them up around the vegetated containers. Explain that in this activity, they will play the role of an aviary estuary predator, such as a blue heron. On your command, they are to remove their blindfolds and study the scene in front of them until you give the cue to cover their eyes again. (If blindfolds are not available, participants can cover their eyes with their hands.) During this time, their assignment is to silently count all the animals they can see. Their viewing time will be only three to five seconds. If the group is large and there are not enough containers to allow everyone to view at once, have the participants view in shifts. However, explain that they must keep their animal counts to themselves until the very end.
2. Once the participants have counted fish in a vegetated container, lead them to a bare container and have them do the same thing.
3. After all of the participants have seen both "snapshots," allow individuals to share how many animals they were able to see in each container. Which container was easier to spot prey in? Which colors were easier to see? After participants have discussed their findings, take them back to the containers for longer viewing. Discuss how this activity reflects real life. Eelgrass beds are critical habitat for juvenile fish and invertebrates because they provide protective camouflage, helping to ensure healthy future populations. What would be the effects on higher trophic levels if there were no eelgrass beds?

Students counting "fish" suspended in tanks during the Predator Snapshot activity

Activity 2: Clean up the Bay

This activity focuses on the complexities of cleaning up polluted waters. It connects well with "Stressful Situation!" (see next activity), which focuses on how water quality affects seagrass populations.

Grade level: 5–8

Objectives:

- Distinguish between effective and ineffective clean-up techniques.
- Understand how individual actions add up on a watershed-wide scale.
- Identify ways to mitigate individual contributions to watershed pollution.

Materials: For each group of six students, one clear or white container of approximately four liters (one gallon) capacity,

Photographs: Paul Sokoloff

The 'bay' after students tried to clean out pollutants.

Students prepare to pollute the waters during the Clean up the Bay activity.

filled half way with water; one pitcher of water, approximately one liter (one quart); six "pollutants" from readily available household materials (e.g., food coloring for nutrient additions, coffee grounds for sediment, vegetable oil for motor oil) placed into six labeled film canisters; four to six tools for "cleaning" the water (e.g., strainers, slotted spoons, tongs)

Procedure:

1. Divide the participants into groups of approximately six. Give each group a container of clean water and a set of film canisters filled with the pollutants and labeled accordingly. Set aside the second containers of clean water for later.
2. Depending on the age of the students, brainstorm potential sources of the six pollutants. Then allow each student to add a pollutant to the water until all canisters are empty.
3. When all of the pollutants have been discharged into the container, provide each group an assortment of tools for cleaning the water. Have them pick the tool they think will be most useful and justify their reasoning (e.g., tongs for large material, strainer for smaller sediment). Continue having the groups choose the next best tool until they have exhausted their options.
4. Have the students look at their containers and consider whether they successfully cleaned their water. Provide the groups with the second, one-liter container of clean water for comparison. What were they able to remove and what weren't they? (While much of the particulate matter will likely have been removed, pollutants dissolved in the water will remain.) What tools were most useful and why?
5. Take a minute to brainstorm with the participants how the remaining pollutants might be removed. Offer the students the clean water as a way of treating the polluted water. Does this help? In real life, is adding more clean water a feasible solution for improving water quality? Have students brainstorm the consequences of increasing the quantity of water in a system (flooding). While adding more water isn't a good option, what would have the same effect? (If less of the pollutants were added to a watershed in the first place, so much wouldn't accumulate.) Brainstorm ways to reduce pollution. Have each person think of an example specific to the pollutant he or she added to the clean water earlier in the activity. Which actions would be easy to accomplish and which would not?

Activity 3: Stressful Situation!

This activity emphasizes the impact of stressors on eelgrass productivity. The term "stressor" is used to describe any factor (cloudy water, excess nutrients) that inhibits the functional ability of eelgrass (photosynthesis, root growth, leaf growth). The stressors can be as broad or specific as the instructor needs to emphasize particular inputs of the system.

Objectives:

- Observe the effects of environmental stressors on overall eelgrass function.
- Monitor the functional ability of stressed plants.
- Identify possible mitigation efforts to improve eelgrass function.

Materials: Four cones or other objects to mark boundaries

Preparation: In a gymnasium or large outdoor area, mark two parallel lines that are 8–10 meters (25–30 feet) apart and long enough for all participants to line up along them.

Procedure:

1. Have participants stand along one of the lines. One member of the group will be an environmental stressor, such as turbid water, and the rest will be eelgrass plants. The stressor begins by standing in the area between the

Paul Sokoloff

Students taking on the role of eelgrass in the activity Stressful Situation!

two lines, facing the other participants. On the designated signal, the eelgrass will run to the opposite line. It is important to explain that the movement back and forth does not represent eelgrass uprooting itself and running along the floor of an estuary. The motion is illustrating the productivity of different processes within a plant (photosynthesis, root growth, leaf growth). As the eelgrass passes from one side to another, the role of the environmental stressor is to tag as many individuals as possible. Once plants cross the line, they are off limits for the stressor.

2. When all of the participants are standing on the opposite line, ask for a show of hands from those who were affected (tagged) by the stressor. Plants that were affected have a lower functional ability than the healthy plants. To represent this, the plants affected by the stressor must cross the playing field hopping on one leg in the second round.
3. Once all of the plants have crossed for a second time, ask the participants how many healthy plants were affected by the stressor. These individuals will lose the use of one leg in the next round. Then ask how many stressed plants were again affected by the stressor. These doubly stressed plants will be reduced to crawling in the next round. If in subsequent rounds the highly stressed (crawling) eelgrasses get tagged by the stressor, they will be considered dead and must sit out the remainder of the activity. An alternative is for dead eelgrass individuals to become additional stressors in the system.
4. After several rounds, discuss the implications of the different stress levels. How did the stressor affect healthy plants? *(Slowed them down slightly/reduced ability to carry out normal functions).* How did the stressor affect the already stressed plants? *(Severely reduced movement/function of plants).* What might these stressors be? *(Cloudy water from sediment or algal blooms caused by nutrient loading).* How could we reduce their effect? *(Reduce their input into the system: plant vegetative buffers to reduce sediment, apply less fertilizer, better sanitation systems).*

Activity 4: Habitat Hopscotch

Habitat Hopscotch is an active game that highlights fragmentation of eelgrass habitat in the Great Bay Estuary in New Hampshire. It was adapted from Migration Headache[24] and Wetlands Hopscotch.[25]

Objectives:

- Understand the implication of habitat fragmentation on higher trophic levels.
- Learn potential causes of habitat loss in the Great Bay Estuary.
- Identify possible solutions and mitigation efforts for habitat loss.

Materials: 10–15 carpet squares or other non-slip placemats to represent eelgrass beds, 8–10 "fate cards" (see examples below) in a bag or other container

Possible Fate Cards:

- Eliot builds a golf course on the waterfront – remove 1 square
- Newington develops a water park next to the river – remove 1 square
- Wagon Hill Park purchases abutting land for more trails – remove no squares
- Newmarket installs a new sewage treatment facility – remove 1 square
- Summer houses are built on Nanny Island – remove 2 squares
- Newington power plant shut down – remove no squares
- Restoration effort replants grass – add 1 square
- Students urge conservation commission to restore vegetation in a park below Oyster River dam – remove no squares
- Clear cutting for new housing development – remove 1 square

Paul Sokoloff

Learning about habitat fragmentation in Habitat Hopscotch.

Procedure:

1. Start the activity by arranging the "eelgrass patches" (carpet squares) into a hopscotch-like formation. Explain to the participants that they have been transformed into small fish within the Great Bay Estuary. Their mission is to travel from one end of the estuary to the other without getting eaten by larger predators. To do this, the fish must remain within eelgrass habitat at all times. Start by letting each fish hop easily from eelgrass patch to patch until they reach the end of the estuary.
2. Have one of the participants pick a fate card from the bag and read it aloud. Apply the fate to the eelgrass and have the fish travel through the estuary again. Fish who are not able to make it from one end of the estuary to the other are eliminated from the round. At the end of each round, determine by a show of hands how many fish survived. For future or graphical analysis, the instructor can record the number of eelgrass patches and surviving fish.
3. Play through several rounds with the fate cards until the students can no longer travel the entire estuary or understand the implications of habitat fragmentation. Afterwards, discuss with the participants what potential actions could be taken to reduce or restore eelgrass habitat.

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The research and outreach associated with this article was created at the University of New Hampshire's Jackson Estuarine Laboratory. It is contribution 488 from the Laboratory towards published literature.

Notes

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The Hawk in the Nest

A circle game for teaching early elementary students about trophic levels

by **Edith Pucci Couchman**

PLAYING CIRCLE GAMES is a traditional way for people to have fun together. Here's a version of "The Farmer in the Dell" that can help children up to age seven or eight — or perhaps older — learn about food chains within a given habitat. On one level, this is a classic singing, skipping and choosing game. On another level, it builds students' understanding of how energy is transferred through various creatures within a community.

Here are the basics: Let everyone know that this game is similar to "The Farmer in the Dell." The melody of the song is identical, but the words are different. The point is to create realistic food chains and have fun learning in a group.

Hawk: Top carnivore

To begin, everyone joins hands and forms a large circle. The circle represents the interconnecting trees and other inhabitants of a forest ecosystem. One person is selected to be the "Hawk." The hawk is, of course, a top carnivore in numerous food webs in North America. Since Broad-Winged Hawks, with their short, highly maneuverable wings, are especially well-suited for life in New England forests (where my classes play this game), I usually designate this species as our starting player. By calling students' attention to the existence of different types of hawks in their region, I hope to stimulate their awareness of biodiversity.

Hawk goes into the center of the ring where he or she stands or swoops about, acting hawk-like. Meanwhile everyone else begins circling clockwise, singing once or twice, "The Hawk in the nest, the Hawk in the nest, Heigh-ho, the forest oh, the Hawk in the nest."

The next line is: "The Hawk takes the _____." At this phrase, everyone stops circling and listens as Hawk announces what (or rather whom) he or she is having for supper. As needed, the teacher prompts, "Which creature would a hawk select for dinner: a mouse, a squirrel, a careless sparrow, or perhaps a chipmunk?" Any creature that a real hawk might use for food can be named. Students forming the circle call out menu suggestions to Hawk. When Hawk has made up his/her mind, he or she chooses a student and leads that person from the ring into the central area. Let's imagine that Hawk has chosen a deer mouse, a small white-footed rodent that is very common in our forests. Everyone sings, "The Hawk takes the Deer Mouse. The Hawk takes the Deer Mouse. Heigh-ho, the forest oh, the Hawk takes the Deer Mouse."

Deer Mouse: Omnivore

Next, the circling students sing, "The Deer Mouse takes the _____." And now it's time for Deer Mouse to tell what his/her favorite snack might be. At this point, the youngsters almost invariably call out, "Cheese." Teachers can then explain that just now the goal is to build a forest food chain without careless campers who might have left behind cheese sandwiches. Suggest that students consider instead what deer mice eat in their environment when there are no people around. Perhaps Deer Mouse will choose a crunchy June beetle or a softer moth larva or a huckleberry, etc. As you can see, this game offers many opportunities to provide detailed but very relevant natural history information.

Suppose that Deer Mouse selects a June beetle. Cue the students to the most euphonious, rhythmic chant possible, i.e., you might shorten the creature's name to simply "Beetle" or perhaps drop the word "the" and replace it with "June." The resultant lyric might be "The Deer Mouse takes June Beetle. The Deer Mouse takes June Beetle. Heigh-ho, the forest oh, the Deer Mouse takes June Beetle." During the singing, Deer Mouse surveys the revolving students, selects one to be Beetle, and brings that child into the center.

June Beetle: Herbivore

Now that everyone is beginning to understand the process, one of the youngsters might call out, "June Beetle, what are you going to eat?" Here's an opportunity for a discussion about what kinds of things different beetles eat at various stages of their lives. Do students know that some beetles are like the tigers of the forest floor racing about gobbling other insects, while others eat plant parts such as pollen or roots, or that still others are recyclers and decomposers of dead creatures? In this particular instance, let's assume that our well-informed June Beetle replies to the questioners, "A leaf of the red oak tree." This would prompt the others to sing, "June Beetle takes the Oak Leaf. June Beetle takes the Oak Leaf. Heigh-Ho, the forest oh, June Beetle takes the Oak Leaf." Now June Beetle has the enviable social challenge of choosing an Oak Leaf from the circling singers.

Oak Leaf: Photosynthesizer

Next it's Oak Leaf's turn to select the food. This is a key moment in the game — a fine chance to transmit or reinforce important information about botany and photosynthesis. Remind the students that trees, grasses, berries, nuts, flowers and seeds are all beings or parts of organisms that belong to the great kingdom of Plants (a difficult concept for children to grasp until the stage of operational thinking, usually sometime after age eight).

Make certain that the youngsters know that most green plants obtain their food (energy) from the sun. Keeping this in mind, they'll understand why the child representing a plant (whether an oak leaf, a walnut, a milkweed blossom or a bit of maple bark) always chooses the sun as a food source. If the group is patient and interested, you could explain that green plants (like the Oak Leaf) use the sun's radiant energy to transform water and carbon dioxide into energy-rich food molecules. The plants weave the tiny atoms together to create sugars and starches. At the same time, they release free oxygen. This wonderful process (photosynthesis) allows the plants (and certain bacteria and protists) not only to feed themselves but also to feed other creatures. Plants form the foundation of the food webs here on Earth. Without plants and the sun, most life as we know it couldn't exist on our planet. Thinking about this, the children sing, "The Oak Leaf takes the Sun. The Oak Leaf takes the Sun. Heigh-ho, the forest oh, the Oak Leaf takes the Sun."

The Sun: Earth's energy source

As the game draws to a close, things become a little more exciting. The selection of the Sun is accomplished with great fanfare and enthusiastic commentary. I usually make a point of saying that the sun is an immensely powerful source of energy and our closest star. Energy from the sun (solar energy) not only forms and flows through almost all of Earth's food webs but it also helps power the winds and weather, the water cycles, and even, to some extent, the ocean currents. For older groups, I might mention that the sun is a place where nuclear fusion is constantly occurring, transforming matter into energy and sending vast quantities of light and other types of electromagnetic radiation out into space. And given that the sun is *so* powerful and *so* very hot, everyone has to be very careful not to get too close to the sun itself. Therefore, once the Sun is chosen and brought gingerly into the center, all of the other food chain creatures must scamper from the middle and rejoin the outer circle, thereby avoiding being burnt to bits. The entire ring stretches out to give the Sun plenty of room to shine. The children skip and sing, "The Sun helps feed us all. The Sun helps feed us all. Heigh-ho, the Forest oh, The Sun helps feed us all."

And this concludes the game. After giving thanks to the food chain creatures for their clever work and to the Sun for being such a brilliant star, the teacher can start a new round by asking Sun to select the next Hawk. And so the game continues. The physically active kids have had a chance to move about; the shy ones have participated in a structured, relatively pleasant and inclusive group; the more socially-minded youngsters have had some time to build their relationships with peers; the musically inclined have been able to sing; and many of the students have learned something new and true about the inhabitants of the forest.

Variations and extensions

Certainly, there are thousands and thousands of food chains that can be realistically constructed. For the forest habitat, you could challenge your class to see how long a food chain they can devise — and fit into the circle. Could they think of a different top carnivore or perhaps start with a scavenger? Could there be a "Barred Owl in the Pine Tree" or a "Bobcat in Its Den?" What about a game for a different habitat? A game for wetlands could have an opening line about "A Heron in the Marsh, A Heron in the Marsh, Heigh-ho, the Wetlands oh, The Heron in the Marsh." You could have "The Pickerel in the Stream" for a freshwater habitat or "Tree Swallow in the Meadow" for a temperate forest in early succession. There could be "Sea Stars in a Tide Pool" for a rocky shore biome or "The 'Gator in the Swamp" for a southern wetland. Older students who have been studying biomes on other continents could form teams and create variations on this game to teach their classmates what they've learned. Imagine "The Jaguar in the Ferns" for a South American rainforest or "The Hawksbill mid the Corals" for the Great Barrier Reef of Australia.

Finally, for any of these scenarios, it's especially fun if the children act like the creatures they're representing. Encourage them to use gestures and sounds. Can't you just see the Leopard Frog hopping or the Flying Squirrel gliding or hear the Field Cricket chirping?

Circle games — the fun and learning are almost never-ending.

Edith Pucci Couchman teaches art and environmental science for Beaver Brook Association in Hollis, New Hampshire, and at Maple Dene Elementary School in Pepperell, Massachusetts.

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Acting Out Energy Forms

A pantomime activity for teaching about different forms of energy

by **Arianna Alexsandra Grindrod**

LIGHTING HOMES, heating water, warming spaces, running machines, driving cars and flying planes — everything we do requires energy. In a most basic sense, energy is a force capable of performing work or of organizing or changing matter. But how do we teach about it this invisible force? "Acting Out Energy Forms" is an engaging pantomime activity that helps provide a context for teaching scientific principles related to energy transformations, chemical transformations, electricity and light, which are central to many clean energy technologies. Using pantomime is a fun and effective way to teach if you are comfortable having your students out of their chairs and getting a bit riled up. Active learning helps students comprehend complex ideas. They may not remember the term "kinetic energy," but once they have acted it out, they will remember that energy can be in motion.

For younger students you may decide to introduce energy as a basic concept and pick only a few energy forms to pantomime. For older students you may decide to use this activity as a template to teach the concepts and then have your students create or construct representations of various energy forms as artistic expression pieces or physical science displays.

In addition to introducing students to energy forms, this activity can be used as a stepping stone to larger, interdisciplinary topics such as human impacts on energy supply and demand, climate change, current and future lifestyles, sustainability practices, distributed power generation and innovative energy technologies.

Background: Energy forms and sources

Energy occurs in many forms and is classified as either kinetic energy (in motion) or potential energy (stored) and can be converted from one form to another.

Kinetic energy

Electrical energy is the movement of electric charges. Electricity, which is the movement of electrons through a wire or other conductor, is an example of electrical energy. Lightning is another example.

Mechanical energy is the movement of objects or matter. Throwing a ball, lifting a weight, pulling a wagon and pedaling a bike are all examples of mechanical energy. Wind and moving water are also examples of mechanical energy. Sound, which is the movement of molecules in a wave, is another example of mechanical energy.

Radiant or light energy travels in electromagnetic waves. It includes visible light, which our eyes can see, and also gamma rays, x-rays, ultraviolet radiation, infrared (heat)

radiation, microwaves and radio waves. Sunlight is an example of radiant energy.

Thermal (heat) energy is the vibration and movement of atoms and molecules within a substance. The hotter a material is, the faster the atoms and molecules that make up that material are moving.

Potential energy

Chemical energy is energy stored in the bonds that hold molecules together. Food, batteries, fossil fuels and biomass (plants) are examples of items that have stored chemical energy.

Stored mechanical energy or **elastic energy** is energy stored in objects that are either compressed or stretched. Stretched rubber bands or compressed springs are examples of stored mechanical energy.

Magnetic energy is energy produced by the magnetic field that causes magnets to attract or repel.

Nuclear energy is the energy that holds the nucleus of an atom together. This energy is released when nuclei are split apart (called fission) or combined (called fusion). Nuclear power plants split atoms to release energy. The sun releases energy when it combines hydrogen atoms to form a helium atom.

Potential energy or **gravitational energy** is the energy of position. An object has potential energy when it is in a position to be acted upon by gravity. Water stored behind a dam is an example of potential energy. A book teetering on a bookshelf is another example.

Energy resources

Energy resources are natural resources that can be extracted or captured for the energy they contain. Crude oil, coal, sunlight and wind are all examples of energy sources. Renewable energy sources, such as wind, sunlight, plants and moving water, are those that are naturally and continually replenished. Compared to non-renewable energy sources, such as fossil fuels, renewable energy sources are more sustainable and less damaging to the health of organisms and to the environment on which life depends. "Green energy" is energy obtained from renewable resources that produce little or no pollution and that replenish themselves faster than humans consume them.

Acting out Energy Forms

Objectives:

- Students learn that there are several forms of energy.
- Students are introduced to scientific principles related to energy transformations, electricity and light.

Grade level: K–8

Procedure:

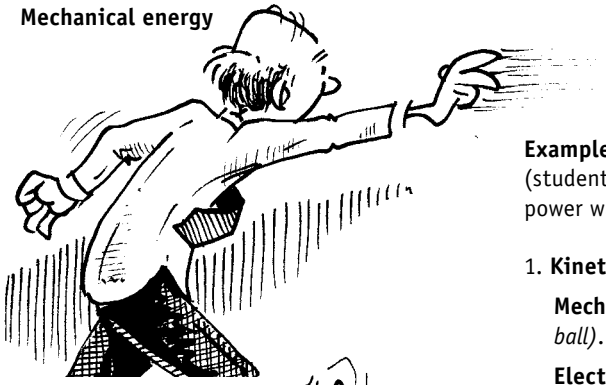
1. Discuss the topic of energy with your students, referring to the background information provided above.
2. Choose an open area large enough to facilitate moving about. Introduce the activity by telling students, "In order to learn a little bit about how energy works in our lives, we are going to act out the various forms of energy." Explain that they will need to listen and watch, because this is a repeat-after-me, do-as-I-do game.
3. Using the "Acting Out Energy Forms" activity reference sheet (see page 40), have students mimic you as you act out energy forms. After many chuckles, inquire what knowledge your students retained. Challenge them to state or act out each energy form's definition.
4. For classes that keep science journals, have students write the definition, as they remember it, of each energy form and draw a representational image the definition.

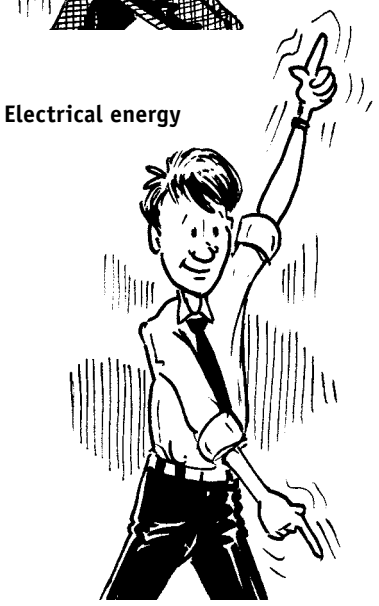
Arianna Alexsandra Grindrod is the Education Director at the Northeast Sustainable Energy Association in Greenfield, Massachusetts. She created the "Acting Out Energy Forms" activity for the Northeast Sustainable Energy Association's teacher-training series Energy Thinking.

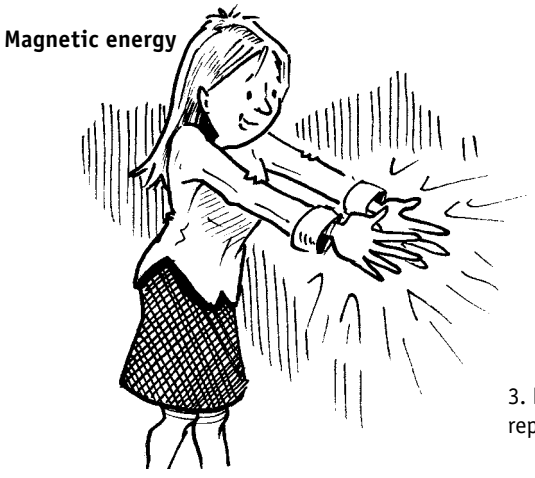
The **Northeast Sustainable Energy Association (NESEA)** focuses on promoting the understanding, development and adoption of energy conservation and non-polluting, renewable energy technologies. The NESEA K-12 Education Department offers professional development opportunities and resources for teachers, non-formal educators, and community mentors, and curriculum and programs on energy efficiency and energy conservation, and on forms and applications of renewable energy. Visit www.nesea.org or call (413) 774-6051.

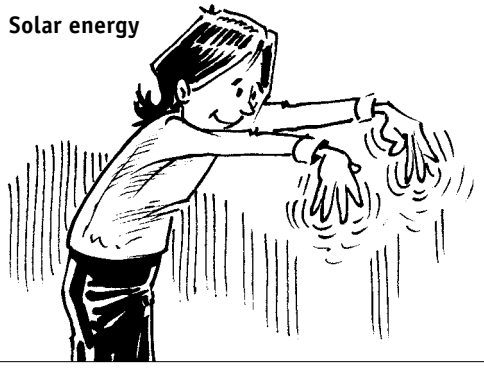
Acting Out Energy Forms

Leader's Reference Sheet









Example: The leader says, "Kinetic energy" (students repeat) "is energy" (students repeat) "in motion" (students repeat). The leader pretends to power walk, and the students mimic the action.

1. **Kinetic energy** is energy in motion *(pretend to power walk)*.

   Mechanical energy is energy that is a moving object *(pretend to throw a ball)*.

   Electrical energy is energy that is electrons moving through wires *(put hands at sides and shuffle fast a few paces, turn and continue to shuffle, as if you are moving inside a wire)*. Electrical energy is also lightning! *(Pose with your hand raised at a diagonal, finger pointed up to the sky and then point down across your body to the ground. Repeat a few times. Think disco dancing.)*

   Radiant energy is the energy of electromagnetic waves, or light, traveling from the sun *(splay fingers, pointing slightly down and move your arms in a downward wave motion, mimicking sunrays traveling to Earth)*.

   Thermal energy is energy that is vibrating due to heat *(jiggle up and down slightly)*. The hotter the matter gets, the faster it moves *(jiggle body up and down faster)*.

2. **Potential energy** is energy that is waiting *(tap your foot and look at your wrist)*.

   Chemical energy is energy stored in food *(pretend to pick up a treat and smack your lips)*, in batteries *(pretend to hold a battery up examining it)*, in fossil fuels *(squat into a ball like a lump of coal)*, and in plants *(feet and legs together, arms out like leaves, head arced to sunlight)*.

   Elastic energy is energy stored in an object that is either compressed *(tighten up your body)* or stretched *(stretch your body out like a rubber band)*.

   Magnetic energy is energy created by a magnetic field *(pretend your hands are magnets attracting and repelling)*.

   Nuclear energy is energy that holds the nucleus of an atom together *(pretend to hold something small in your hands)*. Energy is released when nuclei are split apart *(pretend to pull something apart between your hands)* or forced together *(clap your hands once)*.

   Gravitational energy is energy in a position to be acted upon by gravity *(look down and teeter on your feet, as if you are about to fall — be dramatic with hands waving, body bobbing)*.

3. **Renewable Energy** is energy from sources that are naturally and continually replenished.

   Solar energy is energy that comes from the sun *(splay fingers, pointing slightly down and move your arms in a downward wave motion, mimicking sunrays traveling to Earth)*. The sun's rays touch the solar panel and the energy inside gets excited *(dance in place)* and makes electricity *(diagonally hand dance up and down)*.

   Wind energy is energy that comes from wind turning big metal turbine blades in the sky *(wave your arms in big slow circles and make a low and constant "whoosh" sound)*.

   Water power is energy that comes from moving water *(move hands in wave-like motion)* falling down on turbine blades and turning them *(bend over sideways as if falling and spinning your arms)*.

Resources

Resource reviewers:
Debra Bridgeman, Alan Crook, Tim Grant, Jon Hayes, Phyllis McKenzie, Nate Meyer, Tracy Norris, Nancy Sklavos

Architecture and Education

What happens when architects and educators intersect? School buildings, from kindergartens to community colleges, are designed as inspired spaces for experiential learning.

Anne Taylor's groundbreaking book *Linking Architecture and Education: Sustainable Design for Learning Environments* bridges the realms of architecture and education to show stunning examples of holistic school designs from around the world. Each chapter features case studies of green buildings and an analysis of their impact on the environment. For Taylor, a successful design must respond to the needs of its users, and thus she encourages the involvement of students and the community in shaping a plan. With contributions from many architects, educators, designers and school planners, this hefty book is idealistic in its vision, but includes practical design considerations for green classrooms, composting facilities, trails, school gardens and outdoor classrooms. In its hundreds of inspiring examples, architects, administrators, school boards and teachers will find much worth exploring in this beautiful, wide-ranging book. – *(JH)*

University of New Mexico Press, 2009, ISBN 978-0-8263-3407-7, 471 pp., $100 from UNM Press, (800) 249-7737, <www.unmpress.com>.

EcoTipping Points

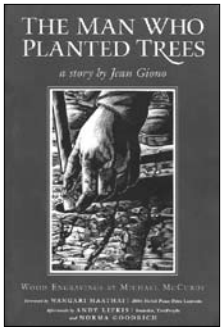
The EcoTipping Points website features over 100 environmental success stories collected from around the world by a team of scientists and journalists. The stories address diverse topics, but what they have in common is a "lever," referred to as an "EcoTipping Point" — a community process that reverses environmental decline and establishes a course towards restoration and sustainability. Building upon insights from the science of human ecology, the website offers lessons based on the stories, while explaining how EcoTipping Points work and what it takes to create them. – *(TG)*

<www.ecotippingpoints.org>

Big Ideas

The Center for Ecoliteracy's aptly named book *Big Ideas* focuses on "the enjoyment of food as a starting point for understanding the web of ecological relationships." The book is divided into chapters for Grades K-2, 3-5, 6-8 and 9-12, each of which is further divided into four interconnected thematic areas — Food, Culture, Health and the Environment. In each section, the authors introduce a big idea and then provide essential questions, key concepts and sample activities to guide the exploration of that idea. Students will be captivated by the questions, which help to uncover the ways in which culture influences our beliefs about food: for example, "What do farm animals need to survive and thrive? (Grades K-2); "What food traditions do different cultures have? (Grades 3-5); "In what ways do decisions about agriculture influence people's health? (Grades 6-8); and "What are examples of ways in which our society favors individual rights over the collective good as it relates to food?" (Grades 9-12). Most of the activities engage students in experiential learning, such as through creating a food garden or visiting a local food bank. This resource is an especially useful tool for anyone interested in environmental curriculum at all grade levels. – *(TN)*

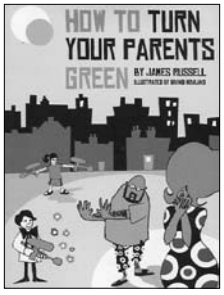
The Center for Ecoliteracy, 2008, ISBN 978-0-9818409-0-1, 120 pp., US$16.95 from Acorn Naturalists, (800) 422-8886, <www.acornnaturalists.com>.



The Man Who Planted Trees

Jean Giorno's famous story *The Man Who Planted Trees* is an inspiring tale of a shepherd who spends his life planting hundreds of thousands of trees throughout his mountainous community in the foothills of the Alps. His tireless efforts repair a damaged environment and restore its life-giving systems. This story of how a barren landscape is transformed into a thriving ecosystem through the devoted efforts of a single man is beautifully illustrated by Michael McCurdy's wood engravings. In the back of the book, a brief biography of Jean Giorno precedes a report by Andy Lipkis about how the tree-planting efforts of TreePeople had a positive impact on communities and individuals in the Los Angeles area. Suitable for 10- to 18-year-old readers, *The Man Who Planted Trees* is a highly motivational tale that reminds readers of the positive impact one person can have on the world. – *(NS)*

Chelsea Green Publishing Company, 2005, ISBN 978-1-933392-81-3, 61 pp., US$10 from Chelsea Green, (800) 639-4099, <www.chelseagreen.com>.

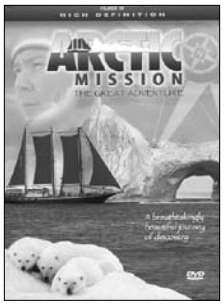


How to Turn Your Parents Green

James Russell's humorous *How to Turn Your Parents Green* is a pocket-sized, non-fiction book designed to empower 9- to 15-year-olds (the Greens) to challenge their parents (the Groans) to join them in becoming eco-warriors. The Groans grumble and gripe and are responsible for global warming, but will leave the Greens with the mess. The book provides a charter for the Groans to sign, and suggests fines to impose on

the adults refusing to change their wasteful ways. It presents information about global warming and other issues in a bold, colorful design with kid-friendly illustrations. Chapters such as Revolting Rubbish, Water Wasters, and Pester for the Planet ask questions and provide planet-saving suggestions. – *(NS)*

Tangent Books, 2007, ISBN 978-0-9553520-9-6, 91 pp., US$10.60/C$11.20 from Tangent Books, (0117) 972-0645, <www.tangentbooks.co.uk>.



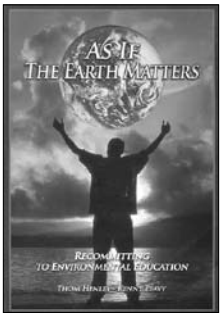
Arctic Mission

This five-DVD documentary series about a 2002 scientific research voyage to study the effects of global warming in the Arctic is indeed "a breathtakingly beautiful journey of discovery," as described in its promotional literature. It is also not subtle: the first scene shows a dead polar bear washed up on a beach; the last scene is an aerial view of wormlike trails left when caribou attempt to cross the now too-thin ice during their fall migration, breaking through again and again until they die of exhaustion and hypothermia. The film attempts to put a human face on, and evoke human reactions to, the fact of global warming. The first part describes the ship, the *Sedna IV*, and chronicles its five-month, 16,000-kilometer adventure through the Northwest Passage. It touches sufficiently on all of the topics covered in the series that it could stand alone, particularly for younger audiences. The other parts look at Inuit concerns about melting permafrost and erosion; the causes and dynamics of global warming from a northern perspective; climate adaptations of Arctic wildlife; and Inuit responses to climate change through the seasons. The videography is amazing and evocative, the Inuit throat singing haunting, and the pace slow, making you feel as if you're there. David Suzuki provides effective narration, and perspectives from the crew provide a personal touch. Also available is the DVD *Arctic Mission: An Interactive Adventure*, a question-and-answer game for ages 9-12. Players are on a mission to save the polar bears and must answer questions in order to proceed on the journey. Used thoroughly, this game provides an overview that could replace the first segment of the documentary. Overall, *Arctic Mission* offers a minimum of information about what kids can do to slow global warming (mostly on the interactive DVD), so be prepared to provide some hope and direction, or despair may prevail. For that reason, I'd avoid using it below Grade 6. But use it I would. – *(AC)*

National Film Board of Canada, 2005, ISBN 0-7786-2333-5, 5-DVD set, 384 minutes, C$237.95; Interactive Adventure DVD, C$79, from National Film Board of Canada, (800) 267-7710, <www3.nfb.ca>.

As If The Earth Matters

Thom Henley and Kenny Peavy's *As If The Earth Matters* succeeds quite admirably in its aim to "help you organize positive experiences in nature for your students." The authors' extensive experience in leading overnight camping experiences comes through loud and clear. The book has three major sections — awareness (a misnomer, as conceptual understanding is covered as well), immersion and stewardship. Awareness and individual immersion activities are generally well-described, using quotes from instructors and participants to make it seem more immediate. However, some details are left out in a few of the more complex activities. Seasoned hands will immediately fill in the gaps, but they may be problematic for neophyte leaders. Seasoned hands will also find lots of their old favorites, as well as some, at least to me, new and innovative stuff. Common camp games and some old standards (e.g., "Web of Life"), are dressed up with some good adaptations, extensions and probing questions. However, some activities from other programs, most notably "Oh, Deer!" from *Project WILD*, appear to be adapted without recognition of sources. This should be corrected in the next edition. The extended immersion and stewardship experiences are first-hand descriptions of case examples, not detailed how-tos. They are meant to inspire, and they do. While the stewardship examples have enough detail to direct general planning, the extended immersion experiences do not. There is a good focus on indigenous cultures throughout. A short tool kit gives teachers a sample proposal for an outdoor classroom and some tips on working with kids outside. Copious color photographs only increase the attractiveness of this book – *(AC)*



New Society Publishers, 2007, ISBN 974-93937-2-4, 256 pp., C$23.95/US$19.95 from New Society Publishers, (800) 567-6772, <www.newsociety.com>.

The Whale Game

The Whale Game is a computer game that takes players on a globe-girdling voyage of scientific adventure and discovery. It is also one giant quiz on everything you should know about whales, whale behavior, whaling and by-catch. There's lots of reading, with information presented in hyperlinked sections and geared for Grade 7 and up. In some cases, you must answer questions correctly or make good decisions to increase the whales' chances of survival, while in others you just observe and learn. But learn fast, because the hard part's right at the start. To raise money for your expedition, you must answer ten questions. If you miss one, you're back at the start with some new questions to deal with, and they're not easy. Your journey is also broken up by simple games in which success helps the whales' chances. The game would be useful for independent study, a unit review or as a class effort projected on a SmartBoard. It requires some self-motivation because there aren't enough bells and whistles to encourage most students to finish the voyage independently. Check out the demo at their website. – *(AC)*

C$9.50 from Environmental Education Games, <www.environmental-education-games.com>.

Eagle Eye

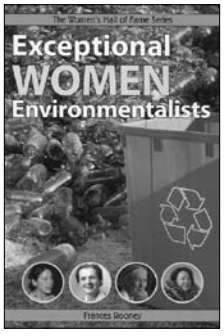
Eagle Eye: A Life and Death Tale of Ecological Intrigue, written and performed by Peter Donaldson, is a thought-provoking one-man performance that beautifully relates knowledge and questions about sustainability, biodiversity and climate change in the form of a legend. Through the eyes of a young bald eagle, we ponder, "Is

the Earth in me or am I in the Earth?" and take a systemic look at the impact and value of humans as part of the web of life. The film of the performance is supported on the DVD by a curriculum that includes 22 inquiries drawn from the script and presents the topics in a way that invites further exploration. In addition to the performance, interviews with experts give insights into the three themes of the play: sustainability, systems thinking and biodiversity. Intended for high school and college students in the sciences, social studies and performing arts, the performance may also work well as an introduction to the topics of biodiversity and sustainability for upper middle school students. – *(PM)*

Peter Donaldson, 2007, two 40-minute DVDs (plus free online supplements at <www.fraservalleybaldeaglefestival.ca>), C$20 from Eagle Eye, c/o Mission Regional Chamber of Commerce, 34033 Lougheed Highway, Mission, BC V2V 5X8, Mark.Johnson@dfo-mpo.gc.ca; US$20 from Eagle Eye, 3635 88th Ave. SE, Mercer Island, WA 98040 <peter@peterdonaldson.net>.

Exceptional Women Environmentalists

Addressing eco-themes from around the world, Frances Mooney's *Exceptional Women Environmentalists* provides an engaging introduction

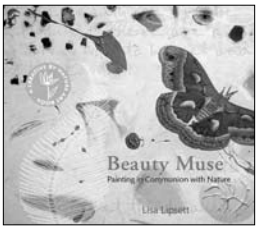


to ten of the world's top environmentalists. This accessible book tells us about a diverse group of passionate and courageous women, including Rachel Carson, Jane Goodall, Vandana Shiva, Dai Qing of China, Fatima Jibrell of Somalia and Sheila Watt-Cloutier of Nunavut. We learn from each biographical entry how the woman became interested in the natural world, the importance of the issues she is associated with, and the current status of the projects she has been involved in. We also learn of the barriers (education, age, gender, health, imprisonment) each faced in her work. As an introduction to many environmental and social topics, this enlightening volume will appeal to ages 9-13. – *(PM)*

Second Story Press, 2007, ISBN 978-1-897187-22-7 (pb), 110 pp., C$10.95 from Second Story Press, 20 Maud Street, Suite 401, Toronto, ON, M5V 2M5, (416) 537-7850, <www.secondstorypress.ca>.

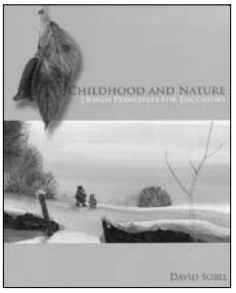
Beauty Muse

Lisa Lipsett's E-book *Beauty Muse: Painting in Communion with Nature* describes the journey of an environmental educator to reconnect with



the natural world in order to find new meaning and energy. Her "natural painting" method — painting how a natural object feels emotionally or spiritually rather than how it looks — is intended to create deeper bonds between the painter and the object. By expanding beyond their intellectual and sensory perception of nature, students connect to the natural world more holistically and record their experience of it in a new way. Teachers who use journaling as a means of recording nature experiences will find many techniques to engage to students of all ages. For students and teachers of psychology and art therapy, the book provides a framework to help clients connect holistically, both with themselves and with their world. – *(PM)*

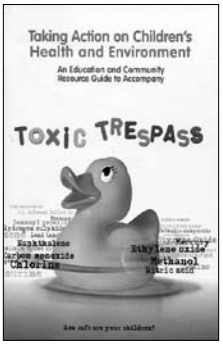
Creative by Nature Centre, 2009, E-book, 186 pp. C$10, downloadable from Creative by Nature Centre, <www.creativebynature.org>.



Childhood and Nature

In *Childhood and Nature: Design Principles for Educators*, David Sobel challenges us with the assertion that "One transcendent experience in nature is worth a thousand nature facts." He provides teachers with guiding principles for creating these transcendent experiences — making activities adventurous, incorporating animal allies, drawing on imagination, working with maps or miniature worlds, hunting or gathering, and creating and celebrating forts or other special places. In the first half of the book, Sobel describes these design principles and explains why they are important. Then he draws on his own experiences to illustrate vividly how each principle works in practice. Sobel's entertaining, clear voice helps us escape the dry focus on content, benchmarks and lessons found in most guides. Though directed primarily at early childhood to middle school teachers, this book will also be helpful to those in nature centers, camps and other non-formal education programs. This is one of the few books that should sit on every environmental educator's shelf. – *(NM)*

Stenhouse Publishers, 2008, ISBN 978-1-57110-741-1, 168 pp., US$17.50 from Stenhouse Publishers, (800) 988-9812, <www.stenhouse.com>, C$23.95 from Pembroke Publishing, (800) 997-9807, <www.pembrokepublishers.com>.



Toxic Trespass

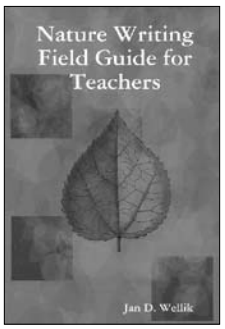
Subtitled "Taking Action on Children's Health and Environment," *Toxic Trespass* is a DVD and resource guide that examines the serious health effects of high levels of environmental toxins in human and non-human populations, especially in industrialized areas. Writer and narrator Barri Cohen takes the viewer on a journey to understand the effects of pollution on children and adults in the southern Ontario region known as "chemical valley." Cohen probes the latest research and interviews policy makers, industry representatives and scientists who confirm the direct link between chemical pollution and abnormally high health risks. She also interviews members of Aamjiwnaang First Nation, who are affected by disturbing numbers of miscarriages and stillbirths, as well as alarming birth defects and health problems in children. The companion *Education and Community Resource Guide* is designed for developing workshops and programs of "provocative dialogue" that challenge participants to

take action in their local areas. This is an excellent resource for science and society education from middle school up to university. – *(DB)*

National Film Board of Canada & If You Love Our Children Productions, 2008, DVD, 52 or 80 minutes (two versions) and 67-page guide, C$34.95 (home use)/$129.95 (institutional use) from NFB, (800) 267-7710, <www.onf-nfb.gc.ca>; US$19.95 (home use) from NFB via Dylan McGinty, (718) 855-1702. For US institutional use, contact: Women Make Movies, (212) 925-0606, <www.wmm.com>.

Nature Writing Field Guide

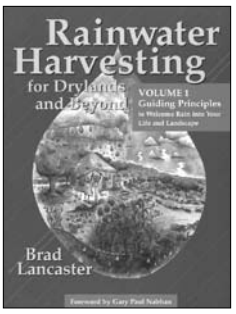
Author Jan Wellik describes her *Nature Writing Field Guide for Teachers* as a tool that blends English and Science and expands students' literary creativity as they explore the outdoors. The book begins with brief descriptions of numerous nature-inspired creative writing activities for students in Grades 1-5, 6-8 and 9-12. Wellik then outlines two multi-week seasonal (Grades 6-8) and one garden-themed lesson plan (Grades 1-5) that weave her writing activities with outdoor exploration, science and social studies activities. As there are no specific outcomes, learning goals or skills stated, the field guide is less a curriculum than an idea book. It may spark ideas for teachers who want novel ways to pull their environmental education a little beyond the sciences. It is ideal for newer camp counselors, cooped inside on a rainy day, who want something a little different than crafts to keep their children engaged. It is not for the teacher seeking to learn about or deeply integrate writing-to-learn into their curriculum. – *(NM)*



Eco Expressions, 2008, ISBN 978-0-6151-9461-5, 53 pp., US$24.95 from Eco Expressions, (619) 884-3075, <www.ecoexpressions.org>.

Rainwater Harvesting

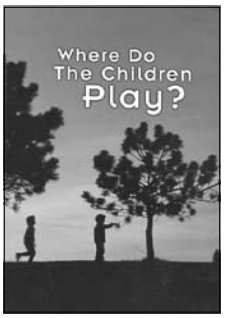
As groundwater becomes stressed by development and pollution, the ability to use rainwater to meet our domestic needs becomes extremely important. Brad Lancaster's *Rainwater Harvesting for Drylands and Beyond – Volume 1: Guiding Principles to Welcome Rain into Your Life and Landscape* is a thorough guide to using the free water falling on and around one's land. Armed with a history of water use, an understanding of the hydrologic cycle, calculations of how much water falls on an area of land, and eight rainwater harvesting principles, readers are led through the process of creating a water management plan for their own home. By providing formulas, resources and real-life case studies, *Rainwater Harvesting* can help readers safely harvest rainfall, thereby reducing stress on aquifers, lowering water bills and providing clean water for household use. Middle school up to adult learners who are studying water resources, land health, agriculture, landscaping, urban renewal and energy management will find this volume filled with practical knowledge and action steps appropriate in either dry or wet climates. – *(PM)*



Rainsource Press, 2006, ISBN 978-0-9772464-0-3, 183 pp., US$24.95 from Chelsea Green Publishing Company, (800) 639-4099, <www.chelseagreen.com>.

Where Do the Children Play?

The film *Where Do the Children Play?* shows how children raised without free, unstructured play time miss out on developing social and leadership skills, sensible risk-taking behaviors, creativity and imagination, and observation skills. These core character traits, it is argued, result from kids playing together, often in natural areas, without adult intervention. Interviews with Richard Louv, Elizabeth Goodenough and other experts in children's play point out that children living in rural areas fare best in developing these skills, that children in suburbs are most isolated, and urban children may still have the chance to play and learn from each other. In a world in which children are so immersed in electronics, music lessons and organized sports, this film is a valuable resource for convincing parents, teachers and administrators of the importance of unstructured play in natural areas as well as in the classroom. – *(PM)*



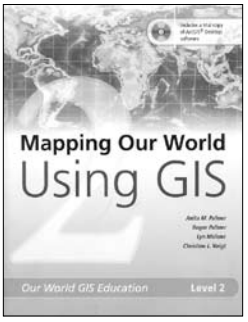
Michigan Television WFUM TV-28, 2007, ISBN 978-0-9816527-0-2, 56-minute DVD, US$19.95 from The University of Michigan Press, (800) 343-4499 x 154, <www.wfum.org>.

Color Me Green

If you are looking for some excellent songs promoting environmental awareness, the upbeat, comical songs on the *Color Me Green* CD might be right for you. Written by Mike Nobel and performed with the young Color Me Green singers, standout tracks include "A Party in the Marsh," a rap song about the ecosystem of the Atlantic Salt Marsh; "Plant a Tree," a perfect inspiration for a tree-planting ceremony; and "Stand Up!," a rallying song for protecting Mother Earth. Representing a wide range of musical styles, including rock, rap, ballads and Motown, the CD offers some songs that will get you dancing, along with emotional tunes that will encourage reflection. Written from a child's perspective and sung in part by child singers, *Color Me Green* gives voice to children's environmental concerns. While interesting and complex, these songs are easy enough for kindergarten through Grade 4 students to learn. – *(JH)*

Mike Nobel, 2009, 41-minute CD, C/US$11.95 plus $5 shipping (for 1-4 copies) from Mike Nobel, (207) 839-6455, <mainesongwriter@gmail.com>.

Mapping Our World



Combining a large teacher's guide and a student workbook, *Mapping Our World (MOW)* is designed to introduce Grades 6-12 students to Global Information Systems (GIS), using ArcGIS Desktop software, an industry standard. Paired with basic steps to geographic inquiry, *MOW* uses GIS

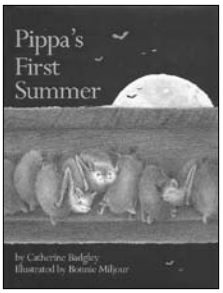
to examine a variety of topics, such as earthquakes and volcanoes, temperatures and climate, populations, disputes over national boundaries, the distribution of economic wealth, and the potential impact of global warming on sea level. In using GIS to answer some intriguing geographic questions, students learn the program as a by-product of scientific investigation. Effective assessments, assessment rubrics and detailed answer keys allow the teacher to focus on teaching, aided by a detailed student workbook complete with screen captures and clear, step-by-step instructions. No single lesson uses all potential GIS components, but taken together, the *MOW* lessons provide an effective introduction to the world of GIS. A companion website provides additional resources by module, solutions to common problems, and significant changes or corrections as they come up. This very professional program includes a software DVD, one-year trial license and a data CD. – *(AC)*

ESRI Press, 2008, teacher's guide ISBN 978-1-58948-203-6, 216 pp., US $49.95; student workbook ISBN 978-1-58948-185-5 (also available as PDF files on teacher's guide disk), US$12.95 from ESRI Press, (800) 648-3104, <www.esri.com>.

A Sense of Wonder

I approached this DVD about Rachel Carson with great anticipation. As Bill Moyers says on the cover, "you cannot walk away unmoved." *A Sense of Wonder* is a film adaptation of the one-woman play written and performed by actor Kaiulani Lee, in which Lee uses dramatic monologue to portray Carson in the last year of her life. Carson simply talks, as if having a conversation with a silent, off-camera friend. The first half takes place at Carson's actual cottage on the coast of Maine, a location that enhances the many quotes from her book, *A Sense of Wonder*, that are used in the script. The second half, set in Washington, DC, focuses on Carson's book *Silent Spring* and her ongoing battles with chemical companies, even as she herself battles cancer. Autobiographical squibs throughout give us some sense of the woman who was behind the words and, ultimately, a movement. For kids a generation or two removed from Carson's life and battles, the film may offer little to grab and hold, but for older students and us old combat vets, it may bring a tear or two to the eye. – *(AC)*

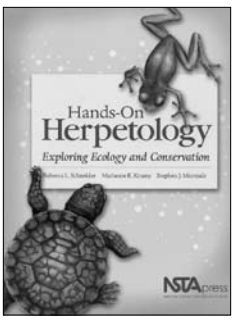
Sense of Wonder Productions, 2009, DVD, 55 min. plus features, ISBN 1-59458-851-1, $29.95 for home use from Sense of Wonder Productions, <www.asenseofwonderfilm.com>, $250 for public/educational uses from Bullfrog Films, (800) 543-3764, <www.bullfrogfilms.com>.



Pippa's First Summer

To promote a deeper understanding of a creature feared by many, Catherine Badgley weaves an endearing story about a season in the life of Pippa, a young big brown bat born in the rafters of a big red barn. As this beautifully illustrated story unfolds, we discover how bats learn to communicate, feed and fly using echolocation, and of the many dangers and hurdles that jeopardize their lives. As such, *Pippa's First Summer* successfully combines an enchanting story with information about bats. Older elementary students will enjoy reading about Pippa's adventures, and younger children will delight in having this book read to them. – *(NS)*

Mitten Press, 2005, ISBN 978-1-58726-281-4, 113 pp., US$14.95 from Mitten Press, (877) 722-2264, <www.mittenpress.com>.



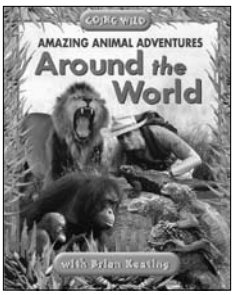
Hands-On Herpetology

Hands-on Herpetology: Exploring Ecology and Conservation by Rebecca Schneider, Marianne Krasny and Stephen Morreale is an ambitious instructional guide. Moving beyond traditional frog dissection, it favors a deep and wide study of "herps" (amphibians and reptiles). In impressive detail, the guide progresses through the biology, ecology and conservation of herps, delving into their evolution, behavior, population, heredity and adaptations. Twenty-one activities are included for students aged 10 to18, half that are set indoors and half outdoors. The authors suggest many conservation-oriented projects, including restoring frog-friendly ponds and monitoring amphibian malformations and declines (and contributing these results online). A wealth of background information is included. Given the density of this resource, it would be best to choose a handful of grade-appropriate activities and engage with these in a meaningful way. – *(JH)*

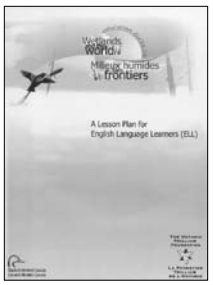
National Science Teachers Association Press, 2001, ISBN 978-0-87355-197-7, 146 pp, US$26.96 from NSTA, (800) 277-5300, <http://www.nsta.org>.

Amazing Animal Adventures

Conservationist and adventurer Brian Keating manages both to inform and to inspire in this first title of the *Going Wild* series, *Amazing Animal Adventures Around the World*. Captivating first-hand accounts of Keating's global animal explorations are the basis of this book. From kayaking among walruses on Ellesmere Island to sleeping above nocturnal hippos in Ghana, Keating's stories convey the awesomeness of wildlife and the importance of protecting wild spaces. Subjects such as animal behavior, adaptation, local culture and ecology are interwoven throughout. Each chapter is complemented with interesting facts, selections from Keating's field notebook and choice vocabulary builders. This book's colorful layout and photographs (almost all taken by Keating) bring the book to life, especially for reluctant readers. Although it may be read and enjoyed from cover to cover, this book lends itself very well to browsing. Best suited for Grades 5-7, it could also be enjoyed by Grade 3 and 4 students. – *(JH)*



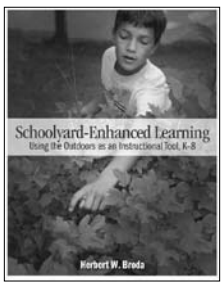
Fifth House, 2004, 1-894856-22-8, 48 pp, C$8.95 from Fitzhenry & Whiteside, (800) 387-9776, <www.fitzhenry.ca>.



Wetlands and the World

Kudos to Ducks Unlimited for recognizing the lack of environmental education materials for new Canadians and moving to fill it with their *Wetlands and the World* kits of English and French Language Learner materials for K-8 classes. These kits include several components. A large world map identifies major wetland areas and describes their value. Ten cut-and-fold, 3-D paper models of wetland creatures include information about each creature in English or French and one of nine other languages, including Chinese, Cree, Arabic and Punjabi. A 43-page Teacher's Guide includes nine lessons on the composition, structure, functions and values of the world's wetlands. Finally, a CD includes digital versions of all print materials, along with a brief slide show on wetlands around the world. All materials are effectively utilized in the nine progressive lessons, which end with a three-lesson role-play simulation on town growth, planning and wetland conservation. Ideally to be used in units on habitats or biodiversity, or with language learners of any age, the kit meets Ducks' high standards and now sets the standard for environmental programming in language instruction. Class sets are free while supplies last. – *(AC)*

2008, free from Ducks Unlimited Canada, Ontario Region, (888) 402-444, <www.education.ducks.ca>.



Schoolyard-Enhanced Learning

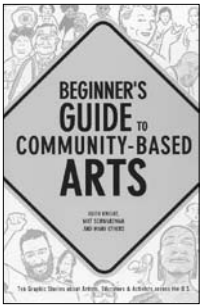
The refreshingly accessible handbook *Schoolyard-Enhanced Learning* by Herbert W. Broda focuses on practical applications and supporting research for using the outdoors as an essential element in all K-8 subjects, regardless of whether or not one's school is close to natural areas. One chapter is devoted to improving school grounds by creating inviting outdoor places to sit, write and reflect. Another describes the "nuts and bolts" of planning, such as the importance of instructing students on content prior to going outside. Yet another chapter provides lesson ideas for math, science, language and arts. For example, Broda shows how a unit on watersheds in science can be enhanced by taking students outside to observe how puddles form and water flows after a rainstorm. Finally, in a chapter on teaching process skills, he provides ten "Skills Quests" that require an outdoor setting in which to complete the tasks. This well-written and illustrated resource is adaptable for any elementary or middle school classroom – *(DB)*

Stenhouse Publishers, 2007, ISBN 978-1-57110-729-9, 168 pp., US$17.50 from Stenhouse Publishers, (800) 988-9812, <www.stenhouse.com>; C$22.95 from Pembroke Publishers, (800) 997-9807, <www.pembrokepublishers.com>.

Green's Not Black & White

Subtitled "The Balanced Guide to Making Eco Decisions," *Green's Not Black & White* looks at over 50 dilemmas in a point-form, *yes-but* fashion. When author Dominic Murin does lead us toward a solution, it is often neither of the most obvious choices, but rather a more difficult third option. Each of the book's eight chapters addresses issues associated with a particular topic, such as food, transport and travel, and disposal and recycling. As an example, one of the dilemmas in the food chapter is the question of whether it is best to buy local or organic foods. Such decisions are not easy, and as the author states, "you will need to learn more… [and] think more," but "you are the best person to decide." Because the choices are not clear-cut, this book won't make your life easier. It does, however, contain well-sourced facts, and provides a great deal of useful information, along with good principles for making any enviro-decision that comes along. I didn't find a lot that was new, but it did confirm what I'd already found out the hard way. The guide is probably most effective for adults who are fairly new to the game, as well as for advanced students in grades 8 and up. Interestingly, the book is printed on recycled paper (yes!) in China (but!!). – *(AC)*

Ivy Press Ltd., ISBN-13: 978-0-7641-4248-2, 2009, 144 pp, C$17.99/US$14.99 from Barron's Educational Series, (800) 645-3476, <www.barronseduc.com>.



Beginner's Guide to Community-Based Arts

Authors Keith Knight and Mat Schwarzman define community-based art as "any form or work of art that emerges from a community and consciously seeks to increase the social, economic and political power of that community." In their *Beginner's Guide to Community-Based Arts*, they introduce us to a creative process defined by five steps: connect, research, action, feedback and teaching. They introduce real-world stories to illustrate each step, using a graphic, comic-book format accessible to teens. In these stories, we learn how individuals or groups have chosen a topic of concern, gathered feedback from their community, and taken steps to achieve change. Each story presents lessons that we can use within our own communities. Whether organizing dance classes for youth in high crime areas or providing disposable cameras to enable teens to photograph things they like and dislike in their communities, this well-organized introduction to using the creative process will help teens and their mentors develop and implement positive change in their communities. – *(PM)*

New Village Press, 2006, ISBN 978-0-9766054-3-0 (pb), 171 pp., US$19.95/C$26.95 from New Village Press, (510) 420-1361, <www.newvillagepress.net>.

Earth Matters

Now in its third edition, the CD *Earth Matters* is a secondary science and social science curriculum containing 16 units on such themes as Population Dynamics, Climate Change, Biodiversity, Urbanization,

Food and Hunger, and the World's Women. Each contains a background reading, a case study, two to five activities with assessment ideas, a glossary and additional resources, some of which are web-based. Units are cross-referenced to readings, case studies and activities in other units, and navigation around the CD is flawless and easy. Also included are simulations, role plays, board games, a mock trial, lab demos, debates, a community survey, and a model UN session on Climate Change. All of the units provide an opportunity for students to think critically and solve problems related to the issue being discussed. Through follow-up activities, students are often encouraged to apply what they have learned within their own communities. This is a solid, well-researched program that delivers. While materials state that it is "appropriate for use in U.S. and Canadian classrooms," Canada is pretty much an afterthought from a content perspective, and most measurement units are US rather than metric. – *(AC)*

ISBN 0-945219-20-2, 2007, CD with 16 units, 32 readings, 43 activities, US$15 from Population Connection, (800) 767-1956, <www.populationeducation.org>.

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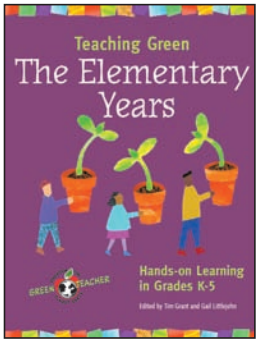
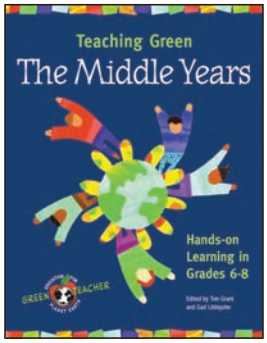
BOOKS from Green Teacher

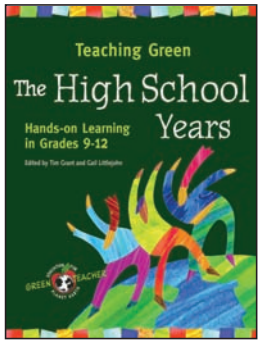
Teaching Green

Hands-on Learning in Grades K–5, 6–8 and 9–12

240 pages, 8 1/2" x 11"







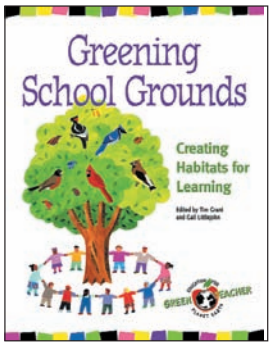
The ***Teaching Green*** books are complete "green" teaching resources for anyone working with young people in Grades K–5, 6–8 or 9–12, whether inside or outside of schools. Each book contains over 50 of the best teaching strategies and activities contributed to ***Green Teacher*** magazine during the past decade by educators across North America — all updated and revised for these special anthologies. Readers will find a wealth of kid-tested ideas covering a wide spectrum of environmental topics, from biodiversity to resource use to green technology. They include practical projects and new learning strategies that promote interdisciplinary hands-on learning about natural systems and foster critical thinking about environmental issues. Supported by rich illustrations and a curriculum index, these books will appeal to a wide range of teachers, educators and parents seeking innovative ideas for incorporating green themes into their programs.

Prices: *Single copies* CAN$25.95 *2–10 copies* US/CAN$20.95 *100+ copies* US/CAN$12.50

Greening School Grounds

Creating Habitats for Learning

2001, 144 pages, 8 1/2" x 11", for grades K-12



Schoolyard "greening" is an excellent way to promote hands-on, interdisciplinary learning about the environment through projects that benefit schools and increase green space and biodiversity in communities. This anthology from ***Green Teacher*** magazine contains step-by-step instructions for numerous schoolyard projects, from tree nurseries to school composting to native-plant gardens, along with a great many suggestions for connecting these outdoor activities to classroom learning.

Prices: *Single copies* US/CAN$20.95 *2-10 copies* US/CAN$16.95 *50+ copies* US/CAN $11.95

Teaching About Climate Change

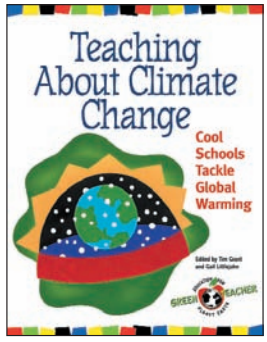
Cool Schools Tackle Global Warming

2001, 80 pages, 8 1/2" x 11", for grades K-12

also available in French as

Des idées fraîches à l'école

Activités et projets pour contrer les changements climatiques



Helping educators to tackle the challenging topic of climate change, this anthology from ***Green Teacher*** offers a framework for teaching fundamental concepts and a variety of activities that can be undertaken in school, at home and in the community. Teachers will find practical ideas for making the intangibles of climate change more concrete to students, including experiments that demonstrate the greenhouse effect and school energy and waste audits.

Prices: *Single copies* US/CAN$14.95 *2-10 copies* US/CAN$11.95 *30+ copies* US/CAN $9.50

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